

STATE OF MINNESOTA  
DEPARTMENT OF HIGHWAYS

27-516-01 62-511-01

FORCE & EQUIP. DIARY

LEVEL BOOK

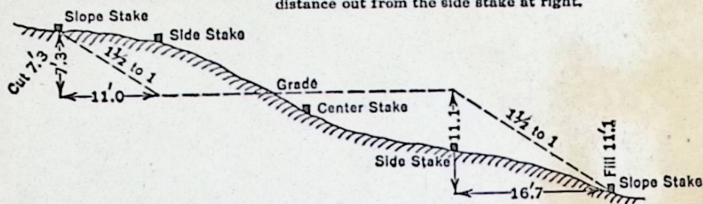
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8

## DISTANCES FROM SIDE STAKES FOR CROSS-SECTIONING

Roadway of any Width. Side Slopes  $1\frac{1}{2}$  to 1.

In the figure below: opposite 7 under "Cut or Fill" and under .3 read 11.0, the distance out from the side stake at left. Also, opposite 11 under "Cut or Fill" and under .1 read 16.7, the distance out from the side stake at right.

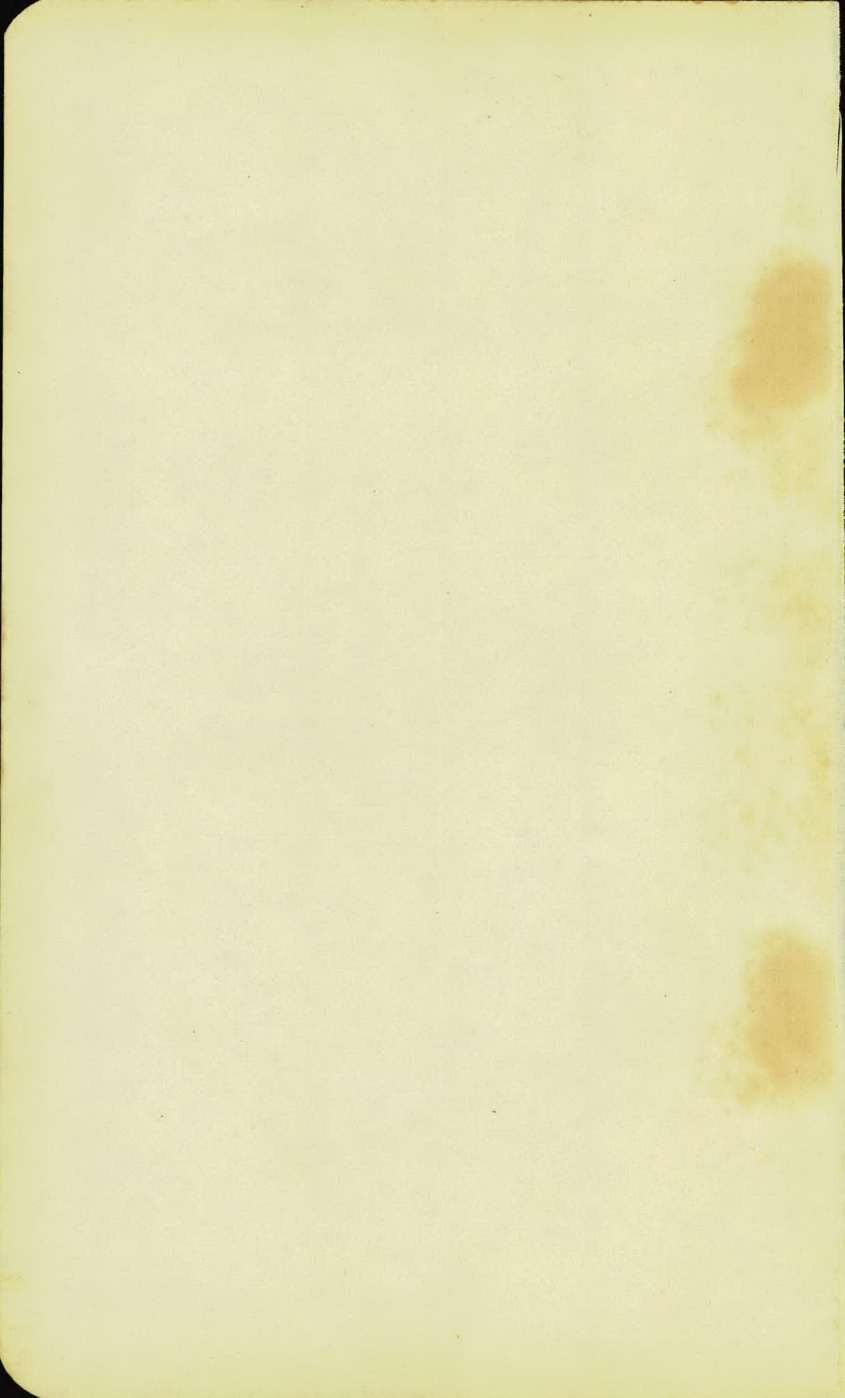


| Cut or Fill | Distance out from Side or Shoulder Stake |      |      |      |      |      |      |      |      |      | Cut or Fill |
|-------------|--|------|------|------|------|------|------|------|------|------|-------------|
|             | 0  | .1   | .2   | .3   | .4   | .5   | .6   | .7   | .8   | .9   |             |
| 0           | 0.0                                      | 0.2  | 0.3  | 0.5  | 0.6  | 0.8  | 0.9  | 1.1  | 1.2  | 1.4  | 0           |
| 1           | 1.5                                      | 1.7  | 1.8  | 2.0  | 2.1  | 2.3  | 2.4  | 2.6  | 2.7  | 2.9  | 1           |
| 2           | 3.0                                      | 3.2  | 3.3  | 3.5  | 3.6  | 3.8  | 3.9  | 4.1  | 4.2  | 4.4  | 2           |
| 3           | 4.5                                      | 4.7  | 4.8  | 5.0  | 5.1  | 5.3  | 5.4  | 5.6  | 5.7  | 5.9  | 3           |
| 4           | 6.0                                      | 6.2  | 6.3  | 6.5  | 6.6  | 6.8  | 6.9  | 7.1  | 7.2  | 7.4  | 4           |
| 5           | 7.5                                      | 7.7  | 7.8  | 8.0  | 8.1  | 8.3  | 8.4  | 8.6  | 8.7  | 8.9  | 5           |
| 6           | 9.0                                      | 9.2  | 9.3  | 9.5  | 9.6  | 9.8  | 9.9  | 10.1 | 10.2 | 10.4 | 6           |
| 7           | 10.5                                     | 10.7 | 10.8 | 11.0 | 11.1 | 11.3 | 11.4 | 11.6 | 11.7 | 11.9 | 7           |
| 8           | 12.0                                     | 12.2 | 12.3 | 12.5 | 12.6 | 12.8 | 12.9 | 13.1 | 13.2 | 13.4 | 8           |
| 9           | 13.5                                     | 13.7 | 13.8 | 14.0 | 14.1 | 14.3 | 14.4 | 14.6 | 14.7 | 14.9 | 9           |
| 10          | 15.0                                     | 15.2 | 15.3 | 15.5 | 15.6 | 15.8 | 15.9 | 16.1 | 16.2 | 16.4 | 10          |
| 11          | 16.5                                     | 16.7 | 16.8 | 17.0 | 17.1 | 17.3 | 17.4 | 17.6 | 17.7 | 17.9 | 11          |
| 12          | 18.0                                     | 18.2 | 18.3 | 18.5 | 18.6 | 18.8 | 18.9 | 19.1 | 19.2 | 19.4 | 12          |
| 13          | 19.5                                     | 19.7 | 19.8 | 20.0 | 20.1 | 20.3 | 20.4 | 20.6 | 20.7 | 20.9 | 13          |
| 14          | 21.0                                     | 21.2 | 21.3 | 21.5 | 21.6 | 21.8 | 21.9 | 22.1 | 22.2 | 22.4 | 14          |
| 15          | 22.5                                     | 22.7 | 22.8 | 23.0 | 23.1 | 23.3 | 23.4 | 23.6 | 23.7 | 23.9 | 15          |
| 16          | 24.0                                     | 24.2 | 24.3 | 24.5 | 24.6 | 24.8 | 24.9 | 25.1 | 25.2 | 25.4 | 16          |
| 17          | 25.5                                     | 25.7 | 25.8 | 26.0 | 26.1 | 26.3 | 26.4 | 26.6 | 26.7 | 26.9 | 17          |
| 18          | 27.0                                     | 27.2 | 27.3 | 27.5 | 27.6 | 27.8 | 27.9 | 28.1 | 28.2 | 28.4 | 18          |
| 19          | 28.5                                     | 28.7 | 28.8 | 29.0 | 29.1 | 29.3 | 29.4 | 29.6 | 29.7 | 29.9 | 19          |
| 20          | 30.0                                     | 30.2 | 30.3 | 30.5 | 30.6 | 30.8 | 30.9 | 31.1 | 31.2 | 31.4 | 20          |
| 21          | 31.5                                     | 31.7 | 31.8 | 32.0 | 32.1 | 32.3 | 32.4 | 32.6 | 32.7 | 32.9 | 21          |
| 22          | 33.0                                     | 33.2 | 33.3 | 33.5 | 33.6 | 33.8 | 33.9 | 34.1 | 34.2 | 34.4 | 22          |
| 23          | 34.5                                     | 34.7 | 34.8 | 35.0 | 35.1 | 35.3 | 35.4 | 35.6 | 35.7 | 35.9 | 23          |
| 24          | 36.0                                     | 36.2 | 36.3 | 36.5 | 36.6 | 36.8 | 36.9 | 37.1 | 37.2 | 37.4 | 24          |
| 25          | 37.5                                     | 37.7 | 37.8 | 38.0 | 38.1 | 38.3 | 38.4 | 38.6 | 38.7 | 38.9 | 25          |
| 26          | 39.0                                     | 39.2 | 39.3 | 39.5 | 39.6 | 39.8 | 39.9 | 40.1 | 40.2 | 40.4 | 26          |
| 27          | 40.5                                     | 40.7 | 40.8 | 41.0 | 41.1 | 41.3 | 41.4 | 41.6 | 41.7 | 41.9 | 27          |
| 28          | 42.0                                     | 42.2 | 42.3 | 42.5 | 42.6 | 42.8 | 42.9 | 43.1 | 43.2 | 43.4 | 28          |
| 29          | 43.5                                     | 43.7 | 43.8 | 44.0 | 44.1 | 44.3 | 44.4 | 44.6 | 44.7 | 44.9 | 29          |
| 30          | 45.0                                     | 45.2 | 45.3 | 45.5 | 45.6 | 45.8 | 45.9 | 46.1 | 46.2 | 46.4 | 30          |
| 31          | 46.5                                     | 46.7 | 46.8 | 47.0 | 47.1 | 47.3 | 47.4 | 47.6 | 47.7 | 47.9 | 31          |
| 32          | 48.0                                     | 48.2 | 48.3 | 48.5 | 48.6 | 48.8 | 48.9 | 49.1 | 49.2 | 49.4 | 32          |
| 33          | 49.5                                     | 49.7 | 49.8 | 50.0 | 50.1 | 50.3 | 50.4 | 50.6 | 50.7 | 50.9 | 33          |
| 34          | 51.0                                     | 51.2 | 51.3 | 51.5 | 51.6 | 51.8 | 51.9 | 52.1 | 52.2 | 52.4 | 34          |
| 35          | 52.5                                     | 52.7 | 52.8 | 53.0 | 53.1 | 53.3 | 53.4 | 53.6 | 53.7 | 53.9 | 35          |
| 36          | 54.0                                     | 54.2 | 54.3 | 54.5 | 54.6 | 54.8 | 54.9 | 55.1 | 55.2 | 55.4 | 36          |
| 37          | 55.5                                     | 55.7 | 55.8 | 56.0 | 56.1 | 56.3 | 56.4 | 56.6 | 56.7 | 56.9 | 37          |
| 38          | 57.0                                     | 57.2 | 57.3 | 57.5 | 57.6 | 57.8 | 57.9 | 58.1 | 58.2 | 58.4 | 38          |
| 39          | 58.5                                     | 58.7 | 58.8 | 59.0 | 59.1 | 59.3 | 59.4 | 59.6 | 59.7 | 59.9 | 39          |
| 40          | 60.0                                     | 60.2 | 60.3 | 60.5 | 60.6 | 60.8 | 60.9 | 61.1 | 61.2 | 61.4 | 40          |

# 8

6529

49144



Hennepin

County road C S.P. 27-516-01

Ramsey

SB 62-511-01

Sta 12+83.7  
00

Snelling

S.P. 6216-02

Diary kept by M. O'Sullivan

Aug 26-42 Cool, light rains.

Contractor began work on County Road C again. 3 Cats @ Leterneaus and one cat @ sheepfoot. Sta 0+00 to county line Sta 12+83 and 0+00 - 10+00 in Ramsey County. Equipment moved up from above noted Sta. to Sta 79+00 to 93 at 9 PM on Nite shift. Rained again during nite got things pretty wet. Lost about 1 1/2 hrs because of rain.

2 hrs Hen 27-516-01

Aug 27, 1942 Cloudy

Went out to take force and equip.

Found D8 cat #61 in camp getting repaired  
also 75 cat #66, A.C. cat #64 left  
for snelling ave to pull sheepsfoot.  
Crew worked all day Sta. 79-93.

2 hrs 62-511-01

Aug 28-1942

Crew back to Sta 0100 to 1100  
Ramsey at beginning of shift.

A.C. cat #64 still pulling units #80 & #81  
Cat #60 & Lot 84, Cat #68 & Lot #86 and

Bulldozer #65 working. See Diary  
62-16-02 for rest of day

1 hr 62-511-01

Aug 29

Rain in AM.  
Showers in P.M.

Moving Groveville to St. Paul

Equipment on job much the same

as Aug 28. Cat 61 & 83, 68 & 86,

60 & 84 and A.C. cat pulling 80-81

worked 3 hrs in AM. Sta. stop to

Sta 15 Forced to stop by rain

resumed work on nite shift got in full

shift.

Aug 31, 1942 Cloudy, showers  
Went out to take force and  
equipment. Cats 60 & 84,  
61 & 83, 68 & 86, Patrol 69  
50 cat A & 80 started 5:00 A.M.,  
New shift time, Sta 8+00 to  
24+00 too wet so moved up  
to Sta 82 to 92 until 12 Noon  
Back to 8+00 to 24+00 at 12:30 P.M.  
Had one heavy shower in AM,  
not enough to stop work. Light  
showers during P.M. Heavy rain  
set in about 11 P.M. Contractor  
quit at midnite.

Sept 1, 1942

No work, grade a mess.

Sept. 2 1942

Only one piece of equipment

Spreader Dragline  $\frac{3}{4}$  yd. worked

10 hrs. start on 62-511-01, except

that dozer #63 worked draining

burrow pit B and along sill

immediately west of Pit B.

Sept - 3 - 1942

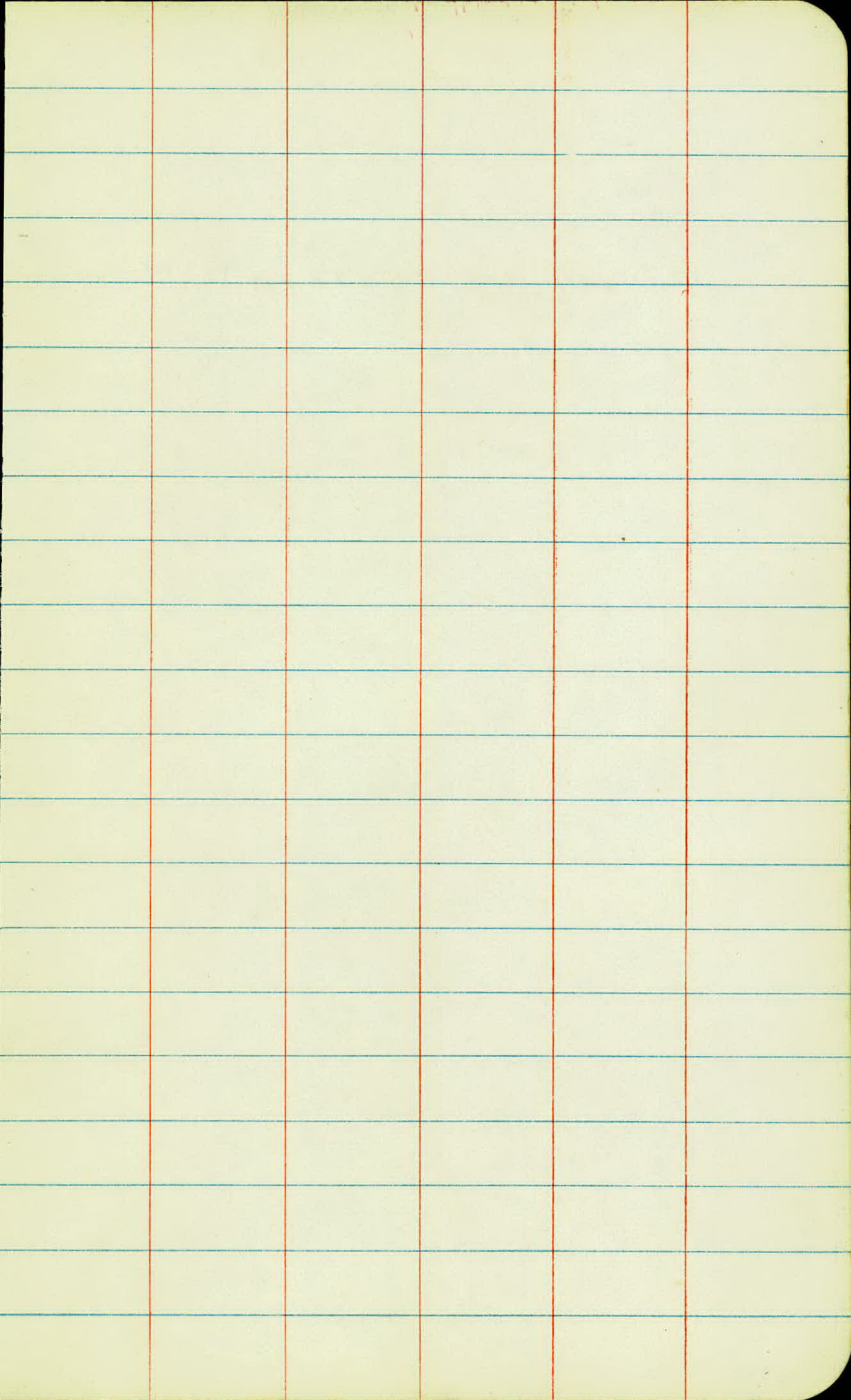
(Day)

Speeder Dragline working  
under telephone line along  
county C Sta. 66 - 67 + 50.

1 hr time

9 mi.

nite



Sept 4, 1942

Cat & scraper crew started to work this project again beginning of shift. Working opposite Borrow P. - B. Moved down to Sta. 35-41 at 7 AM. worked there rest of day shift.

D8 #61, AC. #64 worked all day here.

#68 worked opposite borrow. <sup>to</sup>

until ? then moved over to snelling as TD40 Dozer was broke down

and it <sup>#68</sup> was used to knock down fill.

Patrol #69 blading practically full length of county road C trying to dry out grade.

Nite

Nil  
~~~~~

Sept 5 1942

Speeder drag still taking out ends  
of cuts. Broke down for about 4 hrs.  
Cats #64 and #61 worked in cut.

### Nite

Doyzer 65 - Cat + Scraper 64-85 D4 62-80

worked between 16.40 - until

dark then moved equip over to Snelling.

Sept 8-1942

A.C. cat and scraper working  
Sta. 42-46 also Patrol 69

Speeder Drag working Sta. 32-36  
taking out ends of cuts etc. on  
North side road.

Nite.

cat 61 - Dozer 65 Cat. 64 worked  
St. 42-46 till approx 8 - Cat. 61

Brokedown hauled to shop for repairs.

Started scarifying old road at 1<sup>30</sup>  
% of cat + Lat. hauling could not  
get good results - Told them to

Day Sept 9

Shovel #51 moved into cut Sta. 85-93  
from Pit A. Started to haul this A.M.  
to Henn. Co Sta. 0+00 to 12+00  
Cats #61 and #68 working Sta 43-53  
Dozer 65 working same.

### Nite

- 5 Shovel 51 still at Sta 85-93 across
- 6 from Pit A. Hauling fill to Sta 0+0 to 14+00
- 7 Cat 66 + Roller Sta 0+00 to 14+00
- 8 Cat. 61-68 + 64 working Sta. 26 to 53
- 9 Dozer 65 working Sta. 43 to 53

Checked along Job - Tough dumping  
between Cleveland + #8 a/c No Lights

Instructed Foreman that old road  
would have to be scarified near  
Cleveland he said he would keep  
fill off road. Also told J. Doherty.  
Koehring moved to Pit A at 12<sup>55</sup>

let it go till tomorrow in daylight

Day Sept 10

Patrol #69 Scarifying Bit. Mat Sta  
53 to 63. Cats #51, #64, #61 taking  
out subcut <sup>Henn.</sup> 15+60 to 12. also  
working as far East as Sta 16  
in Ramsey Bulldozer #65 same  
#62 and #80 shpft. same.

Speeder drag working Sta 63-67.

Burned up after lunch time.

Not much loss. Std. Const. laying  
x culv. Sta 5+70 Henn.

Contractor set 300' Forms Henn. End Co C.

Note St. Const completed lay x culv. &  
Backfilled 1/2 of road cut out trench &  
drained water thru ready to lay balance pipe  
Doger 65 - Cat 61 & 71 worked until 8 PM  
then pulled out over on Snelching  
all down @ 8 PM.

Day Sept 11

Contractor setting forms and getting ready to start paving. 3 men on this. St. Const. completing laying of No. End of culv Sta. 570

Patrol # 69 blading out - 23 Ramsey, Cal.

Dozer 65, Cat 71 & 84, Cat 64 & 85, Cat 62 & 80 and Cat 61 & 83 working Sta 30 - 53

Cat 61 down changing cables at 9:30

Speeder Clam being repaired. Throttle sealed by Industrial Com. yesterday until certain changes have been made on shovel.

### Nite

St. Const. completed laying x Culv. 1/2 Rdway + Backfilled & Tamped so Truddie could pass over. Excav. other 1/2 of Trench till dark.

Dozer. 65 - Cat 71 & 84 Cat 64 & 85

Cat. 62 & 80 worked till rain between 6<sup>30</sup> - 7<sup>00</sup>

Sept 12

Rain last nite messed things up quite a bit. Dozer 65, Cat & Let 71 & 84, cat & bet 84-85 and cat and Let 61 & 83 working Sta 43-63.

Std. Const. completing laying of culv. Sta. 7+09

It was necessary to use dozer to help gas trucks thru low spot Sta 49.

Patrol #69 ripping up Bit mat. Sta. 86-94.

Nite Sept. 12

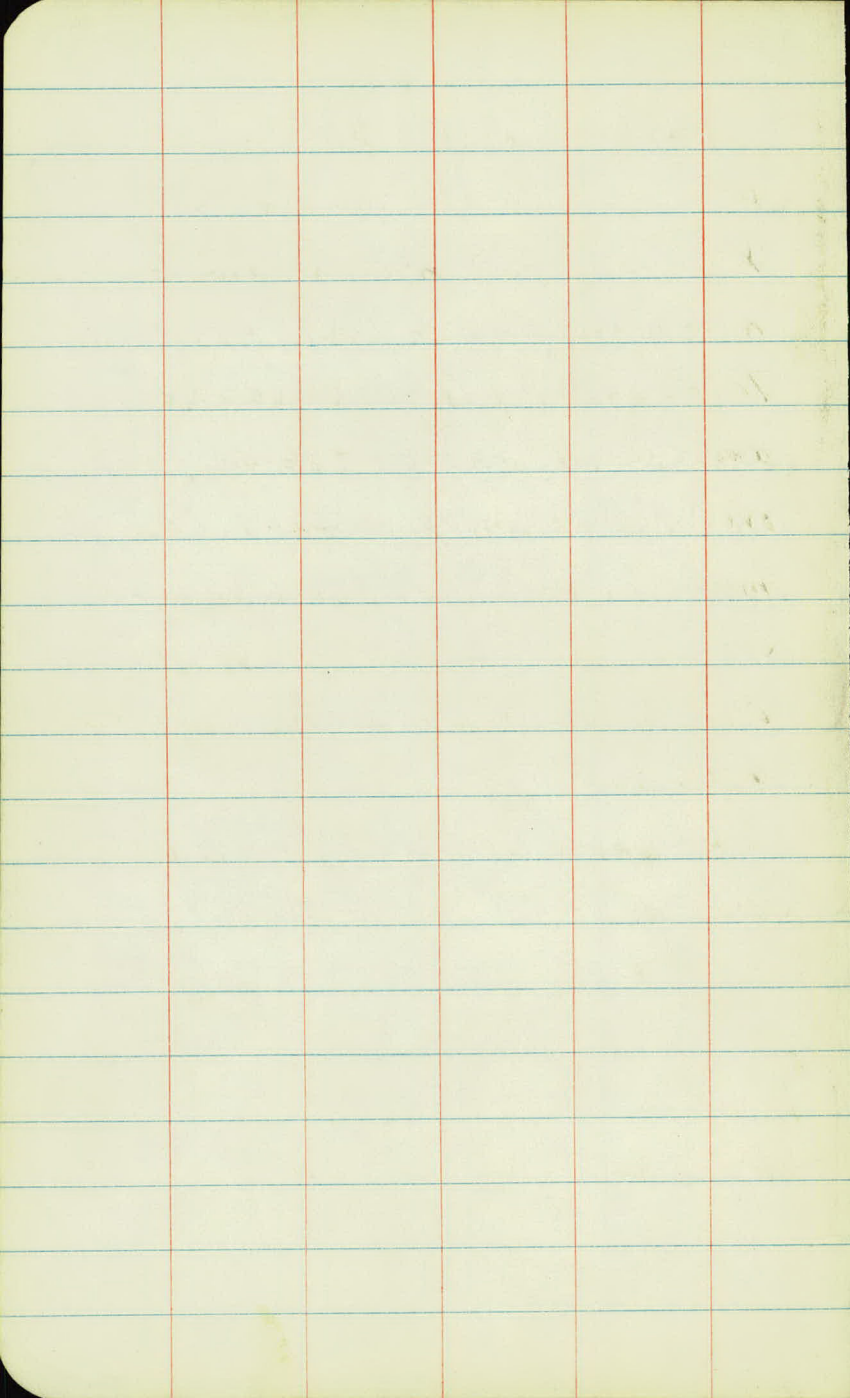
At. Cty C + Cleveland Cat. 71-84

Doyer 85 Cat. 61-83 Cat 66-81

Worked all night. Blocked Cleveland  
Temp. one way Traffic at Cty C-2 for  
about 1 hour + then flagged Traffic  
over new fill until completed about  
midnight. Doyer 65 used to pull  
stalled Old Trucks.

Cleveland intersection in good shape  
after midnight.

Doyer + Ober stayed all night to  
assist Trucks if necessary.



Night, Sept. 13

Cat + Roller 68-80 - Cat 61-83

Cat + ✓ 66-81 - Cat 64-85

Doger 65 - Cat 68-86 + Patrol 69

worked on City C. mostly vicinity of Cleveland. Patrol 69 Broke up + rolled Blacktop. Soft Spot kept showing up west of Cleveland + Doger 65 had to pull Oil Truck thru. Had Blade cut out + refilled with dryer fill - helped for a while but would soften up under Traffic.

Shut down at 10 PM. Grade looks good but a misty rain starting to Fall.

Cat + Opr. ordered to stay until sure Oil Trucks can make it + if it rains to stay all night -

Day Sept 14

Patrol 69 Blading soft spot  
Sta 49 and helping gas trucks  
thrusome. Std Const. digging out  
for X Curb. 55+60. Cat & scraper  
71 & 84 Broke down. # 61 & 83, 68 &  
86, 64 & 85, 62 & 80 and Dozer #65  
working Sta 62-67. Speeder drag  
finally pulled out of way and  
is being repaired. Clam # 50  
helping set up paving equip-  
ment. Looks like a few more  
days before they'll start paving.

Nite Sept. 14

Std. Const. Backfilled over Culv. at Cleveland  
& Excav.  $S^u$   $1/2$  of Trench. The Excav. was  
not a good line Too far West.

Patrol 69 - Blading, grade - Cat 68-86

Cat 64-85 - Doyer 65 - Cat + Roller 62-80

Cat 71-84 - Cat 61-83 worked on grade  
vicinity of Cleveland until 8 then moved  
up to section just West of Snelling + salvaged  
Blanktop. then worked on grade vicinity  
of old P. + B.

Day Sept 15

Heavy rain last nite soaked things up. Contractor has 3 cats and 2 blades working in soft spot Sta. 46-49. pulling gas & fuel trucks thru. Bad Mess. Nothing else moving on the grading on this project. Contractor working on his paving equipment and setup. Showers this A.M. cleared off about 11:00 A.M. Nice this P.M. Only 2 cats working on soft spot pulling trucks this P.M. No actual work on const. this shift. Only equipment moving was at soft spot. Contractor had gravel hauled on west outlet road from Tank Farm. Material hauled from Shiely plant. 89,833 lbs sand, 297,920 gravel and 66,120 lbs sand and gravel.

Nite Sept. 15

Doyzer 65 - Cat 64-85 Cat 71-84  
Cat 61-83 Worked sawaging  
Black top East of Sta 94. Then  
moved at 6<sup>30</sup> to Snelling Sta 159.

Doyzer 72 + Cat 62 stationed  
at Cleveland to pull Out Trucks  
Thru soft spots in Grade.

M<sup>r</sup> Chard arrived at Cleveland intersection  
at about 8 PM just as I was going home  
He watched trucks + ordered the

Blacktop brought down from near  
old Pit B + spread in Soft Spots. Had  
Supt. get Cat + Scraper which pulled  
in + Spread 6 Loads of Black Top.  
It helped a lot but Trucks still  
had to be pulled.

Left at 11 PM.

Starting to sprinkle rain + looks  
like bad weather in S.W.

Day Sept 16

Light Sprinkle this AM at 7:45.  
of short duration but weather is  
still threatening. Cat & Let #61 & 83  
A.C. cat & scraper #64 & 85, Cat & Let 71 & 84  
Blade #67, Dozer 65 and Cat & Slipst.  
62 & 80 working Sta. 85 to Saelling Ave.  
Cat & Let 68-86 being repaired  
Clam #50 still sitting at Sta. 59 & 60.  
Std. Const working on Culv Sta 55 & 60  
TD40 Dozer sitting at Cleveland towing  
gas trucks thru last 50' ft still a little soft.  
Most of the trucks get thru under  
their own power. Stayed at culv site  
and watched laying and back filling. It started  
to rain again just as last pipe was laid.  
Back filling with material from Pit C.  
Rain greased up road so that trucks had  
to be pushed last 50' or 75' again.  
Mr. Chard on job at 12:40

16 Continued

Took 6 loads to backfill culv # 3-2,  
# 36-3 and # 13-1. Cat 68 was down  
from 8 AM. till 12 noon.

Clam # 50 started digging class  
C. exc. Sta 59 at 10:15. Too big  
a piece of equipment to have working  
under wires. Runner warned 3 diff-  
rent times to watch out for wires.  
Culv crew moved up to culv site  
just west New Brighton road.  
Weather still threatening at 3:30 P.M.

Ken Erickson was injured this AM.  
by culv. being let into trench by  
P & H. Hoe shove). Accident occurred  
at site of culv sta 53+46

Nite 16

No Work

Nite Sept. 17

Patrol 69 Doyer 65 + 63

Worked on City C Blading grade  
+ assisting Oil Trucks

8 Trucks hauled 75 Loads coarse

Sand from Culvert Exc. Trench loaded

by Dragline 54 + dumped along

e West of Cleveland. Mr G. W +

Mr Chard on the Job. Doyer + Patrol

working Fill. + pulling Trucks.

at 2 AM. Patrol 69 still working grade

looks like another storm coming

Day Sept 17, 1942

Heavy rain again last nite. Went out on job to insp. culv. just west New Brighton Rd. but contractor wasn't working. Went out to Cleveland and Co. C. Mr Chand already there. Gas trucks not using Co C They are using North end to Tank Farm from Co. Rd. 2A Jct. of Cleveland and Co. C. very soupy. Only one track open across Co. C. on Cleveland. Contractor had 3 loads of rock hauled into intersection. Trucks # 10 2 lds, # 9 1 ld. dumped their loads at intersection. Trucks # 4 1 ld, # 10 1 ld hauled to road Count 2A to Tank Farm. Told Otto Hoffman to put up red flags at intersection of Co. C and Cleveland as rock was loose and might be a hazard.

Day Sept 18

Still cloudy and threatening nothing going on except the Contractor has blade maintaining No. road into Great Lakes.

Tank Farm also has a bulldozer at Cleveland and Co. C. although all gas trucks are using the No road, this A.M. Contractor having sand and gravel hauled to soft spots. Trucks 1 & 2 each hauled 2 loads

#1-11 of material from batching plant. in A.M.

2-11 started to haul from Std Const ditch

Exc. at 1:30 P.M. #1 & 2 Truck #11 3:30 P.M.

at 1<sup>30</sup> Truck #1 ~~||||~~ ~~||||~~ Pull last load from Shovel @ 8 P.M.

at 1<sup>30</sup> ✓ #2 ~~||||~~ ~~||||~~ Pulled out @ 7<sup>10</sup>

at 3<sup>30</sup> ✓ #11 ~~||||~~ ~~||||~~ Pull last load from Shovel 7<sup>55</sup>

at 6 P.M. ✓ #29 ~~||||~~ ~~||||~~ Pull last load from Shovel 7<sup>50</sup>

Note - Could hauling fill to Tank farm N<sup>o</sup> Road.

No other work being done Blade maintaining

Tank Farm Road.

Nite Sept 31

One nite checker quit. I checked loads at zone 8B on Snelling while M.O.S. went home to eat & get clothes. He then took over checking at this point & I started checking equip. & general operations. Light plants all out for several hours. Both Shovels working Kochring Pit A Eric Pit C. G.W. out for several hours & I spent quite a bit of time at Pit C trying to get more uniform 3 Yd Loads. After much fussing around Supt agreed to load 2 small dippers to Truck instead of 1 full one.

This gave us nearer to the required 3 Yds per truck.

M.O.S. went Home at 1 AM & I checked loads till 3 AM.

Snelling Ave

Day Sept 21

Roy and Clift driving #6931. Took Geo. car and went out to get sample of material to right of frostbail. Brought sample in. Ran test of mat'l and it failed. Also ran test material from P, + C and P, + B. Cat 61 & 83 working frostbail exc Right Borrow B. until 11:00 o'clock then over to snelling #71 & 84, 68 & 86, 62 & 80 working same frostbail. Patrol #69 Blading haul roads and roadbed. #50 clam unloading equipment etc. #66 & 81 worked on Cty C until 11 AM. Then moved to Snelling

Day Sept. 22

Spent 2 hrs in office in AM. Then  
put in the afternoon at batching plant.  
Equipment worked New Brighton  
Rd to Snelling, 64 & 85, 73, 62 & 80  
65, 71 & 84. About 8 hrs each. Blade 49  
haul roads and road. Batch Trucks  
unable to use Cty C. so went around  
by way of T.H. 36

Nite Sept. 22

Cato-Lat. + Sepers + patrol worked  
on grade E of Cleveland fill  
dark - then pulled over to Snelling.  
3 Conc. Fin. working on New Slab  
finishing concrete. Had light taken  
from Snelling to this point as they  
did not finish until way after dark.

Day Sept 23

Trucks hauling to backfill frost  
bail opposite P. + B. Road slippery  
from rain during nite and several  
showers this morning. Patrol #44  
Blading from New Brighton road  
to Snelling. D4 Dozer #73 worked  
until 11 AM at frost bail. Contractor  
shut down operations at 11:00 on  
account of mud. Except that Dozer  
#72 moved over from Snelling at  
11 AM and #65 moved over at  
1 P.M. and worked in P. + B.

Nite Sept. 23

Windy  
Cold-Cloudy

No Work going on.

Day Sept 24.

Trucks from Shovel #53 hauling to frost  
berl opposite Pit B. Patrol #69

working N.B. Rd to snelling cat & shpft.

#62 & 80 working in frost berl at 9 AM.

Cat & scarp. #64 & 95 working Sta 43-65

Also #76 & 88. Very windy and cool

today. Clear to Cloudy finishing

up with snow. Didn't stop operation

on grading

6 PM - Cldy Cold. Windy

Wite Sept. 24

Midnite -

Doyer 72 Cat 61-83 Cat 76-88  
Cat + Roller 62-80 Cat 64-85 working  
grade East of Cleveland.

4 Finishers on new Slab - Finishing Brooming  
& covering with Burlap + Paper. Very slow setup  
men went to supper between 7 & 8.

Patrol 69 working on C all night.

Checked concrete Slab at 10<sup>15</sup> to 11<sup>15</sup>  
3 Finishers on Job.  
only about  $\frac{1}{2}$  completed. Beginning to  
get real frosty. Covering up good as  
each panel is finished with Burlap + Paper.  
Could use another Light Plant to good  
advantage.

12<sup>30</sup> Slab still going very slow.

1<sup>05</sup> Completed Brooming

1<sup>30</sup> Completed covering & finishers  
went Home.

Day 9-25

Blade #69, Dozer #65, Cat & Let #71 & 84

Cat & Scrp. #64 & 85, Cat & Scrp #76 & 88

Cat & Shovel #62 & 80. Patrol blading wet

material over shoulder slopes Sta 30 to

48. Cats bringing in dry material from

Sta. 56-60. Road beginning to shape up

pretty well. Std const on avlv just west

New Br. Rd. Clam #52 moved over from

Smelling and is working Sta 85 to 86

taking out left ditch. All grading equip

moved from above mentioned locations

up to Sta 85 to Smelling Ave at 2 P.M.

Nite Sept 25

3 Finishers on new slab  
slow rain at 6 + 7 becoming  
heavy at 8 + turned to snow  
at 9. At 7<sup>30</sup> I had finishers  
stop try to Belt + Broom +  
told them to cover with  
Burlap + paper. At 8<sup>10</sup>  
PETE arrived + he knew all  
the answers. Light Plants  
not working. At 9<sup>00</sup> most  
of Slab was still not covered  
I left as I was soaked to  
the skin. Concrete should  
have been covered good by  
9 easy but no lights.

Messy Job. After drying  
out in office went back + found slab  
still uncovered - snowing hard + no one in  
J. b. Pete came again at 10 + men come from  
eating at 10<sup>10</sup> Pete left at 10<sup>30</sup> + I left  
at 12. Only 2 men - Would not have covered  
before 1<sup>30</sup> anyway -

Day Sept 28

Worked in office all morning except  
for 1 hr at Con't shack. Cat & Shoff

# 62 @ 80 Cat & Serger #61-83, Cat & Serger

# 71 @ 84 Cat & Serp. # 64 @ 85, 76 @ 88,

Dozer No 65 hauling material

from pit B as far as 800' west N.B.Rd.

# 61 @ 83 worked here until 10 AM.

then moved up to paving job.

Note Sept. 28

clear-cold

Patrol 69 working C full length

Cat 71-84 Cat + Roller 62-80 Cat 64-85

Dogger 72 Cat 61-83 Cat 75-87

Dogger 73 (Till 8 PM) worked hauling fill from

Pit B E+W of N.B. Rd.

Cat 76-88 Broke Draw bar being repaired

between 5 to 10 - Dogger 65 on C about 8 PM.

Cat 64-85 pulled out for smelting at 10<sup>20</sup>

Cat 76-88 resumed work about 10<sup>30</sup>

Day Sept 29

Cats and Scrapers hauling out of  
Pit B. and working as far west  
as sta 70. #61 & 83, #71 & 84, #75 & 87  
#62 & 80 and #65 working this portion  
Cat & Scrp #76 & 88 taken off job  
8:45 this A.M. Road beginning to shape  
up pretty well. Sheepfooting adequate  
on this portion for last two days.  
Cat & Scrp #75 & 87 was pulled off job  
and sent to Rosemont at 1 PM today  
Patrol #69 bladeing City C full length  
of grading. Std const. laying pipe  
across City C. just west N. B. Rd. being  
backfilled with material from Pit B.

Nite Sept. 29

Clear-Cook

Std Coast laid pipe in Culvert west of N.B. Road until dark. Planned to open up shoulder + drain slew but Hoe broke Cat rail + too dark to fix. Backfilled with material from Pit B. Part of roadway. Cat 71-84 Cat 61-83 + dozer 65 worked until dark hauling material from Pit B to vicinity of Culvert W. of the N.B. Rd. Dozer 65 partly Backfilled culvert. Checked new concrete Slab finishing - 3 Finishers + 2 Labor working lights OK - finishing OK + Pete OK Should be all finished + covered by 10<sup>30</sup>

Day Sept 30

Equipment working Sta 60-75

Cats 71 & 84, #6 & 85, 61 & 83 & D8

Dozer #65. Std Const. working  
on first culv. west of N.B Rd.

Shpft # 62 and 80 Broke down, no  
rolling on this job this shift.

Hauling out of Pit B.

Nite Sept. 30.

No work by St. Court on Culverts  
Patrol by Scarify Black Top at Int. Sect.  
of E+N.B.Rd. Cat 64-85  
Cat 71-84 Doyer 65 working about  
Sta 55 to 70 Cat 61-83 - broke  
down being repaired.

Checked over new concrete slab.  
Fin. OK Lights OK crew working  
Fine grading + setting forms.  
at 6-7-8-8<sup>30</sup> Quit at dark

Cat + Sheepfoot came on C+ started about 8  
Checked concrete slab at 9<sup>30</sup> to 10<sup>30</sup>  
1 Finisher + 1 Labor Brooming + covering  
with Paper should be thru by midnight.  
All OK.

Sheepfoot down again by Cleveland  
at 10<sup>30</sup> Trying to repair on road.

Day Oct 1

Cats # 61 & 83, 71 & 84 hauling out  
of Pit B as far west as Sta 63  
Cat 68 acting as snatch cat in Pit  
# 62 and 80 Shpft. fill Std Coast  
working Culv just west Snelling. Cats  
spent 2 hrs this A.M. on sub cut by  
N.B Rd. taking out excess dirt placed  
by nite crew. Finished hauling out of  
Pit B about 2 o'clock today. Dozer  
65 working same as cats

Night Oct. 1

No Work by Std. Const. on Culverts

Patrol 69 worked on C all night

Cat + Roller 62-80 Doyer 65

Cat 61-83 & 71-84 worked on

C till dark cutting down over  
filled grade E. of Cleveland, The  
'nite' shift put very little of this  
dirt in. good job.

checked on new concrete all

OK Finishing - Brooming + covering.

Patrol 69 worked C also tried to

bring section E of Cleveland

near to grade after Cat's cut

out excess dirt.

Day

Oct 2

Cats & Scrp 71 & 84, 61 & 83, cats & scrp  
68 & 80, Patrol 69, D8 Dozer 65 working  
from New Brighton Rd to Snelling. Spent  
1<sup>st</sup> 2 hrs this shift on Snelling. No  
material being hauled west out of Pit B  
today. Practically all mat'l today from ditches  
to bring up fill just west of Snelling  
Took a few loads out of Pit B in last  
45 min of shift all going East.

Note Oct. 2

Cat 71-84 - Doyer 65 cutting,  
fill down to grade at Cleveland + E  
Cat 68 pulled Roller 80 until about  
10 then moved over to Snelling +  
Cat 62 which was being repaired  
moved in on C + worked with 80  
checked new Slab all OK at 8-9  
checked new slab all OK at 10<sup>30</sup> - 11<sup>30</sup>  
While at intersection of Cleveland  
about 10<sup>30</sup> 3 Oil Trucks at various  
Times before 11<sup>30</sup> came around  
barricade on 36 had much  
trouble getting turned around  
at C. One Connely Truck with  
Trailer got stalled in ditch 6 of  
Cont. men + shovels finally got  
him out. No equip on that side  
Suggest solid barricade @ 36

Day Oct 3

D4 Cat and Shipt #80 packing  
from New Brighton Rd to Snelling  
only piece of equipment working  
on this project except for  
Cat # 64 and Scrp. #85 hauling  
in some material not worth  
salvaging as Bit. and placing it  
in fill immediately west of  
Snelling.

Nite Oct 3

Raining at 6. -7-8

Patrol 69 worked C but too wet to do much good. Went over + worked soft spots on C-2 Gas Truck Haul road.

Checked new concrete slab % of rain Belting + Brooming impossible finished off Joints + covered same with Burlap + covered slab with paper completely covered just before 10 PM.

Went + looked over C-2 Haul Road a couple of bad spots breaking thru Supt. decided to keep Patrol on hand all night to take care of any trouble with trucks.

Went Home at 11 PM.

---

Day Oct. 4

Fredrickson Calibrating mixer at TH 8  
and City C. Also D'Sullivan helping



Nite Oct. 9

No Work.

Top of 1902

65 - 100 ft

Bad weather

Top of 1902

Day Oct 5.

No grading operations on this project  
except for some bedding. Spent 2 hrs  
in P.M. with std. Const crew getting  
holes cleared out to pour bases for  
2 manholes just west of N. BRd.

Nite Oct. 5

Placed 2 Concrete Footings for  
M.H. at Inter. N.B. Rd + Cty E.

Too much water + Mud to get good  
Job. Took out as much mud  
+ water as possible then put in  
concrete water flooded same.

Smoothed off as much as could  
be done + told them to let it  
stay flooded till AM. Then  
low spots can be fixed with  
Cem. Sand Mix.

As good a job as could be  
done under the existing  
very poor condition.

Day Oct 6

No grading operations going on  
this project but some blading  
and slipfooting. Std Const Build  
ing manholes on bases poured  
yesterday

Wite Oct 6

Patrol 69 worked over road  
& also worked over Tank farm  
Haul road. Cat & Shpsft did  
some packing over road ahead  
of paving operations

Day

Oct 7

Std Const building manholes just west of N.B. Rd. some blading snelling to N.B. Rd. by Patrol #69

Nite Oct. 7

Patrol 69 worked road several times  
checked fresh Concret Slab at 7-8<sup>30</sup>  
+ 9<sup>30</sup>      Belting Brooming - finishing  
+ covering being done OK.

checked Slab at 10<sup>15</sup> almost completed  
should be all done by 11 PM.

Gats + Sebis carried fill from Sta 129+31  
on Snelling to City C + raised grade  
for about 600 ft.  $\frac{1}{2}$  c low grade.

Day Oct 8

Nite Oct 8

checked new Concrete Slab at 7  
+ finishing going OK.

checked again at 9 - all OK

checked again at 10 - all OK

All finished about midnight.

Day Oct 9

No work with grading equipment.

Mixer finished R side of slab to Snelling

Oct 10

Patrol 69 spent 7 hrs blading  
left of slab in A.M. over on Snelling  
in P.M.

Oct. 11

No work today

Nite Oct 9

No Grading equip. working.

Finishers worked on New Slab

Completed all Finishing at 10 PM.

Wite Oct. 10

No Work.

Nite Oct. 11.

No Work.

Nite Oct. 12

No Work.

Nite Oct. 13.

No Work.

Nite Oct. 14

No Work.

Oct 15 Patrol 2 hrs.

Oct 16 Dozer #73 5 hrs

Oct 17 Patrol 69 7 hrs

Oct 18

cat & sheff #66 & 81 put in  
4 hrs in A.M.

Oct 19

Patrol # 69 3 hrs

Oct 20

Patrol # 69 5 hrs

Oct 21

Patrol # 69 4 hrs.

Oct 22

Patrol # 69 5 hrs.

Nite Oct 15 No Work

Nite Oct 16 No Work

Nite Oct 17 No Work

Nite Oct 18 No Work

Nite Oct. 19

2 Finishers worked till about 10<sup>30</sup>  
+ 2 Labor ✓ ✓ about 12<sup>00</sup>.

Finishing new Slab. Poor job on  
Q - did best could be done. S<sup>4</sup>  
Sect Slab edge broken off so that  
it was almost impossible to get  
a uniform line.

Day Oct. 20.

#6183

5561

Nite Oct. 20

3 Fin. worked on new Slab Edging - Belting + finishing Joints. 2 Laborers worked Brooming + covering with paper. Crew worked on Fine grading until dark also couple of men worked repairing Mixer.

Patrol 69 worked a short while ahead of Fine Graders. About 8 o'clock 2 Fin. went home + 1 Fin + 1 Lab. completed Fin + covering. At 10 they still had a good hours work to go.

Day Oct. 21

Nite Oct. 21

3 Finishers worked till  
dark on Slab after that  
1 Finisher 2 labor.

Started snow about 7  
Heavy by 8. Quit Brooming  
& covered with paper. &  
covered joints with Burlap.  
Then went back & lifted  
up paper & removed  
Joint caps & R markers.  
Concrete did not set up  
& it was difficult to  
get much of a finish job.  
Completed work as good  
as possible at 12<sup>05</sup>.

Day Oct. 22

Nite Oct. 22

1 Finisher 2 Labor - Finishing  
Joints - Brooming + Covering.

At 7 o'clock it was  $32^{\circ}$  - We  
used all the Burlap on hand  
+ covered good with paper.

Also covered Fine Grade up to  
machine with paper. Started  
light snow about  $7^{50}$ . Work  
all caught up at 8 o'clock.

Cholide put in Conc. sure helped  
set up a whole lot.

Day Oct. 23

Note Oct. 13

Finishing well up to Mixer  
tonite. Plenty of labor +  
3 Finishers. Covered with  
Blankets + paper. Meek +  
2 men worked on repairing  
Meek. Strike off, till 7<sup>30</sup>  
+ finally got it running.  
Concrete all covered + men  
quit at approx 8 PM.

Day Oct. 24

Nite Oct. 24

1 Finisher edging + fixing  
L. + Brooming - 2 labor  
covering with paper +  $\frac{1}{2}$   
of cold weather forecast had  
Blankets put on top of Paper  
Also labor spread Blankets  
on as much Grade as there was  
covering for.

Finishing all done + covering  
completed by 7<sup>30</sup>.

Day - Oct. 25<sup>+9</sup><sub>-9</sub>

Day Oct. 26<sup>+3</sup>

Nite Oct. 25

Snow  
Cold

No Work.

Nite Oct. 26

Cold.

No Work

Nite Oct. 27

No Work.

Nite Oct. 28

Finishing + taking care of new concrete Slab.

M<sup>r</sup> White was out while Slab was being poured + they made 3 Mixtures 1- St. P. C. 1- Blended Mix + 1 with 2% C. C. the sect with 2% C. C.

was all finished + covered by 7<sup>15</sup> the 2- Other sect. were not completed until approx 9<sup>30</sup>. M<sup>r</sup> White left at 9 P.M. Started to rain at 8.

Covered with paper + Blankets  
Temp at 9<sup>30</sup> - 38°

Day Oct. 29

Note Oct. 29

Finishing & taking care of  
new Concrete.

Completed Brooming - took out  
caps - completed edging &  
Covered with paper weighted  
down good with dirt.

All completed before 7.  
light rain falling.

Day Oct. 30

Nite Oct 30

Dwyer 65 worked in + around  
old Mt B.

No other work.

I drove over City at  
9 & 11 checking lights  
+ Barricades.

Found crossing at Cleveland  
very rough.

Nite Oct 31

No Work.

Nite Nov. 1.

No Work.

Nite Nov. 2.

No Work

Day Nov. 3

Nov 6 Day

Dozer #65 started working cut Lt. side  
Co C at Sta 51-53 at 2:30 P.M.

Nov 6 Nite

Dozer #65 same place all night.

Nov 7 Day

Dozer #65 finished up cut 51-53

then started work cleaning out R. ditch

Cleveland to New Brighton Rd. Scrp. bl 83

working same sta from 9 AM.

Std Const working on culv.

Nite Nov. 3

No Work.

Nite Nov. 4

No Work

10

13

Nite Nov. 5

No Work.

std. Coast working on Culv. Sta 47+50

Nite Nov. 6

Doyce 65 worked on C in the vicinity of Cleveland.

Nite Nov. 7<sup>th</sup>

Patr Seper 61-83 & Doyce 65 worked Co. C. vicinity Cleveland to New B. Rd. until about 7<sup>30</sup> then moved over to Snelling.

Day Nov 11

Dozer #65 and Cat & Scrp 61 & 83  
spent 2 hrs on shouldering, clean-  
ing ditches etc. N.B. road to East  
end.

Day Nov 12

No work

Day Nov 13

Cat & Scrp #61 & 83 and Dozer #65  
worked Sta. N.B. Rd to Snelling.  
Hauling from Pit B. part time

Nov 14 Day

61 & 83, 71 & 84 & Dozer #65 worked  
Sta 75 to Snelling.

Nov 15

No work

Nite Nov 11

Cat & scarp 61 & 83 and dozer #65  
put in 3 hrs Sta. 96-103. Then  
moved over to Snelling

Nite Nov 12

No work

Nite Nov 13

Cat & Scarp #61 & 83, 71 & 84 Dozers #  
72 & 65 worked same as day shift.

Nov 14 Nite

61 & 83, 64 & 85 Dozer 65 worked  
same as day shift.

Nov 16

Cat & Scrp # 61 & 83, 71 & 84 and  
Dozer #65 working Cleveland  
Ave to N.B. Rd. Patrol #69  
working same. No more into shifts

Nov 17

Cats & Scrops # 71 & 84, 61 & 83, Dozer  
#65, Patrol #69 working Cleveland  
to N.B. Rd. Cleaning out ditches and  
shouldering. #61 & 83 moved over to  
snelling at 3:30 PM. worked at Sta 160

Nov 18

Cat & Scrp. 71 & 84 Dozer #72 working  
Cleveland to Great Lakes tank Farm.  
#61 & 83 in Barrow R. & B.  
Dozer #65 shipped to Arkansas yesterday 11/17/44

Nov 19

Cat & Scrp. 71 & 84 Dozer # 72  
and patrol # 69 working Sta 65  
to RR Xing of G.L. Tank Farm.

# 61 & 83 came over from Snelling  
at 9:30. Cont. cleaning ditches and  
Shouldering Dozer # 63 worked 2 hrs in  
P.M. # 72 worked 5 hrs.

Nov 20

Cats & Scrp # 71 & 84, 61 & 83 working from  
Sta 10 Ramsey Co to T.H. No 8. Dozer # 72  
and Dozer 63 idle first part of morning.

# 72, # 61 & 83 and 71 & 84 taken off job at  
10 AM. # 78 & 79 started work at Noon.

Nov 21

# 78 & 79 worked opposite Pit B also  
Dozer # 113 & 63. Shovel # 51 in Pit  
B. 9 Trucks hauling on Ent. on Co. C.  
# 73 worked with Trucks.

Nov 23

Cat and Scrap 78 & 79 and Dozer # 63  
working opposite Pit 13. Dozer # 113  
working Cleveland west. Shovel # 51  
taking out subcut at Cleveland. 3  
Trucks hauling from shovel and dumping  
exc. about 200' N.W. of intersection.  
6 Trucks hauling gravel backfill.

Nov 24.

Dozer # 73 and Patrol # 69 working  
Henneper Co. on Shouldrs. Trucks spotted  
loads on low or short spots on shldr.  
Dozer # 113, Shovel # 51 working Sta.  
74-77. in Pit ditch 5 trucks hauling  
material as far west as TH # 8

Nov 25

Shovel # 51 in ditch Sta 73-75 5 trucks  
hauling west end Dozer # 73 on  
dump and # 113 at shovel

Nov 26

Shovel #51 in Pit B trucks hauling  
between Pit & Snelling for 3 hrs.

Dozer #113 in Pit B for 8 hrs.

Nov 27

Dozer #113 6 hrs in Pit B.

Rest of equipment on Snelling

Nov. 28

No work

The hours shown above for Dozer  
#113 in Pit B were in connection  
with shovel #51 loading from this  
Pit and dressing up cut made by  
shovel on the 26<sup>th</sup>

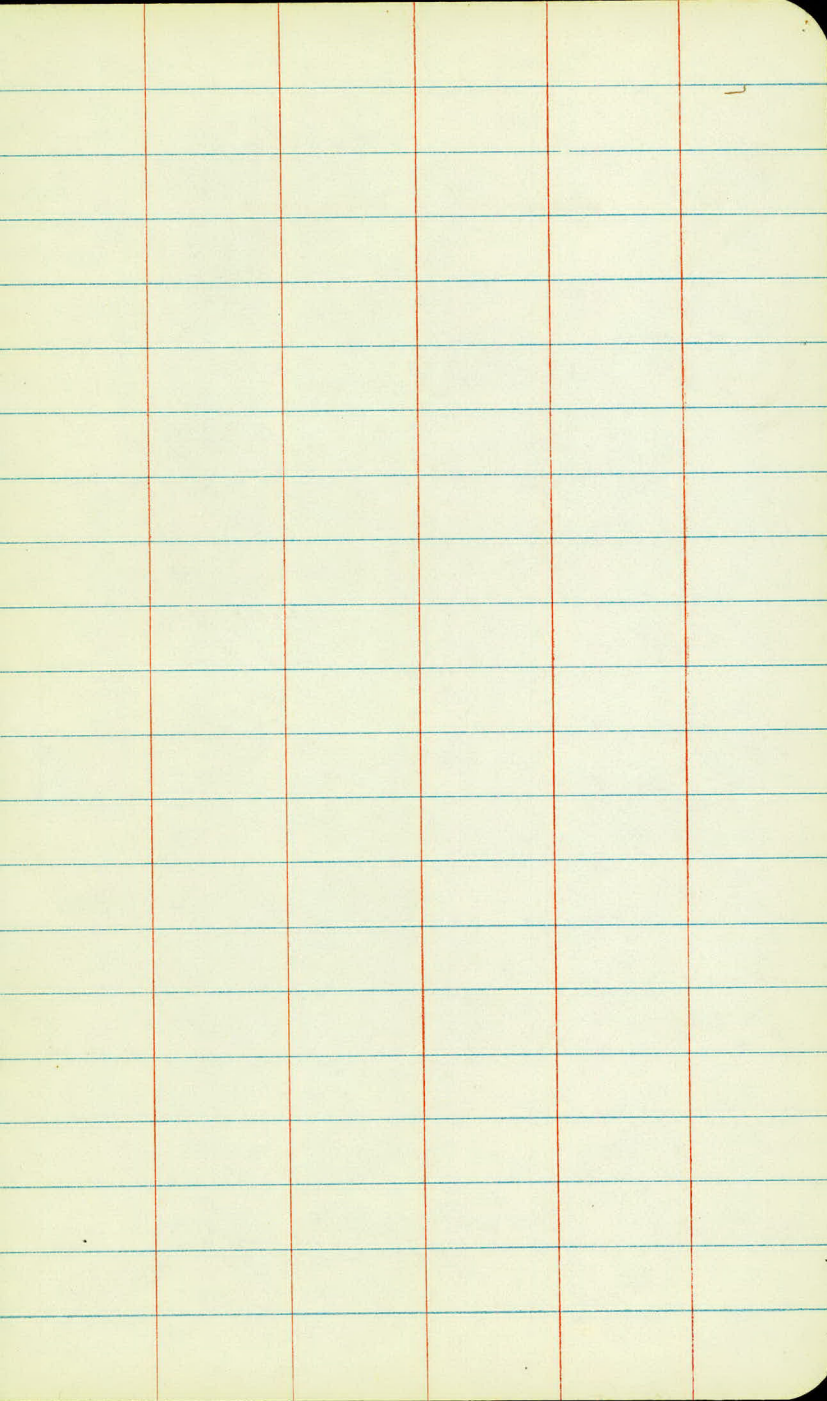
| LT    | LT   | Lt. <sup>side</sup> | RT              |                                                      |
|-------|------|---------------------|-----------------|------------------------------------------------------|
| 0+00  | 44'  | 44'                 | 44'             | } 685.0<br>405.0<br>270.0<br>213.0<br>202.0<br>727.5 |
| +10   | 24.5 |                     | <del>24.5</del> |                                                      |
| +20   | 16   |                     | 16              |                                                      |
| +30   | 11   |                     | 11              |                                                      |
| +40   | 10.3 |                     | 10.3            |                                                      |
| +50   | 9.8  |                     | 10              |                                                      |
| +87.5 | 9.5  |                     | 9.5             |                                                      |

RT. side

| LT   | LT   | RT   |                                                       |
|------|------|------|-------------------------------------------------------|
| 0+00 | 44'  | 44'  | } 700.0<br>422.5<br>282.5<br>222.5<br>203.5<br>1372.0 |
| 0+10 | 26   | 26   |                                                       |
| 0+20 | 16   | 16.5 |                                                       |
| 0+30 | 12   | 12   |                                                       |
| 0+40 | 10.2 | 10.3 |                                                       |
| 0+50 | 10.0 | 10.2 |                                                       |
| 1+20 | 9.5  | 9.5  |                                                       |

5705.5  
Sqft.  
633.9544

Intersection of Co. "C" Rd & Cleveland Ave  
Black-Top



## S.C.P.

|        |                   |    |                      |
|--------|-------------------|----|----------------------|
| Sta    | 15                | 18 | 24                   |
| Henn   |                   |    |                      |
| 5+57   |                   |    | 66                   |
| Ramsey |                   |    | 50 relay             |
| 7+09   |                   |    | 38 New               |
| 8+26   | 28                |    |                      |
| 16+92  | 28                |    |                      |
| 22+58  | 40                |    |                      |
| 24+47  | 40                |    |                      |
| 32+80  |                   | 28 |                      |
| 36+62  | 28                |    |                      |
| 47+52  |                   |    | 38                   |
| 51+95  | Relay<br>12" X 20 |    |                      |
| 53+46  |                   |    | 64                   |
| 57+62  | 28                |    |                      |
| 68+65  |                   |    | 92                   |
| 75+66  |                   |    | 92                   |
| 85+40  |                   | 28 |                      |
| 104+16 |                   |    | 12 old ✓<br>54 new ✓ |

Sewer pipe

75+66 }  
 81+50 } 556' X 18" sewer

C.M

Sta.

12"

15

18

24

3+64

Relay  
20

29+98

Relay  
39

31+50

Relay  
20

51+95

Relay  
4'

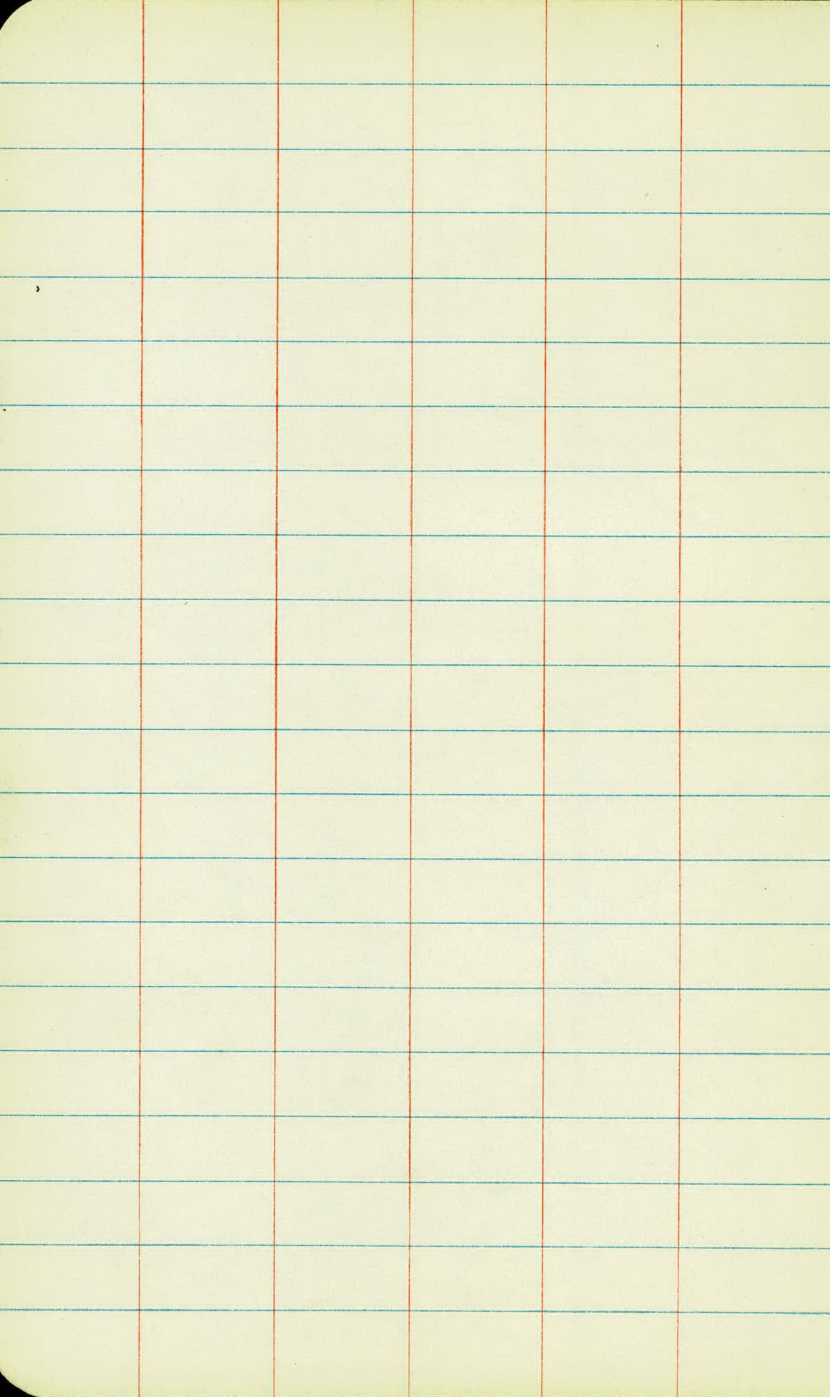
Relay  
4'

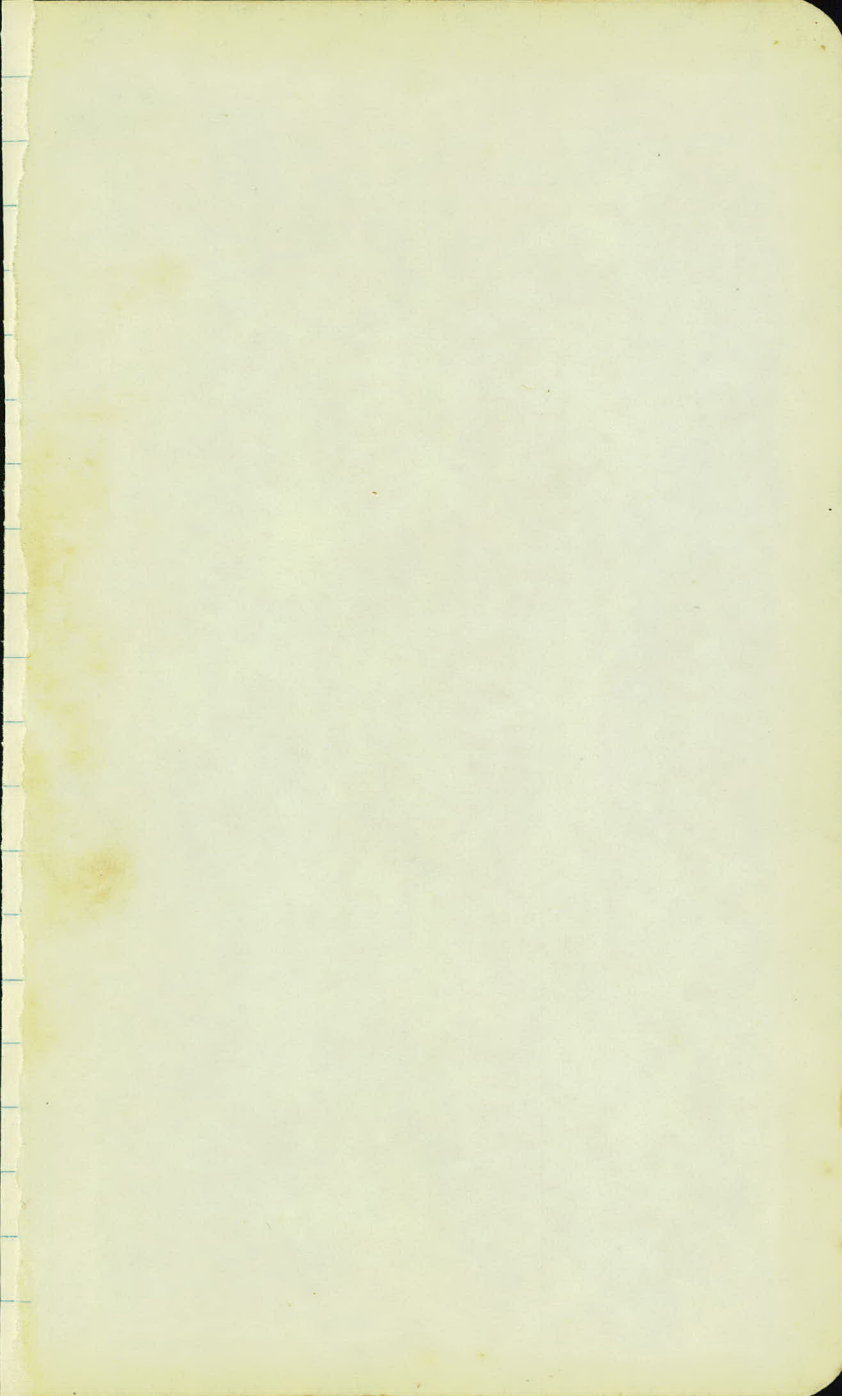
63+98

Relay  
20

101+89

Relay  
26?





Sat Nov 14 P & H. 8 hrs { Oper 8  
Oiler 9

2 pipe layers 9 hrs

1 Truck & Driver 9 hrs.

3 Labor 9

1 Foreman 9

Mon. Nov 16

P & H. 9 { Oper 9  
Oiler 9 + time

1 Foreman 9

1 Pipe lay 9

Truck & drive 9

3 Labor 9

Co. C

Tues Nov 17

Same as Monday

Wed

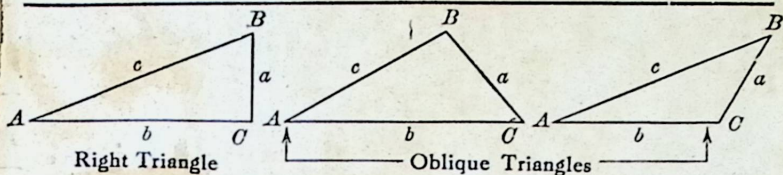
1 Foreman

1 Truck & driver

1 Pipe layer

3 labor, 9 hrs,

# TRIGONOMETRIC FORMULÆ



## Solution of Right Triangles

For Angle  $A$ .  $\sin = \frac{a}{c}$ ,  $\cos = \frac{b}{c}$ ,  $\tan = \frac{a}{b}$ ,  $\cot = \frac{b}{a}$ ,  $\sec = \frac{c}{b}$ ,  $\operatorname{cosec} = \frac{c}{a}$

Given  $a, b$  Required  $A, B, c$

$$\tan A = \frac{a}{b} = \cot B, c = \sqrt{a^2 + b^2} = a \sqrt{1 + \frac{b^2}{a^2}}$$

$a, c$  Required  $A, B, b$

$$\sin A = \frac{a}{c} = \cos B, b = \sqrt{(c+a)(c-a)} = c \sqrt{1 - \frac{a^2}{c^2}}$$

$A, a$  Required  $B, b, c$

$$B = 90^\circ - A, b = a \cot A, c = \frac{a}{\sin A}$$

$A, b$  Required  $B, a, c$

$$B = 90^\circ - A, a = b \tan A, c = \frac{b}{\cos A}$$

$A, c$  Required  $B, a, b$

$$B = 90^\circ - A, a = c \sin A, b = c \cos A$$

## Solution of Oblique Triangles

Given  $A, B, a$  Required  $b, c, C$

$$b = \frac{a \sin B}{\sin A}, C = 180^\circ - (A + B), c = \frac{a \sin C}{\sin A}$$

$A, a, b$  Required  $B, c, C$

$$\sin B = \frac{b \sin A}{a}, C = 180^\circ - (A + B), c = \frac{a \sin C}{\sin A}$$

$a, b, C$  Required  $A, B, c$

$$A + B = 180^\circ - C, \tan \frac{1}{2}(A - B) = \frac{(a - b) \tan \frac{1}{2}(A + B)}{a + b}$$

$$c = \frac{a \sin C}{\sin A}$$

$a, b, c$  Required  $A, B, C$

$$s = \frac{a + b + c}{2}, \sin \frac{1}{2}A = \sqrt{\frac{(s - b)(s - c)}{bc}}$$

$$\sin \frac{1}{2}B = \sqrt{\frac{(s - a)(s - c)}{ac}}, C = 180^\circ - (A + B)$$

$a, b, c$  Area

$$s = \frac{a + b + c}{2}, \text{area} = \sqrt{s(s - a)(s - b)(s - c)}$$

$A, b, c$  Area

$$\text{area} = \frac{bc \sin A}{2}$$

$A, B, C, a$  Area

$$\text{area} = \frac{a^2 \sin B \sin C}{2 \sin A}$$

## REDUCTION TO HORIZONTAL

Horizontal distance = Slope distance multiplied by the cosine of the vertical angle. Thus: slope distance = 319.4 ft. Vert. angle =  $5^\circ 10'$ . From Table, Page IX.  $\cos 5^\circ 10' = .9959$ . Horizontal distance =  $319.4 \times .9959 = 318.09$  ft.

Horizontal distance also = Slope distance minus slope distance times (1 - cosine of vertical angle) With the same figures as in the preceding example, the following result is obtained.  $\text{Cosine } 5^\circ 10' = .9959$ .  $1 - .9959 = .0041$ .  $319.4 \times .0041 = 1.31$ .  $319.4 - 1.31 = 318.09$  ft.

When the rise is known, the horizontal distance is approximately:—the slope distance less the square of the rise divided by twice the slope distance. Thus: rise = 14 ft., slope distance = 302.6 ft. Horizontal distance =  $302.6 - \frac{14 \times 14}{2 \times 302.6} = 302.6 - 0.32 = 302.28$  ft.

