No.

THE PEOPLE'S REPUBLIC OF BANGLADESH

DETAILED DESIGN REPORT
ON
CONSTRUCTION PROJECT
OF
AUTOMOBILE REPAIR & MAINTENANCE WORKSHOP

VOLUME—1

OCTOBER 1978

Japan International Cooperation Agency

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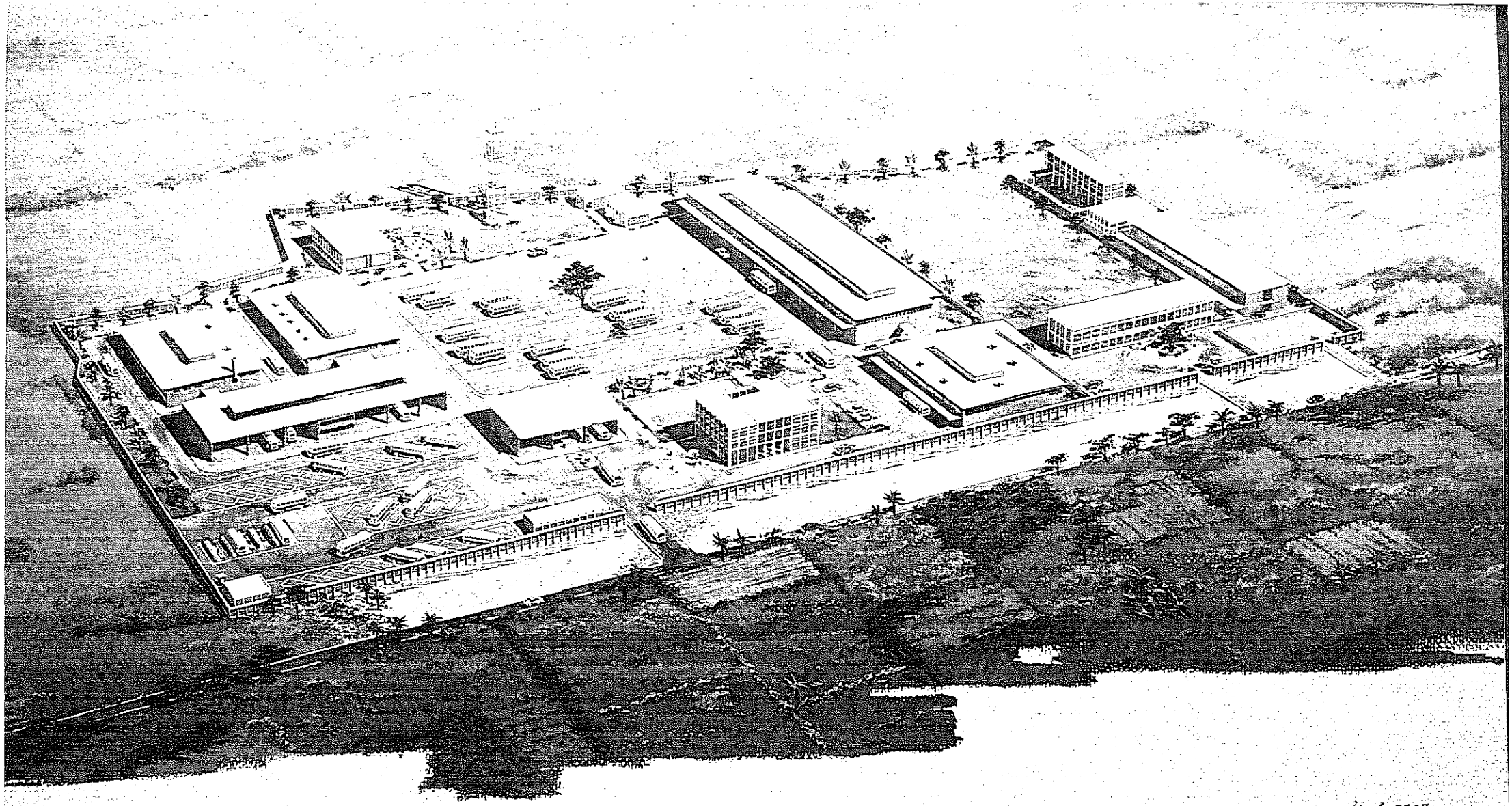
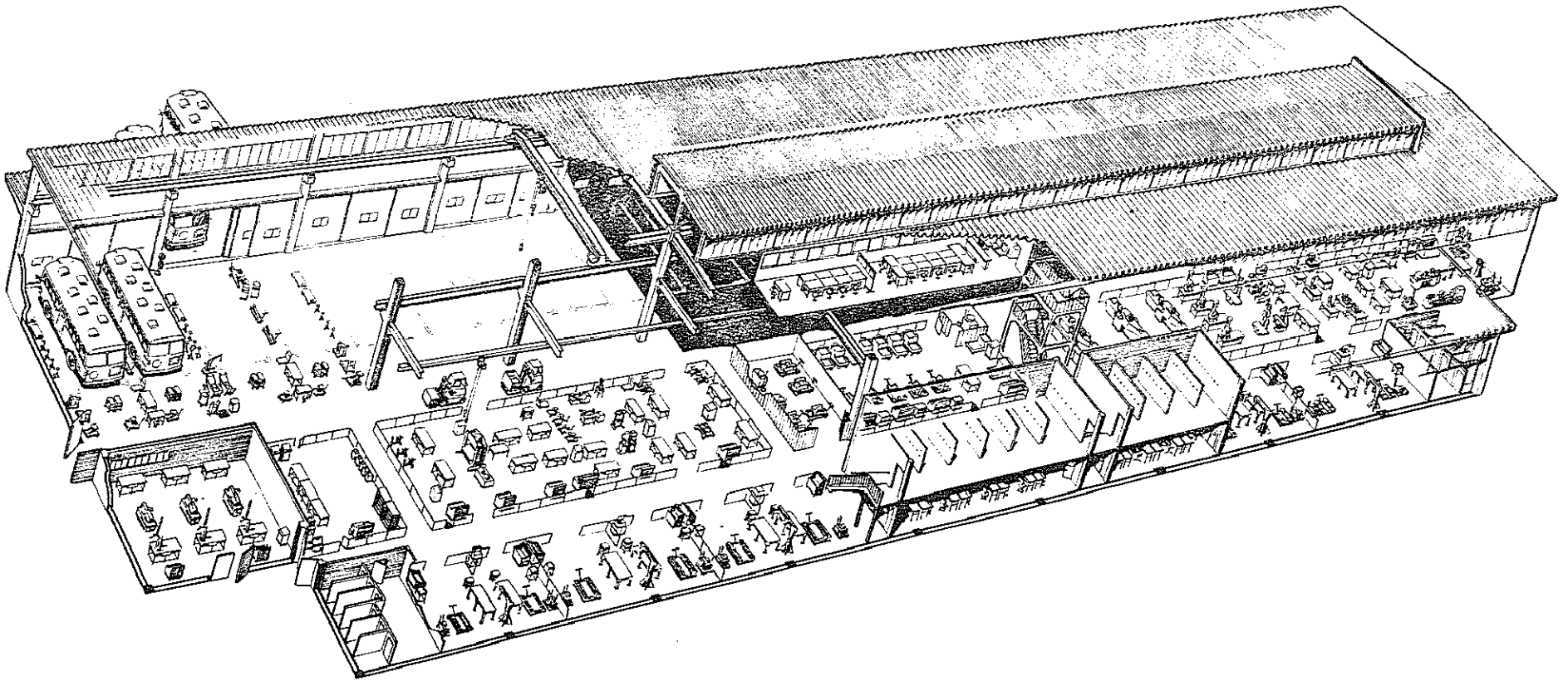
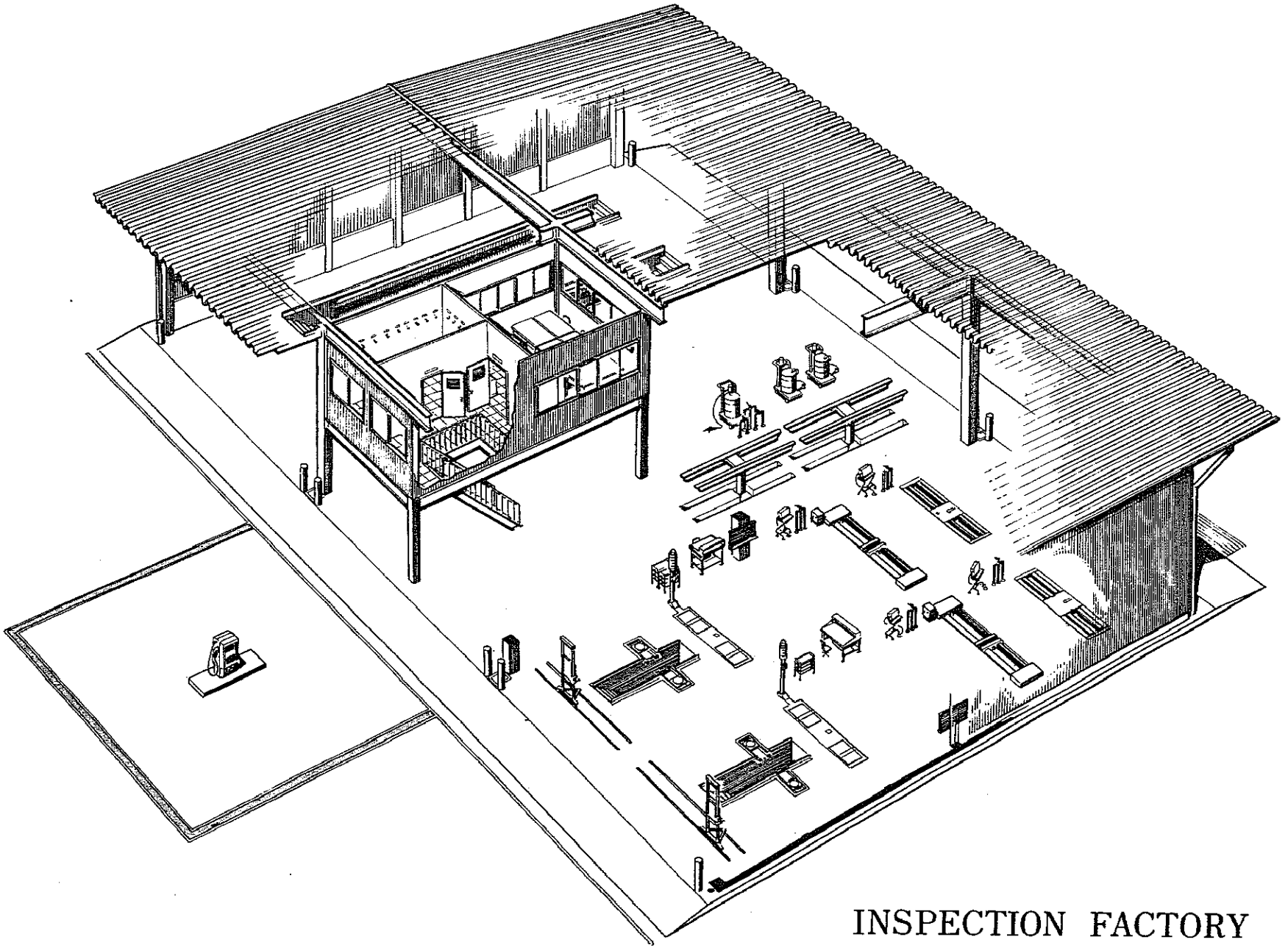


AUTOMOBILE REPAIR & MAINTENANCE WORKSHOP IN BANGLADESH

JAPAN INTERNATIONAL COOPERATION AGENCY



HEAVY REPAIR FACTORY



INSPECTION FACTORY

FOREWORD

In response to the request from the People's Republic of Bangladesh, the Government of Japan has decided to carry out a survey for execution design with respect to construction of a new automotive vehicle repair factory to be made in the People's Republic of Bangladesh, and entrusted execution of said survey to the Japan International Cooperation Agency (JICA).

The Japan International Cooperation Agency organized a pre-survey team composed of three specialists with Akira Gomi of Mitsubishi Motors Corporation as the leader, and dispatched this team to the proposed site of construction of said factory in the period of December 2 through 13 of 1977.

The survey team determined basic configuration of construction of the automotive vehicle repair factory mentioned above based on the preliminaries with those concerned of the Government of the People's Republic of Bangladesh.

Based on the results of the pre-survey thus obtained, a final survey team composed of ten specialists with said Akira Gomi as the leader was dispatched to the site in the period of February 21 through March 21 of 1978, and this team carried out collection of data and information required for execution design of said automotive vehicle repair factory construction project as well as a survey of actual situations of the related facilities.

The survey team made examinations of the results of the surveys made at site, and executed this report after the team returned to Japan.

On presentation of this report, we wish that construction of said automotive vehicle repair factory will make contribution to improvement of traffic situations as well as to the development of industries and economy of the People's Republic of Bangladesh and that it will be helpful in strengthening the ties of friendship between the People's Republic of Bangladesh and Japan.

We would like to take this opportunity to express our heartfelt appreciation to those concerned of the Government of the People's Republic of Bangladesh and of the Japanese Embassy in the People's Republic of Bangladesh for the kind cooperation extended to the subject survey teams, and also to the Ministry of Foreign Affairs and the Ministry of International Trade and Industry of Japan for providing assistance with respect to dispatch of the survey teams.

October 1978

Shinsaku HOGEN
President
Japan International Cooperation Agency
Tokyo, Japan

CONTENTS

1. INTRODUCTION

CHAPTER I. INTRODUCTION

1-1 Outline of BRTC's Business and Its Future Plan (Project)

The Bangladesh Road Transport Corporation (abbreviated BRTC) is the bigest National transport corporation in Bangladesh. Its history goes back to 1961. At that time, the region was East Pakistan and the corporation started as the East Pakistan Road Transport Corporation (abbreviated EPRTC) with 4 buses which were put into operation in Dacca City.

Then, after the country became independent of Pakistan as Bangladesh, the corporation has expanded steadily its fleet under the name of BRTC. The number of buses owned by the corporation is as shown in Table 1-1 as of March 1978.

Table 1-1 Number of Buses Owned by BRTC and Original Countries

Year	Nos. of buses	Original country
1967	25	U.K.
1968	-	
1969	83	Italy
1970	19	Iran (under licence of Germany)
1971	-	
1972	58	India
1973	17 + 100	India + Japan
1974	129	Japan
1975	-	
1976	-	
1977	-	
1978	160	Japan
Total	591	6 countries

Notes:

1. The Nos. of buses in Table 1-1 are only those still in serviceable condition. There are certain number of buses condemned, therefore, the actual number of buses procured before 1974 is not known.
2. A total of 249 buses were procured from Japan during 1973 and 1974. According to this table, 20 buses went out of service during around 5 years.
3. These figures, show only the number of buses, and BRTC procured 10 trucks for material transportation.

The primary business of BRTC is the bus transportation, however, truck transportation was added after independence, since immediately after independence the U.N. trucks that carried emergency materials were given to the Bangladesh Government when the role ended, the Truck Division was newly established within BRTC to operate these trucks to transport cargoes.

The year models are supposed to be 1970 to 1972 models and the number of trucks as of March 1978 is as shown in Table 1-2.

Table 1-2 Number of Trucks Operated by Truck Division

Country of Origin	Nos. of Unit
Sweden	26
Japan	90
U.S.A	80
3 countries	196 units

The BRTC's business started in Dacca City Bus service has expanded to cover the entire country. The service lines connecting major cities passing through important traffic points of the country.

The total length of BRTC bus lines as of March 1978 is about 3,000 km and additional about 800 km new service lines are

currently in planning stage. The bus line network is shown in Fig. 1-3. As the bus line extends, some depots with simple maintenance equipments were established not only in Dacca but important traffic points in other cities and towns. Parts are also allocated to those depots to maintain proper bus operation. Since Dacca, in particular, is the capital of the country and its population is about 1.73 millions which is one fifth the total population of the country. Therefore, Dacca is not only the political, economical and cultural center but the city of the greatest expansion in scale in the country, and by this reason, BRTC-owned buses and depots are centralized in that city. It is said that around 70% of all BRTC-owned buses are to be run in Dacca and the neighboring areas. Table 1-4 shows the number of buses in each depot as of November 1, 1972.

Table 1-4 Number of Buses in Each Depot at the end of 1976

District	Name of Depot	Nos. of Vehicle on Road	Nos. of Vehicle Need Repair	Total
Dacca and Suburbs	Double Decker Depot	12	13	25
	Kallyanpur Depot	34	43	77
	Mohdpur Depot	12	15	27
	Motijheel Depot	33	46	79
	Mirpur-13 Depot	48	16	64
	Joarshahara Depot	21	20	41
	Training Institute	1	-	1
District Far from Dacca	Bogra Depot	5	4	9
	Chittagong Depot	14	12	26
	Comilla Depot	8	3	11
	Faridpur Depot	8	4	12
	Khulna Depot	3	6	9
	Manikganj Depot	7	1	8
	Norsingdi Depot	7	2	9
	Narayan Ganj Depot	6	9	15
	Pabna Depot	10	5	15
	Tangail Depot	8	5	13
	Total	237	204	441

Fig. 1 – 3

B A N G L A D E S H

SHOWING THE ROUTES OF

BANGLADESH ROAD TRANSPORT CORPORATION

Scale : 1 inch = 30 miles
or 2.54 cm 48.28 Km

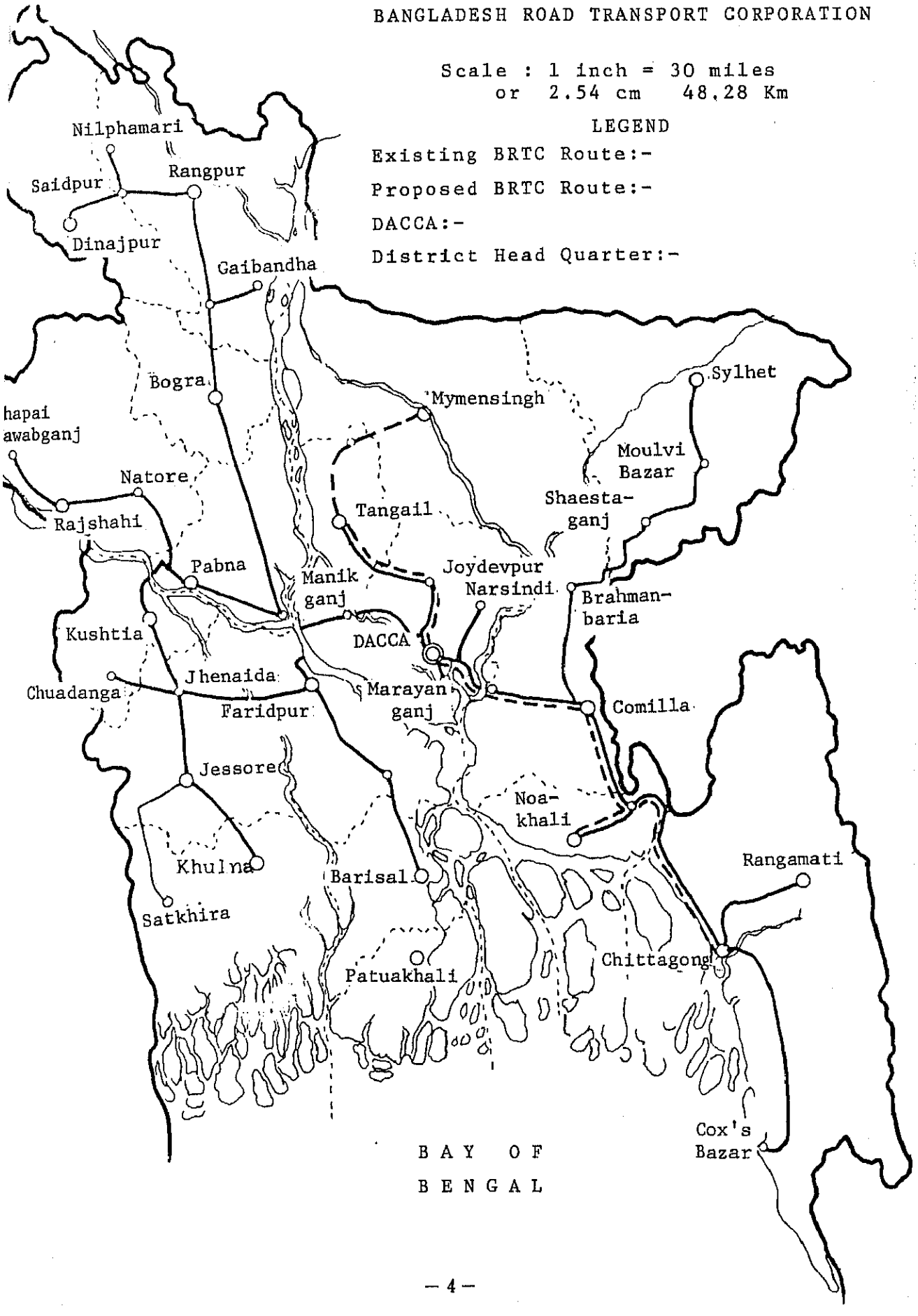
LEGEND

Existing BRTC Route:-

Proposed BRTC Route:-

DACCA:-

District Head Quarter:-



Notes:

1. The above figure includes 10 trucks for transporting material to each depot.
2. The above figures do not include buses to be procured in 1978.

Trucks belonging to the Truck Division in each depot are as shown in Table 1-5.

Table 1-5 Depots and Number of Trucks Assigned

Name of Depot	Nos. of Vehicles on Road	Nos. of Vehicles Need Repair	Total
Dacca Depot	36	23	59
Bogra Depot	32	30	62
Chittagong Depot	26	16	42
Khulna Depot	21	12	33
Total	115	81	196

Statistically, BANGLADESH has the following characteristics.

Total area Approx. 153,000 km^2 (as of 1978, approx. twice the area of Hokkaido)

Population 76.82 millions (as of 1975)

Overall length of railway 3,000 km (as of 1978)

The railway is operated on a single truck. The speed is slow due to rather poor maintenance. The construction of the bridge over a big river is extremely difficult even there are so many rivers, swamps and lagoons, and Chittagong is the only major city that can be reached without changing the train from Dacca. Accordingly, the movement of fantastic poupulation, the density of whch is approx. 502/km^2, should depend on fast moving buses which permit easy cornering and carrying across rivers on ferries. For this reason, buses are now the primary means of

land transportation in lieu of railway. Since buses are feet of general public in a sense that they must move about on buses within the city and inter cities, the Bangladesh Government controls the bus fare.

The bus fare as of March 1978 is as follows.

10 Paisa/mile (1 Paisa = 1/100 Taka 1 Taka ≒ ¥16
1 mile = 1.6 km)

That is, approx. ¥1/1 km. The rate is considered appropriate since the monthly wage of low class laborer is around 200 Taka/month (approx. ¥3,200/month).

However, such low bus fare discourages willingness of those who intend to venture into the private bus enterprise. Therefore, the government must make an effort to accomplish the bus business. The importance of government owned BRTC, particularly bus business, and the tendency of the business expansion may be reasoned as above.

While, many private enterprises are undertaking truck business for the reason that there is no government control of freight and BRTC concentrates its effort on the bus business to avoid useless competition with those private enterprises.

According to BRTC, the total number of bus passengers and total mileage expected in the forthcoming years keeping pace with the economic expansion are as shown in Table 1-6.

Table 1-6 Expected Total Number of Passengers and Mileage of BRTC Buses

Year	Total Passengers in 1,000	Total Mileage in 1,000 Miles	Total Mileage (in 1,000 kms)
1978	50,504	23,652	(37,850)
1979	55,994	26,280	(42,050)
1980	65,326	30,660	(49,060)
1981	81,658	38,325	(61,320)
1982	102,244	47,961	(76,740)
1983	127,908	60,060	(96,010)
1984	163,316	76,650	(122,640)

As seen, in 1981, the number of passengers almost equal to the entire population must be carried. The number of passengers will continue to grow larger and in 1984 it will become twice the entire population.

To satisfy the need it is planned to increase the number of buses as shown in Table 1-7. Buses in this plan are serviceable buses. Referring now to Table 1-1 and Table 1-4 and subtract 204 in Table 1-4 which is the number of buses considered to require major repair from 591 in 1978 shown in Table 1-1. 387 thus obtained is the number of serviceable buses. From Table 1-7, in 1978 the number of buses becomes short by 153 buses against 540 buses required.

The shortage must be made up for either by new acquisition or by making moajor repair. According to BRTC, it purchased 106 buses from Japan in March 1978 nearly satisfying the need in 1978.

Table 1-7 BRTC's Vehicle Expansion Plan

Year	Bus	Truck	Total
1978	540	247	787
1979	600	252	852
1980	700	312	1,012
1981	875	402	1,277
1982	1,095	485	1,580
1983	1,370	560	1,930
1984	1,750	640	2,390

According to the Bangladesh Year Book issued in 1975, the number of buses in this country at the end of 1973 is as follows.

Petrol	3,066 (202)
Diesel	2,964 (900)
Total	6,030 (1,102)

Figures in parentheses are the seating capacity of 35 to 45 buses which are most extensively used due to the road condition in the country. The number of the BRTC buses of this class in Table 1-1 is 258 at the end of 1973, i.e., those from England and Iran are excluded. This figure represents 23% of all buses in the country and in case of Diesel version it represents 29% of all Diesel buses at the end of 1973. Such a high percentage is an evident of how important role BRTC is playing as a "foot" of general public.

1-2 Significance of Establishing Central Workshop in BRTC and Necessity of Training Function

1-2-1 Significance of Establishing Central Workshop (abbreviated CWS)

As shown in 1-1, the numbers of vehicles and depots have been steadily increased since its inauguration in 1961. However, the maintenance equipment held in the depot in Dacca City is small in quantity and old and some of the equipment are left in unserviceable condition. The present status is such that the maintenance in depots must depend largely on the manual labor.

This is assumed to be the result of the lack of maintenance know-how due to personal reassignment, improper handling of equipment which requires correct handling and material shortage, etc., under circumstance of independent war. At present, two members of Volunteer from Japan are working and their superhuman efforts keep the vehicles operating. It is quite wasteful that even repairable vehicles are being condemned one by one because there is little equipment available.

As seen in Table 1-4, and Table 1-5 the availability status in the BRTC Bus and Truck Division discloses such situation.

According to those tables

Serviceable vehicle (A)

Bus	237
Truck	115

Vehicles to be repaired (B)

Bus	204
Truck	81

Total (C)

Bus	441
Truck	196

Availability (A ÷ C × 100%)

Bus	53.7%
Truck	58.7%

That is, one out of two vehicles is to be repaired. However, the extent to which the repair can be done by manual labor is limited and repair function is almost non-existent. Under the circumstances, repairable vehicles have to continue the work until they become totally unfit to service.

For one thing, there is no "periodic inspection/maintenance" in this country, which is owner's responsibility in Japan. For this reason, the vehicle life is short. The life of vehicle such as bus which runs a certain distance every day is said to be around 5 years. While the same bus is used for around 10 years in Japan and remains serviceable for several more years after being exported to Southeast Asian countries as a used car. Vehicles in Bangladesh have surprisingly short life. Secondly, there are few service shops in this country which are common in Japan. The second survey team visited the BRTC depot while in Dacca and found a poor maintenance function as mentioned above.

The team had a chance to see the factory exclusively for the vehicle maintenance operated by BRTC. It is an obsolete shop operated with the facilities of 6 machines donated from U.S.S.R. and 9 miscellaneous machines that have been in use from the time of Pakistan.

Because of unbalanced equipment available and poor layout of equipment, operation process encounters problems in many points. Hence the maintenance work of BRTC vehicles is hindered and results a long queue of vehicles waiting maintenance.

According to BRTC, this shop is the only one shop in Bangladesh and is originally intended to maintain the vehicles that belong to the government agencies. BRTC itself has no shop exclusively for service! This fact is for us unbelievable that the corporation that is under the obligation to operate hundreds of vehicles has no shop of this kind at all!

Thirdly, there are very few service shops even in Dacca City. Sales agencies of foreign automobile makers have thier own simple

service facilities and parts warehouses, however, independent private service shop is almost non-existent. Even if one fortunately find a service shop, the capacity of the shop is limited to the service of motorcycles and small passenger cars and the service of large diesel vehicles is beyond its capability.

In addition to BRTC owned diesel cars, diesel vehicles of private enterprises are in operation, of course. In case of trouble, the repair of those vehicles would most probably require such extended time as to be counted by months, especially for heavy maintenance.

It is commonly recognized in any country of the world that commercial vehicles such as buses, trucks, etc. are productive goods and are more expensive than small cars and passenger cars. Therefore, it is quite exceptional that such productive goods are discarded after one-time use as in Bangladesh. Morever, such situation is the result of the lack of shops for maintenance with proper capacity. Then, it is understandable from the above mentioned fact that how earnestly the officials of the Ministry of Transportation and Communication in the Bangladesh Government and BRTC's directors desire the construction of CWS.

1-2-2 Necessity to Provide Training Function to CWS

The education system in Bangladesh is as follows.

Elementary school	5 years	(age 6 to 10)
Middle school	3 "	(11 to 13)
High school	2 "	(14 to 15)
College	2 "	(16 to 17)
University	2 "	(18 to 19)

Since the number of instructors is insufficient and from the other reasons, the number of pupils/students attending schools seems to be small. For this reason, it is assumed that workers employed by BRTC are relatively at low intelligence level.

BRTC has a training center in Dacca established by the assistance from UNDP, ILO and it conducts the drivers' retraining and forman's retraining each for around 9 weeks sequentially. A similar training institute is located in Chittagong and provides similar retraining to workers. In either case, intra-business refresher training (re-education) is exclusively conducted.

The second survey team visited the center and as a result of discussion with BRTC representatives it was agreed that the facility to train personnel in BRTC would be established within CWS site. Subjects discussed include the following.

a. Existing training center is operated by the financial aid from UNDP, ILO. Since the aid will be terminated at the end of 1979, BRTC must run the center by itself.

b. The number of trainees at the center is large as compared with the training facility, hence training cannot be given adequately. Number of instructors is small (around 10 traineees/instructor). Hence the training period (9 weeks) may be wastefully spent.

c. While the education level of workers is low (most workers finished only elementary school and a few workers completed middle school), the content of training is too high except drivers' re-training and the training period is too short.

d. The quality of the basic maintenance work at the depot is very poor, but correction is not made. Measuring work is virtually non-existent.

From the reasons listed above, it has become questionable that even if up-to-date CWS is constructed, the shop and equipment can be operated properly.

On the other hand, this country enacted the Wage Earners' Scheme and encourages people to go to the Near East countries to find job opportunity with resultant loss of persons with some skill

and aggravation of shortage of qualified persons. Approx. 100 BRTC employees are said to have gone to the Near East countries taking advantage of this scheme.

Under the above circumstances, it is critical that the workers are trained for the proper knowledge of automobile maintenance. While, the BRTC's training center is the only available training institute for automobile maintenance. Only general information given at the technical high school and the facility at the vocational training institute are far from adequate and are comparable to the BRTC training center.

Taking the above factors into account and considering the termination of aids from UNDP, ILO an opportune time, the existing ineffective training center and its system has been reviewed and the training institute which imparts correct maintenance techniques and emphasizes practice rather than theory has been designed. Since from the purpose of this training institute on-the-job training in CWS should be considered, the site shall be selected somewhere witin the site of CWS. The training institute has been designed also to satisfy the desire that all trainees be accommodated in a domitory to facilitate recruitment of trainees and centralized training that is required to supplement the intra-business re-training.

The graduates of this training institute are expected to acquire the knowledge and skill essential to the operation of modern CWS and they doubtlessly contribute to the proper operation of CWS and to the promotion of general maintenance techniques in Bangladesh.

1-3 The Purpose of the Second Survey Team

The second survey team sent from the Japanese Government to survey CWS to be constructed in Bangladesh was organized by 10 members, stayed mostly in Dacca City from February 21, 1978 to March 21 and made a survey together with the counterpart members assigned by the Bangladesh Government.

The ultimate purpose of this survey team is to perform the designs required for the construction of modern automobile maintenance shop of proper scale within the proposed area in accordance with the regional peculiarities of Bangladesh and to prepare reports on the shedule, costs, operation, the procedure for the technical guidance and others.

The training institute to be annexed to CWS is subject to the same survey.

1-3-1 Activities in Dacca

The survey team conducted the following surveys and prepared the following documents during its stay in Dacca.

a. General

(1) Outline of BRTC business and future plan (including maintenance business and training institute)

(2) Effects of CWS and training institute on BRTC and domestic automobile transport business

b. Basic conception

(1) Determination of proper scale of CWS and economic assessment

(2) Determination of service system in CWS

(3) Merits relative to the establishment of training institute

(4) Determination of annual construction schedule of CWS and training institute

c. CWS design

c-1 General specification and layout of CWS

(1) Location of each shop and general specification of shop buildings

(2) Preparation of main repair machines list, assignment of machines to each shop, determination of required space and determination of machine specification

(3) Determination of the size of parts warehouse and general specification of warehouse

(4) Preparation of Plot Drawing of CWS and T.I.

c-2 Construction design

(1) Surveys of conditions such as meteorological conditions, flood measures, rainfall, earthquake, etc.

(2) Surveys of labor conditions, wage, etc.

(3) Locally available products survey
Survey of locally available construction materials, and prices. Import condition check for items to be imported to the country.

(4) Others
Confirmation of topography and boundary of proposed construction site
Survey of terrain and traffic conditions of proposed construction site
Survey of land leveling, soil quality, bearing force, etc. of proposed construction site

c-3 Others

(1) Estimate of required costs within the scope of above surveys

(2) Scope, conditions, etc. of design (as shown in 2-2)

(3) Technical guidance (as shown in 4-3)

(4) Annual construction schedule (as shown in 2-2)

1-3-2 Activities in Japan

a. Construction work related activities

(1) Land leveling and border construction design

(2) Design of each shop, office, T.I. and other buildings. Design of electricity, water and air supply works

(3) Determination of detailed specification of above works and preparation of strength calculation sheet

(4) Detailed design of all infrastructures

(5) Preparation of calculation data of environmental performance such as ventilation, water supply capacity, sewage-treatment (sewage disposal), etc.

(6) Preparation of costs estimation for above construction works

b. Repair-related activities

(1) Determination of detailed specification and quantity of repair machines and tools

(2) Determination of equipment/facilities in parts storage in detail

(3) Determination of machines and training aids to be provided in training institute in detail

(4) Preparation of estimation for expendables such as water, oil, fuel, grease, air, power, etc.

(5) Preparation of estimation for required repair machines, tools, etc.

c. Repair work related activities

(1) Determination of repair system (heavy maintenance, periodic maintenance, reclamation, etc.)

(2) Determination in detail of required time schedule for repair, documents to be issued, etc. covering repair and parts jobs.

(3) Preparation of estimation for workforce required in each shop and office.

(4) Determination of office organization including necessary divisions, sub-divisions and groups, preparation of Office & Shop regulations, detailed bylaws of organization and determination of employee's qualification

(5) Determination of schedule of technical guidance to be followed before, during and after construction

(6) Activities for training institute similar to (3) and (4) above.

(7) Preparation of recommendation on training schedule, screening test, qualification after graduation, etc.

(8) Preparation of estimate of required costs for training institute

The survey team discussed on the above and other subjects with the counterpart in Bangladesh, made a tentative determination, reviewed each subject in detail in Japan and prepared the report which was the ultimate objective.

2. BACKGROUND FACTS

CHAPTER II. BACKGROUND FACTS

2-1 Circumstances That Led to Engineering Design

BRTC which started in 1961 has grown larger and larger in terms of the bus network, the number of buses in operation and the size of the depots as described in Chapter I. While, the construction of maintenance facilities matching with the number of owned buses was not proceeded and remained as a very serious problem even after Bangladesh was born in March 1971 after the war for independence.

To replenish BRTC's buses that were decreased due to the war for independence, 249 buses of Japanese make were provided as the U.N. aid to BRTC in 1973. The transportation capacity of BRTC was enhanced, but the lack of maintenance facility continued to be the serious problem.

Japanese bus maker who supplied buses during 1973 and 1974 sent service engineers to Dacca for the guidance of service activities. They were asked to give suggestions concerning to the construction of service facilities by the chief exectives of BRTC and in response to such requests Japanese bus maker furnished its proposals twice to BRTC.

Political change started in August, 1975 was not settled down until April, 1977 and some of BRTC directors were replaced. Nevertheless, the efforts to construct service repair facilities and training facilities were continued uninterruptedly during these years by bus maker.

Meanwhile, the training institute was started in 1975 as a BRTC's intra-business training organization under the support of UNDP and ILO. (Financial aid of those international organizations will be terminated in 1979). A 19-acre land was obtained near Joydepur, 16 miles northeast of Dacca as the construction site of repair facility. Said land is used as a paddy field and is leased to the former owner until start of maintenance shop construction work. The area around Joydepur is relatively high and there is no probability of being washed by water. There are factories such as BMTF (Bangladesh Machine Tool Factory), BDP (Bangladesh Diesel Plant), etc. the Japan assisted Central Agricultural Promotion Laboratory (CERDI), USA assisted Agricultural Laboratory, and new airport (under construction), etc. in the neighborhood. The area is expected to be the center of studies and industrial activities in the future.

2-1-1 Background Facts on Sending the First Survey Team

BRTC offered a proposal to the Ministry of Planning regarding the construction of CWS and submitted necessary documents, and the Ministry approved the proposal as a government project.

The project was registered as Scheme No. 3, 77/78 Annual Development Program. The guideline of this program was published by the BRTC engineers in June 1977 as a provisional document relating to the construction and operation of the workshop, included in the documents submitted. This guideline entitled "PROJECT STUDY FOR CONSTRUCTION OF INTEGRATED CENTRAL WORKSHOP" represents the Bangladesh's view on the matter expressed for the first time.

After reviewing this Project Study, UNDP made a survey, but no substantial development of the matter resulted.

In July 1977, Mr. M.M. Zaman, secretary of Ministry of Communication, Bangladesh, visited Japan. He discussed with the concerned officials of the Ministry of Foreign Affairs, Japan,

on the subject of the construction of CWS and requested technical assistance from Japan.

In November 1977, the first survey team was organized for CWS construction. The team members were

Technical cooperation, general
Mr. Juichi Kokubo

Building & machine, general
Mr. Ichizo Tsuda

Automobile repair, general
Mr. Akira Gomi

The survey team stayed in Dacca from December 2 to December 13 for required survey.

The first survey team visited the Ministry of Communication, the Ministry of Planning, BRTC head office, depots, proposed site of CWS construction, Training Institute, BRTC facilities in Chittagon, Politechnic Institute, Technical Training Center, etc. The team also called on the construction site of Japanese Government assisted Central Agricultural Promotion Lavolatory (CERDI) and had a chance to hear the opinion of Japanese Government officials stationed in that center.

For the report of the first survey team, refer to The Survey Report of Automobile Repair Shop Construction in Bangladesh dated December 20, 1977.

2-1-2 Background Facts about Sending the Second Survey Team

The first survey team furnished a brief report to BRTC prior to departure to Japan. The report is entitled "A BRIEF REPORT OF JAPANESE SURVEY TEAM", dated December 13, 1977.

The main points of the above report which was furnished to Bangladesh Government are as follows.

a. The survey team recognized that the Bangladesh Government was very earnest for the implementation of this construction

project and found that it was critical for Bangladesh that BRTC should have CWS.

b. The survey tean pointed out that not only CWS construction but training system was important. It was found that BRTC had a small scaled facility and that BRTC planned to combine this facility with CWS.

c. Since the preparations on the part of Bangladesh were completed, the survey team notified that the second survey team would be sent for engineering design as the primary purpose and mutual agreement was obtained on the survey team organization, survey items/tasks, etc.

It was also agreed that the Bangladesh counterpart would also be organized.

d. It was requested and accepted that some preliminary works should be done by the Bangladesh side prior to the arrival of the second survey team.
The first survey team reported to the government agencies concerned about the survey after arrival in Japan.
The second survey team was organized in February 1978.
Team members are as follows.

Leader	Generalization	Mr. Akira Gomi
	Coordination	Mr. Juichi Kokubo
	Economic analysis	Mr. Takeo Miyake
	Repair machinery	Mr. Kakumasa Fukuzawa
	"	Mr. Jinichi Ito
	Repair/operation	Mr. Masatoshi Takahashi
	"	Mr. Toshihiro Matsui
	Architect	Mr. Michio Hoshino
	"	Mr. Masami Sato
	Parts	Mr. Ryozo Muraoka

The counterpart members of Bangladesh team are as follows.

Chairman	Mr. Muhammad Habibur Rahmann
Leader	Col. (ret'd) Quamruddin Ahmed
T.I.	Mr. Nizamuddin Ahmed
Architect	Mr. Muhammad Ibrahim
Service	Mr. Fouz Mohammad
Planning	Mr. Abdul Muqtadir
Parts	Mr. A.K.M. Shahriar

The survey team stayed mostly in Dacca from February 21, 1978 to March 21. BRTC provided the work room to the survey team in the 6th floor of BRTC head office. The survey team examined the survey items that were studied by the first survey team in more detail.

As the members of the second survey team, we wish to express our thanks to the officials concerned CERDI construction for their warm treatment and cooperation during our stay.

The survey team completed the interim report prior leaving for Japan with the complete agreement of the Bangladesh counter part.

As the interim report was intended to be used for orienting the tasks to be done by the members after the arrival in Japan, this final report was completed by the construction group, service group and parts group worked individually based on the interim report.

2-2 Engineering Design, Scope of Tasks and Conditions

The purpose of the second survey team and the tasks are described in 1-3 in detail. Prior to the commencement of these taks, the scope of tasks and conditions were discussed with the counterpart and were defined.

2-2-1 Scope of Design and Tasks

It might be said that the survey team covered all survey items required for BRTC to construct and operate CWS and TI including construction, operation, costs, etc. However, those are all what the team considered to do.

a. Construction

(1) Supplier of materials for land leveling and construction are not considered.

(2) Waste water such as factory waste water and sewage are considered up to the collection in a certain point and will be discharged outside the factory site.

(3) Waste oil is considered only up to the collection in a point.

(4) Electric power supply and telephone connection from outside of site are not considered.

(5) Provision of place for Islamic worship in the shop is not considered.

(6) Structures that the survey team decided not directly related to the factory operation are not considered.

b. Facilities and Operation

(1) Except those that the survey team decided necessary, spare parts, standby (reserve) machines and tools are not considered.

(2) Rest areas for workers, couriers and sweepers are not considered.

(3) Lodgings and commutation means for all persons working in this installation are not considered.

(4) Space for the guards' house and the house of the chief guard will be provided, but the buildings thereof are not considered.

(5) Employee's cafeteria is considered, but other welfare facilities are not considered.

(6) Forms of documents are specified. Stationeries and utensils are not considered.

(7) Facilities, equipment and personnel that the survey team decided not necessary because there is no direct relation to the work are not described in this report.

2-2-2 Conditions of Design and Works

a. Although the shop will be a sophisticated one, the work will be done by manual labour whenever it is possible. And maintanence and business machines (such as computer) will be omitted as far as possible.

b. As for the buildings of CWS and T.I. the materials of Bangladish will be used as far as possible. But as for the factory, the most materials may not be from native country since it should be designed for a highly efficient work environment.

c. The quality and durability of maintenance machinery, and spare parts availability of said machinery have serious effect on the performance of CWS. Therefore, survey team has precisely specified the specifications of machinery and tools. Furthermore, those will be limited to the products approved (qualified) by the Japanese Government or competent agency (for example, Japan Automobile Maintenance Machine and Tool Industry Society).

d. In order to avoid concentrated investment of the Capital, the construction period is divided into three phases, but after the completion of each phase, relevant operation shall be possible independently.

e. Though CWS is under the control of BRTC including TI, as the work efficiency increases the capacity will exceed the internal demand. Then, the workshop will be used for the repair of common vehicles not belonging to B.R.T.C.

3. BASIC CONCEPTION

CHAPTER III. BASIC CONCEPTION

3-1 Basic Conception on Maintenance Function

3-1-1 Establishment of Maintenance and Repair System

The second survey team and BRTC counterpart members analyzed and studies the optimum maintenance system taking into account the current situation of Bangladesh.

According to the survey, the monthly operation status of BRTC long-distance buses is as follows.

25 days/month	Actual Servicing day/month
200 miles to 320 km/day	Actual Servicing distance/month

8,000 km/month (320 x 25)

96,000 km/year (8,000 x 12)

Max 8,000 km/month or 96,000 km/year

Min 5,760 km/month or 69,120 km/year

Accordingly, assuming that engines are overhauled after 200,000 km travel, heavy maintenance is required every two years.

While BRTC's service status up to the present is as follows.

a. There is no service system. Vehicles are used as far as they move. Of course, there is certain system-like entity, but due to the lack of know-how and experience, system development and working knowledge are not made. Though various reasons are admittedly present, scheduled maintenance system which worked out from overall merit by the

improvement of vehicle operation rate and extension of vehicle life, etc., is not employed.

b. Maintenance status, facilities and skill in the depots are not adequate. Accordingly, the maintenance is empty without substance. Such situation inevitably results in many troubles and low operation rate.

   All counterplots against accidents depend upon the information of drivers and job clerks, but unfortunately, they themselves have little knowledge about vehicle and maintenance, thus they have no effective means for accident prevention.

c. There is absolutely no parts control system. Mostly parts are piled up in the damp room located inside of BRTC head office with no order and difficult to find out the most critical parts in depots where preventive maintenance is being done every day. Therefore, there are so many points to be improved concerning parts control and supply system.

d. Management organization is not simplified. For example, the request for heavy maintenance to current WS must be approved by the BRTC head offce. Such system is considered ineffective and incomprehensible from the view point of survey team.

e. The responsibility of volunteers is mainly to promote techniques and skill through appropriate guidance. They are contributing for the improvement of techniques through the instruction of know-how in the aspect of practice.

f. Because of the forced operation in spite of the lack of maintenance capability, the number of vehicles waiting for heavy maintenance is almost equal to the number of vehicles the heavy maintenance of which is completed, i.e., in the so-called queue in balance state. Accordingly, the present worst situation remains. Such balance can be broken only by the provision of sufficient maintenance facilities.

In sum, the service system to support vehicle operation is not organized and orderly scheduled, therefore, the survey team has a strong impression that just many different individual or depot service systems exists in a disorderly manner.

Decision of survey team

As a result of analysis and examination of the findings from the above surveys by the members of both teams, it was confirmed that the status is abnormal, that the measures taken are only makeshift, that heavy maintenance is necessary for breaking the balance of this abnormal nature, that more periodical maintenance system is required to achive economic effectiveness, normal safe operation and lengthened service life and that investment should be made worthy. Decisions were made as follows.

(1) Establishment of service system and order.

(2) Establishment of heavy, and periodical maintenance facility and systematic operation thereof.

(3) Determination of service cycle in accordance with the situation in Bangladesh referring to service cycle data obtained by BRTC (Table 3-1).

(4) Inplementation of complete heavy maintenance in the above decided service cycle and introduction of new periodic maintenance.

These will enable BRTC more effective preventive maintenance, safe operation and longer service life which is most critical.

Table 3-1 BRTC Bus Service Termination

	Item	BRTC Data		Japanese Team Estimate		Decision
		Travel Distance	Month Operated	Travel Distance	Month Operated	
		km	months	km	months	
Heavy Service	Engine Overhaul	160,000	20	190,000	24	2-year inspection/ maintenance (equivalent to 19,000 km)
	Steering Gear Case Overhaul	160,000	20	190,000	24	
	F/R Axle Overhaul	320,000	40	190,000	24	
	Body Check & Wiring Harness Check	220,000	40	190,000	24	
	Gear Box Check	120,000	15	190,000	24	
Quarterly Inspection	Clutch Disc Replacement	80,000	10	24,000	3	Quarterly inspection/maintenance (equivalent to 24,000 km)
	Nozzle Tip Check	80,000	10	24,000	3	
	Injection Pump Check	80,000	10	24,000	3	
	Brake Shoe Lining Change	40,000 80,000	5 10	24,000	3	
	Dymano Starter Relay Check	960,000	12	24,000	3	
Semiannual Inspection	Brake Booster Check	80,000	10	48,000	6	Semiannual inspection/maintenance (equivalent to 48,000 km)
	Brake System Check	96,000	12	48,000	6	
9-month Inspection	Chassis Spring Check (F/R)	96,000	12	72,000	9	9-month inspection/ maintenance (equivalent to 72,000 km)
	Propeller Shaft Check	96,000	12	72,000	9	
Annual Inspection	Battery Check	96,000	12	96,000	12	Annual inspection/ maintenance (96,000 km)
	Seat Check	96,000	12	96,000	12	

3-1-2 Study on Optimum Scale of CWS

BRTC operation plan (refer to Table 1-6) and vehicle reinforcement plan (refer to Table 1-7) were established. The construction of CWS with optimum scale has been decided through following process after taking into consideration that the time required for starting of vehicle reinforcement, that the capacity of existing work shop which is the cause of above mentioned bad cycle, that the priority of each shop construction. The construction schedule is shown in 3-2.

a. Determination of Shop Size

The number of required stalls is determined based on the following conditions.

(1) Periodic and heavy repair items (refer to Table 3-1)

(2) Number of vehicles to be serviced 2400 units (refer to Table 1-7)

The number of buses and trucks of BRTC will reach 2400 by 1984 in accordance with BRTC vehicle reinforcement plan. If the number of vehicles exceeds the above quantity, a new CWS should be established at somewhere in Chittagon. The present shop size should be maintained without expansion.

(3) Assignment of service to each facility

70% of BRTC buses are operated mainly in Dacca area (refer to Table 1-4). Repair operation should be made more effective through the assignment of maintenance to each facility (refer to Table 3-2). That is, 70% of all vehicles (2400), i.e., 1680 vehicles will receive periodic maintenance at CWS and the remaining 30%, i.e., 720 vehicles, will receive periodic maintenance at each depot. While, heavy maintenance will be performed only at CWS (refer to Table 3-2).

Table 3-2 Assignment of Service Operation

Repair/Check	Place	Vehicles Applicable
1. Heavy Repair	CWS	All BRTC vehicles (only engine for double decker)
2. Periodical Repair	CWS	Vehicles in Dacca and neighboring area (70% of all vehicles)
3. Daily Check/ Light Repair	All BRTC Depot	Vehicles in other area (30% of all vehicles) Entire Vehicles

The maintenance shop, parts storege, etc. of BRTC shall be arranged in accordance with the above assignment to assure effectiveness.

b. Determination of number of required stalls

The number of required stalls will be determined in accordance with the following formula.

$$S_N = \frac{N}{(n/no)}$$

where S_N = Number of stalls necessary

n = Working days/month

no = Duration of stay in a stall, days/vehicle

N = Number of vehicles requiring maintenance/month

c. Determination of heavy maintenance stalls

Based on the determined number of vehicles to be maintained and maintenance termination,

Number of vehicles to be covered = 2400/year

Engine overhaul 2-year cycle, therefore 1200/year

∴Number of vehicles to be turned in,

monthly $\frac{1200}{10 \text{ month}} \fallingdotseq 120$ units/month (Actual working months is assumed 10 month/year)

daily $\frac{120}{24 \text{ days}}$ = 5 units/day (Actual working day is assumed 24 days/month)

where, Number of days required for maintenance

Engine dismounting	0.5 day
Disassembling & cleaning	1.0 day
Machining	1.0 day
Engine assembling	1.0 day
Reinstallation	0.5 day
Total	4.0 days

From turn-in to release 4 days/vehicle

Required number of days for service are equal to number of stall staying days.

Accordingly,

Number of heavy maintenance stalls

$$\frac{120}{\frac{24}{4}} = 20 \text{ stalls}$$

d. Determination of number of periodical maintenance stalls

Number of vehicles covered; 2400 x 70% = 1680

Annual number of turn-in vehicles; 1680 x 7/2 = 5880
(24 months/3 months = 8, but including heavy maintenance once every 24 months)

Monthly number of turn-in vehicles;

5880 ÷ 10 = 588 units/month

Required number of days for service 1 day/vehicle/1 stall

Accordingly, Number of periodical maintenance stalls

$$\frac{588}{\frac{24}{1}} = 25 \text{ stalls}$$

e. Acceptance (preliminary) inspection

Number of vehicles for acceptance inspection per day;

30 vehicles (combining heavy maintennace and periodical maintenance)

Inspection time; 0.5 hour

Daily working hours; 7.5 hours

Number of stalls $\frac{30}{\frac{7.5}{0.5}}$ = 2 stalls

f. Finish (final) inspection

Same as above.

g. Touchup 1 stall

h. Determination of number of body maintenance stalls

According to BRTC's analysis, 15% of all vehicles are seriously damaged due to collision, etc.,

Therefore,

Annual number of vehicles covered;

2400 x 15% = 360 vehicles/year

Monthly number of vehicles covered;

360 ÷ 10 ≈ 36 units/month

Duration of staying stall

Sheet metal correction	4 days
Painting and touchup	4 days

Therefore, necessary number of stall

Sheet metal work $\frac{36}{\frac{24}{4}}$ = 6 stalls

Painting and touchup stall $\frac{36}{\frac{24}{4}}$ = 6 stalls

i. Determination of tire recapping shop size

In Bangladesh, tires wear rapidly. Considering that tires are expensive, recapping is most effective for reduction of purchasing cost among automobile parts. Under such circumstances peculiar to Bangladish, BRTC very strongly desired

to have a tire recapping shop. In response to such desire and from the prospective investment value it holds, the survey team determined as follows including a metal casting shop.

Based on the view of the survey team that the tire recapping shop is a productive plant and should be isolated from the maintenance shop in accordance with its inherent nature, the recapping shop has been determined to have the capacity whereby the tires of vehicles operating in or near Dacca can be replaced once a year through one-shift working.

Based on the above conditions, the following calculation of the capacity was made.

Number of vehicles

2400 x 70% = 1,680 units

Annual travel distance 96,000 km/vehicle

Tire replacement cycle 50,000 km/vehicle

Annual number of times of tire replacement $\frac{96,000}{50,000} \fallingdotseq 2$

Number of tires mounted/vehicle 6

Accordingly,

Annual number of tires to be replaced

$1680 \times 2 \times 6 = 20160$

Monthly number of tires to be replaced

$20160 \div 12 = 1680$

Number of tires to be recapped on once-a-year basis

$1680 \div 2 \fallingdotseq 800$

Therefore,

Annual recapping capacity

800 x 10 months = 8,000 tires/year/one shift

j. Metal casting and forging

Since Bangladesh imports all parts and considerable time is required for procurement, frequently it happens that no

necessary parts are available, therefore, even broken or wrong parts have to be installed after correction and adjustment for emergency use. Accordingly, the metal casting and foring facility has been decided to be installed. However, as facility is utilized only for emergency use, the size thereof will be similar to the size of existing WS facility.

k. Parts supply

The parts division will be responsible for the parts required for a smooth job, and storage facilities with the capacity to store at least 3-month supply of parts, consumables and sub-materials to be used mainly in CWS will be provided. An efficient system will be established to allow systematic ordering, clear-cut stock control, consideration of special parts and parts reclamation procedure.

Details will be given in Chapter IV.

l. Maintenance equipment and machineries

Duplication of service equipment and machinery is avoided. Spare or reserve units are kept minimum. Those equipment and machinery are arranged in a minimum size required.

Details are given in Vol. 4.

m. Materials required

The outline of water, air and oil (fuel) necessary for the operation of the Factory are as shown in the following table. The details are described in Chapter 6.

Table 3-3 Outline of Materials Required

Water consumption	Approx. 305 ton/day
Oil (fuel) consumption	Approx. 50 Kℓ/month
Air "	Approx. 2 Kℓ/day with 14 kg/cm^2
Power "	Approx. 320 KWH

3-1-3 Training Facility

The necessity of the training facility to be annexed to CWS is as shown in 1-2-2. To satisfy such need, the CWS itself must also be used as a place for the training. Accordingly, it was desined that the training institute would be located within the site of CWS.

a. Purpose

(1) To train mechanics so as to be capable of handling problems likely to arise from anticipated increase of automobiles in Bangladesh and sophistication of automobile technologies.

(2) Training shall be emphasized on practice with adequate teaching material and equipment through man-to-man training method and in order to complete the training in Technical Institute, even CWS shall be used as the place of practice (as intern period in medical education), thus expect to cope with present situation of training system in Bangladesh.

(3) To reduce the number of those who have no confidence in repair operation due to lack of practical knowledge which can be acquired only through practice.

In addition, persons will be finally trained for the maintenance of agricultural machines, marine, civil engineering machine, mining machines, etc. whose engines, gears, electric units, etc. are similar to those used in automobiles.

As above mentioned, the training is intended to develop trainees to have sufficient servicing ability through the use of their own hands and abilities.

b. Operation

(1) New employee training

(a) Recruited new employee training

The training include basic automobile engineering and general information such as mathematics, physics, automobile terms in English, etc. shall be conducted at the existing training institute that was established by the aid from UNDP.ILO.

Training period Approx. 9 weeks

(b) Thereafter, training is conducted at the training institute annexed to CWS.

Automobile maintenance, general theory
Approx. 11 weeks

Maintenance practice
Approx. 26 weeks

(c) After completion of the above training (1-year course), on-the-job training is conducted at CWS for 6 months. During 6 months trainees are assigned the task of automobile reclamation. When the trainee completed the training satisfactorily, he will receive the certificate of qualification.

(d) Trainees are all accommodated in a dormitory. As shown in 4-2, extra activities or curriculums such as morning assembly, clean-up, message, home room, etc. are scheculed so as to boast trainee's pride.

(2) Intra-business re-training

(a) Intra-business re-training is conducted at the existing training institute as has been conducted so far.

(b) Re-training will be conducted at new training institute only when the new employee training is conducted at the existing training institute established by the aid of UNDP.ILO. (Approx. 9

weeks) The re-training is given only to the candidates for higher position. Those candidates are trained for the spirit similar to that for the trainees of new employee training except that the candidates need not enter the domitry during training period.

c. Curriculums

(1) Taking into account the school system and percentage of people entering school, the training is designed to give profound knowledge and skill in particular subject after completion of basic automobile engineering rather than the practice on overall vehicle components. Intra-business re-training will be conducted with special emphasis placed on practice.

(2) In practice, the course of training will be engine, power line, steering & brake system and electric system which are the most important components. The number of trainees for each course will be around 20.

d. Admittance and graduation.

(1) Applicants will be admitted in the training institute through a selective examination.

(2) Graduates will be provided with the certificate attesting the ability for the second grade mechanic in accordance with the achievement.

e. Training facilities

(1) The training facility of the institute is a building consisting of 4 classrooms that can accommodate 20 trainees, a library & material storeroom, an audio-visual & book room, an instructor's room and an office and mainly automobile maintenance theory is given here.

(2) The training shop designed for practice is divided into areas for the engine course, steering & brake course, power line course and electric system course. It is so arranged that 5 groups of each course (each group consisting of 4 trainees) can have practice training. An instructor is assigned to each group. The number of trainees in a group is 5 ~ 10 in Japan and 3 ~ 5 in Indonesia.

(3) Since all trainees are to be accomodated in a dormitory, the dormitory is provided, which consists of 20 rooms, (4-trainees in a room) a superintendet room, mess hall and washing room.

It is expected that the above structural composition and facilities serve to accomplish the original purpose. Technical guidance from abroad is described in 4-4 in detail.

3-2 Basic Conception of Construction Plan

Construction plan execution design is practically completed based on the result of the survey described in 3-1 in such a manner that the basic conception of construction plan is utilized.

The outline of the construction plan execution design will be described below, but its outline is almost identical to the contents of the interim report submitted in March 1978, and there are not much differences.

3-2-1 Basic Conditions for Design

Survey was carried out as for the following items prior to execution design, and the result of the survey was used as the basic conditions for design.

a. Meteorological conditions

Items of survey - Weather, precipitation, temperature, humidity, wind direction, wind velocity, damage from storm and flood, earthquake, lightning.

(1) It is necessary to pay attention on the influence of humidity, precipitation, cyclone, hail, etc. in rainy season into account. Particularly, humidity is nearly 100 percent. Therefore, countermeasures should be considered for the buildings which should avoid humidity, Parts Storage space for for instance.

(2) As for constant wind, south wind and south east wind are common in rainy season in particular. Therefore, these winds are used as reference for the site planning.

(3) It is necessary to take the influence of cyclone into consideration.

(4) Countermeasures against flood in rainy season is taken into consideration. For this purpose, the ground level

will be made as high as possible, and water drainage plan will be made carefully.

(5) As for earthquake, even if the Site is not included in the zone where earthquake often occurs, however, countermeasures are incorporated in the structural planning to stand earthquakes in future.

(6) Lightning equipment will be provided as thunderbolt often occurs.

b. Ground conditions

Items of survey - Soil condition, strata, ground-water level, bearing power of soil

(1) The soil is silty clay with little permeability. This fact will be taken into account in the water drainage plan.

(2) Ground-water level is high. Therefore, waterproofing will be taken into account for underground structures (such as pits).

(3) High bearing power of soil cannot be expected. Therefore, this fact should be fully taken into account for design of structure.

c. Conditions of the Site and of surrounding area

Items of survey - Current situation of the Site (difference in altitude, trees and ponds), confirmation of borders, conditions of adjacent grounds, environment of surrounding area, traffic.

(1) As for ponds, trees in the Site, their positions were recorded and were incorporated in the Site. As for the difference in altitude, current situation was seized and used as a reference for establishment of standard ground level.

(2) Current situation of adjacent grounds and buildings was surveyed and used as a reference for planning fences and drainage.

(3) Check of borders was made, but there are some places where borders are not clear. It is necessary to clarify the borders before commencement of construction work on witness of B.R.T.C. and Owners of adjacent grounds.

d. Material availability in Bangladesh

Items of survey - Bricks, concrete aggregate (sand, gravel, crushed stones), cement, concrete strength, steels, reinforcing bars, wood, etc.

(1) Even though many materials are available locally, these materials which will be incorporated in the design are limited as follows after the quality and supply conditions were taken into consideration.

Bricks, sand, gravel, crushed stone, terazzo, lime terracing waterproofing, jute carpets, wood.

(2) Materials other than what were stated in Paragraph (1) above will be imported. The materials to be imported will be either Japanese products or equal.

e. Labor conditions

Construction labor conditions at the Site were surveyed.

Items of survey - Actual conditions of constructors, ability of labors, wages and construction costs.

3-2-2 Planning

General layout plan is shown in Fig. 3-1, and plan view of each building is shown in Figs. 3-2 and subsequent.

The breakdown of planned floor area is as shown below. It is so planned that total construciton schedule is divided into three phases, as described in Section 3-4.

		Building Name	Structure		Total m^2
			Reinforced concrete structure	Steel structure	
Phase I	1	General Office BLDG	1,396.52		1,396.52
	2	Class Room Office BLDG	1,056.71		1,056.71
	3	Dormitory	1,165.34		1,165.34
	4	Cafeteria	754.95		754.95
	5	Training Room		1,161.38	1,161.38
	6	Check Gate	129.92		129.92
	7	Aircompressor House	88.94		88.94
	8	Paint Grease & Oil Storage	136.74		136.74
	9	Sub Station	117.50		117.50
	10	Heavy Repair Factory		4,283.46	4,283.46
	11	Parts Storage		1,717.20	1,717.20
	12	Retreading & Metal Casting Factory		1,453.05	1,453.05
		Total:	4,846.62	8,615.09	13,461.71
Phase II	13	Inspection Factory		689.00	689.00
	14	Periodical Repair Factory		2,125.30	2,125.30
		Total:		2,814.30	2,814.30
Phase III	15	Paint & Body Factory		1,653.75	1,653.75
		Total:		1,653.75	1,653.75
		Grand Total:	4,846.62	13,083.14	17,929.76

Note: Site area: 19.04 acres (77,049.3 m^2, 23,307 tsubo)
Excluding Wellhouse and Pump house (21.41 m^2 in total)

a. Matters requiring special remarks out of the matters related to the Site planning.

(1) CWS and Training Institute were clearly separated.

(2) Working procedures of repair and maintenance functions were established. The passages within the Site were established based on said procedures so that the flow of vehicles can be smoothly made.

(3) As for the layout of each building, construction schedule was taken into account in addition to combination of functional working procedures.

(4) Care was exercised to make use of a pond and trees in the site so that CWS can provide pleasant working environment within the extent that they do not affect the functions of the factories.

b. Matters requiring special remarks out of the matters related to ground plan of each building.

(1) Heavy Repair Factory

Heavy Repair Factory is of the scale and appearance suitable to the functional center of the CWS. Besides 2-ton travelling crane provided at the stalls, cranes are provided at a number of places to smoothen the flow of work.

For providing overall vision of the entire factory, partition of workshops is made as a rule by using wire net fences with appropriate height, and walls are used only for those which required rigid partition from the functional standpoint (injection pump room, for instance).

The office room which is required for management of the factory is located on the first floor, and a locker room is provided on the mezznine floor above

the office. Central control office is provided in the upper part of the high ceiling area located at the center of the factory where a vision of almost entire factory can be obtained, for management of work.

Particular care was exercised as for lighting and ventilation of the factory so that high working efficiency can be obtained.

(2) Parts Storage

Eaves of the depth of 3m are continuously provided on the inlet side of the Storage for acceptance and unpacking of parts.

The interior is divided into heavy parts section and light parts section. Racks are arranged with ample spare provided to facilitate adjustment and rearrangement.

As conveyance of parts within the Storage is made by using fork lift trucks, passages are clearly provided in the Storage.

As for lighting and ventilation, design was made with suitable consideration. Specially, ventilation is very difficult when meteorological conditions at the Site are taken into account. Detailed explanation of ventilation will be made in the outline of equipment design.

As structural plan of the building, it is of such a structure that shuts off humidity in rainy season and dust in dry season.

(3) Inspection Factory and Periodical Repair Factory

These factories are mainly composed of stalls and inlets are always open. Therefore, they are of the buildings with roof alone.

Office is located on the mezzanine at such places where good vision of each factory is obtained.

(4) Paint and Body Factory, Retreading & Metal Casting Factory

Thorough consideration was made as for lighting and ventilation.

Even if these factories are located within the same building, each shop is separated by partition walls.

Toilet and locker room are provided for each section, and the office of each section is located on the mezzanine to have a vision of the entire factory.

(5) General Office Building

General Office Building is the gateway to and the center of this maintenance facilities. But the scale of this building is kept as minimum because staff members are located in the office of each shop as many as possible.

However, with its characteristic of being the gateway to the factory taken into consideration, ample space is provided around the hall.

Large room system is basically adopted for office space, and the policy of not making small individual rooms was established. This system is advantageous from the standpoints of efficiency of office work and of space economy.

The buildng is formed in H-shape to provide many external walls for improving lighting and ventilation with the aim of improving living comfort in the office. In addition, an existing pond is led to the recessed part of the building to provide charming environment.

(6) Cafeteria

As the number of employees is about 1,000 Cafeteria is designed to accommodate about 450 persons at a time based on the assumption that they will be on two shifts for dining. Cafeteria for the management is separately provided. Both of them are of self-service system.

It was determined not to provide toilets for Cafeteria from the standpoint of hygiene, as each factory is provided with toilets. But a hand washing space is provided in the entrance hall. As this cafeteria is entered by many people, ceiling is made high and good care was exercised as for lighting and ventilation.

(7) Training Institute

Training Institute comprised of three building, Training Room Building and Dormitory.

As already described in Plot Plan, it is intended that Training Institute is separated from the factory block to maintain good training environment, so that calm and gentle atmosphere is created.

Classroom Building is of two floors. The 1st floor is minaly occupied by Instructors'room and office, and classrooms (20 persons course x 4 rooms) and library are located on the 2nd floor.

The hall and the corridor are of open type with ventilation and lighting taken into account. The Training Room Building accommodates practice shops for four courses, and an 2-ton overhead travelling cranes is provided on the ceiling. These buildings are of steel structure from the standpoint of its function.

Dormitory is composed of bed rooms, cafeteria, shower room and washing room. As Dormitory is designed for 80 trainees, twenty bed rooms are provided and each room

accommodates four trainees. The corridor is of open type like classroom to provide good ventilation.

3-2-3 Finish Design

a. Reinforced concrete buildings

General Office, Cafeteria, Classrooms and Dormitory will be made of reinforced concrete because they are easy in the Ground Plan, and consideration was made so that locally produced materials are used for these buildings. The walls will be made by laying bricks.

For waterproofing of roofs, lime concrete waterproofing process which has established results at site will be used.

For the purpose of avoiding direct sunlight, eaves will be suitably provided and ornament bricks will be used.

From meteorological conditions, consideration was made to provide as good ventilation as possible. It was so designed that locally produced materials are used as much as possible for internal finish.

b. Steel structure buildings

It was determined to employ steel structure for factory buildings such as Heavy Repair Factory and Parts Storage as well as Training factory of the Training Institute from the standpoint of their functions. The floors of these buildings will be concrete floors. Equipment for draining water and oil will be provided so as to maintain clean environment.

As for the walls, the lower part will be prepared by laying bricks and the surfaces will be finished by mortar to withstand impact that may be applied by heavy articles. Upper part of walls will be made by colored steel sidings.

As for roofs, it was determined to use colored steel folded plates in order to reduce weight and also to reduce the construction costs.

Monitor roofs will be provided on the roofs of factory buildings for lighting and ventilation of the factories.

c. Exterior plan

(1) Site planning (Separate work to be provided by Owner)

The Site is generally lower than the level of the road passing in front of site, and there are some very low portions, therefore, tremendous amount of earth is required if banking is made to the level identical to that of the front road.

If the planning is made to the same level as that of the front road, it would be ideal for draining water. However, it will require earth of about 150,000m^3 which is of large problem from the standpoints of funds and construction schedule. Accordingly, minute plan and concern will be needed prior to the construction.

(2) Fences (Separate work to be provided by Owner)

Brick fences of the height of 2,400m will be provided along all sides of the Site.

(3) Pavement of passages in the Site, etc.

The passages will be paved with concrete, and parking space will be paved with bricks. As for other areas, one part will be made into gardens and the rest will be only levelled, as shown in the exterior drawing.

(4) Drainage plan

The area in the vicinity of the Site is generally free from difference of elevation, and there are nothing like rivers or waterways in the vicinity. Therefore, drainage plan of the area inside and outside of the Site should be seized as a very difficult problem.

As for drainage of water from Car Washer and a part of the Heavy Repair Factory, an oil separating tank will be provided and waste water will be treated by this tank before being discharged, because oil and grease may be contained.

(5) Piping racks

Pipings for compressed air and steam to be used in factories will be laid on the ground as a rule. Therefore, piping racks will be provided on the ground. For the pipings which are laid along buildings, racks will be provided from posts and girders of the buildings. The height of piping racks is determined as 4.5m to allow passage of vehicles.

3-2-4 Structure

a. As already described, all the buildings can be classified into two groups, that is, those of reinforced concrete structure and those of steel structure.

Reinforced concrete structure is applicable to non-factory buildings having such structural characteristics that both span and floor height are small, there are many walls and number of rooms of large spaces is small.

Steel structure is applicable to factory buildings requireing large span and high ceiling height as large spaces.

b. Frame structure will be adopted not only for reinforced concrete structures but also for steel structures in order to eliminate the restrictions of utility, due to curtain walls and wall braces for the future planning.

c. The foundation will be placed on soil providing sufficient bearing power if possible. Under unavoidable circumstances due to the extent of weight of the building or the condition of the ground, piles which are mainly dependent on friction force will also be used.

d. Seismic force of horizontal seismicity of 0.10 and storm of 60m/sec. are considered as external forces.

e. The standard of reinforcing bars and steels to be used will be based on Japanese Standard, but products of Bangladesh

will also be used to the most possible extent as for aggregate and bricks to be used for curtain walls.

f. The Standards and Specifications to be used for structural design will be what have been established by The Architectural Institute of Japan. However, it is needless to say that local circumstances and conditions will be fully taken into consideration.

3-2-5 Plumbing Installations

a. Water supply installation

A deep well will be excavated on the west side of the site and water will be pumped out of it by using a submarine pump. The water pumped out of the well will be once contained in the water reservoir for settlement of sand and is then pumped up to the elevated water tank for delivery to each building. Water feeding rate will be 305m^3 per day and 42m^3 per hour, and feeding pressure will be 1kg/cm^2 or higher.

b. Drainage installation

Of Drainage living drainage, sanitary sewage (water from water closets) will be caused to flow through the purifying tank privided for each building before being discharged to the side ditch. Miscellaneous waste water (water from washrooms and shower rooms) will be directly discharged to the side ditch. Waste water from kitchen will be discharged to the side ditch after being caused to flow through a grease trap.

Of factory waste water, waste water from engine washing group of the Heavy Repair Factory will be caused to flow through oil separating tank before being discharged. Other floor waste water will be directly discharged to the side ditch.

c. Sanitary fixtures

Each toilet and shower room as well as other necessary places will be equipped with the fixture which correspond to the application. Washing of closet bowls will be of flush system.

d. Kitchen fixtures

Cafeteria will be designed for feeding approx. 450 persons at a time in two shifts, that is, 900 persons in total. Training Institute will be for 100 persons. The entire heat supply shall be electric power, and racks, tables and shelves shall be made of stainless steel.

e. Septic tank

Each purifying tank will be of independent treatment long time aeration system, and the tank main unit will be made of concrete to be placed at the site. A spare blower for aeration will always be prepared.

f. Fire extinguishing equipment

Large size fire extinguishers will be provided in each factory.

g. Well

The well will be of the depth of 100m and of the diameter of 200mm. A strainer of the length of 15m will be provided. The pump to be used will be a submarine pump, and a spare will be always prepared.

h. Compressed air feeder

Compressed air of the pressure of 14kg/cm^2 will be delivered from the air compressor house to the necessary points of each factory through overhead pipings.

i. Fuel tank

The fuel tank for the boiler for the Retreading Factory shall be installed. The tank shall be of semi-ground burial type.

j. Compressor cooling water equipment

The cooling tower for the air compressor cooling water shall

3-2-6 Air Conditioning and Ventilation Installations

a. Air conditioning installation

The injection pump shop of the heavy repair factory will be air conditioned by a package type air conditioner. General manager room of the general office will be air conditioned by a window type air conditioner.

Design condition will be as follows.

	Dry bulb temp.	Relative humidity
Ambient temp. and humidity	35°C	90%
Room temperature and humidity	26°C	55%

b. Ventilating equipment

Forced ventilation by ventilator fans will be provided for the body shop and paint shop of Paint & Body Factory, steam cleaner room of Heavy Repair Factory, metal casting shop of Retreading & Metal Casting Factory, Parts Storage, kitchen of the Cafeteria and Kitchen of the Dormitory.

3-2-7 Electrical Installation

Design of electrical installation within the site is based on the local conditions and design conditions specified in Paragraph a.

The contents of the electrical installation are described in Paragraphs b. and c., and Design Drawings are in Vol. 2,

also specifications are in Vol. 3, therefore, refer to these two volumes in actual construction work.

The outline of construction programme from Phase I to Phase III is described below.

Phase I:

Electrical installation necessary for the maintenance facilities to be constructed in Phase I, and major equipment such as Substation equipment, telephone branch-exchange equipment and master clock, etc., and necessary electric equipments for the maintenance facilities to be constructed in Phase II & III will be provided in this work.

Phase II & III:

Electrical equipment required for the maintenance facilities will be constructed in Phase II & III.

a. Design conditions

(1) Place and point of incoming

Distribution lines which are capable of supplying electric power to the CWS facilities are not currently available near the Site where construction of the CWS facilities is scheduled. Consequently, supply of power will be prepared by P.D.B. (Power Development Board). The place of incoming will be Substation in the Site, and the point of incoming will be the primary side of the section switch on the incoming panel.

(2) Incoming voltage

Transmission voltage is available at either 33kV or 11kV, but 33kV, 50Hz of three-phase three-wire system will be used from the standpoint of reliability of supply of power and of the scale and contents of the CWS facilities.

(3) Distribution in the site

415V/240V, 50Hz of three-phase four-wire system which is identical to local rating will be used.

(4) Rating of electrical equipment

Standard rating will be single phase 240V and three-phase 415V.

(5) Standards and specifications

Standards and specifications of Japan or equivalent will be used.

(6) Equipment and materials to be used

Equipment and materials to be used shall be Japanese products or equivalent.

(7) Separate works to be provided by the Owner

a) Supply of power to the Substation in the Site from the outside of Site

b) Central office trunk to the general office in the Site from the outside of Site

c) Countermeasures against interruption of service and and voltage fluctuation

b. Designed items

The following electrical installation are designed in this report.

(1) Substation equipment

(2) Main line

(3) Power control system

(4) Lighting fixture and socket outlet system

(5) Telephone and electric clock system

(6) Lighting conductor

c. Outline of design

The outline of design of the items described in Paragraph b. above is shown below.

(1) Substation equipment

Substation equipment will be provided in the Site to receive supply of power and also to convert the power into the required system for distribution in the site.

Indoor type cubicles will be installed in Substation Building and Safety protection of the equipment is taken into consideration.

(2) Main line

This equipment will be used for distribution of power to each building from the Substation equipment. Underground cables will be used from the standpoints of safety and appearance.

(3) Power control system

This equipment will be used for supply and control of power to the power machines for repair and also to the equipments required for air conditioning, ventilation, water supply and water drainage.

(4) Lighting fixture and socket outlet system

Lighting fixture and socket outlet will be provided in each room in each building and also at necessary outdoor points.

The socket outlet for repair equipment will be as described in sub-paragraph (3) above.

Fluorescent lamps, incandescent lamps and mercury arc lamps will be used for lighting.

(5) Telephone and electrical clock system

a) Telephone equipment

Private automatic branch-exchange will be installed in the general office to enable inter-office communication among major points and to enable communication with the outside of Site through telephone operators.

b) Electrical clock equipment

Electrical clocks will be provided at major points in each building; and time recorders for attendance control and sirens for informing beginning and end of working hours will be installed at necessary points. The master clock will be installed in the general office.

(6) Lighting conductor

Equipment for arresting lightning will be provided for each building and facility.

3-3 Colateral Conditions for Design and Operation of CWS

(1) Execution design documents shall make in the units of M.K.S.A.

(2) The materials to be imported shall be Japanese products or equal.

(3) Lodgings and means of transportation of factory employees are not considered at all. Provided, however, the site for the lodging for security officers is taken into consideration.

(4) It is assumed that in and out of double decker's buses to and from this factory will not occur. Therefore, for repairing double decker's buses, the blocks to be repaired shall be dismounted from buses and be brought to this factory.

(5) It is so designed that the steam to be used at car washer and at the engine wash in the heavy repair factory will be supplied from the boiler in the retreading factory to be completed in the third term construction work. During the operation before completion of said factory, treatment will be made with a private steam cleaner provided for CAR WASHER and engine wash respectively.

(6) For treatment of waste oil (engine oil, transmission oil, etc.) from Heavy Repair Factory and Periodical Repair Factory, a waste oil tank will be installed near these factories and waste oil accumulated in it will be taken out once every one to two months.

3-4 Construction Schedule

3-4-1 Schedule of Execution Design

The work of execution design was commenced in April, 1978 based on Interim Report prepared by the second survey team in Bangladesh. As shown in Table 3-4, the work was commenced with the preparation of general maintenance procedure and management system of CWS, including list up of necessary machineries and parts stock control system, and after completion of above mentioned study execution design of construction was commenced based on the systems.

The report is systematically arranged from the significance of establishment of the CWS to construction schedule, and studies, for example, collection of data and examination for preparation of the report were systematically carried out with the members of the survey team as the nucleus.

3-4-2 Construction Schedule

It is planned that construction and operation will be divided into three phases respectively because the volume of the work is tremendous, the work is complicated and to avoid concentrated use of funds.

This schedule was established in accordance with the wish of the Bangladesh side, and considerable efforts and detailed schedule plan are required on the execution of this schedule because the terms of construction work are shortened to a considerable extent if the conventional and actual situations of construction processes in Bangladesh are taken into consideration.

a. Preparatory work

The following works shall be completed before the construction work of Phase I is commenced.

(1) Levelling of the ground

(2) Construction of gates and fences

(3) Excavation of well

(4) Installation of watchman's temporary office and watch boxes.

(5) Power incoming work

b. Construction work of Phase I

(1) General Office

(2) Training Institute (Class Rooms)

(3) " " (Dormitory)

(4) Cafeteria

(5) Training Institute (Training Room)

(6) Check Gate

(7) Air Compressor House

(8) Paint, Grease & Oil Storage

(9) Substation

(10) Heavy Repair Factory

(11) Parts Storage

(12) Watchman Station

(13) Car Washer

(14) Gas Station

(15) Exterior

c. Construction work of Phase II

(1) Inspection Factory

(2) Periodical Repair Factory

(3) Exterior

d. Construction work of Phase III

(1) Paint & Body Factory

(2) Retreading & Metal Casting Factory

(3) Exterior and Gardening

Construction Schedule

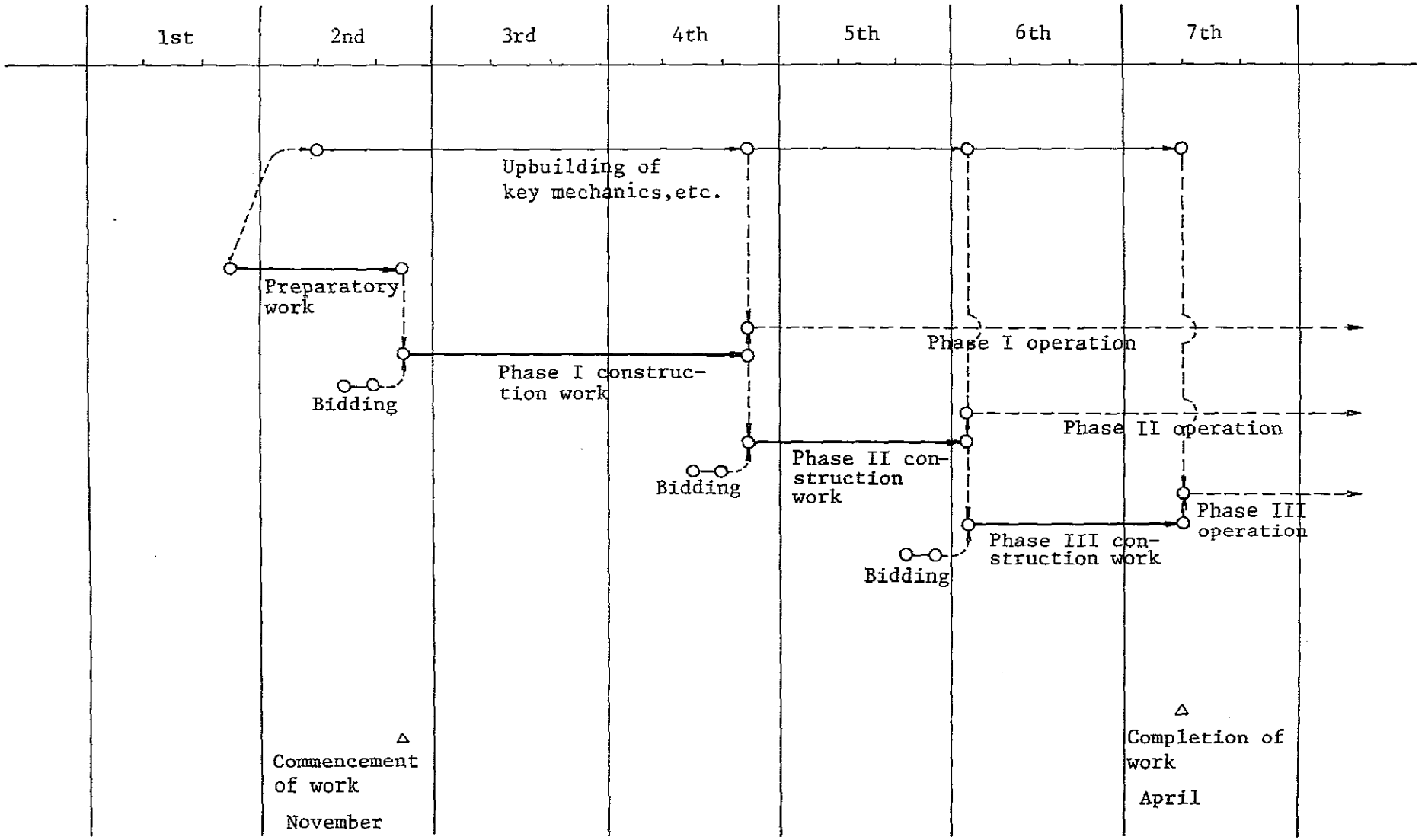


Fig. 3-4 Design Schedule of CWS