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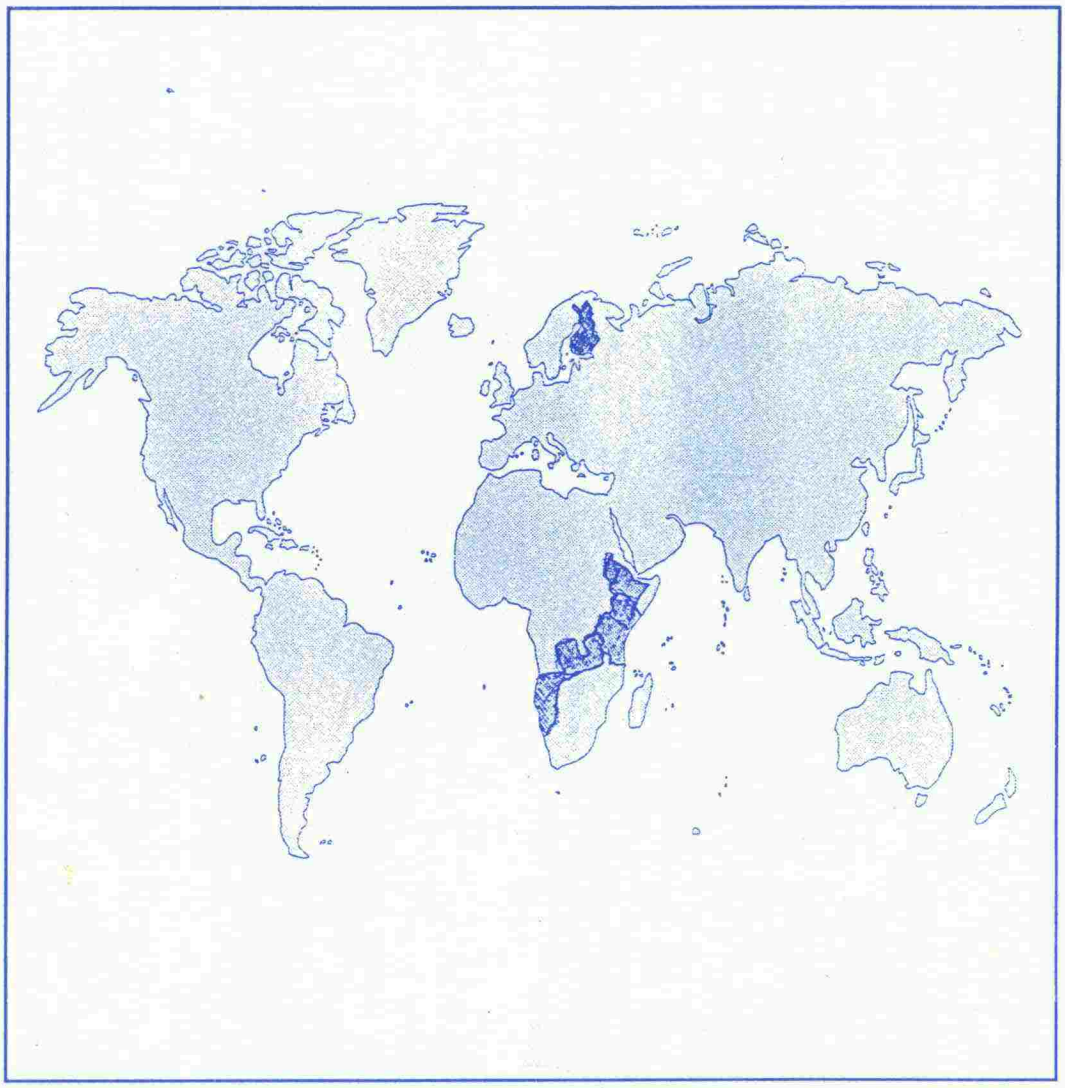
FUNCTIONAL CLASSIFICATION OF THE ROAD NETWORK



FINNRA

VIATEK TAPIOLA OY

FUNCTIONAL CLASSIFICATION OF THE ROAD NETWORK

INTRODUCTION

The study concerns road classification systems in Finland and five African countries; namely, Kenya, Tanzania, Zambia, Ethiopia and Namibia. The emphasis of the study is on functional classification.

Originally, most road classification systems have developed because of administrative reasons. Defining the legal owner of the roads and the responsibilities for road construction and maintenance costs were the main factors.

The functional classification of roads is a newer system. It has different objectives such as:

- to guarantee the mobility offered by a trunk road network, formed by the most important national routes; and
- to develop equal access in different parts of the country.

Additionally, the functional classification aims at minimizing the need of road funds and improving road safety. Compared with the administrative classification, functional classification looks towards the future – not only at today's needs.

The study has been prepared by the Finnish National Road Administration on behalf of the World Bank. The consultants for the project were Tom Granberg and Peet Ranniste of Viatek Group Ltd.

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FUNCTIONAL CLASSIFICATION OF THE ROAD NETWORK

SUMMARY

I. THE PURPOSE FOR FUNCTIONAL CLASSIFICATION

I.1 Historical Evolution

Functional classification of roads in Finland has its background in old postal routes which conected main centers in the country through a transport network. The connections were required in order to guarantee fast throughput of the central regime's important messages to regional administrations. These routes had service stations (taverns or inns) at regular intervals. Travellers could rest there and messengers could obtain new horses.

When motorization developed, main routes connected the most important centers. Other roads, sometimes with heavy traffic, were relegated to be of minor importance.

The background in developing countries was somewahat different. Typically some major transport connections were necessary for the ruler of the country to control the area. This was the case in Kenya, where the construction of the Ugandan Railroad from Mombasa to Kampala also generated a road. This link formed the backbone for Kenya's entire road network. Road connections were added to this main trunk line which connected the hinterland to the ocean outlet in Mombassa. Similarly in other regions, the British, French (and German) colonies developed, or connected to, parts of a north – south route through the continent. Locally, important routes to harbours were also established.

The road classification system also varies bewtween the two. In Finland, the classification system has long been meshed with the financing system. It has been more of an administrative tool than a functional classification system that serves road network design and planning activities.

In Africa, the countries do not commonly have independent municipalities. A central administration (e.g. Ministry of Local Government) regulates the local authorities. Financing is determined at the national level with minor municipal input. Functional classification systems have been designed as a tool for planning, design and maintenance purposes.

The quick development from a society without roads to a modern state has in some instances produced a more sound functional classification. The classification system, however, does not alter the fact that the countries are suffering road network deficiencies.

The quality and extent of the road network in countries can be compared by some simple indicators such as the length of the network in relation to the population or land area. Both indicators are misleading, however, if a country is exceptionally large with a low population or is at the opposite extreme. However, in the 'average' cases such ratios make it easier to spot differences.

In Nordic Countries, Denmark has 14, Finland 15 and Sweden 16 kilometers of roads per 1000 population. In Norway, the corresponding figure is over 20 and in Iceland some 30 km. Both of these are examples of sparsely populated countries. France has some 17 and German less than 10 kilometers per 1000 population. With over 230 inhabitants a sq-km, Germany represents a country at the opposite extreme to Norway or Iceland.

Table 1: Road Networks by Country

Country	Population in millions	Area sq-km	GNP/ capita US$	Total Road network (km)	Roads km/ 100 sq-km	Roads km/ 1000 pop.
FINLAND	5.0	338 000	16 300	77 500	22.9	15.4
KENYA	24.9	580 000	360	63 300	10.9	2.5
ZAMBIA	7.8	753 000	290	37 000	4.9	4.7
ETHIOPIA	50.3	1222 000	120	43 100	3.5	0.8
TANZANIA	24.4	945 000	160	46 000	4.9	1.9
NAMIBIA	1.7	824 292	1200	41 800	5.1	24.6

The above countries have a wide variation in population, GNP, etc. All of them, however, are fairly large and not densely populated. The African countries have very high population concentrations though.

I.2 Functional Classification System

The functional classification system is largely based on definitions of centers and their connections. In Finland, the classification system is now more general than earlier on. The theoretically more exact system is not used in practice. In African countries, the system seems to be about the same. In different countries, the main roads and the connections are defined as follows:

Table 1: Main Roads, 1st class

Class I, Finland	Connect the most important centers (old:the national and provincial), serve as international routes, form a backbone for the road network. Level of service and the road quality is targeted to the highest level. 7486 km
Class A: Kenya International Trunk Roads,	Link centers of international importance, international boundaries or terminals at ports 3119 km
International Main Roads Zambia	International routes, connections to borders etc. 3537 km
Trunk Roads*) Tanzania	National trunk road network, usually served with scheduled bus service throughout the year, interdistrict/regional transport 10300 km
Trunk Roads Namibia	4324 km

*) Tanzania has one class "trunk/main roads" opposite to the other countries; these have part of the main roads in the following table 2.

Table 2: Main Roads 2nd class

Class II, Finland	This road class completes the class I network in Finland. Technically, the two highest classes are similar each other. Differences largely due to historical reasons. 4048 km
Class A: Kenya International Trunk Roads	Link centers, towns or areas of national importance, such as provincial headquarters 2748 km
Territorial Zambia	Connect main centers to others and complete the primary road network 3139 km the
Main roads Namibia	8792 km

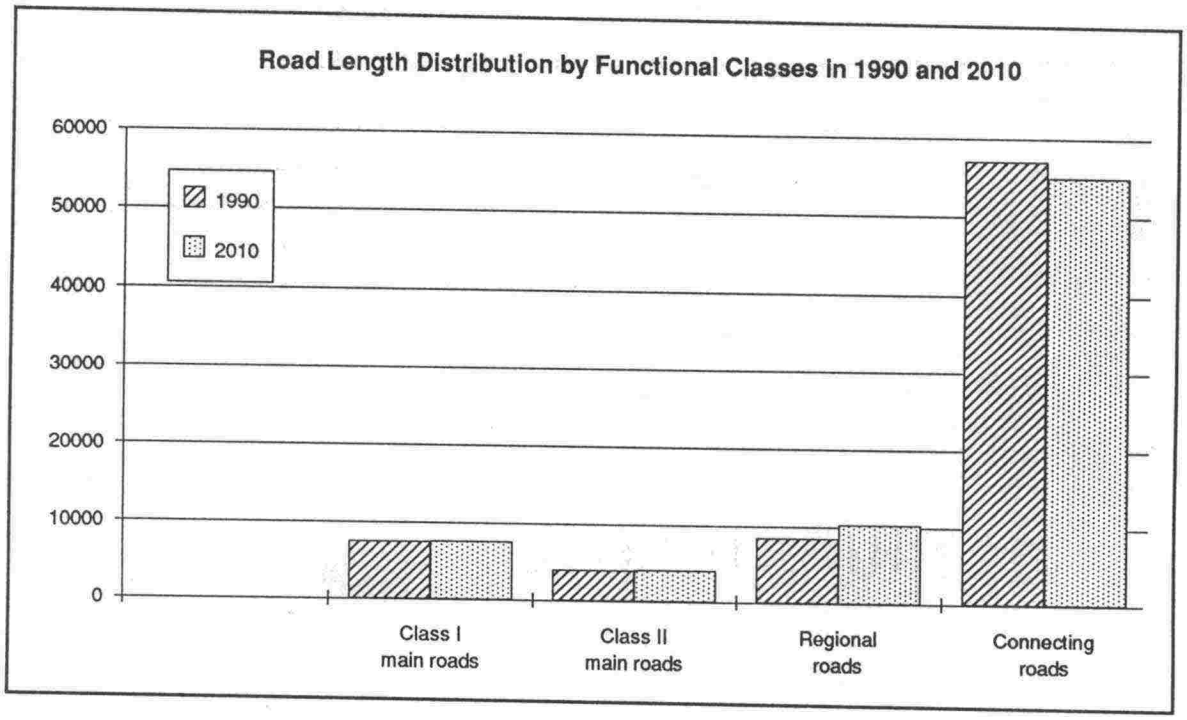
As shown in the above list, the main roads represent a fairly small share of the network. Secondly, the definitions, the names etc. vary by country. Some of the road classes may be inherited from earlier times, at least the two main road classes in Finland. Furthermore, developing countries with relatively short road networks seem to have fairly detailed network classifications.

The regional road network corresponds better to the size of the country than main roads do.

Table 3: Regional Roads

Regional Roads Finland	Serve important regional connections and also those to national and international networks. 8044 km
Class C, D Kenya Primary Roads, Secondary Roads	Connect locally important centers (class C: district, class D: divisional) to other centers and to higher class roads 19175 km
District Roads Zambia	Form secondary road network linking local centers and districts with primary road network 23882 km
Regional Roads Tanzania	Connect divisional headquarters to district headquarters, (mostly earth surfaced) 21000 km
District Roads Namibia	28684 km

The Finnish network development scenario is based on the National Main Road Network Plan shown in the Figure below. As indicated, the future network will be essentially the same as the existing one. Based on the review of the African countries, no major changes are neither planned in any of the countries, at least in the short term. Emphasis is on maintenance and upgrading of the existing road network.



II CONCEPTS OF FUNCTIONAL CLASSIFICATION

II.1 National Roads

The need for the functional classification of roads in Finland has changed during the past in several ways. Originally, the system served economic and administrative responsibilities (legal ownership). With growing traffic volumes, the network development questions became more important.

Road policy has been an important part of the equal development of regions in the country. To guarantee opportunities for political decision making, all the main road designs are confirmed by Ministry of Transport and Communication of Finland. Generally, all final decisions concerning the main roads are made by the Ministry.

Functional classification served as a tool for defining the important linkages to be developed. There was a general demand for equality in the different parts of the country. After identifying the major regions and centers, a road network scheme to create the connections could be defined.

The quality standards for main roads is one tool to achieve road policy objectives. The road network is generally there. So, the main questions are how to create good traffic flow conditions and road safety. Technically, this is realized by defining road width by road class and traffic volume, and speed limit (which partly determines the design speed) by road class and urban development. Both of these factors form a basis for design elements that are detailed in the Finnish design guidelines.

It must be noted that the functional classification is a system based on future needs. Both estimated development and the policy objectives have an impact on each road's final class. By the technical solutions the policy goals are supported in road maintenance and construction.

The third question in road policy concerns the road's relationship to the environment. Main roads have uninterrupted traffic flow conditions as a high priority. So, low speed limits (less than 80 km/h) in urban areas are not acceptable in the long term. The technical solution should allow fast traffic and transport. This would be achieved by using by-pass roads and strict access control. Basically, these criteria also relate to class II main roads.

Technical matters are not only restricted to design issues; maintenance needs to be addressed also. It is important to guarantee the connections during every season and under all weather conditions. Therefore, Maintenance Classification has been modified so that it is not simply based on traffic volumes. Functional classification is taken into account also.

More details about the winter maintenance standards appear in Appendix 3.

Highway Winter Maintenance Classification

ADT	TRUNK ROADS	MAIN ROADS	REGIONAL ROADS	CONNECTING ROADS
> 12000	Isk	Isk	Isk	Is
6000 - 12000	Is	Is	Is	I
3000 - 6000	I	I	I / Ib	Ib
1500 - 3000	I	Ib	Ib	Ib
500 - 1500	Ib	II	II	II
200 - 500	II	II	II	III
< 200		II	III	III
Pedestrian and Bicycle paths	IV	IV	IV	IV

Bare Pavement Roads
Snow Surface Roads During Cold Winter Conditions
Snow Surface Roads

Summer maintenance is not a major problem in Finland because of advanced maintenance equipment, high mobility and computerized follow–up systems such as PMS. Accordingly, requirements for 'fire brigade' type activities (like during snow storms in winter) occur extremely seldom.

In developing countries, maintenance needs are different. The maintenance is often carried out by a chain of bases along the road, each responsible for a certain section. The maintenance base and depot system should be in line with the importance of the road because of shortages of vehicles and materials etc. Labour based methods are used commonly. Lack of transport appears sometimes. An optimization system for basic maintenance is necessary in any country, but the parameters for the process will be different.

II.2 FUNCTIONAL CLASSIFICATION OF THE URBAN NETWORK

The urban road network classification system in Finland is related to town planning. The national roads are systematically changed to streets when approaching Helsinki's CBD which is situated on a cape. In minor cities and towns, national main roads have their own road reserve in town plan. The classification system used in urban areas in Finland does not differ much from, for example, that in Kenya.

The connection between urban and national (functional) classification is described schematically on the next page.

National Roads	Urban Roads
Main Roads I	Main Streets I
Main Roads II	
Regional Roads	
Local Roads	Main Streets II (Collectors)
Access/Private Roads	Collectors / Local Streets

Class I main roads will always be designed to by-pass urban areas. Urban traffic congestion and other problems should be avoided. Also, class II roads normally by-pass towns or other urban areas.

Local roads or connecting roads will not have a separate designation in town plans. Within the plan area, they will be considered municipal roads or streets.

The design of the road or street is dependent on the functional classification determined by the speed limit. Design speed is supposed to be based on this limit. Other factors affecting the design elements include the area where the road / street is situated (e.g. CBD, fringe, outer, residential, or OBD), junctions and the need for traffic signals.

Recently, jointly accepted guidelines for designing roads in urban areas (or major streets) have been produced by the Finnish National Road Administration in cooperation with municipal organizations.

II.3 Other factors

The basic concept for the main road system is to produce high standard connections between different parts of the country. Combined with the need for good road safety and demands for high quality road design, construction and maintenance are necessary. Main roads, after all, are intended for mobility.

The demands for high quality roads have produced safer roads. Main roads in Finland have an accident rate of 0,10 injuries per million auto kilometers. Corresponding rates on regional and connecting roads is 0,15 and 0,18 respectively. In comparison, the accident rate on Kenyan main roads (1985) is about 4–5 which, however, is not a high value in Africa.

Environmental demands have created numerous changes in detailed design but in general they have supported the need for strict access control. A typical example is the noise barrier.

III Procedures for Functional Classification

Road classification systems, as indicated in the previous chapters, serve many roles: administrative, functional and technical. The functional classification is the base though. Once the function of the road is determined and a road hierarchy is established, the roads can be further classified according to characteristics such as jurisdiction and design standards.

Once the system has been established it will be a planning tool for assisting in the development of the road network on a systematic basis. It is linked to most, if not all, planning and budgeting decisions. Maintenance and rehabilitation works, for instance, can be prioritized more effectively.

Concerning the above factors, the systems in the six countries do not much differ from each others. The only remarkable differences are connected with the financing: e.g. in Zambia, the lower class roads are funded differently from the main roads.

The data behind the classification covers both traffic and land use. Land use, and in its broader sense, activities creating demand for travel is key. Also the development objectives, and the equality of the different parts of the country are taken into consideration. Related to land use is the transportation inventory traffic (e.g. volumes and origin–destination) and design data. The desired level of service both existing and in relation to future travel forecasts is required for all travel modes. Quantitative techniques such as demand forecasting can help in this regard.

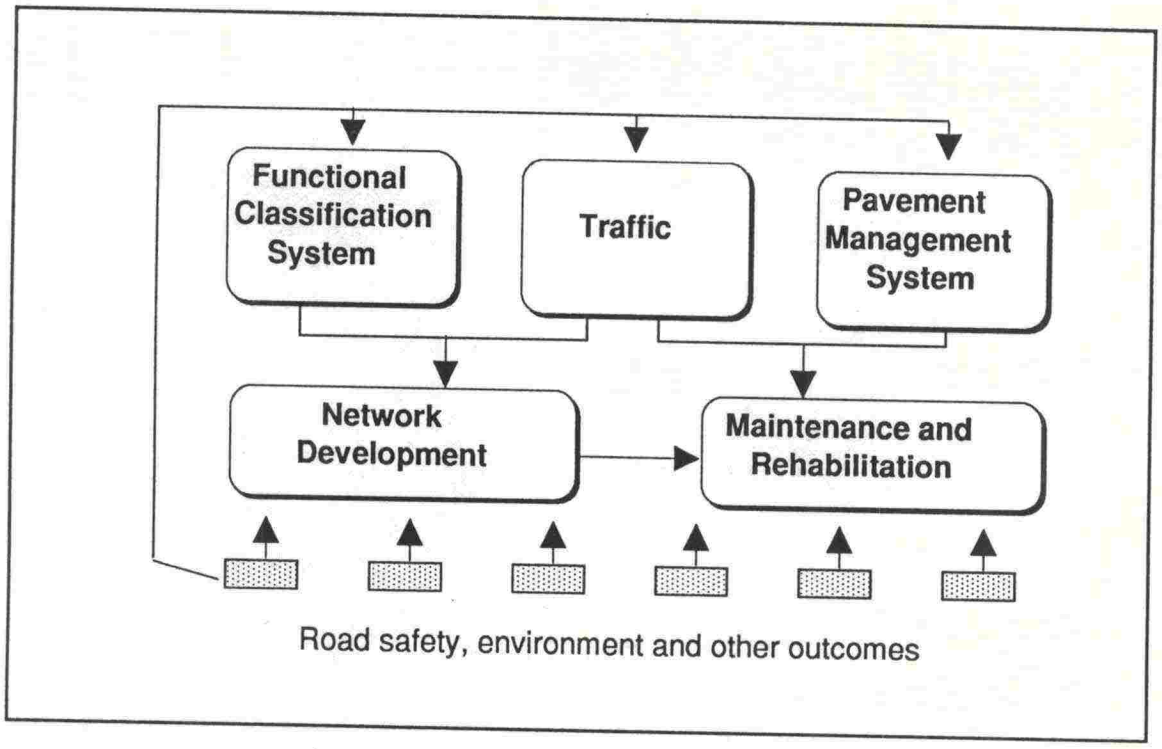
An important feature of functional classification is that it is based on the future of road network and the land use development – not only the existing situation. This is how functional classification also supports the general development objectives

In conclusion, it is important that the road classification system serves the transportation goals of the country rather than dictating them. Thus mechanisms for updating the system are important.

The main tools to achieve the policy objectives are the quality standards connecting the classification to the technical solutions. The second major factor is financing. In Finland, the FinnRA takes care of all public roads, but for example in Zambia the regional roads are funded differently.

In order to connect the policy issues to technical design, systematic quality standards for each road class may be defined. These standards give a practical form for the degree of mobility and access of each road class. The result is better road safety as well as smoother and more economic connections throughout the road network.

Another connection to design is the network development (or management) which relates to the pavement management system. The linkage of the two systems is depicted in the Figure on the next page.



Urban areas have their own road classification systems which serve the local development objectives. However, it has connections to that of the public roads: the role of the road varies in urban areas by the road class: main roads are mainly separate corridors passing by or going through the area, regional and lower class roads are changed to serve the urban land use as main roads or collectors.

Network Classification

1. ROAD CLASSIFICATION

1.1 History

Finland gained independence in 1917. Its new road law of 1920 was among the first ones in Europe that gave government full responsibility over the road network between areas and centers. The concept in Finnish can be literally translated as 'land roads' meaning public roads in general. Earlier land owners in the countryside were in charge of maintaining the road network. Local and private roads, on the other hand, remained the responsiblity of local municipalities and land owners.

Private roads serve only one estate or they are situated within one. These roads may also be owned by a group of land owners. Traffic on private roads is only exceptionally limited; they are normally for public use. They are regulated by a separate law.

The administrative class of the road was of importance due to the economic effects of the road class. There were a number of ways (and there still has remained some) of acquiring funds from the government for construction and maintenance of local roads. The state was responsible for the public roads. Some of the main points were:

- because of the independence of municipalities and their right to taxation the public road stopped at the town border (unless especially designated for public road purposes -- this option appeared fairly late and was strictly controlled). For construction and maintenance of the *continuation of the public road in the town area* the municipality could apply for government funding (60% or so). These roads were classified as 'roads important for through traffic'.

- *Local roads* were funded at a rate of 75% by the government. Very often, these roads were constructed instead of streets.

- *Private road boards* could apply for funds for maintenance, rehabilitation and reconstruction of a road. These funds are controlled by municipalities.

Government has been responsible of all public roads in Finland for decades. This means that the local roads are also constructed and maintained by the government. The only exception is the county of Ahvenanmaa (Åland) which has limited autonomy. Here the county administration adopts the government's role.

The Finnish National Road Administration (FinnRA) is the agency responsible for organizing all the road sector activities. In practice, it may rely on private enterprises for different tasks.

1.2 Policy Formulation and Decision Making

The road management activities can be grouped into three:

- **system planning**, covering for example national main road networks
- **Project planning and design**, including project study, preliminary designs, road plans (to reserve right–of–way etc.), and also decision making including final acceptance
- **Planning of the up–keeping activities**, e.g. 10 year programme (10–Programme) and Economic and Technical Plan (TTS)

Basically, FinnRA is responsible for preparing programmes and design etc. FinnRA is also the decision making body for regional and lower classified roads. MTCF participates in policy decisions pertaining to the following:

- all decisions concerning the most important main roads (class I) including
  * road projects
  * the system level decisions relating to the network, e.g. quality goals
- decisions on economic and technical development programming (10–programme and TTS)
- general matters relating to road, traffic and environmental quality

The phases of road planning and design and their connections to land use planning and decision making are descibed as a schematically on the next page.

1.3 Classification concept

The road classification may include administrative, technical, functional or maintenance based categories. Additionally, there are different bases for classifying roads in urban areas and as part of the national road network. The relationship between the urban and national (functional) classifications is represented schematically as follows:

National Roads	Urban Roads
Main Roads I	Main Streets I
Main Roads II	
Regional Roads	
Connecting Roads	Main Streets II (Collectors)
Access/Private Roads	Collectors / Local Streets

In areas with a town plan, a special corridor (road reserve) may be reserved for public roads. This provision, however,is only for main road classes (main roads I and II, or regional roads). Local roads (administratively) or connecting roads (functional classification) are always changed to streets or municipal roads within the town plan.

THE PHASES OF ROAD PLANNING AND DESIGN AND THE CONNECTIONS WITH LAND USE PLANNING

Road network plan
Classification /Quality Standards

Feasibility Study
- Development needs
- Objectives

Decision on Project

Regional Plan

Preliminary Engineering
- Overall location
- Operational solutions
- Effects

Action Decision

Master Plan

Road and Right-of-Way Plan
- Land occupied by road
- Detailed solutions
- Prevention of disadvantages

Approval Decision

Detailed Plans
- Town Plan
- Building Plan

Final Engineering

Public Roads
- MInistry of Transport&Communications
- Finnish National Road Administration
  * Central Administration
  * Road Districts (9)

Land Use
- Ministry of Environment
- Regional Councils
- Provincial Gocernments
- Municipalities

2
CLASSIFICATION OF PUBLIC ROADS

2.1 General

The different needs of administrators, planners and road designers led to several different road classification systems during the past years. In communications, difficulties some times arose in understanding the different views.

The technical and administrative classifications serve today's needs. Practical questions – though they vary a lot – need practical solutions.

Functional classification applies at a different level. While it is partly an existing system it is partly a system for the future as well. It is closely related to polcy decisions. As such, it actually forms the backgound for the development of both administrative and technical classifications.

2.2 Administrative Classification

Administrative classification is a system which defines the legal owner and the economic responsibility for the roads.

Public Roads, as a name, is a term used in the road legislation. Practically speaking, streets, local roads and most of the private roads are public as well. The public road system (state wide) is totally separated and different from that of municipal streets (local systems) and others in terms of classification.

The administrative road classification of Public Roads is based on the road law of 1920. The class defines the authority legally and financially responsible for the road. There are two main classes:

- Main roads (land roads)
- Local roads

The administrative classification is based on the road law. Sub–classifications of the main roads include the most important connections which are called Main Road 1st and 2nd class (or national highways) and the other main roads ("land roads"). The decision as to which roads belong to which class is made by Ministry of Transport and Communication of Finland (MTCF).

2.3 Technical Classification

<u>Technical class</u> of the road defines, in general, the technical quality of the the road segment. Secondly, the classification has an impact on maintenance standards and road safety.

In Finland, roads for motor traffic form a technical road class which has been defined in the road legislation; namely it has total access control and no pedestrians nor slow vehicles (bicycles, mopeds, tractors etc.) vehicles are allowed.
The highway may be divided (motorway) or non–divided (motor traffic road with two lanes). Both types have grade separated interchanges.

Other technical road classes are not generally used today. Preferably, the *technical standard* is based on the functional class, environmental factors, land use, and the terrain.

Maintenance classification which defines the quality and the quantity of the maintenance operations might be considered as a kind of technical classification, too. The Finnish system is mostly – earlier totally – based on vehicle volumes. Through this criterion, the maintenance clasification relates to the technical classification, and in a minor way to the functional classification.

Winter maintenance priorities are explained in the following Figure:

Highway Winter Maintenance Classification

ADT	TRUNK ROADS	MAIN ROADS	REGIONAL ROADS	CONNECTING ROADS
> 12000	Isk	Isk	Isk	Is
6000 - 12000	Is	Is	Is	I
3000 - 6000	I	I	I / Ib	Ib
1500 - 3000	I	Ib	Ib	Ib
500 - 1500	Ib	II	II	II
200 - 500	II	II	II	III
< 200		II	III	III
Pedestrian and Bicycle paths	IV	IV	IV	IV

Bare Pavement Roads
Snow Surface Roads During Cold Winter Conditions
Snow Surface Roads

The first three maintenance classes mean that snow removal, de–icing etc. operations should be carried out within 2–2,5 hours, and the target condition is maintained with only minor exceptions 24 hours a day.

Additional information on road classification and maintenance is given in Appendix 3.

2.4 Functional Classification

2.4.1 Classification System

Following the period when attempts were made to differentiate between the classes in order to clarify the definitions, a new approach has been sought; namely, to combine the different classification systems into one. Consequently, the administrative classification has been selected to also be the basis for the functional classification. And, the technical features of the road are defined, at least partly, by the functional classification.

In 1991 a draft for the long term plan for the road administration was released. It includes objectives for developing the road system up to the year 2010. Comments from the various administrative sections were received and the final decision by MTCF was signed in December 1992 for the Main Roads 1st class and in June 1993 for the Main Roads 2nd class. Both related to the trunk road network.

The renewal process is described in section 2.42.

In connection with the decision regarding 1st class main roads, MTCF also decided that the functional classification of public roads will comprise the following four classes (instead of the earlier five):

* Main Roads 1st class (National Highways)
* Main Roads 2nd class (Trunk Roads)
* Regional Roads
* Local Roads (Connecting Roads)

Regional and Local Roads are designated by FinnRA. Issues relating to the larger network and the need for more detailed studies postponed the final decision until June 1994.

Main Roads I

Class I Main Roads form a uniform network covering the whole country. These roads serve traffic between population centers in the country, to and from international nodes like harbours, airports and border crossings, and connecting to the most important international networks (Europe or E–Roads). Level of service and the road quality is targeted to the highest level.

Quality goals cover design speed, road width, number of lanes and access control.

Design speed is 120 km/h on motorways and 100 km/h on other main roads. Exceptions are made when necessary because of traffic constraints, economic considerations or environmental reasons.

The width of the main roads is based on the average traffic volumes as follows:

Table 5: Main Road Quality Standards

ADT	Total width / number of lanes
< 3000	9 m
3000 – 10 000	two lane highway of 10,5 m or exceptionally motorway with 4 or 2 lanes
10 000 – 12 000	two lane highway of 10,5 m (or four lane h.) or exceptionally motorway with 4 or 2 lanes
12 000 – 39 000	four lane highway or alternatively motorway with 4 lanes
> 40 000	Six lane highway or motorway

Generally, the target road width is 10,5 m consisting of 2 x 3,75 lanes and 1,5 m wide shoulders.

In town areas and other urban zones, separate pedestrian and bicycle routes will be produced along the main roads.

The number of junctions (intersections) is limited as much as possible to reduce traffic interruptions and, most of all, to improve road safety. Visibility of junctions is guaranteed and they are provided with necessary turn lanes. Direct access is basically denied; on motorways there is a law to this effect.

Grade separated interchanges are used at important road connections, especially when traffic volumes are high. Traffic signals are avoided.

The Road numbers range from 1 – 39. Red number signs are used. The network is shown in Appendix 1.

Main Roads II

Main Roads II complete the primary road network in Finland. Technically, they are very close to the Class I roads. The differences are mainly due to past considerations. Originally, the classification has been based on the importance of district centers. When a center has a small population the traffic volume is low and the importance of the road consequently drops. Some of these roads, however, can carry even more traffic than Class I roads.

These roads are 2 or 4 lanes wide with the same design speed standards as Class I roads. Also, maintenance standards are the same. Road width is typically 10 m with 3,75 m lanes when traffic volume is over 6 000 vpd (or 3,5 m if the design speed is 80 km/h). If the traffic volume is less than 3000 per day, the roadway width is 8 m, otherwise 9 m.

Road numbers are between 41 – 99. Yellow number signs are used.

Regional Roads

The Regional road system was defined by FinnRA in June 1994. The total length of these roads is 13 534 km. The network also includes connections which do not fully meet the road class requirements. The network, therefore, can be viewed more or less as a future one.

Quality standards for these roads include:

- design speed is 80 km/h and the speed limit is usually the same but it can be 100 or 60 km/h. The lower speed is applicable to urban areas.
- width of the regional roads depends on traffic volume (ADT) as follows:

ADT	Total width / number of lanes
< 3000	7 m
3000 – 6000	8 m
6000 – 10'000	9 m

- Regional roads are numbered between 100 – 999 with numbers increasing from south towards north. The signs are white with black numbers.

Connecting Roads (Local Roads)

Connecting roads have a large variation in traffic volumes and in the general road quality. Many are old 'landroads'. The oldest is from the 15th century while the newest one is of high quality and carries large traffic volumes. Most Connecting Roads link houses in rural areas. They have been improved on a step by step basis for vehicular traffic.

The dimensions of connecting roads are defined according to traffic volume, locally determined design speed (usually between 60 to 80 km/h), land use and other environmental factors. Road width may vary from 4,5 to 8 (and occasionally 9) meters. They are generally 7 m wide with 0,25 m shoulders.

In urban areas (within town plan), connecting roads are always changed to a street (or municipality road).

2.41 Renewal of the Classification

In 1989 the Finnish National Road Administration (then it was known as the Roads and Waterways Administration) initited a study concerning the development of the main road network. It was noted that the network was extensive but not uniform from the traffic point of view. Additionally, high standard main roads were viewed as important for the development of Finland as a large, fairly scarcely populated area.

The study report was produced during 1989. Large studies concerning, e.g. the economic and environmental effects and impacts on modal split were carried out. Comments from different interest groups were requested during the next two years, and after receiving the final statements, a new classification system was confirmed.

The problems behind the proposal were the growing traffic volumes and the fact that road investments have decreased in real terms during the last two decades. Investments had become already smaller than required to maintain the system at past levels. Economic conditions and the general policy simply did not support growing investments. Therefore, funds were used in an optimal way; namely, to improve mobility and safety in a carefully selected main road network and to reduce emphasis on roads which mostly serve regional traffic.

On 1 January 1989, about 76200 km of public roads existed, with 11400 km of main roads. Motorways and semi-motorways accounted for 400 km. Main roads were projected to carry over 60% of vehicle kilometers in 2010. The transport costs are about 10% of domestic product prices and 15% of export goods.

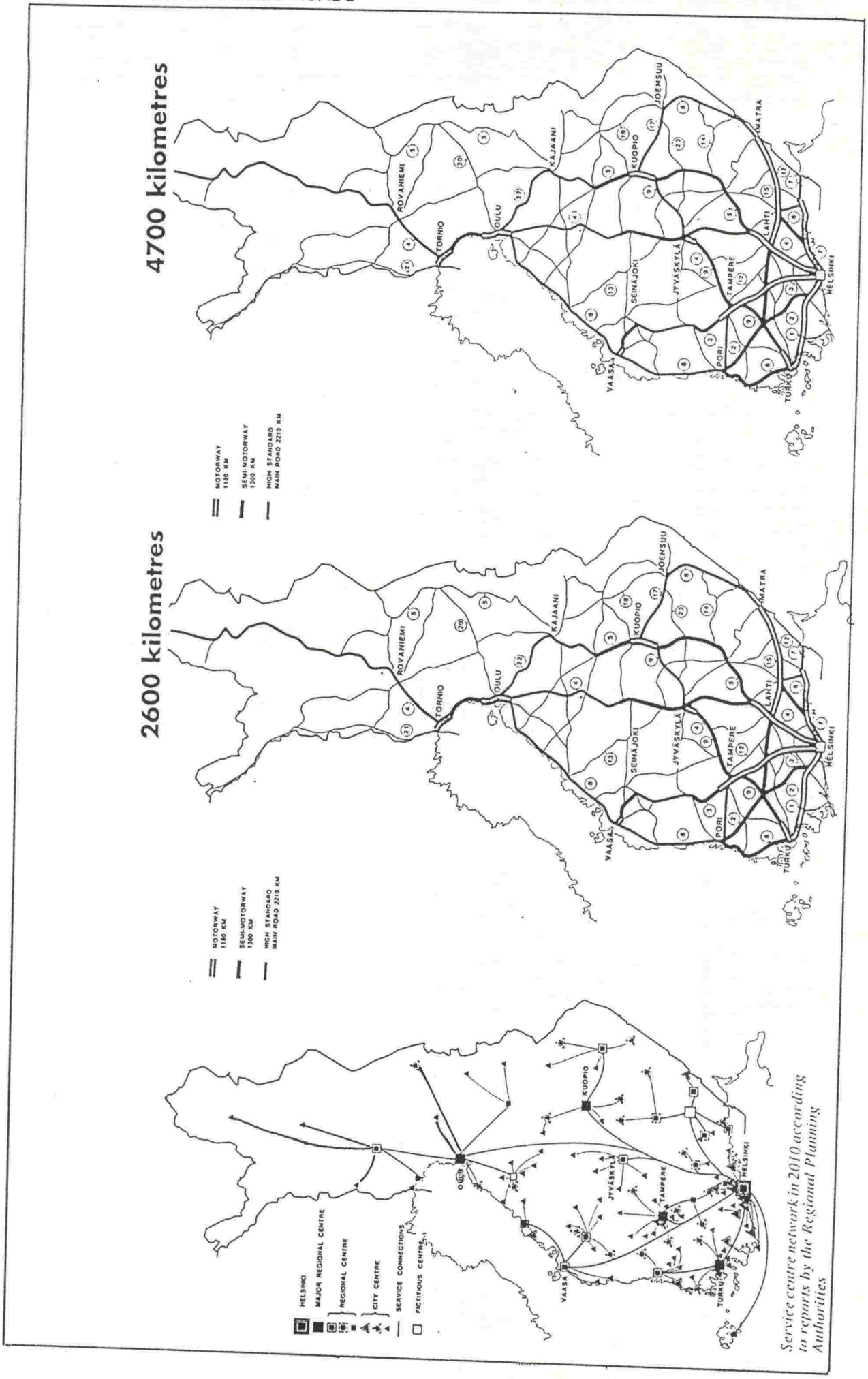
The main cities and the capital area together produce over 70% of the total GNP of the country although they represent somewhat less than 50% of the population. While the average GNP in 1990 was about US$ 18600 per capita, in the capital area it was nearly 30 000. This economic fact emphasises the need for fast and reliable connections between the main production areas and the capital area. The Just-On-Time (JOT) production techniques need a reliable and flexible network to guarantee positive development of transport costs.

A uniform standard for main roads defined on the basis of their functional classification also improves road safety aspects. A motorist can readily recognize a high speed road when entering one. Access control also improves the situation. High quality means higher costs. This is why the number of roads should be minimized but they must still fulfill the needs for the main connections.

Two proposals were worked out for the main road network. They were based on the land use structure of the country. The proposals are shown in the Figure on the next page. The main road networks totalled either (1) 2600 km comprising mainly motorways, or (2) 4700 km. It was also proposed to reduce the number of the road classes by having only one main road class. The reasons for this approach relate to regional structure, economy, traffic safety, main road unity, international connections (especially those to harbours and main airports), and the control of environmental problems.

Comments received about the proposal from different administrations, especially from the regional bodies, were definitely negative. The new system was seen as a threat to the quality of (regional) roads and also to local development funding.

Finally, the political decision was to keep the main road network and to even expand it slightly. It was agreed to modify the classification system by combining "collectors" and "connecting roads", the two lowest classes.



Service centre network in 2010 according to reports by the Regional Planning Authorities

3. URBAN ROAD CLASSIFICATION

The most developed classification system for urban networks is in Helsinki, the capital of Finland. The population of the city is about 0,5 million while the total metropolitan area has 0,85 – 1,0 million inhabitants depending on the definition of boundaries.

The road classification is based on a functional system. Technical standards depend on

* traffic volume
* the environment

In urban areas the environment means e.g. CBD area, CBD fringe area, or outer urban areas.

The road classes are as follows:

1. Motorways (Main Street I)

   Serves national or regional traffic, equipped mainly with grade separated interchanges. Speed limit (and design speed) normally ≥ 80 km/h

2. Main Street

   Serves regional traffic or traffic between major town areas, normally equipped with at-grade junctions (intersections). Speed limit/ design speed ≥ 50 km/h.

3. Areal Collector

   Serves traffic within a major town area and connects to the main street network. Long distance traffic will be kept off the street when possible. Speed limit normally 50 km/h.

4. Local Collector

   Serves internal traffic of a township connecting access streets to main streets or areal collectors. Speed limit normally 40 km/h.

5. Access Streets

   Serves access and connections to collectors. Planned normally as a cul-de-sac or closed ring. Speed limit 40 or 30 km/h depending on the environment, street length, pedestrian safety factors etc.

The area where the road is situated has a large impact on the technical standards. For instance, a 4 lane main street is normally traffic signal controlled in the city center, but has grade separated interchanges in outlying areas. Design speed and speed limits

are normally 50 km/h in the CBD, 60 km/h in the fringe and 80 km/h in outer areas. Lane width varies from a minimum of 3,25 (occasionally 3,0) m to 3,75 depending on the area. Major variations in these standards may appear locally, however. Emphasis is on maintaining a logical standard throughout every traffic connection.

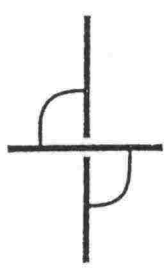
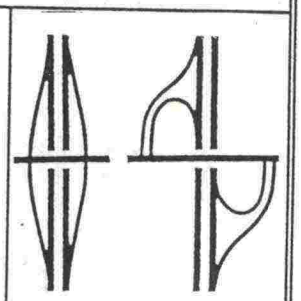
Main roads have a guidance system based on that of FinnRA, i.e. public roads. Minor streets may have a guidance sign when a specific reason exists, e.g. those roads leading to/from harbours. Signing is also used to give priorities (yield signs) for the main roads at junctions.

Parking and direct access are not allowed, in principle, along main streets. This is difficult to achieve in certain cases both technically and politically. So, a number of exceptions exist. All rules, policy decisions and so on are applied in connection with new projects. The old streets in the "stone city" will remain more or less as they are now.

Geometric Design

Geometric design of major urban streets and roads is being changed so that it is consistent with public roads in urban areas. The system is based on quality classes and this quality mainly concerns uninterrupted traffic flow.

The classes are a function of junctions, lanes and traffic volumes as follows:

Quality Class	Types of Main Roads and Approximate Traffic Volumes			
	Number of Lanes			
	1+1	1+1	2+2	2+2
				
Good	< 8'000	< 10'000	10'000–20'000	< 40'000
Fair	8'000–12'000	10'000–16'000	20'000–25'000	40'000–50'000
Mini-mum	12'000–15'000	16'000–30'000	25'000–30'000	50'000–60'000

The technical features of the roads are based on the above classes. The guidelines cover system planning, geometric design of roadways and special lanes, features of junctions and interchanges, pedestrian, cyclist and bus traffic facilities, signing etc. The report (guidelines) contains over 80 pages with appendices.

4. ROADWAY CLASSIFICATION SYSTEMS IN SELECTED AFRICAN COUNTRIES

4.1 General

For comparison purposes, a review of roadway classification systems in Kenya, Zambia, Ethiopia, Tanzania, and Namibia was carried out through correspondence, a limited literature review and personal experience.

The following provides general observations about the road system and the road classification system in these countries. With countries that are so diverse it is admittedly very difficult to generalize but the following provides a snapshot of existing conditions. As indicated, all the countries (including Finland) are facing similar issues.

Appendix 2 provides a summary of the road networks and classification systems for each country surveyed.

4.2 Roadway Network

Road networks in the five African countries have developed largely as a consequence of:

(i) economic needs

In landlocked countries such as Zambia the most important roads are the international main roads that connect the country to the highway system in other countries and onward to ports for export. In Kenya, the roads developed as a subsidiary of the railway system connecting the country to the ocean outlet in Mombassa. Access to agricultural areas is also an important function although it is often the secondary roads that fulfill this role.

(ii) population

Main roads also link main centres of population and government.

Road network coverage ranges from 1–5 km/1000 population. Namibia's ratio is much higher (close to 25) indicating its greater economic development. Ethiopia is the lowest at 0.8 but conditions such as rugged terrain are an important limiting factor.

Traffic volumes are generally on the low side outside urban areas. Typical volumes are about 1000 vpd on main roads and 100 vpd on minor roads. Commercial traffic dominates.

New roads are not being built. Emphasis is on maintenance and upgrading of the existing network.

4.3 Roadway Classification System

All five countries have a roadway classification system; usually legacies of their colonial past. Ethiopia, though, is in the process of developing a totally new one.

The systems are typically based on function. And usage (i.e. traffic volumes) is usually directly related to the function; but not always.

Administrative responsibilities usually correspond to the functional classification in that the state looks after the main roads while local authorities (i.e. regional/district councils) are responsible for the secondary road network. Cities and towns generally look after their own roads. Namibia's organization is perhaps the closest to Finland's in that the state looks after all roads except for those in urban areas.

The technical classifications also seem to be in accord. The higher the class of road, for example, the more likely that the road is engineered, paved and provides a better level of service. And, since usually the local authorities suffer from even more severe financial constraints than the national government, district roads are in much poorer shape. State administered trunk and main roads receive greater priority and have better design and maintenance standards. In Zambia, for example, the Roads Department has begun to maintain trunk road segments in the urban areas since they are being neglected by th elocal authorities.

For classified roads the following systems are used:

Kenya:	international trunk, national trunk, primary, secondary, minor, special purpose road
Zambia:	international trunk, main, district, rural
Tanzania:	trunk, regional, district, feeder
Ethiopia:	trunk, secondary, feeder, rural access
Namibia:	trunk, main, district

In general, there is a need to update the classification systems although in most countries it seems to be performing satisfactorily. Action is underway on a number of fronts, though. Ethiopia has asked for Consultant proposals to develop a totally new classification system. Zambia will be slightly modifying its system including design construction and maintenance standards in accordance with forthcoming Southern African Transport and Communications Commission (SATCC) recommendations. Kenya reviews its classification system on an ongoing basis in light of land use changes.

Appendix 1

FINLAND

GENERAL

Population:	5,0 mill.
Area (sq-km):	338 000
Pop. Density:	15 sq-km
GNP/capita:	$ 16 300
Road Network:	76756 km
(total public roads)	
Road density:	
km/100 sq km	0,23
km/1000 popul.	15,4

Finland is situated between the 60th and 70th degrees latitude north and about 400 km of the country lies north of the Arctic Circle.

Population is mostly concentrated in the southern parts of the country; The density of Uusimaa county is 114 people per sq-km, which is about the same as that of Denmark.

The capital of the country is Helsinki which is located on the south coast. The population of the Helsinki metropolitan area is about 0,8 million.

Economy

The economic structure is dominated by services (42%), industry and construction (26%) and commerce (15%). Transport and communication represents 8 % of the GNP while agriculture accounts for 9 %.

The export is dominated by metal and engineering products (US$ 11 billion). Forestry products (such as paper and timber) are next in importance with US$ 9 billion. Chemical industry and textiles account for US$ 3 billion and other products amount to US$ 1,5 billion.

Nearly 70 % of the imports are raw materials and fuels. Consumer goods comprise about 20 %.

Finland's most important trade partners are Germany (US$ 6,0 billion), Sweden (US$ 4,4 billion), UK (US$ 4,1 billion), USA (US$ 3,1 billion) and Russia (US$ 2,4 billion). In 1993, total exports were US$ 23 billion and imports were US$ 18,0 billion.

Road Network

The total public road network was 76 756 km (1.1.1993). It was divided into the following administrative road classes:

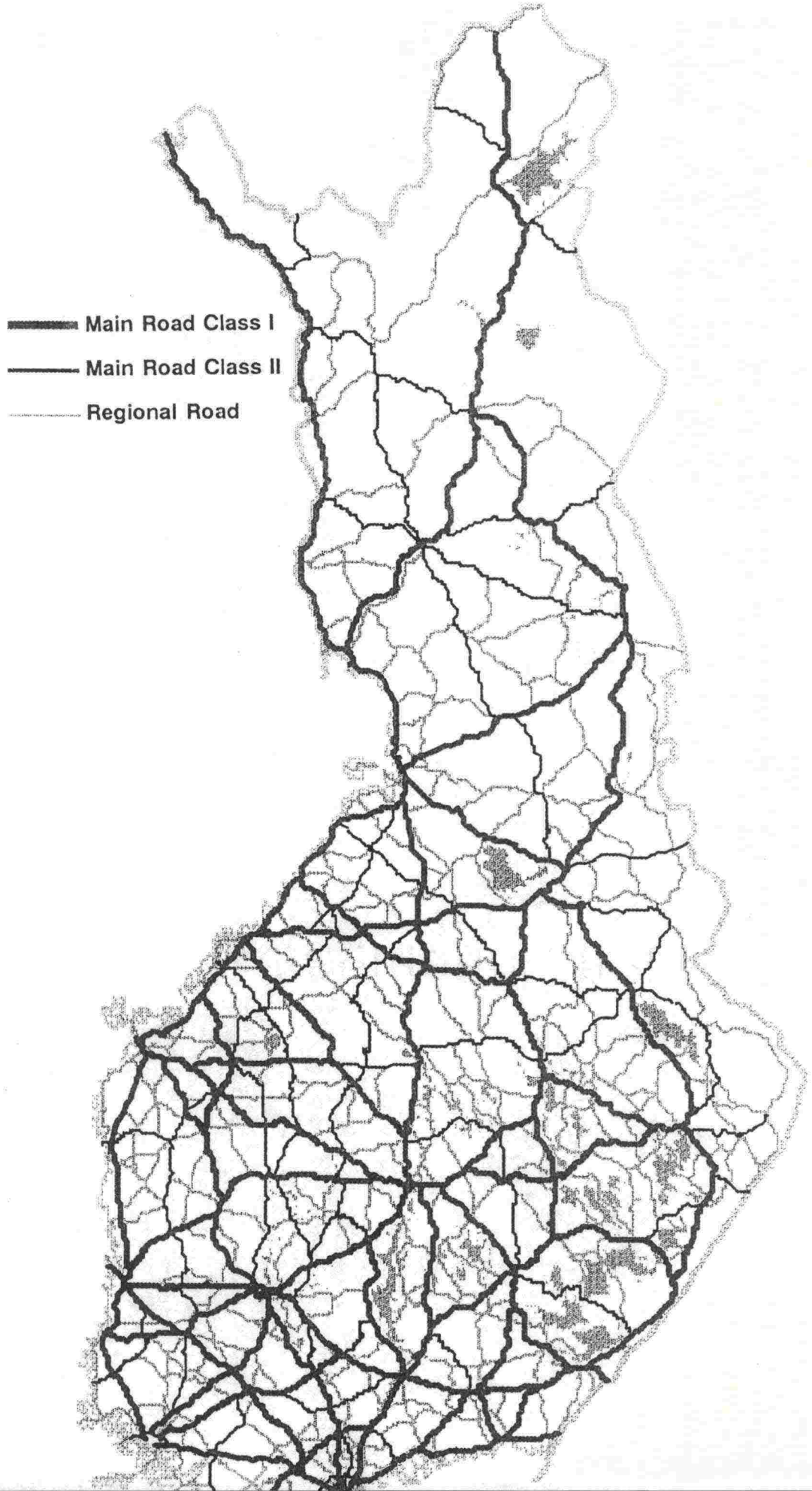
Table 4: Roads in Finland, administrative classification

Road class	Length in km	Length in km
Main Roads 1st class	7457	
Main Roads 2nd class	4042	
Other main roads	29516	
MAIN ROADS TOTAL		41 015
of which motorways		318
LOCAL ROADS		35741

The road network length (76'756 km) corresponds to about 15 km per inhabitant. Compared with other European countries Finland represents a good average.

The main road network of Finland and detailed statistics are shown on the next two pages.

FUNCTIONAL CLASSIFICATION OF MAIN ROAD NETWORK



General statistics of Finnish National Highways (Public Roads)

	Main Roads		Regional	Main Roads	Connecting	Total
	Class I	Class II	Roads	Total	Roads	
Length (km)	7486	4107	8044	19637	57862	77499
ADT (vehicles)	4288	2565	1420	2753	351	959
Summer ADT/Annual ADT	1,21	1,21	1,24	1,22	1,26	1,13-1,32

Transport work (mill.km/a	11716	3785	4169	19670	7412	27082
distr. by pavement:asphalt	11428	3401	2934	17763	2882	20645
light (asphalt)	287	384	1233	1904	3259	5163
gravel	0	0	2	2	1269	1271

Road Length (km) Distribution by Traffic Volume

ADT						
-1000	834	1293	4631	6758	57697	61162
1000 - 3000	2918	1856	2678	7452	2797	10249
3000 - 6000	2177	726	561	3464	497	3961
6000 - 9000	769	93	98	960	83	1043
9000 - 12000	372	50	30	452	50	502
12 000 -	416	89	46	551	31	582

Road Length (km) Distribution by Road Width (m)

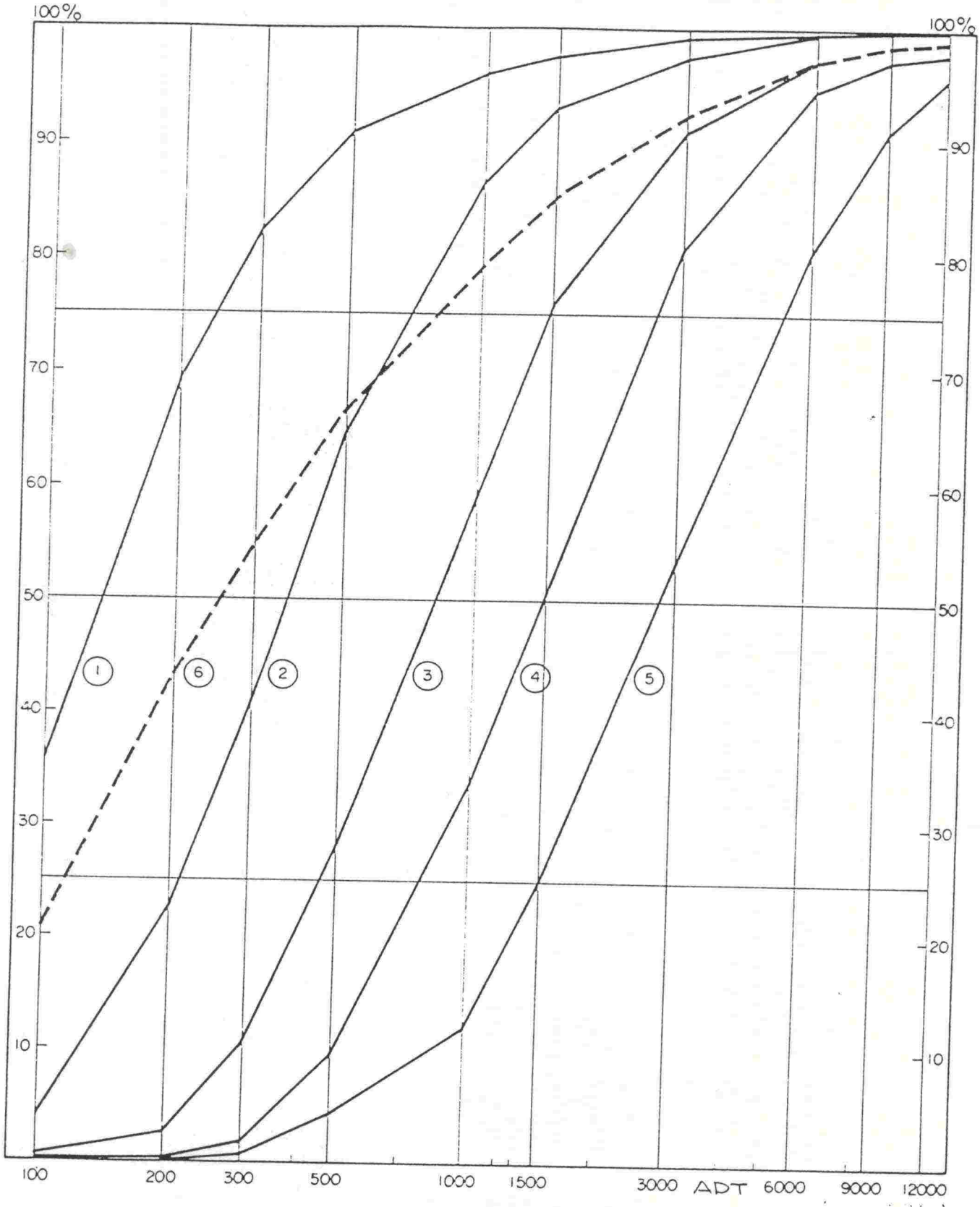
Pavement Width (m)						
< 5	0	0	42	42	1920	1962
5 - 5,9	0	13	300	313	9067	9380
6 - 6,9	531	1144	4038	5713	36031	41744
7 - 7,9	2877	1778	2417	7072	9760	16832
8 - 8,9	1306	319	570	2195	660	2855
9 -	2395	793	641	3829	406	4235
Divided Highways	376	61	36	473	19	492
	7485	4108	8044	19637	57862	77499

Accidents with person injuruies

Number of Accidents	1223	396	620	2239	1358	3597
Number of Casualties	1614	534	836	2985	1833	4818
Acc.Density (by km)	0,16	0,10	0,08	0,11	0,03	0,05
Acc.Rate (by 100 mill.km)	10,3	10,60	14,9	12,7	17,9	13,1
Acc.Rate by Speed - 50	21,1	20,3	26,7	22,9	28,7	27,4
(km/h) 60	22,3	22,3	23,7	22,7	18,9	20,5
(often signal control) 70	14,6	12,1	10,8	12,5	16,2	15,3
80	14	12,7	11,5	11,9	14,8	12,9
100	8,8	8,2	0,05	8,9		8,9
(motorways) 120	3,8	0,00		3,8		3,8

Road Length Distribution by Traffic Volume Classes

1 Connecting Roads
2 Collectors
3 Regional Roads
4 Main Roads 2nd class
5 Main roads 1st class
6 All public roads



DEFINITIONS
concerning the Finnish classification system

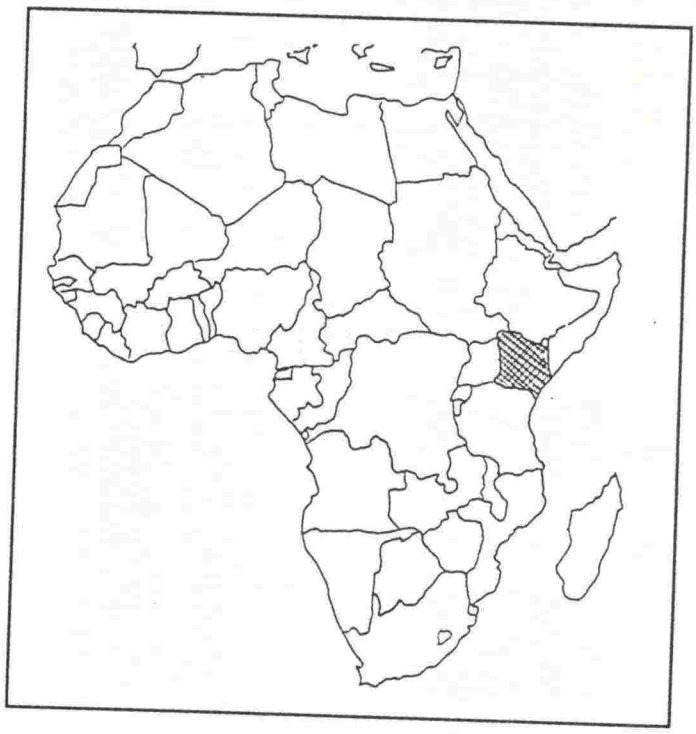
Because of difficulties in translation and the different earlier translation of the road classes, the following provides a short description of the road classes as used today and in the past. The names used in this report are written in bold and underlined.

Direct translation of Finnish	Names used in some translations	Function
National roads Trunk roads I class National highways Trunk roads	**Main roads I class**	Connect the most important centers of the country (national and over-regional centers) to each other and to international networks. Form the backbone of the road network
Trunk roads Trunk roads II class Main roads	**Main roads II class**	Connect urban centers to the most important directions and to complete the trunk road network
Land roads Main roads Other main roads Regional roads	**Regional roads**	Connect the minor urban centers (towns) to important traffic generating areas. Link the network to the trunk roads and generally serve regional and local traffic
Collector roads Cocal collectors Collector roads	**Local roads**	Main function to collect traffic from connecting roads and feed in to main road network. Serve local traffic and limitedly also access, mainly that of larger traffic generators like shopping centers or industrial plants
Connecting roads Secondary roads Access roads	**Connecting roads**	Serve connections to local roads and centers and to local accesses when necessary

KENYA

GENERAL

Population:	24.9 mill.
Area (sq-km):	580 000
Pop. Density:	43 sq-km
GNP/capita:	$ 360
Total Road Network: (classified)	63324 km
Road Network density:	
km/100 sq km	10.9
km/1000 population	2.5



CLASSIFICATION SYSTEM

The Kenya road network is divided into two categories

unclassified roads	87276 km
classified roads	63324 km
total	150600 km

The Ministry of Public Works and Housing is responsible for the classified road network. The unclassified roads comprise earth tracks that are either maintained by the county councils or left unattended.

The classified roads are divided into:

international trunk road class A
link centres of international importance and cross international boundaries or terminals at international ports (e.g. Mombassa)

national trunk road class B
connect towns, centres or areas of national importance such as provincial headquarters.

primary road class C
link locally important centres such as district headquarters to each other and to higher road classes

secondary road class D
link locally important centres such as divisional headquarters to each other and to higher class roads.

minor road class E
provide access to market centres in an area. Also link to higher class roads

special purpose roads are identified by the service they provide. They provide access to important development programmes. Examples include government access roads, rural access roads, settlement roads, tea roads, sugar roads, and wheat roads.

EVOLUTION

The classification system was adopted from the British. The road system in Kenya initially developed as a subsidiary of the railway system. Roads were developed as connections to the railway lines which formed the main trunk lines connecting the hinterland to the ocean outlet in Mombassa.

CHARACTERISTICS OF ROADWAY CLASSES

Characteristics of the roadway classes are given in Exhibit 2–1. As indicated:

ADT and surface type relate to road class

- 73% of class A roads are paved (51% of B, 31% of C, 10% of D, 3% of E, and 2% of SPR)
- and, in general, higher class roads carry more traffic, especially roads having greater traffic volumes than 1000 vpd.

PROCEDURES

Classification may change depending on any functional change to the centres or roads that it is linked to.

There are no plans to change the system.

REFERENCES

Correspondence with Mr. S.T. Akute, Chief Engineer (Roads), Roads Department, Ministry of Public Works and Housing.

Exhibit 2–1

3.Road characteristic table

Road Class	Surf type	Average Daily Traffic >2000	1001-2000	501-1000	301-500	201-300	101-200	31-100	0-30	Total Km
A	B	646.2	643.8	418.7	163.1	69.0	103.4	18.5	604.4	2667.1
	G	0.1	0.0	0.0	0.0	0.0	205.7	498.0	79.0	782.8
	E	0.0	0.0	0.0	0.0	0.0	89.0	0.0	152.0	241.0
	Tot	646.3	643.8	418.7	163.1	69.0	398.1	516.5	835.4	3690.9
B	B	18.6	421.0	358.1	342.1	0.0	88.4	27.5	147.6	1403.3
	G	0.0	0.0	52.1	41.0	0.0	118.0	186.2	423.3	820.6
	E	0.0	0.0	0.0	157.2	0.0	0.0	292.0	75.0	524.2
	Tot	18.6	421.0	410.2	540.3	0.0	206.4	505.7	645.9	2748.1
C	B	55.0	395.8	735.9	357.2	353.9	337.4	198.0	57.7	2500.9
	G	0.0	2.2	77.4	212.4	470.2	809.7	1277.0	455.3	3304.2
	E	0.0	0.0	14.5	0.0	31.5	194.7	265.2	1642.4	2148.3
	Tot	55.0	398.0	827.8	569.6	855.6	1341.8	1740.2	2155.4	7953.4
D	B	24.9	51.1	61.6	111.6	143.6	330.4	202.2	238.2	1163.5
	G	0.0	0.0	48.0	122.7	182.1	199.8	3162.3	1755.7	6170.5
	E	0.0	0.0	40.0	11.0	9.5	418.1	883.1	2536.1	3887.8
	Tot	24.9	51.1	149.6	245.2	335.2	1548.3	4247.6	4520.0	11221.9
E	B	0.0	11.5	6.3	16.2	42.0	54.3	88.4	448.4	667.1
	G	0.0	1.4	0.0	20.3	35.1	215.7	743.3	5982.1	6997.8
	E	0.0	0.0	25.1	31.0	14.2	334.8	1528.9	17024.5	18958.7
	Tot	0.0	12.9	31.4	67.5	91.3	604.8	2360.6	23455.0	26623.6
SPR	B	0.0	3.7	2.0	5.2	13.4	17.4	28.3	143.5	213.5
	G	0.0	1.6	0.0	24.5	42.4	260.6	897.8	7226.3	8453.3
	E	0.0	0.0	3.3	4.0	1.8	42.8	195.1	2172.8	2419.6
	Tot	0.0	5.3	5.3	33.7	57.6	320.8	1121.2	9542.6	11086.4
Totals		754.8	1532.1	1843.0	1619.4	1408.7	4520.2	10491.8	41154.3	63324.3

Surface type B = Bitumen G = Gravel E = Earth

Urban Network Classification
(proposal for Manual on Urban Transportation Planning)

In a well-planned community the classes serve certain type of traffic as follows:

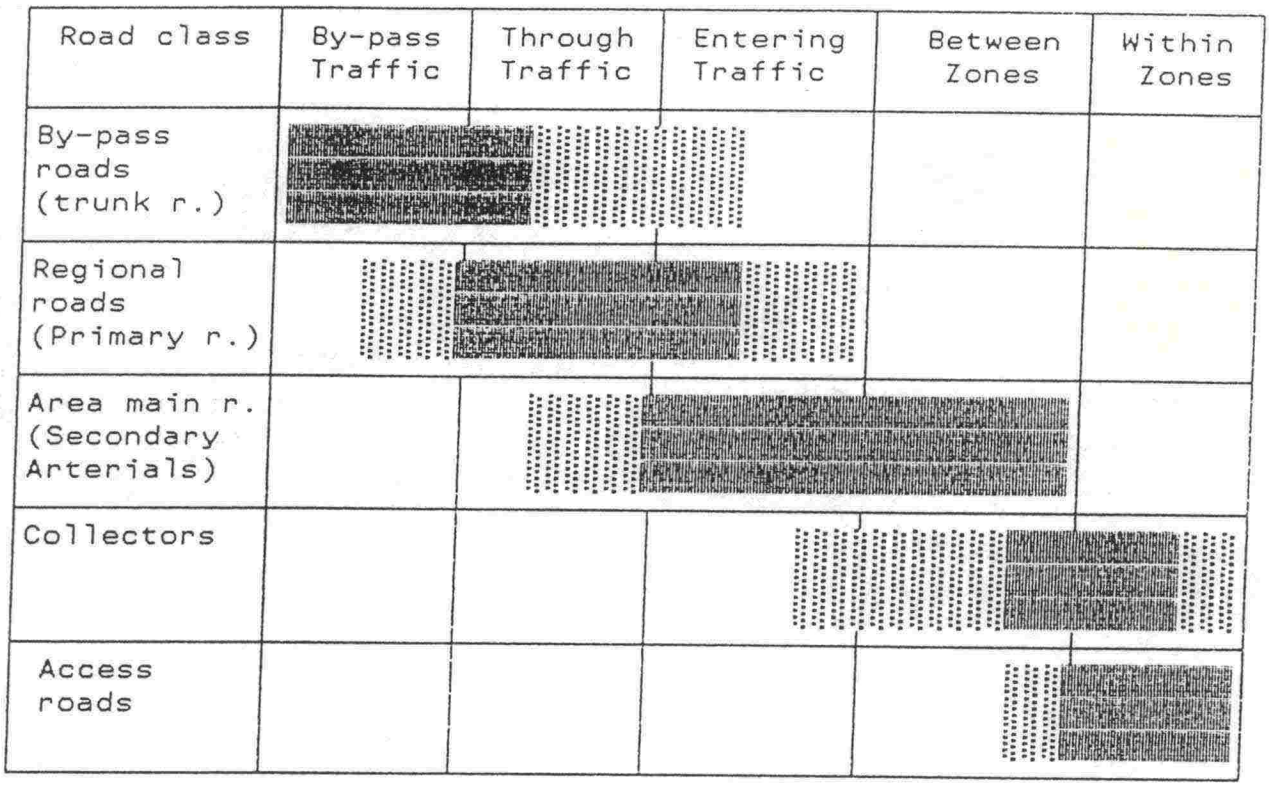
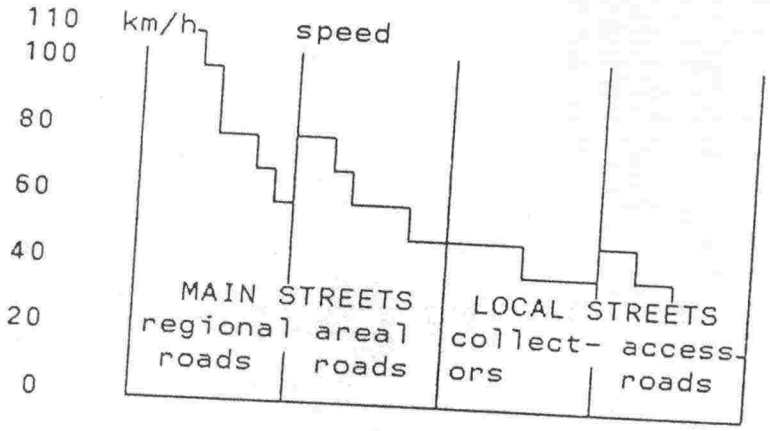


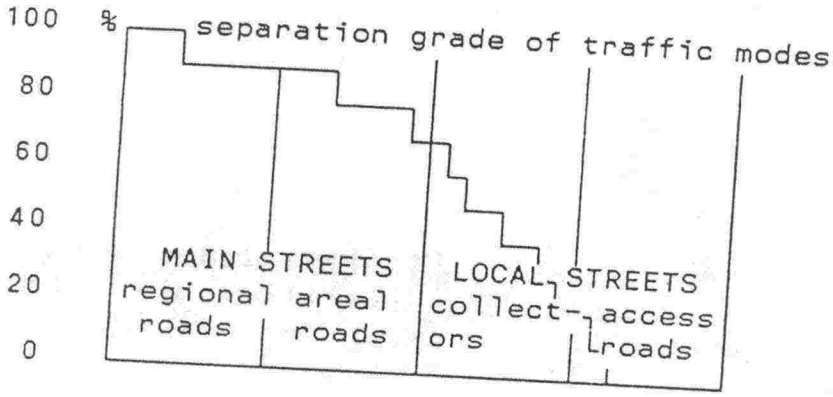
Figure 14: Functional Classes and the Traffic Composition

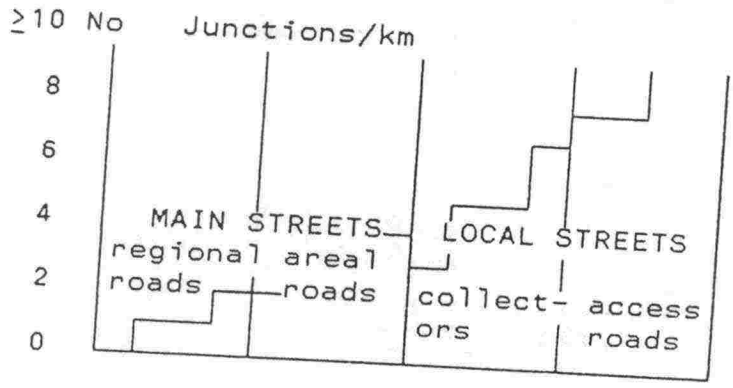
Structure plan is the tool to fix the location and geometry of main roads in great extent. The local streets will not get their final form until the construction of the street and the surrounding plots takes place. Only the junctions to higher class roads will be fixed in the structure and town plans.

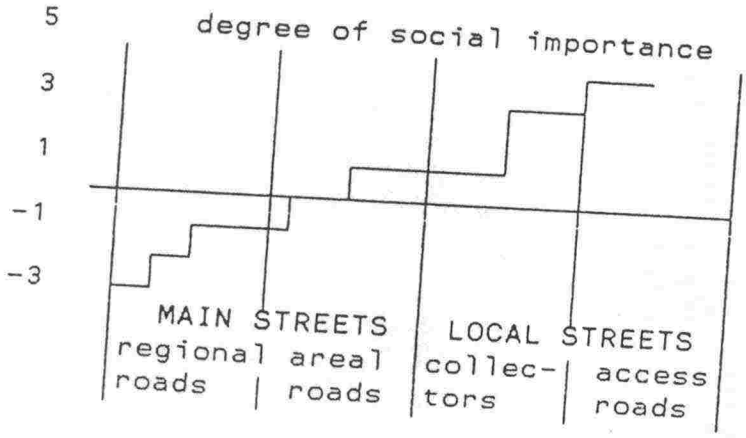
Because the type of traffic varies on different roads and the environmental demands differ from each other, the planning standards, geometry etc. shall be different. In the table of next page there are the most important aspects concerning designs of different classes of urban roads:

Some of these features can be described graphically as in the following :









	By-pass Roads		Regional Roads Urban Arterials		Areal Main Roads	Collectors	Local Streets
Number of lanes	≥ 2+2	2	≥ 2+2	2	≥ 2	2	1...2
Design speed (kph)	110	100	90-70	70-50	60-50	50-40	40-20
Access control	full	full	full	full	full-partial	partial	none
Minimum junction distance	1.5km	1.5km	0.5km	0.3km	0.2km	50m	-
Parking	no stopping		no parking		no parking	exceptionally	short time
Pedestrian traffic along road	only on separate walkways				sep. walkways/ pavements	foot paths	mixed traffic
Crossing pedestrian traffic	grade separated		grade separated or signalized		signalized or level crossings		level crossings
Minimum width of median island (m)	6.5		4.00 -1.8		1.6	1.2	-
Road reserve (m)	60	50	50	40	30	20	20-8
Stopping sight (m)	180	200	130-90	90-60	75-60	60-40	40-20
Bus stops	separated from main road		lay-bays		lay-bays	-	-
Design volume (VEH/DAY)	35,000	12,000	40,000	15,000	15,000	6,000	-
Lane width (m)	3.6-3.4	3.6-3.5	3.4	3.5	3.4- 3.2	3.2	3.2...2.5
Shoulder width (m)	2.0	2.0	1.0-0.5	1.5	1.0	0.5	0.25
Minimum radius (m) Horizontal curve	1,000	1,100	600	350	180	130	50
Vertical Curve	10,000	12,000	2,500	1,500	1,100	800	200
Maximum gradient/no junction	5	5	6	5	7	8	10
Maximum gradient at junction	3	3	4	4	5	5	6
Noise area (m)	180	150	130	100	70	30	15

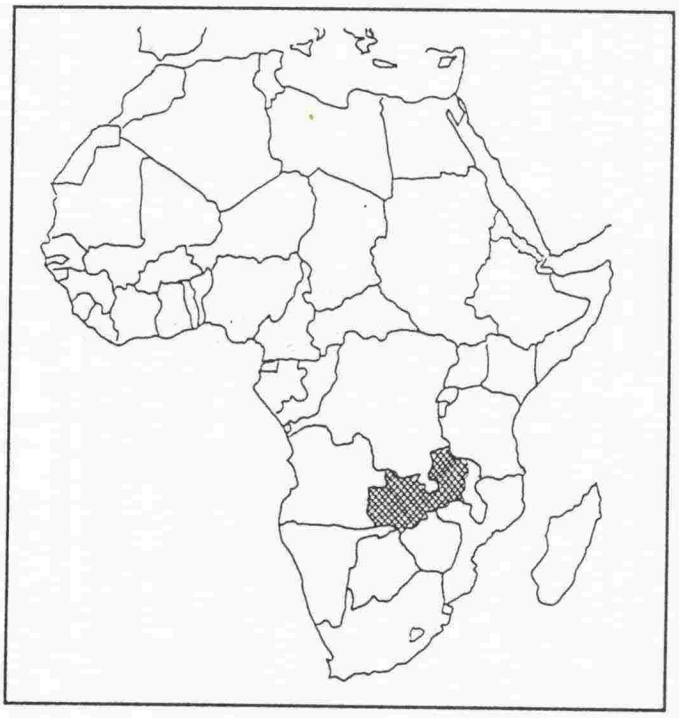
Design Speed is the speed which can safely be used when no other traffic is causing disturbance. Design speed defines the road geometry.

Stopping Sight is the distance, within which a driver, driving on design speed can stop after noticing a barrier on road. The road geometry and other facilities must always leave this sight distance free.

ZAMBIA

GENERAL

Population:	7,8 mill.
Area (sq-km):	753 000
Pop. Density:	10 sq-km
GNP/capita:	$ 290
Total Road Network: (classified)	36 700 km
Road Network Density:	
km/100 sq km	4.9
km/1000 population	2.5



Zambia ia a landlocked country where the economy is dominated by the mining industry which is heavily dependent on international trade, especially for exports. The railways handle bulk traffic while road transport handles intermediate and consumer goods.

ROAD NETWORK

In terms of the Roads and Traffic Ordinance, CAP. 766, the highway system of Zambia comprises:

- International Main (T) Roads
- Main (M) Roads
- District (D) Roads
- Rural District (RD) Roads
- Branch (B) Roads
- Rural (R) Roads
- Estate (E) Roads

The Roads Department in the Ministry of Works and Supply is responsible for the operation and maintenance of the T, M, and more than half the D roads. Other roads are under the jurisdiction of local authorities (urban and rural District Councils), which fall under the authority of the Ministry of Local Government and Housing.

Zambia has a fairly extensive road network with 36800 km of classified roads. The core network of T-roads is, however, only 3100 km. As depicted in Exhibit 2-2, the north south "spine" road from the Copperbelt to Lusaka and onward to the Zimbabwe border (via Livingstone and Chirundu) as well as the connections from Lusaka to Tanzania (via Tunduma) and Malawi (via Chipata) are the most important roads.

In addition, there are roughly 15-20000 km of non gazetted roads or tracks which are the responsibility of District Councils.

Except for in Lusaka and the Copperbelt areas, ADT is rarely above 1000 vehicles. ADT on District Roads is usually less than 100 but can reach up to 300.

ROAD CLASSIFICATION SYSTEM

Altough no specific definitions are given for the various classes of roads, it is generally understood that they serve the following purposes:

T and M Roads

T Roads are the international main roads which together with the M Roads form the primary road network connecting the Zambian highway system with that of neighbouring countries, linking provincial seats of government and the main centres of population.

Specifically, the interterritorial roads connect Lusaka and the Copperbelt with Zimbabwe, Malawi, Tanzania, Zaire, and Angola. The main roads form the major network of roads connecting the large centres within the country. For example, such roads connect Mongu with Lusaka, Zambezi with the Copperbelt, and Mansa with Kasama. They form the basis for the distribution of imports and the collection of potential exports.

D and RD Roads

D Roads form the secondary road network linking local centres of population, districts, and special development areas with the primary network. Currently, some are of local and others of national importance. RD roads are low standard tracks of local importance connecting local areas with the secondary network. They are key to transportation of agricultural produce from small farms. They are referred to as Feeder Roads.

Specifically, D roads connect districts to one another. An example is the roads connecting Mporokoso to Kasama. Such roads are used in the distribution of goods from provincial centres and supply an essential service to the public.

B Roads

B Roads are entirely of local importance and are usually designed to preseve a public right of way. The Minister has the power to appoint a highway authority for such roads which are not generally constructed or maintained at public expense.

R Roads

R Roads are generally low standard tracks of local importance connecting local areas with the secondary road network. The local Rural Council is the highway authority for such roads, the construction and maintenance of which is grant aided by Central Governemnt.

E Roads

E Roads serve as internal access in areas being developed by the Governmnet or for residential or industrial plots or farms. To date no such roads have been designated.

As indicated in Exhibit 2–4 there is about 37000 km of gazetted (i.e. classified) roads:

International Main Roads (T)	3119 km
Territorial Main Roads (M)	4048 km
District Roads (D)	23882 km
Rural Roads	5714 km
Not maintained by government funds	164 km

The roads that are maintained wholly at public expense (ie the T, M, and D Roads) are also broadly classified technically both geometrically and structurally into the following classes:

class I	bitumen paved
class II	engineered roads with gravel wearing course
class III	engineered roads with earth (and gravel where necessary) wearing course unclassified roads non engineered roads

The design standards for these classes appear in Exhibit 2–5.

These technical classification standards do not always fall in line with the administrative/functional classification. A development road may have higher standards than a main road or even an Inter–Territorial road.

EVOLUTION

The above system dates back to Northern Rhodesia under the Federation of Rhodesia and Nyasaland, before Northern Rhodesia became Zambia. The system has literally remained unchanged since then. However, some roads have since been upgraded while others have been downgraded.

Recent developments within the Southern African Development Commission Conference (SADCC) region towards harmonization of Standards and Specifications for road design, construction and maintenance means these countries, including Zambia, have to review their road networks. This is being carried out now in Zambia taking note that whatever additions, modifications, and improvements are considered most suitable for local Zambian conditions.

The Southern African Transport and Communications Commission (SATCC) are presently studying the trunk route number system proposed for the region. Once implemented, Zambia's interterritorial (T) roads, which are part of the regional trunk road network will also be reclassified. This in turn will lead to the reclassification of the entire road network in Zambia.

PROCEDURES

The road classification system serves to identify the various road classes, their usage and importance. It assists in setting maintenance priorities especially in times like now when resources are minimal.

For a road to change from say a Rural District (RD) to a District (D) road it must undergo major improvements to the satisfaction of the Roads Department. And, it must satisfy all the geometric standards for the higher class. Once certified satisfactory a Gazette Notice is prepared and advertised to run for a period during which time any objection can be raised. If the time lapses without objections, a Statutory Instrument is signed classifying such a road as a D road.

The existing classification works well so far. However, confusion can arise when a trunk road passes through a Municipality or town. In maintaining these trunk roads, the Roads Department had in the past excluded the section traversing the the town. These sections which have been left out have not been adequately maintained by the Councils and have deteriorated quickly. It has now been decided, in principle, that such sections should also be maintained by the Roads Department. This may necessitate reclassifications.

The Roads Department has plans to reclassifying the system as soon as SATCC has completed its route numbering system. Design, construction and maintence standards will soon be concluded in Zambia, with slight modifications to the SATCC recommendations.

REFERENCES

Correspondence with Mr J.D. Mwila, AG. Director of Roads, Ministry of Works and Supply, Republic of Zambia

Howard Humphreys & John Burrow Joint Venture, Zambia First Road Project: Road Maintenance, Organisation and Training Study

Morkrid AS, Consulting Engineers, Zambia: Appraisal of Road Sector Programme Proposal for NORAD, July 1993

CLASS	Formation Wwidth at Finished Surface Level (m)	Carriageway Width (m)	Type of Surface
CLASS IA	13.3	7.3	Bituminous
CLASS IB	10.7–12.7 (According to traffic needs)	6.7	Bituminous
CLASS IC	10.1	6.1	Bituminous
CLASS II	10.1	Min: 6.1	Gravel
CLASS III	7.5	Min: 5.5	Gravel, where necessary all weather std.
UNCLASSIFIED	Cleared and stumped track pf 5.5 minimum and Skeleton Drainage		Earth with 3.5 m gravel where essential

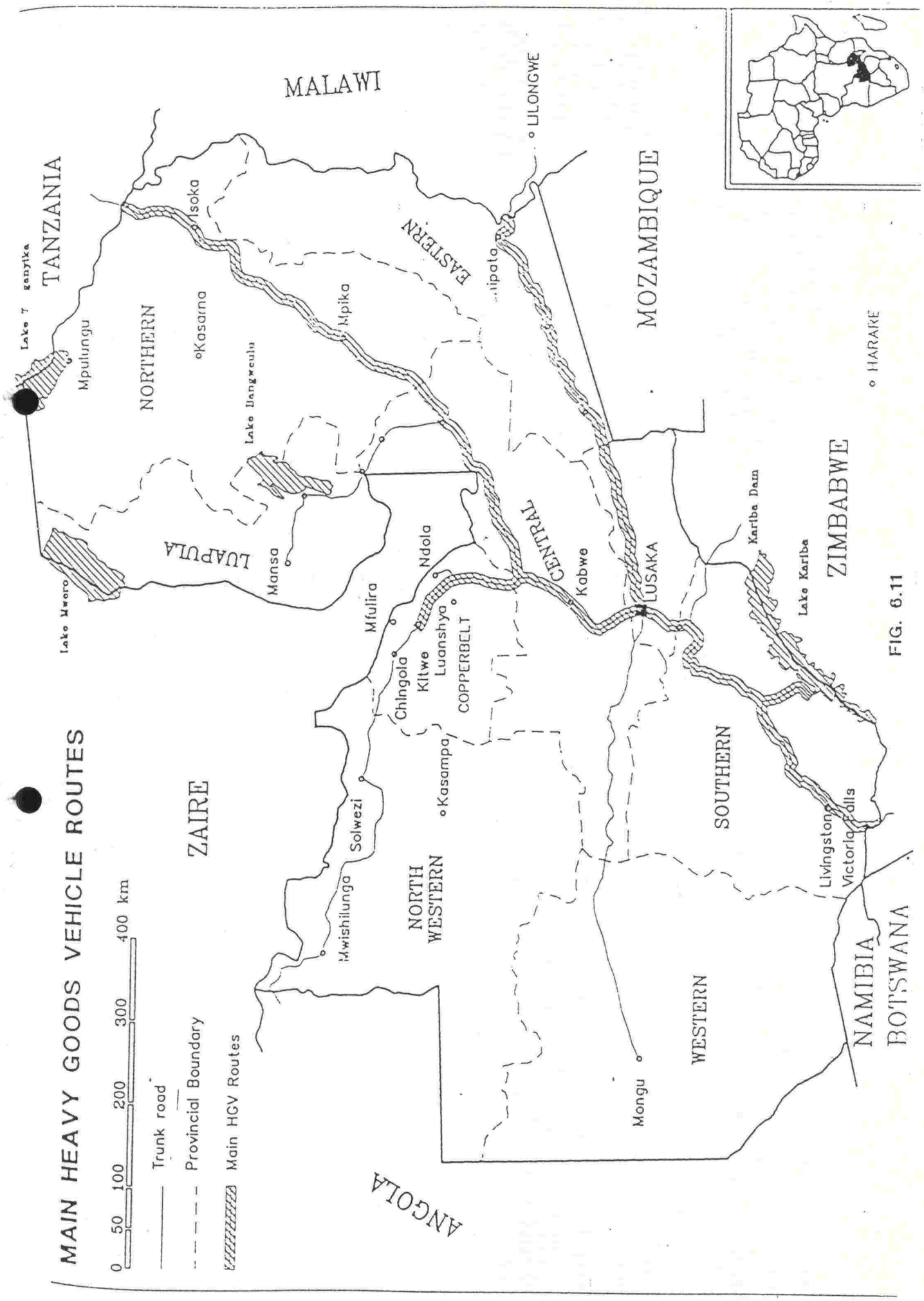

MAIN HEAVY GOODS VEHICLE ROUTES
0 50 100 200 300 400 km
Trunk road
Provincial Boundary
Main HGV Routes
TANZANIA
MALAWI
MOZAMBIQUE
ZAIRE
ZIMBABWE
ZAMBIA
ANGOLA
NAMIBIA
BOTSWANA
NORTHERN
LUAPULA
EASTERN
CENTRAL
COPPERBELT
NORTH WESTERN
SOUTHERN
WESTERN
Lake Tanganyika
Lake Mweru
Lake Bangweulu
Lake Kariba
Kariba Dam
Mpulungu
Kasama
Isoka
Mpika
Mansa
Mfulira
Ndola
Chingola
Kitwe
Luanshya
Kasompa
Solwezi
Mwishilunga
Kabwe
LUSAKA
Mongu
Livingstone
Victoria Falls
Lipata
ULONGWE
HARARE

FIG. 6.11

ZAMBIA: REGIONAL ROAD NETWORK.

CLASSIFICATION	MAINTENANCE AUTHORITY	CLASS I	CLASS II	CLASS III	UNCLASS.	TOTAL
International Main Roads, T	Roads Department	2916.1	0	0	139.8	3,055.9
	Local Authority	62.7	0	0	0	62.7
	Total	2,978.8	0	0	139.8	3,118.6
Main Roads, M	Roads Department	1991.2	1210.7	612.2	216.4	4,030.5
	Local Authority	17.3	0	0	0	17.3
	Total	2,008.5	1210.7	612.2	216.4	4,047.8
District Roads, D	Roads Department	1489.3	1049.2	5487.4	5670.3	13,696.2
	Local Authority	0	0	0	10185.8	10,185.8
	Total	1,489.3	1049.2	5487.4	15856.1	23,882.0
Rural Roads	Local Authority	0	0	0	5714.3	5,714.3
	Total	0	0	0	5714.3	5,714.3
Not maintained from Government funds						164.1
Grand Total		6,476.6	2,259.9	6,099.6	21,926.6	36,762.7
Source : Roads Department						

TANZANIA

GENERAL

Population:	24.4 mill.
Area (sq-km):	945 000
Pop. Density:	25,8 sq-km
GNP/capita:	$ 160
Total Road Network:	46 000 km
(excluding feeder roads)	
Road Network density:	
km/100 sq km	4.9
km/1000 population	1.9

Agriculture is the dominant sector of the Tanzanian economy.

ROAD NETWORK

Tanzania's trunk road network is shown in Exhibit 2-6 together with traffic flows. Freight haulage between Dar es Salaam port and neighbouring landlocked countries. With the excetion of Tanzam Highway where approaches to Dar Es Salaam have daily volumes of about 7000 vpd traffic volumes are generally low, ranging typically between 150-500 vpd.

ROAD CLASSIFICATION SYSTEM

Exhibit 2-7 displays the hierarchy of road networks in Tanzania together with functional aspects and administrative responsibilities.

As indicated, Tanzania's primary road system is classified into trunk and regional roads. Trunk roads typically connect major urban areas, ports and border points, and areas of high agricultural output. Regional roads provide integration with the trunk roads. Trunk roads are the responsibility of the Ministry of Works while the regional roads are under the 20 regional administrations.

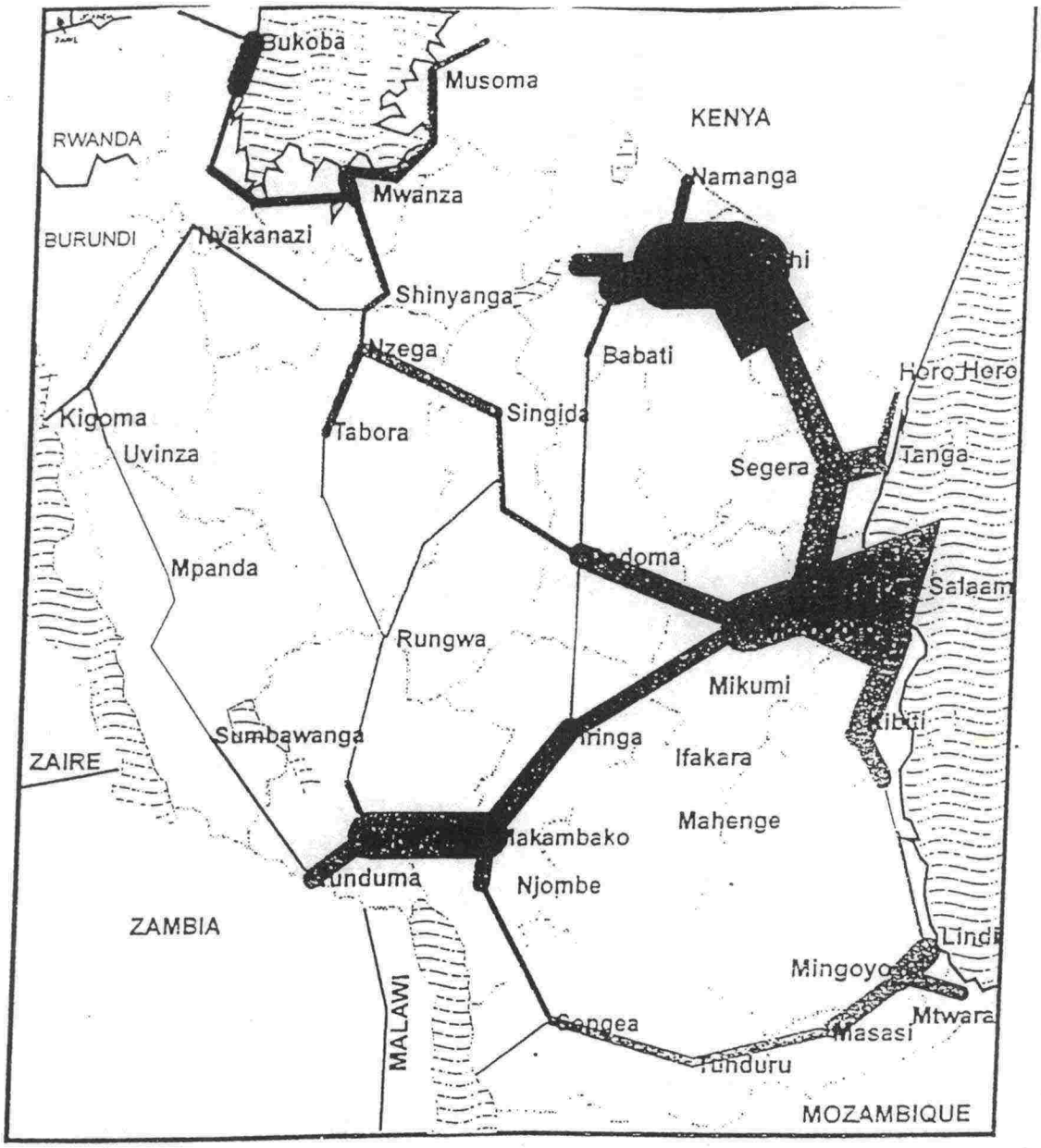
District and feeder roads (mostly earth surface) are maintained by district councils.

trunk roads	10300 km	(3800 km bitumen, 3300 gravel and 3200 earth surface).
regional roads	21000 km	
district roads	14600 km	
feeder	36300	

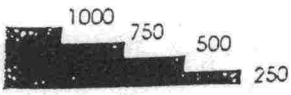
REFERENCES

Ministry of Works, Ministry of Communications and Transport, Presentation of the Second Integrated Roads Project (IRP II), June 1993

COWIconsult, Agricultural Feeder Roiads Study, Final Report, Volume A Executive Summary, March 1988



TRAFFIC FLOWS
ON THE TRUNK ROAD NETWORK



Scale - Vehicles per Day

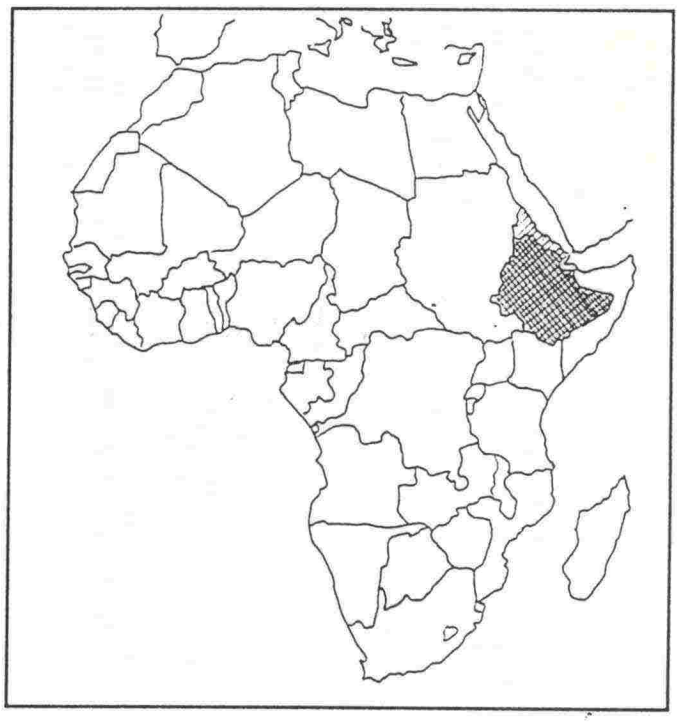
HIERARCHY OF THE ROAD TRANSPORT NETWORK IN RURAL AREAS

ROAD NETWORK	CHARACTERISTICS	ADMINISTRATION
Paths and Tracks	Usually unformed - 80% (domestic and agriculture) of the travel and transport requirements of the households takes place mainly by walking and using IMTs.	Tracks/paths are developed and maintained by the villages which are served by them.
Feeder Roads	Usually earth surface - connecting village centres to district/regional roads. The village godowns and crop collection/buying centres are usually located along these roads. The major transport modes are walking/porterage and IMTs. Motorized transport is rare and in most cases limited to tractor-trailers, pick-ups and land-rovers during market days.	Feeder roads are usually constructed and maintained by district councils. However, some of these. roads are private (large scale farms, forest reserves etc.) and others are constructed and maintained by communities on self-help basis.
District Roads	Mostly earth surface - connecting divisional centres to District Headquarters and in some cases served with some kind of scheduled bus service. Ward godowns for produce are usually located along these roads for easy access by lorries.	District roads are maintained by the district councils and receive a small budgetary allocation from Central Government (PMO). 20% of the Roads Fund is allocated for district and municipal roads. However, the district roads are yet to benefit from the Roads Fund.
Trunk and Regional Roads	Usually all-weather surface - regional roads connect district headquarters to the national trunk road network, and are usually served with scheduled bus service throughout the year, and for inter-district/regional crop movements.	Regional and trunk roads are under the responsibility of the REO, which receives funds for their maintenance from the Roads Fund (80%) through MOW.

ETHIOPIA

GENERAL

Population:	50.3 mill.
Area (sq-km):	1 222 000
Pop. Density:	41 sq-km
GNP/capita:	$ 120
Total Road Network: (classified)	63324 km
Road Network density:	
km/100 sq km	3.5
km/1000 population	0.8



Ethiopia is a landlocked country, with about 90% of the population lives in rural areas, the majority deriving their livelihood from agriculture. The agricultural sector dominates the economy.

ROAD NETWORK

The existing network is old, there is a lack of low volume roads and traffic volume is low on about 80% of the network. The primary network consists of radial extensions from Addis Abbaba. There are few interconnecting links between adjacent regions.

The most heavily travelled road in the country is the Addis Ababa - port of Assab (on the Red Sea) road with sections having more than 2000 vpd.

ROAD CLASSIFICATION SYSTEM

Ethopia, at present, does not have a functional classification system for its road network. Roads are grouped into geometric design classes:

primary/trunk	23300 km (3500 km paved)
secondary	included in above
feeder	8900 km
rural/local access	10900
total	43100

PROCEDURES

There has been confusion about the classification of roads and the type/geometric standard of the road.

The lack of a well established road functional classification system in the country has led to problems and/or deficiencies in the road network planning process including

setting of design, construction and maintenance standards and responsibilities, and priority ordering of rehabilitation and maintenance activities.

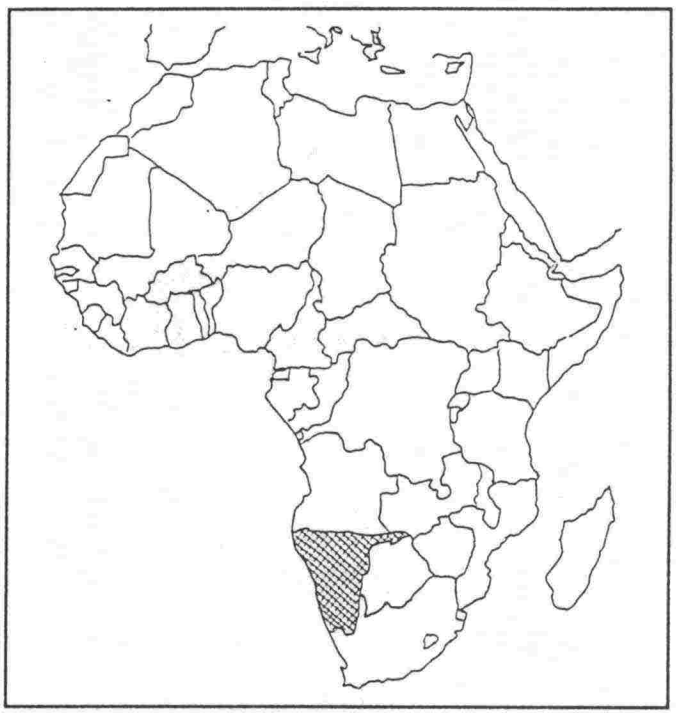
A new road classification system to be developed that takes into account:

- o socioeconomic development pattern of the country and modal split so that it is integrates complements the development of all transportr modes
- o newly structured regional administrative areas and jurisdictional responsibilities
- o respective functions or level of service of the roads
- o jurisdictional responsibilities.

REFERENCES

Ethiopian Roads Authority, Terms of Reference for Consultancy Services for Establishment of Road Classification System and Pavement Management System, 1994.

NAMIBIA



GENERAL

Population:	1.7 mill.
Area (sq-km):	824 292
Pop. Density:	2 sq-km
GNP/capita:	$ 1200
Total Road Network: (classified)	41800 km
Road Network density:	
km/100 sq km	5.1
km/1000 population	24.6

Economy is strongly tied to South Africa.

ROAD NETWORK

Namibia has a high ratio of km of roadway / population. The road network is of high quality and well maintained. There is an imbalance with few roads in certain areas; especially feeder roads in agricultural areas in the north.

Very few roads carry more than 500 vpd.

The Department of Transport is responsible for all activities related to construction and maintenance of roads except in municipal areas.

ROADWAY CLASSIFICATION SYSTEM

Trunk	4324 km
Main	8792
District	28684
Sub-total	41800
Farm	21800
Total	63600

Most of the trunk roads and many of the main ones are surfaced. Most of the unsurfaced main roads are engineered gravel and the majority of the district roads are improved earth.

REFERENCES

Sweco, Transport and Communications in Namibia, 21 March 1990.

WINTER MAINTENANCE METHODS IN FINLAND – OBJECTIVES

The Finnish National Road Administration (FinnRA) has established winter maintenance standards. These determine the level of service that is provided to each highway in Finland. The winter maintenance level of service is based on traffic volume, time of day, and removal operations (snow plowing, de-icing, and slush removal). For winter maintenance measures the highways are classified according to their functional class and traffic volume (ADT). The classification table is as follows:

Highway Winter Maintenance Classification

ADT	TRUNK ROADS	MAIN ROADS	REGIONAL ROADS	CONNECTING ROADS
> 12000	Isk	Isk	Isk	Is
6000 - 12000	Is	Is	Is	I
3000 - 6000	I	I	I / Ib	Ib
1500 - 3000	I	Ib	Ib	Ib
500 - 1500	Ib	II	II	II
200 - 500	II	II	II	III
< 200		II	III	III
Pedestrian and Bicycle paths	IV	IV	IV	IV

Bare Pavement Roads
Snow Surface Roads During Cold Winter Conditions
Snow Surface Roads

(See also table:
Target Condition Values and Cycle Time)

Note: Isk = super divided, Is = super undivided,
Ib = thin layer of packed snow allowed

Table 1: The highway maintenance classification.

The trunk road network is a system which holds together the regional structure of the country. Most trunk roads have two lanes, but the roads of highest traffic volume are freeways or semi-freeways (undivided with interchanges) or four-lane roads.

The main roads complete the trunk road network. The standard of the main roads is very near that of the trunk roads. Main roads are either two-lane or four-lane roads.

The regional roads connect local urban centers and other regionally important locations.

The connecting roads are those public roads which do not come in the higher road classes. Most of them are low traffic volume roads with a gravel surface.

All types of roads described above are maintained and constructed by the National Road Administration.

For each highway maintenance class FinnRA has a certain condition standard. When the road conditions fall short of this standard, it must be brought back up to the required level within a certain time period. Slipperiness, snowiness and evenness are regarded as variables of the condition standards as follows:

	LEVEL OF SERVICE				
Quality class variable	1 Poor	2 Fair	3 Satisfactory	4 Good	5 Excellent
SLIPPERY CONDITION Skid number Road surface texture	0,00-015 Very icy driving or othervise very slippery	0,15-0,25 Dry ice or snow packed	0,25-0,30 Coarse ice or snow packed in cold weather	0,30-0,45 Bare and wet or packed snow between traffic ruts	0,45-1,0 Bare and dry
SNOW CONDITION Dry frozen snow Thawing snow Slush Drifting snow	> 50 mm > 40 mm > 30 mm Easy passage may be difficult in some places, car may become stuck in a snowdrift	< = 50 mm < = 40 mm < = 30 mm Drifting over the road or moderate snow layer at the road edges, driving speed must sometimes be reduced	< = 30 mm < = 25 mm < = 20 mm Drifting here and there over the road, driving speed has to be reduced in some cases	< = 20 mm < = 15 mm < = 10 mm Drifting here and there to the middle of the outermost traffic lane, generally no need to reduce the driving speed	- - - -
EVENNESS Ruts Other roughness	< 30 mm Path very uneven, possible projecting bumps, driving speed must be reduced and uneven spots avoided	< = 30 mm Plenty of worn spots or disturbing holes, driving speed must be reduced in some places	< = 20 mm Path even, possible unevenness does not actually disturb driving	< = 10 mm Thickness of path strips on the road portion under traffic < = 10 mm	- -

Table 2: Finland's quality standards for winter maintenance.

The cycle time is the length of time between a substandard road condition and its restoration. The range of target condition values and cycle times are as follows:

Target Condition Values and Cycle Time

HIGHWAY	TARGET	CYCLE TIME			
Class	Condition Value	De-icing	Snow Removal	Slush Removal	Leveling
Isk	4	2 h	2,5 h	2,0 h	1 day
Is	4	2 h	2,5 h	2,0 h	1 day
I	4	2 h	3,0 h	2,5 h	1 day
Ib	4/3	3 h	3,0 h	3,0 h	1 day
II	3	4 h	4,0 h	4,0 h	3 days
III	2	6 h	6,0 h	6,0 h	5 days
IV	3	4 h	4,0 h	4,0 h	2 days

Table 3: Target Condition Values and Cycle Time

The friction requirements apply when the temperature is not colder than described in the following table.

Application of Target Condition Values

Highway Class	Target Condition Values Apply	Salt used when warmer than °C/°F
Isk	24 h/day	-8 / 18
Is	24 h/day	-6 / 21
I	Always except for the silent night hours.	-6 / 21
Ib	24 h/day for the value 3. Value 4 always except for the silent night hours.	-2 / 28
II	On weekdays: from 6.00 to 22.00 hours. During weekends: only daytime.	-
III	On weekdays: from 6.00 to 22.00 hours. During weekends: only daytime. During other times value 2 applies to slipperiness. The allowed maximum snow depth is 10 cm.	-
IV	Same condition value applies as on adjacent roadway.	

Table 4: Conditions where the required friction values apply.

Further instructions can be given by the Central Administration for each year and specific purposes.