Maintenance, the Regional Divisions have now included the position of an inventory engineer in their organisation. The sole purpose is to continually update the data and to prepare for the adoption of a revised inventory system. At the present moment, it is only a "card system".

The existing inventory system contains only the basic information with no details of the bridge components, installation and repair history. It forms a good basis from which a good computerised data based system can be set up. Archived photos and some design data are available and can be very useful for purposes of bridge assessment and evaluation. A copy of the existing bridge inventory (and the translation) is attached as Figures - 3.2.3to 3.2.7.

3.2.4 Maintenance management and operation

At the present moment, there are no formal maintenance management and operation system for used on the State Highway bridges. None of the divisional directorates have any routine inspection activities in place. The only inspections that has ever carried out are as a result of reported failures as sighted by colleagues or motorists, after traffic accidents and after natural disaster. None of the staff have ever been trained on the aspects of bridge inspection, routine maintenance and essential repairs techniques and materials. The maintenance organisation are mainly geared to highway maintenance and not bridge maintenance. It is the belief that a special bridge maintenance team will be necessary to handle the routine maintenance activities.

The decision on the priority of repair is essentially based on the catalogue of recorded damages and emergency needs. If there is sufficient funding, the repair work is normally let to a contractor after a competitive bidding process. The supervision is provided by the responsible KGM Regional Divisions and the use of consulting engineers is only in the most exceptional case. This is because the KGM considers themselves capable of carrying out the majority of supervision work.

In recent times, there has been a shift of emphasis for the highway repair works to be carried out by the private sector instead. The main reasons are the high cost of labour and the difficulties in achieving economy with a large permanent labour force. There is even a thought that the services for routine maintenance and repairs may be privatised.

3.2.5 Bridge maintenance facilities

The facilities available for carrying out maintenance work can be found at all the maintenance compound of the Regional Divisions. Generally the facilities are inadequate and the availability varies for each of the Regional Divisions depending on the demand of the network. Most of the facilities are normally shared with other maintenance disciplines within the division. Expensive equipment, such as the underbridge inspection platform, had to be shared nationally although it will be based at a particular Regional Division. In practice, this has not been possible as the only underbridge inspection platform available has been actively engaged at the 17th Division, where it is based, and at the neighbouring 1st Division.. Two other underbridge inspection platforms are now available and it is hope that it will provide the required services nationally. As most of the major repair work are contracted out to the private sector, the need for machinery and equipment for bridge maintenance is limited.

KARAYOLLARI GENEL MÜDÜRLÜĞÜ
Köprü Bakım Fen Heyeti Müdürlüğü

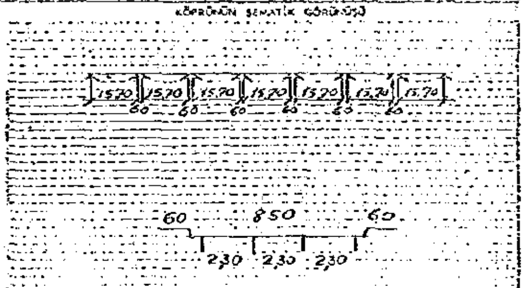
7581120 — KÖPRÜ ENVANTI : ARAZİ KARTI

KÖPRÜ SIRA NO: 13

KÖPRÜNÜN	PROJEDEKİ ADI	ÇANDIR (HASANPAŞA)
	MAHALLİ ADI	
ARABA SAYACI DEĞERLERİ	K. KESİMİ BAŞLANGIÇ YERİ VE Km Sİ	
	KÖPRÜ YERİ Km Sİ	
	K. KESİM SONU Km Sİ	
	ÖNEMLİ NOKTALARIN Km Sİ	
KÖPRÜNÜN BULUNDUĞU YER	BÖLGE No.	14
	K. KESİM No.	02-05 (200-06)
	K. KESİM UZUNLUĞU VE KÖPRÜ YERİ Km Sİ	
	İLİ	Bursa
	YOLU	İnegöl – Bozüyük
KÖPRÜNÜN KATETTİĞİ	SU ADI VE DÖKÜLDÜĞÜ NEHİR VEYA DENİZ	Çandır
	YOL ADI	
	DEMİRYOLU ADI	
KÖPRÜNÜN	CİNSİ	B.A.
	TİPİ	Basit Kiriş
	DÖŞEME UZUNLUĞU(m)	113,85
	Mesnetler arasındaki en uzun açıklık (m)	15,70
BİLGİLERİN ARAZİDE ALINDIĞI TARİH	9/5/1973 FİLM No. 598 POZ No. 5-7 İnegöl	
Bilgileri alanın	ADI - SOYADI - POZİSYONU	Ekrem Demircioğlu

KÖPRÜYE AİT GENEL BİLGİ	VEREVLİK	15°
	DÖŞEMENİN CİNSİ	B.A.
	KİRİŞİN CİNSİ	"
	AYAK YAPISI	B.A. Kolon
	TEMEL YAPISI	
	YAKLAŞIK TONAJI	H20-S16 Beton: Wb28=225 kg/cm² Çelik: St37
	YENİ X 1972 / İYİ X; ESKİ ☐ / ORTA ☐; TARİHİ ☐ / FENA ☐	
	ONARIMA İHTİYAÇ VAR MI?	VAR ☐ YOK X
	ONARIMA İHTİYAÇ VARSA YERİ	

KÖPRÜNÜN ŞEMATİK GÖRÜNÜŞÜ



YENİ KÖPRÜYE İHTİYAÇ VAR MI? VAR ☐ YOK X

Emanet

Figure - 3.2.3 Typical Bridge Inventory Card - Card 1 Page 1 - TRANSLATED

(I

GENERAL DIRECTORATE OF HIGHWAYS
Directorate of Bridge Maintenance and Science Committee

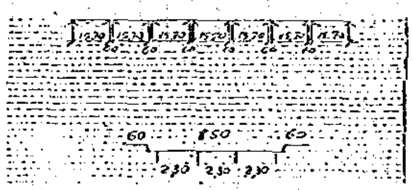
7581120 - BRIDGE INVENTORY FIELD CARD

BRIDGE SERIAL NO

BRIDGE	PROJECT NAME	ÇANDIR (HASANPAŞA)
	LOCAL NAME	
VEHICLE COUNTER VALUES	HIGHWAY SECTION STARTING POINT AND km	
	BRIDGE LOCATION km	
	HIGHWAY SECTION END km	
	IMPORTANT POINTS km	
LOCATION OF BRIDGE	DIVISION NO.	14
	HIGHWAY SECTION NO.	02-05 (200-06)
	LENGTH AND HIGHWAY SECTION BRIDGE LOCATION km	
	PROVINCE	Bursa
	HIGHWAY	İnegöl – Bozüyük
PASSED	WATER NAME AND THE RIVER OR SEA IT FALLS IN	Candir
	HIGHWAY NAME	
	RAILWAY NAME	
BRIDGE	KIND	R/C
	TYPE	Simple Girder
	SLAB LENGTH (m)	113.85
	LARGEST SPAN BETWEEN SUPPORTS (m)	15.70
DATE OF FIELD DATA COLLECTION	9/5/73 FILM No: 598 POSE No: 5-7	
Data Collector	NAME - SURNAME - POSITION	Ekrem Demircioğlu

GENERAL INFORMATION ABOUT BRIDGE	SKEWNESS	15°
	KIND OF SLAB	R/C
	KIND OF GIRDER	R/C
	PIER STRUCTURE	R/C Column
	FOUNDATION STRUCTURE	
	APPROXIMATE TONAGE	H20-S16 Conc: Wb28=225 kg/cm² Steel: St 37
	NEW X; OLD O; HISTORICAL ☐ / GOOD X; MEDIUM O; BAD ☐	
	IS REPAIR NEEDED?	YES ☐ NO X
	IF REPAIR IS NEEDED, ITS LOCATION.	

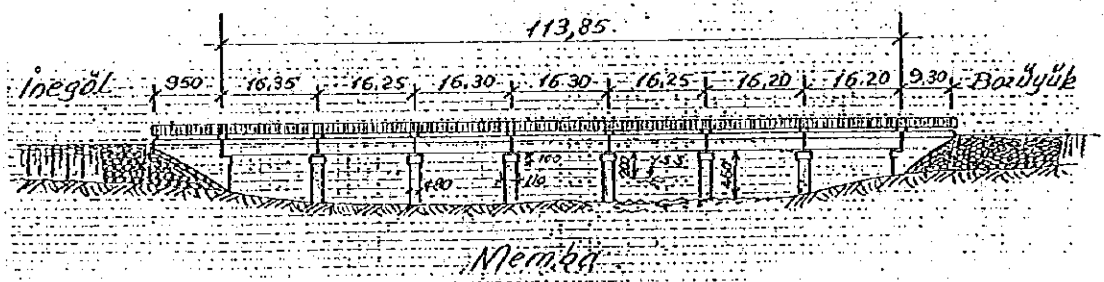
SCHEMATIC VIEW OF THE BRIDGE



NEW BRIDGE NECESSARY? YES O NO X

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 - 3.2.3 Typical Bridge Inventory Card - Card 1 Page 1

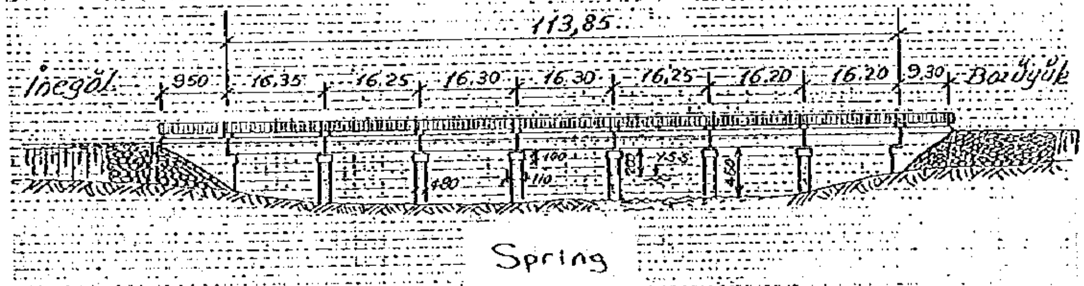
BOYUNA KESİT :



Genel notlar :
Y. Su seviyesi : Yok A. Su seviyesi : Yok .... Debiye kâfimi : Evet ☒ Hayır ☐
Temelde oyulma : Var ☐ Yok ☒ Temelde oyulma var ise onarımı acilmidir. : Evet ☐ Hayır ☐
Tahkimat durumu : İyi ☒ Orta ☐ Fena ☐ onarımı acilmidir. : Evet ☐ Hayır ☐
Pere durumu : İyi ☒ Orta ☐ Fena ☐ onarımı acilmidir. : Evet ☐ Hayır ☐
Anrojman lüzumlu mu : Evet ☐ Hayır ☒ onarımı acilmidir. : Evet ☐ Hayır ☐
Mesnetler durumu : İyi ☒ Orta ☐ Fena ☐ onarımı acilmidir. : Evet ☐ Hayır ☐
Pandüller : İyi ☐ Orta ☐ Fena ☐ onarımı acilmidir. : Evet ☐ Hayır ☐
Kirişler : İyi ☒ Orta ☐ Fena ☐ onarımı acilmidir. : Evet ☐ Hayır ☐
Döşeme : İyi ☒ Orta ☐ Fena ☐ onarımı acilmidir. : Evet ☐ Hayır ☐
Demirler görülüyor mu : Evet ☐ Hayır ☒ Gargoylar çalışıyor mu : Evet ☒ Hayır ☐
Çelik aksam ve korkuluklar : İyi ☒ Orta ☐ Fena ☐ Boya durumu : Boyalı ☒ Boyasız ☐
Diğer notlar :

Figure - 3.2.4 Typical Bridge Inventory Card - Card 1 Page 2 TRANSLATED

LONGITUDINAL SECTION:



General Notes
High Water Level : Figure, Low Water Level : Figure, Water Area Sufficient : Yes ☒ No ☐
Scour in the Foundation : Yes ☐ No ☒ If yes, is repair urgent? : Yes ☐ No ☐
Fortification Condition : Good ☒ Medium ☐ Bad ☐ Is repair urgent? : Yes ☐ No ☐
Riprap Condition : Good ☒ Medium ☐ Bad ☐ Is repair urgent? : Yes ☐ No ☐
Riprap required? : Yes ☐ No ☒ Is repair urgent? : Yes ☐ No ☐
Support Conditions : Good ☒ Medium ☐ Bad ☐ Is repair urgent? : Yes ☐ No ☐
Rocker Condition : Good ☐ Medium ☐ Bad ☐ Is repair urgent? : Yes ☐ No ☐
Girder Condition : Good ☒ Medium ☐ Bad ☐ Is repair urgent? : Yes ☐ No ☐
Slab Condition : Good ☒ Medium ☐ Bad ☐ Is repair urgent? : Yes ☐ No ☐
Rebar Exposed? : Yes ☐ No ☒ Gullies work? : Yes ☒ No ☐
Balustrades and Steel Parts : Good ☒ Medium ☐ Bad ☐ Paint condition : Painted ☒ Not Painted ☐
Other Notes :

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 LINTED	Figure - 3.2.4 Typical Bridge Inventory Card - Card 1 Page 2

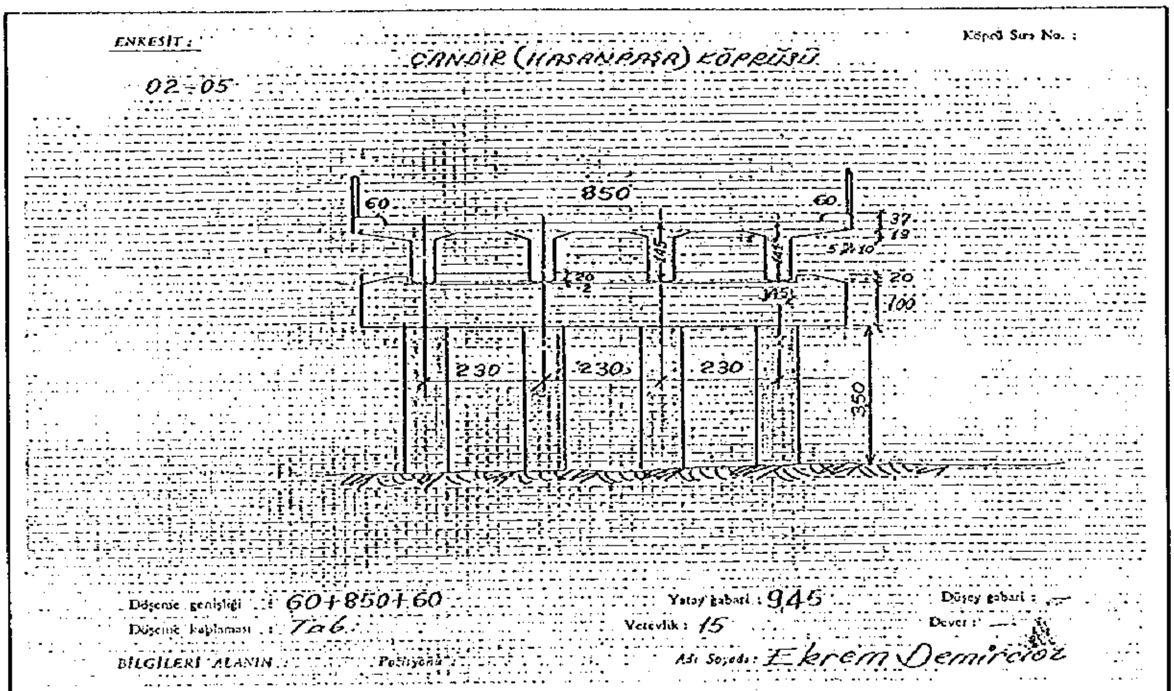
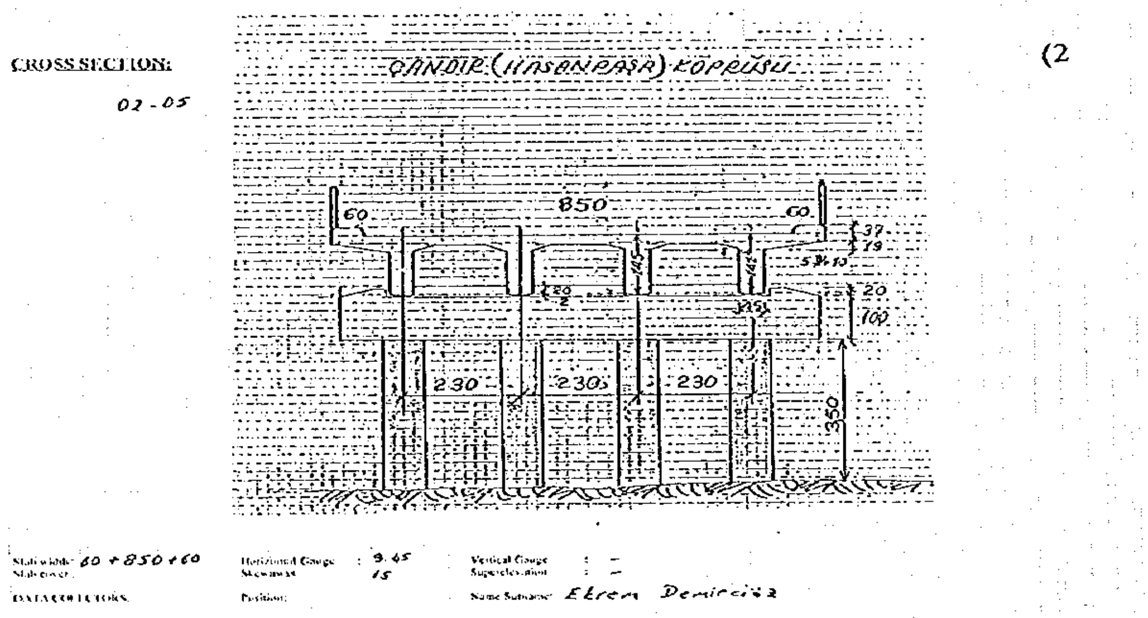


Figure - 3.2.5 Typical Bridge Inventory Card - Card 2 Page 1 TRANSLATED



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 - 3.2.5 Typical Bridge Inventory Card - Card 2 Page 1

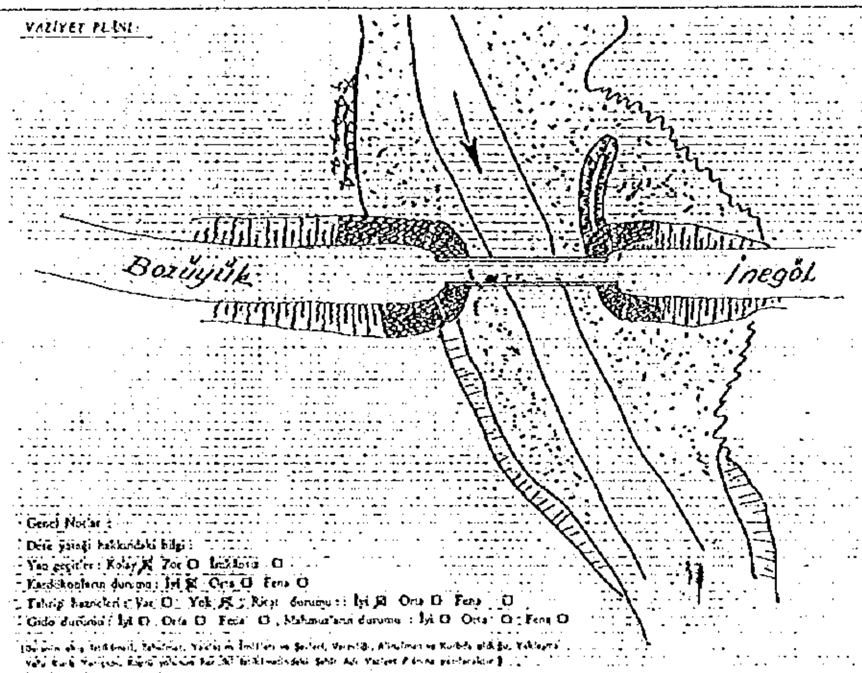
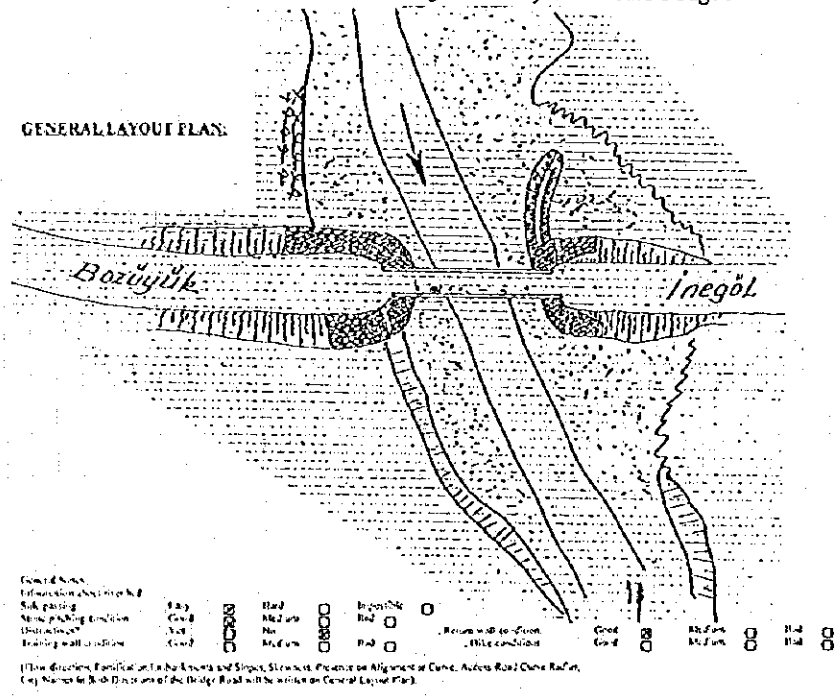
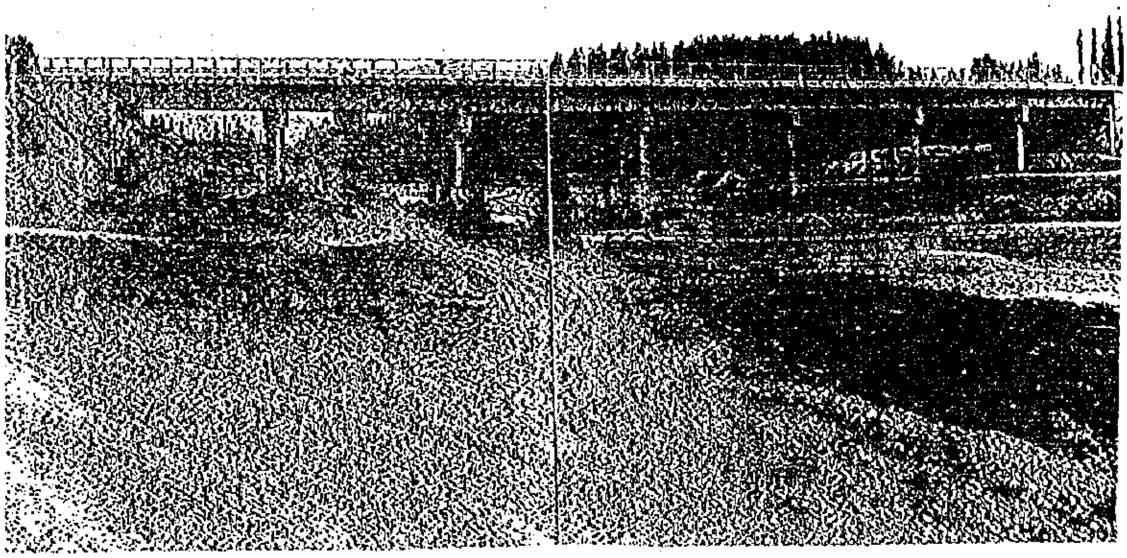


Figure - 3.2.6 Typical Bridge Inventory Card - Card 2 Page 2



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 - 3.2.6 Typical Bridge Inventory Card- Card 2 Page 2



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 LINTED	Figure - 3.2.7 Typical Bridge Inventory Card-Photo of Bridge Elevation

The facilities that should be available at the maintenance compounds can be as follows:

- basic bridge list and/or inventory data - containing little information.
- some as built drawings
- basic traffic management equipment such as cones, temporary signs
- safety equipment such as helmets*, reflective jackets*
- lamp cranes
- vehicles for transport
- access ladders
- testing laboratory

* available but seldom used

Facilities that are available at the KGM General Directorate and certain regional maintenance compounds only are:

- borehole drilling rigs
- computers for bridge maintenance engineers
- underbridge inspection platforms
- remote control hydraulic jacks
- schmidt hammers
- concrete cover meters

The KGM are trying to organise themselves such that a complete and up to date bridge inventory data of all the bridges available in the Regional Divisions are available locally. To achieve this, additional resources (including training) and computing facilities will be necessary. The present main frame computer system is too slow and is hardly used. As a start, a position for an Inventory Engineer has recently been created in the bridges department of the Regional Divisions. Unfortunately the position is still vacant for most of the Divisions as the necessary funding is not available.

3.3 Regulation, Specifications and Guidelines

3.3.1 Related Law and Regulation

The Law defining the establishment and responsibilities of the KGM is defined in the Road Law No 5539 - *Karayollarý Genel Müdürlüðü, Kurulup ve Görevleri Hakkýnda Kanun* dated 16th Feb. 1950. There are also other provisions in this Law such as that described in section 3.1.2

There are certain Law and Regulations concerning the operation of the KGM with regards to the letting of tenders. Of particular importance are the Bidding Law No 2886 (*2886 Sayýlý Devlet Ýhale Kanunu)* and the Regulations for the participating of tenders for the construction and repair works *(Yapý Tesis ve Onarým Ýsleri Ýhalelerine katýlma yönetmeliði)*. This is the applicable statute governing the tenders of all State Highways' works. Due to some extenuating circumstances, a decree can be issued by the government to cover certain aspects that are not covered by the Law. Such is the Decree No 88/13181 - Decree on price difference (*Fiyat farký Kararnamesi)* issued on 28th July 1988. The decree was further superseded by a special Decree No 94/6019, only applicable for 45 days from its issued date, to give contractors/consultants a choice of either

a. terminating their contract without repercussion , i.e. loss of performance bond

b. continue with existing contract with compensation as detailed in this Decree or

c. to continue with the contract and be paid an escalation on the original contract price.

This special decree was the result of the Government's 5th April 1994 package to control the economy of the country, resulting in unforeseen huge tax increases on a number of essential items which are also applicable to the construction industry.

Other Laws which governs the employees are the Labour Law No 5521 *(Ýþ Mahkemeleri Kanunu)*, Social Security Law No 506 *(Sosyal Sigortalar Kanunu)* and Strike and Collective Agreement Law No 2822 *(Toplu Ýþ Sözleþmesi, Grev ve Lokaut Kanunu)*. In these laws the rights of the employees are safeguarded. Such conditions as the existence of a labour union, minimum wage, working hours, holidays, strike action, lockout, retirement, insurance, health and safety at place of work et cetera are spelt out. However, the right to strike for the State employees are excluded.

3.3.2 Materials

Materials and the methods for testing of the materials for use on KGM projects are normally in accordance with Turkish Standards (TS). The development of the Turkish Standards have primarily been adapted from the American AASHO and ASTM although some other standards, such as from German DIN NORM and the British Standards BS have also been included. To date, the Turkish Standards Institute (TSE) have published a considerable range of standards covering the use of local materials, its manufacture and testing. Where a particular Turkish standard is not available, the KGM will normally refer to a relevant foreign standard (in its entirety) as being applicable.

A lot of the materials produced in Turkey for local consumption, are also in compliance with the standards of the export markets. In other industries, compliance with the European Standards, Euro Norm (EN),has also been achieved. The idea behind this is to enable Turkish products to be exported and be competitive within Europe.

3.3.3 Design

The technical specification governing the design of State Highway bridges are given in the Technical Specifications for Road Bridges (*Yol Köprüleri için Teknik Partname)*, published in 1982. The Specification covers the design loading particular to Turkey and the allowable limits for the varies categories of materials such as timber, concrete and steel. As with the Specification for materials, it allows for the substitution of foreign Specification if the materials are not covered or if it is a special bridge or when the span of the bridge is large (although the limit is not defined), provided that is acceptable to the KGM's bridge department. Presently the State Highway bridge design division uses the local Specification for the loading and geometric criteria only and the American Specification AASHTO for all other requirements.

To date KGM have been responsible for the design of all the State Highway bridges except for the one which was funded by the World Bank or the design had been let together with the road project. In the case of the World Bank funded project, the criteria for the selection of a firm of consulting engineer is based on the rules of the Bank. As for the other, the process for selection is as follows:

a. A public announcement will be made in the official paper (*Resmi Gazete*) giving a brief description of the scope of the works and calling for the expression of interests. Normally opened to Turkish registered consultants only.

b. Prequalification of Consultants. The evaluation will be done by a tender committee and be based on such factors as firm's financial strength, work experience, no of years since establishment, similar works undertaken, technical personnel, facilities (computing, drafting etc.), past performance and recommendations from clients. Firms will be evaluated out of possible 100 points.

c. Firms scoring higher than 85 points (varies depending on decision) shall be invited to tender.

d. The financial proposal of the eligible firms will be averaged and multiplied by a factor of 1.1 (again varies depending on decision) and the nearest offer is awarded the work.

For specialist work requiring expert consulting firm, the firm can be directly invited to tender and/or to enter into direct negotiation for the project by the KGM. All these methods of selecting an appropriate consulting firm are within the scope of the Bidding Law 2886.

3.3.4 Manufacturing

Turkey is producing a considerable quantities of the basic construction products both for export and for local consumption although it is not self sufficient and had to rely on imports to suffice the needs. Particularly so are the manufacturer of rebars, cement and prestressing strands (although the wires have to be imported). This has been boosted by the boom in the private sector construction work.

In recent years there has been an increase in the numbers of bridges that has been constructed with precast concrete elements. More companies are now producing precast elements as part of their core business. The method of casting is sophisticated, with the use of steam curing techniques to produce consistent quality products economically. Some manufacturers are even ISO 9001 certified. Typical bridge elements manufactured are precast and prestressed 'I' beams. KGM have issued standard drawings for four categories of beam lengths and manufacturers in varies cities have the formwork for its fabrication. The four categories covers beam lengths from 13 metres to 25 metres. Longer and less common lengths may be accommodated by the manufacturer by prior arrangement.
Associated with the concrete product is the readily available supply of ready-mix concrete for the construction sites. Ready-mix concrete can be supplied by numerous companies are in conformity with the Turkish Standards.

Fabricated steel bridges are still not very popular except for the large bridges. The reasons are the higher capital cost associated with steel construction and the perceived high cost related to the maintenance of steel bridges although facilities for fabrication are available.

3.3.5 Construction

The Specification for construction of highways and bridges on the State Highways are contained in the document called Technical Specifications for Roads - for the works of Roads, Structures, Bridges, Tunnels and Pavement Structures *(Yollar Fenni Þartnamesi - Yol altyapýsý, sanat yapýlarý, köprü, tünel ve üst yapý iþleri)* as published by the KGM. The Specification is not rigid and it leaves a lot of the specifying to the disgression of the designer. This is particularly useful because new products such as epoxy grout, elastomeric bearing and specialist precast elements which are not included in the Turkish Specification can, in the appropriate circumstances, be used.

Contractors wishing to participate in the work programme of the KGM will have to apply for classification in the first instance. The criteria for the evaluation are similar to those for the consultants. At the end of the evaluation by the KGM tender committee, the contractor will receive a certificate indicating the category awarded, which represents the capability of the contractor to undertake related KGM projects. There are three categories as far as the construction work is concern. Each year the Ministry of public Works and Settlement will set the limits of the works that can be undertaken by each of the three categories. The 1995 limits are as follows:

a. Category A - from 100,641,600,000 TL

b. Category B - from 12,580,200,000 TL to 100,641,600,000 TL and

c. Category C- to 12,580,200,000 TL

For specialist work requiring expert contractors, the contractor can be directly invited to tender and to enter into direct negotiation for the project by the KGM. Normally the contractors are requested to gýve a pecentage discount on the total contract price derived from the estimated quantity and using the standard unit rates as published by the Ministry of Public Works and Settlement. Lowest offer is normally chosen. All these methods of selecting an appropriate contractor are within the scope of the Bidding Law 2886.

3.3.6 Operation and maintenance

There are no official Specifications or Guidelines regarding the aspects of operation and maintenance of bridges. As far as the assessment of bridges are concerned, the Technical specifications for Road bridges is applicable. However, there are neither guidelines as to how the existing conditions should be treated nor are there any criteria on the allowable stresses that should be used. It can only be assumed that the applicable loading criteria is to be used and the other interpretations shall be in accordance to AASHTO. No bridge assessment work has ever been carried out by the KGM. The decision on the fate of any existing bridges has always been by sight and the experience of the responsible bridge engineer.

Chapter 4

Inspection and Maintenance Concepts

Chapter 4 Inspection and Maintenance Concepts

4.1 Objects of Inspection and Maintenance

4.1.1 Purpose of Inspection

Inspection of highway bridges is conducted for precise understanding and judgment of a roadway for the purpose of keeping it in a good condition through maintenance and thus avoiding hazards to vehicular traffic and to third parties.

Maintenance work must be carried out effectively. Inspection is the first work to grasp the problem of the bridge and its condition. These vital information will influence the selection of proposed countermeasures such as repairs. Therefore, attention must be given not only to the damage of bridge and how it has been used but also to the traffic condition. Furthermore, the effects of deteriorated bridge structure and facility to the third party should also be considered.

4.1.2 Purpose of Maintenance and Repair

The existing state highway network is playing an important role as the main artery for vehicular traffic in Turkey. It is also expected that this role will become more vital in the future, together with higher economic growth in the country.

The maintenance and repairs to the highway bridges shall be carried out to maintain an efficient level of service, to protect the public from accidents and to fulfill its functions as follows:

deterioration or discoloration on a structure is not an attractive sight and is a blot on the landscape.

It will be possible to minimize the maintenance costs and obtain the higher benefits to both users and KGM itself over an extended period of time by attaining the above objectives.

4.1.3 Systematization of Maintenance

The inspection and maintenance system focuses on improving and enhancing maintenance work by standardizing and systematizing information and work procedures for bridge maintenance.

The system aims to achieve its stated objectives using inspection and repair manuals and computer databases to handle maintenance work from after the construction stage through to the inspection, repair and improvement stages. An inventory database is established after construction while inspections and repairs are carried out efficiently with the aid of manuals and information stored in the same database. This will lead to rationalization and improvement of maintenance work as shown in Figure - 4.1.1.

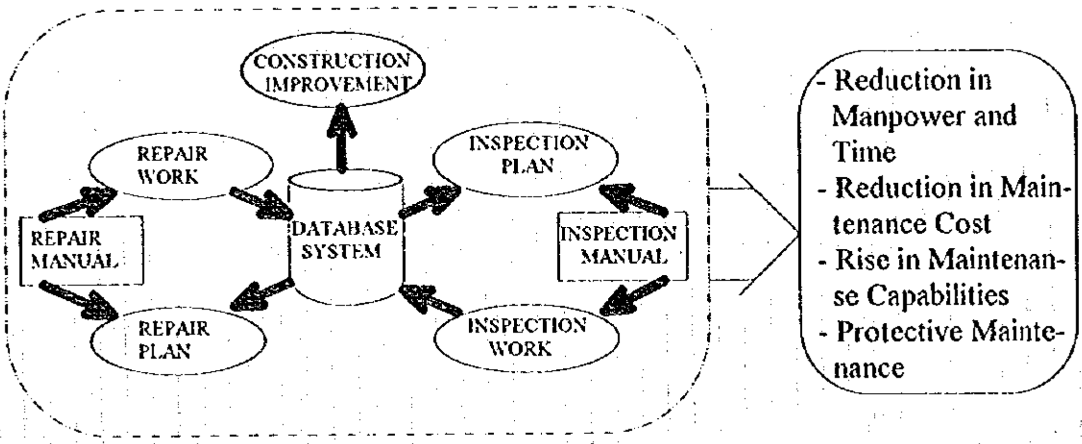


Figure - 4.1.1 Systemalized Maintenance Work Flow

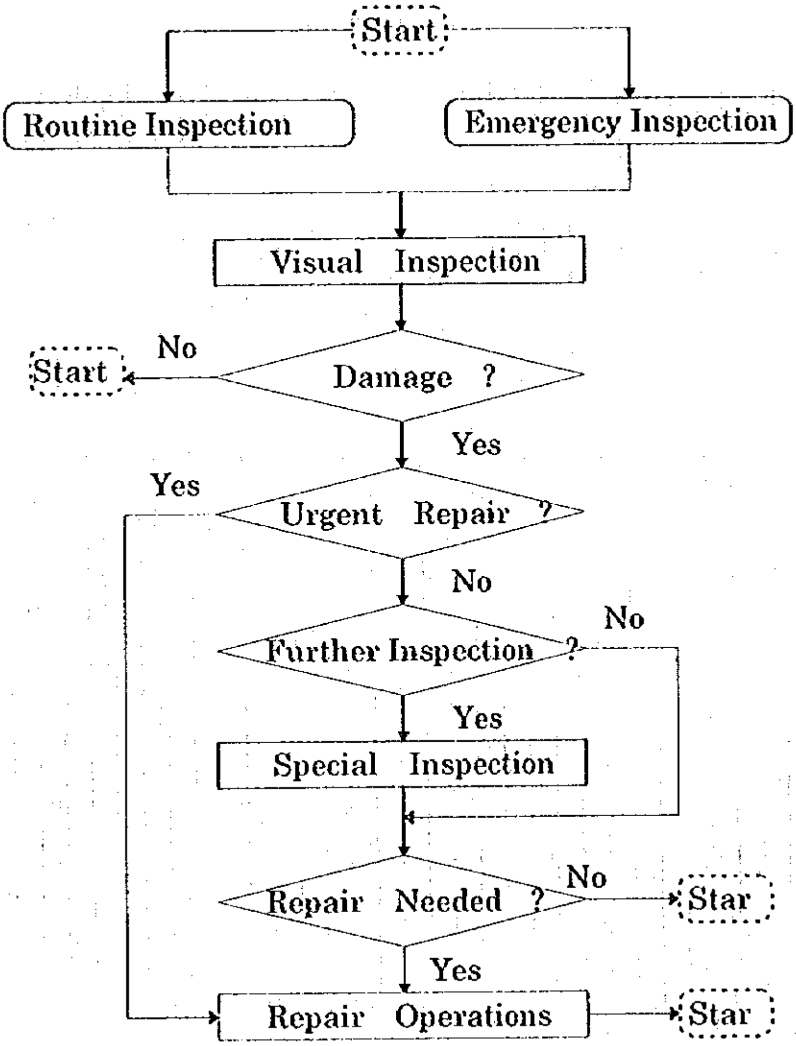
This system will result in assisting social and economic growth of Turkey with improvement in maintenance capabilities of the state highway network.

4.2 Inspection and Maintenance Framework

4.2.1 Work Flow

Maintenance work on highway bridges is conducted to keep them in good condition in order to achieve smoother vehicle traffic flows and to preserve public property for a longer period of time. Maintenance work is composed of inspection and repair work, and is shown in the flow chart of Figure - 4.2.1.

An inspection is first carried out to grasp the condition of highway bridges, which



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 - 4.2.1 Inspection and Maintenance Procedures

influences further measures such as the repairs to be undertaken for damaged bridge components. Therefore, attention must be given not only to damages but also to the causes of damage and their effects on traffic.

Routine inspection forms the basis of the inspection manual and it is carried out as a preventive maintenance measure for highway bridges. All inspection results of the bridge components are stored in the database, even when no damage or defects are found.

When damage or deterioration is found by a routine inspection, the work procedure differs depending on whether it is a primary or secondary member of the bridge and are discussed as follows:

- Damage to Primary Members

  When damage or deterioration is as serious as that of Rating A (urgent repair needed, see Sect. 4.3.2), urgent repairs shall be performed as soon as possible.

In the case where damage on a major bridge component such as a superstructure or pier is as serious as that of Rating B (repair needed, see Sect. 4.3.2), further investigations may usually be carried out to as certain the causes and effects of the damage by special inspection work as described in the inspection manual.

When damage or deterioration is that of Rating B, whether to carryout repairs shall be determined based on the basic concepts for damage ratings, which gives priority to the following 4 functions:

- influences on traffic and third parties,
- the functionality of bridge components,
- the durability of bridge, and
- the annual repair plan, budgets, repair methods, etc.
- Damage to Secondary Members

When damage or deterioration is as serious as that of Rating A, urgent repairs shall be performed as soon as possible without any further inspection on secondary members such as railing, expansion joints and pavement on the bridge.

Observations from inspections and repairs are stored in databases based on measures and procedures described in the manuals on inspection, maintenance and repair. Users can retrieve and output information stored in the database in the form of road inventory, inspection and repair reports to assist them with their maintenance work.

4.2.2 System Framework

1) System Components

The highway bridge inspection and maintenance system plays an important role for engineers in the road maintenance, management and operation. In order to apply the system effectively for the practical maintenance work of the bridge, the system is subdivided into subsystems as shown in Figure - 4.2.2.

The inspection and maintenance system for the highway bridge consists of a database to manage maintenance information and manuals to assist KGM engineers with inspection and maintenance work as below:

- Inspection manual is formulated to assist inspection engineers with routine, and special inspection work for the highway bridge.

- Evaluation manual provides methodology to prioritize damaged bridges for rehabilitation and strengthening to the damaged components.

- Maintenance manual is drawn up so it can be applied to the bridge maintenance in routine works on cleaning and other protective operations, including minor repairs such as spot painting or protective coating.
- Rehabilitation manual provides repair methodology on rehabilitation, strengthening and improvement measures for damaged bridge or its components.

2) Database Framework

a) Structure of Database

The database as shown in Figure - 4.2.3, which is composed of inventory, inspection, and repair information together with their operating applications.

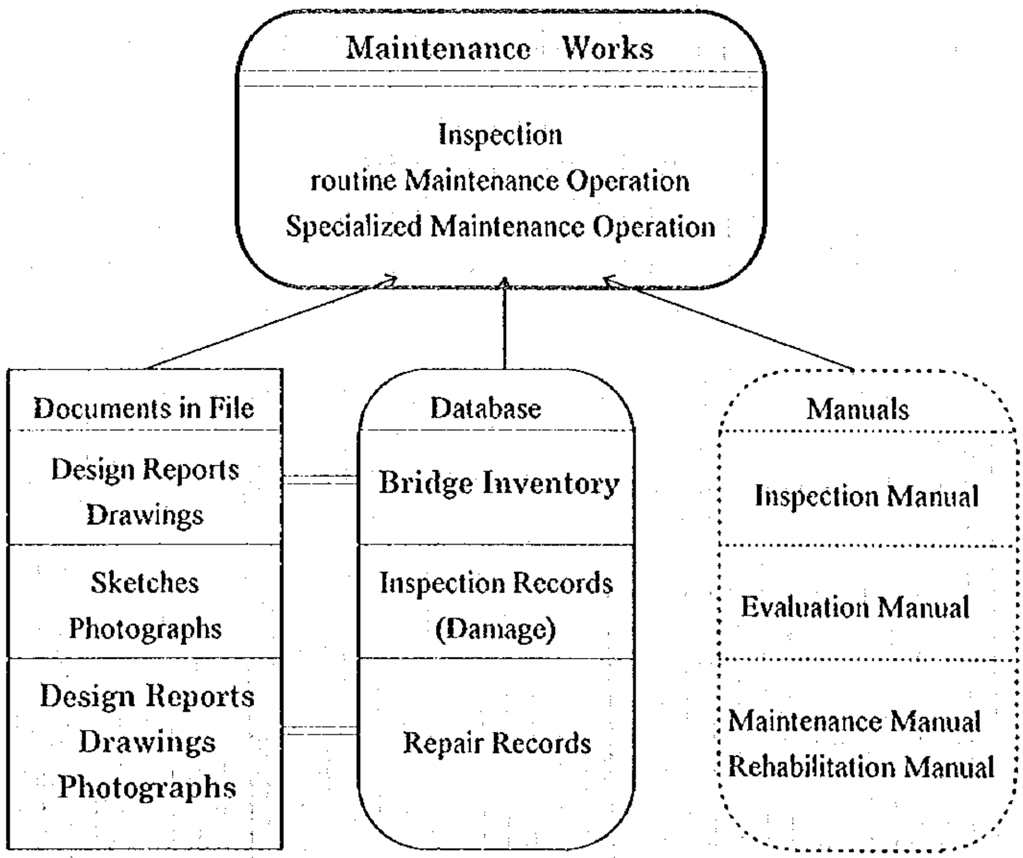
The database compiles all the information necessary to manage highway bridges in the form of a single database file, taking into consideration the easier access and information management by unskilled operators.

Although the database is formulated not to compile the whole data necessary for bridge maintenance (such as photographs, figures and other detailed information obtained in maintenance work) the system is designed in such a way that the related information for maintenance work can be interfaced with key identifiers and record number by work.

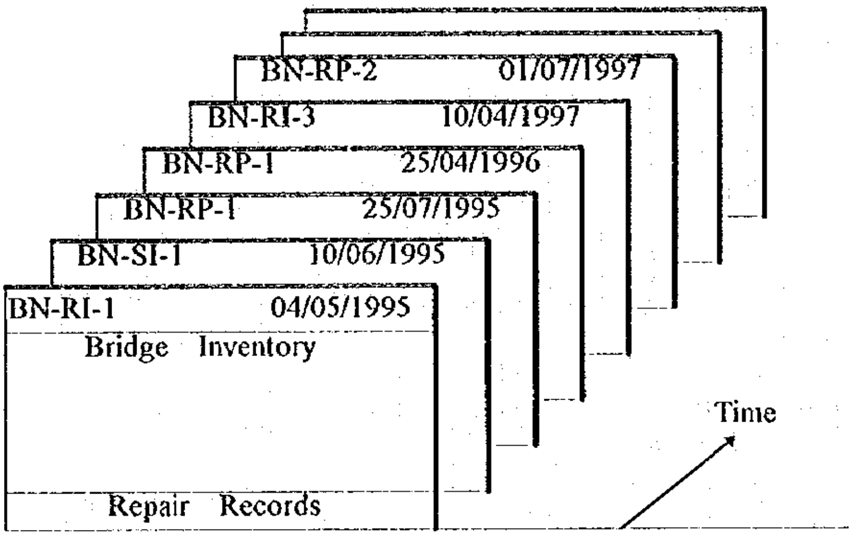
b) Key Identifiers

Database files are similar to a table that consists of columns and rows. Columns are called a field, which corresponds to data items. Rows are called a record, which corresponds to a collection of data belonging to a common key identifier, such as one bridge in a database file. Key identifiers distinguish specific data record from other records in a database file. The whole database for maintenance work possesses several items with key identifiers at the head of each record. Consequently, every record has particular key identifiers to access and extract data from a database.

Key identifiers for the database, which is written into each data record in a form of sheet number, are defined as indispensable items with supplemental items to identify maintenance work conducted and bridge location on the highway. They are composed of 4 items and their combinations are as follows:



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 - 4.2.2 System Framework



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 - 4.2.3 Database Framework (Image)

- Bridge Number
  Bridge number, which is composed of 3 items; route number, highway division in charge and unique bridge number within the above location, which identifies each bridge on the highway.

- Work Category
  Maintenance work in terms of inspection and repair, is to identify maintenance operations conducted for a designated bridge. They are categorized in the following character codes:

  RI: Routine Inspection
  SI: Special Inspection
  RP: Repair

- Ordinal Number
  This item is to identify page (number) in the same combination of the above bridge number and work category, using the ordinary number in a form of 1, 2, 3, and so on.

- Updated Date
  This item is to identify the latest inventory data for a designated bridge in the database file.

According to the above key identifiers in each record in the database, the system can store, copy, and readily retrieve information necessary for information processing.

c) Data Items (under working)

The data items of the database for bridge maintenance on the state highway are determined in consideration of:

- Characteristics of the existing bridges on the highway,
- appropriate data volume to be managed by micro-computer basis,
- effective usage of maintenance work, and
- appropriate data volume to be maintained by KGB staff itself, etc.

The details of the items for database is presented in Table - 4.2.1.

Key identifiers are set up to identify designated data records in the database. Attributive data are information essential to store into a database for maintenance work belonging to a collection of key identifiers. In Table - 4.2.1, abbreviation and marks shows the following:

- Type (type of data): X : character data,
  N : numerical values.

- Digits: number of digits of the item.
- 'code' in remarks is a code item which is provided in character or number code

Table - 4.2.1 Data Items of Database (1/3)

Item	(Name)	Type	Digits	Remarks
(Key Identifer)				
Route		N	3	
Kilo-Post		N	6	
Sub-Division		N	2	by Traffic Direc.
Work Category		X	2	Code
Date of Work		N	6	MM/YY
(Bridge General)				
Bridge Name		X	20	
KGM-Division		N	3	
Division		N	3	
Name of River		X	20	
Design Spec. & Load		X	2	Code
Bridge Length		N	7.2	
Span Composition		X	25	
Carriageway Width		N	5.2	
Side Walk Width		N	5.2	
Skew Angle		N	4	
Contractor		X	20	
Costructed Year		N	4	YY
(Superstructure)				
Bridge Type		X	2	Code
Type of Support		X	2	Code
Type of Structure		X	2	Code
Number of Beams		N	2	
Type of Deck Slab		X	2	Code
Type of Surface		X	2	Code
Type of Railing		X	2	Code
(River Condirion)				
Low Water Level		N	4.1	
Low Water Level Width		N	4.1	
High Water Level		N	4.1	
High Water Level Width		N	4.1	
Current Velocity		N	4.1	
Bridge Height from River Bed		N	4.1	
(Site Condition)				
Topography		X	2	Code
Geology		X	2	Code
Lanf Use		X	2	Code
(Traffic Volume)				in AADT
Bus		N	5	
Lorry		N	5	
Pick-up		N	5	
Passenger Car		N	5	
Total		N	5	
(Inspection)				
Work Category		X	2	Code
Conducted Date		N	6	MM/YY
File Number		X	10	
(Damage Rank)				in A,B,C,D
Pavement: Wave		X	1	
Wheel Indent		X	1	
Crack		X	1	
Potholes		X	1	
Overall Rank		N	2	
Kerb & Railing: Crack		X	1	
Peel Off		X	1	
Rebar Exposure		X	1	
Deformed		X	1	
Corrosion		X	1	
Missing		X	1	
Overall Rank		N	2	
Expansion Joint: Noise		X	1	
Water Leakage		X	1	
Deformed		X	1	
Peel Off		X	1	
Missing		X	1	
Overall Rank		N	2	

Table - 4.2.1 Data Items of Database (2/3)

Item		(Name)	Type	Digits	Remarks
Deck Slab:	Crack		X	1	
	Peel Off		X	1	
	Rebar Exposure		X	1	
	Honeycomb		X	1	
	Void		X	1	
	Water Leakage		X	1	
	Overall Rank		N	2	
Steel Girder:	Deformed		X	1	
	Crack		X	1	
	Corrosion		X	1	
	Worn		X	1	
	Bolt Missing		X	1	
	Paint Damage		X	1	
	Overall Rank		N	2	
Concrete Girder:	Crack		X	1	
	Peel Off		X	1	
	Reber Exposure		X	1	
	Honeteomb		X	1	
	Void		X	1	
	Water Leakage		X	1	
	Overall Rank		N	2	
Bearing:	Main-Damage		X	1	
	Parts Missing		X	1	
	Anchor-Damge		X	1	
	Bed-Damage		X	1	
	Unusual-Movement		X	1	
	Overall Rank				
Drinage:	Pipe-Damage		N	2	
	Blocked		X	1	
	Inlet-Damage		X	1	
	Overall-Rank		X	1	
			N	2	
Column & Footing:	Crack		X	1	
	Peel Off		X	1	
	Rebar Exposure		X	1	
	Honeycomb		X	1	
	Void		X	1	
	Water Damage		X	1	
	Displacement		X	1	
	Scour		X	1	
	Overall Rank		N	2	
Embankment:	Depression		X	1	
	Erosion		X	1	
	Overall Rank		N	2	
Riprap:	Missing		X	1	
	Erosion		X	1	
	Displacement		X	1	
	Overall Rank		N	2	
(Damage Indices)					to be calcurated
Emergency Index			N	3	
Importance Index			N	3	
(Repair Works)					
Pavement:	Conducted Date		N	6	MM/YY
	Work Category		X	2	
	Repair Methods		X	90	Comments
	Cost		N	6	x1,000,000TL
	File Number		X	10	
Kerb & Railing:	Conducted Date		N	6	MM/YY
	Work Category		X	2	
	Repair Methods		X	90	Comments
	Cost		N	6	x1,000,000TL
	File Number		X	10	
Expansion Joint:	Conducted Date		N	6	MM/YY
	Work Category		X	2	
	Repair Methods		X	90	Comments
	Cost		N	6	x1,000,000TL
	File Number		X	10	

Table - 4.2.1 Data Items of Database (3/3)

Item		(Name)	Type	Digits	Remarks
Deck Slab:	Conducted Date		N	6	MM/YY
	Work Category		X	2	
	Repair Methods		X	90	Comments
	Cost		N	6	x1,000,000TL
	File Number		X	10	
Steel Girder:	Conducted Date		N	6	MM/YY
	Work Category		X	2	
	Repair Methods		X	90	Comments
	Cost		N	6	x1,000,000TL
	File Number		X	10	
Concrete Girder:	Conducted Date		N	6	MM/YY
	Work Category		X	2	
	Repair Methods		X	90	Comments
	Cost		N	6	x1,000,000TL
	File Number		X	10	
Bearing:	Conducted Date		N	6	MM/YY
	Work Category		X	2	
	Repair Methods		X	90	Comments
	Cost		N	6	x1,000,000TL
	File Number		X	10	
Drinage:	Conducted Date		N	6	MM/YY
	Work Category		X	2	
	Repair Methods		X	90	Comments
	Cost		N	6	x1,000,000TL
	File Number		X	10	
Column & Footing:	Conducted Date		N	6	MM/YY
	Work Category		X	2	
	Repair Methods		X	90	Comments
	Cost		N	6	x1,000,000TL
	File Number		X	10	
Abutment:	Conducted Date		N	6	MM/YY
	Work Category		X	2	
	Repair Methods		X	90	Comments
	Cost		N	6	x1,000,000TL
	File Number		X	10	
Embankment:	Conducted Date		N	6	MM/YY
	Work Category		X	2	
	Repair Methods		X	90	Comments
	Cost		N	6	x1,000,000TL
	File Number		X	10	
Riprap:	Conducted Date		N	6	MM/YY
	Work Category		X	2	
	Repair Methods		X	90	Comments
	Cost		N	6	x1,000,000TL
	File Number		X	10	
(Comments)					
1			X	75	
2			X	75	
3			X	75	
4			X	75	
5			X	75	

together with detail characters of the window on the monitor screen.

d) System Functions

The database system is formulated in such a way that it is possible to:

- Append:
adds new data to the database. This is used when new facilities are installed or a new bridge on the highway is opened or when inspection or repairs are carried out.

- Alter:
alters information stored in the database based on changes in information and is used in such cases as when a bridge component is renovated.

- Extract:
allows for the extraction of information stored in the database by any combination of retrieval conditions, for effective use of compiled data for a wide scope of maintenance work.

- Output:
prints out information in a form of the latest inventory, inspection report, repair report, and historical records in the same manner, in response to the users request.

e) Hardware and Software

The microcomputer 'IBM PSV model-2411' is used to load the database system. This microcomputer has enough capacity to accommodate the road inventory, inspection and repair results for the state highway bridges. Details on its hardware are as listed below.

- CPU: Intel i486DX4-66 (runs at a speed of 66 MHz)
- External Cache Memory: 256 KB
- Internal Cache Memory: 8 KB
- Flash Memory: 128 KB
- Floppy Disk Drive: 3.5"(1.44 MB) and CD-ROM Drive,
- Hard Disk (AT Bus): 720 MB and External Hard Disk (1GB).

In order to manage information for maintenance work, the database management system (DBMS) is used for the following reasons:

- it is commercially available in Ankara with the possibility of after-care service,
- it has enough functions and can formulate a database system for maintenance work,
- it is easy for KGM staff to maintain and to make improvements in the system.

WINDOWS is used to load the above database management system 'ACCESS' into the microcomputer, and their versions are as follows:

- WINDOW : Version 3.1

- ACCESS : Version 2.0

4.2.3 Selection of Priority Bridge

1) Selection Procedures

In order to select the priority bridges for further measures, such as detailed inspection or repairs, selection procedures are shown in Figure - 4.2.4 which is comprised of the following 11 steps:

Step-1 : Routine Inspection
Routine inspection shall be carried out as per the of inspection manual for the highway bridges as a first maintenance work.

Step-2 : Engineering Prioritizing by the System
After inputting observation results into the database, the system will perform calculations on 'damage index' which are to prioritize the damage degree for each bridge components as well as the whole bridge.

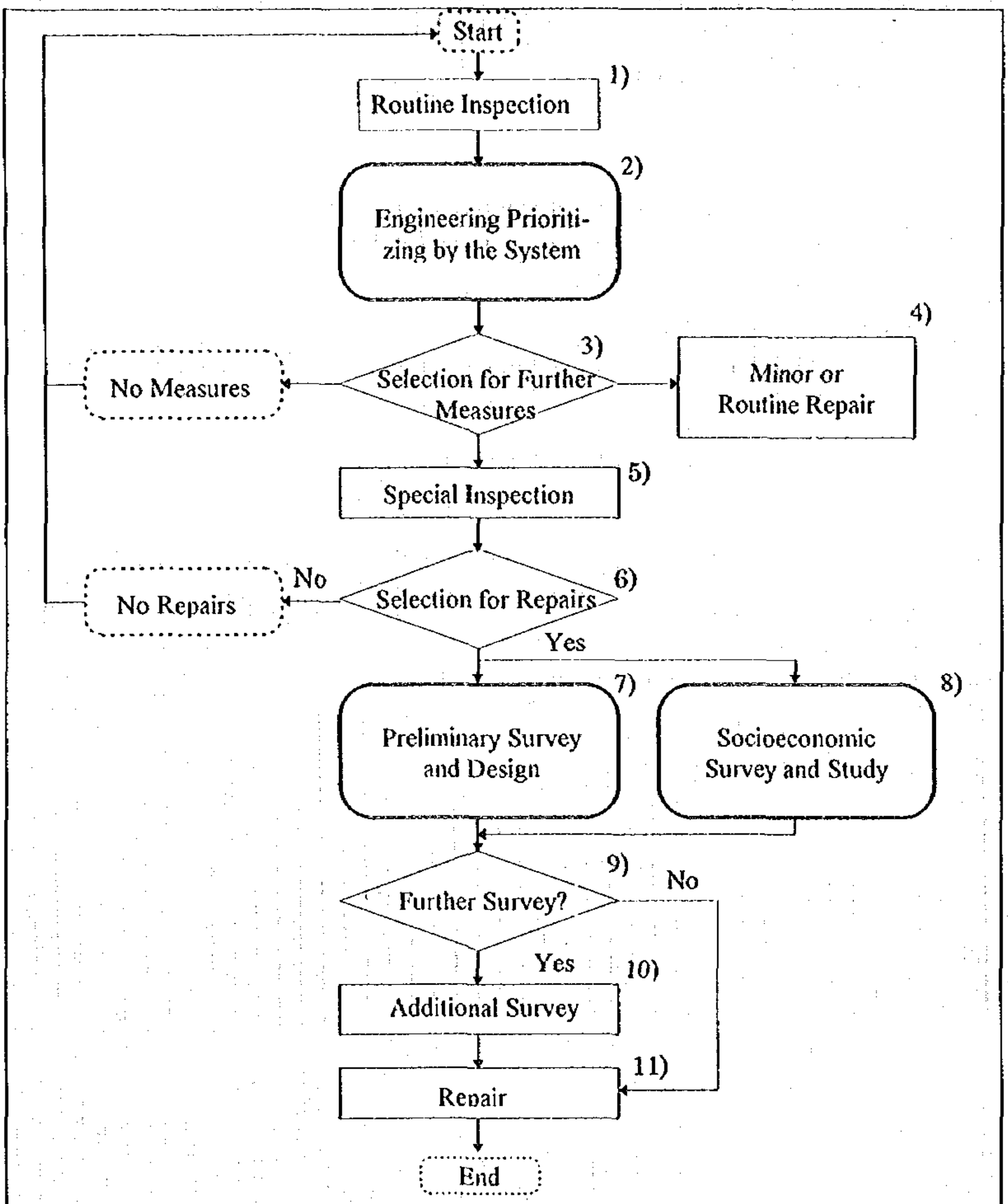
'Damage Index' will comprise two indices. One is the emergency index in terms of emergency degree to restore damages and the other is the importance index to present importance degree on damaged bridge component. This algorithm are drawn up in the later section.

Step-3 : Selection for Further Measures
Further measures for each bridge are determined based on the outputted damage indices from the system into three branches which are no measures, Step-4 and Step-5 as below:
No Measures; There is no necessity to perform any further measures because of non-existence or slight damages.

Step-4 : Minor or Routine Repair;
Some repaing which does not need the dtailed inspection in terms of repair methods, can be conducted on the secondary bridge components, such as railing, pavement and expansion joints.

Step-5 : Special Inspection;
Special inspection will be carried out to clarify the cause or behavior of damages by means of detailed methods based on the inspection manual, especially for the primary bridge components, such as deck slab, girder, column and abutment.

Step-6 : Selection for Repairs
Selection of the priority bridges for the preliminary repair design shall carried out taking damage degree, repair costs, benefits and budget conditions into consideration.



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 - 4.2.4 Selection Procedure on Bridge Maintenance

Step-7 : Preliminary Survey and Design

In order to perform the preliminary repair design, the following work items will be carried out to confirm their site conditions. They are as follows:

- Topographic Survey,
- Boring, Sampling and Soil Tests,
- Initial Environmental Examination (IEE)
- Wheel Axial Load Survey, and
- Preliminary Repair Design.

Step-8 : Socioeconomic Survey and Study

Socioeconomic studies shall carried out to evaluate repair benefits/costs Socioeconomic studies shall carryout to evaluate repair benefits/costs and are as follows:

- Local Material and Construction Costs Survey,
- Repair Costs Estimation, including reconstruction cost if any,
- Traffic Demands Assessment,
- Benefits Estimation, taking the existence of detour /bypass into consideration,
- Financial Study in terms of Economic Internal Rate of Return (EIRR).

Step-9 : Further Survey ?

Further detailed information may be necessary to perform the detailed repair design in certain cases, as described in the next step.

Step-10: Additional Survey

Detail survey for repair design, if necessary, is carried out as below:

- Detailed Measuring of Bridge Dimensions, or
- Environmental Impact Assessment (EIA).

Step-11: Repair

Repair will be performed as a final step of the flow according to the detailed repair design.

2) Prioritizing Method in the System

Generally, damage rating for deteriorated bridge and its components has to be conducted only by skilled and experienced maintenance engineers. However, in order to make them easy for unskilled engineers, systematization and standardization are indispensable. This is not only applicable to damage rating but for prioritizing the deteriorated bridges for further countermeasures as well.

The first task to achieve is rationalization in collection of inspection information on the bridge using a standard inspection sheet and damage rating table as described in the inspection manual. The next task is to standardize prioritizing procedures for the damaged bridges according to observation results.

This inspection and maintenance system will be formulated in such a way that it is possible to:

- quantify directly damage rating into numerical value using ranking system (scoring model) as below,

Table - 4.2.2 Ranking Table of Damage Rating

Criteria		Rank
Rating	'A'	5
	'B'	3
	'C'	1
	'D'	0

- evaluate damage intensity for each bridge elements in two 'Damage Index', which are composed of 'Emergency Index (EIDX)' and 'Importance Index (IIDX)',

- present the emergency intensity for damage restoration in 'EIDX', while the importance intensity of damaged components of the bridge structure in 'IIDX',

- calculate both indices systematically in the system using 'emergency coefficient' and 'importance coefficient', for each bridge element as below,

Table - 4.2.3 Emergency and Importance Coefficient

Bridge Element	Emergency Coef.	Importance Coef.
Pavement	1.00	0.75
Kerb & Railing	1.00	0.50
Expansion Joints	1.00	0.75
Deck Slab	1.00	1.00
Steel Girder	1.00	1.00
Concrete Girder	1.00	1.00
Bearing	1.00	0.75
Drain	1.00	0.50
Column & Footing	1.00	1.00
Abutment	1.00	1.00
Embankment	1.00	0.50
Riprap	1.00	0.50

Emergency coefficients are 1.00, which is common to all bridge elements. This is because the emergency intensity due to damage has been absolutely evaluated through the damage rating table.

For example, a damage in rating 'A', which is for a section or sections of missing railing in the urban area. This may lead to accidents involving children or handicapped person accidentally go through it, should be immediately restored. Another damage, also in rating 'A', which is a punched hole on the slab deck. This may cause a hazard to the traffic and should also be immediately repaired. For this reason, emergency coefficient is given a value of 1.00 for all bridge elements.

Importance coefficients are determined by taking into consideration the structural characteristics of each bridge component as intended in the design. Hence the importance coefficients for the primary bridge components, such as deck slab, girder and column of pier are higher than that of other secondary components.

To evaluate the overall damage intensity of a bridge the sum of the indices for each of the elements shall be taken.

Those rank and coefficient for evaluating damages and the integration methods, are used by road engineers Japan to select bridges necessary for further measures, such as repair or the detailed inspection. However, these coefficients will be reviewed their suitability to state highway bridges in Turkey through the further study.

3) Selection Concepts

a) Selection for Further Measures

As mentioned above, the rank in the rating table means an absolute evaluation of damages on the damaged bridge component, while evaluation using indices means relative evaluation among damaged components or bridge itself. For this reason, the following two procedures should be taken to select bridges necessary for further measures as below:

- Selection by Damage Rank
  Damaged bridge which has any damages in rank 'A' and 'B' shall be firstly selected and reviewed in terms of the necessity of countermeasures for its damage. This is due to fact that by defection in the rating table, damages in rank 'A' and 'B' will need to have countermeasure or further inspection.

- Selection by Damage Indices
  Damage indices 'EIDX' or 'IIDX' can be efficiently used in selecting seriously damaged components or bridges, either for emergency or for further measures. However, critical values on these indices will be presented through the further study in the manual.

b) Selection for Repairs

Actual repairs for damaged bridges shall be performed in consideration with the socioeconomic factors such as cost, benefit, budgets, equipment and annual scheduling, in addition to the engineering evaluation on damage. These methodology and procedures will be presented in the further study.

4.3 Inspection Concepts

4.3.1 Categorization of Inspection

1) General

Inspection work is categorized into the following three types in terms of the purpose, frequency, major objects and method. They are classified and presented in Table - 4.3.1, and are explained as below.

- Routine Inspection

There are two categories of routine inspection performed at regular intervals, from finding defects to evaluation the loading capacity and the durability of bridge components, or to confirm the safety of all the bridge components.

1) General Routine Inspection

This inspection is performed at yearly intervals. Inspection methods is basically by means of visual inspection on foot (on/under the bridge).

2) Major Routine Inspection

This inspection is performed at intervals not exceeding five years. Inspection methods are basically by means of visual inspection on foot (on/under the bridge) and using access equipment to view the exposed structural elements at close range.

- Emergency Inspection

Immediate inspection of highway bridges due to unexpected occurrences such as accidents or natural disasters. This inspection is carried out whenever there is any damage or deterioration caused by an accident such as car collision and fire or after natural disasters such as flooding, earthquake or land slide.

- Special Inspection

Investigation of highway bridges using more detailed methods to obtain detail information on the behavior and/or causes of damage, whenever necessary. This inspection is performed anytime when the need arises, or according to the findings of defects to bridge structures having a damage rating greater than B. In order to obtain more detailed information, it is necessary to investigate the causes of damage and to restore damage components.

Special inspection shall be carried out like a detailed inspection. A Special inspection is only necessary when any damage or damages found during the routine or emergency inspection warrants a closer investigation into the problem. Other kinds of Special inspections which are necessary to collect specific and detailed damage information, span by span for the longer bridges, for repair design are as follows:

- Monitoring
  Monitoring is necessary to understand the damage behaviour and to perform further study on such things as repair design for damaged bridge components after they have been identified as being defective or in a state of deterioration by routine or emergency inspection.

- Detailed Inspection
  Some major members of bridge found damaged or in a state of deterioration by routine or emergency inspection and requiring investigation with methods more detailed than those of routine inspection.

- Principal Inspection
  When damage information obtained by routine inspection is insufficient to conduct further study, such as for repair design of a long span bridge, then detailed damage data for each span of the superstructure or for each column for substructure are necessary.

Table - 4.3.1 Classification of Inspection

Inspection	*Major Object*	*Purpose*	*Frequency*	*Methods*
Routine Inspection	Structures & facilities	Damage finding or confirmation of safety	Periodic	Visual Inspection
Emergency Inspection	Structures & facilities	Damage finding, confirmation of safety	Accident, disaster	Visual or special inspection
Special Inspection	Structures	Detailed investigation, monitoring, repairing	as necessitated	Special Inspection

2) Objective Members by Inspection

The inspection and maintenance system defines its objective structures, facilities and the damage they may sustain in order to standardize information management and work procedures for the effective maintenance of the highway. For this reason, bridge components are classified by considering their functional, material, damage, and maintenance characteristics. Information on maintenance shall also be subjected to this classification to correspond with other information concerning such things as inventory and inspection.

The inspection and maintenance system covers superstructures, bridge piers, pavement, and highway facilities such as traffic safety devices. Objective road structures and facilities are classified into the following 12 types as shown bellow:

- Pavement : pavement of bridge,
- Kerb and Railing : concrete kerb and steel railing,

- Expansion joints	: buried and rubber joints,
- Deck slab	: concrete deck slab,
- Steel girder	: steel girder or truss members, concrete girder including cross-girder,
- Bearing	: rubber pads or steel bearing,
- Drain	: composed of inlets and water leading pipes
- Column & Footing	: columns, beams of pier and footing,
- Abutment	: wall, columns and footing,
- Embankments	: embankment and shoulders within 5 meters of the bridge ends,
- Riprap	: riprap at bridge ends.

All bridge components described in the above have each important function to support live and dead loads as necessitated. However, the primary components whose functions are to support loadings directly are deck slab, girders, columns, abutments and foundation. Therefore, special inspection is only carried out for these primary components of the bridge.

4.3.2 Damage Categorization

1) Damage Rating Concepts

The nature of damage and deterioration of functions differs greatly among highway bridge, and personal judgment on damage varies from inspector to inspector. Consequently, the definition of ratings for observations is very important to manage and maintain highway bridges adequately.

In order to judge the necessity of repair work, observations of damage or deterioration are categorized into four ranks according to the following guidelines.

Rating A

Urgent repairs are necessary to secure the safety of vehicular traffic or to avoid the inconveniences or injuries to third parties from damage or deterioration or possible damage which may be caused in the near future.

Rating B

Repairs are required due to the existence of serious damage or deterioration which affects the function or durability of the structure.

In the case of Rating B, repairs are necessary but not urgent. Implementation of repairs depends on many factors such as the location of damage, the progress of the damage, and whether the damaged member is a primary or secondary member. Further special inspection must be necessary in some cases to ascertain the causes and its effects to the damage.

Rating C

Damage or deterioration is small and no repairs are necessary. However, further attention such as monitoring or observation may be necessary in some cases.

Rating D

Virtually no repairs and no further attention are required due to the existence or non existence of slight damage or deterioration.

2) Damage to Be Inspected

Damage and deterioration to bridge components have been classified in many ways by both engineers and scholars involved in structural and maintenance engineering. However, damage or deterioration is basically defined by the materials used and by the structural nature of a bridge component. In order to be user-friendly in both its theoretical and operational aspects, the types of damage and deterioration that can occur on the highway bridge are determined through a detailed review of maintenance standards in Japan and in other countries.

The types of damage are classified into the following 12 categories, taking into consideration the structural, material and damage characteristics of the bridge component for maintenance.

- Damage to Pavement

Wave:	Damage or defect to the longitudinal evenness of pavement which effect the smooth driving, such as corrugation, faulting and disruption.
Wheel Indent:	Surface roughness in the transverse direction to traffic due to rutting.
Crack:	Cracking on the pavement surface, accompanying disruption of deck structure in case.
Pot Holes:	Partial peeling off or scaling of pavement material, accompanying cracks on the surrounding area in some case.

- Damage to Kerb and Railing

Crack:	Cracking to concrete kerb.
Peel Off:	Peeling off of concrete especially in the corner or side edges.
Rebar Expose:	Exposure of rebars due to peeling or spalling of surface concrete, and rebar corrosion caused by aging with other rusty condition.
Deformed:	Deformation of railing due to car collision or other defects on anchorage.

Corrosion:	Corrosion of railing due to aging or salt or damage to protective paint.
Missing:	Missing of railing components due to car collision or other reasons.

- Damage to Expansion Joints

Noise:	Unusual noise due to damage caused by impact of driving wheels.
Water Leakage:	Water leakage due to damage, defect or deterioration of joints components.
Deformed:	Deformation of joint components due to wheel shock or abrasion.
Peel Off:	Peeling off of joint surface including pavement peeling off in buried type of joints.
Missing:	Missing joint components.

- Damage to Deck Slab

Crack:	Cracking of concrete slab; a punched hole may be present with the close interval of cracks, accompanying water leakage and leaching of free lime in certain cases.
Peel Off:	Peeling off of concrete due to deterioration of surface concrete.
Rebar Expose:	Exposure of rebars due to peeling or spalling of surface concrete, and rebar corrosion caused by aging with other rusty condition such as water leakage.
Honeycomb:	Honeycomb due to poor vibration work during placement of concrete with accompanying rebar exposure in certain cases.
Void:	Void or cavity due to poor vibration work during placement of concrete.
Water Leakage:	Water leakage and leaching of free lime through cracks or voids.

- Damage to Steel Girder

Deformed:	Deformation of flanges, webs or other components due to car collision or buckling.

Crack:	Cracking especially in welded section, or due to material reasons.
Corrosion:	Corrosion of girder components, accompanying leaked water from deck slab.
Worn:	Worn or abrasion due to deterioration of components.
Bolt Missing:	Missing or falling out of bolts at joints.
Paint Damage:	Damage to paint, such as discolour or peeling off of paint, leading to corrosion of steel components.

- Damage to Concrete Girder

Crack:	Cracking of concrete main girders or cross girders, accompanying water leakage and leaching of free lime in case.
Peel Off:	Peeling off of concrete due to deterioration of surface concrete.
Rebar Expose:	Exposure of rebars due to peeling or spalling of surface concrete, and rebar corrosion caused by aging with other rusty condition such as water leakage.
Honeycomb:	Honeycomb due to poor vibration work during placement of concrete with accompanying rebar exposure in certain cases.
Void:	Void or cavity due to poor vibration work during placement of concrete.
Water Leakage:	Water leakage and leaching of free lime through cracks or voids.

- Damage to Bearing

Main-Damage:	Damage or deterioration to the main components of bearing.
Parts Missing:	Missing or falling out of secondary components of bearing.
Anchor-Damage:	Damage to anchor of bearing, or missing of anchor bolts.
Bed-Damage:	Damage to bearing bed.
Unusual Movement:	Unusual movement such as insufficient clearance for sliding.

- Damage to Drain

Pipe-Damage:	Damage or deterioration to drain pipes, including construction defects such as insufficient pipe length.
Blocked:	Accumulation or clogging of debris in drain pipes.
Inlet-Damage:	Damage to drain inlets.

- Damage to Column and Footing

Crack:	Cracking of concrete beams or columns, accompanying water leakage and leaching of free lime in certain cases, or due to peeling by rebar corrosion.
Peel Off:	Peeling off of concrete due to deterioration of surface concrete.
Rebar Expose:	Exposure of rebars due to peeling or spalling of surface concrete, and rebar corrosion caused by aging with other rusty condition such as water leakage.
Honeycomb:	Honeycomb due to poor vibration work during placement of concrete, accompanying rebar exposure in case.
Void:	Void or cavity due to poor vibration work during placement of concrete.
Water Damage:	Damage or deterioration to concrete due to washing or running water on surface, leading to a reduction in cross sectional area of columns.
Displacement:	Displacement of substructure due to incline, settlement or slide of foundation.
Scour:	Damage the to stability of foundation due to running water in washing out of surrounding rocks of the foundation.

- Damage to Abutment

Crack:	Cracking of concrete members, accompanying water leakage and leaching of free lime in certain cases, or due to peeling by rebar corrosion.
Peel Off:	Peeling off of concrete due to deterioration of covering concrete.
Rebar Expose:	Exposure of rebars due to peeling or spalling of surface concrete, and rebar corrosion caused by aging with other rusty

condition such as water leakage.

Honeycomb:	Honeycomb due to poor vibration work during placement of concrete, accompanying rebar exposure in case.
Void:	Void or cavity due to poor vibration work during placement of concrete.
Water Damage:	Damage or deterioration to concrete due to washing or running water on surface, leading to a reduction in cross sectional area of columns.
Displacement:	Displacement of substructure due to incline, settlement or slide of foundation.
Scour:	Damage to the stability of foundation due to running water in washing out of surrounding rocks of the foundation.

- Damage to Embankment

Depression:	Depression or settlement of back fill behind abutment.
Erosion:	Erosion of embankment shoulder.

- Damage to Riprap

Missing:	Missing of localized rock components.
Erosion:	Erosion of riprap.
Displacement:	Settlement or slide of riprap.

4.4 Repair and Rehabilitation Concepts

4.4.1 Categorization of Maintenance and Repair

1) Maintenance and Repair Framework

Maintenance and repair work are categorized as routine maintenance operations and specialized maintenance operations as shown in Figure - 4.4.1.

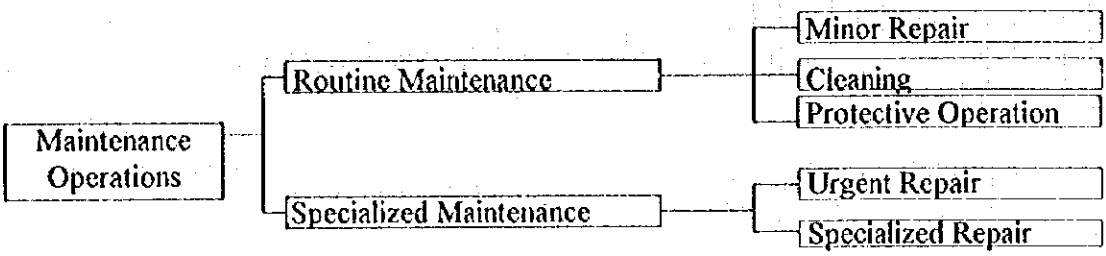


Figure - 4.4.1 Maintenance and Repair Framework

2) Functions of Repair Work

Maintenance and repair works, which aims at the above effects, are classified into the following three categories based on the executed work objectives as follows:

- Rehabilitation
  To restore functions of a damaged or deteriorated bridge component to its initial condition in order to achieve original loading capacity, durability and aesthetics, etc.

- Strengthening
  To strengthen, the capacity of a damaged or deteriorated bridge component to a stronger condition, in order to cope with initial or existing inferior functions or loading capacity.

- Improvement
  To provide a damaged or deteriorated bridge component with the better functions or the higher capacity than it originally possessed in order to cope with an increase in needs.

4.4.2 Maintenance and Repair Operation

1) Routine Maintenance Operation

Routine maintenance operation is composed of cleaning and minor repairs and are as follows:

- Cleaning
  In order to keep the function of bridge components on the highway in better condition, it is required to clean and remove dirt, debris, and vegetation from pier caps, abutment seats, around bearings, expansion joints, drainage inlets, etc.

- Prospective Operations
  Besides cleaning works for bridge component, protective operations to secure functions, durability and aesthetics, is essential, such as periodic repainting for deteriorated paint on steel structures.

- Minor Repairs

Spot painting or protective coating as required of steel bearings and exposed portions of steel members; also small scale repair work for washouts and embankment erosion, and replacement or correcting for loose or missing anchor nuts and bolts, etc.

2) Specialized Maintenance Operation

Specialized maintenance operation comprise urgent repair and special repair for a damaged or deteriorated bridge component as follows:

- Urgent Repair
  Immediate remedial work is needed to restore damaged component to a condition for which only routine maintenance is necessary. Work should be scheduled for completion at an early date to prevent further damage to the component or need for complete reconstruction at a later time.

- Special Repair
  Due to the unexpected damage or deterioration indicated by the results of inspection, special remedial work is necessary requiring special skills, equipment, or materials to restore the functions of a damaged component.
  In addition to the above, emergency measures especially on a daily basis shall be performed immediately to secure vehicles and third parties from the more serious damage or accidents which may cause by an initial damage. Generally, emergency measures are, the removal of damaged members, planing of traffic cones, lit barricading and lane guidance at night, etc.

4.5 Coding, Inputting and Reporting

4.5.1 Coding and Inputting

In order to support engineers via the coding of maintenance information in standardized work procedures, regular coding forms for inspections and repair are provided to maintenance engineers in the form of regular coding sheet which is shown in Figure-4.5.1. Operators who are in charge of inputing coding data can easily input the contents of the forms into the database system.

4.5.2 Outputing and Reporting

After inputing inspected or repaired results into the database system, an inspection and repair report in the form of bridge inventory is outputed in response to the users request.

Inspection and repair reports are to be kept on file. When it is necessary to modify report contents, make the necessary corrections in red and carry out the appropriate alteration of the database system.

In addition to the above bridge inventory form, the system will be formulated to be capable of outputing bridge lists in terms of readily useable information stored in the database

Sheet No :

Visual Inspection Data Sheet

MARHB Study Team

Key Identifier	Route	200	Chainage	59,200	Sub-Division	from	Work Category	IS:Inspection	Date of Work	5/2/95

INVENTORY

Group	Item	Value	Item	Value	Item	Value
Bridge General	Bridge Name	OZCAY	Span Composition			
	KGM-Division	4	Carriageway Width	8.5		
	Division		Side Walk Width	1		
	Name of River	OZCAY	Skew Angle	45		
	Design Spec. & Load	AASHTO H20-S16	Contractor	Intest		
	Bridge Length	27.45	Construction Year	1976		
Superstructure	Bridge Type	RC (Reinforced Concrete)	Type of Deck Slab	RC (Reinforced Concrete)		
	Type of Support	Simple	Type of Surface	Asphalt Pavement		
	Type of Structure	Beam	Type of Railing	ST (Steel)		
	Number of Beam	4				
River Condition	Low Water Level	0.5	High Water Level	24	Current Velocity	2
	Low Water Level Width	5	High Water Level Width	24	Bridge Height from River Bed	5
Site Condition	Topography	Flat	Geology	Sandy	Land Use	Pasture
Traffic Volume in AADT	Bus	1645	Lorry	626	Pick-up	5638
	Passenger Car	5511	Total	13420		

Sketch of Site View

INSPECTION

Work Category		Conducted Date		File Number	

Evaluation	Damage		Damage		Damage		Damage		Damage		Damage		Damage		Damage		
Pavement	Wave	D	Wheel [illegible]	C	Crack	D	Potholes	D									
Kerb & Railing	Crack	D	Peel Off	C	Rebar Exposure	C	Deformed	D	Corrosion	D	Missing	D					
Expansion Joint	Crack	D	Water Leakage	C	Deformed	C	Peel Off	C	Missing	D							
Deck Slab	Noise	D	Peel Off	D	Rebar Exposure	C	Honeycomb	C	Void	D	Water Leakage	D					Overall Ranks
Steel Girder	Deformed		Crack		Corrosion		Worn		Bolt Missing		Paint-Damage						
Concrete Girder	Crack	D	Peel Off	D	Rebar Exposure	C	Honeycomb	C	Void	D	Water Leakage	D					
Bearing	Main-Damage	D	Parts Missing	D	Anchor Damage	D	Bed-Damage	D	Unusual Movement	D							
Drainage	Pipe-Damage	D	Blocked	C	Inlet-Damage	D											
Column & Foot	Crack	D	Peel Off	D	Rebar Exposure	C	Honeycomb	C	Void	D	Water Damage	D	Displacement	D	Scour	D	
Abutment	Crack	D	Peel Off	C	Rebar Exposure	C	Honeycomb	C	Void	D	Water Damage	C	Displacement	D	Scour	D	
Embankment	Depression	D	Erosion	D													
Riprap	Missing	D	Erosion	D	Displacement	D											

Damage Indices	
Emergency Index	
Importance Index	

Photographs

REPAIR

Work Record

Items	Conducted Date	Work Category	Repair Method	Cost x 1,000,000 TL.	File Number
Pavement					
Kerb & Railing					
Expansion Joint					
Deck Slab					
Steel Girder					
Concrete Girder					
Bearing					
Drainage					
Column & Foot					
Abutment					
Embankment					
Riprap					

Comments	
	Central column piles eccentric.

Figure - 4.5.1 Coding Sheet for Database System as below.

- Coding Sheet for Inspection and Repair
  Same layout as that of bridge inventory. However, coding parts for inspection and repair are left blank.

- Bridge List
  Major items for bridge maintenance are printed in one line for each bridge.

- Bridge Inspection Record
  Major items for bridge inspection are printed in one line for each bridge.

- Bridge Repair Record
  Major items for bridge maintenance and repair are printed in one line for each bridge.

Chapter 5

Visual Inspection of Highway Bridges

Chapter 5 Visual Inspection of Highway Bridges

5.1 General

5.1.1 Objectives

A visual inspection of selected bridges is planned to survey the overall characteristics of highway bridges in Turkey and to test a simplified and standardized method of inspection, proposed by the JICA Study Team (hereinafter referred to as " the Team "). There is also a purpose of the technology transfer from the Team to the KGM counterparts.

There are approximately 3,100 bridges of various kinds on the State Highways. A sample of maximum number of approximately 200 bridges are selected and inspected and the information are then stored in the database of a computerized system.

An inspection manual is planned to be prepared based on the findings of the visual inspection and utilizing the data sheet and the computer oriented data base system.

KGM intends to carry out the routine (periodic) inspection by themselves. Hence the selection of the 200 bridges for inspection was aimed to reflect the characteristics of the overall highway bridges in Turkey. The inspection methods are so simplified and standardized that the Turkish engineers will have no difficulty in carrying out the inspection in the future.

Visual Inspection shall be conducted on the following basis:

a) to identify general characteristics of wear and damages on highway bridges,
   - by structure type
   - by material type
   - by traffic situation
   - by terrain conditions
   - by climatic conditions

b) to test visual inspection method proposed by the Study Team, and

c) to transfer the technology of inspection method to the Turkish counterpart.

5.1.2 Work Schedule

There were three parties of inspectors for the visual inspection task. Two during ordinary period and one during the Turkish holiday week (Bayram). The members are composed of the the Team members (playing leading roles) and the KGM counterparts (playing the role of assistants). The role of each member and the arrangement of inspection vehicles for the inspection parties are shown in Table - 5.1.1. Each Party's schedule is presented in Appendix 2.

Table - 5.1.1 Inspection Party Arrangement

	Ordinary Period		Turkish Holiday	Role of Members
	Party A	Party B	Party C	
Members	Koji WADA	Arun Hans SAHNI	Koji WADA	Leader Overall Inspection
	Fumiyoshi KUBOTA	Yoshitoshi KOBAYASHI	Yoshitoshi KOBAYASHI	Sub-Leader, Photograph, Environment
	Assistant Kuzey YILMAZ	Assistant Erdai ALSLAN	Fumiyoshi KUBOTA	Assistant Recording
	Assistant Memet KALMIS	Assistant Adnan GURKAN	Keigo KONNO	Assistant Measurement
			Assistant Ertan SAYIT	Assistant Measurement
Vehicles	Two cars by KGM	Two cars by KGM	Two cars by JICA Team	

Inspection in each day are carried out as a rule in eight hours (08:30 - 17:30 including one hour lunch break), there are some days the work to start early or last until late.

5.1.3 Tools for Inspection

Tools for visual inspection for this Study should be the following items.

- Check sheet
- Camera
- Sketch book including bridge member, drawing, etc.
- Binoculars
- Tape measure
- Ribbon tape
- Hand tape
- Test hammer
- Hammer
- Traffic Corn
- Safety yellow jacket
- Rain coat
- Boots
- Magnifying glass
- Steel straight edge
- Crack gauge
- Calipers
- Feeler gauge
- Test/tapping hammer
- Electric torch
- Levelling staff
- Ranging poles
- String line
- Rope
- Plumb bob
- Brush
- Shovel
- Paint
- Chalk
- G.A. of structure
- Information board
- Field sketchpad/notebook
- Pens and pencils

5.2 Selection of Objective Bridges

5.2.1 Selection Criteria

To satisfy the objectives, the following criteria was set;

a) Classification of selected bridges shall reflect that of the overall highway bridges; (Visual inspection is a study to find a general characteristics of wear and damages on arterial highway bridges as well as a case study of the inspection method proposed by the JICA Study Team. In this regard, the inspection shall cover the representation of typical bridge types.)

b) Selected bridges shall cover typical traffic, terrain and climatic conditions; (Same as the reason as stated above is applied.)

c) Some particular types of bridge structures and materials which are determined for reconstruction in near future; or which require different kind of inspection and maintenance approach shall not be included;
Bridge for reconstruction : composite, gerber
(composite bridges in Turkey is a type with roll-H girders with concrete slab)
Bridge structure not included : pedestrian bridges, culvert, arch,
Bridge material not included : timber, stone masonry, etc.

d) Railway over-bridges are not included since they require different approach on inspection and maintenance to avoid unnecessary disruption to the train operation also require a close cooperation of the railway officials.

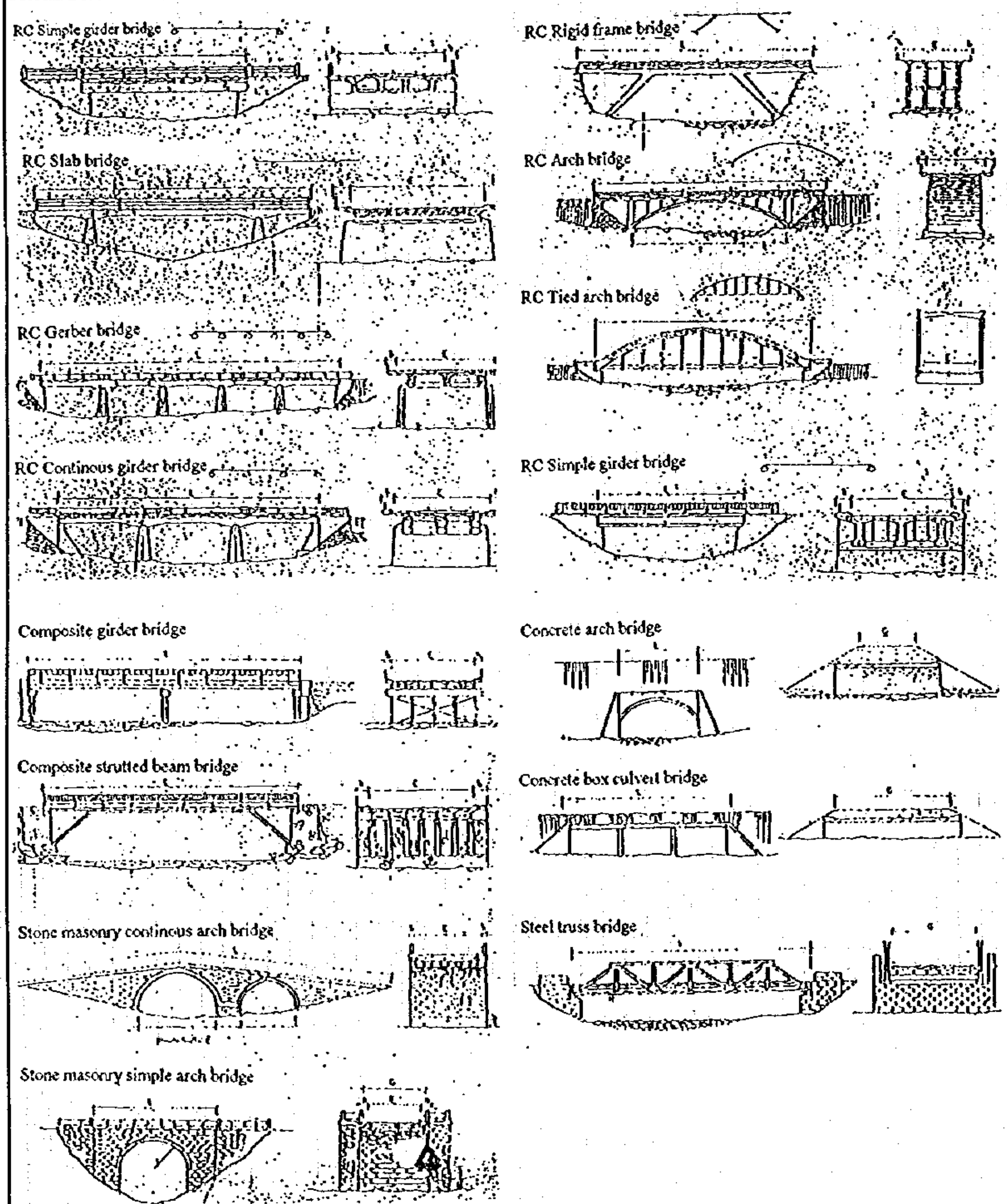
e) Bridges of length shorter than 15m are not included. (Small bridges are easy to inspect, maintain and replace in case of accident)

5.2.2 Selection Process

Considerations are taken for each item of selection criteria along the process of selecting objective bridges, such as;

a) Classification of selected bridges shall reflect that of overall highway bridges; (Overall characteristics of highway bridges are shown in Table - 5.2.1. The dominance of concrete bridges are kept among the bridges selected.)

b) Selected bridges shall cover typical traffic, terrain and climatic conditions; (Five study roads are selected at the beginning. They all radiate from Ankara and direct towards Istanbul, Bursa, Izmir, Antalya, and Rize. Ankara - Istanbul route is dropped from the study after a selecting study because a motorway runs along side the arterial state highway. This can be a relief in the case of a bridge failure on the state highway and vice versa. See Figure - 5.2.1)



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 - 5.2.1 Bridge Type Classification by KGM

c) Some particular uses and types of bridge structures and materials which require different kind of inspection and maintenance approach or are determined for reconstruction in near future was not included;
Bridge structure : pedestrian bridges, culvert, arch, composite, Gerber
Bridge material : timber, stone masonry, etc.
After a discussion among the Study Team members, the following are not included ;
Pedestrian bridges,
culverts,
arches,
composite girders and slabs (these types in Turkey mean bridges with roll-H beams supporting concrete slabs), and
gerber bridges of less than 50m bridge length.

> Note :
> KGM wishes to replace all the Gerber bridges as soon as the financial situation allows them. However, longer ones requiring more cost will be more difficult to be replaced while short ones can be easily restored in the case of bridge failure by temporary structures. Study Team wishes to find the characteristics of wear and damages on long Gerber bridges and to study typical samples of maintenance to lengthen their life.

Bridges situating inside of ring road at Ankara are also not included due to particularly heavy traffic, which may cause some accident without extra traffic safety measures.

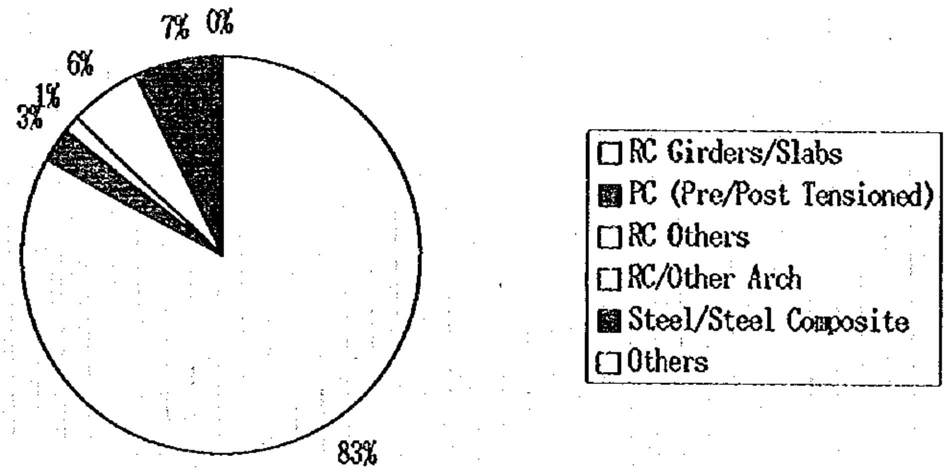
d) Railway over-bridges are not included.

e) Bridges of smaller length than 15m are not included.

After going through the selection process as mentioned above, the number of objective bridges is 208, as shown in Table - 5.2.2.

Table - 5.2.1 Highway Bridges by Type and Material (Data by KGM in 1993)

Types by Material and Structure	Arterial State Highway		Principal Highway		Total	
	No.	Length (m)	No.	Length (m)	No.	Length (m)
RC Simple Girder	1,621	51,869.88	885	24,145.30	2,506	76,015.18
RC Simple Slab	147	2,373.30	78	1,358.70	225	3,732.00
RC Continuous Girder	36	2,419.10	9	354.15	45	2,773.25
RC Continuous Slab	183	7,120.60	54	1,681.00	237	8,801.60
RC Cantilever Girder	147	4,871.10	59	2,246.90	206	7,118.00
RC Cantilever Slab	185	4,256.65	63	1,443.45	248	5,700.10
RC Gerber Simple/Cont.Girder	212	18,258.69	71	5,973.71	283	24,232.40
RC Gerber Simple/Cont.Slab	41	1,609.40	5	138.95	46	1,748.35
RC Arch	39	3,161.82	16	1,130.65	55	4,292.47
PC (Pre-Tension)	73	8,540.76	7	450.90	80	8,991.66
PC (Post Tension)	20	4,332.00	2	207.00	22	4,539.00
RC Rigid Frame Girder	17	657.95	2	56.00	19	713.95
RC Rigid Frame Slab	24	372.35	3	38.90	27	411.25
RC Bowstring	5	321.20	1	72.10	6	393.30
Mass Concrete Arch	69	1,233.35	18	391.50	87	1,624.85
Masonry Arch	66	4,020.00	57	2,686.40	123	6,706.40
Composite	194	7,088.76	142	6,294.25	336	13,383.01
Steel Girder + RC Slab	1	17.25	1	22.00	2	39.25
Steel Girder + Steel Slab	5	68.30	7	213.85	12	282.15
Steel Truss	10	387.55	10	386.20	20	773.75
Ferbeton Reinforced RC Bridge	1	12.20	10	273.35	11	285.55
Timber	4	50.90	3	47.45	7	98.35
TOTAL	3,100	123,043.11	1,503	49,612.71	4,603	172,655.82



(Distribution by type of bridges on Arterial Highways)
Note : See Figure - 5.2.1 for the Bridge Type Classification by KGM.

Table - 5.2.2 Selection of Bridge for Visual Inspection

Study Road (from) (to)	1(AR) ANKARA RIZE	2(AA) ANKARA ANTALYA	3(SB) SIVRIHISAR BURSA	4(AI) AFYON IZMIR	TOTAL
Total Number of bridge	305	101	91	77	574
Pedestrian bridge	99	57	45	39	240
STRUCTURE					
Culvert	3	0	0	0	3
Arch	6	2	0	0	8
Composite	2	1	5	6	14
Gerber(L<50m)	15	0	6	0	21
Small Bridge(L<15m)	32	10	3	9	54
Railway over bridge	11	9	2	3	25
Under or Re-Construction	2	0	0	0	2
Number of objective Bridge	135	22	30	20	207

5.2.3 Objective Bridges and Locations

The list of objective bridges are shown in Table - 5.2.3 and their locations are presented in Appendix 3. The composition of bridges are shown in Table - 5.2.4.

Table - 5.2.3 List of Bridges for Visual Inspection

Bridge No.	Brdge name	km	m	Direction	Bridge type	Length(m)	Construction
AR-200-13-1	KAYAS I	21 +	400	from	RC, Simpl, Girder	20.00	
AR-200-13-2	KAYAS I	21 +	400	to	ditto	17.90	
AR-200-13-3	KAYAS II	22 +	200	from	ditto	22.70	1978
AR-200-13-4	KAYAS II	22 +	200	to	ditto	19.90	
AR-200-13-5	OZCAY	59 +	200	from	ditto	27.45	1976
AR-200-14-1	BALABAN	3 +	200	from	ditto	49.50	1977
AR-200-14-2	IRMAK	7 +	0		ditto	127.40	1982
AR-200-14-3	BULANIK	10 +	0		RC, Cantilever, Slab	25.20	1982
AR-200-14-4	CORUHOZU	33 +	700		Rigit Frame	31.75	1952
AR-200-14-5	ISIKLAR	37 +	0		Rc, Gerber, Slab	25.75	1952
AR-200-14-6	KARANLIKDERE	61 +	700		RC, Simple, Girer	39.00	1989
AR-190-01-1	DELICE-I-	5 +	850		RC, Simple, Slab	16.00	
AR-190-01-2	HACIOBA	8 +	850		ditto	15.50	
AR-190-01-3	KOCACAY	10 +	150		ditto	15.60	
AR-190-02-1	ACIOZ	1 +	0		RC, Cantilever, Girder	28.30	1979
AR-190-02-2	KEMALLI	21 +	650		RC, Simple, Girder	24.15	
AR-190-02-3	BUDAKOZU	26 +	650		ditto	40.25	1959
AR-190-02-4	DICAYI	27 +	150		RC, Cantilever, Slab	25.20	1959
AR-785-05-1	KOPARAN-I-	10 +	200		RC, Simple, Girder	16.00	
AR-785-05-2	KOPARAN-II-	11 +	900		ditto	27.45	
AR-785-05-3	KOPARAN-III-	13 +	500		ditto	33.60	
AR-785-05-4	HACIMUSA	31 +	0		RC, Simple, Slab	16.40	
AR-785-05-5	GAFURLU	32 +	500		ditto	16.20	
AR-785-05-6	TEPEUSTU	39 +	0		RC, Simple, Girde	26.90	
AR-785-05-7	SARSAK	41 +	550		ditto	21.90	
AR-795-04-1	DERINCAY	45 +	0		RC, Cantilever, Girder	33.30	1963
AR-795-03-1	ASAGI KAMISLI	14 +	400		RC, Simple, Girde	16.00	
AR-795-03-2	YUVA MEVKII	20 +	400		ditto	28.60	
AR-100-17-1	MERZIFON	43 +	100	from	PC(post-ten)	36.95	1993
AR-100-17-2	MERZIFON	43 +	100	to	ditto	36.95	1993
AR-100-17-3	UST GECIT II	43 +	700	from	RC, Simple, Girde	20.50	

AR-100-17-4	UST GECIT II	43 + 700	to	ditto	20.50	
AR-100-17-5	PASA PINAR	62 + 0		ditto	26.60	
AR-795-02-1	HACIOSMAN	19 + 200		ditto	21.80	
AR-795-01-1	KURTUN-II- ATAKUM	0 + 100		ditto	82.15	1977
AR-795-01-2	ATAKUM K Y. UST G.	0 + 400		ditto	32.60	1977
AR-795-01-3	ADA	14 + 450		RC, Cantilever, Slab	33.20	1960
AR-795-01-4	ASAGI CAKALLI	34 + 700	from	RC, Simple, Girde	35.60	1964
AR-795-01-5	ASAGI CAKALLI	34 + 700	to	ditto	71.55	1986
AR-010-16-1	MERT IRMAGI	6 + 800		RC, Cantilever, Slab	64.50	1959
AR-010-16-2	KIRAZLIK	13 + 700		RC, Simple, Girde	24.25	1956
AR-010-16-3	SELYERI	20 + 350	from	ditto	27.20	1984
AR-010-16-4	SELYERI	20 + 350	to	ditto	21.70	
AR-010-16-5	GELEMEN	22 + 750	from	ditto	34.55	1984
AR-010-16-6	ABDAL IRMAGI	29 + 500		ditto	32.60	
AR-010-16-7	CARSAMBA-I-	42 + 50		Gerber, Girder	218.50	1961
AR-010-16-8	CARSAMBA K.Y.U.G	42 + 200		RC, Cantiler, Slab	16.00	1964
AR-010-16-9	TERME	63 + 650		RC, Continuous, Slab	47.70	1960
AR-010-16-10	MILIC-I-	69 + 100		ditto	47.70	1962
AR-010-16-11	MILIC-II-	70 + 900		ditto	29.15	1964
AR-010-16-12	AKCAY	82 + 150		RC, Gerber, Girder	106.90	1961
AR-010-17-1	CINARSUYU	2 + 250		RC, Cantilever, Slab	25.20	1984
AR-010-17-2	CURI DERESI	4 + 600		RC, Gerber, Girder	83.90	1962
AR-010-17-3	LAHANA	14 + 700		RC, Simple, Girde	16.10	1956
AR-010-17-4	CEVIZDERE	16 + 250		RC, Gerber, Girder	68.00	1960
AR-010-17-5	NACI DERESI	21 + 900		RC, Simple, Girde	16.30	
AR-010-17-6	KAVAKLAR DER.	27 + 150		ditto	27.15	
AR-010-17-7	ELEKCI	33 + 500		PC(post-ten)	157.50	1975
AR-010-18-1	BOLAMAN	0 + 150		ditto	202.40	1975
AR-010-18-2	ILICASU	1 + 150		RC, Continuous, Slab	48.50	1961
AR-010-18-3	CALISLAR	5 + 500		RC, Simple, Girde	48.60	1961
AR-010-18-4	YALIKOY	9 + 650		RC, Simple, Slab	30.00	
AR-010-18-5	BELLICESU	11 + 850		ditto	20.00	
AR-010-18-6	KOZAGZI	38 + 150		RC, Simple, Girde	22.00	1972
AR-010-18-7	AKCAOVA	46 + 150		RC, Gerber, Girder	59.30	1961
AR-010-18-8	CIVIL DERESI	54 + 600	from	PC(post-ten)	61.60	1993
AR-010-18-9	CIVIL DERESI	54 + 600	to	ditto	61.60	1993
AR-010-18-10	MELET-I-	57 + 650		ditto	251.70	1952
AR-010-18-11	TURNASUYU	63 + 0		ditto	107.70	1951
AR-010-19-1	DOMUZDERE	4 + 650		RC, Simple, Girde	16.10	1961
AR-010-19-2	PAZARSUYU	5 + 300		RC, Gerber, Girder	117.90	1961
AR-010-19-3	INCIGEZ	9 + 150		RC, Simple, Girde	27.00	1959
AR-010-19-4	BULANCAK	10 + 750		ditto	32.35	1965
AR-010-19-5	CEKEK YERI	17 + 450		RC, Continuous, Slab	21.65	
AR-010-19-6	KUCUKGURE	19 + 500		RC, Simple, Girde	27.00	1952
AR-010-19-7	BUYUKGURE	20 + 500		ditto	40.55	1958
AR-010-19-8	BATLAMA 2 SERIT	22 + 450	from	RC, Gerber, Girder	80.50	1982
AR-010-19-9	BATLAMA	22 + 450	to	ditto	80.10	1957
AR-010-19-10	BOGACIK	30 + 400		RC, Simple, Girde	40.40	1959
AR-010-19-11	AKSU	31 + 400		RC, Gerber, Girde	124.35	1963
AR-010-19-12	KARGUN	32 + 100		RC, Simple, Girde	16.20	1956
AR-010-19-13	KESAP	38 + 250		RC, Gerber, Girde	58.75	1962
AR-010-19-14	YOLAGZI	43 + 600		RC, Simple, Girde	28.90	1971
AR-010-19-15	YAGLIDERE	58 + 0		ditto	159.50	1971
AR-010-19-16	GELIVERA TAH-II-	60 + 50		ditto	16.20	1962
AR-010-19-17	YALCI (GOLAGZI)	63 + 50		ditto	32.25	
AR-010-19-18	DOMACIJ	64 + 250		RC, Cantilever, Girder	28.80	1989
AR-010-19-19	HARSIT	74 + 550		RC, Gerber, Girde	248.50	1951
AR-010-20-1	YOGURTDERE	1 + 800		RC, Cantilever, Slab	24.55	
AR-010-20-2	BADA	4 + 800		RC, Simple, Girde	24.05	1961

AR-010-20-3	COMLEKCI	11 + 900		ditto	109.85	1968
AR-010-20-4	KUYUMCUDERE	13 + 600		ditto	27.50	1969
AR-010-20-5	CANAKCI ELEVIDERE	14 + 400	from	RC, Gerber, Girde	154.80	1985
AR-010-20-6	CANAKCI ELEVIDERE	14 + 400	to	ditto	155.50	1951
AR-010-20-7	CAVUSLU	21 + 300		ditto	102.80	1965
AR-010-20-8	DIZGINE	26 + 500		RC, Simple, Girde	46.70	1975
AR-010-20-9	TOPALLI	28 + 100	from	ditto	57.75	1975
AR-010-20-10	TOPALLI	28 + 100	to	ditto	57.75	1975
AR-010-21-1	AKHISAR (AGASAR-I)	4 + 300		ditto	81.10	1964
AR-010-21-2	KURBAGALIDERE	5 + 900		ditto	29.00	1964
AR-010-21-3	CAMLIK	6 + 700		ditto	29.00	1964
AR-010-21-4	FOL (VAKFIKEBIR)	9 + 400		RC, Gerber, Girde	56.20	
AR-010-21-5	RUKA YILDIZDERE	10 + 600		RC, Simple, Girde	41.10	
AR-010-21-6	GORESEN	13 + 200		ditto	40.35	1960
AR-010-21-7	KILITA (YALIKOY)	15 + 800		ditto	40.50	1964
AR-010-21-8	ISKEFIYE CARSIBASI	19 + 200		ditto	72.25	1965
AR-010-21-9	KOFUGUN (KORE)	30 + 700		ditto	20.70	1987
AR-010-21-10	AKCAKALE	32 + 0		RC, Cantilever, Girder	41.80	1961
AR-010-21-11	DARICA (USTURKIYE)	37 + 600		RC, Simple, Girde	24.00	
AR-010-21-12	AHANDA (KAVAKLI)	39 + 500		RC, Cantilever, Slab	25.20	1963
AR-010-21-13	KIRECHANE	43 + 200	from	RC, Cantilever, Girder	28.50	1991
AR-010-21-14	KIRECHANE	43 + 200	to	ditto	28.50	1991
AR-010-21-15	SOGUTLU	43 + 200		PC(post-ten)	87.50	1991
AR-010-21-16	HACIBESIR	49 + 0		RC, Simple, Girde	27.10	1958
AR-010-22-1	DEGIRMENDERE	0 + 100		RC, Gerber, Girde	90.80	1961
AR-010-22-2	SANA	9 + 800		ditto	62.10	1960
AR-010-22-3	YOMRA	11 + 800		ditto	55.20	1957
AR-010-22-4	HARMANLI	14 + 700	from	RC, Simple, Girde	16.10	1984
AR-010-22-5	HARMANLI VARVARA	14 + 700	to	ditto	16.15	
AR-010-22-6	ARSIN 2. SERIT	17 + 400	from	ditto	16.00	1976
AR-010-22-7	ARSIN	17 + 400	to	ditto	16.15	1960
AR-010-22-8	FALKOZ	22 + 200		ditto	26.90	1956
AR-010-22-9	YANBOLU	23 + 600		RC, Gerber, Girde	61.70	
AR-010-22-10	KARADERE (ARAKLI)	30 + 400		ditto	107.20	1962
AR-010-22-11	KUCUKDERE	31 + 800		ditto	59.40	1954
AR-010-22-12	SURMENE	35 + 500	from	RC, Continuous, Girder	77.80	1954
AR-010-22-13	SURMENE 2 SERIT	35 + 500	to	RC, Gerber, Girde	77.70	1981
AR-010-22-14	KASTEL	41 + 100		RC, Simple, Girde	27.00	1960
AR-010-22-15	IVYAN SOGUKPINAR	46 + 600		ditto	32.50	1970
AR-010-22-16	SOLAKLI	49 + 800		ditto	216.90	1969
AR-010-22-17	ESKIPAZAR BALTACI	54 + 300		ditto	72.30	1967
AR-010-23-1	IYIDERE	0 + 100		ditto	217.25	1970
AR-010-23-2	DEREPAZARI	10 + 200	from	ditto	28.50	1978
AR-010-23-3	DEREPAZARI	10 + 200	to	ditto	22.00	1957
AR-010-23-4	CIFTEKAVAK	15 + 0		RC, Gerber, Girde	52.50	1956
AA-200-11-1	SAKARYA	4 + 500		RC, Continuous, Slab	35.00	1959
AA-200-10-1	BABADAT	14 + 500		RC, Cantilever, Slab	25.20	
AA-260-03-1	BURHANLI	7 + 0		ditto	22.30	
AA-260-01-1	AKARCAY(AKCIN)	3 + 400		ditto	25.20	1964
AA-260-01-2	BAYAT(BOGAZCAY)	47 + 200		RC, Simple, Girde	16.20	
AA-260-01-3	YUREGIL (BAYAT)	53 + 0		ditto	32.40	
AA-260-01-4	EMIRDAG (UST GEC.)	71 + 0	from	Rigit Frame	21.00	1983
AA-260-01-5	EMIRDAG (UST GEC.)	71 + 0	to	ditto	21.00	1983
AA-650-09-1	MAHMARI KARADIREK	22 + 600		RC, Simple, Girde	53.95	1967
AA-650-11-1	ADALAR KECIBORLU	13 + 400		ditto	48.30	1993
AA-650-11-2	YAGBASAN	15 + 500		RC, Cantilever, Slab	21.00	1993
AA-650-11-3	SARDERE	26 + 800		RC, Simple, Girde	43.15	1985
AA-650-12-1	ACIDERE	0 + 200		ditto	29.20	1985

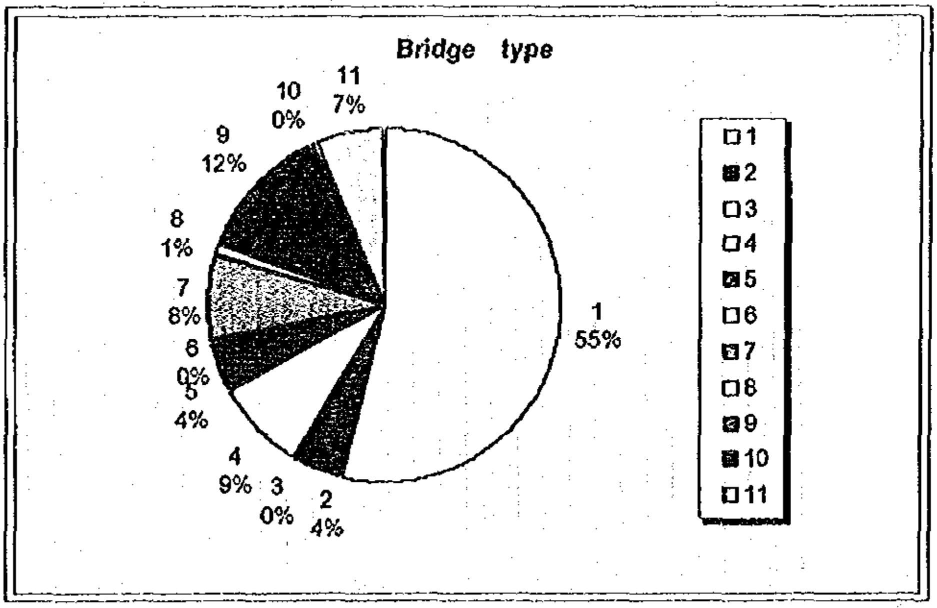
AA-650-12-2	CARSAK	4 + 0		ditto	16.25	1984
AA-650-12-3	CERCIN-II-	5 + 400		ditto	28.30	1981
AA-650-12-4	CERCICAY	6 + 400		ditto	28.50	
AA-650-12-5	ESKIYERE	9 + 700		RC, Cantilever, Slab	25.00	1993
AA-650-13-1	DAGARCIK	2 + 100		ditto	25.20	1988
AA-650-13-2	ONAC	9 + 0	from	RC, Continuous, Slab	17.50	1984
AA-650-13-3	ONAC	9 + 0	to	RC, Simple, Girde	17.75	
AA-650-14-1	KEPEZ KANAL	44 + 500	from	ditto	18.40	1977
AA-650-14-2	KEPEZ KANAL	44 + 500	to	ditto	18.60	1977
AI-300-06-1	BANAZ	33 + 900		RC, Simple, Girde	27.00	
AI-300-06-2	GODIREN CAYI	48 + 800		RC, Continuous, Slab	35.10	
AI-300-05-1	HUDUT-II-	0 + 200		RC, Simple, Girde	22.20	
AI-300-05-2	GEDIZ-II-	10 + 500		RC, Gerber, Girder	90.85	
AI-300-05-3	GERENCAY	21 + 100		RC, Simple, Girde	40.60	
AI-300-05-4	GURECAYI	30 + 500		ditto	27.20	
AI-300-04-1	AZMAK-II-	3 + 0		RC, Continuous, Slab	87.00	1961
AI-300-04-2	MERSINLI	12 + 0		ditto	29.40	1961
AI-300-04-3	SOGUTCAYI	55 + 200		RC, Simple, Girde	48.60	
AI-300-04-4	GEDIZ-I-	60 + 400		RC, Gerber, Girder	81.20	
AI-300-04-5	HUDUT-I-	63 + 900		RC, Simple, Girde	40.40	
AI-300-03-1	AZMAT-I-	48 + 600	from	ditto	67.95	1987
AI-300-03-2	AZMAT-I-	48 + 600	to	ditto	67.95	1988
AI-300-02-1	BUCA UST GECIT	0 + 150	from	RC, Cantilever, Girder	33.00	1972
AI-300-02-2	BUCA UST GECIT	0 + 150	to	ditto	33.00	1972
AI-300-02-3	MELEZCAYI	3 + 800	from	RC, Simple, Girde	35.95	1983
AI-300-02-4	MELEZCAYI	3 + 800	to	ditto	35.95	1983
AI-300-02-5	HILAL-I-SAGIUST GEC	4 + 200	from	PC(post-ten)	476.30	1987
AI-300-02-6	HILAL-I-SAGIUST GEC	4 + 200	to	ditto	476.30	1987
AI-300-02-7	HILAL-II-SAGIUST G.	4 + 700	from	ditto	347.80	1990
AI-300-02-8	HILAL-II-SAGIUST G.	4 + 700	to	ditto	347.80	1990
AI-300-02-9	HALKAPINAR K.U.G.	6 + 200	from	ditto	548.60	
AI-300-02-10	HALKAPINAR K.U.G.	6 + 200	to	ditto	548.60	
AI-300-02-11	ZAFERPAYZIN K.U.G.	7 + 500	from	ditto	239.70	
AI-300-02-12	ZAFERPAYZIN K.U.G.	7 + 500	to	ditto	239.70	
AI-300-02-13	MANDACAYI-I-	8 + 300	from	RC, Cantilever, Slab	25.20	1982
AI-300-02-14	MANDACAYI-I-	8 + 300	to	ditto	25.20	1982
AI-300-02-15	NIFCAYI-I-	23 + 600		RC, Simple, Girde	16.20	1964
AI-300-02-16	NIFCAYI-II-	38 + 800		RC, Continuous, Slab	73.60	1967
AI-300-02-17	SOFULAR	46 + 300		RC, Simple, Girde	16.20	1966
SB-200-08-1	KANAL	19 + 600	from	RC, Simple, Girde	16.20	1973
SB-200-08-2	KANAL	19 + 600	to	ditto	16.20	1973
SB-200-08-3	PORSUK	28 + 100	from	RC, Continuous, Slab	18.20	1973
SB-200-08-4	PORSUK	28 + 100	to	ditto	48.20	1973
SB-200-07-1	MEZIT VII	0 + 500		RC, Simple, Girde	16.30	1974
SB-200-06-1	ABDAL (NILUFER)	0 + 600	from	ditto	73.45	1969
SB-200-06-2	ABDAL (NILUFER)	0 + 600	to	ditto	73.45	1969
SB-200-06-3	DAVUTDEDE	7 + 400	from	RC, Continuous, Slab	34.90	1968
SB-200-06-4	DAVUTDEDE	7 + 400	to	ditto	34.90	1968
SB-200-06-5	HACIVAT	12 + 100	from	ditto	22.30	1965
SB-200-06-6	HACIVAT	12 + 100	to	ditto	21.75	1972
SB-200-06-7	BALIKLI	15 + 200	from	RC, Simple, Slab	30.75	1966
SB-200-06-8	BALIKLI	15 + 200	to	RC, Simple, Girde	43.60	1972
SB-200-06-9	DELICAY	15 + 700	to	ditto	43.25	1972
SB-200-06-10	AKINIS (GOLET)	27 + 600		ditto	32.80	1971
SB-200-06-11	KALBURT	48 + 800		ditto	40.60	1973
SB-200-06-12	CANDIR HASANPASA	62 + 0		ditto	113.85	1972
SB-200-06-13	MEZIT-I-	66 + 100		ditto	17.50	1972

SB-200-06-14	MEZIT-II-	69 + 500	ditto	16.50	1972
SB-200-06-15	MEZIT-III-	71 + 200	ditto	16.50	1972

from : from the bigininng(0 km)
to : to the bigininng(0 km)

Table - 5.2.4 Type of Objective Bridges

Route	AR	AA	AI	SB	Total	%
1 Simple girder	74	12	12	13	111	53.6
2 Simple slab	7			1	8	3.9
3 Continuous girder	1				1	0.5
4 Continuous slab	6	2	4	6	18	8.7
5 Cantilever girder	7		2		9	4.3
6 Pre-stressed(Pre-tension)	1				1	0.5
7 Pre-stressed(Post-tension)	8		8		16	7.7
8 Rigid frame	1	2			3	1.4
9 Gerber girder	23		2		25	12.1
10 Gerber slab	1				1	0.5
11 Cantilever slab	6	6	2		14	6.8
total	135	22	30	20	207	100.0



5.3 Observation Results

5.3.1 Comments On Bridge Damage

1) General:

The comments highlighted in this section relate to damage items observed during the visual inspection of the objective bridges. They follow the same layout as outlined in the implementation manual and database input forms.

The original basic inventory was found to be reasonably accurate. Several bridges, however, had been widened or modified since the data had been initially gathered. A system for notifying and updating such changes needs to be implemented.

2) Pavement:

The quality of the pavement varied enormously on the objective bridges. Most structures were identified as having at least one of the damage items ranked C or above, usually as a consequence of heavy traffic. The most common defect was rutting caused by wheel indentation and wave by a combination of poor surfacing laying and traffic. On older surfacing the incidence of cracking was high and this has lead to potholing in places.

The defects were only ranked if they occurred within the bridge length i.e. between the joints. Defects outside this parameter were assessed as damage item 11-Embankment.

Where excessive surfacing overlay has been observed on the structures this has been noted on the database sheet comments section. This will have a significant effect on the residual load carrying capacity of the bridge span.

3) Kerb and Railing:

Virtually all the railing to the objective bridges was of steel post and rail type with vertical infill steel bars. The posts have been anchored to the deck slab either by means of an anchoring plate or by welding to the existing deck reinforcement. Spalling around the railing post anchorages was the most common fault identified. This is attributable to one of the following:

- Impact damage of the railing causing the parapet to be deformed and the anchorage to spall the cover concrete.

- Corrosion of the parapet anchorage causing the cover concrete to spall.

- Spalling of poor quality concrete on the parapet beam around the anchorages.

The cracking and peel off damage items were usually associated with the above phenomenon.

The last three items referred to the condition of steel parapet with the deformed item being attributable to vehicular impact. Corrosion was generally found to be a minor damage item but sections of railing were found to missing or badly damaged on a few structures.

4) Expansion Joints:

Most of the expansion joints consisted of a gap which has been surfaced over. As a consequence the major damage item is not visible i.e. the condition of the joint cannot be assessed.

The study teams concluded that the majority of the expansion joints were in fact open joints through sub surface water was allowed to leak. This leakage is affecting both the bridge deck soffit and the deck support structures (substructures).

5) Deck Slab:

The deck soffit was the only area visible for inspection apart from a few structures which did not have an asphalt layer on the deck.

Generally cracking and concrete peel off damage items were found to be minor on the structures inspected. However a few structures did have extensive cracking, possibly caused by traffic overloading.

Rebar exposure and honeycombing of the deck slab was found to be extensive and this is mainly attributable to poor construction methods. In some instances, the exposed rebar was in an advanced state of corrosion and these damages were more seriously evaluated.

Water leakage damage was observed to be mainly from the following sources:

- through the deck as a result of no/ineffective deck waterproofing layer.

- through the joints as a result of ineffective watertight expansion joints.

- through the construction joints between the parapet beam and the main body of the deck slab.

- under the parapet edge as a consequence of no effective edge drip detail having been constructed.

- through defective or under length deck drainage outlets discharging on to the deck soffit.

The damage was significantly worse where evidence of salt from winter maintenance activities were observed.

The other important area for damage is on structures having half joints (Gerber). Here significant cracking was observed at the internal corners of the half joints.

6) Concrete Girder:

Comments relating to damage for this item are covered by section 5. The effect of water leakage tended to be reduced, however the extent of rebar exposure and honeycombing had an increased effect on the damage items recorded for concrete girders.

7) Bearing:

In more than 95% of the bridges inspected, the bearings were not visible. Discussions with local bridge engineers resulted in some bearing details being obtained. These are summarised as follows:

- No bearings exist on some structures. The insitu beams rest directly on the substructures.

- Very thin lead bearings are provided. In the majority of structures these have been surrounded in mortar making any initial visual inspection impracticable. However, in the few locations where lead bearings were visible these were observed to have deformed or "squeezed".

- Very thin rubber pads have been provided (only on structures constructed after the late 1980's). Again these have been surrounded in mortar making visual inspection impracticable.

- Elastomeric bearings have been installed on most of the viaduct structures inspected within the Izmir city limits. These were only visible on some abutments and were found to be in good condition. The remaining bearings (on the piers) were not visible without access equipment.
  At all bearing shelves debris from the construction phase was still evident. In locations with open expansion joints above the bearings, large accumulations of additional debris was observed on the bearing shelf.

8) Drainage:

The drainage items inspected relate to the efficient discharge of water from the deck surface safely below the deck soffit.

The drainage outfall were, in the majority of objective bridges, vertical holes through the deck with no collecting pipework for water discharge. A notable exception were six number multi span viaducts in the centre of Izmir on which some outlet pipework was present, but this had been severely damaged in several instances. The damaged pipework had not been replaced as the original and repaired pipework had been regularly stolen.

Pipe damage refers to the drainage condition below the deck soffit. Where drainage outlet pipes do not protrude to at least below the soffit, other structural members were found to have deteriorated. Such an example is water remaining on the deck soffit allowing low cover rebar to corrode.

Several of the objective bridges had drainage inlets that were partially or fully blocked as a result of no regular routine maintenance. In some instances the drainage holes had been surfaced over.

In over 95% of the objective bridges no covers were observed over the drainage inlet hence no inspection was recorded for this item.

9) Column and Footing:

Several serious defects were observed to the columns, though in most instances no footing or foundation was inspected as this item was buried. The following observations were made:

a) Cracks

Serious cracks were noted on some structures. These were, in some instances, subjected to continuous wetting from leaking joints which had caused low cover rebar to corrode.

Serious cracking however was more evident on the newer structures notably the newer viaduct type structures in Izmir. Special mention is made below but the cause of such cracking to these newer structures is at present pure speculation and a detailed investigation need to be carried out. Tentative preliminary suggestions for the Izmir structures include.

- Alkali Silica Reaction

This phenomenon does not generally show itself as visible cracking for 6-7 years (some affected structures have been constructed in 1990). In several locations, the cracking occurs where the column is not subject to external wetting (one of the key promoters of alkali-silica reaction).

Cores will need to be taken and analysed to establish the possibility of alkali-silica reaction.

- Excessive Thermal Cracking

The columns were possibly designed to ASHTO standards which did not cover the effects of thermal cracking. The columns have large solid cross sectional properties and during concrete placement the ensuing heat generation has caused excessive cracking (due to insufficient thermal cracking reinforcement ?). This cracking will require monitoring to establish whether they are "live" or whether the cause of the cracking has subsided. However, this explanation does not answer the cause of the cracking to the pier crossheads which are subjected to external wetting from rain and leaking joints (See Alkali Silica Reaction above).

- Ground Movement

The majority of newer structures have been constructed on reclaimed land which may have settlement problems.

- Extent of Cracking

The depth of cracking appears to extend behind the main reinforcing bars in the two areas investigated again suggesting large stress movements.

The type of cracking to the other structures columns are limited to normal causes such as shrinking or cold or construction joints.

b) Concrete Peel Off

This type of damage was found to be relatively minor and limited to either low cover rebar or impact damage. However, on structures with low concrete strength and high porosity extensive frost damage is evident.

c) Exposed Rebar

This item was noted mainly as a result of poor concrete placement at the time of construction. The condition of rebar had deteriorated in areas which are subjected to water contact.

d) Honeycomb

Again this damage item varied as a result of poor concrete placement.

e) Void

No major damage for this item was noted. However in a few column voids (or concrete peel off) were starting where the column concrete strength was small.

f) Water Damage

Two major damage types were noted under this item and are described as follows.

- Water leakage through the joints which has caused the columns (and especially the column crosshead) to determine resulting most notably in concrete spalling.

- The effects of river flow on the column. In instances where the column concrete is weak or badly placed, concrete is being "plucked" by water action on the column. This is leading to a reduction in cross section of the columns. In the more serious cases the column concrete has been removed behind the rebar, which is also in a high state of deterioration.

g) Displacement

In most of the study bridges, no displacement of the columns were noted. It is unlikely that this fault will be observed unless significant movement has occurred.

h) Scour

This is an area showing large damage potential. Several of the column/piers are located either in or adjacent to rivers. In certain circumstances, scour action has caused the column cross sectional area to diminish exposing reinforcing bars which are corroding. In some instances, depth of scour action is unable to be established without the use of specialist inspection equipment/personnel.

In several locations downstream of the structure, control weirs minimising the river flow speed past the structure were in a bad state of repair. This is increasing scour problems in these locations. These instances have been recorded in the comment section of the database sheet.

10) Abutments:

The abutments have similar problems to those for Columns and Footing above. The additional area of concern is in the crack item where cracks on the abutment have been caused by a restriction in deck movement possibly as a result of an insufficient or in operative deck expansion joint. This has caused localised spalling near the certain walls and bearing shelf.

Concrete peel off has been recorded on some abutments where the concrete girders transfer load onto the abutments. This has been caused either by a concentration of water damage or as a result of extremely caused movements (earthquake ?).

The problem of scour of the abutments is reduced when compared to that under the column and footing item. However scour is significant on small span structures where there is insufficient flow capacity through the structure. This is more significant in older structures where flow capacity may not have been fully taken account of in the design stage.

11) Embankment:

The type of damage noted for this item usually depended on the embankment settlement deformation within 5 metres of the end of the bridge span. Erosion from behind open (skeletal) type abutment were observed in some objective bridges.

12) Rip Rap:

The majority of rip rap inspected consists of rock segments either laid dry with no mortar joints or subsequently mortared. The condition of rip rap varied enormously from structure to structure. In some instances erosion had taken place and this requires urgent attention. Other damage types relate to the rip rap having been "unofficially" removed.

5.3.2 Data Processing

The each data of damaged bridges is arranged in data sheet. The data sheet of these results are presented in Appendix 4.

5.4 Evaluation of Visual Inspection

5.4.1 Evaluation Criteria

Evaluation is carried out by means of fundamental method described in the former section. This evaluation results shows the overall prioritization of damaged bridges and its components in terms of emergency and importance intensities caused by damages on the bridge.

5.4.2 Evaluation Results

1) Evaluation Results

Table - 5.4.1 shows evaluation results in the descending order of important index (IIDX). According to this results, the number of sound bridges is less than 10% (approximately), even when a few damages in rank `C' is considered to be within the allowable range.

2) Characteristics of Bridge Damages

The number of bridges whose bridge components are damaged or deteriorated and have been rank `C' or higher, is summarized in Table - 5.4.2.

Table - 5.4.2 Ratio of Bridge Components with Serious Damage than Rank `C'

Bridge Element	Number of Bridges	(%)
Pavement	101	(49)
Kerb & Railing	185	(89)
Expansion Joint	153	(74)
Deck Slab	135	(65)
Concrete Girder	135	(65)
Bearing	12	(1)
Drainage	117	(57)
Column & Footing	102	(49)
Abutment	87	(42)
Embankment	80	(39)
Riprap	46	(22)

3) Categorization of Damaged Bridges

In order to select bridges for further study, another prioritizing method was used to clarify problem bridges, according to the following reasons as below:

- In the cases where the vast majority of the damages are ranked 'C', there is a possibility that these may have an actual rank higher than 'C' or those already ranked as 'A' and 'B' may actually be lower than or equal to 'C', both indices have a

Table - 5.4.1 Evaluation Results by Basic Formula (A:B:C=5:3:1) (1/4)

Recoard#	RT	CS	BN	BRNAME	BRLGTH	PT	KT	JT	ST	GT	BT	DT	CT	AT	ET	IT	EIDX	IIDX	NA	NB	NC
1	795	1	5	ASAGI CAKALLI	71.55	0	4	6	22	16	0	2	6	9	1	0	68	60	3	10	21
2	200	6	12	CANDIR HASANPASA	113.85	2	0	2	20	4	0	0	10	1	0	0	39	39	5	1	11
3	10	16	12	AKCAY	106.90	0	5	9	7	8	12	4	2	0	1	0	48	37	0	10	16
4	10	17	2	CURI DERESI	83.90	3	6	6	4	16	5	2	0	2	0	0	44	36	2	3	25
5	10	16	4	SELYERI	21.70	0	5	10	5	9	0	2	4	5	0	1	41	34	0	6	23
6	300	2	6	HILAL-I-SAGIUST GEC.	476.30	1	2	5	5	5	1	2	8	4	1	0	34	30	1	3	20
7	300	2	8	HILAL-II-SAGIUST G.	347.80	1	2	5	2	2	0	2	8	10	0	0	32	29	2	2	16
8	300	4	5	HUDUT-I-	40.40	1	3	8	5	3	0	0	6	5	1	2	34	29	0	2	28
9	300	2	7	HILAL-II-SAGIUST G.	347.80	1	1	5	2	1	0	2	8	10	0	0	30	27	2	2	14
10	300	3	2	AZMAT-I-	67.95	0	3	5	4	5	1	1	10	1	0	0	30	27	0	2	24
11	200	13	1	KAYAS I	20.00	4	5	4	1	3	0	1	9	5	1	2	35	27	0	3	26
12	300	3	1	AZMAT-I-	67.95	0	3	5	4	3	0	1	10	3	1	0	30	26	0	2	24
13	785	5	2	KOPARAN-II-	27.45	1	4	3	3	10	0	0	4	4	0	0	29	26	1	1	21
14	300	4	4	GEDIZ-I-	81.20	4	3	9	3	5	1	0	1	3	1	1	31	25	0	2	25
15	650	11	3	SARDERE	43.15	0	2	4	12	3	0	1	3	3	1	0	29	25	1	2	18
16	200	10	1	BABADAT	25.20	2	2	1	3	0	0	1	15	0	2	3	29	25	1	3	15
17	300	5	1	HUDUT-II-	22.20	3	1	5	3	4	1	0	5	6	1	1	30	25	0	0	30
18	300	2	9	HALKAPINAR K.U.G.	548.60	1	2	2	2	2	0	2	6	9	0	0	26	24	2	1	13
19	300	2	10	HALKAPINAR K.U.G.	548.60	2	2	3	2	2	0	2	8	6	0	0	27	24	2	1	14
20	10	19	19	HARSIT	248.50	3	4	3	3	7	1	1	6	0	0	0	28	23	0	3	19
21	10	22	16	SOLAKLI	216.90	0	4	2	7	2	0	2	8	0	0	0	25	22	0	4	13
22	300	4	3	SOGUTCAYI	48.60	3	3	5	4	3	0	0	2	5	1	1	27	22	0	0	27
23	10	18	1	BOLAMAN	202.40	0	3	7	0	3	0	2	10	0	1	0	28	21	0	5	11
24	785	5	4	HACIMUSA	16.40	1	10	2	5	0	0	0	5	3	1	0	27	21	0	3	18
25	300	2	5	HILAL-I-SAGIUST GEC.	476.30	1	2	5	1	1	1	2	6	4	0	0	23	20	1	2	12
26	300	5	2	GEDIZ-II-	90.85	1	2	8	0	3	2	0	4	3	1	1	25	20	0	2	19
27	10	18	7	AKCAOVA	59.30	0	4	5	0	14	0	1	0	0	0	0	24	20	2	1	11
28	200	14	1	BALABAN	49.50	3	1	5	7	2	0	1	3	2	1	0	25	20	0	3	16
29	200	13	2	KAYAS I	17.90	2	4	2	1	2	0	0	4	4	2	3	24	20	0	0	24
30	300	2	11	ZAFERPAYZIN K.U.G.	239.70	1	1	2	2	0	0	1	8	6	1	0	22	19	2	1	9
31	300	5	3	GERENCAY	40.60	2	1	5	2	5	0	1	4	2	1	0	23	19	0	0	23
32	300	2	2	BUCA UST GECIT	33.00	1	6	0	1	13	0	1	1	0	1	0	24	19	2	2	8
33	260	1	3	YUREGIL(BAYAT)	32.40	3	2	3	1	3	0	2	5	3	1	2	25	19	0	0	25
34	650	12	4	CERCICAY	28.50	1	2	4	3	4	0	0	4	3	1	1	23	19	0	0	23
35	650	12	3	CERCIN-II-	28.30	2	2	2	3	6	0	0	3	2	1	0	21	19	0	0	21
36	100	17	5	PASA PINAR	26.60	3	3	1	5	6	0	2	0	0	0	5	25	19	1	1	17
37	260	3	1	BURHANLI	22.30	3	3	4	3	0	0	0	5	2	2	2	24	19	0	1	21
38	10	20	10	TOPALLI	57.75	0	3	2	0	4	0	1	7	3	1	0	21	18	0	2	15
39	190	2	3	BUDAKOZU	40.25	4	3	2	3	3	0	1	2	3	1	0	22	18	0	0	22
40	200	14	4	CORUHOZU	31.75	4	3	1	3	5	0	1	3	1	0	0	21	18	0	0	21
41	785	5	6	TEPEUSTU	26.90	1	4	1	5	2	0	1	4	3	0	0	21	18	0	0	21
42	785	5	7	SARSAK	21.90	4	1	3	4	5	0	0	1	2	1	2	23	18	0	0	23
43	260	1	2	BAYAT(BOGAZCAY)	16.20	3	4	3	2	4	0	0	0	5	1	2	24	18	0	0	24
44	10	19	15	YAGLIDERE	159.50	2	3	3	2	0	0	2	8	0	0	0	20	17	0	2	14
45	200	14	2	IRMAK	127.40	2	2	4	2	3	0	1	4	2	1	0	21	17	0	0	21
46	100	17	1	MERZIFON	36.25	0	5	2	11	2	0	0	0	0	0	0	20	17	0	3	11
47	785	5	3	KOPARAN-III-	33.60	2	4	2	3	4	0	0	2	2	0	0	19	17	0	0	19
48	10	20	4	KUYUMCUDERE	27.50	3	3	1	1	4	0	0	2	4	1	2	21	17	0	0	21
49	300	6	1	BANAZ	27.00	2	2	4	2	3	0	0	3	2	1	2	21	17	0	0	21
50	650	13	2	ONAC	17.75	2	3	3	5	0	0	1	3	3	1	0	21	17	0	0	21
51	785	5	5	GAFURLU	16.20	1	3	2	3	0	0	0	4	5	0	1	19	17	0	0	19
52	650	11	1	ADALAR KECIBORLU	48.30	0	3	0	5	5	0	0	2	2	1	1	19	16	0	0	19
63	795	3	2	YUVA MEVKII	28.60	2	4	3	3	4	0	0	0	3	1	0	20	16	0	0	20

Table - 5.4.1 Evaluation Results by Basic Formula (A:B:C=5:3:1) (2/4)

Record#	RT	CS	BN	BRNAME	BRLGTH	PT	KT	JT	ST	GT	BT	DT	CT	AT	ET	IT	EIDX	IIDX	NA	NB	NC
54	190	2	2	KEMALLI	24.15	3	3	1	1	4	0	0	3	2	1	2	20	16	0	0	20
55	650	12	2	CARSAK	16.25	4	3	2	2	4	0	0	0	3	1	0	19	16	0	0	19
56	10	18	10	MELET-I-	251.70	3	5	3	2	4	0	1	2	0	0	2	22	15	0	0	22
57	10	16	11	TURNASUYU	107.70	0	5	2	2	4	1	1	3	0	1	2	21	15	0	0	21
58	10	23	4	CIFTEKAVAK	52.60	0	3	7	1	5	0	2	1	0	0	0	19	15	0	3	10
59	10	16	10	MILIC-I-	47.70	0	4	2	4	0	0	1	5	2	1	0	19	15	0	1	16
60	10	22	15	IVYAN SOGUKPINAR	32.50	0	3	1	4	8	0	1	0	0	0	0	17	15	0	2	11
61	300	5	4	GURECAYI	27.20	2	2	2	3	2	0	0	2	3	1	1	18	15	0	0	18
62	200	14	5	ISIKLAR	25.75	4	0	3	4	0	0	2	2	3	1	1	20	15	0	0	20
63	300	2	17	SOFULAR	16.20	3	3	3	4	2	0	1	0	3	1	1	21	15	0	0	21
64	100	1	1	DELICE-II-	16.00	3	3	2	4	0	0	0	2	3	0	1	18	15	0	0	18
65	10	16	7	CARSAMBA-I-	218.50	1	4	11	0	3	0	1	0	0	0	0	20	14	0	3	11
66	10	23	1	IYIDERE	217.25	0	4	2	0	1	0	2	8	0	0	0	17	14	0	2	11
67	10	22	1	DEGIRMENDERE	90.60	0	4	1	0	11	0	0	0	0	0	0	16	14	2	0	6
68	10	9	13	KESAP	38.75	0	3	3	3	3	0	2	2	1	0	0	17	14	0	0	17
69	795	1	4	ASAGI CAKALLI	35.60	4	4	3	0	4	0	0	1	2	1	0	19	14	0	0	19
70	200	13	5	OZCAY	27.45	1	2	3	2	2	0	1	2	4	0	0	17	14	0	0	17
71	260	1	1	AKARCAY(AKCIN)	25.20	4	2	0	4	0	0	0	2	3	1	2	18	14	0	0	18
72	10	19	12	KARGUN	16.20	2	3	3	1	6	0	1	0	1	0	0	17	14	0	1	14
73	10	17	3	LAHANA	18.10	2	5	0	5	4	0	2	0	0	1	0	19	14	0	0	19
74	785	5	1	KOPARAN-I-	16.00	1	2	1	4	4	0	0	0	3	1	1	17	14	0	0	17
75	190	1	2	HACIOBA	15.50	4	4	0	5	0	0	0	2	2	0	0	17	14	0	0	17
76	795	1	1	KURTUN-II- ATAKUM	62.15	0	3	5	0	2	0	2	2	2	1	0	17	13	0	0	17
77	10	20	9	TOPALLI	57.75	0	3	2	0	3	0	1	3	3	1	0	16	13	0	0	16
78	650	9	1	MAHMARI KARADIREK	53.95	3	3	2	1	1	0	2	3	1	1	0	17	13	0	0	17
79	10	18	4	YALIKOY	30.00	2	4	1	8	0	0	0	0	0	0	0	15	13	0	2	9
80	795	2	1	HACIOSMAN	21.00	0	3	1	4	5	0	2	0	0	0	0	15	13	0	0	15
81	200	6	15	MEZIT-III-	16.50	2	0	0	8	2	0	0	0	1	0	1	14	13	0	2	8
82	10	20	6	CANAKCI ELEVIDERE	155.60	3	3	1	0	3	0	1	4	0	0	0	15	12	0	1	12
83	10	18	3	CALISLAR	48.00	0	4	4	0	5	0	0	0	0	0	3	16	12	0	1	13
84	300	2	3	MELEZCAYI	35.95	1	3	2	1	1	0	2	2	2	1	1	16	12	0	0	16
85	650	12	1	ACIDERE	29.20	1	3	3	2	2	0	1	2	1	1	1	17	12	0	0	17
86	190	2	4	DICAYI	25.20	4	4	0	5	0	0	1	2	0	0	0	16	12	0	0	16
87	650	12	5	ESKIYERE	25.00	2	1	2	4	0	0	1	2	0	2	2	16	12	0	0	16
88	200	13	3	KAYAS II	22.70	3	2	5	1	0	0	1	3	1	0	0	16	12	0	0	16
89	200	13	4	KAYAS II	19.90	3	4	0	2	3	0	0	1	2	1	1	17	12	0	0	17
90	200	11	1	SAKARYA	35.00	3	2	1	2	0	0	0	2	3	1	1	15	11	0	0	15
91	795	4	1	DERINCAY	33.30	1	5	0	5	3	0	1	0	0	0	1	16	11	0	0	16
92	10	16	2	KIRAZLIK	24.25	0	2	1	2	2	0	2	4	0	0	0	13	11	0	1	10
93	10	20	2	BADA	24.05	2	4	2	1	3	0	1	1	0	0	0	14	11	0	0	14
94	100	17	4	UST GECIT II	20.50	0	3	0	0	8	0	0	0	1	0	0	12	11	0	2	6
95	650	13	3	ONAC	17.75	1	5	0	3	4	0	0	1	0	0	0	14	11	0	0	14
96	10	17	5	NACI DERESI	16.30	0	3	2	2	3	1	2	0	0	0	0	13	11	0	0	13
97	10	19	9	BATLAMA	80.10	0	3	3	3	3	0	1	0	0	0	0	13	10	0	0	13
98	10	18	9	CIVILDERESI	61.60	1	3	3	2	3	0	0	0	0	0	0	12	10	0	0	12
99	200	8	4	PORSUK	48.20	0	0	0	2	0	0	2	7	0	1	0	12	10	0	2	6
100	10	20	8	DIZGINE	46.70	3	2	2	0	0	0	2	1	3	0	0	13	10	0	0	13
101	100	17	2	MERZIFON	36.25	0	3	7	1	2	0	0	0	0	0	0	13	10	0	2	7
102	300	2	4	MELEZCAYI	35.95	0	4	2	1	0	0	1	2	2	1	2	15	10	0	0	15
103	300	6	2	GODIREN CAVI	35.10	1	3	1	4	0	0	0	1	1	1	1	13	10	0	0	13
104	785	1	2	ATAKUM K.Y. UST G.	32.60	0	1	4	0	4	0	2	2	0	1	0	14	10	0	0	14
105	10	19	14	YOLAGZI	28.90	0	3	2	1	3	0	1	1	1	0	0	12	10	0	0	12
106	190	2	1	ACIOZ	28.30	3	4	0	3	3	0	1	0	0	0	0	14	10	0	0	14

Table - 5.4.1 Evaluation Results by Basic Formula (A:B:C=5:3:1) (3/4)

Recoard#	RT	CS	BN	BRNAME	BRLGTH	PT	KT	JT	ST	GT	BT	DT	CT	AT	ET	IT	EIDX	IIDX	NA	NB	NC
107	10	21	16	HACIBESIR	27.10	0	3	2	2	3	0	0	0	1	0	0	11	10	0	0	11
108	10	19	3	INCIGEZ	27.00	2	3	3	0	2	0	0	1	1	1	0	13	10	0	0	13
109	10	18	6	KOZAGZI	22.00	2	3	2	0	2	0	1	2	0	0	0	12	10	0	0	12
110	10	19	5	CEKEK YERI	21.65	0	3	1	6	0	0	1	1	0	0	0	12	10	0	0	12
111	190	1	3	KOCACAY	19.60	3	4	0	3	3	0	1	0	0	0	0	14	10	0	0	14
112	795	3	1	ASAGI KAMISLI	16.00	1	5	1	2	4	0	0	0	0	0	0	13	10	0	0	13
113	10	20	3	COMLEKCI	109.85	0	3	2	2	3	0	0	0	0	1	0	11	9	0	0	11
114	10	18	2	ILICASU	48.50	0	3	2	2	0	0	1	1	2	0	0	11	9	0	0	11
115	200	8	3	PORSUK	48.20	0	1	0	2	0	0	0	7	0	0	0	10	9	0	2	4
116	10	21	7	KILITA(YALIKOY)	40.50	0	3	2	2	2	0	0	1	0	0	0	10	9	0	0	10
117	10	19	4	BULANCAK	32.35	2	3	2	0	2	0	2	0	0	1	0	12	9	0	0	12
118	10	16	3	SELYERI	27.20	0	3	3	4	1	0	0	0	0	0	0	11	9	0	0	11
119	650	13	1	DAGARCIK	25.20	3	0	1	3	0	0	2	1	1	1	1	13	9	0	0	13
120	260	1	5	EMIRDAG(UST GEC.)	21.00	1	2	0	3	0	0	0	0	4	1	0	11	9	0	0	11
121	260	1	4	EMIRDAG(UST GEC.)	21.00	1	2	0	1	0	0	0	0	6	0	0	10	9	0	0	10
122	650	11	2	YAGBASAN	21.00	2	0	1	3	0	0	1	1	1	2	0	11	9	0	0	11
123	300	2	15	NIFCAYI-I-	16.20	3	3	2	0	1	0	0	0	2	1	1	13	9	0	0	13
124	10	22	10	KARADERE(ARAKLI)	107.20	0	5	3	2	2	0	1	0	0	0	0	13	8	0	1	10
125	300	4	1	AZMAK-II-	87.00	1	2	1	2	0	0	2	2	0	1	0	11	8	0	0	11
126	10	21	1	AKHISAR(AGASAR-I)	81.10	0	1	2	0	3	0	0	2	1	0	0	9	8	0	0	9
127	10	22	17	ESKIPAZAR BALTACI	72.30	0	3	3	2	2	0	1	0	0	0	0	11	8	0	0	11
128	10	16	1	MERT IRMAGI	64.50	1	4	3	1	0	0	2	0	0	0	2	13	8	0	0	13
129	10	22	9	YANBOLU	61.70	2	2	3	1	2	0	0	0	0	0	0	10	8	0	0	10
130	10	18	8	CIVILDERESI	61.60	0	3	0	3	2	0	2	0	0	0	0	10	8	0	0	10
131	10	19	7	BUYUKGURE	40.55	0	4	3	0	3	0	2	0	0	0	0	12	8	0	0	12
132	10	21	6	GORESEN	40.35	2	3	3	1	1	0	1	0	0	0	0	11	8	0	0	11
133	10	19	17	YALCI(GOLAGZI)	32.25	0	5	3	0	2	0	1	1	1	0	0	13	8	0	0	13
134	10	19	18	DOMACLI	28.60	0	3	0	3	3	0	1	0	0	0	0	10	8	0	0	10
135	10	17	6	KAVAKLAR DERESI	27.15	0	4	3	0	3	0	2	0	0	1	0	13	8	0	0	13
136	10	20	1	YOGURTDERE	24.55	0	4	0	0	5	0	0	0	0	1	2	12	8	0	1	9
137	10	17	7	ELEKCI	157.50	2	3	3	0	0	0	2	0	0	1	0	11	7	0	0	11
138	10	19	11	AKSU	124.35	0	3	3	0	3	0	1	0	0	1	0	11	7	0	0	11
139	10	22	12	SURMENE	77.80	0	2	2	0	4	0	0	0	0	0	0	8	7	0	0	8
140	300	2	16	NIFCAY-II-	73.60	1	2	0	1	0	0	1	3	0	1	2	11	7	0	0	11
141	200	6	1	ABDAL(NILUFER)	73.45	0	0	0	5	0	0	0	2	0	0	0	7	7	0	0	7
142	10	21	8	ISKEFIYE CARSIBASI	72.25	0	3	2	0	2	0	1	1	0	1	0	10	7	0	0	10
143	10	19	10	BOGACIK	40.40	1	5	4	0	1	0	0	0	0	0	0	11	7	0	0	11
144	10	19	6	KUCUKGURE	27.00	2	3	3	0	1	0	1	0	0	0	0	10	7	0	0	10
145	10	22	8	FALKOZ	26.90	0	2	2	2	2	0	1	0	0	0	0	9	7	0	0	9
146	300	2	14	MANDACAYI-I-	25.20	2	6	0	0	0	0	0	2	0	1	0	11	7	0	0	11
147	10	21	12	AHANDA(KAVAKLI)	25.20	0	4	0	3	0	0	2	1	0	0	0	10	7	0	0	10
148	10	22	7	ARSIN	16.15	0	2	1	1	4	0	1	0	0	0	0	9	7	0	0	9
149	10	22	4	HARMANLI	16.10	0	2	5	0	2	0	1	0	0	0	0	10	7	0	1	7
150	10	21	5	RUKA YILDIZDERE	16.10	0	3	2	0	3	0	1	0	0	0	0	9	7	0	0	9
151	10	19	2	PAZARSUYU	117.90	0	1	3	0	3	0	2	0	0	0	0	9	6	0	0	9
152	10	20	7	CAVUSLU	102.80	0	3	3	0	2	0	1	0	0	0	0	9	6	0	0	9
153	10	22	11	KUCUKDERE	59.40	0	3	3	0	2	0	0	0	0	0	0	8	6	0	0	8
154	10	16	9	TERME	47.70	0	3	3	1	0	0	2	0	0	0	0	9	6	0	0	9
155	10	16	6	ABDAL IRMAGI	32.60	2	1	3	0	1	0	1	0	1	0	0	9	6	0	0	9
156	200	14	3	BULANIK	25.20	0	0	1	3	0	0	1	2	0	0	1	8	6	0	0	8
157	10	17	1	CINARSUYU	25.20	0	3	0	1	0	0	2	2	0	0	0	8	6	0	0	8
158	10	21	11	DARICA(USTURKIYE)	24.00	0	1	2	1	3	0	1	0	0	0	0	8	6	0	0	8
159	650	14	1	KEPEZ KANAL	18.40	2	3	3	0	0	0	1	0	0	1	0	10	6	0	0	10

Table - 5.4.1 Evaluation Results by Basic Formula (A:B:C=5:3:1) (4/4)

Recoard#	RT	CS	BN	BRNAME	BRLGTH	PT	KT	JT	ST	OT	BT	DT	CT	AT	ET	IT	EIDX	IIDX	NA	NB	NC
160	10	19	1	DOMUZDERE	16.10	0	3	3	0	1	0	2	0	0	0	0	9	6	0	0	9
161	10	16	8	CARSAMBA K.Y.U.G.	16.00	0	3	0	3	0	0	2	0	0	0	0	8	6	0	0	8
162	10	19	8	BATLAMA 2.SERIT	80.50	1	3	2	0	0	0	1	0	0	0	0	7	5	0	0	7
163	200	6	2	ABDAL(NILUFER)	73.45	0	0	0	5	0	0	0	0	0	0	0	5	5	0	0	6
164	10	17	4	CEVIZDERE	68.00	1	2	4	0	0	0	1	0	0	0	0	8	5	0	0	8
165	200	14	6	KARANLIKDERE	39.00	0	1	0	2	1	0	0	1	1	0	0	6	5	0	0	6
166	200	5	4	DAVUTDEDE	34.90	0	0	0	2	3	0	0	0	0	0	0	5	5	0	0	5
167	10	16	5	GELEMEN	34.55	0	3	2	0	1	0	0	0	0	0	0	6	5	0	0	6
168	795	1	3	ADA	33.20	0	4	0	0	3	0	1	0	0	0	0	8	5	0	0	8
169	300	4	2	MERSINLI	29.40	1	2	0	0	0	0	2	1	0	1	2	9	5	0	0	9
170	100	17	3	UST GECIT II	20.50	0	2	0	1	2	0	0	0	1	0	0	6	5	0	0	6
171	10	18	5	BELLICESU	20.00	0	4	0	3	0	0	0	0	0	0	0	7	5	0	0	7
172	10	21	4	FOL(VAKFIKEBIR)	56.20	0	1	1	0	3	0	1	0	0	0	0	6	4	0	0	6
173	300	2	1	BUCA UST GECIT	33.00	0	3	0	1	0	0	1	0	1	0	0	6	4	0	0	6
174	10	21	3	CAMLIK	29.00	0	3	2	0	0	0	0	0	0	0	0	5	4	0	0	5
175	10	22	14	KASTEL	27.00	0	2	2	0	1	0	0	0	0	0	0	5	4	0	0	5
176	10	20	5	CANAKCI ELEVIDERE	154.80	0	1	3	0	1	0	1	0	0	0	0	6	3	0	0	6
177	10	22	13	SURMENE 2.SERIT	77.70	0	1	1	1	1	0	0	0	0	0	0	4	3	0	0	4
178	200	6	3	DAVUTDEDE	34.90	1	0	0	2	0	0	0	0	0	0	0	3	3	0	0	3
179	10	21	2	KURBAGALIDERE	29.00	0	1	2	0	0	0	2	0	0	0	0	5	3	0	0	5
180	10	23	2	DEREPAZARI	28.50	0	1	0	0	3	0	1	0	0	0	0	5	3	0	0	5
181	10	21	9	KOFUGUN(KORE)	20.70	1	1	3	0	0	0	0	0	0	0	0	5	3	0	0	5
182	650	14	2	KEPEZ KANAL	18.60	1	1	3	0	0	0	0	0	0	1	0	6	3	0	0	6
183	200	6	13	MEZIT-I-	17.50	0	2	0	1	1	0	0	0	0	0	0	4	3	0	0	4
184	200	7	1	MEZIT VIII	16.30	0	2	2	0	0	0	0	0	0	0	1	5	3	0	0	5
185	10	21	15	SOGUTLU	87.50	0	0	2	0	0	0	0	0	0	0	0	2	2	0	0	2
186	10	22	2	SANA	62.10	0	0	2	0	0	0	0	0	0	0	0	2	2	0	0	2
187	200	6	8	BLIKLI	43.60	0	0	1	0	1	0	0	0	0	1	0	3	2	0	0	3
188	10	16	11	MILIC-II-	29.15	0	1	2	0	0	0	0	0	0	1	0	4	2	0	0	4
189	10	21	14	KIRECHANE	25.20	0	4	0	0	0	0	1	0	0	0	0	5	2	0	0	5
190	200	6	5	HACIVAT	22.30	0	0	0	1	0	0	0	1	0	0	0	2	2	0	0	2
191	200	6	6	HACIVAT	21.75	0	1	0	1	0	0	0	0	1	0	0	3	2	0	0	3
192	200	8	1	KANAL	16.20	0	3	0	0	0	0	0	0	0	1	0	4	2	0	0	4
193	10	19	16	GELIVERA TAH-II-	16.20	0	1	1	0	0	0	1	0	1	0	0	4	2	0	0	4
194	10	22	5	HARMANLI VARVARA	16.15	0	3	0	0	0	0	1	0	0	0	0	4	2	0	0	4
195	200	6	9	DELICAY	43.25	0	0	0	0	1	0	0	0	0	1	0	2	1	0	0	2
196	10	21	10	AKCAKALE	41.80	0	1	0	1	0	0	1	0	0	0	0	3	1	0	0	3
197	200	6	11	KALBURT	40.60	0	2	0	0	0	0	0	0	0	0	0	2	1	0	0	2
198	200	6	7	BALIKLI	30.75	0	1	0	1	0	0	0	0	0	1	0	3	1	0	0	3
199	10	21	13	KIRECHANE	25.20	0	2	0	0	0	0	0	0	0	0	0	2	1	0	0	2
200	200	6	14	MEZIT-II-	16.50	0	2	0	0	0	0	0	0	0	0	0	2	1	0	0	2
201	200	8	2	KANAL	16.20	0	0	0	0	0	0	0	0	0	2	0	2	1	0	0	2
202	10	22	6	ARSIN 2.SERIT	16.00	0	0	1	0	0	0	0	0	0	0	0	1	1	0	0	1
203	300	2	12	ZAFERPAYZIN K.U.G.	239.70	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
204	200	6	10	AKINIS(GOLET)	32.80	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
205	300	2	13	MANDACAYI-I-	25.20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
206	10	23	3	DEREPAZARI	22.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
207	10	22	3	YOMRA	17.00	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	1

tendency to be higher than that of being less number of rank 'A' and 'B'.

- Rank 'A' and 'B' damages, which were already evaluated on the rating table, may require further measure such as repair or further inspection n.

For this reason, score of rank 'C' is changed to zero (1 in initial formula) to emphasize the damages which are rank 'A' and / or 'B'.

Table - 5.4.3 presents calculation results, assuming that when the score of rank 'C' is equal to zero. The number of bridges which requires further inspection or remedial works is 52.

The bridge components which are damaged in the 52 bridges selected, can be summarized as in Table - 5.4.4.

Table - 5.4.4 Number and Ratio Critical Bridge Components in Selected Bridges

Bridge Element	Number of Bridges	(%)
Pavement	0	(0)
Kerb & Railing	2	(4)
Expansion Joint	8	(15)
Deck Slab	8	(15)
Concrete Girder	10	(19)
Bearing	1	(2)
Drainage	0	(0)
Column & Footing	21	(40)
Abutment	1	(2)
Embankment	0	(0)
Riprap	2	(4)

Critical major damages are summarized as follows:

- Damages to column and footing are mainly due to scouring of foundation and possible alkali aggregate reaction in the specific area.

- Damages to girders are due to the following three causes:

- rebar exposure and corrosion which are also common problems may have resulted from poor construction.

- reduced wad carrying capacity due to exposure of rebar by vehicle collision.

- serious cracking to structurally important element, such as half joint.

- Damages to the deck slab are honeycombing, rebar exposure, corrosion and dense cracking which affects the load carrying capacity.

Table - 5.4.3 Candidate Bridges for Further Study

Record#	RT	CS	BN	BRNAME	BRLGTH	PT	KT	JT	ST	GT	BT	DT	CT	AT	ET	IT	EIDX	IIDX	NA	NB	NC
1	705	1	5	ASAGI CAKALLI	71.65	0	0	3	22	14	0	0	0	6	0	0	45	44	3	10	21
2	200	6	12	CANDIR HASANPASA	113.65	0	0	0	18	12	0	0	10	0	0	0	40	40	5	5	9
3	10	16	12	AKCAY	106.90	0	0	9	3	9	3	0	0	0	0	0	24	21	0	8	15
4	10	17	2	CURI DERESI	63.90	0	0	3	0	13	3	0	0	0	0	0	19	17	2	3	25
5	300	2	7	HILAL-II-SAGIUST G.	347.80	0	0	0	0	0	0	0	8	8	0	0	16	16	2	2	14
6	300	2	8	HILAL-II-SAGIUST G.	347.80	0	0	0	0	0	0	0	8	8	0	0	16	16	2	2	16
7	10	16	4	SELYERI	21.70	0	0	9	3	6	0	0	0	0	0	0	18	18	0	6	23
8	300	2	2	BUCA UST GECIT	33.00	0	3	0	0	13	0	0	0	0	0	0	16	15	2	2	8
9	200	10	1	BABADAT	25.20	0	0	0	0	0	0	0	14	0	0	0	14	14	1	3	15
10	300	2	9	HALKAPINAR K.U.G.	548.60	0	0	0	0	0	0	0	5	8	0	0	13	13	2	1	13
11	300	2	10	HALKAPINAR K.U.G.	548.60	0	0	0	0	0	0	0	8	5	0	0	13	13	2	1	14
12	300	2	6	HILAL-I-SAGIUST GEC.	476.30	0	0	3	0	0	0	0	8	3	0	0	14	13	1	3	20
13	300	2	11	ZAFERPAYZIN K.U.G.	239.70	0	0	0	0	0	0	0	8	5	0	0	13	13	2	1	9
14	10	18	1	BOLAMAN	202.40	0	0	6	0	0	0	0	9	0	0	0	15	13	0	6	11
15	10	22	16	SOLAKLI	216.00	0	0	0	8	0	0	0	8	0	0	0	12	12	0	4	13
16	10	18	7	AKCAOVA	59.30	0	0	3	0	10	0	0	0	0	0	0	13	12	2	1	11
17	300	2	5	HILAL-I-SAGIUST GEC.	476.30	0	0	3	0	0	0	0	5	3	0	0	11	10	1	2	12
18	10	22	1	DEGIRMENDERE	90.60	0	0	0	0	10	0	0	0	0	0	0	10	10	2	0	6
19	650	11	3	SARDERE	43.15	0	0	3	8	0	0	0	0	0	0	0	11	10	1	2	18
20	10	19	19	HARSIT	248.50	0	0	0	0	3	0	0	6	0	0	0	9	9	0	3	19
21	100	17	1	MERZIFON	36.25	0	0	0	9	0	0	0	0	0	0	0	9	9	0	3	11
22	200	13	1	KAYAS I	20.00	0	0	0	0	0	0	0	6	3	0	0	9	9	0	3	26
23	200	14	1	BALABAN	49.50	0	0	3	6	0	0	0	0	0	0	0	9	8	0	3	16
24	765	6	2	KOPARAN-II-	27.45	0	0	0	0	8	0	0	0	0	0	0	8	8	1	1	21
25	10	16	7	CARSAMBA-I-	218.50	0	0	9	0	0	0	0	0	0	0	0	9	7	0	3	11
26	10	23	4	CIFTEKAVAK	52.50	0	0	6	0	3	0	0	0	0	0	0	9	7	0	3	10
27	10	23	1	IYIDERE	217.25	0	0	0	0	0	0	0	6	0	0	0	6	6	0	2	11
28	10	19	15	YAGLIDERE	159.50	0	0	0	0	0	0	0	6	0	0	0	6	6	0	2	14
29	300	3	2	AZMAT-I-	67.95	0	0	0	0	0	0	0	6	0	0	0	6	6	0	2	24
30	300	3	1	AZMAT-I-	67.85	0	0	0	0	0	0	0	6	0	0	0	6	6	0	2	24
31	10	20	10	TOPALLI	57.75	0	0	0	0	0	0	0	6	0	0	0	6	6	0	2	15
32	200	8	4	PORSUK	48.20	0	0	0	0	0	0	0	6	0	0	0	6	6	0	2	6
33	200	8	3	PORSUK	48.20	0	0	0	0	0	0	0	6	0	0	0	6	6	0	2	4
34	10	22	15	IVYAN SOGUKPINAR	32.50	0	0	0	0	6	0	0	0	0	0	0	6	6	0	2	11
35	10	18	4	YALIKOY	30.00	0	0	0	6	0	0	0	0	0	0	0	6	6	0	2	9
36	100	17	4	UST GECIT II	20.50	0	0	0	0	6	0	0	0	0	0	0	6	6	0	2	6
37	200	6	15	MEZIT-III-	16.50	0	0	0	6	0	0	0	0	0	0	0	6	6	0	2	8
38	785	5	4	HACIMUSA	16.40	0	6	0	0	0	0	0	3	0	0	0	9	6	0	3	18
39	100	17	5	PASA PINAR	26.60	0	0	0	0	3	0	0	0	0	0	5	8	5	1	1	17
40	300	5	2	GEDIZ-II-	90.85	0	0	6	0	0	0	0	0	0	0	0	6	4	0	2	19
41	300	4	4	GEDIZ-I-	81.20	0	0	6	0	0	0	0	0	0	0	0	6	4	0	2	25
42	300	4	5	HUDUT-I-	40.40	0	0	6	0	0	0	0	0	0	0	0	6	4	0	2	28
43	100	17	2	MERZIFON	36.25	0	0	6	0	0	0	0	0	0	0	0	6	4	0	2	7
44	10	20	6	CANAKCI ELEVIDERE	155.50	0	0	0	0	0	0	0	3	0	0	0	3	3	0	1	12
45	10	18	10	MILIC-I-	47.70	0	0	0	0	0	0	0	3	0	0	0	3	3	0	1	16
46	10	20	1	YOGURTDERE	24.55	0	0	0	0	3	0	0	0	0	0	0	3	3	0	1	8
47	10	16	2	KIRAZLIK	24.25	0	0	0	0	0	0	0	3	0	0	0	3	3	0	1	10
48	260	3	1	BURHANLI	22.30	0	0	0	0	0	0	0	3	0	0	0	3	3	0	1	21
49	10	19	12	KARGUN	16.20	0	0	0	0	3	0	0	0	0	0	0	3	3	0	1	14
50	10	22	10	KARADERE(ARAKLI)	107.20	0	3	0	0	0	0	0	0	0	0	0	3	2	0	1	10
51	10	18	3	CALISLAR	48.00	0	0	0	0	0	0	0	0	0	0	3	3	2	0	1	13
52	10	22	4	HARMANLI	16.10	0	0	3	0	0	0	0	0	0	0	0	3	2	0	1	7

- Damages to expansion joint, which are common to all areas and routes, are missing of plugging on surface.

- Other damages are specific to a designated bridge.

Chapter 6

Detailed Inspection of Highway Bridges

Chapter 6 Detailed Inspection of Highway Bridges

6.1 General

6.1.1 Objectives

There are in general three types of inspection on highway bridges, namely routine inspection, emergency inspection and special inspection. The Routine Inspection is a periodic inspection of intervals of one to five years consisting of general and visual inspections by technical staff. The Emergency Inspection is an ad-hoc inspection conducted when necessary in case of sudden damage to the structural members of bridges to assess the damage, usually caused by a traffic accident, natural disasters such as land slide and flooding, or artificial means such as sabotage.

The Special Inspection is a specialist inspection to assess a fault found during the routine inspection, and emergency inspection is for planning of repair and maintenance, sometimes using special methods necessary to measure particular items of damage.

Detailed inspection is a form of Special Inspection. On this occasion typicsal methods of detailed inspection will be chosen as case studies to demonstrate this type of inspection work. In the future it may be necessary to adapt these procedutes to suit local problems and practices.

6.1.2 Workflow and Schedule

The inspection items shown in Table - 6.1.1 below will conducted within a short time period because of the time constraints. The assignment schedule for Team members and the inspection works are shown in the same table.

Table - 6.1.1 Schedule of JICA Team Member and The Inspection Work

Schedule		September				October					November	
		03	11	18	26	02	09	16	25	30	07	16
Member	A.Hirotani	←	—	—	—	→						
	K.Konno	←	—	—	—	—	—	—	—	—	—	→
	K.Wada		←	—	—	—	—	—	→			
	A.H.Sahni			←	—	—	—	—	→			
	Y.Kobayashi		←	—	—	—	—	—	→			
	C.S.Chiew				←	—	—	—	→			
	D.McEwen			←	—	—	—	—	—	—	—	→
	A.Matsubara										←	→
Inspection	Structure				←	—	→					
	Soil				←	—	→					
	Hydrological				←	—	→					
	Alkali-Aggre.			←	—	—	—	—	→			

6.2 Selection of Bridges for Detailed Inspection

6.2.1 Selection Criteria

The objective bridges for detailed inspection were selected from candidate bridges, of which there are 52 (see Figure - 6.2.1) and were chosen based on the damage rank of each bridge component, for further inspection. To satisfy the objectives, the following criteria is set;

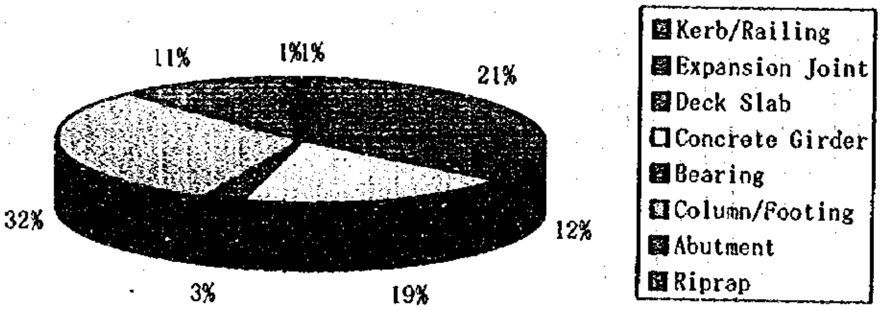
- Selected bridges shall have characteristic damage,
- Where the same kinds of faults were found on several bridges in one division of KGM, only one bridge shall be selected to represent all,
- Bridges under-going repair work presently shall not be selected, and
- Where a new route is planned/constructed, bridges on the old route shall not be selected.

6.2.2 Selection Process

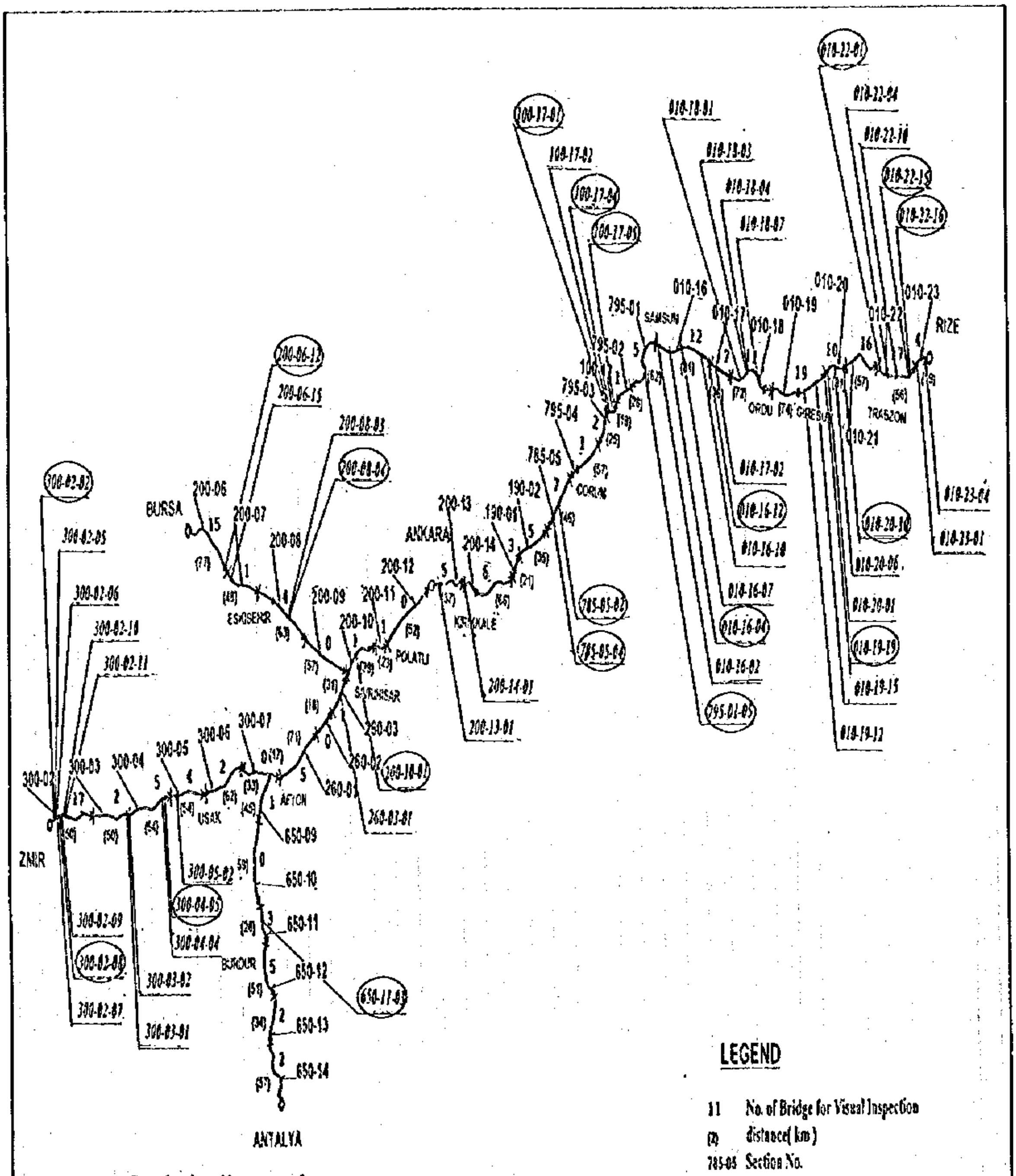
The damage items of the objective fifty-two (52) bridges for detailed inspection are shown in Table - 6.2.1. The number of bridges, for which bridge components are damaged or deteriorated more seriously than damage rank B, is summarized in Table - 6.2.2.

Table - 6.2.2 Ratio of Bridge Components with Serious Damage

Bridge Element	Number of Bridges	Bridge Number Ratio (%)	Whole Ratio (%)
Kerb and Railing	4	8	1
Expansion Joint	17	33	21
Deck Slab	10	19	12
Concrete Girder	15	29	19
Bearing	2	4	3
Column and Footing	25	48	32
Abutment	9	17	11
Riprap	1	2	1



The damaged bridges for each route are shown in Table - 6.2.3. Furthermore, the damaged bridges of each KGM division are shown in Table - 6.2.4.



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 – 6.2.1 Location of Candidate Bridges for Detailed Inspection

Table - 6.2.1 Damage Items of Objective 52 Bridges for Detailed Inspection

レコード番号	RT	CS	BN	KP	MEM1	DMG1	MEM2	DMG2	MEM3	DMG3	MEM4	DMG4	MEM5	DMG5	MEM6	DMG6	MEM7	DMG7	MEM8	DMG8	MEM9	DMG9	MEM10	DMG10	MEM11	DMG11	MEM12	DMG12	MEM13	DMG13
1	795	1	5	34700	EJ	POB	DS	CRB	DS	POA	DS	REA	DS	HCB	DS	VDB	DS	WLB	CG	POB	CG	REA	CG	HCB	CG	VDB	AB	POB	AB	REB
2	200	6	12	62000	DS	CRA	DS	POB	DS	REA	DS	WLA	CG	POB	CG	REB	CG	HCB	CG	WLB	CF	WDA	CF	SCA						
3	10	16	12	82150	EJ	WLB	EJ	POB	EJ	MSB	DS	REB	CG	CRB	CG	REB	CG	WLB	BR	BDB										
4	10	17	2	4600	EJ	WLB	CG	CRA	CG	REB	CG	WLA	BR	BDB																
5	300	2	7	4700	CF	CRA	CF	WDB	AB	CRA	AB	WDB																		
6	300	2	8	4700	CF	CRA	CF	WDB	AB	CRA	AB	POB																		
7	10	16	4	20350	EJ	WLB	EJ	POB	EJ	MSB	DS	CRB	CG	POB	CG	REB														
8	300	2	2	150	KR	POB	CG	POA	CG	REA	CG	HCB																		
9	200	10	1	14500	CF	POB	CF	REA	CF	WAB	CF	SCB																		
10	300	2	9	6200	CF	CRA	AB	CRA	AB	WDB																				
11	300	2	10	6200	CF	CRA	CF	WDB	AB	CRA																				
12	300	2	6	4200	EJ	WLB	CF	CRA	CF	WDB	AB	CRB																		
13	300	2	11	7500	CF	CRA	CF	WDB	AB	CRA																				
14	10	18	1	150	EJ	POB	EJ	MSB	CF	CRB	CF	POB	CF	REB																
15	10	22	16	49800	DS	CRB	DS	REB	CF	REB	CF	WDB																		
16	10	18	7	46150	EJ	WLB	CG	CRA	CG	WLA																				
17	300	2	5	4200	EJ	WLB	CF	CRA	AB	CRB																				
18	10	22	1	100	CG	POA	CG	REA																						
19	650	11	3	26800	EJ	WLB	DS	CRB	DS	REA																				
20	10	19	19	74550	CG	REB	CF	DPB	CF	SCB																				
21	100	17	1	43100	DS	CRB	DS	POB	DS	WLB																				
22	200	13	1	21400	CF	WDB	CF	SCB	AB	SCB																				
23	200	14	1	3200	EJ	POB	DS	CRB	DS	WLB																				
24	785	5	2	11900	CG	REA	CG	HCB																						
25	10	16	7	4250	EJ	WLB	EJ	POB	EJ	MSB																				
26	10	23	4	15000	EJ	POB	EJ	MSB	CG	REB																				
27	10	23	1	100	CF	WDB	CF	SCB																						
28	10	19	15	58000	CF	WDB	CF	SCB																						
29	300	3	2	48600	CF	WDB	CF	SCB																						
30	300	3	1	48600	CF	WDB	CF	SCB																						
31	10	20	10	28100	CF	REB	CF	WDB																						
32	200	8	4	28100	CF	WDB	CF	SCB																						
33	200	8	3	28100	CF	WDB	CF	SCB																						
34	10	22	15	46600	CG	POB	CG	REB																						
35	10	18	4	9650	DS	POB	DS	REB																						
36	100	17	4	43700	CG	POB	CG	REB																						
37	200	6	15	71200	DS	CRB	DS	WLB																						
38	785	5	4	31000	KR	POB	KR	MSB	CF	WDB																				
39	100	17	5	62000	CG	REB	RR	ERA																						
40	300	5	2	10500	EJ	WLB	EJ	POB																						
41	300	4	4	60400	EJ	WLB	EJ	POB																						
42	300	4	5	63900	EJ	POB	EJ	MSB																						
43	100	17	2	43100	EJ	POB	EJ	MSB																						
44	10	20	6	14400	CF	SCB																								
45	10	16	10	69100	CF	WDB																								
46	10	20	1	1800	CG	CRB																								
47	10	16	2	13700	CF	SCB																								
48	260	3	1	7000	CF	SCB																								
49	10	19	12	32100	CG	REB																								
50	10	22	10	30400	KR	POB																								
51	10	18	3	5500	RR	ERB																								
52	10	22	4	14700	EJ	POB																								
53	10	18	10	57650																										
54	300	2	12	7500																										
55	10	17	7	33500																										
56	10	20	5	14400																										
57	200	14	2	7000																										
58	10	19	11	31400																										
59	10	19	2	5300																										
60	10	20	3	11900																										
61	10	18	11	63000																										

Legend

RT: Route number
CS: Control section
BN: Bridge number
KP: Kilo-post
MEM1... MEM13: Number of bridge member
KR: Kerb & railing
EJ: Expansion joint
BR: Bearing
DS: Deck slab
CG: Concrete girder
CF: Column 5 footing
AB: Abutment
RR: Riprap

DMG1... DMG13: Number of damage type
POB: Ranking B for peel off
CRB: Ranking B for cracking
REA: Ranking A for rebar exposure
HCB: Ranking B for honeycomb
VDA: Ranking A for void
WLA: Ranking A for water leakage
WDA: Ranking A for water damage
MSA: Ranking A for missing
SCA: Ranking A for scouring
ERA: Ranking A for erosion
BDA: Ranking A for bed-damage

Table - 6.2.3 Damaged Bridges of Each Route

Route Number	Number of Bridges	Ratio (%)
10	23	44
100	4	8
200	7	13
260	1	2
300	13	25
650	1	2
785	2	4
795	1	2
Total	52	100

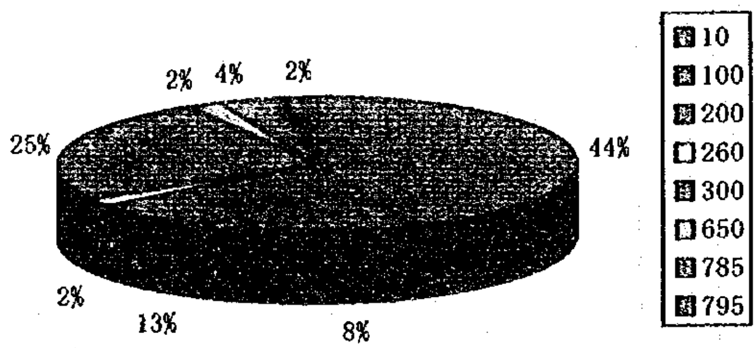
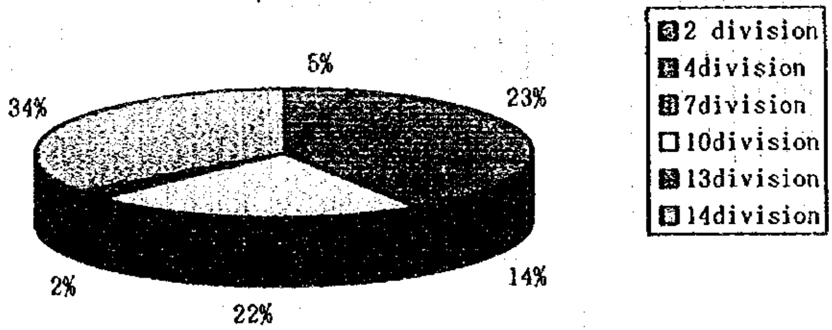


Table - 6.2.4 Damaged Bridges of Each KGM Division

Division	Number of Bridges	Ratio (%)
2	13	25
4	6	11
7	17	33
10	13	25
13	1	2
14	2	4
Total	52	100



The major damaged items, which cause a hindrance to traffic and third parties, are classified into the following nine bridge elements;

- Peel off of Kerb,
- Missing, or water leakage at Expansion joint,
- Crack, peel off and rebar exposure of Deck slab,
- Crack, peel off and rebar exposure of Concrete girder,
- Vehicle accident damage to Concrete girder,
- Crack, crack by Alkali Silica Reaction of Column,
- Scouring and displacement of Column,
- Crack, peel off and rebar exposure of Abutment, and
- Scouring of Abutment.

6.2.3 Objective Bridges

The list of objective bridges for detailed inspection are shown in Table - 6.2.5. The Team selected twenty (20) bridges for detailed inspection. The prioritization classification is as follows;

1) First priority ● - Must be inspected
2) Second priority ○ - Shall be inspected
3) Third priority △ - Continue monitoring
4) No × - No need for immediate inspection

There are ten bridges categorised as 'First priority' and ten categorised as 'Second priority'. Those 20 bridges are the selected bridges for detailed inspection.

The number of bridges for each division are composed of as shown in Table - 6.2.6.

Table - 6.2.6 Number of Bridges for Each Division

Division	Number of Bridges	Bridge for Immediate Remedial Work (mark "●")	Bridge for Preferable Remedial Work (mark "○")
2 (Izmir)	3	2	1
4 (Ankara)	2	1	1
7 (Samsun)	8	4	4
10 (Trabzon)	5	1	4
13 (Antalya)	1	1	0
14 (Bursa)	1	1	0
Total	20	10	10

Table - 6.2.5 Objective Bridges for Detailed Inspection

No.	Bridge No.	Bridge NAME	Division No.	Existing Soil Boring	JICA Soil Planning Boring	KGM selected bridge	JICA selected bridge	Comments	Damage Items: Exp. Joint	Deck Slab	Conc. Girder	Column Crack	Column Scour	Abut. Crack	Abut. Scour	Accid. Girder	Kerb
1	AR-795-01-5	ASAGI CAKALLI	7	○		●	●			○	○			○			
2	SB-200-06-12	CANDIR HASANPASA	14	○		●	●			○			○				
3	AR-010-16-12	AKCAY	7	○		●	●	Repair sample for gerber portion	○	○	○						
4	AR-010-17-2	CURIDERESI	7	○		●	×	Under repairing for settlement of column	○		○						
5	AI-300-02-7	HILAL-II-SAGIUST G.	2				△	Proxy by AI-300-02-08				○					
6	AI-300-02-8	HILAL-II-SAGIUST G.	2				●	Carry out whole ASR				○					
7	AR-010-16-4	SELYERI	7		○		●	Deterioration	○	○	○						
8	AI-300-02-2	BUCA UST GECIT	2	○		●	●	Repair sample for vehicle accident			○					○	
9	AA-200-10-1	BABADAT	4	○		●	●	Repair necessary including riverbank protection				○					
10	AI-300-02-9	HALKAPINAR K.U.G.	2	○		●	△	Proxy by AI-300-02-08				○					
11	AI-300-02-10	HALKAPINAR K.U.G.	2	○		●	△	Proxy by AI-300-02-08				○					
12	AI-300-02-6	HILAL-I-SAGIUST GEC	2				△	Proxy by AI-300-02-08									
13	AI-300-02-11	ZAFERPAYZIN K.U.G.	2	○		●	△	Proxy by AI-300-02-08									
14	AR-010-18-1	BOLAMAN	7	○		●	×	For under constructing new route	○			○					
15	AR-010-22-16	SOLAKLI	10	○		●	○	Repair sample for column scour					○				
16	AR-010-18-7	AKCAOVA	7				△	Carry out repairing by another similar bridge			○						
17	AI-300-02-5	HILAL-I-GAGIUST GEC	2				△	Proxy by AI-300-02-08				○					
18	AR-010-22-1	DEGIRMENDERE	10	○		●	○	Modify vertical alignment of cross-road surface								○	
19	AA-650-11-3	SARDERE	13	○		●	●	Immediately remedial work	○	○							
20	AR-010-19-19	HARSIT	10		○		○	Many span bridge (9 to 10)			○		○				
21	AR-100-17-1	MERZIFON	7	○		●	○	Repair study for deck slab		○							
22	AR-200-13-1	KAYAS 1	4				△	Ranking approx. C					○		○		
23	AR-200-14-1	BALABAN	4				×			○							
24	AR-785-05-2	KOPARAN-II	7	○		●	●	Case study for detour during under repairing			○						
25	AR-010-16-7	CARSAMBA-I	7				△	Monitoring	○								
26	AR-010-23-4	CIFTEKAVAK	10				△	Monitoring		○	○						
27	AR-010-23-1	IYIDERE	10				△	Difficult repair for existing in the sea					○				
28	AR-010-19-15	YAGLIDERE	10				△	Monitoring					○				
29	AI-300-03-2	AZMAT-I	2				△	Monitoring (little discharge volume through year)					○				
30	AI-300-03-1	AZMAT-I	2				△	Monitoring					○				
31	AR-010-20-10	TOPALLI	10	○		●	○	Many column in the sea					○				
32	SB-200-08-4	PORSUK	4	○		●	○	Carry out repairing either bridge					○				
33	SB-200-08-3	PORSUK	4	○		●	△	Carry out repairing either bridge					○				
34	AR-010-22-15	IVYAN SOGUKPINAR	10				●	For girder and slab		○	○						
35	AR-010-18-4	YALIKOY	7	○		●	×	For under constructing new route		○							
36	AR-100-17-4	UST GECIT II	7	○		●	○	Repair sample			○						
37	SB-200-06-15	MEZIT-III	14				△	Monitoring		○							
38	AR-785-05-4	HACIMUSA	7	○		●	○	Repair sample for expansion joints	○			○					
39	AR-100-17-5	PASA PINAR	7		○		○	Repair sample for riprap					○				
40	AI-300-05-2	GEDIZ-II	2	○		●	△	Proxy by AI-300-04-05	○	○	○						
41	AI-300-04-4	GEDIZ-I	2				△	Monitoring	○								
42	AI-300-04-5	HUDUT-I	2				○	Lot of damage of girder	○		○						
43	AR-100-17-2	MERZIFON	7				×	Proxy by AR-100-17-01		○							
44	AR-010-20-6	CANAKCI ELEVIDERE	10				△	Monitoring					○				
45	AR-010-16-10	MILIC-I	7			●	△	High water level and minor damage					○				
46	AR-010-20-1	YOGURTDERE	10	○			△	No main structural member						○			
47	AR-010-16-2	KIRAZLIK	7				△	Damage for central merge					○				
48	AA-260-03-1	BURHANLI	4				△	Minor damage					○				
49	AR-010-19-12	KARGUN	10				△	Minor damage									
50	AR-010-22-10	KARADERE (ARAKLI)	10				×				○						○
51	AR-010-18-3	CALISLAR	7				×	For under constructing new route (Riprap)									
52	AR-010-22-4	HARMANLI	10				×		○								

6.3 Methodology on Detailed Inspection

6.3.1 Objective Bridges

1) Bridges and Damage Outline

a) Objective Bridges

20 bridges were selected for detailed inspection; their total length is 1,625.40 m; they are listed in Table - 6.3.1.

Key for abbreviated titles in Table - 6.3.1:

RT : route number
CS : control section
BN : bridge number
KP : kilo-post (chainage)
DIV : KGM division
BRNAME : bridge name
BRLGTH : bridge length in metres
NOSP : number of bridge spans
HGT : bridge surface height from river bed in metres

Table - 6.3.1 Objective Bridges for Detailed Inspection

RT	CS	BN	KP	DIV	BRNAME	BRLGTH	NOSP	HGT
300	2	2	150	IZM	Buca Ust Gecit	33.00	3	4.2
300	2	8	4700	IZM	Hillal II	347.80	13	4.0
300	4	5	63900	IZM	Hudut	40.40	3	4.2
200	8	4	28100	ANK	Porsuk	48.00	4	4.2
200	10	1	14500	ANK	Babadat	25.20	3	4.0
10	16	4	20350	SMS	Selyeri	21.70	2	3.1
10	16	12	82150	SMS	Akcay	106.90	5	4.1
100	17	1	43100	SMS	Merzifon	36.25	2	5.5
100	17	4	43700	SMS	Ust Gecit II	20.50	1	4.9
100	17	5	62000	SMS	Pasa Pinar	26.60	2	3.5
785	5	2	11900	SMS	Koparan II	27.45	2	3.1
785	5	4	31000	SMS	Hacimusa	16.40	2	2.3
795	1	5	34700	SMS	Asagi Cakalli	71.55	4	12.0
10	19	19	74550	TRB	Harsit	248.50	10	6.5
10	20	10	28100	TRB	Topalli	57.75	4	2.7
10	22	1	100	TRB	Degirmendere	90.80	4	5.9
10	22	15	46600	TRB	Ivyan Sogukpinar	32.50	2	4.2
10	22	16	49800	TRB	Solakli	216.90	15	3.0
650	11	3	26800	ANT	Sardere	43.15	3	5.6
200	6	12	62000	BRS	Candir Hasanpasa	113.85	7	8.0

b) Damage Outline

Damage outline for each bridge is presented in Table - 6.3.2, indicates damaged bridge components and their damage rank. Damage rank is categorized in 4 ranks; A, B, C and D, as described below.

- Rating A
  Urgent repairs are necessary to secure the safety of vehicular traffic or to avoid inconveniencing or injuring third parties, due to outstanding damage or deterioration or possible damage which may result in the near future.

- Rating B
  Repairs are required due to the existence of serious damage or deterioration which affects the function or durability of the structure.

- Rating C
  Damage or deterioration is small and no repairs are necessary. However further study, such as monitoring or observation may be necessary in some cases.

- Rating D
  Virtually no repairs and no further study are required. Only very slight damage or deterioration exists

Key for abbreviated titles in Table - 6.3.2 :

PV	: damage to pavement
KR	: kerb and railing
EJ	: expansion joints
DS	: deck slab
CG	: concrete girder
BR	: bearings
DR	: drainage
CF	: column and footing
AM	: abutment and footing
EM	: embankment
RR	: riprap

Table - 6.3.2 Damage Outline of Objective Bridges

RT	CS	BN	BRNAME	PV	KR	BJ	DS	CG	BR	DR	CF	AM	EM	RR
300	2	2	Buca Ust Gecit	C	B	D	C	A	D	C	C	D	C	D
300	2	8	Hillal II	C	C	C	C	C	D	C	A	B	D	D
300	4	5	Hudut	C	C	B	C	C	D	D	C	C	C	C
200	8	4	Porsuk	D	D	D	C	D	D	C	B	D	C	D
200	10	1	Babadat	C	C	C	C	D	D	C	A	D	C	C
10	16	4	Selyeri	D	C	B	B	B	D	C	C	C	D	C
10	16	12	Akcay	D	C	B	B	B	B	D	D	D	C	D
100	17	1	Merzifon	D	C	C	B	C	D	D	D	D	D	D
100	17	4	Ust Gecit II	D	C	D	D	B	D	D	D	C	D	D
100	17	5	Pasa Pinar	C	C	C	C	B	D	C	D	D	D	A
785	5	2	Koparan II	C	C	C	C	A	D	D	C	C	D	D
785	5	4	Hacimusa	C	B	C	C	D	D	D	B	C	C	D
795	1	5	Asagi Cakalli	D	C	B	A	A	D	C	C	B	C	D
10	19	19	Harsit	C	C	C	C	B	C	C	B	D	D	D
10	20	10	Topalli	D	C	C	D	C	D	C	B	C	C	D
10	22	1	Degirmendere	D	C	C	D	A	D	D	D	D	D	D
10	22	15	Ivyan Sogukpinar	D	C	C	C	B	D	C	D	D	D	D
10	22	16	Solakli	D	C	C	B	C	D	C	B	D	D	D
650	11	3	Sardere	D	C	B	A	C	D	C	C	C	C	D
200	6	12	Candir Hasanpasa	C	D	C	A	A	D	D	A	C	D	D

6.3.2 Items of Detailed Inspection

There are two major objectives for detailed inspection, which are;

a. to obtain additional information for the maintenance design;
   such as inspection on structure, soil investigation, hydrological survey, etc.;
b. to collect special information on abnormal faults.
   such as investigation on Alkali - Silica Reaction.

Following items are to be conducted during this Study.

1. Structural Investigation on superstructure, substructure and foundation.
2. Soil investigation at the bridges which are missing soil data.
3. Hydrological Survey to obtain additional data for the design.
4. Alkali - Aggregate Reaction investigation to obtain additional data for the design.

6.3.3 Methodology

Maintenance design, bill of quantity and construction cost estimate shall be derived from the results of the detailed inspection. Each item of inspection shall be detailed enough to meet this requirement. The following is a description of the methodology for each inspection item.

1) Structural Investigation

a) Typical Faults

During the Visual Inspection of Highway bridges, there are several kinds of dominant faults found among their structural parts. Particularly the faults which would have serious effects on the durability of bridges were given special attention, and were targeted for the detail inspection.

The faults given special attention were:

- Expansion Joint
- Slab
- Girder
- *Column (Pier) and its foundation (surface and scouring)*
- Abutment and its foundation (surface and scouring)
- Accidents
- Others

b) Inspection of Expansion Joint

The form of expansion joint shall be established from the existing drawing and the as-built form checked on site. A base drawing for a site sketch shall be prepared prior to the detailed inspection.

The existing condition of the expansion joint shall be sketched out, taking measurements of missing parts and faults.

c) Inspection of Slab

The structure of the slab shall be established from by the existing drawings and checked on site. A base drawing for a site sketch, both looking down from the carriageway side and looking up from below the bridge, shall be prepared prior to the detailed inspection.

The existing condition of the surface, both above and below, shall be sketched out, taking measurements of concrete peel-off and rebar exposure and any other faults. Spacing, size *of bars and cover shall be confirmed with using profometer and conkid wherever possible.*

The Strength and superannuation of concrete shall be confirmed with using a test hammer.

d) Inspection of Girder

Structure of girder shall be established from the existing drawings and checked on site. A base drawing for a site sketch, for both of up-stream and down-stream faces and looking up from below the bridge, shall be prepared prior to the detailed inspection.

The existing condition of the surfaces, of all the faces (total of three faces), shall be sketched out, taking measurements of concrete peel off and rebar exposure and any other faults. Spacing, size and cover to bars shall be confirmed with using profometer and conkit wherever possible.

The strength and superannuation of concrete shall be confirmed with using a test hammer.

e) Inspection of Column and Foundation

The structure of column and foundation shall be established from the existing drawings and checked on site. Where ordinary observation can confirm. In some special cases, part of the foundation shall be excavated for visual inspection and measurement. A base drawing for a site sketch, from cross-beam down to the foundation, shall be prepared prior to the detailed inspection.

The existing condition of all the surface shall be sketched out, taking measurements of concrete peel off and rebar exposure, scour and any other faults. Spacing, size and cover of bars shall be confirmed with using profometer and conkit wherever possible.

The Strength and superannuation of concrete shall be confirmed with using a test hammer.

f) Inspection of Abutment and Foundation

The structure of abutment and foundation shall be established from the existing drawings and checked on site. Where ordinary observation can confirm. In some special cases, part of the foundation shall be excavated for visual inspection and measurement. A base drawing for a site sketch, from cross-beam and/or parapet down to the foundation, shall be prepared prior to the detailed inspection.

The existing condition of all the surface shall be sketched out, taking measurements of concrete peel off and rebar exposure, scour and any other faults. Spacing, size and cover of bars shall be confirmed with using profometer and conkit wherever possible.

Strength and superannuation of concrete shall be confirmed with using a test hammer.

g) Inspection of Accident Damage to Girder

The structure of the girder shall be established from the existing drawing and checked on site. A base drawing of the accident location for a site sketch, for both up-stream and down-stream faces and looking up from below the bridge, shall be prepared prior to the detailed inspection.

The existing condition of the surface, for all the faces (total of three faces), shall be sketched out, taking measurements of concrete peel-off and rebar exposure and any other faults. Spacing, size and cover of bars shall be confirmed with using profometer and conkit wherever possible. Strength and superannuation of concrete shall be confirmed with using a test hammer.

A longitudinal level survey of the road surface, on which the vehicle was travelling shall be conducted taking measurements at the centre and both sides of the carriageway for a length of 100m in both directions (total of three lines of 200m each).

h) Inspection Planning

For each of the selected 20 bridges, the contents of the detailed inspection shall be as shown in Table - 6.3.3

Table - 6.3.3 Detailed Inspection Bridges and Items

Div No.	Division Name	No. Bri.	Bridge Number	Bridge Name	Exp. Joint	Slab	Girder	Column Found	Abut Found	Acci-dent
		1	AI-300-02-2	Buca Ust Gecit			●			●
2	Izmir	2	AI-300-02-8	Hilal-II				●		
		3	AI-300-04-5	Hudut-I	●		●			
4	Ankara	4	SB-200-08-4	Porsuk				●		
		5	AA-200-10-1	Babadat				●		
		6	AR-010-16-4	Selyeri	●	●	●			
		7	AR-010-16-12	Akcay	●	●	●			
		8	AR-100-17-1	Merzifon		●				
7	Samsun	9	AR-100-17-4	Ust Gecit-II			●			
		10	AR-100-17-5	Pasa Pinar				●		
		11	AR-785-05-2	Koparan-II			●			
		12	AR-785-05-4	Hacimusa	●			●		
		13	AR-795-01-5	Asagi Cakali		●	●			
		14	AR-010-19-19	Harsit			●	●		
		15	AR-010-20-10	Topalli				●		
10	Trabzon	16	AR-010-22-1	Degirmendere						●
		17	AR-010-22-15	Ivyan Sogukpinar		●	●			
		18	AR-010-22-16	Solakli				●		
13	Antalya	19	AA-650-11-3	Sardere	●	●				
14	Bursa	20	SB-200-06-12	Candir Hasanapasa		●		●		

i) Inspection Items

Items for detailed inspection are listed below to satisfy the purpose of the investigation.

- Visual Inspection (VI):
For each of the damage items defined in the inspection manual, site sketches shall be prepared (on base drawings prepared earlier) for components with damage more serious than rating 'C' for all data collection units such as spans and columns. The inspection shall be undertaken at close range, using an inspection platform. Inspection results shall be written on sketches and damage coding sheets.

- Rebar Investigation (RI):
Rebar diameter, spacing and cover are investigated at a few locations using Profometer for concrete components for which damage rating is more serious than rating 'B'.

- Concrete Strength (CS):
Compressive concrete strength is investigated at a few locations using a Schmidt Hammer for concrete components for which damage rating is more serious than rating 'B'.

- Neutralization Test (NT):
Neutralization of concrete is investigated at a few locations using Konkit for concrete components for which damage rating is more serious than rating 'B'.

- Investigation of Damage to Foundation Stability (FS):
Inclination angle and settlement of foundation are investigated using a Transit or Level for damaged columns and abutments for which damage rating is more serious than rating 'B'. In addition to the above, the height of river bed is surveyed surroundings of foundation if any.

- Investigation of Collision Damage (CC):
In order to check the clearance between a girder soffit and the road surface below, a height survey along the road is carried out over a distance of 50 meters from the bridge.

- Photographs:
Photographs are taken of the major defects described above.

- Environmental Investigation:
It is necessary to confirm that any negative effects will not result from the repair operation.

j) Data Collection Unit and Numbering

In order to judge repair area as well as costs, data on damage is collected in a more detailed form by visual inspection as below.

Expansion Joints	: by each joint line
Deck Slab	: by each span
Concrete Girder	: by each span
Column and Footing	: by each column
Abutment and Footing	: by each abutment.

To identify the location of damaged components on the bridge, an ordinal number (1, 2, 3, -) from origin to destination is used.

k) Inspection Items to be applied to bridge

Items for detailed inspection of each bridge are presented in Table - 6.3.4 based on the above descriptions.

Abbreviations are follows in Table - 6.3.4.

VI : Visual inspection
RI : Rebar investigation
CS : Concrete strength
NT : Neutralization test
FS : Investigation of damage to foundation stability
CC : Investigation of collision damage
(n) : Number of data collection unit such as span

Table - 6.3.4 Detailed Inspection Items (1:Izmir)

Bridge	Exp.Joint	Deck	Girder	Column	Abutment
300-02-02 Buca Ust Gecit collision with girder constructed in 1972		VI(3)	VI(3) RI(2) CS(2) CC(1) NT(2)	VI(2)	
300-02-08 Hillal II AAR to Column, abutment constructed in 1990	VI(14)	VI(13)	VI(13)	VI(12) RI(2) CS(2)	VI(2) RI(2) CS(2)
300-04-05 Hudut-I Exp joint damage constructed in 1972	VI(4)	VI(3) RI(2)	VI(3)	VI(2) NT(2)	VI(2)
650-11-03 Sardere Damage to exp. joint and slab, constructed in 1985	VI(4)	VI(3) RI(2) CS(2) NT(2)	VI(3)	VI(2)	VI(2)
200-10-01 Babadat Water damage and scour constructed in 1964	VI(4)	VI(3)		VI(2) RI(2) CS(2) FS(2) NT(2)	

Table - 6.3.4 Detailed Inspection Items (2:Trabzon)

Bridge	Exp.Joint	Deck	Girder	Column	Abutment
010-22-16 Solakli Damage to slab and column by water shock, constructed in 1969	VI(16)	VI(15) RI(2) CS(2)	VI(14)	VI(14) RI(2) CS(2) FS(2) NT(2)	
010-22-15 Ivyan Sogukpinar Damage to girder, constructed in 1970	VI(3)	VI(2)	VI(2) RI(2) CS(2) NT(2)		
010-22-01 Degirmendere Damage to girder by collision constructed in 1961	VI(%)		VI(4) CS(2) CC(1) NT(2)		
010-20-10 Topalli Damage to column by sea wave, constructed in 1975	VI(5)		VI(4)	VI(3) RI(2) CS(2) FS(3) NT(2)	VI(2)
010-19-19 Harsit damage to girder and scour to column	VI(11)	VI(10)	VI(10) RI(2) CS(2) NT(2)	VI(9) RI(2) CS(2) FS(2) NT(2)	

Table - 6.3.4 Detailed Inspection Items (3:Samsun)

Bridge	Exp.Joint	Deck	Girder	Column	Abutment
010-16-12 Akcay damage to exj. slab and girder, constructed in 1961	VI(6)	VI(5) RI(2) CS(2) NT(2)	VI(5) RI(2) CS(2) NT(2)		
010-16-04 Selyeri damage to exj. slab and girder, constructed in 1990	VI(3)	VI(2) RI(2) CS(2)	VI(2) RI(2) CS(2)	VI(1)	VI(2)
795-01-05 Asagi Cakalli damage to slab, girder and abutment, constructed in 1986	VI(5)	VI(4) RI(2) CS(2)	VI(4) RI(2) CS(2)	VI(3) FS(3)	VI(2) RI(2) CS(2) NT(2)
100-17-05 Pasa Pinar damage to girder constructed in 1972	VI(3)	VI(2)	VI(2) RI(2) CS(2) NT(2)		
100-17-04 Ust Gecit-II collision with girder constructed in 1970			VI(1) RI(2) CS(2) NT(2)		VI(2)
100-17-01 Merzifon damage to slab constructed in 1993	VI(3)	VI(2) RI(2) CS(2)	VI(2)		
785-05-02 Koparan II damage to girder constructed in 1977	VI(3)	VI(2)	VI(2) RI(2) CS(2) NT(2)	VI(1)	VI(2)
785-05-04 Hacimusa water damage to column constructed in 1972	VI(3)	VI(2)		VI(1) RI(1) CS(1) FS(1)	VI(2) RI(1) CS(1) NT(2)

Table - 6.3.4 Detailed Inspection Items (4:Bursa)

Bridge	Exp.Joint	Deck	Girder	Column	Abutment
200-08-04 Porsuk water damage and scour constructed in 1973		VI(4)		VI(3) RI(2) CS(2) FS(2) NT(2)	
200-06-12 Candir Hasanapasa damage to slab, girder and column by scour, constructed in 1972	VI(8)	VI(7) RI(2) CS(2) NT(2)	VI(7) RI(2) CS(2) NT(2)	VI(6) RI(2) CS(2) NT(2) FS(2)	VI(2)

2) Soil Investigation

Locations are selected where there is no soil data, but the detailed inspection requires it. Three locations are identified as fitting those criteria; two in Samson (Division 7) area and one in Trabzon (Division 10) area.

a. Samsun (Division 7)

1)	AR-010-16-4	Selyeri
2)	AR-100-17-5	Pasa Pinar

b. Trabzon (Division 10)

3)	AR-010-20-10	Topalli

30m deep boreholes, with SPT (Standard Penetration Test) at in intervals and two samples, shall be undertaken at each location. Samples taken shall be subjected to laboratory test of standard kinds such as relative gravity, grain distribution, etc.

3) Hydrological Survey

For each selected bridge, hydrological data such as high water level, river current, seasonal changes, etc. shall be collected through analysis on previous data, observation at the site, interviews with local people.

The data will be used for the repair design and work schedule planning.

4) Alkali - Aggregate Reaction Investigation

Field investigation should be carried out to identify the occurrence of Alkali Aggregate Reaction (hereinafter referred as AAR) and the material which possibly is causing AAR. Inspection of selected bridges of recent construction (within 10 years), and bridges within a 10 km radius of Izmir, shall be conducted to identify the extent of AAR and to identity the suspect materials.

The Study Team shall produce the test- pieces and core sampling for confirming the content of silica in aggregate to KGM.

6.3.4 Implementation Schedule and Assignment

1) Schedule

Schedules for detailed inspection are presented in Table - 6.3.5 for structural inspection and Table - 6.3.6 for environmental and hydrological inspection.

2) Manpower Assignments

a) Structural Inspection Team

KGM Headquarter : Mr. Adnan Gurkan

KGM Division Members : 1 Engineer
2 tape man
2 for traffic regulation
1 driver for coach
1 driver/operator for lift car

Table - 6.3.5 Schedule For Structural Inspection Team

IZMIR AREA

Date	Accommodation	Bridge No.	Time Arrangement
9/20 (Wednesday) 7:45 TK393	IZMIR	300-2-2	3hr. (10:00~13:00)
		300-2-8	4hr. (14:00~18:00)
9/21 (Thursday)	ISPARTA	300-2-8	+3hr. (9:00~12:00)
		300-4-5	3hr. (14:00~17:00)
9/22 (Friday)	to ANKARA	650-11-3	3hr. (9:00~12:00)
		200-10-1	3hr. (15:00~18:00)

TRABAZON AREA

Date	Accommodation	Bridge No.	Time Arrangement
9/25 (Monday) 13:45 TK424	TRABZON		
9/26 (Tuesday)	TRABZON	10-22-16	7hr. (10:00~18:00)
9/27 (Wednesday)	TRABZON	10-22-15	3hr. (9:00~12:00)
		10-22-1	4hr. (14:00~18:00)
9/28 (Thursday)	TRABZON	10-20-10 10-19-19	4hr. (9:00~13:00) 3hr. (15:00~18:00)
9/29 (Friday) TK427 20:00	to ANKARA	10-19-19	+4hr. (10:00~15:00)

SAMSUN AREA

Date	Accommodation	Bridge No.	Time Arrangement
10/1 (Monday) TK66 8:45	SAMSUN	10-16-12	5hr. (11:00~17:00)
10/3 (Tuesday)	SAMSUN	10-16-4	3hr. (9:00~12:00)
		100-17-5	3hr. (13:00~16:00)
10/4 (Wednesday)	SAMSUN	795-1-5	7hr. (10:00~18:00)
10/5 (Thursday)	SAMSUN	100-17-4	3hr. (10:00~13:00)
		100-17-1	3hr. (14:00~17:00)
10/6 (Friday)	to ANKARA	785-5-2	3hr. (11:00~14:00)
		785-5-4	3hr. (15:00~17:00)

BURSA AREA

Date	Accommodation	Bridge No.	Time Arrangement
10/9 (Monday)	BURSA	200-8-4	4hr. (14:00～18:00)
10/10 (Tuesday)	BURSA	200-6-12	7hr. (10:00～18:00)
10/11 (Wednesday)	to ANKARA		

Table - 6.3.6 Schedule for Soil Boring & Environmental Survey

TRABZON AREA

Date	Accommodation	Bridge No.	Time Arrangement
9/20 (Wednesday) TK424 (13:45～ 15:05)	TRABZON	AR-010-22-15 AR-010-22-16	
9/21 (Thursday)	TRABZON	AR-010-22-1 AR-010-20- 10 (Boring) AR-010-19-19	

SAMSUN AREA

Date	Accommodation	Bridge No.	Time Arrangement
9/22 (Friday)	SAMSUN	AR-010-20- 10 (Boring) AR-010-16-12	AM 4:00PM
9/23 (Saturday)	SAMSUN	AR-010-16-4 (Boring) AR-795-01-5	9:00AM
9/24 (Sunday) (spare day)	SAMSUN		
9/25 (Monday)	SAMSUN	AR-100-17-5 (Boring) AR-100-17-4 AR-100-17-1	9:00AM
9/26 (Tuesday)	to ANKARA	AR-785-05-2 AR-785-05-4	

IZMIR AREA

Date	Accommodation	Bridge No.	Time Arrangement
9/27 (Wednesday) TK393 (7:45～9:05)	IZMIR	AI-300-02-2 AI-300-02-8 Quarry Reconnaissance	
9/28 (Thursday)	ISPARTA	Quarry Reconnaissance AI-300-04-5	AM PM
9/29 (Friday)	to ANKARA	AA-650-11-3 AA-200-10-1	