

# Construction Method of Forest Roads in Turkey

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## Abstract

Forest road construction works were made by General Directorate of Forestry (GDF) in Turkey. Approximately 150000 km forest road was constructed by GDF until this day. It was determined that Turkish forest is needed 201000 km forest road for sustainable management and exploitation according to results of evaluations. Totally 51000 km new forest road will be constructed by GDF future years in Turkey. This means that the forest road construction works will be on the agenda. In Turkey, forest road construction process begins by proposal of related local forest office engineers. Local office engineers and road study stuffs, work for forest regional headquarter; make the terrain survey of needed forest road route. Cut volume and ground class are estimated by the technical stuff and recorded in definite charts in the route survey. After this survey, the road construction cost is calculated. After, road construction work is adjudicated to private construction company according to estimated road cost. Dozers were traditionally used for road building but these days excavators are used for road building because of environment protection. This study; construction method of forest roads was investigated in Turkey.

**Key words:** forest roads, construction method, Turkey

## 1. Introduction

Forest roads are the most important infrastructural facilities to exploit forests that are renewable natural resources. A road network that leads us to our goals needs to be established in order to plan forestry activities sustainably. In addition to forestry services, forest roads provide economic benefit for rural population by enabling them to market their products and help them meet their healthcare, education and other social needs. Forest roads interact with many technical, economic, environmental and social factors to render these services. Although roads are the first step to start exploitation of forestry resources, they are also infamous for paving the way for erosion and sedimentation and for their adverse impact on wild life and water resources, which make forest unavailable for production and other significant forestry activities. Therefore, an environment-friendly and economically and technically sufficient road plan should be implemented. In many countries, forest road networks are realized as a part of the land planning. When a forest road system is planned, condition of the forest, structure of the land, climate data, environmental factors, infrastructure, on-wood forest products and services, user groups of the road, value of access to the forest and national policies are often taken into account (Potocnik,1996; Bjorklund, 2006).

For long years, economical feasibility of forestry production works has served as the main goal in establishment and maintenance of forest road networks. However, recently, utilization of new techniques resulted in or paved the way for evaluation of different factors, too. These studies look into following considerations transportation cost, distance, maintenance cost, vehicle types and road categories, friction distances and costs, road surfaces, road space and density values (Paterson et al., 1975; Wolf, 1996; Greulich, 2002; Huang et al., 2006; Weston et al., 2004; Palmgren et al., 2004; Martin et al., 2001; Saari et al., 2007; Pentek et al., 2007; Demir, 2007; Acar and Unver, 2007; Gumus et al., 2008).

Parallel to the increased competition under globalization, there is also an increase in measuring and comparing the administrative efficiency. Various parametrical and non-parametrical techniques are used both in public and private sector to measure and increase efficiency and productivity (Sowlati, 2005; Fouracre et al., 2006).

The forest area in Turkey covers 21.7 million hectares and 53.3 % of the total area is productive. Turkish government is the owner of almost all forests in Turkey. Turkish forests are run by Government Forest Enterprises. For this reason planning, construction and maintenance of fixed type forest roads is the most important under structure establishment. Turkish Government carries it out along with other forestry operations. All forestry operations are made difficult because forests are generally located on mountainous areas. Exploitation of forests requires intensive forestry practice, rational and appropriate for achieving forestry aims. For this reason, forest roads are one of the most important necessary tools. They enable the transportation of wood, personnel, materials and equipment. On the other hand, forest roads provide traffic facilities and recreation for forest visitors. Thus, forest roads create economical, social and cultural benefits (Erdaset al. 1995; GDF, 2012).

In Turkey, 15 million m<sup>3</sup> of logs are transported on forest roads each year. Furthermore, they play an important role in other forestry activities such as forest protection, forest management, silvicultural activities and protection from erosion and plantation. Forest road construction is more expensive in mountainous areas such as Turkey is. Systematic forest road network planning studies started in 1964 and completed in 1974 by General Directories of Forestry. In these studies, a total of 144,425 km of forest roads have been planned for productive forest areas. These plans, however, had to be revised due to the development of forestry technology, requirements of the national forestry and the actual practice. According to the revision, the total length of planned forest roads amounts to 201,810 km. Up to 2011 a total of 148451 km of forest roads were constructed, which is 73.56% of the total road length. The planned forest road density is 20 m/ha.

## **2. Forest roads in Turkey**

Forest road planning is conducted in accordance with the Communique no. 292 by Directorate General of Forests in Turkey. Place, route, slope, width, curves and lases are examined for evaluation of roads already built in the forest. It has been provided that roads that currently meet the forest road standards are included in the new plan while those that are not possible to re-build even through extensive repair are left out of the road plan (GDF, 2008). This directive covers only technical specifications for evaluation. Nonetheless, economic, environmental and social factors should also be considered as well as technical specifications. There is not any evaluation form developed and approved for an evaluation study in Turkey. It is highly important for a standard practice all around the country to define the factors to be taken into consideration for evaluation and criteria (indicators) that define these factors.

Forest roads are divided into three main groups with respect to the amount of the load to be transported over them, the objective of construction, traffic density and tonnages in Turkey: primary forest roads, secondary forest roads (Type A and Type B secondary forest roads) and tractor roads. Geometrical standards of these roads are shown in Table 1 (GDF, 2008).

**Table 1.** Geometrical standards of these roads.

Road features	Unit	Main forest roads	Secondary forest roads				Tractor roads
			A - Type	B – Type			
				HBT	NBT	EBT	
Platform width	m	7	6	5	4	3	3.5
Number of road line	Number	2	1	1	1	1	1
Roadway width	m	3	3	3	3	3	3
Maximum longitudinal slope	%	8	10	9	12	12	20
Minimum vertical curve diameter	m	50	35	20	12	8	8
Shoulder width	m	0.50	0.50	0.50	0.50	0.50	
Ditch width	m	1.00	1.00	1.00	1.00	0.50	
Superstructure width	m	6	5	4	3	3	
Bridge width	m	7+(2 x 0.6)	6+(2 x 0.6)	5+(2 x 0.6)		4+(2 x 0.6)	

HBT: High standard B type forest road, NBT: Normal B type forest road, EBT: Extreme B type forest road

### 3. Evaluating of forest roads from planning, construction and maintenance

Nowadays, multiple use and sustainable forestry operations are of utmost importance. Multiple uses require a planning that includes not only log production but other forest function, too.

Forest functions are evaluated under three aspects as production forest, protection forest and national parks from the point of view of forest road network planning in Turkey (Yolasigmaz 1998, Eraslan 1982). New approaches must be acquired in accordance with the evaluation of these functions and different road density for each function that has been investigated while planning the general forest road network.

Forest transportation plans must be take into consideration for the best benefit of forest roads while forest road planning. This condition is essential point of view performing duty from forest roads in production forests.

Forest transportation plans are developed after preparing forest products for transportation in accordance with road network plan, management and silviculture plans, terrain conditions, available machine park, work volume, worker capacity and work output. Plans must include care to avoid damage of transported logs, trees in stands, regeneration, forest soil and work power. It is a model that selects the best transportation form taking into consideration the order, timing and type of extraction from compartment as well as transport with trucks on forest roads.

Geographical Information Systems have become an important tool that has been used frequently in decision making process recently. Geographical Information Systems (GIS) is a system in which graphical and non-graphical data exist and can answer various spatial query. Initial usage of geographical information systems in forest road network planning studies started at beginning of 1990's.

In initial studies, it is aimed at developing product plans as quickly and accurately as possible by means of obtaining values for forest road planning from geographical information systems database. Cut and fill volume estimating, the short pat determining between two fixed points, etc. a lot of analyses could be performed easily and quickly by usage of digital terrain models. But, researches are doing their best to improve this analysis.

Recently geographical information systems have been used for selecting the best forest road routes and determining the necessity for road building in Turkey (Acar and Gümüs 1998a, 1998b). Forest roads are the most important infrastructure establishment based on forestry operations. The exclusive use of bulldozers and excavators for leveling road construction operations along the road creates big damages in addition to wrong planning of forest roads. This application, causing loss of terrain or damaging forest cover under the road, is increasingly used in mountainous region. In Turkey, various types of bulldozers have been generally used in traditional forest road construction activities (Acar and Eker, 2003). On the terrains with gentle to moderate hillside slope, bulldozers have been still commonly used in right-of-way, cut-and fill slope, and subgrade activities (Figure 1).

However, in steep and rocky terrain conditions, the efficiency of the bulldozers diminishes and excessive environmental damages may occur since it becomes troublesome to keep the excavated material along the day-light point of fill slopes. In order to reduce the environmental damages on forest ecosystem, especially in steep terrains, hydraulic excavators have replaced bulldozers in forest road construction activities (Stjemberg, 1982) (Figure 2). Besides, using excavator improves the quality of the forest roads, which extends life of the roads, improves the driver's comfort, and reduces the frequency of maintenance activities. In fact, using excavators can be the only option to perform feasible road construction activities in steep mountainous terrains (FAO, 1998). Using bulldozer reduces the road construction cost in terrains with moderate slope and deep cut-slopes; however, they store the excavated material on the roadside along the roadway and these material falls downhill, which results in landslide and erosion problems (Acar and Eker, 2003).

Besides, excavator bucket with blocks of rock to be excavated and cannot be removed with a hammer mounted excavator arm is broken. With a hammer to break the rock blocks uneconomic using explosives are destroyed. At this stage, emerging hard rock blocks to be moved dismembered with explosives in rock blasting holes are opened first. Holes in rock blasting air compressors are used for the opening (Caglar and Turk, 2008).



**Figure 1.** Forest road construction by bulldozer



**Figure 2.**Forest road construction by excavator

#### **4. Conclusion**

Approximately 150000 km forest road was constructed by GDF until this day. Totally 51000 km new forest road will be constructed by GDF future years in Turkey. In Turkey, high portions of forest roads have been constructed but negative phenomena such as insect disaster and landslides, etc. have not been prevented. Terrestrial evaluating is still insufficient even though great attention has been paid to environmental protection in planning stage. Forest road constructions have generally been made somewhat sloppily and hastily and taken into consideration right before production. Water constructions have been built only where momentarily required. Their maintenance has not been good enough. Dozers were traditionally used for road building but these days excavators are used for road building because of environment protection.

As a result, available road network plans must be evaluated again from the point of view of functional planning and transport planning and constructions must continue in accordance with the new plan made for future. Planning of roads damaging the natural environment and aimed only at achieving production, road construction with bulldozer, passing the rocky areas by dynamite, inadequate water construction and untidy maintenance works must be reorganized by using geographical information systems in planning operations. An optimization model was developed to provide the forest road designer with decision support system for evaluating alternative horizontal alignments by finding efficient vertical alignments. By allowing the designer to quickly examine various feasible route paths, design time is reduced in the early stage of the forest road design. Besides, LIDAR data in forestry in Turkey based on scientific studies should begin as soon as possible and then to the practitioners of this technology will bring to the contribution of road building activities can be explained.

#### **5. References**

- Acar, H.H.Eker, M. (2003).The Use of Excavators in Forest Road Construction and Their Environmental Benefits.J. South-West Anatolia For. Res. Inst. 5: 98-128.
- Acar, H. H. and Gumus, S.(1998a). Determining of Technical Data and Maps in Forest Road Network Planning by Geographical Information Systems, KU Artvin Forestry FacultyJournal,.

- Acar, H. H. and Gumus, S. (1998b). Determination of Forest Road Art Construction Requirement Usage of Geographical Information Systems, V. Esri and Erdas Meetings, 8.s, 11-12 June 1998, ODTU, Ankara
- Acar, H.H.Unver, S. (2007). Evaluation and grading of existing forest roads. Turk. J. For. Eng. 44: 37-38.
- Bjorklund, E.S. (2006). Environmental Statement 2005, Wood Supply Europe Report, Stora Enso Forest Product, Sweden.
- Caglar, S. and Y. Turk (2008).Some Techniques and Environmental Problems in Forest Road Construction (Case Study-East BlackseaRegion ). VI. National Forestry Faculty Student Congress, 8–9 May 2008, s. 173-180, Duzce
- Demir, M. (2007). Impacts, management and functional planning criterion of forest road network system in Turkey, Transportation Research Part A, 41: 56-68.
- Eraslan, I., 1982. Forest Management, Istanbul University Pub., Istanbul.
- Erdas, O., Acar, H. H.,Tunay, M., veKaraman, A. (1995). Problems and Its Suggestion of Solution Interested in Forest Ergonomy and Production, Forest Roads, Transportation of Forest Products, Forestry Mechanisation and Cadastral, Turkey Forestry Report, KTU Forestry Faculty Pub. No:48, Trabzon.
- FAO (1998).A manual for the planning, design and construction offorest roads in step terrain.Food and Agriculture Organization of theUnited Nations.Research Paper, Rome, Italy.
- Fouracre PR, Sohail M.Cavill, S. (2006). A participatory approach to urban transport planning in developing countries. Transportation Planning Technol. 29: 313-330.
- GDF (2012). MEF Statistics Division, GDF Management Planning Department, Turkish Republic, General Directorate of Forestry, Ankara.
- GDF (2008).Forest Roads Planning, Construction and Maintenance. Turkish Republic, Forestry and Waer Ministry, General Directorate of Forestry, Construction and Supply Head Department, Edict No: 292, Ankara.
- Gumus S, Acar HH, Toksoy D. (2008). Functional forest road network planning by consideration of environmental impact assessment for wood harvesting. Environ. Monit. Assess. 142: 109-119.
- Potocnik, I. (1996). The multiple use of forest roads and their classification. In: Food and Agriculture Organization of United Nations (eds), Proceedings of the Seminar on Environmentally Sound Forest Roads and Wood Transport held at Sinaia, Romania. pp. 103-108.
- Sowlati, T. (2005). Efficiency studies in forestry using data envelopment analysis. Forest Products J. 55: 49-57.
- Stjemberg, E.L. (1982). The use of hydraulic backhoes in forest roadconstruction: Centre and Eastern Canada. Feric Publications, No.59, Canada.
- Yolasigmaz, H. A. (1998).Preparing of Forest FunctionMaps Whit Geographical Information Systems, K.T.U. MasterThesis, Trabzon.