

дованих дозах нетоксичні для теплокровних і безпечні для працюючих із ними людей. Бензойну кислоту краще застосовувати для зберігання консервованого листа до 10 діб, а максимальний строк – 20 діб. Згодовування гусені дубового шовкопряда листа обробленого бензойною кислотою не впливає негативно на її життєздатність і сприяє збільшенню маси шовкової оболонки коконів до 40 %.

Мікробіологічний консервант – кормові дріжджі – сприяє збереженню поживних речовин листа, передусім білків, протягом тривалого часу зберігання і додатково збагачує корм каротиноїдами. Оброблене листа не втрачає своєї кормової цінності для шовкопряда протягом року. Згодовування гусені листа, обробленого суспензією дріжджів, сприяє збільшенню маси коконів на 5-15 %, шовкової оболонки – на 15-35 %, підвищує життєздатність гусені при живленні її консервованим кормом у молодших віках.

Тривале зберігання консервованого листа здійснюють в герметичних ємностях, що виключає газообмін з навколишнім середовищем. Короткочасне зберігання листової маси з використанням консервантів можливе в земляних траншеях з поліетиленовою плівкою або в прохолодних приміщеннях у поліетиленових мішках.

При використанні свіжого або консервованого листа встановлена можливість одержання цінної шовкової сировини з мінімальними витратами. Продукція шовківництва може застосовуватися у медицині та ветеринарії як шовний матеріал та для виробництва лікувально-профілактичних препаратів, косметології та інших галузях.

Цей напрямок відкриває нові значні перспективи у галузі побічного лісокористування.

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ACAR-T 750 MONORAIL SYSTEM IN TURKISH FORESTRY

In the mountainous regions where take part productive forests, forestry operations are very difficult. Therefore, the mechanization of forest operations are necessary. The monorail an alternative and effectively vehicle for carrying and transporting of personnel and goods. The monorail system both supply time and muscle energy saving and give an opportunity to carry thin diameter roundwood and fuel wood. In this paper, it was mentioned from Acar-T 750 prototype monorail manufactured in Turkey and its experimental results was examined. It provide the saving of time and human force consumption, increasing of work productivity, decreasing of new forest road building, decreasing of quantity and quality losses. As well, it is an ergonomic and modern transportation tool.

Keywords: Wood transportation, Monorail, Acar-T 750, Turkish forestry.

Проф. Гулусі АКАР – Караденізький технічний ун-т, Туреччина

Монорейкова система ACAR-T 750 в лісовому господарстві Туреччини

У гірських регіонах, де ростуть найбільш продуктивні ліси, проведення лісозаготівельних робіт є утрудненим. Для цього потрібні відповідні технічні засоби. Монорейкова система є альтернативним транспортним засобом для перевезення людей та вантажів в таких умовах. Розглянута можливість використання на лісотранс-

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портних роботах в гірських умовах монорейкової системи ACAR-T 750, що випускається в Туреччині. Це дає змогу зекономити час, зберегти мускульну енергію людини, збільшити продуктивність праці, зменшити витрати на дорожнє будівництво та покращити якість лісотransпортних робіт. Монорейкова система – це також сучасний і ергономічний транспортний засіб.

Ключові слова: лісотransпорт, монорейкова система, ACAR-T 750, лісове господарство Туреччини.

Introduction

In the worldwide, the forestland withdraw to mountainous areas due to anthropological reasons. In the mountainously regions where take part productive forests, forestry operations are very difficult. Therefore, the mechanization of forest operation techniques showed oneself. The aim of mechanization is productive and environmentally soundly forestry operations.

In Turkey, annual wood production amount including industrial and fuel wood, is approximately 20 million cubic meter. Through the wood production process, the harvesting activities are carried out on negative circumstances because of topographical and wood characters such as specific gravity of wood.

The main problem of forest operations in Turkish forestry are; the forest road construction is costly and difficulty in mountainously forests and assuring of the machine and equipment is to be used in logging operations is costly. The other issues are the quantity and quality losses of extracted timber, damages on forest soil and standing trees or vegetation and work accidents. Because of many general issues, the work productivity decreases, the work flow is frequently cut and work organization spoils.

The operators and workers have to go and return to workplace at least one a day during working time in harvesting at step terrain. They have to transport the seed and sapling from road to planting areas. The personnel have to reach to fire observation tower. The travellers desire to see deep forest. For that reason, arrival and transportation are an important subject in the forestlands. The monorail an alternative and effectively vehicle for carrying and transporting of personnel and goods. The monorail system both supply time and muscle energy saving and give an opportunity to carry thin diameter roundwood and fuel wood.

The monorail system is a modern forest transportation vehicle. It provide that saving of time and human force consumption, increasing of work productivity, decreasing of new forest road building, decreasing of quantity and quality losses. As well, it is an ergonomic tool.

The Monorail Technique

In Turkish forestry, wood transportation is generally carried out by means of human and animal force. Although forestry mechanization ratio is very high in developed country where topographical condition is similar to Turkey; in Turkish forestry, mechanized wood transportation level is low. For example, while mechanized wood harvesting ratio is 86 percent in Austria forestry, it is 6-7 percent in Turkish forestry (Acar, 2000). However, forest tractors and forest skyline have been used since 1980's in our country (Acar, 1992).

Extraction of harvested thin wood material is not economical by forest skylines. Therefore, thin wood material is abandoned in forest and this cause and economical loss (Yoshimura and Acar, 1996). As a result of a research conducted by Acar (1997), the work productivity of mobile forest skylines is high more than long distance forest skylines since the skyline operator and also workers have to up and down to workplace through long distances (Acar and Yoshimura, 1997).

The monorail is a single rail system, which can be established at steep terrain having % 100 slope level and can transport forest operator and worker and carry fuel wood or nonwood forest products. It has montage and demontage easiness. The monorail can be used to transport seed or sapling. It is very functional vehicle for recreational survey within forest.

Furukawa et al. (1995), determined that the sapling and staff are being recently transported by monorail instead of forest skylines in the planting region in Shirotori and Higashirakawa. In this way, work productivity in planting operations increased 7-25 percent because of minimization of time losses during connection to workplace.

Yamada et al. (1989), during the sapling transportation into forest via sloping forest road that has % 10 slope gradient, measured the walking speed as respectively 30 m/hour and 45 m/hour in walk up and walk down. As well, the monorail speed is measured as 50 m/hour. Yamada notified that the monorail number used in forestry are amount 100 since 1985.

In Hokkaide University forest, it was studied by comparing with walking and monorail. The walking track was 500 meter roudtrip distance with 60 percent slope gradient. As result, it was determined that *quadratus fenoris* muscle was excessively forced in walking down and workload and weariness on leg reduced by using of monorail. In addition, it was stated the walking time and personnel expenditure was to be reduced half and half (Yamada et al., 1996).

The main advantage of monorail system are that:

- The arrival time to reach workplace can be minimized,
- The tiredness of travel to/from workplace can be diminished,
- Transportation and arrival is safe and ergonomic,
- The montage cost is low,
- The maintenance cost is low,
- It is appropriate for especially low sized works,
- It is no needed to soil smoothing when it is set up its route,
- In short distance, this system gains sudden elevation opposite to forest roads,
- It is a mobile tool, it can be installed anywhere,
- It is not cause losses of forest land during installation to terrain,
- It is an environmentally friendly tool.

Material and Method

In this project, the prototype was produced after planning and construction studies. Then, the prototype was tested by test-drive and investigated by resistance studies. The prototype was manufactured in Trabzon (Turkey) by cooperation Karadeniz Technical University Laboratories and Trabzon District Industry.

The prototype was named as "Acar-T750". In the manufacturing of Acar-T750, it was mostly used native material. Some equipment such as engine and hydro-engine, was bought from dominant market as ready-made. It was aimed to

shorten construction time and to minimize set up cost in manufacturing process. Acar-T750 was projected with 300 meter route distance, 5 passenger and 750 kg load capacity. The draft was firstly drawn by manual and then transferred to computer to dimension of monorail. The Figure 1 shows the main part of monorail.

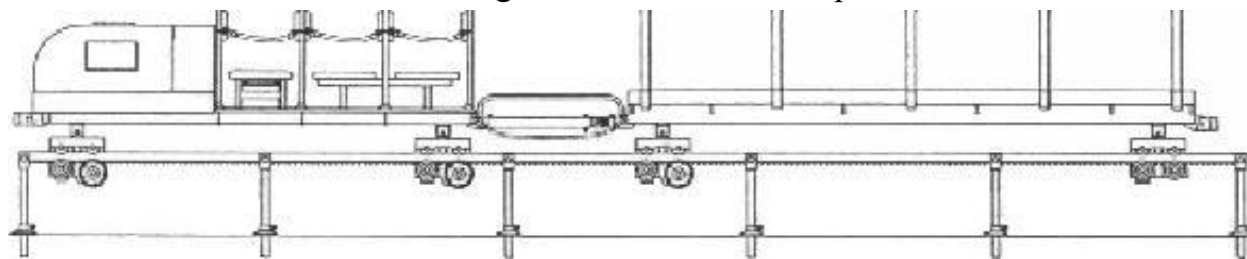


Figure 1. A Monorail Plan

Locomotion railway car:

- Engine with 6 HP power, magnetic ignition, 4 timely upper valve (OHV),
- Locomotion system with hydraulic control,
- Size is 1550 mm × 550 mm,
- Automatic control system for breakdown,
- Capacity for one person as operator

Transportation railway car:

- Maximum load weight is 750 kg,
- A hydraulic control system,
- Size is 2950 mm × 550 mm,
- Capacity for 4 person as passenger.

Tie systems:

- Multiple use binding rod (540 mm),
- Base and sub binding systems.

Rail and Supports:

- Monorail,
- Portable rail system,
- Cogwheel arm and kremayer.

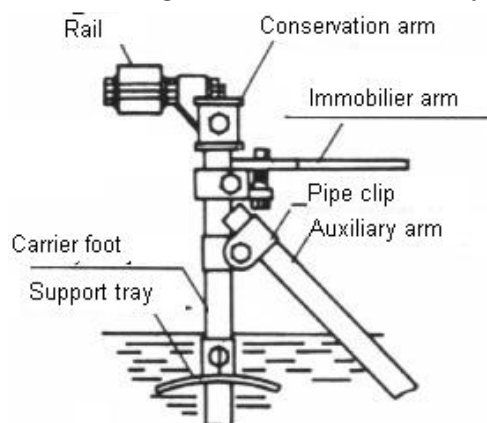


Figure 2. The Lower Part Material of Acar-T 750

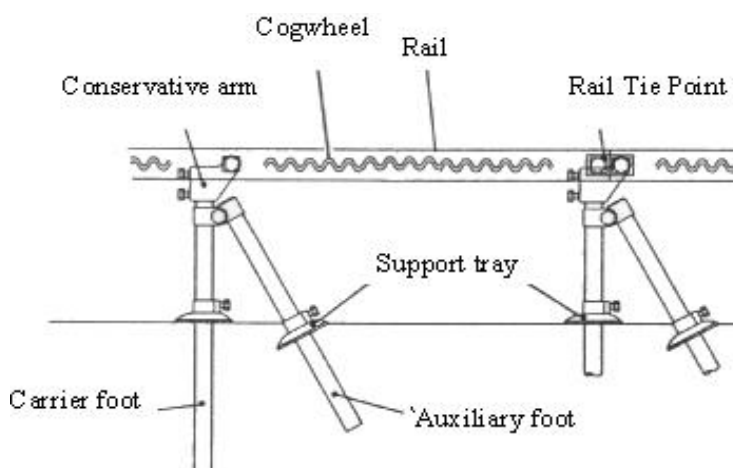


Figure 3. The Rail and Foot Tie of Monorail

As shown in Figure 1, monorail is formed two part as lower and upper structure. But, there is a connection system between upper and lower part, which can provide balancing and moving of monorail. That is, monorail includes a rail mechanism, movement system, and portable railway cars movable on rail. The other elements of monorail take places in Figure 2.

It was separately calculated the strength and load unifying each part in the method of load and strength calculation. The point occurring beam and supports was determined as source center (Taira, 1984).

The rail dimension is angle iron with 50 mm × 50 mm quadrangle. Its membrane thickness is 4 mm and length is 6 m. The main raw material of rail profile is steal – Fe 37 (Table 1). The tie shoe was mounted to provide connection between movable system and rail.

Table 1. Technical Features of Rail

Rail Model	Kremayer type
Material Type	St 37 box profile
Rail Profile Dimension (mm)	50x50x4
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Tooth Space (mm)	31,5
Length (m)	6
Support Space (m)	1
Weight (kg)	40,3

Carrier and supportive foot have 16 mm diameter and 75, 100, 125, 150 cm length. The monorail system, thus, can be established various elevation from earth surface. Tip of the foot was sharpened in order to push to earth. To protect excessive sinking and fall over, it was used support tray.

The upper part of monorail constitutes from locomotive, rail car, walking set, and balance mechanism. The movement organ providing movement on rail is a smooth cogwheel that is mounted to rail and keep kremayer cogwheel. In Acar-T 750 prototype, it was used Tecumseh Geotec 6.0 OHV engine with 6.0 HP. Energy transfer organs are hydromotor, redactor, and end smooth cogwheel. In order that user-machine interaction can be improved, inspection organs calculated and evaluated according to work areas. There are 3 inspection organ: a) direction command arm; b) pressure level valve; c) accelerator arm.

Monorail can easily provide harmony to difficult terrain condition. Establishing of monorail route, it is paid attention to find a taut route (Figure 5). The route is determined by means of compass and the draft is drawn. Rail construction is started from beginning point to end. Demontage is started from end point.

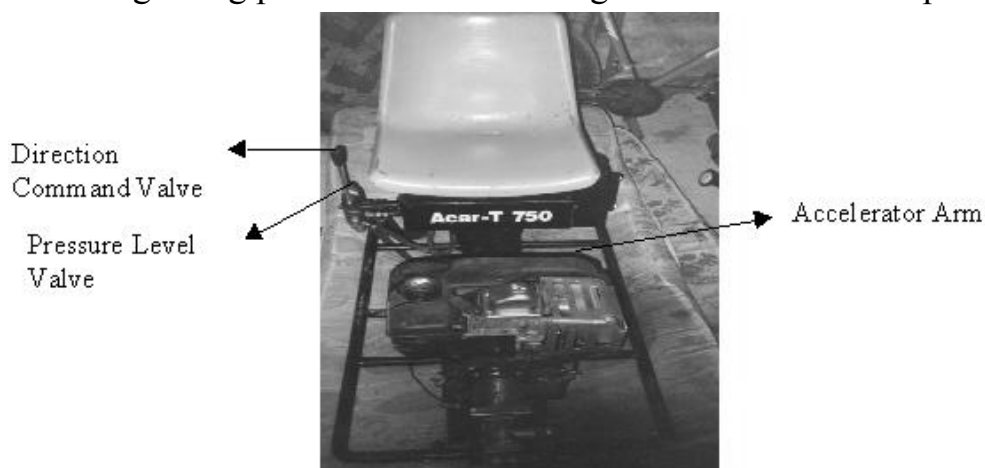


Figure 4. Acar-T 750's Locomotive

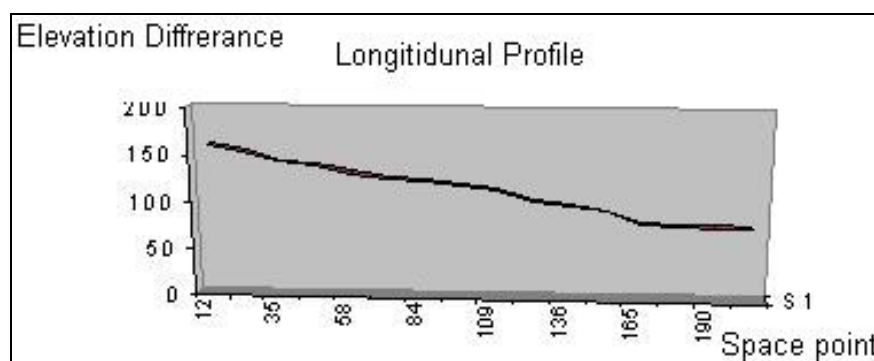


Figure 5. Longitudinal Profile of Monorail Route in Maçka-Kapıköy Region

4. Finding and Discussion

The total project costs are 29488,19 USD. The total cost of Acar-T 750 prototype includes preparing, project, construction, and other cost.

Acar-T 750 prototype model was established in Kapıköy Region, where tending operation was to be realized, of Maçka Forest District in Trabzon. Average slope ratio was 45 percent and maximum slope was 73 percent. There was intensive regeneration. Monorail was established through secondary stream route as 200 m distance. The average slope of monorail was 51,5 percent and altitude was 1145 meter. While monorail establishing corridor was being opened, any sapling was not cut (Acar et al., 2002).

The monorail route distance was 200 meter. On this route, it was carried out fuel wood transportation for experimental goal. In the experimental study, Acar-T 750 could wear the load 750 kg heavy. System speed was measured as 4,9 km/hour. This speed was static until 500 kg load and 70 percent slope limit. However, under condition of 750 kg load heavy and 70 percent slope gradient, the system speed decreased to 3,2 km/hour. Except that loading and unloading time consumption, the system productivity was determined as 12 m³/hour for 200 m distance and 70 percent slope (Figure 6).



Figure 6. A Perspective of Acar-T 750 Prototype

Montage and demontage time is short, thus the system can be easily transferred from anywhere to other. Monorail can work on difficult and roughly terrain. By using of monorail, the opening up forest areas can be maximized.

Particularly, monorail system can be very helpfully for forestry during tending operations. Tending operations are carried out on intensive regenerated conditions and new forest road construction can be very destructive for vegetation in this region. Monorail can prevent this negative effects.

5. Results and Recommendation

In this project, the production of Acar-T 750 prototype monorail was realized. Project costs was totally calculated as 29488,19 USD. In the experiment area, the establishing time of monorail to surface was 10 work day. Actual working time was 16,7 man hour for set up time. Average productivity was determined as 12 m³/hour with 4 worker in set up process.

In the experimental study, Acar-T 750 could easily wear the load 750 kg heavy. System speed was measured as 4,9 km/hour. Under condition of 750 kg load heavy and 70 percent slope gradient, the system speed decreased to 3,2 km/hour. The system productivity was calculated as 12 m³/hour for fuel wood transportation.

A narrow corridor can be suitable for monorail route in intensive regeneration areas. The monorail can work any height from earth surface by means of carrier and supportive foot. Thus, it is an environmentally friendly transportation vehicle.

References

1. **Acar, H.H., Topalak, Ö., Üçüncü, K.**, 2002. "Ülkemiz Koşullarında Monorail Sisteminin Ekonomik Olarak Üretilmesi Ve Ormancılıkta Kullanılması Olanaklarının Araştırılması (A Research on The Economical Production Possibilities of Monorail Systems in Turkey Conditions)", State Planning Organization of Turkish Republic (DPT), Project No: 99k120460, Trabzon.
2. **Acar, H. H.**, 1992. Transporte de madera por cables aereos en Turquia, El revista de maquinas y tractores agricolas (MT), No:3 (11), 31-32 p., Madrid.
3. **Acar, H., H.** 2000. "Dağlık Arazide Tekray Tekniği (Monorail Techniques in Mountainous Terrain), KTÜ Faculty of Forestry Seminars No: 6, 69-75 p., Trabzon.
4. **Acar, H. H., Yoshimura, T.** 1997. "A Study on The Productivity and Cost of Cable Logging in Turkey", J. For.Res., Vol:2 (4), 199-202 p., Tokyo.
5. **Furukawa, K., Okita, E., Hata, S., Jinkawa, M., Tshii, T., Fujii, T.** 1995, Development of the Tram-Car for Slope (II)-Field Demonstration, Transactions of the Japanese Forestry Society, No:106, 527-528 p.
6. **Taira, S.** 1984, "Dynamics of Materials", Ohm sha, P. 273., Tokyo.
7. **Yamada, Y.** 1989, The Optimum Forest Road Density Determined in Relation to The Cost of Walking, J.of Jpn. For. Soc. 71:257-264 p., Tokyo.
8. **Yamada, Y., Yoshimura, T., Aoi, T., Minato, K., Owari, T.** 1996, "Economical Effects of Using a Monorail for Riding in Forestry Operations", Journal of the Japanese Forestry Society, Vol: 78, No: 4, 419-426 p.
9. **Yoshimura, T., Acar, H. H.** 1996, "Present State of Mobile Yarder Operation and Others in Republic of Turkey", Journal of the Forestry Mechanization Society, Vol: 516 (11), 36-43 p, Tokyo.

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ВПЛИВ ПРОФІЛЮ ДОРОГИ НА ШВИДКІСТЬ РУХУ КОЛІСНИХ ЛІСОТРАНСПОРТНИХ ЗАСОБІВ

Подано методику і результати аналітичних досліджень впливу параметрів профілю дороги на швидкість руху колісних лісотransпортних машин.