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Capacity Assessment of SCRB in Iraq

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Abstract:

The Republic of Iraq through the Ministry of Construction and Housing (MOCH) has received financing from the World Bank toward the cost of the Emergency Road Rehabilitation Project implemented by the State Commission for Roads and Bridges (SCRB), and intends to apply part of the proceeds for consultant services.

SCRB intends to shortlist qualified consultants to provide consultancy services for the development of a Road Asset Management System, the preparation of a multi-year Road Rehabilitation Program, and detailed design for a selection of priority road rehabilitation works to be launched the first year of this program. The scope of work of this assignment to be undertaken within a timeframe of maximum eight months would in particular include:

Capacity Assessment. Assess the organization, capacity and work processes of the SCRB including a review of its performance for the last three years.

Establish a road asset management system in line with the SCRB assessed organization and capacity for the management of a defined network of main roads of a total length of about 30,000 km. This would include but not limited to: assessing SCRB road maintenance and rehabilitation practices, establishing a road database (including collecting with SCRB support required road data on characteristics and conditions, completing needed traffic counts); selecting an appropriate maintenance and rehabilitation strategy on the basis of agreed budget constraints..

Prepare a 5-Year Road Rehabilitation Program using the developed Road Asset Management System and in accordance with the

adopted maintenance strategy, carry out its economic analysis, and identify SCRB capacity reinforcement needs for its implementation.

Prepare detailed design and environmental and social assessment for a selection of priority road rehabilitation works to be launched the first year of the Road Rehabilitation Program.

Key words: Roads, SCRB, Assessment, Project, economic, Iraq, Transport.

Abbreviations:

ERRP	Emergency Road Rehabilitation Project
IDA	International Development Agency (of the World Bank)
MOCH	Ministry of Construction and Housing
SCI/AK JV	Stanley Consultants Inc./ Al-Khan Consultation Joint Venture
SCRB	State Commission for Roads and Bridges (Iraq)
TOR	Terms of Reference
WB	The World Bank
VMS	Variable Message Signs
ARRB	Austrian Road Research Board
TRB	Transportation Research Board (USA)
TRRL	Transport and Road Research Laboratory
NCCLR	National Centre for Construction Laboratories and Research

1.1 INTRODUCTION

The Government of Iraq has received an IDA credit from the World Bank to support the implementation of a road and bridge project called the Engineering Road Rehabilitation Project (ERRP). Under the ERRP, one of the components is the Capacity Assessment of SCRB.

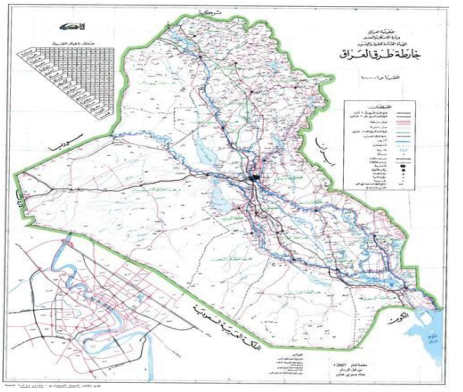
1.2 Commissioning of Consultant

The Ministry of Construction and Housing (MOCH) have selected the Joint Venture of Stanley Consultants Inc and Al-Khan Consultation (SCI/ AK JV) for carrying out this assignment. The contract for the services was signed on 13th August, 2012 with the date of commencement of services as 26th August, 2012.

1.3 Objective of the Study

The Objective of the Emergency Road Rehabilitation Project (ERRP) is to improve the condition of the road asset by rehabilitating highly damaged segments of the Country's highway and rural road network, re-establishing critical river crossings, and restoring the capacity to manage and maintain roads. This would contribute to the Country's economic and social recovery. Transport Network of Iraq is shown in Fig. 1.1

Figure Error! No text of specified style in document.**-1: Transport Network of Iraq**



The ERRP consists of two parts: Part A, which covers the 15 central and southern Governorates; and Part B, which focuses on sub-projects in the three governorates of the KRG.

Parts A and B will be implemented independently by respectively the SCRB and the GDRB.

Part A of the proposed ERRP, which covers the 15 central and southern Governorates, has five components:

A.1: Highway Pilot Rehabilitation Program. This sub-component consists of rehabilitating priority sections of the highway network through a pilot program. The works consist mainly of pavement repairs and strengthening, but also shoulder stabilization, road furnishings, including lane

marking and traffic signs, new guardrails, and drainage repairs.

A.2: Village Access Roads Pilot Program. This sub-component would upgrade village access roads in several locations. The reconstruction and rehabilitation of access roads between isolated villages in various Governorates would be undertaken on a pilot basis.

A.3: Bridge Replacements Pilot Program. This sub-component would provide a limited number of critical river crossings with safer structures by replacing their old decaying floating bridges with permanent concrete bridges.

A.4: Road Asset Management and Road Rehabilitation Programming. This initiative would develop road maintenance and management strategies and establish a road asset management system. It would include support for preparing a multi-year national road rehabilitation program, along with their associated financing plans, as well as capacity building measures.

A.5: Project Management. Financial support would be provided to manage project activities and provide on the job training in project management.

A Project Management Team (PMT) established by the Ministry of Construction and Housing (MOCH) in Baghdad is responsible for the management of all project-Part A, activities including procurement and contract management, design, supervision, studies, quality control, administration of project funds and reporting. The PMT makes payments to suppliers, consultants and contractors, and accounts for funds disbursed according to World Bank guidelines and procedures. PMT staff comes from relevant departments in the SCRB and includes directors, senior technical staff (engineers), procurement

specialists, financial managers, environmental specialist, and administrators.

1.4 Scope of the Study

The scope of work under the present assignment covers the following main tasks:

Capacity Assessment. Assess the organization, capacity and work processes of the SCRB including a review of its performance for the last three years.

Establish a Road Asset Management System in line with the SCRB assessed organization and capacity for the management of a defined network of main roads. This would include but not limited to: assessing SCRB road maintenance and rehabilitation practices, establishing a road database (including collecting with SCRB support required road data on characteristics and conditions, completing needed traffic counts); selecting an appropriate maintenance and rehabilitation strategy on the basis of agreed budget constraints.

The roads to be managed by the road asset management system are the classified main roads (see Table 2.1 below): expressways, primary roads, and secondary roads. The village roads, the military roads and the municipal roads are not concerned by this assignment.

Table Error! No text of specified style in document.**.1: SCRB Main Classified Roads**

Road Classes	Length (Km)
Expressways	1,038
Primary roads	7,724
Secondary roads	4,841
Total	13,603

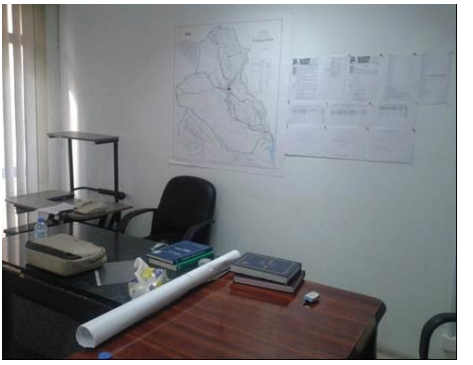
Prepare a *5-Year Road Rehabilitation Program* using the developed Road Asset Management System and in accordance with the adopted maintenance strategy, carry out its economic analysis, and identify SCRB capacity reinforcement needs for its implementation.

Prepare *Detailed Design and Environmental Assessment* for a selection of priority road rehabilitation works to be launched during the first year of the Road Rehabilitation Program.

1.5 Project Organisation and Communication

Consultant's office at Baghdad maintains close coordination with the Client MOCH through their authorised representatives. The Consultants' Team Leader coordinates with SCRB Team of Engineers on behalf of the project Team of experts and engineers.

The project team has been mobilized for carrying out the assignment as per the contract and work schedule to work with SCRB and supervise the execution of the contract requirements. The Consultants Team Leader and representatives have been continuously coordinating with the SCRB's Team of Engineers for collection of secondary data, carrying out the required surveys. The team mobilized is given below with additional staff with specialization for supervising and coordinating with the SCRB branches and representatives to conduct the traffic count and data collection.

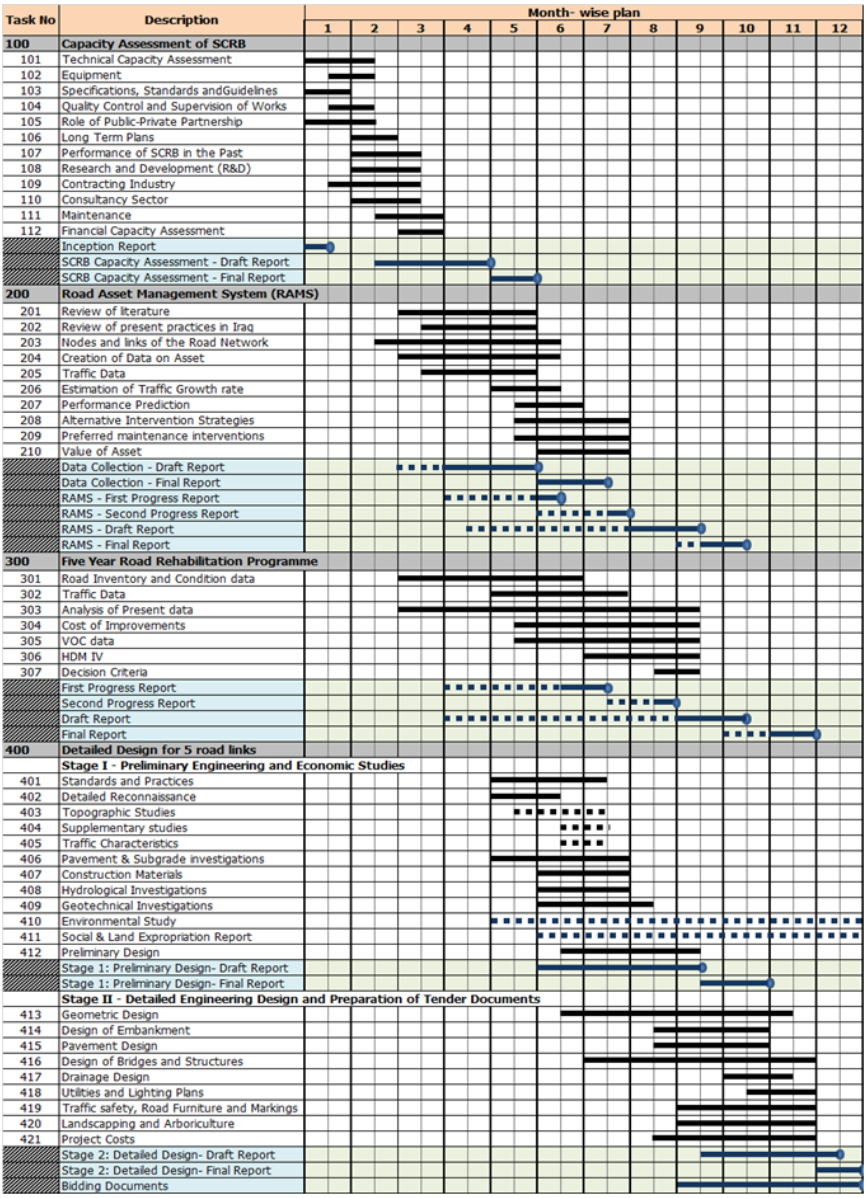


1.6 Revised Works Schedule

The Capacity Assessment of SCRB draft report was due in 12 weeks after the commencement of the assignment but as the information, secondary data required could not be obtained, the draft report submission has been delayed by 4 weeks. The

revised work schedule for carrying the assignment incorporating the delay is presented in Figure 1.2.

Figure Error! No text of specified style in document.**-2: Work Schedule**



1.7 Present Submission: Capacity Assessment

1.7.1 Scope of Work

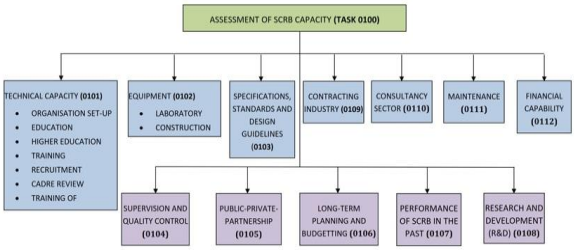
The tasks in respect of Capacity Assessment of SCRB as specified in TOR are:

- ✓ *reviewing (i) SCRB organization, staffing and equipment; and (ii) SCRB accomplishments (in particular budget disbursements and physical outputs) and performance of the past five years;*
- ✓ *Reporting on SCRB plans and programs (objectives, description, cost estimates, financing plans, implementation schedules, and progress);*
- ✓ *Assessing SCRB's performance in the following core functions: planning and programming, budgeting and financial management (including audits and controls), road design and environmental assessment, procurement, supervision of works, works quality control, inventory and surveys of roads and bridges condition, axle load control, traffic counts, and road safety.*

1.7.2 The Approach

The above tasks have been accomplished through a series of sub-tasks or elements. The chart showing the various elements in this Task is given in Figure 1.3.

Figure Error! No text of specified style in document.**-3: Components of Tasks for Assessment of SCRB Capacity (TASK 0100)**



1.7.3 The Capacity Assessment Report (Draft)

The different task has been described in details in the following chapters given in the Capacity Assessment Report. The report has been presented in sixteen chapters. The contents of the report have been briefly described below.

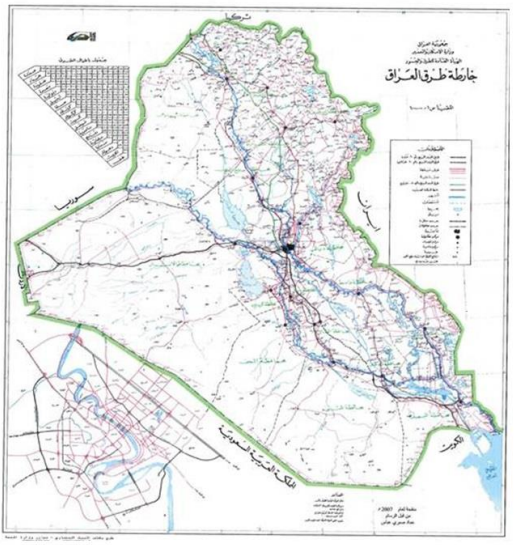
Chapter No.	Chapter	Description
1	Introduction	Project back ground, scope and status
2	Background of Iraq	Brief about Iraq
3	Iraq's Road Network	Brief of Iraq's Road network
4	Technical Capacity Assessment	Describes the technical capability of SCRB organizational setup, engineers, training etc
5	Assessment of SCRB's Capacity for Survey, Investigations, Testing, Inspection and Quality Control	Describes the testing facilities, survey equipment and laboratory facility
6	Specifications, Standards and Design Guidelines	Describes the design and specification standards, policy and environmental issues
7	Quality Control and Supervision of Works	Describes the existing quality control measures and supervision of works,
8	Private Sector Participation	Describes the option of private participation and policy framework
9	Road Vision Statement and Long Term Road Development Plan	Describes the existing road policy and needs for a long a long term plan
10	Performance of SCRB in the Past	Describes the SCRB's performance in achieving plans and targets
11	Research and Development	Review of existing R&D in highway and bridge sector and development of an R&D plan
12	Contracting Industry	Review of the existing contracting industry and establishing different contracting options
13	Consultancy Sector	Review of the existing consultancy services and building a healthy consultancy sector
14	Maintenance of Road Assets	Describes the existing maintenance of roads and bridges, fund allocation and development of maintenance manual and guidelines
15	Financial Capacity Assessment	Reviews the financial outlays and option of a dedicated road fund
16	Recommendations	Recommendations for improving the existing of SCRB

2. IRAQ - A BACKGROUND

2.1 Geographical Setting

Iraq, once known as Mesopotamia, is an independent Arab country of the Middle East, situated at the north-west and the Arabian Gulf (see Map). It has international boundaries with Turkey, Iran, Syria, Jordan, Kuwait and Saudi Arabia. Its land area is 437,393 sq. Km. Baghdad is the national capital. Its physiography is determined by the twin valleys of the Tigris and Euphrates rivers, and in these valleys there are several lakes, marshes and old channels. The western region is a vast desert.

Figure Error! No text of specified style in document.**-2: Map of Iraq**



2.2 Climatic Conditions

Seasonal rainfall, followed by hot arid season, causes the soil to become saline–a problem that has to be recognised in road and bridge construction and maintenance.

Summer temperature can be as high as 43^0C, and winter temperatures can be very low. The selection of road pavement specifications has to take note of these conditions.

2.3 Settlement Pattern

The settlement pattern is the presence of several towns. The urban population is around 67 per cent, and continuous migration of the population takes place from rural areas to towns. The population is largely concentrated in the river valleys. The annual growth rate of population is around 2.5 per cent.

2.4 National Resources and Industry

Iraq is rich in oil reserves. Oil accounts for 44 per cent of the GDP, and 93 per cent of total exports. Other industries include cement, sugar, fertilisers, steel and power.

2.5 Transport Sector

Roads are the predominant transport mode and most Iraq cargo is transported over the road network, as opposed to the railway system, thereby applying significant pressure on the road network and contributing to its deterioration. River transport is also an important mode. Three major railways connect the principal cities and they coverage on Baghdad and Basra. Basra and Umm Qasr are the principal ports. The Asian Highways passes through Iraq and the opening of the Basra Bridge in 1978 provided a direct link between Iraq's road network and the Asian Highway. In the desert area, the land is sufficiently hard to allow cars, trucks and buses to travel across it.

Baghdad and Basra have airports, with flights operating to other Asian, African, Middle East and European countries.

2.6 Special problems of Iraq affecting the Road Infrastructure

Iraq has been affected by several factors in the past such as:

- the First Gulf War (1980–1988)

- the Second Gulf War (1991)
- international economic sanctions (1991–2003)
- fall in the regime established in 1968 and 2003

As a result its economy suffered, and development activities were given low priority because of war efforts. The public sector assumed the central role, and the private sector was marginalised.

2.7 Some Aspects of Iraq's Development Policy

The development policies adopted by Iraq have led to concentration of population and economic activities in a handful of cities. Migration of rural population to the cities has continued on a large scale. Iraq's planners intend to reverse the trend by addressing the development work in the rural areas, and by providing road accessibility to rural habitations.

Iraq's 2010-14 development plan aims at achieving a GDP growth rate of 9.38 per cent. To achieve this, the transport infrastructure requires be strengthening and modernising very quickly.

3. IRAQ'S ROAD NETWORK

3.1 Network Length

Iraq has a national road network of 42,000 Km. It consists of:

	Length in Km		
	2-lane	**4-lane**	**6-lane**
• Expressways	–	–	1084 (2.58%)
• National Highways (Primary Roads or Arterial Roads)	3,300 (7.86%)	7,700 (18.34%)	–
• Secondary Roads	15,200 (36.2%)	–	–
• Village Roads (Rural Roads)	3,700 (8.82%)	–	–
• Special Purpose Roads (Military, Port Roads etc.)	11,000 (26.2%)	–	–

The road network in different Governorate for primary and secondary roads is presented in Table 3.1.

Table Error! No text of specified style in document..**2: Road Network for Primary and Secondary Roads in each Governorate**

S No.	Governorate	Primary Roads (Km)	Secondary Roads (Km)
1	Wasit	432	700.2
2	Diyala	693	420.2
3	Diwaniyah	413	146.5
4	Karbala	591	154.5
5	Kirkuk	493	541
6	Najaf	152	136.5
7	Baghdad	272	198
8	Anbar	1407	756
9	Muthana	167	150
10	Salah Al-Din	456	400
11	Basrah	756	201
12	Dhi-Qar	396	157.25
13	Babylon	344	108
14	Nineveh	550	700
15	Messan	543	347.5
	Total	7665	5116.65

Expressways are access-controlled superior facilities. At present, their length is 1084 Km, (i.e. 2.5 per cent of the total length) consisting of Expressway No. 1 and Abu Garib Expressway. They are six lane divided facilities.

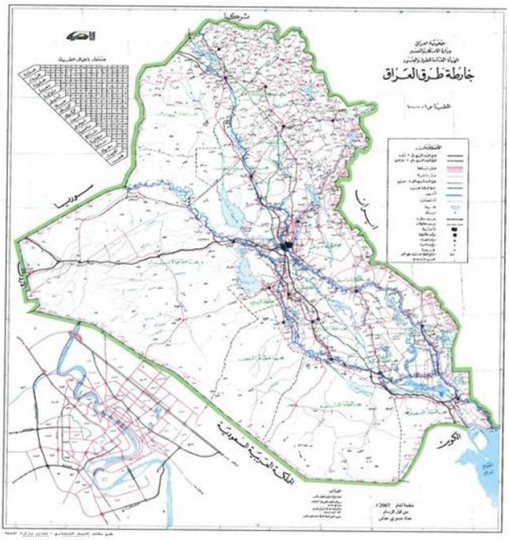
National Highways (Primary Roads or Arterial Roads), 11,000 Km in length, constitute about 26 per cent of the network and link the capitals of the 15 governorates and the Kurdistan Region and international boundaries. Roughly one-third of the length is 2-lane, and the balance is 4-lane. A road map of Iraq's major roads is given in Fig. **Error! No text of specified style in document.**.1.

Secondary roads, 15,200 Km in length, serve as links between the provinces and the districts.

Village Roads (Rural Roads) connect the rural habitations with the secondary and arterial roads. Their length currently is 3,700 Km, constituting about 9 per cent of the network.

Considering that the network has been developed from the earthen caravan tracks which existed at the beginning of the establishment of the Iraqi Government, the country has done well in road development over the past 40 years.

Figure Error! No text of specified style in document.**-3: Road Network of Iraq**



3.2 Road density

The coverage of roads (Km/ sq. Km) is about 0.1 (Area: 434,128 sq. Km, road length: 42,000 Km) and fares very poorly when compared to some other countries (see Table **Error! No text of specified style in document.**.1). For example, India's road density is 1.01, which is 10 times Iraq's. Perhaps, one of the reasons for poor road density is that its urbanisation is 67% and rural population is just 33%. This means that nearly two-thirds of the population lives in urban habitations. This is just the reverse of India's, where only 30 per cent live in urban centres and the majority (70%) live in its numerous villages.

Table 3.1 also gives in the last column the road length in Km per 100 people. The averages for some selected groups of countries are:

Km/ 100 persons

Europe	1.007
Africa	0.238
Asia & Middle East	0.286
Oceania	2.666
USA	2.077

The value for Iraq is 0.148, which is very low by the above standards

Nevertheless, the road density is poor in Iraq and concerted efforts need to be made to increase rural connectivity. Iraq has a length of 2,272 Km of railways, but the bulk of the transport is road based and hence the need for rapid development of roads.

3.3 Bridging needs

Another feature of the geography of Iraq is that it is drained by two major rivers, the Tigris and Euphrates and their tributaries. It becomes necessary to bridge these rivers at several places. SCRB is engaged in constructing new bridges. There are several (60 Nos.) floating bridges (known as pontoon bridges), which need to be replaced by fixed bridges, funds permitting.

Table Error! No text of specified style in document..**3: Country Comparison of Road Density**

S. No.	Country	Area (sq.km)	Road length (km.)	Road density (km/sq.km)	Year	Road length per 100 persons
	EUROPE					1.007
1	Austria	83871	110,778	1.32	2008	1.305
2	Belgium	32545	153,595	4.72	2008	1.46
3	Bulgaria	110910	40,231	0.36	2008	0.567
4	Cyprus	9250	14,671	1.59	2008	1.309
5	Denmark	43094	73,197	1.7	2008	1.324
6	Finland	338145	78,141	0.23	2009	1.486
7	France	547030	951,200	1.74	2008	1.635
8	Germany (FRG)	357022	644,480	1.81	2010	0.791
9	Greece	131940	116,711	0.88	2008	1.092
10	Hungary	93030	197,519	2.12	2010	1.980
11	Iceland	103125	12,869	0.12	2009	4.137
12	Ireland	70273	96,036	1.37	2010	2.056
13	Italy	301230	487,700	1.62	2007	0.799
14	Luxemburg	2586	5227	2.02	2008	1.039
15	Netherlands	41526	136,827	3.29	2010	0.812
16	Norway	386000	93,509	0.24	2010	1.981

S. No.	Country	Area (sq.km)	Road length (km.)	Road density (km/sq.km)	Year	Road length per 100 persons
17	Poland	312685	423,997	1.36	2008	1.103
18	Portugal	92391	82,900	0.9	2008	0.770
19	Rumania	237500	82,386	0.35	2010	0.373
20	Spain	504782	681,298	1.35	2008	1.457
21	Sweden	449964	572,900	1.27	2009	6.303
22	Switzerland	41290	71,454	1.73	2010	0.935
23	Turkey	780580	352,046	0.45	2008	0.447
	AFRICA					0.238
24	Botswana	600370	25,798	0.04	2005	1.249
25	Burundi	27830	12,322	0.44	2004	0.121
26	Egypt	1001450	65,050	0.06	2009	0.079
27	Ethiopia	1104300	36,469	0.03	2007	0.04
28	Gabon	267667	9170	0.03	2004	0.582
29	Ghana	238540	62,221	0.26	2006	0.251
30	Kenya	582650	160,886	0.28	2008	0.392
31	Lesotho	30355	7091	0.23	2003	0.368
32	Liberia	111370	10,600	0.1	2000	0.280
33	Madagascar	587041	65,663	0.11	2003	0.299
34	Malawi	118480	15,451	0.13	2003	0.097
35	Mauritius	2040	11,066	5.42	2006	0.158
36	Morocco	446550	58,256	0.13	2008	0.180
37	Nigeria	923768	193,200	0.21	2004	0.124
38	Senegal	196722	14,008	0.07	2006	0.107
39	South Africa	1219912	362,099	0.3	2002	0.739
40	Tanzania	945090	91,049	0.1	2010	
41	Tunisia	163610	19,232	0.12	2008	0.181
42	Zambia	752614	91,440	0.12	2001	0.659
	AMERICA					
43	Argentina	2760990	231,374	0.08	2004	0.554
44	Brazil	8547000	1,751,868	0.2	2004	0.861
45	Chile	756950	80,505	0.11	2004	0.447
46	Guatemala	108890	14,095	0.13	2001	0.102
47	Mexico	1972550	366,095	0.19	2008	0.322
48	Uruguay	176220	77,732	0.44	2010	2.349
49	U.S.A	9372610	6,506,204	0.69	2008	2.077
	ASIA AND MIDDLE EAST					0.286
50	Afghanistan	647500	42,150	0.07	2006	0.141
51	India	3287590	3,320,410	1.01	2009	0.279
52	Iraq	437072	44,900	0.1	2002	0.148
53	Israel	26900	18,290	0.68	2009	0.245
54	Japan	377835	1,210,251	3.2	2011	0.952
55	Malaysia	329758	98,721	0.3	2012	0.344
56	Nepal	147181	17,282	0.12	2007	0.059
57	Pakistan	803940	260,760	0.32	2010	0.139
58	Sri Lanka	65610	91,907	1.4	2008	0.432
59	Thailand	514000	180,053	0.35	2006	0.270
	OCENIA					2.666
60	Australia	7686850	818,356	0.11	2008	3.735
61	New Zealand	268680	93,911	0.35	2009	2.189

3.4 Need to Preserve the Assets created

The other matter of serious concern in the road sector is the need to maintain and rehabilitate the road assets constructed during the seventies and eighties. The high volume of traffic and high axle loads are causing rapid deterioration of the road and bridge assets which need to be immediately attended to. It is a matter of serious concern that the SCRB has assessed that 80 per cent of the existing roads were in bad condition and needed immediate attention. Another dimension to the problem is the reconstruction of assets (particularly bridges) damaged by war activities.

4. TECHNICAL CAPACITY ASSESSMENT (TASK 0101)

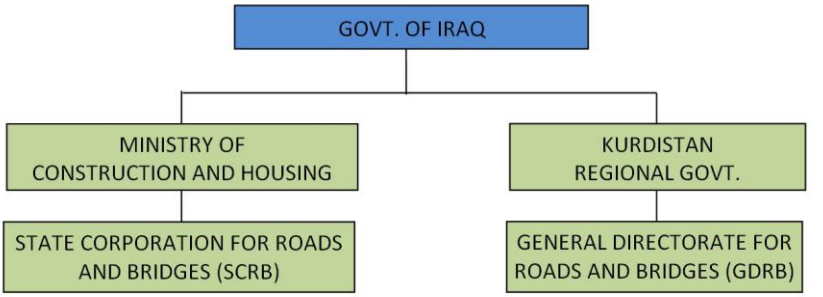
4.1 Introduction

Under this Task, the structure, staff strength, Human Resources Development (HRD), weaknesses and strengths will be assessed from the technical viewpoint. Other aspects of SCRB functions, expectations, performance and financial capacity will be addressed in subsequent Chapters.

4.2 Road and Bridge Construction Agencies in Iraq

The State Corporation for Roads and Bridges (SCRB) was established under the Ministry of Construction and Housing (MoCH), Government of Iraq under an enacted law Numbered 62 of the year 1987. As seen from Fig. **Error! No text of specified style in document.**.1, there is a similar organisation in Kurdistan under the Kurdistan Regional Government's (KRG's) General Directorate for Roads and Bridges (GDRB).

Figure Error! No text of specified style in document.**-4: Organizational Structure of Agencies for Roads and Bridges in Iraq**



4.3 Status of SCRB

SCRB enjoys a legal, financial and administrative independence and complete freedom for achieving the goals set forth in MOCH law No. 62 of 1987.

4.4 Functions of SCRB

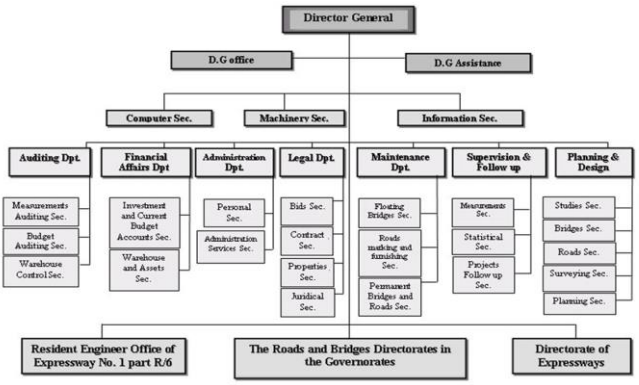
SCRB is mandated to perform the following functions:

1. Preparation of Feasibility studies for roads, bridges, tunnels and interchanges.
2. Designing public road projects (including Expressways) outside the Baghdad mayoralty and other municipalities, including roads, bridges, tunnels, intersections and interchanges.
3. Execution of works mentioned in para 2 above, including supervision and monitoring the progress thereof.
4. Maintenance of works mentioned in para 2, including road furniture, road side facilities and including operation.
5. Emergency maintenance and repairs of roads and bridges as may be required.
6. Acquisition of land required for the projects mentioned in para 2 above, protection of the right-of-way and prevention of encroachments.

4.5 Organisational set-up of SCRB

The SCRB in headed by a Director General. The organisational set-up is given in Fig. **Error! No text of specified style in document.**.2.

Figure Error! No text of specified style in document.**-5: Organizational Set-up of SCRB**



In each of the Governorates, there is a Director-in-charge of the Roads and Bridges.

There is separate Directorate for Expressways. In addition, there is a Resident Engineer for Expressway No. 1, Part R/6.

The Organisation is well defined. However, to improve decentralisation, decision making, division of roles and authority, each engineer/ professional should have access to interact and e-mail facility for prompt communication.

4.6 Staff Strength in SCRB

Table **Error! No text of specified style in document.**.1 gives the staff strength of SCRB at the Headquarters.

Table Error! No text of specified style in document.**.4: Staff Strength of SCRB Engineers at Headquarter**

Job Title	Number
Expert	3
Senior Head Engineers	21
Head Engineers	2
Assistant Head Engineers	6
Senior Engineer	15
Engineer	5
Asst. Engineer	7
Total	59

Out of these, the qualifications are as under:

MSc	4
BSc	54
Higher Diploma	1

In addition, there are 14 staff members dealing with survey, as shown in Table **Error! No text of specified style in document.**.2.

Table Error! No text of specified style in document.**.5: Staff Strength for Survey ain SCRB Headquarter**

Job Title	Number	
Senior Head Surveyor	4	
Head of Survey	1	
Asst. Head of Survey	5	
Senior Surveyor	3	
Surveyor	1	
Total	14	All have Higher Diploma

In the various governorates in the work area, these are the following staff available:

1. Engineers 426

2.	Surveyors	52
3.	Designers	18
4.	For Supervision and Monitoring	10
5.	For Maintenance	6

Under Task 0110 dealing with the Consultancy Sector, we have made a recommendation that the bulk of the work of designing, project preparation, construction supervision and research studies should be got done through Consultants. This will result in the government staff strength in the SCRB will be lean and thin. The present staff strength is adequate for assuming and overseeing role on the tasks assigned to Consultants.

4.7 Adequacy of Engineering Graduates

A recent press note indicated that there has been an increase of 20 per cent in the year 2012-13 in the intake of engineering colleges[1] (Ref 2). The Iraqi Ministry of Higher Education and Scientific Research spokesman said recently (Ref 2) that "there is also need in the private and public sectors for people specialised in engineering in order to support national development".

It is heartening to note that the Iraqi government are aware of the need for augmenting the engineering intake in the colleges keeping in view the development needs of the government in various sectors.

4.8 Human Resources Development of Engineers in the SCRB

The salary structure of various categories of Engineers in the government department is given in Table **Error! No text of specified style in document.**.3 enclosed.

The highest salary is for the Expert and id 948000 ID per month. This comes to US $ 500 per month, with an annual

[1] Number of Iraqi students admitted to medical, engineering colleges leaps, from the Internet web-site http:// mawtani.al-shorfa.com/ en_GB/ articles/ iii/ features/ 2012/ 11/ 14/ feature-02

increment of around US $ 10. The starting basic salary for the Assistant Engineer is 296000 ID per month, and with various allowances it can roughly be about 420,000 ID per month which is US $ 345 per month, with an annual increment of around US $ 5. These salaries are too low to attract good talent and retain them. Young recruits fresh from the college many join the government to start with, but with a couple of years of experience they will command a much better salary structure in the private sector.

Table Error! No text of specified style in document.**.6: Salary Structure of the Iraqi Ministry of Finance**

Job Ranking	Salary scale of the Ministry of Finance					Years of Promotion	Annual Increase
	Amount of Salary						
Expert	1-1	1-2	1-3	1-4	1-5	-	20000
	948000	968000	988000	1008000	1028000		
Senior Chief Engineer	2-1	2-2	2-3	2-4	2-5	5	17000
	758000	775000	792000	809000	826000		
Chief Engineer	3-1	3-2	3-3	3-4	3-5	5	12000
	621000	633000	645000	657000	669000		
Assistant Chief Engineer	4-1	4-2	4-3	4-4	4-5	5	10000
	509000	519000	529000	539000	549000		
Senior Engineer	5-1	5-2	5-3	5-4	5-5	5	7000
	429000	436000	443000	450000	457000		
Engineer	6-1	6-2	6-3	6-4		4	6000
	362000	368000	374000	380000			
Assistant Engineer	7-1	7-2	7-3	7-4		4	6000
	296000	302000	308000	314000			

Thus, attrition of engineers is a serious problem in the government departments. With such a low salary corruption and malpractices also likely to set in. The Consultants strongly advise the SCRB to undertake a review of the salary structure of the engineers to attract the best talent, nurture them and retain them for their full life time career. To attract and build a cadre of competent engineers, the following additional measures are needed:

1. Competitive system to attract the best engineers at the entry level

2. "At entry" training for a period of six months in a training institute exposing the trainees to the various activities of the SCRB, the design guidelines and practices and quality control and supervision duties.
3. "In service" training at least once in five years to update the skills and give the trainees exposure to the latest developments in the field.
4. Sending promising young engineers for acquiring higher qualifications in recognised institutions abroad.
5. Organising yearly Seminars and Workshops on selected topics, where international experts can be invited to deliver lectures.
6. Sponsoring Iraqi Engineers to attend Seminars and Workshops in countries which organise such events in highway related subjects like TRB (USA), TRRL (UK), ARRB (Australia), IRC (India), Asphalt Institute (USA), American Association of Concrete Pavement, etc. This should be organised Government to government, through diplomatic channels.
7. A component of the World Bank aid can be utilised for such activities.

4.9 Proficiency in English

The Consultants strongly feel that the engineers in SCRB should have a high degree of proficiency in the English language. Only then will the engineers be able to access the internet, be updated as regards the latest development in the field and improve their skills. Though the internal communications can in Arabic, it is absolutely necessary to have proficiency in the English language. Even countries like China and Japan, who traditionally use their national language for day-to-day work, have realised the need to acquire proficiency in the English language to be abreast of international developments in the roads sector, and are taking steps to overcome their drawback.

The minimum skill in the English language can be acquired by making it compulsory for all SCRB engineers to attend English language classes, which can be arranged at places and time convenient to the staff.

4.10 Iraq Highway Training Institute

4.10.1 Need

Since Iraq has a major road rehabilitation and modernisation programme to be taken up in the next decades, there is an urgent need to update the skills and competence of SCRB engineers. This task can only be accomplished by setting up a dedicated Highway Training Institute.

4.10.2 Training Levels

The Institute should impart training to the engineers from SCRB, Governorates and NCCLR at the following levels:

1. "At entry" training for a period of six months giving exposure to the fresh entrants to the working of SCRB, the standards for design and construction, modern trends in highway and bridge engineering and quality assurance.
2. "In service" training through Refresher Courses on various topics.
3. Management Programme for Senior Executives.
4. Training of Operators, Mechanics and Skilled technicians.

4.10.3 Refresher Courses for Serving Engineers

The following topics are suggested for Refresher Courses for all members. To make all SCRB members aware of duties, responsibilities, and objectives as well as to overcome gaps in education system for overall improvement in quality, refresher courses are necessary.

4.10.3.1 Planning

- Long-term Plan for Iraq's Road
- Survey and Investigations
- Project Preparation
- Economic Analysis, HDM-IV
- Project Management

4.10.3.2 Design

- Highway Geometric Design
- Pavement Design
- Computer Aided Design
- Use of Geotextiles
- Design of Expressways
- Bridge Design
- Reinforced Earth Walls

Construction

- Specifications
- Quality Assurance/ Quality Control
- Modern Asphaltic Courses
- Cement Concrete Pavement
- Modern Bridge Construction (Segmental and Incremental Construction, Cable-stayed bridge)
- Contract Management (FIDIC Conditions)
- Public-Private Partnership

Maintenance and Asset Management

- Duties and responsibilities
- Inspection and Inventorying
- Asset Management Systems
- Pavement Management Systems
- Bridge Maintenance Systems
- Mechanised and Mobile Maintenance Units

4.11 Acquisition of Software

The SCRB should acquire modern software dealing with highway and bridge design. Some of the software's recommended are:-

1) Bentley's Highway Design Software MX
2) STADD for Bridge Design
3) NCHRP 1–37 A Mechanistic Empirical Pavement Design
4) HDM-IV for Economic Analysis and Highway Management
5) CUBE for Traffic modelling
6) TRANSYT for intersection design

4.12 Acquisition of Hardware

Each engineer in SCRB should have a modern desktop computer with internet and e-mail services. Individual systems should preferably be connected through local server, which in-turn can be networked to central server at SCRB head quarter in Baghdad. Design software and applications can be server based with end-user license provision. It will help in creation and maintenance of structured data base and efficient communication.

It is also recommended that SCRB should have video conferencing facility with Governorates as well as between other parallel Departments. For this purpose, well equipped conference room should also be created.

4.13 Public Consultation and Stake-holders' views

Road construction and improvement programmes have a direct impact on the public because it gives them connectivity, better accessibility, faster travel, reduced user cost and enhanced safety. It also affects some of them if their private party is acquired for road building. Environmental impact such as pollution, noise effect on water bodies, fauna and flora also is felt by the public. Other stake-holders like truck operators, bus operators, port authorities and government agencies dealing with health, education and trade are also keen to associate

themselves with the road development. SCRB should periodically convene meeting of all stake-holders, present the road improvement proposals and utilise the inputs given by the stake-holders for any changes or improvements in the proposals.

The Consultants propose to have a Stake-holder meeting after data on the inventory and condition become available.

5. ASSESSMENT OF SCRB CAPACITY FOR SURVEY, INVESTIGATIONS, TESTING, INSPECTION AND QUALITY CONTROL (TASK 0102)

5.1 Introduction

The Roads Sector of any country has to depend upon a strong team of scientists who are backed up with modern equipment for survey, investigations, testing, inspection and quality control. Though SCRB itself do not have these personnel and laboratory facilities, they are getting these requirements carried out through the National Centre for Construction Laboratories and Research (NCCLR).

5.2 NCCLR

NCCLR is one of the premier institutions under MOCH, providing the back-up research and testing facilities. Established in 1976, the institution has a long experience in material and soil testing and assessment of condition of structures. The institution has a main centre in Baghdad with branches in the 15 provinces and 2 districts as under:

1. Baghdad Construction Laboratory
2. Soil Investigation Laboratory in Baghdad
3. Al- Anbar Laboratory
4. Babylon Laboratory
5. Al- Basrah Laboratory
6. Diyala Laboratory
7. Al- Diwaniya Laboratory
8. Thiqar Laboratory

9. Salahiddin Laboratory
10. Karbala'a Laboratory
11. Kerkuk Laboratory
12. Al- Muthanna Laboratory
13. Misan Laboratory
14. Al- Najaf Laboratory
15. Ninawa Laboratory
16. Wasit Laboratory
17. Al-Hindiya Laboratory
18. Khanaqeen Laboratory

The total work force is 1350 as under:

	Number
Engineers	257
Technicians	395
Workmen	323
Service Staff	132
Administrative Staff	129
Financial Staff	114
	1350

The following numbers of staff have high academic qualifications:

	Number
Doctorate	1
Master's Degree	13
High Diploma	7

It is learnt that NCCLR place a high degree of importance to offering training courses to the staff and to students of colleges. The technical staffs are encouraged to pursue higher education to keep themselves abreast of the latest trends and technology, both in Iraq and outside the country.

5.3 Testing Facilities in NCCLR

The NCCLR have laboratory equipment and facilities for the following tests.

5.3.1 Materials

- Soil
- Aggregates

- Gravel
- Cement
- Gypsum
- Sand
- Bricks
- Concrete
- Tiles
- Blocks
- Kerbs
- Water
- paints

5.3.2 Sub-soil Investigations

- Drilling in soils and rocks
- SPT

It is reported that most of the equipment are very old and are not fit for use. It is suggested that a complete review of the laboratory equipment and facilities be undertaken and immediate measures taken up for replacing the old equipment with modern items.

5.4 Additional Testing Facilities needed in NCCLR

In the list of tests furnished by NCCLR, the following important facilities are missing and may be procured:

1. CBR test of soil, both in the laboratory and in the field
2. Asphalt testing equipment, including tests on mixes (Marshall Stability)
3. Testing Riding Quality (Bump Integrator)
4. Testing Skid Resistance
5. Axle Load Pads (Weigh Stations under installation can serve the purpose)
6. Testing Pavement Strength (Deflection, Falling Weight Deflectometer)
7. Automatic Vehicle Count Equipment

8. Speed testing equipment (Radar, Infra-Red etc.)
9. Weigh-in-Motion Equipment
10. Testing Reflectivity of Road Signs and Thermoplastic Paints
11. Schmidt Hammer for testing concrete strength
12. Mobile Equipment for inspection of bridges
13. Road Inventory and Condition Survey Equipment
14. Equipment for measuring deflections of bridges
15. Ultra-sonic equipment for testing concrete, cracks, corrosion
16. Dynamic Cone Penetrometer
17. Concrete Pavement Core Cutting Equipment

Brief Specifications for some of the above equipment are enclosed.

5.5 Equipment

It is learnt that SCRB itself does not own road construction equipment, and these are owned by the Contractors who are awarded works on a competitive basis.

However, SCRB have procured some equipment for implementing the emergency maintenance work. The equipment's procured are:

1. Scraper
2. Road Roller
3. Grader
4. Road Marking Equipment
5. Water Tanker
6. Welding Machine
7. Asphalt Core Cutter

It is felt that the SCRB should possess the following equipment for maintaining the roads:

- Mobile Road Maintenance Unit consisting of a cold-mix, plate compactor, asphalt tank, asphalt spray equipment.
- Survey Equipment like GPS, Total Stations and Digital/ Auto levels

5.6 Brief Specifications for Equipment to be procured by SCRB/ NCCLR

5.6.1 VEHICLE MOUNTED ROAD CONDITION MONITORING EQUIPMENT

The road condition shall be captured through a laser-based instrumented system mounted on a vehicle capable of 3 dimensional scanning. The vehicle shall be capable of capturing the data while running on a speed of 30 Km per hour. The data shall be capable of being recorded on a GIS platform, giving x, y, z coordinates.

The following information shall be captured, by the instrumented vehicle substantiated by manual inputs:

1. Width of the carriageway and the road formation, and structures (buildings) along the road
2. Side ditches
3. Location of cross-drainage structures with size of opening
4. Roadside furniture like Km/ hectometre posts (distance indicators)
5. Road Signs
6. Road Markings
7. Distress along the road
    - Potholes
    - Cracks of various types
    - Ravelling
    - Patches
    - Shoving

5.6.2 PORTABLE FALLING WEIGHT DEFLECTOMETER

It is necessary to periodically assess the structural adequacy of the pavement and to determine the need for any structural overlay. The Benkelman Beam Deflection is universally accepted as the measure of the structural adequacy. But taking deflection measurements manually by a Benkelman Beam is

very time-consuming. Falling Weight Deflectometers (FWD) are able to assess the structural adequacy quickly and accurately. However, the FWD is costly and heavy equipment. Portable FWDs are light weight and hence easy to carry, while at the same time giving all the details required for assessing the structural adequacy of the pavement, particularly when used for the assessment at the network level.

The following brief specifications are given to enable the SCRB to invite offers from various suppliers.

1.	Total Weight	:	Maximum 20 Kg
2.	Height	:	Up to 120 cm
3.	Diameter	:	Up to 15 cm
4.	Diameter of loading plate	:	Three options of 125 mm, 200 mm and 300 mm
5.	Falling Weight	:	10 Kg
6.	Fall Height	:	80 cm
7.	Operating Voltage	:	9 V Batteries, 3 or 4 in number
8.	Measuring Range	:	0.1 to 5 mm

9. Capable of determining the Modulus E, rebound deflection, maximum deflection, compaction ratio (ratio of the second and further on deflections compared to the first measured deflection).

5.6.3 BRIDGE INSPECTION INSTRUMENTS

1.	Concrete Strength	:	Schmidt Hammer
2.	Quality of Concrete	:	Ultra-sonic Pulse Velocity Equipment
3.	Correction of Steel	:	Electrical Resistivity Meter

4. Mobile Bridge Inspection Unit consisting of a truck with rotating and movable boom with seating arrangement for the inspector. This equipment is known as Snooper-type Truck and is ideal for inspection of the under-deck condition.

5.6.4 WEIGH-IN-MOTION EQUIPMENT

The legal axle load in Iraq is 13 T, which is already high when compared to the standard axle load of 8 T used in the design guidelines. Thus, its damaging power, using the Fourth Power Rule, is 7 times that of the standard axle. As a result, the road pavements in Iraq have to be very thick and structurally adequate to withstand the heavy loads. If overloading beyond the legal axle load of 13 T takes place, even the well-designed pavements will fail prematurely. Hence, it is of great

importance that overloading is prevented. This can be achieved by installing weigh bridges at frequent intervals, detect the violators and punish them.

When the traffic is high, it is time-consuming to stop each and every vehicle, lead it to the weighing pad and record the load. The better practice is to install Weigh-in-Motion equipment which records the loads as the trucks pass over the equipment.

The brief specifications for the equipment are:

1. Maximum Wheel Load : 10 T
2. Speed of Vehicles : Up to 10 Km/ hr.
3. Weight of pad : 20 Kg
4. Material of pad : Stainless steel
5. Electronic Sensors for measuring loads powered from portable battery (9V)
6. Connecting cables between sensors and computer
7. Processing software
8. Capable of storing and printing results manually or automatically
9. Accuracy : ± 2%

5.6.5 AUTOMATIC PERMANENT TRAFFIC COUNTER-CUM-CLASSIFIER

Traffic Counts are an important data for Road Asset Management and finds multiple uses such as capacity assessment and pavement design. The traffic stream consists of a mix of various types of vehicles such as trucks (of various axle configurations), buses, cars, vans, two-wheelers etc. counting manually is a cumbersome task and can be done for only a few days, whereas a continuous count can capture the traffic throughout the year. Permanent Automatic Traffic Counters should be installed at selected locations on important highways. Brief specifications for the equipment are given below:-

1. Lane Configuration : 2 lanes/ 4 lanes/ 6 lanes, of standard lane width of 3.5 m

2. Vehicle Type to be classified :
   - Trucks of various axle configurations
   - Buses
   - Vans
   - Cars
   - Two-wheelers
3. Vehicle Detection System : Piezo Electric Sensors
4. Power Supply : Battery 12 V
5. Loop Cable System connecting Battery to Sensors and to Classifier
6. Software for counting and classifying the data (Windows Based)
7. Storage Capacity : 2 weeks data
8. Laptop and Printer

5.6.6 STATIC LOAD DEFLECTION TEST PROCEDURE (C.G.R.A. METHOD)

SCOPE

This method of test covers a procedure for the determination of the rebound deflection of pavement under static load of the rear axle of a standard truck.

EQUIPMENT

The equipment shall include:

(1) Benkelman Beam

(a)	Length of probe arm from pivot to probe point	244 cm
(b)	Length of measurement arm from pivot to dial	122 cm
(c)	Distance from pivot to front legs	25 cm
(d)	Distance from pivot to rear legs	166 cm
(e)	Lateral spacing of front support legs	33 cm

(2) A 5 tonne truck is recommended as the reaction. The vehicle shall have 8170 Kg rear axle load equally distributed over the two wheels, equipped with dual tyres. Spacing between the tyre walls should be 30-40 mm. The tyres shall be 10 x 20, 12 ply inflated to a pressure of 5.60 Kg/cm^2. The use of tyres with tubes and rib treads is recommended.

(3) Tyre pressure measuring gauge

(4) Thermometer (0-100^{0}C) with 1^0 division

(5) A man drill for making 4.5 cm deep hole in the pavement for temperature measurement. The diameter of the hole at the surface shall be 1.25 cm and at bottom 1 cm.

(1) The point on the pavement to be tested is selected and marked. For highways, the point should be located 60 cm from the pavement edge if the lane width is less than 3.5 m and 90 cm from the pavement edge for wider lanes. For divided four lane highway, the measurement points should be 1.5 m from the pavement edge.

(2) The dual wheels of the truck are cantered above the selected point.

(3) The probe of the Benkelman beam is inserted between the duals and placed on the selected point.
(4) The locking pin is removed from the beam and the legs are adjusted so that the plunger of the beam is in contract with the stem of the dial gauge. The beam pivot arms are checked for free movement.
(5) The dial gauge is set at approximately 1 cm. The initial reading is recorded when the rate of deformation of the pavement is equal or less than 0.025 mm per minute.
(6) The truck is slowly driven a distance of 270 cm and stopped.
(7) An intermediate reading is recorded when the rate of recovery of the pavement is equal to or less than 0.025 mm per minute.
(8) The truck is driven forward a further 9 m.
(9) The final reading is recorded when the rate of recovery of pavement is equal to or less than 0.025 mm per minute.
(10) Pavement temperature is recorded at least once every hour inserting thermometer in the standard hole and filling up the hole with glycerol.
(11) The tyre pressure is checked at two or three hour intervals during the day and adjusted to the standard, if necessary.

CALCULATIONS

(1) Subtract the final dial reading from the initial dial reading. Also subtract the immediate reading from the initial reading.
(2) If the differential readings obtained compare within 0.025 mm the actual pavement deflection is twice the final differential reading.
(3) If the differential readings obtained do not compare to 0.025 mm, twice the final differential dial reading represents apparent pavement deflection.
(4) Apparent deflections are corrected by means of the following formula:
$X_T = X_A + 2.91\ Y$
in which X_T = True pavement deflection
X_A = Apparent pavement deflection
Y = Vertical movement of the front legs i.e. twice the difference between the final and intermediate dial readings
(5) The rebound deflection (%) (i.e. col. 9 of Table 3) shall be the twice of the X_T value.

5.6.7 SKID RESISTANCE TESTING EQUIPMENT

The standard equipment used by most European, American and Asian countries for measuring the skid resistance is the locked wheel tester.

The equipment specification is outlined in ASTM Standard ASTM E 274-97.

The vehicle is driven at the standard test speed of 65 Km/hr., water is delivered ahead of the test tyre and the braking system is made to lock the test tyre. The resulting frictional force is measured by a force transducer.

The output is reported as the Skid Number (SN), which is defined as the force required to slide the locked test wheel at

the stated speed, divided by the effective vertical load applied to the test wheel and multiplied by 100.

6. SPECIFICATIONS, STANDARDS, DESIGN GUIDELINES (TASK 0103)

6.1 SCRB's Specifications and Design Standards

SCRB have prepared Standard Specifications and Design Guidelines for Roads and Bridges. The documents are well prepared and incorporate most of the requirements. However, Consultants have reviewed these documents and have given suggestions to improve and augment them.

6.2 Standards

6.2.1 Axle Load Policy of Iraq

The permissible legal axle load in a country has several implications:

(a) The higher the axle load, the greater is the damaging effect of the load on the pavement. For example, the well-known fourth power rule assumes a standard axle load of 8 T, and the damaging effect is then given by:

$$\text{Damaging effect} = \left(\frac{\text{Axle Load}}{\text{Standard Axle Load}}\right)^4 = \left(\frac{\text{Axle Load}}{8}\right)^4$$

Thus an axle load of 13 T has a damaging factor of:

$$= \left(\frac{13}{8}\right)^4 = 6.97,$$ or nearly 7 times the standard axle of 8 T.

Pavements have to make thicker and stronger, and they deteriorate faster as higher axle loads are permitted.

(b) With higher axle loads, the permissible Gross Vehicle Weight increases. Thus, the truck operators are able to carry higher weights, thus lowering the cost of haulage per tonne-Km.

(c) With higher axle loads, the vehicle chassis and tyres have to be made stronger.

6.2.2 Review of axle load policy world-wide

Table **Error! No text of specified style in document.**.1 attached gives the global scenario of the axle load policy of several countries[2&3]

It is seen Iraq and France are the only countries with an axle load of 13 Ton single axle. On tandem axle, its permitted load is 20.0 T, which is followed in most countries.

While the fixation of legal axle load is the prerogative of each country, based on its specific requirements, one cannot but conclude that road pavements in Iraq have to be designed for a very high axle load, its roads deteriorate faster and its maintenance inputs will have to be higher.

It has also been reported in Iraq's National Development Plan for 2010-14 (Ref 1) that:

"There is no control over loads and vehicle axle weights, which lead to destruction of the road network".

The above document also has one of the following objectives in the Transportation Sector:

"Protecting the road network from excessive weight by constructing weigh stations to detect and deter vehicle weights and axle loads that exceed the allowable limits".

The Consultants strongly endorse the above objective and urge SCRB to install "Weigh in Motion" stations at suitable locations and enforce the legally allowed axle loads strictly. The permissible axle load is already high (having a damaging effect of 7 times the standard axle load of 8T), and any further overloading will have disastrous effect on the performance of the pavements.

Table Error! No text of specified style in document..**7: Axle Load Comparison**

[2] International Road Federation data from the Internet

[3] French Design Manual for Pavement Structure, LCPC, Paris, 1997

S. No.	Country	Permissible Axle Load (Tonnes)			Permissible Gross Vehicle Weight		
		Single Axle	Tandem Axle	Tridem Axle	Single Rigid Vehicle	Semi-Trailer	Truck-Trailer
	ASIA						
1	Azerbaijan	10.0	18.0	25.5	18.0–32.0	36.0–44.0	
2	Bangladesh	10.0	16.5	19.5	22.0	35.0	44.0
3	Cambodia	10.0	19.0	–	25.0	35.0	40.0
4	China	10.0	18.0	22.0	40.0	40.0	46.0
5	India	10.2	19.0	24.0	25.0	26.4–44.0	36.6–44.0
6	Indonesia	10.0	18.0	20.0	12.0–30.0	10.0–20.0	12.0–20.0
7	Iran	6.0	13.0	20.0	19.0	26.0	40.0
8	Iraq	13.0	20.0	27.0	27.0	33.0–39.0	52.0–66.0
9	Kazakhstan	8.0	12.0–19.0	17.4–21.9	18.0–32.0	36.0	
10	Malaysia	10.0	7.0–16.0	14.0–17.0	8.0–20.0	14.0–38.0	–
11	Mongolia	8.0	–	–	–	–	–
12	Myanmar	10.0	16.0	21.0	16.0	25.0	38.0
13	Pakistan	12.0	22.0	31.0	17.5–27.5	29.5–58.5	41.5–61.5
14	Singapore	10.0	20.0	30.0	16.0–24.0	–	–
15	Turkey	11.5	11.5–20.0	21.0–24.0	18.0–32.0	36.0–44.0	
	AFRICA						
16	Botswana	8.2	16.4	24.6	50.2		
17	Malawi	9.0	18.0	24.6	55.0		
18	South Africa	9.0	18.0	24.0	56.0		
	AMERICA						
19	Canada	9.1	17.1	24.0	53.5		
20	USA	9.0	18.0	20.0	36.0		
	AUSTRALIA	9.0	16.5	20.0	44.0		
	EUROPE						
21	U.K.	10.5	20.3	22.5	38.0		
22	Germany	10.0	11.5	21.0	40.0		
23	France	13.0					

6.3 Design Guidelines

6.3.1 SCRB's Guidelines for Bridge Design and Highway Design

SCRB have formulated guidelines for Bridge Design and Highway Design. The guidelines are well prepared and incorporate the latest criteria. Some suggestions for improving these are given in the succeeding paras.

6.3.2 Highway Capacity

6.3.2.1 Capacity Values for Mountainous Terrain

Whereas the design elements (speed etc.) are given for plain, rolling and mountainous terrain, the capacity values are given only for plain and rolling terrain. Suitable values should be suggested for mountainous terrain also.

At the same time, the definition of and criteria for classifying the terrain into plain, rolling and mountainous should be given.

6.3.2.2 Capacity values under mixed traffic conditions

The capacity values are given for 0% and 20% of trucks in the traffic stream. But in certain sections, particularly on roads leading to port, industries and oil refineries, the percentage of trucks can be very high.

Besides, the traffic may consist of two-wheelers like motorcycles and scooters, and articulated multi-axle trucks. The effect of these on the capacity is considerable. The SCRB may, therefore, consider assigning Passenger Car Equivalencies (PCE) to these. This procedure will also overcome the present drawback of having only two values of truck percentages in the traffic stream.

6.3.2.3 Capacity in terms of hourly values or daily values

While capacity values in terms of vehicles per hour are useful for researchers, the average practising engineer in the design office or field needs the capacity values in terms of vehicles per day. Since the hourly variation of traffic on Iraq roads must be known, the daily capacity can be computed from:

$$\text{Capacity in vehicles per day} = \text{capacity in vehicles per hour} \times \frac{100}{\text{percentage of peak hour traffic}}$$

This suggestion may be incorporated in the design guidelines.

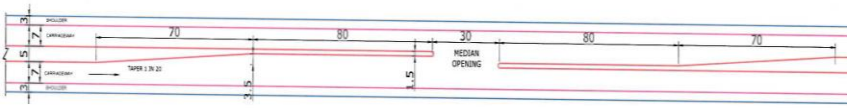
6.3.2.4 Maximum Super-elevation

Whereas Table II-11 gives the maximum super-elevation of 7 per cent, Table II-12 gives radii of turning roadways for super-elevation of 8 percent also. This assumes that the maximum super-elevation in mountainous terrain is 8 per cent. This may be clearly brought out in para 2.3.07.

6.3.2.5 Median Opening

Para 2.6.08 permits median openings at intervals of about 2 Km. this is a good practice. However, the median should allow for left turning traffic by providing recessed bays. The drawing is attached in Figure 6.1 for reference.

Figure Error! No text of specified style in document.**-6: Median Opening with Recessed Bay for Left Turning Vehicles**



6.3.3 Variable Message Signs (VMS)

Variable Message Signs are not covered in the present Road Design Manual. These are necessary for traffic control, management and timely traveller information. They serve to modify motorist behaviour and improve traffic flow and operations. Examples of traveller information provided through VMS are:

- Congestion conditions along a high-speed corridor
- Construction site warnings/ information notices
- Special event notice and motorist instructions
- Maintenance operations schedule
- Severe weather announcement
- Incident or Accident notification

We strongly advise Iraq to introduce VMS in the Design Manual.

6.4. Specifications

6.4.1 Interlocking Concrete Block Pavements

The Iraq Specifications Book does not contain Interlocking Concrete Block Pavements. However, it contains specifications for Flagstones (concrete paving slabs) of size 50 cm x 50 cm x 5 cm for use in footways.

We feel that Interlocking Concrete Block Pavements are widely used all over the world and have been found to have applications in several situations such as:

1. Footpaths and Side-walks
2. Cycle Tracks
3. Residential Streets
4. Car Parks
5. Fuel Stations
6. Rural Roads through Villages
7. Highway Rest Areas
8. Toll Plazas
9. Bus Depots
10. Approaches to Railway Level Crossings
11. Intersections
12. Truck Parking Areas
13. Industrial Floors
14. Urban Streets
15. Container Depots
16. Port Wharfs and Roads

The Interlocking Concrete Block Pavements have several advantages, such as:

1. Being factory made, their quality is assured
2. They restrict the speed of vehicles to 60 Km/hr and are advantageous for use in city streets and intersections. European cities have adopted this specification on a large scale.
3. They are skid-resistant because of rough surface

4. The digging of pavements and reinstatement are easy, and the specification is highly suitable to city streets which house several utilities which need repairs.
5. They are not affected by oil spillage and are thus ideal for fuel stations, bus depots, truck terminals and parking areas.
6. They have long life, and need very little maintenance.
7. They are extensively used in heavily loaded areas like container depots and ports.

The Consultants strongly recommend that Iraq's Specifications should cover this type of road pavement.

6.4.2 Use of Geosynthetics

Geosynthetics is the generic term which includes all synthetic materials used in geotechnical engineering applications and includes:

- Geotextiles
- Geogrids
- Geomembranes
- Geocells
- Geocomposites

Since they find wide application in roads and bridges, the Iraq's Book of Specifications should include this material and in various applications.

The Consultants strongly advocate that the Iraq's Book of Specifications should include this material to be used in the following applications:

(1) Geotextiles

- Woven
- Non-woven
- They are used
- as a separation layer
- as a reinforcing layer, particularly on weak soils and distressed pavements

- as surface protection for erosion control
- as a filtration layer
- as drains
- as reinforcing material for reinforced earth walls

(2) Geogrids

- They are used
- for strengthening distressed pavement
- for strengthening weak soils
- for reinforcing layer in reinforced earth walls

6.4.3 Reinforced Earth Walls

Reinforced Earth Walls are highly economical when compared to conventional RCC or masonry retaining walls. Their use is particularly advantageous for approaches to bridges and other structures. Specifications for Reinforced Earth Walls are not included in Iraq's Book of Specifications. They should be included covering:

- various forms of facial blocks
- various reinforcing elements like galvanised steel strips and Geosynthetics
- capping slab and safety barrier
- material to be used as fill behind the facia wall and covering the reinforcing elements

6.4.4 Use of Polymer Modified Bitumen

Use of Polymer Modified Bitumen enhances the properties of bitumen in hot-mix asphalt, particularly for heavy duty pavements. Various polymers like SBS and Elvaloy are commonly used. The use of crumb-rubber modified bitumen (CRMB) is also practised. Iraq's specifications should include this material.

6.4.5 Stone Matrix Asphalt (SMA)

From the photos of asphalt pavements badly damaged, it is seen that rutting is a serious problem on certain roads. This is primarily due to overloading, high load repetitions, extremely

high temperatures in summer and the inability of hot-mix dense graded asphalt to withstand these conditions. The Stone Matrix Asphalt (SMA) is the answer to these problems and countries in Europe and the USA have adopted this specification in recent times. The Consultants recommend that SMA be included in Iraq's Book of Specifications.

6.4.6 Additional Items for Bridge Works

The specifications for the following items of works pertaining to bridges may be added in Iraq's Book of Specifications:

1. Surface and Sub-surface geotechnical explorations for determining the type and depth of bridge foundations.
2. River Training and protective works
3. Wearing Coat for bridge decks
4. Approach Slabs
5. Drainage Spouts
6. Weep holes
7. Repair of Structures

6.4.7 Pavement Design

SCRB are using the AASHTO Guidelines for Pavement Design. Through the document is an internationally accepted guideline, the climatic and environmental conditions in Iraq are quite different from the conditions in U.S.A. Hence the Consultants strongly recommend that suitable research on pavement performance be intimated on road sections already in service and pavement design guidelines be evolved which are appropriate to Iraq conditions. Both new flexible and rigid pavements and overlays (both flexible and rigid) should be covered:

6.4.8 Design of Bridges

The following aspects of bridge design should be covered:

1. Hydrology and hydraulics of flow in rivers may be added so as to cover determination of (i) discharge of rivers based on the catchment area,
(ii) velocity of flow, (iii) waterway to be provided, (iv) afflux and (v) clearance.
2. Guidelines for determination of scour depth need to be added.
3. Navigational requirements under large bridges needed to be given.
4. Seismological requirements in bridge design need to be included.
5. Illumination of Bridge decks need to be covered.

Under Task 0110 dealing with the Consultancy Sector, we have made a recommendation that the bulk of the work of designing, project preparation, construction supervision and research studies should be got done through Consultants. This will result in the government staff strength in the SCRB will be lean and thin. The present staff strength may be adequate for assuming an overseeing role on the tasks assigned to Consultants.

6.5 Environmental Issues

The design guidelines must address environmental issues. The document should clearly indicate the following specific issues which should be addressed while preparing an Environmental Impact Assessment of any highway project.

	Parameter	Issues of Environmental Concern
1.	Water	Degradation of water quality by contamination with pollutants like kerosene, fuel, lubricants and other waste materials. Sedimentation of surface water bodies Changes in flow of surface water and ground water
2.	Soil	Soil Erosion Slope failures and landslides Loss of productive top-soil in borrow areas Sedimentation into water bodies

	Parameter	Issues of Environmental Concern
3.	Air	Generation of dust Emissions from vehicles Emissions from construction vehicles Suggested Air Quality Standards are:
4.	Ecosystem	Destruction of reproduction and food zones for fish, aquatic and migratory birds Damage to vegetation and biodiversity Harmful effect on wide life sanctuaries
5.	Landscape	Destruction of trees
6.	Community effect	Division of community Loss of source of livelihood for inhabitants Relief and Rehabilitation of Project Affected Persons
7.	Noise and Vibration	Adverse effect of noise on sensitive locations like schools, hospitals and residential areas and loss of sleep Vibration induced by vehicle movement and its adverse effect on the residents Acceptable Noise Levels in dB(A) are:

Concentration in µg/ m^3

		Suspended Particulate Matter	SO_2	NO_x	CO
A.	Industrial and Mixed Use Areas	500	120	120	5000
B.	Residential and Rural Areas	200	80	80	2000
C.	Sensitive Areas	100	30	30	1000

	Day	Night
Country Areas	40	30
Suburban Areas	45	35
Busy Urban Areas	50	35

7. QUALITY CONTROL AND SUPERVISION OF WORKS (TASK 0104)

7.1 Present Arrangement

The supervision of works and adherence to quality standards is at present done by SCRB engineers. However, for very major projects, the practice of hiring consultants to take over this task has been introduced. The selection of Consultants is reported to be based on low cost criterion. Under Task 0110, dealing with the Consultancy Sector, we have recommended that the

consultancy sector should be strengthened and we have given several suggestions in this regard. We again strongly recommend that the SCRB outsource the work of supervision of works to competent consultants.

7.2 Quality Control Manuals and Guidelines

In order to secure uniform practice of Quality Control, there is an urgent need for bringing out the following documents:

1. Handbook of Quality Control for Roads and Bridges
2. Guidelines for Quality Assurance Systems for Roads
3. Guidelines for Quality Assurance Systems for Bridges

An outline for each of the above documents is enclosed.

7.3 Quality Control Cell in SCRB

A Quality Control Cell should be set up in the SCRB, with the following functions:

1. Conduct random checks on quality of works and testing being carried out at the various work sites all over the country, and if necessary, conduct fresh tests.
2. Conduct training courses to SCRB supervision staff, NCCLR experts, contractors and consultants on various topics covering quality control, testing, acceptance/ rejection criteria and statistical aids in quality control, till Iraq Highway Training Institute in set up.

7.4 OUTLINE OF HANDBOOK ON QUALITY CONTROL FOR ROADS AND BRIDGES

1. Need for Quality Control
2. Earthwork
3. Sub-base Courses
4. Base Courses
5. Asphalt Courses

6. Concrete Pavements
7. Control of Alignment, Profile and Surface Evenness of Roads
8. Pile Foundations
9. Caisson Foundations
10. Masonry
11. Formwork
12. Structural Concrete
13. Steel Reinforcement
14. Pressurising
15. Structural Steel
16. Expansion Joints
17. Wearing Coat and Appurtenances
18. Statistical Approach to Quality Control

7.5 OUTLINE OF QUALITY ASSURANCE SYSTEMS FOR ROADS

1. Definition of Terms
2. Classes of Quality Assurance (QA)

Q_1 : Normal QA for Village Roads

Q_2 : High QA for Secondary Roads

Q_3 : Extra High QA for Primary Roads and Expressways

3. Quality Assurance Plan for
    - Project Preparation
    - Design
    - Construction
4. Quality Audit
5. Maintenance of Records

7.6 OUTLINE OF QUALITY ASSURANCE SYSTEM FOR BRIDGES

1. Definition of Terms
2. Classes of Quality Assurance (QA)

Q_1 : Normal QA for Bridges on Village Roads

Q_2 : High QA for Bridges on Secondary Roads

Q_3 : Extra High QA for Bridges on Primary Roads and Expressways

3. Quality Assurance Plan for
    - Survey and Investigations
    - Project Preparation
    - Design
    - Construction
4. Quality Audit
5. Maintenance of Records

8. PRIVATE SECTOR PARTICIPATION IN THE ROAD SECTOR (TASK 0105)

8.1 Introduction

In many developing countries, the funds available with the government for road construction and maintenance are generally inadequate since there are competing demands from other social sectors such as health, education, power, irrigation, water supply, sanitation etc. An ingenious way many developing countries have opted for to augment the resources needed for the road sector is to involve the private sector in funding the road construction and maintenance programme. Public Private Partnership (PPP), as the system is commonly referred to, can take several forms such as:

- BOT Build, Operate and Transfer
- DBFOT Design, Build, Fund, Operate and Transfer
- BOLT Build, Operate, Lease and Transfer
- Annuity Payment
- Performance Based Maintenance Contract

The private concessionaire recoups his investment through collection of toll or deferred payment.

8.2 PPP Option in Iraq

From the information supplied by SCRB, it is learnt that the PPP option is not being exercised. The Consultants strongly recommend that the SCRB introduce this innovative practice, both for new construction, or up gradation of existing roads or for maintenance.

It is gratifying to note that Iraq's National Development Plan for 2010-2014[4] has included the following as one of the means for achieving the road sector plans:

"Strengthening the private sector's role in service provision"

SCRB must take note of this strong recommendation in the country's National Development Plan for 2010-14, and try to evolve suitable models for PPP in the roads sector.

A suggested Policy Framework for the Public-Private Partnership is enclosed.

8.3 Policy Framework for Public-Private Participation (PPP) in Road Infrastructure in Iraq

1. The policy will be implemented by the Ministry of Construction and Housing (MOCH).
2. The road works to be covered shall be
   – Expressways
   – National Highways
   – Any other important road project notified by the MOCH for PPP.
3. The basic principles in identification of the projects for PPP would be that the project is part of the MOCH's plan for road development and is capable of yielding adequate financial returns by way of toll collection (user fee).
4. The MOCH will provide support by carrying out all preparatory work such as:

[4] National Development Plan (of Iraq) for the years 2010-14, from the Internet

– Feasibility Study to establish the design features, preliminary cost and financial viability
– Land for right-of-way and roadside facilities
– Relocation of utility services
– Cutting of trees
– Removal of encroachments and rehabilitation of Project Affected Persons (PPP)

5. Suitable traffic support/ guarantee will be provided on a case to case basis.
6. Exemption will be given for import duty on high quality construction plant and equipment.
7. Foreign Direct Investment (FDI) would be permitted up to 74 per cent. Beyond that proposals would be examined on a case to case basis.
8. A five year tax holiday will be allowed, followed by 30 per cent exemption and this concession can be availed of in any 10 consecutive years during the first 20 years of operation.
9. The Concession Period shall be decided on a case-to-case basis.
10. Real Estate Development can be made an integral part of the PPP project to enhance financial viability.
11. The MOCH can provide grant to cover the viability gap on a case-to-case basis.
12. The MOCH can invest up to 30 per cent of the total equity floated by an entrepreneur to develop a road project.
13. The ownership of the land for the highway and roadside facilities will continue to vest with the MOCH. Mortgaging and subleasing of this land for raising finances will not be allowed. However, land will be given on lease to the entrepreneurs.

14. Entrepreneurs will be protected against force majeure situations, including natural calamities, political and legislative changes.
15. Dispute resolution and arbitration would be governed by UNCITRAL provisions.
16. There will be a standard bidding document which will address the concerns of the various stake holders in the project.

9. ROAD VISION STATEMENT AND LONG TERM ROAD DEVELOPMENT PLAN (TASK 0106)

9.1 Transport and Economy

Transport is a key infrastructure of a country, and a country's economic status is largely governed by how well the country is served by its roads, railways, ports, air transport, inland waterways and pipelines. It has been well said that America is rich because of its good roads, and not that America's roads are good because America is rich. As a country's transport grows, the economy grows, and similarly as the economy grows the demand for transport grows.

9.2 Need for an Integrated Transport System and Transport Policy

A country's transport system consists of various modes such as roads, railways, ports, air transport, inland waterways and pipelines. Each mode has its own advantages and disadvantages. For example, Iraq with its rich oil reserves should well be served by a good system of pipelines. Of course, roads and road transport have several advantages and should receive prime attention. At the same time, other modes have their role to pay too and should not be neglected. The

development of a well-integrated multi-modal transport system should receive the country's planning priority.

Several countries have adopted a long-term National Transport Policy and prepared long-term Transport Plans. The excellent example is USA which adopted the "National Transportation Policy", contained as a preamble to the National Transportation Act of 1940[5], and reproduced below:

"It is hereby declared to be the National Transportation Policy of the Congress to provide for fair and impartial regulation of all modes of transportation subject to the provisions of the Act, so administered as to recognise and preserve the inherent advantages of each; to promote safe, adequate, economical and efficient service and foster sound economic conditions in transportation and among several carriers; to encourage the establishment and maintenance of reasonable charges for transportation service without unjust discriminations, undue preferences or advantages, or unfair or destructive competition practices; to cooperate with the several States and the duly authorised officials thereof; and to encourage fair wages and equitable working conditions, all to the end of developing, coordinating, preserving a national transportation system by water, highway and rail as well as other means, adequate to meet the demands of commerce of the United States, of the Postal Service, and of the national defence. All the provisions of this Act shall be administered and enforced with a view to carrying out the above declaration of policy".

9.3 Need for Road Development Plan

SCRB does not have a Road Vision Statement and a long-term Road Development Plan. It is strongly emphasised that the MOCH prepare a Road Vision Statement and the 20 year Road

[5] Transportation Act of 1940, United States of America

Development Plan. Iraq, however, has a National Development Plan for 2010–14[6].

The Vision Statement should clearly enunciate the Road Policy Iraq is committed to implement. It should encompass features such as:

- balanced development of all modes of transport
- provision of connectivity to all habitations so that very citizen has easy access to education, health, agricultural inputs, trade and employment
- adoption of cost-effective and sustainable road construction technology
- secure safety of all road users and bring down the current high rate of fatalities and injuries caused by road accidents
- maintenance of assets already created with timely interventions

9.4 Identification of Core Network

The Vision Document should identify the future Core Network for the country so that the hierarchy of roads gives a balanced network serving all habitations, market centres, industrial locations, educational centres, health facilities and other modes of transport (railways, water transport, air transport).

9.5 Review of Different Country's Transportation Plan

Several countries and regions of a country have prepared Long-Term Vision Document and Long-Term Transportation Plans. The Consultants have reviewed the documents available from:

1. New South Wales, Australia
2. Jamaica
3. United States of America
4. India
5. South Africa

[6] National Development Plan (of Iraq) for the years 2010-14, from the Internet

9.5.1 New South Wales, Australia

The New South Wales (NSW) (Australia) vision for transport for the next 20 years[7] is as under:

- To put the customer first by ensuring that the transport system is designed around the needs and expectations of the customer.
- To ensure that the transport system of the future is fully integrated by ensuring that the planning, policy and regulation occur in one place.
- To grow patronage on public transport by making it a more attractive choice.
- To maintain and improve a network of smooth-flowing roads in metropolitan, regional and rural NSW.
- To enable the transport system to support the economic development of the state with a particular focus on improving the coordination of freight-traffic
- To promote coordination and integration across all transport modes and all stages of decision making.
- To provide clean, reliable, safe and integrated transport services.
- To ensure that the transport system of the future will be strategic and multi-modal, serving the needs of all customers whatever the purpose of their journey.

9.5.2 Jamaica

Jamaica's Draft Final National Transport Policy[8] has the following Vision Statement.

Sustainable, competitive, safe, accessible and environmentally friendly transport network providing world class Air, Land, Rail and Marine facilities contributing to a

[7] New Long Term Transport Master Plan, Govt. of New South Wales, Australia, 2012

[8] Final Draft National Transport Policy, Govt. of Jamaica, from the Internet

vibrant import, export and transhipment trade for Jamaica and the world.

The key priorities of the Jamaican Transport Policy are:

- encourage greater private sector participation
- improve inter-agency coordination in inter-modal transport
- have users contribute towards the costs of transport services
- facilitate access to subsidies for the provision of transport services to the vulnerable in society
- create policy awareness and further participation in policy development
- improve coordination of transport policy, planning appraisal and implementation across modes
- ensure safety of transport and services
- support reduction of fuel imports

9.5.3 United States of America

The United States of America (USA) have adopted an Act known as MAP-21, Moving Ahead for Progress in the 21st Century[9]. Under this Act, the summary of highway provisions is given below:

- MAP-21 expands the National Highway System (NHS) to incorporate arterials not previously included. Investments targets the enhanced NHS with more than half of highway financing to the new programme to preserving and improving the most important highways–the National Highways Performance Programme.
- Establishes a Performance-based Highway Investment Programme.
- Creates jobs and supports economic growth.
- Supports an aggressive safety programme.

[9] MAP-21, Moving Ahead for Progress in the 21st Century–A Summary of Highway Provisions, Federal Highway Administration

- Accelerates project delivery and promotes innovation.
- Tolling is recognised as a means of augmenting resources for the highways sector.
- The Highway Trust Fund (HTF), created from fuel taxes, is recognised as an important source of funding the MAP-21 programmes.
- Research, Technology Deployment, Training and Education are important components of MAP-21.

Federal role in transportation in the USA in the past 70 years has been:

- provision of capital funding for a national network of high capacity, high-speed highways linking urban areas and regions of the country
- emphasis has been on human mobility by personal motor vehicles and freight by trucks
- expansion of highways for the purpose of congestion mitigation

9.5.4 India

India has prepared the following documents dealing with long-term road plans:

1. Road Development Plan, Vision : 2021[10]
2. Rural Road Development Plan : Vision 2025[11]

The major objectives of overall transport policy and road development outlined are:

- adequate transport capacity to match the projected demand
- adequate rural road network to provide connectivity to all villages for rural development

[10] Road Development Plan, Vision : 2021, Ministry of Road Transport & Highways, India 2001

[11] Rural Road Development Plan : Vision 2025, Ministry of Rural Development, India 2007

- technological up gradation and modernisation of transport equipment for capacity augmentation and productivity improvement
- adequate and timely maintenance
- optimal inter-modal mix
- emphasis on safety, energy efficiency and environment protection
- careful attention to be given to the preservation of assets

9.5.5 South Africa

The National Department of Transport, South Africa has prepared a Rural Transport Strategy[12]. With 50% of the population of the country living in rural areas, the strategy has the following thrusts:

- promotion of coordinated rural nodal and linkage development
- developing demand-responsive, balanced and sustainable rural transport system
- investment in rural access roads to meet the above objective

From the foregoing analysis, it is very obvious that a country must have a vision statement for road development on a long-term basis. This is sadly lacking in Iraq. The Consultants strongly urge the SCRB to take steps to enunciate the Vision Statement and prepare a long term, 20 year plan for the development of the road infrastructure.

9.5.6 Share of countries with Road Policy and Vision Statement

[12] Rural Road Transport Strategy for South Africa, National Department of Transport, 2003

It is reported that many countries in South Asia have road policies and vision statements in place (Ref. 13). The situation is as under:

		Percentage of countries having
1.	Road Policy	60
2.	Investment Plan and Road Master Plan	20
3.	Vision Document	20
4.	Annual Reports	40
5.	Are any of these published regularly?	60

9.6 Review of National Development Plan, Iraq

Iraq's 2010-14 National Development Plan 2010-14[13] has clearly brought out the issues that need to be addressed, as reproduced below:

9.6.1 Problems and challenges facing road and bridge activities:

1. Most cargo is transported over the road network, as opposed to the railway system, thereby applying significant pressure on the network and contributing to its deterioration.
2. There is no control over loads and vehicle axle weights which leads to destruction of the road network.
3. There are few connecting roads between provinces and cities.
4. There are few circular and bypass roads in the cities.
5. There are problems acquiring rights of way, including the objections of owners, rural inhabitants, and farmers.
6. There is a need for significant investments to rehabilitate and construct new projects.

[13] National Development Plan (of Iraq) for the years 2010-14, from the Internet

7. The quality control system is weak.
8. Same-level railroad crossings, contributing to traffic and congestion, are prevalent.

9.7 Vision for Road and Bridge Activities

Iraq will have a road network with a balanced hierarchy that integrates with the other transportation systems while ensuring reduced travel time and cost, greater security, and reduced negative environmental impacts.

9.7.1 Objectives

The objectives for road and bridge activities during the plan period focus on two axes.

1. The first axis consists of:
   - Improving the condition of the current road network by repairing existing roads and reconstructing bridges affected by the war, military operations, and sabotage, as well as installing instructional, directional, and warning signs
   - Performing periodic maintenance on the existing road and bridge network, using modern and advanced techniques that would more quickly and economically implement repair and maintenance procedure, including the cold in-place asphalt pavement recycling technology recently approved in Iraq.

2. The second axis consists of increasing the network's capacity and its level of user safety and security, and protecting it from damage, by:
   - Completing the remaining portions of highways previously constructed, and completing links between these roads and city centers that had not yet been linked thereto
   - Constructing new highways, particularly Highway No. 2, to link urban centers and complete the link between Iraq and neigh boring countries that have not been linked by highways to date

- Continuing to construct secondary lanes on arterial roads and one-lane roads, particularly those that have reached maximum capacity
- Expanding construction of crossroads among the provinces, thereby reducing travel time
- Expanding construction of bypass roads that reduce congestion in cities and limit entry of through-traffic to city centers
- Continuing to implement the plans' remaining stages to replace floating bridges with fixed bridges
- Continuing to eliminate railroad crossings
- Furnishing outer roads with instructional, directional, and warning signs
- Protecting the road network from excessive weight by constructing weigh stations to detect and deter vehicle weights and axle loads that exceed the allowable limits
- Continuing the program of constructing rural roads and increasing their reach to serve the greatest number of rural villages and agricultural projects and ensure their connection of agricultural production centres with markets.

9.7.2 Means of Achieving the Objectives:

1. Directing investments in a manner commensurate with the importance and social and economic role of road and bridge activity to ensure rehabilitation of damaged roads and bridges, and constructing all types of new roads, including highways, arterials, secondary roads, and rural roads
2. Developing railroad transportation to reduce the volume of cargo transported over the roads
3. Passing new laws or amending current laws to impose tolls for use of main roads, arterials, and bridges to ensure appropriate funding for periodic and continuous road and bridge maintenance

4. Improving quality control during road and bridge work by providing necessary and sufficient laboratories to run the tests associated the work. Controlling vehicle weight and axle loads on existing road and bridge projects by constructing weigh stations.
5. Introducing modern and cost-effective technologies to repair and maintain roads, and providing means for their success
6. Strengthening the private sector's role in service provision.

10. PERFORMANCE OF SCRB IN THE PAST (TASK 0107)

10.1 Main functions of SCRB

In Chapter 4, the main functions of SCRB (which was set up in 1987) were listed. These are:

1. Preparation of Feasibility Studies for Roads, Bridges, Tunnels and Interchanges
2. Designing public road projects including Expressways
3. Execution of works, including supervision and monitoring of progress
4. Maintenance of works
5. Emergency maintenance and repair of roads and bridges
6. Acquisition of land, protection of right-of-way and prevention of encroachment

10.2 Assessment of Performance

SCRB has earmarked the staff for carrying out the tasks outlined above both in the headquarters and in the Governorates. However, the Consultants have come to the conclusion that the SCRB's functioning could be improved by

overcoming shortages in manpower quality and other facilities. The Consultants are of the opinion that the staff strength of SCRB should be kept lean and thin, and the organisation should function as the apex body of road and bridge experts, should frame long-term plans, policies, standards and guidelines and it should be the repository of Iraq's knowledge base in the roads sector.

It should outsource tasks such as survey and investigations, preparation of designs, preparation of tender documents and supervision of works to competent consultants.

It should augment its capabilities in the fields of data management of assets and use of reputed design software's for roads and bridges. Full computerisation of functions should be achieved. In Section 4.11 we have listed some of the software's that should be acquired by SCRB.

We have elsewhere drawn attention to the need to update the skills of the engineers by sending them to obtain higher qualifications from reputed institutions abroad, to participate in international conferences and seminars and to increase the proficiency over English language. We have recommended the establishment of an Iraq Highway Training Institute (IHTI) in Section 4.10.

11. RESEARCH & DEVELOPMENT (R&D) (TASK 0108)

11. 1 Background

It is noted that R&D in the highway and bridge sector is a neglected activity in Iraq, perhaps because the country had to face wars and internal security problems. Now, SCRB must undertake R&D activities. To begin with, the effort can be on a modest scale, and the effort can be up scaled in due course.

11.2 Research and Development Plan

A 20 year R&D plan should be prepared, clearly identifying the thrust areas. The National Centre for Construction Laboratories and Research (NCCLR) is ideally equipped to

perform a key role in this field. The branches of the NCCLR in the provinces and districts can provide a good support to the central laboratory. Some of the topics that are suggested for the long-term R&D plan are given below:

11.2.1 Highway Planning

- To prepare a long-term master plan to achieve full connectivity to all villages
- To carry out a Highway Cost Allocation Study to encourage user charge principles in cost recovery of main roads
- To carry out a Road User Cost Study to quantify the
  - Vehicle Operating Cost
  - Time value of occupants of vehicles
  - Accident Cost

11.2.2 Traffic Engineering

- To evolve a Highway Capacity Manual for conditions on Iraq Roads
- To identify Road Accident Black Spots and evolve measures to remedy the situation
- To frame guidelines for the design of grade separated interchanges

11.2.3 Pavement Design

- To study the application of SHRP findings to conditions in Iraq
- To evolve a pavement design methodology for Iraq roads keeping in view the prevalence of excessive overloading
- To study the introduction of Polymer Modified Bitumen for Iraq conditions

11.2.4 Maintenance

- To evolve mobile maintenance equipment for pavement maintenance

- To evolve the use of cold mix technology and warm asphalt mixes for roads in Iraq
- To evolve a Pavement Management System and Bridge Maintenance System for Iraq.

12. CONTRACTING INDUSTRY (TASK 0109)

12.1 Existing Scenario

Iraq has a huge backlog of road improvement programmes and maintenance of assets, particularly because of the damages caused by war and concerns on internal security. Since the country is now getting free from these concerns, the field is set for initiating a major road building and asset management programme. One of the problems that can stand in the way of achieving the targets is the unpreparedness of the contracting industry. It is already noticed that the budgetary funds allotted for maintenance are not utilised fully because the contractors are not geared to take up these works. When such is the situation now, the grand plans for road development and maintenance the country has for the coming years can be seriously affected if the contractors are not able to rise to the occasion and take up the challenges.

The Consultants have given serious thought to help the country build a healthy and robust contracting industry, which can not only take up works within the country but can take up works in the neighbouring friendly countries. Some of the suggestions in this direction are detailed below.

12.2 Adoption of International Competitive Bidding (ICB)

Modernisation of the contracting industry can be speeded up if large works are identified and thrown open for ICB adopting the FIDIC conditions of contract. International players from countries such as Japan, China, India, Australia, USA, UK, Sweden, Spain, France, Germany and several others will be encouraged to bid for such works, with collaboration with Iraqi

counterparts. This will facilitate the induction of latest equipment and technology and give exposure to the country's engineers to modern trends in highway and bridge construction and maintenance. The use of latest equipment will give an incentive to the equipment suppliers to set up equipment manufacturing units in Iraq itself. India's example in this area is worthy of emulation. When India opted for World Bank funding and ICB, its contracting industry and equipment manufacturing industry got a major boost, and the country can now boast of a healthy contracting industry capable of taking up the large highway and bridge works not only within the country but abroad.

12.3 Incentives to local Contractors

SCRB can offer the following incentives to Contractors for developing a healthy Contracting industry:

1. Enable contractors to procure modern equipment by giving them advances
2. Give tax concessions to the import of modern equipment
3. Enable contractors to procure equipment on hire or lease from reputed equipment holding companies by suitably modifying the criteria for pre-qualification
4. Create facilities for training of foremen/ operators of equipment
5. Create facilities for training of senior staff in project management, quality assurance
6. Introduce a system of bidding under a two-cover system, as under:-

Cover No. 1 : Eliciting information on the financial status, equipment held/ hired/ leased, works in hand, works of similar nature recently executed, and evolving a system of marking for each individual attributes.

Cover No. 2 : Financial Bid

The financial bids (Cover No. 2) of only those Contractors will be opened who secure minimum qualifying marks under Cover 1.

7. Maintaining a list of Contractors who have been judged eligible for bidding for contracts of various values, and updating the list periodically.

8. Prompt payment to Contractors

The Contract should ensure that bills raised by the Contractors and verified by the Engineer are promptly paid.

9. Dispute Resolution Mechanism

A system of Arbitration for settling disputes between the Employer and the Contractor should be put in place. The UNCITRAL provisions can be utilised for this purpose.

13. CONSULTANCY SECTOR (TASK 0110)

13.1 Existing Scenario

In the SCRB, the tasks of planning, design and supervision of works have been traditionally performed by the in-house engineers. While this procedure has worked well so far, with the proposed large-scale road improvement and asset management programme the country has decided to implement in the future, the capacity of the in-house engineers will not be sufficient to handle the complex and large tasks. Most of the countries have found that outsourcing such tasks to private consultancy firms will have several benefits such as:

- bringing in latest technology
- delivery of tasks on time
- financially attractive, when compared to the salaries paid to the in-house engineers and their output

The Consultants have noted that the consultancy sector in Iraq is in a formative stage and has a great potential to develop as a pillar of strength to SCRB in the discharge of its assigned tasks.

13.2 Areas where consultancy can be beneficial

Consultancy can be beneficial in the following areas of performance by SCRB:

1. **Pre-Construction Stage**
    - Strategic Options Study and Identification of projects for implementation along with their priority
    - Traffic Studies (Volume Counts, Origin-Destination Studies, Axle Load Studies)
    - Feasibility Studies of highway and bridge projects
    - Detailed Project Reports, including designs, estimates, tender documents and specifications.
2. **Research Studies**
    - Preparation of Vision Document and Long-term Road Development Plan
    - Study of Accident Black Spots and Measures to improve safety
    - Safety Audit
    - Preparation of Manuals, Guidelines and Standard Bidding Documents
    - Study of Vehicle Operating Costs of Vehicles
    - Accident Costing
    - Institutional Strengthening
    - Assessing Training Needs
3. **Construction Stage of Projects**
    - Construction Supervision and Project Management
    - Proof checking of designs
    - Quality Management and Quality Audit
4. **Post-Construction Stage**
    - Project Review and Documentation
    - Performance Monitoring of projects after construction

13.3 Some suggestions to build a healthy Consultancy Sector

The SCRB should maintain and periodically update a list of eligible consultants in the fields of:

- Highway Engineering
- Surveying
- Sub-soil investigations and testing
- Bridge Engineering
- Transport Planning
- Traffic Engineering
- Environmental Engineering

International consultancy firms should be encouraged to have tie-ups with the local consultancy firms, and this cooperation will expose the local experts to international trends and techniques. In the long run, Iraqi consultancy firms can bid for assignments in the friendly neighbouring countries and become leaders in this sector in the Mid-East region.

For important projects, such as major bridges, complex interchange system, consultancy firms can be asked to prepare innovative designs (such as cable-stayed bridges, segmental construction etc.) on a competitive basis.

14. MAINTENANCE OF ROAD ASSETS (TASK 0111)

14.1 Fund Allocation

The funds for maintenance of roads allocated for the year 2012 are 135 milliard Dinar, or roughly 71.7 million US $. If this amount is spread over the SCRB road network of 13,603 Km, the maintenance funds earmarked for maintenance of roads works out to US $ 5271 per Km of road. This presently includes:

(i) Routine repairs like pothole repairs, patching, sealing cracks, maintaining earthwork, drainage structures and bridges.

(ii) Periodic renewals of asphalt surfaces to restore the riding quality.

(iii) Asphalt overlays to strengthen and rehabilitate weak pavements.

(iv) Special repairs to damaged bridges.

(v) With the above tasks to be undertaken to keep the road assets in a good condition, the allotment of funds for maintenance is too meagre.

The funds allocated for road projects by SCRB for the year 2010 are:

1.	On-going Projects	306,329,000	thousand Dinars
2.	New Projects	27,000,000	thousand Dinars
	Total	333,329,000	thousand Dinars
	For Maintenance	150,000,000	Dinars

Thus, the funds for maintenance are 0.045 per cent of funds for road construction.

This is too meagre. For example, India spent the following amounts on National Highways in 2011-12:

Original Works	:	Indian Rupees	324570 (million)
Maintenance	:	Indian Rupees	15720 (million)

Thus the funds for maintenance are 4 per cent of the funds for road construction.

Thus, it is obvious that maintenance is a grossly neglected activity in Iraq. SCRB must take action to increase the allocation for road maintenance in the coming years.

It may also be noted that even the meagre funds allocated for maintenance includes items such as overlaying, improving and widening of roads. These activities are of the nature of original works and are not strictly maintenance works.

14.2 Condition of Road and Bridges

Some of the roads in Iraq are in a good condition; possibly because of they were constructed or rehabilitated recently. The following photographs show some roads in a good condition:

Photo 1

Photo 2

Photo 3

In contrast, condition of roads and bridges is apparently very bad in certain sections as seen from the following photographs:

Photo 4

Photo 5

Photo 6

Photo 7

Photo 8

Photo 9

Photo 10

Photo 11

Photo 12

In Photos 8 and 10 a portion of the pavement has settled by nearly 10 cm, making it dangerous for traffic. In Photo 12, it is seen that the rut depth is about 10 cm.

These photos lead to the following inferences:

1. The quality of initial construction was sub-standard
2. There was severe overloading
3. Preventive maintenance was lacking.

14.3 Maintenance Manual

14.3.1 Road Maintenance

Road maintenance operations involve several steps:

1. Periodic inspections and condition survey
2. Assessment of maintenance needs
    - Pothole filling
    - Crack repairs
    - Patch repairs
    - Renewal of surface
    - Providing overlay
    - Recycling of pavements
    - Reconstruction of badly damaged sections
3. Providing adequate funds for maintenance
4. Carrying out maintenance operations either departmentally or through contract.

A comprehensive maintenance manual needs to be prepared and adopted by the SCRB, covering all the above aspects. An outline of the Maintenance Manual is enclosed.

Photos 13-20 give pictures of the badly damaged bridges. Some of the photos show that the structure can collapse at any time without giving any notice, leading to serious loss of lives and property. Timely inspection of bridges could have identified the distress at the right time and would have led to restoration measures which could have prolonged the life of the structures. There is an urgent need to have a Maintenance Manual for Bridges. An outline is enclosed.

Photo 13

Photo 14

Photo 15

Photo 16

Photo 17

Photo 18

Photo 19

Photo 20

14.3.2 Manual and Guidelines

Several countries and organisations have detailed Manuals and Guidelines on Maintenance of Roads and Bridges. Some of these are listed below:

1. Australia : Highway Maintenance Handbook, AUSTROADS, Sydney, 1990
2. U.K. : 1. Maintenance Management for District Engineers, Overseas Note No. 1, Transport and Road Research Laboratory, Crowthorne, England, 1981.
   2. Maintenance Techniques for District Engineers, Overseas Note No. 2, Transport and Road Research Laboratory, Crowthorne, England, 1985.

3.	PIARC	:	International Road Maintenance Handbook, – Maintenance of Paved Roads – Maintenance of Unpaved Roads – Maintenance of Roadside Areas, Paris, 1982.
4.	OECD	:	Road Monitoring for Maintenance Management, Manual for Developing Countries and Damage Catalogue for Developing Countries, Paris, 1990.
5.	South Africa	:	Routine Road Maintenance Manual, South African National Road Agency, Pretoria, South Africa, 2000.
6.	USA	:	AASHTO Guidelines for Pavement Management Systems, Washington D.C, 1990.
7.	India	:	1. Guidelines for Maintenance Management of Primary, Secondary and Urban Roads, Indian Roads Congress, New Delhi, 2004. 2. Ministry of Shipping and Transport (Roads Wing), Manual for Maintenance of Roads, published by the Indian Roads Congress, New Delhi, 1989. 3. Guidelines for Inspection and Maintenance of Bridges, IRC: SP: 35, Indian Roads Congress, New Delhi, 1990.

14.4 New Technology for Maintenance

It is recognised all over the world that maintenance operations of bituminous pavements can be greatly facilitated by the use of emulsion-based recipes and cold-mix technology. The following are some of the specifications that will be of great help in maintaining bituminous pavements and prolonging their life, besides being environmentally friendly:

1. Micro-surfacing
2. Slurry Seal
3. Fog Seal
4. Emulsion based cold mix, which is storable
5. Cold recycling
6. Hot recycling

The SCRB Book of Specifications (Revised in 2007) does not include the above items. The Book also does not cover maintenance operations of pavements, earthwork, structures and traffic engineering aids like road markings, road signs, guard rails and signals.

Iraq's National Development Plan for the years 2010-14 (Ref 3) has the following to state as one of the objectives of the Transport Sector:

"Performing periodic maintenance on the existing road and bridge network, using modern and advance techniques that would more quickly and economically implement repair and maintenance procedure, including the cold in-place asphalt pavement recycling technology recently approved in Iraq".

The Consultants strongly endorse the above objective which should be implemented by the SCRB.

14.5 Amounts allocated for Maintenance and Actual Expenditure

Table enclosed shows the funds allocated for maintenance, the amount spent, the percentage achievement and reasons for shortfall.

Year	Funds Allotted (Milliard ID)	Actual Expenditure (Milliard ID)	Per Cent Achieved	Reasons for Shortfall
2003	5.9	1.2	21	War
2004	16.0	16.0	100	–
2005	30.0	18.8	63	Delay by Contractors
2006	28.0	8.9	32	Security situation in the country
2007	37.4	28.7	77	Security situation in the country
2008	68.0	68.0	100	–
2009	74.7	74.6	100	–
2010	145.8	53.2	37	Delay in budget allocation by the Government
2011	132.3	106.7	81	Delay by Contractors

It is seen that, apart from the reasons of war and security concerns in the early years, the reasons for the shortfall in the expenditure against funds allotted are:

1. Delay in budget allocation by the Government
2. Delay by the Contractors

The SCRB must take steps to ensure that the requirement of funds for the next year is communicated to the Ministry of

Finance well in advance, substantiating the demand by the backlog in maintenance and how the minimum amount has been worked out:

It is also clear that the Contracting industry is not geared to take up the work, and cannot complete the works planned for the year and utilise the funds. The following suggestions are made to overcome the present deficiency:

- Strengthen the Contracting Industry by offering several incentives which have been detailed out under Task 0109.
- Introduce Output and Performance Based Maintenance Contracts as detailed out in the enclosure. A brief write-up is enclosed.

14.6 MANUAL FOR MAINTENANCE OF ROADS

1. Basic Maintenance Objectives and Policies
2. Definition of terms
3. Inventory of Road
4. Condition Surveys
5. Programming and Plan
6. Annual Calendar of Road Maintenance Activities
7. Inspection
    - Frequency
    - Duties
    - Identification of Defects
8. Criteria for Periodic Renewal of Surface
9. Safety during Maintenance Operations
10. Mechanisation and Mobile Maintenance Units
11. Training of Maintenance Staff
12. Model Contract Document
13. Performance-Based Maintenance Contracts
14. Specifications for items of maintenance works

14.7 MANUAL FOR MAINTENANCE OF BRIDGES

1. Inspection of Bridges
    - Inventory of Bridges

- Routine Inspection
- Detailed Inspection
- Inspection Procedure
  - Foundation
  - Abutments
  - Wing Walls/ returns
  - Piers
  - Columns and Bearings
  - Soffits of the deck
  - Condition of road surface, drainage, parapets
  - Expansion joints
  - Approaches
  - Protective works
- Underwater Inspection
- Use of Bridge Inspection Units

2. Maintenance Techniques
   - Use of polymer/epoxy mortar and concrete
   - Use of cement grout or synthetic resin
   - Painting of steel members
   - Anti-corrosion protection
   - Waterproofing of decks
   - Repair of gullies, channels, discharge pipes
   - Repairs to pitching of protective works
   - Replacement of damaged structural member
3. Planning and Budgeting of Maintenance
4. Introducing Bridge Management System

14.8 A BRIEF DESCRIPTION OF OUTPUT AND PERFORMANCE BASED ROAD MAINTENANCE CONTRACT (OPRC)

14.8.1 Traditional road maintenance contracts

In the traditional road maintenance contract, the Road Authority defines the scope of work by preparing a Bill of Quantities (BOQ) for various items of work such as:

- Pot-hole filling

- Crack filling
- Patch Repairs
- Surface Renewals
- Overlays
- Earthwork in shoulders and slopes of embankment
- Painting road markings
- Maintaining Road Signs
- Repairs to bridge components

The Contractor is selected on the basis of his quoted rates for the above defined items of work. He executes the work in conformity with the specifications for the various items of work. It has been observed that the traditional road contract system leads to sub-optimal results because:

- Deficiencies in the original design
- Contractor's desire to carry out the maximum amount of works, in order to maximise his profits.

14.8.2 Basic features of OPRC

In the OPRC, the contract covers several years (10 years or more) during which period the Contractor is expected to ensure that the physical condition of the road assets are adequate for the needs of the road users. This type of contract significantly expands the role of the private sector from simple execution of works to the management and preservation of road assets. The bidders compete among themselves by essentially proposing a fixed lump-sum price for bringing the road to a certain level initially and maintaining it at that level for the entire contract period. The Contractor is thus not paid directly for the "inputs" or physical works (which he will certainly have to carry out) but for achieving specified Service Levels, i.e. rehabilitation of the distressed road to pre-determined standards, the maintenance and operation of the road ensuring certain Service Levels and specific improvements, all represented in outputs or outcomes, expressed in Service Level criteria. A lump-sum periodic payment is made to the Contractor to cover all his physical,

technical and managerial services provided by him, except for unforeseen emergency works which are paid for separately. In order to be entitled to these periodic payments, the Contractor must ensure that the road assets comply with the Service Levels prescribed in the bid document. It is possible that during the initial period he will have to carry out a large amount of work in order to firstly bring up the road to the prescribed standards, and if he complies with the requirement well initially, his effort in maintaining the asset for the full contract period will be minimised.

Under the OPRC, the Contractor has strong incentives to innovate and introduce new design concepts and new technology, design the facility to optimal condition and provide the best managerial inputs. It establishes a long-term Public-Private Partnership (PPP), under which both the Contractor and the Government have long-term goals and commitments.

The World Bank has come out with a Sample Bidding Document under OPRC[14]. The performance criteria in the documents are:

Road User Service and Comfort measures, such as:

- Road Roughness
- Road and lane width
- Rutting
- Skid resistance
- Vegetation control
- Visibility of road signs and markings
- Availability of each lane-Km for use by traffic
- Integrity and soundness of structures
- Response times to rectify defects that compromise the safety of road users
- Incidence management (attendance at road accidents)
- Drainage

[14] Sample Bidding Documents, Procurement of Works and Services under Output-and Performance based Road Contracts and Sample Specifications, The World Bank, Washington D.C., 2006

Road Durability, measures, which can be expressed in terms such as:

- Longitudinal profile
- Pavement strength
- The extent of repairs permissible before a more extensive periodic maintenance treatment is required
- Degree of sedimentation in drainage facilities

Management Performance Measures, which define the Road Authority, requires to govern the asset during the term of the contract, and to facilitate the next tender round.
Requirements should include:

- Delivery of regular progress reports to the Road Controlling Authority
- Inventory Updates and other data sharing requirements
- Maintenance history (so that subsequent tenderers can price the work).

15. FINANCIAL CAPACITY ASSESSMENT (TASK 0112)

The SCRB, in its planning and design department, collects information from the governorates about the projects in hand; the funds needed for the next year, and prepares the request for the next year's budgets. The monthly physical and financial progress reports are compiled and compared to the planned targets. Software like Microsoft Project and Primavera are available in the department, but they are not used widely.
The Consultants are of the opinion that the section dealing with the financial and audit should be given training in the concepts of CPM and PERT and the use of Microsoft Project and Primavera should be made compulsory.

16. RECOMMENDATIONS

16.1 SCRB Technical Manpower

SCRB has a challenging task of rehabilitating the modernising its road infrastructure in the coming years. The success will depend upon the availability of the best technical manpower

within the organisation. It is strongly recommended that SCRB attract the best talent of young Civil Engineers by holding a competitive examination, offering an attractive salary structure and career advancement.

16.2 Training

An Iraq Highway Training Institute should be established in Baghdad for imparting training at various levels to the SCRB engineers, engineers from the Consultancy Sector and Contracting Industry and foremen, operators and skilled labour.

16.3 Long-term Road Development Plan and Vision Document

The SCRB should adopt a Vision Document clearly enunciating the goals and policies it envisages to adopt. A 20-year long-term road development plan should be prepared, setting out the long-term proposals and phasing them into five-year packages.

16.4 Updating Design Guidelines and Manuals

The present design guidelines for roads and bridges need to be reviewed and updated as indicated in Chapter 6. Particularly, new Manuals on Quality Control and Quality Assurance, Maintenance of Roads and Bridges and Environmental Impact Assessment of Road Projects should be prepared. The work can be entrusted to reputed International Consultants.

16.5 Public-private Partnership (PPP)

Since funds for road construction and maintenance will be always limited, it is desirable to augment the same by involving private investments and awarding the road contracts on a Build-Operate-Transfer (BOT) basis or some such similar pattern. For road maintenance, an Output and Performance Based Road Maintenance Contract (OPRMC) document should

be prepared. A model document has been prepared by the Consultants and has been sent separately.

16.6 Consultancy Sector

A healthy consultancy Sector is very badly needed in Iraq to design and supervise the various road projects. Suggestions in this regard have been made in Chapter 13.

16.7 Contracting Industry

The Contracting Industry in Iraq needs to be strengthened to undertake the large programme of works. Suggestions in this regard have been made in Chapter 12.

16.8 Equipment

Laboratory and field testing equipment and facilities in the NCCLR need to be up scaled and new equipment not available at present need to be acquired. Suggestions in this regard have been made in Chapter 5.

16.9 Axle Load Policy

The permissible axle load in Iraq is BT, which is very high compared to standards in other countries. Thus, the road pavements in Iraq have to make extra strong to withstand the damage caused by heavy axles. It is also necessary to check violation of this already high axle load by overloaded vehicles. Though weigh bridges are installed at various locations, a very strict checking of overloaded vehicles is necessary, with stringent punitive action.

16.10 Road Safety

The road accident fatality rate in Iraq is very high when compared to other countries. Strong and effective measures (Engineering, Enforcement and Education) are needed to bring down the accident rate.

16.11 Road Density

As indicated in Chapter 3, the road density in Iraq is very low, when compared to other countries. Efforts should be made to give connectivity to all villagers and habitations in the coming years.

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