Agricultural Mechanization

Modification of Rural Technology Model Multi-purpose Animal Drawn Cart

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Abstract

Animal drawn carts are popular transport tools in the region. However, their production cost and selling price is becoming prohibitively expensive, reducing their popularity and adoption rate. Perceiving the urgent need to stabilize the market for carts, existing multi purpose 2nd generation animal drawn carts were modified mainly for reducing their production cost. As the wheel-axle assembly is the most important part taking about 40 to 70% of production cost of any cart, more emphasis was given to modify this component. As the result, low cost and easy to produce wheel-axle assembly was developed and produced in the center's workshop. Two carts were then produced using these assemblies (splitting-type rim with hub and spindle), with other body parts similar to that of the previous cart type. The carts were tested in different conditions on a test track to evaluate their suitability and impact strength. Passing this test successfully haulage test was then conducted by distributing the carts to farmers and monitoring for any premature failure while operating under normal working conditions. Both carts extensively worked for about three months in this situation. During all these test periods, the carts and the new assembly performed satisfactorily without any significant failure. As an achievement, the new developed component enabled to reduce production cost by more than 50%.

Key words: haulage test, hub, Impact test, integral rim

Introduction

Access to an effective means of transport is an inevitable tool for promoting the economic and social development of rural community of any country. This is particularly true for small-scale farmers who are living far from main roads. It enables them to have access to agricultural inputs such as fertilizer and improved seeds, paves the way to use manure to improve their yield, allows them to market more produce, and to reduce time and effort spent in

household activities as collecting firewood and water. In Amhara region, where the topography is not suitable and road networks are at lower level, access to motorized vehicle is generally very low. This indicates that it is not in a level to satisfy those farmers who are far from the main roads. Animal drawn carts are hence the most appropriate implements to satisfy most of rural transport needs, as it is possible to be owned by average farmers and are able to operate under most rural road conditions, including serving between farmlands.

In the absence of any other alternative, rural people transport their goods by carrying on their backs or heads. When transporting heavier loads, especially for moving goods and agricultural produce from the farm or homestead to the nearest town or main road is considered, pack animals such as donkeys and mules are usually used. These methods are backward and unduly tedious for human and animals. It demands more labor time per load and exposes the material for post harvest losses. Evidence from many regions, however, shows that animal drawn transport has many economical

On the other hand, local artisans have good experience of producing lower quality animal drawn carts from scrap rear or front axle of old cars, usually obtained from central market. However, as demands created are very high and number of cars that have been put aside in the country road are progressively reduced, the supply of these components is very much limited. Besides, level of oldness of these scrap components differ from car to car and, as maintenance service rendered by the producers is usually very low, the carts may not give the required service, adding to the running cost due to increased break down frequency.

Therefore, producing and distributing carts relying up on imported wheel-axle assembly and scrap old car components could not bring the required progress in rural transport. Bahir Dar Agricultural Mechanization Research center, therefore, has to look for alternatives to produce the wheel-axle assembly from readily available materials in the market. This is foresighted to enable local artisans having small workshop facilities with simple tools to adopt it easily and deliver the carts with reduced price in sustainable manner. Hence, this study was executed with the following objectives:-

- Make possible of producing carts at merely 50% of their current price
- Reduce the manufacturing sophistication so as to make ease of manufacturing and repair of parts near to the areas of utilization; and
- Facilitate technology dissemination

Materials and methods

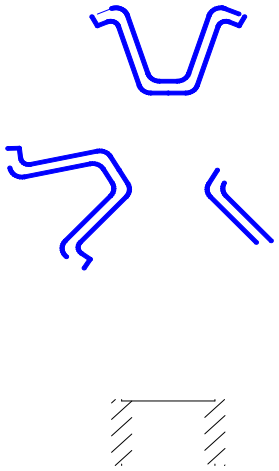
Design and manufacturing of wheel-axle assembly

Two types of integral rim and hub that fit on 7.5x16 tyres were produced. For easy removal and replacements of punctured tyre, the edge of the rims were made to be split type which enables disassembling by merely loosing of the nuts on it.

A 2mm thick sheet metal with 106mm width and 400 mm diameter was rolled and welded at the end. To protect the tyre from bulging out during inflation two types of edge formed over the two sides of the rim by welding.

From 16 mm diameter round iron, two 400 mm diameter rings were made. One of the rings was welded on one edge of the rim and the other attached over the other edge with bolt and nut for easy removal of the tire. Similarly,

from 30x30x3 mm angle iron, 400 mm diameter rings were made and, as that of the round iron ring type, were attached with the rim edge. The hub was made from steel turned on lathe machine. It was then welded to 3 U-shaped spokes made from 14 mm deformed iron. Spokes are weld connected with the underside of the rim (Figure 1). Utmost care has been exercised when welding wheel components to avoid deformation of the rim while under load. Two 7.5x16 size pneumatic tires, inflated to appropriate air pressure, were used over the rim.



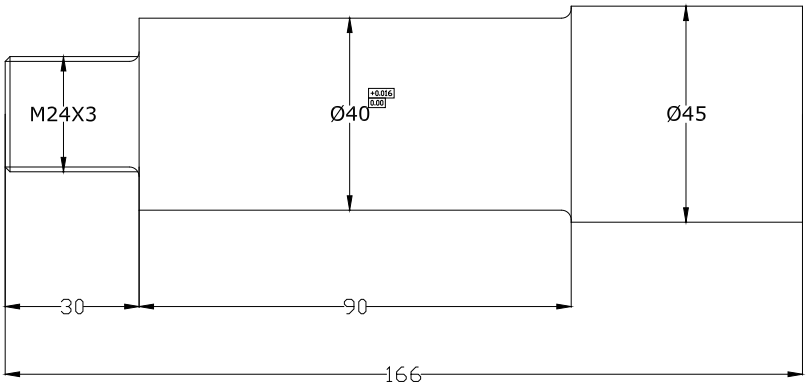


Figure 2. Details of a spindle in the Axle

Other cart components, including brackets, the body and beams were produced without any difference of the existing animal drawn carts, except introduction of deformed iron bracket with 32mm diameter, which is very much common in the local cart but new for the center cart.

Testing and evaluation

After completing of the whole components of cart, two carts where prepared, one with angle iron bracket and the other from deformed iron bracket.

Test bed, which is 25m in length having 20 cm high obstacle, was prepared to check fatigue strength of the cart. Impact test was performed by pulling the cart by a tractor moving at a speed of about 1 m sec^{-1} over this test track. During pulling, the cart was loaded with 50% (400kg), 75% (600kg) and 100% (800kg) of the rated load. At beginning and ending of the test track, the cart was subjected to the obstacle simultaneously. Then after, it faces the obstacle alternatively. It was pulled three times over the test bed before checking. The test procedure was taken from a procedure prepared by Wolelaw *et al,* (1999).

Haulage test was performed by distributing the cart to farmers around Merai for three months (Figure 3).

Figure 3. Modified cart in use

Results and Discussion

After producing the carts, impact and haulage tests were performed to confirm the good performance of the cart before promoting the carts.

Impact test

The manufactured cart operated successfully during the impact test. It has shown no sign of failure under 50%, 75% and 100% of the rated load, the normal load range a single animal can possibly pull.

Haulage (Field) test

The carts given to farmers in Merawi area who used them for transporting construction material, fodders, firewood and any other agricultural and construction material during the test period. Data was recorded progressively on types of loads transported, distance traveled, the road condition and failure occurred. The carts remained with the farmers for three consecutive months working exhaustively. According to the farmers record and expertise observation, no major failure has occurred during the three months.

Cost of modified wheel-axle assembly, excluding cost of tyre and rubber tube, is around 663.00 Eth Birr. However, cost of the imported wheel axle assembly, as it was imported through aid, though not available by now, is not less than 2,000 Eth Birr.

Conclusion and Recommendation

It has become clear that producing the wheel-axle assembly locally is more advantageous than importing readily available standard materials, as long as overall cart price is considered. This method will also pave the way to popularize the cart with reduced production complication and at an affordable price. However, it is recommended that more carts should be produced in the center and distributed to the farmers for further verification. Training of small businesspersons in the manufacturing methods will follow afterwards.

References

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