KINGDOM OF THAILAND

DETAILED DESIGN REPORT

of the

BANGKOK TELEPHONE LOCAL NETWORK PROJECT

November 1 9 7 4

JAPAN INTERNATIONAL COOPERATION AGENCY

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PREFACE

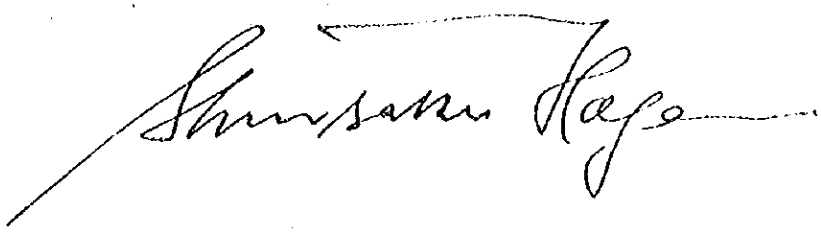
In compliance with a request from the Government of Thailand, the Government of Japan decided to carry out the detailed design for the Bangkok Telephone Local Network Project which is a part of the Telephone Development Project, based on the Third National Economic Development Plan for the Kingdom of Thailand. The execution of the detailed design work was entrusted to the Japan International Cooperation Agency.

The Japan International Cooperation Agency then organized a survey team of 11 experts with Mr. Hideo Sano as the leader and despatched said team to the Kingdom of Thailand where field surveys were conducted over a period of approximately six months from February 11, 1974. The survey team carried out demand forecasts, cable survey, civil work survey and design work on cable and civil works as well as gathered information on desired matters, etc. Upon return to Japan, the survey team executed the detailed design work based on the results of the survey and the report thereof is hereby respectfully submitted.

It is sincerely hoped that this report will be of assistance in pushing the telephone development project of the Kingdom of Thailand and contribute toward the social and economic development of the Kingdom and, furthermore, play a role in the friendly relations between Japan and Thailand.

We hereby wish to express our sincere appreciation for the assistance and cooperation extended to the members of the survey team by the officials of the Government of Thailand, the Telephone Organization of Thailand and the Embassy of Japan in Thailand as well as to the Ministry of Foreign Affairs, the Ministry of Posts and Telecommunications and The Nippon Telecommunications Consulting Co., Ltd. for the cooperation rendered in the despatch of the survey team.

November 1974

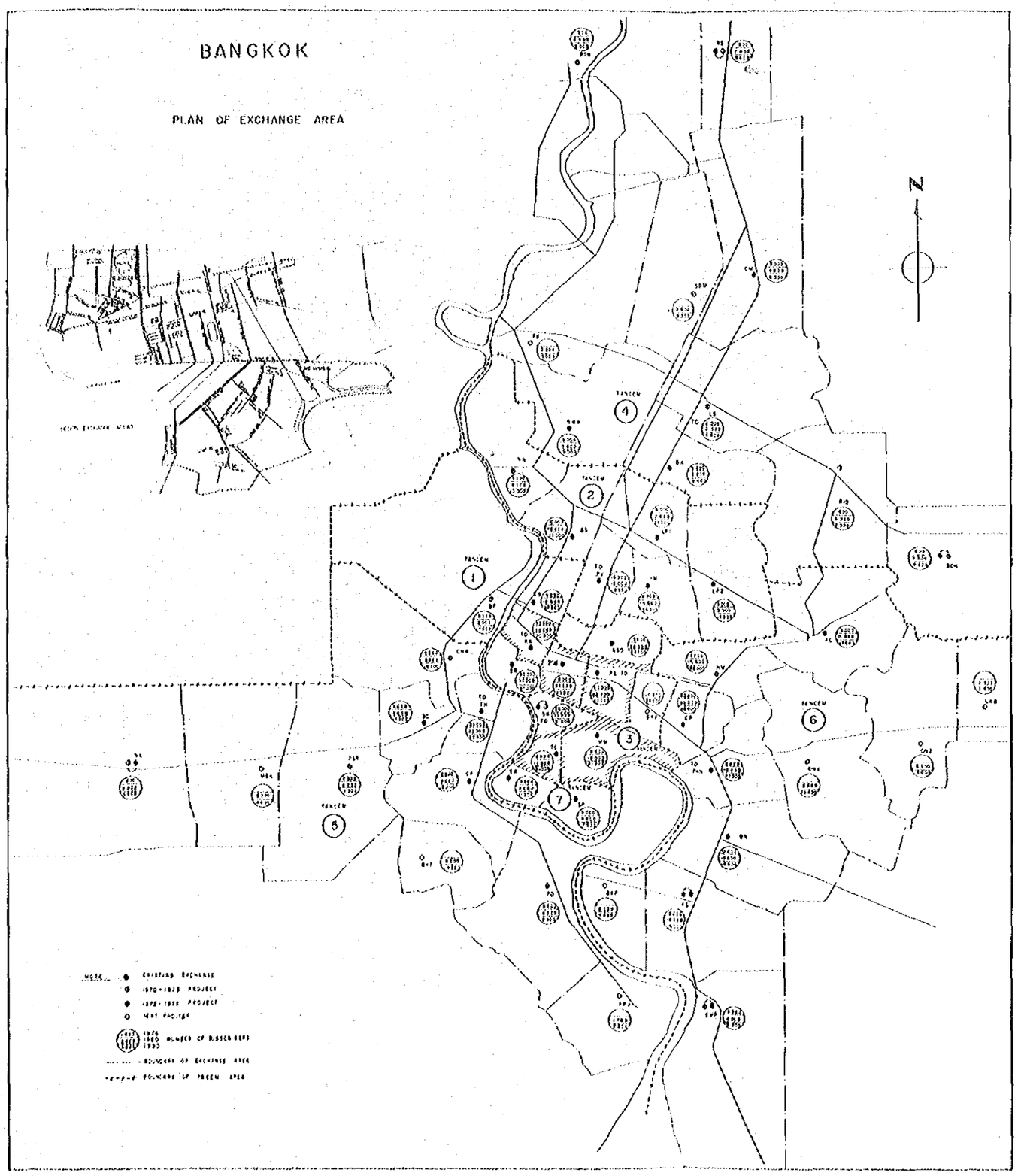


Shinsaku Hogen
President

Japan International Cooperation Agency

BANGKOK

PLAN OF EXCHANGE AREA



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PART I. SUMMARY

CHAPTER 1. PURPOSE AND BACKGROUND OF SURVEY

1. The survey was conducted for the purpose of executing the detailed design of the local cable network of the five exchanges of Krungkasem, Ploenchit, Pathumwan, Tungmahamek and Trokchan comprising the central portion of the Bangkok Telephone Plant Project which is a part of the Telephone Development Project 1972 - 1979 being promoted by the Telephone Organization of Thailand (TOT) to correspond to the Third National Economic Development Plan for the Kingdom of Thailand.

2. The outline of the Bangkok Telephone Plant Project being pushed by the TOT is as follows:

   (1) Acquisition of 19 plots of land for the new telephone exchanges.

   (2) Construction of 13 new telephone exchange buildings.

   (3) Modification and extension of 9 existing telephone exchange buildings.

   (4) Discontinuation of the service of 19,000 Step-by-Step exchange lines.

   (5) Installation of 139,100 exchange lines of new switching equipment.

   (6) Construction of about 264,990 pairs of the primary subscriber network and associated secondary network.

   (7) Construction of about 280,000 pair-kilometers of junction network to expand the existing junction network for the increasing traffic.

   (8) Construction of 130 kilometers of conduit trenches.

CHAPTER 2. SUBSTANCE OF MAIN WORK

The main contents of the survey conducted by the survey team are as follows:

1. Execution of Field Survey and Preparation of Demand Distribution Map

   Although the overall survey had been completed, a forecast was made as to how the demand would be distributed in each direction for the years 1976, 1980 and 1985. The forecast values for each exchange area are indicated in Fig. 1.2.1.

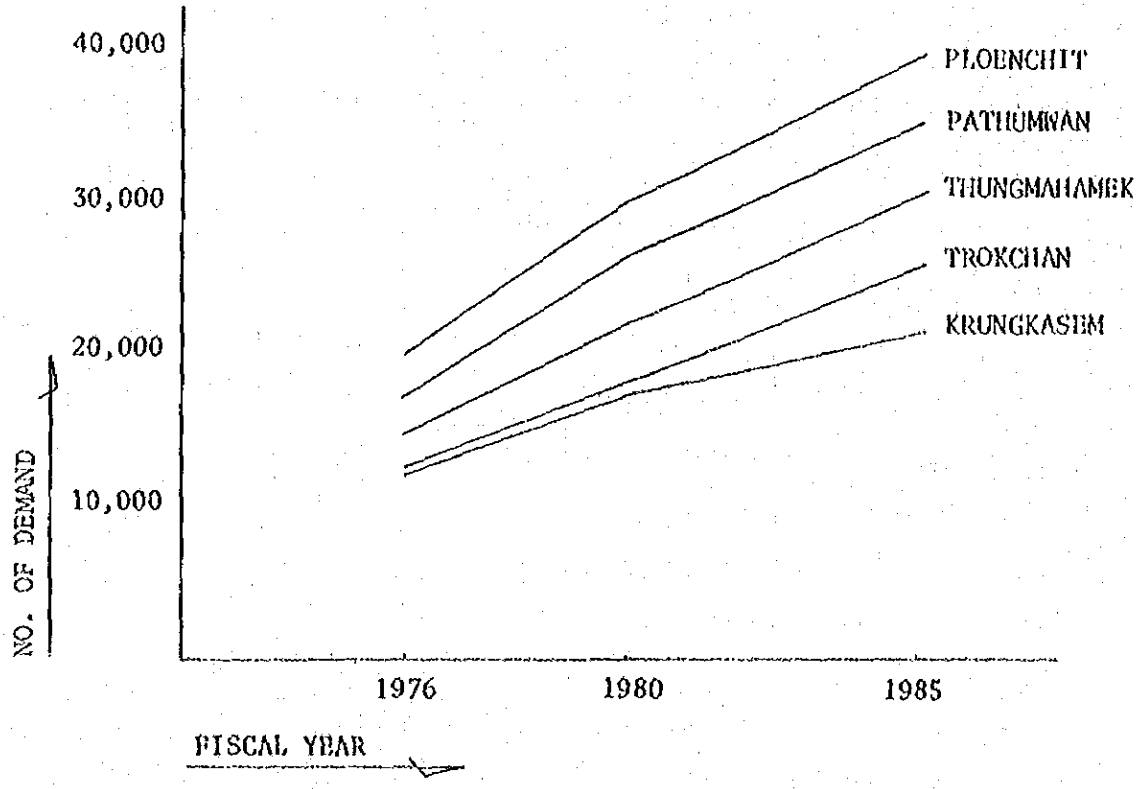


Fig. 1.2.1

On the basis of the field survey, the demand distribution map was prepared.

2. Establishment of Cabinet Area

Cabinet area will be fixed over a long period and are blocks for planning suitable additional installation programs in the effective use of facilities, and have been established for the merits in cable distribution and maintenance. The service area and the number of cabinet area established for each exchange office are shown in Table 1.2.1.

Table 1.2.1

Name of Exchange	Service Area (hectare)	No. of Cabinet Areas	Remarks
Krungkasem	650	83	
Ploenchit	1,150	135	Direct building lead-in -- 5.
Pathumwan	400	139	
Tungmahamek	1,220	84	
Trokchan	650	60	Direct building lead-in -- 1.
Total	4,070	501	

3. Design of Cable Network System

The basic design of underground cable system (study of applicable underground cables, selection of underground routes, determination of number of cable pairs and conductor sizes and cut-over design) and office work design of aerial cable system (selection of aerial routes, determination of number of aerial cable pairs and conductor sizes and study of existing cables to be utilized) were carried out. Field surveys over a distance of approximately 260 kilometers were executed as to whether the designs were suitable to the on-the-site situation and on the conditions of the existing cables in respect to the following matters.

Telephone poles	--	position, classification, existence or not of accessories and ground height.
Guys	--	position, classification, new installation and reinforcement.
Suspension wires	--	Suspension position, classification and tensile strength.
Cables	--	classification, jointing point, suspension position of newly installed cables.
Cabinets & boxes	--	classification, number of pairs, pair numbers and jointing pattern.

4. Surveys

Surveys were carried over a distance of approximately 200 kilometers in regard to the new routes, distance between telephone poles, distance between manholes, etc.

5. Investigation of Manholes (Joint survey by cable engineers and civil engineers)

The investigation of manholes was conducted in order to select the ducts for cable placing. The selection was made as to whether there will be no hindrance in work inside the manhole, no excessive bending of cable required and that there will be no crossing of cables. Furthermore, modification methods were also investigated to correspond with the conditions. The investigation was made on 251 manholes.

6. Design of Civil Works

Route selections over a distance of approximately 50 kilometers were carried out under witness by cable engineers.

CHAPTER 3. ESSENTIAL AMOUNT OF WORKS

The essential amount of works were calculated from the design drawings prepared on the basis of these surveys and investigations. The main works are the laying of 69.0 kilometers of underground cables, placing of 215.7 kilometers of aerial cables and 11.8 kilometers of civil works. The breakdown of these works is indicated in Table 1.3.1.

Table 1.3.1 Essential Amount of Works

Item	Unit	Quantity	Remarks
Telephone pole erection	Poles	220	
Guys	Lines	646	
Aerial cables	Km	215.7	
Underground cables (conduits)	Km	52.2	
" (direct buried and troughs)	Km	16.8	
Gas pressurization system	Unit	2	Air Dryer
Cross-connecting cabinets	Ea.	258	
Terminal sleeves	Ea.	4,677	
Underground conduits	km	11.8	
Manholes	Ea.	49	
Pulling boxes	Ea.	172	

It is desired that the various works, based on the foregoing detailed design, will be safely completed and that the new and expanded installation of the switching and other facilities will also be adequately realized.

It is firmly believed that with the completion of the foregoing works, the problem of waiting subscribers will be solved and will be the foundation for a higher level of telephone service in the capital city of Bangkok.

PART II INTRODUCTION

PART II INTRODUCTION

CHAPTER 1. WHOLE ASPECT OF THAILAND TELEPHONE EXPANSION PROJECT

The Telephone Organization of Thailand (TOT) has drawn up plans for a telephone expansion project for the whole kingdom. The name of the project is the "Telephone Development Project 1972 - 1979", and consists of the following three projects.

1) The Bangkok Telephone Plant Project 1972 - 1979
2) The Provincial Telephone Plant Project 1972 - 1979
3) The Long Distance Telephone Plant Project 1972 - 1979

The entire telephone projects are included in the Third National Economic Development Plan for the Kingdom of Thailand, and are essential national policies. The scope of the individual projects are set forth in the following.

1.1 The Bangkok Telephone Plant Project 1972 - 1979
Under this project, the new installation and expansion of exchange lines in 21 exchanges (26 units) in the capital city of Bangkok and its vicinity will be carried out as well as the removal of the obsolete lines of the step-by-step system, and it is envisaged that there will be a total number of 306,000 terminals at the time of completion in 1979. It further is planned to install new junction lines of about 280,000 pair-kilometre and about 265,000 pairs of primary subscriber network and associated secondary network.

1.2 The Provincial Telephone Plant Project 1972 - 1979
It is planned under this project to install 53,500 lines of automatic switching equipment at 118 exchanges in the medium and small cities, automatize 7920 lines of manual switching equipment and also to install approximately 70,000 pairs of subscriber network at 134 locations.

1.3 The Long Distance Telephone Plant Project 1972 - 1979

Under this project, the installation of long distance equipment such as microwave, coaxial cable and PCM equipment to link all new telephone exchanges with other exchanges in the Kingdom of Thailand and also to expand the existing system to meet the present and future traffic will be executed.

CHAPTER 2. REQUEST FOR TECHNICAL COOPERATION AND ORGANIZATION OF SURVEY TEAM

In order to implement the aforementioned large telephone expansion project, the Organization of Thailand (TOT) would require a considerable number of cable and civil work design engineers. However, due to the insufficiency in the number of such design personnel, it will be necessary to acquire technical cooperation from an overseas administration to augument such shortage, and the Government of Thailand made a request to the Government of Japan for cooperation in survey for the detailed design of the project.

In response to such request the Government of Japan entrusted the Oversea Technical Cooperation Agency (OTCA) (the present Japan International Cooperation Agency) to execute the detailed design survey.

The OTCA despatched a preliminary survey mission composed of four experts with Mr. Kiyoshi Mizuuchi as Chief (refer to Table 2.2.1) to the Kingdom of Thailand for the period from December 13 to December 26 of 1973 and carried out discussions with the officials of the Government of Thailand and the TOT on the fundamental works, etc., and then compiled a draft of the scope of work for the detailed design. The relevant documents are attached hereto.

Table 2.2.1 Organization of Preliminary Survey Mission

Name	Assignment	Present Position
Kiyoshi MIZUUCHI	Chief	Counsellor of Telecommunications, Ministry of Posts & Telecommunications
Hideo SANO	Deputy Chief	Assist. Chief of Outside Plant Engineering Dept., The Nippon Telecommunications Consulting Co., Ltd.
Yoshifumi ITO	Member	Senior Engineer, Nippon Telegraph & Telephone Public Corporation
Shinichi SHOJI	Member	Engineer, Nippon Telegraph & Telephone Public Corporation

On the basis of these results, the Japanese Ministry of Foreign Affairs formally agreed with the Government of Thailand in respect to the execution of technical cooperation according to the Scope of Work for the Detailed Design indicated in Chapter 4 in relation to the Bangkok Telephone Local Network Project.

In line with the foregoing, the OTCA then assigned The Nippon Telecommunications Consulting Co., Ltd. (NTC), a firm with wide experience and project accomplishments, to execute the above work. A survey team composed of 11 experts with Mr. Hideo Sano as leader (refer to Table 2.2.2) was subsequently despatched to Bangkok and carried out field surveys over a period of about six months.

Table 2.2.2 Organization of Survey Team

Name & Assignment	Position in NTC	Survey Period (1974)
Hideo SANO (Overall supervision)	Manager, Bangkok Office & Assist. Chief of Outside Plant Engineering Dept. (Registered Consulting Engineer)	Feb. 11 - Aug. 16
Seinosuke ARAKI (Local outside plant design)	Senior Engineer (Registered Consulting Engineer)	Feb. 11 - May 11
Akio SHIRAISHI (")	Senior Engineer	Feb. 11 - Aug. 9
Tatsuo KOBAYASHI (")	Engineer (Registered Consulting Engineer)	"
Yoshihide NAKAYAMA (")	Engineer	"
Akira MORI (")	"	"
Mitozo NAKAZAWA (")	"	"
Hidesuke KUROSHIMA (")	Assistant Engineer	"
Keizo YAMAZAKI (Civil works design)	Senior Engineer	Mar. 27 - July 5
Michinori MAEHIRO (")	Engineer	Mar. 27 - June 22
Ikuo HIRAKAWA (")	Assistant Engineer	"

Furthermore, for smooth execution of this detailed design work and the supervision thereof, a Work Supervisory Committee was established as shown in the table below.

Table 2.2.3 Organization of Work Supervisory Committee

Name	Assignment	Present Position
Kiyoshi MIZUUCHI	Head	Counsellor of Telecommunications, Ministry of Post & Telecommunications
Shigeo SHISHIDO	Member	Deputy Counsellor of Telecommunications, Ministry of Post & Telecommunications
Koichi SATO	"	General Affairs Group Head, Ministry of Post & Telecommunications
Yoshifumi ITO	"	Senior Engineer, Nippon Telegraph & Telephone Public Corporation
Shinichi SHOJI	"	Engineer, Nippon Telegraph & Telephone Public Corporation

CHAPTER 3. PURPOSE AND POLICY OF SURVEY

The purpose of the survey team was to execute the detailed design of the local cable network of the five exchanges, i.e., Krungkasem, Ploenchit, Pathumwan, Tungmahamek and Trokchan, comprising the central portion of the Bangkok Telephone Local Network Project which is a part of the "Telephone Development Project 1972 - 1979", and thereby contributing to the social and economic development programme of the Government of Thailand. The survey was executed on the three sectors of demand forecast, cable networks and civil works.

The survey was executed with due attention to the following points in particular.

(1) Listening to and adherence to the opinions of the TOT wherever possible.

(2) Since this is a detailed design, it was executed on the basis of the design criteria presented by the TOT.

(3) The survey was not executed by the survey team alone but was carried out witnessed by the TOT staff concerned and the results verified by both parties.

(4) Execution of detailed material calculation with the prerequisite that the installation/construction work will be directly carried out by the TOT.

CHAPTER 4. SCOPE OF WORK FOR THE DETAILED DESIGN

The scope of work for the detailed design of the Bangkok Telephone Local Network Project is as follows:

I. INTRODUCTION

In response to the request of the Government of Thailand, the Government of Japan has decided to provide, in accordance with laws and regulations in force in Japan, a Japanese survey team within the framework under her Overseas Technical Co-operation Programme in order to prepare a detailed design for the local network of five (5) exchange areas in Bangkok Metropolitan Area, i.e. Krungkasem, Ploenchit, Pathumwan, Tungmahamek and Trok Chan.

The Government of Japan has entrusted the implementation of this survey to the Overseas Technical Co-operation Agency (OTCA), which is the sole institution to execute the overseas technical cooperation scheme of the Government of Japan.

This document sets forth a scope of the work regarding this survey.

II. STUDY PROGRAM

1. The following field survey with desk work in the above five (5) exchange areas will be undertaken for a period of about 6 months by the Japanese survey team of about eleven (11) experts.

   (1) Demand Survey

   Demand Survey will be conducted and Demand Distribution Maps will be made, on the basis of the result of the Bangkok Telephone Junction Lines Project survey undertaken by OTCA in 1972.

(2) Detailed Survey

Detailed Survey will be made of all the newly proposed pipe and cable routes. Study of the existing conduits and cables will be made on the basis of the plant records.

If necessary, on-the-spot survey of the existing facilities will be carried out.

(3) Manhole Investigation

Ducts to be used will be selected after checking cable placement and location of cable splices in the existing manholes.

(4) Selection of New Routes

Cable routes will be decided according to the result of investigation of the existing facilities, the study of a future plan, and the comparison of several proposed routes.

(5) Dividing of Cabinet Areas

Dividing of cabinet areas will be carried out according to the cable routes and the demand survey, and then the location of cabinet boxes will be decided.

(6) Survey of MDF and Cable Vault

Locations of riser cables to MDF and ways of cable placement in cable vault will be investigated.

(7) Field Measurement

Field Measurement will be conducted on all proposed cable routes and some existing cable routes. Levels and cross-sections of roads will be measured to determine the locations of the new conduit routes.

2. The last stage of the detailed design work, as indicated below, will be undertaken by the Japanese Survey Team in Japan.

(1) Key Plan

(2) Transmission Sheet Resistance Design Method

(3) Primary Cable General Plan

(4) Secondary Cable General Plan

(5) MDF and Cable Vault Plan

(6) Gas Pressurization Plan

(7) Duct Scheme Plan

(8) Manhole Racking Diagram

(9) Primary Cable Feeder Plan

(10) Cabinet Jointing Plan

(11) Secondary Details

(12) Conduit Plan

(13) Cabinet Serial No. Index

(14) Terminal Box Serial No. Index

(15) List of Materials

III. REPORT

The following documents will be prepared in English and submitted to the Government of Thailand within three (3) months after completing the field survey.

(1) Design Report — Twenty (20) copies

(2) Drawings — Twenty (20) copies
(which consist of fifteen (15) kinds of the drawings as described in above II.2.)

(3) Amount of Work — Twenty (20) copies

IV. CONTRIBUTION BY THE GOVERNMENT OF THAILAND

1. The following will be arranged for the survey team by the Government of Thailand.

   (1) To provide necessary data and materials for the study as shown in annex I.

   (2) To prepare necessary permits for the implementation of the outdoor work by the authorities concerned.

   (3) Appointment of three (3) liaison officers who accompany the team during the field survey.

2. The members of the team engaged in the survey will be entitled to such privileges and exemptions as the Government of Thailand normally extends to Colombo Plan experts.

Annex I

Documents to be supplied by T.O.T. for Local Network Project

1) The boundaries of each exchange area (Map)
2) The forecast number of subscribers on each exchange area
3) Layout of the exchange offices
4) Long-term plan of conduit lines
5) List of waiting subscriptions
6) Standard method of local network design
7) Agreement on joint-use between T.O.T. and M.E.A.
8) Construction and Installation Practice of T.O.T.
9) City Planning in Great Bangkok
10) Plant Records of existing facilities concerned
11) Data and Records belonged to other authorities

Minutes of Meeting on Scope of Work
for Bangkok Telephone Local Network Project

As for the draft of "Scope of Work" the meeting was held on 10 AM in 17th, December, 1973 at Department of Plant Engineering in attendance with T.O.T. representative (TOT) and Japanese mission (Mission).

Attendants:

(T.O.T. representatives)

Chairman:	Mr. Boonchoo Phienpanij	:	Director of Plant Engineering
	Mr. Poge Kovintha	:	Director of Operation
	Mr. Surind Vanichseni	:	Chief of Operational Planning
	Mr. Kiat Siribbarp	:	Member of TOT
	Mr. Adisai Phodharmik	:	Member of TOT
	Mr. Paiboon Limpaphayom	:	Member of TOT

(Japanese Mission)

Mr. Kiyoshi Mizuuchi	:	Chief of mission
Mr. Hideo Sano	:	Assistant Chief of mission
Mr. Yoshifumi Ito	:	Member of mission
Mr. Shinichi Shoji	:	Member of mission

Mr. Boonchoo appointed as the chairman of this meeting expressed his thanks to Japanese mission who have been visiting Bangkok in response to the request of the Government of Thailand and he expected that this project will be proceeded in a good way as well as the junction project in the last year.

Mr. Mizuuchi as chief of the Japanese mission explained the purpose of this visit and pointed out that the field survey on the initial stage will be undertaken for a period of about 6 months in Bangkok. At the same time he called attention to the fact that the documents will be submitted to the Government of Thailand within 3 months after completing the above field survey.

Followingly each person was introduced to the attendants in the meeting by Mr. Boonchoo and Mr. Mizuuchi effectively.

Mr. Ito a member of the Japanese mission explained the content of "SCOPE OF WORK" para. by para. as requested and the main results from the meeting are as shown from No.1 to No.8 in the following "Question and Answer"

There were no any other opinions regarding to the draft of Scope of Work between TOT representatives and Japanese mission.

No.1

Q : TOT questioned whether there are any possibility to change the exchanges which are shown in para. I.

A : Mission answered that it is very difficult in view of the budget and actual work schedule. Finally, this point was agreed with TOT without any changes.

No.2

Q : TOT asked when and how many Japanese experts are coming to Bangkok for their field survey.

A : Mission answered that in the next February about 8 cable design experts are in the schedule on the initial stage if the necessary arrangements are treated and about 3 civil experts will follow on.

No.3

Q : TOT proposed that she can prepare several assistants during demand survey who are familiar with actual situation on the site.

A : Mission accepted her suggestion of 5 assistants in total that is, every one in exchange.

No.4

Q : TOT asked that what is the actual meanings for the expression "The detailed design works in Japan" stipulated Article 2 in para. II. She also suggested that the drafts shall be completed and confirmed in Bangkok on the initial stage.

A : Mission explained that such works as calculation of work amount, making mother drawings, printing of documents etc. will be carried out in Japan and the drafts, of course shall be comfirmed in advance.

Finally each party agreed to put 4 words i.e., the last stage of the detailed design work in Japan, instead.

No.5

Q : TOT asked that when the Japanese supervisory team are coming in Bangkok and whether or not the team will be attend the joint meetings between TOT and actual survey team.

A : Mission answered that the team in the schedule hopes to visit your country twice, i.e., one is in the middle of the field survey and the other is in the last stage at the time of document submission to the Government of Thailand. The team during their stay in Bangkok will attend the meetings if necessary.

No.6

Q : TOT asked that there is any possibility of increase in the numbers of copies more than that of which are stipulated Article 3 para. III.

A. Mission answered that there is no necessity of it because the mother prints of drawings will be submitted together with the copies.

Finally TOT agreed with Mission.

No.7

Q : TOT asked what is the concrete example as for privileges and exemptions as the Government of Thailand normally extends to Colombo Plan experts as stipulated in Article 2, Para. IV.

A : Mission answered that an instance of them is as the immigrations.

The privileges and exemptions will be however treated with the same to the junction project.

No.8

Q : TOT explained the actual situation as follows against Article 3, 5 and 11 which are stipulated in Annex I.

1) Layout of new exchanges are under design at present and therefore they can be prepared during the field survey.

2) List of waiting subscriptions is under study, therefore it will be as much as possible prepared.

3) Periodical joint meeting among the authorities concerned, considering new proposed route of underground plants, can be useful and can also replace with data and records. The necessary draft in this project shall be submitted to the joint meeting for the final comfirmation.

A : Mission agreed with TOT explanation and requested to prepare the information as for Article 1 and 2 during Mission's stay.

Finally TOT agreed to prepare it.

The meeting was friendly and usefully continued for about 2 hours and ended at 12.00 AM.

PART III DETAILED DESIGN WORK

PART III. DETAILED DESIGN WORK

CHAPTER 1. DESIGN OBJECTIVE EXCHANGES AND DEMAND FORECAST

1.1 Outline of the Design Objective Exchanges

The objective exchange offices for the current design work, as shown in the Plan of Exchange Areas, are the five exchanges of Krungkasem (KK), Ploenchit (PL), Pathumwan (PW), Thungmahamek (MM) and Trokchan (TC) located in the central part of Bangkok and of these, the construction of the local PW and TC exchange offices will be commenced.

(1) The KK exchange is a main exchange office including toll services and currently has 20,000 switching lines. The service area is made up of the Palace, Congress building and government offices of the various official organs and the old commercial area, and it is in the central area of the political activity of Thailand.

(2) The PL exchange is in the same compound as the TOT and is a local tandem exchange with 14,000 switching lines. The service area is made up of first class hotels such as the Erawan Hotel, etc., department stores, shopping centers and high class residential area, and is the most modernized downtown area of the city of Bangkok.

(3) The PW exchange is a new exchange to be constructed in the PL exchange service area and is expected to have 5,000 switching lines in the initial stage. The entire area is made up of small factories and wholesale houses.

(4) The MM exchange presently has 9,000 switching lines and is located in the suburbs of Bangkok but with the continued construction of new residences in the empty lots, a rapid increase in telephone demand is anticipated.

(5) The TC exchange is a new exchange to be constructed as a local office in the MM exchange service area and is initially expected to have 5,000 subscriber lines.

The service area is in exactly the same situation as the MM exchange.

1.2 Method of Demand Forecast

1.2.1 General

Demand forecast is classified into overall survey and block survey but the survey carried out at this time was the block survey and based on the overall survey, a distribution forecast for demand in each exchange service area was executed.

This block survey was carried out by using the numerical value of the overall survey which was the basis for the planning of office establishment programme and the numerical value of the block survey executed by the TOT in 1972 as the fundamental data.

Although there are many ways of executing a block survey, the essential methods are the following three methods.

(1) Method based on demand-ratio for social units (Demand forecast for equal demand density per hectare 1)

(2) Method based on demand-density per area (Demand forecast for equal demand density per hectare 2)

(3) Method based on "equal demand density per pole block"

Since these methods were not adequate as they are for adoption in the present Bangkok situation, a separate method was taken. That is, since the Bangkok demand situation with a general use ratio of five subscribers per 100 persons is not in a stage of saturation and will further develop hereafter, the following method which is a combination of the present method being instituted by the TOT and NTC's method was adapted.

1.2.2 Field Survey

A field survey on the following items was executed based on a map (1/1000) for survey use.

(1) The service area was divided into the following four areas.

A. Business area - Mainly stores and other commercial houses.

B. Residential area - Mainly residential.

C. Special demand area - Government offices, schools, hospitals, hotels, factories, army, etc., which area greatly varies in demand density with the surrounding areas.

D. Pre-Construction area - City planning was being conducted at the time of the survey but with the anticipated construction of residences, factories, etc. in the future, it will be an area where it is presumed that grouped demand will be generated.

(2) The present demand for business and residential areas were forecasted according to the following standards in the field survey and inscribed on the map.

These standards were prepared upon discussion with the members of the TOT.

Discussion with members of the TOT.

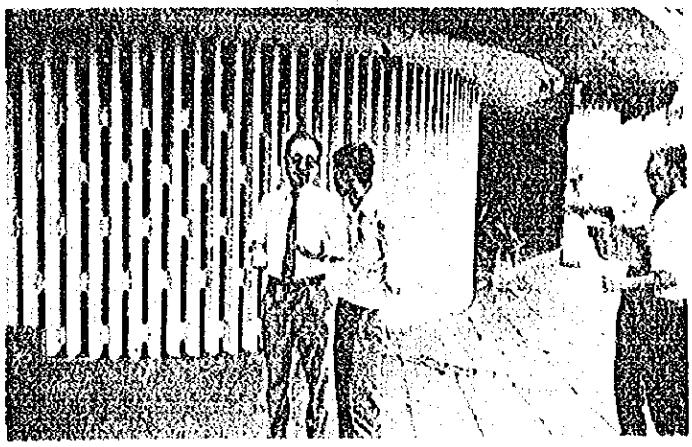
Forecast Standards

Objective Structures	Present Demand	Remarks
Stores	1 telephone for each	No relation with size of the stores
High and middle class residences	1 telephone for each	One house with yard.
Low class residences	1 telephone for 5 houses	Old multiplexes of wooden structure
Gasoline stations, etc.	2 telephones for each	
Small offices	2 telephones for each	
Hotels	1 telephone for each 8 rooms	Including boutiques in the hotels
Rented buildings	1 telephone for floor space of 70 m^2	
Apartment houses (High class)	8 telephones for 10 rooms	

(3) For the buildings, etc. in the special demand area within the exchange service area, the locations and boundaries were inscribed on the survey map, and the present demand for each building, etc. was surveyed.

(4) The pre-construction area (where the construction of groups of residences are anticipated) within the exchange service area, the location and boundaries were inscribed on the survey map and the present demand for each was surveyed.

These surveys were conducted in cooperation with members of the TOT and where suitable replies could not be obtained from the clients, the forecast was made by members of the survey team. The result of this forecast is attached to the reports for each exchange.



Discussion with TOT personnel on demand forecast.

1.2.3 Forecasting Work

The demand forecast for the "fixed distribution block" was carried out as follows:

(1) The forecasts for the special demand area and pre-construction area were made on the basis of various data and new information.

(2) Business and residential area forecasts were made by considering the demand situation for the exchange as a whole and its growth ratio. Then, the future demand forecast was executed by a multiplication of the present demand for the fixed distribution block. Ultimately, the demand was adjusted for each fixed distribution block.

1.3 Demand Table for Each Exchange

On the basis of the demand forecast method prescribed in the preceding paragraph, the demand forecast for each exchange is shown in the table 3.1.1 below. The exchange office with the highest growth ratio is the PW exchange while that of the lowest growth ratio is the KK exchange. The situation at each exchange is described in the report on each exchange.

Table 3.1.1 Demand Forecast for each Exchange

Name of Exchange	1976	1980	1985
KK Telephone demand	12,300	17,500	21,500
Growth ratio	100%	142%	173%
PL Telephone demand	19,900	30,500	40,000
Growth ratio	100%	153%	201%
PW Telephone demand	16,800	26,800	35,200
Growth ratio	100%	160%	210%
MM Telephone demand	14,750	21,800	30,800
Growth ratio	100%	148%	209%
TC Telephone demand	12,500	18,000	26,000
Growth ratio	100%	144%	208%
Total Telephone demand	76,250	114,600	153,500
Growth ratio	100%	150%	201%

CHAPTER 2. ENGINEERING CRITERIA AND AGREEMENT ON JOINT USE OF POLES

The survey team prepared a draft engineering criteria which was submitted to TOT. The engineering criteria attached hereto has been revised after studies by TOT.

The details not indicated in the said criteria were determined upon discussions with TOT whenever required during the design work.

2.1 Engineering Criteria for Local Cable System

The engineering criteria for the local cable system is as follows:

[1] Design Method of Underground Cable System

1.1 Standard for Adoption of Underground Cable System

In case the cable facilities correspond to any of the following, they will be designed as underground cable system.

(1) In case each cable pair exceed the following limits:

0.4 mm	--	600 P
0.5, 0.65 mm	--	400 P
0.9 mm	--	300 P

(2) Places where construction of aerial cables will be difficult due to highways, houses, traffic and other topographical hindrances.

(3) Riser cables (Secondary cables shall be direct buried) near cross connection cabinets.

(4) Places where underground cables would be appropriate such as road crossings and lead-in into buildings.

1.2 Standards of Use for Underground Conduit Cables

Cables to be adopted for Local Network are local PEF Stalpeth cable and local Stalpeth cable, and their standards for use are in the following table.

(1) Types of Cables to be used.

Type of Cable	Conductor Gauge	Number of Pairs					
Local PEF Stalpeth Cable	0.32 mm	3,600					
Local Pair Stalpeth Cable	0.4	300 3,000	600	900	1,200	1,800	2,400
	0.5	300	600	900	1,200	1,800	
	0.65	100	300	600	900	1,200	
	0.9	100	300	600			

(2) Determination of Cable Pairs

Primary cable is the cable from the MDF to the cross-connecting cabinet, and the number of pairs shall be able to meet the demand up to 3 - 5 years, hence.

(3) Determination of Cable Conductor Gauge

The optimal economic conductor gauge will be determined which do not exceed the line loss of 7 dB and loop resistance of 1,500 Ω

Conductor (mm)	Attenuation Constant (dB/Km) at 1 K Hz/S	Loop Resistance (Ω/Km) at 30°C
0.32	2.26	449
0.4	1.82	285
0.5	1.50	176
0.65	1.18	112
0.9	0.82	56

1.3 Direct Buried Cables

Direct buried cable is used in principle between the secondary cable of the cross connection cabinet and the riser pole, and CCP-JF cable shall be adopted.

Type of Cable	Conductor Gauge	Number of Pairs used				
CCP-JF Cable	0.4 mm	50	100	200	300	400
	0.5 mm	50	100	200	300	400

[2] Design Method of Aerial Cable System

2.1 Standard of Adoption for Aerial Cables

The types of cables to be used in aerial lines are shown in Table 1, and the purposes thereof are given below.

(1) CCP-LAP cable or CCP-AP cable will be used in entirety for secondary cable, and the non-Alpeth type will not be adopted.

(2) SS cable will be used in the following cases:

a. When the newly installed cable is 100 pairs or less.

b. When the existing messenger wire of the existing cable line cannot be used at the time of cable replacement.

(3) Round type CCP Cable will be used in the following cases:

a. When the newly installed cable is 200 pairs or more.

b. When the existing messenger wire of the existing cable line can be used.

c. The round type cable will be lashed by lashing wire to the messenger wire.

2.2 Type of Cables to be used

The types of cables and the number of pairs to be used as aerial cables are shown in Table 1. below.

2.3 Determination of Secondary Cable Pairs

The number of pairs will be those which will meet the demand 8 - 10 years; hence. (i.e. 1985)

Table 1. Types of Cables and Number of Pairs

Type of Cable	Conductor Gauge (mm)	Number of Pairs							
Local CCP-AP Cable (AP)	0.4	10	25	50	100	200	300	400	600
	0.5	10	25	50	100	200	300	400	
	0.65	10	25	50	100	200	300	400	
	0.9		25	50	100	200	300		
Local CCP-AP-SS Cable (AP-8)	0.4	10	25	50	100				
	0.5	10	25	50	100				
	0.65	10	25	50	100				
	0.9		25	50					

2.4 Selection of Cable Route and Cable Position

(1) Joint use of MEA pole (Power Co.) as a general rule.

(2) In case there is no MEA pole, TOT will individually erect a pole.

(3) As a general rule, no erection of pole or anchoring of stays will be made in private areas. But in case of necessity negotiation with owner of private areas shall be done by TOT.

(4) Where erection of poles is not possible and in new shopping areas, the cables will be attached to walls.

2.5 Types of Telephone Poles

Concrete poles will be used for telephone poles and the types are shown in the table below.

Length (m)	Dimensions (cm)		Weight Kg/pc	Resisting Bending Moment (Kg.m)	Setting Depth (m)
	Top	Bottom			
8.0	12 x 12	20 x 20	400	1,530	1.7
10.0	14 x 14	24 x 24	920	2,350	1.9
12.0	15 x 18	24 x 27	1,190	2,780	2.0

2.6 Standards of Adoption for Gays

(1) Upper Guy

a. At places where the ground spacing is 37° or more, twisted steel wire of the same type as the suspension strand will be used.

b. Sidewalk Guy

In case of sidewalk guys, twisted steel wire of one rank above the guy in a. will be used.

c. In case guys will not be fixed, ground bracing will be executed.

(2) Anchor Rod

a. Drive-in type anchor will be used but in places where the sub-soil is soft or in water, the Log Anchor method will be used.

b. Adoption of drive-in type anchor will be according to the following.

Uppor Guy	Anchor	Rod (mm)	Designed Load (Kg)	TOT Standard
30 pc	#2	13	2,600	6,000 lbs.
45 pc	#2	13	2,600	10,000 "
65 pc	#3	16	3,750	16,000 "
45 pc x 2	#4	19	5,000	
65 pc x 2	#6	25	9,000	

(Safety ratio: 2)

2.7 Cable Suspension Strand

(1) Type

a. Twisted steel wire

Type	Composition of bare wire (Line/mm)	External Diameter (mm)	Weight (Kg/m)	Designed Load (Kg)	TOT Standard
30 mm^2	7/2.3	6.9	0.231	1,635	6,000 lbs.
45	7/2.9	8.7	0.367	2,600	10,000 "
65	7/3.5	10.5	0.535	3,780	16,000 "

(Safety ratio: 2)

b. Guy for SS Cable

Guy for SS cable shall be of one type of 7 twisted wires of 1/4" diameter with a breaking force of 6,500 lbs. (equal to 30 mm^2)

(2) Installation of Twisted Steel Wire

a. Relation between weight of cable to be installed and the twisted steel wire is as follows:

Twisted Steel Wire	Cable Weight
30 mm^2	2.0 Kg/m or less
45 "	3.4 " "
65 "	3.4 " or more

Reference should be made to the annexed Table of Cable External Diameter and Weight regarding weight of cable.

2.8 Height of Line from Ground Level

Site Condition	Required Height
(1) Over roads	5.4 m or more above road (Minimum 4.5 m or more)
However, in case of no interference with traffic:	
a. Above the sidewalk when there is a distinction between roadway and sidewalk.	2.4 m or more above the road surface
b. Over other roads	4.5 m or more above the road surface.
(2) Over passage between buildings when distribution cable is attached to walls.	4.0 m or more above the road surface.

2.9 Spacing between Cable Line and Power Line

The spacing shall be 61 cm or more.
When the power line pole is low and spacing cannot be taken, spacing will be kept in a horizontal direction by the use of extension arm.

ANNEXED TABLE

Table of Cable External Diameter and Weight

Size	Pairs	Final Outer Dia.	Total Weight	Pulling Eye Size	Size	Pairs	Final Outer Dia.	Total Weight	Pulling Eye Size
PE-Alpeth Cable					PE-Alpeth Cable				
26 AWG (0.4)	10	10.2	113.67	-	22 AWG (0.65)	10	11.6	164.09	-
	25	12.1	167.82	-		25	15.6	307.45	-
	50	14.8	261.94	-		50	23.1	515.08	-
	100	18.9	459.2	-		100	30.1	928.41	WTP-10
	200	26.2	806.15	-		200	40.12	1,862.7	WTP-8
	300	30.7	1,139.6	WTP-10		300	48.3	2,695.94	WTP-6
	400	35.0	1,483.56	WTP-9		400	54.82	3,513.02	WTP-5
	600	41.1	2,135.13	WTP-8		600	66.04	5,153.8	WTP-1
	900	49.4	3,103.78	WTP-6	19 AWG (0.9)	10	14.4	260.9	-
24 AWG (0.5)	10	11.1	130.7	-		25	20.0	526.54	-
	25	14.1	236.18	-		50	29.7	1,003.36	-
	50	17.5	370.63	-		100	39.8	1,840.99	-
	100	24.1	668.37	-		200	54.2	3,478.9	WTP-5
	200	31.5	1,199.47	WTP-10		300	65.4	5,095.96	WTP-2
	300	37.4	1,725.66	WTP-9					
	400	42.22	2,235.78	WTP-8		400	74.5	6,674.26	WTP-1
	600	50.42	3,271.38	WTP-6					
	900	59.9	4,761.84	WTP-3					

[3] Design of Aerial Distribution Method

3.1 Distribution Method

The distribution method will be by the cross connecting cabinet where the primary and secondary cables are jumpered inside the cross connecting cabinet, and the distribution cables will be fixed in each terminal box by pair number according to the "Fixed Distribution Method".

3.2 Establishment of Distribution Area

(1) The distribution areas will be established for about 300 - 400 subscribers according to telephone density to meet the demand up to 8 - 10 years, hence; and such distribution area shall be fixed definitely.

(2) Position for installing the cross connecting cabinet shall be on the exchange office side of the fixed distribution area.

3.3 Determination of Pair Numbers

Fixed exchange lines will be allocated to each terminal box, and the distribution of adjacent multiple lines will not be executed.

[4] Gas Pressurizing Facilities

Primary underground cables will be charged with dry air by use of the air dryer.

4.1 Gas Facilities Room

Since a special room has not been assigned especially as the gas facilities room, the place for installing the air dryer and meter panel should be determined by discussion with the TOT Engineers in charge.

[4] Gas Pressure System (Addition)

The following was indicated by the TOT in addition to the aforementioned engineering criteria.

1. Gas Pressure System shall be applied with Puregas Pressure System continuous feed cable.

2. Gas Equipment should be of Puro Gas Company's product.

3. Underground Cable to be used as primary cable shall be pressurized.

4. Pressure Guard Locations are:

   (1) at the end of each Feeder Cable

   (2) at the end of Branch Cable over 200 meters in length

   (3) at the end of the Underground Building Cable of over 200 meters

   ** Pressure Guard should be fixed in Cross Connecting Cabinet in principle.

5. Test Value Locations are:

   (1) at the branch point of Branch Cable of over 200 meters

   (2) at the middle point, in case of over than 1 km. between Pressure Guard or Testing Value

6. Capacity of Air Dryer shall be indicated by NTC.

2.2 Engineering Criteria for Telecommunication Civil Works

The engineering criteria for telecommunication civil works is as follows:

[1] Conduit

1.1 Kind of Conduit shall be of ordinary Asbestos except crossing railway or attaching to the bridge etc. and riser to cabinet & pole, where GIP shall be used.

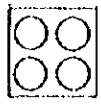
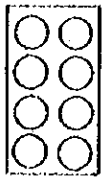
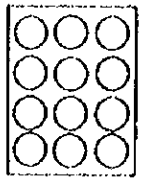
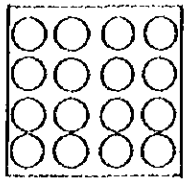
1.2 Diameter of Conduit

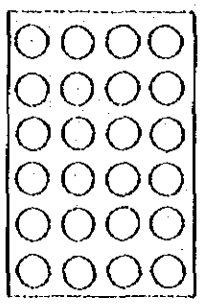
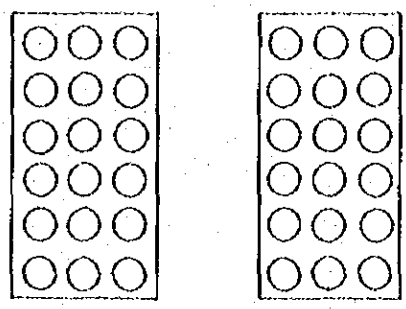
Main Route	4"
Branch	3"
Riser to Cabinet, Pole, Wall	3"

1.3 Depth of ditch for placing conduit

The standard depth of ditch for placing conduit shall be 1.80 - 2.30 meters from bottom of conduit formation to road surface except railway crossing.

1.4 Standard of Conduit arrangements are as below:

No. of Conduit	4 ducts	8 ducts	12 ducts	16 ducts
Duct arrange-ment				

No. of Conduit	24 ducts	36 ducts
Duct arrange-ment		

The above arrangements should be re-arranged in special case.

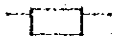
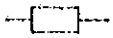
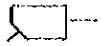
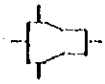
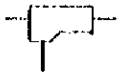
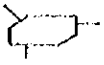
1.5 Number of Conduits

Number of conduits shall be determinated by TOT.

[2] Manhole & Pulling Box

a. Standard of Manhole and Pulling Box are as below:

Manhole

Type	Dwg. No.	No. of Conduit	Shape	Remarks
B	1047	4		
A-1	1048	8		
A-2	1049	12-16	"	
A-3	1050	24	"	
V-1	1051	12 8 branch		
V-1	1052	24 16 "	"	
V-2	1053	24 24 "	"	
V-3	1083	48-36 24 "	"	
V-2C	1084	24 24 "		
L	1074	16		
L	1075	12	"	
C	1056	12		
C	1057	12		
T	1076	16 8 branch		
T	1077	8 4 "	"	
J-4	1078	16 8 8 8 "		
J-4	1079	8 4 4 4 "	"	
J-3	1081	16 8 8 "		
J-3	1082	8 4 4 "	"	
V-2D	1087	24 12		

Pulling Box

Type	Dwg. No.	No. of Conduit	Shape	Remarks
JUP-6	2003	4		For branch
JUP-11	2006	4	"	For main route only
JRC-11	2024	4	"	"
JRC-14	2025	4	"	"

Note: Manhole and Pulling Box Specifications are referred to Standard Drawings attached.

b. Span between Manholes shall be 215 maximum and other shorter spans shall be reduced by a fixed 10 meters such as 205, 195, 185, ...

c. Span between Manhole, Pulling Box and Cabinet shall be 5.5 meters maximum.

d. Distance between Manhole, Pulling Box and Riser shall be 2 meters minimum.

2.3 Agreement on Joint Use Poles

The agreement on the joint use of poles is as under.

Agreement between
The Metropolitan Electricity Authority
and
The Telephone Organization of Thailand
(Translation)

1. The Metropolitan Electricity Authority (MEA) shall not permit the installation of telephone aerial cable on a MEA pole on which 69 KV power cable is suspended.

2. Should it be necessary for the Telephone Organization of Thailand (TOT) to drill a hole in a MEA wooden pole for placement of the telephone aerial cable, the hole(s) must be impregnated with "Penta Grease" for protection against rot. In the case of a concrete pole with no holes, TOT must use brackets. The drilling of holes in such poles is absolutely prohibited.

3. The MEA shall not permit the TOT to install insulators or wooden extension arms on the MEA pole. If it should be necessary to do so, the prior agreement of the MEA must be acquired.

4. A. The MEA shall not permit the TOT to place a cable on a MEA pole of less than 8 meters' height.

   B. The telephone aerial cable on the MEA low voltage 8 meter pole in the Soi must be at a 4.50 meter height on the pole from the pavement surface for traffic clearance. If it should be on the road, the MEA will decide according to the locations.

   C. In the case of the MEA 12 - 14 meter high voltage poles, the TOT telephone aerial cable must be placed at a height of 5.70 meters from the pavement surface for traffic clearance, to be decided case by case.

D. In the event of necessity to change the pole of 7 meter height to one of 8 meters for joint use with the TOT, the TOT shall pay the cost of:

140 Baht per pole for change to 8 meter wooden pole and
385 Baht per pole for change to 8.50 meter concrete pole.

According to the MEA drawing, the low voltage cable in the Soi which is less than 5 meters in width will use 7 meter poles. But should these be changed for 8 meter poles for joint use by the TOT, the cost for such change will be calculated and informed to the TOT on a case by case basis.

E. Should the TOT desire to use the MEA "Service Pole" for drop wiring to the subscriber's premises, the TOT must attach the wire at a position 30 cm. lower than the MEA power cable.

5. The TOT accepts the responsibility to re-arrange the telephone cables which are not in good order or droop down in several areas, and will not carry out additional installation without the prior permission and agreement of the MEA. There are such cables in many places and it is presumed that the re-arrangement will take a long time. Consequently, the TOT will try to make the re-arrangement first at places where they are an eye sore for the passers-by. If, however, the MEA desires to have the TOT to carry out the re-arrangement at some certain place first, such information will be sent to the TOT.

6. For convenience in contacts between the MEA and the TOT, the TOT has designated the number 57399 for direct connection to the TOT. Should the TOT have any urgent problem, the TOT will contact the MEA at number 22000 ext. 31.

7. The 6 telephone Exchange Areas (coloured on the map, except the Watlieb area) are the areas in which it is necessary for the TOT to jointly use the poles with the MEA. Should the MEA erect new poles, the poles of higher height will be reserved for the TOT. The costs for the erection of the higher pole shall be borne by the TOT.

Should it be necessary for the TOT to use anchors together with the MEA, the TOT will inform and provide the Anchor Road Type Triple Eye to the MEA for installation. In the finished places, the TOT will carry it out separately for the TOT.

8. The increase in cost for pole erection for use by the TOT may vary according to the price of materials and cost of labour. This, however, must be decided upon agreement by both parties.

9. The increase in cost for pole erection for use by the TOT on the road or Soi will be billed to the TOT generally once a month, and the TOT will not be over due in payment.

10. When the TOT desires to place the cable on the pole of the required height, the TOT shall inform the MEA to that effect at least by the day prior to start of work. Any telephone information must be confirmed by letter later.

The Governor of the MEA and the Director of the TOT have not as yet signed this agreement. The officials of both parties will use this as a Temporary Agreement until official approval.

CHAPTER 3. DESIGN POLICY

3.1 Establishment of Cabinet Area

3.1.1 Fundamental Philosophy for Establishment

The cabinet area is a control unit for planning the demand and facilities for a suitable extension plan for effective use of the telephone facilities by fixing the service area over a long period.

Consequently, the cabinet area is established for good administration of the design, construction and maintenance in the area.

3.1.2 Capacity of Cross-Connecting Cabinet

The capacity of the cross-connecting cabinet to be newly installed at this time is 800 pairs. Consequently, the design was made so that the total of primary cables and secondary cables should be about 700 pairs and considerations were made to leave space for the extension of 100 terminals in the future. The capacities of most of the cross-connecting cabinets presently being used are 600 pairs, 700 pairs, 750 pairs and 800 pairs.

3.1.3 Establishment Aim of Cabinet Area

The cabinet area was established as a general rule in consideration of the following:

(1) Cabinet area should have roads, river, railroad, etc. as the boundaries.

(2) In consideration of the effective use of the existing distribution cables, the present cabinet areas shall be established by dividing into two areas wherever possible without being a stickler for the number of telephone demand and when unavoidable, limited to three division areas.

(3) For fields and empty lots, where there is no present demand, the cabinet blocks to be determined after studying the development condition of roads and surroundings at the point where such demand would be generated in the future.

(4) For areas with rapid increase in demand, where there are no existing lines and road planning is unclear, it would be difficult to establish clear fixed cabinet areas. Consequently, by totalling the demand for 8 to 10 years hence, they will be restricted to determining the outline of the distribution areas of the future.

(5) The cabinet area will be established by using the standard of about 300 to 400 in the number of telephone demand 8 to 10 years hence.

3.1.4 Definite Example of Establishment of Cabinet Area

The following is a description of a definite method for establishing a cabinet area.

(1) Study of cross-connecting cabinet capacity

The sum total of the demand for each existing cross-connecting cabinet is made and the total is raised to each 50 pairs of the terminal block capacities. That is, it will be arranged by raising 1 to 50 as 50 and 51 to 100 as 100 pairs.

Next, if the sum total of the number of primary cable pairs (according to the demand 3 to 5 years hence) and the number of secondary cable pairs (according the demand 8 to 10 years hence) is larger than the present cross-connecting cabinet capacity, the said distribution area will be divided. The determination of the number of cable pairs is as follows:

Primary cables - The number of demand is the number of pairs raised by 50 pairs, i.e., in the event the number of demand is 120, it will be 150 pairs.

Secondary cables - The size of cable should be decided so that it is about 90% of the capacity of the distribution cable and this is raised by 50 pairs, i.e., in case of 310, it will be 350 pairs.

(2) Division of Cabinet Areas

A. Example of division into 2 areas

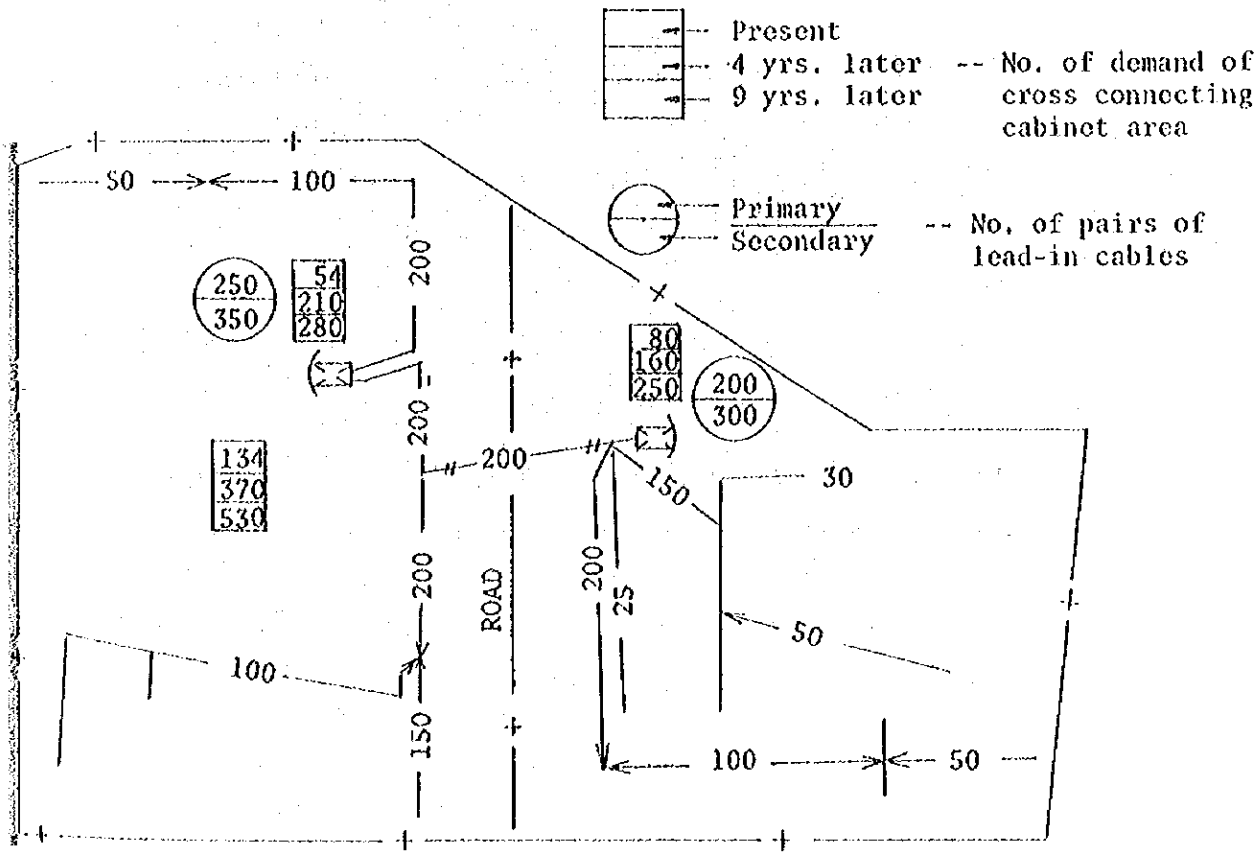


Fig. 3.3.1

B. Example of division into 3 areas

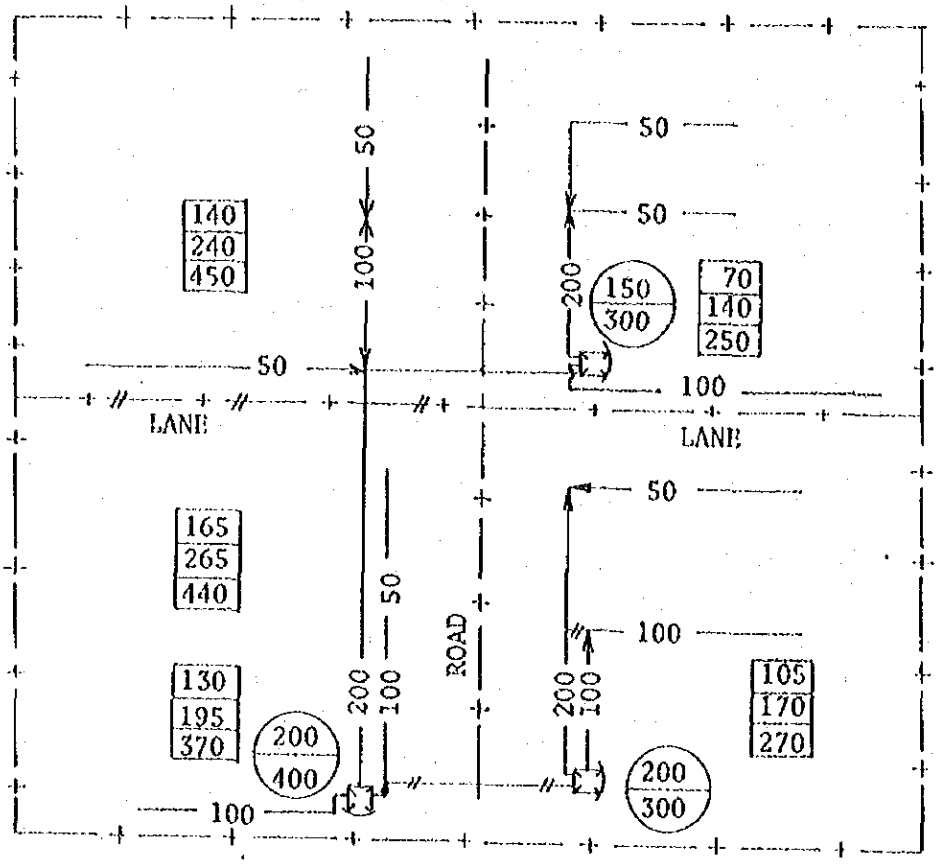
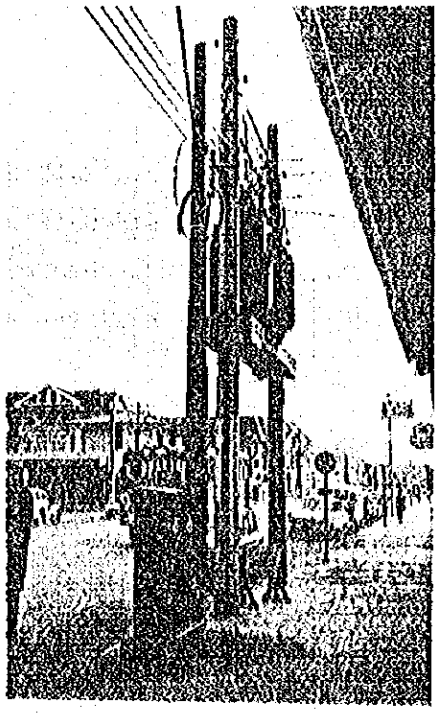


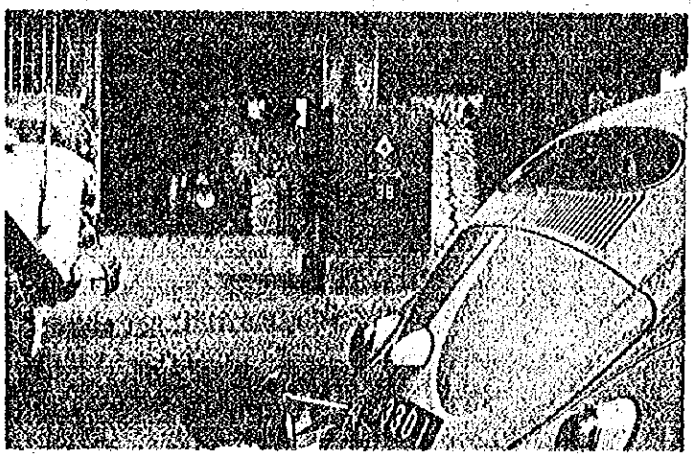
Fig. 3.3.2

3.1.5 Installing Location of Cross-Connecting Cabinet

The location for installation of the cross-connecting cabinet will be on the exchange side of the cabinet area and it should be installed on the road at a place near the manhole or pulling box which is placed primary cables. The following points were considered in the selection of the place for the installation.



Installation position of cross-connecting cabinet (type 600).



Installation position of cross-connecting cabinet (type 600).

(1) On a road with a distinction between sidewalk and carriage way, the cabinet was determined to be installed on the carriage way side of the sidewalk and on the boundary line between the shop. The door of cabinet shall face the sidewalk side. (See Fig. 3.3.3)

(2) On a road without any distinction between sidewalk and carriage way, the place was determined to be selected where the cabinet would not hinder the passage of pedestrians or vehicles, etc. (See Fig. 3.3.4)

(3) Where there presently is no sidewalk and is a Klong (waterway) but over which a sidewalk will be constructed in the future, the cabinet was determined to be installed on the extended line of the existing power pole. (See Fig. 3.3.5)

(4) Considerations were made to avoid as much as possible places such as drainage ditches, rubbish dumps, etc. which would corrode the cabinet.

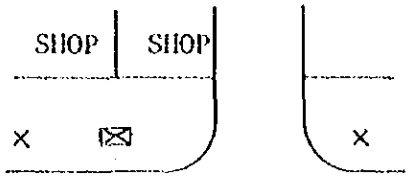


Fig. 3.3.3

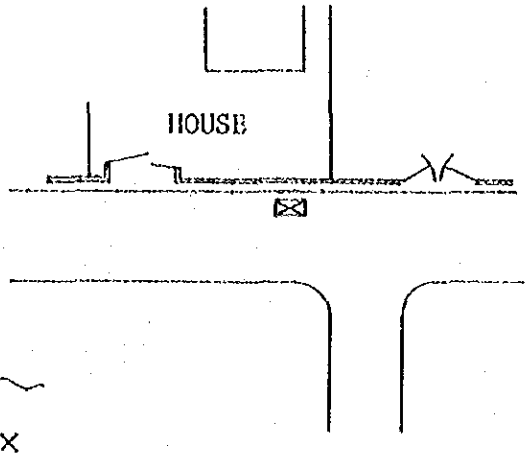


Fig. 3.3.4

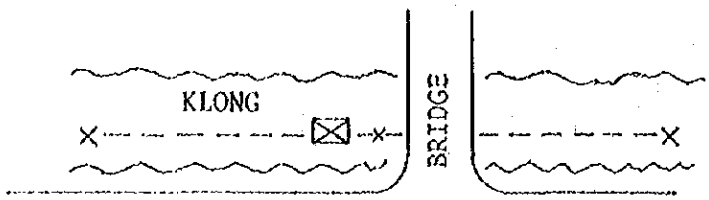


Fig. 3.3.5

3.1.6 Method of Attaching Terminal Block

The method of attaching the terminal block was made, as shown in the diagram below, by attaching the primary cables closely together in the upper rows and the secondary cables in the lower rows without leaving any empty spaces.

The new installations are shown in Fig. 3.3.6 and the extension of existing terminal blocks are shown in Fig. 3.3.7.

1 PRIMARY	10-02	100
101 PRIMARY 150	10-02	1 059-01 SECONDARY 50
1 SECONDARY	059-02	100
1 SECONDARY	059-03	100

Fig. 3.3.6

1 PRIMARY	10-02	100
101 PRIMARY 150	10-02	1 059-01 SECONDARY 50
1 SECONDARY	059-02	100
1 SECONDARY	059-03	100
151 PRIMARY	10-02	250
251 PRIMARY 300	10-02	51 059-01 SEC- ONDARY 100
101 SECONDARY	059-01	200
201 SECONDARY	059-01	300

Fig. 3.3.7

Installation of terminal blocks in cross-connecting cabinet.

3.1.7 Stub Cable Connection of Terminal Block

In the event a manhole is not within 5.5 meters of the location of the newly installed cross-connecting cabinet, a pulling-box (JUF.6 type) was designed to be newly installed and the cable splicing is made in the box. The terminal block stub cable is a standard 8.5 meters. Stub cable splicing point of existing cabinet, which is type 600, is made in the cabinet while that of type 700 is made in a manhole or in a protective trough of the direct buried cable.

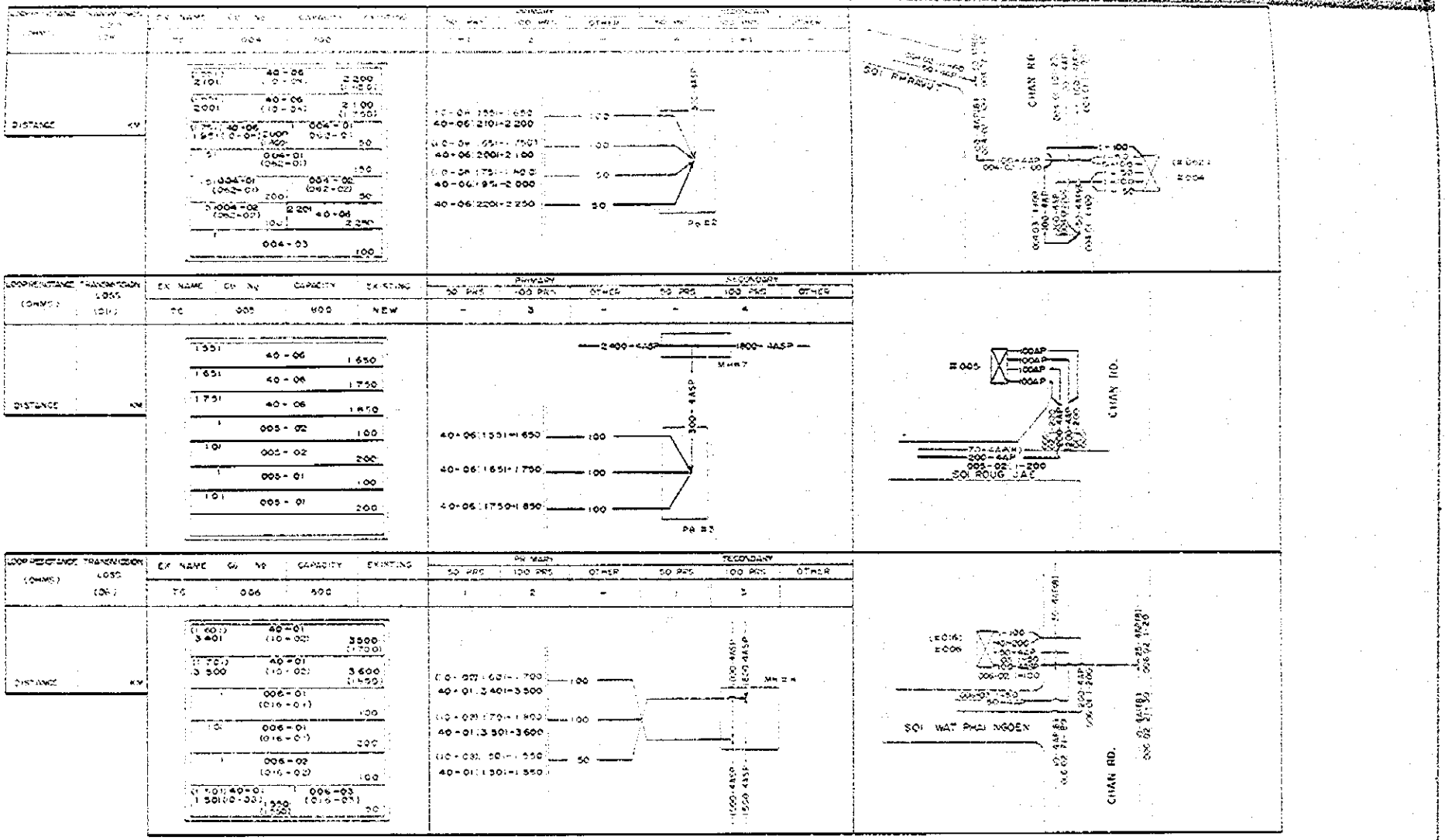


Fig. 3.3.8

BANGKOK TELEPHONE PLANT PROJECT (1972-1976)	
EXCHANGE	(40) TROKCHAN EX.
DRAWING	CABINET JOINTING PLAN
DSN APPD	DRAWING NO
CHECKED	
DRAWN	11-21-2

3.2 Primary Cable Network Design

3.2.1 Route Selection

Primary cable means the cable from the MDF in the exchange office up to the terminal of the cross-connecting cabinet. Although conduit cables mainly form the cable network, there also are directly buried cables and aerial cables, etc. The direct distribution system was not utilized in the current design and since it entirely is the cross-connecting cabinet system, all cables can be classified into primary cables and secondary cables. In respect to many pair building lead-in cables, however, since the MDF in the building has the same function as a cross-connecting cabinet, direct distribution was made.

The following is a description of the conditions for determining the type of the various outside plants and the selection of routes.

(1) Underground Plant Route Selection

The cables laid in underground conduits are local PEF-Stalpeth cables and Stalpeth cables as a general rule. The cable pairs of these cables, as explained in paragraph 2.1, are either many pairs or of large outer diameter and are gas pressurized. The policy for selection of the routes is as follows:

A. Utilization of Existing Outside Plant

When there are existing outside plants, the design will be carried out as in the following.

(a) Plan for positive use of the existing plants.

(b) Should there be a shortage in number of pairs in the existing cables and an increase in cable pairs is required, the design will be made according to the following procedure.

i) If there are vacant ducts, new cables will be laid in these ducts.

ii) When there are no vacant ducts, the existing small pairs cables will be replaced for many pair cables. However, should it be economical to install new ducts and increase the number of cables, then such method will be adopted.

iii) There may be cases where it would be more economical to lay new cables instead of utilizing the existing cables and these will be taken into consideration for study.

B. Installation of New Underground Plant

In the event of installing new underground plants, consideration will be made for contact with the existing plants and as conditions for selection, 2 or 3 routes will be selected from among the following types of roads. After comparative studies, both economical and technical, and upon discussions with the departments concerned, the optimum route will be selected.

(a) Road which will be shortest distance for the underground route.

(b) Road convenient for distribution of aerial cable.

(c) Unpaved road.

(d) Road which is wide and does not greatly hinder the traffic during construction work.

(e) Road which will not be repaired or abandoned due to city planning, etc.

(f) Road with few buried facilities and where underground plant construction work can be easily be carried out.

(2) Direct Buried Cable Route Selection

Direct buried cables are JEF-cables or Stalpeth steel armoured cables as a general rule, and are not positively selected as primary cables. This will not be the case, however, if there are existing troughs. The policy for route selection is as follows:

A. Use of existing direct buried cables

(a) Utilize those direct buried cables which have no problem in maintenance.

(b) Plan for positive use of cables in existing troughs.

B. Installation of new direct buried cables

(a) Avoid as much as possible the installation of new direct buried cables by installing underground conduits or by aerial cables. However, for sections where due to reason of occupancy of the road and the topography make the installation of underground conduits unsuitable or the total number of cable pairs is large and aerial cabling is difficult, then, only in such cases will direct buried cables be newly installed.

(b) If there are existing troughs and it would be more economical to use these troughs in comparison with installing new conduits or aerial cabling, the laying of cables in such troughs will be executed.

(3) Aerial Cable Route Selection

When the number of pairs of primary cable is less than 600 pairs, aerial cabling will be executed as a general rule and the cable to be used is the Alpeth Cable.

3.2.2 Standards for Use of Primary Cable

Cables to be used as primary cables are Stalpeth cable, Local PEF-Stalpeth cable, CCP-JF cable and local Alpeth cable, and the standards for their use are as follows:

(1) Stalpeth unarmoured cable is used in conduit sections where underground cables of 600 pairs or more and conductor diameter of 0.4 mm or more are required. Stalpeth armoured cables are used for direct burying or in trough sections.

(2) Local PEF Stalpeth cable is used in sections where the distance from the exchange office is within 1 km and which require 3,600 pairs, out of the section where the adoption of conductor diameter of 0.32 mm is possible.

(3) CCP-JF cable is used for direct burying or trough cable in section where the cable pairs do not exceed 400 pairs.

(4) Local Alpeth cable is used for aerial cabling and the number of cable pairs does not exceed 600 pairs.

3.2.3 Determination of Number of Cable Pairs

On the basis of the decision on the cabinet area, the number of pairs of primary cables to be allocated to the cabinet area will be those which will satisfy the demand for such area for 3 to 5 years hence, and pairs for cabinet are calculated along the route from end of the cable and lead-in into the exchange office. The procedure for determining the number of cable pairs is as follows:

(1) So far as there is no hinderance in construction work and in maintenance, many pair cables will be utilized for economy in number of ducts.

(2) Project design will be executed so that the number of cable pairs will satisfy the demand for a minimum of 3 to 5 years (in this design work, 4 years).

(3) In respect to vacant lots where it is envisaged that demand will be generated in the future, considerations will be made as to the number of vacant conduits and the extent of such demand and cables will not be laid to satisfy the demand 4 years hence by executing provisional design. Such areas are as under.

A. When road planning is not clear.

B. When rapidly developed areas are further extended and the demand is not suitable.

3.2.4 Selection of Cable Conductor Gauge

The requirements for selection of the cable conductor gauge are that it is most economical and it satisfies the two limitations of: limited value of line loss determined by transmission loss and limited value of D.C. resistance determined by operation conditions of the switching equipment. In consideration of these conditions, the designed results are as follows:

(1) The KK, PW and TC exchange offices satisfy the conditions of 7 dB, 1,500 Ω, and the conductor gauges are all 0.4 mm and 0.32 mm.

(2) The PL and MM exchanges each exceeded 7 dB in one part. The PL exchange exceeded 1.4 dB in the direction of the Rama IV Road and 0.6 dB in the direction of Bonkai Housing Area but it will be within 5% of all subscribers 10 years hence.

The MM exchange exceeded 0.7 dB at the harbor area and 0.5 dB at the Sathupradit Road but since it will be within 5% of the demand of subscribers 10 years hence, there is no problem. For a part of these areas, conductor gauge of 0.5 mm was used.

(3) The limited value of DC resistance was 1,265.0Ω even at the maximum value at these designed exchanges and there is no problem.

3.2.5 Selection of Ducts for Manholes and Pulling-Boxes

(1) Manhole survey was conducted to investigate that the proposed cable will not hinder the work in manholes or pulling-boxes and in the placement and removal of cables in the future, and the ducts were selected so that there is no over bending of cables or the crossing of cables.

(2) Ducts normally are used from the wall side to the center and from the lower row to the upper row.

3.2.6 Cable Placing and Arrangement

(1) Cable Placing

In manholes where it would be possible for straight or nearly straight pulling in the relative ducts, pull through of the cables is executed wherever possible. The limit of this pull through of cables is within 250 meters of the marginal length of the duct.

(2) Cable Arrangement in Manhole and Pulling-box

A. The lead joint sleeves and pulled-in cable in the manhole or pulling-box are fixed to the wall side and supported by the cable rack hooks.

B. The cable hooks are inserted in the holes of each fourth or fifth row of the cable rack. Since the spacing of the holes is 3.8 cm, the upper and lower spacings of the rack hooks will be 15.2 cm or 19.0 cm.

C. Cable bend radius should be more than 6 times the cable outer diameter and even in unavoidable cases, it should be up to 4 times the diameter.

(3) Cable Arrangement Standards in Manhole

The standards for arrangement of ducts and cables are as in the following diagram. (Refer to Fig. 3.3.9)

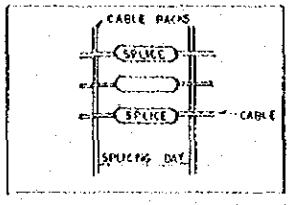
MANHOLE RACKING USED

SINGLE RACK means Cable Rack on which one Cable is placed on Cable Hook.

DOUBLE RACK means Cable Rack on which two Cables are Placed on Cable Hook

SINGLE BAY MANHOLE means Manhole in which Cable Rack is fixed with 2 vertical lines. Splice shall be placed in the middle of these 2 lines and space between these 2 lines is called 'BAY'.

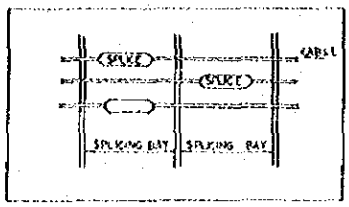
DOUBLE BAY MANHOLE means Manhole in which Cable Rack is fixed with 3 vertical lines. Two Splices shall be placed on the same level in each Bay.



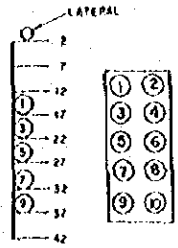
SINGLE BAY MANHOLE

In this case, Cable on each Level shall be placed as under:

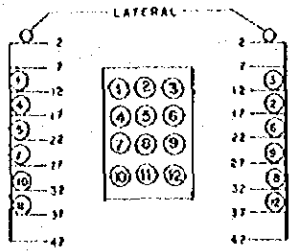
DOUBLE BAY DOUBLE RACKING	Rack Spacing	19 cm (5 holes)
DOUBLE BAY SINGLE RACKING		15.2 cm (4 ")
SINGLE BAY SINGLE RACKING		19 cm (5 ")



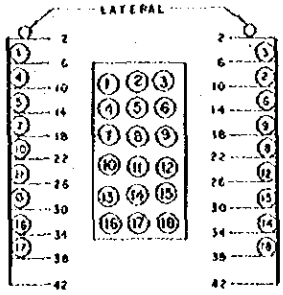
DOUBLE BAY MANHOLE



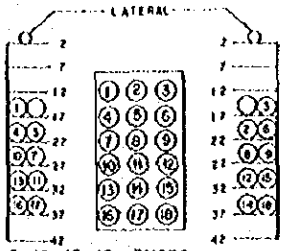
4-10 DUCTS
SINGLE BAY SINGLE RACKING



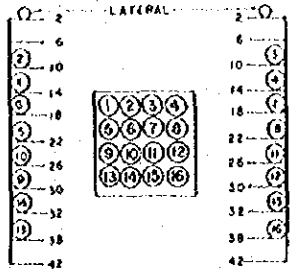
9-12 DUCTS
SINGLE BAY SINGLE RACKING



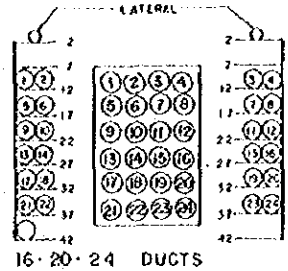
9-12-15-18 DUCTS
DOULE BAY SINGLE RACKING



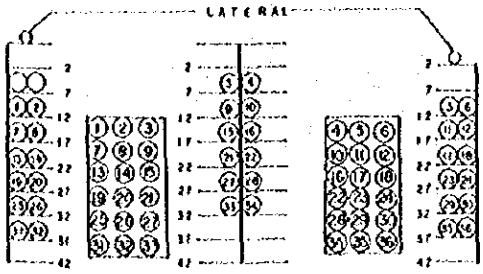
9-12-15-18 DUCTS
DOUBLE BAY DOUBLE RACKING



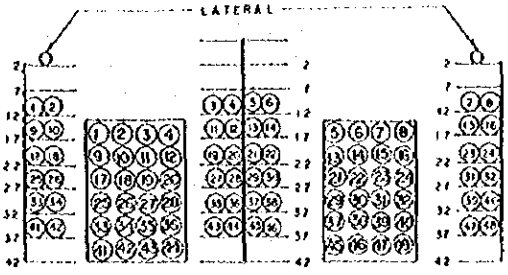
16 DUCTS
DOUBLE BAY SINGLE RACKING



16-20-24 DUCTS
DOUBLE BAY DOUBLE RACKING



36 DUCTS, TYPE "V" MANHOLE WITH
CENTRE RACK DOUBLE BAY DOUBLE RACKING



48 DUCTS, TYPE "V" MANHOLE 2 CENTRE RACK
DOUBLE BAY DOUBLE RACKING

Fig. 3.3.9

3.3 Entrance Cable Design

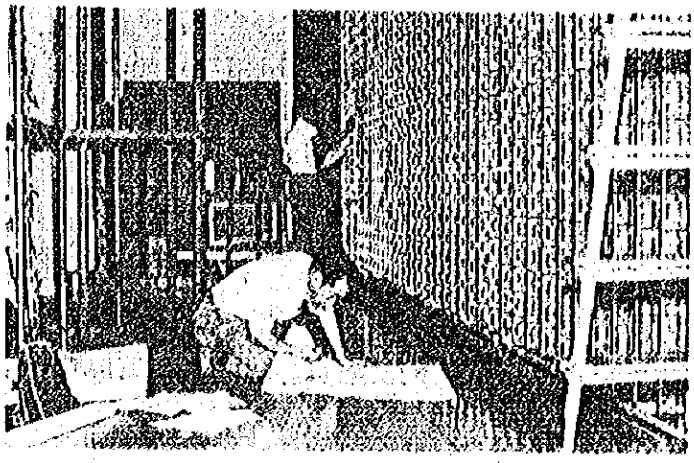
In the current design work, the new installation of cables will not be carried out since the existing entrance cables of the existing KK and PL exchanges are sufficient. In respect to the entrance cables for the new PW and TC local exchanges, the design was made according of the office building layout received from the TOT. Matters which should be especially mentioned from the standpoint of design are as follows:

(1) MDF of the new exchanges are 1 vertical 600 pairs.

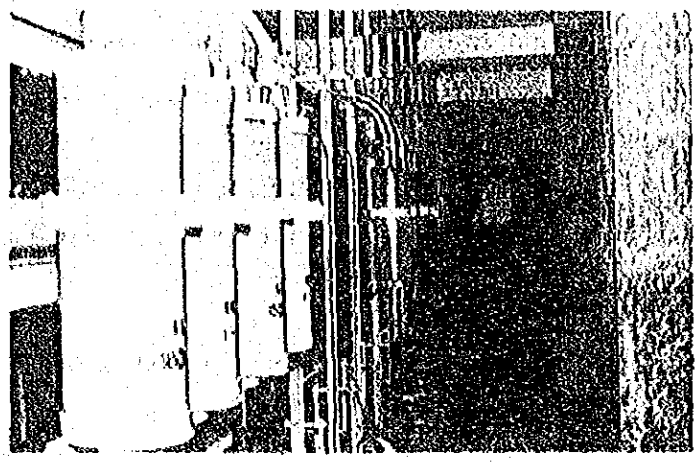
(2) Duct selection and location of termination was determined for the cable vault so that the entrance cables will not cross.

(3) 0.5 mm terminating cable was used. Cables of 0.32 mm 3,600 pairs and 0.4 mm 3,000 pairs were terminated in the cable vault by branching into 2 lines of 1,800 pairs and 2 lines of 1,500 pairs respectivoly.

(4) Location of termination for the entrance cables in the new exchanges was made by utilizing the innermost part of the MDF in the order of junction cables and then subscriber cables.



MDF investigation at KK Exchange.



Cable vault of KK Exchange.

3.4 Conduit Line Design

3.4.1 Selection of Routes

(1) Route with the shortest line distance, existing facilities which can be effectively used and suitable for subscriber distribution were selected.

(2) Roads selected were those which will not be repaired or abandoned due to city planning, etc.

(3) Concrete paved roads were avoided as much as possible and asphalt paved or gravel roads were selected.

3.4.2 Place of Road Occupancy

(1) Roads with a distinction between sidewalk and carriage way, the place of the conduit was under the sidewalk and when this is difficult, the carriage way on the sidewalk side.

(2) Roads with no distinction between sidewalk and carriage way, the place of the conduit to be on the house side.

(3) In case of attachment alongside existing bridges, talks were held with the Bridge Administrator at each time and the position of conduit placement determined.

(4) Road crossings were made as few as possible.

3.4.3 Conduit Line Construction

(1) Type of conduit and specified depth

A. Type of conduit to be used is mainly asbestos pipes wound with reinforced concrete, and only in special sections such as alongside bridges, etc. were galvanized iron pipes (G.I.P.) used in the design.

B. G.I.P. pipes were used as entrance ducts from the manhole and pulling-box to the cross-connecting cabinet.

C. For the conduits from the manhole and pulling-box to the riser pole, G.I.P. pipes were used for the bent pipes and riser pipe and for the other portions, reinforced concrete wound asbestos pipes were fundamentally used.

D. Duct of 4" diameter is adapted to be used for the main conduit line and 3" diameter ducts for the branch conduit line and riser pipe. However, for the vertical portion of the riser pipe, 2" diameter ducts were adapted.

E. The standards for placement of the conduits were that the bottom of the duct formation midway between manholes be at a depth of 1.8 to 2.3 meters from the ground surface with slopes on both sides but this does not apply to special sections such as on both sides of the bridge, under tracks, etc.

(2) Number of Ducts

The number of ducts was determined by totalling the number of cable lines (subscriber, junction and toll) to be accommodated to which the number of spare ducts was added. TOT indicated the number of spare ducts.

(3) Duct Arrangement

The standards for arrangement of the ducts are indicated in the following Fig. 3.3.10 (according to type of manhole)

Conduit Line Construction

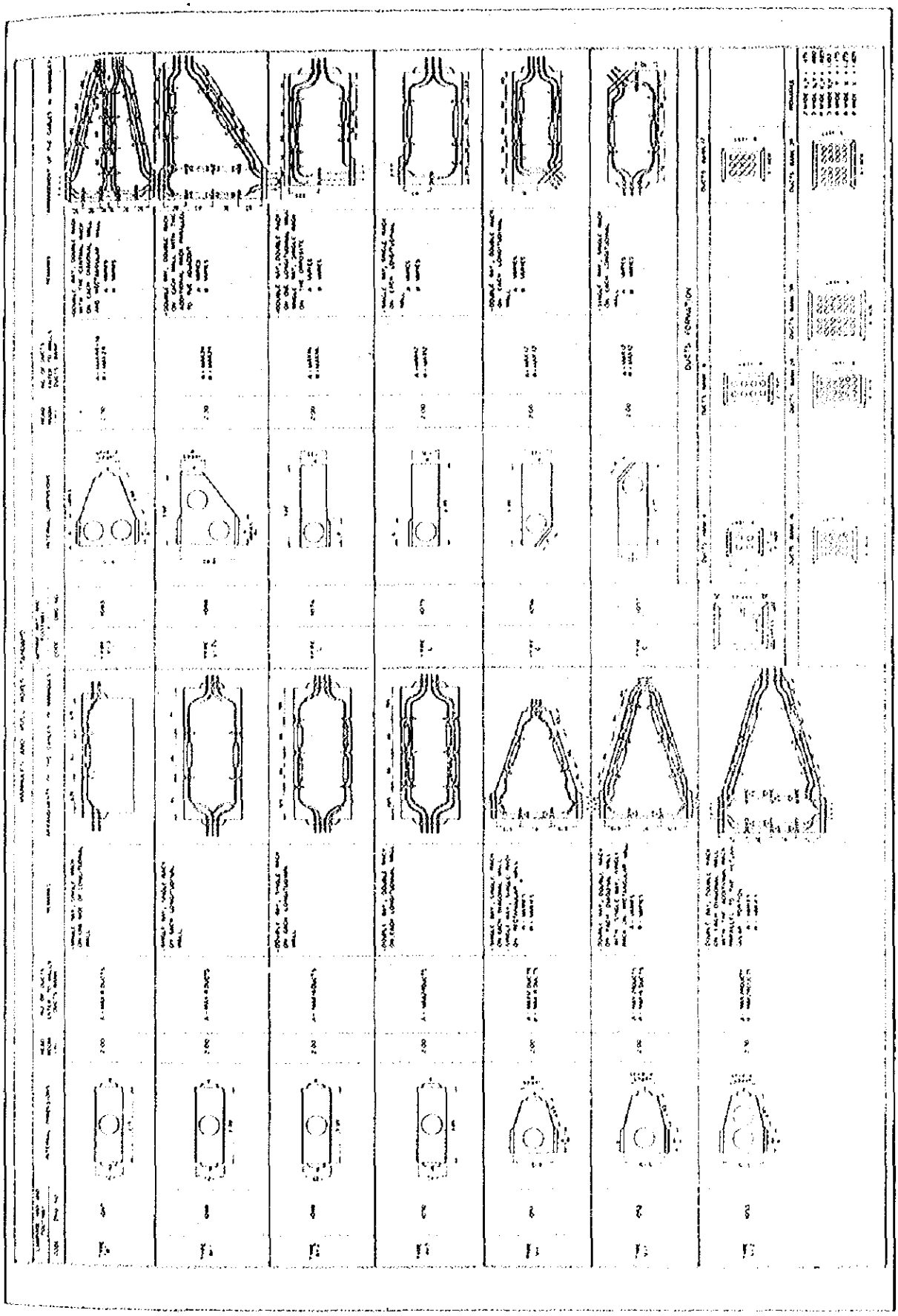


Fig. 3310(A)

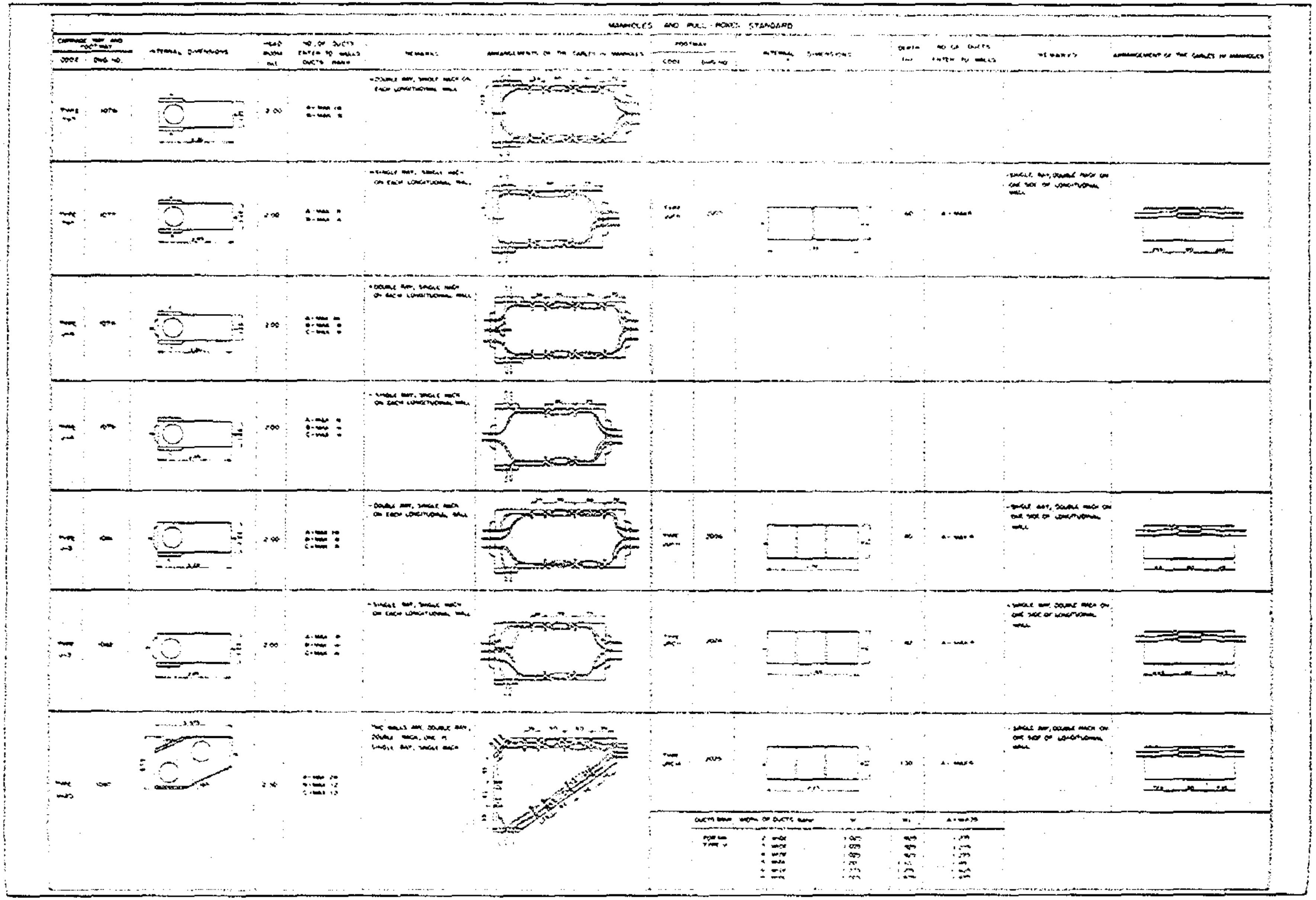
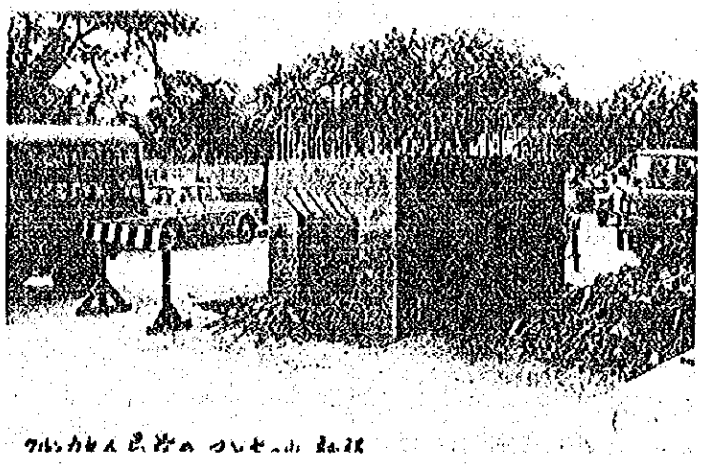
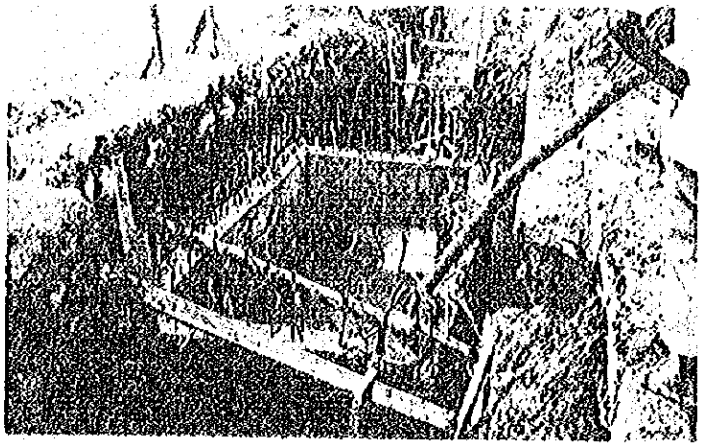

MANHOLES AND PULL BOXES STANDARD
CARRIAGE WAY AND FOOT WAY
CODE
DWG. NO.
INTERNAL DIMENSIONS
NO. OF DUCTS ENTER TO WALLS
REMARKS
ARRANGEMENTS OF THE CABLES IN MANHOLES
FOOTWAY
ARRANGEMENT OF THE CABLES IN MANHOLES

Fig. 2.2.10 (B)



Construction of KK Exchange office manhole



Construction of manhole on Lan Luang Road

3.4.4 Exchange Facilities

(1) The frame for the cable vault in the each exchange building will be designed and constructed by the TOT.

(2) In line with the foregoing, the conduit line from the exchange building to the first manhole will be designed and constructed by the TOT.

3.4.5 Manhole and Pulling Box

(1) The types of manhole and pulling box adopted are shown in the attached Fig. 3.3.10 (A) (B).

(2) Adoption of Pulling Box

A. In the event of placement in sidewalk of branch route, type JUP-11 was adopted and in case of road placement, the type JRC-11 will be adopted.

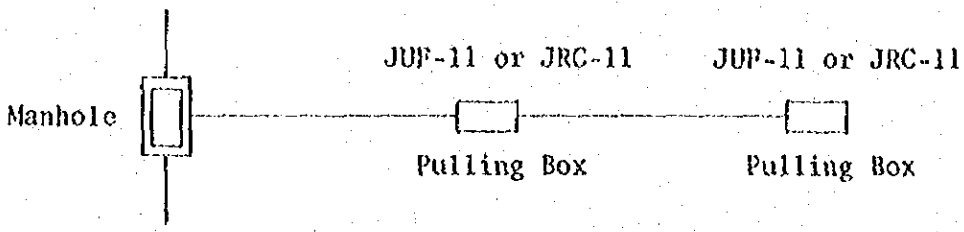


Fig. 3.3.11

For use between the manhole or cross-connecting cabinet and for entrance to the cabinet, the type JUP -6 was adopted.

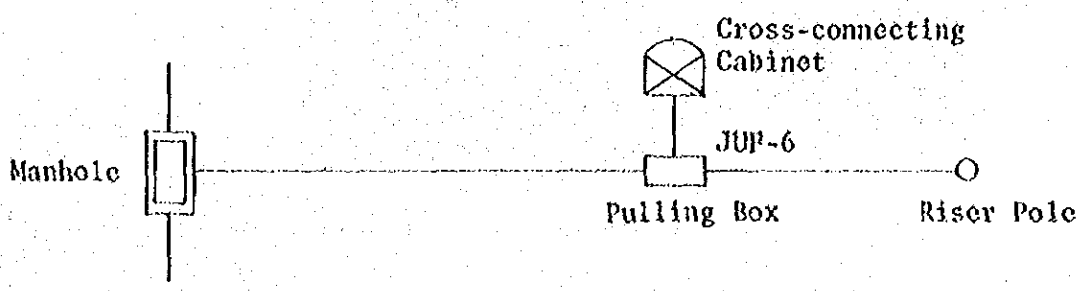


Fig. 3.3.12

(3) Attachment position of riser pipe and branch conduit

The attachment positions of the riser pipe and branch conduit in the manhole and pulling box from the riser pole or cross-connecting cabinet are shown in Fig. 3.3.13.

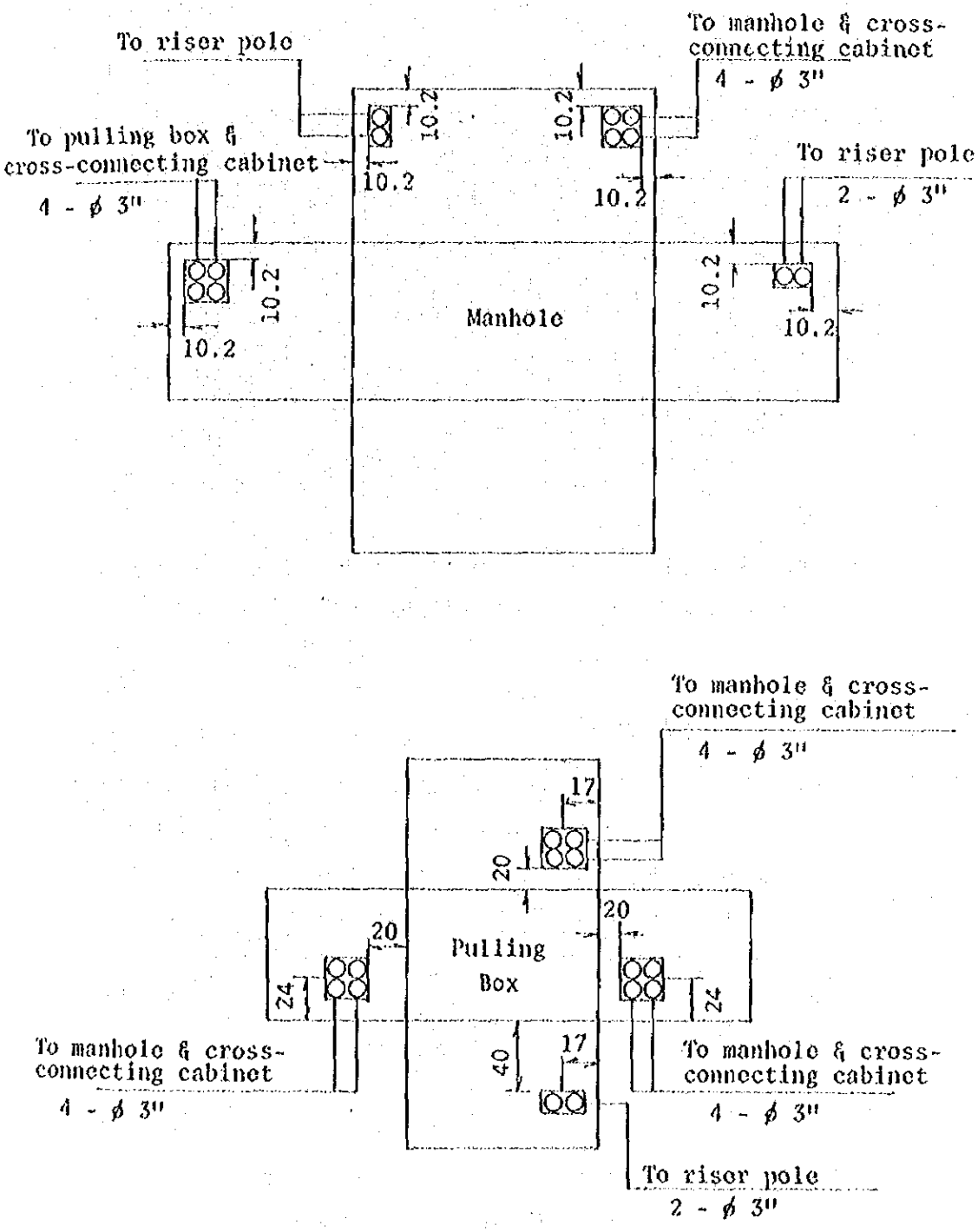


Fig. 3.3.13

(4) In respect to the taking out of direct buried cables from the pulling box, it was indicated at each time in the Duct Arrangement Drawings.

3.5 Gas Pressurization System Design

3.5.1 Exchange Facilities Design

Of the objective exchanges in the current design work, the present facilities at the existing three exchanges (KK, PL and MM exchanges) will be utilized and any shortages such as gas flow meter, etc. will be additionally installed.

The following facilities will be installed in the two new exchanges (TC and PW exchanges).

(1) Air Dryer

A. Type of equipment

The capacity of the air dryer was determined by forecasting the future number of entrance cables and cable extensions.

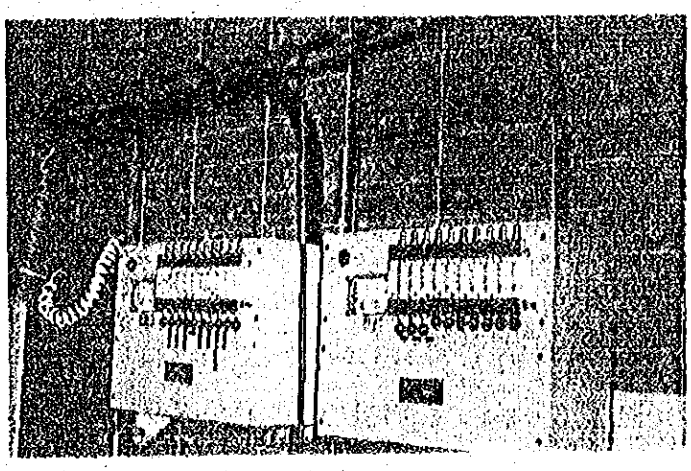
B. Position for Installation

Since a gas facilities room was not especially provided for in the office building design, the position for installing the equipment was selected where the daily maintenance work would be facilitated and the noise and vibration of the air dryer will not affect the exchange equipment and hinder the exchange operational work.

(2) Meter Panel

The meter panel will be installed near the air dryer and the gas flow to each cable will be supervised.

The air dryer and the meter panel will be connected by copper pipes and the supply of dry air to each cable will be by polyethylene pipes (Pole Cortubing). The equipment can charge gas up to 10 cables from 1 meter panel.



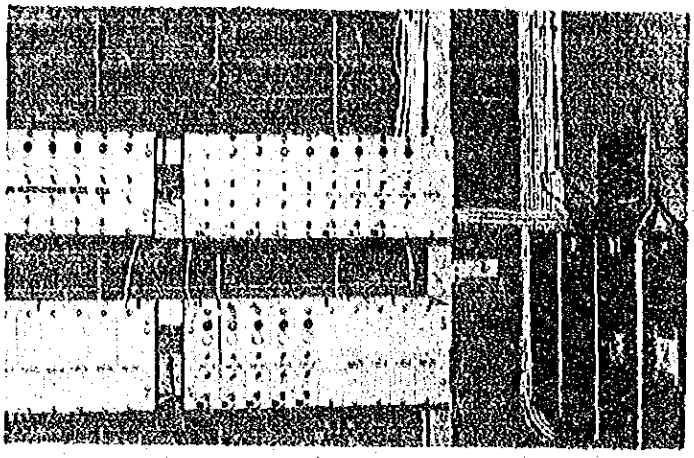
Meter panel

(3) Alarm Panel

To indicate the operation of the pressure guard attached to each cable, pilot lamps and alarm bells are built-in in the alarm panel and one pilot lamp and one alarm bell will be for each cable.

Verification of the position of the pressure guard in operation due to drop in gas pressure will be made by measuring the loop resistance up to each pressure guard.

The alarm panel will be installed in the Test Room and 10 alarm bells can be mounted on one panel.



Alarm panel

3.5.2 Outside Facility Design

(1) Gas Pressurized Cables

All existing primary cables and junction cables are gas pressurized and under the current design, the gas pressurization of aerial cables will not be executed.

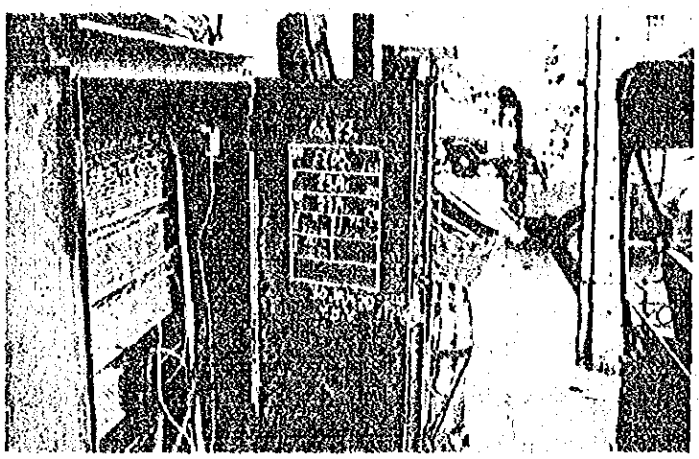
Gas charging pressure shall be 9 psi (660 g/cm^2)

(2) Pressure Guard

Pressure guard is attached inside the cross-connecting cabinets as a general rule but when there is no cross-connecting cabinet at the cable end, it will be attached inside the manhole. The pressure guard is equipped with a talking pair between the test desk and the valve for gas pressure measurement.

When the pressure guard is attached to the cross-connecting cabinet, talk contact is made from the terminal of the primary cable.

In the event of attaching the pressure guard in the manhole, the talking pair will be assigned one lower number than the alarm pair.



Pressure guard attached inside cross-connecting cabinet

(3) Alarm Pair

(a) One circuit of the alarm line will be used for each pressure guard.

(b) The last pair number of the cable at the point of attachment with the pressure guard will be designated as the alarm line. Alarm lines for same cables will be connected in common by using the terminal block of the MDF and connected to the alarm panel for each cable.

(4) Valve Point

For convenience in measurement, etc. of the gas pressure, a valve point will be installed but to facilitate measurement of the pressure, it should be attached to the cross-connecting cabinet wherever possible.

(5) By-Pass Valve

In the event both of the branched cables are lengthy, a by-pass valve will be attached at the branching point so that separate tests can be made on each cable.

Decisions were made upon discussions with the TOT at each time in respect to the applicable cables for by-pass valve attachment.

3.6 Secondary Cable Network Design

3.6.1 Distribution System

The distribution system will be use of the cross-connecting cabinet and as shown in Fig. 3.3.14, the primary and secondary cables are jumper connected inside the cross-connecting cabinet, thereby raising the conductor use ratio for economization of facilities.

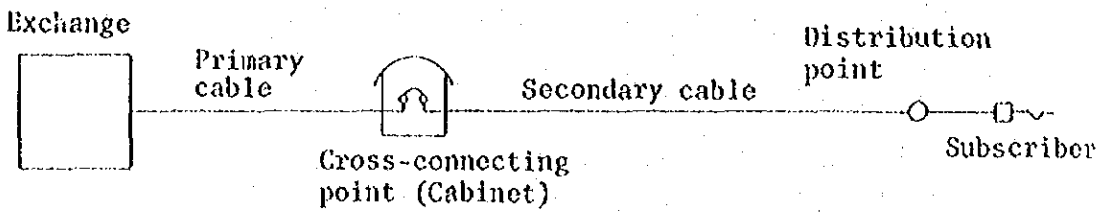


Fig. 3.3.14

The distribution of secondary cables will be by the fixed distributing system and, as a general rule, multiple distribution and adjacent multiple by terminal box will not be executed. An example of the distribution of secondary cables is shown in Fig. 3.3.18 A & B.

3.6.2 Distribution Design

The cabinet area will first be established at the time of primary cable design. Based on the demand within this cabinet area, the design for secondary cables will be executed according to the following procedure.

(1) First select the distribution point and taking up the present demand and demand 3 to 5 years and 8 to 10 years hence near such distribution, gather them at the distribution point as

10	present demand
15	3 to 5 years hence
25	8 to 10 years hence

(2) Next, accumulate the demand along the routes from the cable end of each route.

(3) Decide on the number of cable pairs of about 1.1 fold of this cumulative numerical value.

3.6.3 Cable Expansion

In the event the capacity of the existing cables cannot satisfy the demand 3 to 5 years hence, cable pairs which can satisfy the demand 8 to 10 years hence will be newly installed. In such case, the new cables will be laid over the existing cables, as shown in Fig. 3.3.15, and the removal of existing cables will be avoided as much as possible.

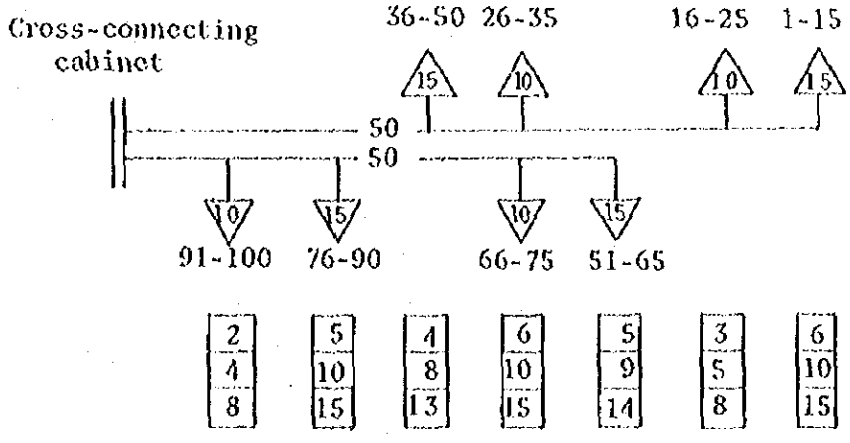


Fig. 3.3.15

3.6.4 Determining Number of Cable Pairs

The number of cable pairs was determined in the following manner.

(1) The number of cable pairs shall meet the demand 8 to 10 years hence.

(2) If there are existing cables, the number of cable pairs shall be the figure derived by substracting the existing cable pairs from the required number of cable pairs.

(3) The cable pairs will be reduced to correspond to the required number of cable pairs but reduction will not be made in the event the declining point is 3 spans or less.

3.6.5 Allocation of Cable Pair Number

The allocation of cable pair number will be made as follows:

(1) Cable pair number will be allocated lower numbers toward the cable end and successively higher numbers will be allocated in the near end of the telephone exchange.

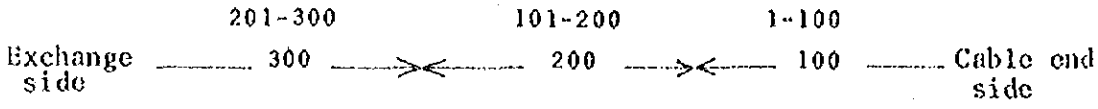


Fig. 3.3.16

(2) Pair allocation for branched cables will be made by giving lower numbers to the cable end side of the branched cable and higher numbers of the branched cable near the exchange side. Multiple distribution will not be executed.

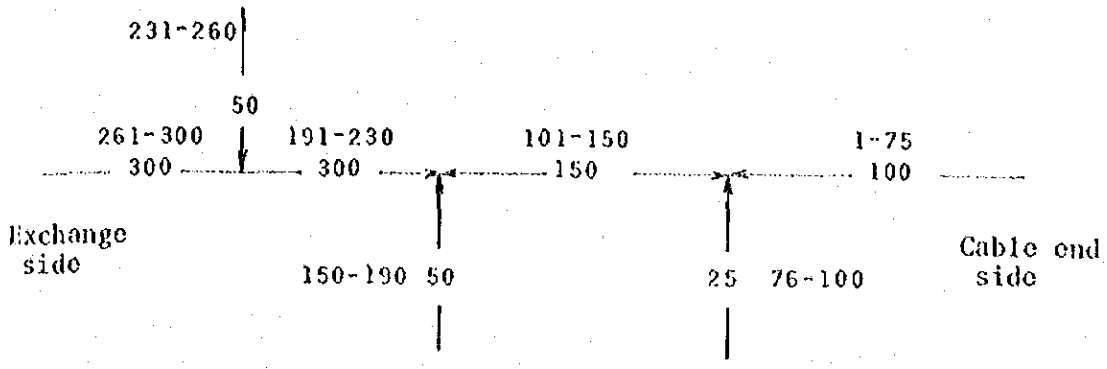

231-260
50
261-300
300
191-230
300
101-150
150
1-75
100
Exchange side
150-190 50
25 76-100
Cable end side

Fig. 3.3.17

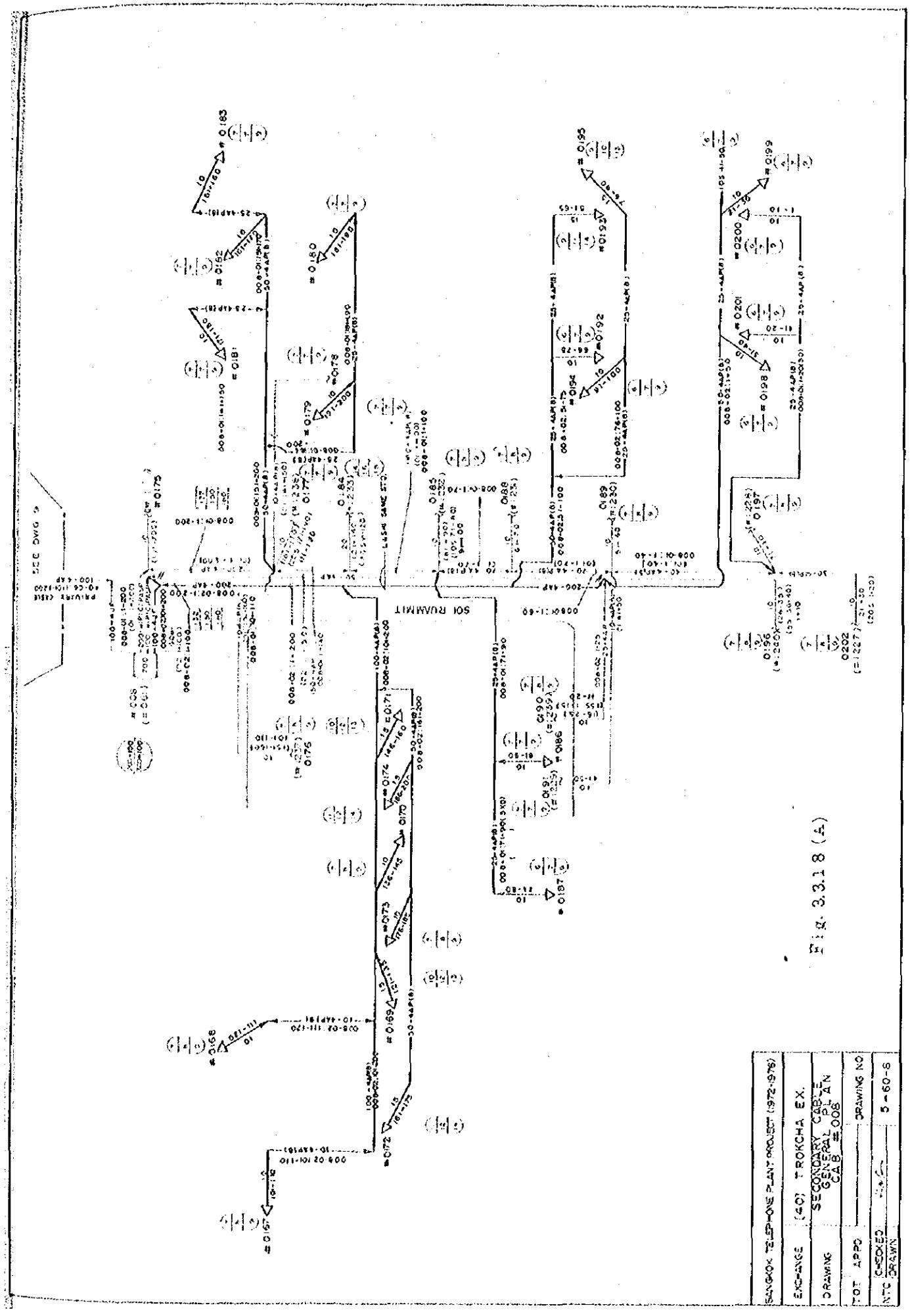
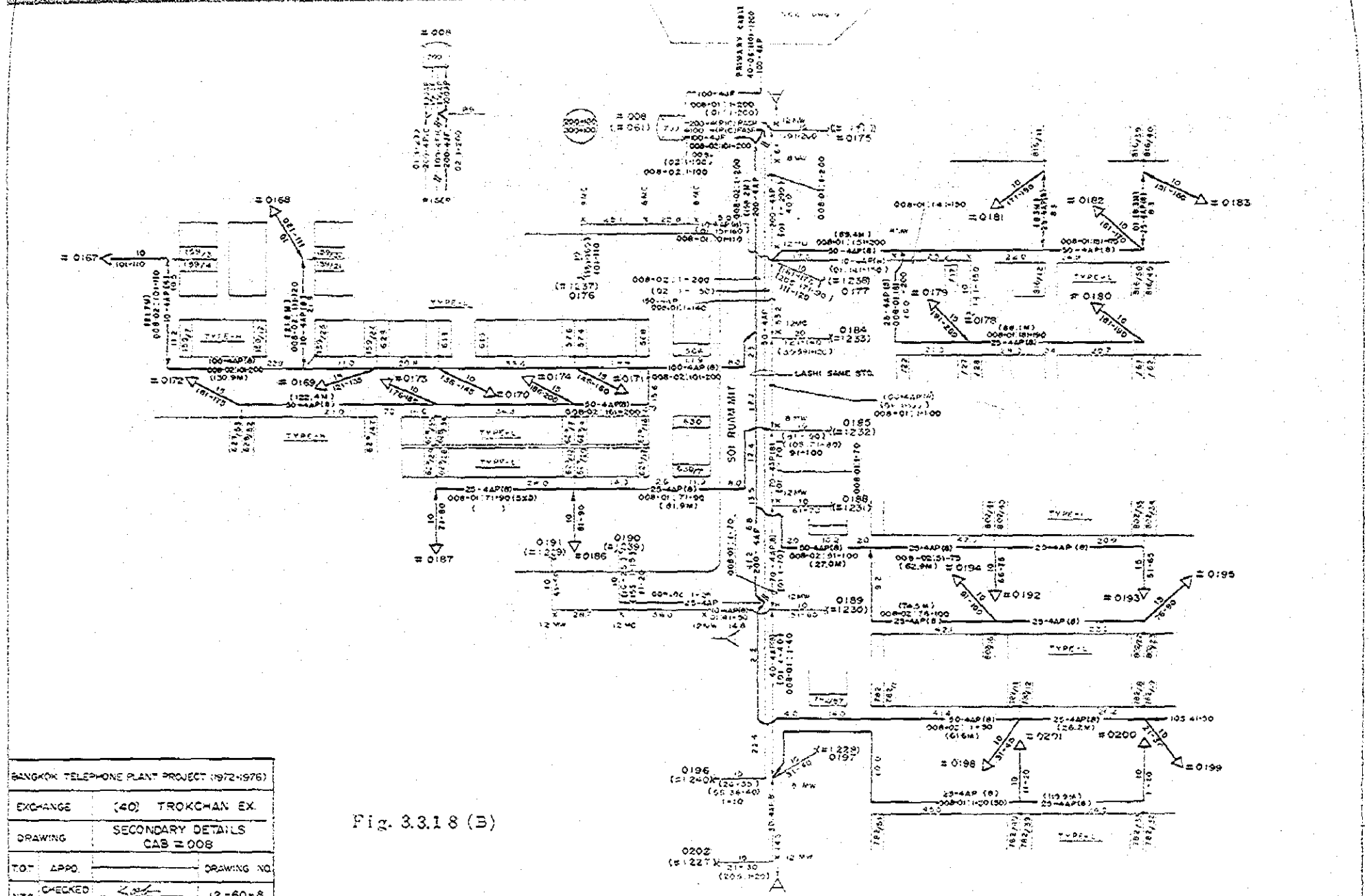

SOI RUAMMIT
BANGKOK TELEPHONE PLANT PROJECT (1972-1976)
EXCHANGE (40) T ROKCHA EX.
DRAWING SECONDARY CABLE GENERAL PLAN CAB #008
FOR APPD
CHECKED
DRAWN
DRAWING NO 5-60-8

Fig. 3.3.18 (A)



BANGKOK TELEPHONE PLANT PROJECT (1972-1976)	
EXCHANGE	(40) TROKCHAN EX.
DRAWING	SECONDARY DETAILS CAB = 008
T.O.T. APPD.	DRAWING NO.
NTC CHECKED / DRAWN	12-60-8

Fig. 3.3.18 (B)

3.6.6 Terminal Boxes

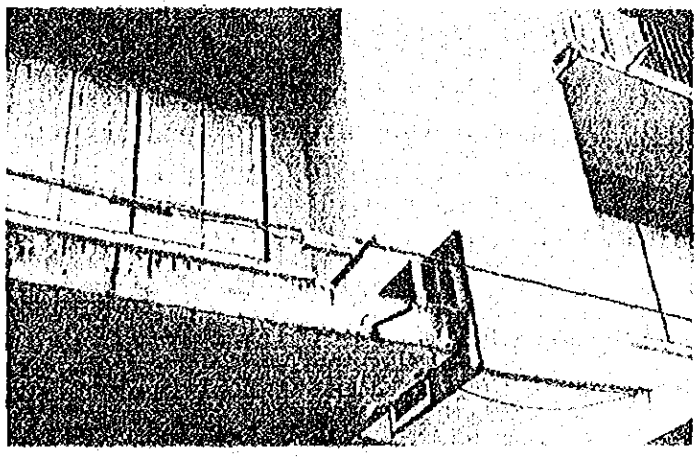
The design of terminal boxes was executed as follows:

(1) Terminal boxes to be newly installed shall be equipped with stub cables.

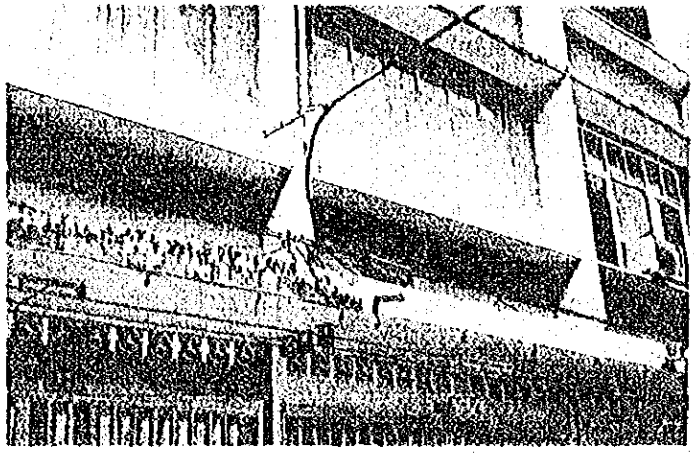
(2) Capacity of the terminal boxes shall be able to accommodate the number of cable pairs to meet the demand 8 to 10 years hence.

(3) In the event the existing terminal boxes cannot accommodate the required number of cable pairs to meet the demand 5 years hence, installation of additional terminal boxes corresponding to the cable pairs and spare pair shall be made or a redistribution of cables shall be executed. Furthermore, increased installation of terminal blocks for the ready access type terminal boxes shall be made.

(4) Two kinds of terminal boxes with stub cables shall be used, i.e., for attaching to the strand wire and for mounting on the wall. Generally, the former is used for aerial cabling and the latter for underground distribution.



Terminal box with stub cable



Ready access terminal box.

3.6.7 Poles

The installation of new aerial cables shall be carried out by joint use of power poles and the stringing along the walls of structures wherever possible. In cases where this was not possible, the erection of TOT poles was considered.

Although the standard length of the poles to be used is 8 meters, decision was made for the use of longer poles in the event of road crossing of the cables.

Place for pole erection to be on the carriage way side of the sidewalk in case of roads with a distinction between sidewalk and carriage way, and for roads with no such distinction, a place which would not hinder the passage of pedestrians, vehicles, etc. was selected.

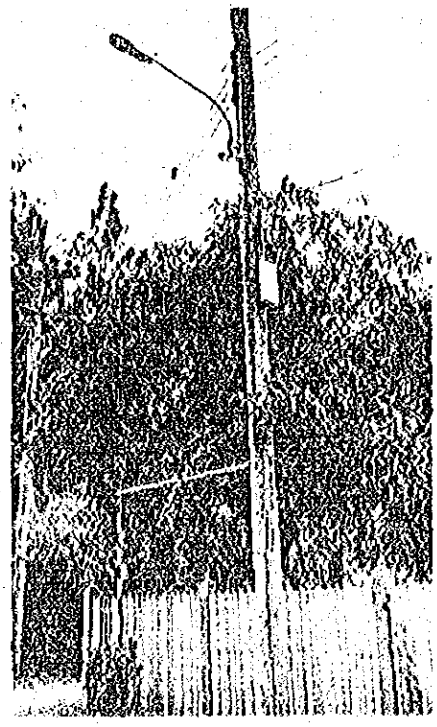
3.6.8 Guys

Guys shall be attached to the poles where there is an unbalance in the tension of the aerial cables.

The gauge of the guy wires shall be of the same as the messenger wire.

When the guys hinder human passage or are in front of entrances, sidewalk guys are to be installed. In this case, the gauge of the guy wires to be used shall be one rank higher than that of the messenger wire.

Insulators shall be inserted for the guys used for joint use power poles.



Sidewalk guy and 25 pair terminal box.

3.6.9 Selection of Cable Line Route

Routes were selected according to the following procedure.

(1) Where there are MEA poles, joint use of such poles.

(2) At places where MEA poles cannot be utilized but there are concrete buildings, the cables are to be attached to such building walls.

(3) Should the aforementioned routes be difficult to select, an independent TOT route shall be selected.

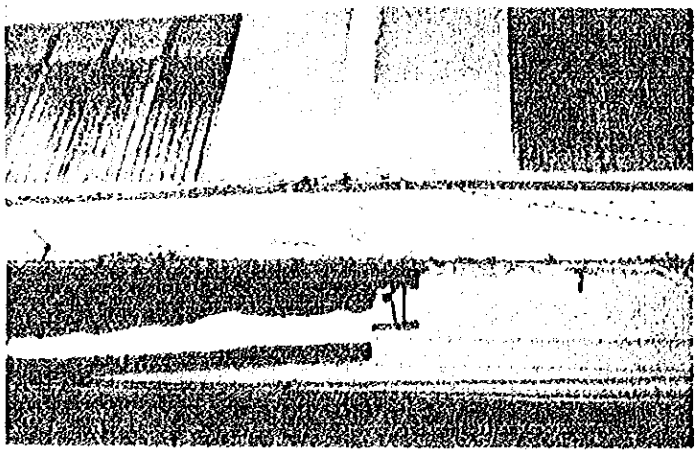
3.6.10 Aerial Cable Placement

The method of aerial cable placement to be as follows:

(1) Although aerial cables are fixed to the messenger wire with lashing wire, if additional cables are to be installed, they will not be installed separately but lashed to the same messenger wire.

(2) In the event of additional placing of wall cable, a new strand will not be hung but additional lashing of the round type cable to the AP-(8) cable will be executed.

(3) When branching a cable between poles, guys will be attached to the branched first pole so that there will be no tension in the branched span.



Lashing of wall mounted cable.

3.7 Cut-Over Design of Local Network

Two kinds of method were adopted in the cut-over design of local network -- cable transfer at the same exchange office as the KK, PL and MM exchanges and cable cut-over with change in service area as in the PW and TC exchanges. In either case, a sure, simple and safe method of design was executed with due attention to prevent hindrance to the present circuits.

3.7.1 Kind of Cut-Over Method and Applicable Section

(1) In case of change in exchange accommodation

This method of cut-over is applied to cases in change of exchange office location such as the PW and TC exchanges. In such case either the cut-over with loop jumper and/or the cut-over with bridge joint will be applied but since the cut-over with loop jumper may give rise to cases where the limited value of line loss and D.C. resistance increases over the standard value, sufficient study should be in regard to this point.

A. Cut-over with loop jumper

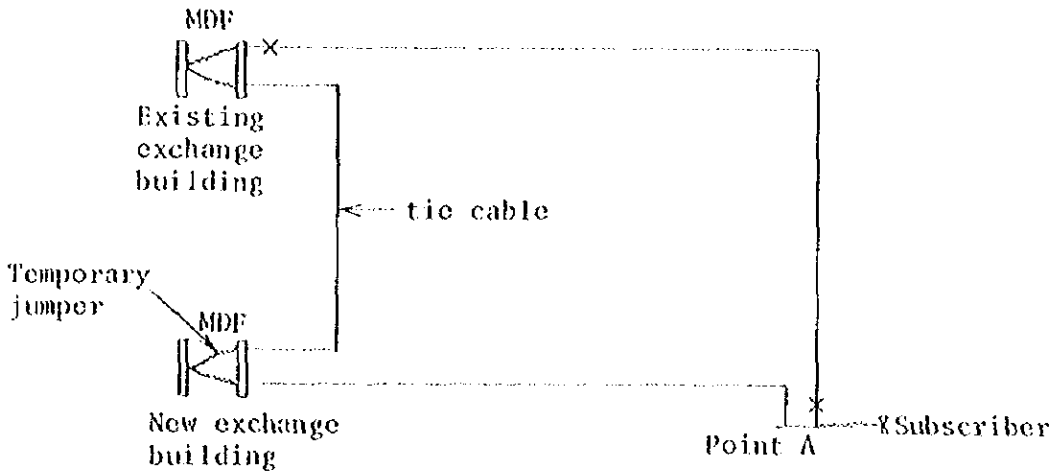


Fig. 3.3.19

The cut-over will be executed as follows:

(a) Insert the insulating piece at the MDF in the new exchange building.

(b) Proper jumpering to the terminal of the new cable pair from the new exchange to Point A and then connect a temporary jumper wire to the terminal of tie cable for tie-in with the existing exchange building.

(c) Connect double jumper wires on the existing exchange side.

(d) Execute the cut-over at Point A.

(e) At the time of service-in of the new exchange building, pull out the insulating piece at the MDF of the new exchange building and, at the same time, insert an insulating piece in the MDF of the existing exchange building.

(f) Remove the jumper wire at the existing exchange building.

B. Cut-over with bridge joint

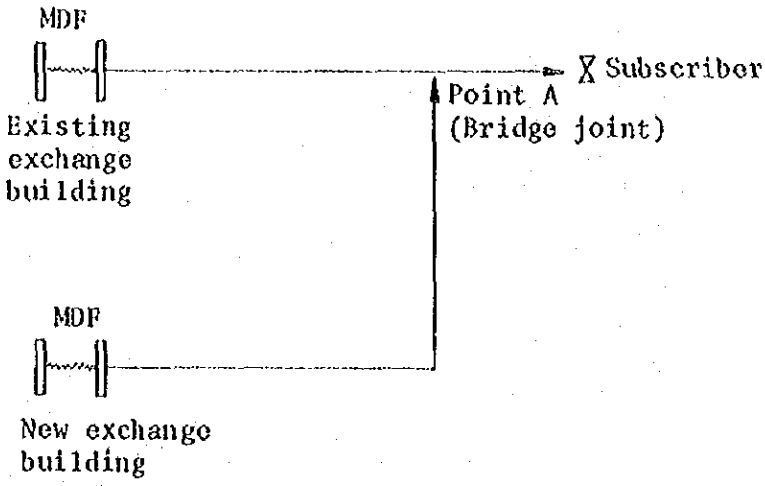


Fig. 3.3.20

The cut-over will be carried out as under.

(a) Insert the insulating piece at the MDF in the new exchange building.

(b) Make multiple connection at Point A.

(c) At the time of service-in of the new exchange, pull out the insulating piece at the MDF of the new exchange building and, at the same time, insert an insulating piece at the MDF of the existing exchange building.

(d) Remove the bridge joint at Point A.

(e) Remove the existing jumper wire at the existing exchange building.

(2) Cable Transfer at Same Exchange Building

In the transfer of cables at the same exchange building, the following methods can be applied.

A. Transfer toward exchange building

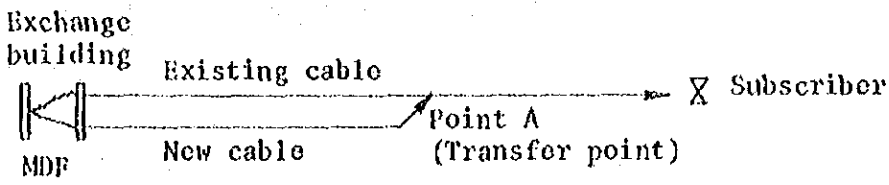


Fig. 3.3.21

The transfer will be carried out as follows:

(a) Properly connect the jumper wire to the new cable; that is, connect double jumper wires.

(b) After pair checking at Point A and then make the transfer.

(c) Remove the existing jumper wire.

B. Transfer toward subscriber

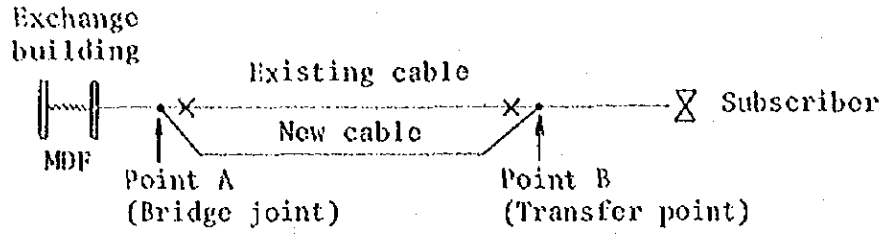


Fig. 3.3.22

The transfer will be executed as under.

(a) Bridge joint the new and existing conductors at Point A.

(b) Make the jointing at Point B, and insulate the existing conductor.

(c) Remove the bridge jointing at Point A.

3.7.2 Attention to be Paid in Cut-Over Design

There are various methods for cable cut-over as mentioned in the foregoing. Since whether or not to prepare tie cables between the new and existing exchanges, the order of construction work, and the conditions, etc. of the existing lines will vary according to the method to be applied, considerations were made from the standpoint of construction, maintenance, economy, etc. and the most suitable method was adopted. Matters which will require attention in the cable changeover are as follows:

(1) Reliability

There are many restrictive matters in cut-over design. Consequently, in order to avoid the occurrence of trouble during construction work, a sure, simple and safe method should be selected.

(2) Limited Value of Line Loss and D.C. Resistance during cut-over Construction Work.

A. The limited value of line loss during the period of work for cable cut-over shall be within 10 dB.

B. The limited value of D.C. resistance shall be within 1,500 ohms but in the event of exceeding this limit, two pairs for one circuit should be utilized to lower the limited value of resistance.

(3) Limitation in Cut-Over Points

As a general rule, the design of circuit cut-over should be made so that there will be no simultaneous cut-over at 3 or more points, including jumper wires, cables, terminal boxes and lead-in cables.

CHAPTER 4. MATERIAL LIST AND CALCULATION METHOD

The method for material calculation was by calculating the requirements according to each drawing, utilizing the attached Calculation Sheets and Computing Table of Number of Works and Materials. The calculation of cable pieces was made in accordance with the TOT method while hardware calculations were made according to NTC's method.

4.1 List of Materials

In respect to the list of materials, please refer to the List of Materials in each Chapter of Part IV.

4.2 Method of Material Calculation

4.2.1 Cables

Cable lengths were computed according to the following method:

(1) Conduit Cables in Existing Conduit Route

Cable length was derived by totalling the lengths for splicing, slacks and spares with the distance between each manhole.

A. For linear type manhole

Length for splicing	-	One side	1.0 m
Slack	-	"	0.5 m
Spare	-	"	1.0 m

B. For other than linear type manhole

The cable length was derived by computing the actual length of the cable inside the manhole to which the lengths for splicing, slack and spare were added.

(2) Conduit Cables for Proposed Conduit Route

In consideration of the change in manhole construction locations for the new conduit route, a further 1.0 meter for one side was added to the cable length computed according to the method in the foregoing paragraph (1).

(3) Direct Buried Cables

A. For Stalpeth armoured cable, a cable piece calculation sheet was prepared by adding the length for splicing to the actual length.

B. For CCP-JF cable, the length for splicing was added to the actual length and the figure raised to the cable drum unit.

(4) Aerial Cable

The cable line lengths compiled for each separate exchange were multiplied by 1.03, and the lengths derived for each exchange were raised to the cable length reeled on the drum.

(5) Terminating Cable

Fractions in the required cable lengths were raised to round numbers of 10 m units.

4.2.2 Materials for Line Construction

(1) Twisted Steel Wires

The weight of the compiled number will be multiplied by 1.03 and the fractions shall be in 100 kg units.

(2) Pole Mounting Hardwares

As to the bolts and nuts, suspension clamps, etc., the numerical values computed from each separate drawing were multiplied by 1.03 and the fractions thereof raised to round numbers of 100 units.

(3) Terminal Boxes

Terminal boxes, cross-connecting cabinets, etc. shall be the actual number required.

(4) Splicing Materials

The numerical values computed for lead sleeves, paper sleeves, etc. will be raised to round numbers of box units.

4.3 Calculation Sheets & Computing Tables (Examples)

Examples of the calculation sheets and computing tables for telephone poles, guys, aerial cabling splicing, underground cable splicing, etc. are shown in Tables 3.4.1 - 3.4.3.

Table 3.4.1 EX( ) MATERIALS FOR AERIAL CABLE CONSTRUCTION (1/3)

DWG NO.	A P CABLE										A P – (B) CABLE					STRAND		LASHING WIRE					
	9.7 m	12.2	14.7	17.0	19.8	23.6	26.4	30.7	33.1	41.1								LENGTH (CABLE DIAMETER)			NO OF SPAN		
	10	25	50	75	100	150	200	300	400	600	10	25	50	75	100	6 M	10 M	0 mm ~ 25	25 ~ 50	50 ~ 75	0 m ~ 20	20 ~ 30	30 ~
(SUB) TOTAL																							

Table 342 EX ( ) MATERIALS FOR AERIAL CABLE CONSTRUCTION (2/3) NO. OF

DWG NO.	POLE			SUSPENSION CLAMP		FIG (81)	PREFORMED GUY GRIP		MACHINE BOLT			STRAIGHT THIMBLEYE BOLT				ANGLED THIMBLEYE BOLT				WASHER 5/8"			FORGED THIMBLEYE 5/8"	FORGED NUTS 5/8" EYE	
	CONCRETE			3 BOLT			DEAD-END	FOR DEAD-END				5/8" x				5/8" x				CURVED	SQUARE	LONG SQUARE			
	M	M	M	CURVED	STRAIGHT	1 BOLT CABLE CLAMP	(FIG (81) (16M))	(FIG (81) (16M))	8"	10"	12"	8"	10"	12"	14"	8"	10"	12"	14"						
	8	9																							
(sub)																									
TOTAL																									

Table 3.43 EX (   )   MATERIALS FOR ASP CABLE SPLICING (½) (SQUEEZING METHOD)   NO.   OF

MH NO.	SPLICING DESIGN	NUMBER OF WORK M / B	3 (4) / C	N	RACK EXTENSION	RACK SECTION HOLES 8	14	18	RACK HOOK LGTH 4	7½	10	VACJI	SLEEVE PE 0.32	PAPER 0.4	0.5	0.65	0.9	MAIN LEAD SLEEVE 40 x 400	50 x 400	60 x 400	70 x 500	80 x 500	90 x 500	100 x 500	110 x 500	120 x 500	130 x 500	140 x 500	x	x	x	SOLDER NO. 1	NO. 4	BONDING RIBON	BINDING CORD	16mm IRON WIRE	STEARINE 2500	DESICCANT	DESICCANT CLOTH 20 x 36	24 x 36	27 x 36	27 x 45	31 x 36	33 x 45	34 x 45	37 x 45	40 x 45	44 x 45	48 x 45	NUMBER OF BRANCHED CABLE [illegible]
	— — —																																																	
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	— — —																																																	
(SUB) TOTAL																																																		

* : Don't Use

CHAPTER 5. AMOUNT OF WORKS

The total amount of works under this detailed design work is indicated in Table 3.5.1. Furthermore, the amount of works for each exchange is shown in the respective chapters of Part IV.

TABLE 3.5.1 TOTAL AMOUNT OF WORKS FOR 5 EXCHANGES

ITEM	BREAKDOWN	Q'ty	REMARK
1 POLE	8 MC	198 ea	
	10 "	22 "	
	TOTAL	220 "	
2. GUY	(1) UPPER GUY 6 M	513 ea	
	" 10 M	202 "	
	" 16 M	4 "	
	TOTAL	719 "	
	(2) ANCHOR ROD # 2	455 ea	
	5/8" x 7'	—	
	3/4" x 7'	186 "	
	1" x 7	5 "	
	TOTAL	646 "	
3 CABLE	(1) UNDERGROUND CONDUIT CABLE		
	3600 - 32 ASP	4 333.2m	STALPETH CABLE
	3000 - 4 "	7 591.3 "	
	2400 - 4 "	8 216.9 "	
	1800 - 4 "	7 340.9 "	
	1200 - 4 "	4 885.9 "	
	900 - 4 "	3 945.0 "	
	600 - 4 "	6 075.9 "	
	300 - 4 "	6 941.7 "	
	1800 - 5 "	230.0 "	
	1200 - 5 "	412.0 "	
	900 - 5 "	1 030.3 "	
	600 - 5 "	427.2 "	
	300 - 5 "	395.0 "	
	100 - 65 "	384.2 "	
	SUB TOTAL	52 209.5 "	
	(2) DIRECT BURED CABLE		
	900 - 4 ASPT	15.0m	STALPETH SHEATHED AND STEEL TAPE ARMOURED CABLE
	600 - 4 "	923.0 "	
	300 - 4 "	1 738.9 "	
	400 - 4 JF	—	JELLY FILLED CABLE
	300 - 4 "	346.2 "	
	200 - 4 "	1 701.5 "	
	100 - 4 "	1 589.1 "	
	50 - 4 "	1 552.3 "	
	SUB TOTAL	7 866.0	
	(3) TROUGH CABLE		
	2400 - 4 ASPT	725.7m	
	1800 - 4 "	1 441.4 "	
	1200 - 4 "	625.8 "	

ITEM	BREAKDOWN	Q'ty	REMARK
3. CABLE	900 - 4 ASPT	2 337.5 m	
	600 - 4 "	940.1 "	
	300 - 4 "	953.4 "	
	900 - 5 "	606.9 "	
	600 - 5 "	208.6 "	
	300 - 5 "	802.5 "	
	100 - 65 "	257.7 "	
	SUB TOTAL	8 899.6 "	
	UNDERGROUND CABLE TOTAL	68 975.1 "	
	(4) AERIAL CABLE		
	600 - 4 AP	324.2 m	INCLUDE AP & AP(8) CABLE
	400 - 4 "	807.7 "	
	300 - 4 "	14 389.6 "	
	200 - 4 "	32 175.2 "	
	100 - 4 "	53 290.7 "	
	50 - 4 "	69 032.0 "	
	25 - 4 "	36 699.8 "	
	10 - 4 "	2 189.1 "	
	400 - 5 "	—	
	300 - 5 "	1 534.0 "	
	200 - 5 "	1 859.1 "	
	100 - 5 "	1 169.6 "	
	50 - 5 "	1 807.1 "	
	25 - 5 "	385.3 "	
	10 - 5 "	—	
	AERIAL CABLE TOTAL	215663.4 "	
4. POT HEAD	2400 P	1 ea	
	1800 P	26 "	
	1200 P	5 "	
	TOTAL	32 "	
5. CROSS CONNECTING CABINET	800 P	258 Box	
6 TERMINAL	(1) TERMINAL BOX		
	FOR AERIAL 25 P	233 ea	
	" 15 P	1 891 "	
	" 10 P	2 532 "	
	FOR BURIAL 20 P	5 "	
	" 15 P	3 "	
	" 10 P	13 "	
	TOTAL	4 677 "	
	(2) TERMINAL BLOCK		
	LEAD SHEATHED STUB 100 P	355 ea	
	" 50 P	143 "	
	POLYETHYLENE SHEATHED STUB 100P	676 "	
	" 50P	170 "	
	TOTAL	1 344 "	

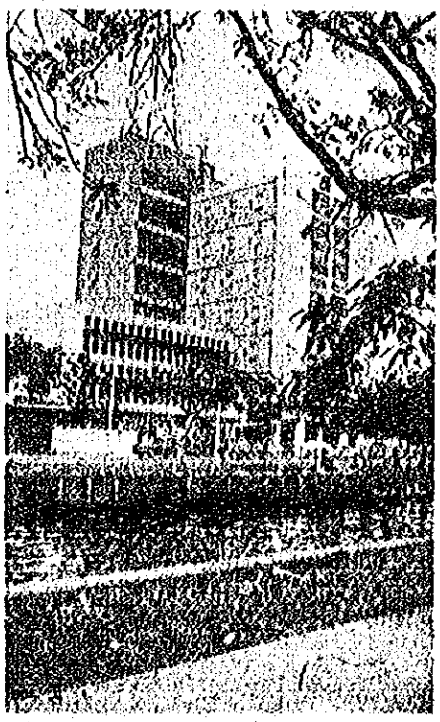
ITEM	BREAKDOWN	Q'ty	REMARK
7. GAS EQUIPMENT	AIR DRYER MODEL 1500	2 ea	
	METER PANEL	3 "	
	ALARE PANEL	3 "	
	PRESSURE GUARD	91 "	
	TESTING VALVE	100 "	
8. CONDUIT	24 - 4"	269.2m	
	16 - 4"	179.3 "	
	12 - 4"	115.0 "	
	8 - 4"	1 499.3 "	
	6 - 4"	41.1 "	
	4 - 4"	5 188.5 "	
	4 - 3"	2 885.2 "	
	3 - 3"	34.6 "	
	2 - 3"	1 562.2 "	
	TOTAL	11 774.4 "	
9. MANHOLE & PULLING BOX	TYPE - A	35 ea	
	" C	1 "	
	" V	4 "	
	" J	3 "	
	" T	1 "	
	" L	3 "	
	ENLARGE	1 "	
	REBUILD	1 "	
	TYPE - JUF - 6	142 "	
	" JUF - 11	30 "	
	TOTAL	221 "	

PART IV. DETAILED DESIGN OF EACH EXCHANGE

CHAPTER 1. KRUNGKASEM TELEPHONE EXCHANGE (KK)

1.1 Service Area

This exchange is a main exchange office with toll services and plays an important position in the Bangkok local telephone network. As shown in Fig. 4.1.1, a part of its service area will be cut-over to the four exchanges of Samsen (SS), Asok Din Daeng (ASD), Pathumwan (PW) and Samran Rat (SR).



Panoramic view of Krungkasem Exchange

(1) Cut-over to SS Exchange

The north side of Rajvithi Road.

(2) Cut-over to ASD Exchange

The northeastern part with the railroad as the boundary.

(3) Cut-over to PW Exchange

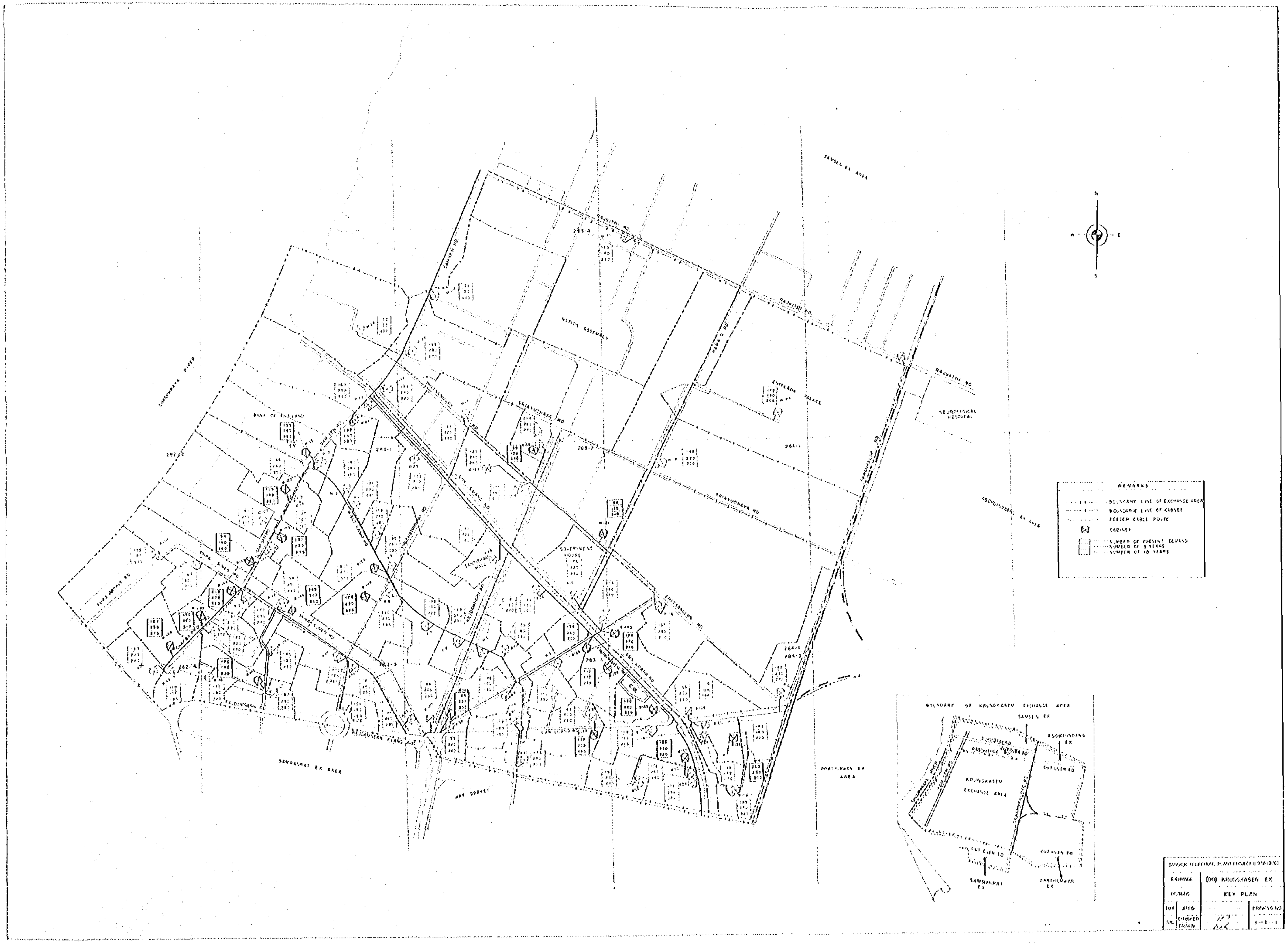
The southeastern part with the railroad as the boundary.

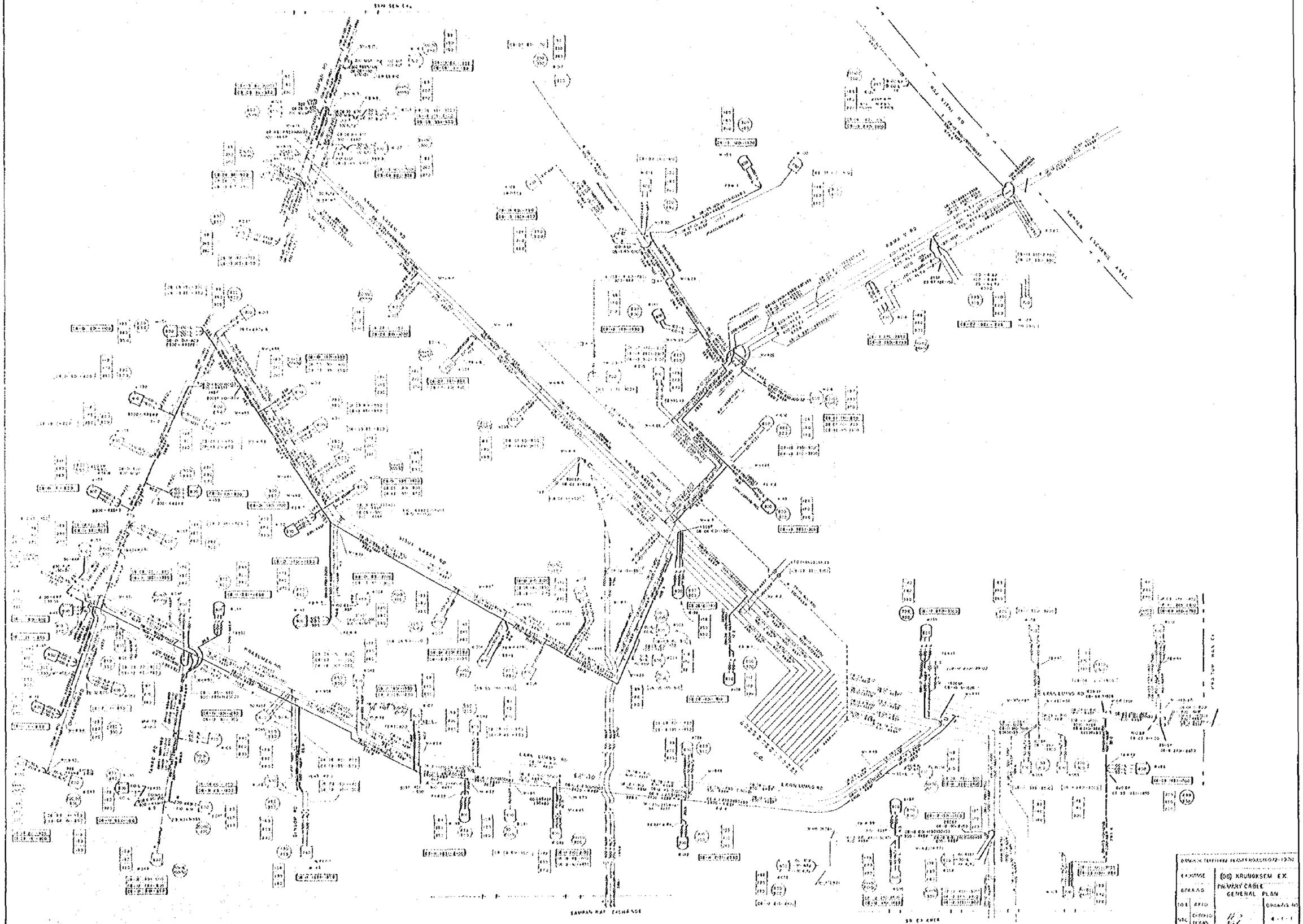
(4) Cut-over to SR Exchange

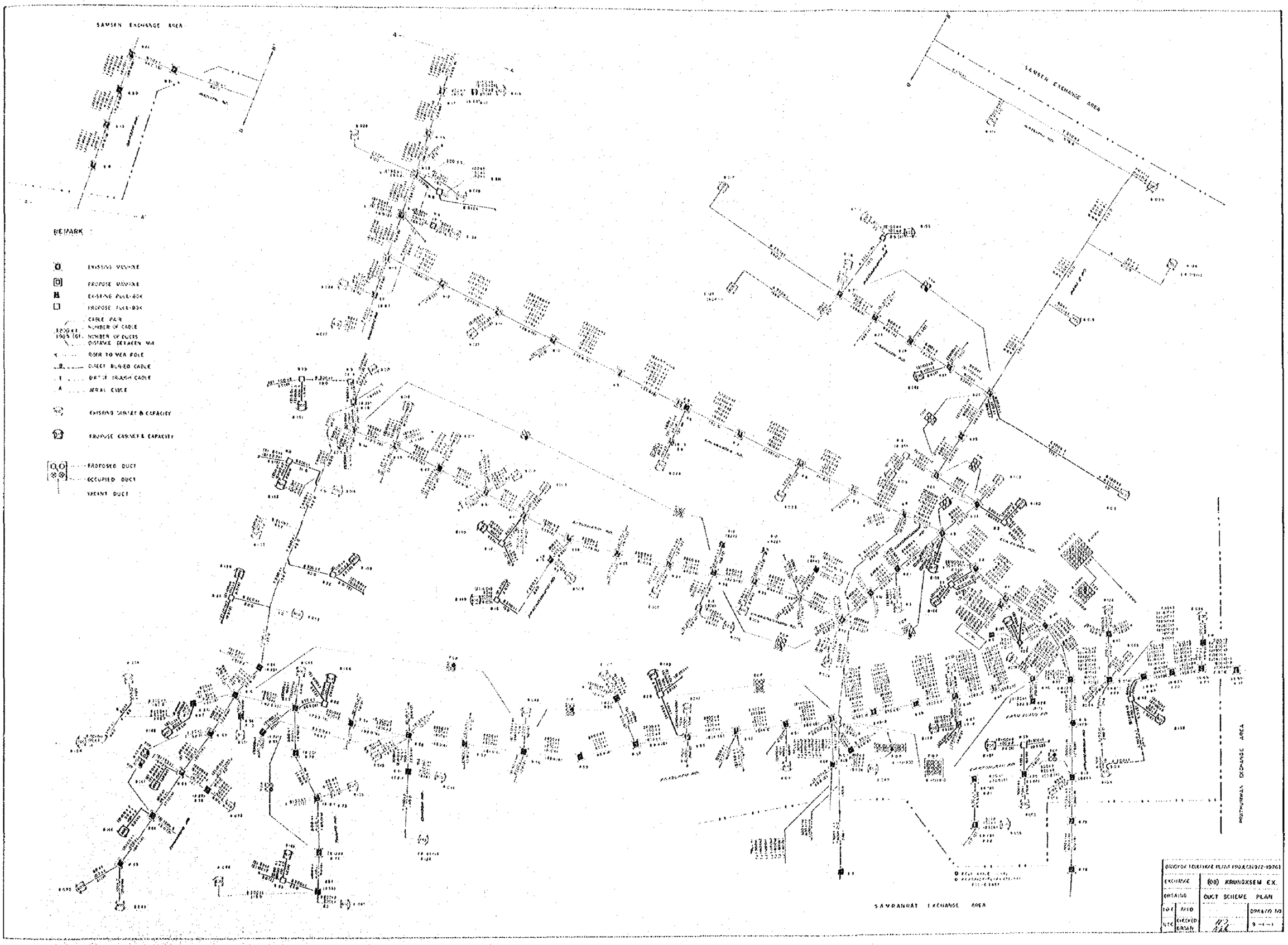
The southern part of Klong Maha Nak.

As the result of the foregoing cut-overs, the service area will become very small and will occupy approximately 650 ha.

PART IV DETAILED DESIGN OF EACH EXCHANGE

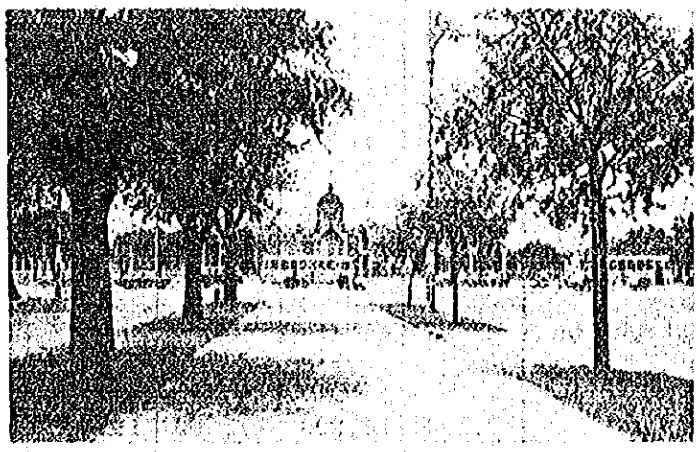

REMARKS
BOUNDARY LINE OF EXCHANGE AREA
BOUNDARIE LINE OF CABINET
FEEDER CABLE ROUTE
CABINET
NUMBER OF PRESENT DEMAND
NUMBER OF 5 YEARS
NUMBER OF 10 YEARS
BOUNDARY OF KRUNGKASEM EXCHANGE AREA
KRUNGKASEM EXCHANGE AREA
(00) KRUNGKASEM EX
KEY PLAN


KRUNGKSEM EX.
PRIMARY CABLE
GENERAL PLAN


SAMSEN EXCHANGE AREA
REMARK :
EXISTING MANHOLE
PROPOSE MANHOLE
EXISTING PULL-BOX
PROPOSE PULL-BOX
CABLE PAIR
NUMBER OF CABLE
NUMBER OF DUCTS
DISTANCE BETWEEN MH
RISER TO MDF POLE
DIRECT BURIED CABLE
DUCTLE TRUNK CABLE
AERIAL CABLE
EXISTING CABINET & CAPACITY
PROPOSE CABINET & CAPACITY
PROPOSED DUCT
OCCUPIED DUCT
VACANT DUCT
SAMSEN EXCHANGE AREA
SAMRANRAT EXCHANGE AREA
PRATHUMWAN EXCHANGE AREA
EXCHANGE (08) KRUNGKSEM EX.
DRAWING DUCT SCHEME PLAN

1.2 Demand Forecast and Outline of Area

The KK exchange area is located in the old downtown section of Bangkok and is occupied in the northern part by the Palace, Congress Building and other central organs of the Government such as the Army, Police, etc. The southern part is in the densely populated old section and there is a gradual trend toward middle rise residences but the tempo is slow.



View in direction of Congress Building

The special features of this area in respect to demand forecast are as follows:

(1) The northern part is occupied by government buildings and a green belt made up of the zoo, etc., and it is believed that there will be no rapid growth in telephone demand.

(2) There is hardly any development space for new residential district in the southern part but there is a trend toward rebuilding the old wooden residences to middle-rise houses.

(3) The area in general is a fixed downtown section and the increase in residents will be about the level of natural increase with no large social increase.

In view of the foregoing points, the forecast values shown in the table below were derived at and the final approval of the TOT was acquired. The growth ratio for telephones, however, is the lowest among the five exchanges to be designed, and will be nearly the level of natural population growth.

Table 4.1.1 Demand Forecast

Year / Area	1976	1978	1980	1982	1985	1987
Commercial Area	5,300	5,900	6,550	7,030	7,650	8,120
Residential Area	2,800	3,100	3,450	3,750	4,050	4,350
Special Area (Including Pre-Construction Area)	4,200	5,900	7,500	8,220	9,500	10,530
Total	12,300	14,900	17,500	19,000	21,200	23,000
Demand Growth Ratio	100.0	121.1	142.2	154.5	172.4	187.0

DEMAND FORECAST OF KK EX.SERVICE AREA

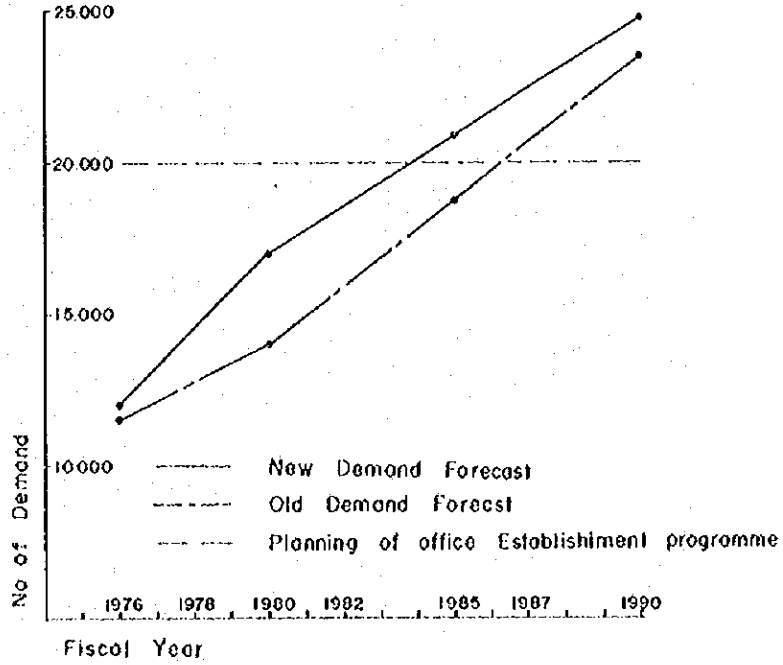


Fig. 4.1.4

1.3 Primary Cable Network Design

1.3.1 Objective Demand for Design

19,000 (in 1982) of Primary cable
23,000 (in 1987) of Secondary cable

1.3.2 Entrance Cable Pairs

Since the vacant cables will be utilized in line with the change in boundaries of service area, the design does not call for the new installation of entrance cables.

Existing	3,600 pairs	-	32 ASP	1	cable(s)
"	3,200 pairs	-	32 ASP	1	"
"	3,000 pairs	-	4 ASP	1	"
"	2,100 pairs	-	4 ASP	1	"
"	1,800 pairs	-	4 ASP	6	"
"	1,500 pairs	-	4 ASP	1	"
"	900 pairs	-	4 ASP	1	"
"	600 pairs	-	4 ASP	1	"
Total				13	" 25,700 pairs

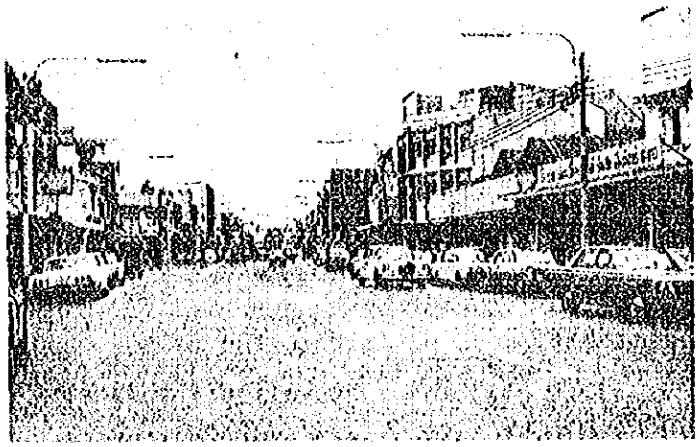
The number of cable pairs for distribution under this design work is 20,800 pairs.

1.3.3 Installation of New Cables for Each Direction

(1) The design is for the new installation of one cable of 900 pairs in the direction of the Royal Palace, and the designed number of cable pairs is to meet the demand in 1982. As entrance cables, the 13 cable (3,200 pairs) which will become vacant after cut-over to the SS Exchange will be used.

(2) Since the 13 and 06 cables which will become vacant, after cut-over to the SS Exchange will be used, the new installation of cable is not required in the SS Exchange direction.

(3) The installation of one new cable of 2,400 pairs is designed in the direction of the Visutkasat Road, and the designed number of cable pairs is to meet the demand in 1982. The design calls for the use of 01 cable : 2,100 pairs, which will become vacant after cut-over to the SR Exchange, as entrance cable. Furthermore, since the entrance cables of 2,100 pairs which are to correspond to the new cables of 2,400 pairs to be installed will have a shortage of 300 pairs, 02 cable : 600 pairs will be appropriated for this purpose and will be held in reserve at MH #3.



View of Visutkasat Road

There are four ducts from the MH #36 to the cable end and in order to have spare conduits for the future, the number of cable pairs was designed to meet the demand in 1987.

(4) The design calls for the installation of one new cable of 2,400 pairs in the direction of the Prasumaen Road, and the designed number of cable pairs is to meet the demand in 1982. The entrance cables to be used will be the 11 cable : 3,600 pairs which will become vacant after cut-over to the PW Exchange and ASD Exchange.

For the existing 16 ducts between MH #46 and MH #56, the design is for the use of 16 ducts -- 4 ducts for local cables, one duct for toll cable and 11 ducts for junction cables -- and there will be no spare duct. However, in accordance with the policy of the TOT, the design is not for the construction of new spare ducts. Since there are only four ducts from MH #56 to the cable ends, the design is for maintaining spare ducts for the future and the number of cable pairs is to meet the demand in 1987.

(5) In respect to the installation from MH #45 east in the direction of the Larn Luang Road, the 03 and 11 cables which will become vacant after cut-over to the PW Exchange and ASD Exchange will be used and no new cables will be installed.

1.3.4 Selection of Trough, Direct Buried and Aerial Cable Routes

(1) Samsen Road

The new cables to be laid to the cross-connecting cabinets #151, #152, #153 and #154 will use the existing trough route and will be Stalpeth armoured cables.

(2) Pracha Ti Pratai Road

The design of new cable for the #149 cross-connecting cabinet will use the existing trough route and will be Stalpeth armoured cable.

(3) Tanao Road

The #145 cross-connecting cabinet is at a short branched route and since it is at the end of the area, it will be a direct buried route using Stalpeth armoured cable.

(4) Rajdamnoen Nok Avenue

Since the route to #155 cross-connecting cabinet is at a short branched route, it will be a direct buried route using Stalpeth armoured cable.

(5) Phisanuloke Road

Since the new cable to the #18 cross-connecting cabinet will be 100 pairs, the existing aerial route will be utilized by the additional placement of AP cable.

(6) Pra Su Maen Road

Since the new cable to the #54 cross-connecting cabinet will be 100 pairs, the existing aerial route will be used by the additional placement of AP cable.

(7) Branch Route from Lara Luang Road

Since the #109 cross-connecting cabinet is at the end of the area and due to difficulty in the construction of new underground conduit because of the heavy volume of traffic, the design is for using an aerial route through placement of AP cable.

1.3.5 Line Loss and D.C. Resistance

The exchange lines have all been designed to be within the allowable values as follows:

Maximum line loss - 5.6 dB
Maximum D.C. resistance - 878 Ω

1.3.6 Plan for Non-Removal of Cables

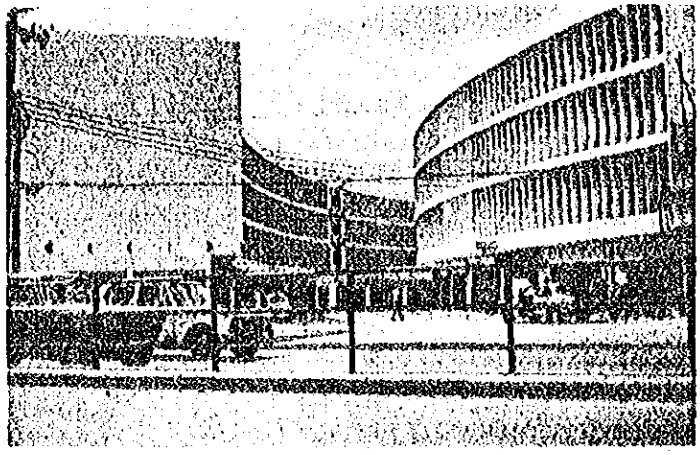
No cables are destined for removal in this design work, and the cables to be reserved to meet future demand are as follows:

(1) 04 : 1,800 Pair Cable

To be held in reserve in the MH #69 for the Saphan Kuao Housing project.

Saphan Kuao Housing Project

1976 demand - 0
1982 " - 1,270
1987 " - 1,480



New Saphan Kuao Residential District

(2) 10 : 1,500 Pair Cable

To be held in reserve at the MH #45 to meet the future demand growth in the direction of the Larn Luang Road.

(3) 02 : 600 Pair Cable

To be held in reserve at the MH #4 to cope with the future demand in the direction of the Visutkasat Road.

1.3.7 Cables to be Removed

Table 4.1.2

Section	No. of Pairs	Span Length	Reason for Removal
MH#13 - MH#15	900 - 4 ASP	226.0 m.	Since 1 cable of 06:1,500 pairs will meet the ultimate demand, these will be removed to create spare duct.
MH#15 - MH#17	600 - 4 ASP	292.6	
MH#17 - MH#18	1,500 - 4 ASP	144.5	At boundary of SS Exch. and not required even in the future.
MH#17 - MH#20	400 - 4 ASP	424.8	
MH#20 - MH#22	150 - 4 ASP	188.4	

(Cont'd)

Section	No. of Pairs	Span Length	Reason for Removal
PW MH#60 - MH#47	1,800 - 4 ASP	387.1 m.	At boundary of PW Exch. and not required even in the future.
PW MH#71 - MH#47	1,800 - 4 ASP	71.8	
PW MH#71 - MH#47	2,700 - 4 ASP	71.8	
MH#45 - MH#76	1,500 - 4 ASP	579.4	At boundary of SS Exch. and not required even in the future.
MH#19 - MH#76	600 - 4 ASP	223.0	
MH#3 - Trough	2,100 - 4 ASP	44.0	Cables in trough section after cut-over to SR Exch. and not required even in the future.
Trough section	1,500 - 4 ASP	644.0	
"	600 - 4 ASP	379.0	
"	300 - 4 ASP	265.0	
"	"	265.0	
"	1,200 - 4 ASP	165.9	
"	600 - 4 ASP	165.9	
"	300 - 4 LTJ	165.9	
"	900 - 4 ASP	288.1	
"	900 - 4 ASP	288.1	
"	300 - 4 LTJ	288.1	
Total	5,568.4 meters		

1.4 Underground Conduit Design

In respect to the new cables to be laid in the various directions after cut-over of the various service areas, since these can all be possible by utilizing the existing underground conduits, the design is for non-construction of main conduits routes.

1.5 Gas Pressurization System Design

1.5.1 Design of Inside Facilities

Since no additional entrance cables will be installed in this design, there will be no need for increase in supervisory facilities.

However, in line with the change in pressure guard pair numbers, the jumper wires will have to be re-connected at the MDF.

1.5.2 Design of Outside Facilities

(1) The design was made in principle for attachment of the pressure guards inside the cross-connecting cabinets. However, in regard to the cables which will become vacant after the cut-over and will be reserved for the future, the design will be made for attachment of pressure guards for underground use to these cables in the following manholes.

02 : 600 pairs - MH #4
04 : 1,800 pairs - MH #69
10 : 1,500 pairs - MH #45

(2) The attachment of valves will be in accordance with the standards.

(3) Even if the pair numbers of the existing pressure guards are not the last pair number of the cables, no change in pair numbers will be made.

1.6 Secondary Cable Network Design

1.6.1 Service Area where Direct Distribution will be changed to System of Cabinet Distribution.

Cross-connecting cabinets #135, #138 and #139.

1.6.2 Cross-Connecting Cabinets with Secondary Cables Held in Reserve.

(1) Cross-connecting Cabinet #136

200 pairs held in reserve for distribution to the Saphan Kuao Housing Project being scheduled.

(2) Cross-connecting cabinet #143

200 pairs held in reserve for distribution to the Metropolitan Police building presently being demolished for re-building.

(3) Cross-connecting cabinet #48

200 pairs held in reserve for distribution to the Lottery Building currently being demolished for re-building.

(4) Cross-connecting cabinet #23

100 pairs held in reserve for distribution to the new building for ECAFE, now under construction.

(5) Cross-connecting cabinet #155

140 pairs held in reserve for distribution to the Radio Station to meet the increased demand.

1.7 Design of Relevant Works

(1) The area of cross-connecting cabinet #122 was designed in accordance with the drawings presented by TOT and on the presumption that it will be installed by TOT.

(2) Temporary cables - Relation with 14 : 900 pair cable

The area of cross-connecting cabinets #15/1 and #16/1 to which the temporary cable 14 : 900 pairs projected by the TOT will be distributed is to be transferred to 13 cable in this design.

1.8 Construction Period

In line with the change in exchange areas, since the vacant cables will be used after cut-over to the SS, ASD, PW, and SR exchanges, the construction work for additional installation of primary cables under this design will be commenced after the cut-over to the foregoing exchanges.

1.9 Amount of Works and List of Materials

Refer to the annexed Table 4.1.3 Amount of Works and Tables 4.1.4 to 4.1.13 List of Materials.

TABLE 4.1.3 KK EX. AMOUNT OF WORKS

ITEM	BREAKDOWN	Q'ty	REMARK
1 POLE	8 MC	7 ea	
	10 〃	— 〃	
	TOTAL	7 〃	
2 GUY	(1) UPPER GUY 6 M	76 ea.	
	〃 10 M	60 〃	
	〃 16 M	— 〃	
	TOTAL	136 〃	
	(2) ANCHOR ROD # 2	59 ea	
	5/8" x 7'	— 〃	
	3/4" x 7'	59 〃	
	1" x 7	— 〃	
	TOTAL	118 〃	
3 CABLE	(1) UNDERGROUND CONDUIT CABLE		
	3600 – 32 ASP	— m	STALPETH CABLE
	3000 – 4 〃	— 〃	
	2400 – 4 〃	3281.4 〃	
	1800 – 4 〃	802.2 〃	
	1200 – 4 〃	— 〃	
	900 – 4 〃	778.3 〃	
	600 – 4 〃	335.4 〃	
	300 – 4 〃	1060.2 〃	
	1800 – 5 〃	— 〃	
	1200 – 5 〃	— 〃	
	900 – 5 〃	— 〃	
	600 – 5 〃	— 〃	
	300 – 5 〃	— 〃	
	100 – 65 〃	384.2 〃	
	SUB TOTAL	6641.7 〃	
	(2) DIRECT BURIED CABLE		
	900 – 4 ASPT	— m	STALPETH SHEATHED AND STEEL TAPE ARMOURED CABLE
	600 – 4 〃	— 〃	
	300 – 4 〃	339.7 〃	
	400 – 4 JF	— 〃	JELLY FILLED CABLE
	300 – 4 〃	— 〃	
	200 – 4 〃	239.4 〃	
	100 – 4 〃	322.4 〃	
	50 – 4 〃	507.7 〃	
	SUB TOTAL	1409.2	
	(3) TROUGH CABLE		
	2400 – 4 ASPT	— m	
	1800 – 4 〃	— 〃	
	1200 – 4 〃	— 〃	

ITEM	BREAKDOWN	Q'ty	REMARK
3 CABLE	900 – 4 ASPT	148.0m	
	600 – 4 〃	186.0 〃	
	300 – 4 〃	〃	
	900 – 5 〃	— 〃	
	600 – 5 〃	— 〃	
	300 – 5 〃	802.5 〃	
	SUB TOTAL	1136.5 〃	
	UNDERGROUND CABLE TOTAL	9187.4 〃	
	(4) AERIAL CABLE		
	600 – 4 AP	— m	INCLUDE AP & AP(8) CABLE
	400 – 4 〃	— 〃	
	300 – 4 〃	572.0 〃	
	200 – 4 〃	2960.1 〃	
	100 – 4 〃	6516.1 〃	
	50 – 4 〃	12464.4 〃	
	25 – 4 〃	5157.7 〃	
	10 – 4 〃	794.4 〃	
	400 – 5 〃	— 〃	
	300 – 5 〃	— 〃	
	200 – 5 〃	— 〃	
	100 – 5 〃	— 〃	
	50 – 5 〃	— 〃	
	25 – 5 〃	— 〃	
	10 – 5 〃	— 〃	
	AERIAL CABLE TOTAL	28464.7 〃	
4 POT HEAD	2400 P	— ea.	
	1800 P	— 〃	
	1200 P	— 〃	
	TOTAL	0 〃	
5 CROSS CONNECTING CABINET	800 P	228ox	
6 TERMINAL	(1) TERMINAL BOX		
	FOR AERIAL 25P	27 ea	
	〃 15P	103 〃	
	〃 10P	409 〃	
	FOR BURIAL 20P	— 〃	
	〃 15P	— 〃	
	〃 10P	— 〃	
	TOTAL	539 〃	
	(2) TERMINAL BLOCK		
	LEAD SHEATHED STUB 100P	25 ea	
	〃 50P	52 〃	
	POLYETHYLENE SHEATHED STUB 100P	35 〃	
	〃 50P	75 〃	
	TOTAL	187 〃	

ITEM	BREAKDOWN	Q'ty	REMARK
7. GAS EQUIPMENT	AIR DRYER MODEL 1500	ea.	
	METER PANEL	— 〃	
	ALARE PANEL	— 〃	
	PRESSURE GUARD	13 〃	
	TESTING VALVE	13 〃	
8. CONDUIT	24 – 4"	— m	
	16 – 4"	— 〃	
	12 – 4"	— 〃	
	8 – 4"	— 〃	
	6 – 4"	— 〃	
	4 – 4"	— 〃	
	4 – 3"	238.3 〃	
	3 – 3"	— 〃	
	2 – 3"	125.5 〃	
	TOTAL	363.8 〃	
9. MANHOLE & PULLING BOX	TYPE – A	— ea.	
	〃 C	— 〃	
	〃 V	— 〃	
	〃 J	— 〃	
	〃 T	— 〃	
	〃 L	— 〃	
	ENLARGE	— 〃	
	REBUILD	— 〃	
	TYPE – JUF – 6	14 〃	
	〃 JUF – 11	1 〃	
	TOTAL	15 〃	

KK EX.

LIST OF MATERIALS

CABLE	DESCRIPTION	T.O.T. CODE NO.	AE CODE NO.	UNIT	QUANTITY	REMARK
STALPETH	CABLE 3600 - 32 ASP			M		
〃	〃 300 - 4 〃			〃	1 217	
〃	〃 600 - 4 〃			〃	356	
〃	〃 900 - 4 〃			〃	825	
〃	〃 1200 - 4 〃			〃		
〃	〃 1800 - 4 〃			〃	835	
〃	〃 2400 - 4 〃			〃	3 416	
〃	〃 3000 - 4 〃			〃		
〃	〃 300 - 5 〃			〃		
〃	〃 600 - 5 〃			〃		
〃	〃 900 - 5 〃			〃		
〃	〃 1200 - 5 〃			〃		
〃	〃 1800 - 5 〃			〃		
〃	〃 100 - 65 〃			〃	457	
STALPETH	STEEL TAPE ARMOURED CABLE					
	300 - 4 ASPT			〃	1 224	
	600 - 4 〃			〃	192	
	900 - 4 〃			〃	161	
	1 200 - 4 〃			〃		
	1 800 - 4 〃			〃		
	2400 - 4 〃			〃		
	900 - 5 〃			〃		
	600 - 5 〃			〃		
	300 - 5 〃			〃		
ALEPETH	CABLE 10 - 4 AP			〃	500	
〃	〃 25 - 4 〃			〃	1 500	
〃	〃 50 - 4 〃			〃	5 000	
〃	〃 100 - 4 〃			〃	4 000	
〃	〃 200 - 4 〃			〃	3 500	
〃	〃 300 - 4 〃			〃	1 000	
〃	〃 400 - 4 〃			〃		
〃	〃 600 - 4 〃			〃		
〃	〃 10 - 5 〃			〃		
〃	〃 25 - 5 〃			〃		
〃	〃 50 - 5 〃			〃		
〃	〃 100 - 5 〃			〃		
〃	〃 200 - 5 〃			〃		
〃	〃 300 - 5 〃			〃		
〃	〃 400 - 5 〃			〃		

DESCRIPTION	T.O.T. CODE NO.	AE CODE NO	UNIT	QUANTITY	REMARK
ALEPETH CABLE 600 - 5 AP			M		
〃 〃 10 - 4 AP (8)			〃	1 000	
〃 〃 25 - 4 〃			〃	4 500	
〃 〃 50 - 4 〃			〃	8 500	
〃 〃 100 - 4 〃			〃	3 500	
〃 〃 10 - 5 〃			〃		
〃 〃 25 - 5 〃			〃		
〃 〃 50 - 5 〃			〃		
〃 〃 100 - 5 〃			〃		
TERMINATING CABLE 300 - 5 P			〃		
JELLY FILLED CABLE 50 - 4			〃	1 000	
〃 〃 〃 100 - 4			〃	500	
〃 〃 〃 200 - 4			〃	500	
〃 〃 〃 300 - 4			〃		

KK EX.

LIST OF MATERIALS

DESCRIPTION	T.O.T CODE NO.	A.E CODE NO.	UNIT PCS	QUANTITY	REMARK
CLAMP EXTENSION - ARM.					
FIGURE 8 CABLE CLAMPS - TYPE PA 296	ECH - 2002		PCE	600	
CABLE LASHING CLAMP TYPE "D"	ECH - 2100		PCE	1400	
" " " "E"	" - 2101				
CABLE SUSPENSION CLAMPS (ONE BOLT CLAMP)	ECH - 2151		PCE	700	
" " " 11/16" THREE BOLTS TYPE	" - 2155		"	300	
CURVED CABLE SUSPENSION CLAMPS 11/16" THREE BOLTS TYPE	ECH - 2171		"	100	
GULVANIZE STEEL KLING GROUND CLAMP	ECH - 2195		"	200	
STRAND GROUND CLAMPS	ECH - 2200		"	400	
GROUND CLAMP (FIG 8)			"	500	
U-CLAMPS 3/8"			"		
BRANCH STRAND CLAMP (6M)			"	100	
ONE-SIDE CLAMP (FIG 8)			"	100	
CABLE EXTENSION METAL ARM TYPE M1	ECH - 2052		"	800	
" " " " " M2	"		"	200	
" " " " " M3	"				
HOSE CLAMP		(JAPAN) 3622			
ADJUSTABLE HOSE CLAMP 1/2" - 29/32"	ECS - 0245				
" " " 13/16" - 1 3/4"	" - 0246				
" " " 1 13/16" - 2 3/4"	" - 0247				
" " " 2 9/16" - 3 1/2"	" - 0248				
" " " 3 1/4" - 4"	" - 0249				
" " " 15/16" - 4"	" - 0250				
GULVANIZED STEEL CABLE SUSPENSION HOOK	S - 524015				
BOLT					
ANGLED THIMBLEYE BOLT 5/8" x 8"	ECH - 1001		PCE	100	
" " " " x 10"	" - 1002		"	100	
" " " " x 12"	" - 1003		"	100	
" " " " x 14"	" - 1004		"		
" " " " x 16"	" - 1005		"		
" " " 1/2" x 8"					
" " " " x 10"		S - 27798			
" " " " x 12"					

DESCRIPTION	T.O.T CODE NO.	A.E CODE NO.	UNIT PCS	QUANTITY	REMARK
DOUBLE ARMING BOLT 5/8" x 8"	ECH - 1102				
" " " " x 10"	" - 1103				
" " " " x 12"	" - 1104				
" " " " x 14"	" - 1105				
" " " " x 16"	" - 1106				
MACHINE BOLT 1/2" x 4"	ECH - 1209	S - 511308			
" " " x 6"	" - 1212				
" " " x 8"	" - 1213				
" " " x 12"	" - 1214				
" " " x 14"	" - 1215				
" " " x 16"	" - 1216				
" " 5/8" x 8"	ECH - 1218	S - 511416	PCE	100	
" " " x 10"	" - 1220	S - 511420	"	500	
" " " x 12"	" - 1221	S - 511422	"	100	
" " " x 14"	" - 1222	S - 511424			
" " " x 16"	" - 1223	S - 511426			
" " " x 18"	" - 1224				
" " 3/4" x 8"		S - 2908			
" " " x 10"		S - 511510			
" " " x 12"		S - 511512			
" " " x 14"		S - 511514			
STRAIGHT THIMBLEYE BOLT 5/8" x 6"	ECH - 1323				
" " " " x 8"	" - 1324		PCE	100	
" " " " x 10"	" - 1325		"	400	
" " " " x 12"	" - 1326		"	100	
" " " " x 14"	" - 1327				
" " " " x 16"	" - 1328				
EXTENSION SHIELD WITH BOLT					
BRIDLE RINGS 1 5/8" WOOD SCREW THREAD	ECF - 1002			2100	
GRIP NUT					
PREFORMED GUY GRIP FOR FALSE DEAD-END					
FIG (8)	ECH - 3001		PCE	200	
6M			"	200	
10M					
PREFORMED GUY GRIP DEAD-END FIG (8)	ECF - 3131		"	800	
" " " 6M				800	
" " " 10M				400	
" " " 16M	ECF - 3132		"		
PREFORMED STRAND SPLICE 6M				10	
10M	ECF - 3133		"		

KK EX.

LIST OF MATERIALS

DESCRIPTION	T.O.T. CODE NO.	AE CODE NO	UNIT PCS	QUANITITY	REMARK
GRIP NUT					
FORGED EYE NUTS 5/8"	ECH-3501		PCE	400	
" " " "	" -3503				
MACHINE BOLTS W/2 NUTS					
GALVANIZED NUTS 5/8" BOLT SIZE	ECH-5072		PCE	600	
EXPANSION SHIELD. STRAP. CLAMP					
THIMBLEYE ROD LIFT PLATE PROTECTOR. SUPPORT					
DOUBLE EXPANSION SHIELDS 3/8" x 2"	ECH-4010 4012				
TWO-HOLE CONDUIT AND CABLE STRAPS			PCE	100	
ONE-HOLE STEEL CABLE CLAMPS			"		
FORGED ANGLE THIMBLEYE 5/8"	ECH-4020		"	100	
GALVANIZED STEEL GROUND ROD 1/2" x 5 FEET	ECH-4222		PCE	200	
CURVED LIFT PLATE 5/8" (2 1/2" x 7" x 3/16")	ECI-5510		"	10	
GALVANIZED GUY WIRE PROTECTORS 7 FEET	ECH-5550		"	200	
B-LASHED CABLE SUPPORTS 3/4 x 10"	ECH-6902		"	400	
" " " 1 3/16 x 16"	" -6903		"	1600	
" " " 2 x 22"	" -6904		"	2100	
" " " 2 5/8 x 28"	" -6905		"		
" " " 3 1/8 x 34"	" -6906			200	
LAG-SCREW STAPLE. STRAP					
LAG SCREWS 5/16" x 2 1/2"	ECH-7027				
" " 3/8" x 3 1/2"	" -7043				
" " 3/8" x 4" GIMLET POINT FOR CURVE LIFT PLATE	ECH-7044		PCE	10	
" " 1/2" x 4" GIMLET POINT FOR SIDEWALK GUY FITTING	ECH-7048				
SERVISLEEVS 5/16" (6M)	ECH-7101			5000	
GALVANIZED STEEL STAPLE	ECH-7140				

DESCRIPTION	T.O.T. CODE NO.	AE CODE NO.	UNIT PCS	QUANITITY	REMARK
STRANDVISE 5/16"-4M-TYPE 5151	ECH-7251				
" " -6M " 5101	" -7252				
" " -6M " 5151	" -7256				
WASHER WIRE LINK					
CURVED WASHER 5/8 (2 1/2" x 2 1/2" x 3/16")	ECH-9001		PCE	200	
SQUARE " (2 1/4" x 2 1/4" x 3/16")	" -9043		"	1600	
LONG SQUARE WASHER 5/8			"	300	
CURVED WASHER 5/8" (2 1/2" x 2 1/2" x 3/16" x 1/16" HOLE DIAM	ECH-9001		"	100	
" " 3/4 (3" x 3" x 1/4" x 13/16" " ")	" -9004		"		
ROUND WASHER 1/2" (2" x 2" x 1/8"-9/16" HOLE DIAM)	ECH-9041				
" " 1/2" (2" x 2" x 1/4-9/16" " ")	" -9042				
" " 5/8" (2 1/4 x 2 1/4" x 3/16" x 11/16" " ")	" -9043				
WIRE LINK-TYPE 5059	ECH-9100				
STRAND LINK FOR FIG(8) CABLE			PCE	100	
STEEL FLAT CROSS ARM BRACES 1 1/2 x 24" x 3/16"					
" " " " " 1 1/2 x 30 x 3/16"					
CABLE EXTENSION ARM (3" x 3" x 3'-3")					
ANCOHOR RODS 3/4" X (REQUIRED LENGTH)			PCE	100	
WOOD LOG FOR ANCHOR ROD				100	
ONE BOLT GUY ATTACHMENTS		S-518205			
SIDE-WALK GUY FITTINGS FOR WOODEN POLE		SR-329	PCE		
" " " POR CONCRETE POLE			"	100	
			"		
GALVANIZED STEEL PIPE ø 2 1/2" (2M)			"	100	
" " " (4M)			"		
S-LON PIPE ø1/2" x 2.5 METER			"	200	
S-LON 90°					
U-GUARDS			PCE	100	
GUY STRAIN INSULATOR TYPE 506	ECI-0073		PCE	200	

KK EX.

LIST OF MATERIALS

DESCRIPTION	T.O.T CODE NO.	JAPAN CODE NO.	UNIT	QUANTITY	REMARK
STEARINE, C-CEMENT, COMPOUND					
STEARINE (250G)		3307	PCE	230	
STEARINE CANDLE	ECS-0100				
C-CEMENT 100G/PCE	"-0230		PCE	190	
" " 402	"-0231				
SCOTCH KOTE	ECS-0380				
WATER PROOF COMPOUND	ECS-0470	3704	KG		
MOISTURE PROOF COMPOUND		3705			
NO 1 ADHENSION AGENT		3706			
NO 2 SPECIAL COMPOUND (WITH HARDNER)		3703	KG	40	
NO 3 " "		3708			
NO 4 " " (RESIN)		3701	KG		
NO 4 " " (HARDNER)		3702			
NO 5 " "		3707	PCE	23	
DESICCANT, DESICCAN-CLOTH, FLOSS-SILK					
PROTEK SORB DESICCANT 160 G	ECS-1020				
" " " 50 G	"-1021				
DESICCANT (DRY AGENT) 50G/BAG	ECS-1091	3031	PEC	1200	
DESICCANT CLOTH 20 x 36 x 25 CM		3034	"	20	
" " 24 x 36 x 29 "		"	"	20	
" " 27 x 36 x 32 "		"	"	10	
" " 27 x 45 x 32 "		"	"	20	
" " 31 x 36 x 36 "		"	"	10	
" " 31 x 45 x 36 "		"	"	10	
" " 34 x 45 x 39 "		"	"	10	
" " 37 x 45 x 42 "		"	"	10	
" " 40 x 45 x 45 "		"	"	10	
" " 44 x 45 x 49 "		"	"	20	
" " 48 x 45 x 53 "		"	"	10	
" " 51 x 45 x 55 "		"	"	10	
" " 53 x 45 x 58 "		"	"	10	
" " 55 x 45 x 60 "		"	"	10	
" " 57 x 45 x 62 "		"	"	10	
" " 59 x 45 x 64 "		"	"	10	
" " 62 x 45 x 67 "		"	"	10	
68 x 45 x 73 "		"	"	18	
80 x 45 x 85 "		"	"	18	
PLASTIC TUBE FITTING-PIPE COUPLING	ECS-1500				
" " " MALE COUPLING	"-1501				
" " " FERRULE	" -1502				

DESCRIPTION	T.O.T CODE NO.	JAPAN CODE NO.	UNIT	QUANTITY	REMARK
FLOSS SILK 10 PCS/BAG	ECS-1700		BAG	10	
TAPE, BONDING-RIBON					
SEALING TAPE NO.1 30-280MM-6 PCS/BAG	ECT-1158	3601	BAG	80	
" " NO.2 40-280 -6 "	" -1159	3602	"	80	
" " NO.3 30-280 -3 "	" -1160	3603	"	400	
" " NO.4 40-280 -3 "	" -1161	3604	"	250	
ADHESIVE ALUMINUM TAPE NO.1 30MM x 20M/ROLL	EC2-1000		ROLL	100	
" PAPER TAPE 50M/ "			"		
" GLASS FIBER TAPE 52M/ "	EC2-1203		"	10	
" P.V.C TAPE NO.1 10M/ "		3611	"	500	
" " " NO.2 20M/ "	" -1001	3612	"	900	
" " " (GENERAL) 20M/ "		3620	"		
BONDING COPPER TAPE 10M/ROLL	EC2-1060	3613	"	50	
" " " (SELF) NO.2 5M/ "		3619	"	"	
COTTON TAPE 38MM x 30M/ "	EC2-1090		"	20	
" " 50MM x 30M/ "	" -1091		"	20	
CR TAPE 28" x 20'	ECS-7024				
DR TAPE 3/4" x 15'	EC2-1120		"		
" " 2" x 15'	" -1121		"		
ELECTRICAL TAPE 3/4" x 66'	" -1132		"		
ELICTION TAPE 3/4" x 60'	" -1185		"		
" " 2" x 60'	" -1186		"		
GLASS TAPE 1" x 108'	" -1201		"		
GLASS FIBER TAPE 38MM x 30M/ROLL	" -1202		"	60	
POLYETHYLENE TAPE 30MM x 20M/ "	" -1275	3605	"		
" " 60MM x 20M/ "	" -1276	3606	"	50	
" " (BLACK) 20M/ "	" -1277	3405	"		
VALCANIZED RUBBER TAPE 10M/ "	" -1300	3406	"		
PVC TAPE FOR TERMINATING JOINT 20M/ "	" -1345	3618	"		
SOFT BONDING TAPE 5M/ "		3419	"	10	
LACING TWINE 6 PLIES	EC2-1501				
MUSLIN TAPE 2" x 10 YDS					
" " 4" x 10 YDS					
ALUMINIUM FOIL TAPE 2" x 20'	ECS-7000				
" " " 4" x 20'	" -7001				
V N TAPE 10M/ROLL		3610	ROLL	600	
SPACER TAPE					
BONDING RIBBON 0.375" x 60'	ECS-4600		ROLL	4	

LIST OF MATERIALS

DESCRIPTION	T.O.T. CODE NO.	JAPAN CODE NO.	UNIT	QUANTITY	REMARK
SOLDER					
NO 1 SOLDER 250G / ROLL		3301	ROLL	1500	
NO. 2 " 1KG / ROLL	ECS-5700	3302			
NO. 3 "		3303			
NO. 4 (CREAM) SOLDER 100G /TIN	ECS-5722	3304	TIN	400	
NO. 4 (") " 200G /TIN		3305			
BAR SOLDER 1 1/2 LBS	ECS-5612				
KESTER SOLDER 1/16" x 0.062 (1LBS)	ECS-5672				
" " 1/8 x 0.125 (5LBS)	" -5686				
TERMINATING MATERIALS					
NO. 50 P.V.C. LID FOR TERMINATING JOINT	ECS-3050				
NO 75 " " "	" -3051				
NO 100 " " "	" -3052				
NO 125 " " "	" -3053				
NO 150 " " "	" -3054		PCE		
NO 200 " " "	" -3055		"		
NO 50 " SLEEVE "	ECS-5270				
NO. 75 " " "	" -5271				
NO 100 " " "	" -5272				
NO 125 " " "	" -5273				
NO 150 " " "	" -5274		PCE		
NO 200 " " "	" -5275		"		
NO. 50 " TUBE "	ECS-7230				
NO. 75 " " "	" -7231				
NO 100 " " "	" -7232				
NO 125 " " "	" -7233				
NO 150 " " "	" -7234		PCE		
NO 200 " " "	" -7235		"		
NO. 50 TERMINATING SLEEVE RECEPTACLE BAND		4601			
NO. 75 " " " "		4602			
NO 100 " " " "	ECS-5300	4603			
NO 125 " " " "	" -5301	4604			
NO 150 " " " "	" -5302	4605	PCE		
NO 200 " " " "	" -5303	4606	"		

DESCRIPTION	T.O.T. CODE NO.	JAPAN CODE NO.	UNIT	QUANTITY	REMARK
NO. 50 TERMINATING SLEEVE FIXING BAND		4611			
NO. 75 " " " "		4612			
NO. 100 " " " "	ECS-5286	4613			
NO. 125 " " " "	" -5287	4614			
NO. 150 " " " "	" -5288	4615	PCE		
NO. 200 " " " "	" -5289	4616	PCE		
CABLE FIXING BAND			PCE		
SLEEVE					
COTTON SLEEVE 3/32"x 3 1/4"x 900 (0.4MM)	ECS-5021				
" " 1/8"x 3 1/4"x 700 (0.5 ")	" -5022				
" " 5/32"x 3 1/4"x 400 (0.65 ")	" -5023				
" " 1/4"x 3 1/4"x 200 (0.9 ")	" -5024				
COMPOUND FILLED PE SLEEVE FOR 0.4MM	ECS-5050				
" " " " " 0.5	" "				
" " " " " 0.65	" "				
" " " " " 0.9	" "				
PLASTIC SLEEVES 0.106" x 3" x 250 (GREEN)	ECS-5150				
" " 0.125" x 3" x 250 (BLACK)	" -5151				
" " 0.148" x 3" x 250 (RED)	" -5152				
" " 0.208" x 3" x 250 (YELLOW)	" -5153				
PAPER SLEEVE FOR 0.4MM CONDUCTOR 200/BAG	ECS-5180	3001	BAG	1100	
" " " 0.5 " "	" -5181	3002		50	
" " " 0.65 " "	" -5182	3003			
" " " 0.9 " "	" -5183	3004			
PLASTIC FILLED SILICE SLEEVE x 550 (YELLOW)	ECS-5200				
" " " " 0.106x 450 (GREEN)	" -5201				
" " " " 0.125x 350 (CLEAR)	" -5202				
" " " " 0.145x 275 (RED)	" -5203				
" " " " 0.145x 225 (BLUE)	" -5204				
POLYETHYLENE SLEEVE FOR 0.32MM CONDUCTOR 200/BAG	ECS-5225	3011	BAG		
" " 0.4 " "	" "	3012	"	600	
" " 0.5 " "	" "	3013		50	
" " 0.65 " "	" "	3014			
" " 0.9 " "	" "	3015			
AUXILIARY PE SLEEVE NO. 363		3244			
" " " NO. 364		3255			
MAIN LEAD SLEEVE					
LEAD SLEEVE 3/4" x 15"	ECS-5334				
" 1" x 15"	" -5335				
" 1/4" x 15"	" -5336				

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LIST OF MATERIALS

DESCRIPTION	T.O.T. CODE NO.	JAPAN CODE NO.	UNIT	QUANTITY	REMARK
MAIN LEAD SLEEVE					
LEAD SLEEVE 1 1/2" x 15"	ECS-5337				
" " 1 3/4" x 17"	" -5338				
" " 2" x 17"	" -5339				
" " 2 1/4" x 17"	" -5340				
" " 2 1/4" x 20"	" -5341				
" " 2 3/4" x 20"	" -5342				
" " 3" x 20"	" -5343				
" " 3 1/2" x 20"	" -5344				
" " 4" x 20"	" -5345				
" " 4 1/2" x 20"	" -5346				
" " 4 1/2" x 22"	" -5347				
" " 5" x 20"	" -5348				
" " 5" x 22"	" -5349				
" " 5 1/2" x 20"	" -5350				
" " 5 1/2" x 22"	" -5351				
" " 6" x 22"	" -5352				
" " 6 1/2" x 24"	" -5353				
" " 7" x 24"	" -5354				
" " 8" x 24"	" -5355				
MAIN LEAD SLEEVE 30 - 300 MM	ECS-5405		PCE		
" " " 40 - 300 "	" -5408		"	190	
" " " 40 - 400 "	" -5409		"	5	
" " " 50 - 400 "	" -5412		"	380	
" " " 60 - 400 "	" -5415		"	300	
" " " 70 - 500 "	" -5420		"	100	
" " " 80 - 500 "	" -5426		"	60	
" " " 90 - 500 "	" -5432		"	50	
" " " 100 - 500 "	" -5435		"	130	
" " " 110 - 500 "	" -5438		"	20	
" " " 120 - 500 "			"	10	
" " " 130 - 500 "			"	50	
" " " 140 - 500 MM	ECS-5441		"	10	
" " " 150 - 500 "	" -5444		"	10	
" " " 160 - 500 "	" -5447		"	5	
" " " 170 - 500 "	" -5450		"	5	
" " " 180 - 500 "	" -5453		"	10	
" " " 190 - 500 "	" -5457		"	10	
" " " 200 - 500 "	" -5460		"	5	
" " " 210 - 500 "	" -5463		"		
" " " 220 - 500 "	" -5466		"	5	
" " " 250 - 500 "			"	5	
AUXILIARY LEED SLEEVE 30 - 110 MM		3141	"	1700	
" " " 50 - 110 "		3142	"	400	
" " " 70 - 110 "		3143	"		

DESCRIPTION	T.O.T. CODE NO.	JAPAN CODE NO.	UNIT	QUANTITY	REMARK
AUXILIARY LEAD SLEEVE 50 - 150 MM		3145			
" " " 70 - 150 "		3146			
" " " 35 - 130 "	ECS-5406		PCE		
" " " 40 - 130 "	" -5407		"		
" " " 45 - 130 "	" -5410		"	40	
" " " 50 - 130 "	" -5411		"	100	
" " " 55 - 130 "	" -5413		"		
" " " 60 - 130 "	" -5414		"	30	
" " " 65 - 130 "	" -5417		"	40	
" " " 70 - 130 "	" -5418		"		
" " " 75 - 130 "	" -5423		"		
" " " 80 - 130 "	" -5424		"		
" " " 85 - 130 "	" -5429		"	30	
" " " 90 - 130 "	" -5430		"	80	
" " " 95 - 130 "		3135	"		
" " " 100 - 130 "		3136	"		
LEAD PLATE					
LEAD PLATE ø 90		3167	PCE	20	
" " ø 110		3151	"	10	
" " ø 120		3152	"		
" " ø 130		3153	"	20	
" " ø 140		3154	"		
" " ø 150		3155	"		
" " ø 160		3156	"		
" " ø 170		3157	"		
" " ø 180		3158	"		
" " ø 190		3159	"		
" " ø 200		3160	"		
" " 4 x 20 CM x 33 CM	ECS-3000				
PERFORATED LEAD PLATE 40 - 250 MM	" -3001	3147	PCE	150	
SPACER					
PLASTIC CABLE SPACER 1/4"	ECS-5800			1300	
" " " 1/2"	" -5801				
" " " 3/4"	" -5802			1200	
" " " 1"	" -5803			100	
SPACER FOR ADAPTER SPCR A 170		3260			
" " " " A 150		3261			
" " " " A 120		3262			
" " " " A 100		3263			
" " " " A 140		3264			
" " " " A 85		3265			
" " " " A 57		3266			
" " " " A 36		3267			

KK EX.

LIST OF MATERIALS

DESCRIPTION	T.O.T. CODE NO.	JAPAN CODE NO.	UNIT	QUANTITY	REMARK
SPACER					
SPACER FOR AUXILIARY PE SLEEVE - SPCR AV x 85					
" " " " " " " 57					
" " " " " " " 36					
PE - CAP, BASE METAL					
PRESSURE VALVE (TEST VALVE)					
PE CAP ø20 WITH PRESSURE VALVE		4915			
" " ø22 " " "		"			
" " ø24 " " "		"			
" " ø26 " " "		"			
" " ø28 " " "		"			
" " ø30 " " "		"			
" " ø32 " " "		"			
" " ø34 " " "		"			
" " ø36 " " "		"			
" " ø38 " " "		"			
" " ø40 " " "		"			
" " ø42 " " "		"			
" " ø44 " " "		"			
" " ø46 " " "		"			
" " ø48 " " "		"			
" " ø50 " " "		"			
" " ø52 " " "		"			
" " ø54 " " "		"			
" " ø56 " " "		"			
" " ø58 " " "		"			
" " ø60 " " "		"			
" " ø62 " " "		"			
" " ø64 " " "		"			
" " ø66 " " "		"			
" " ø68 " " "		"			
" " ø70 " " "		"			
" " ø72 " " "		"			
" " ø74 " " "		"			
" " ø76 " " "		"			
" " ø78 " " "		"			
" " ø80 " " "		"			
" " ø82 " " "		"			
P.V.C CAP ø12MM		4915	PEC		
" " ø14 "		"	"		
" " ø16 "		"	"	5	
" " ø18 "		"	"	10	
" " ø20 "		"			

DESCRIPTION	T.O.T. CODE NO.	JAPAN CODE NO.	UNIT	QUANTITY	REMARK
P.V.C CAP, ø22MM		4915	PCE	20	
" " ø24 "		"	"		
" " ø26 "		"	"		
" " ø28 "		"	"	15	
" " ø30 "		"	"		
" " ø32 "		"	"	5	
" " ø34 "		"	"		
" " ø36 "		"	"		
" " ø38 "		"	"		
" " ø40 "		"	"		
" " ø42 "		"	"		
" " ø44 "		"	"		
BASE METAL FOR COMPOUND INJECTOR		4917	PCE	10	
" " " NO.6 VALVE		4918	"	40	
WIRE, CORD					
GULVANIZED STEEL STRAND GUY WIRE 5/16" - (6M)	DCP - 2002		KG	2300	
GUY STRAND 3/8" (10M)	DCP - 2003		KG	280	
COPPERWELD TELEPHONE LINE WIRE AWG #6			M	2000	
0.9MM ANNEALED CAPPER WIRE		2940	M		
1.6MM IRON WIRE			KG	10	
JUMPERING WIRE			M	45000	
ø5MM CABLE BINDING CORD			M	900	
CABLE LASHING WIRE (0.045")			ROLL	70	

KK EX.

LIST OF MATERIALS

DESCRIPTION	T.O.T. CODE NO.	AE CODE NO.	UNIT	QUANTITY	REMARK
HARDWARES IN M.H					
CABLE RACK EXTENSION			PCE	200	
RACK SECTION (8 HOLES)			PCE	50	
〃 〃 (14 〃)			〃	100	
(18 〃)					
RACK HOOK (4" LGTH)			PCE	20	
〃 〃 (7½" 〃)			〃	250	
〃 〃 (10" 〃)			〃		
CABLE RACK INSULATOR			〃	270	
ZINC CABLE DUCT SHIELD			〃	250	
GALVANIZED IRON PIPE ø2"			PCE	30	
FOR RISER CABLE PROTECTION					
IRON PIPE ø3"			PCE	110	
FOR BURRIED CABLE PROTECTION					

DESCRIPTION	T.O.T. CODE NO.	AE CODE NO.	UNIT	QUANTITY	REMARK
POLE					
CONCRETE POLE (8 M)			PCE	7	
〃 (10 M)			〃		
GUY					
DRIVING ANCHOR #2			PCE	65	
〃 〃 #3			〃		
AUXILIARY EYES				20	
CROSS CONNECTING CABINET 800P			〃	22	
TERMINAL BLOCK FOR CABINET					
50P - LEAD SHEATH STUB			PCE	25	
100P - 〃 〃 〃			〃	52	
50P - POLYETHYLENE SHEATH STUB			〃	35	
100P - 〃 〃 〃			〃	75	
25P - TERMINAL BLOCK FOR TOT TYPE				2	
RELIABLE TYPE ST CABLE TERMINAL					
10 P			PCE	409	
15 P			〃	103	
25 P			〃	27	
WALL MOUNT TERMINAL BOX (JAPAN)					
FOR TROUGH CABLE 10 P			PCE		
〃 〃 〃 15 P			〃		
〃 〃 〃 20 P			〃	1	
6P-TERMINAL BLOCK (FOR READY ACCES)			〃	130	
STRAIGHT NOZZLE (FOR READY ACCES)			〃	20	
BRANCH NOZZLE (〃)			〃	10	
TERMINAL FOR M.D.F					
25B - TERMINAL BLOCK					

KK EX.

LIST OF MATERIALS

DESCRIPTION	T.O.T CODE NO.	JAPAN CODE NO.	UNIT	QUANTITY	REMARK
PUREGAS EQUIPMENT & MATERIALS					
MODEL 1500 AIR DRYER			PEC		
METER PANEL			〃		
DUAL PRESSURE PANEL			〃		
PEC 522 ALARM PANEL			〃		
〃 522A MASTER ALARM MODULE			〃		
〃 522B ALARM MODULE			〃		
〃 522C LOCAL AIR DRYER ALARM MODULE			〃		
〃 522D MODULE BLANKS			〃		
〃 522E ALARM PANEL FRAME			〃		
〃 412 MAILE ELBOW			〃	13	
〃 523 PRESSURE GUARD (CABLE MOUNTED)			〃		
〃 524 〃 〃 (POLE, WALL MOUNTED)			〃	11	
〃 525 〃 〃 (UNDERGROUND)			〃	2	
〃 401C FLANGE			〃	11	
PEC 402D FLANGE			〃	10	
〃 404B PRESSURE TESTING ELL			〃	3	
〃 405 SEALING CLAMPS					
PEC 408 LEAD TUBING (O.D 1/2", SOFT COILS)			M	13	
〃 409 COPPER TUBING (O.D 3/8" OR 1/2")			〃		
PEC 501F PRESSURE TESTING VALVE (INSTALLED IN CORD FLANGE)			PCE	15	
〃 502P 〃 〃 〃 (END OF LEAD PIPE)			〃		
〃 503C 〃 〃 〃 (DIRECT INSTALLATION)			〃	45	
〃 504M VALVE CAP (INSTALLED BY WRENCH)			〃		
〃 505R 〃 〃 (〃 〃 HAND)			〃	15	
PEC 508 DUAL STEM BY-PASS VALVE					
PEC 419 MALE ELBOW			PCE		
〃 421 UNION (EXTEND LENGTH OF PLASTIC TUBING)					
〃 424 TEE (BRANCH AIR FLOW - 〃 〃)					
〃 426 PLASTIC SHEATH FITTING			〃		
〃 429 PLASTIC TUBE RACK					
PEC 431 POLY-CORTUBING 3 TUBES			M		
〃 5 〃			〃		
〃 10 〃			〃		

DESCRIPTION	T.O.T CODE NO.	JAPAN CODE NO.	UNIT	QUANTITY	REMARK

K.K EX.

CABLE DRUM LENGTH SHEET

DRUM NO	KIND OF CABLE			CABLE LENGTH (M)	LOCATION
1	2400 - 4 ASP			308.0	MH # 3 ~ MH # 32
2	〃 〃			281.0	〃 # 32 ~ 〃 # 34
3	〃 〃			300.0	〃 # 34 ~ 〃 # 37
4	〃 〃			308.0	〃 # 37 ~ 〃 # 39
5	〃 〃			293.0	〃 # 45 ~ 〃 # 47
6	〃 〃			337.0	〃 # 47 ~ 〃 # 49
7	〃 〃			179.0	〃 # 49 ~ 〃 # 50
8	〃 〃			194.0	〃 # 50 ~ 〃 # 52
9	〃 〃			260.0	〃 # 52 ~ 〃 # 54
10	〃 〃			237.0	〃 # 54 ~ 〃 # 56
11	〃 〃			342.0	〃 # 56 ~ 〃 # 58
12	〃 〃			198.0	〃 # 58 ~ 〃 # 59
13	〃 〃			179.0	〃 # 59 ~ 〃 # 60
14	1800 - 4 ASP			252.0	〃 # 39 ~ 〃 # 41
15	〃 〃			268.0	〃 # 41 ~ 〃 # 43
16	〃 〃			315.0	〃 # 43 ~ 〃 # 44, 〃 # 60 ~ 〃 # 61
17	900 - 4 ASP			355.0	〃 # 3 ~ 〃 # 23, 〃 # 23 ~ 〃 # 25
18	〃 〃			209.0	〃 # 25 ~ 〃 # 27
19	〃 〃			261.0	〃 # 61 ~ 〃 # 63
20	600 - 4 ASP			356.0	〃 # 27 ~ 〃 # 29, 〃 # 69 ~ PB # 42
21	300 - 4 ASP			649.0	BETWEEN MH ~ PB
22	〃 〃			568.0	〃 MH ~ PB 〃 MH.PB ~ RISER
23	100 - 65 AST			457.0	〃 MH ~ PB MH.PB ~ CABINET
24	900 - 4 ASPT			161.0	〃 MH ~ TROUGH
25	600 - 4 ASPT			192.0	〃 TROUGH ~ TROUGH
26	300 - 4 ASPT			543.0	〃 MH ~ PB 〃 MH.PB ~ TROUGH
27	〃 〃			681.0	〃 〃
28					
29					
30					
31					
32					
33					
34					

DRUM NO.	KIND OF CABLE			CABLE LENGTH (M)	LOCATION
35					
36					
37					
38					
39					
40					
41					
42					
43					
44					
45					
46					
47					
48					
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"KK" ANNEX Demand Forecast for Special Area in KK Exchange

Bldg. Name	Demand Forecast			Remarks
	1976	1980	1985	
Royal Palace	110	200	240	
Race Course	10	60	70	
Commercial College	5	8	10	
Vacational Education Institute	4	6	10	
Bank for Agriculture and Co-operatives	15	20	25	
Identification Card Division	10	13	15	
A Timber Dealer	2	3	4	
Police Station	8	20	25	
JK Co.	3	5	6	
The Bureau of Regist-ration & Identification	3	5	6	
NSC	170	190	260	
TOT	3	4	5	
Wat Benjama-Bopit	2	2	3	
Zoo	3	4	7	
Assembly Hall	100	110	150	
Seventh Day Adventists Hospital	15	20	30	
Guest House	12	15	20	
The Board of National Development	70	100	140	
The National Statistical Office	20	25	30	

(Cont'd)

Bldg. Name	Demand Forecast			Remarks
	1976	1980	1985	
Dept. of Technical & Economics Corp.	30	45	70	
Pon Prab District Office	6	8	10	
Public Welfare	60	70	90	
Narayana Phan	5	7	8	
RS Hotel	25	30	40	
Bangkok Bank	6	10	12	
Guest House	12	15	20	
Bangkok Poly-Technic College	3	4	5	
Suan Dusit College	3	4	5	
Army Military Police	10	15	20	
Suan Sunantha College	17	25	30	
Nongkran Palace	21	30	40	
Accelerated Fural Dept. Office	10	20	30	
Army Military Police	3	5	8	
First Region Army Command	20	25	30	
Army Meeting Hall	15	20	25	
Army (Wang Suankularb)	5	10	15	
Army Club	5	7	10	
National Library	16	18	20	
The Privy Property Office	30	50	70	
Army Radio Center	220	360	400	

(Cont'd)

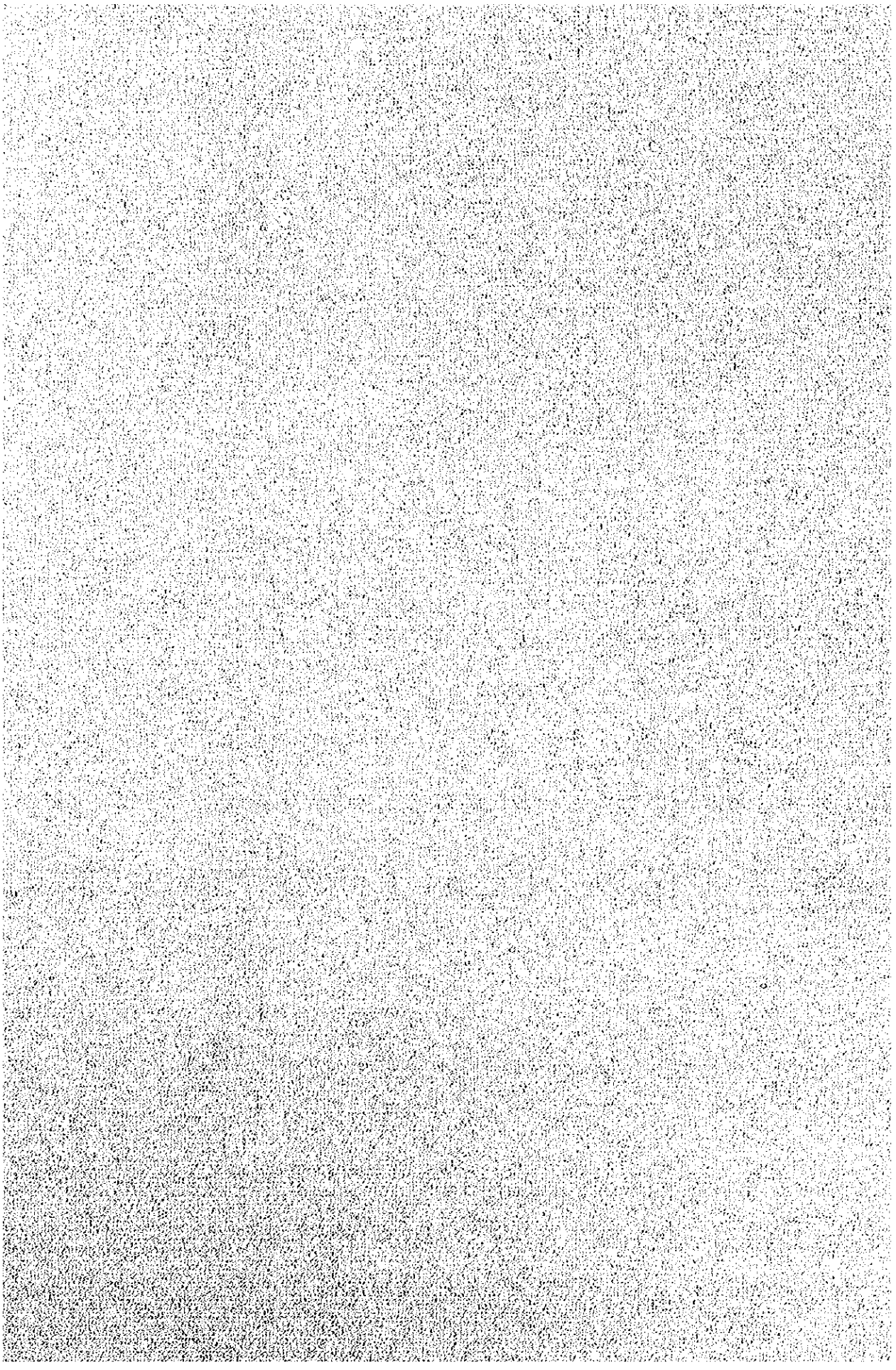
Bldg. Name	Demand Forecast			Remarks
	1976	1980	1985	
Amporn Garden	30	40	45	
Report Division	40	55	75	
Army Military Police	10	20	30	
Army Academy	25	35	45	
The Ministry of Education	180	280	360	
Kuru-sapa Hall	15	25	30	
Office of the Civil Supervise Commission	20	30	40	
Government House	175	200	250	
Presidency of the Council of Ministry	10	20	25	
Santi-dham Hall	160	200	240	
Union Development Co.	2	3	4	
Military Map School	4	7	10	
The Ministry of Agriculture	110	145	180	
Wat Som-manas	3	4	4	
Army Cremation Office	2	3	3	
Forestry Industrial Organization	20	30	40	
Boxing Stadium	4	6	8	
Tourist Organization of Thailand	10	24	33	
Ministry of Communi-cation	44	70	90	
Goldon Horse Hotel	5	8	10	
Auto Sale Agent	4	5	5	

(Cont'd)

Bldg. Name	Domand Forecast			Remarks
	1976	1980	1985	
United Machinery Co.	10	15	20	
The Metropolitan Police Bureau	0	130	150	
Thai Airway Bldg.	30	40	50	
Dept. of Publics Municipal Works	55	70	80	
The Ministry of National Development	75	90	120	
Majestic Hotel and Night Club	8	12	15	
Stationer Bldg.	20	25	30	
Thai Wood Craft	2	3	3	
Veteran Association	3	5	5	
Co-operative Accounting Inspection Dept.	7	12	16	
Flower Market	10	13	15	
Ministry of Public Health	91	105	115	
Thai Hotel	12	16	22	
Wat Tree Tosathep	3	3	5	
Army Apartment	30	40	45	
Police Communication	100	140	180	
Thai TV	75	110	130	
National Bank	75	130	180	
Banknote Printing House	50	65	90	
Wat Sam Phya	6	8	11	

(Cont'd)

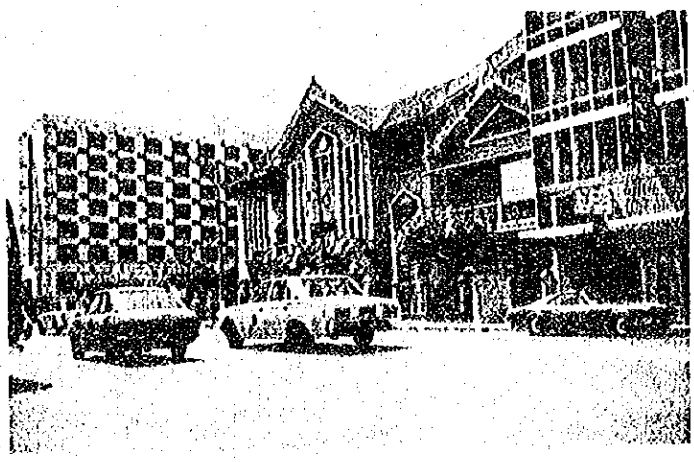
Bldg. Name	Demand Forecast			Remarks
	1976	1980	1985	
The Siam Commercial Bank	20	25	30	
Library & Supor Market	3	5	6	
Lottery Bureau	75	85	95	
The Bureau of Revenue Affairs of BKK Metro.	10	15	20	
Mint	10	15	20	
Treasury Dept.	20	25	30	
Computer Center	50	65	80	
Revenue Dept. (1)	80	90	110	
Revenue Dept. (2)	35	45	55	
Lottery Printing House	10	18	30	
Investigation Dept.	10	16	22	
Buddhist Association of Thailand	4	5	5	
Regional Office for Asia and the Far East	10	15	20	
The UN Bureau of Children Fund	12	18	22	
Army Medical Science Dept.	15	20	23	
Association	7	10	12	
Police Station	6	8	10	
Public Rolations Dept.	75	85	110	



CHAPTER 2. PLOENCHIT TELEPHONE EXCHANGE (PL)

2.1 Service Area

The PL Exchange Office is situated in the central part of Bangkok, and is in the same compound as the TOT. Various kinds of cables such as conduit cables, trough cables, direct buried cables and aerial cables are laid in the exchange area, and the distribution method is divided into direct distribution in the direction of Sukhumvit and the cross-connecting cabinet system for the other direction.



Front View of Ploenchit Exchange

In line with the commencement of services of the PW Exchange, the cut-over will be executed as shown in Fig. 4.2.1.

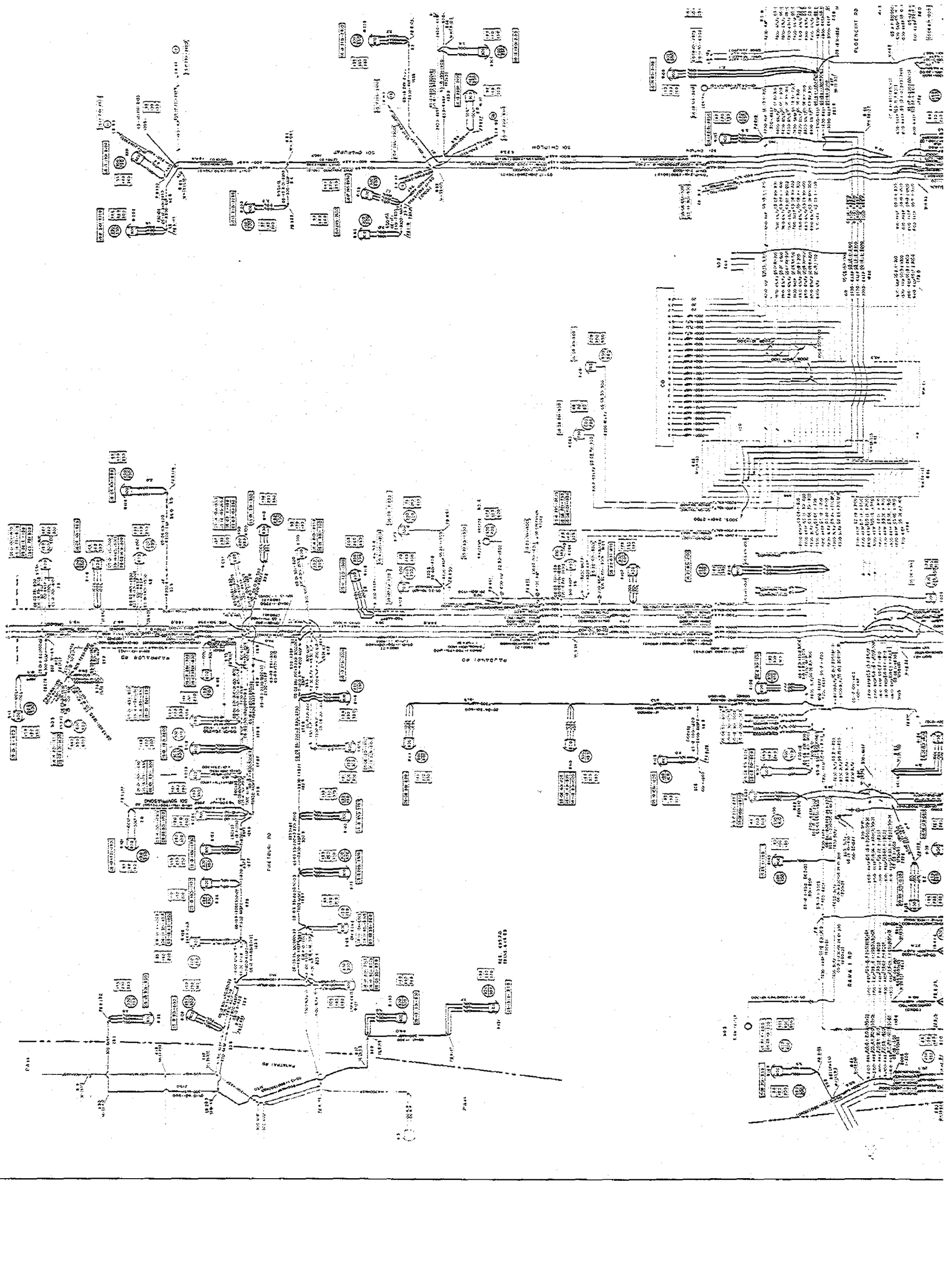
(1) Cut-over to ASD Exchange
The area on the north side of the railroad.

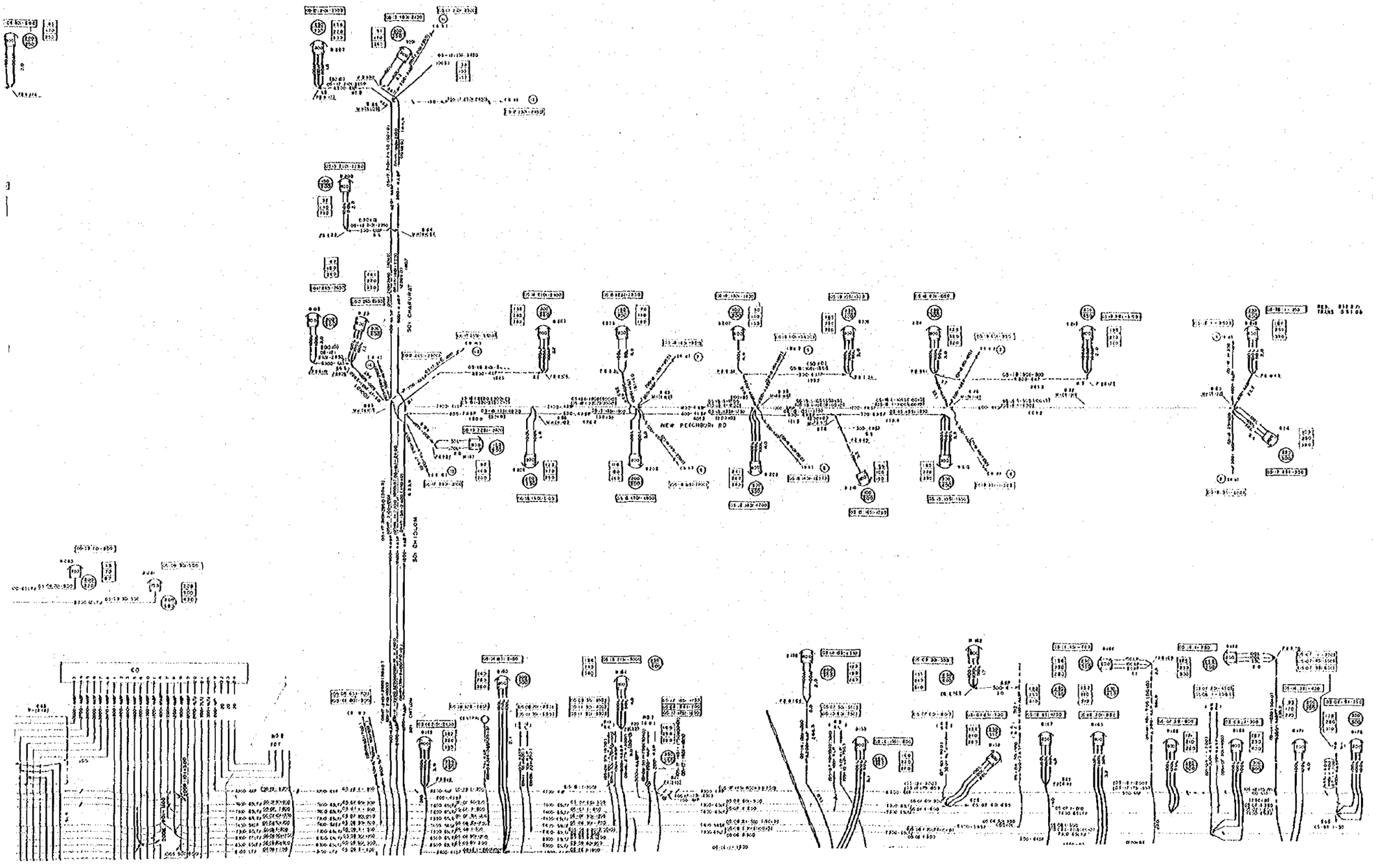
(2) Cut-over to PW Exchange
The area on the west side of the Phya Thai Road.

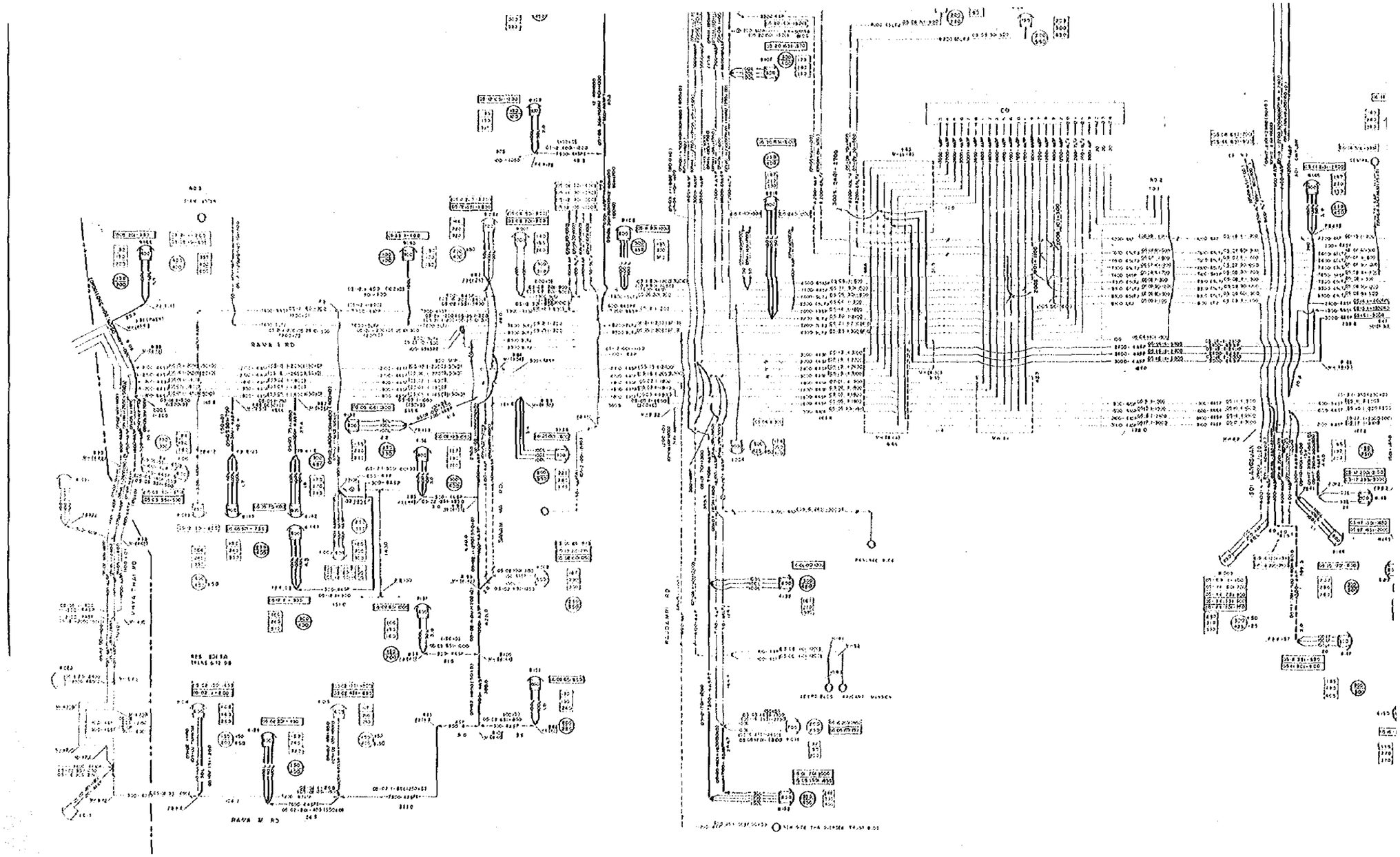
(3) Cut-over from MM Exchange
The area on the north side of the Rama 4 Road.

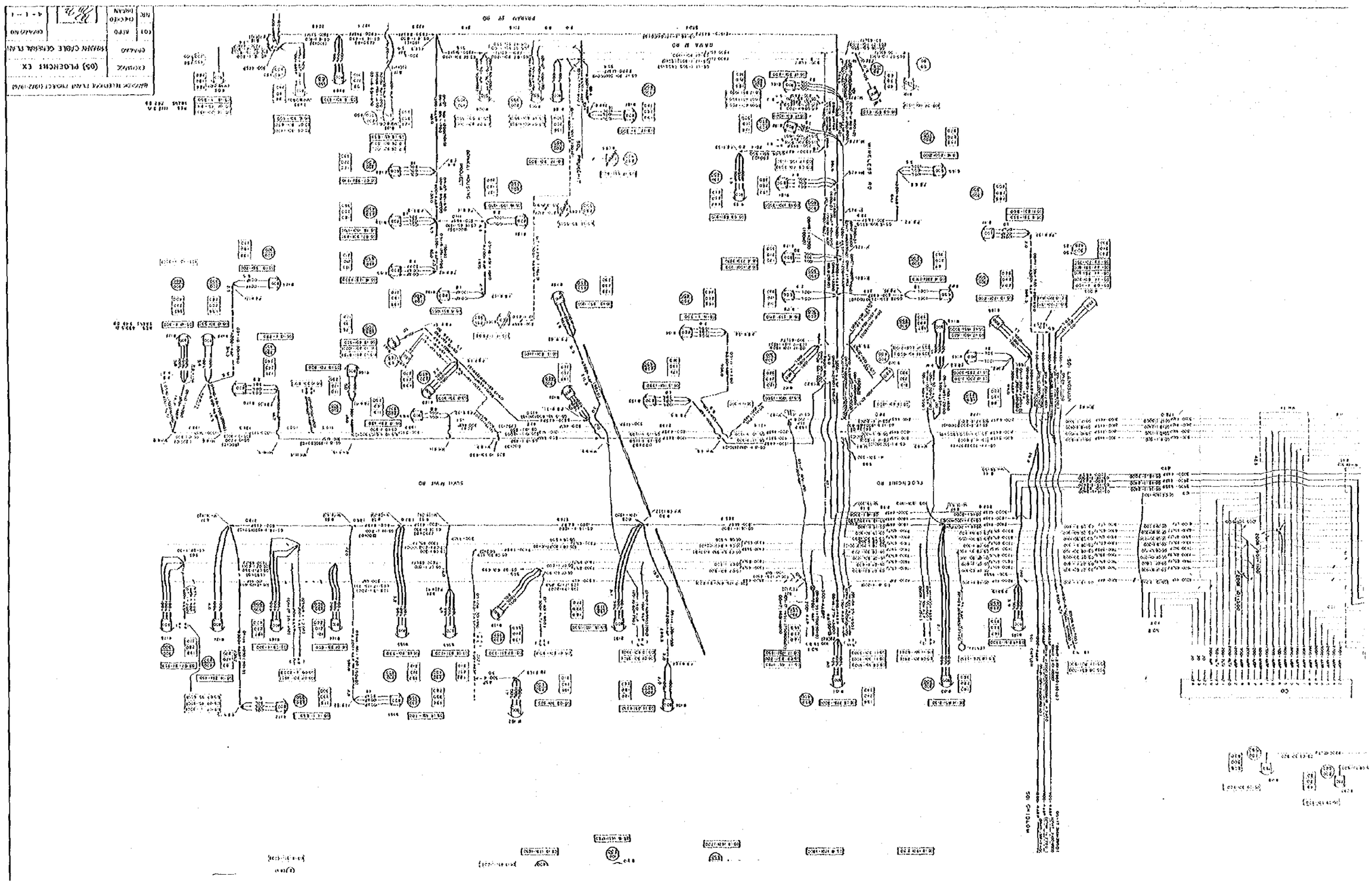
When the foregoing cut-overs are completed, the area of the service area will be approximately 1,150 ha.

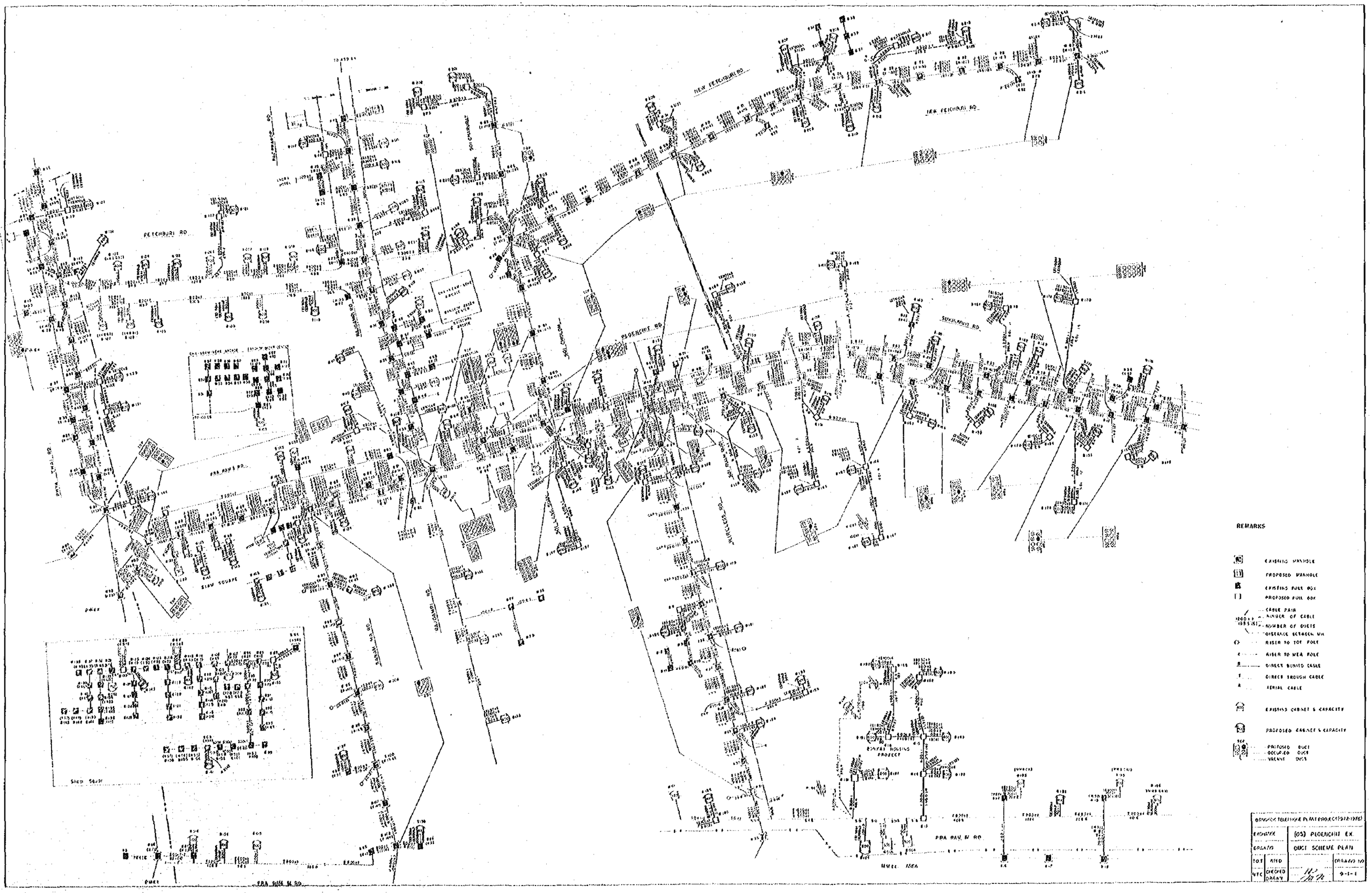

ASOKE DINDANG EXCHANGE
CHAYA PHUK EXCHANGE
THUNG MAHAMEK EXCHANGE
REMARKS




SO CHESTNUT
NEW PEACHBURN RD
SO CHESTNUT
CO






PETCHBURI RD.
NEW PETCHBURI RD.
PHAYATHAI RD.
RAJDAMRI RD.
PLOENCHIT RD.
SUKHUMVIT RD.
WIRELESS RD.
RAMA I RD.
SIAM SQUARE
CENTRAL BUILDING PROJECT
PRA RAM IV RD.
REMARKS
EXISTING MANHOLE
PROPOSED MANHOLE
EXISTING PULL BOX
PROPOSED PULL BOX
CABLE PAIR
NUMBER OF CABLE
NUMBER OF DUCTS
DISTANCE BETWEEN MH.
RISER TO TOT POLE
RISER TO MEA POLE
DIRECT BURIED CABLE
DIRECT THROUGH CABLE
AERIAL CABLE
EXISTING CABINET & CAPACITY
PROPOSED CABINET & CAPACITY
PROPOSED DUCT
OCCUPIED DUCT
VACANT DUCT
OVERHEAD TELEPHONE PLANT PROJECT (1972-1976)
EXCHANGE
(05) PLOENCHIT EX.
DRAWING
DUCT SCHEME PLAN
TOT
AISD
NTC
CHECKED
DRAWN
DRAWING NO
9-1-1

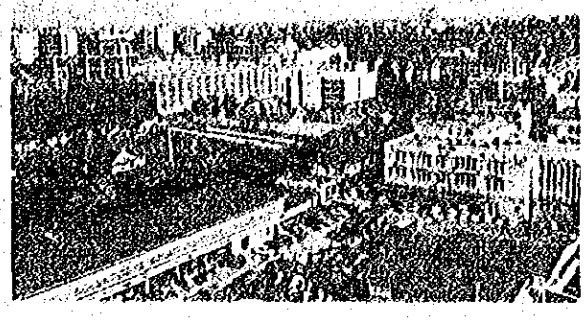
2.2 Demand Forecast and Outline of Area

This area is a newly developed district of Bangkok and can largely be classified into the high-class residential district of Sukhumvit, the commercial district of Rajdamri Siam Center, etc., the green belt district of the Lumpini Park, Race Course, etc. and the educational and cultural district of the Chulalongkorn University, Red Cross Hospital, etc.

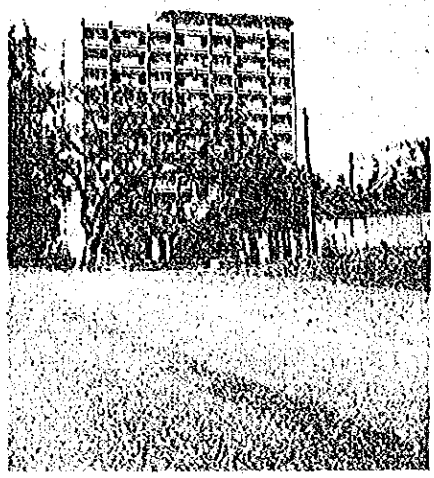
There further are first class hotels such as the Erawan Hotel and the embassies and official residences of the United States, Great Britain and other large countries are situated in this area. The tree-lined Wireless Road passing through the area will become one of the most beautiful roads of Bangkok.

The special features of this area in respect to demand forecast are as follows:

(1) The commercial street with the Rajadamri Center, Daimaru Department Store, etc. is a very busy section and with the new construction of the Central Department Store, hotels, etc., it is envisaged that it will further develop as a high-class commercial district.



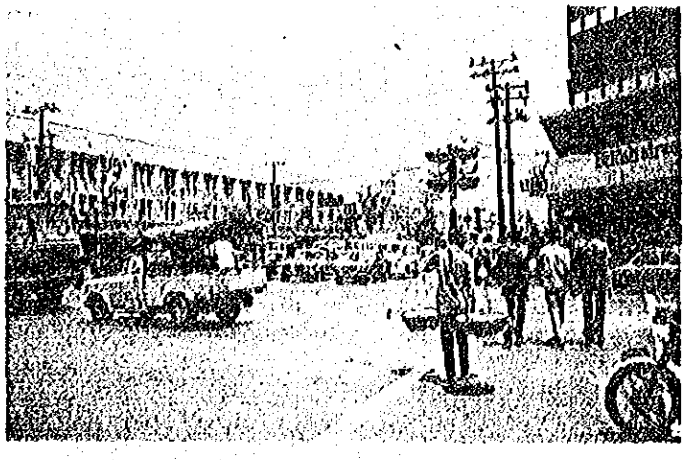
View in Direction of TOT and
the Central Department Store



High Rise Mansions of Sukhumvit

(2) There are hardly any empty lots in the high-class residential district of Sukhumvit and with the envisaged construction of high-class mansions, the demand for telephones will show a futher high growth.

(3) Although the construction of hotels, apartment houses, etc. were expected along the Wireless and Rajdamri Roads which have presently been designated as green belts and/or residential districts, measures for stoppage of construction have recently been taken under the area designation problem and the outcome of whether construction will be permitted in the future will have a large effect on the features of this area.



View in direction of Rajdamri Road

In consideration of the foregoing, the forecast values were derived at and, ultimately, the approval of the TOT was acquired.

Table 4.2.1 Demand Forecast

Area \ Year	1976	1978	1980	1982	1985	1987
Commercial area	6,400	8,400	10,300	11,600	13,500	14,500
Residential area	5,300	6,900	8,500	9,600	11,200	12,200
Special area (Including Pre-construction area)	8,200	9,900	11,700	13,100	15,300	16,700
Total	19,900	25,200	30,500	34,300	40,000	43,400
Demand Growth Ratio	100.0	126.6	153.3	172.4	201.0	218.1

DEMAND FORECAST OF PL EX. SERVICE AREA

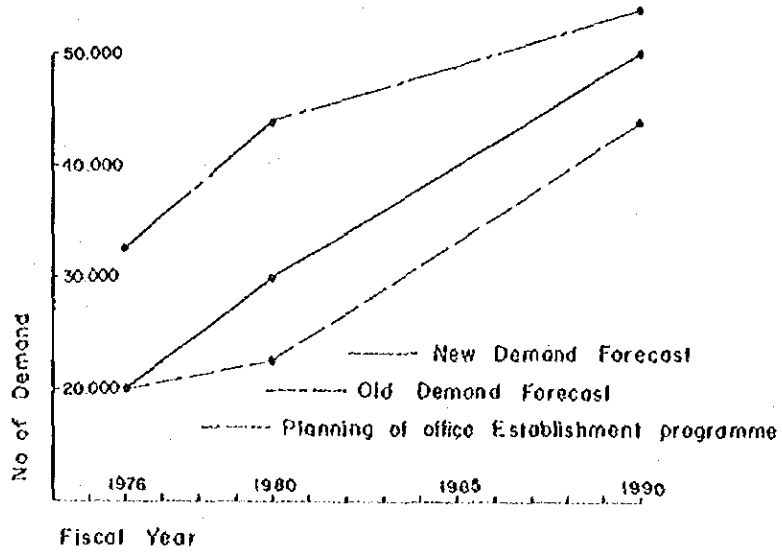


Fig. 4.2.4

2.3 Primary Cable Network Design

2.3.1 Objective Demand for Design

34,300 (in 1982) of Primary cable
43,400 (in 1987) of Secondary cable

2.3.2 Entrance Cable Pairs

The number of pairs of the entrance cables for this exchange is 36,160 pairs and of this number, 1 cable of 200 pairs will be removed. The design will not require the additional installation of entrance cables.

Existing	3,000 pairs - 4 ASP	3	cable(s)	
"	2,700 " - 4 ASP	1	"	
"	2,400 " - 4 ASP	2	"	
"	2,100 " - 4 LTJ	1	"	
"	1,800 " - 4 ASP	4	"	
"	1,500 " - 4 ASP	3	"	
"	1,200 " - 4 ASP	3	"	
"	900 " - 4 ASP	1	"	
"	600 " - 65 ASP	1	"	
"	300 " - 9 LTJ	1	"	
"	200 " - 7 LTJ	1	"	
"	20 " - 4 AP	3	"	
Sub-total		25	"	36,160 pairs
Removal	200 pairs	1	"	200 pairs
Total				35,960 pairs

Out of the foregoing, the distributed number of cable pairs under this design work was 34,010 pairs.

2.3.3 Installation of New Cables for Each Direction

(1) Direction of Sukhumvit Road

The existing underground routes in this direction are those of conduits and troughs.

There further is a separate conduit route being constructed on the same road. In this dosign, the existing conduits and the newly constructed conduit will be utilized to meet the demand 3 to 5 years hence by the additional installation of 2 lines of 1,800 pairs.

(2) Direction of Wireless Road

Due to change in exchange area, there is an area to be cut-over from the MM Exchange in this direction and the design will be for the new installation of 3,000 pairs.

The Wireless Road is the junction cable route to the MM Exchange and the cables are placed in conduits. There are troughs from MH #31 in the direction of Rama 4 Road and 2 lines of existing cables are placed in these troughs. The design is for the laying of new armoured cables in these troughs.

(3) Direction of New Petchburi Road

The conduit route extends to the cable end and this route is the junction cable route in the direction of the ASD Exchange. The design is for the additional installation of 1,200 pairs to meet the demand 3 to 5 years hence.

(4) Direction of Rajprarop Road

Since the service area north of the railroad (north from MH #42) will be cut-over to the ASD Exchange, the existing cables of 3,000 pairs, 1,500 pairs and 900 pairs in this direction will become vacant.

In the direction of the Petchburi Road, since a part of the service area of the KK Exchange will be cut-over to the PL Exchange, the design is for the laying of new cables in the troughs on both sides of the road and these cables are armoured cables of 2,400 pairs and 1,200 pairs.

(5) Direction of Rama 1 Road

Since the area in the direction from the Phyathai Road to the Bangkok Central Station will become the service area of the new PW Exchange, the existing cables of 2,700 pairs, 2,100 pairs and 1,800 pairs are to be removed.

(6) Direction of Sanamma Road

This is the junction cable route to the SW Exchange and a new underground route has already been constructed by the TOT. Although there presently is only one existing cross-connecting cabinet on the Sanamma Road, and two existing cross-connecting cabinets on the Rama 4 Road, the design is for the new installation of 1,800 pairs in order to accommodate four new cross-connecting cabinets and three existing ones. Since there are troughs from MH #102 to the existing cross-connecting cabinet #14, armoured cables will be adopted.

(7) Direction of Rajdamri Road

There is an existing trough and the design is for the laying of a new armoured cable of 600 pairs.

2.3.4 Selection of Trough, Direct Buried and Aerial Routes

(1) Direction of Rama 4 Road

There are existing troughs alongside the sidewalk from the MH #13 to the far end of the exchange and these will be utilized for the laying of new cables. The cable extending part way from the troughs to the Bonkai Housing Area will partly be placed in conduits and the end (300 pairs) will be aerialed.

(2) Direction of Wireless Road

The cable of 300 pairs to be newly placed from the direct buried cable near the MH #28 will utilize the aerial route which is the same as for the secondary cables.

(3) Direction of Sukhumvit Road

A. The cable of 300 pairs to be newly installed on the Soi Ruam Rudi, if aerialed, would bring about problems in cable placement near the riser pole due to exceeding the limit in number of cable pairs and has been designed to be direct buried alongside the sidewalk.

B. The cable to be newly installed to the #160 and #161 cross-connecting cabinets at Soi 4 will be direct buried up to the #160 cross-connecting cabinet and aerialed up to the #161 cross-connecting cabinet.

C. Due to difficulty in cable placement of the existing aerial route, the cable of 300 pairs to be newly installed at Soi 15 will be direct buried under the sidewalk.

D. Since aerial cable placement will be possible for each route at Soi 1, 2, 11 and 12, they will be aerial cables.

(4) Direction of New Petchburi Road

The cables from cross-connecting cabinets #203, #209 and #213 were initially planned to cross under the road from manholes #66, #74 and #77 and then connected to the cross-connecting cabinets with pulling boxes to be newly installed. However, due to impossibility of road excavation between the manholes and the pulling boxes at some places, the design is for utilizing the existing lateral conduits.

(5) Direction of Rajdamri Road

Excluding the 2 cables of 100 pairs for direct distribution, the existing cables are laid in troughs and the additional cables of 600 pairs will also be placed in these troughs.

(6) Direction of Sanamma Road and Rama 4 Road

Although the cable between the Pulling Box #91 and the existing troughs will partially be direct buried cable, the cable to the cross-connecting cabinet #014 at the cable end will be placed in the existing troughs.

(7) Direction of Petchburi Road

There are existing troughs on both sides of this road and the cables to be newly installed will be placed in these troughs.

2.3.5 Line Loss and D.C. Resistance

Although the line loss of the cable on the Rama 4 Road exceeded the limit value of 7 dB, since the demand in this area 10 years hence will be within 5% of the total demand of 43,400 and within 10 dB, this matter is no problem and TOT has agreed.

(1) Direction of Rama 4 Road

Maximum Line Loss	8.38 dB
Maximum D.C. Resistance	1,265.0 Ω
Demand	560

(2) Direction of Bonkai Housing Area

Maximum Line Loss	7.56 dB
Maximum D.C. Resistance	1,121.6 Ω
Demand	270

2.3.6 Removal of Cables

Table 4.2.2

Section	No. of Pairs	Span Length	Reason for Removal
MH #31 - MH #41	3,000 - 4 ASP	501.7 m.	Portion to be cut-over to ASD Exch. and not required also in the future.
MH #43 - MH #32	3,000 - 4 ASP	236.4	Due to cut-over to ASD and PW Exchanges.
MH #43 - MH #32	2,700 - 4 ASP	236.4	- ditto -
MH #32 - MH #89	2,700 - 4 ASP	1,021.6	- ditto -
MH #43 - MH #84	2,400 - 4 ASP	738.5	- ditto -
MH #84 - MH #89	2,100 - 4 ASP	519.5	- ditto -
MH #32 - MH #89	1,800 - 4 ASP	1,021.6	- ditto -
MH #84 - MH #89	1,800 - 4 ASP	519.5	- ditto -

2.4 Underground Conduit Design

2.4.1 New Branch Route in Bonkai Housing Area

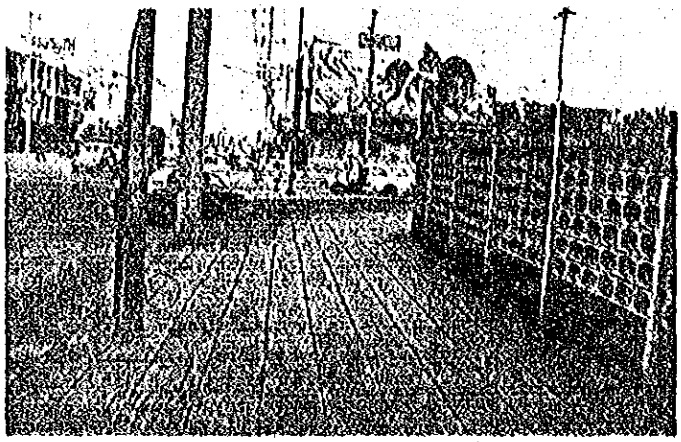
(1) Design was made from the housing area construction design drawings.

(2) There will be 4 ducts and the pulling boxes will be the "JUF-11" type.

(3) Position of the new conduits will be under the sidewalks.

2.4.2 Conduit Crossing New Petchburi Road

This is a busy traffic road and since the TOT has instructed that the City Office will not permit excavation of the concrete pavement, the existing lateral pipe will be utilized. The method to be taken will be to remove the bent portion of the riser pipe, and joint the lower part of the riser pipe to the new conduit and then connect the lateral pipe to the new pulling box.

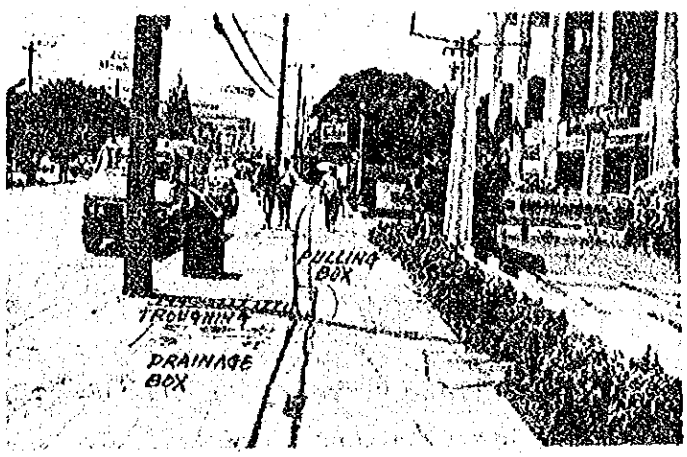


View of New Petchburi Road

2.4.3 Conduit Crossing Sukhumvit Road

Road excavation is impossible for the same reason as the New Petchburi Road and the existing lateral conduits will be utilized. There is a drainage culvert (width 1.40 m. x depth 1.40 m.) laid under the center of the sidewalk of this road and since the top of the culvert is 0.30 m. beneath the sidewalk, the conduit cannot be extended. Therefore, trough will be constructed to connect the conduit to the pulling box to be constructed.

The bent portion of the riser pipe of the existing lateral conduit will be cut at a suitable place underground for connecting the conduit to the trough.



View of Sukhumvit Road

2.4.4 Main Conduit Route Between MH #43 (#133) and MH #20

(1) Since 6 cap ducts will be laid from MH #43 (#133) on Ploenchit Road to MH #20 on Wireless Road in the junction cable construction work (in 1974), this design is for the laying of 6 ducts from the ends of the cap ducts to MH #20.

(2) The existing MH #20 is of the "A-1" type and this will be rebuilt to the "A-3" type.

2.5 Gas Pressurization System Design

2.5.1 Design of Inside Facilities

There will be no new entrance cables to be installed in this design and, therefore, there will be no need for additional devices. However, there will be a change in a part of the pair numbers for the pressure guards.

2.5.2 Design of Outside Facilities

(1) Gas will be charged to conduit cables, trough cables and direct buried cables. Since CCP cables will be used for aerial cables, these will not be gas pressurized.

(2) The existing trough cables and direct buried cables with small number of cable pairs will not be gas pressurized in principle.

(3) The attachment of pressure guards, in principle, will be in the cross-connecting cabinets at the end of each of the gas pressurized cables.

2.6 Secondary Cable Network Design

2.6.1 Service Area where Direct Distribution will be changed to System of Cabinet Distribution

The area with direct distribution in the direction of the Sukhumvit Road and the New Petchburi Road will be changed to the cross-connecting cabinet system in this design work.

In this area, there are direct distributions where the 27 risers will be removed and 50 cross-connecting cabinets will be newly installed.

2.6.2 Cross-Connecting Cabinets with Reserve Secondary Cables

(1) Cross-Connecting Cabinet #195

This is in an area which previously was a slum district but presently is a vacant area due to fire. 150 pairs are reserved for the demand in this area.

(2) Cross-Connecting Cabinets #109 and #111

These are in the area adjacent to the Rajprasong Shopping Center and presently is a vacant area. 200 pairs are reserved for the demand in this area.

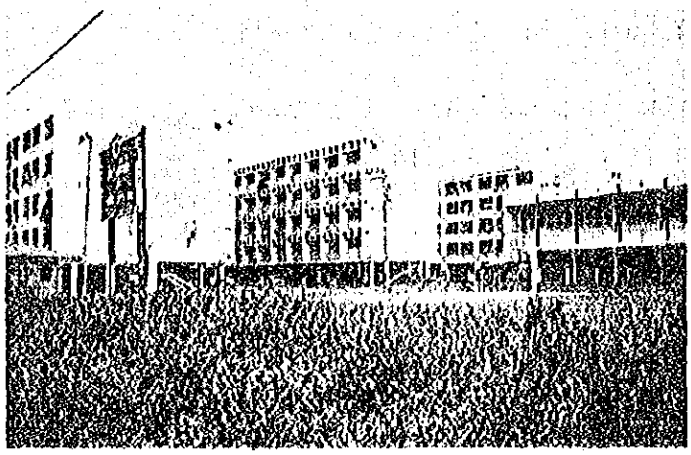
2.6.3 Building Lead-In Cable

For ordinary buildings and high-class apartment houses where there is a high demand for telephones, lead-in cables will be adopted wherever possible.

2.6.4 Desk Work Design Area

The projected Bonkai Housing Area is presently a slum district but the following construction of residences is planned.

1974	-	864 units
1975	-	968 "
1976	-	888 "
Total		2,720 units



Bonkai Housing Area

Since high-rise apartment houses will be constructed for the above number of housing units, the design is for the new installation of 1,200 pairs based on the housing design drawings.

2.7 Design of Relevant Works

In respect to new installation of primary cables in the direction of Rajdamri Road.

The Bangkok Bazaar Shopping Center (relevant to cross-connecting cabinets #102 & #103), Co-operation Store and Suvisa Building are under construction. The distribution to this area has been designed by the TOT, and orders have already been placed for materials.

2.8 Construction Period

Since this design is for utilization of the vacant cables after cut-over to the PW and ASD Exchanges, the construction work will be commenced after service-in of these two exchanges.

2.9 Amount of Works and List of Materials

Refer to the annexed Table 4.2.3 Amount of Works and Tables 4.2.4 to 4.2.14 List of Materials.

TABLE 4.2.3 PL EX. AMOUNT OF WORKS

ITEM	BREAKDOWN	Q'ty	REMARK
1. POLE	8 MC	43 ea.	
	10 "	-- "	
	TOTAL	43 "	
2. GUY	(1) UPPER GUY 6 M	97 ea.	
	" 10 M	22 "	
	" 16 M	-- "	
	TOTAL	119 "	
	(2) ANCHOR ROD #2	92 ea.	
	5/8" x 7'	-- "	
	3/4" x 7'	21 "	
	1" x 7	-- "	
	TOTAL	113 "	
3. CABLE	(1) UNDERGROUND CONDUIT CABLE		
	3600 - 32 ASP	-- m	STALPETH CABLE
	3000 - 4 "	834.2 "	
	2400 - 4 "	1 478.0 "	
	1800 - 4 "	3024.7 "	
	1200 - 4 "	1 975.7 "	
	900 - 4 "	1 024.6 "	
	600 - 4 "	2 189.2 "	
	300 - 4 "	2 454.1 "	
	1800 - 5 "	-- "	
	1200 - 5 "	-- "	
	900 - 5 "	-- "	
	600 - 5 "	-- "	
	300 - 5 "	-- "	
	100 - 65 "	-- "	
	SUB TOTAL	12980.5 "	
	(2) DIRECT BURIED CABLE		
	900 - 4 ASPT	-- m	STALPETH SHEATHED AND STEEL TAPE ARMOURED CABLE
	600 - 4 "	435.0 "	
	300 - 4 "	1 172.1 "	
	400 - 4 JF	-- "	JELLY FILLED CABLE
	300 - 4 "	292.7 "	
	200 - 4 "	907.0 "	
	100 - 4 "	839.0 "	
	50 - 4 "	738.6 "	
	SUB TOTAL	4384.4	
	(3) TROUGH CABLE		
	2400 - 4 ASPT	502.7m	
	1800 - 4 "	1 166.4 "	
	1200 - 4 "	218.8 "	

ITEM	BREAKDOWN	Q'ty	REMARK
3. CABLE	900 - 4 ASPT	1 154.5m	
	600 - 4 "	691.0"	
	300 - 4 "	845.9"	
	900 - 5 "	606.9"	
	600 - 5 "	208.6"	
	100 - 65 "	257.7"	
	SUB TOTAL	5652.5"	
	UNDERGROUND CABLE TOTAL	23017.4"	
	(4) AERIAL CABLE		
	600 - 4 AP	-- m	INCLUDE AP & AP(8) CABLE
	400 - 4 "	20.2"	
	300 - 4 "	5565.5"	
	200 - 4 "	9903.3"	
	100 - 4 "	12040.0"	
	50 - 4 "	14032.4"	
	25 - 4 "	10753.7"	
	10 - 4 "	85.0"	
	400 - 5 "	-- "	
	300 - 5 "	-- "	
	200 - 5 "	-- "	
	100 - 5 "	-- "	
	50 - 5 "	-- "	
	25 - 5 "	-- "	
	10 - 5 "	-- "	
	AERIAL CABLE TOTAL	52400.1"	
4. POT HEAD	2400 P	-- ea.	
	1800 P	-- "	
	1200 P	-- "	
	TOTAL	-- "	
5. CROSS CONNECTING CABINET	800 P	104Box	
6 TERMINAL	(1) TERMINAL BOX		
	FOR AERIAL 25P	103 ea.	
	" 15P	453 "	
	" 10P	519 "	
	FOR BURIAL 20P	-- "	
	" 15P(PE)	5 "	
	" 10P(PE)	3 "	
	" (PE)	13 "	
	TOTAL	1096 "	
	(2) TERMINAL BLOCK		
	LEAD SHEATHED STUB 100P	216 ea.	
	" 50P	52 "	
	POLYETHYLENE SHEATHED STUB 100P	360 "	
	" 50P	45 "	
	TOTAL	673 "	

ITEM	BREAKDOWN	Q'ty	REMARK
7. GAS EQUIPMENT	AIR DRYER MODEL 1500	-- ea.	
"	METER PANEL	-- "	
	ALARE PANEL	-- "	
	PRESSURE GUARD	23 "	
	TESTING VALVE	25 "	
8. CONDUIT	24 - 4"	-- m	
	16 - 4"	-- "	
	12 - 4"	-- "	
	8 - 4"	-- "	
	6 - 4"	41.1 "	
	4 - 4"	30.4"	
	4 - 3"	1280.4"	
	3 - 3"	34.6"	
	2 - 3"	307.0"	
	TOTAL	1693.5"	
9. MANHOLE & PULLING BOX	TYPE - A	-- ea.	
	" C	-- "	
	" V	-- "	
	" J	-- "	
	" T	-- "	
	" L	-- "	
	ENLARGE	-- "	
	REBUILD "A"	1 "	
	TYPE - JUF - 6	46 "	
	" JUF -11	12 "	
	TOTAL	59 "	

PL. EX.

LIST OF MATERIALS

CABLE DESCRIPTION	T.O.T. CODE NO.	AE CODE NO.	UNIT	QUANTITY	REMARK
STALPETH CABLE 3600 - 32 ASP			M		
" " 300 - 4 "			"	2830	
" " 600 - 4 "			"	2295	
" " 900 - 4 "			"	1099	
" " 1200 - 4 "			"	2068	
" " 1800 - 4 "			"	3165	
" " 2400 - 4 "			"	1548	
" " 3000 - 4 "			"	878	
" " 300 - 5 "			"		
" " 600 - 5 "			"		
" " 900 - 5 "			"		
" " 1200 - 5 "			"		
" " 1800 - 5 "			"		
" " 100 - 65 "			"		
STALPETH STEEL TAPE ARMOURED CABLE					
300 - 4 ASPT			"	2105	
600 - 4 "			"	1161	
900 - 4 "			"	1185	
1200 - 4 "			"	227	
1800 - 4 "			"	1196	
2400 - 4 "			"	511	
900 - 5 "			"	620	
600 - 5 "			"	213	
300 - 5 "			"		
100 - 65 "				264	
ALEPETH CABLE 10 - 4 AP			"	500	
" " 25 - 4 "			"	4500	
" " 50 - 4 "			"	10500	
" " 100 - 4 "			"	11000	
" " 200 - 4 "			"	10500	
" " 300 - 4 "			"	6000	
" " 400 - 4 "			"	500	
" " 600 - 4 "			"		
" " 10 - 5 "			"		
" " 25 - 5 "			"		
" " 50 - 5 "			"		
" " 100 - 5 "			"		
" " 200 - 5 "			"		
" " 300 - 5 "			"		
" " 400 - 5 "			"		

DESCRIPTION	T.O.T. CODE NO.	AE CODE NO.	UNIT	QUANTITY	REMARK
ALEPETH CABLE 600 - 5 AP			M		
" " 10 - 4 AP (8)			"	500	
" " 25 - 4 "			"	7500	
" " 50 - 4 "			"	5000	
" " 100 - 4 "			"	2000	
" " 10 - 5 "			"		
" " 25 - 5 "			"		
" " 50 - 5 "			"		
" " 100 - 5 "			"		
TERMINATING CABLE 300 - 5 P			"		
JELLY FILLED CABLE 50 - 4			"	1000	
" " " 100 - 4			"	1000	
" " " 200 - 4			"	1000	
" " " 300 - 4			"	500	
LEAD SHEATHED AND POLYETHYLENE PROTECTED CABLE 10 - 4 P			"	500	

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LIST OF MATERIALS

DESCRIPTION	T. O. T CODE NO.	A. E CODE NO.	UNIT PCS	QUANTITY	REMARK
CLAMP EXTENSION - ARM.					
FIGURE 8 CABLE CLAMPS - TYPE PA 296	ECH - 2002		PCE	400	
CABLE LASHING CLAMP TYPE "D"	ECH - 2100		PCE	3800	
" " " " "E"	" - 2101		"		
CABLE SUSPENSION CLAMPS (ONE BOLT CLAMP)	ECH - 2151		PCE	800	
" " " 11/16" THREE BOLTS TYPE	" - 2155		"	400	
CURVED CABLE SUSPENSION CLAMPS 11/16"	ECH - 2171		"	100	
THREE BOLTS TYPE					
GULVANIZE STEEL KLING GROUND CLAMP	ECH - 2195		"	300	
STRAND GROUND CLAMPS	ECH - 2200		"	700	
GROUND CLAMP (FIG 8)			"	300	
U-CLAMPS 3/8"			"		
BRANCH STRAND CLAMP (GM)			"	100	
ONE-SIDE CLAMP (FIG 8)			"	200	
CABLE EXTENSION METAL ARM TYPE M1	ECH - 2052		"	1100	
" " " " " M2	"		"	300	
" " " " " M3	"				
HOSE CLAMP		(JAPAN) 3622			
ADJUSTABLE HOSE CLAMP 1/2" - 29/32"	ECS - 0245				
" " " 13/16" - 1 3/4"	" - 0246				
" " " 1 13/16" - 2 3/4"	" - 0247				
" " " 2 9/16" - 3 1/2"	" - 0248				
" " " 3 1/16" - 4"	" - 0249				
" " " 15/16" - 4"	" - 0250				
GULVANIZED STEEL CABLE SUSPENSION HOOK	S - 524015				
BOLT					
ANGLED THIMBLEYE BOLT 5/8" x 8"	ECH - 1001		PCE	100	
" " " " x 10"	" - 1002		"	100	
" " " " x 12"	" - 1003		"	100	
" " " " x 14"	" - 1004		"		
" " " " x 16"	" - 1005		"		
" " " 1/2" x 8"					
" " " " x 10"		S - 27798			
" " " " x 12"					

DESCRIPTION	T. O. T CODE NO.	A. E CODE NO.	UNIT PCS	QUANTITY	REMARK
DOUBLE ARMING BOLT 5/8" x 8"	ECH - 1102			50	
" " " " x 10"	" - 1103				
" " " " x 12"	" - 1104				
" " " " x 14"	" - 1105				
" " " " x 16"	" - 1106				
MACHINE BOLT 1/2" x 4"	ECH - 1209	S - 511308			
" " " x 6"	" - 1212				
" " " x 8"	" - 1213				
" " " x 12"	" - 1214				
" " " x 14"	" - 1215				
" " " x 16"	" - 1216				
" " 5/8" x 8"	ECH - 1218	S - 511416	PCE	200	
" " " x 10"	" - 1220	S - 511420	"	100	
" " " x 12"	" - 1221	S - 511422	"	400	
" " " x 14"	" - 1222	S - 511424		100	
" " " x 16"	" - 1223	S - 511426		100	
" " " x 18"	" - 1224				
" " 3/4" x 8"		S - 2908			
" " " x 10"		S - 511510			
" " " x 12"		S - 511512			
" " " x 14"		S - 511514			
STRAIGHT THIMBLEYE BOLT 5/8" x 6"	ECH - 1323				
" " " " x 8"	" - 1324		PCE	100	
" " " " x 10"	" - 1325		"	200	
" " " " x 12"	" - 1326		"	100	
" " " " x 14"	" - 1327			100	
" " " " x 16"	" - 1328			100	
EXTENSION SHIELD WITH BOLT				1400	
BRIDLE RINGS 1 5/8" WOOD SCREW THREAD	ECF - 1002				
GRIP NUT					
PREFORMED GUY GRIP FOR FALSE DEAD-END					
FIG (8)	ECH - 3001		PCE	100	
6 M			"	100	
10 M					
PREFORMED GUY GRIP DEAD-END FIG (8)	ECF - 3131		"	900	
" " " 6 M				800	
" " " 10 M				100	
" " " 16 M	ECF - 3132		"		
PREFORMED STRAND SPLICE 6M				10	
10M	ECF - 3133		"		

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LIST OF MATERIALS

DESCRIPTION	T.O.T. CODE NO.	AE CODE NO	UNIT PCS	QUANITITY	REMARK
GRIP NUT					
FORGED EYE NUTS 5/8"	ECH-3501		PCE	300	
" " " "	" -3503				
MACHINE BOLTS W/2 NUTS					
GULVANIZED NUTS 5/8" BOLT SIZE	ECH-5072		PCE	900	
EXPANSION SHIELD. STRAP. CLAMP					
THIMBLEYE. ROD LIFT PLATE. PROTECTOR. SUPPORT					
DOUBLE EXPANSION SHIELDS 3/8" x 2"	ECF-4010 4012				
TWO-HOLE CONDUIT AND CABLE STRAPS			PCE	400	
ONE-HOLE STEEL CABLE CLAMPS			"		
FORGED ANGLE THIMBLEYE 5/8"	ECH-4020		"	100	
GALVANIZED STEEL GROUND ROD 1/2" x 5 FEET	ECH-4222		PCE	400	
CURVED LIFT PLATE 5/8" (2 1/2" x 7" x 3/16")	ECI-5510		"	100	
GALVANIZED GUY WIRE PROTECTORS 7 FEET	ECH-5550		"	200	
B-LASHED CABLE SUPPORTS 3/4 x 10"	ECH-6902		"	600	
" " " 1 3/16 x 16"	" -6903		"	3100	
" " " 2 x 22"	" -6904		"	3800	
" " " 2 5/8 x 28"	" -6905		"		
" " " 3 1/8 x 34'	" -6906			200	
LAG-SCREW. STAPLE. STRAP					
LAG SCREWS 5/16" x 2 1/2"	ECH-7027				
" " 3/8" x 3 1/2"	" -7043				
" " 3/8" x 4" GIMLET POINT			PCE	100	
FOR CURVE LIFT PLATE	ECH-7044				
" " 1/2" x 4" GIMLET POINT				100	
FOR SIDEWALK GUY FITTING	ECH-7048				
SERVISLEEVS 5/16" (6M)	ECH-7101			1500	
GALVANIZED STEEL STAPLE	ECH-7140				

DESCRIPTION	T.O.T. CODE NO.	AE CODE NO.	UNIT PCS	QUANITITY	REMARK
STRANDVISE 5/16"-4M-TYPE 5151	ECH-7251				
" " -6M " 5101	" -7252				
" " -6M " 5151	" -7256				
WASHER WIRE LINK					
CURVED WASHER 5/8 (2 1/2" x 2 1/2" x 3/16")	ECH-9001		PCE	300	
SQUARE " (2 1/4" x 2 1/4" x 3/16")	" -9043		"	1300	
LONG SQUARE WASHER 5/8			"	400	
CURVED WASHER 5/8"(2 1/2" x 2 1/2" x 3/16" x 1/16" HOLE DIAM)	ECH-9001		"	50	
" " 3/4 (3"x 3" x 1/4" x 13/16" " ")	" -9004		"		
ROUND WASHER 1/2" (2"x 2" x 1/8"-9/16" HOLE DIAM)	ECH-9041				
" " 1/2" (2"x 2" x 1/4-9/16" " ")	" -9042				
" " 5/8" (2 1/4 x 2 1/4" x 3/16" x 11/16" " ")	" -9043				
WIRE LINK - TYPE 5059	ECH-9100				
STRAND LINK FOR FIG(8) CABLE			PCE	100	
STEEL FLAT CROSS ARM BRACES 1 1/2 x 24" x 3/16"					
" " " " 1 1/2 x 30 x 3/16"					
CABLE EXTENSION ARMS (3'x 3"x 3"- 3')					
ANCOHOR RODS 3/4" X (REQUIRED LENGTH)			PCE	50	
WOOD LOG FOR ANCHOR ROD				50	
ONE BOLT GUY ATTACHMENTS		S-518205			
SIDE-WALK GUY FITTINGS FOR WOODEN POLE		SR-329	PCE	10	
" " " POR CONCRETE POLE			"	30	
			"		
GALVANIZED STEEL PIPE ø 2 1/2" (2M)			"	30	
" " " (4M)			"		
S-LON PIPE ø1/2" x 25 METER			"	300	
S-LON 90°					
U-GUARDS			PCE	200	
GUY STRAIN INSULATOR TYPE 506	ECI-0073		PCE	200	

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LIST OF MATERIALS

DESCRIPTION	T.O.T CODE NO.	JAPAN CODE NO.	UNIT	QUANTITY	REMARK
STEARINE, C-CEMENT, COMPOUND					
STEARINE (250G)		3307	PCE	500	
STEARINE CANDLE	ECS-0100				
C-CEMENT 100G/PCE	〃 -0230		PCE	350	
〃 〃 402	〃 -0231				
SCOTCH KOTE	ECS-0380				
WATER PROOF COMPOUND	ECS-0470	3704	KG		
MOISTURE PROOF COMPOUND		3705			
NO. 1 ADHENSION AGENT		3706			
NO. 2 SPECIAL COMPOUND (WITH HARDNER)		3703	KG	60	
NO. 3 〃 〃		3708			
NO. 4 〃 〃 (RESIN)		3701	KG		
NO. 4 〃 〃 (HARDNER)		3702			
NO. 5 〃 〃		3707	PCE	40	
DESICCANT, DESICCAN-CLOTH, FLOSS-SILK					
PROTEK SORB DESICCANT 160 G	ECS-1020				
〃 〃 〃 50 G	〃 -1021				
DESICCANT (DRY AGENT) 50G/BAG	ECS-1091	3031	BAG	3000	
DESICCANT CLOTH 20 x 36 x 25 CM		3034			
〃 〃 24 x 36 x 29 〃		〃		80	
〃 〃 27 x 36 x 32 〃		〃		10	
〃 〃 27 x 45 x 32 〃		〃		40	
〃 〃 31 x 36 x 36 〃		〃		20	
〃 〃 31 x 45 x 36 〃		〃		10	
〃 〃 34 x 45 x 39 〃		〃		10	
〃 〃 37 x 45 x 42 〃		〃		30	
〃 〃 40 x 45 x 45 〃		〃		20	
〃 〃 44 x 45 x 49 〃		〃		20	
〃 〃 48 x 45 x 53 〃		〃		10	
〃 〃 51 x 45 x 55 〃		〃		20	
〃 〃 53 x 45 x 58 〃		〃		10	
〃 〃 55 x 45 x 60 〃		〃		10	
〃 〃 57 x 45 x 62 〃		〃		10	
〃 〃 59 x 45 x 64 〃		〃		30	
〃 〃 62 x 45 x 67 〃		〃		10	
65 x 45 x 70 〃				10	
68 x 45 x 73 〃				10	
PLASTIC TUBE FITTING-PIPE COUPLING	ECS-1500				
〃 〃 〃 MALE COUPLING	〃 -1501				
〃 〃 〃 FERRULE	〃 -1502				

DESCRIPTION	T.O.T CODE NO.	JAPAN CODE NO.	UNIT	QUANTITY	REMARK
FLOSS SILK 10 PCS/BAG	ECS-1700		BAG	10	
TAPE. BONDING-RIBON					
SEALING TAPE NO.1 30-280MM-6 PCS/BAG	ECT-1158	3601	BAG	190	
〃 〃 NO.2 40-280 -6 〃	〃 -1159	3602	〃	150	
〃 〃 NO.3 30-280 -3 〃	〃 -1160	3603	〃	1000	
〃 〃 NO.4 40-280 -3 〃	〃 -1161	3604	〃	600	
ADHESIVE ALUMINUM TAPE NO.1 30MM x 20M/ROLL	EC2-1000		ROLL	250	
〃 PAPER TAPE 50M/〃			〃		
〃 GLASS FIBER TAPE 52M/〃	EC2-1203		〃	20	
〃 P.V.C TAPE NO.1 10M/〃		3611	〃	1400	
〃 〃 〃 NO.2 20M/〃	〃 -1001	3612	〃	2000	
〃 〃 〃 (GENERAL) 20M/〃		3620	〃		
BONDING COPPER TAPE 10M/ROLL	EC2-1060	3613	〃	100	
〃 〃 〃 (SELF) NO.2 5M/〃		3619	〃	〃	
COTTON TAPE 38MMx 30M/〃	EC2-1090		〃	50	
〃 〃 50MMx 30M/〃	〃 -1091		〃	40	
CR TAPE 28" x 20'	ECS-7024				
DR TAPE 3/4" x 15'	EC2-1120		〃		
〃 〃 2" x 15'	〃 -1121		〃		
ELECTRICAL TAPE 3/4" x 66'	〃 -1132		〃		
ELICTION TAPE 3/4" x 60'	〃 -1185		〃		
〃 〃 2" x 60'	〃 -1186		〃		
GLASS TAPE 1" x 108'	〃 -1201		〃		
GLASS FIBER TAPE 38MMx 30M/ROLL	〃 -1202		〃	150	
POLYETHYLENE TAPE 30MMx 20M/〃	〃 -1275	3605	〃		
〃 〃 60MMx 20M/〃	〃 -1276	3606	〃	100	
〃 〃 (BLACK) 20M/〃	〃 -1277	3405	〃		
VALCANIZED RUBBER TAPE 10M/〃	〃 -1300	3406	〃		
P.V.C TAPE FOR TERMINATING JOINT 20M/〃	〃 -1345	3618	〃		
SOFT BONDING TAPE 5M/〃		3419	〃	10	
LACING TWINE 6 PLIES	EC2-1501				
MUSLIN TAPE 2" x 10YDS					
〃 〃 4" x 10YDS					
ALUMINIUM FOIL TAPE 2" x 20'	ECS-7000		ROLL		
〃 〃 〃 4" x 20'	〃 -7001		〃		
V N TAPE 10M/ROLL		3610	〃	1500	
SPACER TAPE			〃		
BONDING RIBBON 0.375" x 60'/ROLL	ECS-4600		〃	10	

PL EX.

LIST OF MATERIALS

DESCRIPTION	T.O.T. CODE NO.	JAPAN. CODE NO.	UNIT	QUANTITY	REMARK
SOLDER					
NO. 1 SOLDER 250G / ROLL		3301	ROLL	3800	
NO. 2 〃 1KG / ROLL	ECS-5700	3302			
NO. 3 〃		3303			
NO. 4 (CREAM) SOLDER 100G / TIN	ECS-5722	3304	TIN	1800	
NO. 4 (〃) 〃 200G / TIN		3305			
BAR SOLDER 1½ LBS	ECS-5612				
KESTER SOLDER 1/16" x 0.062 (1LBS)	ECS-5672				
〃 〃 1/8 x 0.125 (5LBS)	〃 -5686				
TERMINATING MATERIALS					
NO. 50 P.V.C. LID FOR TERMINATING JOINT	ECS-3050				
NO. 75 〃 〃 〃	〃 -3051				
NO. 100 〃 〃 〃	〃 -3052				
NO. 125 〃 〃 〃	〃 -3053				
NO. 150 〃 〃 〃	〃 -3054		PCE		
NO. 200 〃 〃 〃	〃 -3055		〃		
NO. 50 〃 SLEEVE 〃	ECS-5270				
NO. 75 〃 〃 〃	〃 -5271				
NO. 100 〃 〃 〃	〃 -5272				
NO. 125 〃 〃 〃	〃 -5273				
NO. 150 〃 〃 〃	〃 -5274		PCE		
NO. 200 〃 〃 〃	〃 -5275		〃		
NO. 50 〃 TUBE 〃	ECS-7230				
NO. 75 〃 〃 〃	〃 -7231				
NO. 100 〃 〃 〃	〃 -7232				
NO. 125 〃 〃 〃	〃 -7233				
NO. 150 〃 〃 〃	〃 -7234		PCE		
NO. 200 〃 〃 〃	〃 -7235		〃		
NO. 50 TERMINATING SLEEVE RECEPTACLE BAND		4601			
NO. 75 〃 〃 〃 〃		4602			
NO. 100 〃 〃 〃 〃	ECS-5300	4603			
NO. 125 〃 〃 〃 〃	〃 -5301	4604			
NO. 150 〃 〃 〃 〃	〃 -5302	4605	PCE		
NO. 200 〃 〃 〃 〃	〃 -5303	4606	〃		

DESCRIPTION	T.O.T. CODE NO.	JAPAN CODE NO.	UNIT	QUANTITY	REMARK
NO. 50 TERMINATING SLEEVE FIXING BAND		4611			
NO. 75 〃 〃 〃 〃		4612			
NO. 100 〃 〃 〃 〃	ECS-5286	4613			
NO. 125 〃 〃 〃 〃	〃 -5287	4614			
NO. 150 〃 〃 〃 〃	〃 -5288	4615	PCE		
NO. 200 〃 〃 〃 〃	〃 -5289	4616	PCE		
CABLE FIXING BAND			PCE		
SLEEVE					
COTTON SLEEVE 3/32"x 3¼"x 900 (0.4MM)	ECS-5021				
〃 〃 1/8"x 3¼"x 700 (0.5 〃)	〃 -5022				
〃 〃 5/32"x 3¼"x 400 (0.65 〃)	〃 -5023				
〃 〃 1/4"x 3¼"x 200 (0.9 〃)	〃 -5024				
COMPOUND FILLED PE SLEEVE FOR 0.4MM	ECS-5050		〃		
〃 〃 〃 〃 〃 0.5	〃 〃				
〃 〃 〃 〃 〃 0.65	〃 〃				
〃 〃 〃 〃 〃 0.9	〃 〃				
PLASTIC SLEEVES 0.106" x 3" x 250 (GREEN)	ECS-5150				
〃 〃 0.125" x 3" x 250 (BLACK)	〃 -5151				
〃 〃 0.148" x 3" x 250 (RED)	〃 -5152				
〃 〃 0.208" x 3" x 250 (YELLOW)	〃 -5153				
PAPER SLEEVE FOR 0.4MM CONDUCTOR 200/BAG	ECS-5180	3001	BAG	2400	
〃 〃 〃 0.5 〃 〃	〃 -5181	3002	〃	40	
〃 〃 〃 0.65 〃 〃	〃 -5182	3003	〃	20	
〃 〃 〃 0.9 〃 〃	〃 -5183	3004	〃	10	
PLASTIC FILLED SPLICE SLEEVE x 550 (YELLOW)	ECS-5200				
〃 〃 〃 〃 0.106x 450 (GREEN)	〃 -5201				
〃 〃 〃 〃 0.125 x 350 (CLEAR)	〃 -5202				
〃 〃 〃 〃 0.145 x 275 (RED)	〃 -5203				
〃 〃 〃 〃 0.145 x 225 (BLUE)	〃 -5204				
POLYETHYLENE SLEEVE FOR 0.32MM CONDUCTOR 200/BAG	ECS-5225	3011	BAG	1800	
〃 〃 〃 0.4 〃 〃 〃	〃 〃	3012	〃	200	
〃 〃 〃 0.5 〃 〃	〃 〃	3013			
〃 〃 〃 0.65 〃 〃	〃 〃	3014			
〃 〃 〃 0.9 〃 〃	〃 〃	3015			
AUXILIARY PE SLEEVE NO. 363		3244			
〃 〃 〃 NO. 364		3255			
MAIN LEAD SLEEVE					
LEAD SLEEVE 3/4" x 15"	ECS-5334				
〃 1" x 15"	〃 -5335				
〃 1/4" x 15"	〃 -5336				

LIST OF MATERIALS

DESCRIPTION	T.O.T. CODE NO.	JAPAN CODE NO.	UNIT	QUANTITY	REMARK
MAIN LEAD SLEEVE					
LEAD SLEEVE 1 1/2" x 15"	ECS-5337		PCE		
" " 1 3/4" x 17"	" -5338		"		
" " 2" x 17"	" -5339		"		
" " 2 1/4" x 17"	" -5340		"		
" " 2 1/4" x 20"	" -5341		"		
" " 2 3/4" x 20"	" -5342		"		
" " 3" x 20"	" -5343		"		
" " 3 1/2" x 20"	" -5344		"		
" " 4" x 20"	" -5345		"		
" " 4 1/2" x 20"	" -5346		"		
" " 4 1/2" x 22"	" -5347		"		
" " 5" x 20"	" -5348		"		
" " 5" x 22"	" -5349		"		
" " 5 1/2" x 20"	" -5350		"		
" " 5 1/2" x 22"	" -5351		"		
" " 6" x 22"	" -5352		"		
" " 6 1/2" x 24"	" -5353		"		
" " 7" x 24"	" -5354		"		
" " 8" x 24"	" -5355		"		
MAIN LEAD SLEEVE 30 - 300 MM	ECS-5405		PCE	40	
" " " 40 - 300 "	" -5408		"	290	
" " " 40 - 400 "	" -5409		"	20	
" " " 50 - 400 "	" -5412		"	430	
" " " 60 - 400 "	" -5415		"	680	
" " " 70 - 500 "	" -5420		"	360	
" " " 80 - 500 "	" -5426		"	120	
" " " 90 - 500 "	" -5432		"	140	
" " " 100 - 500 "	" -5435		"	50	
" " " 110 - 500 "	" -5438		"	50	
" " " 120 - 500 "			"	120	
" " " 130 - 500 "			"	30	
" " " 140 - 500 MM	ECS-5441		"	20	
" " " 150 - 500 "	" -5444		"	20	
" " " 160 - 500 "	" -5447		"	10	
" " " 170 - 500 "	" -5450		"	10	
" " " 180 - 500 "	" -5453		"	20	
" " " 190 - 500 "	" -5457		"	30	
" " " 200 - 500 "	" -5460		"	20	
" " " 210 - 500 "	" -5463		"	10	
" " " 220 - 500 "	" -5466		"		
" " " 250 - 500 "			"	5	
AUXILIARY LEED SLEEVE 30 - 110 MM		3141	"	3000	
" " " 50 - 110 "		3142	"	1600	
" " " 70 - 110 "		3143	"		

DESCRIPTION	T.O.T. CODE NO.	JAPAN CODE NO.	UNIT	QUANTITY	REMARK
AUXILIARY LEAD SLEEVE 50 - 150 MM		3145			
" " " 70 - 150 "		3146			
" " " 35 - 130 "	ECS-5406		PCE		
" " " 40 - 130 "	" -5407		"		
" " " 45 - 130 "	" -5410		"	5	
" " " 50 - 130 "	" -5411		"	200	
" " " 55 - 130 "	" -5413		"	5	
" " " 60 - 130 "	" -5414		"	90	
" " " 65 - 130 "	" -5417		"	70	
" " " 70 - 130 "	" -5418		"	50	
" " " 75 - 130 "	" -5423		"	20	
" " " 80 - 130 "	" -5424		"		
" " " 85 - 130 "	" -5429		"	90	
" " " 90 - 130 "	" -5430		"	10	
" " " 95 - 130 "		3135	"	5	
" " " 100 - 130 "		3136	"	20	
LEAD PLATE					
LEAD PLATE ø 90		3167	PCE	90	
" " ø 110		3151	"	20	
" " ø 120		3152	"		
" " ø 130		3153	"	10	
" " ø 140		3154	"		
" " ø 150		3155	"		
" " ø 160		3156	"		
" " ø 170		3157	"		
" " ø 180		3158	"		
" " ø 190		3159	"		
" " ø 200		3160	"		
" " 4 x 20 CM x 33 CM	ECS-3000				
PERFORATED LEAD PLATE 40 - 250 MM	" -3001	3147	PCE	450	
SPACER					
PLASTIC CABLE SPACER 1/4"	ECS-5800		"	3800	
" " " 1/2"	" -5801		"		
" " " 3/4"	" -5802		"	3700	
" " " 1"	" -5803		"	200	
SPACER FOR ADAPTER SPCR A 170		3260			
" " " " A 150		3261			
" " " " A 120		3262			
" " " " A 100		3263			
" " " " A 140		3264			
" " " " A 85		3265			
" " " " A 57		3266			
" " " " A 36		3267			

PL EX.

LIST OF MATERIALS

DESCRIPTION	T.O.T. CODE NO.	JAPAN CODE NO.	UNIT	QUANTITY	REMARK
SPACER					
SPACER FOR AUXILIARY PE SLEEVE-SPCR AV x 85					
〃 〃 〃 〃 〃 〃 〃 57					
〃 〃 〃 〃 〃 〃 〃 36					
PE-CAP, BASE METAL					
PRESSURE VALVE (TEST VALVE)					
PE CAP ø20 WITH PRESSURE VALVE		4915			
〃 〃 ø22 〃 〃 〃		〃			
〃 〃 ø24 〃 〃 〃		〃			
〃 〃 ø26 〃 〃 〃		〃			
〃 〃 ø28 〃 〃 〃		〃			
〃 〃 ø30 〃 〃 〃		〃			
〃 〃 ø32 〃 〃 〃		〃			
〃 〃 ø34 〃 〃 〃		〃			
〃 〃 ø36 〃 〃 〃		〃			
〃 〃 ø38 〃 〃 〃		〃			
〃 〃 ø40 〃 〃 〃		〃			
〃 〃 ø42 〃 〃 〃		〃			
〃 〃 ø44 〃 〃 〃		〃			
〃 〃 ø46 〃 〃 〃		〃			
〃 〃 ø48 〃 〃 〃		〃			
〃 〃 ø50 〃 〃 〃		〃			
〃 〃 ø52 〃 〃 〃		〃			
〃 〃 ø54 〃 〃 〃		〃			
〃 〃 ø56 〃 〃 〃		〃			
〃 〃 ø58 〃 〃 〃		〃			
〃 〃 ø60 〃 〃 〃		〃			
〃 〃 ø62 〃 〃 〃		〃			
〃 〃 ø64 〃 〃 〃		〃			
〃 〃 ø66 〃 〃 〃		〃			
〃 〃 ø68 〃 〃 〃		〃			
〃 〃 ø70 〃 〃 〃		〃			
〃 〃 ø72 〃 〃 〃		〃			
〃 〃 ø74 〃 〃 〃		〃			
〃 〃 ø76 〃 〃 〃		〃			
〃 〃 ø78 〃 〃 〃		〃			
〃 〃 ø80 〃 〃 〃		〃			
〃 〃 ø82 〃 〃 〃		〃			
P.V.C CAP ø12MM		4915	PCE		
〃 〃 ø14 〃		〃	〃		
〃 〃 ø16 〃		〃	〃	10	
〃 〃 ø18 〃		〃	〃	10	
〃 〃 ø20 〃		〃	〃		

DESCRIPTION	T.O.T. CODE NO.	JAPAN CODE NO.	UNIT	QUANTITY	REMARK
P.V.C CAP, ø22MM		4915	PCE	10	
〃 〃 ø24 〃		〃	〃		
〃 〃 ø26 〃		〃	〃		
〃 〃 ø28 〃		〃	〃	10	
〃 〃 ø30 〃		〃	〃		
〃 〃 ø32 〃		〃	〃	10	
〃 〃 ø34 〃		〃	〃		
〃 〃 ø36 〃		〃	〃		
〃 〃 ø38 〃		〃	〃		
〃 〃 ø40 〃		〃	〃		
〃 〃 ø42 〃		〃	〃		
〃 〃 ø44 〃		〃	〃		
BASE METAL FOR COMPOUND INJECTOR		4917	PCE		
〃 〃 〃 NO.6 VALVE		4918	〃	30	
WIRE, CORD					
GULVANIZED STEEL STRAND GUY WIRE 5/16"-(6M)	DCP-2002		KG	3500	
GUY STRAND 3/8" (10M)	DCP-2003		KG	100	
COPPERWELD TELEPHONE LINE WIRE AWG #6			M	2200	
0.9MM ANNEALED CAPPER WIRE		2940	M		
1.6MM IRON WIRE			KG	20	
JUMPERING WIRE			M	102000	
ø5MM CABLE BINDING CORD			M	1900	
CABLE LASHING WIRE (0.045")			ROLL	230	

PL EX.

LIST OF MATERIALS

DESCRIPTION	T.O.T. CODE NO.	AE CODE NO.	UNIT	QUANTITY	REMARK
HARDWARES IN M.H					
CABLE RACK EXTENSION			PCE	490	
RACK SECTION (8 HOLES)			PCE	130	
" " (14 ")			"	150	
(18 ")			"		
RACK HOOK (4" LGTH)			"	70	
" " (7½" ")			"	560	
" " (10" ")			"		
CABLE RACK INSULATOR			"	630	
ZINC CABLE DUCT SHIELD			"	500	
GALVANIZED IRON PIPE ø2"			PCE	100	
FOR RISER CABLE PROTECTION					
" IRON PIPE ø3"			PCE	100	
FOR BURRIED CABLE PROTECTION					

DESCRIPTION	T.O.T. CODE NO.	AE CODE NO.	UNIT	QUANTITY	REMARK
POLE					
CONCRETE POLE (8 M)			PCE	43	
" (10 M)			"		
GUY					
DRIVING ANCHOR #2			PCE	100	
" " #3			"		
AUXILIARY EYES			"	10	
CROSS CONNECTING CABINET 800P			"	104	
TERMINAL BLOCK FOR CABINET					
50P - LEAD SHEATH STUB			PCE	52	
100P - " " "			"	216	
50P - POLYETHYLENE SHEATH STUB			"	45	
100P - " " "			"	360	
RELIABLE TYPE ST CABLE TERMINAL					
10 P			PCE	518	
15 P			"	453	
25 P			"	103	
WALL MOUNT TERMINAL BOX (JAPAN)					
FOR TROUGH CABLE 10 P			PCE	16	
" " " 15 P			"	5	
" " " 20 P			"		
6P-TERMINAL BLOCK (FOR READY ACCES)			"	140	
STRAIGHT NOZZLE (FOR READY ACCES)			"	70	
BRANCH NOZZLE (")			"	20	
TERMINAL FOR M.D.F					
258-TERMINAL BLOCK			"		

PL. EX.

LIST OF MATERIALS

DESCRIPTION	T.O.T CODE NO.	JAPAN CODE NO.	UNIT	QUANTITY	REMARK
PUREGAS EQUIPMENT & MATERIALS					
MODEL 1500 AIR DRYER			PCE		
METER PANEL			"		
DUAL PRESSURE PANEL			"		
PEC 522 ALARM PANEL			"		
" 522A MASTER ALARM MODULE			"		
" 522B ALARM MODULE			"		
" 522C LOCAL AIR DRYER ALARM MODULE			"		
" 522D MODULE BLANKS			"		
" 522E ALARM PANEL FRAME			"		
" 412 MAILE ELBOW			"	23	
" 523 PRESSURE GUARD (CABLE MOUNTED)			"		
" 524 " " (POLE, WALL MOUNTED)			"	22	
" 525 " " (UNDERGROUND)			"	1	
" 401C FLANGE			"	22	
PEC 402D FLANGE			"	7	
" 404B PRESSURE TESTING ELL			"	18	
" 405 SEALING CLAMPS			"		
PEC 408 LEAD TUBING (OD 1/2", 50FT COILS)			M	50	
" 409 COPPER TUBING (OD 3/8" OR 1/2")			"		
PEC 501F PRESSURE TESTING VALVE (INSTALLED IN CORD FLANGE)			PCE	20	
" 502P " " " (END OF LEAD PIPE)			"	80	
" 503C " " " (DIRECT INSTALLATION)			"	10	
" 504M VALVE CAP (INSTALLED BY WRENCH)			"		
" 505R " " (" " HAND)			"	30	
PEC 508 DUAL STEM BY-PASS VALVE					
PEC 419 MALE ELBOW			PCE		
" 421 UNION (EXTEND LENGTH OF PLASTIC TUBING)			"		
" 424 TEE (BRANCH AIR FLOW " " ")			"		
" 426 PLASTIC SHEATH FITTING			"		
" 429 PLASTIC TUBE RACK					
PEC 431 POLY-CORTUBING 3 TUBES			M		
" 5 "			"		
" 10 "			"		

DESCRIPTION	T.O.T CODE NO.	JAPAN CODE NO.	UNIT	QUANTITY	REMARK

PL EX.

CABLE DRUM LENGTH SHEET

DRUM NO.	KIND OF CABLE			CABLE LENGTH (M)	LOCATION
1	3000 - 4ASP			252.0	MH # 43 - MH # 45 - MH # 46
2	〃 〃			215.0	MH # 46 - MH # 47
3	〃 〃			223.0	MH # 47 - MH # 48
4	〃 〃			188.0	MH # 48 - MH # 20 - MH # 21
5	2400 - 4ASP			271.0	MH # 38 - PB # 73 MH # 43 - MH # 45 - MH # 46
6	〃 〃			215.0	MH # 46 - MH # 47
7	〃 〃			252.0	MH # 43 - MH # 45 - MH # 46
8	〃 〃			112.0	MH # 21 - MH # 22
9	〃 〃			211.0	MH # 22 - MH # 23
10	〃 〃			209.0	MH # 23 - MH # 24
11	〃 〃			278.0	MH # 24 - MH # 25 - MH # 26
12	1800 - 4ASP			273.0	MH # 93 - MH # 94 - MH # 95
13	〃 〃			187.0	MH # 95 - MH # 96
14	〃 〃			187.0	MH # 96 - MH # 97
15	〃 〃			188.0	MH # 97 - MH # 98
16	〃 〃			223.0	MH # 47 - MH # 48
17	〃 〃			217.0	MH # 48 - MH # 49
18	〃 〃			163.0	MH # 49 - MH # 50
19	〃 〃			217.0	MH # 46 - MH # 47
20	〃 〃			278.0	MH # 47 - MH # 48 - MH # 20
21	〃 〃			209.0	MH # 20 - MH # 4 - MH # 5
22	〃 〃			137.0	MH # 5 - MH # 6
23	〃 〃			292.0	MH # 26 - MH # 27 - MH # 28
24	〃 〃			209.0	MH # 28 - MH # 29
25	〃 〃			181.0	MH # 29 - MH # 30
26	〃 〃			204.0	MH # 30 - MH # 31 MH # 32
27	1200 - 4ASP			227.0	MH # 98 - MH # 99
28	〃 〃			207.0	MH # 99 - MH # 100
29	〃 〃			179.0	MH # 37 - MH # 72 PB # 13 - PB # 14
30	〃 〃			265.0	MH # 50 - MH # 51 - MH # 52
31	〃 〃			276.0	MH # 52 - MH # 53 - MH # 54
32	〃 〃			236.0	MH # 6 - MH # 7 - MH # 8
33	〃 〃			187.0	MH # 46 - MH # 2 - MH # 60
34	〃 〃			169.0	MH # 60 - MH # 61

DRUM NO.	KIND OF CABLE			CABLE LENGTH (M)	LOCATION
35	1200 - 4ASP			160.0	MH # 61 - MH # 62
36	〃 〃			162.0	MH # 62 - MH # 63
37	900 - 4ASP			352.0	MH # 100 - MH # 101 - MH # 102 - PB # 85
38	〃 〃			283.0	PB # 14 - PB # 15 PB # 149 - (PW)MH # 17 - (PW)MH # 29 - (PW)MH # 28
39	〃 〃			286.0	(PW)MH # 28 - (PW)MH # 37 - PB # 148 MH # 37
40	〃 〃			178.0	MH # 54 - MH # 55 MH # 8 - PB # 151
41	600 - 4ASP			314.0	MH # 16 - PB # 155 MH # 55 - MH # 56 - MH # 57
42	〃 〃			308.0	MH # 8 - MH # 9 - MH # 10 - MH # 11
43	〃 〃			343.0	MH # 63 - MH # 64 MH # 63 - MH # 66
44	〃 〃			312.0	MH # 66 - MH # 67 - MH # 68
45	〃 〃			361.0	MH # 68 - MH # 69 - MH # 70 MH # 73 PB # 33, MH # 75 - PB # 41, MH # 37
46	〃 〃			312.0	MH # 70 - MH # 71 - MH # 72 - MH # 73
47	〃 〃			345.0	MH # 73 - MH # 74 PB # 15 - PB # 16 , MH # 63 - PB # 28
48	300 - 4ASP			401.0	MH # 89 - (PW) MH # 81 - PB # 146
49	〃 〃			480.0	PB # 107 - PB # 94 - PB # 95 - PB # 98 - PB # 100 PB # 100 - PB # 101 - PB # 102 - PB # 103
50	〃 〃			441.0	PB # 148 - PB # 147 (PW)MH # 29 - (PW)MH # 30 - PB # 150
51	〃 〃			508.0	MH # 11 - MH # 12 - MH # 13 MH # 13 - MH # 14 - MH # 15
52	〃 〃			527.0	MH # 64 - MH # 65 - MH # 30 MH # 74 - MH # 75
53	〃 〃			473.0	MH # 25 - PB # 7 - PB # 8 PB # 33 - PB # 34
54	2400 - 4ASPT			223.0	PB # 73 - CAB # 119
55	〃 〃			288.0	CAB # 119 - CAB # 094
56	1800 - 4ASPT			261.0	CAB # 094 - CAB # 122 - CAB # 124
57	〃 〃			281.0	CAB # 124 - CAB # 126 MH # 31 - SPLICING POINT
58	〃 〃			203.0	SPLICING POINT - SPLICING POINT
59	〃 〃			204.0	SPLICING POINT - CAB # 186
60	〃 〃			247.0	CAB # 186 - PB # 13
61	1200 - 4ASPT			227.0	PB # 72 - CAB # 118 CAB # 126 - SPLICING POINT
62	900 - 4ASPT			306.0	PB # 85 - SPLICING POINT PB # 149 CAB # 108 SPLICING SPLICING POINT -
63	〃 〃			204.0	SPLICING POINT - CAB # 015
64	〃 〃			181.0	CAB # 118 - CAB # 056
65	〃 〃			187.0	CAB # 056 - CAB # 120
66	〃 〃			307.0	CAB # 120 - CAB # 123
67	600 - 4ASPT			225.0	MH # 32 - SPLICING POINT CAB # 015 - CAB # 139
68	〃 〃			204.0	SPLICING POINT - CAB # 132

PL EX.

CABLE DRUM LENGTH SHEET

DRUM NO.	KIND OF CABLE			CABLE LENGTH (M)	LOCATION
69	600 - 4ASPT			287.0	CAB# 123 - CAB # 125 SPLICING POINT - CAB# 110
70	〃 〃			220.0	PB # 151 - SPLICING POINT
71	〃 〃			225.0	SPLICING POINT - PB # 166
72	300 - 4ASPT			295.0	CAB# 132 - CAB # 093
73	〃 〃			327.0	CAB# 093 - CAB # 133 MH # 38 - CAB# 113 PB# 76 - CAB# 117
74	〃 〃			435.0	CAB# 125 - CAB # 127 PB # 73 - CAB # 114 CAB# 110 - CAB# 111
75	〃 〃			338.0	CAB # 004 - PB # 13 SPLICING POINT - CAB# 112 PB# 5 - SPLICING POINT
76	〃 〃			348.0	SPLICING POINT - PB# 158 SPLICING POINT - PB# 178, SPLICING POINT - CAB# 186
77	〃 〃			362.0	SPLICING POINT - CAB# 187, PB# 28 - PB# 172 MH # 57 - PB# 170 SPLICING POINT PB# 21
78	900 - 5ASPT			205.0	PB # 13 - SPLICING POINT
79	〃 〃			233.0	SPLICING POINT - CAB # 193
80	〃 〃			182.0	CAB # 193 - CAB # 194
81	600 - 5ASPT			213.0	CAB # 194 - PB # 18
82	100 - 65ASPT			264.0	CAB # 093 - CAB # 133 TROUGH INSERT

DRUM NO.	KIND OF CABLE			CABLE LENGTH (M)	LOCATION

"PL" ANNEX Demand Forecast for Special Area in PL Exchange

Bldg. Name	Demand Forecast			Remarks
	1976	1980	1985	
ETO Bus Office	15	20	30	
Boxing Stadium	5	10	20	
Christani & Nielsew (Thai) Co., Ltd.	15	20	25	
Siam Hotel	19	23	25	
Japanese Embassy	25	35	50	
Diethelm Co., Ltd.	15	20	25	
BR Bldg.	18	20	30	
Atami	6	8	12	
Donbosco Technical School	5	7	10	
B Grim & Co.	15	17	25	
3M Company	57	60	80	
Saint Dominic School	4	7	10	
Prince Hotel	6	20	25	
S. Piya Motors Co., Ltd.	7	10	15	
Astra Hotel	6	8	10	
Nakorn Petch Hotel	7	8	13	
Vimol Court	19	22	26	
Crown Bowl	9	12	16	
Railway School	10	15	25	
Railway Hospital	7	10	15	
Railway Police Station	10	15	25	
School	2	3	5	

(Cont'd)

Bldg. Name	Demand Forecast			Romarks
	1976	1980	1985	
School	2	3	5	
Kai Chock Chon Foundation	11	12	15	
Republic of China Embassy	35	36	55	
Government Bank	8	10	15	
School	2	3	5	
Honey Hotel	5	7	10	
Chivin & Srid Apart.	8	8	8	
Villa Apartment	37	37	37	
Nanhattan Hotel	19	23	25	
Chatra Court	7	7	7	
Ruamchai Apartment 1	8	8	8	
" " 2	21	21	21	
RC Court	10	16	16	
Watana Vitayalai School	5	7	10	
International School	10	15	20	
Apartment	3	6	6	
Richi Court	33	33	33	
Rama Mansion	5	16	16	
Terrace Court	3	21	21	
Pawa Apartment	2	6	6	
Ratana Court	16	16	16	
Siam Mansion	24	24	24	
Bangkapi Mansion	21	21	21	
Asia House	5	15	20	

(Cont'd)

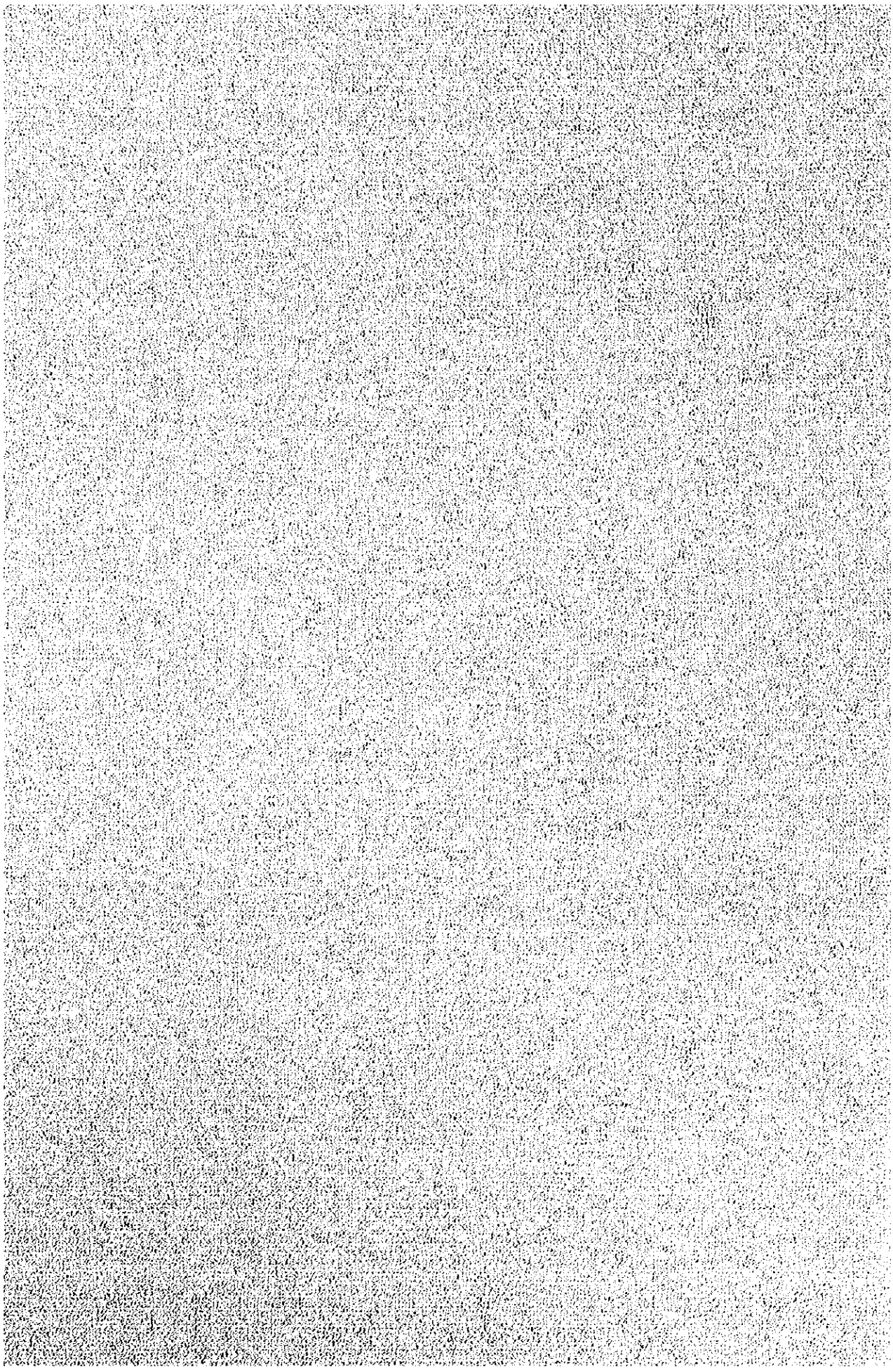
Bldg. Name	Demand Forecast			Remarks
	1976	1980	1985	
Sukchai Court	15	15	15	
B & P Bldg.	20	30	50	
Firestone Bldg.	10	15	20	
Miami Hotel	13	17	20	
Chavalit Hotel	30	37	45	
Ambassador Hotel	50	60	70	
Insaf Mansion	20	30	40	
Federal Hotel	13	17	20	
Chan House	42	42	42	
Chaiyos Mansion	7	13	15	
Hotel Play Boy	7	10	13	
Bangkok Bank (Bangkapi Branch)	10	15	20	
TP Court	5	9	9	
School	2	3	3	
Bangkok Mansion	15	15	15	
City House	5	10	10	
555 Hotel	5	7	10	
Rich Hotel	12	15	20	
Krung Thep Sahakol Co.	30	40	50	
Warehouse	15	18	25	
Park Hotel	20	23	30	
Nai Leard Bldg.	80	100	125	
Fortuna Hotel	40	45	50	
Siva Court	10	15	25	

(Cont'd)

Bldg. Name	Demand Forecast			Remarks
	1976	1980	1985	
AS Villa	10	17	25	
Thaweesuk Hotel	10	18	25	
Raja Hotel	30	45	55	
OK Court	8	13	17	
Calvary Baptist Church	4	7	8	
Silver Court	10	15	20	
Tobacco Monopoly	85	95	120	
Nana Hotel	18	27	35	
Grace Hotel	20	25	30	
Pakistani Embassy	12	18	25	
The Fellowship of Buddhist	10	13	15	
Krisana Mansion	50	50	50	
Golden Palace	6	7	10	
Kindergarten	3	4	5	
Piyatham Court	55	60	70	
Swiss Embassy	12	18	25	
Hanuman Film Studio	4	6	10	
New Bldg.	50	70	80	
Apartment	15	20	30	
Uthai Court	20	30	40	
American Embassy	80	140	200	
New Hotel	40	70	100	
New Ruam Rudee Hotel	10	15	20	
Bangkok Tower Hotel	5	10	15	
Lumpini Police Station	7	10	15	

(Cont'd)

Bldg. Name	Demand Forecast			Remarks
	1976	1980	1985	
Dept. of Horse Police	15	20	25	
Imperial Hotel	22	30	40	
Thewee Court	8	13	15	
White Court	7	11	13	
SV Apartment	15	20	30	
Monet House .	7	15	20	
Ruam Rudee House	15	20	30	
Wat Payatai	5	6	7	
Lumpini Park	40	50	70	
The Royal Army Signal	50	60	75	
Bank of Ayudhaya	210	250	300	
Embassy of Netherland	7	15	20	
New Building	0	50	100	
Erawan Motors Co.	15	20	25	
Kian Guan Bldg.	120	150	200	
President Hotel	65	75	100	
T.O.T.	350	400	500	
BOAC	50	70	100	
Suvisa New Building	70	150	200	
Co-operative Store	61	70	100	
Raj - damri Arcade	473	550	600	
Chalermloke Arcade	250	270	300	
Bangkok Bazaar Arcade	50	250	350	
" " "	70	350	440	

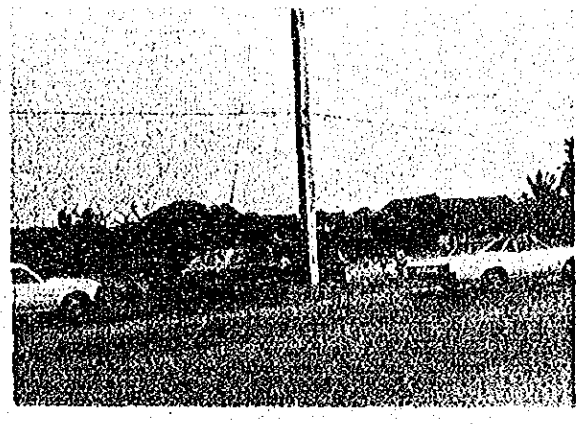


CHAPTER 3. PATHUMWAN TELEPHONE EXCHANGE (PW)

3.1 Service Area

This telephone office will be situated near the central part of Bangkok City and will service-in as a new exchange after the cut-over of a part of the service areas of the KK Exchange and PL Exchange to this exchange office, as shown in Fig. 4.3.1.

The Exchange area, moreover, is occupied by various steel material wholesale houses, automobile sales stores, repair shops, etc.



Site of new exchange office

(1) Cut-over from KK Exchange

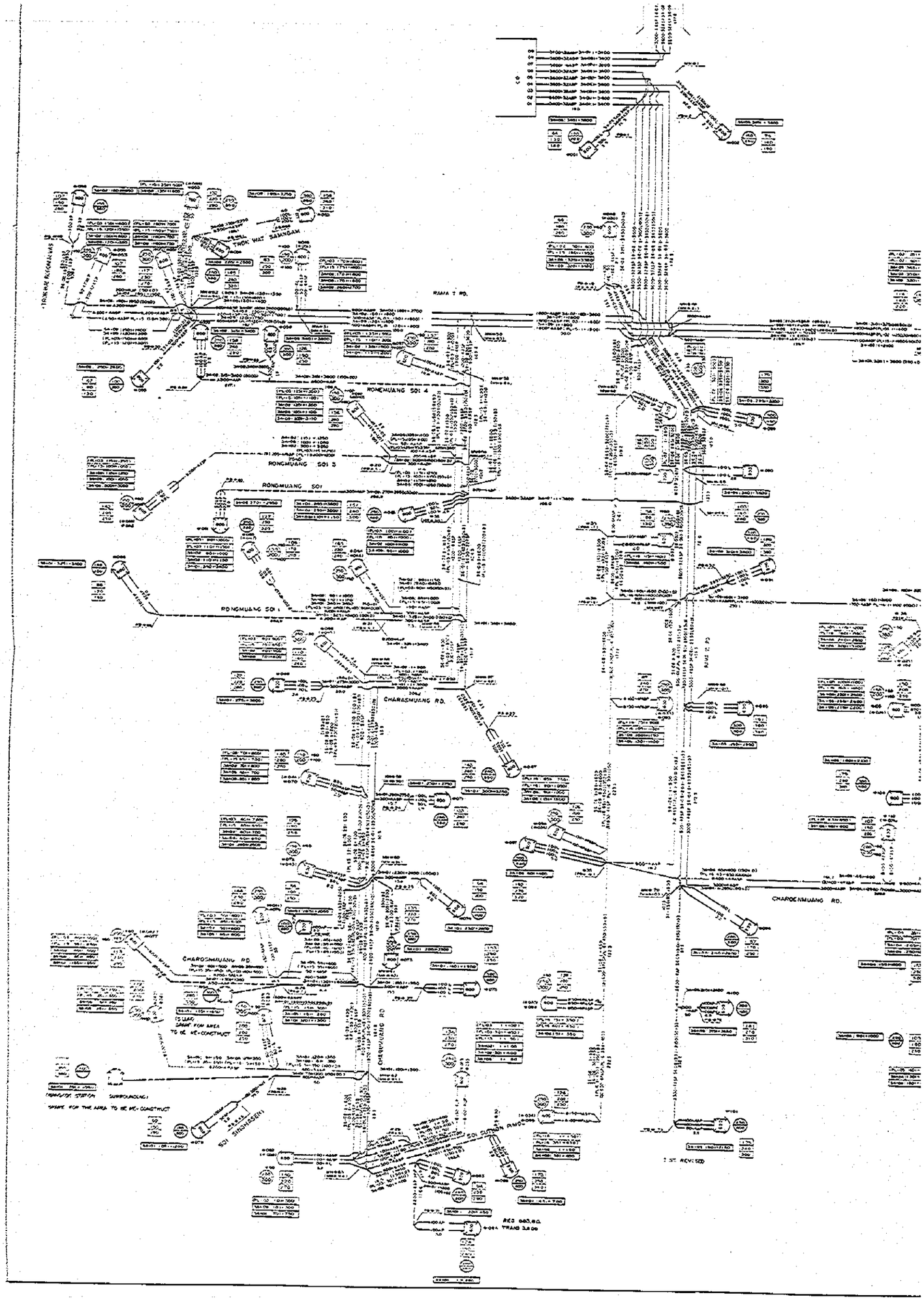
The service area from the east side of the railroad up to the Phyathai Road.

(2) Cut-over from PL Exchange

The service area on the entire west side of the Phyathai Road.

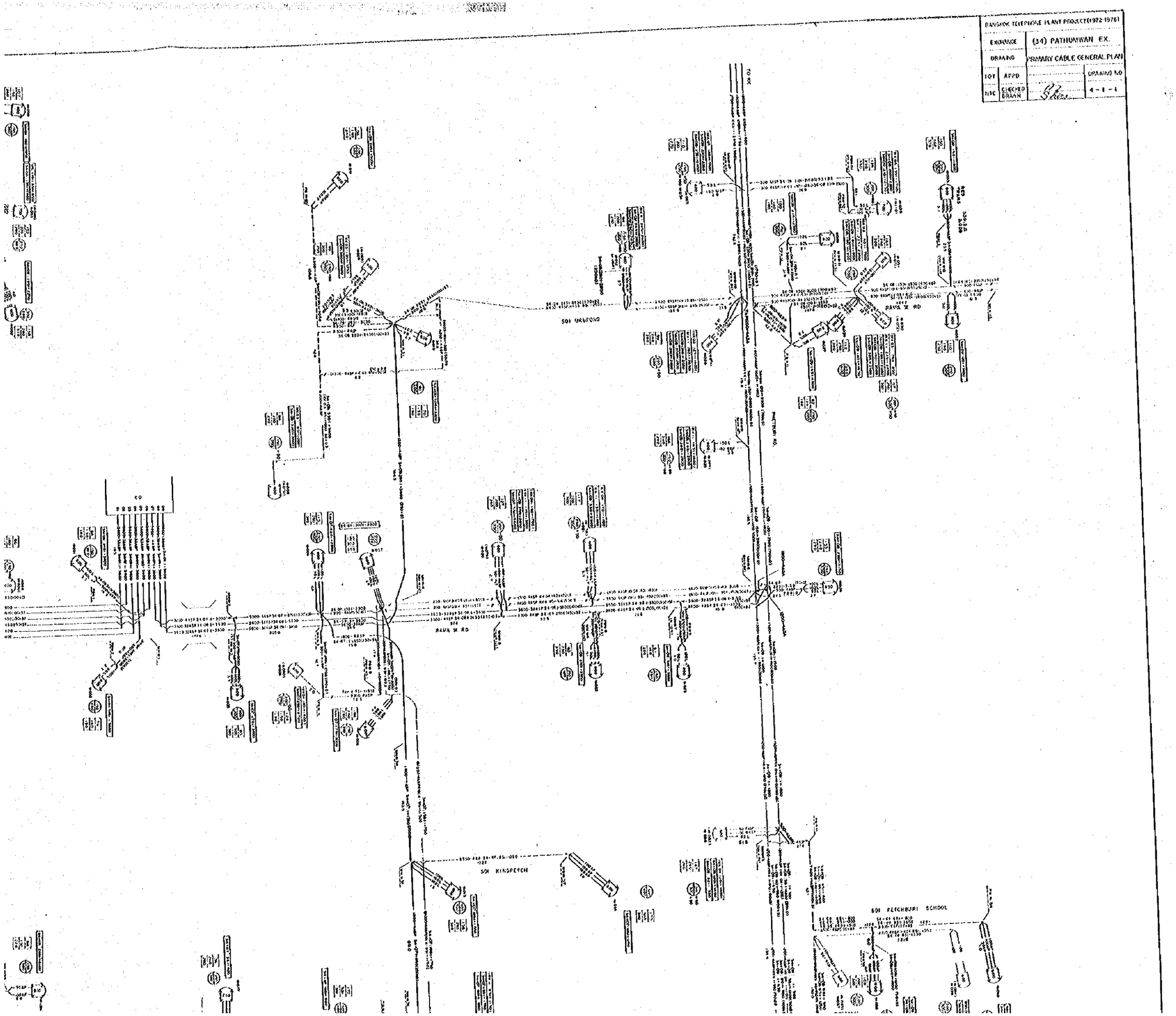
With the cut-over of the above service areas, the service area of the PW Exchange will be approximately 400 hectares.

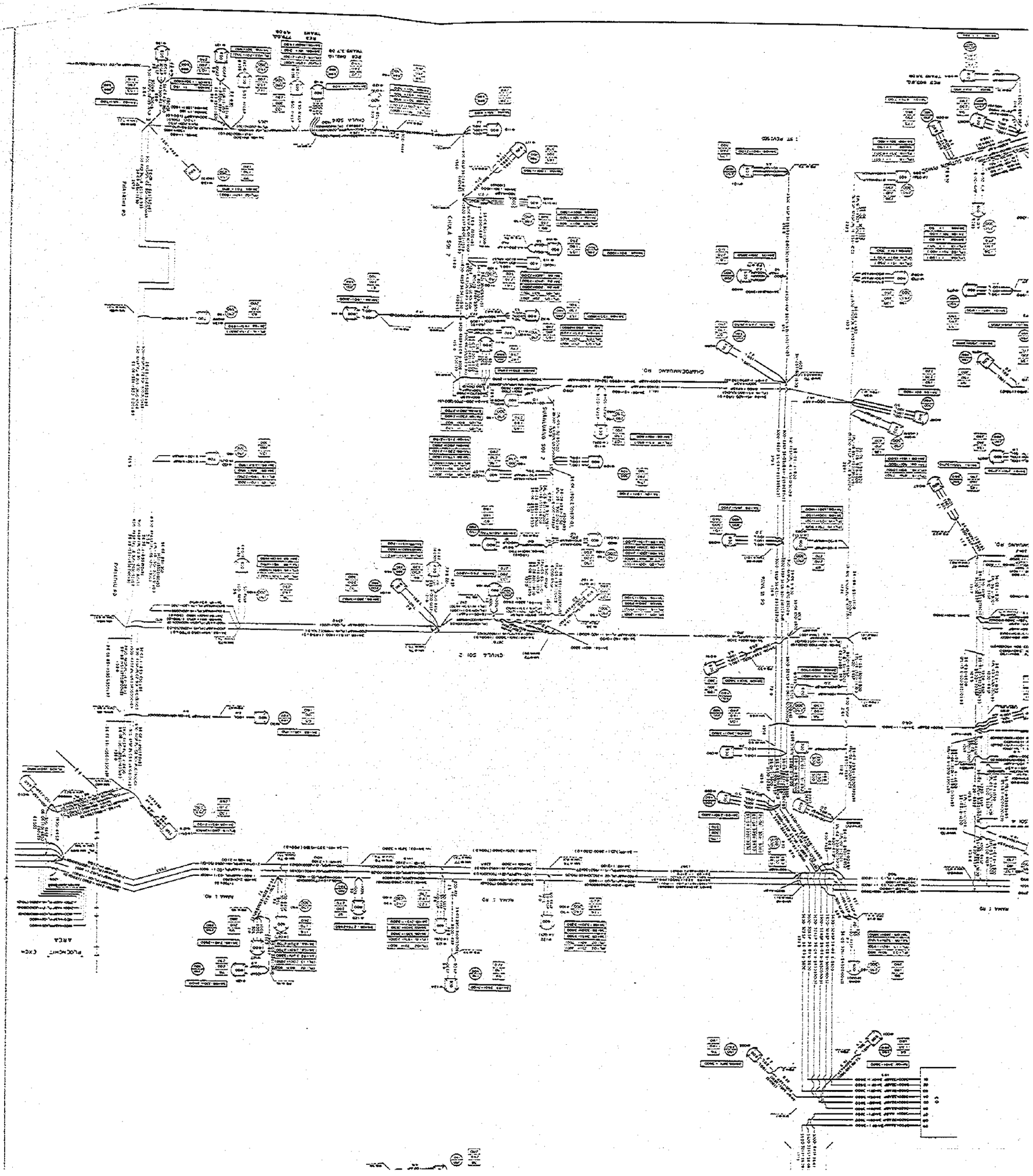
NATIONAL STADIUM
RAMA I RD
REMARKS
BOUNDARY LINE OF EXCHANGE AREA
BOUNDARY LINE OF CABINET
FEEDER CABLE ROUTE
CABINET
NUMBER OF PRESENT DEMAND
NUMBER OF 5 YEARS
NUMBER OF 10 YEARS
EXCHANGE
(34) PATHUMWAN EX
DRAWING
KEY PLAN
APPD
CHECKED
DRAWN

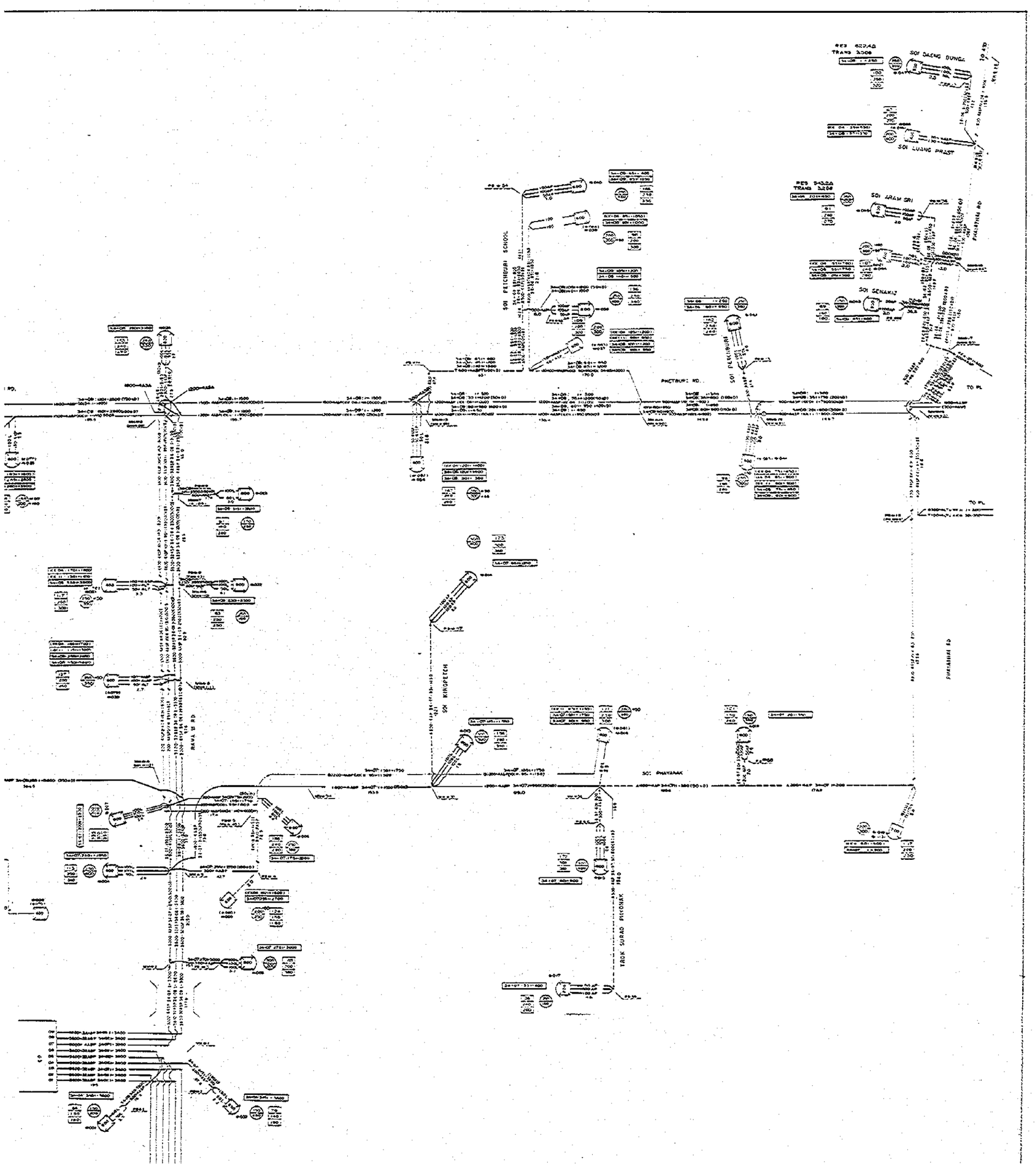

RONGMUANG SOI 4
RONGMUANG SOI 3
RONGMUANG SOI 1
CHAROENMUANG RD.
CHAROENMUANG RD
SOI SINGHASERI
SOI CHAROEN MUANG
RAMA 1 RD.

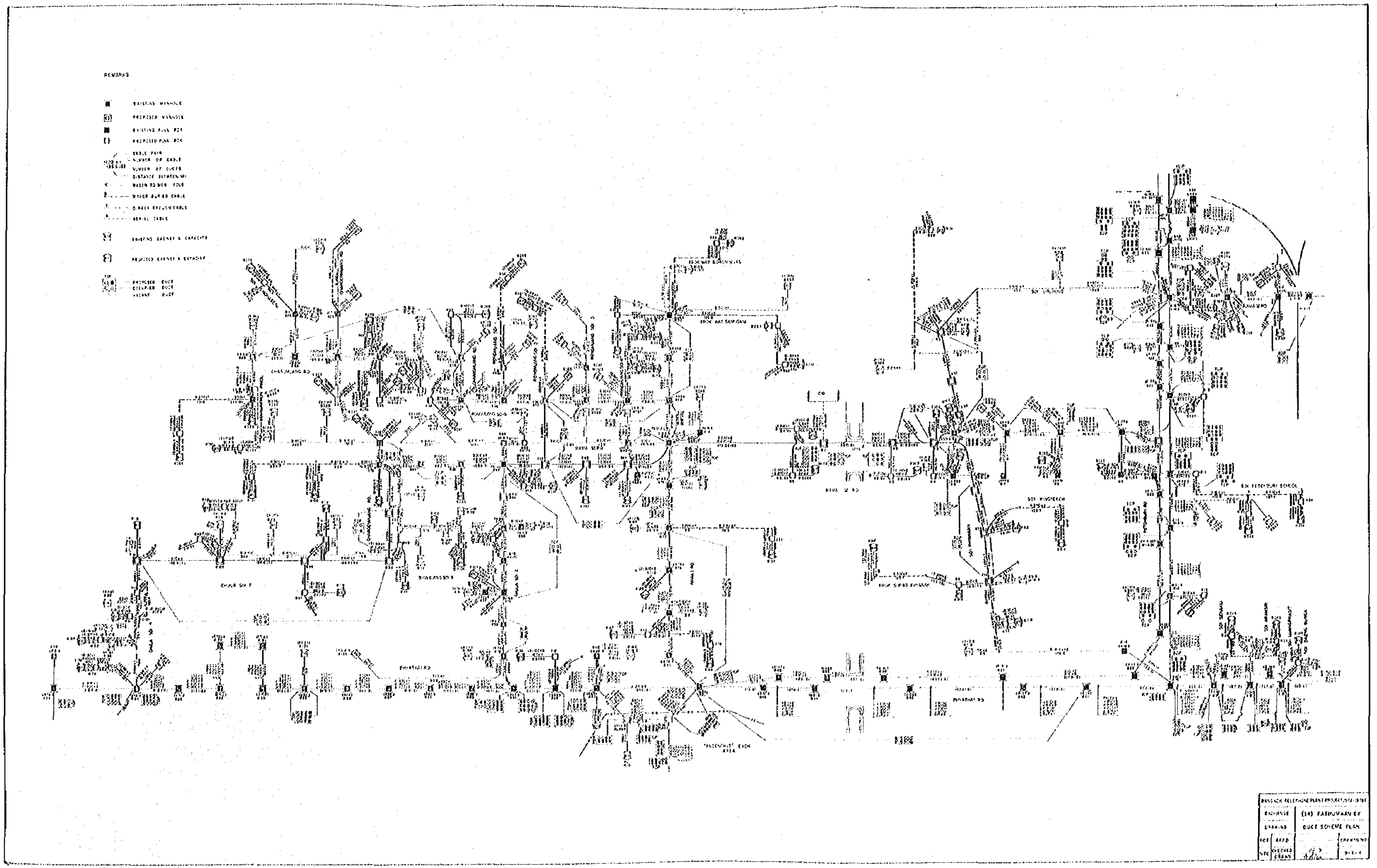
BANGKOK TELEPHONE PLANT PROJECT (1972-1976)

EXCHANGE		(34) PATHUMWAN EX.
DRAWING		PRIMARY CABLE GENERAL PLAN
TOT	APPD	DRAWING NO
NTC	CHECKED DRAWN	4 - 1 - 1






SOI PETCHBURI SCHOOL
PHETBURI RD.
SOI DAENG BUNGA
SOI LUANG PHAST
SOI ARAM SRI
SOI SENAKIJ
SOI PETCHBURI
SOI RINGPETCH
SOI PHAYANAK
TROK SURAO PHONAK
RAMA VI RD
PHISANULOK RD
TO PL


REMARKS
EXISTING MANHOLE
PROPOSED MANHOLE
EXISTING PLAN BOX
PROPOSED PLAN BOX
CABLE PAIR
NUMBER OF CABLE
NUMBER OF DUCTS
DISTANCE BETWEEN MH
DIRECT BURIED CABLE
AERIAL CABLE
PROPOSED CABINET & CAPACITY
PROPOSED DUCT
OCCUPIED DUCT
VACANT DUCT
EXCHANGE
(14) PATHUMWAN EX
DRAWING
DUCT SCHEME PLAN
APPD
CHECKED
DRAWN

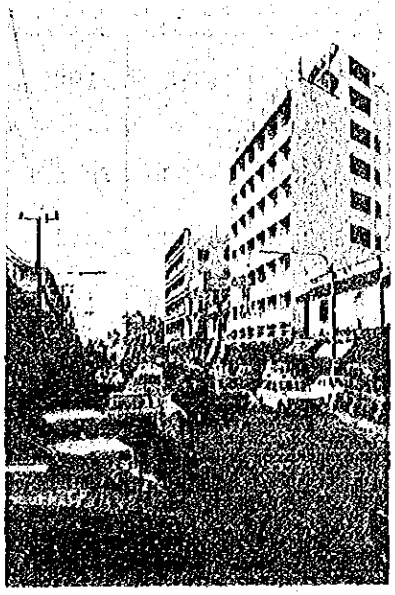
3.2 Demand Forecast and Outline of Area

As mentioned in the foregoing, the service area of the PW Exchange has a special area centralized around steel material wholesale houses along the Charoen Muang Road and automobile sales stores and repair shops in the southern direction of the Rama 6 Road and a mixed area made up of ordinary residences and commercial district. The residential district has a high ratio of old structures and a rebuilding to middle-rise multi-unit residences is being rapidly conducted in recent years.

The special features of this service area from the standpoint of demand forecast are as follows:

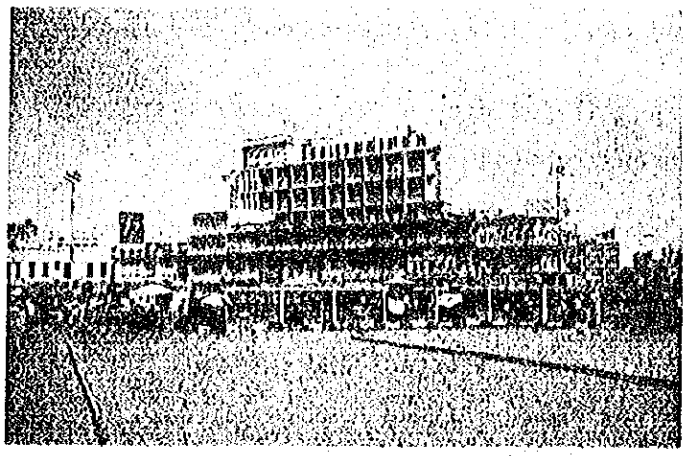
(1) Although there are few vacant lots for residential sites, the rebuilding of old residences is gradually being executed.

(2) With the commercial and economic development, it is envisaged that there will be a demand growth in the direction of the Charoen Muang Road and Rama 6 Road.



View of Charoen Muang Road

(3) As a consequence of the metropolitan redevelopment program in the vicinity of the Bangkok Central Station, it is anticipated that there will be a demand growth in line with the construction of high-rise buildings in the future.



Bangkok Central Station Plaza

Table 4.3.1 Demand Forecast

Area \ Year	1976	1978	1980	1982	1985	1987
Commercial Area	10,500	13,600	16,800	18,900	22,100	24,200
Residential Area	5,200	6,800	8,400	9,400	11,000	12,000
Special Area (Including Pre-Construction Area)	1,100	1,400	1,600	1,800	2,100	2,300
Total	16,800	21,800	26,800	30,100	35,200	38,500
Demand Growth Ratio	100.0	129.8	159.5	179.2	209.5	229.2

DEMAND FORECAST OF PW EX.SERVICE AREA

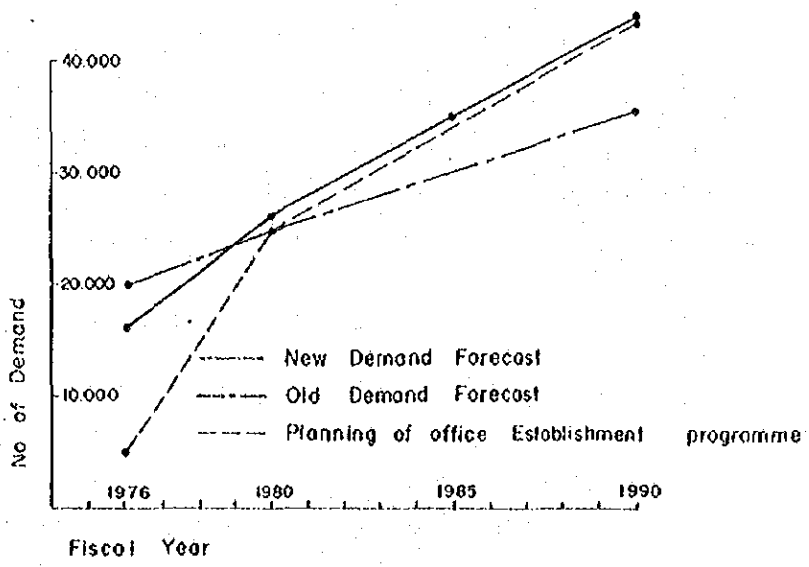


Fig. 4.3.4

3.3 Primary Cable Network Design

3.3.1 Objective Demand for Design

30,100 (in 1982) of Primary Cable
38,500 (in 1987) of Secondary Cable

3.3.2 Entrance Cable Pairs

The entrance cables for this exchange will all be cables to be newly installed.

New installation	3,000 pairs - 4 ASP	1 Cable(s)	
"	3,600 pairs - 32 ASP	8 "	
Total		9 "	31,800 pairs

Of the foregoing, the number of cable pairs for distribution in this design is 31,450 pairs.

3.3.3 Termination in Exchange

Termination of cables in the exchange will be as follows:

MDF One vertical 600 pairs

In the MDF, although from the furtherest end frame will be utilized in principle, 10 frames will be left vacant for the termination of junction cables 1,800 x 2 and 1,200 x 2 and the termination of local cables will be carried out.

3.3.4 Installation of New Cables for Each Direction

(1) Service Area cut-over from KK Exchange

A. New installation of conduits and increase in ducts will be made in the direction of Rama 6 Road and to meet the demand in 1982, 2 cables of 3,600 pairs and 1 cable of 300 pairs will be laid. In respect to the Petchburi Road, due to cut-over the existing cables of the KK Exchange will be utilized to satisfy the demand in 1982.

B. New conduits will be installed on the Soi Phyanak Road and to meet the demand in 1982, 1,800 pairs in the direction of the Asia Hotel and 1,200 pairs in the direction of Wat Phrayayang will be laid.

(2) Service Area cut-over from PL Exchange

A. Conduits will be newly installed between MH #1 to MH #48 (Ploenchit MH #81) for connection with the existing route and to satisfy the demand in 1982, 6 cables with 3,600 pairs will be laid.

B. With the addition of 1 cable of 1,800 pairs to the existing cable in the direction of the Rama 1 Road MH #48, the demand for 1982 will be satisfied.

C. In respect to the Rong Muang Soi 5 and Charoen Muang Road direction, conduits will be newly installed for connection to the existing route. As to the far end part section from MH #55, by utilizing the existing conduit route and with the addition of 3,600 pairs, the demand for 1982 can be satisfied. Furthermore, in preparation for the redevelopment in the vicinity of the Bangkok Station, 300 pairs each will be placed in reserved in Pulling Boxes #26 and #28 (PL #7 and #8).

D. Conduits will be newly installed in the direction of the Chula Soi 2, Tock Suon Luang Road and Rama 6 Road and to meet the demand in 1982, 3,600 pair and 1,200 pairs cables will be laid. In the said section, furthermore, the 3,000 pairs cable to be distributed in the direction of Chula Soi 7 will be also laid.

E. Conduits will be newly installed from MH #70 in the direction of Chula Soi 7 and 3,000 pair cable will be laid to meet the demand in 1982.

F. In regard to the east direction of Rama 1 Road and the direction of the Phyathai Road from MH #48, the existing cables of PL Exchange will be spliced with newly laid cables at MH #48 to satisfy the demand in 1982.

G. Since the PL-.05 cable on Phyathai Road will be used as a local cable for the PW Exchange, a 300 pair cable will be laid between PL MH #29 and MH #90 for cut-over at the cross-connecting cabinet #010.

3.3.5 Selection of Trough, Direct Buried and Aerial Routes

(1) Trough System

In regard to the 600 pair cable (07 cable) for the cross-connecting cabinets #039 and #040, since there are existing troughs from the Pulling Box #14 up to the riser pole, these troughs will be utilized.

(2) Direct Buried System

Although the roads listed below generally should adopt the underground conduit system, due to difficulty in underground conduit design in connection with width and form of the roads and the traffic volume and also difficulty in using the aerial cable system from the construction of the aerial line, the design is for adopting the direct buried system using Stalpeth armoured cables.

A. Soi Samngam - 600 pair Stalpeth armoured cable.

B. Charoen Muang Road - 200 pair JF cable.

(3) Aerial System

The roads listed below are sections where underground conduits should be applied but due to difficulty because of the narrow width of the roads and high volume of traffic and, moreover, the aerial system will be possible from the composition of the line, the design is for adoption of the aerial system.

Name of Road	No. of Cable Pairs
Soi Petchburi School	600 pairs
Soi Phyanark	400 "
Phyathai Road	400 "
Rong Maung Soi 4	600 "
" " " 2	300 "
Sonthon Phimon	300 "
Rama 6 Road	600 "

3.3.6 Line Loss and D.C. Resistance

The exchange cables have all been designed to be within the allowable values as follows:

Maximum line loss - 4.9 dB
Maximum D.C. resistance - 779 Ω

3.3.7 Plan for Non-Removal of Cable

The PL-03 cable of 1,800 pair - 4 ASP (named PW-03 cable after cut-over) will not be removed in the section below and will be kept in reserve for future demand growth.

Between MH #79 and PL MH #90

3.3.8 Cable to be Removed

Table 4.3.2

Section	No. of Pairs	Span Length	Reason for Removal
MH #10 - MH #47	2,700 - 4 ASP	282.8 m.	At boundary of KK Exch. and no plan for use even in future.
MH #12 - MH #115	900 - "	161.5	At boundary of ASD Exch. and no plan for use even in future.
MH #12 - MH #115	600 - "	161.5	" "
MH #10 - CAB #012	400 - "	183.1	Reverse distribution (including riser portion)
MH #10 - CAB #012	150 - "	183.1	" "
CAB #010 Vicinity	200 - "	44.5	Change in route.
"	400 - "	28.4	"
MH #4 - PB #5	200 - "	17.8	"
PB #4 - PB #5	200 - "	72.5	"
MH #4 - MH #5	200 - "	97.6	Remove small cable due to saving ducts.
MH #4 - MH #5	200 - "	97.6	"
MH #5 - MH #6	300 - "	90.9	"

(Cont'd)

Section	No. of Pairs	Span Length	Reason for Removal
MH #5 - MB #8	400 - 4 ASP	211.4 m.	Remove small cable due to saving ducts.
MH #6 - MB #8	600 - "	121.0	"
MH #19 - MH #96	600 - "	156.8	At boundary of ASD Exch. and no plan for use even in future.
MH #48 - PB #19	150 - "	55.1	Change in duct attaching position due to enlarging of manhole.
"	100 - "	55.1	"
MH #74 - PB #74	1,000 - 4 PASP	262.7	Reverse distribution (conduit parallel route and instruction of TOT)
"	400 - "	262.7	"
MH #79 - MH #89	900 - 4 ASP	252.7	At boundary of PL Exch. and no plan for use even in future.
MH #74 - MH #75	1,200 - "	239.0	Reverse distribution.
MH #16 - PB #18	200 - "	18.6	"
PB #4 - CAB #019	200 - "	173.6	"
CAB #059 - CAB #055	50	165.6	Small cable
Total		3,394.7 m.	

3.4 Underground Conduit Design

3.4.1 Relation to Exchange Office

Hardwares in exchange office and the conduit (4" 36 ducts) from the exchange office to MH #1 will be designed and constructed by the TOT.

3.4.2 Suspension on Charoen Phol Bridge on Banthad Thong Road

(1) According to instructions from the City Office, no occupancy of the main beam of the bridge nor damage to the cross beam shall be permitted. Even if other methods are taken, the building of structures under the main beam in order to maintain effective clearance will not be permitted.

(2) In consideration of the foregoing, the method of suspension under the sidewalk will be adopted and the acknowledgement of the City Office was acquired.

(3) The number of ducts to be suspended will be 12 and the kind of pipe will be 4" galvanized iron pipe (G.I.P.).

Strength calculations are indicated in the PW EX. Annex-II.

Charoen Phol Bridge

3.4.3 New and Additional Conduit Routes from Banthad Thong Road to Petchburi Road.

(1) Number of Ducts

A. Of the number of ducts between MH #1 and MH #2, it was decided upon consultation with the TOT that the number of ducts up to the point of crossing of the Charoen Phol Bridge will be 12 and from that point until connection with MH #2 will be 8 ducts.

B. Eight (8) ducts will be newly installed between MH #2 and MH #3.

C. Eight (8) ducts will be newly installed between MH #3 and MH #4.

D. The number of ducts between MH #4 and MH #7 will be eight (8) of which 4 are existing ducts and 4 will be the new additions.

E. Eight (8) ducts will be newly installed between MH #7 and MH #20.

(2) Manhole

A. The #1 manhole is of the "V-3" type.

B. MH #2 is expected to be connected in the future with the 12 conduits suspended from the bridge and is of the "A-2" type design.

C. Since the MH #3 will have 12 ducts of which 8 ducts will be in the direction of the far end of the area and 4 ducts will be branched to the Soi Phya Nak Road, the design is of the "A-2" type.

D. The existing manhole between MH #4 and MH #7 is of the "A-1" type and will not be enlarged.

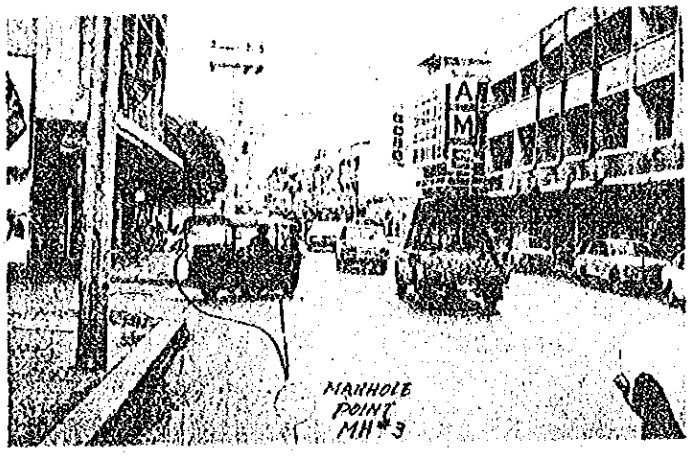
E. The MH #20 is an in-between manhole for connecting the junction cable route and the local cable route. This is a "V-2" type manhole and the standard drawing number is 1053.

(3) Road occupancy position

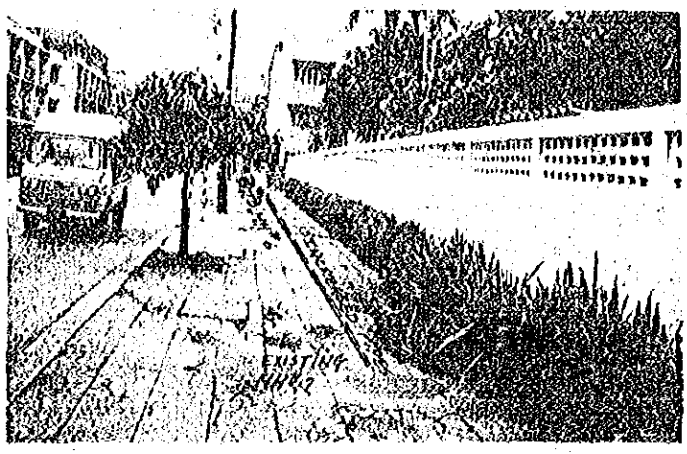
A. The new conduit will occupy the road side 1.65 m from the curb stone of the sidewalk.

B. The additional conduit will be installed on the upper side of the existing pipes.

C. As to the suspension position on the bridge, please refer to the detail design drawing (civil works).



Occupancy position in new section of Banthad Thong Road.



Additional section on Banthad Thong Road.

3.4.4 New Main Conduit Route on Soi Phya Nak Road

(1) Conduits in the direction of MH #34 - MH #36 are branch conduits from MH #3.

(2) Conduits in direction of MH #31 - MH #33 are branch conduits from MH #4.

(3) The number of ducts will be 4.

(4) Road occupancy of the conduit route will be determined by avoiding underground buried obstacles.

3.4.5 Conduits on Banthad Thong Road (Between Banthad Thong Road: Exchange MH #1 and Chula Soi 2: MH #68)

(1) Number of Conduits

A. Between MH #1 - MH #48 will be 16 ducts.
B. " MH #48 - MH #66 will be 8 "
C. " MH #66 - MH #67 will be 4 "
D. " MH #66 - MH #55 will be 4 "

(2) Type of Manhole

A. Since the existing MH #48 is of the "J-4" type, it will be enlarged to the "V" type. Please refer to the attached detail design drawing (civil work).

B. The "J-3" type, standard drawing number 1082, will be adopted for MH #66.

C. Since MH #67 and MH #55 are of the "A-1" type, they will not be enlarged.

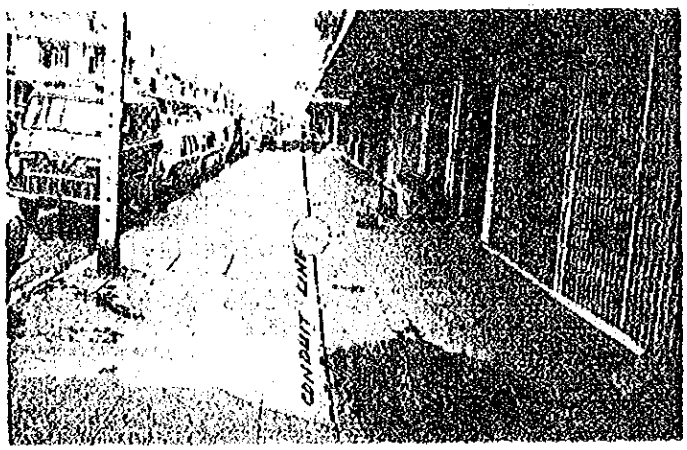
(3) Road occupancy position

A. Road occupancy of the conduit between MH #1 - MH #48 will be on the road side 1.65 meters from the curb stone of the sidewalk.

B. Position for road occupancy of the conduit from MH #48 to MH #67 will be changed to the same side as the existing MH #67, that is, crosses under the road between MH #48 and MH #64.

3.4.6 New Main Conduit Route on Charoen Muang Road and Chula Soi 7

(1) The number of ducts will be 4.



Road occupancy position on Charun Muang Road.

(2) Road occupancy position

A. The conduit from MH #70 - MH #97 - MH #98 will occupy the position under the sidewalk on Charoen Muang Road.

B. As to the conduit between MH #98 - MH #101, since the sidewalk of Chula Soi 7 is narrow and there are underground buried objects, it will occupy the road (concrete pavement).

3.4.7 Other Changes

When MH #48 is partially enlarged, the existing 3" pipes between MH #48 and Pulling Box #19 will become a hindrance. Therefore, the design is to construct a separate route of 4 pipes of 3" diameter and remove the existing cables in these pipes and then abandon the existing 3" pipes.

3.5 Gas Pressurization System Design

3.5.1 Design of Inside Facilities

(1) Since the PW Exchange will be a new exchange, the following gas facilities will be installed.

Air Dryer (type 1500)
Meter Panel
Alarm Panel

(2) The Air Dryer and Meter Panel will be installed in the MDF Room, and the attachment of Alarm Panel will be in the Test Room to facilitate Alarm.

3.5.2 Design of Outside Facilities

(1) Attachment of pressure guard

Pressure guards will all be attached inside the cross-connecting cabinets.

(2) Attachment of by-pass valve

In order to facilitate gas pressure checks at the branch jointing points of big cables, by-pass valves will be attached inside the following manholes in accordance with instructions from the TOT.

MH #8 - 09 cable
" - 08 "
MH #48 - 02 "
" - 03 "

3.6 Secondary Cable Network Design

3.6.1 Service Area where Direct Distribution will be changed to System of Cabinet Distribution

Since all existing secondary cables in the PW Exchange service area are already of the cross-connecting cabinet system, there are no such area in this design work.

3.6.2 Cross-Connecting Cabinets with Reservation of Secondary Cables

Road expansion construction work is presently being conducted in portions of the Soi Auruphong Road, and the secondary cables will be held in reserve in the following cross-connecting cabinets.

#010 - 50 pairs of secondary cables
#012 - 100 " "

3.6.3 Attention to be Paid in Joint Use Poles

In sections where joint use of MEA poles for primary and secondary cables are made, the section where the cable extension method will be carried is as shown in the Secondary Cable Detail Design and for the other sections, the standard method will be executed.

3.7 Design of Relevant Works

The work of laying 4 lines of junction cables will have to be executed in line with the service-in of the PW Exchange but discussions have already been made with the TOT in regard to the cable terminating positions on the MDF, use of ducts.

3.8 Service Area Cut-Over Design

3.8.1 Cut-Over from KK Exchange

Refer to Table 4.3.3.

(1) 04 and 11 (1-1450) cables

Bridge jointing will be made with PW-08 and 09 cables at MI #8 and although bridge cut-over and loop cut-over will be carried out, the cross-connecting cabinets #016 and #019 (PL #081 and PL #113) will, after cut-over to the PW-07 cable, be cut-over by loop jumper wires at the new exchange.

(2) Cross-connecting cabinets #068, #069 and #070

After the cut-over to the PW-09 cable, the vacant pairs of the foregoing loop circuits will be utilized for cut-over by loop jumper wires at the new exchange.

(3) Cross-connecting cabinets #077, #074, #072, #071, #067 & #110

In the same manner at in (2) above, the vacant pairs of the loop circuits will be used for cut-over by loop jumper wires at the new exchange.

(4) Line loss and line resistance (maximum value) in the event of cut-over by loop jumper wires are shown in Fig. 4.3.5 below.

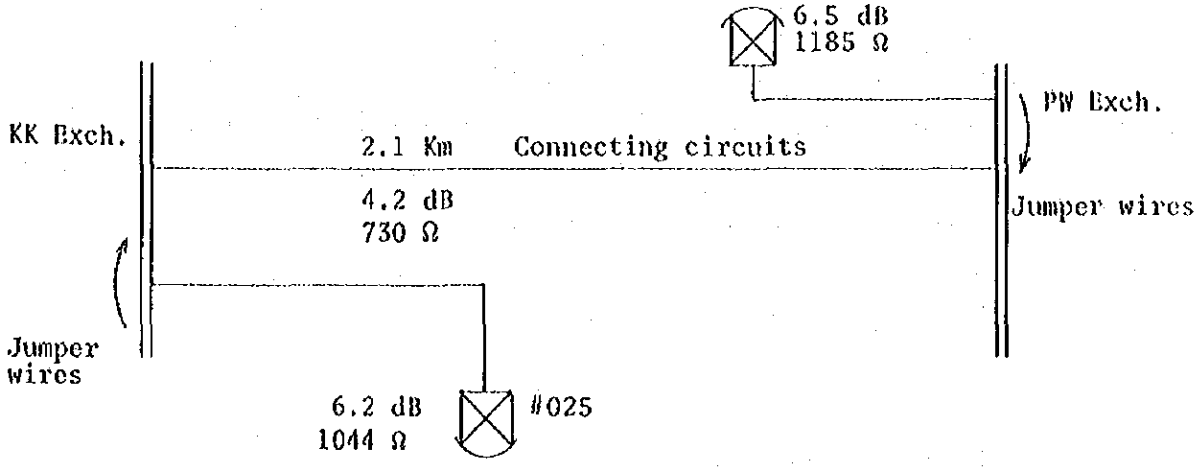


Fig. 4.3.5

3.8.2 Cut-Over from PL Exchange

Refer to Table 4.3.4

(1) 03 cable

The conductors of this cable will be cut and connected to the PW-02 cable at the MH #48, and the PW-02 cable will be cut-over by loop jumpering at the new exchange.

(2) 15 cable

This cable will be bridge jointed with the PW-03 cable in the MH #48 and the 15 : 1-1950 will be cut-over by loop jumpering at the new exchange. Cross-connecting cabinet #028 will be bridge cut-over at the MH #77 and the cross-connecting cabinet #027 will be bridge cut-over at the MH #79.

(3) 02 Cable.

This cable will be bridge jointed with the PW-03 cable at the MH #48 and the 02 : 1-250 and 301-600 will be cut-over by loop jumpering at the new exchange. The cross-connecting cabinet #029 will be cut-over at the MH #76 by bridge jointing. Furthermore, 02 : 601-900 will be cut-over by loop jumpering at the old exchange by use of the junction cable between the PL and PW Exchanges and the vacant pairs of the above loop circuits.

(4) 16 cable (1 - 1400)

This cable will be cut-over by bridge jointing with the PW-06 cable at the MH #67.

(5) Cross-connecting cabinet #018

This will be cut-over by bridge jointing with PW-04 cable at the cut-over point of the cross-connecting cabinet.

(6) 05 : 201-800

This cable will be cut-over by bridge jointing with the 04 cable at Pulling Box #40.

(7) 02, 05 & 16 cables (In direction of Phyathai, Chula Soi 2 & Soi 7)

The design is for the laying of 2,400 pairs between MH #67 and MH #72, 1,200 pairs between MH #72 - MH #75 and 900 pairs between MH #75 - MH #80 and by utilizing PW-06 : 1401-3600, these cables will be bridge cut-over at MH #75 and MH #84.

(8) Cross-connecting cabinet #092

By utilizing the junction cable between the PL and PW Exchanges and the vacant pairs of the above loop circuits, this cross-connecting cabinet will be cut-over by loop jumpering at the old exchange.

(9) Subscriber lines of 01 : 151-220 at the cross-connecting cabinet #010 will be cut-over to the PW Exchange but the cut-over will be by loop jumpering at the old exchange as in the above sub-para. (8).

(10) Line loss and line resistance (maximum value) in the event of cut-over by loop jumpering are shown in Fig. 4.3.6.

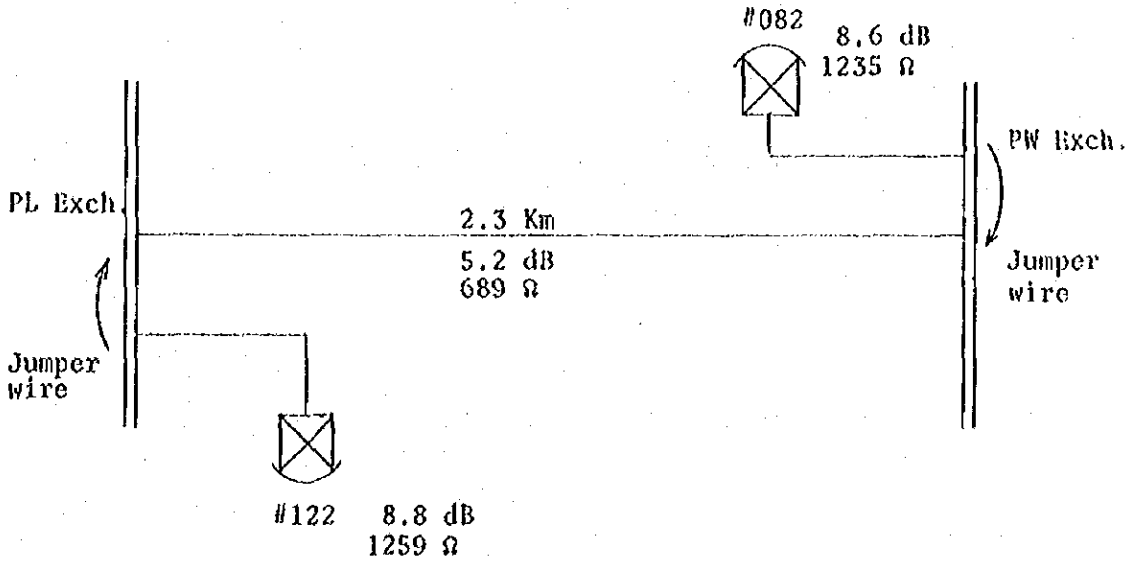


Fig. 4.3.6

Table 4.3.3 Cut Sheet (KK Exch. → PW Exch.)

Cut-over Point	Cut-over Method	Name of Cable and Line No.		Circuit Now Used
		Existing	New	
MH #8	B	04:301-1400	08:301-1400	648
"	"	04:1401-1600	08:1401-1600	-
PB #4	C	04:1401-1600	09:2551-2700	83
CAB #003	"		09:2701-3000	-
MH #8	B	04:1601-1700	08:3501-3600	83
"	"	11:1151-1300	08:3101-3250	70
"	"	04:1701-1800	08:3251-3350	92
"	"	11:1301-1450	08:3351-3500	100
"	"	11:1-600	08:1601-2200	None
"	"	11:601-800	08:2201-2400	154
CAB #019	C	11:601-800	09:1-200	-
MH #8	B	11:801-900	08:2401-2500	40
"	C	11:801-900	07:801-900	-
"	B	11:901-950	08:2501-2550	1
"	C	11:901-950	07:901-950	-
"	B	11:951-1150	08:2551-2750	118
MH #4	C	11:951-1150	09:1551-1750	-
PW EX (CAB #012)	L	11:2451-2600	07:2651-2800	58
" (" #011)	"	03:1001-1250	07:2851-3200 3401-3600	120
" (" #008)	"	03:851-1000	07:3201-3400	19
KK EX (CAB #025)	"	11:1451-1600		74
" (" #26)	"	03:1251-1400 11:2601-2650		132 7
" (" #30)	"	03:751-850 11:2351-2450		68 23
" (" #31)	"	03:601-750 11:2251-2350		118 1
" (" #34)	"	03:1401-1550		87
" (" #35)	"	03:1551-1750		115
				2,211

B: BRIDGE JOINT C: CUT-OVER L: LOOP JUMPERING

Table 4.3.4 Cut Sheet (PL Exch. → PW Exch.)

Cut-over Point	Cut-over Method	Name of Cable and Line No.		Circuit
		Existing	New	Now Used
MH #48	B	03:1-1800	01:1-1800	1,411
"	C	03:1-1800	01:1801-3600	-
"	B	15:1-2050	05:1-2050	-
"	C	15:1-1800	03:1-1800	930
"	"	15:1801-1950	03:3351-3500	66
MH #77	B	15:1951-2000	05:1951-2000	30
MH #79	"	15:2001-2050	05:2001-2050	45
MH #48	B	02:1-600	05:3001-3600	-
"	C	02:1-250	04:2951-3200	163
"	"	02:301-500	04:3251-3450	178
"	"	02:501-600	03:3251-3350	60
MH #76	B	02:251-300	05:251-300	30
PL Ex (CAB #122)	L	02:601-700		62
" (" #123)	"	02:701-800		85
" (" #126)	"	02:801-900		87
MH #67	B	16:1-1400	01:1-1400	1,083
CAB #120	"	02:901-1050 16:2051-2100	04:301-500	124 25
PB #40	"	05:401-600	04:1301-1500	164
"	"	05:201-250 601-700	04:2001-2050 2401-2500	137
"	"	05:251-400 701-800	04:2051-2200 2501-2600	185
MH #84	"	02:1051-1200 16:2101-2150	06:1401-1550 1901-1950	90 35
"	"	02:1201-1350	06:1551-1700	113
"	"	02:1651-1800	06:1701-1750 1801-1900	133
"	"	16:2151-2400	06:1951-2200	84
MH #75	"	05:1201-1300 16:1901-2050	06:2601-2700 2851-3000	53 1
"	"	05:1301-1400 16:1851-1900	06:2701-2800 2801-2850	18 3

(Cont'd)

Cut-over Point	Cut-over Method	Name of Cable and Line No.		Circuit Now Used
		Existing	New	
MH #74	B	05: 1-150, 801-900	06: 3151-3400	108
"	"	05: 151-200, 901-1000	06: 1751-1800, 2201-2300	83
		16: 1551-1600	06: 2501-2551	37
		05: 1001-1100	06: 2301-2400	75
		16: 1601-1650	06: 2551-2600	41
"	"	05: 1101-1200	06: 2401-2500	36
		16: 1401-1550	06: 3001-3150	83
"	"	16: 1651-1850	06: 3401-3600	16
PL BX (CAB #129)	L	16: 2401-2600		16
"		PL CAB #010 (II) Cable		
				5,890

B: BRIDGE JOINT

C: CUT-OVER

L: LOOP JUMPERING

3.9 Construction Period

Unless each of the following works are completed, the relevant cut-over work at the PW Exchange cannot be executed.

1. KK-04 cable -- Service-in of ASD Exchange.
2. KK-11 cable -- Cut-over work to PL Exchange.
3. PL-02 cable -- Route change work at PL Exchange.

Therefore, in consideration of the work periods at both the ASD and PL Exchanges, establishment of such work periods will be necessary.

3.10 Amount of Works and List of Materials

Refer to the annexed Table 4.3.5 Amount of Works and Tables 4.3.6 to 4.3.15 List of Materials.

TABLE 4.3.5 PW EX. AMOUNT OF WORKS

ITEM	BREAKDOWN	Q'ty	REMARK
1. POLE	8 MC	69 ea.	
	10 "	— "	
	TOTAL	69 "	
2. GUY	(1) UPPER GUY 6 M	79 ea.	
	" 10 M	82 "	
	" 16 M	3 "	
	TOTAL	164 "	
	(2) ANCHOR ROD #2	67 ea.	
	5/8" x 7'	— "	
	3/4" x 7'	72 "	
	1" x 7	4 "	
	TOTAL	143 "	
3. CABLE	(1) UNDERGROUND CONDUIT CABLE		
	3600 - 32 ASP	3 614.7m	STALPETH CABLE
	3000 - 4 "	2 159.0"	
	2400 - 4 "	889.6 "	
	1800 - 4 "	871.4 "	
	1200 - 4 "	1 203.5 "	
	900 - 4 "	1 094.5 "	
	600 - 4 "	339.1 "	
	300 - 4 "	1 374.8 "	
	1800 - 5 "	— "	
	1200 - 5 "	— "	
	900 - 5 "	— "	
	600 - 5 "	— "	
	300 - 5 "	— "	
	100 - 65 "	— "	
	SUB TOTAL	11 546.6 "	
	(2) DIRECT BURIED CABLE		
	900 - 4 ASPT	— m	STALPETH SHEATHED AND STEEL TAPE ARMOURED CABLE
	600 - 4 "	122.0 "	
	300 - 4 "	227.1 "	
	400 - 4 JF	— "	JELLY FILLED CABLE
	300 - 4 "	18.5 "	
	200 - 4 "	334.2 "	
	100 - 4 "	328.4 "	
	50 - 4 "	149.0 "	
	SUB TOTAL	1 179.2	
	(3) TROUGH CABLE		
	2400 - 4 ASPT	— m	
	1800 - 4 "	— "	
	1200 - 4 "	— "	

ITEM	BREAKDOWN	Q'ty	REMARK
3. CABLE	900 - 4 ASPT	— m	
	600 - 4 "	63.1 "	
	300 - 4 "	— "	
	900 - 5 "	— "	
	600 - 5 "	— "	
	300 - 5 "	— "	
	SUB TOTAL	63.1 "	
	UNDERGROUND CABLE TOTAL	12 788.9 "	
	(4) AERIAL CABLE		
	600 - 4 AP	324.2m	INCLUDE AP & AP(8) CABLE
	400 - 4 "	271.6 "	
	300 - 4 "	3 238.4 "	
	200 - 4 "	8 292.4 "	
	100 - 4 "	14 292.3 "	
	50 - 4 "	16 094.7 "	
	25 - 4 "	10 936.9 "	
	10 - 4 "	664.4 "	
	400 - 5 "	— "	
	300 - 5 "	— "	
	200 - 5 "	— "	
	100 - 5 "	— "	
	50 - 5 "	— "	
	25 - 5 "	— "	
	10 - 5 "	— "	
	AERIAL CABLE TOTAL	54 114.9 "	
4. POT HEAD	2400 P	— ea.	
	1800 P	17 "	
	1200 P	1 "	
	TOTAL	18 "	
5. CROSS CONNECTING CABINET	800 P	73Box	
6. TERMINAL	(1) TERMINAL BOX		
	FOR AERIAL 25 P	72 ea.	
	" 15 P	654 "	
	" 10 P	649 "	
	FOR BURIAL 20 P	— "	
	" 15 P	— "	
	" 10 P	— "	
	TOTAL	1375 "	
	(2) TERMINAL BLOCK		
	LEAD SHEATHED STUB 100 P	— ea.	
	" 50 P	— "	
	POLYETHYLENE SHEATHED STUB 100 P	— "	
	" 50 P	— "	
	TOTAL	— "	

ITEM	BREAKDOWN	Q'ty	REMARK
7. GAS EQUIPMENT	AIR DRYER MODEL 1500	1 ea.	
	METER PANEL	1 "	
	ALARE PANEL	1 "	
	PRESSURE GUARD	20 "	
	TESTING VALVE	18 "	
8. CONDUIT	24 - 4"	— m	
	16 - 4"	179.3 "	
	12 - 4"	115.0 "	
	8 - 4"	672.1 "	
	6 - 4"	— "	
	4 - 4"	1911.8 "	
	4 - 3"	857.6 "	
	3 - 3"	— "	
	2 - 3"	645.3 "	
	TOTAL	4381.1 "	
9. MANHOLE & PULLING BOX	TYPE - A	13 ea.	
	" C	1 "	
	" V	2 "	
	" J	1 "	
	" T	— "	
	" L	1 "	
	ENLARGE "J" TO "V"	1 "	
	REBUILD	— "	
	TYPE - JUF - 6	42 "	
	" JUF - 11	11 "	
	TOTAL	72 "	

PW EX.

LIST OF MATERIALS

CABLE DESCRIPTION	T.O.T. CODE NO.	A.E. CODE NO.	UNIT	QUANTITY	REMARK
STALPETH CABLE 3600 - 32 ASP			M	3836	
" " 300 - 4 "			"	1821	
" " 600 - 4 "			"	456	
" " 900 - 4 "			"	1163	
" " 1200 - 4 "			"	1273	
" " 1800 - 4 "			"	957	
" " 2400 - 4 "			"	940	
" " 3000 - 4 "			"	2282	
" " 300 - 5 "			"		
" " 600 - 5 "			"		
" " 900 - 5 "			"		
" " 1200 - 5 "			"		
" " 1800 - 5 "			"		
" " 100 - 65 "			"		
STALPETH STEEL TAPE ARMOURED CABLE					
300 - 4 ASPT			"	266	
600 - 4 "			"	204	
900 - 4 "			"		
1200 - 4 "			"		
1800 - 4 "			"		
2400 - 4 "			"		
900 - 5 "			"		
600 - 5 "			"		
300 - 5 "			"		
ALEPETH CABLE 10 - 4 AP			"	500	
" " 25 - 4 "			"	3000	
" " 50 - 4 "			"	8000	
" " 100 - 4 "			"	10500	
" " 200 - 4 "			"	9000	
" " 300 - 4 "			"	3500	
" " 400 - 4 "			"	500	
" " 600 - 4 "			"	350	
" " 10 - 5 "			"		
" " 25 - 5 "			"		
" " 50 - 5 "			"		
" " 100 - 5 "			"		
" " 200 - 5 "			"		
" " 300 - 5 "			"		
" " 400 - 5 "			"		

DESCRIPTION	T.O.T. CODE NO.	A.E. CODE NO.	UNIT	QUANTITY	REMARK
ALEPETH CABLE 600 - 5 AP			M		
" " 10 - 4 AP (8)			"	1000	
" " 25 - 4 "			"	8500	
" " 50 - 4 "			"	9500	
" " 100 - 4 "			"	4500	
" " 10 - 5 "			"		
" " 25 - 5 "			"		
" " 50 - 5 "			"		
" " 100 - 5 "			"		
TERMINATING CABLE 300 - 5 P			"	1000	
JELLY FILLED CABLE 50 - 4			"	500	
" " " 100 - 4			"	500	
" " " 200 - 4			"	500	
" " " 300 - 4			"	500	

PW EX

LIST OF MATERIALS

DESCRIPTION	T. O. T CODE NO.	A. E CODE NO.	UNIT PCS	QUANTITY	REMARK
CLAMP EXTENSION - ARM.					
FIGURE 8 CABLE CLAMPS - TYPE PA 296	ECH - 2002		PCE	800	
CABLE LASHING CLAMP TYPE "D"	ECH - 2100		PCE	2500	
" " " "E"	" - 2101				
CABLE SUSPENSION CLAMPS (ONE BOLT CLAMP)	ECH - 2151		PCE	1000	
" " " 11/16" THREE BOLTS TYPE	" - 2155		"	900	
CURVED CABLE SUSPENSION CLAMPS 11/16"	ECH - 2171		"	200	
THREE BOLTS TYPE					
GULVANIZE STEEL KLING GROUND CLAMP	ECH - 2195		"	500	
STRAND GROUND CLAMPS	ECH - 2200		"	500	
GROUND CLAMP (FIG 8)			"	400	
U-CLAMPS 3/8"			"		
BRANCH STRAND CLAMP (6 M)			"	100	
ONE-SIDE CLAMP (FIG 8)			"	200	
CABLE EXTENSION METAL ARM TYPE M1	ECH - 2052		"	1200	
" " " " " M2	"		"	1200	
" " " " " M3	"				
HOSE CLAMP		(JAPAN) 3622			
ADJUSTABLE HOSE CLAMP 1/2" - 29/32"	ECS - 0245				
" " " 13/16" - 1 3/4"	" - 0246				
" " " 1 13/16" - 2 3/4"	" - 0247				
" " " 2 9/16" - 3 1/2"	" - 0248				
" " " 3 1/14" - 4"	" - 0249				
" " " 15/16" - 4"	" - 0250				
GULVANIZED STEEL CABLE SUSPENSION HOOK	S - 524015				
BOLT					
ANGLED THIMBLEYE BOLT 5/8" x 8"	ECH - 1001		PCE	100	
" " " " x 10"	" - 1002		"	100	
" " " " x 12"	" - 1003		"	100	
" " " " x 14"	" - 1004		"		
" " " " x 16"	" - 1005		"		
" " " 1/2" x 8"					
" " " " x 10"		S - 27798			
" " " " x 12"					

DESCRIPTION	T. O. T CODE NO.	A. E CODE NO.	UNIT PCS	QUANTITY	REMARK
DOUBLE ARMING BOLT 5/8" x 8"	ECH - 1102		PCE	50	
" " " " x 10"	" - 1103		"		
" " " " x 12"	" - 1104		"		
" " " " x 14"	" - 1105		"		
" " " " x 16"	" - 1106		"		
MACHINE BOLT 1/2" x 4"	ECH - 1209	S - 511308	PCE		
" " " x 6"	" - 1212		"		
" " " x 8"	" - 1213		"	10	
" " " x 12"	" - 1214		"	30	
" " " x 14"	" - 1215		"		
" " " x 16"	" - 1216		"		
" " 5/8" x 8"	ECH - 1218	S - 511416	PCE	200	
" " " x 10"	" - 1220	S - 511420	"	300	
" " " x 12"	" - 1221	S - 511422	"	300	
" " " x 14"	" - 1222	S - 511424	"	100	
" " " x 16"	" - 1223	S - 511426	"	100	
" " " x 18"	" - 1224		"	50	
" " 3/4" x 8"		S - 2908	"		
" " " x 10"		S - 511510	"		
" " " x 12"		S - 511512	"		
" " " x 14"		S - 511514	"		
STRAIGHT THIMBLEYE BOLT 5/8" x 6"	ECH - 1323		PCE		
" " " " x 8"	" - 1324		"	100	
" " " " x 10"	" - 1325		"	100	
" " " " x 12"	" - 1326		"	100	
" " " " x 14"	" - 1327		"		
" " " " x 16"	" - 1328		"		
EXTENSION SHIELD WITH BOLT					
BRIDLE RINGS 1 5/8" WOOD SCREW THREAD	ECF - 1002		"	3600	
GRIP NUT					
PREFORMED GUY GRIP FOR FALSE DEAD-END					
FIG (8)	ECH - 3001		PCE	100	
6 M			"	100	
10 M				100	
PREFORMED GUY GRIP DEAD-END FIG (8)	ECF - 3131		"	1000	
" " " 6 M				1000	
" " " 10 M				200	
" " " 16 M	ECF - 3132		"		
PREFORMED STRAND SPLICE 6 M			"	10	
10 M	ECF - 3133		"		

PW EX.

LIST OF MATERIALS

DESCRIPTION	T.O.T. CODE NO.	AE CODE NO.	UNIT PCS	QUANITITY	REMARK
GRIP NUT					
FORGED EYE NUTS 5/8"	ECH-3501		PCE	200	
" " " "	" -3503		"		
MACHINE BOLTS W/2 NUTS					
GULVANIZED NUTS 5/8" BOLT SIZE	ECH-5072		PCE	500	
EXPANSION SHIELD. STRAP. CLAMP					
THIMBLEYE . ROD. LIFT PLATE . PROTECTOR . SUPPORT					
DOUBLE EXPANSION SHIELDS 3/8" x 2"	ECF-4010 4012				
TWO-HOLE CONDUIT AND CABLE STRAPS			PCE	500	
ONE-HOLE STEEL CABLE CLAMPS			"		
FORGED ANGLE THIMBLEYE 5/8"	ECH-4020		"	100	
GALVANIZED STEEL GROUND ROD 1/2" x 5 FEET	ECH-4222		PCE	500	
CURVED LIFT PLATE 5/8" (2 1/2" x 7" x 3/16")	ECI-5510		"	100	
GALVANIZED GUY WIRE PROTECTORS 7 FEET	ECH-5550		"	300	
B-LASHED CABLE SUPPORTS 3/4 x 10"	ECH-6902		"	800	
" " " 1 3/16 x 16"	" -6903		"	2300	
" " " 2 x 22"	" -6904		"	3500	
" " " 2 5/8 x 28"	" -6905		"		
" " " 3 1/8 x 34"	" -6906		"	60	
LAG-SCREW. STAPLE. STRAP					
LAG SCREWS 5/16" x 2 1/2"	ECH-7027				
" " 3/8" x 3 1/2"	" -7043				
" " 3/8" x 4" GIMLET POINT			PCE	30	
FOR CURVE LIFT PLATE	ECH-7044				
" " 1/2" x 4" GIMLET POINT			"	20	
FOR SIDEWALK GUY FITTING	ECH-7048				
SERVISLEEVS 5/16" (6M)	ECH-7101		"	2000	
GALVANIZED STEEL STAPLE	ECH-7140				

DESCRIPTION	T.O.T. CODE NO.	AE CODE NO.	UNIT PCS	QUANITITY	REMARK
STRANDVISE 5/16"-4M-TYPE 5151	ECH-7251				
" " -6M- " 5101	" -7252				
" " -6M- " 5151	" -7256				
WASHER WIRE LINK					
CURVED WASHER 5/8 (2 1/2" x 2 1/2" x 3/16")	ECH-9001		PCE	300	
SQUARE " " (2 1/4" x 2 1/4" x 3/16")	" -9043		"	1400	
LONG SQUARE WASHER 5/8			"	300	
CURVED WASHER 5/8"(2 1/2" x 2 1/2" x 3/16" x 1/16" HOLE DIAM	ECH-9001		"	100	
" " 3/4 (3" x 3" x 1/4" x 13/16" " ")	" -9004		"	30	
ROUND WASHER 1/2" (2" x 2" x 1/8"-9/16" HOLE DIAM)	ECH-9041		"		
" " 1/2" (2" x 2" x 1/4-9/16" " ")	" -9042		"	50	
" " 5/8" (2 1/4 x 2 1/4" x 3/16" x 11/16" " ")	" -9043		"		
WIRE LINK-TYPE 5059	ECH-9100				
STRAND LINK FOR FIG(8) CABLE			PCE	100	
STEEL FLAT CROSS ARM BRACES 1 1/2 x 24" x 3/16"			"		
" " " " " 1 1/2 x 30 x 3/16"			"		
CABLE EXTENTION ARM (3' x 3" x 3-3")			"	30	
ANCOHOR RODS 3/4" X (REQUIRED LENGTH)			PCE	100	
WOOD LOG FOR ANCHOR ROD			"	50	
ONE BOLT GUY ATTACHMENTS		S-518205			
SIDE-WALK GUY FITTINGS FOR WOODEN POLE		SR-329	PCE	50	
" " " POR CONCRETE POLE			"	100	
GALVANIZED STEEL PIPE ø2 1/2" (2M)			"	50	
" " " (4M)			"	50	
S-LON PIPE ø1/2" x 2.5 METER			"	500	
S-LON 90°					
U-GUARDS			PCE	100	
GUY STRAIN INSULATOR TYPE 506	ECI-0073		PCE	300	

PW EX.

LIST OF MATERIALS

DESCRIPTION	T. O. T CODE NO	JAPAN CODE NO.	UNIT	QUANTITY	REMARK
STEARINE, C-CEMENT, COMPOUND					
STEARINE (250G)		3307	PCE	500	
STEARINE CANDLE	ECS - 0100				
C - CEMENT 100G/PCE	" - 0230		PCE	400	
" " 4 02	" - 0231				
SCOTCH KOTE	ECS - 0380				
WATER PROOF COMPOUND	ECS - 0470	3704	KG	50	
MOISTURE PROOF COMPOUND		3705			
NO. 1 ADHENSION AGENT		3706			
NO 2 SPECIAL COMPOUND (WITH HARDNER)		3703	KG	100	
NO. 3 " "		3708			
NO. 4 " " (RESIN)		3701	KG	370	
NO. 4 " " (HARDNER)		3702			
NO. 5 " "		3707	PCE	100	
DESICCANT, DESICCAN - CLOTH, FLOSS - SILK					
PROTEK SORB DESICCANT 160 G	ECS - 1020				
" " " 50 G	" - 1021				
DESICCANT (DRY AGENT) 50G / BAG	ECS - 1091	3031	BAG	3500	
DESICCANT CLOTH 20 x 36 x 25 CM		3034	PCE	10	
" " 24 x 36 x 29 "		"	"	70	
" " 27 x 36 x 32 "		"	"		
" " 27 x 45 x 32 "		"	"	20	
" " 31 x 36 x 36 "		"	"	10	
" " 31 x 45 x 36 "		"	"	10	
" " 34 x 45 x 39 "		"	"	10	
" " 37 x 45 x 42 "		"	"	20	
" " 40 x 45 x 45 "		"	"	40	
" " 44 x 45 x 49 "		"	"	20	
" " 48 x 45 x 53 "		"	"	10	
" " 51 x 45 x 55 "		"	"	20	
" " 53 x 45 x 58 "		"	"	20	
" " 55 x 45 x 60 "		"	"	10	
" " 57 x 45 x 62 "		"	"	20	
" " 59 x 45 x 64 "		"	"	30	
" " 62 x 45 x 67 "		"	"	20	
" " 68 x 45 x 73 " 80 x 45 x 85 "		"	"	20	
PLASTIC TUBE FITTING - PIPE COUPLING	ECS - 1500				
" " " MALE COUPLING	" - 1501				
" " " FERRULE	" - 1502				

DESCRIPTION	T. O. T CODE NO	JAPAN CODE NO.	UNIT	QUANTITY	REMARK
FLOSS SILK 10 PCS / BAG	ECS - 1700		BAG	20	
TAPE, BONDING - RIBON					
SEALING TAPE NO.1 30 - 280MM - 6 PCS / BAG	ECT - 1158	3601	BAG	250	
" " NO.2 40 - 280 - 6 "	" - 1159	3602	"	200	
" " NO 3 30 - 280 - 3 "	" - 1160	3603	"	1000	
" " NO 4 40 - 280 - 3 "	" - 1161	3604	"	600	
ADHESIVE ALUMINUM TAPE NO.1 30MM x 20M/ROLL	EC2 - 1000		ROLL	300	
" PAPER TAPE 50M/ "			"		
" GLASS FIBER TAPE 52M/ "	EC2 - 1203		"	20	
" P.V.C TAPE NO.1 10M/ "		3611	"	1000	
" " " NO.2 20M/ "	" - 1001	3612	"	1900	
" " " (GENERAL) 20M/ "		3620	"		
BONDING COPPER TAPE 10M/ROLL	EC2 - 1060	3613	"	100	
" " " (SELF) NO.2 5M/ "		3619	"		
COTTON TAPE 38MM x 30M/ "	EC2 - 1090		"	50	
" " 50MM x 30M/ "	" - 1091		"	70	
CR TAPE 28" x 20'	ECS - 7024				
DR TAPE 3/4" x 15'	EC2 - 1120		"		
" " 2" x 15'	" - 1121		"		
ELECTRICAL TAPE 3/4" x 66'	" - 1132		"		
ELICTION TAPE 3/4" x 60'	" - 1185		"		
" " 2" x 60'	" - 1186		"		
GLASS TAPE 1" x 108'	" - 1201		"		
GLASS FIBER TAPE 38MM x 30M/ROLL	" - 1202		"	150	
POLYETHYLENE TAPE 30MM x 20M/ "	" - 1275	3605	"		
" " 60MM x 20M/ "	" - 1276	3606	"	150	
" " (BLACK) 20M/ "	" - 1277	3405	"		
VALCANIZED RUBBER TAPE 10M/ "	" - 1300	3406	"		
PVC TAPE FOR TERMINATING JOINT 20M/ "	" - 1345	3618	"	70	
SOFT BONDING TAPE 5M/ "		3419	"	20	
LACING TWINE 6 PLIES	EC2 - 1501				
ALUMINIUM FOIL TAPE 2" x 20'	ECS - 7000		ROLL		
" " " 4" x 20'	" - 7001		"		
V N TAPE 10M/ROLL		3610	"	1300	
SPACER TAPE			"		
BONDING RIBBON 0.375" x 60'/ROLL	ECS - 4600		"	10	

PW EX.

LIST OF MATERIALS

DESCRIPTION	T.O.T. CODE NO.	JAPAN CODE NO.	UNIT	QUANTITY	REMARK
SOLDER					
NO. 1 SOLDER 250G / ROLL		3301	ROLL	4100	
NO. 2 " 1KG / ROLL	ECS-5700	3302			
NO. 3 "		3303			
NO. 4 (CREAM) SOLDER 100G / TIN	ECS-5722	3304	TIN	950	
NO. 4 (") " 200G / TIN		3305			
BAR SOLDER 1 1/2 LBS	ECS-5612				
KESTER SOLDER 1/16" x 0.062 (1LBS)	ECS-5672				
" " 1/8 x 0.125 (5LBS)	" -5686				
TERMINATING MATERIALS					
NO. 50 P.V.C. LID FOR TERMINATING JOINT	ECS-3050				
NO. 75 " " "	" -3051				
NO. 100 " " "	" -3052				
NO. 125 " " "	" -3053				
NO. 150 " " "	" -3054		PCE	1	
NO. 200 " " "	" -3055		"	17	
NO. 50 " SLEEVE "	ECS-5270				
NO. 75 " " "	" -5271				
NO. 100 " " "	" -5272				
NO. 125 " " "	" -5273				
NO. 150 " " "	" -5274		PCE	1	
NO. 200 " " "	" -5275		"	17	
NO. 50 " TUBE "	ECS-7230				
NO. 75 " " "	" -7231				
NO. 100 " " "	" -7232				
NO. 125 " " "	" -7233				
NO. 150 " " "	" -7234		PCE	1	
NO. 200 " " "	" -7235		"	17	
NO. 50 TERMINATING SLEEVE RECEPTACLE BAND		4601			
NO. 75 " " " "		4602			
NO. 100 " " " "	ECS-5300	4603			
NO. 125 " " " "	" -5301	4604			
NO. 150 " " " "	" -5302	4605	PCE	1	
NO. 200 " " " "	" -5303	4606	"	17	

DESCRIPTION	T.O.T. CODE NO.	JAPAN CODE NO.	UNIT	QUANTITY	REMARK
NO. 50 TERMINATING SLEEVE FIXING BAND		4611			
NO. 75 " " " "		4612			
NO. 100 " " " "	ECS-5286	4613			
NO. 125 " " " "	" -5287	4614			
NO. 150 " " " "	" -5288	4615	PCE	1	
NO. 200 " " " "	" -5289	4616	PCE	17	
CABLE FIXING BAND			PCE	18	
SLEEVE					
COTTON SLEEVE 3/32"x 3/4"x 900 (0.4MM)	ECS-5021				
" " 1/8"x 3/4"x 700 (0.5 ")	" -5022				
" " 5/32"x 3/4"x 400 (0.65 ")	" -5023				
" " 1/4"x 3/4"x 200 (0.9 ")	" -5024				
COMPOUND FILLED PE SLEEVE FOR 0.4 MM	ECS-5050				
" " " " " 0.5	" "				
" " " " " 0.65	" "				
" " " " " 0.9	" "				
PLASTIC SLEEVES 0.106" x 3" x 250 (GREEN)	ECS-5150				
" " 0.125" x 3" x 250 (BLACK)	" -5151				
" " 0.148" x 3" x 250 (RED)	" -5152				
" " 0.208" x 3" x 250 (YELLOW)	" -5153				
PAPER SLEEVE FOR 0.4MM CONDUCTOR 200/BAG	ECS-5180	3001	BAG	2500	
" " " 0.5 " "	" -5181	3002	"	50	
" " " 0.65 " "	" -5182	3003	"		
" " " 0.9 " "	" -5183	3004	"		
PLASTIC FILLED SPLICE SLEEVE x 550 (YELLOW)	ECS-5200		"		
" " " " 0.106x 450 (GREEN)	" -5201		"		
" " " " 0.125 x 350 (CLEAR)	" -5202		"		
" " " " 0.145 x 275 (RED)	" -5203		"		
" " " " 0.145 x 225 (BLUE)	" -5204		"		
POLYETHYLENE SLEEVE FOR 0.32MM CONDUCTOR 200/BAG	ECS-5225	3011	BAG	1000	
" " 0.4 " " "	" "	3012	"	1200	
" " 0.5 " "	" "	3013	"		
" " 0.65 " "	" "	3014	"		
" " 0.9 " "	" "	3015	"		
AUXILIARY PE SLEEVE NO. 363		3244	"		
" " " NO. 364		3255	"		
MAIN LEAD SLEEVE					
LEAD SLEEVE 3/4" x 15"	ECS-5334				
" 1" x 15"	" -5335				
" 1/4" x 15"	" -5336				

PW EX.

LIST OF MATERIALS

DESCRIPTION	T.O.T. CODE NO.	JAPAN CODE NO.	UNIT	QUANTITY	REMARK
MAIN LEAD SLEEVE					
LEAD SLEEVE 1 1/2" x 15"	ECS-5337				
" " 1 3/4" x 17"	" -5338				
" " 2" x 17"	" -5339				
" " 2 1/4" x 17"	" -5340				
" " 2 1/4" x 20"	" -5341				
" " 2 3/4" x 20"	" -5342				
" " 3" x 20"	" -5343				
" " 3 1/2" x 20"	" -5344				
" " 4" x 20"	" -5345				
" " 4 1/2" x 20"	" -5346				
" " 4 1/2" x 22"	" -5347				
" " 5" x 20"	" -5348				
" " 5" x 22"	" -5349				
" " 5 1/2" x 20"	" -5350				
" " 5 1/2" x 22"	" -5351				
" " 6" x 22"	" -5352				
" " 6 1/2" x 24"	" -5353				
" " 7" x 24"	" -5354				
" " 8" x 24"	" -5355				
MAIN LEAD SLEEVE 30 - 300 MM	ECS-5405		PCE		
" " " 40 - 300 "	" -5408		"	400	
" " " 40 - 400 "	" -5409		"	10	
" " " 50 - 400 "	" -5412		"	500	
" " " 60 - 400 "	" -5415		"	630	
" " " 70 - 500 "	" -5420		"	250	
" " " 80 - 500 "	" -5426		"	100	
" " " 90 - 500 "	" -5432		"	130	
" " " 100 - 500 "	" -5435		"	15	
" " " 110 - 500 "	" -5438		"	50	
" " " 120 - 500 "			"	120	
" " " 130 - 500 "			"	40	
" " " 140 - 500 MM	ECS-5441		"	10	
" " " 150 - 500 "	" -5444		"	20	
" " " 160 - 500 "	" -5447		"	20	
" " " 170 - 500 "	" -5450		"	10	
" " " 180 - 500 "	" -5453		"	15	
" " " 190 - 500 "	" -5457		"	25	
" " " 200 - 500 "	" -5460		"	15	
" " " 210 - 500 "	" -5463		"	15	
" " " 220 - 500 "	" -5466		"	20	
" " " 250 - 500 "			"	10	
AUXILIARY LEED SLEEVE 30 - 110 MM		3141	"	3300	
" " " 50 - 110 "		3142	"	1300	
" " " 70 - 110 "		3143	"		

DESCRIPTION	T.O.T. CODE NO.	JAPAN CODE NO.	UNIT	QUANTITY	REMARK
AUXILIARY LEAD SLEEVE 50 - 150 MM		3145			
" " " 70 - 150 "		3146		"	
" " " 35 - 130 "	ECS-5406		PCE	10	
" " " 40 - 130 "	" -5407		"	10	
" " " 45 - 130 "	" -5410		"	10	
" " " 50 - 130 "	" -5411		"	175	
" " " 55 - 130 "	" -5413		"	10	
" " " 60 - 130 "	" -5414		"	90	
" " " 65 - 130 "	" -5417		"	50	
" " " 70 - 130 "	" -5418		"	40	
" " " 75 - 130 "	" -5423		"		
" " " 80 - 130 "	" -5424		"	5	
" " " 85 - 130 "	" -5429		"	180	
" " " 90 - 130 "	" -5430		"	25	
" " " 95 - 130 "		3135	"	5	
" " " 100 - 130 "		3136	"	50	
LEAD PLATE					
LEAD PLATE ø 90		3167	PCE	60	
" " ø 110		3151	"	35	
" " ø 120		3152	"	35	
" " ø 130		3153	"	25	
" " ø 140		3154	"		
" " ø 150		3155	"		
" " ø 160		3156	"		
" " ø 170		3157	"		
" " ø 180		3158	"		
" " ø 190		3159	"		
" " ø 200		3160	"		
" " 4 x 20 CM x 33 CM	ECS-3000				
PERFORATED LEAD PLATE 40-250 MM	" -3001	3147	PCE	500	
SPACER					
PLASTIC CABLE SPACER 1/4"	ECS-5800			4100	
" " " 1/2"	" -5801				
" " " 3/4"	" -5802			3900	
" " " 1"	" -5803			200	
SPACER FOR ADAPTER SPCR A 170		3260			
" " " " A 150		3261			
" " " " A 120		3262			
" " " " A 100		3263			
" " " " A 140		3264			
" " " " A 85		3265			
" " " " A 57		3266			
" " " " A 36		3267			

PW EX

LIST OF MATERIALS

DESCRIPTION	T.O.T. CODE NO.	JAPAN CODE NO.	UNIT	QUANTITY	REMARK
SPACER					
SPACER FOR AUXILIARY PE SLEEVE-SPCR AV x 85					
" " " " " " " 57					
" " " " " " " 36					
PE-CAP, BASE METAL					
PRESSURE VALVE (TEST VALVE)					
PE CAP ø20 WITH PRESSURE VALVE		4915			
" " ø22 " " "		"			
" " ø24 " " "		"			
" " ø26 " " "		"			
" " ø28 " " "		"			
" " ø30 " " "		"			
" " ø32 " " "		"			
" " ø34 " " "		"			
" " ø36 " " "		"			
" " ø38 " " "		"			
" " ø40 " " "		"			
" " ø42 " " "		"			
" " ø44 " " "		"			
" " ø46 " " "		"			
" " ø48 " " "		"			
" " ø50 " " "		"			
" " ø52 " " "		"			
" " ø54 " " "		"			
" " ø56 " " "		"			
" " ø58 " " "		"			
" " ø60 " " "		"			
" " ø62 " " "		"			
" " ø64 " " "		"			
" " ø66 " " "		"			
" " ø68 " " "		"			
" " ø70 " " "		"			
" " ø72 " " "		"			
" " ø74 " " "		"			
" " ø76 " " "		"			
" " ø78 " " "		"			
" " ø80 " " "		"			
" " ø82 " " "		"			
P.V.C CAP ø12MM		4915	PCE		
" " ø14 "		"	"		
" " ø16 "		"	"	10	
" " ø18 "		"	"	10	
" " ø20 "		"	"		

DESCRIPTION	T.O.T. CODE NO.	JAPAN CODE NO.	UNIT	QUANTITY	REMARK
P.V.C CAP, ø22MM		4915	PCE	20	
" " ø24 "		"	"		
" " ø26 "		"	"		
" " ø28 "		"	"	10	
" " ø30 "		"	"		
" " ø32 "		"	"		
" " ø34 "		"	"		
" " ø36 "		"	"		
" " ø38 "		"	"		
" " ø40 "		"	"		
" " ø42 "		"	"		
" " ø44 "		"	"		
BASE METAL FOR COMPOUND INJECTOR		4917	PCE		
" " " NO.6 VALVE		4918	"	70	
WIRE, CORD					
GULVANIZED STEEL STRAND GUY WIRE 5/16"-(6M)	DCP-2002		kg	5900	
GUY STRAND 3/8" (10M)	DCP-2003		kg	400	
" " (16M)			"	50	
COPPERWELD TELEPHONE LINE WIRE AWG #6			M	2800	
0.9MM ANNEALED CAPPER WIRE		2940	M	50	
1.6MM IRON WIRE			KG	25	
JUMPERING WIRE			M	150,000	
ø5MM CABLE BINDING CORD			M	2600	
CABLE LASHING WIRE (0.045")			ROLL	200	

PW EX.

LIST OF MATERIALS

DESCRIPTION	T.O.T. CODE NO.	AE CODE NO.	UNIT	QUANTITY	REMARK
HARDWARES IN M.H					
CABLE RACK EXTENSION			PCE	550	
RACK SECTION (8 HOLES)			PCE	130	
" " (14 ")			"	200	
(18 ")			"		
RACK HOOK (4" LGTH)			"	40	
" " (7½" ")			"	700	
" " (10" ")			"	20	
" FOR CABLE BOLT			"	50	
CABLE RACK INSULATOR			"	800	
ZINC CABLE DUCT SHIELD			"	600	
GALVANIZED IRON PIPE ø2"			PCE	130	
FOR RISER CABLE PROTECTION					
IRON PIPE ø3"			PCE	15	
FOR BURRIED CABLE PROTECTION					

DESCRIPTION	T.O.T. CODE NO.	AE CODE NO.	UNIT	QUANTITY	REMARK
POLE					
CONCRETE POLE (8 M)			PCE	69	
" (10 M)			"		
GUY					
DRIVING ANCHOR #2			PCE	90	
" " #3			"		
AUXILIARY EYES			"	20	
CROSS CONNECTING CABINET 800P			"	73	
TERMINAL BLOCK FOR CABINET					
50P - LEAD SHEATH STUB			PCE	49	
100P - " " "			"	103	
50P - POLYETHYLENE SHEATH STUB			"	64	
100P - " " "			"	278	
RELIABLE TYPE ST CABLE TERMINAL					
10 P			PCE	649	
15 P			"	654	
25 P			"	72	
WALL MOUNT TERMINAL BOX (JAPAN)					
FOR TROUGH CABLE 10 P			PCE		
" " " 15 P			"		
" " " 20 P			"		
6P-TERMINAL BLOCK (FOR READY ACCES)			"	250	
STRAIGHT NOZZLE (FOR READY ACCES)			"	40	
BRANCH NOZZLE (")			"	10	
TERMINAL FOR M.D.F					
258-TERMINAL BLOCK			"	318	

LIST OF MATERIALS

PW EX.

DESCRIPTION	T.O.T CODE NO.	JAPAN CODE NO.	UNIT	QUANTITY	REMARK
PUREGAS EQUIPMENT & MATERIALS					
MODEL 1500 AIR DRYER			RCE	1	
METER PANEL			"	1	
DUAL PRESSURE PANEL			"		
PEC 522 ALARM PANEL			"	1	
" 522A MASTER ALARM MODULE			"		
" 522B ALARM MODULE			"		
" 522C LOCAL AIR DRYER ALARM MODULE			"		
" 522D MODULE BLANKS			"		
" 522E ALARM PANEL FRAME			"		
" 412 MAILE ELBOW			"	20	
" 523 PRESSURE GUARD (CABLE MOUNTED)			"		
" 524 " " (POLE,WALL MOUNTED)			"	20	
" 525 " " (UNDERGROUND)			"		
" 401C FLANGE			"	20	
PEC 402D FLANGE			"	11	
" 404B PRESSURE TESTING ELL			"	8	
" 405 SEALING CLAMPS			"	18	
PEC 408 LEAD TUBING (O.D 1/2", 50FT COILS)			M	70	
" 409 COPPER TUBING (O.D 3/8")			"	5	
PEC 501F PRESSURE TESTING VALVE (INSTALLED IN CORD FLANGE)			PCE	10	
" 502P " " " (END OF LEAD PIPE)			"		
" 503C " " " (DIRECT INSTALLATION)			"	140	
" 504M VALVE CAP (INSTALLED BY WRENCH)			"		
" 505R " " (" " HAND)			"	25	
PEC 508 DUAL STEM BY-PASS VALVE			"	4	
PEC 419 MALE ELBOW			PCE	9	
" 421 UNION (EXTEND LENGTH OF PLASTIC TUBING)			"		
" 424 TEE (BRANCH AIR FLOW " " ")			"		
" 426 PLASTIC SHEATH FITTING			"	9	
" 429 PLASTIC TUBE RACK				50	
PEC 431 POLY-CORTUBING 3 TUBES			M		
" 5 "			"		
" 10 "			"	50	

DESCRIPTION	T.O.T CODE NO.	JAPAN CODE NO.	UNIT	QUANTITY	REMARK

PW EX.

CABLE DRUM LENGTH SHEET

DRUM NO.	KIND OF CABLE	CABLE LENGTH (M)	LOCATION
1	3600 - 32 ASP	230.0	PWEX ~ MH # 48
2	〃 〃	232.0	MH # 48 ~ 〃 # 65
3	〃 〃	258.0	〃 # 65 ~ 〃 # 55
4	〃 〃	246.0	〃 # 55 ~ 〃 # 57
5	〃 〃	230.0	PWEX ~ 〃 # 48
6	〃 〃	231.0	〃 ~ 〃 # 48
7	〃 〃	226.0	〃 ~ 〃 # 48
8	〃 〃	226.0	〃 ~ 〃 # 48
9	〃 〃	224.0	〃 ~ 〃 # 48
10	〃 〃	229.0	MH # 48 ~ 〃 # 65
11	〃 〃	219.0	〃 # 65 ~ 〃 # 67
12	〃 〃	223.0	PWEX ~ 〃 # 2
13	〃 〃	212.0	MH # 2 ~ 〃 # 3
14	〃 〃	242.0	〃 # 3 ~ 〃 # 6
15	〃 〃	129.0	〃 # 6 ~ 〃 # 8
16	〃 〃	221.0	PWEX ~ 〃 # 2
17	〃 〃	258.0	MH # 2 ~ 〃 # 4
18	3000 - 4 ASP	213.0	〃 # 57 ~ 〃 # 58
19	〃 〃	192.0	〃 # 58 ~ 〃 # 60
20	〃 〃	232.0	〃 # 48 ~ 〃 # 65
21	〃 〃	220.0	〃 # 65 ~ 〃 # 67
22	〃 〃	165.0	〃 # 67 ~ 〃 # 68
23	〃 〃	131.0	〃 # 68 ~ 〃 # 69
24	〃 〃	268.0	〃 # 69 ~ 〃 # 97
25	〃 〃	224.0	〃 # 97 ~ 〃 # 98
26	〃 〃	225.0	PWEX ~ 〃 # 2
27	〃 〃	213.0	MH # 2 ~ 〃 # 3
28	〃 〃	199.0	〃 # 4 ~ 〃 # 6
29	2400 - 4 ASP	264.0	MH # 60 ~ MH # 61, MH # 98 ~ MH # 99
30	〃 〃	266.0	〃 # 67 ~ 〃 # 72
31	〃 〃	279.0	〃 # 72 ~ 〃 # 74
32	〃 〃	131.0	〃 # 6 ~ 〃 # 8
33	1800 - 4 ASP	281.0	POT HEAD, SPLICING MH # 61 ~ 〃 # 62
34	〃 〃	297.0	MH # 48 ~ MH # 50, MH # 99 ~ MH # 100
35	1800 - 4 ASP	116.0	MH # 48 ~ MH # 64
36	〃 〃	263.0	
37	1200 - 4 ASP	274.0	MH # 64 ~ MH # 66
38	〃 〃	243.0	〃 # 66 ~ 〃 # 68
39	〃 〃	247.0	〃 # 74 ~ 〃 # 75
40	〃 〃	114.0	POT HEAD, SPLICING MH # 35 ~ MH # 36
41	〃 〃	208.0	MH # 4 ~ MH # 32
42	〃 〃	184.0	〃 # 32 ~ 〃 # 31
43	900 - 4 ASP	251.0	MH # 62 ~ MH # 63, MH # 50 ~ MH # 51
44	〃 〃	302.0	〃 # 51 ~ 〃 # 52, 〃 # 50 ~ 〃 # 53 〃 # 89 ~
45	〃 〃	171.0	〃 # 98 ~ 〃 # 40, 〃 # 100 ~ 〃 # 101
46	〃 〃	286.0	MH # 68 ~ MH # 70
47	〃 〃	153.0	〃 # 75 ~ 〃 # 84, 〃 # 3 ~ 〃 # 4 〃 # 10 ~
48	600 - 4 ASP	222.0	〃 # 63 ~ PB # 29, MH # 61 ~ RISER 〃 # 53 ~ MH # 54, MH # 53 ~ 〃 # 62 ~ PB # 28, 〃 # 60 ~
49	〃 〃	234.0	〃 # 79 ~ PB # 45, MH # 72 ~ PB # 74 〃 # 101 ~ 〃 # 44, 〃 # 13 ~ 〃 # 14 〃 # 72 ~ 〃 # 74,
50	300 - 4 ASP	507.0	〃 # 56 ~ 〃 # 21, MH # 59 ~ PB # 24 〃 # 57 ~ 〃 # 22, 〃 # 60 ~ 〃 # 25 〃 # 58 ~ 〃 # 23, 〃 # 61 ~ 〃 # 27
51	〃 〃	490.0	〃 # 98 ~ 〃 # 40, 〃 # 1 ~ 〃 # 2 〃 # 99 ~ 〃 # 41 〃 # 100 ~ 〃 # 43
52	〃 〃	430.0	〃 # 44 ~ RISER, MH # 3 ~ PB # 4 PB # 29 ~ 〃 MH # 2 ~ PB # 3
53	〃 〃	394.0	MH # 10 ~ PB # 11, PB # 51 ~ PB # 52 PB # 11 ~ 〃 # 12, MH # 6 ~ 〃 # 9 MH # 47 ~ 〃 # 51
54	600 - 4 ASPT	204.0	PB # 14 ~ RISER MH # 62 ~ PB # 61
55	300 - 4 ASPT	266.0	RISER ~ CAB 012, CAB 106 ~ PB # 105 PB # 61 ~ PB # 62, 〃 # 44 ~ CAB 120
56	600 - 4 AP		
57			
58			
59			
60			
61			
62			
63			
64			
65			
66			
67			
68			

"PW" ANNEX-I Demand Forecast for Special Area in PW Exchange

Bldg. Name	Demand Forecast			Remarks
	1976	1980	1985	
Vacant Area	20	30	50	Beside Sakol Hotel
Bangkok Station	4	5	6	
National Stadium	40	60	80	
Vacant Area	60	80	100	Near Chula Stadium
Chulalongkorn University	10	15	20	
School	3	4	5	
Student Apartment	4	5	6	
Vacant Area	50	70	90	Soi Wat Sam-ngam
Chainakorn Hotel	6	7	10	
Temple	4	6	10	
Market	5	7	8	
School	2	3	4	
Pathumwan Engineering School	5	6	10	
Siam Motors Co.	63	80	90	
SR Motor	5	6	7	
Grand Hotel (rental office)	35	40	60	
Boonpong Bus Co.	3	5	7	
Thai Watana Panich Co.	7	8	10	
Vacant Area	25	35	50	Rongmuang Soi 4
Hospital	7	8	10	
Temple	2	3	4	
Siam Auto Co.	5	7	8	

(Cont'd)

Bldg. Name	Demand Forecast			
	1976	1980	1985	
Vacant Area	7	20	30	Near Charoenpol Bldg.
" "	20	25	30	
" "	50	60	70	Soi Wat Sam-ngam
Thep Aksorn School	2	3	4	
Siam Motor Co.	12	16	20	
Vacant Area	10	15	20	Kasemsan Soi 2
Bangkok Motor	16	20	25	
Vacant Area	30	40	60	Kasemsan Soi 1
School	2	3	4	
Pakdee Hotel	5	7	10	
Southerner Society	3	4	5	
Asia Hotel	35	40	50	
Raj Panya School	2	3	4	
Wat	3	4	5	
School	2	2	3	
"	2	3	3	
Vacant Area	30	50	70	Near Rama 6 Rd.
Wat	2	3	4	
Wat Duangkae School	2	2	3	
Factory	10	15	20	
Sitabut Bamrung School	2	2	3	
Vacant Area	5	10	20	Near Rama 1 Rd.
" "	5	15	20	Near Trok Salak-hin
" "	5	20	35	" " "

(Cont'd)

Bldg. Name	Demand Forecast			Remarks
	1976	1980	1985	
Trimit Suksa School	2	2	3	
Patumwan Police Station	4	5	10	
Patumwan District	10	12	15	
Apart. of Fire Station	2	4	6	
Fire Station	3	3	4	
Rajathani Hotel	10	15	20	
Bangkok Central Station	20	25	30	
Station Hotel	5	7	10	
Watana Wut Vitaya School	2	2	3	
Vacant Area	5	10	20	Near Rama 6 Rd.
Taiyu Association of Thailand	3	3	4	
Vacant Area	30	40	60	Along the Chula Soi 7
Patumwan Nursing Home	5	7	10	
Teacher's Apartment	4	7	10	
" "	4	7	10	
" "	20	25	30	
" "	8	10	15	
Vacant Area	25	40	60	Along Suanluang Soi 3
" "	40	70	100	" " " 3
Sakol Hotel	15	20	30	
School	2	2	3	
Chulalongkorn High School	13	13	14	
Chulalongkorn University	15	17	20	

(Cont'd)

Bldg. Name	Demand Forecast			Remarks
	1975	1980	1985	
Now Building	25	27	30	
Chulalongkorn University	26	28	35	
Ice Factory	3	4	5	
Railway Printing House	3	4	5	
Everet Hotel	3	4	5	
Kingpetch School	3	4	5	
Vacant Area	5	10	20	Near Graveyard Soi Kingpetch
Srithong Hotel	3	4	6	
35 Hotel	5	6	7	
25 Hotel	4	5	6	
Jarumi Vitaya School	2	2	3	
Prathuangvit School	2	2	3	
Sudarak School	2	3	3	
Sanyanukorn Vitaya School	2	2	3	
Wat Payayoung	2	2	3	
Srisuk Hotel	4	5	6	
Vacant Area	5	50	100	Near Graveyard Soi Kingpetch
Flat	30	35	40	
School	2	3	5	
Petchburi Vitayalong-korn College	2	3	3	
Gas Station	3	5	8	
Post Office	5	10	15	
Phothitat School	2	3	3	
Vacant Area	10	15	20	Near Rongmuang Soi 3
" "	5	20	30	Along Petchburi Rd.
Women Association of Thailand	4	5	10	

"PW" ANNEX-II

CHAROEN PHOL BRIDGE CALCULATION OF SUSPENSION HARDWARE STRESS

1. Attachment to Bridge

A. Design conditions

a) As shown in Fig. 1, 12 lines of ϕ 100 mm galvanized iron pipes (G.I.P.) will be attached by ϕ 16 mm suspension bolts.

b) Allowable stress

i) Suspension bolt

$\sigma ta = 600$ Kg/cm^2 (Allowable tensile stress)

ii) Suspension hardware

$\sigma ta = 1{,}400$ Kg/cm^2

c) Suspension interval -- 3.0 m.

B. Load

a) ϕ 100 mm G.I.P. (12.8 Kg/m) 12.8 x 12 = 153.6 Kg/m

b) Cable (9.2 Kg/m) 9.2 x 12 = 110.4 Kg/m

Total 264.0 Kg/m

Load at one place of attachment 3.0 x 264.0 = 792.0 Kg

c) Suspension bolt (ϕ 16 mm) (1.58 Kg/m)

d) Suspension hardware (L-75 x 75 x 9) (9.96 Kg/m)
Load at one place of attachment 9.96 x 0.8 $\fallingdotseq$ 8.0 Kg (Use of one)

e) Suspension hardware (L-50 x 50 x 6) (4.43 Kg/m)
Use at one place of attachment - 2 hardwares of 0.05 m,
1 of 0.10 m

$\therefore$ 0.2 x 4.43 $\fallingdotseq$ 1.0 Kg

f) U type bolt (ϕ 9 mm) (0.499 Kg/m)
Use at one place of attachment -- 1 bolt of 1.06 m and
1 bolt of 0.93 m

0.499 x 1.99 $\fallingdotseq$ 1.0 Kg

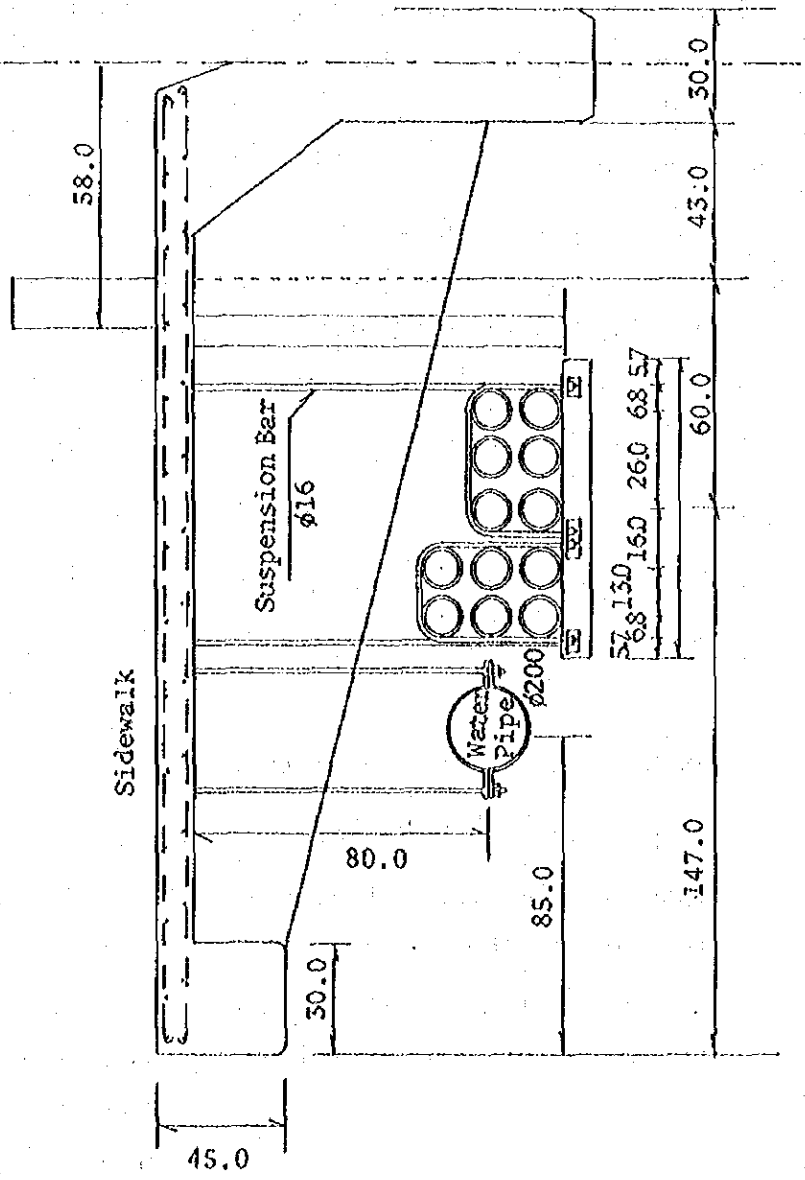

58.0
30.0
43.0
60.0
147.0
Suspension Bar
ϕ16
Sidewalk
Water Pipe
ϕ200
80.0
85.0
30.0
45.0
57
68
26.0
160
130
57
68

Fig. 1

C. Determining Size of Suspension Bolt

a) Load P on 1 suspension bolt

$$P = (792.0 + 8.0 + 1.0 + 1.0)/2 = 401 \text{ Kg}$$

b) Calculation of tensile stress intensity

$$\sigma_t = \frac{P}{0.5d^2} = \frac{401}{0.5 \times 1.6^2} = 313.3 \text{ kg/cm}^2$$

$\therefore \sigma_{ta} = 600 \text{ kg/cm}^2 > \sigma_t = 313.3 \text{ kg/cm}^2$ --- is safe.

Therefore, ϕ 16 mm suspension bolt will be used.

D. Determining Type of Suspension Hardwares (L-75 x 75 x 9)

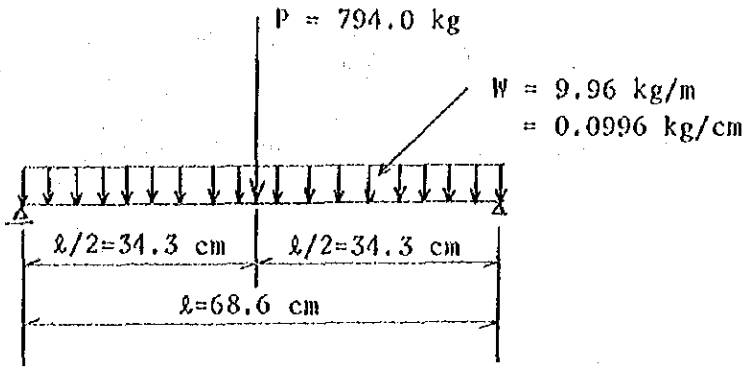
The suspension hardware will be the simple beam at the supports which are the point supported by 2 suspension bolts, and the external force on the beam is the concentrated load. The beam itself will be calculated as a uniform load.

a) Maximum bending moment (Max M)

i) Concentrated load

Max M (p) according to P

P = 792.0 + 1.0 + 1.0 = 794.0 Kg.



$$\text{Max M (p)} = \frac{P\ell}{4} = \frac{794.0 \times 68.6}{4} = 13,617.1 \text{ Kg·cm}$$

ii) Max M (w) according to uniform load w

$$w = 9.96^{Kg.m} = 0.0996^{Kg.cm}$$

$$\text{Max M (w)} = \frac{w\ell^2}{8} = \frac{0.0996 \times 68.6^2}{8} = 58.59^{Kg.cm}$$

iii) Max M (p + w)

$$\text{Max M (p + w)} = 13,617.1 + 58.59 \doteq 13,675.7^{Kg.cm}$$

b) Tensile stress intensity

$$\sigma t = \frac{M}{Z} = \frac{13,675.7}{12.1} = 1,130.2 \text{ Kg/cm}^2$$

Z = Section modulus

$\sigma ta = 1,400 \text{ Kg/cm}^2 > \sigma t = 1,130.2 \text{ Kg/cm}^2$... Therefore, is safe.

C) Deflection

I : Moment of inertia

E : Modulus of elasticity

$$Y(p) = \frac{P\ell^3}{48\ EI} = \frac{794 \times 68.6^3}{48 \times 2.1 \times 10^6 \times 64.4} = 0.039^{cm}$$

$$Y(w) = \frac{5w\ell^4}{384\ EI} = \frac{5 \times 0.096 \times 68.6^4}{384 \times 2.1 \times 10^6 \times 64.4} = 0.002^{cm}$$

$$Y(p + w) = 0.039 + 0.0002 = 0.0392 \doteq 0.04^{cm}$$

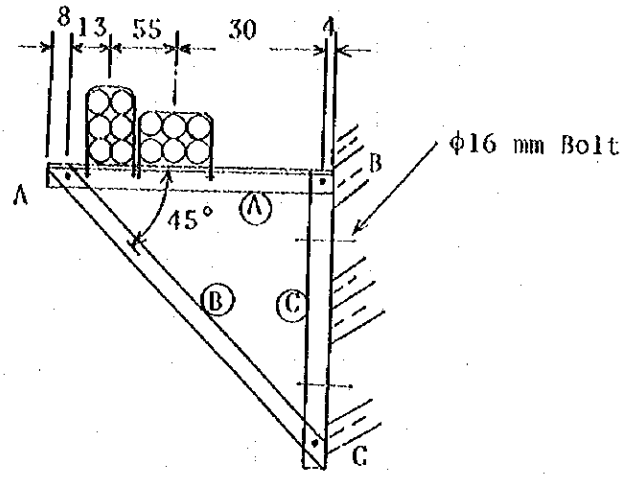
$$\ell \times \frac{1}{300} = 68.6 \times \frac{1}{300} > 0.04^{cm} \text{ .... Therefore is safe.}$$

d) Use L-75 x 75 x 9 as conduit supporter.

2. Attachment to Wing Wall

A. Design Conditions

a) Attachment method is shown in diagram below.



b) Dimensions of parts

Use L-100 x 100 x 7 for the A part and L-75 x 75 x 9 for the other parts.

c) Allowable stress

$\sigma ta = 1{,}400\ Kg/cm^2$ (Allowable tensile stress)

$\sigma o = 1{,}300 - 0.06\ (\ell/\gamma)^2\ [0 < \ell/\gamma \leq 110]$

$\sigma o = 7{,}200{,}000\ (\gamma/\ell)^2\ [\ell/\gamma > 110]$

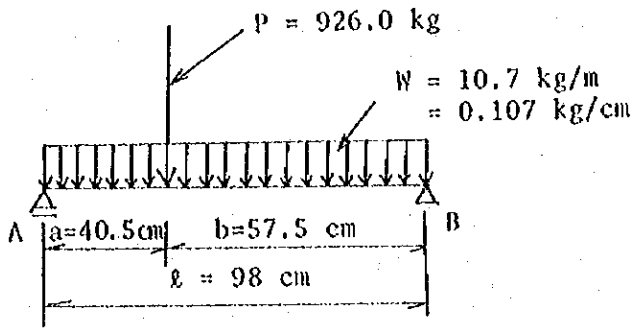
σo = Allowable compressive stress

d) Attachment spacing --- 3.5 (at maximum spacing)

B. Calculation of Load Bearing Power of A Part

The A Part will be the simple beam, and the load will be calculated as the concentrated load as follows:

$P = 264.0 \times 3.5 + 1.0 + 1.0 = 926.0$ Kg



$$\max M\ (p) = \frac{Pab}{\ell} = \frac{926.0 \times 40.5 \times 57.5}{98} = 22{,}004.3\ \text{Kg.cm}$$

$$\max M\ (w) = \frac{w\ell^2}{8} = \frac{0.107 \times 98^2}{8} = 128.5\ \text{Kg.cm}$$

$$\max M\ (p + w) = 22{,}004.3 + 128.5 = 22{,}132.8\ \text{Kg.cm}$$

$$\sigma t = \frac{M}{Z} = \frac{22{,}132.8}{17.7} = 1{,}250.4\ \text{Kg/cm}^2$$

[Z (Section modulus)]

$\sigma ta = 1{,}400\ \text{Kg/cm}^2 > 1{,}250.4\ \text{Kg/cm}^2$ ... Therefore, is safe.

$$Y(s) = \frac{Pa^2b^2}{3\ EI\ell} = \frac{926.0 \times 40.5^2 \times 57.5^2}{3 \times 2.1 \times 10^6 \times 129 \times 98} = 0.063^{cm}$$

$$Y(w) = \frac{5\ w\ell^4}{384\ EI} = \frac{5 \times 0.107 \times 98^4}{384 \times 2.1 \times 10^6 \times 129} = 0.0005^{cm}$$

$$Y(p + w) = 0.063 + 0.0005 \fallingdotseq 0.064^{cm}$$

$$\ell \times \frac{1}{300} = 98 \times \frac{1}{300} > 0.064^{cm} \quad \text{.... Therefore, is safe.}$$

C. Calculation of Load Bearing Power of B Part

Neutral axis force of B Part is the component force (45° neutral) of the reaction at A point of the A Part. Therefore, it will be calculated as the Long Column which will bear this component force.

Neutral axis force $Pc = R_A \sec 45°$

$$= \left(\frac{Pb}{\ell_A} + \frac{w\ell_A}{2}\right) \sec 45°$$

$$= \left(\frac{926 \times 57.5}{98} + \frac{0.107 \times 98}{2}\right) \times 1.414 = 775.7 \text{ Kg}$$

Length of B part $98 \times 1.414 \fallingdotseq 139^{cm}$

$$\frac{\ell}{\gamma} = \frac{139}{3.08} = 45.13 \ldots [45.13 < 110]$$

[γ: Radius of gyration]

$$\sigma_o = 1{,}300 - 0.06\,(\ell/\gamma)^2 = 1{,}300 - 0.06 \times 45.13^2 = 1{,}177.8 \text{ Kg/cm}^2$$

$$\sigma_{oA} = 1{,}177.8 \times 13.62 = 16{,}041.6 \text{ Kg/cm}^2$$

[σ_{oA} = Load possible to be placed.]

Therefore, is safe.

A = gyration calculation

The C part is considered safe from the composition and the calculation will be omitted.

D. Calculation of Load Bearing Power of Anchor Bolt (ø 16 mm)

τsa (Kg/cm^2): Allowable shearing stress

$\tau s = \tau sa \cdot \frac{\pi d^2}{4}$ (Kg) τs (shearing stress)

The external force that will bear on this anchor bolt shall be the entire weight of all suspended objects.

$P = 926.0 + 10.7 \times 1.1 + 9.96 \times 2.2 = 959.68^{Kg}$

$\tau s = 800 \times 2.011^{cm^2} = 1,608.8^{Kg}$

$\therefore 1,608.8^{Kg} > 959.68^{Kg}$ Therefore, is safe.

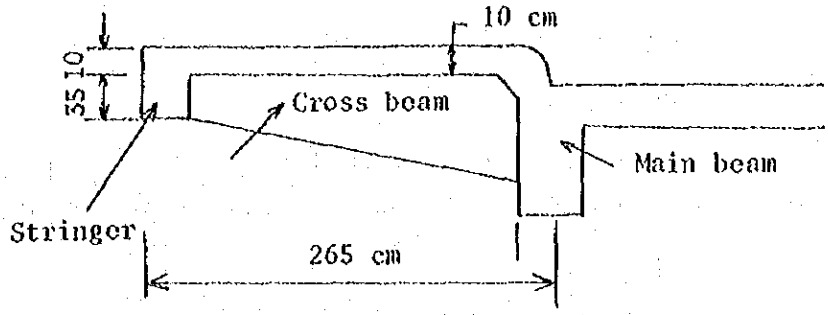
3. Study on Effect of Suspension on Bridge Beam

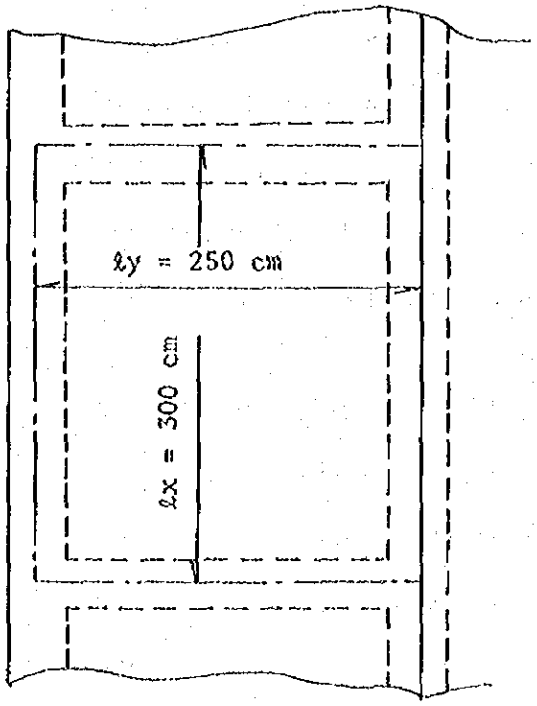
A. Study Items

a) Water supply pipe is presently suspended on the bridge. In the event the telephone conduit is additionally suspended, the effect on the sidewalk bed slab will be studied.

b) The sidewalk bed slab, as shown in the following diagram, will be calculated as a two-way slab supported on four sides by the stringer and cross beam of the bridge.

Sidewalk bed slab





B. Load Weight Items

a) Suspension weight (Pw) of water supply pipe

i) Weight of water supply pipe (ϕ 200 mm) -- 32.1 Kg/m

ii) Weight of water in pipe

$$\frac{\pi d^2}{4} \times 1{,}000 = \frac{0.2^2 \times 3.14}{4} \times 1{,}000 = 31.4 \text{ Kg/m}$$

iii) Weight of suspension bolts (ø 19 mm) -- 2.23 Kg/m

0.8 x 2 bolts x 2.23 ≒ 3.6 Kg

iv) Other hardwares ≒ 0.4 Kg

The water supply pipe is suspended by hardwares at a spacing of 2.3 m. Therefore, the weight Pw borne at one place of suspension is:

Pw = (3.6 + 0.4) + (32.1 + 31.4) x 2.3 = 150.1 Kg

b) Suspension weight (Pt) of conduit

i) Conduit and cable -- 264 Kg/m

ii) Weight of suspension bolt (ø 16 mm) -- 1.58 Kg

1.58 x 2.8 m ≒ 4.4 Kg

iii) Suspension hardwares and others -- 10.0 Kg

Suspension spacing is 3.0 m.
Therefore,

Pt = (4.4 + 10.0) + 264.0 x 3.0 = 806.4 Kg

c) Weight of slab and uniform load

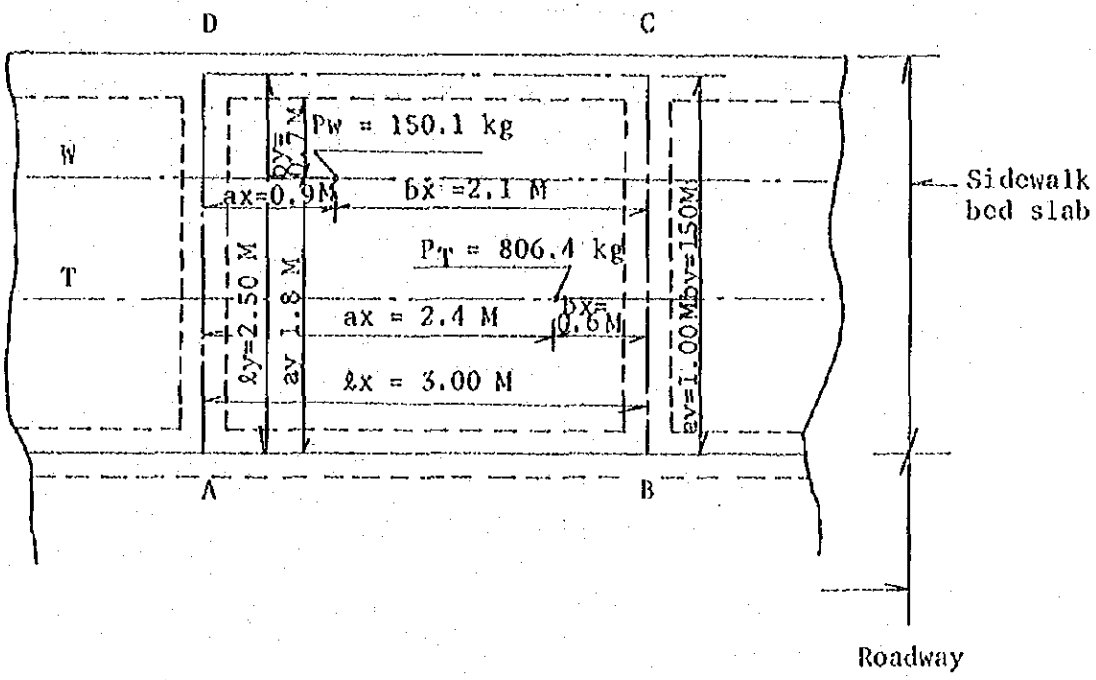
i) Slab weight: 0.1 x 2,400 = 240 Kg/m

ii) Uniform load 500 Kg/m

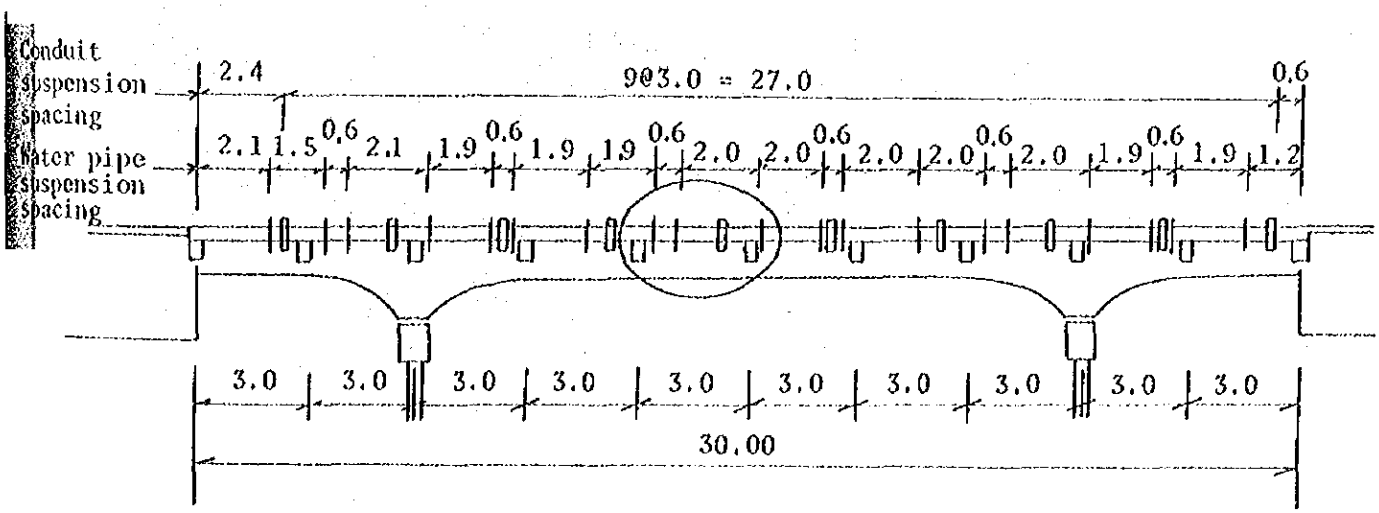
Total 740 Kg/m

C. Loading Condition of Pw and Pt

Plane



Side View



D. Max M according to Pw and Pt

The two-way slab (fixed on four sides) will be calculated as receiving the concentrated load of Pw and Pt.

Since the deflection at the loading point of the beam with both ends fixed (width 1 meter) of two-ways x and y must be equivalent, the load ratio to be borne by lx and ly will be computed from the following calculation.

From

$$\frac{Px\ a_x^3\ b_x^3}{3\ EI\ \ell_x^3} = \frac{(P - Px)\ a_y^3\ b_y^3}{3\ EI\ \ell y^3}$$

$$Px = \frac{P.a_y^3.b_y^3.\ell_x^3}{a_y^3.b_y^3.\ell_x^3 + a_x^3.b_x^3.\ell_y^3} \quad \ldots\ldots\ (1)$$

$$Py = \frac{P\ a_x^3.b_x^3.\ell_y^3}{a_x^3.b_x^3.\ell_y^3 + a_x^3.b_x^3.\ell_x^3} \quad \ldots\ldots\ (2)$$

Therefore,

$$Pw(x) = \frac{150.1 \times 1.8^3 \times 0.7^3 \times 3.0^3}{1.8^3 \times 0.7^3 \times 3.0^3 + 0.9^3 \times 2.1^3 \times 2.5^3} = 50.83\ Kg$$

$$Pw(y) = \frac{150.1 \times 0.9^3 \times 2.1^3 \times 2.5^3}{0.9^3 \times 2.1^3 \times 2.5^3 + 1.8^3 \times 0.7^3 \times 3.0^3} = 99.27\ Kg$$

$$P_T(x) = \frac{806.4 \times 1.0^3 \times 1.5^3 \times 3.0^3}{1.0^3 \times 1.5^3 \times 3.0^3 + 2.4^3 \times 0.6^3 \times 2.5^3} = 533.33\ Kg$$

$$P_T(y) = \frac{806.4 \times 2.4^3 \times 0.6^3 \times 2.5^3}{2.4^3 \times 0.6^3 \times 2.5^3 + 1.0^3 \times 1.5^3 \times 3.0^3} = 273.07\ Kg$$

a) Calculation of x-way

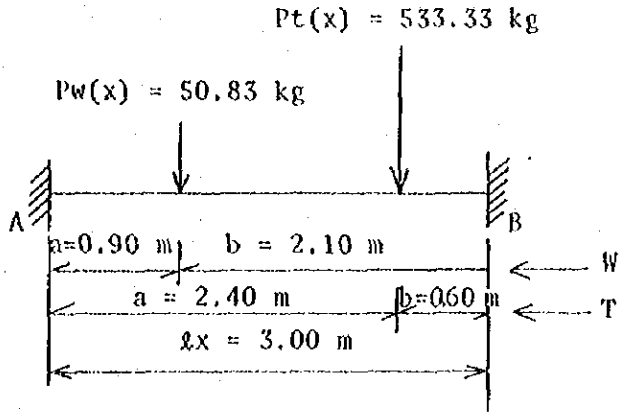
$$\max Mw(x) = \frac{2Pw(x)\ a_x^2\ b_x^2}{\ell x^3} = \frac{2 \times 50.83 \times 0.90^2 \times 2.10^2}{3.00^3} = 13.45^{Kg.m}$$

$$\max M_T(x) = \frac{2P_T(x)\ a_x^2\ b_x^2}{\ell_x^3} = \frac{2 \times 533.33 \times 2.40^2 \times 0.60^2}{3.00^3} = 81.92^{Kg.m}$$

Bending moment of support point

$$Mw(A) = \frac{Pw(x)\ a_x\ b_x^2}{\ell x^2} = \frac{-50.83 \times 0.9 \times 2.1^2}{3.0^2} = -22.42^{Kg.m}$$

$$M_T(A) = \frac{P_T(x)\ a_x\ b_x^2}{\ell x^2} = \frac{-533.33 \times 2.4 \times 0.6^2}{3.0^2} = -51.20^{Kg.m}$$



$$Mw(B) = \frac{Pw(x)\ a_x^2\ b_x}{\ell x^2} = \frac{-50.83 \times 0.9^2 \times 2.10}{3.0^2} = -9.61^{Kg.m}$$

$$M_T(B) = \frac{P_T(x)\ a_x^2\ b_x}{\ell x^2} = \frac{-533.33 \times 2.4^2 \times 0.6}{3.0^2} = -204.80^{Kg.m}$$

Therefore,

$$\max M[w + T](x) = 13.45 + 81.92 = \underline{95.37}^{Kg.m}$$

$$M[w + T](A) = -22.42 - 51.20 = \underline{-73.62}^{Kg.m}$$

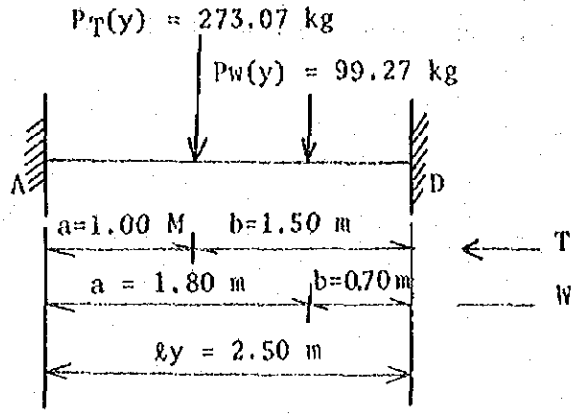
$$M[w + T](B) = -9.61 - 204.80 = \underline{-214.41}^{Kg.m}$$

b) Calculation of y-way

$$\max M_w(y) = \frac{2P_w(y)\, a_y^2\, b_y^2}{\ell_y^3}$$

$$= \frac{2 \times 99.27 \times 1.8^2 \times 0.7^2}{2.5^3}$$

$$= 20.17^{Kg.m}$$



$$\max M_T(y) = \frac{2P_T(y)\, a_y^2\, b_y^2}{\ell_y^3}$$

$$= \frac{2 \times 273.07 \times 1.0^2 \times 1.5^2}{2.5^3} = 78.64^{Kg.m}$$

Bending momont of support point

$$M_w(A) = \frac{-P_w(y)\, a_y\, b_y^2}{\ell_y^2} = \frac{-99.27 \times 1.8 \times 0.7^2}{2.5^2} = -14.01^{Kg.m}$$

$$M_T(A) = \frac{-P_T(y)\, a_y^2\, b_y}{\ell_y^2} = \frac{-273.07 \times 1.0 \times 1.5^2}{2.5^2} = -98.31^{Kg.m}$$

$$M_w(D) = \frac{-P_w(y)\, a_y^2\, b_y}{\ell_y^2} = \frac{-99.27 \times 1.8^2 \times 0.7}{2.5^2} = -36.02^{Kg.m}$$

$$M_T(D) = \frac{-P_T(y)\, a_y^2\, b_y}{\ell_y^2} = \frac{-273.07 \times 1.0^2 \times 1.5}{2.5^2} = -65.54^{Kg.m}$$

Therefore,

$$\max M[w + T](y) = 20.17 + 78.64 = 98.81^{Kg.m}$$

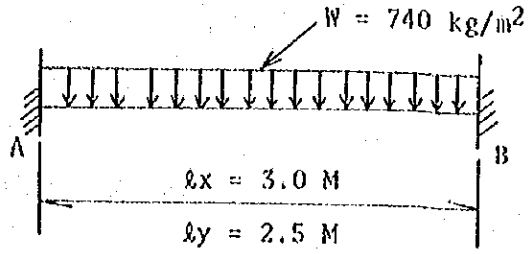
$$M[w + T](A) = -14.01 - 98.31 = -112.32^{Kg.m}$$

$$M[w + T](D) = -36.02 - 65.54 = -101.56^{Kg.m}$$

E. Max M according to Slab Weight and Sidewalk Live Load

In case ly/lx = 0.833, comparative example from the Table 1 is:

$\alpha = 0.01176 \quad \beta = 0.02448 \quad \gamma = 0.3254 \quad \delta = 0.6746$



$\max Mx = \alpha . w . lx^2$

$= 0.01176 \times 740 \times 3.0^2$

$= 78.32^{Kg.m}$

$\max My = \beta . w . ly^2$

$= 0.02448 \times 740 \times 2.5^2 = 113.22^{Kg.m}$

Bending moment of support point

$Mx = -\frac{1}{12} \gamma . w \, lx^2 = -\frac{1}{12} \times 0.3254 \times 740 \times 3.0^2 = -180.6^{Kg.m}$

$My = -\frac{1}{12} \delta . w . ly^2 = -\frac{1}{12} \times 0.6746 \times 740 \times 2.5^2 = -260.0^{Kg.m}$

F. Maximum Bending moment

$\max M(x) = 95.37 + 78.32 = 173.69^{Kg.m}$

$\max M(y) = 98.81 + 113.22 = 212.03^{Kg.m}$

$\max M_A(x) = -73.62 - 180.6 = -254.22^{Kg.m}$

$\max M_B(x) = -214.41 - 180.6 = -395.01^{Kg.m}$

$\max M_A(y) = -112.32 - 260.0 = -372.32^{Kg.m}$

$\max M_D(y) = -101.56 - 260.0 = -361.56^{Kg.m}$

Therefore, Maximum bending momont of x-way is:

$$\max Mx = -395.01^{Kg.m} = -39,501^{Kg.cm}$$

and Maximum bending movent of y-way is:

$$\max My = -372.32^{Kg.m} = 37,232^{Kg.cm}$$

G. Effect of Bending Moment on Sidewalk Bed Slab

Effective height of slab: d Steel rod cut area: As

$$d = c_1\sqrt{\frac{M}{b}} \qquad As = C_2\sqrt{M.b}$$

$\sigma ca = 50\ Kg/cm^2$ Allowable bending pressure stress of concrete

$\sigma ca = 1,200\ Kg/cm^2$ Allowable tensile stress of steel rod } Refer to Table 2

$C_1 = 0.345$ Coefficient

$C_2 = 0.00277$ "

a) In regard to x-way

$$d(x) = 0.345\sqrt{39501/100} = 6.86^{cm}$$

$$As(x) = 0.00277\sqrt{39501 \times 100} = 5.51^{cm^2}$$

b) In regard to y-way

$$d(y) = 0.345\sqrt{37232/100} = 6.66^{cm}$$

$$As(y) = 0.00277\sqrt{37232 \times 100} = 5.34^{cm^2}$$

H. Calculation of Sidewalk Bed Slab Thickness and No. of Reinforcement Steel Rods

i) Since the thickness of both x way and y way is 10 cm and rise of reinforcement steel rod is about 2 cm,

x way $d = 6.86^{cm}$ Therefore, even when rise of 2 cm is added 8.85^{cm}:

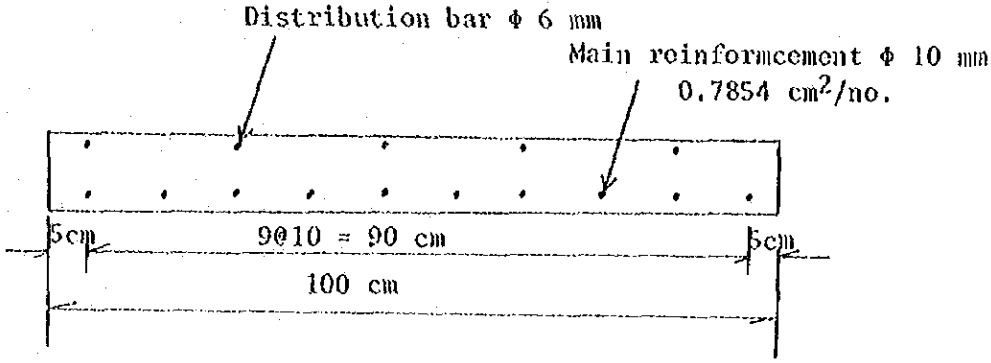
$\therefore 8.86^{cm} < 10^{cm}$ ... is safe.

y way $d = 6.66^{cm}$ Rise of 2 cm, total $\doteqdot 8.66^{cm}$

$8.66^{cm} < 10^{cm}$ ... is safe.

ii) No. of reinforcement steel rods

a) x way

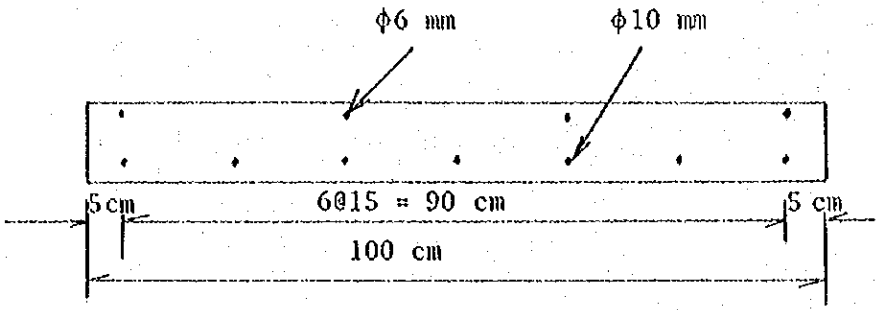


From the above diagram, 10 round steel rods of ϕ 10 mm are used.

$As = 10 \times 0.7854 = 7.854^{cm^2}$

$\therefore 7.854^{cm} > 5.51^{cm^2}$ Therefore, is safe.

b) y way

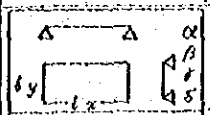
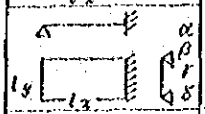
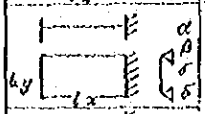
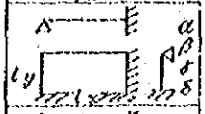
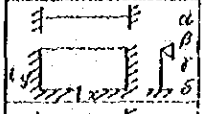
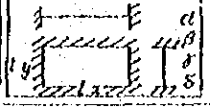


As = 7 x 0.7854 ≒ 5,498 $^{cm^2}$

∴ 5,498 $^{cm^2}$ > 5.34 $^{cm^2}$ .... Therefore, is safe.

Table 1. Bending Moment Coefficient of Two-Way Slab Bearing Uniform Load

(According to (11) formula and (12) formula)

l_y/l_x	0.60	0.70	0.80	0.90	1.00	1.10	1.20	1.30	1.40	1.50
	0.01053 0.08121 0.1147 0.8853	0.01623 0.06761 0.1936 0.8064	0.02258 0.05512 0.2906 0.7094	0.02931 0.04471 0.3962 0.6038	0.03616 0.03636 0.5000 0.5000	0.04388 0.02997 0.5912 0.4058	0.05141 0.02479 0.6746 0.3254	0.05877 0.02058 0.7407 0.2593	0.06572 0.01711 0.7935 0.2065	0.07210 0.01424 0.8350 0.1650
	0.01172 0.07302 0.2117 0.7553	0.01691 0.05818 0.3751 0.6249	0.02239 0.04548 0.5059 0.4941	0.02798 0.03524 0.6212 0.3788	0.03341 0.02721 0.7143 0.2857	0.03812 0.02102 0.7854 0.2146	0.04286 0.01629 0.8383 0.1617	0.04667 0.01270 0.8771 0.1229	0.04989 0.00997 0.9057 0.0943	0.05258 0.00790 0.9268 0.0732
	0.01141 0.06204 0.3932 0.6068	0.0150 0.04626 0.5456 0.4544	0.01933 0.03383 0.6719 0.3281	0.02354 0.02460 0.7664 0.2336	0.02668 0.01794 0.8333 0.1667	0.02925 0.01330 0.8798 0.1202	0.03131 0.00983 0.9120 0.0880	0.03290 0.00743 0.9349 0.0651	0.03427 0.00569 0.9505 0.0495	0.03532 0.00441 0.9620 0.0380
	0.00686 0.05296 0.1147 0.8853	0.01109 0.04620 0.1936 0.8064	0.01608 0.03926 0.2906 0.7094	0.02147 0.03272 0.3962 0.6038	0.02692 0.02692 0.5000 0.5000	0.03216 0.02197 0.5912 0.4058	0.03702 0.01785 0.6746 0.3254	0.04138 0.01449 0.7407 0.2593	0.04520 0.01177 0.7935 0.2065	0.04850 0.00958 0.8350 0.1650
	0.00722 0.04835 0.2059 0.7941	0.01103 0.04013 0.3244 0.6756	0.01569 0.03228 0.4503 0.5497	0.01905 0.02511 0.5675 0.4325	0.02263 0.01977 0.6667 0.3333	0.02574 0.01532 0.7454 0.2546	0.02835 0.01185 0.8057 0.1943	0.03050 0.00924 0.8510 0.1490	0.03224 0.00721 0.8848 0.1152	0.03366 0.00572 0.9101 0.0899
	0.00436 0.03362 0.1147 0.8853	0.00718 0.02991 0.1936 0.8064	0.01053 0.02583 0.2906 0.7094	0.01426 0.02174 0.3962 0.6038	0.01794 0.01794 0.5000 0.5000	0.02138 0.01460 0.5912 0.4058	0.02445 0.01179 0.6746 0.3254	0.02710 0.00949 0.7407 0.2593	0.02934 0.00764 0.7935 0.2065	0.03121 0.00616 0.8350 0.1650

Note:

(1) α and β are maximum positive bending moment coefficients x way and y way respectively.

x way $\quad \max Mx = \alpha w l_x^2$

y way $\quad \max My = \beta w l_y^2$

(2) γ and δ are load division ratio of x way and y way respectively.

(3) Supporting point moment will be derived from the following formulas for x way and y way respectively.

a) In case of one end fixed and other end simple support

x way $\quad Mx = -\frac{1}{8}\gamma w l_x^2$

y way $\quad My = -\frac{1}{8}\delta w l_y^2$

b) In case of both ends fixed supports

x way $\quad Mx = -\frac{1}{12}\gamma w l_x^2$

y way $\quad My = -\frac{1}{12}\delta w l_y^2$

Where w = uniform load

Table 2. Coefficient C_1 and C_2

(In case N = 15)

σ_c	σ_s=1 100 kg/cm²		σ_s=1 200 kg/cm²		σ_s=1 300 kg/cm²	
(kg/cm²)	C_1	C_2	C_1	C_2	C_1	C_2
30	0.504	0.00200	0.518	0.00177	0.533	0.00153
35	0.445	0.00229	0.457	0.00203	0.469	0.00182
40	0.401	0.00257	0.411	0.00228	0.421	0.00204
45	0.366	0.00285	0.375	0.00253	0.383	0.00227
50	0.338	0.00311	0.345	0.00277	0.353	0.00248
55	0.315	0.00337	0.321	0.00309	0.328	0.00269
60	0.295	0.00362	0.301	0.00323	0.307	0.00290
65	0.279	0.00387	0.284	0.00345	0.289	0.00310
70	0.264	0.00411	0.269	0.00367	0.274	0.00330

σ_c	σ_s=1 400 kg/cm²		σ_s=1 500 kg/cm²		σ_s=1 600 kg/cm²	
(kg/cm²)	C_1	C_2	C_1	C_2	C_1	C_2
40	0.430	0.00184	0.440	0.00167	0.449	0.00153
45	0.391	0.00205	0.400	0.00186	0.408	0.00170
50	0.360	0.00224	0.367	0.00204	0.375	0.00187
55	0.334	0.00244	0.341	0.00222	0.347	0.00203
60	0.313	0.00263	0.319	0.00239	0.324	0.00219
65	0.295	0.00281	0.300	0.00256	0.305	0.00235
70	0.279	0.00299	0.284	0.00273	0.288	0.00250
75	0.265	0.00316	0.269	0.00289	0.274	0.00265
80	0.253	0.00334	0.257	0.00305	0.261	0.00280
85	0.242	0.00350	0.246	0.00320	0.250	0.00294
90	0.233	0.00368	0.236	0.00335	0.239	0.00308