CR 343(6)

14th NORTH

UTILITIES, CROSS SECTIONS

1975

82 0020

Weatherproof Field Book

"Rite in the Rain" paper
32 pages

4⅝" x 7¼"

Keuffel & Esser Co., Morristown, N.J. 07960 Made in U.S.A.

CROSS SECTION CR 343(6)

CURVE FORMULAS

$T = R \tan \frac{1}{2} I$

$T = \frac{50 \tan \frac{1}{2} I}{\text{Sin.} \frac{1}{2} D}$

$\text{Sin.} \frac{1}{2} D = \frac{50}{R}$

$\text{Sin.} \frac{1}{2} D = \frac{50 \tan \frac{1}{2} I}{T}$

$R = T \text{ cot. } \frac{1}{2} I$

$R = \frac{50}{\text{Sin.} \frac{1}{2} D}$

$E = R \text{ ex. sec } \frac{1}{2} I$

$E = T \tan \frac{1}{4} I$

$\text{Chord def.} = \frac{\text{chord}^2}{R}$

$\text{No. chords} = \frac{I}{D}$

$\text{Tan. def.} = \frac{1}{2} \text{ chord def.}$

The square of any distance, divided by twice the radius, will equal the distance from tangent to curve, very nearly.

To find angle for a given distance and deflection.

Rule 1. Multiply the given distance by .01745 (def. for 1° for 1 ft.) and divide given deflection by the product.

Rule 2. Multiply given deflection by 57.3, and divide the product by the given distance.

To find deflection for a given angle and distance. Multiply the angle by .01745, and the product by the distance.

GENERAL DATA

Right Angle Triangles. Square the altitude, divide by twice the base. Add quotient to base for hypotenuse.

Given Base 100, Alt. 10. $10^2 \div 200 = .5$. $100 + .5 = 100.5$ hyp.

Given Hyp. 100, Alt. 25. $25^2 \div 200 = 3.125$. $100 - 3.125 = 96.875 =$ Base.

Error in first example, .002; in last, .045.

To find Tons of Rail in one mile of track: multiply weight per yard by 11, and divide by 7.

Leveling. The correction for curvature and refraction, in feet and decimals of feet is equal to $0.574 d^2$, where d is the distance in miles. The correction for curvature alone is closely, $\frac{2}{3} d^2$. The combined correction is negative.

Probable Error. If d_1, d_2, d_3, etc. are the discrepancies of various results from the mean, and if Σd^2 = the sum of the squares of these differences and n = the number of observations, then the probable error of the mean = $\pm 0.6745 \sqrt{\frac{\Sigma d^2}{n(n-1)}}$

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

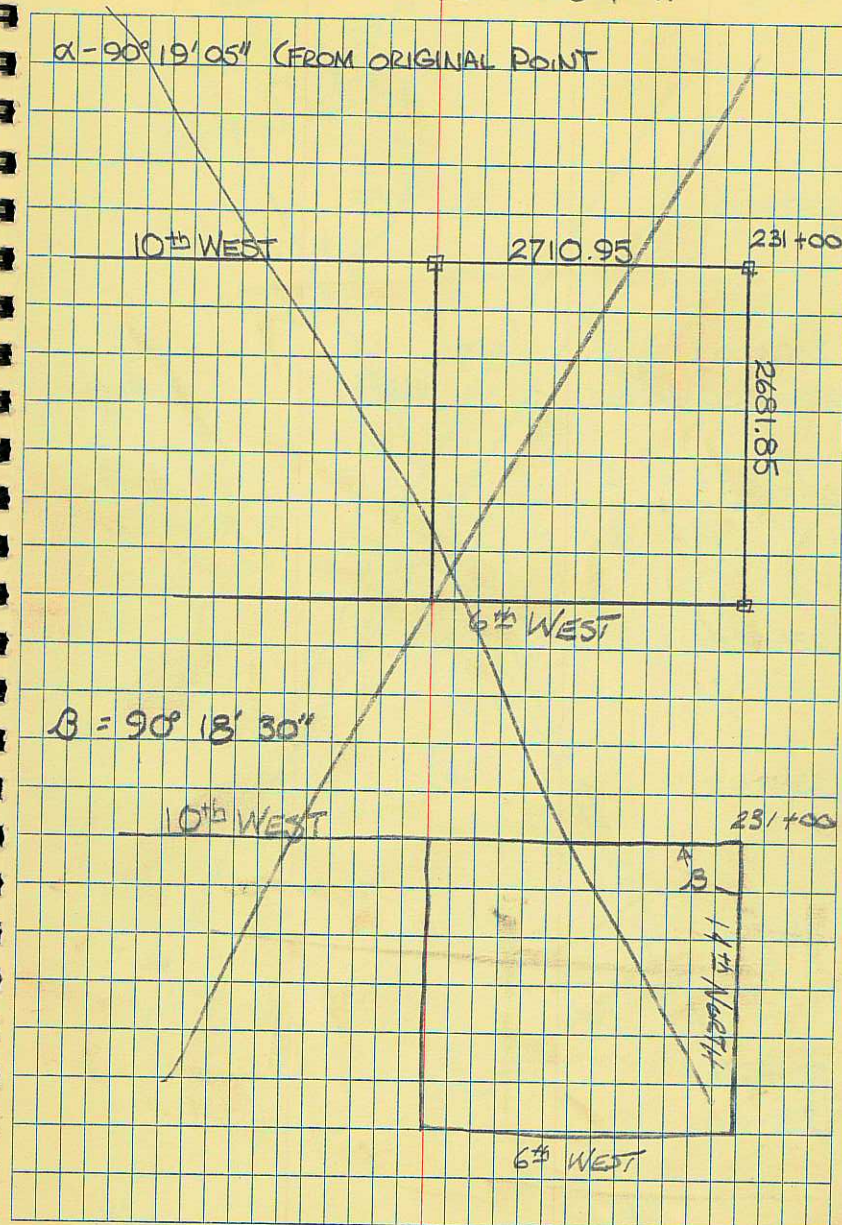
INCHES IN DECIMALS OF A FOOT

1-16	3-32	⅛	3-16	¼	5-16	⅜	½	⅝	¾	⅞
.0052	.0078	.0104	.0156	.0208	.0260	.0313	.0417	.0521	.0625	.0729

1	2	3	4	5	6	7	8	9	10	11
.0833	.1667	.2500	.3333	.4167	.5000	.5833	.6667	.7500	.8333	.9167

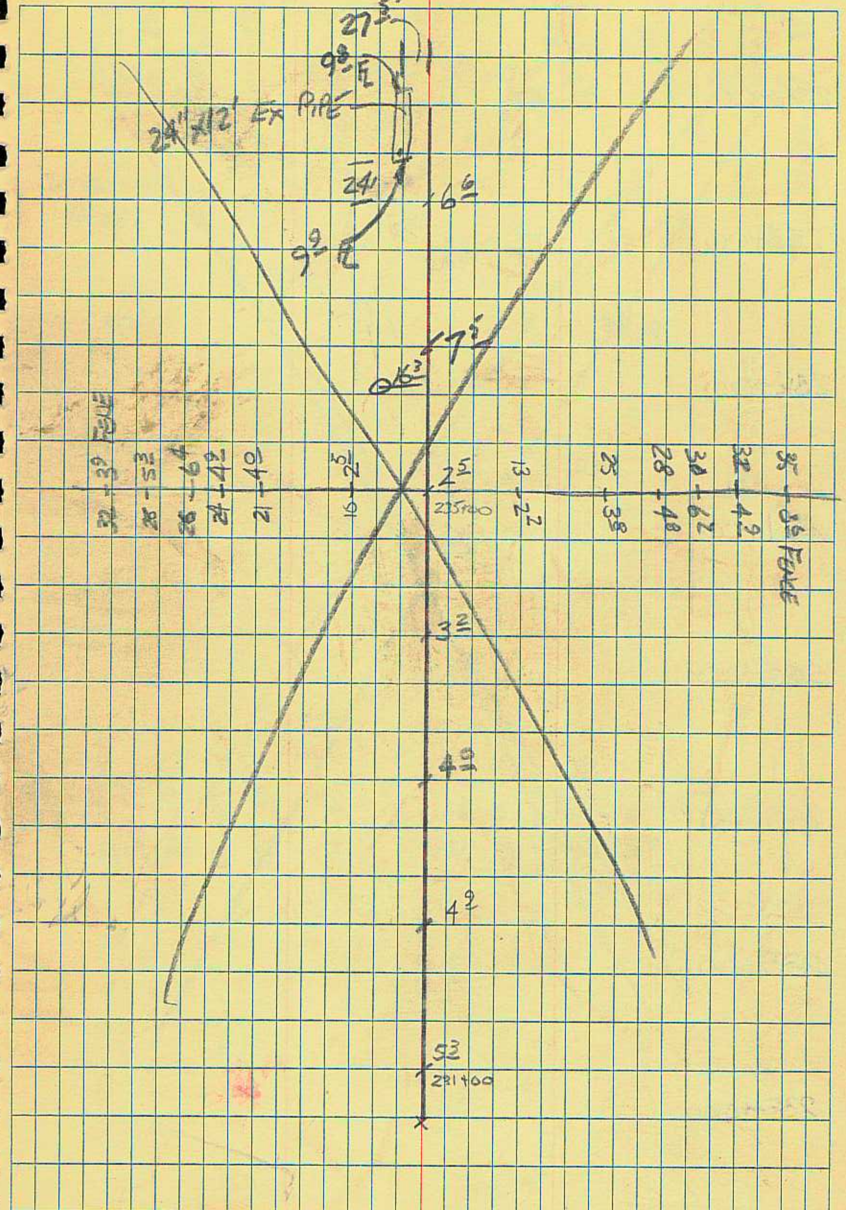
MANHOLE AJUSTMENT. 24

OBSOLETE SEE P 11

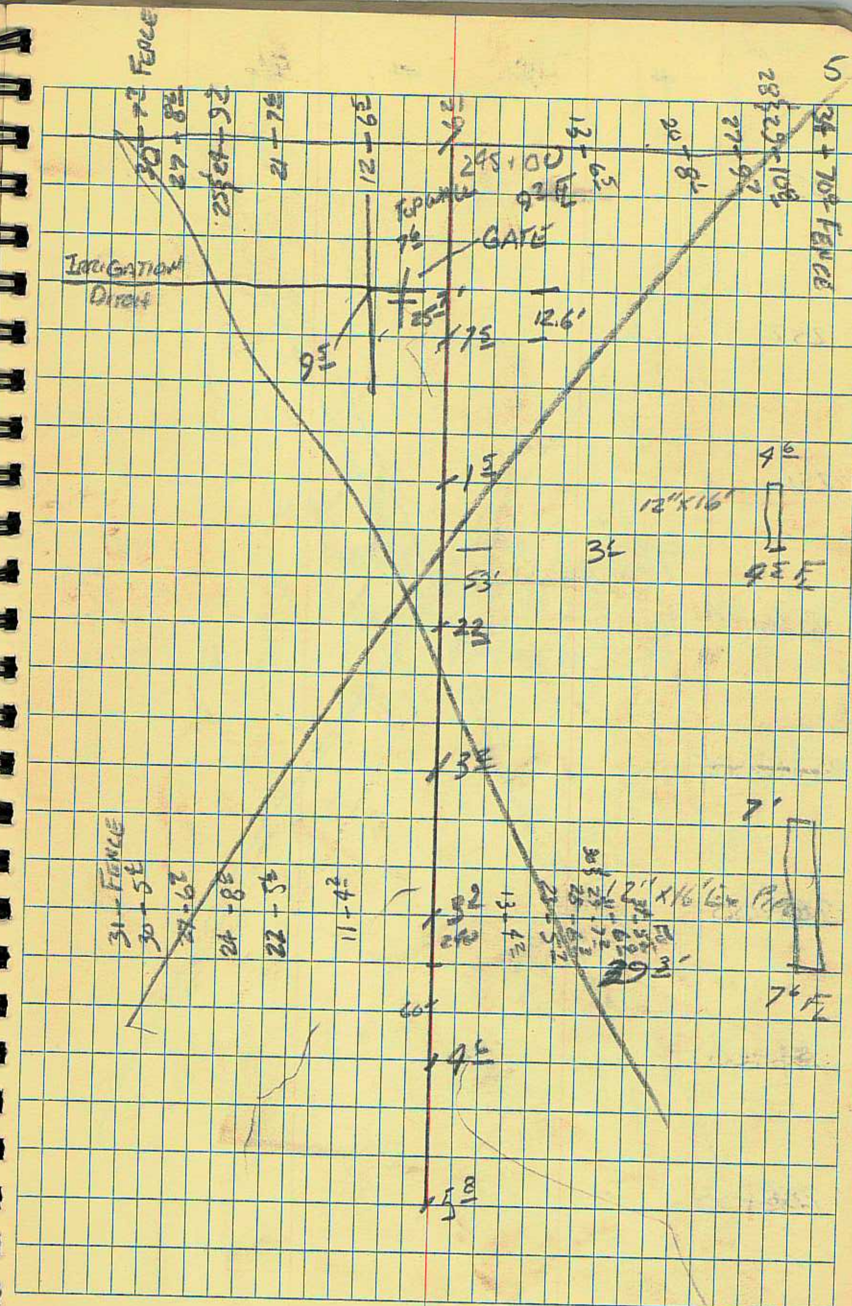


	+	HI	-	EL	
237+00					
236+00					
235+74.30 MANHOLE	8^{45}		2^{76}		MANHOLE
235+00					
234+00					
233+00					
232+00					
231+00					
231+00					
	6^{60}				BM

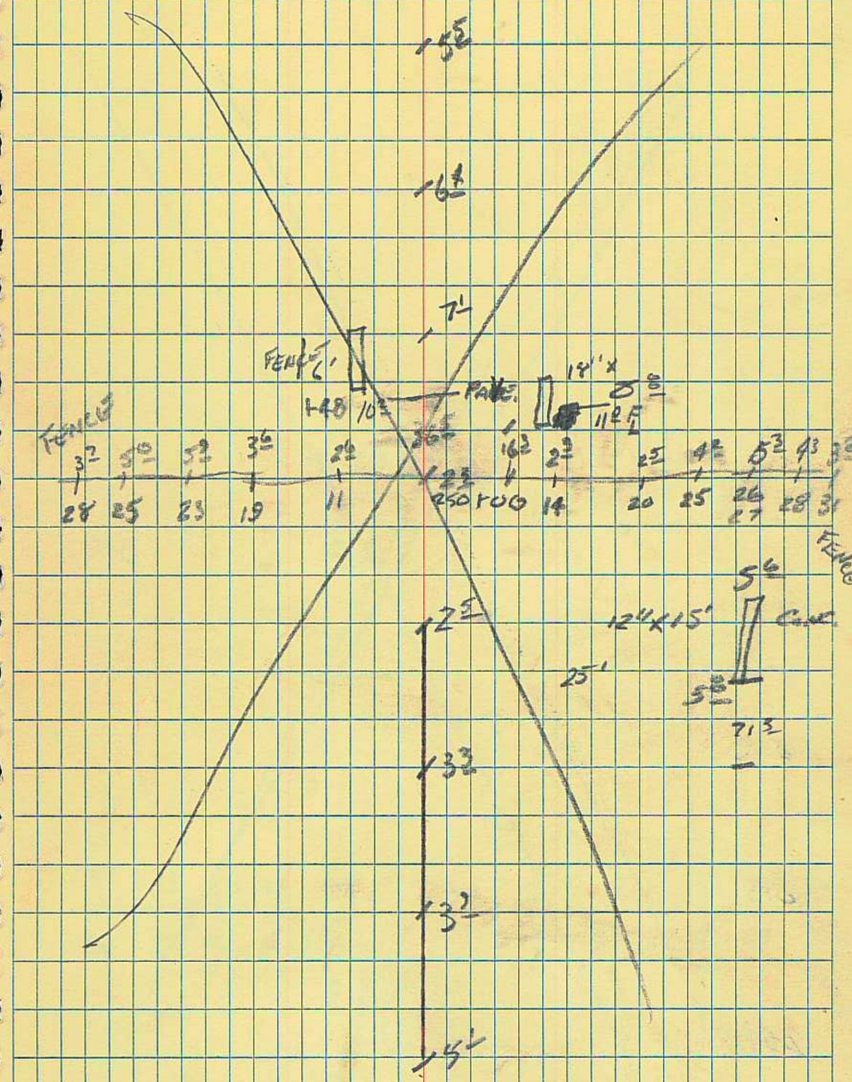
OBSOLETE SEE P 13-15



	+	HI	-	EL
245+00				
244+00				
	8 82		1 46	TP.
243+00				
242+00				
241+00				
240+00				
239+00				
238+00				



Station	+	HI	−	EL	
253					
252					
251					
	7.47		2.15		T.P.
250					
2 249 ~~257+81.85~~					
248+00					
247+00					
246+00					



257

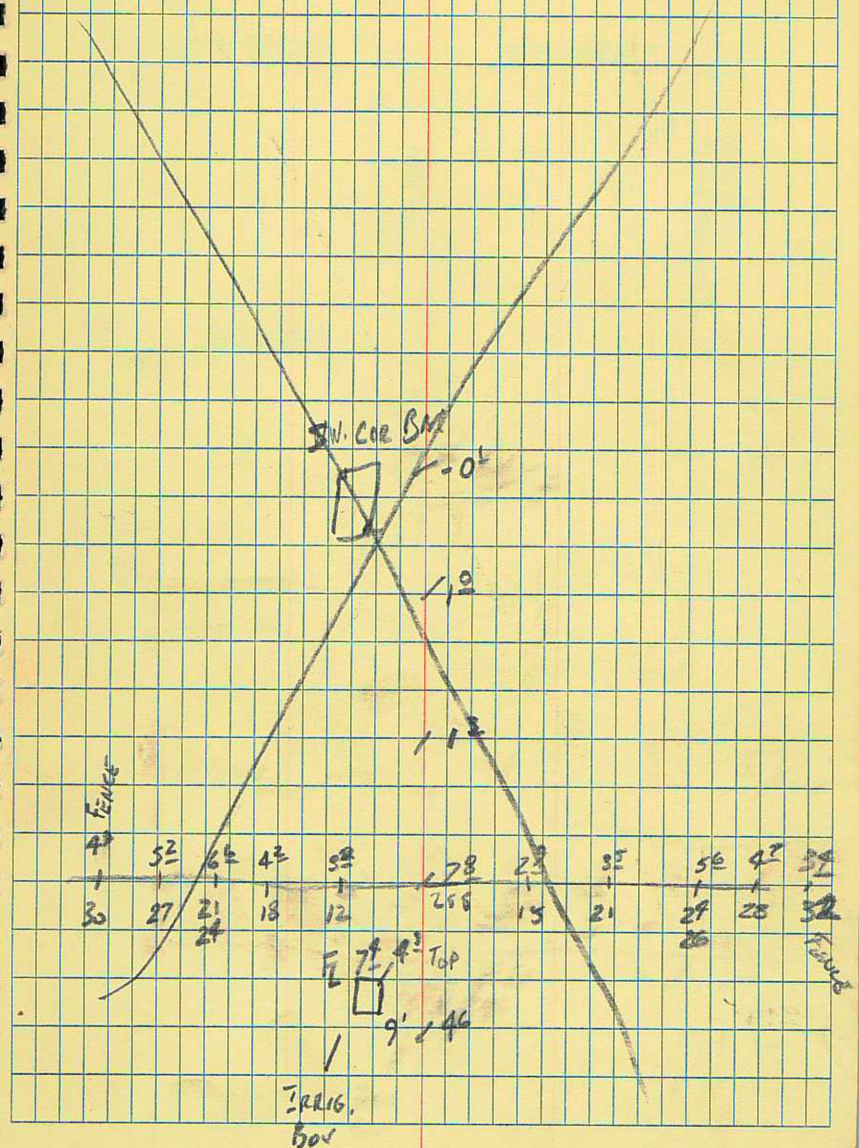
256

255

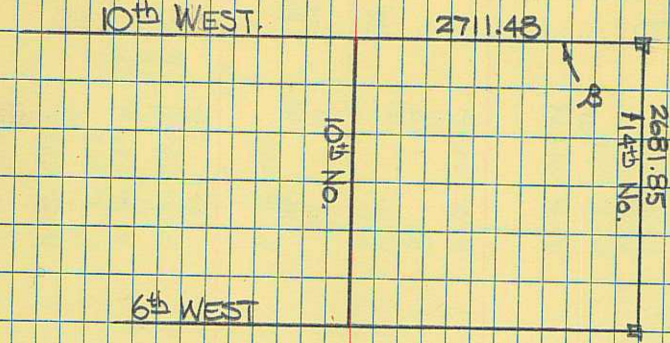
254

1 30

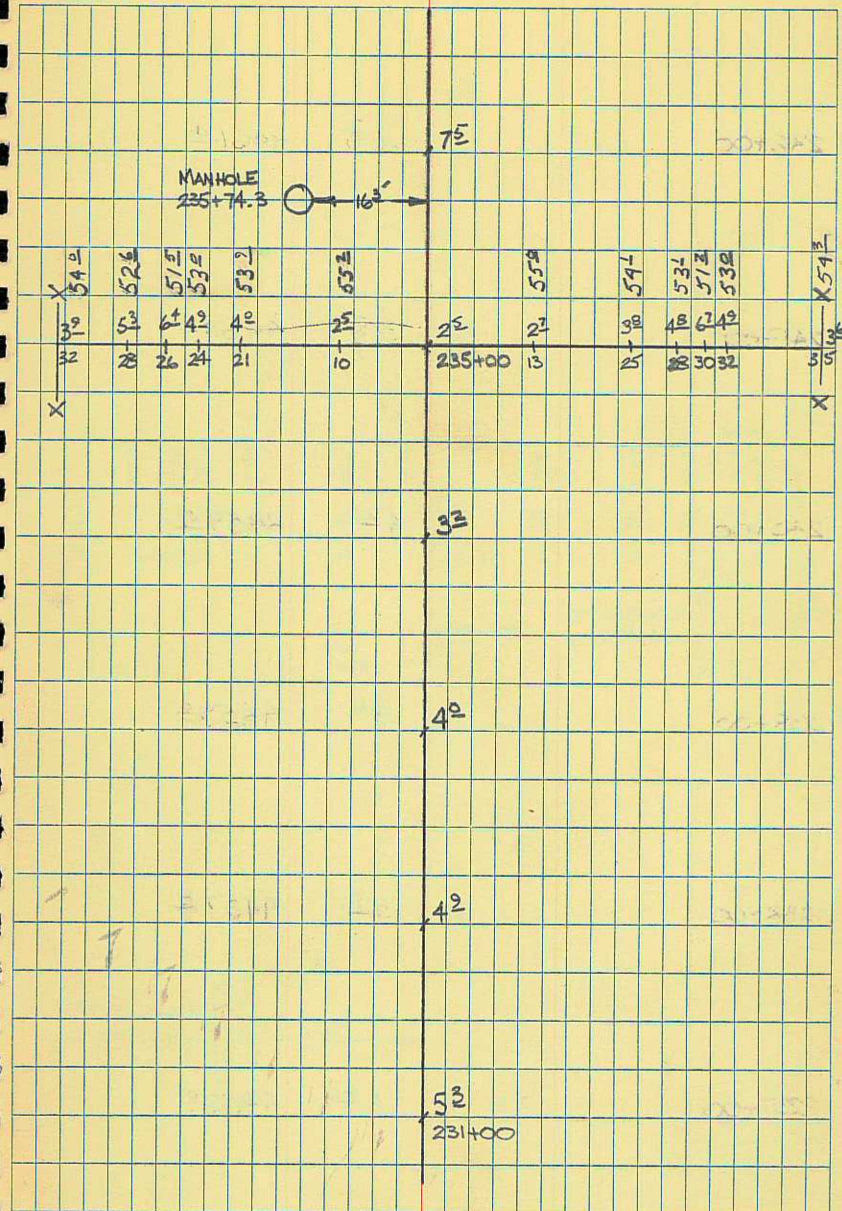
BM



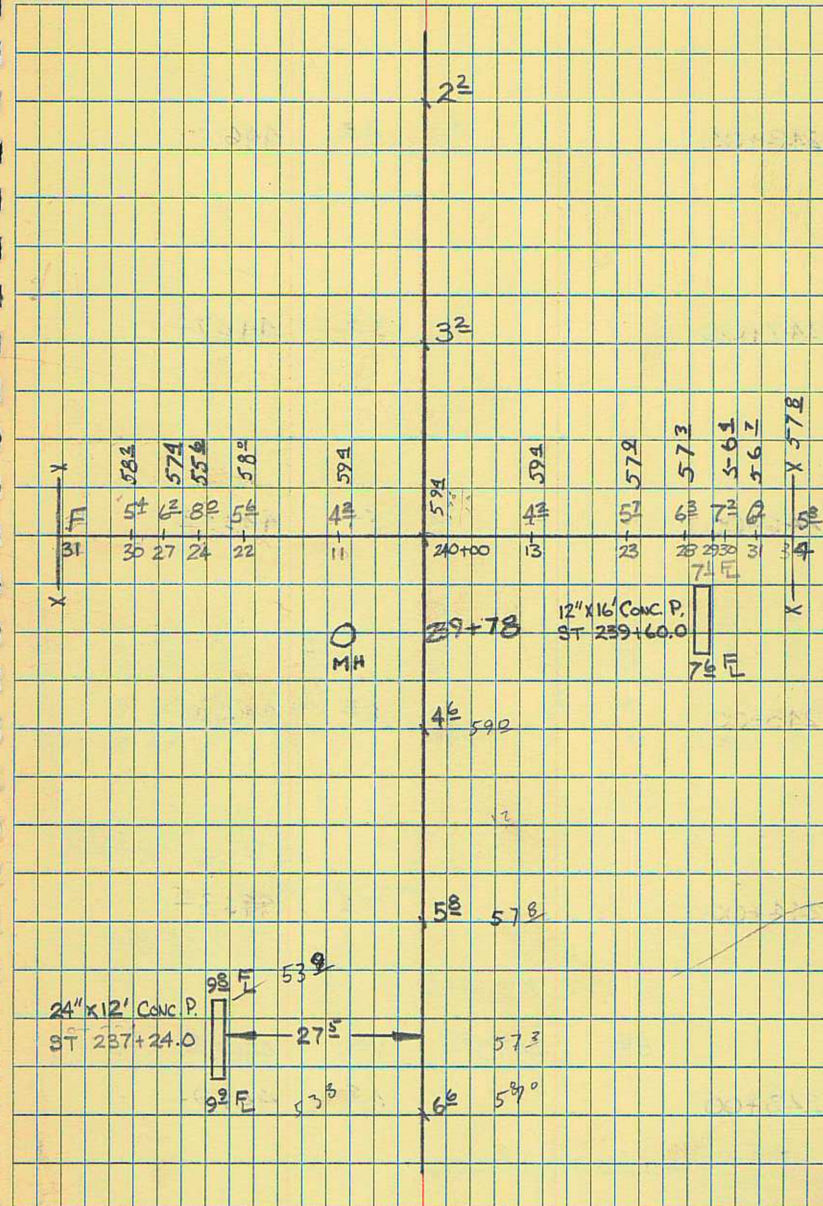
β = 90°18'30"



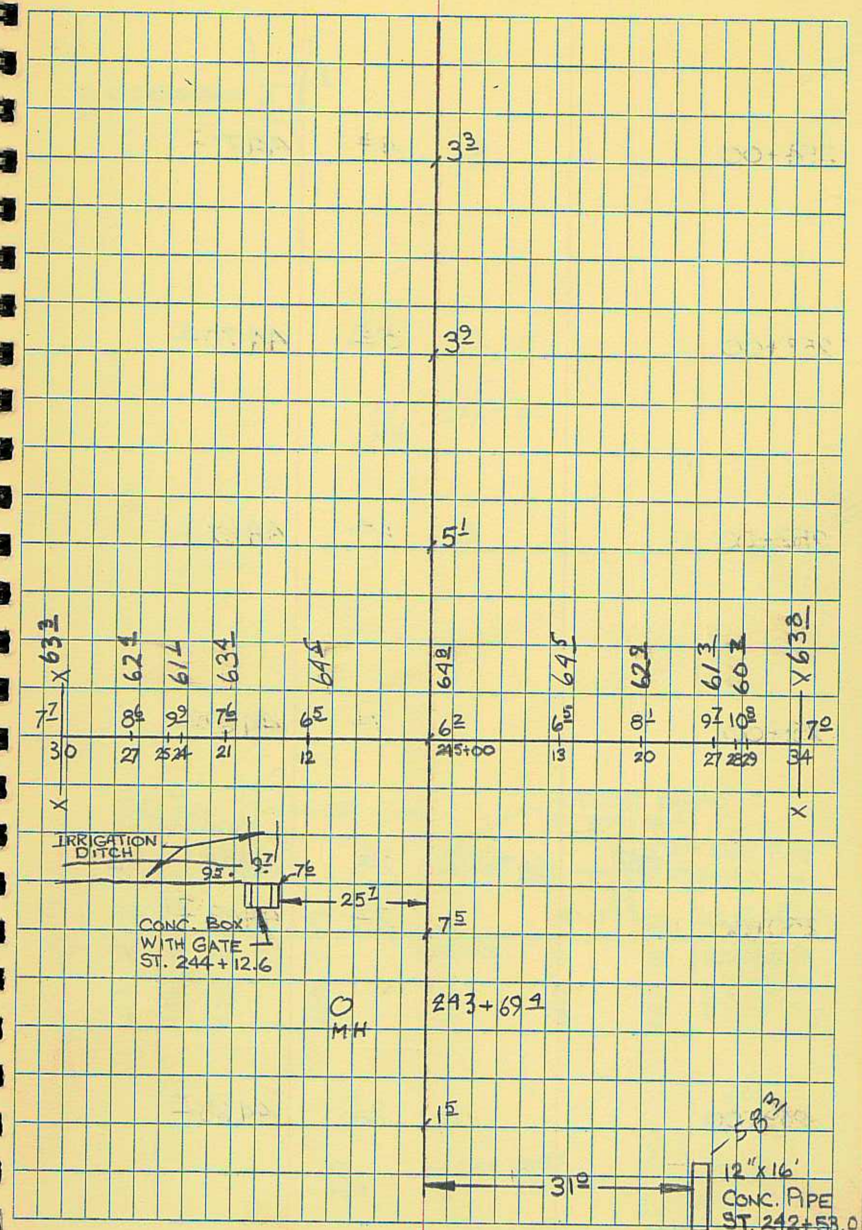
	+	HI	-	EL	
236+00			7^{5}	4456^{1}	
	8^{45}	4463^{61}	2^{76}	4455^{16}	MANHOLE BM
235+00			2^{5}	4455^{4}	
234+00			3^{2}	4454^{7}	
233+00			4^{0}	4453^{9}	
232+00			4^{2}	4453^{0}	
231+00			5^{3}	4452^{6}	
	6^{60}	4457^{92}		4451^{32}	BM



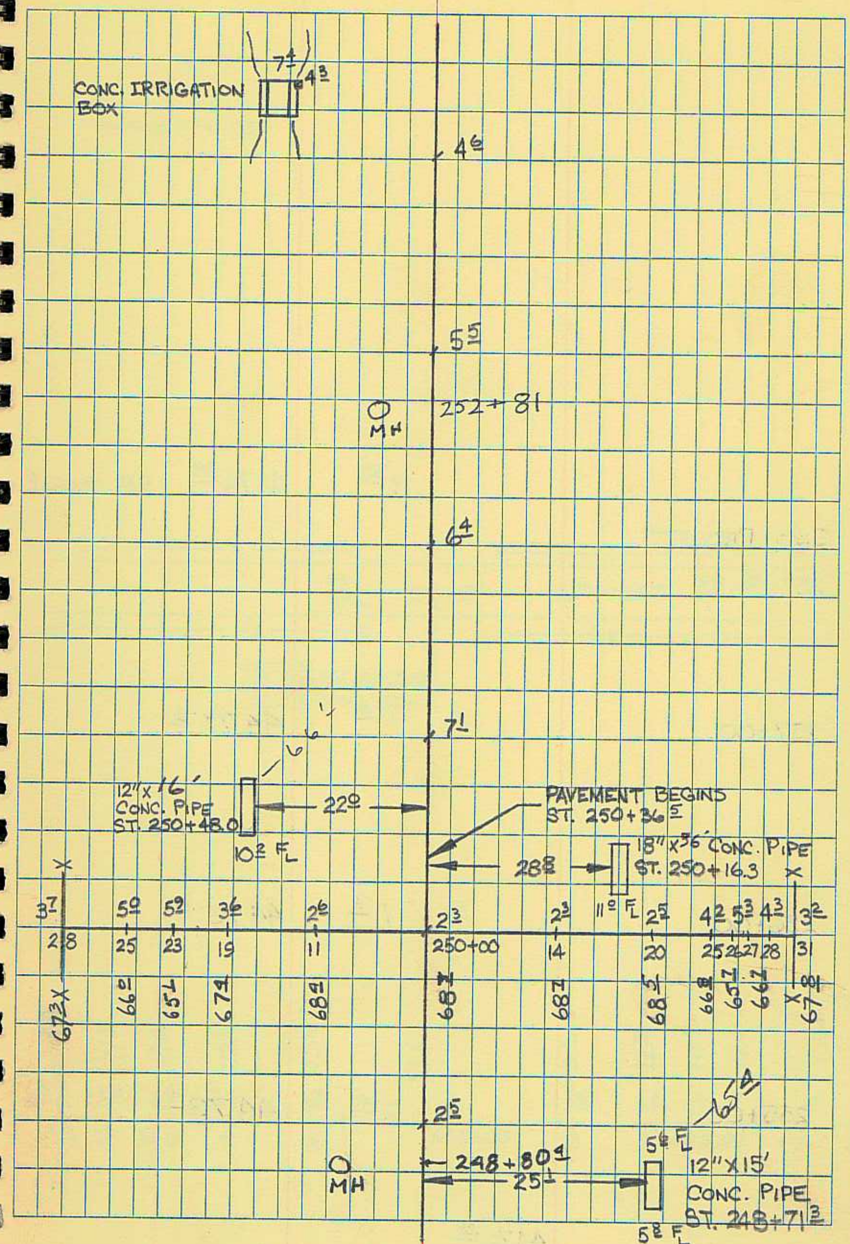
	+	HI	-	EL
242+00			2^{2}	4461^{4}
241+00			3^{2}	4460^{4}
240+00			4^{2}	4459^{4}
239+00			4^{6}	4459^{0}
238+00			5^{8}	4457^{8}
237+00			6^{6}	4457^{0}
		4463^{61}		



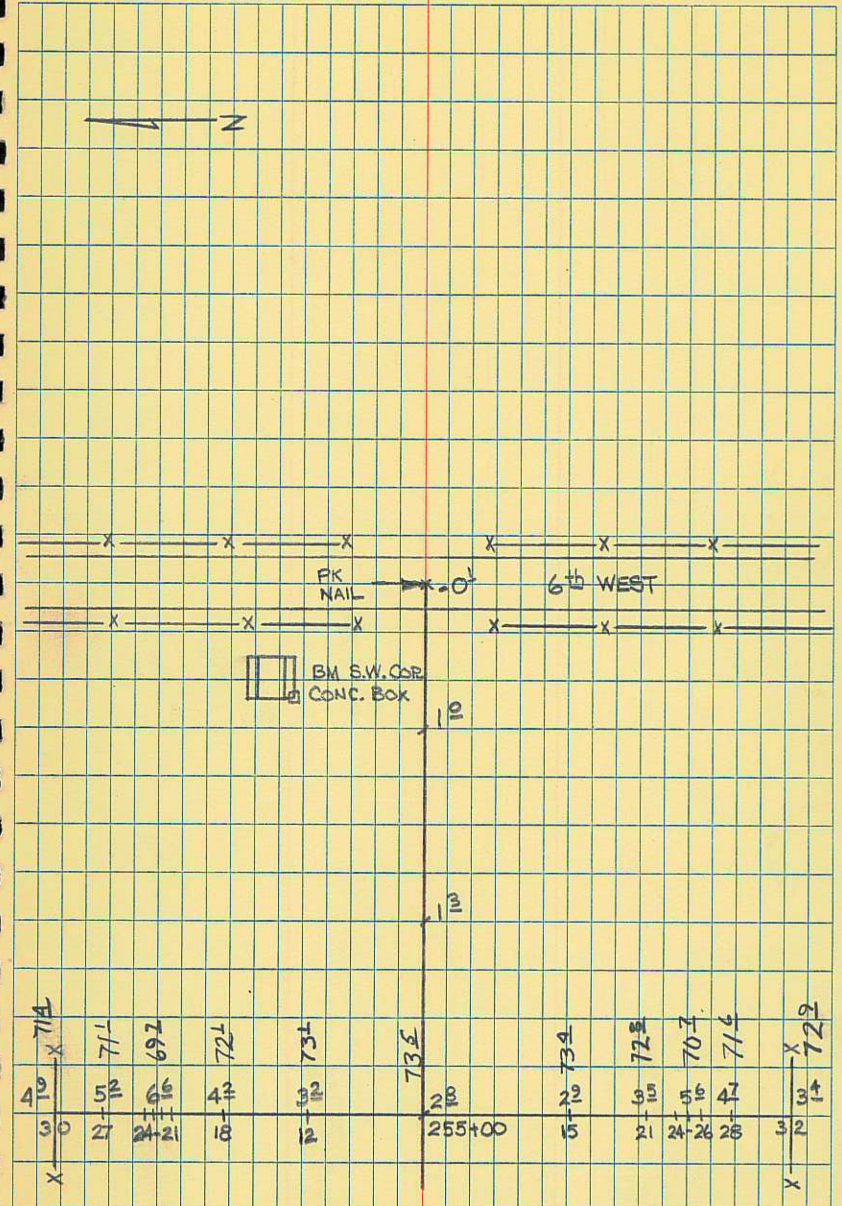
	+	HI	-	EL.	
248+00			$3^{\underline{3}}$	$4467^{\underline{7}}$	
247+00			$3^{\underline{9}}$	$4467^{\underline{1}}$	
246+00			$5^{\underline{1}}$	$4465^{\underline{9}}$	
245+00			$6^{\underline{3}}$	$4464^{\underline{8}}$	
244+00			$7^{\underline{5}}$	$4463^{\underline{5}}$	
	$8^{\underline{82}}$	$4470^{\underline{97}}$	$1^{\underline{46}}$	$4462^{\underline{15}}$	T.P.
243+00			$1^{\underline{5}}$	$4462^{\underline{1}}$	
		$4463^{\underline{61}}$			



	+	HI	-	EL	
254+00			4^{6}	4471^{7}	
253+00			5^{5}	4470^{8}	
252+00			6^{4}	4469^{2}	
251+00			7^{1}	4469^{2}	
	7^{47}	4476^{28}	2^{16}	4468^{81}	T.P.
250+00			2^{3}	4468^{7}	
249+00			2^{5}	4468^{5}	
		4470.97			



	+	HI	-	EL	
			1^{30}	4474^{98}	BM CONC. B.
END PROJECT 257+81.85					
257+00			1^{0}	4475^{3}	
256+00			1^{3}	4475^{0}	
255+00			2^{8}	4473^{5}	
		4476^{28}			



MAN HOLE STATIONS & ELEVATIONS

4-3-75
COOL (45°) APPROX.
VERY WINDY
T WARD
P WILLIAMS

STATION	+	HI	−	ELEV	
			-4.64	69.07	BM
252+81			3.30	70.41	MH5
248+80.1			6.48	67.23	MH4
TP	+9.31	73.71	-1.53	64.40	
243+69.4			4.01	61.92	MH3
239+78			7.77	58.16	MH2
TP	+7.00	65.93	-0.63	58.23	
235+73			4.41	55.15	MH 1
	+8.24	59.56			
				4451.32	BM

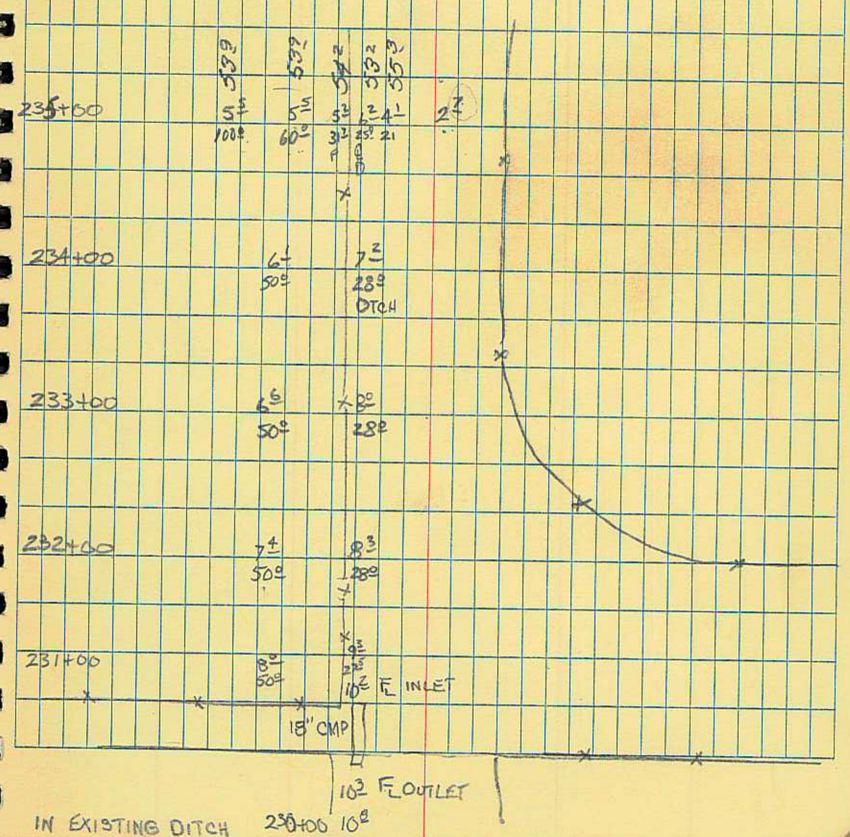
385
382
777

+	HI	-	EL	
		8.02	4451.33	BM 14th No. (51.32)
8.03	4459.35		4451.32	BM TP 14th No UNIMPROVED SECTION

8/11/75

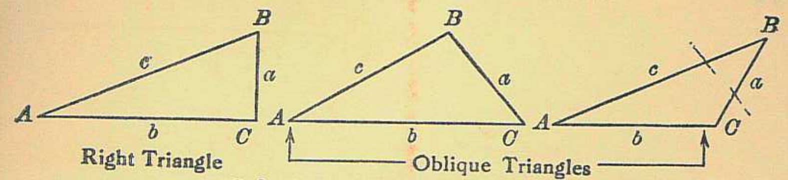
Ward
Williams
Hoang

AS BUILT CROSS-SECTION AND PIPE ELEVATION, TO DETERMINE CHANGES IN DITCH FL EL.



242 + 43.47

TRIGONOMETRIC FORMULAS



Solution of Right Triangles

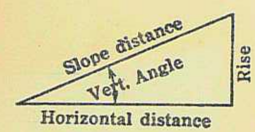
For Angle A. $\sin = \frac{a}{c}$, $\cos = \frac{b}{c}$, $\tan = \frac{a}{b}$, $\cot = \frac{b}{a}$, $\sec = \frac{c}{b}$, $\text{cosec} = \frac{c}{a}$

Given	Required	
a, b	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	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	B, b, c	$B = 90° - A,\ b = a \cot A,\ c = \frac{a}{\sin A}$
A, b	B, a, c	$B = 90° - A,\ a = b \tan A,\ c = \frac{b}{\cos A}$
A, c	B, a, b	$B = 90° - A,\ a = c \sin A,\ b = c \cos A$

Solution of Oblique Triangles

Given	Required	
A, B, a	b, c, C	$b = \frac{a \sin B}{\sin A},\ C = 180° - (A+B),\ c = \frac{a \sin C}{\sin A}$
A, a, b	B, c, C	$\sin B = \frac{b \sin A}{a},\ C = 180° - (A+B),\ c = \frac{a \sin C}{\sin A}$
a, b, C	A, B, c	$A+B = 180° - C,\ \tan \frac{1}{2}(A-B) = \frac{(a-b)\tan\frac{1}{2}(A+B)}{a+b},\ c = \frac{a \sin C}{\sin A}$
a, b, c	A, B, C	$s = \frac{a+b+c}{2},\ \sin\frac{1}{2}A = \sqrt{\frac{(s-b)(s-c)}{bc}},\ \sin\frac{1}{2}B = \sqrt{\frac{(s-a)(s-c)}{ac}},\ C = 180° - (A+B).$
a, b, c	Area	$s = \frac{a+b+c}{2}$, 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 $= \frac{a^2 \sin B \sin C}{2 \sin A}$

REDUCTION TO HORIZONTAL



Horizontal distance = Slope distance multiplied by the cosine of the vertical angle. Thus: slope distance = 319.4 ft. Vert. angle = 5° 10′. Since cos 5° 10′ = .9959, horizontal distance = 319.4 × .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. Cosine 5° 10′ = .9959. 1 − .9959 = .0041. 319.4 × .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.