ALBERTA'S WEIGHT ENFORCEMENT PROGRAM AND ITS IMPACT ON PAVEMENT COSTS

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ABSTRACT

The weight enforcement program in Alberta, through permanent weigh scales and mobile units, is the chief means of controlling overloads on the provincial highway system. The number and magnitude of vehicular axle-loads can have an adverse effect on pavement, namely, premature damage and reduction in service life, with consequent increases in the costs of pavement upkeep.

Using traffic volume and vehicle weight data that had been collected at a weigh-in-motion site, as well as Alberta Transportation and Utilities' pavement management system, the cost of pavement damage due to overloads is estimated on a network level.

The level of enforcement provided by Alberta's weight enforcement program and the extent to which these efforts reduce the costs of pavement rehabilitation is then estimated.

INTRODUCTION

The number and magnitude of vehicular axle-loads travelling on our roadways can adversely affect pavement, bridges, and roadway safety. Overloading can cause premature damage to highways, thereby reducing the riding quality and serviceability of the road infrastructure (1). Additionally, increased vehicle weights are associated with increased crash severity, especially when heavy vehicles collide with light vehicles (2). To help counter these effects, overloads are controlled by the weight enforcement program of Motor Transport Services Division, Alberta Transportation and Utilities. The purpose of this paper is to estimate the cost of pavement damage from overloading and to assess the effectiveness of Alberta's weight enforcement program in minimizing these costs.

PAVEMENT DAMAGE FROM OVERLOADING

To help estimate the cost of pavement damage from overloading, traffic volume data and truck weight data that had been collected at a weigh-in-motion site (WIM) on Highway 2 at Leduc, were utilized for this study. Figure 1 shows the locations of Alberta's Vehicle Inspection Stations while Figure 2 shows the criteria for classifying trucks passing over the WIM scale. Trucks at this site were travelling northbound towards Edmonton and there was no Vehicle Inspection Station (VIS) nearby to which they must report. While truck traffic was largely uncontrolled at the WIM site, trucks travelling north from Calgary would have had to have reported to the Balzac VIS on Highway 2 (about 250 km south of the WIM test site), providing they did not bypass it. It should be noted that Highway 2 is regularly patrolled by police and, at times, by mobile weight enforcement units so data from the WIM test site was used to estimate overloads in the absence of a nearby VIS but in the presence of regular police enforcement.

Data from the WIM test site was collected from February 1, 1983 to January 31, 1984. The results of the analysis are summarized in Table 1. Across all trucks, four percent were overloaded. To assess the influence of overloads on cumulative equivalent single axle loads (ESALs), standard load applications contributed by overweight trucks had to be determined. Also as shown in Table 1, the 4 percent overweight trucks contributed 20 percent of the total ESALs. Trucks in groups 9, 12, 14 and 15 were most likely to be overweight and these four groups accounted for 87.6 percent of the ESALs due to overloads.

Vehicle group 9, consisting mainly of five axle truck - semi-trailers (3S2), accounted for approximately 43 percent of the total truck volume and, while only 5.4 percent of these vehicles were overloaded, 61.7 percent of ESALs due to overloads were from vehicles in group 9.

Six axle truck-trailer combinations (vehicle group 12) represented only 1.5 percent of the total truck traffic, but almost 20 percent were overloaded and 9.4 percent of ESALs due to overloads were from this group.

Seven axle trucks (groups 14 and 15) were 7.8 percent of all trucks, 6.6 percent were overloaded and 16.5 percent of ESALs due to overloads were from these two groups.

Four percent is probably a very conservative estimate of the proportion of overloaded trucks travelling on Alberta highways, given the fact that many of the trucks in this study were already weighed upstream at the Balzac VIS and that Highway 2 is regularly patrolled by police and mobile enforcement units.

To determine the costs associated with overloads on the primary and secondary highways, the change in pavement service life, as a result of increased ESALs due to overloads, was estimated using the department's Pavement Management System. The additional rehabilitation requirements associated with this reduction in service life were established and then converted into a dollar amount.

The estimated cost of pavement damage due to overloads is $12.24 million per year, with $7.64 million for rehabilitation of the primary highways and $4.6 million for the secondary network. It should be noted that the secondary roads are designed for much lower ESAL accumulation rates and that the increase in ESALs resulted in dramatic reductions in their pavement service life.

EFFECTIVENESS OF ALBERTA'S WEIGHT ENFORCEMENT PROGRAM

As stated, a very conservative estimate of the rate of overloaded vehicles was calculated on the basis of 1983/84 WIM data. On the assumption that this four percent rate does not overstate the proportion of overloaded vehicles travelling in more recent years on Alberta highways, the effectiveness of Alberta's weight enforcement program was assessed using data from April 1, 1986 to September 30, 1987. See Table 2.

Permanent Weigh Scales

During the 1986/87 fiscal year (April 1 to March 31), 660,059 trucks were weighed at the 19 permanent weigh scales. With a four percent overload rate, the total expected number of apprehensions would be 26,403. In actual fact, however, only 6,543 trucks were apprehended. Therefore, the enforcement level provided by Alberta's network of vehicle inspection stations during the 1986/87 fiscal year can be estimated to be about 25 percent (6,543/26,403 x 100).

Over the next six month period, 348,561 trucks were weighed at the permanent weigh scales. Again, using a four percent overload rate, the total expected number of apprehensions would be 13,943. As 4,324 apprehensions were made, the estimated enforcement level over the six month period from April 1, 1987 to September 30, 1987 was about 31 percent (4,324/13,943 x 100).

The two major reasons why permanent weigh scales detect only a portion (25 to 31 percent) of the overloaded vehicles are:

- truckers can bypass the scales using alternate routes and;
- truckers can adjust their schedules in order to travel during those times when the scales are closed (1).

Portable Scales

The mobile patrol is an important component in Alberta's weight enforcement program. Equipped with four portable scales, a mobile unit can detain and weigh a truck suspected of bypassing the permanent scale or of travelling overweight when the scale is closed.

Enforcement data on the mobile patrol units became available as of April 1, 1987. Over the six month period from April 1 to September 30, 1987, 596 trucks were apprehended by the 31 mobile patrol units that operated out of the 10 mobile unit districts shown in Table 3. As an estimated 13,943 trucks were overloaded during that period, the level of enforcement provided by the mobile units is estimated to be about four percent (596/13,943 x 100).

Despite the relatively few trucks apprehended by the mobile units in comparision to the permanent weigh scales, it should be noted that mobile units tend to have a much higher "hit rate" when looking at the number of trucks apprehended as a proportion of total trucks weighed. During the first six months of the 1987/88 fiscal year, 17 percent of the trucks weighed by the mobile patrol units were overweight versus about one percent of those weighed at the permanent scales. This occurs because the mobile patrol units weigh only those trucks suspected of being overloaded and about one time in six (17%) the mobile patrol officer detects an overloaded truck. At the permanent scales, however, all trucks are weighed, regardless of whether or not they are suspected of being overloaded. It should also be pointed out that the mobile units enforce many other regulations besides those for overweights. Hence, mobile units spend only a portion of their time enforcing overweight regulations.

A final limitation that should be noted is that there is no data available at this time with which to determine the proportion of ESALs due to overloads detected by the weight enforcement program. Only the proportion of overloaded trucks is available. While 31 percent of the overloaded trucks were apprehended at the weigh scales, and 4 percent by the mobile units, it is likely that the mobile units apprehended much more than 4 percent of the ESALs due to overweight. A trucker who bypasses a scale is likely to know his load is overweight, while those travelling to the scales are probably unsuspecting. Consequently, one would expect to find higher ESALs per overweight truck for trucks apprehended by the mobile units than for those apprehended at the scales.

CONCLUSIONS

The estimated enforcement level during the first six months of fiscal 1987/88 for Alberta's entire weight enforcement program is 35 percent, with 31 percent attributable to the permanent weigh scales and 4 percent to the mobile units. In other words, the program controlled an estimated 35 percent of the overloads travelling on the provincial highway system.

If all overloads had remained undetected, this would have cost the province an estimated $12.24 million per year in pavement rehabilitation. The pavement cost savings attributable to Alberta's vehicle weight inspection program is about $4.28 million per year (0.35 x 12.24).

Notwithstanding the impact that Alberta's vehicle weight enforcement program has on reducing pavement costs, the program also helps increase safety as well as increase the service life of the highway system's bridges. While estimates of the savings from increased safety or bridge life are outside the scope of this study, these savings would be in addition to the estimated $4.28 saved in pavement rehabilitation.

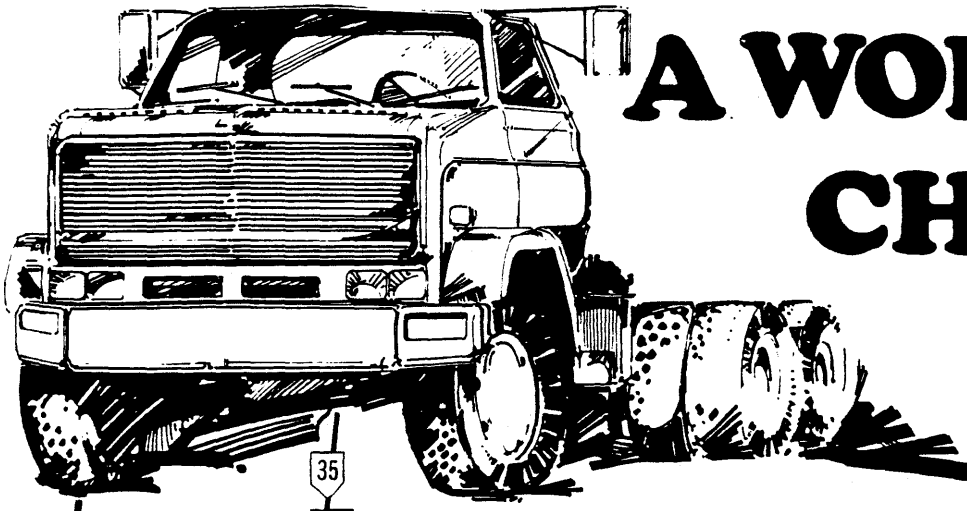
In summary, this study underscores the important role that weight enforcement programs play in the management of a jurisdiction's pavement resources. A close working relationship is needed between enforcement and pavement management professionals if the global needs of the highway system and its users are to be met.

REFERENCES

1. Comptroller General of the United States, Excessive Truck Weight: An Expensive Burden We Can No Longer Support, Washington, D.C., 1979.

2. National Motor Vehicle Safety Advisory Council, Motor Vehicle Safety Seminar - Key Issues in Heavy Truck Safety: Proceedings, Washington, 1976.

GIVE YOUR TRUCKS A WORKING CHANCE



Alberta
TRANSPORTATION
AND UTILITIES
Motor Transport Services

FIGURE 1

Vehicle Inspection Stations

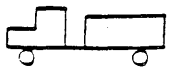
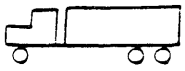
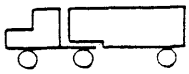
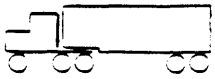
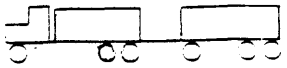
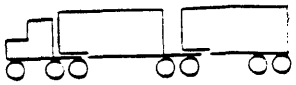
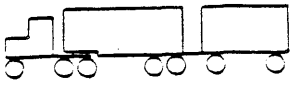
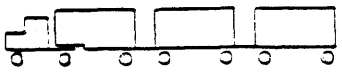
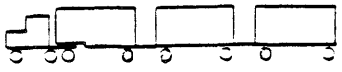
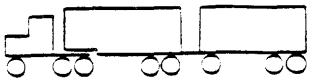
Demmit
Grimshaw
Grande Prairie
Whitecourt
Radway
St. Paul
Edmonton
Edson
Acheson
Ardrossan
Leduc
Vermilion
Yellowhead (Hinton)
Motor Transport Services
Head Office
Red Deer
Morrin
Jumping
Pound
Balzac
Strathmore
Cochrane
CALGARY
Dunmore
Lethbridge
Burmis
Coutts

Legend

- Inspection Station
- District Office
- Inspection Station and District Office
- 2 Highway Number
- * Motor Transport Services Head Office

FIGURE 2

VEHICLE CLASSIFICATION FOR ANALYSIS OF WEIGH-IN-MOTION DATA

Vehicle Class	Truck Type	Axle Config.	
3	2S0	1,1	
4	3S0	1,2	
5	2S1 or 2S0-1	1,1,1	
7	2S2 or 2S0-2	1,1,2	
8	Undefined 4 Axle Vehicles		
9	3S2 or 3S0-2	1,2,2	
10	2S1-2	1,1,1,1,1	
11	Undefined 5 Axle Vehicles		
12	3S0-3	1,2,1,2	
13	3S1-2	1,2,1,1,1	
14	3S2-2	1,2,2,2	
15	3S2-2	1,2,2,1,1	
16	2S1-2-2	1,1,1,1,1,1,1	
17	3S1-2-2	1,2,1,1,1,1,1	
18	3S2-3	1,2,2,1,2	
19	Undefined 6 or more axles		

Source: Alberta Research Council, 1985.

TABLE 1

LEDUC WEIGH-IN-MOTION TRUCK TRAFFIC AND WEIGHT INFORMATION*

Vehicle Group	Number of Trucks	Average ESAL/Pass	ESALs	ESALs Due to Overloads	% Trucks Overloaded
3 (2S0)	70990 (23.3%)	0.2	14198 (3.9%)	1206 (1.7%)	0.37
4 (3S0)	23765 (7.8%)	0.95	22576 (6.2%)	4131 (5.7%)	4.5
5 (2S1/2S0-1)	7922 (2.6%)	0.37	2931 (0.8%)	185 (0.3%)	0.25
7 (2S2/2S0-2)	18280 (6.0%)	0.73	13345 (3.7%)	1495 (2.1%)	1.1
8 (Undef-4 Axle)	5180 (1.7%)	0.91	4713 (1.3%)	-	-
9 (3S2/3S0-2)	130403 (42.8%)	1.57	204732 (56.6%)	44836 (61.7%)	5.4
10 (2S1-2)	1523 (0.5%)	0.71	1082 (0.3%)	174 (0.2%)	0.6
11 (Undef-5 Axle)	2742 (0.9%)	1.32	3620 (1.0%)	-	-
12 (3S0-3)	4570 (1.5%)	4.38	20017 (5.5%)	6806 (9.4%)	19.8
13 (3S1-2)	4570 (1.5%)	1.1	5027 (1.4%)	91 (0.1%)	0.1
14 (3S2-2)	16148 (5.3%)	2.24	36171 (10.0%)	8030 (11.1%)	7.2
15 (3S2-2)	7617 (2.5%)	2.25	17138 (4.7%)	3925 (5.4%)	5.4
16 (2S1-2-2)	1219 (0.4%)	0.95	1158 (0.3%)	28	0.2
17 (3S1-2-2)	2437 (0.8%)	1.52	3705 (1.0%)	348 (0.5%)	1.9
18 (3S2-3)	2437 (0.8%)	1.93	4704 (1.3%)	245 (0.3%)	2.0
19 (Undef-6+ Axle)	4266 (1.4%)	1.55	6612 (1.8%)	1150 (1.6%)	2.6
TOTAL	**304,069**	**1.18**	**361,730**	**72,650 (20%)**	**4.0**

*NOTE: 16 wheel trailers do not register on the WIM due to their width.

Source: Alberta Research Council, 1985.

TABLE 2

PERMANENT WEIGH SCALE ENFORCEMENT DATA

Scale Location	1986/87*		1987**	
	Trucks Weighed	Overweight Apprehensions	Trucks Weighed	Overweight Apprehensions
Acheson	21553	156	10299	138
Ardrossan	43193	162	18167	127
Balzac	56658	837	33192	595
Burmis	46336	623	21132	305
Cochrane	4146	217	7861	113
Coutts	33559	62	14123	68
Demmitt	15519	106	5677	71
Dunmore	41504	22	31710	62
Grande Prairie	18350	352	8613	278
Grimshaw	15709	532	10218	356
Jumping Pound	55002	475	23606	215
Leduc	79475	1264	47532	769
Morrin	10225	71	8888	59
Radway	30873	372	11458	222
Red Deer	12778	111	9367	63
Strathmore	27238	66	11930	79
Vermilion	71420	136	30955	95
Whitecourt	50918	933	26330	652
Yellowhead (Hinton)	25603	46	17503	57
TOTAL	**660,059**	**6,543**	**348,561**	**4,324**

* From April 1, 1986 to March 31, 1987.
** From April 1, 1987 to September 30, 1987.

Source: Alberta Transportation and Utilities, 1988.

TABLE 3

MOBILE UNIT WEIGHT ENFORCEMENT DATA*

Mobile Unit District	1987* Trucks Weighed	1987* Overweight Apprehensions
Calgary	288	57
Edmonton	136	47
Edson	89	15
Grande Prairie	270	77
Grimshaw	270	52
Lethbridge	1349	90
Red Deer	368	136
St. Paul	178	44
Vermilion	244	32
Whitecourt	279	46
TOTAL	**3,471**	**596**

* From April 1, 1987 to September 30, 1987

Source: Alberta Transportation and Utilities, 1988.