

Keynote Address: Low-Volume Roads in Finland

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Roads and streets, railways, waterways, harbors, and airports form the basic transportation infrastructure in Finland. Its total capital worth is FIM 270 billion or around 370 billion if we count vehicles, rolling stock, and other means of transportation. Finland's remote location, long distances, low traffic volumes, and severe climate all add to the costs of transportation. The cold, that is, frost and snow, adds some 15 percent to the costs of civil engineering compared with costs on the Continent. The Finnish export industry spends two or three times the European Economic Area (EEA) average to move goods to its main market, and transportation costs represent about 15 percent of the price of every Finnish export product.

Recent government spending on the transportation infrastructure has averaged FIM 10 billion per year. The real value of investment rose slightly in the 1980s but has since fallen sharply because of the very bad recession that Finland currently faces.

The Finnish road network is already comprehensive, and main emphasis is currently being moved from constructing new links to maintaining and upgrading existing roads. Congestion is not a big problem in Finland even though some 1,000 km of roads, mainly around major cities, become congested from time to time. Environmental goals on the roads include reducing noise and damage to groundwater and improving road surroundings in built-up areas. The road safety goal is to

cut at least 70 accidents involving personal injury annually through the action of the Road Administration.

HISTORY

Finland is a sparsely populated country. To give some scale, compare Finland and Germany. Finland is about the same size as Germany in area but has 5 million inhabitants versus nearly 80 million in Germany. Population in Finland is, however, scattered fairly equally all over the country, and therefore the transportation network must be comprehensive. Low-volume roads supplement this network. They provide access to remote areas for settlement and utilization of natural resources.

The structure of the Finnish transportation system is linked to the history of Finnish society. After World War II, nearly half a million people moved to what remained of Finland from areas that were given to the former USSR. These immigrants were given land for farming. This immigration led to a substantial volume of road construction during the two postwar decades. To create jobs during that period, the Finnish National Road Administration (FinnRA) hired many of the unemployed to construct these roads.

Until the late 1950s, Finland continued to be an agricultural country. Industrialization and urbanization started in the 1960s and led to a great migration from rural areas to Helsinki and Sweden. Even entire rural

communities and villages emptied, and consequently the traffic volumes on minor roads decreased. As a result, Finland has a fairly dense network of low-volume roads.

Another reason for the development of low-volume roads in Finland was to utilize the forest resources. A significant number of forest roads are used for this purpose. Expansion of the Finnish forest road network began in the late 1940s as government started to grant subsidies to encourage utilization of wood resources. During the past 10 years, about 2,000 to 2,500 km of forest roads have been constructed annually.

STATISTICS

Finland has about 400,000 km (250,000 mi) of low-volume roads [traffic volume less than 1,500 vehicles per day (vpd)]. FinnRA maintains roughly 15 percent of the total length, which accounts for about 80 percent of the traffic usage (millions of vehicle kilometers) on the Finnish low-volume road system. The length of different low-volume road types in Finland is as follows:

Road Type	Road Length	
	Kilometers	Percent of Total
Public roads (maintained by FinnRA)	65,000	16
Private roads for small communities	100,000	24
Private roads for forestry and agriculture	90,000	22
Property access roads	140,000	34
Streets	15,000	4
Temporary winter roads	250	0
Total	410,250	100

Public roads are maintained by FinnRA. Low-volume public roads are functionally mostly local roads (85 percent). Main and regional roads account for the remaining 15 percent. Property owners are responsible for construction and maintenance of private roads. Normally they form a cooperative society to perform this task. Federal and local government can grant subsidies for construction and maintenance of private roads. Government subsidies may cover 30 to 80 percent of the approved construction or maintenance budget. Private roads that serve permanent communities are eligible for these subsidies. In sparsely populated regions of northern Finland, cities have taken a significant role in private road upkeep. In these areas, the

cities' share of maintenance costs varies between 70 and 100 percent.

Based on a different act, upkeep of private roads that serve only forestry and agriculture can also be subsidized. About 20 to 30 percent of forest roads are plowed during some winter months. Forest roads have been designed to accommodate heavy wood transport vehicles.

Property access roads (inside one property) are not eligible for subsidies. Normally, these roads carry very low volumes of traffic. Low-volume streets located inside built-up areas are maintained by the cities.

Temporary winter roads are connections that, during winter, shorten distances compared with the permanent road network. They consist of plowed routes on lakes and wetlands.

LOW-VOLUME ROAD UPKEEP

Finland is located about as far north as Alaska is on the American continent. Winters are cold, dark, and long. Average temperatures vary between -1° and 63° F in northern Finland and 15° and 71° F in southern Finland. Finns are experts in road upkeep in these extreme circumstances. Winter maintenance is very advanced and features efficient maintenance equipment such as fast plows, extendable plows, and other innovations. Methods for treatment of frost-susceptible road sections have been developed. These methods include various geotechnics-related concepts such as use of geotextiles, drainage, improvement of bearing capacity, and soil reinforcement.

Special requirements for road structure need to be met to address temperature variation and frost problems. Finns have gained expertise on these issues because of long practical experience as well as research and development. FinnRA uses a very advanced pavement management system (PMS) to optimize rehabilitation and maintenance measures on the road network. Using the road user's perspective, FinnRA helps road officials find the best possible use of available funds and other resources. An Infrastructure Management System (IMS) has been developed based on this PMS for the World Bank to use in the former Soviet Union. IMS covers bridges in addition to roads.

All FinnRA's low-volume roads are kept in a drivable condition 24 hr a day through the winter. The main goal of winter maintenance activities is snow clearance. FinnRA does not try to keep low-volume roads bare during winter, and they are normally snow covered. Salting is not used as an antiskid measure. Slipperiness is controlled by sanding at such problem sites as hills and intersections. Only in extreme conditions is all the road section sanded.

Winter maintenance costs per kilometer on FinnRA's low-volume roads are roughly 10 to 30 percent of the costs on main roads. However, costs for the upkeep of low-volume roads account for about 60 percent of all maintenance costs. This percentage can be explained by the low-volume road network length, which is 85 percent of the length of all public roads. A debate is going on whether the standard of winter maintenance on low-volume roads is too high. The current practice can be justified by regional equity, but the prevailing high maintenance standard is not profitable in terms of cost-benefit analysis.

Figure 1 shows public road length by pavement type and traffic volume. Most roads that carry up to 200 vpd have gravel surfaces. On roads that carry between 200 and 1,000 vpd emulsion gravel is the most common pavement, and when traffic volume is higher than 1,000 vpd, asphalt pavement starts to dominate.

Emulsion gravel is a pavement that is used mainly in Finland and Sweden. Currently, it is normally a mixture of fluid bitumen and stone material. A type of oil was used earlier, but this practice has been changed to eliminate environmental risk. Emulsion gravel is extremely flexible pavement. Minor defects caused by ground frost or increased load do not cause cracking as they do with asphalt pavements. Cracks that appear in the winter disappear in the summer. Also, maintenance of emulsion gravel is simple. Holes and potholes can be repaired with mixtures from storage. A hole can be filled with the mixture, which is then compacted by a truck wheel. Mixed emulsion gravel can be stored for years. According to economic analysis, emulsion gravel is beneficial on roads with traffic volumes from 350 to more than 1,000 vpd.

Roads with very low traffic volumes mainly have a gravel surface. Maintenance of these roads has developed considerably during the past decades, and today, because of advanced working methods, use of suitable

wearing course materials, and drainage, FinnRA's gravel roads deteriorate only during the thawing period. Also, dust control during summer is very developed.

GOALS FOR UPGRADING LOW-VOLUME ROADS

In terms of cost-benefit analysis, upgrading low-volume roads is very rarely profitable. Savings resulting from upgrading are too small to cover the construction costs. The most common problems involve bumpy road surface, poor structure, and poor geometry. Solving these problems does not bring the significant benefits to road users that normally result from upgrading high-volume roads with capacity problems. Actually, improving geometry may lead to an increase in speed and consequently an increase in the number of accidents. Projects for upgrading roads can normally be justified economically only if there is a risk that the road section will break down totally.

Because there is little cost benefit to upgrading low-volume roads, the reason for the upgrades must be based on regional policy. An issue that needs to be addressed is whether we should keep the whole country populated. The current tendency is centralization; people are moving from the countryside to bigger centers. Should we try to stop this trend or not?

There is little evidence that upgrading minor roads vitalizes remote districts. It could have the reverse effect. High-standard connections may encourage people to go shopping at bigger centers, a trend that leads to the death of rural services.

Many minor roads are of scenic value. However, tourism alone seldom provides justification for road improvement. The standard of a road has been found to have only a minor effect on tourist streams and income from tourism. After all, the extra earnings of some businesses on the upgraded route are only displacements from one route to another; nothing new has been created. There are winners and losers because of the investment, and, from the perspective of the country, this kind of displacement investment is not justifiable.

BALTIC AND RUSSIAN LOW-VOLUME ROADS

Finland has been cooperating with the Baltic countries, especially Estonia, since these countries became independent. All Finnish road regions have "sister" regions in Estonia. Finns have donated a significant amount of used road maintenance equipment to Estonia. The Baltic people are experts in getting the best value for the insufficient funds they have for road upkeep. They lack everything: funds, equipment, personnel, training, and so on. Whereas countries with a developed infrastruc-

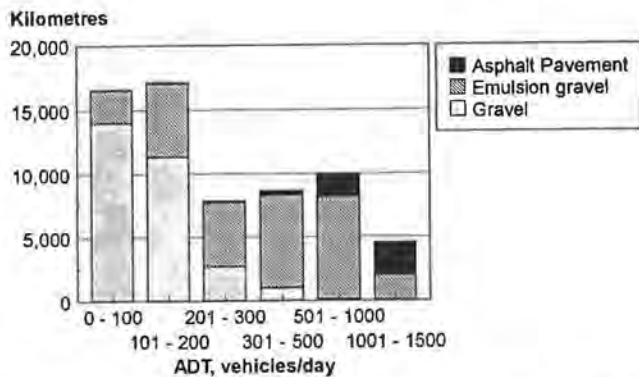


FIGURE 1 Public roads in Finland by pavement type and traffic volume in 1993.

ture are discussing the optimization of standards for road upkeep activities, the Baltic countries are wondering how to prevent roads from breaking down and ensure access to all parts of the country.

In 1993 FinnRA and FHWA established a Technology Transfer Center in Helsinki to provide training and material aid for Baltic road agencies.

The situation with the Russian road network is very much the same as it is in the Baltic countries. Even major roads are in poor condition. Heavy loads are best transported in the winter when the road structure is frozen.

Finns import a lot of wood from Karelia, a province of Russia along the Finnish border. This import represents about 20 percent of the wood consumption of the Finnish wood-processing industry. The wood is brought to Finland mainly by train. Logging the forest on the Russian side requires construction of a forest road network and the rehabilitation of existing roads. If Finland becomes a member of the European Community, it will also form the community's border with Russia.

SUMMARY

Finland has about 400,000 km of low-volume roads [traffic volume less than 1,500 vehicles per day (vpd)]. FinnRA maintains roughly 15 percent of the total length, which accounts for about 80 percent of the traf-

fic on the Finnish low-volume road network. FinnRA's roads are called public roads.

The remaining 85 percent of low-volume road types comprises private roads for small communities and forestry and agriculture, property access roads, streets, and temporary winter roads.

History and development of the Finnish low-volume road network were significantly influenced by the population movements after World War II.

Finns are experts on cold-region road maintenance. Long experience, along with research and development, have led to several innovations in such fields as winter maintenance equipment and maintenance management.

In Finland, emulsion gravel is a common pavement type for low-volume roads. It is a flexible mixture that makes maintenance easy. Economic analysis shows that emulsion gravel is beneficial on low-volume roads with traffic volumes from 350 vpd up to more than 1,000 vpd.

Upgrading low-volume roads can only rarely be justified with cost-benefit analysis. It should rather be seen as a means of regional policy that addresses the issue of services in remote regions.

Finland is helping the Baltic countries and Karelia in Russia reconstruct and maintain their road networks. The goal is to prevent roads from breaking down rather than to allocate funds as effectively as possible. A Technology Transfer Center was established in Helsinki in 1993 to provide training and other aid for these road agencies.