REGIONAL INITIATIVE ON HEAVY VEHICLE OVERLOAD CONTROL: NAMIBIA'S PROGRESS TOWARDS CONTROLLED PAVEMENT CONSUMPTION

L Kiggundu and C Lutombi

Roads Authority
Private Bag 12030, Windhoek, Namibia. E-mail: kiggundul@ra.org.na and lutombic@ra.org.na

ABSTRACT

The road sector co-ordinating organ of the Southern African Development Community (SADC) has identified heavy vehicle overloading as one of the priority area that requires urgent attention for the purpose of reducing the rate of deterioration of the road networks of member states.

Namibia recognised long before the negative impact of overloading on its road network and has such developed a strategy to minimise the said impact, through constructing weighbridge facilities at strategic locations along the most traffic road sections, together with the establishment of a section within the Roads Authority dedicated to heavy vehicle overload control and road safety.

Statistics from operations carried out at the completed weighbridge facilities show a positive reduction in the extent and degree of overloading which will ultimately transmit in a reduction in pavement consumption in terms of the cumulative E80's or Equivalent Standard Axles and at the same time reduce on costs through the construction of lighter pavements.

INTRODUCTION

The carrying capacities of heavy goods vehicles have increased tremendously over time as a result of advancement in technology. As such overloading of heavy vehicles is common on road networks that lack effective control of axle, axle group, axle combinations and gross vehicle masses, resulting in rapid deterioration of the pavement structures.

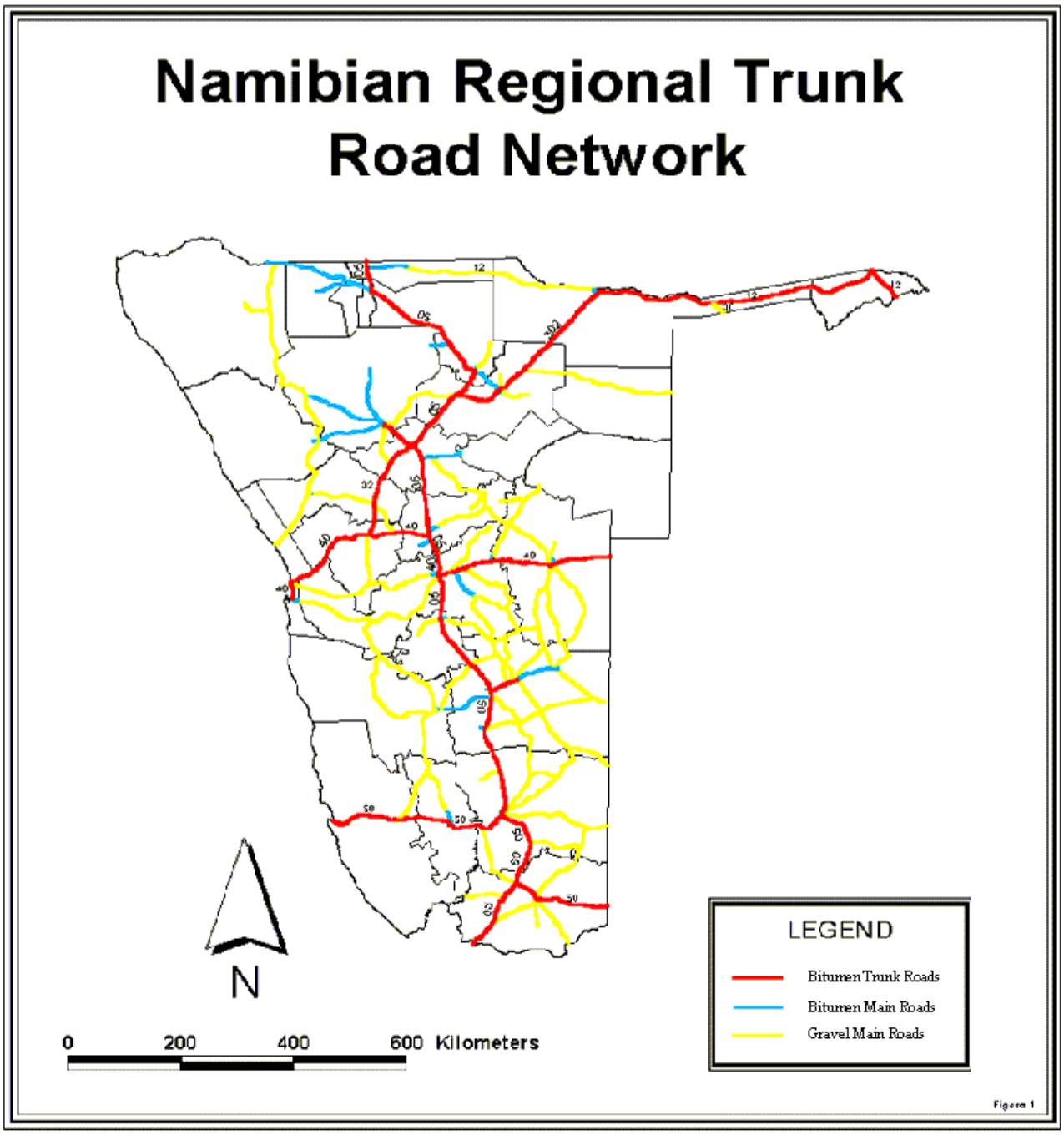
The Southern African Development Community (SADC) Protocol on Transport, Communications and Meteorology under Subclause 2 of Article 6.6: Loads on Vehicles requires the development and implementation of a regional overloading control strategy which inter alia shall:

- coordinate overloading control activities
- provide effective enforcement which shall include the establishment of an integrated network of weighbridges at strategic points on the Regional Trunk Road Network (RTRN)

This paper presents the measures so far implemented in Namibia to control the consumption of road pavements and discusses the progress achieved to date.

THE ROAD NETWORK

The national road network of Namibia totals to 46 000 km comprising of trunk, main and district roads of which 5 500 km are of bitumen surfaced standards, 40 500 km are unsealed comprising of roads of gravel and salt standards and tracks, complimented by a total of 600 bridges and 2 000 culverts with spans greater than 1.5 metres. This gives a per capita length of road of 0.027 km or 27 km for every 1000 persons, which is among the highest in the region and the continent at large. The layout of the network is presented in Figure 1.



The trunk road network consists of a north-south link running from the border with South Africa to the border with Angola, the Trans-Kalahari Highway, a west-east link running from Walvis Bay at the west coast to the border with Botswana, and a third link through the Caprivi Region known as the Trans-Caprivi Highway. Secondary links connect these major corridors with one another.

The three links are part of the regional development corridors originating from the coast, all identified as potential drivers of economic growth, enhancement of regional co-operation and promotion of tourism. The three corridors namely, the Walvis Bay-Oshikango-Namibé Development Corridor, the Walvis Bay-Botswana-Gauteng-Maputo Development Corridor and the Walvis Bay-Ndola-Lubumbashi Development Corridor are all serviced by the Namibian trunk road network.

The average age of the bitumen road network comprising the RTRN in Namibia, based on the date of the first upgrade is 25.8 years, but improves to 23.1 years when the major rehabilitation interventions done over the period are taken into account. On the average the bitumen road network therefore is serving beyond its

design life and major rehabilitation will be required in the short to medium term. Table 1 below gives the percentage distribution of the network by age.

Table 1. RTRN road network: age distribution: years.

	>30	30≤ Age<25	25≤ Age<30	20≤ Age<15	15≤ Age≤10	<10
Length (km)	1 364	675	484	75	193	844
% of Total	37.5	18.6	13.3	2.1	5.3	23.2
Cumulative %	37.5	56.1	69.4	71.5	76.8	100.0

Operations carried out in 2001 to determine the status of overloading gave levels ranging between 12% and 42%. The overall average on the network stood at 28%, transmitting into an annual cost of N$34 million (USD 5.2 million).

Given the high incidence of overloading and the extent and age of the network, it became necessary to develop a strategy to control the consumption of the road pavements, and reduce the rate of increase of the maintenance costs.

OVERLOAD CONTROL STRATEGY

With the above in view, a strategy on overload control was developed and recommended the following:

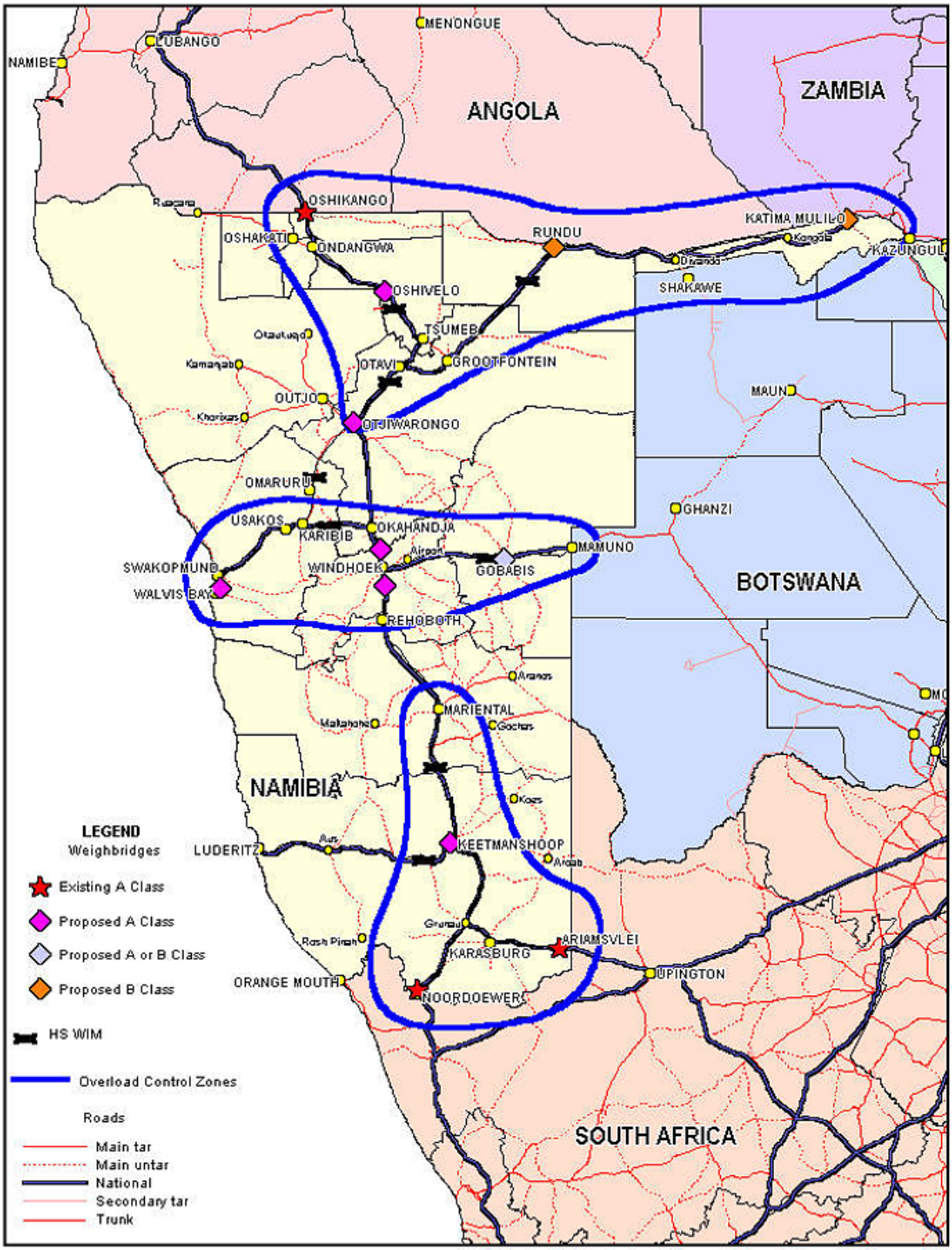
- development of weighbridge facilities at strategic locations on the network
- establishment of a cadre of personnel dedicated to overload control and other road safety enforcement
- maintaining the efficiency and effectiveness of overload control through private sector participation in the management of overload control operations
- developing a networking system of all the weighbridge facilities for monitoring of the operations and minimise human interventions and therefore malpractices
- consult with the stakeholders at all stages and particularly educate the judicial system on the implications of overloading
- encouragement of joint overload control operations across borders and sharing of information
- introduction of overload fees that fully recover the cost of damage to the road pavements

Weighbridge network

The criteria used for the selection of weighbridge sites at strategic points on the road network were:

- the level of heavy vehicle traffic on the road sections
- the presence of essential services to minimise inconvenience to the heavy vehicle operators and the overload control personnel
- future road network development and potential to generate heavy vehicle traffic
- for cross-border traffic, the availability of weighing facilities across the border

Three overload control zones were identified on the trunk road network covering, the Trans-Caprivi Highway and its future extension, the Trans-Kalahari Highway and the southern link with the Republic of South Africa. Twelve strategic weighbridge sites were chosen based on the above criteria. Figure 2 presents the weighbridge network.



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EXISTING AND PROPOSED WEIGHBRIDGE NETWORK

FIGURE 2.

Because of varying levels of traffic on the road network, two classes of weighbridge facilities were adopted, Class A for construction at sites with high daily heavy vehicle traffic and Class B for relatively low daily heavy vehicle traffic with provision of upgrading to Class A when traffic justifies. The following facilities are provided for each of the classes:

Class A
- weighing facilities, comprising of a multi-deck platform
- slow speed weigh in motions (WIM's) for screening
- vehicle testing facilities
- control room
- ablution facilities
- parking area for apprehended vehicles

Class B
- 3 x 4 m single deck platform
- a control room
- parking area for apprehended vehicles

Dedicated personnel

The recognition of the damage potential of overloaded heavy goods vehicles to pavements and the costs associated thereof, resulted in the Roads Authority as the road network manager, to establish within its organisational structure a section dedicated to traffic law enforcement, especially concentrating on one of its core functions as provided by the Roads Authority Act, that is, "prevention of excessive damage of roads by road users or any other parties".

The section Road Inspection Services has representation country wide and is responsible for overload control operations at all the existing weighbridge facilities. The operations include weighing of the heavy vehicles, issuing of fines and prosecuting those operators that exceed prescribed load maximums on axles, axle groups, axle combinations and gross vehicle masses. The data collected is forwarded on a monthly basis for analysis to determine the trend of heavy vehicle loading and pavement loading in terms of E80's.

Weighbridge networking

One of the problems facing overload control in the region is the occurrence of malpractices at weighbridge facilities due to human intervention. The Roads Authority is investigating a computer based system for implementation, to network the operations at all weighbridges.

The system will have the capability of transmitting the weighing data to a central system for easy access by the data manager and the Road Management System.

In addition a fully integrated management information system at each weighbridge will record, process and produce the following reports:
- offence information, i.e number of offences, maximum overloads, fine notices issued, etc
- audit trail
- incident reports
- status of activities at the stations
- loading profile statistics
- effectiveness of overload control operations
- measurable indicators of pavement loading in terms of E80's

RESULTS OF OPERATIONS

Weighing operations

Procedures

The weighing procedure requires heavy vehicles to be directed on to the weighbridge, and the driver to provide details of the vehicle, origin and destination and the cargo being carried. The axle and axle group loads are automatically recorded and displayed on the monitor and compared to the legal load limits to determine compliance. An allowance of 5% is given on the axle, axles group and gross vehicle mass to account for possible movement of loads during transportation and weighing tolerances of the weighing platforms. Legally loaded heavy vehicles and those loaded within the 5% allowance limit are permitted to

proceed. Those loaded above the 5% allowance but below 1 000 kg overload are issued with a Notice and fined according to the relevant provision of the legislation and are suspended from operating on public roads until the loads are adjusted to legal levels.

Heavy vehicles that overload beyond 1 000 kg are impounded and the drivers arrested and are only released upon payment of bail and subsequent appearance in court. The vehicles can only be released upon adjustment of their loads to comply with the legal axle, axle group, axle group combinations and gross-vehicle mass, with the provision that if this involves off-loading, the load is off-loaded on-to another vehicle. The movement or off-loading and the procurement of another vehicle remains the responsibility of the driver or operator, which acts as a deterrent to overloading. The security of the vehicles and goods for overnight stay also remains the responsibility of the driver or operator.

Weighing statistics

Weighing statistics over the period April 2002 to January 2003 for three permanent weighbridges gives an indication of the trend of overloading. Table 3 presents the statistics of overloading over a ten month period.

Table 3. Percentage of overloaded vehicles by month.

	Month										
Station	1	2	3	4	5	6	7	8	9	10	Average %
TR3/1: Noordoewer	18.0	0.6	1.3	1.1	1.9	3.4	0.8	0.5	0.0	0.9	2.9
TR1/1: Ariamsvlei	1.2	7.2	6.9	6.4	4.2	5.7	3.6	0.0	0.0	0.5	3.6
TR1/4: Onhuno	2.6	3.3	3.0	0.8	2.9	7.0	8.7	8.1	1.2	0.0	3.8
Average	7.3	3.7	3.7	2.8	3.0	5.4	4.4	2.9	0.4	0.5	3.4

Table 4. Percentage of heavy vehicles within 5% allowance.

	Month										
Station	1	2	3	4	5	6	7	8	9	10	Average %
TR1/12: Onhuno	4.2	5.9	6.1	0.7	1.7	4.2	7.0	5.4	0	1.2	3.6

The trend at each of the weighing stations shows a general reduction of the percentage of overloaded vehicles as the operators start complying with the legal limits. The monthly overload averages for the period considered ranges between 0.4% and 7.3% as compared to the 28.9% obtained in 2001.

For one of the stations now in operation for the last three years, it has been noted that there is an increase in the percentage of vehicles within the 5% allowance. The allowance has effectively been utilised by the operators to purposely marginally overload with fuel which after travel from the place of origin is consumed to bring the loads to within the 5% tolerance by the time the vehicles are weighed.

Pavement loading

The data from the weighbridges is used to determine the level of pavement loading in terms of equivalent standard axles (E80's).

The E80 equivalents are calculated using the well-known Liddle Formula for axles as follows:

$$F_e = (P/P_2)^n \quad (1)$$

where

F_e - number of equivalent E80's
P - axle loading in kg
P_2 - standard axle loading for the configuration
= 6 600 kg for a single axle, single wheels
= 7 600 kg for separate axles in multi-axle combinations
= 8 200 kg for a single axle, dual wheels
n = load equivalent factor

The value of n varies between 1 and 6 and depends on mode of failure of the pavement. The value of n is commonly taken as 4 in Southern Africa.

Overload control operations carried out on the trunk road network at seven strategic locations early in 2001, gave E80 equivalents per heavy vehicle ranging between 6.3 and 10 for the weighed vehicles. When adjusted to take into account the entire spectrum of heavy vehicle traffic on each individual road section the E80 equivalent averaged at 4.0. Table 5 presents the E80 heavy vehicle equivalents from the overload control operations carried out early 2001.

Table 5. Weighted equivalent heavy vehicle loading: early 2001.

Road No	Daily Heavies	Average Weighed/ Day	% O/Loaded	No O/Loaded	No Empty	Legally Loaded	E80/ Weighed Vehicle	E80 Weighed Legal	Adjusted E80/ Heavy
1/1	55	7	20.1	11	28	16	10.0	9.0	4.7
1/5	127	15	12.2	15	64	48	7.9	6.4	3.4
1/7	161	44	41.7	67	81	13	9.2	6.8	4.4
3/1	90	6	32.2	29	45	16	9.6	5.7	4.1
7/1	170	41	20.4	35	85	50	6.3	6.1	3.1
1/11	141	55	37.4	53	71	18	9.6	8.0	4.6
1.12	146	22	38.3	56	73	17	7.4	7.2	3.7
Average			28.9				8.6	7.0	4.0

An analysis of weighing data at two weighbridges over a nine month period indicates a decrease in the E80 equivalents for heavy vehicles, hence a reduction in pavement consumption as presented in Table 6.

Table 6. Pavement loading in E80's by month.

	Month									
Station	1	2	3	4	5	6	7	8	9	Average
1/12: Onhuno	2.48	2.22	2.46	2.39	2.43	2.40	2.29	1.62	1.59	2.21
1/11:Oshivelo	2.36	2.32	2.34	2.33	2.31	2.35	-	-	-	2.34
Average										2.28

Significant reductions of E80 equivalents have been achieved as a result of overload control operations. An average of 2.28 E80's per vehicle is a reduction of over 43% as compared to the 4.0 E80 equivalent measured in 2001. This implies significant reductions in the cumulative traffic loading over the service lives of pavements hence savings in pavement thicknesses and therefore costs.

DISCUSSION

The age of the bitumen road network coupled with the effects of backlog maintenance makes it necessary to have in place an efficient and effective overload control system. A network of weighbridges consisting of 12 facilities is currently under construction envisaged for completion by 2007. The overload control operations are delegated to dedicated personnel with future management of especially those facilities on heavily trafficked routes to be contracted out to the private sector.

A computer based networking system is under investigation to facilitate monitoring of the overload control operations on a continuous basis to firstly timeously identify malpractices if any and secondly to collate data and produce reports on a regular basis for use in planning future interventions.

Significant reduction in the percentage of overloaded heavy vehicles has been registered from 28.9% to 3.4% at the operational weighbridge facilities and compares favourably with the reduction in E80 equivalent of heavy vehicles from 4.0 E80's to 2.28 E80's per heavy vehicle.

CONCLUSION

The completion of the overload control system will facilitate the control of the consumption of the pavements and result in improved road safety. Significant reductions in the percentage of overloaded

vehicles and the E80 equivalents have been registered, which will result in less maintenance costs and less expensive pavement designs.

REFERENCES

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