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Task Group 1
BOOK 1
BY H. GANTON
CONSTITUTION

U.S. GOVERNMENT PRINTING OFFICE
1967 O - 344-100
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DOCUMENT CONTROL

BACKUP BOOK E
DEVIL CANYON-CONCRETE COSTS

F-1



OFFICE MEMORANDUM

WATANA

E

TO: See Distribution

Date: January 16, 1982

FROM: James R. Plummer

File: P5700.07.09

SUBJECT: Susitna Hydroelectric Project
Task 9 Estimating/Takeoff
Assumptions

cc: D. MacDonald J. Lawrence
F. Toth J. Hayden
R. Lang R. Ibbotson
R. Beal D. Lamb
D. Meilhede N. Bond

The following assumptions have been developed for use on the Susitna Hydroelectric Project and will be used for the Feasibility Study Estimate:

1. Concrete Mix-For Sizing of Batch Plants

- Nominal 4,000 psi mix (28 day)
- Ratios: Water/cement 0.51
Aggregate/cement 5.74
- Weight lbs/cy: Water 275
Cement 540
Fine Aggregate 1,250
Coarse Aggregate 1,850

2. Reinforcing Steel

- ~~70~~ lbs/cy
- GALLERY SLABS
- Structural slabs & beams 100 lbs/cy
- Structural walls 80 lbs/cy
- Shotcrete mesh (6") 80 lbs/cy or 1.48 lbs/sf
- Shotcrete mesh (9") 60 lbs/cy or 1.66 lbs/sf
- Concrete in underground caverns 100 lbs/cy
- Devil Canyon main dam & thrust blocks 7 lbs/cy

A review of these items by the project designers has been requested.

3. Steel Mesh

Steel mesh (safety protection) will be required for all underground work except grout and access galleries of 10 feet or smaller diameter. Mesh will cover 100 percent of crown from springline to springline. It is assumed that a mesh will be left in place in all concreted areas and that no additional mesh will be required as a separate item in these areas. This item will be taken off on a square foot basis. Pricing will include additional bolting for mesh support. Steel mesh will also be required for 100 percent of vertical or near vertical cuts above concrete structures. Pricing will be for complete installation on a square foot basis.

4. Underground Rockbolts (High Yield, Resin Grout)

Underground rockbolts will be estimated as an "each" basis according to Schedule 1. Aboveground bolting will be taken off on a structure-by-structure basis. Generally 1 inch bolts by 15 feet long will be used in a 10 foot by 10 foot pattern for 25 percent of the exposed rock side slopes unless otherwise noted or shown on drawings.

5. Underground Support

Underground support will be estimated as shown on Schedule 2 on a per ton basis.

6. Shotcrete

Shotcreting will be estimated as shown on Schedule 3 on a square foot basis.

7. Surface Preparation

Surface preparation will be taken as a square foot item for the invert of all underground excavation. No surface preparation will be listed for inclined (wall) underground surfaces. Aboveground surface preparation will be taken on a square foot basis and be identified as horizontal (slab or invert) and inclined (walls) for all concrete contact areas. In addition, surface preparation quantities will be developed for contact areas of the fill dam shells and core/filters.

8. Dental Concrete & Overbreak

No dental

Core/Filter

Concrete will be estimated except under the main Watana Dam (1 cf/sf contact area). The concrete overbreak allowance will include any dental concrete needed elsewhere. As previously developed, this overbreak allowance is as follows:

Aboveground & Major Underground--

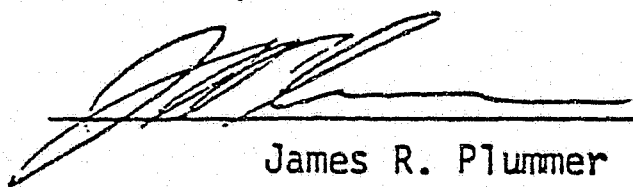
Horizontal (Slab) Surfaces - 1.5 cf/sf concrete contact area
Inclined (Walls) Surfaces - 1.0 cf/sf concrete contact area

Tunnels--

0.5' Additional Thickness for Walls & Slabs

9. Penstock

A line item for consolidation grouting and contact grouting (behind liner) will be developed.


James R. Plummer

DM:dmb

Attachments



(F)

OFFICE MEMORANDUM

TO: Dave H. MacDonald
FROM: James R. Plummer
SUBJECT: Susitna Hydroelectric Project
Concrete Mix Design

Date: January 20, 1982

File: P5700.07.09

Reference should be given to your memo of January 15, 1982.

1 - Arch Dam

Concrete mix design for Devil Canyon arch dam shall be:

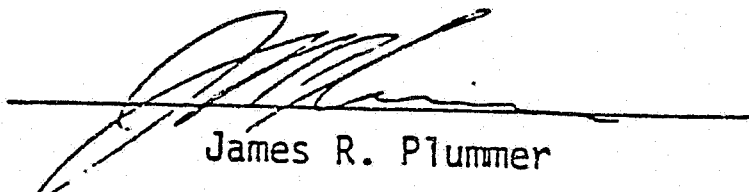
- a) Strength: 5,000 psi at 90 days
- b) Cement: Low Heat, Type IV.
- c) Water Cement Ratio: .40
- d) Maximum Aggregate Size: 3"

The estimate shall also be based on:

- a) Lift Height: 5'
- b) Joint Spacing: 50' along the length of dam fall width
of arch dam
- c) Reinforcing Steel: 7 lbs/cy

2 - Other Structures

Please refer to our memo dated January 16, 1982, attached.


James R. Plummer

JRP:dmb

Attachment

cc: F. Toth
R. Lang
R. Beal


J. Lawrence
J. Hayden
R. Ibbotson
D. Lamb
N. Bond

(E)

Unit Prices - Backup Calculations

DEVIL CANYON

Concrete Works

Summary
Structures
Summary
Powerhouse
Transformer Gallery
Auxiliary Spillway
Emergency Spillway
Surge Chamber
Intake
Bus Tunnels & Shafts
Summary
Division Tunnel
Tailrace Tunnel
Main Access Tunnel
Grout Galleries
Cable Shaft
Access Shaft
Penstocks
Forming Crews
Placing Crews
Supply of Concrete
Concrete Production
Cement
Coarse Aggregate
Fine Aggregate
Supply & Install Rebar

(E) Concrete Works
Summary



Calculations

SUBJECT

DEVIL CANYON

CONCRETE WORKS - SUMMARY

By HEK

Date

82/2/15

Project No.

P5700

Checked

Date

Calculation No.

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SUMMARY OF TOTALS

Rev

By

Checked

\$/C.Y.

C.Y.

LABOR

ITEM

LAB

MAT'L

EQUIP.

U/C

QUANTITY

TOTAL COST

A. STRUCTURES

1. POWERHOUSE

86⁵⁵74⁵⁶58⁸⁹

220

31,600

6,952,000

O/B

54⁵⁰47⁶⁰39⁹⁰

142

6,600

937,200

2. TRANS. GALL.

159⁵⁰144⁶⁰85⁹⁰

390

2,100

819,000

O/B

39⁵⁰47⁶⁰32⁹⁰

120

1,000

120,000

3. AUX. SPILLWAY

(a) STRUCTURE

44⁷⁰58¹⁵37¹⁵

140

47,500

6,650,000

O/B

27⁵⁰45⁶⁰26⁹⁰

100

1,900

190,000

(b) CHUTE

44⁷⁰58¹⁵37¹⁵

140

33,500

4,690,000

O/B

27⁵⁰45⁶⁰26⁹⁰

100

6,300

630,000

4. EM. SPILLWAY

32⁵⁰49⁶⁰27⁹⁰

110

6,900

759,000

O/B

32⁵⁰49⁶⁰27⁹⁰

110

3,300

363,000

5. SURGE CHAMBER

68⁵⁰50⁶⁰43⁹⁰

163

6,200

1,010,600

O/B

54⁵⁰46⁶⁰38⁹⁰

140

2,200

308,000

6. INTAKE

57⁹⁰69⁶⁰45⁵⁰

173

80,000

13,840,000

O/B

-

-

-

-

-

-

7. FIRE PROT.

HEAD TANK

157⁵⁰64⁶⁰83⁹⁰

306

250

76,500

O/B

44⁵⁰46⁶⁰37⁹⁰

129

45

5,800

8. SADDLE DAM

DENTAL CONC

40⁵⁰47⁶⁰27⁹⁰

116

7,100

823,600

SUBTOTAL A.

161⁴²

236,495

38,174,700

4



Calculations

SUBJECT

DEVIL CANYON

CONCRETE WORKS - SUMMARY

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SUMMARY OF TOTALS - CONT'D

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C.Y.

ITEM	LAB.	MAT'L.	EQUIP.	U/C	QUANTITY	TOTAL COST
<u>B. TUNNELS &</u>						
<u>SHAFTS</u>						
1. DIVERSION						
567,000 (a) LINING	52 ⁵⁰	96 ⁷⁰	30 ⁸⁰	180	10,800	1,944,000
85,250 O/B	27 ⁵⁰	45 ⁶⁰	26 ⁹⁰	100	3,100	310,000
508,000 (b) PORTALS	86 ¹⁰	63 ⁸⁰	57 ¹⁰	207	5,900	1,221,300
185,000 O/B	64 ⁵⁰	44 ⁶⁰	40 ⁹⁰	150	-	-
(c) PLUG	46 ²⁵	50 ⁸⁵	38 ⁹⁰	136	4,000	544,000
2. TAILRACE						
2,325,000 (a) LINING	46 ⁵⁰	54 ⁶⁰	38 ⁹⁰	140	50,000	7,000,000
404,250 O/B	24 ⁵⁰	50 ⁶⁰	24 ⁹⁰	100	16,500	1,650,000
64,600 (b) PORTAL	86 ¹⁰	63 ⁸⁰	57 ¹⁰	207	750	155,300
O/B	64 ⁵⁰	44 ⁶⁰	40 ⁹⁰	150	-	-
3. MAIN ACCESS						
TUNNEL						
114,450 (a) SLAB	65 ⁴⁰	51 ²⁰	43 ⁹⁰	160	1,750	280,000
31,050 O/B	34 ⁵⁰	45 ⁶⁰	29 ⁹⁰	110	900	99,000
147,650 (b) PORTAL	46 ⁵⁰	47 ⁶⁰	34 ⁹⁰	129	3,175	409,600
O/B	39 ⁵⁰	45 ⁶⁰	31 ⁹⁰	117	-	-
C/F					96,875	13,613,200



Calculations

SUBJECT

DEVIL CANYON

CONCRETE WORKS - SUMMARY

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SUMMARY OF TOTALS - CONT'D

Rev	By	Checked

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c.y.

ITEM	LAB.	MAT'L	EQUIP.	U/C	QUANTITY	TOTAL COST
B/F					96,875	13,613,200
4. GROUT GALLERIES						
(a) SLAB	154 ⁵⁰	64 ⁶⁰	80 ⁹⁰	300'	1,600	480,000
O/B	122 ⁵⁰	54 ⁶⁰	62 ⁹⁰	240'	2,846	683,000
(b) PORTAL	46 ⁵⁰	47 ⁶⁰	34 ⁹⁰	129'	1,200	154,800
O/B	39 ⁵⁰	45 ⁶⁰	31 ⁹⁰	117'	—	—
5. ACCESS TO GALLERIES						
(a) SLAB	154 ⁵⁰	64 ⁶⁰	80 ⁹⁰	300'	500	150,000
O/B	122 ⁵⁰	54 ⁶⁰	62 ⁹⁰	240'	250	60,000
6. CABLE SHAFT						
(a) LINING	126 ⁵⁰	208 ⁶⁰	224 ⁹⁰	560'	1,340	750,400
O/B	74 ⁵⁰	104 ⁶⁰	100 ⁹⁰	280'	670	187,600
7. ACCESS SHAFT						
(a) LINING	76 ⁵⁰	113 ⁶⁰	109 ⁹⁰	300'	4,800	1,440,000
O/B	46 ⁵⁰	74 ⁶⁰	53 ⁹⁰	175'	1,300	227,500
8. PENSTOCKS						
(a) LINING	93 ⁵⁰	112 ⁶⁰	101 ⁹⁰	308'	12,600	3,880,800
(b) PLUG	93 ⁵⁰	80 ⁶⁰	65 ⁹⁰	240'	—	—
(c) O/B	83 ⁵⁰	74 ⁶⁰	61 ⁹⁰	220'	4,120	906,400
9. BUS TUNNEL						
(a) SLAB	116 ⁵⁰	60 ⁶⁰	82 ⁹⁰	260'	700	182,000
O/B	64 ⁵⁰	44 ⁶⁰	40 ⁹⁰	150'	500	75,000
C/F					129,301	22,790,700



Calculations

SUBJECT

DEVIL CANYON

CONCRETE WORKS - SUMMARY

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C.Y.

ITEM	LAB.	MAT'L	EQUIP.	U/C	QUANTITY	TOTAL COST
B/F					129,301	22,790,700
10. COMPENSATING WATER TUNNEL						
(a) SLAB	116 ⁵⁰	60 ⁶⁰	82 ⁹⁰	260'	1030	267,800
O/B	64 ⁵⁰	47 ⁶⁰	40 ⁹⁰	153'	540	82,600
11. BOX DRAIN GALLERIES						
(a) SLAB	51 ¹⁰	51 ⁹⁰	40 ⁰⁰	143'	13,000	1,859,000
(b) WALLS	56 ¹⁵	55 ⁹⁰	39 ⁹⁵	152'	20,500	3,116,000
(c) O/B	24 ⁵⁰	46 ⁶⁰	28 ⁹⁰	100'	6,300	630,000
12. DRAIN GALLERIES						
(a) SLAB	129 ⁵⁰	87 ⁶⁰	82 ⁹⁰	300'	400	120,000
O/B	69 ⁵⁰	57 ⁶⁰	52 ⁹⁰	180'	200	36,000
SUBTOTAL B				168 ⁷⁵	171,271	28,902,100
ADD TOTALS :						
A. STRUCTURES					236,495	38,174,700
B. TUNNELS & SHAFTS					171,271	28,902,100
TOTAL CONCRETE				164 ⁵⁰	407,766	\$67,076,800

(E) Concrete Works
Structures

(E) Concrete Works
Summary



Calculations

SUBJECT

DEVIL CANYON

CONCRETE WORKS - SUMMARY

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STRUCTURES

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ITEM	LAB.	MAT'L	EQUIP.	U/C	QUANTITY	TOTAL COST
<u>1. POWERHOUSE</u>						
FORMING (F)	29 ⁷³	26 ⁷⁶	17 ⁸⁴	74 ³³		
POURING (P)	40	3	17	60 ⁰⁰		
CONCRETE (C)	14 ⁵⁰	44 ⁶⁰	22 ⁹⁰	82 ⁰⁰		
MISC.	2 ³²	0 ²⁰	1 ¹⁵	3 ⁶⁷		
	86 ⁵⁵	74 ⁵⁶	58 ⁸⁹	220	31,600	6,952,000
<u>OVERBREAK</u>						
P.	40	3	17	60 ⁰⁰		
C.	14 ⁵⁰	44 ⁶⁰	22 ⁹⁰	82 ⁰⁰		
	54 ⁵⁰	47 ⁶⁰	39 ⁹⁰	142	6,600	937,200
						\$ 7,889,200
<u>2. TRANSFORMER GALLERY</u>						
F.	120	98	54	272		
P.	25	2	9	36		
C.	14 ⁵⁰	44 ⁶⁰	22 ⁹⁰	82		
	159 ⁵⁰	144 ⁶⁰	85 ⁹⁰	390	2,100	819,000
<u>OVERBREAK</u>						
P.	25	3	10	38		
C.	14 ⁵⁰	44 ⁶⁰	22 ⁹⁰	82		
	39 ⁵⁰	47 ⁶⁰	32 ⁹⁰	120	1000	120,000
						\$ 939,000

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Calculations

SUBJECT

DEVIL CANYON

CONCRETE WORKS - SUMMARY

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ITEM	LAB.	MAT'L	EQUIP.	U/C	QUANTITY	TOTAL COST
<u>3. AUXILIARY SPILLWAY</u>						
<u>(a) STRUCTURE</u>						
F	13 ²⁰	11 ⁵⁵	8 ²⁵	33		
P	17	2	6	25		
C	14 ⁵⁰	44 ⁶⁰	22 ⁹⁰	82		
	44 ⁷⁰	58 ¹⁵	37 ¹⁵	140	47,500	6,650,000
OVERBREAK						
P	13	1	4	18		
C	14 ⁵⁰	44 ⁶⁰	22 ⁹⁰	82		
	27 ⁵⁰	45 ⁶⁰	26 ⁹⁰	100	1,900	190,000
						\$ 6,840,000
<u>(b) CHUTE</u>						
F	13 ²⁰	11 ⁵⁵	8 ²⁵	33		
P	17	2	6	25		
C	14 ⁵⁰	44 ⁶⁰	22 ⁹⁰	82		
	44 ⁷⁰	58 ¹⁵	37 ¹⁵	140	33,500	4,690,000
OVERBREAK						
P	13	1	4	18		
C	14 ⁵⁰	44 ⁶⁰	22 ⁹⁰	82		
	27 ⁵⁰	45 ⁶⁰	26 ⁹⁰	100	6,300	630,000
						\$ 5,320,000



Calculations

SUBJECT

DEVIL CANYON

CONCRETE WORKS - SUMMARY

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ITEM	LAB.	MAT'L	EQUIP.	U/C	QUANTITY	TOTAL COST
<u>4. EMERGENCY SPILLWAY</u>						
F.	4	3	1	8		
P.	14	2	4	20		
C.	14 ⁵⁰	44 ⁶⁰	22 ⁹⁰	82		
	32 ⁵⁰	49 ⁶⁰	27 ⁹⁰	110	6900	759,000
OVERBREAK						
P.	18	5	5	28		
C.	14 ⁵⁰	44 ⁶⁰	22 ⁹⁰	82		
	32 ⁵⁰	49 ⁶⁰	27 ⁹⁰	110	3300	363,000
						\$1,122,000
<u>5. SURGE CHAMBER</u>						
F.	4	3	3	10		
P.	50	3	18	71		
C.	14 ⁵⁰	44 ⁶⁰	22 ⁹⁰	82		
	68 ⁵⁰	50 ⁶⁰	43 ⁹⁰	163	6200	1,010,600
OVERBREAK						
P.	40	2	16	58		
C.	14 ⁵⁰	44 ⁶⁰	22 ⁹⁰	82		
	54 ⁵⁰	46 ⁶⁰	38 ⁹⁰	140	2200	308,000
						\$1,318,600



Calculations

SUBJECT

DEVIL CANYON

CONCRETE WORKS - SUMMARY

By HEX

Date 82/2/15

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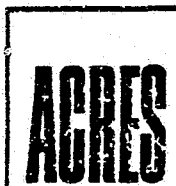
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ITEM	LAB.	MAT'L	EQUIP.	U/C	QUANTITY	TOTAL COST
<u>6. INTAKE</u>						
F.	26 ⁴⁰	23 ⁰⁰	16 ⁶⁰	66		
P.	17	2	6	25		
C.	14 ⁵⁰	44 ⁶⁰	22 ⁹⁰	82		
	57 ⁹⁰	69 ⁶⁰	45 ⁵⁰	173	80,000	13,840,000
<u>OVERBREAK</u>						
P.				-		
C.				-		
				-	-	-
						\$ 13,840,000
<u>7. FIRE PROT. HEAD TANK</u>						
HAUL	13	5	12	30		
P.	100	10	40	150		
C.	14 ⁵⁰	44 ⁶⁰	22 ⁹⁰	82		
MISC.	30	5	9	44		
	157 ⁵⁰	64 ⁶⁰	83 ⁹⁰	306	250	76,500
<u>OVERBREAK</u>						
P.	30	2	15	47		
C.	14 ⁵⁰	44 ⁶⁰	22 ⁹⁰	82		
	44 ⁵⁰	46 ⁶⁰	37 ⁹⁰	129	45	5,800
						\$ 82,300
<u>8. SADDLE DAM DENTAL CONC.</u>						
P.	26	3	5	34		
C.	14 ⁵⁰	44 ⁶⁰	22 ⁹⁰	82		
	40 ⁵⁰	47 ⁶⁰	27 ⁹⁰	116	7,100	\$ 823,600

(E) Concrete Works

Powerhouse



Calculations

SUBJECT

DEVIL CANYONCONCRETE WORKS - STRUCTURESBy HEKDate FEB. 11/82Project No. P5700

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1. POWERHOUSE

TOTAL CONCRETE = 31,600 cyd.

TIME = 78 WK.

RATE OF POUR = 68 cyd/SHIFT.

Rev	By	Checked

FORMING : AVE. COST = \$10.05 / SF. FROM NIPAWIN
 = 10.05 x 1.36
 ALASKA FACTOR
 = 13.66

SAY \$13.69 / S.F.

FORM RATIO = 5.43 - FROM D.H. McD.
 TOTAL FORM AREA = 31,600 x 5.43
 = 171,600 S.F.

COST OF FORMING = 171,600 x 13.69
 = \$2,349,000

COST SUMMARY:

(SEE Pg. 1(a)) CONCRETE = 31,600 x 82⁰⁰ = 2,591,000
 POURING = 31,600 x 60⁰⁰ = 1,896,000
 FORMING = 171,600 x 13.69 = 2,349,000
 MISC. = 5% OF POURING = 95,000
\$6,931,000

U/C = $\frac{6,931,000}{31,600}$ = \$220/cyd

OVERBREAK : TOTAL CONCRETE = 6600 cyd.

CONCRETE = \$82/cyd
 POURING = \$60/cyd
 U/C = \$142/cyd



Calculations

SUBJECT

By HEX.Date 82/2/16Project No. P5700

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1(a)

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POWERHOUSE - CONT'D

POURING

REQ'D PRODUCTION = 68 cyd/SHIFT

USE CREW No. 1(a)

LABOUR = 2507.67

68

= 37

SAY \$40/cyd

EQUIPMENT = 904.50

68

= 13.30

SAY \$17/cyd

MATERIAL = \$200/SHIFT

= \$3/cyd

(E) Concrete Works

Transformer Gallery



Calculations

SUBJECT

By HEK Date FEB. 11/82 Project No. P5700

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2. TRANSFORMER GALLERY

TOTAL CONCRETE = 2100 cyd

TIME = 15 WK.

No. OF POURS = 90

RATE OF POUR = 36 cyd/SHIFT

FORMING - QUANTITIES CALCULATED FROM
DWG. # SK-5700-C6-531 (REC'D. JAN. 20/82)

$$\begin{aligned} \text{SLAB} &= 1' \times 600' \times 1 \\ &\quad 1' \times 600' \times 8 \\ &\quad 1' \times 600' \times 3 \\ &= 7200 \text{ FT}^2 \end{aligned}$$

$$\text{JOINT} = \frac{600'}{20'} \times 98$$

$$= 2940 \text{ FT}^2$$

$$\begin{aligned} \text{WALLS} &= 4 \times 2 \times 86 \times 24 = 16,512 \\ &= 4 \times 2 \times 86 \times 16 = 11,008 \\ &= 4 \times 4 \times 26 \times 20 \times 2 = 16,640 \\ &\quad \underline{44,160} \\ &\quad \text{FT}^2 \end{aligned}$$

TOTAL FORMS:

$$\text{SLAB BULKHEAD} = 7200$$

$$\text{SLAB JOINT} = 2940$$

$$\text{FIRE WALL} = 44,160$$

$$\underline{54,300 \text{ FT}^2}$$

$$\text{FORM COST} = \$8.00 / \text{FT}^2 \text{ (FROM NIPAWIN)}$$

$$\text{ADD 30\% FOR ALASKA} = \$10.50 / \text{FT}^2$$

COST SUMMARY

$$\text{CONCRETE} = 2100 \times 82^{\infty} = 172,000$$

$$\text{POURING} = 2100 \times 36 = 75,600$$

$$\text{FORMING} = 54,300 \times 10.50 = 570,000$$

$$\underline{\$817,600}$$

$$U/C = \frac{817,600}{2100} = \$3.90 / \text{cyd}$$

OVERBREAK: CONCRETE = \$82[∞] / cyd
POURING = \$38[∞] / cyd

$$U/C = \$120 / \text{cyd}$$

$$\text{TOTAL CONCRETE} = 1000 \text{ cyd.}$$



Calculations

SUBJECT

By HEK Date 8/2/16 Project No. P5700

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TRANSFORMER GALLERY - CONT'D

POURING

REQ'D PROD. = 36 cyd/SFT.

USE CREW No. 1(b)

LABOUR = $1014.03 \div 36$
= 28

SAY \$25/cyd

EQUIPMENT = $324 \div 36$ = \$9/cyd

MATERIAL = $\$72/\text{SFT.}$ = \$2/cyd

(E) Concrete Works

Auxiliary Spillway



Calculations

SUBJECT

By HEK. Date FEB. 11/82 Project No. P5700

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3. AUXILIARY SPILLWAY - STRUCTURE

	CONCRETE (C.Y.)	FORMWORK (S.F.)	
WALLS =	15,500	83,230	66 % OF FORMS.
PIERS =	7,200	35,670	28
DECK =	1,600	4,500	4
HOIST COL. =	200	1000	1
ROLLWAY =	23,000	1000	1
	<u>47,500 C.Y. × 2.64 =</u>	<u>125,400 S.F.</u>	<u>100 %</u>

<u>FORMING</u>	<u>QUANTITY</u>	<u>\$/S.F.</u>	<u>COST</u>
WALLS	83,230	11.05	919,700
PIERS	35,670	15.60	556,450
DECK	4,500	16.12	72,540
HOIST COL.	1000	15.60	15,600
ROLLWAY	1000	7.80	7,800
	<u>125,400</u>	<u>12.⁵⁰</u>	<u>\$1,572,090</u>

POURING (SEE Pg. 3(a))

			<u>PROD (C.Y./SFT.)</u>
WALLS =	15,500 × 26 ⁰⁰	= 403,000	129
ROLLWAY =	23,000 × 23 ⁰⁰	= 529,000	204
OTHERS =	9,000 × 30 ⁰⁰	= 270,000	64
	<u>47,500 × 25³⁰</u>	<u>= \$1,202,000</u>	

COST SUMMARY

CONCRETE =	47,500 × 82	= 3,895,000
POURING =		= 1,202,000
FORMING =		= <u>1,572,000</u>
		<u>6,669,000</u>

$$U/C = \frac{6,669,000}{47,500} = \boxed{\$140 / \text{cyd}}$$



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AUX. SPILLWAY - CONT'D

POURING

(a) WALLS - REQ'D PROD. = 129 cyd/SFT.

ACHIEVED PROD. = 175 cyd/SFT.

USE CREW NO. 2.

$$\text{LABOUR} = 3144.42 \div 175 = \$18/\text{cyd.}$$

$$\text{EQUIPMENT} = 1332.90 \div 175 = \$7/\text{cyd.}$$

$$\text{MATERIAL} = \text{L.S.} = \$1/\text{cyd.}$$

$$\underline{\$26/\text{cyd.}}$$

(b) ROLLWAY - REQ'D PROD. = 204 cyd/SFT.

ACHIEVED PROD. = 240 cyd/SFT.

USE CREW NO. 3.

$$\text{LABOUR} = 3895.70 \div 240 = \$16/\text{cyd.}$$

$$\text{EQUIPMENT} = 1385.10 \div 240 = \$5/\text{cyd}$$

$$\text{MATERIAL} = \text{L.S.} = \$2/\text{cyd}$$

$$\underline{\$23/\text{cyd.}}$$

(c) MISSC. - REQ'D PROD. = 64 cyd/SFT.

ACHIEVED PROD. = 120 cyd/SFT

USE CREW NO. 1(a)

$$\text{LABOUR} = 2507.67 \div 120 = \$21/\text{cyd}$$

$$\text{EQUIPMENT} = 904.50 \div 120 = \$7/\text{cyd}$$

$$\text{MATERIAL} = \text{L.S.} = \$2/\text{cyd}$$

$$\underline{\$30/\text{cyd}}$$



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3. AUX. SPILLWAY - CHUTE

TOTAL CONCRETE = 33,500 cyd.

- SAME AS SPILLWAY STRUCTURE

$$u/c = \boxed{\$140/cyd}$$

OVERBREAK : TOTAL CONCRETE = 1900 + 6300 = 8,200 cyd

CONCRETE = \$82/cyd

POURING = \$18/cyd.

$$u/c = \boxed{\$100/cyd}$$

(E) Concrete Works

Emergency Spillway



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4(a) EMERGENCY SPILLWAY - SLAB

TOTAL CONCRETE = 6900 cyd

NO. OF POURS = 58 (SEE "FORMING")

PRODUCTION = 1 POUR/SHIFT

= 119 cyd/SHIFT

FORMING

SLAB = 205' x 450' = 92,250 FT²

POUR = 40' x 40' = 1600 FT²

NO. OF POURS = 58

FORM AREA = (2 x 450 x 6) + (2 x 205 x 13)
= 10,800 FT²

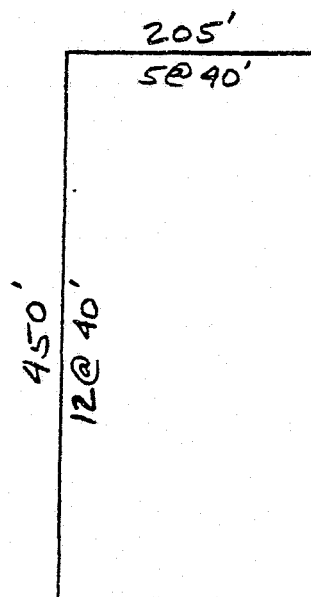
TOP 8" WITH DOWELS = 1 USE

= 3600 FT²

REMAINDER = 6 USES

= 7200 ÷ 6 = 1200 FT²

∴ FORM REQ'D = 4800 FT²



COST SUMMARY

CONCRETE = 6900 x 82 = 565,800

POURING = 6900 x 20 = 138,000

FORMING = 4800 x 11.05 = 53,040

756,840

U/C = $\frac{756,840}{6900}$ = \$110/cyd

OVERBREAK

TOTAL CONCRETE = 3300 cyd

CONCRETE = \$82/cyd

POURING = \$28/cyd

U/C = \$110/cyd



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EMERGENCY SPILLWAY - CONT'D

POURING

REQ'D PROD. = 119 cyd/SFT.

USE CREW No. 1(c).

LABOUR = $1602.18 \div 119 = \underline{\underline{\$14/cyd}}$

EQUIPMENT = $476 \div 119 = \underline{\underline{\$4/cyd}}$

MATERIAL = L.S. = $\underline{\underline{\$2/cyd}}$

TOTAL POURING COST = $\underline{\underline{\$20/cyd.}}$

(E) Concrete Works
Surge Chamber



Calculations

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4.(b) EMERGENCY SPILLWAY - BRIDGE

LUMP SUM ITEM

5. SURGE CHAMBER

TOTAL CONCRETE = 6200 cyd.

PRODUCTION = 34 cyd/SHIFT.

FORMING - ASSUME FORM RATIO = 1 FT²/cyd.∴ FORM AREA = 6200 FT².

COST SUMMARY

CONCRETE = 6200 × 82 = 508,400

POURING = 6200 × 71 = 440,200 (SEE BELOW)

FORMING = 6200 × 10 = 62,000
\$1,010,600

$$U/C = \frac{1,010,600}{6200} = \boxed{\$163/\text{cyd.}}$$

OVERBREAK : TOTAL CONCRETE = 2200 cyd.

CONCRETE = \$82/cyd

POURING = \$58/cyd

U/C = \$140/cyd.

POURING - REQ'D PROD. = 34 cyd/SHIFT

ACHIEVED PROD. = 50 cyd/SHIFT (ASSUMED)

USE CREW No. 1(a)

∴ LABOUR = 2507.67 ÷ 50 = \$50/cyd.

EQUIPMENT = 904.50 ÷ 50 = \$18/cyd.

MATERIAL = L.S. = \$3/cyd

\$71/cyd

(E) Concrete Works

Intake



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6 INTAKE

TOTAL CONCRETE = 80,000 cyd.
 PRODUCTION = 150 cyd/SHIFT

FORMING - FORM RATIO = 4 FT²/cyd.
 = 320,000 FT².

WALLS & SLABS (60%)	= 192,000 FT ² × 11.05	= 2,121,600
PIERS (10%)	32,000 × 15.60	= 499,200
DECK (10%)	32,000 × 16.12	= 515,840
TRANSITION (10%)	32,000 × 38.15	= 1,220,800
CURVED (10%)	32,000 × 28.60	= 915,200
		<u>\$5,272,640</u>

COST SUMMARY

CONCRETE	= 80,000 × 82	= 6,560,000
POURING	= 80,000 × 25	= 2,000,000 (SEE BELOW)
FORMING	=	= <u>5,272,640</u>
		<u>\$13,832,640</u>

$$U/C = \frac{13,832,640}{80,000} = \boxed{\$173/\text{cyd}}$$

OVERBREAK

NOT GIVEN.

POURING - REQ'D PROD. = 150 cyd/SHIFT.
 ACHIEVED PROD = 175 cyd/SHIFT. (ASSUMED)

USE CREW NO. 2

LABOUR	= 3144.42 ÷ 175	= \$17/cyd
EQUIPMENT	= 1332.90 ÷ 175	= \$6/cyd
MATERIAL	= L.S.	= \$2/cyd
		<u>\$25/cyd</u>

(E) Concrete Works

Bus Tunnels & Shafts

(E) Concrete Works

Summary



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Page 1 of 8TUNNELS & SHAFTS

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ITEM	LAB.	MAT'L.	EQUIP.	U/C	QUANTITY	TOTAL COST
<u>I. DIVERSION</u>						
<u>(a) LINING</u>						
F.	24 ⁰⁰	50 ⁶⁰	3 ⁴⁰	78		
P.	14 ⁰⁰	1 ⁵⁰	4 ⁵⁰	20		
C.	14 ⁵⁰	44 ⁶⁰	22 ⁹⁰	82		
	52 ⁵⁰	96 ⁷⁰	30 ⁸⁰	180	10,800	1,944,000
OVERBREAK						
P.	13 ⁰⁰	1 ⁰⁰	4 ⁰⁰	18		
C.	14 ⁵⁰	44 ⁶⁰	22 ⁹⁰	82		
	27 ⁵⁰	45 ⁶⁰	26 ⁹⁰	100	3,100	310,000
<u>(b) PORTAL</u>						
<u>U/S & D/S.</u>						
F.	21 ⁶⁰	16 ²⁰	16 ²⁰	54		
P.	50 ⁰⁰	3 ⁰⁰	18 ⁰⁰	71		
C.	14 ⁵⁰	44 ⁶⁰	22 ⁹⁰	82		
	86 ¹⁰	63 ⁸⁰	57 ¹⁰	207	5,900	1,221,300
OVERBREAK						
P.	50 ⁰⁰	-	18 ⁰⁰	68		
C.	14 ⁵⁰	44 ⁶⁰	22 ⁹⁰	82		
	64 ⁵⁰	44 ⁶⁰	40 ⁹⁰	150	-	-
<u>(c) PLUG</u>						
F.	3 ²⁵	1 ⁵⁰	1 ⁵⁰	6 ²⁵		
P.	28 ⁵⁰	4 ⁷⁵	14 ⁵⁰	47 ⁷⁵		
C.	14 ⁵⁰	44 ⁶⁰	22 ⁹⁰	82		
	46 ²⁵	50 ⁸⁵	38 ⁹⁰	136	4,000	544,000
						\$4,019,300



Calculations

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ITEM	LAB.	MAT'L.	EQUIP.	U/C	QUANTITY	TOTAL COST
<u>2. TAILRACE</u>						
<u>(a) LINING</u>						
F.	19	18	3	40 ⁰⁰		
P.	10	6	2	18		
C.	14 ⁵⁰	44 ⁶⁰	22 ⁹⁰	82		
	46 ⁵⁰	54 ⁶⁰	38 ⁹⁰	140	50,000	7,000,000
OVERBREAK						
P.	10	6	2	18		
C.	14 ⁵⁰	44 ⁶⁰	22 ⁹⁰	82		
	24 ⁵⁰	50 ⁶⁰	24 ⁹⁰	100	16,500	1,650,000
<u>(b) PORTAL</u>						
F.	21 ⁶⁰	16 ²⁰	16 ²⁰	54		
P.	50	3	18	71		
C.	14 ⁵⁰	44 ⁶⁰	22 ⁹⁰	82		
	86 ¹⁰	63 ⁸⁰	57 ¹⁰	207	750	155,300
OVERBREAK						
P.	50	-	18	68		
C.	14 ⁵⁰	44 ⁶⁰	22 ⁹⁰	82		
	64 ⁵⁰	44 ⁶⁰	40 ⁹⁰	150	-	-
						\$ 8,805,300



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ITEM	LAB.	MAT'L.	EQUIP.	U/C	QUANTITY	TOTAL COST
<u>3. MAIN ACCESS TUNNEL</u>						
<u>(a) SLAB</u>						
F.	28 ⁹⁰	4 ⁶⁰	12 ⁵⁰	46		
P.	22	2	8	32		
C.	14 ⁵⁰	44 ⁶⁰	22 ⁹⁰	82		
	65 ⁴⁰	51 ²⁰	43 ⁹⁰	160	1,750	280,000
OVERBREAK						
P.	20	1	7	28		
C.	14 ⁵⁰	44 ⁶⁰	22 ⁹⁰	82		
	34 ⁵⁰	45 ⁶⁰	29 ⁹⁰	110	900	99,000
<u>(b) PORTAL</u>						
F.	7	2	3	12		
P.	25	1	9	35		
C.	14 ⁵⁰	44 ⁶⁰	22 ⁹⁰	82		
	46 ⁵⁰	47 ⁶⁰	34 ⁹⁰	129	3,175	409,600
OVERBREAK						
P.	25	1	9	35		
C.	14 ⁵⁰	44 ⁶⁰	22 ⁹⁰	82		
	39 ⁵⁰	45 ⁶⁰	31 ⁹⁰	117	-	-
						\$ 788,600



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ITEM	LAB.	MAT'L.	EQUIP.	U/C	QUANTITY	TOTAL COST
<u>4. GROUT GALLERIES</u>						
<u>(a) SLAB</u>						
F.	30	10	18	58		
P.	110	10	40	160		
C.	14 ⁵⁰	44 ⁶⁰	2 ⁹⁰	82		
	154 ⁵⁰	64 ⁶⁰	80 ⁹⁰	300	1600	480,000
OVERBREAK						
P.	108	10	40	158		
C.	14 ⁵⁰	44 ⁶⁰	22 ⁹⁰	82		
	122 ⁵⁰	54 ⁶⁰	62 ⁹⁰	240	2846	683,000
<u>(b) PORTAL</u>						
F.	7	2	3	12		
P.	25	1	9	35		
C.	14 ⁵⁰	44 ⁶⁰	22 ⁹⁰	82		
	46 ⁵⁰	47 ⁶⁰	34 ⁹⁰	129	1200	154,800
OVERBREAK						
P.	25	1	9	35		
C.	14 ⁵⁰	44 ⁶⁰	22 ⁹⁰	82		
	39 ⁵⁰	45 ⁶⁰	31 ⁹⁰	117	-	-
						\$ 1,317,800



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ITEM	LAB.	MAT'L.	EQUIP.	U/C	QUANTITY	TOTAL COST
<u>5. ACCESS TO GALLERIES</u>						
SLAB	F.	30	10	18	58	
	P.	110	10	40	160	
	C.	14 ⁵⁰	44 ⁶⁰	22 ⁹⁰	82	
		154 ⁵⁰	64 ⁶⁰	80 ⁹⁰	300	500
OVERBREAK						150,000
	P.	108	10	40	158	
	C.	14 ⁵⁰	44 ⁶⁰	22 ⁹⁰	82	
		122 ⁵⁰	54 ⁶⁰	62 ⁹⁰	240	250
						60,000
						\$ 210,000
<u>6. CABLE SHAFT</u>						
	F.	52	104	124	280	
	P.	60	60	78	198	
	C.	14 ⁵⁰	44 ⁶⁰	22 ⁹⁰	82	
		126 ⁵⁰	208 ⁶⁰	224 ⁹⁰	560	1340
OVERBREAK						750,400
	P.	60	60	78	198	
	C.	14 ⁵⁰	44 ⁶⁰	22 ⁹⁰	82	
		74 ⁵⁰	104 ⁶⁰	100 ⁹⁰	280	610
						187,600
						\$ 938,000



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ITEM	LAB.	MAT'L.	EQUIP.	U/C	QUANTITY	TOTAL COST	
<u>7. ACCESS SHAFT</u>							
F.	30	39	56 ⁵⁰	125 ⁵⁰			
P.	32	30	30 ⁵⁰	92 ⁵⁰			
C.	14 ⁵⁰	44 ⁶⁰	22 ⁹⁰	82			
	76 ⁵⁰	113 ⁶⁰	109 ⁹⁰	300	4,800	1,440,000	
OVERBREAK							
P.	32	30	31	93			
C.	14 ⁵⁰	44 ⁶⁰	22 ⁹⁰	82			
	46 ⁵⁰	74 ⁶⁰	53 ⁹⁰	175	1,300	227,500	
						\$1,667,500	
<u>8. PENSTOCKS</u>							
(a) <u>LINING</u>							
F.	50	17	21	88			
P.	69	30	39	138			
C.	14 ⁵⁰	44 ⁶⁰	22 ⁹⁰	82			
	93 ⁵⁰	112 ⁶⁰	101 ⁹⁰	308	12,600	3,880,800	
(b) <u>PLUG</u>							
F.	10	6	4	20			
P.	69	30	39	138			
C.	14 ⁵⁰	44 ⁶⁰	22 ⁹⁰	82			
	93 ⁵⁰	80 ⁶⁰	65 ⁹⁰	240	-	-	
(c) <u>OVERBREAK</u>							
P.	69	30	39	138			
C.	14 ⁵⁰	44 ⁶⁰	22 ⁹⁰	82			
	83 ⁵⁰	74 ⁶⁰	61 ⁹⁰	220	4,120	906,400	
						\$4,787,200	



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ITEM	LAB.	MAT'L	EQUIP.	U/C	QUANTITY	TOTAL COST
<u>9. BUS TUNNELS</u>						
SLAB	F	31	12	22	65	
	P	50	3	18	71	
	C	14 ⁵⁰	44 ⁶⁰	22 ⁹⁰	82	
MISC.		16	-	16	32	
HAUL		5	1	4	10	
		116 ⁵⁰	60 ⁶⁰	82 ⁹⁰	260	700
						182,000
<u>OVERBREAK</u>						
	P.	50	-	18	68	
	C.	14 ⁵⁰	44 ⁶⁰	22 ⁹⁰	82	
		64 ⁵⁰	44 ⁶⁰	40 ⁹⁰	150	500
						75,000
						\$ 257,000
<u>10. COMPENSATING WATER TUNNEL</u>						
SLAB	F.	31	12	22	65	
	P.	50	3	18	71	
	C.	14 ⁵⁰	44 ⁶⁰	22 ⁹⁰	82	
MISC.		16	-	16	32	
HAUL		5	1	4	10	
		116 ⁵⁰	60 ⁶⁰	82 ⁹⁰	260	1030
						267,800
<u>OVERBREAK</u>						
	P.	50	3	18	71	
	C.	14 ⁵⁰	44 ⁶⁰	22 ⁹⁰	82	
		64 ⁵⁰	47 ⁶⁰	40 ⁹⁰	153	540
						82,600
						\$ 350,400



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ITEM	LAB.	MAT'L.	EQUIP.	U/C	QUANTITY	TOTAL COST
<u>11. BOX DRAIN GALLERIES</u>						
(a) SLAB	F.	10 ⁴⁵	6	6	22 ⁴⁵	
	P.	26 ¹⁵	1 ³⁰	11 ¹⁰	38 ⁵⁵	
	C.	14 ⁵⁰	44 ⁶⁰	22 ⁹⁰	82	
		51 ¹⁰	51 ⁹⁰	40 ⁰⁰	143	13,000
(b) WALLS	F.	15 ⁴⁵	10	6	31 ⁴⁵	
	P.	26 ²⁰	1 ³⁰	11 ⁰⁵	38 ⁵⁵	
	C.	14 ⁵⁰	44 ⁶⁰	22 ⁹⁰	82	
		56 ¹⁵	55 ⁹⁰	39 ⁴⁵	152	20,500
(c) OVERBREAK	P.	10	2	6	18	
	C.	14 ⁵⁰	44 ⁶⁰	22 ⁹⁰	82	
		24 ⁵⁰	46 ⁶⁰	28 ⁹⁰	100	6,300
						630,000
						\$ 5,605,000
<u>12. DRAIN GALLERIES</u>						
SLAB	F.	20	10	10	40	
	P.	55	13	30	98	
	C.	14 ⁵⁰	44 ⁶⁰	22 ⁹⁰	82	
MISC.		20	10	10	40	
HAUL		20	10	10	40	
		129 ⁵⁰	87 ⁶⁰	82 ⁹⁰	300	400
						120,000
OVERBREAK	P.	55	13	30	98	
	C.	14 ⁵⁰	44 ⁶⁰	22 ⁹⁰	82	
		69 ⁵⁰	57 ⁶⁰	52 ⁹⁰	180	200
						36,000
						\$ 156,000
						50

(E) Concrete Works
Diversion Tunnel



Calculations

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CONCRETE WORKS - TUNNELS & SHAFTS

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1. DIVERSION TUNNEL

LENGTH $\approx$ 1500 FT.

TOTAL CONCRETE = 10,800 cyd.

PRODUCTION = 290 cyd/SHIFT.

No. of POURS = 37 (@ 40 FT. EACH)

FORMING (STANDARD LABOUR & EQUIPMENT CREWS)

(a) WALLS & ROOF

WORKING TIME = $37 \times 16 = 592$
 $\uparrow$ 2-8HR. SHIFTS.

LABOUR = $227.34 \times 592 = \$134,600$ EQUIPMENT = $30^{\infty} \times 592 = \$17,760$ MATERIAL: STEEL FORM = $3280 \text{ FT}^2 \times \$100/\text{S.F.} = \$328,000$

MAINTENANCE = 50,000

ACCESSORIES = 50,000

MISC. = 50,000

\$478,000

(b) INVERT - POUR 80' PER SHIFT. ($\frac{1}{2}$ FORMING CREW)

WORKING TIME = $\frac{1500}{80} \times 9 = 168 \text{ HR.}$

SURFACE PREP. = 168 HR

TOTAL TIME = 336 HR.

LABOUR = $(\frac{1}{2} \times 227.34 \times 168) + 227.34 \times 168 = \$57,300$ EQUIPMENT = $30^{\infty} \times 336 = \$10,080$

MATERIAL = \$40,000



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Page 2 of _____DIVERSION TUNNEL (CONT'D)

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(C) CURB - 1 FORMING SHIFT PER 40' POUR.
 WORKING TIME = $37 \times 8 = 296$ HR.

LABOUR = $227.34 \times 296 = \$67,300$
 EQUIPMENT = $30.00 \times 296 = \$8,880$
 MATERIAL = $\$30,000$

TOTAL FORMING COST

LABOUR =	259,200	<u>u/c</u>
EQUIPMENT =	36,720	24
MATERIAL =	548,000	3
	<u>\$843,920</u>	51
		78

COST SUMMARY

CONCRETE = $10,800 \times 82 = 885,600$
 POURING = $10,800 \times 20 = 216,000$
 FORMING = $= 843,900$
1,945,500

$$u/c = \frac{1,945,500}{10,800} = \boxed{\$180/cyd}$$

OVERBREAK - TOTAL CONCRETE = 3100 cyd.
 PRODUCTION = 290 cyd/SHIFT.

CONCRETE = $\$82/cyd$ POURING = $\$18/cyd$

$$u/c = \boxed{\$100/cyd}$$



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DIVERSION TUNNEL - CONT'DPORTAL - U/S.

TOTAL CONCRETE = 3500 cyd. , TIME = 20 WK.

PRODUCTION = 29 cyd/SHIFT.

FORMING

FORM RATIO = 4.0 S.F./cyd.

FORM REQ'D. = 4×3500
= 14,000 FT².

- FORM DISTRIBUTION & COSTS ADAPTED FROM NIPAWIN.

TYPE OF FORM	%	AREA	COST/SF.	AMOUNT
SLAB	25	3,500	11.05	38,700
WALLS	48	6,700	11.05	74,000
PIERS	15	2,100	15.60	32,800
TRANSITION	7	1,000	38.15	38,200
MISC.	5	700	7.80	5,400
	100	14,000		\$ 189,100

COST SUMMARYCONCRETE = $3500 \times 82 = 287,000$ POURING = $3500 \times 71 = 248,500$ FORMING = $\underline{189,100}$
724,600

$$U/C = \frac{724,600}{3500} = \boxed{\$207/\text{cyd}}$$

PORTAL - D/S - TOTAL CONCRETE = 2400 cyd.

- SAME COST AS U/S ABOVE.

$$U/C = \boxed{\$207/\text{cyd}}$$



Calculations

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DIVERSION TUNNEL - CONT'DPLUG

TOTAL CONCRETE = 4000 cyd.

DIAMETER = 33 FT.

TIME = 8 WK. = 48 SHIFTS.

$$\text{PRODUCTION} = \frac{4000}{48} = 83 \text{ cyd/SHIFT}$$
FORMINGASSUME FORM RATIO = $\frac{1}{3}$ S.F./cyd.
$$\text{FORM REQ'D} = \frac{1}{3} \times 4000$$

$$= 1334 \text{ S.F.}$$

ASSUME COST = \$18.70 (INCLUDING INSTALLATION)

$$\therefore \text{FORMING COST} = 18.70 \times 1334 = \$25,000$$
COST SUMMARYCONCRETE = $4000 \times 82 = 328,000$ POURING = $4000 \times 47^{75} = 191,000$

$$\text{FORMING} = 25,000$$

$$\underline{\$544,000}$$

$$\frac{Y}{C} = \frac{544,000}{4000} = \boxed{\$136/\text{cyd}}$$



Calculations

SUBJECT

 By HEK. Date 82/2/16 Project No. P5700
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 Page 4(a) of _____
DIVERSION TUNNEL - CONT'DPOURING

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(a) LINING - REQ'D PRODUCTION = 290 cyd/SHIFT.

CREW No. 4(a).

$$\begin{aligned}
 \text{LABOUR} &= 3605.90 \div 290 = 12.40 \text{ SAY } \$14.00/\text{cyd} \\
 \text{EQUIPMENT} &= 1320.00 \div 290 = \$4.50/\text{cyd} \\
 \text{MATERIAL} &= \text{L.S.} = \$1.50/\text{cyd} \\
 &\quad \underline{\$20/\text{cyd}}
 \end{aligned}$$

 (b) PORTAL - REQ'D PRODUCTION = 251 cyd/SHIFT.
 ACHIEVED PROD. = 50 cyd/SHIFT. (ASSUMED)

CREW No. 1(a).

$$\begin{aligned}
 \text{LABOUR} &= 2507.67 \div 50 = \$50/\text{cyd} \\
 \text{EQUIPMENT} &= 904.50 \div 50 = \$18/\text{cyd} \\
 \text{MATERIAL} &= \text{L.S.} = \$3/\text{cyd} \\
 &\quad \underline{\$71/\text{cyd}}
 \end{aligned}$$

(c) PLUG - REQ'D PROD. = 83 cyd/SHIFT.

CREW No. 4(c).

$$\begin{aligned}
 \text{LABOUR} &= 2351.16 \div 83 = 28.50/\text{cyd} \\
 \text{EQUIPMENT} &= 1203.00 \div 83 = 14.50/\text{cyd} \\
 \text{MATERIAL} &= \text{L.S.} = 4.75/\text{cyd} \\
 &\quad \underline{\$47.75/\text{cyd}}
 \end{aligned}$$



Calculations

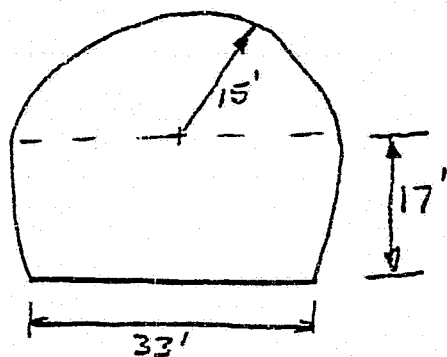
SUBJECT

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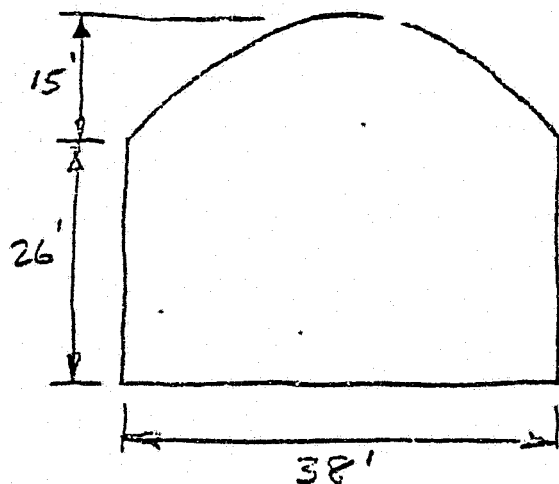
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FORMWORK

DIVERSION TUNNEL

$$\begin{aligned} \text{FORMED PERIMETER} &= \frac{1}{2}\pi(30) + 34 \\ &= 82' \end{aligned}$$

$$\begin{aligned} \therefore \text{FORM AREA} &= 82 \times 40 \\ &= 3280 \text{ FT}^2 \end{aligned}$$

TAILRACE TUNNEL

$$\begin{aligned} \text{FORMED PERIMETER} &= 2(26) + 52 \\ &= 104' \end{aligned}$$

$$\text{FORM AREA} = 4160 \text{ FT}^2$$

(E) Concrete Works

Tailrace Tunnel



Calculations

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2. TAILRACE TUNNEL

LENGTH = 6800 FT.

TOTAL CONCRETE = 50,000 cyd.

NO. OF POURS = $\frac{6800}{40}$

= 170

PRODUCTION = 1 POUR / SHIFT = 290 cyd / SHIFT.

FORMING(a) WALLS & ROOFWORKING TIME = $170 \times 16 = 2720$ HR.LABOUR = $227.34 \times 2720 = \$618,360$ EQUIPMENT = $30^{00} \times 2720 = \$81,600$ MATERIAL - STEEL FORM = $4160 \text{ FT}^2 \times \$144/\text{FT}^2 = 600,000$

MAINTENANCE = 75,000

ACCESSORIES = 75,000

MISC. = 75,000

\$825,000S.T. = \$1,524,960.(b) INVERTWORKING TIME = $\frac{6800}{80} \times 2 \text{ Hr / Shift / Day} = 170 \text{ HRS.}$

SURFACE PREP. TIME = 765 HR.

LABOUR = $227.34 \times 170 = \$38,590$ EQUIPMENT = $30^{00} \times 170 = \$5,100$

MATERIAL = L.S. = \$10,000

\$53,690



Calculations

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TAILRACE TUNNEL - CONT'D

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(C) CURB

$$\text{WORKING TIME} = 170 \times 8 = 1360 \text{ HR.}$$

$$\text{LABOUR} = 227.34 \times 1360 = \$309,200$$

$$\text{EQUIPMENT} = 30^{00} \times 1360 = \$40,800$$

$$\text{MATERIAL} = \text{L.S.} = \$70,000$$

$$\underline{\$420,000}$$

TOTAL FORMING COST (a+b+c)

LABOUR	=	966,150	<u>4</u>
EQUIPMENT	=	127,500	19
MATERIAL	=	905,000	3
			<u>18</u>
		$\$1,998,650 \div 50,000$	40

COST SUMMARY

$$\text{CONCRETE} = 50,000 \times 82 = 4,100,000$$

$$\text{POURING} = 50,000 \times 18 = 900,000 (\text{SEE P. 8})$$

$$\text{FORMING} = \text{SEE ABOVE} = \underline{2,000,000}$$

$$\underline{\$7,000,000}$$

$$\text{U/C} = \frac{7,000,000}{50,000} = \boxed{\$140/\text{cyd}}$$

OVERBREAK - TOTAL CONCRETE = 16,500 cyd.

$$\text{CONCRETE} = \$82/\text{cyd}$$

$$\text{POURING} = \$18/\text{cyd}$$

$$\text{U/C} = \boxed{\$100/\text{cyd}}$$



Calculations

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TAILRACE - CONT'D

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PORTAL

TOTAL CONCRETE = 750. cyd.

USE SAME PRICE AS DIVERSION PORTALS.

$$U/C = \$207/cyd$$

POURING

REQ'D. PRODUCTION = 290 cyd/SHIFT
 ACHIEVED PRODUCTION = 360 cyd/SHIFT (ASSUMED)

CREW No. 4(a)

$$\begin{aligned} \text{LABOUR} &= 3605.90 \div 360 = \$10/cyd. \\ \text{EQUIPMENT} &= 1320.00 \div 360 = \$3.80 \text{ SAY } \$2/cyd. \\ \text{MATERIAL} &= \text{L.S.} = \$6/cyd. \\ &\quad \underline{\$18/cyd.} \end{aligned}$$

(E) Concrete Works

Main Access Tunnel



Calculations

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3. MAIN ACCESS TUNNEL

LENGTH = 3000 FT.

TOTAL CONCRETE = 1750 cyd. (INVERT ONLY)

NO. OF POURS = $\frac{3000}{80} = 38$ POUR LENGTH = 80 FT.PRODUCTION = $\frac{1750}{38} = 46$ cyd/SHIFT.

FORMING

WORKING TIME = $38 \times 9 = 342$ HR.

SURFACE PREP. TIME = 342 HR.

LABOUR = $148^{\text{00}} \times 342 = 50,600$ EQUIPMENT = $64^{\text{00}} \times 342 = 21,900$

MATERIAL - L.S. = 8000

	U/C
	28 ⁹⁰
	12 ⁵⁰
	4 ⁶⁰
<u>\$80,500</u>	<u>46/cyd</u>

COST SUMMARY

CONCRETE = $1750 \times 82 = 143,500$ POURING = $1750 \times 32 = 56,000$ (SEE Pg. 10(a))

FORMING = SEE ABOVE = 80,500

\$280,000U/C = $\frac{280,000}{1750} = \boxed{\$160/\text{cyd}}$ OVERBREAK - TOTAL CONCRETE = 900 cyd.

CONCRETE = \$82/cyd

POURING = \$28/cyd

U/C = $\boxed{\$110/\text{cyd}}$



Calculations

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MAIN ACCESS TUNNEL - CONT'DPORTAL

TOTAL CONCRETE = 3175 cyd.

TIME = 15 WK = 90 SHIFT.

PRODUCTION = $\frac{3175}{90} = 36 \text{ cyd/SHIFT.}$

POUR 2 PLACES / DAY.

FORMING

FORM AREA

$$\begin{aligned}
 &= 2 \left[5(31) + \frac{1}{2}(21)(28) \right. \\
 &\quad \left. + 17.5(33) - [8(35) \right. \\
 &\quad \left. + 9.68(35) + (\frac{1}{2})(10.32)(35) \right] \\
 &= 2053 - 799 \\
 &= 1254
 \end{aligned}$$

SAY 1300 S.F. / FACE.

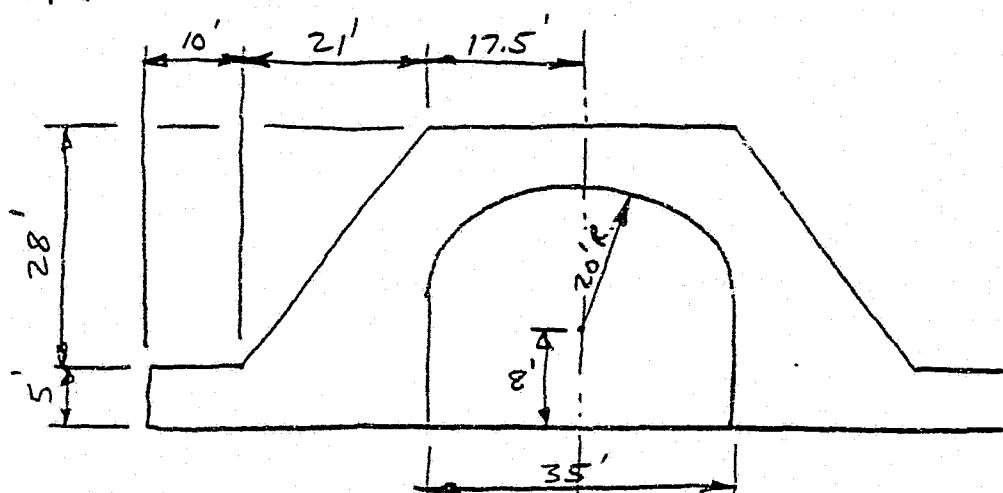
- ASSUME 2 FACES FORMED $\Rightarrow$ FORM AREA = 2,600 S.F.

$$\begin{aligned}
 \text{ASSUME COST} &= \$15/\text{S.F. INSTALLED} \\
 &= 2600 \times 15 \\
 &= \$39,000
 \end{aligned}$$

COST SUMMARY

$$\begin{aligned}
 \text{CONCRETE} &= 3175 \times 82 = 260,300 \\
 \text{POURING} &= 3175 \times 35 = 111,100 \text{ (SEE Pg. 10(a))} \\
 \text{FORMING} &= \underline{39,000} \\
 &= \$410,400
 \end{aligned}$$

$$U/C = \frac{410,400}{3175} = \$129/\text{cyd.}$$





Calculations

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10(a)

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MAIN ACCESS TUNNEL - CONT'DPOURING(a) SLAB - REQ'D PROD. = 46 cyd/SHIFT.

CREW No. 4(b).

LABOUR = $1135.17 \div 46 = 24.70$ SAY \$22/cyd.
 EQUIPMENT = $368.00 \div 46 =$ \$8/cyd.
 MATERIAL = L.S. = \$2/cyd.
\$32/cyd

(b) PORTAL - REQ'D. PRODUCTION = 36 cyd/SHIFT.

CREW No. 1(b).

LABOUR = $1014.03 \div 36 = 28$, SAY \$25/cyd.
 EQUIPMENT = $324 \div 36 =$ \$9/cyd.
 MATERIAL = L.S. = \$1/cyd.

(E) Concrete Works
Grout Galleries



Calculations

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4. GROUT GALLERIES

LENGTH = 3800 FT.

TOTAL CONCRETE = 1600 cyd.

$$\text{NO. OF POURS} = \frac{3800}{80} = 48$$

$$\text{PRODUCTION} = \frac{1600}{48} = 33 \text{ cyd/shift}$$

FORMING 160 FT/SHIFT.

$$\text{TIME} = \frac{3800}{160} = 24$$

FORMING

$$\text{WORKING TIME} = 24 \times 9 = 216 \text{ HR.}$$

$$\text{LABOUR} = 1.0 \times 227.34 \times 216 = 49,100$$

$$\text{EQUIPMENT} = 4.4 \times 30^{00} \times 216 = 28,500$$

$$\text{MATERIAL} = \text{L.S.} = 16,000$$

u/c

30

18

10

$$93,600 \div 1600 = \$58/\text{cyd}$$

ADJUSTMENT FOR HAUL
& DIFFICULTIES.

COST SUMMARY

$$\text{CONCRETE} = 1600 \times 82 = 131,200$$

$$\text{POURING} = 1600 \times 160 = 256,000 \text{ (SEE Pg. 12)}$$

$$\text{FORMING} = 93,600$$

$$\underline{\$480,800}$$

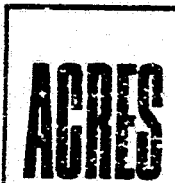
$$\text{u/c} = \frac{480,800}{1600} = \$300/\text{cyd}$$

OVERBREAK - TOTAL CONCRETE = 2846 cyd.

$$\text{CONCRETE} = \$82/\text{cyd.}$$

$$\text{POURING} = \$158/\text{cyd.}$$

$$\text{u/c} = \$240/\text{cyd.}$$



Calculations

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GROUT GALLERY - CONT'DPORTAL

TOTAL CONCRETE = 1200 cyd.

USE SAME PRICE AS MAIN ACCESS TUNNEL PORTAL

$$U/C = \$129 / \text{cyd}$$

POURING THE SLAB

REQ'D PRODUCTION = 33 cyd./SHIFT.

CREW No. 4(a)

$$\text{LABOUR} = 3605.90 \div 33 = \$110 / \text{cyd.}$$

$$\text{EQUIPMENT} = 1320.00 \div 33 = \$40 / \text{cyd.}$$

$$\text{MATERIAL} = \text{L.S.} = \$10 / \text{cyd.}$$

$$\underline{\$160 / \text{cyd.}}$$



Calculations

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5. ACCESS TO GROUT GALLERIES

LENGTH = 1325 FT.

TOTAL CONCRETE = 500 cyd.

- UNIT COST SAME AS FOR GROUT GALLERIES

$$u/c = \$300 / \text{cyd.}$$

OVERBREAK - TOTAL CONCRETE = 250 cyd.

$$u/c = \$240 / \text{cyd}$$

(E) Concrete Works

Cable Shaft



Calculations

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6. CABLE SHAFT

TOTAL CONCRETE = 1340 cyd.

LENGTH = 633 FT.

DIAMETER = 7.5 FT.

NO. OF POURS = $\frac{633}{10} = 64$

PRODUCTION = 21 cyd/SHIFT.

FORMING

WORKING TIME = $64 \times 16 = 1024$ HR.LABOUR = $68.00 \times 1024 = \$69,600$ EQUIPMENT = $162.30 \times 1024 = \$166,200$ MATERIAL = STEEL FORM (236 FT²) = 68,300

MAINTENANCE = 6800

ACCESSORIES = 6800

MISC. = 6800

SET-UP ABOVE GROUND = 50,660

\$139,400

U/C

52

124

104
\$280/cyd

TOTAL FORMING COST = \$375,200

COST SUMMARY

CONCRETE = $1340 \times 82 = 109,900$ POURING = $1340 \times 198 = 265,300$ (SEE p. 14(a))

FORMING = 375,200

\$750,400

U/C = $\frac{750,400}{1340} = \$560/\text{cyd}$ OVERBREAK - TOTAL CONCRETE = 670 cyd.

CONCRETE = \$82/cyd

POURING = \$198/cyd.

U/C = \$280/cyd



Calculations

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14(a)

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CABLE SHAFT - CONT'DPOURING

REQ'D PRODUCTION = 21 cyd/SHIFT

CREW No. 5 (a).

LABOUR = $1200.^{11} \div 21 = 57$, SAY \$60/cyd.
 EQUIPMENT = $1638^{00} \div 21 =$ \$78/cyd.
 MATERIAL = L.S. = \$60/cyd.
\$198/cyd

(E) Concrete Works

Access Shaft



Calculations

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7. ACCESS SHAFT

TOTAL CONCRETE = 4800 cyd.

LENGTH = 900 FT.

DIAMETER = 24 FT.

No. OF POURS = $\frac{900}{10} = 90$ PRODUCTION = $\frac{4800}{90} = 53 \text{ cyd/SHIFT.}$ FORMINGWORKING TIME = $90 \times 16 = 1440 \text{ HR.}$ LABOUR = $\$100^{\text{hr}} \times 1440 = 144,000$ EQUIPMENT = $188.30 \times 1440 = 271,200$ MATERIAL = STEEL FORM (754 FT²) = 107,200

MAINTENANCE = 10,000

ACCESSORIES = 10,000

MISC. = 10,000

SET-UP ABOVE GROUND = 50,000

187,200 $\frac{\$602,400}{4800} = \$125.50/\text{cyd}$ COST SUMMARYCONCRETE = $4800 \times 82 = 393,600$ POURING = $4800 \times 92.50 = 444,000 \text{ (SEE Pg. 15(a))}$ FORMING = 601,7001,439,300 $\frac{1,439,300}{4800} = \$300/\text{cyd}$ OVERBREAK - TOTAL CONCRETE = 1300 cyd.

CONCRETE = \$82/cyd.

POURING = \$93/cyd

 $\frac{1,439,300}{8000} = \$175/\text{cyd}$



Calculations

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Page 15(a) of _____ACCESS SHAFT - CONT'D

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POURING

REQ'D PRODUCTION = 53 cyd/SHIFT.

CREW No. 5(c).

$$\begin{aligned}
 \text{LABOUR} &= 1652.23 \div 53 = \$32/\text{cyd.} \\
 \text{EQUIPMENT} &= 1617.00 \div 53 = \$30.50/\text{cyd.} \\
 \text{MATERIAL} &= \text{L.S.} = \$30/\text{cyd.} \\
 &\quad \underline{\$92.50/\text{cyd.}}
 \end{aligned}$$

(E) Concrete Works

Penstocks



Calculations

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8. PENSTOCKS

TOTAL CONCRETE = 12,600 cyd.

No. OF PENSTOCKS = 4

LENGTH = 4 x 540 = 2160 FT.

DIAMETER = 17 FT.

No. OF POURS = $\frac{540}{10} = 54$ POURS/EA.PRODUCTION = $\frac{12600}{54 \times 4} = 58$ cyd/SHIFTFORMING

ASSUME 2 FORMS USED

∴ 2 PENSTOCKS / FORM.

WORKING TIME = 54 x 4 x 16 = 3456 HR.

LABOUR = 183.75 x 3456 = 634,867

EQUIPMENT = 75⁰⁰ x 3456 = 259,200MATERIAL = STEEL FORM (534 FT²) = 155,000

MAINTENANCE = 15,000

ACCESSORIES = 15,000

MISC. = 15,000

SET-UP ABOVE GROUND = 15,000

215,000TOTAL FORMING COST

LABOUR = 634,867

EQUIPMENT = 259,200

MATERIAL = 215,000

 $\$1,109,067 \div 12,600 = \$88/\text{cyd.}$
U/C
 50
 21
 17



Calculations

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PENSTOCKS - CONT'DCOST SUMMARY

$$\text{CONCRETE} = 12,600 \times 82 = 1,033,200$$

$$\text{POURING} = 12,600 \times 138 = 1,738,800 \text{ (SEE BELOW)}$$

$$\text{FORMING} = \underline{1,109,700}$$

$$\underline{\$3,881,700}$$

$$U/C = \frac{3,881,700}{12,600} = \boxed{\$308/\text{cyd.}}$$

OVERBREAK - TOTAL CONCRETE = 4,120 cyd.

$$\text{CONCRETE} = \$82/\text{cyd}$$

$$\text{POURING} = \$138/\text{cyd}$$

$$U/C = \boxed{\$220/\text{cyd}}$$

POURING

REQ'D PRODUCTION = 58 cyd/SHIFT.

CREW No. 5(b).

$$\text{LABOUR} = 4084.11 \div 58 = \$69/\text{cyd}$$

$$\text{EQUIPMENT} = 2263.00 \div 58 = \$39/\text{cyd.}$$

$$\text{MATERIAL} = \text{L.S.} = \$30/\text{cyd.}$$

$$\underline{\$138/\text{cyd}}$$

(E) Concrete Works.

Forming Crews

3/17

Date JAN. 25/82

SITE: DEVIL CANYON

WORK TYPE: FORMWORK IN TUNNELS

QUANTITY:

PRODUCTION:

LABOUR

COST PER UNIT QUANTITY:

ESTIMATOR: F. TOTH

4/17

Date JAN. 25/82

SITE: DEVIL CANYON

WORK TYPE: FORWORK IN TUNNELS

QUANTITY:

PRODUCTION:

EQUIPMENT

COST PER UNIT QUANTITY:

११

P5700.09

PRODUCTION:

ESTIMATOR: F. TOTH

6/17

Date JAN. 25/82

SITE: DEVIL CANYON

WORK TYPE: FORMWORK IN SHAFTS

QUANTITY:

PRODUCTION:

<u>Item</u>	<u>Type</u>	<u>Number</u>	<u>Rate \$/hr</u>	<u>Cost \$/hr</u>	<u>Remarks</u>
	HOIST WITH H. FRAME	1	64. ⁵⁰	64. ⁵⁰	
	4x4 PICKUP	1	25. ⁰⁰	25. ⁰⁰	
	NOTE				
	IN CASE OF CABLE SHAFT & ACCESS SHAFT				
	USE Equip cost = 180. ⁰⁰ /Hr (~) - FEB 11/82				
	IN CASE OF PENSTOCK USE				
	Equip cost = 75. ⁰⁰ /Hr - FEB 11/82				
	TOTAL			89. ⁵⁰	

COST PER UNIT QUANTITY:

ESTIMATOR: F. TOTH

(E) Concrete Works
Placing Crews



Calculations

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CONCRETE PLACING CREWS

CREW No. 1

PRODUCTION = 50 - 120 cyd/SHIFT.

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LABOUR

RATE \$/HR	(a)		(b)		(c)	
	No.	COST	No.	COST	No.	COST
FOREMAN 35 ³¹	1	317 ⁷⁹	-	-	1	317 ⁷⁹
CEMENT FIN. 33 ¹¹	2	595 ⁹⁸	1	297 ⁹⁹	1	297 ⁹⁹
LABOUR 30 ⁵⁴	3	824 ⁵⁸	2	549 ⁷²	3	824 ⁵⁸
CRANE OP. 36 ⁹⁶	1	332 ⁶¹	1/2	166 ³²	-	-
HELPER 30 ⁵⁴	1	274 ⁸⁶	-	-	-	-
CARPENTER 34 ⁵¹	1/4	77 ⁶⁵	-	-	1/4	77 ⁶⁵
STEEL WORKER 37 ⁴¹	1/4	84 ¹⁷	-	-	1/4	84 ¹⁷
-	8 1/2	2507. ⁶⁷	3 1/2	1014. ⁰³	5 1/2	1602 ¹⁸

PER
SHIFTEQUIPMENT

RATE \$/HR	(a)		(b)		(c)	
	No.	COST	No.	COST	No.	COST.
50 ^T CRANE 63 ⁰⁰	1	567 ⁰⁰	-	-	-	-
ELEPHANT TRUNK 1 ⁵⁰	1	13 ⁵⁰	1	13 ⁵⁰	1	13 ⁵⁰
3" VIBRATOR 2 ³⁰	3	62 ¹⁰	3	62 ¹⁰	3	62 ¹⁰
375 COMPRESSOR 24 ⁵⁰	1	220 ⁵⁰	-	-	1	220 ⁵⁰
2 CY. HOPPER 1 ⁴⁰	1	12 ⁶⁰	-	-	1	12 ⁶⁰
50 FT. CONVEYOR 3 ²⁰	1	28 ⁸⁰	-	-	1	28 ⁸⁰
SMALL TOOLS & MISC. L.S.	-	-	-	-	-	138 ⁵⁰
30 ^T CRANE 27 ⁶⁰	-	-	1	248 ⁴⁰	-	-
-	-	904. ⁵⁰	-	324 ⁰⁰	-	476 ⁰⁰

PER
SHIFT.

E 74



Calculations

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CREW No. 2PRODUCTION = 121 - 175 cyd/SHIFT.

LABOUR

	RATE \$/HR.	No.	COST
FOREMAN	35 ³¹	1	317. ⁷⁹
CEMENT FIN.	33 ¹¹	2	595. ⁹⁸
LABOUR	30 ⁵⁹	4	1099. ⁴⁴
CRETER OP.	36 ⁹⁶	1	332. ⁶⁹
COMPRESSOR OP.	29 ²⁹	1	308. ⁶¹
CARPENTER	34 ⁵¹	1/2	155. ³⁰
IRON WORKER	37 ⁹¹	1/2	168. ³⁴
MECHANIC	36 ⁹⁶	1/2	166. ³²
-	-	10 1/2	3144. ⁴²

PER
SHIFT

EQUIPMENT

	RATE \$/HR	No.	COST
CRETER CRANE	110 ⁰⁰	1	990 ⁰⁰
ELEPHANT TRUNK	1 ²⁰	1	10 ⁸⁰
3" VIBRATOR	2 ³⁰	2	41 ⁴⁰
.375 COMPRESSOR	29 ⁵⁰	1	220 ⁵⁰
2 CY. HOPPER	1 ⁴⁰	1	12 ⁶⁰
50 FT. CONVEYOR	3 ²⁰	2	57 ⁶⁰
-	-	-	1332 ⁹⁰

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Calculations

SUBJECT

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CREW No. 3

PRODUCTION = 176 - 240 cyd/SHIFT.

LABOUR

FOREMAN

CEMENT FIN.

LABOUR

CRETER OP.

COMPRESSOR OP.

CARPENTER

IRON WORKER

MECHANIC

RATE \$/HR.	No.	COST.
35 ³¹	1	317. ⁷⁹
33 ¹¹	4	1191. ⁹⁶
30 ⁵⁴	4	1099. ⁴⁴
36 ⁹⁶	1	332. ⁶⁴
34 ²⁹	1	308. ⁶¹
34 ⁵¹	1	310. ⁵⁹
37 ⁴¹	1/2	168. ³⁵
36 ⁹⁶	1/2	166. ³²
-	13	3895. ⁷⁰

PER
SHIFT

EQUIPMENT

CRETER CRANE

ELEPHANT TRUNK

3" VIBRATOR

375 COMPRESSOR

2 CY. HOPPER

50 FT. CONVEYOR

RATE \$/HR.	No.	COST
110 ⁰⁰	1	990 ⁰⁰
1. ²⁰	2	21 ⁶⁰
2. ³⁰	4	82 ⁸⁰
24. ⁵⁰	1	220 ⁵⁰
1. ⁴⁰	1	12 ⁶⁰
3. ²⁰	2	57 ⁶⁰
-	-	1385 ¹⁰

PER
SHIFT.



Calculations

SUBJECT

By HEK Date 82/2/16 Project No. P5700

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Page 4 of 5CREW No. 4 - TUNNEL CONCRETE

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LABOUR

FOREMAN
CONC. PUMP OP.
CARPENTER
IRONWORKER
LABOUR

RATE \$/HR	(a)		(b)		(c)	
	No.	COST	No.	COST.	No.	COST
35 ³¹	1	317 ⁷⁹	-	-	1	317 ⁷⁹
31 ⁸⁵	1	286 ⁶⁵	-	-	1	286 ⁶⁵
34 ⁵¹	1.5	465 ⁸⁹	1	310 ⁵⁹	1	310 ⁵⁹
37 ⁴¹	1	336 ⁶⁹	-	-	1	336 ⁶⁹
30 ⁵⁴	8	2198 ⁸⁸	3	824 ⁵⁸	4	1099 ⁴⁴
-	12 1/2	3605 ⁹⁰	4	1135 ¹⁷	8	2351 ¹⁶

EQUIPMENT

CONCRETE PUMP
VIBRATOR
PICKUP
350 COMPRESSOR
500 COMPRESSOR
SMALL TOOLS

RATE \$/HR	(a)		(b)		(c)	
	No.	COST	No.	COST	No.	COST
80 ⁰⁰	1	720 ⁰⁰	-	-	1	720 ⁰⁰
2 ⁵⁰	4	90 ⁰⁰	4	90 ⁰⁰	4	90 ⁰⁰
16 ⁰⁰	1	144 ⁰⁰	1	144 ⁰⁰	1	144 ⁰⁰
-	1	117 ⁰⁰	1	117 ⁰⁰	-	-
-	1	232 ⁰⁰	-	-	1	232 ⁰⁰
-	L.S.	17 ⁰⁰	L.S.	17 ⁰⁰	L.S.	17 ⁰⁰
-	-	1320 ⁰⁰	-	368 ⁰⁰	-	1203 ⁰⁰



Calculations

SUBJECT

By HEK. Date 82/2/16 Project No. F5700

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CREW No. 5 - SHAFT CONCRETELABOUR

FOREMAN
HOIST OP.
CONC. LABOUR
CARPENTER
FLAGMAN
LABOUR

RATE \$/HR	(a)		(b)		(c)	
	No.	COST	No.	COST	No.	COST
35 ³¹	1/4	79 ⁴⁵	1	317 ⁷⁹	1/2	158 ⁹⁰
35 ¹⁰	1/2	157 ⁹⁵	1	315 ⁹⁰	1/2	157 ⁹⁵
32 ⁷⁸	3	885 ⁰⁶	4	1180 ⁰⁸	4	1180 ⁰⁸
34 ⁵¹	1/4	77 ⁶⁵	2	621 ¹⁸	1/2	155 ³⁰
30 ⁵⁴	-	-	1	274 ⁸⁶	-	-
30 ⁵⁴	-	-	5	1374 ³⁰	-	-
-	4	1200. ¹¹	14	4084. ¹¹	5 1/2	1652. ²³

EQUIPMENT

HOIST WITH FRAME
PICKUP
VIBRATOR
MIX BOX
HEATER
350 COMPRESSOR
500 COMPRESSOR
SMALL TOOLS
MISC. & SPECIAL EQ.
MAN HOIST

RATE \$/HR	(a)		(b)		(c)	
	No.	COST	No.	COST	No.	COST
64 ⁵⁰	1	580 ⁵⁰	1	580 ⁵⁰	1	580 ⁵⁰
16 ⁰⁰	1	144 ⁰⁰	1	144 ⁰⁰	1	144 ⁰⁰
2 ⁵⁰	2	45 ⁰⁰	2	45 ⁰⁰	2	45 ⁰⁰
10 ⁰⁰	1	90 ⁰⁰	1	90 ⁰⁰	1	90 ⁰⁰
4 ⁰⁰	1	36 ⁰⁰	1	36 ⁰⁰	1	36 ⁰⁰
13 ⁰⁰	1	117 ⁰⁰	1	117 ⁰⁰	1	117 ⁰⁰
25 ⁷⁵	-	-	1	232 ⁰⁰	-	-
-	L.S.	45 ⁰⁰	L.S.	24 ⁰⁰	L.S.	24 ⁰⁰
-	-	-	L.S.	414 ⁰⁰	-	-
64 ⁵⁰	1	580 ⁵⁰	1	580 ⁵⁰	1	580 ⁵⁰
-	-	1638 ⁰⁰	-	2263 ⁰⁰	-	1617 ⁰⁰

(E) Concrete Works

Supply of Concrete



Estimate Work Sheet

ITEM REFERENCE No. P.H./SPILLWAY/INTAKE/TUNNELS

JOB No. P5700

DESCRIPTION

SHEET 1 OF 1.

PROJECT SUSITNA HYDROELECTRIC.

OPERATION No.

REF.

BY P.J.S.

CONTRACT DEVIL CANYON.

DESCRIPTION

CKD DATE

DESCRIPTION AND BASIS OF ESTIMATE	QUANTITY	UNIT	LABOR		JOB MATERIALS		PERM. MATERIALS		SUBCONTRACTS		EQPT. OWNERSHIP		EQPT. OPERATION		Equiv UNIT	TOTAL AMOUNT
			UNIT COST	AMOUNT	UNIT COST	AMOUNT	UNIT COST	AMOUNT	UNIT COST	AMOUNT	UNIT COST	AMOUNT	UNIT COST	AMOUNT		
SUPPLY OF CONCRETE:																
SUPPLY OF FINE AGGREGATES. 1.48	150,000	cycl.	2 ⁵⁰	375,000	0 ¹⁷	25,500	-	-	-	-	5 ³⁰	795,000	-	-	7 ⁹⁷	1,195,500
SUPPLY OF COARSE AGGREGATES. 3.90	180,000	cycl.	5 ⁵⁰	990,000	0 ⁶⁷	120,600	-	-	-	-	9 ⁷⁰	1,746,000	-	-	15 ⁸⁸	2,858,400
SUPPLY OF CEMENT. 1.77	68,580	TON.	6 ⁵⁴	448,720	-	12,296,620	-	-	-	-	-	879,140	-	-	-	13,624,480
PRODUCTION OF CONCRETE. 7.72	254,000	cycl.	17 ⁷²	1,961,162	-	571,000	-	-	-	-	-	1,871,487	-	-	-	4,410,000
TOTAL. 14.87	254,000	cycl.	14 ⁸⁶	3,774,882	51 ²⁴	13,013,720	-	-	-	-	83 ²⁰	5,291,627	-	-	96 ⁸⁶	22,088,380
USE THE FOLLOWING PRICE AGREED WITH J. PLUMMER L. COUSINEAU R. LANG. 10 FEB/82.	254,000	cycl	14 ⁵⁰	3,683,000	44 ⁶⁰	11,328,400	-	-	-	-	90 ²²	5,816,600	-	-	82 ⁰⁰	20,828,000

FOLD LENGTH

12
11
8.5
8

AUTO

MANUAL

FEED

(E) Concrete Works

Concrete Production



Estimate Work Sheet

ITEM REFERENCE No. P/H - INTAKE - SPILLWAY - TUNNELS. JOB No. P5700.

DESCRIPTION CONCRETE

SHEET 1 OF 1.

PROJECT SUSITNA. HYDROELECTRIC

OPERATION No.

REF.

BY P. J. S.

CONTRACT DEVIL CANYON.

DESCRIPTION CONCRETE PRODUCTION.

CKD fbb DATE 4/11/82

DESCRIPTION AND BASIS OF ESTIMATE	QUANTITY	UNIT	LABOR		JOB MATERIALS		PERM.MATERIALS		SUBCONTRACTS		EQPT.OWNERSHIP		EQPT.OPERATION		Equiv UNIT	TOTAL AMOUNT
			UNIT COST	AMOUNT	UNIT COST	AMOUNT	UNIT COST	AMOUNT	UNIT COST	AMOUNT	UNIT COST	AMOUNT	UNIT COST	AMOUNT		
<u>CONCRETE PRODUCTION.</u>																
(a) MOBILIZATION @ YARD.	-			5873		2500		-		-		1720		-		10,093
(b) HANDLING @ YARD.	-			9,145		3500		-		-		9,510		-		22,155
(c) TRANSPORTATION TO SITE & BACK.	-			24,696		20,000		-		-		51,944		-		46,640
(d) SITE PREPARATION	-			5,975		1,000		-		-		4,450		-		11,425
(e) FOUNDATION & SERVICES.	-			31,547		9,000		-		-		23,415		-		63,962
(f) ASSEMBLY & REMOVAL OF PLANT.	-			35,678		10,000		-		-		14,778		-		60,456
(g) ERECTION & REMOVAL.	-			28,474		6,000		-		-		17,550		-		52,024
(h) TESTING & COMMISSIONING.	-			34,582		7,600		-		-		21,530		-		63,712
(i) WINTERIZATION OF PLANT.	-			48,952		200,000		-		-		19,370		-	268,322	263,322
(j) OPERATION OF PLANT.	-			552,150		127,000		-		-		162,000		-		841,150
(k) HEATING AGG & WATER.	-			106,000		53,000		-		-		212,000		-	371,000	371,600
(l) SERVICE & MAINTENANCE.	-			136,890		42,000		-		-		48,750		-		227,640
(m) READY MIX TRUCKS.	-			846,300		-		-		-		690,000		-	1,536,300	1,554,300
(n) POWER - STANDBY.	-			80,000		40,000		-		-		37,770		-		97,770
(o) DEMOBILIZATION @ SITE.	-			9,000		4,000		-		-		5000		-		18,000
(p) CONCRETE LAB.	-			20,000		30,000		-		-		50,000		-		100,000
(q) GENERAL CLEAN-UP	-			20,000		5,000		-		-		25,000		-		50,000
(r) MISC.	-			20,000		5,000		-		-		25,000		-		50,000
(s) DEMOBILIZATION @ YARD.	-			5,900		5400		-		-		1,700		-		13,000
(t) AGG. HANDLING Equip	-			-		-		-		-		150,000		-		150,000
(u) CONCRETE BATCH PLANT.	-			-		-		-		-		300,000		-		300,000
TOTAL	254,000	cyd.	7.12	1,961,162	225	571,000		-		-	7.37	1,871,487		-	17 ³⁴ 17 ³⁴	4,410,000 1,403,499
104																



Calculations

E 82

By HEK Date FEB. 3/82 Project No. P5700.09

SUBJECT

Checked _____ Date _____

Calculation No. _____

DEVIL CANYON

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CONCRETE PRODUCTION

CAPACITY = 80 cyd/HR.

TOTAL CONCRETE = 254,000 cyd.

Rev	By	Checked

COST SUMMARY

ITEM	COST	ITEM	COST
a) MOBILIZATION @ YARD	10,100	m) READY MIX TRUCKS	1,554,300
b) HANDLING @ YARD	22,200	n) POWER	
c) TRANSPORTATION (2-WAY)		- TRANSMISSION LINE	40,000
- BY LAND (LOWER 48)	25,800	- STAND-BY GENERATOR	37,800
- BY SEA	42,000	- MISC.	20,000
- BY LAND (ALASKA)	29,000		97,800
	96,800	o) DEMOBILIZATION	18,000
d) SITE PREPARATION	11,500	p) CONCRETE LAB	100,000
e) FOUNDATION & SERVICES	64,000	q) GENERAL CLEAN-UP	50,000
f) ASSEMBLE PLANT @ SITE	60,400	r) MISC.	50,000
& DISASSEMBLE		s) DEMOBILIZATION @ YARD	13,000
g) ERECTION OF PLANT	52,000	t) AGG. HANDLING EQUIP.	150,000
& REMOVAL		u) SUPPLY OF PLANT	300,000
h) TESTING & COMMISSIONING	63,700		
i) WINTERIZATION OF PLANT	268,300		
j) OPERATION OF PLANT	841,100		
k) HEATING AGGREGATE & WATER	371,600		
l) SERVICE & MAINTENANCE	227,700		
		TOTAL COST	4,422,500
		UNIT COST = $\frac{4,422,500}{254,000}$	
		= \$17 ⁴¹ / ₁₀₀ /cyd.	
C.F.	2,089,400		



Calculations

SUBJECT

DEVIL CANYONBy P. SINGH Date 82/2/3Project No. P5700

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CONCRETE PRODUCTION - 80 cyd/HR PLANT.

Rev	By	Checked

@ MOBILIZATION @ CONTRACTOR'S YARD

TIME = 20 HR.

LABOUR

FOREMAN = 36.21

OPERATOR = 70.20

LABOUR = 122.16

MECHANIC = 35.10

OTHER = 30.00

293.67 x 20 HR. = \$5873

MATERIAL

TIMBER = 500

PACKING MATERIAL = 1000

ROPE & CHAIN = 200

MISC. = 800

\$2500

EQUIPMENT

1/2 TON PICKUP = 16.⁰⁰CRANE = 35.⁰⁰BOOM TRUCK = 20.⁰⁰SMALL TOOLS = 10.⁰⁰MISC. = 5.⁰⁰86.⁰⁰ x 20 HR. = \$1720

SUMMARY

LABOUR = 5873

MATERIAL = 2500

EQUIPMENT = 1720

\$10,093



Calculations

SUBJECT

By P. SINGH Date 82/2/3Project No. P5700

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Page 2 of 21

Rev	By	Checked

⑥ HANDLING @ CONTRACTOR'S YARD

TIME = 30 HR.

LABOUR

FOREMAN = 38.06
 OPERATOR = 73.92
 MECHANIC = 35.10
 LABOUR = 122.16
 DRIVER = 35.58

 $304.82 \times 30 \text{ HR.} = \$9,145$
MATERIAL

CHAIN / SLING = 500
 ROPE / BLOCKS = 1500
 MISC. = 1500
\$ 3500

EQUIPMENT

PICKUP = 16.00
 CRANE 15^T = 35.00
 CRANE 50^T = 175.00
 TRACTOR-TRAILER = 81.00
 SMALL TOOLS = 5.00
 MISC. = 5.00

 $317.00 \times 30 \text{ HR.} = \$9,510$
SUMMARY

LABOUR = 9,145
 MATERIAL = 3,500
 EQUIPMENT = 9,510
\$ 22,155



Calculations

SUBJECT

By P. SINGH Date 82/2/3Project No. P5700

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Page 3 of 21

© TRANSPORTATION TO SITE

(i) LAND TRANSPORTATION (TO PORT IN LOWER 48)

Rev	By	Checked

TIME = 8 HR.

LABOUR (LOADING)

FOREMAN = 38.06
 LABOUR = 122.16
 OPERATOR = 36.96
 DRIVER = 35.58
 MECHANIC = 35.10

267.86 × 8 HR. = \$2,143

MATERIAL

L.S. = \$2000

EQUIPMENT (LOADING)

CRANE 50^T = 175.00
 TRACTOR-TRAILER = 81.00
 PICKUP = 16.00
 FLATBED = 20.00
 SMALL TOOLS = 5.00
 MISC. = 5.00

302.00 × 8 HR. = \$2,416

SUB-CONTRACT (TRANSPORT)

RATE = \$0.03/lb

TOTAL WEIGHT = 210,000 lb (ASSUMED)

COST = 0.03 × 210,000 = \$6,300

SUMMARY

LABOUR = 2,143
 MATERIAL = 2,000
 EQUIPMENT = 2,416
 SUB-CONTRACT = 6,300

\$12,859 × 2 WAYS = \$25,800

108



Calculations

SUBJECT

By P. SINGH Date 82/2/3Project No. P5700

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© TRANSPORTATION - CONT'D.(ii) BY SEA TO ALASKA

- INCLUDES LOADING & UNLOADING.

SUB-CONTRACT

$$\text{RATE} = \$0.10 / \text{lb}$$

$$\text{TOTAL WEIGHT} = 210,000 \text{ lb.}$$

$$\begin{aligned} \text{COST} &= 0.10 \times 210,000 \\ &= \$21,000 \end{aligned}$$

$$\begin{aligned} \text{TOTAL COST} &= 21,000 \times 2 \text{ WAYS} \\ &= \$42,000 \end{aligned}$$

ASSUME THE BREAKDOWN.

$$\text{LABOUR} = 12,000$$

$$\text{MATERIAL} = 15,000$$

$$\text{EQUIP} = 15,000.$$

$$\underline{\underline{\$42,000}}$$

SUMMARY OF TRANSPORTATION.

	LAB	MAT	EQUIP	
LAND	= 2,423	+ 2,000	+ 8,716	= 12,859
SEA	= 6,000	+ 7,500	+ 7,500	= 21,000
SITE	= 4,205	+ 500	+ 9,756	= 14,461
TO SITE	= 12,348	+ 10,000	+ 25,972	= 48,320
BACK TO YD	= 12,348	+ 10,000	+ 25,972	= 48,320
TOTAL	= 24,696	+ 20,000	+ 51,944	= 96,640



Calculations

SUBJECT

By P. SINGH Date 82/2/3Project No. P5700

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Rev	By	Checked

② TRANSPORTATION - CONT'D(iii) BY LAND TO SITE (IN ALASKA)

TIME = 16 HR.

LABOUR (LOADING & UNLOADING)

FOREMAN = 38.06

MECHANIC = 35.10

OPERATOR = 36.96

LABOURER = 152.70 $262.82 \times 16 \text{ HR.} = \$4,205$ MATERIAL L.S. = \$500EQUIPMENT (LOADING & UNLOADING)

CRANE = 175.00

PICKUP = 16.00

FLATBED = 20.00

MISC. = 5.00 $216.00 \times 16 \text{ HR.} = \$3,456$ SUB-CONTRACT (TRANSPORT)

RATE = \$0.03 / lb.

WEIGHT = 210,000 lbs.

$$\begin{aligned} \text{COST} &= 0.03 \times 210,000 \\ &= \$6,300 \end{aligned}$$
SUMMARY

LABOUR = 4,205

MATERIAL = 500

EQUIPMENT = 3,456

SUB-CONTRACT = 6,300 $\$14,461 \times 2 \text{ WAYS} = \$29,000$



Calculations

SUBJECT

By P. SINGH Date 82/2/3Project No. P5700

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④ SITE PREPARATION

TIME = 20 HR.

LABOUR

FOREMAN	=	36.21
MECHANIC	=	35.10
3 OPERATOR	=	105.30
1 LABOURER	=	122.16
		<u>298.77</u>

$298.77 \times 20 \text{ HR.} = \$5,975$

MATERIAL

TIMBER	=	200
PIPE - C.S.P.	=	200
DRILL STEEL	=	200
HOSE/NOZZLE	=	200
MISC.	=	200
		<u>1000</u>

EQUIPMENT

DOZER D-7	=	85
LOADER 3 CY.	=	30
PICKUP	=	16
AIR TRACK	=	28.50
COMPRESSOR (350)	=	18
DUMP TRUCK	=	40
SMALL TOOLS	=	5
		<u>222.50</u>

$222.50 \times 20 \text{ HR.} = \$4,450$

SUMMARY

LABOUR	=	5,975
MATERIAL	=	1,000
EQUIPMENT	=	4,450
		<u>\$11,425</u>



Calculations

SUBJECT

By P. SINGH Date 8/2/23 Project No. P5700

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© FOUNDATION & SERVICES

-INCLUDES EXCAVATION, CONCRETE,
GRADING, MISC.

TIME = 100 HR.

LABOUR

FOREMAN	=	40.35
2 CARPENTER	=	69.02
2 IRONWORKER	=	74.82
2 OPERATOR	=	70.20
3 LABOURER	=	<u>61.08</u>
		315.47 x 100 HR. = \$31,547

MATERIAL

A-BOLTS	=	1000
CONCRETE	=	3000
REBAR	=	1500
FORMWORK	=	2500
BRACING	=	700
SMALL TOOLS	=	<u>300</u>
		\$9,000

EQUIPMENT

DOZER	=	85
BACKHOE	=	53
F.E.L.	=	30
PICKUP	=	16
BOOM TRUCK	=	20
AIR COMP. (365)	=	18
WATER PUMP	=	5.15
HOSE & NOZZLES	=	2
SMALL TOOLS	=	<u>5</u>

SUMMARY

LABOUR	=	31,547
MATERIAL	=	9,000
EQUIPMENT	=	<u>23,415</u>
		\$63,962

234.15 x 100 HR. = \$23,415



Calculations

SUBJECT

By P. SINGH Date 82/2/3 Project No. P5700

Checked _____ Date _____ Calculation No. _____

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Rev	By	Checked

⑨ ASSEMBLE & DISASSEMBLE THE PLANT

TIME = 27 HR.

LABOUR

FOREMAN	=	38.06
2 MECHANIC	=	70.20
3 OPERATOR	=	110.88
10 LABOURER	=	305.40
2 DRIVER	=	71.16
2 CEMENT FIN.	=	<u>65.10</u>
		660.72 x 27 = \$17,839

MATERIAL

ROPE/SLING	=	1000
MISC. STEEL	=	2000
BOLTS/WASHER	=	1000
MISC.	=	<u>1000</u>
		\$5,000

EQUIPMENT

WELDING EQUIP.	=	6.65
CRANE 20 ^T	=	60
BOOM TRUCK	=	20
FLAT BED	=	20
COMPRESSOR (350)	=	36
CRANE 50 ^T	=	87.50
F.E.L.	=	7.50
PICKUP	=	16
SMALL TOOLS	=	5
MISC.	=	5
CUTTING & BURNING.	=	<u>10</u>

273.65 x 27 HR. = \$7,389

SUMMARY

LABOUR	=	17,839
MATERIAL	=	5,000
EQUIPMENT	=	<u>7,389</u>
		\$30,228
DISASSEMBLE	x 2	
TOTAL	=	<u>\$60,400</u>



Calculations

SUBJECT

By P. SINGH Date 82/2/3Project No. P5700

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⑨ ERECTION & REMOVAL OF PLANT

TIME = 27 HR.

Rev	By	Checked

LABOUR

FOREMAN	=	40.35
2 MECHANIC	=	70.20
2 OPERATOR	=	73.92
4 LABOURER	=	122.16
4 IRONWORKER	=	149.64
2 CARPENTER	=	<u>71.02</u>
		527.29 x 27 HR. = \$14,237

MATERIAL

CONSUMMABLES	=	1000
ROPE, SLING, ETC.	=	500
BRACING	=	500
OTHER	=	<u>1000</u>
		\$3,000

EQUIPMENT

CRANE 50 ^T	=	175
CRANE 20 ^T	=	60
CHERRY PICK	=	20
WORKING PLATFORM	=	8
COMPRESSOR (350)	=	36
PICKUP	=	16
SMALL TOOLS	=	5
MISC.	=	<u>5</u>
		325.00 x 27 HR. = \$8,775

SUMMARY

LABOUR	=	14,237
MATERIAL	=	3,000
EQUIPMENT	=	<u>8,775</u>
		\$26,012 x 2 = <u>\$52,000</u>



Calculations

SUBJECT

By P. SINGH Date 82/2/3Project No. P5700

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① TEST & COMMISSION PLANT

TIME = 100 HR.

LABOUR

FOREMAN	=	43.03
2 MECHANIC	=	70.20
1 ELECTRICIAN	=	40.23
2 OPERATOR	=	70.20
4 LABOURER	=	<u>122.16</u>

$$345.82 \times 100 \text{ HR.} = \$34,582$$

MATERIAL

TOOLS	=	200
CONSUMMABLE	=	200
CEMENT	=	2000
FLYASH	=	1000
AGGREGATE	=	4000
MISC.	=	<u>200</u>
		<u>\$7,600</u>

EQUIPMENT

PICKUP	=	32
CRANE 15 ^T	=	40
BOOM TRUCK	=	20
COMPRESSOR (600)	=	54
WELDER	=	14.30
READY MIX TRUCK	=	50
MISC.	=	<u>5</u>

$$215.30 \times 100 \text{ HR.} = \$21,530$$

SUMMARY

LABOUR	=	34,582
MATERIAL	=	7,600
EQUIPMENT	=	<u>21,530</u>
		<u>\$63,712</u>



Calculations

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By P. SINGH Date 82/2/3Project No. P5700

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① WINTERIZATION OF PLANT

TIME = 130 HR.

LABOUR

1 FOREMAN = 40.35
 4 LABOUR = 122.16
 2 CARPENTER = 69.02
 2 OPERATOR = 70.20
 2 IRONWORKER = 74.82

 $376.55 \times 130 \text{ HR.} = \$48,952$
MATERIAL

POLY FILM = 20,000
 TIMBER & NAILS = 10,000
 STEEL = 10,000
 WIRE ROPE = 10,000
 TARPS = 30,000
 MISC = 20,000

 $100,000 \times 4 \text{ YR.} \div 2 \text{ USES} = \$200,000$
EQUIPMENT

CRANE 15^T = 35
 BOOM TRUCK = 20
 FLATBED = 20
 PICKUP = 16
 SAWS = 20
 COMPRESSOR (350) = 18
 TOOLS = 10
 MISC. = 10

 $149.00 \times 130 \text{ HR.} = \$19,370$
SUMMARY

LABOUR = 48,952
 MATERIAL = 200,000
 EQUIPMENT = 19,370
\$268,322



Calculations

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① OPERATION OF PLANT

TIME = 5000 HR.FROM P. MACDONALD.

LABOUR

OPERATOR = 35.10

MECHANIC = 35.10

ELECTRICIAN = 40.23 $110.43 \times 5000 \text{ HR.} = \$552,150$

MATERIAL

PARTS = 1.00

CONSUMMABLE = 5.50

REPAIRS = 3.50

SERVICES = 4.20

MAJOR REPAIRS = 2.00

LUB / OIL = 8.20

MISC. = 1.00 $25.40 \times 5000 \text{ HR.} = \$127,000$

EQUIPMENT

PICKUP = 16.00

CRANE 15^T = 8.75

WELDING EQUIP. = 6.65

MISC. = 1.00 $32.40 \times 5000 = \$162,000$

SUMMARY

LABOUR = 552,150

MATERIAL = 127,000

EQUIPMENT = 162,000\$841,150



Calculations

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(K) HEATING WATER & AGGREGATES

TOTAL CONCRETE = 254,000 cyd.

FINE AGGREGATE = 132,000 cyd

COARSE AGGREGATE = 168,000 cyd.

WATER = 6,985,000 gal.

ASSUME 50% REQUIRES HEATING: FINE = 66,000 cyd.
 COARSE = 84,000 cyd.
 WATER = 3,493,000 gal.

FUEL COST: FINE = 2.0 liter/cyd × 20¢/l. = 40¢/cyd
 COARSE = 2.0 liter/cyd × 20¢/l. = 40¢/cyd.

A. WATER - EQUIPMENT

BOILER = 100,000
 PIPE & FITTINGS = 10,000
 MISC. = 10,000
 ENCLOSURE = 5,000
\$125,000

OPERATION

FUEL = \$30,000

B. COARSE AGGREGATE

ENCLOSURE = 0.10/cyd
 EQUIPMENT - RENTAL = 0.40/cyd
 - OPERATION = 0.40/cyd
 LABOUR = 0.40/cyd
 MATERIAL = 0.10/cyd
\$1.40/cyd × 84,000 cyd.
 = \$117,600



Calculations

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HEATING - CONT'DC. FINE AGGREGATE

ENCLOSURE = 0.10

EQUIPMENT - RENTAL = 0.40

- OPERATION = 0.50

LABOUR = 0.40

MATERIAL = 0.10

 $\$1.50/\text{cyd} \times 66,000 \text{ cyd.}$ $= \$99,000$ SUMMARY

A. WATER = 155,000

B. COARSE AGG. = 117,600

C. FINE AGG. = 99,000

 $\$371,600$ ASSUMPTIONS FOR HEATING PROCESS

1. MATERIAL TO BE HEATED FROM 20°F. TO 55°F.

2. NO MOISTURE TO BE REMOVED FROM SAND.

3. NATURAL GAS IS USED AS FUEL @ 20¢/LITER.

4. BREAK DOWN.

LAB = 106,000

MAT = 53,000

Equip = 212,000

 $\$371,000$



Calculations

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① SERVICE & MAINTENANCE

$$\begin{aligned} \text{TIME} &= 1300 \text{ DAYS} \times 3 \text{ HR/DAY} \\ &= 3900 \text{ HR.} \end{aligned}$$

LABOUR

$$\text{MECHANIC} = 1 \text{ No.} \times 3510 \times 3900 \text{ HR.} = \$136,890$$

MATERIAL

$$\begin{aligned} \text{FUEL} &= 10,000 \text{ gal.} \times 1.00 = 10,000 \\ \text{LUBE \& OIL} &= 5,000 \text{ gal.} \times 4.80 = 24,000 \\ \text{CONSUMMABLE} &= 2,000 \text{ gal.} \times 2.00 = 4,000 \\ \text{MISC.} &= \quad \quad \quad = 4,000 \\ &\quad \quad \quad \underline{\$42,000} \end{aligned}$$

EQUIPMENT

$$\begin{aligned} \text{PICKUP} &= \frac{1}{4} \text{ No.} \times 16 = 4.00 \\ \text{SERVICE TRUCK} &= \frac{1}{4} \text{ No.} \times 30 = 7.50 \\ \text{SMALL TOOLS} &= \quad \quad \quad = 0.50 \\ \text{MISC.} &= \quad \quad \quad = 0.50 \\ &\quad \quad \quad \underline{\quad \quad \quad} \end{aligned}$$

$$12.50 \times 3900 \text{ HR} = \$48,750$$

SUMMARY

$$\begin{aligned} \text{LABOUR} &= 136,890 \\ \text{MATERIAL} &= 42,000 \\ \text{EQUIPMENT} &= 48,750 \\ &\underline{\$227,640} \end{aligned}$$



Calculations

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(M) READY MIX TRUCKS

TIME = 5,000 HR.

PROVIDE 4 No. OF 10 cyd. READY MIX TRUCKSLABOUR

4 DRIVERS =

= 142.32

LABOUR =

= 30.54 $172.86 \times 5000 = \$864,300$ EQUIPMENT

READY MIX TRUCKS (OPERATION) =

= 60.00

PICKUP =

= 16.00

SMALL TOOLS =

= 2.00 $78.00 \times 5000 \text{ HR.}$

= \$390,000

PURCHASE OF READY MIX TRUCKS (4 No.)

= 300,000

\$690,000

SUMMARY

LABOUR = 864,300

EQUIPMENT = 690,000\$1,554,300



Calculations

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(n) POWER(i) TRANSMISSION LINE

LENGTH = 2000 FT.

RATE = \$20 / FT.

COST = 20 x 2000 = \$40,000(ii) STAND-BY GENERATOR - DIESEL OPERATED
OUTPUT = 1000 KW.LABOUR = 35.41 x 5,000 HR x $\frac{1}{100}$ = \$1,770

MATERIAL = \$6,000

EQUIPMENT-RENTAL = 5.00 x 5000 HR = \$25,000

- OPERATION = \$5,000

TOTAL = \$37,770(iii) MISCELLANEOUSPROVISIONAL SUM = \$20,000

LAB. = 20,000.

MAT = 40,000.

Equip = 37,770.

\$93,700



Calculations

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⑥ DEMOBILIZATION

LABOUR = 9,000
 MATERIAL = 4,000
 EQUIPMENT = 5,000
\$ 18,000

⑦ CONCRETE LAB

LABOUR = 20,000
 MATERIAL = 30,000
 EQUIPMENT = 50,000
\$ 100,000

⑧ GENERAL CLEAN-UP

LABOUR = 20,000
 MATERIAL = 5,000
 EQUIPMENT = 25,000
\$ 50,000

⑨ MISCELLANEOUS

LABOUR = 20,000
 MATERIAL = 5,000
 EQUIPMENT = 25,000
\$ 50,000



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⑤ DEMOBILIZATION @ YARD

LABOUR - SAME AS ④ MOBILIZATION

\$5,900

MATERIAL

TIMBER	=	1,500
PACKING MATERIAL	=	2,000
ROPE & CHAIN	=	900
MISC.	=	<u>1,000</u>
		\$5,400

EQUIPMENT - SAME AS ④ MOBILIZATION

\$1,700

SUMMARY

LABOUR	=	5,900
MATERIAL	=	5,400
EQUIPMENT	=	<u>1,700</u>
		\$13,000



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① AGGREGATE HANDLING EQUIPMENT

PROVISIONAL SUM = \$150,000

② SUPPLY OF PLANTFROM O.R.B.A. (ONTARIO ROAD BUILDER'S ASSOCIATION)
12TH EDITION (APRIL 1979)

SIZE OF PLANT = 85/120 cyd/HR.

PRICE = \$275,000 IN APRIL 1979.

= \$385,000 IN JAN. 1982 (ASSUMING 40% ESC.)
THIS IS IN CANADIAN DOLLARS.∴ PRICE = 385,000 $\frac{1.2}{1.2}$
= \$320,000 U.S.

ASSUME SALVAGE VALUE = \$20,000

∴ COST = \$300,000

(E) Concrete Works

Cement



Estimate Work Sheet

ITEM REFERENCE No. P/H. INTAKE. SPILLWAY. TUNNELS.

JOB No. P5700

DESCRIPTION CONCRETE.

SHEET 1 OF 1.

PROJECT SUSITNA. HYDROELECTRIC

OPERATION No.

REF.

BY P.J.S.

CONTRACT DEVIL CANYON.

DESCRIPTION Supply & STORAGE OF CEMENT

CKD

DATE

DESCRIPTION AND BASIS OF ESTIMATE	QUANTITY	UNIT	LABOR		JOB MATERIALS		PERM. MATERIALS		SUBCONTRACTS		EQPT. OWNERSHIP		EQPT. OPERATION		Equiv UNIT	TOTAL AMOUNT
			UNIT COST	AMOUNT	UNIT COST	AMOUNT	UNIT COST	AMOUNT	UNIT COST	AMOUNT	UNIT COST	AMOUNT	UNIT COST	AMOUNT		
<u>Supply & STORAGE CEMENT.</u>																
(a) TRANSPORTATION OF Silos				47,000		25,600		-		-		110,000		-		182,000
(b) SITE PREPARATION.				36,200		16,500		-		-		21,200		-		73,900
(c) ERECTION & INSTALLATION.				36,800		4,900		-		-		13,100		-		54,800
(d) TESTING & COMMISSION.				20,100		15,000		-		-		4,200		-		39,300
(e) OPERATION OF Silo.				162,900		12		-		-		33,300		-		208,200
(f) DISMANTLE @ Silo				36,800		4		-		-		13,100		-		54,800
(g) FOUNDATIONS & SERVICES				36,200		16,-		-		-		21,200		-		73,900
(h) POWER - STANDBY.				51,720		73,220		-		-		49,440		-		125,000
(i) GENERAL clean-up.				11,000		7,600		-		-		9,600		-		28,200
(j) MISCELLANEOUS				10,000		10,000		-		-		12,000		-		32,000
(k) Supply of silos.				-		-		-		-		592,000		-		592,000
(L) Supply of CEMENT.				-		12,111,000		-		-		-		-		12,111,000
TOTAL	254,000	cyl	77	448,720	41	12,296,620	-	-	-	-	45	879,140	-	64	53	13,624,480

FOLD LENGTH

 12
 11
 8.5
 8

AUTO

MANUAL

FEED



Calculations

SUBJECT
DEVIL CANYON

By P. SINGH Date 82/2/2
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CEMENT FOR CONCRETE - SUMMARY

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PLANT = 32 SILOS
STORAGE CAPACITY = 2400 TONS.

COST SUMMARY

ITEM	COST	ITEM	COST
a) TRANSPORTATION (Z-WAY)		SUBTOTAL (B/F)	878,000
A. BY LAND (LOWER 48)	50,900	k) PURCHASE OF SILOS	592,000
B. BY SEA TO ALASKA	87,000		
C. BY LAND TO SITE	50,000		
	187,900	COST OF PLANT	1,470,000
b) SITE PREPARATION	73,900	l) SUPPLY OF CEMENT	12,111,000
c) ERECTION & INSTALLATION	54,800		
d) TEST & COMMISSION	39,300	TOTAL COST	13,581,00
e) OPERATION OF SILOS	208,200		
f) DISMANTLE @ SITE	54,800		
g) SITE CLEARING & LEVELLING	73,900		
h) POWER			
(i) TRANSMISSION LINE	49,700		
(ii) STAND-BY GENERATOR	58,300		
(iii) MISC.	17,000		
i) GENERAL CLEAN-UP	28,200		
j) MISCELLANEOUS	32,000		
SUBTOTAL	878,000		

TOTAL CONCRETE = 254,000 cyd.

UNIT COST = 53^{47} / cyd.



Calculations

SUBJECT

DEVIL CANYON

CEMENT FOR CONCRETE - 32 SILOS

By P. SINGH Date 82/2/2Project No. P5700

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@ TRANSPORTATION TO SITE

NO. OF SILOS = 32
 WEIGHT/SILO = 6.75 TONS.
 TOTAL WEIGHT = 6.75×32
 = 216 TONS
 = 432,000 lbs.

A. BY LAND IN LOWER 48

(i) LOADING @ RAIL SPUR

TIME = 25 HRS.

LABOUR: FOREMAN =
 IRONWORKER =
 OPERATOR =

= 33.23

= 112.23

= 35.10
 $180.56 \times 25 = \$4,514$

MATERIAL: LUMBER = 400
 CHAIN = 400
 MISC. = 300
 \$ 1,100

EQUIPMENT: CRANE 50' =
 FLATBED =
 TRUCK =
 MISC. =

= 65

= 12

= 10

= 2
 $89.00 \times 25 = \$2,225$

(ii) TRANSPORT

RATE = \$0.03/lb
 COST = $0.03 \times 432,000$
 = \$13,000



Calculations

SUBJECT

E 107

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TRANSPORTATION - CONT'D

A. (iii) UNLOADING & LOADING TO SHIP

SAME CREW AS A.(i) ; TIME = 13 HR.

LABOUR = 2347
MATERIAL = 1,100
EQUIPMENT = 1157
\$4,604

A. SUMMARY : (ABOVE VALUES X2 FOR RETURN TRIP)

LABOUR = 13,700
MATERIAL = 4,400
EQUIPMENT = 6,800
SUB-CONTRACT = 26,000
\$50,900

B. BY SEA TO ALASKA

(i) TRANSPORT : RATE = \$0.09/lb

COST = 0.09 x 432,000
= \$38,700

(ii) UNLOADING @ ANCHORAGE :

SAME AS A.(iii)

LABOUR = 2347
MATERIAL = 1100
EQUIPMENT = 1157
4604

B. SUMMARY :

LABOUR = 4694
MATERIAL = 2200
EQUIPMENT = 2314
SUB CONTRACT = 77,800
\$87,008

} 2-WAY TRIP



Calculations E 108

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TRANSPORTATION - CONT'DC. BY LAND TO SITE (IN ALASKA)(i) LOADING:

SAME AS A(i)

LABOUR = 4514

MATERIAL = 1100

EQUIPMENT = 2225

\$7,839(ii) TRANSPORT: RATE = \$0.04 / lb
$$\begin{aligned}\text{COST} &= 0.04 \times 432,000 \\ &= \$17,200\end{aligned}$$
C. SUMMARY: (2-WAY TRIP)

LABOUR = 9028

MATERIAL = 2200

EQUIPMENT = 4450

SUB-CONTRACT = 34,400

\$50,078 → SAY \$50,000



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LAB : MAT : EQUIP : TOTAL : REMARK

AT PAUL SPUR	4,514	1100	2,225	7,839	-
TRANSPORTATION	2,000	3000	8,000	13,000	-
LOAD/UNLOAD SHIP	2,347	1100	1,157	4,604	TOMCA.
SHIPPING.	6,000	2,000	30,000	38,900	-
LOAD/UNLOAD	2,347	1100	1,157	4,604	ANCHORAGE
LOAD/UNLOAD	2,347	1100	1,157	4,604	GOLD CREEK
TRUCKING	4000	2,000	11,200	17,200	
SIT.	23,555 + 12,500 + 54,896 = 90,751				

$$23,555 + 12,500 + 54,896 = 90,751$$

TOTAL BOTH WAYS = 47,000 + 25000 + 110,000 = 182,000



Calculations

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⑥ SITE PREPARATION

- CLEARING, FOUNDATIONS, ETC..

TIME = 96 HRS.

LABOUR : FOREMAN = 40.35
 LABOURER = 122.16
 IRONWORKER = 74.82
 CARPENTER = 69.02
 OPERATOR = 35.10
 DRIVER = 35.58
 377.03 x 96 = \$36,200

MATERIAL : TIMBER (FORMS) = 3000
 REBARS = 6000
 A-BOLTS = 1500
 CONCRETE = 6000
 \$16,500

EQUIPMENT : BACKHOE = 53
 F.E.L. = 30
 DOZER = 85
 READY MIX TRUCK = 25
 SMALL TOOLS = 12
 PICKUP = 16
 221.00 x 96 = \$21,200

SUMMARY :

LABOUR = 36,200
 MATERIAL = 16,500
 EQUIPMENT = 21,200
 \$73,900



Calculations

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© ERECTION & INSTALLATION OF SILOS

$$TIME = 4 \text{ HR./SILO} \times 32 = 128 \text{ HR.}$$

<u>LABOUR</u> :	FOREMAN	=		=	40.35
	IRONWORKER	=		=	149.64
	OPERATOR	=		=	36.96
	LABOURER	=		=	<u>61.14</u>
					$288.09 \times 128 = \$36,800$

<u>MATERIAL</u> :	TEMP. BRACING	=	4,000
	WIRE ROPE	=	500
	GROUTING	=	200
	MISC.	=	<u>200</u>
			<u>\$4,900</u>

<u>EQUIPMENT</u> :	CRANE 50 ^T	=	70
	COMPRESSOR (350)	=	18
	AIR TOOLS/HOSE	=	5
	MISC.	=	<u>10</u>
			$103.00 \times 128 = \$13,100$

SUMMARY:

LABOUR	=	36,800
MATERIAL	=	4,900
EQUIPMENT	=	<u>13,100</u>
		<u>\$54,800</u>



Calculations

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① TEST & COMMISSION SILOS

TIME = 60 HR.

LABOUR: FOREMAN = 43.03
 PIPEFITTER = 74.48
 ELECTRICIAN = 80.46
 MECHANIC = 39.17
 OPERATOR = 36.93
 LABOURER = 61.08
 335.15 × 60 = \$20,100

MATERIAL: CONSUMMABLE = 3,000
 BLOCK, ETC. = 6,000
 MISC. = 6,000
 \$15,000

EQUIPMENT: WORKING PLATFORM = 8
 PICKUP = 32
 WELDER = 6.65
 GAS CUTTING TORCHES = 10
 SMALL TOOLS = 8
 MISC. = 5
 69.65 × 60 = \$4,200

SUMMARY:

LABOUR = 20,100
 MATERIAL = 15,000
 EQUIPMENT = 4,200
 \$39,300



Calculations

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© OPERATION OF SILOS

$$\begin{aligned}
 \text{TIME} &= \text{LOADING \& SERVICE CALLS} \\
 &= 20 \text{ HR/WK.} \times 208 \text{ WKS} \\
 &= 4160 \text{ HR.}
 \end{aligned}$$

$$\text{LABOUR: MECHANIC} = 1 \text{ No.} \times 39.17 \times 4160 = \$162,900$$

$$\begin{aligned}
 \text{MATERIAL: PAINT} &= 3000 \\
 \text{GREASE/OIL/LUBE} &= 3000 \\
 \text{CONSUMMABLE} &= 3000 \\
 \text{MISC.} &= 3000 \\
 &\hline
 &12,000
 \end{aligned}$$

$$\begin{aligned}
 \text{EQUIPMENT: SMALL TOOLS} &= 4.00 \\
 \text{MISC.} &= 4.00 \\
 &\hline
 &8.00 \times 4160 = \$33,300
 \end{aligned}$$

SUMMARY :

$$\begin{aligned}
 \text{LABOUR} &= 162,900 \\
 \text{MATERIAL} &= 12,000 \\
 \text{EQUIPMENT} &= 33,300 \\
 &\hline
 &208,200
 \end{aligned}$$



Calculations

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⑧ DISMANTLE @ SITE

SAME AS ③ ERECTION & INSTALLATION

LABOUR = 36,800
 MATERIAL = 4,900
 EQUIPMENT = 13,100
\$ 54,800

⑨ SITE CLEARING & LEVELLING

SAME AS ⑥ SITE PREPARATION

LABOUR = 36,200
 MATERIAL = 16,500
 EQUIPMENT = 21,200
\$ 73,900



Calculations

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(h) POWER

(i) TRANSMISSION LINE (DISTANCE = 2000 FT)

TIME = 40 HR.

LABOUR: FOREMAN = 43.03
 OPERATOR = 140.40
 MECHANIC = 70.20
 LABOURER = 61.08
 ELECTRICIAN = 201.15
 $515.86 \times 40 = \$20,600$

MATERIAL: POLES, CROSS BARS, ETC. = 3,000
 WIRE ROPE & STAY = 2,000
 CONDUCTOR = 3,000
 BREAKER & SWITCHES = 2,500
 MISC. = 1,000
 $\$11,500$

EQUIPMENT: CABLE REEL TRUCK = 30
 POWER WINCHES = 60
 DOZER = 81
 PICKUP 4x4 = 50
 TRUCK AUGER = 65
 MOBILE HOIST = 40
 CRANE 20T = 60
 COMPRESSOR (350) = 30
 DRILL & HOSES = 20
 MISC = 2
 SMALL TOOLS = 2
 $440.00 \times 40 = \$17,600$

SUMMARY: LABOUR = 20,600
 MATERIAL = 11,500
 EQUIPMENT = 17,600
 $\$49,700$



Calculations

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POWER - CONT'D

(ii) STAND-BY GENERATOR (100 KW DIESEL)

IDLING TIME = 1 HR/WK.

TIME TO SUPPLY POWER = 2.5 HR/WK.

OPERATING TIME = 3.5 x 208 WKS.
= 728 HR.

SUMMARY:

LABOUR	=	40
EQUIPMENT	=	20
MATERIAL	=	10
SUB-CONTRACT	=	10

$80.00 \times 728 = \$58,300$

(iii) MISCELLANEOUS

- REPAIR/SERVICE BY MANUFACTURER

SUB-CONTRACT = \$17,000

SUMMARY - POWER

	L.	M.	E.	T.
TRANSMISSION LINE. =	20,600	11,500	17,600	49,700.
STAND-BY - POWER. =	29,120	7,280	21,840	58,300
Misc =	2,000	5,000	10,000	17,000.
<u>TOTAL</u>	<u>51,720</u>	<u>73,220</u>	<u>49,440</u>	<u>125,000</u>



Calculations

SUBJECT

By P. SINGH Date 82/2/2 Project No. P 5700

Checked _____ Date _____ Calculation No. _____

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Rev	By	Checked

① GENERAL CLEAN-UP

TIME = 32 HRS.

LABOUR : FOREMAN = 38.06
 OPERATOR = 184.80
 LABOURER = 122.16
345.02 × 32 = \$ 11,000

MATERIAL : CONSUMMABLE = 4000
 OTHER = 3600
\$ 7,600

EQUIPMENT : DOZER = 155
 F.E.L. = 30
 BACKHOE = 53
 PICKUP = 16
 GRADER = 45
299.00 × 32 = \$ 9,600

SUMMARY :

LABOUR = 11,000
 MATERIAL = 7,600
 EQUIPMENT = 9,600
\$ 28,200

② MISCELLANEOUS

PROVISIONAL SUM = \$ 32,000



Calculations

SUBJECT

By P. SINGH Date 82/2/2

Checked _____ Date _____

Project No. P 5700

Calculation No. _____

Page 2 of 14

Rev	By	Checked

① PURCHASE OF SILOS

CAPACITY OF SILO = 75 TON

PRICE = \$21,880 CANADIAN - INCLUDING ALL ACCESSORIES
AND FILLING EQUIPMENT

= \$18,233 U.S. (\$1 U.S. = \$1.20 CAN.)

SAY \$18,500/SILO

No. OF SILOS = 32

COST = 18,500 × 32

= \$592,000



Calculations

SUBJECT

By P. SINGH Date 82/2/2 Project No. P 5700

Checked _____ Date _____ Calculation No. _____

Page 13 of 14

Rev	By	Checked

① SUPPLY OF CEMENT

SUPPLY PRICE RECEIVED BY D.H. MACDONALD
ON FEB. 2/82:

F.A.S. ANCHORAGE	=	130.00
ANCHORAGE TO GOLD CREEK	=	20.60
GOLD CREEK TO SITE	=	16.00
LOADING TRUCK	=	10.00
		<u>\$176.60 / TON</u>

TOTAL CEMENT REQ'D = 68,580 TONS.

SUPPLY COST = \$176.60 × 68,580

= \$12,111,228

(E) Concrete Works

Coarse Aggregate



Estimate Work Sheet

ITEM REFERENCE No.

PH/SPILLWAY/INTAKE/TUNNELS.

JOB No. P5700

DESCRIPTION

Supply of CONCRETE.

SHEET 1 OF 1

PROJECT SUSITNA HYDRO ELECTRIC.

OPERATION No.

REF.

BY P.J.S.

CONTRACT DEVIL CANYON.

DESCRIPTION

COARSE AGG.

CKD

DATE

DESCRIPTION AND BASIS OF ESTIMATE	QUANTITY	UNIT	LABOR		JOB MATERIALS		PERM. MATERIALS		SUBCONTRACTS		EQPT. OWNERSHIP		EQPT. OPERATION		EQUIV UNIT	TOTAL AMOUNT
			UNIT COST	AMOUNT	UNIT COST	AMOUNT	UNIT COST	AMOUNT	UNIT COST	AMOUNT	UNIT COST	AMOUNT	UNIT COST	AMOUNT		
<u>COARSE AGGREGATES FOR CONCRETE</u> (a) EXCAVATION @ BORROW. (b) HAUL TO PLANT. (c) CONSTRUCTION LOADS. (d) SEPARATING & SCREENING. (e) CRUSHING. (f) HAUL TO STOCKPILE	-	cyl.	45		01						13				59	
			0		0						0				1	
			24		-						0				1	
			25		-						0				0	
			28		01						0				0	
			28		0						0				0	
		cyl.	83		66						5				10	
			3		0						0				1	
			24								0				1	
TOTAL - USE THE FOLLOWING	180,000	cyl	5 ⁵⁰	990,000	6 ⁷	120,600					9 ⁷⁰	1,746,000			15 ⁸⁸	2,858,400

FOLD LENGTH

12

11

8.5

8

AUTO

MANUAL

FEED



Calculations

SUBJECT

DEVIL CANYON

By _____ Date _____

Checked _____ Date _____

Project No. P 5700

Calculation No. _____

Page ____ of ____

Rev	By	Checked

AGGREGATE QUANTITIES FOR PROCESSING

-REC'D FROM D. MACDONALD
ON 19 JAN. /82.

COARSE AGGREGATE = 1,930,000

FINE AGGREGATE = 360,000

TOTAL CONC. AGG. = 2,300,000 cyd.

SADDLE DAM = 1,300,000

TOTAL = 3,000,000 cyd.



Calculations

SUBJECT

DEVIL CANYON

COARSE AGGREGATE PROCESSING

By HEKDate 82/2/19Project No. P5700

Checked _____

Date _____

Calculation No. _____

Page 1 of 13

Rev	By	Checked

1. EXCAVATION

USE 3 - 25 CY. & 3 - 15 CY.

WALKING DRAGLINES.

1 - 15 cy for project req'd

THIS FLEET ENSURES A MAX. OUTPUT OF 4500 CY./HR.
AVERAGE PRODUCTION = 4000 CYD/HR.

VOLUME TO BE EXCAVATED = 3,000,000 CYD.
+ 300,000 10% LOSS OF OVERSIZE.
3,300,000 CYD.

LOOSE CY. FACTOR = 1.15

∴ VOLUME = 3.8×10^6 CYD.

∴ TIME FOR EXCAVATION = $\frac{3.8 \times 10^6}{4000} = 950$ HRS.

LABOUR:

FOREMAN	=	3	×	43.03	=	129.09
MECHANIC	=	9	×	36.96	=	332.64
OILER	=	6	×	33.53	=	201.18
ELECTRICIAN	=	4	×	40.23	=	160.92
OPERATOR	=	6	×	36.96	=	221.76
TRUCK DRIVER	=	5	×	35.58	=	177.90
LABOURER	=	12	×	30.54	=	366.40
DOZER OP.	=	3	×	35.10	=	105.30
LAB. FOREMAN	=	2	×	33.23	=	66.46
CRANE OP.	=	1	×	36.96	=	36.96
LOW BOY OP.	=	1	×	35.58	=	35.58

$1804.19 \times 950 = \$1,714,000$

U/C = $\$0.451/\text{CYD}$



Calculations

SUBJECT

By HEX Date 82/2/19 Project No. P5700

Checked _____ Date _____ Calculation No. _____

Page 2 of 13

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EXCAVATION - CONT'D

MATERIAL: - STEEL PADS FOR DRAGLINES
- MOBILE ASSEMBLY SHED

$$u/c = \underline{\$0.007/cyd} \quad \text{FROM F. TOTL}$$

EQUIPMENT: 680-M DRAGLINE = $3 \times 813.93 =$
 380-M DRAGLINE = $3 \times 386.34 =$
 LIGHT PLANT = $12 \times 4.50 =$
 4x4 PICKUP = $12 \times 20.00 =$
 FUEL TRUCK = $2 \times 28 =$
 SERVICE TRUCK = $3 \times 30 =$
 1 T. TRUCK = $6 \times 20 =$
 D-7 DOZER = $3 \times 85 =$
 20^T CRANE = $1 \times 65 =$
 40^T LOW BED = $1 \times 42 =$

$$4522.81 \times 950$$

$$= \$4,296,670$$

$$u/c = \underline{\$1.131/cyd.}$$

SUMMARY - EXCAVATION

LABOUR = 0.451
 MATERIAL = 0.007
 EQUIPMENT = 1.131
\$1.589/cyd.



Calculations

SUBJECT

By HEK Date 8/2/19 Project No. P5700

Checked _____ Date _____ Calculation No. _____

Page 3 of 13

Rev	By	Checked

2. HAUL TO PLANT

DISTANCE = 2 MILES.

- USE 120 CY. HAULERS
- EACH HAULER MAKES 4 TRIPS/HR.
- ASSUME 6 UNITS

$$\therefore \text{PRODUCTION} = 6 \times 4 \times 120 \\ = 2880 \text{ cyd/HR.}$$

$$\text{TOTAL VOLUME TO BE HAULED} = 1.93 \times 10^6 \times 1.30 \text{ (30\% LOSSES)} \\ = 2.5 \times 10^6 \text{ cyd.}$$

$$\therefore \text{TIME} = \frac{2.5 \times 10^6}{2880} = 868 \text{ HR.}$$

<u>LABOUR</u> : FOREMAN	=	2 x 38.09	=	76.18
ATLEY OP.	=	6 x 36.84	=	221.04
DOZER OP.	=	3 x 35.10	=	105.30
SERV. TR. DRIVER	=	2 x 33.47	=	66.94
PICKUP DRIVER	=	4 x 30.54	=	122.16
CRANE OP.	=	1 x 35.10	=	35.10
LIGHT PLANT	=	2 x 34.29	=	68.58
FIELD MECH.	=	2 x 36.96	=	73.92
FLAGMAN	=	4 x 30.54	=	122.16
TRAFFIC CONTR.	=	3 x 30.54	=	91.62

$$983.00 \times 868 = \$853,244$$

$$u/c = \underline{\underline{\$0.341 / \text{cyd}}}$$



Calculations

SUBJECT

By HEK Date 82/2/19 Project No. P5700

Checked _____ Date _____ Calculation No. _____

Page 4 of 13HAUL TO PLANT - CONT'D

Rev	By	Checked

EQUIPMENT: PH180 ATLEY = 6 x 180 = 1080

" STANDBY = 1 x 81 = 81

DOZER D-9 = 3 x 175 = 525

LIGHT PLANT = 30 x 4.50 = 135

SERV. TRUCK = 1 x 30 = 30

FUEL TRUCK = 1 x 28 = 28

4x4 PICKUP = 4 x 20 = 80

1 TON TRUCK = 4 x 20 = 80

BULL MOOSE = 1 x 35 = 35

 $\$2074.00 \times 868 = \$1,800,232$

U/C = \$0.720/cyd.

25% STANDBY & MAINT. REPAIR = $\frac{0.180}{\$0.900/\text{cyd}}$ SUMMARY - HAUL

LABOUR = 0.341

MATERIAL = -

EQUIPMENT = 0.900

\$1.241/cyd.



Calculations

SUBJECT

By HEKDate 8/2/19Project No. P5700

Checked _____

Date _____

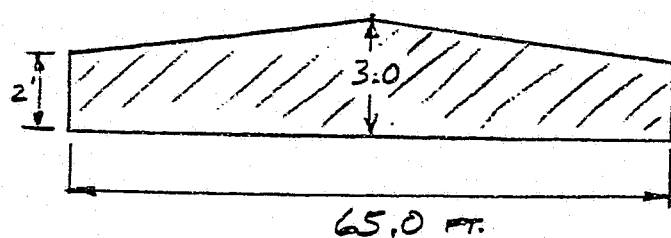
Calculation No. _____

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Rev	By	Checked

3. CONSTRUCTION ROADS & MAINTENANCE

ASSUMED CROSS-SECTION :



ESTIMATED LENGTH = 3 MILE
= 15,800 FT.

$$\therefore \text{VOLUME} = \left[\frac{(65.0 \times 2.5) \div 2 \times 3.0}{27} \right] \times 15,800$$

$$= 95,000 \text{ cyd.}$$

ASSUME SITE IS ALREADY CLEARED.
(ie. IN BORROW AREA)

a) EXCAVATION & HAUL - UNIT PRICES CALCULATED BY F. TOTH
FOR WATANA DAM.

$$\text{LABOUR} = 1.53 \times 95,000$$

$$= \$145,350$$

$$\text{MATERIAL} = 0.029 \times 95,000$$

$$= \$2,755$$

$$\text{EQUIPMENT} = 3.861 \times 95,000$$

$$= \$366,795$$



Calculations

SUBJECT

By HEKDate 82/2/19Project No. P5700

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Page 6 of 13

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CONST. ROADS - CONT'D.b) LEVELLING

$$\begin{aligned} \text{PRODUCTION} &= 8,000 \text{ C.Y. / 10 HR. DAY.} \\ &= 800 \text{ C.Y. / HR.} \end{aligned}$$

$$\begin{aligned} \text{TIME} &= 95,000 \div 800 \\ &= 118 \text{ HRS.} \end{aligned}$$

<u>LABOUR</u> :	FOREMAN	=	2 x 37.60	=	75.20
	DOZER OP.	=	6 x 35.10	=	210.60
	GRADER OP.	=	4 x 35.10	=	140.40
	COMP. OP.	=	4 x 35.10	=	140.40
	HAULER OP.	=	2 x 36.84	=	73.68
	WATER TRUCK OP.	=	1 x 33.47	=	33.47
	GRADEMAN	=	4 x 30.94	=	123.76
	LABOUR	=	4 x 30.54	=	122.16
	FLAGMAN	=	1 x 30.54	=	30.54

$$950.21 \times 118 = \$112,125$$

<u>EQUIPMENT</u> :	DOZER D-8	=	4 x 162	=	648
	" D-7	=	2 x 85	=	170
	GRADER	=	4 x 71	=	284
	COMPACTOR	=	4 x 64	=	256
	HAULER	=	2 x 180	=	360
	LOADER	=	1 x 185	=	185
	4x4 PICKUP	=	4 x 20	=	80
	WATER TRUCK	=	1 x 26	=	26

$$2009.00 \times 118 = \$237,062$$



Calculations

SUBJECT

By HEKDate 82/2/19Project No. P5700

Checked _____

Date _____

Calculation No. _____

Page 7 of 13CONST. ROADS - CONT'Dc) ROAD MAINTENANCE

DURATION = 4 YRS. @ 5 MONTHS/YR.
 = 86 WKS. x 40 HR/WK.
 = 3440 HR.

LABOUR: FOREMAN = 1 x 37.05 = 37.05
 OPERATOR = 2 x 35.10 = 70.20
 DRIVER = 1 x 35.58 = 35.58
 LABOURER = 2 x 30.54 = 61.08

203.91 x 3440 = \$701,450

EQUIPMENT: DOZER D-7 = 1 x 85 = 85
 COMPACTOR = 1 x 64 = 64
 GRADER = 1 x 71 = 71
 4x4 PICKUP = 1 x 20 = 20
 40^T TRUCK = 1 x 113 = 113

353.⁰⁰ x 3440 = \$1,214,320

SUMMARY - CONST. ROADS

	LABOUR	MATERIAL	EQUIPMENT	TOTAL
a) ROAD BED	145,350	2,755	366,795	514,900
b) LEVELLING	112,125	-	237,062	349,187
c) MAINTENANCE	701,450	-	1,214,320	1,915,770
TOTAL	958,925	2,755	1,818,177	2,779,857
UNIT COST (VOL. = 3,800,000 ccyd)	0.252	-	0.479	0.731



Calculations

SUBJECT

By HEKDate 82/2/19Project No. P5700

Checked _____

Date _____

Calculation No. _____

Page 8 of 134. SCREENING & STOCKPILE

VOLUME = 2,500,000 cyd.

PRODUCTION = 2872 cyd/HR.

TIME = 2,500,000 ÷ 2872 = 870 HR.

LABOUR: FOREMAN = 2 × 43.03 = 86.06
 DOZER OP. = 8 × 35.10 = 280.80
 LOADER OP. = 3 × 36.96 = 110.88
 MECHANIC = 3 × 36.96 = 110.88
 ELECTRICIAN = 2 × 40.23 = 80.46
 HELPER = 3 × 30.54 = 91.62
 TRUCK DRIVER = 1 × 36.84 = 36.84

797.54 × 870 = \$693,860

U/C. = \$0.278/cyd

EQUIPMENT: DOZER D-10 = 4 × 185 = 740
 DOZER D-8 = 2 × 162 = 324
 DOZER D-6 = 2 × 60 = 120
 48" LOADER = 3 × 67.80 = 203.40
 4x4 PICKUP = 2 × 20 = 40
 SERV. TRUCK = 1 × 25 = 25
 LIGHT PLANT = 6 × 4.50 = 27
 GRIZZLY = 3 × 3 = 9

1488.40 × 870 = 1,294,900

U/C = 0.518

0.130 25% FOR STANDBY.

\$0.648/cyd.MATERIAL:

48" BELT = \$8,000

U/C = \$0.003/cydSUMMARY - SCREENING

LABOUR = 0.278

MATERIAL = 0.003

EQUIPMENT = 0.648

\$0.929/cyd



Calculations

SUBJECT

By HEKDate 82/2/19Project No. P5700

Checked _____

Date _____

Calculation No. _____

Page 9 of 135. PROCESSING AGGREGATE

PLANT CAPACITY = 440 cyd/HR.

TOTAL PROCESSED = 3,000,000 cyd.

$$\text{TIME} = \frac{3,000,000}{400} = 7500 \text{ HR.}$$

LABOUR : PLANT SUP ^L .	=	1	=
FOREMAN	=	3	=
OPERATOR	=	6	=
MECHANIC	=	3	=
ELECTRICIAN	=	3	=
HELPER	=	6	=
WELDER	=	3	=
HELPER	=	3	=
LOADER OP.	=	3	=
GEN. OP.	=	1	=
HELPER	=	1	=
PIPEFITTER	=	1	=
HELPER	=	1	=

$$1305.90 \times 7500 = \$9,794,250$$

MATERIAL : CONVEYOR	=	112,000
SCREEN DECKS	=	1,650,000
WELDING MAT'L	=	125,000
BELT REPL.	=	700,000
		<u>\$2,587,000</u>



Calculations

SUBJECT

By HEKDate 82/2/19Project No. P5700

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Date _____

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Page 10 of 13PROCESSING - CONT'D

EQUIPMENT: TOTAL = \$2260 x 7500 HR
(SEE LIST BELOW) = \$16,950,000

100' - 48" BELT
90' - 36" "
100' - 30" BELT
100' - 42" - 3" SURGE
100' - 36" - 3" SEC.
150' - 30" - 3 + 1/2 STORAGE
150' - 24" - 1 1/2 + 3/4 STORAGE
90' - 24" CRUSHER RUN
100' - 30" - 3/4"
100' - 30" - 3/4"
100' - 24" - 3/4" + #4
80' - 24" - 3/4"
100' - 24" - #4
100' - 24" SAND TO BIN
100' - 18" BIN TO SCREEN
RECLAIM - 1200' - 42"

SUBTOTAL = \$489

- 1 - FEEDER HOPPER
- 1 - PRIMARY CRUSHER
- 2 - 5'x14' D.D. SC.
- 2 - 48" x 60" FEEDER
- 3 - 4' - 14' D.D. SC.
- 1 - SEC. ROLL CRUSHER
- 1 - 42" x 60" FEEDER
- 4 - 5'x14' D.D. SC.
- 2 - 32' EAGLE CLASSIFIER
- 1 - 4' - 12' S.D. SC.
- 4 - 48" x 72" FEEDER
- 1 - DOZER D-6
- 2 - LOADER
- 1 - 600 KW GEN.

SUBTOTAL = \$1771 ⇒ TOTAL = \$2260/HR.



Calculations

SUBJECT

By HEKDate 82/2/19Project No. P5750

Checked _____

Date _____

Calculation No. _____

Page 11 of 13PROCESSING - CONT'DINSTALLATION & REMOVAL = \$1,700,000

Rev	By	Checked

SUMMARY - PROCESSING

	LABOUR	MATERIAL	EQUIPMENT	TOTAL
PROCESS	9,794,000	2,000,000	16,950,000	28,744,000
INSTALL & REMOVE	1,700,000			1,700,000
TOTAL	11,494,000	2,000,000	16,950,000	30,444,000
UNIT COST (VOL. = 3,000,000 cyd)	3.831	0.667	5.650	10.148



Calculations

SUBJECT

By HEK Date 82/2/19Project No. P5700

Checked _____ Date _____

Calculation No. _____

Page 12 of 13

Rev	By	Checked

6. HAUL TO STOCKPILE

DISTANCE = 2 MILES

COST = SAME AS 2. HAUL TO PLANT

SUMMARY:

LABOUR = 0.341

MATERIAL = -

EQUIPMENT = 0.900

\$1.241/cyd



Calculations

SUBJECT

DEVIL CANYONBy HEK.Date 82/2/19Project No. P5700

Checked _____

Date _____

Calculation No. _____

Page 13 of 13

Rev	By	Checked

COARSE AGGREGATE PROCESSING

- UNIT PRICES DEVELOPED FROM NOTES
MADE BY F. TOTH FOR WATANA
DAM EARTHWORKS.

SUMMARY OF UNIT PRICES

DESCRIPTION	LABOUR	MATERIAL	EQUIPMENT	TOTAL
EXCAVATION	0.451	0.007	1.131	1.589
HAUL TO PLANT	0.341	-	0.900	1.241
CONSTRUCTION RDS.	0.252	-	0.479	0.731
SCREENING	0.278	0.003	0.648	0.929
PROCESSING	3.831	0.667	5.650	10.148
HAUL TO STOCKPILE	0.341	-	0.900	1.241
TOTAL	5.494	0.677	9.708	15.879

(E) Concrete Works

Fine Aggregate



Estimate Work Sheet

ITEM REFERENCE No. PH/spillway/INTAKE/TUNNELS.

JOB No. P 5700.

PROJECT SUSITNA- HYDROELECTRIC.

DESCRIPTION Supply of CONCRETE

SHEET 1 OF 4

CONTRACT DEVIL CANYON.

OPERATION No.

REF.

BY P. J. S.

DESCRIPTION FINE AGG.

CKD

DATE

DESCRIPTION AND BASIS OF ESTIMATE	QUANTITY	UNIT	LABOR		JOB MATERIALS		PERM.MATERIALS		SUBCONTRACTS		EQPT.OWNERSHIP		EQPT.OPERATION		Equiv UNIT	TOTAL AMOUNT
			UNIT COST	AMOUNT	UNIT COST	AMOUNT	UNIT COST	AMOUNT	UNIT COST	AMOUNT	UNIT COST	AMOUNT	UNIT COST	AMOUNT		
<u>FINE AGGERGATES FOR CONCRETE</u>																
(a) EXCAVATION @ BORROW.	185,000	cycl.	0 ⁴⁵		0 ⁰¹		-	-	-	-	1 ¹³		-	-	1 ⁵⁹	
(b) Haul To plant.	180,000	cycl.	0 ³⁴		-	-	-	-	-	-	0 ⁹⁰		-	-	1 ²⁴	
(c) CONSTRUCTION ROADS.			0 ²⁵		-	-	-	-	-	-	0 ⁴⁸		-	-	0 ⁷³	
(d) SEPARATING & SCREENING.	170,000	cycl.	0 ²⁸		0 ⁰¹		-	-	-	-	0 ⁶⁵		-	-	0 ⁹⁴	
(e) CRUSHING & PROCESSING.	40,000	cycl.	0 ⁸⁴		0 ¹⁵		-	-	-	-	1 ²⁴		-	-	2 ²³	
(f) Haul TO stock pile	160,000	cycl.	0 ³⁴		-	-	-	-	-	-	0 ⁹⁰		-	-	1 ²⁴	
TOTAL.	1,50,000	cycl.	2 ⁵⁰	375,000	0 ¹⁷	25,500	-	-		-	5 ³⁰	795,000	-	-	7 ⁹⁷	1,195,500

FOLD LENGTH

— 12

— 11

— 8.5

— 8

AUTO

MANUAL

FEED



Calculations

SUBJECT

DEVIL CANYONBy HEK.Date 82/2/19Project No. P5700

Checked _____

Date _____

Calculation No. _____

Page 1 of 1FINE AGGREGATE PROCESSING

- SAME PRICE AS COARSE AGGREGATE,
EXCEPT THAT ONLY 22% REQUIRES
PROCESSING COST.

∴ TAKE 22% OF PROCESSING COST.

SUMMARY OF UNIT PRICES

DESCRIPTION	LABOUR	MATERIAL	EQUIPMENT	TOTAL
EXCAVATION	0.451	0.007	1.131	1.589
HAUL TO PLANT	0.341	-	0.900	1.241
CONST. ROADS	0.252	-	0.479	0.731
SCREENING	0.278	0.003	0.648	0.929
PROCESSING	0.843	0.147	1.243	2.233
HAUL TO STOCKPILE	0.341	-	0.900	1.241
TOTAL	2.506	0.157	5.301	7.964

(E) Concrete Works

Supply & Install Rebar



Estimate Work Sheet

ITEM REFERENCE No. *

MAIN DAM / STRUCTURES.

JOB No. P. 5700

DESCRIPTION REINFORCING. STEEL.

SHEET 1 OF 8.

PROJECT SUSITNA. HYDROELECTRIC

OPERATION No.

REF.

BY P. J. S.

CONTRACT DEVIL CANYON.

DESCRIPTION

CKD HEK. DATE 17. FEB 82

DESCRIPTION AND BASIS OF ESTIMATE	QUANTITY	UNIT	LABOR		JOB MATERIALS		PERM. MATERIALS		SUBCONTRACTS		EQPT. OWNERSHIP		EQPT. OPERATION		Equip UNIT	TOTAL AMOUNT
			UNIT COST	AMOUNT	UNIT COST	AMOUNT	UNIT COST	AMOUNT	UNIT COST	AMOUNT	UNIT COST	AMOUNT	UNIT COST	AMOUNT		
<u>REINFORCING. STEEL.</u>																
HANDLING @ SITE.	18,648	TON		371,632		24,000		-		-		135,762		-	31 ¹⁸	581,394
FABRICATION SHOP & YARD.	18,648	TON		106,746		216,000		-		-		55,395		-	20 ²⁸	378,141
FABRICATION OF REBAR.	18,648	TON		771,627		36,000		-		-		423,200		-	66 ⁰⁰	1,230,827
MOVING TO WORK AREA.	18,648	TON		189,007		12,000		-		-		131,100		-	17 ⁸⁰	332,107
INSTALL. REBAR.	18,648	TON		2,740,500		70,000		-		-		1,660,000		-	239 ⁷²	4,470,500
SUPPLY REBAR. F.O.B. SITE.	18,648	TON		-		-		10,069,920		-		-		-	540 ⁰⁰	10,069,920
GENERAL CLEAN-UP.	18,648	TON.		-		-		-		20,000		-		-	1 ⁰⁰	20,000
TOTAL. - REBAR. DEVIL CANYON	18,648	TONS.	224 ¹²	4,179,512	19 ²⁰	358,000	540 ⁰⁰	10,069,920	1 ⁰⁰	20,000	131 ⁶⁷	2,455,457		-	916 ⁰⁰	17,082,889
In Estimate			226 ⁻		19		540		0		59		72		916	



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REBAR - DEVIL CANYON.

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REBAR QUANTITIES FOR DEVIL CANYON.
 Provided By D. MACDONALD. JAN/82

A. MAIN ARCH. DAM.

$$\begin{array}{rcl}
 \text{DAM.} & = & 5866 \\
 \text{CONT } \frac{1}{2} \% & = & 32 \\
 \hline
 \text{S.T.} & = & 5898 \text{ T}
 \end{array}$$

B. ABOVE GROUND STRUCTURES.

$$\begin{array}{rcl}
 \text{AUX. SPILLWAY.} & = & 2636 \\
 \text{EMERGENCY SPILLWAY} & = & 1200 \\
 \text{INTAKE.} & = & 1984 \\
 \text{CONT.} & = & 180 \\
 \hline
 \text{S.T.} & = & 6000 \text{ T}
 \end{array}$$

C. UNDERGROUND STRUCTURES.

$$\begin{array}{rcl}
 \text{POWER HOUSE} & = & 1250 \\
 \text{DRAFT TUBE} & = & 660 \\
 \text{TUNNELS, ACCESS.} & = & 254 \\
 \text{SHAFTS, ACCESS.} & = & 383 \\
 \text{BUS. TUNNEL} & = & 98 \\
 \text{TRANSFORMER GALLERIES.} & = & 110 \\
 \text{CABLE SHAFT.} & = & 140 \\
 \text{DIVERSION TUNNEL.} & = & 1035 \\
 \text{SURGE CHAMBER} & = & 65 \\
 \text{PENSTOCKS.} & = & 1055 \\
 \text{TAIL RACE} & = & 1385 \\
 \text{CONT.} & = & 316 \\
 \hline
 \text{S.T.} & = & 6750 \text{ T}
 \end{array}$$

TOTAL

18,648 TONS



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REBAR. DEVIL CANYON.

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① HANDLING MATERIAL @ SITE

TOTAL QUANTITY = 18.648 TON.

PRODUCTION = 30 TON / HR

TIME = $\frac{19000}{30} = 634 \text{ HR.}$ LABOUR.FOREMAN = 1 NO. $\times 40.35 = 40.35$ IRON WORKERS. = 8 NO. $\times 37.41 = 299.28$ OPERATORS. = 2 NO. $\times 36.96 = 73.92$ OLLERS. = 2 NO. $\times 32.94 = 65.88$ DRIVER = 3 NO. $\times 35.58 = 106.74$ \$ 586.17 $\times 634 = 371,632$ EQUIPMENTCRANE 50T. = 1 NO. $\times 110$ PICKUP 1/2T. = 1 NO. $\times 16$ FLAT BED & BOOM. = 3 NO. $\times 60$ CRANE. 15T. = 1 NO. $\times 97$ SMALL TOOLS = L.S. $\times 5$ MIS. = L.S. $\times 5$ \$ 293 $\times 634 \text{ HR} = 185,762$ MATERIALS

DISTING. = 2000

BLOCKING. = 2000

MISC = 2000

6000 $\times 4 \text{ YEAR} = \$ 24,000.$



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REBAR. DEVIL CANYON.

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(b) FABRICATION SHOP & YARD.

WORKING TIME = 300 HR.

<u>LABOUR.</u> 1 FORMAN	=	43.03
2 IRONWORKER.	=	74.82
2 CAR.	=	69.02
2 LAB.	=	61.08
2 OPER.	=	70.20
1/2 MIZH.	=	17.55
1/2 ELECT	=	20.12
		<u>\$ 355.82</u>
		$355.82 \times 300 = 106,746.$

EQUIP

CRANE 1ST	=	97.00
Pickup 1/2T.	=	16.00
BOOM TRUCK	=	20.00
WELD.	=	6.65
CUTTING.	=	10.00
COMPLETE-ER.	=	25.00
TOOLS.	=	5.00
SMALL TOOLS	=	5.00
		<u>\$ 184.65</u>
		$184.65 \times 300 \text{ Hr} = 55,395$

MATERIAL.

Bld	=	9,000
MISC.	=	15,000
CONSUMABLE	=	111,000
		<u>\$ 216,000</u>



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REBAR - DEVIL CANYON.

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(C) FABRICATION OF REBAR.

TIME = 2300 Hr.

LABOUR

1 FORMAN.	=	= 40.35	1
6 IRONWORKS.	=	= 224.46	6
1 OPERATOR.	=	= 35.10	1
1 DRIVER	=	= 35.58	1

 $335.49 \times 2300 = \$ 771,627$

EQUIPMENT

CRANE	=	= 97.00
BOOM TRUCK	=	= 20.00
Pickup	=	= 16.00
WELDER	=	= 6.65
CUTTER.	=	= 10.00
COMP.	=	= 25.00
TOOLS.	=	= 5.00
MIS.	=	= 5.00

 $184.65 \times 2300 = \$ 423,200$

MATERIAL

CONSUMABLE	=	12,000
MATERIAL. MISC.	=	12,000
MISC. - SUPPLIES	=	12,000
		<u>\$36,000.</u>



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REBAR DEVIL CANYON.

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(d). MOVING REBAR TO WORK AREA.

TIME = 475 Hr.

LABOUR.

FOREMAN	=	= 40.35
4 - IRONWORKER	=	= 149.64
2 1/2 OPERATOR	=	= 92.40
3 DRIVER	=	= 106.74
1/4 MECH	=	= 8.74
		<u>\$ 397.91 x 475 = 189,007⁰⁰</u>

EQUIPMENT.

CRANE	=	= 160
FLAT BED	=	= 90
Pickup	=	= 16
B. TRUCK	=	= 10
		<u>\$ 276 x 475 = 131,100⁰⁰</u>

MATERIAL.

CONSUMABLE	=	4000
OTHER	=	4000
MISC	=	4000
		<u>\$ 12,000</u>



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REBAR - DEVIL CANYON.

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© INSTALL REBAR.

TOTAL TIME = 10.000 HR.

LABOUR

1 FOREMAN.	=	= 40.35
6 IRONWORKER	=	= 224.46
1/4 OPERATOR	=	= 9.24
		<u>= 274.05 x 10.000</u>
		= 2,740,500

EQUIPMENT

CRANE	=	= 110.00
Pickup	=	= 16.00
B. TRUCK.	=	= 20.00
Cutting.	=	= 10.00
SMALL. TOOLS.	=	= 5.00
MISC.	=	= 5.00
		<u>= 166.00 x 10.000.</u>
		= \$1660,000.

MATERIAL.

MISC.	=	15,000
CONSUMABLE	=	40,000
CONT	=	15,000
		<u>\$ 70,000.00</u>



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REBAR - DEVIL CANYON.

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(f) SUPPLY OF REBAR.

Provided By. RON LANG ON 15 FEB / 82

BREAKDOWN.

Supply of REBAR. - Included
 TRANSPORTATION TO. - -
 - PORT @ WEST COAST - Included
 - SEA TO ALASKA. - Included.
 - TO SITE - Included.
 - UNLOADING @ SITE - Included.

UNIT PRICE = 0.27 PER lb.

TOTAL = 18,648 TONS.

TOTAL COST = \$10,069,920.(g) GENERAL UP.

PROVISIONAL SUM = \$20,000.