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MISSISSIPPI RIVER: STUDY OF ALTERNATIVES FOR
REHABILITATION OF LOCK AND D. (U) CORPS OF ENGINEERS ST
PAUL MN ST PAUL DISTRICT APR 76

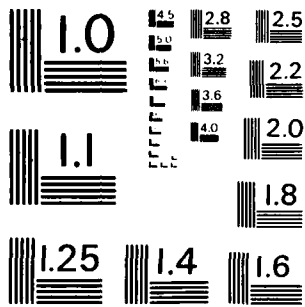
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**STUDY OF ALTERNATIVES FOR REHABILITATION
OF LOCK AND DAM NO. 1**

MINNEAPOLIS, MINNESOTA

D

**SUPPORTING DATA
FOR
APPENDIX A
ALTERNATIVE PLANS OF REHABILITATION**

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ST. PAUL, MINNESOTA**

APRIL 1976

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SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

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| 19. KEY WORDS (Continue on reverse side if necessary and identify by block number) LOCKS (WATERWAYS) INLAND WATERWAYS MISSISSIPPI RIVER | | |
| 20. ABSTRACT (Continue on reverse side if necessary and identify by block number) It is recommended that both the landward lock, the riverward lock and the dam at Lock & Dam no. 1, Minneapolis, Minnesota be completely rehabilitated. Based on studies completed to the date of this report, more detailed studies are required to firmly establish cost estimates, environmental effects, and the construction scheduling necessary to insure the work can be completed in the proposed two year construction period without delaying navigation. | | |

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DEPARTMENT OF THE ARMY
St. Paul District, Corps of Engineers
1210 U. S. Post Office & Custom House
St. Paul, Minnesota 55101

MISSISSIPPI RIVER
STUDY OF ALTERNATIVES FOR REHABILITATION OF LOCK AND DAM NO. 1
MINNEAPOLIS, MINNESOTA

SUPPORTING DATA
FOR
APPENDIX A
ALTERNATIVE PLANS OF REHABILITATION

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HARZA
ENGINEERING
COMPANY
CHICAGO

SUBJECT SUPPORTING DATA - APPENDIX A
ALTERNATIVE PLANS OF REHABILITATION
COMPUTED _____ CHECKED _____

PROJECT LOCK & DAM No. 1
FILE NO. 800 A
DATE 4/24/75 PAGE 1 OF 1 PAGES

TABLE OF CONTENTS
FOR
COMPUTATIONS AND NOTES
COVERING CIVIL WORKS COSTS,
CONSTRUCTION SCHEDULING
AND MANPOWER:

| <u>Description of Item</u> | <u>Page Numbers</u> |
|---|---------------------|
| Excavation and Embankments | 1 - 8 |
| Steel sheet piling | 9 |
| Shelter for Winter Work | 10 - 15 |
| Removal of Concrete | 16 - 17 |
| Slurry Trench | 18 |
| Landscaping | 19 - 22 |
| Concrete | 23 - 33 |
| Sand Fill in Main Dam | 34 - 35 |
| Rock Anchors | 36 - 38 |
| Shear Keys | 39 - 41 |
| Vents | 41 |
| Discharge Manifolds with Stilling Basin East of River Wall - Plan No. 4A | 42 |
| Discharge Manifolds with Bent Discharge Structure East of River Wall - Plan No. 4B | 43 |
| Reconstruction of Extension of River Wall | 44 |
| Repair of Concrete Surfaces | 45 |
| Scheduling and Manpower | 46 - 65 |

| | | |
|--|-----------------------------------|---|
| HARZA ENGINEERING COMPANY CHICAGO | SUBJECT <u>Cost Estimate</u> | PROJECT <u>Lock & Dam No 1</u> |
| | <u>Excavation and Embankments</u> | FILE NO <u>80017</u> |
| | COMPUTED <u>GJK</u> CHECKED _____ | DATE <u>11/2/75</u> PAGE <u>1</u> OF <u>65</u> PAGE |

Figure costs for the various types of excavation for Lock & Dam No. 1. As before use current labor rates for Minneapolis & current equipment costs from CECRB. Use 35% for profit & overhead. Add 15% for escalation. Note: Relatively insignificant items will not be covered in these notes.

Dredging:

Use backhoe on the bank, figure low production rate for under water work. Say 1 cu. yd. machine at 30 cy/hr.

| | | | |
|-------------------------|--------------|--------------|--------------|
| 1 Operator | 8.90 | 8.90 | |
| 1 Diler | 8.00 | 8.00 | |
| 3 Truck Dr. | 7.20 | 21.60 | |
| 2 Flagman | 7.70 | 15.40 | |
| | | <u>53.90</u> | |
| | W/OT at 8.3% | 58.40 | 58.40 |
| 1 Backhoe | | 24.00 | |
| 3 10 cy Trk. on highway | 19.00 | 57.00 | |
| | | <u>81.00</u> | <u>81.00</u> |
| | | | 139.40 |

Per cu yd. 4.65
 W/profit & overhead 35% 6.27
 W/ Esc. 15% 7.21
 Small quantity use \$9.00

Backhoe excavation for structures

Say product would be 50 cy/hr Add disposal separately

| | |
|-----------------------|---------------------------------|
| diler & Operator W/OT | 18.30 |
| Backhoe | 24.00 |
| 2 Flagmen W/OT | <u>16.70</u> |
| Direct | 59.00 |
| per cy (1.50) | 1.18 |
| Add disposal | <u>1.49</u> |
| Total Direct | 59.67 |
| 55% | W/ Profit, overhead & Esc. 5.68 |
| | use \$6.00/cu yd. |

| | | |
|--|-----------------------------------|---|
| HARZA ENGINEERING COMPANY CHICAGO | SUBJECT <u>Cost Estimate</u> | PROJECT <u>Lake Dam No.</u> |
| | <u>Excavation and Embankments</u> | FILE NO <u>800A</u> |
| | COMPUTED <u>GJK</u> CHECKED _____ | DATE <u>4/1/75</u> PAGE <u>2</u> OF <u>65</u> |

Figure Disposal Costs for Various Distances

Truck cycle: 10 cy on-Highway Truck

| | <u>1 mi</u> | <u>3 mi</u> | <u>5 mi</u> | <u>10 mi</u> |
|------------------|-------------|-------------|-------------|--------------|
| Load | 5.0 | 5.0 | 5.0 | 5.0 |
| Haul | 4.0 | 10.0 | 15.0 | 24.0 |
| Dump | 3.0 | 3.0 | 3.0 | 3.0 |
| Return | 3.3 | 9.0 | 13.0 | 21.4 |
| Lost | <u>0.7</u> | <u>1.0</u> | <u>2.0</u> | <u>3.6</u> |
| Total | 18.0 | 28.0 | 38.0 | 57.0 |
| Trips/Hr | 2.8 | 1.8 | 1.3 | 0.9 |
| Production cy/hr | 28 | 18 | 13 | 9 |

| | | | | |
|-------------|----------|---|------|------|
| Labor, w/OT | 7.00 | → | | |
| Truck | 19.00 | → | | |
| Direct Cost | \$ 26.80 | | | |
| per cu yd | \$ 0.96 | | 1.49 | 2.06 |

Add Flagmen separately

Use this.
or \$2.30 w/Prof. O.H. & Esc.

| | | |
|--|---------------------------------------|---|
| HARZA ENGINEERING COMPANY CHICAGO | SUBJECT <u>Cost Estimate</u> | PROJECT <u>Lock & Dam No. 1</u> |
| | <u>Excavation and Embankments</u> | FILE NO <u>800 A</u> |
| | COMPUTED <u>GJK</u> CHECKED <u>JR</u> | DATE <u>1/2/75</u> PAGE <u>3</u> OF <u>65</u> PAGES |

Front end Loader excavation, for alluvial deposits and backfill excavation in open areas.

Say we'll use a 2 cy with a production of $2 \times 50 / .75 = 130$ cy/hr. Assume 30% dozer assistance.

Labor

| | | |
|-------------------|--------------|--------------|
| 1 FEL oper. | | 8.90 |
| 30% 1 Dozer oper. | 8.70 | 2.60 |
| 2 Flag men | | 15.40 |
| 1 Misc Common | | 7.70 |
| | | <u>34.60</u> |
| | W/OT (1.082) | 37.50 |

Equipment

| | | |
|-----------------|-------|--------------|
| 1 FEL 2 cy | | 15.00 |
| 30% 1 Dozer D-7 | 19.50 | 5.85 |
| | | <u>20.85</u> |

Total
SubTotal Direct 58.35

Per cy yd 0.45

Add Disposal 1.49

Total Direct 1.94

Profit & Overhead 0.67

w/ Esc .39

Use \$ 3.00

Use this for acc. rd. removal

Sandstone

Use all as above but add full time dozer-ripper. Say production drops to 90 cy/hr

Labor & Equip above 58.35

add .7 Dozer op. W/OT 6.60

add ripper to D-7 3.00

Total 67.95

Per cu yd 0.76

Add Disposal 1.49

w/ Profit & O/H & Esc. 3.48

Use \$ 3.50

(3/11/75) ✓
Note - for small quant, close gtrs, use \$ 15.00/c.y

| | | |
|--|-----------------------------------|--|
| HARZA ENGINEERING COMPANY CHICAGO | SUBJECT <u>Cost Estimate</u> | PROJECT <u>Lock & Dam No 1</u> |
| | <u>Excavation and Embankments</u> | FILE NO <u>800 A</u> |
| | COMPUTED <u>FEL</u> CHECKED _____ | DATE <u>1/2/75</u> PAGE <u>1</u> OF <u>65</u> PAGE |

Clamshell excavation - for cofferdam removal and rock dike excavation.

Assume a 3 cy crawler crane loading trucks with 180° swing. $3 \times 50 / 0.90 = 166$; use .90 cu yds/hr per due to truck maneuvering. (Using small on highway haul units)

| | |
|-----------------------|---------------|
| Labor - operator | 8.90 |
| oiler | 8.00 |
| 4 Flagmen | 7.70 30.80 |
| 2 misc | 15.40 |
| | <u>62.10</u> |
| W/O T | 68.30 |
| Equipment - Clamshell | 54.20 |
| Sub Total | <u>122.50</u> |
| Per cy 90 | 1.36 |
| Add Disposal | 1.49 |
| Total | <u>2.85</u> |
| W/Profit & Overhead | 3.84 |
| W/Escalation | 4.41 |
| use | 4.50 ✓ |

Double this for crib removal

stripping - use same as FEL excavation.

| | | |
|--|-----------------------------------|--|
| HARZA ENGINEERING COMPANY CHICAGO | SUBJECT <u>Cost Estimate</u> | PROJECT <u>Lock & Dam No. 1</u> |
| | <u>Excavation and Embankments</u> | FILE NO <u>800 A</u> |
| | COMPUTED <u>GJK</u> CHECKED _____ | DATE <u>1/2/75</u> PAGE <u>5</u> OF <u>65</u> PAGE |

Figure Fill costs for Lock & Dam No. 1. Same assumptions as before. Assume all but random fill has to be purchased.

Access Road Random fill

Say that 12,000 cy of this 19,000 cy fill can come from Land Wall backfill excavation.

The remainder will come from borrow say 8 mi away.

Placing only: say a D-8 w/ towed roller can place and compact 150 cy/hr.

| | |
|---------------------|-------------|
| Labor: { 1 Dumpman | 8.35 |
| w/OT { 1 Dozer oper | 9.45 |
| | <hr/> 17.80 |

| | |
|-----------|-------|
| D-8 Dozer | 29.00 |
|-----------|-------|

| | |
|------------------------------------|------|
| Tow ^{ed} Sheepfoot Roller | 1.20 |
|------------------------------------|------|

| | |
|--|-------------|
| | <hr/> 30.20 |
|--|-------------|

| | |
|--------------|-------|
| Total Direct | 48.00 |
|--------------|-------|

| | |
|-------------------|------|
| per cy. yd. (150) | 0.32 |
|-------------------|------|

Borrow and Haul and Place

from 8 miles truck production would be about 11 cy/hr/truck for 110 yd³/hr use 10 trucks

| | |
|----------------|------|
| Labor 1 FEL op | 8.90 |
|----------------|------|

| | |
|-------------|-------|
| 10 Truck dr | 72.00 |
|-------------|-------|

| | |
|----------------|-------------|
| 4 Misc Flagman | 7.70 |
| | <hr/> 30.80 |

| | |
|----------------|-------|
| 1 Placing crew | 17.80 |
|----------------|-------|

| | |
|--|--------------|
| | <hr/> 129.50 |
|--|--------------|

Equipment

| | |
|-----------|-------|
| 1 2cy FEL | 15.00 |
|-----------|-------|

| | |
|----------------|--------|
| 10 Truck 10 cy | 190.00 |
|----------------|--------|

| | |
|------------------|-------|
| 1 Dozer w roller | 30.20 |
|------------------|-------|

| | |
|--|--------------|
| | <hr/> 235.20 |
|--|--------------|

| | |
|--------------|--------|
| Total Direct | 364.70 |
|--------------|--------|

| | | |
|--|-----------------------------------|--|
| HARZA ENGINEERING COMPANY CHICAGO | SUBJECT <u>COST Estimate</u> | PROJECT <u>Lock & Dam No 1</u> |
| | <u>Excavation and Embankments</u> | FILE NO <u>800 A</u> |
| | COMPUTED <u>GJK</u> CHECKED _____ | DATE <u>1/2/75</u> PAGE <u>6</u> OF <u>65</u> PAGE |

Access Road Random Fill

B, H & P. Total Direct 364.70
 per cy (2.110) 3.31

Composite Price

12/19 x 0.32 0.20

7/19 x 3.31 1.22

Composite Direct 1.42

w/ 35% Profit & OH 1.92

w/ 15% Esc 2.20

Use \$ 2.50 / cy

Use \$ 3.00 / cy for Access Ramp
for Land Cells

add \$ 3.00 for removal

Granular Cell Fill

Purchased material, barged from downstream 8 mi.

Local quote, say gravel & sand at \$ 200 / ton avg.

Say 15 ton / cy or 3.00 / cy

Hauling 8 mi $8 \times 15 \times 1.5 = 1.80 / cy$

Total mat'l 4.80 / cy delivered

Place by clamshell at 100 cy/hr

1 operator 8.90

1 oiler 8.00

1 misc 7.70

24.60

w/o T 26.65

1 clamshell 54.20

80.85

per cy 0.81

Add mat'l's 4.80

5.61

w/ Profit & OH 7.57

w/ Esc 8.70

Use \$ 9.00 / cy

remove @ 4.50

\$ 13.50

| | | |
|--|-----------------------------------|--|
| HARZA ENGINEERING COMPANY CHICAGO | SUBJECT <u>Cost Estimate</u> | PROJECT <u>Lock & Dam No 1</u> |
| | <u>Excavation and Embankments</u> | FILE NO <u>800 A</u> |
| | COMPUTED <u>GJK</u> CHECKED _____ | DATE <u>1/2/75</u> PAGE <u>7</u> OF <u>65</u> PAGE |

Impervious Fill

Placed by clamshell from barges, spread by dozer & roller. Say 100 cy/hour

Labor

| | |
|------------|-------------|
| 1 Crane op | 890 |
| 1 diler | 800 |
| 1 Dozer op | 870 |
| 1 Dumpman | 710 |
| 2 misc. | <u>1540</u> |
| | 4870 |
| w/OT | 52.75 |

Equipment

| | |
|--------------|------------|
| 1 Clamshell | 54.00 |
| 1 DOZER | } 30.20 |
| 1 Roller | |
| 2 gas tamper | <u>450</u> |
| | 88.70 |
| | 141.45 |

| | |
|----------------------|-------------|
| Per cy | 1.41 |
| w/ material purchase | <u>4.50</u> |
| | 591 |
| w/ Profit & Overhead | 7.98 |
| w/ ESC 15% | 9.17 |

use \$ 9.00/cy + 3.00 for removal

Dumped Rock, Rip rap, Random Rock fill

| | |
|----------------------|-------------|
| Purchase & deliver | \$ 9.00/cy |
| Place w clamshell | <u>1.00</u> |
| | 10.00 |
| w/ Profit & overhead | 13.50 |
| w/ Esc | 15.52 |

\$ 16.00/cy + 4.50 remove } when
 \$ 25.00/cy + 4.50 remove } req'd.

| | | |
|--|-----------------------------------|---|
| HARZA ENGINEERING COMPANY CHICAGO | SUBJECT <u>Cost Estimate</u> | PROJECT <u>Locks & Dam No</u> |
| | <u>Excavation and Embankments</u> | FILE NO <u>800 A</u> |
| | COMPUTED <u>GJK</u> CHECKED _____ | DATE <u>1/2/75</u> PAGE <u>8</u> OF <u>65</u> PAGES |

Gravel & Gravel Filters

Purchased & Hauled Placed by clamshell from barges
 spread by Dozer & roller.

Purchase 6.00
 Place 0.75

6.75

W/ Profit & OH 9.11

W/ Esc. 10.50

10.50 + 3.00 = 13.50 (removed) Use \$13.50 to incl. removal
 if req'd.

Back fill around Structures

Hand compacted material from excavation
 Dozer placed, Production say 20 cy/hr

1 Dozer op 8.70

4 Cannon 30.80

39.50

W/OI 42.75

1 Dozer D-7 19.50

4 gas tamper 9.00

28.50

71.25

prcy 3.56

W/ Profit & OH 4.80

W/ Esc 5.53

Use \$6.00/cy

In larger back fill sites say 75% machine
 compaction 25% hand compaction

Page 4 .75 x 0.32 = 0.24

.25 x 3.56 = 0.89

1.13

W/ Profit & OH 1.53

W/ Esc 1.75

say \$ 2.00/cy

| | | |
|--|------------------------------|---|
| HARZA ENGINEERING COMPANY CHICAGO | SUBJECT <u>Cost Estimate</u> | PROJECT <u>Lock & Dam No. 1</u> |
| | <u>Steel Sheet Piling</u> | FILE NO. <u>800 A</u> |
| COMPUTED <u>JAT</u> | CHECKED _____ | DATE <u>1/7/75</u> PAGE <u>9</u> OF <u>65</u> PAGES |

1. Temp. Work

Sheet Piling

1) Drive, Pull & Salvage

Based on previous bidding experience and Means Construction Cost Data 1975

| | |
|---|-----------------------|
| Labor & Equip. to drive & extract | \$ 213.00/Ton |
| Piling etc. @ 75% salvage value | 75.00 |
| Waste allowance 10% of \$300.00 | 30.00 |
| | <u>318.00</u> |
| (due to the fact that some may be driven from barge) } Add 20% for difficult conditions | 62.00 |
| | <u>380.00</u> |
| | Profit & Overhead 35% |
| | 133.00 |
| | <u>513.00</u> |
| | Escal. 15% |
| | 77.00 |
| | <u>\$ 590.00</u> |

Use \$ 600.00/Ton

2) Drive & Leave in Place

| | |
|----------------------------|-------------------|
| Labor & Equipment to drive | 142.00 |
| Piling | 300.00 |
| | <u>442.00</u> |
| | Prof & O.H. 35% ± |
| | 158.00 |
| | <u>\$ 600.00</u> |
| | Escal 15% |
| | 90.00 |
| | <u>\$ 690.00</u> |

Use \$ 700.00

3) Trim Piles \$ 200 / lin. ft.

Pumping - Roughly \$ 350.00/day

Figure the cost of winter protection for Lock & Dam No. 1. Locks. Use current labor rates and material prices for Minneapolis from ENR. Use equipment hourly costs from CECRG. Add escalation at 15% per year for one year. (Construction will be in Nov, 75 as per DAD schedule). Use 25% of direct costs for contractor's profit & overhead.

The job will consist of erecting a column supported roof-truss over the locks, placing a wood and tar paper roof deck and enclosing the frame with canvas.

Crew sizes and production rates:

a) Drillers - say an 8 man - layout, drilling and grouting crew can do about 40 ft. of drilling per hour. say 4 holes per column, one 11 ft deep or $51 \times 4 \times 4 = 816$ lin ft
Total job time $816/40 = 20.4$ hour say 2-8 hr days

b) Steel Erection - use a crew of steel workers and equipment operators w/ truck crane to erect about 17 tons of steel per 8 hr day. say $300/17 = 17.6$, 3 weeks, 6 days/week

c) Wood & Tar Paper - use a crew of 7 men assisted by a crane to place 600 sq ft/hr
Total job time $510 \times (56 + 56 + 29) / 600 = 120$ hr per crew, say $120/48 = 2.5$ wks total

d) Canvas - say the wood & paper crew can do this work in a week

e) Hauling: Assume that two trucks can bring in enough materials to keep up with production - $3\frac{1}{2}$ wks

f) Total Job time $3\frac{1}{2}$ wks.

1) Drilling and Placing Anchor bars - say 3 days of 24hrs Labor

| | | |
|---|------|------------|
| 2 Drillers | 8.45 | 16.90 |
| 1 Helper | | 7.70 |
| 1 Air comp op | | 8.15 |
| 2 Grout & Bar men | 7.70 | 15.40 |
| 1 layout man - misc. | | 7.70 |
| O.T. for 6 day week $40 + (6.5 \times 8)$ | | 55.85 |
| 148 | | |
| Add 8.3% | | \$ 60.50 |
| For 24 Hrs | | \$ 1452.00 |

Equipment

| | | |
|---------------------|-----|-----------|
| 1 Air compr 250 | | 9.00 |
| 2 Jackhammer | .35 | 0.70 |
| 1 Misc. grout tools | | 0.30 |
| | | 10.00 |
| For 24. Hrs | | \$ 240.00 |

Materials

| | | |
|--|--|------------|
| Threaded bars $1\frac{1}{2}$ " dia (arbitrary) | | |
| 6 #/FT x \$.30/16 x 816 = | | \$ 1469.00 |
| Drill steel .40/16 x 816 | | 326.00 |
| Grout w/waste, 20 cuft., \$18/cuft. | | 360.00 |

| | | |
|-----------------------|-----|------------|
| Total Direct | | \$ 3847.00 |
| w/ Profit & CH 35% | | 5193.00 |
| w/ ESC 15% | 524 | \$ 6000.00 |
| (by 816) per lin. Ft. | | \$ 7.34 |

2) Steel Erection - From Means & Stubbs, 17 Tons/hr Labor

| | | |
|-----------------|------|--------|
| 1 Foreman | | 12.00 |
| 4 St. Worker | 9.95 | 39.80 |
| 90% 1 Crane op. | 8.90 | 8.00 |
| 90% 1 Oiler | 8.00 | 7.20 |
| 1 Compr op | | 8.15 |
| 2 Cannon | 7.70 | 15.40 |
| 80% 2 Truck Dr. | 7.20 | 11.50 |
| | | 102.05 |

| | | |
|--|--|---|
| HARZA ENGINEERING COMPANY CHICAGO | SUBJECT <u>Cost Estimate</u> | PROJECT <u>Lock E' Dam No.</u> |
| | <u>Shelter for Winter Work</u> | FILE NO. <u>800 H</u> |
| | COMPUTED <u>GJK</u> CHECKED <u>JAT</u> | DATE <u>12/9/74</u> PAGE <u>12</u> OF <u>65</u> |

2) Steel Erection - cont'd

Labor per hr. 102.05
 w/OT at 8.3% 110.50
 for 3 wks, or 144 Hrs \$ 15,912.

Equipment 80% 2 Trucks 20.00 32.00
 90% 1 Truck Crane 25 T. 17.00 15.30
 1 Air Comp. 9.80
 4 Torque Wrench 0.60 2.40
 Misc. Clamps Hoses, Equip 1.30
 60.00

for 18 days 144 Hrs 8,640

Materials

Roof Trusses, 164 tons or 328,000 #
 at 28 \$/lbs. x 328,000 9,184.
 Struct. Beams .18 \$/lbs. x 172,000 30,960.
 Struct. Angles .20 \$/lbs. x 100,000 20,000.
 Bolts, etc. 1,484

Total Direct 534 \$ 170,000
 w/ Profit & Overhead \$ 229,500
 w/ Exc 15% say 263,925 256,000.
 534 - 265,000

3) Roofing - crew of 7 at 600 SF/hr - 2.5 wks.

Labor

1 Foreman 12.00
 32% 1 Crane op 8.90 2.85 -
 44% 2 Truck dr. 7.20 6.35 -
 2 Carpenter 9.20 18.40 -
 4 Common 7.70 30.80 -
 32% 1 Oiler 8.00 2.55 -
 72.95

w/OT at 8.3% 79.00
 for 15 days, 120 Hrs \$ 9,480.

3) Roofing, cont'd

| | | | |
|-------------|-------|--------------|-------|
| Labor | | | 9480. |
| Equipment | | | |
| 32% Crane | 17.00 | 5.45 | |
| 44% 2 Truck | 20.00 | 17.60 | |
| Misc Tools | | 0.95 | |
| | | <u>24.00</u> | |

for 120 Hrs 2880.

Materials

| | | |
|-----------|--------------------------|----------------|
| Lumber | 143 MBF at \$220/mbf | 31460. |
| Tar Paper | 95,000 SF at \$7.00/100# | |
| 15 #/sq, | 95000 x 7.00 x .15/9 | <u>11,050.</u> |

Total Direct 54900
w/ Profit & OH & Exc. (about) \$ 85,000.

4) Canvas

| | | |
|-------------------|------------------------------|-------------|
| Labor Crew above, | 73.00 x 48 | 3504 |
| Equipment - Crane | 5.45 x 48 | 262 |
| Materials, say | 5¢/SF x 27,000 | <u>1350</u> |
| | | 5116 |
| | w/ Profit & OH & Exc (about) | \$ 8,000.00 |

5) Summary

| | |
|-------------------|-------------------|
| 1) Drilling | 6,000.00 ✓ |
| 2) Steel Erection | 265,000.00 ✓ |
| 3) Roofing | 85,000.00 ✓ |
| 4) Canvas | <u>8,000.00 ✓</u> |

Erection

\$ 364,000.00
say \$ 365,000.00

Removal - (see Page 5)

| | |
|----------------|-----------------|
| 1 Anchor Bolts | 650.00 |
| 2 Steel | (26,000.00) |
| 3 Roofing | 20,000.00 |
| 4 Canvas | <u>3,000.00</u> |

Total Job \$362,000 (2350.00)

Removal

1) Anchor Bolts - 40 Bolts/hr
 Labor - 2 Common 7.70 x 1.083 16.70
 Equipment - Cutting Torch 0.50
 Grinder 0.15
 Hourly Total 17.35 \$/hr
 W/ Profit OH & Esc 27.00 \$/hr
 for 24 Hrs 524 \$650.00

2) Steel Framing - say the steel crew can dismant.
 about 25 tons/day, assisted by a crane, say
 steel will be sold to buyer who picks it
 up on site at 30% Purchase Price.

Labor - steel crew w/ Truck dr. 90.55

W/ OT 95.00

Equipment - No Trucks 28.00

Subtotal 126.00 ✓

For 300/25 = 12 days 12,096

W/ Profit & Overhead & Esc. 18,780 ✓

Steel Salvage

148,800 x .30 = (44,640)

Net Salvage (25,860)

say (26,000)

3) Roofing - mean's says 4 Laborers can remove
 4000 BF/day - 8hr. use 10 for 10,000 BF.
 140/10 = 15 days or 120 Hrs. 844

Labor 1 Foreman 12.00

10 Common 7.70 77.00

20% Crane op 8.90 1.80

20% Oiler 8.00 1.60

92.40

W/OT \$ 100.00/hr

Equip. 20% Crane 3.10

Misc. 1.60

Total \$ 105.00

W/ Profit OH & Esc 163.00

4 Canvas - 50% labor & equip. For 120 Hrs say 19,560 \$ 20,000
 \$ 3,000

| | | |
|--|-----------------------------------|--|
| HARZA ENGINEERING COMPANY CHICAGO | SUBJECT <u>Cost Estimate</u> | PROJECT <u>Lock & Dam No. 1</u> |
| | <u>Shelter for Winter Work</u> | FILE NO. <u>800 A</u> |
| | COMPUTED <u>JAT</u> CHECKED _____ | DATE <u>1/7/75</u> PAGE <u>15</u> OF <u>65</u> PAGES |

Heat Temporary Shelter

2,200,000 cu.ft. — poorly insulated. 5 months

Assuming a well insulated area costs about \$0.025 per cu.ft., the poorly insulated shelter might cost \$0.10/cu.ft. for the 5 months

or use \$250,000.00 Plan No. 1
Double for Plan No. 2

Lighting & Pumping - use \$10,000 for each.

| | | |
|--|-----------------------------------|---|
| HARZA ENGINEERING COMPANY CHICAGO | SUBJECT <u>Cost Estimate</u> | PROJECT <u>Lock & Dam No. 1</u> |
| | <u>Removal of Concrete</u> | FILE NO <u>800 A</u> |
| | COMPUTED <u>JAT</u> CHECKED _____ | DATE <u>1/10/75</u> PAGE <u>16</u> OF <u>65</u> PAGES |

Removal of Existing Concrete -

This material must be drilled and light blasted generally from bottom to top in the case of new conduit excav. Compute typical round of 3.5'

Cross sec 120 sq. ft.

No. of drill holes use 60 @ 4' depth = 240

Drill time - with 4 drills =

@ 0.6' min./drill $\frac{240}{2.4} = 100 \text{ min}$

(vol./round = $(10 \times 12 \times 3.5) \div 27 = 58 \text{ yd/cy}$)

load & shoot 60 x 2 ÷ 2 (2 men) 60

muck out 30

set up drills 30

220 min

Cost/round: = 3.66 hrs — use 4.5 hrs

Labor:

drillers, powdermen, front
end loader oper., welder for
old rebars, compressor oper.,
truck driver, other labor

say 15 @ 8.00 x 4.5 = 540.00

Equipment about 900/hr = 405.00

Materials

Drill steel, bits, explosives 80.00

Total 1,025.00

$\frac{1,025 \times 1.35 \times 1.15}{15} = \$ 106$

15

Use 110.00/cu.yd.

Use this for conduit excav. and enlarging
conduits

Removal of concrete — not involving tunnel oper.

— use \$65.00/cu.yd.

For Gate Slots involving mostly air hammer work \$150.00/cy.
Same for 3.5' roof depression

| | | |
|--|------------------------------|---|
| HARZA ENGINEERING COMPANY CHICAGO | SUBJECT <u>Cost Estimate</u> | PROJECT <u>Lock & Dam No. 1</u> |
| | <u>Removal of Concrete</u> | FILE NO. <u>800A</u> |
| | COMPUTED <u>GJK</u> | CHECKED <u>[Signature]</u> |
| | | DATE <u>8/21/75</u> PAGE <u>17</u> OF <u>65</u> PAGES |

Removal of Concrete - Revised w/o blasting.

From Meiri's costs 1975 a crew consisting of a foreman, comp. oper., and 4 laborers can remove about 2.5 cy of reinforced concrete per 8 hr day w/o blasting. Figure 12 laborers plus foreman, loader oper, welder and comp. op. 16 men in all to produce 1 cy/hr.

| | | | |
|---------------------------------------|-------|--------------|----------|
| Labor 16 x \$8.00/hr. avg. = \$128.00 | | | \$128.00 |
| Equipment | | | |
| 12 jackhammers | 0.30 | 1.20 | |
| 2 900 cfm air compressor | 14.00 | 28.00 | |
| 1 welding set | | 0.30 | |
| 10% F.E.L. - carry loading | 15.00 | 1.50 | |
| Misc Hoses | 3.80 | 3.80 | |
| | | <u>35.00</u> | \$35.00 |

Materials - Drill Steel, Bits
12 x 0.6 x 50 x 30¢

| | | | |
|---|--|---------|--------------------|
| | | per hr. | \$271.00 |
| | | | \$270.00/cy |
| 270 x 1.35 x 1.15 (w/Prof & O.H. & Esc) | | | = say \$420.00/cy. |
| where blasting is permitted outside tunnels | | | |
| use as before | | | \$65.00 |

For Gate slab - air hammer work in the open
use as before \$150.00

| | | |
|--|-----------------------------------|--|
| HARZA ENGINEERING COMPANY CHICAGO | SUBJECT <u>Cost Estimate</u> | PROJECT <u>Lock & Dam No. 1</u> |
| | <u>Slurry Trench</u> | FILE NO <u>800A</u> |
| | COMPUTED <u>JAT</u> CHECKED _____ | DATE <u>1/13/75</u> PAGE <u>18</u> OF <u>65</u> PAGE |

Drains - Perf. Clay Pipe (Means Constr. Cost Data '75)
 12" $\$4.70 \times 1.35 \times 1.15 =$ say $\$6.00/\text{ft.}$
 24" Use $\$15.00/\text{lin. ft.}$

Slurry Trench 180 cu yd.
 Excavation, Slurry and Earth Backfill usually
 costs about 1.50 to 2.50 /cu ft.
 Use $\$2.00 \times 180 \times 27 = \$9,720$
 add concrete - Pg. 31:
 $180 \times 80 = \frac{14,400}{\$24,120}$
 $24,120 \div 180 =$ say $\$130.00/\text{c. y}$ to 135.00
 Use $\$10,000$ for shelter

Air Vents
 (12") Drill hole 100' @ 60.00 (incl. setup) = 6,000
 Casing 40' @ 25.00 = 1,000
 Grouting = 3,000
 Prof., O.H. & Escal. incl. $\$10,000$
 Unit price $\$100.00/\text{ft.}$

Misc. Connections $\$5,000$

Valve operating Structures
 Remove Existing @ $\$1,000.00$
 New Construction @ $\$2,500.00$

Remove Existing Control Structure $\$10,000$
 Construct New Control Structure

All prices other than concrete from 1975 Means
 Constr. Cost Data.

Misc. Metalwork $\$1.25/\text{lb}$ (Grills)
 Misc. Steel $\$1.00/\text{lb}$

| | | |
|--|---|---|
| HARZA ENGINEERING COMPANY CHICAGO | SUBJECT <u>LANDSCAPING Lock & Dam No. 1</u> | PROJECT <u>L + D No. 1</u> |
| | <u>cost estimate</u> | FILE NO <u>800A</u> |
| | COMPUTED <u>SOS/ku</u> CHECKED <u>[Signature]</u> | DATE <u>12-1-74</u> PAGE <u>19</u> OF <u>65</u> PAGES |

NOTE: Landscaping of land adjacent to Lock & Dam No. 1 shall consist of planting sod, trees, and shrubs to enhance the aesthetic appearance of the site.

List of Species

Trees

- Acer rubrum - red maple
- Acer saccharum - sugar maple

Shrubs

- Juniperus chinensis pfitzeriana - Pfitzer juniper
- Juniperus virginiana globosa - Globe juniper
- Taxus cuspidata nana - Dwarf japanese yew

Sod

Perfect sod

| Quantity | Scientific Name | Height | Caliper | Condition | Nursery Unit Price | Install. | Transportation | Totals | |
|----------------------|------------------------|--------|---------|-----------|--------------------|---------------------|-------------------|---------------------|----------|
| | | | | | | | | Per tree | Per tree |
| 4 | Acer rubrum > 12' | 5" | BB | \$ 190 | 124 ¹¹ | 19.00 | 335 ¹¹ | | |
| 4 | Acer saccharum > 18' | 5" | BB | 225 | 146 ¹¹ | 22.50 | 393 ¹¹ | | |
| <u>Shrubs</u> | | | | | | | | | |
| 10 | Juniperus chinensis p. | 4' | - | BB | 23 | 17.00 ²¹ | - | 22.00 | |
| 10 | " virginiana, g. | 3' | - | BB | 20 | 10.00 | 2.00 | 32 ²¹ | |
| 10 | Taxus cuspidata n. | 3' | - | BB | 27 | 19.00 ²¹ | 2.70 | 46.70 ²¹ | |
| 10 | Taxus cuspidata n. | 3' | - | BB | 24 | 12.00 ²¹ | 2.40 | 38 ¹¹ | |
| <u>Sod</u> | | | | | | | | | |
| 600 yds ² | Perfect sod | - | - | - | 2.70 | 1.60 | 2.00 | 2.00 | |
| | total tree | | | | 2.00 | 1.50 | .20 | 3.70 | |

- 11 Installation 65% of material cost MEANS
- Installation 50% of material cost MEANS
- 31 Transportation 10% of material cost MEANS

| | | |
|--|--|--|
| HARZA ENGINEERING COMPANY CHICAGO | SUBJECT <u>Landscaping costs</u> | PROJECT <u>L&D No. 1</u> |
| | COMPUTED <u>505/GJK</u> CHECKED <u>[Signature]</u> | FILE NO. <u>ENOA</u> |
| | | DATE <u>12-16-77</u> PAGE <u>20</u> OF <u>65</u> |

| <u>Scientific Name</u> | <u>Quantity</u> | <u>Unit Price</u> | <u>Total Price</u> | | |
|--|-----------------|--------------------------|--------------------|----------|--------------------|
| <u>Acer Rubrum</u> | <u>4</u> | <u>333.⁰⁰</u> | <u>1332</u> | <u>✓</u> | <u>1332</u> |
| <u>Acer Saccharum</u> | <u>4</u> | <u>393.⁵⁰</u> | <u>1574</u> | <u>✓</u> | <u>1574</u> |
| <u>Juniperus chin.</u> | <u>10</u> | <u>32.⁰⁰</u> | <u>320</u> | | <u>42.00 420</u> |
| <u>" virginiana</u> | <u>10</u> | <u>43.⁷⁰</u> | <u>437</u> | | <u>48.70 487</u> |
| <u>Taxus cuspidata</u> | <u>10</u> | <u>38.⁴⁰</u> | <u>384</u> | | <u>58.40 584</u> |
| <u>500</u> | <u>600 yds</u> | <u>3.⁷⁰</u> | <u>2220</u> | | <u>4.00 2400</u> |
| | | | <u>6262</u> | | <u>6597</u> |
| <u>Contractors Profit & Overhead @ 35%</u> | | | <u>2191.70</u> | | |
| | | | <u>8453.70</u> | | <u>8905</u> |
| | | | | | <u>USE \$9,000</u> |

Figure the Cost of pulling, storing and replacing
5 Elm trees at Lock & Dam No 1.

Say procedure is as follows:

- 1) Cut roots at 10 FT radius to 3 FT depth,
say, 3 FT wide trench. Backfill.
- 2) Remove using a Crawler Crane and 2
large front end loaders and a 4 man
labor crew for one day per tree
- 3) Maintain and water during construction period
say 7 man-hours/wk avg.
- 4) Excavate, Return, Replace, same crew as
before, same time.
- 5) Maintain for 6 mo. at 7 man-hr/wk.

- 1) Cut Roots, say 3x3 trench for $3.14 \times 20 = 60$ FT
 $5 \times 3 \times 3 \times 60 / 27 = 100$ cu yds.

Use Backhoe & Operator for 1/2 day due
to tight quarters

| | | | |
|-------|-------|-----------------------------|---------------|
| Labor | 8.90 | $\times 1.002(OT) \times 4$ | 38.55 |
| Equip | 25.00 | $\times 4$ | <u>100.00</u> |
| | | | 138.55 |

Backfill, say 2 hours same as above

69.27
207.82

W/Profit & Overhead 35% 280.55
Use \$ 300.00

- 2) Remove - 5 days - 40 Hrs

Labor

| | | |
|------------|-------|--------------|
| 1 Foreman | 11.00 | 11.00 |
| 3 Equip op | 8.90 | 26.70 |
| 4 Labor | 7.70 | <u>32.80</u> |
| | | 68.50 |

W/OT 1.083 74.19

Equipment: 1 Crane 150 Ton 60.00
2 FEL Cat. 992 160.00

Total All 294.19

W/Profit & OH for 40 Hrs 15,886.26 \$16,000

| | | |
|--|--|--|
| HARZA ENGINEERING COMPANY CHICAGO | SUBJECT <u>Cost Estimate</u> | PROJECT <u>Lock & Dam 1</u> |
| | <u>Landscaping</u> | FILE NO. <u>800 A</u> |
| | COMPUTED <u>GJK</u> CHECKED <u>[Signature]</u> | DATE <u>12/18/74</u> PAGE <u>22</u> OF <u>65</u> PAGES |

3) Maintain - 7 man-hours/wk + materials
for \approx 2 years

Labor: $7 \times 2 \times 52 \times 7.70 \times 1.083 = 6070.00$

Equip: Pump, Hoses $728 \times 1.00 = 728.00$

Materials: Mulch, 3000 SF 524 4 times in
2 year $12000 \text{ SF} \times 0.15$ 1800.00

8598.00

w/ Profit & OH 35% 11607.00

524 \$ 11,700.00

4) Return - same as #2 16,000.00

5) Maintain - 6 mo. $11700/4 \approx$ \$ 3,000.00

Total

\$ 47,000

Use

\$ 30,000

| | | |
|--|--|--|
| HARZA ENGINEERING COMPANY CHICAGO | SUBJECT <u>Cost Estimate</u> | PROJECT <u>Lock & Dam No. 1</u> |
| | <u>Concrete</u> | FILE NO. <u>800 A</u> |
| | COMPUTED <u>JAT</u> CHECKED <u>SMA</u> | DATE <u>3/3/75</u> PAGE <u>23</u> OF <u>65</u> PAGES |

The initial estimates for the various schemes (Jan. 17, 1975) were covered in our "Back-Up Computations" pages 1-21 inclusive. These prices, in some cases were rather carefully calculated, and others were based on bidding experience. Since the cost estimates will influence the selection of a scheme, all of the unit prices should be reviewed. Certain of the prices should be calculated in more detail with respect to prevailing working conditions, rates of production and construction methods which may be used. These notes are intended to cover any items, the unit prices of which may be questionable.

1. Consider all concrete work:

Plans 1 & 4 These plans would be scheduled to be accomplished during 5 winter or near winter months. Weather conditions will slow the production rate. The heated shelter will not cover the discharge or intake manifolds, so that production for these features will be slower and costs higher. Because of weather & the work quantity, Plan 4 could be expected to be the most costly and Plan 1 nearly as costly as Plan 4.

Plan 2 Some of this work will be done in winter and most of it in Summer and Fall. One might expect these concrete costs to be somewhat less than similar work for Plan 1.

Plan 3 Since navigation would be halted, all work could be done in Spring, Summer and Fall for the cheapest price.

| | | |
|--|--|--|
| HARZA ENGINEERING COMPANY CHICAGO | SUBJECT <u>Cast Estimate</u> | PROJECT <u>Lock & Dam No. 1</u> |
| | <u>Concrete</u> | FILE NO <u>800 A</u> |
| | COMPUTED <u>JAT</u> CHECKED <u>SMA</u> | DATE <u>3/9/75</u> PAGE <u>24</u> OF <u>65</u> PAGES |

1. Concrete Work, Cont'd.

Assume that a typical concrete placement crew will consist of the following

| Labor | rate | amt | Shifts | Shift: |
|---|-------|-----------|--------|--------|
| | | | 2@10hr | @ 10 |
| 1 Foreman | 10.35 | 10.35 | | |
| 1 Crane Operator 50% | 9.00 | 9.00 | | |
| 1 Pumpcrete Operator | 7.75 | 7.75 | | |
| 1 Compressor Operator | 7.75 | 7.75 | | |
| 2 Vibrator men | 7.75 | 15.50 | | |
| 1 Form Checker | 8.00 | 8.00 | | |
| 1 Finisher | 8.00 | 8.00 | | |
| 3 Laborers | 7.00 | 21.00 | | |
| Subtotal | | 87.35 | | 87.35 |
| * Shift diff. & Overtime allowance 22.5%: | | 19.65 | 17% | 14.65 |
| Total Labor | | \$ 107.00 | | 102.00 |

Equipment

| | | | |
|-------------------------|-------|---------------|------------------|
| (157) 1 Truck Crane 50% | 13.00 | 6.50 | see ① page 25 |
| 1 Compressor | 9.00 | 9.00 | |
| 1 Pumpcrete | 16.00 | 16.00 | |
| 2 Vibrators | 0.50 | 1.00 | |
| Misc. Tools | | 2.50 | |
| Total Equipment | | \$ 35.00/hour | |

Cost of crew, Labor & Equipment \$ 142.00 or \$ 137.00

Materials

Concrete, ready mix - delivered, use \$ 27.00/cu. yd. (② page 25.)
 Reinforcing steel - use \$ 0.25/lb. (direct cost with mark-up total bid would be \$ 0.39/lb. - including ironworker's time).

Note: Concrete work will be divided into categories with varying rates of production and quantities of reinforcing steel.

* Assume 2@ 10 hr. shifts/day, 6 days/wk

$$\frac{\text{hrs. prod}}{\text{hrs. worked}} = \frac{[(40 \times 1) + (20 \times 1.5)] + [(40 \times 1.1) + (20 \times 1.5 \times 1.1)]}{60 + 60} = 1.225$$

and $(40 + 39) \div 60 = 1.17$ for 1@ 10 hrs/day, 6 days/wk.

| | | |
|--|--|--|
| HARZA ENGINEERING COMPANY CHICAGO | SUBJECT <u>Cost Estimate</u> | PROJECT <u>Lock & Dam No. 1</u> |
| | <u>Concrete</u> | FILE NO. <u>B00 A</u> |
| | COMPUTED <u>JAT</u> CHECKED <u>SM2</u> | DATE <u>3/4/75</u> PAGE <u>25</u> OF <u>65</u> PAGES |

1. Concrete Work, Cont'd

We will figure on 10 hour shifts, 6 days per week.
 Double shift to be used where schedule is tight.
 We have used single shift rates for equipment, even though the double shift rate is somewhat cheaper.
 Under average conditions, the above crew should place from 5 to 7 cu.yds of concrete per hour while actually placing concrete.

From Page 23

Cost for double shift crew = \$142.00/hr

Cost for single shift crew = \$137.00/hr

(Composite for Plan 2 - about \$139.00/hr)

We will assume the following average production rates per crew hour:

- ① (Page 24). Truck Crane, 15 Ton, price from C.E.C.R.G. (Grove TM 15 Ton - \$14.49/hr on 20 hour day.)
- ② (Page 24). Concrete price \$27.00/c.y. for 3000 psi concrete. ENR March 6, 1975 price \$23.50 + 15% heat and waste = \$27.00/c.y.

These averages have been adjusted for the various categories of concrete, job conditions, etc.:

| | cubic yards per hour | | | |
|---------------------------|----------------------|------|------|-----|
| | P L A N No. | | | |
| | 1 | 2 | 3 | 4 |
| New Manifolds & Conduits | 4.25 | 4.5 | 5.5 | 4.0 |
| Slots | 2.0 | 2.0 | 2.0 | 1.7 |
| Fill Gate Slots & Conduit | 8.0 | 10.0 | 10.0 | 7.5 |
| Walls | 6.0 | 8.0 | 10.0 | 5.5 |
| Slabs & Footings | 8.0 | 10.0 | 10.0 | 7.5 |
| Slurry Trench | 8.0 | 8.0 | 8.0 | 7.5 |
| Fill Shear Keys | 6.0 | 8.0 | 8.0 | 5.5 |
| Bridge & Control House | 5.0 | 7.0 | 7.0 | 4.5 |
| Misc. | 2.0 | 2.0 | 2.0 | 1.5 |

| | | |
|--|---------------------------------------|--|
| HARZA ENGINEERING COMPANY CHICAGO | SUBJECT <u>Cost Estimate</u> | PROJECT <u>Lock & Dam No. 1</u> |
| | <u>Concrete</u> | FILE NO. <u>800 A</u> |
| | COMPUTED <u>SMA</u> CHECKED <u>JX</u> | DATE <u>3/6/75</u> PAGE <u>26</u> OF <u>65</u> PAGES |

Tabulation of concrete type volumes.

| | PLAN No. | | | |
|--------------------------------------|--------------|--------------|--------------|---------------|
| | 1 | 2 | 3 | 4 |
| 1. New Manifolds + Conduits | | | | |
| Discharge man. downstr. of land lock | 900 | 900 | 900 | 900 |
| " " " " river " | 900 | 900 | 900 | 1,350 |
| Intake manifold: | | | | |
| Upper guide wall | 800 | 800 | 800 | 800 |
| Land wall | 60 | 60 | 60 | 60 |
| Intermediate wall | 1,100 | 1,100 | 1,100 | 1,650 |
| River wall | 0 | 0 | 0 | 1,100 |
| Discharge manifold: | | | | |
| Lower guide wall | 1,300 | 1,300 | 1,300 | 1,300 |
| Intermediate wall extension | 2,500 | 2,500 | 2,500 | 4,150 |
| River wall extension | 0 | 0 | 0 | 3,000 |
| Other: | | | | |
| Rebuilt ports for land wall | 130 | 130 | 130 | 130 |
| New ports for intermediate wall | 110 | 110 | 110 | 110 |
| Total | 7,800 | 7,800 | 7,800 | 15,110 |
| 2. Slots | | | | |
| New bulkhd. gate slot for land wall | 35 | 35 | 35 | 35 |
| " " " " "interm. " | 35 | 35 | 35 | 70 |
| " " " " "river " | 0 | 0 | 0 | 35 |
| Total | 70 | 70 | 70 | 140 |

| | | |
|--|--|--|
| HARZA ENGINEERING COMPANY CHICAGO | SUBJECT <u>Cost Estimate</u> | PROJECT <u>Lock + Dam No. 1</u> |
| | <u>Concrete</u> | FILE NO. <u>800 A</u> |
| | COMPUTED <u>SMA</u> CHECKED <u>[Signature]</u> | DATE <u>2/6/75</u> PAGE <u>27</u> OF <u>65</u> PAGES |

| | PLAN NO. | | | |
|---------------------------------------|----------|-------|-------|-------|
| | 1 | 2 | 3 | 4 |
| B. Fill Gate Slots + Conduit | | | | |
| Lowered conduit for land wall | 400 | 400 | 400 | 400 |
| Fill gate slot " " " | 40 | 40 | 40 | 40 |
| Existing conduit " " " | 200 | 200 | 200 | 200 |
| Depress cond. cost " " " | 300 | 300 | 300 | 300 |
| Fill exist. gate slot " " " | 300 | 300 | 300 | 300 |
| Lowered conduit for intermediate wall | 400 | 400 | 400 | 800 |
| New fill. gate slot " " " | 40 | 40 | 40 | 80 |
| Existing conduit " " " | 200 | 200 | 200 | 200 |
| Depress cond. cost " " " | 300 | 300 | 300 | 600 |
| Close old ports " " " | 40 | 40 | 40 | 80 |
| Fill exist. gate slots " " " | 300 | 300 | 300 | 600 |
| Lowered conduit for river wall | 0 | 0 | 0 | 400 |
| Fill gate slot " " " | 0 | 0 | 0 | 40 |
| Existing conduit " " " | 0 | 0 | 0 | 200 |
| Depress cond. cost " " " | 0 | 0 | 0 | 300 |
| Conduit ports " " " | 0 | 0 | 0 | 130 |
| Fill exist. gate slots " " " | 0 | 0 | 0 | 300 |
| Total | 2,520 | 2,520 | 2,520 | 4,970 |

| | | |
|--|--|--|
| HARZA ENGINEERING COMPANY CHICAGO | SUBJECT <u>Cost Estimate</u> | PROJECT <u>Lock + Dam No. 1</u> |
| | <u>Concrete</u> | FILE NO. <u>BDD A</u> |
| | COMPUTED <u>SMA</u> CHECKED <u>[Signature]</u> | DATE <u>3/7/75</u> PAGE <u>28</u> OF <u>65</u> PAGES |

| | PLAN NO. | | | |
|----------------------------------|----------|-------|-------|-------|
| | 1 | 2 | 3 | 4 |
| 4. Walls | | | | |
| River guide wall monolith | 0 | 0 | 0 | 370 |
| Total | 0 | 0 | 0 | 370 |
| 5. Slabs + Footings | | | | |
| Upstream apron slab (2' thick) | 1,400 | 1,400 | 1,400 | 1,400 |
| Land wall footings | 14 | 14 | 14 | 14 |
| Repair of concrete surfaces | 900 | 900 | 900 | 900 |
| Total | 2,314 | 2,314 | 2,314 | 2,314 |
| 6. Slurry trench | | | | |
| Discharge manifold slurry trench | 180 | 180 | 180 | 260 |
| Total | 180 | 180 | 180 | 260 |
| 7. Fill shear Keys | | | | |
| Intermediate wall (reinforced) | 26 | 26 | 26 | 26 |
| River wall | 0 | 26 | 0 | 26 |
| Total | 26 | 52 | 26 | 52 |

| | | |
|--|---------------------------------------|--|
| HARZA ENGINEERING COMPANY CHICAGO | SUBJECT <u>Cost Estimate</u> | PROJECT <u>Lock & Dam No. 1</u> |
| | <u>Concrete</u> | FILE NO. <u>800 A</u> |
| | COMPUTED <u>SMA</u> CHECKED <u>JK</u> | DATE <u>3/7/75</u> PAGE <u>29</u> OF <u>65</u> PAGES |

| | PLAN NO. | | | |
|---------------------------------|----------|--------|--------|--------|
| | 1 | 2 | 3 | 4 |
| B. Bridge & Control House | | | | |
| Bridge & elevator | 220 | 220 | 220 | 220 |
| Control house | 400 | 400 | 400 | 230 |
| Total | 620 | 620 | 620 | 450 |
| P. Miscellaneous | | | | |
| Dead men | 20 | 20 | 20 | 20 |
| Land wall cribbing | 20 | 20 | 20 | 20 |
| Cable trenches for land wall | 7 | 7 | 7 | 7 |
| Mooring bits " " " | 140 | 140 | 140 | 140 |
| Cable trenches for interm. wall | 7 | 7 | 7 | 14 |
| " " " river " | 0 | 0 | 0 | 7 |
| Fill inclined shaft in dam | 15 | 15 | 15 | 15 |
| Total | 209 | 209 | 209 | 223 |
| TOTAL OF ALL CONCRETE | 13,739 | 13,765 | 13,559 | 23,899 |

| | | |
|--|---|--|
| HARZA ENGINEERING COMPANY CHICAGO | SUBJECT <u>Cast Estimate</u> | PROJECT <u>Lock & Dam No. 1</u> |
| | <u>Concrete</u> | FILE NO. <u>800 A</u> |
| | COMPUTED <u>SMA</u> CHECKED <u>[initials]</u> | DATE <u>3/7/75</u> PAGE <u>30</u> OF <u>65</u> PAGES |

Computation of Average Productivity

| WORK TYPE | PLAN NO. | | | |
|------------------------------|----------|-------|-------|--------|
| | 1 | 2 | 3 | 4 |
| 1. New Manifolds & Conduits | | | | |
| yd ³ /hr | 4.25 | 4.5 | 5.3 | 4.0 |
| yd ³ | 7,800 | 7,800 | 7,800 | 15,110 |
| crew hours | 1,835 | 1,733 | 1,472 | 3,777 |
| 2. Slots | | | | |
| yd ³ /hr | 2.0 | 2.0 | 2.0 | 1.7 |
| yd ³ | 70 | 70 | 70 | 140 |
| crew hours | 35 | 35 | 35 | 82 |
| 3. Fill Gate Slots & Conduit | | | | |
| yd ³ /hr | 8.0 | 10.0 | 10.0 | 7.5 |
| yd ³ | 2,520 | 2,520 | 2,520 | 4,970 |
| crew hours | 315 | 252 | 252 | 663 |
| 4. Walls | | | | |
| yd ³ /hr. | 6.0 | 8.0 | 10.0 | 5.5 |
| yd ³ | 0 | 0 | 0 | 370 |
| crew hours | 0 | 0 | 0 | 67 |
| 5. Slabs & Footings | | | | |
| yd ³ /hr. | 8.0 | 10.0 | 10.0 | 7.5 |
| yd ³ | 2,314 | 2,314 | 2,314 | 2,314 |
| crew hours | 289 | 231 | 231 | 309 |
| 6. Slurry Trench | | | | |
| yd ³ /hr. | 8.0 | 8.0 | 8.0 | 7.5 |
| yd ³ | 180 | 180 | 180 | 260 |
| crew hours | 22 | 22 | 22 | 35 |
| 7. Fill Shear Keys | | | | |
| yd ³ /hr. | 6.0 | 8.0 | 8.0 | 4.5 |
| yd ³ | 26 | 52 | 26 | 52 |
| crew hours | 4 | 7 | 3 | 12 |

| | | |
|--|--|--|
| HARZA ENGINEERING COMPANY CHICAGO | SUBJECT <u>Cost Estimate</u> | PROJECT <u>Lock & Dam No. 1</u> |
| | <u>Concrete</u> | FILE NO. <u>800 A</u> |
| | COMPUTED <u>SMA</u> CHECKED <u>JAT</u> | DATE <u>2/7/75</u> PAGE <u>31</u> OF <u>65</u> PAGES |

| WORK TYPE | PLAN NO. | | | |
|--|----------|--------|--------|--------|
| | 1 | 2 | 3 | 4 |
| 8. Bridge & Control House | | | | |
| yd ³ /hr | 50 | 7.0 | 7.0 | 4.5 |
| yd ³ | 620 | 620 | 620 | 450 |
| crew hours | 124 | 89 | 89 | 106 |
| 9. Miscellaneous | | | | |
| yd ³ /hr. | 2.0 | 2.0 | 2.0 | 1.5 |
| yd ³ | 209 | 209 | 209 | 223 |
| crew hours | 105 | 105 | 105 | 147 |
| TOTAL CREW HOURS | 2,729 | 2,474 | 2,209 | 5,194 |
| TOTAL CONCRETE (yd ³) | 13,739 | 13,765 | 13,559 | 23,889 |
| AVG. PRODUCTIVITY (yd ³ /crew hour) | 5.03 | 5.56 | 6.13 | 4.59 |
| | 5.0 | 5.6 | 6.1 | 4.6 |

These weighted averages are reasonable

| | | |
|--|------------------------------|--|
| HARZA ENGINEERING COMPANY CHICAGO | SUBJECT <u>Cost Estimate</u> | PROJECT <u>Lock & Dam No. 1</u> |
| | <u>Concrete</u> | FILE NO. <u>800 A</u> |
| COMPUTED <u>JAT</u> | CHECKED <u>SMH</u> | DATE <u>3/7/75</u> PAGE <u>32</u> OF <u>65</u> PAGES |

Concrete Work, Cont'd

Plan 1. About 13,740 cu.yds. of concrete. (all double shift)

| Description | ① cu.yds. placed per hr. | ② Concrete at site per cu.yd. | ③ Place, Vibrated & Finish | ④ Re-Steel @ \$0.25 per lb. | ⑤ Total Direct cost | ⑥ Price per cu.yd. w/ Profit & c. (rounded) |
|----------------------------|-----------------------------------|--|-------------------------------------|--------------------------------------|------------------------------|---|
| New Manifolds & Conduits | 4.25 | 27.00 | 142.00 | 85.00 | 80.41 | 125.00 |
| Gate Slots | 2.0 | 27.00 | 142.00 | 40.00 | 118.00 | 185.00 |
| Fill Gate Slots & Conduits | 8.0 | 27.00 | 142.00 | 60.00 | 52.25 | 80.00 |
| Walls | 6.0 | 27.00 | 142.00 | 45.00 | 58.16 | 90.00 |
| Slabs & Footings | 8.0 | 27.00 | 142.00 | 120.00 | 59.75 | 95.00 |
| In Slurry Trench | 8.0 | 27.00 | 142.00 | 60.00 | 52.25 | 80.00 |
| Fill Shear Keys | 6.0 | 27.00 | 142.00 | 150.00 | 75.66 | 115.00 |
| Bridge & Control House | 5.0 | 27.00 | 142.00 | 220.00 | 99.40 | 155.00 |
| Misc | 2.0 | 27.00 | 142.00 | 80.00 | 138.00 | 215.00 |

Plan 2 About 13,770 cu.yds. of concrete (30% double shift and 70% single shift.)

| | | | | | | |
|----------------------------|------|-------|--------|--------|--------|--------|
| New Manifolds & Conduits | 4.5 | 27.00 | 139.00 | 90.00 | 77.88 | 120.00 |
| Gate Slots | 2.0 | 27.00 | 139.00 | 40.00 | 116.50 | 180.00 |
| Fill Gate Slots & Conduits | 10.0 | 27.00 | 139.00 | 75.00 | 48.40 | 75.00 |
| Walls | 8.0 | 27.00 | 139.00 | 60.00 | 51.87 | 80.00 |
| Slabs & Footings | 10.0 | 27.00 | 139.00 | 150.00 | 55.90 | 85.00 |
| In Slurry Trench | 8.0 | 27.00 | 139.00 | 60.00 | 51.87 | 80.00 |
| Fill Shear Keys | 8.0 | 27.00 | 139.00 | 200.00 | 69.37 | 110.00 |
| Bridge & Control House | 7.0 | 27.00 | 139.00 | 308.00 | 90.85 | 140.00 |
| Misc. | 2.0 | 27.00 | 139.00 | 80.00 | 136.50 | 210.00 |

$$\textcircled{5} = \left[\left[\textcircled{1} \times \textcircled{2} \right] + \textcircled{3} + \textcircled{4} \right] \div \textcircled{1}$$

$$\textcircled{6} = 1.35 \times 1.15 \times \textcircled{5}$$

| | | |
|--|--|---|
| HARZA ENGINEERING COMPANY CHICAGO | SUBJECT <u>Cost Estimate</u> | PROJECT <u>Lock & Dam No. 1</u> |
| | <u>Concrete</u> | FILE NO <u>800 A</u> |
| | COMPUTED <u>JAT</u> CHECKED <u>SMA</u> | DATE <u>3/7/75</u> PAGE <u>33</u> OF <u>65</u> PAGE |

Concrete Work, Cont'd

Plan 3 About 13,560 cu.yds. of concrete (all single shift

| | cu.yds placed per hr | Concrete at site per cu.yd. | Place, Vibrate and Finish | Re Steel @ \$0.25 per lb. | Total Direct Cost | Price per cu. yd. w/profit & G.H. & escal (founder) |
|----------------------------|----------------------------|--------------------------------------|------------------------------------|---------------------------------|-------------------------|--|
| New Manifolds & Conduits | 5.3 | 27.00 | 137.00 | 106.00 | 72.84 | 115.00 |
| Gate Slots | 2.0 | 27.00 | 137.00 | 40.00 | 115.50 | 180.00 |
| Fill Gate Slots & Conduits | 10.0 | 27.00 | 137.00 | 75.00 | 48.20 | 75.00 |
| Walls | 10.0 | 27.00 | 137.00 | 75.00 | 48.20 | 75.00 |
| Slabs & Footings | 10.0 | 27.00 | 137.00 | 150.00 | 55.70 | 85.00 |
| In Slurry Trench | 8.0 | 27.00 | 137.00 | 60.00 | 51.62 | 80.00 |
| Fill Shear Keys | 8.0 | 27.00 | 137.00 | 200.00 | 69.12 | 105.00 |
| Bridge & Control House | 7.0 | 27.00 | 137.00 | 308.00 | 90.57 | 140.00 |
| Misc. | 2.0 | 27.00 | 137.00 | 80.00 | 135.50 | 210.00 |

Plan 4 About 23,890 cu.yds. of concrete (all double shift,

| | | | | | | |
|----------------------------|-----|-------|--------|--------|--------|--------|
| New Manifolds & Conduits | 4.0 | 27.00 | 142.00 | 80.00 | 82.50 | 130.00 |
| Gate Slots | 1.7 | 27.00 | 142.00 | 34.00 | 130.52 | 200.00 |
| Fill Gate Slots & Conduits | 7.5 | 27.00 | 142.00 | 56.00 | 53.40 | 85.00 |
| Walls | 5.5 | 27.00 | 142.00 | 41.00 | 60.27 | 95.00 |
| Slabs & Footings | 7.5 | 27.00 | 142.00 | 115.00 | 61.00 | 95.00 |
| In Slurry Trench | 7.5 | 27.00 | 142.00 | 56.00 | 53.40 | 85.00 |
| Fill Shear Keys | 5.5 | 27.00 | 142.00 | 138.00 | 77.90 | 120.00 |
| Bridge & Control House | 4.5 | 27.00 | 142.00 | 198.00 | 102.55 | 160.00 |
| Misc. | 1.5 | 27.00 | 142.00 | 60.00 | 161.66 | 250.00 |

| | | |
|--|--|--|
| HARZA ENGINEERING COMPANY CHICAGO | SUBJECT <u>Cost Estimate</u> | PROJECT <u>Lock & Dam No. 1</u> |
| | <u>Sand Fill in Main Dam</u> | FILE NO. <u>800 A</u> |
| | COMPUTED <u>JAT</u> CHECKED <u>SMA</u> | DATE <u>3/6/75</u> PAGE <u>84</u> OF <u>65</u> PAGES |

Cost of Pumping Sand Into Main Dam Cavity.

(Originally this was planned as lean concrete)

a) Work consists of clearing each 6" ϕ relief hole by hand excavation inside of dam, then place wire mesh against opening and fill (2 \pm cu. ft.) of gravel to provide drainage after sand is pumped in.

2 per 16' bay = 72 holes

Assume 6 holes per 8 hr day, Total hrs = 96
Use 100 hrs

Labor

| | | |
|------------|--------------|---------------------|
| Foreman | 8.40 | |
| 3 laborers | 21.00 | |
| | <u>29.40</u> | $\times 8 = 235.20$ |

Equipment

| | | |
|--------------------|------|--------------------|
| Wheel barrow, etc. | 2.00 | $\times 8 = 16.00$ |
|--------------------|------|--------------------|

Mat'l

| | | |
|--|-------------|-------------|
| Gravel | 4.00 | |
| 195 \square Screen $\frac{1}{2}$ " mesh (0.35) | 4.72 | |
| Mat'l | <u>8.72</u> | <u>8.72</u> |

| | |
|-------------------------------|---------------------|
| Total = Per day | 259.92 |
| $(259.92 \div 6) \times 72 =$ | \$3,119 direct cost |

b) Fill in by pumping 5000 cu. yds. of mixture of sand and water, use pump similar to pumpcrete capable of 25 cu. yds/hr. With delays figure job can be done at average of 15 cu. yds/hr or say 320 hours. Assume sand can be dumped onto draft tube deck by truck @ \$6.00/cu. yd. Small (Bobcat) dozer will move material to small mixer where sand is mixed with water pumped from tailrace. Mixture then pumped into dam through 6 inch pipe.

| | | |
|--|--|---|
| HARZA ENGINEERING COMPANY CHICAGO | SUBJECT <u>Cost Estimate</u> | PROJECT <u>Lock & Dam No. 1</u> |
| | <u>Sand Fill in Main Dam</u> | FILE NO. <u>500 A</u> |
| | COMPUTED <u>JAT</u> CHECKED <u>SMA</u> | DATE <u>3/6/75</u> PAGE <u>35</u> OF <u>65</u> FIGURE |

Cost of Pumping Sand Into Main Dam Cavity

Cost

Labor

| | |
|-----------------------|--------------|
| Foreman | 10.50 |
| Dozer (Bibicat) Oper. | 8.70 |
| Water Pump Oper | 7.75 |
| Mixer Oper | 7.75 |
| Pump Oper | 7.75 |
| 4 Laborers | <u>28.00</u> |
| Labor / hr | 70.45 |

Equipment

| | |
|---------------|--------------|
| Dozer | 5.00 |
| Pumps & mixer | <u>30.00</u> |
| Equip / hr | 35.00 |

Materials

| | |
|-------------------|-------------|
| Sand 15 cy @ 6.00 | 90.00 |
| Pipe rental | <u>3.00</u> |
| Mat'l / hr | 93.00 |

Total per hour 198.45

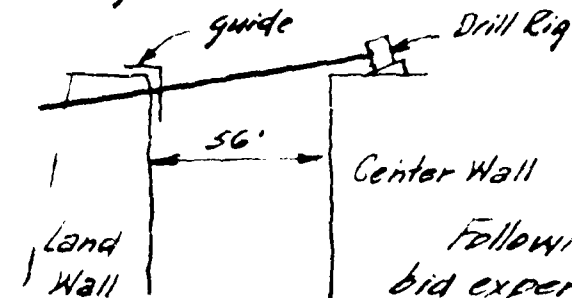
$$[(198.45 \times 320) + 3119] \times 1.35 \times 1.15 = \$103,432$$

$$\text{Per cu. yd. } (\div \text{ by } 5,000) = \$20.68$$

Say \$21.00 / cu. yd.

| | | |
|--|--|--|
| HARZA ENGINEERING COMPANY CHICAGO | SUBJECT <u>Cost Estimate</u> | PROJECT <u>Lodge & Dam No. 1</u> |
| | <u>Rock Anchors</u> | FILE NO <u>800 A</u> |
| | COMPUTED <u>JAT</u> CHECKED <u>SMA</u> | DATE <u>3/6/75</u> PAGE <u>36</u> OF <u>65</u> PAGES |

Cost of Rock Anchors for Stabilization of Land Wall



Following prices are either from bid experience or worked out.

Alt. 1 (1 3/8" single anchors)

a) Setup drill - 6 hrs

Labor

1 Driller 8.00 8.00

2 Helpers 7.00 14.00

22.00/hr x 6 = 132.00

Place guide, and support
for drill rig. L.S.

100.00
232.00

$232 \times 1.35 \times 1.15 = \$ 360.18$

To allow for moving drill to center wall and removal of guides and supports, use per setup \$ 400.00

b) Drilling Holes

Drill & Crew costs about \$ 30.00/hr

Use 5 ft/hr for drilling

$\frac{30 \times 1.35 \times 1.15}{5} = \$ 10.00 / \text{lin. ft.}$

c) for Core Recovery use \$ 10.00 / lin. ft.

| | | |
|--|--|--|
| HARZA ENGINEERING COMPANY CHICAGO | SUBJECT <u>Cost Estimate</u> | PROJECT <u>Lock & Dam No. 1</u> |
| | <u>Rock Anchors</u> | FILE NO <u>800 A</u> |
| | COMPUTED <u>JAT</u> CHECKED <u>SMA</u> | DATE <u>3/6/75</u> PAGE <u>37</u> OF <u>65</u> PAGES |

Cost of Rock Anchors, Cont'd.

d) Place Grout & tension Anchor Bars
 Figure total time per Anchor @ 8 hrs

Labor

| | |
|-----------------|-------------------|
| Foreman | 10.50 |
| Welder 50% | 4.50 |
| Grout Pump Oper | 8.00 |
| 3 Laborers | 21.00 |
| | <u>\$44.00/hr</u> |

Equipment

| | |
|------------------------------------|-----------------|
| Grout Pump, Welding Equip. & Misc. | 15.00 |
| Labor & Equip | 8 x 59.00 = 472 |

Material

| | |
|------------------------------|--------------|
| 90' of bar with fittings | 160.00 |
| Grout 44 cu.ft. @ 2.00 (384) | <u>10.00</u> |
| Material/hole | 170.00 |
| | <u>170</u> |
| | 642 |

$$\frac{642 \times 1.35 \times 1.15}{90} = 11.07$$

Use \$11.00 / lin. ft.

Alt. 2 1 1/2" Double Anchors

a) Set up - same as Alt. 1 = \$400.00

b) Drilling Hole 4"

Production might be slightly slower than Alt. 1.
 Use \$12.00 / lin. ft.

c) Core Recovery, Same as Alt. 1 \$10.00 / lin. ft.

| | | |
|--|------------------------------|---|
| HARZA ENGINEERING COMPANY CHICAGO | SUBJECT <u>Cost Estimate</u> | PROJECT <u>Lock & Dam No. 1</u> |
| | <u>Rock Anchors</u> | FILE NO <u>Sec A</u> |
| COMPUTED <u>JAT</u> | CHECKED <u>SMA</u> | DATE <u>9/27/75</u> PAGE <u>38</u> OF <u>65</u> PAGES |

Cost of Rock Anchors Cont'd.
Alt. 2, Cont'd (1 1/2" Double Anchors)

d. Place, Grout & Tension Anchor Bars
Figure time for 2 @ 95' bars @ 10 hrs

Labor (Alt. 1) $44.00 \times 10 = 440.00$
 Equipment $15.00 \times 10 = 150.00$
 Bars
 $95 \times 2 \times 4.172 @ \$0.35 = 277.43$
 Grout 8.3 cu.ft. @ \$2.00 $\frac{16.60}{294.03 \text{ say } 300.00}$
 Total $890 \times 1.35 \times 1.15 = \14.54
 95

Use \$15.00/lin.ft.

Alt. 3 1 1/2" Triple Anchors

a) Set up - same as Alt. 1 & Alt. 2 \$400.00

b) Drill 5" hole

Use 3'/hr. same hourly cost

as Alt. 1

$30 \times 1.35 \times 1.15 = \15.52 use \$16.00/ft.

3

c) Core Recovery use \$10.00/ft.

d) Place, Grout & Tension Anchor Bars

Figure 3 @ 100 bars @ 14 hrs

Labor (Alt. 1 & 2) $44.00 \times 14 = 616.00$

Equipment $15.00 \times 14 = 210.00$

Bars $3 \times 100 \times 4.172 \times \$0.35 = 438.00$

Grout 13.66 cu.ft. @ \$2.00 $\frac{27.32}{\$465.32}$

$\frac{465.00}{\$1291.00}$

$1291 \times 1.35 \times 1.15 = \20.00

100

Use \$20.00/lin.ft.

| | | |
|--|--|---|
| HARZA ENGINEERING COMPANY CHICAGO | SUBJECT <u>Cost Estimate</u> | PROJECT <u>Lock & Dam No. 1</u> |
| | <u>Shear Keys</u> | FILE NO <u>800 A</u> |
| | COMPUTED <u>JAT</u> CHECKED <u>SMA</u> | DATE <u>3/25/75</u> PAGE <u>39</u> OF <u>65</u> PAGES |

Compute costs of Shear Keys

a) Drilling, Vertical Holes - use rotary drill.

| Costs | <u>While Drilling</u> (Equip. Dep. & Op.) | <u>While Setting Up</u> (Equip. Dep.) |
|------------------|--|--|
| Labor | | |
| 1 Foreman | 10.35 | 10.35 |
| 1 Drill Operator | 9.00 | 9.00 |
| 2 Helpers | 7.00 | 7.00 |
| 1 Pump operator | <u>7.75</u> | <u>7.75</u> |
| Subtotal | 34.10 | 34.10 |
| 17% S.D. & D.T. | <u>5.90</u> | <u>5.90</u> |
| Labor per Hr. | 40.00 | 40.00 |

| | | |
|--------------|-------------|-------|
| Equipment | | |
| 1 Drill | 35.00 | 15.00 |
| 1 Pump | 5.00 | 1.00 |
| Bit cost | <u>5.00</u> | - |
| Equipment/hr | 45.00 | 16.00 |

| | | |
|-------------------------------------|--------------|--------------|
| Total Per Hr | 85.00 | 56.00 |
| w/35% Profit & O.H. + 15% escal. | <u>47.00</u> | <u>31.00</u> |
| Total/Hr | \$132.00 | \$87.00 |

Production 1 ft/hr avg. \$132.00/lin.ft.
Use \$140.00/lin.ft.

Setup time incl. move in &
move out, average 3 hrs

Cost of move & set-up 384 \$250.00

| | | |
|--|--|---|
| HARZA ENGINEERING COMPANY CHICAGO | SUBJECT <u>Cost Estimate</u> | PROJECT <u>Lock & Dam No. 1</u> |
| | <u>Shear Keys</u> | FILE NO <u>800A</u> |
| | COMPUTED <u>JAT</u> CHECKED <u>SMA</u> | DATE <u>3/25/75</u> PAGE <u>40</u> OF <u>65</u> PAGES |

Shear Keys, Cont'd.

b) Drilling Horizontal Holes use - jackhammers

The drilling will be done from moveable scaffolding. Hole pattern will be drilled such that inner core of concrete can be removed with out blasting.

This will involve considerable drilling. The opening desired should be equivalent of 2' ϕ hole or 3" could be square of say 22". Figure cost one opening which will require about
6' x 11' x 4' = 264 lin.ft. to drill

Assume avg. production @ 1/2' / minute; Total drill time 8.8 hrs. At 75% efficiency use 12 hrs. for drill time only.

Scaffolding would be moveable and required for other operations as well, such as well clean up, shotcrete, etc. Prices for these items are considered high enough to includes scaffolding which would cost say about \$2,500.00 per well surface, or about \$10,000.00 for the job, on a rental basis.

Drill one opening & remove material

Labor $[(1.7 \times 1.7 \times 6) = 27] = \text{about } 0.7 \text{ cu.yd.}$

| | |
|---------------|-------|
| Foreman | 9.30 |
| 1 driller | 7.75 |
| 1 helper | 7.00 |
| 1 compr. oper | 7.75 |
| Subtotal | 31.80 |
| 17% SD & OT | 5.40 |

$$37.20 \times 12 = 446.40$$

$$\text{Equipment } 10.00 \times 12 = 120.00$$

remove 0.7 cu.yd @ 5.00

$$3.50$$

$$\$ 569.90$$

W/35% Profit & Overhead & 15% escalation

$$\$ 883/\text{opening}$$

| | | |
|--|--|---|
| HARZA ENGINEERING COMPANY CHICAGO | SUBJECT <u>Cost Estimate</u> | PROJECT <u>Lock & Dam No. 1</u> |
| | <u>Shear Keys - Vents</u> | FILE NO <u>800 A</u> |
| | COMPUTED <u>JAT</u> CHECKED <u>SMR</u> | DATE <u>3/25/75</u> PAGE <u>41</u> OF <u>65</u> PAGES |

Shear keys

Cost of one horizontal hole = \$ 883.00
(this does not include scaffolding)

We have 16 holes.

Assume 30% of scaffolding rent is
charged to these holes

$$\frac{.30 \times 10,000}{16} = 187.50$$

Total/hole \$ 1,070.50

Cost per hole, use \$ 1200.00

or \$ 200.00/lin. ft. for excavation

Enlarge Vent system

Set up over hole - Page 3B of 63 \$ 250.00

Drill 3'-0" dia hole

Assuming .85'/hr - Page 3B of 63 \$ 165.00

Pipe @ 75¢/lb

Misc. Connections, etc use 10% of pipe cost

for excavation and backfill use \$ 10.00/c.y.

ESTIMATE

HARZA ENGINEERING COMPANY
CHICAGO, ILLINOISProject Rehabilitation of Lock and Dam No. 1 Date Nov. 1975 Page 42 of 65 Pages
Structure Discharge Manifolds with Stilling Basin East of River Wall Estimated by JAT/VT Checked by VT

| Item No. | ITEM | Quantity | Unit Price | Amount |
|----------|---|--------------|------------|---------|
| | <u>PLAN No. 4A</u> | | | \$ U.S. |
| | Removal of Slab and Apron; Pg. 5 of 20 of Estimate | | | 72400 |
| | Lower Guide Wall; Pg. 5 of 20 of Estimate (Unit price of concrete revised from Plan No. 1 to Plan No. 4) | | | 249250 |
| | Laterals Downstream of Landward Lock; Pg. 6 of 20 of Estimate (Unit price of concrete revised from Plan No. 1 to Plan No. 4) | | | 206935 |
| | Intermediate Wall Extension; Pg. 6 of 20 of Estimate (Unit price of concrete revised from Plan No. 1 to Plan No. 4) | | | 310900 |
| | Laterals Downstream of Riverward lock; Pg. 7 of 20 of Estimate (Unit price of concrete revised from Plan No. 1 to Plan No. 4) | | | 215120 |
| | Subtotal | | | 1054605 |
| | <u>Stilling Basin</u> | | | |
| | Excavation, Alluvium | 2,000 c.y. | 65.00 | 6000 |
| | Remove Concrete Slab | 130 c.y. | 65.00 | 8450 |
| | Gravel Filter | 150 c.y. | 13.50 | 2025 |
| | Concrete Slabs | 175 c.y. | 95.00 | 16625 |
| | Concrete Walls | 360 c.y. | 130.00 | 46800 |
| | Forms, Straight | 9,000 sq.ft. | 3.00 | 27000 |
| | Riprap | 200 c.y. | 16.50 | 3300 |
| | Subtotal Stilling Basin | | | 110200 |
| | <u>Discharge Channel</u> | | | |
| | Excavation, Alluvium | 7,500 c.y. | 3.00 | 22500 |
| | <u>Additional Cofferdam</u> | | | |
| | Steel Sheet Piling | 50 tons | 600.00 | 30000 |
| | Cell Fill | 500 c.y. | 13.50 | 6750 |
| | Rock Protection, Flow Side | 100 c.y. | 20.50 | 2050 |
| | Subtotal Additional Cofferdam | | | 38800 |
| | Subtotal Discharge Manifolds with Stilling Basin | | | 1226105 |

ESTIMATE

HARZA ENGINEERING COMPANY
CHICAGO, ILLINOIS

Project Rehabilitation of Lock and Dam No. 1 Date Nov. 1975 Page 43 of 65 Pages
Structure Discharge Manifolds with Bent Discharge Structure East of River Wall Estimated by JAT/VT Checked by VT

| Item No. | ITEM | Quantity | Unit Price | Amount |
|----------|---|----------------|------------|-----------|
| | <u>PLAN No. 4B</u> | | | \$ U.S. |
| | Removal of Slab and Apron; Pg. 5 of 20 of Estimate | | | 72 400 |
| | Lower Guide Wall; Pg. 5 of 20 of Estimate (Unit price of concrete revised from Plan No. 1 to Plan No. 4) | | | 249 250 |
| | Laterals Downstream of Landward Lock; Pg. 6 of 20 of Estimate (Unit price of concrete revised from Plan No. 1 to Plan No. 4) | | | 206 935 |
| | Intermediate Wall Extension; Pg. 6 of 20 of Estimate (Unit price of concrete revised from Plan No. 1 to Plan No. 4) | | | 310 900 |
| | Laterals Downstream of Riverward Lock; Pg. 7 of 20 of Estimate (Unit price of concrete revised from Plan No. 1 to Plan No. 4) | | | 215 120 |
| | Subtotal | | | 1 054 605 |
| | <u>Discharge Structure East of River Wall</u> | | | |
| | Excavation, Alluvium | 1,500 c.y. | 3.00 | 4 500 |
| | Remove Concrete Slab | 130 c.y. | 65.00 | 8 450 |
| | Gravel Filter | 150 c.y. | 13.50 | 2 025 |
| | Concrete Slabs | 350 c.y. | 95.00 | 33 250 |
| | Concrete Walls | 800 c.y. | 130.00 | 104 000 |
| | Forms, Straight | 11,000 sq. ft. | 3.00 | 33 000 |
| | Forms, Curved | 200 sq. ft. | 6.00 | 1 200 |
| | Riprap | 250 c.y. | 16.50 | 4 125 |
| | Subtotal Discharge Structure | | | 190 550 |
| | <u>Discharge Channel</u> | | | |
| | Excavation, Alluvium | 6,200 c.y. | 3.00 | 18 600 |
| | <u>Additional Cofferdam</u> | | | |
| | Steel Sheet Piling | 50 tons | 600.00 | 30 000 |
| | Cell Fill | 500 c.y. | 13.50 | 6 750 |
| | Rock Protection, Flow Side | 100 c.y. | 20.50 | 2 050 |
| | Subtotal Additional Cofferdam | | | 38 800 |
| | <u>Total Discharge Manifolds with Bent Discharge Structure East of River Wall</u> | | | 1 302 555 |

ESTIMATE

HARZA ENGINEERING COMPANY
CHICAGO, ILLINOIS

Project Rehabilitation of Lock and Dam No. 1 Date Nov. 1975 Page 44 of 65 Pages

Structure Reconstruction of Extension of River Wall Estimated by JAT/VT Checked by VT

| Item No. | ITEM | Quantity | Unit Price | Amount |
|----------|-------------------------------|----------------------------|------------|----------------|
| | <u>PLANS NOS. 4A & 4B</u> | | | <u>\$ U.S.</u> |
| | Remove Rockfill Dike | 1,800 c.y. | 4.50 | 8,100 |
| | Remove Mass Concrete | 400 c.y. | 65.00 | 26,000 |
| | Remove Timber Cribs | 850 c.y. | 9.00 | 7,650 |
| | Place New Timber Piles | 2,000 lin.ft. | 6.00 | 12,000 |
| | Trim Timber Piles | 94 ea. | 3.00 | 282 |
| | Reconstruct Timber Cribs | 850 + 350 = 1,200 c.y. | 15.00 | 18,000 |
| | Concrete | 400 c.y. | 95.00 | 38,000 |
| | Forms, Straight | 3,000 sq.ft. | 3.00 | 9,000 |
| | Reconstruct Rockfill Dike | 1,800 + 1,200 = 3,000 c.y. | 5.00 | 15,000 |
| | <u>Subtotal</u> | | | <u>134,032</u> |
| | | | <u>USE</u> | <u>135,000</u> |

HARZA ENGINEERING COMPANY
CHICAGO, ILLINOIS
ESTIMATE

Project REHABILITATION LOCK AND DAM #1 Date MARCH 1975 Page
Structure REPAIR OF CONCRETE SURFACES Estimated by RPH

| Item No. | ITEM | PLAN NO 1 | | | PLAN Quantity |
|----------|---------------------------------|----------------------------|------------|---------|------------------|
| | | Quantity | Unit Price | Amount | |
| | REPAIR OF CONCRETE SURFACES | | | | |
| | WITHOUT WALL ARMOR | | | | |
| 1. | CONCRETE REMOVAL | 1650 CY | 65.00 | 107 250 | |
| 2. | SHOTCRETE | 1150 CY | 175.00 | 201 250 | |
| 3. | CONCRETE (W/OT REINF. STEEL) | 500 CY | 80.00 | 40 000 | |
| 4. | PRECAST PANELS | 220 CY | 202.00 | 44 400 | |
| 5. | FORMWORK | 9000 SF | 3.00 | 27 000 | |
| 6. | BEDDING (PER GRAVEL) | 150 CY 220 TONS | 11.50 | 1 725 | |
| 7. | REPAIR CRACKS | 250 LF | 4.00 | 1 000 | |
| 8. | EPXY GROUT | 50 GAL | 25.00 | 1 250 | |
| 9. | ROCK BOLTS FOR MESH | 3120 LF | 6.00 | 18 720 | |
| 10. | REINFORCEMENT (REPAIR AND MESH) | 75000 LBS | 0.40 | 30 000 | |
| 11. | UPPER PROTECTION ANGLE | 126,000 LBS | 1.00 | 126 000 | |
| 12. | WALL ARMOR | | | | |
| 13. | ANCHOR BARS 4' | 3100 LBS | 1.75 | 5 425 | |
| 14. | ANCHORS 3/4" Ø X 1' | 3500 LBS | 2.00 | 7 000 | |
| 15. | JOINT SEALER | 11,000 LF | 3.00 | 33 000 | |
| | Total | | | 443 770 | |
| | | | Use | 443 000 | |

1

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CHICAGO

SUBJECT Feasibility of Lock
Winter Rehabilitation
COMPUTED SMH CHECKED _____

PROJECT Lock & Dam No. 1
FILE NO 225 A
DATE 5/24/75 PAGE 46 OF 65 PAGES

The lock rehabilitation, for any of the four plans considered, involves work in five primary locations:

1. Lock interior - floor and walls
2. Culvert interiors
3. Ends of locks - miter gates, valves
4. Upstream of lock - intake manifold
5. Downstream of lock - discharge manifold

The last three of these areas involve work which can, using the assumed crew sizes shown in the computations, be easily accomplished during the 5 month winter construction period required by plans 1 and 4. The first two locations appear to require close supervision and planning in order to meet the desired schedule. In considering the feasibility of this winter work, the following sequences of events were arrived at as a means of completing the required work in the allotted time.

1. Lock Interior

clean surfaces

inspect concrete and repair lock floor

bore and fill grout holes

drill orifice holes

removal wall vertical face concrete

remove concrete for new orifices; clean up loose

install req'd wall reinforcement + shotcrete

reinforce, form, + pour new conduit orifices + plug old orifices

strip forms + clean up

This sequence of events would be accomplished with crew sizes chosen so that each major activity, would proceed at the same rate. In this way, a

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SUBJECT Feasibility of
Lock Winter Rehabilitation
COMPUTED SMA CHECKED _____

PROJECT Lock & Dam No. 1
FILE NO. 300 A
DATE 2/24/75 PAGE 47 OF 65 PAGES

steady flow of work could be maintained, with each task following the one preceding it around the lock. A consequence of this sort of scheduling is that the demand for manpower would be less variable. The manpower curve computed on the basis of the rough CPM diagram represents a pessimistic picture of actual fluctuations to be expected, since it does not consider the refined flow of activities described above. However, since some levelling of peaks in the manpower curve has already occurred in the computations (through the use of 'avg. weekly crew sizes', which consider a one-day crew of 6 equivalent to a one-week crew of 1), the manpower curve will be presented unmodified.

2. Culvert Interiors

drill & fill grout holes; drill orifice holes
cut break lines in culvert ceiling
remove culvert ceiling concrete
drill enlarged vent openings
install & grout vent pipes
install ceiling reinforcement
slip form & pour ceiling concrete
Clean up

While this work occurs, the culvert lowering and valve installation activities at the upstream culvert end proceed. It should be noted that some or all of the discharge conduits leading from the main culverts to the lock interiors might also be made working from the interior of the culverts, rather than from the lock interior itself. The suggested activity sequence should allow

| | | |
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| HARZA ENGINEERING COMPANY CHICAGO | SUBJECT <u>Feasibility of Lock Winter Rehabilitation</u> COMPUTED <u>S.M.A.</u> CHECKED _____ | PROJECT _____ FILE NO. _____ DATE <u>22 Dec 70</u> Page <u>48</u> of <u>65</u> |
|--|--|--|

*for plan no. 1
 a smooth flow of work in the culvert interior, avoiding the congestion the confined working area implies. Note that grouting occurs only in the intermediate wall culverts. This means that the lowering of the culvert ceiling in the land wall could proceed while grouting is in progress in the intermediate wall culvert or culverts.

Finally, consideration of the extent of rehabilitation must be made. Only the plans (1 and 4) involving major winter work are considered here, since the other plans are not subject to the rigid time constraints. If plans 1 and/or 4 can be accomplished, then certainly plans 2 and 3 are feasible.

The event sequencing described above, in view of the computed manpower curve for the project, implies the feasibility of plan 1, in which the landward lock only is rehabilitated, during the winter. The question of whether both locks could be repaired at this time remains.

If plan 4 is implemented, no increased congestion is foreseen in the lock interior work areas, since the riverward lock activities would be physically separate from those in the landward lock. The approximate doubling in overall manpower and equipment usage levels could, however, cause congestion in the staging areas.

Notes: 1. Activity durations are based on the assumption of two 10-hour shifts per day, six days per week.

2. No adjustment was applied to outdoor work to reflect the slower pace of construction in cold weather. Since this work is not critical

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SUBJECT Feasibility of Lock
Winter Rehabilitation
COMPUTED SMA CHECKED _____

PROJECT Lock & Dam No.
FILE NO. 300 A
DATE 2/25/75 PAGE 49 OF 65

Notes (cont.):

to the overall project completion deadline, this approach should not affect the feasibility of the project.

3. In order to accomplish small activities not broken down on the CPM (such as installation of compressed air lines for the dewatering system), the manpower curve projected for this project should be inflated by 10%. This addition will also subsume the extra man hours needed to accomplish the outdoor work under winter conditions.

Comments

Plan No. 1 - As indicated by the manpower curve, the peak manpower demand should be about 125 men, working upstream from the locks, downstream, and in the lock interiors. It is felt that this number will not overtax the capacity of the staging and project access areas; this plan is therefore considered feasible. Since no mechanical rehabilitation of the riverward lock is included under this plan, any delay in completing the winter construction will delay use of the lock the following spring. Scheduling is tight, but work should proceed smoothly if scheduled as suggested above.

Plan No. 2 - Peak manpower demand should be less than that for Plan No. 1, due to the longer period of lock rehabilitation and the higher worker productivity to be expected in the summer. This plan appears to present the least possibility of impediment to river traffic. Two possible problems require consideration. First, since

| | | |
|--|-----------------------------------|--|
| HARZA ENGINEERING COMPANY CHICAGO | SUBJECT <u>Plan comparison</u> | PROJECT <u>K&D Dam No. 1</u> |
| | COMPUTED <u>SMA</u> CHECKED _____ | FILE NO. <u>800 A</u> DATE <u>3/22/76</u> PAGE <u>50</u> OF <u>65</u> PAGES |

Plan No. 2 (cont) - summer lock interior work proceeds without a cofferdam, the ability of the new lock bulkheads to keep the landward lock dry for long periods of time must be assured. Secondly, leakage of water from the adjacent riverward lock into the landward lock must be minimized. This could present a problem since grouting under the intermediate wall is not scheduled to begin until the summer.

Plan No. 3. The extended duration allowed the contractor for lock interior and exterior work under this plan makes it the easiest one for him to complete according to schedule. Manpower peak requirements should be even less than those for plan no. 2. Unlike plan no. 2, no mechanical improvements are scheduled for the riverward lock, making it more difficult to use that lock should future repairs to the landward lock be required. The year long closure to river traffic is, of course, the primary disadvantage.

Plan No. 4 - With some exceptions, this plan represents a stereo duplication of plan no. 1. Little or no extra congestion is expected in the lock areas, since the workers in the two locks will be physically separate. Peak manpower requirements should be less than double those of plan no. 1, since not all work is duplicated (i.e. both plans require grouting through both intermediate wall culverts) and since such a situation would encourage development of specialized crews to do one major task (such as culvert work) throughout the project, thereby

| | | |
|--|-----------------------------------|--|
| HARZA ENGINEERING COMPANY CHICAGO | SUBJECT <u>Plan Comparison</u> | PROJECT <u>Lock + Dam No. 1</u> |
| | COMPUTED <u>SMA</u> CHECKED _____ | FILE NO <u>800 A</u> DATE <u>3/3/75</u> PAGE <u>51</u> OF <u>65</u> PAGES |

Plan No. 4 (cont.) - increasing overall worker productivity.

All Plans - There were two alternatives suggested concerning protection of the guidewalls from snubbing impact. The more expensive of the two involves removal of 1.3 feet of wall face concrete, installation of reinforcement and embedment of wall armor, and the forming and pouring of concrete. The second involves the removal of 4 inches of wall surface concrete, to be replaced by reinforced shotcrete. Both schemes include installation of steel angle protection for the edges of the walls.

The calculations upon which the manpower and concrete curves are based assume use of the second of these two schemes. Employment of the first scheme requires approximately half again as much concrete. Both schemes involve the use of precast panels, which are not explicitly considered in this analysis.

A large amount of reinforcing steel (.2 tons for each c.y. of poured concrete) was assumed in computing crew sizes, in order to include the manpower requirements for activities not always explicitly considered, such as stripping forms and installing precast panels.

| | | |
|--|-------------------------------------|--|
| HARZA ENGINEERING COMPANY CHICAGO | SUBJECT <u>Guidewall Protection</u> | PROJECT <u>Lock Dam No. 1</u> |
| | <u>Manpower Requirements</u> | FILE NO. <u>B20 A</u> |
| | COMPUTED <u>SMA</u> CHECKED _____ | DATE <u>7/2/75</u> PAGE <u>52</u> OF <u>65</u> PAGES |

For protection scheme w/o wall armor, a total of about 1320 c.y. of shotcrete are to be applied to vertical wall faces of the upper guidewalls, lock interior, and lower guidewall (plans 1, 2, 3). Since each of these structures is about 400 feet long, I will divide this total shotcrete evenly among the three structures:

| concrete removed | shotcrete applied | structure |
|------------------|-------------------|---------------------|
| 660 c.y. | 460 c.y. | upper guide walls |
| 660 " | 460 " | lower " " |
| 660 " | 460 " | lock interior walls |

Double the usually assumed reinforcement quantity will be included, in order to cover the extra time required to install anchor bolts and upper protection steel angle.

| reinforcement | structure |
|---------------|---------------|
| 184 tons | u.g.w. |
| 184 " | l.g.w. |
| 184 " | lock interior |

Manpower requirements are determined using the Means Cost Data book, as for other activities included in this report.

| | | |
|--|-----------------------------------|--------------------------------|
| HARZA ENGINEERING COMPANY CHICAGO | SUBJECT <u>Manpower Levels</u> | PROJECT <u>Lock + Dam No.</u> |
| | <u>for Upstream Work</u> | FILE NO. <u>800-A</u> |
| | COMPUTED <u>SMA</u> CHECKED _____ | DATE <u>3/20/58</u> PAGE _____ |

| Work Type | ① | | ② | | daily pro- duction (8 hrs.) |
|-------------------------------------|-------|-----------|--------|-----------|-----------------------------------|
| | amt | unit | crew | type size | |
| 1. Landward Intake Man. | | | | | |
| a) v.g.w. monoliths 1+2 sht. piling | 21 | tuns | 9 men | 9 | 30 |
| b) remove " " of v.g.w. | 550 | cy. | B-5 | 8 | 40 |
| c) lower v.g.w. foundation 3 ft. | 1000 | cy. | 1 FEL | 2 | 560 |
| d) remove culvert concrete | 110 | cy. | B-5 | 8 | 10 |
| e) plug land wall intakes | 60 | cy. | C-14 | 30 | 38 |
| f) form. land. intake manifold | 6450 | s.f. | C-1 | 4 | 215 |
| reinf. " " " | 160 | tons | 4 rods | 4 | 2.3 |
| pour " " " | 800 | cy. | C-7 | 8 | 80 |
| 2. Intermediate Intake Man. | | | | | |
| a) remove top of mon. #1 conc. | 1,150 | cy. | B-5 | 8 | 40 |
| b) plug interm. wall intakes | 60 | cy. | C-14 | 30 | 38 |
| c) remove culvert concrete | 90 | cy. | B-5 | 8 | 10 |
| d) form. interm. wall intake man. | 2500 | s.f. | C-1 | 4 | 215 |
| reinf. " " " " | 116 | tons | 4 rods | 4 | 2.3 |
| pour " " " " | 580 | cy. | C-7 | 8 | 80 |
| e) form. top of monolith #1 | 3,950 | s.f. | C-2 | 5 | 260 |
| reinf. " " " " | 92 | tons | 4 rods | 4 | 3.0 |
| pour " " " " | 460 | cy. | C-7 | 8 | 95 |
| 3. Upstream Apron | | | | | |
| a) excavate (sand) | 3000 | cy. | 1 FEL | 2 | 560 |
| b) apply gravel bedding (6") | 350 | cy. | 1 FEL | 2 | 500 |
| c) form. concrete slab (2") | slab | | | 6 | - |
| reinf. " " " | 140 | tons | 4 rods | 4 | 2.3 |
| pour " " " | 1,400 | cy. | C-7 | 8 | 100 |
| 4. Guidewalls | | | | | |
| a) remove vertical face conc. | 660 | cy. | | 1 | 8 |
| b) reinforce " " " | 184 | tons rods | | 4 | 1.6 |
| c) apply " " " | 460 | cy. | | 5 | 20 |

Lock & Dam No. 1
 800-A
 Page 59 of 65

HARZA
 ENGINEERING
 COMPANY
 CHICAGO

SUBJECT _____

 COMPUTED _____ CHECKED _____

PROJECT _____
 FILE NO _____
 DATE _____ PAGE 59 OF 65 PAGES

| W | daily pro- duction size (8 hrs.) | duration (weeks) ⊗ x 2.5x6 | Allowed Activity Duration (weeks) | Req'd avg. Weekly crew size | Week no.s | Concrete Pours l.y./week |
|----|--|----------------------------------|---|-----------------------------------|--------------|--------------------------------|
| 9 | 30 | 1/6 | 4 | say 2 | 1-5 | |
| 8 | 40 | 1 | 3 | 3 | 5-8 | |
| 2 | 560 | 1/6 | 1 | say 2 | 8 | |
| 8 | 10 | 1 | 1 | 8 | 8 | |
| 30 | 38 | 1/6 | 1 | 5 | 9 | |
| 4 | 215 | 2 | 2 | 4 | 9-11 | |
| 4 | 2.3 | 5 | 5 | 4 | 11-16 | |
| 8 | 80 | 1 | 3 | 3 | 16 | 800 |
| 8 | 40 | 2 | 3 | 8 | 5-8 | |
| 30 | 38 | 1/6 | 1 | 5 | 10 | |
| 8 | 10 | 1/2 | 1 | 4 | 8 | |
| 4 | 215 | 1 | 2 | 4 | 9-11 | |
| 4 | 2.3 | 4 | 2 | 8 | 9-11 | |
| 8 | 80 | 1/2 | 3 | 4 | 11 | 580 |
| 5 | 260 | 1 | 2 | 5 | 13 | |
| 4 | 3.0 | 3 | 2 | 6 | 13-15 | |
| 8 | 85 | 1/2 | 3 | 3 | 15 | 460 |
| 2 | 560 | 1/2 | 1 | say 2 | 1 | |
| 2 | 500 | 1/6 | 1 | say 2 | 2 | |
| 6 | - | 1 | 1 | 6 | 3 | |
| 4 | 23 | 4 | 4 | 4 | 4-8 | |
| 8 | 100 | 2 | 2 | 8 | 8-10 | 700 |
| 1 | 8 | 27 | 15 | 2 | 2-17 | |
| 4 | 16 | 12 | 6 | 8 | 12-18 | |
| 5 | 20 | 2 | 2 | 5 | 18-20 | 230 |

| | | |
|--|------------------------------------|---|
| HARZA ENGINEERING COMPANY CHICAGO | SUBJECT <u>Manpower Levels for</u> | PROJECT <u>Lackt Dan No.</u> |
| | <u>Downstream Works</u> | FILE NO <u>B00 A</u> |
| | COMPUTED <u>SMA</u> CHECKED _____ | DATE <u>3/20/75</u> PAGE <u>1</u> OF <u>1</u> |

Work Quantities - Plan No. 1

| Work Type | amount | unit | Crew type | size | daily production (hr.) | duration (week) |
|-------------------------------------|--------|------|-----------|------|------------------------|-----------------|
| Manifolds | | | | | | |
| a) install sheet piling | 5,400 | sf. | B-30 | 3 | 500 | |
| b) remove l.g.w. manos. 1,2, & 3 | 1,100 | c.y. | B-5 | 9 | 40 | |
| c) rem. timber cribs | ? | | 2 | 2 | | |
| d) excavation for new manos. | 280 | c.y. | B-10FF | 2 | 560 | |
| f) back fill l.g.w. monolith | 250 | c.y. | B-10FFEL | 2 | 250 | |
| g) clean apron & slab | 500 | c.y. | B-10FFEL | 2 | 250 | |
| h) remove " " | 1,100 | c.y. | B-5 | 9 | 30 | |
| i) excavate (sandstone) | 1,000 | c.y. | B-10 | 2 | 100 | |
| j) manifold forms | 10,000 | sf. | C-1 | 4 | 215 | |
| " reinf. | 180 | tons | 4 rod m | 4 | 3.0 | |
| " pouring | 900 | c.y. | C-7 | 8 | 150 | |
| e) l.g.w. man. mon forms | 7,500 | sf. | C-2 | 5 | 235 | |
| " " reinf. | 260 | tons | 4 rod. | 4 | 2.3 | |
| " " pouring | 1,300 | c.y. | C-7 | 8 | 80 | |
| k) install drain pipe (12" & 24" Ø) | 705 | ft. | B-21 | 4 | 110 | |
| l) backfill on drains (gravel) | 200 | c.y. | 1 (lab) | 1 | 12 | |
| m) cutoff wall & downstr. manif. | 1080 | c.y. | B-11 | 2 | 90 | |
| n) place rock protection | 650 | c.y. | B-10 | 2 | 1000 | |
| o) excavate sandstone (int. wall) | 300 | c.y. | B-10 | 2 | 100 | |
| p) interm. wall extension forms | 13000 | sf. | C-2 | 5 | 200 | |
| q) " " " reinf. | 350 | tons | 4 rod m | 4 | 23 | |
| r) " " " pouring | 2,500 | c.y. | C-7 | 8 | 95 | |
| Guidewalls | | | | | | |
| a) remove vert. face concrete | 660 | c.y. | | 1 | 8 | |
| b) reinf. " " " | 184 | tons | rod m. | 4 | 16 | |
| c) apply " " " | 460 | c.y. | | 5 | 20 | |

notes: 1. For jobs which require less than 1 week, t
 2. Jobs completed before the allotted time r

PROJECT Lock & Dam No. 1
 No. EDD A
 3/20/75 PAGE 60 OF 65 PAGES

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 CHICAGO

SUBJECT _____

COMPUTED _____ CHECKED _____

PROJECT _____
 FILE NO _____
 DATE _____ PAGE 60 OF 65 PAGES

* From Means Cost Data, 1975 ed.

| Crew size | daily production (8 hr.) | duration (weeks) | Allowed Activity Duration (weeks) | Req'd avg. weekly crew size | Week Nos. | Concrete Pours Cy./Week |
|-----------|--------------------------|------------------|-----------------------------------|-----------------------------|-----------|-------------------------|
| 3 | 500 | 1 | 1 | 3 | 1 | |
| 9 | 40 | 2 1/2 | 2 | 9 | 2-4 | |
| 2 | | 1 | 1/6 | 2 | 3 | |
| 2 | 560 | 1/6 | 1/6 | 2 | 4 | |
| 2 | 250 | neg. | - | say 2 | 15 | |
| 2 | 250 | neg. | - | 1 | 4 | |
| 9 | 30 | 2 | 2 | 9 | 4-6 | |
| 2 | 100 | 1 | 1 | 2 | 5 | |
| 4 | 215 | 3 | 2 | 6 | 7-9 | |
| 4 | 3.0 | 4 | 2 | 8 | 7-9 | |
| 8 | 150 | 1/2 | 1 | 4 | 9 | 450 |
| 5 | 235 | 2 | 1 | 10 | 10-12 | |
| 4 | 2.3 | 8 | 1 | 16 | 10-12 | |
| 8 | 80 | 2 | 1 | 16 | 12 | 1300 |
| 4 | 110 | 1 | 1 | 4 | 6 | |
| 1 | 12 | 2 | 1/6 | 12 | 7 | |
| 2 | 90 | 1 | 1 | say 4 | 8 | 1000 |
| 2 | 1000 | 1 | 1 | 2 | 13 | |
| 2 | 100 | 1 | 1 | 2 | 9 | |
| 5 | 200 | 6 | 3 | 10 | 14-17 | |
| 4 | 23 | 10 | 3 | 15 | 14-17 | |
| 8 | 95 | 2 | 2 | 8 | 17-19 | 1250 |
| 1 | 8 | 27 | 15 | 2 | 2-17 | |
| 4 | 1.6 | 12 | 6 | 8 | 12-18 | |
| 5 | 20 | 2 | 2 | 5 | 18-20 | 230- |

When 1 week, the crew size is averaged over a whole week.
 allotted time nevertheless employ full crews for the allotted time.

| | | |
|--|-----------------------------------|---|
| HARZA ENGINEERING COMPANY CHICAGO | SUBJECT <u>Manpower levels -</u> | PROJECT <u>Lock & Dam No.</u> |
| | <u>Interior Work</u> | FILE NO <u>800 A</u> |
| | COMPUTED <u>SMA</u> CHECKED _____ | DATE <u>3/21/75</u> PAGE _____ OF _____ |

1. Base + vertical face of wall - Plan No. 1

| work type | amount | unit | type |
|---|--------|-------|------|
| a) clean surfaces | 1 | lock | |
| b) inspect + repair floor + floor slabs | 1 | lock | |
| c) break out cond. opngs. - land w. | 110 | c.y. | |
| " " " " - int w. | 100 | c.y. | |
| d) Remove wall face concrete | 660 | c.y. | |
| e) clear " " " " " | 660 | c.y. | |
| f) " " " " " " " " " " " " | 184 | tons | |
| g) " " " " " " " " " " " " | 460 | c.y. | |
| h) Clean up shotcrete | 1 | lock | |
| i) orifice reinf. - land w. | 26 | tons | |
| " " " " - int. w. | 30 | tons | |
| j) " " formwork - land w. | 2200 | s.f. | |
| " " " " - int. w. | 1500 | s.f. | |
| k) " " concrete - land w. | 130 | c.y. | C-7 |
| " " " " - int. w. | 150 | c.y. | C-7 |
| l) strip orifice tmwk - land w. | 2200 | s.f. | |
| " " " " - int. w. | 1500 | s.f. | |
| m) drill grout holes - int. w. | 132 | holes | |
| n) pump grout - int. w. | 132 | holes | |
| p) drill 2" orifice holes - B/orifice - land wall | 80 | holes | |
| p) " " " " " " - int. wall | 80 | holes | |

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| Lock & Draw No. <u>1</u> <u>800 A</u> 12/175 PAGE _____ OF _____ PAGES | HARZA ENGINEERING COMPANY CHICAGO | SUBJECT _____ _____ _____ COMPUTED _____ CHECKED _____ | PROJECT _____ FILE NO _____ DATE _____ PAGE <u>61</u> OF <u>65</u> PAGES |
|--|--|---|--|

| unit | type | crew size | Daily Prod. (20 hrs.) | Duration (weeks) | Allowed act. duration | Req'd avg. week-ly crew size | Week Nos. | Concrete c.y./week |
|-------|------|-----------|-----------------------|------------------|-----------------------|------------------------------|-----------|--------------------|
| | | 3 | - | 1/6 | 1/6 | 1 | 1 | |
| | | 2 | - | 7 | 5 | 3 | 2-9 | |
| c.y. | | 4 | 14 | 2 | 2 | 4 | 2-4 | |
| c.y. | | 4 | 14 | 2 | 5 | 2 | 2-7 | |
| c.y. | | 1 | 4 | 27 | 15 | 2 | 2-17 | |
| c.y. | | 1 | 20 | 6 | 15 | 1 | 2-17 | |
| tons | | 4 | 25 | 12 | 6 | 8 | 11-17 | |
| c.y. | | 5 | 50 | 2 | 2 | 5 | 17-19 | 230 |
| | | 3 | - | 1/6 | 1/6 | 1 | 20 | |
| tons | | 4 | 25 | 2 | 4 | 2 | 7-11 | |
| tons | | 4 | 25 | 2 | 4 | 2 | 7-11 | |
| s.f. | | 4 | 750 | 1/2 | 4 | 1 | 14-18 | |
| s.f. | | 4 | 750 | 1/2 | 4 | 1 | 14-18 | |
| c.y. | C-7 | 8 | 100 | 3 | 1 | 3 | 18 | 130 |
| c.y. | C-7 | 8 | 100 | 3 | 1 | 3 | 18 | 150 |
| s.f. | | 4 | 3000 | 1/6 | 1 | 1 | 20 | |
| s.f. | | 4 | 3000 | 1/6 | 1 | 1 | 20 | |
| holes | | 3 | 3 | 7 1/2 | 8 | 3 | 2-10 | |
| holes | | 3 | 6 | 3 3/4 | 8 | 3 | 6-10 | |
| holes | | 3 | 4 | 3 1/2 | 2 | 8 | 2-4 | |
| holes | | 3 | 4 | 3 3/4 | 4 | 4 | 2-6 | |

| | | |
|--|-----------------------------------|---|
| HARZA ENGINEERING COMPANY CHICAGO | SUBJECT <u>Man power levels -</u> | PROJECT <u>Lock & Dam No. 1</u> |
| | <u>Interior Work</u> | FILE NO <u>B00 A</u> |
| | COMPUTED <u>SMA</u> CHECKED _____ | DATE <u>3/21/75</u> PAGE _____ OF _____ |

Work Quantities - Plan No. 1

2. Top of walls, ends of lock

| Work Type | Amount | Unit | Type | Crew Size |
|--------------------------------------|--------|-------|--------|-----------|
| a) remove stoney gate | 4 | - | | 4 |
| b) remove miter gate operator | 4 | - | | 4 |
| c) remove valve bulkhead concr. | 160 | c.y. | | 4 |
| d) remove loose concrete | 160 | c.y. | | 5 |
| e) install mt. gt. op. embedded pts | 4 | - | | 4 |
| f) " " " " reinforcement | 5 | ton | rod m. | 4 |
| g) " " " " formwork | 100 | s.f. | C-2 | 5 |
| h) pour " " " concrete | 10 | c.y. | C-7 | 8 |
| i) install valve blkd. embedded pts. | 6 | - | | 3 |
| j) " " " " reinforcement | 7 | tons | rod m. | 4 |
| k) " " " " formwork | 200 | s.f. | C-2 | 5 |
| l) pour " " " concrete | 80 | c.y. | C-7 | 8 |
| m) strip forms | 300 | s.f. | | 1 |
| n) install new mt. gt. operator | 4 | - | | 4 |
| o) drill shear keys (vert. & horiz.) | 8 | holes | | 6 |
| p) pour shear keys (" ") | 52 | c.y. | C-7 | 8 |
| q) misc. (mooring bits, etc.) | | | | 30 |
| r) upper miter gate repairs | 1 | lock | | 9 |
| s) lower " " " " | 1 | lock | | 14 |
| t) upper miter gate sandbl. & pntng. | 1 | lock | | 4 |
| u) lower " " " " | 1 | lock | | 4 |
| v) remove lock blkhd concrete | 140 | c.y. | | 4 |
| w) install " " embedded parts | 4 | - | | 4 |
| x) " " " reinforcement | 4 | tons | rod m. | 4 |
| y) " " " formwork | 500 | s.f. | C-2 | 5 |
| z) pour " " concrete | 70 | c.y. | | 8 |
| aa) reinforce slab on tops of walls | 180 | tons | rod m. | 4 |
| ab) form " " " " | 20000 | s.f. | C-2 | 5 |
| ac) pour " " " " | 900 | c.y. | C-6 | 6 |

| | | | |
|--|--|---|--|
| PROJECT <u>Jack Dam No. 1</u> FILE NO <u>300 A</u> DATE <u>3/21/75</u> PAGE _____ OF _____ PAGES | HARZA ENGINEERING COMPANY CHICAGO | SUBJECT _____ _____ _____ COMPUTED _____ CHECKED _____ | PROJECT _____ FILE NO _____ DATE _____ PAGE <u>62</u> OF <u>65</u> PAGES |
|--|--|---|--|

| Type | Crew Size | Daily (20 hr.) Production | Duration (weeks) | Allowed Activity Duration | Req'd avg. Weekly Crew Size | Week Nos. | Concrete c.y./week |
|--------|-----------|---------------------------|------------------|---------------------------|-----------------------------|-----------|--------------------|
| | 4 | — | 2 | 2 | 4 | 2-4 | |
| | 4 | — | 1 1/3 | 5 | 4 | 5 | |
| | 4 | 15 | 2 | 6 | 2 | 4-10 | |
| | 5 | 100 | 3 | 3 | 2 | 10 | |
| | 4 | — | 1 | 2 | 4 | 8 | |
| rod m. | 4 | 42 | 1/6 | 1 | 1 | 9 | |
| C-2 | 5 | 250 | 1/6 | 1 | 1 | 10 | |
| C-7 | 8 | 40 | 1/6 | 1 | 2 | 11 | 10 |
| | 3 | — | 7 | 2 | 12 | 10-12 | |
| rod m. | 4 | 42 | 1/3 | 1 | 2 | 13 | |
| C-2 | 5 | 250 | 1/6 | 1 | 1 | 14 | |
| C-7 | 8 | 40 | 1/3 | 2 | 3 | 15 | 80 |
| | 1 | 600 | 1/6 | 1 | 1 | 16 | |
| | 4 | — | 2 | 3 | 4 | 14-17 | |
| | 6 | 23 | 2 | 2 | 6 | 4-6 | |
| C-7 | 8 | 40 | 1/3 | 3 | 8 | 6 | 52 |
| | 30 | — | 1 | 15 | 2 | 2-17 | |
| | 9 | — | 3 | 3 | 9 | 3-6 | |
| | 14 | — | 3 | 3 | 14 | 6-9 | |
| | 4 | — | 4 | 4 | 4 | 6-10 | |
| | 4 | — | 4 | 4 | 4 | 10-14 | |
| | 4 | 15 | 2 | 2 | 4 | 9-11 | |
| | 4 | — | 1 | 1 | 4 | 11 | |
| rod m. | 4 | 42 | 1 | 1 | 4 | 12 | |
| C-2 | 5 | 250 | 1/2 | 1/2 | 3 | 13 | |
| | 8 | 40 | 1/3 | 1/3 | 3 | 13 | 70 |
| rod m. | 4 | 75 | 1 | 4 | 4 | 2-6 | |
| C-2 | 5 | 250 | 6 | 6 | 5 | 10-16 | |
| C-6 | 6 | 287 | 4 | 4 | 6 | 16-20 | 225 |

| | | |
|--|-----------------------------------|--|
| HARZA ENGINEERING COMPANY CHICAGO | SUBJECT <u>Lock Interior</u> | PROJECT <u>Lock + Dam N</u> |
| | <u>Work Scheduling, Plan 1</u> | FILE NO <u>B00 A</u> |
| | COMPUTED <u>SMA</u> CHECKED _____ | DATE <u>3/21/75</u> PAGE <u>1</u> OF _____ |

Work Quantities - Plan No. 1

3. Culverts - interior of lock walls

| Work Type | Amount | Unit | Type | Crew Size |
|---------------------------------------|--------|-------|---------|-----------|
| a) drill grout holes (int. wall only) | 198 | holes | | 3 |
| b) inject grouting (" " ") | 198 | holes | | 3 |
| c) enlarge vents in culverts | 400 | ft. | | 2 |
| d) cut culvert ceiling break-line | 1600 | ft. | A-1 | 2 |
| e) remove " " concrete | 100 | c.y. | | 2 |
| f) install " " vent pipes | 400 | ft. | | 3 |
| g) grout " " " " | 10 | c.y. | | 3 |
| h) pour " " concrete | 600 | c.y. | C-7 | 8 |
| i) remove conc. to lower culverts | 1200 | c.y. | B-9 | 8 |
| j) form new lower culverts | 2000 | sf. | C-1 | 4 |
| k) reinforce " " " | 160 | tons | 4 rod m | 4 |
| l) pour conc. for " " | 800 | c.y. | C-7 | 8 |
| m) reinf. upper culverts & gate slots | 80 | tons | 4 rod m | 4 |
| n) fill " " " " | 1000 | c.y. | C-7 | 8 |
| o) install new slide valves | 2 | valve | | 3 |
| p) drill 2" orifice holes - 8/orifice | 80 | holes | | 3 |

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|---------------------------|-------------|----------|---------------|
| PROJECT Lock + Dam No. 1 | HARZA | SUBJECT | PROJECT |
| No 300 A | ENGINEERING | | FILE NO. |
| 3/21/75 page 1 of 1 pages | COMPANY | COMPUTED | CHECKED |
| | CHICAGO | | DATE 63 or 65 |

| Crew Type | Crew Size | Daily (8-hr.) Production | Duration (Weeks) | Allowed Activity Duration | Req'd Avg. Weekly Crew Size | Week Nos. | Concrete C.Y./week |
|------------|-----------|--------------------------|------------------|---------------------------|-----------------------------|-----------|--------------------|
| les | 3 | 1.2 | 11 | 8 | 6 | 2-10 | |
| les | 3 | 2.4 | 5 1/2 | 8 | 3 | 3-11 | |
| | 2 | 10 | 4 | 2 | 4 | 2-4 | |
| A1 | 2 | 182 | 4 | 1 | 8 | 4 | |
| | 2 | 5 | 2 | 2 | 2 | 5-7 | |
| | 3 | 80 | 3 | 3 | 1 | 7 | |
| | 3 | 5 | 4 | 1 | 1 | 7 | |
| sy. C-7 | B | 50 | 1 | 5 | use 4 | 8-15 | 120 |
| sy. B-9 | B | 70 | 1 1/2 | 3 | 4 | 4-7 | |
| st. C-1 | 4 | 170 | 1 | 3 | 2 | 8-11 | |
| ons 4 rodm | 4 | 18 | 6 | 3 | 8 | 7-10 | |
| sy. C-7 | B | 160 | 1 | 4 | 2 | 11-15 | 200 |
| ons 4 rodm | 4 | 18 | 3 | 3 | 4 | 7-10 | |
| sy. C-7 | B | 120 | 1 | 4 | use 2 | 11-15 | 250 |
| ake | 3 | 4 | 1/2 | 2 | 2 | 15 | |
| les | 3 | 1.6 | 3 1/3 | 4 | 3 | 2-6 | |

2

HARZA
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CHICAGO

SUBJECT Manpower + concrete
Weekly Volumes - Summary
COMPUTED SMA CHECKED _____

PROJECT Lock + Dam N
FILE NO 300 A
DATE 3/20/75
CPMS-7 3/22/75

| Week no. | Upstream | | Downstream | |
|----------|-------------|-----------------|-------------|-----------------|
| | labor (men) | concrete (C.Y.) | labor (men) | concrete (C.Y.) |
| 1 | 4 | 0 | 3 | 0 |
| Nov. | 2 | 6 | 11 | 0 |
| | 3 | 10 | 13 | 0 |
| | 4 | 8 | 14 | 0 |
| | 5 | 17 | 13 | 0 |
| Dec. | 6 | 17 | 6 | 0 |
| | 7 | 17 | 28 | 1300 |
| | 8 | 29 | 20 | 1080 |
| Jan. | 9 | 43 | 8 | 0 |
| | 10 | 25 | 28 | 0 |
| | 11 | 10 | 28 | 0 |
| | 12 | 14 | 26 | 450 |
| | 13 | 25 | 12 | 450 |
| Feb. | 14 | 20 | 35 | 0 |
| | 15 | 17 | 37 | 0 |
| | 16 | 13 | 35 | 0 |
| | 17 | 13 | 16 | 1250 |
| March | 18 | 10 | 18 | 1480 |
| | 19 | 5 | 10 | 230 |
| | 20 | 0 | 0 | 0 |

PROJECT Lock & Dam No. 1
 DS No 300 A
300/75 of PAGES
 DATE 3/22/75

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 COMPANY
 CHICAGO

SUBJECT _____

 COMPUTED _____ CHECKED _____

PROJECT _____
 FILE NO _____
 DATE _____ Page 64 of 65 PAGES

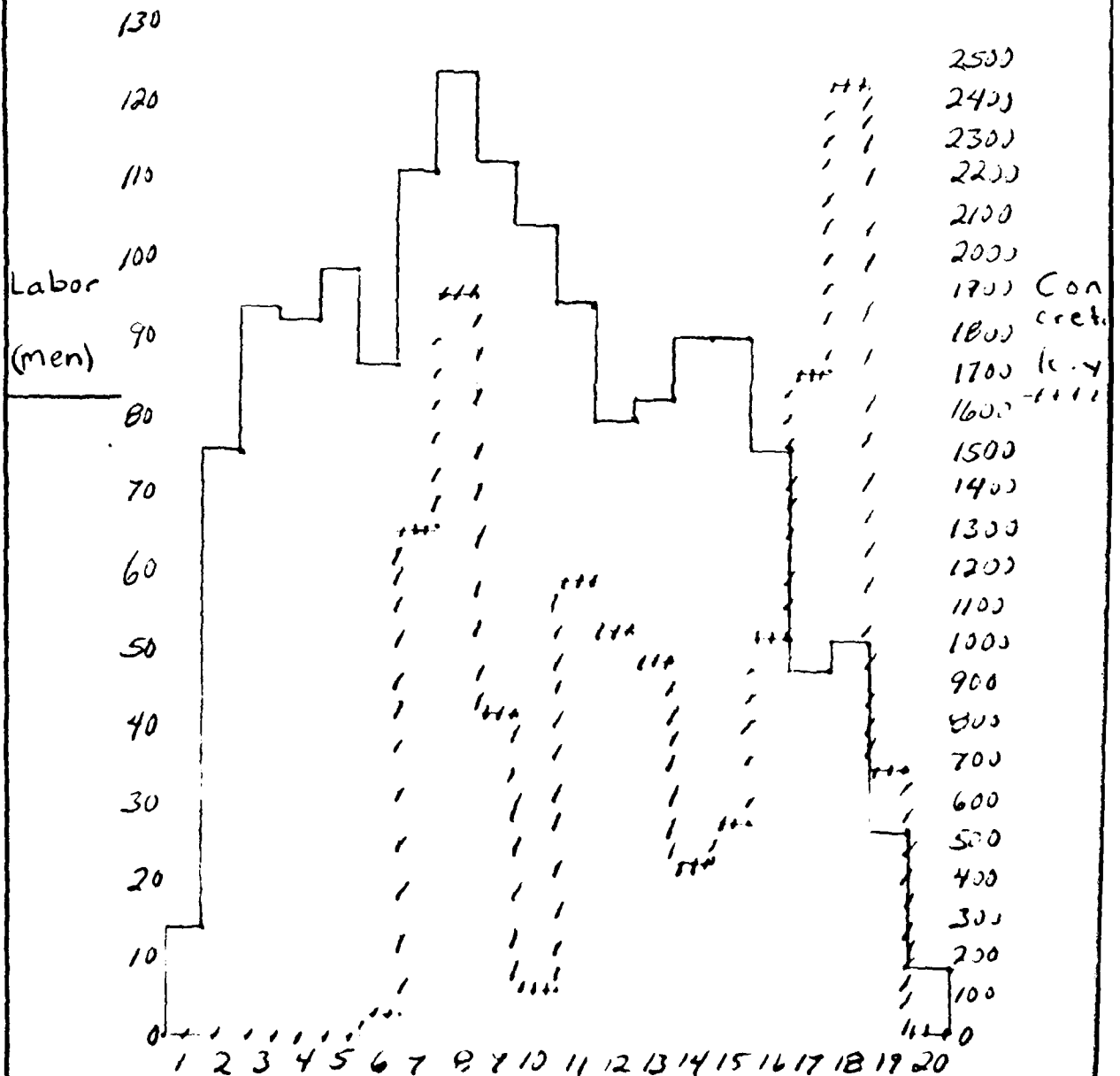
| | Subtotal | | Lock Interior | | Total |
|--------------------|----------------|--------------------|----------------|--------------------|--------------------------------------|
| Downstream | Exterior | | | | |
| concrete (c.y.) | labor (men) | concrete (c.y.) | labor (men) | concrete (c.y.) | labor (men) concrete (c.y.) |
| 0 | 7 | 0 | 6 | 0 | 13 0 |
| 0 | 17 | 0 | 58 | 0 | 75 0 |
| 0 | 23 | 0 | 70 | 0 | 93 0 |
| 0 | 22 | 0 | 70 | 0 | 92 0 |
| 0 | 30 | 0 | 68 | 0 | 98 0 |
| 0 | 23 | 0 | 64 | 52 | 87 52 |
| 1300 | 45 | 1300 | 66 | 0 | 111 1300 |
| 1080 | 49 | 1780 | 74 | 120 | 123 1900 |
| 0 | 51 | 700 | 61 | 120 | 112 820 |
| 0 | 53 | 0 | 51 | 120 | 104 120 |
| 0 | 38 | 580 | 53 | 580 | 94 1160 |
| 450 | 40 | 450 | 39 | 570 | 79 1020 |
| 450 | 37 | 450 | 45 | 520 | 82 970 |
| 0 | 55 | 0 | 34 | 450 | 89 450 |
| 0 | 54 | 460 | 34 | 80 | 89 540 |
| 0 | 48 | 800 | 27 | 225 | 75 1025 |
| 1250 | 29 | 1250 | 18 | 455 | 47 1705 |
| 1480 | 28 | 1710 | 22 | 715 | 50 2425 |
| 230 | 15 | 460 | 11 | 225 | 26 685 |
| 0 | 0 | 0 | 8 | 0 | 8 0 |

24

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SUBJECT Manpower + Concrete
Flow Levels - Plan No. 1
COMPUTED SMA CHECKED _____

PROJECT Lock + Dam No 1
FILE NO 800 A
DATE 3/31/75 PAGE 65 OF 65 PAGES



— 8
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