3.3.2 Planning of the Project

(1) Factors Determining Workshop Size

The GCRB currently has 1,550 construction machines and vehicles throughout the country as shown in Table 3-2, of which 1,040 are distributed in north Yemen with Sana'a acting as the nerve centre. The number of estimated operable construction machines, heavy vehicles and light vehicles in five years' time are shown in Table 3-3 taking the likely number of scrapped and newly procured items in these five years into consideration.

The optimal size of the construction machinery workshop, which will act as a model workshop in Yemen for the future, must be decided based on the following factors.

1) Number of operating construction machines in the northern region

2) Number of operating machines/vehicles by type

3) Annual number of working days and hours

4) Working conditions

5) Conditions of on-site maintenance

6) Size and quality of workforce at the workshop

7) Scope of repair work to be conducted by the workshop

8) Contents of repair tools and equipment

After careful examination of the implications of the above factors, the following scope of work, facilities and equipment are considered suitable for the planned workshop.

1) The subject machinery for the maintenance and repair services to be provided by the workshop is that currently in operation in the northern region. (Since the workshop is planned to be of medium size, approximately one-third of the machinery in operation will be actually served.)

2) The maintenance and repair services will extend to both heavy and light vehicles.

3) Full-scale services, including overhauling, will be provided.

Table 3-2 DETAIL DEPLOYMENT OF GCRB EQUIPMENT

DATE : 92.5.5

RER MAP CODE	LOCATION / WORK SITE	WORK ACTIVITY TYPE	HERVY EARTH WORK-ROAD CONSTRUCTION MACHINES																			TRANSPORT AND LIGHT DUTY MACHINES										GENERAL SERVICE AND CAMP EQUIPMENT												TOTAL
			DOZERES	GRADERS	LOADERS	ROAD ROLLERS	SWEEPERS	CRUSHERS	SCREENS	JACK HAMMERS	WAGON DRILLS	COMPRESSORS	ASPHALT PLANT	ASPHALT MIXER	BASE MIXERS	CONCRETE MIXER	ASPHALT PAVERS	ASPHALT BURNER	EXCAVATORS	CRANE	FORKLIFTS	TRUCK W/WINCH	DUMP TRUCKS	TRUCKS TRACTOR	LORRIES	WATER TANKER	ASPHALT C. TRUCK	FUEL T TRUCKS	BUS	SMALL CARS	TRUCK W. SHOVEL	TRAILERS	WATER PUMS	GENARATORS	GREHSE TRUCKS	WORK SHOPS	ASPALT CUTING	TYRE INF. COMP	STEAM CLEANER	BAT. CHARGER	BLASTING M/C	TYRE NUMB. MACH	FUEL ST. PUMPS	WELDING SET	ROAD MARKING M/C	
1-B	HEAD OFFICE		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	2	32	-	-	-	-	-	-	-	-	-	-	-	-	-	-	35
1-B	WORK SHOP		71	33	27	33	-	-	-	23	1	29	-	-	-	-	2	3	1	1	2	1	46	11	4	14	-	3	6	85	-	7	9	29	1	1	-	3	1	1	-	1	4	5	-	458
1-B	STORES		18	14	7	14	3	-	1	-	-	8	-	6	-	-	3	3	1	-	2	-	19	-	-	1	2	-	-	15	-	3	-	1	-	1	1	-	-	-	-	1	-	-	1	125
1-B	QUARRY SITE (NUGUM)	REGIONAL BRANCHS	-	-	2	2	-	1	-	-	-	-	1	-	-	2	-	3	-	1	2	-	1	1	-	1	-	-	-	1	-	1	-	-	-	-	-	-	-	-	-	-	3	-	22
2-B	TAIZ R		5	2	2	2	-	-	-	3	-	5	-	-	-	1	-	1	-	1	-	-	4	1	1	1	3	1	-	15	-	-	-	3	-	-	2	-	1	1	-	-	2	-	57
2-B	TAIZ TRAINING CENTER		1	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	2	2	-	-	-	2	-	-	-	-	-	-	-	-	3	-	15
3-B	HODEIDAH		5	3	2	2	-	1	-	2	-	3	-	1	-	-	-	1	-	3	1	-	10	1	-	4	2	-	2	9	-	2	4	10	2	-	-	2	1	2	1	1	2	2	2	83
4-B	IBB		3	3	3	3	-	-	-	2	-	1	-	1	-	2	-	1	-	-	-	1	2	-	1	-	-	1	1	5	1	3	1	3	1	-	1	1	1	1	1	-	3	3	-	50
5-B	RADA'		5	2	2	3	-	-	-	6	1	3	-	-	-	-	-	-	-	-	-	-	3	-	2	2	-	-	-	9	-	-	2	4	1	1	1	-	-	1	1	-	1	3	-	53
6-B	ADEN		1	3	1	1	1	-	-	-	-	1	-	-	-	-	1	1	-	-	-	1	1	-	-	-	1	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	14
3-P	HARAD - HUTH		18	4	5	3	1	2	2	10	2	4	1	-	1	-	-	-	1	1	-	-	19	1	1	5	-	1	1	17	-	1	5	4	1	-	-	-	-	-	2	-	-	1	-	114
2-P	HARAD - SA'ADA		11	1	-	2	-	-	-	9	2	4	-	-	-	-	-	-	-	-	-	1	-	-	-	2	-	1	1	11	-	2	5	2	1	2	-	1	-	1	1	-	2	1	-	63
1-P	SA'AD - HARD	CONSTRUCTION	3	1	-	-	-	-	-	4	-	2	-	-	-	-	-	-	-	-	-	-	1	-	-	2	-	-	-	2	-	-	-	-	-	-	-	-	-	-	1	-	-	-	16
5-P	ALUDEIN - AL - JARAHI	PROJECTS	6	-	-	-	-	-	-	2	1	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	5	-	-	-	1	-	1	-	-	-	1	-	-	-	-	23
4-P	DHAMAR - AL HUSSAINIA		15	2	4	3	-	-	-	10	3	6	-	-	-	-	-	-	-	-	-	-	-	1	1	4	-	2	-	8	-	1	1	2	1	2	-	2	-	1	2	-	-	1	-	72
8-P	MASKIAR - HAJJA		2	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	1	-	-	-	-	6
8P-C	ZABID - HUDEIDA	CONT.CONSTRUCTION PROJECT NOUN NCER. GREC	-	1	-	1	1	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	1	6	-	-	-	-	-	-	-	-	-	-	-	-	-	11
7P-C	SANA'A - HUDEIDAH		1	2	2	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9	-	-	1	-	-	-	-	-	-	-	4	-	-	1	-	-	1	-	-	-	-	22
11-M	MAINTENCE - DEPRT. FLYING CRE		3	2	1	2	1	-	-	-	-	1	-	-	-	-	-	3	-	-	-	-	10	-	-	4	-	1	-	2	-	-	-	1	-	-	1	-	-	-	1	-	-	-	33
11-M	MAINTENCE - ROAD MARKING SEC		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	1	-	-	11	14
11-M	SANA'A HUDEIDA MENT. SEC		-	-	1	1	-	-	-	2	-	-	-	-	-	1	-	1	-	-	-	-	2	-	-	1	-	1	-	2	-	-	2	2	-	-	-	-	-	-	-	-	-	-	16
1-M	SANA'A SA'ADA MENT. SEC		-	1	1	1	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	4	-	-	1	1	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	12
11-M	SANA'A MARIB MENT. SEC		-	1	1	1	-	-	-	1	-	-	-	-	-	-	-	1	-	-	-	-	2	-	-	1	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	10
11-M	ARHAB - ARURA MENT. SEC		-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4
11-M	JIHANA - MARIB MENT. SEC	ROAD MAINTENANCE	-	-	-	-	-	-	-	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	1	-	3	-	-	-	1	-	1	1	-	-	3	-	16
1-M	ADDALI'E MENT. SEC	SECTIONS	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	2	-	-	-	3	-	-	-	-	-	-	-	1	-	8
3-M	AMRAN - HAJJA MENT. SEC		1	1	2	1	-	-	-	3	-	-	-	-	-	-	-	1	-	-	-	-	3	-	-	1	-	-	-	2	-	-	3	-	-	-	1	-	-	-	1	1	-	21
4-M	SHIBAM - ALNAHAIIT MENT. SEC		1	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1	-	1	-	1	-	1	-	-	-	-	-	1	-	-	1	-	10
2-M	MARIB - SAFIR MENT. SEC		1	1	1	1	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	1	-	-	1	-	1	-	2	-	-	2	4	-	-	-	2	-	1	-	-	-	-	20
5-M	MABAR - BAJIL MENT. SEC		1	1	1	1	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	3	-	-	1	-	1	-	2	-	-	1	2	-	-	-	-	-	-	-	1	-	16
6-M	YERIM ;- QUATABA MENT. SEC		-	1	1	1	-	1	-	-	-	-	-	-	-	-	1	-	-	-	1	-	-	2	-	1	-	-	1	-	1	-	-	3	3	-	-	-	1	-	1	1	-	-	-	20
	UNSERVICEABLE EQUIP.		8	8	10	14	1	-	-	-	-	12	-	-	-	3	1	3	-	-	-	-	16	-	2	3	1	-	1	20	-	-	3	3	-	-	1	1	-	-	-	-	-	-	-	111
	TOTAL		180	91	78	93	8	5	3	81	10	86	2	8	1	10	8	26	3	8	7	3	162	16	13	53	10	16	17	268	1	22	41	87	8	8	6	17	4	12	16	3	13	31	14	1,550

4) With regard to the manufacture of spare parts using in-house machine tools, the machining and heat treatment of large parts will be commissioned to outside specialists.

5) The following sections will provide maintenance and repair services.

- body maintenance and repair
- undercarriage and travelling mechanism maintenance and repair
- body work (sheet metal processing) and welding
- engine maintenance and repair (including performance test)
- transmission and hydraulic mechanism maintenance and repair
- machining
- electrical equipment maintenance and repair
- fuel supply system maintenance and repair
- vehicle body repair
- tyre repair
- paint shop
- carpentry shop
- washing stand
- tool room and control counter
- spare parts warehouse

(2) Number of Subject Machines and Vehicles for Maintenance Service

It is necessary to first decide the number of subject machines and vehicles for the maintenance service to determine the size of the workshop (as this number is crucial to deciding the number of bays required to meet the maintenance needs of the subject machines). In order to calculate an adequate number of bays, the number of machines subject to maintenance for upto at least five years should be considered to avoid the early necessity for workshop expansion.

Given the fact that most of the machines and vehicles are currently in operation under very severe working conditions, the number of those to be scrapped is expected to exceed the number of newly acquired machines and vehicles in the five year period. (The volume of self-purchase by the GCRB is likely to remain small because of the tight situation of public finance in Yemen.) Consequently, the number of machines and vehicles in operation in north Yemen around Sana'a is expected to be as shown in Table 3-3.

Table 3-3 Estimated Number of Construction Machines and Vehicles in Operation in Five Years' Time in North Yemen

	Current Number	Estimated Number in 5 Years' Time	Number of Machines/ Vehicles to be Serviced by New Workshop
Construction Machinery	655	600	200
Heavy Vehicles	123	100	70
Light Vehicles (Automobiles)	262	230	150
Total	1,040	930	420

The estimated number of construction machines to be serviced of 200 is calculated based on the number of employees and the technical capability of the present GCRB, the daily working hours and the agreement between the two countries that the workshop will be a medium-size model workshop.

(3) Guidance for OJT

The workshop will, in principle, be constructed to improve the operation rate of construction machinery through improved maintenance and repair and it is not intended to become a major training centre for construction machinery-related skills. Nevertheless, use of the workshop as a place for the transfer of basic skills/technologies to GCRB employees through OJT is important using the machines and equipment provided at the workshop.

There is currently a GCRB training centre relating to construction machinery in Taiz while a vocational training centre which was formerly managed by the Ministry of Construction of the former South Yemen Government is located in Aden. The mechanisms of construction machinery, diesel engines and automobiles are taught at both centres but the teaching contents are rather elementary. The GCRB intends to recruit graduates of the Taiz Training Centre to form the core workforce of the new

workshop. However, the provision of OJT for these young workers appears necessary to upgrade their technical skills with a view to improving the efficiency of their maintenance and repair work. As part of the actual work at the workshop, this OJT will also prove essential for trainees sent from the existing local workshops to promote the transfer of maintenance and repair skills to local areas. The contents of the OJT should be of a higher level than that currently provided by the Taiz Training Centre.

1) Managenet of Workshop
2) Engine

   overhaul, theory
3) Fuel Injection Pump

   mechanism and functions, overhauling, performance testing, theory
4) Reconditioned Engine

   performance testing of reconditioned engines, theory
5) Hydraulic Cylinder and Valves

   mechanism and functions, overhauling, review of theory
6) Torque Flow and Transmission

   mechanism and functions, overhauling, review of theory
7) Torque Converter

   mechanism and functions, overhauling, review of theory
8) Suspension Unit for Construction Machinery

   removal and mounting, overhaul, build-up welding
9) Braking Device for Dump Truck

   mechanism and functions, overhauling, review of theory
10) Suspension Unit for Dump Truck

    mechanism and functions, review of theory
11) Special Tools

    trouble-shooting for all types of machinery
12) Control of spare parts storage
13) Practical Training

    field service practice

Each maintenance and repair section of the new workshop will receive one or two trainees (mechanics) sent from the existing local workshops who will undergo both practical training and theoretical lessons to upgrade their technical skills and knowledge with the guidance of staff members of the relevant section. One OJT session is expected to last for approximately four months. It is important that the GCRB introduce a promotion system whereby those trainees completing an OJT session should be promoted by at least one rank as shown in Fig. 3-2.

On-the-Job Training (OJT) System

1. Upgrading System through OJT

Sub-Routine		In-House Routine
Employees of Other Workshops		Employees of Sana'a Workshop
Foreman	⇔	Foreman
⇑ ⇓		⇑ ⇓
Trainees from Other Workshops	⇔	Skilled Worker
⇑ ⇓		⇑ ⇓
Trainees from Other Workshops	⇔	Semi-Skilled Worker
⇑ ⇓		⇑ ⇓
Trainees from Other Workshops		Helper

Notes: ⇑ Upgrading, ⇓ OJT Guidance

2. Facilities Required for OJT

1) Meeting rooms
2) Cutaway models
3) Dormitory for trainees from other workshops (approximately 20 trainees)
4) Audio visual equipment

Fig. 3-2 Concept of OJT

3.3.3 Location and Conditions of Project Site

The planned project site is located in the eastern suburbs of Sana'a on a slope of Mt. NUKUM. It faces the First Ring Road at the front and provides excellent access for the construction machinery and vehicles to be serviced or repaired at the workshop. There are no buildings at the back of the site except for Mt. NUKUM. The existing Sana'a workshop is located in the city centre and is under strong pressure to move because of noise and other environmental problems. It is believed that such environmental problems are unlikely to occur at the planned project site.

Immediate good access to the project site is provided by the First Ring Road which encircles Sana'a, and which will allow the easy transportation of Project-related materials and equipment to the project site. The GCRB is currently constructing part of the 60m wide Second Ring Road.

There is currently no public water supply system on or around the project site. A borehole with an approximate depth of 150m is located on the site to supply water to the existing buildings. This borehole and the existing water tanks will be used for the Project-related buildings and water will be supplied via a water tank to be attached to each building.

There is currently no public sewerage system on or around the project site. According to data of the Water Supply and Sewerage Authority, the nearest public sewer to the project site is located at a distance of some 500m. Through consultations between the Basic Design Study Team and the Yemeni side, it was decided that the ground infiltration system would be selected. As a result, the boring depth for the No. 4 boring site for the commissioned soil survey was changed from the original 3m to 25m and a water injection test was conducted to examine the infiltration performance of the ground formation.

Sana'a does not yet have a gas supply system and the residents use LPG cylinders. A 500 gallon or 1,000 gallon LPG tank is to be used as the heating fuel supply source for the Project-related buildings.

The project site is currently served by a 15KV overhead high voltage distribution line and a 220-380V low voltage distribution line. However, a power failure in winter can last as long as six hours, necessitating the provision of an emergency power generating unit as part of the Project. As it is planned to change the voltage of the high voltage distribution line from the current 15KV to 11KV in the future, appropriate preparations for the Project-related buildings must be made to accommodate such a change.

One telephone line is currently used at the guardhouse at the entrance to the site and additional lines can be arranged. There are no specific problems vis-a-vis domestic and international calls except occasional waiting due to the limited number of lines.

3.3.4 Natural Conditions

(1) Temperature

Sana'a is located in a basin at an elevation of around 2,300m which is part of Yemen's central plateau and which is surrounded by mountains. As the climate is mild throughout the year (mean temperature in July: 22.5°C), air-conditioning is seldom required, even in summer.

(2) Humidity

The relative humidity in Sana'a is extremely low and the air easily becomes dusty due to wind. The humidity reaches its maximum level of 66 percent in April during one of the rainy seasons while it usually remains under 50 percent in other months. In general, Sana'a's climate is quite pleasant because of the mild temperature and low humidity.

(3) Rainfall

Sana'a has two rainy seasons, i.e., between March and April, and between July and August. The annual rainfall is around 200mm-300mm, but greatly varies from year to year. Thunderclouds tend to appear in the afternoon in Sana'a, causing torrential showers with occasional lightning. As the visit of the Basic Design Study Team to Yemen coincided with the July rainy season, the Team members met with heavy afternoon showers on several days.

(4) Wind Direction

The wind in Sana'a is normally weak. The maximum wind velocity ever recorded of 23m/sec is rather modest because of the absence of any meteorological phenomenon similar to a typhoon in Japan. The prevailing winds are north or northeast winds throughout the year.

(5) Earthquakes

Sana'a has never been hit by a severe earthquake. Immediately after the preparation of the second 5-Year Plan (1982-1986), a fairly large earthquake hit Dhamar which is located halfway between Sana'a and Taiz in December 1982, resulting in the loss of

lives and damage to buildings. Most houses in Yemen are made of stone with a small amount of cement and are not resistant to a strong earthquake. Even today, earthquake-proof structures are not widely seen, suggesting the possibility of substantial damage should a large earthquake occur. The design for the buildings to be constructed under the Project will incorporate earthquake-proof features.

(6) Sandstorms

Sandstorms, which are a characteristic of the Middle Eastern climate, occur in June and August. Minor sandstorms also tend to occur in other months because of the very dry air, causing poor visibility. Table 3-4 gives monthly meteorological data for Sana'a.

Table 3-4 Meteorological Data for Sana'a

Month		1	2	3	4	5	6	7	8	9	10	11	12
Temperature (°C)	Max.	24.1	25.7	26.4	25.9	29.7	30.6	31.5	29.1	28.1	25.5	25.6	24.3
	Min.	0.5	6.2	10.2	9.5	11.5	12.7	14.1	14.0	10.5	5.6	5.4	4.3
	Mean	12.8	15.9	18.6	17.3	21.3	22.8	22.5	21.3	20.1	16.6	16.9	14.4
Rainfall (mm)		0	1.5	45.8	60.8	4.5	23.6	8.1	63.5	2.1	0	0	3.4
Relative Humidity (%)		42	56	55	66	42	42	48	49	42	40	40	30
Wind Velocity (m/s)		12	20	15	23	20	15	15	23	17	13	13	15

(Source: Meteorological Agency)

3.3.5 Outline of Facilities and Equipment

(1) Scope of Facilities Judged Suitable for the Project

The main facilities to be constructed under the Project are described below.

1) Workshop (partial two-storey Reinforced Concrete building with a total floor area of 1,932.0m^2)

The building will consist of a service section and an administration section and the following maintenance and repair shops and other facilities will make up the service section.

- Chassis shop

- Undercarriage shop
- Body repair and welding shop
- Engine shop (work will include engine performance testing)
- Power line and hydraulic room
- Machine shop
- Electric room
- Fuel injection test room
- Tool room and control counter
- Spare parts warehouse

In the case of the administrative section, the following offices and rooms will be provided to administer the above services and to assist OJT.

- General manager's office
- Assistant general manager's office
- Administration room
- Workshop room
- Secretary's room
- Practice room
- Pantry
- Kitchenette
- Rest room and locker room
- Toilets and shower room
- Boiler room
- Entrance hall, corridors and staircases
- Store room

2) Dormitory (two-storey Reinforced Concrete building with a total floor area of 458.9m^2)

This facility will be provided to accommodate trainees undergoing OJT at the workshop and will consist of the following rooms.

- Dormitory (12 rooms to accommodate 20 people)
- Administration office
- Multi-purpose room (canteen)
- Kitchen
- Staff room
- Store room
- Toilets
- Boiler room
- Entrance hall, corridors and staircases

3) Auxiliary Building

This building will house the following facilities to assist the maintenance and repair work to be mainly conducted at the workshop.

- Carpentry shop
- Paint shop
- Tyre repair shop
- Oil and grease storage
- Petrol stand
- Washing bay
- Loading bay
- Travelling test area

(2) Scope of Equipment Judged Suitable for the Project

The main equipment of which provision under the Project is under consideration is listed below.

- o Chassis Shop
  - Overhead crane
  - Hand truck
  - Hydraulic garage jack
  - Parts cleaner
  - Others
- o Engine Shop
  - Monorail crane
  - Jib crane
  - Engine stand
  - Cylinder head workbench
  - Valve seat refacer
  - Piston heater
  - Cylinder head test stand
  - Parts cleaner
  - Others
- o Engine Test Room
  - Engine dynamometer
  - Fuel consumption meter
  - Diesel timing tachometer
  - Otehrs
- o Fuel Injection Test Room
  - Diesel fuel injection pump tester
  - Cummings P-T pump tester
  - Injector tester
  - Others
- o Electrical Room

- Universal electrical equipment tester
- Armature tester
- Headlight tester
- Others

o Power Line and Hydraulic Room
- Hydraulic cylinder service stand
- Jib crane
- Hydraulic component universal tester
- Hydraulic hose cap cramper
- Others

o Battery Charging Room
- Silicom quick charger
- Water purifier
- Others

o Machine Shop
- Jib crane
- Hacksaw machine
- Bench drill machine
- Others

- o Welding & Body Repair Shop
  - Semiauto welder
  - Gas welder set
  - Hydraulic press
  - Others
- o Undercarriage Shop
  - Truck press
  - Shoe bolt impact wrench
  - Others
- o OJT Materials
  - Cutaway models
  - Plastic models
  - Audio-visual equipment
- o Others
  - Station wagon
  - Mobile workshop
  - Pick-up
  - Forklift

3.3.6 Maintenance Plan

(1) Maintenance System, Method and Personnel

The GCRB has adopted the principle of in-house maintenance of construction machinery and does not commission such work to the private sector. There are several private workshops (equivalent to a small independent workshop in Japan) in Sana'a and Taiz which are engaged in engine repair work and simple machining for mainly private vehicles. The construction machinery owned by the GCRB is stored at its workshops and equipment yards next to construction sites when not in use. Maintenance and repair work is conducted at these locations but the scope of work is obviously determined by the availability of both repair equipment and spare parts. In

general, these workshops and equipment yards lack an adequate range of repair equipment and the construction machinery maintenance conditions are rather poor.

The construction machinery maintenance system of the GCRB has many problems vis-a-vis repair equipment, personnel and organization, and the GCRB is examining the possibility of introducing the new system shown in Fig. 3-1 to manage the planned new workshop with a new organization.

A new job-ranking system, together with clearly defined job assignments, must be established in order for the workshop to fully perform its functions. In this regard, the model shown in Table 3-5 has been drafted through consultations with the Yemeni side.

Table 3-5 Job Assignments at New Workshop

Position	Educational Career and Practical Experience	Required Work
Senior Engineer	1) University graduate of an engineering department with 7 years or more experience as a field engineer. 2) Person with leadership qualities.	1) To assist Deputy Workshop Manager (Workshop). 2) To educate/train engineers. 3) To support foremen and skilled technicians as an instructor. 4) To examine the desirability of adopting new technologies. 5) To solve technical problems. 6) To plan on-site work schedule.
Engineer	University graduate of an engineering department with less than 7 years experience as a field engineer.	1) To provide technical support for foremen. 2) To support technicians. 3) To design jigs and tools. 4) To prepare work standards. 5) To assist senior engineer. 6) To check daily work reports and repair reports and to prepare statistical data.
Foreman	1) Graduate of a technical high school with 7 years or more experience as a field technician. 2) Graduate of GCRB's training centre with 10 years or more experience as a field technician. 3) Person with leadership qualities.	1) To prepare field work schedules. 2) To instruct on repair work. 3) To supervise assigned work sites. 4) To provide OJT for technicians and workers. 5) To control work progress. 6) To prepare daily work reports.
Skilled Worker	1) Graduate of a technical high school with 3 years or more practical experience. 2) Graduate of a training centre with 5 years or more practical experience. 3) Graduate of a secondary school with 10 years or more practical experience.	1) To conduct actual work. 2) To provide OJT for workers and semi-skilled technicians. 3) To conduct preparatory work. 4) To prepare daily work reports.
Semi-skilled Worker	1) Graduate of a technical high school with less than 3 years practical experience. 2) Graduate of a training centre with less than 5 years practical experience. 3) Graduate of a secondary school with 10 years or more practical experience.	1) To conduct actual work. 2) To support technicians.
Helper	1) Graduate of a secondary school with less than 10 years practical experience. 2) Person with long history of practical experience.	To conduct actual work under the guidance of a technician or worker.

(2) Procurement of Spare Parts

A spare parts warehouse is currently being constructed by the Yemeni side at the planned workshop site and there are plans to transfer all spare parts which are presently stored at the existing Sana'a workshop upon the completion of this warehouse.

The spare parts storage levels for the main construction machinery owned by the GCRB are shown in Table 3-6.

Table 3-6 Spare Parts Stock Rate by Machine

Machine Type	Model	Qty.	Stock Rate (%)	Machine Type	Model	Qty.	Stock Rate (%)
Bulldozer	Komatsu D50, D65, D85, D155	138	90	Dump Truck	Nissan TC-20, 80 TWD-82 CW-50	80	20
Grader	Komatsu GD37, 40, 500, 605, 661, 705	89	68		Hino KB212	20	10
Excavator	Komatsu D50S, 75S, 85S	18	40	Air Compressor	Komatsu ED210, 105	26	70
Wheel Loader	Komatsu W90, 300, 320, 420	53	70-90		Atlas XA80, 85, 120, 350	50	50

(Source: GCRB)

As the Japanese construction industry considers an adequate spare parts stock rate to be around 50 percent, the stock levels of the spare parts for construction machinery of the GCRB are judged to be adequate to deal with the likely maintenance and repair requirements in the near future. Moreover, the World Bank has announced its policy of providing continuous assistance for the procurement of spare parts. With regard to dump trucks which have a spare parts stock rate as low as 20 percent, these parts can be procured from private workshops. It has been decided not to include the provision of spare parts in the Project, as a disruption of the service work at the new workshop due to a shortage of spare parts is believed unlikely.

(3) Maintenance Cost

In planning the facilities to be introduced under the Project, the easy maintenance of these facilities is obviously an important consideration. In addition, in regard to building maintenance and equipment handling, the transfer of technology will be conducted by the contractor to the workshop staff upon the completion and delivery of the facilities to the Yemeni side. Manuals and concrete demonstrations will be provided to ensure that the Yemeni side understands proper maintenance, use and inspection methods. The maintenance cost, operation cost and cost of expendables, etc., of the workshop will be borne by the GCRB in its budget.

The annual running cost of the workshop, estimated based on the field survey findings and reference data, is given below.

Personnel	12,382,000 YR
Operation, Lighting and Heating	3,942,000 YR
Materials, Equipment and Expendables	1,478,000 YR
Maintenance	3,806,000 YR
Miscellaneous	924,000 YR
Total	22,532,000 YR

The equipment to be provided for the workshop will require renewal every 10 or 15 years due to natural deterioration. As the cost of new equipment is accounted for in the budget in the form of depreciation, no problems are anticipated in regard to securing the necessary funds for the procurement of new equipment.

CHAPTER 4 BASIC DESIGN

CHAPTER 4 BASIC DESIGN

4.1 Design Policy

The ultimate objectives of the planned workshop are the improvement of the operation rate of construction machinery through the provision of appropriate maintenance and repair services, and the training of relevant technicians with upgraded skills through OJT at the workshop. Consequently, the design policy for the workshop facilities and equipment to be installed emphasises the function of the workshop of a key maintenance and repair station in northern Yemen, and the safe, easy to use and easy to maintain, features of these facilities and equipment. The design policy should also be compatible with the local socieconomic conditions, including the technical level and natural conditions, and particularly the climate.

4.1.1 Design Policy Vis-a-Vis Natural Conditions

Sana'a is situated in a basin at an elevation of 2,300m above sea-level and surrounded by mountains. The project site is located at the piedmont of Mt. Nucum to the east of Sana'a. The sloping site faces the First Ring Road at the front and Mt. Nucume at the back. The GCRB is currently using this site as a parking lot for construction machinery, a plant site for the production of road paving asphalt, and a warehouse site and is also building an additional storage for parts storage. The Basic Design Study Team conducted a field study at the site and then commissioned a local surveying company to conduct surveying of the borders, area and ground undulations of the area suitable for the planned workshop and surrounding areas. Consequently, the borders of the planned site were confirmed and the difference in ground elevation was obtained as shown on the Site Map at the beginning of both this Report and the Appendix.

The Basic Design Study Team also commissioned a local soil testing company to conduct both the boring and laboratory soil tests. Boring to a depth of 3m was conducted in three places and boring to a depth of 25m was also conducted once to check the N value, the geological formation and the soil characteristics. The findings of the boring test are summarised below.

Up to 1m in depth from the surface: dry sandy silt

Below 1m in depth from the surface: gravel mixed with basalt.

Based on the standard penetration test results, a soil bearing capacity of 40 tons/m^2 can be safely assumed.

The groundwater level at the planned project site is estimated to be as deep as 150m-200m based on a reply by the GCRB that the depth of the drinking water borehole on the site is more than 150m. This borehole is expected to supply water for drinking, showering and other purposes associated with the workshop and other buildings.

The location of the planned project site is shown on the Location Map at the beginning of this Report and the site enjoys a relatively mild climate throughout the year as outlined in 3.3.4 - Natural Conditions. As the temperature can just exceed 30°C in summer, air-conditioning is not an absolute necessity. Consequently, easy to maintain air-conditioning equipment will be installed only in the offices of such senior staff as the workshop manager.

The prevailing winds at the site are from the north and northwest throughout the year, and the engine test room, which will generate substantial noise, will be located as far as possible from the administration block and the dormitory block.

There are no building standards or guidelines in Yemen. Moreover, the concept of an earthquake-proof design does not exist. While Sana'a has never experienced a severe earthquake and its location is outside any known seismic belt, serious earthquake damage did occur in 1982 at Dhamar which is located nearby. It has been agreed through consultations with the Yemeni side that Japanese building standards will be adopted for the building design to ensure sufficient strength and safety vis-a-vis earthquakes and strong winds.

4.1.2 Design Policy Vis-a-Vis Social Conditions

More than 90 percent of the population of Yemen, located in the southeastern corner of the Arabian Peninsula, are Muslim and Islamic. These two customs and cultures dominate social life. Careful consideration must, therefore, be given to the local customs, including the use of Arabic style water closets, in the design of the facilities for the Project.

4.1.3 Design Policy Vis-a-Vis Local Construction Conditions

(1) Permits and Authorisation for Project Implementation

No government permit or authorisation is required in Yemen for the planning and construction of a building. There are no laws regulating building construction and all donor countries use their own building standards, i.e., ACI and BS in the case of the United States and the United Kingdom respectively, etc., to construct buildings under their own aid projects.

(2) Related Laws and Regulations

There is nothing in Yemeni law binding the construction work under the Project. The planned workshop will be constructed on a site owned by the Ministry of Construction and the Project will be implemented by the GCRB. All service work for the site, such as the provision of electricity and telephone lines, will be conducted by the Yemeni side at its expense. In short, there is no law which could interfere with the implementation of the Project.

(3) Technical Level of Local Construction Companies

Yemen does have its own construction companies, architectural design offices and building consultants. Since the detailed design and work supervision for the Project will be provided by a Japanese consultant, it is unlikely that a need will arise to appoint a local design office or building consultant within the scope of work for the Japanese side. In regard to the construction of buildings and the installation of equipment, however, a Japanese general contractor will commission the work to local companies and, therefore, the conditions of local construction companies are described next.

There are various companies in Sana'a working in such fields as general construction, plumbing, doors and windows, air-conditioning, electrical installation and waterproofing, etc. In many parts of the city, seven to ten storey reinforced concrete office buildings and apartment buildings are under construction, indicating the reliability of the technical level of local companies for the requirements of the present Project.

Local general construction companies can largely be classified into the following three groups.

- companies with modern management style supported by foreign capital

- long-standing local companies with rather old-fashioned management style (expanded family-owned companies)

- relatively new companies established by engineers after studying abroad

All these companies have been consolidating technical skills and experience as the construction industry in Yemen has been enjoying a favourable business situation for some time. However, it must be pointed out that these companies tend to accept government contracts which are not necessarily profitable simply to build up their business records. At the construction sites visited by the Basic Design Study Team members during the field survey, all the companies were found to be capable of producing good results (in terms of a precise finish to the specifications) using local construction methods. With regard to the building construction and equipment installation for the Project, these companies should be able to satisfy the quality standards and other requirements with the provision of some technical guidance by the Japanese general contractor. Process control is one weak point of the local construction industry and the provision of technical guidance by Japanese engineers will be essential to complete the Project-related work within the comparatively short period required by the Japanese grant aid cooperation system.

(4) Worker Capability and Availability

All the technicians and workers observed at construction sites in Sana'a are Yemenis. However, many foreign workers, especially Ethiopians and Somalis, are seen at such port cities as Hodeidah and Aden. As Yemenis are generally hard working and courteous, no problems of worker capability and availability are anticipated in relation to the implementation of the Project.

(5) Quality and Availability of Local Construction Materials

There should be a ready local supply of such construction materials as cement, sand, gravel, bricks, concrete blocks, reinforcing bars and mould materials, etc. As far as finishing materials are concerned, raw materials are imported to locally process and assemble doors, window frames and board, etc. While the quality is reasonable, the supply is generally short of the demand. Steel products, such as structural frames, can be locally procured. Since their raw materials are imported, as in the case of doors and window frames, etc., there is some concern regarding both punctual delivery and manufacturing precision. Therefore, the planned procurement of doors, window frames, board and structural steel, etc., from Japan is appropriate.

(6) Infrastructure

Yemen has several main ports at Hodeidah, Al Mukha and Aden. Taking the requirement to transport construction materials and equipment to the project site into consideration, Port Hodeidah appears to be the most appropriate landing port for the Project. Port Hodeidah allows access by 20,000 ton class vessels and unloading operations are expected to be smoothly conducted without requiring long anchorage. Although the distance between Hodeidah and Sana'a is some 100km in a straight line, the actual road length is 226km because of both the steep mountainous topography and the necessity to climb 2,300m. Despite the steepness and many bends, the road is well maintained and no special difficulties in transporting the Project-related materials and equipment along this road are anticipated.

The planned project site is in suburban Sana'a and the site is already provided with all basic services, such as electricity, telephone and road access, etc., indicating the lack of specific problems in project implementation in terms of the infrastructure. In winter, however, frequent power failures can last as long as six hours at a time, necessitating the provision of an emergency power generating unit of minimum capacity to maintain the essential operations of the workshop.

4.1.4 Design Policy Vis-a-Vis Use of Local Companies, Equipment and Materials

(1) Use of Local Companies

The construction of a spare parts warehouse for the GCRB is currently in progress in a corner of the planned project site. The building is a single-storey, steel-frame building with a span length of 23m and a total length of 84m. The local general construction company which has been commissioned to construct this building has constructed many buildings for the GCRB and some large-scale buildings, including a chemical plant, in the private sector. The use of such a local company (or companies) as subcontractor(s) of the Japanese general contractor for the purposes of the present Project will be very significant in terms of the transfer of technology to the Yemeni construction industry, and also in terms of the desirable economic impact of the Project.

(2) Local Availability of Construction Machinery

The largest construction machinery required for the Project will be a 20 ton truck crane to hoist the roof truss and an overhead crane. It was confirmed during the field survey that the local leasing of this machinery is possible.

In short, most construction machinery and equipment, except surveying equipment and concrete testing instruments, etc., can be either procured or leased locally.

(3) Local Availability of Construction Materials

In view of the local delivery reliability, product quality and manufacturing precision, etc., of construction equipment and materials, the steel-frame roof truss, steel doors, calcium silicate boards and building service equipment, including electrical equipment, etc., will be procured in Japan. In comparison, all basic materials, including concrete, reinforcing bars, cement and concrete blocks will be procured locally. The maintenance and repair tools and equipment for the new workshop will be procured in Japan as procurement in Yemen would prove difficult.

4.1.5 Design Policy Vis-a-Vis Operation and Maintenance Capability of Project Implementation Body

In conducting the basic design for and the selection of the facilities and equipment to be provided under the Project, the selection of equipment, materials, construction methods and training equipment, etc., which is easy to maintain and which will result in a low running cost, is necessary.

As far as the building construction work is concerned, local construction methods using locally available materials should be employed where possible so that maintenance and repair work in the future can be conducted by the Yemeni side without reliance on outside assistance. Similarly, popular use in Yemen should be an important criterion in the decision on building service equipment, materials and operation systems, etc.

The tools and equipment to be provided for each shop should again be those popularly used or the use of which is expected to become popular in the future. Moreover, equipment selection should also be conducted in such a way as to provide easy operation and maintenance and to reduce the maintenance cost.

4.1.6 Design Policy Vis-a-Vis Scope and Level of Facilities and Equipment

(1) Facility Plan

The basic design for the Project must take the natural conditions, social conditions, state of the local construction industry and the technical competence, as well as the operation and maintenance capability of the project implementation body, into consideration. In addition, proper attention should be paid to such aspects of the Project as the construction period, construction methods and the need to keep the project cost to a minimum.

The planned facilities are intended to provide maintenance and repair services for construction machinery and vehicles, both of which are essential for the progress of road construction/improvement work in Yemen, and to improve the operation rate of this machinery and these vehicles from the current 60 percent to 85 percent in five years.

The planned facilities (buildings) consist of the following.

- workshop (including administration facilities)
- dormitory
- auxiliary buildings

The exterior civil engineering work (land preparation, landscaping and the construction of premise roads) is not covered by the Project.

(2) Equipment Plan

The basic design for the equipment to be provided under the Project must take the same conditions and aspects described for the facility plan above into consideration. Special points to note in the selection of equipment are given below for each shop.

● Chassis Shop

The improved efficiency of the overhauling of heavy construction machinery is aimed at by the installation of a mobile 5-ton manual crane. Various hydraulic jacks and support equipment will also be provided to deal with the chassis of heavy machinery.

- Engine Shop

  A one ton jib crane to hoist engines and a three ton fixed manual crane will be installed to achieve the efficient movement of disassembled parts and components in the shop. An engine mounting table will also be installed for safe and proper engine service work. Additional work of the shop will include the boring and honing of cylinders, the grinding and correction of valves and the grinding of cylinder heads.

- Engine Test Room

  The serviced/reconditioned engines will be thoroughly tested in this testing room where a three ton fixed manual crane will be installed.

- Electrical Room

  A comprehensive electrical equipment tester will be installed to test such various electrical equipment as starter motors and AC generators, etc. mounted to construction machines.

- Power Line and Hydraulic Room

  The tools and equipment required for the servicing of transmission devices, excepting engines and suspension units (torque converters, transmission differential gears and clutches, etc.), and a general-purpose hydraulic equipment tester will be provided.

- Fuel Injection Test Room

  Two types of testers, i.e., Bosch and Cummings, will be installed to service the fuel injection systems of construction machinery.

- Machine Shop

  As described in the equipment list later, many of the machine tools currently in use at the Sana'a workshop have not yet reached the end of their lives and will be transferred to the new workshop to conduct the machining of general parts and to assist engine maintenance. The machines in question include, among others, lathes, several ordinary machine tools, an engine crank shaft grinding machine and a line boring machine.

- Undercarrige Shop

  Such equipment as a tyre removal press, a track press and a truck shoe bolt removal machine will be provided for the suspension shop to reduce the spare parts cost by prolonging the life of suspension-related parts.

- Air-Compressor

  A diesel-operated air-compressor will be installed in the engine testing room to supply compressed air throughout the workshop.

- Battery Charging Room

  The necessary tools and equipment to repair and charge the batteries of construction machines and vehicles will be provided together with a distilled water maker.

- Tyre Shop

  The equipment to remove and repair tyres, including extra-large tyres for construction machinery, will be provided.

- Paint Shop

  While construction machines do not require full paint work for the entire body due to their purpose of use, vehicles do require such paint work. A separate building will be constructed for both sheet metal and painting work.

- Washing Stand

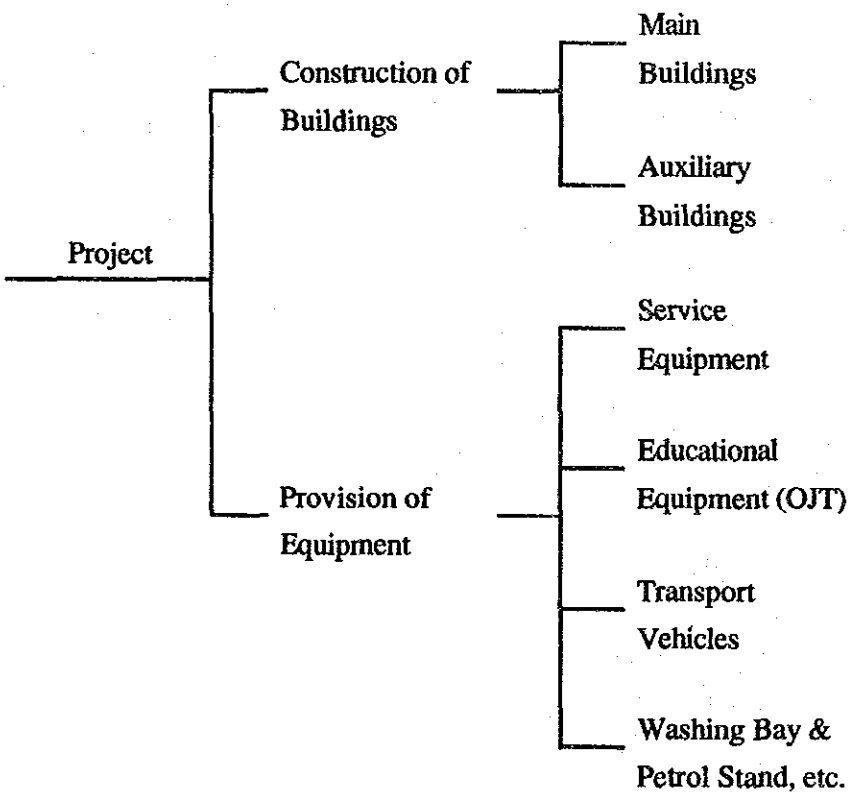
  When construction machines are transported to the workshop by trailer or other means, they are usually covered with dirt. They must first be thoroughly washed before being allowed to move to the workshop section for the disassembly of the chassis. A high-pressure hot water spray and a steam cleaner will be provided for this purpose.

In addition to the equipment described above, mobile workshop, pick-up truck and station wagon will be stationed at the workshop as part of the field service system.

4.1.7 Design Policy Vis-a-Vis Construction Schedule

In principle, both the construction contract and the actual work will be completed in the same fiscal year in accordance with Japan's grant aid cooperation system. Although the Project consists of two components, i.e., the construction of buildings and the provision of equipment, it is desirable that these components be unified under a single project relating to the construction of buildings so that the Project can accordingly be completed in a single fiscal year. The project implementation schedule is given in Table 4-4-5, in which a 12-month construction period after the conclusion of the overall construction project is anticipated.

The Project consists of the following contents.



4.2 Examination of Design Conditions

4.2.1 Facility Plan

(1) Calculation of Required Number of Service Bays

The following examination process should be employed to calculate the required number of service bays which will provide the basis to determine the size of the facilities to be constructed under the Project.

The following formula commonly used in Japan will be adopted to calculate the required number of service bays for the workshop.

$$\text{Number of Bays} = \frac{\text{Standard Length of Work (d)} \times \text{Number of Subject Machines (N)} \times \text{Service Frequency (E)}}{\text{Total Working Days in a Given Period (D)}}$$

Annual Working Days at GCRB (D) : 300 (days)

Number of Subject Items

- Construction Machines : 200/year
- Heavy Vehicles : 70/year

1) Service Bays for Construction Machinery

① Standard Length of Work (d)

The servicing of construction machinery is classified into the following three types of services.

Minor Service - replacement of various elements and engine oil, general inspection and adjustment

Standard Service - servicing of each unit (engine, clutch, brakes, hydraulic system and parts of suspension)

Major Service - general overhaul

Since a road construction site is often located far from a workshop, it is very common for a service vehicle (together with a technician/mechanic) to be dispatched to the site to conduct minor service. This is also the case in Yemen. Consequently, the services conducted at a workshop are generally either a standard service or major service.

The field survey found that the current services at the workshop are a lengthy affair due to the insufficient availability of service facilities and equipment. In the case of the new workshop, however, the following standard (target) length of work will apply.

	Present Length	Standard Length in Japan	Target Length
Standard Service	20 days	10 days	13 days
Major Service	60 days	30 days	40 days

Although the field survey findings suggest that service work in Yemen requires double the amount of time in the case of Japan, the above targets are set for the new workshop based on the anticipated improved work efficiency.

② Service Frequency (E)

On average, the construction machinery owned by the GCRB operates 1,000 hours/year and the following service frequency is set for the new workshop.

Standard Service - every 2,000 hours (every 2 years)*

According to local records, some 50 percent of standard services are conducted on-site.

Major Service - every 6,000 hours (every 6 years)*

* These figures are taken from common maintenance manuals used in Japan.

③ Service Bay Requirement Calculation

$$\text{Standard Service Bay} = \frac{13\text{ (d)} \times 200 \times 50\text{ (\%)} \times 1/2\text{ (year)}}{300\text{ (D)}} = 2.2$$

$$\text{Major Service Bay} = \frac{40\text{ (d)} \times 200 \times 1/6\text{ (year)}}{300} = 4.4$$

The resulting number of required service bays for construction machinery is approximately six.

2) Service Bays for Vehicles

① Standard Length of Work (d)

The servicing of heavy vehicles is similarly classified into the following three types of services.

Minor Service - replacement of various elements and engine oil, brake adjustment and inspection of electrical equipment

Standard Service - engine conditioning, brake and clutch lining replacement and others

Major Service - overhaul of engine, transmission, brakes and suspension

As in the case of construction machinery, minor services are usually conducted on-site. According to local maintenance records, the present length of service work is as follows.

	Present Length	Standard Length in Japan
Standard Service	10 days	8 days
Major Service	25 days	20 days

② Service Frequency (E)

The average travelling distance of the vehicles owned by the GCRB is 10,000km/year and the following service frequency is set for the new workshop pursuant to the guidelines for standard service work set by the Federation of Japan Automobile Service Associations.

Standard Service - every 25,000km

Major Service - every 100,000km

③ Service Bay Requirement Calculation

$$\text{Standard Service Bay} = \frac{10\,(d) \times 70 \times 1/2.5}{300\,(D)} = 0.9$$

$$\text{Major Service Bay} = \frac{25\,(d) \times 70 \times 1/10}{300\,(D)} = 0.6$$

The resulting number of required service bays for vehicles is 1.5 which is translated to two to cover special requirements for additional services. The total number of service bays required at the new workshop is, therefore, eight, i.e., six for construction machinery and two for vehicles.

(2) Floor Area and Height of Each Shop/Room

The following standard specifications to calculate the floor area of each shop/room are adopted to plan the overall size of each building. These specifications have been decided based on standard practices in Japan, standard practice in Yemen and the results of consultations with the Yemeni side.

1) Workshop

- Chassis Shop (6 bays) : space required for overhauling of machine bodies (6.0m x 12.0m/bay)
- Heavy Vehicles (1 bay) : as above
- Vehicles (1 bay) : as above
- Undercarriage Shop : to be decided based on equipment layout and size of equipment to be introduced
- Welding Shop : as above
- Body Repair Shop : as above
- Engine Shop : as above
- Engine Test Room : as above (including Control Room)
- Power Line and Hydraulic Room : as above Shop
- Battery Charging Room : as above Electrical Equipment Shop
- Tool Room : sufficient space to store tools
- Spare Parts Storage : to store parts used very often
- Administration Office/Reception: 4.5-5.5m^2/person
- Workshop Manager's Office : 20-25m^2/person (inclusive of reception space)
- Engineers' Office : 10-15m^2/person (inclusive of meeting space)
- Practice Room : 3.0-4.0m^2/person (inclusive of AV system and cutaway model space)
- Meeting Room : 3.5-4.5m^2/person

- Rest Room/Locker Room: 1.2-1.5m^2/person

- Shower Room: 10 shower booths

- Toilets: 2 locations

2) Dormitory

- Bedrooms : 10-15m^2/person
- Administration Office : 4.5-5.5m^2/person
- Multi-Purpose Room (Canteen) : 2.0-3.0m^2/person
- Kitchen : 0.7-1.0m^2/person
- Warden's Room : 20m2

(3) Path of Flow

1) Workshop

The chassis shop and suspension shop will be located near the entrance and the centre of the workshop so that construction machinery and vehicles can be serviced without travelling inside the workshop. Other shops will be located further inside the building. The engine testing room, welding shop and body shop, etc., which are particularly noisy, will be located in one corner far from the administration block. The administration block will have two storeys and the workshop manager's office, meeting rooms and training rooms will be located on the upper floor so that they are independent.

2) Dormitory

The multi-purpose room (canteen) will be located at the centre of the building while the bedrooms will be located on both floors. The overall layout will be designed to emphasise the different functions of these two types of space.

(4) Supplementary Facilities

Two mobile manual cranes will be installed in the workshop between the service bays. A chainblock or jib crane will be provided for the other shops where necessary. Each bay will be equipped with at least one compressed air outlet and one power outlet. There will be a boiler room to supply hot water to the shower room.

4.3 Basic Plan

4.3.1 Facilities Plan

(1) Site and Layout

The planned site for the workshop and its auxiliary facilities has an approximate area of five hectares (250m in the north-south direction and 200m in the east-west direction) and is located on the westward slope of Mt. Nucum. It has three split levels and some buildings, including a warehouse, already located on the site. The western side of the site is bordered by the First Ring Road.

The required facilities for the workshop, identified by the field survey and the domestic work conducted by the Basic Design Team, consist of a workshop building together with an administration block, dormitory building and other auxiliary buildings. The layout of these facilities, described below, has been decided to ensure functional and efficient distribution taking the natural conditions at the site into consideration.

1) The main gate for the workshop will be located in a place where the ground level of the site least differs from that of Ring Road in order to secure easy access to the workshop from Ring Road with little land preparation work.

2) The front of the workshop will directly face the access road and the administration block will be located at the centre of the workshop complex. The ground level of the workshop will be equal to that of the spare parts warehouse.

3) In view of the strong northerly seasonal wind at the site, the auxiliary buildings will be located to the north of the workshop building to form a windbreak.

4) The dormitory building will be located on high ground at some distance from the workshop building.

5) An exclusive road testing space for the serviced/repaired machinery and vehicles will be provided on the high ground at the eastern part of the site.

6) Several parking lots will be provided to serve different types of machinery and vehicles.

(2) Building Plan

1) Floor Planning

The planned functions and floor area of each shop/room are given in Table 4-1.

① Workshop

Table 4-1 Functions and Floor Area of Planned Shops/Rooms (1/5)

Shop / Room	Seating Capacity	Unit Floor Area	Planned Area (m^2)	Functions / Remarks
Chassis Shop	—	6.0mx12.0m/bay	360.0 (6 bays)	disassembly and assembly of heavy units and general servicing
Heavy Vehicle Shop	—	"	72.0	"
Light Vehicle Shop	—	"	72.0	"
Undercarriage Shop	—	depends on equipment layout	72.0	maintenance of suspension and travelling mechanisms (inclusive of caterpillars) of construction machinery
Welding Shop	—	"	36.0	"
Body Repair Shop	—	"	36.0	"
Engine Shop	—	"	76.5	engine overhauling
Engine Test Room (including Control Room)	—	"	59.5	testing room for serviced engines and testing control room
Power Line and Hydraulic Room	—	"	85.0	servicing and testing of transmissions and clutches, etc.
Machine Shop	—	"	161.5	general machining using lathe and drilling machine, etc.
Fuel Injection Test Room	—	"	42.5	servicing, repair and testing of fuel supply systems, including fuel injection pumps
Battery Charging Room/Electrical Room	—	"	34.0	servicing, repair and testing of electrical equipment
Corridors	—	—	135.0	with sufficient width for forklift operation
Total			1,242.0	

②-1 Administration Block (Downstairs)

Table 4-1 Functions and Floor Area of Planned Shops/Rooms (2/5)

Shop / Room	Seating Capacity	Unit Floor Area	Planned Area (m^2)	Functions / Remarks
Entrance Hall/Corridors	—	—	67.5	inclusive of staircase
Tool Room	—	—	23.75	office responsible for tool storage and supply
Spare Parts Storage	—	—	15.0	to store spare parts
Reception	1	4.5-5.5m^2/person	5.0	*reception for service/repair* ordering
Shopfloor Office	4	"	16.25	monitoring and control of service work
Administration Office	16	"	75.0	for clerical work
Pantry/Toilet	—	—	15.0	(3 water closets, 2 urinals and 2 washbasins)
Rest Room/ Locker Room	60	1.2-1.5m^2/person	85.0	
Shower Room	—	—	17.5	10 shower cubicles
Pantry	—	—	3.0	
Toilet	—	—	15.0	5 water closets, 3 urinals and 3 washbasins
Boiler Room	—	—	7.0	
Total			345.0	

②-2 Administration Block (Upstairs)

Table 4-1 Functions and Floor Area of Planned Shops/Rooms (3/5)

Shop / Room	Seating Capacity	Unit Floor Area	Planned Area (m^2)	Functions / Remarks
Hallway/Corridors	—	—	34.5	inclusive of staircase
Workshop	3	20-25m^2/person	33.75	
Manager's Room				
Secretary's Room	—	—	6.75	
Administration Office	6	4.5-5.5m^2/person	26.25	for clerical work
Storage	—	—	12.0	
Engineers' Room	4	10-15m^2/person	41.25	
Practice Room	20	3.0-4.0m^2/person	82.5	inclusive of installation space for AV system and cutaway model (and staircase)
Meeting Room	30	3.5-4.5m^2/person	90.0	staff meeting room
Pantry	—	—	7.5	
Toilet	—	—	10.5	3 water closets, 2 urinals and 2 washbasins
Total			345.0	

③ Dormitory

Table 4-1 Functions and Floor Area of Planned Shops/Rooms (4/5)

Shop / Room	Seating Capacity	Unit Floor Area	Planned Area (m^2)	Functions / Remarks
Bedroom	20	10-15m^2/person	240.0	to accommodate trainees
Multi-Purpose Rom Room	20	2.0-3.0m^2/person	55.8	for canteen and other purposes
Kitchen	—	0.7-1.0m^2/person	20.0	inclusive of food storage
Office	1	4.5-5.5m^2/person	5.0	
Storage	—	—	5.0	
Toilet	—	—	5.0	
Entrance Hall/ Corridors/Staircase	—	—	98.1	(inclusive of upstairs)
Boiler Room	—	—	6.0	
Warden's Room	—	—	24.0	inclusive of laundry and toilet
Total			458.9	

④ Auxiliary Buildings

Table 4-1 Functions and Floor Area of Planned Shops/Rooms (5/5)

Building	Unit Floor Area	Planned Area (m^2)	Functions/Remarks
Carpentry Shop	—	24.0	
Paint Shop	—	24.0	
Tyre Repair Shop	—	24.0	
Oil and Grease Storage	—	18.0	Oil and Grease Storage
Total		90.0	

⑤ Other Facilities

- Petrol Stand
- Washing Bay
- Loading Bay
- Cooling Water Tank

2) Sectional Planning

① Workshop

- In view of the construction machinery currently owned by the GCRB and subject to the planned service work, the floor height of the workshop area where the overhead travelling crane will operate will be decided based on a crane hoisting height of 7m, the required clearance above the crane and the beam height.
- The floor height of each shop will be decided based on the installation height of the jib crane and the beam height.
- The floor height of the parts storage will be decided based on the parts rack height (two shelves) and the beam height.
- A suspended ceiling will be used for the workshop manager's office, the administration office and the meeting room, etc., with a ceiling height of 2.6-2.8m above floor level. The floor height will be decided taking the ceiling height, beam height and equipment installation space into consideration.

② Dormitory

To achieve the maximum economy, suspended ceilings will not be employed except for the building service space. The floor height of each floor will be 2.8-3.2m.

3) Structural Planning

① Basic Principles

The following basic principles will apply for the structural design of the buildings to be constructed under the Project.

- Where possible, the design will allow the use of a local construction method.
- The design will ensure safe, durable buildings.
- The design will suit the local environmental conditions as well as the site conditions.
- The design will allow the maximum use of local materials.

② Basic Design

As shown in the Appendix, the soil bearing capacity of the planned site is approximately 40 tons/m^2 at 1m below the ground surface. The planned building is a two-storey building with a maximum load per column of approximately 50 tons, necessitating the use of a spread foundation.

③ Design of Superstructure

Beams and slabs in Yemen usually have a reinforced concrete structure while walls are made of either concrete blocks or bricks.

The size of the planned buildings allows the use of local construction methods which will be economical. In principle, therefore, a RC structure will be employed. With regard to the chassis bay in the workshop which will have a long span and a high ceiling height, the use of a steel-frame roof truss is planned because of the difficulty involved in structural support and also due to the limited construction period.

④ Aseismic Design

The project site is not located in an earthquake-prone area and, therefore, there is no requirement for an aseismic design. However, a large earthquake has once occurred at Dhamar nearby and a study by Sana'a University does not rule out the possibility of an earthquake in the Sana'a area in the near future. In view of these facts, a standard shear modulus of 0.20 (equivalent to the Japanese standard) will be employed for the present structural design to provide the buildings with sufficient strength to resist an earthquake.

⑤ Dead Load

The weight of all the structural materials, finishing materials and fixed equipment will be calculated to obtain the dead load.

⑥ Live Load

The live load used for the present structural design will be based on Japan's Building Standards Act as shown in Table 4-2.

Table 4-2 Standard Live Load for Structural Calculation

(Unit: kg/m^2)

Category	Floor/Small Beam	Main Beam/Column/Foundation	Aseismic Design
Office	300	180	80
Meeting Room Corridor Hallway	360	330	210
Warehouse	500	300	200
Bedroom	180	130	60
Laboratory	550	400	200

⑦ Wind Load

There is no special requirement to take the wind load into consideration for the two-storey RC sections. However, this is not the case for the steel-frame section.

The recorded maximum wind velocity in the area, i.e. 23m/sec, plus an additional safety margin of 7m/sec will be used to calculate the design wind pressure (load), pursuant to the corresponding regulation in the Japan's Building Standards Act as shown below.

Maximum Wind Velocity (V) : 30m/sec

Assumed Air Density (ρ): 0.125kg sec^2/m

q (design wind pressure) $= 1/2 \times \rho \times (V)^2$

$= 1/2 \times 0.125 \times 30^2 = 56$ kg/m^2

$= 60$ kg/m^2

4) Electric Installation Plan

① Planning Principles

- The electric installation plan must take the local conditions, including the climate and customs, and the special conditions of the planned facilities into consideration.
- Electric installation must be easy to operate and maintain.
- The electrical equipment, appliances and their components (parts) to be used for the Project should preferably be standard products in view of easy replacement.
- The zoning for lighting should adopt small units for energy saving purposes.

② Substation

The 15KV distribution line of the Electricity Supply Corporation will be extended to the substation and lower voltage power supply will be made to all the facilities.

Secondary Voltage

- power equipment 3 phases, 4 wires, 380V, 50Hz
- lighting and outlets single phase, 220V, 50Hz

As the voltage of the distribution line is expected to become 11KV in the near future, the substation should be capable of handling 11KV.

③ Lighting and Outlets

Lighting will mainly be provided by fluorescent lamps and outlets will be installed in desirable positions in each shop/room. The expected average luminous intensity is given below for the main rooms.

- office/meeting room/canteen 300-400 lux
- service shop 200-300 lux
- storage 50-100 lux
- outdoor 5-10 lux

④ Telephone

Three subscriber lines will be extended to the site. One line will be for the exclusive use of the workshop manager while the other two lines will allow the connection of extension lines. Ten extensions will be provided in the administration office and other places.

⑤ Emergency Power Generation Unit

An emergency diesel power generator will be installed in preparation for power failures which are expected to occur very frequently in winter. The load will consist of emergency lights and hoisting cranes, etc., and the design power generation capacity is 100 KVA.

5) Building Services Plan

1. Planning Principles

- The building services design must take the local climate and environmental conditions fully into consideration.

- Equipment which is easy to operate and maintain should be selected.

2. Air-Conditioning

A heat-pump air-conditioner will be installed in the workshop manager's office and the engineers' office.

3. Ventilation

Ventilation facilities will be installed for the toilets, kitchen, shower room and each shop. In principle, the required ventilation capacity is 10 times the room capacity per hour.

4. Water Supply

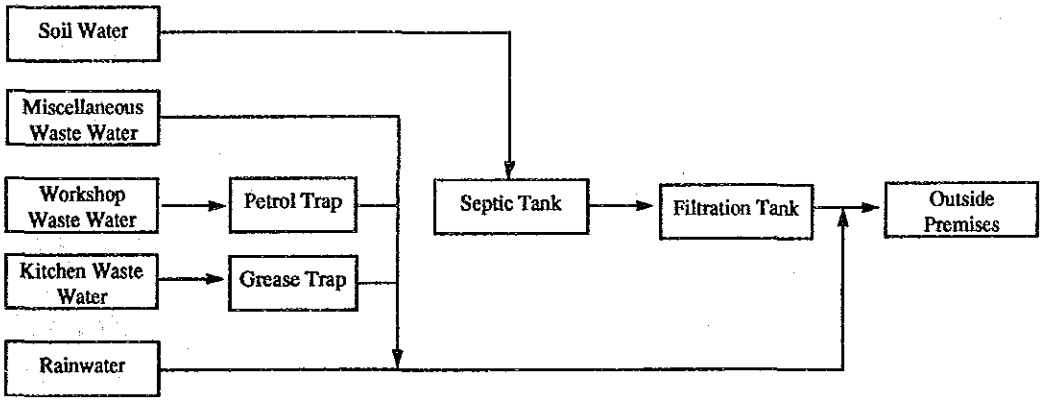
Water drawn from the existing well on the site will be supplied (at a rate of 120l/person plus the water required by the installed equipment) to consumption areas via water tank and elevated water tank.

5. Hot Water Supply

A central hot water supply system will be installed to supply hot water to the shower room, kitchen, kitchenettes and laundry, etc.

6. Water Drainage

The following five water drainage systems will be mainly employed for natural filtration at the site after treating waste water by septic tank, petrol trap or grease trap.



7. Gas Supply

Two outdoor gas supply facilities using LPG cylinders will be established near the boiler room of the workshop building and the kitchen of the dormitory building.

8. Sanitary Fixtures

Sanitary fixtures will be installed in the toilets and other relevant places. Many of the water closets for the staff will be oriental-style water closets.

9. Compressed Air Supply

Compressed air supply will be provided for necessary areas of the workshop building.

10. Kitchen

Cooking facilities to cater for 20 people will be provided for the kitchen in the dormitory building.

11. Refrigerator

A refrigerator to store food will be provided for the above kitchen.

12. Fire-Fighting Facilities

- indoor fire plugs in workshop building : 3

- fire extinguishers (ABC power extinguisher: 10kg)

workshop building	: 8
dormitory building	: 4
boiler room	: 2

The main electrical equipment and building services facilities to be provided for each shop/room are listed in Table 4-3. Lighting will be provided for all the shops/rooms.

Table 4-3 Provision of Building Service Facilities (1/2)

	Air-Conditioning	Ventilat-ion	Water	Hot Water	Compressed Air	Gas	Telephone	Fire-Fighting
(1) Workshop Building								
- Chassis Shop		O				O		O
- Suspension Shop		O				O		O
- Welding Shop		O				O		O
- Engine Shop		O				O		O
- Engine Testing Room		O				O		O
- Control Room		O						
- Transmission & Hydraulic Unit Shop		O				O		O
- Machining Shop		O				O		
- Battery Charging Room		O						
- Electrical Equipment Shop		O						
- Fuel Injection Pump Testing Room		O				O		
- Tool Room		O						
- Parts Storage		O						
- Administration Office		O					O	O
- Reception		O					O	
- Rest Room/Locker Room		O						O
- Shower Room		O	O	O				
- Kitchenette		O	O		O			
- Toilet		O	O					
- Boiler Room		O	O		O			O
- Meeting Room		O						
- Training Room		O						
- Engineers' Office	O	O					O	
- Workshop Manager's Office	O	O					O	
- Secretary's Room		O					O	
- Storage		O						
- Administration Office		O					O	
- Kitchenette		O						
- Toilet		O	O					

Table 4-3 Provision of Building Service Facilities (2/2)

	Air-Conditioning	Ventilat-ion	Water	Hot Water	Compressed Air	Gas	Telephone	Fire-Fighting
(2) Dormitory Building								
- Bedroom		O						O
- Shower Room/Toilet		O	O	O				
- Multi-Purpose Room		O						O
- Kitchen		O	O	O	O			O
- Reception Office		O					O	
- Storage		O						
- Toilet		O	O					
- Food Storage		O						
- Boiler Room		O	O		O			O
- Warden's Room		O					O	O
- Laundry		O	O					
- Toilet		O	O	O				
(3) Auxiliary Buildings								
- Woodwork Shop		O						
- Paint Shop		O				O		
- Tyre & Repair Shop		O						
- Oil & Grease Storage	O	O						
- Petrol Stand	O	O				O		
- Washing Bay		O				O		
- Loading Bay		O						
- Water Tank		O						

6) Finish

In principle, the materials required for the finishing work for the planned buildings will be procured locally. (Structural steels and door/window frames which involve manufacture or processing jobs, corrugated steel roof sheets, concrete floor hardener and others which are unobtainable locally will be procured from Japan). The following points must be taken into consideration in the selection of materials.

- high durability in view of easy maintenance
- compatibility with Yemeni standards or equivalents in view of easy maintenance
- wide availability and popular use locally to ensure high work quality and to shorten the construction period

The main materials to be used for exterior and interior finishing are listed below.

① Exterior Finishing

i) Workshop and Dormitory Buildings

Roof:	bituminous membrane waterproofing with cement tiles (for Reinforced Concrete roof) or long corrugated steel sheets (for chassis shop and undercarriage shop)
External Walls:	mortar finish with emulsion paint coating
Doors and Windows:	aluminium frames, aluminium doors and steel shutters
Apron:	trowel finish concrete
Gutter:	vinyl chloride

ii) Auxiliary Buildings

Roof:	long corrugated steel sheets
External Walls:	exposed concrete and fair-faced concrete block work

Doors and Windows: steel shutters

iii) Petrol Stand and Washing Bay

Floor: trowel finish concrete

Ceiling: exposed corrugated steel sheets and exposed structural steel with OP coating

Columns: exposed structural steel with OP coating

② Interior Finishing

i) Workshop Buildings

Chassis Shop/Undercarriage Shop

Floor:	trowel finish concrete
Walls:	mortar finish with emulsion paint coating
Ceiling:	exposed corrugated steel sheets with insulation materials and exposed structural steel with oil paint coating

Other Shops/Passages/Boiler Room

Floor:	trowel finish concrete
Walls:	mortar finish with emulsion paint coating
Ceiling:	concrete with cement plastering and emulsion paint coating

Entrance Hall / Corridors / Staircases / Offices / Workshop Manager's Office / Meeting Room / Training Room/Engineers' Office

Floor	terrazzo tiles
Walls	mortar finish with emulsion paint coating
Ceiling	rockwool acoustic board

Rest Room/Locker Room

Floor	terrazzo tiles
Walls	mortar finish with emulsion paint coating
Ceiling	concrete with cement plastering and emulsion paint coating

Toilets/Shower Room

Floor	terrazzo tiles
Walls	tiles (H=2,100)
Ceiling	flexible board with emulsion paint coating

ii) Dormitory Building

Entrance Hall / Corridors / Staircase / Office /Bedrooms / Multi-Purpose Room / Warden's Room / Kitchen

Floor	terrazzo tiles
Walls	mortar finish with emulsion paint coating
Ceiling	concrete with cement plastering and emulsion paint coating

Toilets/Shower Room

Floor	terrazzo tiles
Walls	tiles (H=2,100)
Ceiling	concrete with cement plastering and emulsion paint coating

iii) Auxiliary Buildings

Carpentry Shop/Paint Shop/Tyre Repair Shop/Oil and Grease Storage

Floor	trowel finish concrete
Walls	exposed concrete and fair-faced concrete block work
Ceiling	exposed corrugated steel sheet and exposed structural steel with oil paint coating

4.3.2 Equipment Plan

(1) Selection of Equipment for Workshop

The design policy for the provision of equipment has already been explained in 4.1.6, and the tools and equipment, etc., to be provided for each shop are listed in detail below.

Table 4-4 Equipment List (1/8)

(Chassis Shop)

Item No.	Reference No.	Item	Specifications	Qty.	Remarks
1		Overhand crane	3, 5 ton	1	each
2		Hand truck	300kg	2	
3		Pallet truck	2,000kg	1	
4		Sling chain kit	1-3.2 ton	1	
5		Sling wire kit	9mm, 12mm	1	each
6		Portable hydraulic jack	30 ton, 50 ton	2	each
7		Parts shelves		5	
8		Parts wagon		3	
9		Mechanic tool set	for vehicles	2	
10		Mechanic tool set	for const. equip	4	
11		Tool cabinet		2	
12		Parts cleaner		1	
13		Hydraulic garage jack	10 ton	2	
14		Portable lubricator	for engine	2	
15		Grease lubricator		2	
16		Transmission jack		1	
17		Tractor support	for front	2	
18		Tractor support	for rear	4	
19		Drum carrier		1	
20		Other equip. & tools		1	set

Table 4-4 Equipment List (2/8)

(Engine Shop)

Item No.	Reference No.	Item	Specifications	Qty.	Remarks
1		Monorail crane	3 ton	1	
2		Jib crane	1 ton	1	
3		Workbench with drawers		2	
4		Hand truck	300kg	2	
5		Bench drill press		1	
6		Engine stand	3,000kg	2	
7		Parts shelves		4	
8		Parts wagon		2	
9		Cylinder head workbench		1	
10		Valve seat refacer		1	
11		Valve spring tester		1	
12		Microphone		2	
13		Cylinder gauge		2	
14		Outside micrometer caliper		2	set
15		Piston heater		1	
16		Connecting rod aligner		1	set
17		Tool cabinet		2	
18		Mechanic tool set	metric	1	set
19		Cylinder head test stand		1	
20		Parts cleaner		1	
21		Mobil floor crane	1 ton	1	
22		Other equip. & tools		1	set

Table 4-4 Equipment List (3/8)

(Engine Testing Room)

Item No.	Reference No.	Item	Specifications	Qty.	Remarks
1		Engine dynamometer	400 ps/4,000 rpm	1	
2		Fuel consumption meter		1	
3		Non-resistant muffler		1	
4		Diesel timing tachometer		1	
5		Liquid column manometer		1	
6		Workbench with drawers		1	
7		Exhaust gas analyzer		1	set
8		Other equip. & tools		1	set

(Fuel Injection Test Room)

Item No.	Reference No.	Item	Specifications	Qty.	Remarks
1		Diesel fuel injection pump tester		1	set
2		Cummins P-T pump tester		1	
3		Injector tester		1	
4		Nozzle tester		1	
5		Workbench		1	
6		Mechanic tool set		1	
7		Parts shelf		1	
8		Other equip. & tools		1	set

Table 4-4 Equipment List (4/8)

(Electrical Room)

Item No.	Reference No.	Item	Specifications	Qty.	Remarks
1		Universal electrical equipment tester		1	
2		Armature tester		1	
3		Insulation tester		1	
4		Headlight tester		1	
5		Workbench		1	
6		Parts shelf		1	
7		Other equip. & tools		1	set

(Power Line & Hydraulic Room)

Item No.	Reference No.	Item	Specifications	Qty.	Remarks
1		Mechanic tool set		1	
2		Tool cabinet		1	
3		Parts shelves		2	
4		Workbench with drawers		2	
5		Hydraulic cylinder service stand		1	
6		Jib crane		1	
7		Hydraulic component universal tester		1	
8		Hydraulic hose cap cramper		1	set
9		Other equip. & tools		1	set

Table 4-4 Equipment List (5/8)

(Battery Charging Room)

Item No.	Reference No.	Item	Specifications	Qty.	Remarks
1		Battery carrier		1	
2		Silicon quick charger		2	
3		Battery tester		1	
4		Water purifier		2	

(Machine Shop)

Item No.	Reference No.	Item	Specifications	Qty.	Remarks
1		Jib crane	1 ton	2	
2		Hacksaw machine		1	
3		Bench drill machine		1	
4		Bench grinder		1	
5		Mobil floor crane		1	
6		Drill chank	straight	1	
7		Drill chank	taper	1	
8		Tool locker & cabinet		5	
9		Parts shelves		3	
10		Cutter (lathe, milling) set		1	each
11		Workbench		2	
12		Other equip. & tools		1	set

(Welding & Body Repair Shop)

Item No.	Reference No.	Item	Specifications	Qty.	Remarks
1		Semi-auto welder	CO2	1	
2		Engine drive welder		2	
3		Gas welder set		2	
4		High-speed cutter		1	
5		Hydraulic press	100 ton	1	
6		Other equip. & tools		1	set

Table 4-4 Equipment List (6/8)

(Undercarriage Shop)

Item No.	Reference No.	Item	Specifications	Qty.	Remarks
1		Roller idler press	100 ton	1	
2		Track press	200 ton	1	
3		Shoe bolt impact wrench		1	
4		Electric grinder		1	
5		Disc grinder		2	
6		Other quip. & tools		1	set

(Tool Room)

Item No.	Reference No.	Item	Specifications	Qty.	Remarks
1		Set of special tools and metric-inch size standard tools, and measurement tools		1	set

Table 4-4 Equipment List (7/8)

(Other Facilities)

Item No.	Reference No.	Item	Specifications	Qty.	Remarks
		Paint Shop			
1		Air compressor and painting & dry up equipment		1	set
		Tyre Shop			
2		Tyre remover	heavy, light	1	each
3		Tyre lever		3	
4		Tyre service tools		2	set
5		Bead breaker		2	
6		Vulcanizer set		2	
7		Air compressor		1	set
8		Wheel balancer		1	
		Carpentry Shop			
9		Band saw		1	
10		Jig saw		1	
11		Electric planer		1	
12		Boring machine		1	
13		Motor disk saw		1	
14		Motor drill		1	
15		Motor planer		1	set
16		Hand set		1	
		Others			
17		Fuel stand (gasoline, diesel)	with tank	1	each
18		Oil and grease storage		1	
19		Washing stand	for vehicle	1	set
20		Washing stand	for const.equip.	1	set
21		Air compressor		1	
22		Unloading deck		1	
23		Water pool	for engine test	1	

Table 4-4 Equipment List (8/8)

(Vehicles)

Item No.	Reference No.	Item	Specifications	Qty.	Remarks
1		Station wagon		1	
2		Pick-up		1	
3		Mobil workshop		1	
4		Forklift	3 ton	1	

(OJT Materials)

Item No.	Reference No.	Item	Specifications	Qty.	Remarks
1		Fuel injection pump		1	
2		Turbocharger		1	
3		Torqueflow transmission		1	
4		Transmission control valve		1	
5		Steering clutch		1	
6		Track roller		1	
7		Hyd. control valve		1	

(Plastic Models)

Item No.	Reference No.	Item	Specifications	Qty.	Remarks
1		Planetary gears		1	
2		Torque converter		1	

(AV Equipment)

Item No.	Reference No.	Item	Specifications	Qty.	Remarks
1		Overhead projector		1	set
2		Slide film projector		1	set
3		TV and video deck		1	set
4		Video camera		1	set

(2) Selection of Spare Parts

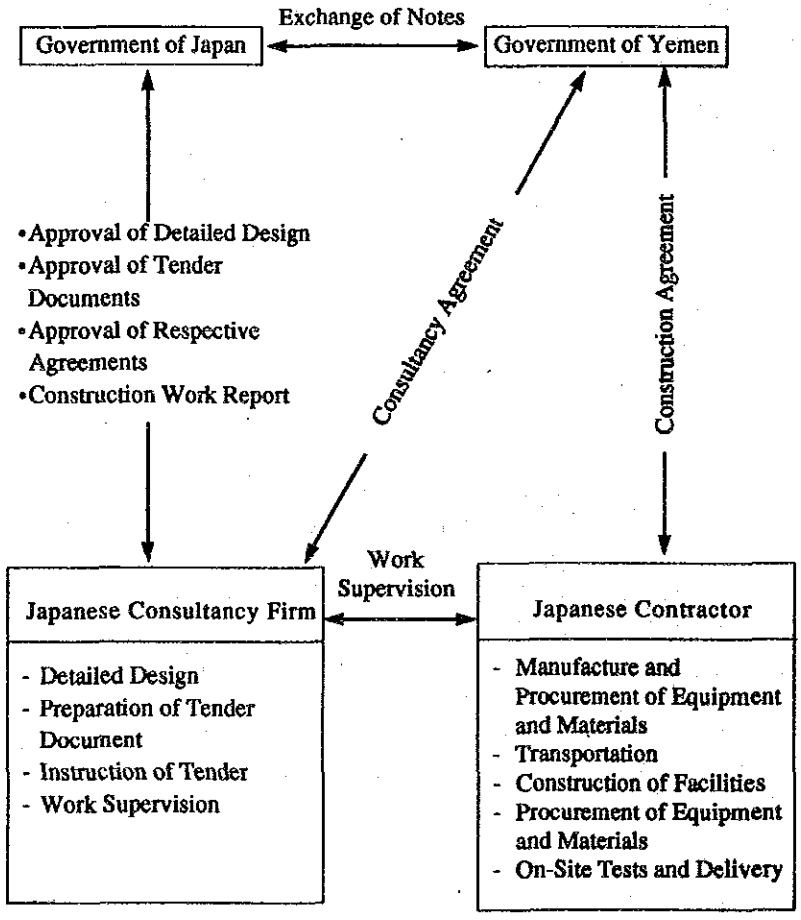
As already explained in 3.3.6, the provision of spare parts for construction machinery and vehicles is not included in the Project in view of the current spare parts inventory level of the GCRB and the relevant aid programme of the World Bank. Nevertheless, a minimum amount of spare parts for service equipment (to cover 2-3 percent of the parts and components of this equipment) will be provided.

4.4 Project Implementation Plan

4.4.1 Project Implementation Policy

(1) Project Implementation Body

Assuming the implementation of the Project based on Japanese grant aid cooperation, the overall structure of project implementation will take the following form.



The project implementation body on the Yemeni side will be the GCRB.

In accordance with Japan's grant aid cooperation system, the detailed design and the work supervision will be assigned to a Japanese consultancy firm and the general contractor for the construction work will be a Japanese general construction company for both aspects of the Project, i.e., construction of facilities (buildings) and provision of equipment.

(2) Consultant

A grant aid cooperation project like the project in question requires the appointment of a consultant. Following the signing of the E/N, the GCRB must swiftly conclude a consultancy agreement with a Japanese consultant. The consultant appointed by the GCRB will then provide engineering services, including the preparation of the detailed design for both facilities and equipment, preparation of tender documents, instruction of tender and work supervision, as well as taking the overall, important responsibility for the completion of the Project.

(3) Contractor

The Japanese contractor, who is the successful tenderer in the pre-qualified open competitive tender system based on technical capability and cost competitiveness, will conclude a construction agreement with the GCRB to conduct the actual construction work for the Project.

This contractor has the obligation to construct the planned facilities (buildings) and to deliver and install the planned equipment to the satisfaction of the GCRB within the time limit set out in the construction agreement.

4.4.2 Points to Note for Construction Work

Local subcontractors should be able to carry out the construction work for the buildings planned under the Project to a satisfactory standard as discussed in 4.1.3 and 4.1.4. Nevertheless, special attention should be paid to the following points.

- All Yemeni laws and regulations must be abided by throughout the entire construction period.
- Careful consideration must be given to preventing any adverse impact of the construction work, i.e., noise, vibration and waste water, etc., on the surrounding area.

- The work schedule must take the local labour customs (Ramadan and Hajj holidays, etc.) into consideration.

- The transportation of machinery and equipment (particularly construction machinery) must not cause any damage to the existing roads and structures.

- Due attention must be paid throughout the construction period to the safety of vehicles and pedestrians using the First Ring Road in front of the Project site.

- Given the proximity of the anticipated construction sites to existing buildings, every care must be taken to avoid damage to these buildings.

- Normal business will be conducted at the existing buildings, including the warehouse, on the Project site throughout the construction period. Every care must be taken to prevent any accident or damage to third parties.

4.4.3 Work Supervision Plan

(1) Basic Principles of Work Supervision

Assuming that the Project is implemented with Japanese grant aid cooperation, the following requirements must be noted in carrying out the detailed design and work supervision.

- Thorough understanding of the background of the Project.

- Thorough understanding of the contents of the Basic Design Study Report.

- Thorough understanding of the grant aid cooperation system.

- Proper understanding of the contents of the E/N signed by both the Japanese and Yemeni governments.

- Compatibility of the Project with Yemen's national development plan and the road construction programme.

- Compatibility of the Project with the technical cooperation project under which experts will be dispatched to provide technical assistance.

Assuming that the above requirements are met, the contents of and points to note in regard to the detailed design and work supervision are outlined below.

1) Scope of Consulting Work

Following the signing of the E/N, the consultant will enter into a consultancy agreement with the Government of Yemen within the scope determined by the E/N. The scope of the consulting work is given below.

① Detailed Design

- Preparation of detailed design and tender documents.
- Securing of approval of tender documents by the Government of Yemen.
- Organization of tender, evaluation of tender results and reporting of tender results to the Government of Yemen. Witnessing of construction agreement.
- Confirmation of the scope and progress of the work to be undertaken by the Government of Yemen prior to the commencement of Project-related construction work.

② Work Supervision

- Issue of notice to proceed.
- Preparation of pre-work report.
- Discussions with parties involved in construction work prior to the commencement of the work.
- Securing of official approval for the work schedule plan and holding of work schedule meetings.
- Securing of official approval for work drawings.
- Witnessing of the inspection of materials/equipment, witnessing of construction work and the issue of relevant instructions as and when deemed necessary.
- Inspection of interim progress of the work. Inspection for final handing-over and issue of final acceptance certificates.
- Preparation of monthly progress reports throughout the construction period.
- Conducting of all necessary work for final handing-over.

- Preparation of final report and implementation of project completion procedure.

2) Important Points to Note

① Detailed Design

i) Reconfirmation of Equipment Procurement Conditions

Reconfirmation of the procurement conditions of the construction and service equipment, identified at the basic design stage, is necessary. As the construction materials and equipment will be procured locally where possible, it is important to check whether or not they meet the requirements/ specifications set by the basic design.

ii) Preparation of and Briefing on Order Documents

The contents of the order documents must comply with the objectives of the grant aid cooperation and must be thoroughly examined by both parties during the field survey for the basic design so that they can be authorised as official tender documents together with the detailed design drawings.

② Work Supervision

i) Progress Control

The work schedule shown in Table 4-6 is currently understood to be the most likely schedule for the Project. Since the Project will be implemented under Japan's grant aid cooperation system, the actual work schedule to be prepared as part of the detailed design must reflect certain conditions attached to this system. It is needless to say that the work must be completed as planned. The progress of the work can be seriously affected by the timing of the delivery of equipment, etc., to be imported. Strict progress control must be conducted on the manufacture and import of machinery/equipment, and also on the delivery of domestically procured materials/equipment.

ii) Quality Control

The materials and equipment to be procured in Yemen may not be of uniform quality, forcing some alterations of the specifications relating to materials which are established as part of the detailed design. In the case of alterations,

proper quality control of the new materials must be conducted to ensure that the original design requirements are met.

iii) Supervisors

Supervisors should arrive at the Project site as soon as the notice to proceed is issued to the contractor. At least one full-time supervisor responsible for building construction must be on-site throughout the construction period. Supervisors in such special fields as machinery, building services and electrical equipment will be dispatched in accordance with a request by the on-site supervisor to conduct specific supervisory work.

Japanese experts will also be required to conduct the factory inspection of equipment procured in Japan prior to shipment to Yemen.

4.4.4 Procurement Plan

(1) Material and Equipment Sources

The materials and equipment to be used in the Project will be procured in Yemen as long as such conditions as availability in sufficient quantity, good quality, punctual delivery and low cost, etc., are met. It appears that some 60 percent - 70 percent of the materials and equipment required will be procured locally. However, it will be necessary to import equipment for building service work and for installation at the new facilities. This is because most building service equipment and maintenance/repair equipment currently available in the local market are foreign products due to the absence of the relevant manufacturing industries in Yemen.

Table 4-5 Material and Equipment Sources

	Local Supply	Import from Japan
Building Construction	aggregates, cement, bricks, reinforcing bars, terrazzo tiles, formwork, waterproofing materials, paint, wooden doors and windows, carpets, glass	structural steels, metal doors and windows, finishing hardware, shutters, long corrugated steel sheets, specially machined products
Air-Conditioning	—	air-conditioners, ventilation fans, pipes
Plumbing	concrete pipes, sanitary fixtures (in part)	pumps, pipes, shower units, kitchen equipment, sanitary fixtures (in part)
Electrical Installation	lamps, power outlets, cables (in part)	transformer, distribution panel, telephone switchboard, lighting equipment
Equipment to be Provided	—	service (maintenance and repair) equipment, OJT teaching materials and equipment, vehicles

4.4.5 Implementation Process

(1) Scope of Work

The Government of Japan and the Government of Yemen will undertake the following work for the implementation of the Project.

1) Work to be Undertaken by Government of Japan

Buildings

① Workshop

② Dormitory

③ Carpentry shop

④ Paint shop

⑤ Tyre shop

⑥ Oil and grease storage

⑦ Petrol stand

⑧ Washing stand

Building Services Work

① Water supply facilities (including fire-fighting facilities)

② Drainage facilities (rainwater and soil water drainage facilities and oil/grease traps)

③ Substation (power cables and transformer

④ Emergency power generation unit

Other Incidental Facilities

① Septic tank and seepage pit

② Cooling water tank

③ Standard furniture

Provision of Equipment

① Equipment for the maintenance and repair of construction machinery and also for relevant OJT

② AV equipment for OJT

③ Vehicles

④ Washing equipment

⑤ Petrol filling equipment

⑥ Some spare parts and expendables for the above equipment

2) Work to be Undertaken by Government of Yemen

Actual Work

① Securing of land for construction of the planned facilities

② Ground preparation prior to the commencement of construction work and the removal of structures on the site obstructing construction work

③ Building service work

- Extension of power line to buildings:
  300KVA (3 phase 4 wires, 15KV, 50Hz)

- Extension of telephone line to buildings

- Extension of water supply line to buildings

④ Landscaping

⑤ Erection of perimeter fence and gate

⑥ Construction of two guardhouses

⑦ Construction of premise roads

⑧ Provision of furniture and fixtures (including curtains)

Additional Work and Cost Sharing

① Provision of necessary information and data for the implementation of the Project.

② Ensurance of prompt customs clearance of machinery and equipment required for the Project and their exemption from any domestic taxes.

③ Exemption of Japanese companies and personnel involved in the Project from any domestic taxes (customs duties, income tax and VAT, etc.).

④ Accordance to Japanese personnel of all facilities necessary for them to conduct their Project-related assignments during their stay inYemen.

⑤ Bearing of all maintenance expenses of the planned buildings and equipment.

⑥ Make the following arrangements and bear the cost incurred

- Banking services

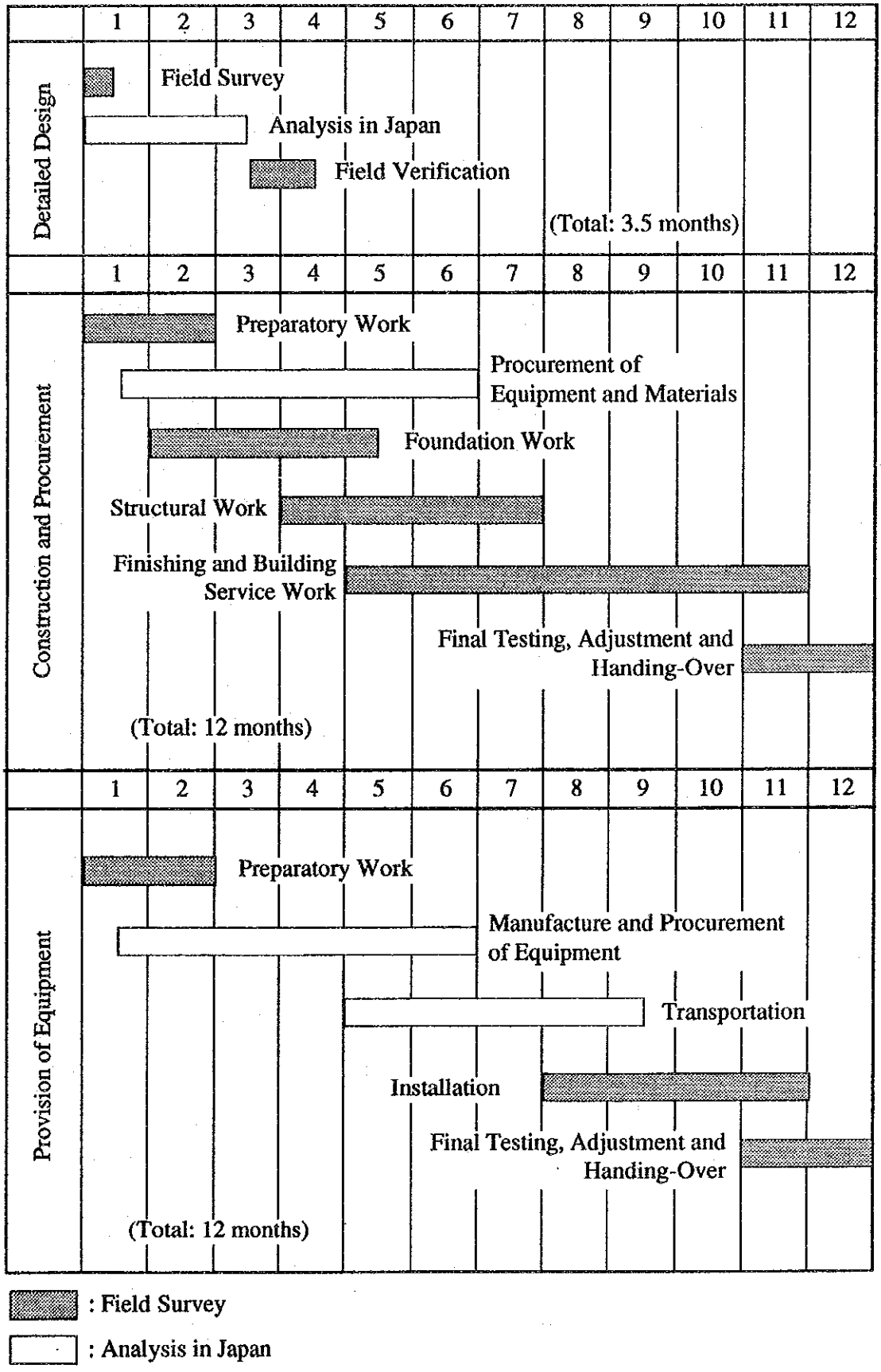
- Electricity and telephone services

- All costs relating to official permits or required authorization.

(2) Project Implementation Schedule

The implementation schedule for the Project is outlined in Table 4-6.

Table 4-6 Project Implementation Schedule



CHAPTER 5 POSITIVE EFFECTS OF THE PROJECT AND CONCLUSIONS

CHAPTER 5 POSITIVE EFFECTS OF THE PROJECT AND CONCLUSIONS

5.1 Positive Effects of the Project

The construction and improvement of the road network in Yemen has been making rapid progress with an improved paved road ratio under the strong commitment of the Government of Yemen. Nevertheless, fresh efforts to not only construct new roads but to also widen existing roads (from 2 lanes to 4 lanes), and to pave gravel or earth roads with asphalt while conducting the adequate maintenance of all types of roads, are required to stimulate the further development of Yemen's economy and industries.

One of the characteristics of road work in Yemen is the harsh topography of the country. A large part of Yemen consists of mountainous areas with many undulations. Road work is often forced to cut through mountainous areas with the efficient use of such construction machinery as bulldozers and graders which play a crucial role in the progress of such work.

Despite the strong demand, there is a shortage of skilled operators, as well as technicians/mechanics, for this construction machinery, resulting in a high machinery redundancy rate of almost 40 percent. Consequently, the efficient and effective use of construction machinery, which is essential for road construction work, has not been maintained, delaying the planned completion of many road projects. The causes contributing to this high machinery redundancy rate are, among others, (1) inaccurate maintenance, (2) inappropriate handling/operation by mechanics, (3) general deterioration of machinery, (4) inadequate repair skills, (5) shortage of technicians/mechanics, (6) shortage of spare parts and (7) inadequate provision of repair facilities and equipment.

While the training of operators, technicians and mechanics for road construction machinery is currently provided by the Taiz Training Centre, the inadequate provision of training and educational facilities and equipment has made it impossible to respond to the demand for skilled technicians and mechanics.

The present Project intends to improve the above situation in Yemen by increasing the operation rate and prolonging the life of road construction machinery through the construction of a workshop. The Project also intends to use the workshop and auxiliary facilities to systematically train and educate technicians and mechanics for construction machinery through OJT at these facilities.

The implementation of the Project will result in the first workshop in Yemen which is capable of providing full-scale maintenance and repair services for construction machinery. The GCRB currently owns some 1,600 pieces of road construction machinery and equipment, of which 80 percent is distributed in northern Yemen with Sana'a located at the central point. However, only 60 percent of this machinery and equipment is currently operational. With the establishment of a reliable service system, this rate is expected to improve to 85 percent, stimulating road construction/improvement work in the area. The OJT to be provided at the new workshop for technicians of the existing workshops will improve their technical knowledge and skills with positive effects spread throughout not only northern Yemen, but also to other areas.

As such, the Project is compatible with the policy priority of the Government of Yemen of improving the country's road network as the very basis of all economic activities, and its positive effects should be felt in terms of more active and efficient road construction/improvement work. Regional development plans, other similar programmes and industrial activities will benefit from vigorous road construction/improvement work. Furthermore, the Project will contribute to the development of manpower in the road construction field.

5.2 Conclusions

The Project is compatible with the objectives of regional development plans and all other industrial/economic development programmes in such fields as agriculture, manufacturing and trade, etc.. The more efficient and effective implementation of road projects will consolidate the road network which is the basis of all socioeconomic activities in Yemen. Manpower development, which is one of the Project's objectives, will also have an indirect bearing on the development of all industries in Yemen.

The Project will result in a higher construction work efficiency in both the public and private sectors, particularly in the field of road construction, shorter construction period, improved operation rate and a longer life of construction machinery, and will reduce the construction cost through these improvements. Moreover, as Yemen is suffering from an accumulation of foreign debt, the Project could help to reduce the size of the budgetary deficit.

The implementation of the Project appears to be an urgent necessity for Yemen which spends some 20 percent of the national budget on road construction and improvement. An improved and well maintained road network resulting from the implementation of the

Project will have a significant impact on the improvement of public life and the development of Yemen's economy in which roads play a crucial role.

As described in 4.4.6, the Government of Yemen's share of the Project cost is expected to be 27.2 million YR (approximately 295 million yen). The GCRB, the implementation body of the Project, has already started the procedure to secure the necessary budgetary appropriation. In view of the overall budget sizes of the Ministry of Construction and the GCRB, there should not be much difficulty in meeting the above amount.

Following completion, the planned facilities will be run by 168 staff members, including General Manager, under the supervision of the GCRB. The GCRB is the sole agency in Yemen responsible for the improvement of roads and has a nationwide network of offices and management experience vis-a-vis the existing workshops.

Should the proposed technical cooperation involving the dispatch of Japanese experts to provide technical guidance be implemented, the management of the new workshop will be improved to further consolidate the positive effects of the Project.

The above analysis confirms that the Project satisfies the objectives of Japanese grant aid cooperation and its implementation is deemed highly appropriate. It is, therefore, believed that the Project should be urgently implemented with the provision of both Japanese grant aid cooperation and technical cooperation.

5.3 Recommendations

The Government of Yemen is required to conduct the following tasks for the Project to be implemented based on Japanese grant aid cooperation and technical cooperation, and for the workshop to be efficiently run by the Yemeni side to achieve the Project objectives.

(1) Tasks Relating to Management

1) The establishment of the necessary organization, the securing of sufficient manpower and budgetary appropriation for the smooth running of the facilities after their completion.

2) The securing of capable instructors, the provision of preferential treatment in terms of promotion and wages for those completing OJT at the new workshop so that the OJT provided can be a continued success in the upgrading of the technical skills of

trainees, and in the spread of high levels of maintenance and repair skills throughout the country.

3) The establishment of a reliable spare parts supply system to allow the quick and efficient obtaining of various parts, supported by the relevant budgetary appropriation for the procurement of spare parts for equipment installed at the workshop and construction machinery in order to maintain a high operation rate of the equipment to be provided under the Project.

(2) Tasks Relating to Project Completion

1) It is imperative that the Government of Yemen complete all its assigned work in connection with the Project, particularly the construction of premise roads, guardhouses and perimeter fence, ground preparation, removal of obstructing structures on the project site and the extension of such building services as electricity, water and telephone to the site, prior to the commencement of the construction work to be conducted by the Japanese side.

2) It is important that the Government of Yemen provide the necessary facilities required by the Japanese side in terms of the swift customs clearance of imported materials and equipment during the construction work by the Japanese side. Moreover, a swift response or handling by the Yemen side of the tasks relating to the implementation of the Project is required whenever such tasks arise.

APPENDIX

Appendix-1 List of Study Members

Appendix-2 Study Schedule

Appendix-3 List of Interviewee,

Appendix-4 Minutes of Discussions

Appendix-5 Items to be Undertaken by Government of Yemen

Appendix-6 Country Data

Appendix-7 Report for Site Investigation

Appendix-8 Spot Elevation Map

Appendix-9 Basic Design Drawings

Appendix-10 Japanese Economic Cooperation for Yemen (1976-1990)

Appendix-11 List of Collected Material

Appendix-12 List of Cited Material

Appendix-1

List of Study Members

Appendix-1 List of Study Members

(1) Basic Design Study Team

Mr. Ryo YAMANA	Team Leader Manager of Machinery Division First Maintenance Department Second Operation Bureau Honshu-Shikoku Bridge Authority
Mr. Shinichi MORI	Grant Aid Planner, Grant Aid Division Economic Cooperation Bureau Ministry of Foreign Affairs
Mr. Hisashi KUROKOUCHI	Architectural Planner Yachiyo Engineering Co., Ltd.
Mr. Takayasu KASE	Architect Yachiyo Engineering Co., Ltd.
Mr. Akira SHIMA	Construction Machinery Planner Yachiyo Engineering Co., Ltd.
Mr. Masashi KOMIYA	Building Facility Planner Yachiyo Engineering Co., Ltd.
Mr. Yutaka TAKAHASHI	Cost Estimation and Field Survey Engineer Yachiyo Engineering Co., Ltd.
Mr. Shintaro MORI	Interpreter Yachiyo Engineering Co., Ltd.

(2) Draft Report Explanation Team

Mr. Ryo YAMANA	Team Leader Manager of Machinery Division First Maintenance Department Second Operation Bureau Honshu-Shikoku Bridge Authority
Mr. Toshiyuki IWAMA	Second Basic Design Study Division Grant Aid Planning and Survey Department Japan International Cooperation Agency (JICA)
Mr. Hisashi KUROKOUCHI	Architectural Planner Yachiyo Engineering Co., Ltd.
Mr. Takayasu KASE	Architect Yachiyo Engineering Co., Ltd.
Mr. Akira SHIMA	Construction Machinery Planner Yachiyo Engineering Co., Ltd.
Mr. Shintaro MORI	Interpreter Yachiyo Engineering Co., Ltd.

Appendix-2

Study Schedule

(1) Basic Design Study Team

Date	Movement	Accom-modation	Activities
Apr. 11 (Sat.)	Arrive at Sana'a	Sana'a	
Apr. 12 (Sun.)			Courtesy call and discussion at the Japanese Embassy Courtesy call, explanation of Inception Report, Questionnaire and tentative schedule of the study to GCRB
Apr. 13 (Mon.)	Sanaa to Taiz	Taiz	Survey of existing workshop
Apr. 14 (Tue.)	Taiz to Aden		Ditto
Apr. 15 (Wed.)	Aden to Sana'a	Sana'a	Site survey in Sana'a Preparation of geological and topographic survey at site
Apr. 16 (Thu.)			Discussion with GCRB
Apr. 17 (Fri.)			Internal Meeting
Apr. 18 (Sat.)			Explanation of draft of Minutes of Discussions (M/D) and discussion with GCRB
Apr. 19 (Sun.)			Signing of the M/D
Apr. 20 (Mon.)	Leave Sana'a (Government members, Mr. Yamana and Mr. Mori)		Survey of IBB Workshop Market survey Collection of data
Apr. 21 (Tue.)			Survey of Taiz Workshop Market survey Collection of data
Apr. 22 (Wed.)			Discussion with GCRB
Apr. 23 (Thu.)			Meeting and discussion with General Corporation for Elec-tricity and Water & Sewage
Apr. 24 (Fri.)			Internal Meeting

Date	Movement	Accom-modation	Activities
Apr.25(Sat)	Sana'a to Hodeidah		Discussion with GCRB and related organization Market survey Collection of data
Apr. 26 (Sun.)	Hodeidah to Taiz		Ditto
Apr. 27 (Mon.)	Taiz to Aden		Ditto
Apr. 28 (Tue.)	Aden to Sana'a		Preparation of field report Market survey Collection of data of boring test and topographic survey at site
Apr. 29 (Wed.)			Ditto
Apr. 30 (Thu.)	Leave Sana'a (2 Members Mr. Komiya and Mr. Takahashi)		Ditto Market survey Collection of data
May 1 (Fri.)			Ditto
May 2 (Sat.)			Ditto
May 3 (Sun.)			Discussion with GCRB on the field report Market survey
May 4 (Mon.)			Ditto
May 5 (Tue.)			Ditto
May 6 (Wed.)			Farewell Visit for GCRB and Japanese Embassy
May 7 (Thu.)	Leave Sana'a (4 members Mr. Kurokochi, Mr. Shima, Mr. Kase and Mr. Mori)		All members left Sanaa
May 9 (Sat.)			Arrive in Tokyo

(2) Draft Report Explanation Team

Date	Movement	Accom-modation	Activities
Jul. 18 (Sat.)	Leave Narita	Frankfurt	Departure of the survey team from Japan
Jul.19 (Sun.)	Leave Frankfurt Arrive Sana's	Sana'a	Arrival of the survey team in Yemen
Jul.20 (Mon.)			Courtesy call at GCRB, Courtesy call and discussion at the Japanese Embassy, Explanation of and discussion with GCRB
Jul.21 (Tue.)	Leave Sana'a Arrive at Hodeidah	Hodeidah	Inspection of the road between Sana'a and Hodeidah Visit GCRB Hodeidah Branch
Jul.22 (Wed.)	Leave Hodeidah Arrive at Sana'a	Sana'a	Inspection of GCRB Workshop and survey of newly imported construction machinery Inspection of the road Hodeidah and Sana'a
Jul.23 (Thu.)		Sana'a	Discussion with GCRB on Draft Report Explanation of and discussion with GCRB on M/D
Jul.24 (Fri.)		Sana'a	Amendment and supplementation of M/D
Jul.25 (Sat.)		Sana'a	Confirmation of the content of M/D Courtesy call on the Minister of Construction Signing of the M/D Farewell visit to the Japanese Embassy Courtesy call at the Ministry of Planning and Development
Jul.26 (Sun.)	Leave Sana'a Arrive at Paris	Paris	Departure of the survey tema from Yemen
Jul.27 (Mon.)	Leave Paris	in airplane	
Jul.28 (Tue.)	Arrive at Narita		Arrival of the survey team

Appendix-3

List of Interviewee

Appendix-3

List of Interviewee

Embassy of Japan	
Mr. Kazuo Wanibuchi	Ambassador Extraordinary & Plenipotentiary
Mr. Yuichi Ishii	Counsellor
Mr. Mitsuru Murase	First Secretary
Mr. Yasuo Nakano	First Secretary
World Bank	
Mr. Terje Wolden	
Mr. Luis Revuelta	
Ministry of Planning and Development:	
Mr. A. El-Agil	Deputy Minister
Mr. Hamud Al-Hamdani	Director of Bilateral Cooperation with Japan,
Mr. Izzi Al-Mansoob	Director of Contracting Department
Ministry of Construction:	
H. E. Abudullah H. Al-Korshomi	Minister of Construction
(Aden Branch)	
Mr. Anis Masir Al-Samawi	Deputy Minister of Construction, Aden Branch
Mr. Husein Muhammad Nasir	General Director for Statistics and Planning
General Corporation for Roads and Bridges:	
(Headquarters)	
Mr. Abdullah Haify	Vice Chairman
Mr. Kassim Abdul Kadir Mohamedoh	Department Director of Planning Statistics & Monitoring Department
Mr. Fadhel Al-Junaid	General Director for Supervision Department
Mr. Abdulhamid Almutawakel	General Director for Design Department
Mr. Husein Abdulkarim Rashid	General Director for Studies
Mr. Yahya Ali Alakwa	Engineer for Construction Department
Mr. Abdullah Al-Kibsi	Manager of Construction Department
Mr. Ahmad Abdulwahid	General Director for maintenance
Mr. Abdo Saeed	General Director for Traffic Department

Mr. Mahmood Al-Moshigi	General Director for Training
Mr. Michaeel Atallah	Training Expert
Mr. Muhammad Al-Ghazali	General Director of Mechanical Department
Mr. Nashir kadri karbash	Purchase Manager
Mr. Suleiman Naser	Manager International & Bilateral Relations
Mr. Abdulkareem Al-Haifi	General Director of Construction Department
Mr. Thabet Shiban	Manager for Survey Department
Mr. Yahya Al Ashwai	Design Engineer of Design Department
Mr. Behrooz Rohani	Design & Project Engineer

(Sana's Workshop)

Mr. Ali Al Amry	Manager of Sana's Workshop
Mr. Ahmed El Sunidar	Manager of General Stores
Mr. Abdalla El Husam	Manager of Stores
Mr. Ahmed Abbas El Mahdy	General Supervisor for Plants

(Ibb Workshop)

Mr. Suleiman	Manager of Ibb Branch
Mr. Muhammad Ahmad Mansur	Engineer

(Taiz Training Center)

Mr. Abdullah Fully	Manager of Taiz Branch
Mr. Abdulkadir Fully	Manager of Taiz Training Center
Mr. Tilack Raj Setia	Trainer of Mechanic
Mr. Ahmed Ali Ati	Assistant Manager of Mechanical Department
Mr. Mohammed Abdutah Saif	Welding Teacher
Mr. Ali Abdullah Nasir	Manager of Workshop

(Aden Vocational Training Center)

Mr. Isam Abduh Ali	Manager of Aden Vocational Training Center
Mr. Fahd Ahmad Hasan	Technical Assistant Manager

(Aden Workshop)

Mr. Ghalib Qabbasi	Workshop Superintendent
Mr. Abdullah Muhammad Rudaini	Manager of Warehouse

(Sana's-Hodeidah Road Project)

Mr. Saeed Ahmad Akhtar	Resident Engineer

(Hodeidah Workshop)

Mr. Mohammed Sallam	Manager of Hodeidah Workshop
Mr. Muhammad Ahmad Zaim	Deputy Manager of Hodeidah Workshop

General Corporation for Water and Sewerage:

Water Department (Sana's Branch)

Mr. Hasan Al-Mutawakkil	Manager of Purchase Department
Mr. Abdullah Ismail Al-Mutawakkil	Manager of Sanitary Department

Sewerage Department (Sana's Branch)

Mr. Monir Mon'd Al-Gahafi	Manager of Maintenance and Operation Dept.

General Corporation for Electricity:

(Sana's Branch)

Mr. Mohamed Saif Ghanim	Manager of Sana's Branch

Sana's University:

Dr. ALi M. Al-Ashwal	Dean of the faculty

Ministry of Oil and Mineral Resources:

Mr. Abwbaker Al-Maisari	LPG project manager
Mr. Abdullah Jahhaf	Manager of Sana's Branch
Mr. Muhammad Ali Al-Zariga	Deputy Manager of Sana's Branch

Yemen Petroleum Co.:

Mr. Kais Ali Shaher	Technical Manager
Mr. Uaamah Ali Qasim	Deputy Commercial Manager

Military Engineering Corporation:

Mr. Fadal Mashor	Deputy Manager
Mr. Hamed Al-Sabri	Manager of Roads Department
Mr. Mohamed Ali Saeed	Manager of Ministry Works Department

Appendix-4

Minutes of Discussions

Appendix-4 Minutes of Discussions

(1) Basic Design Study

MINUTES OF DISCUSSIONS
BASIC DESIGN STUDY ON THE PROJECT FOR
THE ESTABLISHMENT OF THE WORKSHOP FOR
ROAD CONSTRUCTION MACHINERY IN THE REPUBLIC OF YEMEN

Based on the results of the Preliminary Study, the Japan International Cooperation Agency (JICA) decided to conduct a Basic Design Study on the Establishment of the Workshop for Road Construction Machinery in the Republic of Yemen (hereinafter referred to as "The Project").

JICA sent to the Republic of Yemen a study team, which is headed by Mr. Ryo Yamana, Manager of Machinery Division, First Maintenance Department, Second Operation Bureau, Honshu-Shikoku Bridge Authority, and is scheduled to stay in the country from April 11 to May 7, 1992.

The team held discussions with the officials concerned of the Government of the Republic of Yemen and conducted a field survey at the study area.

In the course of discussions and field survey, both parties have confirmed the main items described on the attached sheets. The team will proceed to further works and prepare the Basic Design Study report.

Sana'a, April 19, 1992

Ryo Yamana
Leader
Basic Design Study Team
JICA

Abdullah H. Al Korshomi
Minister of Construction and
Chairman of General Corporation
for Roads & Bridges

19/4

19.4.1992

Abdulwali Al-Agil
Deputy Minister of Planning and
Development

ATTACHMENT

1. Title of the Project

The Project for the Establishment of the Workshop for Road Construction Machinery in the Republic of Yemen.

2. Objective

The objective of the Project is to establish a workshop for road construction machinery.

3. Project Site

The site of the Project is located at Sana'a.
(Project area and site map is attached as ANNEX-I.)

4. Executing Agency

General Corporation for Roads and Bridges, Ministry of Construction

5. Items requested by the Government of the Republic of Yemen

After discussions with the Basic Design Study Team, the following items were finally requested by the Yemeni side.

(1) Construction of the buildings
   a) Workshop building
   b) Dormitory building
   c) Ancillaries (Generator Shed, Garage and Fuel Stand)

(2) Procurement of the equipment

a) Workshop equipment

b) Vehicles (Microbus and Station Wagon)

c) Emergency generator set

d) Mobile workshop

e) Equipment for OJT (On the Job Training)

f) Standard furniture for dormitory

However, the final items of the Project will be decided after further studies through consultation with the authorities concerned in Japan.

6. Japan's Grant Aid System

(1) The Government of the Republic of Yemen understood the system of Japan's Grant Aid explained by the Basic Design Study Team.

(2) The Government of the Republic of Yemen will take necessary measures described in ANNEX-II, for smooth implementation of the Project on condition that the Grant Aid Assistance by the Government of Japan is extended to the Project.

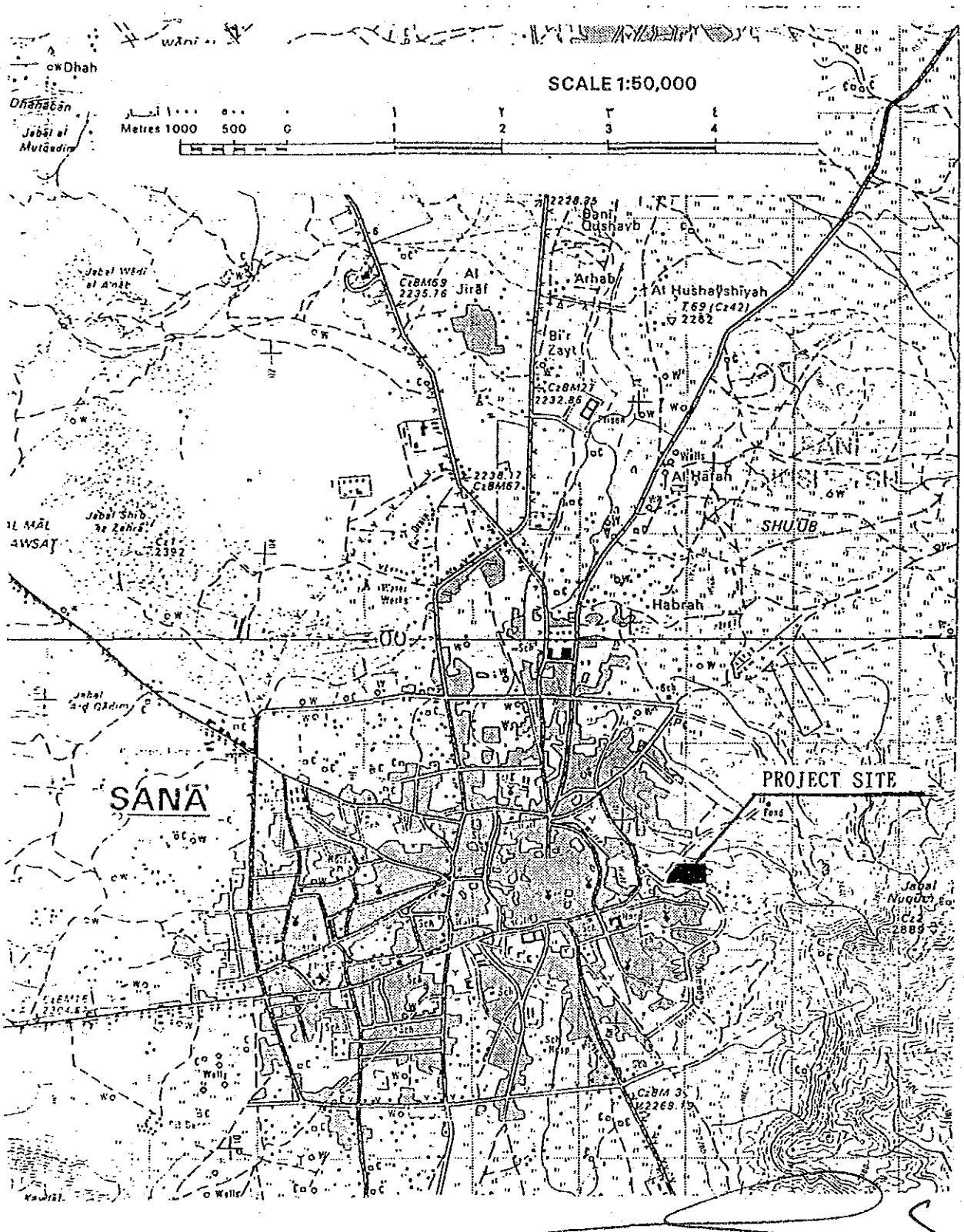
7. Schedule of the Study

(1) The Basic Design Study Team will conduct further studies in Yemen until May 7, 1992.

(2) JICA will prepare the draft report in English and dispatch a mission in order to explain its contents around July, 1992.

(3) In case that the contents of the draft report is accepted in principle by the Yemeni side, JICA will complete the final report and send it to the Government of the Republic of Yemen around October, 1992.

ANNEX-I LOCATION MAP

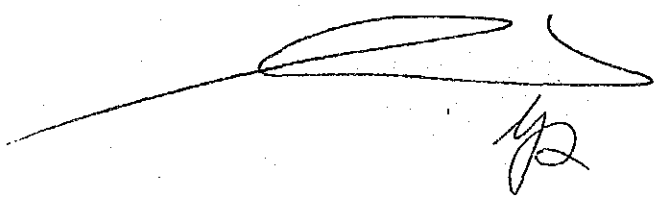


ANNEX-II:

Necessary measures to be taken by the Government of the Republic of Yemen in case that Japan's Grant Aid is executed are as follows:

1. To secure a lot of land necessary for the construction of the building and facilities including temporary land for a construction liaison office, warehouse, stockyard, etc.
2. To clear, level and reclaim the Project site, when needed, prior to commencement of the construction.
3. To undertake incidental outdoor works such as gardening, fencing, gates and exterior lighting in and around the Project site.
4. To construct the access road to the Project site prior to commencement of the construction.
5. To provide following and other incidental facilities to the Project site prior to commencement of the works.
   1) Electricity distribution line to the site
   2) Water supply line to the site
   3) Drainage and sewage line from the site
   4) Telephone trunk line to the main distribution panel to be installed in a building
   5) General furniture such as carpets, curtains, tables, chairs, etc., and office equipment
6. To bear payment commissions to the Japanese foreign exchange bank for the banking services based upon the Banking Arrangement (B/A).
7. To exempt Japanese nationals from customs duties, internal taxes and other fiscal levies which may be imposed in the Republic of Yemen with respect to the supply of the products and services under the Verified Contracts.
8. To accord Japanese nationals whose services may be required in connection with the supply of the products and the services under the Verified Contracts such facilities as may be necessary for their entry into the Republic of Yemen and stay therein for the performance of their work including preparation of ID card for them.

9. To bear all the expenses, other than those covered by the Grant, necessary for the construction of the facilities as well as for the transportation and the installation of the equipment.
10. To coordinate and solve any matters related which may arise with third party and inhabitants living in the Project area during implementation of the Project.
11. To provide necessary data and information for detailed design.
12. To give permission required for boring and topographic survey at the Project site, if necessary.
13. To take necessary actions to expedite the approval for executions of the Project by the authorities concerned in the Republic of Yemen.
14. To witness and confirm by the authorities concerned when site test are carried out at the time of construction.
15. To take necessary measures for inhabitant's cooperation and traffic control, if necessary.
16. To provide disposal places of the soil, water, etc., discharged during the construction period.
17. To ensure prompt unloading and customs clearance at ports of disembarkation in the Republic of Yemen and internal transportation therein of the products purchased under the Grant.
18. To ensure that the facilities constructed and the products purchased under the Grant be maintained and used properly and effectively for the execution of the Project.



(2) Draft Report Explanation Team

MINUTES OF DISCUSSIONS

BASIC DESIGN STUDY ON THE PROJECT FOR
THE ESTABLISHMENT OF THE WORKSHOP FOR ROAD CONSTRUCTION MACHINERY
IN
THE REPUBLIC OF YEMEN

(CONSULTATION ON DRAFT REPORT)

In April 1992, Japan International Cooperation Agency (JICA) dispatched a Basic Design Study Team on the Project for the Establishment of the Workshop for Road Construction Machinery (hereinafter referred to as " the Project ") to the Republic of Yemen, and has prepared the draft report of the basic design study through examining the results of the study in Japan.

In order to explain the components of the draft report to the Government of Yemen as well as to consult with Yemeni side on the contents of the report, JICA sent to Yemen a study team, which is headed by Mr. Ryo Yamana, Manager of Machinery Division, First Maintenance Department, Second Operation Bureau, Honshu-Shikoku Bridge Authority, and is scheduled to stay in the country from July 19, 1992 to July 26, 1992.

As a result of discussions, both parties confirmed the main items described on the attached sheets.

Sana a, July 25, 1992

Ryo Yamana

Mr. Ryo Yamana
Leader
Draft Report Explanation Team
Japan International Cooperation Agency

Mr. Abdullah H. Al Korshomi
Minister Construction and
Chairman of General Corporation
for Roads & Bridges

Mr. Abdulwali Al-Agil
Deputy Minister of Planning and
Development

25.7.92

ATTACHMENT

1. Components of Draft Report

The Government of Yemen has agreed and accepted in principle the components of the draft report proposed by the team. The items agreed during the discussions are summerized as Annex Ⅲ.

2. Japan's Grant Aid system

(1) The Government of Yemen has understood the system of Japan's Grant Aid including further schedule of the study explained by the team.

(2) In addition to the AnnexⅡ of the Minutes of Discussions signed and exchanged on April 19, 1992 as attached in Annex Ⅱ, the Government of Yemen shall take the measures described in Annex Ⅰ for smooth implementation of the Project on condition that the grant aid by the Government of Japan is extended to the Project.

3. Further schedule of the study

The team will make the final report in accordance with this minutes of discussions, and send it to the Government of Yemen around October 1992.

4. Operation and maintenance for the facilities

The Government of Yemen confirmed the allocation of necessary budget for the works including construction, operation and maintenance of the facilities and equipment to be constructed under the Project.

ANNEX I

In addition to Annex II, measures shall be taken by the Government of Yemen in case Japan s Grant Aid is extended.

1. To take necessary assistance in case of the stoppage of electricity and water during a construction period.

2. To dismantle and remove the existing facilities not to be used for the Project in the Project site.

3. To provide a bench mark at the site.

4. To control traffic during the inland transportation of the facilities of the Project, if necessary.

5. To provide the disposal places of the surplus soil during the construction period.

6. To secure the approval for access to public and private land for the Project, if necessary.

7. To secure the approval for protection works for the existing facilities, if necessary.

8. To assign exclusive officer in charge to the Project in order to transfer the operation and maintenance technique for the Project and to witness and confirm construction when inspection are carried out.

NOTE;THIS ANNEX WAS ATTACHED WITH THE MINUTES OF DISCUSSION WHICH WAS SIGNED BY BOTH GOVERNMENTS ON APRIL 19,1992.

ANNEX II

Necessary measures to be taken by the Government of the Republic of Yemen in case that Japan's Grant Aid is executed are as follows:

1. To secure a lot of land necessary for the construction of the building and facilities including temporary land for a construction liaison office, warehouse, stockyard, etc.
2. To clear, level and reclaim the Project site, when needed, prior to commencement of the construction.
3. To undertake incidental outdoor works such as gardening, fencing, gates and exterior lighting in and around the Project site.
4. To construct the access road to the Project site prior to commencement of the construction.
5. To provide following and other incidental facilities to the Project site prior to commencement of the works.
   1) Electricity distribution line to the site
   2) Water supply line to the site
   3) Drainage and sewage line from the site
   4) Telephone trunk line to the main distribution panel to be installed in a building
   5) General furniture such as carpets, curtains, tables, chairs, etc., and office equipment
6. To bear payment commissions to the Japanese foreign exchange bank for the banking services based upon the Banking Arrangement (B/A).
7. To exempt Japanese nationals from customs duties, internal taxes and other fiscal levies which may be imposed in the Republic of Yemen with respect to the supply of the products and services under the Verified Contracts.
8. To accord Japanese nationals whose services may be required in connection with the supply of the products and the services under the Verified Contracts such facilities as may be necessary for their entry into the Republic of Yemen and stay therein for the performance of their work including preparation of ID card for them.

9. To bear all the expenses, other than those covered by the Grant, necessary for the construction of the facilities as well as for the transportation and the installation of the equipment.

10. To coordinate and solve any matters related which may arise with third party and inhabitants living in the Project area during implementation of the Project.

11. To provide necessary data and information for detailed design.

12. To give permission required for boring and topographic survey at the Project site, if necessary.

13. To take necessary actions to expedite the approval for executions of the Project by the authorities concerned in the Republic of Yemen.

14. To witness and confirm by the authorities concerned when site test are carried out at the time of construction.

15. To take necessary measures for inhabitant's cooperation and traffic control, if necessary.

16. To provide disposal places of the soil, water, etc., discharged during the construction period.

17. To ensure prompt unloading and customs clearance at ports of disembarkation in the Republic of Yemen and internal transportation therein of the products purchased under the Grant.

18. To ensure that the facilities constructed and the products purchased under the Grant be maintained and used properly and effectively for the execution of the Project.

ANNEX III

The items agreed during the discussions are as follows;

1. First-aid station

A first-aid station equiped with proper first-aid kit shall be arranged within the administration area of the Workshop.

2. Road pavement within the site

The road pavement is classified into three kinds, i.e., concrete pavement. asphalt pavement for heavy traffic and asphalt pavement for ordinary traffic. Applicable extent of each pavement is shown on the attached drawing B1-1a.
The concrete pavement shall be covered by the Grant.
The asphalt pavement shall be executed by the Government of Yemen with use of the pavement materials provided by the Grant.

3. Station wagon

One station wagon shall be added to the Vehicles for the purpose of the field training and services.

4. Equipment for Workshop

The equipment for the Workshop listed in the Table 4-4 was corrected as the Table 4-4a.

5. Furniture of the Dormitory

It was confirmed that a set of standard furniture shall be installed in each room of the Dormitory by the Grant.

6. Location of the job site office

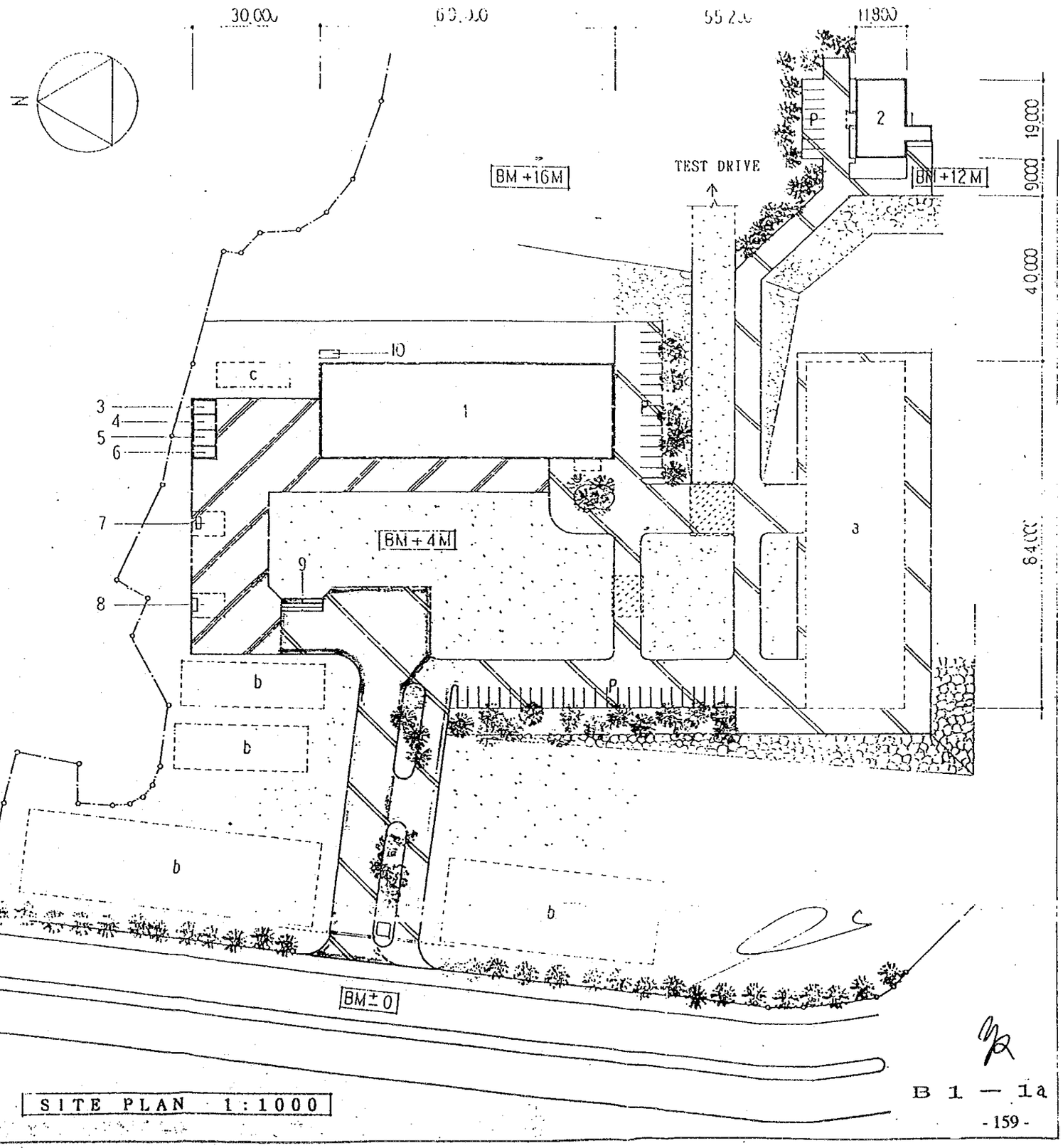
The location of the site office shall be instructed later by the G.C.R.B.

1 WORKSHOP
2 DORMITORY
3 CARPENTRY SHOP
4 PAINT SHOP
5 TYRE SHOP
6 LUBRICANT STORE
7 FUEL & LUBRICANT STAND
8 WASHING STAND
9 UNLOADING DECK
10 WATER POOL

P PARKING

a PARTS WAREHOUSE (UNDER CONSTRUCTION)
b WAREHOUSE(EXISTING)
c JOB SITE OFFICE

: STEEL TROWEL FINISHED CONCRETE
: ASPHALT PAVED ROAD — FOR HEAVY TRAFFIC / FOR ORDINARY TRAFFIC
: STEEL PROTECTION COVER
: GRAVEL



SITE PLAN 1:1000

B 1 — 1a

Table 4-4a

(Chassis Shop)

Item No.	Reference No.	Item	Specifications.	Qty.	Remarks
1		Overhead crane	3ton, 5ton	1	each
2		Hand truck	300kg	2	
3		Pallet truck	2,000kg	1	
4		Sling chain kit	1-3.2ton	1	
5		Sling wire kit	9mm, 12mm dia.	1	each
6		Portable hydraulic jack	30ton, 50ton	2	each
7		Parts shelves		5	
8		Parts wagon		3	
9		Mechanic tool set	for vehicle	2	
10		Mechanic tool set	for const.equip.	4	
11		Tool cabinet		2	
12		Parts cleaner		1	
13		Hydraulic garage jack	10ton	2	
14		Portable lubricator	for engine	2	
15		Grease lubricator		2	
16		Transmission jack		1	
17		Tractor support	for front	2	
18		Tractor support	for rear	4	
19		Drum carrier		1	
20		Other equip.& tools		1	set

(Engine Shop)

Item No.	Reference No.	Item	Specifications	Qty.	Remarks
1		Monorail crane	3ton	1	
2		Jib crane	1ton	1	
3		Workbench with drawers		2	
4		Hand truck	300kg	2	
5		Bench drill press		1	
6		Engine stand	3,000kg	2	
7		Parts shelves		4	
8		Parts wagon		2	
9		Cylinder head workbench		1	
10		Valve seat refacer		1	
11		Valve spring tester		1	
12		Microphone		2	
13		Cylinder gauge		2	
14		Outside micrometer caliper		2	set
15		Piston heater		1	
16		Connecting rod aligner		1	set
17		Tool cabinet		2	
18		Mechanic tool set	metric	1	set
19		Cylinder head test stand		1	
20		Parts cleaner		1	
21		Mobil floor crane	1ton	1	
22		Other equip.& tools		1	set

(Engine Test Room)

Item No.	Reference No.	Item	Specifications.	Qty.	Remarks
1		Engine dynamometer	400ps 4,000rpm	1	
2		Fuel consumption meter		1	
3		Non-resistant muffler		1	
4		Diesel timing tachometer		1	
5		Liquid column manometer		1	
6		Workbench with drawers		1	
7		Exhaust gas analyser		1	set
8		Other equip.& tools		1	set

(Fuel Injection Test Room)

Item No.	Reference No.	Item	Specifications.	Qty.	Remarks
1		Diesel fuel injection pump tester		1	set
2		Cummins P-T pump tester		1	
3		Injection tester		1	
4		Nozzle tester		1	
5		Workbench		1	
6		Mechanic tool set		1	
7		Parts shelf		1	
8		Other equip.& tools		1	set

(Electrical Room)

Item No.	Reference No.	Item	Specifications	Qty.	Remarks
1		Universal electrical equip. tester		1	
2		Armature tester		1	
3		Insulation tester		1	
4		Headlight tester		1	
5		Workbench		1	
6		Parts shelf		1	
7		Other equip.& tools		1	set

(Power Line & Hydraulic Room)

Item No.	Reference No.	Item	Specifications	Qty.	Remarks
1		Mechanic tool set	for const.equip.	1	
2		Tool cabinet		1	
3		Parts shelves		2	
4		Workbench with drawers		2	
5		Hyd.cylinder service stand		1	
6		Jib crane	1ton	1	
7		Hyd.component universal tester		1	
8		Hyd.hose cap cramper		1	set
9		Other equip.& tools		1	set

(Battery Charging Room)

Item No.	Reference No.	Item	Specifications	Qty.	Remarks
1		Battery carrier		1	
2		Silicon quick charger		2	
3		Battery tester		1	
4		Water purifier		2	

(Machine Shop)

Item No.	Reference No.	Item	Specifications	Qty.	Remarks
1		Jib crane	1ton	2	
2		Hacksaw machine		1	
3		Bench drill machine		1	
4		Bench grinder		1	
5		Mobil floor crane		1	
6		Drill chank	straight	1	
7		Drill chank	taper	1	
8		Tool locker & cabinet		5	
9		Parts shelves		3	
10		Cutter (lathe,milling)set		1	each
11		Workbench		2	
12		Other equip.& tools		1	set

(Welding & Body Repair Shop)

Item No.	Reference No.	Item	Specification	Qty.	Remarks
1		Semi auto welder	CO2	1	
2		Engine drive welder		2	
3		Gas welder set		2	
4		High-speed cutter		1	
5		Hyd.press	100ton	1	
6		Other equip.& tools		1	set

(Undercarriage Shop)

Item No.	Reference No.	Item	Specifications	Qty.	Remarks
1		Rollier idler press	100ton	1	
2		Track press	200ton	1	
3		Shoe bolt impact wrench		1	
4		Electric grinder		1	
5		Disc grinder		2	
6		Other equip.& tools		1	set

(Tool Room)

Item No.	Reference No.	Item	Specifications	Qty.	Remarks
1		Set of special tools and metric-inch size standerd tools, and measurement tools		1	set

(Other Facilities)

Item No.	Reference No.	Item	Specifications	Qty.	Remarks
Paint Shop					
1		Air compressor and painting & dry up equipment		1	set
Tyre Shop					
2		Tyre remover	heavy, light	1	each
3		Tyre lever		3	
4		Tyre service tools		2	set
5		Bead breaker		2	
6		Vulcanizer set		2	
7		Air compressor		1	set
8		Wheel balancer		1	
Carpentry Shop					
9		Band saw		1	
10		Jig saw		1	
11		Electric planer		1	
12		Boring machine		1	
13		Motor disc saw		1	
14		Motor drill		1	
15		Motor planer		1	set
16		Hand set		1	
Others					
17		Fuel stand(gasoline,diesel)	with tank	1	each
18		Oil & grease storage		1	
19		Washing stand	for vehicle	1	set
20		Washing stand	for const.equip.	1	set
21		Air compressor		1	
22		Unloading deck		1	
23		Water pool	for engine test	1	

(Vehicles)

Item No.	Reference No.	Item	Specifications	Qty.	Remarks
1		Station wagon		1	
2		Pick-up		1	
3		Mobil workshop		1	
4		Forklift	3ton	1	

(OJT Materials)

Item No.	Reference No.	Item	Specifications	Qty.	Remarks
1		Fuel injection pump		1	
2		Turbocharger		1	
3		Torqueflow transmission		1	
4		Transmission control valve		1	
5		Steering clutch		1	
6		Track roller		1	
7		Hyd.control valve		1	

(Plastic Models)

Item No.	Reference No.	Item	Specifications	Qty.	Remarks
1		Planetary gears		1	
2		Torque converter		1	

(AV Equipment)

Item No.	Reference No.	Item	Specifications	Qty.	Remarks
1		Overhead projector		1	set
2		Slide film projector		1	set
3		TV and Video deck		1	set
4		Video camera		1	set

Appendix-5

Items to be Undertaken by Government of Yemen

Appendix-5 — Items to be Undertaken by Government of Yemen

1) Ground preparation
2) Fence, gate and wall
   - Frence
   - Gate
   - Wall
3) Guard house
4) Premise road and breast wall
   - Premise road
   - Breast wall
5) Building Services
   - Water
   - Sewerage
   - Electricity
   - Telephone
6) Landscaping
7) Transportation of Equipment from existing workshop

   Cost of 14 machines from existing workshop
8) Outside lighting
9) Exclusive officers
10) Banking services
    - Advising commission
    - Payment commission
11) Customs clearance
12) Furniture and fixture
13) Warehouse
14) Others
15) Land

Appendix-6

Country Data

Appendix-6 Country Data

I. Basic Indicies

(1) The Republic of Yemen

(Capital : Sana'a)

(2) Date of Unification

May 22, 1990

(3) Land Area and Population

Land Area : 528,000km2 (1.4 times of Japan)
Population : 11.4 million (1990)
Population Growth Rate : About 3.1%

(4) Political System

Republic
The Single Chamber System

(5) Compulsory Education

6 years

(6) Exchange Rate

1$ = 11.997 YR (March 4, 1991)

(7) Geography

- Lowland (upto 200m EL) along the Red Sea and Arabian Sea
- Hill areas (200m-1,500m EL) at the piedmonts of mountains
- Mountains area (over 1,500m EL)
- Highland (around 1,000m EL) dominating the eastern part of the country

Sana'a, the capital of Yemen, is located at 2,300m above sea-level. In general, the most prominent feature is mountains areas with many undulations.

(8) Climate

The climate of Yemen is mild throughout the year and there is practically no necessity for air-conditioning even in the middle of summer (mean July temperature:22.5C). In winter, the temperature can drop below zero in the evening and early morning, sometimes necessitating heating. The relative humidity in the dry season is extremely low and wind tends to cause a dusty environment, particularly during the daytime. There are two rainy season, i.e. from March to April and from July to August. The annual rainfall is 200-500mm but considerably varies from year to year. In Sana'a, thunderclouds tend to appear in the afternoon, causing torrential showers with occasional lighting.

(9) Teritorial Waters

16 nautical miles

(10) Holiday

Friday

II. Socio-Economic Indices

(1)
- GNP : $7,203 million (1989)
- GNP per capita : $640 (1989)
- Economic Growth Rate : 4.5% (1986)
- Prices Growth Rate : 29.4% (1986)
- Export : $530 million (1988)
- Import : $ 1,910 million (1988)
- Debt : 7,256 million (1989)
- Public Finance
  Revenue : 35,300 million YR (1991)
  Expenditure : 62,000 million YR (1991)

(2) Major Industry

Agriculture : Sugar Cane, Wheat, Vegetable, Grape, Coffee and Cotton

Oil :
Estimated amount of oil : 10,000 million barrels
Production : 200,000 B/D

(3)
- Major Export Items : Oil, Vegetable, Fruit, Tabacco, Leather and Coffee to USA, Italy, France and Saudi Arabia
- Major Import Items : Cereal, Vehicle, Oil Product, Livestock and Chemical Product from Saudi Arabia, Holland, Germany and Japan

III. National Defence Budget

$5,300 million (1988)

IV. Relationship between Yemen and Japan

Export to Japan : $89 million (1990)
(Coffee and Oil)

Import from Japan : $91 million (1990)
(Steel Manufactures, Machinery, Vehicles, Textile and Food)

Appendix-7

Report for Site Investigation

دلتا للهندسة
DELTA ENGINEERING
CONSULTANTS • ARCHITECTS • ENGINEERS
مهندس/ طارق احمد عفيف
Engr. Tarek Ahmed Afif
ص.ب (١٠٣٣٠) - تلفون ٢٧٥٤٨٣ صنعاء اليمن
P. O. Box (10330) Tel. 275483 Sana'a - Yemen

REPORT FOR

SITE INVESTIGATION

GCRB WORKSHOP

JICA

دلتا للهندسة تصاميم استشارات
DELTA ENGINEERING
Consultants . Architects . Planners
P.O.Box 10330
Sana'a, Yemen.
Tel. 275483
Telex.
Fax.

DATE : MAY 6, 1992
REF : 4522/92

MR. HISASHI KUROKOUCHI
STUDY TEAM REPRESENTATIVE
JAPAN INTERNATIONAL COOPERATION AGENCY

SUBJECT : SITE INVESTIGATION FOR GCRB WORKSHOP IN SANA'A - NUQUM.

DEAR SIR,

WE HAVE CARRIED OUT THE SITE INVESTIGATION FOR THE ABOVE MENTIONED PROJECT IN ACCORDANCE WITH THE TOR OF THE CONTRACT AGREEMENT SIGNED ON THE 18th DAY OF APRIL, 1992 AND ALSO THE ADDITIONAL WORK REQUESTED BY YOUR LETTER, REF.NO. YEC-YB-L201.

THE SITE INVESTIGATION ENDED UP WITH CONCLUSIONS AND RECOMENDATIONS RELEVANT TO THE FINDINGS. THOSE, IN ADDITION TO THE ANALYSIS OF FIELD AND LABORATORY TESTS ARE INCLUDED IN THIS REPORT.

WE THANK YOU FOR YOUR CONFIDENCE AND LOOKING FORWARD FOR FURTHER COOPERATION. WE REMAIN.

DELTA ENGINEERING
PROJECTS MANAGER
TAREK AFIF