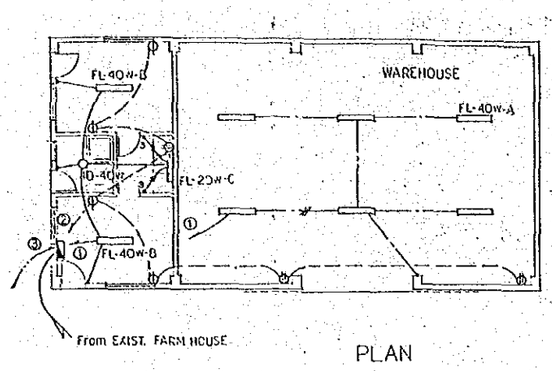


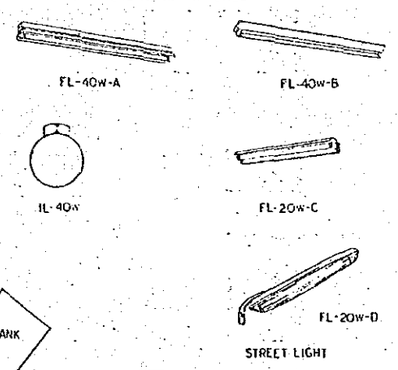
PLAN

0 4m
Scale

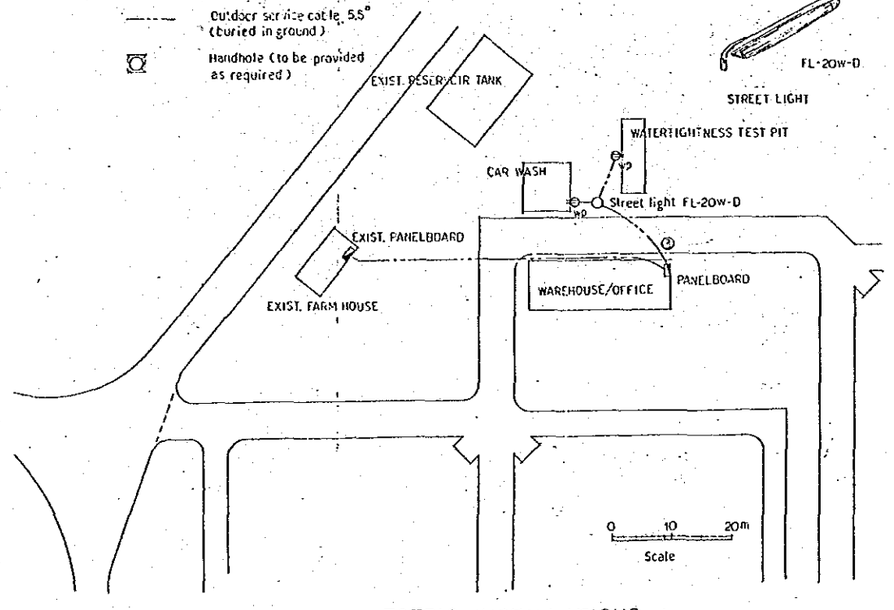
LEGEND

- FL — Fluorescent lighting fixture
- ID — Incandescent lighting fixture
- Single receptacle outlet
- Duplex receptacle outlet
- WP — Waterproof receptacle outlet
- Panelbord
- NYA 2/2.5 E2.5VE 3/4" Ceiling
- NYA 2/2.5 E2.5VE 3/4" Floor
- NYM 2C/2.5 Ceiling
- Outdoor service cable 5.5° (buried in ground)
- Handhole (to be provided as required)

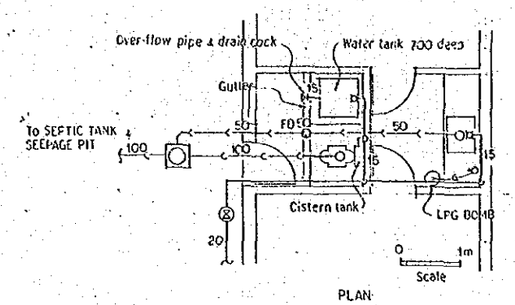
LIGHTING FIXTURES



STREET LIGHT



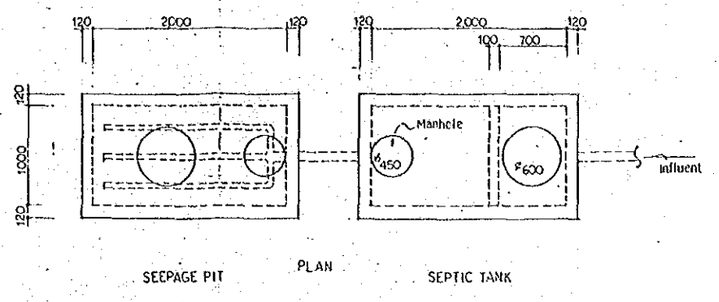
ELECTRIC INSTALLATIONS

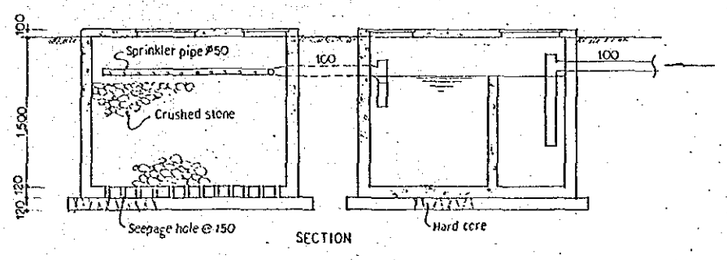


PLAN

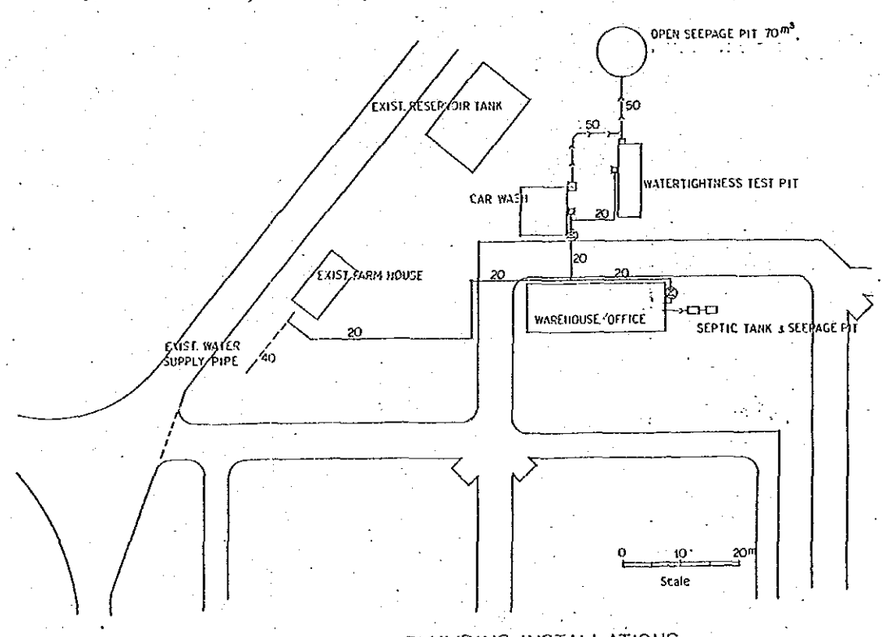
LEGEND

- Faucet
- Gas cock
- Drain outlet
- Floor drain
- Sluice valve in casing
- Manhole in soil line w/inverts
- Catch basin in waste water or storm drain line
- Water supply pipe GSP
- Soil pipe PVC
- Waste water or storm drain pipe PVC





SEPTIC TANK & SEEPAGE PIT



PLUMBING INSTALLATIONS

DIRECTORATE GENERAL OF FOOD CROP AGRICULTURE
THE MODEL INFRASTRUCTURE IMPROVEMENT WORKS FOR THE CENTER FOR DEVELOPMENT OF APPROPRIATE AGRICULTURAL ENGINEERING TECHNOLOGY (ATA – 220)

ELECTRIC AND PLUMBING INSTALLATIONS

JAPAN INTERNATIONAL COOPERATION AGENCY | DWG NO. 21

第七章　関連資料

7．1　実施設計短期専門家リスト

谷田部　権治郎

永薬　暢夫

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

DETAIL DESIGN SURVEY TEAM
FOR
THE PROJECT OF THE CENTER FOR DEVELOPMENT OF
APPROPRIATE AGRICULTURAL ENGINEERING TECHNOLOGY (C.A.A.E.)
(ATA-220)

12th September, 1988

Dr. Ir. A. Muin Pabinru
Director General of Food Crop Agriculture,
Ministry of Agriculture

Dear Sir,

Re: The model infrastructure work for the Project of the Center for Development of Appropriate Agricultural Engineering Technology (ATA-220)

We, the Detail Design Survey Team, have been organized by JICA for the purpose of promoting infrastructure improvement work which is as stipulated in the clause V of the Annex of the Attached Document to the Record of Discussions between the authorities concerned of the Government of Japan and the Government of the Republic of Indonesia on the Japanese Technical Cooperation for the Project of the Center for Development of Appropriate Agricultural Engineering Technology (AT-220) signed on 7th February, 1988.

The Team has, so far, made a series of site reconnaissances and discussions with your staff concerned in order to fix and determine the scales and sizes of expected facilities.

We would like to hereby confirm the matters which were mutually understood and agreed through discussions and site reconnaissances as per the attachment.

In accordance with the above confirmed items, we will proceed with your staff to further field surveys and investigations at the site and to make the detail design on the basis of the result of those surveys, though some revisions might be necessary in relation with costs incurred. After the completion of detail design and assessment of its costs estimated by JICA, you will be informed its result through the JICA Indonesia office.

Further, for the timely commencement of the construction we would like to request you to take the necessary formalities in due consultation with the JICA Indonesia office.

Lastly, we would like to appreciate for kind cooperation of your staff during the survey work.

Sincerely yours,

M Irie

MICHIO IRIE
Team Leader

c.c.:
- Director of Production
- Embassy of Japan

FIELD REPORT OF THE JICA EXPERTS
(Information of Outline on Construction Work)

I. Introduction

This Report was prepared in accordance with the attached documents (outline of the schedule on the project) of our letter dated 12th September, 1988. This presents an information of outline on the construction work for infrastructure improvement for the Center for Development of Appropriate Agricultural Engineering Technology.

During the Team's stay in Indonesia, it made a series of field surveys, investigations and discussions with Indonesian and Japanese staff concerned. The Team, so far, made rough design on the basis of the result of those surveys and discussions as will be stated hereinafter.

In accordance with the rough design, the detail design will be made in Japan. After the completion of detail design and assessment of its costs estimated by Japan International Cooperation Agency (JICA), the Government of the Republic of Indonesia will be informed its result through the JICA Indonesia office.

It is noted that views and opinions of personnel concerned were reflected in the process of the determination-making on the location and scale of the facilities.

II. On-farm Development

1) The area which can be used for agricultural purpose is approximately 2.9 ha, which can be categorized into two, existing upland field with approximately 1.6 ha located on the south of the existing road, and newly developed field with approximately 1.3 ha situated in the north of the said road.

   The former is not proposed to be graded since irrigation will not be made by gravity. The latter is further divided into two, the upland field with 0.8 ha and wetland (rice) field with 0.5 ha. Both fields of the

latter will be levelled because irrigation will be performed by gravity or by ponding water.

2) Three types of road are proposed to be constructed. One is asphalt paved road which is facilitated to access the structures to be constructed such as carwash, warehouse, office, etc. This road is designed to be 5 m wide. The other two are designated as farm road which will be constructed to access each farm lot. Two types of farm road are proposed to be provided according to the intensity of traffic. One is 5 m wide and the other is 3 m wide. The 5 m wide road will be paved with gravel.

III. Irrigation and Drainage Facilities

1) A deep well will be drilled near the existing water tank to supply water to all the field lots. The well will be approximately 200 m deep. The well will be equipped with a submergible motor pump to lift up water to the said tank. The water stored in the tank will be boosted by another volute pump which will be connected with PVC pipeline that conveys water to each field lot. The pipeline will be equipped with hydrants. To operate the two pumps electric wires will be furnished from the control panel located in the existing laboratory and testing.

Deep well		
- Depth	:	Approx. 200 m
Submergible motor pump		
- Total pump head	:	80 m
- Capacity	:	330 liter/min.
Volute pump		
- Total pump head	:	25 m
- Capacity	:	500 liter/min
PVC pipeline		
- Length	:	480 m
- Diameter	:	ø 3"
Steel pipe		
- Length	:	52 m
- Diameter	:	ø 3"
- Hydrant	:	15 nos.
- Air valve	:	2 nos.
Electric wire		
- Length	:	Approx. 450 m

2) Drainage canals will be excavated to collect excess water. The water collected by the canals will be drained into five pits which will be excavated in the low lying area. The design is made to drain water of 100 mm/day.

IV. Other Facilities to be provided in the Center.

Water tightness test pit	:	4 m x12 m
Warehouse	:	8 m x20 m
Office	:	8 m x 4 m
Carwash	:	8 m x 8 m

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

DETAIL DESIGN SURVEY TEAM FOR THE PROJECT OF THE CENTER FOR DEVELOPMENT OF APPROPRIATE AGRICULTURAL ENGINEERING TECHNOLOGY (C.A.A.E.) (ATA-220)

30th September, 1988

Dr. Ir. A. Muin Pabinru
Director General of Food Crops Agriculture,
Ministry of Agriculture

Dear Sir,

Re: The model infrastructure work for the Project of the Center for Development of Appropriate Agricultural Engineering Technology (ATA-220)

This is to inform you that the Detail Design Survey Team organized by JICA which came to Indonesia for the purpose of promoting infrastructure work of the Center for Development of Appropriate Agricultural Engineering Technology (AT-220) will terminate its assignment in Indonesia on 1st October, 1988.

During the Team's stay in Indonesia, it made a series of field surveys, investigations and discussions with your staff concerned. The Team, so far, made rough design on the basis of the result of those surveys and discussions as per the attachment.

In accordance with the rough design, the detail design will be made in Japan. After the completion of detail design and assessment of its costs estimated by JICA, you will be informed its result through the JICA Indonesia office.

It is, however, noted that some revisions might become necessary during the course of detail design in relation with cost incurred.

Further, for the timely commencement of the construction we would like to request you to take the necessary formalities in due consultation with the JICA Indonesia office.

Lastly, we would like to appreciate kind cooperation of your staff during the survey work.

Sincerely yours,

M Irie

MICHIO IRIE
Team Leader

c.c.:
- Director of Production
- Embassy of Japan

FIELD REPORT OF THE JICA EXPERTS
(Information of Outline on Construction Work)

I. Introduction

This Report was prepared in accordance with the attached documents (outline of the schedule on the project) of our letter dated 12th September, 1988. This presents an information of outline on the construction work for infrastructure improvement for the Center for Development of Appropriate Agricultural Engineering Technology.

During the Team's stay in Indonesia, it made a series of field surveys, investigations and discussions with Indonesian and Japanese staff concerned. The Team, so far, made rough design on the basis of the result of those surveys and discussions as will be stated hereinafter.

In accordance with the rough design, the detail design will be made in Japan. After the completion of detail design and assessment of its costs estimated by Japan International Cooperation Agency (JICA), the Government of the Republic of Indonesia will be informed its result through the JICA Indonesia office.

It is noted that views and opinions of personnel concerned were reflected in the process of the determination-making on the location and scale of the facilities.

II. On-farm Development

1) The area which can be used for agricultural purpose is approximately 2.9 ha, which can be categorized into two, existing upland field with approximately 1.6 ha located on the south of the existing road, and newly developed field with approximately 1.3 ha situated in the north of the said road.

   The former is not proposed to be graded since irrigation will not be made by gravity. The latter is further divided into two, the upland field with 0.8 ha and wetland (rice) field with 0.5 ha. Both fields of the

latter will be levelled because irrigation will be performed by gravity or by ponding water.

2) Three types of road are proposed to be constructed. One is asphalt paved road which is facilitated to access the structures to be constructed such as carwash, warehouse, office, etc. This road is designed to be 5 m wide. The other two are designated as farm road which will be constructed to access each farm lot. Two types of farm road are proposed to be provided according to the intensity of traffic. One is 5 m wide and the other is 3 m wide. The 5 m wide road will be paved with gravel.

III. Irrigation and Drainage Facilities

1) A deep well will be drilled near the existing water tank to supply water to all the field lots. The well will be approximately 200 m deep. The well will be equipped with a submergible motor pump to lift up water to the said tank. The water stored in the tank will be boosted by another volute pump which will be connected with PVC pipeline that conveys water to each field lot. The pipeline will be equipped with hydrants. To operate the two pumps electric wires will be furnished from the control panel located in the existing laboratory and testing.

Deep well		
- Depth	:	Approx. 200 m
Submergible motor pump		
- Total pump head	:	80 m
- Capacity	:	330 liter/min.
Volute pump		
- Total pump head	:	25 m
- Capacity	:	500 liter/min
PVC pipeline		
- Length	:	480 m
- Diameter	:	ø 3"
Steel pipe		
- Length	:	52 m
- Diameter	:	ø 3"
- Hydrant	:	15 nos.
- Air valve	:	2 nos.
Electric wire		
- Length	:	Approx. 450 m

2) Drainage canals will be excavated to collect excess water. The water collected by the canals will be drained into five pits which will be excavated in the low lying area. The design is made to drain water of 100 mm/day.

IV. Other Facilities to be provided in the Center.

Water tightness test pit	:	4 m x12 m
Warehouse	:	8 m x20 m
Office	:	8 m x 4 m
Carwash	:	8 m x 8 m

7．4 短期専門家行程表

ITINERARY OF THE DETAIL DESIGN SURVEY TEAM

Date			Activity
Aug.	24	(Wed)	Arrival at JKT from TYO by GA-873
Aug.	25	(Thu)	Visit to JICA JKT, CP Experts and CDAET
Aug.	26	(Fri)	Collecting Data in JKT, preparation for Topographic Survey
Aug.	27	(Sat)	Preparation for Topographic Survey in JKT
Aug.	28	(Sun)	Establishment of Work Schedule in JKT
Aug.	29	(Mon)	Preliminary Meeting with Japanese Experts, Reconnaissance Survey at CDAET
Aug.	30	(Tue)	Traverse Survey at CDAET
Aug.	31	(Wed)	Traverse Survey and Result Arrangement, Preparation of Mesh-Level Survey at CDAET
Sept.	1	(Thu)	Mesh-Level Survey at CDAET
Sept.	2	(Fri)	-do-
Sept.	3	(Sat)	-do- Plane Table Survey at CDAET
Sept.	4	(Sun)	Plane Table Survey at CDAET
Sept.	5	(Mon)	Preparation of Basic Layout at CDAET
Sept.	6	(Tue)	Data collection of Deep Well at IRIGASI-II in JKT, Internal Meeting on Basic Layout at CDAET
Sept.	7	(Wed)	Meeting with Japanese Experts of CDAET on Basic Layout, Rearrangement of Layout
Sept.	8	(Thu)	Data Collection of Construction Cost at Construction Guidance Service Center in Bekasi, at PU and at JICA in JKT
Sept.	9	(Fri)	Preparation of Layout and Basic Plan of Work, Meeting on Layout with Indonesian Staff of CDAET
Sept.	10	(Sat)	Basic Design, B/Q of Architectural and Electrical Structures, Study on Unit Price
Sept.	11	(Sun)	-do-
Sept.	12	(Mon)	Data Collection of Deep Well, Unit Price at PU, DKI, IRIGASI-II in JKT, Interview with General Contractors and Pump Makers

Date			Activity
Sept.	13	(Tue)	Discussion on Work Progress at CDAET, Collecting Data at JICA in JKT
Sept.	14	(Wed)	Work Volume Calculation at CDAET
Sept.	15	(Thu)	-do- Bearing Capacity Survey at CDAET
Sept.	16	(Fri)	Data Collection of Price for Pump in JKT
Sept.	17	(Sat)	Data Collection of Unit Price in JKT, Study on Unit Price and Work Volume Calculation at CDAET
Sept.	18	(Sun)	Study on Unit Prices and Rough Estimation of Work Quantity at CDAET
Sept.	19	(Mon)	Interview with General Contractor at JKT, Submission of "Basic Plan of Work" at CDAET
Sept.	20	(Tue)	Preparation of General Layout
Sept.	21	(Wed)	Soil Investigation at CDAET. Visit to Embassy of Japan
Sept.	22	(Thu)	Visit to Directorate of Food Crops Production Development Unit Price Survey in JKT
Sept.	23	(Fri)	Unit Price Survey in JKT, Work Quantity Estimate at CDAET
Sept.	24	(Sat)	Unit Price Survey and Collected Data Arrangement in JKT
Sept.	25	(Sun)	Preparation of Field Report of the Experts at CDAET
Sept.	26	(Mon)	Unit Price Survey in JKT, Preparation of "Field Reports of the Experts" at CDAET
Sept.	27	(Tue)	Rough Estimate of Construction Cost at CDAET
Sept.	28	(Wed)	Preparation of "Field Report of the Experts", Rough Estimate of Construction Cost at CDAET
Sept.	29	(Thu)	Preparation of "Field Report of the Experts" at CDAET
Sept.	30	(Fri)	Meeting with staff of CDAET on "Field Report of the Experts", modification and submission of the Report
Oct.	1	(Sat)	Visit to JICA JKT and other persons concerned, Departure to TYO by GA-872
Oct.	2	(Sun)	Arrival at TYO

7．5 面会者リスト

LIST OF PERSONNEL CONCERNED

Directorate of Food Crops Protection

Ir. Thamrin Bastari	Director for Food Crops Protection Development

Center for Develpment of Appropriate Agricultural Engineering Technology

Ir. R. Dadang Tarmana	Project Director for the Center
Ir. B. Gultom	Chief of Test and Evaluation
Ir. Zaidir S.	Chief of Systems Analysis
Ir. Wahyu S.	Chief Design, Development and Improvement
Ir. Rachman M.	Chief of Training
Ir. Agung H.	Counterpart

Directorate of Irrigation-2

Ir. Hendratno Remiel

Ir. Suratmo

Construction Guidance Service Center

Ir. Jorgis Sirait

Drs. Rimdanis

Embassy of Japan

Mr. Goichiro Yukawa	First Secretary

JICA Indonesia Office

Mr. Yasuo Kitano	Resident Representative
Mr. Mikiharu Sato	Deputy Resident Representative
Mr. Manabu Aiba	Assistant Resident Representative

Japanese Expert of the Center for Development of Appropriate Agricultural Engineering Technology

Mr. Michio Irie	Team Leader
Mr. Yasuhiro Kimura	Coordinator/Liaison Officer
Mr. Tadashi Watahiki	Design, Development and Improvement
Mr. Hidaki Takeshima	- do -
Mr. Motomu Masuzawa	Test and Evaluation
Mr. Mitsuo Suzuki	Systems Analysis

Directorate General of Water Resources Development, Ministry of Public Works

Mr. Katsuhiko Kimura	Directorate of Planning and Programming, Team Leader
Mr. Yoshimi Dokyu	Colombo Plan Expert, Directorate of Irrigation-1
Mr. Yasuo Nakajima	Colombo Plan Expert, Construction Guidance Service Center
Mr. Koichi Imai	- do -
Mr. Koji Imai	Colombo Plan Expert, Directorate of Irrigation-2

7．6　収集資料一覧表

1　センターでの水質分析結果　　１９８８年２月

2　気象資料

日雨量（セルボン）	１９７４－８８
月別相対湿度（チュルグ）	１９７６－８５
月別風速（チュルグ）	１９７６－８５
月別気温（チュルグ）	１９７６－８５
月別日照時間（チュルグ）	１９７６－８５

3　地形図　（１：５０、０００）

4　センターの完工図面　（創造社）

5　Feasibility Study Report on the Cisadane River Basin Deveiopment Project　　Sep. 1987

Vol.1　Main Report
Vol.2　Hydrology
Vol.3　Groundwater
Vol.4　Groundwater Data Reoprts
Vol.5　Geotechnical Investigations
Vol.6　Dam Design
Vol.7　Agriculture/Irrigation/Fisheries
Vol.8　Topographic Surveys & Mapping
Vol.9　Urban Water Supply
Vol.10　Socio-economic Survey
Vol.11　Environmental Impact
Vol.12　Water Management Planning & Economic Analysis

6　深井戸掘削費見積書（灌漑二局）

7　単価資料（インドネシア語）

インドネシアにおける材料費・労務費	１９８８年
建築・建設資材費単価表	１９８８年６・７月
建設契約における労務費標準単価	１９８８年８月
インドネシアにおける労務費（単価）	１９８８／１９８９
建設工事における標準労務単価	１９８８年１月

8　ポンプ見積書

9　インドネシア国作物保護強化フェーズＩＩ計画

モデルインフラ整備事業実施設計調査報告書（国際協力事業団）

１９８８年３月

１０　パイプ・電線カタログ

Pipeline Hydraulic Calculation

Section	Distance	Reduced Distance	Proposed Ground Level	Pipe Center Level	Head Loss	Dynamic Water Pressure	Dynamic Water Level	Discharge	Hydraulic Gradient	Diameter	Velocity	Hydrostatic Pressure	Remarks
	m	m	m	m	m	m	m	l/s	0/00	mm	m/s	m	
PL-1													
No. 0 (BP)	0.00	0.00	18.60	17.60		25.40	43.00					30.40	
No. 1 + 24.50	49.50	49.50	20.43	19.20	0.66	23.14	42.34	500	13.26	dia.100	1.06	28.80	BP of PL-2
No. 2 + 4.50	5.00	54.50	20.43	19.21	0.07	23.06	42.27	do	do	do	do	28.79	Hyd-1
No. 3 + 19.00	39.50	94.00	20.43	19.31	0.52	22.44	41.75	do	do	do	do	28.69	Hyd-2
No. 5 + 9.00	40.00	134.00	21.06	19.40	0.53	21.82	41.22	do	do	do	do	28.60	Hyd-3
No. 5 + 24.50	15.50	149.50	19.90	18.70	0.21	22.31	41.01	do	do	do	do	29.30	Asphalt Road
No. 7 + 7.00	32.50	182.00	20.00 (19.11)	18.60	0.43	21.98	40.58	do	do	do	do	29.40	DD-5 Crossing
No. 9 + 5.50	48.50	230.50	20.85	19.80	0.64	20.14	39.94	do	do	do	do	28.20	Hyd. 4 & 5
No. 10 + 23.50	43.00	273.50	22.40	21.26	0.57	18.11	39.37	do	do	do	do	26.74	Hyd. 6 & 7
No. 11 + 11.50	13.00	286.50	22.70	21.70	0.17	17.50	39.20	do	do	do	do	26.30	Hyd. 8 & 9
No. 13 + 4.50 (EP)	43.00	329.50	21.25	20.20	0.57	18.43	38.63	do	do	do	do	27.80	Hyd. 10 & 11
PL-2													
No. 0 (BP)	0.00	0.00	20.43	19.20		23.14	42.34					28.80	
No. 1 + 17.00	42.00	42.00	20.37	19.40	0.57	22.37	41.77	500	13.26	dia. 100	1.06	28.60	Hyd. 1
No. 2 + 13.00	21.00	63.00	18.48	17.50	0.28	23.99	41.49	do	do	do	do	30.50	Hyd. 2
No. 3 + 9.50	21.50	84.50	18.48	17.46	0.29	23.74	41.20	do	do	do	do	30.54	Hyd. 3
No. 5 + 22.50 (EP)	63.00	147.50	16.18	15.20	0.84	25.16	40.36	do	do	do	do	32.80	Hyd. 4

Note 1) Hydraulic formula: Hazen - Williams Formula
2) Hydrosttic level: 18.0 + 25.0 + 5.0 = 48.0 m
3) Hydraulic gradient: Total loss = 1.1 x friction loss

-- for Steel Pipe --

dx1: Deflection due to long term load

dx2: Deflection due to short term load

M : Maximum bending moment due to outer pressure

dx : Total horizontal deflection

-- for Reinforced Concrete Pipe --

P1 : Horizontal load at pipe top

P2 : Horizontal load at pipe bottom

Pc : Breaking or cracking outer pressure in case of zero inner pressure

Hc : Breaking or cracking inner pressure in case of zero outer pressure

Ph : Outer pressure

Do : Nominal diameter of pipe

D : Inner diameter of pipe

Dc : Outer diameter of pipe

T : Thickness of pipe

R : Mean radius of pipe

Wp : Self weight of pipe

Ws : Unit weight of soil

Φ : Angle of internal friction

B : Excavation width at pipe top

T-9: 9 ton truck load / D-11: 11ton bulldozer

K : Rankin's coefficient of earth pressure

e' : Soil coefficient of passive resistance

rsd: Settlement ratio

p : Projection ratio

C : Coefficient of earth pressure for design

Cd : Coefficient of earth pressure for ditch type

Cc : Coefficient of earth pressure for projection type

H : Depth to pipe top from surface of backfill or embankment

He : Depth to pipe top from isometric settlement plane

Wv : Vertical earth pressure

Pv : Horizontal earth pressure

M1 : Maximum bending moment due to long term load

i : Shock factor

α : Vertical load factor due to truck load

Ww : Vertical load due to truck load

Pw : Horizontal load due to road surface load

M2 : Maximum bending moment due to short term load

H1 : Allowable hydrostatic pressure

H2 : Allowable water hammer pressure

＊＊＊　管体構造計算（とう性管）　＊＊＊

ケース：　　管種：ＶＰ

呼　　径 Do= 100　　(mm)
内　　径 D = 100.8　(mm)
外　　径 Dc= 114.0　(mm)
管　　厚 T =　6.6　(mm)
平均 半径 R =　53.7　(mm)
管 自 重 WP=　3.2　(kg/m)
土の単位重量 Ws=1800　(kg/m³)
内部摩擦角 φ=　30　(度)
管頂掘削巾 B = 0.610　(m)

路 面 荷 重　　300　(kg/m²)
群 集 荷 重
埋　　設　：　素掘り（溝　形）
設 計 支持角　　90　(度)　自由支承
土 圧 係 数　　K =0.333
抵 抗 係 数　　e'= 28.0
沈　下　比　　rsd=-0.10
突　出　比　　P =　1.0
＊　1：C=Cd　2：C=Cc　3：C=1
ポンプ――管路――水槽　系

H (m)	He (m)	C	＊	Wv (kg/cm²)	Pv (kg/cm²)	M1 (kg·cm/cm)	i	Alpha (1/cm²)	Ww (kg/cm²)	Pw (kg/cm²)	M2 (kg·cm/cm)	タワミ率 (%)	H1 (kg/cm²)	H2 (kg/cm²)	許容内圧 (kg/cm²)
0.60	0.08	1.000	3	0.1080	0.0000	1.045	0.0	0.000	0.0300	0.0000	0.272	0.22	14.94	8.97	23.91
0.80	0.08	1.000	3	0.1440	0.0000	1.371	0.0	0.000	0.0300	0.0000	0.272	0.27	14.71	8.83	23.54
1.00	0.08	1.000	3	0.1800	0.0000	1.697	0.0	0.000	0.0300	0.0000	0.272	0.33	14.49	8.69	23.18
1.20	0.08	1.000	3	0.2160	0.0000	2.023	0.0	0.000	0.0300	0.0000	0.272	0.38	14.26	8.55	22.81
1.50	0.07	1.000	3	0.2700	0.0000	2.512	0.0	0.000	0.0300	0.0000	0.272	0.46	13.91	8.35	22.26
2.00	0.07	1.000	3	0.3600	0.0000	3.327	0.0	0.000	0.0300	0.0000	0.272	0.60	13.34	8.00	21.34
2.50	0.07	1.000	3	0.3600	0.0000	3.327	0.0	0.000	0.0300	0.0000	0.272	0.60	13.34	8.00	21.34
3.00	0.07	1.000	3	0.3600	0.0000	3.327	0.0	0.000	0.0300	0.0000	0.272	0.60	13.34	8.00	21.34

＊＊＊　管体構造計算（とう性管）　＊＊＊

ケース：　　管種：ＡＺ

呼　　径 Do= 100　　(mm)
内　　径 D = 105.0　(mm)
外　　径 Dc= 114.0　(mm)
管　　厚 T =　4.5　(mm)
平均 半径 R =　54.8　(mm)
管 自 重 WP=　2.2　(kg/m)
土の単位重量 Ws=1800　(kg/m³)
内部摩擦角 φ=　30　(度)
管頂掘削巾 B = 0.610　(m)

路 面 荷 重　　300　(kg/m²)
群 集 荷 重
埋　　設　：　素掘り（溝　形）
設 計 支持角　　90　(度)　自由支承
土 圧 係 数　　K =0.333
抵 抗 係 数　　e'= 28.0
沈　下　比　　rsd=-0.10
突　出　比　　P =　1.0
＊　1：C=Cd　2：C=Cc　3：C=1
ポンプ――管路――水槽　系

H (m)	He (m)	C	＊	Wv (kg/cm²)	Pv (kg/cm²)	M1 (kg·cm/cm)	i	Alpha (1/cm²)	Ww (kg/cm²)	Pw (kg/cm²)	M2 (kg·cm/cm)	タワミ率 (%)	H1 (kg/cm²)	H2 (kg/cm²)	許容内圧 (kg/cm²)
0.60	0.08	1.000	3	0.1080	0.0000	1.082	0.0	0.000	0.0300	0.0000	0.282	0.45	9.09	5.45	14.54
0.80	0.08	1.000	3	0.1440	0.0000	1.420	0.0	0.000	0.0300	0.0000	0.282	0.56	8.75	5.25	14.00
1.00	0.08	1.000	3	0.1800	0.0000	1.759	0.0	0.000	0.0300	0.0000	0.282	0.67	8.41	5.05	13.46
1.20	0.08	1.000	3	0.2160	0.0000	2.098	0.0	0.000	0.0300	0.0000	0.282	0.78	8.08	4.85	12.92
1.50	0.07	1.000	3	0.2700	0.0000	2.606	0.0	0.000	0.0300	0.0000	0.282	0.95	7.57	4.54	12.12
2.00	0.07	1.000	3	0.3600	0.0000	3.453	0.0	0.000	0.0300	0.0000	0.282	1.23	6.42	3.50	9.92
2.50	0.07	1.000	3	0.3600	0.0000	3.453	0.0	0.000	0.0300	0.0000	0.282	1.23	6.42	3.50	9.92
3.00	0.07	1.000	3	0.3600	0.0000	3.453	0.0	0.000	0.0300	0.0000	0.282	1.23	6.42	3.50	9.92

＊＊＊　管体構造計算（とう性管）　＊＊＊

ケース：　　管種：ＶＰ

呼　　径	Do= 100	(mm)	
内　　径	D = 100.8	(mm)	
外　　径	Dc= 114.0	(mm)	
管　　厚	T = 6.6	(mm)	
平均 半径	R = 53.7	(mm)	
管 自 重	WP= 3.2	(kg／m)	
土の単位重量	Ws=1800	(kg／m³)	
内部摩擦角	φ= 30	(度)	
管頂掘削巾	B = 0.610	(m)	

路面荷重	D- 11 （ｔｏｎ）	施工時
地盤状態	： 普 通	
埋　　設	： 素掘り（溝 形）	
設計支持角	90 （度）	自由支承
土圧係数	K =0.333	
抵抗係数	e'= 28.0	
沈 下 比	rsd=-0.10	
突 出 比	P = 1.0	

＊ 1：C＝Cd　2：C＝Cc　3：C＝1

ボンプ－－管路－－水槽 系

H (m)	He (m)	C	＊	Wv (kg/cm²)	Pv (kg/cm²)	M1 (kg·cm/cm)	i	Alpha (1/cm²)	Ww (kg/cm²)	Pw (kg/cm²)	M2 (kg·cm/cm)	タワミ率 (%)	H1 (kg/cm²)	H2 (kg/cm²)	許容内圧 (kg/cm²)
0.60	0.08	1.000	3	0.1080	0.0000	0.995	0.0	0.000	0.1607	0.0000	1.455	0.41	22.32	13.39	35.71
0.80	0.08	1.000	3	0.1440	0.0000	1.321	0.0	0.000	0.1419	0.0000	1.285	0.43	22.17	13.30	35.47
1.00	0.08	1.000	3	0.1800	0.0000	1.647	0.0	0.000	0.1419	0.0000	1.285	0.49	21.94	13.16	35.10
1.20	0.08	1.000	3	0.2160	0.0000	1.973	0.0	0.000	0.1419	0.0000	1.285	0.54	21.71	13.03	34.74
1.50	0.07	1.000	3	0.2700	0.0000	2.462	0.0	0.000	0.1419	0.0000	1.285	0.63	21.37	12.82	34.19
2.00	0.07	1.000	3	0.3600	0.0000	3.277	0.0	0.000	0.1196	0.0000	1.083	0.73	20.89	12.53	33.42
2.50	0.07	1.000	3	0.3600	0.0000	3.277	0.0	0.000	0.0977	0.0000	0.885	0.69	20.98	12.59	33.57
3.00	0.07	1.000	3	0.3600	0.0000	3.277	0.0	0.000	0.0826	0.0000	0.748	0.67	21.05	12.63	33.68

＊＊＊　管体構造計算（とう性管）　＊＊＊

ケース：　　管種：ＡＺ

呼　　径	Do= 100	(mm)	
内　　径	D = 105.0	(mm)	
外　　径	Dc= 114.0	(mm)	
管　　厚	T = 4.5	(mm)	
平均 半径	R = 54.8	(mm)	
管 自 重	WP= 2.2	(kg／m)	
土の単位重量	Ws=1800	(kg／m³)	
内部摩擦角	φ= 30	(度)	
管頂掘削巾	B = 0.610	(m)	

路面荷重	D- 11 （ｔｏｎ）	施工時
地盤状態	： 普 通	
埋　　設	： 素掘り（溝 形）	
設計支持角	90 （度）	自由支承
土圧係数	K =0.333	
抵抗係数	e'= 28.0	
沈 下 比	rsd=-0.10	
突 出 比	P = 1.0	

＊ 1：C＝Cd　2：C＝Cc　3：C＝1

ボンプ－－管路－－水槽 系

H (m)	He (m)	C	＊	Wv (kg/cm²)	Pv (kg/cm²)	M1 (kg·cm/cm)	i	Alpha (1/cm²)	Ww (kg/cm²)	Pw (kg/cm²)	M2 (kg·cm/cm)	タワミ率 (%)	H1 (kg/cm²)	H2 (kg/cm²)	許容内圧 (kg/cm²)
0.60	0.08	1.000	3	0.1080	0.0000	1.029	0.0	0.000	0.1607	0.0000	1.513	0.84	13.48	8.09	21.57
0.80	0.08	1.000	3	0.1440	0.0000	1.368	0.0	0.000	0.1419	0.0000	1.336	0.89	13.27	7.96	21.22
1.00	0.08	1.000	3	0.1800	0.0000	1.707	0.0	0.000	0.1419	0.0000	1.336	1.00	12.93	7.76	20.69
1.20	0.08	1.000	3	0.2160	0.0000	2.045	0.0	0.000	0.1419	0.0000	1.336	1.11	12.59	7.56	20.15
1.50	0.07	1.000	3	0.2700	0.0000	2.554	0.0	0.000	0.1419	0.0000	1.336	1.28	12.09	7.25	19.34
2.00	0.07	1.000	3	0.3600	0.0000	3.401	0.0	0.000	0.1196	0.0000	1.126	1.49	11.39	6.83	18.22
2.50	0.07	1.000	3	0.3600	0.0000	3.401	0.0	0.000	0.0977	0.0000	0.920	1.42	11.53	6.92	18.45
3.00	0.07	1.000	3	0.3600	0.0000	3.401	0.0	0.000	0.0826	0.0000	0.777	1.38	11.63	6.98	18.60

＊＊＊ 管体構造計算（とう性管） ＊＊＊

ケース：　　管種：VP

呼　　径 Do= 100　　(mm)
内　　径 D = 100.8　(mm)
外　　径 Dc= 114.0　(mm)
管　　厚 T = 6.6　　(mm)
平均 半径 R = 53.7　(mm)
管 自 重 WP= 3.2　　(kg/m)
土の単位重量Ws=1800　(kg/m³)
内部摩擦角 φ= 30　　(度)
管頂掘削巾 B = 0.610　(m)

路 面 荷 重　T- 9 (ton)　1 台
路 面 状 態　：未舗装
埋　　設　：素掘り（溝 形）
設 計 支持角　90 (度) 自由支承
土 圧 係 数　K =0.333
抵 抗 係 数　e'= 28.0
沈　下　比　rsd=-0.10
突　出　比　P = 1.0
＊ 1：C=Cd 2：C=Cc 3：C=1
ポンプ――管路――水槽 系

H (m)	He (m)	C	*	Wv (kg/cm²)	Pv (kg/cm²)	M1 (kg·cm/cm)	i	Alpha (1/cm²)	Ww (kg/cm²)	Pw (kg/cm²)	M2 (kg·cm/cm)	タワミ率 (%)	H1 (kg/cm²)	H2 (kg/cm²)	許容内圧 (kg/cm²)
0.60	0.08	1.000	3	0.1080	0.0000	1.045	0.4	0.874	0.4405	0.0000	3.988	0.84	13.16	7.90	21.06
0.80	0.08	1.000	3	0.1440	0.0000	1.371	0.4	0.571	0.2879	0.0000	2.607	0.66	13.60	8.16	21.75
1.00	0.08	1.000	3	0.1800	0.0000	1.697	0.4	0.398	0.2004	0.0000	1.815	0.58	13.75	8.25	21.99
1.20	0.08	1.000	3	0.2160	0.0000	2.023	0.4	0.290	0.1459	0.0000	1.321	0.56	13.75	8.25	22.00
1.50	0.07	1.000	3	0.2700	0.0000	2.512	0.3	0.223	0.1043	0.0000	0.945	0.58	13.59	8.15	21.74
2.00	0.07	1.000	3	0.3600	0.0000	3.327	0.3	0.154	0.0719	0.0000	0.651	0.66	13.16	7.89	21.05
2.50	0.07	1.000	3	0.3600	0.0000	3.327	0.2	0.111	0.0481	0.0000	0.436	0.63	13.26	7.95	21.21
3.00	0.07	1.000	3	0.3600	0.0000	3.327	0.2	0.084	0.0362	0.0000	0.328	0.61	13.31	7.99	21.30

＊＊＊ 管体構造計算（とう性管） ＊＊＊

ケース：　　管種：AZ

呼　　径 Do= 100　　(mm)
内　　径 D = 105.0　(mm)
外　　径 Dc= 114.0　(mm)
管　　厚 T = 4.5　　(mm)
平均 半径 R = 54.8　(mm)
管 自 重 WP= 2.2　　(kg/m)
土の単位重量Ws=1800　(kg/m³)
内部摩擦角 φ= 30　　(度)
管頂掘削巾 B = 0.610　(m)

路 面 荷 重　T- 9 (ton)　1 台
路 面 状 態　：未舗装
埋　　設　：素掘り（溝 形）
設 計 支持角　90 (度) 自由支承
土 圧 係 数　K =0.333
抵 抗 係 数　e'= 28.0
沈　下　比　rsd=-0.10
突　出　比　P = 1.0
＊ 1：C=Cd 2：C=Cc 3：C=1
ポンプ――管路――水槽 系

H (m)	He (m)	C	*	Wv (kg/cm²)	Pv (kg/cm²)	M1 (kg·cm/cm)	i	Alpha (1/cm²)	Ww (kg/cm²)	Pw (kg/cm²)	M2 (kg·cm/cm)	タワミ率 (%)	H1 (kg/cm²)	H2 (kg/cm²)	許容内圧 (kg/cm²)
0.60	0.08	1.000	3	0.1080	0.0000	1.082	0.4	0.874	0.4405	0.0000	4.146	1.72	6.06	3.50	9.56
0.80	0.08	1.000	3	0.1440	0.0000	1.420	0.4	0.571	0.2879	0.0000	2.710	1.36	6.95	3.50	10.45
1.00	0.08	1.000	3	0.1800	0.0000	1.759	0.4	0.398	0.2004	0.0000	1.886	1.20	7.26	3.50	10.76
1.20	0.08	1.000	3	0.2160	0.0000	2.098	0.4	0.290	0.1459	0.0000	1.374	1.14	7.28	3.50	10.78
1.50	0.07	1.000	3	0.2700	0.0000	2.606	0.3	0.223	0.1043	0.0000	0.982	1.18	6.94	3.50	10.44
2.00	0.07	1.000	3	0.3600	0.0000	3.453	0.3	0.154	0.0719	0.0000	0.677	1.36	6.04	3.50	9.54
2.50	0.07	1.000	3	0.3600	0.0000	3.453	0.2	0.111	0.0481	0.0000	0.453	1.28	6.26	3.50	9.76
3.00	0.07	1.000	3	0.3600	0.0000	3.453	0.2	0.084	0.0362	0.0000	0.341	1.25	6.36	3.50	9.86

＊＊＊　管体構造計算（とう性管）　＊＊＊

ケース：　　管種：VU

呼　　径 Do= 100　　(mm)
内　　径 D = 107.8　(mm)
外　　径 Dc= 114.0　(mm)
管　　厚 T = 3.1　　(mm)
平均 半径 R = 55.5　(mm)
管 自 重 WP= 1.5　　(kg/m)
土の単位重量Ws=1800　(kg/m³)
内部摩擦角 φ= 30　　(度)
管頂掘削巾 B = 0.610　(m)

路面荷重　T- 9 (ton)　1 台
路面状態　：未舗装
埋　　設　：素掘り(溝 形)
設計支持角　90 (度)　自由支承
土圧係数　K =0.333
抵抗係数　e'= 28.0
沈 下 比　rsd=-0.10
突 出 比　P = 1.0
＊ 1：C=Cd　2：C=Cc　3：C=1
ポンプ――管路――水槽 系

H (m)	He (m)	C	*	Wv (kg/cm²)	Pv (kg/cm²)	M1 (kg·cm/cm)	i	Alpha (1/cm²)	Ww (kg/cm²)	Pw (kg/cm²)	M2 (kg·cm/cm)	タワミ率 (%)	H1 (kg/cm²)	H2 (kg/cm²)	許容内圧 (kg/cm²)
0.60	0.08	1.000	3	0.1080	0.0000	1.106	0.4	0.874	0.4405	0.0000	4.252	2.48	1.12	1.12	2.24
0.80	0.08	1.000	3	0.1440	0.0000	1.454	0.4	0.571	0.2879	0.0000	2.779	1.96	1.89	1.89	3.78
1.00	0.08	1.000	3	0.1800	0.0000	1.801	0.4	0.398	0.2004	0.0000	1.935	1.73	2.16	2.16	4.31
1.20	0.08	1.000	3	0.2160	0.0000	2.149	0.4	0.290	0.1459	0.0000	1.409	1.65	2.17	2.17	4.33
1.50	0.07	1.000	3	0.2700	0.0000	2.670	0.3	0.223	0.1043	0.0000	1.007	1.70	1.88	1.88	3.75
2.00	0.07	1.000	3	0.3600	0.0000	3.539	0.3	0.154	0.0719	0.0000	0.694	1.96	1.10	1.10	2.21
2.50	0.07	1.000	3	0.3600	0.0000	3.539	0.2	0.111	0.0481	0.0000	0.465	1.85	1.29	1.29	2.58
3.00	0.07	1.000	3	0.3600	0.0000	3.539	0.2	0.084	0.0362	0.0000	0.350	1.80	1.38	1.38	2.76

＊＊＊　管体構造計算（とう性管）　＊＊＊

ケース：　　管種：VP

呼　　径 Do= 75　　(mm)
内　　径 D = 80.9　(mm)
外　　径 Dc= 89.0　(mm)
管　　厚 T = 4.1　　(mm)
平均 半径 R = 42.5　(mm)
管 自 重 WP= 1.5　　(kg/m)
土の単位重量Ws=1800　(kg/m³)
内部摩擦角 φ= 30　　(度)
管頂掘削巾 B = 0.590　(m)

路面荷重　T- 9 (ton)　1 台
路面状態　：未舗装
埋　　設　：素掘り(溝 形)
設計支持角　90 (度)　自由支承
土圧係数　K =0.333
抵抗係数　e'= 28.0
沈 下 比　rsd=-0.10
突 出 比　P = 1.0
＊ 1：C=Cd　2：C=Cc　3：C=1
ポンプ――管路――水槽 系

H (m)	He (m)	C	*	Wv (kg/cm²)	Pv (kg/cm²)	M1 (kg·cm/cm)	i	Alpha (1/cm²)	Ww (kg/cm²)	Pw (kg/cm²)	M2 (kg·cm/cm)	タワミ率 (%)	H1 (kg/cm²)	H2 (kg/cm²)	許容内圧 (kg/cm²)
0.60	0.06	1.000	3	0.1080	0.0000	0.643	0.4	0.876	0.4416	0.0000	2.502	1.37	8.74	5.24	13.98
0.80	0.06	1.000	3	0.1440	0.0000	0.847	0.4	0.572	0.2883	0.0000	1.633	1.08	9.29	5.57	14.86
1.00	0.06	1.000	3	0.1800	0.0000	1.051	0.4	0.398	0.2006	0.0000	1.136	0.95	9.48	5.69	15.17
1.20	0.06	1.000	3	0.2160	0.0000	1.255	0.4	0.290	0.1460	0.0000	0.827	0.91	9.49	5.69	15.18
1.50	0.06	1.000	3	0.2700	0.0000	1.561	0.3	0.223	0.1044	0.0000	0.591	0.94	9.28	5.57	14.85
2.00	0.06	1.000	3	0.3600	0.0000	2.071	0.3	0.154	0.0719	0.0000	0.407	1.08	8.73	5.24	13.97
2.50	0.06	1.000	3	0.3600	0.0000	2.071	0.2	0.111	0.0481	0.0000	0.273	1.02	8.86	5.32	14.18
3.00	0.06	1.000	3	0.3600	0.0000	2.071	0.2	0.084	0.0362	0.0000	0.205	0.99	8.93	5.36	14.28

＊＊＊ 管体構造計算（とう性管） ＊＊＊

ケース：　　管種：VU

呼　　径 Do= 100　(mm)
内　　径 D = 107.8　(mm)
外　　径 Dc= 114.0　(mm)
管　　厚 T = 3.1　(mm)
平均 半径 R = 55.5　(mm)
管 自 重 WP= 1.5　(kg/m)
土の単位重量Ws=1800　(kg/m³)
内部摩擦角 φ= 30　(度)
管頂掘削巾 B = 0.610　(m)

路 面 荷 重　300　(kg/m²)
群 集 荷 重
埋　　設　：　素掘り（溝　形）
設 計 支持角　90　(度)　自由支承
土 圧 係 数　K =0.333
抵 抗 係 数　e'= 28.0
沈　下　比　rsd=-0.10
突　出　比　P = 1.0
＊ 1：C=Cd　2：C=Cc　3：C=1
ポンプ――管路――水槽　系

H (m)	He (m)	C	*	Wv (kg/cm²)	Pv (kg/cm²)	M1 (kg·cm/cm)	i	Alpha (1/cm²)	Ww (kg/cm²)	Pw (kg/cm²)	M2 (kg·cm/cm)	タワミ率 (%)	H1 (kg/cm²)	H2 (kg/cm²)	許容内圧 (kg/cm²)
0.60	0.08	1.000	3	0.1080	0.0000	1.106	0.0	0.000	0.0300	0.0000	0.290	0.64	4.29	4.29	8.58
0.80	0.08	1.000	3	0.1440	0.0000	1.454	0.0	0.000	0.0300	0.0000	0.290	0.80	3.88	3.88	7.76
1.00	0.08	1.000	3	0.1800	0.0000	1.801	0.0	0.000	0.0300	0.0000	0.290	0.97	3.47	3.47	6.94
1.20	0.08	1.000	3	0.2160	0.0000	2.149	0.0	0.000	0.0300	0.0000	0.290	1.13	3.06	3.06	6.12
1.50	0.07	1.000	3	0.2700	0.0000	2.670	0.0	0.000	0.0300	0.0000	0.290	1.37	2.45	2.45	4.90
2.00	0.07	1.000	3	0.3600	0.0000	3.539	0.0	0.000	0.0300	0.0000	0.290	1.77	1.43	1.43	2.86
2.50	0.07	1.000	3	0.3600	0.0000	3.539	0.0	0.000	0.0300	0.0000	0.290	1.77	1.43	1.43	2.86
3.00	0.07	1.000	3	0.3600	0.0000	3.539	0.0	0.000	0.0300	0.0000	0.290	1.77	1.43	1.43	2.86

＊＊＊ 管体構造計算（とう性管） ＊＊＊

ケース：　　管種：SP

呼　　径 Do= 80　(mm)
内　　径 D = 80.7　(mm)
外　　径 Dc= 89.1　(mm)
管　　厚 T = 4.2　(mm)
平均 半径 R = 41.5　(mm)
管 自 重 WP= 4.5　(kg/m)
土の単位重量Ws=1800　(kg/m³)
内部摩擦角 φ= 30　(度)
管頂掘削巾 B = 0.590　(m)

路 面 荷 重　300　(kg/m²)
群 集 荷 重
埋　　設　：　素掘り（溝　形）
設 計 支持角　90　(度)　自由支承
土 圧 係 数　K =0.333
抵 抗 係 数　e'= 28.0
沈　下　比　rsd=-0.10
突　出　比　P = 1.0
＊ 1：C=Cd　2：C=Cc　3：C=1

H (m)	He (m)	C	*	Wv (kg/cm²)	dx1 (cm)	Pv (kg/m²)	i	Alpha (1/cm²)	Ww (kg/cm²)	dx2 (cm)	Pw (kg/m²)	M (kg·cm/cm)	dx (cm)	タワミ率 (%)	許容内圧 (kg/cm²)
0.60	0.06	1.000	3	0.1080	0.00	0.0000	0.0	0.000	0.0300	0.00	0.0000	0.8	0.00	0.05	65.52
0.80	0.06	1.000	3	0.1440	0.00	0.0000	0.0	0.000	0.0300	0.00	0.0000	1.0	0.01	0.06	64.60
1.00	0.06	1.000	3	0.1800	0.01	0.0000	0.0	0.000	0.0300	0.00	0.0000	1.2	0.01	0.08	63.69
1.20	0.06	1.000	3	0.2160	0.01	0.0000	0.0	0.000	0.0300	0.00	0.0000	1.4	0.01	0.09	62.77
1.50	0.06	1.000	3	0.2700	0.01	0.0000	0.0	0.000	0.0300	0.00	0.0000	1.7	0.01	0.11	61.39
2.00	0.06	1.000	3	0.3600	0.01	0.0000	0.0	0.000	0.0300	0.00	0.0000	2.1	0.01	0.14	59.09
2.50	0.06	1.000	3	0.3600	0.01	0.0000	0.0	0.000	0.0300	0.00	0.0000	2.1	0.01	0.14	59.09
3.00	0.06	1.000	3	0.3600	0.01	0.0000	0.0	0.000	0.0300	0.00	0.0000	2.1	0.01	0.14	59.09

＊＊＊　管体構造計算（とう性管）　＊＊＊

ケース：　　管種：ＳＰ

呼　　径	Do=	80	(ｍｍ)	路面荷重		T- 9 (ｔｏｎ)	1 台
内　　径	D =	80.7	(ｍｍ)	路面状態	：	未舗装	
外　　径	Dc=	89.1	(ｍｍ)	埋　　設	：	素掘り（溝 形）	
管　　厚	T =	4.2	(ｍｍ)	設計支持角		90 (度) 自由支承	
平均 半径	R =	41.5	(ｍｍ)	土圧係数		K =0.333	
管 自 重	WP=	4.5	(kg／m)	抵抗係数		e'= 28.0	
土の単位重量	Ws=	1800	(kg／m³)	沈 下 比		rsd=-0.10	
内部摩擦角	φ=	30	(度)	突 出 比		P = 1.0	
管頂掘削巾	B =	0.590	(ｍ)	＊ 1：C=Cd 2：C=Cc 3：C=1			

H (m)	He (m)	C	＊	Wv (kg/cm²)	dx1 (cm)	Pv (kg/m²)	i	Alpha (1/cm²)	Ww (kg/cm²)	dx2 (cm)	Pw (kg/m²)	M (kg·cm/cm)	dx (cm)	タワミ率 (%)	許容内圧 (kg/cm²)
0.60	0.06	1.000	3	0.1080	0.00	0.0000	0.4	0.676	0.4416	0.01	0.0000	3.0	0.02	0.19	55.02
0.80	0.06	1.000	3	0.1440	0.00	0.0000	0.4	0.572	0.2883	0.01	0.0000	2.4	0.01	0.15	58.01
1.00	0.06	1.000	3	0.1800	0.01	0.0000	0.4	0.398	0.2006	0.01	0.0000	2.1	0.01	0.13	59.33
1.20	0.06	1.000	3	0.2160	0.01	0.0000	0.4	0.290	0.1460	0.00	0.0000	2.0	0.01	0.13	59.81
1.50	0.06	1.000	3	0.2700	0.01	0.0000	0.3	0.223	0.1044	0.00	0.0000	2.1	0.01	0.13	59.49
2.00	0.06	1.000	3	0.3600	0.01	0.0000	0.3	0.154	0.0719	0.00	0.0000	2.4	0.01	0.15	58.02
2.50	0.06	1.000	3	0.3600	0.01	0.0000	0.2	0.111	0.0481	0.00	0.0000	2.2	0.01	0.14	58.63
3.00	0.06	1.000	3	0.3600	0.01	0.0000	0.2	0.084	0.0362	0.00	0.0000	2.2	0.01	0.14	58.93

＊＊＊　管体構造計算（とう性管）　＊＊＊

ケース：　　管種：ＳＰ

呼　　径	Do=	80	(ｍｍ)	路面荷重		D- 11 (ｔｏｎ)	施工時
内　　径	D =	80.7	(ｍｍ)	地盤状態	：	普 通	
外　　径	Dc=	89.1	(ｍｍ)	埋　　設	：	素掘り（溝 形）	
管　　厚	T =	4.2	(ｍｍ)	設計支持角		90 (度) 自由支承	
平均 半径	R =	41.5	(ｍｍ)	土圧係数		K =0.333	
管 自 重	WP=	4.5	(kg／m)	抵抗係数		e'= 28.0	
土の単位重量	Ws=	1800	(kg／m³)	沈 下 比		rsd=-0.10	
内部摩擦角	φ=	30	(度)	突 出 比		P = 1.0	
管頂掘削巾	B =	0.590	(ｍ)	＊ 1：C=Cd 2：C=Cc 3：C=1			

H (m)	He (m)	C	＊	Wv (kg/cm²)	dx1 (cm)	Pv (kg/m²)	i	Alpha (1/cm²)	Ww (kg/cm²)	dx2 (cm)	Pw (kg/m²)	M (kg·cm/cm)	dx (cm)	タワミ率 (%)	許容内圧 (kg/cm²)
0.60	0.06	1.000	3	0.1080	0.00	0.0000	0.0	0.000	0.1607	0.00	0.0000	1.5	0.01	0.09	96.92
0.80	0.06	1.000	3	0.1440	0.00	0.0000	0.0	0.000	0.1419	0.00	0.0000	1.6	0.01	0.10	96.48
1.00	0.06	1.000	3	0.1800	0.01	0.0000	0.0	0.000	0.1419	0.00	0.0000	1.8	0.01	0.11	95.56
1.20	0.06	1.000	3	0.2160	0.01	0.0000	0.0	0.000	0.1419	0.00	0.0000	1.9	0.01	0.13	94.64
1.50	0.06	1.000	3	0.2700	0.01	0.0000	0.0	0.000	0.1419	0.00	0.0000	2.2	0.01	0.14	93.26
2.00	0.06	1.000	3	0.3600	0.01	0.0000	0.0	0.000	0.1196	0.00	0.0000	2.6	0.01	0.17	91.53
2.50	0.06	1.000	3	0.3600	0.01	0.0000	0.0	0.000	0.0977	0.00	0.0000	2.5	0.01	-0.16	92.09
3.00	0.06	1.000	3	0.3600	0.01	0.0000	0.0	0.000	0.0826	0.00	0.0000	2.4	0.01	0.15	92.48

＊＊＊ 管体構造計算（不とう性管） ＊＊＊

ケース：　　管種：RCP － 2K

呼　　径 Do= 300　(mm)
内　　径 D = 300.0　(mm)
外　　径 Dc= 360.0　(mm)
管　　厚 T = 30.0　(mm)
平均 半径 R = 165.0　(mm)
管 自 重 WP= 76.2　(kg／m)
土の単位重量Ws=1800　(kg／m³)
内部摩擦角 φ= 30　(度)
管頂掘削巾 B = 1.310　(m)

路 面 荷 重　T- 9 (t o n)　1 台
路 面 状 態 : 未舗装
埋　　設 : 素掘り（溝 形）
設 計 支持角　90 (度)　自由支承
土 圧 係 数　K =0.333
抵 抗 係 数　e'= 28.0
沈　下　比　rsd= 0.70
突　出　比　P = 1.0
＊ 1：C=Cd　2：C=Cc　3：C=1
安全率 S= 1.5

H (m)	He (m)	C	＊	Wv (kg/cm²)	P1 (kg/cm²)	P2 (kg/cm²)	i	Alpha (1/cm²)	Ww (kg/cm²)	Pc (kg/cm)	Hc (kg/cm²)	M (kg·cm/cm)	Ph (kg/cm)	許容内圧 (kg/cm²)
0.60	0.60	2.337	2	0.1514	0.0000	0.0000	0.4	0.826	0.4164	19.0	2.0	50.0	9.53	0.46
0.80	0.63	3.419	2	0.2215	0.0000	0.0000	0.4	0.552	0.2784	19.0	2.0	44.2	8.42	0.61
1.00	0.54	4.314	2	0.2795	0.0000	0.0000	0.4	0.389	0.1960	19.0	2.0	42.1	8.02	0.66
1.20	0.51	5.201	2	0.3370	0.0000	0.0000	0.4	0.286	0.1439	19.0	2.0	42.6	8.11	0.65
1.50	0.49	6.532	2	0.4233	0.0000	0.0000	0.3	0.221	0.1034	19.0	2.0	46.5	8.86	0.55
2.00	0.47	8.744	2	0.5666	0.0000	0.0000	0.3	0.153	0.0715	19.0	2.0	56.0	10.67	0.30
2.50	0.46	10.958	2	0.7101	0.0000	0.0000	0.2	0.111	0.0480	19.0	2.0	66.2	12.62	0.01
3.00	0.46	13.165	2	0.8531	0.0000	0.0000	0.2	0.084	0.0361	19.0	2.0	77.5	14.76	−0.34

＊＊＊ 管体構造計算（不とう性管） ＊＊＊

ケース：　　管種：RCP － 2K

呼　　径 Do= 300　(mm)
内　　径 D = 300.0　(mm)
外　　径 Dc= 360.0　(mm)
管　　厚 T = 30.0　(mm)
平均 半径 R = 165.0　(mm)
管 自 重 WP= 76.2　(kg／m)
土の単位重量Ws=1800　(kg／m³)
内部摩擦角 φ= 30　(度)
管頂掘削巾 B = 1.310　(m)

路 面 荷 重　D- 11 (t o n)　施工時
地 盤 状 態 : 普 通
埋　　設 : 素掘り（溝 形）
設 計 支持角　90 (度)　自由支承
土 圧 係 数　K =0.333
抵 抗 係 数　e'= 28.0
沈　下　比　rsd= 0.70
突　出　比　P = 1.0
＊ 1：C=Cd　2：C=Cc　3：C=1
安全率 S= 1.0

H (m)	He (m)	C	＊	Wv (kg/cm²)	P1 (kg/cm²)	P2 (kg/cm²)	i	Alpha (1/cm²)	Ww (kg/cm²)	Pc (kg/cm)	Hc (kg/cm²)	M (kg·cm/cm)	Ph (kg/cm)	許容内圧 (kg/cm²)
0.60	0.60	2.337	2	0.1514	0.0000	0.0000	0.0	0.000	0.1607	19.0	2.0	26.7	5.09	1.72
0.80	0.63	3.419	2	0.2215	0.0000	0.0000	0.0	0.000	0.1419	19.0	2.0	31.1	5.92	1.65
1.00	0.54	4.314	2	0.2795	0.0000	0.0000	0.0	0.000	0.1419	19.0	2.0	36.0	6.87	1.57
1.20	0.51	5.201	2	0.3370	0.0000	0.0000	0.0	0.000	0.1419	19.0	2.0	40.9	7.80	1.47
1.50	0.49	6.532	2	0.4233	0.0000	0.0000	0.0	0.000	0.1419	19.0	2.0	48.3	9.21	1.33
2.00	0.47	8.744	2	0.5666	0.0000	0.0000	0.0	0.000	0.1196	19.0	2.0	58.7	11.18	1.10
2.50	0.46	10.958	2	0.7101	0.0000	0.0000	0.0	0.000	0.0977	19.0	2.0	69.1	13.16	0.85
3.00	0.46	13.165	2	0.8531	0.0000	0.0000	0.0	0.000	0.0826	19.0	2.0	80.0	15.24	0.56

＊＊＊ 管体構造計算（不とう性管） ＊＊＊

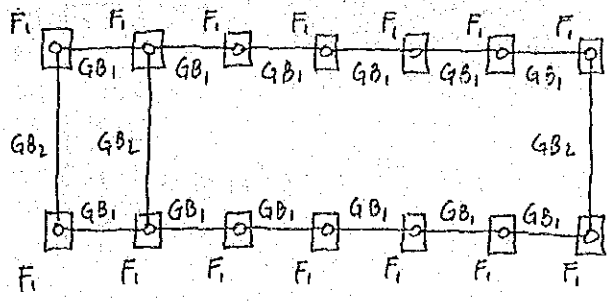
ケース：　　管種：ＲＣＰ － 2Ｋ

呼　　径	Do= 300	(mm)	路面荷重	300	(kg/㎡)	
内　　径	D = 300.0	(mm)	群集荷重			
外　　径	Dc= 360.0	(mm)	埋　　設	： 素掘り（溝　形）		
管　　厚	T = 30.0	(mm)	設計支持角	90	(度)	自由支承
平均 半径	R = 165.0	(mm)	土圧係数	K =0.333		
管 自 重	WP= 76.2	(kg／m)	抵抗係数	e'= 28.0		
土の単位重量	Ws=1800	(kg／m³)	沈　下　比	rsd= 0.70		
内部摩擦角	φ= 30	(度)	突　出　比	P = 1.0		
管頂掘削巾	B = 1.310	(m)	＊ 1：C=Cd 2：C=Cc 3：C=1			
			安全率	S= 1.5		

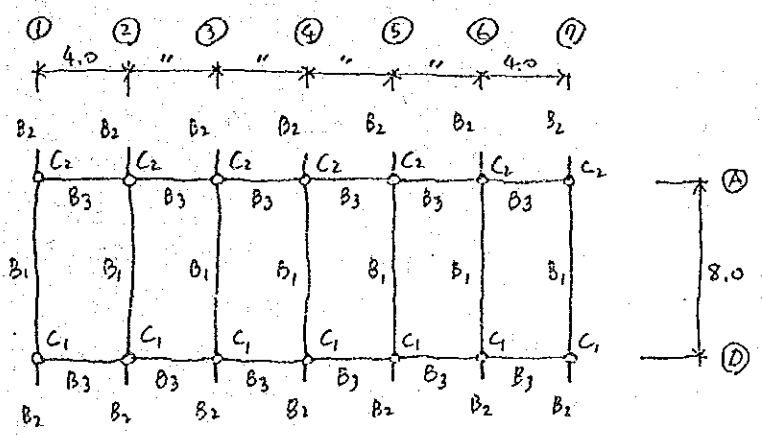
H (m)	He (m)	C	＊	Wv (kg/c㎡)	P1 (kg/c㎡)	P2 (kg/c㎡)	i	Alpha (1/c㎡)	Ww (kg/c㎡)	Pc (kg/cm)	Hc (kg/c㎡)	M (kg·cm/cm)	Ph (kg/cm)	許容内圧 (kg/c㎡)
0.60	0.60	2.337	2	0.1514	0.0000	0.0000	0.0	0.000	0.0300	19.0	2.0	16.9	3.23	1.16
0.80	0.63	3.419	2	0.2215	0.0000	0.0000	0.0	0.000	0.0300	19.0	2.0	22.9	4.37	1.06
1.00	0.54	4.314	2	0.2795	0.0000	0.0000	0.0	0.000	0.0300	19.0	2.0	27.9	5.32	0.97
1.20	0.51	5.201	2	0.3370	0.0000	0.0000	0.0	0.000	0.0300	19.0	2.0	32.8	6.25	0.87
1.50	0.49	6.532	2	0.4233	0.0000	0.0000	0.0	0.000	0.0300	19.0	2.0	40.2	7.66	0.71
2.00	0.47	8.744	2	0.5666	0.0000	0.0000	0.0	0.000	0.0300	19.0	2.0	52.4	10.00	0.40
2.50	0.46	10.958	2	0.7101	0.0000	0.0000	0.0	0.000	0.0300	19.0	2.0	64.7	12.33	0.05
3.00	0.46	13.165	2	0.8531	0.0000	0.0000	0.0	0.000	0.0300	19.0	2.0	76.9	14.66	-0.33

WAREHOUSE

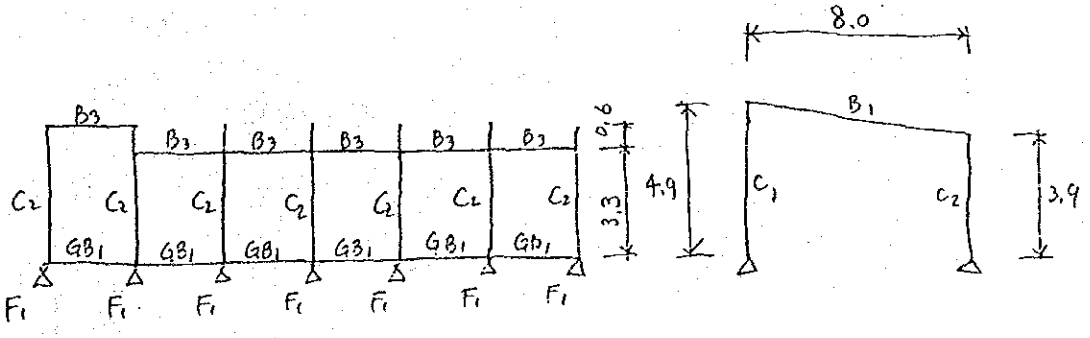
1. 骨格体図



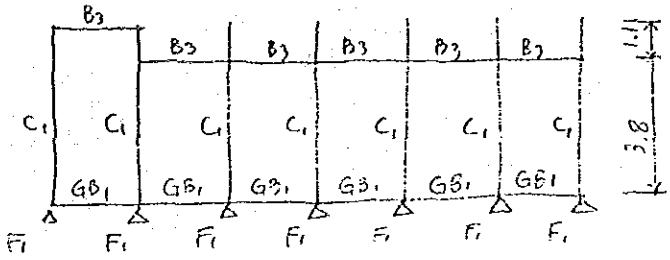
基礎伏図



屋根伏図



Ⓐ - 軸組図　　③～⑥ - 軸組図



Ⓓ - 軸組図

2、部材断面仮定

	b×D	I(bD³/12)	ℓ	K	剛
C_1	26×40	138,667	490	283	1
C_2	26×40	138,667	390	356	1.26
B_1	26×50	270,833	800	339	1.20
B_2	26×25				
B_3	20×30				
GB_1	30×45				
GB_2	30×70				

3、荷重

③～⑥ ラーメンについて

屋根　波形スレート　$20^{kg/m^2} \times 4^{m} =$ 80

母屋　L-75×75×6　$9.96^{kg/m} \times 1/0.85 \times 4^{m} =$ 47

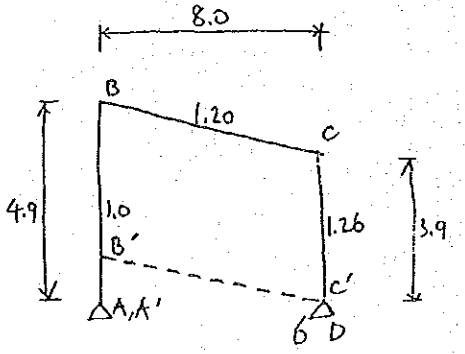
L.L.　$60^{kg/m^2} \times 4 =$ 240

コンクリート梁　$0.26 \times 0.50 \times 2.4 =$ 312

679 kg/m → 680

4、③～⑥ ラーメンの応力計算

仮想仕事方法を使用



独立部材数　部材総数 − 2×用鎖形数

$= 3 - 2 \times 1 = 1$

柱CDを独立部材とする。

部材角の関係

$$R_{DC} = 1 - \frac{D'C'}{DC} = 1 - 0 = +1.0$$

$$R_{AB} = 1 - \frac{A'B'}{AB} = 1 - \frac{1.0}{4.9} = +0.80$$

$$R_{BC} = 1 - \frac{B'C'}{BC} = 1 - 1 = 0$$

各部材の固定モーメント

	剛	R	剛R	−100剛R
AB	1.0	+0.80	+0.80	−80
BC	1.2	0	0	0
CD	1.26	+1.0	+1.26	−126

上記の固定モーメントを分配する。

	B		(1.20)		C	
	0.455	0.545		0.488	0.512	
	-80				-12.6	
	36.4	43.6		61.5	64.5	
		30.8		21.8		
	-14.0	-16.8		-10.6	-11.2	
(1.0)		-5.3		-8.4		(1.26)
	2.4	2.9		4.1	4.3	
		2.1		1.5		
	-1.0	-1.1		-0.7	-0.8	
		-0.4		-0.6		
	0.2	0.2		0.3	0.3	D
		A 0.2		0.1		
	-56.0	56.2		69.0	-68.9	

分部材のモーメント総和 ΣMR

	R	M	ΣM	ΣMR
AB	+0.80	-56.0	-56.0	-44.8
BC	0	—		
CD	+1.0	-69.0	-69.0	-69.0
				Σ -113.8

荷重（3-項）によるモーメント分配

0.455	0.545		0.488	0.512
	-3.63		3.63	
1.65	1.98		-1.79	-1.86
	-0.89		0.99	
0.40	0.49		-0.48	-0.51
	-0.24		0.25	
0.11	0.13		-0.12	-0.13
	-0.06		0.07	
0.03	0.03		-0.03	-0.04
	-0.02		-0.02	
2.19	-2.21		2.52	-2.54
	2.20		2.53	

B, C 端の C, M_0, θ_0

$$C = \frac{\omega \ell^2}{12} = \frac{0.68 \times 8^2}{12} = 3.63$$

$$M_0 = \frac{\omega \ell^2}{8} = \frac{0.68 \times 8^2}{8} = 5.44 \text{ t·m}$$

$$\theta_0 = \frac{\omega \ell}{2} = \frac{0.68 \times 8}{2} = 2.72 \text{ t}$$

各部材のモーメント総和 ΣmR

	R	m	Σm	ΣmR
AB	+0.80	+2.20	+2.20	+1.96
BC	0	−		
CD	+1.0	−2.53	−2.53	−2.53
				Σ −0.77

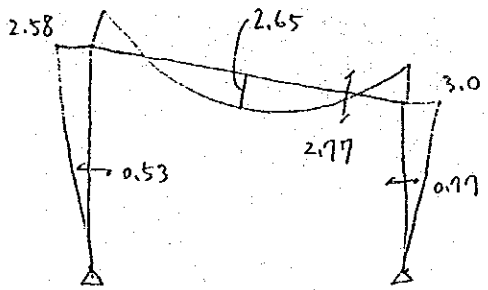
釣合方程式 $\Sigma MRx + (\Sigma PC + \Sigma mR + \Sigma MR) = 0$

$-113.8x + (-0.77) = 0 \quad \therefore x = -0.0068$

各部材応力 $[m] + (-0.0068)[M]$

部材端	m	$-0.0068M$	m
BA	+2.20	+0.38	+2.58
BC	−2.20	−0.38	−2.58
CB	+2.53	+0.47	+3.00
CD	−2.53	−0.47	−3.00

応力図



$M_C = 5.44 - \frac{(2.58 + 3.0)}{2} \times \frac{2.77}{2} = 2.65$

$\theta_e = 2.72 + (3 - 2.58) \times \frac{1}{8} = 2.77$

5. 部材の配筋

B_1 : 26×50

$j = \frac{7}{8}d = \frac{7}{8} \times 46 = 40.3, \quad M = 3.0, \quad f_t = 1.6$

$a_t = 100M / f_t j = 300 / 1.6 \times 40.3 = 4.7\ cm^2 \rightarrow 3-D16$

$\zeta = \frac{Q}{bj} = \frac{2770}{26 \times 40.3} = 2.6 < 6.0 \quad O.K$

C_2 : 26×40

$bD = 26\times40 = 1040$, $bD^2 = 26\times40^2 = 41600$

頂部

$P_t = 2.77^t$, $M_t = 3.0^{tm}$

$P_t/_{bD} = {}^{2770}/_{1040} = 2.7$

$M/_{bD^2} = {}^{300000}/_{41600} = 7.2$

$P_t = 0.5\%$ $\quad a_t = 1040\times0.005 = 5.2^{cm^2} \rightarrow \underline{3-D16}$

底部

$P_b = 2.77 + 0.26\times0.4\times2.4\times3.9 + 0.2\times0.3\times2.4\times4 = 4.32^t$

$M_b = 0$

$P_b/_{bD} = {}^{4320}/_{1040} = 4.2$ $\quad M_b/_{bD^2} = 0$ $\quad P_t = 0\%$

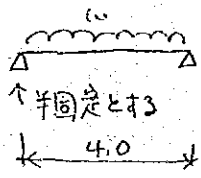
C_1 : 26×40

C_2 と同様

6. 地中梁の設計

GB_1 : 30×45

$j = \frac{7}{8}\times38 = 33$



w : 自重 $0.3\times0.45\times2.4 = 0.324$

レンガ壁 $(0.38+0.08)\times3.1 = 1.886$ → 2.46

$2.21^{t/m}$

レンガ壁 1/2B の場合 ↓

0.324

0.837

$1.16^{t/m}$

$M = \frac{wl^2}{10} = \frac{2.21\times16}{10} = 3.54^{tm}$

$= \frac{1.16\times16}{10} = 1.86^{tm}$

$a_t = {}^{354}/_{1.6\times33} = 6.7^{cm^2} \rightarrow \underline{4-D16}$

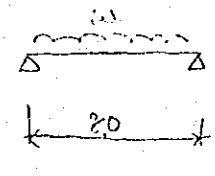
$= {}^{186}/_{1.6\times33} = 3.5^{cm^2}$ ↓ $\underline{2-D16}$

$Q = \frac{wl}{2} = \frac{2.21\times4}{2} = 4.42^t$

$\tau = {}^{4420}/_{30\times33} = 4.5 < 6.0$ $\quad$ O.K

GB_2 : 30×70

$j = \frac{7}{8}\times63 = 55^{cm}$



w : 自重 $0.3\times0.7\times2.4 = 0.504$

レンガ壁 $0.46\times3.4 = 1.564$

$2.07^{t/m}$

0.504

$0.29\times3.4 = 0.918$

$1.422^{t/m}$

$M = \frac{wl^2}{8} = \frac{2.09 \times 8^2}{8} = 16.6^{tm}$, $Q = \frac{wl}{2} = \frac{2.09 \times 8}{2} = 8.38^{t}$, $= \frac{1.42 \times 8^2}{8} = 11.36^{tm}$

$at = 1660 / 1.6 \times 55 = 18.9^{cm^2} \rightarrow 9 - D16$

$= 1136 / 1.6 \times 55 = 12.9 \rightarrow 6 - D16$

$z = 8280 / 30 \times 55 = 5.0 < 6.0$ O.K

B_3 : 20×30

$j = \frac{7}{8} \times 26 = 22.8^{cm}$

w : 自重 $0.2 \times 0.3 \times 2.4 = 0.144$
レンガ壁 $0.46 \times 1.1 = 0.506$
扉 0.150
$0.8^{t/m}$

0.144
$0.29 \times 1.1 = 0.297$
0.150
0.591

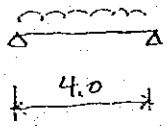
$M = \frac{wl^2}{10} = \frac{0.8 \times 16}{10} = 1.28^{tm}$, $Q = \frac{wl}{2} = \frac{0.2 \times 4}{2} = 1.6^{t}$, $= \frac{0.59 \times 16}{10} = 0.95$

$at = 128 / 1.6 \times 22.8 = 3.5 \rightarrow 2 - D16$

$= 95 / 1.6 \times 22.8 = 2.6$ ↓ $2 - D16$

$z = 1600 / 20 \times 22.8 = 3.5 < 6.0$ O.K

7. 母屋の設計



w = スレート $20^{kg/m^2} \times 0.85 = 17.0$
母屋 L-75×6 $9.96^{kg/m} = 9.96$
L.L. $60^{kg/m^2} \times 0.85 = 51$
$78.0^{kg/m}$

$M = \frac{wl^2}{8} = \frac{78 \times 4^2}{8} = 156^{kg\,m}$

$z = 15600 / 1600 = 9.75^{cm^3} \rightarrow L-75 \times 75 \times 9 \ (= 12.1^{cm^3})$

L.L. $30^{kg/m^2}$ なら
$w = 17 + 10 + 25.5 = 52.5^{kg/m}$
$M = \frac{52.5 \times 4^2}{8} = 105^{kg\,m}$
$z = 10500 / 1600 = 6.6^{cm^3} \rightarrow L-75 \times 75 \times 6 \ (= 8.47^{cm^3})$

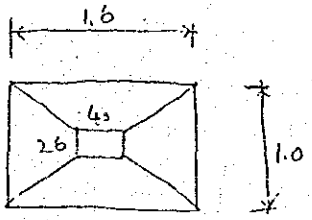
8、基礎の設計

最大荷重基礎 → ②-Ⓓ 基礎

N：	B_1	$0.26\times0.5\times2.4\times4$	$=1.248$	〃
	C_1	$0.26\times0.4\times2.4\times4.4$	$=1.098$	〃
	B_3	$0.2\times0.3\times2.4\times4$	$=0.576$	〃
	GB_1	$0.3\times0.45\times2.4\times4$	$=1.296$	〃
	GB_2	$0.3\times0.7\times2.4\times4$	$=2.016$	〃
	レンガ壁	$0.46\times3.9\times4$	$=7.176$	$0.29\times3.9\times4=4.212$
		$0.46\times3.9\times4$	$=7.176$	$0.29\times3.9\times4=4.212$
	屋根	$0.02\times4\times5$	$=0.400$	〃
		$0.00996\times1/0.85\times4\times5$	$=0.226$	〃
		$0.06\times4\times5$	$=1.200$	〃
			$P'=22.442\ t$	$16.484\ t$

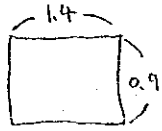
地面耐力 $15\ t/m^2$ と仮定

必要底面積 $A_r=22.4/15=1.49\ m^2$ $\quad A_r=16.49/15=1.1\ m^2$



左図に於て $A=1.6\times1.0=1.6>1.49$ O.K

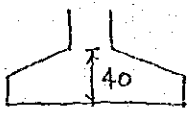
$l/a=160/40=4$



$\alpha=3.5$

$A=1.26$

$\frac{Q_F}{P'}=0.234$, $\frac{M_F}{P'a}=0.21$



$Q_F=22.4^t\times0.234=5.24^t$

$M_F=22.4^t\times0.26\times0.21=1.22^{tm}$

$D=40^{cm}$, $\quad b'=26+80=106^{cm}$

$j=\frac{7}{8}\times33=28.9^{cm}$

$\tau=Q_F/b'j=5240/106\times28.9=1.7<6.0$ O.K

必要鉄筋周長

$\psi=Q_F/f_{bj}=5240/10.8\times28.9=16.8^{cm}$

Φ9 使用なら（$\psi=2.83^{cm}$）

$@=b'/\psi/2.83=106/16.3/2.83=17.9^{cm}$

D12 使用なら（$\psi=3.77$）

$@=106/16.8/3.77=23.8^{cm}$

必要 鉄筋断面

$a_t = M_F / f_t j = 122 / 1.6 \times 28.9 = 2.64\ cm^2$

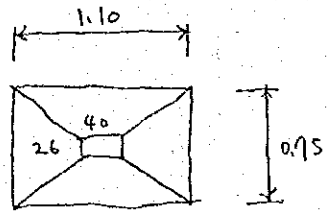
鉄筋間隔 (Φ9 使用)

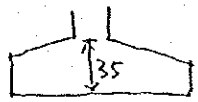
$@ = b' / a_t / 0.64 = 106 / 2.64 / 0.64 = 25.7\ cm > 17.9\ cm$ OK

通常基礎 (Ⓐ-③～⑥)

N :	B_1	= 1.248	〃
	C_1	= 1.098	〃
	B_3	= 0.576	〃
	GB_1	= 1.296	〃
	レンガ壁 0.46×2.5×4	= 4.600	0.29×2.5×4 = 2.90
	屋根	= 1.826	〃
		$P' = 10.64^t$	8.75^t

必要底面積 $A_r = 10.64 / 15.0 = 0.71\ m^2$ | $A_r = 8.75 / 15 = 0.58$

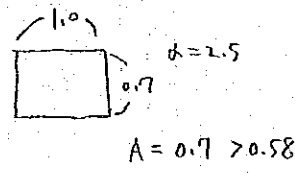




左図に於て $A = 1.1 \times 0.75 = 0.83\ m^2 > 0.71$ O.K

$\ell / a = 110 / 40 = 2.75$

$\frac{Q_F}{P'} = 0.217$, $\frac{M_F}{P'a} = 0.11$



$A = 0.7 > 0.58$

$Q_F = 0.217 \times 10.64 = 2.31^t$

$M_F = 0.11 \times 10.64 = 1.17\ t\cdot m$

$D = 35\ cm$, $b' = 26 + 70 = 96\ cm$

$j = \frac{7}{8} \times 28 = 24.5\ cm$

$\tau = 2310 / 96 \times 24.5 = 0.98 < 6.0$ O.K

必要鉄筋間長

$s = 2310 / 10.8 \times 24.5 = 8.7\ cm$

Φ9 使用なら ($s = 2.83\ cm$)

$@ = 96 / 8.7 / 2.83 = 31.2\ cm$

必要鉄筋断面

$a_t = 117 / 1.6 \times 24.5 = 2.98\ cm^2$

$@ = 96 / 2.98 / 0.64 = 20.6\ cm$

9. 地震力の検討

地震加速度 $a_t = k_i \cdot k_d \cdot k_t$

$\therefore a_t = 0.1$

k_i ; 高さ係数 $= 0.1$
k_d ; 地域係数 $= 1.0$
k_t ; 地盤係数 $= 1.0$

(1) X方向 (Ⓐ～Ⓓ列) はレンガ壁が耐震壁として働くものとする。
(2) ①, ②, ⑦ 列フレームもレンガ壁が耐震壁として働くものとする。
(3) ③～⑥ フレームのY方向について検定する。

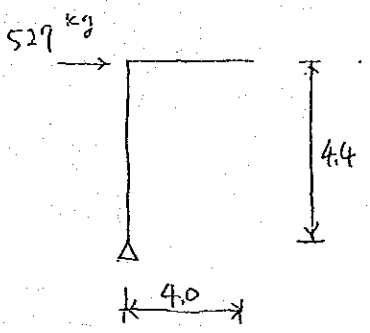
L.L. はないものとする。
柱高の半分が地震荷重とする。

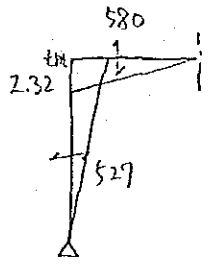
Ⓐ-③ 柱について検討

W ; C_2 $0.26 \times 0.4 \times 2.4 \times (2.8 + 0.6) \times 1/2 = 0.424$
B_1 $0.26 \times 0.5 \times 2.4 \times 4 = 1.248$
B_3 $0.2 \times 0.3 \times 2.4 \times 4 = 0.576$
レンガ壁 $0.46 \times 4 \times 1.3 = 2.392$
屋根 $0.02 \times 4 \times 5 = 0.400$
$0.00996 \times 1/0.85 \times 4 \times 5 = 0.234$
$5.274\ t$

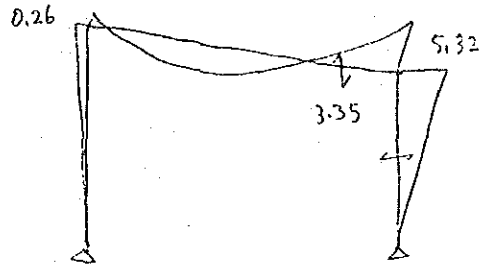
水平力 $H = 5.274\ t \times 0.1 = 527\ kg$

簡略のため高さ均一のフレームとする、平均高 $h = 4.4$





長期との合成応力図



B1 の検定

$M = 5.32^{tm}$　$Q = 3.35^{t}$

$a_t = 532 / 2.4 \times 40.3 = 5.5^{cm^2} \rightarrow 3-D16$

$\tau = 3350 / 26 \times 40.3 = 3.2 < 12$　O.K

C2 の検定

$M_c = 5.32^{tm}$

P_t ： 波形スレート　$20^{kg/m^2} \times 4 \times 5 = 400$

母屋 L-75×75×6　$9.96^{kg/m} \times 1/0.85 \times 4 \times 5 = 234$

コンクリート梁　$0.26 \times 0.5 \times 2.4 \times 4 = 1.248$

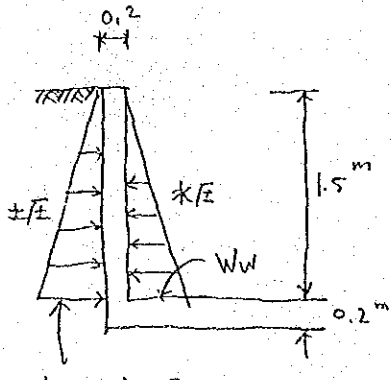
$0.2 \times 0.3 \times 2.4 \times 4 = 0.576$

$P_t = 2.458^{t}$

$\frac{P_t}{bD} = 2458 / 1040 = 2.4$　$\frac{M_t}{bD^2} = 532000 / 41600 = 12.8$

$p_t = 0.63\ \%$,　$a_t = 1040 \times \times 0.0063 = 6.6^{cm^2} \rightarrow 3-D16$

WATERTIGHTNESS TEST PIT



$j = \frac{7}{8} \times 13 = 11.4$ cm

(1) 水が満水で土圧がない場合を想定

$W_w = 1.5$ t/m²

$M = \frac{W_w l^2}{6} = \frac{1.5 \times 1.5^2}{6} = 0.56$ tm

$a_t = 56 / 1.6 \times 11.4 = 3.1$ cm² → 3 - D13

(2) タンクが空で土圧がかかる場合

土の単位重量 $\omega_s = 1.8$ t/m³ (想定)

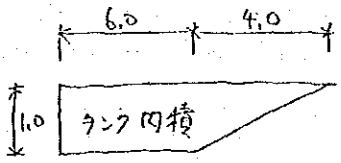
土の主働土圧係数 $K_a = 0.5$ (仮定)

主働土圧力 $P_0 = 1.8 \times 0.5 = 0.9$ t/m²

水圧の場合と同じ.

(3) 浮力に対する検討

タンクが空で, 地下水位が GL-500 と想定



浮力 $= 6.2 \times 4.4 \times 1.2 + 4.3 \times 4.4 \times 1.2 \times 1/2 = 44.1$ t

タンク躯体重量

下: $0.2 \times 4.4 \times 12.9 = 11.18$

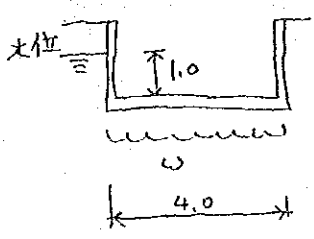
$0.2 \times 1.5 \times (6.1 + 6.1 + 4.2) = 4.92$

$0.2 \times 1.5 \times 6.0 \times 1/2 \times 2 = 1.8$

17.9 m³

$W = 17.9 \times 2.4 = 60.9$ t > 44.1 O.K

タンク底スラブの検討



端部の支持状態を半固定と考える.

$M = \frac{\omega l^2}{10} = \frac{(1.2 - 0.2 \times 2.4) \times 4^2}{10} = 1.15$ tm

$a_t = 115 / 1.6 \times 11.4 = 6.3$ → 6 - D12