BASELINE AXLE LOAD SURVEY IN MALAWI - 2014

M Roux, S Lötter* and P Nordengen**

CSIR Built Environment, PO Box 395, Pretoria, 0001
Tel.: 012 841 2666; Email: mproux@csir.co.za
*Road Traffic Specialist (Technical Assistance under the Malawi Road Sector Policy Support Programme)
Tel.: +265 (0) 992 182; Email: stefan.lotter.uk@gmail.com
**CSIR Built Environment, PO Box 395, Pretoria, 0001
Tel.: 012 841 3945; Email: pnordengen@csir.co.za

ABSTRACT

As part of the project to update the Malawian Directorate of Road Transport and Safety Services' (DRTSS) 2005 Axle Load Control Strategy and to provide a five-year implementation plan, a country-wide axle load survey was undertaken to assess the incidence of overloading on the paved road network in Malawi. The baseline axle load survey was undertaken by staff members from the DRTSS after attending a two-day training course on overload control and the operation of the portable scales that were used for the survey. Heavy vehicles were weighed at 17 sites in two phases. 2 691 heavy vehicles were weighed on 68 weigh days at an average of 39 heavy vehicles per day. Of the 2 691 vehicles weighed, 1 356 were overloaded, which represents an extent of overloading of 50.4%. The average overloaded mass on the 1 356 overloaded vehicles was 4 264 kg, representing an average degree of overloading of 26.1%. Weigh data from 4 of the 5 permanent weighbridges in Malawi were also analysed to compare the extent and degree of overloading measured at the permanent weighbridges with what was measured during the axle load survey. This analysis showed that the average extent of overloading measured at the fixed weighbridges was 3.1% and the average degree of overloading 5%.

1 INTRODUCTION

1.1 Background

Overloading of trucks is a major problem in many countries throughout the world and the continent of Africa and the Republic of Malawi in particular, are no exception. Uncontrolled and widespread overloading of trucks causes premature deterioration of the road network, negatively impacts on road safety and creates a distorted market for transport operators, consignors and consignees. Attempts to control overloading of trucks in Africa have, generally speaking, had limited success. In many countries effective overload control strategies have been developed over the years, but lack of implementation of these strategies is usually the problem. Constraints to implementation are often sustainable funding (particularly for operations and maintenance of weighing equipment) and human capacity.

1.2 Problem Statement

An Axle Load Control Strategy for Malawi was prepared in 2005. In 2009 a study was undertaken with a focus on management and operation proposals to effectively operate the weighbridges in Malawi. Some of the proposals emanating from these two studies have been successfully implemented, including the recruitment of additional staff for managing load control operations and the upgrading of the weighbridge software at the weighbridges. However, there are still a number of areas where there has been little or no progress, primarily due to insufficient funding. A need was therefore identified for the updating of Malawi's 2005 Axle Load Control Strategy and to provide a five-year implementation plan based on the updated strategy. This project formed part of an European Union funded project entitled *Technical Assistance to the Road Sector Policy Support Programme*.

In Malawi, the Directorate for Road Traffic and Safety Services (DRTSS) in the Ministry of Transport and Public Works (MoTPW) is responsible for vehicle load control and currently operates five fixed weighbridges of which four are located close to border posts. Weigh statistics from these five weighbridges show an extent of overloading as low as 3%, which is not considered to be representative of the situation on the Malawi road network. The first step in the review of the Malawi axle load control strategy was therefore to undertake a country-wide axle load survey to assess the incidence of vehicle overloading in Malawi.

1.3 Aim of the Paper

This aim of the paper is firstly to give information on planning and executing a country-wide axle load survey, the analysis and reporting of the survey data and secondly to emphasize the need for axle load surveys or similar exercises to establish a more representative picture of the incidence of overloading in a country.

1.4 Scope of the Paper

This paper reports on the planning of the baseline axle load survey, the training of the staff, the execution of the survey and the analysis of the data collected during the survey. The paper then presents the results of the data analysis and compares these results with what is recorded at the five fixed weighbridges in Malawi.

2 PLANNING AND EXECUTION OF THE BASELINE AXLE LOAD SURVEY

The axle load survey was undertaken by staff members from the DRTSS using three sets of portable scales procured by the DRTSS. Funding for Phase 1 of the survey was provided by the EU and covered the per diems payable to the DRTSS staff members, the cost of fuel for the vehicles used for the survey and the purchase of consumables. The total cost of the survey was around MK 7.6 million (MK is Malawi Kwacha) (approximately R 30 000 in 2014). This cost excludes the normal salaries paid to the DRTSS staff members.

The survey was initially planned to be conducted in two phases, with Phase 1 running from December 2013 to mid-February 2014 (9 weeks) and Phase 2 from April 2014 until June 2014 (13 weeks).These two phases were selected to coincide as far as possible with the various harvesting periods in Malawi, when heavy vehicle transport of agricultural produce and fertilizer increases.

Due to delays in the delivery of the portable scales by the supplier, the first phase of the survey only commenced on 16 February 2014, which did not coincide with one of the harvest periods. Phase 1 ended on 6 April 2014 (7 weeks), while Phase 2 took place from 11 August 2014 until 29 August 2014 (3 weeks). Phase 2 took place during a harvest period.

Heavy vehicles were weighed at 17 sites, with 3 sites in the Northern Region; 5 sites in the Central Region; and 9 sites in the Southern/Eastern Region. The sites were chosen as far as possible to be on road links carrying the highest number of heavy vehicles, but also to ensure widespread coverage of the Malawi main road network. The positions of the 17 survey sites are shown on the map in Figure 1. The latest traffic counts available at the time of planning the survey are 2010 manual traffic counts. The 2010 counts covered 863 links, of which only 7 have an Average Daily Truck Traffic (ADTT) count of more than 1 000 and 32 links with an ADTT count between 500 and 1 000. Of the 824 links with an ADTT count below 500, 528 are below 100, while 169 links carried no heavy vehicles. The highest ADTT count recorded is 1 813 on a section of the M1 through Lilongwe. These ADTT values show that in general the Malawi road network carries very low volumes of heavy vehicles.

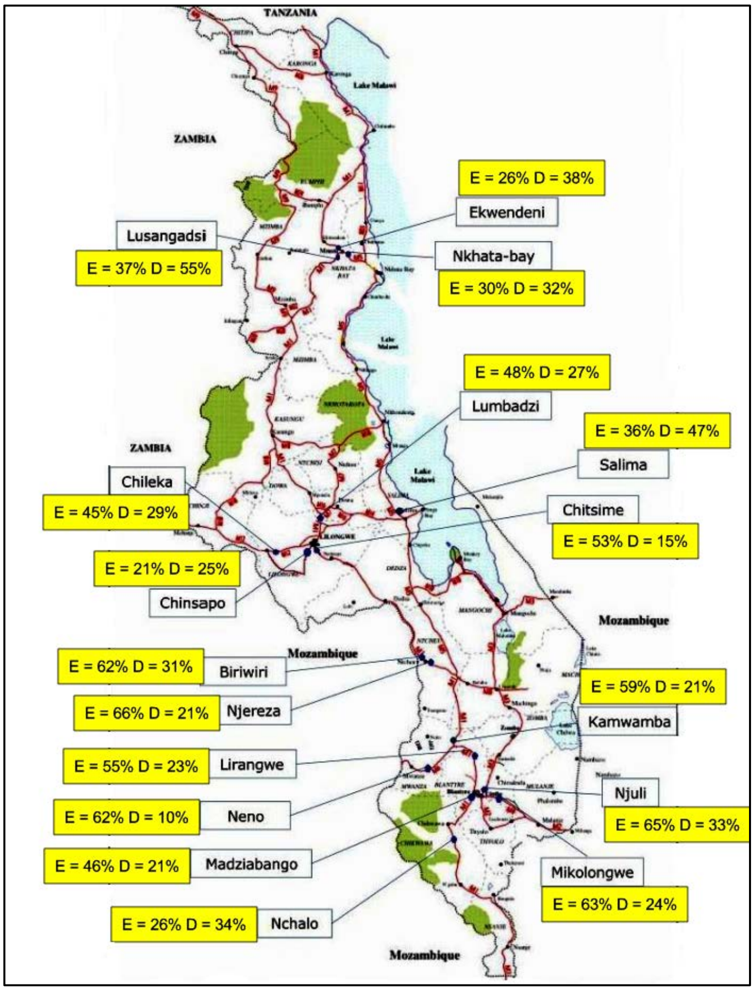

Figure 1: Location of 17 axle load survey points, showing the measured extent and degree of overloading per site – 2014 (Roux & Nordengen, 2014)

It is difficult to obtain an unbiased sample when conducting axle load surveys. Drivers start to avoid survey points as soon as word gets out that vehicles are being weighed. Survey points are avoided by either using alternative routes or by postponing trips. To try and minimise this, no law enforcement was carried out during the axle load surveys and this was communicated to heavy vehicle drivers by the DRTSS staff as widely as possible.

During the two phases of the survey, 2 691 heavy vehicles were weighed during 68 weigh days at an average of 39 heavy vehicles per day. Information regarding the two phases is summarised in Table 1.

Table 1: Information on the two phases of the baseline axle load survey

Phase	**1**	**2**	**1 & 2**
Start date	12/02/2014	11/08/2014	
End date	06/04/2014	29/08/2014	
Vehicles weighed	1 948	681	2 691
Weigh days	54	14	68
Vehicles weighed per day (average)	36	48	39

3 TRAINING OF DRTSS STAFF

The DRTSS staff members who conducted the axle load surveys are Road Transport Officers (RTO) employed at the five fixed weighbridges in Malawi. RTOs do not receive any formal training before or after employment and have to rely on in-service training at the weighbridge station where they are deployed. The training conducted prior to the axle load survey was therefore used as an opportunity to provide some formal training on vehicle load control in addition to training dealing specifically with the axle load survey.

The training provided the RTOs with an appreciation of the necessity for vehicle load control, an understanding of the excessive road consumption by overloaded heavy vehicles, the traffic safety aspects of overloaded vehicles and unfair competition between operators. The RTOs were also equipped with knowledge of the Malawi Road Traffic Regulations (RTR) and clauses in the Malawi Road Traffic Act (RTA) that deal with the permissible loads on vehicles, to enable them to apply these regulations correctly.

Focussing specifically on the axle load survey, the RTOs were given an understanding of the usefulness of the data collected during the axle load survey for vehicle load control operations and for road pavement design. RTO's also received practical training on the use of the portable scales and completion of the survey forms.

4 ANALYSIS OF THE BASELINE AXLE LOAD SURVEY DATA

When considering the incidence of overloading, two aspects are important *viz*. the extent of overloading and the degree of overloading. The extent of overloading indicates how many heavy vehicles on the road network are overloaded, while the degree of overloading indicates the average overload of all overloaded vehicles. A vehicle (combination) can be overloaded on axles only, on total vehicle (combination) mass only or on both axles and total vehicle (combination) mass. To determine whether a vehicle (combination) is overloaded, the permissible maximum mass of all axles and axle units on the vehicle (combination) must be determined and compared with the measured axle and axle unit masses. In addition, the permissible maximum vehicle (combination) mass must be determined and compared with the measured vehicle (combination) mass.

4.1 Determining the permissible maximum axle or axle unit mass

The method to determine the permissible maximum mass of an axle or axle unit, as prescribed in the Malawi RTR, is illustrated in Figure 2. For the purposes of the axle load survey, the tyre and vehicle manufacturers' ratings were not recorded as it would have been too time-consuming. The mass limits in terms of the carrying capacity of the road pavement were therefore used as the permissible maximum axle or axle unit masses. In general, the permissible maximum axle or axle unit masses are equal to the road pavement limits. The exceptions are the steer axle on the majority of vehicles, where the permissible maximum axle mass is normally limited by the manufacturer's rating; 2-axle rigid vehicles with a Gross Vehicle Mass (GVM) of less than 18 t and 3-axle rigid vehicles with a GVM of less than 26 t. The limits in terms of the tyre and vehicle manufacturers' ratings are set by the respective manufacturers for safety reasons.

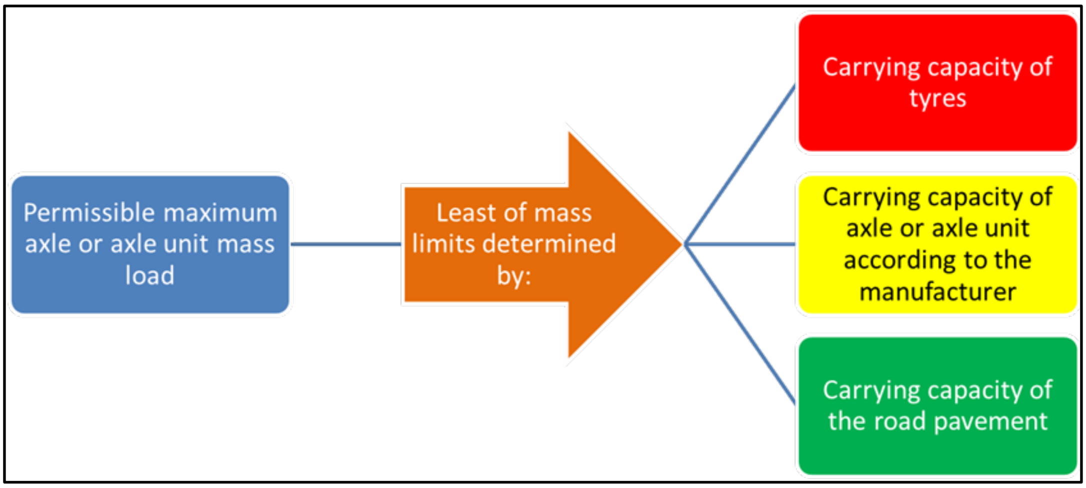

Figure 2: Method to determine the permissible maximum mass of an axle or axle unit (Roux & Nordengen, 2014)

4.2 Determining the permissible maximum vehicle or combination mass

The method to determine the permissible maximum mass of a vehicle or combination of vehicles, as prescribed in the Malawi RTR, is illustrated in Figure 3. The Gross Vehicle Mass (GVM) and Gross Combination Mass (GCM) values were recorded as part of the axle load survey, but the distance between the first axle and the last axle of the vehicles or combination of vehicles was not recorded. The bridge formula could therefore not be included in the calculation of the permissible maximum vehicle or combination mass. In most cases, the permissible maximum vehicle or combination mass is limited by the sum of the permissible axle and axle unit masses or the 56 t overall limit. The exceptions are once again mostly 2-axle rigid vehicles with a GVM of less than 18 t and 3-axle rigid vehicles with a GVM of less than 26 t. In these cases, the GVM is generally the lowest value that limits the permissible maximum vehicle or combination mass.

The purpose of the sum of the permissible axle and axle unit masses requirement is to protect the road infrastructure, while the purpose of the bridge formula is to protect road structures. The GVM/GCM; drive axle mass ratio; and 56 000 kg requirements addresses safety issues.

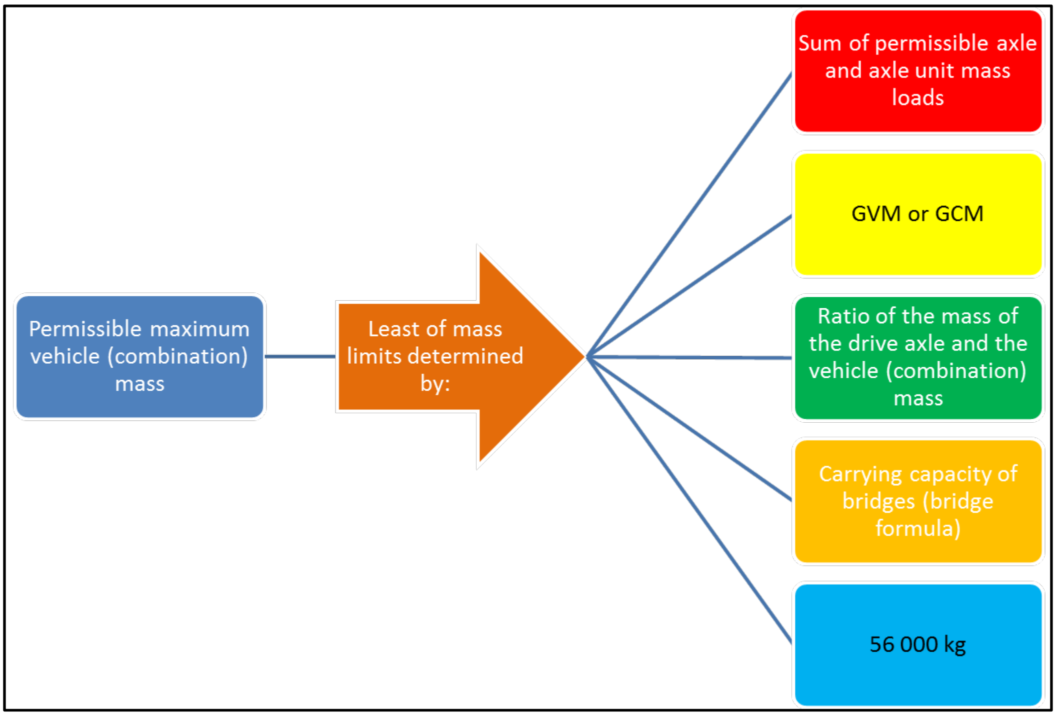

Figure 3: Method to determine the permissible maximum mass of a vehicle or combinations of vehicles (Roux & Nordengen, 2014)

4.3 The application of mass tolerances in Malawi

The Malawi RTR make allowance for a 5% tolerance on axle and axle unit masses and on total vehicle and combination masses. To apply the tolerance on axle and axle unit masses, 5% of the road mass limits in terms of the carrying capacity of the road pavement are deducted from the measured masses and this reduced mass (referred to as the calculated mass) is then compared with the permissible mass to determine whether the axle or axle unit is overloaded. This in effect allows an extra 400 kg on a steer axle (5% of 8 000 kg); 500 kg on a single axle with dual wheels (5% of 10 000 kg); 900 kg on a tandem axle unit with dual wheels (5% of 18 000 kg); and 1 200 kg on a tridem axle unit (5% of 24 000 kg).

To apply the tolerance on total vehicle or combination mass, the permissible maximum vehicle or combination mass is increased by 5%. The recorded vehicle or combination mass is then compared with the increased permissible mass to determine whether the vehicle or combination of vehicles is overloaded.

These tolerances are not viewed as tolerances in Malawi, but rather as an increase in the permissible maximum masses. A vehicle (combination) is therefore only considered overloaded if these increased permissible maximum masses are exceeded. As such, the term “overload” in this paper, unless otherwise specified, refers to vehicles, vehicle combinations, axles or axle units that are more than 5% overloaded.

5 RESULTS OF THE ANALYSIS OF THE BASELINE AXLE LOAD SURVEY DATA

Of the 2 691 vehicles weighed, 1 356 were overloaded, which represents an extent of overloading of 50.4%. The degree of overloading is determined by calculating the overloaded mass on an overloaded vehicle and then expressing it as a percentage of the permissible maximum mass of the vehicle. The average overloaded mass on the 1 356 overloaded vehicles was 4 264 kg, representing an average degree of overloading of 26.1%. The extent and degree of overloading as measured during the axle load survey are summarised in Table 2.

Table 2: Overall extent and degree of overloading

Vehicles weighed	Extent of Overloading		Degree of overloading	
	Vehicles Overloaded		Average overload per Overloaded Vehicle	
	No.	%	kg	%
2 691	1 356	50.4%	4 264	26.1%

The extent and degree of overloading per survey site are summarised in Table 3 and Figure 4, showing that the sum of the extent and degree of overloading was the highest at the Njuli site (on the M3 between Limbe and Zomba) and the lowest at the Chinsapo site (south of Lilongwe on the S124). The highest degree of overloading was recorded at the Lusangadzi site on the M12 at an average of 6 194 kg per overloaded vehicle.

Table 3: Extent and degree of overloading per survey site - 2014

Region	Site	Route	Number of Vehicles Weighed	Extent of Overloading		Degree of Overloading		Extent + Degree of Overloading
				Vehicles Overloaded		Average overload per Overloaded Vehicle		
				No.	%	kg	%	%
South	Njuli	M3	130	85	65.4%	3 920	33.0%	98.4%
South	Biriwiri	M1	119	74	62.2%	4 619	30.6%	92.8%
North	Lusangadzi	M12	269	99	36.8%	6 194	55.2%	92.0%

Region	Site	Route	Number of Vehicles Weighed	Extent of Overloading		Degree of Overloading		Extent + Degree of Overloading
				Vehicles Overloaded		Average overload per Overloaded Vehicle		
				No.	%	kg	%	%
South	Njereza	M1	231	152	65.8%	3 951	24.5%	90.3%
South	Mikolongwe	M4	60	38	63.3%	3 490	23.6%	86.9%
Central	Salima	M5	50	18	36.0%	4 996	46.8%	82.8%
South	Kamwamba	M1	304	178	58.6%	4 264	20.5%	79.1%
South	Lirangwe	M1	310	169	54.5%	4 183	23.2%	77.7%
Central	Lumbadzi	M12	303	146	48.2%	5 295	26.9%	75.1%
Central	Chileka	M12	107	48	44.9%	3 011	28.9%	73.8%
South	Neno	M6	247	153	61.9%	3 647	9.9%	71.8%
Central	Chitsime	M12	83	44	53.0%	3 309	14.8%	67.8%
South	Madziabango	M12	137	63	46.0%	3 563	20.5%	66.5%
North	Ekwendeni	M12	174	46	26.4%	4 423	37.7%	64.1%
North	Nkhata Bay	M5	54	16	29.6%	3 485	31.9%	61.5%
South	Nchalo	M1	65	17	26.2%	4 801	34.3%	60.5%
Central	Chinsapo	S124	48	10	20.8%	1 862	25.1%	45.9%
All sites			**2 691**	**1 356**	**50.4%**	**4 264**	**26.1%**	**76.5%**

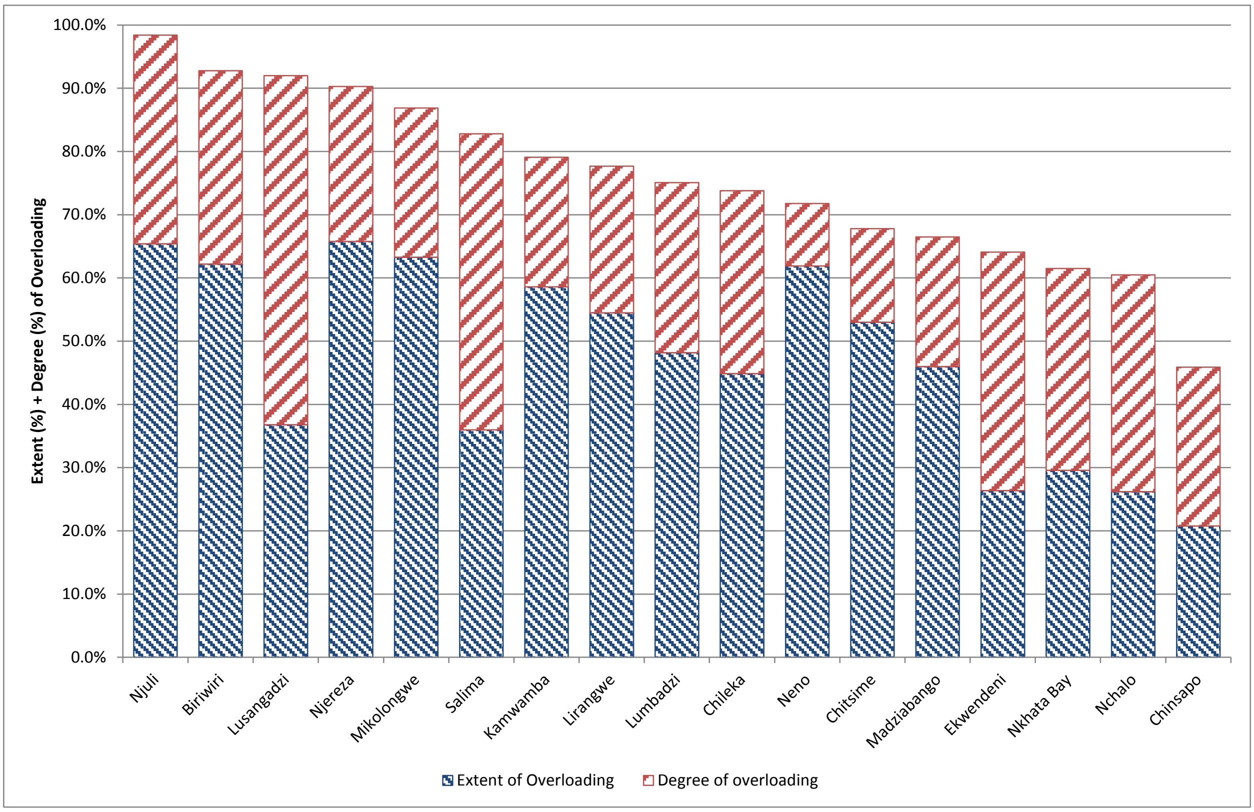

Figure 4:Extent plus degree of overloading per survey site - 2014

The extent and degree of overloading per heavy vehicle type are summarised in Table 4. The four heavy vehicle types operating on the Malawi road network are rigid vehicles; articulated vehicles; vehicle combinations; and buses. Rigid and articulated vehicles were the two types most often weighed during the axle load survey. 44% of the vehicles weighed were rigid vehicles, while 36% were articulated vehicles; 2% were vehicle combinations; and 18% were buses. The vehicle class with the highest extent of overloading (60%) was vehicle combinations. The vehicle class with the highest degree of overloading (34.8%) was rigid vehicles.

Table 4: Extent and degree of overloading per vehicle type- 2014

Vehicle Type	Number of Vehicles weighed	Percentage of Vehicles Weighed	Extent of Overloading		Degree of Overloading	
			Vehicles Overloaded		Average overload per Overloaded Vehicle	
			No.	%	kg	%
Rigid	1 188	44%	574	48.3%	3 736	34.8%
Articulated	959	36%	515	53.7%	5 274	17.1%
Combination	50	2%	30	60.0%	9 582	32.8%
Bus	494	18%	237	48.0%	2 677	23.9%
All vehicles	**2 691**	**100%**	**1 356**	**50.4%**	**4 264**	**26.1%**

The vehicles weighed during the axle load survey were classified in terms of their cross-border status as domestic, import, export and transit. The extent and degree of overloading for these four categories are summarised in Table 5. Approximately 80% of the vehicles weighed were domestic and 20% were cross-border vehicles. The export vehicles had the highest extent of overloading (53%), while the import vehicles had the lowest extent of overloading (49%). The domestic vehicles had the highest degree of overloading (29.8%), while the export vehicles had the lowest degree of overloading (7.9%).

Table 5: Extent and degree of overloading according to cross-border status - 2014

Cross Border Status	Number of Vehicles weighed	Percentage of Vehicles Weighed	Extent of Overloading		Degree of Overloading	
			Vehicles Overloaded		Average Overload per Overloaded Vehicle	
			No.	%	kg	%
Domestic	2 129	79%	1 075	50.5 %	4 353	29.8 %
Export	132	5%	70	53.0 %	3 227	7.9%
Import	365	14%	179	49.0 %	4 188	12.0 %
Transit	65	2%	32	49.2 %	3 995	20.4 %

Cross Border Status	Number of Vehicles weighed	Percentage of Vehicles Weighed	Extent of Overloading		Degree of Overloading	
			Vehicles Overloaded		Average Overload per Overloaded Vehicle	
			No.	%	kg	%
All vehicles	**2 691**	**100%**	**1 356**	**50.4 %**	**4 264**	**26.1 %**

The commodities being transported were recorded during the axle load survey. Of the 200 commodity types that were recorded, 30 (15%) were carried by 80% of the vehicles weighed. The extent and degree of overloading for these 30 commodity types are summarised in Table 6, sorted from highest to lowest according to the sum of the extent and degree of overloading per commodity. It can be seen that the commodities with the highest extent and degree of overloading are mostly bulk commodities, such as agricultural products and construction materials.

Table 6: Extent and degree of overloading per type of commodity - 2014

Commodity	Number of Vehicles weighed	Extent of Overloading		Degree of overloading		Extent + Degree of overloading
		Vehicles Overloaded		Average overload per Overloaded Vehicle		
		No.	%	kg	%	%
Quarry stones	120	99	82.5%	4 958	28.2%	110.7%
Machinery	22	5	22.7%	3 809	87.6%	110.3%
Soya beans	18	10	55.6%	4 303	51.8%	107.4%
Groceries	18	12	66.7%	2 800	40.2%	106.9%
Sugar	61	55	90.2%	4 495	14.1%	104.3%
Timber	74	51	68.9%	4 451	34.9%	103.8%
Premixed Concrete	23	19	82.6%	4 543	19.9%	102.5%
Cement	97	71	73.2%	5 429	28.8%	102.0%
Flour	32	25	78.1%	5 591	23.8%	102.0%
Coal	27	24	88.9%	5 463	12.6%	101.5%
Clinker	34	30	88.2%	5 443	12.1%	100.3%
Peas	16	14	87.5%	3 462	8.3%	95.8%
Maize	144	105	72.9%	4 261	20.7%	93.6%
Fuel	118	85	72.0%	5 729	20.8%	92.8%
Plastic	18	6	33.3%	3 879	58.8%	92.2%
Beverages	58	17	29.3%	8 702	61.3%	90.7%
Fertilizer	83	54	65.1%	4 336	24.1%	89.1%
Soap	32	20	62.5%	3 848	26.4%	88.9%
Bricks	14	7	50.0%	4 231	35.5%	85.5%
Milk	29	14	48.3%	2 701	31.1%	79.3%
Cooking oil	18	9	50.0%	5 727	24.9%	74.9%
Passengers	512	243	47.5%	2 675	23.7%	71.1%
Livestock	22	7	31.8%	6 306	38.3%	70.1%
Sand	24	9	37.5%	2 638	30.9%	68.4%

Commodity	Number of Vehicles weighed	Extent of Overloading		Degree of overloading		Extent + Degree of overloading
		Vehicles Overloaded		Average overload per Overloaded Vehicle		
		No.	%	kg	%	%
Tea	45	21	46.7%	4 029	20.6%	67.2%
Assorted goods	259	80	30.9%	4 383	35.8%	66.7%
Beer	68	24	35.3%	4 103	26.3%	61.6%
Bread	37	6	16.2%	2 620	40.3%	56.5%
Steel	20	8	40.0%	2 903	7.7%	47.7%
Tobacco	106	26	24.5%	4 759	22.3%	46.8%

6 ANALYSIS OF WEIGH DATA FROM PERMANENT WEIGHBRIDGES

Weigh data from 4 of the 5 permanent weighbridges were analysed to compare the extent and degree of overloading measured at the permanent weighbridges with what was measured during the axle load survey. 13 396 weigh records were analysed for a total of 1 183 weigh days, representing 39 months of data. The weigh data analysed was for the following periods per weighbridge:

Balaka: 14/11/2013 to 08/01/2014
Mchinji: 16/08/2013 to 20/07/2014
Muloza: 10/12/2011 to 14/09/2014
Songwe: 28/05/2014 to 15/07/2014

Table 7 contains a summary of the average and maximum number of vehicles weighed per day at the 4 permanent weighbridges. The overall average of 15 vehicles weighed per day is significantly lower than the average of 39 achieved during the axle load survey. The ADTT values, based on the 2010 manual counts, for the links on which the permanent weighbridges are situated are included in Table 7. The average number of vehicles weighed at the permanent weighbridges is expressed as a percentage of these ADTT values. These percentages show that very few of the vehicles passing the permanent weighbridges were actually weighed. The situation is especially serious at the Mchinji and Muloza weighbridges.

Table 7: Average and maximum number of vehicles weighed at the permanent weighbridges - 2012 to 2014

Weighbridge	Number of Vehicles Weighed		ADTT (2010 manual counts)	Average Percentage of Heavy Vehicles Weighed
	Average	Maximum		
Balaka	74	117	576	13%
Mchinji	14	48	240	6%
Muloza	6	26	156	4%
Songwe	23	47	106	22%
Combined	**15**	**126**	**270**	**6%**

The extent and degree of overloading per weighbridge are summarised in Table 8. These values were calculated after allowance had been made for the 5% tolerance. No GVM or GCM data are currently captured at the fixed weighbridges. The extent and the degree of overloading were therefore calculated using the lowest value of the sum of the permissible axle and axle unit masses or 56 t as the permissible maximum vehicle or combination mass. The average extent of overloading of 3.1% and even the maximum extent of overloading of 6.5% (at Songwe) are significant lower than the extent of overloading recorded during the axle load survey. The same applies to the average degree of overloading of 5% and the maximum degree of overloading 6.4% (at Muloza).

Table 8: Extent and degree of overloading measured at the permanent weighbridges - 2012 to 2014

Weighbridge	**Number of Vehicles weighed**	**Extent of Overloading**		**Degree of overloading**	
		Vehicles Overloaded		**Average overload per Overloaded Vehicle**	
		No.	**%**	**kg**	**%**
Balaka	4 128	82	2.0%	1 505	5.8%
Mchinji	3 502	184	5.3%	1 369	4.6%
Muloza	4 667	80	1.7%	2 096	6.4%
Songwe	1 099	71	6.5%	1 527	3.1%
Combined	**13 396**	**417**	**3.1%**	**1 562**	**5.0%**

7 CONCLUSIONS

The results of the axle load survey show that the incidence of overloading in Malawi is very high, with 50.4% of the heavy vehicles (HV) that were weighed being overloaded. These overloaded vehicles are on average overloaded by **4.3 t** or **26.1%** of the permissible maximum vehicle mass.

Rigid and articulated vehicles make up 80% of the vehicles weighed. Vehicle combinations had the highest extent of overloading (60%), while rigid vehicles had the highest degree of overloading (34.8%).

Approximately 80% of the vehicles weighed were domestic vehicles and 20% were cross-border vehicles. 50% of the cross-border vehicles were overloaded, with an average degree of overloading of 13.5%. The domestic vehicles had the highest extent of overloading (50.5%) and the highest degree of overloading (29.8%).

The commodities with the highest extent and degree of overloading are agricultural products and construction materials.

The average extent and degree of overloading of 3.1% and 5%, respectively, for vehicles weighed at four of the five permanent weighbridges are significantly lower than what was recorded during the axle load survey. On average, only 15 vehicles are weighed per day at each of the permanent weighbridges, which is significantly lower than the average of 39 achieved during the axle load survey. Comparing the ADTT values for the links past the permanent weighbridges with the average number of vehicles weighed at these weighbridges shows that on average only 16% of the vehicles passing the permanent weighbridges are actually weighed.

8 RECOMMENDATIONS

The baseline axle load survey conducted in Malawi in 2014 emphasizes the need for axle load surveys to establish a representative picture of the incidence of overloading in a country. This need was underlined by the large discrepancy in the incidence of overloading measured during the axle load survey in 2014 and that measured at the fixed weighbridges in Malawi. An unbiased measurement of the incidence of overloading can also be achieved by using high-speed weigh-in-motion (HS-WIM) installations, provided that the equipment is installed and verified correctly and maintained on an ongoing basis.

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