CAPITAL DEVELOPMENT AUTHORITY

ISLAMIC REPUBLIC OF PAKISTAN

WATER SUPPLY IN ISLAMABAD

LEAKAGE CONTROL

JULY 1971

prepared for

OVERSEAS TECHNICAL COOPERATION AGENCY

GOVERNMENT OF JAPAN

by

JAPAN SURVEY TEAM FOR WATER SUPPLY IN ISLAMABAD

PREFACE

At the request of the Pakistan Government, the Japanese Government in 1970 sent the First Waterworks Survey Team to Islamabad for three-month field survey. The report of the Team was duly submitted with its findings and recommendations.

Among the various subjects taken up in this report, one of those recommended for an immediate attention was on the control of water leakage, and the Pakistan Government fully cognizant of the problem, responded immediately by requesting the Japanese Government for a dispatch of another survey team on this particular subject and also for supply of necessary materials.

In compliance with this request, the Japanese Government supplied the Capital Development Authorities of Pakistan with necessary materials and entrusted the Overseas Technical Cooperation Agency of Japan with the task of field survey.

Overseas Technical Cooperation Agency therefore organized Second Survey Team of 7 members headed by Mr. M. Masuda, Waterworks Section, Environmental Sanitation Bureau, Ministry of Health and Welfare. For a period of three months beginning early part of January, 1971, the Team conducted a field survey on the leakage condition of the water supply system by using materials supplied from Japan and, at the same time, undertook necessary repairs. Through these series of work serving as a demonstration, local engineers were given training on detailed procedure of leakage control programme. The Team also conducted a study and made record of existing pipe lines, which should be the valuable contribution to the future operation and maintenance of the system.

The present report aims to outline the various services rendered by the Survey Team. It is appended by a manual on leakage control with

three major subjects, i.e., procedure on prevention or water leakage, procedure on repair of water meters, and procedure on water pipe installation, together with instruction on making drawings of distribution pipes and also drawings showing the existing water distribution pipe system.

It is hoped that this report will prove to be useful for the future management and operation of waterworks in Islamabad, thus contributing to the promotion of friendship existing between the countries of Pakistan and Japan.

In closing, Overseas Technical Cooperation Agency wishes to take this opportunity in expressing its profound gratitude to the agencies concerned within the Pakistani Government for the cooperation and assistance rendered to the Survey Team in the performance of field surveys.

July, 1971

K. Tatsuki

Keiichi Tatsuki
Director-General
Overseas Technical Cooperation Agency

LETTER OF TRANSMITTAL

TO: Mr. Keiichi Tatsuki
Director-General
Overseas Technical Cooperation Agency

The Second Waterworks Survey Team which has completed the survey on Islamabad water supply, Pakistan, takes great pleasure in submitting herewith the accompanying report to you.

The survey was conducted exclusively on the water leakage control in accordance with the recommendation included in the previous report on general survey of the waterworks in Islamabad 1970.

The Survey Team carried out the work on leakage control in a selected district of Islamabad in cooperation with local engineers and employees of Capital Development Authority by using materials supplied by the Japanese Government and gave advice on the installation of meter repair shop and on water analysis. We consider that these efforts are most rewarding.

However, in order to solve the existing problem of water shortage, the Capital Development Authority has great task ahead in expanding leakage control programme in the entire area served by the existing water supply system in accordance with the advice furnished by our Team. Furthermore, effort has to be undertaken in rehabilitation and expansion of the water supply network to satisfy the real need of the water. For this purpose, further assistance is indispensable, since essential materials for the work are not available on the local market and the engineering experience required is not sufficient. Thus, the field of contribution, financial and technical, by the Japanese Government will continue to be great, and render technical guidances.

In submitting this report, the Survey Team wishes to express its

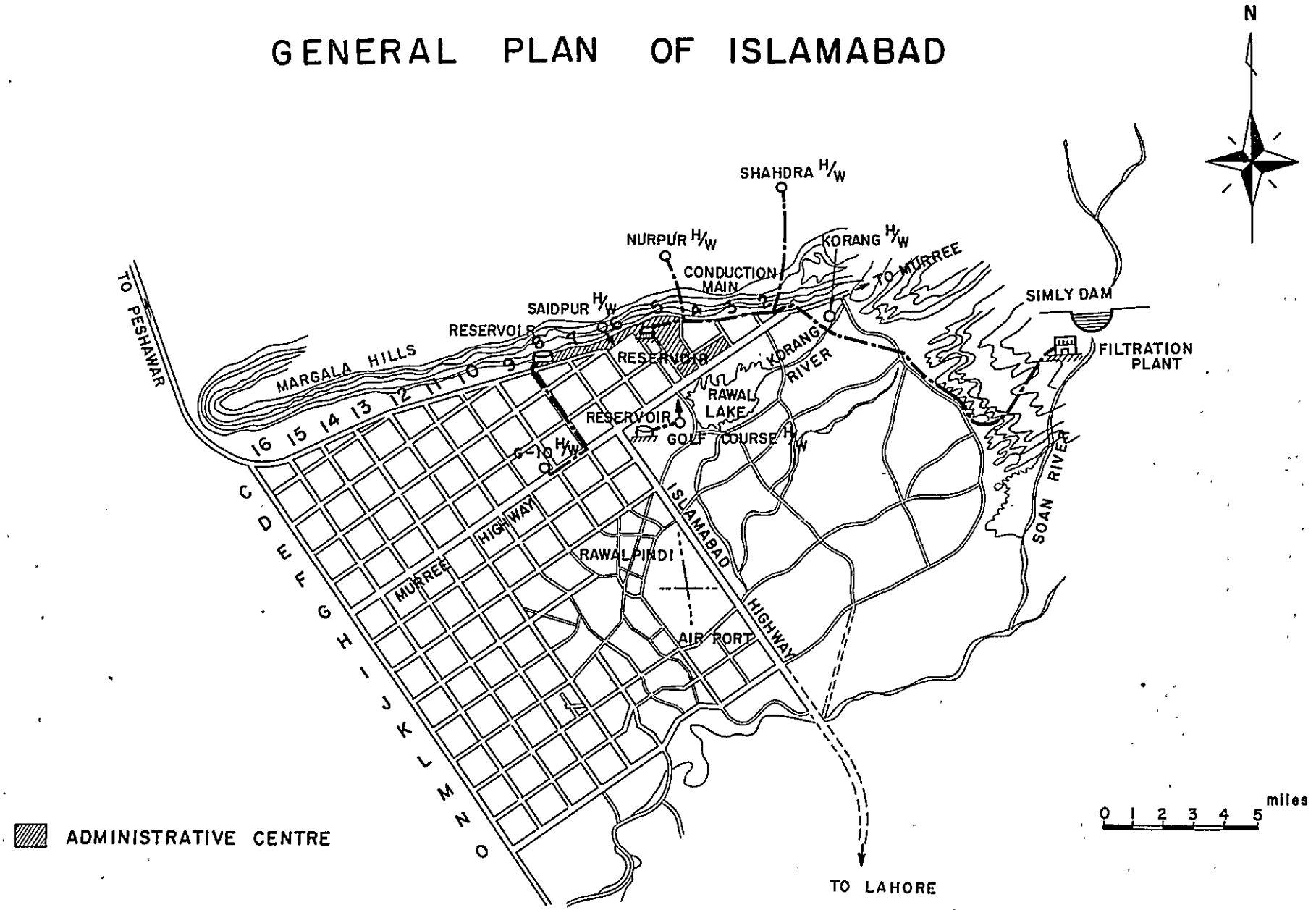
deep gratitude to the agencies concerned in the Pakistan Government, Japanese Embassy in Pakistan, Ministry of Foreign Affairs, Ministry of Finance, Ministry of Health and Welfare, Municipal Office of Kobe, Overseas Technical Cooperation Agency, Japan Waterworks Association, Japanese Federation of Waterworks Industrial Organizations, Nihon Suido Consultants and other related parties for their cooperation rendered in connection with the performance of our assignment.

July, 1971

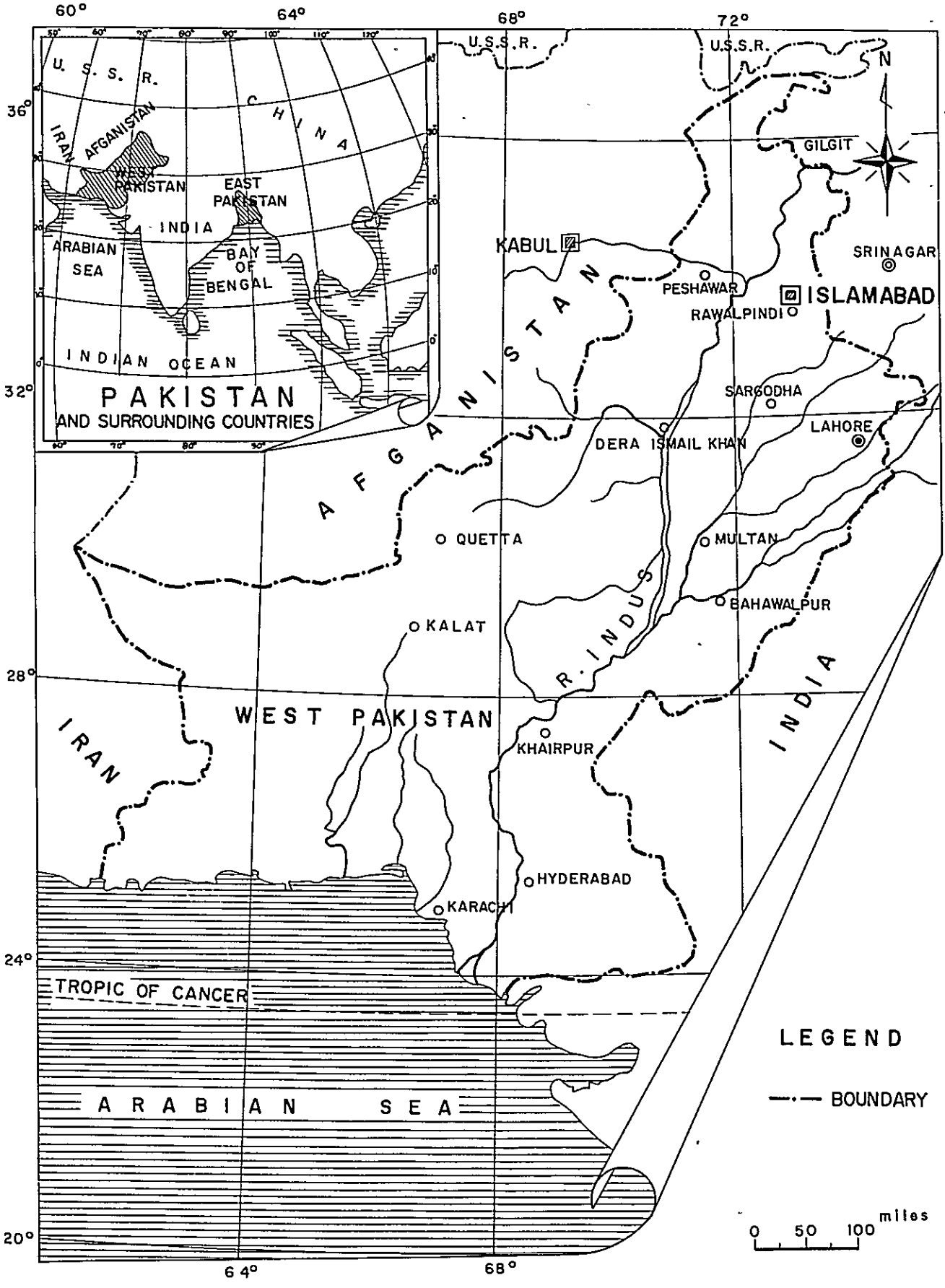
M. Masuda

Masahao Masuda
Team Leader
Deputy Chief, Waterworks Section,
Environmental Sanitation Bureau,
Ministry of Health and Welfare,
Government of Japan

GENERAL PLAN OF ISLAMABAD



KEY AND LOCATION MAP



WATER SUPPLY IN ISLAMABAD

LEAKAGE CONTROL

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CHAPTER 1. INTRODUCTION

1-1 Services of Japanese Water Supply Engineers

The city development programme of Islamabad, including its water supply system, has been carried out by the hands of Capital Development Authority (CDA), ever since the city was decided as the new Capital of Pakistan in 1960.

The actual supply services started from 1963 and CDA has made continuous efforts to ensure sufficient supply of water. Despite this endeavors, CDA has been unable to secure water sources enough to keep pace with the unusual increase of demand due to sharp growth of population. In the dry season of 1969, for instance, the increased daily water demand reached to an estimated volume of 11.25 mgd while the daily supply capacity was barely 5 mgd. This seems to suggest that shortage of water supply has always lingered for a fairly large period of a year. To cope with the situation, the Government of Pakistan, in January 1970, requested the Japanese Government to conduct a survey so as to help establish emergency measures and to work out future programme.

In February 1970, the Japanese Government (through Overseas Technical Cooperation Agency) sent a survey team led by Mr. K. Yamamura, Deputy-Chief, Water Works Section, Ministry of Health and Welfare, for a 70-day survey. Findings of the survey are:

a) Fair amount of supplied water are lost due to the leakage on the conduction mains, and distribution pipe lines, and also due to the broken valves.

b) Insufficient pipe lines for the distribution net work is causing uneven distribution of water supply resulting in greater handicap to certain districts of the city.

c) House meters are not working properly due to several reasons and together with the inadequate current tariff collection system for water consumption, this seems to be inviting the wastage of water by the consumers.

The report further points out that, although it is basically necessary to increase the capacity of water supply by development of water sources, the situation calls for emergency measures such as:

(1) Works on control of leakage

(2) Repairing and addition of house meters to maintain normal performance

(3) Rearrangement of distribution networks to ensure even distribution of water.

In compliance with the advice contained in the report, the Pakistan Government again submitted a request to the Japanese Government for technical assistance exclusively for the purpose of leakage control in Islamabad Water Supply System. In January 1971, therefore, the Japanese Government (through OTCA) sent a survey team led by Mr. M. Masuda, Deputy-Chief, Water Works Section, Ministry of Health and Welfare, for an 82-day survey. At the same time, the Japanese Government donated some of materials and equipments necessary for leakage control works.

1-2 Terms of Reference of the Team

The terms of reference of the Team is therefore to conduct the works on water leakage control and the house metering rehabilitation in cooperation with CDA staff including engineers by using the machineries, equipments and materials denoted by the Japanese Government in accordance with the emergency programme as recommended October 1970, by Survey Team of Water Supply in Islamabad. The eventual success of this undertaking shall only be determined by the fact whether or not CDA staff,

particularly engineers, will be able to continue to carry out this unobtrusive programme satisfactorily in the future.

At the Islamabad Water Works Office, the piping design drawing which was made out at the outset of the development of water supply system was the only data kept in file. Thus, it became necessary for the Survey Team to check the existing water pipe lines against this drawing and to make out a drawing of the existing water pipe lines. Since such drawing is indispensable not merely for the works of leakage survey and piping rehabilitation but equally for the purpose of good water supply operation and maintenance. The survey disclosed a marked discrepancy between the original design and the existing network. However, it was carried out for too short a period of time to conduct exhaustive checking and therefore the complete drawing of existing water pipe lines was not possible. For this purpose, the CDA staff must continue to check the existing water pipe lines until completion of such drawing.

1-3 Work Schedule of the Team

1-3-1 Work in Islamabad

The field leak survey was carried out at Islamabad for a period of 82 days from January 7 through March 29, 1971, with seven members of the Team commissioned by OCTA as shown below:

Leader	Masanao Masuda, Water Works Section, Environmental Sanitation Bureau, Ministry of Health and Welfare
Deputy leader	Shigeki Nakajima, Nihon Suido Consultants Co., Ltd.
Member	Toyoharu Amaha, Investigation Section, Water Works Bureau, Kobe Municipal Government
"	Tamaki Nakadonari, Nihon Suido Consultants Co., Ltd.
"	Kiyohisa Yoshioka, Nihon Suido Consultants Co., Ltd.

Member	Shoji Sasaki, Nihon Suido Consultants Co., Ltd.
"	Ryuma Hirayama, Overseas Technical Cooperation Agency

1-3-2 Work in Japan

Nihon Suido Consultants Co., Tokyo, who provided majority of the field survey team, was commissioned by OTCA to prepare the Manual of Water leakage prevention and Instruction for Drawing Distribution Pipes, together with the drawing of existing water pipe lines in Islamabad Water Supply System under the supervision of Mr. M. Masuda, leader of the Team.

CHAPTER 2. SUMMARY AND RECOMMENDATION

2-1 Present Situation

The water supply system in Islamabad is presently supplying water for a population of 75,000 in a total supply area of 36 km^2 by using an aggregate of about 100 miles of conduction mains and distribution pipe lines.

At the outset, the design drawing showing the distribution pipe nets of the Islamabad Water Supply System to a scale of 1/1000 was given to the Team by CDA Water Works. This is a design drawing prepared at the time of the development of Islamabad in 1963.

On the basis of this, spot check was conducted on the existing conduction mains and distributicn pipe lines against this design drawing. Practically all the fire hydrants indicated in this drawing have not actually been installed. Pipe diameters were substantially in agreement with those indicated in the drawing, but still certain discrepancies were found. At many points where valves were supposed to have been placed, neither valve bodies nor spindles were found but wooden plugs were used to close openings originally left for insertion of valves. At some points, valve bodies were found, but they were devoid of spindles and were closed with wooden plugs. All these improvised valve closings were causing leakage. Some valves were complete with spindles and valve bodies and yet were not in working condition and others were lacking valve boxes and could not be located at all. Thus, the valves which were found in actual service were not in conformity with those indicated in the original design drawing.

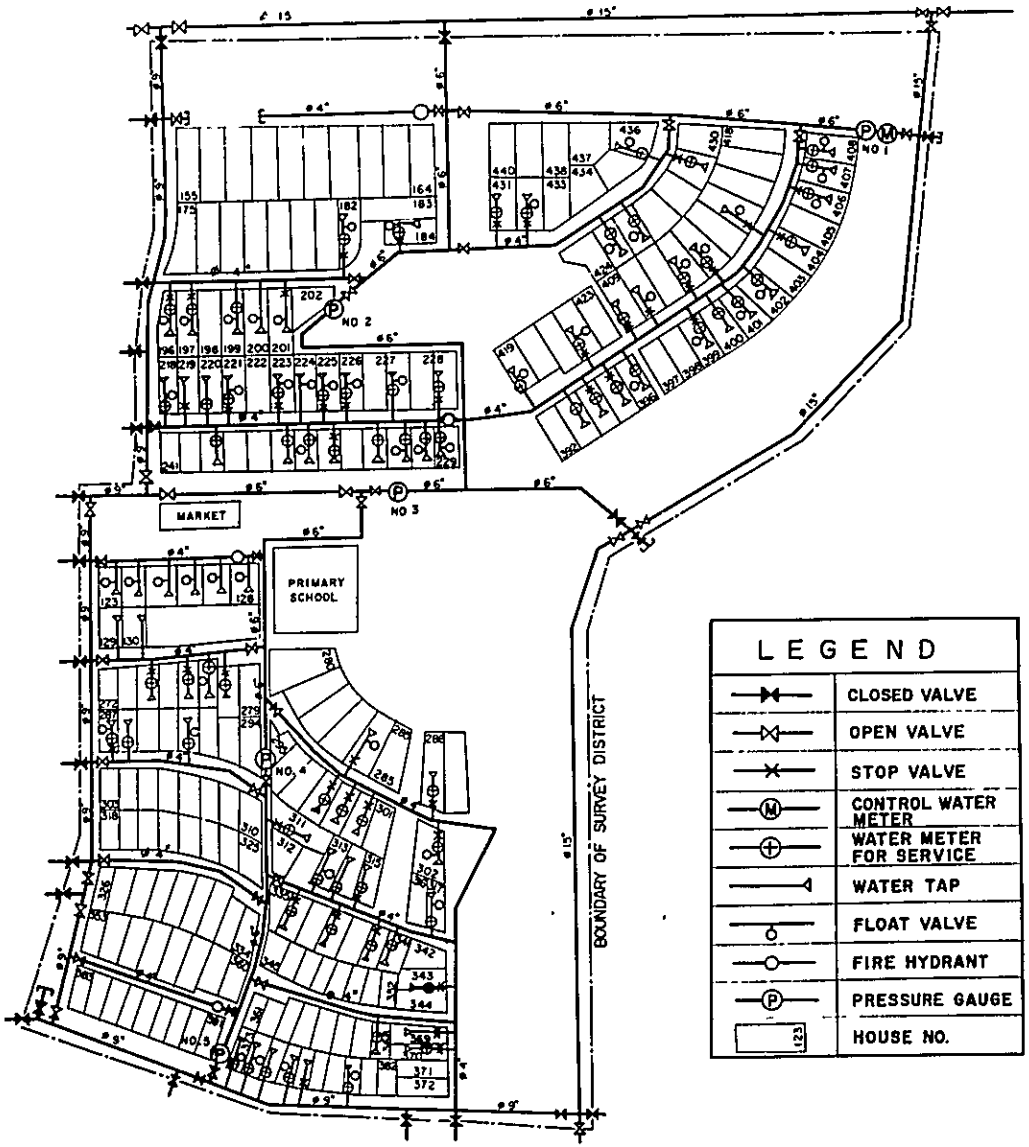
In the initial city planning program, the city was to be divided into 2 mile squares and the water was to be supplied inside each sector via distribution pipes ramified from periphery mains laid along the

borders of each sector. Since the demand for water grew at a greater pace than the expected, CDA had to rely on small rivers and brooks flowing near the Islamabad District and to expand head works at random without any specific plan. Consequently, connections between transmission lines and periphery mains are confusing and no detailed drawings are available for showing such connections.

As to the service pipe from the stop valve onward to the faucet, CDA Water Works has not enacted any specific provisions for the designation of authorized plumbers, mandatory submission of service pipe drawing, inspection of piping work, etc., which makes the operation and maintenance of service pipes most unsatisfactory. Neither industrial standard nor inspection system for products has been adopted with respect to valves as well as pipes, and this makes even simple repair or replacement extremely difficult, causing continued loss of water.

2-2 Work Performed

One district at F-6/3 in the high-class residental sector was selected for leakage survey on the basis of the consideration on the existing situation of Islamabad water supply distribution pipe nets. A drawing was prepared to show the existing pipes in this district as shown in Fig. 1 and investigation was made on the valves in use in order to isolate this district from the other districts. It was found that, of total of 105 valves used in this district, only 52 valves were in working condition. Among the total of 94 houses supplied of water, no water meter was installed at 10 of them. No stop valve was available at 38 houses and the stop valves in use for 19 houses out of the remaining 56 houses were found in such an imperfect condition that the water supply could not be stopped.



LEGEND	
	CLOSED VALVE
	OPEN VALVE
	STOP VALVE
M	CONTROL WATER METER
	WATER METER FOR SERVICE
	WATER TAP
	FLOAT VALVE
	FIRE HYDRANT
P	PRESSURE GAUGE
123	HOUSE NO.

SURVEY DISTRICT	F-6/3
DISTRIBUTION PIPE	
Ø 15"	3,900 FT
Ø 9"	4,800
Ø 6"	7,350
Ø 4"	5,700
VALVE	
Ø 15"	3 NOS
Ø 9"	10
Ø 6"	15
Ø 4"	31
FIRE HYDRANT	4 NOS
SERVICE CONNECTION	94 NOS
LEAKAGE	
LEAKAGE BEFORE PROTECTION WORKS	
LEAKAGE AFTER PROTECTION WORKS	
AMMOUNT OF LEAK PREVENTION	

FIG. 1 COMPLETION DRAWING OF LEAKAGE PROTECTION WORKS

For the purpose of isolating the district, faulty valves were replaced and set to closed position so as to allow water to be supplied only through one inlet. Then a master meter was installed to measure variation of flow quantity. However, it was not possible to find the minimum flow, because many stop valves were in imperfect working condition and also because consumers made a point of collecting water in an underground tanks during the night.

While it was not possible to establish a definite findings for each steps of leakage survey undertaken under the circumstance mentioned above, CDA staff was given sufficient opportunity in familializing with the standard procedure of leakage survey. In addition, the Team demonstrated use of pipe detector and leak detector along the distribution mains which were believed to be suffering from heavy leakage. PRCC pipes involving heavy leakage were also replaced with ductile iron pipes donated by the Japanese Government under the cooperation between the survey team and the CDA staff. A water meter shop was established for the test of meters which is of cardinal importance for the metering system. The detailed discussion of the work is further mentioned in Chapter 3.

In the following pages is given a table enumerating the machineries, equipments and materials donated by the Japanese Government for the project.

LIST OF WATER SUPPLY EQUIPMENT

S. No.	Name of Items	Qty	Remarks
1	2	3	4
(A)	Leak Detection Equipments & Material		
1.	Leak detector	2 Nos.	
2.	Pipe detector	2 "	
3.	Sound detection bar	6 "	
4.	Pressure gauge & recorder	6 "	
5.	Pressure gauge for tap.	6 "	
6.i)	Corporation cock 8" ϕ	20 "	
ii)	- do - 10" ϕ	20 "	
iii)	- do - 12" ϕ	20 "	
7.	Electrical drill	2 "	
(B)	Equipment for Water Quality Control		
1.	Thermometer for water temperature	1 "	
2.	Turbidity meter	2 "	
3.	PH & Cl_2 comparater	10 "	
4.	Conductivity meter	2 Sets	
5.	Test paper for coliform group	5 "	
6.	Jar tester	3 "	
7.	Sample bottle (Two liter)	12 Nos.	
8.	Sample bottle (One liter)	12 "	
(C)	Leakage Measurement Equipment & Material		
1.	Woltmann water meter (ϕ400 mm)	2 Nos.	
2.	Waltmann water motor (ϕ300 mm)	2 "	
3.	Test water meter	6 "	
(D)	Water Meter Repairing Tools		
1.	Testing meter joint	100 "	
2.	Testing bases joint	14 "	
3.	Bushing for strainer	2 "	
4.	Single end spanner	8 "	
5.	Indicator box driver	6 "	
6.	Testing U joint	20 "	
7.	Letter punch	2 "	
8.	Cutting nipper	2 "	
9.	Pincers	4 "	
10.	Piller driver	2 "	
11.	Hair brush	2 "	
12.	Special box spanner	6 "	
13.	Box spanner	6 "	
14.	Fan wheel regulation jig	2 "	
15.	Screw driver	1 Set	
16.	Hammer	4 Nos.	
17.	Fan wheel test rod	2 "	

S. No.	Name of Items	Qty	Remarks
1	2	3	4
18.	Fan wheel test jig	2 Nos.	
19.	Wire brush	10 "	
20.	Special wire brush	10 "	
21.	Brass wire brush	5 "	
22.	Pivot driver	6 "	
23.	Pincette	4 "	
24.	Flat filter	4 "	
25.	Filter set	4 Sets	
26.	Oaktree hammer	4 Nos.	
27.	Acid Pickling basket	4 "	
28.	Electric solding iron	1 "	
29.	Vise	1 "	
30.	Bench drilling machine	1 "	
31.	Polish machine	1 "	
32.	Compressor	1 "	
33.	Air-gun & hose	1 "	
34.	Meter holding bad	1 "	
(E)	Water Leak Repairing Equipment & Material		
1.	Steel ring	10 Sets	
2.	Grinder	1 Nos.	
3.	Welder with engine	1 "	
4.	Portable generator	1 "	
5.	Pipe cutter with engine	2 "	
6.	Chain block (Complete with 6 legs & holder)	1 "	
7.	Rammer with engine	1 "	
8.	Submersible pumps	2 "	
9.	Tools for lead calking	1 Set	
10.	Yarn	50 Kg	
11.	Lead for joint	700 "	
12.	Tools for mechanical jointing	1 Set	
13.	Tools for Tyton jointing	1 "	
14.	Stop valve with box (JWWA Standard)	10 Nos.	
	ϕ200 mm (8")		
	ϕ250 mm (10")	10 "	
	ϕ300 mm ((12")	10 "	
	ϕ450 mm (18")	5 "	
15.	Air valve (JWWA Standard) (ϕ75 mm)	2 "	
16.	Air valve - do - (ϕ100 mm)	2 "	
17.	T type handle for hand operating of valve	2 "	
118.	Pipes with one flange for valve connection		
	(JWWA Standard) ϕ200 mm	20 Nos.	
	ϕ250 mm	20 "	
	ϕ300 mm	20 "	
	ϕ450 mm	10 "	
19.	Collars for ductile iron pipe		
	(JWWA Standard) ϕ200 mm	20 "	
	ϕ250 mm	20 "	
	ϕ300 mm	20 "	
	ϕ450 mm	20 "	

S. No.	Name of Items	Qty	Remarks
20.	Ductile iron pipe (JWWA Standard) ϕ200x5m	10 Nos.	
	ϕ250x5m	10 "	
	ϕ300x6m	10 "	
	ϕ450x6m	20 "	
21.	PVC pipes (JIS Standard) ϕ200x4m	15 "	
	ϕ250x4m	15 "	
22.	Tools for jointing (PVC Pipe)	1 Set	
23.	Paste "Devcon" for pipe connection	50 Tubes	
24.	Cast iron fittings for setting Woltmann water meter (JWWA Standard)	4 Sets	

2-3 Recommendation

The Survey Team submits the following recommendations on the basis of the survey.

(1) Leakage survey and repairing:

There should be organized one leakage survey team and one repair team separately of each other based on the Manual of Leakage Prevention in Islamabad Water supply. They should assume responsibilities of their own and engage in water leakage prevention as a routine work in accordance with a fixed work schedule. The teams should keep a record of daily works and keep in file the records for future reference.

(2) Metering:

The meters which are currently stocked in the store should be installed in every service pipes leading to individual consumers' houses, so that due water charges may be collected in accordance with the readings indicated on the meters. The meters already in use should be collected in turn according to the scheduled time table, tested at the Water Meter Shop according to the Manual and, those in good working condition should be recorded in a ledger and be back to service. A system should be established under which the checking of meters is carried out as a routine work on schedule with a cycle of five years.

(3) Inspection of materials:

A shop designed exclusively for inspection by pressure test to all the materials used in water works, including valves and taps as well as service pipes to be used by consumers should be established. In this connection, CDA should establish and enforce regulations that only materials which have passed the test and on which a certifying mark has been inscribed are allowed

to be used in water works.

(4) Detailed design and extension of distribution pipes:

The current per capita consumption of water supplied by CDA is almost twice that which was estimated at the start of the water supply in 1963, due to, among others, the fact that there are no other water sources available to consumers in and around Islamabad. In order to distribute the limited supply effectively rechecking of the existing distribution networks should be undertaken in determining best suited diameters and kinds of pipe, on the basis of which detailed designing on rehabilitation and extension of pipe lines should be considered.

(5) Completion of drawings on existing supply pipe nets

The drawings on existing supply pipe nets serve as the basis of various maintenance works such as leakage control and distribution pipe rehabilitation and, therefore, should be completed at the earliest possible date. At the request of OTCA, Nihon Suido Consultants Co. has made out 1/1000-scale maps of existing supply pipe nets on the basis of the drawing which was prepared in 1963, and is attached herewith. However, this should in no way be considered as completed, but should further be checked against the actual pipe nets, supplemented as required and brought up to date according to the Instruction for Drawing Distribution Pipes in Islamabad Water Supply.

These recommendations are all essential for good management of Islamabad water supply. It is hoped that the above shall be implemented, materialized at the earliest possible date and shall produce satisfactory results for the benefit of the people of Islamabad.

CHAPTER 3. LEAKAGE CONTROL

3-1 State of Existing Distribution Pipe

Due to the importance of the subject among the terms of reference of the Team, further details of the work performed in a sector selected is enumerated herewith. The Sector F-6/3 in which the leak survey was conducted is a typical residential district of Islamabad with a market place and an elementary school. The height of this district above sea level ranges from 1,895 ft to 2,000 ft. Table-1 shows the aggregate length of pipes and Table-2 shows the number of houses receiving supply of water and other data. Table-3 shows water pressures measured at a few selected points within this district.

CDA has not made out any drawing of the existing pipe lines for maintenance and control. Only a design drawing prepared at the time of construction is kept at the office. Thus, the office has to rely for location of buried pipes upon the memory of persons concerned. In the distribution pipe nets, many of the valves now in service are at fault. In this district, 53 valves or approximately 50% of the total of 105 valves are not functioning properly because of leakage and absence of spindle. As stated already, since materials are not standardized and there exist no regulations on authorization of water works or work inspection, the service installations are in quite inadequate condition. Table-4 shows the results of the survey conducted on service installations.

Table-1: Aggregate length of pipe broken down by pipe diameter and type

Diameter	Kind of pipe	Aggregate length
ϕ15"	PRCC	1,300 m
ϕ 9"	PRCC	1,600 m
ϕ 6"	CIP	2,450 m
ϕ 3"	CIP	1,900 m

Table-2: Status of water supply

No. of served houses	Served population	Planned number of houses	Supplied area
94	752	207	0.68 KM^2

Table-3: Water pressure

Measurement point	No. 1	No. 2	No. 3	No. 4	No. 5
Min.	0.1 kg/cm^2	0 kg/cm^2	0 kg/cm^2	0 kg/cm^2	0.95 kg/cm^2
Max.	1.6	0.9	0.3	0.9	2.9
Mean	0.9	0.5	0.06	0.4	2.1

Table-4: Status of water meter and valve

No. of served houses	No. of uninstalled water meters	Stop valve	
		Uninstalled	Imperfect
94	10	38	19

3-2 Work in Islamabad

3-2-1 Making of control drawing

A control drawing showing the existing distribution pipes in this district has been made out on the basis of the design drawing which was prepared at the time of construction. The location of buried pipes has been checked with the aid of memory of persons concerned and correctly entered in the new drawing. In the case of some pipes of uncertain location, the exact location has to be confirmed by digging ground.

3-2-2 Completion of valves

The volume of water supplied to a given district cannot be measured accurately unless valves are functioning properly. Thus, as stated earlier, all the valves in this district were checked against the design drawing. Of the total of 105 valves, 53 valves were found in imperfect closing allowing some amount of passage of water through closed valves including the leaking from the absence of spindle. Of these 53 valves, 26 valves which were considered to be necessary for repairing were replaced with locally made new valves currently in stock with CDA but they were still not in perfect condition as the passage of water could be heard through the sound bar even after the closure of valves.

3-2-3 Measurement of flow of water

The volume of water supplied is measured in Japan by the use of a portable water meter since great number of fire hydrants are installed. In Islamabad, no fire hydrants are actually installed, although their installation is indicated in the design drawing. For the purpose of this measurement, therefore, a water meter 6" in diameter was installed at one inlet, so that when the valves

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located on the boundary of this district are closed, the water will flow into this district only through this water meter. Furthermore when all the stop valves in service within this district are closed, the volume of water indicated on this water meter, if any, would mean the water lost through leakage.

The first measurement of water supply volume was carried out on February 22 and 23, 1971, while the volume of water lost through leakage could not be measured because some of the valves and stop valves were not functioning properly, it served as demonstration to CDA staff for them to carry out the measurement by themselves in the future. However a survey on the time vs flow volume relation for a period of 24 hours was successfully conducted, and the results of the survey are shown in Fig. 2. While, reveals the actual status of water consumption in this district.

3-2-4 Leakage detection

The training of CDA staff on leakage detection procedure was also undertaken on the basis of the following theory: The sound bar is applied directly to a stop valve for the detection of leakage. The stop valve is closed when an abnormal noise is detected. If the noise persists after the closure of stop valve, this indicates that leakage occurs outside the stop valve under test. If the noise is stopped on closure of stop valve, this indicates that leakage occurs inside the premises of the consumer. Then the exact point of leak must be determined with the aid of leak detector and pipe detector, followed by the necessary repairing works. The leak detector is normally used on distribution pipes. Pickups are placed on the ground surface at intervals of 3 meters (10 feet) along the course of pipe and the detector is set to work to determine the presence or absence of

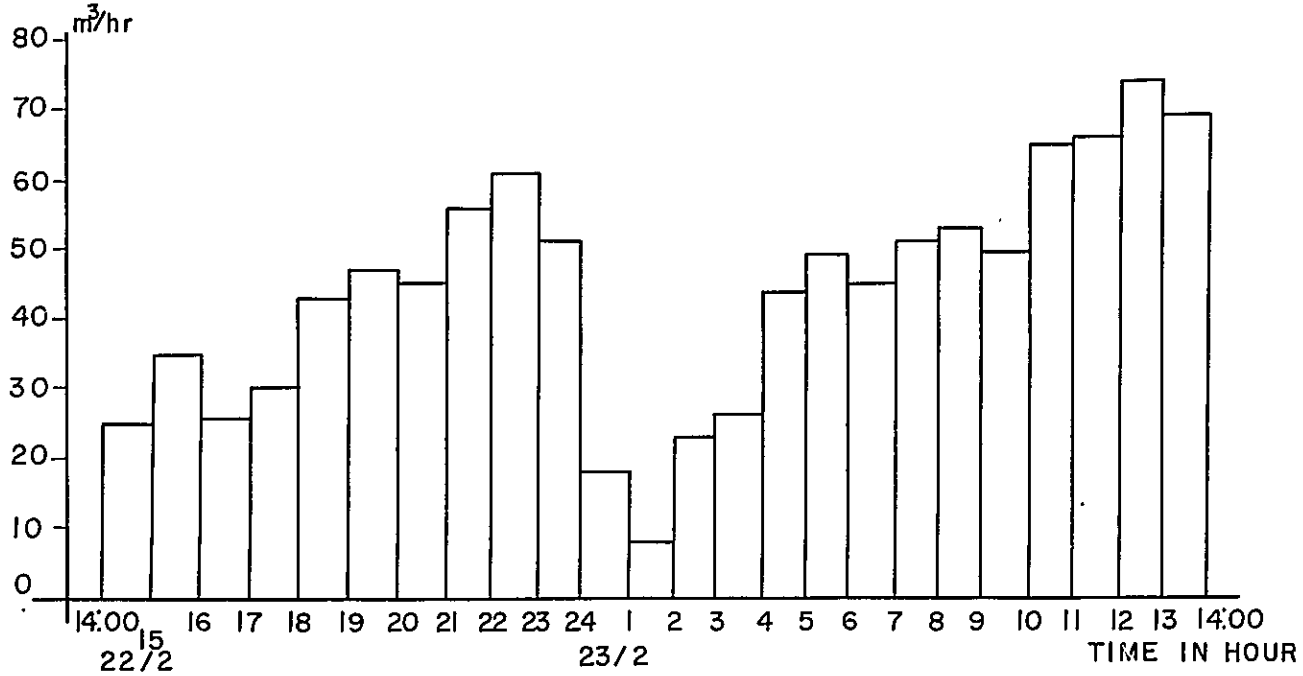


FIG.2 VARIATION OF WATER FLOW AT CONTROL POINT

(14:00 22ND FEB. ~ 14:00 23RD FEB. 1971)

leaking sound. The mark is placed where the leaking sound is loudest.

In the course of demonstration of above, it was found that in the case of PRCC pipes, leaking sound was detected nearly always at intervals of 10 feet. Thus, it was decided to replace PRCC pipes with ductile iron pipes, ϕ 12" in diameter, which were donated by the Government of Japan, and was executed accordingly. However, in this district alone, an aggregate of 2,750 feet of PRCC pipes still remain to be replaced. Leaks detected in cast iron pipes were repaired by the use of Devcon A (product by Kimmon Manufactory Co., Ltd.).

3-3 Training of Personnel in Leakage Control

Throughout the leakage survey, CDA has always provided five members of the ranks indicated below to work with the Japanese team.

One deputy director

One assistant engineer

One overseer

Two foremen

The CDA staff, through the on-the-site training, has been able to acquire full knowledge on overall procedure on leakage survey and, in particular, the method for correct use of sound bar, pipe detector, leak detector, etc. At the beginning of the survey period, the works were carried out only during day time, but afterward, night works were performed as usually required. In repairing the leaks detected in cast iron pipes and steel pipes, new products called "Davcon A" were used. This product contains steel and epoxy material and served to shorten the time requirement for repair to a great extent. Since the survey revealed that PRCC pipes are unsuitable for use as distribution

pipes, ductile iron pipes of mechanical type and PVC pipes were used, for the first time in Islamabad, for replacing these pipes. The CDA staff was given training on the right procedure of works, comprising, 1) making out a design drawing preparatory to the actual replacement of pipe, 2) determining proper method of repair, 3) selecting necessary materials in accordance with the list of materials indicated on the design drawing, 4) transporting these materials to the site of replacement and, 5) on completion of all other preparations, starting the work of replacement. At the same time, correct use of pipes of new materials was taught.

As to the testing of water meters, since the Water Meter Shop has been established, the CDA is now in a position to do the testing in accordance with the Manual provided in the present report.

3-4 Work in Japan

3-4-1 Manual on Water Leakage Control for Islamabad Water Supply

In order to benefit CDA staff in carrying out meaningful leakage control programme in the future, the manual was compiled in Tokyo.

This manual covers all aspects of technical procedure on water leakage control with particular attention to the local condition at Islamabad.

3-4-2 Drawings of existing distribution pipes

To keep the record of complete drawings of existing distribution pipe lines is the basic requirement for good operation and management of water supply system.

It is indispensable not only for the pipe laying works but also for the maintenance of the systems including leakage control programme. Lacking this basic information in Islamabad water supply,

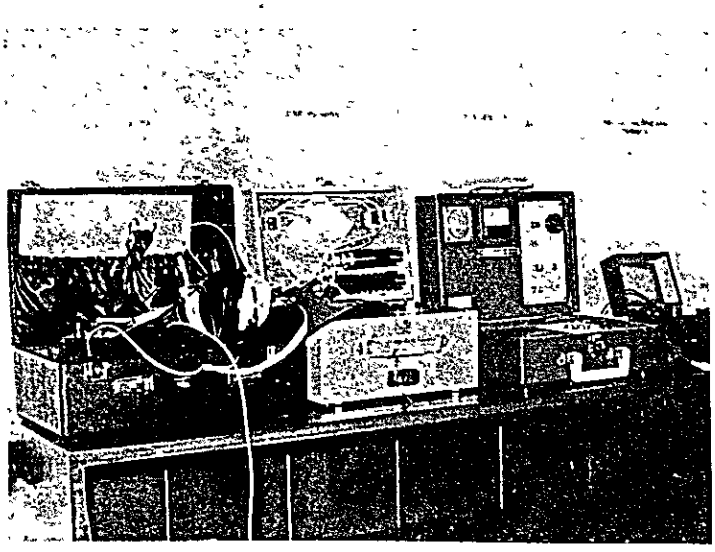
there is great inconvenience in pipe laying works and water service control at the office of CDA.

As already stated repeatedly in the present report, on the basis of planning map of distribution pipe lines in Islamabad at the beginning of development, drawings of existing distribution pipe lines to the scale of 1/1000 and its general plan to the scale of 1/5000 etc. was done in Tokyo.

3-4-3 Instruction for drawing distribution pipe lines

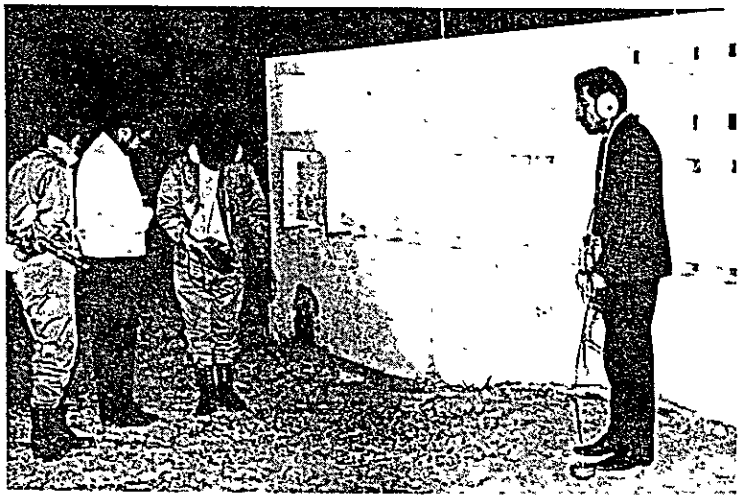
In case of drawings on distribution pipe lines, which require series of related drawings, there should be an uniformity maintained throughout the copies of drawings in sizes, scales, symbols, etc.

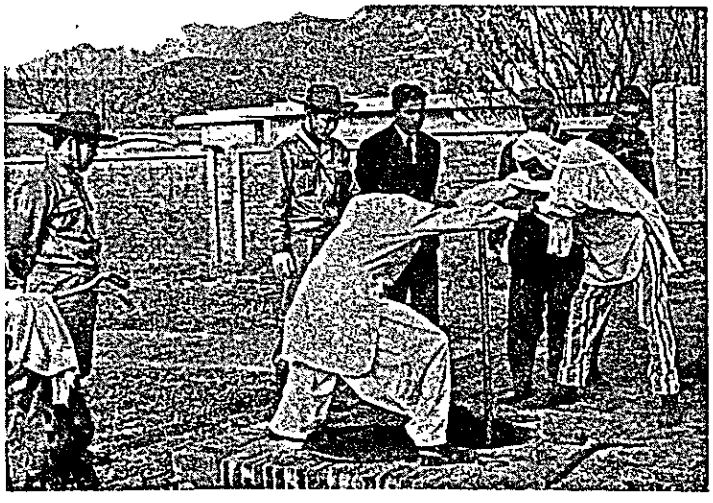
Instruction on this respect was therefore worked out in Tokyo and is attached to the present report.



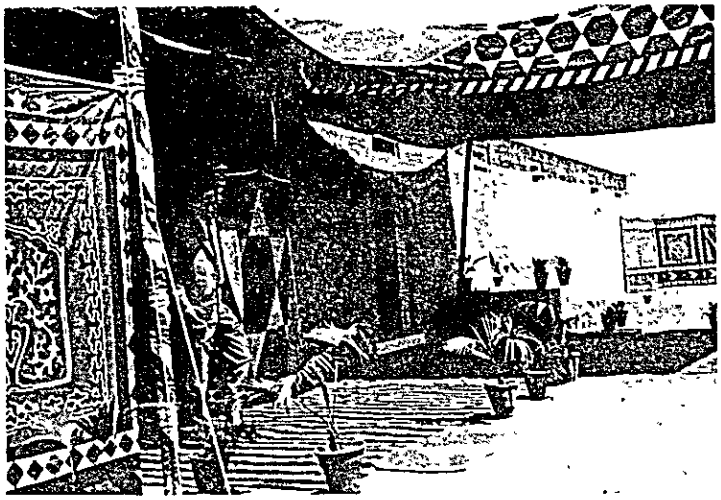
Donated tools for leakage detection works and others.
From left, leak detector, turbidimeter, pipe detector, and residual chlorine & pH comparator.

Works in the night on leakage detection

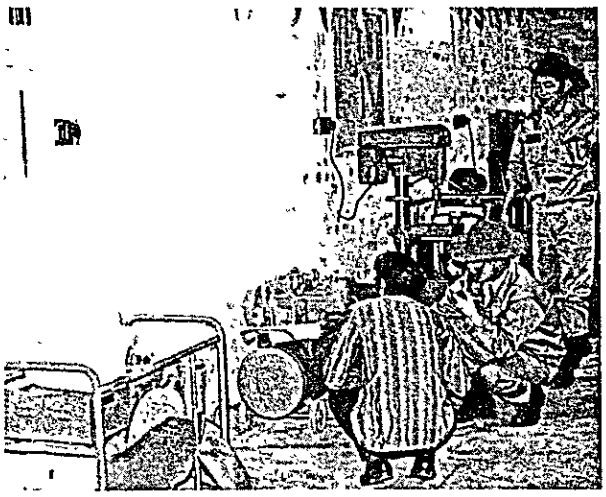




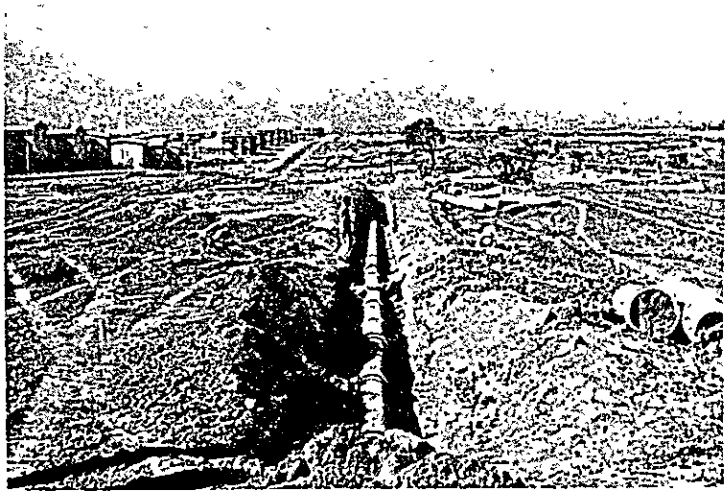
Checking valve



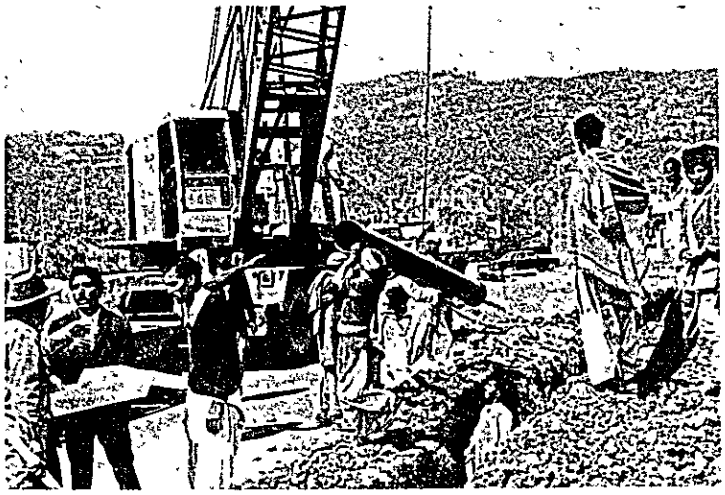
Opening ceremony of Water Meter Repair shop, CDA



Part of donated tools setted in Water Meter Repair Shop, CDA



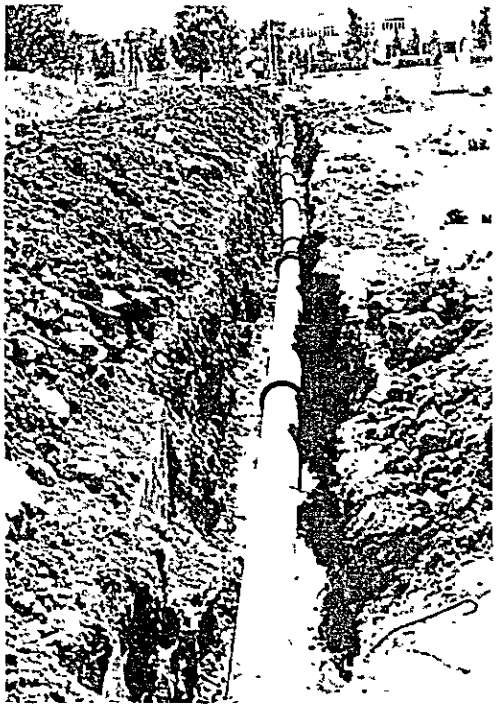
View of distribution pipe line, under construction in Islamabad



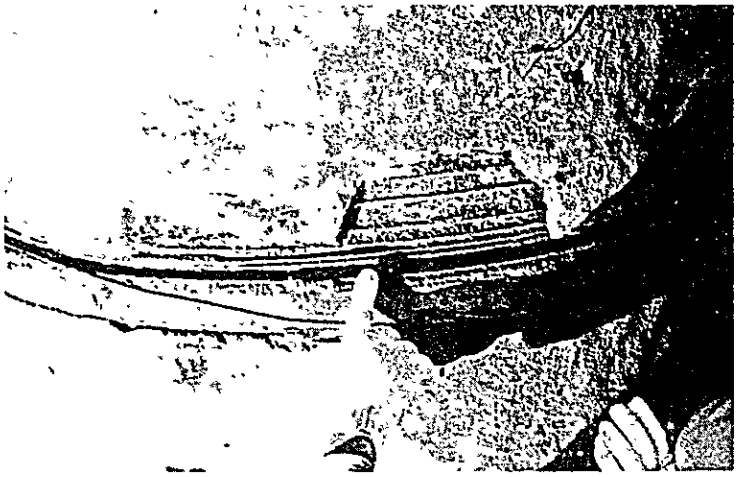
ϕ9" distribution pipe replacement works in Islamabad
March 1971

Pipe laying

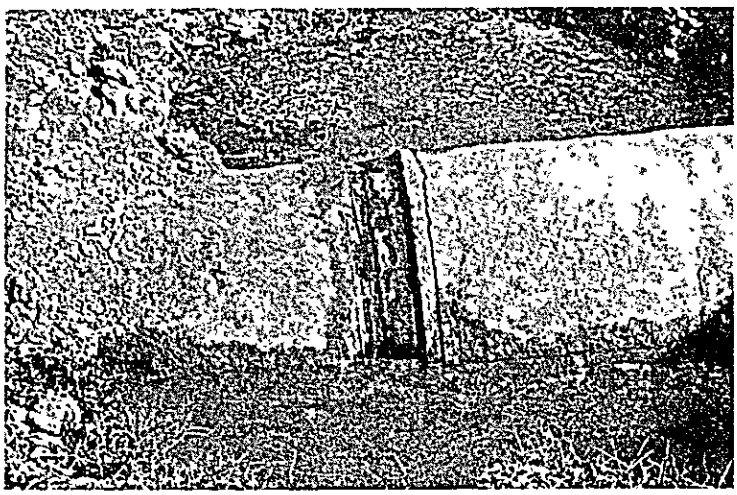
Jointing works of Tyton Joint, ϕ250 mm DIP



Replaced pipe line,
ϕ250 mm DIP



Crack caused a large amount of leak on Simly Conduction Main, ϕ36"



Repaired with steel plate