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16. Abstract

In Rider 36, the Texas Legislature in the 2012–2013 General Appropriations Act directed the Texas Department of Transportation (TxDOT) to conduct a study on road damage caused by oversized and overweight (OS/OW) vehicles and to provide recommendations for permit fee and fee structure adjustments, which are to be submitted to the Legislative Budget Board and the Governor. TxDOT commissioned CTR and the University of Texas at San Antonio to evaluate the damage that OS/OW vehicles (including exempt vehicles) cause to the transportation infrastructure (including pavements and bridges) along with direct costs imposed by OS/OW vehicles on highway appurtenances (such as signs, traffic signals, and light poles) and other direct costs that other state agencies and local jurisdictions accrue from OS/OW enforcement or management.

The project developed methodologies to quantify pavement and bridge consumption rates per mile. The consumption rates were calculated for multiple axle loads and axle configuration and are independent of the commodity being transported. Per mile fees for bridges were also calculated for non-routed loads. In addition to the consumption rates for bridges and pavements due to the effect of axle loads, the researchers developed a new fee schedule that considers costs associated with oversize vehicles that exceed legal width, height, or length for 34 rate categories. These new fees were also calculated based on vehicle miles traveled.

Based on the new permit fee structure the research team conducted a revenue analysis by comparing it to FY 2011 permit sales numbers and associated revenue. In FY 2011, the Motor Carrier Division sold 574,578 OS/OW permits that generated just over $111.4 million in permit fee revenue. The revenue based on the new pavement and bridge consumption and operational and safety impact fees is an estimated $521.4. This figure represents an increase of $410 million over actual permit fee revenue reported in FY 2011. The new permit fee structure includes a $10 administrative fee for each permit sold, and a new TxDOT Base Fee of $40 for all permits sold to help fund costs identified that are not currently recovered by existing permit fee revenues. Using the new permit fee structure, the revenue for currently exempt vehicles was estimated to be approximately $150 million. Using the new permit structure, revenue estimates based on FY 2011 permit sales for currently permitted vehicles and proposed new permits for exempt vehicles would be $671.4 million.

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Executive Summary

The 82nd Texas Legislature required the Texas Department of Transportation (TxDOT) to conduct a study to evaluate increased pavement and bridge consumption by oversize and/or overweight (OS/OW) vehicles, including exempt OS/OW vehicles carrying loads such as agricultural products, solid waste or recycled materials, ready mix concrete, and milk. The study, referred to as Rider 36, also requires TxDOT to provide recommendations for permit fee and fee structure adjustments to the Governor and the Legislative Budget Board by December 2012. TxDOT commissioned the Center for Transportation Research (CTR) at The University of Texas at Austin and the University of Texas at San Antonio to undertake this study.

Report highlights and recommendations include the following:

- The study concluded that the state's current OS/OW permit fee structure is inadequate to recover OS/OW truck-related infrastructure consumption costs.
- The research team used permit and trip data and rigorous engineering analysis to quantify infrastructure consumption costs associated with each type of OS/OW truck, including those that state law currently exempts from permit requirements.
- The research team proposes a model alternative fee structure that builds on the state's online permitting system; links OS/OW permit fees to the cost of infrastructure consumption; and generates additional revenue to address OS/OW vehicle-related administrative and enforcement costs as well as the cost of maintaining and preserving the state's transportation infrastructure.
- The research recommends streamlining the number of permit types and reducing exempt truck classes.
- The proposed model for an alternative fee structure uses vehicle miles travelled (VMT) and vehicle characteristics that exceed legal limits (i.e., weight, height, width, and length) to determine the permit fees. These proposed fees also include operational and safety cost components.
- Adopting the research's proposed model alternative fee structure could increase annual state OS/OW permit revenue to $521 million from $111 million collected in FY 2011, an increase of $410 million.
- Applying the research's proposed model fees to trucks exempt from permit requirements under current law—based on estimates of their numbers and adjusting for seasonal use and load types—could yield an additional $150 million in annual permit revenue.

The following summary provides an overview of the work, methods, and findings that are documented in each chapter of this report.

Chapter 1: Report Structure and Overview

Chapter 1 presents a comprehensive literature review of OS/OW permit systems used by the Western Association of State Highway and Transportation Officials (WASHTO) states.

Chapter 1 also documents a Trucking Industry Forum that was held by CTR on March 29, 2012 and attended by over 30 representatives from different sectors of the trucking industry. In addition, the results of numerous interviews are presented that were conducted in person or by telephone with TxDOT district and division personnel; county and city public works employees; the Texas Department of Motor Vehicles—Motor Carrier and Enforcement Divisions; the Department of Public Safety—Commercial Vehicle Enforcement Section; the Office of the Attorney General; and the Texas Department of Insurance. In addition, at the request of certain truck fleet operators, researchers met with and discussed the purpose of the Rider 36 Study and obtained information about the value of certain types of permits to these companies.

Chapter 1 also provides a historical review of legislation regarding OS/OW vehicles, including OS/OW exemption statutes that have been enacted for certain types of vehicles or commodities. The review spans the period from 1929 to the present and provides the background information needed to trace and understand changes in OS/OW statutes and the timeframes in which exemptions were enacted. It is important to recall that during the Trucking Industry Forum, the trucking industry representatives indicated that they were not opposed to a permit fee increase "as long as we are on a level playing field...everyone should pay their fair share." This concept provided the framework for the pavement and bridge consumption analyses models developed. The consumption models consider only increased consumption related to an overweight load independent of the load type. This means that all vehicles of the same configuration and weight, including currently exempt vehicles, were evaluated using exactly the same procedures, resulting in a rate/VMT that is the same for a vehicle of a given configuration regardless of the cargo. This same concept was also applied to the oversize vehicle infrastructure operations and safety fee schedule, presented in Chapter 4, in that the fee for operating a vehicle that is overheight, overwidth, or overlength is the same regardless of the commodity, vehicle, or load type.

During the course of this study the research team assembled data from many different sources to provide the information needed to accomplish the study objectives. The data was used to develop, analyze, and perform the pavement and bridge consumption analyses presented in Chapters 2 and 3; and to develop the infrastructure operations and safety fee schedule for oversize vehicles, which might or might not also be overweight, presented in Chapter 4. This information was used to calculate a permit fee revenue based on consumption, operations, and safety impacts for the same numbers and types of permits sold in FY 2011 by the Motor Carrier Division (MCD); and to calculate new permit revenue for currently exempt OS/OW vehicles presented in Chapter 5. The next section provides a summary of the pavement consumption analysis including the methodology, recommendations, and associated rate/VMT analysis process.

Chapter 2: Methodology and Recommendations for Pavement Consumption Analysis

The pavement consumption methodology and analyses discussed in Chapter 2 were developed using a pavement analysis program developed under the direction of the American Association of State Highway and Transportation Officials (AASHTO) through the National Cooperative Highway Research Program. This widely used computer program provided the research team with the capabilities needed to compute the increased pavement consumption costs related to OS/OW vehicles. The fundamental principles used in the analysis methodology include the following:

1. Consumption costs are calculated based on additional weight above the legal load limit for a given pavement. The Texas System includes pavements that are load zoned at 58,420 lbs gross vehicle weight (GVW) and pavements that can carry the maximum legal load of 80,000 lbs GVW.
2. Consumption costs for overweight vehicles are determined relative to the allowable weight limits for the vehicle configuration under consideration.
3. Consumption costs per VMT are calculated only for loaded conditions. Load factors were developed for different vehicle types considering that certain vehicles might be overweight in one direction and empty otherwise; might be overweight in both directions; or might present other possible load conditions.
4. The research team determined the cost to build a pavement able carry the legally loaded design traffic on a given route for a 20-year period. The OS/OW vehicle loads were then added to the design traffic loads to determine the reduction in pavement life due to accelerated pavement life consumption by the OS/OW loads. The increased consumption cost was then calculated based on the cost to strengthen the pavement by adding additional thickness in order to carry both the design traffic and the OS/OW vehicles for 20 years.
5. The research team then calculated the accelerated consumption cost/VMT for each axle group type and load. This provided the means for adding axle groups together to represent different vehicle configurations so that the rate/VMT for any given vehicle configuration and load could be determined.

The research team used these methods to compute the rate/VMT for selected vehicle configurations and route types for both single-trip routed, annual non-routed loads that are presented in case studies in Chapter 4.

Chapter 3: Bridge Consumption

The bridge consumption analysis methodology used information about each bridge on the state-maintained network contained in the TxDOT Bridge Inspection and Appraisal Program (BRINSAP) database. The research team used methods to determine accelerated bridge life consumption that are widely accepted in bridge engineering practice. The research team used the same vehicle and load configurations as used in the pavement consumption analysis; however, the spacing between axle groups was also required to determine accelerated bridge consumption due to OS/OW vehicle configurations. This is because an overweight but short wheelbase vehicle that can fit between two bridge supports and is therefore carried by one bridge span can result in greater bridge life consumption than the same load carried by a longer wheelbase vehicle, which distributes the load across two or more bridge spans.

Since bridges are location specific, rather than continuous, as are pavements, each bridge crossed during an analysis must be analyzed independently considering the specific bridge design factors and OS/OW vehicle configuration and weight. The consumption cost is determined by calculating the accelerated consumption of bridge life based on the bridge design type and bridge construction costs. The reduction in bridge life due to the OS/OW load is determined in relation to the design vehicle load specified for that particular bridge. BRINSAP contains the design vehicle load and configuration and the details about the bridge span lengths and bridge beam strengths.

The bridge consumption rate/VMT was determined by calculating the accelerated consumption cost for each bridge along OS/OW vehicle route. The accelerated consumption costs are then summed for all bridges crossed and then divided by the total VMT to arrive at the rate/VMT. This was done to provide a bridge consumption rate/VMT compatible with the rate/VMT concept used for pavements.

The rate/VMT will necessarily vary depending on the route travelled and the numbers and types of bridges crossed. The researchers determined that there are fewer bridges in west Texas than in east Texas. Based on this the researchers developed a means for determining a normalized rate/VMT for non-routed loads considering the region of the state. Generally, the normalized bridge consumption rate/VMT is lower in west Texas than in east Texas for this reason.

Chapter 3 contains additional details about the bridge consumption analysis; case studies that combine the pavement and bridge consumption fees to arrive at the total consumption rate/VMT are presented in Chapter 4.

Chapter 4: Cost Analysis

Chapter 4 addresses several topics associated with costs related to OS/OW vehicles that are not currently captured in OS/OW permit fees. Case studies are presented showing how the pavement and bridge consumption rate/VMT and the infrastructure operations and safety impact fee rate/VMT are applied to determine permit fees for single-trip routed OS/OW vehicles and annual non-routed OS/OW vehicles.

An infrastructure operations and safety impact fee structure is presented for oversize vehicles. The fee structure was developed in consideration of the impacts that overdimension vehicles or loads have on roadway operations, capacity, and safety. Chapter 4 presents the results of analysis of 1,137 crashes on Texas highways in which the investigating officer identified the contributing factor as “oversize vehicle or load.” The researchers found that of the 4 fatalities and over 30 injuries that resulted from these crashes, the OS/OW driver or a passenger in the OS/OW vehicle was the victim in all but 7 cases. Based on the Federal Highway Administration’s safety impact crash cost analysis method, these crashes resulted in costs exceeding $27 million. However, these figures did not include approximately $10 million in TxDOT property damage that occurred primarily due to overheight vehicles hitting bridges or traffic signals.

The infrastructure operations and safety impact fee structure provides a rate/VMT for incremental increases in height, width, or length above legal limits. As with the consumption analysis methods, the researchers recommend that permits for all oversize vehicles are based on this fee structure without exceptions.

Additional costs identified are related to modifications to bridges and adjustments to highway grades or intersections that are made to accommodate OS/OW vehicles but are not recovered in the current permit fee structure. The estimated additional costs for infrastructure upgrades, repairs to damaged property, and OS/OW vehicle enforcement exceeds $60 million per year. The cost information developed in Chapter 4 was used to develop the Revenue and Fee Assessments presented in Chapter 5.

Chapter 5: Revenue Analysis and Recommendations

The revenue analysis compares the FY 2011 MCD permit fee revenues to revenues that would have been accrued for the same types and numbers of permits using the consumption and infrastructure operations and safety impact fee rates/VMT. In FY 2011 approximately $111 million in permit fees were collected. Based on the consumption, operations, and safety impact fee rates, total revenues could have been $521 million, which is an increase of approximately $410 million. In addition, new permit fee revenue for currently exempt vehicles would have been approximately $150 million. Thus, the total increase in revenues for permitted and currently exempt vehicles would have generated $560 million in additional revenue.

Based on information obtained from the Department of Public Safety and State Comptroller of Public Accounts, the average overweight truck citation adjudicated by cities or counties is approximately $110. This figure is close to the minimum overweight truck fine that can be administered under state statutes. Previous studies have shown that low overweight truck fines do little to discourage illegal overweight truck operations and might encourage a small number of truckers to risk operating without a permit. In these cases, a $110 overweight truck fine is considered "the cost of doing business." The research team recommends that further study is undertaken to evaluate the current overweight truck fine amounts and methods of adjudication.

Chapter 5 also includes the following recommendations based upon the research objectives, data gathered, and methodologies created for consideration by the Governor's Office, the State Legislature, and TxDOT.

1. Simplify the permit fee structure to reduce the number of existing permits types and remove industry-specific permits. This step will also reduce the number of potential new permit types for currently exempt vehicles.
2. Implement the Pavement and Bridge **C**onsumption fee system based on VMT for all permits.
3. Implement an Operations and **S**afety Fee System based on VMT for assessing permit fees for oversize vehicles.
4. Apply the Consumption and Operational and Safety fee (COS) schedule to all permits.
    a. If the existing permit system and type is continued, the fee structure presented in Chapter 4, Table 4.4, which has been expanded to include 34 rate categories, should be adopted and applied to determine the infrastructure operations and safety impact rates and to calculate fees for all permit types as applicable.
5. Apply a $10 administration fee to each permit sold.
6. Include a $40 TxDOT base fee for each permit sold to help recover additional costs associated with OS/OW operations not currently covered by permit fees.
7. Create an OS/OW and Heavy Vehicle Training, Education, and Study Center (OVEC). OVEC shall be funded through a portion of the new permit administration fee.
8. Certain exemptions should be excluded from consideration for a permit fee. These are listed in Chapter 4, Table 4.2.

9. The counties in which OS/OW permitted vehicles are intended to operate should be identified in every permit.
10. OS/OW vehicle fine revenue should be deposited in Fund 6, because these vehicles cause accelerated pavement and bridge consumption rates.

Additionally, the research team also identified eight other elements that require further consideration, analysis, or research. The research team recommends that OVEC conduct these research initiatives.

1) TxDOT, TxDMV, CTR, and UTSA will work cooperatively to identify a steering committee that would oversee OVEC's operations. OVEC would guide development of the goals, objectives, and next steps for its implementation.
2) The research team can be made available to help conduct education and awareness programs for county judges, city administrators, and the trucking industry regarding impacts to state, city, and county pavement and bridge infrastructure due to illegal OS/OW vehicles.
3) Gather more information from the trucking industry on issues and needs surrounding OS/OW vehicle operations, including incorporating the economic benefits of these vehicles within the permit system.
4) Further studies are needed to evaluate methods for considering operation of legally loaded heavy vehicles and OS/OW permitted vehicles in the Safety Improvement Index contained in TxDOT's Highway Safety Improvement Program Manual, particularly in cases in which a rural road is frequently used for permitted loads.
5) Evaluate vehicle configurations and loads that can occur due to the combination of a temporary registration permit and the agricultural 12 percent over-axle tolerance exemption.
6) Develop methods to evaluate and quantify increased pavement and bridge consumption due to super-heavy loads that may not be visually evident from a visual distress survey of the permit route.
7) Conduct further research to evaluate the current OS/OW fine structure and identify policies and processes that increase the effectiveness of fine structure administration to discourage operation of illegal overweight trucks on Texas roads and bridges.
8) Perform analysis to address the types of information that should accompany each permit purchase to develop improved models of pavement and bridge consumption, infrastructure operations, and safety impacts.

Chapter 1. Project Introduction

1.1 Report Structure and Overview

The 82nd Texas Legislature required the Texas Department of Transportation (TxDOT) to conduct a study to evaluate increased pavement and bridge consumption by oversize and/or overweight (OS/OW) vehicles, including exempt OS/OW vehicles carrying loads such as agricultural products, solid waste or recycled materials, ready mix concrete, and milk. The study, referred to as Rider 36, also requires TxDOT to provide recommendations for permit fee and fee structure adjustments to the Governor and the Legislative Budget Board by December 2012. TxDOT commissioned the Center for Transportation Research (CTR) at The University of Texas at Austin and the University of Texas at San Antonio (UTSA) to undertake this study.

This report contains five main chapters. Chapter 1 provides a background for this study and information on industry and stakeholder input to the project. Chapter 2 outlines the pavement consumption cost methodology. Chapter 3 provides the bridge consumption cost methodology. Chapter 4 details the costs gathered in chapters 1 through 3 to produce a cost per mile for pavement and bridge consumption for OS/OW vehicles. This is further broken down by height, width, and length of vehicles. Chapter 5 details the research team's revenue analysis based on Chapter 4's costs analysis and makes recommendations for a permit fee and potential permit structure.

1.2 Background

TxDOT, like many state DOTs, is increasingly challenged by inadequate funding from traditional federal and state fuel taxes, permit fees, and other ad-hoc fees used to maintain and add capacity to the transportation network. These traditional funding sources have not increased with inflation and, given increasing maintenance and construction costs and fuel-efficient vehicles, have become largely inadequate. In Texas, the 2030 and 2035 Committee Reports have pointed to significant deficits and an increasing gap between available funding and increasing maintenance and capacity needs.

The primary objectives of this study are to evaluate pavement and bridge consumption by OS/OW vehicles by

- evaluating current OS/OW activity (for both permitted and unpermitted loads) and routes to calculate the costs attributable to each vehicle configuration;
- developing and implementing an analysis framework of the bridge cost responsibilities of OS/OW loads by modeling bridge life consumption induced by permitted loads;
- assessing other cost elements associated with road safety and damage to appurtenances; and
- developing an approach to analyze future OS/OW activity and calculate overall costs.

The outcome of this study will be recommended permit fees and fee structure adjustments to compensate for highway and bridge consumption of Texas's road infrastructure.

1.3 History of OS/OW Regulation in Texas

Statutory regulation of truck size and weight and of oversize and overweight trucks has been in effect in Texas since 1929. The passage of House Bill No. 583 amended Articles 833 and 834 of the 1925, Texas Penal Code.

Article 833 was amended to give authority to the State Highway Commission to forbid the use of roads and bridges under certain circumstances. This included the authority to post notices to forbid the use of such highway or section thereof "by any vehicle or loads of such weight or tires of such character as will unduly damage such highway." The statute also authorized the state to set the maximum load permitted on highways and the times when their use would be prohibited. Article 834 amended the Penal Code and gave the Commissioners' Court of any county—subject to this law—as well as the State Highway Commission power and authority to regulate the tonnage of trucks and heavy vehicles which by "reason of the construction of the vehicle or its weight and tonnage of the load shall tend to rapidly deteriorate or destroy the roads, bridges and culverts along road or highway." The law required notices to be posted about the maximum load permitted and the time such use is prohibited.

Two other bills were passed during this session that regulated size, weight, and dimensions of vehicles using the public highways. SB 11 and SB 10 regulated the operation of super-heavy or oversize trucks on the public highways.

SB 10 set out the permitting system for operation of super-heavy or oversize equipment on the public highways where (i) the commodities could not be reasonably dismantled and (ii) where the gross weight or size exceeded the limits allowed by law and the State Highway Department concluded that they could not be operated without material damage to the highway. SB10 did not prevent the full control of movement or operations on city streets by ordinance. The bill also set out the application for permit authorization. It required the applicant to file a bond with the State Highway Department in an amount set by the department to pay for damage that might be sustained. The bond fee was set at $5, which was to be deposited to the credit of the Highway Maintenance Fund. SB10 also required the permit to "contain details on the applicant, equipment to be transported over the highway along with weight and dimensions and the kind and weight of the specific commodity." The bill also required the permit to state "the highway and distance over which the commodity would be transported and list any conditions that related to the issuance of the permit."

SB 11 set out the tolerances for weight and axles spacing for vehicles to operate on the public highways:

> No vehicles with four wheels or less, whose gross weight, including load was more than 22,000 pounds; no vehicle with six wheels, whose gross weight, including load, is more than 30,000 pounds (axles of this type of vehicle to be spaced over 40 inches apart); No vehicle having a greater weight than 16,000 pounds on any one axle; and no vehicle having a greater weight than 700 pounds per inch width of tire upon any wheel concentrated upon the surface of the Highway (said width in the case of solid rubber tires to be measured between the flanges of the rim), shall be permitted or operated on the public highways of this State.

The bill also required that where axles of any vehicle (or combination of vehicles) were spaced less than 8 feet apart:

> the load on any one axle shall not exceed 10,400, pounds, provided, however, that when any vehicle equipped with not more than two axles, shall have one of said axles

mounted upon four wheels (two wheels at each end of the axle operating in tandem), the maximum weight permitted on each axle of this type shall not exceed 18,000 pounds.

SB 11 prohibited the operation of commercial vehicles on the public highway if their weight was in excess of 5 percent of the registered gross weight.

HB 6 of the 41st Regular Legislative Session in 1929 also set up within the General Laws of Texas for the construction, maintenance, regulation, and supervision of public highways and provided revenue for this by the licensing of vehicles and distribution and apportionment of fees to the state and county highway funds.

For many years, these regulations stayed in the same form, with one amendment occurring in 1931 and 1949, respectively, However, since 1971, the size and weight laws have been modified many times, as can be seen in Table 1.1 This includes not only changes to basic gross vehicle weights but also more robust regulation of oversize and overweight trucks, the exemption of certain classes of vehicles, the introduction of the 2060/1547 permit as a one-stop permit to allow OS/OW carriers to operate in multiple counties, and recent changes regarding fees and payment for the TxPROS routing system. In many instances, these changes have been directly tied to maintenance and rehabilitation of the highway network and provide revenues for permit issuance and inspection of loads by the Department of Public Safety and other law enforcement jurisdictions.

OS/OW permits currently authorized include the following:

- Single trip permits
- General
- Crane and well servicing unit mileage
- Manufactured housing
- Portable buildings
- Super-heavy
- Multi-state (WASHTO)

Table 1.1: Major Legislative Changes for Oversize and Overweight Governance

Bill No	Year	Major Components
HB 336	1931	Authorized Department of Highways to issue permits limited to periods of 90 days or less for transportation of oversize/overweight or overlength commodities that could not be reasonably dismantled and transport of super-heavy or oversized equipment. Authorized department to designated county judges along with its designated agencies who were granted authority to issue such permits. Also authorized Commissioners Courts through the County Judges to issue permits for movement over the highways of their respective counties. Authorized Commissioner's courts to require a bond in amount sufficient to guarantee payment of any damages to road/bridge.
HB 465	1949	Applicant permit fee was augmented permit fee $5, single trip permit $5, $10 for permits not exceeding 30 days, $15 for permits not exceeding 60 days and $20 for permits not exceeding 90 days. This was to be deposited to State Highway Fund.

Bill No	Year	Major Components
HB 182	1971	Gave County Judges and Commissioner's Courts separate independent authority to issue permits. Gives authority to incorporated municipalities to regulate movement and operation of overweight or oversize or overlength commodities that cannot be reasonably dismantled.
SB 351	1971	Authorized short-term movement of seasonal agricultural products to markets/point of sale that are of larger tonnage for one year. Permit fee was set as percentage of difference between regular annual registration and annual fee for heavier tonnage based on number of months requested.
SB 142	1973	Gave department authority to issue an annual permit with $50 fee for movement of unladen lift equipment motor vehicles that exceed maximum weight and width limitations.
HB 81	1977	Registration and width requirements for vehicles used to transport/spread fertilizer, including agricultural limestone. Annual licenses fee for vehicle used exclusively for this purpose set at $50. Width requirements do not apply to vehicle registered that was 136 inches or less at its widest part.
HB 1121	1977	Authorized vehicles used exclusively to transport milk to use highways if distance between front wheel and forward tandem axle and rear wheel of rear tandem axle was at least 28 feet and maximum load carried on any group of axles does not exceed 68,000 pounds.
HB 638	1979	Authorized vehicles used to exclusively transport seed cotton modules to exceed limitation for length but may not exceed 48 feet and to exceed limitations on weight provided load on any one axle cannot exceed 20,000 pounds and 44,000 pounds on a tandem axle. Required overall GVW to not exceed 64,000 pounds. Owner of vehicle with tandem axle weight greater than 34,000 ponds shall compensate state for all damages to highway caused by weight of tandem axle load.
HB 931	1981	Amendment on width limit allowed on interstate highways.
SB 869	1981	Allows vehicle that does not exceed 100,000 pounds and is transporting grain to cross width of highway from private property to another private property. Requires agreement with department to indemnify for cost of maintenance/repair for damage caused by vehicles crossing that portion of highway.
HB 691	1983	Further prohibits commercial vehicles of excessive weight from utilizing state-maintained highways inside of incorporated city limits of cities with more than 1.5 million in population.
HB 860	1983	Sets height limit for vehicles transporting cottonseed at 14 feet, 6 inches.
HB 1114	1983	Extends the standard weight limits to state highways located in incorporated cities. Adds enforcement by municipal police offices from cities with a population greater than 1.5 million. Sets a stricter fine. Exempts loading of agricultural of forestry commodities prior to first processing of commodity.
HB 1601	1983	Amended definitions for truck-tractors to conform to federal statutes and amended various statutes to eliminate prescribed limits for truck-tractor combinations and establish limits for lengths of trailers and semi-trailers.
HB 1602	1983	Amended Articles 6701d-11 and 6701d-11a, VTCS to raise width limits and set lower limits on specially designated highways. Amended related statutes to conform with federal laws.
SB 1438	1983	Amended Article 6701-1/2, VTCS by adding new language that prohibits manufactured housing from being moved over roads except in accordance with permits issued by department. Local subdivisions were authorized to designate routes to be used within their boundaries but could not require additional fee or license.
HB 797	1985	Created system for oversize/overweight permits to be acquired by phone. Exempts oilfield equipment transportation vehicles from truck length limits. LBB estimated revenues losses from the highway fund of $5,860,000 each year for the five years post bill passage.

Bill No	Year	Major Components
HB 1344	1985	Amends regulation to allow municipal police officers in cities with a population of 100,000 to enforce weight laws.
SB 1114	1985	Allowed dealers moving oversize implements or husbandry to secure annual permits for $90. Authorized County Judge to issue annual permit.
HB14	1986	Amended Article 6701a, VTCS to allow telephone permits for OS/OW vehicles.
HB 9	1987	Repealed Article 6701d-15,VTCS, which set length of oil well service units that could be operated over state highways at 40 feet so that these vehicles could now operate at limits of 45 feet.
HB 647	1987	Allowed courts to set a lesser fine than previously stipulated for violations of axle load if the gross weight limit is not exceeded.
HB 1646	1987	Amended Article 6701a, VTCS by adding a new section on penalty provisions for offenses of provisions contained in the bill. Violations of the act are misdemeanors.
HB 361	1989	Amended Article 6701d-11, VTCS to allow module haulers to transport cotton and equipment used in transport and processing of cotton. Deleted all axle load weight limits and required owner of vehicle with GVW over 59,400 pounds to compensate political subdivision for damages to roads and bridges caused by weight of load.
HB 1892	1989	Amends Article 6701d-11, VTCS to bring Texas length limits into compliance with federal statute that established a length limit of 59 feet for semi-trailers.
HB 2060	1989	Amends Article 6675a-6-1/2 VTCS to allow operation on public roads of certain vehicles and for deposits to the country road and bridge fund. It also authorized the department to issue permits to allow commercial motor vehicle, truck tractor, trailer or semitrailer to operate at a weight that exceeds that allowable axle weight by a tolerance allowance of 10 percent and exceeds the allowable grow weight by a tolerance of five percent. Permits were valid for one year, and set at $75. $50 of this permit fee was to be remitted to the counties in a ratio based on total number of miles maintained by the county and the total number of miles of county roads. A bond was required to be filed with the department in amount of $15,000.
HB 490	1991	Amends 6701d-11 and 6675a-1, VTCS to change width requirements for vehicles transporting cotton or cotton-related equipment. Provides for issuance of special license plates for these vehicles.
SB 944	1991	Amends 6701d-11, VCTS for vehicles loaded with timber, pulp, wood chips, cotton, or agricultural product to have a defense to prosecution as long as they were not on a federal highway.
HB 1896	1993	Authorizes the transportation commission to enter into agreements with other states to issue permits (either for state or on behalf of other states) authorizing transportation of vehicles that exceed legal size/weight limitations.
HB1547	1995	Amends Article 6701d-11 VTCS to authorize the operation of a vehicle carrying agricultural commodities at weight that exceeded allowable axle weight by tolerance of 10 percent and exceeds the allowable grow weight by a tolerance of five percent. Required TxDOT to notify the county clerk of each county listed in the permit application that the permit holder intends to operate an OW vehicle in that county. $25 base fee to be deposited to highway fund 6, and for an annual fee to be paid based on number of counties indicated by the applicant that they will be operating within. Fee will be distributed to counties by a formula, and it can only be used for the purpose authorized by Section 4.003(b) Article 6701-a VTCS. Required that a sticker was attached to the windshield of the vehicle.
HB 1345	1997	Authorizes TxDOT to issue an annual permit for movement of certain oversize/oversight vehicles. The bill sets out a set of load characteristics for safe travel on state highway system. Sets out how permits fees will be distributed to general revenue fund and to Fund 6.

Bill No	Year	Major Components
SB 1631	1997	Allows TxDOT to contract with third party to act as its agency for processing permit application and distribution. Allowed TxDOT to adopt rules prescribing payment method, including use of electronic funds/credit cards. Requires that for a single trip, the permit must state highways to be utilized but removed requirement for distance. Requires region/area over which equipment is operated to be stated on permit for multiple trips.
SB 1276	1997	Added Subchapter K to Chapter 623, Transportation Code for new optional procedure for permit issuance by port authorities in counties contiguous to Gulf of Mexico or a bay/inlet and bordering Mexico (e.g., Port of Brownsville). Stipulates elements required to be stated in the permit.
HB 1147	1999	Changes to lighting and flag requirements for vehicles with extended loads.
HB 1538	1999	Amended Transportation Code to allow motor carriers to acquire an annual permit to operate a super-heavy or oversize vehicle if it is properly registered. Eliminated department's reporting requirement on cumulative effects of permits issued on state highway system.
SB 844	1999	Authorizes cities with population of 50,000 or more to enforce weight standards in city limits.
SB 934	1999	Requires statement on cargo being transported over SH 48 and 4 between Port of Brownsville and International Bridge.
HB 3467	1999	Amended the disposition of proceeds of fines if they occurred within 20 miles of an international border, providing that entire amount shall be deposited for purpose of road maintenance in municipal treasury if fine imposed by municipal court and county treasury if by justice court.
HB 1679	2001	Provides that tow truck operators are not required to obtain a permit to exceed vehicle weight limitations if town truck provides services necessary to remove disabled, abandoned, or accident damaged vehicle, and towing is to nearest authorized place of repair, termini, or storage.
SB 545	2001	Requires that holder of 2060 permits can operate a vehicle on country road or bridge of a county designated in permit application only with approval of county judge or judge's appointee. Increased fees associated with this permit.
SB 886	2001	Major updates to various provisions of size and weight restrictions, which had some provisions dating back to 1930s to reflect current practices.
SB 889	2001	Amended some provisions concerning bonds for carriers who are exempt from the 2060/1547 permit requirement but are required to have a $15,000 bond (concrete, solid waste, and recyclable material haulers). It required that copy of bond be carried in vehicle when it is on a public highway and presented to an officer authorized to enforce these provisions.
SB 20	2003	Provided for operational procedure for permit issuance by Victoria County Navigation District for movement of OS/OW loads on state highways located in the county using FM 1432 to and from Victoria Barge Canal up to but not past intersection with SH185.
SB 1748	2003	Amended date for continuation of law authorizing issuance of OS/OW vehicle permits by certain port authorities to June 1, 2007.
HB 1044	2005	Provided operational procedure for permit issuance by Chambers County for movement of OS/OW vehicles in the county. Permit issued under this chapter can only be used on FM1405, frontage road of SH99 located in a specific business park for movement of cargo weighing less than 100,000 pounds. County can collect fee that does not exceed $80.
SB 737	2005	Amended jurisdictional authority relating to prosecution of offenses.
SB 1641	2005	Continuation of law relating to issuance of permits by port authorities for two more years until 2009.

Bill No	Year	Major Components
HB 2093	2007	Authorizes TxDOT to revoke motor carrier registration for violating certain provisions of statute regarding OW or for not paying penalties imposed. Set out new hearing process and eliminated different hearing processes based on type of violation. Provides for penalties and revocations for OW/OS permit violations. Authorized TxDOT to investigate and impose sanctions on shippers that provide false information. Made major changes to fees for 2060/1547 permits and for heavy vehicle permits. Changes to weight for equipment transporting cotton seed—now 64,000 pounds. Highway maintenance fee was increased. Fees for manufactured houses increased.
HB 4594	2009	Amended Transportation Code to expand permit movement of OS/OW cargo in Chambers County. Added FM 565 from intersection with FM1405 for approximately 6200 linear feet; added FM2354 from intersection with FM1405 for approximately 300 linear feet.
SB 1571	2009	Authorized Port of Corpus Christi to issue permit for OS/OW vehicles on roadway owned by port.
SB 1373	2009	Amended Transportation Code to provide for fees collected under the subsection. These fees, less administrative costs, can be used for maintenance and improvement of the state highways listed within the chapter. The administrative costs, which cannot exceed 15 percent of fees collected, can be retained by the port authority.
HB 422	2011	Authorizes permits for OS/OW vehicles with auxiliary power units that exceed maximum weight, but department finds an exemption would reduce nitrogen oxide emissions. Authorizes TxDOT to issue permit to transport multiple loads of same commodity over state highways if loads are traveling between same general locations and state can determine that this will benefit from consolidated permit process. Permit fee capped at $9,000. Permit administration fee not to exceed 15 percent of total fee. All fees deposited to Fund 6.

Sources: Legislative Reference Library of Texas and Texas Constitutes and Statutes online at http://www.statutes.legis.state.tx.us/

Current Specialty Permits issued include the following:

- 30/60/90 day permits
- Company specific envelope
- Fracing trailer
- Hay
- Quarterly hubometer
- Implements of husbandry
- Manufactured housing
- Mobile crane (unladen lift equipment)
- Oil well servicing unit
- Over-axle/over gross weight tolerance (2060/1547 permit)
- Rig-up truck
- Utility pole(s)
- Vehicle specific envelopes
- Water well and drilling machinery and equipment

1.3.1 Exempted Vehicles and 2060/1547 Permit

State statute currently allows operation of trucks with axle or gross vehicle weights that exceed the legal limits if the vehicle is of a certain type or carrying a specific product under the 2060/1547 permit system (named after the legislation that created them). The vehicles can exceed the maximum allowable axle weight by ten percent, or the maximum allowable gross vehicle weight by 5 percent. Under the statute(s), the vehicle operator must pay a base fee of $90, and administrative fee of $5, and a fee based on the number of counties in which the vehicle will operate as well as post a $15,000 bond. The current fees for counties are shown here:

Number of Counties	**Fee**
1–5	$175
6–20	$250
21–40	$450
40–60	$625
6–90	$800
81–100	$900
101–254	$1000

However, a few exceptions exist in which operators are not required to purchase a permit. Table 1.2 displays the statutes that affect TxDMV activities vis-à-vis OS/OW vehicles (MCD, 2011).

Table 1.2: Statutes that Affect Texas Department of Motor Vehicles

Type of Vehicle or Product	Statute (Transportation Code)	Description	Permit/Fee	Bond	Revenue—GR or HWY
Grocery, farm products, and liquefied petroleum (LP) gas on state roads	§621.102(g)	Allows vehicles making deliveries of groceries, farm products, and liquefied petroleum (LP) gas to exceed maximum posted limits on state Farm to Market (FM) and ranch-to-market roads and bridges.	No permit or fee required	No bond required	No fees
Garbage collection vehicles and garbage recyclable collection vehicles	§621.206(b)	Allows vehicles with front-end loading attachments or containers actively engaged in collecting garbage, rubbish, or recycled material to exceed the 3 feet front extension (overhang).	No permit or fee required	No bond required	No fees
Miscellaneous motor vehicle extended length limits	§621.2061	Allows certain motor vehicles with a trailer to carry a load that extends more than 4 feet beyond the rear of the trailer if the load is a motor vehicle designed and intended to be used to load or unload a commodity on or off the trailer. However, rear extension cannot exceed 7 feet.	No permit or fee required	No bond required	No fees
Grocery and farm products on county roads	§621.302 Formerly TVCS 6701d-11 Sec 5 ½	Allows vehicles making deliveries of groceries and farm products to exceed maximum posted limits on county roads and bridges set by a Commissioners' Court. Unlike §602.102(g), LP gas is not permitted on county roads and bridges with posted limits.	No permit or fee required	No bond required	No fees
Ready-mixed concrete trucks and concrete pump trucks	§§622.011-622.017 Formerly TVCS 6701d-12	Allows vehicles transporting ready-mixed concrete or concrete pump trucks to operate with tandem axle weights up to 46,000 lbs., a single axle up to 23,000 lbs., and a gross weight up to 69,000 lbs. Excludes travel on Interstate and Defense highways. Vehicles may not exceed load zoned road or bridge postings.	No permit or fee required	A bond amount not to exceed $15,000 per vehicle will be set by the department. This bond must be filed with TxDOT. Counties or municipalities may impose an additional bond requirement.	No fees

Type of Vehicle or Product	Statute (Transportation Code)	Description	Permit/Fee	Bond	Revenue—GR or HWY
Milk trucks	§§622.031-622.032 Formerly TVCS 6701d12a	Allows vehicles used exclusively for transporting milk to operate on a public highway if the load carried on any group of axles does not exceed 68,000 lbs. and where the distance between the forward tandem axle and rear tandem axle is 28 feet or more. Excludes travel on Interstate and Defense highways.	No permit or fee required	No bond required	No fees
Poles, piling and unrefined timber; raw wood products	§§622.041-622.045 Formerly TVCS 67 6701d-19a O1d-13	Allows poles, piling, or unrefined timber to be transported from the point where the timber is felled to a wood processing mill. Combined length of vehicle and load cannot exceed 90 feet, and the distance traveled cannot exceed 125 miles. Such vehicles are exempt from the 4-foot rear extension limitations provided in §621.206(a). Vehicles transporting raw wood products may not exceed load-zoned bridge postings. A vehicle or combination of vehicles transporting raw wood products with an outer bridge of 39 feet or more may have a maximum gross weight of 80,000 lbs. Excludes travel on Interstate and Defense highways. Movement during daytime hours only.	No permit or fee required		No fees
Electric power transmission poles * annual permit	§§622.051–622.053 Formerly TVCS 6701d-14	Allows the issuance of an annual permit for the transport of poles required for the maintenance of electric power transmission/distribution lines. Combined length of vehicle and load cannot exceed 75 feet. Movement during daytime hours only unless the vehicle is being operated to prevent interruption or impairment of electric service or to restore electric service that has been interrupted. Speed not to exceed 55 mph. Statute also contains lighting requirements.	$120		Fees to GR

Type of Vehicle or Product	Statute (Transportation Code)	Description	Permit/Fee	Bond	Revenue—GR or HWY
Vehicles transporting poles or pipes	§§622.061–622.063	Allows poles or pipes to be transported provided the length of the vehicle and load does not exceed 65 feet, including the load. Movement during daytime hours only. Statute also contains lighting requirements.	No permit required		No fees
Cotton vehicles with size exceptions	§622.101 Formerly TVCS 6701d-11 Sec 3B	Vehicles transporting chile pepper modules, seed cotton modules, cotton, cotton burrs, or equipment used in transporting or processing of chile pepper modules or cotton may be up to 10-feet wide, 48-feet long, and 14-feet, 6-inches high. However, they may not travel on highways that have a designated width limit of 8 feet set by §621.202. Vehicles must be registered under §504.505	No permit or fee required		No fees
Recyclable materials	§§622.131-622.136 Formerly TVCS 6701d19c	Allows vehicles transporting recyclable materials to operate on public highways, excluding the interstate and defense highways, with a tandem axle not to exceed 44,000 lbs., a single axle not to exceed 21,000 lbs., and a gross load not to exceed 64,000 lbs. This exclusion only applies to the tandem weight, not the single axle weight; bond filing is for those with tandem weight in excess of 34,000 lbs. Vehicles may not exceed load-zoned road or bridge postings.	No permit or fee required	A bond amount not to exceed $15,000 per vehicle will be set by the department. This bond must be filed with TxDOT.	No fees
Miscellaneous width exceptions	§622.901	Allows an exemption for certain miscellaneous vehicles, such as highway building or maintenance machinery; vehicle owned or operated by a public, private, or volunteer fire department; recreational vehicles; vehicles registered under 502.164; farm tractors or implements of husbandry; and water well drilling machinery, etc., that are over legal width, as provided by §621.201, to travel during daylight hours on public highways. Travel on highways and part of national system of Interstate and Defense highways is limited to 50 miles.	No permit or fee required	No bond required	No fees

Type of Vehicle or Product	Statute (Transportation Code)	Description	Permit/Fee	Bond	Revenue—GR or HWY
Miscellaneous length exceptions	§622.902	Allows an exemption from the length requirements of §§621.203-621.205 for certain miscellaneous vehicles, such as water well drilling machinery, fire department vehicles, and vehicles operated by a municipality exclusively in the territory of a municipality; combination vehicles used exclusively to transport a commodity in the construction, operation, and maintenance of pipelines used for discovery, production, and processing of natural gas or petroleum; and combination of tow trucks and other vehicles that were abandoned on a highway and towed directly to nearest place of repair or terminal/destination. Drive-away saddlemount vehicle transporters and vehicles used to transport a combine used in farm custom harvesting operations on a farm cannot exceed 97 feet in length.	No permit or fee required	No bond required	No fees
Width limitations for certain recreational vehicles	§622.903	A recreational vehicle may exceed a width limitation established by 621.201 or 621.202 if the excess width is attributable to an appurtenance that extends six inches or less beyond a fender on one or both sides of the vehicle.	No permit or fee required	No bond required	No fees
Fire department vehicles	§622.952	Allows public, private, or volunteer fire department vehicles an exemption to weight limitations of §621.101. However, the weight of the fire department vehicles cannot exceed the manufacturer's gross vehicle weight capacity or axle design rating.	No permit or fee required	No bond required	No fees
Seed cotton and chile pepper modules with weight exceptions	§622.953	Single vehicles used exclusively to transport seed cotton modules may not exceed 64,000 lbs. Single vehicles used exclusively to transport chile pepper modules may not exceed 54,000 lbs.	No permit or fee required	No bond required	No fees

Type of Vehicle or Product	Statute (Transportation Code)	Description	Permit/Fee	Bond	Revenue—GR or HWY
Over-axle/over gross weight tolerance HB2060 /HB1547	§§623.011-623.019 (excluding §623.017) Formerly TVCS 6701d-11, Sec 5B	Allows issuance of an annual permit to vehicles hauling loads that can be reasonably dismantled to exceed gross weight and axle tolerances. Allows for travel on state and county roads, excluding Interstate and Defense highways. Additionally, these vehicles may not exceed load-zoned road or bridge postings.	$90 base fee; $ 5 administration fee, plus the following sliding scale fee based on number of counties selected: 1–5 counties: $175 6–20 counties: $250 21–40 counties: $450 41–60 counties: $625 61–80 counties: $800 81–100 counties: $900 101–254 counties: $1,000	For commodities not defined by §623.012(a) as agricultural, a bond or letter of credit in the amount of $15,000 must be filed with TxDOT.	$50 of base fee distributed to GR; $25 of base fee to HWY Fund. $5 admin fee to HWY Fund. Sliding scale fee: 1–5: $125 to GR & $50 to HWY 6–20: $125 to GR & $125 to HWY 21–40: $345 to GR & $105 to HWY 41–60: $545 to GR & $60 to HWY 61–80: $785 to GR & $15 to HWY 81–100: all to GR 101–254: all to GR
Annual hay permit	§623.017 Formerly TVCS 6701d-11 Sec	Allows issuance of an annual permit for the transport of cylindrically-shaped bales of hay that exceed legal width but do not exceed 12 feet.	$10	No bond required	Fees to HWY Fund
Highway crossings	§623.052 Formerly TVCS 6701d -11 Sec 5 2/3	Allows certain vehicles that do not comply with Subchapter C of Chapter 621 or §621.101 to be moved across the width of any road or a highway from private property to other private property, other than a controlled access highway defined by Section 203.001.	No permit or fee required	Agreement and surety bond required	No fees
General OS/OW permits	§§623.091-623.104 Formerly TVCS 6701a	The basic permit law provides for the movement of OS/OW loads that cannot be reasonably dismantled; cylindrically shaped bales of hay; annual implements of husbandry by a dealer; and water well drilling machinery/equipment or harvesting equipment being moved as part of an agricultural operation and annual envelope permit. This law does allow for the issuance of oil field drill pipe or drill collars stored in a pipe box that are overweight to be transported over farm-to-market (FM) and ranch-to-market (RM) roads.	Multiple fees apply depending on permit and vehicle type	Moving authority or bond required when applicable	Multiple fees apply

Type of Vehicle or Product	Statute (Transportation Code)	Description	Permit/Fee	Bond	Revenue—GR or HWY
Manufactured housing	§§623.091-623.104 Formerly TVCS 6701½	Allows issuance of single trip or annual permits for the movement of manufactured housing. Annual permit only allows for transportation of new manufactured homes from a manufacturing facility to a temporary storage location not to exceed 20 miles from the point of manufacture.	$40 single trip $1,500 annual (*this fee determined by rule. Statute provides for a max of $3,000).	Must be registered as a motor carrier with TxDMV or licensed by Texas Department of Housing and Community Affairs (TDHCA) or moving as the home owner.	$19.70 to GR and $20.30 to HWY Fund All to GR
Portable building units and compatible cargo	§§623.121-623.129 Formerly TVCS 6701a-2	Allows issuance of single trip permits for the movement of portable buildings and compatible cargo that do not exceed 14 feet in height or 80 feet in length.	$15	No bond required	$7.50 to GR and $7.50 to HWY Fund
Oil well servicing units and oil well drilling rigs: single trips and quarterly permits	§§623.141 - 623.150 Formerly TVCS 6701d-16	Allows issuance of single trip and time permits for the movement of oil well servicing and drilling vehicles.	Fees are set by administrative rule and are based on width, weight, and distance traveled. Annual: $52 per axle	Units with “machinery” or 72/144 temporary registration are required to have a $10,000 surety bond on file with TxDOT unless a single trip mileage or hub permit is purchased.	All fees to HWY Fund
Solid waste	§§623.161–623.165 Formerly TVCS 6701d-19a	Allows vehicles transporting solid waste to operate on public highways, excluding Interstate and Defense highways, with a tandem axle not to exceed 44,000 lbs., a single axle not to exceed 21,000 lbs., and a gross load not to exceed 64,000 lbs.	No permit or fee required	A bond amount not to exceed $15,000 per vehicle will be set by the department. This bond must be filed with TxDOT.	No fees
Mobile cranes annual permit	§§623.181-623.182 Formerly TVCS 6701d-18	Allows issuance of annual permits for the movement of unladen lift equipment motor vehicles.	Annual: $100	Must file a $10,000 surety bond with TxDOT.	$50 to GR and $50 to HWY Fund

Type of Vehicle or Product	Statute (Transportation Code)	Description	Permit/Fee	Bond	Revenue—GR or HWY
Mobile cranes: Single trip and quarterly permits	§§623.191 - 623.200 Formerly TVCS 6701d-19b	Allows issuance of single trip and time permits for the movement of unladen lift equipment motor vehicles (motor cranes).	Fees are set by administrative rule and are based on width, weight, and distance traveled.	Units with "Machinery" or 72/144 temporary registrations are required to have a $10,000 surety bond on file with TxDOT unless a single trip mileage or hub permit is purchased.	All fees to HWY Fund
Port authority permits	§§623.210–623.219	Provides an optional procedure for the issuance of a permit for the movement of oversize or overweight vehicles carrying cargo on state highways located in counties contiguous to the Gulf of Mexico or a bay or inlet opening into the gulf and bordering the United Mexican States. Gross weight may not exceed 125,000 lbs.	Fees set by port authority, not to exceed $80.	No bond required.	85% of fees to HWY Fund 15% of fees to the issuing port authority
Victoria County Navigation District permits	§§623.230-623.239	Provides an optional procedure for issuance of permits by the Victoria County Navigation District for movement of OS/OW vehicles traveling on state highways in Victoria County. Gross weight may not exceed 125,000 lbs. Speed not to exceed 55 mph or posted, whichever is less. Only for travel to and from the Victoria Barge Canal using FM Road 1432.	Fees set by district, not to exceed $80.	No bond required.	85% of fees to HWY Fund 15% of fees to Victoria County Navigation District
Chambers County permits	§§623.250-623.259	Provides an optional procedure for issuance of permits by Chambers County for movement of OS/OW vehicles traveling state highways in Chambers County. Speed not to exceed 55mph or posted, whichever is less. Gross weight not to exceed 100,000 lbs. Only for travel on FM 1405 between FM 2354 and FM 565; the frontage road of State Highway 99 in the Cedar Crossing Business Park; FM 565 from FM 1405 east approx. 6,200 linear feet to western edit of pipeline easement; FM 2354 from FM 1405 northwest approx. 300 linear feet to end of state maintenance.	Fees set by county, not to exceed $80.	No bond required.	85% of fees to HWY Fund 15% of fees to Chambers County
Administrative enforcement of size and weight provisions.	§§623.271-623.274	Provides for the administrative enforcement of Chapters 623, 622, and 621; provides for penalties.	N/A	N/A	Penalties to GR

Type of Vehicle or Product	Statute (Transportation Code)	Description	Permit/Fee	Bond	Revenue—GR or HWY
Port of Corpus Christi Authority roadway permits	§§623.280-623.288	Provides an optional procedure for issuance of permits by Port of Corpus Christi Authority for movement of OS/OW vehicles traveling a roadway owned and maintained by Port of Corpus Christi Authority. Speed not to exceed 55mph or posted, whichever is less.	Fee set by port authority, not to exceed $80.	No bond required.	All fees to port authority.

Since 1989, Texas has issued an annual 2060/1547 permit (also known as the 1547 permit) that allows an additional 5 percent gross weight and 10 percent axle weight above the maximum allowable weights that would otherwise apply to the vehicle (Luskin et al., 2001).

As interpreted by the Texas Attorney General and later by the courts, the maximum allowable weight should be calculated without regard to load posted limits. For most vehicles with the permit, the maximum allowable gross weight without a permit would be the general cap of 80,000 lbs. rather than a lower limit determined by the Federal Bridge Formula. For these vehicles, the permit allows a gross weight of 84,000 lbs. (5 percent above 80,000 lbs.). "Although the 2060/1547 permit does not require that loads be divisible, the vast majority of loads actually carried appear to be highly divisible, such as shipments of gravel or crude oil" (Luskin et al., 2001).

1.3.2 Width Limits

Current width limits in Texas can be seen in Table 1.3. Width is measured from the outside points of the widest extremities, excluding safety devices.

Table 1.3: Vehicle Width Limits in Texas

Explanation	Measurement
Legal width limit	8', 6" (102")
Maximum width permitted on holidays	14', except for manufactured housing
Maximum width permitted on controlled access highways* (Interstate Highway System)	16', except for manufactured housing
Maximum width permitted without route and traffic studies and certification by applicant on file	20'
Maximum width permitted for new houses	34'
Maximum width permitted for existing houses	40'
Maximum width permitted for new tanks	34'
Maximum width permitted for existing tanks	40'
Maximum width permitted for portable buildings	No limit
Maximum width for manufactured housing	No limit

Note*_Controlled access highways are those highways that must be entered from an access road, not from a stop sign. Traffic can cross the highway only by way of an overpass or underpass. Controlled access highways are usually considered to be the Interstate Highway System._

- One escort is required for all loads exceeding 14' up to 16' wide. Two escorts are required for all loads exceeding 16' wide. The escort must precede the load on a two-lane highway to warn oncoming traffic of the approaching overwidth load. The escort must follow the load on a roadway of four or more lanes to warn approaching traffic of the overwidth load ahead.
- Loads exceeding 20' in width must physically inspect a proposed route and certify to the Motor Carrier Division by letter or facsimile that the overwidth load can safely negotiate the route.
- There are special requirements for manufactured housing.

1.3.3 Height Limits

Current height limits in Texas can be seen in Table 1.4.

Table 1.4: Vehicle Height Limits in Texas

Explanation	Measurement
Legal height limit	14'
Maximum height permitted on holidays	16'
Maximum height permitted without a route and traffic study and route certification by applicant on file	less than 19'

- **One escort required for loads over 17' in height. The escort must be equipped with a height pole to accurately measure overhead obstructions.**
- **Front and rear escorts are required for loads exceeding 18' in height.**
- **Loads 19' or higher must physically inspect a proposed route and certify to the Motor Carrier Division by letter or facsimile that the overheight load can safely negotiate all power, communication, and cable television lines, and all other low vertical obstructions.**

Current vehicle length limits in Texas can be seen in Table 1.5.

Table 1.5: Vehicle Length Limits in Texas

Vehicle Type	Legal	Maximum
Truck or single vehicle	45'	75'
Truck and trailer combination	65'	
Commercial truck and stinger-steered semi-trailer combination transporting automobiles or boats	75'	
Combinations such as truck, travel trailer & boat or motor home, boat and towing a car	65'	
Truck-tractor	unlimited	unlimited
Truck-tractor combination	overall unlimited, trailer limited to 59'	
Semitrailer		
Single unit	59'	
2 trailers	28', 6"	
Front overhang	3'	25'
Rear overhang	4'	30'
Maximum overall length		unlimited
Maximum length permitted without route and traffic study and route certification by applicant on file	125'	125'

One escort is required for loads exceeding
- 110', but not exceeding 125' long
- 20' front or rear overhang

Front and rear escorts are required for loads exceeding 125' in length.
NOTE: The overall length indicated on the permit includes any overhang, but the amount of the overhang must be noted on the permit.

1.3.4 Weight Limits

The basis for maximum legal weight is the number of axles. This is used in conjunction with the Permissible Weight table to determine maximum legal weight for a vehicle. The following terms are used in relation to weight:

- drive axles—the axles that power a vehicle

- inner bridge distance—the distance from the center of the first drive axle to the center of the last trailer axle
- outer bridge distance—the distance from the center of the steering axle of the truck to the center of the last trailer axle
- steering axle—the front axle of the truck (legal weight and permitted weight are the same on steering axles)
- tandem axle weight—the total weight transmitted to the road by two or more consecutive axles whose centers may be included between two parallel transverse vertical planes spaced more than 40 inches and not more than 96 inches apart across the full width of the vehicle.
- Maximum legal gross weight cannot exceed 80,000 pounds.
- Maximum legal weight for a single axle cannot exceed 20,000 pounds.
- Maximum legal weight for a tandem axle group cannot exceed 34,000 pounds.
- Tires may not carry a weight heavier than the weight specified and marked on the sidewall of the tire.

1.3.5 Permissible Weight Table

This is a guide to determine the maximum legal weight on any group of two or more consecutive axles. The table may be applied to inner axle groups (i.e., the drive axles and the trailer(s) or the entire combination of axles (i.e., from steering axle of the power unit to the last trailing axle of the trailer (Table 1.6).

The number for gross weight in pounds is the required distance in feet between the extremes of any group of two or more consecutive axles. The remaining column indicates the maximum weight for various numbers of axles in the group of axles being considered. The maximum weights shown in the table are based on either of these formulas:

$$W=500 [(LN/(N-1)) +12N+36]$$

L=length and N=number of axles

Table 1.6: Permissible Weight Table

	Number of Axles				
Distance in Feet	**34,000**	**3**	**4**	**5**	**6**	**7**
4	34,000					
5	34,000					
6	34,000					
7	34,000					
8	34,000	34,000				
8+	38,000	42,000				
9	39,000	42,500				
10	40,000	43,500				
11		44,500				
12		45,000	50,000			
13		45,500	50,500			
14		46,500	51,500			
15		47,500	52,000			
16		48,000	52,500	58,000		
17		48,500	53,500	58,500		
18		49,900	54,000	59,000		
19		51,400	54,500	60,000		
20		52,800	55,500	60,500	66,000	
21		54,000	56,000	61,000	66,500	
22		54,000	56,500	61,500	67,000	
23		54,000	57,500	62,500	68,000	
24		54,000	58,700*	63,000	68,500	74,000
25		54,500	59,650*	63,500	69,000	74,500
26		55,500	60,600*	64,000	69,500	75,000
27		56,000	61,550*	65,000	70,000	75,500
28		57,000	62,500*	65,500	71,000	76,500
29		57,500	63,450*	66,000	71,500	77,000
30		58,500	64,000*	66,500	72,000	77,500
31		59,000	65,350*	67,500	72,500	78,000
32		60,000	66,300*	68,500	73,000	78,500
33			67,250*	68,500	74,000	79,000
34			68,200*	69,000	74,500	80,000
35			69,150*	70,000	75,000	
36			70,100*	70,500	75,500	
37			71,050*	71,050	76,000	
38			72,000*	72,000*	77,000	

	Number of Axles					
Distance in Feet	**34,000**	**3**	**4**	**5**	**6**	**7**
39			72,000*	72,500	77,500	
40			72,000*	73,000	78,000	
41			72,000*	73,500	78,500	
42			72,000*	74,000	79,000	
43			72,000*	75,000	80,000	
44			72,000*	75,500		
45			72,000	76,000		
46			72,500	76,500		
47			73,500	77,500		
48			74,000	78,000		
49			74,500	78,500		
50			75,500	79,000		
51			76,000	80,000		

*These figures were carried forward from Article 6701d-11, Section 5(a)(4) when SB 89 of the 64th Texas Legislature amended it on December 16, 1974. The amendment provided that axle configurations and weights that were lawful as of that date would continue to be legal under the increased weight limits.
+These figures apply only to an axle spacing greater than 8 feet but less than 9 feet.

1.3.6 WASHTO States Regulation

The research team reviewed the fees for overweight permitted loads in the Western Association of State Highway and Transportation Officials (WASHTO) states for purposes of comparison. Some of these states take a ton mileage approach to overweight permitted vehicles. Table 1.7 illustrates the various approaches taken by these states. Texas fees are presented in the first row.

Table 1.7: WASHTO Overweight Fee Comparisons

State	Weight Fees Approach	Fee Type	Fee Cap
Texas	Highway maintenance fees ranging from $150 to $375 (max) in $75 increments for each 40,000 pounds in excess of legal GVW in addition to $60 base permit fee	Tonnage only	$375
Alaska	Base fee plus $25 for overweight up to 150,000 GVW, then an additional $20 fee. For oversize AND overweight, basic fee of $60 and surcharge of $20 for width in excess of 10’ to 16’ or $30 for width greater than 16’. For height in excess of 16’ to 16’6” $20 and height in excess of this $30. If GVW > 150,000 lbs., an additional $20 is applied. Following are the fees for an extended period for oversize OR overweight: 30 days $75 1–3 months $200 3–6 months $300 6–9 months $450 Up to 12 months $500 For oversize AND overweight 30 days $150 1–3 months $350 3–6 months $550 6–9 months $850 Up to 12 months $1000	Administrative	N/A
Arizona	Fixed fee of additional $60 over the basic oversize fee of $15 for single trip for weights up to 250,000 GVW. For loads over the 250,000 pound limit, a Class C permit is required and includes ADOT engineering study fees of either $125 per 50 miles of route (if prepared by ADOT) or $75 per 50 miles if only reviewed and approved by ADOT engineer	Administrative	N/A
Colorado	Single trip permit $15 plus $5 per axle; for a special transport, the permit fee is $125. The overweight annual permit is $400 per power unit. For overweight permits for loads exceeding weight limits > 250, GVW annual permit is $250, and single trip permit is $15 plus $5 per axle.	Administrative	N/A
Idaho	In addition to an administrative fee of $32 for overweight permits compared to just oversize, there is also a "road use" fee based weight/axles/mileage combination. It starts at $0.04 per mile for weights and number of axle combinations. If the weight for three axles is exceeded, the fee goes up $0.04 per additional ton on that axle combo. For excessive (weight/axle) loads, the fee starts at $1.02 per mile and increases $0.07 per ton. There is also an opportunity for a percent reduction on the road use fee up to 25% per vehicle.	Ton Mileage	None

State	Weight Fees Approach	Fee Type	Fee Cap
	There is a reduction per axle group up to maximum of 16 tires per axle. The excess weight annual fee for authority to exceed 80,000 lbs. up to 105,500 lbs. is $43. The permit fee for a single trip is $33; for two trips it is $43. A weekly permit is $71. There is also an over legal permit manual fee plus sales tax for residents of $5.		
Montana	Uses a formula of excess weight (in 5,000 pound increments) with a cost per 25 miles of travel. Example: 100,00 pound excess weight traveling 200 miles ($70 x 8 = $560)	Ton Mileage	None
Nebraska	Only charges an administrative fee of $10-$20 for over dimensional permit.	Administrative	N/A
Nevada	Nevada charges a $25 permit fee (assumed to be an administrative cost recovery) and $60 for each additional 1,000 pounds over the 80,000 GVW. Maximum additional fee is $2,940.00.	Tonnage Only	N/A
New Mexico	New Mexico only charges a $25 permit fee.	Administrative	N/A
North Dakota	Overweight permit fee of $20 for up to 150,000 pounds GVW then $10 increases for each 10,000 pounds increase in GVW up to $70 max.	Administrative	N/A
Oklahoma	$10 per 1,000 pounds overweight.	Tonnage Only	None
Oregon	Oregon uses a GVW/axle combination to charge per mile for overweight. The fees appear to be structured in a way that encourages dispersing the weight across multiple axles (fees go down for the same GVW with more axles).	Ton Mileage	None
South Dakota	For excess weight (either over-axle or GVW), a fee of $0.02 per mile for each ton of excess weight.	Ton Mileage	None
Utah	Overweight fees are based on GVW and mileage (50 mile increments) but do not exceed $540 in weight fees. The fees increase incrementally as the GVW goes up but still cap at $540.	Ton Mileage	$540
Washington	Charges $0.07 per mile for excess weight of 1-9,999 pounds over, then an additional $0.07 per mile for each 5,000 pound increase in weight up to 100,000 pounds of excess weight. Loads > 100,000 pounds or more in excess are charged $4.25 per mile incrementing $0.50 per mile for each additional 5,000 pounds of excess.	Ton Mileage	None
Wyoming	Minimum of $25 for overweight fee computed at $0.04 per ton, per mile on weight > legal	Ton Mileage	None

In addition, the research team also looked at other states adjacent to Texas. Louisiana, for example, sets its overweight fee based on GVW in increments from 80k to 254k combined with

50 mile increments. For loads greater than 254k, it is $10 plus $0.50 per ton mile (for weights heavier than 80k). There are also additional assessment fees from $125 to $850 depending on the structure types being crossed. Arkansas' overweight fees are based on mileage increments (0–100 then 50-mile increments, with a maximum range of 250 miles) and tonnage with a fee per mileage increment increasing after 5 tons over and then again after 10 tons over.

The research team also reviewed legislation from other countries regarding their OS/OW permit programs, specifically Canada, Mexico, Australia, the European Union (EU), and certain countries within the EU. The results are presented in Appendix E.

1.4 Industry Forum

As part of this study, the research team hosted a one-day industry forum to discuss study objectives and analysis approach with the trucking industry and solicit input from those who may potentially be impacted by permit fee changes.

This one-day forum was held Thursday, March 29, 2012, from 10 a.m. to 3:30 p.m. at the AT&T Conference Center at The University of Texas at Austin. The next section summarizes the outcome of the forum. It also provides participant information, forum format, and input received from participants during afternoon roundtable discussions.

1.4.1 Participants

To represent OS/OW haulers, the research team randomly selected 70 companies from the Texas Permitting & Routing System (TxPROS) database, the TxPROS Customer Work Group, and the Texas Super Load Common Interest Group. The sample was stratified to include companies that have worked with TxDOT before on permitting issues and to account for different types of users in terms of number of permits used and annual expenses of permits. These 70 companies were supplemented with company names received from the Texas Department of Motor Vehicles (TxDMV) to account for exempt haulers, the weight tolerance permit users, and time and annual permit users. In total, through emails and phone calls, the research team reached out to 105 companies potentially impacted by permit fee changes. The team also invited these seven industry associations:

- Specialized Carriers and Rigging Association
- Texas Motor Transportation Association
- Texas Cotton Ginners' Association
- Texas Farm Bureau
- Texas Forestry Association
- International Milk Haulers Association
- The Associated General Contractors

An example of the invitation letter that was e-mailed/faxed to the identified companies and associations is included in Appendix H. In addition, each participant was provided with the following items:

- an agenda (Appendix J)

- a one-page overview the study (Appendix I)
- biographical information for the study team

1.4.2 Industry Forum

Ms. Wendy Reilly, Project Director, TxDOT State Government Relations Division, TxDOT, welcomed the industry forum participants and thanked them for their time and participation. Ms. Carol Davis, TxDOT's Director of Motor Carrier Division (MCD), reiterated these sentiments and asked participants to work with the research team by providing information and insight to reduce the need for assumptions in the study and ensure a reliable deliverable.

Dr. C. Michael Walton moderated the morning session, reviewing the project objectives and format of the forum. The morning session was made up of four presentations:

- Dr. Mike Murphy provided an overview of MCD OS/OW permit fees.
- Dr. Jorge Prozzi presented the method that will be used to estimate the pavement consumption imposed.
- Dr. José Weissman presented the method that will be used to estimate bridge consumption.
- Ms. Jolanda Prozzi presented the components of the cost and revenue analysis.

1.4.3 Roundtable Discussion

After lunch, forum attendees participated in a roundtable discussion. Attendees were pre-assigned to specific tables to ensure a diverse perspective on the questions presented. The following questions were discussed during the afternoon session:

1. What are any missing study elements, components, or comments?
2. Could you describe the impacts of Texas's road conditions on industry costs?
3. How could TxDOT balance overall impacts of OS/OW loads and road maintenance?
4. How should exempt loads be considered in a potentially revised permit fee structure?
5. Given the maintenance backlog and insufficient revenue stream, how should users pay for system use and consumption?

A member of the research team facilitated roundtable discussions, and comments were recorded. Table 1.8 provides the names of the 37 forum participants. Table 1.9 provides a summary of the discussion. Appendix K provides a detailed record of the roundtable discussions.

Table 1.8: Participants by Agency/Company

Participant Name	Agency/ Company
Carol Davis	Texas Department of Motor Vehicles—Motor Carrier Division
Scott McKee	Texas Department of Motor Vehicles—Motor Carrier Division
Duwayne Murdock	Texas Department of Motor Vehicles—Motor Carrier Division
Kinnan Golemon	KG Strategies, LLC
Jennifer Newton	The Associated General Contractors of Texas
Lester Parker	United Parcel Service (UPS)
Ed Small	Texas Forestry Association
Ren Nance	Committee Director, Senator Craig Estes
Norman Garza	Texas Farm Bureau
Les Findeisen	Texas Motor Transportation Association
Bubba Rouse	Palletized Trucking, Inc.
Rick Collins	Texas Department of Transportation—Research and Technology Implementation Office
Wendy Reilly	Texas Department of Transportation—State Government Relations Division
Jackie Shults	Lehigh Hanson, Inc.
David Ainsworth, Sr.	Ainsworth Trucking
Mark Borskey	Borskey Government Relations LLC
Clay Jones	Austin Bridge and Road
Jean Bohuslav	Texas Department of Motor Vehicles—Motor Carrier Division
Damon Tofte	IESI Corporation—Progressive Waste Solutions
Charlie Gee	Texas Logging Council
Jim Townsend	H.L. Chapman Pipeline Construction, Inc.
John Pellizzari	Energy Service Company
Wayne Griffin	Texas Logging Council
Brett Bray	Texas Department of Motor Vehicles—General Council Director
Bob Pollick	Campbell Concrete & Materials, LLC
Maurice Brown	H. Brown Inc.
Kenneth Nolley	Torqued-Up Energy Services
John Phinny	Torqued-Up Energy Services
John Esparza	Texas Motor Transportation Association
Jody Richardson	Allen Boone Humphries Robinson, LLP
Jay Alligood	Texas Concrete Partners, LP
Jesse Hereford	S & B Infrastructure, LTD.
Kenny Jordan	Association of Energy Service Companies
Tom Brown	IESI—Progressive Waste Solutions
Bernie Carrasco	Texas Department of Transportation—Bridge Division/Field Operations
Lisa Anderson	National Solid Wastes Management Association
Jenny Li	Texas Department of Transportation—Construction Division

Table 1.9: Summary of Roundtable Discussion

Questions	Table 1	Table 2	Table 3	Table 4	Table 5	Table 6
1. What are any missing study elements, components, or comments?	• Every state has different regulations—some states allow heavier garbage trucks. We should build the type of roads they are building. • Texas weight regulations don't allow trucks to be filled to full capacity. • Would consider a permit more favorably if it allowed trucks to run at full capacity (higher weight limit)—could run fewer trucks and save money. • Have to buy a permit to move a super-heavy load truck that's empty	• Presentation too technical; not clear what is missing. • Proposed pavement model assumes pavement type/design—actual pavement consumption may be different. • Tire pressure should be considered. • Likelihood of getting ticket is low; ticket cost is less than permit. • Examine economic balance (benefits and costs) of industries. • Examine uniformity amongst jurisdictions requiring and enforcing	• Simplify fee schedule and ensure it is equitable. • Permits based on road and bridge impact, not on commodity being hauled; exempt loads need fees. • Consider all state fees (licensing, registrations, additional permits). • Research Fund 6 allocations and identify diversions.	• Contextualize the OS/OW permit process and history. • Perspective on how this all came to be; i.e., the original point of the current fee structure. • Taking a system that was not meant to be a revenue generator and trying to turn it into one; e.g., 2060/1547 permits were not meant to be a revenue generator. • Counties need to be approached for this study, as currently they are the "missing stakeholder," and county roads are deteriorating rapidly.	• Historical perspective (post 1980s)—permitting driven by safety, not revenue issues. • Tires per axle—is this addressed and does it matter? • OS/OW routes should be integrated into a highway network that serves everyone while facilitating special loads.	• Educate public and officials that properly loaded OS/OW trucks cause no additional damage compared to normal truck traffic. • Include historical review of Texas's permit system (e.g., why exemptions exist and how permit system came about). • Permit fees originally to cover routing costs and for safety—not road maintenance fees. • OS/OW fleet should not pay sole cost for road maintenance. • Economic benefits of OS/OW truck

Questions	Table 1	Table 2	Table 3	Table 4	Table 5	Table 6
		permits.				movements need to be acknowledged.
2. Impacts of Texas road conditions on industry costs?	• Solid waste operators use county roads and city streets as much as the state system—consider an escrow account to help maintain infrastructure in certain regions. • Heavy load trucking also uses county roads—these roads are in bad shape, and fees should go to counties. • State roads are in good condition. Concern about condition of FM roads (e.g., ruts, pavement edge drop offs) • Money should be managed by the state, not counties.	• Oilfield and logging use a lot of county roads. • States roads are good; why need more funds? • County roads are in bad shape; not enough funds or mismanagement by county commissioners.	• Texas IH, US, and SH roads better than most states. • FM roads in poor condition and rapidly deteriorating. • Increased vehicle maintenance (suspension, shocks, and tires) and operating costs due to poor FM road condition. • Increased fuel expenses and travel time when attempting to bypass poor condition roads. • Increased fuel expenses and wear on secondary and tertiary roads (to avoid congestion on main roads, FM roads are used,	• Super-heavy hauler panelists noted that they often do their own testing for pavement damage before asking for permit. They use portable scales to determine axle weights when out in the field. • Noted that there are more costs when road conditions are worse. E.g., it may add 100+ miles to a trip when bridge cannot be used. • Something needs to be done about the county roads. • For some industries (e.g., oil services), if a delivery has to be made, they will look to see the	• Lane narrowing like that proposed on IH-35 in Austin will raise trucking costs (UPS) and may restrict routing of OS/OW loads, thus reducing system capacity. • All supply chains use trucks at some point, and poor roads damage vehicles. • UPS cited springs, shocks, mirrors, damage to cargo, and reduced vehicle life in miles.	• State highway system is in good condition. • County roads impact industry, as poor conditions impact safety and increase accident risks. • Increased maintenance costs as result of increased road condition deterioration. • Sometimes forced to take alternative routes due to the deteriorating roads, resulting in higher fuel expenses. • Condition of FM system is imposing costs (e.g., tires, shocks, and suspension) on oil well service

Questions	Table 1	Table 2	Table 3	Table 4	Table 5	Table 6
	• If permit increase is high enough, it could affect customer choices about where to off load trucks. The cost of maintaining roads should not come from one source—use several revenue sources. • Do not try to fund needs from one industry that happens to be doing well at the time. E.g., right now, oil and gas is doing well so everyone thinks this industry should pay.		contributing to deterioration of FM roads).	legal routes and timing. If none are available or they are not economical, they will not take the job. So road conditions impact economic activity. • Are not bothered about paying the permit fee; care about getting the permit quickly and that everyone is paying their fair share. (Caveat: this table had large super-heavy representation.)		companies. • Should consider how permit fee changes might affect overall economy.
3. How could TxDOT balance overall impacts of OS/OW loads and road maintenance?	• Lowering fees if an axle is added won't always work. Some cities require contracts based on fewer axles because of the belief that a single axle does	• Haulers are paid same amount per load—road condition is more important for haulers. Hauling more weight per load is more important for	• Allocate maintenance dollars to upgrade OS/OW routes to better handle these loads. • All permits should be routed; can obtain routes	• Education needed for law enforcement to spot illegal loads. • Repetitions do more damage than one heavy load, especially when they are not	• Develop OS/OW corridors that are suitably maintained, as loads are sometimes diverted to FM roads due to simultaneous maintenance	• A weight distance fee will be most equitable. • Road maintenance component of permit fee should go for road

Questions	Table 1	Table 2	Table 3	Table 4	Table 5	Table 6
	less damage than a tandem axle. Education for public officials may be needed on truck axle damage relationships. • OS/OW permit fees should go to improve routes and bridges that OS/OW trucks want/need to travel, e.g., load-zoned bridges and geometrics.	industries. • Propose sliding scale; can haul more weight for higher fee.	at no additional cost.	correctly loaded • Load-zoned roads sometimes have to be used. • Maintenance fee that has a per mile fee component: "The weight you carry and the miles you travel."	activities on alternative routes. • Some TxDOT districts are improving their coordination so that maintenance or construction does not occur on key longer routes used by OS/OW trucks—should implement this across the state.	maintenance.
4. How should exempt loads be considered in a potentially revised permit fee structure?	• Exempt trucks don't know when they are overweight, so "How are you (the research team) going to figure out what exempt trucks should pay if I don't know the weight?"	• Not real farmers get away with cheapest agricultural permit. • Revisit all permit types and base on consumption.	• Need equitable fee structure—should be based on configuration, loads, axle weight. • Industry/ commodity being hauled should not be considered.	• If they use the road, they should have to pay for it; against exemptions. • If the objective is to generate revenue, then exemptions should pay. • Whole new permitting system is needed—start from scratch and not merely update.	• Exempt truck owners pay a bond, but why should the revenue go to an insurance company when claims are so difficult to prove? Instead, send it directly to Fund 6.	• Permits are preferred over bonds; bonds regarded totally ineffective. • In Houston, exempt vehicles can hardly capitalize on load limit as most freeways are part of the IH system—industry is losing money and would pay fee to improve

Questions	Table 1	Table 2	Table 3	Table 4	Table 5	Table 6
				• As a trade-off for the currently exempted classes, one suggestion was to keep 20/60 system but not issue any new permits under this system; all new permits will fall under the new system.		efficiency. • Need for equity. "Pay for consumption" may thus be better principle. • Tax breaks or other incentive may be better option for exempt vehicles today.
5. Given the maintenance backlog and insufficient revenue stream (based on all current projects seen from the feds and state), how should users pay for system use and consumption?	• Gas tax increase is more equitable, but right now is not the time to increase due to high fuel prices • Raising the vehicle registration fee would be equitable—everyone would pay. • Ton-mile fee would be equitable, but should not be the only source of revenue for the system.	• Urban system: congestion tax. • Rural system: ensure maintenance of existing system. • Stop diversion of transportation funds. • Privatize all maintenance. • Spread burden across all users; increase fuel tax, registration fees, and permits. • Dedicate vehicle sales tax to transportation. • Index the gas	• Fees based on VMT, no exemptions. • Pay based on usage/ consumption; oversize pay by mileage, overweight pay by per ton-mile. • Indexing of gas tax. • Revisit permit fee allocation; eliminate diversions from Fund 6. • Simplify current permit system and reduce number of	• Raising the gas tax is neither fair nor smart as it will never catch up with the gap we face, given that vehicles are getting more fuel efficient and are using different fuels. • In the future, gas tax will be VMT based, so truck fees should be VMT based to get a head start. • Open to technology on trucks; GPS mandate in permit fee	• Update traditional gas and diesel fuel taxes. • Increase TxDPS weight enforcement on key energy routes. • If heavy loads and exempt vehicles help drive the state economy and enrich key funds, why should TxDOT not be included in some way? Energy pays more than 95% of the "rainy day" funding, so why should some	• Increase the diesel tax • Heavy Vehicle Use tax—what percentage of revenues is returned to states? • Funding infrastructure from the General Revenue fund is a difficult option. • Should consider channeling existing fees to highway maintenance. • Diversion of fuel tax revenues should be

Questions	Table 1	Table 2	Table 3	Table 4	Table 5	Table 6
	• Create escrow account that different industries pay into to provide revenue to address road and bridge infrastructure needs; in return, industry will receive reduced future taxes or other incentives.	tax. • Traffic impact fees (e.g., new turn lane paid for by new business). • Donations.	permits for more equity (no bias based on industry or commodity).	structure. • New fee system that is based on consumption and VMT would be fairer and more equitable, as it would be based on weight carried and miles traveled. • Any permit fee increase will be passed on to customer.	not come back to repair the damage to highway infrastructure? • End diversions from Fund 6.	addressed. • Increased registration fees. • Toll roads.

1.5 Interviews

As part of the study, the research team gathered data on other costs associated with OS/OW loads through a series of interviews. The literature review conducted during the initial months of the research revealed a number of direct cost elements imposed by the movement of these loads, such as (i) administrative costs associated with processing permit applications and the escorting of certain loads; (ii) reduction in pavement life; (iii) reduction in bridge life; (iv) damage to appurtenances such as message signs; (v) accidents resulting in property damage, injuries, and fatalities; (vi) enforcement costs; (vii) reduced highway capacity; and (viii) legal costs for damage recovery.

As part of this task, the team gathered data and conducted multiple interviews to identify and gather relevant cost elements data and information for quantifying the impact of OS/OW loads, exempt loads, and super-heavy loads in Texas. Specifically, the team conducted the following interviews to gather data on these other direct cost elements, processes, and procedures and to follow-up on anecdotal comments that had been heard during the project:

- TxDOT Motor Carrier Division
- TxDOT Districts and Maintenance Divisions
- Cities of Dallas, Houston, and Fort Worth
- Ector and Tarrant Counties
- Texas Department of Motor Vehicles (TxDMV)
- Texas Department of Public Safety (TxDPS)
- TxDOT Office of General Counsel
- Office of the Attorney General
- Texas Department of Insurance (TDI)

Additionally, the research team met with industry representatives and trucking groups throughout the project upon request. For example, members of the research team met with the Aggregate Transportation Association of Texas (ATAT) in September 2012.[1]

Three survey questionnaires were developed for the interview process. The first was for interviews with TxDMV and cities/counties. The second was for TxDPS. The third was for TxDOT districts and divisions. Figures 1.1 through 1.3 contain the survey instruments.

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[1] Over and above the trucking industry forum attendees from the Mach 2012 workshop that was hosted as part of Task 5 for the project.

TxDOT Project 0-6736: Rider 36 Oversize Overweight Vehicle Fees Study
TxDOT District:________ _______ City / County: ____________________________
Section / Branch: ____
Name of person providing information: ____________________________
Introduction
The State Legislature required TxDOT to report on costs associated with Oversize and Overweight loads (OS/OW), including OS/OW exempt loads due to accelerated pavement and bridge life consumption, and damage to appurtenances such as signs, traffic signals, guard rail and other TxDOT property.
John Barton P.E., will be giving testimony before the Legislature during the upcoming 2013 Legislative session in response to this request. UT-CTR was awarded a research project to develop information about these costs and to help TxDOT Administration develop a new Permit fee structure.
We would appreciate your help in assisting us to gather the following data to help prepare the information the State Legislature has requested:

Survey Questions

1. Do you keep records of damage to roadside appurtenances, such as message signs, guardrail, safety barriers, traffic signals, etc., by oversize or overweight vehicles?
2. What type of damage typically occurs—are there any types of damage specifically associated with OS/OW vehicles?
3. How often does this type of damage occur?
   Never has happened in our district ______________
   Maybe once a year ____________________________
   Several times (please describe below):
4. Is this damage ever caused by trucks that are exempt from permitting?[2]
5. Could you provide copies of your damage claim reports prepared over the past four years (not including the police report) for damage caused by OS/OW or exempt vehicles? The costs information will be most helpful for this study and will be kept confidential by the research team.
6. Do you keep records of any OS/OW or exempt vehicle accidents that result in injuries/fatalities?
7. Do you use the proceeds of bonds taken out by industry to cover the cost of damage?
8. Can you please supply your road estimator template?
9. Have you ever received a public complaint regarding an OS/OW, super-heavy, or exempt vehicle that damaged public or private property?
   a. Details regarding type of damage
   b. Number and frequency of complaints
   c. Additional details
10. Can you suggest a city or county contact person who might have knowledge about OS/OW or exempt vehicle damage in their community?

Figure 1.1: Local Area Questionnaire

[2] **Increased allowable loads for exempt vehicle types**: Groceries, LP Gas & farm products not subject to load zone limits; agriculture and livestock (12% over-axle tolerance during harvest); ready mix/concrete trucks (23,000 lbs. steering, 46,000 lbs. tandem); bulk milk trucks (68,000 lbs. on inner two tandems relaxed rules for federal bridge formula); utility poles, piling, raw wood products (logs, bark, sawdust, pulpwood) (relaxed rules for federal bridge formula, rear tandem up to 50,000 lbs; max 80,000 lbs. GVW); recycling trucks (auto salvage, scrape iron, residential service, paper, etc.) (21,000 lbs. steering, 44, 000 lbs. tandem); fire trucks (23,000 lbs. steering, 26,000 lbs. single rear axle, 53,000 lbs. tandem); solid waste and garbage trucks (21,000 lbs. steering, 44,000 lbs. tandem); cotton seed or Chile Pepper modules: cotton 64,000 lbs. on single unit truck ~ 50,000 lbs. on rear tandem; Chile Peppers 54,000 lbs. on single unit truck ~ 40,000 lbs. on rear tandem. **Increased allowable dimensions:** Cottonseed or Chile Pepper modules on tractor semi-trailer: 10’ wide x 48’ long x 14’-6” high (legal is 8.5’ wide x 59’ long x 13’-6” high). Garbage trucks allowed greater front extension (3’ front extension is the legal limit). Truck and trailer allowed 7’ rear overhang, such as concrete beam hauler (4’ is the legal limit). Poles, piling and raw wood products; allowed 90’ total length, including load within 125 miles of point of origin (59’ trailer and 4’ rear overhang is the legal limit). Poles and piling: single unit truck 65’, including load overhang – during daylight only (legal is 65’ with 4’ load overhang). Various width exemptions for farm equipment, fire trucks, highway construction, and recreational vehicles; various length exemptions for oil & gas exploration, water well drilling, fire trucks and farm equipment.

Project 0-6736: Rider 36 — Oversize/Overweight Vehicle Fee Structure' Damage and Cost Impacts due to Oversize/Overweight Loads.
Contact Person ____________ Primary Responsibilities ____________________________________
Date ______________ District ______________

Background and Purpose of the Survey Questionnaire
The purpose of this survey is to obtain information from districts and divisions regarding damage and cost impacts due to OS/OW vehicles operating on the state-maintained roadway system. This information will help determine the total costs associated with increased consumption of pavement, bridge and safety treatments, traffic signals, and other infrastructure maintained by TxDOT.

Question 1: Can you identify types of OS/OW loads that have caused damage to the state-maintained highway system in your district? Some examples of load/vehicle types include:

Wind turbine equipment transport vehicles	Power Transformers
Oil Industry Equipment	Water Well Drilling Equipment
Heavy Construction Machinery	Cranes
Ready Mixed trucks	Agricultural Product transport trucks
Cotton Trucks	Chile Pepper Module Trucks
Logging or Raw Wood Product Trucks	LPG Gas Trucks
Trucks Carrying Pipes or Poles	Mill Trucks
Garbage Trucks	Recycling Trucks
Gravel or Rock haulers	Concrete Beam trucks
Fire Trucks	Super-Heavy Loads: (>250,000 lbs.)
Other	

Question 2: Can you please describe specific types of damage that have occurred in your district from the vehicles listed in Question 1?

Pavement: Bridge: Signs: Traffic Signals: ____________________________

Safety Devices (Guard Rail, Vehicle Impact Attenuators) Other: ____________________________

Question 3: How often does your district experience damage from OS/OW loads (permitted or not)?

Question 4: How often are you able to submit a damage claim because a police report was written when the damage occurred?

Question 5: Can you identify the three main types of industries or loads that cause OS/OW damage in your district?

Question 6: Can you identify steps you've taken to reduce OS/OW damage, such as raise one or more bridges, change traffic signal design, install laser beacon, low clearance system or other steps?

Can you provide cost estimates for the world you've done to reduce OS/OW damage in your district?

Bridges raised	Roadway profile lowered	Signals updated and raised
Low clearance warning systems	Other	

Figure 1.2: District Questionnaire

TxDOT Project 0-6736: Rider 36 Oversize/Overweight Vehicle Fees Study
Introduction
The State Legislature required TxDOT to report costs associated with oversize and overweight (OS/OW) loads. This includes not only the costs of pavement and bridge consumption but also the safety, administrative, and enforcement costs that DPS incurs as part of its weight enforcement duties.
TxDOT Administration will give testimony before the Legislature during the upcoming 2013 Legislative session in response to this request. UT-CTR was awarded a research project to develop information about these costs and to help TxDOT Administration develop a new permit fee structure.
We would appreciate your help in assisting us to gather the following data to help prepare the information the State Legislature has requested:

1. Roughly how much does DPS spend each year specifically on OS/OW weight enforcement, including personnel, equipment, and related expenditures?
    a. Is this included as a specific line item in your budget?
    b. Does it cover, in your opinion, the costs for effective enforcement activities?
2. Do you work with local law enforcement jurisdictions (cites/counties) to manage enforcement activities?
3. How often are OS/OW loads involved in crashes or damage overpasses, guardrail, signs, signals, or related public property?
    a. Can you provide additional DPS information or reports related to damage due to OS/OW loads?
    b. Do you know of any cities/counties that could provide such data?
4. Relating to OS/OW exempt loads such as concrete trucks, bulk milk trucks, garbage and recycling trucks, agriculture and logging trucks, etc., what is DPS' authority to enforce state laws regarding these loads?
5. Can you clarify for us the section of TC code associated with agricultural loads during harvest period? We think 12% over-axle tolerance is permitted, but have heard anecdotal evidence that actual loads can be much higher.
6. Does DPS provide any escort vehicles for OS/OW vehicles?
    a. If yes, what does an average escort cost (manpower, fuel, other costs)?
    b. Do you know of any localities that also do this?
7. Any additional comments or references materials you can suggest or further contacts regarding OS/OW load impacts on the state system would be very much appreciated.

Figure 1.3: DPS Questionnaire

Interviewees (in alphabetical order) from these various state and local agencies include

- Abilene District—Director of Maintenance
- Atlanta District—Director of Operations
- Austin District—Traffic Section
- Austin District—Traffic Signal Shop—Foreman
- Bryan District

- Dallas County—Public Works Department: Transportation & Planning—Assistant Director
- City of Dallas—Street Service: Heavy Maintenance
- City of Dallas—Department of Street Services—Routine Maintenance
- City of Dallas—Public Works—Traffic Signals
- El Paso District—Pavement Engineer
- Ector County—Road & Bridge
- City of Fort Worth—Assistant Director Transportation and Public Works
- Fort Worth District—PMIS/BRINSAP Coordinator
- Fort Worth District –Traffic Operations
- Fort Worth District—Maintenance Engineer
- Fort Worth District—Bridge Engineer
- Harris County Infrastructure—Traffic Section
- Lubbock District—Littlefield Area Engineer
- Lubbock District—Pavement Engineer
- Lufkin District—Maintenance Director
- Paris District—Director of Operations
- San Angelo District
- Tarrant County—Transportation Department
- Texas Department of Insurance—Commercial Property & Casualty: Manager
- Texas Department of Motor Vehicles—Enforcement Division
- Texas Department of Public Safety
- Texas Office of Attorney General
- Waco District—Maintenance Engineer
- Wichita Falls District –Traffic Engineer
- Yoakum District

The next section sets out the major findings from the interviews. Section 1.6 contains the interviews from TxDOT districts and divisions, and Section 1.7 details interviews with state and local government public sector agencies.

1.6 TxDOT Districts and Divisions

This section contains interviews with TxDOT districts and divisions conducted during July through October of 2012.

It should be noted that TxDOT maintains signals in cities with populations less than 50,000. Once the population exceeds this level, the city takes over signal maintenance and management. For example, the City of Austin has about 1,200 signals on the city system, but 13 to 14 of these are actually TxDOT signals. TxDOT pays the city roughly $1,000 per signal per month to maintain and manage them.

The types of damage that can occur when OS/OW vehicles hit TxDOT and other local government property vary. Very minor to large-scale damage can occur. Figures 1.4 and 1.5 display major damage caused to an overpass at US 385 at SH 158 in TxDOT's Odessa District on May 24, 2012. Damage costs were $500,000. Figure 1.6 shows damage on HI 20 at the PR 41 bridge in Odessa District. Figures 1.7 and 1.8 shows seal delamination from heavy loads traveling on steep grade.

Source: TxDOT Odessa District

Figure 1.4: Bridge Damage from OS/OW Load at Overpass on US 385 at SH 158—Odessa District

Source: TxDOT Odessa District

Figure 1.5: Bridge Damage from OS/OW Load at Overpass on US 385 at SH 158—Odessa District

Source: TxDOT Odessa District

Figure 1.6: Damage to Bridge at IH20 & PR 41

Source: TxDOT

Figure 1.7: Seal Coat Damage Due to Heavy Load

Source: TxDOT

Figure 1.8: Seal Coat Damage Due to Heavy Load

1.6.1 Abilene District

District officials noted that bridges have occasionally been hit by overheight loads. They commented that construction equipment haulers were the most common vehicles associated with this type of damage.

The district raised a bridge—a new construction, not a retrofit—on IH 20 at the US 83/84 interchange about four years ago. However, officials could not think of any bridge height retrofits that were performed recently. District officials noted, "We do have several bridges we need to raise, but money is a problem." Figure 1.9 shows damage on IH 20.

The district has large number of signs, object markers, and delineators that get hit by loads making turns at intersections or by wide loads traveling along a FM. Here, farm equipment is the biggest problem with OW loads hitting delineators or other markers along the road. The district has started to use a "self-righting"-type vertical panel that is more expensive because of hits due to farm equipment.

District officials indicated that the problem with farm equipment has more to do with width than load; however, they could not say, "Farm trucks cause significant damage to our roads due to being over loaded, it's more the equipment being overwidth." Another problem the district faces with OW loads is crushed culvert ends.

Figure 1.9: Damage to Sign on IH 20 in Abilene District

District officials mentioned that the three most prevalent types of OS/OW loads in the district that cause damage to TxDOT property are related to wind energy, oil field, and farming. Regarding the wind energy industry, the main damage occurs during construction of the pads. This is because hundreds of truckloads of base material and concrete are brought in to build one farm. Although district officials cannot say that the trucks are necessarily overloaded, the sheer volume of truckloads damages FM roads substantially.

Officials could not recollect any damage occurring from movement of the wind turbine parts themselves, noting, "Again, it's more the construction of the pads and the equipment involved in hauling materials." For oil field equipment, weight inflicts the most damage.

The district could not recall any crashes involving OS/OW loads. Essentially, these types of loads are not a big problem in the district other than the damage caused by wind, energy, and farming equipment.

1.6.2 Atlanta District

Atlanta District officials commentated, "Many of the hits that occur on our bridges are by non-permitted loads." In some cases, they noted that the load is permitted but not following the route specified in the permit.

District officials stated that a county road bridge crossing IH 30 was hit the day before this interview by an OS/OW load carrying storage tanks, further commenting that when loads of this type hit a bridge, there is substantial damage and currently, the CR overpass is closed to traffic. Officials also stated that when loads of this type hit a bridge, quite often the driver must pull over due to damage to the load. A TxDPS trooper then arrives and prepares an accident report. For example, district officials observed that on roughly two-thirds of the bridges hit, there is a TxDPS report that TxDOT can use to file a damage claim. For the remaining one-third of bridge hits in the Atlanta District, there is no accident report, so TxDOT absorbs the cost of repairs.

The research team asked district officials about a news story reporting that an OS load hit the IH 30, FM 992, and CR 2033 overpasses in February 2012. CTR had the crash record for this incident, and officials stated that repairs were done in-house with Atlanta and Dallas Bridge Crew personnel. The total cost of the repair was $58,273.87.

The research team inquired about traffic signal hits. District officials noted that roughly 25 percent of hits are accompanied by a police report. The remaining 75 are not reported, so TxDOT again absorbs the costs. Officials estimate that one traffic signal is hit each month. In most cases, the only damage occurs when the black background is shifted out of position. In other cases, such as a house move, the OS/OW vehicle might get hung up in an intersection while attempting a turn.

District officials stated, "On average, each year we are able to recover about $300,000 in damage claims and end up paying about $200,000 for damage that occurred for which no claim could be filed." This varies from year to year depending on the amount of damage. In 2011, the district recovered higher damage claims.

The district has invested in several laser/clearance beacon systems. It has also raised the height of several bridges along IH 30 to reduce risk of OS load hits. A rough estimate of the cost to raise a bridge is about $250,000. The district has also lowered the grade on one project to increase clearance under a bridge, costing roughly $150,000.

District officials noted, "The types of loads that hit our bridges and signals are roughly in three categories: 1) oil and gas industry, 2) logging industry, 3) contractors or equipment transporters." One bridge hit on IH 30 was actually due to a contractor moving a track hoe. The track hoe hit an overpass on the way to the construction site and damaged the bridge. Other damage that has occurred in the district includes about 200 feet of pedestrian fencing on a bridge that was torn out by a wide load a few years ago.

1.6.3 Austin District

The CTR research team asked the traffic signal shop about traffic signals. Officials noted that the Austin District has 410 traffic signals on the state system that are maintained by TxDOT (simple repairs) or the district signal shop for heavier repairs or complete replacement. To expedite repairs to damaged signals and reduce travel costs, local maintenance personnel are first responders. If necessary, they contact the signal shop once a damage assessment is made. The Austin District has also installed sensors in each signal head, as well as an automated system that alerts the signal shop when a signal goes off line or is not functioning properly.

District officials commented that although the number of OS/OW signal hits has not increased over the past five years, they have not decreased. This number has also been impacted by the modernization of older signals in the system, e.g., installation of mast and arm signals heads that provide greater clearance but cost more—$150,000 per set, on average.

The Austin District has only one county where oil and gas exploration occurs, and it has "worked to improve our intersection signal pole and signal head designs to reduce damage from mobile homes and wind turbine loads." One district official noted that rural districts have more oil and gas exploration but typically experience less signal damage due to lower traffic volumes and reduced need for traffic signals. Whereas the Austin District has more than 400 signals, a rural district might have 70 to 80 signals. Therefore, there is less potential for damage even in light of heavier oil and gas OS/OW traffic.

Damage to signals, signal poles, and railway crossings signals and arms by OS/OW vehicles or routine traffic is often first reported by local residents or local law enforcement. A call is made to CTECC or the local TxDOT maintenance office when a signal has been damaged.

There is often no police accident report associated with signal damage due to OS/OW loads. Currently, the district is experiencing the greatest number of OS/OW hits on traffic signals in Caldwell County along SH 80 and SH 20. These hits are mainly associated with oil and gas industry oilrigs and support equipment. Hits along these routes occur weekly, with multiple hits occurring at certain intersections. Although oil and gas industry OS/OW hits primarily affect this one county, district officials noted, "We have more damage to our signals from mobile homes than from the oil and gas industry." Figure 1.10 shows a damaged traffic signal.

Figure 1.10: Damaged Traffic Signal

District officials noted that super-heavy load rigs are preceded by an escort vehicle carrying personnel armed with wire poles. Escort personnel raise wires and signals as the rig approaches, minimizing the risk of damage. However, most OS/OW loads do not have an escort, so no one is there to raise the wires if the rig is too high. This is particularly true for mobile home movers, because these are generally one-man operations.

The Austin District also experiences signal hits along the US 183 corridor due to mobile home moves. District officials commented, "We've learned that the strand-wire type traffic signal pole and signal head designs are more vulnerable to OS/OW vehicle damage, including mobile homes. These vehicles will travel through an intersection and take down the wires and signal heads, especially when making turns." One incident in Cedar Park a few years ago involved a mobile home mover who took out several signals along the route. According to district officials, other than Caldwell County and perhaps Lee County, traffic signal hits occur about once a month elsewhere in the district.

Wind turbines are another type of OS/OW load that can cause signal damage or other types of problems. District officials noted that they have changed traffic signal designs because of OS/OW load hits. The design guidelines allow a traffic signal to be mounted between 15 to 19 feet high, with the typical height being 17 feet, 6 inches. The height is controlled by the driver's cone of vision, which is 20º, and limits the maximum signal height.

The district now places signals at the maximum 19-foot height and is also transitioning from a strand wire pole design to a mast arm design. Mast arms cost about $150,000 per four-arm intersection to install compared to $70,000 to $100,000 for a four-arm strand wire. The mast arm design eliminates wires and allows OS/OW loads to move through the intersection with less chance of striking the signal.

When economic stimulus funds became available in 2008, the Austin District used a portion of those funds to begin installing the mast arm design configuration and to install the radio communications system that alerts the signal shop if a signal is malfunctioning or off-line. A video system would be very helpful for determining which types of vehicles hit the signals, but TxDOT communications systems bandwidth does not permit installation of these camera systems.

Signal head repair methods have also been modified in the Austin District so that a full lane closure is now required, costing about $900. A signal head repair usually requires two employees and a bucket truck. The district experienced an incident in Lockhart several years ago when a TxDOT employee was working on a signal from a bucket truck parked on the side of the road. A truck came through and hit the bucket, knocking out the bottom. The employee grabbed the strand wires and held on as long as he could but finally dropped to the ground and suffered a broken collarbone.

TxDOT has been approached by companies marketing a radar system that senses the approach of an overheight vehicle near an overpass or other obstacle and switches on a warning light. However, TxDOT staffers believe "that some OS/OW drivers would still disregard the warning light and continue driving until they hit the obstacle."

According to Austin District officials, the Yoakum District has installed a simple system utilizing a PVC pipe and wire strung between two poles that is mounted in advance of an overpass or other height obstacle. If an overheight truck hits the PVC pipe, the driver knows that he will hit the overpass and stops the rig. This device has had some success in reducing hits on overpasses.

Another problem with transitioning from strand wire signal installations to mast arms is that it can take up to six months to obtain a replacement when a mast arm is damaged or destroyed from a hit. This is particularly true when a special design mast arm spans a shoulder, two travel lanes, and a center turn lane. The "arm" can be up to 55 feet in length, and the mast arm company does not begin fabricating the new mast and arm until these parts are ordered. This means that in order to restore signal service, the district might have to use a mast arm that has been received for another project to replace the damaged unit. Another less desirable option is to install a timber pole with strand wires until the new mast arm arrives.

The Austin District has considered using temporary traffic signals like those used at bridge projects; however, these do not command the same respect as permanent traffic signals and therefore are not considered a viable solution.

Other types of signal damage from OS/OW loads include hits on signal beacons and railroad crossing signals or arms. The National Cooperative Highway Research Program has conducted research regarding lowboy trailers that might not provide adequate clearance at railroad crossings. These trailers can bottom out and present a serious potential for a truck/train crash.

When discussing costs attributed to OS/OW vehicle hits, district officials noted that replacing a damaged traffic pole costs about $5,000. The Austin District has a traffic signal maintenance budget of about $200,000 to $400,000 per year, so "you can see that we don't have sufficient funds to replace many damaged traffic masts and signal heads." The district does receive contributions from developers, increasing the number of signals that can be installed or replaced. However, the district is still only able to replace about 20 signals per year with its budget—even with those contributions from developers.

Federal regulations also pose problems for replacing signals. For example, federal funds cannot be used to repair or replace a portion of a damaged signal installation if it is built using prison labor. Federal rules also prohibit the use of used parts and requires U.S. steel and a testing certificate. This makes repair more complex. For example, officials noted, "if we have a set of signals knocked out by an OS/OW load and we replace them on the existing mast arm, there is a question whether federal funds can be used, because the mast arm is 'used'."

Austin District officials also noted that they know that Houston has had problems with mast arm damage and mast arms fatiguing from wind loads. They also noted, "actually, any corridor that along which wind turbine loads are moving are candidates for traffic signal mast arm damage. SH 21 is another corridor to examine."

1.6.4 Bridge Division

The CTR research team also met with the director of field operations for TxDOT's Bridge Division (BRG). This division's officials also provided key data and pictures regarding damage to overpasses and other TxDOT property by permitted and non-permitted OS/OW loads. This included preparing a listing that shows all of the bridges that have been raised during the past few years. BRG officials did comment, "Not all of these bridges were raised due to clearance problems from overheight vehicles; however, in some cases, a new pavement was placed under the bridge that reduced the clearance and required raising the bridge. However, in many cases bridges are raised due to repeated hits by overheight loads."

BRG officials requested districts to provide them with a list of bridges that have been hit repeatedly during the past few years. These bridges will be reviewed to determine which will be selected for installation of a laser/beacon/clearance sign. Costs are obviously an issue. The estimated cost of installing these systems at one bridge location can vary, but is around $70,000 to $80,000 per bridge. For example, if BRG earmarks 100 bridge locations that require installation of these systems due to repeated hits, the total cost is between $7 and $8 million statewide.

BRG officials pointed out that even if a bridge is raised due to overheight load hits, there is no guarantee it won't be struck again. For example, one bridge in Odessa was raised from 16 feet, 6 inches to 18 feet, 6 inches due to repeated overheight load hits. A 19-foot-tall load subsequently came through and hit the newly raised bridge.

The research team asked how many bridge hits are reported. BRG officials noted that while the Atlanta District's experience is that about two-thirds of bridge hits are reported and a police report made, the statewide experience is very different. The percentage of bridge hits for which no police report exists is much higher. An anecdotal reason that BRG officials noted could be that a trucker's insurance company will not pay for damage caused if a traffic law violation occurred, "so if the driver can leave the scene [sic] with his truck and load intact, that is what often happens." Officials went on to comment that for bridge hits where there is a real "blow up," i.e., the bridge is heavily damaged and chunks of concrete are lying in the roadway with the truck or its load in the ditch, TxDPS or local law enforcement are able to report the incident.

However, BRG officials pointed out that just because there is a police report, this does not mean that the driver of the oversize load will get a ticket. For example, the driver of the OS load that struck the IH 35 overpass over Stassney Lane in 2012 did not get a ticket from the Austin Police Department.

BRG usually only gets calls when a bridge is badly hit, not for minor dings that occur fairly frequently.

The Bridge Inventory database contains only one bridge height or vertical clearance, which is the lowest clearance under a bridge. However, some bridges, like the arch slab span bridges over IH 35 have a clearance of 13 feet, 2 inches for the outer lanes and 15 feet, 9 inches for the center lane. The motor carrier needed to know the clearance for all lanes for all bridges, so BRG contracted with a vendor to conduct a LIDAR inventory for every bridge and sign bridge structure in the state—and for all lanes to provide envelope data. The survey cost about $2 million. Information was processed and provided to TxDMV-MCD for use in TxPROS; however, the question now is how to keep this information current and how it will be funded. The LIDAR survey provided a snapshot in time, and various clearances can change if a district constructs a two-inch overlay or raises or replaces a bridge. Currently, there is no system in place to capture this information to keep the TxPROS database current; however, TxDOT is working on a system to capture LIDAR data on a routine basis. Table 1.10 shows 185 bridges with repeated damage due to high loads by each TxDOT district as of September 2012.

Table 1.10: 2012 Bridges with Repeated Damage Due to High Loads from TxDOT Districts

District	Bridge No	Location	Miscellaneous
Abilene	08-209	US 180 & SH 351	
	08-115-0005-06-080	FM 700 & IH20	
	08-115-0005-06-081	FM 700 & IH20	
	08-115-0005-06-085	Moss Lake Rd & IH20	
	08-115-0005-06-084	Moss Lake Rd & IH20	
	08-115-0005-06-077	FM 821 & IH20	
	08-115-0005-06-078	FM 821 & IH20	
	08-115-0005-06-071	FM 820 & IH20	
	08-115-0005-06-072	FM 820 & IH20	
	08-115-0005-06-088	Salem Rd & IH20	
	08-115-0005-06-089	Salem Rd & IH209	
	08-115-0005-06-066	FM818 & IH20	
	08-115-0005-06-067	FM818 & IH20	
	08-221	US 83 (Winters Freeway) over S. 7th St	
	08-221	IH20 over FM707	
	08-221	LP322 over SB US83/84	
	08-208	FM1673 (Ave E) over US84	
	08-208	US180 over US 84	
	08-208	FM1611 over US84	
Amarillo	04-188-0041-05-005	XXX over BNSF	
	04-188-0275-01-017	IH 40 WB over Ross St	
	04-188-0275-01-018	IH40 EB over Ross St	
	04-188-0275-01-044	IH 40 WB over Whitaker Road	
	04-188-0275-01-045	IH 40 EB over Whitaker Road	
	04-188-0275-01-046	IH40 WB Over Loop 335	
	04-188-0275-01-047	IH40 EB Over Loop 335	
	04-191-0168-09-061	C.R. 163 over IH27	
	04-191-2635-02-024	Jct. Loop 335 & FM 1541	
	04-188-0041-070-065	Jct. Loop. 87 & LP 335	
	04-107-0169-09-038	US60 EB & US83 SB	
	04-056-0040-03-006	US 54	
	04-059-0168-05-044	US 385 over BNSF	
	04-059-0226-05-019	US 60 over BNSF	
	04-091-0455-03-003	XXX over BNSF	
	04-033-0356-02-006	XXX over BNSF	
Atlanta	19-019-0610-06-113	SH 8 over IH 30	
	19-019-0610-06-114-	CR 2003(Red Bayou) over IH 30	
	19-019-0495-08-241	CR 3110 (Galilee Road) over IH 20	
	19-019-0495-08-271	Lansing Switch Road over IH 20	
	19-183-0063-03-059	US 59 SB over US 79	
	19-183-0063-03-060	US 59 NB over US 79	
	19-225-0610-03-057	IH 30 WB over US 271	

District	Bridge No	Location	Miscellaneous
	19-225-0610-03-058	IH 30 EB over US 271	
Austin	14-106-0016-03-125 14-227-0015-13-070 14-227-0015-13-071 14-227-0015-13-072 14-227-0015-13-101 14-227-0015-13-101 14-227-0015-13-189 14-227-0015-13-190 14-227-0015-13-380 14-227-0113-13-087 14-227-0151-09-041 14-227-0152-01-053 14-227-0152-01-054 14-227-0152-01-068	IH 35 SB ML over SH 80 EAST 38 1/2 ST over IH 35 LOWER LEVEL E 32ND ST over IH 35 LOWER LEVEL MANOR ROAD over IH 35 LL LP 343/Cesar Chavez St over IH 35 SB IH 35 NB over Holly St EAST 12TH ST over IH 35 EAST 11TH ST over IH 35 IH 35 NB over Cesar Chavez St US183SB TO SH71EB over SH 71 WB FM 969 over US 183 SH 71 WB over US 813 SH 71 EB over US 183 US 183 NB over US 183 to SH 71 EB	New interchange planned New interchange planned New interchange planned New interchange planned New interchange planned
Beaumont	None reported		
Bryan	17-021-0049-12-081 17-021-0049-12-102 17-094-0050-03-074 17-094-0050-03-075 17-094-0050-03-103 17-094-0050-03-104 17-145-0205-04-059 17-145-0166-04-017 17-145-0675-03-139 17-166-0186-01-025 17-239-0338-08-091	SH 6 over Woodville Rd SH 6 SB over SH 30 SH 6 SB over SH 90 SH 6 NB over SH 90 SH 6 SB over SH 105 SH 6 NB over SH 105 US 79 over FM 39/MPRR SH 75 over UPRR IH 45 SB over SH 164 SH 36 over UPRR FM 390 over BNSF	
Brownwood		CR 235 over IH 20 WB	
Childress	25-242-0275-12-066	FM 3075 over IH40	
Corpus Christi	16-178-0074-06-084 16-178-0074-06-172 16-178-0101-06-044 16-178-0101-06-063	McBride Lane over IH 37 Carancahua St over IH 37 US 181 over Burleson St US 181 SB over Nueces Bay	hit freq at low speeds
Dallas		Miller Rd over IH 30 Gross Rd over US 80 Gallaway Rd over US 80 St Francis over IH 30 Irving Blvd over Loop 12 MacArthur Turnaround over IH 635 Audelia over NW Hwy Corinth over IH 35 US 287 over IH 45 SB US 380 over Main St SH 114 over FM 156 IH 35E over Whitlock IH 635 over Elam Rd IH 35E over 12th St US 380 over SH 78 Loop 12 at Skillman (MH 72) US 75 over SH 121 IH 35 over Quail Rd	

District	Bridge No	Location	Miscellaneous
		IH 30 over FM 549 IH 45 over FM 739 SH 183 over Loop 12 SH 114 over US 377 US 380 over IH 35 Loop 12 over Old Irving Blvd IH 625 EB over MacArthur IH 635 WB over MacArthur US 75 NB at Ridge View US 75 SB at Ridge View	
El Paso	24-072-2121-02-140 24-072-2121-02-141 24-072-2121-02-163 24-072-2121-02-164 24-072-2121-03-103 24-072-2121-03-105 24-072-2121-03-134 24-072-2121-07-155	IH 10 WB over SH 20 (Mesa Ave) IH 10 EB over SH 20 (Mesa Ave) IH 10 WB over Trowbridge IH 10 EB over Trowbridge IH 10 over FM 2316 (McRae) IH 10 over Sumac Dr IH 10 over Yarbrough US 85 WB over Racetrack Dr US 85 EB over Racetrack Dr	
Fort Worth	02-127-0014-03-194 02-220-0008-12-362 02-220-0008-13-165 02-220-0008-13-424 02-220-0008-13-428 02-220-0014-15-384 02-220-0014-16-182 02-220-0014-01-440 02-220-0172-06-067 02-220-0366-03-014 02-220-1068-02-039 02-220-2266-02-044 02-220-2266-02-996	IH 35 W NB over exit SH 183 WB over Crosslands US 287 WB Ramp over IH 820 SB IH 20 WB DC to IH 35 SB over IH 35 IH 20 WB to IH 35 NB over Sycamore Cr US 81/287 SB over Blue Mound Rd IH 35W SB over UPRR IH 35W SB over Meacham Blvd US 287 NB over Carey St Sylvania Ave over SH 121 Fielder Rd over IH 30 SH 360 SB over Mayfield Rd RR over SH 360	
Houston	 12-085-0500-04-219 12-020-1524-01-003 12-020-178-03-039	Meadows St/US59 IH45NBML/SH 146 FM 521/Brazos River bridge access road underneath Sh35/UPRR upass IH10E/McCarty O/Pass IH10 East/Wayside O/pass	
Laredo	22-240-0018-05-110 22-240-0018-06-080 22-240-0018-06-084 22-240-0018-06-085 22-240-0018-06-087 22-xxx-xxxx-xx-xxx	 IH 35 SB over Calton Rd IH 35 SB over Mann Rd IH 35 SB over Del Mar Blvd IH 35 NB over Chicago St IH 35 at FM 469	recent near misses due to oilfield equipment
Lubbock	None Reported		
Lufkin		BU 59 over LP 287 SH 7 over US 69 SH 103 over US 96	
Odessa	06-069-0004-07-039 06-165-0005-15-200	Crane Ave over IH 20 CR 1150 over IH 20	
Paris	01-081-0610-02-020	IH 30 over Sp 423	

District	Bridge No	Location	Miscellaneous
	01-081-0610-02-021 01-113-0009-09-181 01-113-0010-02-257 01-117-0009-13-157 01-117-0009-13-158 01-117-0009-13-159 01-117-0009-13-160 01-117-0009-13-161 01-117-0009-13-162 01-117-0009-13-163 01-117-0009-13-164 01-117-0009-13-165 01-117-0009-13-166 01-139-0136-06-085 01-139-1690-01-004 01-139-1690-01-022 01-139-1690-01-098	IH 30 over Sp 423 Bs 67 over IH 30 Loop 301 over IH 30 IH 30 over FM 2642 IH 30 over FM 2642 IH 30 over FM 1565 IH 30 over FM 1565 IH 30 over FM 36 IH 30 over FM 36 IH 30 over FM 1903 IH 30 over FM 1903 IH 30 over FM 1570 IH 30 over FM 1570 SH 19/SH 24 over Loop 286 Rail Road over US 82 (N Loop) U-Turn Road over US 82 (N Loop) US 82 (N Loop) over US 271	
Phar	21-xxx-0039-17-277 21-xxx-0039-17-135	Bicentennial Underpass US 83 at SP 115	
San Antonio		IH 35 at New Braunfels, San Antonio IH 10 EB at Graytown Rd, San Antonio IH 10 WB at Graytown Rd, San Antonio IH 10 at FM 1516, San Antonio IH 35 SBFR under Kohlenberg Rd	
San Angelo		US 87 SB over US 277 NB	project underway to lower roadway
Tyler		IH 20 at US 259 (Eastman Rd) IH 20 at US 69 Underpass	
Waco	09-014-xxxx-xx-xxx 09-098-xxxx-xx-xxx 09-074- 09-074- 09-074-	US190/SH36 (underpass) at UPRR US 281 over US 84 SH 6 BS (underpass) at UPRR (north) SH 6 BS (underpass) at UPRR (south) SH 6 BS (underpass) at Bennett St	
Wichita Falls	03-243-0043-09-088 03-243-0043-09-090 03-244-0043-06-071 03-244-0043-06-072	US 287 at Huntington US 287 at Wellington US 287 NB over US 70 US 287 SB over US 70	
Yoakum	13-008-0271-08-419 13-076-0269-01-037 13-045-0535-08-186 13-045-0535-08-187 13-241-0089-06-180	SH 36 under US 90 Main St over US 77 IH 10 WB over SH 71 IH 10 EB over SH 71 FM 441 over US 59	replacement project held up with historic issues minor damage minor damage minor damage

According to BRG officials, the sign bridge inventory is another issue. They have the sign clearances from the LIDAR survey but don't have a current database that identifies the location of every sign bridge in the state. Sign bridges are hit by overheight vehicles, as are structural bridges. Sign bridge support columns are also sometimes hit.

Overheight loads are the biggest problem with bridges. BRG officials do not see many problems from overlength or overwidth loads. The most frequent type of damage is caused by hits on overpasses. However, vehicles occasionally run off the road, get behind the guardrail, and strike a bridge column. BRG officials noted that one should keep in mind that bridge column and bridge rail hits can be due to regular 18-wheelers and other vehicles, not just overheight loads.

BRG officials indicated that they had seen damage claims up to $950,000 for impacts on a bridge that resulted in a fire. This incidence occurred on IH 30 in Dallas. Tanker fires have caused extensive bridge damage, but those did not necessarily occur due to overheight loads.

Bridge hits that don't involve fire that are also on the high end of the cost spectrum are those in which vehicles hit numerous beams and damage the bridge deck. When the deck is damaged, bridge repair can be quite costly. The most common types of loads that hit bridges are lumber and oil and gas:

a) Lumber constitutes about 50 percent of hits in East Texas. Logging trucks stack logs fairly high, and the load will bounce as it travels down the road. The remaining 50 percent of hits are primarily caused by equipment haulers, mainly track hoes or back hoes.

b) Oil and gas OS/OW loads don't constitute as high a percentage of the overheight loads. Most of the oil and gas traffic is made up of regular 18-wheelers servicing wells. Occasionally, hits from crane derricks occur, but these are not as frequent as the other types of loads.

BRG officials noted that TxDOT has laser/beacon lights as one type of warning device currently in use. Other warning devices include a radar-based system and the drop tube system used by the San Angelo District. TxDOT has had some vandalism problems with the laser systems, as they are stolen for copper wire. One such theft occurred in San Antonio. BRG officials commented that there is a maintenance cost associated with these systems, as well as issues regarding how to set laser sensitivity. For example, the laser system can be tripped by a bird flying through the laser beam, setting off the beacon. The target size can be changed using the control settings so that a larger object must pass through the beam before it sets off the beacon. However, if a small section of a track hoe passes through the beam—a section roughly the size of a bird—it's essential that the laser beam set off the beacon.

CTR researchers then addressed the issue of super-heavy loads. BRG officials indicated that there is an analysis performed for every bridge along a super-heavy route and that these loads must have an escort so damage to bridges is not as frequent. Drivers are also required to navigate the route before the load is moved so they can identify any problems beforehand. TxDOT will work with the haulers, but at times these loads must travel through a small town and make a turn at an intersection that makes taking down the signals necessary. In many cases, it is harder to work with small towns, and they represent another cost.

1.6.5 Bryan District

Bryan District officials identified types of OS/OW loads that have caused damage to the state-maintained highway system:

- Wind turbine equipment
- Power transformers
- Oil industry equipment
- Heavy construction machinery

- Logging and raw wood product trucks
- Gravel and rock haulers
- Super-heavy loads heavier than 250,000 lbs.

Super-heavy vehicles and those related to the oil field industry inflict the most OS/OW damage in this district.

The types of pavement damage that has incurred include logging trucks damaging ditches and pavement and driveway pipes. Rock haulers and oil field haulers have also damaged pavement, causing failures and picking up seal coats. With respect to bridges, oil field equipment has hit bridges with overheight unpermitted loads. Typically, this has caused beam impact damage.

Damage to signs had also occurred, and officials reported that house movers, oil field haulers, and super-heavy trucks had damaged numerous signs. Occasionally, drivers take these down to get their load through and fail to put them back in place. Numerous traffic signals have been damaged by oil industry equipment, transformers, and super-heavy loads. This includes damage to signals heads and span wires. There has also been some damage from super-heavy vehicles or overwidth loads to safety devices such as guardrails and vehicle impact attenuators.

District officials reported that they note damage from OS/OW loads about once to twice a month. They commented that drivers of most loads failed to unbolt signal mast arms as directed in the permit. Officials also noted that the trucking industry uses bucket trucks to jack or pull mast arms up without first loosening the bolts. On average, damage occurred every month before the summer of 2012. During summer of 2012, damage occurred daily.

Often, the district cannot submit a damage claim because very rarely is the police or TxDOT notified. The only time district officials can ascertain if a damage claim exists is if TxDOT or the police happen to drive up when the load is passing through.

The district has taken some steps to reduce the OS/OW damage, including installing extra bridge height sings and adding permit restrictions.

1.6.6 El Paso District

The El Paso District does experience much damage to bridges or traffic signals due to OS/OW loads. Most of the damage seen in this district is related to pavements and is due to super-heavy loads or repeated 18-wheeler heavy loads such as aggregate haulers. District officials could not specify how much load the aggregate haulers are carrying. More than 10 years ago, the district conducted a study to help determine how much pavement life a super-heavy load consumed. The District Engineer had wanted to know if a super-heavy traveled over a new overlay and if so, how much of the life was consumed by that one load. (Dar Hao conducted this study.)

District officials reported that they have many super-heavy loads traveling through the district from Houston headed west to Arizona or California. A number of super-heavy loads also travel from the Odessa District along US 62/US 180. In 2011, the district had to determine a way for a seal coat contractor to place about 20 miles of seal coat and at the same time allow several super-heavy loads to travel while this project was underway. The district worked with the MCD, the carriers, and the contractor so that permits would vehicles to travel only at night. As it turned out, there was favorable weather in the district, and temperatures dropped while loads were moving so that during the day, the high temperatures were around 90 to 95 degrees F. At night, temperatures dropped by 20 degrees F. Therefore, the loads did not cause damage to the seal coat. According to district officials, “We were lucky. This same situation is going to occur again next year, because we are going to seal coat about 40 miles along that same route.”

In terms of super-heavy loads, the district sees a lot of OS/OW loads for the refinery industry, transformers, and quarry type dump truck body parts. From an overall perspective, the district considers “that aggregate haulers and the refinery industry have the greatest impact on our system.”

District officials reported that aggregate trucks coming into the city have caused a lot of pavement damage. In particular, they notice rutting and shoving, especially at intersections where these trucks come to a stop and then accelerate. For example, the McKelligon quarry in El Paso is practically in the downtown area. The city rebuilt the streets leading to the quarry and used PCC for the loaded direction and ACP for the unloaded (return) direction. However, TxDOT was not involved in this project because it was funded by the city.

District officials noted, “One of the reasons we don’t see more damage on our (TxDOT) roadways due to OW loads is that we have good material sources in our district.”

1.6.7 Fort Worth District

The CTR research team interviewed four people from the Fort Worth District to investigate bridge engineering, traffic operations, maintenance, and PMIS/Brinsap coordination in this district.

District officials observed that they have “perhaps two bridge hits per month, mostly from oil field equipment but also from construction equipment.” They commented that quite often the damage is not that severe but occasionally they do have a hit that causes damage that requires replacing a beam. If the concrete rail and deck is damaged, repairs can be more substantial.

According to officials, the cost for repairing this damage varies significantly depending on the extent of damage, type of structure (concrete or steel—steel is usually more expensive), the length of the span, and other factors. Repair usually involves removing and replacing the concrete that has been damaged once a beam is hit. Occasionally, a wing wall is hit, but this is not a costly repair. When an overpass is hit and the steel strands remain intact, repair is not considered substantial. However, if the strands have been cut, they may need to be spliced. As mentioned, this depends on the extent of damage. District officials reported that the most expensive types of damage are fairly rare.

Officials noted that they have raised a number of structures along IH 20 in the past few years. This was not specifically due to OS/OW hits, although some might have occurred. For the most part, bridges were raised when the roadway under the bridge was repaved. This may necessitate raising or even replacing the bridge. However, the district did not increase the clearance of a new structure beyond minimum requirements—bridges with a clearance of 16 feet, 6 inches are typically constructed.

District officials reported very few hits on sign bridges. When these occur, the maintenance crew takes care of the repairs. The district has installed a few laser-beacon systems to warn drivers of low clearance structures.

CTR researchers asked Fort Worth District officials how they find out about bridge hits. They observed that most of the time they “do know who hit our bridge due to reports from the local police or sheriff’s department or because a maintenance employee saw the damage occur and can identify who hit the structure.” A district official stated, “I would say that the oil and gas industry most commonly is involved in our OS/OW structure hits—we do get hits on our bridges by other types of vehicles. In fact, I would say that most hits on columns are caused by non-OS/OW loads."

A traffic operations staffer noted that in the past three months, OS loads inflicted five hits on signal mast arms. When a traffic signal is hit frequently, traffic operations contacts the MCD in Austin to warn them not to route overheight loads along that particular route. The traffic operations staffer noted, "We often don't know who hits our traffic signals. We expect they are unpermitted loads, and we've talked about installing a camera system to record the hit so that we can get the truck company name."

The staffer also commented that in the past, "We've had a number of hits on our sign bridges, but it's not quite a frequent now." Traffic operations notes, on average, one hit every five months. Historically, a sign bridge on SH 21 was hit frequently, so an ITS group installed a sensor beacon system that senses when an overheight truck is approaching. The system flashes, warning the truck driver to exit before the bridge.

Other than installing the beacon, the staffer remarked that traffic operations has not done much retrofitting or design modification to accommodate OS/OW loads. Nearly all of the district's signals consist of mast arms. "We don't have many of the temporary strand wire signal systems," the staffer reported.

The district's maintenance engineer also commented that most of the design changes in the district have been related to pavements, noting that "we've had to go to thicker pavement designs to handle the heavier loads related to the oil industry." Bridge hits were problematic a few years ago due to inexperienced drivers; however, this has decreased with time.

The maintenance engineer also observed that on the maintenance side, the district has more problems with overlength loads on FM roads or at county road intersections within its right of way, specifically in cases where a county road intersects an FM. Most of the district's roadways are designed for interstate commerce, so problems usually occur when an OS/OW load travels on the lower volume roads. For example, overlength loads cause many crushed culvert ends, concrete pipe and corrugated metal pipe, at FM road intersections. This is because the intersection was not designed to handle the turning radius that these heavier and longer oil field trucks require, so they end up knocking down or running over signs and culverts. If a culvert end gets crushed, drainage problems result which in turn affect the pavement.

District officials also noted that another issue is county roads that intersect with the on-system network. County roads are designed to the same thickness or materials specifications as state roads. When heavier oil field trucks come to a stop at an intersection, this causes a county road to shove and rut. Because the county road intersection is in TxDOT right of way, TxDOT is responsible for repairs. Saltwater trucks are usually too long to operate on narrow FM and county roads and cause a fair amount of these problems. District officials pointed out that local roads lead up to well heads, resulting in problems caused by oil field trucks. Often, these trucks track mud onto the FM that ends up rubbing off the pavement striping. These trucks tear up the raised pavement markers as well. Trucks make turning movements at the location of the well head where it leads to a FM road with a seal coat. These seal coats are not designed to take a lot of wear and tear caused by turning movements, and the truck ends up eroding the aggregate. TxDOT usually has to go back with a cold mix patch to repair these areas. District officials mentioned that "we also have had more edge repairs to do because of the heavy oil field traffic on narrow FM roads. The trucks tend to ride the outside pavement edge, which ends up causing a pavement drop-off which has to be repaired."

The district maintenance engineer commented, "I'd say the three main types of OS/OW loads that cause damage are oil field, equipment haulers, and overheight loads that are off their permit route or are operating without a permit."

CTR researchers also interviewed the district staffer who performs all the BRINSAP inspections. This staffer stated that he is on-call 24/7 to review bridges after they are hit. This staffer used to keep a diary to record bridge hits and the type of damage that occurred; however, there were so many requests for information, a database proved to be more functional. This database contains information about which bridge was hit, when it was hit, the type of damage that occurred, and repair costs. The database also contains photographs.

The district staffer noted that most bridge damage it not related to weight; an inspection of bridges conducted before and after a super-heavy load crosses a bridge reveals no evident damage, unlike pavement. The staffer had previously worked as permit coordinator for the El Paso District and had traveled with some super-heavy loads. The staffer recalled that one load weighed 900,000 lbs. Two hot-mix trucks followed the load to make repairs to the pavement where rutting occurred. However, this type of load damage is not typical to bridges. Most of the damage observed is due to bridge hits, and, in fact, some bridges have been hit numerous times. If a load damages a pre-stressed beam, replacing the beam can cost upwards of $120,000. If two beams must be replaced, the cost is close to $150,000.

The staffer noted that the Jack County commissioner was "pretty smart" in striking a deal with wind farm developers bringing in components ill-suited to some county roads and cross drainage structures. Apparently, the commissioner informed developers that if they wanted to use the county roads to transport loads, they would have to pick up the bill for replacing the structures. The developers paid for structures that needed to be replaced.

1.6.8 Lubbock District

The Lubbock District pavement engineer stated that he had communicated with his traffic section, which noted that there was no problem with sign damage from OS/OW loads. The district has upgraded its signals to the mast arm design, but this modification was not related to OS/OW loads.

The engineer observed that there have been several hits on signals in Seminole. Because the engineer sees every OS/OW load that goes through the district, he worked with the permit group to establish restrictions. For example, if a particular intersection has several hits, the route is restricted, and OS/OW loads must make a detour around the town. Another option is requiring an OS/OW load to have a police escort through town to make sure damage does not occur. The police escort is placed as a requirement on the permit.

The district pavement engineer remarked that in the past, there have been few problems with loads getting stuck under a bridge, and these instances are rare. One load traveling on North Loop got stuck under a bridge. The air was let out of the vehicle's tires, but the vehicle remained stuck. The bridge was subsequently jacked up, and considerable damage was inflicted to the bridge seats.

Another bridge known as the Old Cemetery Bridge in Tahoka has been hit multiple times. The district pavement engineer placed a permanent restriction on this route. However, a number of the bridge or signal hits are due to unpermitted loads. The engineer observed that "…I will say that although most of our OS/OW loads are associated with the oil industry, there is one company that is very good about getting their permits. I can't say the same thing about all of the oil companies, though."

The district pavement engineer remarked that all kinds of OS/OW loads move through the district on the way west or north to Oklahoma. Because Odessa has had problems with bridges getting hit and one bridge closed, the Lubbock District has had more big loads routed through it. The week before CTR researchers interviewed district officials, 15 permits had been issued for windmill parts heading north to Oklahoma. The district had to put length restrictions on its south loop because of its cloverleaf ramps. Some of the turbine blades couldn't make the turn, so the route was restricted.

The engineer has also seen a number of big generators move through the district, some headed west to California en route to Japan. These generators were ordered to replace the nuclear power plants that were being taken off line. The engineer had also witnessed generators moving north, which could be related to wind turbine plants.

The district pavement engineer noted that in Parmer, Bailey, and Lamb counties, a fair amount of pavement damage is due to the dairy and agriculture industry. The engineer stated, "The dairy trucks must be running overweight. They have exemptions, so there's nothing we can do." Also, that area of the district has gone to two harvest seasons each year for corn and maize to feed the dairy cattle. There are numerous dairy farms in the area—around Muleshoe, for example.

The engineer commented, "I've been trying to get a new weigh-in motion system installed on US 60 to measure the loads associated with the dairy and agricultural truck traffic. The amount of truck traffic in that area has really increased."

The engineer also noted that the district has a lot of quarry dump truck components that move through the district. However, he could not say that equipment haulers in particular were problematic with regard to hitting bridges or signs.

Finally, the engineer commented that in the past, there were problems with damage to the FM road system during construction of wind turbines. However, he could not say, "We've had a big problem with overheight loads hitting our property."

1.6.9 Lubbock District—Littlefield Area Engineer

The Littlefield Area engineer for the Lubbock District indicated that there are 35 dairies in the counties he manages. If a dairy is located along a four-lane, divided roadway with 48 feet of paved width, damage is at a minimum. However, if a dairy is located on a 20-foot-wide FM road, dairy trucks cause extensive damage. The engineer pointed out that these roads were built in the 1950s and cannot bear the loads some of dairy operations place on them.

CTR researchers inquired about the types of trucks that the district sees operating from the dairies. According to the area engineer, these include milk trucks 18-wheeler tanker trucks. However, he could not say that particular attention had been paid to axle spacing to determine if the trucks fell into the exception, which allows tandem axle sets on the tractor and the trailer to be spaced at 28 feet as opposed to the legal requirement of 36 feet. The engineer could not recall if the trucks looked any different regular 18-wheelers. The trucks that inflict the most damage are manure trucks that operate from the dairy after pens are cleaned. These trucks are usually 6-yard dump trucks, but they are loaded to capacity and more often loaded to 8 or even 10 yards. The low-volume, narrow FM roads cannot take that kind of load.

CTR researchers asked if the district could determine how much these manure trucks weighed. The area engineer estimated that "they are overloaded by at least 50 percent," likely weighing close to 80,000 lbs. The engineer commented that "although the exemption might specifically apply to milk tank trucks, the local interpretation of the law is that any truck going into or out of a dairy is exempt from load limits." The engineer went on to state that these vehicles tear up the edges of the roads, resulting in edge drop offs. The drought posed many problems during the past couple of years as well. The engineer noted that if it rains and the manure trucks start running, "we might see an 11-foot-wide lane deteriorate to 9-and-a-half feet within a week or so."

Lubbock's Littlefield Area has three overpasses, and these structures have been hit several times by overheight loads. In the last few years, two of these structures have been replaced. The area engineer noted that on low-volume FM roads, there are multiple box culverts, built back in the 1950s and 1960s. The concrete was of higher quality during these decades, and more reinforcing steel was used than is now. Therefore, these structures hold up well to heavy trucks.

CTR researchers inquired if the district had noticed ends culverts getting crushed by heavy or long oil field trucks making turns on FM roads. Researchers also asked if there were problems with signs getting knocked down. The area engineer replied, "No. Actually, we usually have 100-foot ROW limits on our FM roads, and that allows us to extend our culverts out further. We also put safety end treatments on our culverts, so I'd have to say that's not really a problem for us." However, edge drop-off damage from dual wheels is the biggest problem noted on FM roads; trucks often run right onto the pavement edge.

The area engineer mentioned that the damage inflicted by dairy trucks doesn't even compare to that caused by oil field traffic. One county in this district experiences heavy oil field traffic, and while a dairy truck can weigh 80,000 to 100,000 lbs., an oil field truck or some bigger equipment can weigh 80,000, 300,000, or 400,000 lbs., and even up to 700,000 lbs. These rigs run on narrow FM roads in temperatures of 105 degrees F., and observable damage was noted on one FM road in one afternoon. By the end of the day, it resembled a "caliche haul road."

This area also has a lower volume of FM roads, so the ADT can be 700 vehicles per day with 200 trucks. The district does widen these routes, but with a cost of roughly $2 million, it usually executes only one contract every other year. However, the district does not have the funds to widen every FM road that needs it. The area engineer remarked that the district does more mileage with its own maintenance crews, widening the roads to 26 feet, and might do 20 miles of widening with maintenance forces in a year. The district typically uses one of two strategies on widening projects: caliche or RAP.

1.6.10 Lufkin District

The Lufkin District's maintenance director noted that an OS/OW load hit a bridge the week before this interview. In this instance, it was a storage tank; however, the director noted that "our biggest problem is the logging industry." The majority of damage caused by OS/OW loads in the Lufkin District is due to non-permitted or "boot-leg" loads. The director indicated that a trucker hauling an overheight load may hit a bridge and just keep driving, noting, "(I)n fact, we have a pile of logs in some areas which we've found in the road which have been knocked off as the truck(s) went under the overpass(es)." A number of years ago, district officials reported that a logging truck hit a bridge; the top log came off the trailer and hit the car traveling behind the truck, resulting in a fatality.

Logging trucks not only hit structures but also railway bridges. For example, one railway bridge has been hit fairly frequently by logging trucks and non-permitted loads. The railway company has to come out and straighten and/or repair the steel beams.

The Lufkin District typically designs traffic signals at the 19-foot clearance height; district officials observed that it does not cost much more to go to the 19-foot maximum compared to 18 feet when doing the design. Changing the height of signals or structures after they're built is more expensive. The district does not have many span wire signal systems; most signals are mast arm.

The Lufkin District has raised some TxDOT structures to increase clearance. For example, the East Loop 287 bridge was raised about six years ago for around $1 million dollars. The district currently has a contract in development for approximately $10 million dollars to replace and provide more clearance at a railway bridge that gets hit by overheight loads fairly frequently. This requires considerable coordination with the railway, and the district has worked with the railway company about six months on that project, which has recently been approved. Another railway bridge was raised by one foot about five years ago.

The district has a $30 to $40 million interchange project in which raising structure heights is part of the design. A part of this project includes raising a bridge that has had problems with hits in the past: Business 59 going over US 59. Another bridge that has been hit recently is on Business 69. An equipment carrier hauling forklifts left the forks up, and the forks hit the overpass.

The maintenance director pointed out that the costliest problem occurs when OS/OW loads tear up a fresh seal coat. This happens frequently in urban areas, where the OS/OW truck is trying to miss traffic signals and ends up turning the rock on the fresh seal coat. The district ends up with flushing and must do an overlay to fix the problem. In another instance, lowboys were hung up at the intersection between a FM road and US 190 in San Jacinto County. The road profile at this intersection was reworked so the lowboy would have more clearance. This cost about $15,000.

The director observed that "our top three types of OS/OW loads that cause damage in our district that we know about are logging, oil field, and heavy equipment."

CTR researchers asked if low-clearance signals had been installed; the director noted that two sets of laser-flashing beacon systems were in place. Finally, the director pointed out that the district's biggest problem is bootleg loads, and that the second biggest problem is the TxPROS permit itself. "You really should get a copy of one of those permits and try to follow the directions given for a routed load," he stated. The maintenance director remarked that he had come across OS/OW loads sitting on the side of the road or at a low bridge and had stopped to read the permit directions to try to help the driver figure out which route he was supposed to take. He commented, "Even I can't understand the directions—although I live here." A major problem is that the permit will often use local community names, and these communities may not now exist. So, for example, a permit may state, "Turn right at X community." As stated above, the maintenance director did not know where the community was. The truck driver, who may often not be local, couldn't locate it either and was unable to follow the permit directions. If the load is permitted but the directions are hard to read, the driver is likely to veer from the permitted route at some point.

1.6.11 Paris District

The Paris District director of operations noted that this district is not in one of the booming parts of the state, e.g., Fort Worth, as it does not have energy sector development. However, he had attended a meeting where Fort Worth officials described the NE Texas Traffic and Operations and the pavement damage problems they deal with due to oil field traffic.

There have been some bridge hits by OS loads in the Paris District; however, this is not attributed to any specific industry. The director observed that some loads are large concrete or steel components, while others are compressors or maybe a track hoe. If a bridge is hit, the district usually has a call-out contract for the damage repair to do epoxy injection of the damaged area—around $20,000 per repair.

The district has had to make adjustments to maintain clearance under a bridge when doing an overlay. For example, the district was doing a bonded concrete overlay on a jointed concrete pavement along US 75 and had to transition down as it approached the bridge to maintain adequate clearance. Again, the district director stated, "I can't say that it was directly related to OS/OW loads."

The district has not had to adjust any traffic signals, and the only low clearance beacon the district had was removed when the IH 30/SH 34 interchange was rebuilt.

Overall, the director of operations noted, "I'd have to say that OS/OW load damage is not a major problem in our district."

1.6.12 San Angelo District

District officials commented on damage from OS/OW loads affecting a bridge on US 277 that has been hit between 5 and 10 times. The district now has a contract to raise the bridge and lower the roadway under the bridge. The total project cost is $300,000. This project will add an additional 6 inches of clearance to the bridge.

District officials have not always been able to write a damage claim when this bridge is hit; however, the last two times, the truckers who hit it were identified, and a claim was filed. When bridges are hit, damage can vary markedly. Scraps may simply be noted along a few beams, or chunks of concrete can fall to the pavement below and expose the reinforcing steel. The last hit to the aforementioned bridge was caused by a short haul move. The driver was moving an excavator without a permit.

District officials identified the top three types of loads that hit bridges and signals as

(i) Equipment haulers

(ii) Oil field business—vehicles often haul big trusses or machinery used in the oil field.

    a. These items can be overdimensional and heavy.

(iii) Wind Turbines

    i. District officials have made emergency calls when wind turbines were traveling along a route through an intersection and got hung up in the signals. This backed traffic up considerably until the signals could be temporarily raised so the wind turbine could pass through with adequate clearance. District officials commented that they would "guess (that) considering a bucket truck, two personnel, traffic control, and related costs, it's about $2,000 for us to make one of these emergency calls to reset the signals."

It is difficult to quantify the costs associated with OS/OW loads in the Paris District, because there are so many different types of damage that occur or other costs associated with work the district needs to do to accommodate these loads. For example the district noted, "We have a fair amount of oil field traffic that ends up causing four- to six-inch drop-offs at our pavement edges due to repeated loading. We can pull the shoulder up to take care of this problem; however, if a wide load comes through with their duals running right on the pavement edge, they make break off a foot of pavement. We can't pull the shoulders up to take care of that problem. It means we will need to do an edge repair at each location."

The district has experienced guardrail hits from OS/OW loads, and OS/OW loads have become stuck in construction zones. In this instance, the trucks were not supposed to be traveling along that route due to restricted lane widths. However, many of these loads run without a permit, so drivers don't know when to avoid a certain route where construction is underway. These loads can enter the construction zone and hit concrete traffic barriers.

Another type of damage that occurred this summer was due to super-heavy loads traveling through the Paris District. A steep grade exists at one location in Junction, close to Lakey. The district had just finished placing a seal coat on the pavement when two super-heavy loads came through. As the vehicles started up the incline, the trucks started tearing up seal coat. There was no place for the load to pull over, so they peeled up about one mile of seal coat before coming to a stop.

Paris district officials also mentioned another specific instance in which several OS/OW loads hit a truss bridge leading across the Llano River (Lake Junction) on Loop 481 in Junction, Kimble County. This bridge had lead paint, and it needed to be repainted. The district had to construct a structure somewhat like a tunnel to allow traffic through, all the while protecting it from the paint residue being removed. The tunnel was also designed to trap and capture the lead paint as it was removed. This reduced the bridge to one lane, and it was closed to OS/OW load permitted vehicles. Again, several unpermitted OS/OW loads attempted passage and got hung up in the tunnel system. One load actually tore out a portion of the tunnel liner. District officials also recollected that a motor home might have been stuck as well.

As this project progressed, to help alert truckers of the low clearance, the district installed a PVC pipe installation with the pipes hanging down permanently (not dangling, like the drop tube system). If a trucker hit and broke off the PVC pipes, he knew that he was going to hit the tunnel liner.

The district does have one low-clearance device installed, but it is not a laser/beacon system; rather, it consists of an older system that uses a light beam and shrill whistle to let drivers hauling OS/OW loads know they will hit the bridge.

1.6.13 Waco District

CTR researchers interviewed the Waco District maintenance engineer. He had contacted his maintenance supervisors to request information about OS/OW damage, which is documented in the following e-mail excerpts.

In Bell County, district officials recollected that over the past 25 years, four bridges had been hit by excavators being moved, resulting in beam damage. Three bridges were repaired, and one bridge on IH 35 at SH 53 was completely replaced and raised. Concerning roadway damage, they could not attribute damage specifically from OS/OW loads. There have been a few instances of sign and guardrail damage. The IH 35 bridge in Bell County was replaced in conjunction with the construction projects going on, so it was not raised solely because it had been hit.

In Hill County, district officials noted that a couple of signs were damaged ("we suspected") by long concrete power pole haulers on a 5C project. Although drivers weren't caught in the act, there were a lot of pole hauling activities at that time. These trucks also damaged some pavement edges on IH 35 SBSF at CR 3102. However, this damage was left alone, as the roadway will be eliminated later on in construction.

In Coryell/Hamilton Counties, no damage has been noted. Most loads in these counties have been wind turbines and generators.

In McLennan County, a staffer could only think of two locations that consistently experience damage: US 77 at SH 6 and SH 6 at SP412. At US 77 at SH 6, the guardrail is often hit and repaired by contract. The staffer commented, "Over the years, we have asked for a requirement that loads going through this cloverleaf to get on US 77 south normally, and have a turning axle on the rear. This helps some, but damages still occur there." The staffer noted that long loads carrying windmill parts are typically the problem, or, in some instances just long loads. On SH 6 at SP412, the low bridge often gets hit, despite clearance signs with flags that have been posted. The hits occur when vehicles travel both directions. Mobile home haulers are normally the problem, district officials say.

1.6.14 Wichita Falls District

According to the Wichita Falls District's traffic engineer, OS/OW damage is usually caused by unpermitted overheight loads. A bridge had just been hit by a track hoe, damaging every beam. The repair bill is about $180,000.

About six months ago, a truck hauling a piece of scrap steel from an oil field hit a signal and then a sign bridge; the vehicle finally stopped before hitting an overpass. The driver hit the signal and sign bridge and kept on going. The damage wasn't that extensive, and the district was able to make repairs to the sign bridge and the signal for around $5,000.

The traffic engineer commented that "about 50 to 75 percent of the damage due to OS/OW loads are unpermitted vehicles; we don't have a lot of overpasses in our district and had about three to four hits last year." The three most frequent types of loads involved in damages to TxDOT property in this district were energy industry, equipment, and agriculture. Farm equipment occasionally hits a signal or a bridge, but the damage is less severe because these trucks don't travel as fast as those bearing other types of loads. The only other type of cost that district officials could recall having been incurred due to OS/OW loads was a project in Bowie, which was extended to include a railroad crossing so the crossing could be reworked. Lowboys would sometimes get hung up on the tracks.

CTR researchers inquired about signal clearance installation, and the engineer noted that the district has not installed any laser systems or low clearance beacons.

Finally, the traffic engineer stated, "The only other comment I would make is that the real damage is caused by the overweight trucks to our pavements. The fees don't nearly cover the cost of damage."

1.6.15 Yoakum District

The Yoakum District has started to utilize two different devices to warn drivers with overheight loads of low overpass clearances.

The "ding-a-ling" system was developed by the district to warn truckers that their rig height exceeds the height of an overpass they are approaching. See Figure 1.11 for the schematic for this device.

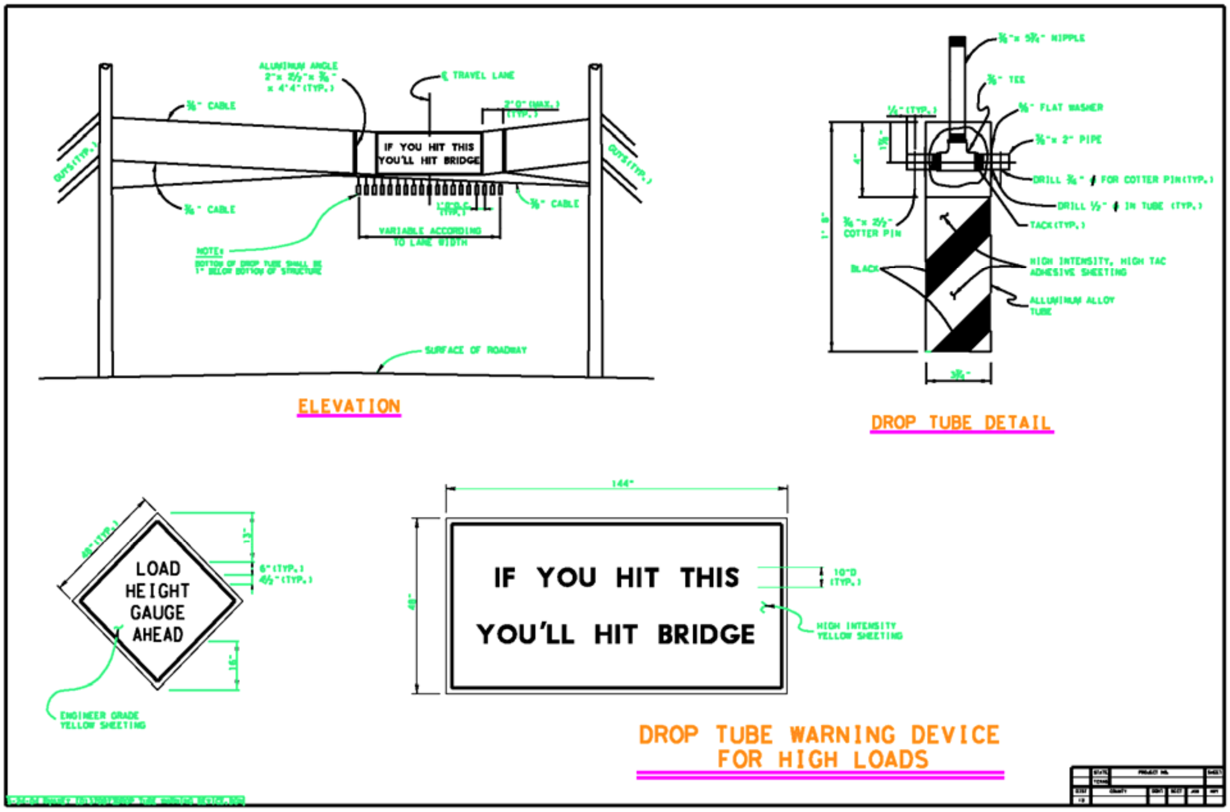


Figure 1.11: Drop Tube Warning Device for High Loads: "Ding-a-Ling" System

The district has installed four of these systems in Columbus and Sealy; however, one system was eliminated when a low clearance railway bridge was removed, and the other was replaced with a laser and flashing warning beacon/low clearance sign. The laser/beacon assembly cost $23,000 to install. District officials noted that they were able to use the posts that had previously been used for the ding-a-ling system.

The laser/flashing beacon was installed at the IH 10 EB overpass in Columbus (Colorado County) and has been successful; however, the district does have some problems because the bridge is near several restaurants, and truckers sometimes park in front of the sign/beacon and obscure it. District officials have had discussions with the city regarding enforcement of the "no parking" signs. This system projects a laser line across the road, so an overheight vehicle will break the beam and cause the warning beacon to flash. Figure 1.12 shows the light transmitter and light receiver. Figure 1.13 shows the typical warning sign and typical last sign.

Figure 1.12: Light Transmitter and Receiver

Figure 1.13: Typical Warning Sign and Last Sign

The IH 10 EB overpass has a clearance of 14 feet, 5 inches heading north, so low clearance is an issue. About 10 years ago, the district also raised two low clearance bridges on IH 10 that were also hit fairly often.

District officials commented that before the laser and beacon systems were installed, "we had a ding-a-ling system at this location, and it has been hit, and, in fact, torn out in one instance. When a truck hits the PVC pipe, which is placed at the same height as the overpass clearance, a noise is produced which alerts the driver of the potential hazard. However, because these devices do create noise, there are problems using them near residential areas and businesses."

The ding-a-ling system in Sealy is placed near a railway bridge on SH 36 SB approaching old US 90. When the district first installed these systems, they worked well and did not require maintenance; however, these units use aluminum drop tubes, and during the years, the quality of the tubes has varied (due to the low bid system), resulting in heavier tubes that cause stretching of the cables and lowering of the PVC pipe. This means the district has to periodically check the height and make adjustments when necessary. Also, the tubes take quite a beating and require replacement.

There is no particular industry associated with OS/OW damage, district officials state. In Cuero, however, there are numerous hits on signals due to energy-related loads. These hits don't always result in replacement of the signal head or mast. In many cases, the signal head has been turned and requires readjustment. Quite often, these loads are traveling unescorted and may have a piece of equipment with an adjustable height that had not been completely lowered.

There are approximately 128 signals in the Yoakum District (11 counties). In 2006 or 2007, the district upgraded its signals to 12-inch LEDs and lost some height as a result. As the district upgrades signal pole installations, it is installing the signals at the maximum height (19 feet) to provide added clearance. However, the district is not specifically installing upgraded mast arms and signals or changing signal heights/designs to accommodate OS/OW loads. Usually, when a city wants to upgrade an intersection to include pedestrian crossing signals, which is not possible with the older style signal systems. There are two locations like this in Cuero. The district also noted that limited funding exists to upgrade existing span wire signal installations.

Another type of signal installation that the district plans to upgrade is two traffic posts placed diagonally at an intersection with a wire stretched across the intersection. These installations require the signal head to be mounted vertically, limiting clearance.

District officials commented that "other than the overpass structures, we have problems with signs being knocked down by wind turbine loads coming from Hallettsville through Yoakum and traveling to Shiner." Apparently, the vehicles had detoured through Yoakum due to bridge construction that is underway along the route they would normally take.

District officials noted that within the past year, an OS load hung up on the railroad tracks in Bellville on SH 159 in Austin County. The load was hit by a train, but there were no injuries. There is an overpass in Schulenburg on US 77 that gets hit fairly frequently. The overpass is a local street with less than 15 feet of clearance.

1.7 State and Local Government Departments and Divisions

This section contains interviews with state and local government districts and divisions conducted July through October 2012.

1.7.1 Attorney General's Office

CTR researchers spoke to an attorney in the Office of the Attorney General (OAG) referred to them by TxDOT's Office of General Council, as the OAG had current cases regarding OS/OW vehicle damage. The attorney estimates that he has at least one OS/OW case a year; however, he has only worked for attorney general for one year.

CTR researchers asked how many cases the OAG is handling that involve OS/OW vehicles. According to the attorney, the office took on three cases this year, and two are still pending.

Case 1 involved $600,000 damage to a bridge. It went to trial for a week. Approximately $100,000 in AG attorney's fees was spent on this case. Apparently, this case was complex, as the company had used the route given under the permit. The plaintiff argued therefore that the accident and damage was TxDOT's fault. TxDOT argued that the plaintiff did not take caution and care while driving, nor did he take notice of height/load postings on the route. The jury split liability 50/50 in this case.

The two pending two cases are for bridge hits, with approximately $200,000 in damages to the bridge in each instance. The attorney noted that one issue that often arises in bridge hit cases is that when the bridge is repaired, it is often improved. Therefore, plaintiffs argue that they should only have to pay the actual cost of restoring the bridge to its original condition. In such instances, the attorney representing the state meets with TxDOT staffers to determine what the actual cost should be.

Overall, the OAG has approximately 900 pending damage claims, but not all of these involve an OS/OW vehicle. TxDOT first tries to collect all the costs of damages through the damage claims process. If this does not work, TxDOT submits all citations to OAG to handle.

The OAG will go after damage of any kind, no matter how small, once handed cases by TxDOT. The OAG will sue both driver and the company. However, in most cases, the driver does not contest the case. Therefore, the suit against the driver is dropped, and the OAG sues the company. In most cases, the OAG ascertains that the accident happened when driver was an employee of a company and then drops this case and to pursue the company.

Attorney's fees can be claimed in such suits, so most companies opt to settle. Checks are cut from both company and insurance companies. CTR researchers asked if the OAG ever receives or posts suit on the bonds that are posted for OS/OW vehicles. The attorney representing the OAG noted that the office does not pursue funds via the bonds that get posted.

Once fines and damage amounts are received, the OAG submits a form to TxDOT indicating how much has been received and how these monies are to be allocated. The attorney did not know if the money TxDOT receives is applied to Fund 6.

1.7.2 City of Dallas

Officials for the City of Dallas Department of Street Services noted that while they did not have any quantifiable information about the impact of OS/OW loads on its infrastructure, they did have general observations about the types of damage that occurs.

The most damaging vehicle type on city streets is the bus. The damage buses cause due to heavy loads applied along the same routes day after day is visually evident. The second most damaging types of OW loads are construction vehicles operating on city or local streets during the construction of a large commercial building, subdivision, or apartment complex. It is easy to see how fast the streets are torn up when heavy equipment and materials such as asphalt are trucked to a construction site. Officials noted that this was especially true if the access point is a side street where other heavy traffic typically doesn't operate. The street is damaged due to construction traffic related to a specific building. They noted that they have no way to recover the damages that occur; some might consider this part of the cost of economic development.

CTR researchers asked if they noticed other types of traffic such as gravel haulers, oil field equipment, and agriculture. City officials responded that they "could not attribute a specific type of truck or industry that does the most damage, because the heavy trucks are mixed together and operate amongst all of the other traffic. So it would be hard to say which type of truck caused specific damage to the roadway. Partially this is because traffic is concentrated on the state routes entering the city, so you might see large numbers of heavy trucks on specific corridors, but once the traffic reaches the city street system, it disperses. This means that we might see damage on certain streets in heavy industrial areas of the city or at a ready mix or hot mix asphalt plant. But otherwise, we don't really see extensive damage due to the oil industry or other specific groups that you might see on a state route."

The researchers inquired if city officials noticed much damage to other types of city property such as guardrails or bridges, for example. They stated that they did not have any factual data on this. It could occur, but they were not aware of specific instances in the city. They did note that shale operations west of the city have had problems with damage from oil field trucks. However, the shale oil field work hasn't yet pushed into the City of Dallas, so they were not currently seeing damage specifically related to the oil sector.

CTR researchers then asked city officials if they had seen damage to city streets due to garbage or ready mix trucks that are exempt from legal load limits and that can operate at higher axle load limits. The city officials noted that Dallas has an extensive alley system that garbage trucks use. This offsets damage to city streets. For ready mix trucks, damage can occur on routes leading directly to and from a ready mix plant, but from there, the loads disperse and travel in different directions so it's difficult to state that ready mix specifically caused damage noted. Officials did note, however, that when the trucks hauling equipment or materials arrive at a new housing development, they notice increased damage as the truck loads become more concentrated.

City officials did note that they see damage from heavy trucks at intersections due to stopping and acceleration. Damage to driveways and curb and gutter at locations where heavy trucks are delivering their loads is also evident. There city had also seen a problem with school buses making turns that knock down signs. They also note that they do encounter problems with heavy trucks making turns at intersections not designed for the size of the vehicle. Therefore, damage is done to signal poles and/or signs; however, city officials estimated that in only 10 percent of the cases "do we know who actually caused the damage." If there is a police report related to damage, it is usually due to a serious accident, or the traffic mast arm was knocked down. However, this occurs with routine traffic as well, so it is hard to say that OS/OW trucks in particular cause the damage.

The city has a monitoring program to help manage traffic signal installations and identify span wire signals or signals mounted at lower heights. These are prioritized, and they identify locations where higher numbers of hits occur. The City of Dallas is working toward replacing these, but funding must be considered.

The city has not installed any type of low clearance warning signs or beacons on its system. City officials consider knocked down signs or even signal damage as just a regular part of its business that occurs due to both routine traffic and heavy trucks. They do not specifically identify OS/OW vehicles as a major contributing factor.

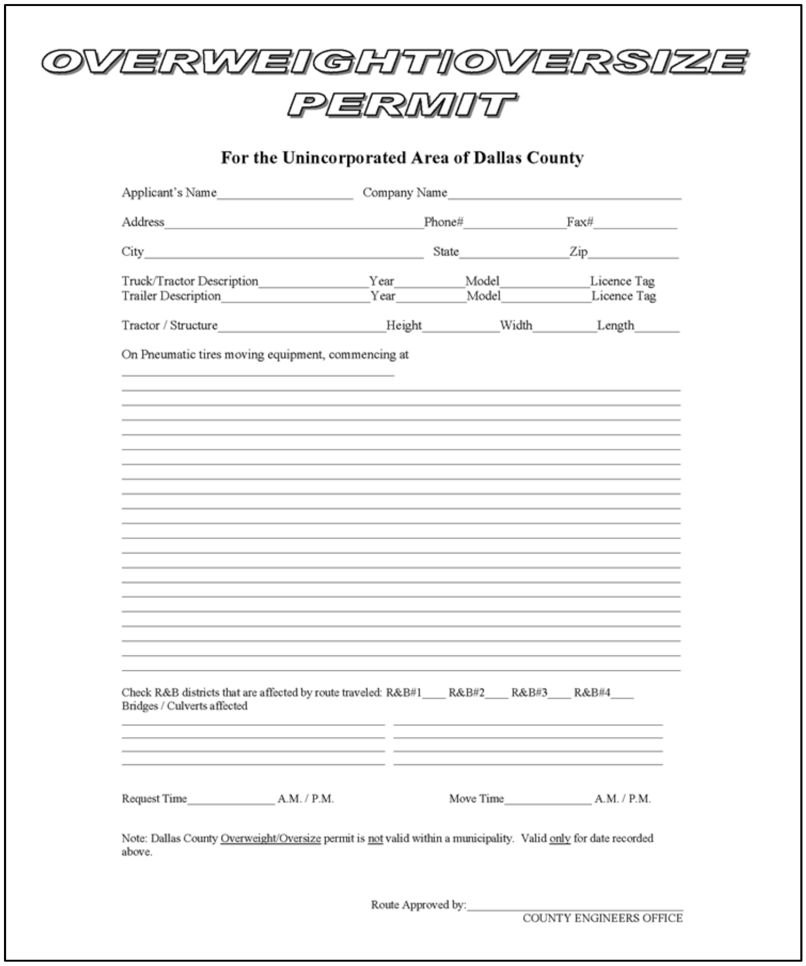
According to city officials, they do not see OS/OW trucks in particular being a major problem in Dallas.

1.7.3 Dallas County

The Dallas County's Assistant Director of Transportation & Planning County Public Works Department was interviewed by CTR researchers. The assistant director noted that Dallas County has about 120 miles of roadway under its management, and most of this mileage is made up of local streets, not major arterials. Most of the bridges on the county network are TxDOT structures. OS/OW loads didn't cause too much damage in Dallas County. The assistant director commented, "When incidental damage does occur, we often don't know how it occurred or what type of load was involved." The county does not keep records of the damage or cost of repairs.

The county only occasionally saw OS/OW loads on its network, and these are typically very large loads, such as transformers. The assistant director commented, "Since the permit route is pre-planned, we typically do not see damage during these moves." The assistant director could not recall any specific steps that they have taken to specifically address OS/OW loads. County officials are aware, however, that the damage from these loads is a problem on the state system.

The county does have an oversize permit request form. This can be seen in Figure 1.14.



OVERWEIGHT/OVERSIZE PERMIT

For the Unincorporated Area of Dallas County

Applicant's Name___________________ Company Name________________________________

Address____________________________________Phone#_______________Fax#____________

City_______________________________________ State_______________Zip____________

Truck/Tractor Description________________Year__________Model_____________Licence Tag
Trailer Description_____________________Year__________Model_____________Licence Tag

Tractor / Structure_______________________Height___________Width_________Length_______

On Pneumatic tires moving equipment, commencing at

Check R&B districts that are affected by route traveled: R&B#1____ R&B#2____ R&B#3____ R&B#4____
Bridges / Culverts affected

Request Time______________ A.M. / P.M. Move Time______________ A.M. / P.M.

Note: Dallas County Overweight/Oversize permit is not valid within a municipality. Valid only for date recorded above.

Route Approved by:________________________________
COUNTY ENGINEERS OFFICE

Figure 1.14: Dallas County OW/OS Permit Form

1.7.4 Ector County—Road and Bridge

Ector County officials noted that they don't have any bridges on the Ector County system, so the main impacts they have seen from OS/OW vehicles is damage to signs and heavy damage to asphalt roadways.

On average, three to four signs are knocked down each week by heavy oil field trucks that can't make turns within their narrow right of way. The signs have been reset further back from the road as a compensatory measure. County officials noted that the damage to asphalt roads occurs primarily when an oil field company is moving a rig. They observed that "we don't really have damage from other types of OS/OW loads. It is mainly all oil field related." County officials indicated they would pass on recent images of damage.

1.7.5 City of Fort Worth

City of Fort Worth officials noted that gas drilling and operations have had a major impact on city streets. These were not designed to handle this type of traffic, which causes tremendous damage to local residential streets. The top three industries that they are seeing damage from are oil and gas, construction, and trash/recycling.

The city had commissioned a study a few years ago to review and suggest a policy for OS/OW vehicle management. However, this policy was not implemented. City officials noted that a couple of other cities, such as Denton, had also examined this issue.

City officials stated that they are using an ad-hoc process for working with companies (regular and OS/OW loads) to develop routes to stay on stronger major arterials. This is done on a case-by-case basis. A visual inspection is performed prior to the load moving; afterward, another visual inspection is completed to determine "the damage which will be paid by the operator to rehab the street." The negotiation is with an individual company, and city officials estimated that damage amounts received from these private companies ranges from $30,000 to $100,000 per incident.

Another common type of damage is bridge hits. Fort Worth has quite a few bridges with a low clearance of 13 feet, and all types of trucks constantly hit these bridges. Some warning signals have been installed around these low-clearance bridges. Officials could not recall if there were a substantial number of hits to signals. They noted that they raise bridges up to a 16-foot clearance whenever they have the opportunity.

Other specific types of truck damage in Fort Worth were caused by local construction trucks, super-sized concrete mixer trucks (10-yard rear axle base), and garbage and solid waste and recycling trucks. Local streets were not constructed to tolerate these loads and trips.

The city does require a bond to be held by trucking companies, but officials noted, "This is not for damage, specifically. The contract of the company is bonded so the city is not liable for its financial impacts. It does not cover damage to infrastructure." City officials noted that they rarely catch the individuals who do damage.

The city does issue permits Table 1.11 depicts the fee schedule. The issuing department has recently changed; it has just been moved to the Development Department.

Table 1.11: City of Forth Worth OS/OW Permit Fee

Overweight load—single trip	$20
Oversize load	
Single trip	$20
Not to exceed 30 days	$45
Not to exceed 60 days	$60
Not to exceed 90 days	$75
Any permit issued hereunder shall include at least the following: The name of the applicant, the date, a description of the equipment is to be operated and a description of the commodity to be transported. The signature of an authorized member of the police department and the public works department. The time for which the permit is issued. The specified street or streets over which the equipment is to be operated, insofar as it can be determined at the time the permit is issued.	

1.7.6 Harris County

CTR researchers interviewed staffers in Harris County Infrastructure's traffic section, who noted that they had not seen a lot of damage to traffic signals because of OS/OW loads. This is because escorts usually do a pretty good job making sure the signals are out of the way before the load comes through. Frequently, the escorts that provide these services are actually traffic signal installation firms that are subcontracted by the heavy haul company. Therefore, they usually know what they are doing. The only time Harris County experiences problems is when an escort tries to move quickly to keep up with the load and the signals aren't put back exactly right. County personnel make the adjustments for about $300 per service call.

A staffer stated than in his more than 20 years of experience, he had seen about three instances when an equipment load caused damage to signals. He noted that when it happens, it's catastrophic, but it does occur rarely. The staffer indicated that an issue the county runs into is when companies who purchase a TxDOT permit think they are good to travel on any roadway in the state. Companies often don't know that Harris County also has OS/OW permits and that having a TxDOT permit doesn't allow them to run on the county system. Aside from this, the staffer commented that any damage that occurs due these loads is rare and "just a routine part of our business."

Harris County apparently sells approximately five OS/OW permits per year. The OS/OW permit request and road rules are available at the following website: http://hcpid.org/permits/rec_all_docs_forms.html. Figure 1.15 depicts the various vehicle permit types, and Figure 1.16 shows the permit form. Harris County Road Law and its Bond Form can be seen in Appendix F.

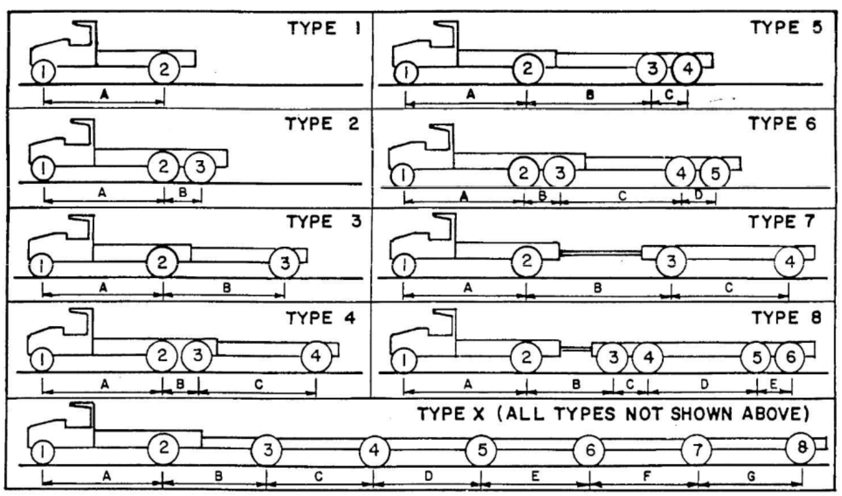


Figure 1.15: Harris County: Diagrams of Various Types of Vehicles

HARRIS COUNTY

APPLICATION FOR PERMIT TO MOVE SUPERHEAVY OR OVERSIZE EQUIPMENT OR LOAD OVER COUNTY ROADS

HARRIS COUNTY, TEXAS ____________________________, Texas Date____________________, 20_____.

Within the provisions of law, permission is hereby requested by,

____, of

_______________________________________, to transport the following equipment and maximum load, over the routes given below. (Give beginning and ending points on each road with distances):

	Make and Model	Engine No.	License No.	Weight
Truck	________________	________________________	_______________________	________________ lbs.
Trailer	________________	________________________	_______________________	________________ lbs.

Description of Load ____ ________________ lbs.

Maximum total gross weight of equipment and load to be transported _______________ ________________ lbs.

Maximum width _____________feet; Maximum height _____________ feet; Maximum length __________ feet.

Movement to begin not earlier than __________, 20_____. To be completed by _____________________, 20____.

LOADING DATA

Type of vehicle ______________________ (See other side of this page for diagrams of different types of vehicles).

AXLE SPACING		MAXIMUM AXLE LOADS		TIRE SIZES	
				TIRES ON AXLE	
Distance	Distances Between Axles	On Axle No.	Gross Axle Load Which Will Not Be Exceeded	No.	Size
A		1	Lbs.		
B		2	Lbs.		
C		3	Lbs.		
D		4	Lbs.		
E		5	Lbs.		
F		6	Lbs.		
G		7	Lbs.		
TOTAL		8	Lbs.		

It is expressly understood that the County of Harris shall not be responsible in any way for any damage of whatever nature that may result from the movement of the above described vehicle and load over County Roads and that all such responsibility is hereby accepted on behalf of the applicant.

Routes:____

____

____

Remarks:____

____

____

I, the undersigned, certify that I am authorized to sign this application for the person or firm whose name appears on this application committing the above obligation, and that the statements in this application are true and correct.

Signed: ____

By: ____

Title:

Subscribed and sworn to before me this the __________________ day of ___________________________, 20_____.

Notary Public ____________________County, Texas

P:\FORMS\Applications Receiving Area\Oversize Overweight Application Aug 2010.doc REV AUG 2010

Figure 1.16: Harris County Oversize Overweight Application Form

1.7.7 Tarrant County Transportation Department

CTR researchers interviewed the interim director of the Tarrant County Transportation Department.

The interim director noted that most of the bridges on the county's system are TxDOT overpasses with a roadway passing under TxDOT's structures. The county does have a few bridges that have been upgraded through contracts by TxDOT for a 10 percent county match. Around 10 years ago, the county had some wooden bridges on its system that have since been upgraded to standards; the county is responsible for bridge maintenance. However, the county has not seen much in the way of damage to its bridges from OS/OW loads.

The interim director indicated that the main damage (pavement damage) is caused by heavy OW trucks. Truck traffic is impacting the county, and there are a lot of heavy trucks using local roads that were never designed to carry heavy weights.

The interim director observed that oil and gas industry trucks are the main source of pavement damage. Any truck can go down any road on the county system. While the county can load post a road if there is a bridge, it would have to hire a consultant to study load limits for a pavement. The county had not wanted to undertake this from a policy perspective because "if we load posted one pavement, everyone would want their road load posted."

The county does get some TxDOT permitted truck traffic on its system. The interim director observed that "it's not to the point that it's really hurting our system yet," but had heard at the local COG meeting that the State Legislature is considering raising truck weight limits to 100,000 lbs. This could hurt the county because "our roads are mainly local street designs and carry the occasional garbage truck, mainly two-inch hot mix, and those roads couldn't carry 100,000 lbs."

In terms of reimbursement for damage costs, the interim director commented that if it's a dead-end roadway with a well head at the end, the trucking company is contacted by letter indicating that the road and ditch line has been damaged and that its truck caused the damage. The county has been reimbursed for damaged to pavements and ditches. The interim director stated, "In fact, we're batting 1000 percent on getting reimbursements." However, if a road carries different kinds of trucks, such as oil and gas, gravel trucks, etc., it's more difficult to pinpoint a single company and get reimbursed for damage. The company will ask how the county knows that its operation is the specific cause of the damage.

CTR researchers inquired if the county had any low clearance beacons. The interim director pointed out that Tarrant County—Fort Worth and Arlington—is growing, so about the time a section of the county has grown to the point a signal is needed, Fort Worth will annex it. There are no traffic signals on the county system; it has only one stop sign with a flashing beacon on top.

1.7.8 Texas Department of Insurance (TDI)

CTR researchers interviewed TDI officials to obtain information about rules regarding insurance company responsibility for OS/OW vehicle damage to TxDOT property.

CTR researchers noted that a question had arisen regarding who was responsible to pay claims for damage by an OS/OW vehicle if the carrier had violated the law at the time of the crash. CTR's researchers had heard anecdotally that insurance companies refused to pay if the carrier was in violation of the law when the crash occurred. This specifically refers to the vehicle insurance company policy and not the bond that a carrier must file to purchase an OS/OW permit. With regard to violating the law, these are hypothetical examples; however, an OS/OW carrier might be operating without a permit, or the vehicle might be off the specified route at the time of the crash. Also, the driver might not have a commercial driver's license or might be speeding.

CTR researchers had contacted the Specialized Carrier & Rigging Association, an industry trade group that represents many OS/OW carriers, as well as some of the approximately 75 insurance companies listed on the SC&RA website. However, researchers received no response.

TDI officials noted that the OS/OW carrier is required to establish financial responsibility to operate in Texas. This means that its insurance coverage would necessarily need to cover damages that occurred whether or not the carrier violated the law. There might be exclusions in a carrier's policy, just as there are exclusions in any auto policy, e.g., exclusions for "racing," which likely doesn't occur with an OS/OW load in any case; or exclusions for "acts of war" or "causing pollution." However, these are general types of exclusions that might appear in any type of auto insurance policy. TDI officials could not think of an instance in which an insurance company has had a specific exclusion regarding "non-coverage in the event a law was violated."

TDI officials did note that "every policy is different, and not all insurance companies provide the same coverage." For example, an insurance company might place a limit on the amount of damage that will be covered if an accident occurs. However, TDI officials were unaware of a case in which a company rejected a claim simply because the law was violated at the time of the accident.

TDI officials noted that an insurance carrier might not cover damage associated with a crash if the driver was not eligible to drive. This may also be the case for auto coverage. CTR researchers asked, "If a driver did not have a valid commercial driver's license, it is possible that the insurance carrier would not cover damages caused in the course of a crash?" TDI officials responded that in general, that could be possible. Researchers inquired if there might be certain circumstances in which the carrier might deny coverage similar to circumstances that would exist for an auto insurance carrier. TDI officials indicated that this is correct but did not believe, for example, that if the carrier were operating over the speed limit at the time of a crash, this would justify the insurance company refusing to cover resulting damage.

1.7.9 Texas Department of Motor Vehicles—Enforcement Division

CTR researchers also interviewed the enforcement division within the Texas Department of Motor Vehicles (TxDMV). They are involved with conducting enforcement of individual companies to bring them back into compliance. Division officials indicated that TxDPS is involved at the individual level, and TxDOT looks at overall compliance. This division receives a spreadsheet once a month from TxDPS that shows all the size and weight violations attributed to companies. The division then looks for patterns and visits with these companies to find opportunities to get them back into compliance through an investigation process. The investigation can end in one of three outcomes: fine, penalty, or referral to an attorney if multiple investigations have occurred and the company does not cooperate. If the company develops a plan of action, the investigation may not result in a penalty or fine. The penalty may also be significantly reduced. There is also another internal report for bridge hits that is created each month and that is utilized within this process.

In 2012, there were 332 investigations. Table 1.12 shows the number of yearly investigations since 2008.

Table 1.12: TxDMV Enforcement Division Investigations 2008–2012 (to date)

Year	No of Investigations
2012	332
2011	350
2010	210
2009	120
2008	71

In 2012, 332 size and weight investigations were completed. However, there are also 82 contested cases and 18 closed contested cases.

The division has nine full time employees and one assistant. Annual salaries are $720,072. Travel is $30,000 per investigator, on average. Investigators utilize TxDOT's internal vehicle fleet when possible. In 2011, the amount of fines imposed for OS/OW vehicles was $733,050. This money is sent to general revenue in the state budget, not to Fund 6. As of July 2012, $263,350 in fines was imposed. Figure 1.17 shows fines imposed from 2008 to July 2012.

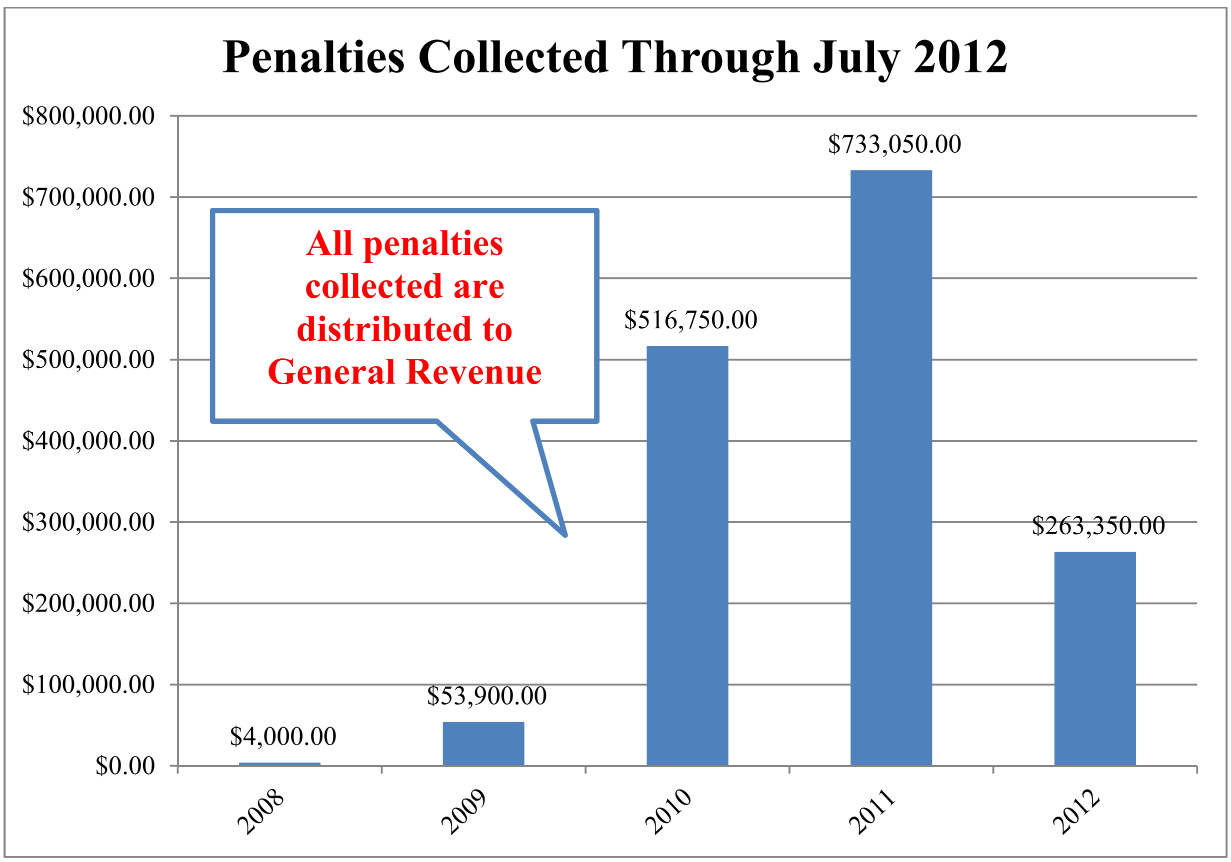


Figure 1.17: OS/OW Penalties Collected 2008 through July 2012

The division examines all size and weight issues and reviews the monthly report from TxDPS mentioned earlier. Staff also asks TxDPS to conduct spot checks. One comment that they made was that for agricultural trucks that are exempted they cannot do an administrative review unless the vehicle is 3 percent over-axle weight. This means that these trucks actually run at 84,000 lbs (3 percent over the legal limit) and then another 3 percent over this weight before a citation is issued. Ready mix trucks are problematic, especially on interstates and frontage roads. These vehicles are not permitted to use these roads but do so anyway.

Within an investigation to determine weight, investigators look at commodity type to determine weight. They indicated that it would be helpful if TxDOT could weigh more (even using WIM) as more data could help determine whether an investigation was warranted.

They also noted garbage trucks are frequently investigated. The Motor Carrier Division may ask investigators to review a specific carrier.

1.7.10 Texas Department of Public Safety

The research team met with TxDPS officials to gather data on enforcement statistics and costs. TxDPS officials noted that there were 32,482 inspections for OS/OW vehicles in 2011. These inspection reports take an hour of a trooper's time, on average. A trooper costs $47 per hour on average, or $30 for a civilian. The commercial vehicle enforcement service manpower statistics can be seen in Table 1.13.

Table 1.13: Commercial Vehicle Enforcement Service: Manpower Division

Captains	9
Lieutenants	16
Sergeants	57
Corporals	55
Canine Troopers	1
Troopers	376
Total Commissioned Personnel	**514**
CMV Inspectors	176
NEP/CR Field Supervisors	6
NEP Investigators	23
CR Investigators	58
Total Non-Commissioned Personnel	**263**
Total Manpower	**777**

Source: TxDPS as of July 1, 2012

TxDPS officials provided CTR researchers with data. The size and weight statistics from the Commercial Vehicle Enforcement system (CVE), for example, can be seen in Table 1.14. There were 30,290 tickets issued in 2011, as noted. Weight tickets made up 28,641 violations; weight violations made up 65,988; size tickets made up 1,649; and size violations made up 2,502 of the violations.

Table 1.14: 2011 TxDPS Commercial Vehicle Enforcement Inspections Size and Weight Statistics

Inspections	Tickets	Violations	Warning	Weight Tickets	Weight Violations	Weight Warnings	Size Tickets	Size Violations	Size Warning
37,626	30,290	68,491	38,201	28,641	65,988	37,347	1,649	2,502	854

The number of commercial vehicles weighed in motion was 1,830,862. The weigh in motion statistics for the 2011 calendar year can be seen in Table 1.15.

Table 1.15: Calendar Year 2011 Weigh in Motion Statistics

SVC	Category	Total
LW	Vehicles Weighed—permanent scales	121,106
LW	Vehicles weighed—portable scales	16,060
LW	Vehicles weighed semi portable scales	20,193

TxDPS receives funding from two main sources, so it is difficult to attribute funding streams to specific line items for OS/OW operations. There is an enforcement grant for the border and other areas, along with appropriations from the state budget. The two sets of funding streams for commercial vehicle enforcement for registered trucks are also used for OS/OW truck inspections. TxDPS does 95 percent of the enforcement of OS/OW tucks. If cities or counties want to undertake enforcement activities through their local police force, they can take training through the Motor Carrier Safety Alliance Program. However, this is expensive, and the equipment to be able to do the inspections is also expensive. For example, a set of portable scales costs just more than $15,000 per set. There are also measuring poles and other equipment that are required for inspections (Figure 1.18).

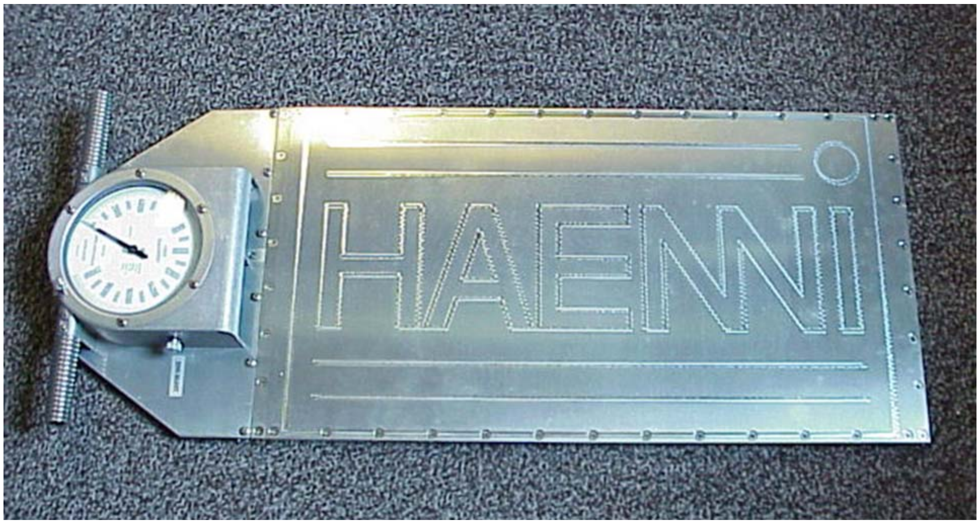


Figure 1.18: 17mm thick TxDPS Scales

The scales and measuring poles also require a larger vehicle (SUV Tahoe or equivalent) for transport. TxDPS does not provide escort vehicles for OS/OW loads, although officials noted that some cites/counties might require them.

As can be seen in Chapter 1, determining other costs associated with OS/OW loads is extremely complex. In some instances, agencies and local governments do not keep records of the direct costs for damage, inspection, levying fines, and other ancillary costs, or costs associated with reduced highway capacity, lane closures, and staffing costs.

Chapter 2. Methodology and Recommendations for Pavement Consumption Analysis

2.1 Introduction

The Texas Department of Motor Vehicles' (DMV) Motor Carrier Division processes more than 500,000 Oversize/Overweight (OS/OW) permits every year. By law, loads allowed by these permits can exceed current legal axle load limits of 20,000 lbs. for a single axle, 34,000 lbs. for tandem axles (two axles spaced up to 4 feet apart), and 80,000 lbs. total Gross Vehicle Weight (GVW)[3]. Alternately, by law, permits may apply to vehicles that exceed the legal dimensions of 8 feet 6 inches in width, 14 feet in height, and 65 feet in length.

Permitted OS/OW equipment can be self-propelled (e.g., a mobile crane) or consist of a specialized truck-trailer configuration to carry the load. Therefore, OS/OW loads may not be readily comparable to a typical 5-axle truck or 18-wheeler. These permitted vehicles can travel short distances of 10 miles or traverse Texas using the state and county road network. Depending on the permit type, the GVW can range from 80,001 lbs. to 254,000 lbs. in the "overweight" and "mid-heavy" weight classes or from 254,300 lbs. to heavier than 2,000,000 lbs. in the "super-heavy" class (TxDOT, 2011a). Because OS/OW permitted vehicles typically operate at much heavier loads with specialized equipment configurations, it is difficult to quantify the damage caused by OS/OW loads compared to that caused by a legally loaded 18-wheeler. Currently, these calculations are based on empirical relationships developed many years ago using different vehicle and pavement and bridge technologies.

This chapter focuses on developing a methodology for establishing equivalencies between OS/OW loads based on the concept of "equivalent consumption" to the pavement structure using mechanistic-empirical pavement analysis procedures. In the proposed methodology, each pavement section is evaluated using three different distress criteria: (i) surface deformation or rutting, (ii) load-associated fatigue cracking, and (iii) riding quality in terms of roughness (International Roughness Index, or IRI). It should be noted that roughness in the true sense is not a distress mechanism but rather a measure of the riding quality for a given highway facility as perceived by drivers.

In the context of this study, a certain pavement structure that reaches the pre-set failure criteria for a given axle load and configuration is defined as having equivalent consumption (or equivalent performance) to a different loading condition that also results in the same level of distress (rutting, cracking, or roughness). Bridges are affected by truck configuration, but pavement structures are affected by individual axles or axle groups (i.e., tandem, tridem, or quads). To wit, *pavements feel axles, not trucks*. The proposed methodology represents a significant enhancement over previous procedures, allowing the analyst to adopt a modular approach towards calculation of the overall load equivalency for any given truck configuration because the overall pavement consumption due to a combination of different axles is equivalent to the sum of the consumption caused by each individual axle.

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[3] See Transportation Code, Chapter 621 (General Provisions Relating to Vehicle Size and Weight), Chapter 622 (Special Provisions and Exceptions for Oversize and Overweight Vehicles), and Chapter 623 (Permits for Oversize and Overweight Vehicles).

2.2 Objective

The primary objectives of the pavement analysis component of this study are to

- Determine the equivalent consumption factor (ECF) for different axle loads and axle configurations and to calculate the overall equivalency of OS/OW vehicles on pavement structures with different structural capacities with respect to three different failure mechanisms: rutting, fatigue cracking, and roughness. The effect of different environmental conditions is also assessed.
- Generalize results using appropriate statistical analyses and establish robust relationships between the ECF and the type of highway facility, including its functional classification, structural capacity, or both. This is done for different axle types (single, tandem, tridem, and quads) under a range of environmental conditions that occur in Texas.

2.3 Background

An extensive body of literature on this subject suggests that, in the past, the two terminologies successfully used to quantify the effect of axle loads on pavements are (i) Load Equivalency Factor (LEF) and (ii) Equivalent Damage Factor (EDF). Although both terms have similar meanings, LEF was developed based on analysis of American Association of State Highway and Transportation Officials (AASHTO) Road Test results, while EDF was more recently introduced to distinguish between the different approaches followed in the analysis of the AASHTO Road Test (i.e., empirically-based) and the current procedure (mechanistically-based) (AASHTO 1974). A number of factors that were traditionally included into one single coefficient (LEF) are now assessed individually by means of partial factors through the mechanistically based approach. Currently, three partial factors have been developed, but there is scope for further addition to assess other aspects like loading rate and aging conditions. Prozzi et al. (Prozzi et al., 1997b and 1997a) suggested the following relationship for determination of EDF_L for a particular axle load and configuration (Equation 2.1):

$$EDF_L = GEF_L \times ALF_L \times CSF_L \tag{2.1}$$

Where
GEF : Group Equivalency Factor
ALF : Axle Load Factor
CSF : Contact Stress Factor

where
Group Equivalency Factor (GEF) is defined as the ratio between the life of the pavement under a single axle to the life of the pavement under a group of axles. This factor considers only the number of axles and inter-axle spacing and expresses the number of single axles that would cause the same damage to the pavement as the group. By definition, the GEF of a single axle is one.

Axle Load Factor (ALF) is defined as the ratio between the life of the pavement under a single axle of 18 kips and the life of the pavement under a single axle of a different load. The acronym ALF is proposed because this factor only takes into account the effect of axle load and it is equivalent to the traditional LEF.

Contact Stress Factor (CSF) is the ratio between the life of the pavement under a dual-wheel single axle with a tire pressure of 120 psi and that under a dual-wheel single axle with a different tire pressure.

In summary, the framework proposed by Prozzi et al. establishes the EDF for different axle loads, configurations, and tire pressures (Prozzi et al., 1997b and 1997a).

2.4 Methodology for Flexible Pavements

2.4.1 Calculation of Equivalent Consumption Factor (ECF)

This study establishes equivalency factors for different axle loads and configurations for flexible pavement sections using mechanistic-empirical pavement design principles, as outlined in the previous section. In this work, the concept is referred to as the Equivalent Consumption Factor (ECF). The fundamental principle behind the proposed methodology involves assumption of equivalencies between different axle loads and configurations that result in the same level of pavement distress, pavement performance, or pavement consumption. In establishing such equivalencies, a standard 18-kip single axle was used as a frame of reference. Recent studies have also shown that equivalency factors for different axle loads and configurations are partially governed by the bearing capacity of the pavement structure and environmental conditions (Prozzi et al. 2007). Therefore, it is essential to determine ECFs for different axle loads over a spectrum of pavement structures ranging from thin bituminous surface courses to full-depth flexible pavements.

As suggested, load equivalencies are established based on the notion of time (or traffic) to reach a certain failure criterion. The terminal distress values used as in this study were decided after taking into consideration common practices on pavement design and management. These failure criteria are given here:

- 0.5 inches of rutting (surface deformation) at the end of the design life;
- 10 percent of the cracked area (fatigue cracking associated with load) at the end of the design life; and
- 125 inches/mile of roughness in terms of the International Roughness Index (IRI) at the end of the design life (an initial IRI of 63 inches/mile was used in the analysis).

Each pavement is designed to reach terminal distress values under given traffic and environmental conditions by the end of its design period—in this case, 20 years. However, due to inherent differences in the failure mechanisms, it is impossible to reach each of the three terminal distress values simultaneously at the end of the design period. It becomes necessary to determine the required traffic volume that would result in a terminal distress value equal to each of the failure criteria expressed above. The calculated traffic volume will depend on the distress mechanism considered. In general, there will be one traffic volume for rutting, one for cracking, and one for roughness.

Once design traffic volumes are determined, the next step involves analyzing each pavement structure for a range of different axle loads and configurations and determining the time (or traffic) to reach each failure criteria. Note that axles with an ECF of less than one will take longer than 20 years to reach failure criteria, while axles associated with an ECF one or more will take less than 20 years. The equation used for calculation of the ECF in this study follows (Equation 2.2):

$$ECF = \frac{T_{18}}{T_L} \tag{2.2}$$

Where

T_{18} : time to failure under "N" repetitions of a standard 18-kip axle

T_L : time to failure under "n" repetitions of any given axle load "L"

Therefore, the ECF represents the relative pavement life for any given pavement structure under given environmental conditions under an 18-kip single standard axle over the life of the same pavement under the same conditions under any given load and configuration.

The AASHTO Road Test established that heavier vehicles reduce the serviceability of a pavement structure much faster than light vehicles. Results from the test indicated that the damage to the pavement structure varies approximately according to the fourth power of the axle load, which provides the basis for the so-called "fourth power law" (Kinder et al., 1988). In the context of the AASHTO Road Test, this led to the terminology LEF, where an axle load is said to be equivalent (producing equal pavement wear) to a number of applications of a reference (standard) axle load. This is expressed mathematically as Equation 2.3:

$$LEF = \frac{N_{18}}{N_L} = \left(\frac{W_L}{W_{18}}\right)^4 \tag{2.3}$$

where W_x and W_{18} are axle loads and N_L and N_{18} are the corresponding number of load applications.

A logarithmic transformation of Equation 2.3 suggests a linear relationship between the LEF and the normalized load in a log-log scale, the slope of this linear relationship being equal to approximately four.

Previous studies show that this slope, represented by the exponent in Equation 2.3, depends on the bearing capacity of the pavement structure (Prozzi et al., 2007). In the case of flexible pavements, structural capacity can be represented by a parameter known as the Structural Number (SN), which was first introduced as part of the analysis of the AASHTO Road Test results. The SN represents the overall structural requirement needed to sustain the design traffic loadings under given support conditions. SN is a dimensionless number that expresses the structural strength of a pavement required for given combinations of soil support, total traffic expressed in number of equivalent single axle loads (ESALs), terminal serviceability level, and environmental conditions (Florida DOT, 2008). Therefore, in principle, one should be able to establish a relationship between the exponents of the power law and the SN in the case of flexible pavements.

It is important to note that in this process, one would develop separate ECFs based on each distress criteria mentioned above. From a practical standpoint, a given axle configuration loaded to "L" kips should have a single ECF. For this reason, it is important to establish a weighing mechanism to be applied to individual ECFs (i.e., rutting, cracking, and roughness) for establishing the combined and unique ECF for a particular axle load and configuration. The weighing mechanism should be devised so it takes into account fundamental engineering principles. For example, Texas is divided into five different environmental regions: Wet-Warm, Dry-Warm, Wet-Cold, Dry-Cold, and Mixed. Rutting is more critical in warm climates, while cracking is the dominant distress mechanism in colder regions. Ultimately, it is important to ensure that the weighing scheme assigns different weights to individual ECFs depending on the climate. The inherent variability of ECFs is another key concern. For example, an ECF calculated using the rutting criteria could result in a lower standard error (that is, lower uncertainty) compared to those obtained using the cracking or roughness criteria, which are predicted with the highest uncertainty. It is recommended that a relatively higher weight be instituted for ECFs with lower variability as part of the weighing mechanism in these instances.

In the context of this study, the objective is to determine consumption equivalency for different OS/OW loads and configurations. Currently, vehicle owners/operators must obtain permits for all OS/OW loads from the DMV's Motor Carrier Division (MCD). Routing of these loads is processed using the Texas Permitting and Routing Optimization System (TxPROS), an online portal. Given that route information is available, it is then possible to assign approximated SNs to any highway facility in Texas based on its functional classification, level of access-control, location, and traffic volume. As mentioned, one should then be able to obtain the ECF for any given axle load and configuration from the established relationship that relates the exponent of the power law to the SN for a particular highway facility. The exponent of the power law (Equation 2.3) is a measure of the sensitivity of a particular pavement structure to axle loading under given environmental conditions.

2.4.2 Mechanistic-Empirical Pavement Analysis

Reliance on a widely supported analysis procedure that can be applied beyond Texas's borders is imperative. For this reason, AASHTO's newly developed pavement design software, DARWin-ME™, was used for analysis and computation of pavement distress resulting from imposed traffic. DARWin-ME™ uses the same mechanistic-empirical concepts as its predecessor, the Mechanistic-Empirical Pavement Design Guide (MEPDG), developed under the National Cooperative Highway Research Program (NCHRP). The pavement performance prediction models, as well as the required inputs, are the same in both programs. However, the updated software released in 2011 is a quantum leap over the older MEPDG because computation time is reduced to one-tenth of the time it used to take to calculate a similar pavement structure. Furthermore, the newer software was designed to take advantage of and utilize multiple CPUs for running analyses (CRSI, 2002). DARWin-ME™ is now approved by AASHTO and supported by the Federal Highway Administration (FHWA).

In a mechanistic-empirical pavement analysis, fundamental pavement responses under repeated traffic loadings are calculated using a multi-layer, linear elastic approach. This approach assumes that a flexible pavement is a multi-layered structure and that each layer exhibits a linearly elastic response to traffic loads. Although this is not the case, the linearity assumption is reasonable at the low strain levels typical of highway traffic. The method computes stresses and strains borne by pavement layers due to traffic loadings. These critical pavement responses are then related to field distresses using empirical relationships that are calibrated based on field observations.

2.4.3 Experimental Design

As highlighted earlier, the ECF for any given axle load and configuration is expected to be a function of the structural capacity of the highway facility (Prozzi et al., 1997b and 1997a). Furthermore, it is important to realize that environmental conditions determine several site features, including the climatic profile and type of subgrade support. In turn, these affect pavement response and performance typical to specific regions. For these reasons, it is important to design an experiment that encompasses different pavement structures, traffic levels, and climatic regions (see Table 2.1).

Table 2.1: Experimental Design for ECF on Flexible Pavements

Climatic Region	Pavement Structure	Traffic Volume		
		Low	Medium	High
Dry-Cold	Granular Base	5	2	0
	Asphalt Base	1	0	1
	Treated Base	1	2	2
	Perpetual Pavement	0	0	0
Wet-Cold	Granular Base	0	4	2
	Asphalt Base	1	2	3
	Treated Base	1	1	2
	Perpetual Pavement	0	0	1
Dry-Warm	Granular Base	1	2	3
	Asphalt Base	1	1	1
	Treated Base	0	0	1
	Perpetual Pavement	0	0	4
Wet-Warm	Granular Base	1	2	0
	Asphalt Base	3	3	2
	Treated Base	2	2	4
	Perpetual Pavement	0	0	0
Mixed	Granular Base	2	3	2
	Asphalt Base	2	2	2
	Treated Base	0	2	1
	Perpetual Pavement	0	0	2

A comprehensive experiment is impractical, as evidenced by Table 2.1. For example, one would typically not design a perpetual pavement for low traffic volumes. Therefore, a partial factorial was designed to address project objectives for the purpose of this study. The partial experiment was based on statistical considerations as well as the availability of pavement sections in each design cell of the experiment described in Table 2.1.

This study also includes determination of ECFs for rigid pavements for a variety of axle loads and configurations. Given that the most common type of concrete pavement in Texas is continuously reinforced concrete pavement (CRCP), the study includes the following experimental design for evaluating the ECF on concrete pavements (Table 2.2).

Table 2.2: Experimental Design for ECF on Rigid Pavements

Climatic Region	Traffic Volume		
	Low	**Medium**	**High**
Dry-Cold	2	2	2
Wet-Cold	2	2	2
Dry-Warm	1	2	2
Wet-Warm	2	2	2
Mixed	1	2	3

OS/OW loads do not conform to typical legal limits placed on highway vehicles in terms of height, width, length, or weight. Due to the nature of the payload, these vehicles can have atypical axle configuration and axle loads. This aspect led the research team to simulate a wide range of axle loads with different configurations so the full axle spectra for OS/OW loads can be characterized. Table 2.3 summarizes the range of axle load and configurations that were included as part of this research study.

Table 2.3: Simulated Axle Loads and Configurations

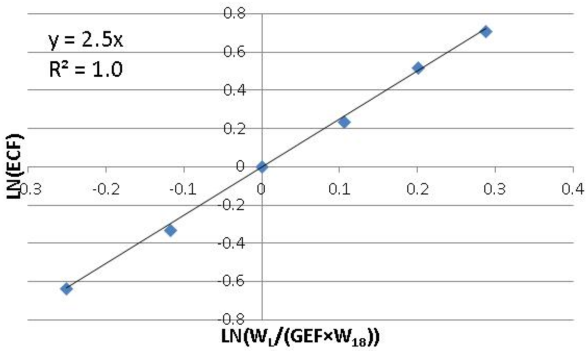
	Axle Configuration			
	Single	**Tandem**	**Tridem**	**Quad**
Axle Loads (in kips)	8	18	30	30
	10	22	36	36
	12	26	42	42
	14	30	48	48
	16	34	54	54
	18	38	60	60
	20	42	66	66
	22	46	72	72
	24	50	78	78

Contact stress (assumed to be equal to tire inflation pressure) was restricted to 120 psi for all possible combinations of axle loads and configurations used in the study.

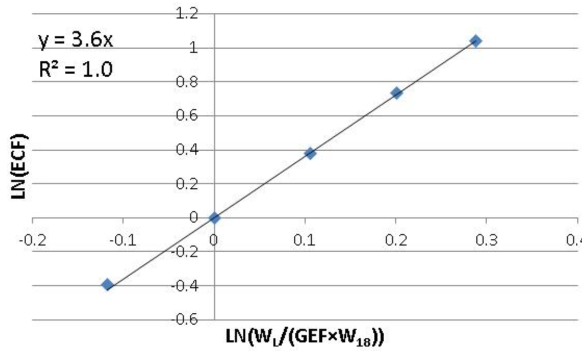
2.4.4 Results for Flexible Pavements

Determination of ECF for Rutting

Equation 2.2 suggests that it is possible to establish a linear relationship between the ECF and the normalized load on a log-log scale. Figure 2.1 shows a strong linear relationship between these two variables. The slope of the line, which represents the exponent of the power law, varies significantly among the different sections included in this study.



(a) Section 01, single axle



(b) Section 02, single axle

Figure 2.1: ECFs Based on Rutting Criterion for Flexible Pavements

The fact that the slope of the line differs from section to section indicates that the ECF for any given axle load and configuration is influenced by pavement material properties, structural capacity of the highway, and environmental conditions. When examining tandem, tridem, and quad axles, the research team introduced the group equivalency factor (GEF) to establish the ECF. As discussed, in the case of single axles, the GEF is one. Therefore, the ECF and ALF are analogous for single axles. For other axle configurations, the GEF was incorporated for calculating the normalized load. The following generalized expression was used to calculate the ECF for any given axle load and configuration while using the rutting failure criteria (Equation 2.4):

$$ln(ECF) = \alpha \times ln\left(\frac{T_{18}}{T_L}\right) = \alpha \times ln\left(\frac{W_L}{\beta \times W_{18}}\right) \quad (2.4)$$

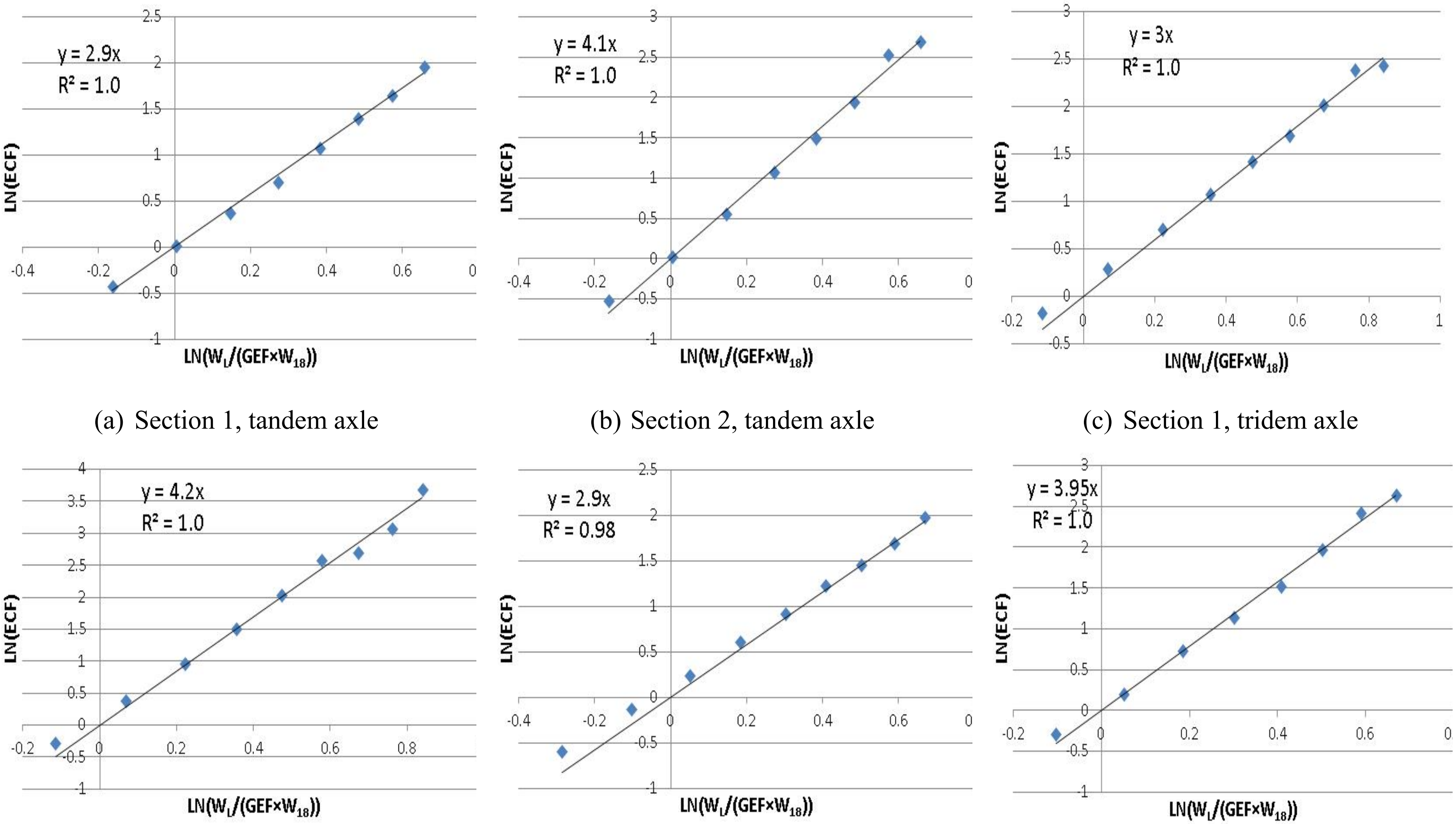
Where
α = Axle Load Factor (ALF)
β = Group Equivalency Factor (GEF)

Figure 2.2 shows the relationship between the ECF for tandem, tridem, and quad axles and the normalized load as calculated for two selected sections.

Figures 2.1 and 2.2 reveal that the ALF is quite consistent for a given pavement structure and changes negligibly for different axle groups. Following are the GEF values that were estimated for determining the ECF using the rutting criterion:

- Tandem Axles: 1.44
- Tridem Axles: 1.87
- Quad Axles: 2.22

Based on literature, ALFs are expected to be a function of the structural capacity of pavement structures. This implies that the ALF should exhibit high correlation with the structural number as the GEF is optimized such that it gives the best linear predictor between the ECF and the normalized load in a log-log scale for all pavement sections examined in this study. In theory, one would expect the ALF to be lower for thicker, stronger pavements because the structural capacity of a pavement increases exponentially with increasing thickness, thus making the pavement less sensitive to increases in axle loads.



(a) Section 1, tandem axle

(b) Section 2, tandem axle

(c) Section 1, tridem axle

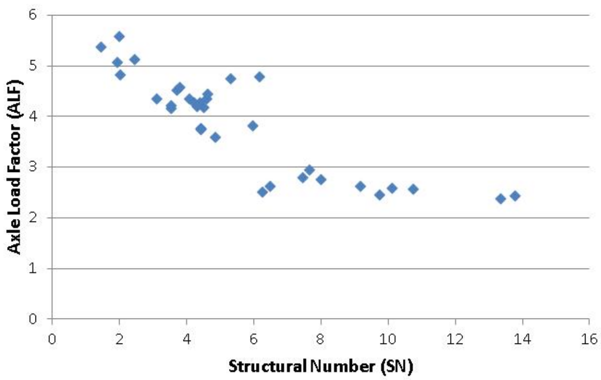
(d) Section 2, tridem axle

(e) Section 1, quad axle

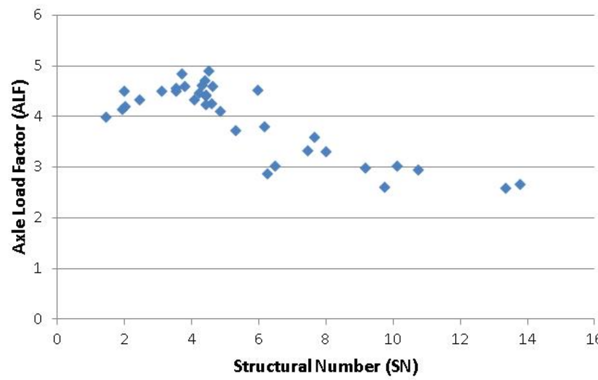
(f) Section 2, quad axle

Figure 2.2: ECFs Based on Rutting Criterion for Flexible Pavements

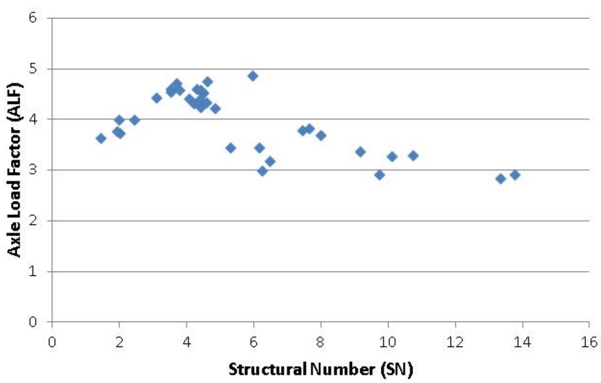
Figure 2.3 represents the correlation between the ALF and pavement structural capacity as represented by its structural number (SN). Figure 2.3 shows that the relationship between the ALF and SN is non-monotonic for the conditions of the current study. There appears to be a critical thickness beyond which the ALF gradually drops with increasing thickness. This pattern is particularly identifiable in the case of multiple axles (i.e., tandem, tridem, and quad axles). For the pavement structures analyzed, this critical structural number is around SN = 4.0. It is also interesting to note that in the case of single axles, the relationship between the ALF and SN appears to be monotonic and is in agreement with the hypothesis that increasing thickness results in lower ALF values. In this case, there is no interaction between axles.



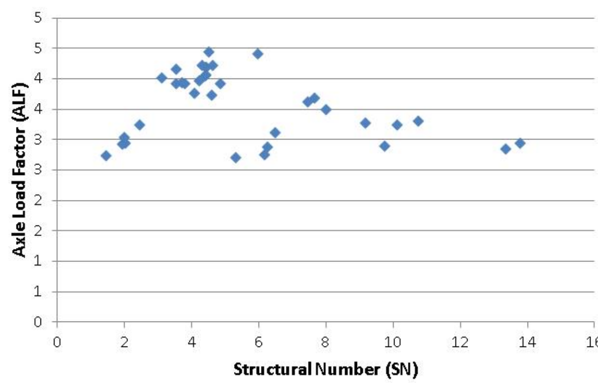
(a) Single



(b) Tandem



(c) Tridem



(d) Quad

Figure 2.3: Relation between ALF and SN Based on Rutting Criterion

Based on the trends highlighted, the study team decided to model the ALF for single axles using a power relationship between the ALF and SN. The model parameters are provided in Table 2.4. Figure 2.4 shows the fit of the model with respect to the observed data.

Table 2.4: Parameters for Single Axle ALF Based on Rutting Criterion

Standard Error		1.14	
f-statistic		0.00	
Adjusted R-squared		0.77	
	Coefficient	t-stat	p-value
Intercept	2.00	29.9	0.00
Structural Number	-0.43	-10.7	0.00

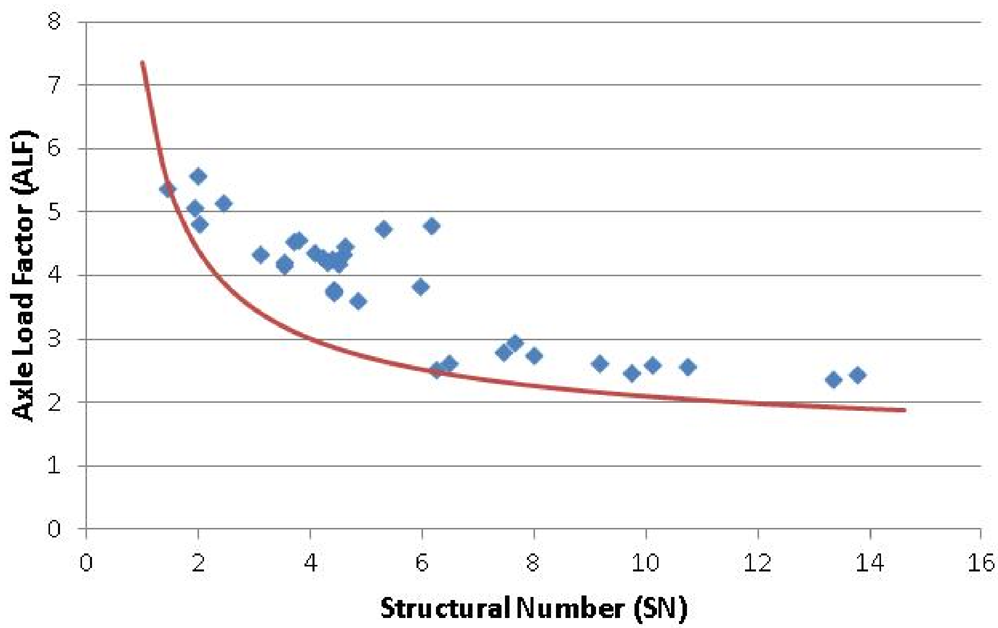


Figure 2.4: Single Axle ALFs Fitted to a Power Law (Rutting Criterion)

Following is the final relationship for calculating the ECF for single axles from a rutting standpoint (Equation 2.5):

$$ln(ECF) = (7.39 \times SN^{-0.43}) \times ln\left(\frac{W_L}{(0.41n+0.61)\times W_{18}}\right) \quad (2.5)$$

In the case of tandem, tridem, and quad axles, data trends suggest that a non-monotonic relationship is needed to capture the critical thickness. In fact, the study team noticed that the ALF peaks for structural numbers in the range of 4.0 and then decreases, becoming asymptotical to a value of about 2.5. Furthermore, it was observed that an asymmetric function that is positively skewed had to be applied to capture the observed relationship. Given these constraints, the following relationship was chosen to capture the observed data (Equation 2.6):

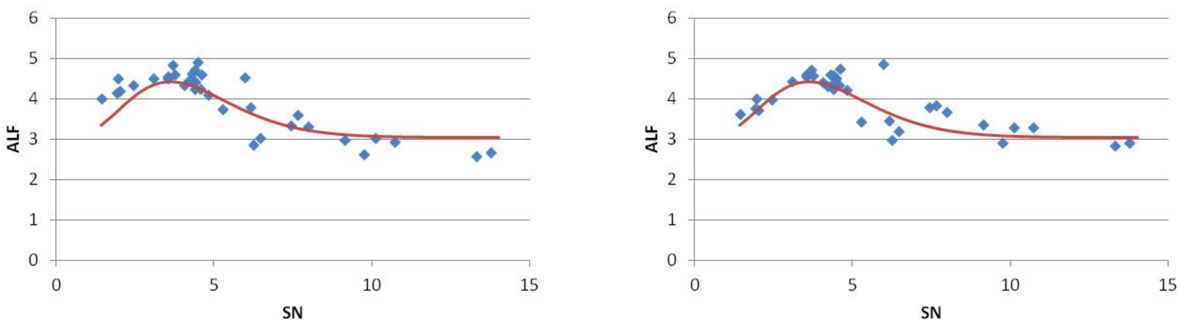
$$ALF = \alpha \times SN^{\beta} \times e^{-SN^{\gamma}} + \delta \quad (2.6)$$

where α, β, γ, and δ are regression parameters. Table 2.5 provides estimates for the model coefficients and their statistical significance.

Table 2.5: Parameters for Single Axle ALFs Based on Rutting Criterion

Standard Error		0.42	
	Coefficient	t-stat	p-value
α	0.26	1.90	0.05
β	4.45	5.70	0.00
γ	1.09	14.2	0.00
δ	3.04	27.0	0.00

Figure 2.5 demonstrates the goodness-of-fit of the aforementioned model to observed values of the ALF. The research team also realized that the GEF obtained for single, tandem, tridem, and quad axles could be related with the number of axles for a given axle group using a simple linear relationship (see Figure 2.6).



(a) Tandem (b) Tridem

Figure 2.5: ALFs Based on Rutting Criterion

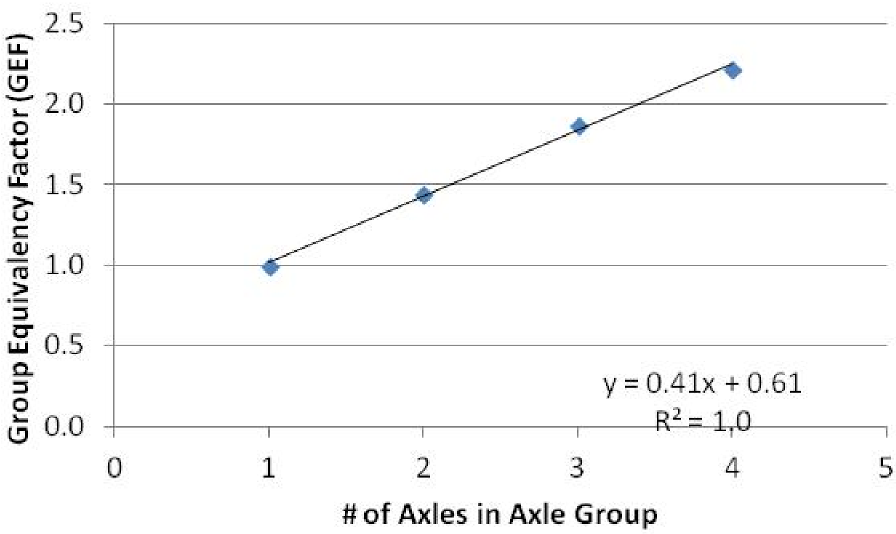


Figure 2.6: Relationship between GEF and Number of Axles (Rutting Criterion)

Equation 2.6 and the generalized model illustrated in Figure 2.6 can be used for computing the GEF for any axle group from a rutting standpoint. Following is the generalized relationship for computing the ECF for generic axle configurations and loads (Equation 2.7):

$$ln(ECF) = \left(0.26SN^{4.45}e^{-SN^{1.09}} + 3.04\right) \times ln\left(\frac{W_L}{(0.41n+0.61)\times W_{18}}\right) \qquad (2.7)$$

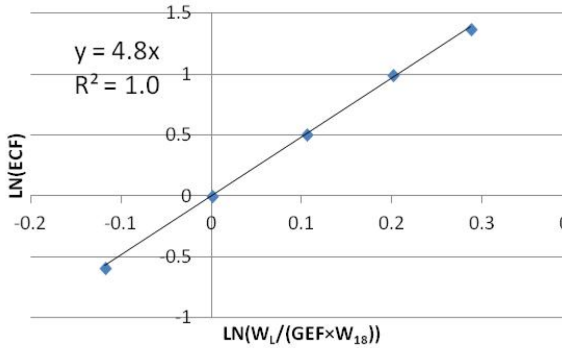
Determination of ECF for Fatigue Cracking

The calculation of ECF from a fatigue cracking perspective was undertaken using the same approach as that for rutting. Figure 2.7 depicts the relationship between normalized loads and the ECF on a log-log scale.

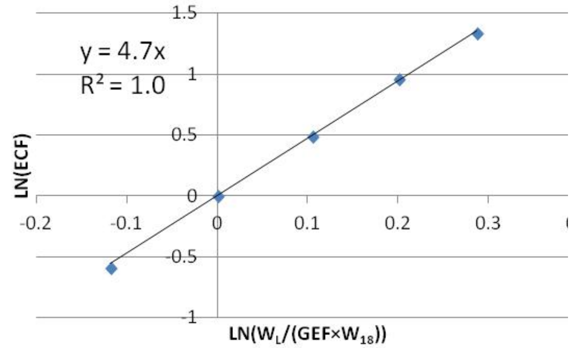
The relationship between a normalized load and the ECF is explained using the fundamental principle illustrated in Equation 2.3 (Figure 2.7). The research team again observed that the calculated ALF follows a similar pattern for different axle configurations for different pavement sections. It is important to note that the rutting and fatigue cracking transfer functions used in the mechanistic analysis have similar specification forms. This explains why the relationship between these two variables has similar characteristics. However, ALF values computed using the fatigue cracking failure criterion are numerically higher than those calculated using the rutting criterion. It was also noticed that GEF values were significantly higher than those for rutting:

- Tandem Axles: 1.89
- Tridem Axles: 2.59
- Quad Axles: 3.10

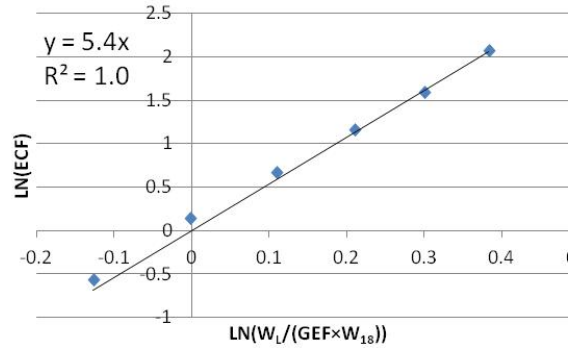
A key observation made while calculating the ECF for different axle loads and configurations using the fatigue cracking failure criteria was that thin asphalt sections, especially those on top of cement-treated bases (CTBs), did not show visible signs of deterioration in terms of cracking. Fatigue cracking results from tensile stresses exceeding the tensile strength of material due to repeated load cycles. In the case of thin asphalt sections, due to the strong underlying support, the governing stress state is compression. This explains why these sections failed to reach the terminal fatigue cracking distress criteria.



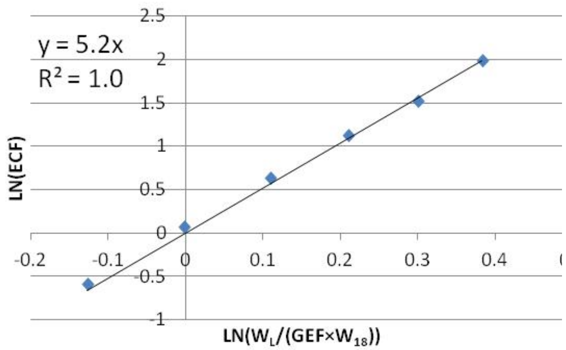
(a) Section 1, single axle



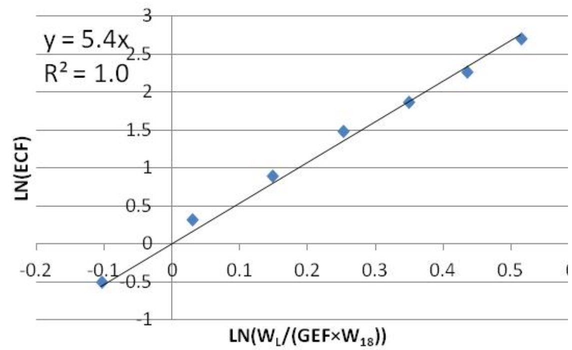
(b) Section 2, single axle



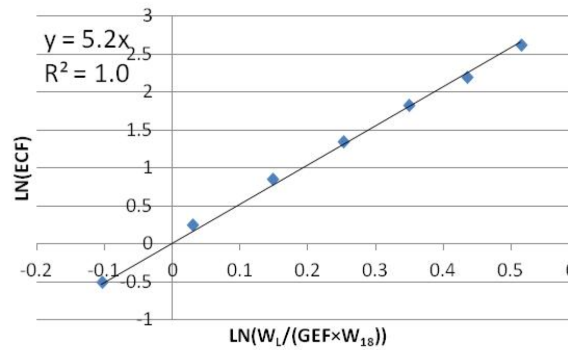
(c) Section 1, tandem axle



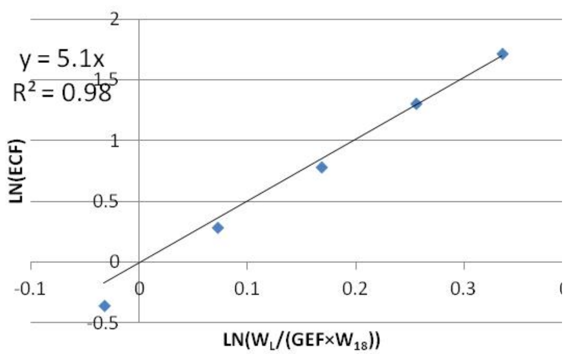
(d) Section 2, tandem axle



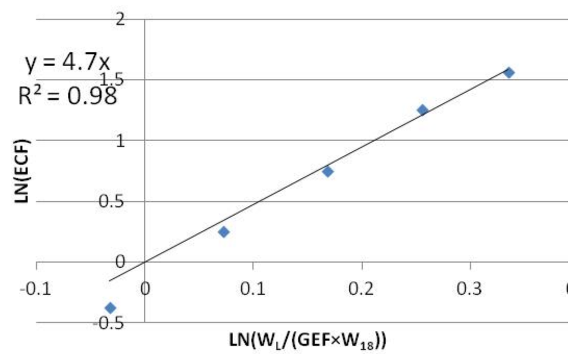
(e) Section 1, tridem axle



(f) Section 2, tridem axle



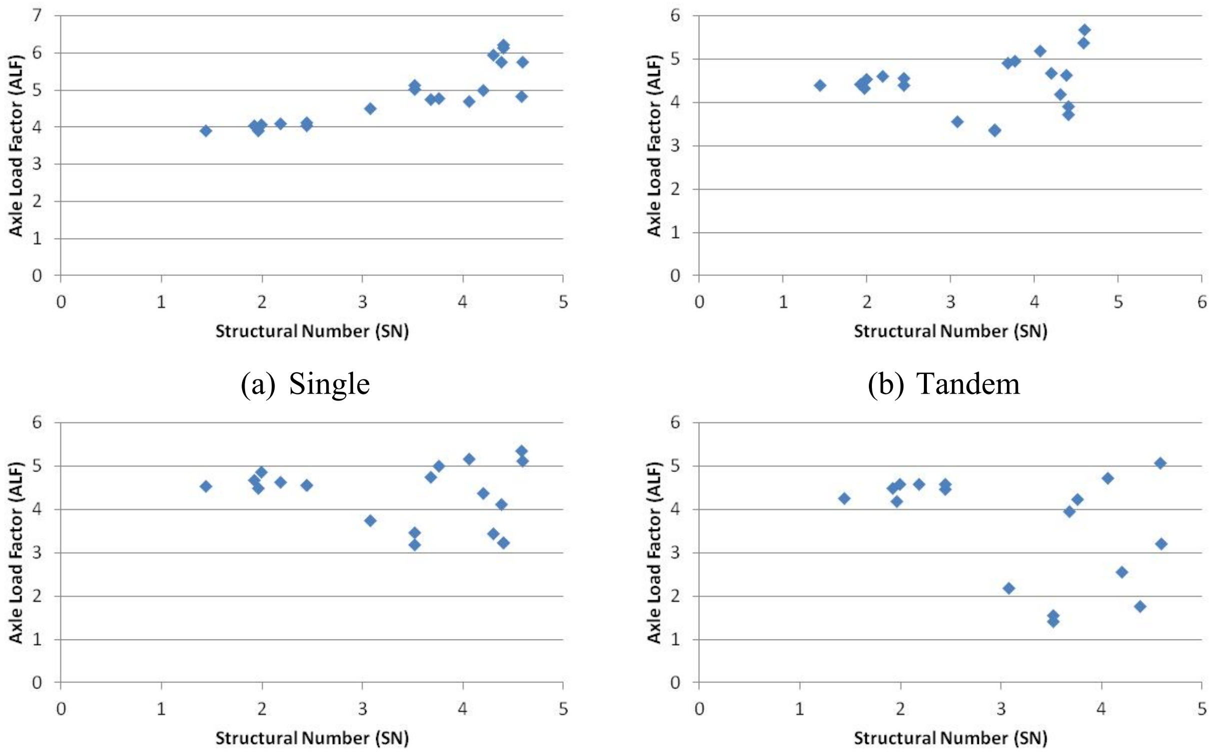
(g) Section 1, quad axle



(h) Section 2, quad axle

Figure 2.7: ECF Based on Fatigue Criterion

A noticeable relationship between the ALF and SN was observed across different axle configurations for the rutting failure mechanism, but the situation was not the same for fatigue cracking. Figure 2.8 illustrates the ALF obtained for single, tandem, tridem, and quad axles using the fatigue cracking failure criterion.



(a) Single (b) Tandem (c) Tridem (d) Quad

Figure 2.8: Relation between ALF and SN Based on Cracking Criterion

Due to the lack of a significant correlation between the ALF and SN in this case, the study team decided to compute an average for each axle configuration included in this study. Following are the average ALFs for single, tandem, tridem, and quad groups:

- Single Axles: 5.2
- Tandem Axles: 4.6
- Tridem Axles: 4.4
- Quad Axles: 3.6

It is interesting to note that there is a noticeable trend in the mean of the ALFs for the different axle groups. In general, the ALF decreases with increasing number of axles per axle group (Figure 2.9). In terms of axle groups, an opposite trend was observed in GEF values where values increased with increasing number of axles in an axle group (Figure 2.9).

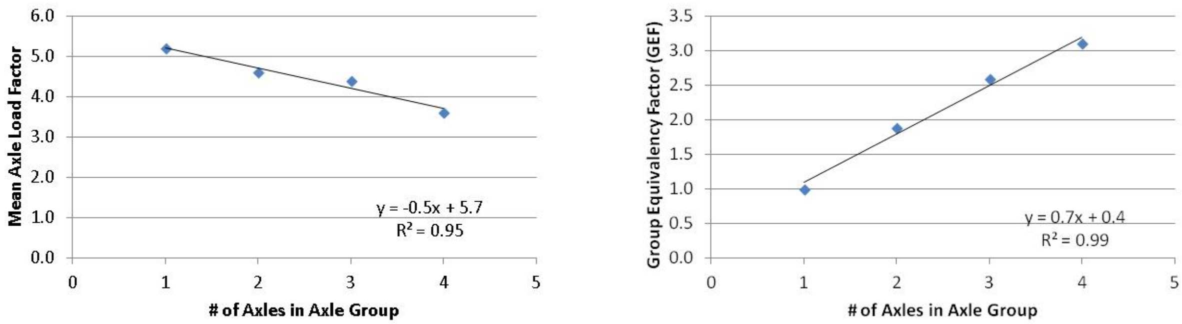


Figure 2.9: Correlation between ALF and SN (left) and GEF and Number of Axles (right)

Using the aforementioned relationships, it is possible to compute the ECF for any given axle load and configuration based on the fatigue cracking criterion. The final expression for computing the ECF is given as Equation 2.8:

$$ln(ECF) = (-0.498n + 5.72) \times ln\left(\frac{W_L}{(0.7n+0.395)\times W_{18}}\right) \tag{2.8}$$

Where

N : Number of axles in axle group

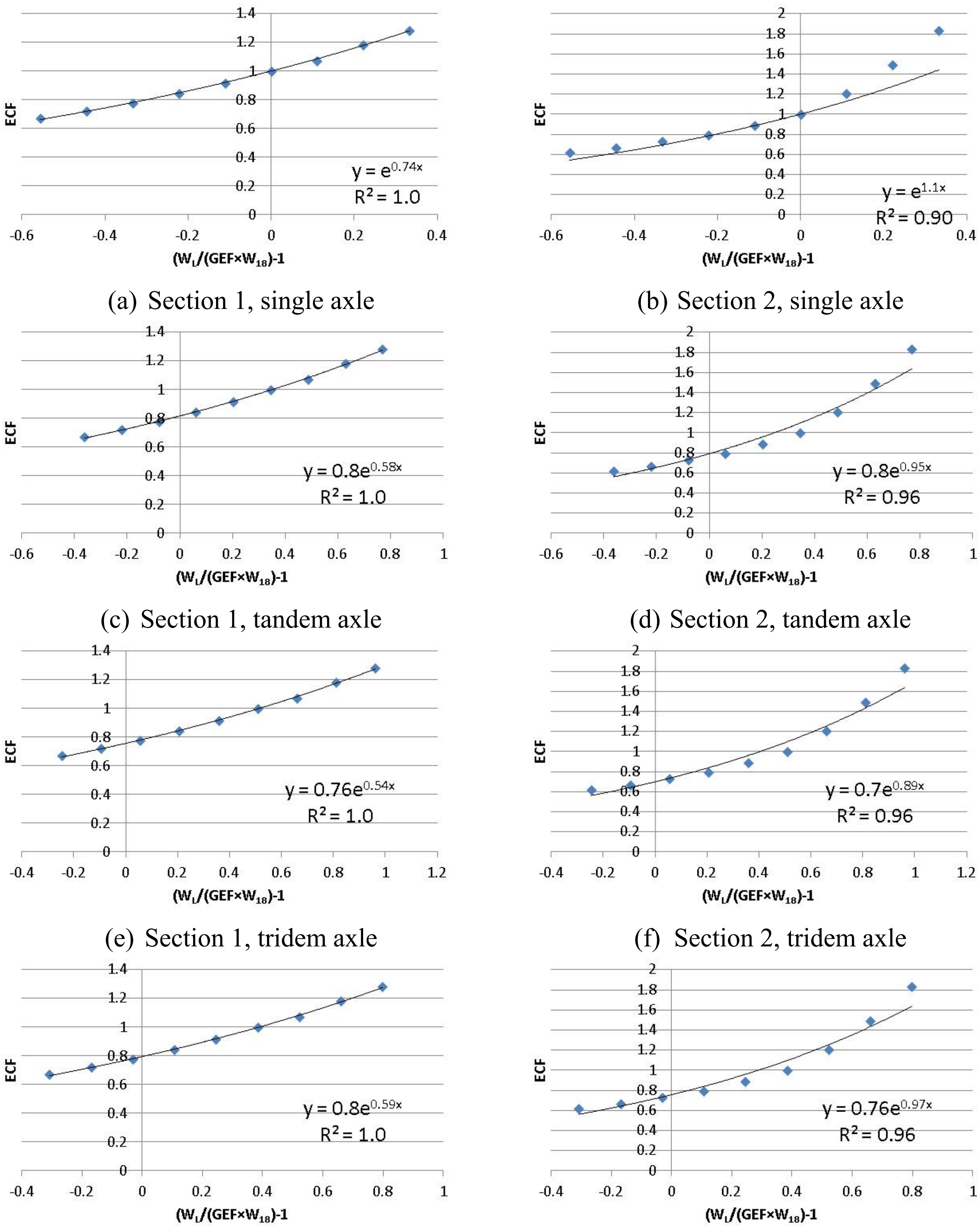
W_L : axle load in kips for any given axle

W_{18} : axle load in kips for the standard axle (18 kips)

Determination of ECF (Roughness)

Determination of the ECF based on roughness was approached differently than that for rutting or fatigue cracking. Initial estimates for the ECF were calculated using Equation 2.8, where the time to failure for a given axle load and configuration was normalized using the time it took for the pavement to fail under the standard 18-kip single axle. Riding quality deteriorates and roughness increases as a result of the increase of one or more primary distresses including rutting, shoving, fatigue, or thermal cracking. DARWin-ME™ employs a transfer function that relates predicted roughness values (in terms of IRI) with other forms of distress using a linear model. Therefore, unlike rutting or fatigue cracking, the ECFs calculated did not follow a power relationship.

After careful investigation of trends in the data, the study team realized that the relationship between the normalized load and the ECF could be approximated by an exponential relationship. Figure 2.10 presents ECFs calculated for single, tandem, tridem, and quad axles for two different sections based on the roughness analysis.



(a) Section 1, single axle (b) Section 2, single axle

(c) Section 1, tandem axle (d) Section 2, tandem axle

(e) Section 1, tridem axle (f) Section 2, tridem axle

(g) Section 1, quad axle (h) Section 1, quad axle

Figure 2.10: ECFs Based on Roughness Criterion

Following is the relationship used to relate the ECFs calculated using the roughness failure criteria with the normalized load (Equation 2.9):

$$\ln(ECF) = ALF \times \left(\frac{W_L}{GEF \times W_{18}} - 1\right) \quad (2.9)$$

It is interesting to note that GEF values obtained using the roughness failure criterion are significantly different from those obtained using rutting or fatigue cracking. Following are the estimated values for tandem, tridem, and quad axles:

- Tandem: 1.57
- Tridem: 2.21
- Quad: 2.41

The study team noticed a strong linear relationship between GEFs and number of axles in the axle group in the case of rutting and fatigue cracking, but the same was not true for GEFs calculated using roughness criteria. In fact, it was noticed that a power law could relate the GEF to the number of axles in the group (see Figure 2.11).

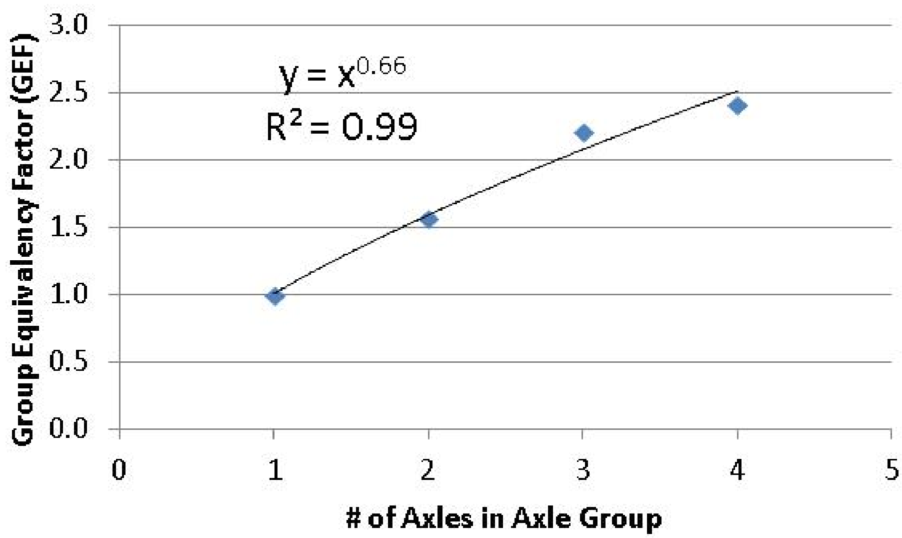
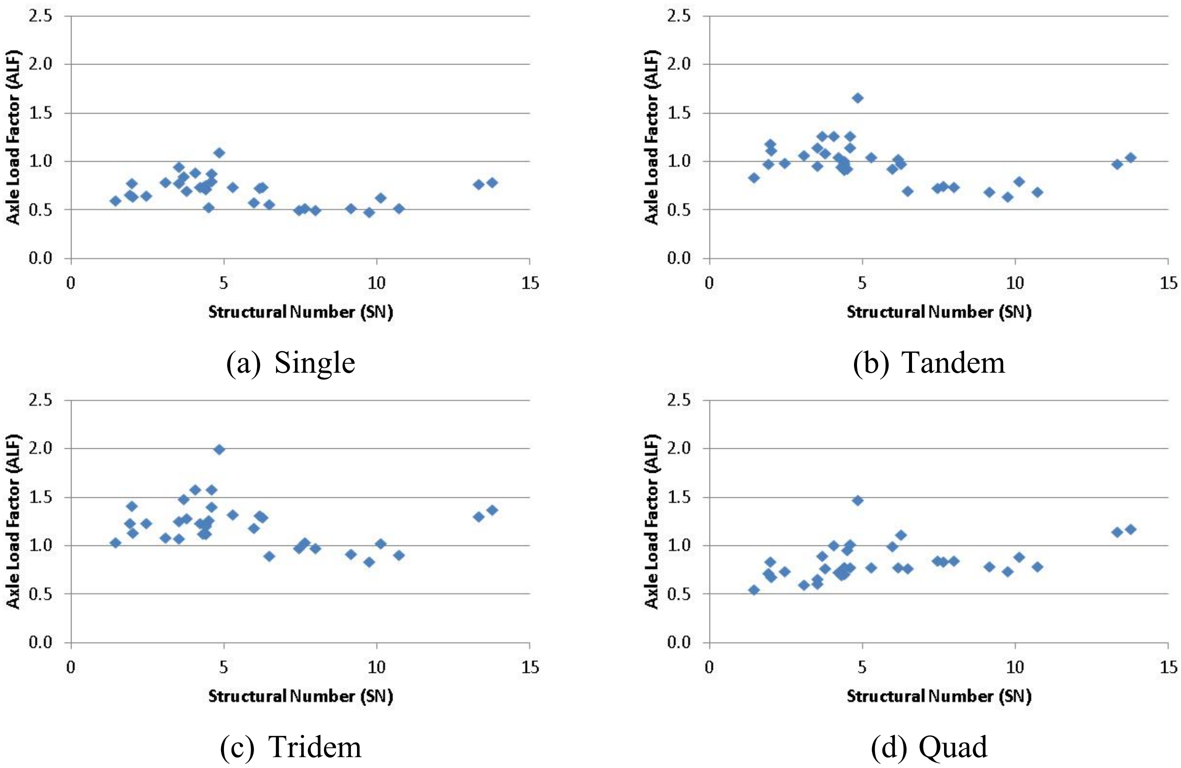


Figure 2.11: Relationship between GEF and Number of Axles Based on Roughness

When evaluating the correlation between ALFs with the bearing capacity of highways in terms of SN, no systematic trends were found. ALFs calculated for different pavement structures are plotted against their respective SN for single, tandem, tridem, and quad axles in Figure 2.12. Following this observation, the study team decided to use sample averages for ALFs for different axle groups.



(a) Single (b) Tandem

(c) Tridem (d) Quad

Figure 2.12: Relation between ALF and SN Based on Roughness

Unlike the case of fatigue cracking, there was no significant trend between the averages of the ALFs for the different axle groups. Following are mean ALFs for the single, tandem, tridem, and quad axles:

- Single: 0.703
- Tandem: 0.962
- Tridem: 0.943
- Quad: 0.931

For this reason, an ALF of 0.703 is proposed for single axles and 0.945 for other axle groups. The final relationship for determining ECFs using roughness is as follows (Equation 2.10a and 2.10b):

$$\ln(ECF) = 0.703 \times \left(\frac{W_L}{GEF \times W_{18}} - 1\right) \text{ for single axles} \quad (2.10a)$$

$$\ln(ECF) = 0.945 \times \left(\frac{W_L}{GEF \times W_{18}} - 1\right) \text{ for tandem, tridem and quads} \quad (2.10b)$$

2.4.5 Methodology for Rigid Pavements

The study team adopted the same procedure for determining ECFs in the case of rigid pavements. However, it is important to note that while the approach remains the same, the distress mechanisms differ. The three primary types of rigid pavements are

- Jointed Plain Concrete Pavement (JPCP)
- Jointed Reinforced Concrete Pavement (JRCP)
- Continuously Reinforced Concrete Pavement (CRCP)

JPCP uses contraction joints to control cracking and does not contain reinforcing steel. Transverse joint spacing is selected so that temperature and moisture stresses do not produce intermediate cracking between joints. This results in spacing no longer than about 20 feet—typically 15 feet. Dowel bars are typically used at transverse joints to assist in load transfer. Tie bars are typically used at longitudinal joints.

JRCP uses contraction joints and reinforced steel to control cracking. Transverse joint spacing is longer than that for JPCP and typically ranges from about 25 to 50 feet. Temperature and moisture stresses are expected to cause cracking between joints. Therefore, reinforcing steel or steel mesh binds these cracks tightly together. Dowel bars are typically used at transverse joints to assist in load transfer, while reinforcing steel or wire mesh assists in load transfer across cracks.

CRCP does not require contraction joints. Transverse cracks are allowed to form but are held tightly together using continuous reinforcing steel. Research shows that the maximum allowable design crack width is about 0.02 inches to protect against spalling and water penetration (CRSI, 2002). During the 1970s and early 1980s, CRCP design thickness was typically about 80 percent of the thickness of JPCP. However, a substantial number of these thinner pavements developed distress sooner than anticipated. Consequently, the current trend is to make CRCP the same thickness as JPCP (FHWA, T 5080.14). Reinforcing steel is assumed to only handle non-load-related stresses, and any structural contribution to resisting loads is ignored.

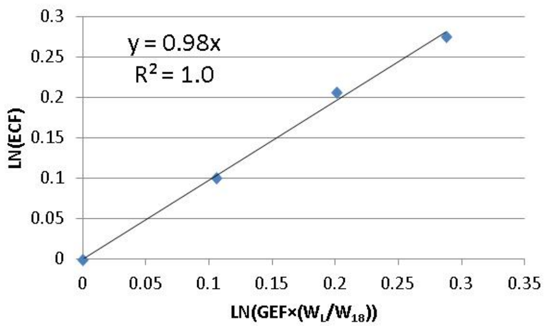
In Texas, the most common type of rigid pavement constructed today is CRCP. The most common distress to this type of pavements is punchouts. Punchouts in CRCP are caused by excessive wheel loading applications and insufficient structural capacity of the CRCP, such as deficient slab thickness (design issue) or sub-base support (design/construction issue). Punchouts are characterized by blocks of concrete connected by transverse and longitudinal cracks that are depressed. Normally, longitudinal steel at the transverse cracks of punchouts ruptures. Punchouts are by far the most serious distress type in CRCP. Roughness also remains a major concern in rigid pavements because it directly relates people's perception of riding quality to pavement performance, as well as to user costs due to increased vehicle operating costs. Therefore, the research team chose the following distress criteria to evaluate ECFs for different axle loads and configurations on rigid pavements:

- 1 punchout/mile at the end of design life (typically 30 years); and
- 120 inches/mile of roughness in IRI at the end of the design life.

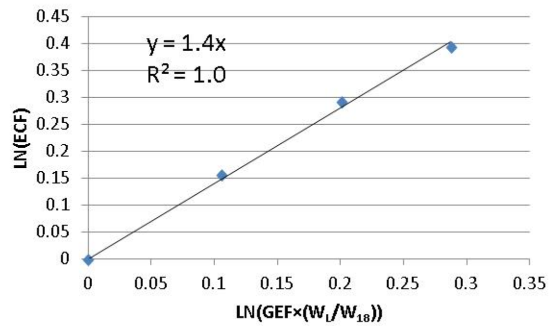
2.5 Results for Rigid Pavements

2.5.1 Determination of ECF (Punchout Criterion)

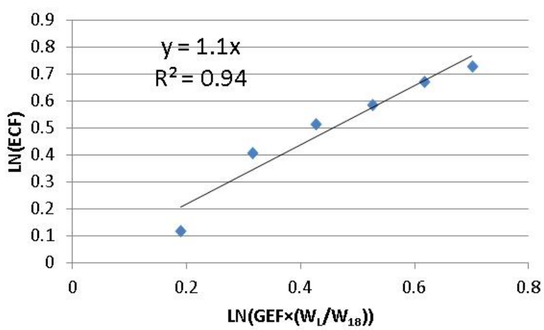
The research team undertook calculation of ECFs for rigid pavements using punchout failure criteria using the same approach as that for flexible pavements in the case of rutting or fatigue cracking. In determining the possible relationship between the ECF and normalized axle load, the team realized that a linear relationship between these two variables—the normalized load and the ECF—exists when transformed to a log-log scale (see Figure 2.13).



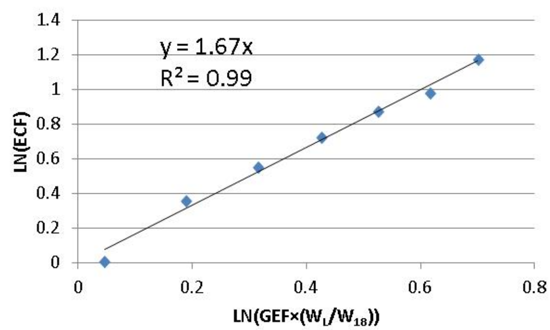
(a) Section 1, single axle



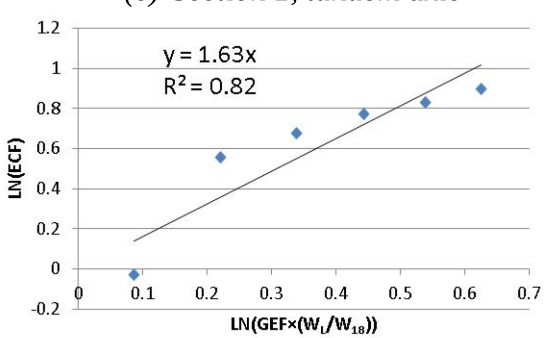
(b) Section 2, single axle



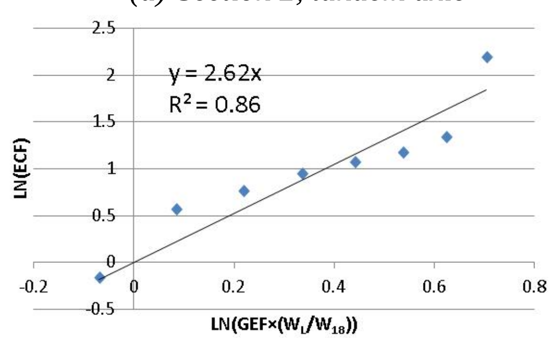
(c) Section 1, tandem axle



(d) Section 2, tandem axle



(e) Section 1, tridem axle



(f) Section 2, tridem axle

Figure 2.13: ECFs Based on Punchout Criterion

Figure 2.13 depicts a linear relationship that captures more than 93 percent of the correlation between the ECF and normalized load in the case of single and tandem axles but only about 84 percent for tridem axles. However, the linear regression between the log of ECF and the normalized load is an adequate representation of the relationship between the two variables. There is still a systematic trend in the slope of the linear relationship: ECFs increase with an increasing number of axles. It is also evident that the slope of the line for any given axle group is different for different pavement sections.

In the next step, the study team investigated the relationship between the ALF and structural capacity of rigid pavement sections. In the case of rigid pavements, the pavement's structural capacity is best represented by slab thickness. Surprisingly, the team discovered that there was little evidence to support a strong correlation between the two variables (see Figure 2.14). Furthermore, differences in the mean ALF between the axle groups were statistically insignificant. This led researchers to compute an average ALF for different axle configurations: **ALF = 3.27.**

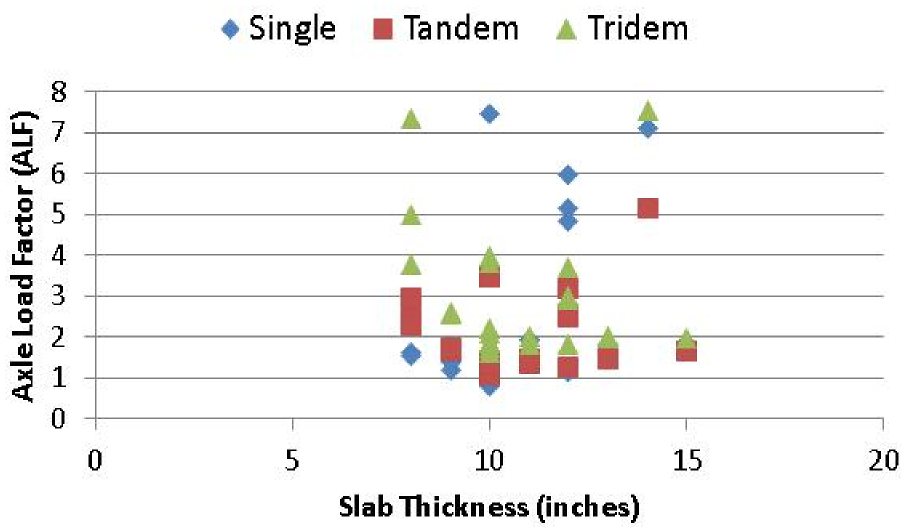


Figure 2.14: Relation between ALF and Slab Thickness Using Punchout Criterion

On the other hand, a noticeable correlation was observed between the calculated GEF for each simulated axle group and number of axles. Figure 2.15 suggests that an exponential relationship can effectively explain the relationship between the GEF and number of axles.

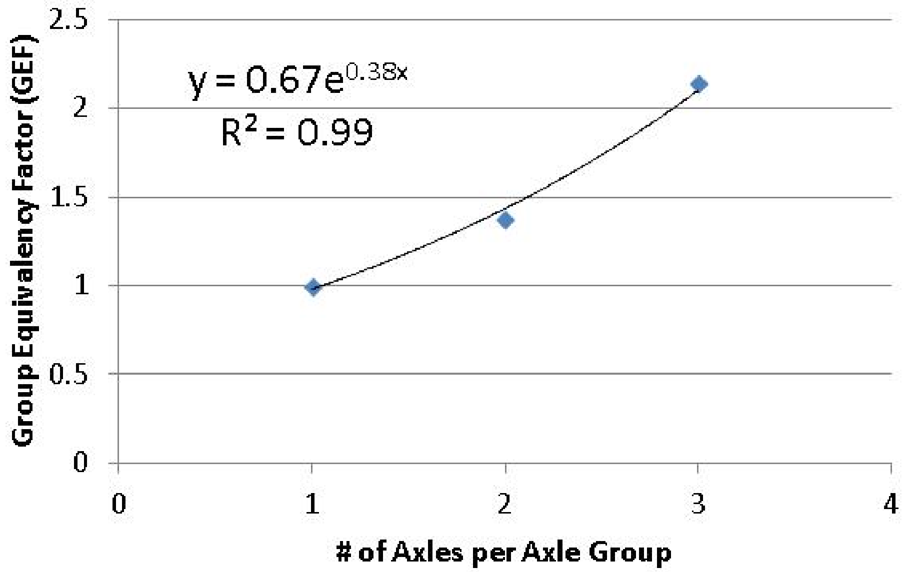


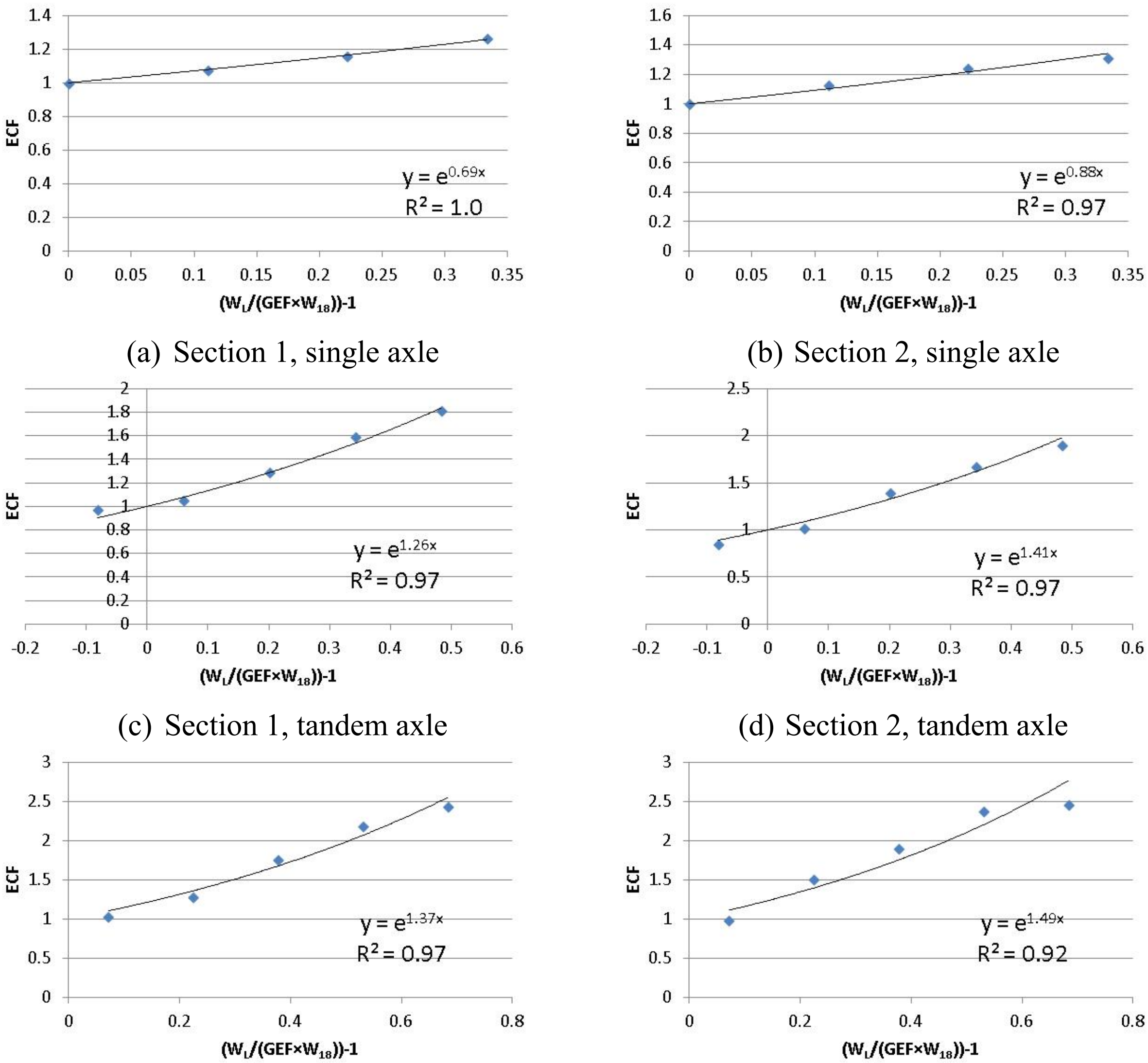
Figure 2.15: Relationship between GEF and Number of Axles (Using Punchout)

Given the overall average ALF and the relationship between the GEF and number of axles per axle group, it is possible to compute the ECF for different axle configurations using the punchout failure criterion. Equation 2.11 provides the final relationship developed for calculating ECFs using the terminal punchout distress value:

$$ln(EDF) = 3.27 \times ln\left(\frac{W_L}{0.67e^{0.381n} \times W_{18}}\right) \tag{2.11}$$

Determination of ECF (Roughness Failure Criteria)

The study team approached determination of the ECF for rigid pavements using the roughness failure criterion by referring to the framework previously adopted for flexible pavements. In the case of CRC pavements, predicted roughness is a function of the number of punchouts per lane mile and local features specific to the section. The team found that the relationship between the normalized load (W_L/W_{18}) and the ECF could be best represented using an exponential relationship (Figure 2.16).



(a) Section 1, single axle

(b) Section 2, single axle

(c) Section 1, tandem axle

(d) Section 2, tandem axle

(e) Section 1, tridem axle

(f) Section 2, tridem axle

Figure 2.16: ECFs Based on Roughness Criterion

Figure 2.16 shows that although there is a strong relationship between these two parameters, the exponents vary considerably. To assess this aspect, the study team evaluated the variability between the different sections in terms of their respective structural capacities, i.e., slab thicknesses in each rigid pavement section. However, the observed data did not suggest a correlation between the exponents and slab thicknesses (see Figure 2.17). The team also noticed that the differences in mean ALF values were no different than those for different axle types. This led researchers to compute a gross average ALF for any given axle configuration equal to 1.46.

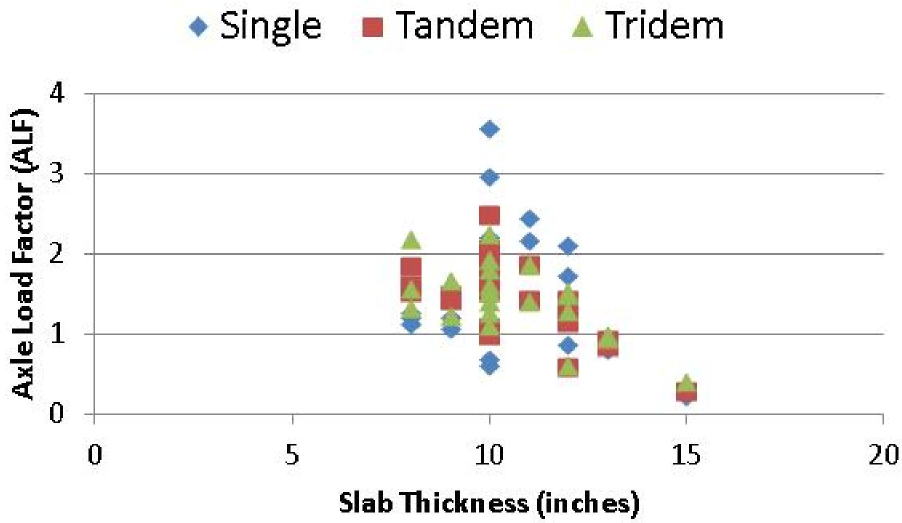


Figure 2.17: ALF vs. Slab Thickness for Rigid Pavements Using Roughness Criterion

A linear relationship between the GEF and number of axles was observed. The study team also noted that GEF values were similar to those computed for flexible pavements using the roughness criterion (see Figure 2.18).

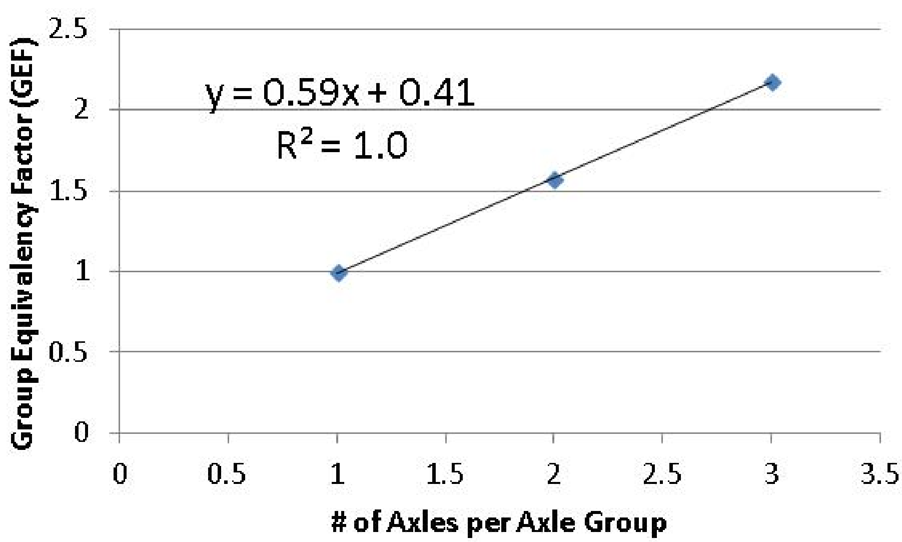


Figure 2.18: Relationship between GEF and Number of Axles (for Roughness)

The final relationship developed for determining ECFs using the roughness failure criterion for rigid pavements follows (Equation 2.12):

$$\ln(ECF) = 1.46\left(\frac{W_L}{(0.4+0.59n)W_{18}} - 1\right) \tag{2.12}$$

2.6 Methodology for Surface Treated Pavements

A surface treatment is characterized by a single application of asphalt binder followed by a single application of cover aggregate; both are placed on a prepared flexible or stabilized base. Two or three such applications are possible. In Texas, surface treatments are used as surface courses in low-volume roads in the form of either one- or multiple-course treatments. One-course surface treatments are rare and typically used for only a short period of time before being covered by another one-course surface treatment or other type of surface course. In the case of multiple treatments, two or three courses of surface treatments are applied to provide a durable surface course. These surface treatments provide an economical pavement surfacing alternative compared to hot-mix asphalt (HMA) concrete. A surface treatment used as a pavement wearing surface must be strong enough to withstand traffic and climate-induced stresses. It must also be durable. Most importantly, it seals the pavement base and foundation, providing a surface that is operational all year long.

In many instances, surface treatments are also used as interlayers, or underseals, between the base and surface courses. Some examples of such applications are cape seals (a combination of an underseal and microsurfacing) and stress-absorbing membrane inter-layers (SAMI). A surface treatment underseal has several functions in a pavement. An underseal can provide a stronger bond between the base and HMA layer, thereby significantly reducing the stresses in the HMA, resulting in a longer fatigue life.

Similar to a surface treatment wearing course, an underseal is a very effective method to protect the base course and foundation of the pavement from moisture. This can significantly extend a pavement's service life. A flexible underseal can also act as a SAMI, reducing reflective cracking in the HMA layer. Because underseals are eventually covered with HMA in Texas, they can be used in highly trafficked pavements.

The application of surface treatment produces a small increase in thickness of the road surface, but it is not intended to provide additional structural capacity to the pavement. Therefore, the base course provides all of the structural strength in such a pavement. Such a pavement structure cannot be effectively used in high traffic volume roadways because the base and sub-base layers cannot provide strength sufficient for the pavement. However, asphalt surface treatments provide a variety of additional benefits: they make the pavement waterproof, provide a skid-resistant wearing surface, and cost less during the pavement's life cycle.

Most rural and farm–to–market (FM) roads in Texas experience relatively low traffic volumes. Each year, construction and maintenance of state-managed road networks require a significant appropriation of state funds. Therefore, effective utilization of these funds is of utmost importance. The use of surface treatments is an appropriate, economical, and reliable technique, particularly for low volume roads.

Most surface treatments are limited to a maximum thickness of one inch. Distresses typically observed with flexible pavements have different significance in the context of chip seals. However, it has been acknowledged that asphalt cement must have a high enough shear stiffness so that it can retain aggregates and stop them from getting dislodged by traffic loads. Similarly, the traditional definition of fatigue or thermal cracking is less evident in the case of chip seals. Under cold weather conditions, there is always the possibility of the asphalt binder can lose its ductile character and become susceptible to fracture. Therefore, fracture resistance in asphalt cement is a desired feature.

Roughness remains a major concern in the case of surface treatments. In fact, surface treatment applications use uniform gradation. Therefore, they do not have an even distribution of particle sizes, resulting in a relatively high macro-texture. In most cases, surface treatments have relatively higher roughness values that contribute to a rougher ride to the common passenger. The distress mechanisms used to determine the ECF for flexible pavements are still relevant when considering surface treatment applications.

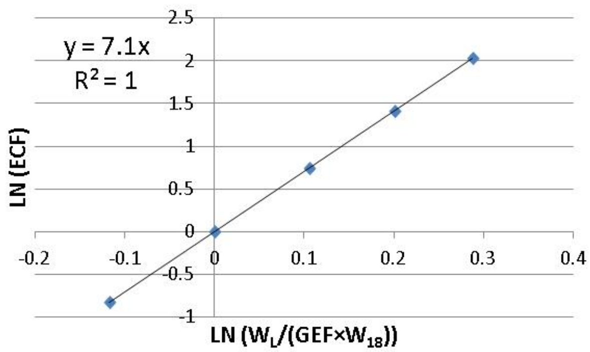
As mentioned in this chapter, load equivalencies are established based on the notions of time or traffic to reach a certain failure criterion. Therefore, the first step to consider involves establishing a set of acceptable failure criteria or terminal service levels. The study team decided on the terminal distress values used as part of this study after considering common practices on pavement design and management. These failure criteria are given here:

- 0.5 inches of rutting (surface deformation);
- 10 percent of the cracked area (load-associated fatigue cracking); and
- 125 inches/mile of roughness in terms of IRI (an initial IRI of 63 inches/mile was used in the analysis).

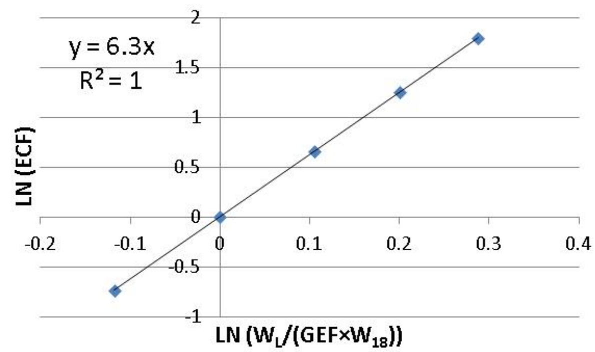
The traffic volumes calculated depend on the distress mechanism being considered due to inherent differences between these failure mechanisms. Once the design traffic volume is determined for each distress type, the next step involves analysis of each pavement structure for a range of axle loads and configurations and the determination of the time to reach each of the aforementioned failure criteria. This ultimately leads to a determination of respective ECFs.

2.6.1 Determination of ECF Using the Rutting Criterion

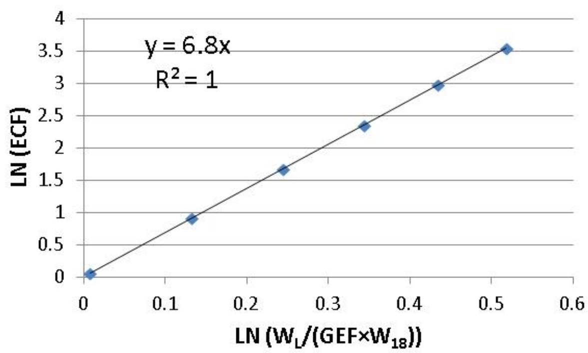
Figure 2.19 depicts the relationship between the ECF and axle load and presents supporting evidence for single, tandem, tridem, and quad axles based on data obtained from single and multiple course surface treatment pavement sections. However, the slope of the line, which represents the ALF, varies among the different sections included in this study.



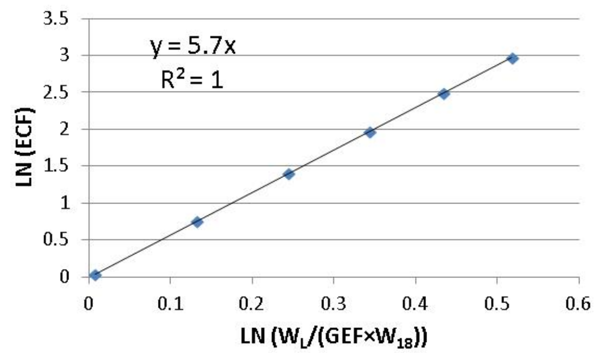
(a) Single Axle (Section A)



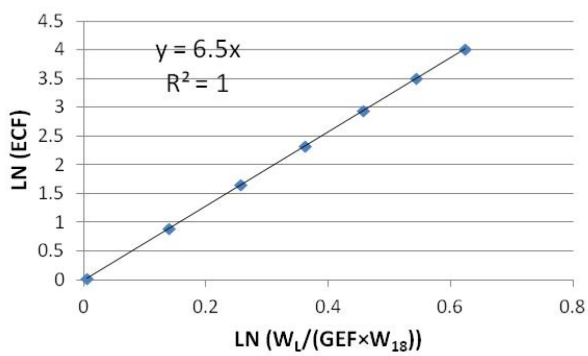
(b) Single Axle (Section B)



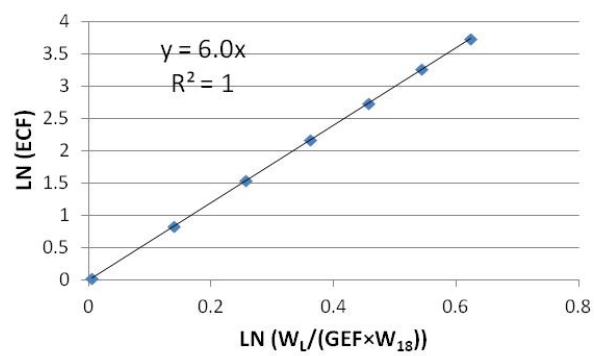
(c) Tandem Axle (Section A)



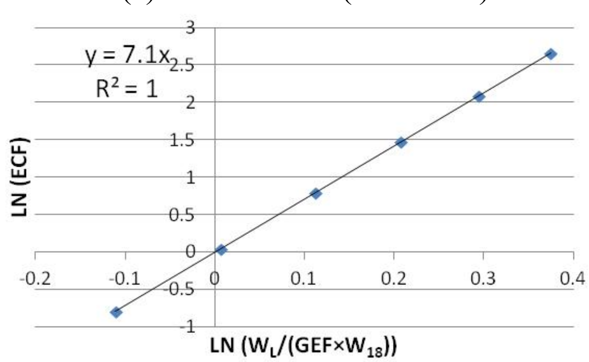
(d) Tandem Axle (Section B)



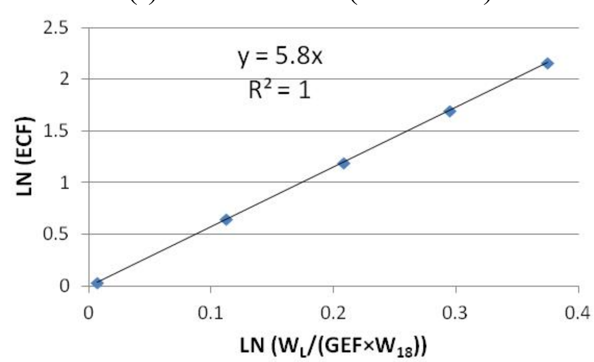
(e) Tridem Axle (Section A)



(f) Tridem Axle (Section B)



(g) Quad Axle (Section A)



(h) Quad Axle (Section B)

Figure 2.19: ECFs Based on Rutting Criterion for Surface Treatments

The following generalized expression was used for calculation of the ECF for any given axle load and configuration while using the rutting failure criteria for surface treatments (Equation 2.13):

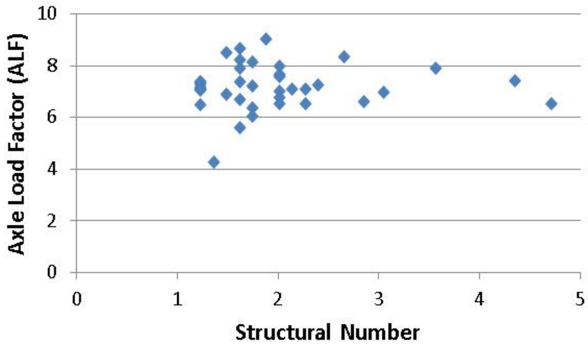
$$ln(EDF) = \alpha \times ln\left(\frac{T_{18}}{T_L}\right) = \alpha \times ln\left(\frac{W_L}{\beta \times W_{18}}\right) \quad (2.13)$$

Where
α = Axle Load Factor (ALF)
β = Group Equivalency Factor (GEF)

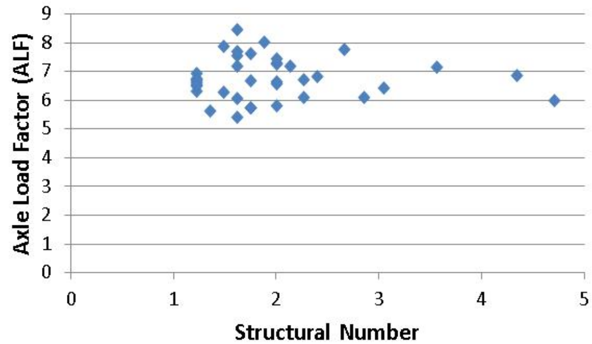
The ALF is almost constant for a given pavement structure and hardly differs between different axle groups (Figure 2.19). Following are GEF values estimated for determining the ECF using the rutting criterion:

- Tandem Axles: 1.65
- Tridem Axles: 2.32
- Quad Axles: 2.98

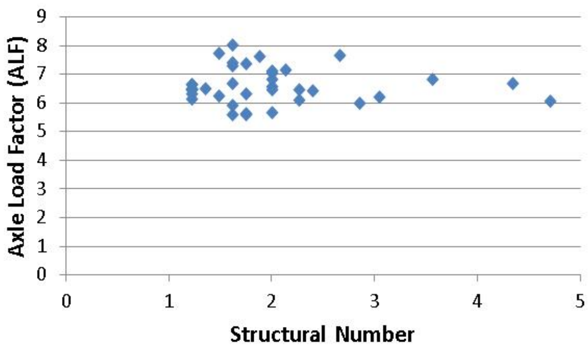
In the case of flexible pavements, the research team observed that the structural number had a significant influence on the computed ALF for different pavement sections. In fact, pavement structure is most sensitive to traffic loads for structural numbers equal or close to 4.0. The team investigated the possibility of a similar relationship in the case of surface treated sections. However, results showed otherwise, as there was not a noticeable trend to suggest the aforementioned finding (see Figure 2.20).



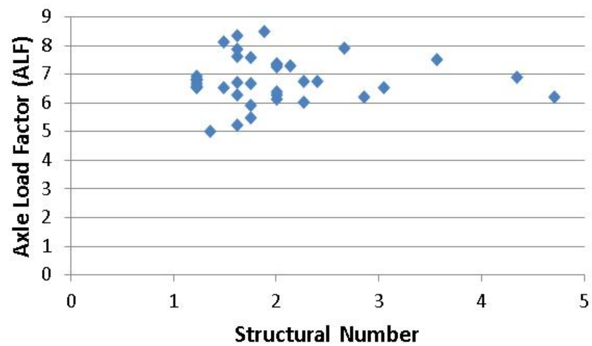
(a) ALF (Single Axles)



(b) ALF (Tandem Axles)



(c) ALF (Tridem Axles)



(d) ALF (Quad Axles)

Figure 2.20: ALFs Calculated Based on the Rutting Criterion for Surface Treated Sections

Following are the mean ALFs calculated for single, tandem, tridem, and quad axles:

- Single: 7.18
- Tandem: 6.75
- Tridem: 6.60
- Quad: 6.80

Furthermore, the mean of the ALF varies little between different axle groups. This encouraged the study team to compute an average ALF of 6.83. The final relationship for determining ECFs for single and multiple course surface treatments using the rutting failure criterion is as follows (Equation 2.14):

$$ln(ECF) = 6.83 \times ln\left(\frac{W_L}{GEF \times W_{18}}\right) \tag{2.14}$$

Determination of ECF Using the Cracking Criterion

Figure 2.21 presents data depicting the relationship between the ALF and axle load for single, tandem, tridem, and quad axles based on data obtained for single and multiple course surface treatment pavement sections.

The following generalized expression was developed to calculate the ECF for any given axle load and configuration using cracking failure criteria (Equation 2.15):

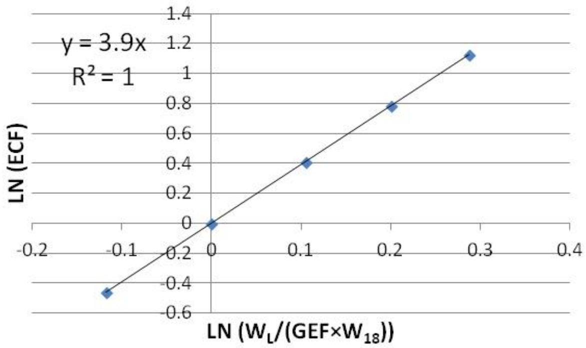
$$ln(EDF) = \alpha \times ln\left(\frac{T_{18}}{T_L}\right) = \alpha \times ln\left(\frac{W_L}{\beta \times W_{18}}\right) \quad (2.15)$$

Where

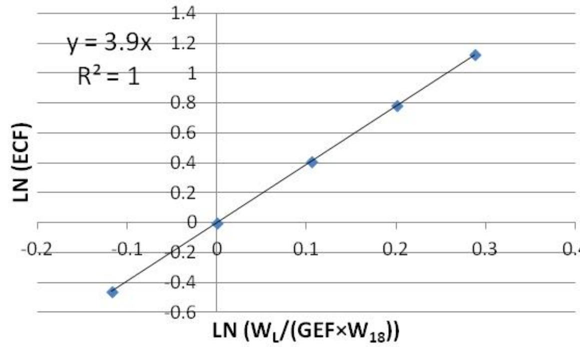
α	:	Axle Load Factor (ALF)
β	:	Group Equivalency Factor (GEF)

Following are the GEF values estimated using the cracking failure criterion:

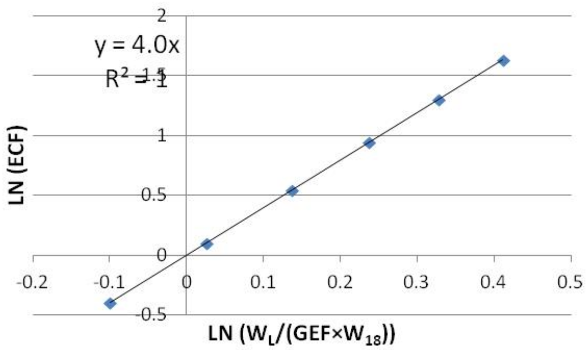
- Tandem Axles: 1.84
- Tridem Axles: 2.51
- Quad Axles: 3.09



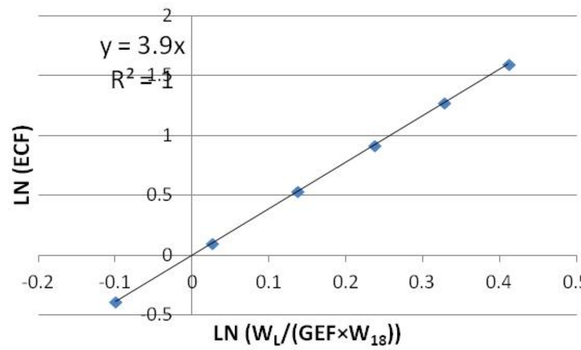
Single Axle (Section A)



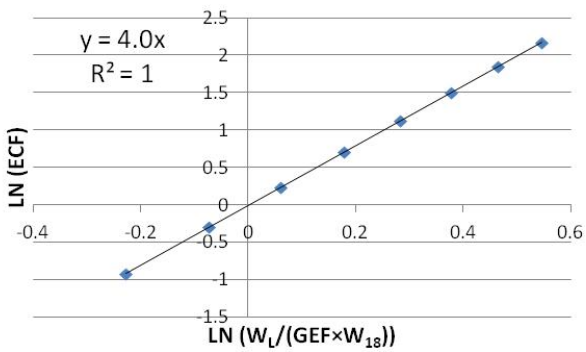
Single Axle (Section B)



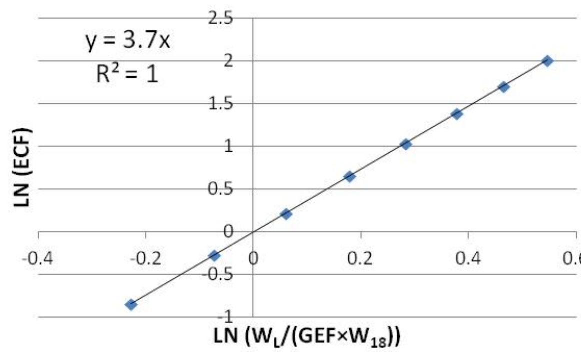
Tandem Axle (Section A)



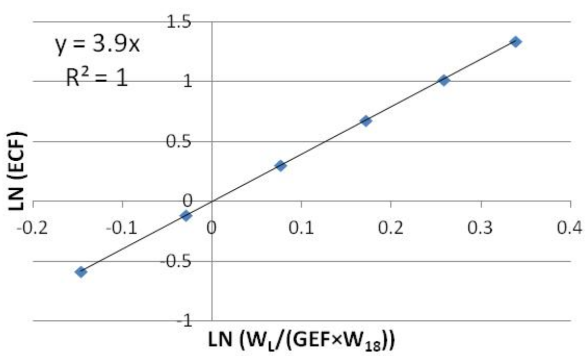
Tandem Axle (Section B)



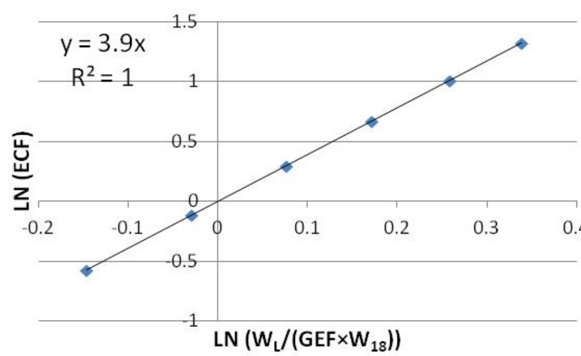
Tridem Axle (Section A)



Tridem Axle (Section B)



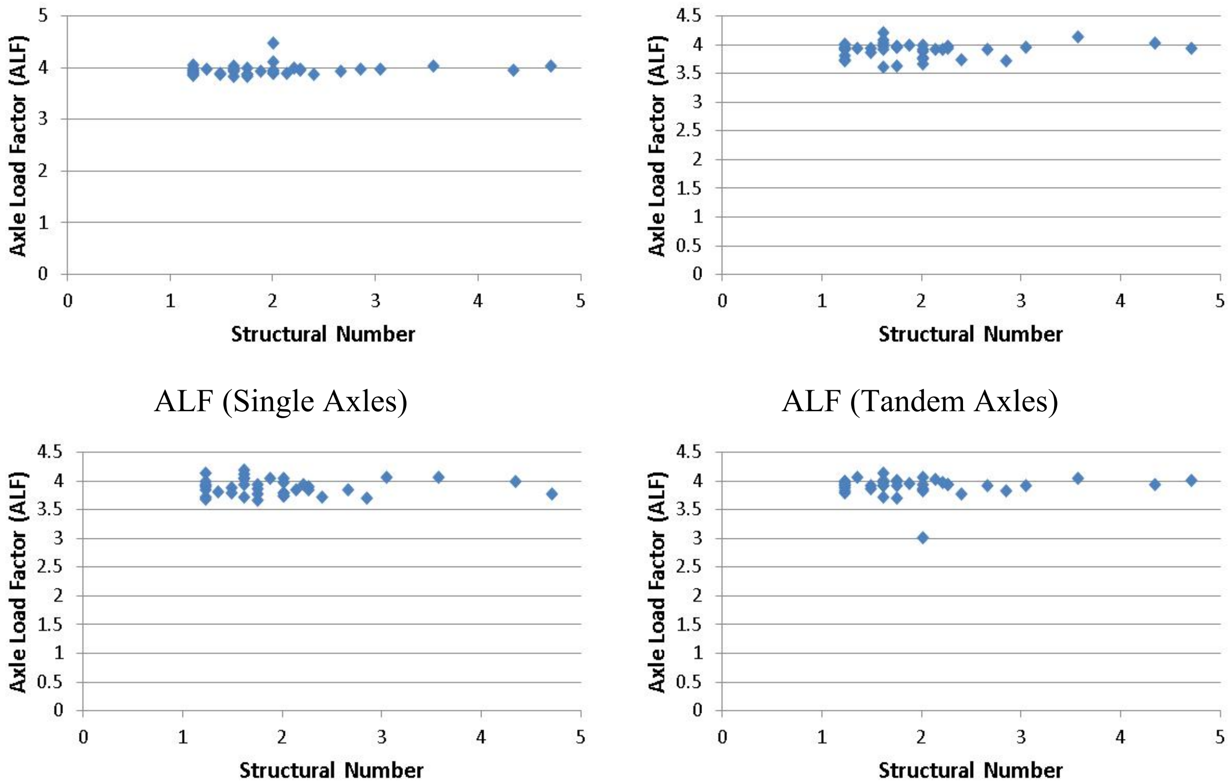
Quad Axle (Section A)



Quad Axle (Section B)

Figure 2.21: ECFs Based on Cracking Criterion for Surface Treatment Sections

The research team investigated the possibility of establishing a relationship between the ALF determined using cracking failure criteria and the structural number for the given section. Results indicated that ALFs were fairly consistent across different sections and largely independent of their respective structural numbers (see Figure 2.22). However, it was interesting to note that the ALF was approximately equal to 4.0, which validated the so-called fourth-power law described earlier in this report.



ALF (Single Axles)

ALF (Tandem Axles)

ALF (Tridem Axles)

ALF (Quad Axles)

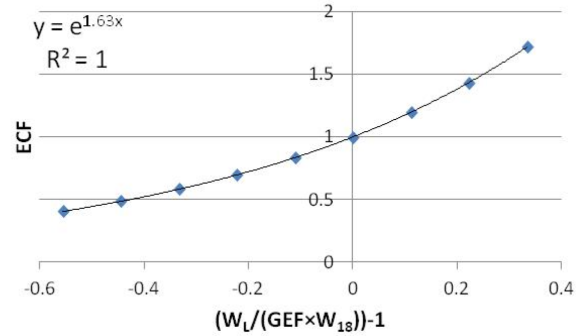
Figure 2.22: ALFs Calculated Using the Cracking Criterion for Surface Treated Sections

The research team therefore decided to use an average ALF of 3.92. The final relationship for determination of ECFs on single and multiple course surface treatments using the cracking failure criterion is given as Equation 2.16:

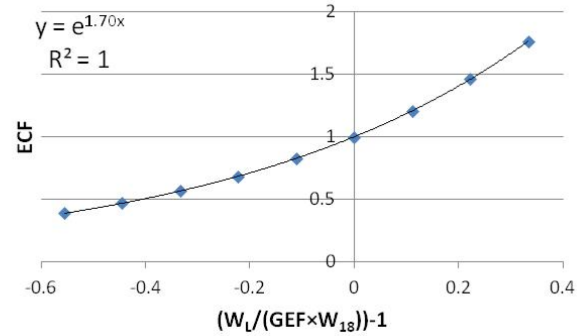
$$ln(EDF) = 3.92 \times ln\left(\frac{W_L}{GEF \times W_{18}}\right) \tag{2.16}$$

Determination of ECF Using the Roughness Failure Criterion

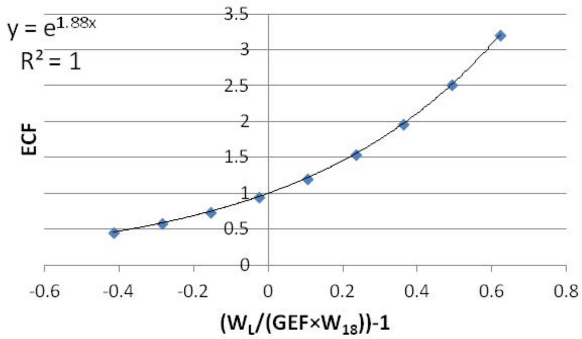
After careful investigation of trends in the data, the research team realized that the relationship between the normalized load and ECF could be approximated by an exponential relationship. Figure 2.23 presents ECFs calculated for single, tandem, tridem, and quad axles for two different surface treated sections.



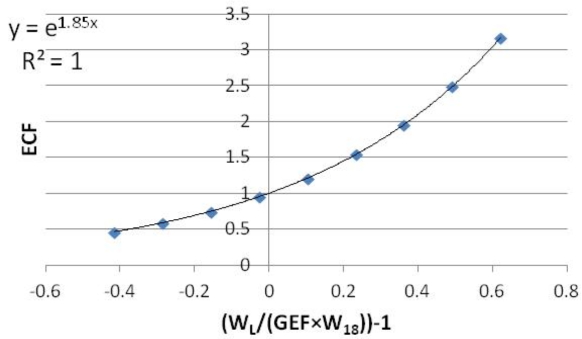
Single Axle (Section A)



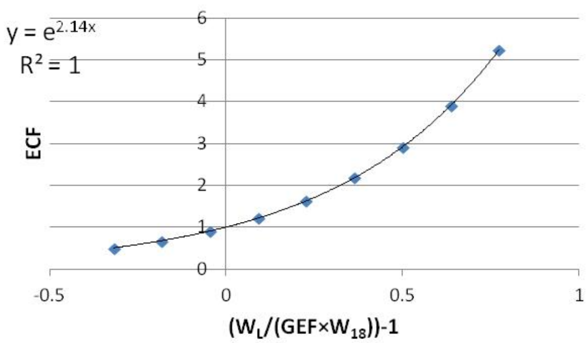
Single Axle (Section B)



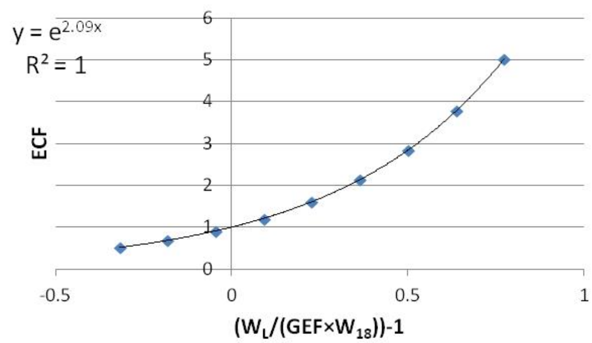
Tandem Axle (Section A)



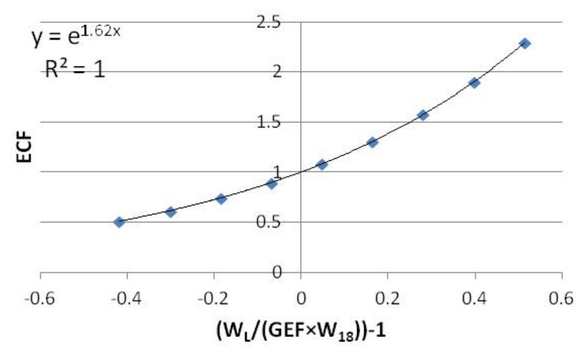
Tandem Axle (Section B)



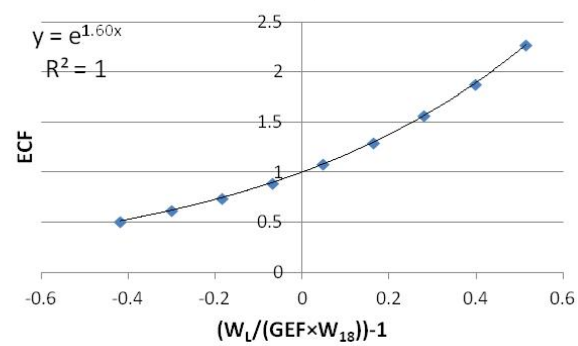
Tridem Axle (Section A)



Tridem Axle (Section B)



Quad Axle (Section A)



Quad Axle (Section B)

Figure 2.23: ECFs Based on Roughness Criterion for Surface Treatment Sections

Following is the relationship developed to estimate ECFs using the roughness failure criteria with a normalized load (Equation 2.17):

$$\ln(ECF) = ALF \times \left(\frac{W_L}{GEF \times W_{18}} - 1\right) \quad (2.17)$$

The estimated GEF values for tandem, tridem, and quad axles are as follows:

- Tandem: 1.71
- Tridem: 2.44
- Quad: 2.86

The study team tried to determine if there was a relationship between the structural number and the ALFs computed using the roughness failure criterion. The team found little evidence to support a relationship between these parameters (see Figure 2.24).

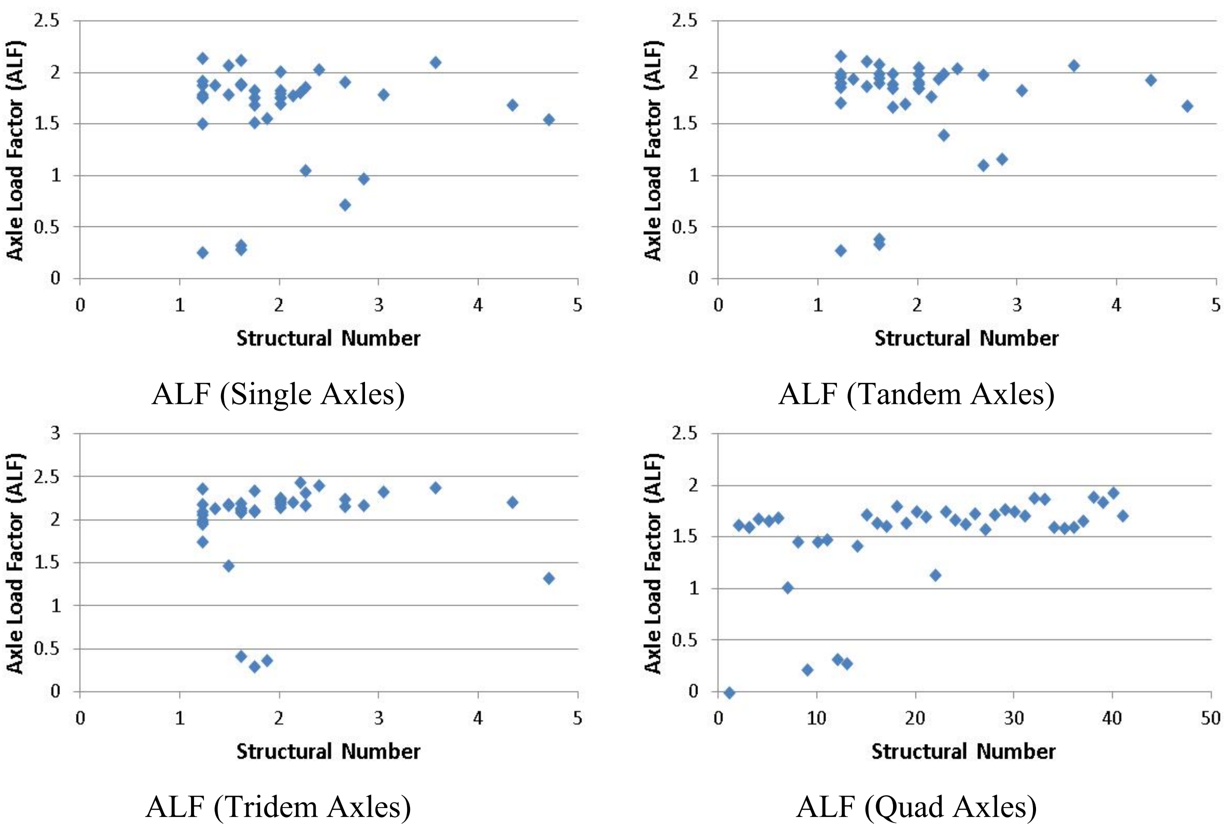


Figure 2.24: ALFs Based on Roughness Criterion for Surface Treatments

Given a negligible relationship between the ALF and structural number, the team decided to use an average ALF of 1.73. Equation 2.17 shows that the ECF is proportional to the ALF. While in the case of flexible pavement sections, the average ALF computed using the roughness criterion was 0.885, the same in the case of surface treated sections is twice as high. This confirms that surface treatments are relatively more sensitive to traffic loads as compared to flexible pavements. The final relationship for determining the ECF using the roughness failure criterion follows (Equation 2.18):

$$\ln(ECF) = 1.73 \times \left(\frac{W_L}{GEF \times W_{18}} - 1\right) \qquad (2.18)$$

2.6.2 Application Example: Flexible Pavements

The preceding sections describe the methodology the research team adopted to determine equivalent consumption factors (ECFs) of different axle loads and configurations. The developed relationship between the ECF and the most significant variables that affect performance were described and presented. By definition, ECFs express pavement consumption due to any axle configuration and load relative to the consumption caused by an 18-kip single axle load.

Because ECFs can be applied to any axle load and configuration, one can compute the load equivalency for a given OS/OW load using any of the three failure criteria evaluated in this study. Following determination of the individual ECFs, one can apply any weighing system that might be most practical and appropriate for a particular region. As an interim measure, an even distribution of weights for each of the three distress mechanisms included in this study was applied. Figures 2.25, 2.26, and 2.27 illustrate ECFs computed for single, tandem, tridem, and quad axles using the rutting, fatigue, cracking, and roughness failure mechanisms for flexible pavements.

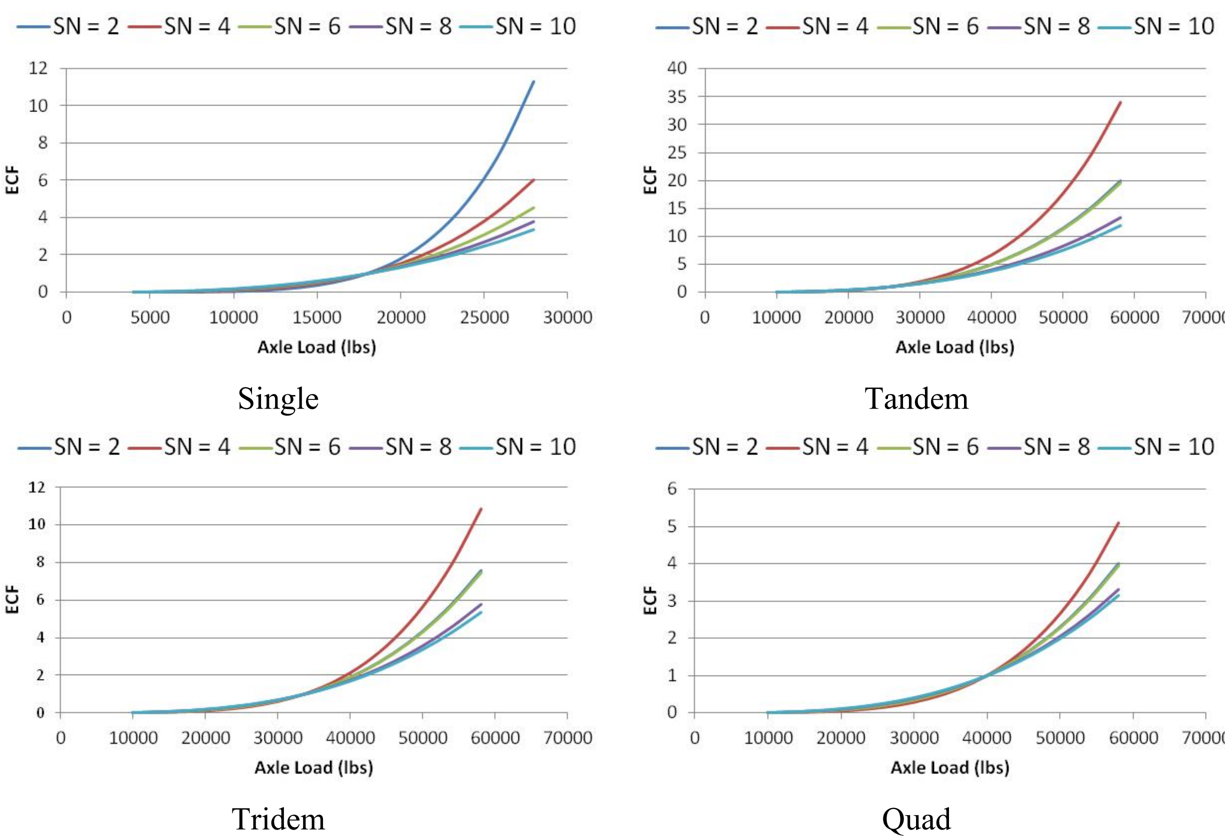


Figure 2.25: ECFs Based on Rutting for Flexible Pavements

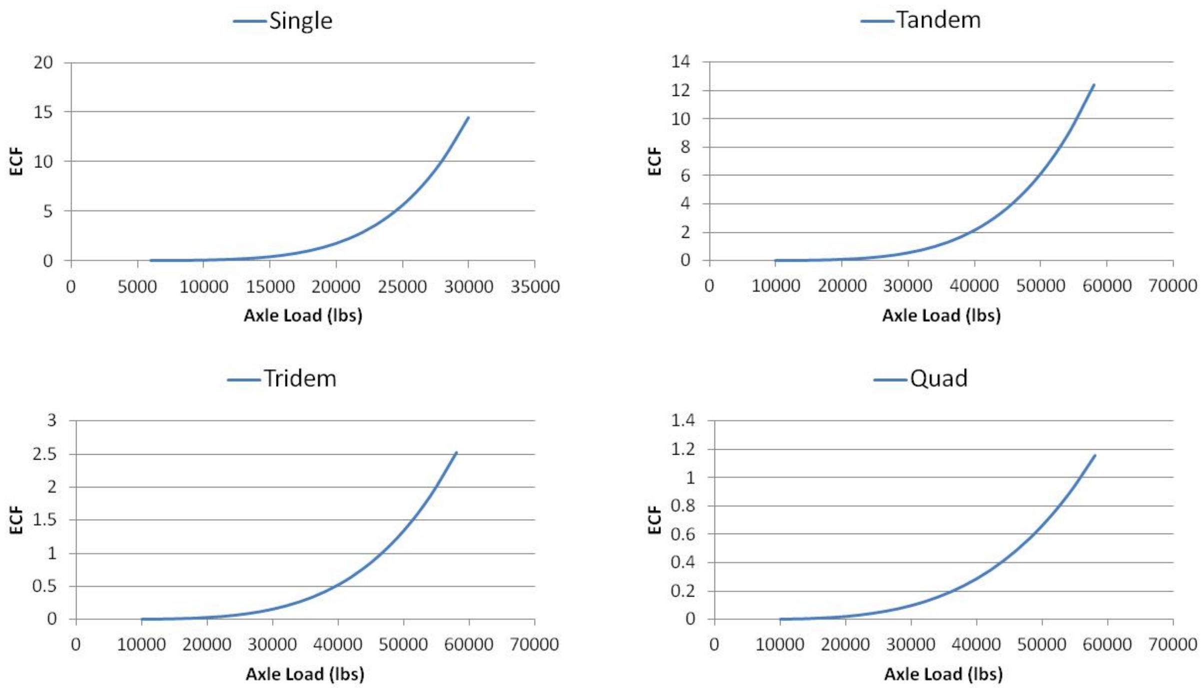


Figure 2.26: ECFs Based on Fatigue Cracking for Flexible Pavements

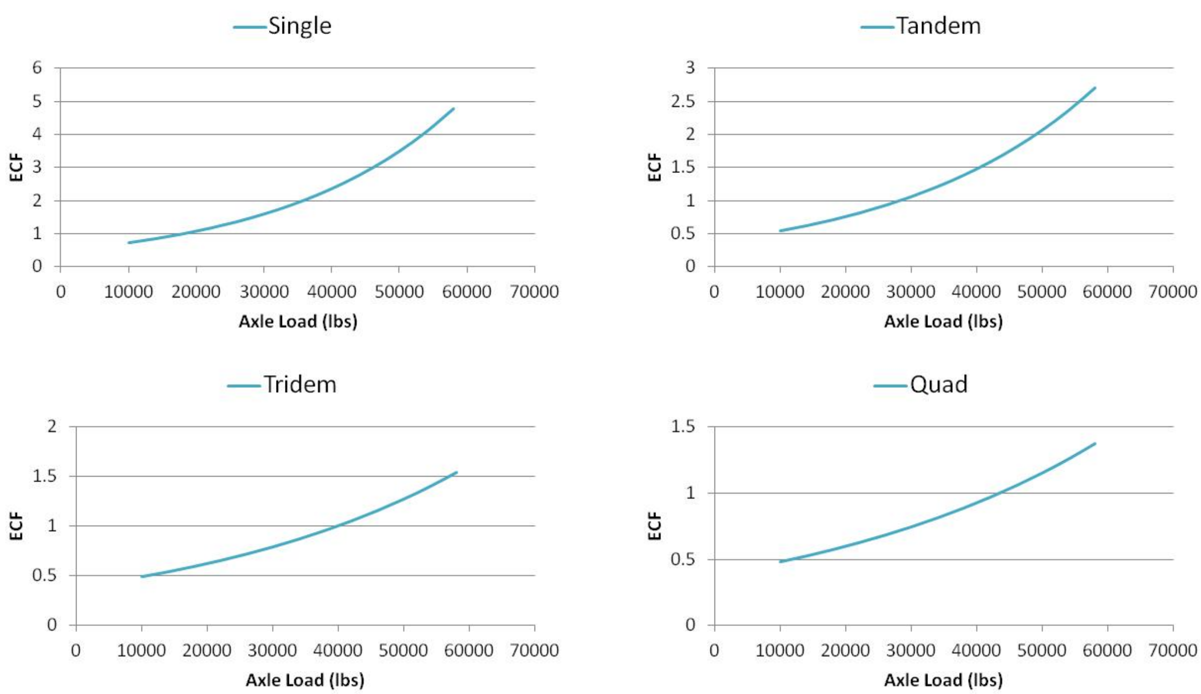


Figure 2.27: ECFs Based on Roughness for Flexible Pavements

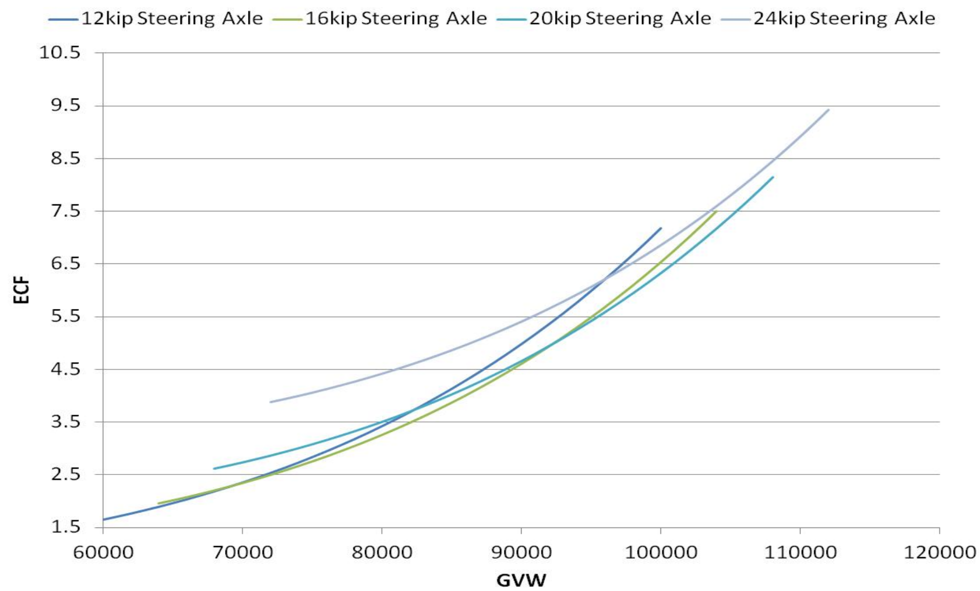
Figures 2.25, 2.26, and 2.27 form the basis for estimating load equivalencies for OS/OW vehicles using a modular approach. For example, a typical 18-wheeler (Class 9, according to the Federal Highway Administration) loaded to 80,000 lbs. with 12,000 lbs. on the steering axle and 34,000 lbs. on each tandem axle would result in ECFs of 6.8, 5.7, and 4.9 on flexible pavement sections with structural numbers of 4, 6, and 10 using rutting failure criteria. However, the corresponding ECF for the same truck computed using fatigue cracking and roughness failure criteria drops to 2.1 and 3.2, respectively. Therefore, if uniform weights are assigned to the three criteria to compute an overall ECF for a Class 9 truck traveling on a facility with SN = 6, the same would have been equal to 3.67. See Table 2.6.

Table 2.6: Gross ECF for a Class 9 Truck Moving 80,000 lbs.

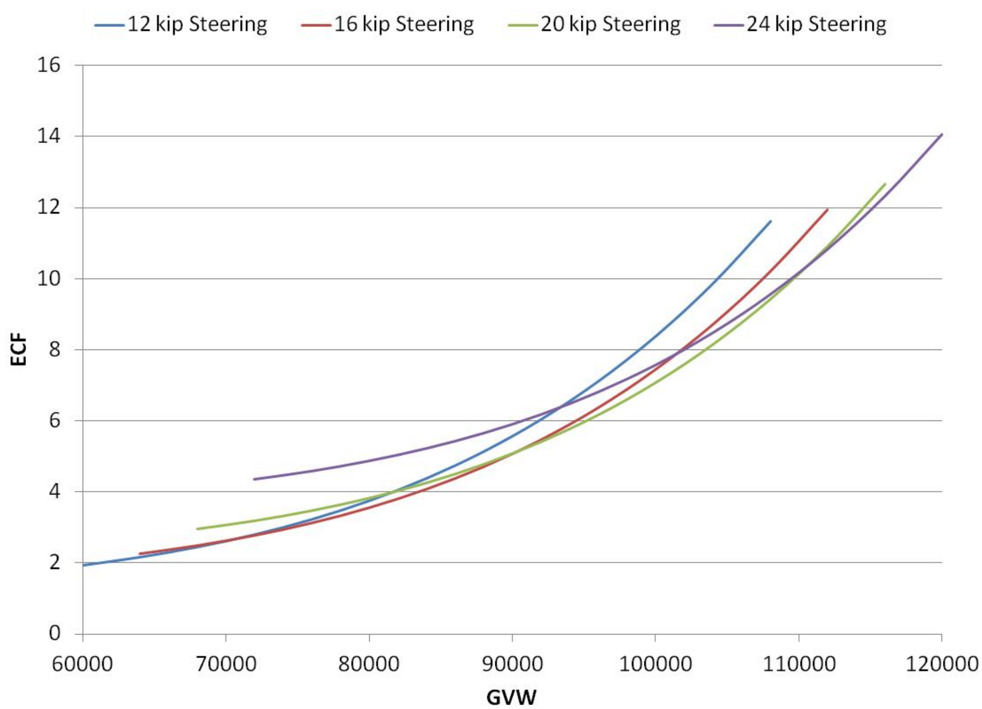
	SN	Single Axle	Tandem Axle	Tandem Axle	Gross ECF
Rutting	4.0	0.19	3.28	3.28	6.75
	6.0	0.25	2.72	2.72	5.70
	10.0	0.33	2.30	2.30	4.93
Cracking		0.12	0.99	0.99	2.11
Roughness		0.79	1.20	1.20	3.19
ECF (Computed using uniform weights) [SN = 6.0]		0.41	1.63	1.63	3.67

Class 9 and Class 11 trucks are both five-axle trucks, but the former has two tandem axles and a steering axle, while the latter has five separate single axles. Therefore, they will have different ECFs, with the Class 9 truck having a lower impact (lower relative consumption) on the pavement structure (see Figure 2.28). This is primarily due to two reasons: (i) the way the GVW is distributed over each of the individual axles, and (ii) the fact that a 34-kip tandem axle will have approximately the same impact as that of the 18-kip single axle (as captured by the GEF concept).

Pavement damage increases as an exponential function of axle weights. Therefore, a higher number of axles reduces the overall ECF for any given vehicle moving the same payload. For example, if a Class 10 truck moves a given load with 12,000 lbs. on the steering axle and 34,000 lbs. on each of the tandem and tridem axles, its ECF is 2.64. Certainly a lower ECF would also imply lower permit costs on grounds of lower impact to the pavement infrastructure.



FHWA Class 9



FHWA Class 11

Figure 2.28: ECFs Calculated for Class 9 and Class 11 on Flexible Pavements

2.6.3 Application Example: Rigid Pavements

Figures 2.29 and 2.30 illustrate ECFs computed for single, tandem, tridem, and quad axles using the punchout and roughness failure criteria in the case of rigid pavements. As pointed out earlier, the research team did not notice a correlation between calculated ECFs and slab thicknesses. The figures shown below provide the same modular architecture adopted previously in the case of flexible pavements. Assuming an equal weight is assigned to each failure mechanism—punchout and roughness—the ECFs for a Class 9 truck loaded to 80,000 lbs. are 5.2 and 3.3, respectively. Just as in the case of flexible pavements, additional axles can also lower the gross ECF of the truck in the case of rigid pavements. A similarly loaded Class 10 truck would have ECFs in the range of 3.5 and 2.8, respectively, when evaluated in terms of punchout and roughness criteria.

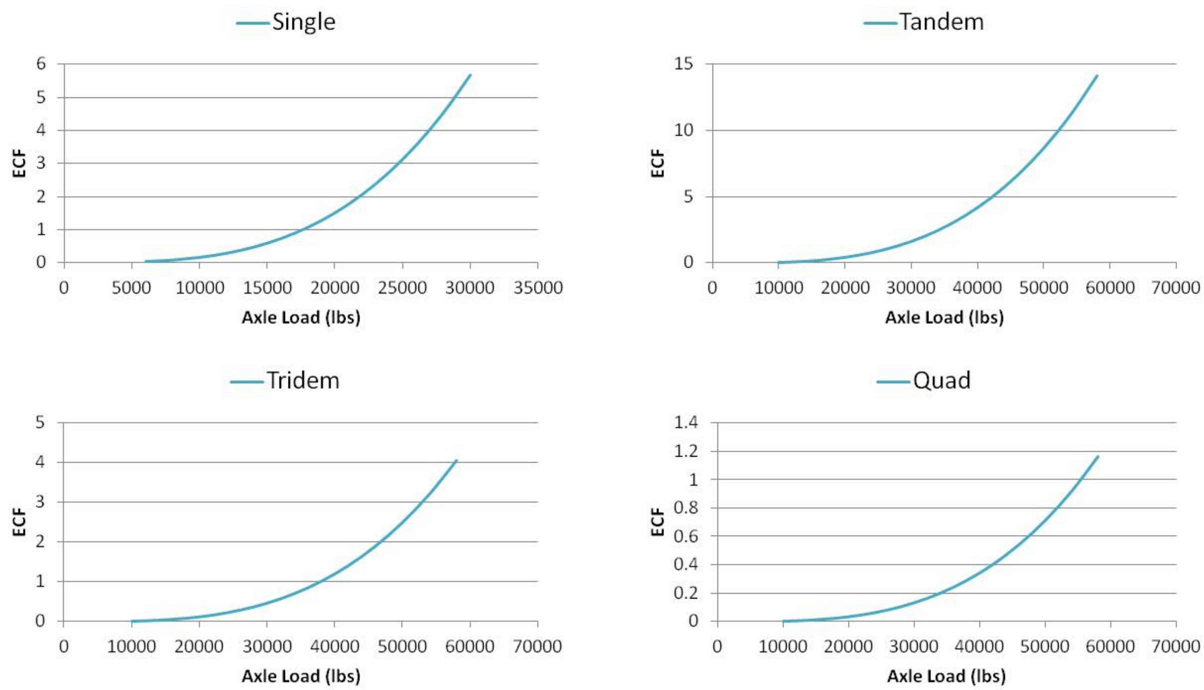


Figure 2.29: ECFs Calculated Using Punchout Failure Criteria for Rigid Pavements

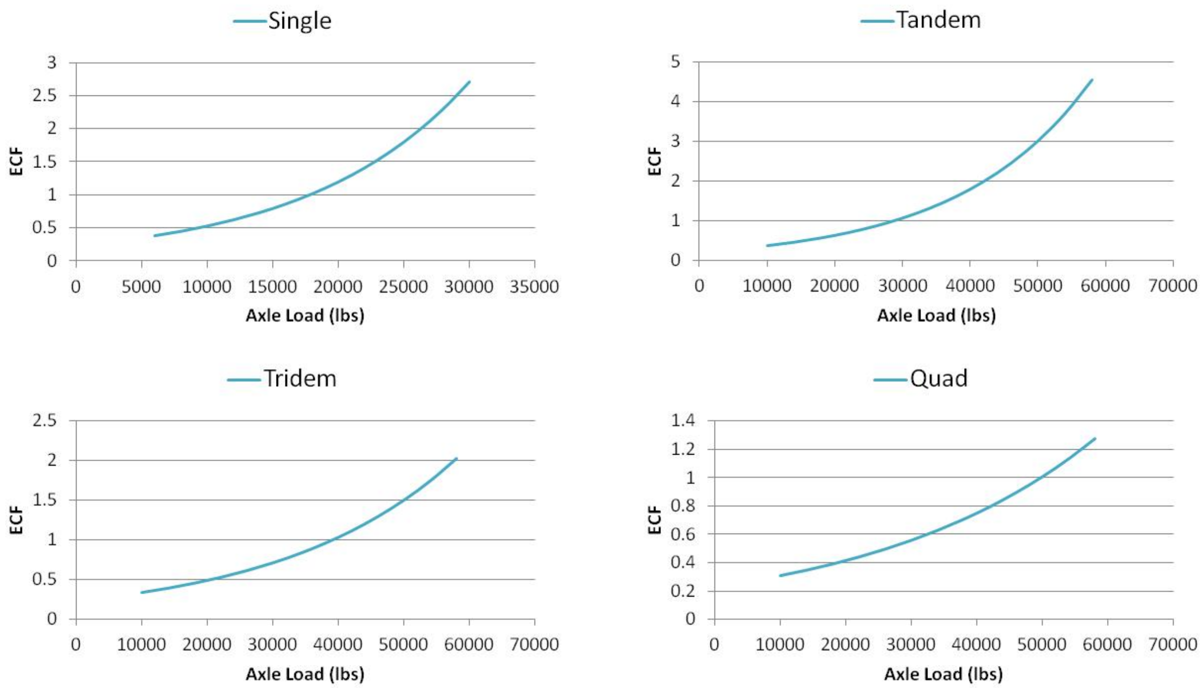


Figure 2.30: ECFs Calculated Using Roughness Failure Criteria for Rigid Pavements

Figure 2.31 depicts ECFs computed for Class 9 and Class 10 trucks and demonstrates benefits associated with an additional axle in the case of the latter. The specific example also illustrates that the ECF approach developed in this study could be used by the industry to determine axle configuration and loads that are friendlier to pavement structure to minimize pavement damage and pavement consumption, resulting in lower OS/OW permit fees.

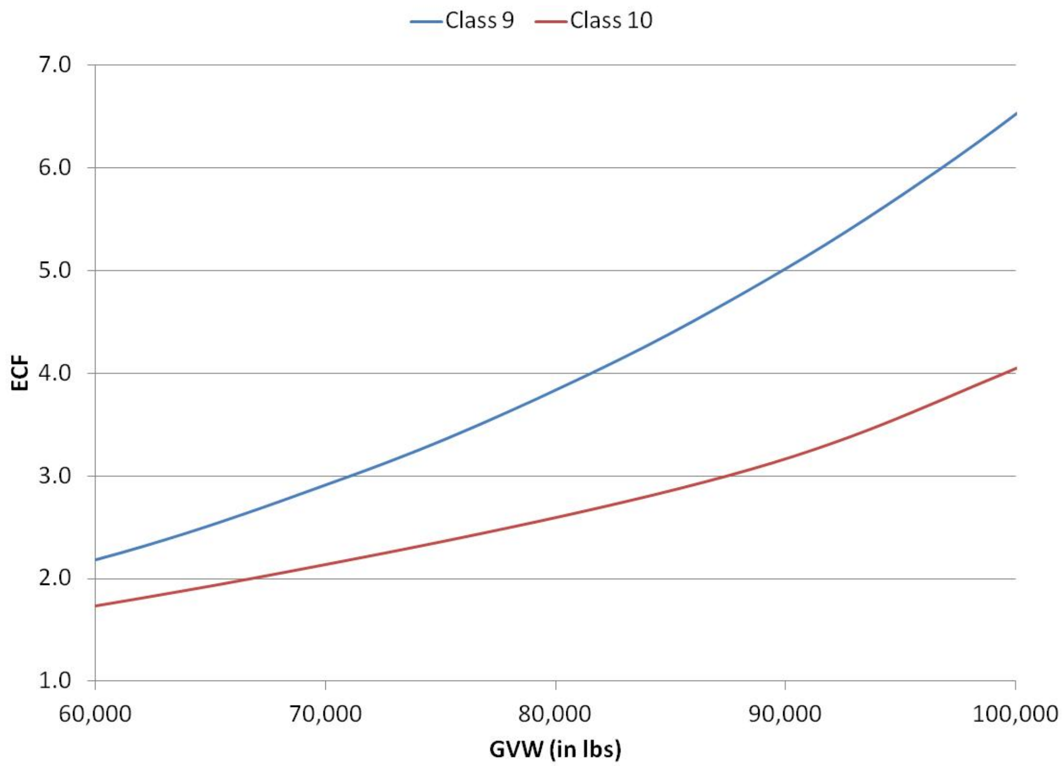


Figure 2.31: ECFs Calculated for FHWA Class 9 and Class 10 Trucks

2.6.4 Application Example: Surface Treated Pavements

Figures 2.32, 2.33, and 2.34 provide a graphic illustration of load equivalencies for single, tandem, tridem, and quad axles loaded to different weights using the three different distress criteria: rutting, cracking, and roughness. As indicated previously, this study emphasizes using a modular approach when calculating load equivalencies for different truck configurations and axle loads. Figures 2.32, 2.33, and 2.34 are useful because they provide individual load equivalencies for different axle loads and configurations. Given that the gross equivalency of a given truck configuration is equivalent to the linear combination of the load equivalencies of individual axles, one can determine its ECF by summing the respective ECFs for the individual axles.

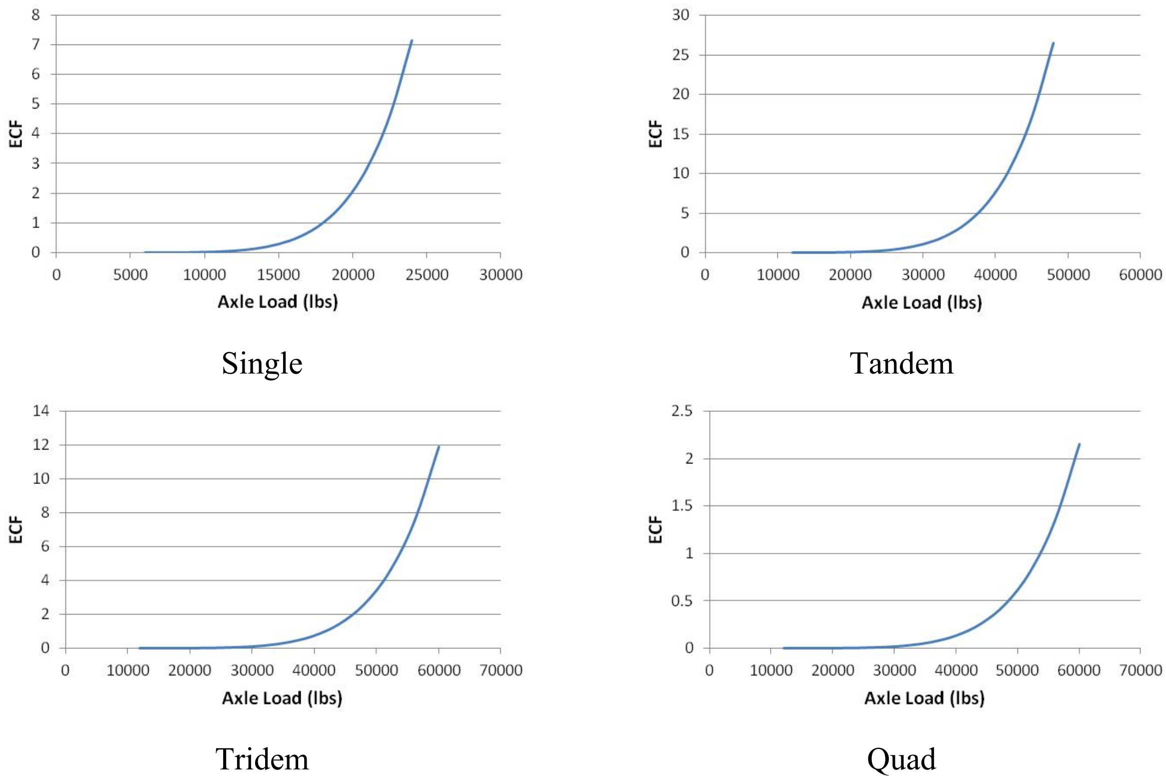


Figure 2.32: ECFs Calculated Using the Rutting Criterion for Surface Treated Pavements

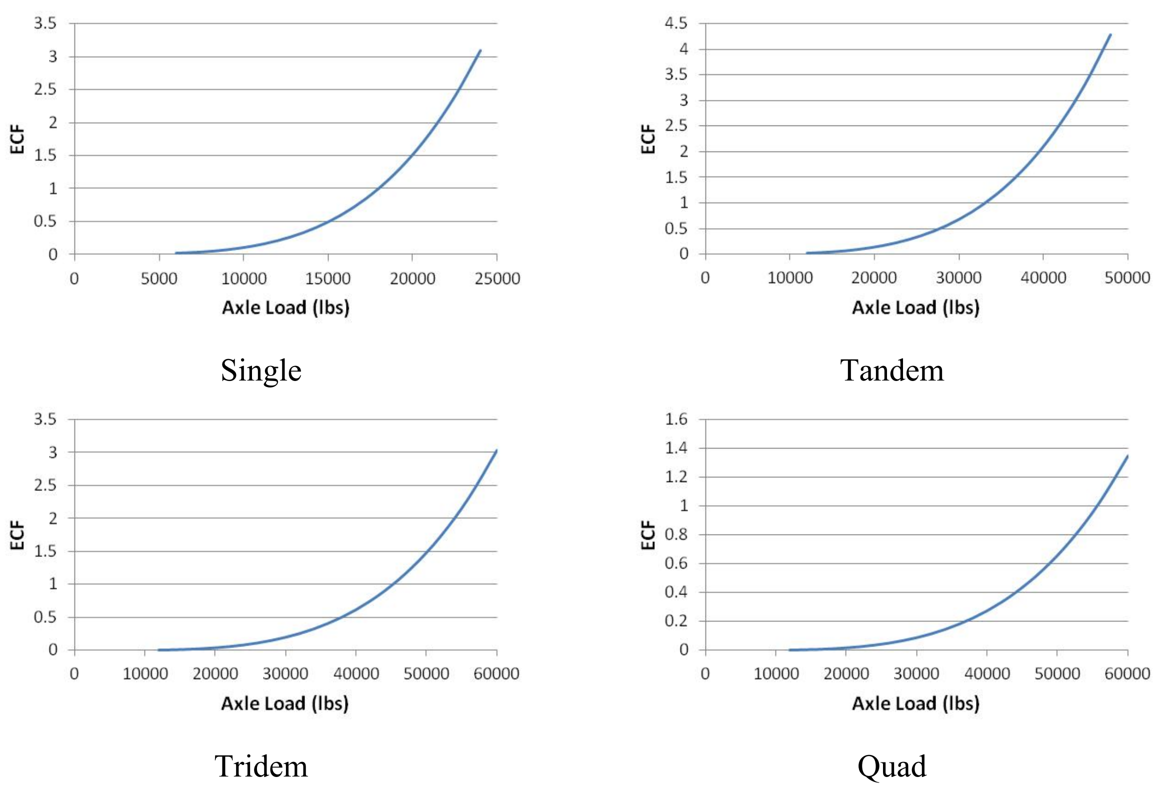
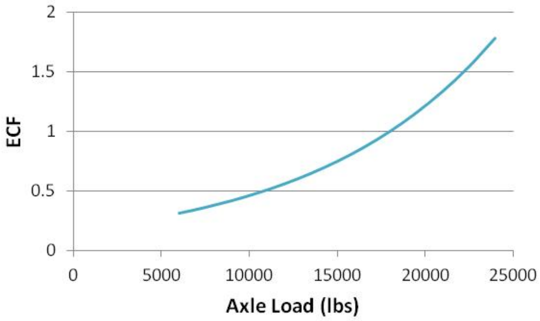
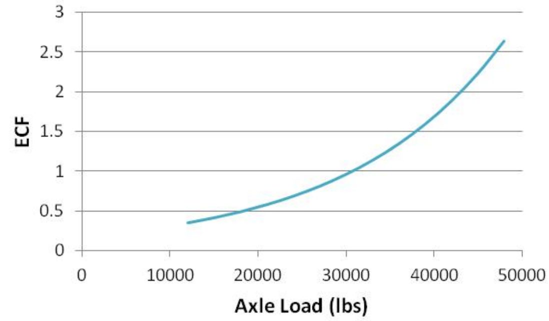


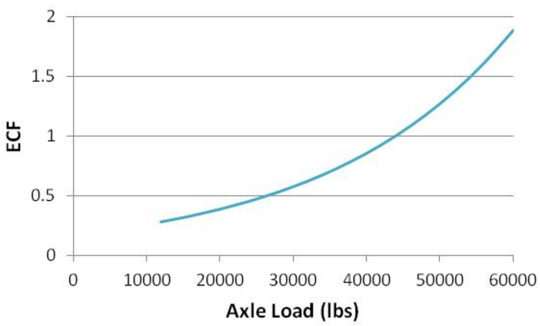
Figure 2.33: ECFs Calculated Using the Cracking Criterion for Surface Treated Pavements



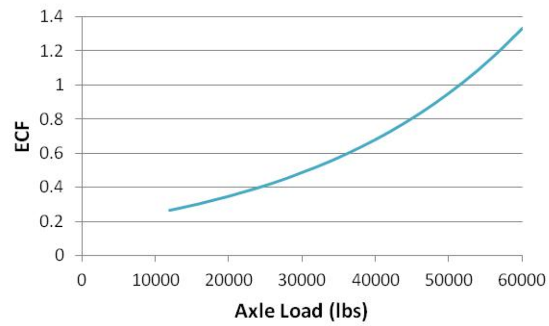
Single



Tandem



Tridem



Quad

Figure 2.34: ECFs Calculated Using the Roughness Criterion for Surface Treated Pavements

Figure 2.35 presents a case study highlighting the benefits associated with higher axle groups by making a comparison between the load equivalencies of Class 9 and Class 11 trucks. Each of the single axles, when loaded to 18 kips, is equivalent to a standard axle. This implies that a Class 10 truck loaded to 90 kips with the GVW evenly distributed over five axles has a gross equivalency of 5.0. In the case of the Class 9 truck, the load equivalency of a tandem axle loaded to 34 kips will vary depending on the distress mechanism considered. Assuming an even distribution of weights for each of the three distress mechanisms, a Class 9 truck loaded to 86 kips will have a gross equivalency of 4.2 (at 90 kips, it will have an ECF of 5.3), provided the tandem axles bear 34 kips each.

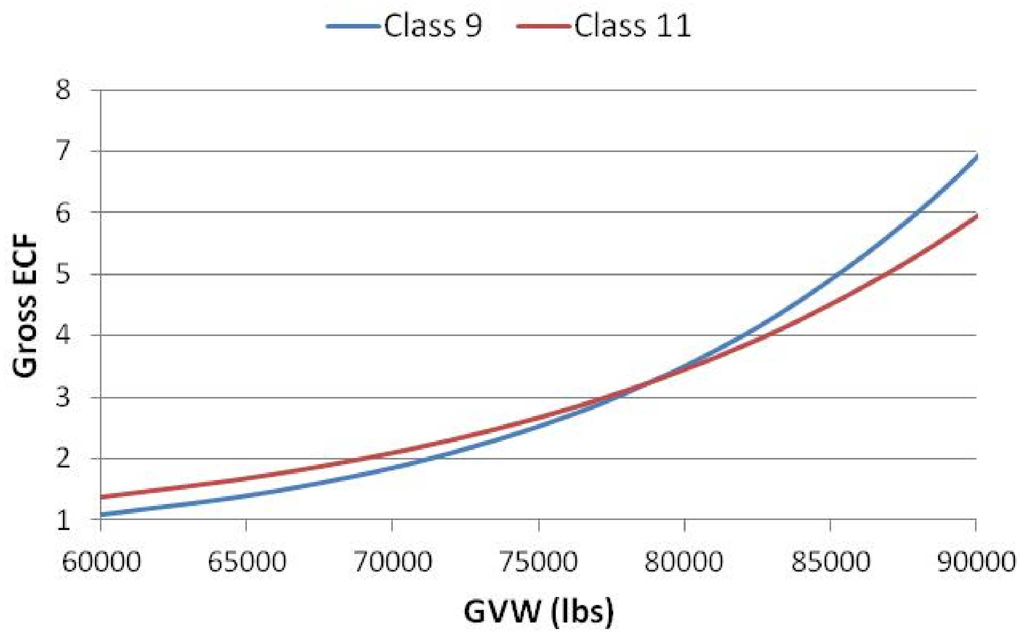


Figure 2.35: ECFs Calculated for FHWA Class 9 and Class 11 Trucks

2.7 Methods of Cost Determination

The Motor Carrier Division (MCD) routinely issues oversize/overweight (OS/OW) permits for movement of loads that exceed regulated size or weight restrictions permitted on the state highway network. In most cases, these permits originate from ports or manufacturing units and terminate at the point of installation or the state line in the case of inter-state shipments. On most occasions, the fee assessed for such permits is primarily an administrative fee to cover establishment costs incurred by TxDOT with some portion allocated to highway maintenance.

During the recent economic downturn, state highway departments have been severely affected and their highway construction and maintenance budgets cut considerably. Therefore, it becomes necessary to look for new revenue streams that could potentially make up for maintenance budget deficits faced by these departments. The addition of a consumption-based permit fee structure for OS/OW permits would help departments make up for lost revenue and at the same time develop a self-sustaining highway maintenance fund.

When developing a permit fee structure based on the aforementioned framework, it is vital to realize the economic benefits the trucking industry brings to this state. Therefore, it is essential to ensure that permit fees assessed to the OS/OW truck fleet are commensurate with the imposed additional infrastructure consumption. The fees assessed for OS/OW permits will likely be a burden to the trucking industry, which in turn will impact its competitive edge over the railroad industry. The volatility in the energy sector coupled with the economic recession has forced the trucking industry to operate at all-time low profit margins. Thus, any additional fees assessed to the trucking sector may have serious consequences, forcing smaller agencies to cease operations. It is no simple task to accurately quantify the economic prosperity that this industry brings to Texas. Therefore, the study team did not consider socio-economic impact as part of this study. The team can only recommend that the permit fee structure suggested be purely based on consumption of the service life of the highway infrastructure by OS/OW truck traffic. No attempts were made to account for specific economic benefits associated with increased axle loads.

Highway construction costs are allocated to road users based on cost allocation studies conducted at the federal and state levels (Luskin et al., 2001). In cost allocation, there are three basic requirements: *marginality*, *completeness,* and *rationality*. *Marginality* refers to the cost allocated to a specific vehicle class that should be sufficient to recover costs incurred by that class. *Rationality* refers to the fact that the apportioned cost for a particular vehicle class should not exceed what it would have otherwise paid had it joined a smaller coalition where it would have operated on a privately owned facility. Finally, *completeness* refers to net highway expenditures, which should be fully recoverable by assigning the costs to each of the participating vehicle classes. There are several approaches for allocating highway construction costs to the responsible parties. Among these, the most widely used methodologies are (i) the Incremental Method, (ii) the Proportional Method, and (iii) the Modified Incremental Method.

Under the **incremental method**, the pavement structure is first built to accommodate the lightest vehicle class and the expenditure incurred is assigned to the specific group. This is followed by the next lightest vehicle class and the resulting increase in thickness is assigned to the specific group and the process continues. However, it is important to note that the structural capacity of a pavement increases exponentially with increasing thickness of the pavement structure. Therefore, allocated costs depend on the order in which vehicle classes are added. It is also interesting to note that the definition of "lightest vehicle class" can often be subjective. A specific vehicle class might have the highest GVW but at the same time use more axles to distribute the load to the pavement structure. Pavement distresses are determined by the axle weights that are loaded on a specific structure and not by overall vehicle weight. Thus, the vehicle class with the heaviest GVW may not be as detrimental to the pavement structure compared to one with a larger number of heavier axles.

The **proportional method** allocates highway costs based on certain vehicular characteristics, including Equivalent Single Axle Load (ESAL), Vehicle Miles Traveled (VMT), Passenger Car Equivalent (PCE), etc. The selection of cost allocators plays an important role in the proportional method. For example, highway construction costs or costs resulting from load-related damage should use ESAL or GVW as the allocator. On the other hand, costs that can be attributed to capacity increase should use other relevant parameters, such as PCE.

The **modified incremental method** starts by allocating highway costs that can be attributed to certain specific vehicle classes. Once all such costs are accounted for, in the following step, highway costs attributable to a coalition of two or more vehicles classes are identified and apportioned based on some measure of proportionality like Vehicle Miles Traveled (VMT), etc.

As part of this study, the research team adopted a modified version of the proportional method in determining permit fees that could be charged to the OW truck fleet. Because the focus of this study is primarily geared towards overweight permits, it is therefore understood that the most appropriate allocator would be related to the concept of ESAL, as it takes into account the weight characteristics of individual axles which in turn determine the consumption of service lives of highway facilities.

2.7.1 Cost Determination Scenarios

According to the proportional method, highway construction costs are allocated based on a measure of the damage imposed by individual OW truck classes to the pavement or, as defined in this study, by pavement consumption. The methodology suggests redesigning the pavement structure so it is sufficient to accommodate additional OW truck traffic while ensuring the same terminal condition.

This implies increasing the structural capacity of the pavement structure, which could be achieved in several different ways, including increased thickness of the main structural course or improved material quality. Given that it is a design problem, there may be several ways to increase structural capacity: increasing the thickness of the asphalt concrete, increasing the thickness of the base, blending the natural subgrade with higher quality material, or even stabilizing the base or subgrade. The design choice made as part of this study consists of increasing the thickness of the primary structural layer. In the case of flexible pavements, this implied increasing the thickness of the surface course or one of the underlying layers in situations where the surface course had a different function other than providing structural support. On other occasions, like in the case of rigid pavements, the same objective was addressed though increased slab thickness. As for surface treated sections, an increase in the thickness of the base course was considered to accommodate additional OW truck traffic while ensuring the same terminal distress level. In some cases, provision of an asphalt overlay was considered.

It should be noted that the increased thickness and the associated cost refers to the total highway construction cost required to accommodate the entire OW truck fleet. However, the overall cost was apportioned based on the damage imposed by individual truck classes to determine the permit cost for each OW truck class.

The research team considered a scenario where the total number of ESALs owing to the OW truck fleet equals that of the design truck volume. However, designing the pavement structure to exclusively cater to OW truck volume was not considered, as it would be inappropriate because the highway facility was designed for the design truck traffic. Therefore, OW truck traffic was added to the design traffic volume. The additional traffic volume implies increased structural capacity, which would be provided by additional thickness. Associated costs would be apportioned to the total number of OW trucks.

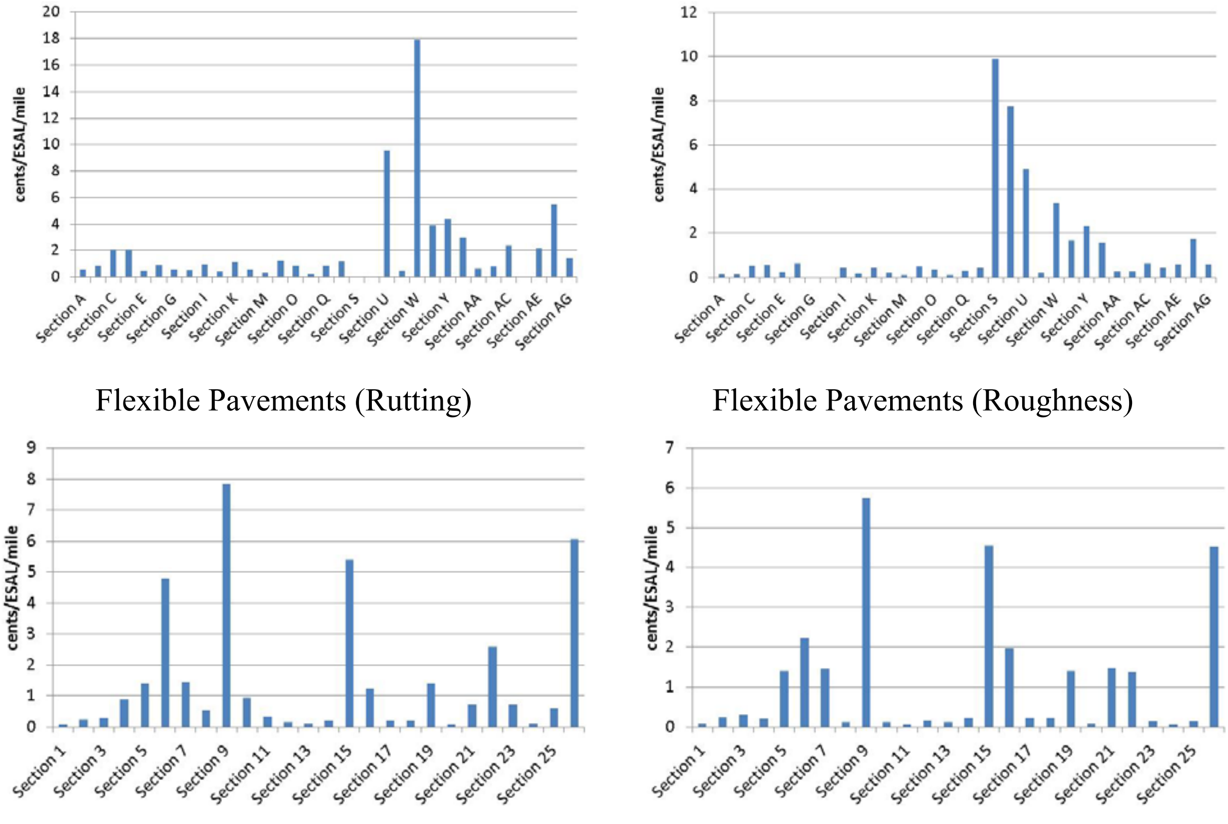
In the case of flexible and surface treated pavements, these costs were estimated using each of the three primary distress mechanisms earlier discussed: rutting, cracking, and roughness. In the case of rigid pavements, the cost was assessed using the two distress mechanisms considered in this study, namely, punchout, and roughness.

In summary, the methodology used to calculate pavement costs due to OW vehicles considered providing additional structural capacity to the highway facility and calculated any costs thus incurred. A key component of the entire procedure involved obtaining reliable estimates for construction costs. This particular objective was addresses by referring to TxDOT's average low bid price portal. This provided the research team with unit costs for each of the different materials (see Table 2.7).

Table 2.7: Average Low Bid Price for Construction Materials

Flexible Pavements (HMAC)		Rigid Pavements (CRCP)	
Description	Unit Cost ($/TON)	Description	Unit Cost ($/SY)
Dense-Graded Type B PG 64-22	58.99	Slab Thickness: 8”	38.89
Dense-Graded Type B PG 70-22	99.88	Slab Thickness: 9”	37.34
Dense-Graded Type C PG 64-22	73.58	Slab Thickness: 10”	39.12
Dense-Graded Type C PG 64-28	127.85	Slab Thickness: 11”	41.88
Dense-Graded Type C PG 70-22	95.67	Slab Thickness: 12”	38.85
Dense-Graded Type C PG 76-22 SAC-B	61.05	Slab Thickness: 13”	40.17
Dense-Graded Type C PG 76-22 SAC-A	137.65	Slab Thickness: 15”	65.64
Dense-Graded Type D PG 64-22	83.84		
Dense-Graded Type D PG 70-22	129.53		
Dense-Graded Type D PG 70-28	103.0		
Dense-Graded Type D PG 76-22 SAC-A	111.85		
Dense-Graded Type D PG 64-22 SAC-B	72.50		
SMA-D PG76-22 SAC-A	95.21		
SMA-D PG76-22 SAC-B	108.41		
SMA-D PG76-28 SAC-B	108.00		

In the following step, unit costs were multiplied with the total quantity of material required to provide additional structure to support OW traffic. The calculated costs were determined in terms of cents/ESAL/traveled-mile. Figure 2.36 provides detailed information with regards to the calculated costs for each of the individual flexible and rigid pavement sections using the different distress mechanisms considered in this study.



Flexible Pavements (Rutting) Flexible Pavements (Roughness)

Rigid Pavements (Punchout) Rigid Pavements (Roughness)

Figure 2.36: Pavement Costs Assessed for OS/OW Loads

The research team realized that there was a negligible relationship between calculated fees and the functional classification or the structural number for a given highway facility. This particular finding encouraged researchers to obtain average fees irrespective of the highway facility: 1.8 cents/ESAL/mile for flexible pavements and 1.3 cents/ESAL/mile for rigid pavements. However, computed costs vary over a wide range for both flexible (3.54 cents/ESAL/mile for rutting; 2.28 cents/ESAL/mile for roughness) and rigid pavement structures (2.11 cents/ESAL/mile for punchouts; 1.58 cents/ESAL/mile for roughness). In this situation, one would rather be safe constructing a 95-percent confidence interval on the calculated costs that should be assessed on the OS/OW loads. This implies increased fees of between 3.7 cents/ESAL/mile (Mean = 1.8 cents/ESAL/mile) for flexible pavement structures and between 2.9 cents/ESAL/mile (Mean = 1.3 cents ESAL/mile) for rigid pavement structures.

The permit fee structure proposed above refers to the fee that should be assessed on OS/OW loads. However, the definition of "legal load" is an important factor that requires further consideration. A truck that does not exceed a GVW of 80,000 lbs. is not subject to any fees under the current fee structure. Such rules also apply to single axles not exceeding 20,000 lbs., tandem axles not exceeding 34,000 lbs., and tridem axles not exceeding 42,000 lbs. Therefore, under the proposed fee structure, these vehicles should continue to have the same exemptions they enjoy today. The researchers propose that the suggested fee structure be considered as a marginal fee applicable to OS/OW loads once they exceed the legal limits, proportional to the amount that exceeds these limits.

2.8 Conclusion

This report presents a methodology to determine load equivalencies for different vehicles. The methodology developed uses a modular architecture that focuses on determination of the ECFs for different axle loads and configurations that can subsequently be aggregated to establish the ECF of any OW vehicle.

The research team observed that the structural capacity of individual pavement sections had secondary bearing on the ECFs that were calculated except in the case of rutting in flexible pavement. It is interesting to note that ECFs calculated using rutting criteria showed that a structural number of four yields the highest ALF for tandem, tridem, and quad axles. This implies that pavements with structural numbers around four are most sensitive to high axle loads while their effect dissipates for both thicker and thinner pavements.

In general, the ALFs computed for flexible pavements using rutting and fatigue cracking failure criteria are around four for pavement, with structural number equal to 4.0. Therefore, results of this study concur with the widely known fourth power law. However, the results have greater implications and a wider range of application.

In the case of rigid pavements, similar observations were also made while analyzing the ECFs evaluated using punchout failure criteria. However, data suggested the ALF to be slightly more than 3.0. Nevertheless, the research team found that GEFs for single, tandem, and tridem axles were similar to those noted in the case of flexible pavements using rutting or fatigue cracking failure criteria.

In the case of surface treated pavement sections, researchers did not observe a noticeable relationship between the ALF and the structural number for the highway facility. However, the GEF values calculated using rutting, cracking, and roughness criteria were relatively higher. This indicates that the standard load corresponding to an ESAL equal to one would be relatively higher in the case of surface treated sections if ALF values remain unchanged. Interestingly, it was also noticed that ALF values were higher in the case of surface treated sections, sometimes up to twice of those calculated for flexible pavement sections. This indicates that surface treatments are relatively more sensitive to axle loads compared to flexible pavement sections. It was also observed that the ALF computed using the cracking criterion was approximately equal to 4.0, once again validating the significance of the fourth-power law.

This chapter also illustrates how one could use the models developed in this study for determining load equivalencies for OW permits. It was shown through an example that the addition of axles to a given vehicle results in lower ECFs.

In the final section of this chapter, the research team discussed in detail the methodology adopted for determining permit fees assessed to OW loads. This methodology is based on the assumption that the cost of providing additional structure adequate to support OW loads should be recovered through such fees. To that effect, the researchers considered providing the additional structure by increasing the thickness of the primary structural layer. The cost incurred was apportioned to OW truck traffic. Because this study uses a modular approach to determine the impact on the highway infrastructure due to OW loads through consideration of ESALs, the resulting fee structure was proposed in equivalent units. The research team proposes an average permit fee of 3.7 and 2.9 cents/ESAL/mile on rigid and flexible pavements, respectively.

The study team proposes an average permit fee of 3.7 and 2.9 cents/ESAL/mile on rigid and flexible pavements, respectively

Chapter 3. Bridge Consumption

3.1 Chapter Objective and Organization

This chapter discusses bridge analysis methodology, hypotheses, and assumptions; summarizes the data collected; and provides analysis and summaries of the oversize/overweight (OS/OW) permit 2009 data. It also documents a bridge consumption methodology based on bridge fatigue concepts developed in this project. This methodology is applicable for both routed and non-routed permits. Finally, results are presented for routed and non-routed permits.

3.2 Analysis Objective and Approach

The bridge analysis objective is to estimate the bridge consumption costs of representative OS/OW permit configurations. The approach is neither a full-cost nor a cost allocation study; rather, it develops measures of bridge consumption cost per mile to support the revision of OS/OW fees. The calculations estimate the effects of OS/OW configurations on bridge consumption, treating each passage of the OS/OW permitted load as a fractional consumption of the bridge's design life. In its methodology, the research team did not consider other cost externalities such as the impacts of delays caused by work zones and detours to upgrade bridges deficient for OS/OW operations.

3.3 Methodology Overview and Available Data

3.3.1 General Overview

The bridge analysis methodology relies on the data sources summarized in Table 3.1. The following steps provide an overview of the methodology to estimate bridge consumption costs for routed and non-routed permits:

1. Routed permits
    a. Develop the methodology to calculate bridge consumption and corresponding cost per mile;
    b. Merge bridge data to all routes in the Geographic Information System (GIS) platform containing 2009 routed permits;
    c. Determine representative configurations for routed permits;
    d. Assign representative configurations to routes and estimate mileage;
        e. Harmonize gross weight categories used in the GIS platform (Middleton et al., 2012) with Central Permit Office categories (see also pavement analysis chapter);
    f. Retrieve the bridges on all routes and calculate the consumption; and
    g. Calculate the bridge consumption cost per mile.
2. Non-routed permits
    a. Monte Carlo simulation of routes to reflect annual mileage for each configuration;
    b. Calculate bridge consumption with the methodology developed by this research project (See Step 1 of this list); and
    c. Calculate bridge consumption cost per mile.

Table 3.1: Data Sources

Data type	Source
Bridge data	Bridge Inspection and Appraisal Program (BRINSAP) (FHWA, 1995)
Non-routed permits	Additional research work performed by the research team for the Rider 36 project identified the characteristics of non-routed permits, and the results are documented in a previous chapter of this report. The research team conducted a separate survey to identify annual mileage and load configurations for non-routed permits. Results are documented in a separate chapter of this report.
Routed permits	Central Permit Office database Summary of 2009 routed permits data in GIS (Middleton et al., 2012)

3.3.2 Bridge Consumption Analysis

Bridge analysis for policy purposes must rely on readily available data. The Federal Highway Administration's National Bridge Inventory (NBI) (FHWA, 1995), known as the Bridge Inspection and Appraisal Program (BRINSAP) in Texas, is the only dataset that meets this objective. BRINSAP/NBI contains data describing the bridge length, support type, design type, and material. These data are sufficient to estimate and compute live load bending moments.

BRINSAP/NBI does not contain detailed data on individual bridge design elements, thus ruling out analysis of fatigue details such as stiffeners and connections, shear stresses, or other stresses that require this level of analysis detail. This data limitation is primarily why previous studies of national truck size and weight (TS&W) policy issues (Moses, 1989) have either ignored fatigue effects and other less critical stresses or handled them in a very simplified manner.

Previous truck size and weight studies used bending moment stresses as a defensible surrogate for bridge stresses. This report developed a unique and innovative approach that treats each passage of an OS/OW load as consuming a dollar amount of the bridge asset value. This approach uses a simplified fatigue approach to evaluate bridge consumption due to the operation of OS/OW permitted load configurations. This methodology for bridge analysis is documented in the section titled "Bridge Consumption" in this chapter.

3.4 Routed Permits

3.4.1 Determining Bridges on Permitted Routes

Until recently, the Texas Department of Transportation's (TxDOT) Motor Carrier Division maintained the Central Permit Office permit file and provided the research team with six fiscal years (2004–2009) of overweight load permit history for analysis and reporting purposes at the beginning of this project. The research team concentrated on the 2009 file, because TxDOT Research Project 0-6404 ("Accommodating Oversize and Overweight Loads," Middleton et al., 2012) summarized the permit statistics for 2009 based on gross vehicle weight (GVW) categories. The research team characterized routed permitted loads using statistical summaries of the data.

Figure 3.1 presents the data format available in this GIS file. For the specific GIS segment highlighted in Figure 3.1, there were 63 permits in the 80 to 120 kips GVW category, 32 permits in the 120 to 150 kips GVW category, and so on. The segment length is 168,304 feet, or approximately 32 miles. The length information on the segment is necessary to calculate bridge consumption per mile for both routed and non-routed permits.

Figure 3.1 also depicts the two overlaid layers (bridges and permitted routes) and a data block from the permit file for the highlighted segment. The overlaid layers were obtained after the double-counting issues discussed above. Other less common issues were corrected using extensive Statistical Analysis System (SAS) programming. In Figure 3.1, permit routes (Middleton et al., 2012) are represented by black lines overlaid to the point-base GIS layer containing the bridges, which are represented by red dots. This combined GIS dataset was used in bridge consumption calculations for both routed and non-routed loads documented later in this chapter.

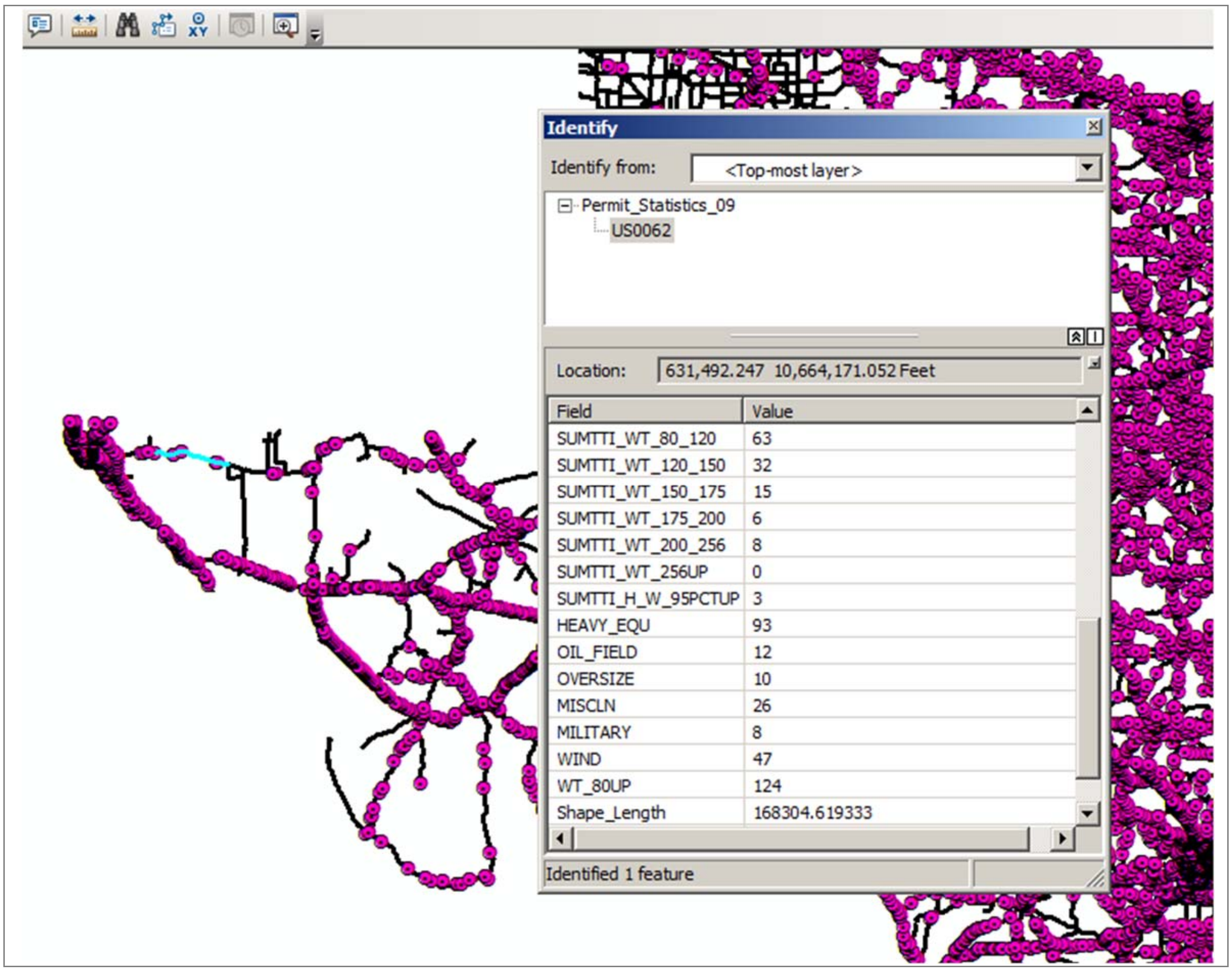


Figure 3.1: GIS Data from Project 0-6404

The geo-referenced GIS layer merging the bridge data available in BRINSAP with permitted routes was generated using a GIS proximity algorithm. Extensive SAS programming for cleaning up the GIS proximity algorithm results was then developed and used to filter inconsistencies. The most important proximity algorithm issues necessitating data filtering were those resulting in bridges being double counted. The most common double-counting issues were the following:

- At over/underpasses, the proximity algorithm assigns the same bridge record for the route on the bridge, as well as the route under it. A SAS code detects these intersections to delete non-existing bridge records.
- When there are two segments located within the proximity algorithm parameters, the algorithm may assign a bridge to both roads. A SAS code detects these cases and deletes non-existing bridges.

Figure 3.2 illustrates a GIS data block containing the BRINSAP information for the same segment highlighted in Figure 3.1. The data block is for the BRINSAP bridge record with Structure ID 241160037404016. This specific data block was selected to illustrate a double-counting issue inherent to the one-way nature of permitted loads: parallel bridges. The two structures appearing at the same US 62 location in Figure 3.2 physically exist as parallel bridges. These cases were filtered during the bridge analysis in order to consider the one-way nature of routed permit loads. Culverts were not considered in the bridge consumption analysis.

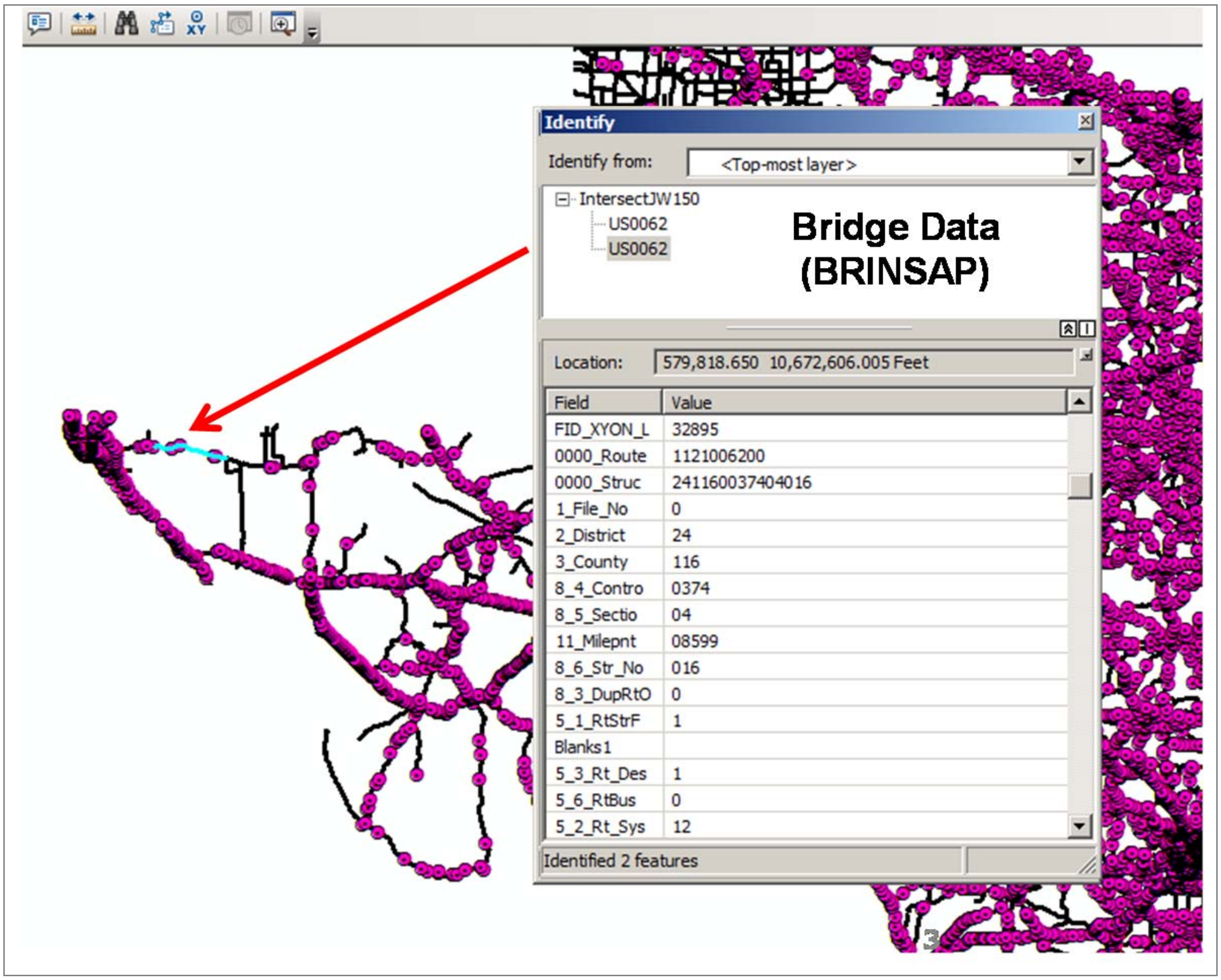


Figure 3.2: GIS Data from Project 0-6404 Combined with BRINSAP Data

3.4.2 Representative Loads for Routed Permits

The next step of the data analysis was to import GIS information (Middleton et al., 2012) into SAS and perform statistical analyses of the permits to determine representative axle configurations. The Central Permit Office permit file consists of 128 fields in one table. Fields relevant to the data analysis are those related to the load description, axle spacing, and axle loads.

In the 2009 permit file, there are 529,899 permit records, 166,554 of which belong to routed loads where weight information is available. Table 3.2 summarizes the permit statistics by GVW for routed loads. The first column depicts the GVW categories available in the GIS database (Ibid). Approximately 44 percent of the permits, or 73,423, fall in the 80 to 120 kips category. The fourth, fifth, and sixth columns display 2009 data summarized by the Central Permit Office categories utilized for the cost estimate, which were also used in the pavement consumption analysis documented in a previous chapter of this report. The bridge consumption analysis followed the GVW categories summarized in the fourth column of Table 3.2.

Table 3.2: Summary Statistics for the 2009 Permit Data File

GIS Data Category (kips)	Number of Permits	Percent	Central Permit Office Category (kips)	Number of Permits	Percent
80 to 120	73,423	44.08%	80-120	73,423	44.36%
120 to 150	42,899	25.76%	120-160	62,119	37.53%
150 to 175	29,996	18.01%	160-200	23,247	14.05%
175 to 200	12,471	7.49%			
200 to 256	7,119	4.27%	200-254	6,723	4.06%
256 and up	646	0.39%			
Total	166,554		Total	165,512	

The research team performed statistical analysis of the 2009 Central Permit data using the GVW categories summarized in the first column of Table 3.2 and determined the representative permitted configurations with an analytical procedure. The team conducted a separate survey to identify annual mileage and load configurations for non-routed permits. This survey and its results are documented in a previous chapter. The purpose of using an analytical procedure for routed loads was to identify representative configurations for use in the bridge consumption analysis. This procedure is explained below using the most frequent category (80 to 120 kip GVW) as an example.

The analytical procedure was coded in SAS and utilizes two variables from the 2009 Central Permit File:

- Spacing1 to spacing24 (spacing between two consecutive axles), and
- Weight1 to weight25 (axle weights).

The number of variables weight1 to weight25 with values greater than zero corresponds to the total number of axles. For example, a record with weight1 to weight5 greater than zero corresponds to a five-axle truck. Variables spacing1 to spacing4 indicate how these axles are arranged (single, tandem, tridem, etc). Table 3.3 shows the frequencies of number of axles in the 80 to 120 kip GVW category. The most frequent configuration (45.3 percent) has six axles.

Table 3.4 shows the axle spacing statistics of the six-axle truck in the 80 to120 kip GVW category. Table 3.5 indicates the weight statistics. From examination of these data, the configuration depicted in Figure 3.3 clearly stands out as the fully loaded (from the weight data) truck with typical axle arrangement (from the axle spacing data).

Table 3.3: Number of Axles in the 80–120 Kips Category

Number of Axles	Number of Permits	Percent
2	19	0.0
3	12	0.0
4	4,533	6.2
5	22,488	30.6
6	33,252	45.3
7	9,499	12.9
8	1,514	2.1
9	1,057	1.4
10	359	0.5
11	344	0.5
12	176	0.2
13	167	0.2
14	3	0.0
Total	73,423	

Table 3.4: Summary of Spacings in the 6-Axle, 80–120 Kips Category (ft.)

Variable	Min.	Quartile			90% Percentile	Mean	Std. Dev.	Mode	Max.
		1st	*2nd*	*3rd*					
spacing1	4	15	18	19	20	18	10.1	18	918
spacing2	4	4	4	4	5	4	2.2	4	60
spacing3	4	32	36	40	65	40	22.4	38	536
spacing4	4	4	4	5	5	5	6.1	4	107
spacing5	3	4	4	5	5	4	2.2	4	61

Table 3.5: Summary of Weights in the 6-Axle, 80–120 Kips Category (kips)

Variable	Min.	Quartile 1st	2nd	3rd	90% Percentile	Mean	Std. Dev.	Mode	Max.
Weight1	1.3	12	12	14	15	13	1.7	12	24
Weight2	2.3	19	20	23	23	20	2.3	20	24
Weight3	2.3	19	20	23	23	20	2.3	20	30
Weight4	1.3	17	19	20	20	18	2.3	20	30
Weight5	1.8	17	19	20	20	18	2.3	20	30
Weight6	1.3	17	19	20	20	18	2.3	20	30

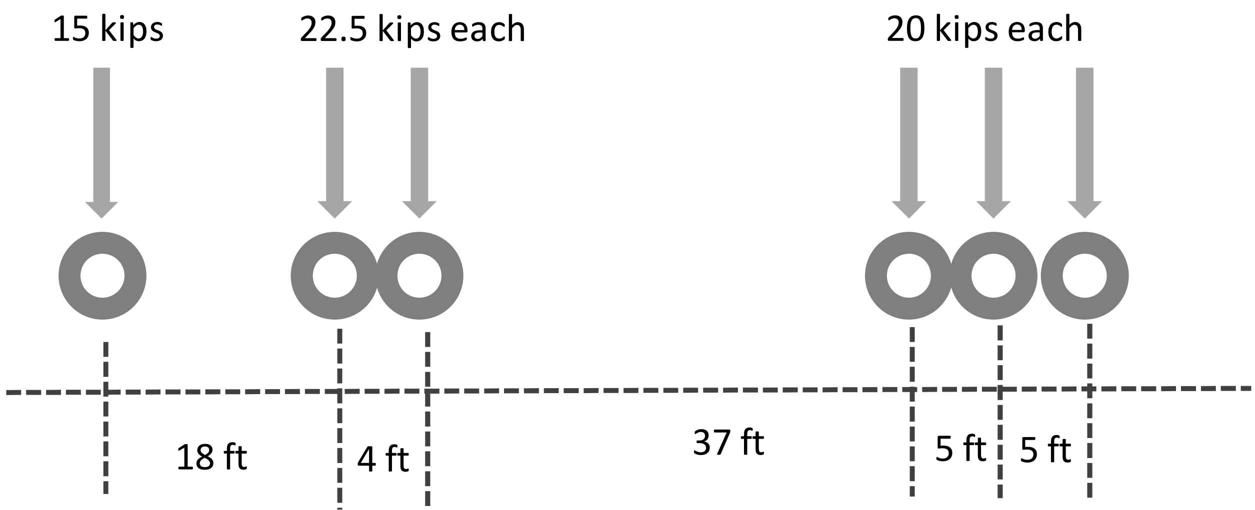
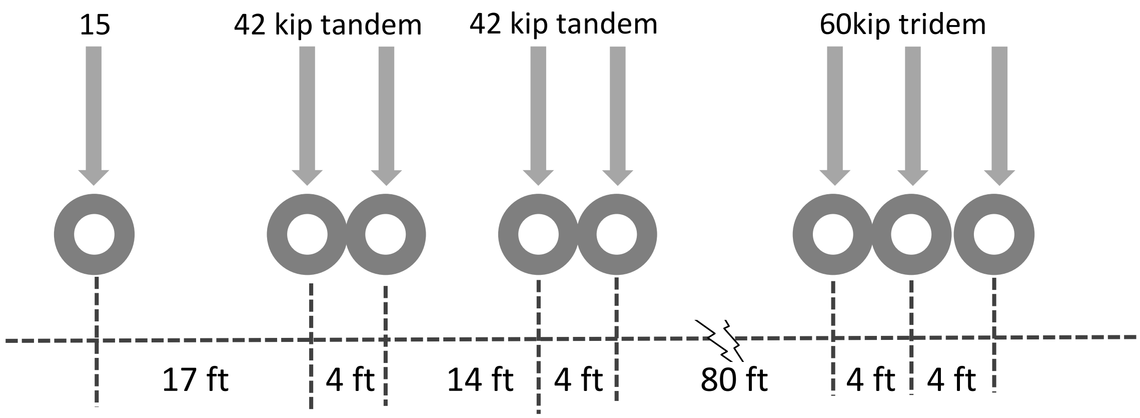


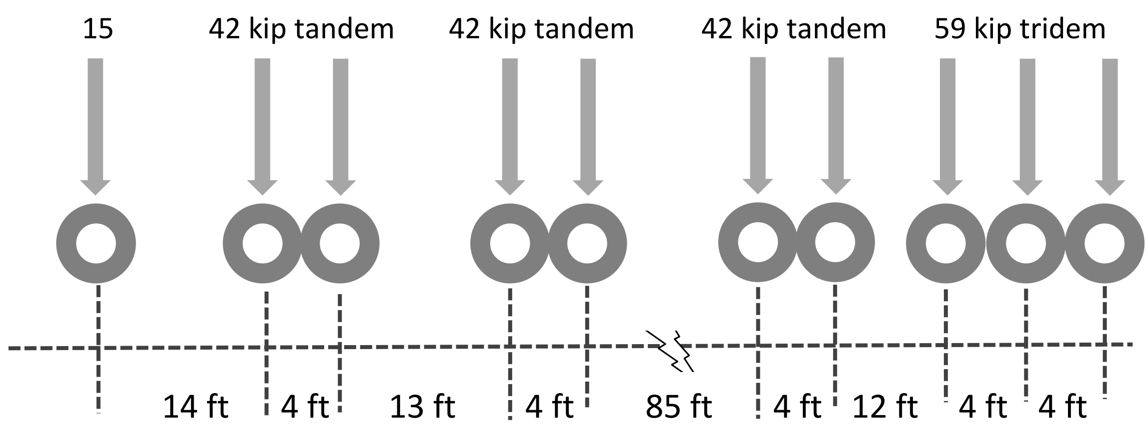
Figure 3.3: Analysis Configuration for the 80–120 Kip GVW Category

The other typical configurations were determined in an analogous manner and then assigned to routes according to the corresponding GVW categories available in the GIS file (Middleton et al., 2012). This analysis includes the typical configurations depicted in Figures 3.4 through 3.6.



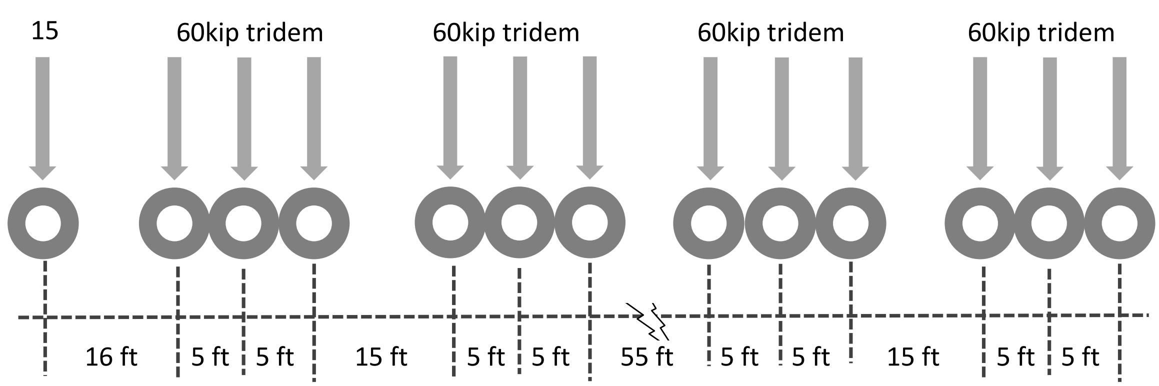
(axle weights in kips)

Figure 3.4: Analysis Configuration for the 120–160 Kip GVW Category



(axle weights in kips)

Figure 3.5: Analysis Configuration for the 160–200 Kip GVW Category



(axle weights in kips)

Figure 3.6: Analysis Configuration for the 200–254 Kip GVW Category

3.5 Bridge Consumption Methodology

3.5.1 Background

Bridge consumption may be understood as a fatigue process in which each load passage over a given bridge consumes part of the bridge design life. The American Association of State Highway and Transportation Officials bridge design specifications (AASHTO, 1990) include fatigue curves that imply a certain number of stress cycles that define the bridge design life. Figure 3.7 depicts one of the fatigue curves included in the AASHTO bridge design specifications. This set of curves is for steel bridge details and is in a logarithmic scale. As evidenced by this set of curves, the wider the stress range, the lower the number of stress cycles to get to the end of the design life of a specific structural detail. Fatigue curves for other materials such as reinforced concrete and pre-stressed concrete follow this general shape but have different numerical parameters. Equation 3.1 presents the generic mathematical formulation of the bridge fatigue curves.

AASHTO specifies a 75-year design life or two million applications of the design load. Design loads are specified as specific load configurations with defined axle spacing and axle loads. Inventory rating loads (recorded in BRINSAP/NBI) induce stresses equivalent to design load stresses but reflect the current load rating for a given bridge.

3.5.2 Methodology Description

The data available in the NBI/BRINSAP database allows for the application of simplified methodologies to estimate bridge consumption for load configurations at the policy level. Applying Equation 3.1 twice, once for the Inventory rating load and again for the oversize/overweight permit load and then subtracting one result from the other, one obtains Equation 3.2.

At the policy level, it is not feasible to calculate actual stress ranges for bridge details. Digital descriptions of bridge cross sections and other characteristics are not available. Even if they were, computational demands would make this task unfeasible within this project's time frame. An acceptable method successfully used in previous oversize/overweight studies involves using live load bending moments as surrogates for the stress range (Imbsen et al., 1987; Weissmann & Harrison, 1992; and Weissmann, et al., 2002). This approach substitutes the stress ranges in Equation 3.2 with bending moments, defining the bridge consumption ratio as depicted in Equation 3.3. Simply put, Equation 3.3 states that the bridge consumption ratio induced by a bending moment of an inventory rating load passage on a given bridge is equal to 1. Loads inducing bending moments twice as large as the inventory rating bending moment lead to a bridge consumption ratio of two to the power m, where m is a function of the bridge material.

Table 3.6 presents m values recommended in the literature for the corresponding BRINSAP structure type codes (Altry et al., 2003 and Overman et al., 1984).

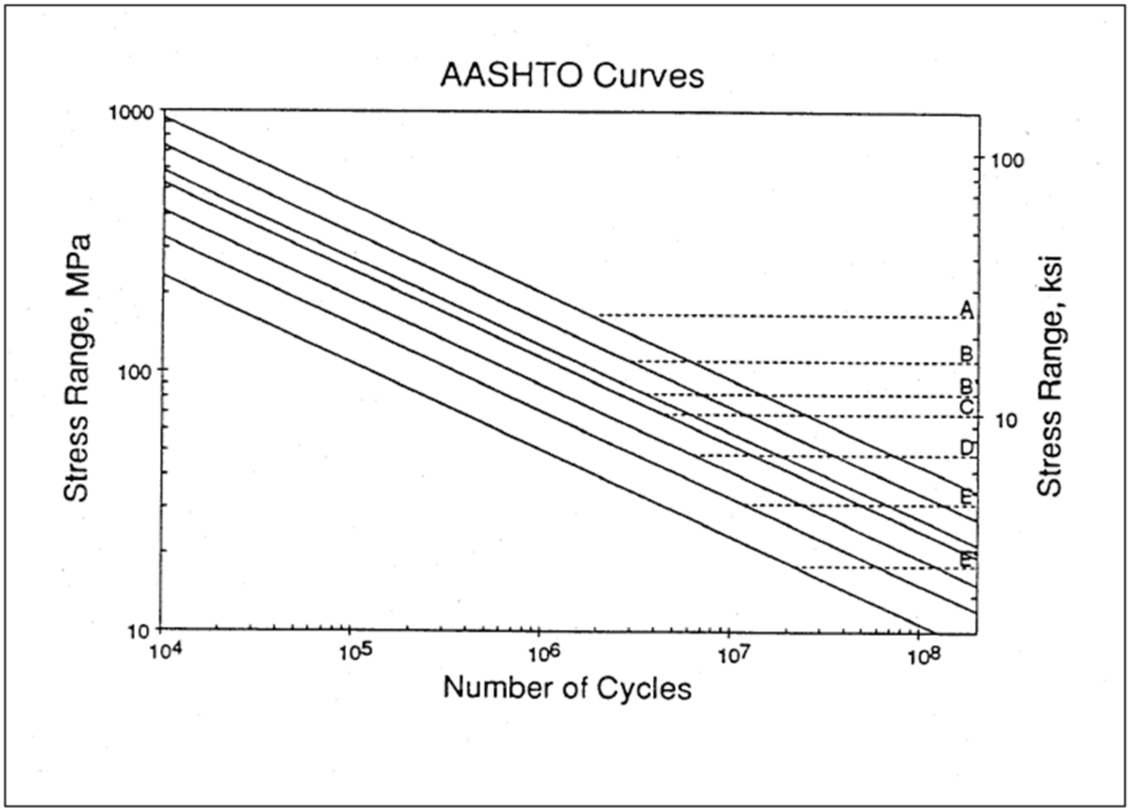


Figure 3.7: AASHTO Bridge Fatigue Curves

$$\log N = C - m \log S \tag{3.1}$$

Where:
N – Number of cycles or load applications
S – Stress range
m – Constant: material dependent
C – Constant

$$\frac{N_{Inventory}}{N_{OSOW}} = \frac{S_{OSOW}^{m}}{S_{Inventory}^{m}} \tag{3.2}$$

Where:
Ninventory – Number of load applications for the inventory rating load
NOSOW – Number of load applications for the oversize overweight load
Sinventory – Stress range for the inventory load
SOSOW – Stress range for the oversize overweight load
m – Constant: material dependent

$$ConsumptionRatio = \left(\frac{M_{OSOW}}{M_{Inventory}} \right)^{m} \tag{3.3}$$

Where:
Minventory – Live load bending moment for the inventory rating load
MOSOW – Live load bending moment for the oversize overweight load
m – Constant: material dependent

Table 3.6: Values of ^{m} Constant for Bridge Fatigue Analysis

Structure Type	**m**
Concrete Slab 101	4.1
Concrete Girders 102	3.5
Concrete T Beam 104	4.1
Concrete Box Beam 105	4.1
Concrete Continuous Slab 201	4.1
Concrete Continuous T Beam 204	4.1
Steel Girder 302	3.0
Steel Continuous Girders 402	3.0
Steel Continuous Girder 403	3.2
Steel Continuous Box Beam 405	3.2
Steel Continuous Box Beam 406	3.2
Prestressed Concrete 500	3.5
Prestressed Concrete Slab 501	3.5
Prestressed Concrete Girder 502	3.5
Prestressed Concrete Box Beam 505	3.5
Prestressed Concrete Continuous 601	3.5
Prestressed Concrete Continuous 602	3.5

The bridge consumption in dollars due to the passage of a given load is estimated by using Equation 3.3 combined with a consumable asset value for the bridge. Research developed in support of the Texas 2030 Committee established that the current asset value of a bridge is $190 per square foot of deck area (Texas 2030, 2009). Previous highway cost allocation studies established that the asset value of a bridge should be allocated according to the Table 3.7, with 11 percent of the bridge asset value attributable to loads that are over HS20-44 (FHWA, 2000). HS20-44 is a standardized bridge design load, and bridge current inventory ratings are usually represented as multiples of the HS20 design load when recorded in NBI/BRINSAP.

Table 3.7: Bridge Asset Value Percentages for GVW Categories

Vehicle Class	Percent Allocation
Passenger Vehicles	65.02%
Trucks	
Single Unit	7.67%
Combinations	
under 50 kips	2.68%
50 - 70 kips	5.15%
70 - 75 kips	8.41%
Over HS20-44 Loading	11.08%
TOTAL =	**100.00%**

With the help of computerized routines, Equation 3.4 is applied on a bridge-by-bridge basis to all bridges in the GIS data previously described in this chapter. Bridge asset consumption results for each bridge are summarized and aggregated to determine an overall cost for a given permit load, which can be divided by the mileage to get a cost-per-mile for bridge consumption.

$$Consumption_{OSOW} = [(Area)(190)(0.11)\left(\frac{M_{OSOW}}{M_{Inventory}}\right)^{m}] \div (2{,}000{,}000) \quad (3.4)$$

Where:

$M_{inventory}$ – Live load bending moment for the Inventory Rating Load for each bridge in the permit dataset

M_{OSOW} – Live load bending moment for the Oversize Overweight Load for each bridge in the permit dataset

^{m} – Constant: material dependent

190 – Asset value for a bridge in dollars per bridge deck square foot

0.11 – The bridge asset value responsibility for heavy trucks (see Table 3.7).

2,000,000 – Number of allowable load cycles that define bridge design life according to AASHTO

3.5.3 Bridge Bending Moment Analysis at the Network Level

The computer program Moment Analysis of Structures (MOANSTR) was used to calculate live load moment ratios as required by Equation 3.4 for the bridges in the routes identified using the GIS approach discussed earlier in this chapter. The MOANSTR program's core is a finite differences routine that calculates live load moment envelopes generated by OS/OW configurations and NBI/BRINSAP rating loads. The MOANSTR routine incorporates previous research by Matlock (Matlock et al., 1968) and others (Weissmann & Harrison, 1992 and Weissmann et al., 2002). MOANSTR calculates moment envelopes and identifies the maximum live load bending moments (positive and negative) induced by the OS/OW configuration and the inventory rating load.

3.5.4 Bridge Consumption Methodology Summary

The following steps summarize the implementation of the concepts previously discussed:

1. Permit routes from Project 0-6404 (GIS) (Middleton et al., 2012)
2. Geo-reference BRINSAP data
3. Overlay bridges onto GIS permit routes
4. Characterize routed permit loads (axle weights and spacing) per weight category
5. Characterize non-routed loads (axle weights and spacing) and annual mileage
6. Calculate bending moments
7. Calculate bridge consumption using Equation 3.4
8. Calculate cost-per-bridge on each segment
9. Estimate cost-per-mile for each permit GVW weight category

A few variations of some of the steps above were required to analyze non-routed permits. These modifications are discussed later in this chapter using a case study for one of the non-routed permits.

3.6 Bridge Consumption Results: Routed Permits

3.6.1 Routed Permits Example

Figure 3.8 depicts the distribution of the moment ratios for the 80 to 120 kip GVW category. The moment ratios (permit to inventory) are concentrated in values greater than 1.2 (63 percent). Equation 3.4 indicates that consumption results for this configuration are expected to be significant.

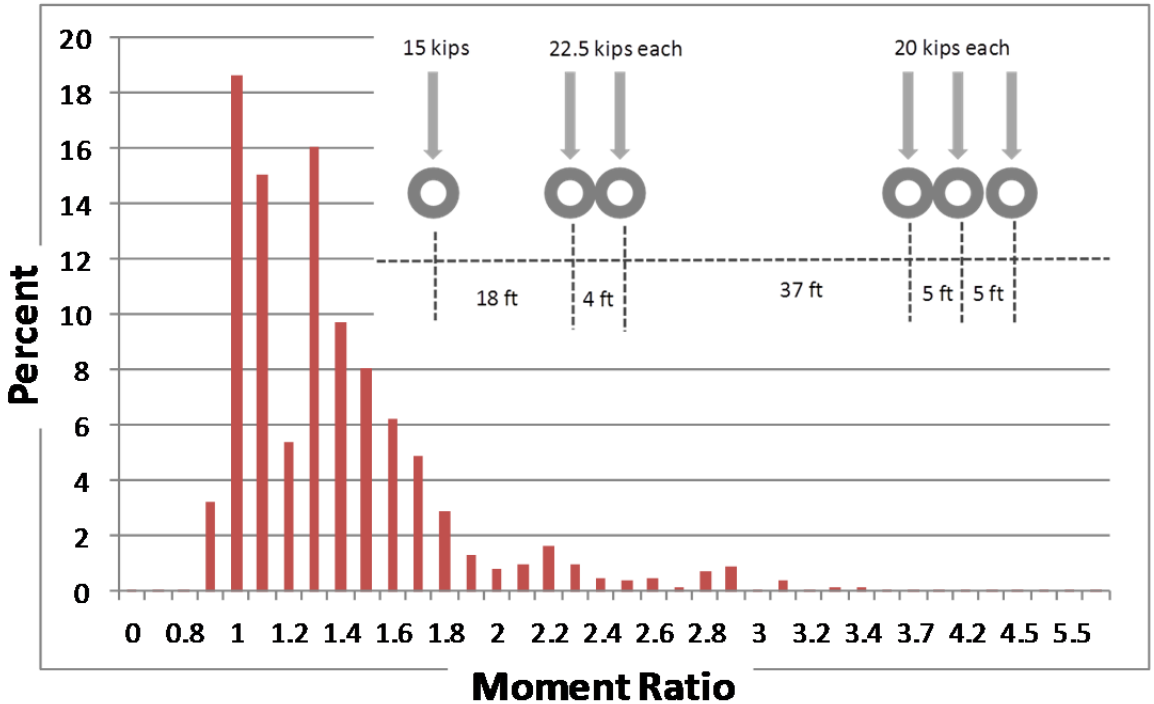


Figure 3.8: Moment Ratios Distribution for the 80 to 120 Kip GVW Category

Table 3.8 presents a sample of the results of the consumption analysis of the 80 to 120 kip GVW category. The first column in Table 3.8 includes the BRINSAP Structure ID for a specific bridge in a permit route. Subsequent columns contain the following data:

- Bridge deck area in square feet
- Unique GIS segment ID
- Route number
- Number of permits that traveled in that segment in 2009
- Permit mileage that needs to be divided by the number of bridges on a given GIS segment
- Structure type (used to determine the ^{m} coefficient in the bridge fatigue equations)
- Bridge count used in calculating the segment miles (number of bridges in a given GIS segment)
- Moment ratios (calculated with the MOANSTR computerized routine)
- Bridge consumption (calculated using Equation 3.4)
- Segment miles (calculated dividing the permit mileage by the bridge count)

The last two columns are aggregated to determine network-wide bridge consumption and the total mileage attributable to the 80 to 120 kip GVW category. The bridge consumption cost-per-mile for this permit category is obtained by dividing total bridge consumption by total miles.

Results for the 80 to 120 kip GVW category are summarized in Table 3.9, which shows that this class of routed permits traveled more than 3.9 million miles in 2009 with a total bridge consumption of $ 909,968, leading to a bridge consumption cost-per-mile of 23 cents.

Table 3.8: Partial Results of the Bridge Consumption Analysis for the 80 to 120 Kip GVW Category

Structure ID	AREA sqft	GIS segment	Route#	# of 80_120 permits	Permit Mileage	Structure Type	Bridge Count	Moment Ratio	Bridge Consumption $	Segment Miles
10600013604079	11,268	18787	SH0019	12	54.06	102	3	1.69	8.8	18.0
10600013604101	6,448	18420	SH0019	12	7.69	102	1	1.64	4.5	7.7
10600040001016	35,391	18116	SH0019	11	35.15	201	3	1.45	18.4	11.7
						101	1	2.06	19.2	
10750004520040	10,268	19123	FM1752	2	2.66	502				2.7
10750004520191	12,650	19089	US0082	71	71.56	502	2	1.33	23.2	35.8
10750004520219	13,110	19089	US0082	71	71.56	502	2	1.38	27.5	35.8
10750004520230	11,088	19110	US0082	93	466.71	502	1	1.33	26.7	466.7
10750020202028	2,493	18551	FM0151	29	44.6	102	1	1.79	5.8	44.6

Table 3.9: Bridge Consumption per Mile for the 80 to 120 Kip GVW Category

Total mileage	Total Consumption $	Bridge Consumption
3,939,917	909,968	$0.23 per mile

3.6.2 Bridge Consumption for the Routed GVW Categories

Similar analyses were performed for the other GVW categories previously discussed in this chapter. Table 3.10 summarizes the results. As expected, bridge consumption per mile for the 80 to 120 kip GVW category is less than that of the 120 to 160 kip GVW category, and the mileage is higher. The 80 to 120 kips GVW permits traveled about 3.9 million miles in 2009, inducing a bridge consumption of $900,968, leading to a bridge consumption of 23 cents per mile. Representative configurations for the routed permits are depicted in Figures 3.9 to 3.12.

Table 3.10: Bridge Consumption per Mile for All GVW Categories—Routed Loads

GVW category	Miles	Bridge Consumption ($)	$/mile
80–120k	3,939,917	909,968	0.23
120–160K	1,104,370	416,613	0.38
160–200k	534,260	259,374	0.49
200–254k	239,610	214,603	0.90

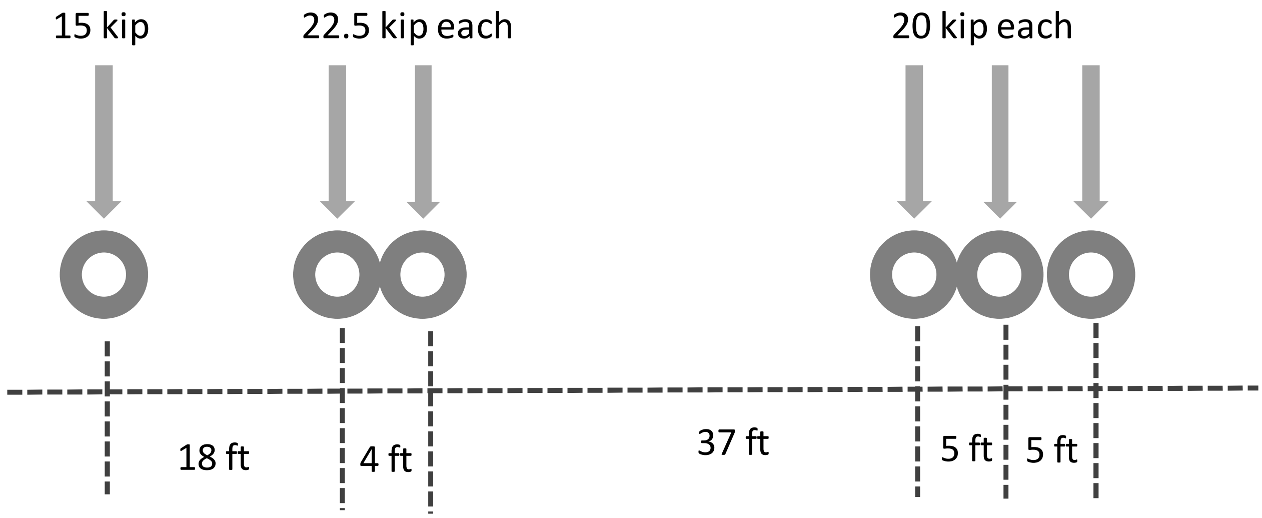


Figure 3.9: Representative Load for the 8–120 Kip GVW Category

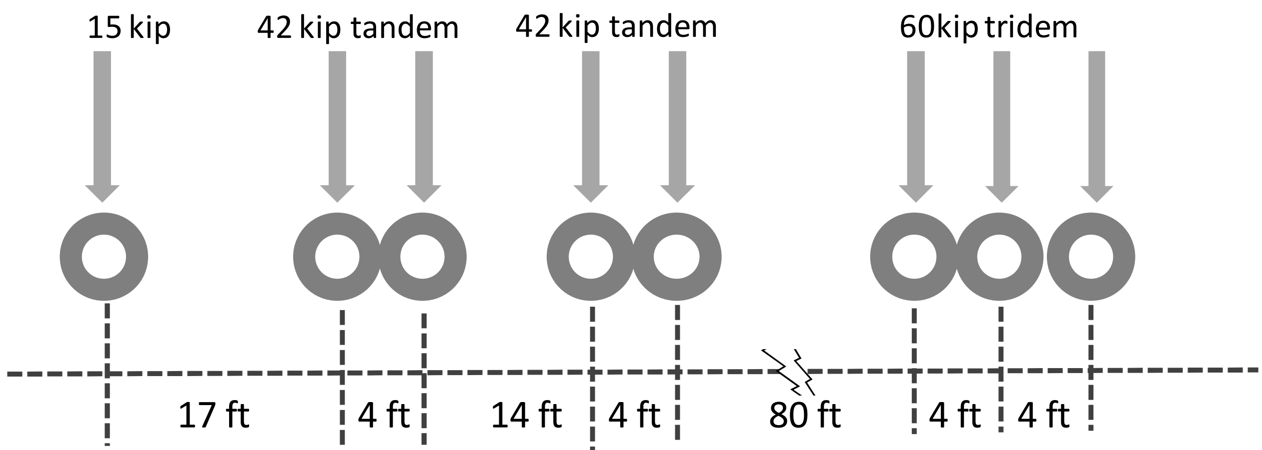


Figure 3.10: Representative Load for the 120–160 Kip GVW Category

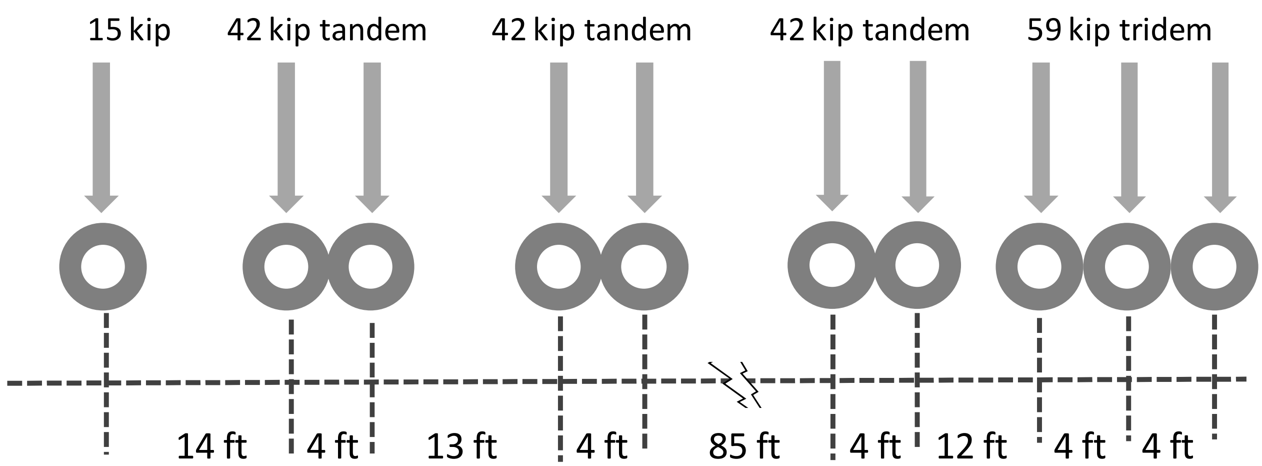


Figure 3.11: Representative Load for the 160–200 Kip GVW Category

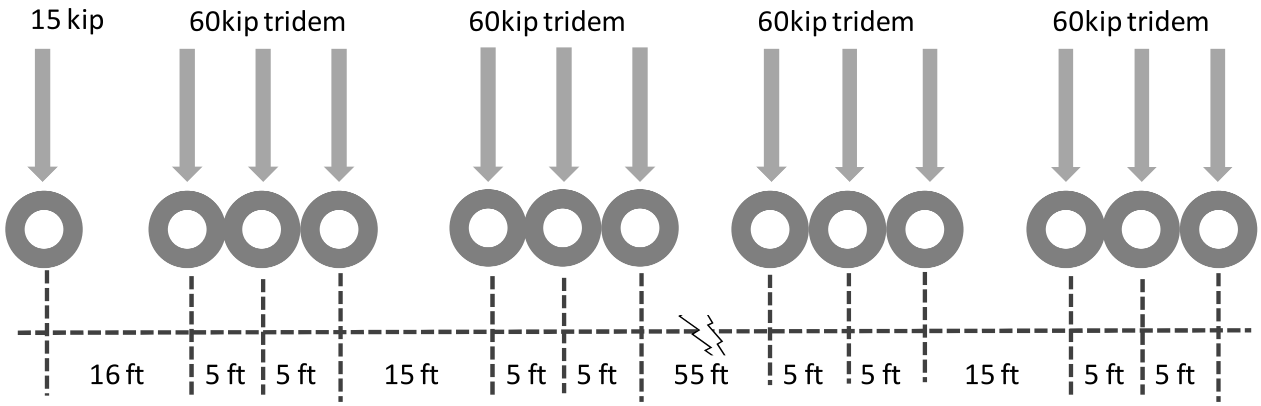


Figure 3.12: Representative Load for the 200–254 Kip GVW Category

3.7 Bridge Consumption: Non-Routed Permits

3.7.1 Methodology

The research team analyzed bridge consumption for non-routed permits using a Monte Carlo simulation, where GIS segments of the permit database described previously were randomly sampled. Each randomly sampled segment contains a certain number of bridges and has a certain length. Each randomly sampled set of segments is capped at the expected annual mileage for the non-routed permit. This mileage was defined in additional research documented in a previous chapter of this report that discusses non-routed permits mileage statistics and truck configurations.

After establishing this random GIS segment data set, the analysis follows steps similar to those previously described for routed permits. Bending moments for permit and inventory rating loads are calculated using the MOANSTR computerized routine, and results for Equation 3.4 are calculated for all bridges identified in the randomly assigned GIS segments to determine bridge consumption. Finally, results are aggregated for mileage and bridge consumption, allowing for the calculation of bridge consumption costs-per-mile.

Because the routes are not fixed as in the routed permit case, segments were randomly assigned to approximately fulfill the established annual mileage. Bridge density (bridge count by GIS segment) is also relevant to these calculations. Statistical analyses of bridge count per mile showed a significant difference in bridge density for East and West Texas counties. To properly consider the issue of different bridge densities, the analysis for non-routed permits was segregated into East and West Texas as depicted in Figure 3.13.

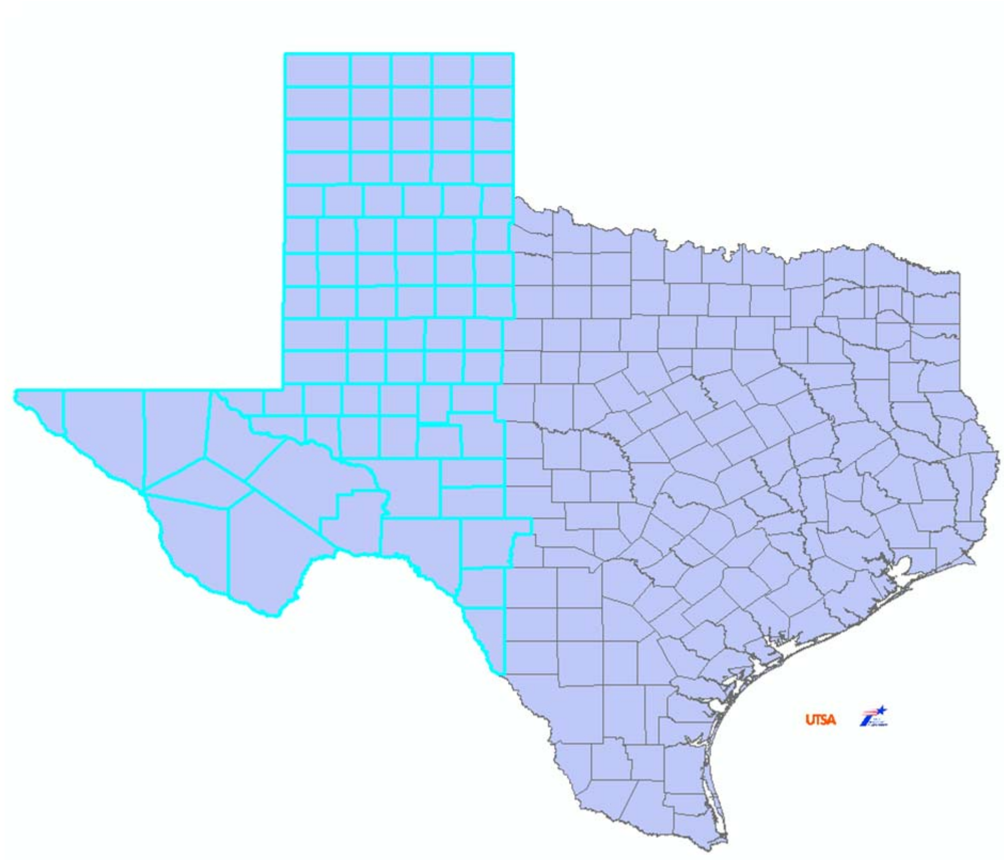
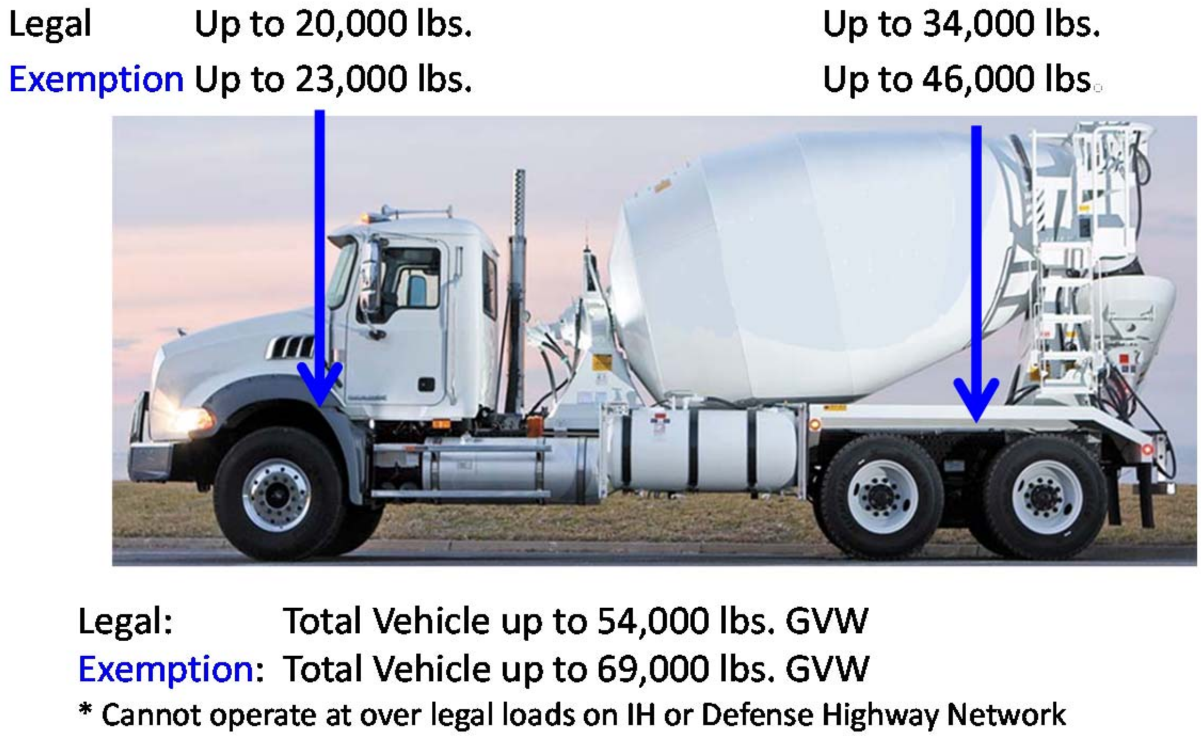


Figure 3.13: Segregation of Bridge Consumption Calculation for Non-Routed Permits into East and West Texas

3.7.2 Bridge Consumption Results Example for Non-Routed Permits

Figure 3.14 depicts one of the non-routed configurations analyzed in this study. This non-routed permit applies to vehicles defined in Section 622.011, Transportation Code as TTC 622.01-017, ready mix concrete and concrete pump trucks. These vehicles can operate at up to 69,000 lbs. and are not allowed on IH and US highways. Annual loaded mileage for these trucks was summarized in a previous chapter of this report and is estimated to be around 20,000 loaded miles.



Source: Baker Ready Mix website: http://www.bakerreadymix.com/

Figure 3.14: Representative Load Configuration for One Non-Routed Permit Load-Ready Mixed Truck

Table 3.11 summarizes results for the ready mix load configuration depicted in Figure 3.14. Results show an average difference in bridge consumption between East and West Texas counties of around 11 cents per mile.

To test the robustness of the methodology, the research team performed several Monte Carlo simulations with different random seeds. Bridge consumption results per mile changed very little with seed value, confirming the robustness of this numerical approach.

Table 3.11: Bridge Consumption per Mile for Non-Routed Ready-Mixed Truck

Randomly Assigned Miles	Total Bridge Consumption ($)	Counties	$/mile
22,453	2,058	West	0.092
20,837	2,511	East	0.120
		Average	**0.106**

3.7.3 Bridge Consumption for Non-Routed Categories

The identification of the analysis configurations and annual mileages of non-routed permits is documented in a previous chapter. Table 3.12 summarizes bridge consumption calculations for non-routed loads. The first column of the table identifies the permit type and the estimated annual mileage for that permit load configuration. The subsequent columns summarize the number of randomly assigned mileage GIS segments for each permit category and the corresponding bridge consumption values.

The randomly assigned mileage matches as closely as possible with the estimated mileage determined by the research team and documented in a previous chapter. Exact matches are not possible due to the random nature of the Monte Carlo procedure, which assigns GIS route segments and associated bridges. However, calculated values are not very sensitive to mileage values, because results are averaged out as bridge consumption costs per mile. The analysis (and thus the results) is segregated for East and West Texas due to reasons discussed earlier in this chapter.

Figures 3.15 to 3.23 depict the load configurations used in the analysis summarized in Table 3.12.

Table 3.12: Summary of Bridge Consumption Results for Non-Routed Permits

Truck Type & Loaded Annual Mileage	Region	Randomly Assigned Miles	Total Bridge Consumption Cost ($)	$/mile
LP Gas Bobtail 35,000 miles	West	34,700	2,224	0.064
	East	34,960	2,274	0.065
	Average			*0.065*
Ready Mix 20,000 miles	West	22,453	2,058	0.092
	East	20,837	2,511	0.120
	Average			*0.106*
Garbage & Recycling 17,000 miles	West	17,031	1,411	0.083
	East	16,165	1,943	0.120
	Average			*0.102*
Cotton Module 15,000 miles	West	14,352	1,592	0.111
	East	14,004	2,414	0.172
	Average			*0.142*
Chilli Pepper Module 15,000 miles	West	14,108	673	0.048
	East	14,420	1,191	0.083
	Average			*0.065*
Aggregate Hauler 45,000 miles	West	44,553	2,070	0.046
	East	42,073	3,212	0.076
	Average			*0.061*
Grain Hauler 12% Statute 9,000 miles	West	9,884	468	0.047
	East	7,709	614	0.080
	Average			*0.064*
Grain Hauler 2060 Permit 9,000 miles	West	9,122	377	0.041
	East	7,709	577	0.075
	Average			*0.058*
Logging 36,000 miles	West	36,561	1,038	0.028
	East	31,040	1,646	0.053
	Average			*0.041*
Milk 63,000 miles	West	61,217	1,468	0.024
	East	62,025	2,892	0.047
	Average			*0.035*

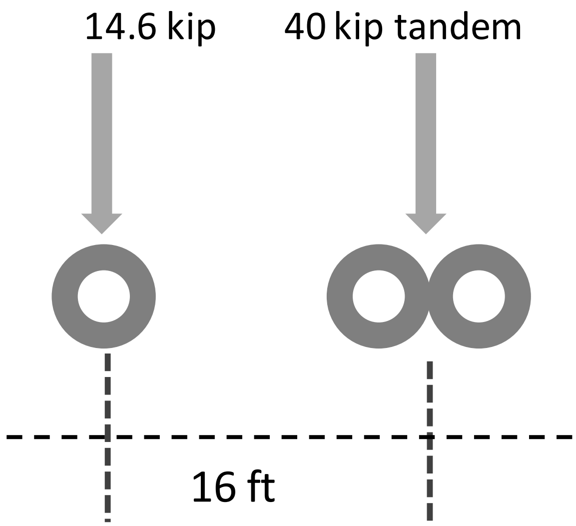


Figure 3.15: LP Gas Bobtail Permit Configuration

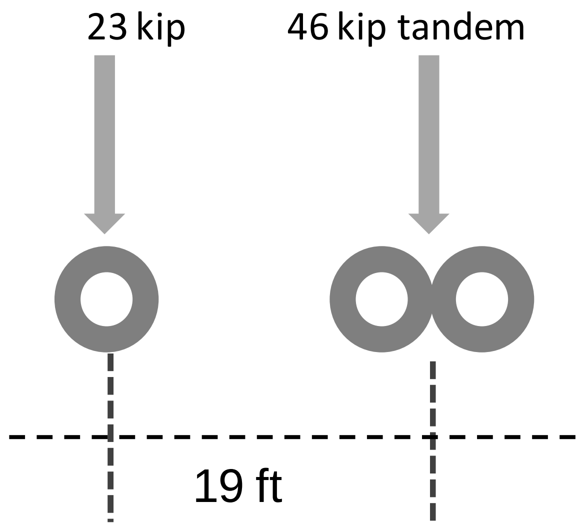


Figure 3.16: Ready Mixed Permit Configuration

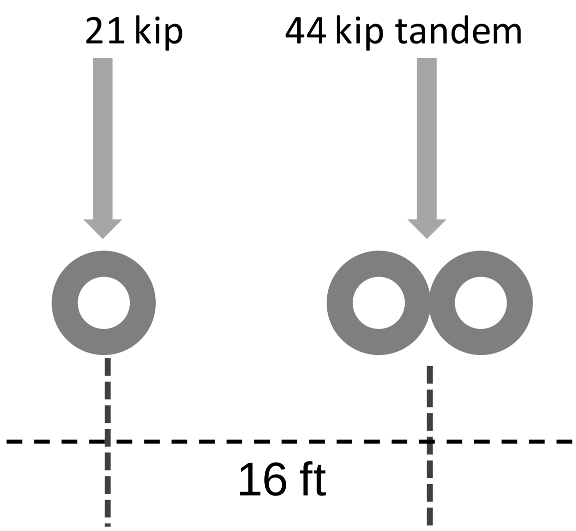


Figure 3.17: Garbage and Recycling Permit Configuration

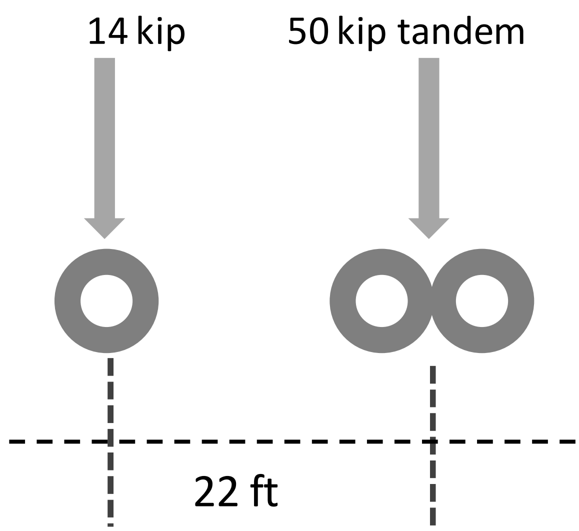


Figure 3.18: Cotton Module Permit Configuration

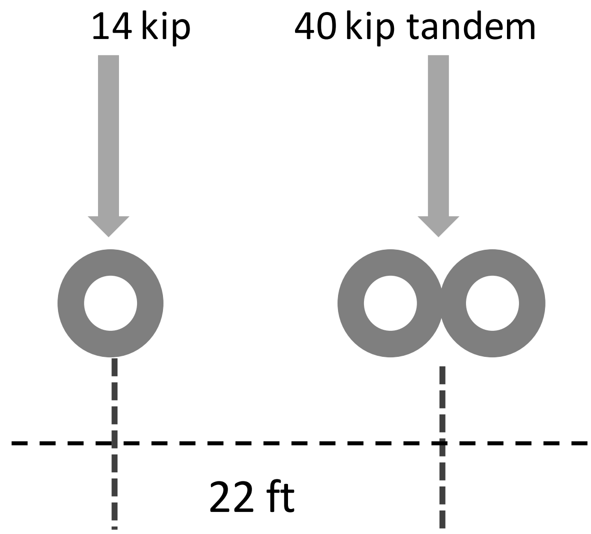


Figure 3.19: Chile Pepper Module Permit Configuration

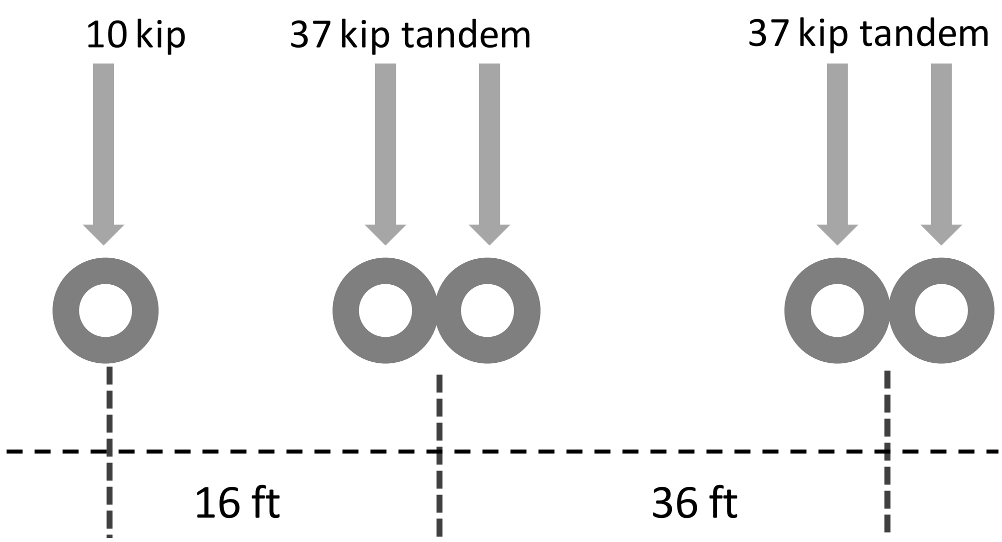


Figure 3.20: Aggregate Hauler Permit Configuration

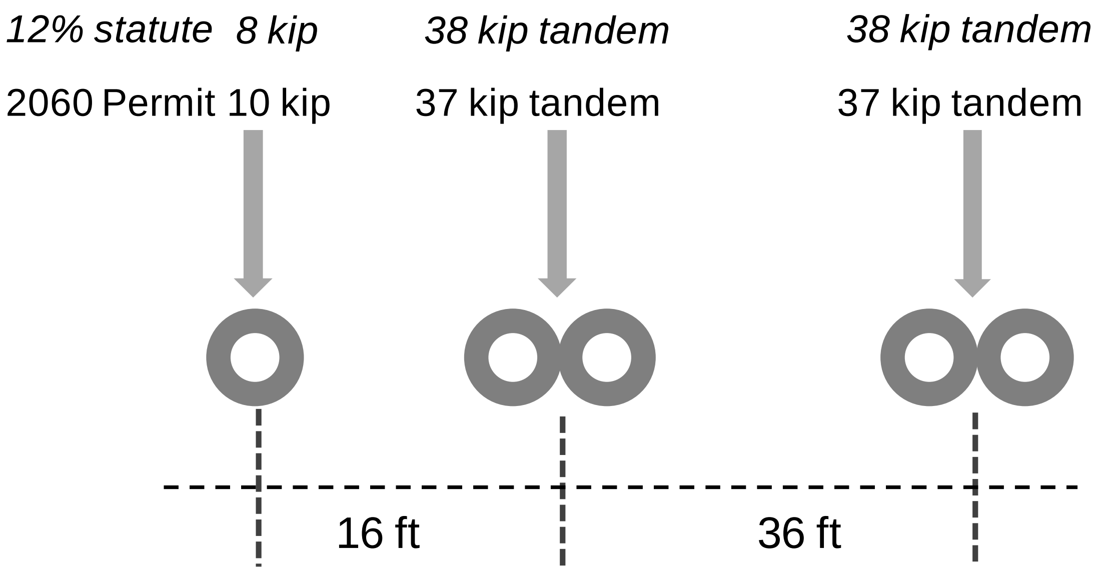


Figure 3.21: Grain Hauler Permit Configuration

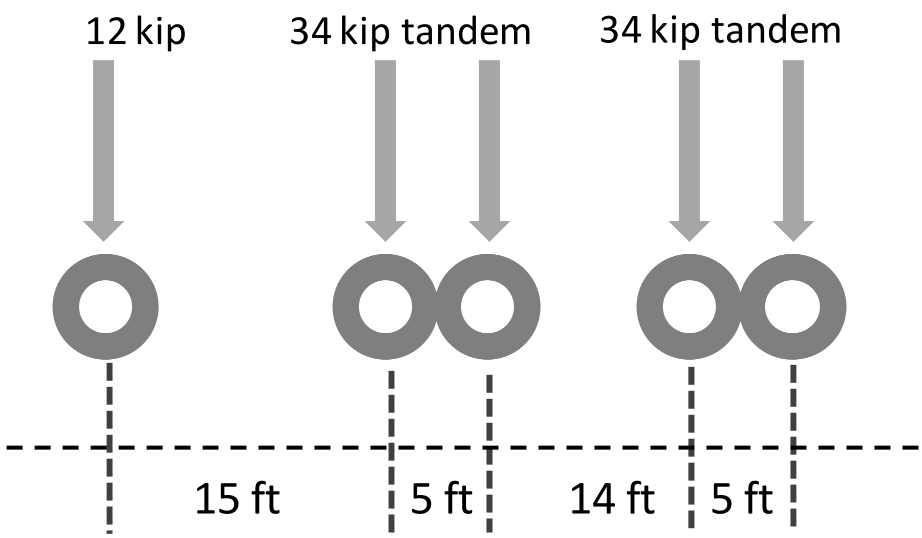


Figure 3.22: Logging Permit Configuration

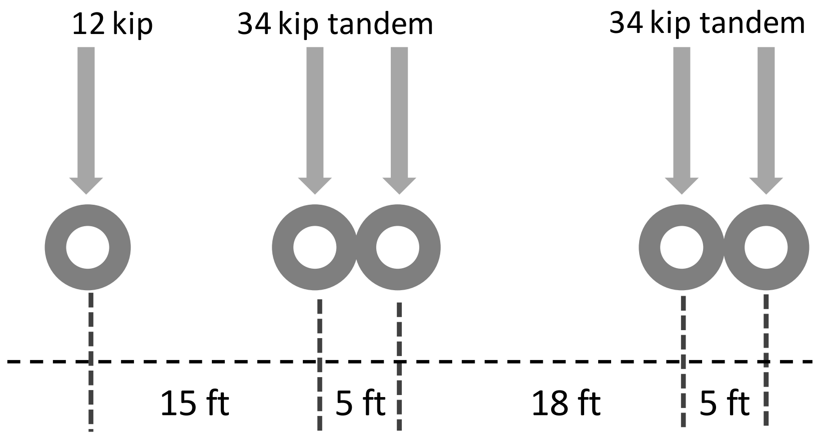


Figure 3.23: Milk Permit Configuration

3.8 Summary

This chapter documented the methodology for and results of the bridge consumption analysis developed for this project. Bridge consumption methodologies were developed and applied for routed and non-routed permits. Bridge consumption costs on a per-mile basis are summarized for the routed and non-routed permits in Tables 3.10 and 3.12, respectively.

Chapter 4. Cost Analysis

4.1 Introduction

Chapter 4 builds on work discussed in the first three chapters and focuses on identifying all costs associated with OS/OW infrastructure consumption, other impacts to state infrastructure, and costs associated with administration and enforcement of OS/OW permitting and operations. This chapter also provides the framework and equations for calculating total permit fees and the information necessary to analyze permit fees and revenue presented in Chapter 5. The revenue assessment presented in Chapter 5 uses actual FY 2011 permit revenues as the base year data that was provided by TxDOT's finance division (TxDOT, 2010). This information was compared to permit revenue estimates using the proposed new consumption cost methodologies presented in Chapters 2 and 3 and the additional permit costs identified in Chapter 4. The permit revenue amounts based on the new permit fees was calculated using the same number of permits sold in FY 2011 for key permit types that made up more than 90 percent of permit sales and permit revenue in FY 2011. Proposed new permits for exempt vehicles are also included in the Chapter 5 revenue assessment.

It is important to recall that the Rider 36 study addresses all OS/OW loads operating on the state system that include single-trip routed and non-routed permitted loads and OS/OW loads currently exempt from purchasing a permit by state law. In addition, based on information obtained during the course of this study and previous research studies, it is apparent that a percentage of OS/OW loads operate illegally. Consumption rates and other costs associated with exempt and illegal OS/OW loads are the most difficult to quantify due to lack of detailed information about numbers of vehicles, loaded and empty Vehicle Miles Traveled (VMT), and related factors. However, the research team has prepared estimates of the numbers of vehicles and related information associated with non-routed permitted and exempt loads based on an analysis of previous research, the Federal Motor Carrier Safety Administration's SAFERSYS.org database, information obtained from the TxDMV Enforcement Section (complaints investigation database), TxDMV vehicle registration information, and information obtained during the truck industry forum and interviews discussed in Chapter 1. An estimated number of exempt vehicles of each type is necessary to calculate revenue based on new permits for these vehicles. [FMCSA 2012] [TxDMV-ENF 2012]

As documented in Chapter 1, an extensive review of the Texas Transportation Code and other statutes was also conducted with respect to provisions governing OS/OW vehicles, including exempt vehicles, as well as associated laws in other states and other countries. The research team also reviewed legislation in our North American Free Trade Agreement (NAFTA) treaty partner countries: Canada and Mexico. Numerous interviews were conducted with officials representing TxDOT districts and divisions, Texas cities and counties, and various state agencies involved in OS/OW vehicle operations. Furthermore, interviews were conducted with personnel from various agencies in other states regarding OS/OW vehicle permitting, including longer combination vehicles. This information provided a baseline for determining how Texas and other states address exemptions for certain types of cargo or industries; allowable weight, width, length, and height limits; and other factors. This information also provided a basic understanding of the relationship between OS/OW laws and state statutes addressing size and weight enforcement and associated penalties. Based on previous studies, it is apparent that there must be a direct link and cooperation between OS/OW vehicle operators, state enforcement agencies, state legislators, and court judges (Batelle Team, 1995; Euritt, 1992; Lundy & McCullough, 1987). Two necessary aspects of an effective and equitable OS/OW permitting process are strong and effective enforcement of state truck size and weight laws and adjudication of fines.

The research team found that ensuring the safety of the traveling public, including OS/OW vehicle operators, is a primary strategic goal of the state legislature, TxDOT, TxDMV's Motor Carrier Division and enforcement section, and TxDPS size and weight enforcement section. Chapter 4 carefully documents costs associated with OS/OW operations, but it is also intended to emphasize the fact that due to weight and dimensions, OS/OW vehicles often must travel on lower volume routes that are least capable of transporting these loads in terms of load capacity, prevailing geometric design, and safety features.

Thus, the research team's efforts in identifying the costs associated with operation of OS/OW loads is also intended to underscore the need for additional funding to provide safe, efficient, and cost-effective routes for movement of OS/OW loads. Previous studies have discussed separating heavy vehicles from light duty vehicles along a transportation corridor to increase safety for both the general traveling public and heavy vehicle operators (Gonzalez-Ayala, McCullough & Harrison, 1993; NCHRP/NCFRP, 2010). If complete separation of heavy and light vehicles isn't possible, routes specifically designed to safely accommodate the weight, dimensions, and operational characteristics of heavy vehicles, including OS/OW loads, is a desirable alternative. This is not only due to the difference in the weight and dimensions of these permitted loads but also due to differences in the vehicles' operating characteristics, including turning, braking, ability to negotiate steep grades, and other related factors.

The research team anticipates that potential increases in OS/OW permit fees will provide the state legislature, TxDOT, cities, and counties with additional revenue to address safety aspects of OS/OW operations, as well as reimbursement of costs associated with increased consumption. The following sections provide a summary of costs associated with OS/OW vehicles and a proposed new permit fee structure. Note that because the Motor Carrier Division was transferred from TxDOT to TxDMV in 2012, cited references associated with MCD are published by both agencies.

4.2 Consumption Costs Associated with Oversize/Overweight Loads

Research results presented in Chapters 2 and 3 discuss the methodologies developed to calculate the associated cost (rate) per loaded VMT for pavement and bridge consumption, respectively. These methodologies consider the additional GVW and axle group weights above legal load limits, axle group configurations, and axle spacing. Methods developed to model the wide range of potential OS/OW vehicle configurations are modular in nature. This allows researchers to combine axle groups to model a particular vehicle/load configuration and determine load-related consumption costs. Therefore, OS/OW vehicle configurations can be modeled for a wide range of vehicle types to calculate new permit fee costs for 1) a single-trip routed permit, 2) a quarterly non-routed permit, or 3) an annual non-routed permit. In each case, only the load exceeding legal limits was considered when determining OS/OW vehicle consumption rates. Although this seems simple, the processes for accurately determining the marginal costs can be complex. The new load consumption cost methodology and models can also take into account potential reductions in consumption rates and lower permit costs that could result by adding axles, axle groups, or changing axle group spacing. In practice, accounting for consumption costs based on load, axle groups, axle spacing, and VMT is straightforward for a single-trip permit, because this information is required at the time the permit is purchased.

However, TxPROS does not currently offer features that allow permit purchasers to obtain a non-routed permit that considers axle configurations. Addition of these features may result in lower consumption costs and associated permit fees. Annual permit fees are typically flat rate or based on an increasing fee related to the number of counties in which a purchaser plans to operate. Therefore, truck configurations that incorporate additional axles are not reflected in the current fee structure, even though additional axles result in lower pavement and bridge consumption rates. In addition, the total VMT is not currently considered in state statutes or MCD OS/OW rules when calculating the cost of non-routed permits.

For a given OS/OW vehicle consumption rate/loaded VMT analysis, the research team identified an associated legally loaded vehicle configuration as the baseline for determining the marginal overweight axle and GVW loads. The baseline legal vehicle load limits were determined using the Federal Bridge Formula for a given vehicle configuration. For example, a three-axle straight truck is legally permitted to carry 34,000 lbs. GVW if the outer bridge axle spacing is at least eight feet and the individual axles of the tandem axle group are spaced at least four feet apart. The maximum legal GVW for a three-axle straight truck is 54,000 lbs. if the outer bridge axle spacing is at least 21 feet. The TxDMV website provides an online table showing the allowable axle group or total vehicle weight limits based on the federal bridge formula (TxDMV, 2012.)

Allowable load limits for a given route must also be determined. Load-zoned roads are posted at 58,420 lbs. GVW, whereas routes that allow the maximum legal load limits are rated at 80,000 lbs. GVW; 20,000 lbs. for single axle loads; 34,000 lbs. for tandem axle loads, and/or 42,000 lbs. for tridem axle loads. The marginal increase in consumption and related costs for a given OS/OW vehicle permit analysis must take into consideration the allowable legal load for a given vehicle configuration, the permitted vehicle load and configuration, and the load limit permitted for each route segment.

4.2.1 Total and Loaded VMT Calculations

The VMT traveled by single trip routed vehicles can be determined from the TxPROS database as an additional consideration. However, TxPROS contains no information regarding the VMT traveled by OS/OW vehicles for non-routed permits or for exempt vehicles. As previously mentioned, estimates of VMT for non-routed vehicles of different types were based on information obtained from the Federal Motor Carrier Safety Administration's SAFERSYS.ORG database and previous research (FMCSA, 2012; Luskin, Harrison, Walton & Zhang, 2000; Prozzi, Harrison & Prozzi, 2006). The SAFERSYS.ORG database includes information input by each company that applies for a new USDOT number or renews an existing number. The company also inputs the number of power units operated, total fleet VMT, number of drivers, and safety information regarding number of crashes, inspections, and other related information.

The research team developed a methodology to download data from SAFERSYS.ORG to an Excel spreadsheet to capture data for companies operating vehicles in Texas. This allowed researchers to build a database of companies and related vehicle and fleet VMT information for each particular permit type or current exemption statute. This data includes vehicles with registered USDOT numbers from other states operating on Texas roadways. Information about vehicles from other states operating in Texas was obtained from the DMV enforcement section database and the research team's observations of OS/OW vehicles operating on state roadways. Using this information, the research team computed the average VMT power unit for each company and the overall VMT, considering all companies associated with a given permit or exhibit vehicle type.

In some cases, data outliers were identified in SAFERSYS.ORG records and not considered in the calculations when it became evident the data was entered incorrectly. For example, a company reporting one power unit but 1,500,000 VMT was considered a mis-entry. Likewise, a company reporting 25 power units with a fleet VMT of 25,000, resulting in an average of 1,000 VMT for each power unit, was also considered erroneous.

Once outliers were removed, the average and median VMT per power unit were calculated along with the standard deviation. The VMT per power unit used in the permit calculations was determined by calculating the average VMT plus one standard deviation. Researchers made this decision after considering the large variations in VMT data. These variations were considered to be due in part to evaluating a mixed dataset for each permit or exemption type that typically included a few very large companies with hundreds or even thousands of power units and a much larger number of small companies that had only between one and five power units. In some cases, the research team observed that very large companies made up approximately 50 percent of the power units, while very small companies or an operator with a single truck made up the remaining 50 percent.

Once the VMT for a given permit type or exempt vehicle was calculated, a load factor was determined to arrive at the number of loaded VMT per power unit. Therefore, if a vehicle is loaded in one direction and empty on the return trip—this is typical for a vehicle that operates with a permit—the average VMT per power unit was multiplied by a load factor of 0.5. If a vehicle is only authorized by state statute to operate at higher axle load tolerances during harvest season, as is the case with various agricultural exemptions, the average VMT per power unit was multiplied by a load factor of 0.125 (0.25 [three-month seasonal harvest adjustment] x 0.5 [adjustment for being loaded in only one direction]) to obtain the total loaded VMT. Total loaded VMT adjustments were applied to each non-routed permitted or exempt vehicle accordingly.

It is possible to significantly improve VMT data for each routed or non-routed vehicle type by implementing a GIS-based permit system that includes an electronic system, such as a radio frequency identification (RFID) tag mounted on each permitted vehicle. The GIS unit would provide exact mileage information, while the RFID tag would provide information about the type of permit, vehicle, load, and company/owner. Using this method, there would be no assumption about the number of loaded VMT per year for a permitted vehicle. A permit purchaser would only pay for consumption based on the measured VMT traveled considering route load limits and the actual marginal consumption load/VMT rate.

In the absence of GIS-based VMT data for each vehicle and detailed information about exact vehicle configurations and loads, the analyses presented in Chapters 4 and 5 incorporate informed, simplified assumptions as described. Again, these simplifications were necessary due to the wide range in possible vehicle and load configurations associated with the hundreds of thousands of OS/OW permits sold by DMV-MCD and hundreds of thousands of exempt vehicles. The analysis methodology and related information is further discussed in case studies presented in Chapter 4. In addition, these informed assumptions are used to determine proposed new permit fees and the revenue assessment presented in Chapter 5.

It is important to again emphasize that the methodologies developed through this research can compute pavement and bridge consumption costs and the infrastructure operations and safety impact costs for any vehicle configuration. The simplifications used to develop the case studies presented in future sections are only to demonstrate and discuss how the new permit fees are calculated based on representative vehicles.

4.2.2 Permit Cost Components and Equations

The current MCD single-trip mileage permits and quarterly hubometer permit fees are calculated as shown in Equation 4.1. This permit fee equation is presented here because it includes the concept of a rate/mile for weights over the legal limit, as well as a rate/mile for widths and heights over the legal limit (TxDOT, 2011).

Actual mileage to be traveled x Highway Use Factor x Total Rate per mile x Registration Reduction x Indirect Cost Share = Permit Fee (4.1)

This permit fee equation provides for fee reductions if the permitted vehicle is registered for the maximum legal load (a 25 percent registration reduction) and also considers a highway use factor of 0.6 for single-trip mileage permits and 0.3 for quarterly hubometer time permits, further reducing the total cost of the permit. Based on a discussion with MCD personnel, the 25 percent registration reduction is not applied in practice due to the complexity of determining the registered maximum allowable GVW for a vehicle and calculating the reduction factor.

By comparison, the new consumption rate/VMT fee only considers the marginal cost for the load above legal load limits. The Highway Use Factor in equation 4.1 is analogous to the new load factor previously discussed. The Indirect Cost Share factor is discussed in following sections.

The Total Rate per mile calculation for a MCD single-trip routed permit is shown in Equation 4.2:

Total Rate per mile = [(6 cents per foot or fraction thereof for over legal width) + (4 cents per foot or fraction thereof for over legal height) + (4.5 cents x (weight for any axle or group of axles with a total weight of 20,000 – 25,000 lbs – legal axle weight/1000)) + (5.5 cents x (weight for any axle or group of axles with a total weight of 25,000 – 30,000 lbs – legal axle weight/1000))]. (4.2)

The Total Rate per mile for an MCD quarterly hubometer non-routed permit is shown in Equation 4.3:

Total Rate per mile = [(6 cents per foot or fraction thereof for over legal width) + (4 cents per foot or fraction thereof for over legal height) + (4.5 cents for any axle or group of axles with a total weight of 20,000 – 25,000 lbs) + (5.5 cents for any axle or axle group with a total weight of 25,001 – 30,000 lbs)]. (4.3)

The single-trip mileage and hubometer permits also include an Indirect Cost Share factor that apportions the cost of providing statewide OS/OW support services. This factor is determined by the state comptroller each year and is a flat rate. Currently, the Indirect Cost Share factor is 1.0305. Therefore, the total permit fee is calculated based on roadway usage and infrastructure operations and safety impacts (overwidth, overheight) rates multiplied by miles traveled (VMT) multiplied by the Indirect Cost Share factor, which accounts for statewide OS/OW support services.

The proposed new single-trip routed permit fee consists of different consumption/infrastructure operations and safety impact cost components as shown in Equation 4.4:

Total Consumption cost + Infrastructure operations and safety impact cost = (Pavement consumption rate + Bridge consumption rate + Overwidth rate + Overheight rate + Overlength rate) x (Total VMT x load factor). (4.4)

Where:
Total Consumption cost = total cost in dollars due to reduced pavement and bridge life

Infrastructure operations and safety impact = total cost in dollars from operations and safety impacts due to the width, height, and length of the OS/OW load that exceeds legal or design vehicle limits

Pavement consumption rate = pavement consumption cost per loaded VMT for a specific load and vehicle configuration in the case of a routed single-trip permit or the normalized cost per loaded VMT for a non-routed or exempt vehicle

Bridge consumption rate = bridge consumption cost per VMT for a specific load and vehicle configuration in the case of a routed single-trip permit or the normalized cost per VMT for a non-routed or exempt vehicle

Overwidth rate = cost per VMT for a specific load and vehicle configuration that exceeds the legal width limits; rate dependent on overwidth categories

Overheight rate = cost per VMT for a specific load and vehicle configuration that exceeds the legal height limits; rate dependent on overheight categories

Overlength rate = cost per VMT for a specific load and vehicle configuration that exceeds the legal or typical design vehicle length limits; rate dependent on overlength categories

Total VMT = the single-trip VMT while carrying the load or the estimated number of quarterly or annual VMT associated with a currently permitted, non-routed, or exempt OS/OW vehicle

Load factor = A factor multiplied by the total VMT to determine the loaded VMT for permit fee calculations. For example, in the case of a truck that is loaded in one direction and returns empty, the factor = 0.5 x total VMT = Loaded VMT.

Case studies are provided in later sections to show calculated permit fees for selected vehicles. These studies include associated rates/costs for each component in Equation 4.4. These examples illustrate the concepts, basis, and framework for determining the rate for each of these five consumption or operational impact cost components. Information is also provided to address OS/OW administrative and related costs identified in Equation 4.5.

Therefore, the proposed comprehensive OS/OW permit cost equation includes the components identified in Equation 4.4 plus additional components to incorporate costs that may not be directly considered in the current MCD permit fee structure that are associated with OS/OW loads. Equation 4.5 incorporates all identified cost components:

Total Permit Fee Cost = [(Pavement consumption rate + Bridge consumption rate + Overwidth rate + Overheight rate + Overlength rate) x (loaded VMT for permitted loads)) + (apportioned Administrative costs for (DMV- MCD + DMV-Enforcement Section) + (apportioned Administrative costs for TxDPS size & weight enforcement) + (apportioned costs for TxDOT data collection & surveys to support OS/OW permits) + (apportioned costs for TxDOT infrastructure upgrades to accommodate OS/OW loads) + (apportioned court costs accrued by the Office of the Attorney General (OAG)) + (Base fee paid to TxDOT) + (Base fee paid to General Revenue – non appropriated)] (4.5)

Where:

Consumption and infrastructure operations and safety impact cost components are as defined in Equation 4.4

Apportioned costs for DMV-MCD = Costs associated with development, implementation, continued maintenance, and upgrade of the TxPROS permit system, staffing, and salaries for MCD

Apportioned costs for DMV-ENF = Costs associated with DMV enforcement section operations, including investigations related to a pattern of OS/OW TxDPS citations for a given carrier

Apportioned costs for TxDPS S&W = Costs associated with TxDPS size and weight enforcement related to OS/OW vehicles

Apportioned costs for TxDOT = Costs for bridge and sign bridge envelope surveys and other information related to OS/OW operations; infrastructure upgrades such as modifying or replacing a bridge to increase clearance or redesigning an intersection to accommodate OS/OW loads

Apportioned costs for OAG = Court costs associated with TxDOT property damage claims and DMV enforcement investigations related to OS/OW operations referred to an attorney

Base fee paid to TxDOT = As established by state statute to compensate for reductions in other OS/OW registration or fee revenue sources redirected by the legislature

Base fee paid to GR = A portion of the base fee is currently paid to general revenue (Fund 1), non-apportioned

Equation 4.5 is consistent with and expands on the MCD single-trip mileage and quarterly hubometer permit equation concepts. However, the research team proposes it be applied to all permit types sold by MCD. The apportioned administrative costs, TxDOT data, and infrastructure costs and court costs could be replaced with a single factor to simplify the equation, as is currently done by the state comptroller in the case of the Indirect Cost Share factor identified in Equations 4.1 and 4.2.

The new total permit fee cost for currently permitted and exempt vehicles, whether routed single-trip permits, time permits, mileage, or non-routed permits, is determined using the components contained in Equation 4.5 as applicable. An OS/OW vehicle that operates at or below legal limits for one or more of these components will not be charged a fee for that particular component.

Application of overdimension infrastructure operations and safety impact costs for all OS/OW loads regardless of permit or exemption type is consistent with the concept of creating a level playing field that distributes consumption and infrastructure operations and safety impact costs among all permit purchasers. The following sections address each cost component in Equation 4.5 and present examples so that the methods and rationale associated with the cost calculations can be clearly understood.

4.2.3 Pavement Consumption

As discussed in Chapter 2, the pavement consumption rate/VMT analysis methodology is based on equivalent consumption factors that provide a means for calculating the cost of additional load above legal load limits for a given route independent of the commodity type. No particular industry or commodity is given preferential treatment; all OS/OW load types are on a level playing field with regard to permit fee costs. The cost for a given single-trip permit is based on the current permit rules and state statutes governing maximum permitted axle weights, axle spacing, and axle configurations.

4.2.4 Bridge Consumption

The bridge consumption rate/VMT analysis takes a different approach than the pavement analysis because bridges are location-specific, and the number and types of bridges along a given route can vary significantly. Based on the bridge team's analysis, it was determined, for example, that there are fewer bridges in West Texas than East Texas. Therefore, the consumption rate/VMT should be calculated considering these regional differences. Figure 4.1 depicts the demarcation line between West and East Texas, which is related to fewer or greater numbers of bridges respectively, and, the resulting differences in bridge consumption rates.

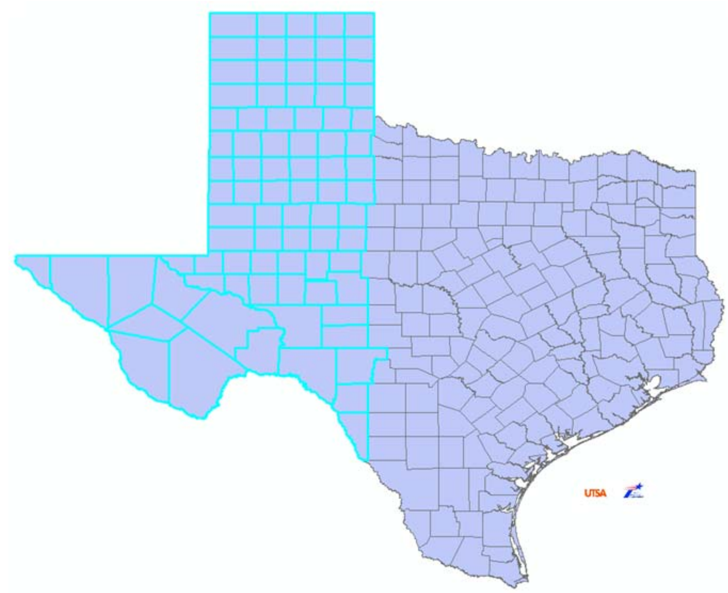


Figure 4.1: Texas Map Showing Demarcation Line between East and West Texas for Bridge Rate Analysis Purposes

For routed single-trip permits, detailed route information, including the specific bridges that will be crossed, is based on the Bridge Inspection and Appraisal Program (BRINSAP) database. This information, along with load configuration, is used to compute bridge consumption rates using the methods described in Chapter 3.

Case Study 1: Single-trip permits and routed permits—pavement and bridge consumption only

Single-trip routed permits are easiest to model because the route is known, as is the percentage of loaded VMT traveled on IH, US, SH, and FM pavements that are posted at legal load limits or load-zoned limits. The pavement consumption cost for a particular vehicle configuration and load can therefore be computed by determining the associated equivalent consumption factors for each route segment, the length of each route segment, and the associated consumption rate/loaded VMT.

A sample case study is given below that considers a typical configuration for a general OS/OW permitted vehicle. The study provides pavement and bridge consumption costs only. Later sections address overdimension rates. Figure 4.2 shows an example of a mid-heavy OS/OW load traveling along an IH frontage road, southbound. This vehicle is representative of a single-trip routed permitted load. This configuration includes 10 axles in five groups, including three tandem axles, one tridem axle, and one steering axle. This photo is shown for illustration purposes only; the actual configurations used in Case Study 1 vary by weight class.

Figure 4.2: General OS/OW Single-Trip Mid-Heavy Range Load Example

Single-trip routed permits are only available for non-divisible loads. MCD single-trip non-divisible load permits have been developed for weight class categories that also provide additional width, length, and/or height allowances that exceed legal dimension limits. The total value of the permit is therefore related to increased load and increased dimensions that exceed legal limits.

Sample calculations are presented below for a representative vehicle at the upper load range for each general OS/OW single-trip weight class. In practice, the new rate/VMT would be computed for a specific route, load, and vehicle configuration in order to consider different route and pavement types, as well as the specific bridges along the route. Therefore, the need for specific weight classes would no longer exist. Table 4.1 shows the costs for each weight class for an assumed trip length of 300 miles.

Table 4.1: Example Consumption Fees for General OS/OW Single-Trip Permit Weight Classes

Weight Class	Pavement Rate	Bridge Rate	Composite	Consumption Fee	HWY Maintenance Fee FY 2011
80,001–120,000 lbs.	$0.347	$0.231	$0.58	$173.39	$150
120,000–160,000 lbs.	$0.494	$0.377	$0.87	$261.37	$225
160,001–200,000 lbs.	$0.648	$0.485	$1.13	$340.04	$300
200,001–254,000 lbs.	$0.861	$0.896	$1.76	$526.99	$375

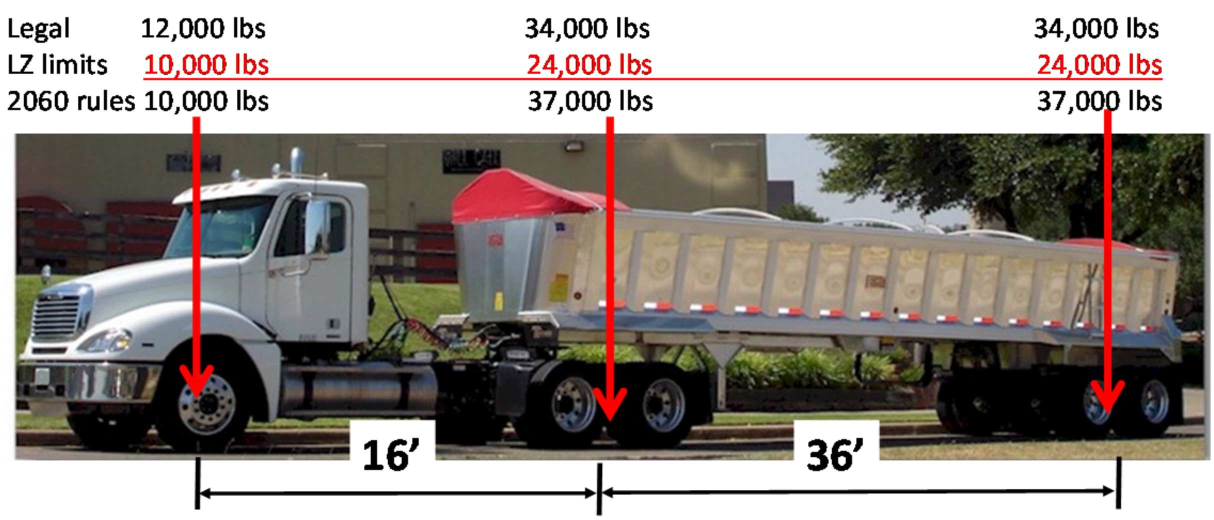
The rates shown in Table 4.1 are examples only and do not represent the actual proposed cost of a single-trip permit for each of these weight classes. The permit fee cost for an OS/OW load would be based on actual axle group weights and spacing, vehicle/load dimensions, route characteristics, and loaded trip VMT. Therefore, the permit cost would be computed for each individual OS/OW load based on these factors and could vary depending on vehicle configuration and other considerations.

Table 4.1 illustrates how an OS/OW permit purchaser could potentially reduce overall permit cost by configuring the OS/OW transporter with additional axles and/or different axle spacing that reduce pavement and/or bridge consumption rates. The research team recommends that TxDMV and TxDOT consider a new analysis module for TxPROS that allows a permit purchaser to determine the optimum vehicle configuration to minimize consumption rates and related permit fee costs along a given route.

Case Study 1 only considers pavement and bridge consumption rates and will be revisited in a later section to address overdimension infrastructure operations and safety impact costs and rate/VMT for a vehicle in each weight class that is overheight, overwidth, and/or overlength.

Case Study 2: 2060/1547 non-routed permit

The 2060/1547 over-axle tolerance permit is used as an example to show the method for calculating pavement consumption costs using a normalized rate for a non-routed permit. A 2060/1547permit authorizes a five-axle tractor-semi trailer truck to operate on load-zoned roadways and routes with legal load limits (not including IHs) at a maximum GVW of 84,000 lbs (5 percent GVW tolerance) and a 10 percent over-axle tolerance for single axle and tandem axle loads as long as the total GVW tolerance is not exceeded. A typical 2060/1547 permitted truck has an assumed load distribution as shown in Figure 4.3.



Source: CKJ Trucking website: http://www.ckjtrucking.com/

Figure 4.3: Typical Tractor-Semi Trailer Configuration for a 2060/1547 Permitted Vehicle

A typical 2060/1547 permitted vehicle travels 100,000 miles per year (Luskin, 2000). For this analysis, the research team assumed that the loaded VMT represent 50 percent of this number or 50,000 loaded VMT per year.

The pavement consumption analysis methodology provides a normalized consumption rate of seven cents per VMT. This rate is based on an analysis that calculates the total consumption cost on a 50,000-mile route composed of different route segments, including legal and load-zoned roadways. The normalized rate was determined by calculating the weighted average consumption based on the percentage of VMT traveled on load-zoned and legal load route segments including IH, US, SH, and FM roads.

Note that the percentage of VMT traveled on each route type can vary between markets located in metro regions and those located in rural regions depending on the commodity and other factors. Future enhancements to the permit fee calculation process could include consumption rates/VMT adjusted by region or for each county selected for a non-routed permit.

The research team used a Monte Carlo simulation approach to apply OS/OW load applications to bridges on randomly selected routes for the number of loaded annual VMT determined. The team performed multiple simulations for the same vehicle load and axle load/spacing configuration to determine if the resulting rates based on different runs were essentially equivalent. Analyses showed that the Monte Carlo simulation approach is robust and results in a normalized consumption rate/VMT that varies within tenths of a cent when considering multiple runs. Normalized rates for non-routed and exempt vehicle load and axle spacing configurations were determined and subsequently converted to a rate/loaded VMT consistent with the pavement consumption rate/loaded VMT concept. The total consumption costs for all bridges considered during the Monte Carlo simulation were divided by the total loaded VMT to arrive at a bridge consumption rate/loaded VMT.

Monte Carlo simulations were performed for routes in West and East Texas because of the difference in total bridge number in these regions. Normalized non-routed permit rates were calculated as the average consumption rate for the East and West regions for a given vehicle configuration.

Using the same vehicle configuration and related factors utilized for the pavement non-routed analysis (based on the 2060/1547 permit configuration), a non-routed five-axle truck traveling 50,000 loaded VMT results in a bridge consumption rate of 6 cents/VMT. This is an average between the bridge rate per mile for East Texas (7.6 cents/VMT) and West Texas (4.6 cents/VMT) for this particular vehicle configuration and the percentage of VMT traveled on each route type, including legal and load-zoned roadways.

The normalized total consumption rate is 7 cents/VMT for pavements and 6 cents/VMT for bridges for a normalized rate of 13 cents/VMT. The total annual consumption cost for a 2060/1547 permitted vehicle is 13 cents/VMT x 50,000 loaded VMT = $6,500. Because a 2060/1547 vehicle is within legal dimensions, there are no additional costs for overwidth, overheight, or overlength infrastructure operations and safety impacts.

4.3 Exempt Vehicles

State statute provides 18 vehicle weight, dimension, or operational exemptions. These provisions identify certain types of vehicles and/or vehicles carrying specific commodities that are

- exempt from legal allowable axle and/or GVW weights or weight tolerances; and/or
- allowed to have shorter minimum inner or outer bridge lengths; and/or
- allowed to operate above legal dimensions; and/or
- allowed to cross non-controlled access state roadways above legal weight/dimension limits without a permit.

These exemptions do specify weight or dimension limits within which exempt vehicles must operate. These vehicles are in no case exempt from any weight or dimension limits at all.

The majority of exemptions are applicable year round; however, certain exemptions, such as those for agricultural operations, apply only during the harvest season. General or specific exemptions are also provided for vehicles that exceed legal dimensions. A summary of the state statutes and vehicle size and weight exemptions was published by MCD and can be seen in Table 1.2 in Chapter 1. It can also be accessed at the MCD website (TxDOT, 2011).

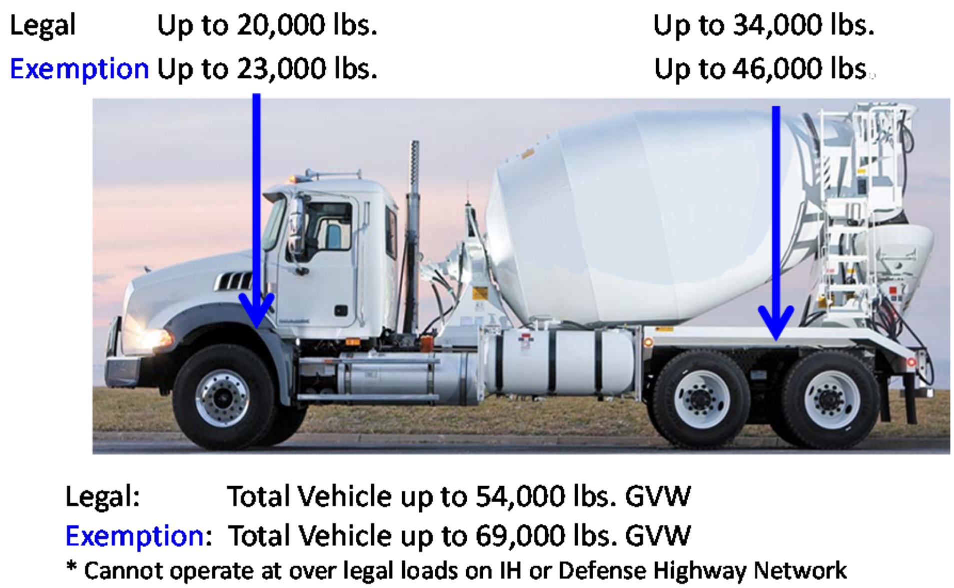
The research team recommends that certain exemptions be excluded from consideration for a permit fee (Table 4.2). The exemptions and rationale for exclusion are as follows:

Table 4.2: Recommended Exemptions Excluded from Permit Consideration

Transportation Code Section	Type of vehicle/commodity being moved	Rationale
622.9018	OS/OW farm implements transported locally by the owner.	Local use only for short distances; difficult to enforce.
621.302	Grocery and farm products transported on load-zoned county roads and bridges.	County roads and bridges are load-zoned by the County Commission with TxDOT District Engineer approval. TxDOT is not responsible for maintenance and repairs.
621.206(b)	Exemption from 3’ maximum front extension for garbage trucks.	Extension exemption primarily for front load garbage trucks that must use a hydraulic front forklift for dumpsters. During this operation, garbage trucks are stopped.
622.061	Exemption for vehicles transporting poles or pipes may operate on the state system if <= 65’.	Legal length limits for semi-tractor truck trailers, tractor-trailer units carrying cars, or boats equal or exceed these length limits.
622.952	Exemption for fire trucks operating at over legal axle weights based on the manufacturer’s axle/suspension/tire weight limitations.	Fire trucks operate as a community service and are non-profit.
602.902	Length exemption for fire trucks.	Fire trucks operate as a community service and are non-profit.
602.903	Exemption allowing 6” extension for rear view mirrors on recreational vehicles.	Exemption is for safety reasons and for a personal vehicle that is operated not-for-profit.
623.051	Exemption for certain OS/OW vehicles crossing a state highway but excluding controlled access roads when crossing from private property to private property.	State statutes require vehicle operator to indemnify the TxDOT to repair any damage caused.
MCD Rule § 28.16	Military vehicles that are OS/OW must apply for a permit but are exempt from paying a permit fee or posting a bond.	Military vehicles are operated by the U.S. government, which can reimburse TxDOT for any damage incurred.

Case Study 3: Exempt vehicle—Ready mixed concrete truck permit fee calculation

Sections 622-017–622.022 of TC provide allowable maximum GVW and axle load exemptions that are above legal load limits for ready mix or concrete pump trucks. A typical three-axle ready mix truck is shown in Figure 4.4. There are many ready mix or concrete pump truck vehicle configurations.



Source: Baker Ready Mix website: http://www.bakerreadymix.com/

Figure 4.4: Ready Mix Truck—Typical Configuration with Exempt Allowable Axle and GVW Loads

The research team conducted an analysis for a three-axle ready mix truck operating at the maximum allowable exemption weight limits. Ready mix trucks that operate with a booster axle or pusher axles or that operate at lower than maximum exemption weight limits could have different consumption rate/loaded VMT values. The five-axle ready mix truck depicted in Figure 4.5, which would have a different consumption rate/loaded VMT, is used as an example of another potential configuration for this vehicle.

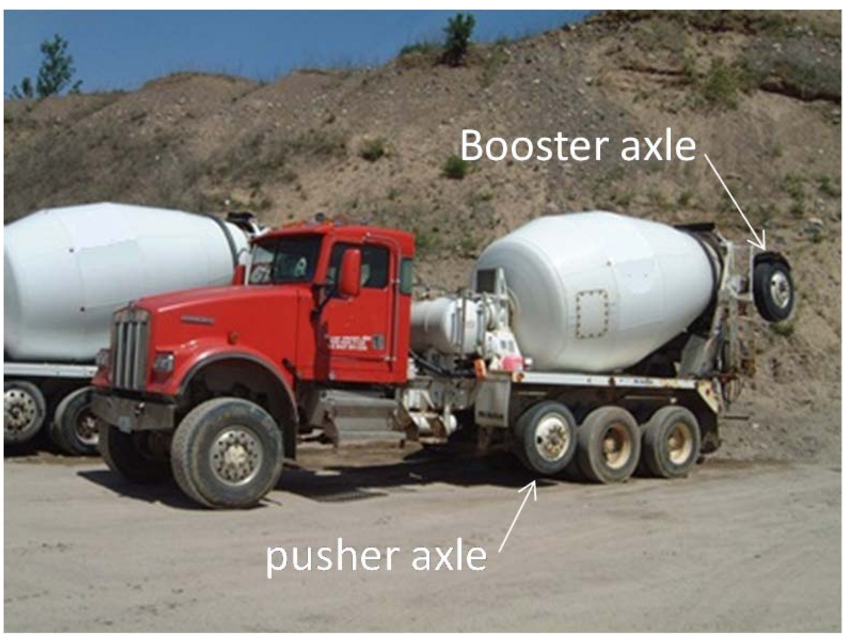


Figure 4.5: Five-Axle Ready Mix Truck with Pusher and Booster Axles

The pavement and bridge consumption analysis methodologies described in Case Study 2 resulted in a consumption rate of 19 cents/VMT for pavements and 11 cents/VMT for bridges for a normalized rate of 30 cents/loaded VMT. Researchers determined the normalized rate by calculating the weighted average consumption based on assumed percentages of VMT on load-zoned and legal load route segments, including US, SH, and FM roads. According to information provided by SAFERSYS.ORG, a ready mix truck in Texas averages 40,000 VMT per year. The load factor used for a ready mix truck is 0.5, which resulted in 20,000 loaded VMT per year. The pavement and bridge consumption permit fee cost is 20,000 loaded VMT x a normalized rate of 30 cents/mile = $6,000 per year.

The following sections discuss the methodology developed to determine rate/VMT for overdimension vehicles.

4.3.2 Over Legal Dimension Loads

Thousands of lane miles of existing rural and suburban roadways were not originally designed to carry today's heavy legal truck loads, exempt vehicle loads, or OS/OW permitted loads that exceed legal dimensions and/or load magnitudes. A typical truck configuration for which these roads were originally designed is shown in Figure 4.6.

Source: Ken Goudy 2010

Figure 4.6: Three-Axle Tractor-Semi-Trailer Unit of the 1940s–1950s

Much larger and heavier vehicles often travel on legal load limit state routes or on load-zoned FM roads using a non-routed OS/OW permit or a single-trip routed OS/OW permit. The need to transport these heavy vehicles on load-zoned roads may be due to the location of a rural quarry, farm, ranch, residential or commercial building site, or other facility. Single-trip routed OS/OW loads may require a route plan that includes rural FM roads when traversing bridges, ramps, intersections, other route geometric features and clearance restrictions on higher functional class urban routes.

Vehicles with weights and/or dimensions that exceed legal limits can be a safety and operational concern when they travel along narrow routes. Heavy loads applied next to or on an unsupported pavement edge can result in edge failures, rutting, cracking, and deteriorated ride conditions. Lack of a paved shoulder can result in damage to the pavement edges from legally loaded heavy trucks, as well as OS/OW loads. In addition, lower volume rural collector roads may have reduced clear zone widths and fewer safety treatments than urban routes with higher traffic volumes.

Lower type two-lane FM roads also may not have pavement edge striping or options for installing edge or center line rumble strips or rumble stripes (dimensional striping). This is due to narrow paved shoulder widths or no paved shoulder in addition to a seal coat pavement surface that cannot be milled like an asphalt concrete surface to produce a safety rumble strip.

Figure 4.7 depicts an 18-wheeler on a narrow FM road that has moved off the paved surface. Note that this roadway does not have edge striping or other features that help distinguish the paved surface edge during inclement weather or at night. Current budget constraints and other factors limit the ability of districts to add paved shoulders and safety treatments on routes of this type.

Figure 4.7: Five-Axle Tractor Trailer Unit on a Narrow FM Road with No Edge Striping or Paved Shoulder

A large percentage of crash fatalities occur on rural roads. TxDOT manages rural road safety through the Hazard Elimination (HES) program and the High Risk Rural Road (HRRR) program (TxDOT, 2008). The guidelines for these programs and the benefit/cost equations used to help select funded projects are in the TxDOT Highway Safety Improvement Program Manual. This manual provides guidelines that address several factors including average daily traffic, crash rates, number of fatalities and injuries, and other factors associated with costs and benefits to evaluate different treatment options. The average cost figures for fatal and injury crashes are provided annually to each district during the Safety Improvement Program call.

Currently, there are no factors that directly consider the number or percentage of heavy vehicles and/or OS/OW permitted vehicles for evaluating a rural route or specific location using the Safety Improvement Index calculations. The research team recommends that further research be conducted to include factors that consider the operation of legally loaded heavy vehicles and OS/OW permitted vehicles in Safety Improvement Index calculations, particularly in cases when a rural road is frequently used for permitted loads.

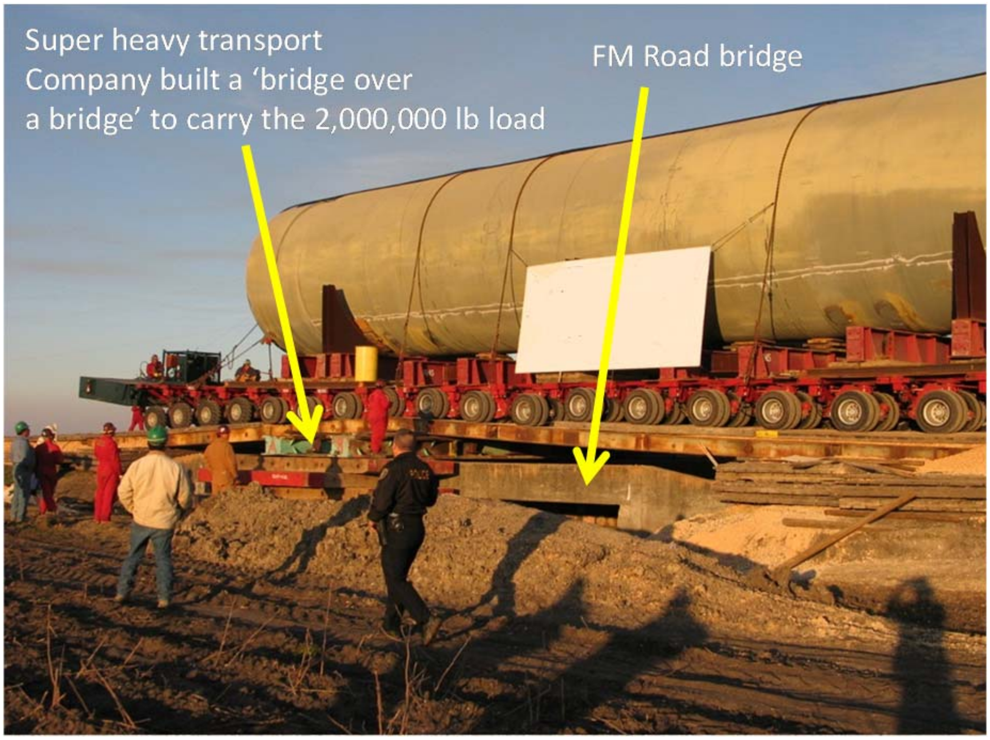
Depending on load magnitude, narrow FM roads can suffer immediate, extensive damage due to mid-heavy and super-heavy loads. The companies transporting these loads are responsible for repairing or paying the repair cost for damage caused by heavy loads or vehicle dimensions. However, in some cases, the responsibility for these repairs has been challenged and resulted in court proceedings. Figures 4.8 through 4.10 depict a super-heavy load that caused severe pavement damage to county and state roadways during transport. The company did repair the damage; however, these photographs demonstrate the potential damage that can occur on routes that were not designed to carry loads of this type.

Source: John Bilyeu—CST

Figure 4.8: 2,000,000 lb. GVW Hydrotreater Reactor on Narrow FM Road

Source: John Bilyeu—CST

Figure 4.9: Severe Rut Damage Occurring under Heavy Wheel Loads due to Lateral Shear Failure



Source: John Bilyeu—CST

Figure 4.10: Temporary Bridge Built over an FM Road Bridge that Could Not Carry the Load

Figures 4.11 through 4.17 illustrate operational constraints due to route geometry, including lane width and route horizontal and vertical curve alignments. In each case, MCD selected routes that could accommodate the load size and weight and also considered the safety of the traveling public, the load transport crew, and the load being transported.

However, as these photos show, transporting OS/OW loads can result in damage to TxDOT property depending on circumstances, including the transporter's adherence to the permitted route and permit rules. The impacts due to OS/OW loads depicted in these photographs was documented at the time the damage occurred. Therefore, negotiations with the responsible party could be conducted to seek damage claims and reimbursement. This is not always the case.

In addition, OS/OW loads, including currently exempt loads, are transported on the state highway system without a permit. Therefore, the transport company or vehicle driver does not have the benefit of a prior assessment of the pavement and bridge load capacities, bridge and other clearances, or related information regarding construction work zone restrictions, newly placed paved surfaces that cannot yet accommodate high axle loads, and other factors.

Documentation regarding the number of incidents and extent of damage due to illegal OS/OW loads or unpermitted exempt loads is not available. However, anecdotal evidence obtained during interviews with TxDOT district and division personnel suggests that 50 to 70 percent of property damage from crashes is due to hit-and-run incidents for which there is no police report.

The researchers emphasize that not all TxDOT property damage is caused by OS/OW loads; however, in the case of bridge overpass and traffic signal hits, overheight loads were definitely involved. When no police report exists or the damage was done by a hit-and-run driver, the costs to repair this damage must be absorbed by the TxDOT district in which the damage occurred. This means that the district's maintenance or construction budgets must fund repairs to TxDOT property that exceeds millions of dollars each year, thus requiring delay of planned repairs, replacement, or upgrades to other portions of the state highway system.

Figure 4.11: Long Load Negotiating a One-Lane Ramp that Required Driving off the Paved Surface

Figure 4.12: Vehicle Queue Forming behind OS/OW Vehicles Transporting Manufactured Housing

Figure 4.13: The dimensions and operational characteristics of OS/OW loads can affect other drivers' behavior.

Figure 4.14: Driver overtaking Manufactured Housing on Wrong Side of Road

Increased funding to add shoulders, signing, and other safety features on rural roads can help reduce poor driver decisions and potential crashes.

Source: John Bilyeu—CST

Figure 4.15: Super-heavy Load Negotiating a Steep Grade with Resulting Damage to a New Seal Coat

Source: John Bilyeu—CST

Figure 4.16: Seal Coat Picked Up by Drive Axles of Prime Mover Due to High Surface Shear Forces

Source: John Bilyeu—CST

Figure 4.17: Damaged Seal Coat from Super-heavy Load Prime Mover Tandem Drive Axles

In this particular case, permit rules were not followed because the super-heavy load was required to use two prime movers to transport the load. The driver of the smaller, white prime mover first attempted to transport the 570,000-lb. boiler up the steep grade, causing damage to the pavement surface due to high shear forces at the pavement interface and the drive axle tires. The single prime mover was unable to transport the load up the grade, at which point a second prime mover was summoned to provide the additional power required.

Damage to FM roads also occurs due to exempt vehicles and other types of OS/OW vehicles that carry less weight or are smaller than the vehicles shown in the previous figures. Figures 4.18 and 4.19 depict a heavily loaded three-axle, exempt agricultural truck operating along a newly rehabilitated FM road and the resulting pavement damage.

Figures 4.20 through 4.22 show pavement damage to asphalt surfaced FM roads in the Bryan District due to heavy trucks entering and leaving a collection point or repeatedly traveling the same route. Rutting is not only a structural concern for pavement engineers but also can be a steering safety hazard for motorcycles and small cars. In addition, rutting can pond water during a rain, causing hydroplaning. TxDOT maintenance forces work to identify and repair rutted pavements using localized repairs or reconstruct short sections, but insufficient funds are available to address all maintenance needs caused by legally loaded heavy trucks and OS/OW permitted vehicles.

Figure 4.18: Heavily Loaded Three-Axle Straight Truck Transporting Farm Products on an FM Road

Figure 4.19: Severe Rutting and Shoving Due to Heavy Axle Loads from Three-Axle Farm Trucks

Source: Darlene Goehl—Bryan District

Figure 4.20: Asphalt Concrete Pavement with Wide Surface Rut Due to Repeated Heavy Loads

Figure 4.21: Heavy Trucks Operating along a Narrow FM Road and Resulting Pavement Deformation

Figure 4.22: Excessive Surface Deformation from Heavy Wheel Loads near the Pavement Edge

Although not included as an objective in this study, the research team and TxDOT acknowledge the economic contributions and benefits that Texas enjoys as a result of the products and services transported by the trucking industry, including OS/OW operators. These photographs are intended to demonstrate that the roads traveled by modern trucks, including OS/OW loads, were not designed to carry these loads. Additional revenue is needed to address the maintenance, repair, and rehabilitation of these routes and to upgrade safety to improve transportation service for all Texans. The research team recommends that further studies be conducted to identify the benefits the trucking industry confers to the state economy and to develop methods for incorporating these benefits as part of a more comprehensive OS/OW permit analysis process.

4.3.3 Legal Vehicle Dimensions

The legal maximum vehicle dimensions in Texas are 8 feet 6 inches in width and 14 feet for height. Legal length varies depending on the vehicle combination. State statutes permit different maximum lengths depending on the type of vehicle or vehicle combination as noted below (TxDOT, 201):

1. Tractor-stinger steered semi-trailer carrying automobiles or boats: length <= 75’
2. Traditional tractor-trailer carrying automobiles or boats: length <= 65’
3. Truck and full trailer combination: length <= 65’
4. Truck and semi-trailer combination: length <= 65’
5. Truck tractor length: no length limits
6. Semi-trailer length: single unit <= 59’ as measured from the king pin to the rear of the trailer; for two trailer units, 28’ 6” from kingpin to the rear of the first trailer; and 28’ 6” total trailer van box length for the second trailer
7. Truck tractor-semi trailer length: overall length unlimited
8. Maximum length permitted without a route and traffic study: 125’

The TxDOT Roadway Design Manual provides guidelines for minimum, maximum, and desirable design criteria and other factors related to roadway widths, horizontal and vertical geometry, and turning radii to accommodate long combination vehicles that exhibit off-tracking and other factors (TxDOT, 2010). Although the 2010 TxDOT Roadway Design Manual is helpful to understand current design criteria in relation to OS/OW load width, height, and length, the research team again emphasizes that a significant number of rural roadway lane miles were designed using design criteria from previous decades that do not necessarily comply with current design standards.

The next sections provide additional information regarding overwidth, overheight, and overlength considerations for OS/OW loads with regard to costs and appropriate per mile rates.

4.3.4 Over Legal Width

Overwidth loads are common on all route classifications in Texas. Figures 4.23 through 4. 25 depict typical overwidth loads.

Figure 4.23: Overwidth and Overheight Load IH 35 NB—Austin District

Figure 4.24: Manufactured Home on IH 35 SB Frontage Road—Austin

Figure 4.25: Transporter with Cylindrical Bales of Hay—up to 12' Wide

The width of a highway travel lane varies depending on route type and whether the route is in a rural or urban location and other factors. Table 4.3 contains a summary of the total lane miles of roadway by route type and lane widths based on the FY 2012 Pavement Management Information System (PMIS) database (TxDOT, 2012).

Table 4.3: Number of Lane Miles Summarized by Route Type and Lane Width (ft.)

Number of Through Lane-miles by Route type and Lane width							
Route Type	**>13'**	**13'**	**12'**	**11'**	**10'**	**9'**	**8'**
IH	356	122	13,147	797	47		
IH FR	546	472	3,629	588	3,711	3	37
US	3,209	4,247	26,343	1,816	463	163	
US FR	111	54	1,462	168	1,349		
SH	3,524	4,140	25,461	4,096	2,064	490	
SH FR	1,287	438	534	256	280		
BU or BI	772	284	1,514	450	144	15	
FM / RM	3,364	6,065	28,539	11,105	33,072	2,859	54
Sub-Totals	13,169	15,822	100,628	19,276	41,130	3,530	91
Total	193,646						

Table 4.3 does not include park or recreation road lane mileage. Based on Table 4.3, approximately 33 percent of state-maintained lane miles are less than 12 feet in width, and 23 percent of lane miles are equal to or less than 10 feet in width.

Referring again to Table 4.3, lane widths greater than 12 feet typically occur along roadway segments where the number of lanes is transitioning or at the approaches to an intersection, particularly on higher functional class routes. These roadway segments are relatively short in length. Therefore, the total number of lane miles listed in Table 4.3 for lane widths exceeding 12 feet does not imply that there are continuous routes of substantial length on the state roadway network with 13-foot-wide or wider lane widths.

Figures 4.26 and 4.27 show lane transition areas on US 281 associated with a 'Super 2' three-lane section and the approaches to a major at grade intersection. The summation of individual route segments at transition areas, and intersection approaches as depicted comprise a significant portion of the 13-foot-wide lanes or more listed in Table 4.3. In addition, a FM, SH, or US route can be a higher functional class roadway, particularly when located in or near a metro or urban area. Examples are FM 1960 in the Houston District, US 183 in the Austin District, and State Loop 1604 in the San Antonio District.

Figure 4.26: Extra-Wide Lane within Transition from One to Two Lanes on "Super 2" Route on US 281

Figure 4.27: Extra-Wide Lanes within the Vicinity of a Major At-Grade Intersection along US 281

Although the largest percentage of travel lanes less than 12 feet in width are located in rural areas, quite often OS/OW loads, and in particular overdimension loads, must be routed along rural roads to bypass low clearance overpasses and sign bridges. In addition, routes must be avoided that include ramps or interchange connections with geometric features that do not accommodate the OS/OW transporter widths, heights, or lengths and trailer off-tracking characteristics. As a consequence, MCD rules specify that a load more than 16 feet in width will not be routed on the main lanes of a controlled access highway unless an exception is granted based on a route study (MCD, 2011). Construction work zones or routes with concrete traffic barriers or other types of longitudinal barrier safety features can also create width restrictions that require overdimension loads to be routed on lower type roadways.

For evaluation purposes, Table 4.4 presents width, length, and height statistics from 2,000 TxPROS OS/OW permits, along with the current MCD per-mile rates for overwidth and overheight categories. These categories are based on increments provided by TxDMV-MCD for single trip mileage and quarterly hubometer permits as previously discussed when defining the terms in Equations 4.1 and 4.2. Note that MCD currently does not provide a rate/mile for overlength loads. The research team proposes the rate/VMT categories shown be discussed in more detail in a later section. It is proposed that these rate categories be applied consistently to all permits regardless of vehicle or commodity type.

Table 4.4: Number of Permits and Rate/Mile Width, Height, and Length Categories for 2,000 General OS/OW Single-Trip Permits

Infrastructure Operations and Safety Impact Fee Schedule														
	OS/OW Widths summarized by category													
Category	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
Width Categories	<= 8'-6"	8'-7 / 9'-6'	9'-7 / 10'-6'	10'-7 / 11'-6'	11'-7 / 12'-6'	12'-7 / 13'-6'	13'-7 / 14'-6'	14'-7 / 15'-6'	15'-7 / 16'-6'	16'-7 / 17'-6'	17'-7 / 18'-6'	18'-7 / 19'-6'	19'-7 / 20'-6"	20'-7" -21'-6"
Number of Permits/Category	343	98	267	219	479	175	258	70	49	10	12	2	8	10
Current MCD rate / VMT	0	6¢	12¢	18¢	24¢	30¢	36¢	42¢	48¢	54¢	60¢	66¢	72¢	78¢
	OS/OW Heights summarized by category													
Category	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
Height Categories	< 14'-1"	14'-1" -15'	15' -1"- 16'	16'-1" - 17'	17'-1" - 18'	18'-1" - 19'	19'-1" - 20'	20'-1" - 21'	21'-1" - 22'	22'-1" -23'	23'-1" - 24'	24'-1" - 25'	25'-1" - 26'	26'-1" - 27'
Number of Permits/Category	1081	423	398	77	15	2	3	1	0	0	0	0	0	0
Current MCD rate / VMT	0	4¢	8¢	12¢	16¢	20¢	24¢	28¢	32¢	36¢	40¢	44¢	48¢	52¢
	OS/OW Lengths summarized by category													
Category	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
Length Categories	< 82' ^	82'-1" - 90'	90'-1" - 100'	100'-1" - 110'	110'-1" - 120'	120'-1" - 130'	130'-1" - 140'	140'-1" - 150'	150'-1" - 160'	160'-1" - 170'	170'-1" - 180'	180'-1" - 190'	190'-1" - 200'	200'-1" - 210'
Number of Permits/Category	997	279	256	228	86	60	16	41	5	6	15	2	7	2
Proposed new rate / VMT	0	2¢	4¢	6¢	8¢	10¢	12¢	14¢	16¢	18¢	20¢	22¢	24¢	26¢

Note: Although 14 rate categories are shown, a total of 34 rate categories have been developed based on the same rate increments.
^ Maximum allowable legal length for a stinger-steered car transporter = 75’ + 3’ front overhang + 4’ rear overhang = 82’

Table 4.4 shows 14 dimension and rate categories. However, the research team prepared a rate/VMT table with 34 categories to calculate the full range in overdimension loads sizes discussed in MCD guidelines and based on a review of maximum permitted dimensions from historical permit records. Therefore, although widths up to 21 feet, 6 inches are shown in Table 4.4, the MCD OS/OW rules provide guidance for house movements that are up to 40 feet in width. Widths more than 40 feet are permitted after the District Engineer approves them. Furthermore, although categories in Table 4.4 include lengths up to 210 feet, loads have been permitted that exceed this length and therefore require additional rate categories. The same is true for overheight loads.

The most frequently occurring permitted load categories in Table 4.4 are the Category 5 overwidth loads, which range from 11 feet, 7 inches to 12 feet, 6 inches: rate = 24¢/VMT. Category 2 overheight loads range from 14 feet, 1 inch to 15 feet: rate = 4¢/VMT. Note that the rates presented are the current MCD overdimension rates that the research team retained for the new permit fee structure. This decision was made because permit purchasers are already familiar with these overwidth and overheight rate/VMT categories, which provide a solid foundation for wider application to all permit types.

In addition, a new overlength rate/VMT is introduced in Table 4.4 based on an evaluation of overdimension rates in other states for longer combination vehicles and overdimension OS/OW permitted vehicles. The overlength rates also consider impacts to safety, system operation, and congestion that can occur due to the presence of these loads in mixed traffic.

The overdimension rates and rate categories were developed using the same concept as that used in developing the pavement and bridge load-based consumption rates: equivalent treatment for all vehicle/commodity types. This is consistent with comments made by various truck fleet operators during the trucking industry forum that "the new permit structure should treat everyone the same; everyone should be on a level playing field." This basic precept, which guided development of the pavement and bridge consumption rates, is that the load type is not a factor in determining fee rates. Therefore, the rate for one additional pound of heavy equipment above legal load limits is the same as one pound of wheat, aggregate, ready mix, or any other commodity.

With regard to overdimension loads, the rate/VMT for an additional increment of width, height, or length above legal limits or above the vehicle lengths used in designing the roadway network is the same regardless of the type of load being moved. The research team developed a rate/VMT fee calculation methodology that will support a fee schedule supporting a "level playing field."

4.3.5 Over Legal Height

The TxPROS routing system makes route determinations based on providing sufficient clearance for an OS/OW vehicle considering vertical and lateral dimensions. TxPROS and MCD must identify routes that satisfy these conditions before making a final permit route selection that provides for safe movement of the load both for the OS/OW transport operator and the traveling public. Figure 4.28 shows an example of an OS/OW load that is over the legal height.

Figure 4.28: Super-Heavy Load Transporter with Transformer on IH 35 NB Main Lanes—Austin

To support TxPROS permitting operations and increase route options, TxDOT hired a vendor to conduct a light detection and ranging (LIDAR) survey of every bridge and sign bridge on the entire state network in order to provide the TxPROS routing system with a vertical clearance measurement for every lane passing under each bridge or sign bridge. This information was not previously available, as the BRINSAP program database only contains information regarding the lowest clearance height associated with a bridge structure.

Variable lane clearances such as the one shown in Figure 4.29 were planned to be included in the TxPROS database, so that an OS/OW load could be routed in a particular lane along a roadway that previously might not have been considered due to lack of complete vertical clearance information. The research team was later informed that TxDMV-MCD does not route OS/OW loads in specific lanes at this time.

Figure 4.29: IH 35 Overpass Clearance, by Lane, to Determine Potential OS/OW Route Options

The LIDAR survey cost TxDOT approximately $2,000,000. However, the survey would necessarily need to be conducted on a periodic basis to account for changes in vertical clearances due to new overlays, modifications made to bridges to increase clearances for structures that have been hit repeatedly by overheight loads and other factors.

Retrofit modifications to increase bridge clearance to better accommodate overheight loads have cost TxDOT an estimated $ 8,000,000 during the past five years. Figure 4.30 shows a retrofit bridge pedestal modification to raise the bridge beams and increase clearance on a bridge over IH 35 in the Austin District.

In addition, TxDOT has installed a variety of signs and warning devices to alert overheight vehicle operators that they are approaching a low clearance bridge. Figures 4.31 through 4.32 show a standard drawing and photographs of high load/low vertical clearance warning devices.

Figure 4.30: Retrofit Bridge Modifications (Pedestals) to Increase Vertical Clearance

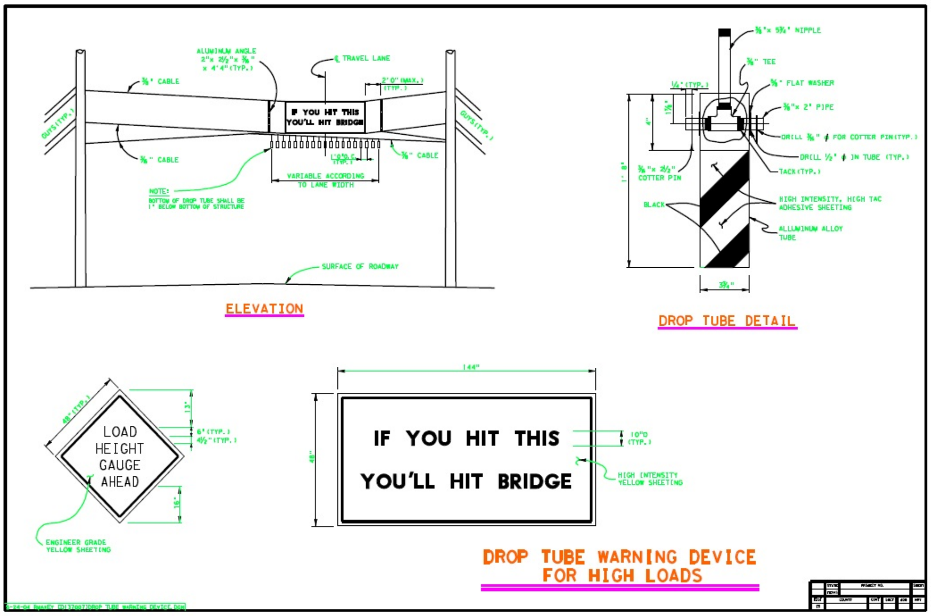


Figure 4.31: Drop Tube Warning Device for High Loads—Yoakum District Standard (TxDOT, 2012)

Figure 4.32: Overheight Load Detection Device—Yoakum District (ELTEC 2012)

Damage costs to repair bridges impacted by overheight loads can vary from a few thousand dollars to more than $500,000 depending on the extent and type of damage. Costs tend to be more when bridge beams and the bridge deck are damaged. TxDOT property damage caused by an OS/OW vehicle is the financial responsibility of both the driver and the company hired to transport the load. The Texas Department of Insurance (TDI) was contacted to discuss financial responsibility of OS/OW operators and their insurance carriers. Based on this discussion, an insurance carrier is responsible for damage to TxDOT property even if the driver violated the law at the time of the crash. Exceptions can exist within an insurance policy regarding the legal authority of the driver to operate the vehicle and other factors. In these instances, litigation might ensue to determine financial liability, resulting in court costs associated with the OS/OW crash as discussed in Chapter 1.

The TxDOT bridge division has worked with districts to identify additional bridges with a history of being hit by overheight loads. The division has compiled a list of 185 frequently hit and damaged bridges through this effort (see Table 1.10 in Chapter 1). Of these bridges, 63 are on IH routes, 36 are on US routes, 29 are on SH routes, 16 are on FM roads, and 35 bridges are on city streets or railway bridges that overpass a state route. Due to the original design, age, condition, and other factors, it may not be feasible to increase bridge clearance height using retrofit methods, as is the case for the bridge type shown in Figure 4.29. In this case, total replacement of a bridge is necessary, which is significantly more expensive than a retrofit. Figure

4.33 shows a close-up of the leading edge of the bridge arch, which has been hit multiple times by overheight loads. In fact, this is one of the bridges identified by the district for replacement and is included among the 185 bridges mentioned previously.

Figure 4.33: Concrete Spalling and Exposed Rebar Attest to Several OS/OW Hits—Austin District

Replacing a bridge over IH 35 in downtown Austin, which carries a major east to west arterial, would be expensive not only in terms of the bridge costs but also in terms of traffic control, impacts on frontage roads, and parallel street operations and additional consumption of local and TxDOT roadways due to construction traffic transporting materials and equipment to this site. TxDOT's Bridge Division (BRG) provided a rough estimate of the cost to replace or raise the 185 bridges that have experienced repeated damage due to overheight loads at approximately $225 million. This is a rough approximation only; costs could increase significantly as specific site conditions, cost of materials, and other factors are taken into account.

The consequences of not increasing vertical clearances of frequently hit bridges can be quite expensive as well if these bridges continue to be hit. These costs only consider the direct damage costs and not the indirect costs due to traffic congestion during the crash incident and during repairs. If bridge damage is severe, the bridge might be taken out of service, which requires OS/OW loads to detour many miles to follow an alternate route to accommodate their load weight and dimensions.

It should be noted that bridges and other types of TxDOT property, including traffic signals and sign bridges, are hit by overheight loads, and in some cases by a permitted overheight load that is off the designated route. In other cases, damage is caused by an OS/OW load without a permit and therefore does not have the advantage of a known route that designates the clear path. In addition, certain exempt loads can operate at over legal widths, lengths, or heights and are non-routed loads. Even if the bridge does not sustain severe damage due to an OS/OW vehicle hit, the collision and impact forces can result in cargo shift or loss, loss of OS/OW vehicle driver control, and possible collision with one or more adjacent vehicles. In extreme cases, the OS/OW vehicle may become jammed under the bridge. Extradition of an OS/OW vehicle from under a bridge can be very costly and have a major impact on traffic operations. An OS/OW collision with a bridge can also result in potential additional crashes by vehicles immediately behind the OS/OW vehicle or vehicles that queue up while emergency crews work to resolve the problem.

Figure 4.34 shows an OS/OW transporter that lost its load that consisted of two large, empty oil storage tanks when the overheight load collided with a bridge in the Odessa District.

Source: Mike Stroope—Odessa District

Figure 4.34: Oil Tanks Lying in the Travel Lane Immediately after Collision with a Bridge

The loads depicted in the previous figures exceed legal heights by several feet. Super-heavy loads often require routing off the primary system due to widths, heights, lengths, and loads that far exceed bridge clearances or load capacities. Figures 4.35 and 4.36 show super-heavy loads with extremes in heights, widths, and lengths that must be transported on the state highway network.

Figure 4.35: Two 1.8 Million Lb. Pressure Vessels Being Transported on a Frontage Road—Houston

Figure 4.36: Super-Heavy Load during Transport to a Refinery along the Texas Gulf Coast

4.4 Crash Record Information System Database Analysis

The research team evaluated the TxDOT Crash Record Information System (CRIS) database to obtain information about crashes that involved OS/OW vehicles. To identify these crashes, CRIS database records for Fiscal Year 2010–2013 were extracted and examined and included crashes with a first, second, or third contributing cause, determined as “oversized vehicle or load” by the investigating officer. Crashes involving OS vehicles including limousines, ambulances, large pickup trucks, and other vehicles that do not require a MCD OS/OW permit were removed from the analysis database (TxDOT, 2012).

A total of 1,137 crashes was identified and an Excel spreadsheet database developed containing the law enforcement officer’s crash report data for each crash. Of these crashes, 259, or approximately 23 percent, involved damage to TxDOT property. Due to time and personnel limitations, it was not considered feasible to request TxDOT to extract the damage claim records for these 259 crashes. To determine the cost of these damage claims, a database of damage claim records was obtained from the South Region and West Region damage claim processing centers. This data was evaluated and summarized in an Excel spreadsheet to identify property damage incidents consistent with the types of damage related to OS/OW crashes.

Based on this analysis, the total estimated damage claim costs associated with the 259 crashes involving TxDOT property are approximately $9.7 million. These are direct costs associated with these crashes, including the cost to repair damage to a bridge, traffic signal, or other property. Tables 4.5 and 4.6 summarize the crash events identified by the investigating officer for these crashes.

These crashes also resulted in fatalities and injuries, as shown in Table 4.7. In each case, the fatalities or incapacitating injuries were suffered by the OS/OW driver or a passenger in the OS/OW transporter. Crash cost factors for fatalities and injuries are provided in the FHWA Highway Safety Improvement Program Manual (FHWA, 2012). The “property damage only” crash costs are for general reference and are not associated with TxDOT property damage cost estimates given previously.

Table 4.5: TxDOT Property Damage Associated with OS/OW Crashes by Crash Event (CRIS 2012)

Officer's Crash Event Description	TxDOT Property Damaged due to Event 1 or 2						
Event 1 or 2	Bridge/ Overpass	Traffic Signal	Light Pole	Signs	Traffic Barrier	Damage Roadway	Retaining Wall
Collision involving fixed object	83	46	4	6	12	3	
Non-collision ran off road				2	2	2	
Non-collision Over turn / Rollover		1				2	
Non-collision - equipment failure					1	2	
Collision with motor vehicle	5				4	1	
Cargo Shift or loss						2	
Other cause or explained in narrative	27	22	3	7	15	6	1
Totals	115	69	7	15	34	18	1

Table 4.6: TxDOT Property Damage Cost Estimates Based on TxDOT Statewide Damage Claims

TxDOT Property - Item	# of Incidents	Average Cost/Incident	Estimated Total Cost
Bridge/Overpass	115	$80,000	$9,200,000
Traffic Signal	69	$3,500	$241,500
Light Pole	7	$2,900	$20,300
Signs (small & large)	15	$1,000	$15,000
Traffic Barrier	34	$5,000	$170,000
Damaged Roadway	18	$5,000	$90,000
Retaining Wall	1	$10,000	$10,000
		Total	$9,746,800

Table 4.7: Fatality and Injury Costs Associated with 1,137 OS/OW Crashes

FHWA Highway Safety Improvement Manual - Comprehensive Crash Costs			
Injury Severity Level	**Comprehensive crash cost**	**Occurences**	**Total cost by Category**
Fatality	$4,008,900	4	$16,035,600
Disabling Injury	$216,000	5	$1,080,000
Evident Injury	$79,000	18	$1,422,000
Possible Injury	$44,900	12	$538,800
Property Damage Only	$7,400	1,137	$8,413,800
		Total	$27,490,200

The research team again emphasizes that all of the fatalities and disabling or evident injuries and seven of the 12 possible injuries suffered in these crashes were either the OS/OW driver or a passenger in the OS/OW transporter. These costs are not presented with regard to OS/OW permit fee costs. Rather, they underscore that there is a human and societal cost associated with operation of OS/OW loads due to crashes involving other motorists and involving fixed objects along the travel way. Additional revenue from permit fees can be used to address both consumption and safety improvements to help reduce the fatalities, injuries, and property damage associated with OS/OW load operations. It should also be emphasized that the ”property damage only” comprehensive crash costs in Table 4.7 are average national costs; the property damage costs to TxDOT alone for 259 of the 1,137 crashes identified exceeded $9.7 million. These 1,137 crashes also resulted in property damage to bridges and traffic signals owned by cities, bridges owned by railway companies, toll booths, camera systems and vehicle impact attenuators owned by toll authorities, power poles, wiring, cabling and other equipment owned by utilities and telecommunications companies, and property owned by other businesses and private citizens. The sum of these damages is not available due to the difficulty in making accurate cost estimates. Damage costs to the OS/OW transporter and OS/OW load are not included; however, as depicted in the following figures, damage to OS/OW loads that strike bridges or become involved in crashes can result in substantial losses for the owner and the OS/OW transport company.

4.4.1 Over Legal Length Loads

The length categories shown in Table 4.4 were developed by the research team based on different factors, including a review of the TxDOT Design Division Roadway Design Manual, which provides guidance for designing curves, intersections, and other highway features considering vehicle and trailer turning radii and trailer off-tracking (TxDOT, 2010).

The longest of the standard vehicles used by TxDOT to establish design criteria are the WB-12, WB-15, and WB-19 standard tractor-semi trailers and the WB-20D tractor double-trailer unit. The total lengths of these combination units as presented in the manual trailer off-tracking diagrams are 45.5 feet, 55 feet, 68.5 feet, and 72.33 feet, respectively. However, the vehicle with the longest maximum legal length specified in state statutes is a stinger-steered automobile transporter, which can be up to 75 feet in length with an additional three-foot front overhang and four-foot rear overhang, for a total length of 82 feet (see Figure 4.37) (TxDOT, 2011). For comparison purposes, Figure 4.38 shows a saddle-mount tractor trailer unit operating on IH 35 which, based on a state statute that allows various overlength exemptions, is authorized to operate at a maximum length of 97 feet.

Figure 4.37: Stinger Steered Automobile Transporter on IH 35 NB

Figure 4.38: Saddle-Mount Truck Tractor Unit Operating along IH 35 SB—Austin District

By comparison, over length permitted loads are shown in Figures 4.39 and 4.40. Typical concrete beam transporter lengths can range from 90 to 200 feet in length, with the average length equal to 130 feet based on the available data sample. Wind turbine blade transporters can range from 155 to 175 feet in length.

Figure 4.39: Concrete Beam Hauler on IH 35 NB—Austin District

Figure 4.40: Wind Turbine Blade Transporter on IH 35 NB—Austin District

There is no maximum total length limit for a truck tractor in Texas and therefore no limit for the maximum length of a tractor semi-trailer unit. However, there are maximum allowable single trailer (59 feet) and double trailer unit lengths (28.5 feet per trailer or total 69 feet cargo space length). There is also a maximum practical total vehicle length that can negotiate turns at intersections, within ramps, interchange flyovers, and other highway features due to the geometric design criteria specified in the manual.

It is also important to realize that the design speeds and related design criteria for routes of different ages might vary. A route constructed in 1950, 1960, 1970, or 1980 can have features designed to different geometric standards and thus different vehicle dimension limitations than a similar route designed and constructed in 1990, 2000, or 2010. Therefore, the geometric features along certain urban or rural routes today may not easily accommodate OS/OW vehicles and load dimensions.

These features can include turning radii and lowboy under-trailer vertical clearances at intersections, lateral clearances to signs, light poles, traffic signal mast arm assemblies and traffic controller cabinets at or near intersections, vertical and lateral clearances at bridges, and horizontal and vertical curve geometry that can vary significantly on different portions of the state-maintained system. These variations can occur particularly between routes of different functional classes. Routes of the same functional class typically have similar design criteria. For comparison purposes, examples of pavement and bridge lane width criteria are presented in Tables 4.8, 4.9, 4.10, and 4.11. Data was obtained from the 1976, 1986, and 2010 Roadway Design Manuals, respectively.

Table 4.8: Rural Two-Lane Total Roadway Width Design Criteria—1976

1976 Roadway Design Manual - Rural 2-lane Roadway Criteria				
Design Speed (mph)	**Traveled Way Widths, Ft[1]**			
	Current ADT[1]			
	0- 250	250 - 400	400 - 750	750 - 1500
50 or less	20	20	22	24
over 50	20	22	22	24
	Usable Shoulder Widths, Ft[2]			
All	4	4	6	8
New Bridge Widths, Ft.				
50 or less	28	28	34	40
over 50	28	34	34	40

[1]Traffic volume in terms of mixed traffic. For design speeds of 50 mph or less, traveled ways that are two feet narrower may be used on minor roads with few trucks. Federal aid projects shall not have the two-foot reduction without prior approval from the FHWA.
[2] Two-foot width of each shoulder may be surfaced.

Source: TxDOT, 1976

Note that the traveled-way width must be divided by two to obtain the lane width. Also, based on Table 4.3, there are approximately 2,800 lane miles of FM roadways with 18-foot traveled ways or 9-foot lane widths. These roadways would likely have been designed and constructed in the 1940s and 1950s when construction of the majority of the FM road system was underway.

Table 4.9: Rural Two-Lane Roadway Lane Width Design Criteria—1986

1986 Roadway Design Manual - Rural 2-lane Roadway Criteria							
Functional Class	Design Speed	Feature	Minimum Lane Width Current ADT		Minimum Lane Width - Future ADT		
			0 - 250 ADT	250 - 400 ADT	750 - 1500	1500 - 3000	3000 or more
Arterial	All	Lane Widths	12'	12'	12'	12'	12'
		Shoulder Width	4'	4'	6'	8'-10'	10'
Bridges			34'	34'	38'	40 - 44'	44'
Collector	Design Speed	Lane Widths					
	30		10	10	10	11	12
	40		10	10	11	11	12
	50		10	10	11	12	12
	60		11	11	11	12	12
		Shoulder Width	2', 6'	2', 6'	4'	8' - 10'	8' - 10'
Bridges			28' - 30'	28' - 30'	28' - 30'	38' - 44'	40' - 44'

Source: TxDOT 1986

Table 4.10: Rural Two-Lane Roadway Lane Width Design Criteria—2010

2010 Roadway Design Manual - Rural 2-lane Roadway Criteria						
Functional Class	Design Speed	Feature	Minimum Lane Width - Future ADT			
			< 400 ADT	400 - 1500	1500 - 2000	> 2000
Arterial	All	Lane Widths	12'	12'	12'	12'
		Shoulder Width	4'	4' or 8'	8'	8' - 10'
Collector	Design Speed	Lane Widths				
	30		10	10	11	12
	35		10	10	11	12
	40		10	10	11	12
	45		10	10	11	12
	50		10	10	12	12
	55		10	10	12	12
	60		11	11	12	12
	65		11	11	12	12
	70		11	11	12	12
	75		11	12	12	12
	80		11	12	12	12
		Shoulder Width	2'	4'	8'	8' - 10'

Source: TxDOT, 2010

Table 4.11: Minimum Structure Widths for Bridges to Remain in Place on Rural Two-Lane Roadways

2010 Roadway Design Manual 'Minumum Structure Widths for Bridges to Remain in Place on Rural Two-lane Highway'				
Functional Class	Roadway Clear Width [1] (ft) for ADT of:			
	< 400	400 - 1500	1500 - 2000	> 2000
Collector	22	22	24	28
Arterial	Traveled Way + 6 ft.			

Source: TxDOT 2010

Considering the previous photographs showing the dimensions of OS/OW vehicles, when required to travel there narrow rural routes, other traffic might be forced to leave the roadway entirely as the load passes. In the case of super-heavy loads, a convoy of equipment and personnel travels ahead of the load to raise power lines or traffic signal wires to ensure clearances of railway signals and other potential obstructions. Figures 4.41 through 4.43 illustrate these operations. However, loads less than 110 feet in length are not required to have an escort, and loads less than 125 feet in length are not required to have a pre-approved route, nor is the OS/OW transport operator required to inspect the route he plans to take.

Source: John Bilyeu—CST

Figure 4.41: Raising Traffic Signal Wires to Provide Clearance for an OS/OW Load

Source: John Bilyeu—CST

Figure 4.42: Checking Railway Signal Clearances for an OS/OW Load

Source: Paul Rollins—BRG

Figure 4.43: Limited vertical clearance under a transporter trailer restricts route choices.

Limited vertical clearance under an OS/OW transporter is an additional issue discussed with TxDOT district personnel interviewed. Districts may need to redesign intersections to eliminate high points on which lowboy trailers bottom out and become stuck. Low under-trailer clearance can result in safety problems and, in some cases, catastrophic consequences. Although the crash depicted in Figure 4.44 did not occur in Texas, the load did originate in Houston.

This OS/OW load included a super-heavy transporter measuring 135 feet in length, 15 feet in width, and 18 feet, 6 inches in height. The transporter was hauling a condenser unit for use in a refinery. The load trailer had a ground clearance of six inches. The load traveled through Texas on its journey to Glendale, California (NTSB, 2000). The NTSB report documents that during the trip through Texas, the load encountered several problems, including striking a traffic signal, sign and overhead telephone lines; the vehicle required re-routing due to bridge and railway clearance problems.

The load arrived in Glendale and ultimately became stuck at a railroad crossing due to problems with routing and escort directions. The driver worked to extricate the vehicle but was only able to drive away with the transporter and forward portion of the transport unit before the load and trailer were struck by a train and carried 1,100 feet before coming to a stop. The estimated damages were $2 million.

Figure 4.44: Super-Heavy Load with Condenser Struck by Train at Railway Crossing in Glendale, California [NTSB 2000]

The estimated costs to re-profile a roadway to accommodate low clearance heavy vehicles and OS/OW loads were estimated by one district at approximately $20,000 per location. The cost of reconstructing the vertical alignment of a road varies depending on the amount of adjustment needed, drainage considerations, and other factors.

Figures 4.45 and 4.46 show TxDOT property damaged due to OS/OW loads during turning movements at intersections that were not designed for vehicles of this length.

Source: Scott Cunningham—Austin District

Figure 4.45: Concrete Beam Hauler with Downed Traffic Signal Mast/Arm Assembly—Austin

Source: Stacey Young—Lubbock District

Figure 4.46: Traffic Sign Downed by Wind Turbine Loads Turning at a Rural Intersection—Lubbock

A four-corner, high mast traffic signal installation at the maximum 19-foot vertical signal head placement height is estimated to be $150,000 per intersection. Repairing damage as shown in the photograph can vary significantly depending on whether the mast, arm, and signal heads were only damaged or totally destroyed, as shown. In addition, if the traffic signal controller cabinet is also struck during the crash, the repair or replacement costs can increase by an additional $8,500 per incident. Although small signs such as the one shown in Figure 4.46 are not expensive by comparison and usually cost in the range of $300 to $500 to replace depending on the sign type, the true impact is due to the loss of information to other drivers. The incident depicted in Figure 4.46 only shows one location along a several-mile-long route in which wind turbine tower component transporters could not negotiate rural FM road intersections. Although a route identification sign has been knocked down in this instance, damage claim reports show that stop, yield, and other traffic regulatory signs are also knocked down or destroyed due to turning movements. In these cases, loss of these signs deprives other drivers of important guidance and information necessary for safe vehicle operations.

4.5 Longer Combination Vehicle Operations in Other States

The researchers sought additional information to identify and characterize different factors that should be considered when evaluating a potential new rate/VMT fee for overdimension OS/OW vehicles, and in particular, those that are over length. To achieve this, telephone interviews were conducted with state tax commissions, state departments of motor vehicles, OS/OW permit sections, and departments of public safety regarding 18-wheeler and LCV registration fees and/or permit costs in other states.

The research team realizes that in many cases, the allowable GVW is also higher for LCVs; however, axle loads are typically maintained at legal limits. Cases to the contrary were documented during these interviews.

Figures 4.47 through 4.52 show examples of LCVs operated in various states in which they are permitted, in addition to LCVs operated in Canada and Mexico. Based on the assessment of 2,000 overlength OS/OW loads shown in Table 4.4, approximately 41 percent were legal length or less, and an additional approximately 51 percent were between 82 and 120 feet, which encompasses the maximum length of an LCV in any US state. Therefore, the lengths of more than 90 percent of permitted loads in this sample were between the maximum legal vehicle length listed in state statutes and the maximum length of double- or triple-trailer LCVs routinely operated by other states that are part of the Western Association of State Highway and Transportation Officials (WASHTO), as is Texas. It should be further noted that MCD issues multi-state permits for OS/OW vehicles traveling through WASTHO states and has worked with those states to simplify and coordinate agreements on vehicle configurations that can operate across state lines.

Source: Hank Suderman, 2011

Figure 4.47: Turnpike Double (TPD) Longer Combination Vehicle (LCV)

Source: Jim Steele, 2002

Figure 4.48: Rocky Mountain Double Longer Combination Vehicle

It is helpful to compare the photographs of these LCVs with photographs of the concrete beam transporter or turbine blade transporter in Figures 4.39 and 4.40. In the case of a concrete beam transporter, such as the one depicted, this load is at least 30 feet longer and 30,000 lbs. heavier than the maximum dimensions and weights of any of the LCVs shown. However, the length of these LCVs equals or exceeds the length of more than 90 percent of the permitted loads evaluated in the 2,000-permit sample.

Source: Hank Suderman, 2010

Figure 4.49: Triple Trailer Unit Longer Combination Vehicle

Source: Tim Gibson, 2010

Figure 4.50: Michigan "Caterpillar Rig"

Source: Martin Phippard, 2012

Figure 4.51: Canadian B-Train Double Longer Combination Vehicle

Source: Martin Phippard, 2012

Figure 4.52: Mexican T3-S2-R4 Longer Combination Vehicle

Table 4.12 summarizes information obtained from discussions with state agencies that manage longer combination vehicle (LCV) registration and permitting for the states listed. The state laws governing operation of LCVs vary significantly from state to state due to differences in the routes on which LCVs can operate regardless if the operator purchases a single-trip, six-month, or annual permit and other factors.

The purpose of obtaining the information in Table 4.12 was to calculate an estimated rate/VMT for permitted overlength operations of LCVs. This information was considered a benchmark for calculating a proposed new rate/VMT for overlength vehicles in Texas.

The average rate/VMT based on the information obtained for overlength operations only is $0.042/VMT. The median is $0.02/VMT, and the standard deviation is $0.066/VMT. Based on this assessment, the research team proposes a base rate of $0.02/VMT, which increases as length categories increase, as is the case with the overwidth and overheight categories. Therefore, the length categories in Table 4.4 begin at the legal maximum length of 82 feet for a stinger-steered auto transporter, for which there is no charge. The next category is from 82 feet, 1 inch to 90 feet at a rate of $0.02/VMT, after which each category increases on approximate 10-foot increments with a rate increase of $0.02/VMT for each category.

Table 4.12: Longer Combination Vehicle Permit Fees and Estimated Rates/VMT by State

Longer Combination Vehicle (LCV) Types, Associated Alowable lengths and Permit Fees								
LCV lengths by State	**Tractor - Turnpike Doubles**	**Tractor Rocky Mountain Doubles**	**Tractor - Triple Trailers**	**LCV Permit Fee Single Trailer**	**LCV Permit Fee Double Trailer**	**LCV Registration or Permit Fee Triple Trailer**	**Double Trailer - Estimated Cost per VMT**	**Triple Trailer - Estimated Cost per VMT**
Alaska	120' depending on the route	120' depending on the route	120' depending on the route	$500 Length only, $500 weight only, $1000 both L&W	$500 Length only, $500 weight only, $1000 both L&W	$500 Length only, $500 weight only, $1000 both L&W	$0.005	$0.005
Colorado	105'	105'	105'	$250 Length only: $400 additional for max weight 1 truck; $350 for each truck thereafter	$250 Length only: $400 additional for max weight 1 truck; $350 for each truck thereafter	$250 Length only: $400 additional for max weight 1 truck; $350 for each truck thereafter	$0.003	$0.005
Kansas (I-70 to Goodland or I-70 toll only)	119'	119'	119'		(I-70 CO border to Goodland, KS $2000 / company + $50 per truck; or, I-70 toll $14	(I-70 CO border to Goodland, KS $2,000 / company + $50 per truck; or, I-70 toll $14	$0.205	$0.205
Montana	110'	110'	110'	<=75' $75 length only	$125.00 length only	$200.00 length only	$0.001	$0.002
Nebraska			105'		$250 annual	$250 annual	$0.003	$0.003
Nevada	95' cargo max	95' cargo max	95' cargo max		$2,940.00 annual	$2,940.00	$0.029	$0.029
North Dakota (route and seasonal limits)	110'	110'	110'		$20 single trip only	$20 single trip only	$0.040	$0.040
Oklahoma	110'	110'	110'		$20 annual	$120 annual	$0.000	$0.001
Oregon		105'	105'	LCV at 80,000 lbs $0.1638/VMT - $8 Over dimension permit fee	LCV at 80,000 lbs $0.1638/VMT - $8 Over dimension permit fee	LCV at 80,000 lbs $0.1638/VMT - $8 Over dimension permit fee	$0.168	$0.168
South Dakota	110'	110'	110'	$10 / 24 hour trip	$10 / 24 hour trip	$10 / 24 hour trip	$0.020	$0.020
Texas	Not Authorized	Not Authorized	Not Authorized	Not Authorized	Not Authorized	Not Authorized		
Utah	95' cargo max	95' cargo max	95' cargo max	$30 Single Trip, $75 6 months, $90 annual	$30 Single Trip, $75 6 months, $90 annual	$30 Single Trip, $75 6 months, $90 annual	$.0.06 $0.02 $0.001	$.0.06 $0.02 $0.001
Wyoming	81' max cargo length	81' max cargo length	Not Authorized	LCV must be licensed - no permit fee	LCV must be licensed - no permit fee	LCV must be licensed - no permit fee	-	-

Notes: Annual rates computed assuming 100,000 VMT. Six month rate: 50,000 VMT. Single-trip rates: 500 VMT. LCV maximum lengths are specified by total vehicle length in some states and by maximum trailer cargo lengths in other states as noted.

Case Study 4: Single-trip permit fees considering consumption and dimensions

Based on the information in Table 4.13, Case Study 1 is revisited to add the overdimension rate/VMT for each general OS/OW weight class. Therefore, for Case Study 4, the same pavement and bridge consumption rate/VMT and resulting permit costs are retained and overwidth, overheight, and overlength rates/VMT considered for a vehicle that is 12 feet wide, 15 feet high, and 100 feet long. The same vehicle dimensions are considered for each weight class. For a vehicle of these dimensions traveling 300 VMT, the following additional permit fee costs would accrue:

12’ width—Category 5 = \$0.24/VMT x 300 miles = \$72.00

15’ height—Category 2 = \$0.04/VMT x 300 miles = \$12.00

100’ length—Category 3 = \$0.04/VMT x 300 miles = \$12.00

Table 4.13: Consumption and Infrastructure Operation and Safety Impact Fees

Weight Class	Consumption	Overwidth	Overheight	Over Length	New Fee	HWY Maintenance Fee FY 2011
80,001–120,000 lbs.	\$173.39	\$72	\$12	\$12	**\$269.39**	\$150
120,000–160,000 lbs.	\$261.37	\$72	\$12	\$12	**\$357.37**	\$225
160,001–200,000 lbs.	\$340.048	\$72	\$12	\$12	**\$436.04**	\$300
200,001–254,000 lbs.	\$526.99	\$72	\$12	\$12	**\$622.99**	\$375

As in Case Study 1, the new fee includes the consumption and infrastructure operations and safety impact fees. It does not include an administrative fee or a base fee, which will be discussed in the next section.

4.6 OS/OW Administrative and Enforcement Cost Items

The research team conducted in-person interviews with the Texas Department of Public Safety (TxDPS) and the Texas Department of Motor Vehicles (DMV) enforcement section; and telephone interviews with the Texas Department of Insurance (TDI) and the Texas Office of the Attorney General (OAG). In addition, the team had numerous face-to-face meetings, telephone discussions, and e-mail exchanges with TxDMV-MCD, TxDOT district and TxDOT division personnel.

The following sections summarize specific OS/OW cost categories incurred by TxDOT districts and divisions, DMV, TxDPS, and OAG that are not captured in current OS/OW fees based on research. In some cases, the cost item identified is estimated per equipment installation; however, a total district or statewide cost figure was not available. Some cost items, such as

TxDOT property damage due to hit-and-run OS/OW loads, might not be appropriate to include in permit fees but are costs incurred by TxDOT due to OS/OW loads in any case.

4.6.1 TxDMV Motor Carrier Division

The TxDOT Motor Carrier Division (MCD) was transferred to the Texas Department of Motor Vehicles in FY 2011 as directed by the State Legislature. TxDOT was directed to transfer $6.3 million to TxDMV to fund operation of MCD and the Enforcement Division during this move. TxDMV-MCD is responsible for administering the OS/OW permitting program among other functions associated with servicing and authorizing the operation of commercial motor carriers. MCD issued more than 590,000 permits in FY 2011, which accrued more than $110 million in permit fees. In FY 2012, more than 722,000 OS/OW permits were issued with the help of the new Texas Permitting and Routing Optimization System (TxPROS) (TxDMV, 2012). The FY 2013 operating budget for MCD is **$7,962,221** based on the FY 2013 TxDMV Approved Operation Budget report (TxDMV, 2012).

TxDMV- Enforcement Division

The TxDMV Enforcement Division conducts investigations of commercial vehicle operators that have shown a pattern of violations with regard to the items listed below. Based on a review of information obtained from the DMV complaints investigation database, it appears that investigations are ranked as follows according to frequency or total numbers of investigations:

1. No insurance or improper insurance
2. No registration or improper registration
3. A pattern of OS/OW violations
4. Non-compliance with consumer protection requirements

TxDMV-ENF conducts approximately 350 investigations per year with about 10 percent of investigations resulting in penalties. The section employs 11 investigations, one manager, and one administrator for a total staff of 12 fulltime employees. The section budget is approximately $688,000 per year. The goal of the enforcement division is to meet with a carrier that is out of compliance and work to develop a plan of action to bring the company back into compliance.

For the three-year period from September 2009 to September 2012, the section conducted 424 company investigations due to a pattern of OS/OW citations. Of these investigations, 99 cases were referred to an attorney.

The TxDOT-MCD annual report indicates that roadside size and weight violations cited by TxDPS troopers decreased 77 percent for companies the section investigated and that had received a penalty in FY 2011. This suggests that, dollar for dollar, the MCD Enforcement Section is very effective in reducing illegal OS/OW operations, thus reducing pavement and bridge consumption rates (TxDOT, 2011).

TxDPS Commercial Vehicle Enforcement Service

The interview with TxDPS provided researchers information about the number of weight measurements TxDPS conducts annually, citations, and staffing and administrative costs associated with the size and weight enforcement branch. During the interview with TxDPS, the research team learned that costs involved in enforcement of permitted OS/OW vehicles are not tracked or recorded separately from other size and weight enforcement functions. Therefore, only information regarding total commercial vehicle enforcement operations is presented.

During the 2011 calendar year, TxDPS troopers conducted 37,626 vehicle inspections and issued 30,290 tickets and 68,491 warnings. With regard to overweight operations, 65,988 overweight violations were cited, resulting in 28,641 overweight tickets and 37,347 warnings.

In addition, TxDPS measured more than 1.8 million vehicles using weigh in motion equipment; 121,106 vehicles were weighed using permanent scales; 16,060 vehicles were weighed using portable scales; and 20,193 vehicles were weighed using semi-portable scales.

Commercial Vehicle Enforcement Service manpower includes 777 full-time personnel, including 514 commissioned personnel; and 263 non-commissioned personnel, including 176 CMV inspectors. Based on TxDPS' operating budget report for FY 2012, the TxDPS Commercial Vehicle Enforcement Service was budgeted at $65,718,391 (TxDPS, 2011).

Office of the Attorney General

The OAG becomes involved in cases regarding disputed OS/OW damage claim cases and cases referred to an attorney by MCD's enforcement section.

Although the OAG could not provide an annual estimate of court costs specifically due to OS/OW litigation because each attorney handles dozens of cases at any given time, a few examples of cases and court costs were provided.

Based on recent court case that involved more than $600,000 damage to a TxDOT bridge, the estimated court costs were $100,000 in attorney's fees. This court trial lasted one week. Settlements of OS/OW damage claims or jury decisions can result in a portion of the damage claim costs being paid by the OS/OW operator or a transport company and the remainder by TxDOT. In any case, attorney's fees are often included in the damage claim. It is therefore difficult to determine the exact amount of court costs that would be borne by the state due to juries' split decision regarding OS/OW damage claims. The number of cases of this type would likely vary from year to year, as would court costs.

During the interview, the OAG attorney indicated that currently 900 damage claim court cases are at the OAG's office; however, not all are related to OS/OW operations. If 5 percent of these cases is attributed to OS/OW damage claims—a conservative estimate—this would result in an estimated 45 damage claim cases. If 25 percent of these cases resulted in a split decision resulting in the state assuming 50 percent and the OS/OW carrier 50 percent of the damages and associated court costs, a rough estimate of the annual court costs paid by the state for OS/OW cases would be approximately 11 x $50,000 = $550,000 annually.

4.7 Estimate of Costs Associated with OS/OW Operations

The previous sections discussed costs paid by TxDOT to conduct surveys and upgrade infrastructure to accommodate OS/OW loads. In addition, costs associated with the administration and enforcement of OS/OW laws and transport companies and administration of the OS/OW permitting process were identified. Table 4.14 summarizes costs TxDOT pays to provide data and information for OS/OW operations or adjustments, modification, or replacement of road and bridge infrastructure not currently captured in permit fee cost categories. These estimates are based on interviews with TxDOT personnel and information provided to help quantify these costs. A more thorough analysis is needed to fully and accurately estimate all costs paid by TxDOT that are not currently reimbursed to Highway Fund 6 (Fund 6) through

OS/OW permit revenue. Nevertheless, the research team has provided cost categories and general cost estimates that provide a ballpark estimate.

In addition, as stated earlier, discussions with TxDPS Commercial Motor Vehicle Enforcement Service personnel indicated that there is no estimate available of the percentage of the budget allocation solely attributed to OS/OW enforcement operations. The research team again used available information and assumptions regarding these amounts.

Based on this study, the estimated additional cost associated with OS/OW operations not currently captured in permit fees is approximately $60.1 million. In addition, researchers provide the following annual estimates: $10,000,000 for hit-and-run damage to TxDOT property and $550,000 for unreimbursed court costs. TxDOT or the State of Texas must absorb these expenses, as they cannot be directly charged to OS/OW permit costs. Therefore, the total costs not covered by OS/OW permit fees by TxDOT and the State of Texas is $70.65 million annually.

Table 4.14: Additional Cost Categories Not Currently Captured in OS/OW Permit Operations

Additional Cost Category	Estimated cost for each location (where applicable)	Total cost estimate	Time Period	Annual Cost	Costs Not Currently Apportioned to OS/OW Permits	Non-apportioned CostsSubtotal	Costs Currently Apportioned to OS/OW Permits	Apportioned Cost Subtotal
Texas Department of Transportation								
Bridge retrofit costs to increase clearance height - 68 Bridges		$8,000,000	5 years	$1,600,000	$1,600,000			
Modification or replacement of 185 additional low clearance bridges		$225,000,000	10 years	$22,500,000	$22,500,000			
LIDAR survey of bridge / sign bridge clearance envelope for TxPROS		$2,000,000	1 year	$2,000,000	$2,000,000			
Adjust grades, redesign intersections for OS/OW operations (x 25)	$20,000	$500,000	1 year	$500,000	$500,000			
Emergency inspection of damaged bridges by Districts & BRG (x 50)	$2,000.00	$100,000	1 year	$100,000	$100,000			
Bridge & Signal repairs due to 'hit and run' over height loads (x 200)	$50,000.00	$10,000,000	1 year	**$10,000,000**				
Installation of low clearance warning drop tube systems (x 50)	$3,500	$175,000	2 years	$87,500	$87,500			
Installation of high load warning sensor systems (x 25)	$20,000	$500,000	2 years	$250,000	$250,000			
Installation of high mast & arm signals with 19' signal mount (x 25)	$150,000	$3,750,000	1 year	$3,750,000	$3,750,000			
Funds transferred to TxDMV to fund MCD and ENF (2011)			1 year		$6,300,000			
						$30,787,500		
TxDMV - Motor Carrier Division OS/OW Permit Operations		$7,962,000	1 year	$7,962,000			$8,650,000	**$8,650,000**
TxDMV - Enforcement Division		$688,000	1 year	$688,000				
TxDPS Commercial Vehicle Enforcement		$65,718,000	1 year	$65,718,000				
Assume 40% allocated for OS/OW enforcement		$26,287,200	1 year	$26,287,200	$26,287,200			
Overweight citation revenue paid to Fund 1 (30,290 citations)	$100	$3,029,000	1 year	$3,029,000	$3,029,000	**$29,316,200**		
OAG Court Costs	unknown	unknown						
Attorney fees paid by state due to settlements/jury decisions	estimated		1 year	**$550,000**				
					Grand Totals	**$60,103,700**		

4.8 Conclusions

Chapter 4 presented the methodologies and recommended equations to compute permit fee costs based on pavement and bridge consumption rate/loaded VMT and infrastructure operations and safety impacts due to overdimension OS/OW vehicles.

In addition, a detailed discussion supported the methodology and rate/VMT fee schedule based on categories for overwidth, overheight, and overlength vehicles.

Four case studies were presented to show how consumption and impact costs are used to compute new permit fee costs.

Additional costs that are not currently addressed or identified in permit fee calculations were identified. These costs are associated with survey data and related information provided by TxDOT to accommodate OS/OW permit fee routing and modifications or redesign of roadway and bridge infrastructure specifically to accommodate OS/OW vehicle operations. These costs are estimated to be approximately $60.1 million that can potentially be apportioned to permit fees and an additional $10.5 million that cannot be apportioned to permit fees but are directly attributed to OS/OW vehicle operations.

Finally, the research team identified costs associated with OS/OW permit fee operations, enforcement, and court attorney costs that may or may not be possible to apportion to permit fees.

Chapter 5. Revenue Analysis and Recommendations

5.1 Introduction

Chapter 4 recommended Equation 4.5 for computing permit fee costs for any type of permit based on the vehicle axle configuration, marginal weights, width, height, and length of an OS/OW transporter and load. Equation 4.5 was used to compute proposed new permit fee costs in three case studies that demonstrated application of the pavement and bridge consumption analysis methods for 1) general OS/OW single-trip routed vehicle permit associated with four different weight classes; 2) a non-routed, permitted 1547 five-axle tractor-trailer unit; and 3) a proposed new permit for a currently exempt three-axle ready mix truck operating at the maximum allowable GVW and axle loads permitted by state statutes.

A new Infrastructure Operations and Safety Impact Fee Schedule was also presented in Chapter 4 that provides rates/VMT based on 34 categories for vehicles that are over legal width, legal height, or legal length with respect to state statutes and in consideration of TxDOT design standards. The fee schedule can be used to calculate permit fee rates for vehicles that are both oversize and overweight or vehicles that are oversize only. The new methods calculate fees only if the vehicle and load exceeds maximum allowable limits or legal dimensions including legal, inner- or outer-axle bridge lengths. Case Study 4 revisited the four vehicle types analyzed in Case Study 1 and calculated additional overdimension fee/VMT costs to demonstrate how the fee schedule is applied.

Chapter 4 also presented estimated costs that are not currently included in OS/OW permit fees but are directly attributable to TxDOT's efforts to accommodate OS/OW operations through signing, roadway or bridge modifications, and TxDPS-MCE and DMV-ENF Section enforcement of state size and weight laws. In addition, unrecoverable costs were presented that are associated with damage to TxDOT property by hit-and-run overdimension loads and court costs that are paid by the State of Texas due to jury decisions related to litigation of OS/OW court cases.

The total costs attributed to OS/OW load operations that are not currently captured in OS/OW permit fees were estimated to be $60.1 million annually. The costs associated with OS/OW operations that cannot be apportioned to OS/OW permit fees for the reasons cited in Chapter 4 were estimated to be $10.5 million annually. It is important to note that these costs do not represent administrative costs or the cost of doing business for TxDOT and other state agencies; rather, these costs are directly related to OS/OW operations that are not currently funded by permit fees and therefore must be funded through other sources such as a district's routine maintenance or construction budget categories. This means that planned projects must be postponed to fund these unplanned costs.

In light of the austere maintenance budget constraints under which districts currently operate, there is a critical need for additional revenue to address the increased pavement and bridge consumption costs; infrastructure operations and safety-impact related costs; unpaid damage claims; and other related costs associated with OS/OW permitted loads.

The research team recognizes that the trucking industry, including companies that operate OS/OW permitted loads, also face difficult economic conditions. This is due to high energy prices, longer haul distances to reach markets, and increased competition due to truck operators from the other 49 states and several other countries that compete with Texas operators for profits and business in the state.

In recognition of these issues, the research team developed a methodology that calculates permit fee costs independent of load or commodity type. This was done to create a level playing field for all OS/OW permit purchasers so a particular industry or sector of the economy does not bear a disproportionately high cost of the consumption and infrastructure operations and safety impacts. Rather, each permit purchaser pays exactly the same rates/VMT as all other permit purchasers for the same vehicle loads and dimensions. In this way, each permit purchaser pays his fair share for consumption of TxDOT transportation assets.

Equation 4.5 and the methodologies developed by the research team also provide a was for permit purchasers to reduce pavement and bridge consumption by adding axles, changing axle spacing, or making other modifications. Permit purchasers can make decisions about how to best configure OS/OW transporters and loads to minimize consumption rate/loaded VMT and resulting permit costs. This is a win-win approach in which lower consumption rates result in extended pavement and bridge life while lowering the cost of doing business for the permit purchaser.

The research team further emphasizes that the concepts used to develop Equation 4.5 are based on the goals of the Legislature, TxDOT, TxDMV-MCD and the MCD Enforcement Section, TxDPS, OAG, and other state agencies that emphasize providing a safe and efficient transportation system that meets the needs of all Texans. Maintaining and rehabilitating the existing roadway system while providing upgrades that improve the safety of the traveling public, which includes OS/OW transport operators, is good for the state and good for a vibrant Texas economy. To this end, the new permit fees and additional revenue discussed in the following sections address and support these goals. This goal will be accomplished through an equitable distribution of the new permit costs among all OS/OW permit purchasers, including individuals or companies that currently operate exempt OS/OW vehicles at the maximum weights or dimensions allowed under current state statutes.

5.2 Revenue Analysis Based on New Permit Fees

5.2.1 Vehicle Configurations and Operations

As discussed in Chapter 4, the exact vehicle and load configuration for a single-trip routed permit can be known based on information provided by the permit purchaser through the TxPROS system. However, due to hundreds of thousands of permits sold by MCD for single-trip routed, quarterly non-routed, and annual non-routed vehicles, it is impractical for the research team to calculate a new permit fee amount for every permit sold in FY 2011. Table 5.1 presents the representative vehicle configurations chosen by the research team for single-trip general OS/OW vehicles and the other permit types discussed in later sections to compute permit fee costs for the revenue analysis. In actual practice, permit fees would be calculated for the specific OS/OW vehicle configuration when the operator purchases a single-trip routed permit. Current rules for non-routed permits will require modification to allow the purchaser to take advantage of a configuration that reduces bridge and pavement consumption or infrastructure impacts.

Lack of specific details about the exact makeup and configurations of the Texas exempt vehicle fleet, which are all non-routed vehicles, required the research team to make educated decisions about representative exempt vehicle configurations. These decisions were based on guidance provided in state statutes, including the maximum load, dimensions, reduced inner- or outer-bridge lengths, and periods of operation. However, little information exists about variations in the use and numbers of three or more axle straight trucks, tractor-semi-trailer, or truck-trailer combinations. Therefore, agricultural exemptions were assumed to be "quarterly" and applicable during a three-month harvest period for evaluating farming, livestock, and raw forest product permit fees. Other types of exempt vehicles might operate throughout the year, thus fitting into the annual, non-routed permit category, or they might operate on an "as needed" basis to perform services related to the energy sector, water well servicing, and other applications.

Furthermore, the way in which exempt vehicles operate might result in a different load factor for each exempt vehicle type in order to determine the loaded VMT. The rationale used for determining the load factor was based on educated assumptions regarding loaded vs. empty VMT and the amount of time per year that the additional load or dimension exemptions would be used. Table 5.21 presents load factors used for the exempt vehicle loaded VMT calculations, including the rationale for calculating these factors.

5.2.2 Temporary Registration

In FY 2011, MCD sold more than 23,600 temporary vehicle registration permits. Based on information contained in the MCD OS/OW Rule Manual and the TxDPS Commercial Vehicle Enforcement Guide for Farm Vehicle Compliance, the operator of an agricultural vehicle can purchase a temporary registration permit that allows operation at a GVW above the legal registered weight of that vehicle (TxDOT, 2011; TxDPS, 2010). Based on this information and as contained in the Section 502.434, TC, a truck, truck-tractor, trailer, or semi-trailer may obtain a temporary permit to haul more load than the vehicle is legally registered to carry. These permits can be purchased by farmers hauling crops during harvest season and by out-of-state farm vehicles operated in Texas to transport Texas farm products. State residents can purchase these temporary permits for a period of 30 days to one year or by out-of-state vehicle operators during the harvest period for a period of 30 days; however, three temporary registration permits may be purchased within a one-year period.

This information suggests that certain agricultural vehicles used to transport products from the point of origin to the first point of production, whether a silo, livestock market or mill can operate above their legal registered weight limits in addition to the agricultural exemptions allowed by law. The complexity of this issue is beyond the scope of this research, and further study is recommended to evaluate the vehicle configurations and loads that can occur due to the combination of a temporary registration and the agricultural exemption. The research team points out that temporary registration permits are also purchased for short periods of time to allow movement of other types of vehicles across state lines or within Texas state borders.

The following section addresses the development of a permit analysis worksheet tool by the research team that allows the user to compute the new permit fee for a given vehicle and determine how the fee revenue will be apportioned. At the time this report was written, not all vehicle configuration selections had been made operational in the new tool due to the complexity of ensuring that both the existing and proposed new permit structures are correctly entered and "proof tested." In any case, the tool has been demonstrated to TxDOT administration to demonstrate its functionality. In addition, MCD rules allow an OS/OW vehicle to combine certain permit types under specific circumstances. Further study is needed to address all of the different potential scenarios that might occur.

Following a discussion of the worksheet, the FY 2011 and new permit revenues will be presented and discussed (Table 5.5). This information will be presented for the majority of permit types and number of permits sold in FY 2011 and will include specific information regarding how the permit fee revenue was allocated to different budget funds.

Table 5.1: OS/OW Existing Permit Representative Vehicle Configurations Used in the New Permit Calculations and Revenue Assessment

FY 2011 OS/OW Permit Categories Included in the Revenue Assessment													
State Statute or Permit Type	**VMT (Loaded) new Permits**	**Weight Class / Max GVW lbs**	**Steering Axle weight lbs**	**Tandem Axle weight lbs**	**Tandem Axle weight lbs**	**Tandem Axle weight lbs**	**Tridem Axle Weight lbs**	**Tridem Axle Weight lbs**	**Tridem Axle Weight lbs**	**Tridem Axle Weight lbs**	**Width**	**Height**	**Length**
2060/1547 over axle tolerance	50,000	84,000	10,000	37,000							Legal	Legal	Legal
General OS/OW single-trip													
< 80,000 lbs / over dimension only	300	≤ 80,000	12,000	34,000	34,000						12'	15'	100'
80,001 - 120,000 lbs	300	120,000	15,000	45,000			60,000				12'	15'	100'
120,001 - 160,000 lbs	300	160,000	15,000	42,500	42,500		60,000				12'	15'	100'
160,000 - 200,000 lbs	300	200,000	15,000	42,000	42,000	42,000	59,000				12'	15'	100'
200,000 - 254,000 lbs	300	254,000	15,000				60,000	60,000	60,000	60,000	12'	15'	100'
Annual - Envelope (Specific)	9,000	120,000	12,000	45,000			60,000				12'	Legal	110'
Annual - Envelope (Non-Specific)	9,000	120,000	12,000	45,000			60,000				12'	Legal	110'
non-routed 30 day over width	4,000	≤ 80,000	12,000	34,000	34,000						13'	Legal	Legal
non-routed 60 day over width	8,000	≤ 80,000	12,000	34,000	34,000						13'	Legal	Legal
non-routed 90 day over width	12,000	≤ 80,000	12,000	34,000	34,000						13'	Legal	Legal
non-routed 30 day over length	4,000	≤ 80,000	12,000	34,000	34,000						Legal	Legal	110'
non-routed 60 day over length	8,000	≤ 80,000	12,000	34,000	34,000						Legal	Legal	110'
non-routed 90 day over length	12,000	≤ 80,000	12,000	34,000	34,000						Legal	Legal	110'
Well servicing Unit - annual	15,000	75,000		35,000	40,000						10'	Legal	Legal
Well servicing Unit -mileage	15,000	75,000		35,000	40,000						10'	Legal	Legal
Concrete Beams - single trip	300	160,000	15000	42,500	42,500		60,000				Legal	Legal	160'
Portable Buildings	300	≤ 80,000	12,000	34,000	34,000						14'	14'	80'
Manufactured Housing	200	≤ 80,000	Legal	Legal			Legal				16'	15	100'
Implement of Husbandry	2,500	≤ 80,000	12,000	34,000	34,000						16'	16'	110'
Fracing Trailers - on LZ roads	50,000	80,000	12,000	34,000	34,000						Legal	Legal	Legal
Hubometer - outer bridge 28'	37,500	75,000		35,000	40,000						10'	Legal	Legal

Table 5.2: Exempt Vehicle Load Factors and Rationale for Calculations

Exempt Vehicle Load Factors used to computer Loaded VMT		
Vehicle / Commodity	**Exempt Vehicle Load Factor and rationale**	
	Load Factor	Rationale
Agriculture - farm harvest to silo (3 months)	0.125	Exemption during Harvest period (3 months) - loaded one-way / empty otherwise (3/12 months * 0.5 = 0.125)
Agriculture - livestock to market (3 months)	0.125	Exemption during Harvest period (3 months) - loaded one-way / empty otherwise (3/12 months * 0.5 = 0.125)
Agriculture- logs to mill (3 months)	0.125	Exemption during Harvest period (3 months) - loaded one-way / empty otherwise (3/12 months * 0.5 = 0.125)
Farm Products, Groceries & LP Gas on LZ Roads - annual	0.33	Vehicle starts trip loaded and delivers products at points along the route. Assume above LZ limits 1/3 of VMT
Ready mix & Concrete Pump Trucks - annual	0.5	Vehicle travels loaded to the job site, delivers product and returns empty.
Raw Milk Tank trucks inner bridge ≥ 28' - annual	0.5	Vehicle is loaded and then travels to milk processing plant. The tanker is empty otherwise - inner bridge of ≥ 28' less than legal 36'.
Poles, Piling & Raw Wood Products < 125 miles - annual	0.5	Vehicle is loaded and then travels to mill or jobsite. The log, pole or piling trailer is empty otherwise.
Raw Wood Products outer bridge ≤ 39' - annual	0.5	Vehicle is loaded and then travels to mill. The log or wood chip trailer is empty otherwise. Outer bridge ≤ 39' less than legal 51'
Recyclable Materials - annual	0.33	Vehicle accumulates recycled material until fully loaded and then travels to the processing plant.
Solid Waste / Garbage Trucks - annual	0.33	Vehicle accumulates garbage or waste until fully loaded and then travels to the land fill or waste facility.
Cotton Seed Modules - 3 months	0.125	Exemption during Harvest period (3 months) - loaded one-way / empty otherwise (3/12 months * 0.5 = 0.125)
Chili Pepper Modules - 3 months	0.125	Exemption during Harvest period (3 months) - loaded one-way / empty otherwise (3/12 months * 0.5 = 0.125)
Miscellaneous Width Exemptions		
Water Well Drilling machinery	1	The drilling rig is a service unit that does not vary in width during travel. It is therefore full width the entire VMT
Tractor - trailer with farm implement	0.5	The tractor-trailer is loaded with the harvesting machine, tractor or other implement to the delivery point and empty otherwise.
Miscellaneous Length Exemptions		
Highway maintenance machinery	0.5	The tractor-trailer is loaded with construction or maintenance equipment that is delivered to the job site and is empty otherwise.
Water Well Drilling machinery	1	The drilling rig is a service unit that does not vary in length during travel. It is therefore full length the entire VMT
Gas & Oil pipeline service & exploration	0.5	The tractor-trailer is loaded with pipe, tools and machinery during travel to the jobsite and considered empty otherwise.
Drive away saddle mount tractor unit (single trip)	1	Single-trip only. A tow vehicle is combined with other truck tractors as a single unit and delivered to a sales location or other point.

Table 5.3: Representative Exempt Vehicle Configurations Used in the New Revenue Assessment

FY 2011 OS/OW Permit Representative Exempt Vehicle Configurations used in Revenue Assessment										
State Statute	**Exemption**	**Vehicle Description**	**Weight Class / Max GVW lbs**	**Steering Axle weight lbs**	**Single Drive Axle**	**Tandem Axle weight lbs**	**Tandem Axle weight lbs**	**Width**	**Height**	**Length**
TTC 621.508	Agriculture - farm harvest to silo 12% axle (3 months)	5-axle Tractor - semi trailer	≤ 80,000	8,000		38,000	38,000	Legal	Legal	Legal
TTC 621.508	Agriculture - livestock to market 12% (3 months)	5-axle Tractor - Livestock trailer	≤ 80,000	8,000		38,000	38,000	Legal	Legal	Legal
TTC 621.508	Agriculture- logs to mill 12% (3 months)	5-axle tractor - log trailer	≤ 80,000	8,000		38,000	38,000	Legal	Legal	Legal
TTC 621.102(g)	Farm Products, Groceries & LP Gas on LZ Roads - annual	2 axle straight truck	33,000	10,000	23,000			Legal	Legal	Legal
TCC 621.012	Ready mix & Concrete Pump Trucks - annual	3 axle straight truck	69,000	23,000		46,000		Legal	Legal	Legal
TCC 622.031	Raw Milk Tank trucks inner bridge ≥ 28' inner bridge - annual	5-axle Tractor - semi tank trailer	≤ 80,000	12,000		34,000	34,000	Legal	Legal	Legal
TCC 622.041	Poles, Piling & Raw Wood Products < 125 miles - annual	5-axle tractor - pole/log trailer	≤ 80,000	12,000		34,000	34,000	Legal	Legal	90'
TCC 622.0435	Raw Wood Products outer bridge ≤ 39' outer bridge - annual	5-axle tractor - log trailer	≤ 80,000	12,000		34,000	34,000	Legal	Legal	Legal
TCC 622.131 - .136	Recyclable Materials - annual	3 axle straight truck	64,000	20,000		44,000		Legal	Legal	Legal
TCC 623.161 - .165	Solid Waste / Garbage Trucks - annual	3 axle straight truck	64,000	20,000		44,000		Legal	Legal	Legal
TCC 622.953	Cotton Seed Modules - 3 months	3 axle straight truck	64,000	14,000		50,000		10'	14'-6"	48'
TCC 622.953	Chili Pepper Modules - 3 months	3 axle straight truck	54,000	14,000		40,000		10'	14'-6"	48'
TCC 622.901	**Miscellaneous Width Exemptions**		≤ 80,000	12,000		34,000	34,000	Legal	Legal	110'
	Water Well Drilling machinery	4 axle straight truck						see below	Legal	110'
	Tractor - trailer with farm implement	5-axle tractor with lowboy						10'	Legal	Legal
TCC 622.902	**Miscellaneous Length Exemptions**									
	Highway maintenance machinery	5-axle tractor with lowboy						Legal	Legal	110'
	Water Well Drilling machinery	4 axle straight truck						see above	Legal	110'
	Gas & Oil pipeline service & exploration	5-axle tractor with semi-trailer						Legal	Legal	110'
	Drive away saddle mount tractor unit (single trip)	Tow tractor w/ 3 addt'l tractors						Legal	Legal	97'

5.3 Permit Analysis Worksheet

The permit analysis worksheet allows a user to select either an existing permitted vehicle type or an exempt vehicle type to calculate the existing and proposed new permit fees. The worksheet is an Excel spreadsheet composed of three main components as follows:

1. The first component is a user interface screen that allows the user to select a specific non-routed vehicle type and to calculate the annual permit fee based on existing rules and the proposed new permit fee methods.
2. The second component is a user interface screen that allows the user to evaluate existing or potential new permit types and calculate the total permit revenues as selections are made by the user regarding types and numbers of vehicles for which a particular permit might be necessary.
3. The third component is a default database spreadsheet that is linked to the two user interfaces and allows the user to input information regarding each permit or exempt vehicle type, total VMT, load factor, loaded VMT, pavement and bridge consumption rates, and infrastructure operations and safety impacts fee schedule rates. The default database also contains tables for selected permit types (at this time) with information that is needed to calculate an existing permit fee based on options available for that permit type.

The following sections present each of these components in more detail and describe the functionality of the worksheet.

5.3.1 Worksheet Component 1

Component 1 is the Annual Non-routed OS/OW Load Permit Fee Calculator. A screen shot of the fee calculator is shown in Figure 5.1. This interface allows the user to select a specific vehicle type and compute the current permit fee, along with the proposed new permit fee, based on selections made by the user. User selections are related to permit purchaser choices that might affect the price of a permit. Lookup tables contained in the default table provide information based on the permit rules that are used by the program based on selections made by the user. An example will be presented to show the functionality of the calculator.

Example 1: Ready mix truck—currently exempt

As previously discussed, a ready mix truck is currently exempt and can operate with a total GVW of 69,000 lbs., a steering axle load of 23,000 lbs., and a tandem axle load of 46,000 lbs.

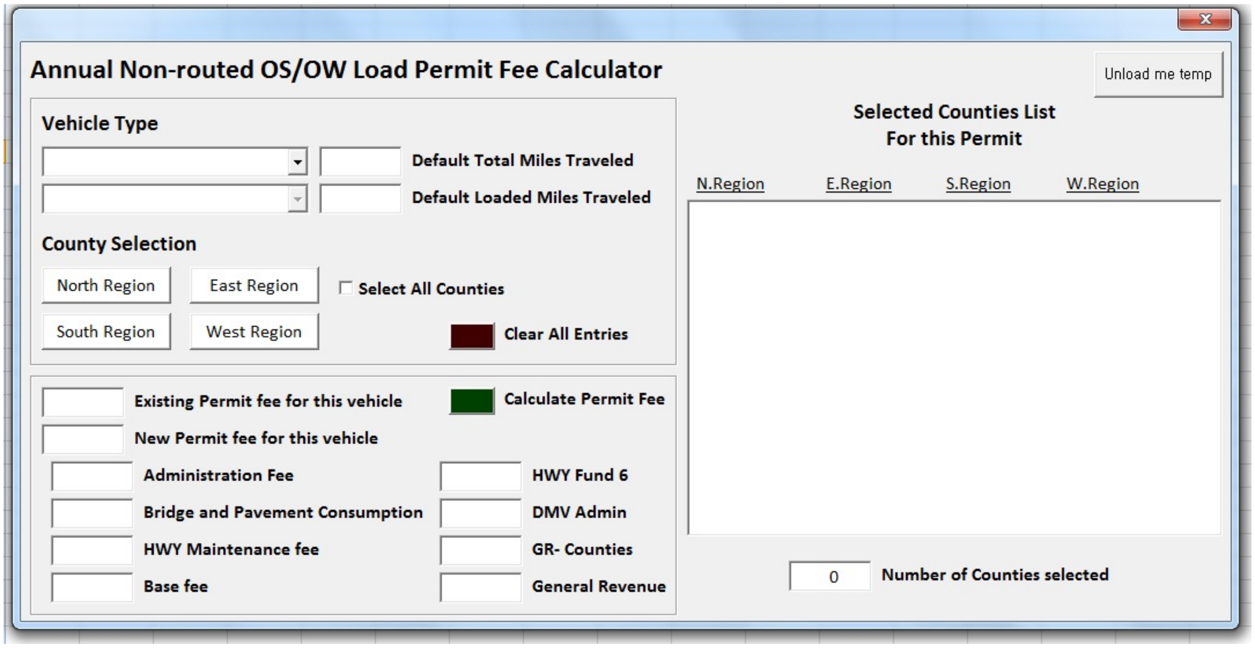


Figure 5.1: Permit Analysis Worksheet—Permit Fee Calculator User Interface Screen

The following steps are performed and depicted in a series of additional screen shots of the program in Figures 5.2–5.4 and 5.7–5.8.

Step 1: Select "Vehicle Type" from the drop-down box.

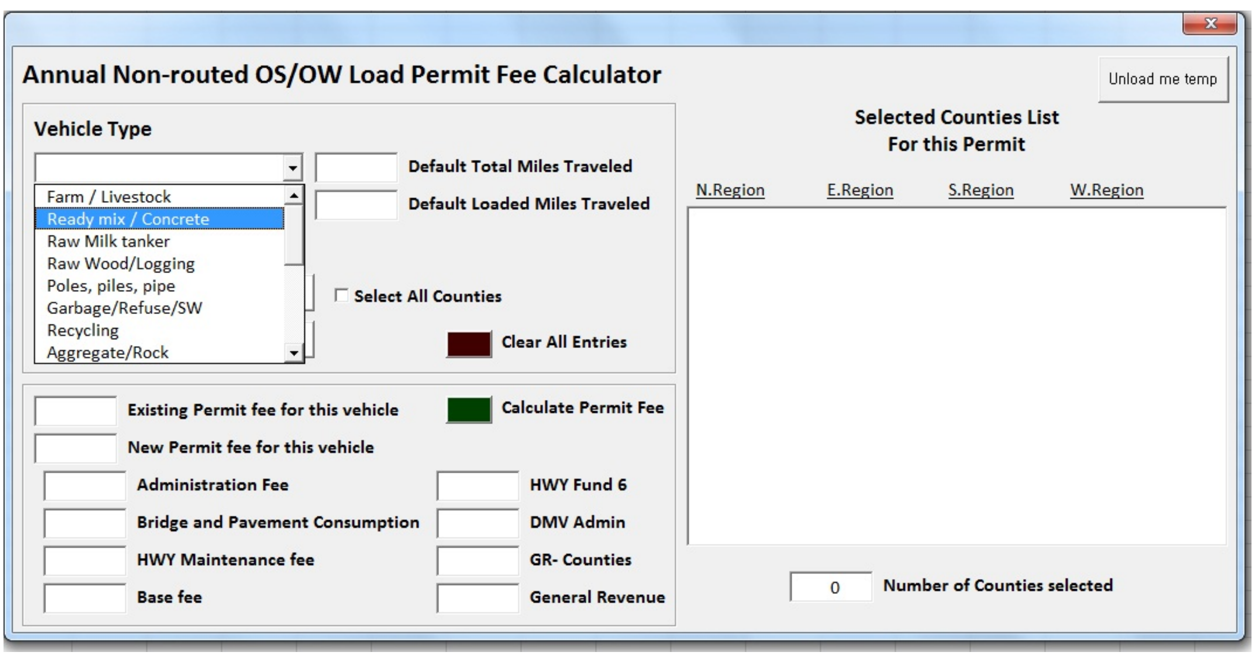


Figure 5.2: A list of vehicle and/or exemption types is provided and the ready mix truck is selected.

Step 2: Click on *Ready mix truck* to show Default Total and Loaded Miles (VMT).

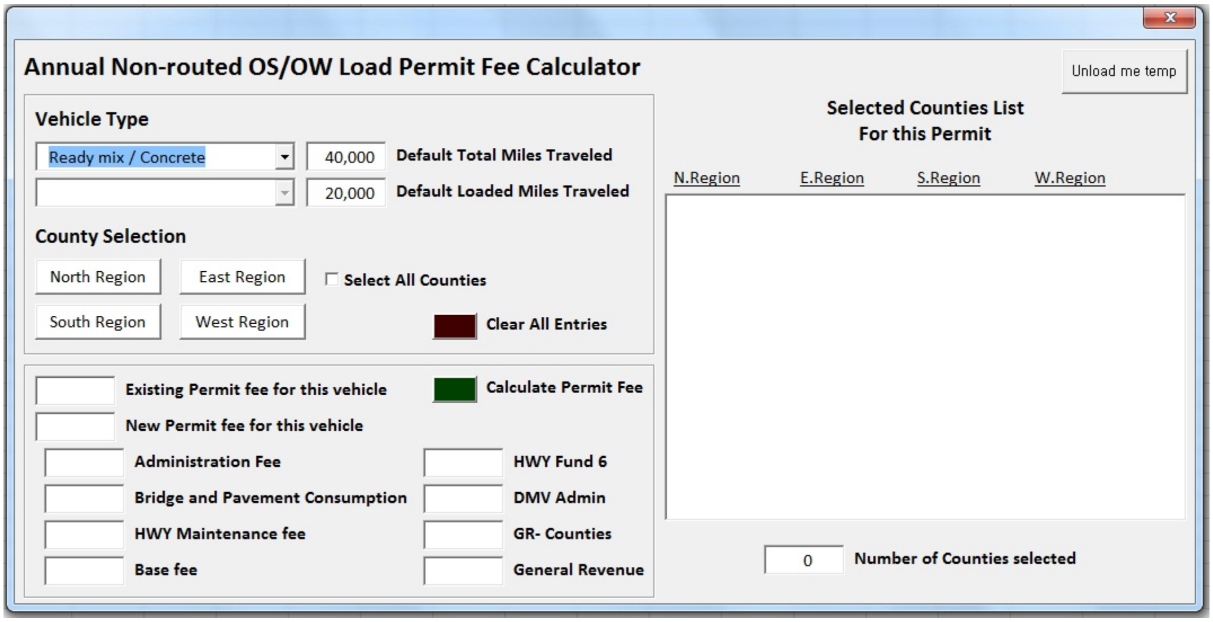


Figure 5.3: The default total and loaded miles (VMT) are diplayed for the vehicle selected.

The total and loaded VMT values are stored as defaults in the default table and can be modified by the user to change the new permit fee amount calculated using the user interface tool.

Step 3: Click on *North Region* and select counties within which this vehicle will operate.

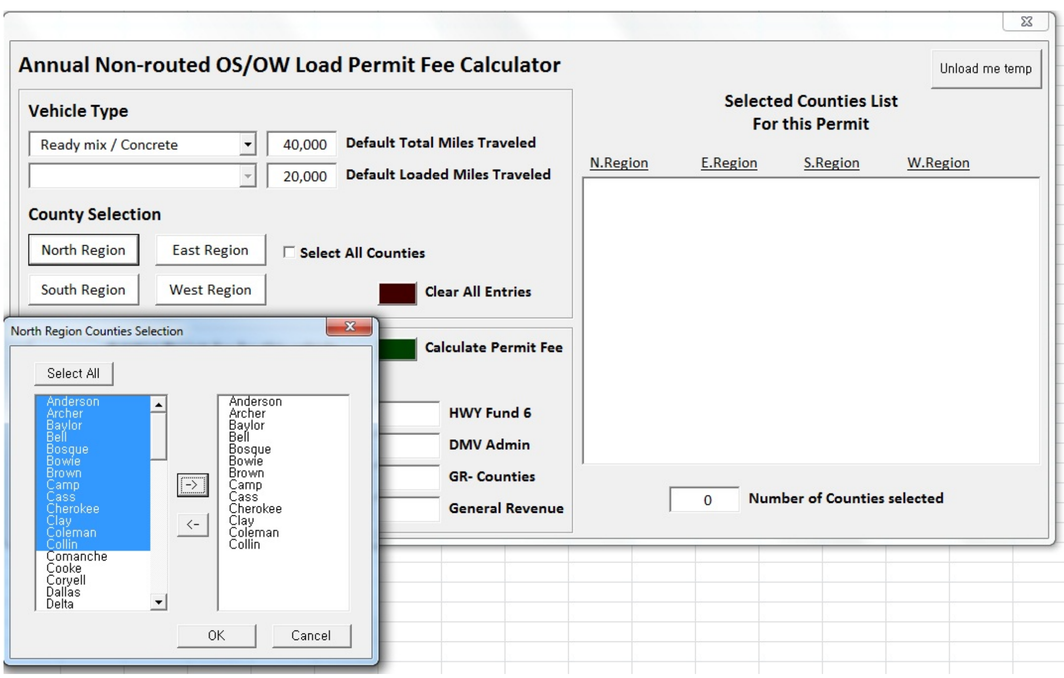


Figure 5.4: The drop-down box shows county selections for the TxDOT North Region.

The user must select counties from at least one of the four TxDOT regions before advancing to the next step in the process. The user clicks on the North, South, East, or West Region button to open drop-down boxes that contain the associated list of counties for that region. Counties can be selected one at a time by clicking the right arrow in the middle of the dialogue box. A county can be deselected by highlighting it and clicking the left arrow. A range of counties can be selected by highlighting the desired counties and clicking the right arrow.

The research team points out that there is a significant benefit in requiring all permit users to specify the counties in which they intend to operate whether or not the county selection is related to permit cost. The concept is based on the county selection requirement for the 2060/1547 over-axle tolerance permits that apportion highway maintenance fees to Fund 6 and GR (Fund 1) for distribution to the selected counties according to rules established by the State Legislature. However, identifying the counties in which a permit purchaser intends to operate also provides valuable information for later analysis regarding the relationships between pavement deterioration and bridge damage within a county or a group of counties selected by permit purchasers.

An example application of this concept is depicted in Figures 5.5 and 5.6, which show the distribution of county authorizations. These have been categorized into four groups based on 2060/1547 over-axle weight tolerance permits purchased in FY 2010.

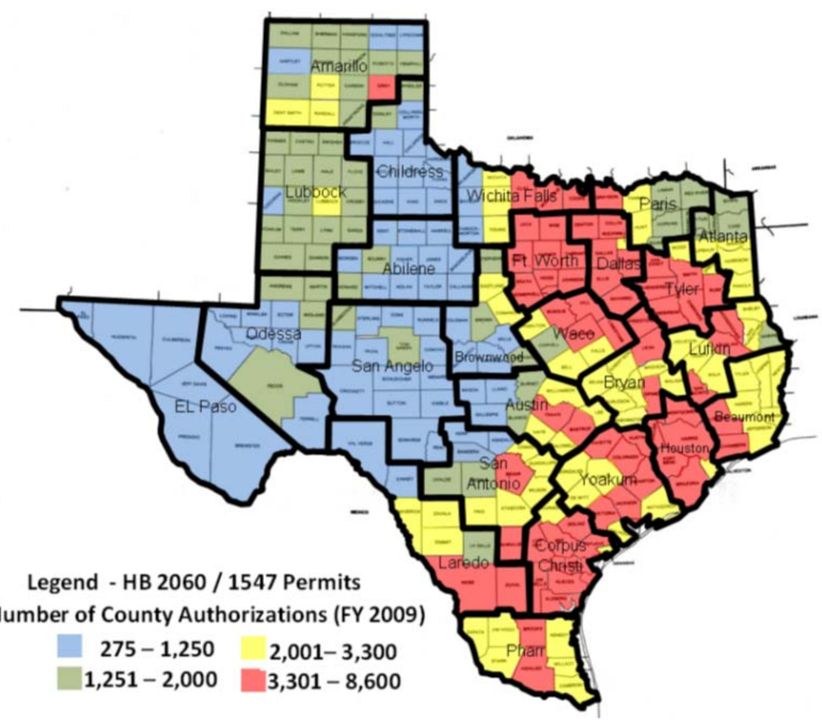


Figure 5.5: Distribution of 1547 Authorized Counties by County and District

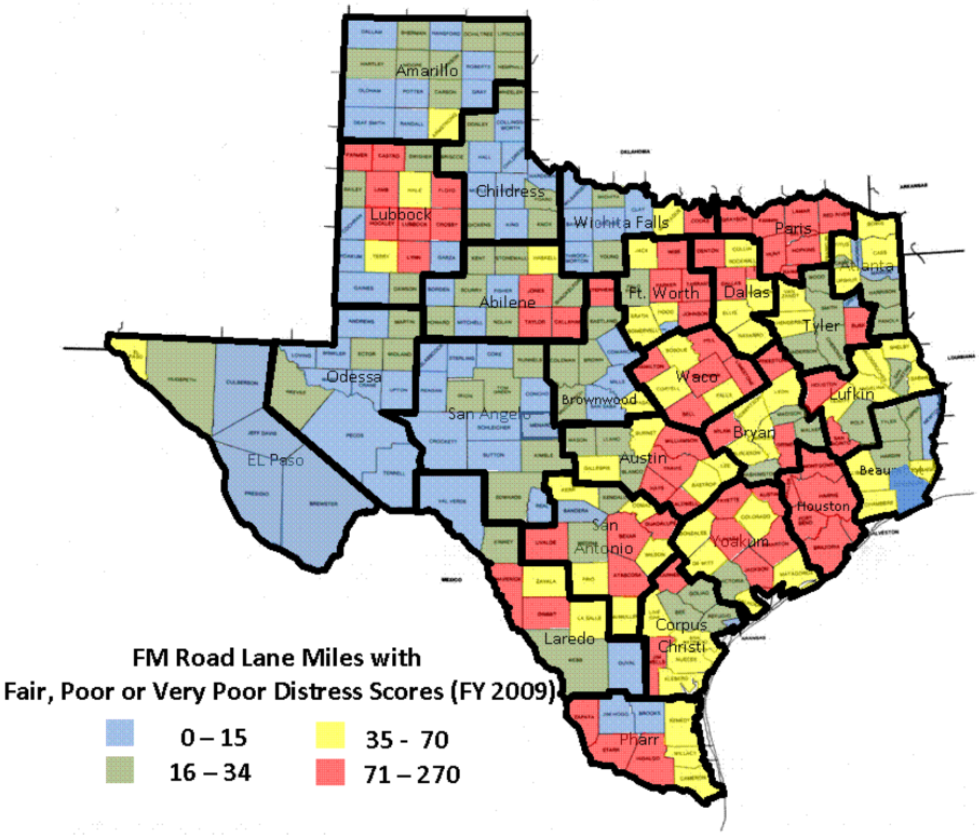


Figure 5.6: Distribution of FM Road Lane Miles with Fair, Poor, or Very Poor Distress Scores

The "authorized counties" are those selected by a permit purchaser and indicate the counties for which the permit is valid and within which the purchaser intends to operate the permitted vehicle(s). This information is used to apportion highway maintenance funds to the counties selected by all permit purchasers according to the number of authorizations for each county. There is no benefit to the permit purchaser or to counties in which the permitted vehicle actually operates if the user selects counties in which the vehicle is not operated. In this case, a county would receive highway maintenance fees for nonexistent deterioration. Additional work is needed to improve the county selection process and ensure that only counties in which a permitted vehicle was operated receive apportioned highway funds.

There is an obvious visual relationship between districts with higher numbers of authorized counties and those with more lane miles of FM roads with fair, poor, or very poor distress conditions. The research team thinks that county selection information provided by permit purchasers for all existing permit types and new permit purchasers for exempt vehicles can provide extremely valuable information for future use in relating increased consumption to total numbers of county authorizations. Additionally, knowing which types of vehicles operate in each county will provide opportunities to study consumption impacts by combining authorizations for specific types of permits and/or vehicle types.

Step 4: Click on the "OK" button to select the counties.

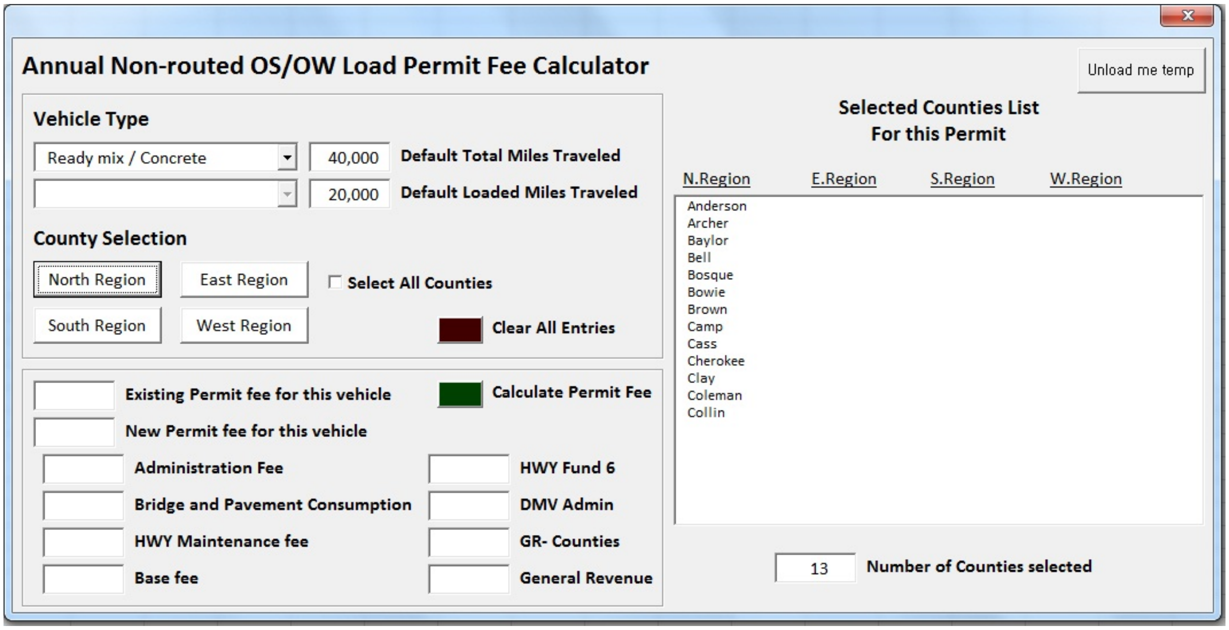


Figure 5.7: The county selections are shown in the Selected Counties List.

When the 'OK' button in the dialogue box is clicked, the dialogue box closes and the selected counties are transferred to the window on the right hand side of the user screen. The counties are organized by TxDOT region, and the total number of counties selected is shown. The number of counties that are selected by a permit purchaser determines the amount of the highway maintenance fee associated with 2060/1547 permits.

Step 5: Click the "Calculate Permit Fee" button.

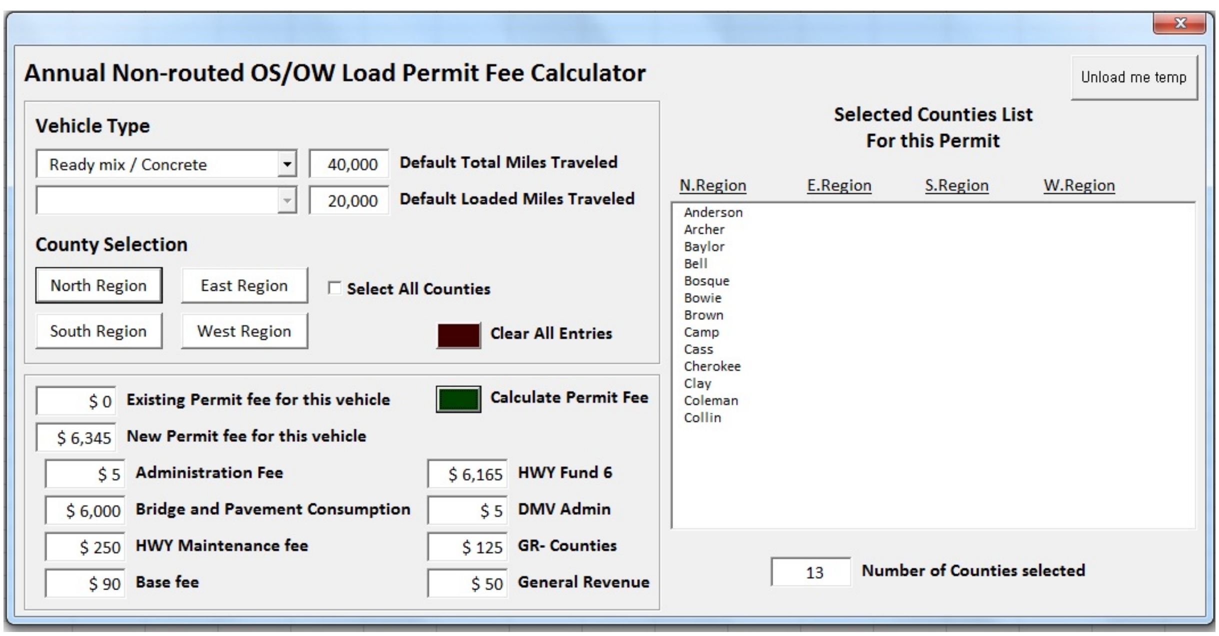


Figure 5.8: The current permit fee and new permit fee are calculated and apportioned.

When the "Calculate Permit Fee" button is clicked, the permit fee for the vehicle is calculated based on the default values and rules established for this permit type stored in the default table. In the above example, because a ready mix truck is currently exempt, there is no current permit fee. The new permit fee based on pavement and bridge consumption is calculated based on the normalized fee/loaded VMT and the number of default loaded miles (VMT) listed at the top of the screen.

Step 6: Click on the "Clear All Entries" button to clear the screen in preparation for another calculation.

The spreadsheet tab can be saved with a different name if the user desires. In this way, different permit rates can be examined for different default total and loaded VMT values and other changes as determined by the user and then stored in the default table.

Step 7: To end the user session, click the "Unload me temp" button in the upper right hand corner of the user screen.

5.3.2 Worksheet Component 2

The permit analysis worksheet also allows the user to explore the total permit Revenue that might accrue for a given permit type based on different numbers of vehicle operators that might purchase the permit. The following steps demonstrate these functions. Figures 5.9–5.16 present accompanying screen shots.

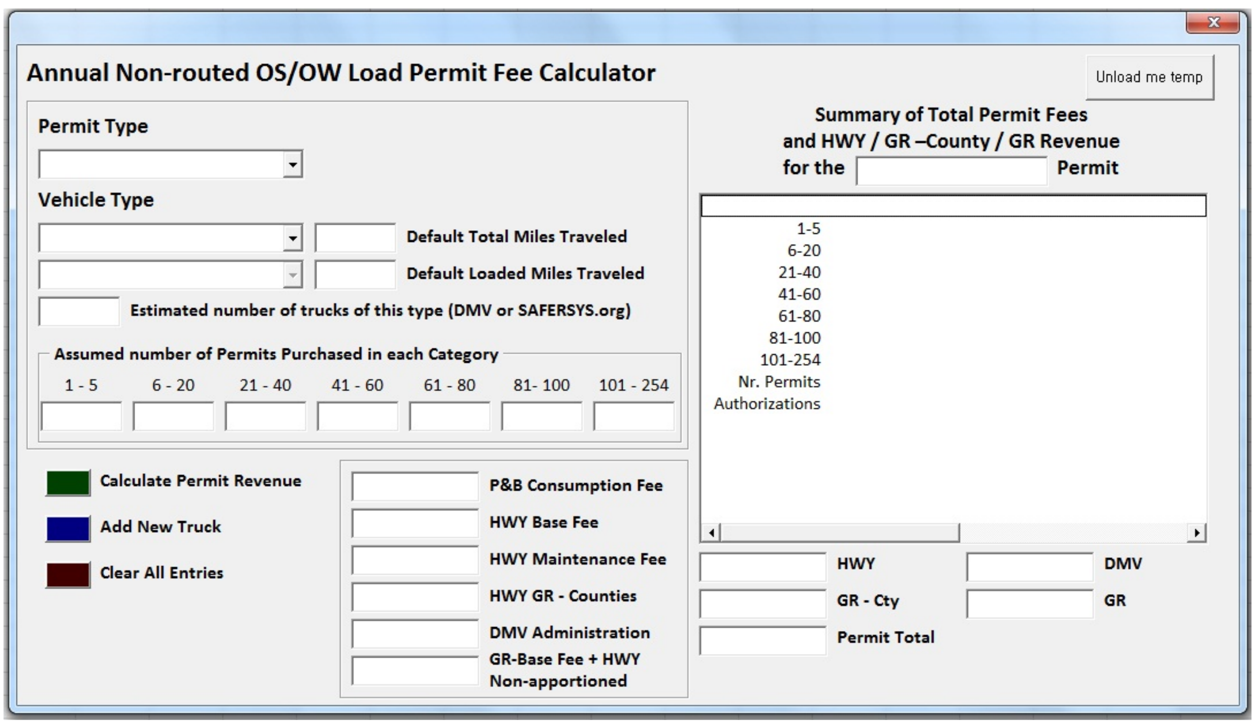


Figure 5.9: The User Interface Screen for the Total Permit Fee Revenue Estimator

The screen has a similar appearance to the permit fee estimator but has different functionalities.

Step 1: To begin the process, click the "Permit Type" drop-down box arrow for a list of options.

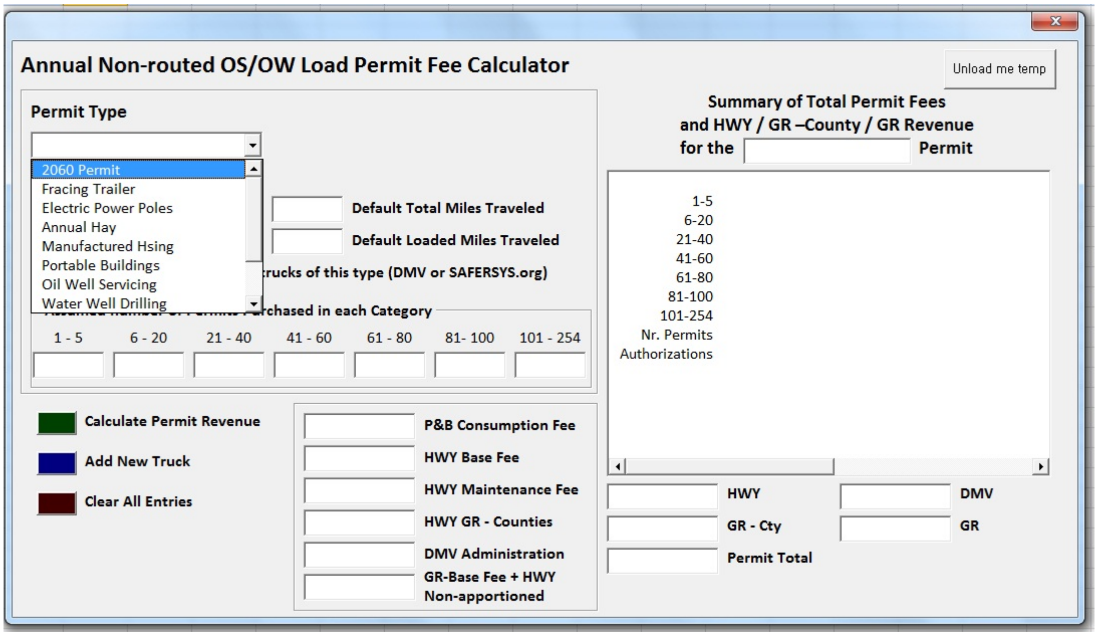


Figure 5.10: Select a permit type for analysis from the drop-down box.

In this example, the 2060/1547 permit will be selected for analysis.

Step 2: Once the permit type is selected, select the "Vehicle Type" drop-down box to display the different types of vehicles listed in the Default Table.

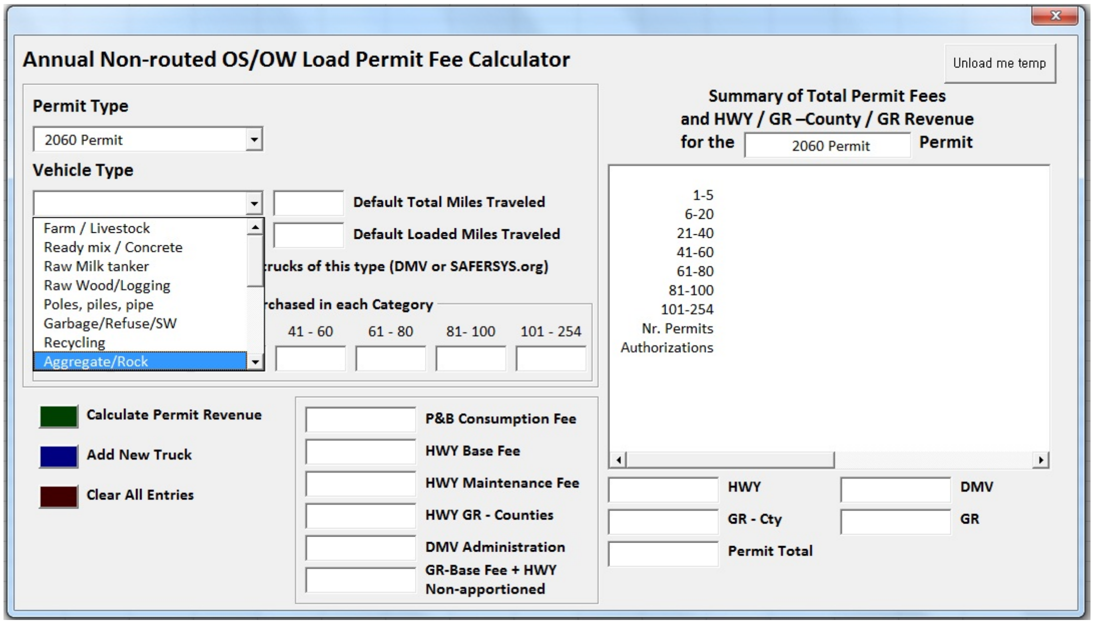


Figure 5.11: Drop-down box with list of vehicles for selection (in this case, an aggregate truck)

Step 3: Once the vehicle type is selected, default values for the total and loaded miles (VMT) are shown along with the estimated number of vehicles of this type operating in Texas.

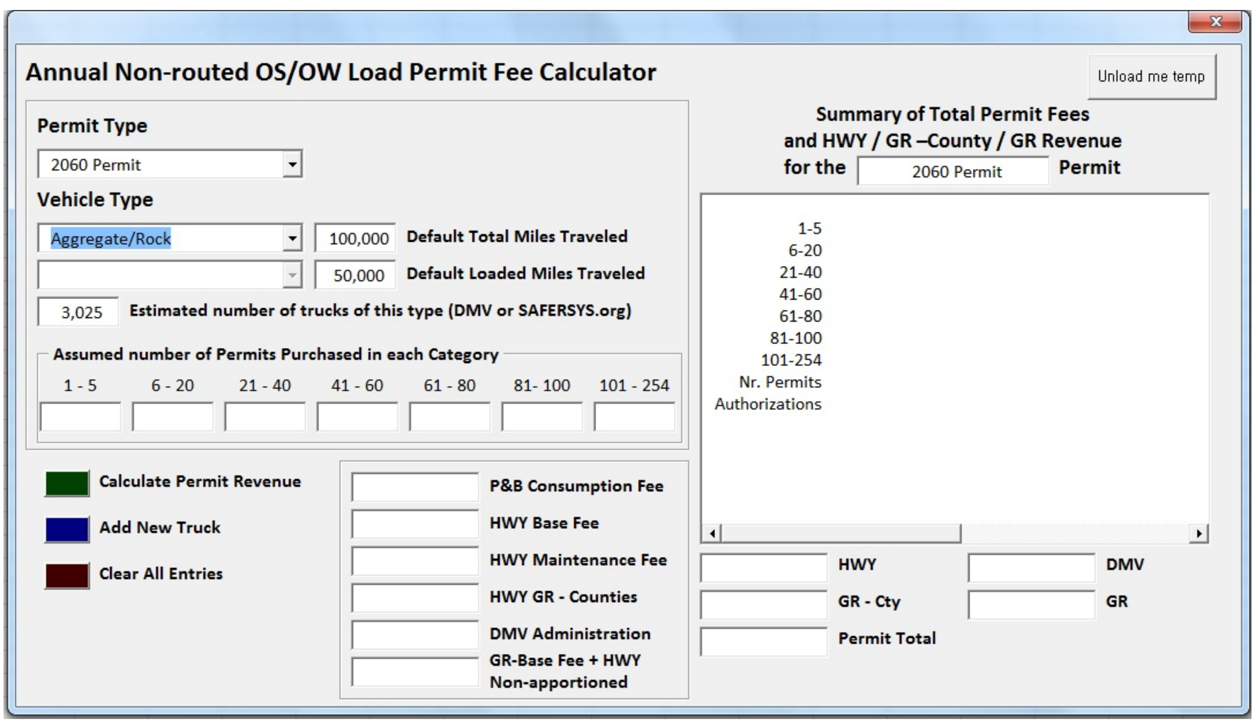


Figure 5.12: Aggregate/Rock Hauler Listed with Total and Loaded VMT and Estimate of Number of Vehicles Operating in Texas

For this example, the data from more than 229 companies that operate aggregate haul trucks in Texas was used to evaluate aggregate and rock haul trucks. This information was obtained from the Federal Motor Carrier Safety Administration (FMCSA) SAFERSYS.ORG database discussed in Chapter 4. Additional information was obtained from previous studies conducted by CTR researchers regarding typical total VMT for vehicles operating with a 2060/1547 permit. TxDMV provided the research team registration information for different types of trucks and trailers through an Open Records Request. According to DMV, more than 94,000 dump trucks are registered in Texas. However, companies or individuals that provided information to SAFERYSYS.org when applying for or renewing their USDOT number reported far fewer dump trucks. The number of trucks of any given type operating in the state is important because this is the potential market for a given permit type. It would not be reasonable to evaluate potential permit fee revenue if the assumed number of permits sold actually exceeds the number of trucks that fit the permit type.

Further research is required to develop more accurate estimates of the numbers of registered trucks used for different types of operations and to haul different products or commodities in Texas. This study should include vehicles operated by companies from other states and countries that operate a portion of their fleet in Texas either temporarily or routinely.

In the above example, the number of trucks shown will be used to determine the number of permits purchased for each county authorization category listed in the series of input boxes. The boxes are labeled based on current state statutes that link the number of counties selected to the amount of the highway maintenance fee charged when the permit is purchased.

The selection used in this example is shown in Figure 5.13 and involved the purchase of 1,870 permits sold according to the county authorizations categories indicated.

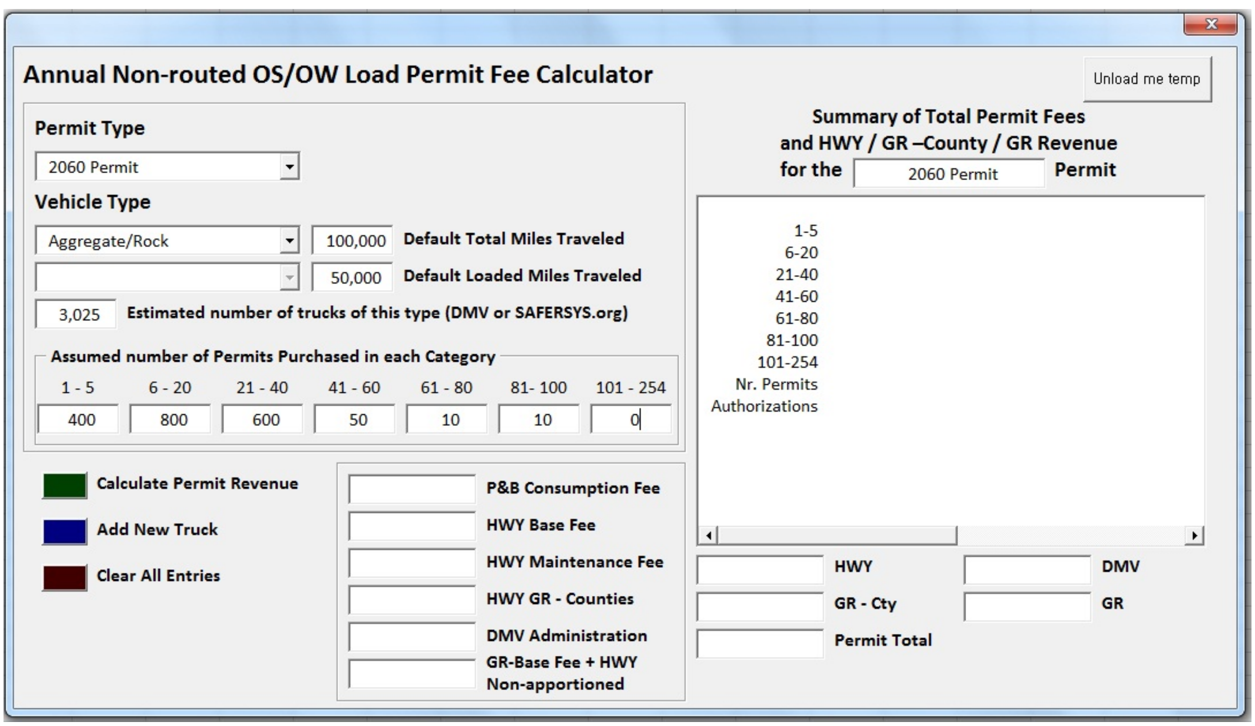


Figure 5.13: Numbers of Permits for Each County Authorization Category

Step 4: After selecting the number of permits, click the "Calculate Permit Revenue" button.

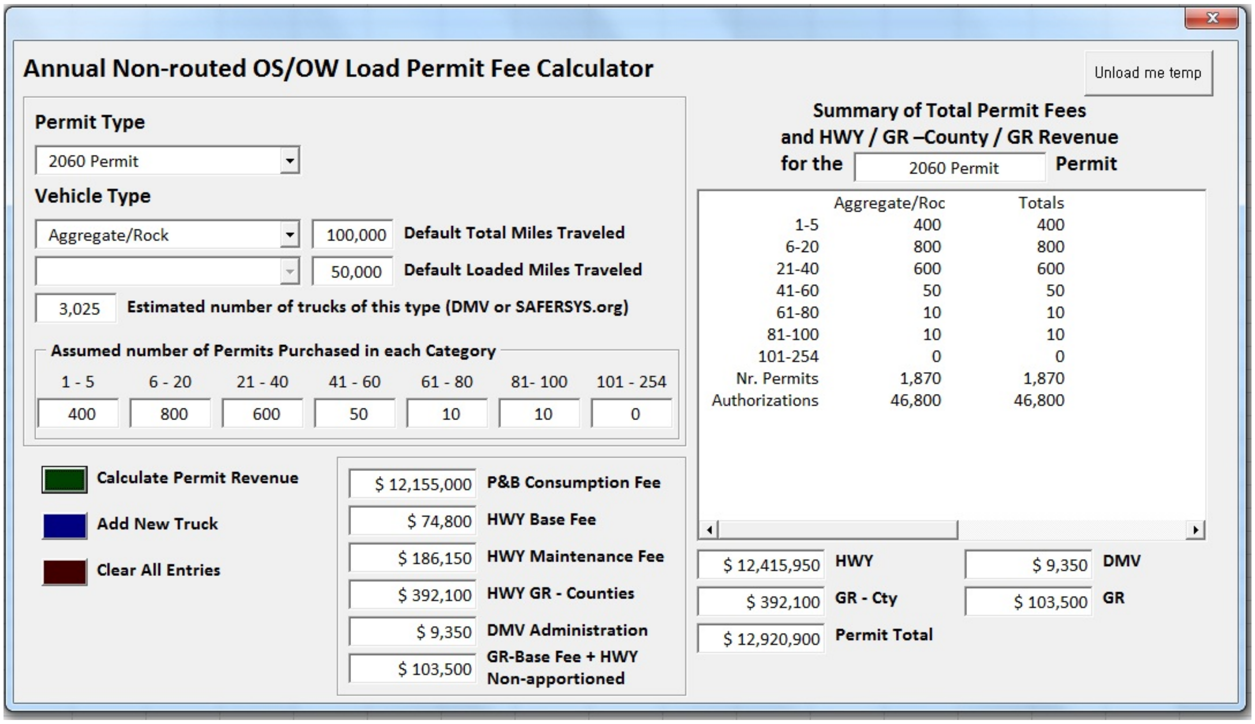


Figure 5.14: Permit Revenue is calculated and apportioned to different budget funds.

The total permit revenue for 1,870 2060/1547 permits is calculated based on the current permit fee rules and based on the new pavement and bridge consumption rate/VMT fees. In this example, both fee sources are shown because a decision by the State Legislature would be necessary to determine how funds are to be apportioned and whether certain types of existing fees are retained or adjusted.

Based on these calculations, 1,870 2060/1547 permits resulted in $12,155,000 in fees based on pavement and bridge consumption fee rates. The user interface retains information about each vehicle type selected for a given permit and lists the vehicle type and number of county authorizations in the display window to the right. The user can select additional vehicle types, make permit purchase selections, and review the results in revenue for each budget category for all permits sold. To add another vehicle, simply click the "Add New Truck" button and the input fields are cleared to prepare for the next selection.

Figure 5.15 shows an example in which the next vehicle type added is a farm/livestock vehicle, which is currently exempt but is being considered for a new OS/OW permit. This vehicle type was selected to show that sub-type levels are also listed for additional agricultural vehicles that fall under this category. The example farm vehicle selected (harvest) qualifies for the 12 percent of over-axle weight tolerance during harvest.

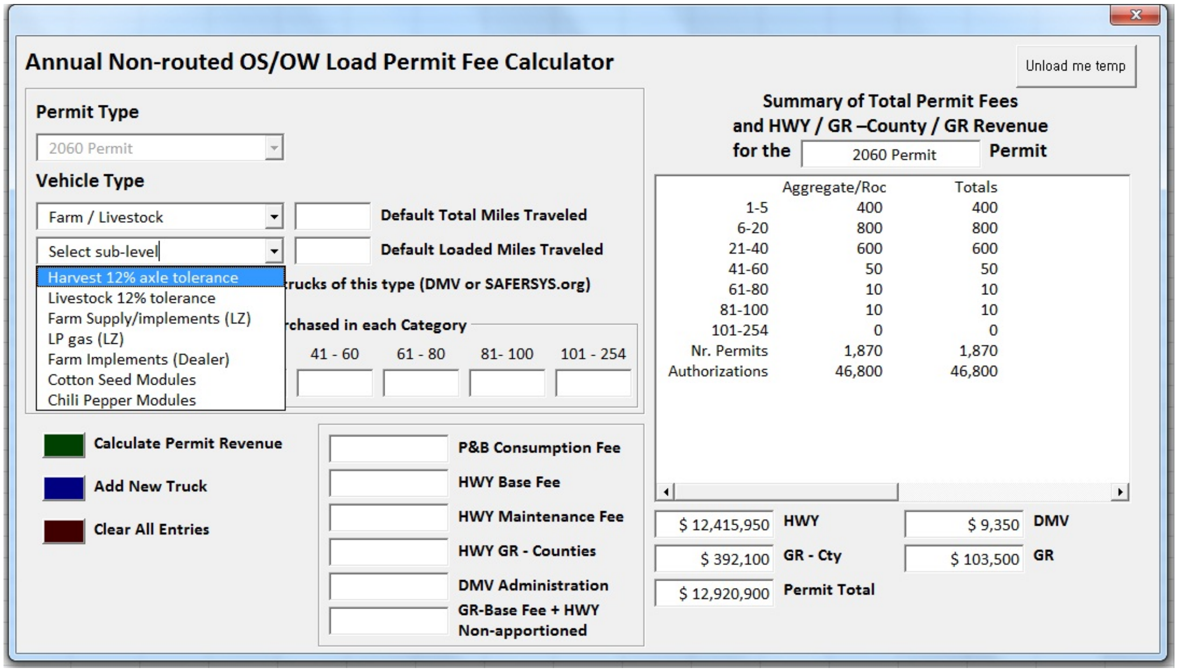


Figure 5.15: Farm/Livestock Vehicle Types with a Sub-Level Showing Different Options

Step 5: Once the new vehicle type is selected, the screen displays the number of vehicles of this type and the number of permits chosen for the analysis.

Figure 5.16 shows the resulting permit selection and revenue.

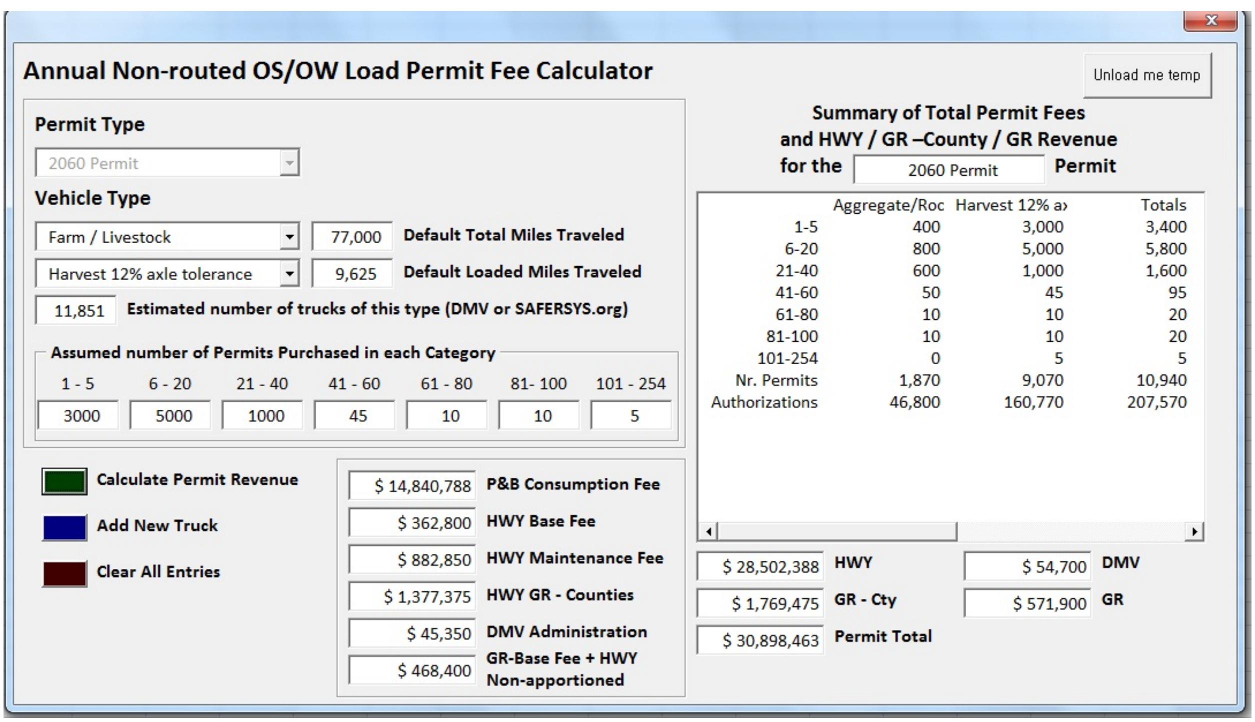


Figure 5.16: Revenue Summary and Total Number of Authorizations

The total number of county authorizations for each vehicle type is shown in the display window along with the total revenue calculated for 10,940 total permits representing 207,570 county authorizations. This tool provides the user with a way to evaluate questions, including whether to create new permits for a specific exempt vehicle type or to include these vehicles under an existing permit and permit rule set. Again, the default table is used to provide the necessary inputs to represent rule sets for existing permits. It can also be used to create new rule sets for new permits, including how the permit fees are apportioned to different budget fund categories.

The next section presents the results of the revenue assessment, which compares actual revenues from permits sold in FY 2011 to revenues that would accrue using the new pavement and bridge consumption fee/VMT calculations methods and the infrastructure operations and safety impact (COS) fee schedule.

5.4 FY 2011 Permit Fee Baseline

The research team conducted a permit fee and revenue analysis by comparing FY 2011 permit sales numbers and associated revenue based on information provided by the TxDOT Finance Division to permit fees that would be generated using the new permit fee structure. In FY 2011, the MCD sold 574,578 OS/OW permits for a total of $111,363,655 in permit fee revenue. Permit fees accrue to different budget fund categories including TxDOT Fund 6; General Revenue Fund 1—non-appropriated; General Revenue Fund 1—county appropriations; and MCD administrative fees. The apportionment is based on statutes and rules established by the State Legislature. The revenue analysis involved summarizing the permit fees by funding category for approximately 96 percent of the total number of permits sold in FY 2011, which comprised approximately 97 percent of the total OS/OW permit revenue.

The new Pavement and Bridge Consumption, Infrastructure Operations and Safety Impact fee (COS) rates were used to calculate the new permit fee revenue for each permit type for the same numbers of permits sold in FY 2011. It is important to note that while COS fee schedule can be used to determine a unique permit fee for any OS/OW vehicle and load configuration, simplified assumptions were required for the revenue assessment. The research team selected representative vehicle configurations and VMT amounts based on TxPROS and other data sources for each permit type based on weight classes and other criteria. This was necessary due to the extremely large variation in vehicle configurations associated with more than 570,000 permits that are categorized into more than 20 permit types and sub-types.

5.5 Permit Revenue Assessment

Table 5.4 summarizes the FY 2011 permit fee numbers and related revenue in the left half of the chart. The new permit revenues are displayed in the right half of the Table and are allocated to different budget funds. Currently FY 2011 permit revenue is allocated to different budget funds (which were provided by the Finance Division according to state statutes). The new permit revenues were not allocated to different budget funds but were simply allocated to three budget categories: 1) TxDOT Fund 6; 2) MCD administrative fees; and 3) proposed fees to fund the development of a new OS/OW Vehicle Education, Training, and Study Center (OVEC). The research team anticipates that the State Legislature, Texas Transportation Commission, and TxDOT Administration will discuss how the new permit revenue funds should be apportioned i.e., whether to Fund 6, to be administered by TxDOT to fund state highway projects, and city or county projects associated with OS/OW infrastructure consumption, operational impacts, and safety improvements.

The estimated revenue based on the COS fees is estimated to be $521,390,308. Compared to the actual fee revenue reported in FY 2011 ($111,363,655), this represents an increase of $410,024,643.

The new permit fee structure includes a $10 administrative fee for each permit sold; $7.50 of this fee is allocated to TxDMV-MCD operations, and $2.50 is deposited in a separate budget account to fund the proposed OVEC Center. OVEC would be located at The University of Texas at Austin and overseen by a Steering Committee formed by TxDOT, TxDMV, TxDPS, and industry partners that represent the OS/OW vehicle community. OVEC would conduct training for public agencies, city and county officials, and others regarding OS/OW consumption and operational impact concepts that will help improve communications and cooperation among all Center stakeholders. OVEC would also conduct research under the guidance of the Steering Committee to address issues of mutual interest and develop new methods and processes regarding OS/OW vehicle operations and safety to benefit the Texas transportation system, OS/OW operators and companies, and the state's economy.

A new TxDOT base fee of $40 is proposed for all permits sold to help fund costs identified in Chapter 4 that are not currently captured in permit fee revenues. If the new base fee had been used in FY 11 it would have generated approximately $20.6 million and would provide revenue for the approximately $30.1 million in costs not currently addressed in permit fees. Because the base fee is directly tied to the number of permits sold, the amount of revenue is expected to increase based on permit sales trends of the past several years.

5.5.1 New Permit Revenue—Exempt Vehicles

Rider 36 directed that the OS/OW study shall consider all OS/OW vehicles including those currently operating under state statutes that provide an exemption. The research team used several data sources, including the FMCSA– SAFERSYS.ORG database, to estimate the number and total VMT for a representative OS/OW vehicle configuration associated with each exemption type. Load adjustment factors were developed and applied to account for loaded vs. empty VMT and expected number of months per year the exemption would be used. Load adjustment factors account for increased allowable sizes or weights related to new non-routed seasonal (harvest); non-routed, annual; or single-trip permits as noted in Table 5.5. Table 5.5 lists the state statute associated with each exemption, the estimated total number of vehicles operating under the exemption, the estimated total and loaded VMT, the COS Fees, the estimated permit fee cost for each exempt vehicle, and total estimated revenues for each exemption type.

Table 5.4: Comparison of FY 2011 Permit Numbers and Revenue with Revenue Based on New Permit Fee Calculation Methods

FY 2011 Permit Fee Sales and Revenue by Fund Category									New Proposed OS/OW Revenue Based on FY 2011 Permit Sales						
Permit Type	Number of Permits Sold FY 2011	RY 2011 Temporary Registration Fee - Fund 1	FY 2011 Permit Administration Fee	FY 2011 Fund 6 Base or Permit Fee	FY 2011 GR Fund 1 Base or Permit Fee	FY 2011 HWY Maintenance TxDOT Fund 6	FY 2011 HWY Maintenance GR-Counties Fund 1	FY 2011 Revenue from all fee Categories	New Permit Administration + OS/OW Education and Study Center Fee	New Pavement and Bridge Consumption Fee	New Infrastructure Operations & Safety Impact Fees	New TxDOT Base Fee	GR Fund 1 Base or Permit Fee Now to Fund 6	HWY GR - Counties to Fund 6 for Apportionment	New Permit Revenue
2060/1547 over axle tolerance	33,269		$166,345	$831,725	$1,663,450	$3,415,886	$7,265,114	$13,342,520	$332,690	$216,248,500				$7,265,114	$223,846,304
General OS/OW single-trip		$213,595						$213,595							$0
< 80,000 lbs / over dimension	184,242			$5,527,260	$5,527,260			$11,054,520	$1,842,420		$18,424,200	$7,369,680	$5,527,260		$33,163,560
80,001 - 120,000 lbs	64,530			$1,935,500	$1,935,500	$9,679,500		$13,550,500	$645,300	$11,188,857	$6,194,880	$2,581,200	$1,935,500		$22,545,737
120,001 - 160,000 lbs	78,147			$2,344,410	$2,344,410	$17,583,075		$22,271,895	$781,470	$20,425,281	$7,502,112	$3,125,880	$2,344,410		$34,179,153
160,000 - 200,000 lbs	28,102			$843,060	$843,060	$8,430,600		$10,116,720	$281,020	$9,555,804	$2,697,792	$1,124,080	$843,060		$14,501,756
200,000 - 254,000 lbs	6,919			$207,570	$207,570	$2,836,790		$3,251,930	$69,190	$3,646,244	$664,224	$276,760	$207,570		$4,863,988
Annual - Envelope (Specific)	1,932			$5,796,000	$1,932,000			$7,728,000	$19,320	$10,085,040	$5,216,400	$77,280	$1,932,000		$17,330,040
Annual - Envelope (Non-Specific)	2,967			$8,901,000	$2,967,000			$11,868,000	$29,670	$15,487,740	$8,010,900	$118,680	$2,967,000		$26,613,990
non-routed 30 day over width	8,449			$506,940	$506,940			$1,013,880	$84,490		$10,138,800	$337,960	$506,940		$11,068,190
non-routed 60 day over width	493			$44,370	$44,370			$88,740	$4,930		$1,183,200	$19,720	$44,370		$1,252,220
non-routed 90 day over width	11,051			$551,310	$551,310			$1,102,620	$110,510		$39,783,600	$442,040	$551,310		$40,887,460
non-routed 30 day over length	3,617			$217,020	$217,020			$434,040	$36,170		$2,652,240	$144,680	$217,020		$3,050,110
non-routed 60 day over length	179			$16,110	$16,110			$32,220	$1,790		$1,736,160	$7,160	$16,110		$1,761,220
non-routed 90 day over length	3,381			$405,720	$405,720			$811,440	$33,810		$128,880	$135,240	$405,720		$703,650
Well Servicing Unit - annual	57			$5,940	$5,940	$2,325		$14,205	$570	$111,150	$102,600	$2,280	$5,940		$222,540
Well Servicing Unit - mileage	3,008	$44,040		$212,561	$93,248			$349,849	$30,080	$5,865,600	$5,414,400	$120,320	$93,248		$11,523,648
Concrete Beams - single trip	176				$5,280	$13,950		$19,230	$1,760	$62,832	$8,448	$7,040	$5,280		$85,360
Portable Buildings - single trip	16,002	$1,710		$120,000	$120,000			$241,710	$160,020		$1,728,216	$640,080	$120,000		$2,648,316
Manufactured Housing - single trip	64,127			$1,301,778	$1,263,302			$2,565,080	$641,270		$7,182,224	$2,565,080	$1,263,302		$11,651,876
Implement of Husbandry - annual	658			$86,805	$86,805	$22,425		$196,035	$6,580		$1,019,900	$26,320	$86,805		$1,139,605
Fracing Trailers	5			$1,036				$1,036	$50	$17,500		$200			$17,750
Hubometer	14,815				$459,265	$6,972,074		$7,431,339	$148,150	$28,889,250	$26,667,000	$592,600			$56,297,000
Temporary Registration	23,601	$856,785						$856,785	$236,010			$944,040	$856,785		$2,036,835
Column Subtotals		**$1,116,130**		**$29,856,115**	**$21,195,560**	**$48,956,625**	**$7,265,114**		**$5,497,270**	**$321,583,798**	**$146,456,176**	**$20,658,320**	**$19,929,630**	**$7,265,114**	
Total Permits in the analysis	**549,727**			**Total Revenue considered in the Analysis**				**$108,555,889**				**Total Revenue - New Permit Fee rates**			**$521,390,308**
Total Permits sold in FY 2011	**574,578**			**Total Permit Fees accured in FY 2011**				**$111,363,655**				**Total Revenue to HWY Fund 6**			$515,893,038
				Total Permit Fees accured to Fund 1 General Revenue				$29,576,804				**Total Revenue to TxDMV-MCD Administration**			$4,122,953
				Total Permit Fees accured to Fund 6 TxDOT				$78,812,740		**Total Revenue to Fund New OS/OW Vehicle Education and Study Center**					$1,374,318
				Total Administration Permit Fees Collected				$166,345							
				Percentage of Permits included in analysis				**96%**							
				Percentage of Permit Revenue included in Analysis				**97%**							

Table 5.5: Revenue Estimate for OS/OW Exempt Vehicles Based on New Permit Fee Calculations

OS/OW Exempt Vehicle Types Included in the Revenue Assessment										
				Exempt Vehicle Analysis Factors						
State Statute	Vehicle / Commodity	Estimated Number of Vehicles of this Type Operating in Texas	Number of vehicles used in calculations	Estimated Total VMT	Load Factor	Loaded VMT	Normalized Pavement & Bridge Consumption rate/VMT	Infrastructure Operation & Safety Fee/VMT	OS/OW Permit Fee per Vehicle	Total New OS/OW Revenue
Exemption Statute										
TTC 621.508	Agriculture - farm harvest to silo (3 months)	12,000	12,000	77,000	0.125	9,625	$0.17	Legal	$1,636	$19,635,000
TTC 621.508	Agriculture - livestock to market (3 months)	600	600	109,000	0.125	13,625	$0.17	Legal	$2,316	$1,389,750
TTC 621.508	Agriculture- logs to mill (3 months)	1,050	1,050	72,000	0.125	9,000	$0.17	Legal	$1,530	$1,606,500
TTC 621.102(g)	Farm Products, Groceries & LP Gas on LZ Roads - annual	500	500	70,000	0.33	23,100	$0.11	Legal	$2,541	$1,270,500
TCC 621.012	Ready mix & Concrete Pump Trucks - annual	11,000	6,500	40,000	0.5	20,000	$0.30	Legal	$6,000	$39,000,000
TCC 622.031	Raw Milk Tank trucks inner bridge ≥ 28' - annual	3,500	3,500	126,000	0.5	63,000	$0.07	Legal	$4,410	$15,435,000
TCC 622.041	Poles, Piling & Raw Wood Products < 125 miles - annual	3,900	2,500	70,000	0.5	35,000	$0.07	$0.02	$2,450	$6,125,000
TCC 622.0435	Raw Wood Products outer bridge ≤ 39' - annual	1,050	1,050	70,000	0.5	35,000	$0.07	Legal	$2,450	$2,572,500
TCC 622.131 - .136	Recyclable Materials - annual	2,277	1,500	52,000	0.33	17,160	$0.23	Legal	$3,947	$5,920,200
TCC 623.161 - .165	Solid Waste / Garbage Trucks - annual	16,368	12,000	52,000	0.33	17,160	$0.23	Legal	$3,947	$47,361,600
TCC 622.953	Cotton Seed Modules - 3 months	887	887	30,000	0.125	3,750	$0.24	$0.16	$1,500	$1,330,500
TCC 622.953	Chili Pepper Modules - 3 months	350^	350	30,000	0.125	3,750	$0.13	$0.16	$1,088	$380,625
TCC 622.901	**Miscellaneous Width Exemptions**									
	Water Well Drilling machinery	430	430	12,000	1	12,000		$0.12	$1,440	$619,200
	Tractor - trailer with farm implement	1,000	1,000	5,000	0.5	2,500		$0.12	$300	$300,000
TCC 622.902	**Miscellaneous Length Exemptions**									
	Highway maintenance machinery	3,800	3,800	50,000	0.5	25,000		$0.04	$1,000	$3,800,000
	Water Well Drilling machinery	430	430	12,000	1	12,000		$0.04	$480	$206,400
	Gas & Oil pipeline service & exploration	2,700	2,000	67,000	0.5	33,500		$0.04	$1,340	$2,680,000
	Drive away saddle mount tractor unit (single trip)	2,500 units^	2,500	300	1	300		$0.04	$12	$30,000
							Total new Proposed Revenue			$149,662,775

The total estimated permit revenue for currently exempt OS/OW vehicles is $149,662,775. This is an estimate, because more information is needed regarding exempt vehicle configurations, vehicle numbers, actual loadings, and total VMT.

5.5.2 New Revenue Estimate—Currently Permitted and Exempt Vehicles

The new revenue estimate for currently permitted vehicles presented in Table 5.4 and exempt vehicles presented in Table 5.5 is estimated at $521,390,308 + $149,662,775 = $671,053,083. This exceeds actual FY 2011 permit sales by $671,053,083 - $111,363,655 = $559,689,428.

Revenue Analysis

Revenue calculations from the previous section indicate that the total revenue for the number of permits sold in 2011 should have been approximately six times more than the actual permit revenue in order to reimburse TxDOT for the marginal pavement and bridge consumption costs and infrastructure operations and safety impacts from the 570,000+ OS/OW permits sold. It is important to consider certain factors when evaluating these numbers in order to put results into perspective.

The current Texas state gas tax is $0.20 per gallon and has not been increased since 1991. The current registration fee for an 18-wheeler tractor-semi trailer unit operating intrastate in Texas is $937.50 and has not been increased since 1986.

The state gas tax and light duty personal vehicle and heavy truck / trailer registration fees are intended to provide sufficient revenue to pay for pavement and bridge consumption maintenance costs, as well as funds for new added capacity projects. In fact, this is not the case.

The research team re-emphasizes the fact that the pavement and bridge consumption rates/loaded VMT and the infrastructure operations and safety impact rates/loaded VMT are used to compute OS/OW permit fees and resulting revenue for the marginal cost of the increased load and oversize dimensions. These permit fees were not priced to cover, nor are they intended to cover, the entire maintenance and construction revenue needs for the 195,000 lane-miles and 51,000 bridges that make up Texas's state-maintained highway network.

Although, by comparison, The new 2060/1547 permit fee based on consumption is $6,500 and is significantly higher than the current minimum 2060/1547 permit fee of $265, which allows operation of an 84,000-lb., five-axle tractor trailer unit in five counties. However, this is the true consumption cost for this vehicle operating 50,000 loaded VMT.

By comparison, based on today's fuel prices and average truck fuel mpg rates (5 miles/gallon), the 33,269 vehicle operators with 2060/1547 permits would spend the following:

Total fuel purchases: 100,000 VMT / 5 mpg = 20,000 gallons of fuel at $3.50 per gallon = $70,000 in fuel per year per vehicle.

The total fleet of 33,269 vehicles would have expended $70,000 x 33,369 = $2.238 billion in fuel costs in FY 2011.

Total fuel taxes paid: 20,000 gallons of fuel x $0.20 gas tax per gallon = $4,000 per vehicle in gas taxes.

The total fleet of 33,269 vehicles would have traveled an estimated 3.327 billion VMT on Texas highways and would have generated a total of 33,269 x $4,000 = $133,076,000 dollars in gas tax revenue, of which 25 percent would have be apportioned to schools and the remaining 75 percent to TxDOT. However, the actual gas tax revenue paid to the comptroller would include diversions of fuel taxes to fuel distributors (discussed in a later section) and revenue retained by the comptroller's office for fuel tax program oversight.

The resulting gas tax revenue apportioned to TxDOT would be $99,870,000 or about $0.03 per VMT. By comparison, Oregon, which has dispensed with a gas tax in favor of a load/mile rate, currently charges $0.168 per mile for an 80,000-lb., five-axle 18-wheeler that is within legal size limits. Using Oregon's rate/mile instead of Texas's $0.20/gallon gas tax, the VMT traveled by the 33,269 permitted vehicles would have resulted in $558,936,000 dollars in rate/VMT fees.

The registration fees for these 33,269 vehicles, if registered for intrastate operation (interstate registration fees are more expensive), are 33,269 x $937.50 = $31,189,687. Based on the same VMT as discussed in items 1 and 2, this results in about $0.01 per VMT in revenue. Thus, the gas tax revenue and registration revenue fees that go to Fund 6 to cover the maintenance, operations, and safety impacts of these 33,269 vehicles for the base 80,000-lb., legal GVW load limit is approximately $0.04/VMT. By comparison, the normalized pavement and bridge consumption rate/VMT for the marginal increased OS/OW load is $0.13/VMT. This disparity brings into sharp focus the inadequate funding provided by the current gas tax and heavy vehicle registration fees in Texas to fund pavement and bridge needs.

These new consumption and infrastructure fee rates produce permit fee costs that are based on a rational assessment of the true marginal costs of increased loads and dimensions. This information is based on facts, sound engineering principles, and analysis processes.

5.6 Additional Considerations

In Chapter 4, the research team presented information regarding additional costs associated with OS/OW loads that are not reimbursed through current permit fee rates. The new proposed TxDOT base fee of $40 per permit will help recover a portion of these costs.

5.6.1 OS/OW Fines in Texas

In Chapter 4, researchers emphasized that previous studies by several different research teams at the state and national levels have shown that a strong vehicle size and weight enforcement program is necessary to help reduce increased consumption due to illegal OS/OW loads. The research team also noted that the TxDMV Enforcement Section is effective in reducing OS/OW vehicle operations through complaint investigations it conducts directly with companies with a history of DPS issued OS/OW citations. Based on information provided by TxDPS and the state comptroller's office through open records requests, the number of overweight truck violations reported by the Texas Department of Public Safety has averaged about 30,000 per year between 2007 and 2011.

Increasing the overweight vehicle fine structure is not intended to be punitive; rather, it is designed to persuade operators of overweight vehicles to operate at the legal load limit or to purchase an appropriate overweight permit (Conway & Walton, 2004; Euritt, 1988).

Reducing the number of overweight vehicles will reduce accelerated pavement and bridge deterioration rates. The state comptroller reported that an estimated $1.6 million was paid to the General Revenue Fund by city and county courts through overweight truck violations (TxCPA, 2010a; TxCPA F40-145, 2010b; TxCPA F40-132, 2010c).

Transportation Code Section 621.506 "Offense of Operating or Loading Overweight) requires cities and counties to report overweight truck violations to TxDPS. Cities within 20 miles of the Texas-Mexico border are authorized to keep 100 percent of fines derived from overweight vehicle, but they must still report violations to TxDPS. Again, based on information provided by the TxDPS, approximately 30,000 overweight truck violations are issued annually.

Therefore, the average overweight truck fine is approximately $110 ($3,335,032/30,000 violations). Section 621.506 TC currently sets the minimum overweight fine at $100 for excess weight less than 5,000 lbs. over legal limits; $300 for loads of or more than 5000 lbs. but less than 10,000 lbs. over the legal limit; and $500 for loads greater than 10,000 lbs. over the legal limits. This suggests that almost all overweight truck violation fines adjudicated by cities and counties in Texas are the minimum value ($100).

Literature regarding overweight truck fines indicates that low fines do little to discourage overweight truck operations. For the minority of truckers who chose to operate over the legal load limit, estimated to be between 15 and 30 percent depending on truck type, overweight fines are considered "a cost of doing business." An increase in the minimum overweight truck fine may discourage illegal overweight operations and reduce accelerated deterioration of pavements and bridges (FOEDR, 2009; Taylor et al., 2000; Battelle Team, 1995; Barron et al., 1994; and Lundy & McCullough, 1987).

Because OS/OW vehicle fine revenue is associated with increased pavement and bridge consumption, the research team recommends that these fines be deposited in Fund 6.

5.6.2 Gas Taxes Paid to Fuel Distributors

Motor fuel tax receipts that otherwise would accrue to Fund 6 are retained by motor fuel suppliers and distributors or importers for early payment of motor fuel tax receipts to the Texas Comptroller of Public Accounts. Furthermore, the state comptroller retains a percentage of gross motor fuel tax receipts for enforcement and administration of motor fuel tax laws. The below estimates of diverted gas tax revenue from Fund 6 are based on gross motor fuel tax receipts of $4.5 billion annually (2030 Committee Report–Appendix E, 2011).

Approximately $213 million in motor fuel tax revenue is diverted from Fund 6 and the school fund. Per state statutes, 75 percent of motor fuel tax revenue is paid to Fund 6 and 25 percent to the school fund. Based on this distribution, $160 million is diverted from Fund 6 and $73 million from the school fund. A study is recommended to evaluate the percentages paid and amount of motor fuel tax that is diverted through these processes. If 50 percent of the $160 million diverted from Fund 6 could be recaptured, this would provide approximately $80 million in additional pavement and bridge maintenance funds (Texas Comp, 2011a; Texas Comp, 2011b; and Texas LBB, 2010).

5.7 Conclusions and Recommendations

A revenue and permit fee assessment was conducted based on the new pavement and bridge consumption rate/loaded VMT methodology and COS fee schedule. Results show that based on an assessment of permit fees collected in FY 2011 for more than 570,000 permits, the actual OS/OW consumption and impact fees were more than six times greater that the fees collected.

Additionally, comparing the consumption fee rates for pavements and bridges that represent the marginal cost of increased weight above legal limits, the current state gas tax and registration fees for heavy vehicles are significantly lower than the revenue needed to address pavement and bridge consumption due to legally loaded vehicles.

5.8 Recommendations

The research team makes the following recommendations based upon the research objectives, data gathered, and methodologies created.

1. Simplify the permit fee structure to reduce the number of existing permits types and remove industry-specific permits. This will also reduce the number of potential new permit types for currently exempt vehicles.
2. Implement the Pavement and Bridge **C**onsumption fee system based on vehicle-miles-traveled (VMT) for all permits.
3. Implement an Operations and **S**afety Fee System based on VMT for assessing permit fees for oversize vehicles.
4. Apply Consumption and Operational and Safety fee (COS) schedule to all permits.
    a. If the existing permit system and type is continued, the fee structure presented in Table 4.4, which has been expanded to include 34 rate categories, should be adopted and applied to determine the infrastructure operations and safety impact rates and to calculate fees for all permit types as applicable.
5. Apply a $10 administration fee to each permit sold.
6. Include a $40 TxDOT base fee for each permit sold to help recover additional costs associated with OS/OW operations.
7. Create an OS/OW and Heavy Vehicle Training, Education and Study Center (OVEC). OVEC shall be funded through a portion of the new permit administration fee.
8. Certain exemptions should be excluded from consideration for a permit fee. These are listed in Table 4.2.
9. The counties in which OS/OW permitted vehicles are intended to operate should be identified in every permit.
10. OS/OW vehicle fine revenue should be deposited in Fund 6, because these vehicles cause accelerated pavement and bridge consumption rates.

Additionally, the research team also identified eight other elements that require further consideration, analysis or research. The research team recommends that these should be conducted by the OVEC.

1) TxDOT, TxDMV, UT-CTR and UTSA will work cooperatively to identify a steering committee that would oversee the operations of OVEC. OVEC would guide development of the goals, objectives, and next steps for its implementation.

2) The research team can be made available to help conduct education and awareness programs for county judges, city administrators, and the trucking industry regarding impacts to state, city, and county pavement and bridge infrastructure due to illegal OS/OW vehicles.

3) Gather more information from the trucking industry on issues and needs surrounding OS/OW vehicle operations, including incorporating the economic benefits of these vehicles within the permit system.

4) Further studies are needed to evaluate methods for considering operation of legally loaded heavy vehicles and OS/OW permitted vehicles in the Safety Improvement Index contained in TxDOT's Highway Safety Improvement Program Manual, particularly in cases in which a rural road is frequently used for permitted loads.

5) Evaluate vehicle configurations and loads that can occur due to the combination of a temporary registration permit and the agricultural 12 percent over-axle tolerance exemption.

6) Develop methods to evaluate and quantify increased pavement and bridge consumption due to super-heavy loads that may not be visually evident from a visual distress survey of the permit route.

7) Conduct further research to evaluate the current OS/OW fine structure and identify policies and processes that increase the effectiveness of fine structure administration to discourage operation of illegal overweight trucks on Texas roads and bridges.

8) Perform analysis to address the types of information that should accompany each permit purchase to develop improved pavement and bridge consumption model development and infrastructure operations and safety impacts.

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Appendix A: Methodology and Recommendations for Pavement Damage Analysis: DARWin-ME™

DARWin-ME™ is a pavement analysis program originally developed under the National Cooperative Highway Research Program (NCHRP). It is now endorsed and managed by the American Association of State Highway and Transportation Officials (AASHTO). It is a mechanistic-empirical pavement design method for the design of new and rehabilitated flexible and rigid pavements.

Flexible Pavements

In the mechanistic-empirical method, the fundamental pavement responses for flexible pavements under repeated traffic loadings are calculated using a multi-layer linear elastic algorithm. It assumes that a pavement structure is a multi-layered structure and that each layer in the pavement structure exhibits an elastic behavior that is linear in nature. This implies that if loads are doubled, so is the response of the material under the imposed loads. The method computes stresses and strains induced to pavement layers due to traffic loadings. These pavement responses are then related to field distresses using empirical relationships, also known as transfer functions.

DARWin-ME™ uses an iterative approach towards design of pavement structures wherein the designer starts with a trial pavement structure with typical material characteristics for the given region (see Figure A1). The designer also decides on the most appropriate failure criteria and reliability level, which in most cases is based on the specifications of the highway agency. It is also important to note that DARWin-ME™ allows the user to choose input levels depending on the level of detail available for each of the design variables. In the case of material properties, DARWin-ME™ requires resilient moduli for unbound materials and dynamic moduli for bituminous materials at the highest input level (Level 1). However, if such detailed information is not available, typical volumetric properties are considered sufficient for estimating the properties of the materials. These properties include aggregate gradation, binder type and content, air voids, and bulk density. For characterizing unbound materials, information on sieve analysis data, Atterberg's limits, maximum dry density, and optimum moisture content at the very minimum are required at. DARWin-ME™ uses detailed information pertaining to traffic characterization. This information includes average daily truck traffic count, traffic growth rates, truck classification, and axle load distributions for each truck class. The program also provides the designer with the flexibility to vary the truck classification and axle spectra depending on the month of the year. Other capabilities include hourly variation in truck volume, axle spacing, number of axles per truck, etc.

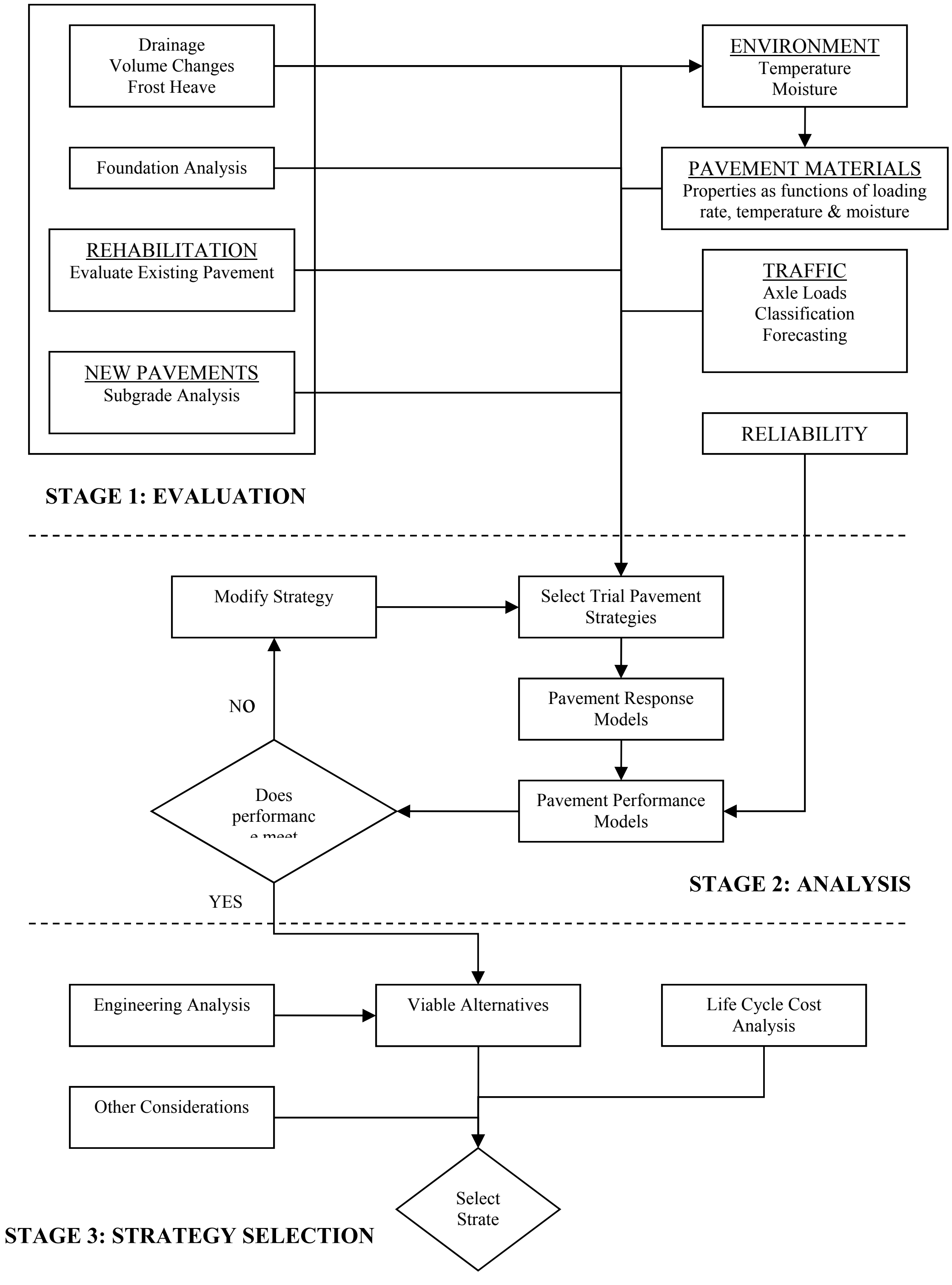


Figure A1: DARWin-ME™ Design Procedure

Provided the designer has the required information available, DARWin-ME™ can analyze the specific pavement section to determine the structure's adequacy in terms of key distresses. The program does not recommend a particular thickness for each structural layer; rather, it evaluates and determines if the trial section can support the imposed truck traffic volume under given environmental conditions. The designer must interact with the program and make a choice while considering all available choices. These may include modifying the thickness or using higher quality materials. DARWin-ME™ is a pavement analysis tool that helps determine the adequacy of the pavement structure and aid the designer in making a well-informed decision on the optimal design.

A significant improvement introduced into DARWin-ME™ is the consideration of climatic effects on pavement materials, responses, and distress in an integrated manner. These effects are estimated using the Enhanced Integrated Climatic Model (EICM), which is used to model temperature and moisture within each pavement layer and the foundation. The climatic model considers hourly ambient climatic data in the form of temperature, precipitation, wind speed, cloud cover, and relative humidity from weather stations across the United States for estimating pavement layer temperatures and moisture conditions. The pavement layer temperature and moisture predictions from the EICM are calculated hourly and used in various ways to estimate the material properties for the foundation and pavement layers throughout the design life.

DARWin-ME™ was nationally calibrated taking into consideration various climatic regions across the country. The national calibration of the design guide was based on a wide spectrum of conditions. The vast majority of pavement sections used in the global calibration were adopted from the Long-Term Pavement Performance (LTPP) database.

Calibrating the transfer functions in DARWin-ME™ requires an extensive database for proper characterization of the individual layers of the entire pavement structure, the geographical conditions, and the traffic. Additionally, project-specific performance data are required for each distress mechanism for which the transfer function requires calibration. However, in the context of this study, project level performance data was not available. Therefore, calibration of the transfer functions was not possible within the timeframe of the study. Given these limitations, the performance predictions obtained from DARWin-ME™ would be biased. However, in the context of this study, the focus was geared towards determining the Equivalent Consumption Factor (ECF) to establish load equivalencies between different loads based on the concept of equivalent pavement responses, eliminating the need for project level calibration. The approach is based on computing ratios between the time to failure for the pavement structure under different axle loads. Because calibration factors are multiplicative factors, this implies that any potential systematic error is canceled out in the process.

The following detailed discussion explains the transfer functions used in DARWin-ME™ for rutting, fatigue cracking, and roughness, given that these are the same distress mechanisms used for computation of the ECFs in this study.

Rutting

Rutting is one of the most prominent distress mechanisms for flexible pavements. It results from the permanent deformation of pavement layers and is directly related to the internal friction of the aggregate and cohesion of the asphalt binder. The primary factors affecting rutting are material properties, temperature, moisture, number of load applications, loading frequency, and state of stress. The critical conditions for permanent deformation accumulation are elevated temperatures and slow moving traffic.

The model for calculating total permanent deformation uses the plastic vertical strain under specific pavement conditions for the total number of trucks within that condition. Conditions vary with time, so DARWin-ME™ calculates the state of stress every two-week period.

In the laboratory, the accumulation of plastic deformation is measured using repeated load permanent deformation triaxial tests for both bituminous and unbound layers. The laboratory-derived relationship is then adjusted to field-observed rut depths. DARWin-ME™ uses the following transfer function to relate laboratory-measured material responses to field observed rut depths:

$$\Delta_{p(HMA)} = \varepsilon_{p(HMA)} h_{HMA} = \beta_{1r} k_z \varepsilon_{r(HMA)} 10^{k_{1r}} n^{k_{2r}\beta_{2r}} T^{k_{3r}\beta_{3r}} \quad \text{(A1)}$$

Where

$\Delta_{p(HMA)}$	:	Accumulated permanent vertical deformation in the HMA layer/sublayer, inches
$\varepsilon_{p(HMA)}$	:	Accumulated permanent axial strain in the HMA layer/sublayer, inches/inches
$\varepsilon_{r(HMA)}$	:	Resilient or elastic strain calculated by the structural response model at the mid-depth of each HMA sublayer, inches/inches
h_{HMA}	:	Thickness of the HMA layer/sublayer, inches/inches
n	:	Number of axle-load repetitions
T	:	Mix or pavement temperature, °F
k_z	:	Depth confinement factor
$k_{1r, 2r, 3r}$	:	Global field calibration parameters
$\beta_{1r, 2r, 3r}$	:	Local or mixture field calibration constants

DARWin-ME™ uses a separate field-calibrated transfer function to calculate plastic vertical deformation within all unbound pavement sublayers and the foundation or embankment soil.

$$\Delta_{p(soil)} = \beta_{s1} k_{s1} \varepsilon_v h_{soil} \left(\frac{\varepsilon_0}{\varepsilon_r}\right) e^{-\left(\frac{\rho}{n}\right)^{\beta}} \quad \text{(A2)}$$

Where

$\Delta_{p(soil)}$	:	Permanent or plastic deformation for the layer/sublayer, inches
n	:	Number of axle-load applications
ε_0	:	Intercept determined from laboratory-repeated load permanent deformation tests, inches/inches
ε_r	:	Resilient strain imposed in laboratory test to obtain material properties ε_0, ε, and ρ, inches/inches

ε_v	:	Average vertical resilient or elastic strain in the layer/sublayer and calculated by the structural response model, inches/inches
h_{Soil}	:	Thickness of the unbound layer/sublayer, inches
k_{s1}	:	Global calibration coefficients for granular materials
ε_{s1}	:	Local calibration coefficient for the rutting in the unbound layers

It should be noted that the global calibration of the transfer functions was not based on actual measurements of rut depths for each individual layer due to unavailability of trenches for LTPP test sections. This problem was addressed by proportioning the total rut depth measured to the different layers using a systematic approach.

Load-Associated Fatigue Cracking

Fatigue cracking occurs when asphalt materials are subjected to repeated loads at stress levels lower than the tensile strength of the material. Consequently, the thickness of the hot-mix asphalt (HMA) layer should be designed to resist the maximum number of repetitive loads before significant cracking occurs. Fatigue cracking is considered a load-associated failure mechanism affected by external factors such as underlying support, placement and compaction quality, age of the asphalt layer, and traffic volume.

Although the reason for fatigue cracking is debatable, it is generally agreed that fatigue cracking can be categorized into two groups based on the crack initiation mechanism: bottom-up and top-down cracking. Top-down cracking is thought to be the governing mechanism for longitudinal cracking and results from high radial tire pressures. Bottom-up cracking responds to the more traditional approach of modeling fatigue cracks where it is assumed that the cracks start at the bottom of the HMA layer where tensile stresses are higher. Due to repeated loading cycles, the cracks propagate upward until they appear on the pavement surface and start to interconnect with longitudinal cracks, giving pavement the appearance of an alligator's back. Thus, fundamentally both alligator and longitudinal cracks result from traffic load-associated fatigue in the material.

DARWin-ME™ computes the allowable number of axle-load applications under each load application and adds the damage into the incremental damage index for both top-down and bottom-up cracking using the following relationship:

$$N_{f-HMA} = k_{f1}(C)(C_H)\beta_{f1}(\varepsilon_t)^{k_{f2}\beta_{f2}}(E_{HMA})^{k_{f3}\beta_{f3}} \quad \text{(A3)}$$

Where

$N_{f\text{-}HMA}$	:	Allowable number of axle-load repetitions for a flexible pavement and HMA overlays
ε_t	:	Tensile strain at critical locations and calculated by the structural response model, inches/inches
E_{HMA}	:	Dynamic modulus of HMA measured in compression, psi
$k_{f1, f2, f3}$:	:	Global field calibration parameters
$\beta_{f1, f2, f3}$	:	Local or mixture specific field calibration constants

$C = 10^M$

M	:	material constant that depends on effective asphalt content by volume, percent air voids in the HMA mixture and C_H (a thickness correction term)

The incremental damage index (ΔDI) is calculated by dividing the actual number of axle loads by the allowable number of axle loads within a specific time increment and axle load interval for each axle type. The cumulative damage index (DI) is determined by adding the incremental damage indices over time using Equation A4:

$$DI = \sum(\Delta DI)_{j,m,l,p,T} = \sum\left(\frac{n}{N_{f-HMA}}\right)_{j,m,l,p,T} \quad \text{(A4)}$$

Where

n	:	Actual number of axle-load applications within a specific time period
j	:	Axle-load interval
m	:	Axle-group
l	:	Truck classification
p	:	Month
T	:	Median temperature, °F

DARWin-ME™ relates the cumulative damage index with bottom-up cracking (alligator cracking) using the following transfer function:

$$FC_{Bottom} = \left(\frac{6000}{1+e^{\left(C_1 C_1^* + C_2 C_2^* log(DI_{Bottom} \times 100)\right)}}\right) \times \left(\frac{1}{60}\right) \quad \text{(A5)}$$

Where

FC_{Bottom}	:	Area of alligator cracking that initiates at the bottom of the HMA layers, % of total lane area
DI_{Bottom}	:	Cumulative Damage Index at the bottom of the HMA layers
$C_{1,2,4}$	:	Transfer function regression constants

In the case of top-down cracking (longitudinal cracking), DARWin-ME™ uses the following relationship to predict the length of longitudinal fatigue cracks:

$$FC_{Top} = \left(\frac{C_1}{1+e^{\left(C_1 - C_2 log\left(DI_{Top}\right)\right)}}\right) \times 10.56 \quad \text{(A6)}$$

Where

FC_{Top}	:	Length of longitudinal cracks that initiate at the top of the HMA layer, ft/mile
DI_{Top}	:	Cumulative Damage Index near the top of the HMA surface

$C_{1,2,4}$	:	Transfer function regression constants

It is reported that the fatigue cracking models—bottom-up as well as top-down—have relatively high prediction errors due to the complexity of the cracking process.

Roughness

The International Roughness Index (IRI) is a measure of the riding quality of the pavement. It is obtained from measuring the longitudinal road profile and calculated using a quarter-car vehicle model. Since its introduction in 1986, IRI has become the road roughness index most commonly used worldwide for evaluating and managing road systems.

The IRI was defined as a mathematical property of a two-dimensional road profile. As a profile-based statistic, the IRI had the advantage of being repeatable, reproducible, and stable over time. DARWin-ME™ relates the IRI with other forms of pavement distress and site features. DARWin-ME™ uses the following expression to predict the IRI over time for HMA-surfaced pavements:

$$IRI = IRI_0 + 40(RD) + 0.4(FC_{Total}) + 0.008TC + 0.015(SF) \quad \text{(A7)}$$

Where

IRI_0	:	Initial IRI after construction, in/mile
SF	:	Site Factor

$$SF = Age[0.02003(PI + 1) + 0.007947(Precip + 1) + 0.000636(FI + 1)]$$

Where

Age	:	Pavement age, years
PI	:	% plasticity index of soil
FI	:	Average annual freezing index, °F days
Precip	:	Average annual precipitation or rainfall, inches
FC_{Total}	:	Area of fatigue cracking, % of total lane area
TC	:	Length of transverse cracking, ft./mile
RD	:	Average rut depth, inches

Rigid Pavements

The characteristic feature of CRC pavements, as opposed to other types of rigid pavements, is the presence of longitudinal reinforcement at or above mid-depth designed to hold shrinkage cracks tightly closed. Transverse joints exist solely for construction purposes and to separate at-grade structures. The base and sub-base layers can consist of a wide variety of unbound materials, asphalt or cement stabilized material, lean concrete, crushed concrete, or other materials.

In this study, the study team considered punchouts and roughness as the primary distress mechanisms in CRC pavements and evaluated the ECFs of different axle configurations and loads using these two distress mechanisms. The team used the same approach stated earlier for computing ECFs, that is, a ratio of the time to failure under different load configurations to establish load equivalencies. The following paragraphs discuss in detail the transfer functions that are integrated into DARWin-ME™ for predicting distress in CRC pavements.

Punchouts

Punchouts in CRCP are caused by excessive wheel loading applications and insufficient structural capacity of the CRCP, such as deficient slab thickness (design issue) or sub-base support (design/construction issue). Punchouts are characterized by blocks of concrete connected by transverse and longitudinal cracks that are depressed. Longitudinal steel at the transverse cracks of the punchouts eventually ruptures. Punchouts are the most serious distress type in CRCP. Better design and construction practices by TxDOT throughout the years were successful in significantly reducing the frequency of punchouts.

DARWin-ME™ uses the following transfer function to predict CRCP punchouts as a function of accumulated fatigue damage due to top-down stresses in the transverse direction:

$$PO = \frac{A_{PO}}{1+\alpha_{PO} DI_{PO}^{\beta_{PO}}} \quad \text{(A8)}$$

Where

PO	:	Total predicted number of medium and high-severity punchouts/mile
DI_{PO}	:	Accumulated fatigue damage (due to slab bending in the transverse direction) at the end of y^{th} year
A_{PO}, α_{PO}, β_{PO}:		Calibration constants

Roughness in CRC Pavements

In the case of CRC pavements, increases in the roughness value are attributed to a combination of the initial as-constructed profile of the pavement and any change in the longitudinal profile over time due to development of pavement distresses and foundation movements. Key distresses affecting roughness values for CRCP include punchouts. The following relationship is used for roughness prediction in DARWin-ME™:

$$IRI = IRI_1 + C_1(PO) + C_2(SF) \quad \text{(A9)}$$

Where

IRI_1	:	Initial IRI, inches/mile
PO	:	Number of medium and high severity punchouts/mile
C_1, C_2	:	Regression coefficients
SF	:	Site Factor

$$SF = \frac{AGE(1 + 0.556FI)(1 + P_{200})}{10^6}$$

Where

AGE	:	Pavement age, years
FI	:	Freezing Index, °F days
P_{200}	:	Percent subgrade material passing # 200 sieve

Appendix B: Gross ECFs Calculated for Typical Truck Configurations on Flexible Pavement Sections

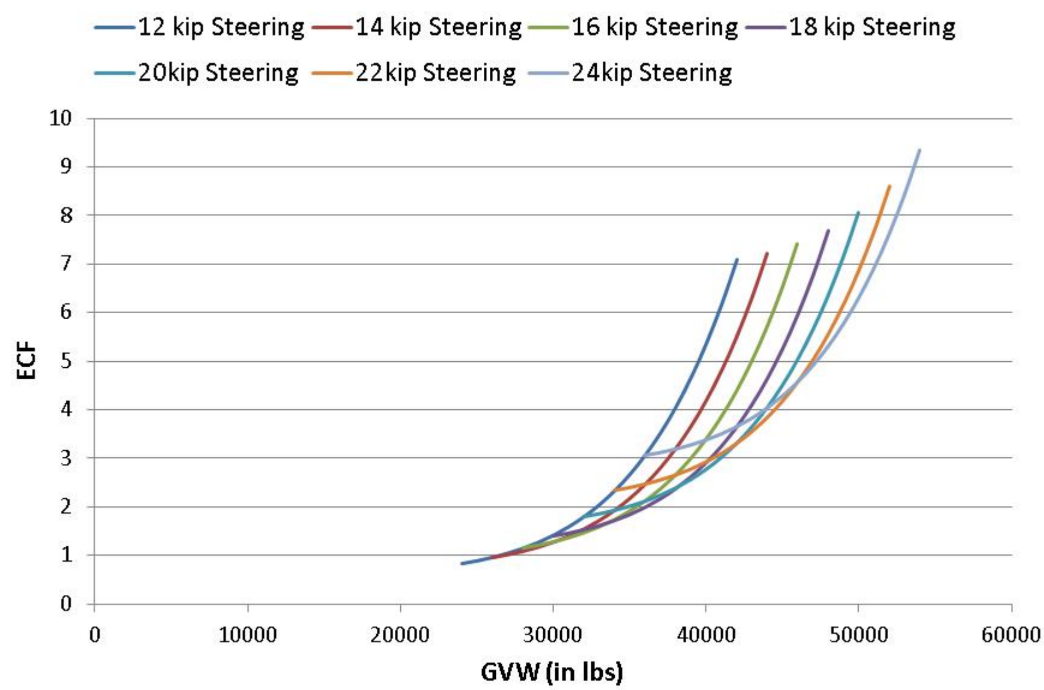


Figure B.1: Gross ECF for a FHWA Class 5 Truck

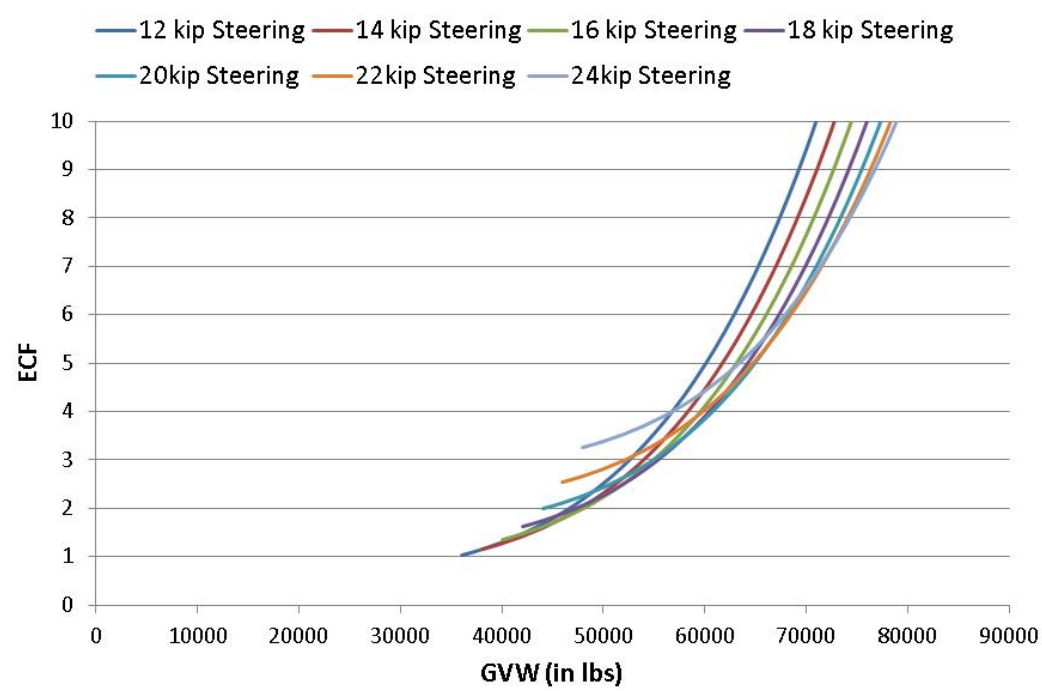


Figure B.2: Gross ECF for a FHWA Class 6 Truck

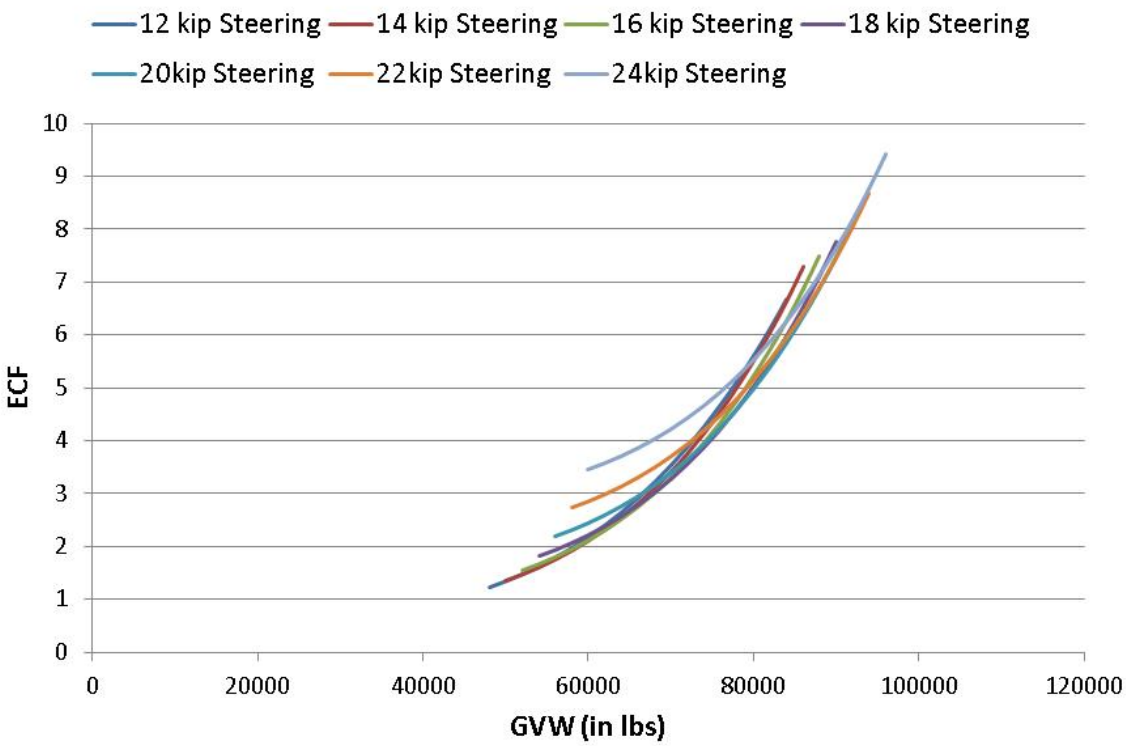


Figure B.3: Gross ECF for a FHWA Class 7 Truck

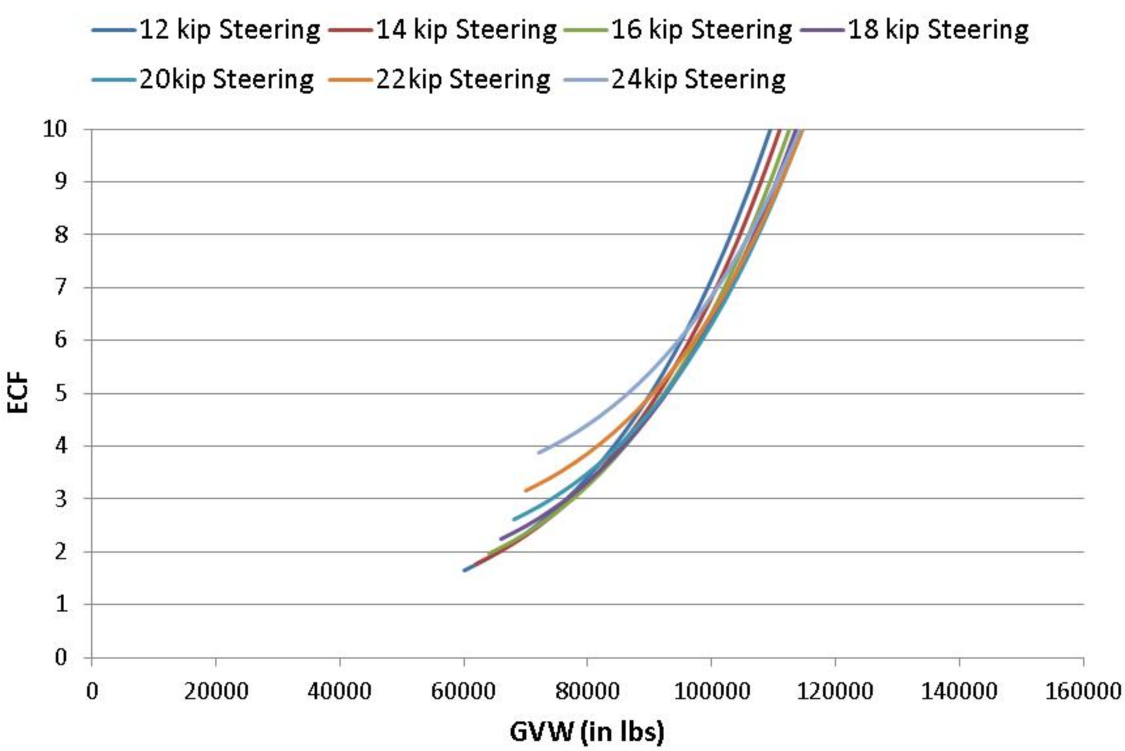


Figure B.4: Gross ECF for a Class 9 Truck

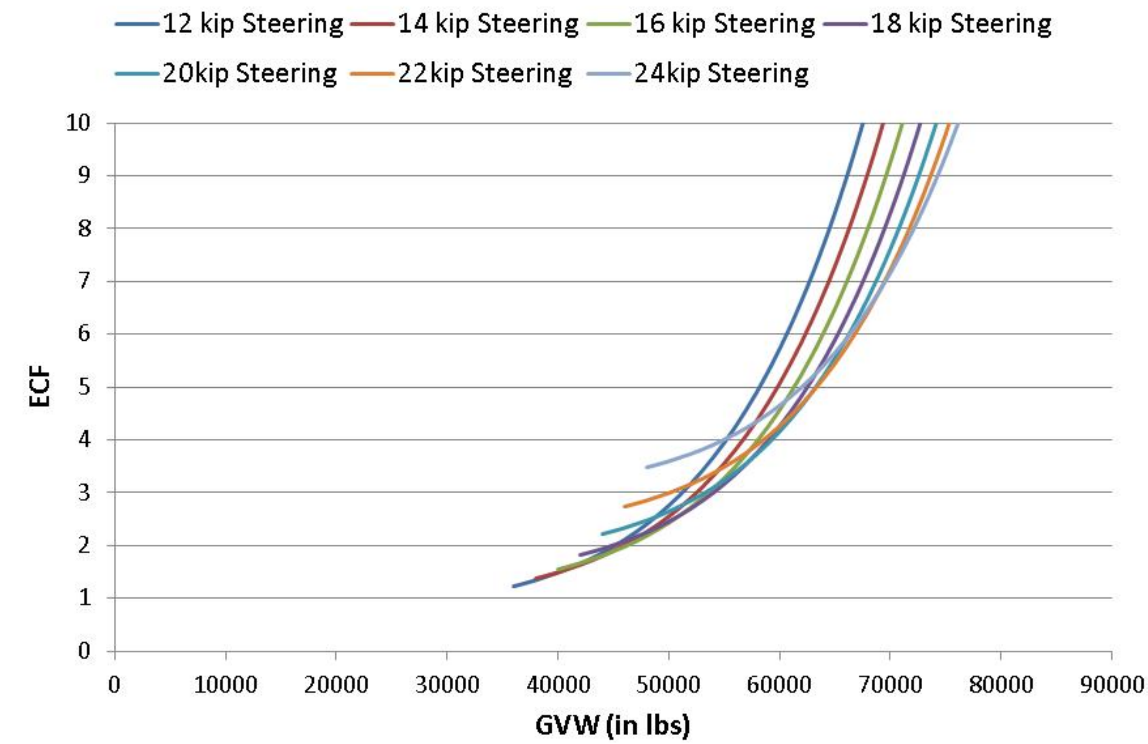


Figure B.5: Gross ECF for a FHWA Class 8 Truck

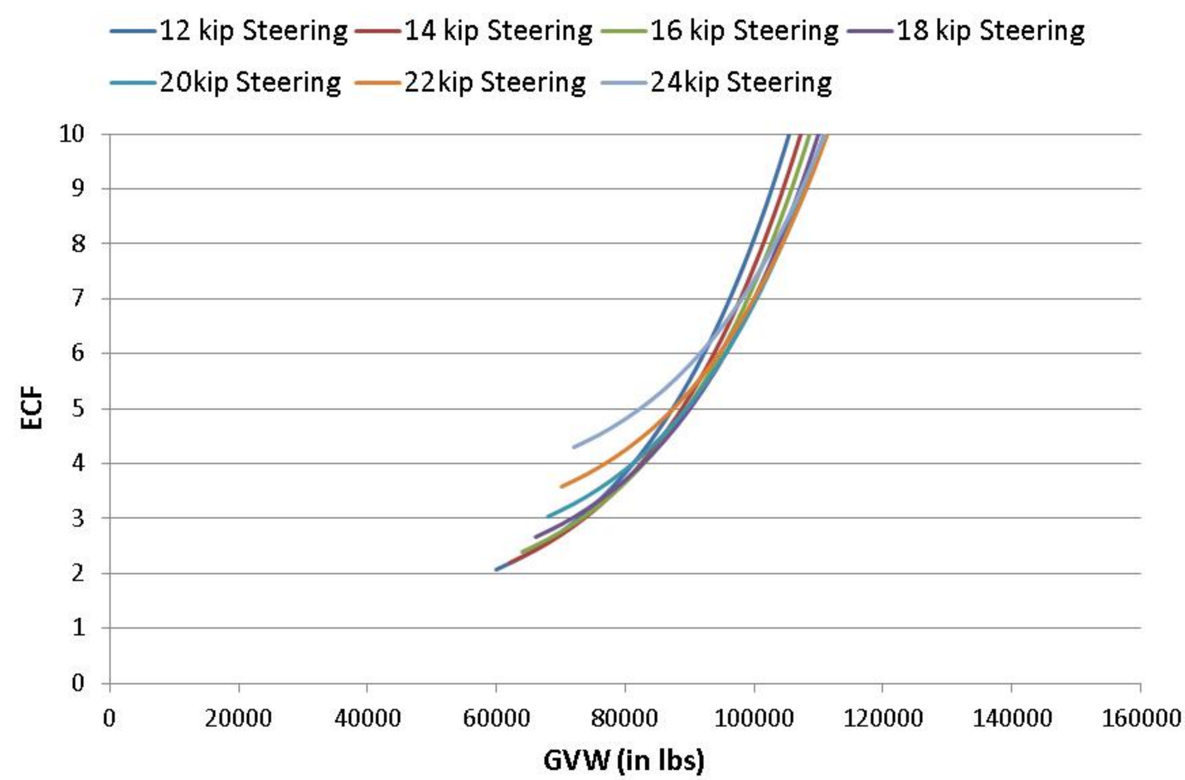


Figure B.6: Gross ECF for a FHWA Class 11 Truck

Appendix C: Gross ECFs Calculated for Typical Truck Configurations on Rigid Pavement Sections

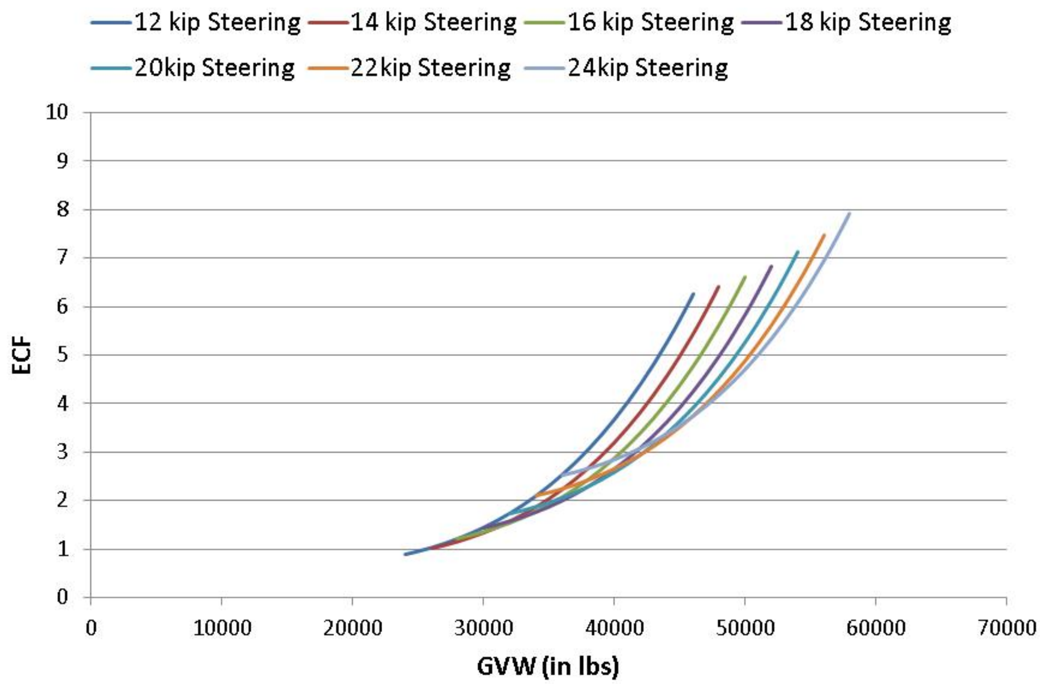


Figure C.1: Gross ECF for a FHWA Class 5 Truck

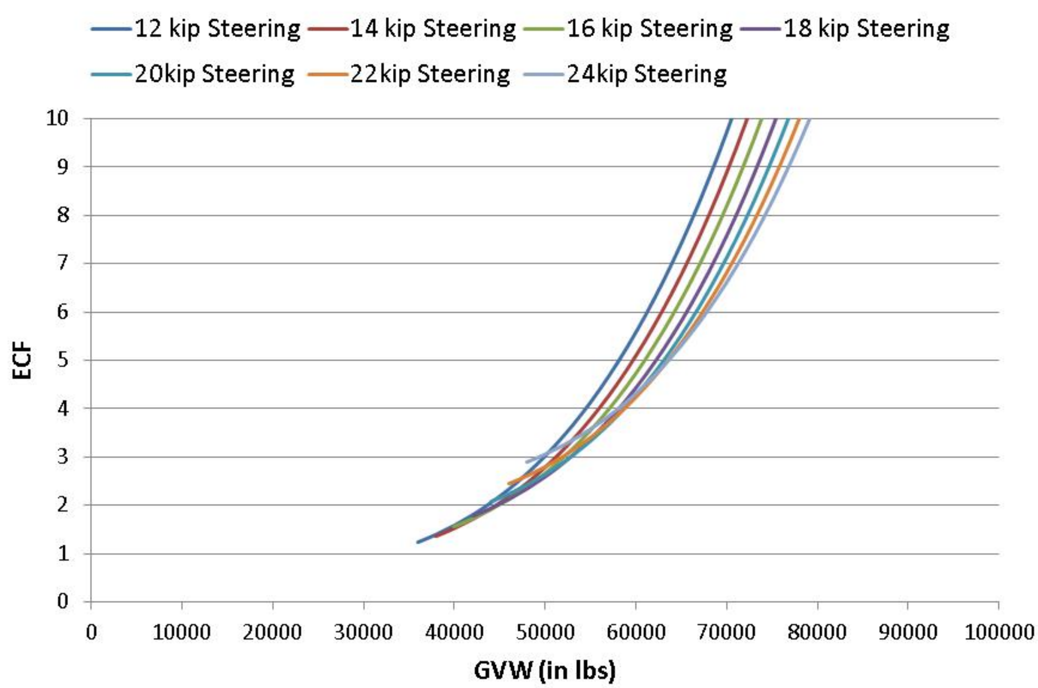


Figure C.2: Gross ECF for a FHWA Class 6 Truck

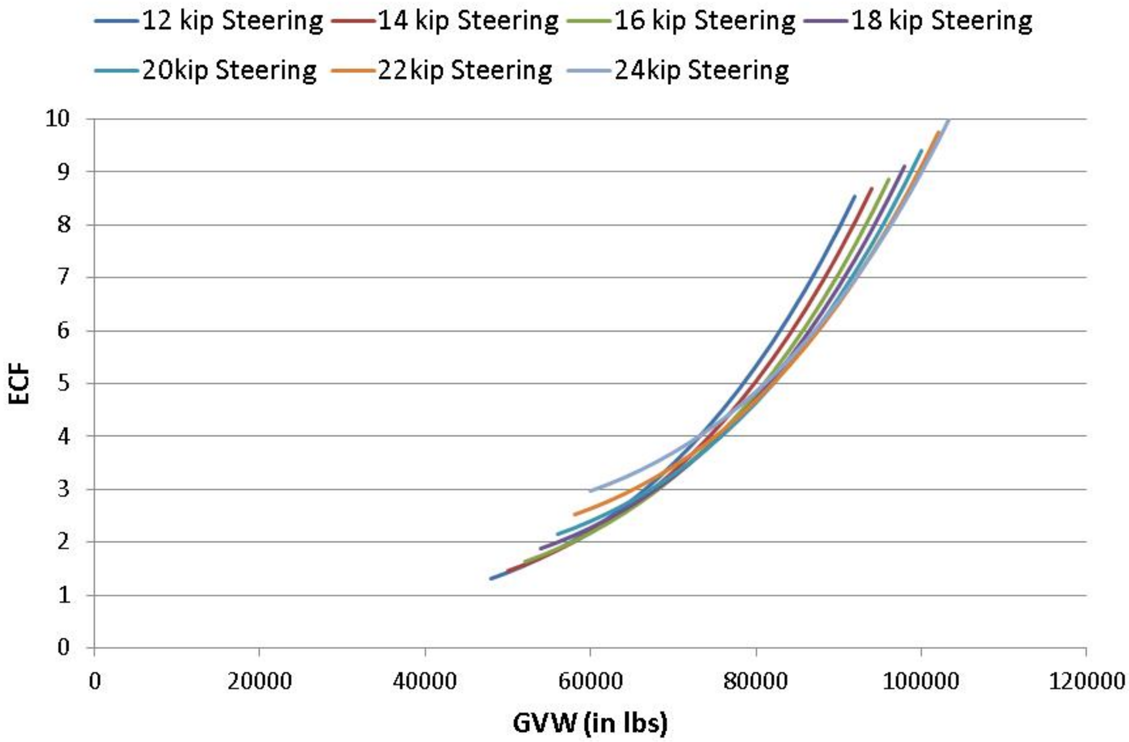


Figure C.3: Gross ECF for a FHWA Class 7 Truck

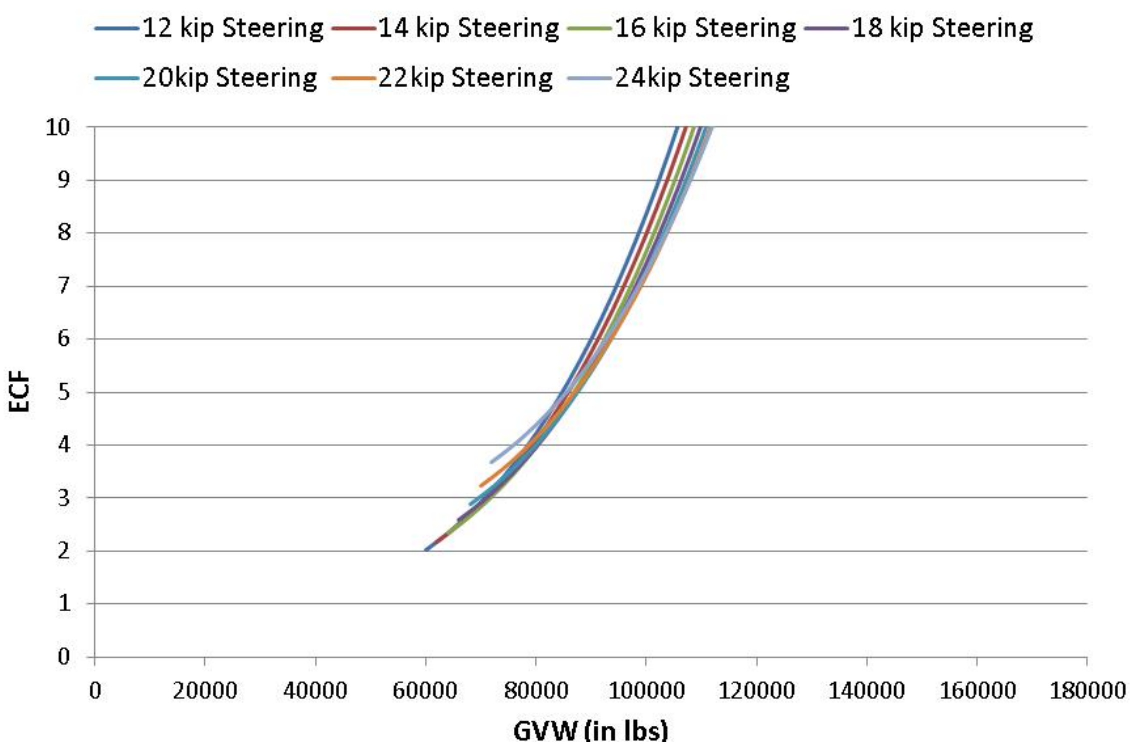


Figure C.4: Gross ECF for a FHWA Class 9 Truck

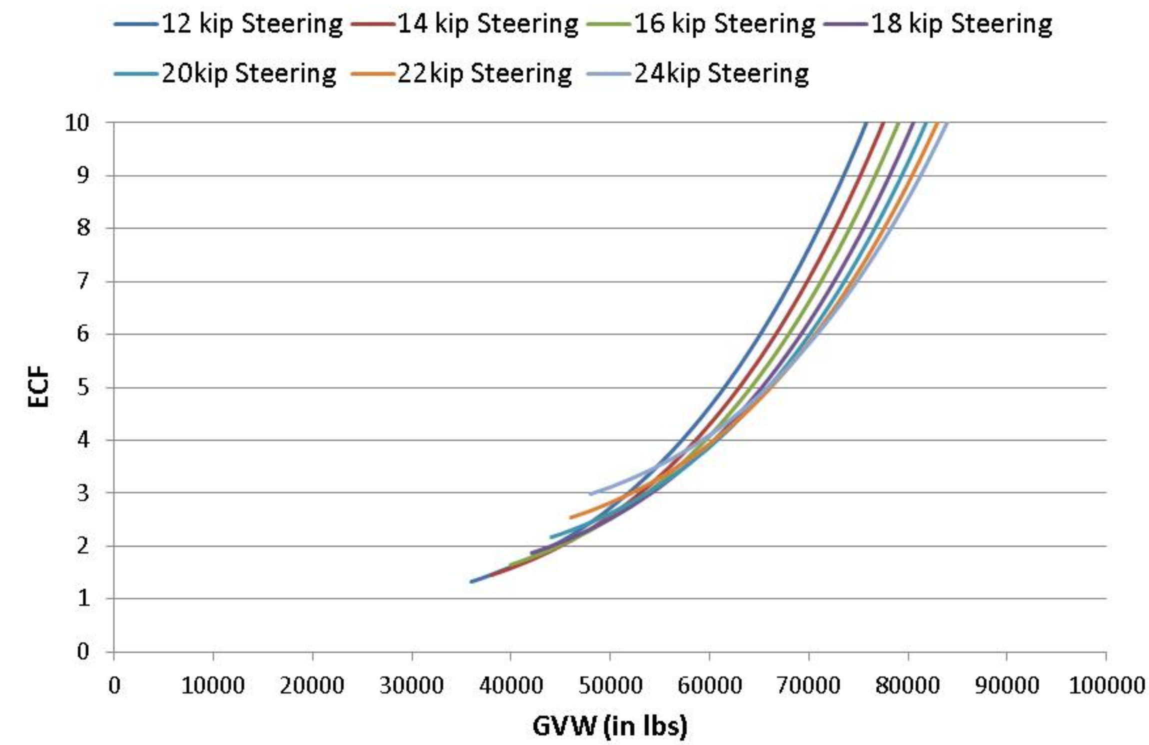


Figure C.5: Gross ECF for a FHWA Class 8 Truck

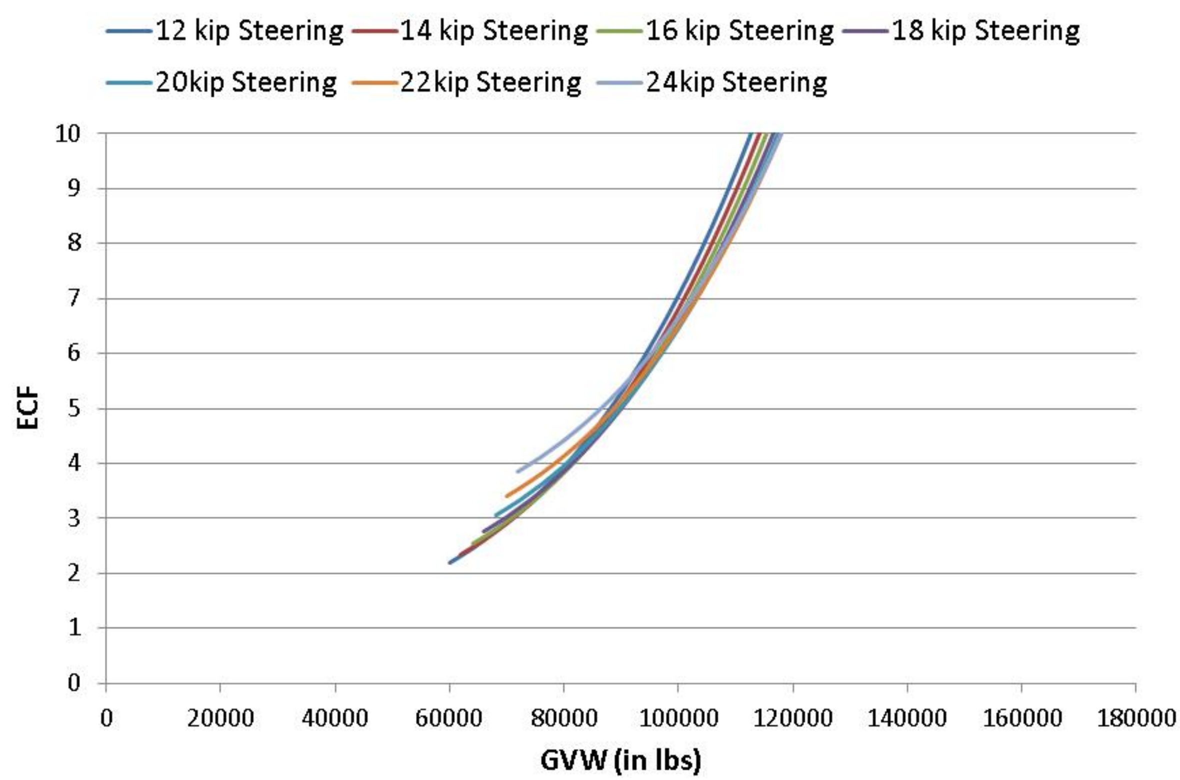


Figure C.6: Gross ECF for a FHWA Class 11 Truck

Appendix D: Gross ECFs Calculated for Typical Truck Configurations on Surface Treated Pavement Sections

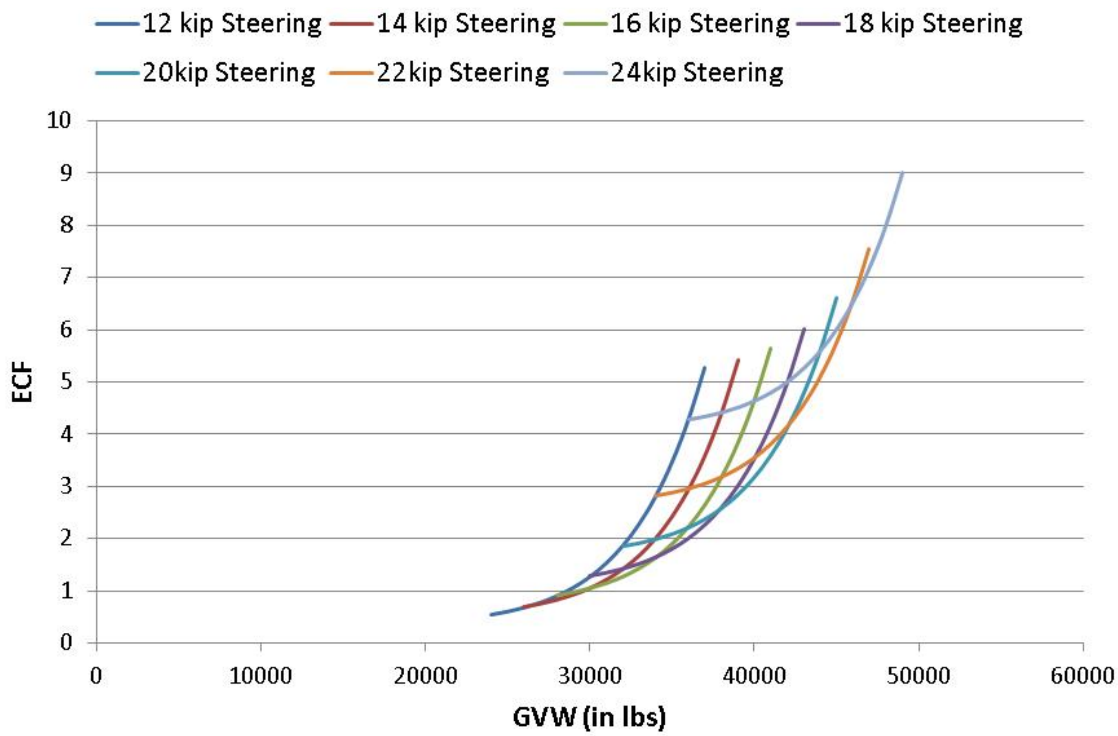


Figure D.1: Gross ECF for a FHWA Class 5 Truck

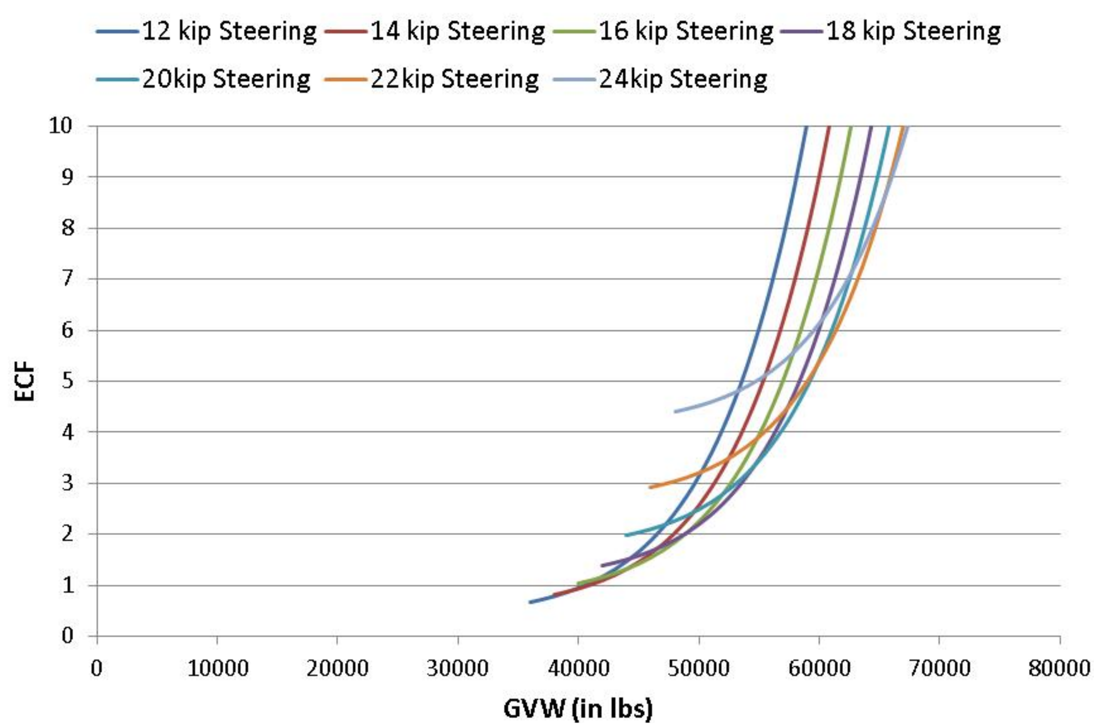


Figure D.2: Gross ECF for a FHWA Class 6 Truck

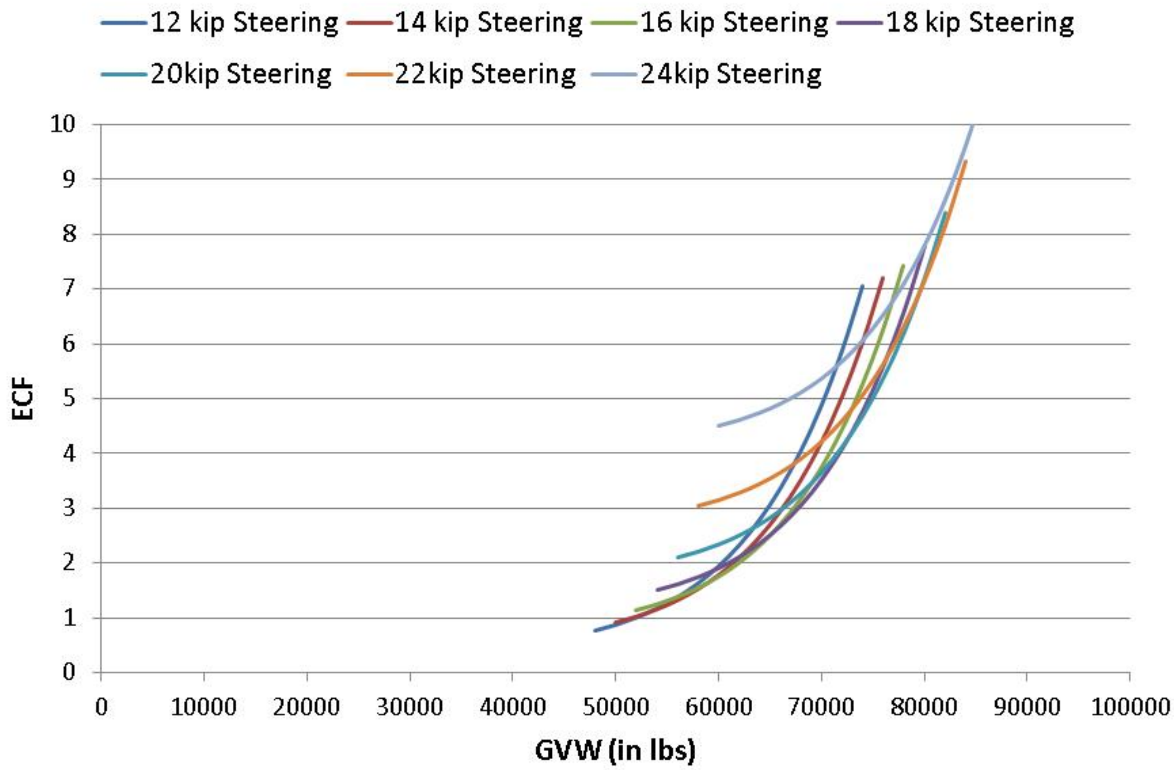


Figure D.3: Gross ECF for a FHWA Class 7 Truck

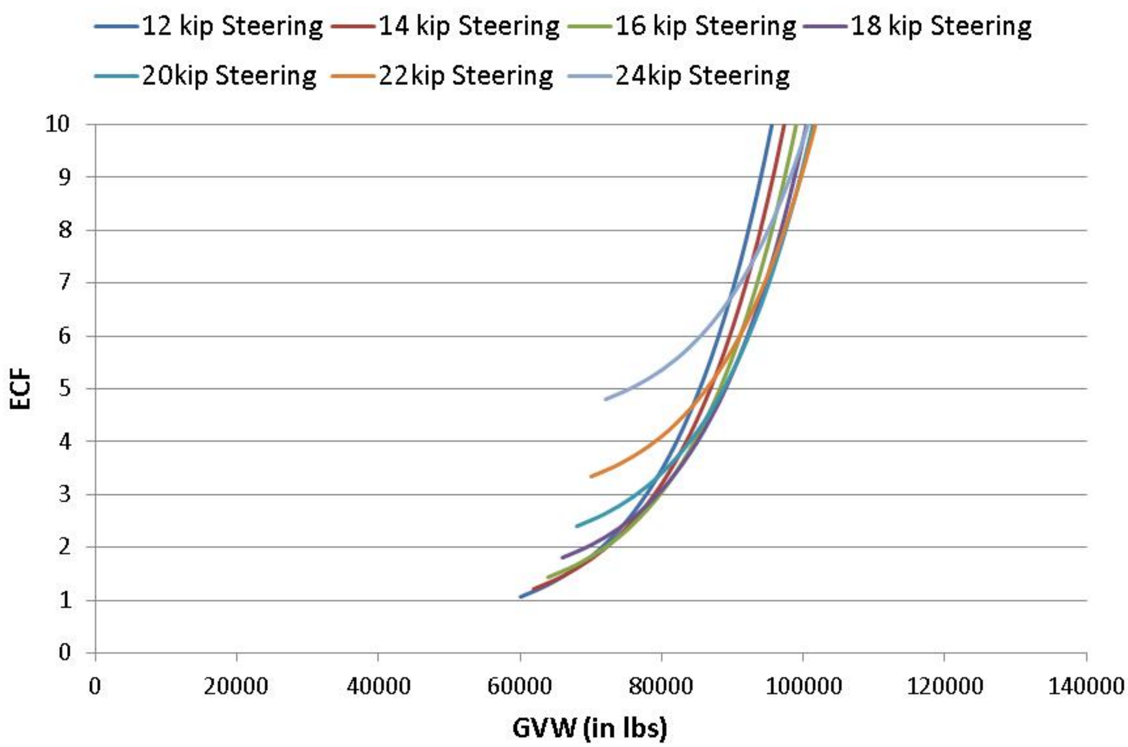


Figure D.4: Gross ECF for a FHWA Class 9 Truck

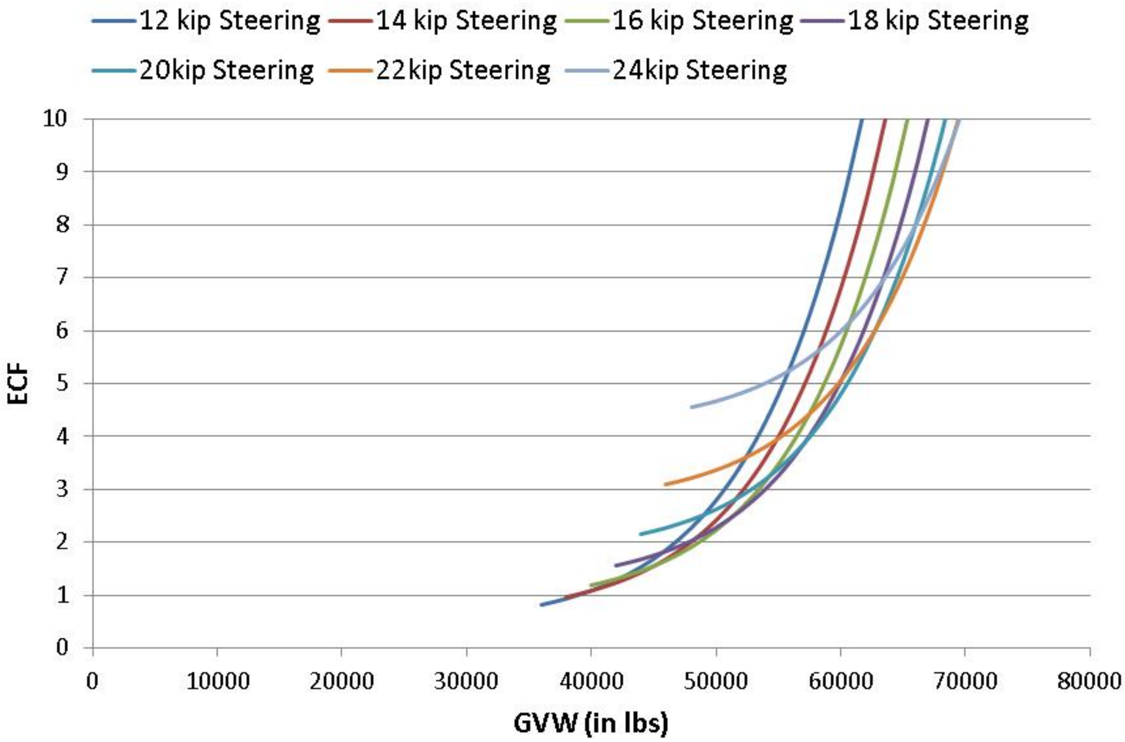


Figure D.5: Gross ECF for a FHWA Class 8 Truck

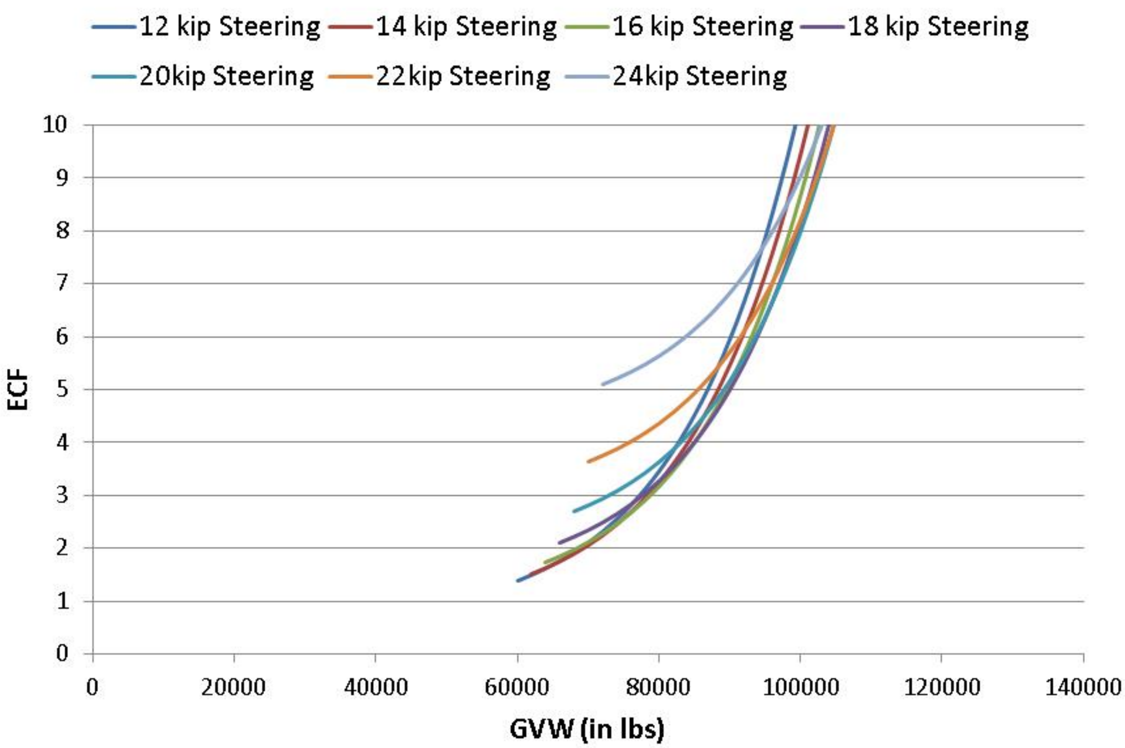


Figure D.6: Gross ECF for a FHWA Class 11 Truck

Appendix E: International Review of OS/OW Regulations

As part of Task 6 for the project, an international review of NAFTA partner counties, Australia, and selected European Union countries was undertaken to see how they account for OS/OW vehicle pavement consumption and how they permit and charge for these vehicles.

The policies and programs in these other counties are demonstrably different than those in Texas. The most noticeable differential element is that many of these countries—Australia, Canada, and Mexico—operate at higher base weights, authorize the use of longer combination vehicles, and, in the case of Australia, road trains. Both Mexico and Canada have similar "freight" systems to the United States in that they have highly profitable and exceptionally well-functioning freight rail networks that form part of the "freight-system" within these countries and within NAFTA.

Canada

Canada's jurisdiction over motor carriers is shared between the federal government and the country's provinces. The federal role is mostly coordination and facilitation, and the federal legislation Motor Vehicle Transport Act (MVTA) allows the provinces to set their own rules subject to MVTA conditions. In 1988, the Task Force on Vehicle Weights and Dimensions Policy was created to pursue greater national and/or regional uniformity of policies, regulations, and enforcement practices for heavy vehicle weight and dimensions. The task force has met six times since its inception.

At the provincial level, the various provinces have laws and programs in place to regulate movement of heavy vehicles and heavy haul and extraordinary loads. In many instances, Canadian provinces have seasonal load restrictions due to winter weather impacts on highways. A selection of provinces bordering the U.S. was reviewed for this research project.

British Columbia (B.C.)

The Transportation Act 2004 (as amended) British Columbia (B.C.) Law authorizes the minister of transport to set terms and conditions considered appropriate for use of provincial public highways. This includes authorization of a period for use of highway to limit or prohibit access or entry of "Extraordinary Traffic," which, within Section 66 (1), can include quantity of goods carried, mode or time of use, and speeds that can alter or increase burdens imposed on the highway by proper use by ordinary traffic or cause damage and expense to the provincial highway beyond what is *reasonable or ordinary*. The Commercial Transport Act (as amended) and its implementing regulations set forth specifications for vehicles and loads and when permits are required. Exemptions exist for vehicles driven by B.C. Hydro/Power Authority employees, highway maintenance contractors, and specially authorized vehicles such as Indian war canoes, parade floats, vehicles used for exhibition purposes, and other vehicles that may be authorized by the ministry, although permits are required. No fees are charged for vehicles owned or leased and operated by:

- The governments of Canada its providences and territories
- The governments of the U.S. and any state or county in the U.S.
- Municipalities and school districts outside of B.C.

Within its Commercial Transport Procedures Manual, B.C. sets forth heavy haul and extraordinary load guidelines, as well as general permit guidelines and information. Route maps for 16- and 24-wheeler tridems and tandem tridems are also in place. These lists specify load-posted routes, along with bridge tolerances.

Permits are available via telephone request from the provincial permit center for

- Non-resident permits
- Term oversize and/or overweight permits
- Single-trip oversize and/or overweight permits
- Motive fuel user permits
- Extra-provincial temporary operating permits
- Temporary operating permits (emergency situations only)
- Highway crossing permits

Since 2008, permits available through the Permitting System Online Service include

- Term oversize permit
- Non-resident single-trip permit
- Motive fuel user permit
- Overweight permits (single-trip)
- Oversize overweight permits
- FR application permits

The legal dimensions for extraordinary loads that exceed general policy limits and heavy haul size and overall dimensions are as shown in Figure E.1:

Dimensions	
OAH	No limit - dependent on route and commodity requested • (T-53D required to be completed if over 4.88 m, 5 m in East Kootenay Area (route specific - see 6.4.2 below) or 5.33 m in the Peace Rover Area)
OAL	• 50 m
OAW	No limit - dependent on route and commodity requested (T-53D required to be completed if over 6 m or up to 8 m in East Kootenay Area (route specific - see 6.4.2 below)) • Axle width of trailer must be at least half of the width of the load
Weights	
Governed by vehicle configuration, route requested and structures crossed	
Travel Conditions	
• 0001 - 0500 hrs transport times (Monday to Friday excluding General Holidays) • 3 - 5 pilot cars depending on overall weights, dimensions, and routing • Other conditions, such as lights and signs, will be as per closest applicable T-Form	

<u>Note</u>:
CVSE has the right to impose more pilot cars or restrict hours further than those listed if needed.

"OAH" - overall height measured from the ground to the top of the vehicle and/or load.
"OAL" - overall length measured from the front of the vehicle and/or load to the end of the vehicle and/or load.
"OAW" - overall width measured from the widest point on the left side of the vehicle and/or load to the widest point on the right side of the vehicle and/or load.

Source: Chapter 6 British Columbia Commercial Transport Procedures Manual

Figure E.1: Legal Dimensions for Extraordinary Loads

The bridge formula is calculated in B.C. by

> 30 x wheelbase in centimeters (cm) + 18000 kilograms (kg) = maximum weight allowed by permit.

B.C. also allows a term axle overweight permit (TRAX). This is for empty heavy haul configurations and allows empty, non-PME heavy haul configurations to exceed the legal weight limit of 6,000 kg up to 7,300 kg on the steering axle only. This permit costs C$100 per month for a term of up to one year.

The first step in applying for extraordinary load approval is the request form, which is either emailed or faxed to the permit center. Turnaround time for approval of oversize loads is usually 48 hours. Identical overload approval usually takes one to three business days. Bridge overload approval can take as little as 11 calendar days. However, on average, and 95 percent of approvals are granted within 19 calendar days. Loads that require applicants to undertake their own bridge engineering fall into another category. These usually fall in the seven-business-day time frame. For identical overloads, approval can be expedited if data includes:

- Same truck configuration, including axle groups and spacing, and all axle weights are the same or lighter than the previous approval
- Same roads are traveled in the same direction, with the same start and end locations
- Previous bridge approval (overload) number
- Approval within the last five years

Single-trip Oversize/Overweight Permits

These permits are issued for up to seven days. However, the permit may be valid for up to 30 days in some instances. Conditions of travel are listed in the permit and are based on sizes/weights of commodity and vehicle. If the vehicle leaves B.C. from its initial destination, the return trip can be purchased on this permit if the sizes/weights are commensurate. The permit fee doubles for the return trip. The permit is issued to the power unit. An oversize single-trip permit fee is C$15 per trip. The fee for an overweight single-trip permit is calculated by overload in kilograms and kilometers of travel. Table E.1 shows the fee schedule for each 10 km of operation or fraction thereof. Figure E.2 shows how the overload fee is calculated. The minimum fee is C$25.

Table E.1: Fee Schedule per 10 km of Operations

Kilometers traveled	C$	Kilometers traveled	C$
0 – 2,000	0.95	15,001 – 16,000	7.25
2,001 – 3,000	1.15	16,001 – 17,000	8.25
3,001 – 4,000	1.40	17,001 – 18,000	9.15
4,001 – 5,000	1.60	18,001 – 19,000	10.10
5,001 – 6,000	1.85	19001 – 20,000	10.90
6,001 – 7,000	2.15	20,001 – 21,000	11.85
7,001 – 8,000	2.45	21,001 – 22,000	12.70
8,001 – 9,000	2.95	22,001 – 23,000	13.95
9,001 – 10,000	3.35	23,001 – 24,000	14.95
10,001 – 11,000	3.75	24,001 – 25,000	16.10
11,001 – 12,000	4.25	25,001 – 26,000	17.85
12,001 – 13,000	4.95	26,001 – 27,000	19.85
13,001 – 14,000	5.60	27,001 – 28,000	21.40
14,001 – 15,000	6.25		

Source: Chapter 3 B.C. Commercial Transport Procedures Manual

There is also an option for companies to purchase overweight permits to temporarily increase a vehicle's GVW:

a) any positive weight difference between.

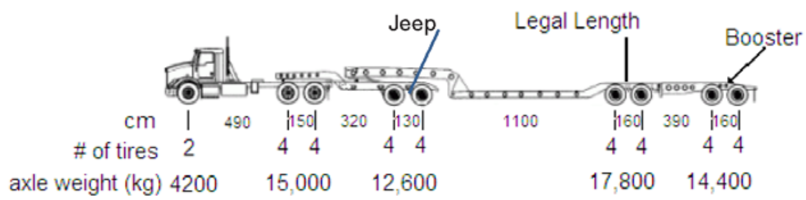
i) the axle weight and the maximum axle unit weight or the maximum gross weight for a group of axles allowed under these regulations

ii) the gross vehicle weight and the gross vehicle weight allowed for the particular vehicle or vehicle combination under these regulations, or

iii) the gross vehicle weight and the licensed gross vehicle weight, or

b) the total weight of any axle unit or group of axles, beyond 27.5 m overall length, of an empty (noload) vehicle combination.

iii) When calculating gross vehicle weight (GVW) allowable on overload permits, the lesser of the actual weight or legal allowable must be used for all axles or axle groups. When actual weights are known from weighing of a vehicle/load this may cause the GVW allowable to be lesser than the legal allowable as shown in example below.



Actual GVW = 64 000 kg

Licensed GVW = 63 500 kg

Tire Size - 27.9 cm x 55.9 cm

Legal Allowable: (5 500 + 28 000 + 31 000) kg = 64 500 kg (Table 1)

GVW Allowable (6 Weight Section of MV 4000

(4 200 + 15 000 + 12 600 + 31 000)kg = 62 800 kg

Overload = 1200 kg (actual - GVW allowable)

Source: Chapter 3, B.C. Commercial Transport Procedures Manual

Figure E.2 Calculating the Overload Fee

Oversize/Overweight Permits

Oversize/overweight permits can be issued for one-month period increments or for a term of up to 12 months for loads, vehicles, or combinations thereof. Applicants can request a permit for a single commodity. They can also request that additional commodities be added to the permit. The permit price does not change if additional commodities are added to the term permit. The cost for an oversize term permit is C$15 for a single-trip permit and C$30 for one month, while the cost for an overweight term permit is C$100 per month. There is no oversize/overweight term permit; rather, two separate permits are issued. As part of the general term permits for oversize vehicles, these basic conditions are required:

- 16 meters (m) in overall length for a single vehicle
- 27.5 m in overall length for heavy haul operations
- 31.5 m in overall length for mobile homes, modular buildings, etc.
- 31 m in overall length for vehicle combinations
- 3.8 m in overall width

- 4.3 m in overall height (5.33 m in the Peace River Area)
- 3 m front projection beyond the kingpin or forward of the front bumper
- 6.5 m rear projection beyond the turn center
- Conditions as per T-53, T-53A, and T-53C

There are multiple T-forms—a total of 29—designed to be attached to and form part of oversize and/or overweight permits. For overweight term permits, bridge formula or policy maximums cannot be exceeded. These are not available for loads hauled on trailers, e.g., heavy haul, expandos, and steering trailers, or for fixed equipment on its own axles that functions as a semi-trailer.

B.C. also has seasonal load restrictions to protect the roadway through the Seasonal Strength Loss Program for heavy vehicles on the network. Load restrictions are removed only when the road has been deemed structurally sound. Section 66 of the Transport Act (as amended) imposes specific weight restrictions, usually during spring. The restrictions are deliberately intended to refer only to axle weights and are generally shown as:

- 100 percent of legal axle loading
- 70 percent of legal axle loading
- 50 percent of legal axle loading

Under the Commercial Transport Act (1991) and Commercial Transportation Fees Regulation 2009 (B.C. Reg. 351/2008), commercial vehicle registration fees in B.C. are based on gross vehicle weight (GVW) on a sliding scale that ranges from C$42 (for a GVW not exceeding 500 kg) up to C$3,905 for a GVW up to 63,500 kg.

Alberta

Alberta also has established maximum vehicle weight and dimension limits to preserve infrastructure and ensure safety. Some oversize and overweight permits can be obtained through a web-based system called TRAVIS, and some permits must be obtained through a central permit office. Web-based permits for over overweight and overdimensional vehicles include:

- Single-trip overweight
- Drilling rig overweight
- Multi-trip overweight
- Single-trip overdimension
- Multi-trip overdimension
- Public entertainment vehicles
- Tridems on local roads
- Single-trip licensing
- 30/30/90 day licensing

- Winter log haul and seasonal log haul dimensional
- Salvage log haul dimensional

The Commercial Vehicle Dimension and Weight Regulation Act (CVDWRA) 2002 (AR 315/2002) governs OS/OW vehicles. A single-trip permit fee for an overdimensional vehicle is C$15. A multi-trip overdimensional permit is C$60. An extended length permit is C$300. A high load corridor permit for overdimensional vehicles is based on a fee-per-kilometer x-height of the vehicle:

- For a vehicle with height more than 6m but less than 8.96m, is the permit costs C$1, plus C$.20 cents for every 10 centimeters (cms) over 6m in height.
- For a vehicle with height over 8.9m, the permit costs C$6.80.

For a single-trip overweight permit or single-trip overweight and overdimensional permit, the fee for each vehicle to which the permit pertains is the total of amounts:

- C$0.03 per ton per kilometer over the lesser of
    - Registered weight, and sum of allowable axle weights (being gross weight for steering axle and base weight for all other axles)
- Steering axle weight fee calculated using another schedule (Schedule 9)
- Axle group weight fee calculated using another schedule (Schedule 9)

For a multi-trip overweight permit or multi-trip overweight and overdimensional permit, the fee is the total of the below amounts:

- C$60
- Steering axle weight using Schedule 10
- Axle group weight fee using Schedule 11

Schedules 8, 9, 10, and 11 can be seen in Tables E.2 through E.5.

Table E.2: Single-Trip Steering Axle Fee Table—Schedule 8

Permitted weight above legal weight Tons	Fee per KM C$
0 to 1 ton	0.06
Greater than 1 to 2 tons	0.15
Greater than 2 tons to 3 tons	0.22
Greater than 3 tons to 4 tons	0.35
Greater than 4 tons to 5 tons	0.50
Greater than 5 tons to 6 tons	0.67
Greater than 6 tons to 7 tons	0.87
Greater than 7 tons to 8 tons	1.08
Greater than 8 tons	1.40

Table E.3: Single-Trip Axle Group Weight Fee Table—Schedule 9

	Fee per KM C$			
Permitted Weight Range Per Axle Group over Base Weight	A Single, Tandem and Tridem Axle Groups	B 16 wheel tandem	C Wide 16 wheel tandem	D 24 wheel tandem
0 ton to 1 ton	0.04	0.04	0.04	0.04
> than 1 to 2 ton	0.09	0.08	0.08	0.08
> than 2 to 3 ton	0.15	0.14	0.13	0.13
> than 3 to 4 ton	0.23	0.21	0.18	0.17
> than 4 to 5 ton	0.33	0.28	0.24	0.23
> than 5 to 6 ton	0.45	0.36	0.31	0.30
> than 6 to 7 ton	0.58	0.46	0.40	0.36
> than 7 to 8 ton	0.72	0.57	0.48	0.43
> than 8 to 9 ton		0.67	0.57	0.51
> than 9 to 10 ton		0.80	0.67	0.59
> than 10 to 11 ton		0.94	0.76	0.67
> than 11 to 12 ton		1.08	0.88	0.77
> than 12 to 13 ton			1.00	0.87
> than 13 to 14 ton			1.12	0.90
> than 14 to 15 ton			1.25	1.08
> than 15 to 16 ton			1.39	1.20
> than 16 to 17 ton			1.53	1.31
> than 17 to 18 ton				1.42
> than 18 to 19 ton				1.57
> than 19 to 20 ton				1.70
> than 20 to 21 ton				1.84
> than 21 ton				1.98

Base Weights
Single Axle Group 9100kb
Tandem Axle group 17,000 kg
Tridem Axle Group

- **If axle spread is 3.6m or more but not more than 3.7m 24,000kgs**
- **If axle spread is 3m or more but not more than 3.6m 23,000kgs**
- **If axle spread is 2.4m ore more but not more than 3m 21,000kgs**

16 wheel tandem 25,000kgs
Wide 16 wheel tandem 32,000kgs
24 wheel tandem 39,000kgs

Table E.4: Multi-Trip Steering Axle Fee Table—Schedule 10

Permitted weight above legal weight Tons	Fee per KM C$
0 to 1 ton	2.00
Greater than 1 to 2 tons	10.00
Greater than 2 tons to 3 tons	17.00
Greater than 3 tons to 4 tons	30.00
Greater than 4 tons to 5 tons	45.00
Greater than 5 tons to 6 tons	60.00
Greater than 6 tons to 7 tons	85.00
Greater than 7 tons to 8 tons	105.00
Greater than 8 tons	140.00

Table E.5: Multi-Trip Steering Axle Fee Table—Schedule 11

Permitted weight above legal weight Tons	Fee per Month C$
0 to 1 ton	1.75
Greater than 1 to 2 tons	7.00
Greater than 2 tons to 3 tons	12.00
Greater than 3 tons to 4 tons	21.00
Greater than 4 tons to 5 tons	32.00
Greater than 5 tons to 6 tons	44.00
Greater than 6 tons to 7 tons	60.00
Greater than 7	75.00

The feel for an overload self-recording permit is C$15; the single-trip overweight permit fee is also payable. For vehicles hauling logs, another set of criteria is applied:

a) C$200 per log haul season, and
b) C$20 per route map, where it is a condition of the overweight permit that a route map must be attached to the permit for its validity.
    a. The Director of Transport sets the term of log haul season.

No fee is payable for an overweight or overdimensional permit issued to the Government of Canada, Government of Alberta or another province, a foreign government, or municipality or board defined by the School Act. No fee is payable for an overweight or overdimensional permit issued for a point-to-point move within the corporate limits of a city or town. In a municipality other than a city or town, no fee is payable for an overweight or overdimensional permit issued for a point-to-point move within an industrial park, or if a municipality has passed a by-law to that effect. The CVDWRA specifies that any fee payable under its provisions be rounded off to the nearest dollar.

In Alberta, an exemption for farm equipment movements is also in place. Farm vehicles are not subject to width restrictions, but vehicle height is limited to minimize issues with utilities and other overhead structures. There is no permit fee for farmers. A fee for an overdimensional permit for commercial operators is $60 per year for the whole company.

Saskatchewan

The Vehicle Weight and Dimension Regulations (Chapter H-3-01, Reg 8) effective November 12, 2010 and amended by Saskatchewan Regulations 46/2011 set forth permit fees for OS/OW vehicles in the province in Part VI, Permit Fees, Sections 21–23. No permit fee is required under Section 21 if it is issued for:

a) (moving a) grain bin (of any dimension);
b) operating a vehicle of any dimension that is transporting a load of hay;
c) towing, operating, or transporting farm equipment of any dimension, including the load or contents of any description; or
d) towing, operating, or transporting a vehicle or machinery of any dimension, including the load or contents of any description, on a provincial highway for a distance of not more than 10km.

Single-trip Permit

Under Section 22, if a permit is issued for a single-trip providing for any axle unit to carry a weight exceeding the maximum allowable gross weight, the fee is C$42 plus C$0.05 for each kilometer traveled. If a permit is issued for a single trip providing for any group of axles that is not an axle unit, the fee is C$42 plus C$0.05 for each kilometer traveled.

If a permit is issued for a vehicle to transport a divisible load where the gross vehicle weight exceeds the maximum allowable gross vehicle weight limits and the permit is issued subject to an agreement entered into by the minister pursuant to clause 4(1)(g) or (h) of the Act, no fee is payable.

If a permit for a single trip of road construction and maintenance equipment is issued, the fee payable is C$20 plus C$0.20 for each kilometer traveled over 10 kilometers.

Multi-trip Permit

For a multi-trip permit, the fee is C$66 per ton, or part of a ton, in excess of the allowable gross weight, per year. This fee is calculated based on gross weight carried by the axle unit that most exceeds the weight set forth in the regulations. If a multi-trip permit is issued for less than one year, the fee shall be prorated at the rate of one-twelfth for each month or part of a month for which the permit is issued, but the minimum fee payable is C$10.

Overwidth and Overlength Vehicles

Table E.6 lists the permit costs for an over-width vehicle or load for a single-trip.

Table E.6: Single-trip Over-Width Vehicle or Load

Width	Fee C$
vehicle or load that is more than 2.6m wide but not more than 3.1m wide	0
vehicle or load that is more than 3.1m wide but not more than 3.7m wide	17
vehicle or load that is more than 3.7m wide but not more than 4.3m wide	36
vehicle or load that is more than 4.3m wide	72

The permit cost for an over-width vehicle or load for multiple trips (annual permit) is shown in Table E.7:

Table E.7: Annual Multiple-trip Permit Over-Width Vehicle or Load

Width	Fee C$
vehicle or load that is more than 2.6m wide but not more than 3.1m wide	15
vehicle or load that is more than 3.1m wide but not more than 3.7m wide	100
vehicle or load that is more than 3.7m wide but not more than 4.3m wide	144
vehicle or load that is more than 4.3m wide	144

Permits are also issued for over-width buildings. For an over-width building that is more than 2.6m wide but not more than 3.05m wide, the permit costs nothing. For a building that is more than 3.05m wide but not more than 6.0m wide, a permit fee is C$36. A permit fee for a building that is more than 6.0m wide costs C$72.

Permits are also issued for over-length vehicles. The fee schedule for a single-trip permit is as follows:

i. vehicle that is more than 12.5m long but not more than 23m long, nil;
ii. vehicle that is more than 23m long but not more than 29m long, C$10; and
iii. in the case of a vehicle that is more than 29m long, C$15.

The fee schedule for a multiple-trip permit for one year for an over-length vehicle is as follows:

i. vehicle that is more than 12.5m long but not more than 23m long, C$10;
ii. vehicle that is more than 23m long but not more than 29m long, C$60; and
iii. vehicle that is more than 29m long, C$120; and
iv. fee for a multiple-vehicle, multiple-trip permit for one year issued to a permit holder operating under an EEMV agreement or a long combination vehicle permit is C$300.
    a) An EEMV agreement means an Energy Efficient Motor Vehicle Transportation Partnership Agreement entered into between the minister and a permit holder for the purpose of allowing the permit holder to operate an energy efficient motor vehicle.

Over-Height Vehicles and High-Load Corridor Routes

Under Section 23.1, high-load corridor routes are laid out for over-height or overweight vehicles, namely:

- Provincial Highway No. 4, from the junction of Provincial Highway No. 15 to the junction of Provincial Highway No. 7;
- Provincial Highway No. 7, from Saskatoon to the Alberta Boundary; or
- Provincial Highway No. 15, from Melville to Provincial Highway No. 4, including those portions of Provincial Highway No. 6 and Provincial Highway No. 20 required to connect north and south junctions of Provincial Highway No. 15.

For permits issued for an over-height vehicle or load for travel in a high-load corridor route, the fee is:

- C$1 plus C$0.20 for every 10cms over 6ms in height for each kilometer traveled for a vehicle having a height that is more than 6m but less than 8.9m; or
- C$6.80 for each kilometer traveled for a vehicle having a height of 8.9m or greater.

Overdimensional Vehicle Partnership Agreements

If vehicles exceed a regulated dimension with a single piece of cargo, they can be issued single-trip permits through the SGI permit. This permit allows the vehicle to carry additional cargo as long as it does not exceed any other legal dimension in addition to the dimension it is permitted for, in which case it would require a TPA (Government of Saskatchewan, not dated (c)). The overdimensional haul agreement principles allow movement of vehicles that are overly long or overly wide and/or loads on the provincial highway system subject to the following:

- Carrier must follow routes designated in the agreement.
- An administration fee of C$1000 is charged annually.
- Vehicle permits issued are pursuant to agreements. Permits will show permitted dimensions.

Additional conditions of overdimensional haul agreements include:

- Dynamic stability characteristics must be within safe limits.
- Speed is restricted (speed recording devices are required) for vehicles or loads exceeding 26m in length and/or over legal width and for all configurations where reduced speeds would bring dynamic stability within TAC standards.
- Operation is not allowed where inclement weather or other conditions impair visibility (rain/snow), traction (ice), or handling (winds).
- Drivers are subject to special qualifications and performance criteria where length exceeds 26m.
- Vehicles exceeding specific dimensions must be properly flagged and/or lit and accompanied by escort vehicle(s).
- Hours of operation are restricted where required in accordance with The Vehicle Weight and Dimension Regulations, 1999.

Canada New West Partnership

In 2010, Canada's New West Partnership was created between B.C., Alberta, and Saskatchewan to strengthen economies in Western Canada (Ppartnership). The Partnership focuses on four areas: trade, international cooperation, innovation, and procurement. In July 2011, B.C., Alberta, and Saskatchewan implemented a schedule to harmonize the provinces' vehicle weight and dimension laws. For divisible load oversize permits, B.C. and Saskatchewan are redeveloping their divisible load policies using Alberta's permit conditions as a model. The partnership also provides for an increased maximum allowable weight on truck tractors for steering axles. For tridem drive truck tractors, the partners will defer to Alberta's dimension laws. The three provinces also agreed to harmonize overall lengths of double trailer combinations.

Areas set for negotiation by July 2012 include reviewing weight limits for vehicles used to haul very heavy equipment, along with turnpike doubles, rocky mountain doubles, and tandem axle weight limits. For divisible oversize load permits, the partnership is reviewing polices to determine opportunities for reconciliation in the various approaches. For oversize/overweight corridors, they are reviewing current routes to determine if more interprovincial connections can be constructed. They are also reviewing how provinces could provide road and construction information, including highway geometry and clearance, to plan multi-state permitted moves.

Manitoba

The Motor Carrier Permits and Development (MCPD) administers and issues oversize and overweight permits and collects permit fees in the province of Manitoba. The MCPD also develops and implements the Spring Road Restrictions Program and maintains the automated routing and permitting system (ARPS). On February 11, 2011, Manitoba and Saskatchewan signed a memorandum of understanding on the harmonization of regulations and cooperation on transportation issues.

Overweight Permits

The Highway Traffic Act and Highway Traffic Act Regulations 197/2006 set forth permit fee costs for oversize and overweight permits. The cost of a non-annual overweight permit is the greater of C$0.036 per km from point of departure multiplied by each increment of 1,000kg or part of such increment or C$6.

An annual overweight permit is C$75 for each increment of 1,000kg or part of such increment. This permit allows a vehicle to be over the allowable axle weights for its axle units. If an annual overweight permit covers two or more highways, the lightest of the allowable axle weights for each axle unit is used to determine by how many kilograms the permit allows the axle to exceed its allowable axle weight.

Over-Width Permits

Over-width permits are issued for non-divisible loads that result in a vehicle with a width of more than 2.6m. D signs and "wide load" signs are required for vehicles with a width exceeding 3.05m; an escort is required for a vehicle wider than 4.6m. Permits for vehicles with a width of 9m or more must be requested at least two business days prior to the move date. Restrictions typically prohibit over-width vehicles from traveling on the highways during spring, because they can damage vulnerable shoulders. Vehicles with widths in excess of 4.6m are also not allowed on PTHs 100 and 101 from 7 to 9 a.m. and from 3.30 pm to 5.30 p.m. They are also not allowed on commuter routes or truck routes outside of Winnipeg during these times unless a permit is specifically approved. Table E.8 lists overdimensional permit costs for single-trip and annual permits.

Table E.8: Overdimensional Permit Costs—Single-Trip and Annual

C$ Single	C$ Annual	Width
6	20	Authorizes width of 2.61m to 3.05m
15	45	Authorizes width of 3.06m to 3.70m
36	95	Authorizes width of 3.71m to 4.30m
72	195	Authorizes width of 4.31m or more
6	20	Authorizes projection of any length from front of vehicle
6	20	Authorizes length of 20.1m to 23m
8	80	Authorizes length of 23.1m to 30m
12	160	Authorizes length of 30.1m or more

Manitoba Trucking Productivity Improvement Fund

Section 34.1(1) of the Highways and Transportation Act establishes the Manitoba Trucking Productivity Improvement Fund (TPIF) for (a) funding or supplementing the funding of highway rehabilitation to remedy accelerated deterioration attributed to overweight or overdimensional vehicle traffic, (b) improvements in the load carrying capacity, productivity, and safety of highways, and (c) other projects prescribed in the regulations that benefit Manitobans and the trucking industry. Permit fees paid for OS/OW vehicles are deposited into this fund according to the guidelines set out in the Act, along with any monetary penalties payable to the fund that are prescribed by regulation.

The TPIF is a voluntary user-pay program that allows increased loading on lower class highways. A trucking company completes an application form that details in great specificity a route and vehicle information and the commodity being transported. The application must be accompanied by an insurance certificate with a minimum of C$5,000,000 coverage per occurrence, as well as general liability insurance coverage for non-owned vehicles with a minimum limit of C$5,000,000.

A letter of permission is required from a municipality if the route includes a municipal road. The route is then analyzed and evaluated, a cost is determined accordingly, and a TPIF contribution for each route is applied. There is also a C$20 administrative fee for each permit issued.

Ontario

Ontario's Highway Traffic Act 1990 (as amended) and regulations establish laws governing overweight and oversize vehicles. The maximum width of a vehicle load is set at 2.6m. Some exceptions include:

- Raw forest products (en route)—2.8m.
- Road service vehicles traveling to and from a maintenance site or repair center—no specified limit.
- Loose fodder (including rectangular and round bales of hay)—no specified limit.

The maximum length of a single vehicle including load is 12.5m with exceptions for:

- A fire apparatus
- A semi-trailer
- An articulated bus

The maximum length of a semi-trailer and its load is 14.65m. This does not include any extension in length caused by auxiliary equipment or machinery not designed for carrying a load.

The maximum length of a combination of vehicles and their load is 23m. The maximum height of a vehicle and it load is 4.15m.

Maximum weight allowances are determined using axle configurations and spacings. A permit is required if the axle and/or GVW exceeds the limits set out in the Act. Implements of husbandry are subject to an overdimensional permit. These include overdimensional farm machinery, farm tractors, and self-propelled implements of husbandry (SPIH) carried on a plated motor vehicle or plated trailer drawn by a motor vehicle.

Permits are issued for indivisible vehicles and/or loads when, if separated into smaller loads or vehicles, separation would

- Compromise the intended use of the vehicle or load
- Destroy the value of the load or vehicle
- Require more than eight work hours to dismantle

The permit application process requires application forms be submitted by fax, e-mail, mail, or in person at an Ontario Ministry of Transportation Permit issuing office. Ontario allows some municipalities to set overweight permits. These must be obtained from the individual municipalities. The permit issuer can consider multiple factors before granting an OS/OW permit which include:

- Complete and accurate application.
- Effect of the move on the safety and convenience of other highway users.
- Physical characteristics of the proposed route(s) including bridge restrictions, likely traffic conditions, any special events occurring.
- Time of year and potential weather conditions, distance to be traveled, time to complete a move, and where move takes place.
- Can the move be reasonably carried out using an alternative means of transportation?
- Can the load be reduced in size or weight?
- Can the load travel on roads other than province highways in accordance with the rules of the jurisdiction/municipality?
- Is there a traffic management plan in place for exceptional moves?

The permit issuer may limit the time and particular highway(s) that can be used and can also include certain special conditions or provisions in the permit considered necessary to protect the safety and integrity of the highways and other road users. Before issuing the permit, the ministry may also require a bond or other security sufficient to cover the cost of repairing possible damage to the highway be posted. The permit grants movement of overweight loads on highways under provincial jurisdiction. Municipalities may accept ministry permits, or they can issue their own permits for highways under their jurisdiction. The carrier must contact the appropriate municipality(ies) to ensure compliance with local by-laws.

The ministry issues four types of permits:

- Annual
- Project
- Single-trip
- Special Vehicle Configuration

Permit Fees

The permit fee structure is as shown in Table E.9:

Table E.9: Permit Fees

Permit Type	Cost C$
Annual Permit	300
Project Permit	200
Single-trip Permit	
Oversize	50
Overweight: weight up to 120,000 kg travel on provincial highways	
Up to 100km	100
From 101km to 500 km	150
Over 500km	200
Overweight over 120,000 kg regardless of distance	500
Oversize and overweight	Prices as for overweight above
Special vehicle configuration	Refer to Act S110.1 (10)
A C$5 fee is applied to each single-trip permit that is faxed long distance. Payment can be made by credit card or certified personal check unless payment is sent by mail. Cash for walk-in clients only.	

Source: Ontario Ministry of Transportation Guide to OS/OW Vehicles and Loads

Annual Permits

Annual permits are usually processed in 10 to 15 business days. Dimensions for an annual permit are set out in Table E.10.

Table E.10: Maximum Dimensions Permitted on Annual Permit

Single	Combination	Width	Height
12.5m length including a max rear overhang of 4.65m	22.5m length with max rear overhang of 4.65m	3.7m on two land highways and 3.85m on multi-lane (same for single/ combination vehicles)	7.26m (same for single/combination vehicles)
Weight is per the Act	Overweight requires contact with permit office		

Project Permits

A project permit can be issued to allow contractors to move similar loads, objects, and structures over the same specified route for a period of up to, and including, six months. A copy of the project contract is required in the application. The letter of contract must be written on company letterhead and include the following information:

- Name and address of the carrier
- Contract number (if available)
- Duration of the contract
- Description of the product being transported
- Origin of load and destination with complete route specified including municipal roads

The permit office will assess traffic and construction issues before approving and issuing the permit. The weights and dimensions in the application must be load-specific. The maximum dimensions allowed on a project permit are as follows in Table E.11:

Table E.11: Maximum Dimensions on Project Permit

Single	Combination	Width
12.5m length, including a max rear overhang of 4.65m Height up to 4.26m	36.5m length with max rear overhang of 4.65m No height limit if load is on float type trailer. Height greater than 4.3m require route clearance	Up to 4.30m (same for single and combination) Escort vehicles may be required.
Weight is per the Act	Weight up to 70,000kg	

Single-Trip Permits

A single-trip permit may be issued for an overweight move for a one-way trip along a specified route for a limited time period. These must be applied for 24 hours before the proposed move date, but two to three business days is recommended. Table E.12 depicts the dimensions allowed for single-trip permits:

Table E.12: Dimensions for Single-Trip Permit

<table>
<tr><th></th><th>Length</th><th>Width</th><th>Height</th><th>Weight</th></tr>
<tr><td>Combination Vehicle</td><td>23m – 45.75m
Over 45.75m must be submitted to SCT permit office</td><td>2.61 to 5m
Over 5.0m must be submitted to STC</td><td>4.16m or greater
Max height on flatbed trailer is 4.26m</td><td rowspan="2">120,000kg subject to weight and load engineers approval</td></tr>
<tr><td>Single Vehicle</td><td>12.5m, including overhang up to 4.65m</td><td>2.61 to 5m (any permit office)
Over 5.0m must be submitted to STC</td><td>Max 4.26m</td></tr>
</table>

For exceptional dimensions permits for more than 5m in width, and/or 45.75m or more in length, and/or over 120,000 kg, applicants must send their application to a specialized permit office five days before the proposed move date. The approval process minimum turnaround time is 72 hours but can take up to 14 days to process.

Superloads

Loads in excess of 120,000kg GVW, and/or 6m in width, and/or 45.75m in length that intend to use a two-lane highway route or 7m-wide multi-lane highways are considered "superloads." Superloads are not considered routine applications and require additional processing time. Applications require supplementary documentation and are reviewed by the Ministry of Transportation's weight and load engineer and other ministry personnel. The application also requires a project justification for the intended move that normally includes:

- Documentation outlining why alternate means of transportation (e.g., rail, water, or possibly air) are not being pursued;
- Detailed description of the load, including an engineering drawing when applicable illustrating the item's construction and why it cannot be reduced in size or weight; and
- Detailed description of the project the item is intended for, including: construction schedule, consequences of late delivery, and the economic benefits associated with the project.

After reviewing the project justification documents, the ministry will consider the necessity of permitting the move. If the move is satisfactorily justified and considered to be absolutely necessary, the applicant is required to:

- Hire a designated consultant engineer to evaluate the bridges on route and submit the evaluation for approval.
- Submit a detailed traffic management plan describing all aspects of the intended move, including:
    - Detailed escort requirement and procedures identifying the responsibility of all units involved (OPP and private);
    - Detailed route survey indicating all appropriate locations for road closures, pull-over areas, emergency parking, fuel stops, significant turning movements, and any anticipated roadside related activities such as restricting roadside parking;
    - Contingency plans for breakdowns; and
    - Municipalities requiring separate permits.

Special Vehicle Configuration

Special Vehicle Configuration permits are issued for vehicles that vary from the requirements of the HTA and regulations. The purpose of Special Vehicle Configuration permits is to harmonize configurations, weights, and dimensions applicable to a class of vehicles with those in any other jurisdiction; to allow for a trial of a vehicle; or to allow for a variance from a limit within a specific geographical area.

Night Moves

Night moves are allowed for all permit types with certain restrictions provided that all conspicuity requirements are met. Two criteria are applied here for different vehicle dimensions.

Criteria 1: for overlength and/or overwidth allows night moves for vehicles (and loads) up to and including 3.05m wide and 25m long. These are restricted to multi-lane controlled access highways with a median. The lane width on these types of highways is 3.75 m.

Criteria 2: for overheight and/or overweight allows night moves for vehicles and loads up to and including 4.26m high and 63,500 kg. These can travel on all the "King's Highways."

If both criteria are in play, the conditions for both criteria are "conspicuity requirements" and must be met during a night move. These consist of the extremities of the vehicle or load being marked with a solid amber lamp(s) visible in the front and rear, conforming to SAE Code P2 or P3 with markings to appear on the lamp(s), and a retro-reflective "D" sign must be present. Night moves are restricted when inclement weather conditions prevail[4].

Public Holiday Moves

Overweight moves are allowed for all permit types on public holidays (New Year's Day, Family Day, Good Friday [Easter], Victoria Day, Canada Day, August Civic Holiday, Labor Day, Thanksgiving, Christmas Day, and Boxing Day) and the preceding day of a public holiday, subject to the restrictions below.

Overweight moves are allowed between a half hour before sunrise and noon on a public holiday for dimensions that do not exceed:

- width of 3.70m on two-lane highways and 3.85m on multi-lane highways
- length no greater than 25m for combination vehicles and 12.50m for single vehicles
- height maximum of 4.26m
- weight no greater than 63,500kg.

Vehicles and/or loads exceeding the dimensions listed above cannot travel on a public holiday but can travel on the preceding day subject to:

Preceding day means the day before a statutory holiday restriction. If the statutory holiday is a Saturday, Sunday, or Monday, the preceding day is the Friday. If the statutory holiday is on any other day of the week, the preceding day is the day before the holiday.

Overweight moves are allowed all day on the preceding day of a statutory holiday for dimensions that do not exceed the following dimensions:

- width of 3.70m on two-lane highways and 3.85m on multi-lane highways
- length no greater than 25m for combination vehicles and 12.50m for single vehicles
- height maximum of 4.26m
- weight no greater than 63,500kg.

[4] Road conditions, weather conditions, or visibility make traveling hazardous to the operator or the driving public. Conditions shall be deemed to be hazardous upon any accumulation of ice or snow on the roadway or if the continuous use of windshield wipers is required. Vehicles that are underway when inclement weather occurs shall exit the road at the first available location and park in a safe place until the weather and road conditions clear.

Vehicles and/or loads in excess of the dimensions listed above are only allowed to travel between a half-hour before sunrise and noon on the preceding day of a public holiday. Weekend moves are allowed for all permit types with certain restrictions on dimensions. Weekend moves also have restrictions during the summer months. Overweight moves are allowed all day on Saturday and Sunday for dimensions that do not exceed the following dimensions:

- width of 3.70m on two-lane highways and 3.85m on multi-lane highways
- length no greater than 25m for combination vehicles and 12.5m for single vehicles
- height maximum of 4.26m
- weight no greater than 63,500kg.

Sunday travel is not permitted between noon and midnight during the restricted summer months of June, July, and August in Southern Ontario and July and August in Northern Ontario for any overweight vehicles and/or loads.

Friday restrictions during the summer months prohibit travel between 3:00 pm and midnight during the restricted summers months of June, July, and August in Southern Ontario and July and August in Northern Ontario for any overweight vehicles and/or loads. There is an exception for this: vehicles and/or loads with heights up to, and including, 4.26m and an overall weight not exceeding 63,500kg may travel between 3:00 pm and midnight on Fridays during summer.

Long Wheelbase Tractors

Per Ontario Regulation 413/05, the province prefers to restrict the wheelbase of tractor units to the 6.20m national standards; however, many carriers that specialize in the movement of overweight indivisible loads often operate such overlength tractors to accommodate the additional axles, heavier duty suspensions, and/or sliding fifth wheel assemblies for weight distribution. Ontario's Ministry of Transport routinely authorizes carriers to operate such fleets of specialized vehicles for routine "permitted" transportation of lighter OS/OW loads. The ministry notes that this accommodation *"…is not intended to inadvertently authorize operation of overlength tractors equipped with large sleeper berths or living quarters frequently utilized in other jurisdictions."*

Permit issuing staff must verify tractor wheelbase dimensions, and they can to ask for clarification and/or support documentation defining the requirements for an overlength tractor.

Greater Toronto Area Restrictions

Within the Greater Toronto Area (GTA), vehicles and/or loads traveling under a single-trip or project permit are often subject to a congested traffic condition (Condition). The Condition applies to all single-trip and project permits with dimensions that exceed the following dimensions:

- width of 3.70m on single highways and 3.85m on multi-lane highways
- length exceeding 25m
- height exceeding 4.26m
- weight in excess of 63,500kg

Under the Condition, permits are not valid for vehicles traveling in the specified area directions entering the GTA between the hours of 7:00 a.m. to 9:30 a.m., as well as vehicles traveling in the area directions exiting the GTA between the hours of 3:30 p.m. to 6:30 p.m.

Bonds and Securities

The Ministry may require a bond or other security sufficient to cover the cost of repairing possible damage to the highway to be posted before a permit is issued. The following sets of circumstances may be sufficient to warrant a bond being posted:

- where loading on tires must exceed 11kg per millimeter width,
- where loading on the axle must exceed 10,000kg during reduced load period,
- where total GVW exceeds 120,000kg subject to engineering analysis of bridge structures and geotechnical assessment of roadway structure,
- where overweight vehicles must be routed over substandard bridge structures subject to engineering analysis of bridge structures, or
- deemed to be warranted by the Director of the Carrier Safety and Enforcement Branch.

The Ministry determines the amount of the bond. A carrier may be required to pay for the services of ministry-approved geotechnical and/or structural consultants to assess conditions and evaluate any damages caused by the move.

Escort Vehicles

A permit may be issued on the condition that the permit holder provides escort vehicle(s) either preceding or following an overweight vehicle or load. No escort is required:

- for widths from 2.61m to 3.99m
- for lengths from 23.01m to 36.75m
- for heights from 4.16m to 4.86m

A private escort warning vehicle is required for widths:

- from 4m to 4.99m, one escort vehicle is required on multi-lane highways
- from 4m to 4.59m, one escort vehicle is required on two-lane highways
- from 4.6m to 4.99m, two escort vehicles are required on two-lane highways

A private escort warning vehicle is also required for overlength vehicles:

- from 36.76m to 45.74m, one escort vehicle required
- rear overhang greater than 4.65m, one escort vehicle required at the rear of load

An exception exists for mobile/modular homes: for a height greater than 4.87m, one escort vehicle (pole car) is required. Mobile and/or modular homes greater than 29.25m in length cannot travel in convoy and require two private escort warning vehicles to accompany each load. Annual and project permit holders must provide a private escort warning vehicle on certain highways when the load measurement meets or exceeds the listed widths.

Reduced Load Period

Annual and project permits for moving heavy vehicles, loads, objects or structures that exceed legal weight limits are not valid on any King's Highway during the months of March and April in Southern Ontario and March, April, and May in Northern Ontario. Weights exceeding legal limits are only allowed when specifically authorized to do so under permit conditions.

Single-trip permits may be issued for movements on highways subject to reduced loading restrictions. However, the weight and load engineer must approve these moves. Annual permits with special weight condition for specific axle weight configurations have an additional condition for reduced load periods.

Corridor Moves

OS/OW permits may be issued to Canadian or U.S. carriers for movements within or through the province of Ontario under the following conditions:

- move originates and terminates in Ontario;
- move originates in Ontario and terminates in another province or territory;
- move originates in another Canadian province/territory, or one of the states of the United States of America, and terminates in Ontario;
- move originates in another Canadian province or territory and terminates in another/same Canadian province and/or territory, or one of the states of the United States of America, where Ontario is to be used as a corridor.
- move originates in one of the states of the United States of America and terminates in another Canadian province or territory, where Ontario is to be used as a corridor.
- move is a mobile home that originates and terminates in the United States of America, Ontario may be used as a corridor.

Convoy moves are not permitted. Loads must be separated by at least 45 minutes. When en route, a minimum spacing of 10km is required. Annual and project permit holders may encounter construction zones where the horizontal clearance has been reduced to less than 3.70m or a vertical clearance has been reduced to less than 4.26m. Before traveling through any construction zone, the permit holder is responsible for verifying clearances.

Metric Conversion: Ontario measurement standards are in metric. To convert imperial measurement to metric:

* Convert measurement to inches and multiply by 0.0254, e.g.,
9'6" = (9' x 12”) + 6"
= 108" + 6"

= 114"
114" x 0.0254 = 2.89 meters

* To convert weight from pounds to kilograms, divide pounds by 2.205.
E.g., 154,000 lbs. ÷ 2.205 = 69,841 kgs

Australia

Australia operates under a very different set of heavy vehicle configurations and weights, charges, and policy prescriptions, including the Higher Mass Limits scheme (HML). Through a permit system, heavy vehicles can operate with additional mass on certain types and groups of axles on a restricted network subject to specific conditions. The axle mass limit increases that can be used on vehicles fitted with "road-friendly suspensions"[5] are:

- 0.5 ton increase on tandem axles to 17 tons
- 2.5 ton increase on tri-axle groups to 22.5 tons
- 1 ton increase on single drive axles on buses to 10 tons
- 1 ton increase on six-tired tandem axles to 14 tons
- 0.7 ton increase on steering axles of long combination vehicle prime movers (road trains) fitted with wide single tires regardless of suspension type
- Increases for tri-axles are restricted to members of the National Vehicle Accreditation Scheme

The penalties for overloading or noncompliance for overheight or overwidth vehicles are set out within each state. For example, in New South Wales, the penalty for an overheight vehicle that proceeds past a clearance sign is A$1,824, along with six demerit points on the commercial drivers license. Courts can also apply additional fines up to A$3,300 if the vehicle is off route or other conditions are not complied with, e.g., driving at the wrong time or without a specified pilot or escort vehicle. Three states were reviewed for this project (New South Wales, Queensland, and Victoria).

Australia also uses a pay-as-you-go system (Paygo) for heavy vehicle charges that is based on a fixed annual registration and fuel-based road-user charges to recover revenue to contribute to building better roads. Paygo was introduced in 1992. As part of Paygo, approximately 40 percent of larger costs are recovered via state and territory registration fees, and the balance is paid through a fuel-based road charge determined by the commonwealth government. The fee is adjusted annually to ensure that charges keep pace with heavy vehicles' share of spending on roads. The formula is calculated as follows:

Annual adjustment (per cent) = road expenditure factor + road user factor

The annual adjustment factor is applied in July of each year to ensure that the charges keep pace with the road spending program. A productivity commission independently audited the Paygo program and found that it was "conservative" by international standards, keeping

[5] Road friendly suspensions must be undertaken through a certified vendor.

prices low. In March 2010, for the adjustment process the National Transportation Commission consulted with the trucking industry and government to set the adjustment fee. The year 2010-2011 charges saw a 4.2 percent increase in both registration and fuel-based road charges that resulted in an increase of A$0.9 per liter in the road user heavy vehicle fuel charge, raising it to 22.6 cents per liter. Registration fees also increased by more than 4.2 percent from previous heavy vehicle fees determination in 2007.

In November 2011, the Standing Council on Transport and Infrastructure also requested the that National Transport Commission review A-trailer registration charges as industry had noticed that the costs were having a negative impact on some operators. Four options were reviewed, and the A-trailer fee was reduced; however, other vehicle registration fees were increased. Table E.13 shows the new fee schedule for July 1, 2012 to June 30, 2013. To operate a vehicle heavier than 125 tons carrying an indivisible load, the permit fee for the load is calculated as A$4 cents x ESA km.

Table E.13: 2012–2013 Registration Charges for Heavy Vehicles

Vehicle Type	**Division 1 – Load Carrying Vehicles (A$)**			
Trucks	2-axle	3-axle	4-axle	5-axle
Type 1	542	859	759	759
Type 2	859	1021	1021	1021
Short combination truck	859	1021	1854	1854
Medium combination truck	6783	6783	7326	7236
Long combination truck	9361	9661	9361	9361
Prime Movers				
Short-combination prime mover	1164	4744	5030	5030
Multi-combination prime mover	9457	9457	10402	10402
	Division 2 Load Carrying Trailers (A$)			
Trailer Type	Single axle	Tandem axle	Tri-axle	Quad-axle and above
Pig trailer	550	550	550	550
Dog trailer	550	550	550	550
Semi trailer	550	550	550	550
B-double lead trailer and middle trailers	550	1050	1100	1100
Converter dolly or low loader dolly	550	550	550	550
	Division 4 –Special Purpose Vehicles (A$)			
Type P	No charge			
Type T	292			
Type O	365 (Calculated using Formula 365+(365 x Number of axles >2))			

Truck Type 1: rigid truck under 12.0t (two axles), 16.5t (three axles), or 20t (four or more axles)
Truck Type 2: rigid truck over 12.0t (two axles), 16.5t (three axles), or 20t (four or more axles)
Short combination trucks means to haul one trailer when (a) the combination has six axles or fewer, and (b) maximum total mass that is legally allowed is 42.5 tons or less.

In 2009, the Council of Australian Governments (COAG) decided to establish a single national heavy vehicle regulator by the end of 2012 that regulates all vehicles heavier than 4.5

gross tons. COAG's intent was to end the conflicting and separate regulatory regimes that the states imposed. COAG had undertaken a regulatory impact statement process to instigate a single national system for heavy vehicle regulation that consisted of:

- A single entity to administer a body of national laws
- A national heavy vehicle registration scheme
- A consistent approach to minimum standards for heavy vehicle driver competency and testing, along with a single driver's license
- A body of national heavy vehicle laws that would be an aggregation of the existing laws and regulations.

In February 2010, Queensland was selected as the host jurisdiction for the national heavy vehicle laws and regulator entity. In November 2011, an implementation board was also established to help set up the new National Heavy Vehicle Regulator. Additional legislation should be passed when the Queensland Parliament convenes in Fall 2012, and the CEO for the regulator should be in place by early 2013.

New South Wales

New South Wales (NWS) has a series of options for addressing the operation of oversize and overweight vehicles. These include higher mass limits, concession mass limits overdimension vehicles, and the Intelligent Access program for heavy vehicles.

Over-dimension Vehicles

Vehicles that exceed the dimensions defined in the Road Transport (Registration) Regulation 2007 are subject to specific operating conditions and require permit notice and route assessment guidelines (see Table E.14 for the statutory dimension limits).

Table E.14: NSW Statutory Dimension Limits

Vehicle	Height (m)	Width (m)	Length (m)
Agricultural vehicle	4.3	2.5	12.5
Agricultural combination	4.3	2.5	19.0
Special-purpose vehicle	4.3	2.5	12.5
Special-purpose combination	4.3	2.5	19.0
Rigid motor vehicle	4.3	2.5	12.5
Combination consisting of a prime mover and a semi-trailer	4.3	2.5	19.0
Rigid vehicle and trailer combination	4.3	2.5	19.0
Articulated low loader	4.3	2.5	19.0

The cost is A$72 for an oversize and overmass permit. Single trip and annual permits can be applied for. No sales tax is applied to the cost of the permit. Existing annual permits can be renewed electronically and emailed to the Special Permits Unit. There are three heavy vehicle types with indivisible loads that can be applied for:

1) Load Carrying Permit—for vehicles that are oversize or overmass because of the indivisible load being transported.
2) Special Purpose Vehicle or Agricultural Vehicle Permit—for vehicles (except Tow Trucks) built for a purpose other than carrying a load and that exceed a mass or dimension limit by construction (including water carried by concrete pumps and fire trucks).
3) Mobile Crane Journey Permit—for mobile cranes that already have a NSW Class 1 permit and require travel on a route not currently available for oversize/overmass travel.

It takes an average of seven business days for permits to be approved. Applications for exceptional loads with extreme dimension or mass or for travel at difficult locations can take longer to process. The permit is issued to the registered operator. Overlength permits are only issued to articulated prime mover combinations carrying a long load. If the load is too long for the vehicle, a larger vehicle is required.

Restrictions may also apply; NSW has established some day, night, holiday, and weekend restrictions. Pilot vehicles are also required.

Overmass Vehicles

If a vehicle exceeds standard weight limits or is carrying an indivisible load that exceeds standard weight limits, an overmass permit is required. These can be issued to the following vehicles or equipment:

- A non-load-carrying vehicle such as a mobile crane; or
- A prime mover with:
  - low loader dolly;
  - low loader described in Vehicle Standards Information Sheet 45 (VSI 45);
  - jinker;
  - platform;
  - non-load-carrying towed vehicle such as an amusement ride or crushing plant;
  - extendable trailer not carrying a plant item with 11 meters between the center of the last axle of the preceding unit and the center of the first axle of the extendable trailer; or
  - any combination of the above.

Overmass permits establish maximum limits for loadings on individual axles or axle groups. Axle loading limits depend upon their spacing, groups and widths, tire sizes and ply ratings, and the route to be used. The permit can be issued for single items that cannot be readily divided into smaller parts. Both sets of permit conditions can be placed onto a single combined permit if a vehicle is both overmass and oversize. If the weight exceeds 75 tons, the permitee or principal shall pay to the authority the cost of repairing and/or strengthening the road/roads described in the permit. This includes any structures. The permittee is also required to indemnify the authority against liability for any costs damages and expenses that result from the movement of such a vehicle or load.

The fee for vehicles up to 125 tons gross mass is the standard permit administrative fee that applies to overmass and oversize permits: A$72. If both permits are required, a single fee is charged. If the gross mass exceeds 125 tons, a road charge fee of 4 cents per journey kilometer per equivalent standard axle is applied. (Note that there is currently a moratorium on this road charge fee.)

Overheight Vehicles

Another permit for vehicles over 4.3m high is required. These vehicles are also subject to special conditions. For vehicles shorter than 4.3m in height, there are restricted routes on which the vehicle *must* travel. They also must comply with the 4.6m-high Vehicle Route Notice issued in 2008. Penalties are assessed for non-compliance. These penalties were changed in 2010, and currently include an on-the-spot fine of A$1,824 and six demerit points applied to the license for a vehicle that proceeds past a clearance sign. The court can also apply fines up to A$3,300 if the vehicle is detected off route or conditions are not met.

Vehicles taller than 4.6m in height are subject to more stringent conditions and routes, and they must apply for a permit. The permit cost is A$72.

Queensland

Queensland issues permits for excess mass and excess dimension along with “letters of no objection” for specific operations.

A conditions of operation database is maintained that allows operators to ensure they are in compliance with current conditions of operation. This includes changes to routes and posted load routes. Through this database, they can also ascertain conditions for a particular excess mass permit, Queensland-wide conditions of operation between selected dates, and whether conditions have changed since a selected date.

Intelligent Access Program

Queensland has also developed an Intelligent Access Program (IAP) that provides improved road access for heavy vehicles by monitoring their compliance with access conditions. IAP is mandatory for transport operators to haul higher mass limits in Queensland; it is also available for some types of heavy mobile cranes that operate under permit. The IAP is part of a national program that was developed by all the road agencies in Australia and uses satellite tracking and wireless communication to remotely monitor when and how heavy vehicles are being operated on the road network. The policy behind the IAP is to protect vulnerable road infrastructure, especially bridges and culverts, while still allowing special purpose, innovative, or higher productivity vehicles on the road system.

Excess Mass

The Excess Mass system was established by the Transport Operations (Road Use Management—Mass, Dimensions and Loading) Regulation 2005. This regulation establishes vehicle and mass limits and conditions of operations for vehicles up to 40 tons or carrying an indivisible item to 59.5 tons. This also includes route restrictions. An application to register as an approved heavy haulage operator is required. For each special purpose vehicle or prime mover operating in excess mass, operators must request an "authority to operate" that contains vehicle description and any approved operating masses. The overmass vehicle fee permit is A$79.85 for a single-trip permit or A$303.45 for a stated period.

Excess Dimensions

Under the Transport Operations (Road Use Management—Mass, Dimensions and Loading) Regulation 2005, vehicles operating with excess dimension—either vehicles carrying indivisible articles or special purpose vehicles or vehicles that require a pilot/escort—also require a permit. The guidelines for this permit were reissued in February 2012. The permit fee is the same as the excess mass permit fee. The onus falls to the operator to check the route in advance, and they must also obtain all other relevant permissions or authorizations prior to the movement to ensure that the movement does not pose a danger to property or other road users. For an oversize vehicle that is transporting an invisible article longer than 30m, the vehicle must have a rear-end steering unit. For an excess dimension movement, a "letter of no objection" issued by the main roads permit management office is also required. These permits are required for vehicles over 5.5m in width and/or 4.8m in height.

Victoria

The state of Victoria also has an annual permit schedule to facilitate transportation of large indivisible loads. In general, the gross mass allowed is developed based on bridge capacity on arterial roads. Routes available for the approved higher mass limit network and the B-doubles can usually be utilized for such loads. If operators need to use roads that are not within two schedules that have been developed, they can request a specific permit for up to one month.

Scheme A allows the following mass and dimension on listed road: up to 77 ton (low loader and dolly combinations at approved axle and axle group spacing), up to 4.8m in height and 26m length for major highway type roads and 25m for B roads. Restrictions are in place for the Melbourne metropolitan area; on freeways and OD routes, vehicles can be 5m in width; on local roads, 4m in width; and on rural roads, between 4 and 5m, depending on road class.

Scheme B allows gross combination mass on B-doubles and higher mass limit network. Up to 60 tons are allowed for low-loader and dolly combinations at approved axle and axle group spacing; up to 4.8m in height and 26m in length for major highway type roads; and 25m for B roads.

To be eligible for a permit, the operator must also conform to the Victoria roads low loader mass limits tables. A separate permit is required for each vehicle or combination. A permit fee applies, and this has been set at A$59.80. The permit can be applied for in person, by fax, or by post. Applications can be made for:

- Overdimensional permits
- Overdimensional and mass permits
- B-double or higher mass limit permits
- Special purpose vehicle permits
- Tow truck permits

Europe

A limited review of European countries was undertaken, along with a review of European Union (EU) regulations and rules for heavier trucks.

In 1984, the EU issued its first Directive (which is to be applied and implemented as law(s) in the member states) on vehicle size and weights. Directive 85/3/EEC issued in December 1984 established weights, dimensions, and other characteristics within the framework of a common transport policy. Part of the policy goal behind the directive was to move towards EU-wide common standards permitting improved use of vehicles between states that would reduce the adverse effects upon competition between member states as a consequence of multiple laws that established authorized lengths, widths, and weights for commercial vehicles. The European Commission considered these an obstacle to efficient trade.

85/3/EEC was amended multiple times, and in 1996, the EU issued a new directive establishing vehicle size and weights that amalgamated all the various amendments currently issued. Directive 96/53/EC established the maximum authorized dimensions and weight for national and international traffic for vehicles traveling within the EU. The directive also specified that member states could not reject or prohibit use of vehicles that did not comply with their national weight/dimensions laws if the vehicles complied with limit values that the directive now stipulated.

The EU has also issued two directives regarding heavy goods vehicles and tolls/time-based user charges for heavy goods vehicles heavier than 3.5 tons. The most recent was issued in 2011. It establishes common rules for distance-related tolls and time-based user charges for goods vehicles for use of certain infrastructure (1999/62/EC, as modified by 2006/38/EC and 2011/76/EU).

The 2011/76/EU framework policy aims to improve the functioning of the road network by reducing differences between the member states regarding tolls and vignettes, taking better account of the principles of fair and efficient pricing, and providing for differentiation in the systems in line with the costs associated with road use. The directives also target greenhouse gas (GHG) emissions reduction in line with EU GHG reduction policies.

Charging for heavy goods vehicles is not mandatory within the EU. The Directives set out a framework of rules to be followed by member states if they wish to levy charges. The most important framework conditions are:

- Tolls must be levied according to distance traveled and type of vehicle; if a vignette is used, it must be scaled to duration and use made of the infrastructure and also by vehicles emission class.
- Directive does not permit the use of tolls and vignettes to be applied on a road section at the same time.
- National tolls/vignettes must be non-discriminatory.
- Charging schemes should cause as little hindrance as possible to the free flow of traffic.
- Directive stipulates the maximum average tolls that can be set in relation to construction, operation, and development of infrastructure.
- Schemes can include an external cost charge that reflects the costs of air pollution and noise pollution.

- Revenue should preferably be used for development of the trans-European network.

Within the EU certain countries have aligned together to develop vignettes for road charging purposes. Belgium, Denmark, Luxembourg, Netherlands, and Sweden have a Eurovignette agreement that levies a fee on all heavy goods vehicles with a total weight of 12 tons or more. The road fee is based on number of axles and vehicle emission class. The user charge (toll) is paid in one of the participating countries and is valid in the road network of all the other countries. The information on the vignette is stored online in a central database. Police can search this database to see if the toll for a vehicle has been paid. The tariff for 2012 based on axles and emission class can be seen in Table E.15 (* in Swedish Krona).

Table E.15: Vignette Tariff for Belgium, Denmark, Luxembourg, Netherlands, and Sweden

Max axles	**3**	**3**	**3**	**4**	**4**	**4**
Emission Class	**0**	**1**	**2**	**0**	**1**	**2**
1 day	73*	73	73	73	73	73
1 week	239	212	184	377	341	304
1 month	884	783	691	1428	1290	1152
1 year	8849	7835	6913	14288	12905	11522

Source: Swedish Tax Agency

Austria, Germany, the Czech Republic, and Switzerland (which is not a member of the EU) have independently implemented distance-based charging schemes for all heavy goods vehicles. The most notable of these is the German "Gant" scheme, which uses GPS technology to track trucks on the federal network and levies a per-mile charge for use of the network. The charges are ring-fenced to be used for network/system improvements. Germany also has specific requirements for OS/OW trucks that are set forth in the Road Traffic Licensing Regulations (Straßenverkehrs-Zulassungs-Ordnung §6, as amended June 1, 2012). These were enacted by the Ministry of Transport's Building and Regional Development. There are four types of permits issued:

1. Oversize
2. Overweight (heavy haulage); i.e., an indivisible load
3. Combination of 1 and 2
4. Overlength (longer than 20m)

Under traffic regulations, Section 29 authorizes permission for use of roads, and the permit is then issued under Section 70. A police escort may be required. The movement of such loads is also restricted to specific periods of time. For oversize transports, these usually proceed only on Monday's between 9 a.m. and 3 p.m. For overlength or overwidth vehicles, these are usually allowed to move during the nighttime hours of 10 p.m. and 6 a.m. The permit will stipulate the weights, vehicle registration number, axle distances and loads, number of wheels per axle, and specific route to used. Permits are issued for one month or a year. Most OS/OW transit companies have annual permits. In 2009, 159,047 permits were issued (SBSR, pg 40). An online system (VEMAGS) is used in all the federal states. The monthly permit costs vary from €

10 to €767 depending on route, vehicle, and the region (SBSR Oversize Strategy 2011 Report, pg 116). On average, annual permits are twice the cost of the monthly permit. There are also fees applied for police escort. Price varies by municipality, but according to SBSR, it averages €5 per transport

From 2009 to 2011, the EU also funded the Oversize Baltic Initiative in which a group of Baltic states (Sweden, Lithuania, Germany, and Poland) teamed together to develop an oversize transport strategy. The projects main goal was to conduct an analysis on the current oversize transport network, including reviewing barriers to efficient movement to improve these networks, and helping carriers find the right information for their oversize cargo movements. As a consequence, the Oversize Baltic Initiative, in its two year duration, helped create a common strategy that can be applied across these states. As part of this project, they developed corridor maps where cargo would be able to move with minimal major obstacles (Oversize EU, 2011) and mapped routes for specific transport of items, e.g., windmills. Figure E.3 shows the main road transit corridors for OS/OW vehicles from Norway to Finland that were mapped as part of this project.

Source: Oversize EU Strategy 2011

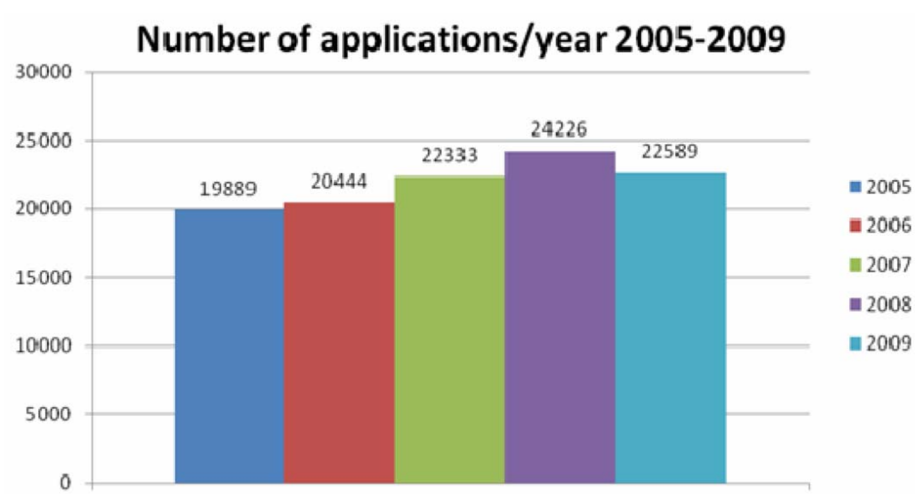
Figure E.3: Road Transit Corridors from Norway to Finland (blue) and Rail Transit Corridors for Norwegian Domestic Transport (red)

Figure E.4 shows the oversize transport corridors that the project identified and recommended for EU funding from the TEN-T program.

Source: Oversize EU Strategy 2011

Figure E.4: South Baltic Oversize Transport Corridors

In 2011, Oversize Europe released its Oversize Strategy. It found that more than 60,000 permits to transport oversize cargo are issued on average in the Baltic region, often as a result of major energy projects. However, Poland's data on oversize and overweight permits was difficult to obtain, as no centralized office issued the permits. Sweden's oversize permit applications can be seen in Figure E.5.



Source: Oversize EU Strategy 2011

Figure E.5: Oversize Permits Issued in Sweden 2005–2009

Germany has a one-stop shop for all oversize vehicles to be registered while in Germany. The online system is called VEMAGS. This was developed and made operational in August 2007. Figure E.6 shows the breakdown of permits by state for 2009.

Federal State	*Applications*	*Permissions*
Baden-Württemberg	32689	28325
Bayern	15880	13778
Berlin	2589	2444
Brandenburg	4106	3568
Bremen	2591	2186
Hamburg	14069	13037
Hessen	4410	3726
Mecklenburg-Vorpommern	3413	3200
Niedersachsen	18540	15705
Nordrhein-Westfalen	27665	23969
Rheinland-Pfalz	7594	6920
Saarland	925	833
Sachsen	20201	17843
Sachsen-Anhalt	12428	12775
Schleswig-Holstein	8109	7763
Thüringen	3270	2975
Sum	178479	159047

Source: Oversize EU Strategy 2011

Figure E.6: Number of Oversize Permits issued by State in Germany 2009

UK

The UK requires that abnormal indivisible loads notify various government bodies in advance of a journey using the Electronic Service Delivery for Abnormal Loads System (ESDAL). This may also include an application for a vehicle special order to move certain special types of vehicles by road. The maximum gross weight in tons that can be moved in the UK is 44 tons on a six-axle draw-bar type vehicle. The ESDAL system allows an operator to plot routes, and it gives information on all the organizations that an operator will need to notify before the making the movement. Once this information is input, it will deliver fully complaint notifications. Road, bridge, and police authorities can manage these incoming notifications in this system as well, so that routes can be appraised for suitability of proposed moves. For such loads, a form of indemnity is required. No permit fees are paid for these abnormal vehicles to operate.

The UK maintains a list of “High and Heavy Load Grids” (HHLG) that are advisory routes for extremely high and heavy abnormal loads. These can be used by the haulage industry to plan moves and ensure routes are maintained to agreed capacities. The high load routes are either 18 or 20 feet, and the heavy load route categories start at 223.52 tons on 12 axles or 259.08 tons on 14 axles. HHLGs are set by a series of categories A+ to F, which relate to a set of vehicles on 12- and 14-axle trailers and 300 tons on 12 axles for the M25 orbital motorway around London.

The HHLGs were compiled in the early 1970s under Road Circular 61/72. Originally, they consisted of two maps showing routes capable of carrying loads up to 20 feet (6.1m) high and 400 tons gross weight. They have been consistently kept up to date, and the Highways Agency updates HHLG with new suggestions from the trucking industry to increase the robustness of the network. HHLGs are being moved into ESDAL to enable haulers to interactively follow the grids.

Finally, the UK is currently undergoing a trial of longer semi-trailers. This began in January 2012. The trial involves 900 semi-trailers 14.6m in length, which is one meter longer than semi-trailers in use, and another 900 trailers that are 15.65m in length, which is two meters longer than the current maximum. These must operate within the current weight limit of 44 tons. The trial is voluntary and will run for a maximum of 10 years. An independent monitoring body is reviewing the impact of these longer semi-trailers on carbon emission, truck miles, and accident rates. The demand to be part of this trial apparently significantly exceeded the quota.

City of Dublin, Ireland

The city of Dublin charges €9 for a daily permit to use a heavy goods vehicle with five or more axles (City of Dublin).

Mexico

In Mexico, the federal government has authority to set truck size and weight and dimension limits, which apply to an extensive system of federal highways. This authority also includes responsibility for issuing special permits for OS/OW loads or other restricted departures from normally regulated limits (CTR, 2010). The Mexican paved network is made up of approximately of 48,000kms (30,000m), most of which about 41,000kms (25,600m) are non-tolled (Moreno-Quintero, 2007). The latter issue poses a maintenance hardship on the Secretaría de Comunicaciones y Transportes (Secretariat of Communications and Transport, SCT), because in Mexico, there is no highway or similar transportation fund dedicated or allocated specifically to road construction or maintenance.

Mexico began regulating large commercial vehicles in 1980. Since that time, significant changes have occurred regarding maximum allowed size and weight. Many of those changes have been induced by economic or technical reasons, but many others resulted from pressure from various groups that benefit from larger and heavier trucks (NCHRP, 2011). Current Mexican maximum weight and size limits vary depending on highway classification and vehicle and/or axle configuration. A major contributor to the adoption of heavier trucks in Mexico is the *Mexican Bridge Formula*, which is less conservative than in the United States with regards to permissible gross vehicle weight (GVW) (NCHRP, 2011).

Regulatory Background to Issue Rules and Norms Applicable to OS/OW Vehicles.

The operation of commercial vehicles in Mexico is defined and regulated by several rules and regulations. Laws (leyes) or regulations (reglamentos) establish the subject matter and standards in general terms. Norms (normas) might go into further detail regarding specific precepts included in the laws or regulations. Therefore, for each regulation, there might be one or more norm, or Norma Oficial Mexicana (NOM), which makes up the official standards for technical definitions or specifications (NCHRP, 2011). In Mexico, SCT establishes truck size and weight regulations for operation on the federal highway system. The states do not have the authority to establish different standards from those established by the federal government, specifically the SCT (NCHRP, 2011).

The National Consultation Committee of Standard in Land Transportation (Comité Consultivo Nacional de Normalización de Transporte Terrestre, CCNN-TT) develops the Mexican NOMs in the transportation sector. The CCNN-TT is chaired by the SCT's transportation undersecretary and includes four groups of members (NCHRP, 2011):

- Federal agencies—officials pertaining to the sectors of economy, security, treasury, environment, foreign relations, health, national defense, tourism, labor, agriculture, fishing, natural resources, and petroleum (PEMEX).
- Industry and trade organizations (mostly those involved in transportation) such as Cámara Nacional del Autotransporte de Carga (CANACAR), a trade association representing individual carriers within the Mexican trucking industry; Asociación Nacional de Productores de Autobuses, Camiones y Tractocamiones (ANPACT), an association of bus and truck manufacturers; and Asociación Nacional de Transporte Privado (ANTP), an association of private transporters, among others.
- Education and academic institutions, including the Mexican Transportation Institute (Instituto Mexicano del Transporte, IMT) and the National Autonomous University (Universidad Nacional Autónoma de México), among others.
- The Federal Consumer Commission (Procuraduría Federal del Consumidor).

The CCNN-TT's main functions regarding truck size and weight regulations include developing proposals for new standards, requesting the publication or amendment of a NOM, inter-institutional and stakeholder coordination, and analyzing Regulatory Impact Statements (Manifiesto de Impacto Regulatorio, MIR), amongst others (NCHRP, 2011).

The CCNN-TT meets at least every three months and also has subcommittees that analyze the NOMs in more detail. Before any regulation or NOM is published in Diario Oficial de la Federación (the Mexican Federal Register), it must be approved by the Federal Regulatory Improvement Commission (Comisión Federal de Mejora Regulatoria, COFEMER). The COFEMER requires that all federal agencies present a MIR together with the draft of any NOM (NCHRP, 2011). The MIR is open to the public for comments, and if it is approved and the cost-benefit analysis results are positive, the COFEMER approves the MIR, and the NOM is published and enforced.

Current Laws and Regulations Applicable to OS/OW Vehicle Operations

General Freight Carrier Permit

To transport OS/OW vehicles, a carrier must first obtain permission from the SCT and pay for the necessary permits applicable to federal carriers to haul freight (Servicio de Autotransporte Federal de Carga). The carrier must provide several documents, including proof of the legal ownership of the vehicle(s), proof of compliance with environmental standards, legal registration of the company, insurance information, and ancillary documentation. The carrier is required to pay an approximate amount of:

- For the first vehicle to register with one license plate: MXP $2,351 (USD $196 approx.); and with two license plates: MXP $3,080 (USD $257 approx.), and
- For subsequent vehicles with one license plate: MXP $1,181 (USD $152 approx.); and with two license plates: MXP $2,547 (USD $212 approx.) (SCT, 2012).

The only requirement that is different for OS/OW load movement is the vehicle's configurations ("Special Vehicle Combinations") submitted for SCT's review in order to obtain the permits.

Regulatory Framework for OS/OW Operations

Table E.16 summarizes all laws, regulations, and NOM that regulate the use and permits applicable to OS/OW vehicles in Mexico.

Table E.16: Current Mexican Regulatory Framework Applicable to OS/OW Permits and Operations

Regulation	Rule
Law of Roads, Bridges, and Federal Motor Transportation (*Ley de Caminos, Puentes y Autotransporte Federal,* LCPAF)	Article 50 establishes that it in order to transport OS/OW objects, it is necessary to obtain a special permit from SCT in accordance to applicable regulations and norms.
Regulation of Federal Motor Transportation and Auxiliary Services (*Reglamento de Autotransporte Federal y Servicios Auxiliares, RAFSA*)	Article 41 establishes that Specialized Freight Services include the transportation of OS/OW objects and industrial cranes; these require a special permit issued by SCT.
Regulation Concerning Weights, Dimensions, and Capacity of Commercial Vehicles that Travel on the Highways and Bridges of Federal Jurisdiction (*Reglamento sobre el Peso, Dimensiones y Capacidad de los vehículos de Autotransporte que transitan en los Caminos y Puentes de Jurisdicción Federal*, RPD)	Articles 16 through 19 establish the necessary paperwork companies or responsible parties must submit to SCT to obtain an OS/OW permit.
NOM-040-SCT-2-1995 and PROY-NOM-040-SCT-2-2008	This 1995 NOM, which is currently under review (since 2008), is the governing set of rules for OS/OW vehicles, industrial cranes, and special combination vehicles that might transport indivisible OS/OW objects. Any permit for an OS/OW load of more than 90 tons is reviewed on a case-by-case basis.

It is important to note that a new version of standard NOM-040-SCT-2-1995 is under development as a project. Because PROY-NOM-040SCT-2-2008 is at an advanced stage in the approval process, the following paragraphs solely reflect the latter's regulations and provisions. Also, all regulations are applicable to OS/OW vehicles of 90 tons or less unless otherwise specified. Permits for OS/OW vehicles of 90 tons or more are reviewed by SCT on a case-by-case basis for permit approval. Additionally, the current information applies to OS/OW loads, excluding industrial cranes, for which similar regulations apply and can be found in PROY-NOM-040-SCT-2-2008.

Vehicle Dimensions

Generally, the maximum vehicle dimensions are: maximum length is established as 31m (101.71 ft.); the maximum width for commercial vehicles is 2.60m (8.5 ft.), not including mirrors; and the maximum height is 4.25m (14 ft.) for all types of combination vehicles and on all road classes. The maximum length also varies with the type of road and type of combination vehicle. Additionally, SCT prohibits trailer and semitrailer lengths from exceeding 13.70m (45 ft.) except on ET types of highways, where it allows 16.2-m (53-ft.) semitrailers (single semitrailers, not configured as LCVs).

Thus, in accordance with the applicable NOM, the following are the types of special vehicle combinations in accordance to the dimensions (Table E.17).

Table E.17: Mexican Classification of OS/OW Special Vehicle Combinations by Dimension

Classification by Type of OS/OW Special Vehicle Combinations			
Type	Dimensions in Meters		
	Length	Width	Height
1	Up to 23 (75.4 ft.)	2.6 ft.	4.25 (14 ft.)
2	Up to 28 (91.9 ft.)	Up to 3.1 (10.2 ft.)	Free
3	Up to 28 (91.9 ft.)	Up to 3.3 (10.8 ft.)	Free
4	Up to 30 (98.47 ft.)	Up to 3.7 (12.1 ft.)	Free
5	More than 30 (98.47 ft.)	Up to 3.7 (12.1 ft.)	Free
6	Free	More than 3.7 (12.1 ft.)	Free

Source: PROY-NOM-040-SCT-2-2008.

Gross Vehicle Weight

For non-divisible loads, NOM-040-SCT-2-2008 establishes that for special loads, the maximum GVW is the sum of the maximum axle weights. Cargo must be positioned in the truck so that the axle weight does not exceed the maximum allowed. See Table E.18.

Table E.18: Maximum Axle Load Weight for OS/OW Special Vehicle Combinations

Maximum Axle Load Weight for OS/OW Special Vehicle Combinations				
Axle Type or Group	Tires per Axle	Maximum Weight per Tire in Tons	Load per Axle Type in Tons	
			Load per Axle	Load per Axle Group
Single	2	3.3	6.6	6.6
Single	4	2.75	11.0	11.0
Single	8	2.75	22.0	22.0
Double or Tandem	8	2.75	11.0	22.0
Double or Tandem	16	2.75	22.0	44.0
Triple or Tridem	12	2.75	11.0	33.0
Triple or Tridem	24	2.75	22.0	66.0
Quadruple or more axles	8 POR EJE	2.25	18.0	Variable
Quadruple or more axles	12 POR EJE	2.25	27.0	Variable

Source: PROY-NOM-040-SCT-2-2008

Speed

In the case of bridges, trucks must also travel along the center of a bridge, and the maximum speeds allowed are as follows:

- loads weighing less than 70 tons on bridges: 30 km/hr (19 mph);
- for loads weighing between 70 and 90 tons: 20 km/hr (12 mph); and
- for loads heavier than 90 tons: 10 km/hr (6 mph)—minimizing acceleration and breaking.

In the case of roads, if the load capacity of the configuration does not exceed 90 tons, the maximum speed allowed varies between 20 km/hr and 70 km/hr (12 mph and 44 mph, respectively) depending on the vehicle configuration and road type. Pneumatic suspension is usually required.

The carrier must prove that the load and axle configuration complies with the maximum allowed. If the load capacity of the configuration exceeds 90 metric tons, the carrier must comply with any further rules specified on the permit SCT issues on a case-by-case basis. In addition, the carrier must inform the SCT and Federal Highway Police of the route and schedule of the trip at least 24 hours in advance.

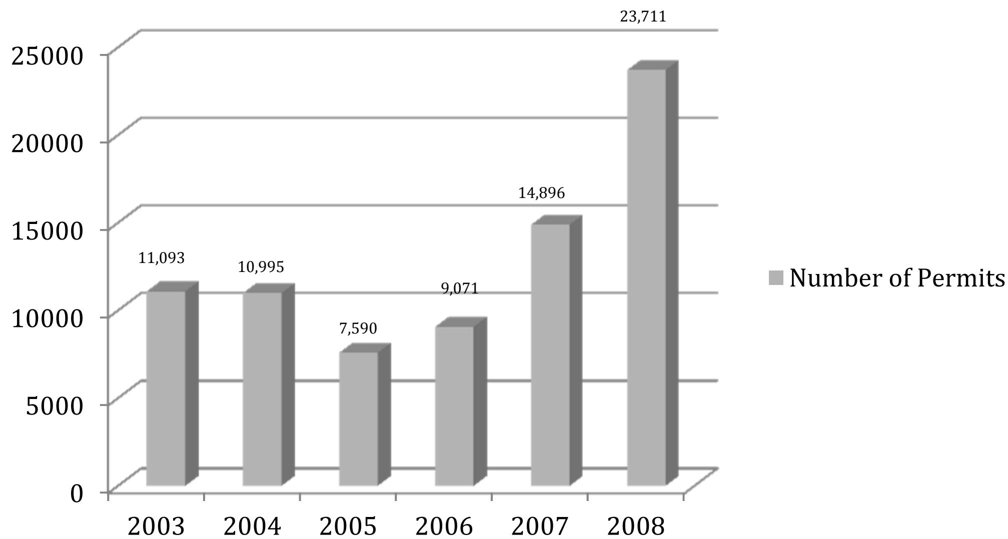
Depending on the special vehicle configuration type, escort vehicles (or pilot cars) with warning lights are required to improve safety and facilitate transportation of the oversize vehicle. Oversize Configuration Types 1 through 3 do not require escort vehicles; Type 4 requires one escort vehicle; and Types 5 and 6 require two escort vehicles. These special vehicle configurations are not allowed to travel on federal highways between sunset and midnight.

Permits Issued and General Data Applicable to Mexican OS/OW Permits

As of 2008, the SCT had 487 permit holders (specialized freight carriers) registered to transport OS/OW Special Vehicle Combinations. In 2008, the SCT had the following numbers of registered OS/OW combinations that had been granted a specialized freight carrier permit:

- 1,054 OS/OW special vehicle configurations
- 294 industrial crane special vehicle configurations

The permits issued between 2003 and 2008 are illustrated in Figure E.7.



Source: SCT, 2009

Figure E.7: OS/OW Permits Granted by SCT for Load Below 90 Tons—2003 to 2008

The current cost of an OS/OW permit as of October 2012 is MXP $533 (USD $44 approx.) for a single-trip permit. This cost is irrespective of the 90 ton limit.

In case of loads above 90 tons, the carrier must submit the following to SCT: the vehicle combination (including dimensions), weight distribution, potential route or origin, and destination data, amongst others. SCT´s Technical Services Directorate then analyzes routes, pavement conditions, bridge conditions, and/or heights in the route, and other important variables before authorizing or denying the permit and establishes, if applicable, a specific route to the carrier. The latter information must be shared with the Federal Highway Police at least 24 hours in advance of the trip.

The industries that are the main users for OS/OW transport services and permit requests are the following: construction, energy, mining, iron and steel sector, chemicals, and petroleum.

Update on PROY-NOM-040-SCT-2-2008

PROY-NOM-040-SCT-2-2008 is a new version of the previous standard and is still under development and going through the approval process by COFEMER and public consultation. It is important to emphasize that there are no substantive changes between the 1995 regulations and

NOM-040-SCT, merely a rearrangement of the regulations to avoid legal gaps and clarify confusing language.

The only substantive change relates to the ***responsibility of carriers with regards to road damage***: while the 1995 NOM did not held the carrier responsible, the new 2008 NOM establishes that SCT will hold responsible any carrier transporting an OS/OW vehicle causing road damage, opening the possibility for SCT to seek compensation.

On July 25, 2012, SCT published comments from the public in the Official Journal (Diario Oficial de la Federación), including responses addressed by SCT regarding draft PROY-NOM-040-SCT-2-2008. The latter was officially first published in the Official Journal on April 26, 2010. The approval process is expected to continue, as corrections need to be made. Therefore, this document is still awaiting final approval and publication as of October 2012.

Appendix F: Harris County Road Law

Harris County Road Law can be seen in Figures F.1 through F.15.

HARRIS COUNTY
ROAD LAW

Compiled & Indexed by the Office of

Vince Ryan
County Attorney

Distributed By

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Figure F.1: Harris County Road Law

HARRIS COUNTY ROAD LAW
(10/17/03)

As Compiled by the Office of

VINCE RYAN
County Attorney

Explanatory Note

The *Harris County Road Law* was originally passed in 1913 as a Special Law by the 33rd Legislature pursuant to Tex. Const. art. VIII, §9. This constitutional provision authorizes the Legislature to pass local laws for the maintenance of the public roads and highways without the local notice required for special or local laws. The validity of the *Harris County Road Law* was recognized by the Court of Civil Appeals in *Hughes v. County Commissioners' Court of Harris County*, 35 S.W.2d 818 (Tex.Civ.App.—Houston [1st Dist] 1931, no writ).

In making this compilation, the original law and amendments have been set out verbatim as found in the session laws, although some inconsistency in the matter of capitalization and some typographical errors in the original bills as passed are evident.

This compilation has been made for the convenience of the office of the County Attorney of Harris County for reference purposes only. Anyone desiring the official text of any provision of the Harris County Road Law should consult the session laws of the State of Texas.

Figure F.2: Harris County Road Law

Section 1. [General purpose.]

That, subject to the provisions of this Act, the Commissioners Court of Harris County shall have control of all roads, bridges, drains, ditches, culverts and all works and constructions incident to its roads, bridges, and drainage, that have been heretofore laid out or constructed, or that may hereafter be laid out or constructed by Harris County, or under its direction. *Act of March 5, 1913, 33rd Leg., ch. 17, 1913 Tex. Spec. Laws 64.*

Section 1-A. [Regulation of discharges into drainage ditches.]

The Commissioners Court of Harris County may prohibit the discharge of sewage and municipal, recreational, agricultural, or industrial waste into drainage ditches in the right-of-way of county roads when such waste is not being discharged in accordance with a permit issued by the Texas Natural Resource Conservation Commission. The court may adopt rules to administer this section. *Act of May 29, 1983, 68th Leg., ch. 801, 1983 Tex. Gen. Laws 464; Act of May 26, 1999, 76th Leg., ch. 923, §1, 1999 Tex. Gen. Laws 3645.*

Section 1-B. [Placement of fatality markers.]

To mark the location of a traffic accident that resulted in a fatality, the Commissioners Court of Harris County may design and place a marker or other sign in the right-of-way of: (1) a county road in the county; or (2) a state, city, or other public road in the county if the Commissioners Court has the written permission of the state agency, city, or other governmental entity that has primary responsibility for maintaining the road.

Section 2. [Regulation of construction and maintenance of roads, driveways, culverts, bridges and other structures in county road right-of-way; regulation of construction, maintenance, and repair of facilities in, under, across, or along right-of-way; collection of fees; remedies.]

(a) Subject to the provisions of this Act, the Commissioners Court of Harris County shall have the power and right to adopt such rules and regulations for:

(1) the proper construction and maintenance of its roads, bridges and drainage as it may see proper;

(2) the construction and maintenance of driveways, culverts, bridges, and other structures within the county road right-of-way to provide access to and from the traveled portion of the road to property adjoining such road which may include the following:

(A) to require any individual or entity to give notice to Harris County prior to the placement, removal, or relocation of driveways, culverts, bridges, and other structures within the county road right-of-way; or

(B) to set requirements for the size, type and location of such driveways, culverts, bridges and other structures within the county road right-of-way;

(3) the laying, constructing, maintaining and repairing of pipelines, lines, mains, cables, or other public utility facilities in, under, along, across, or over the county road right-of-way by any individual or entity authorized to do so by law, which may include the following:

(A) to require notice to Harris County prior to the laying, constructing, maintaining, or repair of said pipelines, mains, cables, or other public utility facilities within the county road right-of-way; or

Figure F.3: Harris County Road Law

(B) to set minimum requirements and conditions for such laying, constructing, maintaining and repairing of such pipelines, lines, mains, cables, or other public utility facilities in, under, across, and/or along such county road right-of-way;

(4) the drainage of land into a road, road right-of-way, or appurtenant drainage facility;

(5) the collection of reasonable fees set by the Commissioners Court from any person or entity required by such rules and regulations to give notice to Harris County.

(b) Fees collected under Subsection (a)(b) of this section may be used only to defray the expense of administration of such rules and regulations promulgated by the Commissioners Court.

(c) The Commissioners Court shall further have the power from to add to, alter, repeal, or amend said rules and regulations.

(d) Any person who shall violate any provisions of any rules or regulations adopted by Commissioners Court pursuant to this section shall be guilty of a Class C misdemeanor.

(e) A county may institute a civil suit in district court against a person who violates a rule or regulation adopted by the Commissioners Court under this section. On a finding that the person has violated, is violating, or is threatening to violate the rule or regulation, the Court may:

(1) grant injunctive relief to restrain the person from engaging in or continuing the violation;

(2) impose a civil penalty payable to the county of not more than $200; or

(3) grant the injunctive relief and impose the civil penalty.

(f) When such rules and regulations are adopted, amended, or repealed, there shall be present at least three Commissioners and the County Judge. If two of the Commissioners are absent from regular weekly meeting of the Commissioners Court for as long as two days in succession, then upon the third day the Commissioners Court may, two Commissioners and the County Judge being present, act on any matter covered by this section as if three members and the County Judge were present. *Act of March 5, 1913, 33rd Leg., ch. 17, 1913 Tex. Spec. Laws 64; Act of May 29, 1983, 68th Leg., ch. 801, 1983 Tex. Gen. Laws 4643; Act of May 26, 1999, 76th Leg., ch. 923, §2, 1999 Tex. Gen. Laws 3645.*

Section 3. [Regulations recorded in the minutes of the Commissioners Court.]

Whenever any rules, regulations or course of procedure in connection with the construction or maintenance of the roads, bridges, and drains of Harris County have been adopted, they shall thereupon be reduced to writing, approved by the County Judge and recorded by the clerk in the minutes of the Commissioners Court, and shall thereafter be binding. *Act of March 5, 1913, 33rd Leg., ch. 17, 1913 Tex. Spec. Laws 64*; *Act of May 26, 1999, 76th Leg., ch. 923, §3, 1999 Tex. Gen. Laws 3645.*

Section 4. [Office of ex-officio road commissioner abolished.]

It is hereby specially provided that the office of ex-officio Road Commissioner as now provided by law is hereby abolished in the County of Harris, and from and after the final passage of this Act the several Commissioners of Harris County shall cease to act as ex-officio Road Commissioners, and their bonds as such shall be null and void; except for their official acts prior to the date of final passage of this Act. *Id.*

Section 5. [County Commissioner designated ex-officio precinct road supervisor.]

From and after the passage of this Act, each county Commissioner shall be ex-officio a precinct road supervisor, and subject to the provisions of this Act, and under the orders and supervision of the Court, shall have charge of all teams, tools, equipment and property of all kinds committed to his care by the Court for work in his precinct, and shall superintend the laying out of all work of all

Figure F.4: Harris County Road Law

kinds in his precinct, subject to such control as the Court may see fit to provide. *Id.*

Section 5-*A*. *Repealed.*

Act of May 26, 1999, 76th Leg., ch. 923, §5, 1999 Gen. Laws 3645.

Section 6. [Additional bond to be filed by each precinct road supervisor.]

Before entering upon the duties of his office, each precinct Road Supervisor shall enter into a bond, in addition to his bond as County Commissioner, in the sum of Three Thousand Dollars ($3,000), payable to the County Judge and his successors in office for the use and benefit of the Road and Bridge Fund, with two (2) or more good and sufficient sureties, who shall be either owners of unencumbered [*sic*] real estate in Harris County of the value of at least the full amount of the bond, or be a surety company having an agent in Harris County authorized by law to execute surety bonds, and having a capital stock of at least One Hundred Thousand Dollars ($100,000), or more, the bond to be conditioned that such County Commissioner in discharging his duties as precinct Road Supervisor will well and truly perform the duties required of him by law, or by the Commissioners Court, and that he will account for all County property of every kind that may come into his possession or control in the course of the discharge of his duties as such officer. *Act of March 5, 1913, 33rd Leg., ch. 17, 1913 Tex. Spec. Laws 64; Act of May 1, 1947, 50th Leg., ch. 205, 1947 Tex. Gen. Laws 358.*

Section 7. [Meetings of the Commissioners Court.]

Meetings of the Commissioners Court of Harris County must be in compliance with the requirements of all laws governing the convening of the Commissioners Court, including the open meetings law, Chapter 551, Government Code. *Act of March 5, 1913, 33rd Leg., ch. 17, 1913 Tex. Spec. Laws 64; Act of April 11, 1995, 74th Leg., R.S., ch. 25, 1995 Tex. Gen. Laws 287.*

Section 7a. [Grant of easement or right-of-way over, along, or across public road in the incorporated areas of Harris County; fixing of bond for use, occupancy, maintenance, and repair of easement.]

The Commissioners Court of Harris County shall have the power to grant to any person, firm or corporation an easement or right of way over, along or across any public road or highway, street or alley in Harris County and under the jurisdiction of the Commissioners Court of Harris County outside of the limits of any incorporated city or town. The terms or conditions under which such person, firm or corporation shall use or occupy such easement or right of way shall be specifically set forth in the minutes of the Commissioners Court, and any terms or conditions of any agreement relating thereto not so set forth shall be void. The Court may prescribe such reasonable conditions or restrictions as it may find necessary or desirable, including the charging of a reasonable compensation and the fixing of the amount and conditions of a bond or bonds to be entered into by such person, firm or corporation relating to the use and occupancy of the easement and right of way. Such bond, when executed, shall continue in full force and effect during the use and occupancy of the easement or right of way by the person, firm or corporation to whom it is granted, and shall not be affected or released by any subsequent change in the personnel of either parties to the agreement. No such easement or right-of-way shall be granted when it impedes or seriously interferes with the use and occupancy of such public thoroughfare as such; nor shall any such easement or right of way be granted without provision being made upon the part of the grantee for the protection and repair of the road or thoroughfare by suitable bond. Any grant made without such bond shall be void. *Act of May 1, 1947, 50th Leg., ch. 205, 1947 Tex. Gen. Laws 358.*

Figure F.5: Harris County Road Law

Section 8. [Removal for failure or neglect to perform duties as county commissioner or precinct road supervisor.]

It is hereby specially provided that it shall not be unlawful for any County Commissioner to engage in any other occupation or business, but should a County Commissioner, by virtue of such other business or occupation, fail or neglect to perform his duties as County Commissioner, or as Precinct Road Supervisor, he shall be subject to removal from office, in the manner provided by law for the removal of County officers. A failure to attend meetings regularly shall be grounds for such removal. *Act of March 5, 1913, 33rd Leg., ch. 17, 1913 Tex. Spec. Laws 64.*

Section 9. [Purchases.]

The Commissioners Court of Harris County shall make necessary purchases and enter into such contracts as are necessary to carry out the purposes of the Harris County Road Law.

The making of all such purchases shall be subject to all of the provisions of the general laws applying to Harris County governing the budget, accounting, approval and countersignature of warrants, depository laws and such reasonable regulations as may be made under authority of law.

Section 10. [Final accounting upon death, resignation, or retirement of officer or employee.]

Upon the death, resignation or retirement of any officer or employee, the Auditor shall require an accounting of all property of every kind of the County or its political subdivisions of which he has custody, possession, control or supervision, and shall not approve the payment of any sums to such officer or employee or his estate until such accounting is made.

Sections 11 and 12. REPEALED.

The provisions of General Laws applying to counties of the population of Harris County with respect to depositories, budgets, accounting, approval and countersignature of warrants, shall govern and control all purchases and contracts made under authority of this law, except as herein otherwise expressly provided. Eminent domain proceedings shall be governed by the General Statutes authorizing counties to institute and maintain such proceedings. *Act of May 1, 1947, 50th Leg., ch. 205, 1947 Tex. Gen. Laws 358.*

Section 13. [Taking of earth, stone, gravel, or the material for grading, construction, building, repair, improvement, or maintenance of road.]

Said Court may enter upon and take from any land adjacent to or most convenient, or accessible to any public road of said County, earth, stone, gravel or other material necessary or suitable for the grading, construction, building, repair, improvement or maintenance of such road, excepting fuel and wood, paying therefore, if the owner of the land the Court can agree on the price thereof, the value of such material so taken, and the amount of damages, if any, thereby occasioned, to such land or appurtenances; but if such owner and the Court cannot agree thereon, the value of such material and the damages, if any, may be ascertained, determined and paid, under the next preceding section of this Act, as same shall be applicable to such case. *Act of March 5, 1913, 33rd Leg., ch. 17, 1913 Tex. Spec. Laws 64.*

Section 14. [Cleaning of ditches; suit to recover costs of work and material.]

Whenever it shall be made to appear to the satisfaction of said Court that it is necessary for the better drainage of any public road or roads within said County, that the ditches along the right-of-way

Figure F.6: Harris County Road Law

of any railway company, corporation, individual, association, or the receiver thereof in said County, should be opened and cleaned out, or the bar pits along such right of way emptied and drained, said Court may by an order entered upon its minutes, at a regular or special term of the Court, require any such railway company, corporation, individual, association or the receiver thereof, whose ditches or bar pits are so constructed or so out of repair as to impede the easy and rapid flow of water accumulating on, along or near its right-of-way, to the nearest gully, ravine, creek, water course or outlet, and it shall be the duty of said railway company, corporation, individual, association or the receiver thereof, in reference to which said order is made and entered, within sixty days after a certified copy of said order shall have been delivered to any general officer of such railway company, association or corporation, or to said individual or person, or to any agent of such railway company, association, corporation, individual or person, in said County, to supply proper and sufficient drainage in the premises, and within sixty days thereafter to commence the work so ordered to be done, and to continue such work with reasonable dispatch until its completion, to the satisfaction of said court; and in the event such railway company, corporation, individual, association or the receiver thereof, shall fail to comply with the terms of said order, and shall fail to commence work within sixty days from the day of such service of such certified copy of such order, and finish the same within reasonable time, the Commissioners Court shall have said work performed, keeping an accurate account of the money expended upon said work, and the value of said work and material may be recovered from the railway company, corporation, individual, association or the receiver thereof, along whose right-of-way said work was done, at the suit of the County for the benefit of its road and bridge fund, in any court of competent jurisdiction in Harris County. *Id.*

Section 15. [Petition for a proposed road.]

Whenever there shall be filed with the County Clerk any petition for a road under any law now in force or that may hereafter be enacted, it shall be his duty at once to notify the precinct road supervisor, who shall, as early as practical, inspect the route of the proposed road, and shall make a report to the Court as to the advisability of granting or refusing said petition, or of changing the route or class of said road; and no jury of view shall ever be appointed to lay out any road until such report by the precinct road supervisor has been made, either in writing or in open court and a minute made of same. *Id.*

Section 16. [Control of construction and maintenance of county roads, bridges, and drainage.]

The Commissioners Court shall have control of all matters in connection with the construction and maintenance of County roads, bridges and drainage, except such as it may from time to time, by resolution, delegate to the precinct road supervisor, and then under such rules and regulations as it may prescribe, and subject to their recall at its pleasure. *Id.*

Section 16-A. [Control of construction and maintenance of county roads, bridges, drains, culverts, and ditches in areas annexed by municipalities.]

The Commissioners Court shall have control over all matters in connection with the construction and maintenance of all roads, bridges, drains, culverts and ditches, formerly located outside the city limits of any city, town or village, which has become a part of said city, town or village by reason of annexation of new territory and where legality of said annexation has been contested and final decision has not been determined by the Courts. Provided, that the authority herein given the Commissioners Court shall cease when the litigation over the validity of the annexation is finally disposed of. *Act of March 14, 1957, 55th Leg., ch. 27, 1957 Tex. Gen. Laws 49.*

Figure F.7: Harris County Road Law

Section 17. [Clerk of Commissioners Court.]

Should the Commissioners Court deem it advisable, it shall have the right to require the County Clerk to furnish all clerical assistance necessary to attend to the affairs of the Commissioners Court, and all clerical work connected with the official duties of the members thereof. For such clerical assistance the County Clerk shall be allowed a sum to be fixed by the Court, and this amount shall not be considered a fee of office, nor reported as such, and shall be paid out of the general fund of the County, or any other available fund. In addition to such clerical assistance furnished by the clerk, it shall be lawful for the County to employ such additional assistance as it may require. *Act of March 5, 1913, 33rd Leg., ch. 17, 1913 Tex. Spec. Laws 64.*

Section 18. [Filing and publication of monthly report by County Auditor.]

The County Auditor shall file a monthly report with the Commissioners Court, which shall include the receipts and disbursements of all the funds of the County, and the status of all budget appropriations. This report shall contain a statement of any bond or special funds which the County may have. It shall be certified to by the County Auditor and published by him once in a daily newspaper published in Harris County. *Id.*; *Act of March 1, 1927, 40th Leg. ch. 17, 1927 Tex. Spec. Laws 179; Act of March 4, 1931, 42nd Leg., ch. 15, 1931 Tex. Spec. Laws 34.*

Section 19. [Employment of road foremen, superintendents, and other employees.]

The Commissioners Court shall have full authority to employ road foremen, superintendents and such employees as it may deem proper, subject to the provisions of the General Laws with respect to budgets, accounting, depository, approval and countersignature of warrants, and certification of funds. *Act of March 5, 1913, 33rd Leg., ch. 17, 1913 Tex. Spec. Laws 64; Acts 1947, 50th Leg., ch. 205, 1947 Tex. Gen. Laws 358.*

Section 20. [Monthly reports regarding tools, machinery, supplies, and other materials used on road projects.]

Whenever any tools, machinery, wagons, supplies or other materials shall be delivered to any precinct road supervisor, road superintendent or other employee, he shall be charged by the County Auditor with same. He shall make monthly reports showing the disposition of same, which reports shall be made to the auditor and kept in a permanent file for the inspection of the finance committee and the Court, or other person interested. *Act of March 5, 1913, 33rd Leg., ch. 17, 1913 Tex. Spec. Laws 64.*

Section 21. [Laying out of road, ditch, or drain crossing any railway, canal, or levee.]

Whenever the Commissioners Court shall deem it advisable to lay out, on petition, or otherwise, any road, ditch, or drain, and same shall cross any railway, street railway, interurban railway, any canal or levee owned by any person, firm or corporation it shall have the right to do so whenever and wherever same shall be necessary, regardless of the distance to the next crossing, and, if compensation for damages cannot be agreed upon with the owner, then same shall be determined by a jury of view appointed by the Court in accordance with the law governing the laying out of roads by juries of view, insofar as the same are applicable. *Id.*

Section 22. [Maximum road width of 120 feet.]

The Commissioners Court shall have the right to lay out roads to a width of not more than one hundred and twenty feet, provided same shall connect with main roads leading into the city of

Figure F.8: Harris County Road Law

Houston. *Id.*

Section 23. [Weight limits; bond or cash deposit; remedies.]

Whenever any person, firm, corporation or individual shall contemplate, or be engaged in hauling any load or loads, which by virtue of the great weight or great number of same, are calculated to damage any paved or graded road to an extent greater than the average wear and tear to which the road is ordinarily subjected by the travel of the public, the Commissioners Court shall have the right, and it shall be its duty, to prohibit the said use of the road, or to require a bond or a cash deposit to cover damages. Any person violating such order of the Court shall be guilty of contempt, and may be punished as now provided for contempt of the Commissioners Court, and in addition shall be liable in damages to the County for all damages thus caused. *Id.*

NOTE: *See also Act of March 4, 1931, 42nd Leg., ch. 282, 1931 Tex. Spec. Laws 507* (provisions relating to regulation of weight, height, and length of vehicles codified in Chapters 621 and 623 of Tex. Transp. Code).

Section 24. [Selection of County Engineer.]

The Commissioners Court shall have the right at the first meeting after they shall be sworn in, or as soon thereafter as possible, to select a competent engineer to act as County Engineer. He shall hold office during the tenure of office of the Court by which he was elected, and shall receive such salary and shall perform such professional services as may be agreed upon at the time of his selection. A contract shall be entered into embodying the terms of his employment and signed by the said engineer, and the County Judge, and recorded in the minutes of the Court. Provided, that this contract may be made with any person, firm, or engineering corporation in like manner as it may be made with an individual, and provided further, that this shall not conflict with the terms of existing contracts, if any. *Id.*

Sections 25, 26 and 27. REPEALED.

Sections 25, 26 and 27, of Acts 1913, Regular Session, Special Laws, Page 64, Chapter 17, relating to the employment of convicts and convict labor, are hereby repealed. *Act of May 1, 1947, 50th Leg., ch. 205, 1947 Tex. Spec. Laws 358.*

Section 28. [Issuance of road bonds; County Auditor's countersignature on warrants.]

Should Harris County deem it expedient to issue bonds for the construction of lasting and permanent roads or bridges, or both, it may do so in the manner provided by the General Laws; provided, that where bonds are voted for a specific purpose, it shall not be lawful to use any funds so derived for any other purpose, unless there shall remain a surplus after the final completion of the improvements for which said bonds were voted, and the County Auditor shall not countersign warrants in payment of claims against said funds except in accordance with this Section. *Act of March 5, 1913, 33rd Leg., ch. 17, 1913 Tex. Spec. Laws 64; Act of March 4, 1931, 42nd Leg., ch. 15, 1931 Tex. Spec. Laws 34.*

Section 28-A. [Installation and maintenance of accounting system by County Auditor; County Auditor's countersignature on warrants.]

It shall be the duty of the County Auditor to install and maintain a modern accounting system and to prescribe and prepare the forms to be used by all officials and employees in keeping their accounts and in reporting receipts and disbursements of all road and bridge funds, sinking funds,

Figure F.9: Harris County Road Law

special funds, and funds from bond issues. No funds of the County shall be expended except by warrant duly authorized by the Commissioners Court, issued by the County Clerk, and countersigned by the County Auditor. The County Auditor shall countersign no warrant for the payment of any claim which has not been legally contracted. He shall have authority to require reports from all persons having charge or control of any property or funds of the County, and, in the event the County Auditor shall be unable to secure proper reports or an adequate accounting from any person or official with reference to the taxes, funds, fees, or property of the County, he shall have authority to enforce an accounting thereof, and to take such steps as are necessary to protect the interest of the County.

The County Auditor is authorized to employ such assistants and to purchase such books, equipment, and supplies as may be necessary to properly perform his duties. Harris County shall defray such expenses as may be incurred by the County Auditor in the enforcement of any duty with which he is charged under this Act. After due hearing, the Commissioners Court may make allowance for special services where such services are not required by the General Laws, and for which compensation is not prescribed. *Act of March 5, 1913, 33rd Leg., ch. 17, 1913 Tex. Spec. Laws 64; Act of March 4, 1931, 42nd Leg., ch. 15, 1931 Tex. Spec. Laws 34.*

Section 28-B. REPEALED.

Act of May 26, 1999, 76th Leg., ch. 923, §5, 1999 Tex. Gen. Laws 3645.

Section 29. [Definition of road.]

Whenever in this Act, or any general law, the word "Road", is used, the same is hereby defined to mean in so far as Harris County is concerned, all road beds, ditches, drains, bridges, culverts and every part of every road, whether inside or outside of any incorporated city or town in Harris County, or not. *Act of March 5, 1913, 33rd Leg., ch. 17, 1913 Tex. Spec. Laws 64.*

Section 30. [Investment of sinking funds.]

The Commissioners Court may from time to time invest the various sinking funds of the County not otherwise required, in its own bonds or in bonds of any district of Harris County, provided that the Commissioners Court of Harris County shall have the right to invest any of its sinking funds not otherwise required in the bonds of Harris County or of any district thereof, regardless of the maturities of the bonds to be purchased, where the interest to be derived from the bonds purchased shall be sufficient when deposited in the sinking funds of the bonds for which the investment is made to retire said bonds on or before maturity. *Act of March 5, 1913, 33rd Leg., ch. 17, 1913 Tex. Spec. Laws 64; Act of August 29, 1917, 35th Leg. 2nd C.S., ch. 1, 1917 Tex. Spec. Laws 29.*

Section 30-A. [Use of sinking funds.]

That the Commissioners Court of Harris County in the State of Texas is hereby authorized and empowered, whenever it may be deemed advisable to use any sinking funds or sinking funds now on hand or hereafter acquired for the redemption and payment of any outstanding bonds of such County or Road District therein, for the purpose of purchasing, taking up and carrying any anticipation warrants of said county now issued and outstanding; and such anticipation warrants shall thereafter be extended in time of payment or refunded by the issuance of substitution warrants payable and maturing at such time or times as such Commissioners Court may select and fix; provided that no such anticipation warrants so taken up, or substitution warrants so issued in lieu thereof, shall by their terms mature at a date subsequent to the time of maturity of the bonds for the payment of which such sinking

Figure F.10: Harris County Road Law

fund was created; provided, however, that no such anticipation warrants shall be so taken up with and by the use of such sinking fund or funds unless provision shall have been made at the time of the creation of such debt, or debts, evidenced by such warrants, for levying and collecting a tax sufficient to pay the interest thereon, if any, and providing at least two percent, as a sinking fund for the payment thereof, as provided in Article 11, Section 7, of the Constitution of the State of Texas; and provided further that provision shall have been made, or shall be made, at the time of so taking up of such anticipation warrants or the issuance of substitution funding warrants in lieu thereof, so that sufficient tax shall be levied and collected each year to provide such sinking fund for the payment of such anticipation warrants within the time that the same, or the substitution funding warrants issued in lieu thereof, shall mature, such maturity date not to extend in any event beyond the time of maturity of the bonds or other obligations for the payment of which the sinking fund being used was created, as hereinabove provided. *Act of July 19, 1919, 36th Leg. 2nd C.S., ch. 41, 1919 Tex. Spec. Laws 107.*

Section 31. [Trains remaining upon or across any public crossing.]

It is hereby declared to be unlawful for the crew on any train of any kind, or for any person in charge of same, to cause, allow or permit any train, car, engine, or part of a train, to be or to remain upon or across any public crossing, of any County road, for a longer period of time than ten minutes. By county road is meant any road used by the public and maintained at the expense of Harris County, in whole or in part. Any person who shall violate this provision shall be guilty of a misdemeanor, and shall upon conviction, be fined in a sum not less than five ($5.00) dollars, nor more than one hundred dollars ($100.00). *Act of March 5, 1913, 33rd Leg., ch. 17, 1913 Tex. Spec. Laws 64.*

Section 31-A. [Competitive bidding.]

In all cases involving any contract, purchase or requisition in connection with any road or public highway in Harris County, if any person, or corporation shall bring suit against Harris County in any Court to recover for the value of any labor, material or supplies which were delivered to or acquired by any officer of Harris County in person or through his deputy or employee without compliance by such officer, deputy or employee, with the laws and regulations governing advertising for bids, taking of proposals, or the making of contracts governing such matters, the County may implead such officer, deputy or employee, or all of then, in the suit. If recovery be had against the County in quantum meruit, or quantum valebat because such purchase, contract or requisition was void as not being in compliance with the laws governing it, then such officer, deputy or employee and the surety or sureties on their official bonds shall be jointly and severally liable for all attorney's fees, costs and expenses of every character incurred by the County or its attorneys in the defense of such suit; and in addition thereto, the claimant may plead and prove his reasonable attorney's fees and expenses incurred by him, and may have recovery thereof against such officer, deputy or employee and the sureties on their official bond; but nothing herein contained shall be construed as in anywise enlarging the liability of the County. *Act of May 1, 1947, 50th Leg., ch. 205, 1947 Tex. Gen. Laws 358.*

Section 31-B. [Contracts relating to construction of tunnels under any stream or body of water; certification of funds.]

The Commissioners Court of Harris County may enter into such contracts and agreements as it finds necessary with the United States, the State of Texas, or any officer, board or agency thereof, relating to or in connection with the construction of a tunnel or tunnels under any stream or body of water in Harris County or bordering on Harris County; and for the purpose of accomplishing the construction of such tunnel or tunnels, it may authorize the expenditure of bond funds or other funds available for the purpose. Such tunnels are hereby declared to be an essential public highway unit.

Figure F.11: Harris County Road Law

Funds may be expended at such times, in such manner, and subject to such rules and regulations as may be agreed upon between the Court and the officer or agency. All such agreements so made shall be subject to the approval of the County Auditor and his certificate that funds are or will be available for the payment when due of obligations so created. When such contracts shall have been entered into, the money pledged for such purpose shall not be expended or diverted to any other purpose during the continuance of such agreement. Such agreement may be canceled only by mutual agreement of the parties. Funds may be paid to or through the agency with whom the contract is made in installments as the work progresses. All agreements for the construction of such works and the expenditure of such funds shall be in writing and one (1) executed copy thereof shall be filed with the County Auditor as a public record. No condition or requirement of such agreements or contracts not so reduced to writing and not so filed shall be binding upon the County.

Tentative agreements or contracts between the County and the United States or the State of Texas or any agency thereof relating to the construction of such tunnels heretofore entered into by Harris County and entered in the minutes of the Commissioners Court are hereby in all things ratified, validated and confirmed. *Id.*

Section 31-C. [Road log; right-of-way with minimum of 20 and maximum of 600 feet; approval of subdivision or plat of lands in unincorporated area by Harris County and Harris County Flood Control District.]

In acquiring rights-of-way for roads in Harris County, the Commissioners Court shall determine the width of the right-of-way required, and establish the lines and alignment of the road. All of the field notes of roads so established and determined shall be filed with the Commissioners Court and be recorded on the Road Log of Harris County, and no expenditures shall be made by the Commissioners Court upon any road not carried on the Road Log. The Commissioners Court may adopt a system for carrying roads on the Road Log with the required width of the right-of-way to be established by the Court. Provided, however, no road shall be carried on the Road Log or maintained by the County on a right-of-way less than twenty (20) feet nor more than 600 feet in width unless the right-of-way was laid out or established on or after January 1, 1963. No subdivision or plat of lands in Harris County outside of incorporated cities shall be filed for record by the County Clerk of Harris County, Texas, until such plat or subdivision bears the signature of the County Engineer to the effect that the roads, as indicated on the plat, have met the requirements of the system adopted by the Commissioners Court pursuant to this Section as to the width of the right-of-way and have a base and surface of at least twenty (20) feet in width with the base and surface meeting the minimum requirements prescribed by the Commissioners Court by order duly entered in the minutes of said Court, and that all requirements of Harris County and the Harris County Flood Control District as to drainage have been complied with. *Act of March 5, 1913, 33rd Leg., ch. 17, 1913 Tex. Spec. Laws 64; Act of May 21, 1963, 58th Leg. ch. 369, 1963 Tex. Gen. Laws 940; Act of May 24, 1973, 63rd Leg,. ch. 614, 1973 Tex. Gen. Laws 1688.*

Section 31-D. [Building lines; hearing; eminent domain; protection from encroachment.]

(a) Whenever the Commissioners Court of Harris County deems that the general welfare will be promoted thereby, it is hereby authorized and empowered to establish building lines on highways and roads, or any part thereof, in Harris County, and to prohibit any new building being located within such building lines outside of the corporate limits of any city, village or incorporated town in said County. Such Commissioners Court is further authorized and empowered to regulate and to limit and to change and amend by order such building lines on such highways or roads and to prohibit any new building being located within such building lines outside the corporate limits of

10

Figure F.12: Harris County Road Law

any city, village or incorporated town within said County, subject to the provisions of subparagraph (d) hereof.

(b) Before the adoption of any plan or the establishing of building lines on any highway or road in Harris County, the Commissioners Court shall hold at least one public hearing related thereto after having given at least fifteen (15) days' notice of the time and place of such hearing by the publication thereof in a newspaper having general circulation within Harris County, such publication being at least fifteen (15) days prior to the date of the hearing. If practicable, and solely at the discretion of the Commissioners Court, each landowner affected by the establishment of such building lines shall be given actual notice by United States Registered Mail of such hearing. Any hearing so set by the Commissioners Court may be continued from time to time until within the discretion of said Court all interested persons shall have had an opportunity to be heard. After the Commissioners Court has heard all interested persons and shall have found that the establishing of such building lines is for the general welfare of the County, said Court shall pass its resolution adopting such building lines. Such resolution shall contain an exact description of the area included within such building lines by either field notes or by map or by both, and a certified copy thereof shall be filed immediately with the County Clerk of Harris County. Thereafter the Commissioners Court may, upon public hearing with like notice thereof, amend, supplement, grant exceptions thereto, or alter the building lines so established as in its discretion it may determine necessary.

(c) Upon the filing of the aforesaid resolution containing the full description of the area within such building lines, all persons shall be charged with notice of the requirements of such resolution and after the establishment of such building lines, no building or other structure shall be erected, constructed or substantially repaired, and no new building or other structure or part thereof shall be erected or re-erected within said lines so established, subject to the provisions of subparagraph (d) hereof.

(d) In case any building or part thereof is erected, reconstructed or substantially repaired, or if any person shall by an overt act or other means indicate an intention to erect, reconstruct or substantially repair any building within the area as set by such building lines, then the County Attorney, upon resolution of the Commissioners Court giving due authorization, shall institute eminent domain proceedings to acquire the area within said building lines. If eminent domain proceedings are not instituted as herein provided within ninety (90) days after written notice, either of the erection, reconstruction, substantial repair or of the intention to erect reconstruct or substantially repair any building, has been mailed properly stamped and addressed to the Commissioners Court, 1001 Preston, 9th Floor, Houston, Texas, 77002, the building lines as established shall not affect damages to be paid in eminent domain proceedings thereafter instituted to acquire said area within said building lines but such damages shall be determined and paid as though such building lines had not been established.

(e) It is the intention of this Act to give the Commissioners Court of Harris County the right to protect from encroachment those areas which in the opinion of the Commissioners Court will be necessary for future rights-of-way for highways and roads within Harris County. It is not the intention of this Act to give the Commissioners Court the power to acquire property without due process of law and without proper compensation therefore. *Act of May 14, 1953, 53rd Leg. ch. 385, 1953 Tex. Gen. Laws 924.*

Section 31-E. [Sale of property no longer needed for road purposes; execution of quitclaim deed; sale, exchange, conveyance and surrender of possession herein provided for shall be and remain in all things subject to the right of and continued use by public utility or common carrier.]

When the Commissioners Court shall determine that any real property or interest therein,

Figure F.13: Harris County Road Law

heretofore or hereafter acquired by Harris County for road purposes, is no longer needed for road purposes, the Commissioners Court shall have the power to sell such real property, or when the Commissioners Court makes such determination, at its discretion it shall have the power to exchange any such real property needed by Harris County for road purposes. It shall be the duty of the Commissioners Court to determine the reasonable market value of any such real property to be sold or exchanged and when such property is to be exchanged, to determine also the reasonable market value of the property to be received in exchange. Provided, however, when the Commissioners Court determines that such real property should be sold, it shall be sold with the following priorities:

(1) To abutting or adjoining landowners;
(2) to the original grantors, their heirs or assigns of the original tract from whence said real property was conveyed; or
(3) to the general public at public auction, notice of which sale shall be advertised at least twenty (20) days before the day of sale, by having the notice thereof published once a week for three consecutive weeks preceding such sale in a newspaper of general circulation in Harris County.

All monies derived from sales of such real property shall be deposited to the credit of the Road and Bridge Fund of Harris County.

When the right or interest of Harris County in any real property consists only of an easement or right-of-way for road purposes and the Commissioners Court determines that such property is no longer needed for road purposes, the Commissioners Court shall have the power to authorize execution of a quitclaim deed relinquishing all right and title and interest of Harris County thereto to the owner of the fee of such property. Whenever any real property or interest therein owned by Harris County and sold or exchanged and conveyed hereunder is being used by a public utility or common carrier having the right of eminent domain for right-of-way and easement purposes, the sale, exchange, conveyance and surrender of possession herein provided for shall be and remain in all things subject to the right and continued use of such public utility or common carrier. *Act of May 22, 1967, 60th Leg., ch. 244, 1967 Tex. Gen. Laws 557.*

Section 32. [Conflicts of interest; criminal penalty.]

It shall be unlawful for any member of said Commissioners Court, or for any County officer of Harris County, to be or become financially interested, directly or indirectly, in any contract with said County, for road work, or for the purchase or sale of any material or supplies of any character, or in any transaction whatever in connection with any of the business of said county, excepting only his own salary, fee, or per diem. If any such County Commissioner, or such County officer, shall willfully violate any of the foregoing provisions of this Section, he shall be deemed guilty of malfeasance in office, and upon conviction thereof, shall be punished by a fine of not less than $500.00, nor more than $1,000.00, or by imprisonment, in the County Jail of said County, for not more than one year, or by both such fines and imprisonments; and in addition thereto, shall be forthwith removed from office. *Act of March 5, 1913, 33rd Leg., ch. 17, 1913 Tex. Spec. Laws 64*; *Act of May 26, 1999, 76th Leg., ch. 923, §4, 1999 Tex. Gen. Laws 3645.*

Section 33. [Cumulative effect of laws.]

The provisions of this Act are, and shall be held and construed to be cumulative of all General Laws of this State, on the subjects treated of in this Act, when not in conflict.

Figure F.14: Harris County Road Law

BOND COVERING OVERSIZE, OVERWEIGHT, OVERLENGTH AND OVERHEIGHT LOADS OVER HARRIS COUNTY ROADS

STATE OF TEXAS § BOND NO. ____________________
§
§ KNOW ALL MEN BY THESE PRESENTS:
§
COUNTY OF HARRIS §

That we, ____,

of ____as Principal,

and, ____as

Surety, are held and firmly bound unto Harris County, Texas, in the penal sum of

____

($ ________________________________) Dollars, to the payment of which, well and truly to be made, we hereby bind ourselves, our heirs, executors, administrators, and assigns.

The conditions of the above obligation is such that the Principal will make payment to Harris County, Texas for any and all damages that may be sustained to any highway or bridge as a consequence of the Principal's operation of any vehicle or vehicles or equipment the operation of which on such highway or bridge requires the presentation of a bond or cash deposit pursuant to the order of Commissioners Court of Harris County under Section 2 of TEX. REV. CIV. STAT. art. 6701d-11, as amended, and /or Section 23 of the Harris County Road Law, ch. 17, §23, Acts 1913, 33rd Leg., Regular Session.

Now, therefore, if the Principal shall pay to Harris County, Texas any and all damages for which the principal is obligated hereunder, then this obligation shall be null and void, otherwise to remain in full force and effect.

Dated this ___________ day of _______________________, A.D. 20 ______.

APPROVED:

____

County Judge

____

Principal

By________________________

Title: ____________________

____

Address

____

City, State, Zip

____

Phone No.

____

Surety's Name

By: ____________________

Attorney-in-Fact

____

Address

____

City, State, Zip

____

Phone No.

P:\FORMS\Applications Receiving Area\Oversize Overweight Bond Form.doc 30 August 2006

Figure F.15: Harris County OS/OW Bond Form

Appendix G: City of Fort Worth City Code, Part II, Chapter 22 Article IV: Truck Traffic

22-117. - Vehicle restrictions.

(a) Except as otherwise provided in this article, it shall be unlawful for any person to drive, operate or move, or to cause or permit to be driven, operated or moved, on any public street within the city, any commercial motor vehicle with or without load, contrary to any of the regulations contained in this section.

(b) Commercial motor vehicles shall be subject to the vehicle width, length and height limitations and restrictions which are delineated in Vernon's Texas Civil Statutes, Article 6701d-11, section 3.

(c) No commercial motor vehicle, truck-tractor, trailer, semitrailer nor combination of such vehicles shall be operated or caused or permitted to be operated upon any public street within the city having a weight in excess of any one or more of the following limitations:

(1) In no event shall the total gross weight, with load, of any vehicle or combination of vehicles, exceed eighty thousand (80,000) pounds.

(2) No axle shall carry a load in excess of twenty thousand (20,000) pounds. An axle load shall be defined as the total load transmitted to the road by all wheels whose centers may be included between two (2) parallel transverse vertical planes forty (40) inches apart, extending across the full width of the vehicle.

(3) The total gross weight concentrated on the highway surface from any tandem axle group shall not exceed thirty-four thousand (34,000) pounds for each such tandem axle group. Tandem axle group is defined to be two (2) or more axles spaced forty (40) inches or more apart from center to center having at least one common point of weight suspension.

(4) Vehicles used exclusively to transport ready-mix concrete may be operated upon the public streets of the city with a tandem axle load not to exceed forty-four thousand (44,000) pounds, a single axle load not to exceed twenty thousand (20,000) pounds and a gross load not to exceed sixty-four thousand (64,000) pounds. Before any vehicle used exclusively to transport ready-mixed concrete with a tandem axle load in excess of thirty-four thousand (34,000) pounds may be operated upon the public streets of the city, the owner thereof shall file with the office of consumer affairs a surety bond in the sum of fifteen thousand dollars ($15,000.00). Such bond shall be conditioned that the owner of such vehicle will pay to the city all damages done to the public streets and highways by reason of the operation of such vehicle with a tandem axle load in excess of thirty-four thousand (34,000) pounds.

(5) A limit is placed on the amount of load which may be carried by vehicle tires, according to the width in inches of the tires, as follows:

a. 650 pounds per inch for low pressure tires;

b. 600 pounds per inch for high pressure tires.

(d) The provisions of this section shall not apply to:

(1) Any person operating or causing to be operated a motor vehicle under a valid and subsisting permit for the operation of overweight or oversize equipment for the transportation of such commodities as cannot be reasonably dismantled issued by the state highway department under the provisions of article 6701a of the Revised Civil Statutes as such article now exists or might from time to time be amended;

(2) Emergency vehicles operating in response to any emergency call;

(3) Vehicles operated for the purpose of constructing or maintaining any public utility in the city.

(4) Vehicles used exclusively to transport solid wastes, as defined in Vernon's Texas Civil Statutes, may be operated in accordance with article 6701d-19a of that statute.

(5) Vehicles used exclusively to transport milk may be operated in accordance with article 6701d-12a of Vernon's Texas Civil Statutes.

(e) The permits referred to in subparagraph (d)(1) of this section shall be subject to the following:

(1) Upon written application timely made by any person who desires to operate or cause to be operated on the public streets within the city, overweight or oversize equipment for the transportation of such commodities as cannot be reasonably dismantled, where the total gross weight or size of the vehicle and its load exceed the limits allowed by this section, the office of consumer affairs, after consulting with the public works department, shall issue a permit for the operation of such equipment or fleets of equipment for a specified period of time, over a route or routes to be designated by the public works department, if such routes can be determined at the time application for the permit is made.

(2) The application for the permit provided for in this section shall be in writing and contain the following:

a. The kind of equipment to be operated, with a complete description of same and a statement as to its weight.

b. The kind of commodity to be transported and a certificate as to its weight.

c. The street or streets over which the equipment is to be operated, and the date or dates and the approximate time of the operation, and the number of trips to be made, except when the nature, route, time or frequency of operation cannot be determined at the time the permit is issued.

d. d.The application shall be dated and signed by the applicant.

(3) Before a permit is issued under this section, the applicant for the same shall file with the office of consumer affairs a bond in an amount to be set and approved by the public works department. The amount of such bond shall not exceed the product of the number of vehicles for which a permit is sought multiplied by fifteen thousand dollars ($15,000.00), which bond shall be payable to the city and conditioned that the applicant will pay to the city the sum of money necessary to repair any damage which might be occasioned to any public street or publicly owned fixture appurtenant to such street by virtue of operation of any commercial vehicle under such permit. Venue of any suit for recovery upon the bond shall be in the county and any bond issued hereunder shall contain an unambiguous contractual provision to that effect.

(4) A fee shall be charged for each permit as follows:

a. a. Overweight load, single-trip permit only: $20.00

b. b. Oversize load:

1. Single-trip $20.00
2. Not to exceed 30 days 45.00
3. Not to exceed 60 days 60.00
4. Not to exceed 90 days 75.00

(5) Any permit issued hereunder shall include at least the following:

a. a. The name of the applicant, the date, a description of the equipment is to be operated and a description of the commodity to be transported.

b. b. The signature of an authorized member of the police department and the public works department.

c. c. The time for which the permit is issued.

d. d. The specified street or streets over which the equipment is to be operated, insofar as it can be determined at the time the permit is issued.

(Code 1964, § 26-80; Ord. No. 7887, § 1, 2-27-79; Ord. No. 9983, §§ 1—6, 10-13-87; Ord. No. 10012, § 1, 11-24-87)

Appendix H: Industry Forum Invitation

March 8, 2012

Specialized Carriers and Rigging Assoc
2750 Prosperity Ave., # 620
Fairfax, VA 22031
Dear Mr. Ball:

Oversize/Overweight Vehicle Permit Fee Study
The 82nd Texas Legislature required the Texas Department of Transportation (TxDOT) to conduct a study to evaluate the increased pavement and bridge consumption by oversize and overweight vehicles (OS/OW)—including, exempt overweight vehicles carrying loads such as agricultural products, solid waste or recycled materials, ready mix concrete, and milk. The study also requires TxDOT to provide recommendations for permit fee and fee structure adjustments to the Governor and the Legislative Budget Board by December, 2012. TxDOT commissioned the Center for Transportation Research (CTR) at the University of Texas at Austin to undertake this study.

As part of this study, CTR is hosting a one-day Industry Forum to:

- discuss the study objectives and analysis approach with industry; and,
- solicit input from those that may potentially be impacted by permit fee changes.

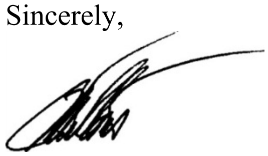
The one-day Industry Forum is scheduled for Thursday, March 29, 2012 from 10:00 am to 3:30 pm at:
The AT&T Conference Center
University of Texas at Austin
1900 University Avenue | Austin, Texas 78705
www.meetattexas.com

Please RSVP to loftusotway@mail.utexas.edu by March 25, 2012.

There is NO COST for attending the event. Attendees will receive a $5.00 discount if parking at the underground, attached garage of the AT&T Conference Center.

Finally, if you have any questions or concerns, please do not hesitate to contact Jolanda Prozzi at jpprozzi@mail.utexas.edu or 512 232 3079 or Lisa Loftus-Otway at loftusotway@mail.utexas.edu or 512 232 3072.

Sincerely,



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Appendix I: Workshop Agenda

Agenda

Trucking Industry Forum
Draft Agenda

Thursday, March 29, 2012
Austin, Texas

9:30 - 10:00 Arrival and Registration

10:00 - 10:30 Welcome/Introductions/Study Objectives
(Mr. John Barton, Ms. Wendy Reilly, and Ms. Carol Davis)

10:30 - 12:00 Presentations/Remarks

- Industry Forum Objectives and Format *(Dr. C. Michael Walton)*
- Texas' OS/OW Permit Fees: An Overview *(Dr. Mike Murphy)*
- Pavement Consumption Analysis Method *(Dr. Jorge Prozzi)*
- Bridge Consumption Analysis Method *(Dr. José Weissmann)*
- Cost and Revenue Analysis *(Ms. Jolanda Prozzi)*

12:00 - 1:00 Lunch*

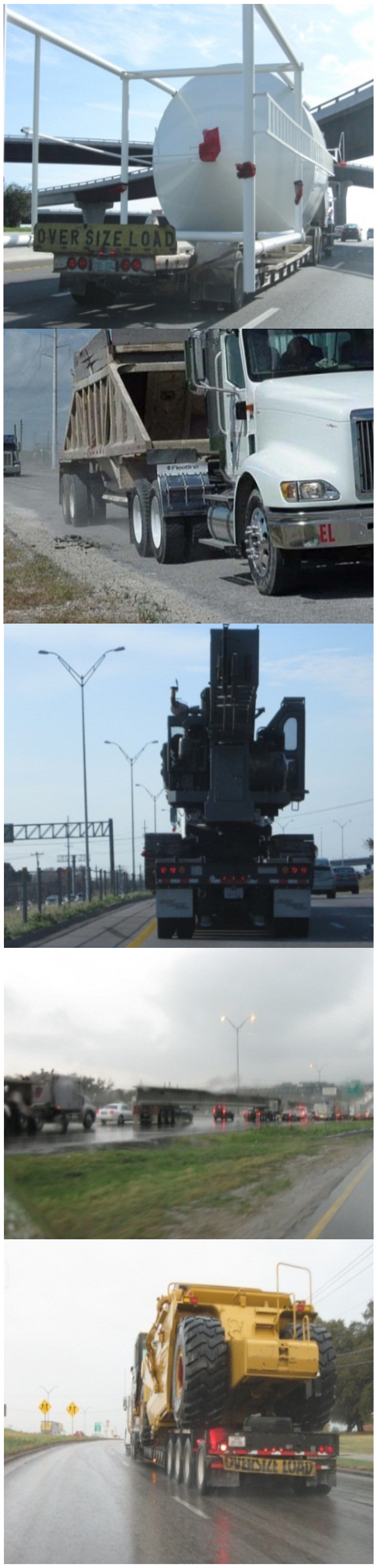
1:00 – 3:00 Discussion

1) Missing Study Elements/Components and Comments
2) Impact of Texas' Road Conditions on Industry Costs
3) Balancing Overall Impacts of OS/OW Loads and Road Maintenance
4) Considering Exempt Loads in a Potentially Revised Permit Fee Structure
5) Given Maintenance Backlog and Insufficient Revenue Stream—How Should Users Pay for System Use?

3:00 – 3:30 Administrative Matters

3:30 Adjourn

* Break/Lunch Sponsors - Texas Motor Transportation Association (TMTA), Association of Energy Service Companies (AESC), Associated General Contractors (AGC)
* Break/Lunch Hosts - Texas Logging Council (TLC), Texas Farm Bureau (TFB), Texas Forestry Association (TFA)



Appendix J: Overview

TxDOT Research Project 0-6736
Rider 36 Oversize and Overweight Vehicles Study

The 82nd Texas Legislature required the Texas Department of Transportation (TxDOT) to conduct a study to evaluate the increased pavement and bridge consumption by oversize and overweight vehicles (OS/OW), including exempt overweight vehicles carrying loads such as agricultural products, solid waste or recycled materials, ready mix concrete, and milk. The study also requires TxDOT to provide recommendations for a permit fee and fee structure adjustments to the Governor and the Legislative Budget Board by December 2012. TxDOT commissioned the Center for Transportation Research (CTR) at the University of Texas at Austin to undertake this study.

TxDOT, like many State DOTs, is increasingly challenged by inadequate funding from traditional federal and state fuel taxes, permit fees, and other ad-hoc fees used to maintain and add capacity to the transportation network. These traditional funding sources have not increased with inflation and, given increasing maintenance and construction costs and fuel-efficient vehicles, have become largely inadequate. In Texas, the 2030 and 2035 Committee Reports have pointed to significant deficits and an increasing gap between available funding and increasing maintenance and capacity needs.

The primary objectives of this study are to evaluate pavement and bridge consumption by OS/OW vehicles by:

1. Evaluating current OS/OW activity (for both permitted and unpermitted loads) and routes to calculate the costs attributable to each vehicle configuration;

2. Developing and implementing an analysis framework of the bridge cost responsibilities of OS/OW loads by modeling bridge life consumption induced by permitted loads;

3. Assessing other cost elements associated with road safety and damage to appurtenances; and

4. Developing an approach to analyze future OS/OW activity and to calculate overall costs.

The outcome of this study will be recommended permit fees and fee structure adjustments to compensate for highway and bridge consumption of Texas's road infrastructure.

Any input or insight would be greatly appreciated and can be shared with the Principal Investigator, Dr. C. Michael Walton, at cmwalton@mail.utexas.edu or the Co-Principal Investigator, Dr. Jorge Prozzi, at prozzi@mail.utexas.edu

Appendix K: Workshop Roundtable Discussions

Table 1

Facilitator: Dr. Mike Murphy
Note Taker: Pedro Serigos

Attendee A: Can you explain the difference between TTI and CTR to me? TTI is more technical, right?

Facilitator: No, actually, the basic difference between TTI and CTR is that TTI is a state agency just as TxDOT is a state agency, which means they have a legislative appropriation of somewhere between $10 and $15 million per year. CTR is not a state agency, and therefore, its funding comes solely from research projects it wins through competitive proposals. In fact, that is the same situation for all other state universities with transportation programs, like UT–El Paso, UT–Arlington, Texas Tech, etc. We feed our graduate students and pay for operations through research projects we win, whereas TTI gets $15 million up front and then also competes for research projects.

Attendee B: I didn't realize TTI was a state agency.

Facilitator: But going back to your question, there are areas of technical expertise at TTI and UT–CTR—some expertise is in the same areas—but the expertise is related to people. For example, Jorge Prozzi is an expert in flexible pavements. The TxDOT system is composed of 93 percent flexible or asphalt pavements and 7 percent Portland cement concrete or rigid pavements. Therefore, Jorge's expertise in flexible pavements relates to the vast majority of the types of pavements on the TxDOT network. Dr. Moon Won at Texas Tech is an expert in Portland cement concrete pavement; Dr. Won used to work at UT–CTR but moved to Texas Tech. Although concrete pavements are a smaller percentage of the total system, they are primarily located in high traffic urban areas and therefore are very important in terms of traffic volume that is carried. They cost more to build upfront, but there are longer periods of time in between maintenance actions, so we don't have to close the road down as often. However, the cost to rehabilitate a concrete pavement may be high when time comes to do repairs.

In any case, the point I was trying to make is that there are experts that work at both UT–CTR and TTI. Some are experts in the same area, and others have expertise that is unique. Sometimes CTR and TTI will team up to conduct research, and other times we compete with each other. The same is true regarding other universities in Texas.

It's time for us to get started talking about the five questions we need to discuss this afternoon.

Attendee A: Solid waste operators travel as much on city streets and county roads as on the state highway system. Our industry has discussed the idea of creating an escrow account in certain regions to help develop or maintain the transportation infrastructure, since county roads in particular are in poor shape and they don't have the money to address their problems. However, we discussed this idea with the Governor's office and they did not support the idea.

Attendee C: Actually, we travel county roads as well, and it's the county roads that are in bad shape. If the OS/OW permit fees are going to be increased, some of that money needs to go to the counties. How will you ensure that happens?

Facilitator: The 2060/1547 permits are set up to allocate funds to TxDOT and the counties. When a 2060/1547 permit is purchased, the buyer indicates which counties they plan to operate in. The cost of the permit is related to the number of counties designated. The portion of the fee that is related to counties accrues to General Revenue, and that money is then distributed to each county based on the number of permits that designate a given county.

Attendee C: They must not be getting much from those permits though, or they are not spending it on the roads.

Attendee A: I would like to add that though we were trying to think of solutions for funding county transportation projects, we would want to see this money managed by the state, not the counties. There are too many "good old boy" deals we already have to face.

Facilitator: What do you mean?

Attendee D: For example, a county will come to me and say a bridge rail has been damaged. Your trucks are the biggest that travel that route, so it's your trucks that did the damage. Repairing the damage will cost $X; however, instead of giving us the money, we will take (a load of gravel or some other item the county needs). We don't have a way of disproving their claim…there's a lot of that that goes on.

Attendee D and Attendee E: Also, your (research team's) idea about possibly keeping fees the same or even lowering them if an axle was added would not always work for our industry. For example, when we bid a contract for some cities or towns, we are required to provide trucks with a single rear axle. The city mayor believes that a single axle does less damage to their roads and bridges than a tandem axle. I've tried to explain that we do less damage when the load is spread over two axles, but the mayor just doesn't understand.

Facilitator: It sounds like we need a public education process to help cities understand truck axle damage relationships.

Attendee D: Here is a picture of a drop axle I can add to the back of a garbage truck, which would help us meet the bridge formula requirements. That axle would cost me $50,000.

Facilitator: What is this air lift able tag axle that's just behind the cab?

Attendee D: That's a load bearing steerable axle.

Facilitator: You mean this garbage truck has twin steer axles?

Attendee D: No, the axle isn't steerable like the front axle, but it does track the movement of the steering axle as the wheels turn. That's one of the types of damage that counties complain about from garbage trucks—scrubbing of our tandem axle tires on their residential streets when we make turns.

Attendee E: Another thing I don't understand (is that) every state has different weight regulations regarding operation of garbage trucks. The same truck I run in Texas at 55,000 lbs. GVW I can run in Maryland at 70,000 lbs. Whatever type of roads they build up there, we need to build down here.

Attendee D: That's right. In Louisiana, I can run 106,000 lbs. off the Federal System without a permit.

Attendee E: The Texas weight regulations mean that I can't fill my truck to full capacity. I could actually haul 66,000 lbs. GVW.

Facilitator: So if a permit was developed that allowed you to run at a higher weight limit—to the capacity of your trucks—you would be more open to considering it?

Attendee E: I'm not going to say we are in favor of permits, since we're currently exempt, but I would certainly consider a permit more favorably if it allowed me to run at full load capacity.

Facilitator: Even if you could carry more load, wouldn't you still have to operate the same number of trucks? It would seem that the routes would stay the same, so you'd still have to have the same number of trucks to cover all routes.

Attendee E: No, I'd be able to figure out how to run my routes so that I covered all my customers running fewer miles and with less trucks. If I could haul more in each truck, I'd run less trucks, which would save me money.

Attendee C: It seems that on super-heavy loads, the big focus is on the trailer tire loads, but that's not what causes the damage; it's the drive axles on the tow vehicle. If I add a push truck to a super-heavy load, that will decrease the amount of damage that the pull truck will create due to the traction forces of the pull truck's drive axles, which is better for the road. But if I add a push truck, that might put me over the 500,000 lb. GVW limit and increase my permit cost and the amount of time to get the permit. So even though adding a push truck would reduce pavement damage potential, it would cost me more money, so I go with a pull truck only.

Facilitator: We are interested in knowing other ideas like this that could help reduce damage and at the same time help improve your profitability or business operations.

Attendee E: Well, another problem I have is there is a load-zoned bridge on a route which is the only access to a residential area. If the OS/OW permit fees could help eliminate that load-zoned bridge, I could bid to provide service to that community. As it is, I can't drive my trucks over that load-zoned bridge, so I can't bid for that service.

Attendee C: There is a route I could travel to carry some of my mid-heavy loads. However, the route includes a fly-over ramp, which can carry the load, but it's a one-lane ramp. I can't take that route because of geometric issues. It would be nice if someone thought of the size of the heavier loads when designing the system.

Another example is an FM road that "T's" into another FM road—if I'm running a super-heavy load, I can't make that turn without knocking down fences, placing boards, and plywood over the ditches and maybe cutting some trees down. Again, the geometrics are the problem, not the road condition itself.

Attendee C: If we pay more for our permits, how can you assure me that the money is going to go to maintaining pavements and bridges?

Facilitator: You are right, if the permit fees are increased, there needs to be accountability within TxDOT to ensure that the money is used to maintain the network or possibly address some of the issues you've raised about load-zoned bridges or improved geometrics.

Attendee C: Do they load-zone a road because it has a load-zoned bridge on the route?

Facilitator: No, there are about 660 load-zoned bridges on the state system—that's about 660 bridges out of 50,000. However, there are about 16,500 miles of load-zoned roadway out of

80,000 miles of state road. So there are a lot more load-zoned roadways than there are load-zoned bridges.

These pavements were load-zoned back in the late 1950s when the federal government announced they were going to raise the national load limit to around 74,000 lbs. Since these roads had been designed to 58,420 lbs., which was the legal load limit at that time, the state load posted all of the newly build FM roads to protect the system they had just built.

Facilitator - I'm interested in the idea Attendee A mentioned about setting up a bond to pay for infrastructure improvements, which is then repaid through tax incentives.

Attendee A: It's not a bond, it's an escrow account that different industries can pay into to help create the revenue needed to address road and bridge needs in an area. The money can be used to address needs now in return for reduced taxes or other incentives in the future. The advantage is that the businesses get use of the infrastructure now, the government gets the money it needs without raising taxes, and the businesses get a tax break at some point in the future. But like I said, the governor's office doesn't support this idea.

Attendee E: You asked about how the highway system might affect increased maintenance costs on our trucks. Actually, I'm running off the state paved road system much of the time in a landfill or on county roads; if I'm on a paved state road, I've got no problems. The state road system is good compared to some of roads I have to travel.

Attendee D: You also asked if we relate road conditions to the cost of our operations or if our customers consider road conditions as a factor.

We don't think in terms of miles per gallon when running a garbage truck. Actually, since our operations are stop and go, we are idling most of the time. We think in terms of gallons per hour.

Attendee C: Yeah, and I think in terms of gallons per mile, not miles per gallon when running mid-heavy and super-heavy loads. As far as the state road system is concerned, I am concerned about the condition of FM roads especially if there are ruts or no shoulders (or) if the pavement edge has drop offs.

Attendee D: That is a problem, but I will say that Texas has more paved shoulders that any other state we operate in.

Attendee C: I'm not just concerned about the wheel tracks and edge problems due to my operations, but my daughter drives on those same roads.

Attendee A: Yes, if a truck gets caught in those wheel tracks, it can throw them right into the path of a vehicle traveling in the other lane. Safety of the system is an issue.

Attendee F: I think you need to generate a longer list of people contributing to the needs. If you have a lot of people contributing a little bit, it's a lot better than just a few people trying to cover the costs.

Facilitator: With that in mind, the current state gas tax is 20 cents a gallon, and the last time there was a state gas tax increase was 1991. Five cents of the state gas tax goes to the school fund and five cents to repay debt. The remaining 10 cents goes to TxDOT to pay for transportation needs. If there was a 10-cent-a-gallon gas tax increase, that would generate $1 billion in revenue. That would be an equitable way to generate revenue, because everyone who drives a vehicle would be contributing.

Attendee F: But right now is not the time to be discussing a gas tax increase—not with the price of fuel as high as it is. I agree that it's equitable in that everyone contributes.

Attendee F: I know one independent trucker who said he grossed $168,000 last year, but half of that went to fuel. He said if the price of fuel goes any higher, he's going to sell his truck.

Attendee D: We are considering moving to LP gas for our fleet. There will be a cost involved in outfitting each truck, and we will also have to develop the infrastructure to fuel our fleet with LP gas, but we've calculated that we can save about $9 to $10 per hour per truck burning LP gas — that's a substantial savings. Garbage trucks operating with LP fuel do weigh more when they are empty though.

Attendee F: Has your (research) team considered taxing alternative fuels or fuels that currently aren't taxed? How is LP gas taxed?

Attendee D: There is a gas tax equivalence applied to LP gas. But there's red diesel that isn't taxed.

Attendee F: But red diesel is primarily used for off-road equipment. That wouldn't affect pavement conditions.

Attendee F: Going back to Attendee E's comment about the capacity of their garbage trucks — the water trucks we use to service oil wells can carry up to 135 barrels. However, we can't run our trucks at capacity due to the permit load restriction. We think there is a safety concern with running our trucks partially empty due to turnover potential with fluid sloshing around inside our tanks. If we could run at capacity, that would help us reduce truck loads and improve our efficiency. Our trucks run at about 10 percent below capacity.

Facilitator: What load do you currently carry running at partial capacity?

Attendee F: It depends on what type of fluid that is being hauled. If we are carrying saltwater, that's about 7.9 lbs. per gallon. But we sometimes carry fluids, which contain a lot of sediment, which can weigh as much as 20 lbs. per gallon. We typically run between 100,000 to 120,000 lbs.; that's with 115 to 120 barrels.

Facilitator: Do you think that there would be an impact on your operations or your customers if permit fees were increased?

Attendee C: Well, of course. We will have to pass the increase on to our customers.

Facilitator: Do you think that an increase in the permit fee could cause some customers to move to another state?

Attendee D: Well, I can't move to another state—I haul people's garbage.

Attendee C: It depends on how much of an increase you're talking about. I will say that there are heavy loads that dock at Houston instead of New Orleans because of the huge heavy load fees that Louisiana has. A super-heavy load permit in Louisiana can cost $10,000 or more.

Facilitator: So you're saying that depending on how much of an increase in permit fees might occur in Texas, some customers might choose to off load in another state.

Attendee C: Yes, depending on how much the permit fee increases. It's amazing how much super-heavy load fees vary from state to state. I move exactly the same load with the same configuration from Missouri to Kansas to Oklahoma to Texas, and the fees range significantly. I like Kansas: a super-heavy load permit costs $15. However, if you go to Missouri, the same load might cost $1,500. Texas has their permits priced about right, but I do remember when a super-heavy load permit in Texas cost $21.

Facilitator: You've said that you think a ton-mile permit fee would be fair.

Attendee F: Yes, as long as everyone is on a level playing field and treated the same.

Attendee A: That's a good point. It seems that whoever is doing good economically is the one everyone goes after when money is tight. Right now, oil and gas is doing good, so everyone thinks that getting more money from the oil and gas industry is the way to go. However, although there might be a lot of oil and gas trucks operating in the Eagleford Shale formation, there are other types of trucks running those roads as well. Aggregate haulers—

Attendee D:—and our garbage trucks.

Attendee A: —So the cost should not be borne by whoever is doing well financially at the time. Everyone using the road should help pay for it.

Facilitator: Well, I can tell you that a pavement can't tell the difference between a pound of milk or a pound of something else. So the analyses that Jorge and Jose are looking at are strictly load and effect on pavement or bridge consumption. The type of load is not a factor as far as the analysis is concerned.

Another point I wanted to make during the general session, but didn't—I'll say it now: even though MCD has provided us with information about load configuration and axle loads and routes for our analyses, we have not been given any private information about who the mover or company is for the loads.

Attendee B: What about the motor carrier registration fee—that's only $10?

Attendee A: What about the vehicle registration fee? I know if the vehicle registration fee is only raised by $2 people get upset. But if the vehicle registration fee was increased, that would be equitable. Everyone would pay.

Facilitator: What about the 18-wheeler registration fee? Texas registration fees are around $800 to $900. If you look at the average 18-wheel registration fee in the Western AASHTO states, it averages around $1,350.

Attendee F: Again, I think it would be better to come up with a lot of ideas for raising money that costs a little bit and spread it around so that you get the money you need from lots of sources.

Facilitator: Going back to the ton-mile fee idea mentioned a few minutes ago, Attendee E said that he thinks that the permit fee should consider the fact that his truck runs empty part of the time, partially loaded part of the time, and is fully loaded part of the time. However, he doesn't know at any point what his truck weighs.

In order to have an equitable ton-mile fee charge, would you be willing to have a GPS-enabled device in your vehicle that could record your route and, if we could include a load measuring device, would also measure load. It would be somewhat like a toll tag. You would be charged only for the mileage you travel at or above the legal load.

Attendee C: I don't think many in our industry would go for that.

Attendee F: Would everyone have a device like that in their vehicle? Again, if there's a level playing field, and everyone is charged the same way for usage of the system, that would be more equitable. Even though the ton-mile fee would be equitable, it should not be the only source of revenue for the system—only one among several sources.

Attendee C: Mississippi has a ton-mile permit fee system I think is fair. They charge five cents for each 1,000 lbs. over 80,000 lbs. per mile. Oklahoma has a similar system, but they start charging at 90,000 lbs.

Facilitator: The first question we discussed was whether the study is leaving out some factor or idea that should be considered. Is there some aspect of your operation, a cost or other considerations, we should think about?

Attendee C: As far as the cost of moving heavy loads, I have a lot of coordination I have to do to move a load. The last load I moved had eight bucket trucks from different little communities following behind me in a train. Each one was there to raise the wires in their community. Even though a community only had one wire to move, one of the other communities couldn't move it for them; they had to be there to move it. It cost me $75,000 just in bucket trucks and escort fees to move that load.

Attendee E: Enforcement fees.

Facilitator: What do you mean?

Attendee E: If DPS pulls one of my trucks over, weighs it, and it's overweight, that costs $500 the first time. If they pull the same truck over two weeks later and it's overweight, the second offense increases to $1,500. DPS enforcement fees are a part of our business cost.

Attendee E: The problem is, I don't know when my trucks are overweight, so that makes me wonder how your study is going to figure out what exempt loads should be paying. How are you going to determine what our weights are?

Facilitator: The exempt loads are going to be an issue. We can know how many of a certain type of truck is registered in the state by going to DMV—for example, how many garbage trucks or how many ready mix or concrete trucks. However, we can't know where those trucks are operating or how many miles they are traveling.

Attendee E:—Or how much they weigh. Or when they are actually operating empty.

Attendee C: That's a good point. I have to buy a permit for my super-heavy load rig just to move it empty from one location to another. It might cost me $1,000 to move my super-heavy load rig empty.

Attendee C: I said that Louisiana's permit fees were high, but one thing I will give them: if I travel into Louisiana with a permit and stop at the first weigh station to be weighed (and) if it turns out that I'm overweight, they will just make me pay the difference between the permit I have and the cost of a permit I need at the higher weight. They don't charge me a fine for running overweight in addition to the extra fee.

I typically add some percentage to a load because the customer may not be exactly sure how much it weighs.

Attendee C: Going back to Kansas—I love Kansas—it takes me half a day to get a super-heavy load permit. However, it might take two weeks or longer to get a permit in Texas. I know part of that time is involved in doing your bridge analysis —

Attendee B:—and the bridge analysis for routes is done by a consultant, not by TxDOT.

Attendee C:—but the point is, if you can do something to speed up the process of getting a permit, that would be a big help. Attendee B, you're doing a great job. I love TxPROS, but getting a permit faster would be a big help to our business.

Attendee C: Another thing I don't understand about our loads: I've got trunnion axles on my rig, and I'm often running at tire loads much lower than what the legal load limit allows. I'm quite often at 500 lbs/inch or less. So if my tire loads are lower, I should be doing less damage than a truck with higher tire loads, right? Can you explain that to me?

Facilitator: As I mentioned, I've been involved in a number of super-heavy load move analyses, and I can tell you what I've seen and what has been measured with instrumentation. Are you running goldhofer trailers? (*Yes*) Although you may calculate that the load is equally distributed across all your lines and tires, in actuality, because a road, and in particular an FM road, often has a roof top crown, the applied load shifts to the center of your trailer and is much higher for the tires in the center than at the edge. We've seen super-heavy loads create rutting as we walked along with the load due to this condition. We knew the road wasn't strong enough to carry the load, but the FM road was the only route the load could take. The mover and TxDOT knew that going in. But the point is that the loads are only equally distributed across each line and tire when the load is symmetrical and when the load is sitting level on a level pavement.

Attendee C: I would like to invite you to visit Palletized Trucking, and I'll show you that our hydraulically controlled system does equalize the load across all the tires.

Attendee B: Gentlemen, I will ask you to take your discussion outside. It's getting way too technical.

Facilitator: I agree. I didn't intend to get off into the technical details.

Attendee B: Yes, you did.

Attendee C: Have the researchers looked at what other states do in terms of oversize/overweight permit fees?

Facilitator: Yes. In particular, we've looked at Washington State, Oregon, and Minnesota, since they have charts which have been developed that relate the cost per mile based on the weight carried.

Attendee F: You are going to have to do a lot of upfront work with the industry to get them on board with the idea of raising permit fees. When I go back to my group, they are going to ask me three questions:

- How much is it going to cost me?
- What do I get out of it?
- When do I get it?

Facilitator: I know I've raised this question a couple of times now about how road conditions affect your operations, but I'd like to pose this question again. When CTR supported the 2030

Committee, Ken Allen with HEB was the retired VP in charge of their fleet operations. He knew which city tire wear was highest, what speed drivers should operate at to minimize fuel consumption, how long the tires would last depending if they were on a steer axle, drive axle or trailer axle…HEB had their cost of operation down to the penny. They understood how road conditions affected the cost of their operations (and) how it affected truck maintenance costs.

I'd like to ask again if you can think of any other aspects of the transportation system you think can be improved to help your profitability or how road conditions affect the cost of your operations.

Attendee C: I can't think of any other factors than the geometrics and safety conditions already discussed. Texas has one of the best road systems in the U.S. I am curious, though, about whether speed affects pavement damage. If I drive over a pavement faster, will I damage it less? Are trucks lighter the faster they travel?

Facilitator: Actually, that's somewhat of a complicated question with two aspects. If you could feel the load pulse of a truck approaching a point in the pavement, the load pulse would increase as the truck approached and would peak when the truck passed over the point. The faster the truck travels across that point, the faster the load pulse peaks and then dissipates. Therefore, actually, the pavement does deflect less the faster a truck is traveling. If you travel over that point at 30 mph, the pavement will deflect more than if you travel over it at 60 mph.

However, the other aspect of that relationship is truck dynamics. If the road is rough, the truck will bounce up and down as it travels down the road, and depending on the amount of roughness, the dynamic load applied to the pavement can exceed twice the static load weight of an axle. Therefore, smooth roads are important to motorists, because that is one of the key road conditions they consider when determining if TxDOT is doing a good job or not. However, roughness is also a consideration in terms of dynamic loading, which impacts pavement deterioration rates.

Getting back to the subject, though—it seems that most of your businesses run overweight loads.

Attendee C: I run oversize and overweight. I know that my super-heavy load takes up more space. In fact, it may take up the entire roadway width and might be (150 feet) long.

Facilitator: We know that oversize loads can cause damage to the roadway network, such as bridge beams being hit if the carrier forgets that he is running an oversize load. Signals and signs can be damaged as well.

Attendee C: Oversize loads take up more space. If I'm taking up the entire roadway width, no one else can travel on the road while I'm there.

Facilitator: I guess it's difficult for us to separate the idea of oversize load impacts in your operation because you are also running overweight.

Adjourn to Room 104 for close-out session.

Table 2

Facilitator: Dr. Khali Persad
Note Taker: Maria Burton

1. **Missing study elements/components/comments**
   - Presentations were too technical: not clear what is included in the study, so difficult to identify missing elements/suggest additional aspects.
   - Proposed pavement consumption model starts with assumption about pavement type/design, but most existing pavements are a mixed bag of different layers/overlays, etc. Consumption factor may be different.
   - What about tire pressure? This changes imprint of loading.
   - Why buy a permit when you are not likely to get a ticket or the cost is less than the permit?
     - Risk vs. reward
   - Examine economic trends among different industries.
     - What value is that industry receiving compared to what they are giving back (economic balance)?
     - Is there a critical mass level when to start charging? Example: it probably wasn't feasible three years ago to charge petroleum businesses, but economic factors have changed.
   - Besides technical issues, examine uniformity among jurisdictions in requiring and enforcing permits.
2. **Impacts of road condition on industry costs**
   - Oilfield and logging companies use a lot of county roads.
   - State roads are good, so why the need for additional funds?
   - County roads are in bad shape—not enough funds or mismanagement by county commissioners
     - What percent of fees/fines/taxes the county gets vs. what the state gets.
     - Cheaper to buy county road permits in East Texas than to buy a bond. County commissioners will charge you the full amount of your bond because they don't have to justify how they assess the damages.
     - Urban people move to the country and expect CRs to be as good as state highways. They have the same vote as other residents and are very vocal to the commissioners, so residential roads get fixed but not the ones used by businesses.
     - Should not let counties keep money to use as they see fit. Instead, dedicate it for transportation.

3. **How to balance impacts of OS/OW loads with added costs**
   - Haulers get paid the same amount per load, so it doesn't matter if they can haul more weight—it's about the road condition (damage to axles, suspension, etc.). But there's a threshold for every industry (example: HEB).
   - How about a sliding scale, where if you want a permit for 86,000 lbs., you pay a little more than an 80,000-lb. permit?
4. **What to do about permits for currently exempt loads**
   - Lots of people buy an agricultural permit when in fact they do all sorts of hauling. All they need to do is show they meet one of the conditions. They are not really farmers, but get away with the cheapest permit.
   - Revisit all types of permits and make all a consumption basis.
5. **How should users pay for transportation system use/consumption**
   - Dual interests
     a. Urban: Congestion, need for added capacity. Urban highways cost a lot more than rural. How about a congestion tax?
     b. Rural: Maintenance of existing system. Seems to be going quite well.
   - Too much diversion of transportation funds—they not being used for constitutionally dedicated purposes. Need to stop the diversions before you ask for more money.
     - Debt service (example: bonds)—need to address this.
   - Need to keep up with what we have. We need to increase maintenance funding as the number of miles of highway goes up.
     - Privatize all maintenance.
   - Privacy objections to the vehicle miles traveled (VMT) toll.
   - Instead of increasing permits, why not spread the burden across all users/funding mechanisms? Example: increase fuel taxes, registration fees, permits, etc.?
     - How many cars to do same damage as one truck? There are a lot more cars than trucks, so let them pay.
   - Registration fees currently collect about $1 billion per year and haven't increased in ages. An increase would generate more revenue than any permit fees.
   - Vehicle sales tax? Dedicate to transportation in general.
   - Index the gas tax instead of having to go back perennially to raise it.
   - Traffic impact fees? Example: if a new business requires a left-turn lane, they should pay for it.
   - Donations. Drillers laid down four inches of rock on a county road so they could haul their heavy equipment in.
   - If businesses are making money, they are willing to pay for good roads.

Table 3

Facilitator: Ray Hutchinson
Note Taker: Daniel Evans

1. What are any missing study elements, components, or comments?

- Group discussed the complexity of the current OS/OW permit structure and if currently exempt loads were going to need permits, wouldn't it be better to simplify and permit based on size and weight without regard for the commodity being hauled. This would not only be simpler but would be more equitable across the board. The fees should be based on the impact on roads and bridges. However, the group also brought up that the entire fee structure (everything paid to the state to operate in Texas), not just for the OS/OW permit but for all of the associated state fees (licensing, registrations, additional permits, etc.) should be considered.
- Fund 6 allocation of all of these fees should also be researched and diversions away from Fund 6 identified.
- Discussion migrated back to the need for simplification of the fee schedule, but simplification should ensure an equitable fee schedule and look at all alternative fee sources (VMT, like loads based on weight distribution, state workforce used, etc.).

2. Impacts of Texas road conditions on industry costs?

- Although the group was in consensus that Texas IH, US, and SH roads are better than most states, there was concern that our farm-to-market (FM) roads, in an ever-increasing number of areas, are poor (fair at best) and rapidly deteriorating due to heavy traffic.
- Travel (sometimes forced by permit or size/weight) on these off roads or FM roads has an impact on increased maintenance (suspension, shocks, tires, overall maintenance) costs. In other situations, they bypass these poor condition roads and in doing so incur additional operating costs in terms of fuel consumed and travel time. These costs are dealt with in these situations:
    - Businesses “eat” costs (reducing margin)
    - Costs passed to consumers (increasing final cost)
- It was noted (and agreed on by the group) that even with the challenges of the deteriorating FM roadways (in specific areas), the overall quality of Texas roads helps retain business in the state.
- Traffic congestion problems were also discussed as a form of road condition impacting businesses because businesses will travel considerable "extra" distances in order to avoid metropolitan congestion. This results in:
    - Increased fuel expenses
    - Increased wear on secondary and tertiary roadways (avoiding the congestion on main roadways) and consequently contributes to the deterioration of the FMs

3. **How could the DOT balance overall impacts of OS/OW loads and road maintenance?**
    - Based on route analysis (frequent corridors of travel), allocate maintenance dollars (especially those from permit fees) to "beef up" or upgrade those routes to better handle the OS/OW traffic.
    - There was discussion on the approach that all permits should be routed. The new permitting system (TxPROS) has the capability for routing not only single-trip routed permits but for customers to obtain routes (7X24) for "time period" permits as well. There is no additional cost to obtain the routes, and all the benefits of having routing permits would be achieved (safety, avoiding "bad" roads, knowledge of "traffic corridors," etc.). This could be considered and potentially recommended in the study.
    - There was discussion on how improved restriction management (timely, accurate, needed) could help to accommodate routing to better roads.
4. **How should exempt loads be considered in a potentially revised permit fee structure?**
    - Discussion revisited some of the items brought up in question #1 focusing on the idea that the fee structure needs to be equitably constructed.
    - Analysis leading to the proposed structure should be based on configuration, loads, and axle weight (consumption of the resources) independent of the industry or the commodity being hauled.
    - Everyone at the table agreed that for the purpose of this study everything should be on the table.
5. **Given the maintenance backlog and insufficient revenue stream (based on all current projects seen from the feds and state), how should users pay for system use and consumption?**
    - There were a number of ideas discussed, including:
        - VMT, mileage (equitably, with no exemptions)
        - Pay based on usage/consumption (on a per ton-mile basis)
            - Oversize: Mileage
            - Overweight: Per ton-mile
        - Indexing of gas tax
        - Revisit allocation of permit fees (eliminating diversions from Fund 6)
    - Other issues: Revisited the need to review the current perceived overlap of similar permits and simplifying (reducing) the number of permits for not only simplification but also for more equity (no bias based on industry or commodity)

Table 4

Facilitator: Lisa Loftus-Otway
Note Taker: Bridgett Bienkowski

Big Picture Take-away

Need to have a totally new permit structure that creates a level playing field for everyone. Do not update the old structure.

Our permit slogan for OS/OW Permit Consumption Fee: the weight you carry and the miles you travel. Create a maintenance-based fee that also has a per mile fee component.

Level the playing field for everyone—there should be no exemptions.

"We will pay the fee, but help us do business."

Suggestion for trade-off when this hits the legislature: keep the current 2060/1547 permit but issue no more and in the new permit fee structure allow no exemptions. This would allow time for adjustment, and it would eventually reduce the number of the old-type permits.

Provide funds for enforcement, as there are persistent fragrant violators. Need to penalize those who are out of compliance and have stricter enforcement.

- It should not be cheaper to just pay the penalty than to be legal in the first place.
- Education needs to be provided regarding axle weights.
- End diversions—and any new money from any new permit fee structure should be dedicated to Fund 6.

1. What are any missing study elements, components, or comments?

Would be good to contextualize the OS/OW permit process and history—give some perspective on how this all came to be. What is the original point of the current fee structure?

Taking a system that was not meant to be a revenue generator and trying to turn it into one. For example, the 2060/1547 permits were not meant to be a revenue-generating item. It would be good to discuss this in our introduction to the study.

There was also discussion that the counties need to be approached for this study, as they are currently the "missing stakeholder," and county roads are deteriorating rapidly.

2. Impacts of Texas road conditions on industry costs?

The table participants comprised two super-heavy haulers, two TxDOT employees, TMTA, and a lobbyist for the oil services industry.

Super-heavies noted that they often do their own testing for pavement damage before requesting a permit. They will also use portable scales to determine axle weights when out in the field.

They did note that there are more costs when road conditions are worse. For example, it may add 100+ miles to a trip when a bridge cannot be used.

If a delivery has to be made, the oil services industry will review the legal routes and timing. If none are available or they are not economical, they will not take the job. They noted that a company will take this bid and may run illegally.

They noted that they are not bothered about paying the permit fee. They care about getting the permit quickly and that everyone pays their fair share.

Other general comments about the permits:

- Super-heavy permitting takes way too long.
- Suggested that there is a need for quicker permit turnover for super-heavy loads, and it can be done, because it has been done for special cases.
- Trucking companies are often the "subcontractor" in the business transaction.
- Costs are incurred at the state lines:
  - Some surrounding states are quicker to give permits, so a slow process in Texas can also slow down vehicles that are traveling through.
  - Some states also require different configurations, so this can also slow down the process.
  - Every state has a different way of doing things, so any slow-down in the process of getting permits impacts business.

3. How could the DOT balance overall impacts of OS/OW loads and road maintenance?

- Weight structure is acceptable (people are comfortable with it since they know it so well).
- Ten percent of the weight limit is doing a lot of damage, because there are so many of them compared to permitted OW.
- Repetitions do more damage than just one heavy load.
- Permit fee increase when more administration people are needed.
- To enforce compliance, more money is needed.
- Need to educate law enforcement to spot illegal loads.
- Need to hire people from the industry to enforce compliance. That way, they know what to look for and how people cheat the system.
- Improperly loaded trucks can be worse than properly loaded OW trucks.
- Problems with getting permits for less than load than what they actually carry.
- Load-zoned roads: sometimes they *have* to use them.
- TxDOT looks at axle weight and overall weight; if not over a certain amount, will not even look at it.
- Tire loading is extremely important.
- Sometimes the lateral inch weight on an OW vehicle could be less than an 80K.
- Port of Houston is the busiest port concerning super-heavy.
- TxDOT is liberal with the permits (even though it takes a while), so it benefits the economy.

4. How should exempt loads be considered in a potentially revised permit fee structure?

- How can you continually exempt certain trucks?
  - If they use the road, they should have to pay for it.
  - Totally against exemptions.
  - Has to be addressed.
- If this is going to be a new revenue generator system, exemptions should pay.
- The impact on economic productivity is extremely important.
- A whole new permitting system is needed—need to start from scratch and not merely update.
  - As a "trade-off" for the currently exempted classes, a suggestion was to keep 2060/1547 system but do not issue any new permits under this system; all new permits will fall under the new system.
  - Need to change the entire process.
- Is this going to be a law?
  - Must be; need accountability and gives TxDOT enforcement jurisdiction.
- Problem with people being issued one permit, but how many trips are they making with that one permit?
- Legal companies have to compete with the illegal companies.
- Think of commerce!
- Louisiana's permits are based on miles:
  - Should check around to see what the other DOTs are doing.
  - Keep competitive with surrounding states so Texas does not lose business.
- Other states may need to update their system too, so do not rely on them.
- Per mile fee better than a lump sum fee.
- TxPROS seems to decrease admin fees.
- Penalize those that are out of compliance. Strict enforcement:
  - Flagrant violators need to be dealt with.

5. Given the maintenance backlog and insufficient revenue stream (based on all current projects seen from the feds and state), how should users pay for system use and consumption?

- Raising the gas tax would not be fair.
- In the future, gas tax will be moved to VMTs, so truck fees should be VMT based to get a head start.

- Increasing the gas tax is not smart (it will never catch up with the gap), especially as vehicles get more fuel-efficient or use a different type of fuel that is not in current tax system.
- People like to see manifestation of their money.
- Something needs to be done about county roads.
- Very open to technology on trucks:
  - GPS-enabled.
  - Would approve GPS mandate in a new permit fee structure.
- New fee system that is based on consumption and VMT would be fairer and equitable, as it would be based on weight carried and miles traveled.
  - However, it was noted that any permit fee increase will get passed on to the customer.
- Economic impact is very important.

Table 5

Facilitator: Rob Harrison
Note Taker: Sarah Lind

1. What are any missing study elements, components, or comments?

- Historical perspective (post 1980s): permitting driven by safety, not revenue issues.
- Tires per axle: is this addressed, and does it matter?
- OS/OW routes should be integrated into a highway network that serves everyone while facilitating special loads.

2. Impacts of Texas road conditions on industry costs?

- Lane narrowing like that proposed on IH-35 in Austin will raise trucking costs (UPS) and may restrict routing of OS/OW loads, thus reducing system capacity.
- All supply chains use trucks at some point, and poor roads damage vehicles.
- UPS cited springs, shocks, mirrors, damage to cargo, and reduced vehicle life in miles.

3. **How could the DOT balance overall impacts of OS/OW loads and road maintenance?**

- Develop OS/OW corridors that are suitably maintained, as currently loads are sometimes diverted to FM roads due to simultaneous maintenance activities on alternative routes.
- Some TxDOT districts are improving their coordination so that maintenance or construction does not occur on key longer routes used by OS/OW trucks. This coordination should be strengthened across the entire state.

4. How should exempt loads be considered in a potentially revised permit fee structure?

- Exempt truck owners pay a bond, but why should the revenue go to an insurance company when claims are so difficult to prove? Send it directly to Fund 6.

5. Given the maintenance backlog and insufficient revenue stream (based on all current projects seen from the feds and state), how should users pay for system use and consumption?

- Update traditional gas and diesel fuel taxes.
- Increase DPS weight enforcement on key energy routes.
- If heavy loads and exempt vehicles help drive the state economy and enrich key funds, why should TxDOT not be included in some way? Energy pays more than 95 percent of the "rainy day" funding, so why should some not come back to repair the damage to highway infrastructure?
- End diversions from Fund 6.

Table 6

Facilitator: Jolanda Prozzi
Note Taker: Ambarish Banerjee

1. What are any missing study elements, components, or comments?

- OS/OW truck traffic represents about 5 to 7 percent of the entire trucking industry.
- It is necessary to develop literature to educate the public and officials that properly loaded OS/OW trucks do not cause any additional damage compared to normal truck traffic.
- The study should include a historical review of Texas's permit system (e.g., why exemptions exist and how the permit system came about). The revenues from the majority of the permits were not designated for road maintenance. Permit fees were originally intended to recover costs associated with routing and safety, not road maintenance. Also, if the revenue is designated for road maintenance, a share should not be diverted for, for example, public education.
- The question was raised whether the study is going to include an analysis of the economic benefits associated with OS/OW truck movements. The facilitator explained that although the economic productivity benefits are recognized, the study is not going to attempt to quantify those. It was subsequently recommended that the economic benefits be acknowledged. Mention was made of a Senate Interim Study that will quantify the costs of the infrastructure impacted by OS/OW loads versus the productivity and safety benefits realized.
- It was recommended that a balance be determined between the road impacts of OS/OW vehicles and light duty vehicles. The OS/OW fleet should not pay for all road maintenance costs, only its portion. Trucks cause more damage to road infrastructure, but they are also charged much higher fees.

2. Could you describe the impacts of Texas's road conditions on industry costs?

- Texas's State Highway system is considered in good condition. Texas's county roads sometime impact industry, as deteriorated road conditions impact safety and increase the risk of accidents. Additionally, the industry can see increases in maintenance costs and increased tire wear if road conditions deteriorate.
- A participant representing an energy service company mentioned that potholes on the FM road system are causing trucking companies to change tires and shocks more frequently. The latter costs cannot be passed on to the clients. Companies are starting to see increased tire wear, shock replacements, and suspension problems because of deteriorated FM road conditions. Most oil well sites are accessed via FM roads. If traffic is diverted to avoid FM roads in poor condition, then the company incurs higher fuel costs, which impact the company's profitability.
- Participant mentioned that oil service companies are operating on a 2006 price list. Most companies thus operate on very slim margins. Most are paid per mile and would be

concerned about how a change in permit fees/permit fee structure would impact their industry. For example, the cost of 2060/1547 permit fees cannot be passed on to the consumer by the trucking industry, but super-heavy permit fees can be passed on to the consumer as a separate line item.

- The summary needs to address how the changes to the permit fee structure might affect the overall economy.

3. How could the DOT balance overall impacts of OS/OW loads and road maintenance?

- A weight distance fee will potentially be the most equitable fee structure.
- However, if permit fees have a road maintenance fee component, then that portion should be secured for road maintenance.

4. How should exempt loads be considered in a potentially revised permit fee structure?

- When exempt vehicles exceed weight limits, some are required to reduce their weight while others are required to purchase a permit.
- Permits are in general preferred over bonds. The bond system is considered totally ineffective, because it would cost too much in legal costs for DMV to access the bond. It was proposed that industry purchase a $100 annual permit rather than a $100 bond. This will generate revenue for TxDOT while imposing no additional costs on the industry.
- Exempt loads are not allowed to use the Interstate Highway (IH) system. In Houston, exempt vehicles can hardly capitalize on the load limit, because most of the freeways are part of the IH system. As a result, the industry is often landlocked and loses money in Houston. Industry is therefore ready to pay a fee to improve efficiency.
- Most exempt loads operate on FM roads that were not designed to move these heavy loads. Milk/agricultural trucks are impacting the FM system. Also, cotton seed modules are very heavy, resulting in substantial pavement damage.
- It is necessary to review the history of the permit fees. The justification for agricultural exemptions had been that farmers do not have the ability to weigh in the field. There is a substantial weight difference between transporting dry and wet produce.
- There is a need for equity between different groups of exempt vehicles. Also, the fee structure needs to be equitable for different kinds of businesses. Some exempt loads are heavier than permitted loads. The fee structure should be equitable insofar that everybody should pay their fair share. "Pay for consumption" may thus be a better principle.
- Someone made a policy decision a long time ago to subsidize certain operations, i.e., exempt loads. Tax breaks or another incentive may be more appropriate today.

5. Given the maintenance backlog and insufficient revenue stream, how should users pay for system use and consumption?

- Industry remarked that when OS/OW fees were tripled a couple of years ago, it represented a mere drop in the bucket in terms of revenues generated.
- A diesel tax increase is generally supported by industry (specifically, TMTA). Diversion of fuel tax revenues should be addressed

- An increased registration fee is another option, as are toll roads.
- It was, however, remarked that commercial trips are not discretionary trips. Industry cannot save on trips.
- Funding infrastructure maintenance from General Revenue is considered a difficult option.
- Industry mentioned the payment of a Heavy Vehicle Use Tax (IRS 2290), a fee that is levied every year per vehicle. This fee amounts to $634 per vehicle, per year. It was recommended that the study team determine if a portion of this revenue is returned to the states.
- Rather than introducing new fees, consider channeling existing fees to highway maintenance (i.e., Fund 6).
- It was concluded that there is no “silver bullet” when it comes to how users should pay for system use and consumption.

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