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No. 52

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

MINISTRY OF PUBLIC WORKS
AND SETTLEMENT
THE REPUBLIC OF TURKEY

STUDY
ON
MOTORWAY MAINTENANCE, OPERATION
AND
TRAFFIC MANAGEMENT SYSTEM

FINAL REPORT
MAIN REPORT

JULY 1993

PACIFIC CONSULTANTS INTERNATIONAL
YACHIYO ENGINEERING CO., LTD.

The following foreign exchange rate is applied in the Study:

1992 US$1.00=6,900 Turkey Lire (as of June 1992)

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PREFACE

In response to a request from the Government of the Republic of Turkey, the Government of Japan decided to conduct the Study on Motorway Maintenance, Operation and Traffic Management System in Turkey, and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA sent to Turkey a study team headed by Mr. Tetsuya Siraishi, Pacific Consultants International in association with Yachiyo Engineering Co., Ltd., three times between April 1992 and May 1993.

The team held discussions with the officials concerned of the Government of Turkey, and conducted field surveys at the study area. After the team returned to Japan, further studies were accomplished and the present report was prepared.

I hope that this report will contribute to the promotion of the project and to the enhancement of friendly relations between the two countries.

I wish to express my sincere appreciation to the officials concerned of the Government of Republic of Turkey for their close cooperation extended to the Study Team.

July, 1993

Kensuke Yanagiya

Kensuke Yanagiya
President
Japan International Cooperation Agency

July 1993

Mr. Kensuke Yanagiya
President
Japan International Cooperation Agency
Tokyo, Japan

Letter of Transmittal

Dear Mr. Yanagiya

We are pleased to submit to you the final report on the Study on Motorway Maintenance, Operation and Traffic Management System (OMM System) in Turkey.

This study has been conducted by Pacific Consultants International in association with Yachiyo Engineering Co., Ltd. based on a contract with JICA, from March 1992 to July 1993. Throughout the study, we have taken into full consideration the present situation in Turkey, and have recommended the OMM System in the scheme of Japan's technical cooperation.

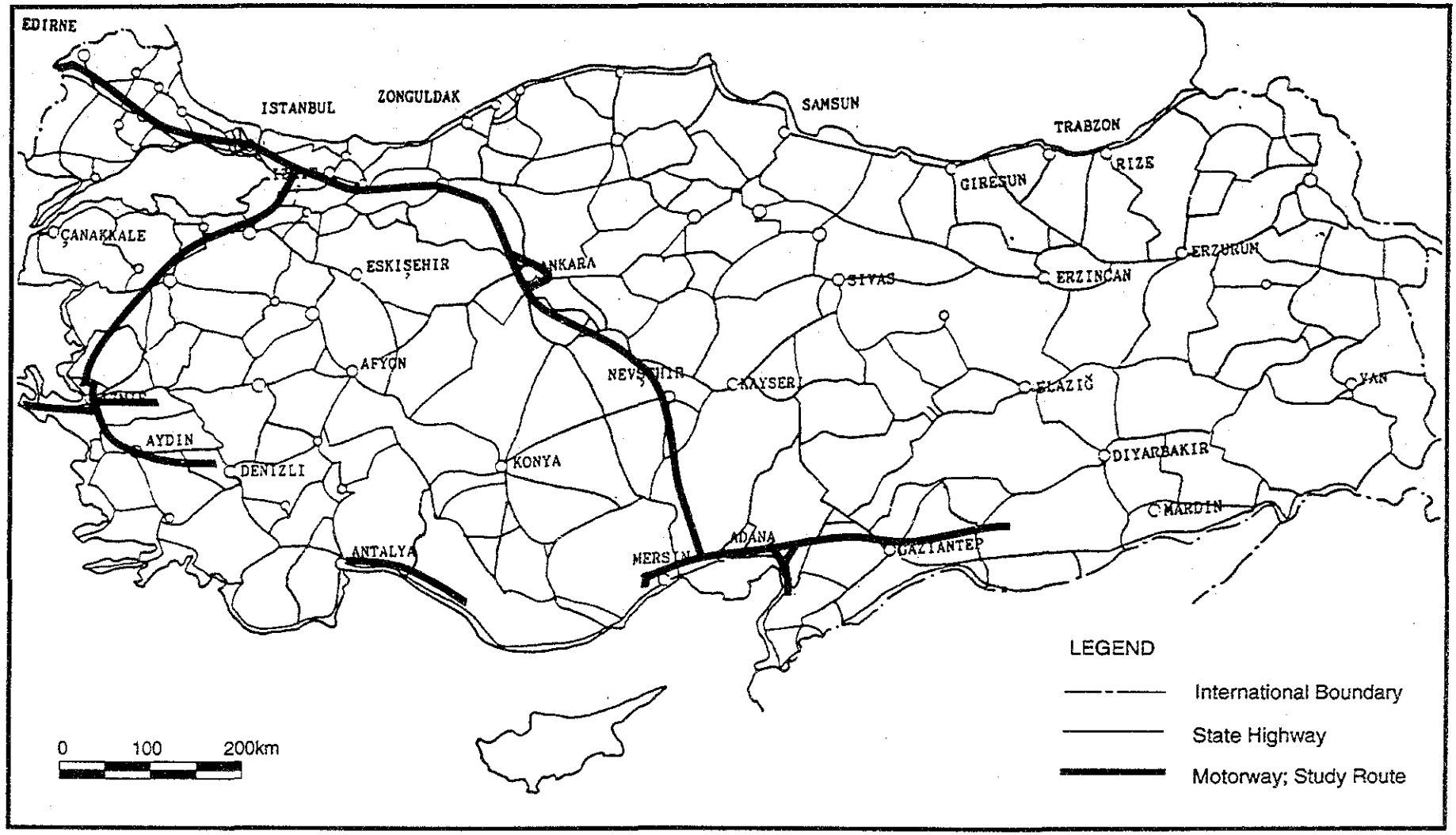
We wish to take this opportunity to express our sincere gratitude to your Agency, the Ministry of Foreign Affairs in Japan. We also wish to express our deep gratitude to the officials concerned of General Directorate of Highways (KGM), the Ministry of Public Works and Settlement in Turkey for their close cooperation and assistance during our study.

Finally, we hope that this report will be effectively used for the promotion of the OMM System in Turkey.

Very truly yours,

T. Shiraishi

Tetsuya Shiraishi
Team Leader
Motorway Maintenance,
Operation and Traffic Management System
Pacific Consultants International in Association
with Yachiyo Engineering Co., Ltd.



LOCATION MAP

Republic of Turkey
Study on
Motorway Maintenance, Operation
and
Traffic Management System

Summary

(1) Objectives of the Study

- To formulate a basic plan of the motorway maintenance, operation and traffic management system (motorway OMM system) for the long term plan of 3,000 km motorway network.

- To prepare a short-term implementation program and operation manual of the motorway maintenance, operation and traffic management system within 1,500 km motorway network.

(2) Basic Plan of the Motorway Maintenance, Operation and Traffic Management System

1) Goals of Motorway OMM System

The Motorway OMM system has three goals, which are identified as ensuring "traffic safety", "smooth traffic flow", and "user's comfort" by an efficient and economical system operation.

2) Organization

Two new divisions, Division of Motorway Maintenance, Traffic Management and Control and Division of Toll Management and Motorway Revenues are proposed to be created for the motorway OMM system under the present Department of Motorways of KGM headquarters.

And under the existing Regional Divisions concerned of KGM, Main Maintenance Center and Maintenance Offices are proposed to be established. A main maintenance center is located for the motorway length of 200 to 500 km and responsible for the control and planning of actual maintenance and operations and toll collection services. In each main maintenance center, a traffic control room is located to generally control traffic management. Maintenance office is located for every 50 to

70 km motorway section to execute daily field operations such as traffic patrol and maintenance work in each section. In each maintenance office, a traffic operation room is located to carry out field work of traffic control and management and to assist the traffic control room.

3) Basic Plan for Traffic Management and Operations

Generally, as the traffic volume increases, the traffic management with higher quality system is required for the operation. In consideration of efficiency of investment for establishing traffic management system, it is rational to deploy personnel, facilities and equipment to each motorway section corresponding to the traffic volume in the section.

Thus, the following three levels of service are set up based on the traffic volume as follows:

Service Level 1:	>10,000 pcu/day/lane	-	Traffic congestion is expected
Service Level 2:	6-10,000 pcu/day/lane	-	Traffic congestion is possible
Service Level 3:	< 6,000 pcu/day/lane	-	Traffic congestion is unlikely

Note: Critical value by service level based on TEM (Trans European North-South Mortorway).

For the 3,000 km motorway network, application of the proper service level for each section is specified and quality of service to be provided in each section, which is reflected in personnel, facilities and equipment therein, are determined based on the traffic volume forecast, climatic conditions, locations of long tunnels and bridges, record of natural disaster along the route as seen in Table 5.3 on page 19 of this summary report.

In order to enable efficient and systematic traffic management and operations, comprehensive flows of information and communications are clarified and roles and functions of traffic control room is proposed as the core of the operations. The traffic control room is the center to control motorway traffic flow, to receive report of traffic accident, to conduct control in emergency, and to request assistance to hospitals, fire stations or traffic police as required. The maintenance offices with a traffic operation room are to carry out field related activities such as the provision of traffic patrols, first-aid assistance, law enforcement and traffic accident investigation.

4) Basic Plan for Maintenance and Operation

In order to provide motorway maintenance service on the specified level of services, a basic plan is formulated to enable timely and adequate service on inspection, maintenance and repairs for the 3,000 km motorway. The basic plan includes the following:

- Communications (instruction, response, duty, decision and coordination) system among headquarters, regional division office, main maintenance center and maintenance offices, and extent of activity and responsibility of each office.

- The number and types of equipment required at each main maintenance center and maintenance office.

- Data base and management system consisting of as-built drawings and design documents of road structures and facilities, records of extraordinary incidents and maintenance works, etc.

- Planning to operate motorway maintenance for timely execution.

For further details, reference is made to 5.7 of this summary report.

5) Operation System during Unusual Conditions

In order to maintain user's safety and smooth traffic flow under unusual conditions due to man-made accidents such as traffic accidents, spilled loads etc., or natural accidents such as fog, heavy rain, earthquake, etc., the following proposals are made on the traffic management system:

- Disaster prevention system to control collection and dissemination of information among disaster prevention task forces, main maintenance center and maintenance offices.

- Planning and implementation of traffic control and maintenance work to recover from disaster.

The summary of the proposal is indicated in 5.8 of this summary report.

6) Traffic Safety Plan

Based on the principle to minimize damage to motorway users and property, traffic safety plan including the following components is recommended.

- Improvement plans for safe road environment consisting of restriction on intrusion of animals and pedestrians, installation of warning signs on sharp curves or steep vertical grades, and installation of warning signs on severe weather conditions
- Dissemination of information on traffic safety and safe driving practice
- Accident analysis and reporting system consisting of preparation of motorway accident investigation form, establishment of accident reporting system and creation of accident analysis team

(3) Short Term Implementation Program

1) Implementation Program of Traffic Management and Operations

For the short term plan of 1,500 km motorway network, an implementation program with its organization for traffic management and operation system is proposed as follows (Reference to Figure 6.1 in this summary report):

- Traffic Control Room

The traffic control room located at each main maintenance center is the core of the traffic management and operation system. It accommodates a computer system and associated equipment as well as staff to operate the system and to plan for countermeasures to be taken when incidents occur.

- Traffic Operation Room

The traffic operation room located at each maintenance office is to gather and distribute data from/to roadside equipment and to monitor information so as to promptly respond to incidents. Another important function of the traffic operation room is to back up the functions of the traffic control room in the case of communication interruption between the traffic operation room and the traffic control room.

- Information Collection System (on traffic data and traffic accidents)

  Emergency telephone, vehicle detector, weather observatory, CCTV system for traffic surveillance, vehicle measurement equipment, patrols and information from toll gates

- Information Processing and Decision Making System

  All the information collected by the above system is transferred to and processed at the traffic control room where judgment and decision are made for countermeasures for accidents, assistance to drivers, implementation of detouring, provision of special traffic restrictions, etc., corresponding to the traffic situation.

- Information Dissemination System

  Information dissemination equipment for variable message signs located along motorway is controlled by the traffic control room and the road traffic information is transferred to motorway users. For the inquiry by telephone call, response services by means of both direct personal response and tape recording are provided.

- Execution and Enforcement

  Traffic control measures such as speed limit reduction during an adverse weather condition, closure of a shoulder, closure of a lane, and total closure of a section of motorway must be executed in a coordinated manner by both KGM and the traffic police.
  The traffic control room has a major responsibility for overseeing such activities.

To support the above system operation, installation standard for various system equipment is given corresponding to the three service levels and operation manual for traffic patrol and traffic management during unusual situations is prepared in a separate volume.

2) Implementation Program of Maintenance and Operations

The organization for maintenance and operations is proposed and an operation manual is prepared for the following work items:

- inspection
- road cleaning

- vegetation control
- snow and ice control
- repairs of traffic safety facilities
- maintenance of pavement
- maintenance of bridges
- maintenance of tunnels
- maintenance of other structures
- maintenance of cut & fill slopes

For further details, please refer to Operation Manual in a separate volume of this report.

(4) Cost Estimate

Estimation of the cost to develop the motorway OMM system is made for the following items:

- procurement and installation of traffic management equipment and procurement of equipment for maintenance operations
- operation of traffic management and maintenance
- maintenance of equipment and facilities

As the result, the total project investment is estimated at US.$. 371 millions, and the annual operation cost in 1966 (proposed year of inauguration) is estimated at US.$.102 millions.

(5) Financial Evaluation

The Government of Turkey has so far obtained financial resources for the construction of motorways through KOI (abbreviation of Turkish name of the organization, Public Partnership Fund in English translation), a financial agency for public work development, mainly from contractors' credit. In this system, KOI is to receive 90% of the total toll revenue as the investment fund for motorway development including payoffs to contractors and management of toll revenues. KGM, who is responsible for operations of motorway OMM system, is to receive the remaining 10% of the toll revenue. However, detailed allocation of expenditures and responsibilities for establishing and operating the OMM system on a long term basis seems not to have been clearly defined. Under these circumstances, in order to clarify items which are necessary to maintain and operate OMM system of an international standard on a financially sound basis, a base case is set up with basic assumptions

given below and other several cases derivative from this base case are analyzed for the review of financial situation of this project.

1) Assumptions for Base Case

- The total project investment of US.$.371 millions is borne by KGM.
- The system corresponding to the above investment is assumed to start operation in 1996 and the project life is assumed 15 years since then.
- The toll revenue forecast is made based on traffic volume forecast by JICA study team and 10% of the toll revenue is assumed to be allocated for OMM operation.
- The toll rate is assumed fixed at the present rate converted in US. currency for the duration of project life.

2) Result of Financial Analysis of Base Case

The OMM account continues to show red balance during the total project life.

3) Results of Financial Analysis of Derivative Cases

- The toll share of 20 % will be required for OMM operation to ensure about 10 % of internal rate of return (IRR) without changing other basic conditions. About 10 % of IRR is generally considered moderate for a government project financing.
- The toll share of 15% for OMM operation will ensure about 10 % of internal rate of return if the total project investment cost mentioned above is borne by KOI.
- The toll revenue forecast adopted herein should be understood to involve some 20 or 30 % error. If the actual toll revenue is 10% larger than the forecast, the IRR will be improved by about 5%.
- KGM is a large governmental organization with 33,000 employees. About 4,400 personnel is required for the motorway OMM operation. If a half of the required personnel is managed to obtain by the conversion of existing employees, the toll share for OMM operation may be decreased by about 2 %. The similar discussion is also possible on the equipment and facilities. Thus, KGM's effort on such self-reliant basis will also be required.

(6) Recommendation

- The Government of Turkey is recommended to review more carefully the present financial framework for the motorway development and operations and reach a more practical and balanced framework coordinating the matter among KOI, KGM, Ministry of Finance and Customs and all other authorities concerned if any.

- The KGM are recommended to try their best to transfer duty and responsibility of the main maintenance centers to maintenance offices as promptly and widely as possible through the accumulation of actual operation and systematically programmed training of employees.

- Next to the effective utilization of existing personnel, privatization of the system operations should be positively studied by KGM. Toll collection services, the privatization of which is now considered extremely difficult by KGM may also be carried out by private companies if a workable inspection system by KGM is properly introduced and a proper insurance or guarantee system is arranged.

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Introduction

1. Introduction

1.1 Background of the Study

The government of Japan, in compliance with a request from the Government of Turkey, agreed to conduct "The Study on Motorway Maintenance, Operations and Traffic Management System" (hereafter referred to as the OMM system), in accordance with the laws and regulations of Japan. Based on this decision, the Japan International Cooperation Agency (hereinafter referred to as "JICA"), an official agency responsible for the execution of technical assistance programs for the government of Japan, was assigned to carry out the study in close cooperation with Turkish authorities.

JICA dispatched a preparatory study team in November, 1991, to Turkey to finalize the scope of work for the Study. The scope of work together with the study schedule was agreed to by both the Directorate General of Highways, Ministry of Public Works and Settlement of Turkey (hereinafter referred to as "KGM") and the JICA preparatory study team. KGM will act as the counterpart agency to the study team and also as the coordinating body for other relevant organizations required for the implementation of the study.

Pacific Consultants International of Japan, in association with Yachiyo Engineering Co. Ltd. of Japan, were selected by JICA to compose the Study Team and to provide the consulting services required for the study. The Study Team was mobilized to Turkey on April 17, 1992, and commenced the study with submission of the Inception Report to KGM.

On July 24, 1992, the Phase 1 Study was completed with submission of the Progress Report, which discussed the results of the traffic survey, other analyses, and the outline of the basic concept for the motorway OMM system.

The Interim Report, which summarized the results of Phase 1 and Phase 2 study, was submitted to KGM in October, 1992 wherein the formulation of a basic plan of the motorway OMM system was proposed based on the study of existing conditions in Turkey. Phase 1 efforts were focused on identification of the current state of road maintenance, management and traffic control for the existing highway and motorway network. Phase 2 was composed of the development of a basic plan for the motorway OMM system as well as the preparation of the immediate implementation plan.

The Draft Final Report consists of the results and discussions from the Phase 1 and Phase 2 studies, which were updated based on the latest findings and remarks from KGM during several meetings, and from the Phase 3 study which included formulation of the short-

term implementation program for the OMM system for 1,500km of motorway as well as the implementation manuals for OMM.

1.2 Objectives of the Study

Based on the scope of work, the overall objectives of the study were discussed at a meeting on the Inception Report held on April 24, 1992, between KGM and the Study Team, and approved, as follows:

(1) To formulate a basic plan of the maintenance, operation and traffic management system for the future 3,000 km motorway network.

(2) To prepare a short-term implementation program and operation manuals of the maintenance, operation and traffic management system within the 1,500 km motorway network.

(3) To pursue the transfer of technology from the JICA Study Team to the Turkish counterpart personnel during the OMM study.

1.3 Study Area

The study area covered a motorway network (totaling about 3,000 km) in the Republic of Turkey. In view of the importance of the international motorway linkage for the country, the study took into account existing and planned motorway networks of the surrounding countries.

1.4 Study Phase

The study was divided into the following three major phases, which are also shown in Figure 1.1.1:

(1) Phase 1: Study of existing conditions

The key points of Phase 1 were to identify the current levels of service for motorway operations, maintenance and traffic management and to create a basic concept for the motorway OMM system in Turkey.

(2) Phase 2: Formulation of a basic plan of the motorway OMM system

Based on the results of the analysis of existing conditions in phase 1, a basic plan for the motorway OMM system (for the 3,000 km motorway network) was developed. Based on this plan a detailed plan for both the short-term 1,500 km motorway and an immediate implementation plan for the existing motorway network was prepared.

(3) Phase 3: Preparation of short-term implementation program

This phase covered the final project work to be conducted in both Turkey and Japan. A priority analysis was carried out to identify an implementation program for the OMM system to be applied to the 1,500 km motorway network. Manuals were prepared for Operations, Maintenance, and Traffic Management, based on the selected motorway OMM System. As a final product, the study team will prepare a final report which includes all of the results of the discussions between KGM and the study team.

1.5 Participants of the Study

Participants of the Study are: (1) Turkish members of the Steering Committee, (2) Turkish members of the Technical Committee, (3) Japanese Advisory Committee members, (4) the JICA Study Team and (5) Turkish Counterparts to the JICA Study Team (KGM).

(1) Turkish Members of the Steering Committee

Mr. Dincer YIGIT (Chairman)	Director General
Mr. Cetin FIRAT	Deputy Director General
Mr. Asim CAVUSOGLU	Head, Department of Program and Planning
Mr. Hikmet TUGLU	Head, Department of Motorways
Mr. Nurettin SURI	Head, Department of Maintenance

(2) Turkish Members of the Technical Committee

Mr. Hikmet TUGLU (Chairman)	Head, Department of Motorways
Mr. Yurtcan GURSU	Director, Division of Materials and Laboratory
Mr. Recep MALKOC	Chief, Division of Motorway Design
Mr. Hasan PISKIN	Chief, Division of Motorway Bridges

Ms. Derya SENYAY	Director, Division of Training and Evaluation
Mr. Umit GUNGOREN	Director, Division of Motorway Maintenance
Mr. Hilmi Zeki KADAS	Director, Division of Maintenance
Ms. Berrin PARLA	Engineer, Department of Maintenance
Mr. Guralp SERHAT	Director, Division of Planning
Ms. Merih YAL	Chief, Division of Motorway Construction
Mr. Nizamettin ATES	Chief, Division of Traffic

(3) Japanese Advisory Committee Members

Mr. Shigeru KIKUKAWA (Chairman)	Deputy Director, Road Division, Chubu Regional Construction Bureau, Ministry of Construction
Mr. Junichi INOUE	Manager, Traffic Engineering Division, Engineering Department, Tokyo First Operation Bureau, Nihon Doro Kodan (Japan Highway Public Corporation)
Mr. Naoki TANAKA	Senior Engineer, Planning Division, Planning Department, Nihon Doro Kodan (Japan Highway Public Corporation)
Mr. Masaki KOBAYASHI	Senior Engineer, Design Division, Tokyo Maintenance Department, (Tokyo) Metropolitan Expressway Public Corporation

(4) JICA Study Team Members

Mr. Keikichi YOSHIDA	Study Team Leader (till Feb., '93)
Mr. Tetsuya SHIRAISHI	Study Team Leader (from Mar., '93)
Mr. Toshihiro HOTTA	Road Planning
Mr. Haruo SAKASHITA	Operation and Maintenance
Mr. Tsutomu KUDO	Traffic Management
Mr. J.K. MARCUSON	Traffic Operations
Mr. Kimio KANEKO	Traffic Control System Design
Mr. Yutaka TAKAHASHI	Facilities Design
Mr. Yoichi ENOKIDO	Traffic Survey

(5) Turkish Counterparts to the JICA Study Team (KGM)

Mr. Guralp SERHAT	Director, Division of Planning
Ms. Leyla UNAL	Chief, Division of Planning
Ms. Berrin PARLA	Engineer, Department of Maintenance
Mr. Umit GUNGOREN	Director, Division of Motorway Maintenance
Mr. Recep MALKOC	Chief, Division of Motorway Design
Mr. Yurtcan GURSU	Director, Division of Materials and Laboratory
Ms. Derya SENYAY	Director, Division of Training and Evaluation
Ms. Nursen AYDIN	Division of Training and Evaluation
Ms. Saadet YILDIRIM	Division of Maintenance
Ms. Merih YAL	Chief, Division of Motorway Construction

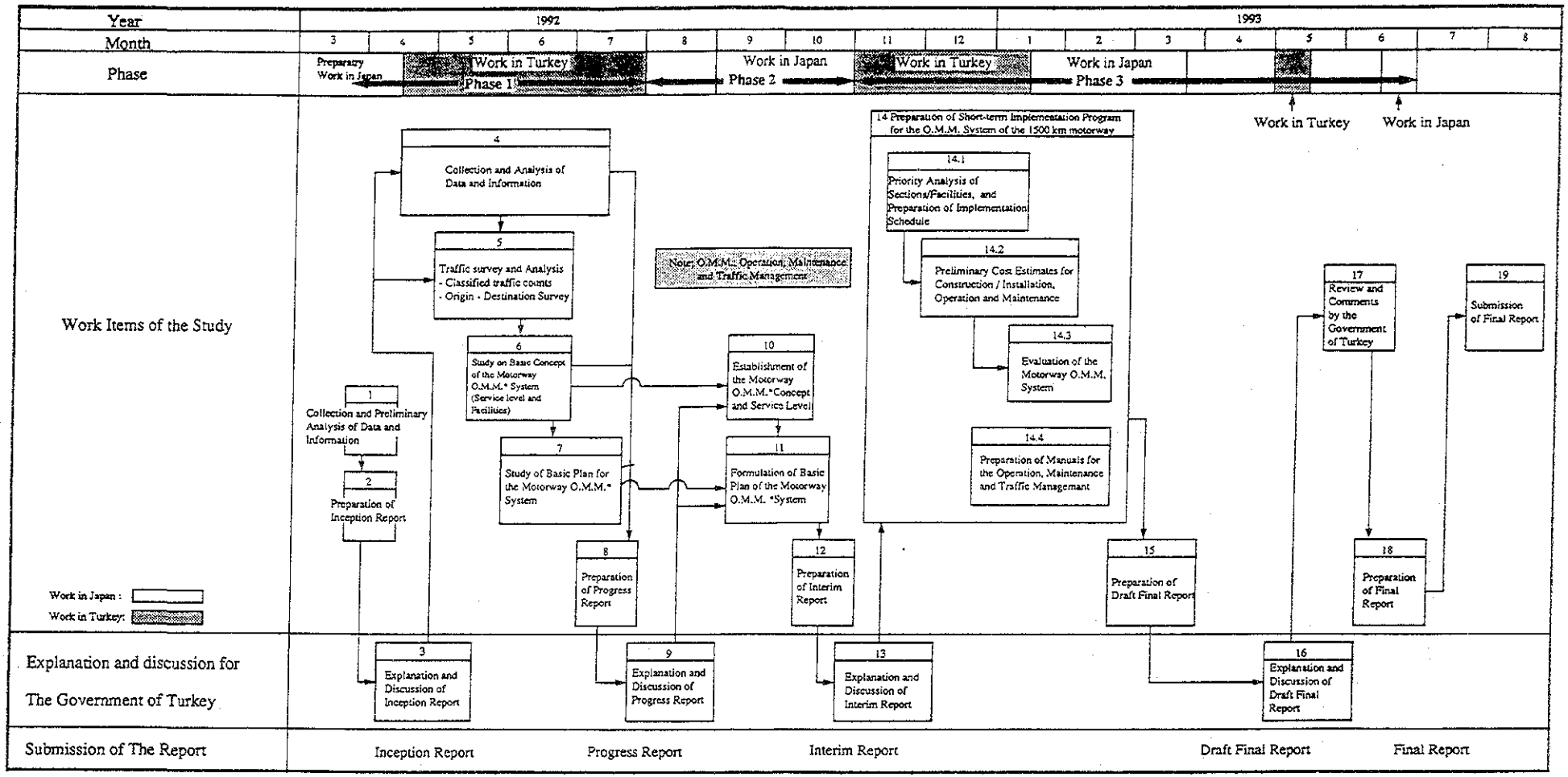


Figure 1.1.1 Flow Chart of the Study

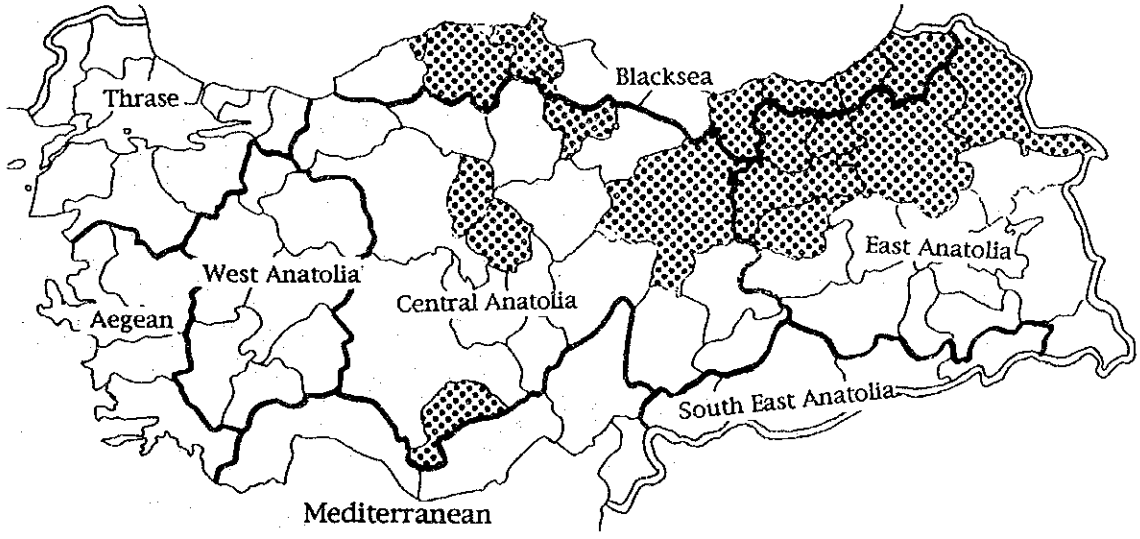
General Background of the Republic of Turkey

2. General Background of The Republic of Turkey

2.1. Socioeconomic Conditions

2.1.1 Population

The population of the Republic of Turkey, which was 13.6 million in 1927, and 35.6 million in 1970, reached 56.5 million in 1990. It has been growing steadily with an annual growth rate of 2.3 to 2.4% in the last twenty years. The State Institute of Statistics Prime Ministry in the Republic of Turkey foresees an annual population growth rate of 2.2% and estimates the population of Turkey to be 70.1 million by the year 2000, and 87.2 million by 2010. At the same time they estimate that the population will decrease in northeast Turkey, along the coast of the Black Sea, as shown in Figure 2.1.1. In the mountainous areas on the outskirts of the metropolitan areas, where productivity is relatively low, the population growth rate between 1990 and 2010 is estimated to be less than 10%. The estimated growth rates are also expected to be low in the rich agricultural areas near the Marmara Sea and the Greek border. Table 2.1.1 shows the population of Turkey by region.



Source: State Institute of Statistics Prime Ministry, 1991
Mayis 1991 de Turkey Economis Istatistik ve Yorumlar

Figure 2.1.1 Estimated Population Decrease by Province in 2010

Table 2.1.1 Population by Region

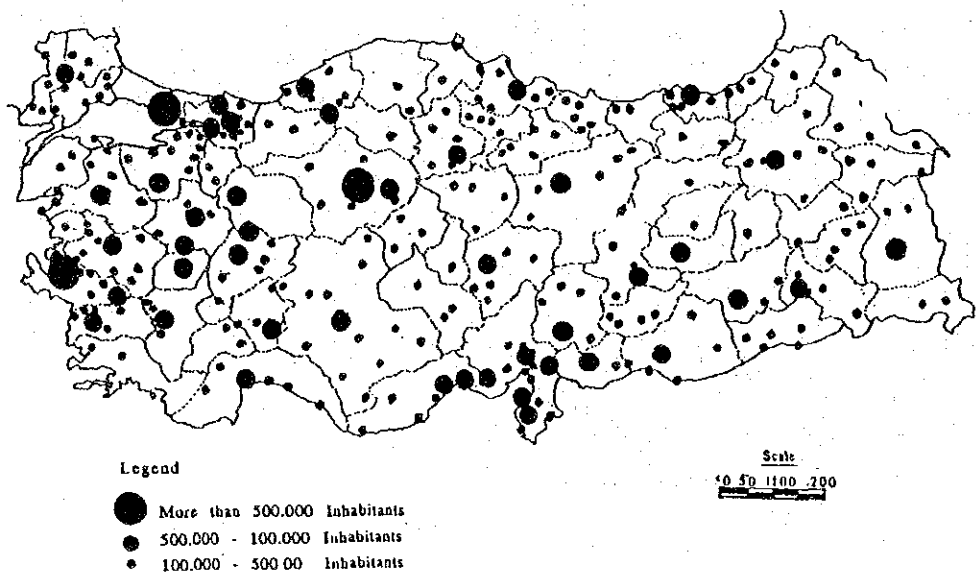
Persons (Thousands)

Region \ Year	1970	1975	1980	1985	1990	2000	2010
Thrace & Marmara	6,698	7,927	9,288	10,936	13,120	18,746	26,490
Black Sea	4,538	4,859	5,204	5,536	5,607	5,681	5,661
Agean	3,167	3,557	4,009	4,597	5,237	6,679	8,328
Mediterranean	2,795	3,368	3,934	4,653	5,444	7,377	9,874
W. Anatolia	2,809	3,017	3,221	3,538	3,865	4,529	5,192
C. Anatolia	9,345	10,598	11,439	12,697	13,633	15,508	17,347
SE. Anatolia	1,597	1,832	1,976	2,413	2,962	4,203	5,848
E. Anatolia	4,656	5,185	5,662	6,290	6,605	7,441	8,435
Total	35,605	40,343	44,733	50,660	56,473	70,164	87,175

Source: State Institute of Statistics Prime Ministry
May is 1991 de Turkey Economis Istatistik ve Yorumlar

The percent of population living in urban areas reached 59 % in 1990. The average annual growth rate in the urban areas during the past five years record a high value of 4.5 %.

Figure 2.1.2 shows the population distribution of major cities as of 1990. Each of the cities of Istanbul, Ankara, and Izmir have populations of more than one million, and 39 cities, including Adana, have a population of more than 100 thousand.



Source: State Institute of Statistics Prime Ministry
Statistical Yearbook of Turkey 1990 and 1987

Figure 2.1.2 Population Centers

2.1.2 Economy

Turkey achieved high economic growth until the 1970's. The real growth rate of the GNP (Gross National Product) was 6.6% during the first five-year program (1963 - 67), and 7.1% during the second five-year program (1968 - 72). In the 1970's, however, exports were level because of the failure to increase productivity and the lack of modernization. During these economic conditions, the oil crisis occurred and caused an increase in inflation, a reduction in income, and an increase of foreign debts. Because of these factors the rate of economic growth was 4.2% in the second half of 1970's.

In the first half of 1980's, the government basically adopted a tight economic policy based on the economic stabilization program, which was established by the State Planning Organization Prime Ministry and conformed to the recommendation of International Monetary Fund (IMF) and International Bank for Reconstruction and Development (IBRD). On the other hand, the government had to increase domestic demand by consolidating infrastructure to promote industrialization and to reduce the unemployment rate. As a result, though the GNP showed an annual 5 % growth rate, an inflationary spiral existed after 1985. High inflation rates were recorded after 1985 (75.2 % in 1987), and the government adopted a tight economic policy as an anti-inflation measure after 1988. Although industrial production rates improved in late 1989, the GNP recorded low growth rates of 1.5% in 1988 and 0.9 % in 1989. These rates reflected the substantial decrease in agricultural products due to a drought. By 1990 the economy recovered, and the average annual growth rate of GNP in those five years increased to 5.8 %.

The sixth five-year program began in 1990, with the targeted average GNP annual growth rate being 7.0 %.

The 1990 per capita GNP in Turkey was approximately $2000. Table 2.1.2. illustrates the Gross National Product (GNP). Turkey has been identified as a developing country with medium income according to the IBRD classification system. Within Turkey, there are many regional differences. East Anatolia has the lowest average income with a per capita GNP being one fourth of the Thrace and Marmara regions. The Thrace and Marmara regions have 34% of the total economic output. The southeast and east Anatolia regions generate only 7% of the economy. Attempting to moderate such regional differences is one of the major issues in Turkey's economic policy. Table 2.1.3 illustrates the Gross Regional Domestic Product (GRDP).

Table 2.1.2 Gross National Product

Year	GNP Billion TL.	Growth Rates %	GDP Billion TL.
1970	33,551	4.8	32,848
1971	36,017	7.3	34,764
1972	39,480	9.6	37,493
1973	41,489	5.1	38,775
1974	43,004	3.7	41,124
1975	45,720	6.3	44,193
1976	49,986	9.3	48,977
1977	51,500	3.0	50,669
1978	52,228	1.4	51,528
1979	51,880	-0.7	51,114
1980	50,678	-2.3	50,104
1981	53,377	5.3	52,799
1982	55,371	3.7	55,026
1983	57,900	4.6	57,954
1984	62,401	7.8	62,232
1985	65,189	4.5	64,976
1986	70,092	7.4	70,026
1987	76,612	9.3	76,316
1988	77,799	1.5	77,998
1989	78,469	0.9	77,620
1990	86,050	9.7	85,036
1991	86,348	0.3	85,827

PRICES = 1987 in Constant Price

Source: State Institute of Statistics Prime Ministry Republic of Turkey
Ucer Aylik Donemler Itibariyle Gayri Saft Milli Hasila Sonuclari
(31. 03. 1992)

Table 2.1.3 Gross Regional Domestic Product

Region \ Year	1970	1975	1980	1985	1990
Thrace & Marmara	10,202	13,725	13,858	18,691	24,320
Black Sea	2,452	3,298	3,659	4,018	5,069
Agean	2,962	3,985	5,148	6,530	8,409
Mediterranean	2,242	3,016	3,888	4,290	5,516
W. Anatolia	1,794	2,414	2,849	3,486	4,173
C. Anatolia	5,155	6,935	8,210	9,196	15,452
SE. Anatolia	607	817	975	1,209	1,500
E. Anatolia	1,575	2,119	2,319	2,520	3,108
Total	26,989	36,309	40,906	49,940	67,547

Price in 1987 Billion TL.

Source: Istanbul Sanayi Odasi
Turkiye Gayri Safi Yurtici Hasilasinin
Iller Itibariyle Dagilimi 1979 ~ 1986
1970, 1975 and 1990 values assumed by JICA Study Team

2.2 Topographic and Climatic Conditions

2.2.1 Topography

Turkey's prominent land feature is an elevated plateau. The average elevation of the land is 1,132m, and plains with elevations of lower than 250m make up less than 10% of the total land mass. Land with elevations between 500 - 1,500m covers 55% of the country. The land is undulating and mountains often extend to the coast. The major mountain ranges are as follows: the Koroglu Mountains and East Black Sea Mountains along the Black Sea, the Toros Mountains along the Mediterranean Sea, and the Guneydogu Toroslar Mountains, which includes Mt. Ararat, 5,165m, along Syria and Iraq. The motorway route is mostly in flat or rolling areas. To cross mountains, passes, foothills, or steep land along a coast, motorway tunnels and bridges are frequently necessary. Figure 2.2.1 illustrates the locations of the mountain ranges in Turkey.

In these sections, large scale cuts and embankment can be seen. In lowlands along the rivers in the Thrace area and areas facing the Mediterranean Sea, soft clay layers of earth can be seen. In the Koroglu Mountains near the Black Sea (where earthquakes occur frequently) landslide areas are common.

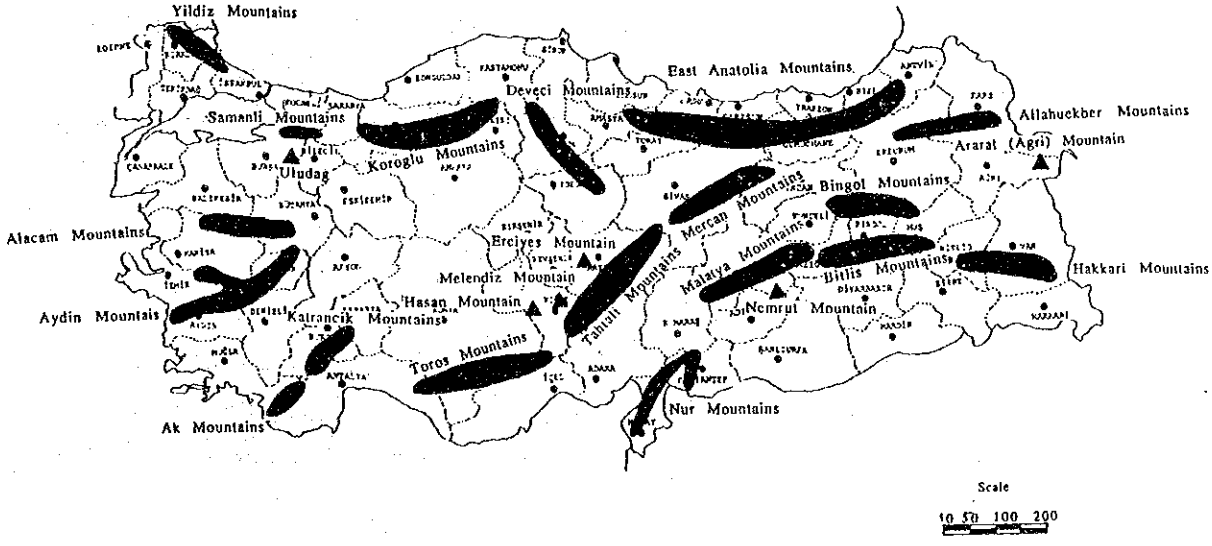


Figure 2.2.1 Location of Mountains

2.2.2 Climate

1) Overall Conditions

The diverse nature of the landscape and the location of mountains parallel to the coast cause varying climatic conditions throughout Turkey. Though there are differences by area, there is relatively little change in the weather from June to September, when Turkey has high temperatures and low humidity. From October to May, rainfall is consistent from month to month.

(1) The Mediterranean and the Aegean Region

The climate is a relatively mild Mediterranean climate, with an average annual temperature of 18 - 20 degrees Celsius. It is hot and dry during the summer. In the winter, it is 8 - 12 degrees Celsius and rains frequently.

(2) The Black Sea Region

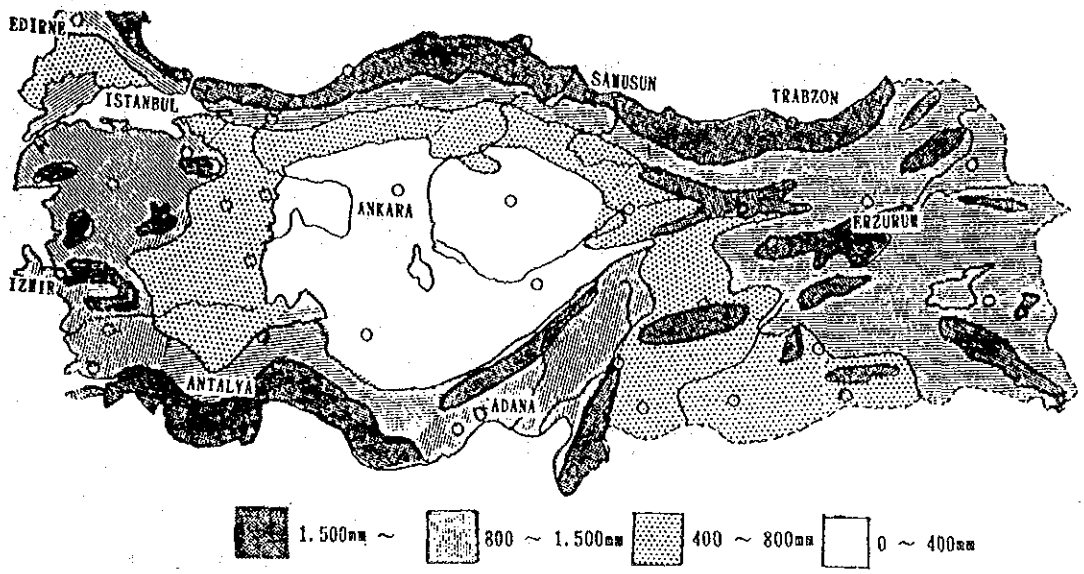
It rains in every season and has an average annual temperature of 14 - 15 degrees Celsius. The temperature in summer is 22 - 24 degrees Celsius. During the winter, in January and February, the temperature decreases to 5 - 7 degrees Celsius.

(3) Inland Areas

The average temperature range depends upon the elevation, and varies between 4 - 18 degrees Celsius. The west and central Anatolia regions have a continental climate and little rain, but have large variations in temperature. The eastern part of Turkey has a long-hard winter, with severe temperature drops and heavy snowfalls.

2) Rainfall Distribution

Figure 2.2.2 shows the national rainfall distribution. It rains heavily along the coast and in the mountainous areas, and is extremely heavy in the Trabzon region near the Black Sea where it reaches 2,000 mm. The rainfall of central and west Anatolia is only about 400 mm./year.



Source: State Institute of Statistics Prime Ministry
Statistical Yearbook of Turkey 1990

Figure 2.2.2 Annual Average Rainfall

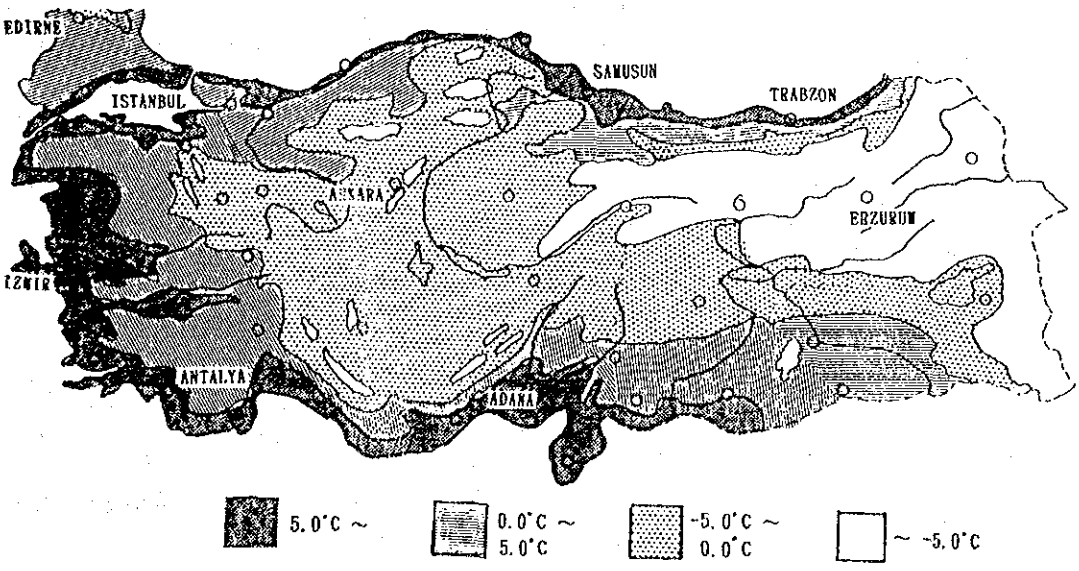
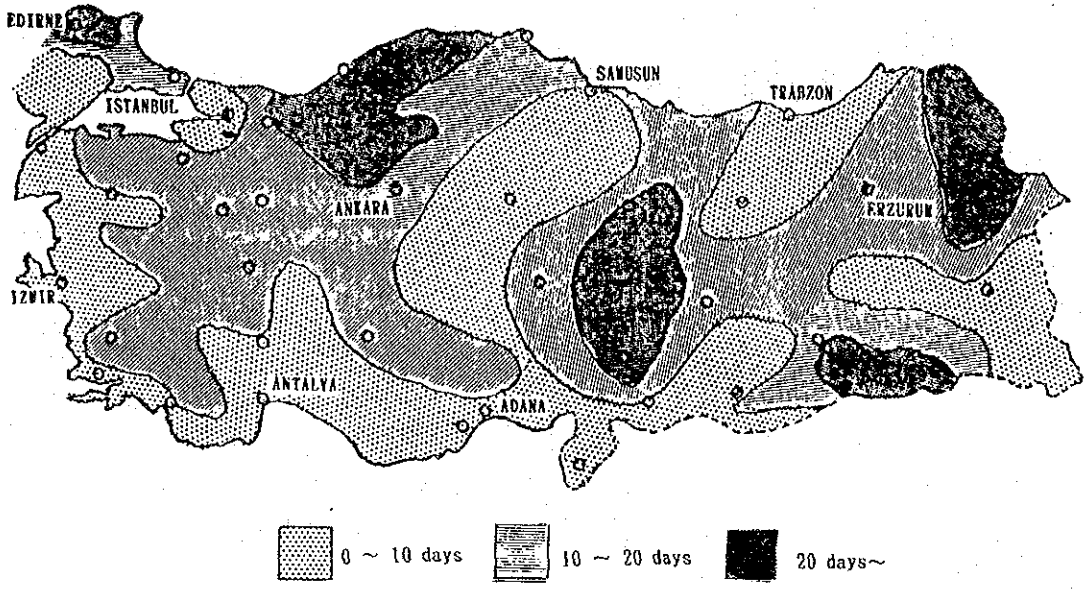


Figure 2.2.3 Average Temperature in January



Source: State Institute of Statistics Prime Ministry
Statistical Yearbook of Turkey 1990

Figure 2.2.4 Annual Number of Foggy Days

Table 2.2.1 Meteorological Data for Cities Adjacent to the Motorway Routes

Location	Temperatures			Frost Day		Rainfall		Max snow	Ave. Foggy
	Average	Max.	Min.	Term.	Days	Volume	Days	depth cm	Days
Denizli	15.7	41.3	-11.9	Nov. - Apr.	29	539	85	50	30
Aydin	17.6	43.6	-11.0	Nov. - May	13	666	81	8	1.2
Izmir	17.6	42.7	-8.2	Nov. - May	6.2	698	82	-	0.5
Bolu	10.2	39.6	-34.0	Oct. - Mar.	98	538	138	72	32
Antalya	18.1	43.9	-14.6	Nov. - May	7	1,156	94	-	-
Adana	18.8	45.6	-8.4	Nov. - May	7	642	76	1	4
Mersin	18.5	40.0	-6.6	Nov. - May	5	599	61	2	2
Ankara	11.7	40.0	-24.9	Oct. - Apr.	85	372	102	33	24
Edirne	13.5	41.5	-22.2	Oct. - Apr.	56	597	110	36	2.2
Kirklareli	13.0	39.4	-15.8	Oct. - Apr.	48	583	85	24	14
Tekirdag	13.8	31.6	-13.5	Nov. - Apr.	28	583	94	44	6
Istanbul	14.0	40.5	-16.1	Nov. - Apr.	22	677	123	75	11
Izmit	14.5	42.9	-18.0	Nov. - Apr.	19	768	135	90	14
Sakarya	14.2	41.8	-14.5	Nov. - Apr.	24	243	117	34	32
Gaziantep	14.5	42.0	-17.5	Oct. - Apr.	56	502	86	100	11

Source: State Institute of Statistics Prime Ministry

2.2.3 Disaster

1) Traffic Restrictions Caused by Disasters

Figure 2.2.5 shows the distribution of traffic restrictions caused by disasters in the past three years in areas adjacent to the motorway network.

(1) Traffic Restrictions by Heavy Rains

Relatively small rivers can swell with heavy rains and cause traffic restrictions.

(2) Traffic Restrictions by Floods

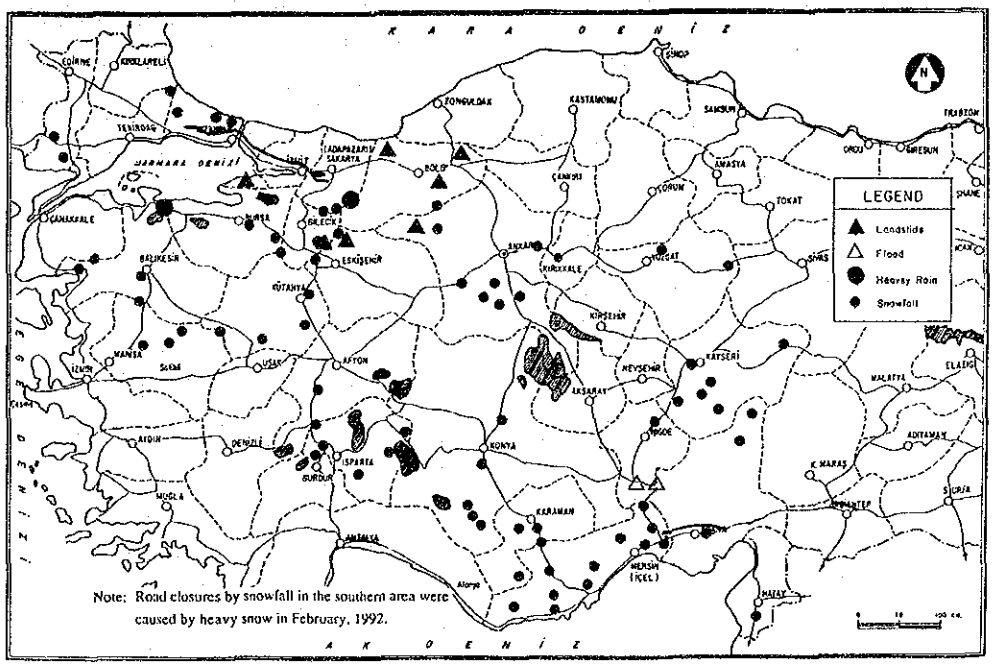
These can occur along relatively large rivers such as the Sakarya and Nilufer Rivers.

(3) Traffic Restrictions by Snowfalls

These occur most often in mountainous areas.

(4) Traffic Restrictions by Landslides

These occur in the landslide areas of the Koroglu Mountains.



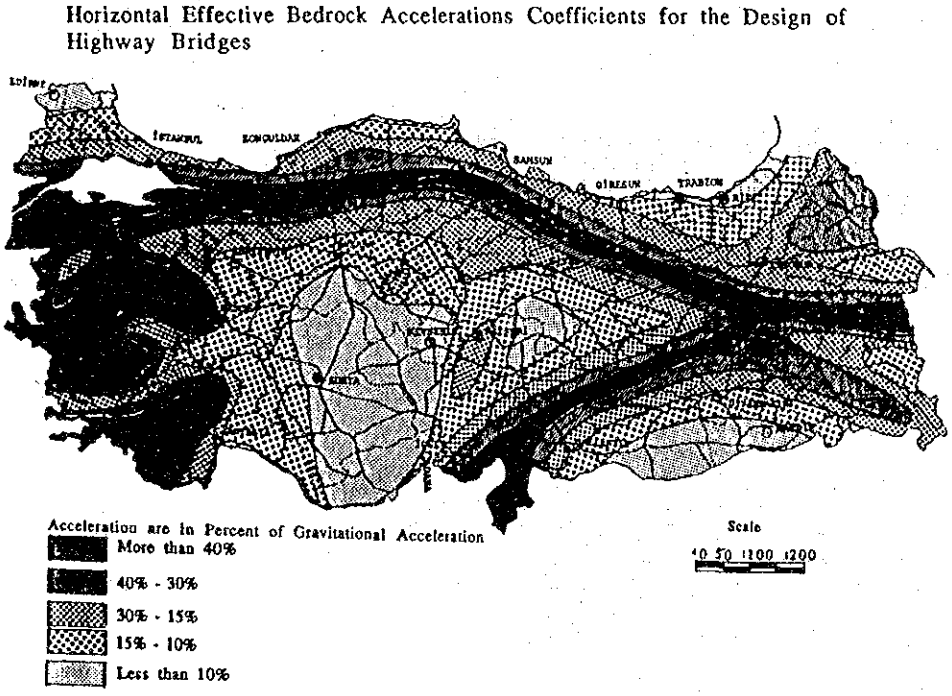
Source: KGM

Figure 2.2.5 Location of Road Closures Caused by Natural Disasters (January, 1989 - March, 1992)

2) Seismic Disasters

Earthquakes frequently occur as represented by Seismic Disasters in the Erzincan state of eastern Turkey. Earthquake zones lie in the mountains along the Marmara Sea to the Black Sea in northern Turkey, and the mountains extending from Iran and the Commonwealth of Independent States, and the mountainous area in southeast Anatolia.

The seismic coefficients shown in Figure 2.2.6 are used by KGM to design bridges and motorways. Seismic dampening devices are provided for preventing superstructure failures in the event of an earthquake.



Source: KGM

Figure 2.2.6 Seismic Map

2.3 Transport

2.3.1 Road Transport

Turkey serves as the geographic connection between Europe, the Middle East and Eastern Europe. Because of this, the road network has been substantially improved during the last 20 years with huge amounts of investment. The main highways crossing Turkey are the

following European Highways, E5 (D-100 & D-750 in Turkey) from Romania and Bulgaria to Syria, E24 (D-550 & D-400) to Iraq, and E23 (D-300 & D-200) to Iran. At the end of 1990, the total length of roads was 59,128 km including the state highways (31,149 km) and the provincial roads (27,979 km). The Trans-European North-South Motorway enters Turkey at Edirne on the Bulgarian border and passes through Istanbul, Sakarya and Ankara. In Izmir and Mersin, some stretches of the motorway are opened to traffic, some are under construction and some are being planned.

The road network plays an important role not only for the movement of passengers, but also for the movement of cargo. In 1990, the road passenger movement was 135 billion passenger kilometers, which was 95% of the total passenger kilometers. The movement of cargo was 66 billion ton kilometers, which was 74% of the total ton kilometers.

2.3.2 Railway

The railway is managed and operated by the national railway enterprises. In 1983, the Government established a transportation master plan which emphasized the strengthening of the railway transportation network. The plan identified the construction of new direct intercity lines, the rehabilitation of existing routes, the installation of double-track, and the need to electrify and to introduce electric locomotives for strengthening cargo transportation.

The total length of railway was 8,430 kilometers in 1990, including an electrified stretch of 582 kilometers. The number of passengers carried was 136 million in 1985 and increased slightly to 139 million in 1990. The railway was not well managed and operated at a deficit. It is considered that the railroad operation was unsatisfactory because of inadequate maintenance and a lack of investment in infrastructures and rolling stocks.

2.3.3 Sea Transport

Turkey is surrounded by the Mediterranean Sea, the Black Sea and the Aegean Sea and has a coastline of 8,000 kilometers. Many ports and harbors have been developed along this coastline, and among them there are five major ports. These major ports at Istanbul, Izmir, Mersin, Iskenderun and Trabzon serve as commercial and industrial centers. There are also 30 smaller ports and another 35 ports have been built by enterprises.

The shipping capacity has risen sharply, with a cargo handling volume of 3.6 million tons. In 1988, the Turkish ports handled 52.5 million tons from foreign trade and 37.5 percent of that was carried by Turkish vessels. The total capacity of the Turkish vessels is 3 million tons.

Table 2.3.1 Transportation Facilities by Transport Mode

	Year		1985	1986	1987	1988	1989
Road	National Roads	(km)	57,278	59,302	58,915	58,851	58,552
	Concrete, Asphalt	(km)	40,771	42,277	45,179	45,594	46,310
	Stone Block	(km)					136
	Unpaved	(km)	16,507	17,025	13,736	13,257	12,242*
	Passenger Cars	(Nos.)	998,335	1,079,890	1,239,112	1,332,385	1,590,917
	Trucks	(Nos.)	478,854	520,645	560,493	581,712	632,685
	Buses, Mini-buses	(Nos.)	14,062	155,287	174,065	183,366	206,036
Railway	Passengers	(Nos.)	136,354	129,352	129,909	135,706	146,359
	Freight	(Million ton)	15	14	14	14	13
	Distance	(km)	8,400	8,401	8,439	8,430	8,430
	Locomotives	(Nos.)	1,051	1,028	991	912	753
	Diesel cars	(Nos.)	25	24	20	20	—
	Electric cars	(Nos.)	78	86	86	86	86
	Coaches	(Nos.)	1,095	1,101	1,076	1,006	1,030
	Freight cars	(Nos.)	21,134	20,468	19,940	20,255	20,603
	Others	( )	4,722	4,754	4,678	4,563	—
Sea Transport	Passengers	(Mperson)	11	113	121	133	124
	Freighters	(Gton)	487,144	690,784	—	—	—
	Passenger liners	(Gton)	117,098	131,325	—	117,148	110,126
	Tankers	(Gton)	126,692	186,267	—	—	—
Air Transport	No. of Passengers		2,508,049	2,721,895	3,260,942	3,806,196	3,792,251
	Domestic		1,551,449	1,730,121	2,062,128	2,142,419	2,332,230
	International		956,600	991,774	1,198,814	1,663,772	1,460,021
	Freight	(ton)	35,224	40,172	39,551	40,716	48,018
	No. of air flight movements	(Nos.)	29,645	29,556	30,998	35,235	36,073
	Domestic		20,456	19,490	20,015	22,731	23,366
	International		9,189	10,066	10,983	12,504	12,707

Source: Central Bank of Turkey, Annual Report 1989, Statistical Yearbook of Turkey, 1990

To promote foreign investments and encourage industrial employment and production, six free trade zones were established in 1986. Mersin and Antalya have an operation of 924 companies including 112 foreign enterprises. In Yumurtalik, preparation to procure the land is underway and Istanbul, Trabzon and Izmir are in the planning process. Izmir and Yumurtalik have export processing zones and the others are free ports.

2.3.4 Air Transport

There are three major international airports located at Istanbul, Ankara and Izmir. There are also 17 domestic airports including Adana, Dalaman and Antalya, which can also accommodate international charter flights. There were a total number of 36,073 flights, consisting of 12,707 international and 23,366 domestic flights in 1989. The total number of annual air passengers is 3.8 million including 1.5 million domestic and 2.3 million international travelers. The Turkish Airline is Turk Hava Yollari which is a national enterprise and its air routes have connections to 17 domestic airports and 50 cities abroad. In 1988 routes to New York, Riyad, Tunis, Alge, Oslo and Helsinki were opened, and in 1989 a route opened to Tokyo.

2.4 Road Network

2.4.1 Road Classification

The road network in Turkey has been in existence since the Roman Empire. The history of the construction, maintenance and management of its modern roads began in the 1950's when the General Directorate of Highways, Ministry of Public Works and Settlement (KGM) was established.

Roads in Turkey can be classified as motorways, state highways, and provincial roads controlled by KGM. Village roads are controlled by the Ministry of Cultivation and Village Affairs, and city streets are controlled by each municipality. Streets are divided into boulevards, main roads, and minor roads according to the road hierarchy.

Motorways are classified into two categories as follows:

Urban Motorways:	Motorways with partial access control, typically peripheral roads in large cities such as Istanbul, and usually toll free.
Regional Motorways:	Motorways connecting major cities, with full access control at toll gates.

The usage of motorways in urban areas is free of charge, except for the first and second Bosphorus Bridges in Istanbul, where east-bound traffic is charged. As for motorways between cities, roads are constructed with full access control since tolls are collected with a closed system. The total length of motorways open to traffic (as of 1992) is about 901 km. (see Table 3.2.1 in Section 3)

State highways are facilities which connect major cities in Turkey, and the total length is about 31,100 km. Provincial roads connect local cities with state highways, and the total length is about 28,000 km.

2.4.2 Road Network

Road construction in Turkey has improved substantially since KGM was established in 1950. The national road network of state highways and provincial roads is now approximately 59,000 km.

State highways are numbered from D-010 and D-100 ~ D-400 from east to west, and from D-550 ~ D-950 from south to north. The roads with numbers such as D-100, D-200 and D-550 are key roads which compose the backbone of the roadway network for the country. For roads specified as international roads, the international route number is provided along with the Turkish road number. The international routes are E5 (D-100 & D-750 in Turkey), E23 (D-300 & D-200) and E24 (D-550 & D-400), which are shown in Figure 2.4.1. E23 (D-300 & D-200) connects the center of Turkey with eastern and western Turkey. E23 (D-300 & D-200) starts in Izmir, passes through Ankara, and extends to the Iranian border. E5 (D-100 & D-750) starts in Europe, passes through Istanbul and Ankara, and connects to the ports of Mersin and Adana in the South, and extends to the Syrian border. E24 (D-550 & D-400) runs from the Greek border and connects the Mediterranean coastal cities such as Izmir, Antalya, and Adana, and inland cities such as Gaziantep and Mardin along the Syrian border, and extends to the Iraqi border.

2.4.3 Road Facilities Conditions

1) Pavement Conditions

Table 2.4.1 indicates the total length of roads by surface type as of 1991. The percentage of state highways with asphalt pavement is 94.1 %. The percentage of state highways with asphalt concrete which is used to support heavy truck usage is much lower at 13.7 %. Figure 2.4.2 shows the distribution of asphalt concrete pavement. According to KGM, the percentages of state roads which fall in the width under 6.5 m, 6.5 - 8.0 m, 8.0 - 10.0 m, 10.0 - 12.0 m, and

over 12.0 m categories, are 22.7 %, 32.4 %, 26.2 %, 13.2 %, and 5.5 % respectively (as of 1980). Data from 1990 show that the total length of multi-lane sections of state highways is 1,835 km, which is 6.3 % of the total, and the locations are shown in Figure 2.4.3. As for provincial roads, multi-lane sections are only 0.5 % of the total, or 136 km (Table 2.4.2).

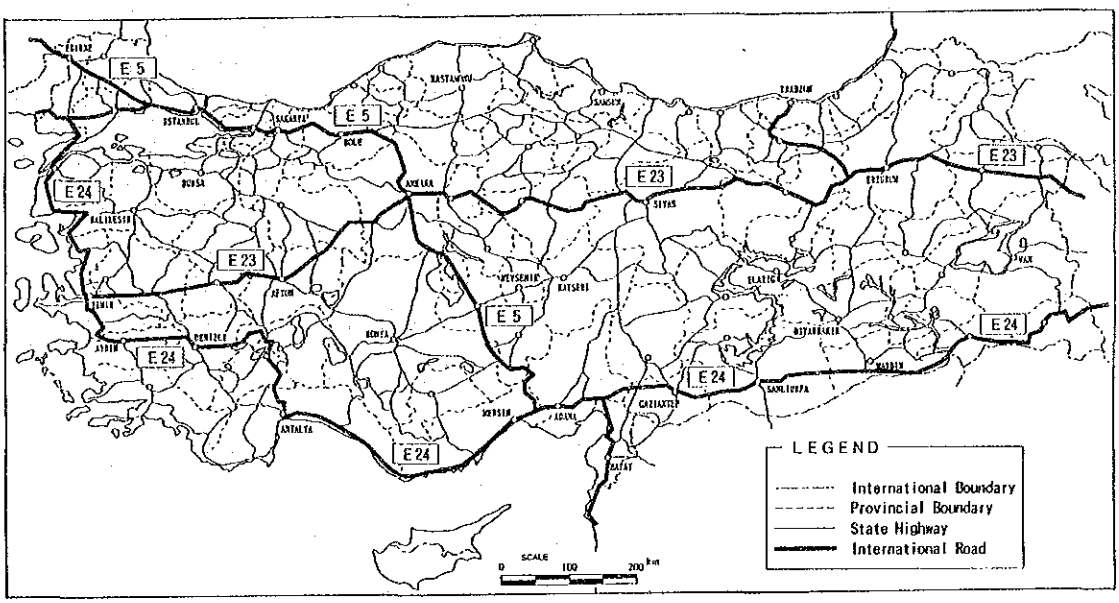
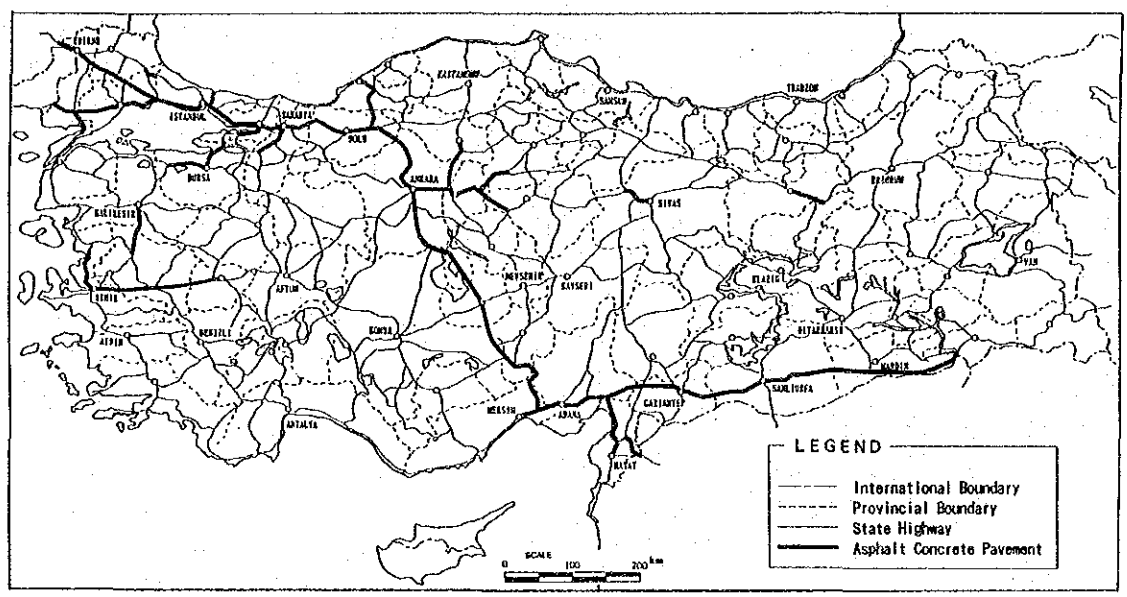


Figure 2.4.1 State Highway Network

Table 2.4.1 Pavement Road Length by Surface Types - 1991

Pavement	Motorway (km.)	State Highway (km.)	Provincial Road (km.)
Asphalt Concrete	343	4,305	109
Bitumen Surfacing	-	24,787	1,987
Block (Stone)	-	45	89
Gravel		1,596	6,454
Earth		110	1,217
Others		418	1,004
Total	343	31,261	27,960

Source: KGM



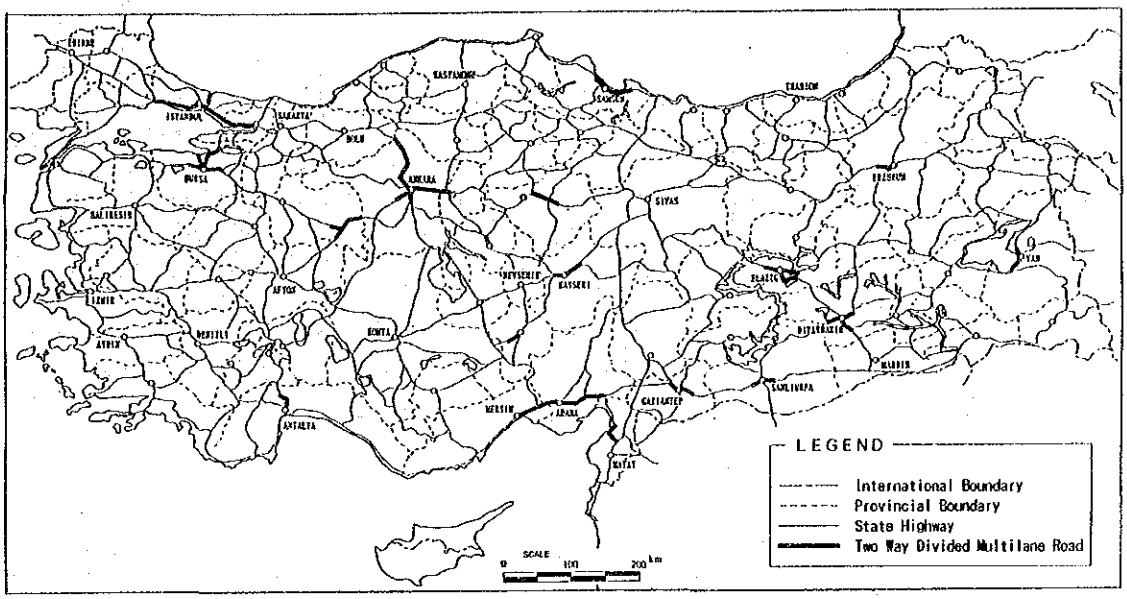
Source: Karayollari Genel Mudurlugu (KGM)1992
Yili Develet ve Il Yollari Uzunlugu

Figure 2.4.2 Asphalt Concrete Paved Roads - 1991

Table 2.4.2 Motorway and Divided Road - 1991

	Type of Roads	(km)
1.	Motorway	387
2.	Divided Road, State Highway	1,835
3.	Divided Road, Provincial Road	136
4.	Others	57,250
	Total	59,608

Source: KGM



Source: Karayollari Genel Mudurlugu (KGM)1992 Yili Develet ve Il Yollari Uzunlugu

Figure 2.4.3 Two Way Divided Multilane Roads - 1991

2) Road Conditions

The primitive sections cover 1.3 % of the state road network and 3.6 % of the provincial road network, which are 418 km and 1,004 km, respectively (as of 1992). Winter maintenance is required on all roads in Turkey except for a portion of the Mediterranean area. The total lengths of roads requiring winter maintenance are 95.8 % of state highways and 60.2 % of provincial roads, or approximately 30,000 km and 16,800 km, respectively.

3) Road Signs

Design speeds for highways are not always clear. The speed limit is 90 kph in rural areas, and 50 kph in urban areas. KGM provides road signs near junctions. For international routes, the international route number, the names of major cities that are connected, and the distances to those cities are indicated on the road signs.

2.5 Basic Traffic Information

2.5.1 Vehicle Ownership

The number of vehicles registered in Turkey was 2,360,000 in 1990, about 7.9 times as many as the 300,000 in 1970. The number of persons per vehicle was 120 in 1970, and 24 in 1990. The average annual increase from 1985 to 1990 is 9% which is high compared to the 6.5% annual increase registered in 1985. The increase in passenger cars is remarkable, with an annual increase of 11%. Figures 2.5.1 and 2.5.2 show the geographic distribution of the number of vehicles registered in 1990, and indicate vehicle ownership expressed as persons per vehicle. According to these figures, both the number of vehicles and vehicle ownership are high in metropolitan areas, such as Ankara, Istanbul, and Izmir.

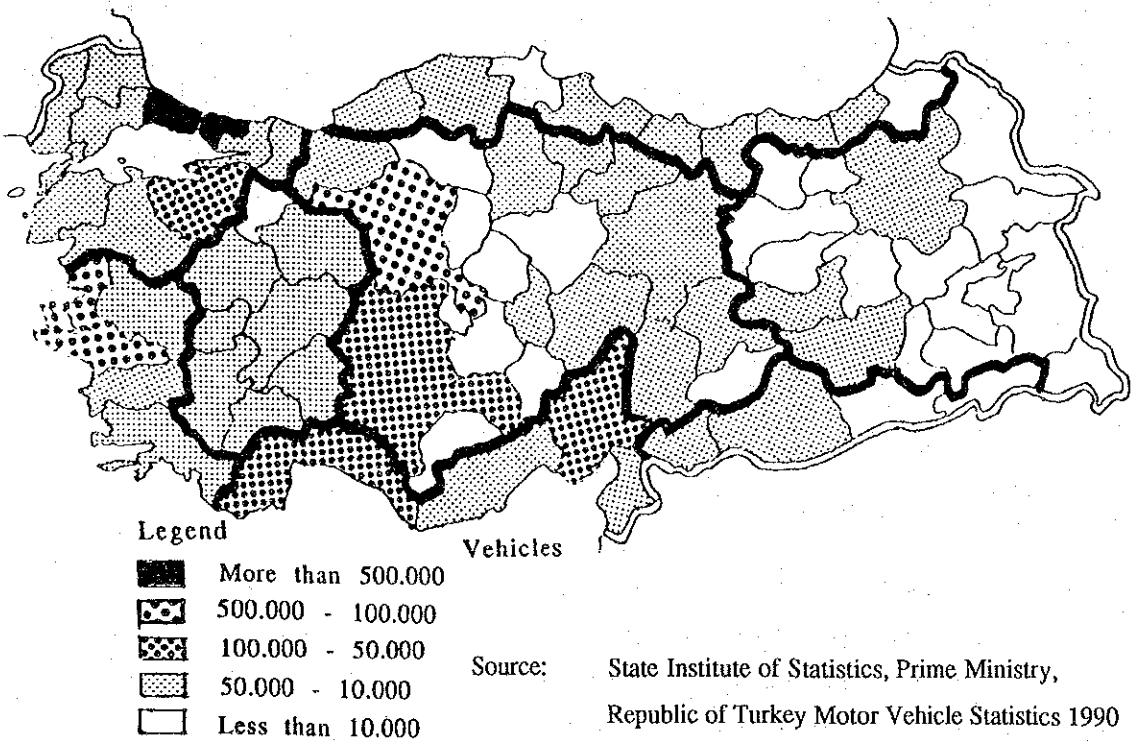


Figure 2.5.1 Vehicle Ownership by Province

In general, vehicle ownership correlates with GDP and population. In this study, the relationship between these factors was analyzed. As a result of a multiple correlation analysis of the factors of population, GDP, and vehicle ownership, parameters were computed with very high multiple correlation coefficients and a low standard of error shown in Tables 2.5.1 and 2.5.2. These were calculated using the above mentioned relationship and applying future population estimates furnished by the State Institute of Statistics, and the planned GDP based

on the total GDP of the current five-year program. The results of this analysis are that the number of passenger cars would reach 3 million in 2000 and 5.7 million in 2010, which are 1.8 times and 3.4 times greater than the present. This means that the national average of persons per vehicle would be 11.5 in 2010, which is the current value in Ankara. The number of vehicles registered in Ankara is higher than average because, as the Capital of Turkey, there are many more high-level officials, diplomats, and wealthy individuals who require transportation by automobile than those who could be expected in a typical Turkish city, and the registration of vehicles is concentrated in Ankara.

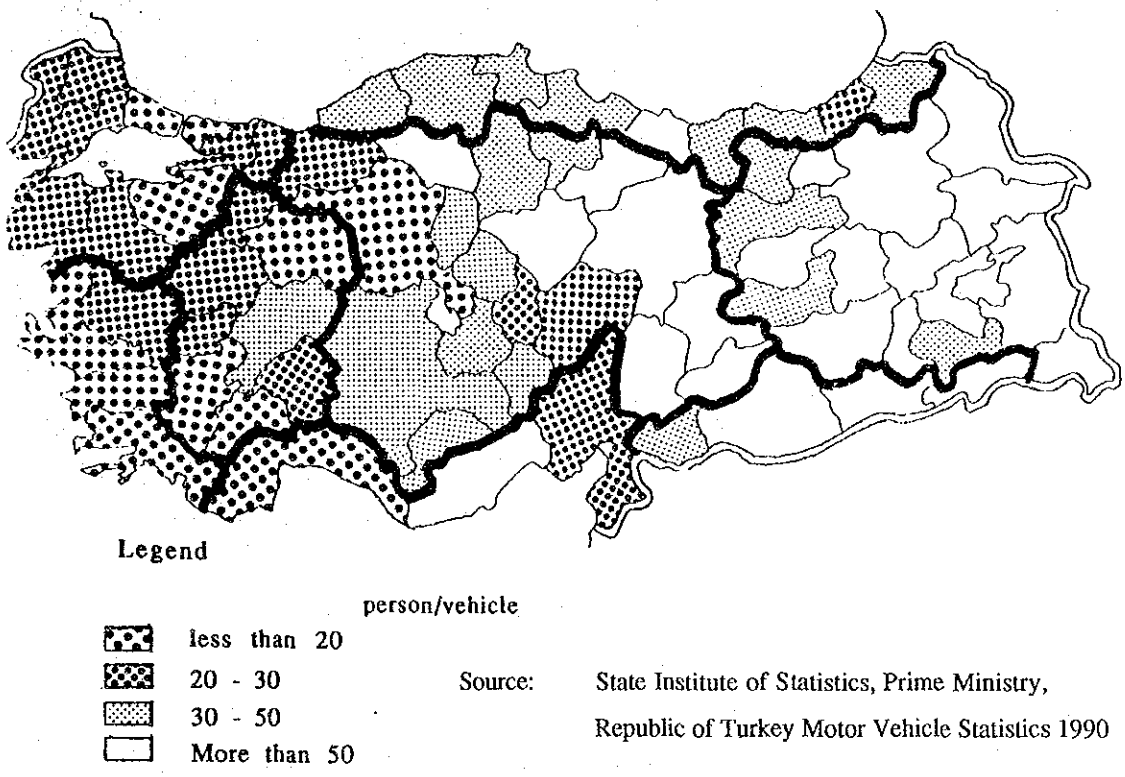


Figure 2.5.2 Vehicle Ownership (Inhabitants per Vehicle)

Table 2.5.1 Parameters for Multiple Regression Model of Vehicle Ownership

Type of Vehicle	Population Million	GDP Trillion TL.	Constant	Multiple Correlation Coefficient	Standard Error (F Value) (1000.)
Passenger Car	37.7	12.3	-1,652	0.98	59.5
Mini Bus	2.9	0.9	-117	0.99	2.6
Bus	1.2	0.5	-45	0.99	1.5
Small Truck	10.8	0.1	-338	0.98	9.6
Truck	9.1	0.3	-268	0.98	9.2

Source: JICA Study Team

Table 2.5.2 Vehicle Ownership by Year

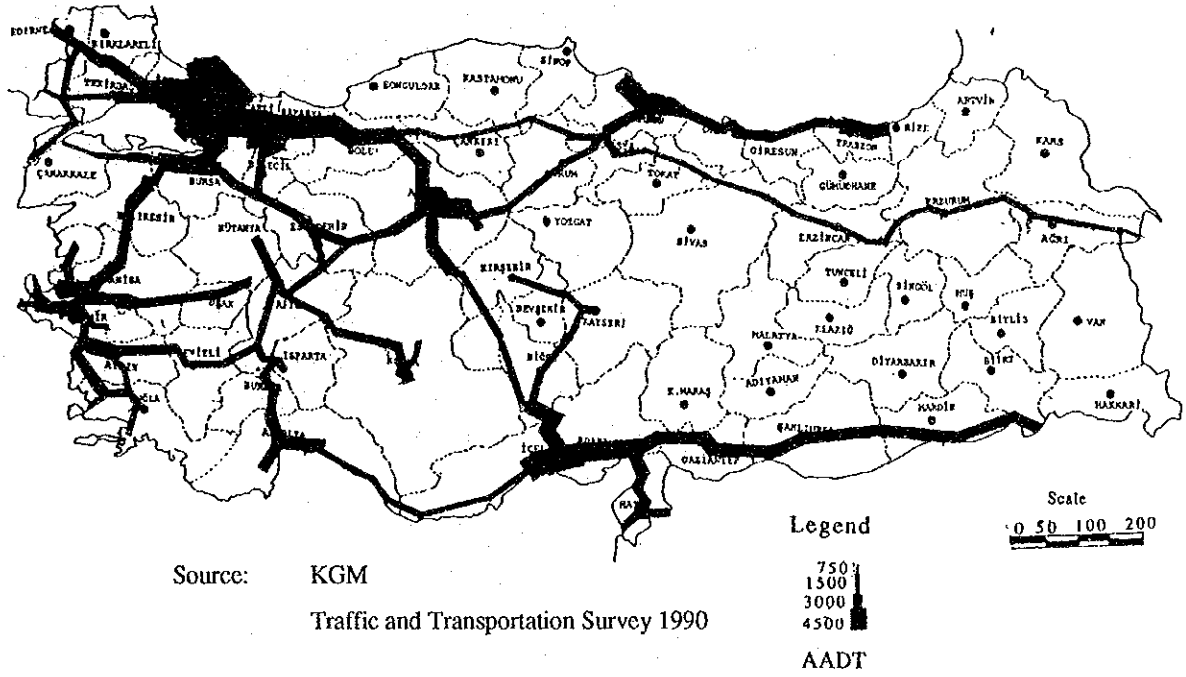
Year	Paccenger Car	Mini Bus	Bus	Small Truck	Truck	Total Vehicles	Persons/ Vehicle
1970	138	21	16	52	71	298	119.6
1971	153	22	17	57	73	322	113.5
1972	187	25	18	62	78	370	101.3
1973	240	30	20	71	87	448	85.8
1974	313	34	21	81	95	544	72.4
1975	404	41	24	99	108	675	59.8
1976	488	46	25	116	122	797	51.7
1977	560	51	27	134	138	910	46.3
1978	624	57	29	144	147	1,001	42.9
1979	689	62	31	155	157	1,094	40.1
1980	742	65	33	166	165	1,110	40.3
1981	776	67	34	172	172	1,221	37.6
1982	811	70	35	179	181	1,276	36.9
1983	856	73	38	186	190	1,343	36.0
1984	920	81	44	198	198	1,441	34.3
1985	983	88	47	213	205	1,537	33.0
1986	1,087	98	51	225	217	1,678	30.9
1987	1,193	106	54	233	226	1,812	29.2
1988	1,310	113	56	241	234	1,954	27.7
1989	1,435	118	59	264	258	2,094	26.4
1990	1,650	125	64	293	293	2,360	23.9
2000	3,046	239	117	437	423	4,263	16.5
2010	5,672	434	214	636	629	7,585	11.5

Source: State Institute of Statistics, Prime Ministry, Republic of Turkey
Motor Vehicle Statistics 1990
2000 and 2010 Values Estimated by JICA Study Team

2.5.2 Traffic Volumes

KGM currently conducts traffic analyses and traffic projections for the motorway network so that they might accurately determine future traffic volume estimates for the purpose of establishing and recommending appropriate toll fares for motorway users. After the discussions with KGM, it was determined that the Study Team should conduct its own traffic projections, utilizing a multiple regression analysis to forecast future traffic volumes. As future traffic projections for the motorways are closely affected by the estimate of future economic activities within Turkey, i.e., the results being the projected travel(vehicle km) for freight transport and for passenger travel, it was thought prudent to assume two different levels of economic growth for the Republic of Turkey. The two levels of projected economic growth selected to be used in the multiple regression traffic projection analysis were annual GDP growth rates of 5%(low estimate) and 7 % (high estimate).

Traffic volumes on major state highways in 1990 are shown in Figure 2.5.3. Volumes are higher near urban areas such as Istanbul (Thrace and Marmara), Ankara (Central Anatolia), Izmir (Aegean), Adana, and Mersin (Mediterranean). The annual traffic volume growth in Turkey based on vehicle km is 5 to 10 %. From a multiple regression analysis of traffic volumes, population, and GDP for the past twenty years, parameters were computed with multiple correlation coefficients and standard errors (F value) indicated in Tables 2.5.3 and 2.5.4.



Source: KGM
Traffic and Transportation Survey 1990

Figure 2.5.3 Traffic Flow Map - 1990

Table 2.5.3 Parameters for Multiple Regression Model of Kilometers Driven

Type of Vehicle	Population Million	GDP Trillion TL.	Constant	Multiple Correlation Coefficient	Standard Error (F Value) x 10^9
Passenger Car	-0.196	0.245	2.89	0.83	1.42
Bus	0.062	0.027	-1.39	0.87	0.24
Truck	0.066	0.118	-3.06	0.97	0.50

Source: JICA Study Team

Table 2.5.4 Kilometers Driven by Year (State Highways)

Vehicle*KM/Year Unit 10^9 km

Year	Passenger Car	Bus	Truck	Total
1970	2.51	0.78	2.82	6.11
1971	2.81	0.82	3.05	6.68
1972	3.38	0.88	3.39	7.65
1973	4.17	1.01	3.67	8.86
1974	5.65	1.02	4.19	10.86
1975	6.88	1.04	4.75	12.67
1976	7.72	1.08	5.47	14.27
1977	9.24	1.20	6.17	16.61
1978	9.40	1.24	6.74	17.37
1979	7.86	1.07	6.05	14.98
1980	7.02	1.03	5.89	13.95
1981	-	-	-	15.96
1982	-	-	-	16.60
1983	-	-	-	17.26
1984	-	-	-	17.95
1985	8.11	1.74	8.82	18.67
1986	8.14	1.85	9.00	18.95
1987	9.42	1.94	9.57	20.93
1988	10.26	2.15	9.92	22.22
1989	11.99	2.94	9.33	24.26
1990	12.48	2.15	9.96	24.59
1991	13.43	2.30	10.33	26.06
2000	27.80*	2.79*	20.19*	50.78*
	(21.76)	(2.14)	(17.28)	(41.18)
2010	61.84*	6.83*	39.32*	107.99*
	(38.94)	(4.36)	(28.29)	(74.58)

GDP Annual Growth Rates
* : 7%
( ): 5%

Source: KGM

2000 and 2010 Values Estimated by JICA Study Team

Assuming GDP growth rates of 5 % and 7 %, the traffic volume forecasts for 2010 using this model are 71.6 billion (5 % GDP) and 107.0 billion (7 % GDP) vehicle-km, which are 2.8 times (5 % GDP) and 4.1 times (7 % GDP) as large as that in 1990. This also assumes that the population in 2010 is 87.2 million, increasing by 1.54 times. The estimated growth of traffic volumes in 2000 and 2010, calculated using a multiple regression model based on traffic volumes, population and GRDP (Gross Regional Domestic Product) of the corridors in each region, is shown in Table 2.5.5. In this Table the country is divided into eight regions according to geographical features, road networks, and industrial characteristics.

Table 2.5.5 Future Traffic Demand by Region, 2000 and 2010

2000

Region		Autos		Buses		Trucks	
		7% GRDP Growth Rate	5% GRDP Growth Rate	7% GRDP Growth Rate	5% GRDP Growth Rate	7% GRDP Growth Rate	5% GRDP Growth Rate
1.	Thrace and Marmara	2.0*	1.7	2.2	1.9	1.7	1.7
2.	Blacksea	3.5	2.6	3.4	2.6	1.8	1.5
3.	Aegean	6.4	3.2	3.6	2.2	2.3	1.8
4.	Mediterranean	2.7	1.9	1.1	1.3	1.9	1.8
5.	West Anatolia	4.2	2.7	1.4	1.3	1.5	1.5
6.	Central Anatolia	1.8	1.5	1.5	1.4	1.3	1.3
7.	South East Anatolia	3.0	2.9	2.9	1.8	2.5	2.3
8.	East Anatolia	2.6	1.5	1.5	1.4	1.5	1.4

2010

Region		Autos		Buses		Trucks	
		7% GRDP Growth Rate	5% GRDP Growth Rate	7% GRDP Growth Rate	5% GRDP Growth Rate	7% GRDP Growth Rate	5% GRDP Growth Rate
1.	Thrace and Marmara	4.1	2.8	4.2	3.2	2.6	2.6
2.	Blacksea	8.5	5.3	8.3	5.2	2.9	2.4
3.	Aegean	20.0	8.7	9.9	4.5	4.9	3.0
4.	Mediterranean	6.7	3.7	1.1	1.4	3.2	2.6
5.	West Anatolia	11.9	6.3	1.9	1.8	2.3	2.1
6.	Central Anatolia	3.2	2.4	2.2	1.9	1.6	1.6
7.	South East Anatolia	7.3	3.9	7.3	3.5	4.8	3.9
8.	East Anatolia	5.9	3.8	2.2	2.0	2.1	1.9

* These are relative growth factors for each region, where 1990 is used as a base condition. I.e., Thrace and Marmara have 2.0 times (assuming 7 % annual GRDP Growth Rate) as many autos in 2000 as in 1990.

2.5.3 Traffic Accidents

Along with increases of vehicle ownership and traffic volumes, traffic accidents have increased. The number of accidents has been increasing rapidly, especially since 1986, and this is creating a serious social problem. On the existing road, the accident rate was 300/100 x 10^6 vehicle-km before 1985 and has increased to 450 ~ 525/100 x 10^6 vehicle-km. The fatality rate has increased from 180 ~ 130 to 270 ~ 230 persons/ 100 x 10^6 vehicle-km.

Table 2.5.6 Traffic Accidents on Existing Highways

Unit Ratio : persons/100 x 10^6Veh. - km

	Accidents		Fatalities		Injuries		Total Fatalities and injuries
Year	Numbers	Ratio	Persons	Ratio	Persons	Ratio	Ratio
1976	11,954	84	3,285	23	10,974	77	100
1977	13,719	83	3,709	22	12,422	75	97
1978	13,816	80	3,067	21	11,812	68	86
1979	11,031	74	2,555	20	9,886	66	83
1980	10,420	75	2,643	18	10,047	72	91
1981	11,419	72	2,704	17	11,175	70	87
1982	12,977	78	3,081	16	14,447	87	106
1983	15,134	88	3,341	18	17,217	100	119
1984	15,694	87	3,224	19	18,089	101	119
1985	16,083	86	3,292	17	21,614	116	133
1986	19,268	100	4,097	17	28,395	147	168
1987	23,070	110	4,138	20	31,600	151	171
1988	21,741	90	3,564	17	30,285	125	140
1989	21,326	88	3,332	15	29,431	121	135
1990	23,420	95	3,231	14	32,111	131	144

Source: Road Traffic Accident Statistics 1990
Statistical Yearbook of Turkey
State Institute of Statistics, Prime Ministry

The accident rate is approximately 80 - 90/100 x 10^6 vehicle-km, the fatality rate is approximately 14 - 20 deaths/100 x 10^6 vehicle-km, and the injury rate is approximately 130 - 150 persons/100 x 10^6 vehicle-km on existing highways. The absolute numbers are increasing as traffic volumes and vehicle-km traveled continue to grow.

On the other hand, within Istanbul-Sakarya motorway section (124.9 km) in the jurisdiction of Division 1, the number of accidents was 323, the accident rate was 71/100 x 10^6 vehicle-km, the death rate was 8/100 x 10^6 vehicle-km, and the injury rate was 54/100 x 10^6 vehicle-km in 1990. These ratios are less than the average.

The accident rate on motorways in Turkey is nearly the same as some other countries. However, the fatality and injury rates are higher than others as shown in Table 2.5.7 (for example, the fatality rate is 0.76 persons/100 x 10^6 vehicle-km, and the injury rate is 19 persons/100 x 10^6 vehicle-km in Japan). Because of this, it is important to introduce stronger safety measures for motorways.

Table 2.5.7 Fatality Accidents

Unit: Persons/100 x 10^6 vehicle-km

Year	1980	1981	1982	1983	1984	1985	1986	1987
U.S.A.	0.92	0.93	0.80	0.75	0.75	0.70	0.68	0.69
United Kingdom	0.75	0.80	0.71	0.60	0.60	0.64	0.58	0.59
Germany	1.00	0.98	0.94	1.00	0.76	0.71	0.74	0.63
France	1.49	1.46	1.48	1.30	1.34	1.12	1.14	1.08
Italy	2.43	2.04	1.94	2.13	1.83	1.88	2.02	1.81
Switzerland	0.80	0.51	0.53	0.53	0.75	0.56	0.65	0.55
*Japan	0.73	0.85	0.81	0.94	0.87	0.78	0.71	0.64
Average	1.16	1.08	1.03	1.04	0.98	0.91	0.93	0.86

Source: Entiwieklung der Verkehrssicherheit auf europaischen Autobahnen Strasse und Autobahn Heft 1/1989.

* Motorway Data Handbook

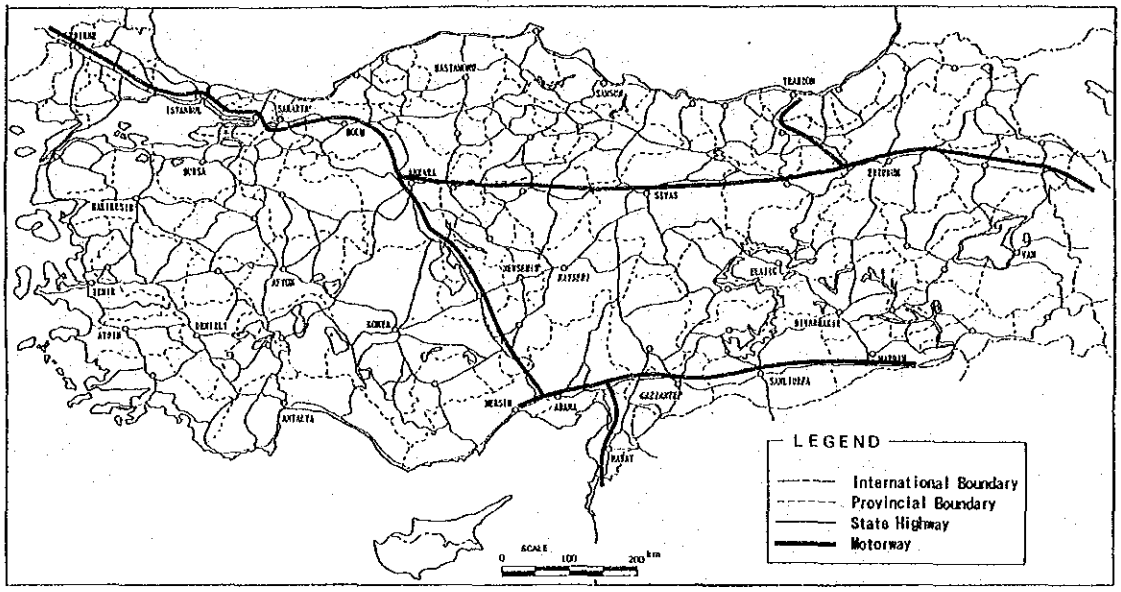
2.6 Motorway Network and Traffic Projection

2.6.1 Network

To deal with the traffic growth in the suburbs of Istanbul after the second half of the 1960's, "The Law for Highways with Access Control No. 1593" was established in June 6, 1972. The Bosphorus Bridges could be constructed as toll bridges, and the construction of motorways to connect to these bridges was initiated.

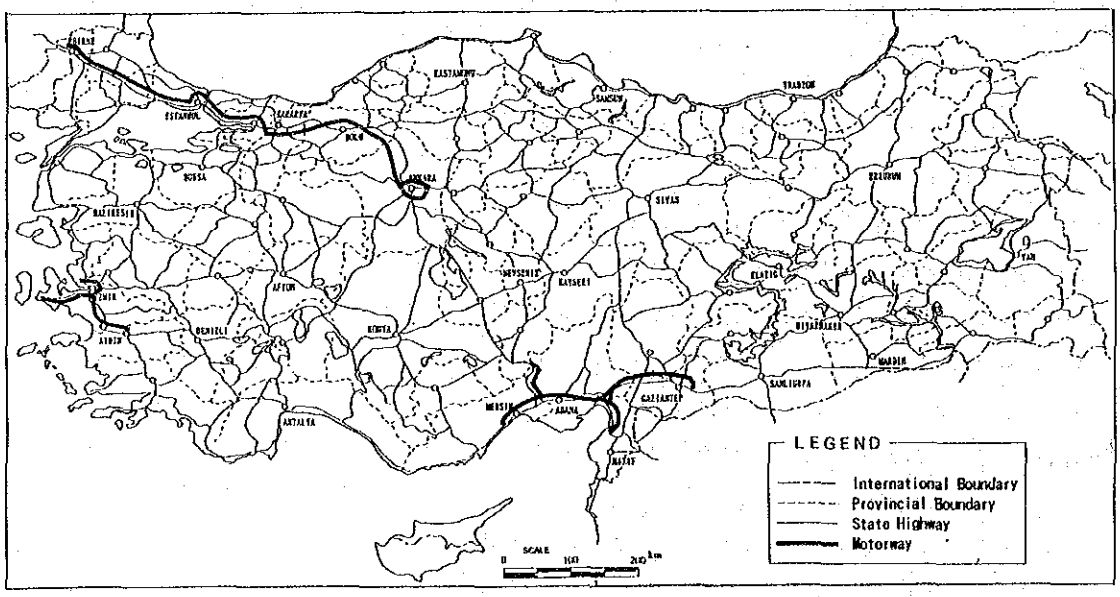
To conform to the concept of the Trans European North-South Motorway (TEM) (See Figure 2.6.1), the Prime Ministry State Planning Organization proposed a motorway project as a part of highway network in "Transportation and Planning 1983 - 1993". Motorway construction was thus started by KGM. Ten countries joined the TEM project. Most of them were East European countries. Turkey is responsible for maintaining 3,000 km of the international route within its borders. These routes connects Europe and the Middle East and starts in Turkey on the Bulgarian border, and passes through Istanbul and Ankara. The southern route connects to Iraq and Syria in the east, and the eastern route connects to Iran and the Commonwealth of Independent States. KGM has a future concept of constructing 11,000 km of motorways, including the TEM route. Construction of 1,500 km was started, and 901 km of this route was opened to traffic as of 1992. The rest is planned to be opened within several years. See Figures 2.6.2, 2.6.3, and 2.6.4.

KGM gave the 3,000 km Motorway Network plan a high priority in the sixth five-year program (1990 - 1994), and is scheduled to be completed by the year 2000.



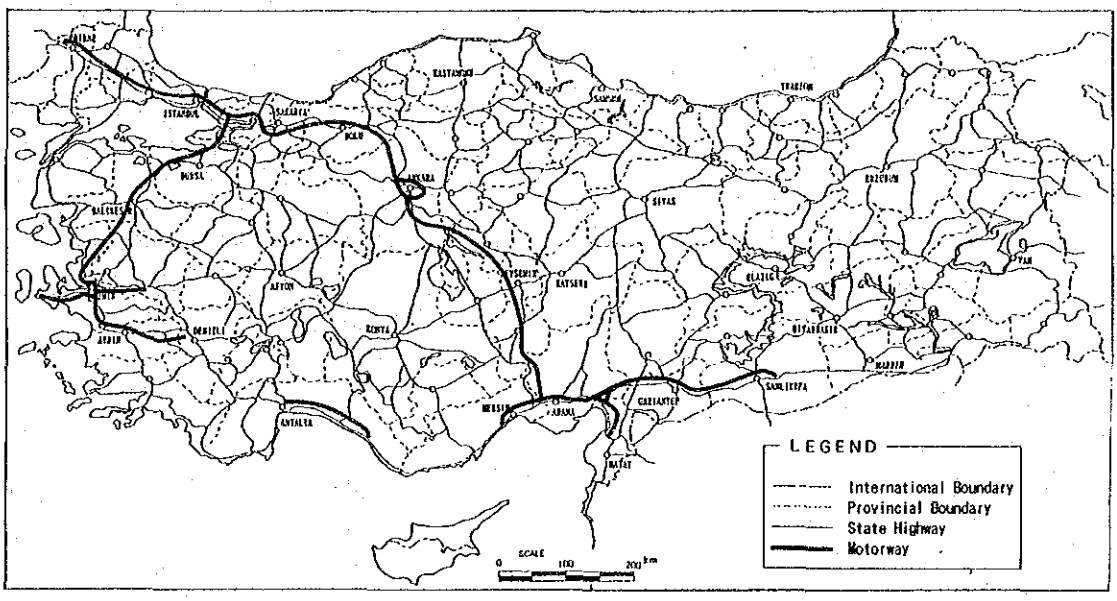
Source: KGM

Figure 2.6.1 TEM Motorway Route



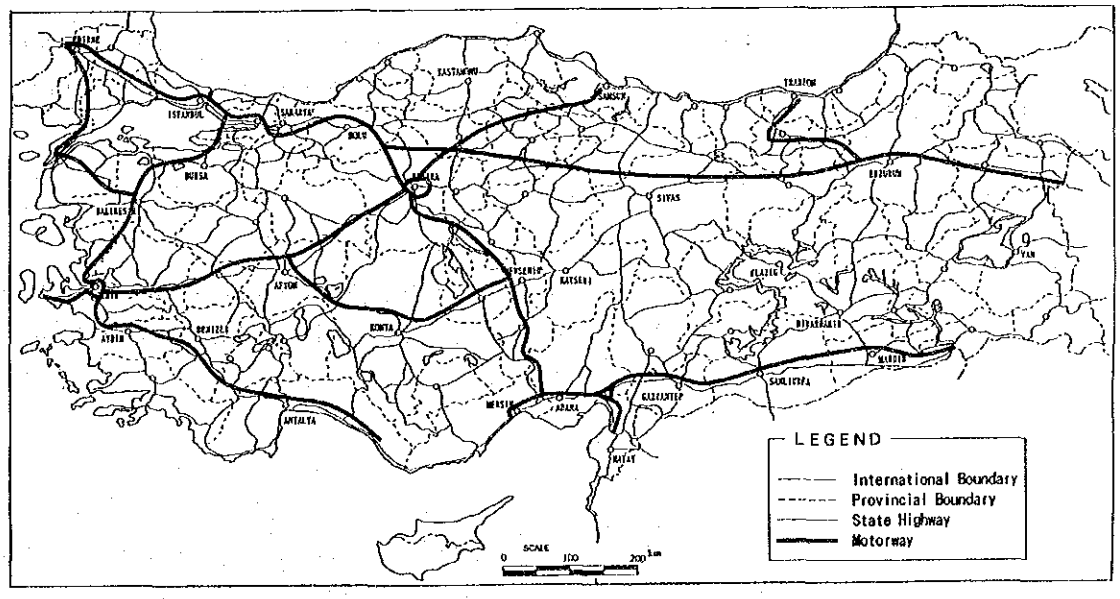
Source: KGM

Figure 2.6.2 Motorway Network 1,500 km Plan



Source: KGM

Figure 2.6.3 Motorway Network 3,000 km Plan



Source: KGM

Figure 2.6.4 Motorway Network 11,000 km Conceptual Plan

2.6.2 Road Design Standards for Motorways

Geometric design standards taken from the TEM's "Standards and Recommended Practices" are shown in Table 2.6.1.

Table 2.6.1 Geometric Design Standards for Motorways (TEM)

TERRAIN	FLAT	ROLLING	MOUNTAINOUS	UNIT
DESIGN SPEED (KM/HOUR)	120	100	80	
Width of Lane	3.75	3.75	3.75	meter
Numbers of Lane	2x3	2x3	2x3	
Outer Shoulder Width	3.00	3.00	3.00	meter
Inside Shoulder	1.00	1.00	1.00	meter
Width of Carriageway	12.00	12.00	12.00	meter
Cross Slope of Pavement	2.0	2.0	2.0	%
Cross Slope of Shoulder	2.5	2.5	2.5	%
Maximum Superelevation	7	7	7	%
Minimum Radius	1,500	1,000	550	meter
Minimum Radius for Concave Vertical Curves	2,800	2,200	1,500	meter
Sight Distance (Stopping Distance)	280	195	135	meter
Maximum Gradient	3	4	5	%
Overhead Clearance	5	5	5	meter
Right of Way	100	100	100	meter

Although KGM follows TEM Standards (adopted in 1991), they have constructed a few segments of motorway (designed between 1972 - 1981) with 2 x 2 lanes instead of 2 x 3 lanes.

1) Design speeds

Design speeds for roads are classified for flat, rolling or mountainous conditions and the design speeds have been established at 120, 100, and 80 km/h respectively.

2) Pavement

All sections are planned to be paved with an asphalt concrete surface. For the design method, KGM consulted "The AASHTO Interim Guide for Design of Pavement Structures". The motorway is designed to carry traffic for twenty years, assuming a design CBR value of 10% and an average wheel load of 8.2 tons based on the results of axle load measurements on state highways.

Although KGM uses AASHTO's criteria for pavement design, it has adopted a standard design section for all motorway design, as shown in Table 2.6.2.

Table 2.6.2 Structure of Pavement

Pavement	Structure
Surface course	5 cm
Binder course	8 cm
Base course (Bituminous stabilized layer)	12 cm
Subbase course (1) (Cement stabilization)	22 cm
Subbase course (2) (Crusher-run)	28 cm
Subgrade	CBR>10

3) Traffic lane width

The standard traffic lane width is 3.75m except for the two-way divided 4-lane sections where it is 3.5m.

4) Shoulder width

The standard shoulder width is 3.5m except for long tunnels where it is 0.50m.

5) Guardrail

Guardrail is provided where the road was constructed on embankment, on a bridge or around road facilities such as lighting or piers.

6) Road lighting

Road lighting is provided at interchanges, parking areas, service areas and in urban areas.

2.6.3 Route and Traffic Projections

1) Route Description

The total length of each motorway section is as follows. Detailed description of each motorway section including the geographic route location, interchanges, length, design speed, number of lanes and traffic demand for the years 2000 and 2010 are shown in Figure 2.6.5 (1) - (11). Also included is a written description of each motorway section.

(1) Edirne - Kinali

The total length is 176 km including 25 km of Edirne Peripheral Road, and the route runs from Edirne City near the Bulgarian borders to the outskirts of Istanbul.

(2) Kinali - Sakarya

The total length is 234.5 km including 36.7 km of the 2nd Istanbul Peripheral Road.

(3) Sakarya - Gerede

The total length is 179.5 km, and the route runs along D-100.

(4) Gerede - Ankara

The route consists of 108.0 km of Ankara Peripheral Road and 106.5 km long section from Gerede to Ankara Peripheral Road along D-750.

(5) Izmir - Aydin

The route consists of 30.8 km of the northern part of Izmir Peripheral Road and 95.2 km section from the peripheral road to Aydin.

(6) Izmir - Cesme

The route consists of 19.6 km of the southern part of Izmir Peripheral Road and 71.5 km section from the peripheral road to Cesme.

(7) Pozanti - Tarsus

The total length is 59.7 km, and the route runs from existing Pozanti Toll Road to Tarsus.

(8) Mersin - Tarsus

The total length is 58.6 km, and the route runs from Davultepe which is located in the west of Mersin to Tarsus.

(9) Tarsus - Toprakkale

The total length is 108.3 km, and the route runs from Tarsus to Toprakkale along D-400 via Adana.

(10) Toprakkale - Gaziantep

The total length is 147.0 km, and the route runs from Toprakkale to Gaziantep crossing Nur Mountains.

(11) Toprakkale - Iskenderun

The total length is 78.4 km, and the route runs along the Mediterranean Sea from Toprakkale to Arsus which is located on the outskirts of Iskenderun.

2) Traffic Projections

Traffic forecasts are made to establish standards to provide maintenance and management of roads and traffic management services. To accomplish this, the following methods are used.

First, estimate future traffic volumes of motorways using future traffic growth of motorways estimated in 2.5.2 by multiple regression analysis with GRDP and population as parameters, and current traffic volumes.

Then estimate future traffic volumes of toll roads by converting the above results using the following diversion rate assumptions by KGM: passenger cars 60 %, buses 70 %, and trucks 80 %.

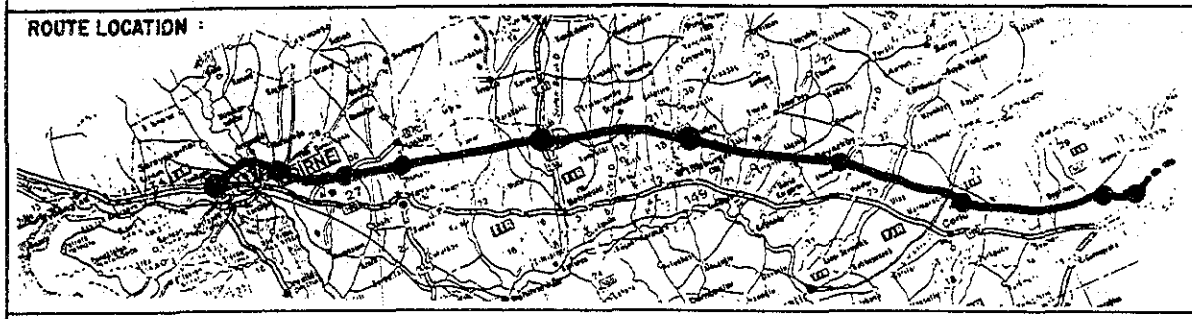
The results are shown in Table 2.6.3.

Table 2.6.3 Future Traffic Volumes of Motorways

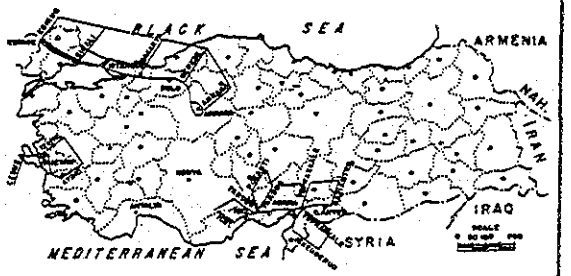
Location Name	Distance (km)	Traffic Volume in 2000			Traffic Volume in 2010		
		Truck	Bus	Total (Inc'd car)	Truck	Bus	Total (Inc'd car)
Edirne - Babaeski	73.0	3,000	700	8,500	4,800	1,400	15,700
Babaeski - Cerkezkoy	90.0	3,500	1,300	10,000	5,400	2,500	18,600
Cerkezkoy - Catalca	54.0	8,000	2,100	30,800	12,300	4,000	58,700
Catalca - Istanbul	69.5	34,800	9,700	69,600	52,500	18,500	123,500
Istanbul - Kandira	87.5	16,700	5,400	44,800	25,600	10,300	82,400
Kandira - Hendek	67.8	11,000	4,800	23,300	16,800	9,200	41,300
Hendek - Caydurt	100.9	5,400	2,400	13,100	6,600	3,500	19,600
Caydurt - Ankara	262.2	3,200	1,200	7,400	4,000	1,700	11,000
Ankara - Nigde	-	2,020	290	3,500	2,500	420	5,030
Nigde - Pozanti	-	1,910	370	3,560	2,500	560	5,160
Pozanti - Tarsus	59.6	5,100	610	7,380	6,250	900	10,150
Izmir - Aydin	126.0	3,350	1,710	19,900	7,130	4,700	58,300
Aydin - Buhurkent	-	3,340	1,330	18,300	7,120	3,660	53,370
Buhurkent - Denizli	-	2,390	1,040	9,600	5,080	2,870	27,300
Izmir - Zeytinler	43.6	1,340	1,860	32,200	2,850	5,100	98,600
Zeytinler - Cesme	27.9	720	430	12,100	1,520	1,200	37,000
Izmir - Salihli	-	8,000	1,560	21,600	17,000	4,280	17,000
Izmir - Manisa	-	3,800	1,840	26,200	8,100	5,000	77,000
Manisa - Balikesir	-	3,700	730	7,600	5,670	1,400	13,500
Balikesir - Gebze	-	6,400	1,240	12,600	9,800	2,400	22,000
Mersin - Tarsus	58.6	6,980	660	20,800	11,700	660	45,000
Tarsus - Toprakkale	110.5	8,150	750	20,700	13,700	750	43,800
Toprakkale - Gaziantep	144.8	6,890	730	12,600	13,220	1,840	272,000
Gaziantep - S. Urfa	-	7,800	500	11,000	15,000	1,260	23,000
Toprakkale - Iskenderun	90.4	4,600	300	7,900	7,750	300	15,500
Antalya - Manavgat	-	3,260	470	13,200	5,500	470	29,500
Manavgat - Alanya	-	2,250	360	6,100	3,800	360	12,700

ROUTE : Edirne – Kinali (176 km)

ROUTE LOCATION :



GEOGRAPHIC LOCATION :



INTERCHANGE :

Edirne, Lalapaşa, Edirne Doğu, Havsa, Babaeski, Luleburgaz, Saray, Çorlu, Çerkezköy, Kinali

DISTANCE (Km)

25.0 (0.6 + 4.4 Toll Free), 21.8, 26.2, 24.0, 38.0, 20.5, 17.5, 13.0

DESIGN SPEED :

120 km/h

NUMBER OF LANES :

4 Lanes — 6 Lanes

TRAFFIC DEMAND (Unit : 1000 PCU) :

YEAR 2000

13-13, 11-12, 16-17, 22-23, 44-77

YEAR 2010

19-23, 25-29, 34-39, 69-82

DESCRIPTION :

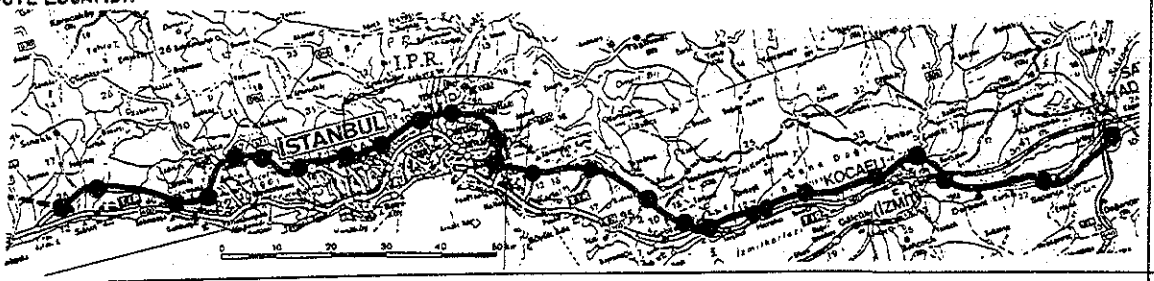
In the 176km section from Bulgaria to Kinali (located on the outskirts of Istanbul), the route runs almost parallel to the Yildiz Mountains. From Bulgaria to a point 25km beyond the Edirne Periheral Road (PRD),the motorway is free. Geographically , the route is located in rolling or flat sections, and since the route parallels the Yuldi Mountains, it often intersects with ridges or rivers, and requires bridges. Flat sections in the bottom of ravines are constructed on soft ground , and settlement of the road is a concern for the future.

Long Bridge (More than 80m) 38 places Total Length 9,780m

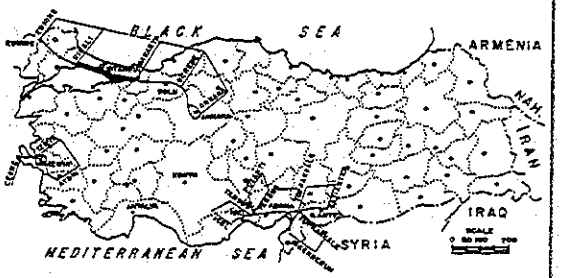
Figure 2.6.5 (1) Route Description Edirne - Kinali

ROUTE : Kinali – Sakarya (235.4 km)

ROUTE LOCATION :



GEOGRAPHIC LOCATION :



INTERCHANGE :

Kinali, Sellmpasa, Selimpasa, Kumburgaz, Catalca, Hadimköy, Avcilar, Mahmutbey (Bati), Anadolu Otoyolu, Samandira, Kurtköy, Sekerpinar, Gebze, Dil Iskelesi, Hereke Bati, Hereke Dogu, Yarimca, Izmit Bati, Kandira, Izmit Dogu, Saponca, Adapazari (Sakarya)

DISTANCE (Km)

15.3 – 12.2 – 7.5 – 6.0 – 12.0 – 6.0 – 12.0 – 39.5 Toll Free / 36.7 I.P.R – 8.7 – 11.1 – 9.3 – 10.2 – 7.2 – 6.1 – 3.1 – 12.8 – 7.2 – 11.8 – 7.2 – 16.8 – 13.4

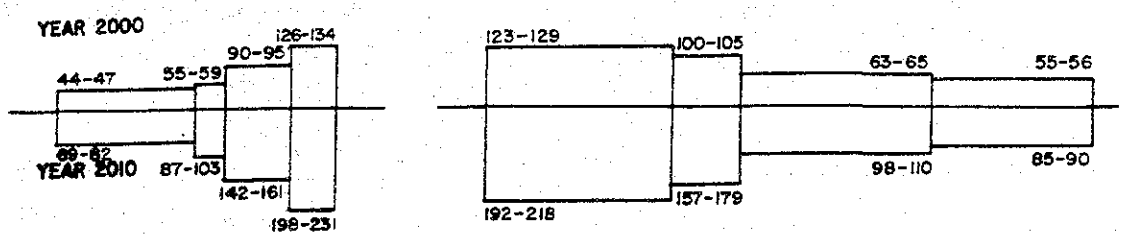
DESIGN SPEED :

120 km/h

NUMBER OF LANES :

4 Lanes — 6 Lanes — 8 Lanes — 6 Lanes — 4 Lanes

TRAFFIC DEMAND (Unit : 1000 PCU) :



DESCRIPTION :

This route contains the 39.5km long 2nd Istanbul Peripheral Road (2nd IPR) as its center , and extends 71.0km to the west and 124.9km to the east of the IPR. This section is 235.4km long from east to west. The 2nd Peripheral Road (39.5km long) and 1st Peripheral Road(24.0km long) are located parallel to each other and are connected by eight highways and other roads to form a ladder - like expressway network. In the city of Istanbul , many on - and off - ramps are provided, and the use of the highways is free except for the Bosphorus Bridges.

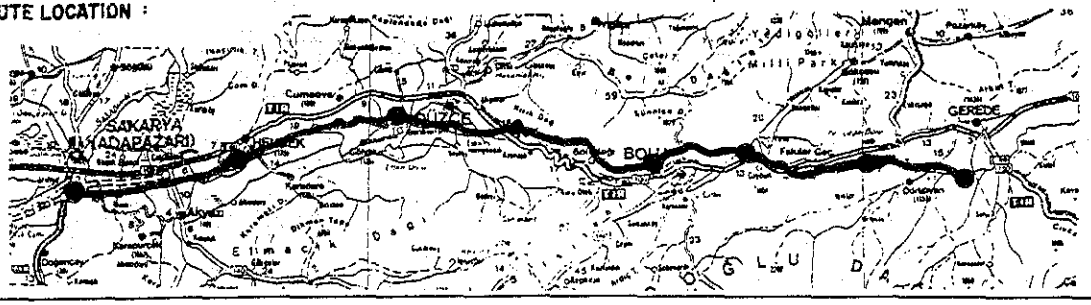
Most of the route is parallel to the Marmara Sea , and most of the roads are in rolling areas. Since the mountains are close to the coast and the ground is steep, viaducts are often used the cross ravines . Particulary, in the section east of Istanbul to Izmit where the Cene Mountains (300 to 500m)are located close to the coast , tunnels and bridges are often required. In this section, unstable surfaces caused by construction can be seen. Between Gebze and Izmit , there are three tunnels shorter than 500m. In Izmit there are two tunnels 980m and 609m long. Altogether, there are five tunnels.

Kinali- IPR			
Long Bridge	4 places	Total length	3,920m
IPR			
Long Bridge Except 2nd Bosphorus Br.	11places	Total Length	4,301m
IPR-Sakarya			
Long Bridge	28 places		
Tunnel	5 places	Total Length	2,570m

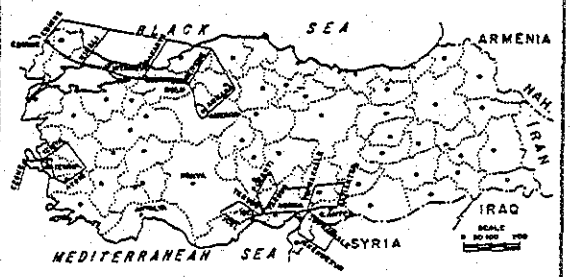
Figure 2.6.5 (2) Route Description Kinali - Sakarya

ROUTE : Sakarya – Gerede (179.5 km)

ROUTE LOCATION :



GEOGRAPHIC LOCATION :



INTERCHANGE :

Adapazari (Sakarya) – Akyazi – Hendek – Duzce – Bolu Dagi – Bolu Bati – Caydurt – Yenicaga – Gerede

DISTANCE (Km)

16.2 – 14.2 – 31.0 – 21.0 – 29.7 – 19.2 – 23.0 – 25.2

DESIGN SPEED :

120 Km/h — 100 Km/h — 120 Km/h

NUMBER OF LANES :

6 Lanes

TRAFFIC DEMAND (Unit : 1000 PCU) :

YEAR 2000

45-46 | 29-30 | 33-34 | 23-23

70-79 | 66-74 | 38-42 | 42-46 | 29-32

YEAR 2010

DESCRIPTION :

This section begins with flat ground in Sakarya , where Sapanca Lake is located, and reaches Gerede , a town located in the pass of the Koroglı Mountains . This pass reaches the Anatolia region where Ankara is located. The total length of this section is 179.5km. The route runs along the same ravine as the exiting road and reaches Gerede. There are seven interchanges in this section. Most of these ICs provide connections to towns located in the Koroglı Mountains in the 29.7km section between Bolu Dagi IC.and Bolu Bati IC. the route is in a steep mountainous area, and there is a long bridge of 2,435m and a tunnel of 3,240m.

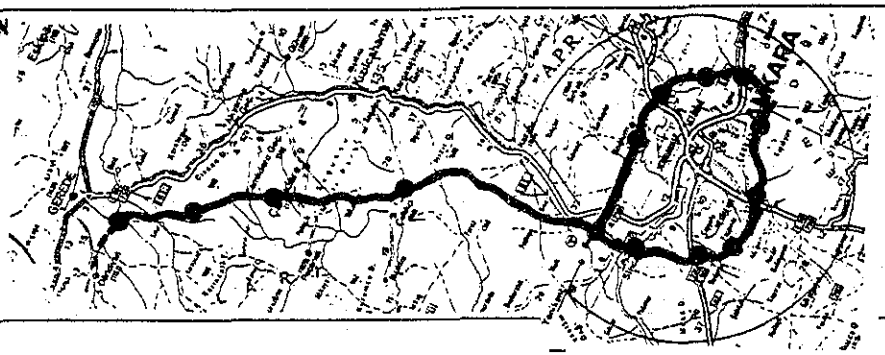
The flat ground in Sakarya sometimes contributes to flooding and forms a soft clay layer. The road was constructed on embankment except when crossing rivers, where bridges are used, and allowance for settlement is necessary . The route crosses the Koroglu Mountains , and large scaled cuts, viaducts, and tunnels are used . This section runs through the earthquake zone of Turkey and is considered to be a landslide area. Maintenance operations necessary for snowfall, freezing and fog are required in this section since the weather is severe in the winter.

Long Bridge	2 places	Total Length	2,617m
Tunnel	1 place	Length	3,240m

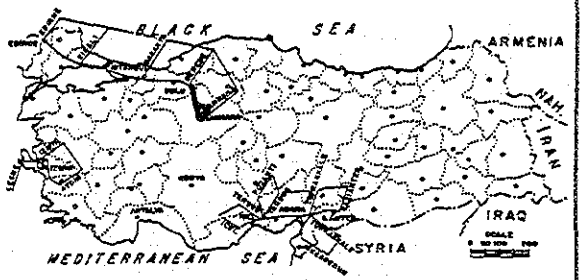
Figure 2.6.5 (3) Route Description Sakarya - Gerede

ROUTE : Gerede - Ankara (106.5 km), Ankara Peripheral Road (107.6 km)

ROUTE LOCATION



GEOGRAPHIC LOCATION :



INTERCHANGE :

Gerede — Servis Area Access — Pelitcik — Celtikci — Ankara Peripheral Motorway J.C.

DISTANCE (Km)

16.5 — 29.3 — 15.8 — 44.9 — 106.5 Toll Free A.P.R.

DESIGN SPEED :

120 km/h — 110 km/h — 120 km/h — 120 km/h

NUMBER OF LANES :

6 Lanes

TRAFFIC DEMAND (Unit : 1000 PCU) :

YEAR 2000

19-19 | 19-19

24-26 | 24-26

YEAR 2010

DESCRIPTION :

The route is located west of the existing road, parallel to the mountains extending from the Koroglu Mountains to Ankara, and runs along the base of the mountains.

The total length of the section from Gerede to the Ankara Peripheral Road (APR) is 106.5km. Ankara Peripheral Road (APR) is a route that encircles Ankara with a radius of 30km and a total length of 108.0km. The APR is connected to radial major roads accessing Ankara, and is planned to be operated without charge to drivers.

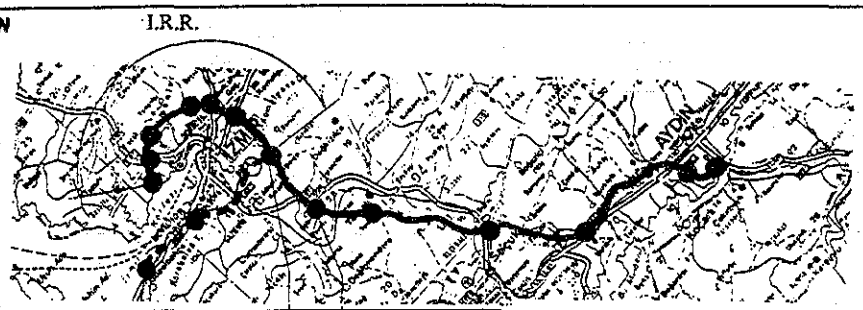
This route is located in the foothills side of the valley near the Koroglu Mountains, and the ground is steep. The road intersects many ridges and rivers, and there are are some large - scale cuts, but no tunnels. The route is located in the highlands, and measures for snow, freezing, fog, and protection for the cut - slope will be required.

Long Bridge 7 places Total Length 2,000m

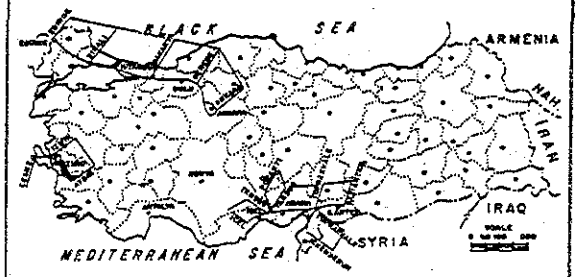
Figure 2.6.5 (4) Route Description Gerede - Ankara

ROUTE : Izmir – Aydin (95.2 km) I.R.R. (30.8 km)

ROUTE LOCATION



GEOGRAPHIC LOCATION :



INTERCHANGE :

Askeri Havaalanı
Çiğli
Örnekköy
Atatürk Mah.
Barnova
Anadolu Lisesi
Işıkkent J.C.
Tahtalıçayı
Torbalı
Belevi
Germencik
Sevketiye
Aydın

DISTANCE (Km)

Toll Free
30.8 | 11.5 | 13.5 | 21.5 | 21.8 | 21.7 | 5.2
Izmir Rings Road

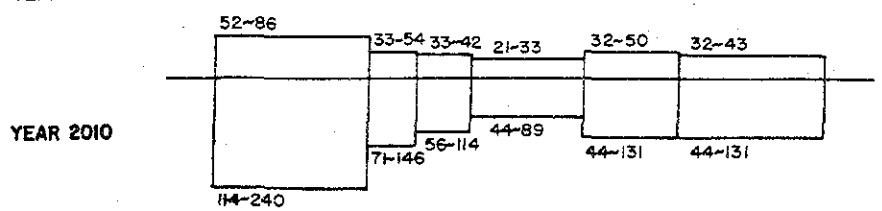
DESIGN SPEED :

120 km/h — 100 km/h — 120 km/h

NUMBER OF LANES :

6 Lanes

TRAFFIC DEMAND (Unit : 1000 PCU) :



DESCRIPTION :

For the most part, this route is located in a flat granary except for the section between the Izmir Ring Road (IRR) and Aydin Mountains. The total length of this route is 126.0km, including the section north of IRR which is 30.8km. The IRR surrounds the urban area with a radius of 5km centered around Izmir Bay. The route is located in a hilly area, and the ground is relatively steep.

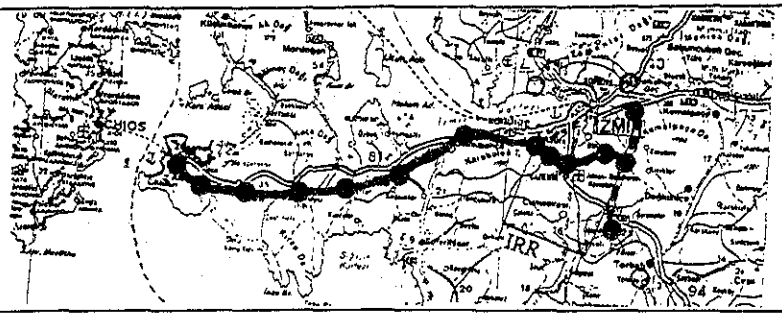
Some sections of the lower granary have a soft clay layer of soil, and the effect of this soft soil on the pavement after construction is of a concern. The IRR has two tunnels : one is 3022m long and penetrates Yamanlar Mountain located in the northern part of the city, and the other is 2950m. long and crosses the Belevi IC and Germenci IC. There are large scale cuts in the area approaching the Aydin Mountains.

IRR			
Long Bridge	8 places	Total Length	2,692m
Tunnel	2 places	Length	275m, 2,970m
IRR-Aydin			
Tunnel	1 place		3,022m
Long Bridge	9 places	Total Length	1,804m

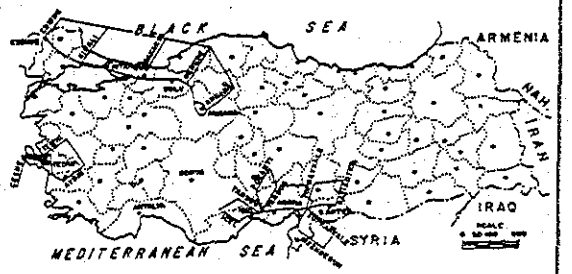
Figure 2.6.5 (5) Route Description | Izmir - Aydin

ROUTE : Izmir - Cesme (71.5 km) I.R.R. (19.6 km)

ROUTE LOCATION :



GEOGRAPHIC LOCATION :



INTERCHANCE :

Cesme, Alacati, Zeytinler, Karaburun, Urla, Seferhisar, Sehitlik, Ikiztepe, Uzundere, Karabaglar, Buca, Isikkent J.C.

DISTANCE (Km)

10.9 17.0 13.4 9.1 9.6 12.5 19.6 Toll Free

Izmir Ring Road

DESIGN SPEED :

120 km/h

NUMBER OF LANES :

6 Lanes

TRAFFIC DEMAND (Unit : 1000 PCU) :

YEAR 2000

8-15 22-40 29-52

YEAR 2010

30-43 53-117 69-123

DESCRIPTION :

The total length of this section is 91.1km including the southern half of the IRR which is 19.6km. The IRR section is planned to be upgraded to a motorway. The route goes alongside the mountains on a peninsula , and reaches the city of Cesme which is located on a point .

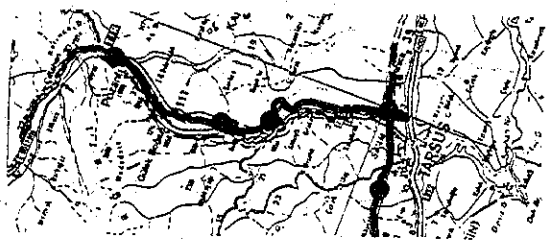
Karabeken Hill is located on the south side of Izmir. The IRR penetrates this hill by means of a 3020m tunnel. In the suburb of Izmir. The road is placed on low embankment created from reclaiming the bay. This road is also used for coast - protection , and the effect of the tide on the road is a concern . The route goes through a mountainous area, and there are many large cuts.

Cesme - Sehitlik			
Long Bridge	2 places	Total Length	1,100m
IRR			
Long Bridge	2 places	Total Length	736m
Tunnel	3 places	Length	290m, 420m, 3,020m

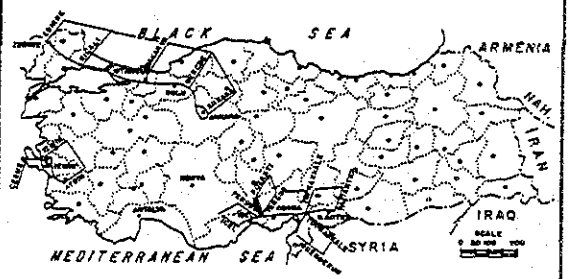
Figure 2.6.5 (6) Route Description Izmir - Cesme

ROUTE : Pozanti - Tarsus (59.7 km)

ROUTE LOCATION :



GEOGRAPHIC LOCATION :



INTERCHANCE :

Pozanti — Tekir — Camalan — Tarsus Pozanti J.C.

DISTANCE (Km)

14.0 — 15.6 — 30.1

DESIGN SPEED :

80 — 100 — 80 — 105 km/h

NUMBER OF LANES :

4 Lanes

TRAFFIC DEMAND (Unit : 1000 PCU) :

YEAR 2000

26-29

44-51

YEAR 2010

DESCRIPTION :

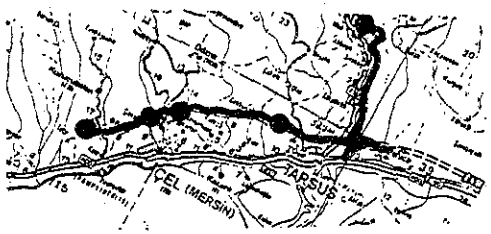
The route starts in the Anatolia plateau and reaches the flats of the Mediterranean Sea coast, running through steep valleys between the Bolkar Mountains and the Ala Mountains, which are part of The Toros Mountains.

Large scale cuts can be seen at those locations where the route goes through mountain ridges. There is only one 200m long tunnel to provide shelter from the falling of stone, and no large bridges. The tunnel is equipped to provide proper drainage, since the land was the reclaimed from the valley. It is a two - way divided 4 - lane road,but the median strip is narrow.

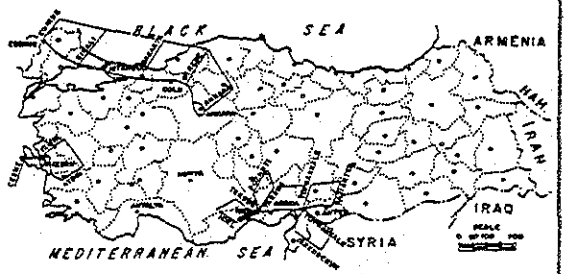
Figure 2.6.5 (7) **Route Description** Pozanti - Tarsus

ROUTE : Mersin – Tarsus (58.6 km)

ROUTE LOCATION :



GEOGRAPHIC LOCATION :



INTERCHANGE :

Davultepe
Mersin
Free Trade (Zone Accress)
Tarsus
Tarsus Pozanti J.C.

DISTANCE (Km)

17.7 4.3 24.4 12.2

DESIGN SPEED :

120 km/h

NUMBER OF LANES :

6 Lanes

TRAFFIC DEMAND (Unit : 1000 PCU) :

YEAR 2000

38-42 42-46

YEAR 2010

58-81 63-86

DESCRIPTION :

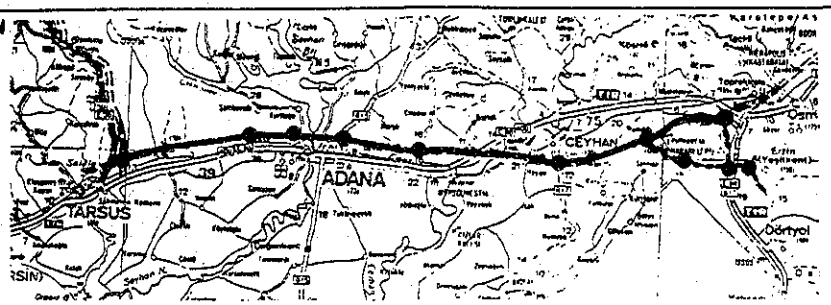
This route is located on the border between hills and flat ground, and connects Davultepe (located west of Mersin) to Tarsus JC.

Long Bridge 6 places Total Length 5,740 m

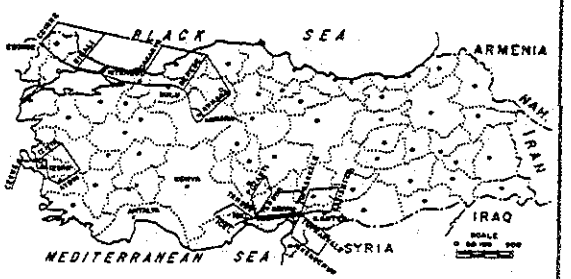
Figure 2.6.5 (8) Route Description Mersin - Tarsus

ROUTE : Tarsus - Toprakkale (108.3 km)

ROUTE LOCATION



GEOGRAPHIC LOCATION :



INTERCHANGE :

Tarsus Pozanti J.C. | Adana Batı | Adana Kuzey | Adana Doğu | Misis | Ceyhan - Yumurtalık | İskenderun Batı J.C. | İskenderun Doğu J.C.

DISTANCE (Km)

19.1 — 7.5 — 15.1 — 15.5 — 23.4 — 11.5 — 16.2

DESIGN SPEED :

120 km/h

NUMBER OF LANES :

8 Lanes — 6 Lanes

TRAFFIC DEMAND (Unit : 1000 PCU) :

YEAR 2000

29-31 | 28-30 | 30-32

YEAR 2010

43-57 | 41-54 | 44-58

DESCRIPTION :

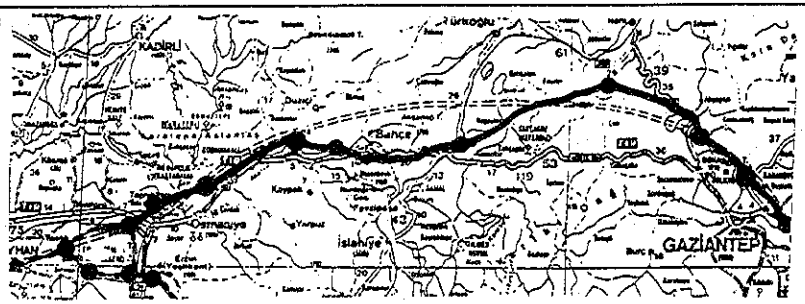
This route begins at Tarsus JC, passes through foothills on the edge of the Adana Plain, and reaches theToprakkale IC after cutting through a large granary in the Ceylan basin. This route is located in both rolling and flat areas. A two - way 8 - lane divided road is located between Tarsus JC and Adana Dogu IC. A 6 - lane road is located from Adana Dogu IC to Toprakkale.

Long Bridge	2 places	Total Length	594 m
Tunnel	1 place	Length	300 m

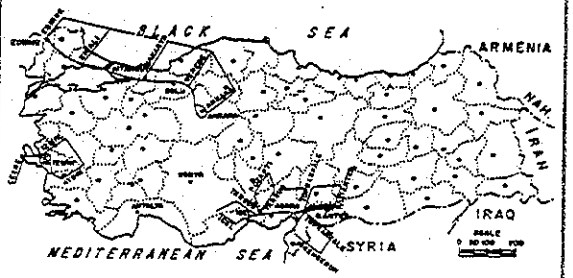
Figure 2.6.5 (9) Route Description Tarsus - Toprakkale

ROUTE : Toprakkale – Gaziantep (147.0 km)

ROUTE LOCATION :



GEOGRAPHIC LOCATION :



INTERCHANGE :

Iskenderun Dogu J.C. | Toprakkale | Osmaniye – Kadirli | Haruniye | Bahce | Kömürler | Nurlı | Gaziantep Batı | Gaziantep Kuzey | Gaziantep Dogu

DISTANCE (Km)

2.2 | 11.7 | 22.0 | 7.8 | 25.0 | 36.7 | 18.8 | 13.5 | 9.8

DESIGN SPEED :

120 km/h

NUMBER OF LANES :

6 Lanes

TRAFFIC DEMAND (Unit : 1000 PCU) :

YEAR 2000	20-22	20-23	24-27	30-34
YEAR 2010	30-39	35-46	41-55	52-70

DESCRIPTION :

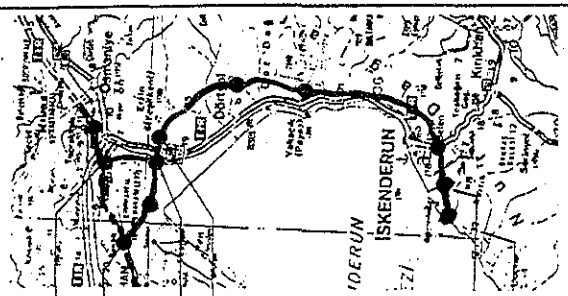
This route begins in the Ceylan basin and goes through the Nur Mountains and ends at the East IC in the City of Gaziantep. The route is planned to be extended further east along the Syrian border to the Iraq border. The 32.8km section betwen Haruniye IC and Komurler IC goes across the Nur Mountains and is in a steep mountainous area. Large scale cuts, tunnels, and viaducts are concentrated in this section. There are four tunnels, with the longest one being 1220m.

Long Bridge	13 places	Total Length	5,115m
Tunnel	14 places	Total Length	2,711m

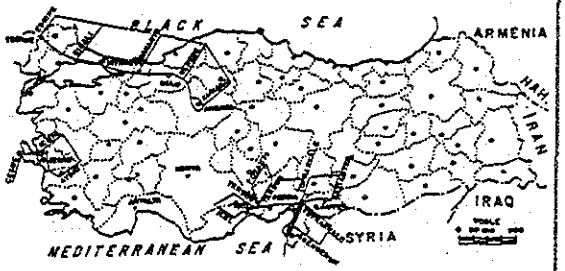
Figure 2.6.5 (10) **Route Description** Toprakkale - Gaziantep

ROUTE : Toprakkale - Iskenderun (78.4 km)

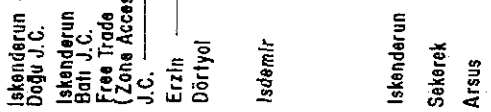
ROUTE LOCATION :



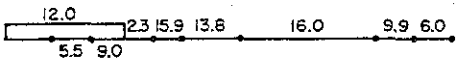
GEOGRAPHIC LOCATION :



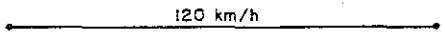
INTERCHANCE :



DISTANCE (Km)



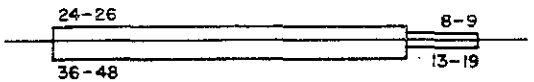
DESIGN SPEED :



NUMBER OF LANES :

TRAFFIC DEMAND (Unit : 1000 PCU) :

YEAR 2000



YEAR 2010

DESCRIPTION :

This route starts at Toprakkale West JC and East JC, runs along Iskenderun Bay in the Mediterranean Sea, and ends at Iskenderun. The Nur Mountains extend to Iskenderun Bay , and the route must cross ridges extending out from these mountains . The ground is steep and large scale cuts can be seen at frequent intervals, especially the area near the Isdemir IC.

Long Bridge (More than 80km) 7 places Total Length 860m

Figure 2.6.5 (11) Route Description Toprakkale - Iskenderun

Existing Conditions of Road Maintenance, Operation and Traffic Management and Operation

3. EXISTING CONDITIONS OF ROAD MAINTENANCE, OPERATION AND TRAFFIC MANAGEMENT AND OPERATION

3.1 Institutional Organization

3.1.1 Legal and Administrative Setting

The organization charts of the Cabinet, the Ministry of Public Works and Settlements, and the General Directorate of Highways (KGM) under the Ministry are shown in Figure 3.1.1, Figure 3.1.2, and Figure 3.1.3 respectively.

The General Directorate of Highways (KGM) was established in 1950 for further development of state highways and provincial roads. KGM is in charge of constructing motorways, state highways and provincial roads along with the maintenance and operation of 59,232 km of highways and roads.

Law No. 5539 (established in 1950) was amended in May, 1973 and allows KGM to construct, maintain and operate motorways (full access controlled roads) and to charge a toll on motorway users.

3.1.2. Organization of Highway Management

1) Structure of General Directorate of Highways (KGM):

KGM has 12 Departments in Headquarters and 17 Regional Divisions. The Department of Motorways is responsible for motorway construction, and consists of the Divisions of Motorway Design, Motorway Construction and Motorway Bridges.

The Division of Motorway Construction has four (4) sections. These sections are Construction, Maintenance and Operations, Final Estimate and other. Reference is made to Figure 3.1.4 for the organization charts of Motorway Construction division.

The Department of Maintenance is responsible for maintenance and operations on state and provincial roads. It has two (2) divisions, the Maintenance Division and the Traffic Division.

Each Regional Division has sixteen (16) sections including the Maintenance and Equipment Sections.
Regional Division 1 in Istanbul, Regional Division 2 in Izmir, Regional Division 4 in Ankara and Regional Division 5 in Mersin each have a special Motorway Section in

addition to the sixteen (16) normal sections. Reference is made to Figures 3.1.6 and 3.1.7. Figure 3.1.8 shows Locations of Regional Division offices and their boundary.

2) Personnel

KGM employed a total of 33,615 personnel as of January, 1992. Among this total, there were 4,739 government officers, 23,778 permanent employees and 5,098 temporary employees. The number of civil engineers was 1,093 (out of 4,739 government officers). The 903 persons of the government officers were located in regional divisions.

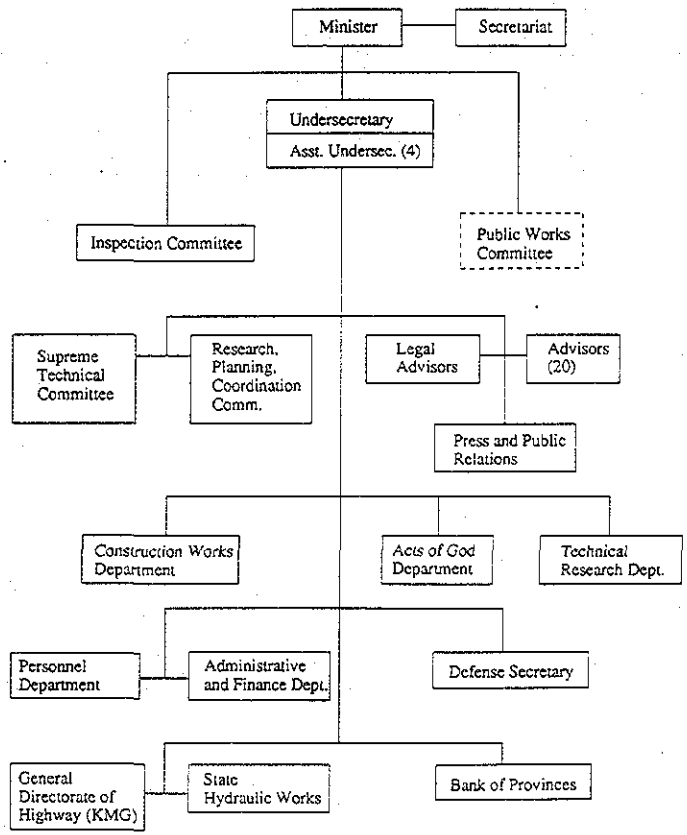


Figure 3.1.2 Organization Chart of the Ministry of Public Works and Settlement

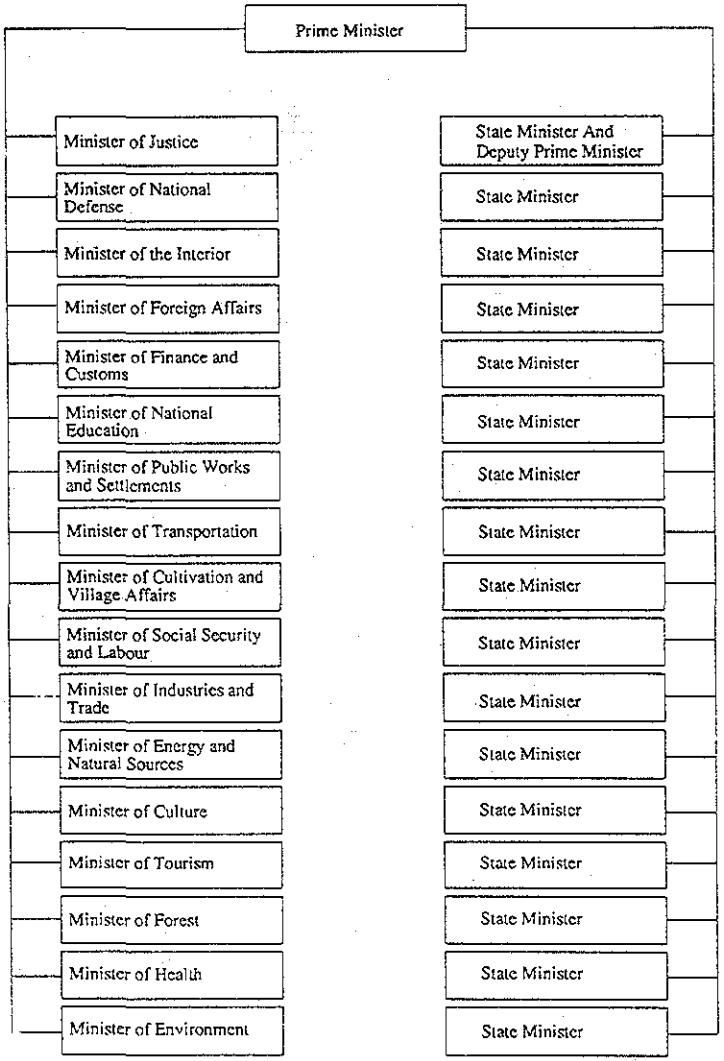


Figure 3.1.1 Organization Chart of the Cabinet

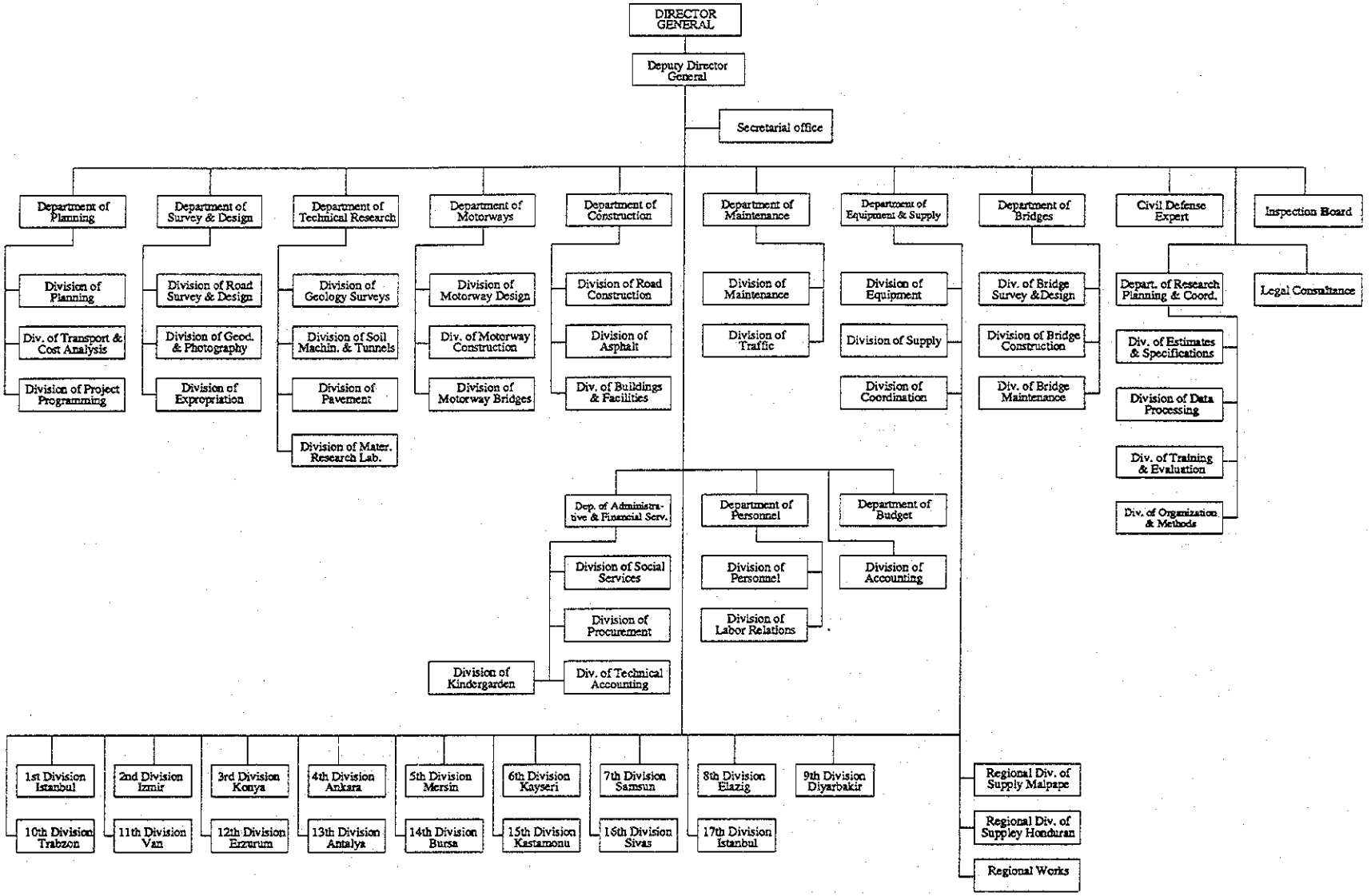


Figure 3.1.3 Organization Chart of the General Directorate of Highway (KGM)