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THE JANAKPUR ZONE AGRICULTURE DEVELOPMENT PROJECT

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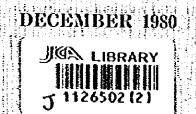
116 833 IN THE KINGDOM OF NEPAL

DESIGN NOTE ON

THE DETAILED DESIGN

FOR

IRRIGATED MODEL FARM SCHEME, SHALLOW TUBE-WELL PROGRAMME



JAPAN INTERNATIONAL COOPERATION AGENCY



THE JANAKPUR ZONE AGRICULTURE DEVELOPMENT PROJECT IN THE KINGDOM OF NEPAL

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IRRIGATED MODEL FARM SCHEME, SHALLOW TUBE-WELL PROGRAMME

DECEMBER 1980

JAPAN INTERNATIONAL COOPERATION AGENCY

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SHALLOW TUBEVELL PROGRAMME

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ATTACHED TABLE AND PIGURE

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TABLE - 1	Kydraulic Properties of Main Canals	4
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1911 - 1914 1917 - 1917 - 1917

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I. GENERAL

This note presents design calculations made in the detailed designs for Irrigated Model Farm Scheme. The note is to be read in conjunction with Report on Implementation and Design for Shallow Tubewell Programme, Design Drawings and Tender Document.

II. HYDRAULIC CALCULATION

2.1 Irrigation Canals

2.1.1 Hydraulic Porsula

For the hydraulic calculations of irrigation canals, Manning forcula is employed as shown below:

$$Q = A \times Y$$

 $Y = \frac{1}{n} \times R^{2/3} \times I^{1/2}$

where, Q : Discharge (m³/s) A : Cross sectional area (m²)

V : Kean velocity (m/s)

R : Hydraulic radius (m)

I : Kydraulic gradient

n : Coefficient of roughness

2.1.2 Coefficient of Roughness

Coefficient of roughnesses applied to Manning formula are as follows:

Brick lined canal	0.020
Earth canal	0.030
Precast concrete pipe :	0.015

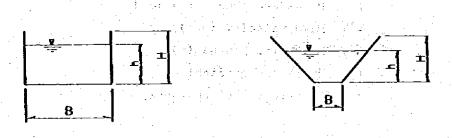
2.1.3 Type of Canal

Irrigation canal consists of main and branch canals. The main canal is brick-lined rectangular open channel and the branch canal is earthern trapezoidal open channel with a side slope of 1:1.

. . . i

The irrigation canals are classified into five according to the discharge, hydraulic gradient and shape as shown below:

Type of canal	B (m)	H (m)	h (@)	I and the second	(n/s)	(m ³ /s)
Shallow tubevell areas		- 1				
Main canal A-1	0.30	0.21	0.11	1/500	0.36	0.012
Kain canal A-2	0.30	0.21	Ŏ.14	1/1,000	0.28	0.012
Branch canal B	0.30	0.30		1/500 - 1/2,000		
Deep tubevell area						
Main canal C	0.40	0.44	0.34	1/2,000	0.29	0.042
Main canal D-1	0.40	0.28	0.21	1/500	0.49	0.042
Main canal D-2	0.40	0.35	0.28	1/1,000	0.38	0.042



Main Canol

Bronch Carol

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2.1.4 Hydraulic Calculations

Hydraulic calculations of the main canals are shown in attached

Table-1.

2.2 Y-notch

2.2.1 Hydraulic Pormula

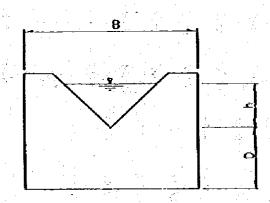
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. To méasure à discharge of the flow, a V-notch is so designed as to be installed at the baffle tank. The following formula is employed for the hydraulic calculations:

$$Q = C + h^{2}$$

 $C = 1.354 + \frac{0.004}{h} + (0.14 + \frac{0.2}{\sqrt{b}}) \times (\frac{h}{B} - 0.09)^{2}$
re. Q : Discharge (m³/s)

vhere, Q : Discharge (m⁻/s) h : Overfloving vater depth (m) C : Coefficient of discharge



2.2.2 Hydraulic Calculations

Overflowing water depth (h) is calculated as shown below by using the above formula:

Area	(m ³ /s)	B (m)	D (m)	h (11)
Shallov tubevell	0.012	0.70	0.70	0.15
Deep tubevell	0.042	1.00	0.80	0.25

Table-1 Hydraulic Properties of Main Canals

Į

(a) (a) </th <th>No. (n VULLENTE ANEA MC</th> <th></th> <th></th> <th>Distance</th> <th>Vorka</th> <th>Gradient</th> <th></th> <th></th> <th>(-/-/</th> <th>(a)</th> <th>(e)</th> <th>(m)</th> <th>КІ. (m)</th> <th></th>	No. (n VULLENTE ANEA MC			Distance	Vorka	Gradient			(-/-/	(a)	(e)	(m)	КІ. (m)	
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- to be continued -

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		Canal (Canal		(m)				-	- - - -	• •	· · · · ·	· · ·		-
Contraction of the second s				- - - - - -			96.85	0.49	10.01	96.84	0.21	96.63	by of NC-5-3	
2	0.042	3.8		Canal type Del	1/500	8.0			· :	.*				
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			-,	No.5, 6 OL		0,02		~ , ~		OR NR	0.21	95.07		
いいま			50°8		•	-	40.04	~ ~						
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-	0.042	100.00	-	Canal type D-1	1/500	0.20	:	÷.;						
No. 54							95,47	0 49	0 01	÷	17-0	C7 *CA		. •
			1.1	No. 9. 10 OL	•	0.20			:1	-			No.9 0L (L). Nu.10 0L (K)	
							95.27	6* 0	ç, ol	92-56	12.0	95.05		1
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		80.12 OL (R)	0. 14 OL (R)	6-16 OL (R)	
	Romarka	No.11 OL (L). No	N . (I) 10 (I. W	No. 15 OL (1). W KP of MG-5-3	
	Cenal Base Elv. (m)	94.85	94.65 24.54	¥. \$	
	Vater Depth	0.21	0.28	0.28	
	Vater Level (m)	95.06 95.04	94.82	5	
	Velocity Noed (m)	10.0	0.01 0.01	0.01	
	Velocity (m/s)	0.49	0.35 0.35	0 8 8	
	Energy Line.EL	95.07 95.05	94.83 24.83	2 \$	
	Loss	0.02	0.20	01.0	
••• • • •	Energy Oradient		1/500	1/1,000	Angle Box Structure on Angle Box Structure
	Vorka	No.11, 12 OL	Canal type D-1 No.15. 14 OL	Canal 1779 5-2-2 No.15, 16 OL	0L (L) 1 0VC1+C (L) 10VC1+C (L)
	Reduced	(m) 00 00	8.00	48. 8 48. 8 48. 8	
		.	8	100.00	
	Daedharge	(w2/w)	0.042	0.042	Beginaring Point Eading Point Nam Cabal Branch Canal Drop Structure
•	Stetion	No. 55	No.55 No.56	No. 57	A A A A A A A A A A A A A A A A A A A

III. PUMPING EQUIPMENT

3.1 Shallow Tubewell Areas

3.1.1 Pumps and Engines

Specifications of pumps and engines to be installed at four shallow tubevell areas are as follows:

Discharge capacity : 1.2 m³/min Total head : 9 m Type : Horizontal shaft, centrifugal and selfpriming

Driving method : Driven by horizontal, single cylindered, vater-cooled and tropicallized diesel engine

Diameter of pipe : 4 inches

3.1.2 Accessories and Materials

Accessories and materials required for four sets of pump and engine are as follows:

(1) Steel common base (4 nos.)

(2) Standard tool kit for maintenance (4 sets)

(3) Starting handle (4 nos.)

(4) Materials listed below

Name of parts	Katerial	Recarks	Q' Ly
Piping	5 kg/cm ² carbon steel pipe	β 4 ⁿ	16 m
Sleeve pipe	- ditto -	\$ 6ª	1.0 m
Pipe fitting	steel butt-veldin pipe fitting	g ø 4n 90 ⁰ elbor	12 pcs
Plange	5 kg/cm ² steel pipe flange	\$ 4 ⁿ	44 pės
Suction unit	steel section	L60 x 60 x 5	10.8 m
- ditto -	steel plate	400 x 400 x 9	4 pcs

- 10 -

Name of parts	Material	Remarks	Q' ty
Pipe support	- ditto -	200 x 255 x 6	4 pcs
- ditto -	÷ ditto -	190 x 90 x 6	4 pcs
End plate	- ditto -	\$ 200 x 6	4 pcs
Anchor bolts & nuts		N16 x 200L	24 sêts
Bolts & nuts		H16 x 30L	32 sets
- ditto -	A Decision of the second se Second second	H16 x 55L	224 sets
U bolts & nuts		Н10 x 165L	4 sets
Sluice valve	5 kg/cm ² cast iro flanged gate valv		4 sets

3.2 Deep Tubewell Area

3.2.1 Pump

Specification of pump and engine to be installed at Irrigation Vater Block No.5 in IAP area is as follows:

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Discharge capacity : 2.52 m<sup>3</sup>/min
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Total head : 9 m

Type : Horizontal shaft and centrifugal

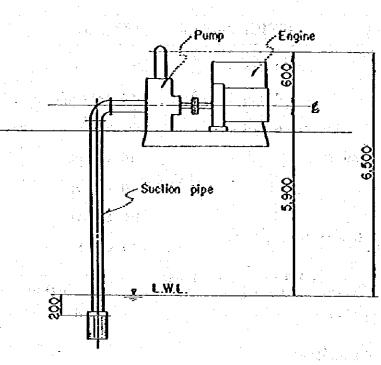
Driving method : Driven by diesel engine

Diameter of pipe : 6 inches

3.2.2 Engine

The engine to be used as prime mover is specified to be a horizontal, single cylindered, vater-cooled and tropicallized. The required horsepover is estimated at eleven as follows:

- 11 -



H = Ha + Hb
Hb = hf + hy
hf =
$$\lambda \times \frac{L}{D} \times \frac{\sqrt{2}}{2g}$$

hy = $\Sigma \xi \times \frac{\sqrt{2}}{2g}$

vhere, H : Total head (m)

- Ha : Actual head (6.5 m)
 - Ho : Loss of head (m)
 - hf : Priction loss of head (m)
 - hy : Loss of head due to bend etc. (m)
 - L : Pipe length (14 m)
 - D : Diameter of pipe (0.15 m)
 - Y : Yelocity (2.377 m/s)
 - λ : Coefficient of friction loss of head (0.03)
 - ξ : Coefficient of loss of head due to bend etc.

- 12 -

Then, h_f and h_v become 0.807 m and 0.676 m, respectively as shown below: 1. S. 1. 1. S. 1.

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Pipe		$V^2/2g$ (m)	h _f (m)
inflow	0.3 x 1	0.288	0.086
bend	0.15 x 5	0.288	0.216
valve	0.15 x 2	0.288	0.036
outflow	Ĩ.	0.288	0.288

Therefore, H and Hb become as follows:

$$Hb = h_f + h_y = 0.807 + 0.676 \Rightarrow 1.5 (m)$$

$$H = Ha + Hb = 6.5 + 1.5 = 8 (m) \longrightarrow 9 (m)$$

The required horsepower is estimated by using following formula: · · · ·

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. 4 ⁶ 6

$$P = \frac{0.222 \times I \times H \times Q}{V} \times (1 + \alpha)$$

where, P : Required horsepower (pH)

is a second

gard C

K : Total head (9 m)

Q : Discharge (2.52 m³/min)

: Pump efficiency (0.6) r

: Allowance (0.30) x

$$P = \frac{0.222 \times 1 \times 9 \times 2.52}{0.6} \times (1 + 0.3) \div 10.91$$

say 11.0

1.1.4.24

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3.2.3 Accessories and Materials

Accessories and materials required for the pump and engine described above are as follows:

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- (1) Steel common base and anchor bolts (1 no.)
- (2) Standard tool kit for maintenance (1 set)
- (3) Starting handle (1 no.)
- (4) Materials listed below

		tan ing kanala sa	Falgate 1 g
Name of part	Material	Remarks	Q'ty
Sluice Yalve	50 kg/cm ² cast iron flanged gate valve	\$ 6"	3 sets
Piping	5 kg/cm ² carbon steel pipe	an an an an β 6 ° an ar a ta an an a	12 n
Pipe fitting	steel butt-velding pipe fitting	\$ 6" 90 ⁰ elbow	6 pcs.
Flange	5 kg/cm ² steel pipe flange	β 6"	22 pcs.
Sleeve pipe	5 kg/cm ² carbon steel pipe	∮ 8 "	350 BA
Bolts & nuts		M 16 x 60 L	104 sets
Anchor bolts & nut	ts in the second s	H 16 x 200 L	6 sets
U bolts & nuts		H 10 x 200 L	2 sets
Suction unit	steel plate	\$ 480 x 22	1 pc.
Stiffer plate for by-pass pipe	- ditto -	280 x 240 x 9	l pc.
Air vent cock	β 3/8" screved plug cock and pipe		l pë.
- ditto -	screved cock		l pc.
Bolts & nuts		H 20 x 65 L	12 sets
Support - I	steel plate - ditto -	100 x 320 x 6 50 x 650 x 3.2	1 pc. 1 pc.
Support - II	steel section	L 60 x 60 x 5	4 a

Name of part	Material	Remarks	Q'ty
Steady blade	steel plate	67 x 110 x 6	6 pcs.
End plate	- ditto -	\$ 280 x 9	l pc.

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IV. LAND IMPROVEMENT

4.1 Earth Volume Calculation

Land improvement work which consists of levelling work and construction work of farm ridges, will be carried out in Sakhuwa area of 5 ha. The area will be divided into 30 plots with the standard size of 50 m x 40 m by the land improvement work. To determine appropriate field elevation of each plot, earth volume calculation for the land improvement work is made based on the following conditions:

i) Cutting and filling earth volumes should be balanced.

- ii) Earth works considered in the calculation are main canal, farm roads, farm ridges and levelling work.
- iii) Hauling earth volume and distance should be as little as possible.
 - iv) Conversion factor of cutting into filling is 0.9.

The calculation is made in the following procedures:

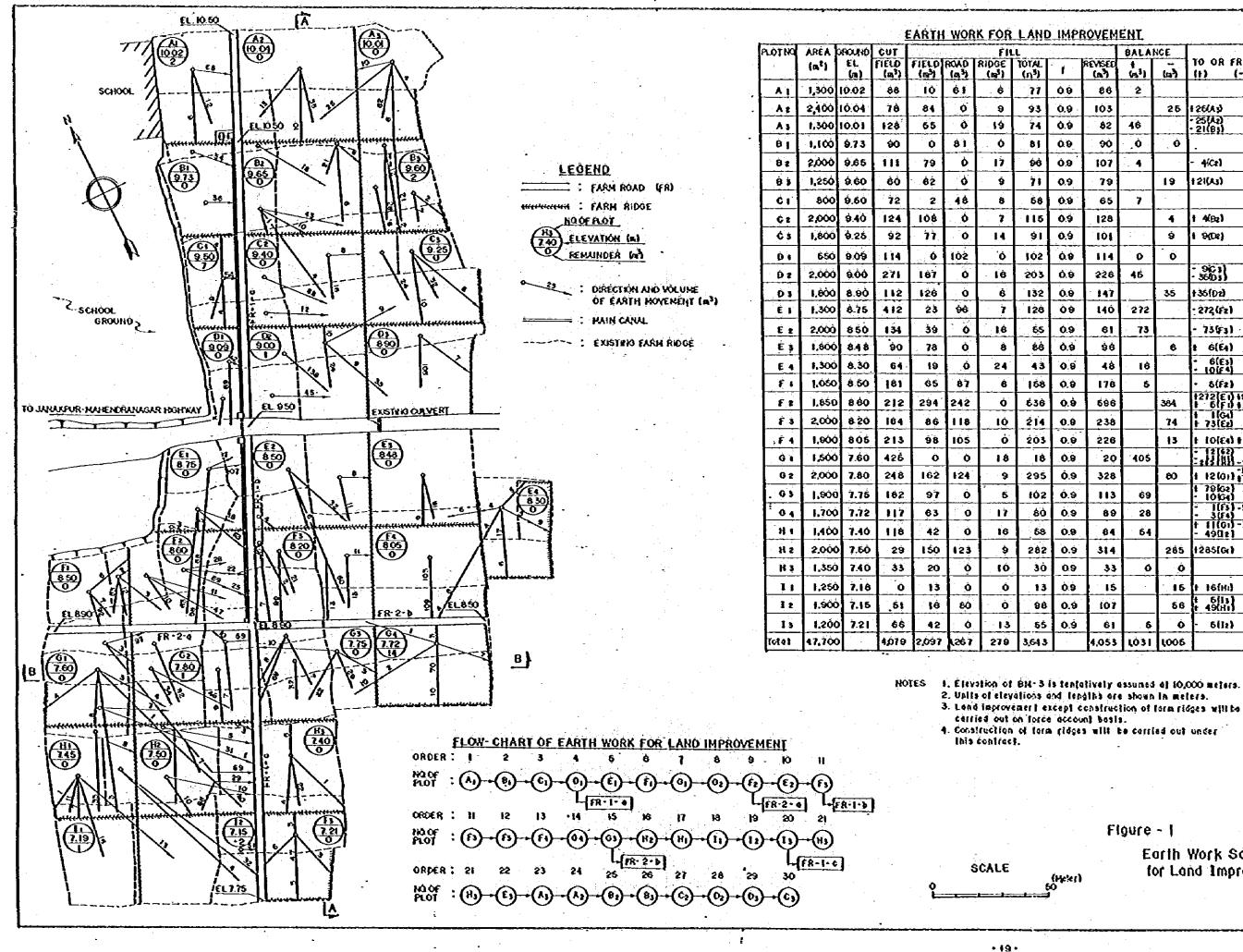
- i) Calculate filling earth volume for the canal and farm roads by using their profiles.
- ii) Calculate filling earth volume for the farm ridges.
- iii) Assume field elevation of each plot.
 - iv) Calculate filling and cutting earth volumes for the levelling work.

v) Repeat the assumption of the field elevations until total filling earth volume for the canal, farm roads, farm ridges and levelling work is equal to total cutting earth volume for the levelling work. (Final field elevations are shown in attached Fig. - 1.)

4.2 Earth York Schedule

The land improvement work is scheduled to be carried out in parallel with construction works of the canal and farm roads. Levelling work of the land improvement work will be carried out on force account basis. The construction works of the canal, farm roads and farm ridges will be carried out on contract basis. Taking into account difference of contract base and order of works, earth work schedule for the land improvement work is established as shown in attached Fig. - 1.

17 -



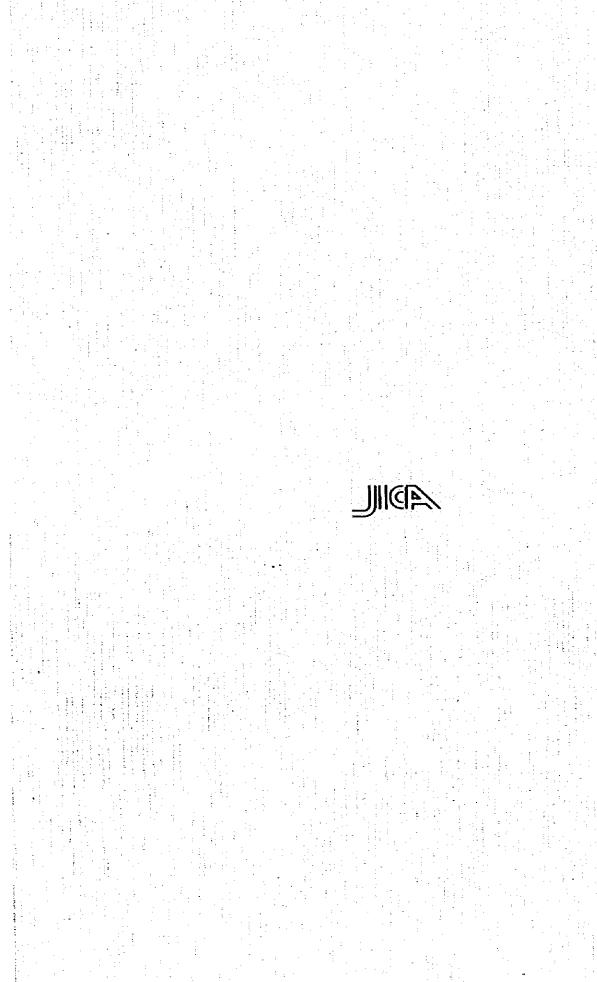
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). 9	82	46		• 25(A2) • 21(83)	Ó
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9.9	147		35	+35(02)	0
9	14 Ô	272		· 272(Fz)	0
9.9	61	73		- 73(F3) ·	0
).ġ	98		6	t 6(E4)	0
9	48	- Lô		• 6(E3) • 10(F4)	Ò
9.9	178	5		• 8(Fz)	0
9.9	696		384	1272(E1) 197(G1) 1 6(F1) 110(G2)	Ó
9.9	238		74	† 11G4) † 73[E2]	Ó
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÷	4,053	LÖ31	1005		26

2. Units of elevations and lengths are shown in meters. 3. Lond improvement except construction of form ridges will to

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Earth Work Schedule for Land Improvement

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