ANIMAL LOADING CAR

A SUCCESS STORY

CO-ORDINATING CELL

ALL INDIA CO-ORDINATED RESEARCH PROJECT ON
INCREASED UTILIZATION OF ANIMAL ENERGY
WITH ENHANCED SYSTEM EFFICIENCY

CENTRAL INSTITUTE OF AGRICULTURAL ENGINEERING
Nabi Bagh, Berasia Road, Bhopal - 462 038, India

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Compiled and Edited by	G.C. Yadava Project Co-ordinator (UAE) CIAE, Bhopal

INTRODUCTION

In India, about 60-65% of the total cultivated area is being managed by draught animals. For efficient use of available draft power, it is necessary to determine the draughtability of different breeds of animals. The draughtability of animals is their ability to exert pull (or draft i.e. horizontal component of pull) under sustained condition.

A variety of draught animals are used for farm operations in sustained working, but due to lack of proper information of their draft capacity, similar type and size of implements are used for almost all types and breeds of animals, thereby under utilizing available draft power. The draftability of individual animal varies depending upon a number of factors namely; breed of animal, age of animal, type of yoke used, working conditions, work-rest-schedule etc. In this age of energy crisis, it is necessary to get maximum output from the animals to meet the tractive energy needs of Indian agriculture. It is possible only when animals are operated under optimum conditions of load, best suited work-rest-schedule with matching implements and improved yokes/harnesses.

There was absence of appropriate/precise loading device to assess the accurate draftability of draught animals. CIAE, Bhopal has designed, developed and evaluated an animal loading car for precise and reliable load settings.

TRADITIONAL PRACTICES AND DEVICES

Traditionally available designs of loading cars may be categorized in five categories.

i. Animal cart loaded with sand bags,

ii. Sledge type loading device,

iii. Winch type loading device,

iv. Loading device using dead weights,

v. Loading device using hydraulic pumps,

Above devices had limitations of sturdiness, maneuverability under field and test track conditions, ease of load settings, preciseness and reliability of load setting. It was therefore considered desirable to develop an animal-loading car for reliable and precise load settings.

DESIGN AND DEVELOPMENT OF ANIMAL LOADING CAR

An animal-loading car was designed, developed and evaluated by Bhopal centre. However, the loading cars/devices were also developed at Ludhiana and Pantnagar centres for assessment of draft capacity of animals under sustained working conditions.

Ludhiana centre has developed two loading cars, one suspended weight type and another friction type. The suspended load type-loading car, loaded the animals through suspended dead weights, which were connected with the yoke of the animals and were hanging on the loading car. The unit was pulled by a tractor at a particular speed and the animal worked between the loading car and the tractor.

The friction type loading car consisted of two rotary drums fixed on an axle fitted with the wheels. A flat belt was provided around each drum and it could be tightened with the help of bolts and nuts. One spring dynamometer was attached to each belt to indicate the force. The frictional load could be varied by varying the tightness of the belt. The loading car was pulled by a pair of bullocks and a seat was provided for the operator. Additional weight could be added at higher frictional loads to avoid skidding of wheels.

Both these loading cars developed at Ludhiana centre had limitations in working. In case of suspended weight type loading car, a tractor was required for pulling the whole system and maintaining the speed of walking of the test animals and in case of friction type loading car, the adjustment of load was not very accurate and convenient.

Pantnagar centre has also developed one suspended weight type loading car similar to that of Ludhiana centre mentioned above.

Bhopal centre has designed and developed an animal loading car to exert draft loads in the range of 20-300 Kg-f. The unit was extensively tested and was found working very satisfactorily for draftability studies. The load settings were not affected by varying the test speed, which is a very desirable feature Fig. 1 shows the CIAE animal loading car with a pair of bullocks..

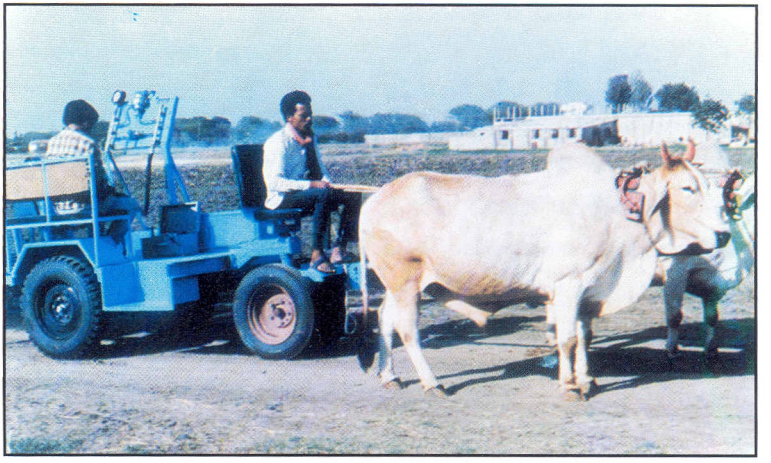


Fig. 1 : CIAE animal loading car with a pair of bullocks

Out of the loading cars developed at Ludhiana, Pantnagar and Bhopal centres, the Bhopal centre design was found more precise and reliable for draughtability studies.

CONSTRUCTIONAL DETAILS OF CIAE LOADING CAR

CIAE animal loading car consists of three main components:

1. Basic Structure

The structure consists of a three wheeled carrier (cart) on which different components of the loading car are mounted. The main structure is a rectangular frame made of channel section of 125 mm x 65 mm x 6 mm and

100 mm x 50 mm x 6 mm sizes. A number of angle iron supports and brackets are welded to this structure for supporting various components. The flooring is of M.S. sheet. The front iron pivot assembly is a box section and is made of 125 mm x 65 mm x 6 mm size MS channels, through this is welded a 80 mm dia pivot tube. At both ends of the tube bronze bushings are fitted.

The front pivot shaft is made of mild steel and is supported in the tube assembly by two bronze bushes. At the lower end of this shaft, the front wheel assembly is fitted. This assembly consists of two ambassador car tyres of 5.90x16.00 size.

The main structure is clamped on standard Mahindra jeep rear wheel differentiial assembly. Standard jeep leaf springs have been used on both the side for proper suspension of the chassis. Proper mudguards are provided for the rear wheels. Different components of the loading car such as fluid tank, pump, control valves, drive systems etc are mounted on the main chassis. Two cushioned seats are provided, one for the bullock operator and another for the operator regulating pressure relief valve for adjusting load or recording data. A toolbox is provided for keeping necessary tools and measuring/recording instruments.

2. Transmission

Using standard jeep differential system and propeller shaft, the drive from the ground wheels has been taken up to a sprocket from where the speed has been stepped up by using two stages chain and sprocket drive arrangement. For disengaging the drive, clutch arrangement has been provided at the first sprocket connecting the propeller shaft. For hitching the loading car with the animals, a long piped beam has been provided. The details of stepping of speed is as follows:

Rear tyre	6.00 x 16.00 Jeep tyre
Gear differential ratio	1:4.27
1st stage chain drive ratio	1:1.9
2nd stage chain drive ratio	1:3.17
Overall wheel to pump ratio	1:25.7
Range of speed of pump at 7-35 rpm of wheels, i.e. at a forward speed of 1-5 kmph	180-900 rpm
Clutch system	Single stage

3. Hydraulic system

One hydraulic pump is provided to exert pressure in the range of 5-140 kg/cm^2. The loading on the car is done by restricting the flow of the oil, pumped from hydraulic pump with the help of a relief valve. Increase in pressure at the outlet of the pump increases torque on the shaft. This in turn increases torque on rear wheel of loading car and as a result, the tractive efforts to pull the car is increased.

Details of the hydraulic fittings are as follows:

Sl. No.	Item	No	Capacity/range
1.	Hydraulic pump	1	Displacement 12.5 cm^2 /revolution
2.	Relief valve	1	5-140 kg/cm^2
3.	Pressure gauge	1	0-200 kg/cm^2
4.	Tank	1	45 litres
5.	Air breather	1	-
6.	Oil filter	1	-
7.	Check valve	2	-
8.	Shut off valve	1	-
9.	Return line filter	1	-
10.	Manifolds, joints nipples and pipes	As per requirement	

PERFORMANCE TESTING OF CIAE ANIMAL LOADING CAR

The loading car was tested under various track conditions to study its functional performance. For maintaining uniform speed, the loading car was first tested by pulling it with a tractor at desired throttle setting, which maintained the speed uniform. Further tests were conducted using a pair of bullocks. In case of animals due to movement of animals, there was slight fluctuation in reading. Fig. 2 & 3 shows the draughtability studies with a pair of bullocks on standard test track and on kuccha road.

Fig. 2 : Draughtability studies on standard tar test track with a pair of bullocks

Fig. 3 : Draughtability studies on kuccha road with a pair of bullocks

Ambient temperatures were recorded before, during and after each test. Temperature of hydraulic oil was also recorded before and after the test runs.

The following parameters were measured to assess the performance of loading car.

i. Pull:

Pull was measured using load cell and load cell indicator. Load cells of 0-250 kg and 0-500 kg capacity were used. The load cell was mounted on the beam of the loading car.

ii. Angle of pull:

Angle of pull was measured with the help of abney level. It was mounted on the beam of the loading car.

iii. Speed

Speed was measured by calculating distance travelled per unit time.

iv. Slip

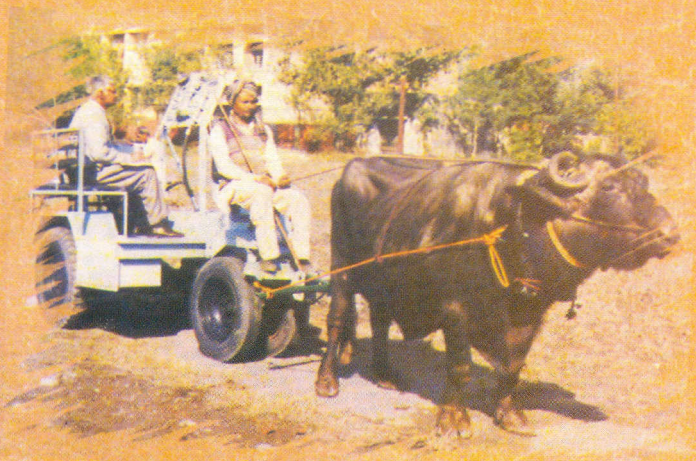
Slip was calculated by counting the actual number of revolution of rear wheel in 50 m length divided by the theoretical number of revolutions and the difference was used to workout percentage of the slip.

Performance of the animal loading car was done using a tractor on tar road at different load settings as shown in the table below.

Sl. No.	Speed, kmph	Pressure, PSI	Average draft, kg
1.	5.00	No load	20
2	5.00	300	95
3	5.00	450	110
4	5.00	630	145
5	5.00	800	175
6	5.00	1000	200
7	5.00	1200	240
8	3.27	1000	290
9	3.27	1550	295

The loading car worked very satisfactorily. Maintenance of load settings was precise and was not affected by variation in speed. Fig. 4 shows the draughtability studies of a buffaloe.

Fig. 4 : Draughtability studies of a buffaloe with use of CIAE animal loading car



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