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HB 2319: Preliminary Report

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HB 2319 Study: Impact of Intermodal Containers on the Pavements and Bridges Located at the Border Between Texas and Arkansas

This Technical Memorandum was prepared in collaboration with the Texas Department of Transportation (TxDOT), the Texas Department of Motor Vehicles (TxDMV), the University of Texas at Austin (UT Austin) and the University of Texas at San Antonio (UTSA) in response to House Bill 2319 of the 85th Texas Legislative Session.

1. House Bill 2319

This study was conducted to evaluate the impact on Texas pavements and bridges due to vehicles with permits issued under the provisions of House Bill 2319 (HB2319) of the 85th Texas Legislative Session, which as implemented under the 2023 Texas Statutes Transportation Code, Title 7: Vehicles and Traffic, Subtitle E: Vehicle Size and Weight, Chapter 623: Permits for Oversize or Overweight Vehicles, Subchapter B: General Permits, Section 623.0172: Permit for Intermodal Shipping Container. The HB2319 relates to the movement of vehicles transporting an intermodal shipping container, which in the bill context means an enclosed, standardized, reusable container that: *"(i) is used to pack, ship, move, or transport cargo; (ii) is designed to be carried on a semitrailer and loaded onto or unloaded from: a ship or vessel for international transportation or a rail system for international transportation; and (iii) when combined with vehicles transporting the container, has a gross weight or axle weight that exceeds the limits allowed by law to be transported over a state highway or county or municipal road."*

HB2319 authorized the Texas Department of Motor Vehicles (TxDMV) to issue an annual permit named "North Texas Intermodal" for the transport of an intermodal shipping container (ISC) by a truck-tractor and semitrailer combination with six total axles, adhering to specific axle weight and spacing restrictions presented in **Table 1.1**.

Table 1.1 Summary of vehicle configuration restrictions under HB 2319

Description	Restrictions
Max. Gross vehicle weight:	93,000 lbs.
Max dist. between 1st and last axle:	647 in.
Truck-tractor	
Max. load for single axle:	13,000 lbs.
Max. load for 2-axle group:	37,000 lbs.
Max. load per axle:	18,500 lbs.
Max. distance between axles[1]:	51 - 52 in.
Max. load for 3-axle group:	n/a
Max. load per axle:	n/a
Max. distance between axles[1]:	n/a
Semitrailer	
Max. load for 3-axle group:	49,195 lbs.
Max. load per axle:	16,400 lbs.
Max. distance between axles[1]:	60 in.

[1] Distance between axles of the same axle-group.

TxDMV initially set the permit fee under this bill at $1,000. However, every two years, TxDMV should reassess and adjust this fee based on a reasonable estimate of the costs associated with the infrastructure assets maintenance or repair.

2. Vehicle Configuration

The TxDMV provided data from the Texas Permit Routing Optimization System (TxPROS) on ISC permits to aid the project team in addressing representative vehicle configurations for pavement and bridge analysis. The TxPROS data from 2018 to 2023 were analyzed, revealing a total of 25 "North Texas Intermodal" permits. However, information regarding vehicle configuration, particularly axle-weight and spacing, was unavailable for these permits. In contrast, axle information was available for other types of truck permits, such as the "General" permits. Therefore, in order to assess the axle weigh distributions, the project team decided to evaluate data from motor carriers issued with a "General" permit. To ensure the analyzed vehicles matched the design vehicle under the provision of HB2319, only vehicles complying with restrictions provided in **Table 1.1** were assessed. Based on the observed axle weight distribution, a sensitivity analysis with nine different loading scenarios was proposed, as summarized in **Table 2.1**.

Table 2.1 Loading scenarios for the 6-axle vehicle configuration

	Axle weight (lbs.)			
Axle Group Configuration	**Single**	**Tandem**	**Tridem**	**GVW (lbs.)**
1-2-3	11,000	32,805	49,195	93,000
	11,000	35,000	47,000	93,000
	11,000	37,000	45,000	93,000
	12,000	31,805	49,195	93,000
	12,000	35,000	46,000	93,000
	12,000	37,000	44,000	93,000
	13,000	30,805	49,195	93,000
	13,000	35,000	45,000	93,000
	13,000	37,000	43,000	93,000

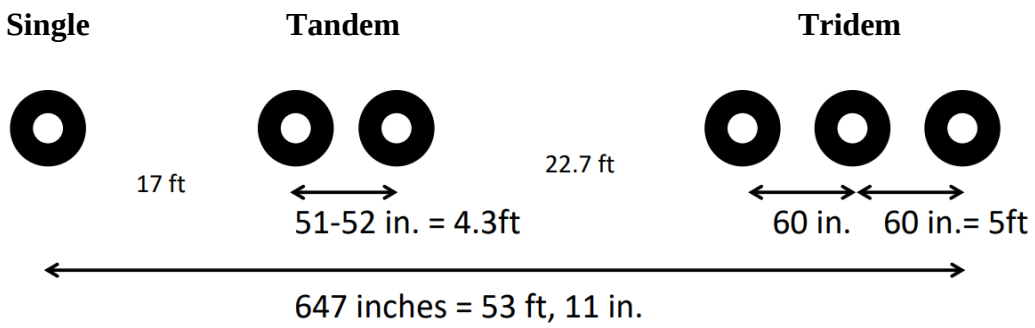

Figure 2.1 Design vehicle schematic.

3. Vehicle Miles Traveled

Vehicles operating under the provisions of HB2319 are restricted to routes that are: (i) located in a county with a population of more than 90,000, (ii) on highways in the state highway system, and (iii) not more than five miles from the border between the states of Texas and Arkansas.

Effectively, these constraints restrict the network available for the North Texas Intermodal permit to a 2.5-mile section of US Highway 71/59 in Bowie County, from the Arkansas state border in the north to the eastbound entrance ramp for Interstate Highway 49 in the south (**Figure 3.1**).

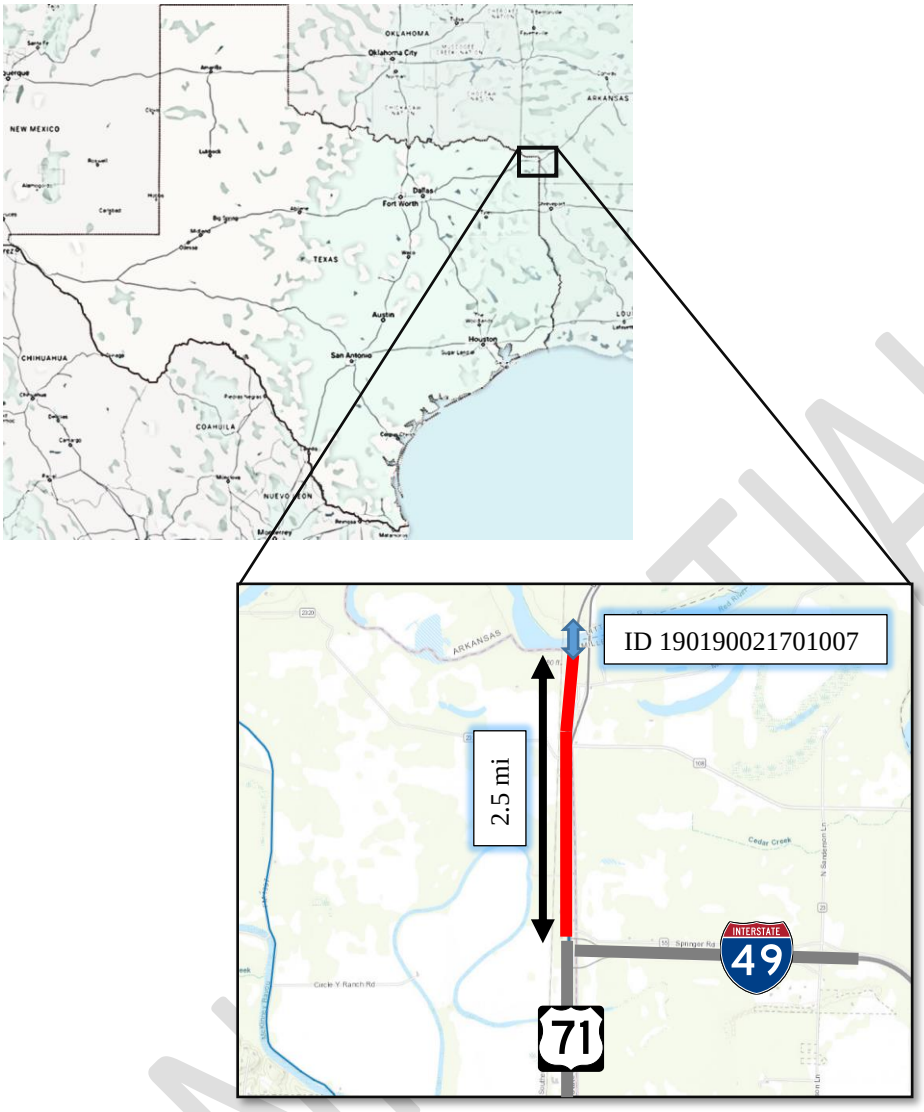

Figure 3.1 Route allowed for permits issued under the provisions of HB2319

As depicted in **Figure 3.1**, this route only includes a single section of a state-managed highway. It should also be noted that only one such permit has been issued between 2022 and 2023.

4. Pavement Analysis

The pavement analysis was based on the methodology developed during the study conducted for the House Bill 2223 (Prozzi et al., 2022a), which was conducted in terms of equivalent consumption factor (ECF). The ECF represents the relationship between the amount of pavement life that a given axle configuration consumes relative to the standard axle. Traditionally, the standard axle is a single axle

equipped with 18,000 lbs. and commonly referred to as equivalent single axle load (ESAL).

The 2.5-mile-long section of interest (**Figure 3.1**) contained only asphalt concrete pavement (ACP). The failure criteria and thresholds considered during the ECF calculation are presented in **Table 4.1**.

Table 4.1 Failure criteria adopted for ACP

Failure Criteria	Threshold
Rutting	0.5 in
Fatigue Cracking	25% area
Roughness[1]	172 in/mi

[1] An initial IRI of 63 inches per mile was used in the analysis.

Due to the inherent differences in the foregoing failure mechanisms, it is impossible to reach all terminal distress levels simultaneously at the end of the design period. Although one would develop separate ECFs based on each failure criterion (**Table** 4.1), from a practical point of view, a given axle configuration should result in a single ECF. Therefore, after finding the traffic volume that would result in a terminal distress value for each failure threshold separately, a weighted average was calculated.

Note that, by definition, axle configurations with an ECF of less than one will take longer than design period (20 years) to reach the failure criteria, while axle configurations associated with an ECF of greater than one will take less than the design period to reach the same failure condition. The ECFs calculated based on the proposed loading scenario are presented in **Table 4.2**.

Table 4.2 Equivalent consumption factors for the proposed loading scenarios

Loading Scenario	Axle Group			ECF
	Single	Tandem	Tridem	
1	11,000	32,805	49,195	3.71
2	11,000	35,000	47,000	3.78
3	11,000	37,000	45,000	3.98
4	12,000	31,805	49,195	3.60
5	12,000	35,000	46,000	3.69
6	12,000	37,000	44,000	3.90
7	13,000	30,805	49,195	3.51
8	13,000	35,000	45,000	3.62
9	13,000	37,000	43,000	3.85

The inherent variability of each ECF was another key concern. For example, an ECF calculated using the surface rutting criterion could result in a lower standard error (that is, lower uncertainty) as compared to an ECF obtained using the fatigue cracking or roughness criteria, which showed the highest uncertainty. Thus, for the ECFs with lower variability, the project team employed a relatively higher weight. In analyzing the allowed route under this permit, the ECF was obtained as the average plus one standard deviation, resulting in a final ECF of 3.89.

Based on this average ECF, the average unit consumption cost for pavements was calculated to be 7.2 cents per ESAL per mile (expressed in April 2024 dollars). Thus, the average pavement consumption cost for the 6-axle vehicle is $ 0.28/mile.

5. Bridge Analysis

The bridge consumption methodology treated each passage of the design vehicle configuration (**Table 1.1**) as a fractional consumption of the bridge's design life, using the moment ratio concept. This procedure was extensively documented on similar previous bridge consumption cost studies (Weissmann et al., 2024).

The bridge consumption analysis is generally divided between state-managed bridges (on-system) and local-managed bridges (off-system) due to the requirements of the analytical procedures and data availability. However, in the section of interest (**Figure 3.1**) there is only one on-system bridge – spanning over the Red River – at the state border, identified by the unique ID 190190021701007.

The total bridge consumption cost, due to one pass of the representative vehicle (6-axle loaded with 93,000 lbs.) under the prevision of HB 2319, was calculated to be of $4.88. Dividing this total cost by the length of the section of interest (2.5 miles), it resulted in a bridge consumption cost of $1.95/mile.

6. Infrastructure Consumption Analysis

By combining the bridge and pavement consumption costs from the previous two sections, it resulted in a total infrastructure consumption cost for the "North Texas Intermodal" permit of $2.23/mile.

From January 2022 to December 2023, only one North Texas Intermodal permit has been issued. Additionally, no information was available on the total vehicle miles traveled or the number of trips per year by this permitted vehicle.

Beginning in 2022, on September 1 of each even-numbered year the department shall set the fee for a permit issued under this section in an amount based on a

reasonable estimate of the costs associated with the operation of vehicles issued a permit under this section, including any increase in the costs necessary to maintain or repair those highways. Of the fee collected for a permit: 90 percent shall be deposited to the credit of the state highway fund; 5 percent shall be deposited to the credit of TXDMV; and 5 percent shall be deposited to the appropriate county road and bridge fund. Since the permit fee is currently $1,000, 90 percent is, in principle, utilized to highway and bridge maintenance and rehabilitation.

Previous studies have conducted sensitivity analyses to determine whether the permit fee aligns with the pavement and bridge consumption costs (Prozzi et al., 2022b). Accordingly, this study also evaluated the number of trips required to balance infrastructure consumption with permit revenue. The results are presented in **Table 6.1**.

Table 6.1 Sensitivity analysis on infrastructure consumption by number of trips

Number of Trips	Pavement Consumption	Bridge Consumption	Total Consumption
10	$7.00*	$48.80**	$55.80
50	$35.00	$244.00	$279.00
100	$70.00	$488.00	$558.00
150	$105.00	$732.00	$837.00
161	***$112.70***	***$785.68***	***$898.38***
200	$141.00	$976.00	$1,116.00
300	$210.00	$1,464.00	$1,674.00
365	$255.50	$1,781.20	$2,036.70

* $0.28/mile x 2.5 miles x 10 trips = $7.00

** $4.88/trip x 10 trips = $48.80

7. Crash Analysis

For the analysis period of this study (January 1st, 2022 to December 31st, 2023), none of the vehicles operating under the permits subject of this bill were involved in crashes within the study area.

8. Conclusions

In preparation of this report, the project team gathered and evaluated relevant permit data provided by the Texas Department of Motor Vehicles, as well as crash data from the Crash Records Information System (CRIS) provided by the Texas

Department of Transportation. To reach the conclusions of this study, the following data were analyzed:

- Gross vehicle weights, axle weight and spacing of vehicles complying with the same axle configuration restrictions of those operating under a North Texas Intermodal permit;
- On-system bridge inventory;
- Pavement performance models developed in the context of Texas roadways; and
- Crash records of vehicles with a North Texas Intermodal permit and within the section of interest for this study.

The project team compiled and analyzed this information and based on the methodology developed under the HB 2223 Study performed a series of analyses in the section of interest to determine and quantify the pavement and bridge consumption, and the associated costs. A sensitivity analysis revealed that the current fee structure is adequate if the permitted vehicle (a six-axle vehicle with 93,000 lbs.) carries up to 161 trips per year over the designated route. However, if the annual number of fully loaded trips by these vehicles exceeds 161, the current annual fee will not cover the consumption cost of roads and bridges.

References

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