

### 3-1-2 Pipeline Facilities

#### (1) Pipe diameter and hydraulic gradient

When implementing pipe installation, it is advisable not to practice exposed piping on a steep incline. Underground piping, buried under the road, path, or farmland, is more recommendable. Yet the method of piping varies depending on topographical conditions. The point 650 m downstream from the intake is high in elevation, and an exposed piping on the incline along the left bank of the valley is practicable there. This topography forms a control point, and the pipe diameter inevitably becomes a little larger. Since the pipe diameter is below 75 mm, the following Weston formula is applied in hydraulic calculation.

$$I = (0.0126 + \frac{0.01739 - 0.1087D}{\sqrt{v}}) \times \frac{v^2}{2gD}$$

Q	1 ℓ/s		2 ℓ/s		3 ℓ/s	
	V	I	V	I	V	I
mm	m/s		m/s		m/s	
40	0.80	1/46	1.59	1/13.5	2.39	1/6.5
50	0.51	1/129	1.02	1/39	1.53	1/19
65	0.30	1/448	0.60	1/135	0.90	1/67
80	0.20	1/1235	0.40	1/375	0.60	1/185

A point approximately 465 m downstream from the intake is supposed to constitute the topographical control point. The installation slope from the intake

to this point is as described below.

Outlet pipe elevation : EL1209.8 m  
of settling box

Pipe elevation of : GH1198.0 - 0.6 =  
control point EL1197.4 m

Total length : 1 = 465 m

Required Slope : 1/37.5  
(1,209.8 - 1,197.4)/465

Therefore the required diameter of pipe is 65mm from the above table in order to get maximum intake discharge 3 l/s and to keep the required minimum slope 1/38.4. The topographical slope downstream from the 650-m point is about 1/10, to which a pipe diameter of 50 mm is applicable.

The designed dimensions pertaining to the maximum design discharge ( $Q_{max} = 3 \text{ l/sec}$ ) are shown below.

Upstream part  $\phi 65$ ,  $I = 1/30 \sim 1/50$ ,  $L = 630 \text{ m}$   
Downstream part  $\phi 50$ ,  $I = 1/18$ ,  $L = 3,600$

## (2) Installation of pipe and route

The pipes shall be installed generally from the upstream on the following routes.

1. Steep incline along the valley (administered by the Forest Bureau):  $\phi 65 \text{ mm}$ , 160 m long (exposed piping)
2. Widened path along the valley (administered by the Forest Bureau):  $\phi 65 \text{ mm}$ , 310 m long (underground piping)
3. Steep slope along the valley (administered by the Forest Bureau):  $\phi 65 \text{ mm}$ , 160 m long (exposed piping)

4. Narrow path along the outer verge of the tea plantation (owned by the tea plantation):

ø50 mm, 1,770 m long  
(underground piping)

5. Road managed by the tea plantation (owned by the tea plantation): ø50 mm, 120 m long  
(underground piping)

6. Grassland and cultivated land of the A.I. Center (administered by the A.I. Center):

ø50 mm, 1,710 m long  
(underground piping)

Total length: 4,230 m

(3) Kind of pipe material

To facilitate maintenance, management, and water quality preservation, the existing 1st water tank (located on the midway) shall be utilized as a pressure reduction water tank in the same way as in the present. Consequently, there are two different pipes available, that is, SGP pipe and pressure pipe.

a. Intake No. 6 + 41 (65 A, 2-1/2 inch)

- Carbon steel pipe for ordinary piping
- SGP pipe equivalent to JIS G-3452
- Test water pressure: 25 kg/cm<sup>2</sup>
- Inside/outside coating: coal tar enamel, asphalt, or epoxy tar
- Joint: underground piping/socket, aboveground piping/5K flange welding
- Pipe outer diameter: 76.3 mm with thickness of 4.2 mm and 7.47 kg/m in unit weight

b. Downstream part (50 A, 2 inch)

When the hydrostatic pressure is less than 100 m:

- Carbon steel pipe for ordinary piping
- SGP pipe equivalent to JIS G-3452
- Test water pressure: 25 kg/cm<sup>2</sup>
- Inside/outside coating: coal tar enamel,  
asphalt, or epoxy tar
- Joint: socket; screw cutting  
(partially 10K flange welding)
- Pipe outer diameter: 60.5 mm with thickness  
3.8 mm and 5.31 kg/m in unit weight

When the hydrostatic pressure is more than/100 m:

- Carbon steel pipe for pressure service
- STPG 38, Model Sch-40, JIS G-3454
- Test water pressure: 70 kg/cm<sup>2</sup>
- Inside/outside coating: coal tar enamel,  
asphalt, or epoxy tar
- Joint: 20K flange welding
- Pipe outer diameter: 60.5 mm with thickness  
3.9 mm and 5.44 kg/m in unit weight

When manufacturing the bend pipe, elbow, cheese, stop valve, air valve, and so on, it is necessary to give consideration to their required water pressure. In principle, flang joints shall be used in the exposed piping where the hydrostatic pressure exceeds 100 m.

c. Hydrostatic pressure and water hammer pressure

This pipeline facilities equips some stop valves in the system and, therefore, the system is called as semi-closed pipeline. The water hammer pressure is obtained in accordance with the following standard.

- In case that hydrostatic pressure is less than  $3.5 \text{ kg/cm}^2$  :

100% of hydrostatic pressure is applied as water hammer pressure

- In case more than  $3.5 \text{ kg/cm}^2$  :

The bigger value between  $3.5 \text{ kg/cm}^2$  and 40% of hydrostatic pressure

Accordingly, hydrostatic pressure and water hammer pressure at the following sections are

1. Intake ~ No.6 + 41 (65A)

$$P = 12 + 12 = 24\text{m} = 2.4 \text{ kg/cm}^2$$

2. No.6 + 41 ~ 1st Tank (50A)

$$P = 202 + 202 \times 0.4 = 283\text{m} = 28.3 \text{ kg/cm}^2$$

3. 1st Tank ~ inlet tank (50A)

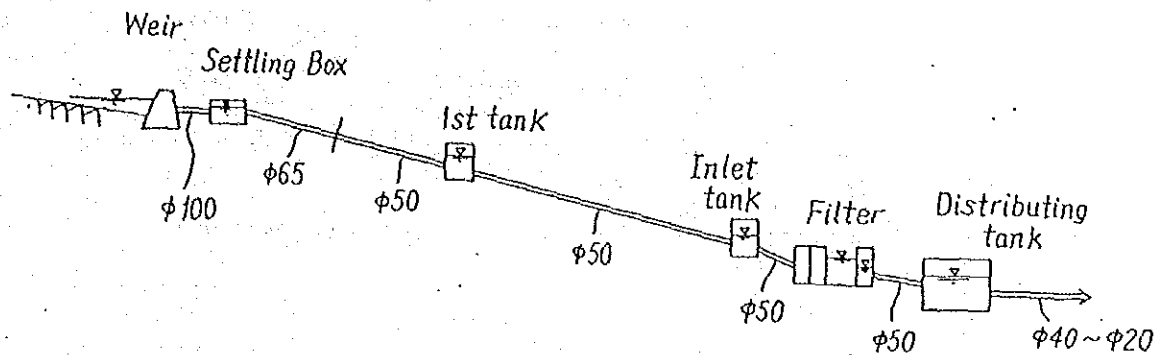
$$P = 152 + 152 \times 0.4 = 213\text{m} = 21.3 \text{ kg/cm}^2$$

4. Inlet Tank ~ terminal

$$P = 91 + 91 \times 0.4 = 127\text{m} = 21.7 \text{ kg/cm}^2$$

(4) Schematic profile of pipeline

The schematic profile of the pipeline is envisaged as following figure



The discharge for design is as follows:

Maximum intake discharge :  $Q = 3 \text{ l/s}$

Minimum intake discharge :  $Q = 1 \text{ l/s}$

Maximum inflow discharge :  $Q = 3.0 \times 95\% = 2.85 \text{ l/s}$   
to inlet tank

Minimum inflow discharge :  $Q = 1.0 \times 95\% = 0.95 \text{ l/s}$   
to inlet tank

Maximum amount of supply water per day :

1) A.l. Center	$Q = 41 \text{ m}^3/\text{day}$
2) Goat feeding facility	$Q = 9 \text{ m}^3/\text{day}$
3) Supply for irrigation	$Q = 196 \text{ m}^3/\text{day}$
Total	$246 \text{ m}^3/\text{day}$

(5) Approximate quantities of improvement works for pipeline are

a. Installation of pipeline

65A, 2-1/2", SGP with socket joint	L = 303m
with flange joint	318m
50A, 2", SGP with socket joint	1,724m
with flange joint	1,893m
Total	4,238m

b. Pipe support

Plain concrete anchor	1 L.S.
Masonry concrete anchor	1 L.S.
Steel support (65A)	L = 120m

c. Installation of blow off and gate valves

$\phi$ 100	2 places
$\phi$ 65	5 places
$\phi$ 50	2 places

b. Installation of air valves

$\phi$ 25	9 places
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c. Improvement of 1st tank

1 place

Fig. 3-1

INSTALLATION PLAN OF PIPELINE

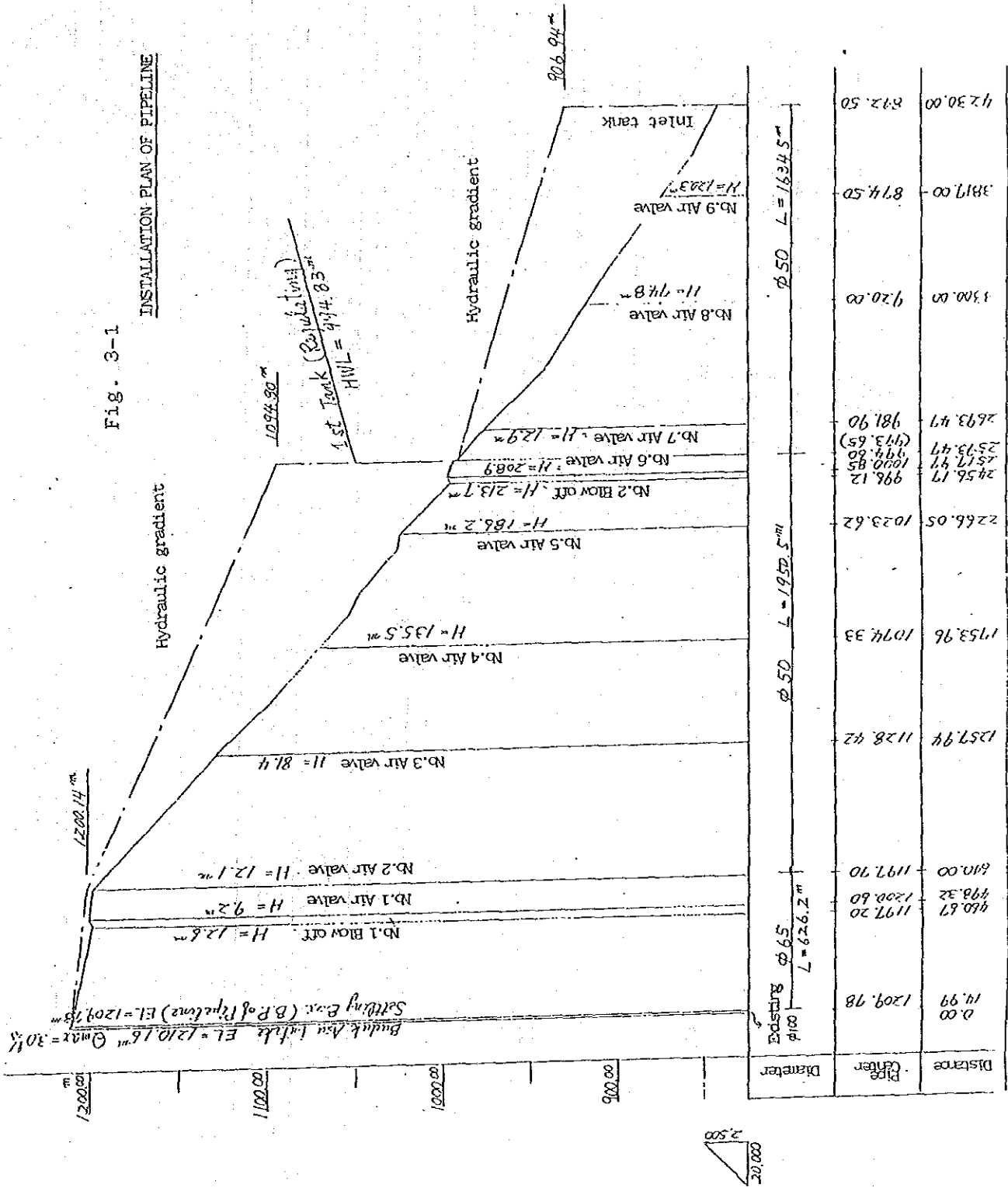
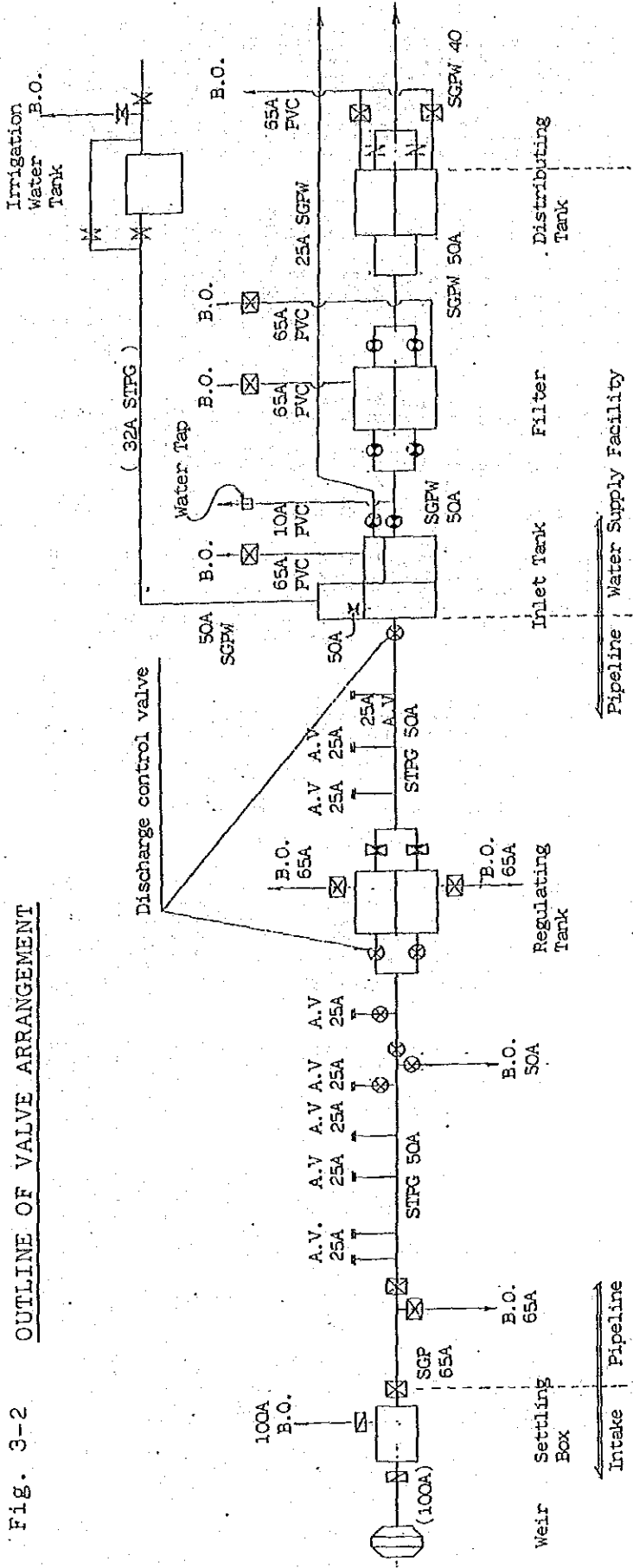




Table 3-1 HYDRAULIC WATER LEVEL OF PIPELINE

	Discharge Diameter ( $\text{mm}$ )	Hydraulic Gradient	Velocity $V(\text{m/s})$	Horizontal Length $l(\text{m})$	Actual Length $l'(\text{m})$	No. of Bend	Loss			Heads			Hydraulic Water Level	Remarks
							Friction	Bend	Inlet etc.	Valve	Others	Total		
$Q_{\text{max}} 3.0 \text{ L/s}$														
Settling Box	3.0	1/66.44	0.904	626.2	626.2	25	9.43	0.13	0.04	0.04	—	9.64	1209.78	
Reducer (65 X 50)	3.0	1/18.85	1.528	1950.5	1964.6	58	104.23	0.89	0.12	0.10	—	105.34	1200.14	
Regulating Tank													1094.80	
Regulating Tank	3.0	1/18.85	1.528	1634.5	1642.1	26	87.12	0.42	0.21	0.10	—	87.89	994.83	
Inlet Tank													906.94	

Fig. 3-2 OUTLINE OF VALVE ARRANGEMENT



- : JIS B2031 5K, Flange, Gate valve,  $\phi$  100
- ⊠ : JIS B2031 5K, Flange, Gate valve,  $\phi$  65
- ⊗ : JIS B2083, 20K, Flange, Gate valve  $\phi$  50
- ⊞ : JIS B2031 10K, Flange, Gate valve,  $\phi$  50
- ⊕ : JIS B2062 7.5K, Flange, Submerged valve,  $\phi$  50
- ⊙ : JIS B2051, Socket, Stop valve,  $\phi$  50
- ⊘ : JIS B2051, Socket, Stop valve,  $\phi$  25
- N : JIS B2051, Socket, Stopvalve,  $\phi$  40
- ⊗ : Existing valve

Abbreviation :

- SGP : Carbon steel pipes for ordinary piping
- SGFW : Galvanized steel pipes for water service
- STPG : Carbon steel pipes for pressure service
- PVC(VP) : Unplasticized polyvinyl chloride pipe
- A : Nominal size
- B.O. : Blow off
- A.V. : Air valve

Table 3-2

\*\*\* Calculation of Pipe Schedul \*\*\*

\*\*\* SINGOSARI A. I. CENTER PIPE LINE \*\*\*

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	Station (NO)	El. of pipe (EL)	Distance (L)	Diff. of El (H)	Slope	Ver. angle (A)	Pipe length (PL)	vertical Bend (V)	Horizon. Bend (C)	Composed Bend (X)
0	+	14.9901209.780	11.840	-0.254	-0.02148	- 1°13'50"	11.843	0° 0' 0"	85° 3' 6"	25° 6' 38"
0	+	26.6401209.526	10.250	-0.220	-0.02148	- 1°13'50"	10.252	0° 0' 0"	51° 2' 35"	51° 1' 49"
0	+	36.8901209.306	15.200	-0.327	-0.02148	- 1°13'50"	15.204	0° 0' 0"	2° 59' 40"	2° 59' 38"
0	+	52.0901208.979	15.760	-0.339	-0.02148	- 1°13'50"	15.764	0° 0' 0"	22° 54' 10"	22° 53' 51"
0	+	67.8501208.640	10.250	-0.220	-0.02148	- 1°13'50"	10.252	0° 0' 0"	6° 26' 35"	6° 26' 30"
0	+	78.1001208.420	13.840	-0.297	-0.02148	- 1°13'50"	13.843	0° 0' 0"	23° 31' 50"	23° 31' 30"
1	+	0.0 1207.950	8.060	-0.173	-0.02148	- 1°13'50"	8.062	0° 0' 0"	0° 0' 0"	0° 0' 0"
1	+	9.2401207.751	9.240	-0.199	-0.02148	- 1°13'50"	9.242	0° 0' 0"	10° 19' 10"	10° 19' 1"
1	+	25.7901207.396	16.550	-0.355	-0.02148	- 1°13'50"	16.554	0° 0' 0"	27° 44' 30"	27° 44' 6"
1	+	51.8401206.836	26.050	-0.560	-0.02148	- 1°13'50"	26.056	0° 0' 0"	14° 20' 30"	14° 20' 18"
1	+	78.7401206.259	26.900	-0.577	-0.02148	- 1°13'50"	26.906	0° 0' 0"	23° 22' 30"	23° 22' 10"
2	+	0.0 1205.802	21.260	-0.457	-0.02148	- 1°13'50"	21.265	0° 0' 0"	0° 0' 0"	0° 0' 0"
2	+	11.8401205.548	11.840	-0.254	-0.02148	- 1°13'50"	11.843	0° 0' 0"	12° 43' 40"	12° 43' 29"
2	+	34.5401205.060	22.700	-0.488	-0.02148	- 1°13'50"	22.705	0° 45' 37"	14° 8' 0"	14° 8' 53"
2	+	62.8401204.076	28.300	-0.984	-0.03476	- 1°59' 27"	28.317	0° 0' 0"	7° 44' 20"	7° 44' 3"
3	+	0.4401202.769	37.600	-1.307	-0.03476	- 1°59' 27"	37.623	0° 0' 0"	7° 13' 50"	7° 13' 34"
3	+	40.9301201.362	40.490	-1.407	-0.03476	- 1°59' 27"	40.514	0° 0' 0"	17° 31' 10"	17° 30' 32"
3	+	84.7301199.840	43.800	-1.522	-0.03476	- 1°59' 27"	43.826	0° 0' 0"	7° 38' 30"	7° 38' 13"
4	+	0.0 1199.309	15.270	-0.531	-0.03476	- 1°59' 27"	15.279	0° 0' 0"	0° 0' 0"	0° 0' 0"
4	+	30.3001198.256	30.300	-1.053	-0.03476	- 1°59' 27"	30.318	0° 0' 0"	21° 19' 10"	21° 18' 23"
4	+	47.1701197.669	16.870	-0.587	-0.03476	- 1°59' 27"	16.880	0° 0' 0"	14° 29' 50"	14° 29' 18"
4	+	60.6701197.200	13.500	-0.469	-0.03476	- 1°59' 27"	13.508	7° 9' 3"	20° 30' 40"	21° 42' 6"
4	+	81.3201199.065	20.650	1.865	0.09031	5° 9' 36"	20.734	0° 0' 0"	18° 20' 0"	18° 15' 30"
4	+	98.3201200.600	17.000	1.535	0.09031	5° 9' 36"	17.069	6° 19' 58"	25° 15' 20"	26° 0' 35"
5	+	0.0 1200.566	1.680	-0.034	-0.02047	- 1°10' 21"	1.680	0° 0' 0"	0° 0' 0"	0° 0' 0"
5	+	44.6701199.651	44.670	-0.915	-0.02047	- 1°10' 21"	44.679	0° 0' 0"	1° 20' 40"	1° 20' 39"
5	+	74.9701199.031	30.300	-0.620	-0.02047	- 1°10' 21"	30.306	0° 0' 0"	24° 16' 20"	24° 16' 1"
6	+	0.0 1198.519	25.030	-0.512	-0.02047	- 1°10' 21"	25.035	0° 0' 0"	0° 0' 0"	0° 0' 0"
6	+	11.9701198.274	11.970	-0.245	-0.02047	- 1°10' 21"	11.973	0° 0' 0"	22° 56' 20"	22° 56' 2"
6	+	40.0001197.700	28.030	-0.574	-0.02047	- 1°10' 21"	28.036	10° 2' 41"	0° 0' 0"	10° 2' 41"
6	+	46.7701196.357	6.770	-1.343	-0.19832	-11°13' 3"	6.902	0° 0' 0"	3° 49' 10"	3° 44' 47"
6	+	95.9701186.600	49.200	-9.757	-0.19832	-11°13' 3"	50.158	6° 59' 52"	54° 48' 20"	54° 40' 53"
7	+	0.0 1186.303	4.030	-0.297	-0.07378	- 4° 13' 10"	4.041	0° 0' 0"	0° 0' 0"	0° 0' 0"
7	+	9.5201185.600	9.520	-0.703	-0.07378	- 4° 13' 10"	9.546	0° 0' 0"	47° 11' 30"	47° 3' 22"

\*\*\* SINGOSARI A.I.CENTER PIPE LINE \*\*\*

	(NG)	(EL)	(L)	(H)	(A)	(PL)	(V)	(C)	(X)
7 +	57.1001182.090	47.580	-3.510	-0.07378	- 4° 13' 10"	47.709	1° 35' 28"	11° 11' 50"	11° 17' 22"
7 +	88.2501180.660	51.150	-1.430	-0.04591	- 2° 37' 42"	31.183	2° 29' 55"	10° 36' 50"	10° 52' 46"
8 +	0.0 1179.606	11.750	-1.054	-0.06972	- 5° 7' 37"	11.797	0° 0' 0"	0° 0' 0"	0° 0' 0"
8 +	30.4001176.878	30.400	-2.728	-0.08972	- 5° 7' 37"	30.522	0° 0' 0"	11° 23' 30"	11° 20' 45"
8 +	66.1501173.671	35.750	-3.207	-0.08972	- 5° 7' 37"	35.894	0° 0' 0"	15° 36' 20"	15° 32' 34"
8 +	90.9001171.450	24.750	-2.221	-0.08972	- 5° 7' 37"	24.849	2° 2' 3"	17° 23' 30"	17° 24' 33"
9 +	0.0 1170.307	9.100	-1.143	-0.12564	- 7° 9' 40"	9.172	0° 0' 0"	0° 0' 0"	0° 0' 0"
9 +	37.5001165.595	37.500	-4.712	-0.12564	- 7° 9' 40"	37.795	0° 0' 0"	4° 38' 40"	4° 36' 29"
9 +	86.2501159.470	48.750	-6.125	-0.12564	- 7° 9' 40"	49.133	0° 2' 58"	13° 24' 20"	13° 18' 5"
10 +	0.0 1157.754	13.750	-1.716	-0.12476	- 7° 6' 42"	13.857	0° 0' 0"	0° 0' 0"	0° 0' 0"
10 +	18.1501155.490	18.150	-2.264	-0.12476	- 7° 6' 42"	18.291	2° 36' 2"	16° 42' 20"	16° 43' 35"
10 +	48.2401150.340	30.090	-5.150	-0.17115	- 9° 42' 44"	30.528	3° 52' 39"	14° 0' 0"	14° 23' 59"
11 +	0.0 1145.051	51.760	-5.289	-0.10219	- 5° 50' 5"	52.030	0° 0' 0"	0° 0' 0"	0° 0' 0"
11 +	67.0401138.200	67.040	-6.851	-0.10219	- 5° 50' 5"	67.389	0° 48' 30"	13° 30' 0"	13° 26' 38"
12 +	0.0 1134.361	32.960	-3.839	-0.11647	- 6° 38' 35"	33.183	0° 0' 0"	0° 0' 0"	0° 0' 0"
12 +	33.2401130.490	33.240	-3.871	-0.11647	- 6° 38' 35"	33.465	1° 51' 16"	17° 45' 0"	17° 45' 26"
12 +	57.9401128.421	24.700	-2.069	-0.08377	- 4° 47' 19"	24.787	0° 0' 0"	21° 34' 30"	21° 29' 56"
12 +	75.0201126.990	17.080	-1.431	-0.08377	- 4° 47' 19"	17.140	4° 13' 1"	5° 51' 30"	7° 10' 58"
13 +	0.0 1123.031	24.980	-3.959	-0.15848	- 9° 0' 20"	25.292	0° 0' 0"	0° 0' 0"	0° 0' 0"
13 +	18.1201120.159	18.120	-2.872	-0.15848	- 9° 0' 20"	18.346	0° 0' 0"	31° 33' 30"	31° 9' 34"
13 +	60.7701113.400	42.650	-6.759	-0.15848	- 9° 0' 20"	43.182	5° 38' 24"	16° 53' 0"	17° 42' 0"
13 +	99.3701111.130	38.600	-2.270	-0.05881	- 3° 21' 56"	38.667	4° 40' 46"	14° 41' 10"	15° 20' 24"
14 +	0.0 1111.041	0.630	-0.089	-0.14134	- 8° 2' 42"	0.636	0° 0' 0"	0° 0' 0"	0° 0' 0"
14 +	66.3001101.670	66.300	-9.371	-0.14134	- 8° 2' 42"	66.959	2° 47' 40"	9° 47' 20"	10° 6' 56"
14 +	87.5201099.720	21.220	-1.950	-0.09189	- 5° 15' 1"	21.309	0° 24' 58"	7° 46' 20"	7° 44' 53"
15 +	0.0 1098.482	12.480	-1.238	-0.09922	- 5° 39' 59"	12.541	0° 0' 0"	0° 0' 0"	0° 0' 0"
15 +	2.9401098.190	2.940	-0.292	-0.09922	- 5° 39' 59"	2.954	2° 11' 58"	11° 53' 10"	12° 3' 0"
15 +	44.2201095.689	41.280	-2.501	-0.06059	- 3° 28' 1"	41.356	0° 0' 0"	0° 1' 30"	0° 1' 30"
15 +	63.0201094.550	18.800	-1.139	-0.06059	- 3° 28' 1"	18.834	5° 17' 17"	45° 3' 10"	45° 4' 39"
15 +	91.5901090.150	28.570	-4.400	-0.15401	- 6° 45' 19"	28.907	2° 50' 29"	13° 9' 0"	13° 20' 47"
16 +	0.0 1089.279	8.410	-0.871	-0.10358	- 5° 54' 50"	8.455	0° 0' 0"	0° 0' 0"	0° 0' 0"
16 +	5.0901088.752	5.090	-0.527	-0.10358	- 5° 54' 50"	5.117	0° 0' 0"	14° 58' 10"	14° 53' 22"
16 +	24.1901086.773	19.100	-1.979	-0.10358	- 5° 54' 50"	19.202	0° 0' 0"	9° 17' 10"	9° 14' 12"
16 +	62.7401082.780	38.550	-3.993	-0.10358	- 5° 54' 50"	38.756	0° 37' 17"	5° 4' 10"	5° 5' 0"
17 +	0.0 1079.328	37.260	-3.452	-0.09263	- 5° 17' 33"	37.420	0° 0' 0"	0° 0' 0"	0° 0' 0"

\*\*\* SINGOSARI A.I.CENTER PIPE LINE \*\*\*

	(NO)	(EL)	(L)	(H)	(A)	(PL)	(V)	(C)	(X)
17	37.230	1075.880	37.230	-3.448	-5°17'33"	37.389	0°0'0"	5°11'0"	5°9'40"
17	53.960	1074.330	16.730	-1.550	-5°17'33"	16.802	2°43'33"	5°1'50"	5°41'29"
17	96.960	1068.273	43.000	-6.057	-8°1'5"	43.425	0°0'0"	8°5'40"	8°0'55"
18	0.0	1067.845	3.040	-0.428	-8°1'5"	3.070	0°0'0"	0°0'0"	0°0'0"
18	33.540	1063.120	33.540	-4.725	-8°1'5"	33.871	2°55'12"	34°36'10"	34°14'11"
18	68.260	1056.410	34.720	-6.710	-10°56'17"	35.362	4°17'57"	5°8'10"	6°39'3"
18	97.740	1052.979	29.480	-3.431	-6°38'20"	29.679	0°0'0"	17°12'40"	17°5'41"
19	0.0	1052.716	2.260	-0.263	-6°38'20"	2.275	0°0'0"	0°0'0"	0°0'0"
19	14.740	1051.000	14.740	-1.716	-6°38'20"	14.840	5°5'55"	21°52'10"	22°23'38"
19	38.190	1050.369	23.450	-0.631	-1°32'25"	23.458	0°0'0"	27°25'50"	27°25'14"
19	63.590	1049.686	25.400	-0.683	-1°32'25"	25.409	0°0'0"	19°52'50"	19°52'24"
19	92.090	1048.920	28.500	-0.766	-1°32'25"	28.510	4°53'37"	31°26'10"	31°43'41"
20	0.0	1048.028	7.910	-0.892	-6°26'2"	7.960	0°0'0"	0°0'0"	0°0'0"
20	17.490	1046.056	17.490	-1.972	-6°26'2"	17.601	0°0'0"	26°22'0"	26°11'51"
20	33.840	1044.212	16.350	-1.844	-6°26'2"	16.454	0°0'0"	15°59'55"	15°53'50"
20	67.840	1040.378	34.000	-3.834	-6°26'2"	34.216	0°0'0"	8°23'10"	8°19'59"
21	0.0	1036.751	32.160	-3.627	-6°26'2"	32.364	0°0'0"	0°0'0"	0°0'0"
21	37.790	1032.490	37.790	-4.261	-6°26'2"	38.030	0°0'0"	3°24'30"	3°23'13"
21	86.470	1027.000	48.680	-5.490	-6°26'2"	48.989	4°0'7"	19°54'40"	20°14'47"
22	0.0	1026.425	13.530	-0.575	-2°25'55"	13.542	0°0'0"	0°0'0"	0°0'0"
22	6.590	1026.145	6.590	-0.280	-2°25'55"	6.596	0°0'0"	23°28'30"	23°27'13"
22	46.380	1024.455	39.790	-1.690	-2°25'55"	39.826	0°0'0"	15°34'0"	15°33'9"
22	66.050	1023.620	19.670	-0.835	-2°25'55"	19.688	9°49'38"	6°15'55"	11°37'21"
22	91.370	1018.118	25.320	-5.502	-12°15'33"	25.911	0°0'0"	12°49'30"	12°31'53"
23	0.0	1016.243	8.630	-1.875	-12°15'33"	8.831	0°0'0"	0°0'0"	0°0'0"
23	25.970	1010.600	25.970	-5.643	-12°15'33"	26.576	8°13'27"	39°11'50"	39°36'47"
23	35.610	1009.920	9.640	-0.680	-4°2'6"	9.664	4°51'52"	27°0'0"	27°15'15"
23	62.100	1005.772	26.490	-4.148	-8°53'58"	26.813	0°0'0"	8°58'10"	8°51'40"
23	91.490	1001.170	29.390	-4.602	-8°53'58"	29.748	3°19'44"	25°7'50"	25°8'41"
24	0.0	1000.340	8.510	-0.830	-5°34'14"	8.550	0°0'0"	0°0'0"	0°0'0"
24	27.170	997.690	27.170	-2.650	-5°34'14"	27.299	2°28'18"	1°27'40"	2°52'9"
24	56.170	996.120	29.000	-1.570	-3°5'56"	29.042	3°23'51"	27°27'50"	27°39'39"
24	92.170	996.308	36.000	0.188	0°17'55"	36.000	0°0'0"	16°5'10"	16°5'9"
25	0.0	996.348	7.830	0.040	0°17'55"	7.830	0°0'0"	0°0'0"	0°0'0"
25	7.970	996.390	7.970	0.042	0°17'55"	7.970	23°44'18"	50°6'34"	53°59'50"

\*\*\* Calculation of Pipe Schedul \*\*\*

\*\*\* SINGOSARI A.I.CENTER PIPE LINE \*\*\*

(NO)	(EL)	(L)	(H)	(A)	(PL)	(V)	(C)	(X)		
25	+ 17.9701000	850	10.000	4.460	0.44600	24° 2'13"	10.950	28° 46' 9"	0° 0' 0"	28° 46' 9"
25	+ 37.970	995.055	70.000	-5.795	-0.08278	- 4° 43' 56"	70.239	0° 0' 0"	18° 48' 54"	18° 48' 54"
25	+ 93.470	994.600	5.500	-0.455	-0.08278	- 4° 43' 56"	5.519	4° 3' 36"	0° 0' 0"	4° 3' 36"
26	+ 0.0	993.590	6.530	-1.010	-0.15467	- 8° 47' 32"	6.608	0° 3' 22"	0° 0' 0"	0° 3' 22"
26	+ 43.470	986.910	43.470	-6.680	-0.15367	- 8° 44' 10"	43.980	0° 0' 0"	35° 0' 0"	34° 34' 52"
26	+ 60.000	984.370	16.530	-2.540	-0.15367	- 8° 44' 10"	16.724	4° 30' 56"	0° 0' 0"	4° 30' 56"
26	+ 93.470	981.900	33.470	-2.470	-0.07380	- 4° 13' 14"	33.561	3° 2' 16"	37° 0' 0"	36° 55' 43"
27	+ 0.0	981.068	6.530	-0.832	-0.12736	- 7° 15' 30"	6.583	0° 0' 0"	0° 0' 0"	0° 0' 0"
27	+ 90.280	969.570	90.280	-11.498	-0.12736	- 7° 15' 30"	91.009	1° 19' 43"	6° 0' 0"	6° 5' 21"
28	+ 0.0	968.102	9.720	-1.468	-0.15100	- 8° 35' 12"	9.830	0° 0' 0"	0° 0' 0"	0° 0' 0"
28	+ 40.280	962.020	40.280	-6.082	-0.15100	- 8° 35' 12"	40.737	1° 50' 32"	14° 52' 50"	14° 51' 39"
29	+ 0.0	954.957	59.720	-7.063	-0.11826	- 6° 44' 40"	60.136	0° 0' 0"	0° 0' 0"	0° 0' 0"
29	+ 67.000	947.034	67.000	-7.923	-0.11826	- 6° 44' 40"	67.467	0° 0' 0"	11° 23' 50"	11° 19' 5"
30	+ 0.0	943.131	33.000	-3.903	-0.11826	- 6° 44' 40"	33.230	0° 0' 0"	0° 0' 0"	0° 0' 0"
30	+ 5.000	942.540	5.000	-0.591	-0.11826	- 6° 44' 40"	5.035	2° 48' 23"	21° 30' 0"	21° 35' 12"
31	+ 0.0	936.000	95.000	-6.540	-0.06884	- 3° 56' 17"	95.225	0° 21' 4"	0° 0' 0"	0° 21' 4"
32	+ 0.0	928.500	100.000	-7.500	-0.07500	- 4° 17' 21"	100.281	0° 34' 10"	0° 0' 0"	0° 34' 10"
33	+ 0.0	920.000	100.000	-8.500	-0.08500	- 4° 51' 30"	100.361	0° 17' 4"	0° 0' 0"	0° 17' 4"
34	+ 0.0	912.000	100.000	-8.000	-0.08000	- 4° 34' 26"	100.319	0° 12' 34"	0° 0' 0"	0° 12' 34"
34	+ 62.500	907.230	62.500	-4.770	-0.07632	- 4° 21' 52"	62.682	1° 37' 6"	8° 0' 0"	8° 7' 47"
35	+ 0.0	903.300	37.500	-3.930	-0.10480	- 5° 58' 58"	37.705	0° 56' 54"	0° 0' 0"	0° 56' 54"
35	+ 42.000	899.600	42.000	-3.700	-0.08810	- 5° 2' 4"	42.163	0° 52' 18"	6° 30' 0"	6° 31' 43"
36	+ 0.0	893.600	58.000	-6.000	-0.10345	- 5° 54' 22"	58.310	1° 50' 6"	0° 0' 0"	1° 50' 6"
36	+ 17.000	892.390	17.000	-1.210	-0.07118	- 4° 4' 16"	17.043	1° 42' 3"	8° 30' 0"	8° 38' 15"
37	+ 0.0	884.000	83.000	-8.390	-0.10108	- 5° 46' 20"	83.423	0° 20' 43"	0° 0' 0"	0° 20' 43"
38	+ 0.0	874.500	100.000	-9.500	-0.09500	- 5° 25' 37"	100.450	2° 9' 40"	0° 0' 0"	2° 9' 40"
38	+ 17.000	873.530	17.000	-0.970	-0.05706	- 3° 15' 56"	17.028	1° 30' 26"	0° 25' 0"	1° 33' 48"
39	+ 0.0	866.600	83.000	-6.930	-0.08349	- 4° 46' 22"	83.289	1° 17' 20"	0° 0' 0"	1° 17' 20"
39	+ 34.000	864.530	34.000	-2.070	-0.06088	- 3° 29' 2"	34.063	2° 4' 50"	4° 30' 0"	4° 56' 41"
40	+ 0.0	858.100	66.000	-6.430	-0.09742	- 5° 33' 52"	66.312	1° 16' 31"	0° 0' 0"	1° 16' 31"
40	+ 22.000	856.450	22.000	-1.650	-0.07500	- 4° 17' 21"	22.062	1° 1' 16"	4° 30' 0"	4° 35' 56"
41	+ 0.0	849.200	78.000	-7.250	-0.09295	- 5° 18' 37"	78.336	1° 4' 26"	0° 0' 0"	1° 4' 26"
41	+ 27.000	847.200	27.000	-2.000	-0.07407	- 4° 14' 11"	27.074	1° 44' 5"	7° 0' 0"	7° 11' 59"
42	+ 0.0	844.011	73.000	-3.189	-0.04369	- 2° 30' 6"	73.070	0° 0' 0"	0° 0' 0"	0° 0' 0"
42	+ 30.000	842.700	30.000	-1.311	-0.04369	- 2° 30' 6"	30.029			

TOTAL Distance L = 4215.200 (M) Actual length PL = 4237.295 (M)

\*\*\* EQUATION \*\*\*  
EQUATION

(NO) 0 + 26.640 0.190

### 3-1-3 Water Supply Facilities

The water supply facilities comprises water supply facilities located downstream inlet tank.

#### (1) Amount of water supply

The amount of water supply is the basic amount of water to determine the structure of facilities and is classified as mean daily amount, maximum daily amount and maximum hourly amount.

Mean daily amount of water supply

- Total usage of water for respective purpose and fundamentals to obtain the design amount of usage of water

Maximum daily amount of water supply

- The amount one and half times of mean daily amount of water supply and fundamentals to design facilities such for supply of clean water

Maximum hourly amount of water supply

- The maximum hourly amount in a day and fundamentals to design water supply and feed pipes. This amount will be decided based on simultaneous water tap opening ratio or one and half times of hourly maximum daily amount of water supply

#### a. Amount of water supply for A.I. Center

1. Seed bull 40 heads x 75 l/day = 3,000 l/day

2. Cow 10 heads x 60 ℓ/day = 600 ℓ/day
3. Office 60 persons x " = 6,000 "
4. Laboratory 2,000 "
5. Washing for farming appliance

Tractor 700ℓ x 1 time/7 days  
= 100 ℓ/nos/day

Track 3 nos. 300 ℓ/day

Sedan 3 nos. 300 "

Sub total 700 "

6. Training office  
25 persons x 150 ℓ/day = 3,750 ℓ/day

7. Domitory  
15 houses x 5 persons x 150 ℓ/day  
= 11,250 ℓ/day

Total (Mean daily amount)  
= 27,300 ℓ/day

= 27.3 m<sup>3</sup>

Therefore,

The maximum daily amount of water supply

Qa is

$$Qa = 27.3 \text{ m}^3 \times 1.5 = 41.0 \text{ m}^3/\text{day}$$

Storage capacity of water tank 41.0 t/tank

- b. Amount of water supply for goat feeding facilities

1. Goat 200 heads x 13 ℓ/day  
= 2,600 ℓ/day

2. Office 5 persons x 100 ℓ/day  
= 500 "

3. Bull 5 heads x 50 ℓ/day  
= 250 "



4. Domitory 3 houses x 5 per. x 150 ℓ/day  
= 2,250 ℓ/day
5. Washing for forming appliance 4 nos  
400 ℓ/day
- Total (mean daily amount) 6,000 ℓ/day

Therefore,

The maximum daily amount of water supply

$Q_b$  is

$$Q_b = 6.0 \text{ m}^3 \times 1.5 = 9.0 \text{ m}^3/\text{day}$$

- c. Design maximum hourly amount of water supply

A.I. Center

- 1) In case that twice of maximum daily amount of water supply is applied

$$Q_H = 41,000 \text{ ℓ/day} \times 1.5 \times \frac{1}{24 \times 60}$$

$$= 43 \text{ ℓ/day}$$

- 2) In case that simultaneous water tap opening ratio is considered

Maximum hourly amount of water supply :  $Q_1$

Amount of water due to simultaneous water tap opening :  $N_1$

Total number of water tap :  $N$

Standard usage of water per water tap :  $q_1$

$$N_1 = N^{0.475} = 7.5 \text{ (water tap : 70 nos)}$$

$$\therefore Q_1 = q_1 \times N_1 = 10 \text{ ℓ/min} \times 7.5 = 75 \text{ ℓ/min}$$

Judging from 1) and 2) above,

$Q_H = 75 \text{ ℓ/min}$  is adopted

### Goat feeding facilities

$$\alpha = 75 \text{ l/min} \div \frac{41,000}{24 \times 60} = 2.63$$

$$Q_h = \frac{9,000}{24 \times 60} \times 2.63 = 16.4 \div 17 \text{ l/min}$$

The minimum diameter of  $\phi 25$  mm is adopted for water supply pipe for goat feeding facilities.

The installation slope of pipe is estimated at more than 1/46.

Table 3-3

## List of Water Taps

	Place	Present Condition	Plan
1)	Bull Shed	2 nos.	$\phi$ 13 $\times$ 2 nos.
		1	$\phi$ 10 $\times$ 2
2)	Cow Shed	—	$\phi$ 13 $\times$ 1
			$\phi$ 10 $\times$ 2
3)	Office	7	$\phi$ 10 $\times$ 7
4)	Laboratory	12	$\phi$ 10 $\times$ 12
5)	Washing of Equip.		$\phi$ 13 $\times$ 2
6)	Training Office	6	$\phi$ 10 $\times$ 7
7)	Dormitory for staff	28	$\phi$ 10 $\times$ 31
8)	Clinic	2	$\phi$ 10 $\times$ 1
9)	Sprinkle Water Tap	2	$\phi$ 13 $\times$ 1
10)	Pond	1	$\phi$ 10 $\times$ 1
11)	Paddock	—	$\phi$ 10 $\times$ 1
	Total	61 nos.	70 nos.

Note: 1) In addition to the above, 12 water taps for goat feeding facilities are considered.

2) Diameters of water taps are for the calculation differing from the actual ones.

Table 3-4 Present Maximum Hourly Amount of Water Supply.

Location No.	of W.T. Accumulated		Simultaneous	Main	Branch
	N nos.	nos.	Water Tap Open $N_1 = N^{0.475}$	Max. Hrly. W.S.	Max. Hrly. W.S.
				ℓ/min	ℓ/min
No 0	—	7.3	7.7	77	—
1	3	70	7.5	75	17
2	2	68	7.4	74	14
3	2	66	7.3	73	14
4	4	62	7.1	71	19
5	1	61	7.0	70	10
6	15	46	6.2	62	36
7	6	40	5.8	58	23
8	6	34	5.3	53	23
9	1	33	5.3	53	10
10	4	29	5.0	50	19
11	2	27	4.8	48	14
12	3	24	4.5	45	17
13	2	22	4.3	43	14
14	1	21	4.2	42	10
15	3	18	3.9	39	17
16	3	15	3.6	36	17
17	12 ( goat )	3	1.7	17	33
18	3	—	—	—	17
<b>Total</b>					

Usage of Water : 10ℓ /min/water tap

Table 3-5

## Hourly Amount of Water Supply (QH max)

Location	No. of W.T.	Accumulated W.T.	Main Pipe		Branch Pipe	
			Simultaneous W.T. Opening	Q <sub>hmax</sub>	Simultaneous W.T. Opening	Q <sub>hmax</sub>
	N nos.	nos.	$N_1 = N^{0.475}$	ℓ/min	$N_1$	ℓ/min
No 0	—	70	7.5	75 φ 40	—	—
1	4	66	7.3	73 "	1.9	19
2	4	62	7.1	71 "	1.9	19
3	2	60	7.0	70 "	1.4	14
4	5	55	6.7	67 "	2.1	21
5	22	33	5.4	54 φ 32	4.3	43
6	7	26	4.7	47	2.5	25
7	1	25	4.6	46	1.0	10
8	4	21	4.2	42	1.9	19
9	1	20	4.1	41	1.0	10
10	2	18	3.9	39 φ 25	1.4	14
11	3	15	3.6	36 φ 25	1.7	17
12	2	13	3.4	34 φ 25	1.4	14
13	1	12	3.3	33 φ 25	1.0	10
14	3	9	2.8	28 φ 25	1.7	17
15	3	6	2.3	23 φ 25	1.7	17
16	3	3	1.7	17 φ 20	1.7	17
17	3	—	—	—	1.7	17
Total	70					

Usage of Water : 10 ℓ/min/water top

Table 3-6

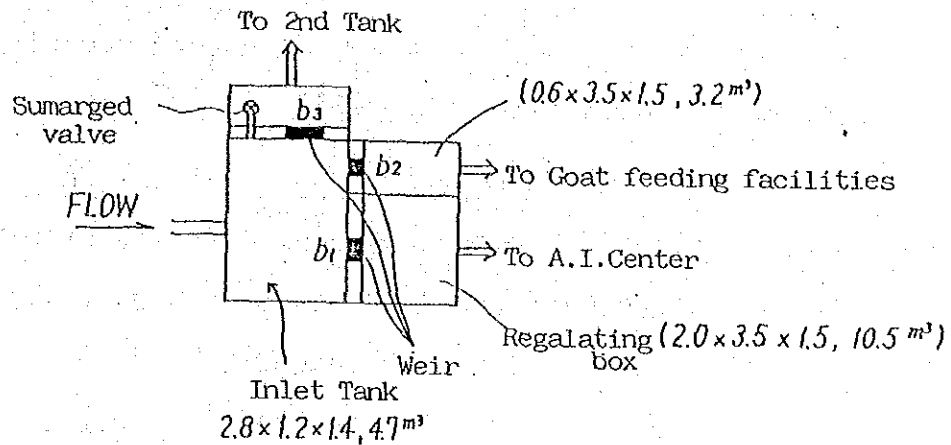
## Hourly Maximum Ratio

Location	Av. Daily W.S.	Max. Daily W.S.	Accumulated	Hourly Maximum ratio	Max. Hourly W.S.
	ℓ/day	ℓ/day	ℓ/day		ℓ
No 0 Distri. Tank	—	—	40,950	2.64	108,000
1 House	1,500	2,250	38,700	2.72	105,120
2 "	1,500	2,250	36,450	2.80	102,240
3 "	750	1,125	35,325	2.85	100,800
4 Bull Shed etc.	3,250	4,875	30,450	3.17	96,480
5 Office etc.	8,000	12,000	18,450	4.21	77,760
6 Train. Office	3,750	5,625	12,825	5.28	67,680
7 Porch	300	450	12,375	5.35	66,240
8 House	750	1,125	11,250	5.38	60,480
9 Paddock	150	225	11,025	5.36	59,040
10 House	1,500	2,250	8,775	6.40	56,160
11 "	750	1,125	7,650	6.78	51,840
12 "	750	1,125	6,525	7.50	48,960
13 "	750	1,125	5,400	8.80	47,520
14 "	750	1,125	4,275	9.43	40,320
15 "	750	1,125	3,150	10.51	33,120
16 Cow Shed	600	900	2,250	10.88	24,480
17 House	1,500	2,250	—	—	—
Total	27,300	40,950			

(2) Inlet tank with diversion

Since diversion discharge is small, the accurate diversion of water can not be expected, so the water is allotted to A.I. Center and goat feeding facilities by means of the proportionate weir length to each diversion discharge.

The structure of inlet tank with diversion is shown in the following figure. An excess water is diverted to 2<sup>nd</sup> water tank. In an ordinary condition, the excess water overflows above the weir, but it can be regulated using submerged valve (see figure).



#### Decision of weir length

- The maximum daily amount of water supply:

For A.I. Center,  $Q_{m1} = 41.0 \text{ m}^3/\text{day}$  (28.5 l/min)

For goat facilities  $Q_{m2} = 9.0 \text{ M}^3/\text{day}$  (6.3 l/min)

- The maximum hourly amount of water supply:

For A.I. Center,  $Q_{h1} = 75.0 \text{ l/min}$  (1.25 l/s)

For Goat facilities  $Q_{h2} = 17.0 \text{ l/min}$  (0.28 l/s)

- Diversion ratio :  $Q_{m1} : Q_{m2} = 4.6 : 1$

- Weir length : For A.I. Center  $b_1 = 46\text{cm}$

For Goat Facilities  $b_2 = 10\text{cm}$

For 2nd Tank  $b_3 = 60\text{cm}$

Overflow discharge through weir is calculated by the following formula.

$$Q = 1.7 \times b \times h^{2/3} \quad (\text{m}^3/\text{s})$$



The relations between overflow depth and discharge for each weir are shown below in accordance with the above formula.

<u>b</u>	<u>h</u>	<u>h<sup>2/3</sup></u>	<u>Q</u>	<u>Q</u>
0.46 m	0.005 m	0.00035	0.00027m <sup>3</sup> /s	16.2ℓ/min
	0.007	0.00059	0.00046	27.6 (28.6)
	0.010	0.00100	0.00078	46.8
	0.014	0.00166	0.00130	78.0 (75.0)
	0.015	0.00184	0.00144	86.4
	0.020	0.00283	0.00221	132.6
	0.025	0.00395	0.00309	185.4
0.10 m	0.005	0.00035	0.00006	3.6
	0.007	0.00059	0.00010	6.0 (6.3)
	0.010	0.00100	0.00017	10.2
	0.014	0.00166	0.00028	17.0 (17.0)
	0.015	0.00184	0.00031	18.6
	0.020	0.00283	0.00048	28.8
	0.025	0.00395	0.00067	40.2
0.60 m	0.005	0.00035	0.00036	21.6
	0.010	0.00100	0.00102	61.2
	0.015	0.00184	0.00188	112.8
	0.020	0.00283	0.00289	173.4
	0.025	0.00395	0.00403	241.8

From the above table, the maximum water depth is estimated at 15 cm.

(3) Filter and distributing tanks

a. Basic dimensions of filter

- Type : The slow filter type is adopted because this type can filterate almost all of suspended material and bacilli and a certain extent of ammonia nitrogen, phenol etc.
- Design filtration discharge : 41.0 m<sup>3</sup>/day for A.I. Center except goat feeding facilities
- Design filtration speed : 5 m/day
- No. of barrel : One barrel for ordinary use and one for reserve
- Size : Filtration area 8.2 m<sup>2</sup>/barrel  
2.05 x 4.00m x 2 barrels

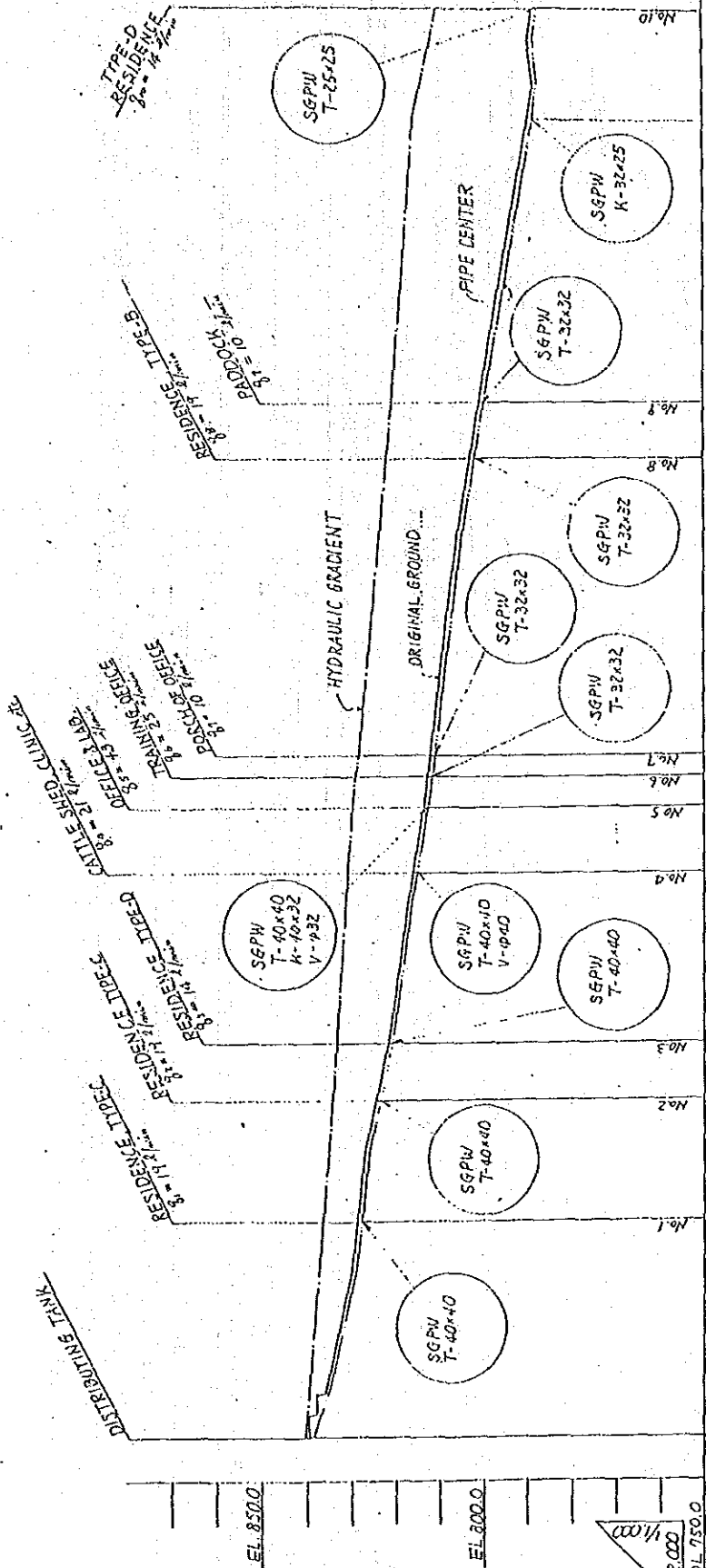
Inlet	Filter 2.05 x 4.00	Regulating box
Inlet 2.05 x 0.70	Filter 2.05 x 4.00	"

Distributing tank 2.50 x 2.50 V = 20.5m <sup>3</sup> , for 12 hrs
- Ditto -

b. Hydraulic properties between tanks

1. Inlet tank effective depth h = 1.45 m
2. Loss head between inlet and filter tanks h = 0.35 m
3. Loss head in filter tank h = 0.90 m
4. Loss head between filter and distributing Tanks h = 0.35 m

5. N.W.L at inlet tank      Ws = 843.70 m  
H.W.L at filter tank      Ws = 841.90 m  
L.W.L at filter tank      Ws = 841.00 m  
H.W.L at distributing      Ws = 840.65 m  
tank

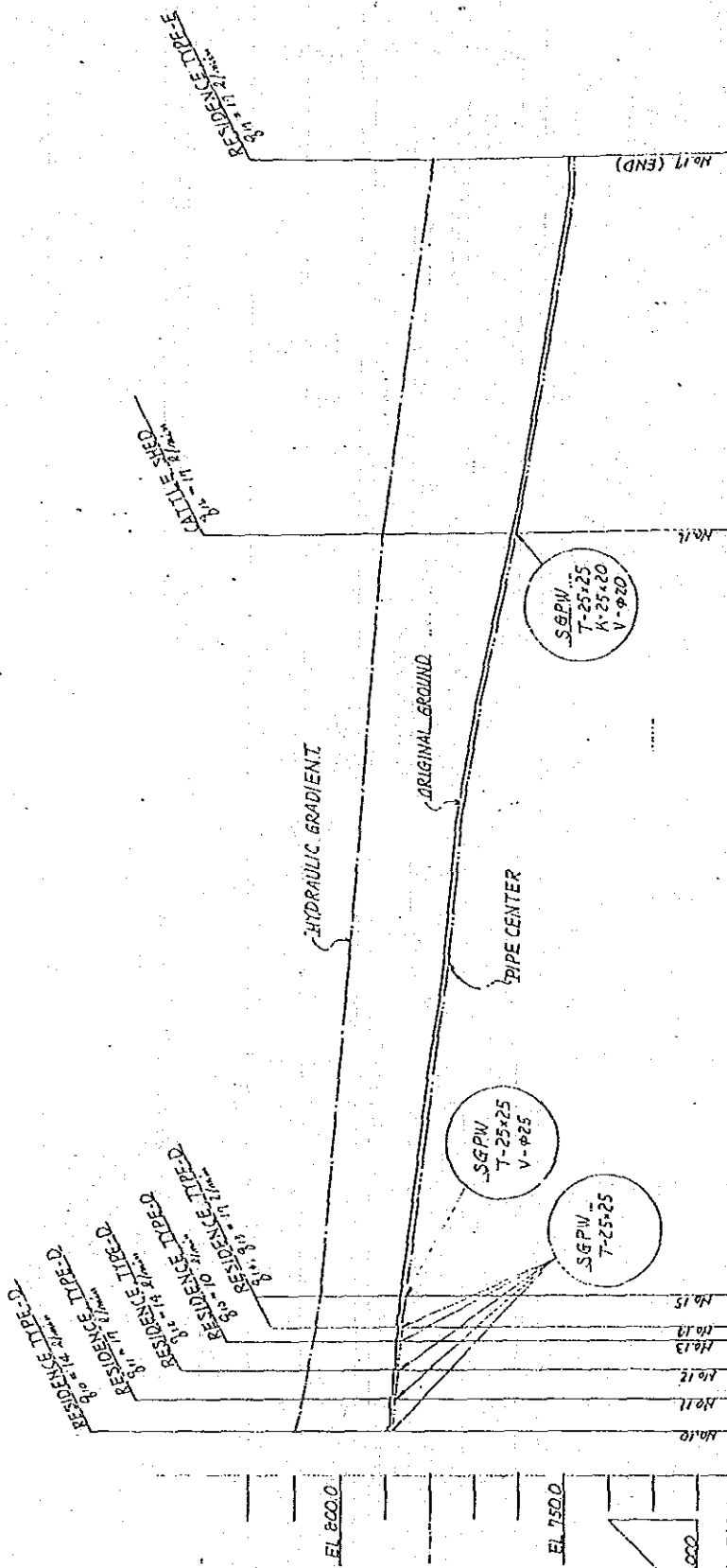


PLAN	HTDRAU. GRADIENT	HTDRAU. PROPERTY	PIPE & DIA. USED	-DISTANCE	ACCUMULATED DISTANCE
No. 1	836.70	$G = 75.84\%$ , $V = 0.99575$ $I = 1/30.86$	S.G.P.W. 40 A	84	84
No. 2	834.17	$G = 73.84\%$ , $V = 0.98824$ $I = 1/30.35$	S.G.P.W. 40 A	55.9	158.3
No. 3	833.70	$G = 70.84\%$ , $V = 0.97876$ $I = 1/34.80$	S.G.P.W. 40 A	25.7	180.0
No. 4	831.01	$G = 67.84\%$ , $V = 0.967876$ $I = 1/39.33$	S.G.P.W. 40 A	30.7	256.6
No. 5	829.91	$G = 57.84\%$ , $V = 0.9174$ $I = 1/54.11$	S.G.P.W. 40 A	30.2	287.3
No. 6	828.70	$G = 44.84\%$ , $V = 0.85376$ $I = 1/65.71$	S.G.P.W. 40 A	13.9	301.2
No. 7	828.32	$G = 37.84\%$ , $V = 0.7974$ $I = 1/84.11$	S.G.P.W. 40 A	9.5	310.7
No. 8	821.99	$G = 22.84\%$ , $V = 0.6870$ $I = 1/120.01$	S.G.P.W. 40 A	136.9	447.4
No. 8	820.94	$G = 41.84\%$ , $V = 0.85076$ $I = 1/51.37$	S.G.P.W. 40 A	26.0	473.4
No. 10	816.07	$G = 19.84\%$ , $V = 0.5722$ $I = 1/160.10$	S.G.P.W. 25 A	130.0	603.4
	810.25			50.6	654.0

**ABBREVIATIONS**

- S.G.P.W. : Galvanized Steel Pipes for Water Service
- T : Tee
- K : Reducer Pipe
- V : Stop Valve
- A : Nominal Size

Fig. 3-3 HYDRAULIC PROFILE OF WATER SUPPLY SYSTEM (1/2)



HYDRAU. GRADIENT	HYDRAU. PROPERTIES	PIPE & DIA. USED	DISTANCE	ACCUMULATED DISTANCE
84.10	①	SGPW 25A	506	506
84.11	②		140	646
84.12	③		130	776
84.13	④		130	906
84.15	⑤		140	1046

- ①  $\theta = 39 \text{ } \frac{1}{1000}$ ,  $V = 1.323 \text{ m/s}$ ,  $I = 1/1102$
- ②  $\theta = 36$ ,  $V = 1.222$ ,  $I = 1/1268$
- ③  $\theta = 34$ ,  $V = 1.154$ ,  $I = 1/1400$
- ④  $\theta = 33$ ,  $V = 1.120$ ,  $I = 1/1475$
- ⑤  $\theta = 28$ ,  $V = 0.951$ ,  $I = 1/1761$

FIG. 3-4 HYDRAULIC PROFILE OF WATER SUPPLY SYSTEM (2/2)

Table 3-7 HYDRAULIC WATER LEVEL OF WATER SUPPLY PIPE IN A.I. CENTER (1/2)

Diversion	Discharge (L/m)	Diameter (mm)	Hydraulic Gradient	Velocity V(m/s)	Horizontal Length l(m)	Actual Length l'(m)	No. of Bend	Loss			Heads			Hydraulic Water Level	Remarks
								Fraction	Bend	(L'/I)(0.056V)	Inlet etc.	Others	Total		
	75	40	1/30.86	0.995	98.4	99.4	8	3.22	0.44	0.03	0.18	3.87	840.65		
No.1	73	40	1/32.35	0.988	55.9	56.5	4	1.75	0.21	0.05	0.10	2.11	836.78	Residence	
No.2	71	40	1/33.95	0.942	25.7	26.0	2	0.77	0.10	0.05	0.05	0.97	834.67	Residence	
No.3	70	40	1/34.80	0.928	76.6	77.4	6	2.22	0.29	0.05	0.13	2.69	833.70	Residence	
No.4	67	40	1/37.53	0.889	30.7	31.0	4	0.82	0.18	0.05	0.05	1.10	831.01	Bull. Shed	
No.5	54	32	1/19.45	1.119	13.9	14.0	2	0.72	0.14	0.10	0.05	1.01	829.91	office & Laboratory	
No.6	47	32	1/24.77	0.974	9.5	9.6	2	0.39	0.11	0.05	0.03	0.58	828.90	Training Office	
No.7	46	32	1/25.71	0.953	136.7	138.1	12	5.37	0.61	0.05	0.30	6.33	828.32	office	
No.8	42	32	1/30.09	0.870	26.0	26.3	2	0.87	0.08	0.05	0.05	1.05	821.99	Residence	
No.9	41	32	1/31.37	0.850	130.0	131.3	10	4.19	0.40	0.05	0.23	4.87	820.94	Paddock	
	41	25	1/10.00	1.392	50.6	51.1	4	5.06	0.43	0.05	0.28	5.82	816.07	Reduced Pipe	
													810.25		

HYDRAULIC WATER LEVEL OF SUPPLY PIPE IN A.I. CENTER (2/2)

Table 3-8

Diversion	Discharge (l/m)	Diameter (mm)	Hydraulic Gradient	Velocity V(m/s)	Horizontal Length l(m)	Actual Length l'(m)	No. of Bend	Loss			Heads			Hydraulic Water Level	Remarks
								Friction	Bend	Inlet etc.	Others	Total			
No. 10	39	25	1/11.02	1.324	14.0	14.1	2	1.28	0.20	0.05	0.08	1.61	810.25	Residence	
No. 11	36	25	1/12.68	1.222	13.0	13.1	2	1.03	0.17	0.05	0.06	1.31	808.64	Residence	
No. 12	34	25	1/14.00	1.154	13.0	13.1	2	0.94	0.15	0.05	0.06	1.20	807.33	Residence	
No. 13	33	25	1/14.75	1.120	6.0	6.1	2	0.41	0.14	0.05	0.03	0.63	806.13	Residence	
No. 14	28	25	1/19.61	0.951	14.0	14.1	2	0.72	0.10	0.05	0.04	0.91	805.50	Residence	
No. 15	23	25	1/27.51	0.781	339.2	342.6	28	12.45	0.98	0.05	0.67	14.13	804.59	Residence	
No. 16	17	20	1/16.84	0.902	168.6	170.3	12	10.11	0.55	0.10	0.54	11.30	790.46	Cow Shed	
No. 17													779.16	Residence	

Table 3-9 HYDRAULIC WATER LEVEL OF PIPELINE FOR GOAT FEEDING FACILITIES

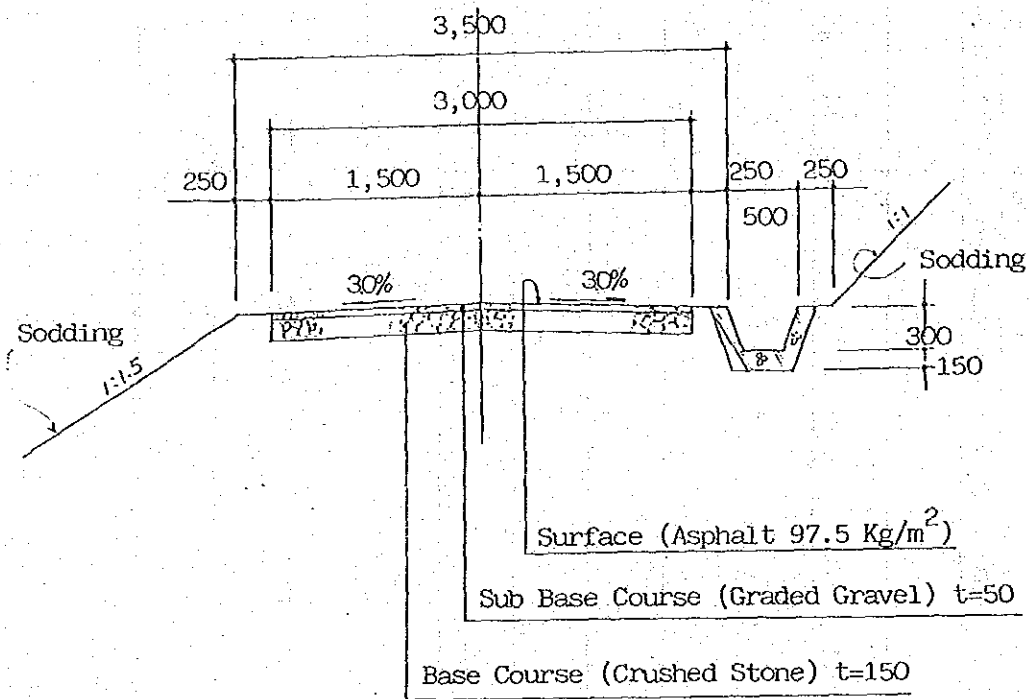
Diversion	Discharge (L/m)	Diameter (mm)	Hydraulic Gradient	Velocity V(m/s)	Horizontal Length l(m)	Actual Length l'(m)	No. of Bend	Loss			Heads			Hydraulic Water Level	Remarks
								Friction	Bend	Others	Inlet etc.	Others	Total		
1. In Cast of Q=174 /min															
Inlet Tank	17.0	25	1/46.09	0.576	453.7	458.2	36	9.94	0.67	0.05	0.53	11.19	843.70	Proposed	
Reducer	17.0	32	1/49.21	0.352	467.0	471.7	37	3.36	0.26	0.10	0.19	3.91	832.51	Existing	
Outlet													828.60		
2. In case of Q=334 /min															
Inlet Tank	33.0	25	1/14.75	1.120	453.7	458.2	36	31.06	2.53	0.10	1.68	35.37	843.70	Proposed	
Reducer	33.0	32	1/45.58	0.684	467.0	471.7	37	10.35	0.97	0.20	0.58	12.10	808.33	Existing	
Outlet													796.23		



Fig. 3-5

TYPICAL CROSS SECTION OF INSPECTION ROAD

( From existing 2nd tank to new inlet tank )



### 3-1-4 Cow Shed Facilities

The following facilities are constructed at a site with area of 1,400 m<sup>2</sup>.

a. Cow shed for ten (10) heads : 1 house, 5 x 17m = 85m<sup>2</sup>

- For cows for training, thus, functions for milk cow are not provided
- The shed is enclosed with brick until 1.0 m in height and the rest is open. The roof is covered by waved asbestos plate.
- Free stool, with wooden cattle mat and steel partition frame, is individual type for each head  
Width : 1.30m, Length : 1.80m, Height : 1.0m
- The passage way is made of plain concrete

The details of the facilities are described as follows;

- Passage way for hay rack : 0.8m in width
- Passage way for excreta ditch : 1.6m "
- Both sideway : 1.0m "
- Entrance : 2 place, 1.5m in width
- Entrance for management : 5 place, 1.2m in width
- Foddor store : 2.0 x 2.5m, 1 room
- Washing room : 2.0 x 2.5m, 1 room

- Hay rack : 2 nos
- Water seservoir tank : 1 nos
- Other electric and water supply system : 1 L.S.

b. Training shed

For practical training, training shed is provided in the same site and in the vicinity of the entrance

- Training shed : 10.0 x 3.5m  
(plain concrete floor)
- Training frame : 0.9 x 1.8 x 1.0m 3 nos  
1.2 x 1.8 x 1.9m 2 nos
- Other electric and water supply facilities : 1 L.S.

c. Related facilities

- Electric fence is installed inside of wooden fence

Electric fence  $l = 135m, h = 1.20m$

Wooden fence  $l = 143m, h = 1.20m$

- Insulators, electric fence instrument and gate handles (4 nos) for electric fence will be supplied by the Project and wire by a contractor.

3-1-5 Slurry Store

(1) Type of the store

Type : Underground and two barrels

Structure : Masonry concrete with reinforced concrete cover  
(manfole for pumping up by slurry tanker)

(2) Capacity of the store

The capacity of the store is calculated by the following formula

$$Q = (A + B) \times N \times F$$

where;

Q : Capacity (M<sup>3</sup>)

A : Discharged excretion per head per day (kg)

B : Washing water for cattle shed

N : Heads of feeded cattle

F : Stored days

therefore,

$$\begin{aligned} \text{Type - I : } Q &= (60 + 10) \times 24 \text{ heads} \times 10 \text{ days} \\ &= 16.8 \text{ m}^3/\text{barrel} \end{aligned}$$

$$\begin{aligned} \text{Type - II: } Q &= (60 + 10) \times 16 \text{ " } \times 10 \text{ days} \\ &= 11.2 \text{ m}^3/\text{barrel} \end{aligned}$$

$$\begin{aligned} \text{Cow shed : } Q &= (30 + 10) \times 10 \text{ " } \times 10 \text{ days} \\ &= 4.0 \text{ m}^3/\text{barrel} \end{aligned}$$

However, average stored days becomes 15 days because two bavel type is applied.

(3) Dimension of the store

In general, stored depth is 1.0 to 1.2 m and free board is 0.3 m.

	<u>Width</u>	<u>Length</u>	<u>Height</u>	<u>Bavel</u>
Type-I	2.5 m	5.6 m	1.5 m	2
Type-II	2.0 m	4.7 m	1.5 m	2
Cow shed	1.3 m	3.1 m	1.3 m	2

3-1-6 Farm Road for Model Pasture Field

The object location of improvement of farm road is the north-east part pasture field of asphalt paved road of A.I. Center. Farm road Type A is arranged at surroundings and center of the area and Type B is in principle adopted to improvement of existing road along present pasture field.

	<u>Total width</u>	<u>Width of Gravel</u>	<u>metalling Thickness</u>
Farm road Type A	3.5 m	3.0 m	0.15 m
Farm road Type B	3.0 m	2.5 m	0.10 m

Length of Type A : New road L = 830 m  
 Improvement L = 630 m  
 Total 1,460 m

Length of Type B : New road L = 720 m  
 Improvement L = 1,560 m  
 Total 2,280 m

Others : Entrance to pasture field 28 places  
 Installation of drain pipe (ø300) 1,275 m  
 Construction of drainage culvert  
 Box section 0.8 x 0.8m 1 place  
 ø300 pipe (Type A) 5 places  
 " (Type B) 14 places  
 Sodding for filled slope.  
 1,280 m<sup>2</sup>

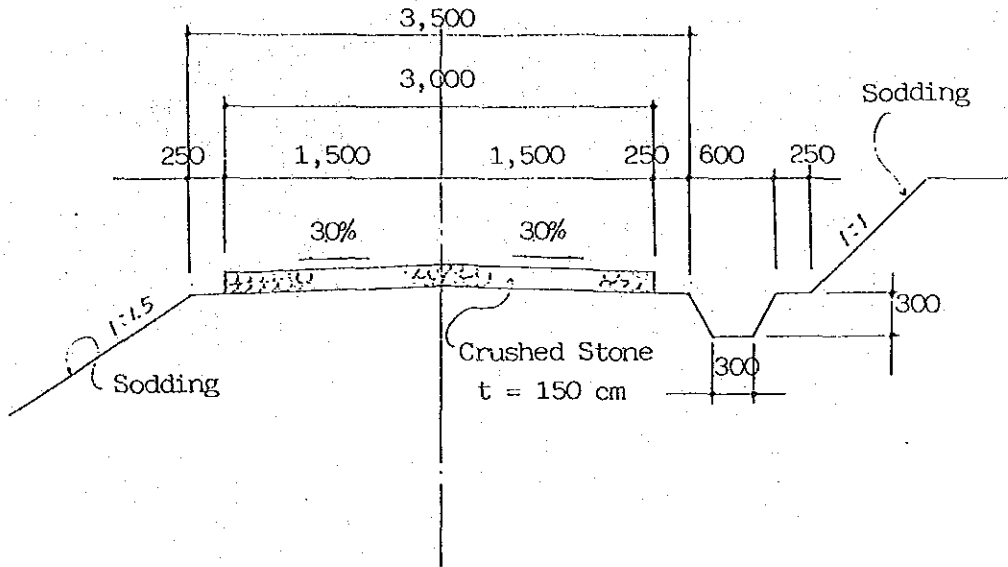
Fig. 3-6

TYPICAL SECTION OF FARM ROAD

S = 1 : 50

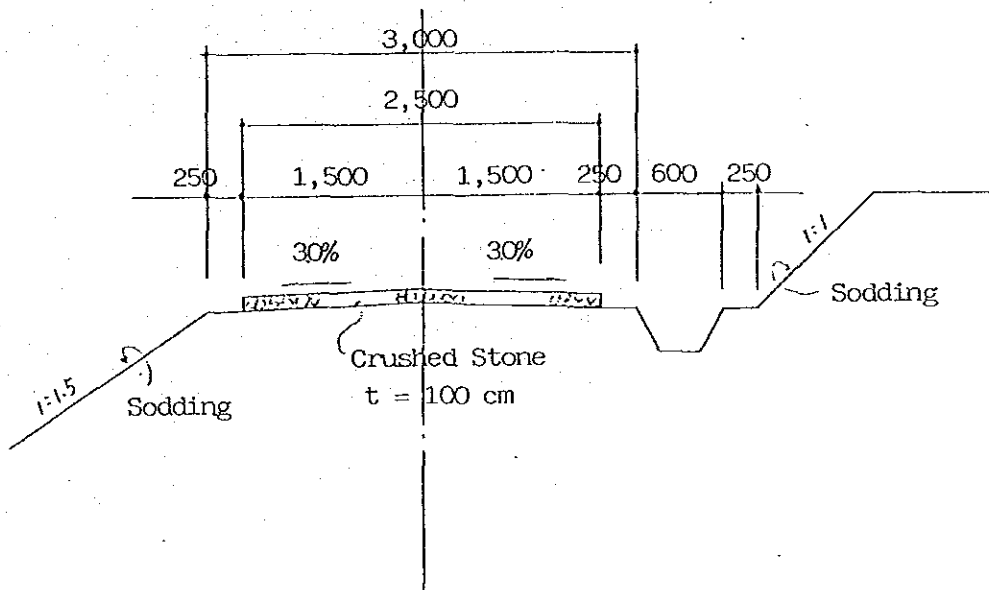
TYPE - A

B = 3.50 m



TYPE - B

B = 3.00 m

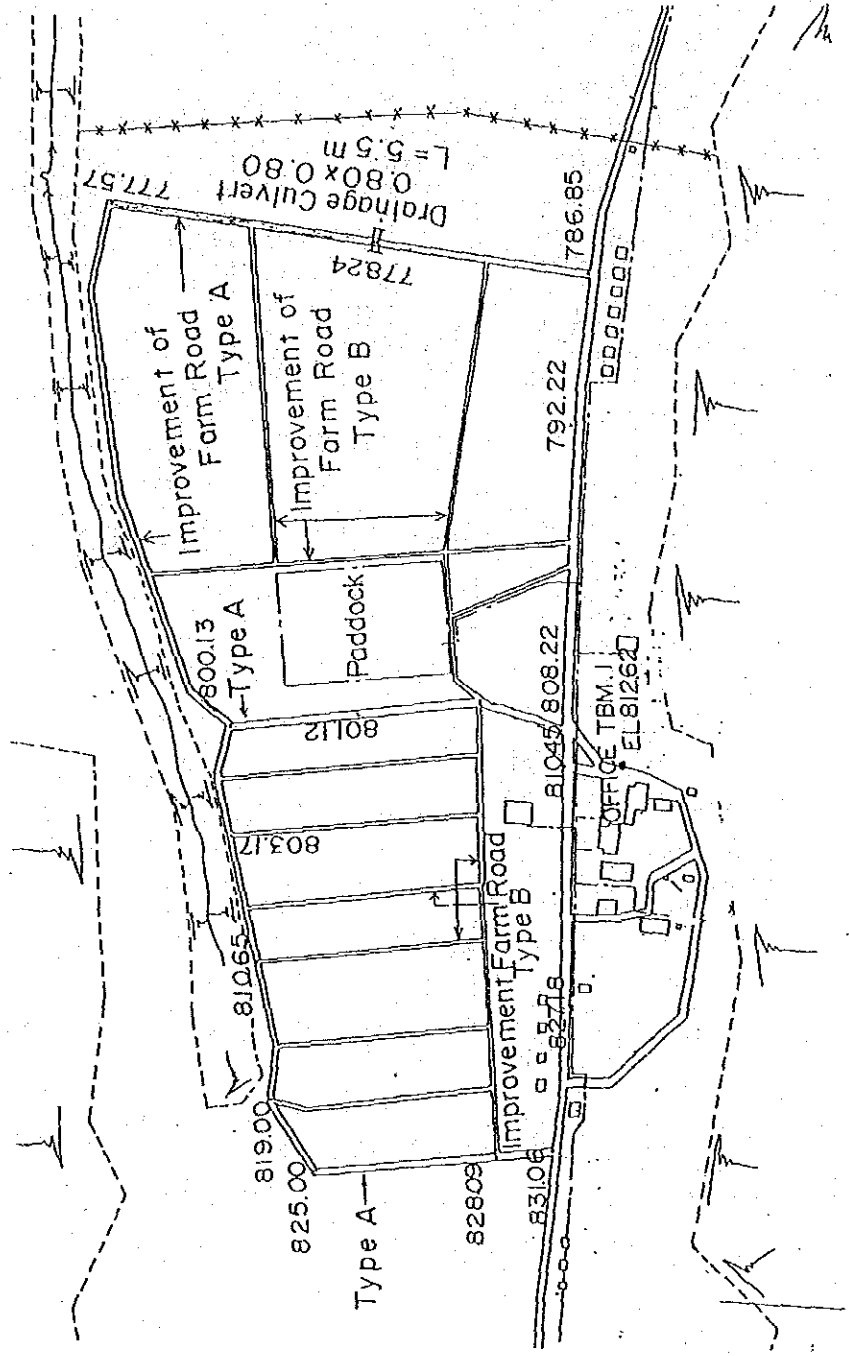


Construction of new road  
 Rehabilitation of existing road



IMPROVEMENT PLAN OF FARM ROAD

Fig. 3-7







### 3-1-7 Other Related Structures

#### (1) Drinking water facility near 1st tank

A drinking water facility is constructed aside the Tea Plantation in the land of A.I. Center diverting from existing pipe ( $\phi$  50).

Unplasticized polyvinyl chloride pipe of  $\phi$ 13 is employed for feed pipe and water tap  $\phi$ 13 is horizontal type.

Water cushion is made of masonry concrete with mortar plastering. The valve installed just downstream of 1st tank shall be replaced for this facility.

#### (2) Drinking water facility in the paddock

The usage of drinking place by many bulls at the same time is not considered because the facility is installed for the use of seed bulls only.

A water tank with circular type with the diameter 900 mm is set up near the entrance of paddock for bull of 2 or 3 heads.

Masonry and mortar finishing works will be applied for this drinking structure.

The water control should be timely carried out by manpower operation of a stop valve which is installed at the out side of paddock.

3 - 2 Construction Planning

3-2-1 Construction Method

The model infrastructure improvement works is composed of rehabilitation works for the existing structures and new construction works such as inlet tank, slow filter, distributing water tank, cow shed, slurry stores and a part of farm road etc.

Each work will be constructed by a contractor but pipes and valves specified in the pipeline works will be provided to DGLS from JICA through the equipment provision for the technical cooperation project.

Machinery construction works will be mainly used in the land preparatory works for cow shed construction and road construction.

The installation works of water supply pipes including earth works will be constructed by manpower except long transportation works.

As to the field work, some portable concrete mixer will be used for concrete works.

At the time of construction, the following items should be remarked.

- a) The construction of intake, pipeline and water supply pipe should be excuted without stopping the water supply to the present facilities, then several detours for the water supply should be prepared in accordance with the site conditions.
- b) Land utilization of Ministry of Forestry and Tea Plantation should be necessary.
- c) Procurement of pipe and valve materials will be separated into two methods which are purchasing in Indonesia and imported from Japan.

### 3-2-2 Construction Time Schedule

The time required for construction of the project will be about 6 months including about 1 month of preparation of tendering and final works of measurement and completion.

The construction schedule for the project is shown in the following figure.

CONSTRUCTION TIME SCHEDULE

Fig. 3-9

Item	Q'ty	1st Month	2nd	3rd	4th	5th	6th
1. Preparation of Tender & Contract							
2. Production & Supply of Pipe, Valve & Others							
3. Temporary Work for Construction							
4. Intake & Pipeline	4.2 Km 2 tanks						
5. Water Supply Facilities	4.0 Km 4 tanks						
6. Cow Shed	2 houses						
7. Slurry Store	3 tanks						
8. Farm Road	3.8 Km						







## CHAPTER 4 COST ESTIMATE

### 4-1 Procurement of Materials to be Supplied by JICA

This model infrastructure improvement works shall be carried out at an earliest possible date in order to manage the smooth implementation of the Project. As the frame of the budget is restricted, the procurement of pipes, valves and other materials shall be made through the equipment provision for the technical cooperation project by JICA. The required materials are desirable to be supplied in Indonesia as much as possible, but some materials shall be procured in Japan due to their specification and/or standard.

#### (1) Materials to be supplied in Indonesia (Pipes)

- a. Long and short : Flange and socket processed and piece pipes coated
- b. Deformed pipe : Tee welded with short piece and flange and coated

#### (2) Materials to be procured in Japan (Pipes and valves)

- a. Bended pipe : Flange and socket processed and coated
- b. Deformed pipe : Special processed high water pressure tee
- c. Stop valve : High water pressure and submerged valves
- d. Rapid air valve



LIST OF MATERIALS & EQUIPMENT SUPPLY BY JICA  
( To Be Purchased in Japan )

<u>Item / Description</u>	<u>Quantity</u>
<b>1. Pipeline &amp; Related Facilities</b>	
<u>Bended Pipes</u>	
SGP 65A, 2F, coated, less than 30°	11 nos.
"    , "    , "    , 55°	1 no.
"    , "    , "    , 85°	1 no.
SGP 65A, with socket, coated, less than 30°	12 nos.
SGP 50A, with socket, coated, less than 30°	21 nos.
SGP 50A, with socket, coated, more than 30°	5 nos.
STPG 50A, 2F, coated, less than 30°	32 nos.
"    , "    , "    , more than 30°	6 nos.
 <u>Special Processed Tee</u>	
STPG 50A, 3F, coated	1 no.
 <u>Valves</u>	
Gate valve 50A, 20K, JIS B2083	7 nos.
 <u>Rapid Air Valve</u>	
∅ 25, FC, 65A, with fitting pipe	2 nos.
∅ 25, FC, 50A,           "	2 nos.
∅ 25, FCD, 50A,         "	3 nos.
∅ 25, SCPH, 50A,       "	2 nos.
 <u>Steel Expansion Flexible Joint</u>	
Victoric joint S-1, Shoulder type ∅ 40A	2 set
"    ,           "    ∅ 50A	4 sets
"    ,           "    ∅ 65A	2 set
 <b>2. Water Supply Facilities</b>	
Stop valve ∅ 50A, JIS B2062	1 no.

3. Slurry Store

Trailer type riding tractor equipped with  
an excrement sprinkler, 2,200 l 1 no.

4. Transportation

Materials for pipeline facilities 1 L.S.

Materials for water supply facilities 1 L.S.

Equipment for slurry store 1 L.S.

LIST OF MATERIALS & EQUIPMENT SUPPLY BY JICA  
( To Be Purchased in Indonesia )

<u>Item / Description</u>	<u>Quantity</u>
1. Pipeline Facilities	
Piping materials	
<u>Long piece pipe (with accessories)</u>	
SGP 65A, 2F, coated, L=6 m	45 pcs.
SGP 65A, socket, coated, L=6 m	44 pcs.
SGP 50A, Socket, coated, L=6 m	271 pcs.
STPG 50A, 2F, coated, L=6 m	298 pcs.
<u>Short piece pipe (with accessories)</u>	
SGP 65A, 2F, coated, L=2 m (mean length)	18 pcs.
SGP 65A, socket, coated, L=2 m (mean length)	10 pcs.
SGP 50A, socket, coated, L=2 m ( " )	40 pcs.
STPG 50A, 2F, coated, L=2 m ( " )	26 pcs.
<u>Tee pipe</u>	
FSGP 65x65x65, 3F, JIS B2311, with short piece pipe	1 nos.
FSGP 65x65x50, 3F, JIS B2311, "	2 nos.
FSGP 50x50x50, 3F, JIS B2311, "	3 nos.
STPG 50x50x50, 3F, JIS B2312, "	5 nos.
2. Inland Transportation	
Materials for Pipeline Facilities	1 L.S.

(3) Equipment supplied by JICA

- a. Slurry tanker for slurry irrigation
- b. Insulators, electric fence instrument and gate handle for electric fence

The material item b above will be provided by the Japanese experts for the Project.

The following are the breakdown of equipment and materials supplied by JICA.

4-2 Project Cost

(1) Estimate of construction cost

For the estimation of construction cost, the material and labour cost are adopted using the standard prices and current market prices which were surveyed on December 1986 in P.U. Cipitakarya and P.U. Irigasi Office in Malang, and Water Supply Services Office in Surabaya and so on.

The construction cost is including safety control of the construction site, quality controll of materials and structures, profit, over head and tax.

The exchange rate used in the cost estimation is Yen 1 is equivalent to Rupiah 10.

(2) Project cost

The total project cost is estimated as follows,

1. Model infrastructure improvement works	¥25,000,000
2. Supply of machinery and equipment by JICA	¥13,500,000
Total project cost	¥38,500,000

The detail of the construction and project cost are summarized in the following table.

BREAKDOWN OF PROJECT COST

A. Construction Cost

1. Improvement of Intake Facilities	1 L.S.	Rp.	1,967,000
2. Improvement of Pipeline and Related Facilities	4.2 Km	Rp.	41,356,000
3. Improvement of Water Supply Facilities	3.0 Km	Rp.	59,726,000
4. Construction of Cow Shed	1 L.S.	Rp.	21,629,000
5. Construction of Slurry Stores	3 Tanks	Rp.	14,049,000
6. Improvement of Farm Road	3.8 Km	Rp.	30,661,000
7. Other Related Structures	1 L.S.	Rp.	550,000
8. General Works (Preparatory works, Temporary works and Other Common works)	1 L.S.	Rp.	21,880,000
Sub Total		Rp.	191,818,000
V.A.T. (P.P.N.)	10 %	Rp.	19,182,000
Total		Rp.	211,000,000
Reservation	1 L.S.	Rp.	21,100,000
Total		Rp.	232,100,000
Miscellaneous	1 L.S.	Rp.	17,900,000
Grand Total		Rp.	250,000,000
		( ¥	25,000,000 )

B. Supply of Machinery and Equipment by JICA

1. Carbon steel pipes, etc. (Purchased in Indonesia)	1 L.S.	Rp.	67,000,000
		( ¥	6,700,000 )
2. Carbon steel pipes with bend, valves, ect. (Purchased in Japan)	1 L.S.	¥	3,800,000
3. Slurry tanker (2,200 liter.)	1 Set	¥	3,000,000
Total		¥	13,500,000

4-3 Bill of Quantities

BILL OF QUANTITIES

No. 1

Item	Description	Unit	Quantities	Unit Price (Rp).	Price (Rp)	Remarks
1-1	Improvement of Intake Facilities					
101	Masonry concrete	m <sup>3</sup>	10.52			
102	Mortar plastering	m <sup>2</sup>	31.82			
103	Plain concrete	m <sup>3</sup>	0.40			
104	Form	m <sup>2</sup>	2.00			
105	Steel works	Ton	0.062			
106	Waterproof mortar	m <sup>2</sup>	27.52			
107	Excavation by manpower	m <sup>3</sup>	14.0			
108	Backfill with compaction by manpower	m <sup>3</sup>	8.4			
109	Sundry materials	L.S.	1.0			
110	Miscellaneous works	L.S.	1.0			
	Sub-total					
1-2	Improvement of Settling Box					
111	Masonry concrete	m <sup>3</sup>	1.00			
112	Mortar plastering	m <sup>2</sup>	2.00			
113	Plain concrete	m <sup>3</sup>	0.70			
114	Form	m <sup>2</sup>	7.20			
115	Steel works	Ton	0.096			



BILL OF QUANTITIES

No. 2

Item	Description	Unit	Quantities	Unit Price (Rp).	Price (Rp)	Remarks
116	Excavation by manpower	m <sup>3</sup>	4.0			
117	Backfill with compaction by manpower	m <sup>3</sup>	2.0			
118	Supply & installation of PVC Ø 100	L.S.	1.0			
119	Supply & installation of SGP Ø 100	L.S.	1.0			
120	Sundry materials	L.S.	1.0			
121	Miscellaneous works	L.S.	1.0			
	Sub-total					
	Total					

BILL OF QUANTITIES

No. 3

Item	Description	Unit	Quantities	Unit Price (Rp)	Price (Rp)	Remarks
2-1	Installation of Pipeline					
201	Installation of SGP 65A ( Flange type )	m	203.7			
202	Installation of SGP 65A ( Flange type )	m	120.0			
203	Installation of SGP 65A ( Socket type )	m	302.6			
204	Installation of STPG 50A ( Socket type )	m	1,706.8			
205	Installation of STPG 50 A ( Flange type )	m	1,882.1			
206	Support for exposed pipe ( Type I )	place	28			
207	Support for exposed pipe ( Type II )	place	15			
208	Processing of pipe bend	place	25			Less than 5°
209	Installation of stop valve Ø 65	place	6			
210	Installation of stop valve Ø 50	place	8			
211	Excavation by manpower	m <sup>3</sup>	1,462.5			Including disposal
212	Dealing of obstacle rocks	m <sup>3</sup>	150.0			
213	Placing of gravel	m <sup>3</sup>	112.5			
214	Clearing	100m <sup>2</sup>	95.9			
215	Finishing of excavated slope	"	22.5			

BILL OF QUANTITIES

No. 4

Item	Description	Unit	Quantities	Unit Price (Rp)	Price (Rp)	Remarks
216	Supply & installation of deformed pipe	L.S.	1.0			
217	Air valve pit for high water pressure	place	2			
218	Air valve pit for ordinary water pressure	place	7			
219	No.1 Blow off pit	place	1			
220	No.2 Blow off pit	place	1			
221	Restoration of existing road in tea plantation	m <sup>2</sup>	81.0			
222	Supply & installation of gate valve Ø 100	nos.	2			JIS B2031 or equivalent
223	Supply & installation of gate valve Ø 65	nos.	5			"
224	Supply & installation of gate valve Ø 50	nos.	2			"
225	Sundry materials	L.S.	1.0			
226	Miscellaneous works	L.S.	1.0			
	Sub-total					
2-2 Improvement of Related Structures						
227	Excavation by manpower	m <sup>3</sup>	12.0			
228	Backfill with compaction by manpower	m <sup>3</sup>	6.0			

BILL OF QUANTITIES

No. 5

Item	Description	Unit	Quantities	Unit Price (Rp)	Price (Rp)	Remarks
229	Reinforced concrete	m <sup>3</sup>	2.70			
230	Plain concrete	"	0.10			
231	Mortar pad	"	0.20			
232	Form	m <sup>2</sup>	29.7			
233	Reinforcement bar	Ton	0.156			
234	Masonry concrete	m <sup>3</sup>	65.30			
235	Steel works	Ton	0.180			
236	Installation of net fence	m	32.0			Including removal of existing fence
237	Supply & installation of PVC 20 A	m	45.0			
238	Waterproof mortar	m <sup>2</sup>	65.2			
239	Miscellaneous works	L.S.	1.0			
	Sub-total					
	Total					

BILL OF QUANTITIES

No. 6

Item	Description	Unit	Quantities	Unit Price (Rp)	Price (Rp)	Remarks
3-1	Construction of Inlet Tank					
301	Reinforced concrete	m <sup>3</sup>	17.70			
302	Form	m <sup>2</sup>	118.1			
303	Mortar pad	m <sup>3</sup>	1.10			
304	Steel works	Ton	0.232			
305	Reinforcement bar	"	0.925			
306	Excavation by manpower	m <sup>3</sup>	47.0			
307	Backfill with compaction by manpower	"	17.0			
308	Masonry concrete	"	1.90			
309	Earthfill by manpower	"	32.0			
310	Supply & installation of PVC 65 A	m	10.0			
311	Installation of stop valve	place	5			
312	Supply & installation of SGPW 50 A	m	5.0			
313	Mortar plastering	m <sup>2</sup>	11.7			
314	Miscellaneous for instal- lation of pipes	L.S.	1.0			
315	Miscellaneous works	"	1.0			
	Sub-total					

BILL OF QUANTITIES

No. 7

Item	Description	Unit	Quantities	Unit Price (Rp)	Price (Rp)	Remarks
3-2	Construction of Filter Tank					
316	Reinforced concrete	m <sup>3</sup>	40.80			
317	Reinforcement bar	Ton	2.316			
318	Form	m <sup>2</sup>	262.5			
319	Mortar pad	m <sup>3</sup>	1.80			
320	Steel works	Ton	0.604			
321	Excavation by manpower	m <sup>3</sup>	75.0			
322	Backfill with compaction by manpower	"	21.0			
323	Earthfill by manpower	"	207.0			
324	Masonry concrete	"	12.2			
325	Graded sand for filter	"	13.1			
326	Graded gravel for filter	"	8.2			
327	Porous brick	nos.	4,000			
328	Mortar plastering	m <sup>2</sup>	41.7			
329	Supply & installation of PVC 65 A	m	30.0			
330	Installation of stop valve	place	6			
331	Supply & installation of SCPW 50 A	m	10.0			
332	Miscellaneous for installation pipes	L.S.	1.0			
333	Miscellaneous works	"	1.0			
	Sub-total					

BILL OF QUANTITIES

No. 8

Item	Description	Unit	Quantities	Unit Price (Rp)	Price (Rp)	Remarks
3-3	Construction of Distributing Tank					
334	Reinforced concrete	m <sup>3</sup>	30.40			
335	Reinforcement bar	Ton	1.720			
336	Form	m <sup>2</sup>	162.6			
337	Mortar pad	m <sup>3</sup>	1.80			
338	Steel works	Ton	0.263			
339	Air vent made of PVC	nos.	2			
340	Excavation by manpower	m <sup>3</sup>	65.0			
341	Backfill with compaction by manpower	"	44.0			
342	Earthfill by manpower	"	108.0			
343	Masonry concrete	"	4.50			
344	Supply & installation of PVC 65 A	m	20.0			
345	Installation of stop valve place	place	4			
346	Supply & installation of SGPW 50 A	m	5.0			
347	- Ditto -, SGPW 40 A	"	5.0			
348	Miscellaneous for piping	L.S.	1.0			
349	Miscellaneous works	"	1.0			
	Sub-total					

BILL OF QUANTITIES

No. 9

Item	Description	Unit	Quantities	Unit Price (Rp)	Price (Rp)	Remarks
3-4	Supply & Installation of Water Supply Pipes					
350	Supply & installation of SCPW 50 A	m	27.0			Including earth works
351	- Ditto -, SCPW 40 A	"	302.0			"
352	- Ditto -, " 32 A	"	351.0			"
353	- Ditto -, " 25 A	"	1,078.0			"
354	- Ditto -, " 20 A	"	177.0			
355	- Ditto -, PVC 20 A	"	164.0			
356	- Ditto -, " 16 A	"	273.0			
357	Deformed pipe of SCPW	L.S.	1.0			
358	Deformed pipe of PVC	"	1.0			JIS B2051 or equivalent
359	Supply of stop valve $\phi$ 40	nos.	1			"
360	- Ditto -, $\phi$ 32	"	1			"
361	- Ditto -, $\phi$ 25	"	1			"
362	- Ditto -, $\phi$ 20	"	2			"
363	Installation of stop valve	place	5			
364	Supply & installation of air valve $\phi$ 13	nos.	2			
365	Connecting works to existing pipes	place	21			
366	Supply & installation of gate valve $\phi$ 65	nos.	5			JIS B2031 or equivalent
367	- Ditto -, stop valve $\phi$ 50	"	5			JIS B2051 or equivalent
367-1	- Ditto -, stop valve $\phi$ 40	"	2			"



BILL OF QUANTITIES

No. 10

Item	Description	Unit	Quantities	Unit Price (Rp).	Price (Rp)	Remarks
368	Supply & installation of stop valve $\phi$ 25	nos.	1			
369	Sundry materials	L.S.	1.0			
370	Miscellaneous works	"	1.0			JIS B2051 or equivalent
	Sub-total					
3-5	Arrangement Works around Inlet, Filter & Distributing Tanks					
371	Clearing	100 m <sup>2</sup>	40.0			
372	Excavation by equipment	m <sup>3</sup>	3,600.0			
373	Supply & installation of fence	m	156.0			
374	Miscellaneous works	L.S.	1.0			
	Sub-total					
3-6	Improvement of 2nd Water Tank					
375	Excavation by manpower	m <sup>3</sup>	5.0			
376	Backfill with compaction by manpower	"	3.0			

BILL OF QUANTITIES

No. 11

Item	Description	Unit	Quantities	Unit Price (Rp)	Price (Rp)	Remarks
377	Reinforced concrete	m <sup>3</sup>	1.40			
378	Plain concrete	"	0.40			
379	Mortar pad	"	0.10			
380	Form	"	10.4			
381	Reinforcement concrete	Ton	0.083			
382	Steel works	"	0.098			
383	Supply & installation of PVC 50 A	m	20.0			
384	Miscellaneous works	L.S.	1.0			
	Sub-total					
3-7	Improvement of Inspection Road					
385	Excavation by manpower	m <sup>3</sup>	212.5			
386	Asphalt pavement	m <sup>2</sup>	550.0			
387	Trimming of ditch	10 m	36.2			
388	Earthfill by manpower	m <sup>3</sup>	60.3			
389	Masonry concrete	"	55.80			
390	Supply & installation of cross drain pipe Ø 300	"	6.4			
391	Miscellaneous works	L.S.	1.0			
	Sub-total					

BILL OF QUANTITIES

No. 12

Item	Description	Unit	Quantities	Unit Price (Rp)	Price (Rp)	Remarks
	Total					

BILL OF QUANTITIES

No. 13

Item	Description	Unit	Quantities	Unit Price (Rp)	Price (Rp)	Remarks
4-1	Construction of Cow Shed					
401	Masonry concrete for base	m <sup>3</sup>	25.50			
402	Foundation gravel	"	6.10			
403	Foundation sand	"	6.10			
404	Base concrete	"	8.50			
405	Base gravel	"	8.50			
406	Brick with mortar	"	11.50			
407	Mortar	"	3.86			
408	Mortar plastering	m <sup>2</sup>	159.84			
409	Fabrication of wooden frame	m <sup>3</sup>	5.08			
410	Roofing with asbestos plate	m <sup>2</sup>	132.2			
411	Fabrication of wooden wall	"	6.8			
412	Cattle mat	m <sup>3</sup>	26.0			
413	Masonry for forage store	"	1.51			
414	Wooden door	place	1			
415	Wooden window	"	1			
416	Wooden hay rack	nos.	2			
417	Water reservoir tank	place	1			
418	Water supply facilities	L.S.	1.0			
419	Electric facilities	"	1.0			
420	Partition frame	nos.	11			

BILL OF QUANTITIES

No. 14

Item	Description	Unit	Quantities	Unit Price (Rp)	Price (Rp)	Remarks
421	Excreta ditch	m	14.2			
422	Miscellaneous	L.S.	1.0			
	Sub-total					
4-2	Construction of Training Shed					
423	Masonry concrete for base	m <sup>3</sup>	4.90			
424	Foundation gravel	"	2.00			
425	Foundation sand	"	2.00			
426	Base concrete	"	3.50			
427	Base gravel	"	3.50			
428	Brick with mortar	"	0.57			
429	Mortar	"	0.20			
430	Mortar plastering	m <sup>2</sup>	12.15			
431	Fabrication of wooden frame	m <sup>3</sup>	2.63			
432	Roofing with asbestos plate	m <sup>2</sup>	55.8			
433	Fabrication of wooden wall	"	5.1			
434	Partition frame	nos.	5			
435	Excreta ditch	m	10.0			
436	Electric facilities	L.S.	1.0			
431	Miscellaneous works	"	1.0			
	Sub-total					

BILL OF QUANTITIES

No. 15

Item	Description	Unit	Quantities	Unit Price (Rp).	Price (Rp)	Remarks
4-3	Other Works for Cow Shed Facilities					
432	Clearing	100 m <sup>2</sup>	15.8			
433	Excavation by equipment	m <sup>3</sup>	2,756.3			
434	Excavation by manpower	"	153.0			
435	- Ditto -	"	38.5			For cow shed
436	Backfill by manpower	"	91.4			For training shed
437	- Ditto -	"	22.8			For cow shed
438	Wooden fence	m	141.8			
439	Electric fence	"	133.8			
440	Miscellaneous works	L.S.	1.0			For training shed
	Sub-total					
	Total					

BILL OF QUANTITIES

No. 16

Item	Description	Unit	Quantities	Unit Price (Rp),	Price (Rp)	Remarks
5-1	Construction of Slurry Store for Cow Shed					
501	Excavation by manpower	m <sup>3</sup>	104.0			
502	Backfill with compaction by manpower	"	70.3			
503	Masonry concrete	"	29.80			
504	Mortar plastering	m <sup>2</sup>	26.50			
506	Plain concrete	m <sup>3</sup>	2.60			
507	Reinforced concrete	"	1.20			
508	Reinforcement bar	Ton	0.087			
509	Form	m <sup>2</sup>	6.0			
510	Excreta box & ditch	L.S.	1.0			
511	Miscellaneous works	"	1.0			
	Sub-total					
5-2	Construction of Slurry Store Type-I for Bull Shed					
512	Excavation by manpower	m <sup>3</sup>	202.2			
513	Backfill with compaction by manpower	"	106.5			
514	Masonry concrete	"	72.90			
515	Mortar plastering	m <sup>2</sup>	69.30			
516	Reinforced concrete	m <sup>3</sup>	5.60			

BILL OF QUANTITIES

No. 17

Item	Description	Unit	Quantities	Unit Price (Rp)	Price (Rp)	Remarks
517	Reinforcement bar	Ton	0.289			
518	Form	m <sup>2</sup>	24.0			
520	Excreta box & Ditch	L.S.	1.0			
521	Miscellaneous works	"	1.0			
	Sub-total					
5-3	Construction of Slurry Store Type-II for Bull Shed					
522	Excavation by manpower	m <sup>3</sup>	166.5			
523	Backfill with compaction by manpower	"	95.4			
524	Masonry concrete	"	56.80			
525	Mortar plastering	m <sup>2</sup>	53.00			
526	Plain concrete	m <sup>3</sup>	0.90			
527	Reinforced concrete	"	3.80			
528	Reinforcement bars	Ton	0.198			
529	Form	m <sup>2</sup>	15.6			
530	Excreta box & ditch	L.S.	1.0			
531	Miscellaneous works	"	1.0			
	Sub-total					
	Total					



BILL OF QUANTITIES

No. 18

Item	Description	Unit	Quantities	Unit Price (Rp)	Price (Rp)	Remarks
6-1	Improvement of Farm Road Type-A & Type-B					
601	Placement of crushed stone for farm road type-A	m <sup>2</sup>	4,363.5			t=15 cm
602	- Ditto -, type-B.	"	5,695.0			t=10 cm
603	Excavation by manpower	m <sup>3</sup>	1,916.8			
604	Earthfill by manpower	"	1,075.2			
605	Finishing for excavated slope	100m <sup>2</sup>	11.4			
606	Finishing for filled slope	"	12.8			
607	Finishing for ditch	10m	500.0			
608	Supply & installation of concrete pipe for drain	m	49.0			ø 300
609	Drainage culvert	place	1			
610	Entrance to pasture field	"	17			For filled part
611	- Ditto -	"	11			For cut part
612	Miscellaneous works	L.S.	1.0			
	Total					

BILL OF QUANTITIES

No. 19

Item	Description	Unit	Quantities	Unit Price (Rp)	Price (Rp)	Remarks
7-1	Construction of Drinking Water Facilities near 1st Tank					
701	Brick with mortar	m <sup>3</sup>	2.70			
702	Mortar plastering	m <sup>2</sup>	25.4			
703	Supply & installation of PVC 20 A	m	45.0			
704	Miscellaneous works	L.S.	1.0			
	Sub-total					
7-2	Construction of Drinking Water Facilities for Paddock					
705	Masonry concrete	m <sup>3</sup>	1.70			
706	Mortar plastering	m <sup>2</sup>	4.90			
707	Miscellaneous	L.S.	1.0			
	Sub-total					
	Total					







CHAPTER 5 BID DOCUMENTS (DRAFT)

5-1 Contract

5-2 Technical Specifications



CONTRACT  
FOR  
CONSTRUCTION OF MODEL INFRASTRUCTURE IMPROVEMENT WORKS  
ON  
THE STRENGTHENING OF ARTIFICIAL INSEMINATION CENTER PROJECT  
IN  
INDONESIA

JAKARTA OFFICE

JAPAN INTERNATIONAL COOPERATION AGENCY





CONTRACT

For Construction of Model Infrastructure  
Improvement Works on the Strengthening of  
Artificial Insemination Center Project  
in Indonesia

This Contract is executed on the \_\_\_\_\_ day of \_\_\_\_\_ 1987  
at the JICA Jakarta Office between

Japan International Cooperation Agency, Jakarta Office by  
Mr. Hideo ENDO Title Resident Representative as its authorized  
representative of the JICA Jakarta Office, hereinafter called  
"the JICA" of the one part, and \_\_\_\_\_

\_\_\_\_\_ whose office is situated at \_\_\_\_\_  
\_\_\_\_\_

\_\_\_\_\_ Represented by \_\_\_\_\_  
\_\_\_\_\_ Nationality \_\_\_\_\_

Title \_\_\_\_\_ hereinafter called "the Contractor",  
of the other part.

Both parties mutually agree under the terms of this Contract  
as follows:

Article 1 (a)

DESCRIPTION OF WORKS

The Contractor shall carry out the construction of model

infrastructure improvement works, hereinafter called "the Works", consisting of improvement of intake facility and pipeline and related structures, improvement of water supply facilities, construction of cow shed and slurry store and improvement of farm road, in Singosari, East Java under the Strengthening of Artificial Insemination Center Project.

Article 1 (b)

The JICA agrees to employ the Contractor and the Contractor agrees to perform the Works as specified below.

1. Improvement of Intake
  - (a) Improvement of intake facility 1 place
  - (b) Improvement of settling box 1 place
  
2. Installation of pipeline
  - (a) Installation of pipeline 4.2 Km
  - (b) Improvement of related structures 1 L.S.
  
3. Improvement of water supply facilities
  - (a) Construction of inlet tank, filter and distributing tank and related structures 3 nos.
  - (b) Installation of supply pipe 1.8 Km
  - (c) Installation of feed pipe 0.7 Km
  - (d) Improvement of related structures 1 L.S.
  - (e) Improvement of inspection road to inlet tank 220 m

- |    |  |          |
|----|--|----------|
| 4. | Construction of cow shed   |          |
|    | (a) Cow shed and training shed   | 2 Houses |
|    | (b) Related structures   | 1 L.S.   |
| 5. | Construction of slurry store   |          |
|    | (a) Slurry store   | 3 nos.   |
|    | (b) Excreta ditch  | 122 m    |
| 6. | Improvement of farm road   |          |
|    | (a) Farm road Type-A   | 1.5 Km   |
|    | (b) Farm road Type-B   | 2.3 Km   |
|    | (c) Related structures   | 1 L.S.   |
| 7. | Other related structures   |          |
|    | (a) Construction of water supply facility<br>near first tank                 | 1 place  |
|    | (b) Construction of water supply facility for<br>paddock                     | 1 place  |
| 8. | General Works (Preparatory works, temporary<br>works and other common works) | 1 L.S.   |

The details of the above terms are given in the attached drawings and specifications.

Article 1 (c)

The following documents shall be deemed to form, be read and constructed as Part of the Contract:

- i) Contract
- ii) Technical specification
- iii) Drawings
- iv) Bill of Quantities

Article 2

CONTRACT PRICE

The Contract price is fixed in Rp. \_\_\_\_\_  
(Say Pupiah \_\_\_\_\_)

which consists of:

- a. Construction cost based on the Bill of Quantities  
in Rp. \_\_\_\_\_ and (Say Rupiah \_\_\_\_\_)  
\_\_\_\_\_ ) and
- b. Indonesian value added tax, namely P.P.N. in  
Rp. \_\_\_\_\_ (Say Rupiah \_\_\_\_\_)  
\_\_\_\_\_ ).

Overhead, profits and other duties and taxes except P.P.N. shall be already calculated in the Unit price of Bill of Quantities..

Article 3

PERFORMANCE BOND

As a security for the faithful performance of the Works under this Contract, the Contractor has on the execution of this Contract deposited a performance bond with the JICA

Rp. \_\_\_\_\_ ( \_\_\_\_\_ )

in cash, or in lieu thereof a Bank Guarantee issued by the

\_\_\_\_\_ bearing the number

\_\_\_\_\_ and dated \_\_\_\_\_ in the

amount of Rp. \_\_\_\_\_ ( \_\_\_\_\_ )

\_\_\_\_\_ ) which represents five (5) percent of the Contract

Price, the name of the issuing bank and the form of the bank

guarantee are to be approved by the JICA.

The JICA will return the performance Bond or the Bank Guarantee

to the Contractor as the case may be at the end of the twelve

(12) months after final acceptance of the Works by the JICA

as stipulated in Article 19 of this Contract, provided that

the completed Works shall not show any defect or damage caused

through the fault of the Contractor, or through the fault of

any new Contractor in the case of termination of Contract by the

JICA under Article 4.

Should the Contractor be in default, the JICA shall have the

right to demand payment from all or any part of the performance

bond. In addition, the Contractor shall remain liable for the

full loss sustained by the JICA.

Article 4

COMPLETION TIME

The Contractor agrees to commence the Works at the site within ten (10) days from the date of signing of this Contract (Commencement date) and the Contractor agrees to satisfactorily complete the Works within \_\_\_\_\_ days (completion time) after the date hereof which will become due on \_\_\_\_\_ 1987 (completion date).

In a case where it is clear that the Contractor is failing to fulfil his obligations within the period referred to in the preceding Article. The Contractor shall inform the JICA of this as soon as possible and if the JICA agrees that the delay is due to such causes as natural calamity or others for which the Contractor is not liable, a reasonable extension of time shall be approved. In this case, the sum referred to in Article 15 shall not be collected.

Article 5

CONSTRUCTION METHOD AND TEMPORARY WORKS

The construction method including implementation schedule and plan of the temporary works such as installation of temporary facilities, offices, ware houses, construction roads, electric wiring, etc. shall be submitted by the Contractor and approved by the JICA at least one (1) week in advance of the commencement of the Works.

Article 6 (a)

PROCESS OF CARRYING OUT OF WORKS

The Contractor shall carry out the work in accordance with the drawings and specification referred to in Article 1(c). And in cases where it is necessary for carrying out such work as is not mentioned therein for the purpose of promoting the present construction or for reasons of established practices, the Contractor shall carry out the said work under the direction of the JICA. In cases where the Contractor finds any doubt in the plans of construction, the Contractor shall ask the JICA for the necessary directions before commencing the work on that part for which there exists some doubt.

Article 6 (b)

COMPLIANCE WITH STATUES AND REGULATIONS

In the execution of the works mentioned in the Article 6 (a), the following conditions will prevail :

1. General conditions on construction works execution of the public works in Indonesia (Supplement State Paper No 14571).
2. General regulations on inspection of construction materials for construction of buildings in Indonesia.
3. Local construction regulations.
4. Decision No 12/1977 of the President of the Republic of Indonesia.



Article 7

CARE OF WORKS

The Contractor shall follow the direction of the JICA or the Engineer to be appointed by the JICA (hereinafter called "the Engineer"). As to materials for the construction, the Contractor shall use only those inspected and approved by the JICA or the Engineer. In cases where any defective work has been done as a result of such use of materials which have not been inspected by the Engineer, the Contractor shall be liable to change the materials or repair the work at his own cost and responsibility. The construction shall be carried out in accordance with the proper technique and durability shall be the principal aim as regards to the construction.

Article 8

EMPLOYMENT OF WORKMEN

As to the workmen to be hired by the Contractor for the works, the Contractor shall assume the responsibility as entrepreneur or employer, as provided for by laws and regulations in Indonesia.

Article 9

SUB-LETTING

The Contractor shall not assign or sublet to a third party the whole or part of the construction, except in cases where the Contractor has obtained written approval from the JICA.

Article 10

DAMAGES TO PERSONS OR PROPERTIES

In cases where any damages are caused to the JICA or a third party, materials or buildings, through carelessness on the part of the Contractor during the course of works or transportation of materials, the Contractor shall be liable to repair or compensate such damages at his own expense by the date appointed by the JICA or the third party.

Article 11

MODIFICATION OF PLAN

If the JICA finds it necessary to make modification of construction design, quantities and/or materials and so forth during the course of construction, the JICA has the right to order the modification of the Works to the Contractor, and such order shall be made in writing from the JICA to the Contractor.

The JICA agrees to adjust upwards or downwards the necessary

expense for such modification to the Contractor, which will be estimated by unit price in the bill of quantities of this Contract in case of modification of quantities of construction works.

If the Contract shall not contain any rates applicable to the extra or additional work, then suitable prices shall be agreed upon between the JICA and the Contractor. In the event of disagreement, the Engineer shall fix such prices as shall in his opinion be reasonable and proper.

Also the extension of the completion time due to the modification shall be given by the JICA who shall have the sole right to decide the number of days of such extension.

## Article 12

### PRICE ADJUSTMENT

In case costs of materials and works have risen sharply as a result of Rupiah-devaluation against US Dollar in Indonesia, the JICA at the request of the Contractor, is open to negotiation on reasonable adjustment of a part of the Contract price on the basis of unit prices of Bill of Quantities. However, the adjustment rates will be subject to total approval from the JICA.

### Article 13

#### RIGHT TO RESCIND CONTRACT AND PENALTY

In cases where the Contractor fails to fulfill his obligations under this contract, the JICA may rescind the whole or part of the Contract.

In such a case, the JICA may collect from the Contractor, as a penalty, a sum of 10 percent (10%) of the amount of rescinded construction in addition to the amount of rescinded construction. When the damage sustained to the JICA on account of the nonfulfillment of Contract by the Contractor exceeds the sum referred to in the preceding sentence, the JICA may further demand the Contractor for payment of the excess.

### Article 14

#### FULFILLMENT OF OBLIGATIONS BY THIRD PARTY

In cases other than provided for in the preceding Article, where the fulfillment of obligations by the Contractor is regarded to be difficult, the JICA may have a third party to fulfill the whole or part of the Contractor's obligations, at the cost of the Contractor. Even if liability of the Contractor exceeds the Contract price of construction referred to in Article 2 in consequence of this, the Contractor may not raise any objection to it.

Article 15

LIQUIDATE DAMAGE FOR DELAY

In cases other than provided for in Article 13, where the Contractor fails to complete the construction with his own responsibility within the time limit referred to Article 4, the Contractor shall be liable for payment of a sum equivalent to 0.05 percent (0.05%) of the Contract price of construction referred to in Article 2, per day of delay within a period fixed by the JICA.

Article 16

DAMAGED CAUSED BY NATURAL CALAMITY, ETC.

In cases where serious damage occurs to the completed part of the works, or the materials, tools, etc., already carried into the field of construction, the Contractor shall promptly inform the JICA of the fact. If such damage is caused by natural calamity, such as an earthquake, a flood, a war, an epidemic, or a general trade strike, rioting or other unavoidable reasons, while it is concluded that the Contractor has taken normal precautions to avoid the occurrence of such damage, the JICA shall be liable for the amount of the damage which shall be fixed through negotiations between the JICA and the Contractor.

Article 17

REPORT FOR COMPLETION OF CONSTRUCTION

At the time of completion of the construction, the Contractor must report to the JICA promptly in writing.

Article 18 (a)

INSPECTION

The work at any stage shall be subject to inspection to be conducted by the JICA or the Engineer appointed by the JICA, in the presence of the Contractor, and necessary labor and articles required for such an inspection shall be provided by the Contractor.

Article 18 (b)

In cases where the work fails to pass the inspection referred to in the proceeding paragraph, the Contractor shall carry out necessary repairs at his own cost, under the direction of the JICA.

Article 19

DATE OF COMPLETION OF CONSTRUCTION AND OBLIGATION THEREAFTER

The date of Completion of Construction shall be regarded as that on which the final work, including removal of temporary

construction and cleaning, has passed the inspection referred to in Article 18, and on that date the object of the construction shall be delivered to the JICA by the Contractor. For a period of one year thereafter, any defect in the construction, the cause of which, in the opinion of the JICA, is judged to be attributable to faulty or inadequate techniques or materials employed by the Contractor; shall be immediately repaired or improved at the cost of the Contractor .

#### Article 20

##### PAYMENT

The JICA agrees to effect payments for the Works to the Contractor in the following manner :

- a. Advance Payment, to be effected upon the bringing of equipment and materials required for the Works and properly stored at the job site by the Contractor, and of value estimated by the JICA. Rupiah \_\_\_\_\_  
\_\_\_\_\_ (Rp. \_\_\_\_\_) which corresponds to Thirty (30) percent of the Contract Price shall be paid upon signing of this Contract at the request of the Contractor.
- b. Interim Payment, to be effected according to the progress of the Works satisfactorily executed by the Contractor and accepted by the JICA Rupiah \_\_\_\_\_

-----  
(Rp. -----) which corresponds to Thirty (30) percent of the Contract Price shall be requested for the payment once during the course of construction at the request of the Contractor. In case that value of the executed construction works estimated by the JICA is less than fifty (50) percent of the Contract Price, interim payment shall be deducted by the full amount of advance payment, balance of which correspond to value of the executed construction works.

- c. Final Payment, to be effected upon the satisfactory completion of the Works by the Contractor and accepted by the JICA. The remainder of Rupiah -----

-----  
(Rp. -----) which corresponds to Forty (40) percent of the Contract Price, shall be paid after the Final Certificate by the JICA for payment to the Contractor.

Payment under (b) and (c) shall be effected within ten (10) day after the respective acceptance of the Works by the JICA.

Taxes payable by the Contractor, if any, shall be deducted at the source by the JICA on each payment.

It is expressly understood that payments by the JICA do not mean acceptance responsibilities under this Contract.



Article 21

SETTLEMENT OF DISPUTE

If there arises any dispute with regard to this Contract or the Drawings or Specifications referred to in Article 1 (c), the JICA and the Contractor shall make efforts for settlement of the dispute with mutual consultation.

Article 22

ARBITRATOR

Should the JICA and the Contractor fail to reach a mutual agreement on such dispute as mentioned in the preceding Article, then it shall be referred to an Arbitrator or Arbitrators acceptable to and appointed by both the JICA and the Contractor, and the decision of this Arbitrator or these Arbitrators shall be binding on both the JICA and the Contractor.

THE CONCLUSION OF THE CONTRACT

Revenue stamp duty of 1/1000 (one promil) of the Contract sum of construction will be paid by the Contractor. Two copies of the Contract shall be prepared with the signature of both parties to each of the copies, one copy to be held by each party.

Jakarta,                     (Date)                    

EMPLOYER

CONTRACTOR

\_\_\_\_\_  
Hideo ENDO  
Resident Representative  
Japan International  
Cooperation Agency

\_\_\_\_\_  
Director  
of ( Name of Company )

WITNESS BY

WITNESS BY

\_\_\_\_\_

\_\_\_\_\_

TECHNICAL SPECIFICATIONS  
FOR  
CONSTRUCTION OF MODEL INFRASTRUCTURE IMPROVEMENT WORKS  
ON  
THE STRENGTHENING OF ARTIFICIAL INSEMINATION CENTER PROJECT  
IN  
INDONESIA

JAKARTA OFFICE

JAPAN INTERNATIONAL COOPERATION AGENCY

TECHNICAL SPECIFICATIONS

- PART 1. SPECIAL PROVISION
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- PART 3. CARE OF WATER DURING CONSTRUCTION
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- PART 5. BACKFILL AND EARTHFILL
- PART 6. STONE MASONRY
- PART 7. CONCRETE WORKS
- PART 8. PIPING WORKS
- PART 9. COW SHED
- PART 10. OTHER RELATED FACILITIES

## TECHNICAL SPECIFICATIONS

### PART 1 SPECIAL PROVISION

#### 1-01 APPLICATION

This specification is applicable to "Construction of Model Infrastructure Improvement Works on the Strengthening of Artificial Insemination Center Project in Indonesia". Main work quantities are stipulated in Article 1 of this Contract. Specifications entered in the drawing shall be treated in reference to this technical specifications.

#### 1-02 ENGINEER

"Engineer" means the engineer who was appointed to supervise the works by the JICA.

#### 1-03 SITE REPRESENTATIVE OF THE CONTRACTOR

Site representative of the Contractor shall be well qualified in construction or have enough experience of construction. The Contractor shall submit career history of a site representative to the Engineer for his approval.

#### 1-04 WORK SCHEDULE

The Contractor shall submit his work schedule before the commencement of the works at the job site. If the Contractor intends to change the work schedule, the approval from the Engineer shall be obtained prior to the modification of schedule.

Also the Contractor shall submit the machineries scheme including the numbers, and kind of machineries and using period of them.

1-05 The Contractor shall exercise utmost care so that his construction operations will not damage any existing structure except such structures as specified to be dismantled. Any damages on such existing structure or

facilities shall be made good by the Contractor at his expense.

1-06 If it is necessary in the prosecution of the work to interrupt or obstruct the flow of existing water supply pipe, the flow of artificial drains and the drainage of the surface, the Contractor shall provide for the same during the progress of the work in such a way that no damage shall result to either public or private interest. For any neglect to provide for either natural or artificial pipeline or drainage which he may interrupt, he shall be held liable for all damages which may result there from during the progress of the work.

1-07 The Contractor is expected to visit the location of the work and make his own estimate of the facilities needed for the work. In the successful execution of the construction, the Contractor is expected to familiarize himself with local conditions, availability of labor, transportation facilities, water and electric supply, uncertainties of weather and other contingencies. From investigations, made at site, it is believed that topographical conditions are approximately as shown on the drawings, but the nature of the materials and the depth of satisfactory foundations, are not guaranteed. It is expressly understood that JICA will not be responsible for any deduction, interpretation, or conclusions made by the Contractor. JICA does not guarantee that other materials will not be encountered or that the proportions of the several materials will not vary from those indicated by the drawings.

1-08 Elevations referred to the datum plane are to be determined from benchmarks established by JICA or the Engineer at the site of the work.

#### 1-09 SETTING-OUT

The Contractor shall entirely be responsible for accurate setting-out the works including staking of centerlines for pipeline and roads, etc. based on the information supplied on the Drawings and the instructions given by the Engineer.

All stakes, benchmarks, etc., placed by the Engineer in laying out the works shall be carefully guarded and preserved by the Contractor, and in such case stakes or marks are misplaced or rendered useless through the carelessness or negligence of the Contractor or his agents, employees

or workmen, they shall be replaced by the Contractor at this expense.

The Contractor shall execute the work to the lines and grades given by the drawings and/or Engineer. The Contractor shall, at his own expense, furnish all stakes, templates, pattern, platforms and labor that may be required in setting or laying out any part of the work.

The costs to conform to the requirements of this Clause shall be entered in the Lump Sum Price of the General Works in the Bill of Quantities.

#### 1-10 DRAWINGS TO BE FURNISHED BY THE CONTRACTOR

The Contractor shall submit the drawings of centerline survey results and longitudinal section in two copies for the construction of pipeline and roads, etc.

Construction of any part of the above works shall not commence until the Drawings have been approved by the Engineer, and there after no change shall be made to any drawing so approved without permission of the Engineer.

In addition to the above, during the working execution, the Contractor shall at his own expense prepare reinforcement drawings based on the Drawings supplied by the JICA at needed for performance of the works.

These reinforcement drawings shall include such bar placing drawings, bar list and any otehr reinforcement drawings as may be required to facilitate fabrication and placement of reinforcement.

All reinforcement drawings prepared by the Contractor shall be submitted to the Engineer for approval. All costs incurred by the Contractor in complying with the requirements of this Clause shall be deemed to be included in the item of General works in the Bill of Quantities.

#### 1-11 ASSISTANCE TO ENGINEER'S STAFF

The Contractor shall render all necessary assistance to the Engineer and shall provide as required by and for use of the Engineer, sufficient quantities of pegs, poles, straight edges, stagings, moulds, templates, profiles and all other requisites for checking the Contractor's setting out and the measurement of the Works.

The cost of all labor and materials required by the Engineer for the said purposes shall be borne by the Contractor. All cost incurred by the Contractor in complying with the requirements of this Clause shall be deemed to be included in the General Works of Bill of Quantities.

#### 1-12 REPORTS

The Contractor shall submit daily or weekly reports to each work section to the Engineer.

The report shall contain, but not limited to, the following data: Weather conditions, staff and labor force employed on the Work, materials used, work in progress, work in preparation, laboratory test data, accidents, photographs and all other information relevant to the progress of the Works.

The payment of all costs incurred by the Contractor in complying with requirements of this Clause shall be deemed to be included in the General work of Bill of Quantities.

#### 1-13 FIELD TEST AND INSPECTION

The field tests in accordance with the specifications and the demands from the Engineer shall be the responsibility for the Contractor. The charges for such fields test shall be included in the item of General Works of Bill of Quantities.

#### 1-14 CLEARANCE OF THE WORK SITE

Upon completion of the works, the Contractor shall clear the site within period of construction.

#### 1-15 GENERAL WORKS

The Contractor shall price the General Works in the Bill of Quantities covering all costs and expenses for preparatory works, temporary works and other common works such as :

- Mobilization and demobilization of equipments (Cause 2-03 and 2-05)



- Maintenance of temporary access road and Construction of haul road (Clause 2-02)
- Land hiring for the Contractor's yard
- Construction, maintenance and subsequent removal of offices, stores, workshops, staff quarters and labor camps with fencing (Clause 2-03)
- Installation, operation, maintenance and subsequent removal of water and electric supply system for the Contractor's offices, workshops, staff quarters and labor camps (Clause 2-03)
- Centerline survey and furnishing of drawings (Clause 1-09 and 1-10)
- Assistance to Engineer's staff for certificates (Clause 1-11)
- Setting out pipeline, roads and structures and staking of reference pegs (Clause 1-09)
- Field tests including provision of testing apparatus, testing engineer, labor and consumables (Clause 1-13)
- Submit of periodical reports and color photographs (Clause 1-12)
- Other works but not limited to.

## PART 2 GENERAL CONSTRUCTION FACILITIES

### 2-01 SCOPE

This part covers the construction and/or maintenance of access roads, setting up of Contractor's camp facilities, providing camp security and the disposition of the Contractor's various facilities at the end of the Contract.

### 2-02 ROADS

(a) The Contractor shall improve, repair and widen, if necessary, existing roads to satisfactorily meet his haulage requirements. He shall also construct all other roads within the construction area which he deems necessary in the prosecution of his work. The improving, widening and maintaining of existing roads and constructing and maintaining new roads shall be made by the Contractor at his expense, and same shall be the responsibility of the Contractor during and up to the completion of all construction work under the Contract.

### 2-03 CONTRACTOR'S CAMP FACILITIES

(a) If the Contractor deems necessary, he shall grade his camp site; construct his office, employee's housing, warehouses, machine and repair shops, fuel storage tanks; and provide such other facilities that the Contractor deems necessary for maintaining health, peace and order in the camp and work areas.

(b) The location, construction, operation and maintenance of such camps and facilities within the areas of the A.I. Center shall be subject to the approval of the Engineer. At least ten (10) calendar days prior to the date on which the Contractor desires to begin to work on in feature of camp construction, the Contractor shall submit for the approval of the Engineer drawings and specifications in sufficient detail to permit determination of suitability of the construction in compliance with these specifications, and no camp construction of any kind shall be undertaken until such drawings and specifications have been approved by the Engineer.

2-04 CAMP SECURITY

The Contractor shall provide his own security force to the extent that he deems necessary for maintaining peace and order in the camps and work areas and to safeguard materials and equipment including fencing.

2-05 DISPOSITION OF CAMP AND CONSTRUCTION FACILITIES

After the completion of the work covered by the Contract, the entire camp of the Contractor, including its water supply system, quarters, warehouses, shops and other facilities therein; and all other temporary installations at work areas shall be removed by the Contractor and the site shall be cleared.

### PART 3 CARE OF WATER DURING CONSTRUCTION

#### 3-01 SCOPE

In accordance with specifications contained in this part, the Contractor shall care the water during construction so that construction work can be performed in areas free from water. Care of water during construction shall include provision for drainage and pumping system for dewatering foundation areas and the construction of temporary bulkheads necessary for the protection of construction operations from encroachment by water.

#### 3-02 DRAINAGE AND PUMPING

The Contractor shall be responsible for dewatering the foundation areas so that work may be carried on in a suitably dry condition, draining and/or pumping all water during the process of construction until its completion. The contractor shall construct drainage ditches, holes, or culverts; furnish, operate, and maintain at his own expense all necessary pumps, to keep all work areas in ample dry condition, and prior to final acceptance of the work by the Contracting Officer, the Contractor shall remove, fill or plug all temporary drainage structures and pumping equipment at his expense.

#### 3-03 PAYMENT

No separate payment shall be made for the care of water during construction. But the cost of furnishing, constructing, operating, maintaining, and removal of temporary drainage structures, canals, and pumping system necessary to keep construction operations free from water shall be included in the item of GENERAL WORKS as indicated in the Bill of Quantities

## PART 4 OPEN EXCAVATION AND FOUNDATION PREPARATION

### 4-01 SCOPE

In accordance with the Specifications contained in this part, and as shown on the drawings, or otherwise directed by the Engineer, the Contractor shall perform all required open excavation and foundation preparation pertinent to the construction work.

### 4-02 OPEN EXCAVATION

#### (a) General

Open excavation under these Specifications consists of the removal, hauling, dumping, and satisfactory disposal of all materials from required excavations for pipe work, roads, and miscellaneous excavations for other structures included under this Contract. Open excavation shall be performed to the lines and grades shown on the drawings or established by the Engineer. The Engineer may modify slopes of excavation to fit conditions encountered during construction. Such changes or modifications shall not be considered by the Contractor as a basis for additional compensation over and above the unit prices bid. All necessary precautions shall be taken to preserve the ground outside the specified lines and grades in the soundest possible condition.

#### (b) Foundation in Loose Material

When the surfaces of excavation upon or against which concrete or stone masonry or embankment fill is to be placed consist of loose materials, the said loose materials shall be removed or replaced with suitable materials and compacted in a manner satisfactory to the Engineer. The cost of removing the loose

materials shall be paid for under the pertinent bid items for open excavation. The cost for the replacement with suitable materials and the compaction of the same shall be paid for under the pertinent bid items for fill.

#### 4-03 DISPOSITION OF EXCAVATED MATERIALS

##### (a) Spoil Areas

The Contractor shall submit for the approval of the Engineer locations, areas, drawings, and other necessary specifications of spoil area which the Contractor proposes to use for the work under this Contract, and any kind of disposition shall not be undertaken before obtaining the said approval. Excavated material not suitable for fill or otherwise not needed shall be wasted in approved spoil areas. Spoil piles shall be constructed to the stable slopes of the material being wasted. Any spoil pile exceeding two (2) meters in height shall not be performed. Spoil material shall be spread and graded so that surface drainage will not be concentrated and will not create and/or accelerate undesirable erosion in spoil areas.

#### 4-04 DEMOLITION, REMOVAL, AND DISMANTLING

When specified in the drawing or the Engineer, existing concrete and/or stone masonry structures, such as concrete masses, stones, etc., shall be demolished and disposed of accordingly.

#### 4-05 FOUNDATION PREPARATION

##### (a) Fill on Earth

All horizontal and sloped earth surfaces, upon which embankment material is to be placed or other foundation surfaces whose locations are specifically indicated by the Engineer, shall

consist of undisturbed or compacted material and shall be clean, damp, free from standing or running water and free from organic matter; and shall be suitable as a foundation for the material to be placed upon them.

(b) Concrete and/or Stone Masonry

All horizontal and sloped earth surfaces upon which concrete and/or stone masonry is to be placed shall be undisturbed or of approved compaction, clean and damp, free from standing or running water, and shall be otherwise suitable as a foundation for the concrete and/or stone masonry to be placed upon them.

4-06 MEASUREMENT FOR PAYMENT

Open Excavation

A survey of the areas to be excavated shall be made by the Contractor prior to the commencement of the work under this Contract, and all measurements of excavation shall be based on this survey without regard to any change that may occur during the prosecution of the work. All such surveys shall be the subject to check and approval by the Engineer. Volumes will be computed and shall be the amount between the original ground determined by the survey and the slopes, lines and grades shown on the drawings or established by the Engineer.

## PART 5 BACKFILL AND EARTHFILL

### 5-01 SCOPE

In accordance with the specifications contained in this section and as shown in the drawings or otherwise directed by the Engineer, the Contractor shall furnish and place the earthfill for construction work, backfill for related structures. Any work of fill and backfill shall not commenced without prior approval of the Engineer. The slope of the embankment shall be finished to the designed gradient by providing fixed rules.

### 5-02 EARTHFILL

The earthfills shall be constructed to the lines, grades and cross sections indicated on the drawings, unless otherwise directed by Engineer. The Engineer may increase or decrease the slopes of the fill or make such other changes in the design as may be deemed necessary to produce a stable structure. Change in quantities of materials resulting from prescribed changes in section, shall not make cause for claims for increased unit prices. Generally, a tolerance of plus or minus 0.05 meter from the slope lines and grades shown on the drawings will be allowed in the finished surfaces of the embankments except that the tolerances shall not be continuous over an area greater than twenty (20) square meters.

The fill material shall be dumped and spread in horizontal layers having an uncompacted thickness of not over 20 cm. When material is spread, chunks larger than 10 cm in size shall be broken down by approved means or removed.

### 5-03 BACKFILL

Backfill, as used herein, is defined as refill for structures. The materials used for backfill for structures shall be free from roots, stones of more than five (5) centimeters in diameter, and other objectionable materials and subject to the approval of the Engineer. Backfill



materials shall be placed in layers, each layer being not more than twenty (20) centimeters thick before compaction, thoroughly compacted by means of power tampers or by other means of approved by the Engineer.

5-04 MEASUREMENT FOR PAYMENT

(1) Earthfill

(a) Measurement:

Measurement for payment of earth fill will be calculated on the number of cubic meters of material placed between the foundation lines as determined on the basis on drawings or a survey made after completion of the excavation and foundation preparation and the lines, grades and slopes shown on the drawings. No allowance will be made for foundation or embankment settlement.

(b) Payment

Payment shall constitute full compensation for all work in connection with the excavation from borrow areas including clearing, grubbing and stripping of borrow areas, hauling, stock-piling, rehandling, foundation preparation, placing, spreading, sprinkling, drying, breaking up, compacting, removal of objectionable material, and all other work required for the construction, protection and maintenance of the fills. No adjustment in payment will be made for substitution of materials and for additional compaction.

(2) Backfill

Measurement for payment of backfill shall be calculated on the number of cubic meters of materials placed among the original ground line, or designated line of backfill and the structure and the neat pay lines of excavation shown in the drawings. Payment will be made on the unit price bid per cubic meter of backfill.

PART 6 STONE MASONRY WORK

6-01 SCOPE

In accordance with the specifications contained in this Part, and as shown on the drawings or as otherwise directed, the Contractor shall furnish all plant, labor, equipment and materials, and perform all operations in connection with the construction of stone masonry.

6-02 MATERIAL

(a) General

Samples of stone proposed for use as provided herein shall be submitted to the Engineer for approval prior to delivery of any such material to the site of work. Unless otherwise specified, all samples shall be obtained by the Contractor and delivered at his expense to a point designated by the Engineer at least 20 days in advance of the time when the placing of the material is expected to begin.

(b) Sand for Mortar

Sand for mortar shall conform to the requirements for PART 7 relative to fine aggregate for concrete.

6-03 FOUNDATION PREPARATION

Areas on which stone work is to be done shall be prepared in accordance with the requirements of PART 4. Where such areas was excavated below the designed line for foundation, they shall be brought to grade by filling with gravel or other materials approved by the Engineer and well compacted, and no additional payment will be made for foundation preparation and any materials thus required.

In the same manner, when such areas are above the designed line for foundation, said areas be brought to grade and the foundation similarly prepared without additional payment.

#### 6-04 STONE MASONRY

##### (a) General

Stone masonry shall be placed at the locations as are indicated on the drawings or otherwise directed. Mortar, sand and stone shall conform to the applicable requirements of paragraph 6-02 as to quality and physical properties. Mortar cement shall conform to the applicable requirements of PART 7. The stone shall be kept free from dirt, oil, or any other injurious material which may prevent the proper adhesion of the mortar. Individual stones shall have a thickness of not less than 10 centimeters.

##### (b) Construction

Mortar shall be one (1) part cement and three (3) parts sand in volume unless otherwise provided. All shaping or dressing of stone shall be done before the stone is laid, and no dressing or hammering which will loosen the stone will be permitted after it is placed. Each stone shall be cleaned and moistened with water before being set. All stones shall be well bedded in freshly-made mortar. After completion, in case any stone is moved or the joint broken, the stone shall be removed, the mortar shall be thoroughly cleaned from bed and joints, and the stone reset in fresh mortar.

#### 6-05 MEASUREMENT FOR PAYMENT

Measurement for payment for stone masonry will be based on the number of cubic meters acceptably placed as computed from the neat lines and grades indicated on the drawings or as directed in the field.

PART 7 CONCRETE WORK

7-01 SCOPE

In accordance with the specifications contained herein and as shown on the detail drawings or otherwise directed, the Contractor shall:

- (a) Furnish all materials, and manufacture, transport, place, finish, protect and cure concrete;
- (b) Furnish, construct, erect and dismantle forms;
- (c) Construct expansion and contraction joints and furnish and place waterstops, joint fillers, and sealing compound, if required; and,
- (d) Prepare, clean, cut, bend and place steel reinforcement.

7-02 CEMENT

(a) General

Cement for mortar and concrete work shall be Portland Cement which conforms to the requirements of the Standard Specifications for Portland Cement (A.S.T.M. Designated C150-69).

(b) Storage

Cement shall be stored in a dry, weather tight and properly ventilated warehouse with adequate provisions for the prevention of absorption of moisture. All storage facilities shall be subject to approval and shall be such as to permit easy access for inspection and identification. Cement which has been stored for more than one month or which are suspected to be damp shall not be used unless otherwise approved by the Engineer.

7-03 FINE AGGREGATE

(a) Composition

Fine aggregate shall be natural sand not including organic matter and other foreign substances.

(b) Quality

Fine aggregate shall consist of hard, tough, durable, uncoated particles. The shape of the particles shall be generally rounded or cubical and reasonably free from flat or elongated pieces. The fine aggregate shall conform to the following specific requirements:

1. Grading - Fine aggregate shall be well graded from fine to coarse and the gradation shall conform to the following requirements as delivered to the mixers:

<u>Sieve Designation</u> <u>U.S. Std. Square Mesh</u>	<u>Cumulative Percentage</u> <u>by Weight Passing</u>
No. 4	95 - 100
No. 16	60 - 75
No. 100	2 - 10

In addition to the grading limits shown above, the fineness modulus shall be in the range from 2.30 to 3.0.

(c) Storage

Fine aggregate shall be stored in such a manner as to avoid the inclusion of any foreign material in the concrete. Sufficient live storage shall be maintained at all times to permit continuous placement of concrete at the rate specified.

7-04 COARSE AGGREGATE

(a) Composition

Coarse aggregate shall consist of gravel, crushed gravel or rock, or a combination of gravel and crushed gravel or rock.

(b) Quality and Grading

1. Quality - Coarse aggregate shall consist of hard, tough, durable, clean and uncoated particles. All foreign materials and dust shall be removed by adequate processing. The particle shape of the smallest size of crushed coarse aggregate shall be generally rounded or cubical, and the coarse aggregate shall be reasonably free from flat and elongated particles in all sizes.
2. Grading - The coarse aggregate shall be well graded from fine to coarse. The grading of the aggregate as delivered to the mixer shall be as follows:

Sieve Designation U.S. Std. Sq. Mesh	Per Cent by Wt. Passing Individual Sieves <u>3/4" Max.</u>
1"	100
3/4"	90 - 100
3/8"	20 - 55

3. Size - Unless otherwise directed, the maximum sizes of coarse aggregate to be used in the various parts of the work shall be 3/4 inch.
4. Storage - Storage of coarse aggregates shall be as that specified in paragraph 7-03(c) for fine aggregates.

#### 7-05 AGGREGATE SAMPLES

Samples of the aggregate shall be furnished at a point designated by the engineer for his approval at least ten (10) days in advance of the time when the placing of concrete is expected to begin.

#### 7-06 WATER

Water used in mixing concrete shall be fresh, clean and free from injurious amount of oil, acid, alkali, salts, or organic matter.

#### 7-07 PROPORTIONING OF CONCRETE

(a) The Contractor shall design the mix proportion for every class of concrete placing for the approval of the Engineer. The Contractor shall carry out the mix test in case being requested by the Engineer. The test is to be made at the expense of the Contractor.

(b) The compressive strength of the age of 28 days shall be as follows and desirable mix proportion is also indicated.

Class	Minimum 28 days Compressive Strength	Mixing proportion by volume cement: fine aggregates: coarse aggregates
A (Reinforced Concrete)	210 kg/cm <sup>2</sup>	1 : 2 : 4
B (Plain Concrete)	160 kg/cm <sup>2</sup>	1 : 3 : 6
C (Concrete Layer)	135 kg/cm <sup>2</sup>	1 : 4 : 6

Other proportions for mixed design may be indicated by the Engineer at the site of work, if it is necessary.

7-08 MIXING

(a) Equipment

Concrete shall be mixed by portable concrete mixer unless otherwise approved by the Engineer.

(b) Measurement

The measurement of every ingredient of concrete shall be made in weight. Nevertheless, the measurement in volume is admitted subject to the approval of the Engineer.

(c) Mixing Time and Method

The mixing time of concrete shall be more than two (2) minutes and less than five minutes. Over mixing, requiring the introduction of additional water to preserve the required consistency, will not be permitted. The mixer shall be completely emptied before receiving the materials for the succeeding batch and shall be kept clean and washed out after stopping work at the end of each shift.

On commencing work, the first batch shall contain sufficient excess of cement, sand and water to coat the inside of the drum to avoid the reduction of the required mortar content of the mix.

7-09 CONVEYING

(a) General

Concrete shall be conveyed from mixer to forms, as rapidly as practicable, by methods which will prevent segregation or loss of ingredients. There shall be no vertical drop greater than 1.5 meters



except where suitable equipment is provided to prevent segregation and where specifically authorized. Belt conveyors, chutes or other similar equipment in which the concrete is delivered to the structure in a thin, continuously exposed flow, will not be permitted except for very limited or isolated sections of the work. Such equipment shall be arranged to prevent objectionable segregation.

#### 7-10 PLACING

##### (a) Approval

Approval of the Engineer shall be obtained before starting any concrete pour.

##### (b) General

Concrete shall be worked into the corners and angles of the forms and around all reinforcement and embedded items without permitting the material to segregate. Not more than three (3) cubic meters shall be deposited in one pile for compaction. Free water shall be collected in depressions away from the forms and removed by bailing prior to placement of additional concrete. All concrete placing equipment and methods shall be subject to approval.

##### (c) Cooling of Aggregates

The aggregate shall be cooled by wetting if it is drier than the condition known as saturated, surface dry.

##### (d) Concrete on Earth Foundation

All concrete shall be placed upon clean, damp surfaces free from standing or running water. Prior to placing concrete, the earth foundation shall be satisfactorily compacted in accordance with approved methods.

(e) Concrete on Other Concrete

Surface upon or against which concrete is to be placed shall be clean, free from oil, standing or running water, mud, drummy rock, objectionable coatings, debris, and loose, semi-detached or unsound fragments. To insure a firm and tight bond between fresh concrete and other concrete, concrete surfaces, where necessary, shall be chipped or roughened as directed by the Engineer. All surfaces shall be wetted thoroughly to keep them in a completely moist condition before placing concrete. All approximately horizontal surfaces shall be covered with a layer of mortar of the same-sand ratio as used in the concrete mix before the concrete is placed.

(f) Consolidation of Concrete

Concrete shall be placed and consolidated with the aid of mechanical vibrating equipment or of hand-spading and tamping. In no case shall vibrators be used to transport concrete inside the forms. In placing concrete through reinforcement, care shall be taken that no segregation of the coarse aggregate occurs.

7-11 FORMS

(a) General

Forms shall be used, wherever necessary, to confine the concrete and shape it to the required lines, or insure against contamination of the concrete. Forms shall have sufficient strength to withstand the pressure resulting from placement and vibration of the concrete, and shall be maintained rigidly in correct position. Forms shall be sufficiently tight to prevent loss of mortar from the concrete. Forms for exposed surfaces against which backfill is not to be placed shall be lined with a form grade plywood or sheet steel. Steel panel forms may also be used.

(b) Cleaning and Oiling of Forms

At the time concrete is placed in the forms, the surfaces of the forms shall be free from incrustations of mortar, grout, or other foreign material that would contaminate the concrete or interfere with the fulfillment of the Specifications' requirements relative to the finish of formed surfaces. Before concrete is placed, the surfaces of the forms shall be oiled with a commercial form oil that will effectively prevent sticking and will not stain the concrete surfaces.

(c) Removal of Forms

Forms shall be removed as soon as practicable in order to avoid delay in curing and to make possible earliest practicable repair of surface imperfections, but in no case shall they be removed before approval. Any needed repair or treatment shall be performed at once, and shall be followed immediately by the specified curing. Forms shall be removed with care so as to avoid injury to the concrete, and any concrete so damaged shall be repaired.

7-12 CURING AND PROTECTION

(a) General

All concrete shall be moist cured for a period of not less than seven (7) consecutive days by an approved method or combination of methods applicable to local conditions, except that the curing period may be reduced to three days for concrete made with high-early-strength cement. The Contractor shall have all equipment needed for adequate curing and protection of the concrete on hand and ready to install before actual concrete placement begins.

(b) Water Curing

Concrete shall be kept wet by covering with an approved, water-saturated material or by a system of perforated pipes or mechanical sprinklers or by any other approved method which will keep all surfaces continuously (not periodically) wet. Water for curing shall be generally clean and free from any element which might cause objectionable staining or discoloration of the concrete.

7-13 REPAIR OF CONCRETE

Repair of imperfections in formed concrete shall be completed within twenty four (24) hours after removal of forms at no additional cost to JICA. Fins shall be neatly removed from exposed surfaces. Concrete that is damaged or honeycombed must be removed to sound concrete and replaced with drypack, mortar, or concrete as hereinafter specified. Where large bulges and abrupt irregularities protrude, the protrusions shall be reduced by bush-hammering and grinding. Drypack filling shall be used for holes left by the removal of fasteners from the ends of form tie rods.

7-14 DRYPACK MORTAR

Drypack shall consist of a mixture (by dry volume or weight) of one (1) part cement to 2-1/2 parts of sand conforming to paragraph 7-03, Fine Aggregate, except that in gradation, 100% shall pass a No.16 sieve. Only enough water shall be used to produce a mortar which, when used, shall stick together on being molded into a ball by a slight pressure of the hands, and shall not extrude water but will leave the hands damp.

(a) General

The Contractor shall furnish deformed steel bar in accordance with the drawings and these specifications. The Contractor shall prepare, clean, cut, bend and place all reinforcements, as shown on the detail drawings or as otherwise directed. The Contractor shall furnish all chains, supports and ties. All reinforcement shall be reasonably free from loose, flaky rust and scale, and free from oil, grease and other coating which might destroy or reduce its bond with concrete.

(b) Relationship of Reinforcement to Concrete Surfaces

The distance from the edge of the main reinforcement to the concrete surface shall be 5 cm except such portions as shown in the drawings. The concrete covering the stirrups, spacer bars, and similar secondary reinforcement may be reduced by the diameter of such bars, unless otherwise indicated.

(c) Lapping

Lapping length at joints of the reinforcing bar shall be at least thirty times of the diameter of bar and shall be bound by steel wire.

(d) Supports

All reinforcements shall be secured in place by use of metal or concrete supports, spacers or ties. Such supports shall be of sufficient strength to maintain the reinforcement in place throughout the concrete operation. The supports shall be used in such a manner that they will not be exposed or contribute in any way to the discoloration or deterioration of the concrete.

7-16 MEASUREMENT FOR PAYMENT

(a) Concrete

1. Measurement for payment for plain or reinforced concrete, will be based on the volume of concrete in place within the lines and grades shown on the drawings.
2. No deduction will be made for rounded or bevelled edges, or space occupied by metal work, or embedded items such as supports, spacers or ties. The cost of construction joint treatment with the attendant loss of material shall be included in the unit price bid per cubic meter of concrete.
3. Payment at the unit prices bid shall constitute full payment for all costs for concrete work. The costs of any dewatering required to maintain dry conditions during the pouring of concrete, furnishing materials, and installing and removing formwork, shall be included in the item of GENERAL WORKS as indicated in the Bill of Quantities.

(b) Steel Reinforcement

Measurement for payment for furnishing, preparing bar cleaning, cutting, bending, and placing steel reinforcement by the Contractor will be based on the number of kilograms placed in accordance with the detail drawings or as otherwise directed. Payment will be made for steel in laps as shown on the drawings; where bars are welded, payment will be made as if they were lapped. Payment will not be made for steel in laps or used which are solely for the convenience of the Contractor. Payment will be made at the unit price bid for steel reinforcement. No separate payment will be made for steel reinforcement supports, and the cost thereof shall be included in the unit price bid.

7-17 WATERPROOFING WORK

(a) General

Waterproofing shall be performed to the lines and grades shown on the drawings for the following structures :

1. Existing settling box
2. Existing 1st water tank

(b) Material for Waterproof Mortar

Sand and cement shall conform to the requirements for PART 7 relative to fine aggregate and cement. As to the waterproof agent, the MANOR or local mortar agent equivalent to JIS-A6101 can be used.

(c) Construction

Waterproofing mortar shall be placed at the inside walls and floor with the thickness of 1.5 cm after chipping work of the inside concrete surface as shown on the drawings or as otherwise directed by the Engineer.

The mortar shall be one (1) part cement and three (3) parts sand in volume unless otherwise provided. Mixing rate of waterproof agent shall be three percent (3%) of cement weight. The mixing proportion per 10.0 m<sup>2</sup> is shown as follows ;

Cement	Fine aggregate	Waterproof agent
90 kg	0.18 m <sup>3</sup>	2.7 kg

## PART 8 PIPELINE WORKS

### 8-1 SCOPE

This part deals with matters of pipeline works from the intake weir to the inlet tank. Carbon steel pipes, valves and appurtenances shall be supplied by the JICA and they are described in the attached list. The contractor shall furnish all pipe materials required except for the pipe materials in the list.

The Contractor shall furnish all labor, materials, equipment and supplies needed for the construction of these pipelines above mentioned and perform installation and testing of them at the site in accordance with Specifications and Drawings.

Pipe materials including gate valves and stop valves proposed by the Contractor shall be submitted to the Engineer for approval prior to delivery of and such material to the site of work. The Contractor shall furnish such materials under the drawings, specification or the direction by the Engineer considering the required bearing water pressure.

### 8-2 Installation

#### (a) General

This new pipe line works shall be executed in parallel with the using of existing pipeline, therefore the Contractor shall prepare the bypass pipes as temporary works in accordance with the procedure of pipe installation works and improvement work of existing water tanks.

#### (b) Excavation of trench

The section of excavation for laying pipes are shown on the Drawings. The excavatkon of trenches shall be made in accordance with specification described in Part 4. Additional costs for the



excavation exceed the limits and backfill to such sections other than by direction of the Engineer shall be borne by the Contractor.

(c) Pipe bedding

The Contractor shall make pipe beds for pipelines as shown on the Drawings.

The bedding material shall be carefully placed on the bottom of the prepared trench, hand tamped and shaped to fit the lower portion of the pipe conduit barrel. Care shall be taken to ensure that the pipe will be uniformly supported on the bedding material.

(d) Pipe joints

Joints for pipe shall be steel welding pipe flange type for high water pressure more than 100 meter and screwed type for less than 100 meter.

In case of flange type, the flange material shall be conformed to the requirements of the standard for Steel Welding Pipe Flanges of JIS B2220.

The contractor shall furnish such flanges including packings, vaults, etc. at necessary places shown on the drawings except for supply by JICA.

In case of screwed type steel pipe fittings, they shall be conformed to the requirement of the standard for JIS B 2302.

Joints shall construct the jointing in accordance with the manufacture's technical instruction. In making connections, dirt, moisture and oil shall be cleaned from pipe and fittings. After cleaning, all joint parts shall be painted with asphalt including flanges. Particular care shall be taken not to overstress threaded connections at joint.

(e) Pipe cutting

When cuts are necessary, they shall be perpendicular to the

axis of the pipe and smooth. Cut shall be made with tools in conformity with the pipe manufacture's recommendations.

(f) Appurtenant equipment

Such as gate valves and rappid air valves shall be installed in accordance with the Engineer's instruction.

(g) Protection device

Such as concrete thrust block or locking device shall be done in accordance with the Drawings.

(h) Running test

After completion of pipe installation, running test shall be executed by the contractor and checked by the Engineer. When the Engineer will approve the result of running test as a satisfactory, the works may be regarded as completion. In case of no approval by the Engineer, the contractor shall repair or improve any part of defect in the construction by the order of the Engineer at the cost of the contractor. Above cost for running test shall be included in the item of GENERAL WORKS in the Bill of Quantities.

(i) LIST OF MATERIALS & EQUIPMENT SUPPLY BY JICA  
 ( To Be Purchased in Japan )

<u>Item / Description</u>	<u>Quantity</u>
<b>1. Pipeline &amp; Related Facilities</b>	
<u>Bended Pipes</u>	
SGP 65A, 2F, coated, less than 30°	11 nos.
" , " , " , 55°	1 no.
" , " , " , 85°	1 no.
SGP 65A, with socket, coated, less than 30°	12 nos.
SGP 50A, with socket, coated, less than 30°	21 nos.
SGP 50A, with socket, coated, more than 30°	5 nos.
STPG 50A, 2F, coated, less than 30°	32 nos.
" , " , " , more than 30°	6 nos.
<u>Special Processed Tee</u>	
STPG 50A, 3F, coated	1 no.
<u>Valves</u>	
Gate valve 50A, 20K, JIS B2083	7 nos.
<u>Rapid Air Valve</u>	
∅ 25, FC, 65A, with fitting pipe	2 nos.
∅ 25, FC, 50A, "	2 nos.
∅ 25, FCD, 50A, "	3 nos.
∅ 25, SCPH, 50A, "	2 nos.
<u>Steel Expansion Flexible Joint</u>	
Victoric joint S-1, Shoulder type ∅ 40A	2 set
" , " ∅ 50A	4 sets
" , " ∅ 65A	2 set
<b>2. Water Supply Facilities</b>	
Stop valve ∅ 50A, JIS B2062	1 no.

(3) LIST OF MATERIALS & EQUIPMENT SUPPLY BY JICA  
 ( To Be Purchased in Indonesia )

<u>Item / Description</u>	<u>Quantity</u>
1. Pipeline Facilities	
Piping materials	
<u>Long piece pipe (with accessories)</u>	
SGP 65A, 2F, coated, L=6 m	45 pcs.
SGP 65A, socket, coated, L=6 m	44 pcs.
SGP 50A, Socket, coated, L=6 m	271 pcs.
STPG 50A, 2F, coated, L=6 m	298 pcs.
<u>Short piece pipe (with accessories)</u>	
SGP 65A, 2F, coated, L=2 m (mean length)	18 pcs.
SGP 65A, socket, coated, L=2 m (mean length)	10 pcs.
SGP 50A, socket, coated, L=2 m ( " )	40 pcs.
STPG 50A, 2F, coated, L=2 m ( " )	26 pcs.
<u>Tee pipe</u>	
FSGP 65x65x65, 3F, JIS B2311, with short piece pipe	1 nos.
FSGP 65x65x50, 3F, JIS B2311, "	2 nos.
FSGP 50x50x50, 3F, JIS B2311, "	3 nos.
STPG 50x50x50, 3F, JIS B2312, "	5 nos.
2. Inland Transportation	
Materials for Pipeline Facilities	1 L.S.

PART 9 COW SHED

9-01 SCOPE

In accordance with the Specifications and as shown on the drawings or otherwise directed by the Engineer, the Contractor shall furnish labor, equipment and materials and perform all operations in connection with the construction of buildings, including earthworks, grading of the houses foundation, concrete works, construction of column, walls, roof, windows, doors, finishings, electrical facilities, water supply facilities and other related works and facilities.

9-02 MATERIALS

All materials used in the building works shall be subject to the Engineer's approval. The Contractor shall submit the Engineer, samples of said materials prior to commencement of relative works for his approval.

9-03 BRICK WORK

Local products can be used and all bricks shall be laid after applying mortar. Mortar shall be prepared in the same way as for plastering. It shall be applied firmly to raked out and well wetted joints with a pointing trowel and well pressed in. All superfluous mortar shall be removed with a trowel.

External surfaces shall be finished with weather struck pointing and internal surfaces given flush pointing.

9-04 CARPENTRY

(a) The work under this paragraph consists of all carpentry works as shown in the drawings.

(b) Local timber can be used. All timber shall be sufficiently seasoned and planned smooth, straight true and free from cracks, cuts, breaks, loose or dead knots, borehole, and any other defect. Metal fittings suitable to local timbers shall be used. As to the floor material, camphor wood shall be used.

(c) All frameworks shall be jointed by optimum jointing methods. Joints shall transmit required loads and withstand stresses, to which they will be subjected and shall be approved by the Engineer. Unless otherwise stated, all joints shall be fixed with as many nails of a proper type as required.

For columns, studs, beams, binders, joists, rafters, and purlins, one piece of timber extended between the supports or the base on which it is to be fitted shall be used. However, when inevitably it is necessary to joint at an intermediate position, such a method that has been approved to cause no hindrance in structure shall be employed.

9-05 ROOFING

Local asbestos sheets can be used and the construction method shall conform to Indonesian specifications.

Wooden door and window work --- Wood fittings shown in drawings shall be manufactured in Indonesia by local timber.

Articles of builders hardware shall be of approved type and well finished. Samples shall be submitted to the Engineer for approval before use. Screws shall be of the same metal as the main article.

All articles shall be fixed in a secure and efficient manner. Articles damaged during fixing shall be removed and new fixed at Contractor's expense. Surface of joinery where effected shall be made good.

Glass shall be 3 millimeters sheet glass of good quality, free from specks, bubbles, air holes and other defects. Sheet glass shall be plain, clear. The glass panes shall be fixed either with wood beads or shall be bedded in oil putty, sprigged, firmly back puttied finished to a chamfer. Rabbets shall be painted one coat of oil paint before glazing. Each pane shall be whole square.

#### 9-06 PAINTING

Painting shall not be carried out to exterior surfaces in wet weather. All surfaces must be thoroughly dry before applying paint. Painting shall not be carried out in windy weather as the paint is likely to be damaged by dust.

Contents of drums or tins shall be stirred well before using. When more than one coat is required to be done, each coat shall vary slightly in shade and shall be passed by the Engineer before the next coat is started. First coat should be thoroughly dry before the second coat is applied.

All brushes, tools, pots, etc. used in carrying out the work shall be clean and free from foreign matter and shall be thoroughly cleaned out before being used for different type of material. Paint shall be applied with proper paint brushes of good quality.

In using proprietary brands of paint, the materials shall be mixed, prepared and applied strictly in accordance with manufacturer's instructions.

9-07 ELECTRICAL AND WATER SUPPLY WORKS

All electrical works and water supply works shall be as shown on the drawings and Indonesian standard specifications or directed by the Engineer.



PART 10 OTHER RELATED FACILITIES

10-01 GENERAL

The construction of model infrastructure improvement works include, under this contract, construction works for appurtenant structure, besides main pipeline and cow shed facility such as improvement works of intake, existing water tanks, farm road and operation road, and construction of slurry tanks, water supply pipe, feed pipe, inlet tank, slow filter, distributing tank, water valves, fencing works, waterproofing, drainage culvert, etc.

The majority of the appurtenant structures shall be either stone masonry structure or concrete structure or road structure, which shall be constructed by means of either the combination of earth work and stone masonry work or that of earth work and concrete, asphalt work, pipe work.

From the view-point stated above, the specification contained in this part describes mainly special conditions for each work.

10-02 INTAKE FACILITIES

The improvement works of intake facilities comprise as follows:

1. Improvement of the foot protection and apron of existing masonry weir with masonry concrete
2. Installation of screen with steel bars
3. Protection of the intake pipe with masonry concrete
4. Ground levelling works for the treatment place of driftwoods
5. Installation of gate valves

$\phi$ 100, JIS B 2031, 1 pce, for main pipe

$\phi$  65, JIS B 2031, 1 pce, for main pipe

$\phi$  65, JIS B 2031, 1 pce, for drain pipe of settling box

Above valves and related short piece of steel pipes shall be furnished by the Contractor.

6. Improvement of settling box including mortar plastering work by water proof mortar, construction of valve boxes with steel cover
7. Installation of drain pipe, VP  $\phi$  100
8. Removal works for existing pipes at the place of inlet, outlet, drain in the settling box

10-03 PIPELINE FACILITIES

Pipes, high pressure valves and air valves shall be supplied by JICA as shown in PART 9 for main pipeline from the beginning point (No 0 + 14.99) to the inlet box (NO 42 + 30).

The Contractor shall price required temporary facilities for pipe installation works including road maintenance in the item of GENERAL WORKS in the Bill of Quantities.

If there is a shortage of main pipes supplied by JICA, the Contractor shall furnish that parts by the direction of the Engineer.

Gate valves except for high pressure valve (7 pieces) and air valves (9 pieces) shall be furnished by the Contractor.

This pipe line works comprise as follows :

1. Installation of main pipe ( $\phi$ 65,  $\phi$ 50) including concrete anchor and steel support
2. Installation of blow off valves, gate valves and rappid air valves
3. Installation of drain pipe, VP  $\phi$ 65
4. Construction of inspection road with gravel metaling
5. Improvement of 1st water tanks including fence work
6. Removal works for existing pipes at the place of 1st tank
7. Others

10-04 WATER SUPPLY FACILITIES

For the purpose of the improvement of water supply system in the A.I center, the following works shall be executed.

A submerged gate valve itself shall be supplied by the JICA, therefore other all required materials as shown on the drawings shall be furnished by the Contractor.

As to the water supply pipe, all parts shall be newly installed, however feed pipe shall be installed up to the outside of houses and buildings.

As to the water supply pipe for goat feeding facilities, a part of existing water pipe can be used as shown on the drawings.

This improvement and construction works comprise as follows:

1. Construction of inlet tank, filter and distributing tank and related structures including washing structure for filter materials and fence work.
2. Installation of water supply pipe
3. Installation of feed pipe including PVC pipe
4. Improvement of 2nd water tank
5. Improvement of inspection road with asphalt metaling specified by the drawing at the place from 2nd water tank to new inlet tank
6. Other

As to the slow filter materials, the thickness of sand layer and the quality shall be specified as follows:

1. The thickness of sand layer shall be 80 cm.
2. The quality of filter material shall be specified by the standard of water supply services in Indonesia or JWWA A103-1967, Testing method of sand filter for water supply services in Japan.

3. Sand filter shall consist of hard, tough, durable, uncoated particles including much quartz material.
4. The effective grain size shall be 0.3 to 0.45 mm.
5. The uniformity coefficient shall be less than 2.0.
6. Washing turbidity shall be less than 30.
7. Specific gravity shall be 2.55 to 2.65.
8. Maximum grain size shall be 2.0 mm.

The thickness of gravel layer and gravel filter shall be specified as follows:

1. The thickness of gravel shall be 50 cm.
2. The gravel filter with the maximum grain size 60 mm and minimum grain size 3 mm shall be separated into four (4) layers using screen or sieves.
3. Coarse material shall be spread in lower layer and fine material in upper layer in good sequence.
4. The thickness and mean grain size are shown as follows:

Surface layer :  $\phi$  3 ~ 4 mm : 10 cm

2nd layer :  $\phi$  10 ~ 20 mm : 10 cm

3rd layer :  $\phi$  20 ~ 30 mm : 15 cm

Bottom layer :  $\phi$  60 mm : 15 cm

As to the porous brick specified on the drawing, they can be changed to the concrete block with holes by the approval of the Engineer, however the cost for this item shall not be changed.

#### 10-05 COW SHED FACILITIES

All of this facilities are newly constructed at the lower place of A.I Center as shown on the drawings. The major works comprise as follows.

1. Construction of cow shed
2. Construction of training shed
3. Ground levelling works
4. Electric fence and wooden fence including entrances
5. Approaching road with gravel metaling for tractor
6. Water supply and electric service works
7. Other

10-06 SLURRY STORE

Three slurry stores shall be newly constructed near existing two bull sheds and new cow shed.

The structures are specified on the drawings.

10-07 FARM ROAD

Improvement of farm road is consists of new construction parts and improvement parts. The contractor shall execute the work to the lines and grades given by the drawings and/or the Engineer including gravel metaling, sodding, culvert, under drain pipe and entrance road to each pasture field.

10-08 OTHER RELATED FACILITIES

Two drinking facilities shall be furnished under this contract. One is used for farmer and the other for bulles in paddock. The structure is specified on the drawings.





CHAPTER 6 ATTACHED DRAWINGS



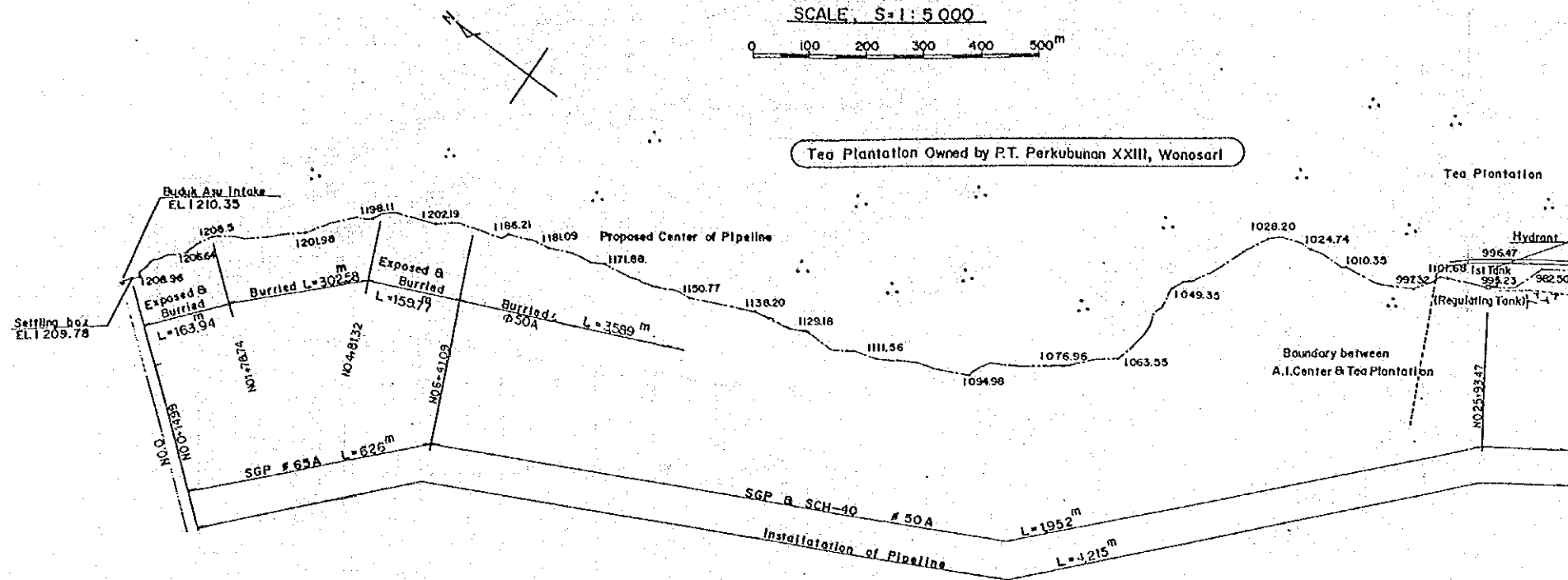


## DRAWING LIST

No.	TITLE OF DRAWING
1	GENERAL PLAN
<u>PIPELINE FACILITIES AND RELATED STRUCTURES.</u>	
2	PLAN & PROFILE ,INSTALLATION OF PIPELINE 1/4
3	— ditto — 2/4
4	— ditto — 3/4
5	— ditto — 4/4
6	PLAN OF IMPROVEMENT OF INTAKE,SETTLING BOX & REGULATING TANK.
7	PIPE SUPPORT ,BLOW OFF PIT,AIR VALVE PIT & IMPROVEMENT OF 2nd TANK
8	INSTALLATION SCHEDULE FOR PIPELINE 1/2
9	— ditto — 2/2
<u>IMPROVEMENT OF WATER SUPPLY FACILITIES</u>	
10	INLET TANK
11	BAR SCHEDULE OF INLET TANK
12	FILTER TANK
13	BAR SCHEDULE OF FILTER TANK
14	DISTRIBUTING TANK
15	BAR SCHEDULE OF DISTRIBUTING TANK
16	SAND WASHING PLACE AND MISCELLANEOUS
17	PLAN OF PIPE ARRANGEMENT FOR WATER SUPPLY AT. A. I. CENTER
18	HYDRAULIC PROFILE OF WATER SUPPLY FACILITIES 1/2
19	— ditto — 2/2
20	DIAGRAM OF PROPOSED PIPE ARRANGEMENT IN A. I. CENTER
<u>CONSTRUCTION OF COW SHED FACILITIES</u>	
21	ARRANGEMENT OF CATTLE SHED FACILITIES
22	COW SHED FACILITIES 1/3 (GENERAL PLAN,DETAIL OF COW SHED)
23	— ditto — 2/3 (SECTION DETAIL OF COW SHED,DETAIL OF FENCE)
24	— ditto — 3/3 (DETAIL OF TRAINING SHED)
<u>CONSTRUCTION OF SLURRY STORE</u>	
25	SLURRY STORE FOR BULL SHED TYPE-I
26	— ditto — TYPE-II
27	SLURRY STORE FOR COW SHED & DRINKING FACILITY FOR PADDOCK
<u>IMPROVEMENT OF FARM ROAD</u>	
28	PLAN OF IMPROVEMENT OF FARM ROAD AND INSPECTION ROAD TO INLET TANK
29	DRAINAGE CULVERT CROSSING FARM ROAD TYPE-A
30	OUTLINE OF VALVE ARRANGEMENT

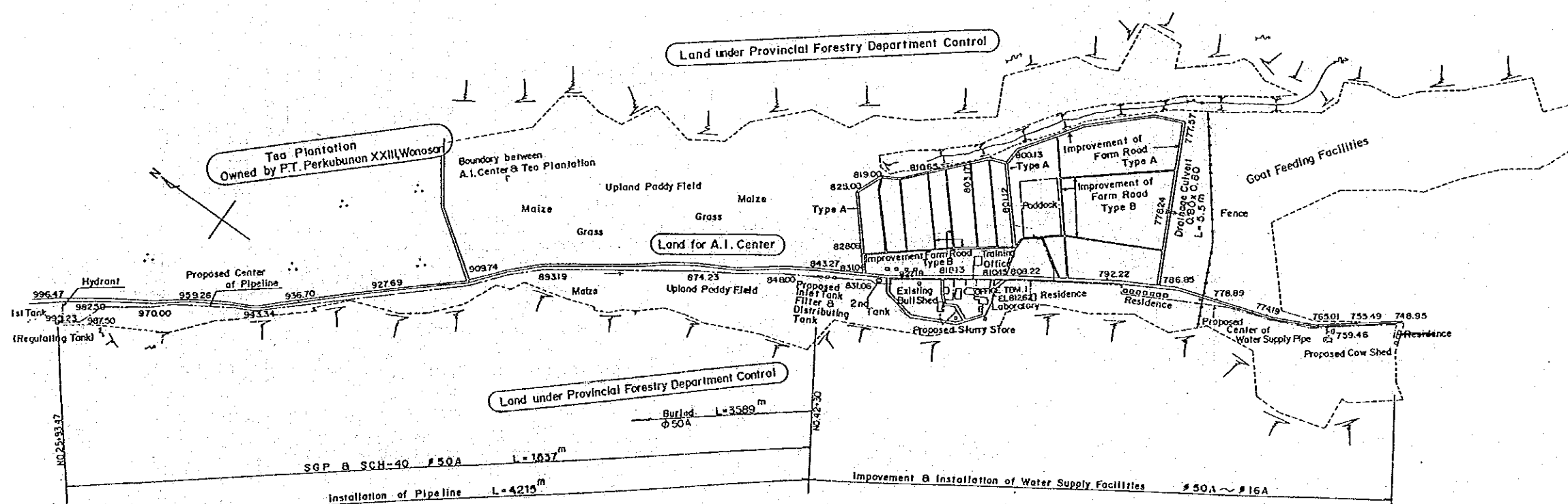
**GENERAL PLAN  
OF  
THE STRENGTHENING OF ARTIFICIAL INSEMINATION CENTER PROJECT**

SCALE S=1:5 000



**THE MODEL INFRASTRUCTURE IMPROVEMENT WORKS FOR THE STRENGTHENING OF ARTIFICIAL INSEMINATION CENTER PROJECT**

- 1. IMPROVEMENT OF INTAKE, PIPELINE & RELATED STRUCTURES**
  1. Improvement of Intake 1 place
  2. Improvement of settling box 1 place
- 2. IMPROVEMENT OF PIPELINE FACILITIES**
  1. Installation of pipeline 4.2 km
  2. Improvement of related structures 1 L.S.
- 3. IMPROVEMENT OF WATER SUPPLY FACILITIES**
  1. Inlet, filter and distributing tanks 3 tanks
  2. Installation of water supply pipes 2.0 km
  3. Installation of feed pipes 1.0 km
  4. Improvement of related structures 1 L.S.
- 4. CONSTRUCTION OF COW SHED FACILITIES**
  1. Cow shed and Training shed 2 houses
  2. Related structures 1 L.S.
- 5. CONSTRUCTION OF SLURRY STORE**
  1. Slurry store 3 tanks
  2. Drain structures 122 m
- 6. IMPROVEMENT OF FARM ROAD**
  1. Farm road Type A B=3.5m 1.5 km
  2. Farm road Type B B=3.0m 2.3 km
- 7. OTHER RELATED FACILITIES**
  1. Drinking structure at the lower place of 1st regulating tank 1 place
  2. Drinking structure at paddock 1 place



DIRECTORATE GENERAL OF LIVESTOCK SERVICES	
THE MODEL INFRASTRUCTURE IMPROVEMENT WORKS FOR THE STRENGTHENING OF ARTIFICIAL INSEMINATION CENTER PROJECT	
TITLE OF DRAWING	
<b>GENERAL PLAN</b>	
JAPAN INTERNATIONAL COOPERATION AGENCY	DWG. NO
TOKYO	1