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NORTH DAKOTA
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# Truck Size and Weight

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North Dakota Department of Transportation
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# The U.S. Department of Transportation's Comprehensive Truck Size and Weight Study

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# Minnesota Truck Size and Weight Project

The second issue of *Public Roads* magazine published in 1918 focused on the problems State highway departments were encountering as the result of truck traffic. The lead article, "*The Highways of the Country and the Burden They Must Carry,*" summarized the issues of that era, many of which are still familiar today:

> Apparently the point has been reached where the demands of traffic have exceeded the strength of the average road to meet them. Highways designed to withstand the pounding of ordinary loads, that have stood up under imposts they were intended to sustain, no longer appear to be adequate to meet the present-day conditions. Widespread failure is demonstrative of the fact the roads can not carry unlimited loadings. Their capacity is limited.

There are two aspects of truck weight that are interdependent and that interact with the highway infrastructure -- axle weight (loading) and GVW. As shown in Table VI-1, the effect of axle weight is more significant to pavements and short-span bridges, whereas GVW is of more significance to long-span bridges.

## Table VI-1
## Highway Infrastructure Elements Affected by TS&W Limits

| Highway Infrastructure Element | | Axle Weight | GVW | Axle Spacing | Truck Length | Truck Width | Truck Height |
|---|---|---|---|---|---|---|---|
| **Pavement** | Flexible | E | | E | | | |
| | Rigid | E | | e | | | |
| **Bridge Features** | Short-Span | E | | E | E | | |
| | Long-Span | | E | e | E | | |
| | Clearance | | | | | e | E |
| **Roadway Geometric Features** | Interchange Ramps | | e | | E | e | |
| | Intersections | | | | E | e | |
| | Climbing Lanes | | E | | | | |
| | Horizontal Curvature | | e | | e | | |
| | Vertical Curve Length | | E | | | | |
| | Intersection Clearance Time | | E | | E | | |
| | Passing Sight Distance | | | | e | | |

Key: E = Significant Effect
e = Some Effect

**Industry Challenges and Considerations**

TS&W limits affect freight transportation costs because they control the amount of payload that can be carried in a truck. Increases in truck weight limits increase the allowable weight per trip, so fewer trips are required to carry the same amount of goods. Freight transportation cost savings due to increases in TS&W limits accrue to shippers, carriers, and consumers.

## Truck-Pavement Interaction

The gross vehicle weight (GVW) of a vehicle is not the prime determinant of a vehicle’s impact on pavements. Rather, pavements are stressed by loads on individual axles and axle groups directly in contact with the pavement.  Of course, the GVW, along with the number and types of axles and the spacing between axles, determines the axle loads.

Axle groups, such as tandems or tridems, distribute the load along the pavement, allowing greater weights to be carried and resulting in the same or less pavement distress than that occasioned by a single axle at a lower weight. While spreading the axles in an axle group is beneficial to short-span bridges, it is detrimental to pavement. It is not GVW but the distribution of the GVW over axles that impacts pavements.

Over time, the accumulated strains (the pavement deformation from all the axle loads) deteriorate pavement condition, ……. If the pavement is not routinely maintained, the axle loads, in combination with environmental effects, will accelerate the cracking and deformation. Proper pavement design relative to loading is a significant factor in pavement life, and varies by highway system and the number of trucks in the traffic stream.

**Pavement Considerations**

Engineers design roads to accommodate projected vehicle loads, in particular, heavy vehicle axle loads. The life of a pavement is related to the magnitude and frequency of these heavy axle loads. Pavement engineers use the concept of an equivalent single-axle load (ESAL) to measure the effects of heavy vehicles on pavements. Any truck axle configuration and weight can be converted to this common unit of measure. Adding axles to a truck can greatly reduce the impact on pavement.

The effect of ESALs on pavements is not constant throughout the calendar year. During the winter when the ground is frozen, a given traffic loading does much less damage to pavements than at other times of the year. During the spring, pavement layers are generally in a saturated, weakened state due to partial thaw conditions and trapped water. A given traffic loading during spring thaw results in five to eight times more damage to pavements than that same loading at other times of the year.

A conventional five-axle tractor-semitrailer operating at 80,000 pounds gross vehicle weight (GVW) is equivalent to about 2.4 ESALs. If the weight of this vehicle were increased to 90,000 pounds (a 12.5 percent increase), its ESAL value goes up to 4.1 (a 70.8 percent increase), because pavement damage increases at a geometric rate with weight increases.

However, a six-axle tractor-semitrailer at 90,000 pounds has an ESAL value of only 2.0, because its weight is distributed over six axles instead of five. An added pavement benefit of the 90,000-pound six-axle truck is that fewer trips are required to carry the same amount of payload, resulting in almost 30 percent fewer ESAL miles per payload ton-mile.

Tables V-1 through V-3 compare the relative pavement consumption of various axle groups and truck configurations evaluated in the study at the maximum allowable weights that would be allowed in the various scenarios. These comparisons are based on the effects of the axle groups and their loads relative to an 18,000-pound single axle load.

These relative effects are expressed in load equivalency factors (LEFs) that may be defined as the number of repetitions of a reference load and axle combination (such as the 18,000-pound single axle) that is equivalent in pavement life consumption to one application of the load and axle configuration in question.

**Table V-1. Theoretical Load Equivalency Factors for Various Axle Groups and Loads for Major Types of Rigid and Flexible Pavement Distress**

| Axle Group | Load (pounds) | Load Equivalency Factors * | | |
|---|---|---|---|---|
| | | Rigid Pavement Fatigue (10-inch thickness) | Flexible Pavement (5-inch wearing surface) | |
| | | | Fatigue | Rutting |
| Steering Axle Single tires | 12,000 | 0.6 | 1.4 | 1.3 |
| | 20,000 | 3.1 | 4.0 | 2.2 |
| Single Axle Dual tires | 17,000 (STAA double) | 0.9 | 0.9 | 0.9 |
| | 20,000 | 1.6 | 1.5 | 1.1 |
| Tandem Axle | 34,000 | 1.1 | 1.6 | 1.9 |
| Spread Tandem-Axle (10-foot Spread) | 40,000 | 1.4 | 3.0 | 2.2 |
| Tridem-Axle (9-foot spread) | 44,000 | 0.6 | 1.4 | 2.4 |
| | 51,000 | 1.0 | 2.5 | 2.8 |

* Based on 18,000 pound single axle with dual tires

Source: Gillespie, et. al. "Effects of Heavy-Vehicle Characteristics on Pavement Response and Performance,"

**Table V-2. Theoretical Load Equivalency Factors for Scenario Vehicles**

| Configuration | Gross Vehicle Weight (pounds) | Number of Axles in Each Group (S=Steering Axle) | Load Equivalency Factors *** | | |
|---|---|---|---|---|---|
| | | | Rigid Pavement Fatigue (10-inch thickness) | Flexible Pavement (5-inch wearing surface) | |
| | | | | Fatigue | Rutting |
| Three-Axle Single Unit Truck | 54,000 | S,2 | 4.2 | 5.6 | 4.1 |
| Four-Axle Single Unit Truck | 64,000 | S,3 | 3.6 | 5.4 | 4.6 |
| | 71,000 | S,3 | 4.1 | 6.5 | 5.0 |
| Five-Axle Semitrailer | 80,000 | S,2,2 | 2.8 | 4.6 | 5.1 |
| Five-Axle Semitrailer (10-foot Spread) | 80,000 | S,2,2 (spread) | 3.1 | 6.0 | 5.4 |
| Six-Axle Semitrailer | 90,000 | S,2,3 | 2.2 | 4.4 | 5.6 |
| | 97,000 | S,2,3 | 2.7 | 5.5 | 6.0 |
| STAA Double (five-axle ) | 80,000 | S,1,1,1,1 | 4.2 | 5.0 | 4.9 |
| B-Train Double (eight-axle ) | 124,000 | S,2,3,2 | 3.3 | 6.0 | 6.5 |
| | 131,000 | S,2,3,2 | 3.8 | 7.1 | 6.9 |
| Rocky Mt.Double (seven-axle) | 120,000 | S,2,2,1,1 | 6.0 | 7.6 | 7.3 |
| Turnpike Double (nine-axle ) | 148,000 | S,2,2,2,2 | 5.0 | 7.8 | 7.3 |
| Triple (seven-axle) | 114,000 (LTL operation)* | S,1,1,1,1,1,1 | 6.0 | 6.8 | 6.7 |
| | 132,000 (TL operation)** | S,1,1,1,1,1,1 | 10.2 | 10.4 | 7.9 |

*LTL= Less-than-truckload
**TL=Truckload
*** Based on 18,000-pound single axle with dual tires

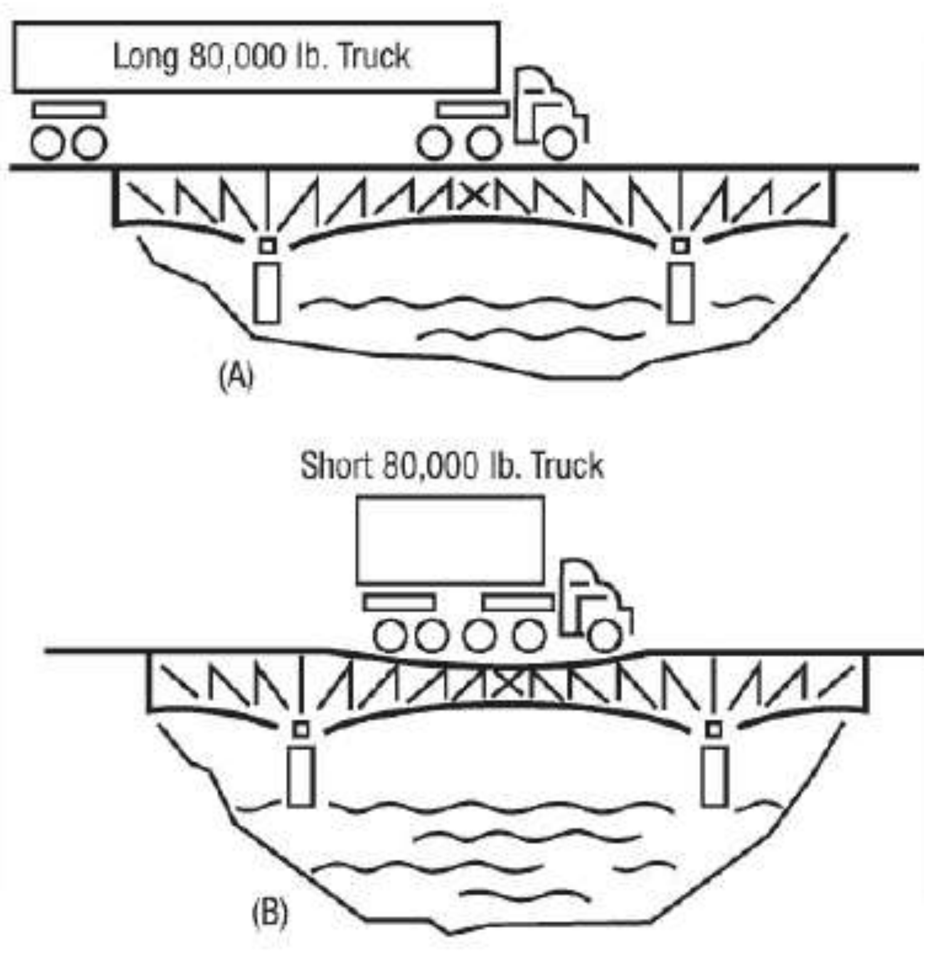
**Table V-3. Theoretical Load Equivalency Factors Per 100,000 Pounds of Payload**

| Configuration | Gross Vehicle Weight (pounds) | Empty Weight (pounds) | Payload Weight (pounds) | No. Of Vehicles per 100,000 pounds of payload | Load Equivalency Factors | | |
|---|---|---|---|---|---|---|---|
| | | | | | Rigid Pavement Fatigue (10-inch thickness) | Flexible Pavement (5-inch wearing surface) | |
| | | | | | | Fatigue | Rutting |
| Three-Axle Single Unit Truck | 54,000 | 22,600 | 31,400 | 3.18 | 13.4 | 17.8 | 13.0 |
| Four-Axle Single Unit Truck | 64,000 | 26,400 | 37,600 | 2.66 | 9.6 | 14.4 | 12.2 |
| | 71,000 | 26,400 | 44,600 | 2.24 | 9.2 | 14.6 | 11.2 |
| Five-Axle Semitrailer | 80,000 | 30,500 | 49,500 | 2.02 | 5.7 | 9.3 | 10.3 |
| Five-Axle Semitrailer (10-foot Spread) | 80,000 | 30,500 | 49,500 | 2.02 | 6.3 | 12.2 | 10.9 |
| Six-Axle Semitrailer | 90,000 | 31,500 | 58,500 | 1.71 | 3.8 | 7.5 | 9.6 |
| | 97,000 | 31,500 | 65,500 | 1.53 | 4.1 | 8.4 | 9.2 |
| STAA Double (five-axle) | 80,000 | 29,300 | 50,700 | 1.97 | 8.3 | 9.9 | 9.7 |
| B-Train Double (eight-axle) | 124,000 | 38,700 | 85,300 | 1.17 | 3.9 | 7.0 | 7.6 |
| | 131,000 | 38,700 | 92,300 | 1.08 | 4.1 | 7.7 | 7.5 |
| Rocky Mt.Double (seven-axle) | 120,000 | 43,000 | 77,000 | 1.30 | 7.8 | 9.9 | 9.5 |
| Turnpike Double (nine-axle) | 148,000 | 46,700 | 101,300 | 0.99 | 5.0 | 7.7 | 7.2 |
| Triple (seven-axle) | 114,000 (LTL operation)* | 44,500 | 69,500 | 1.44 | 8.6 | 9.8 | 9.6 |
| | 132,000 (TL operation)** | 44,500 | 87,500 | 1.14 | 11.6 | 11.8 | 9.0 |

*LTL= Less-than-truckload
**TL= Truckload

**Bridge Considerations**

However, GVW *is* a factor for the life of long-span bridges -- that is, bridge spans longer than the wheelbase of the truck. Bridge bending stress is more sensitive to the spread of axles than to the number of axles. The FBF takes into account both the number of axles and axle spreads in determining allowable GVW.



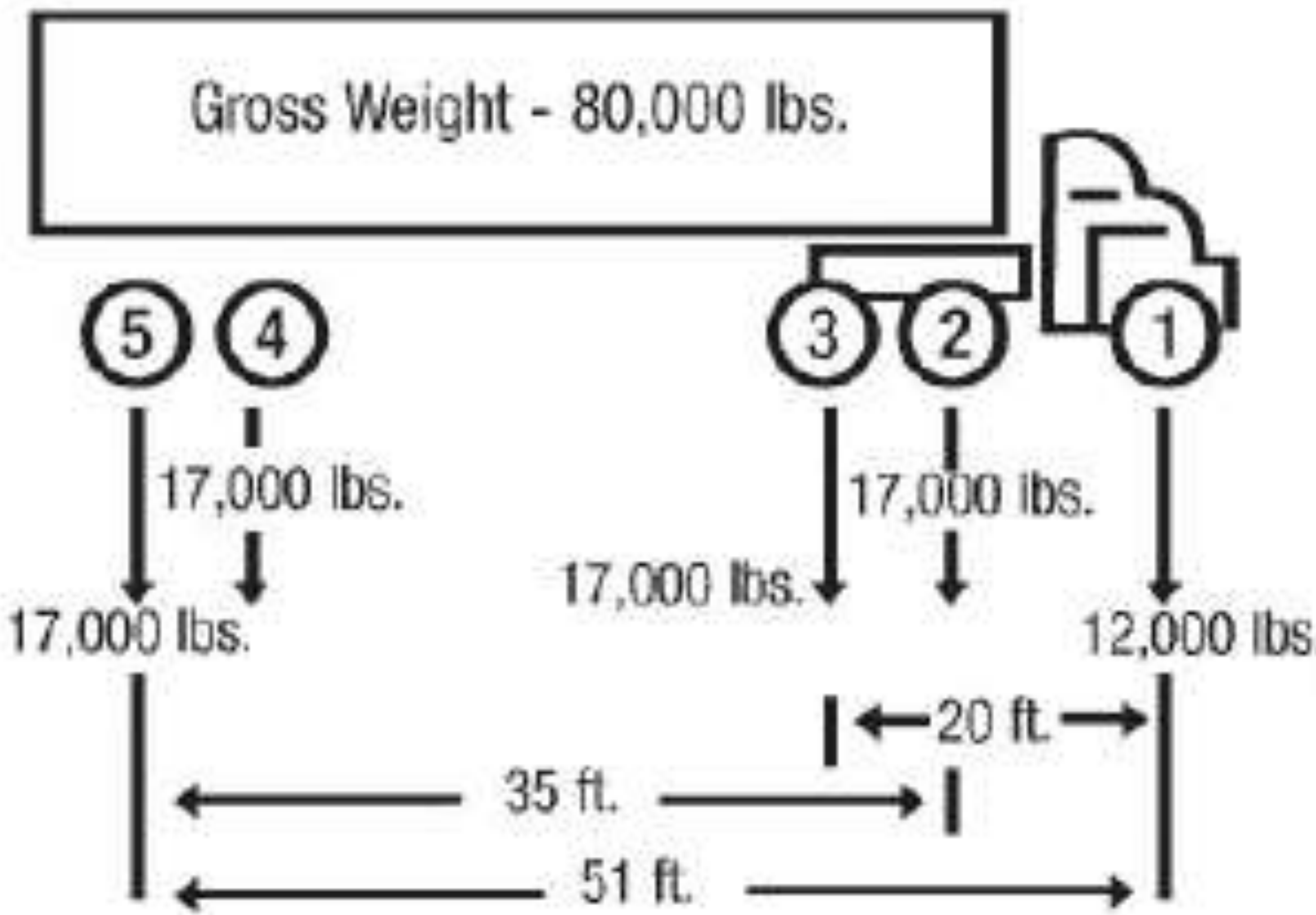

**Is the Formula Necessary?**

Bridges on the Interstate System highways are designed to support a wide variety of vehicles and their expected loads. As trucks grew heavier in the 1950s and 1960, something had to be done to protect bridges. The solution was to link allowable weights to the number and spacing of axles. Axle spacing is as important as axle weight in designing bridges. In Figure A, the stress on bridge members as a longer truck rolls across is much less than that caused by a short vehicle as shown in Figure B, even though both trucks have the same total weight and individual axle weights. The weight of the longer vehicle is spread out, while the shorter vehicle is concentrated on a smaller area.

Increases in truck weight limits can affect bridges in several ways. Should the legally allowable limits change, and the limits exceed the design criteria for a bridge, the bridge must be posted (signed for restricted use) to prevent those heavy vehicles from using it. Changing allowable limits may increase agency costs for inspecting and rating bridges and for posting signs. The number, spacing, and weight of individual axles, as well as the GVW carried on a truck, are important considerations for bridges.

The formula is: $W = 500 [ L N / ( N - 1 ) + 12 N + 36 ]$ where W is the maximum weight of the axle group, L is the distance from the first to last axle in feet, and N is the number of axles. The Federal Highway Administration’s brochure Bridge Formula Weights is available at:

http://www.ops.fhwa.dot.gov/freight/publications/bridge_frm_wts/index.htm


Gross Weight - 80,000 lbs.
5
4
3
2
1
17,000 lbs.
17,000 lbs.
17,000 lbs.
17,000 lbs.
12,000 lbs.
20 ft.
35 ft.
51 ft.

**Based on weight formula** $W = 500 \left[ \frac{LN}{N-1} + 12N + 36 \right]$

Distance in feet (L) between the extremes of any group of 2 or more consecutive axles

**Maximum load in pounds carried on any group of 2 or more consecutive axles**[1]

| | L | N= 2 AXLES | 3 AXLES | 4 AXLES | 5 AXLES | 6 AXLES | 7 AXLES | 8 AXLES | 9 AXLES |
|---|---|---|---|---|---|---|---|---|---|
| Tandem Axle Weight (see pages 3 & 4) | 4 | 34,000 | | | | | | | |
| | 5 | 34,000 | | | | | | | |
| | 6 | 34,000 | | | | | | | |
| | 7 | 34,000 | | | | | | | |
| | 8 | 34,000 | 34,000 | | | | | | |
| | More than 8/less than 9 | 38,000 | 42,000 | | | | | | |
| | 9 | 39,000 | 42,500 | | | | | | |
| | 10 | 40,000 | 43,500 | | | | | | |
| | 11 | | 44,000 | | | | | | |
| | 12 | | 45,000 | 50,000 | | | | | |
| | 13 | | 45,500 | 50,500 | | | | | |
| | 14 | | 46,500 | 51,500 | | | | | |
| | 15 | | 47,000 | 52,000 | | | | | |
| | 16 | | 48,000* | 52,500 | 58,000 | | | | |
| | 17 | | 48,500 | 53,500 | 58,500 | | | | |
| | 18 | | 49,500 | 54,000 | 59,000 | | | | |
| | 19 Example | | 50,000 | 54,500 | 60,000 | | | | |
| | 20 (see page 7) | | 51,000 | 55,500 | 60,500 | 66,000 | | | |
| | 21 | | 51,500 | 56,000 | 61,000 | 66,500 | | | |
| | 22 | | 52,500 | 56,500 | 61,500 | 67,000 | | | |
| | 23 | | 53,000 | 57,500 | 62,500 | 68,000 | | | |
| | 24 | | 54,000 | 58,000 | 63,000 | 68,500 | 74,000 | | |
| | 25 | | 54,500 | 58,500 | 63,500 | 69,000 | 74,500 | | |
| | 26 | | 55,500 | 59,500 | 64,000 | 69,500 | 75,000 | | |
| | 27 | | 56,000 | 60,000 | 65,000 | 70,000 | 75,500 | | |
| | 28 | | 57,000 | 60,500 | 65,500 | 71,000 | 76,500 | 82,000 | |
| | 29 | | 57,500 | 61,500 | 66,000 | 71,500 | 77,000 | 82,500 | |
| | 30 | | 58,500 | 62,000 | 66,500 | 72,000 | 77,500 | 83,000 | |
| | 31 | | 59,000 | 62,500 | 67,500 | 72,500 | 78,000 | 83,500 | |
| | 32 | | 60,000 | 63,500 | 68,000 | 73,000 | 78,500 | 84,500 | 90,000 |
| | 33 | | | 64,000 | 68,500 | 74,000 | 79,000 | 85,000 | 90,500 |
| | 34 | | | 64,500 | 69,000 | 74,500 | 80,000 | 85,500 | 91,000 |
| | 35 | | | 65,500 | 70,000 | 75,000 | 80,500 | 86,000 | 91,500 |
| | 36 | | Exception (see page 8) | 66,000 | 70,500 | 75,500 | 81,000 | 86,500 | 92,000 |
| | 37 | | | 66,500 | 71,000 | 76,000 | 81,500 | 87,000 | 93,000 |
| | 38 | | | 67,500 | 71,500 | 77,000 | 82,000 | 87,500 | 93,500 |
| | 39 | | | 68,000 | 72,000 | 77,500 | 82,500 | 88,500 | 94,000 |
| | 40 | | | 68,500 | 73,000 | 78,000 | 83,500 | 89,000 | 94,500 |
| | 41 | | | 69,500 | 73,500 | 78,500 | 84,000 | 89,500 | 95,000 |
| | 42 | | | 70,000 | 74,000 | 79,000 | 84,500 | 90,000 | 95,500 |
| | 43 | | | 70,500 | 75,000 | 80,000 | 85,000 | 90,500 | 96,000 |
| | 44 | | | 71,500 | 75,500 | 80,500 | 85,500 | 91,000 | 96,500 |
| | 45 | | | 72,000 | 76,000 | 81,000 | 86,000 | 91,500 | 97,500 |
| | 46 | | | 72,500 | 76,500 | 81,500 | 87,000 | 92,500 | 98,000 |
| | 47 | | | 73,500 | 77,500 | 82,000 | 87,500 | 93,000 | 98,500 |
| | 48 | | | 74,000 | 78,000 | 83,000 | 88,000 | 93,500 | 99,000 |
| | 49 | | | 74,500 | 78,500 | 83,500 | 88,500 | 94,000 | 99,500 |
| | 50 | | | 75,500 | 79,000 | 84,000 | 89,000 | 94,500 | 100,000 |
| | 51 | | | 76,000 | 80,000 | 84,500 | 89,500 | 95,000 | 100,500 |
| | 52 | | | 76,500 | 80,500 | 85,000 | 90,500 | 95,500 | 101,000 |
| | 53 | | | 77,500 | 81,000 | 86,000 | 91,000 | 96,500 | 101,500 |
| | 54 | | | 78,000 | 81,500 | 86,500 | 91,500 | 97,000 | 102,000 |
| | 55 | | | 78,500 | 82,500 | 87,000 | 92,000 | 97,500 | 102,500 |
| | 56 | | Interstate Gross Weight Limit (see page 2) | 79,500 | 83,000 | 87,500 | 92,500 | 98,000 | 103,000 |
| | 57 | | | 80,000 | 83,500 | 88,000 | 93,000 | 98,500 | 104,000 |
| | 58 | | | | 84,000 | 89,000 | 94,000 | 99,000 | 104,500 |
| | 59 | | | | 85,000 | 89,500 | 94,500 | 99,500 | 105,000 |
| | 60 | | | | 85,500 | 90,000 | 95,000 | 100,500 | 105,500 |

[1] The values in this table reflect FHWA's policy of rounding down when calculated weights fall exactly halfway between 500-pound increments. Because the Bridge Formula is designed to protect highway infrastructure, FHWA determined that this conservative policy is consistent with the statutory mandate.

*The following loaded vehicles must not operate over H15-44 bridges: 3-S2 (5-axle tractor semitrailer with a wheelbase of less than 38 feet), 2-S1-2 (5-axle semitrailer combination with a wheelbase of less than 45 feet), 3-3 (6-axle truck trailer combination with a wheelbase less than 45 feet), and any truck with 7 or more axles. H15-44 bridges are designed for a specific vehicle load; H15 refers to a 15-ton 2-axle truck; 44 refers to the year AASHTO published the loading information. See *AASHTO Standard Specifications for Highway Bridges*.

**Highway Safety Considerations**

Changes in TS&W regulations can affect highway safety by:

1) increasing or decreasing the amount of truck traffic;
2) causing or requiring changes in vehicle design and vehicle performance that may affect crash rates and severity;
3) causing trucks to shift to highways with higher or lower crash rates.

Crash rates per vehicle-mile increase slightly with gross weight primarily because loading a truck heavier raises its center of gravity and thereby increases the possibility of rollover. However, crash rates per payload ton-mile decrease with a gross weight increase because fewer truck trips are required to haul a given amount of freight.

**Key Findings**

- There needs to be increased flexibility of weight limits and vehicle configurations to allow greater payloads.
- There are concerns about the infrastructure impacts of increased weight limits, particularly on local roads and bridges.
- There are safety concerns about proposed increases in truck weight or length.

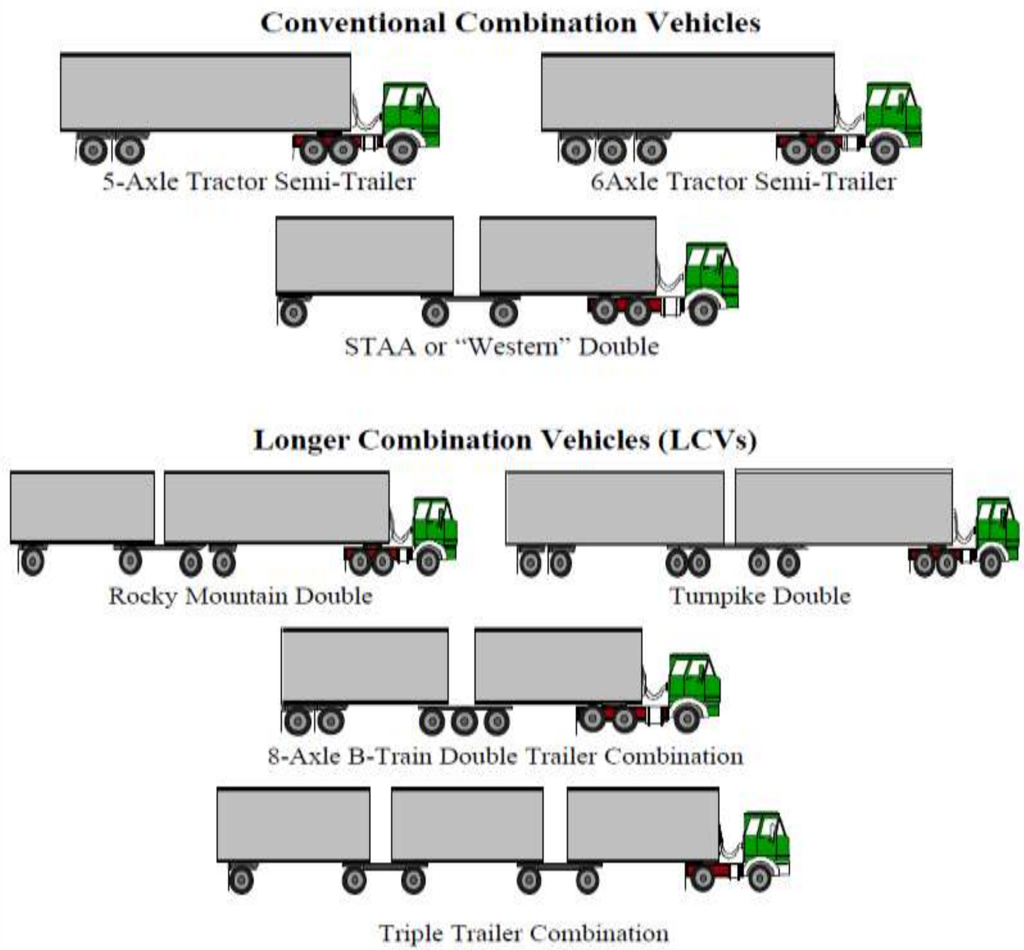
The key finding of the technical analyses was that four heavier truck configurations were found feasible and generated net statewide benefits. A set of changes to spring load restrictions and other related TS&W regulations were also developed and found to offer net benefits. The evaluation considered transport savings, pavement costs, bridge inspection costs, rating and posting impacts, bridge fatigue and deck wear effects, increased bridge design load requirements, safety, and congestion.

Table 3 shows the ESAL values for flexible pavements for the configurations being considered in this study. All the configurations under consideration in this study are better for pavements than the current five-axle tractor-semitrailer at 80,000 pounds based on ESAL factors.

**Table 3. Equivalent Single-Axle Load Values for Flexible Pavements**

| Configuration | Total ESALs |
|---|---|
| Current 5-axle tractor-semitrailer at 80,000 lbs. | 2.4 |
| 6-axle tractor-semitrailer at 90,000 lbs. | 2.0 |
| 7-axle tractor-semitrailer at 97,000 lbs. | 1.5 |
| 8-axle double at 108,000 lbs. | 1.8 |
| Single unit 6- and 7-axle respectively | 0.7 and 0.9 |

**Figure III-10. Comparison of Longer Combination Vehicles With Conventional Trucks**



**Impacts of Proposed Vehicle Configurations**

- Increased payloads and fewer truck trips will lower transport costs significantly.
- Additional axles and fewer truck trips will result in less pavement wear and possible safety increase.
- A modest increase in bridge postings and future design costs will be necessary.

## Summary

- Challenge is to find balance in truck size and weight versus impacts.
- Additional axles and fewer truck trips will result in less pavement wear and possible increase in safety.
- Higher GVW roadways can theoretically require less pavement thicknesses than lower GVW roadways.

| Road Type | Lane Mileage | Sq. Ft. of Pavement | Replacement Cost per sq. ft. | Total Replacement Cost | Design Life in ESALS |
|---|---|---|---|---|---|
| State Highway | 1000 | 63,660 | $4.75 | $302,385 | 200,000 |

A typical 80,000 pound 5-axle TST has a payload of 49,500 pounds and generates 2.4 ESAL per trip.

A 5-axle TST at 90,000 pounds has a payload of 59,500 pounds and generates 4.1 ESAL per trip.

If the annual agricultural harvest generates 100,000,000 pounds of produce, how many trips will each vehicle make to move the products to market?
__________ trips by 5-axle 80,000 lb TST
__________ trips by 5-axle 90,000 lb TST

How many ESALs will each vehicle generate?
__________ ESALs by the 5-axle 80,000 lb TST
__________ ESALs by the 5-axle 90,000 lb TST

How many years will the highway pavement last under use by each vehicle type?
__________ years with the 5-axle 80,000 lb TST
__________ years with the 5-axle 90,000 lb TST

What is the annual cost for replacing the highway pavement for each vehicle type?
__________ per year for the 5-axle 80,000 lb TST
__________ per year for the 5-axle 90,000 lb TST

| Road Type | Lane Mileage | Sq. Ft. of Pavement | Replacement Cost per sq. ft. | Total Replacement Cost | Design Life in ESALS |
|---|---|---|---|---|---|
| State Highway | 1000 | 63,660 | $4.75 | $302,385 | 200,000 |

A typical 80,000 pound 5-axle TST has a payload of 49,500 pounds and generates 2.4 ESAL per trip.

A 5-axle TST at 90,000 pounds has a payload of 59,500 pounds and generates 4.1 ESAL per trip.

If the annual agricultural harvest generates 100,000,000 pounds of produce, how many trips will each vehicle make to move the products to market?
__2020_____ trips by 5-axle 80,000 lb TST
__1681____ trips by 5-axle 90,000 lb TST

How many ESALs will each vehicle generate?
__4848____ ESALs by the 5-axle 80,000 lb TST
__6892____ ESALs by the 5-axle 90,000 lb TST

How many years will the highway pavement last under use by each vehicle type?
__41.3_____ years with the 5-axle 80,000 lb TST
__29.0_____ years with the 5-axle 90,000 lb TST

What is the annual cost for replacing the highway pavement for each vehicle type?
__$7322___ per year for the 5-axle 80,000 lb TST
__$10,427__ per year for the 5-axle 90,000 lb TST

| Road Type | Lane Mileage | Sq. Ft. of Pavement | Replacement Cost per sq. ft. | Total Replacement Cost | Design Life in ESALS |
|---|---|---|---|---|---|
| State Highway | 1000 | 63,660 | $4.75 | $302,385 | 200,000 |

A typical 80,000 pound 5-axle TST has a payload of 49,500 pounds and generates 2.4 ESAL per trip.

A 6-axle TST at 90,000 pounds has a payload of 58,500 pounds and generates 2.0 ESAL per trip.

If the annual agricultural harvest generates 100,000,000 pounds of produce, how many trips will each vehicle make to move the products to market?
___________ trips by 5-axle 80,000 lb TST
___________ trips by 6-axle 90,000 lb TST

How many ESALs will each vehicle generate?
___________ ESALs by the 5-axle 80,000 lb TST
___________ ESALs by the 6-axle 90,000 lb TST

How many years will the highway pavement last under use by each vehicle type?
___________ years with the 5-axle 80,000 lb TST
___________ years with the 6-axle 90,000 lb TST

What is the annual cost for replacing the highway pavement for each vehicle type?
___________ per year for the 5-axle 80,000 lb TST
___________ per year for the 6-axle 90,000 lb TST

| Road Type | Lane Mileage | Sq. Ft. of Pavement | Replacement Cost per sq. ft. | Total Replacement Cost | Design Life in ESALS |
|---|---|---|---|---|---|
| State Highway | 1000 | 63,660 | $4.75 | $302,385 | 200,000 |

A typical 80,000 pound 5-axle TST has a payload of 49,500 pounds and generates 2.4 ESAL per trip.

A 6-axle TST at 90,000 pounds has a payload of 58,500 pounds and generates 2.0 ESAL per trip.

If the annual agricultural harvest generates 100,000,000 pounds of produce, how many trips will each vehicle make to move the products to market?
__2020____ trips by 5-axle 80,000 lb TST
__1710____ trips by 6-axle 90,000 lb TST

How many ESALs will each vehicle generate?
__4848____ ESALs by the 5-axle 80,000 lb TST
__3420____ ESALs by the 6-axle 90,000 lb TST

How many years will the highway pavement last under use by each vehicle type?
__41.3_____ years with the 5-axle 80,000 lb TST
__58.5_____ years with the 6-axle 90,000 lb TST

What is the annual cost for replacing the highway pavement for each vehicle type?
__$7322___ per year for the 5-axle 80,000 lb TST
__$5169___ per year for the 6-axle 90,000 lb TST

# Thank You!