

TECHNICAL SUMMARY

Preliminary Assessment of Pavement Damage Due to Heavier Loads on Louisiana Highways

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P.I.(s) Freddy Roberts & Ludfi Djakfar
Louisiana Technical University

LTRC Contact:
Masood Rasoulian, P.E.
Phone (225) 767-9112

INTRODUCTION

The 1998 Transportation Equity Act for the 21st Century (TEA 21) allows heavier loads for sugarcane haul on Louisiana interstate highways. These loads are currently being applied to state and parish roads that are traveled by vehicles going from the interstates to the processing plants. TEA 21 further provides Federal funding to enable Louisiana to study the effects of increasing the allowable permitted loads for transporting sugar cane. Gross vehicle weight (GVW) on interstate routes has typically been restricted to 80,000 lbs for five axle semi-trailer (LA type 6) vehicles with a maximum tandem axle weight of 32,000 lbs. Permitted loads on the type 6 vehicle during harvest season, have, since 1997, been allowed for up to 83,400 lbs GVW and 35,200 lbs on tandem axles. TEA 21 now extends the GVW to 100,000 lbs with tandem axle weights increasing to 48,000 lbs. Since this legislation opens the door to heavier sugarcane loads, it is necessary to evaluate the effect of increasing the GVW on all special harvest permit vehicles using Louisiana highways.

To complete such an evaluation there are two parts which must ultimately be considered:

- a) An assessment of the additional damage caused by these heavier loads and the resultant maintenance and rehabilitation costs incurred because these trucks are operating at higher loads, and
- b) An assessment of the additional road user costs that should be assessed against the vehicles producing the damage if equity is desired. An equity analysis involves, first, determining the cost incurred by the road authority in providing roadways which accommodate a particular group of vehicles and, second, determining the user fees paid by that group of vehicles as they operate on the roadways. Equity occurs when each group of vehicles, with similar characteristics, pays a percentage of the total cost incurred to provide the roadways that is equal to that group's percentage of total contributed revenues from the various road user taxes paid, i.e., cost responsibility divided by user fees paid equals 1.0.

OBJECTIVE

The principal objective of this study is to provide a preliminary assessment of the effect of increasing the GVW on Louisiana type 2 and type 6 vehicles as allowed by special permits, on pavement costs to rehabilitate the damaged interstate, U.S. and state highways in the state. The special permits include provisions of both TEA 21 and Louisiana regulations on vehicles and weights.

METHODOLOGY

Steps in the research procedure are discussed below:

1. Identify the key commodities which operate under harvest permits, determine what the harvest permit loads are and the harvest permit fees.
2. Review state agricultural statistics to identify parishes with high production of identified commodities.
3. Call the state or industry organization which represents each commodity and get help in identifying a parish whose roads are heavily used to transport the commodity from the field to the first processing point.
4. Using DOTD mainframe computer resources, identify candidate sections of road for which construction data are available and easily accessible. Review project files in the pavement design office to determine if design data is available.
5. Discuss candidate sections with industry representatives and select one interstate, one U.S. highway, and one Louisiana highway section for inclusion in the study. Some parishes do not have interstate highways so that only U.S. and Louisiana highways are included.
6. Secure pavement design data from DOTD to provide information of the latest major rehabilitation on each roadway. The data includes traffic (Equivalent Single Axle Loads), materials, subgrade, and other required data for an assessment of the effects of increasing vehicle weight on rehabilitation costs.
7. For each roadway, determine the tonnage of each commodity hauled from the field to the first processing point. This data will be developed with the help of industry personnel who work with each commodity.
8. Using the data from item 6, estimate the time when the existing pavement will carry all the design traffic for each weight scenario. The weight scenarios to be investigated are:
 - A. Scenario 1: for both state and interstate highways operating without permits - this scenario is to develop base line data to which other scenario results can be compared.
 - 1- 80,000 lbs GVW on type 6 vehicles with nine inch tires on the steering axle with single axle maximum of 22,000 and tandem axle maximum of 37,000 lbs.
 - 2- 49,000 lbs GVW on type 2 vehicles with nine inch tires on the steering axle with tandem axle maximum of 37,000 lbs.
 - B. Scenario 2: for state highways
 - 1- For agronomic/horticultural permits: 100,000 lbs GVW on type 6 vehicles with maximum weights of 12,000 lbs on the steering axle and 44,000 lbs on tandem axles.
 - 2- For cotton module permits: 68,000 lbs GVW on type 2 vehicles with maximum weights of 20,000 lbs on single

axles and 48,000 lbs on tandem axles.

3- Natural forest products: 86,600 lbs GVW for type 6 vehicles with maximum weights of 22,000 lbs on single axles and 37,000 lbs on tandem axles.

C. Scenario 2: for interstate highways

1- For agronomic/horticultural permits: the same as for state highways in scenario 2.

2- For cotton module permits: These vehicles are over length and are not allowed to travel on interstate highways.

3- Natural forest products: 83,400 lbs GVW for type 6 vehicles with maximum weights of 20,000 lbs on single axles and 35,700 lbs on tandem axles.

D. Scenario 3: for all highways

1- For agronomic/horticultural and natural forest products: 100,000 lbs GVW on type 6 vehicles with maximum weights of 12,000 lbs on steering axles and 44,000 lbs on tandem axles.

2- For cotton module permits: These vehicles are overlength and are not allowed to travel on interstate highways. For state highways use the 68,000 lbs GVW on type 2 vehicles with maximum weights of 12,000 lbs on the steering axle and 48,000 lbs on tandem axles.

9. For each weight scenario, determine the empty weight of the type 2 and type 6 trucks so that the average payload per truck can be determined ($\text{Payload} = \text{GVW} - \text{empty weight}$). The number of trucks required to carry the commodity is the total weight of commodity hauled over the road divided by the average payload. This number of trucks is appropriately added into the traffic estimates for each scenario.

10. At the time that the design loading has been achieved for the current performance period, redesign an overlay for each roadway assuming that each weight scenario continues during the next design period. Repeat this procedure for the length of the analysis period and generate a project cost stream which includes the periodic rehabilitations.

11. Calculate the net present worth of the rehabilitation costs for each project using an interest rate provided by the DOTD.

12. Compare the cost differential for the weight scenarios and develop cost differential tables for comparisons between the weight scenarios.

CONCLUSIONS

The following conclusions were drawn from this study:

- Increasing the gross vehicle weight on vehicles transporting commodities on a system of roads that were designed for vehicles operating at a lower GVW decreases the service life of the road in a manner proportional to the ratio of ESALs produced by vehicles under the new GVW divided by the number of ESALs remaining in the design period. The greater the increase in GVW for trucks with the same number of axles, the shorter the remaining service life of the pavements.
- The larger the total number of ESALs that a road is designed to carry, the less the effect of increasing the GVW on vehicles carrying a single commodity. One ramification of this conclusion is that the effects of increasing GVW on the interstate for a single commodity should be lower than would be the effect on either US or Louisiana highways. It should be noted that this conclusion also holds true for an increase in GVW for all commodities but the magnitude of the reduction in service

life and increase in costs would be substantially higher.

- The cost to road users of increasing the gross vehicle weight on vehicles carrying a few select commodities is substantial. As a result, the responsibility for the increase in rehabilitation costs are directly attributable to the operation of the vehicles carrying the heavier loads. The total magnitude of these costs for the whole state of Louisiana has not been estimated.
- The costs developed in this report are developed only from design parameters, (i.e., no distress factors have been included such as rutting or cracking induced by heavier GVWs). It is possible, and indeed, probable that the performance periods based on design considerations would be shortened substantially and the costs of rehabilitation increased if the pavement layers are overstressed by these heavier axle loads so that premature rutting or cracking occurs.

RECOMMENDATIONS

Based on the results from this study and the highway pavement costs which will have to be paid by the DOTD as a consequence of allowing permitted overweight vehicles on Louisiana highways, it is recommended that the Louisiana legislature consider doing one of the following:

- Roll back all gross vehicle weights to the legal limit and issue overweight permits only on an individual trip basis,
- Continue to issue harvest permits but increase the registration and permit fees enough to pay for all the projected roadway damage induced by these overweight vehicles. One alternative to increasing the registration and permit fees is to institute a ton-mile tax to pay for the roadway damage, or:
- Continue to issue harvest permits at the current fee levels but require that all vehicles add enough axles to reduce the damage to the pavement structure to that produced by vehicles loaded to the legal load limits.

The Louisiana DOTD should monitor the performance of a selected group of roadways being subjected to these heavier GVWs in order to determine whether the distress developed is more severe than the pavement design models estimate. The DOTD should also consider developing performance models to predict rutting and fatigue cracking for roads being subjected to these heavier permitted loads.

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