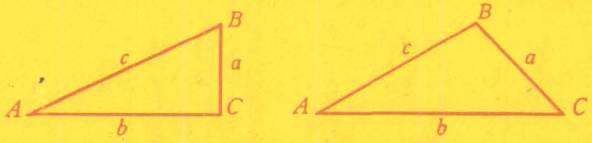
PROJECT NO. 05-000L(18)
--85-07

DESIGN 4-377
STA 764+33.05 TWIN 12'x12'x50'
R.C.B. 30° SKEW RT. AHEAD

TELEDYNE

42

FORMULAE FOR SOLVING RIGHT TRIANGLES



$$\text{Sin } A = \frac{a}{c} = \text{Cos } B \qquad \text{Cot } A = \frac{b}{a} = \text{Tan } B$$

$$\text{Cos } A = \frac{b}{c} = \text{Sin } B \qquad \text{Sec } A = \frac{c}{b} = \text{Cosec } B$$

$$\text{Tan } A = \frac{a}{b} = \text{Cot } B \qquad \text{Cosec } A = \frac{c}{a} = \text{Sec } B$$

Given	Required	Solution
A, c	B, a, b	$B = 90° - A, a = C \sin A, b = C \cos A.$
A, b	B, a, c	$B = 90° - A, a = b \tan A, C = \frac{b}{\cos A}.$
A, a	B, b, c	$B = 90° - A, b = a \cot A, C = \frac{a}{\sin A}.$
a, c	A, B, b	$\sin A = \frac{a}{c}, \cos B = \frac{a}{c}, b = \sqrt{(c+a)(c-a)}$
a, b	A, B, c	$\tan A = \frac{a}{b}, \cot B = \frac{a}{b}, c = \sqrt{a^2 + b^2}$

FORMULAE FOR SOLVING OBLIQUE TRIANGLES

Given	Required	Solution
A, a, b	B, c	$\sin B = \frac{b \sin A}{a}, c = \frac{a \sin C}{\sin A}$
A, B, a	b	$b = \frac{a \sin B}{\sin A}$
a, b, C	A, c	$A + B = 180° - C, C = \frac{a \sin C}{\sin A}$
a, b, c	Area	side $\frac{a+b+c}{2}$, area $= \sqrt{s(s-a)(s-b)(s-c)}$
A, b, c	Area	area $= \frac{bc \sin A}{2}$
A, B, C, a	Area	area $= \frac{a^2 \sin B \sin C}{2 \sin A}$

I M 204 APPENDIX H

Air Test 1 per 20 cy
Slump 1 per 20 cy
Beams 2 for culvert walls
2 for culvert slab

Conc. Yield for every major pour

Steel Certificates

Notify Engr before every pour and before forms buttoned up

Copy of Contract

Distribution Final Acceptance
3-28-79

Form 583 4-72 Sept. 13, 1977 letting

CONTRACT

Kind of Work RCB Culvert

Project No. OS--L(18)--85-07

Miles

County Black Hawk

THIS AGREEMENT made and entered by and between Black Hawk County, Iowa, by its Board of Supervisors consisting of the following members: Lynn G. Cutler, Lloyd Gallagher, Francis Mosserly, Sonia A. Johannsen, Carroll T. Hayes, Chairman, party of the first part, and Silver Construction of Central City, Iowa, party of the second part.

WITNESSETH: That the party of the second part, for and in consideration of --Forty Four Thousand Twenty Eight and 05/100--- Dollars ($ 44,028.05) payable as set forth in the specifications constituting a part of this contract, hereby agrees to construct in accordance with the plans and specifications therefore, and in the locations designated in the notice to bidders, the various items of work as follows:

Item No.	Item	Quantity	Unit Price	Amount
1.	Concrete, Structural	356.420 CY	$85.00	$30,295.70
2.	Steel, Reinforcing	47,960 Lbs	0.22	10,551.20
3.	Excavation, Class 20	509 CY	6.00	3,054.00
4.	Clearing & Grubbing (Engineer's Estimate $127.15)	% of Sched.	100%	127.15
	TOTAL			$44,028.05

Said specifications and plans are hereby made a part of and the basis of this agreement, and a true copy of said plans and specifications are now on file in the office of the County Auditor under date of September 13, 19 77.

That in consideration of the foregoing, the party of the first part hereby agrees to pay to the party of the second part, promptly and according to the requirements of the specifications the amounts set forth, subject to the conditions as set forth in the specifications.

That it is mutually understood and agreed by the parties hereto that the notice to bidders, proposal, the specifications for RCB Culvert Project No. OS--L(18)--85-07 Black Hawk County, Iowa, the within contract, the contractor's bond, and the general and detailed plans are and constitute the basis of contract between the parties hereto.

That it is further understood and agreed by the parties of this contract that the above work shall be commenced on or before, and shall be completed on or before:

Agreed, or Specified Starting Date or Number of Working Days	Specified Completion Date or Number of Working Days
40 working days	June 2, 1978

That time is the essence of this contract and that said contract contains all of the terms and conditions agreed upon by the parties hereto.

It is further understood that the second party consents to the jurisdiction of the courts of Iowa to hear, determine and render judgement as to any controversy arising hereunder.

IN WITNESS WHEREOF the parties hereto have set their hands for the purposes herein expressed to this and three other instruments of like tenor, as of the _____ day of _____, 19 77.

Approved:
IOWA STATE HIGHWAY COMMISSION

By _____
Highway Engineer

Date OCT 24 1977

Black Hawk County, Iowa
Party of the first part

By Carroll T. Hayes
Chairman Carroll T. Hayes

Silver Construction

By Edwin E. Silver
Party of the second part Edwin E. Silver

Silver Const 1-438-6247

INITIALS	NAME
TPS	Thomas Paul Schoellen
DAC	DENNIS A. CLARKE
E.E.S	Edwin E. Silver Silver Construction owner

Item No. ____, Structural Concrete

Item No. & Unit Poured	Date Poured	Mix No.	Batch Size	Dry Weight: No. Batches	Dry Weight: Sand	Dry Weight: Rock	% Moisture Sand	% Moisture Rock	Total Water Lbs/Batch	✓ Steel Placed	Actual Batch Weights: Cement	Actual Batch Weights: Sand	Actual Batch Weights: Rock	Concrete Plan Quant.	Concrete Used	% Used Plan	Treatment	% Air	Slump	Insp Initials
Footing	9/1	C-6	1½	90	1722	1141	3.0	1.0	63	✓	676	1774	1152	88	90	102	H_2O			
WALLS & DECK		C-6	1	92	1722	1141	3.0	1.0		✓	676	1774	1152	90	92	102	C.C			
Footings		C-6	1	12	1722	1141	3.0	1.0		✓	676	1774	1152	11	12	109	C.C			
Footing		C-6	1	79	1722	1141	3.0	1.0		✓	676	1774	1152	77	79	103	C.C			
WALLS		C-6	1	92	1722	1141	3.0	1.0		✓	676	1774	1152	90	92	102	C.C			

Additional Slump, Air Tests & Remarks:

Total Cu Yds Est.	356.42
Total This Report	
Total Last Report	
Total to Date	356.42

3

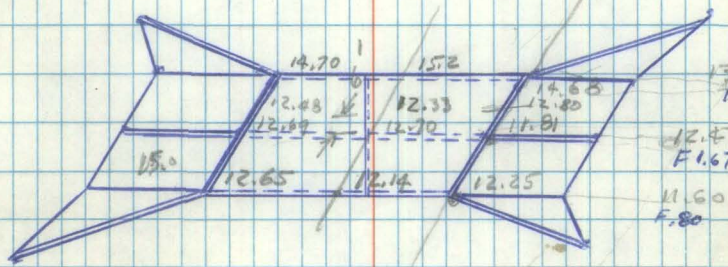
2

Item # 3 EXCAVATION, CLASS 20

LOCATION	DATE EXCAVATED	PLAN QUANTITY	ACTUAL QUANTITY	X-Sect	INITIAL

60
60
30
150
27

804.23 4
.27
AI = 805.00



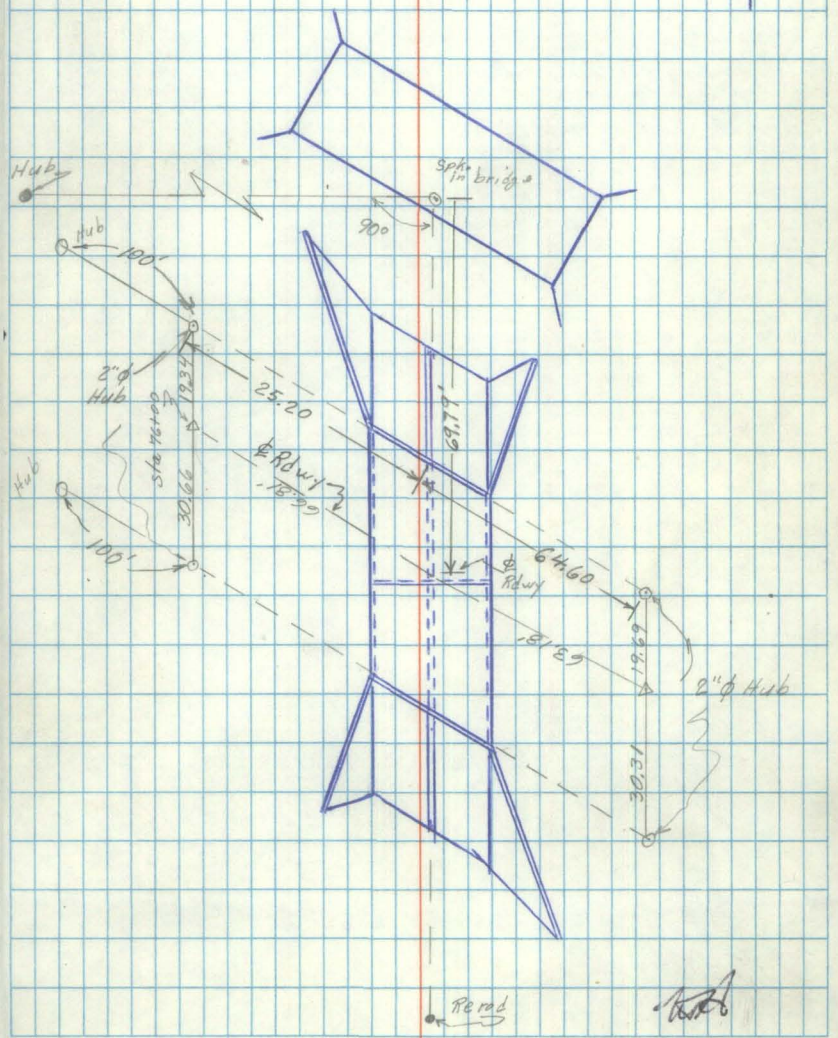
Bench Mark #1 U.S.G.S. #8711-20 S.E. (3)(CEDAR)(1963)
POLE SPIKE AND COLLAR IN SOUTH END OF EAST PILE CAP
ELEV. 804.23

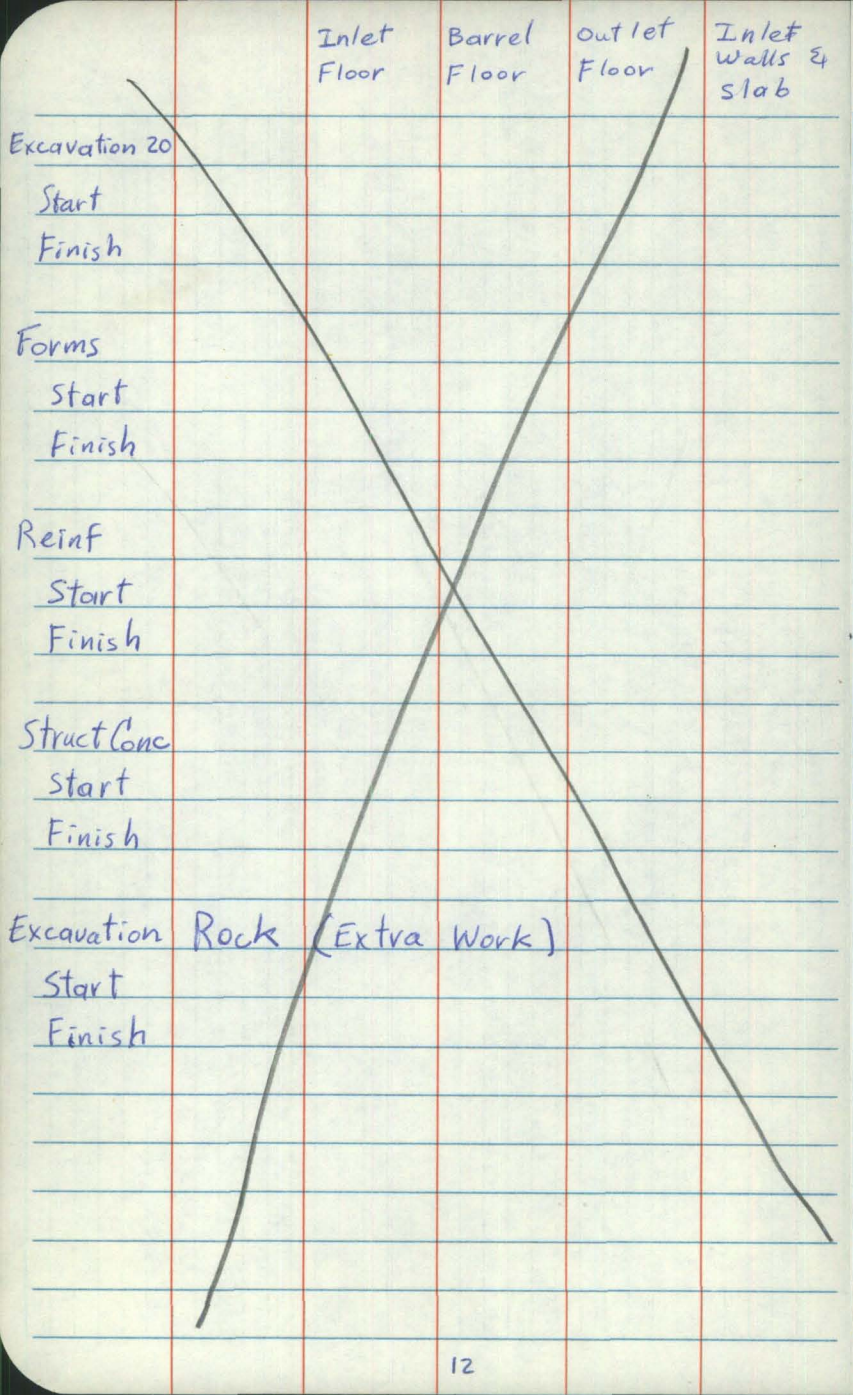
Bench Mark #2 SPIKE IN POWER POLE LT. STA. 83+20 AT
ELEV. 809.63

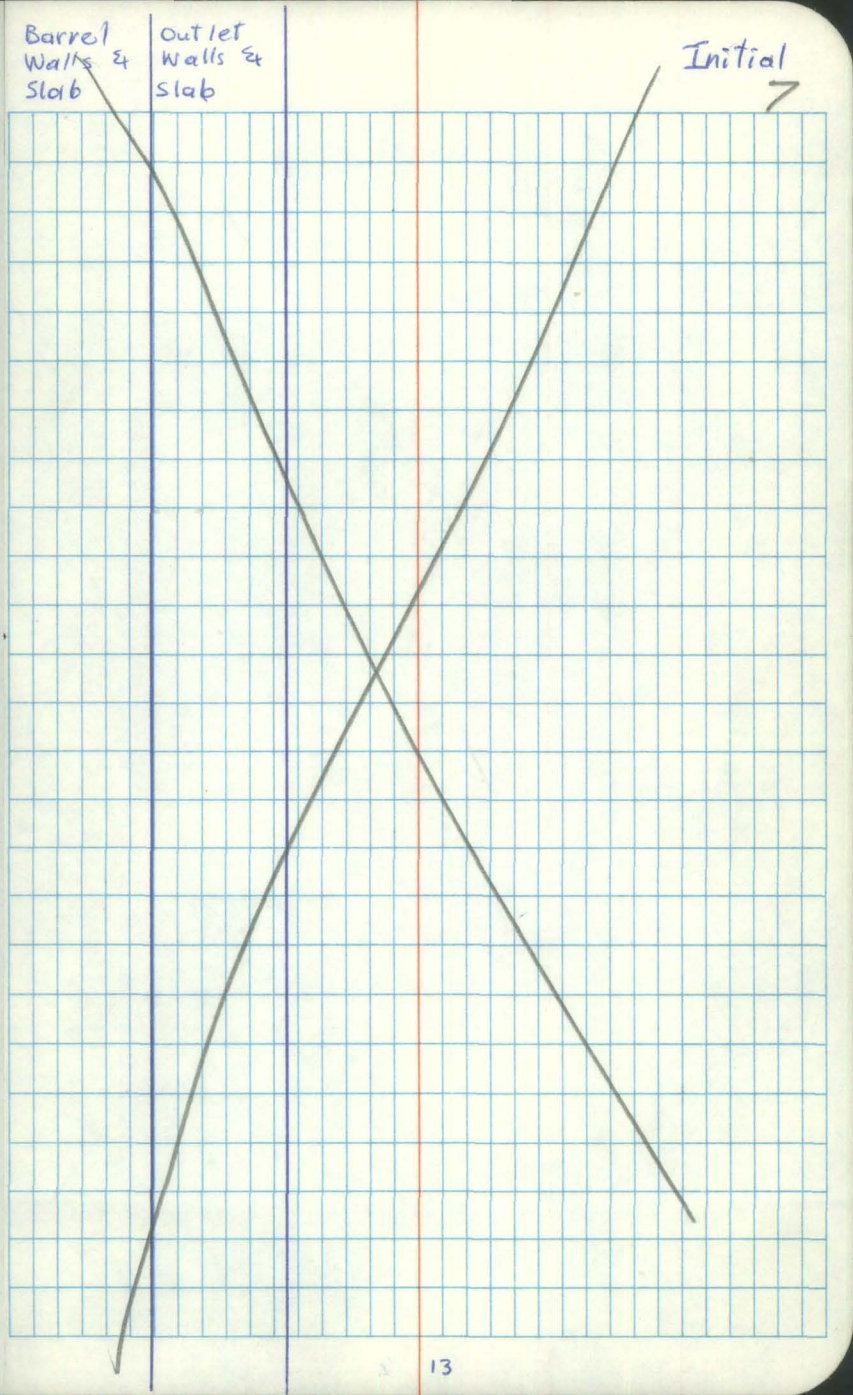
70' ±

N

Staked Oct 27, 1977




Inlet Floor
Barrel Floor
Outlet Floor
Inlet Walls & slab
Excavation 20
Start
Finish
Forms
Start
Finish
Reinf
Start
Finish
Struct Conc
Start
Finish
Excavation Rock (Extra Work)
Start
Finish


Barrel Walls & Slab
Outlet Walls & Slab
Initial

FINAL QUANTITIES

ITEM #1 CONCRETE, STRUCTURAL

DATE	USED	PLAN
9/1/78		88.19
9/22/78	91.75	~~88.19~~ 90.01
9/26/78	12.25	11.00
9/28/78	78.5	77.19
10/3/78	91.75	~~88.19~~ 90.01
	TOTAL	356.43 C.Y.

PLAN QUANTITIES. DMC

SEE FINAL QUANTITIES BOOK

ITEM #2 STEEL, REINFORCING

PLAN QUANTITIES

ART 2404.10

47,060 LBS x $0.22 = $10,551.20

ART 2404.09 FOR QUANTITY CHANGE

PLUS / EXTRA WORK ORDER

SEE FINAL QUANTITIES BOOK

PLAN QUANTITIES SHOWN IN PENCIL

ITEM #3 EXCAVATION, CLASS 20

ART 2402.13 2402.12 B

509 CU YDS X $6.00 = $3,054.00

ART 2402.13 D EXTRA WORK

Plus EXTRA WORK ORDER FOR ROCK.

SEE FINAL QUANTITIES BOOK

ENGINEER's ESTIMATE SHOWN IN PENCIL

10

ITEM #4 CLEARING & GRUBBING

ART 2101.03

100% of #127.15 = #127.15

For actual Form #312

SEE FINAL QUANTITIES BOOK

CONCRETE TEMPERATURE RECORDS

DATE OF POUR	No. DESIGN	UNIT	PLAN VOLUME	POURED APPROX DIM
9-1-78		Footing	88.19	
9-22-78		WALLS DECK	90.02	91.75
9-26-78		Footing	11.00	12.25
9-29-78		Footing	77.19	78.50
10-3-78		WALL DECK	90.02	91.75
	total		356.42	CUBIC YARDS

Doc

Doc

~~COLD~~ WEATHER ~~CONSTRUCTION~~

Time Pour Complete	Protection	Concrete Heated?	Date	Time	Age	Temp Air	Temp Conc	INITIAL
6:00 PM	WATER	NO						Doc
NOON	Comf.	NO						Doc
2:30 PM	"	NO						Doc
NOON	"	NO						Doc
NOON	"	NO						Doc

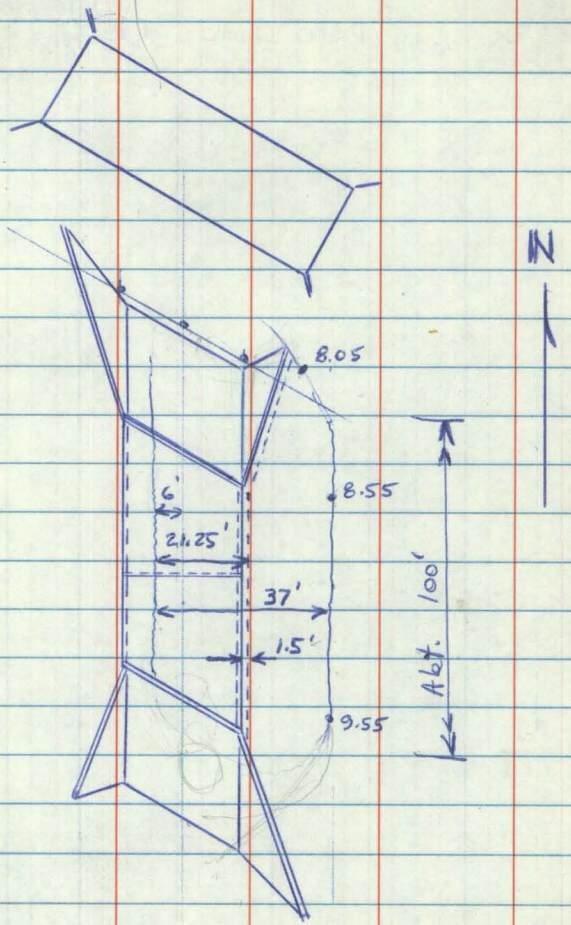
CONCRETE TEMPERATURE RECORDS

Date of Pour	No Design	Unit	Volume	Approximate Dimensions

COLD WEATHER CONSTRUCTION

Time Pour Complete	Protection	Concrete Heated?	Date	Time	Age	Temperature Air	Temperature Conc	Initial

Culvert Layout & Breakdown of Quantities



Paul asked me to make an estimate of the unexpected rock excavation after the contractor had removed it. So the following calculation is a rough estimate.

DATE STAKED 3-22-63 10/17/77

DATE COMPLETED 11/10/77

DATE ACCEPTED 11/10/77

Pent Mon 14

Nov. 10, 1977

QUANTITIES

EXTRA WORK UNEXPECTED ROCK

804.23 — 805.00

.77 — Avg ledge rdg 8.80

805.00 = HI — Avg ledge Elev. 796.20

Flow line Elev. 794.20

Depth of floor 1.17

Elev bot. of floor 793.03

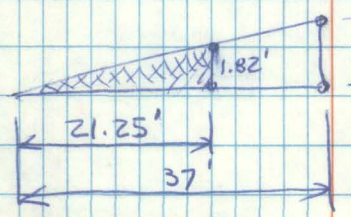
Avg ledge Elev. 796.20

diff = 3.17 feet

$3.17\left(\frac{21.25}{37.0}\right) = 1.82'$

Vol of unexpected rock

$$\frac{\frac{1.82'}{2}(21.25')(100')}{27\ cf/cu.yd} = 71.62\ cu.yd.$$



$\frac{1}{2}(30')(2.0)8 = 8$

TPS

DIARY

October 20

I went to the site to count trees with Mr. Silvers. We counted trees on the West bank. TPS

October 21

I went to the site to meet Mr. Silvers to count trees. We Counted trees on the east bank. Mr. Silvers said he might work Saturday. TPS

October 27, 1977

Mr Silvers said he worked with his son Saturday. He said he worked about a half a day. Mr. Silver said he worked with his brothers Tuesday and Wednesday. TPS

Oct 27, 1977

Ed Silver and his two brothers were working unloading steel with Shirley's over head crane without hard hats. I told Ed Silver that he and his men should be wearing hard hats. The hats were in his truck but he did not have his men wear them.

Ed Silver and his men worked about one hour. TPS

~~October 31, 1977~~

November 1, 1977

I went to the site to try to estimate how much unexpected rock could be paid for. The Contractor had excavated about 30 to 60 cu yd all or most of it beyond the limits of the culvert. The rock was excavated 15 to 20 ft east of the box. TPS

November 1, 1977 I phoned Mr. Ed Silver. He said it was raining in Central City. Mr. Silver said he would not work today. Mr. Silver will meet me Wed. morning at 8:15. TPS

November 1, 1977.

On my phone call to Mr. Silver this morning I promised to give him a level shot. I asked Mr. Silver to bring his bar list so I could show him some errors the fabricator had made.

TPS

November 1, 1977 2:25 pm

I phoned Mr Ed Silver to ask him to mail me a copy of Form 630176 or 176 Certified Transcript of Weekly Payroll. I told him we need it yet this week. I asked Ed Silver to mail a completed PR-1391 Monthly EEO Manpower Report. I told him we need that ~~#~~ report this week or next. Ed Silver said he needed a copy of the poster "Safety and Health on the Job". I told him I would try to help him obtain a copy. TPS

November 1 1977 2:25 pm phone call cont.

I told Mr Silver we would set a grade stake and that I would meet him at 8:15 am.

TPS

November 2 1977

I met Ed Silver at the site around 8:10 AM. I gave Ed Silver grade shots on three flats. BM 804.23 Bs. 1.56. H I 805.79.

FS 1st flat 11.70 Elev 794.09
Bottom of floor 793.04 cut 1.05 ft.

FS. 2nd flat 10.59 Elev 795.20
Bottom of floor 793.04 cut 2.16

FS. 3rd hub 9.61 Elev. 796.18
Bottom of floor 793.04 cut 3.14

I gave Ed Silver Decision No IA77-4209 page 4 and 5. Pay rates - Ed Silver said he already had this information. I asked Ed Silver to put up his bulletin

TPS

November 2, 1977 continued
board. Ed Silver said he did not plan to work, i.e, he was uncertain if he would work. The weather was bad, heavy overcast with a mist or drizal. Silver's men were putting up string lines at the paraget lines. TPS. 11/2/77

November 2, 1977
I took three pictures looking south of the bridge showing the rock excavation west of the box.
TPS 11/2/77

November 3, 1977
I visited the site to inform Mr. Edwin Silver that the box must be entirely on rock or upon a fill. We could not determine if Mr. Silver had undercut the area of the box because of the material he had moved over the area. I told Mr Silver if the box was not on rock that he would be required to follow the plans in regard to the length, depth, etc dimensions of the curtain wall. However if the culvert was placed entirely on rock that we would require only one foot of depth on the curtain wall. I told Mr Silver to phone the Engineer's Office if he needed survey information to help determine where he was in regard to elevation. I told Mr. Silver we would require him to undercut the rock in the area of the culvert in the event that part of the culvert would rest on rock and part on a fill material. I pointed out that the rock sloped downward to the west. Mr Silver had planned to rent a large ~~bull~~ dozer, today, ~~Thursday~~. TPS

November 3, 1977
I phoned the office around 3:35 to check if Mr. Silver had phoned to ask for the survey party. He had not.
TPS

November 7 1977

I phoned Mrs. Silver to have Mr Edwin Silver phone us when he planned to work this week. We were not expecting him to work because of high water. I asked Mrs. Silver to have Ed send us the wage rate forms. She said she thought Ed had mailed them. TPS

Nov 7, 1977

Ed Silver phoned and asked us to give him some level shots so he would know where he was with respect to bottom of footings. I agreed to be at the site at 1 pm

TPS

Nov 7, 1977

Ed phonned around 12:30 pm to cancel the level survey. Darrel answered the phone. Ed asked that we meet him at 9 pm Tuesday. TPS

Nov 8, 1977

Darel and I did a level survey

Nov 8, 1977 Cont.

in the area of the RCB. See attached sketch. TPS

November 8, 1977

Ed Silver brought in 3 copies of form PR-1391. He had not received copies of 830176, so I phoned the Contracts Office in Ames and the secretary said she would have the supplies Office mail Ed Silver copies of form 830176. Paul Schwarting told Mr Silver that the box would remain at the elevation shown on the plans. Paul asked Ed to clean off the area and he would decide later if some mass concrete would be needed to support the west side of the box. I gave Ed Silver a copy of the level survey. TPS

November 10, 1977

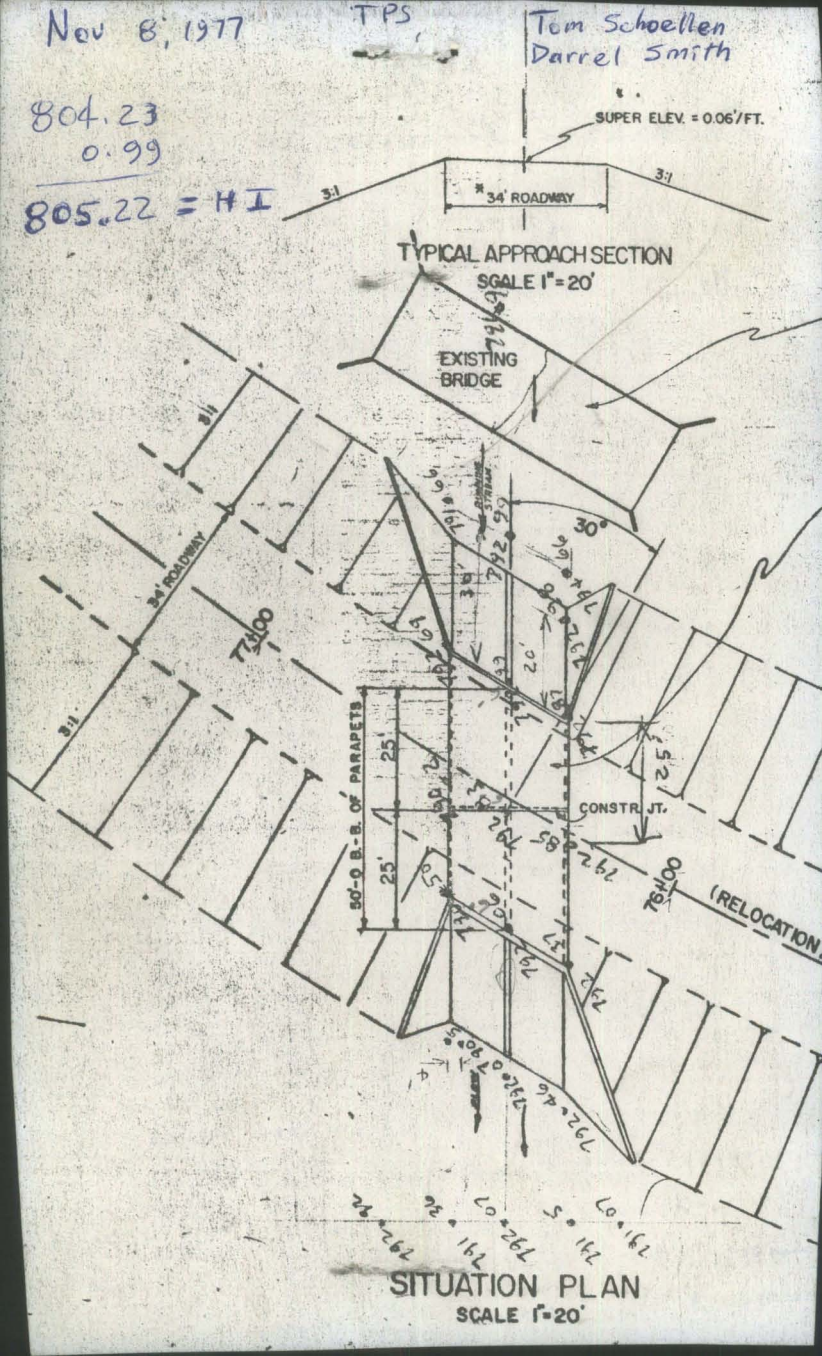
I visited the site. Ed Silver was working with two other men. Also he had an operator and a back hoe cleaning the mud off of the rock. Black Hawk Co. hauled about 8 loads of sand to backfill. I made some calc's for the unexpected rock see pages 26 and 27. Also I made a level

Nov 8, 1977 TPS

Tom Schoellen
Darrel Smith

804.23
0.99

805.22 = HI



SITUATION PLAN
SCALE 1"=20'

Nov 10, 1977 Cont.
survey of the area before it was backfilled with sand. See below—

Nov 14, 1977

I visited site around 8 AM CST. Ed Silver asked for the location of the mass concrete pours. Ed asked if he would be paid for moving sand fill. Told him to phone Paul because I had to be at the Ansborough Bridge at 9 AM

TPS

Nov. 15, 1977

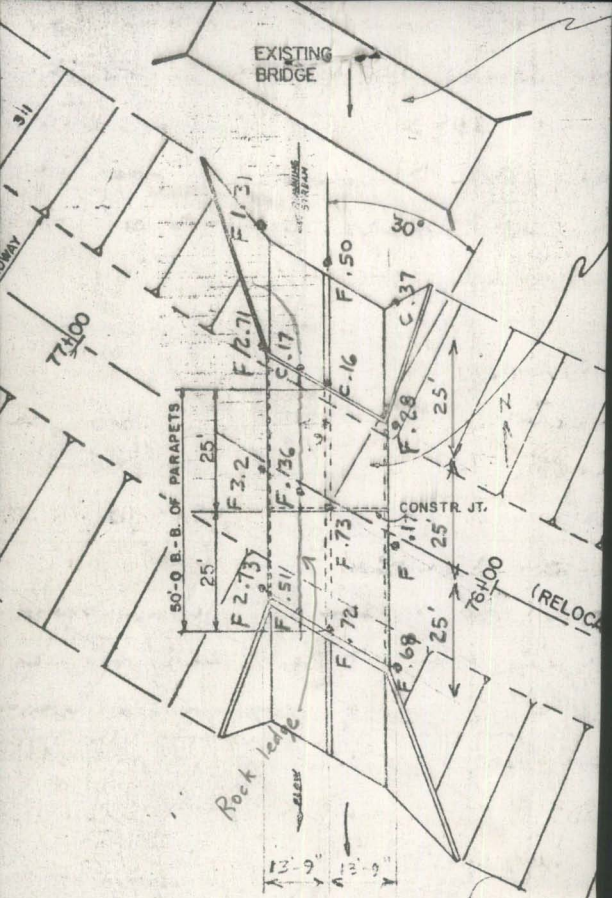
I visited the site to check the staking of the north curtain wall, however it was not staked out when I arrived. I told Ed Silver to phone the Office when he had staked it. I told Ed Silver to have the payroll forms in our office Nov 16.

TPS

November 16, 1977

I visited the site to check the location of some form lines, at Ed Silver's phoned in request. When I arrived there were no form lines. I checked their center line and another line,

Discover


EXISTING BRIDGE
50'-0 B. OF PARAPETS
CONSTR. JT.
Rock ledge
SITUATION PLAN
SCALE 1"=20'

Nov 16, 1977. Cont.
When Ed Silver phoned I told him Paul Schwarting would allow him to use his end loader bucket to haul concrete down to the wall pours in the rock trench.
TPS

November 17, 1977
I phoned Mrs. Ed Silver to give Ed Silver a message. Payroll does not have to be reported Fri to Fri. I asked that Ed Silver sign the statement of compliance on the reverse side of forms 176. I gave the message that if the forms are not complete soon that Paul Schwarting would issue a shut down order. TPS

November 18, 1977
I visited the site to have Ed Silver sign the compliance statement on the back of wage rate forms. Also, I checked the location of his curtain wall and I found that the east wing was located too far to the east. I checked some other dimensions and departed
TPS

November 21, 1977
I phoned Mrs Silver to ask if Ed Silver was working. Mrs. Silver said he was, however, when I arrived at the site, no one was working - Perhaps Ed broke a hose on his end loader.
I took three pictures frame 6 and 7 of the rock excavation of the east wing of the north headwall. I was facing north for the pictures. The third picture frame eight, was taken facing north. This picture was taken of the excavation for the west wing-wall of the north headwall. The picture shows the relative heights of water.
TPS

November 28, 1977
Ed Silver came in the office. We covered what was to be corrected on Certified Transcript of Labor Payroll.
Ed signed the Extra Work Order for Unexpected Rock and some vouchers. Ed asked for a payment. Ed said he stopped construction until he could hire a qualified foreman to run his operation.
TPS

Nov 30, 1977
I visited the site. No one working Ed Silver was going after someone to repair his end loader.
TPS

Nov 30, 1977
We received the corrected Certified Transcript of Labor Payroll by mail, from Silver Court. Today
TPS

December 13, 1977
We phoned Ed Silver to tell him the water was comming up on his end loader. Ed said he knew because he was there today. Ed talked to Paul about out contracting the floor. TPS

January 4, 1978
I visited the site. The impression I got was that the contractor had moved his equipment out
TPS

March 16, 1978
I visited the site. Most of the steel was off the ground and safe from a flood.
TPS

March 31, 1978
I phoned Ed Silver.
Ed Silver has employed Richard O'Brien of Bjorsen Construction Company 208 Collins Road NE to run his job. I told Ed working days start April 1, 1978 TPS

April 3 1978 untell June 2 River was up and down several times preventing Contractor from working on project

June 5, 1978 Worked on excavation for North ½ Floor

" 6 Worked on excavation for North ½ of floor

" 7 Placing Rock under floor To get out of mud

" 8 Work on Rock excavation No. Curtain Wall

June 9 Worked on Rock excavation North Curtain Wall & Forming on N ½ of Footing

June 12 Worked on Forms & Placing Reinforcing in North ½ of footing. Curtain Wall Was excavated one foot into Rock

June 13 Worked on & placing Reinforcing steel in North ½ of footing

June 14 worked on placing reinforcing N. ½ of footing. Rain at noon. charged ½ Work day.
Ed Silver said Richard O'Brian Was No longer his forman That he had Went back To Bjorson Construction. He said he was getting a forman From South of Centerville

June 15, 1978 Contractor did Not work on proj charged a Workday Clear day

June 16 River came up and Flooded proj

River was up and flooded culvert from June 16 untill Aug 4, 1978 No work days were charged.

The Week of Aug 7th To Aug 11 The river was down and contractor could have been Working 5 Work days were charged for This Week

SEPT 1, 1978 - POURED NORTH Footing. STARTED AT 7:30AM FINISHED AT 6:00PM.

SEPT 2, 1978 CONTRACTR FLOODED Footing TO CURE CONCRETE.

SEPT 18, 1978 IOWA CULVERT BUILDERS MOVED IN TO FINISH BOX FOR SILVER'S.

SEPT 22, 1978 - CONTRACTR POURED NORTH END WALLS AND DECK. STARTED 9:00AM FINISHED AT NOON.

IOWA

Sept 26, 1978 - Contractor poured South Curtain wall 12:00 - 2:30 PM.
DOC

Sept 28, 1978 - Contractor poured remaining South Footing. DOC

Oct 3-1978 - Contractor finished last concrete on walls and deck.
DOC

Oct 25, 1978 - Silvers finish dirt work and removed dike from under bridge. Excepted project.
DOC

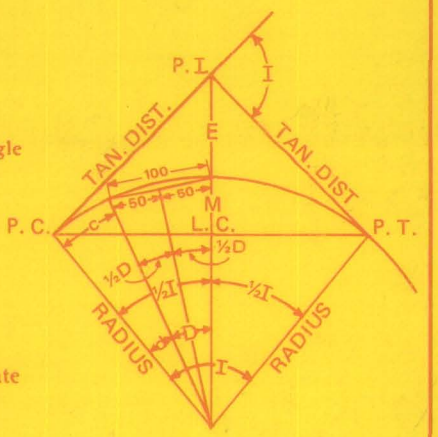
18 miles Nov 3rd @ .15
1½ hours
Doubts to ability to build RCB
Have you or your men had experience with structured concrete, pours, vibration, finishing, curing
Are you or your men familiar with I DOT spec book

Vern + Tony finishing experience
Vern Vibrating experience
No one on culvert

6'-8" + 7" 7 8'-6"

CURVE FORMULAE

D=Degree of Curve
1°=1-Degree of Curve
2°=2-Degree of Curve
P.C.=Point of Curve
P.T.=Point of Tangent
P.I.=Point of Intersection
I=Intersection of Angle, Angle Between Two Tangents
L=Length of Curve, from P.C. to P.T.
T=Tangent Distance
E=External Distance
R=Radius
L.C.=Length of Chord
M=Length of Middle Ordinate
c=Length of Sub-Chord
d=Angle of Sub-Chord



$$R = \frac{L.C.}{2 \sin ½I}, \quad T = R \tan ½I = \frac{L.C.}{2 \cos ½I}$$

$$\frac{L.C.}{2} = R \sin \frac{I}{2}, \quad D\,1° = R = 5730, \quad D\,2° = \frac{5730}{2}, \quad D = \frac{5730}{R}$$

$$M = R\,(1 - \cos ½I), = R - R \cos \frac{I}{2}$$

$$\frac{E + R}{R} = \sec \frac{I}{2}, \quad \frac{R - M}{R} = \cos \frac{I}{2}$$

$$c = 2R \sin ½d, \quad d = \frac{c}{2R}$$

$$L.C. = 2R \sin ½I, \quad E = R\,(\sec ½I - 1), = R \sec \frac{I}{2} - R$$

Minutes in Decimals of a Degree

1′	.0167	11′	.1833	21′	.3500	31′	.5167	41′	.6833	51′	.8500
2	.0333	12	.2000	22	.3667	32	.5333	42	.7000	52	.8667
3	.0500	13	.2167	23	.3833	33	.5500	43	.7167	53	.8833
4	.0667	14	.2333	24	.4000	34	.5667	44	.7333	54	.9000
5	.0833	15	.2500	25	.4167	35	.5833	45	.7500	55	.9167
6	.1000	16	.2667	26	.4333	36	.6000	46	.7667	56	.9333
7	.1167	17	.2833	27	.4500	37	.6167	47	.7833	57	.9500
8	.1333	18	.3000	28	.4667	38	.6333	48	.8000	58	.9667
9	.1500	19	.3167	29	.4833	39	.6500	49	.8167	59	.9833
10	.1667	20	.3333	30	.5000	40	.6667	50	.8333	60	1.0000

Inches in Decimals of a Foot

1/16 .0052	3/32 .0078	1/8 .0104	3/16 .0156	1/4 .0208	5/16 .0260	3/8 .0313	1/2 .0417	5/8 .0521	3/4 .0625	7/8 .0729
1 .0833	2 .1667	3 .2500	4 .3333	5 .4167	6 .5000	7 .5833	8 .6667	9 .7500	10 .8333	11 .9167