

CANE TRANSPORT DEVELOPMENTS AT UBOMBO RANCHES

By P. L. H. BREDIN and N. MURTON

Ubombo Ranches, Big Bend, Swaziland

Abstract

Design and construction of a new tandem trailer unit for direct cane haulage from field to mill has resulted in reduced cycle times and savings in fuel consumption when compared with the original unit. Data on tyre performance, weight transfer and seasonal tons hauled are presented.

Introduction

Ubombo Ranches is a large sugar company in Swaziland, situated at Big Bend in the south-eastern lowveld. Most soils are clays, which in wet conditions can cause serious problems for cane transport. The Big Bend mill crushes about 1 300 000 tons of cane annually, of which 800 000 tons are delivered to the mill by Ubombo Ranches using two methods. The first method accounts for more than 650 000 tons, which are delivered as spiller cane with tractor drawn trailers directly from the field to the mill. The remaining 150 000 tons of cane are transported in bundles by a haulage company from transloading zones to the mill.

All cane at Ubombo Ranches is burnt before cutting by hand and four rows are placed into a windrow, which is then mechanically loaded by a Cameco SP 3000 self-propelled grabloader. In 1986 it was decided to replace the existing cane haulage trailers, which were 20 years old. With a daily mill intake of 7 000 tons, of which 3 800 tons is delivered directly, it was necessary to improve fuel and off-loading time efficiencies. The existing system consisted of a tractor

pulling three trailers, which had to be weighed twice at the weighbridge because of the length of the unit, and two off-loading operations were required. Although the original trailers had given long service, each handling about 15 000 tons a year, they were developing metal fatigue and it was becoming difficult to obtain tyres of the correct specification.

Method

Trailer design constraints

Before opting for any particular type of cane trailer there were several aspects to be considered:

- A nett payload mass of between 20 to 25 tons per haulage vehicle was required for representative sampling purposes at the mill
- The complete unit should be weighed in one operation on the 21,320m mill weighbridge
- The unit should be off-loaded in one operation onto two feeder tables by the double off-loading gantry
- Trailer wheel size should be large enough to ensure adequate flotation in wet field conditions
- A maximum turning radius of 10 m was required for turning in furrow irrigated fields
- The haulage unit should comply with the legal requirements of the Road Traffic Act.

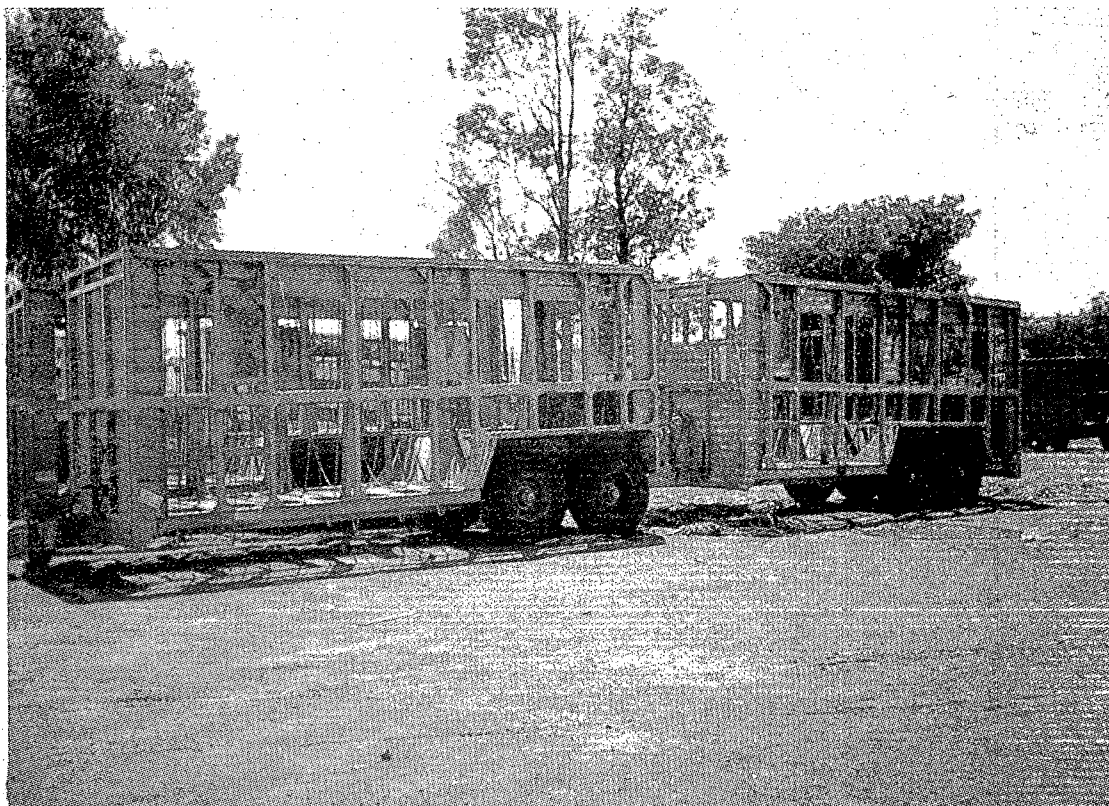


FIGURE 1 The tandem trailer unit.

In October 1986 a second-hand tandem trailer unit was purchased and modified to suit estate requirements. For the proposed tandem trailer units to carry the minimum 20 to 25 tons, and meet with width and length requirements at the unloading gantry, it was necessary to increase the height of the trailers. Although the high cane trailers were able to pass under the gantry, the crane was unable to lift the load high enough to completely clear the unloading chains. This problem was solved by increasing the gantry travel by 1,6 m. Once the height of the trailer had been determined, the length and width were controlled by the unloading gantry dimensions.

The trailers were tested for six weeks during which it became apparent that a considerable saving in weighing and off-loading time could be achieved. This amounted to an average of 18 minutes per delivery or about 20% per round trip. The tare of the tandem unit was 3,3 tons less than the original three trailer system, which resulted in considerable fuel saving. It was therefore decided that four sets of tandem trailers would be built to estate specifications.

Results

Various operational problems and trailer modifications were required and these will now be considered.

Tyres

Tyre choice was critical if a reduction in haulage costs was to be achieved. Experts from France came to assist with choice of tyres. After studying haulage routes and road conditions they recommended 18 x 19,50 super single tyres in conjunction with a walking beam axle. These tyres proved to be quite unsuitable as they chipped so badly that large sections of the tyres were torn out. A larger tyre with a greater carrying capacity was then recommended but also proved

to be unsatisfactory. After extensively testing numerous tyre configurations, 17,5 x 25 earthmoving tyres were chosen, and performed extremely well on the gravel roads of the estate. Tests have indicated that a tyre life of 10 000 hours should be possible, which will reduce considerably haulage costs. Table 1 summarizes the results obtained with the various tyres tested.

Table 1
Summary of tyres tested

Tyre size	Results	Est. life (hours)
18R x 19,5 X2Y	Tread chunks torn out	600
18R x 22,5 X2Y	Tread chunks torn out (remounts)	1 500
17,5 x 25 LR PG6S	Tread chipped, many tyres lost	1 500
17,5 x 25 XLB	Shoulder wear, no chipping	6 000
17,5 x 25 XHA	Even wear, no chipping	10 000

Axle design

Axle design and configuration were also problematic. Initially the axle was welded onto mounting plates which were then bolted to the trailer frame. Axle failures, when they occurred, were always at the weld area. A cradle in which the axle rests is now used and is affixed to the trailer chassis by eight 'U' bolts, and this configuration has proved very satisfactory. The pivot bearings first used were large taper rollers. Although they worked well when new, they required constant adjustment. As such bearings are subjected to a rocking rather than a rotational motion, the bearing cups soon had indents worn into their surfaces, rendering them useless. Eventually a Vesconite bush was chosen for the pivot bearing, with Vesconite thrust washers on either side. When greased, these bearings last for three seasons.

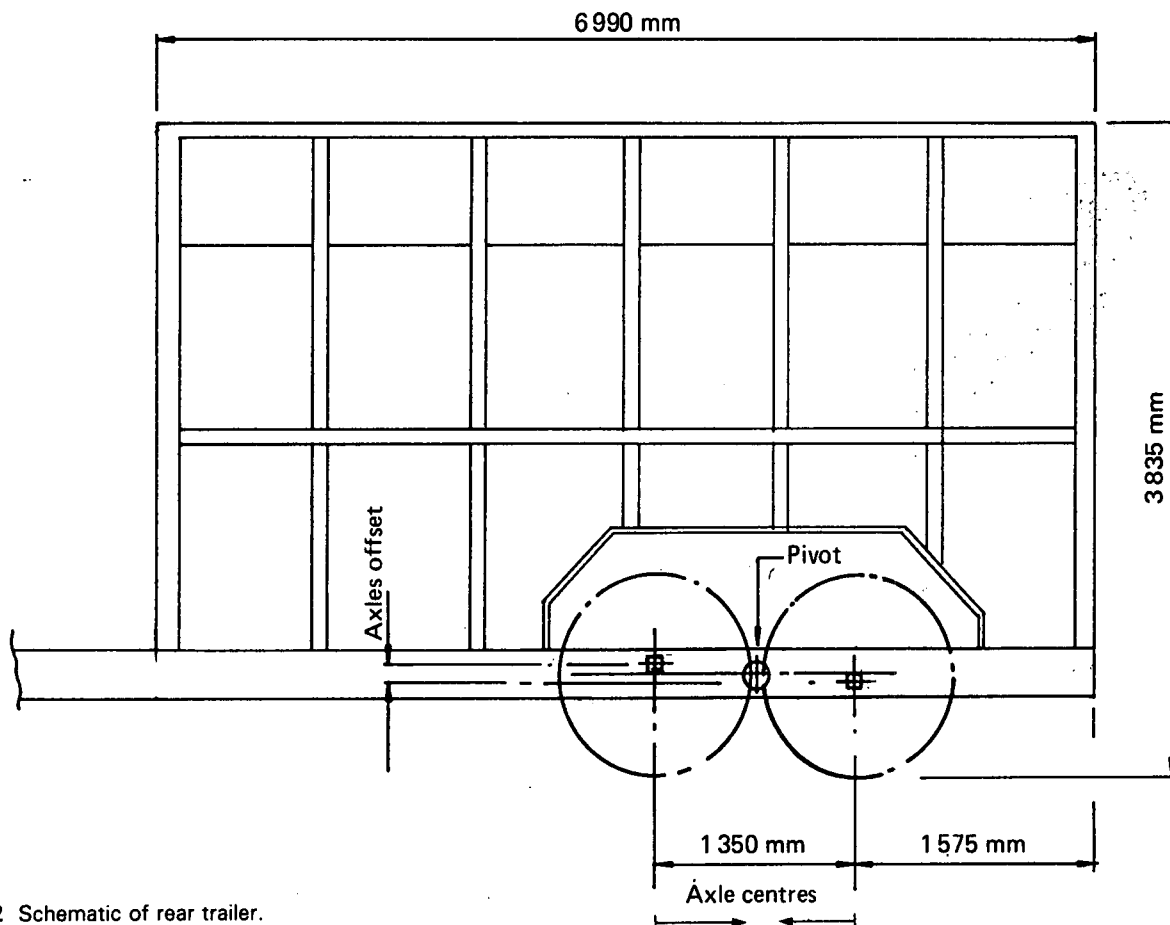


FIGURE 2 Schematic of rear trailer.

Tyre bounce was a problem with unladen trailers and to alleviate this, a walking beam axle with an off-centre pivot is now used. The wheel spacing, relative axle positions and pivot location are illustrated in Figure 1. Air brakes are fitted to each wheel of the trailer, with the two rear wheels having spring brake boosters for additional safety, and parking brake application. The prime movers are fitted with air brake driers which have kept brake problems to a minimum.

Turning circle

The walking beam configuration results in a larger turning circle, consequently more cane rows may suffer slight damage at the drop furrow in furrow irrigated fields than with the original trailers equipped with turntables.

Weight transfer

Under most conditions it is advantageous to transfer an appreciable amount of weight from the leading trailer onto the rear wheels of the haulage tractor. As shown in Table 2, the new Ubombo tandem trailer unit transfers 980 kg (or 49%) more weight onto the tractor, and it is considered that this contributes to improved performance, especially under wet conditions.

Table 2
Axle weights of the trailer

	Axle loading (kg)		Payload/kg
	Loaded	Unladen	
Original trailer			
Front axle tractor	1 860	1 880	
Rear axle tractor	6 300	4 300	
Rear axle 1st trailer	12 080	5 360	
Front axle 2nd trailer	4 480	1 860	
Rear axle 2nd trailer	8 150	3 600	
Front axle 3rd trailer	4 720	1 920	
Rear axle 3rd trailer	7 780	3 580	
Total	45 370	22 500	22 870
Weight transfer onto tractor 2 000kg			
Ubombo trailers			
Front axle tractor	1 780	1 820	
Rear axle tractor	7 420	4 440	
Front axle 1st trailer	8 480	3 380	
Rear axle 1st trailer	8 530	3 760	
Front axle 2nd trailer	7 640	2 500	
Rear axle 2nd trailer	7 800	2 860	
Total	41 650	18 760	22 890
Weight transfer onto tractor 2 980 kg			

Table 3
Bell 1756 tractor with three trailer combination

	Year				Mean
	87/88	88/89	89/90	90/91	
Engine hours	3 099	2 046	2 981	2 191	2 579
1 diesel used	35 019	25 261	34 919	23 911	29 778
1 diesel/hour	11,30	12,35	11,71	10,91	11,55
Tons hauled	48 742	36 632	51 637	35 637	43 208
No of trips	2 285	1 592	2 323	1 601	1 950
1/ton.km (one way)	0,110	0,106	0,103	0,102	0,105
Tons per trip	21,33	23,01	22,23	22,38	22,24
Av payload/trailer (tons)	7,11	7,67	7,41	7,46	7,41
Av trailer combination tare (tons)					17,64

Table 4
Bell 1756 tractor with tandem trailer unit

	Year				Mean
	87/88	88/89	89/90	90/91	
Engine hours	2 988	2 492	3 251	2 659	2 848
1 diesel used	31 581	29 458	33 640	28 791	30 867
1 diesel/hour	10,57	11,82	10,35	10,83	10,84
Tons hauled	55 739	48 785	58 001	45 558	52 021
No of trips	2 524	2 147	2 589	2 037	2 324
1/ton.km (one way)	0,087	0,092	0,089	0,097	0,091
Tons per trip	22,08	22,72	22,40	22,36	22,39
Av payload trailer (tons)	11,04	11,36	11,20	11,18	11,20
Av trailer combination tare (tons)					14,33

Comparative performance of trailer units

Tables 3 and 4 show the comparative performance of the two types of trailer units over the trial period and during the past four seasons. The new Ubombo tandem trailer units have a tare weight which is 3 300 to 3 700 kg lower than that of the original trailer combination. Furthermore, with the latter, the ratio of load:tare of 1,26:1 resulted in high fuel consumption. The Ubombo trailers with a ratio of 1,56:1 have achieved considerable savings in fuel: 0,014 l/ton km or 0,7 l/h. During the crushing season this amounts to more than 60 000 litres of diesel fuel.

Conclusion

The development of the new Ubombo tandem trailer units was achieved within the constraints of the type of off-loading gantry and weighbridge facilities available. Because of the success achieved with the first four sets of tandem trailers, six additional sets are to be built so that, by the end of the 1991/92 season, there should be 10 sets of the newly designed trailer combinations in operation at Ubombo Ranches. The final trailer design features and dimensions, which are similar to those of trailers used in the sugar growing areas of Northern Natal, are given in Appendix 1.

The new tandem trailer units achieved the original objectives, which included:

- Appreciable reduction in fuel usage
- Substantial reduction in tyre costs
- Increase in time efficiency
- Required minimum payload
- Improved performance under wet field conditions.

APPENDIX 1

Ubombo tandem trailer specifications

- The trailers are of all-steel construction, closed at the front and rear with open sides.
- Trailer dimensions are as follows:
Length - 6,99 m
Height - 2,63 m
Width - 2,50 m
- The trailers are equipped with an articulated walking beam axle fitted with 17,5 x 25 earthmoving tyres on 10 stud rims.
- The trailers are fitted with air operated 'S' cam brakes on all four wheels.
- The maximum payload is 15 tons per trailer.
The tare of the front trailer is 7,28 tons.
The tare of the rear trailer is 6,78 tons.
- The percentage weight transferred under loaded conditions from the front trailer to the tractor is 16% of the gross mass of the front trailer.
- The percentage weight transferred under loaded conditions from the rear trailer to the front trailer is 14% of the gross mass of the rear trailer.