BOX 4A - SPEA BMS - THE ECONOMIC ASSESSMENT

The SPEA BMS has been developed by the Spea Ingegneria Europea s.p.a. of Italy and has been built up upon the experience of maintaining the IRI motorway network (3500 km of motorway and 5000 bridges) over some thirty years. The basis of the system involves regular inspection (quarterly) and a file on each bridge. The database is stored on a PC capable of presenting images as well as text. The data on bridges is broken down by components as follows:-

- foundations
- abutments
- piers (uprights and dosserets)
- arches
- decks (beams, crossbeams, slabs, overhangs, thick slabs, girders)
- devices for the runoff of water
- bearings (proper and concrete)
- joints (continuity and waterproofing)
- pavements.

At the heart of the economic assessment are:-

- tendential flow curves of the probably future deterioration of the faults
- estimates of the costs of full or partial maintenance to bring the bridge back to full working order
- an evaluation which enables the manager to see the impact of

(1) restricted budgets, (2) increases in costs associated with delaying maintenance, and (3) the seriousness of other factors, such as safety, in influencing the repair/maintain or not decision. The decisions are made by management and the BMS acts as an aid to that process.

8.4.3 Conclusions and Recommendations

General Conclusions

The Case Studies have illustrated a number of general conclusions on the economic aspects. The most important of these conclusions are that

(a) because of the relatively high traffic levels in Turkey on most of the state highways (5000 vpd and more, often much more) and the high level of expected growth in traffic (often 5-10% per annum), the collapse or closure of a road bridge puts a large cost upon road users and thus upon the Turkish economy. For the most part, the traffic disruption costs of bridge closure or restriction (borne by road users) far outweigh the direct capital costs of repair and rehabilitation of bridges (borne by the highway agency). The picture is similar with the costs of periodic maintenance and routine maintenance. Quite aside from safety considerations, the collapse or indeed forced

closure of a bridge should always be avoided from the viewpoint of the overall Turkish economy.

(b) because of the high rate of traffic growth in Turkey, it is clear that dualling of road bridges will have to take place relatively frequently, and that this dualling should be linked to the programme for the periodic maintenance and rehabilitation of the existing bridges. The economic savings (to road users) by ensuring that the second bridge for the dual carriageway is in place before repairing the existing bridge will generally far outweigh the costs to the highway agency (temporary diversions etc.)

The Economic Case for an Increase in Budget for Maintenance

Whilst poor workmanship at the time of construction has been a significant factor in some of the problems of the 'case study' bridges (for example, Asagi Cakalli), there is no doubt that the inadequacy of maintenance is reducing the economic life of many of the bridges. The reduction in economic life (for example, forty years instead of fifty years) means that the bridges are not going to deliver the same quantity of benefits as they would have under a full economic life. This is a new problem for the existing generation of road bridges.

Some fifty years ago many of the early road bridges were built as single lane bridges (for example, the old bridge at Gelincik). But fairly quickly (i.e. in twenty five years) most of these bridges became functionally inadequate as traffic volumes increased. In a similar manner the traffic growth in Turkey is enforcing a dualling of many main roads, and indeed for some routes, motorways will become the norm. But as a road switches from a single carriageway to a dual carriageway, so its road bridges in fact are able to increase their ultimate capacity (two lanes in one and the same direction, as opposed to two lanes, one in each direction) and so they are able to deliver more benefits, thus making their maintenance particularly worthwhile.

Except where motorways are likely to be built (or indeed where there may be road realignments) the two lane bridge is likely to remain functionally adequate for some considerable time, especially as it is adapted to a single direction in both lanes. This contrasts completely with the early post-war generation of bridges many of which were single lane bridges. In these current circumstances the case for an increased maintenance budget for the road bridges is greatly strengthened.

The OECD has tried to press the case for a minimum budget for periodic and routine maintenance being around 0.5% of the capital cost of the bridges.

In order to make the case for the appropriate level of maintenance budget it is essential to have a continually updated inventory of the stock of assets, their costs of replacement and thus the capital value of the assets, and the likely year of replacement.

Table - 8.4.1 Level of Bridge Management Systems

Level	Characteristics
1.Simple Inspection Records are kept.	Inspection records are kept, and observations are made on the condition of the bridges. Decisions on maintenance, rehabilitation and replacement are based upon the experience and opinion of several engineers. Essentially, this is the system used in Turkey.
2. Priority Ranking Systems are developed.	A number of quantifiable bridge characteristics are combined in order to reach a sufficiency or deficiency rating which describes the performance of the bridge. The priority ranking system allows priority lists of bridges to be drawn up, and allows programmes of maintenance, rehabilitation and replacement for priority bridges to be prepared.
3. Project Level Optimisations take place	Here, at the project level a variety of alternatives can be evaluated for the individual bridge. Such an evaluation means that more sophisticated data is collected about the project such that an optimisation procedure can be followed for an individual project. These optimisation procedures will usually take into account the total life cycle concept (whole-life costing).
4. Network Level Optimisation	Essentially, this is what is now meant by a Bridge Management System (BMS). Not only can alternatives be considered for individual projects but also alternatives can be traded off between different projects within the bridge network. It means that a considerable amount of sophisticated, and immediately comparable information is available for most, if not all, of the bridges in the network.

Chapter 9

Environmental Study

Chapter 9 Environmental Study

9.1 General

9.1.1 Objectives

In performing this bridge maintenance and rehabilitation study project, the Environmental Study is to be carried out in accordance with the environmental policy of Turkey and JICA Guidelines which provide the following principal objectives:

- identify all possible impacts that may be caused
- minimize damages on natural conditions and circumstances
- protect biological resources and eco-system
- prevent or minimize negative effects anticipated, and
- promote sustainable development in the country

9.1.2 Environmental Laws and Administration in Turkey

1) Laws and Regulations

The Environmental Law was enacted in 1983 for prevention of air and water quality contamination as well as providing fundamental regulations to control noise and solid waste. Following the enactment of the Environmental Law, the following regulations were passed in turn:

- The Environmental Pollution Prevention Fund Regulation (1985)
- The Air Quality Regulation (1986)
- The Noise Control Regulation (1986)
- The Regulation concerning the Establishment of Guilt in Fines to be Levied on Ships and other Marine Vessels
- The Procedures for Levying Fines and Receipts to be Issued (1987)
- The Water Pollution Control Regulation (1988)

And in February 1993, the Environmental Impact Assessment (EIA) Regulation was enacted, which placed all projects under an obligation to implement EIA and obtain Ministry of Environment (MOE's) approval. Not only EIA, the Regulation also stipulates pre-EIA projects and formats to be submitted.

Meantime, a bill has been submitted to the Parliament to further strengthen the Environmental Law enacted in 1983. Imposing more severe penalties is the major objective in strengthening this law.

The Air Quality Protection Regulation shows the guideline for controlling exhaust gas of every type. The Turkish Standard TS-4236 and TS-5648 stipulate the standard valued of exhaust gas from automobiles and methods of testing. However, automobile inspection system is not established nor the exhaust gas checked.

For noise control, basic criterion is set at 35-45 dBA and stipulated by zone definition. Regulation is also provided for each waiting hour (06:00-19:00-22:00). The maximum noise level is decided for each vehicle type but definite standards are not available for methods of measurement and evaluation.

2) Administration

The Department of Environment was first established in 1978 as an undersecretariate to the Prime Ministry. It functioned as a simple coordination body but was established as the Ministry of Environment (MOE) in 1991. MOE has now about 600 staff with 3 General Directorates - Environmental Protection, EIA and Pollution Control and Prevention. A further 33 Area Directorates of Environment are established under the jurisdiction of Governors.

General Directorate of Highways (KGM) has the Environment Division (ED) as its division responsible for environment. It belongs to the Department of Survey and Design. The environment Committee was set up within KGM 8 years ago but ED was only officially established in April 1995. At present, ED is operating with only staff in the fields of engineering, archaeology and biology under the control of the Division Director. In the future, it will be composed of 40 staff operating under the Director.

3) EIA Procedure

By the Environmental Impact Assessment Regulation enacted in 1993, all the departments responsible for projects are obliged to conduct environmental study and obtain approval from MOE. For KGM responsible for highway and bridge projects, however, there are some differences between new construction and, repair and rehabilitation. Direct application to MOE is required for new construction and implement EIA regardless of its size, as shown in Figure - 9.1.1. For repair and rehabilitation, basically Initial EIA (IEIA) only is required to implement according to the formats as stipulated by the EIA Regulation (1993) and as shown in Figure - 9.1.2. Then, projects could be commenced in principle after obtaining approval of Provincial Directorates.

9.1.3 General Environmental Characteristics of Turkey

1) Geographic Conditions

This piece of land of 779,000 square kilometers, located between Europe and Asia, serves as a bridge between three continents, and is surrounded on three sides by seas with substantially different characteristics. A large variety of climatic zones coexist due to its topography.

In today's Anatolia there exists a rainy, humid and mild climate in the North, especially north of the Black Sea mountain range; a type of Siberian climate with cold and dry winters in the East; a hot and dry, desert-like climate in the Southeast; a climate with hot and dry summers and cold and snowy winters in the interior regions; and a Mediterranean climate with hot and dry summers and rainy winters in the West and Southwest.

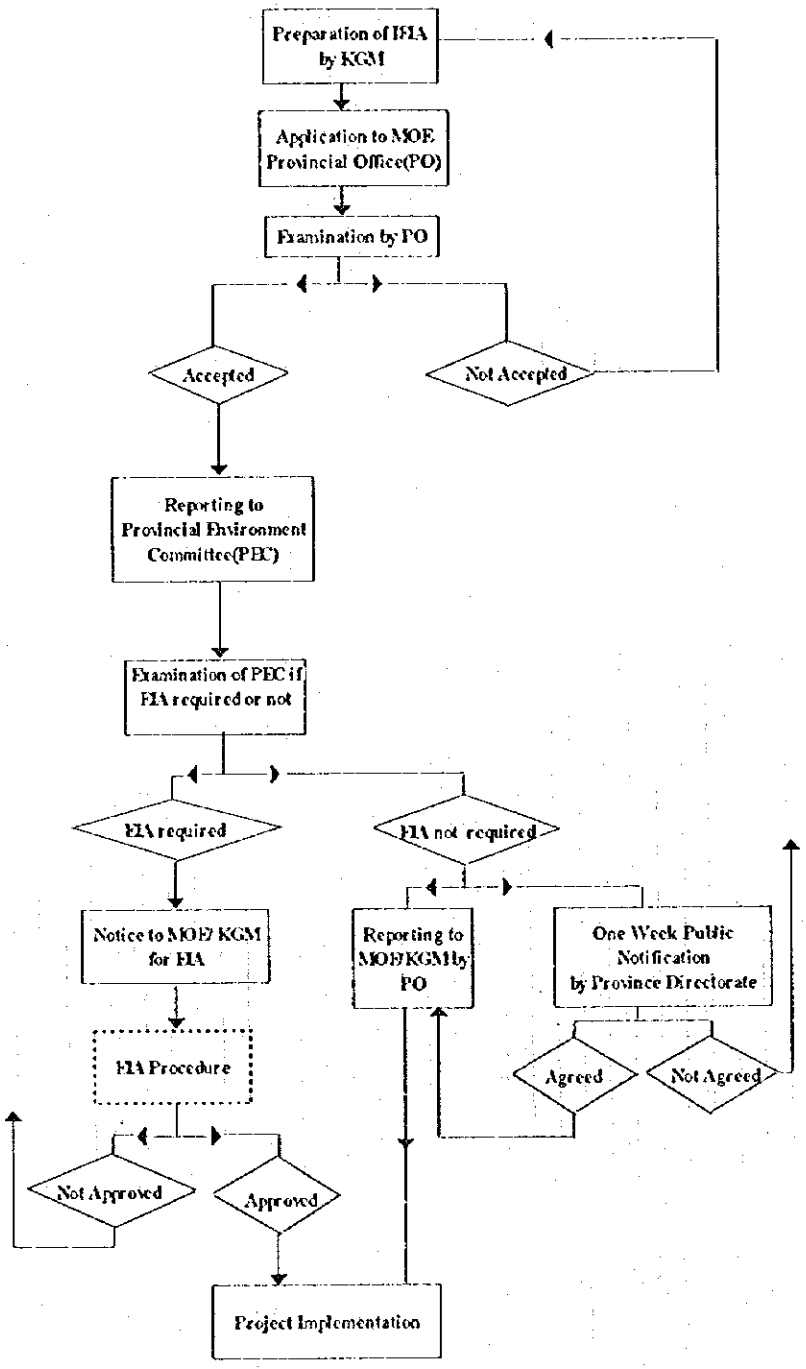

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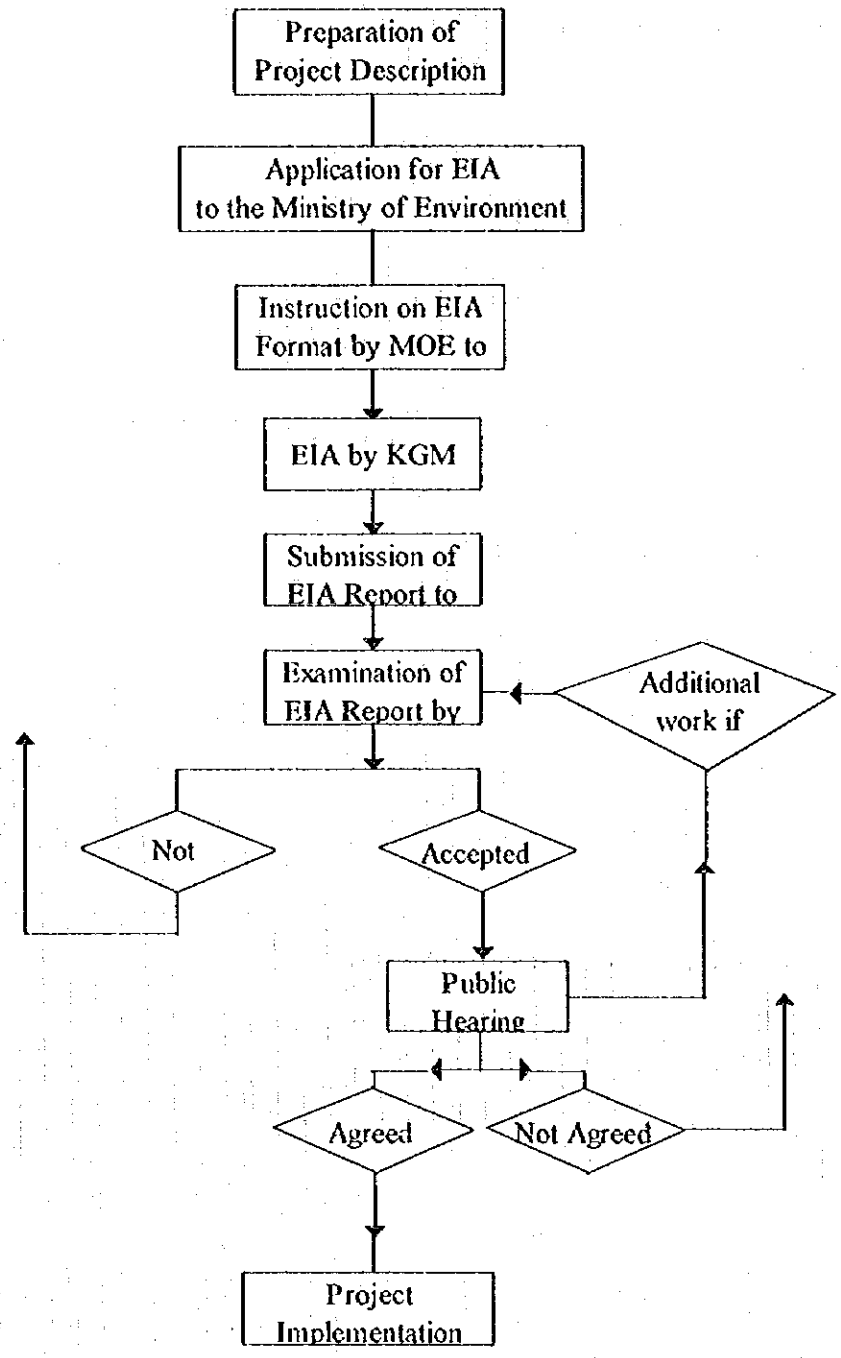
Figure - 9.1.1

Flow of Initial-EIA Procedure for Highway Projects



THE STUDY ON THE MAINTENANCE AND REHABILITATION of HIGHWAY BRIDGES in THE REPUBLIC of TURKEY AUGUST, 1996 ORIENTAL CONSULTANTS COMPANY LIMITED in association with JAPAN OVERSEAS CONSULTANTS COMPANY LIMITED	Figure - 9.1.2 Flow of EIA Procedure for Highway Projects

Turkey is, and has been for a long time, located in the Palearctic zone. For this reason, its current bio-geographic composition and structure may be seen as representative of Palearctic flora and fauna. However, especially in the Southeast and the East, the influence of oriental and Ethiopic (African) elements are observable although this influence diminishes as one goes north.

In the Northeast, there are examples of cold steppe and even Siberian species. Mountains transversing Anatolia and the impact of this geography on the evolution of living things:

There are a number of mountain ranges in Anatolia which constitute effective barriers against the geographical diffusion of living things, which therefore become significant in geo-zoological analyses.

The most important of such barriers are the eastern Taurus mountains, which separate the southeastern Anatolian region from eastern Anatolia, with its cold and dry steppe characteristics; the western Taurus Mountains which separate the Mediterranean littoral with its Mediterranean climate from the interior region of Anatolia with its dry, steppe climate; the Black Sea range which separates the mild and rainy Black Sea coastline from the dry region of the interior and from the cold and dry eastern Anatolian steppes; a series of mountains which cut across Anatolia laterally (Binbo-ga, Munzur, Kargasekmez Mountains, etc.) that constitute the Anatolian diagonal and separate eastern Anatolia from western and Central Anatolia, and, in fact, divide the European continent at its southern limit from all of Asia and Africa.

The Bosphorus and the Dardanelles also constitute effective obstacles to the diffusion of land and fresh water animals. Of secondary importance are the partial barriers constituted by Dinar Baba Dag, etc. which divide the Aegean region with its Mediterranean climate and Central Anatolia characterized by its dry steppe climate.

2) Present Conditions of Environmental Conservation in Turkey

Turkey is surrounded on three sides by seas. The Black Sea on the north, which had until recently been a rich environment for sea life, is unfortunately in the process of rapid decay, due in part to the pollution from the less developed littoral countries, but especially because of the industrial waste deriving from central European discharges into the Danube, which the river deposits into the Black Sea.

The Marmara Sea which connects the Black Sea with the Mediterranean is also rapidly losing its viability due to urbanization and industrialization on its coastline.

The Aegean Sea on the West continues to remain clean despite some local pollution such as the area near Izmir.

The Eastern Mediterranean Sea still preserves its environmental cleanness and species diversity, although this diversity is not as great as in other regions.

Turkish Governments have come to the understanding that the preservation of natural ecology in Anatolia, and thereby the environmental conservation of many species in their natural habitat such as animals, birds, natural forests, other vegetation etc., is of most importance.

Fore the said purposes the following laws and treaties are enacted;

- National Parks Law
- Forest Law
- Land Hunting Law
- Aquatic Products Law
- Law to Protect Cultural and Natural Resources
- Decree-Law on Special Environmentally Protected Area
- International Treaty concerning the Protection of Birds
- Treaty to Protect European Wild life and its Habitats
- RAMSAR Convention

3) Nature Preservation

The followings are the main categories to protect biological diversity in Turkey.

a) National Parks

The first national park in Turkey was established n 1958. Since then their numbers have increased to twenty-one. Some of these parks, which were initially established for archeological and historical purposes are at the same time rich habitats where biological diversity is being protected.

The regional distribution of national parks is as follows: Mediterranean-6, Central Anatolia-5, Marmara-3, Black Sea-3, Aegean-2, Eastern Anatolia-2. Their surface areas vary between 64 hectares (Kuscenneti National Park) and 69,800 hectares (Olympos-Bey reached 400,000 hectares. Within a year 8 new national parks will be nominated by the declaration. The number of national parks will go up from 21 to 29 with 555,000 hectares.

Although the majority of the national parks are found in forest lands, there are also a number which are established in areas where steppe-type vegetation predominates .

b) Nature Reserves

In addition to national parks, 23 nature preserves were designated between 1987 and 1991. Most of these nature preserves are smaller in area than national parks, which allows for their enclosure and leads to more effective protection. All the nature preserves have been designated as such due to various biological characteristics.

c) Special Areas of Environmental Protection

By means of legislation adopted in 1990 Turkish Government have taken under protection twelve areas and have granted these the status of Special Areas of Environmental Protection. These areas have been selected not so much for their biological characteristics but in order to prevent tourism and construction from encroaching on their natural beauty; Among these Mugla-Koycegiz-Dalyan area has been brought under protection because it is the habitat where Caretta caretta (sea turtle), which has recently become the focus of world public attention, lay their eggs. Pamukkale is under protection because of its world famous calcareous sediment; the Ihlara Valley, due to its historical significance as one of the earliest dwelling places of Christians and because of the presence of churches and temples containing paintings and frescoes.

d) Wetland

Wetlands are of enormous importance both in ensuring the ecological balance and in preserving biological diversity. Turkey is the richest country of Europe and Middle East as far as the wetlands are concerned, as these wetlands have a crucial importance for the water birds also on the birds' migrating route between the Europe, Asia and African continents.

According to the International Criteria, there are 19 A Class Type wetlands in Turkey. Eleven of the 19 A Class type wetlands which contain more than 25,000 birds at the same time are under the protection of Ministry of Forest and there is a great increase in the number of the bird population.

e) Other Protection Measures

In addition to the various areas of environmental protection cited above, there are also enclosed zones of smaller scale which are under protection. These serve to protect some animal species which are either rare in Turkey or in the world, or face the danger of extinction. These animals are preserved and bred under special care and some are released into nature when their populations reach a certain level. There are forty such areas of animal protection and they are located in all regions of Turkey. Below is a partial list of the animals which are under protection in these areas.

Fallow Deer, Roe Deer, Bald Ibis, Pheasant, Frankolin, Partridge, Deer, Wild Goat, Water Fowl, and Wild Sheep (mouflon)

9.1.4 Methodology for Environmental Consideration

1) Basic Concept of JICA Guideline

JICA's basic principles with regard to environmental consideration, are to promote sustainable development aimed at improving the living standard of the residents, and harmonize the development with a desirable environment based on the country's willingness.

If environmental consideration is not sufficiently undertaken for implementing a development project and, if careful attention is not paid to the management of the surrounding natural resources, the base of the development might be jeopardized and the development might be halted. The base of the people's livelihood or even their subsistence can be also threatened. It is necessary, therefore, to try to ensure the sustainable development by harmonizing the development project with natural resources and the base of livelihood and subsistence of the residents in the area.

When undertaking the environmental consideration, it is necessary to take into account of the developing country's policies and structures and to understand the country's awareness of environmental problems, while holding sufficient discussions with the people concerned in a flexible manner.

The process of environmental consideration in a project cycle is shown in Figure - 9.1.3. A development project begins with its finding and formulation. At each stage of the cycle, a series of environmental considerations, such as a preliminary environmental survey, an initial environmental examination (IEE), environmental impact assessment (EIA), and the design of environmental protection measures take place. Environmental monitoring is then conducted with project implementation. Through this process, sustainable development can be attained.

Definition of the environmental management plan mentioned here is limited to the monitoring system which handles the environmental impacts caused by the project.

Table - 9.1.1 illustrate the time flows corresponding to the project implementation stages and the environmental consideration stages. The flows start with an environmental survey, followed by the EIA, proceed to the examination of environmental conservation measures, and then to the monitoring stage.

It is necessary to understand the casual relationships between the environmental items and the project related activities during the construction and operation periods. Table - 9.1.2 shows a comprehensive matrix covering 13 sections of social and economic infrastructure development projects.

2) Environmental Consideration for Road (Bridge) Projects

- Definition of Road (Bridge) Projects in the Guidelines
  Road projects in the guidelines deal with the construction and operation of the roads for vehicular traffic and the large-scale rehabilitation and operation of existing roads.

- Typical Possible Impacts and the Points of Environmental Consideration Typical impacts by road projects are described below. Particular consideration of these impacts is necessary.

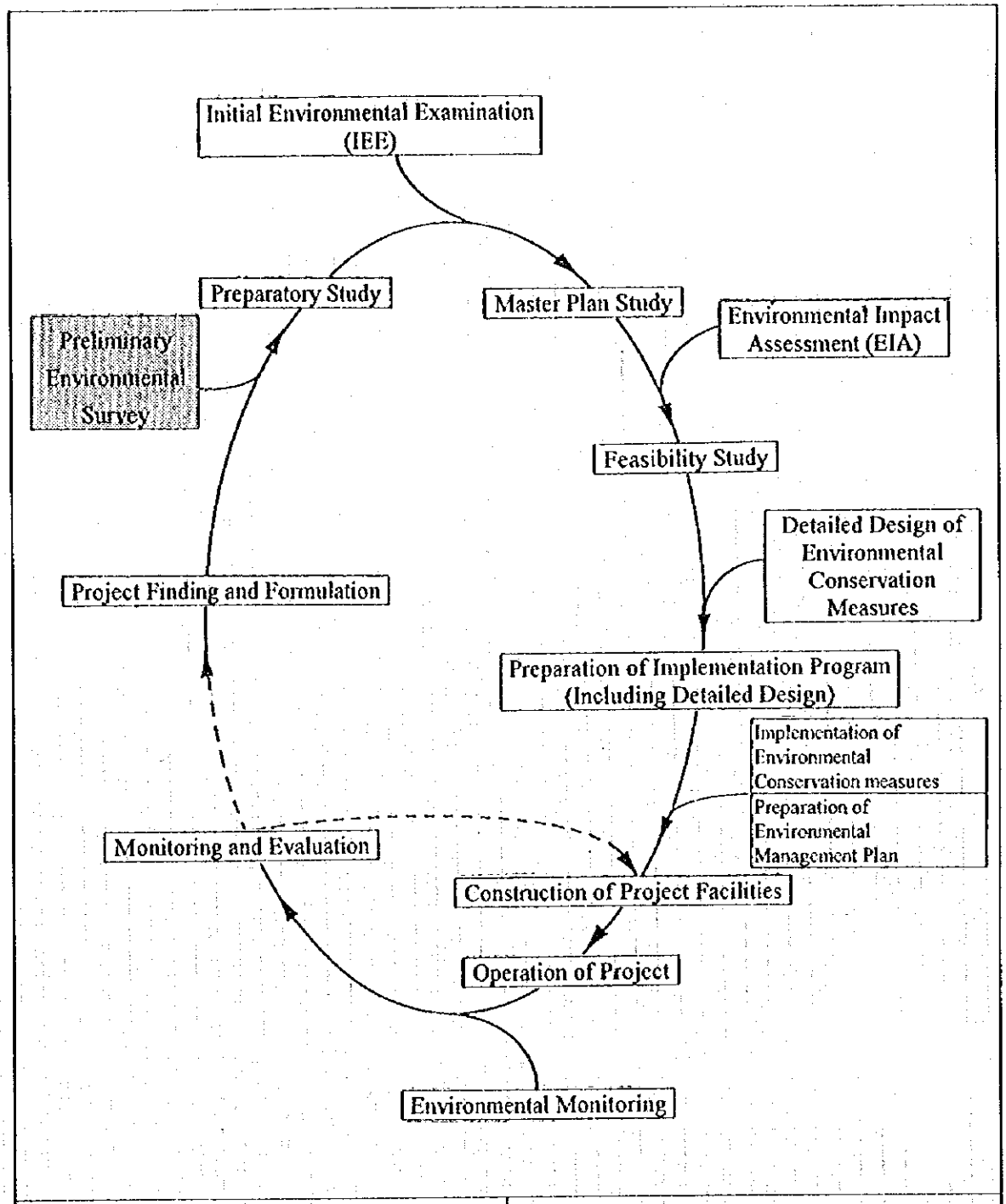


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Figure - 9.1.3

Flow of Environmental Considerations in Project Cycle

Table - 9.1.1 Project Implementation Stage and Corresponding Environmental Consideration Stage

<table>
<tr><td colspan="4">Project Implementation Stages</td><td>Environmental Consideration Stages</td></tr>
<tr><td colspan="4">Preparatory Study</td><td>Preliminary Environmental Survey</td></tr>
<tr><td rowspan="2">Implementation by JICA</td><td rowspan="2">Full-scale Study</td><td>Master Plan Study</td><td rowspan="2">Feasibility Study</td><td>Initial Environmental Examination (IEE)</td></tr>
<tr><td>Feasibility Study</td><td>Environmental Impact Assessment (EIA)</td></tr>
<tr><td rowspan="3">Implementation by Executing Agency</td><td colspan="3">Preparation of Project Implementation Plan (Including Detailed Design)</td><td>Examination of Environmental Conservation Measures</td></tr>
<tr><td colspan="3">Project Construction</td><td>Implementation of Environmental Conservation Measures</td></tr>
<tr><td colspan="3">Project Facility Operation</td><td>Environmental Monitoring</td></tr>
</table>

Notes:
1. This table does not indicate strict correspondence.
2. Some projects do not require IEE or EIA
3. Preparation of the project implementation plan includes the detailed design of the environmental conservation facilities and their construction
4. The item enclosed in a separate box indicates the major boundary for the guidelines.

Resettlement

People living on the project site would be relocated due to land acquisition for road construction. Loss of livelihoods of inhabitants, difficulty in social and cultural adaptation in the resettled site may occur.

Conditions of the inhabitants to be resettled and the resettlement site should be investigated in environmental consideration.

Fauna and Flora

Animals habitats would be lost by the removal of vegetation for road construction. Breeding, plant life and animals would be affected by exhaust gas and noise caused by vehicles after construction. Migration routes and habitat areas could be interrupted by road facilities. Also, reduction of water area, and stemming and diversion of

Table - 9.1.2 Comprehensive Matrix

		Project Type / Sectors / Environment Items	Sectoral Development									Comprehensive Development			
			1. Ports and Harbors	2. Airports	3. Roads	4. Railways	5. River and Erosion Control	6. Solid Waste Management	7. Sewerage	8. Groundwater Development	9. Water Supply	10. Regional Development	11. Tourism Development	12. Transportation Development	13. Urban Transportation Development
Social Environment	1	Resettlement	◎	◎	◎	◎	◎	○	○		○	○	○	○	○
	2	Economic Activities	○	○	○	○						○	○	○	○
	3	Traffic and Public Facilities	○	○	○	○	○	○				○	○	○	○
	4	Split of Communities		○	○	○	○					○	○	○	○
	5	Cultural Property	○	○	○	○	○					○	○	○	○
	6	Water Rights/Rights of Common	◎	○	○	○	◎			○	○	○	○	○	
	7	Public Health Condition				○		○				○	○	○	
	8	Waste	○	○	○	○	○	○	○			○	○	○	○
	9	Hazards (Risk)	○	○	○	○						○	○	○	○
Natural Environment	10	Topography and Soil Condition	○	○	○	○	○					○	○	○	
	11	Soil Erosion		○	○	○						○	○	○	
	12	Groundwater			○	○		○		◎		○			
	13	Hydrological Situation	○	○	○	○	◎	○			○	○	○	○	○
	14	Coastal Zone	◎	○	○	○	○	○				○	○	○	
	15	Fauna and Flora	◎	◎	◎	◎	◎	○	○		○	○	○	○	○
	16	Meteorology										○		○	
	17	Landscape	○	○	○	○	○	○	○		○	○	○	○	○
Pollution	18	Air Pollution	○	○	◎			◎	○			○		○	○
	19	Water Pollution	○	○	○	○	○	◎	○	○	○	○	○	○	
	20	Soil Contamination	○		○			○						○	○
	21	Noise and Vibration	○	◎	◎	◎	○	○	○	○	○	○	○	○	○
	22	Ground Subsidence								◎					
	23	Offensive Odor	○					◎	○			○		○	

Note: ◎: The environmental items to which special attention has to be paid
They might cause serious impacts that may affect the project formulation depending on the magnitude of the impacts and the possibility of the measures.

○: The environmental items which may have a significant impact depending on the scale of project and site conditions

No mark: The environmental items requiring no impact assessment since the anticipated impacts are, in general, not significant.

In case of the comprehensive development projects, all the items are classified in ○, because their studies are usually at the master planning stage and the extent of impacts are not clear.

water courses by construction of revetment banks and piers for bridges are possible impacts on water system for ecology. Commencement of road operations would bring an increase of immigrants who would change the forest along the route into cultivated land thereby disrupting the habitats and environment.
The above impacts would cause a decrease in the number of valuable species or the extinction of predatory species that would result in the degradation of biodiversity.
The decrease and extinction of predatory species and other species could result in an outbreak of other species, especially pests and pathogenic insects.
The value of plants and animals and the ecological features of the site, as well as the social concern for plants and animals, should be studied thoroughly.

Air Pollution
Exhaust gas and dust from construction equipment and vehicles during the construction stage and exhaust gas from vehicular traffic after the commencement of operations would cause air pollution.
The health of inhabitants and plants and animals would be affected. If the volume of exhaust gas is enormous, sulphur oxides and nitrogen oxides may contribute to acid rain; carbon monoxide and dioxide may contribute to global warming.
In urban areas, the effect of soot, carbon monoxide, nitrogen oxides and sulphur oxides must be considered carefully.

Noise and Vibration
During the construction stage, the operation of construction equipment and detonations would create noise and vibration. During the operational stage, vehicles could cause noise and vibration. Noise would affect facilities requiring particular tranquillity, such as hospitals and schools, disturb sleep at night, interfere with the breeding of livestock and cause the dispersion of wildlife.
Highly populated areas, e.g., urban areas, and areas having specific religious facilities, need special consideration.

9.2 Initial Environmental Examination (IEE)

9.2.1 Introduction

The Initial Environmental Examination (IEE) for the Study on the Maintenance and Rehabilitation of Highway Bridges in Turkey was performed between September and October 1995. This IEE has been carried out in line with the Environmental Guidelines for Infrastructure Projects-III Road prepared by JICA together with consideration of Environmental rules in Turkey. This IEE is based on site visits to the project locations and related areas, meeting and discussion with representatives of related sectors, review of documents, regulation and data concerning the project.

9.2.2 Description of the Project (PD)

1) Background

The General Directorate of Highways within the Ministry of Public Works and Settlement of the Republic of Turkey (hereinafter referred to as "KGM") is responsible for the maintenance and operation of around 60,000 km of national highway network, which includes more than 3,000 bridges. More than ninety percent (90%) of the highway bridges are concrete bridges which were designed and constructed more than twenty-five years ago with low axle load capacity.

Due to the occurrence of severe cracks, joint and bearing deformation, concrete deterioration, and being subjected to higher axle load than envisaged (for the freight routes), it will be necessary for a programme of detailed investigation and remedial measures to be implemented for the safety of these bridges.

In view of the increasing number of bridges being "come of age", it is anticipated that systematic inspection, maintenance and rehabilitation shall be required. These improvement activities are required to be carried out promptly as well as appropriately and efficiently under limited funds and staff.

2) Objectives

The objectives of the study are:

a) to provide an overall information of highway bridges by means of visual inspection survey of object bridges located on arterial study roads.
b) to formulate rehabilitation plans for typical damaged highway bridges.
c) to prepare manuals of bridge inspection, evaluation, maintenance and rehabilitation.

The Study covered 207 bridges totally on arterial roads which connect Ankara, Izmir, Rize, Bursa and Antalya. Firstly, visual inspection was performed on 207 bridges from which 20 bridges were chosen for detailed inspection. Finally, 10 bridges were selected for preliminary design

Table - 9.2.1 Selection of Objective Bridges for Preliminary Design

No.	Bridge Name	Division NO.	Bridge Length (m)	Traffic Volume	Objective Bridge
1)	Buca Ust Gecit	2	330	18,090	●
2)	Hilal-II	2	347.8	18,090	●
3)	Hudut-I	2	40.4	5,569	
4)	Polsuk	4	48.2	5,638	
5)	Babadat	4	25.2	7,322	●
6)	Selyeri	7	21.7	5,249	●
7)	Akcay	7	106.90	8,003	●
8)	Merzifon	7	36.25	2,964	
9)	Ust Gecit II	7	20.50	2,964	
10)	Pasa Pinar	7	26.60	2,964	
11)	Koparan-II	7	27.45	3,331	●
12)	Hacimusa	7	16.40	3,331	
13)	Asagi Cakalli	7	71.55	7,537	●
14)	Harsit	10	248.50	5,184	
15)	Topalli	10	57.75	3,955	
16)	Degirmendere	10	90.80	6,413	
17)	Gelincik	10	32.50	4,775	●
18)	Solakli	10	216.90	4,775	
19)	Sardere	13	43.15	5,729	●
20)	Candir Hasanpasa	14	113.85	9,454	●

3) Location

Location of 20 bridges for detailed inspection are shown in Fig - 9.2.1.

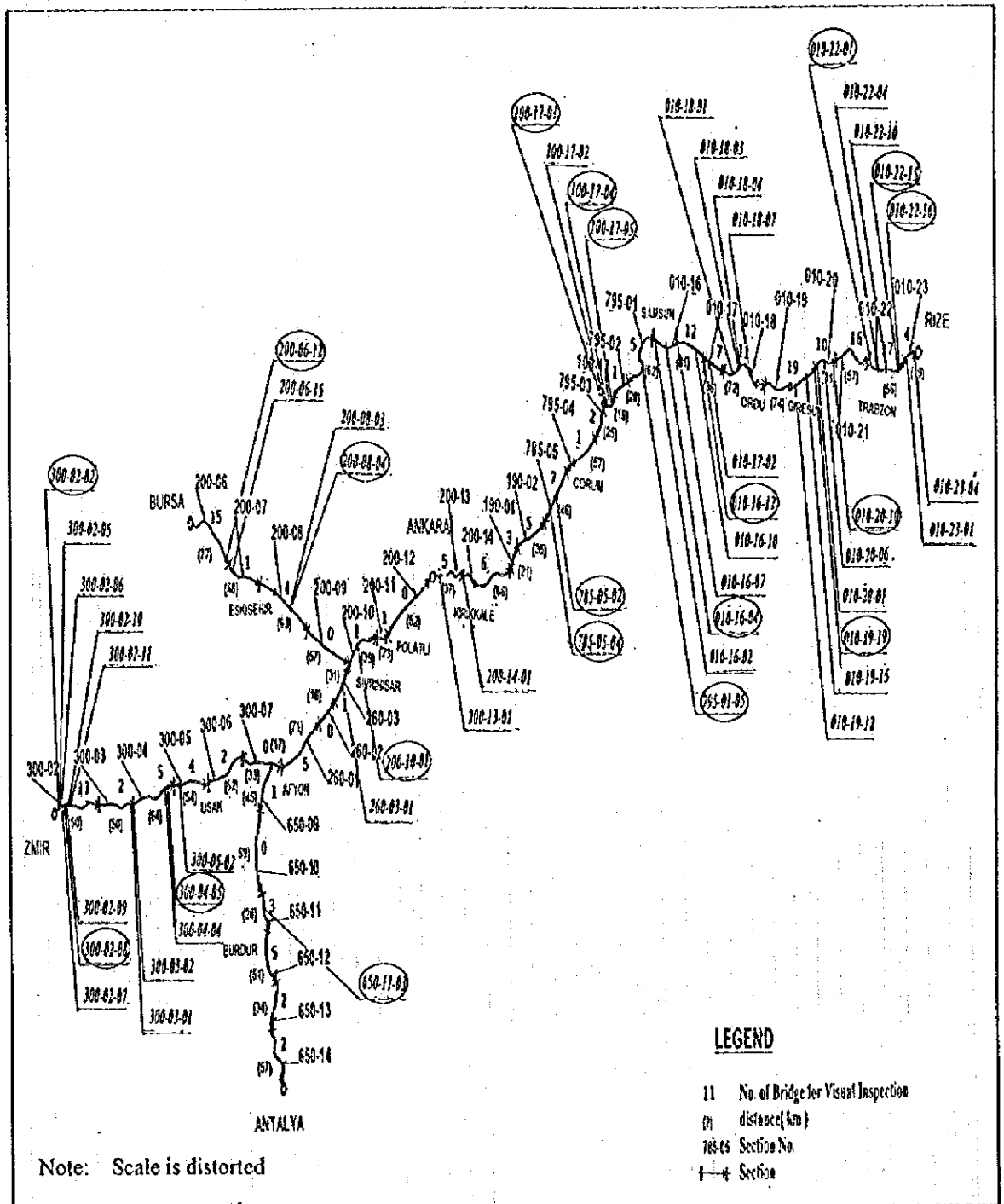
9.2.3 Description of the Site (SD)

1) Site Survey

For each selected bridge site, site survey was conducted using INSPECTION SHEET attached as a sample Fig - 9.2.2 (See Appendix 7). All survey results are summarized and presented in Fig - 9.2.3 accordingly.

2) Environmental Characteristics of the Project Area

Detailed inspection was carried out for 20 bridges whose sites conditions are largely classified as being in the Black Sea coastal area, inland area and around Izmir City. In a narrow belt zone between the Black Sea and the North Anatolia high mountain, a high density of population and settlement could be found along the coast. The inland area is generally flat with the majority of areas having a sparse population. The two bridges in Izmir are located in the city. These are further discussed below item by item.



Note: Scale is distorted

THE STUDY ON THE MAINTENANCE AND REHABILITATION of HIGHWAY BRIDGES in THE REPUBLIC of TURKEY AUGUST, 1996 ORIENTAL CONSULTANTS COMPANY LIMITED in association with JAPAN OVERSEAS CONSULTANTS COMPANY LIMTED	Figure - 9.2.1 Location of Candidate Bridges for Detailed Inspection

Date: October 10, '95	Time: 15:40	Weather: Fine	
Bridge Name: Candir Hasanpasa		Bridge No: JYB-200-06.12	
KGM Division No.: Div. 14		Area: Bursa	
Traffic Volume	Heavy, Medium, Light, Scarce	Approach Gradient: Ak Hat	
Land Use	Urban, Suburban, Rural, Farming, Others		
Topography	Plain, Hilly, Mountainous, Valley, Coastal		

			Left Bank	Right Bank
Environmental Conditions	a)School, b)Hospital, c)Mosque, d)Cemetery, e)Historical relics, f)Others	Down Stream	—	—
		Up Stream	—	—
	a)Office Building, b)Apartment Building, c)Houses, d)Shops, e)Factories, f)Others	Down Stream	—	e)Sand
		Up Stream	e)Sand	—
	a)Forest, b)Trees, c)Barren, d)Desert, e)Wild animals, f)Birds, g)Others	Down Stream	b	b
		Up Stream	b	b
	a)Swampy, b)Grass, c)Fish, d)Birds, e)Insects, f)Others	Down Stream	—	—
		Up Stream	—	—
	Farming: a)Fruit Trees, b)Cereals, c)Vegetables, d)Live Stocks, e)Others	Down Stream	—	d
		Up Stream	d	—

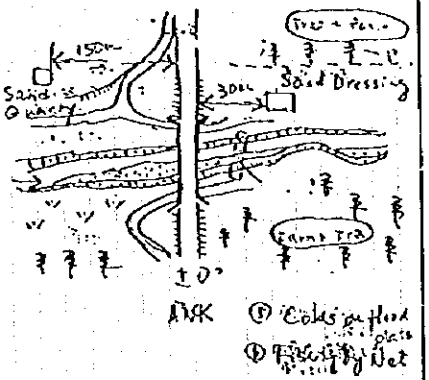
River and Ground Conditions

Water Clearness: Clear, opaque, muddy, brown, mix-sewage, no water. Dry season

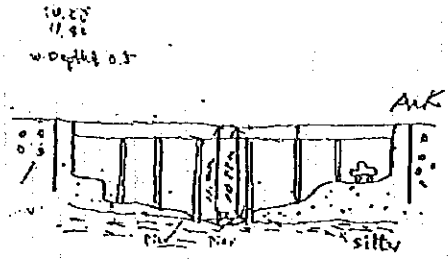
Riverbed Material: Silt and clay, sandy, gravel, rock, solid waste.

Current Velocity: Fast 7m/s m/sec | Scouring: Piers

Plan & Outcrops



Section of Topography, River & Geology



Remarks:
1. Sand quarrying at up-stream
2. Fast current by broken wier
3. Pier Scoured badly
4. Riverbed scouring

THE STUDY ON
THE MAINTENANCE AND REHABILITATION of HIGHWAY BRIDGES in THE REPUBLIC of TURKEY
AUGUST, 1996
ORIENTAL CONSULTANTS COMPANY LIMITED
in association with
JAPAN OVERSEAS CONSULTANTS COMPANY LIMITED

Figure - 9.2.2

Inspection Sheet Environmental and Natural Conditions

Distribution of mosques and schools
In the Black Sea area, mosques are densely distributed near the bridges but hospitals and schools are sparse.

Houses and public transport facilities
The sizes of 1-7 storied houses are distributed near the bridge sites of the Black Sea area. Most of the houses are more than 2 stories and the buildings of 4-storied or so are conspicuously found in city areas. Several cases are also found in which bus terminals are located near bridges in city area.

Conditions around bridges and rivers
Many houses are located around bridges over the rivers in the coastal zone of Black Sea. Untreated sewerage flows from those houses into rivers which deteriorates the water quality. Some rivers give out offensive odor. Waste is dumped in riverbed at many areas. Some places under abutment are used for hacking meat into pieces.

River Flow shape around the River Mouth
No distinctive features are found at the inland area and Izmir but the following 3 types could be classified for stream shapes around the river mouth flowing into Black Sea.

a) a case which abruptly meanders towards the east at the river mouth and flows into the Black Sea
- These cases were seen at many places around the river mouth between Rize and Trabzon but with less discharge.

b) a case which abruptly meanders towards the west at the river mouth and flows into the Black Sea
- These cases were seen at many places around the river mouth passed by Trabzon and near Samson but with less discharge again.

c) a case which directly flows into Black Sea
- A case where much discharge is confirmed. These are considered to be caused by the sea current of the Black Sea and wind direction. Velocity of river current at the Black Sea area was relatively fast and those of more than 1.1w/sec. were confirmed at nearly 30 places. At many bridge location on the inland area the river bed was dry.

Topography around bridge sites
The road gradient is increasing sharply in case of entering into the plateau inland area from coastal zone. But bridge sites are not located in places where the road gradient is conspicuously steep. Road gradient is flat in many places. The maximum gradient is 2-3 degree for up and down.

Soil and geological conditions at bridge sites
The foundation ground at bridge sites are classified into cohesive soil, sandy and gravelly soil and rocks. Rocks were observed at 3 sites and sandy and gravelly soil were found at many locations.

No.	Bridge No.	Bridge NAME	ENVIRONMENTAL															Remarks
			School	Hospital	Mosque	Cemetery	Houses	Forest Trees	Farm Pasture	Varies	Animal Fish	WATER CLEARNESS	CURRENT VEL.	water depth (m)	Geology	Noise	GARBAGE	
1	AI-300-02-2	BUCA UST GECIT	-	-	-	-	◎	-	-	-	-	-	-	-	R	◎	-	Fly-over on slope of hill
2	AI-300-02-3	HILAL-I-SAGUST G.	○	-	○	-	◎	-	-	-	-	BW	SLW	0.5	C+S	◎	◎	Sewage Water
3	AI-300-05-5	HUDUT I	-	-	-	-	-	-	○	-	-	-	-	0	S	-	-	River Dry Up, Farm Land, Basin Top
4	SB-300-08-4	PORSUK	-	-	-	-	○	○	-	-	-	OP	FST	0.5	C	◎	◎	Sewage Water
5	AA-200-10-1	BABADAT	-	-	-	-	-	○	○	-	-	CL	SLW	0.3	C+S	-	-	Trees along The River
6	AR-810-16-4	SELIYERI	-	-	-	-	○	○	○	-	-	MD	FST	0.5	C+S	○	-	Suburb
7	AR-810-16-12	AKCAY	-	-	-	-	-	○	○	-	-	MD	SLW	1.0	S	-	-	Near Coast
8	AR-100-17-1	MERZIFON	-	-	-	-	○	-	○	-	-	-	-	-	S	-	-	Fly-over, Houses, Warehouse
9	AR-100-17-4	UST GECIT II	-	-	-	-	○	-	-	○	-	-	-	-	S	○	-	Fly-over
10	AR-100-17-5	PASA PINAR	-	-	-	-	○	-	○	-	-	OP	FST	0.2	S+(G)	-	-	Upstream Railway, Houses 1F
11	AR-785-05-2	KOPARAN II	-	-	-	-	-	○	○	-	-	CL	FST	0	C+S	-	-	Pastural, Wheat Field
12	AR-785-05-4	HACINUSA	-	-	-	-	-	○	○	-	-	CL	FST	0	C+S	-	-	Pastural, Wheat Field
13	AR-795-01-5	ASAGI CAKALLI	-	-	-	-	○	○	○	-	-	OP	FST	0.2	S+(G)	-	-	Mountainous
14	AR-810-19-19	HARSIT	○	-	○	-	◎	-	-	-	-	MD	FST	1.0	S	○	-	Houses 1F~4F, Factory, Tuff And Mi
15	AR-810-20-10	TOPALLI	○	-	○	-	◎	-	-	-	-	OP	MED	0.3	S	○	-	Coastal
16	AR-810-22-1	DEGIRMENDERE	-	-	-	-	◎	-	-	-	-	MD	FST	0.7	S	○	-	Town, Many Shops and Houses, Near
17	AR-810-22-11	UYVAN SOGUCPINAR	-	-	-	-	○	-	-	-	-	CL	SLW	0.1	S	-	-	Coastal
18	AR-810-22-16	SOLAKLI	-	-	○	-	◎	-	-	-	-	MD	FST	1.0	S	○	-	Town, Coastal
19	AA-650-11-3	SARDERE	-	-	-	-	-	-	○	○	-	CL	MED	0	S+(G)	-	-	Gravel, Wheat Field, Near Lake Bank
20	SB-300-06-12	CANDIR HASANPASA	-	-	-	-	-	○	○	-	-	MD	FST	0.5	S	-	-	Pasture

LEGEND

CURRENT ① SLW-Slow (0.6~0.5m/sec) ② MED-Medium (0.6~1.0m/sec) ③ FST-Fast (1.1m/sec more)

WATER CLEARNESS ① CL-Clear ② OP-Opaque ③ MD-Muddy ④ BW-brown

GEOLOGY ① C-Cohesive ② S-sandy, (G)-Gravel ③ R-Rocks

◎ Dense/Abundant ○ Some - Minimal~Nil

THE STUDY ON
THE MAINTENANCE AND REHABILITATION of HIGHWAY BRIDGES in THE REPUBLIC of TURKEY
AUGUST, 1996
ORIENTAL CONSULTANTS COMPANY LIMITED
in association with
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Figure - 9.2.3

Environmental/Natural Conditions

Table - 9.2.4 Format for Screening

	Environmental Item	Description	Bridge No.																			Remarks
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	
Social Environment																						
1	Resettlement	Resettlement due to land occupancy (transfer of rights of residence/land ownership)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	No new construction nor widening
2	Economic Activities	Loss of bases of economic activities, such as land, and change of economic structure	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	If temporary access diversion are made outside of KGM Lands
3	Traffic and Public Facilities	Impacts on schools, hospitals and present traffic conditions, such as the increase of traffic congestion and accidents	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	Traffic control or diversion required
4	Split of Communities	Community split due to interruption of area traffic	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
5	Cultural property	Damage to or loss of the value of churches, temples, shrines, archaeological remains or other cultural assets	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
6	Water Rights and Rights of Common	Obstruction of fishing rights, water rights, rights of common	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
7	Public Health Condition	Deterioration of public health and sanitary conditions due to generation of garbage an the increase of vermin	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
8	Waste	Generation of construction and demolition waste, debris and logs	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	Minimal volumes only
9	Hazards (Risk)	Increase in risk of landslides, cave-ins and accidents	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
Natural Environment																							
10	Topography and Geology	Changes of valuable topography and geology due to excavation or filling work	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
11	Soil Erosion	Topsoil erosion by rainfall after reclamation and vegetation removal	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	No wide vegetation removal made
12	Groundwater	Change of distribution of groundwater by large-scale excavation	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	No deep excavation
13	Hydrological Situation	Changes of river discharge and riverbed condition due to landfill and drainage inflow	–	O	–	O	–	O	O	–	–	–	–	–	O	O	O	O	O	O	–	O	Minimal for temporary access fill, no water in some rivers
14	Coastal Zone	Coastal erosion and sedimentation due to landfill or change in marine condition	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
15	Fauna and Flora	Obstruction of breeding and extinction of species due to changes of habitat conditions	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
16	Meteorology	Changes of temperature, precipitation, wind, etc. due to large-scale land reclamation and building construction	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
17	Landscape	Change of topography and vegetation due to reclamation. Deterioration of aesthetic harmony by structures	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
Pollution																							
18	Air Pollution	Pollution caused by exhaust gas or toxic gas from vehicles and factories	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
19	Water Pollution	Pollution by inflow of silt, sand and effluent into rivers and groundwater	–	O	–	O	–	O	O	–	–	–	–	–	O	O	O	O	O	O	–	O	In case when temporary access diversion are required, no water in some rivers
20	Soil Contamination	Continuation of soil by dust and chemicals, such as herbicides	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
21	Noise and Vibration	Noise and vibration generated by vehicles	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	Existing Bridges. By Repair Work
22	Land Subsidence	Deformation of land and land subsidence due to the lowerng of groundwater table	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
23	Offensive Odor	Generation of exhaust gas and offensive odor by facility construction and operation	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	No change of road gradient
Overall Evaluation:			O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	Most probably IEE

Animals and birds
In the Black Sea area, no peculiar and precious inhabiting animals are confirmed except that cows and sheeps were put to grazing in the river bed of both upper and down stream sides of bridges. Frogs' cracking was heard very often at this season but broad swamps were not confirmed. On the sandbank under some bridges, 20-30 seabirds were observed gathering.

Fish
For both the Black Sea and inland areas, small signs of fish were seen at some places in rivers but not so many. Casting nets and fishing boats were found at Black Sea around the river mouth.

Trees and Plants
Many areas around bridge sites are used by the people for their living and no precious spieces were confirmed. Fields of "hazel nuts", special products of the agricultural land of the Black Sea area, are largely distributed. Distributions of "cereal" fields are found in the inland area.

Noise and vibration
Traffic noise around bridges in the city is large, even disturbing conversation at several location Vibration caused by automobile traveling is not so large and the human body could not detect it at the roadside on the existing ground.

Water quality etc.
Existing pollution was investigated by visual inspection of the river water colour tone. Clear water was seen but at few places and mostly it was opaque or muddy colour. Most of the rivers in city areas gave out a bad odour.

9.2.4 Screening of Potential Environmental Impact

After site survey and detailed inspection for the selected 20 bridges, the results of screening with respect to potential environmental impact are shown in Fig - 9.2.4 on the format of JICA Guideline.

9.2.5 Results of Initial Environmental Examination (IEE)

Detailed inspection was carried out for 20 bridges from which 10 bridges were selected for preliminary design. These 10 bridges would be repaired or rehabilitated in the future. Construction of new bridges and roads are not required by this project. For repair and rehabilitation, each bridge will have effects upon environment according to its work items. As the results of the study based upon the aforementioned field survey, the following items are considered as environmental effects to be caused by construction:

- economic activities
- waste
- hydrological situation
- water pollution

- noise and vibration

Assessment of these items will be discussed in the next chapter taking into account the preliminary designed construction.

9.3 Environmental Impact Assessment

9.3.1 Description of the Project (PD)

Potential Environment Impacts were screened as the results of IEE. Meantime, 10 bridges were selected for preliminary design according to the detailed inspection of 20 bridges, and as shown in Table - 9.3.1, work items for rehabilitation were decided.

9.3.2 Description of the Site (SD)

SD is as discussed in the Section 9.2.3 Rehabilitation works are not scheduled for bridges as located in such natural preservation areas as important national parks as described in 9.1. 2-3). However, Sardere Bridge in division 13 is situated about 1 km. upper stream of Burdur Lake, one of the wetlands in Class A Type. But the River Sarderesi is usually dry.

9.3.3 Assessment of Environmental Impacts

Assessment of effects has been judged based upon the repair and rehabilitation plan of 10 bridges and in accordance with the Forms stipulated by Turkish EIA Regulation (1993), and shown in Table - 9.3.2.

Overall environment impacts have been assessed by JICA Guideline and shown in Table - 9.3.3. The followings are some explanation for each item.

1) Resettlement

Nature of the project is the rehabilitation of the existing bridges, and most works can be implemented within the present highway boundary of KGM. Therefore, requirement for land acquisition is not anticipated except in case of a temporary access diversion to be constructed at Akcay Bridge in Samson Area where about 1km. temporary detour is planned on shallow water on the up-stream side. Although it crosses a firm and forest land.

2) Economic Activity

Loss of land and change of economic structure are not expected to take place. Rather, there will be temporary benefits only to local residents as they provide food, goods and services to construction workers.

3) Traffic and Public Facilities

In principle, rehabilitation works are executed traffic lane by lane in turn. During the construction of one side, the other side is open to traffic in one way operation controlled by

Table - 9.3.1 Work Items for Rehabilitation of 10 Bridges

No.	Bridge Name	Surface and Superstructure	Substructure	Scaffolding	River Control Works	Traffic Diversion	Traffic Control
1	Buca UG (Izmir) (Slip road westbound only)	Replace of burried joint, Concrete repairs to slab and girder		Usage of Normal scaffolding			○
2	Hilal-II (Izmir) (Dual Carriageway westbound only)	Replace of expansion joint	Concrete repairs to column	Normal scaffolding			○
3	Babadat (Ankara) (Two lane)		Strengthening by wall to pier, Support for structure		Concrete work Fill Material	○	
4	Selyeri (Samsun) (West bound carriageway)	Water Proofing, Concrete repairs to slab and girder Replace of expansion joint		Normal scaffolding			○
5	Akcay (Samsun) (2 lane Gerber Bridge)	Replace of expansion joint Concrete repairs to slab and girder, steel cylindrical bearing, New concrete for girder joint		Normal/Special scaffolding		○	
6	Koparan II (Samsun) (2 Lane)	Concrete repairs to slab and girder	Concrete repairs to abutment and pier	Normal scaffolding		○	
7	Asagi Cakalli (Samsun) (Northbound carriageway)	Water Proofing, Concrete repairs to slab and girder	Concrete repairs to pier and abutment	Normal Special scaffolding			○
8	Gelincik (Trabzon) (2 lane)	Concrete repairs to slab and girder		Special scaffolding			○
9	Sardere (Antalya) (Two Lane)	Concrete repairs to slab and girder. Replace of expansion joint		Normal scaffolding		○	
10	Candir Hasanpasa (Bursa) (Two Lane)	Concrete repairs to slab and girder. Water proofing	Support for Structure Strengthening by wall to column	Normal scaffolding	Concrete work Excavation Fill material Gabion	○	

Table - 9.3.2 Effects on Control Items-Requirement of Turkey EIA Regulation (1993)

No.	Control Item	Bridge No.										Remarks
		1	2	3	4	5	6	7	8	9	10	
1	New Construction	×	×	×	×	×	×	×	×	×	×	Repair & Rehabilitation
2	Earth Work	×	×	△	×	◎	△	×	×	△	○	For temporary access embankment
3	Effect to Flooding	×	×	×	×	×	×	×	×	×	×	
4	Construction Dust	△	△	△	△	△	△	△	△	△	△	By concrete scraping
5	River Works	×	×	△	×	×	×	×	×	×	△	Rather to be Improved
6	Usage of Water	△	△	△	△	△	△	△	△	△	△	In working hours for dust control mainly
7	Solid Waste	△	△	△	△	△	△	△	△	△	△	Scraped concrete and some soil
8	Construction Noise	△	△	△	△	△	△	△	△	△	△	By concrete breaker in scraping
9	Cutting Trees at Road Sides	×	×	△	×	○	△	×	×	×	△	Mostly inside of KGM Lands except No.5
10	Effect to Firming Land	×	×	×	×	○	×	×	×	×	×	Mostly inside of KGM Lands except No.5
11	Danger in Construction Work	△	△	△	△	△	△	△	△	△	△	Ordinary Work
12	Effect to Flora and Founa	×	×	×	×	×	×	×	×	×	×	
13	Others											

◎ Considerable ○ Some △ Minimal × Nil

Table - 9.3.3 Overall Environmental Impacts by the Project

No.	Environmental Item	Impacts	Reason
Social Environment			
1	Resettlement	None	Repair of existing bridges
2	Economic Activities	Positive impact	Temporary benefit by construction workers
3	Traffic/Public Facilities	Minimal	Only during repair work period
4	Split of Communities	None	-
5	Cultural Property	None	Such properties are not observed nor reported nearby
6	Water Rights and Rights of Common	None	Fun fishing by local people only
7	Public Health Condition	None	-
8	Waste	Slight	Small fragments by repair works
9	Hazards (Risk)	None	No slope cut or deep excavation
Natural Environment			
10	Topography and Geology	None	-
11	Soil Erosion	Positive Impact	River Control work at Babadat and Candir Hasanpasa Bridges
12	Groundwater	None	No deep excavation
13	Hydrological Situation	Positive Impact	Smooth flow by river control work same as (11)
14	Coastal Zone	None	No earthwork at coastal bridges
15	Fauna and Flora	Negligible	Roads traverse mostly cultivated area. No nearby Natural Reserves etc. except Sardere.
16	Meteorology	None	-
17	Landscape	None	-
Pollution			
18	Air Pollution	Positive Impact	Due to smooth running by vehicles
19	Water Pollution	Slight	Only during repair works
20	Soil Contamination	None	
21	Noise and Vibration	Positive Impact	More smooth traffic after repairing
22	Land Subsidence	None	-
23	Offensive Odor	None	-

traffic signals or manually. In case that all traffic is to be suspended, a temporary detour shall be constructed. Thus only temporary impacts are expected.

4) Split of Communities

Disruption is not anticipated though with slow traffic closing one lane and also temporary access passage.

5) Cultural Property

There exists no known historic nor cultural sites within the area of influence of the bridges.

6) Water Rights and Rights of Common

Impact on fishing activities will be negligible or minimal.

7) Public Health Condition

During rehabilitation some debris will be generated by construction workers, but they shall be well controlled by supervisors.

8) Waste

There anticipated some waste generated by repair works but those volume shall be minimal.

9) Hazards (Risk)

No landslide nor cave-ins are expected because slope-cuttings will not be done.

10) Topography and Geology

Valuable topography and geology does not exist in and vicinity of the sites.

11) Soil Erosion

No soil erosion by earth work is to be generated. River control works are designed at Babadet and Candir Hasanpasa Bridges but they will act rather positive to prevent soil erosion and (scouring).

12) Ground Water

No deep excavation will be done to disturb flow of ground water.

13) Hydrological Situation

River control work shall act favorably for smooth water flow and maintain the discharge capacity of river.

14) Coastal Zone

No earthwork is planned at bridge sites on the coast.

15) Fauna and Flora

The project roads traverse mostly cultivated areas and will not affect virgin forests and protected areas such as national parks, wetlands and others except Sardere Bridge near Lake Burdur (Wetland). It is judged that impact on fauna and flora will be none or negligibly small due to the nature of this rehabilitation project.

16) Meteorology

No effect is anticipated as no wide earth moving nor tree cutting are planned.

17) Landscape

No change in topography is expected with minimal work for temporary access which shall be removed after completion of repair work.

18) Air Pollution

Improvement is expected in some degree due to rehabilitation work for smooth running of vehicle.

19) Water Pollution

It is anticipated that in-flow of surface water is to be well controlled by repair work.

20) Soil Contamination

Soil will not be contaminated due to no usage of hazardous agents.

21) Noise and Vibration

This rehabilitation work will induce beneficial impacts rather than negative impacts on noise and vibration because the work will greatly improve pavement surface condition.

22) Land Subsidence

No earthwork is to be done to lower ground water table causing land subsidence.

23) Offensive Odour

No additional offensive odour is expected with normal increase of traffic .

9.3.4 Mitigation Measures

As the results of the environmental assessment on the project, the following negative impacts were clarified among 23 items and all are judged to be generated during repair works.

1) Traffic Congestion

The works should be executed side by side in sequence, and one side be always open to traffic controlled by signal except 5 bridge sites where temporary access diversions are to be constructed.

In principle, these temporary diversions are to be demolished as soon as possible after repair works are completed.

2) Waste

- Wastes should be treated properly in accordance with the direction of field supervisors or engineers.
- Monitoring should strictly be conducted by the field supervisors to check manners applied to disposal or conditions of wastes at the construction sites.

3) Water Pollution

Monitoring should strictly be conducted by the field supervisors to prevent inflow of soils and disposal of waste and garbage, and drain dirty water into rivers and groundwater.

9.3.5 Conclusions and Recommendations

Due to the nature of the project which requires only repair and rehabilitation work without new construction, the potential negative impacts by the works are considered minimal and could be offset by the positive economic and social impacts. Successful performance, however, will bring about benefits to traffic and related industries in the area concerned. It is essential to take precaution measures for maintaining the present environmental condition which is considered favorable in general.

However, it should be noted that environmental parameters marked with small effect may threat project sustainability if adequate countermeasures are not taken. Therefore, continuous and appropriate monitoring shall be required.

Chapter 10

Operation Planning

Chapter 10 Opelation Planning

10.1 Introduction

Having gone through the whole process of inspection, technical evaluation and concluding on the urgency of various items of defects, it would be a great disappointment if the next important stages of what is going to be done, is not followed up seriously. This is the implementation of the proposed rehabilitation and maintenance works. The need for maintenance has never been taken seriously by goverrment departments and is all too often considered as unnecessary or of a low priority. Worst is when there are severe limitations on the public expenditure. In such circumstances it would be near impossible to have anyone interested in maintenance.

Funding for maintenance work is a common problem amongst many countries including the United Kingdom and the United States of America. It is a problem that cannot be ignored as the lives and safety of the public are put at risk. For example, it is estimated that about 1000 lives per year are lost in the USA which are directly attributable to accidents involving inadequately maintained bridges, (ref *WHY AMERICA'S BRIDGES ARE CRUMBLING - Scientific American 1993-03 v266 n3 p18-24*). It is therefore a serious enough problem that the two named countries have set aside in their annual highway expenditure budget funds to cope with these requirements.

This chapter briefly illustrates, the method of assessment for the most cost effective planning with a limited budget.

10.2 Prioritization and Planning Operation

10.2.1 Objective

The main objective for prioritization and planning must be for the efficient utilization of available resources in order to maximise benefit. A backlog of maintenance work can be eased somewhat if the available the resources can be directed to that work that desperately requires it rather then just spreading it around on regional basis. Eventually and with fine tuning, it may even be possible to consider preventative maintenance but realistically this is quite a long way away.

10.2.2 Prioritization Criteria

The criteria for the selection of structures are based on the important constraints which are affecting the present useage of each and every bridge. Bridges suffering the same fate of under-maintenance have different level of priority for repair and the basis for such evaluation shall be carefully considered. Local knowledge of the structure and regional variation are essential in arriving at a satisfactory conclusion. The prioritization criteria are set out as follows:

a) Safety of the public.

Is the structure posing a safety hazard and endangering the lives of the travelling public? As an engineer, we owe it to the public to provide safe passages across any structures provided that the load encountered is within the tolerances of the designed values. These designed values should be complimented by adequate level of maintenance.

b) The present function of the bridge.

It is quite possible that the change of use may occur and the importance is not as originally expected. This could be in the case whereby the traffic had been diverted as a result of the construction of a bypass to this route or all the heavy goods vehicles have been diverted to other alternative routes. On the other hand, the bridge could have been subjected to heavier loading than the designed for.

c) The residual carrying capacity of the bridge.

Following an inspection and design assessment, the residual carrying capacity should be determined. This should be compared with the actual imposed loading on which the bridge is subjected. A decision can then be reached as to how critical the condition of the bridge is.

d) What happens if in the event that the bridge becomes unuseable.

Consideration should be given to the effects of the possibility of a bridge being totally closed to traffic. Are there any alternative route(s) and if there is a possibility for the construction of a temporary relief bridge? Is the diversion far and is the existing infrastructures capable of handling the newly imposed traffic loading?

e) Social requirements.

The bridge could be the only link between a regional centre and a collection of settlements. It also provides the local inhibitants with the only source of entertainments. In our case, the study is for bridges on the arterial state highways and such social considerations are not as critical.

f) Economic considerations.

Some important questions have to be asked before a decision is made. Is it cheaper to build a new bridge than to repair? In the short term, will the local economy and sometimes the national economy be affected if the bridge is allowed to deteriorate? Future considerations as to the use is also necessary in the assessment of cost benefits to any proposals.

10.2.3 Prioritization of Bridges

The first part of the final selection is based on the technical deficiencies. The worse the conditions of a bridge the higher the priority is for rehabilitation and maintenance. The second

part is less clear cut as the reasons are subjective and are open to interpretation of the responsible person/authority. However the guidelines are provided to assist in reaching an equitable decision.

1) Technical considerations.

a) Determination of defects and grading.

Routine inspection or a simple inspection is necessary to determine the level of defects which are sustained by the bridges. These defects are graded in accordance into the categories A,B,C and D; all as described in the Inspection and Evaluation Manuals. The grades are in turn converted into points and are multiplied by the corresponding importance and emergency indices. The points are summed to arrive at the cumulative total for the bridge. These values are compared between bridges and those with low score are deemed to be satisfactory and are eliminated from further consideration.

b) Further technical evaluation.

High score bridges, including all grade A defects, are analysed individually and decisions are taken to either instruct simple repair works or to instigate further inspection for more difficult problems and in the case of uncertainty. Information collected from the detailed investigation is essential when deciding on the most effective repair methods and materials to remedy the problems.

c) Final selection and recommendations.

The final selection of priority bridges will be carried out after the further inspection, which in effect is a detailed investigation. The bridges will be ranked in order of worst conditions first. The list will have to cover all spectrum of defects, including possibly for the deterioration of present conditions. It is suggested that a certain amount of the budget be allocated to tackle potential problems with preventative maintenance measures as it is more effective and cheaper in the long term. The bulk of the budget will be for urgent rehabilitation and repair work as concluded by the prioritization ranking. It should be noted that at this stage, any structures that are classed as dangerous should be actioned forthwith because lives are immediately put at risk. Instructions must be issued for urgent temporary safety measures, such as propping, traffic diversion etc., to be in place.

2) Subjective considerations

After the technical consideration process, the prioritization list is reviewed with considerations given to the criterias as given in section 10.2.1. The purpose of the review is to fine tune the ranking to reflect the urgency of the needs of the public from the point of logistic, social and economic considerations; although not necessarily in that order of priority. The importance of each is considered

a) First on the list for consideration is the importance of this bridge to the road network and to the community that is served by it. Generally, where a bridge is on the arterial network it has to be an important link. The next consideration is then the possibility for

the traffic to be temporarily diverted to a parallel bridge in the case of a dual carriageway. This is only postponing the inevitable but in cases where money can be made to stretch, this is one case for which it can be done. In other words, works that would not normally be selected for repair this financial year is now chosen as we are able to defer the spending on a one half of a parallel bridge. Therefore as far as the priority is concern, this is less critical than an equally badly maintained bridge which carries the only carriageway.

b) The economic advantages that could be derived from having the bridge rehabilitated or repaired have also to be assessed. Diversions and traffic management can cause delays and to the economy, it means a loss of money or revenue to the region and the country. The choices have to be evaluated carefully and a comparative scheme cost arrived at for a decision on the selection of an appropriate option and ranking. Sometimes it may even be cheaper to proceed with stage rehabilitation work than to have a complete bridge closure with added diversion and traffic management. In any case, the expenditure should be to consider the economy of the country as a whole and not just how much it is costing KGM.

c) Bridge have special social function too. It is said that the card game of Bridge was invented in Istanbul by two Englishmen who lived on opposite sides of the Goldern Horn. Each night they meet for a game of cards and they took it in turns to cross the Galata Bridge to get to the others' home. Hence the card game they were playing was named Bridge. Generally bridges that link rural communities to regional centres provides, possibly, the only means of access to the only form of entertainment and social activities that is affordable - considering the distance, time and cost of travelling. Inevitably the local economy can also be affected as goods are not able to get to the market and vice versa. However the social importance becomes the deciding factor in this case.

d) Environmental consideration is becoming an important issue for most projects these days. Careful considerations have to be taken with regards to the effects on the environment for proposed maintenance or rehabilitation work due to the presence of unique species of flora and fauna. Other considerations included the level of noise and dust pollution that may be affect the local residents living near or under the bridge. The result may be a change in the hours of working in a given day or season, the use of environmentally friendly materials and methods of working.

e) Some bridges designed and/or constructed in earlier times may have to be preserved for historical and engineering interests. Typical examples are for those bridges which have been designed by emminent local Engineers or Architects, unique construction materials, rare form of construction and design. All of which can be considered the cultural heritage of the nation and should be preserved at some cost.

3) Final selection of priority bridges

The final selection of priority bridges is the combination of the technical and subjective considerations. We have basically come to the conclusion as to which are the critical bridges and

what are the necessary work to be done. The next stage is then to plan the execution of the works.

10.2.4 Planning of Annual Operation

Planning the execution of the works requires good practical site and design office experience in oder to be able to appreciate the complexities and difficulties of maintenance and rehabilitation work. Such works are often more time consuming in its operation and more expensive despite that the volume of materials required are much less than for new construction. For example, time is easily lost where it involves breaking back of concrete surfaces which are not easily accessible, selection of incorrect tools and materials, inadequate accesses et cetera. Hence the emphasis is always for proper planning and selection procedures.

1) Scope of the Works

Maintenance and rehabilitation works can be generally classified into three categories :

a) routine

- work that can be done frequently and easily such as cleaning, cleaning clearing blocked drains

b) periodic

- work that has a certain recurrence after a period of time such as and repainting of parapets, joint replacement, renewal of deck routine waterproofing and resurfacing, accident damaged elements repairs Period could be daily, quarterly, yearly etc and

c) special

- work that is not normally required except as a result of defects, repairs premature failures, damages and failures by natural disasters, The occurrence is mostly unpredictable except for in-built defects.

2) Planning

The various items that have to be considered in the annual planning for maintenance and rehabilitation work are detailed below. It is quite a task to develop a proper plan of action for an entire year especially that there are many variables that have to be taken into consideration. With experience and a documented record of yearly expenditure on the three main categories of work, given in section 10.2.3.1, the possibility of increasing the accuracy for planned expenditure can be greatly enhanced. The various aspects that have to be taken into account when planning, apart from knowing the scope of maintenance works, are as follows:

a) Available budget. It is essential to know how much is allocated for maintenance work and how much can be achieved. Standby reserves should be obtained to cater for the unforseen work and a plan of action should be made.

b) Regional weather variation and seasons. This has an effect on the particular types of work that can be carried out. For example it would not have been possible for repair and inspection of the foundation of river bridges during the end of the rainy season in the Black Sea coast as floods are likely.

c) Availability of appropriate repair materials. It is essential that the right quality of repair materials such as non shrink, self levelling grout, rapid hardening and setting materials, expansion joints etc. can be available. Otherwise the repair may not be successful and money is simply waisted as more repair will be necessary. Efficiency of operation and quality of repair work are more important, with the aim to do and do it right first time.

d) Availability of manpower. Considerations should also take into account the availability of all categories of staff that are necessary for carrying out the repair work. Planned roster for annual vacation may be necessary such that valuable working conditions are not missed.

e) Availability of machinery. It is essential that necessary provisions are made for the availability of specialist machinery. This may mean having to have the machinery delivered from other regions of the country such as in the case of an underbridge inspection platform.

f) Availability of specialist contractors. It is anticipated that major repair and rehabilitation works will not be undertaken by KGM. Therefore it is in the interest that the repair work be given to specialist who are competent in this field.

g) Public information. Information for the public concerning the repair works that are currently in progress should be made available to enable them to plan alternative journeys and to avoid congestion and delay, which is a cost to the national economy.

h) Public holidays. It is prudent that repair works should be stopped or avoided during public holidays such that disruption to traffic can be avoided from an already potentially congested holiday traffic demand.

i) Alternative routes and diversions. Prior to the works, an alternative route and adequate advance traffic management scheme should be designed to assist motorists.

j) Availability of repair know-how. Prior to the actual repair being undertaken, it is essential that an understanding of the detail repair requirement is fully understood. This process of assessment of a particular repair requirement through to successful implementation, has already been given in the text produced by other team members of this study.

10.3 Requirement for Operation

To ensure a successful implementation of highway bridge maintenance operation, it will be necessary to re-evaluate certain important existing crietria.. The willingness on the part of the

KGM maintenance division to fulfill such ambitions will not be fully realised unless there is an equally available willingness on the part of the goverment and other institutions to ensure its success. Some of the major criterias are briefly described below.

10.3.1 Budget

In order that current investment in highways bridges can be satisfactorily preserved, KGM must set a realistic budget for their maintenance. The KGM highway budget for 1995 is 49,213 billion TL and of which 1,365 billion TL is for maintenance, which is approximately 2.8% of the budget. The budget for bridge maintenance is 114 billion, which is approximately 0.23% of the highway budget.

In the UK for example, the planned 1995/96 maintenance budget is 35% of the Department of Transport (Dtp) Roads budget. This amounts to £675 million ($1080 million) and in the opinion of the British Road Federation, an additional 15% will be necessary. In Japan however, the maintenance expenditure is about 20% of the Highway budget and of which 5% is for bridge maintenance. This is indicative of the importance that these governments give to maintenance as preservation of their highway infrastructure investments.

There seems to be some differences in the level of maintenance expenditure between the various countries for the highway infrastructure but the consensus is clear. More spending on maintenance is necessary to protect existing investments. Vehicle owners are very well aware that even the best car will require regular maintenance after a certain distance travelled. Why not for bridges? It is simply wrong to postpone this expenditure which are so essential to the safety of the travelling public. It is the duty of the KGM to provide a safe passage for all the users. There is no necessity for one important public figure to be involved in a fatal accident, due to inadequate maintenance, before changes can be brought about. It will not be good for the credibility of the KGM and the morale of it's staff.

10.3.2 Institutional changes

1) Staff Training

Currently, the knowledge of the maintenance staff is limited only to their own initiatives. No formal training on maintenance is in place and the work that is often carried out is not effective as it is always their first trial. Efforts should be made to formalise trial and trusted methods of repair to enable this knowledge to be passed on. Such an example is the discovery of the existence of Alkali Silica Reaction in Izmir and the tests that had been carried out to established its existence.

Transfer of technology from the more active (with higher volume of work) regional directorates to lesser active directorates should be encouraged. Frequent seminars and discussion forums with expert groups should be encouraged to create awareness amongst all personnel. There is a direct correlation between the design work and the finished product. Often poor design, with bad detailing and reinforcement congestion, coupled with inadequate and non-existent supervision are the perfect recipe for poor quality construction. Hence the awareness of all engineers about the effects of their work and the relationship of their work is

vital. In Japan and in the UK, there exists a national formalised training programme for engineers to be acquainted with most of the facets of the construction industry. No reason why it should not be implemented in the KGM, albeit on a modest scale.

2) Changes in attitudes and criteria

Based on the results of inspection performed by the various engineers in the study team, the salient comment that emerged for most bridges is the comment- poor workmanship. In the 10 bridges selected for study of repair methods, 9 have been so labelled. This is a very disconcerting figure as the age of the bridges are not even up to anywhere near the design life. We have bridges that are as new as 5 years and as old as 34 years. Coupled with our personal experience in Turkey, this brought us to the conclusion that certain attitudes in design, supervision and construction must have to change.

In the UK, bridges that had been constructed below standard have in most cases been asked to be demolished and reconstructed. Such cases include inadequate concrete cover to reinforcement which cannot be easily remedied without extensive breaking back of the concrete. Supervision engineers are not allowed to accept such poor quality of workmanship. Yet for the same quality of bridges in Turkey, they have been accepted as part of the permanent works. This is clearly a case where the Client is not getting quality works from the contractor and the supervision engineer.

The review of certain aspects are considered to be necessary to ensure that future construction works can be as better of quality. They are

a) Review of the design code to cater for new European Union loading criteria and for the code to include guidelines for assessment of residual structural strengths

b) Review of the tendering procedure such that the right quality of competent contractors and consultants can be attracted to carry out their duties professionlly and to accept their professional liabilities. This will inturn lead to a slightly higher initial costs but a saving in the long term. Quality does not come cheap but is worth paying for.

c) Stricter supervision is necessary.. This may sometimes be helpful if the sole authority for the engineering decision is left to the responsible consulting engineers.

10.3.3 Facility and information

The facilities that are available to KGM are variable. In some instances, there are more than required and at other instances, it is non existent. Having the right mix of essential equipment and a regularly updated inventory of all available equipment on a national scale will greatly enhance the possibilities of regional directorates without this equipment, to carry out maintenance activities that they would have otherwise had to ignore.

Targeting the storage of vital but scarce equipments at strategic locations around the country can greatly assist the delivery and access to such facility. Considerations should include a shared programme of maintenance work and available manpower and materials.

10.3.4 Nations economy

Transport forms an important facility in the nations economy. More than ninety percent of all passenger and freight goes on the roads. In the Arterial state highways that we have studied, it will have serious implication in the movement of goods and people should the infracture of these routes becomes unserviceable. With increased trade and sometimes without alternative routes, this would be unthinkable. Therefore it is essential that this infrastructure be regularly maintained and improved to serve the interest of the nation. Support for such just cause must be obtained from the successive goverments for continual investments.

10.4 Operation and Planning of the 10 Study Bridges

10.4.1 The study bridges

The 10 bridges selected for the purpose of this study are as listed below.

1. Buca Ustgecit	in Div 2 Izmir
2. Hilal II	in Div 2 Izmir
3. Babadat	in Div 4 Ankara
4. Selyeri	in Div 7 Samsun
5. Akcay	in Div 7 Samsun
6. Koparan II	in Div 7 Samsun
7. Asagi Cakalli	in Div 7 Samsun
8. Gelincik	in Div 10 Trabzon
9. Sardere	in Div 13 Antalya
10.Candir Hasanpasa	in Div 14 Bursa

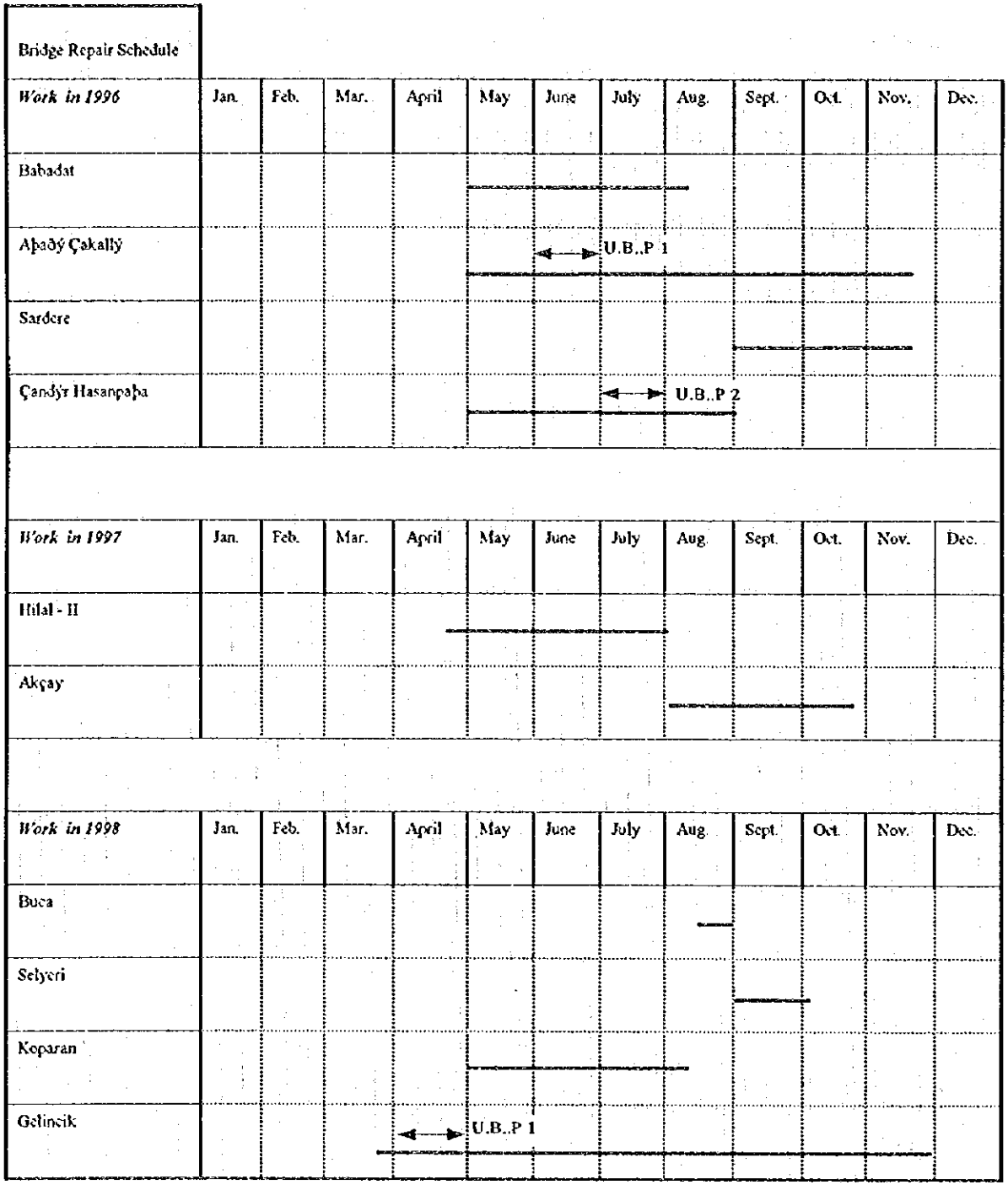
With the exception of Hilal II bridge, unique as it suffers from problem related to Alkali Aggregate Reaction (AAR), all the bridges suffers from a series of problems which are almost identical in nature but of varying degree of intensity. This pattern is representative of the majority of the bridges that had been inspected (See Appendix 8).

10.4.2 Planning and prioritization

As the KGM budget is quite small for the maintenance of bridges, it will be necessary for the rehabilitation work be done with special additional fund. The is one of the most important work to be carried out as an estimated 20% of the entire KGM bridge stock will require similar work. It is an oppurtunity to verify the repair techniques, materials and unit rates for repair works to be carried out in the near future. Some of the study bridges are found to be in a critical state of disrepair. In the interest of public safety, it is proposed that the following groups of repairs be carried out.

1996	4 bridges Babadat, Asagi Cakali, Sardere and Candir Hasanpasa. Total cost $358,000
1997	2 bridges Hilal II and Akcay. Total cost $418,000
1998	4 bridges Buca, Selyeri, Koparan and Gelincik. Total cost $133,000

The repair schedule is as shown to accomodate for the possibility of two teams of KGM supervisory staff for each year.



KEY : 1.) ⟷ U.B.P 1 ; Under bridge platform from Erzincan

2-) ⟷ U.B.P 2 ; Under bridge platform from Ýstanbul

The first group of bridges are the critical bridges. Prior to the repair work on the AAR bridges, it is essential that further studies be carried out on its extent and severity. Hence the programme repair work is scheduled for 1997.

As the location of the bridges are so scattered around the country, it is expected that additional staff experienced in bridge repairs be required to assist the existing KGM maintenance team. It may also be necessary to involved experienced consulting firms to provide the necessary staff to supervise the work and also to train KGM personnel..

10.4.3 Operation

To ensure that the work can be successfully carried out for the repair of the study bridges, we have looked at the requirements for repairs. The necessary repair materials, equipments and machinery are stipulate to aid coordination of scarce resources. A summary sheet is prepared for each of the bridges. They are as attached..

Chapter 11

Financing for Road Maintenance

Chapter 11 Financing for Road Maintenance

Financing for road maintenance in Turkey is not sufficient for implementing the recommendations in this report. How to manage the most grave constraint is entirely up to the administration by Turkish side. Some useful information is summarized for road maintenance financing in this report.

11.1 Financing Road improvement in Japan

11.1.1 Ways and Means for Road Projects

Unlike the administrative categorizations stipulated by "Road Law", road projects in Japan are broken down into three kinds from the perspective of principal investors and sources of financing.

General road projects are financed by national funds (costs paid by the state) and local funds (costs paid by local public body), and are broken down into those conducted by the Ministry of Construction through a local construction agency (directly administered road projects) and those conducted by a local public body with subsidy from the state (subsidized projects). Toll road projects are financed by mainly loans (such as treasury investments and loans) procured by 4 public corporations, 12 local public bodies, 43 local road public corporations and one private company, and repaid by toll revenue after completion. Subsidies are provided from national and local investments and loans. The 4 public corporations are the Japan Highway Public Corporation, Metropolitan Expressway Public Corporation, Hanshin Expressway Public corporation and Honshu-Shikoku Bridge Authority. The single private company is Trans-Tokyo Bay Highway Corporation.

In addition there is independent financing (local funds) by local public bodies. In this form of financing, road projects in Japan are financed mainly by national and local funds and treasury investments and loans.

1) National funds

National funding sources consist of gasoline tax, LPG tax, motor vehicle tonnage tax and other taxes, government construction bonds, and NTT funds. They are used for the cost of executing directly administered projects, for subsidies to local public bodies, and for investments and loans for toll road projects.

2) Local funds

Local fund sources consist of diesel fuel transaction tax, motor vehicle purchase tax, tax revenue transferred from the central government (local road tax, LPG tax and motor vehicle tonnage tax are transferred from the government respectively), other taxes, local bonds and subsidies. They are used for the cost of executing subsidized project and local independent work, as well as for shared cost for work directly administered by central government, and investments and loans for toll road projects.

3) Treasury investments and bans, etc.

Sources of this category of funds include treasury investments and loans, and connection bonds, and they are used for construction cost of toll roads.

11.1.2 Earmarked funds for road improvement

1) Earmarked funds and general funds

Funds for road works from national and local tax revenue fall into two categories: one called earmarked funds which are exclusively used for road works and the other, "general" funds, which are raised for general use purposes.

The sources of national government's earmarked funds for roads are gasoline tax, LPG tax, and motor vehicle tonnage tax. In the case of the local earmarked funds, sources are transfer taxes collected by central government and transferred to the local government, and local taxes collected by the local public bodies to be used for road improvement. Transfer taxes consist of transferred taxes on local roads, LPG and motor vehicle tonnage tax.

The share of earmarked funds account for 50% to 60% of the total of national and local funds.

11.1.3 Outline of Earmarked Tax Revenue for Road Works

A special funding source system for road works was initiated in 1954 when the gasoline tax was set aside as a special funding source for road improvement. After World War II, the demand for road improvement increased, creating the need to establish a new system for road improvement and for securing corresponding funding.

To meet this demand, the toll road system was established in 1952. However, it was not sufficient to meet the rapidly expanding demands of traffic. It was, therefore, determined that the revenues from the gasoline tax be allocated as a funding source for road works based on the concept that road users who enjoy the benefits of improved roads should bear the burden for the improvement, following the example of every country in America and Europe. The outline of earmarked tax revenue is as follows:

(1) Gasoline tax revenues have been applied exclusively to road works since fiscal year 1954.
(2) The local transfer tax has been used to fund road works executed by prefectures, cities (including government-designated cities), towns and villages since fiscal year 1955. This tax imposed on gasoline with the gasoline tax is collected by the national government and transferred to local government.

(3) The diesel fuel transaction tax has been collected by the prefectures since fiscal year 1956 and used to fund road works executed by the prefectures and government-

designated cities.

(4) The motor liquefied petroleum gas tax (LPG Tax) has been collected by the national government since fiscal year 1966. One half of the revenues is applied to national government road works and the remaining half is applied to road works executed by prefectures and government-designated cities.

(5) The motor vehicle purchase tax has been collected since fiscal year 1968. About 30% of the revenue is appropriated by prefectures for their road works. The remainder is applied to road works executed by cities, towns and villages.

(6) The motor vehicle tonnage tax requires more detailed explanation. Initiated in fiscal year 1971 at the start of the 6th Five year Road Improvement Program (fiscal year 1970-1974), its main goal is the expansion of funding sources. The underlying concept is the imposition of a tax on the basis of vehicle weight-a factor which is closely related to the cost of road works. One-quarter of the revenue is appropriated as motor vehicle tonnage transfer tax for road work funds for cities, towns and villages. The remaining three-quarters goes into the General Account, about 80% of which is used for road works, though it should be noted that no fixed provision is prescribed.

(7) Theses earmarked tax revenues are used for road improvement, maintenance, snow removal, administration, research, and other activities, and are considered the most important source, of funds for road works. The origins and revisions of all these taxes can be found in the initiation of one of the Five-year Programs.

In order to secure funding for the 11th Five-year Road Improvement Program, a ¥3/liter increase in gasoline tax, a ¥3/liter reduction of the local road tax (resulting in no net change to the gasoline tax rate), and a ¥7.8/liter increase in the diesel fuel transaction tax were executed in fiscal year 1993.

11.2 Financing Road improvement in Foreign Country

11.2.1 Turkey

The budget is actually set by the government for the expenditure. Each year the KGM will submit to the state planning the projects that they would like to carry in that fiscal year. The State Planning Organization will decide the projects, normally without detail knowledge but only on political grounds or policy. If approved by the State Planning Organization, money is normally available. The money comes from the Treasury which are basically from all the taxes collected, grants and from borrowing. Road tax, car tax and other taxes that relating to roads are not levied for the direct benefit of the road users. The borrowed money may be from commercial banks and government establishments such as OECF.

In the case of the toll motorways and estuarial crossings, so far the financing of

these projects are made by the government only, moneys collected by KGM are transferred back to the government. The amount of money spend on the maintenance of toll motorways and estuarial crossings are also from the central government's annual allocated budget. KGM does not have a direct source of funding their activities. In the past KGM would received 10% of the tolls collected. Via the Public Participation Administration, for the maintenance and future motorway funding. With changes by successive governments, this amount is less than 10% and is not even enough for the maintenance of the crossing and toll motorways.

11.2.2 England

The sources for funding the highway expenditure in the UK are much the same as in Turkey. Taxes collected by government departments are pulled together and are then divided amongst the various ministries according to needs and the political agenda. Each year the various government departments will make a request for their funding requirements. With the available predicted revenues, the spending for each department are considered and allocated. As usual, they do not get the requested sum.

In the case of the tolled motorways and estuarial crossings build on a BOT basis, the responsibility of maintenance is part of the contract negotiated with the operator of the concession. In this particular case, the revenue from the tolls are used to finance the maintenance of the highways and bridges under their control. At the same time there should also be a surplus amount to service the finance charges of the project borrowing and another amount retained as profit. Hence only the most feasible projects are taken up for BOT.

11.2.3 U.S.A

The current finance structure for highways is not producing the funds needed to meet the country's requirements for highway investment. Evidence for this is found by comparing recent trends in highway finance and the annual investment required to maintain the current level of highway system performance. Any adjustments to the existing financing structure should be based on a systematic re-evaluation of all available highway finance options.

1) Recent Trends in Highway Financing

In 1991, all levels of government combined spent $74.5 billion to construct, maintain, and operate the U.S. highway system. To put this into perspective, direct outlays for transportation by passenger and freight users of the transportation system were $969 billion in 1990. Of this, the direct outlays of highway users - including vehicle costs and operating expense for private automobiles, bus and transit, taxis, and trucks - were estimated at $828 billion.

Funding for highways comes from all levels of government. In 1991, the state

and local levels of government provided 78 percent of all funding for highways and 59 percent of the funding for capital outlays, with the federal government providing the remaining funds, almost exclusively for capital.

The following highlights characterize 1991 highway finance sources and trends :

- The largest source of these revenues was motor fuel and vehicle taxes; these provided $47.2 billion, which was 57 percent of total 1991 revenues.
- Tolls, the other major component of what are generally referred to as highway user charges, accounted for $3.1 billion in revenue (4 percent).
- General fund appropriations, benefit charges, and investment income together provided $25.1 billion (31 percent).
- Bond issue proceeds accounted for $6.9 billion (8 percent).

A more historical perspective is reflected in the following points:

- The share of revenues provided by the different funding sources of finance has varied little over the past 10 years as motor-fuel and vehicle taxes have maintained their position as the single largest source. Tolls, other sources, investment income, and bonds have not varied significantly during that time period.
- Since 1981, spending has been almost evenly divided between capital improvements and noncapital maintenance and operation items.

2) Options for Increasing Highway Revenues

The above argues that the current highway financing system is not sufficient to meet current requirements and that it is necessary to systematically examine all possible options to meet this financial shortfall. The range of possible revenue sources can be grouped as follows:

- Increase highway user revenues.
- Increase other taxes and benefit fees.
- Make full use of investment income and other receipts
- Increase bond issue proceeds.
- Enhance private sources.
- Develop and use other financing innovations.

3) Increase highway user revenues

Highway user revenues comprise more than 60 percent of total highway revenues. In 1991, these fees accounted for more than $50.3 billion of the $82.4 billion raised for highways. (See table 1.) These receipts were collected at the federal, state, and

raised for highways. These receipts were collected at the federal, state, and local levels. This funding is equal to about two cents per vehicle miles of travel (VMT). In 1960, this revenue source provided five cents per VMT in constant dollars.

The overwhelming majority of all highway user revenues (94 percent, or $47.2 billion, in 1991) are raised from motor fuel taxes. About $3.1 billion, or 6 percent, of highway user revenues were derived from tolls in 1991.

Increasing these highway user charges represents one option for increasing highway financing. For example, federal legislation enacted in 1993 will redirect 25 cents of federal motor fuel taxes from deficit reduction to surface transportation use beginning in 1995. Also, 17 states increased their gasoline tax rates, and 16 states increased diesel fuel tax rates in 1993.

Most agree that user taxes are the fairest taxes because the consumer pays for use. However, as previously noted, revenues from the highway-user tax base has not kept pace with increases in travel.

11.2.4 France

1) Conservation of Road Property

The road maintenance policy after the sixties was to assure the service level aiming at securing comfort and constancy in all weather. In addition, it was the most economical in terms of attaining these objectives. The policy supposed road preservation each year in order to implement the necessary preventive maintenance. However, due to the budgetary difficulty after 1988, it had to be changed. Consequently, Road Directorate, since 1991, has been seeking the best ways of maintenance of roads, facilities and equipment within the national budget.

As a consequent, Departmental Directorate of Equipment was established for facility and equipment maintenance. By establishing the new Directorate, the mission of the both Road Directorate and Departmental Directorate of Equipment are divided as follows:

- Road Directorate:
  This Directorate is in charge of conceptualization of maintenance policy, promotion of services, policy control and evaluation.

- Departmental Directorate of Equipment:
  This Directorate is in charge of the implementation of policy and adjustment of measures for the execution of the policy.

Since 1991, national road has been categorized into five categories: Rapid Urban Road, Expressway, Large Access Road for National Land Development, Road

with Large Traffic Volume, Road with Small Traffic Volume. Maintenance objectives for each category of road are prepared for facilities and roads.

Each Departmental Directorate of Equipment (DDE) receives fund for the implementation of preventive and curative road maintenance, maintenance of facilities, equipment and winter road. The government made the objective of an adaptation on a local participation after the negotiation.

The Road Directorate provides the DDE with assistance on carrying out actions. They provide a road maintenance guide for modernization which was diffused in 1993 and a guide of quantification of the command of supervisor in 1994. In addition, an National Observation Post of Roads was established so that DDE can compare the practice and cost.

Apart from a technical report which is provided to the Road Directorate, in order to implement efficient evaluation of road quality, the following systems have been developed: Qualitative Image of the National Road Network (IQRN) in 1992 and Qualitative Image of Civil Engineering in 1994. The objectives of these systems are:

-To understand the road quality
-To follow the evolution of the road conditions

2) Quality Image of the National Road Network(IQRN)

The principle of the operation of IQRN is the allotment of a complete number between 0 and 20 to the road, for the immediate financial exploitation, in respect of works to be realized, traffic count and the recent road conditions. The numbers below 17 imply the degradation of structure which needs major intervention, while the numbers above 17 suggest only degradation of road surface. By counting the frequency of degradation and its level of seriousness, the list permits to qualify the conditions of road surface and structure. The advantage of this method is the improvement of efficiency. The data which can be collected will increase significantly that the data on 200m per elementary section will be added by this method.

According to the degree of precision required, the possible output can be: process diagram, cartography, histograms of the number or numerical table.The results of auscultation campaigns after 1992 are as follows:

- In general, the conditions of National Road Network are good that 70% of road is classified as "excellent" or "good."

- 13% of the road is in bad conditions. The problem of maintenance policy of the National Road Network is no longer preventive maintenance but of rehabilitation. The major problems of these roads are: the road which has not been reinforced until now; the road whose traffic has surpassed the initial prevision; or the road whose preventive maintenance has not been sufficient. It is necessary to rapidly

implenient maintenance of these roads, otherwise they might become improper in use in case of unexpected event.

- There is a disparity in terms of qualitative conditions among regions and departments. The objectives of rehabilitation program will be to reduce this disparity.

3) The Rehabilitation Program

The reinforcement program was launched in the late 60s, aiming at the modernization of the major part of National Road Network. As a consequence, in 1994, of 31,000km of the total network, only 2,700km remained eligible for the modernization program. It was important in the program to provide the roads with structures apt to all-weather with the excellent level of services for the user. In order to meet the user's necessity, different objectives are identified as follows:

- The sections which have structural problems:
  Apart from the reduction of disparities among departments, the total abolishment of structural deficiencies of the network which will need the mobilization of means is more important than actual ones. The qualitative objectives will be differentiated according to the classification of the road maintenance.

-The defect of agglomeration
  Taking into consideration their particularities, it is indispensable to treat them in the specific framework.

4) Modernization of Instrument of Production

The Road Directorate consists of the Personal and Service Directorate and the Directorate of Financial Affairs and General Administrative. The responsibility of the production instrument of the Departmental Directorate of Equipment, on the other hand, consists of parks and territorial subdivisions. The following is principal factors of the environment which has profoundly evolved in recent years:

- The new context of the decentralization: There is the consequence of installation of different rapport between DDE, general counsels and principal clients of production instrument.

- Take into consideration the new needs expressed by supervisors, in particular, in the domain of the exploitation of route or its logic of the plan, or the expectation of the users which are very strong in the context of decreasing human means.

- The reflection on the role of State (operative and regulative) which concerns all, particularly the task which does not appear to be directly complementary of the nuclear of public service activities.

11.3 Introduction of Gasoline Tax

Introduction of gasoline tax as a earmarked fund for road improvement is desirable based on the concept that road users should be burdened with the cost of road improvement, and from an impartial view point. The strong point of this taxation is to be able to execute continuously and steadily the road improvement by exclusive use of fund. This taxation is applied to many countries as earmarked fund for road works. As shown in the Table 11.3.1, tax rate is comparatively high in other countries except United States of America.

Table - 11.3.1 Fuel Tax Rate

(Unit: US$/litter)

	Gasoline			Diesel		
	Price	Tax	Tax Rate	Price	Tax	Tax Rate
U.S.A *	0.232	0.064	27.5%	0.235	0.085	36.1%
England *	0.627	0.419	66.8%	0.586	0.393	67.0%
France *	0.794	0.615	77.5%	0.535	0.346	65.2%
Germany *	0.508	0.343	67.5%	0.505	0.325	64.4%
Japan *	0.932	0.433	46.4%	0.550	0.201	36.6%
Turkey **	0.709	0.483	68.1%	0.508	0.313	61.6%

*1988 Japan Energy Economic Institute

**1996 General Directorate of Petroleum Affair in Turkey

Chapter 12

Investigation Into Potential Alkali Aggregate Reaction

Chapter 12 Investigation Into Potential Alkali Aggregate Reaction

12.1 Introduction

During the initial general inspection of the objective bridges carried out during the first study period in Turkey, evidence of extensive cracking was found to substructures of several of the bridges in the Izmir region. With local assistance from KGM 2nd (Izmir) Division Directorate bridge engineers, several bridge sites including those outside the scope of the study were visited to determine the extent and frequency of this cracking phenomena.

Generally cracking was observed in bridges constructed within the last 12 years and in most instances appears to be confined to the substructures. Alkali Aggregate Reaction (AAR) of the concrete was suspected as the primary cause for the cracking.

KGM requested that the cause of this cracking be investigated and included within the terms of reference for the current JICA study on The Maintenance and Rehabilitation of Highway Bridges in the Republic of Turkey. This request was accepted by JICA Headquarters in August 1995 and additional resources were allocated to investigate the cause and to promote countermeasures to the cracking in the substructures.

12.2 Background

12.2.1 Preliminary Sampling

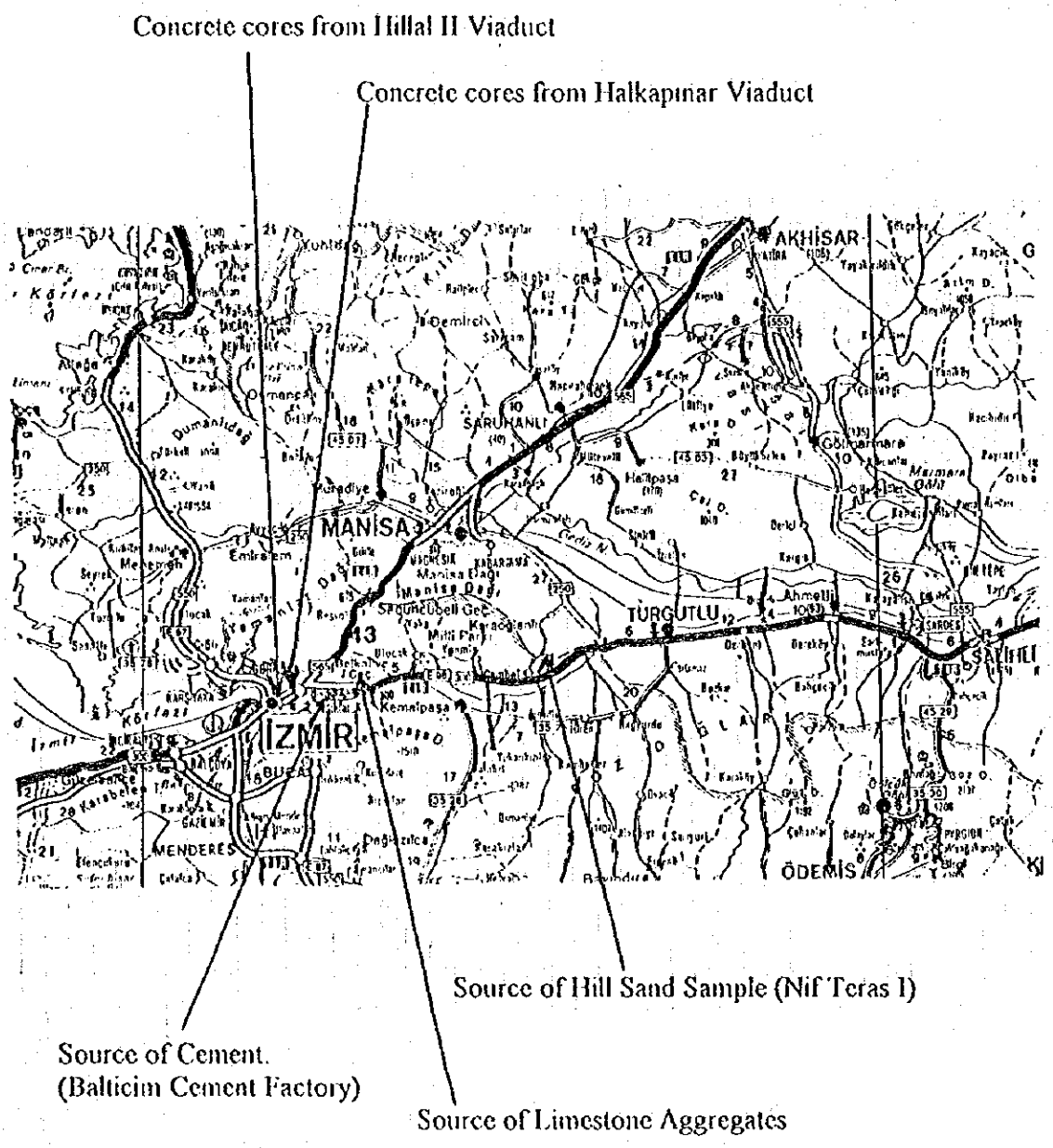
In order to screen for potentially suspect materials that may cause AAR, sources of aggregates, cement and water were identified which have been used in the construction of highway bridges during the last 10 years. Samples of coarse limestone aggregates were obtained from the Belkahve Mountain area of Izmir which has been in production for the last 40 years. Cement samples were also obtained from local cement production plants which use raw materials quarried predominantly from the Belkahve area. Samples of fine aggregates (sand) were obtained from the limestone quarries of Belkahve and from dredged river deposits of Gediz and Nif river systems, situated in excess of 45 Kilometres to the east of Izmir. Sand from this river system has been used extensively for 15 years and is still currently being used but in considerably reduced quantities.

Concrete core samples were taken from the substructures of two affected bridges showing signs of extensive cracking (Hilal II - study structure no. AI- 300- 02- 8 and Halkapinar - study structure AI- 300- 02- 10)

Details of both concrete core locations and concrete constituent sample locations are illustrated in Figure - 12.2.1.

12.2.2 Preliminary Testing And Test Results.

Samples from the aggregate sources were subjected to standard aggregate tests to detect potential alkali silica reactivity in laboratories both in Ankara, Turkey and Tokyo, Japan.



THE STUDY ON THE MAINTENANCE AND REHABILITATION of HIGHWAY BRIDGES in THE REPUBLIC of TURKEY AUGUST, 1996 ORIENTAL CONSULTANTS COMPANY LIMITED in association with JAPAN OVERSEAS CONSULTANTS COMPANY LIMTED	Figure - 12.2.1 Location of Samples for preliminary testing

The samples were subjected to chemical testing in accordance with ASTM C289. The results summarised in Appendices 9.1 and 9.2, indicate that similar test results have been recorded in both Turkey and Japan. These indicate that the limestone aggregates (coarse, medium and fine (sand)) are potentially innocuous. However the hill sand taken from the Nif river system, though categorised as innocuous, is very close to being categorised as potentially expansive.

Accelerated mortar bar tests were carried out in Japan on the limestone aggregates and the hill sand to Canadian Standard CSA A23.2- 25A. The limestone aggregates tested innocuous, though the hill sand currently being produced and used was found deleterious according to the CSA accelerated mortar bar test. The conventional ASTM C289 chemical test failed to detect the potential reactivity of the hill sand.

The concrete cores taken from the two deriorated bridges in Izmir were subjected to microscopic examination of thin sections of the cores. This revealed that the two structures are under going typical alkali -silica reaction due to reactive sand grains containing glassy rhyolite, glassy rhyolitic tuff and calcareous chert contained in small amounts in the sand used for these structures. These sand grains have reacted to form numerous radically to randomly arranged cracks filled with a colourless gel (alkali silica gel) in the concrete. There is no petrographic evidence that the limestone aggregates used these structures have reacted deleteriously.

The concrete cores from the two bridges are undergoing expansion tests to British Standards (Gel Pat Test) in laboratories in Ankara, Turkey. Six months into the testing cycle there is no evidence of alkali silica gel formation.

The rock types currently extracted for use from the Nif river system are generally similar to that of the sand contained in deteriorated concrete structures. These sands largely consist of metamorphic quartz schist and phyollite grains, with minor amounts of potentially reactive volcanic rocks, such as glassy rhyollite and glassy rhyollite tuff.

12.3 Selection of Bridges For Concrete Core Investigations

12.3.1 Background

The four pairs of viaducts of the Izmir Expressway(totaling eight of the study bridges) were visually inspected as part of the initial survey to assess the degree of deterioration of KGM's state highway bridge stock. These viaducts are all of a similar design and were constructed between 1987 and 1990. Visual examination of the structures has revealed the following common defects.

- Cracking is extensive over the majority of the exposed surfaces of the substructures.
- Cracking appears to extend below ground level (in two of the pier bases/top of pile caps examined).
- The cracks do not appear to follow any particular pattern (i.e. random).
- Cursory examination of some of the primary reinforcement bars in both piers and abutments indicates that they are free from corrosion. This is despite cracks that extend well beyond the rebar into the concrete element.
- The cracking appears confined to areas of instu concrete placement to the substructure. The precast deck beams deck suffit in fill appear relatively free from cracks.

Examination of some other bridge in the Izmir area revealed that this cracking phenomena exists in several other structures constructed during the last 12 years. This cracking pattern is strongly associated with alkali aggregate reaction (AAR). As a general rule the older the structure the wider the cracks observed.

12.3.2 Candidate Bridges For Concrete Core Sampling

Thirteen bridges with known cracking were identified as having potential AAR. These are listed in Table - 12.3.1.

Table - 12.3.1 List of Potential Candidate Bridges

	Route (RT)	Section (CS)	Bridge No. (BN)
Hilal I Sagiust Gec	300	02	5
Hilal I Sagiust Gec	300	02	6
Hilal II Sagiust Gec	300	02	7
Hilal II Sagiust Gec	300	02	8
Halkpinar K.U.G	300	02	9
Halkpinar K.U.G	300	02	10
Zaferpagzin K.U.G	300	02	11
Zaferpagzin K.U.G	300	02	12
Buca Motorway Bridge		New Motorway Bridge	
Naldoken Bridge		Bridge Under Construction	
Turan Bridge	550	09	-
Turgutlu Bridge	300	03	-
Bormova Viaduct		Bridge Under Construction	

A site inspection of these bridges were made. As the first eight bridges in Table - 12.3.1 were included in the visual inspection phase of the study, only one of these bridges were selected for further investigation. The remaining four bridges were selected to represent bridges of different ages. The five bridges selected for further investigation and concrete core sampling one listed in Table - 12.3.2.

The location of the bridges investigated in given in Figure - 12.3.1

Table - 12.3.2 List of Bridges Investigated

Structure Name	Structure Age (Years)	Comments
Naldöken Bridge	1	New intersection bridge over highway and railway
Turgutlu Bridge	3	New bridge constructed adjacent to old bridge following dualling of highway
Buca Motorway Bridge	5	Motorway underbridge
Hilal2 Viaduct	7-8	Busy multi span structure carrying Izmir inner expressway
Turan Bridge	>10	Carries highway over railway

12.3.3 Existing Condition of Candidate Bridges

All the candidate bridges are displaying evidence of random crack patterns to the substructures. The degree of cracking is difficult to quantity so a descriptive method has been adopted.

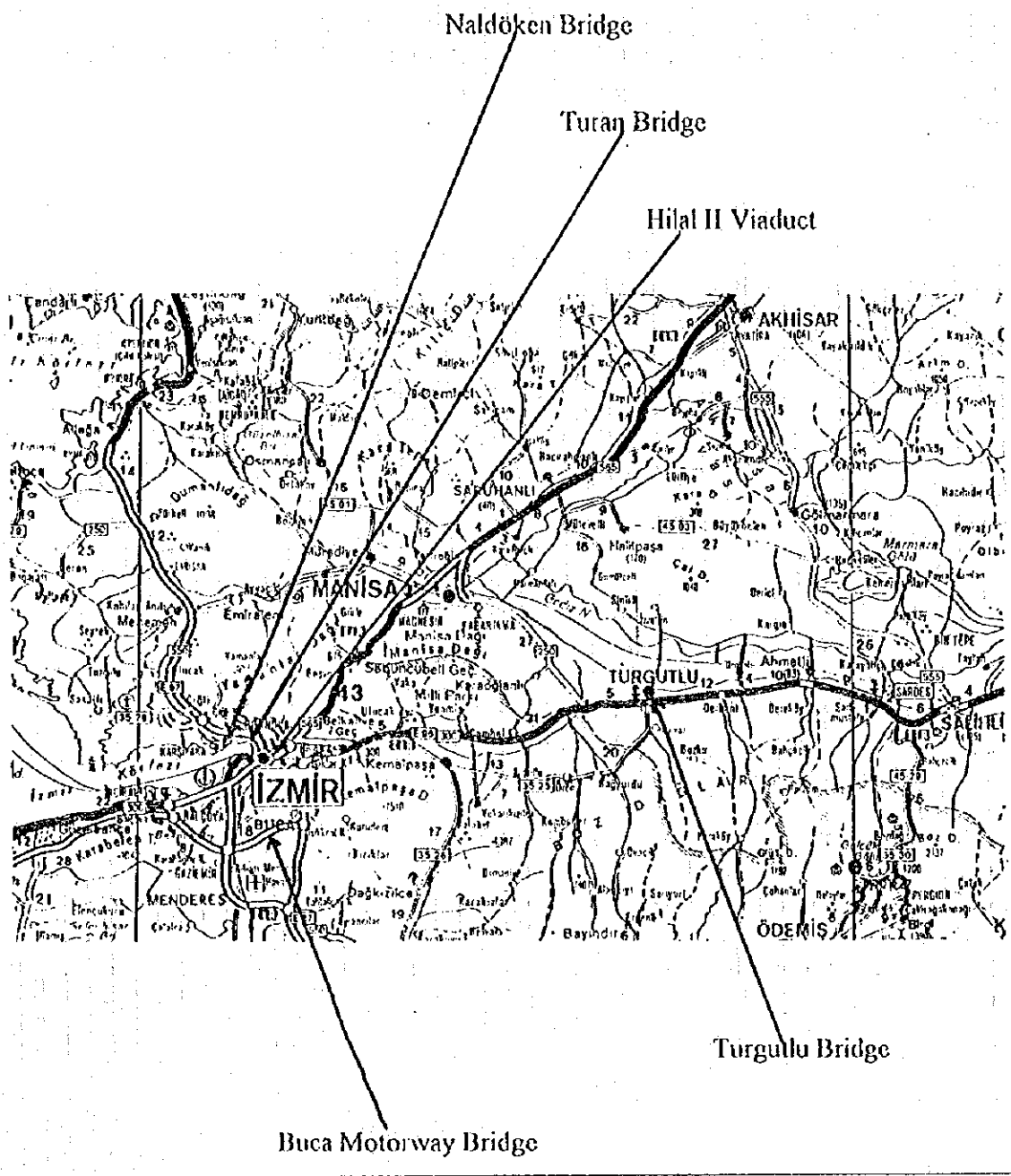
Naldöken Bridge has presently a cracking pattern consisting of mainly vertical and diagonal cracks up to 0.25mm wide. A secondary random crack pattern is developing with cracks up to 0.1mm wide. All the substructure surfaces appear equally affected.

Turgutlu Bridge has cracks which are very evident on the piers. There is a marked preference for cracks in the vertical plane and these are wider (0.3mm)

The cracks on the Afyon abutment tend to be horizontal and at present are approximately at 500mm spacing except at the north end which is displaying a high randomly cracked surface. Cover to the reinforcement is generally in excess of 35mm.

Buca Motorway Bridge has a primary cracking pattern which appears to follow the line of the horizontal reinforcement. These cracks are approximately up to 0.3mm in width. A secondary random cracking pattern has developed with cracks up to 0.25mm width. The cracks are far more evident in areas exposed to direct rain, such as the abutments between the two bridge decks and the abutment wingwalls.

The primary cracks (0.25mm) were sealed last year (September 1994) with an epoxy based sealant. In areas exposed to direct rain the cracks have continued to develop cracking the sealant. This suggest that the cracks are 'live' and are continuing to propagate.



THE STUDY ON
THE MAINTENANCE AND REHABILITATION of
HIGHWAY BRIDGES in THE REPUBLIC of TURKEY
AUGUST, 1996
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Figure - 12.3.1

Location of Bridges Investigated

Hilal2 Viaduct has an extensive randomly arranged cracking pattern over all the exposed pier surface and the majority of the abutment surface. On the piers there is a noticeable tendency for the more vertical cracks to be wider and these tend to be

generally up to 0.5mm in width. In isolated places the cracks are up to 2mm in width and examination of two of these locations has revealed that the structure is cracked at the same width at 150mm depth, which is well behind the element's reinforcement.

Turan Bridge has extensive cracking of the more exposed circular columns supporting the superstructure. Cracks tend to primarily vertical on the columns and generally vary in width up to 1.5mm On affected columns the cracking appears all around the circumference of the column but adjacent columns can be totally free from cracks.

The column crossheads supported on the columns exhibit a very high degree of cracking. Cracks up to 5mm wide have been observed on the weather exposed edges of the crossheads. In five separate crosshead locations the cracking is so severe that the integrity of the crosshead must be in doubt. External support of the crosshead edges is urgently recommended.

Cracking of the abutment face is less severe with cracking up to 0.25mm width.

Table - 12.3.3 Classification of Bridges According to Degree of Cracking

Structure Name	Degree of Cracking*	Measures Required
Naldöken Bridge	Piers-Mild Abutment Mild	Monitoring
Turgutlu Bridge	Piers-Mild Abutment Mild	Monitoring/Protection
Buca Motorway Bridge	Abutment Moderate	Monitoring/Protection
Hilal2 Viaduct	Piers Severe Abutment Severe	Repair
Turan Bridge	Piers Severe Abutment Severe	Support and Urgent Repair

*Mild General cracking up to 0.25mm width.
*Moderate General cracking up to 0.5mm width.
*Severe Cracking greater than 0.5mm width.

At all bridge locations it was difficult to assess the extend of cracking below ground level as a consequence of a nationwide public workers strike which prevents the excavation of the trial holes.

12.3.4 Concrete Core Sampling

A minimum of five cores were taken from each of the five bridges. A covermeter survey was undertaken at each proposed core location in order to reduce the chances of encountering reinforcement during coring.

Despite precautions, steel reinforcement was typically found at depths varying between 100mm and 220mm Additionally intact core recovery was poor partly due to hairline cracking within the concrete element being cored.

The concrete core samples were site referenced, labeled and delivered to KGM Laboratory Headquarters in Ankara. Testing procedures for the cores are described in Section 12.5.

12.4 Concrete Constituent Sampling

The preliminary testing carried out indicated that the hill sand, where used as a concrete component, may contain particles that are reactive leading to alkali silica reaction. Further testing of the cement is considered prudent as cement produced in the Izmir area has alkali content higher than the national average.

12.4.1 Sand Sampling

1) Historically there has been an abundant source of sand for bridge construction from numerous natural aggregate deposits. These have usually concentrated in the Nif/ Gediz system lying to the east of Izmir.

Following interviews with local KGM bridge staff, bridges built up to 8 years ago will probably have used sand from this river system in concrete production. Limited records show that the concrete trial mix for Hilal2 used Ahmetli sand from the Gediz river for the production of the main structural concrete mix.

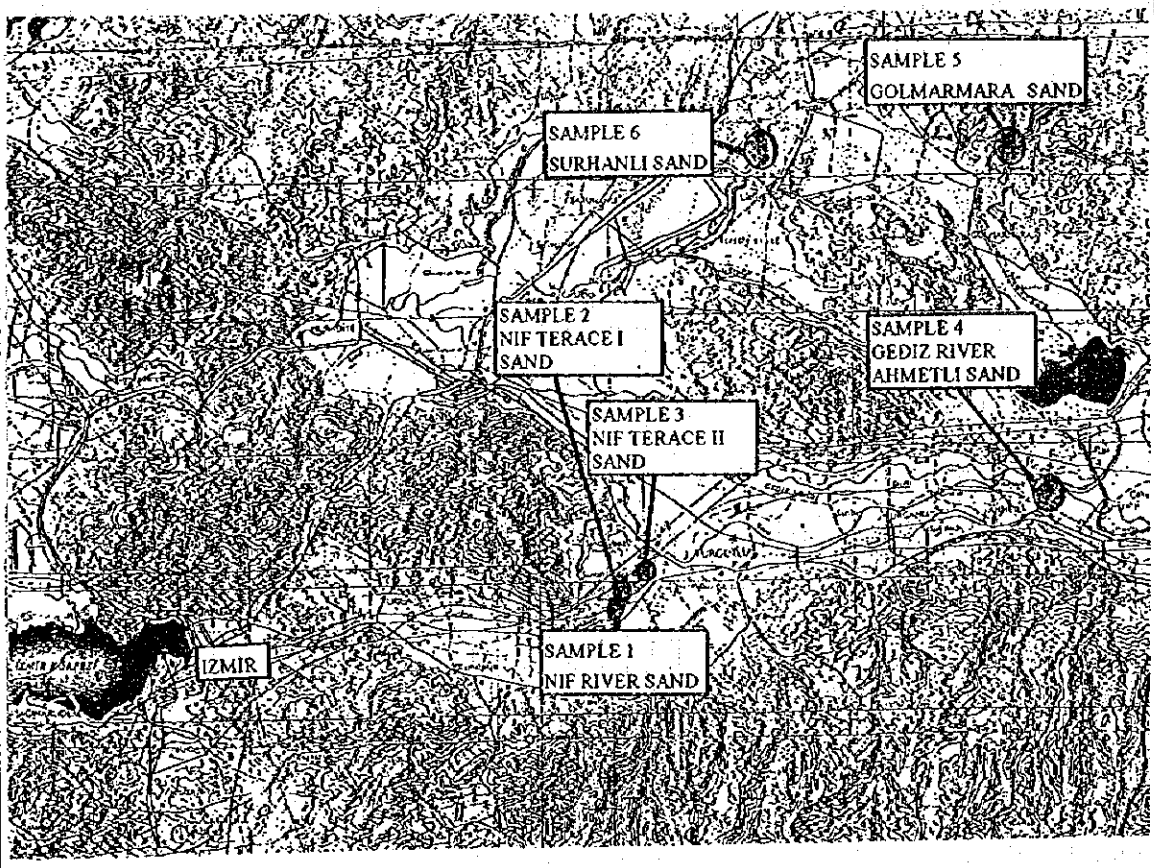
Currently there are numerous small enterprises quarrying sand and gravels in the Nif and Gediz river systems. Over half these enterprises do not have any production facilities of their own and merely bulk excavate the material to be graded elsewhere.

2) The study team was required to sample sand from four sources known to have been incorporated into highway structures within last 12 years. These four sources were supplemented by two recently opened sites involved in bulk sand production. Details of the sand sample, the period that sand from that location has been used, whether sand from these locations are still used and cement production facilities are shown in Table - 12.4.1.

Details of the sample locations are shown in Figure - 12.4.1.

Table - 12.4.1 Summary of Sand Sample Usage and Current Production Facilities

Sample No	Sand Description	Period In Use	Still Used	Production Facilities
1	Nif River	More than 15 years until 5 years ago	Rarely	None
2	Nif Terace 1	8 Years	Yes	Aggregate washing and sieving
3	Nif Terace 2	5 Years	Yes	Aggregate washing and sieving
4	Gediz River	>10 Years	Occasionally	None currently
5	Gölmarmara	2 Years	Yes	Aggregate washing and sieving
6	Surhanlý	2 Months	Yes	None-bulk excavationnly



THE STUDY ON
THE MAINTENANCE AND REHABILITATION of
HIGHWAY BRIDGES in THE REPUBLIC of TURKEY
AUGUST, 1996
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Figure - 12.4.1

Location of Sampling Sites

3) The sand for the sand samples have been quarried from three different geological sources. These are summarized in Table - 12.4.2.

Table - 12.4.2 Summary of Geological Descriptions

Sample No.	Sand Description	Geological Description
1	Nif River	A
2	Nif Terrace 1	C
3	Nif Terrace 2	C
4	Gediz River	A
5	Gölmarmara	C
6	Surhanlý	B

Brief Geological Description

A. Recent River Deposits
This develops in the flood plains along the present Nif and Gediz rivers. The material consists of various sizes of gravels ranging from boulders to pebbles in size mixed with large quantities of silt and sand.

B. Older River Deposits
The terrace topography consists of land greatly sloping down to the present river flood. The deposit consists of cobble to pebble sized gravel mixed with sand fine materials.

C. Quarterary to Tertiary Deposit
This deposit occurs under the old terrace topography and lies between 30 and 50 metres above the present river flood plain. It consists alternating layers of unconsolidated pebble gravel to sandy silt. The thickness of each layer range from 30cm to 1m.

12.4.2 Cement Sampling

Cement production in the Izmir region is dominated by two large manufacturers who supply over 90% of the local needs.

Bati Anadolu Çimento (Batiçim) produces 1.5 M Tonnes of cement annually of which approximately one third is exported. Located 10 Km. east of Izmir on the main highway to Afyon, the company produces four main types of cement for the construction industry. Raw materials for the Portland clinker are quarried from Belkahve mountain whilst the pozzolonic additives are freely available from the Atatürk Mahalle area to the north east of Izmir. Details of the cement types are tabulated in Table - 12.4.2.

Çimentaþ is the second cement production facility located 7km east of Izmir. Raw materials for the Portland clinker are quarried from Altindar mountain which lies to the south of the production facilities.

Additive source and percentage mixed with Portland clinker is as shown. Details of the main cement types are tabulated in Table - 12.4.3.

Table - 12.4.3 Cement Production Types in The Izmir Region

Manufacturer	Cement Type	Additive
Batiçim	PC 32.5	Gypsum Max 5%
	PC 42.5	Gypsum Max 5%
	KC 32.5	Trass and slag in varying quantities to maximum 19%. Thereafter 5% gypsum
	TC 32.5	Trass and slag in varying quantities between 20% and 40%. Thereafter 5% gypsum.
Çimentaþ	PC 32.5	Unknown
	KC 32.5	Unknown
	TC 32.5	Unknown
	Others	Unknown

The JICA Study Team wishes to acknowledge the cooperation at Batýçim who have freely provided information to the team.

12.5 Testing Procedures

12.5.1 Sand Sampling.

The following tests were carried out on the samples.

1) Chemical tests to sand samples comprising
   a) Analysis For The Chemical Screening Test CSA A 23.2 -26A
   b) Chemical Testing ASTM C 289 - 81

2) Petrographic examination of the sand samples to ASTM C 295.

3) Accelerated Mortar Bar Test CSA A23.2- 25A
   Three mortar bars have been manufactured from each of four sand sources. Local (Izmir) Portland cement (PC 32.5) was used in the manufacture of the mortar bars. Readings have been taken at 3, 7 and 14 days.
   Additional mortar bars will be manufactured by KGM for testing two new sources of sand at a later date.

4) Accelerated Mortar Bar Test ASTM C 227- 87
   Three mortar bars have been manufactured from each of the four sand sources. Local (Izmir) Portland cement (PC 32.5) was used in the manufacture of the mortar bars. A comparison of test results will be made by KGM of the tests undertaken to A 23.2-25A.

12.5.2 Cement Testing

Cement supplies have been taken from each of the two main cement manufacturers. The alkali content of each cement as a percentage potassium oxide (K_2O) sodium oxide (Na_2O) has been calculated to a sodium oxide Na_2O equivalent.

The following cement types have been analysed

Baticim Portland Cement PC 32.5
Baticim KC 32.5 Cement
Cimentas Portland Cement PC 32.5
Cimentas KC 32.5 Cement

12.5.3 Concrete Core Sampling

Concrete cores have been taken from each of the five study bridges. The core diameters are 50mm. and in the majority of cases cores exceeding 250mm were obtained.

The allocation of the core samples for testing from each bridge is as follows:

3 cores	For expansion test in accordance with CSA A23.2-25A. These tests have been carried out in KGM Headquarters Laboratories Ankara.
1 core	For Gel Pat Test (To British Standard). This test will be performed by KGM at a later date to enable a comparison to be made with the Canadian standard above
1 core	For examination by testing laboratory in Tokyo, Japan. Test carried out include petrographic examination and one expansion test for each sample in accordance with CSA A23.2-25A.

12.6 Test Results

Following the testing carried out in accordance with section 12.5 the following test results are shown.

Laboratory testing is still being undertaken both in Ankara, Turkey and Tokyo, Japan. The results shown concentrate on the results of the accelerated motor bar test using the six sample sands taken from around the Izmir region and known to have been incorporated in concrete structures.

Section 12.6.1 highlights the test results carried out in Ankara, Turkey. The testing here to date has concentrated on the mortar bar test of four of the sands together with the accelerated concrete core expansion test carried out on cores taken from the five bridges.

Section 12.6.2 shows the tests carried out in Tokyo, Japan. The testing here to date has concentrated on the mortar bar test of the six sands collected together with the accelerated concrete core expansion tests carried out or cores taken from the five bridges.

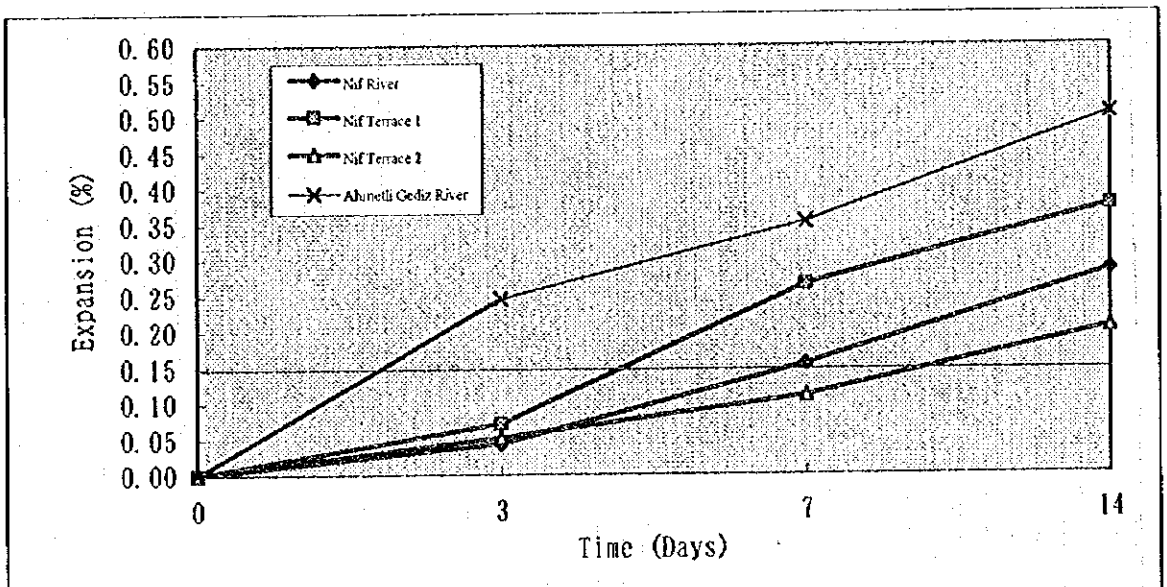
12.6.1 Results of Testing Carried Out in Turkey

Table - 12.6.1 Results of Accelerated Mortar Bar Test Carried Out in Ankara, Turkey.

Results of The Accelerated Mortar Bar Test (CSA A23.2-25A)

Sand Sample	No.	Expansion(%)		
		3Days	7Days	14Days
Sample 1 Nif River	1	0.046	0.155	0.282
	2	0.046	0.158	0.293
	3	0.039	0.153	0.282
	Av.	0.044	0.155	0.285
Sample 2 Nif Terrace 1	1	0.075	0.265	0.423
	2	0.073	0.266	0.377
	3	0.069	0.267	0.326
	Av.	0.072	0.266	0.375
Sample 3 Nif Terrace 2	1	0.056	0.115	0.226
	2	0.054	0.108	0.195
	3	0.045	0.108	0.196
	Av.	0.052	0.110	0.205
Sample 4 Ahmetli Gediz River	1	0.266	0.322	0.489
	2	0.274	0.851*	1.050*
	3	0.198	0.384	0.520
	Av.	0.246	0.353	0.504
Sample 5 Gölmarmara	1	To Be Undertaken By KGM At A Later Date		
	2			
	3			
	Av.			
Sample 6 Surhanli	1	To Be Undertaken By KGM At A Later Date		
	2			
	3			
	Av.			

*Those values have been omitted from calculating the average value.



THE STUDY ON
THE MAINTENANCE AND REHABILITATION of
HIGHWAY BRIDGES in THE REPUBLIC of TURKEY
AUGUST, 1996
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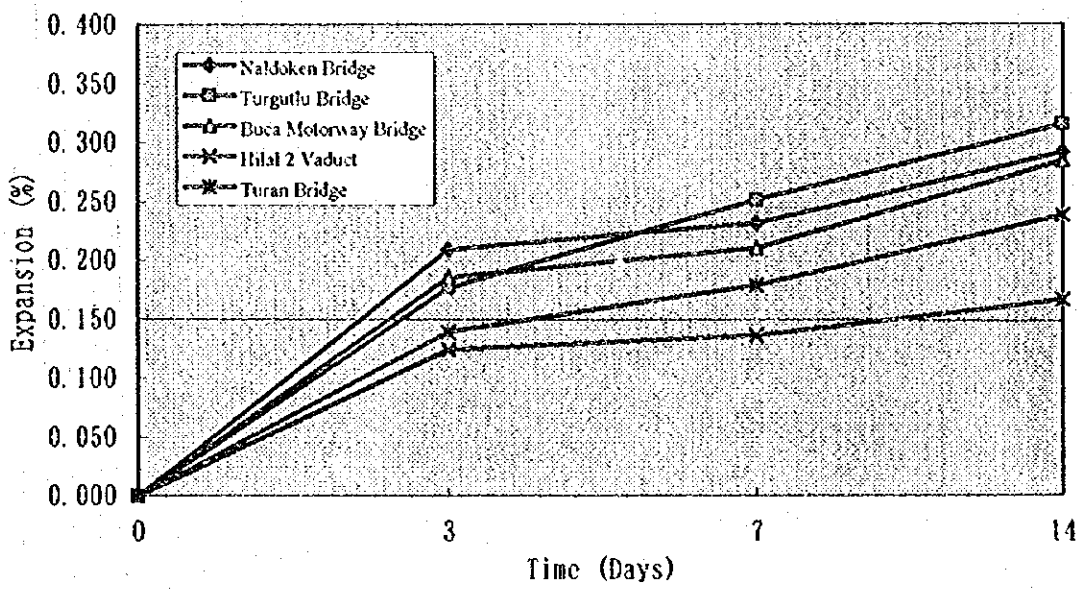
Figure - 12.6.1

Results of Accelerated Mortar Bar Test
(CSA A23.2-25A) Testing Carried Out in Ankara, Turkey

Table -12.6.2 Results of Accelerated Concrete Core Test Carried Out in Ankara, Turkey.

Results of The Accelerated Concrete Core Test (CSA A23.2-25AModified)

Structure Name	Location	Concrete Core No.	Expansion(%)		
			3 Days	7 Days	14 Days
Naldöken Bridge	Abutment	3	0.225	0.318	0.418
	Pier	4	0.230	0.217	0.257
	Pier	7	0.172	0.159	0.198
	Average	-	0.209	0.231	0.291
Turgutlu Bridge	Pier	1	0.192	0.265	0.370
	Pier	4	0.105	0.204	0.259
	Abutment	5	0.235	0.285	0.316
	Average	-	0.176	0.251	0.315
Buca Motorway Bidge	Abutment	1	0.189	0.258	0.388
	Abutment	2	0.146	0.133	0.200
	Abutment	3	0.219	0.239	0.266
	Average	-	0.185	0.210	0.284
Hilal2 Vaduct	Pier8	1	0.069	0.076	0.083
	Pier7	6	0.178	0.197	0.250
	Average	-	0.124	0.136	0.166
Turan Bridge	Column	1	0.138	0.257	0.336
	Abutment	5	0.142	0.109	0.136
	Abutment	6	0.137	0.169	0.242
	Average	-	0.139	0.178	0.238



THE STUDY ON
THE MAINTENANCE AND REHABILITATION of
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AUGUST, 1996
ORIENTAL CONSULTANTS COMPANY LIMITED
in association with
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Figure - 12.6.2

Results of Accelerated Concrete Core Test (CSA A23.2-25A Modified) Testing Carried Out in KGM Laboratories Ankara, Turkey

12.6.2 Result of Testing Carried Out in Japan

Table - 12.6.3 Results of Accelerated Mortar Bar Test Carried Out in Tokyo, Japan.
Results of The Accelerated Mortar Bar Test (CSA A23.2-25A)

Sand Sample	No.	Expansion(%)		
		3Days	7Days	14Days
Sample 1	1	0.029	0.143	0.263
	2	0.028	0.152	0.274
Nif River	3	0.033	0.157	0.285
	Av.	0.030	0.150	0.274
Sample 2	1	0.020	0.113	0.237
	2	0.024	0.125	0.267
Nif Terrace 1	3	0.024	0.121	0.259
	Av.	0.022	0.119	0.254
Sample 3	1	0.024	0.118	0.244
	2	0.026	0.124	0.241
Nif Terrace 2	3	0.024	0.117	0.227
	Av.	0.025	0.120	0.237
Sample 4	1	0.239	0.415	0.502
	2	0.241	0.409	0.498
Ahmetli Gediz	3	0.247	0.425	0.525
River	Av.	0.242	0.416	0.508
Sample 5	1	0.032	0.098	0.177
	2	0.032	0.117	0.191
Gölmarmara	3	0.029	0.092	0.170
	Av.	0.031	0.102	0.180
Sample 6	1	0.087	0.156	0.237
	2	0.092	0.159	0.235
Surhanli	3	0.099	0.180	0.258
	Av.	0.093	0.165	0.244

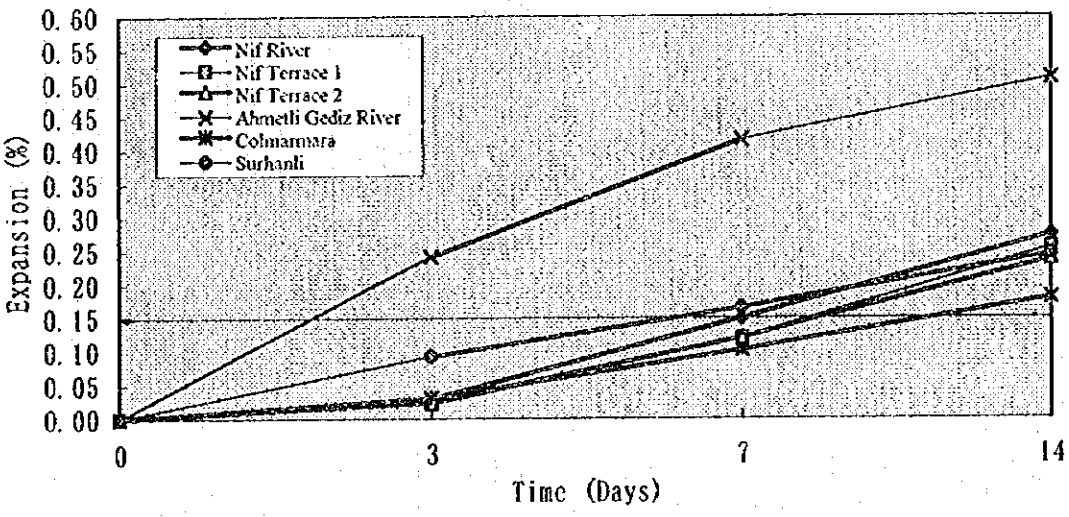

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Figure - 12.6.3

Results of Accelerated Mortar Bar Test
(CSA A23.2-25A) Testing Carried Out in Tokyo, Japan

Table - 12.6.4 Resut of The Acclerated Concrete Core Test Carried Out in Tokyo, Japan.
Result of The Accelerated Concrete Cost Test (CSA A23.3-2SA Mod. fied)

Structure Name	Location	Concrete Core No.	No.	20℃	Expansion % 80℃ 2hrs.*	Initial length	1days	3days	7days	14days
Naldoken Bridge	Pier	6	a	0.000	0.094	0.000	0.064	0.188		
			b	0.000	0.061	0.000	0.044	0.090		
			Av.	0.000	0.078	0.000	0.054	0.139		
Turgutlu Bridge	Pier	2	a	0.000	0.064	0.000	0.097	0.201		
			b	0.000	0.079	0.000	0.053	0.104		
			Av.	0.000	0.072	0.000	0.075	0.153		
Buca Motorway Bridge	Abutment	5	a	0.000	0.076	0.000	0.034	0.118		
			b	0.000	0.096	0.000	0.007	0.061		
			Av.	0.000	0.086	0.000	0.021	0.090		
Hilal 2 Viaduct	Pier 8	4	a	0.000	0.074	0.000	0.043	0.049		
			b	0.000	0.074	0.000	0.037	0.067		
			Av.	0.000	0.074	0.000	0.040	0.058		
Turan Bridge	Abutmet	2	a	0.000	0.072	0.000	0.047	0.106		
			b	0.000	0.062	0.000	0.049	0.131		
			Av.	0.000	0.067	0.000	0.48	0.119		

*Core Samples in the dry over, rapped to avoid shrinkage

12.7 Interpretation of Test Results

12.7.1 Motor Bar Tests (Accelerated)

The test results indicate that the natural sands from all six locations tested are likely to be reactive as to varying degrees all tests undertaken have reached the prescinbed expansive limit of 0.15% after 14 days when tested is accordance with CSA A23.2-25A.

The results of the mortar bar tests carried out in both counties are very similar. Ahmetli Gediz sand has been found to be the most expansive of the six sands tested being 300% above the allowable limit after 14 days. Nit Ferrace 2 sand was found to be the least expansive (when checked against the four common sands tested in both countries) but still 30% above the allowable limit.

The results indicate that all the natural sands have components which tend to be highly reactive but in differing amounts.

12.7.2 Concrete Core Tests (Accelerated)

In using this test, the testing procedure used for the mortar bar tests has been modified. This will enable a quantitive analysis of the results to be made so that a comparison can be made between the different cores recovered from the five bridges in Table - 12.3.2.

The test on cores carried out in Turkey have experienced a rapid initial expansion over the fist 3 days of immersion in the Na 0H solution. The samples then expanded at a much slower rate up to the target date of 14 days.

The tests results (Table - 12.6.2 and illustrated in Figure - 12.6.2) are results of the accelerated core tests from different parts of the substructure. These results have then been averaged to give a representative figure for that structure. Individual results from each structure have indicated considerable variance in the results.

This is possibly due to the highway variable nature of the sand used in the concrete production for the substructures. (Eg. Sec expansion results for Turan Bridge - Column and Abutment)

The test results from Japan give a much slower expansion over the initial 3 days but thereafter follow a very similar expansion rate. This is due to the fact that the core samples were placed in a dry oven at 80℃ and this gave expansions of around 0.07% prior to immersion in the NaOH. solution.

It should be noted that the results obtained in Japan vary slightly from those of obtained in Turkey this is in part due to the fact that only one sample has been tested in Japan which may have come from a concrete element containing sand from a different location than those tested in Turkey.

The results show that in all the test bridges there is still potential for further expansion. (for the samples in Tokyo and Ankara). There is also an indication that the newer structures such as Turgutlu Bridge and Naldoken Bridge has the fastest expansion potential whilst the older bridges are expanding slower.

This information reinforces the findings that the earlier action for repairs of the detected cracking the better.

12.8 Recommendations

The result to date indicate that the majority of the natural sand around the Izmir area is potentially reactive. Further testing presently being undertaken by KGM Ankara on further sand samples obtained from the Izmir area reinforces the study's findings. Some or all of the following recommendations should be implemented. The measures relate to existing and proposed bridges in the Izmir region.

12.8.1 Material Useage

1) The sand quality from the Izmir region is highly variable, even from within one source on a daily basis. Consideration should be given to temporarily banning the use of sand from the Nif and Gediz areas until an appropriate testing regime can be in place. This view is based by examining the 14 day results for the accelerated mortar bartest visual examination of the mortar bar specimens and by the results of the preliminary testing including petrographic examination of the sand. Testing may be prohibitively difficult to carry out considering the number and the sources of bulk and production.

2) Propose that crushed rock be used for the sand component of concrete mixed for new structures until a firm conclusion has been reached as to which areas produce bulk sand which is unlikely to cause AAR.

3) Discussions are held with the two local cement manufacturers to ensure that the alkali equivalent content expressed as Na O can be consistently below 0.65%. This measure in isolation will not prevent AAR but may reduce the likelihood of AAR commencing. Alternatively the use of low alkaline cements should be considered.

12.8.2 Protective Measures

1) Consideration should be given to coat the affected concrete element with an elastic crack bridging paint to prevent further penetration of water vapor into the structure. This will not stop AAR but may slow down the reaction rate (as water will be retained inside the structure). This method may be used isolation on concrete elements which have cracks up to 0.2mm in width. Alternatively epoxy based, polyurethane based or silane based coatings can be used.

2) On structures with cracks greater than 0.2mm the cracks are required to be filled with either polyurethane or epoxy based resin, by crack injection method, prior to coating as above.

3) In cases where the cracking is so severe and causing the concrete to spall, replacement of the spalled concrete is urgently required. In severe cases the replacement of the entire concrete element may be required.

12.8.3 Future Design Mixes

1) Future design mix records should include the source of all aggregates and tested for susceptibility to AAR. Once aggregate sources have been approved then the site staff should ensure that concrete is produced only with materials from the approved source. Where the quality of the aggregate source is variable then additional testing will be required to ensure the specification is achieved.

2) Adequate AAR specification clauses to be included in all future contracts containing structures.

12.8.4 Monitoring

Monitoring of the structures is essential in confirming whether the reaction has stopped or not.

During the course of the field study monitoring points were installed on three of the study bridges as shown in Appendix 9.1 (Figure-9.1.12 to to 9.1.14) inclusive. The monitoring points consisted of a mixture of strain gauge (demec) points and glass plate monitoring points. Future investigations will remeasure the width gap utilizing the strain

gauge measuring points. The A visual examination of the condition of the glass plates will (whether cracked or not) will indicate whether the reaction is ongoing or ceased.

Another way of monitoring crack propagation is to mark out a 1metre square grid on a representative section of the bridge. Cracking patterns are then drawn up on a grid bases and crack widths recorded.

Subseyment monitoring visits will identify whether the crack pattern is increasing or not.

Examples are shown is Appendix 9.1 (Figure - 11.1.16 to 11.1.19) inclusive.

Chapter 13

Conclusion

Chapter 13 CONCLUSION

13.1 The achievements

In 1995, nine foreign experts have been to Turkey to work on this project for a cumulative 26 man-months over a two periods totaling 6 calendar months. This is backed by teams of support staff in Turkey, England and Japan and additional work by the experts whilst not in Turkey. These experts have with them a wealth of expertise and practical knowledge on the subject of bridge maintenance. The three consulting firms from which the experts are from, have a proven track record and are also currently involved in a lot of similar work at home and overseas. Special care have been taken to ensure that these documents are written to cater for, as much as is possible, the locally available technology.

Collectively, alot work had been accomplished in that time and we have been able to produce comprehensive information that, we hope, will greatly assist KGM in the future maintenance and rehabilitation of the State Highway bridges. We have been able to produce for the KGM, amongst other things, the following

- a computer programme for the management of bridge data
- an inventory of 207 bridges including photos and the present condition of these bridges
- a comprehensive report on our studies including environmental impact assessment, economic assessment, planning and operation and 10 case study bridges
- a comprehensive bridge inspection manual
- a comprehensive bridge evaluation manual
- a comprehensive bridge maintenance and rehabilitation manual
- a comprehensive report on the Alkali Aggregate Reaction

The documents are formulated to suit local conditions and practices. It is hoped that these documents will be improved with the experience of KGM personnel in carrying out such work themselves and the new advancement in technology for maintenance and rehabilitation work. Certainly through the technology transfer, when staff from KGM was working closely with the team members, they will be able to carry on from where we have left them.

13.2 The required changes

After our studies of the 207 bridges, we have come to the conclusion that certain fundermental changes will be necessary in order to correct some errors that was inbuilt into these bridges that contributed to the problems we have discovered and highlighted.. The root cause must be stamped out to have any chance of managing a programme of maintenance.

1) Changes that are recommended are as follows:

Poor workmanship. Most of the damages that was observed had been as as result of poor quality workmanship and the lack of proper supervision during the initial construction. Stricter supervision should be exercised to ensure that the KGM gets what they paid for and not a permanent maintenance liability. In normal circumstances internationally, they would have

been repaired satisfactorily before the contractor is paid or issued the completion certificate. In some of the bridges inspected, the finished product would not have been allowed to be incorporated into the permanent works at all, ie demolition and reconstruction at no cost to the KGM would have been necessary. The bridges that we have inspected have been constructed over a period of time spanning at least 40 years but have exhibited similar defects. Thus indicating a change in the attitude of the engineers of all sides, particularly the KGM, is urgently required.

2) Salt attacks.

Bridges, particularly those along the Black Sea Coast, have exhibited damages that are as a result salt attack. Due care should have been taken during the design and construction stages to eliminate thses damages. The use of higher grade and properly compacted concrete have be helpful.

3) Alkali Aggregate Reaction AAR.

In the Izmir region, bridges constructed at least ten years have been detected to be contaminated with AAR materials. The existence of excessive crackings in structures was not followed up with detailed investigations and research, which could have reduced incidences of such problem bridges.

4) Increased traffic loading.

The majority of the bridges had been designed to HS20 loading. Current design vehicle loading are much higher being HS30. With Turkey's membership of the Custom Union, 40te vehicles will be more prevalent on the state highway. Also it is generally observed that the vehicles in Turkey are more heavilly laden. The result is additional stress to the bridges, making it unsafe. Measures should be considered for stricter control of over weight vehicles and general strengthening of bridges.

5) Lack of maintenance.

The level of maintenance of bridges is inadequate. It is inderstood that the main reason for such defficiency is due to the lack of available funds in the highway budget. As a consequence, our study have concluded that approximately 20% of the bridge stock belonging to the KGM are in need of urgent maintenance. Priority should be given to maintenance as it is the nations valuable asset.

6) Vehicular collision.

The main problem seems to be vehicular collision with bridge superstructure and piers, with the former being more serious. This is a problem that could have been eliminated in the design stages with the provision of adequate headroom or adequate safety fencing and clearance to supports.

7) Scour to foundation.

The hydraulic and structural consideration have in alot of incidences, can be considered inadequate. Foundations could be in deeper bearing strata. The hydraulic opening is restricting flow, leading to flood and excessive energy in the water. Foundations are exposed as a result and decks risk being washed away. In some incidences, the extraction of river bed aggregates in the vicinity of the bridges have directly contributed to the scour of the foundations. Considerations should be given to safer design and effective measures of river management.

13.3 Conclusion

The study had indicated that adequate bridge maintenance is urgently required for some 20% of the bridge stock and necessary routine maintenance for the others before it deteriorates further. The state highways are an essential means of transport for the betterment of the nations economy. The public deserves safe passages on these state highways. Hence it is the responsibility of the KGM to deliver the standard of services that is required and expected of them. Attitudes must change and KGM must expect better quality work to be delivered by their consultants and contractors, at a fair price, and with minimum maintenance liability as is at present. More money must be found for maintenance and successive government must be convinced to invest more in protecting the nations investment in transportation infrastructure.

It is the expressed wish of the study team and JICA that the KGM should benefit from the work that had been carried out and the donations of vital equipments. We hoped to have provided KGM with the means to continue to manage the stock of bridges by the provision of an adequate bridge data system and a regular maintenance programme.

13.4 Acknowledgement

The study team sincerely acknowledges the vital support and assistances provided by KGM. The personal interest in this work by the General Director, Mr Dincer YIGIT, is most reassuring and we are most honoured. There are too many other names to mentioned for there invaluable contributions. We would simply like to thank all KGM staff who has been involved in this study, directly and indirectly, for without their continual support this study would not have been possible. For those study team members who had been to Turkey for the very first time, it will be the most memorable one. We hope that we have successfully completed the technology transfer and gratefully acknowledges that KGM staff had successfully completed the cultural transfer. We hope to be back for future assistances.

Tesekkur ederiz ve Hoscakal!