

行 土木書

李慶海藏書

# 昆明市區三角圖根測量計算手簿

昆明市政府地政局市區土地測量隊

廿九年三月



# 昆明市區三角圖根 測量計算手簿

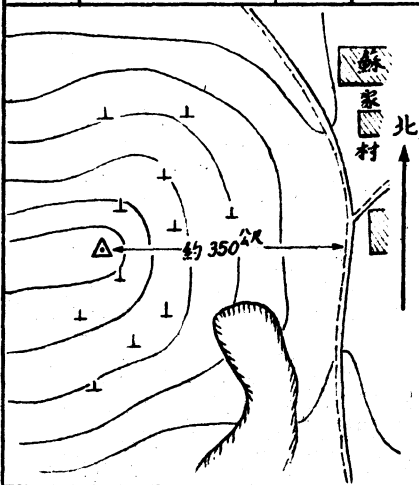
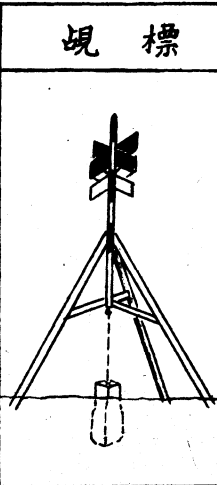
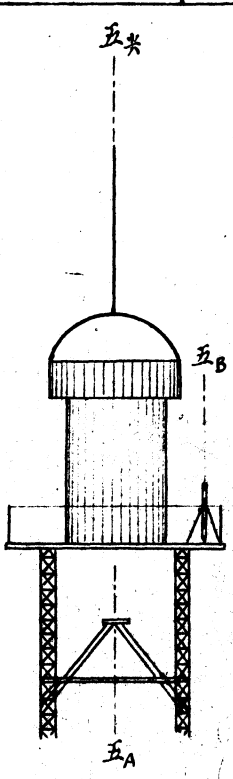
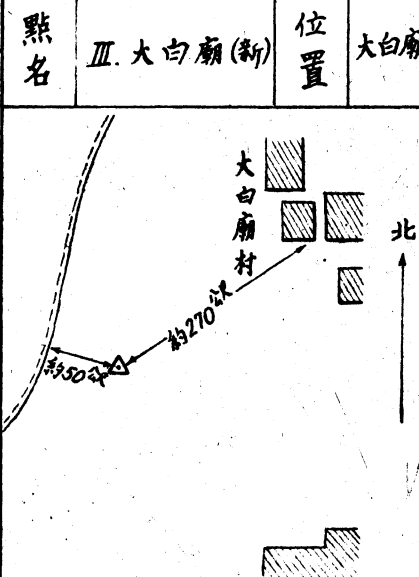
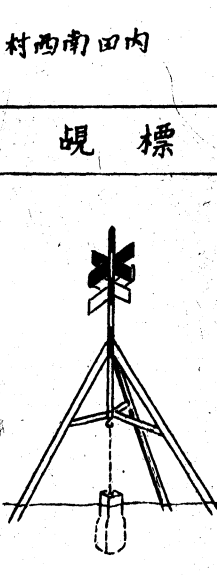
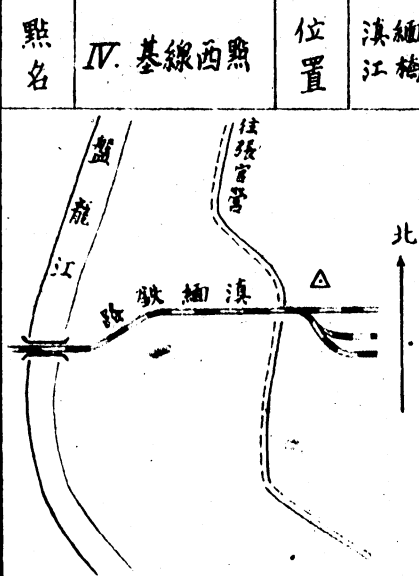
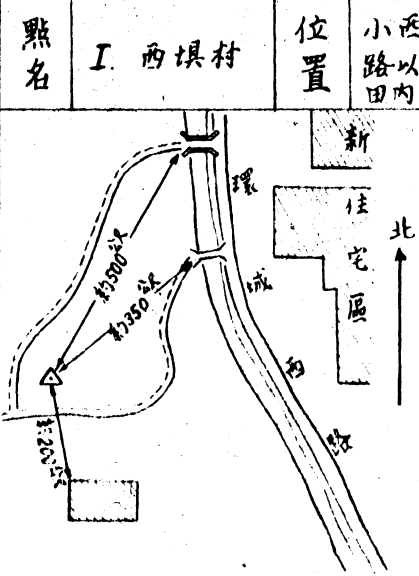
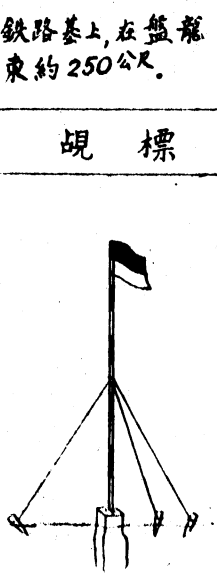
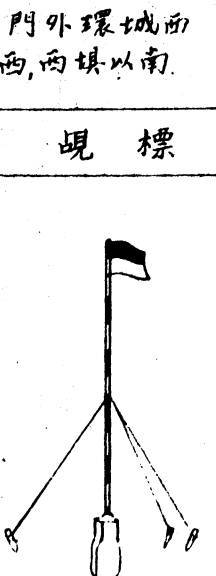
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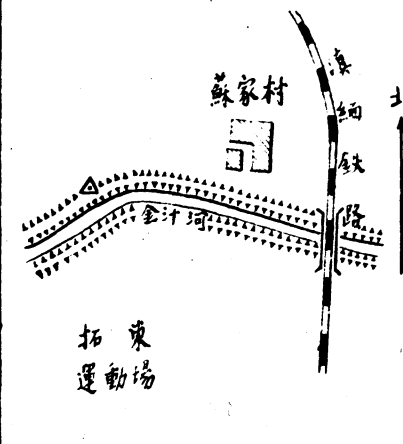
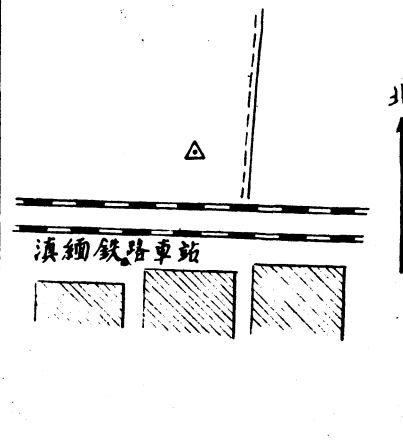
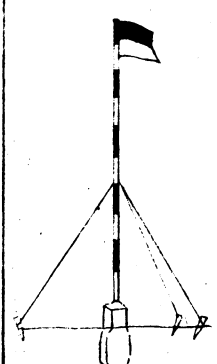
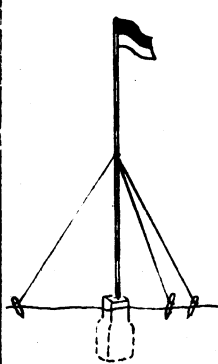
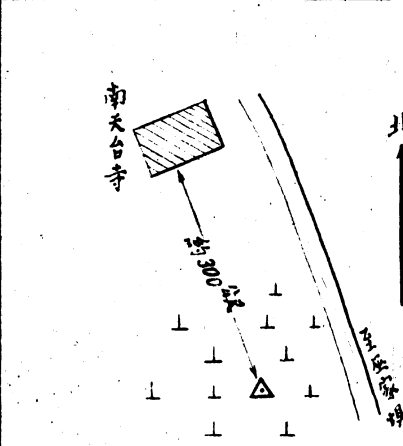
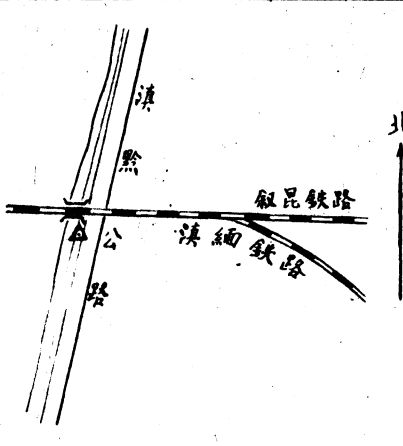
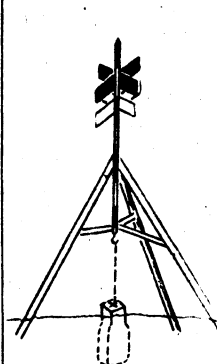
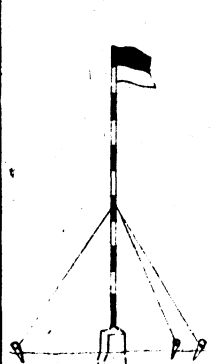
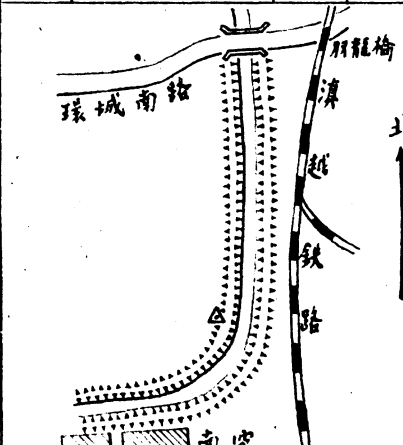
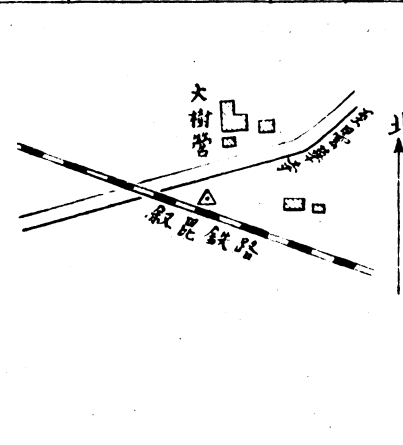
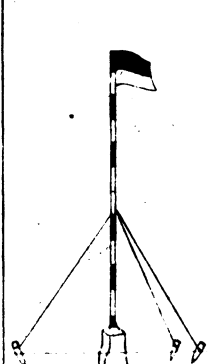
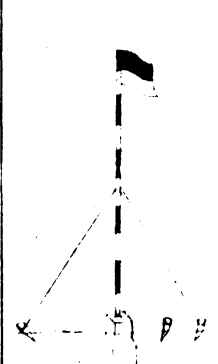
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\* 附註: 2. 3. 4. 5. 各節係工務局所測算.

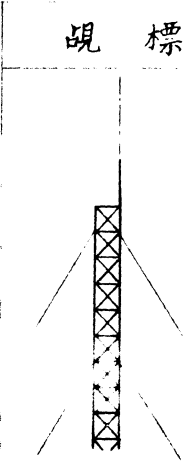
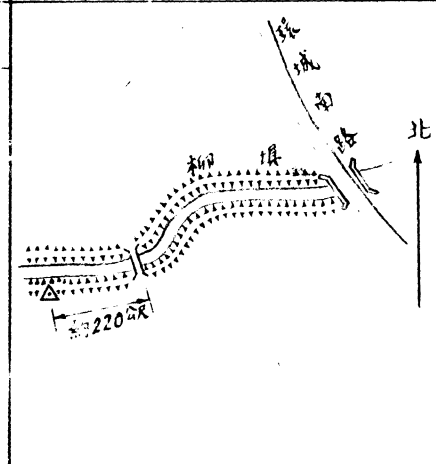
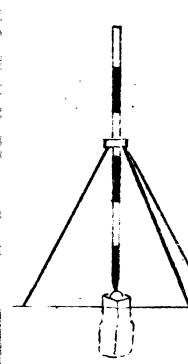
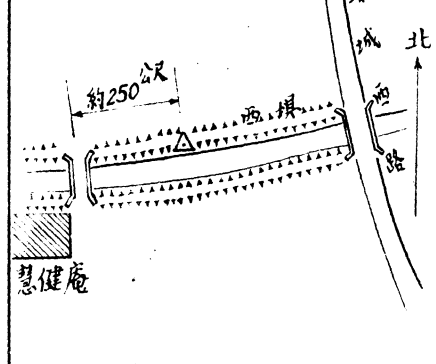
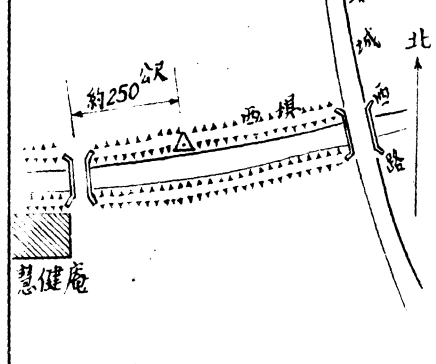
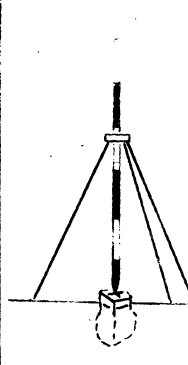
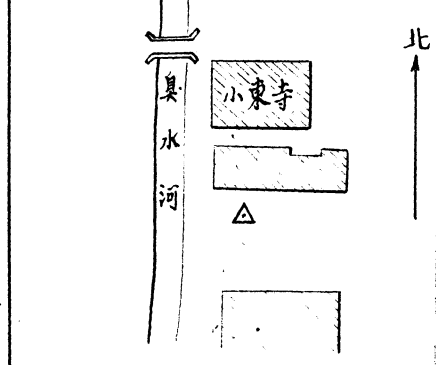
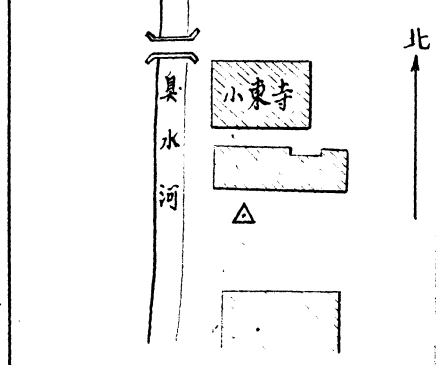
# 三角點說明表

點名	II. 白泥坡	位置	大西門外白泥坡山上	點名	五華山A 五華山B	位置	絳靖公署內 瞭望台上
							
			規 標				
							
							
點名	III. 大白廟(新)	位置	大白廟村西南凹內				
							
			規 標				
							
點名	IV. 基線西點	位置	滇緬鐵路基上, 在盤龍江橋東約250公尺。	點名	I. 西堤村	位置	小西門外環城西 路以西, 西堤以南 田內。
							
			規 標				規 標
							

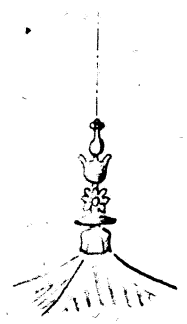
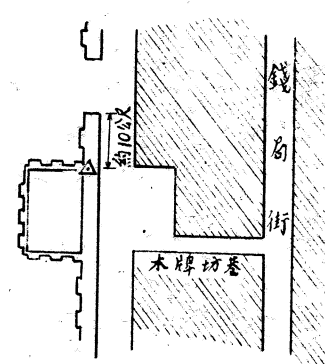
# 三角點說明表

點名	位置	狀元樓東北金汁河北岸河埂上	點名	位置	滇緬鐵路車站前路基上
VIII. 蘇家村	位置	狀元樓東北金汁河北岸河埂上	VII. 基線東點	位置	滇緬鐵路車站前路基上
規 標			規 標		
					
規 標			規 標		
					
IX. 南天台	位置	城東南部南天台寺南乱坟中	VI. 叙細公路(新)	位置	小東門外滇黔公路與滇緬鐵路交叉處
規 標			規 標		
					
規 標			規 標		
					
X. 南窰	位置	南窰村對岸河埂上	XI. 大樹營	位置	大樹營西南約300公尺之叙昆鐵路基上
規 標			規 標		
					
規 標			規 標		
					

# 三角點說明表

點名	無線電台	位置	大東門外無線電台之避雷針	點名	柳堤(新)	位置	柳堤河堤上
			規 標				規 標
	經靖路		北 ↑		環城南路		北 ↑
		△				柳堤	
點名	XIV. 護國門	位置	護國門東城垣上	點名	XV. 慧健庵	位置	西堤河堤上
			規 標				規 標
	護國路		北 ↑		約250公尺		北 ↑
		△			西堤		
		△					
點名	XVI. 南城隄	位置	甘公祠街口城隄穿城垣上	點名	XVII. 東寺塔	位置	南門外東寺塔尖
			規 標				規 標
	甘公祠街		北 ↑		小東寺		北 ↑
		△			臭水河		
		△					

# 三角點說明表

	<p>點名</p>	<p>XVII 圓山亭</p>	<p>位置</p>	<p>圓通公園內亭尖在 水池西北方</p> <p>規標</p> 
	<p>點名</p>	<p>XVIII 西城缺</p>	<p>位置</p>	<p>小西門北城缺附近 城垣上</p> <p>規標</p> 

昆明  
工

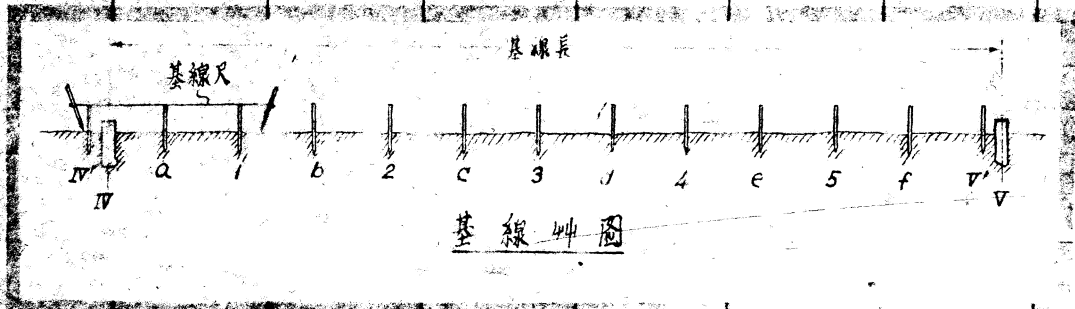
# 基線水準測量記錄

28年10月20日  
晴,大風

測區  
儀器 Keuffel & Esser 40471

觀測者  
記錄者

點	水 準 標 尺 讀 數			高 度 差		真 高	附 註
	後 視	中 視	儀 器 高	前 視	昇		
IV	1.513						1896.879
IV'				0.942	0.571		1897.450
IV'	0.942						
a		0.977					
1				0.959		0.017	
1	0.866						
b		0.854					
2				0.810	0.056		
2	0.678						
c		0.800					
3				0.859		0.181	
3	0.836						
d		0.764					
4				0.688	0.148		
4	0.798						
e		0.883					
5				0.958		0.160	
5	0.874						
f		0.950					
V'				0.853	0.021		
V'	1.421						1896.754
V				0.856	0.565		1897.319



# 觀測記錄

日期：二十八年一月十日 天氣 晴 風

儀器：合金基緯尺

點 由	號 至	第一次測量(往)		第二次測量(返)		平均 值	附 註
		溫度	距離(公尺)	溫度	距離公尺		
Δ IV 1 2 3 4 5 ▽' ▽'	1	27°	50,0905	28°	50,0910		
	2	28°	50,1000	27°	50,1000		
	3	27°	50,1000	26°	50,1000		
	4	27°	50,0000	26°	50,0000		
	5	27°	50,0500	26°	50,0500		
	▽'	27°	49,8000	25°	49,8000		
	△▽	27°	00,4420	25°	00,4405		
	總和		<u>300,5825</u>	總和	<u>300,5815</u>		
Δ IV 1 2 3 4 5 ▽' ▽'	1	26°	50,0905	25°	50,0908		
	2	25°	50,1000	26°	50,1000		
	3	25°	50,1000	26°	50,1000		
	4	25°	50,0000	25°	50,0000		
	5	24°	50,0500	25°	50,0500		
	▽'	24°	49,8000	25°	49,8000		
	△▽	23°	00,4415	24°	00,4400		
	總和		<u>300,5820</u>	總和	<u>300,5808</u>		



# 基線長度

測站		距離	高程差	溫度	傾斜改正	附註	
自	至	公尺	公尺	°C	公尺		
IV	1	50.0905	-0.017	27	-0.000003	+0.000351	
1	2	50.1000	+0.056	28	-0.000031	+0.000401	
2	3	50.1000	-0.131	27	-0.000327	+0.000351	
3	4	50.0000	+0.148	27	-0.000219	+0.000350	
4	5	50.0500	-0.160	27	-0.000256	+0.000350	
5	V	49.8000	+0.021	27	-0.000004	+0.000344	
V	ΔV	00.4420	+0.021	27	-0.000499	+0.000003	
總	和	300.5825			-0.001334	+0.002155	
ΔV	V	00.4405	+0.021	25	-0.000501	+0.000002	
V	5	49.8000	+0.021	25	-0.000004	+0.000249	
5	4	50.0500	-0.160	26	-0.000256	+0.000300	
4	3	50.0000	+0.148	26	-0.000219	+0.000300	
3	2	50.1000	-0.181	26	-0.000327	+0.000301	
2	1	50.1000	+0.056	27	-0.000031	+0.000351	
1	ΔIV	50.0910	-0.017	28	-0.000003	+0.000401	
總	和	300.5815			-0.001341	+0.001904	
ΔIV	1	50.0905	-0.017	26	-0.000003	+0.000301	
1	2	50.1000	+0.056	25	-0.000031	+0.000251	
2	3	50.1000	-0.181	25	-0.000327	+0.000251	
3	4	50.0000	+0.148	25	-0.000219	+0.000250	
4	5	50.0500	-0.160	24	-0.000256	+0.000200	
5	V	49.8000	+0.021	24	-0.000004	+0.000199	
V	ΔV	00.4415	+0.021	23	-0.000500	+0.000001	
總	和	300.5820			-0.001340	+0.001453	
ΔV	V	50.0905	+0.021	24	-0.000501	+0.000002	
V	5	50.1000	0.056	25	-0.000004	+0.000249	
		50.1000	0.160	25	-0.000256	+0.000250	
4	3	50.0000	+0.148	25	-0.000219	+0.000250	
3	2	50.0500	-0.181	26	-0.000327	+0.000301	
		49.8000	+0.056	26	-0.000031	+0.000301	
		00.4400	-0.017	25	0.000003	+0.000250	
總	和	300.5808			-0.001341	+0.001603	

# 基綫長度表

實量次數	實量總長 公尺	修正總長 公尺	度改正總長 公尺	實際總長 公尺
1	300,5825	-0,001339	+0,002155	300,583316
2	300,5815	-0,001341	+0,001904	300,582063
3	300,5820	-0,001340	+0,001453	300,582013
4	300,5808	0,001341	+0,001003	300,581062
平均值				300,582139

# 海平面改正計算表

計算公式 $\Delta L = -\frac{H}{R} \cdot L$		附註 近似計祿
平均海拔 $H = 1897,385$	$H \dots 3,2781555$	$H_1 = 1897,450$
基綫實量平均值 $L = 300,582139$	$L \dots 2,4779632$	$H_2 = 1897,319$
平均地球半徑 $R = 6370,000$ 哩	$ER \dots 3,1958606 - 10$	
近似改正數 $\Delta L = -0,089532$	$\Delta L \dots 8,9519793 - 10$	
海平面改正定之基綫長 =	300,492607 公尺	

# 基線長度校準計算

次數	實際總長 公尺	偏差 $v$	$v^2$
1	300,583316	-0,001177	0,00001385329
2	300,582063	+0,000076	0,00000005776
3	300,582113	+0,000026	0,00000000676
4	300,581062	+0,001077	0,00001159929
總和		+0,00002500	[ $\sum v^2$ ] = 0,00002551710
平均值	300,582139		

每一觀測值之中偏差

$$m = \pm \sqrt{\frac{L \sum v^2}{n-1}}$$

[ $\sum v^2$ ] = 0,00002551710      次數總和  $n = 4$

$$m = \pm 0,000420 \text{ 公尺}$$

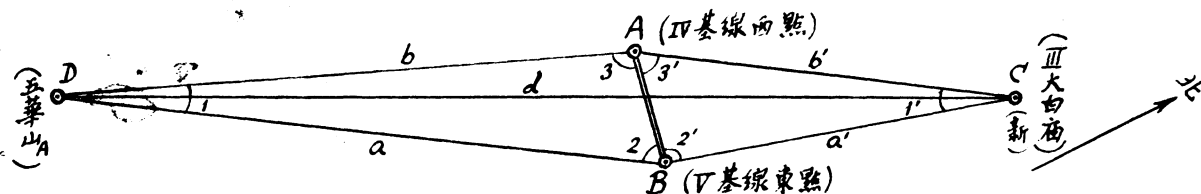
平均值之中偏差

$$M = \frac{m}{\sqrt{n}} = \pm 0,000460 \text{ 公尺}$$

$$\text{基線長度} = 300,582139 \pm 0,000460 \text{ 公尺}$$

# 基線網計算

(I.) 基線網各角之中數差



號數	觀測值	改正數 $v$	$vv$	號數	觀測值	改正數 $v$	$vv$
<u>4 1</u>				<u>4 1'</u>			
1	10° 30' 42"	-2.25	5.063	1	17° 9' 3"	+10.75	115.563
2	48	-8.25	68.063	2	15	-1.25	1.563
3	48	-8.25	68.063	3	15	-1.25	1.563
4	33	+6.75	45.563	4	18	-4.25	18.063
5	33	+6.75	45.563	5	21	-7.25	52.563
6	45	-5.25	27.563	6	12	-1.75	3.063
7	27	+12.75	162.563	7	21	-7.25	52.563
8	39	+0.75	0.563	8	0	+13.75	189.063
9	42	-2.25	5.063	9	18	-4.25	18.063
10	48	-8.25	68.063	10	21	-7.25	52.563
11	33	+6.75	45.563	11	12	+1.75	3.063
12	39	+0.75	0.563	12	9	+4.75	22.563
中數 =	10° 30' 39.75	$[v] = 0.00$	$[vv] = 542.256$	中數 =	17° 9' 13.75	$[v] = 0.00$	$[vv] = 530.256$
$M_1$ (中數差) = $\sqrt{\frac{[vv]}{n(n-1)}} = \sqrt{\frac{542.256}{12 \times 11}} = \sqrt{4.108} = \pm 2.03$				$M_{1'}$ = $\sqrt{\frac{530.256}{12 \times 11}} = \sqrt{4.017} = \pm 2.00$			
<u>4 2</u>				<u>4 2'</u>			
1	68° 7' 36"	-2.25	5.063	1	93° 56' 3"	-0.75	0.563
2	27	+6.75	45.563	2	3	-0.75	0.563
3	39	-5.25	27.563	3	3	-0.75	0.563
4	33	+0.75	0.563	4	0	+2.25	5.063
中數 =	68° 7' 33.75	$[v] = 0.00$	$[vv] = 78.752$	中數 =	93° 56' 2.25	$[v] = 0.00$	$[vv] = 6.752$
$M_2$ (中數差) = $\sqrt{\frac{78.752}{4 \times 3}} = \sqrt{6.563} = \pm 2.56$				$M_{2'}$ = $\sqrt{\frac{6.752}{4 \times 3}} = \sqrt{0.563} = \pm 0.75$			
<u>4 3</u>				<u>4 3'</u>			
1	101° 21' 45"	+2.25	5.063	1	68° 54' 54"	-2.25	5.063
2	+5	+2.25	5.063	2	54	-2.25	5.063
3	+8	-0.75	0.563	3	54	2.25	5.063
4	51	-3.75	14.063	4	45	+6.75	45.563
中數 =	101° 21' 22.5	$[v] = 0.00$	$[vv] = 24.752$	中數 =	68° 54' 51.75	$[v] = 0.00$	$[vv] = 60.752$
$M_3$ = $\sqrt{\frac{24.752}{4 \times 3}} = \sqrt{2.063} = \pm 1.44$				$M_{3'}$ = $\sqrt{\frac{60.752}{4 \times 3}} = \sqrt{5.063} = \pm 2.25$			

(II) 基線網角度之平差

各角之權  $P = K/M^2$        $M =$  各角之中誤差       $K =$  常數 (今假定之為 1)

角	觀測值	M	$1/P = M^2$	v	改正後之值
<b>△DBA</b>					
α <sub>1</sub>	10° 30' 39".75	±2.03	4.108	-0.24	10° 30' 39".51
α <sub>2</sub>	68 7 33.75	2.56	0.563	-0.39	68 7 33.36
α <sub>3</sub>	101 21 47.25	1.44	2.063	-0.12	101 21 47.13
[∑] =	180 0 0.75 W = +0".75		[1/P] = 12.734	-0.75	180 0 0.00
<b>△CBA</b>					
α <sub>1'</sub>	17° 9' 13".75	±2.00	4.017	-3.23	17° 9' 10".52
α <sub>2'</sub>	93 56 2.25	0.75	0.563	-0.45	93 56 1.80
α <sub>3'</sub>	68 54 51.75	2.25	5.063	-4.07	68 54 47.68
[∑] =	180 0 7.75 W = +7".75		[1/P] = 9.643	-7.75	180 0 0.00

附註:  $v = -\frac{W}{[\frac{1}{P}]} = \frac{1}{P}$

單位權之中誤差:

△DBA:  $\mu = \frac{W}{[\frac{1}{P}]} = \pm \frac{0.75}{3.57} = \pm 0".21$

△CBA:  $\mu' = \frac{W'}{[\frac{1}{P}]} = \pm \frac{7.75}{3.11} = \pm 2".49$

角度改正後之中誤差:

△DBA:  $m_1 = W \frac{\sqrt{\frac{1}{P_1} \sqrt{\frac{1}{P_2} + \frac{1}{P_3}}}}{[\frac{1}{P}]} = 0.75 \frac{2.03 \cdot \sqrt{8.626}}{12.734} = \pm 0".36$

△CBA:  $m_{1'} = W' \frac{\sqrt{\frac{1}{P_1} \sqrt{\frac{1}{P_2} + \frac{1}{P_3}}}}{[\frac{1}{P}]} = 7.75 \frac{2.00 \cdot \sqrt{5.026}}{9.643} = \pm 4".75$

$m_2 = W \frac{\sqrt{\frac{1}{P_2} \sqrt{\frac{1}{P_1} + \frac{1}{P_3}}}}{[\frac{1}{P}]} = 0.75 \frac{2.56 \cdot \sqrt{6.171}}{12.734} = \pm 0".38$

$m_{2'} = W' \frac{\sqrt{\frac{1}{P_2} \sqrt{\frac{1}{P_1} + \frac{1}{P_3}}}}{[\frac{1}{P}]} = 7.75 \frac{0.75 \cdot \sqrt{6.071}}{9.643} = \pm 1".82$

$m_3 = W \frac{\sqrt{\frac{1}{P_3} \sqrt{\frac{1}{P_1} + \frac{1}{P_2}}}}{[\frac{1}{P}]} = 0.75 \frac{1.44 \cdot \sqrt{10.071}}{12.734} = \pm 0".28$

$m_{3'} = W' \frac{\sqrt{\frac{1}{P_3} \sqrt{\frac{1}{P_1} + \frac{1}{P_2}}}}{[\frac{1}{P}]} = 7.75 \frac{2.25 \cdot \sqrt{4.580}}{9.643} = \pm 3".87$

最後結果

△DBA:

α<sub>1</sub> = 10° 30' 39".51 ± 0".36

α<sub>2</sub> = 68° 7' 33".36 ± 0".38

α<sub>3</sub> = 101° 21' 47".13 ± 0".28

△CBA:

α<sub>1'</sub> = 17° 9' 10".52 ± 4".75

α<sub>2'</sub> = 93° 56' 1".80 ± 1".82

α<sub>3'</sub> = 68° 54' 47".68 ± 3".87

(III) 邊長 DC (-五<sub>A</sub>-III) 之計算

A.  $\overline{DC}$  之長度:

基綫  $AB = 300.5821$  公尺  $\pm 0.0005$  公尺

$a = AB \sin \alpha_3 / \sin \alpha_1$        $b = AB \sin \alpha_2 / \sin \alpha_1$

$\log AB = 2.4779632$        $\log AB = 2.4779632$

$\log \sin \alpha_3 = 9.9914025$        $\log \sin \alpha_2 = 9.9675503$

$\text{colog} \sin \alpha_1 = 0.7389184$        $\text{colog} \sin \alpha_1 = 0.7389184$

$\log a = 3.2082841$        $\log b = 3.1844319$

$a = 1615.415$        $b = 1529.086$

$\overline{DC}^2 = a^2 + b^2 - 2ab \cos(\alpha_2 + \alpha_3)$

$\alpha_2 + \alpha_3 = 162^\circ 3' 35.16''$

$\log 2 = 0.3010300$

$\log a = 3.2082841$

$\log b = 3.1844319$

$\log \cos(\alpha_2 + \alpha_3) = 9.9783533$

$6.4658200$

$-2ab \cos(\alpha_2 + \alpha_3) = 2922744.595$

$a^2 + b^2 = 3513852.954$

$\overline{DC}^2 = 6436797.647$

$\overline{DC}$  (中數) = 6436797.647

邊長 五<sub>A</sub>-III =  $\overline{DC} = 2537.085$  公尺

$a' = AB \sin \alpha_3' / \sin \alpha_1'$        $b' = AB \sin \alpha_2' / \sin \alpha_1'$

$\log AB = 2.4779632$        $\log AB = 2.4779632$

$\log \sin \alpha_3' = 9.9698987$        $\log \sin \alpha_2' = 9.9989755$

$\text{colog} \sin \alpha_1' = 0.5302913$        $\text{colog} \sin \alpha_1' = 0.5302913$

$\log a' = 2.9781532$        $\log b' = 3.0072300$

$a' = 950.940$        $b' = 1016.787$

$\overline{DC}'^2 = b'^2 + a'^2 - 2b'a' \cos(\alpha_3 + \alpha_3')$

$\alpha_3 + \alpha_3' = 170^\circ 16' 34.81''$

$\log 2 = 0.3010300$

$\log b = 3.1844319$

$\log a' = 2.9781532$

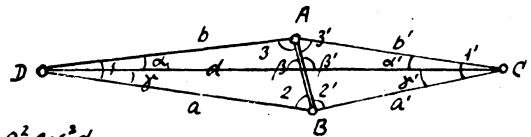
$\log \cos(\alpha_3 + \alpha_3') = 9.9937156$

$6.4864075$

$-2b'a' \cos(\alpha_3 + \alpha_3') = 3064838.028$

$b'^2 + a'^2 = 3371959.716$

$\overline{DC}'^2 = 6436797.744$



B.  $\overline{DC}$  之中外差:

(1).  $M'_d = \overline{DC}$  因角度測量所生之中外差

$$M'_d = \frac{1}{\rho^2} \left\{ \mu^2 \frac{P_1 \overline{AB}^2 \cos^2(\alpha_3 - \alpha_2 + \beta) + P_2 b^2 \cos^2 \gamma + P_3 a^2 \cos^2 \alpha}{(P_1 P_2 + P_1 P_3 + P_2 P_3) \sin^2 \alpha_1} + \mu'^2 \frac{P_1' \overline{AB}^2 \cos^2(\alpha_3' - \alpha_2' + \beta) + P_2' b'^2 \cos^2 \gamma' + P_3' a'^2 \cos^2 \alpha'}{(P_1' P_2' + P_1' P_3' + P_2' P_3') \sin^2 \alpha_1'} \right\}$$

$P = 206265$        $\mu = \pm 0.21$        $\mu' = \pm 2.49$        $\alpha = 3^\circ 53'$        $\beta = 74^\circ 05'$        $\gamma = 6^\circ 19'$

$P_1 = 0.24$        $P_2 = 2.15$        $P_3 = 0.48$        $\alpha' = 5^\circ 50'$        $\beta' = 105^\circ 15'$        $\gamma' = 11^\circ 19'$

$P_1' = 0.25$        $P_2' = 1.78$        $P_3' = 0.20$        $a = 1615$  公尺       $b = 1529$  公尺       $a' = 951$  公尺       $b' = 1017$  公尺

約數

$M_d^2 = 0.00406$        $M'_d = \pm 0.064$  公尺

(2).  $M''_d = \overline{DC}$  用基綫長度測量所生之誤差

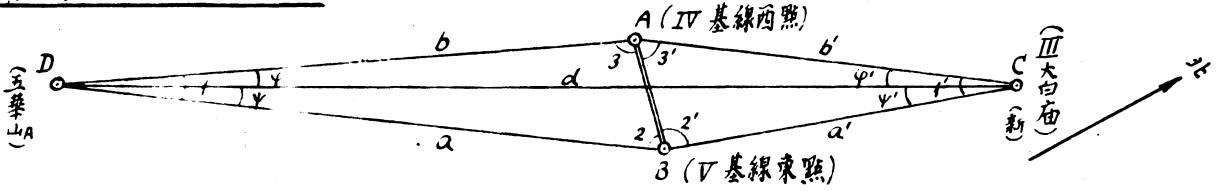
$M''_d = \frac{\overline{DC}}{AB} M_{AB}$        $M_{AB} = AB$  之中外差 =  $\pm 0.0005$  公尺

$M''_d = \pm 0.004$  公尺

$\overline{DC}$  之中外差  $M_d = \sqrt{M_d^2 + M''_d^2} = \pm 0.064$  公尺

# 縱橫線計算

## III, IV, V 各點座標之計算



已知角	已知邊長	(對數)	已知方位
$\alpha 1 = 10^\circ 30' 39.51$	$a = \text{五}-\text{V} = 1615.415$ 公尺	3.208 2841	$\psi_{\text{五A}}^{\text{III}} = 25^\circ 5' 52.0$
$\alpha 2 = 68^\circ 33.36$	$b = \text{五}-\text{IV} = 1529.086$	3.184 4319	已知座標
$\alpha 3 = 101^\circ 21' 47.13$	$a' = \text{III}-\text{V} = 950.940$	2.978 1532	
$\alpha 1' = 17^\circ 9' 10.52$	$b' = \text{III}-\text{IV} = 1016.787$	3.007 2300	
$\alpha 2' = 93^\circ 56' 1.80$	$d = \text{五}-\text{III} = 2537.085$	3.404 3350	$Y_{\text{五A}} = +1700.840$
$\alpha 3' = 68^\circ 54' 47.68$			$X_{\text{五A}} = -732.540$

### III 之座標:

$\log d = 3.404 3350$	$\log d = 3.404 3350$	$Y_{\text{五A}} = +1700.840$	$X_{\text{五A}} = -732.540$
$\log \sin \psi_{\text{五A}}^{\text{III}} = 9.627 5341$	$\log \cos \psi_{\text{五A}}^{\text{III}} = 9.956 9293$	$d \sin \psi_{\text{五A}}^{\text{III}} = +1076.141$	$d \cos \psi_{\text{五A}}^{\text{III}} = +2297.547$
$\log d \sin \psi_{\text{五A}}^{\text{III}} = 3.031 8691$	$\log d \cos \psi_{\text{五A}}^{\text{III}} = 3.361 2643$	$Y_{\text{III}} = +2776.981$	$X_{\text{III}} = +1565.007$

### IV 及 V 之座標:

$\log b = 3.184 4319$	$\psi' = 5^\circ 50' 32.72$	$\varphi = 180^\circ - (\psi' + \alpha 3 + \alpha 3') = 3^\circ 52' 52.47$
$\log \sin (\alpha 3 + \alpha 3') = 9.227 6206 (+)$	$\psi = \alpha 1 - \psi' = 11^\circ 18' 37.80$	$\psi = \alpha 1 - \varphi = 6^\circ 37' 47.05$
$2.412 0525$	$\psi_{\text{五A}}^{\text{IV}} = \psi_{\text{五A}}^{\text{III}} + \psi = 21^\circ 56' 24.72$	$\psi_{\text{五A}}^{\text{IV}} = \psi_{\text{五A}}^{\text{III}} - \varphi = 21^\circ 12' 59.54$
$\log d = 3.404 3349 (-)$	$\psi_{\text{五A}}^{\text{V}} = \psi_{\text{五A}}^{\text{III}} - \psi = 19^\circ 47' 14.20$	$\psi_{\text{五A}}^{\text{V}} = \psi_{\text{五A}}^{\text{III}} + \psi = 31^\circ 43' 39.05$
$\log \sin \varphi = 9.007 7176$		

$\log b' = 3.007 2300$	$\log b = 3.184 4319$	$\log b' = 3.007 2300$	$\log b = 3.184 4319$
$\log \sin \psi_{\text{五A}}^{\text{IV}} = 9.711 0841 n$	$\log \sin \psi_{\text{五A}}^{\text{V}} = 9.558 5810$	$\log \cos \psi_{\text{五A}}^{\text{IV}} = 9.933 3376 r$	$\log \cos \psi_{\text{五A}}^{\text{V}} = 9.969 5181$
$2.718 3141$	$2.743 0129$	$2.940 5676 n$	$3.153 9500$
$b' \sin \psi_{\text{五A}}^{\text{IV}} = -522.774$	$b \sin \psi_{\text{五A}}^{\text{V}} = +553.366$	$b' \cos \psi_{\text{五A}}^{\text{IV}} = -872.103$	$b \cos \psi_{\text{五A}}^{\text{V}} = +1425.443$
$Y_{\text{III}} = +2776.981$	$Y_{\text{五A}} = +1700.840$	$X_{\text{III}} = +1565.007$	$X_{\text{五A}} = -732.540$
$Y_{\text{IV}} = +2254.207$	$Y_{\text{V}} = +2554.206$	$X_{\text{IV}} = +692.904$	$X_{\text{V}} = +641.465$

$\log a' = 2.978 1532$	$\log a = 3.208 2841$	$\log a' = 2.978 1532$	$\log a = 3.208 2841$
$\log \sin \psi_{\text{五A}}^{\text{V}} = 9.377 1560 n$	$\log \sin \psi_{\text{五A}}^{\text{IV}} = 9.720 8868$	$\log \cos \psi_{\text{五A}}^{\text{V}} = 9.987 3030 n$	$\log \cos \psi_{\text{五A}}^{\text{IV}} = 9.929 7043$
$2.355 3093 n$	$2.929 1709$	$2.965 4562 n$	$3.137 9884$
$a' \sin \psi_{\text{五A}}^{\text{V}} = -226.626$	$a \sin \psi_{\text{五A}}^{\text{IV}} = +849.515$	$a' \cos \psi_{\text{五A}}^{\text{V}} = -923.541$	$a \cos \psi_{\text{五A}}^{\text{IV}} = +1374.005$
$Y_{\text{III}} = +2776.981$	$Y_{\text{五A}} = +1700.840$	$X_{\text{III}} = +1565.007$	$X_{\text{五A}} = -732.540$
$Y_{\text{V}} = +2550.355$	$Y_{\text{IV}} = +2550.355$	$X_{\text{V}} = +641.466$	$X_{\text{IV}} = +641.465$

結果: IV:  $Y = +2254.207$   $X = +692.904$       V:  $Y = +2550.355$   $X = +641.466$

# 角度測量記錄

日期 2020年 2月 1日  
天氣 晴 大風

測區 儀器 蔡司二號經緯儀 41023

觀測者 紀增爵  
記錄者 沙鍾瑞

測站	觀測點	I. 望遠鏡位置正						II 望遠鏡位置反						I II之平均值			還原平均值			改正平均值			附註					
		遊標		A		B		平均值	遊標		A		B											平均值				
		°	'	°	'	°	'		°	'	°	'	°	'	°	'												
		°	'	°	'	°	'	°	'	°	'	°	'	°	'	°	'	°	'									
五華山B	III 大白廟	0	27	42.8	27	36.5	27	39.7	18.0	27	19.0	27	14.1	27	16.6	0	27	28.2	0	0	0.0							
	VI 板橋路	38	19	1.2	19	2.0	19	1.6	21.8	18	55.8	18	56.5	18	56.2	38	18	58.9	37	51	30.7							
	VII 大樹壩	71	25	46.2	25	47.0	25	46.6	25.1	25	43.2	25	47.0	25	45.1	71	25	45.9	70	58	17.7							
	XI 柳堤	175	45	39.5	45	41.5	45	40.5	35.5	45	48.7	45	46.0	45	47.4	175	45	44.0	175	18	15.8							
	II 白泥坡	78	5.9	57.0	5.9	58.0	5.9	57.5	9.8	5.9	52.0	5.9	51.0	5.9	51.5	278	5.9	54.5	278	32	26.3							
五華山B	III	45	08	40.0	08	34.0	08	37.0	22.5	08	29.0	08	25.0	08	27.0	45	08	32.0	0	0	0.0							
	VI	82	59	57.5	59	58.2	59	57.9	26.2	59	57.0	59	53.0	59	55.0	82	59	56.5	37	51	24.5							
	VII	116	06	46.2	06	42.0	06	44.1	29.6	06	53.0	06	50.4	06	51.7	116	06	47.9	70	58	15.9							
	XI	220	26	48.0	26	45.8	26	46.9	4.0	26	54.2	26	54.0	26	54.1	220	26	50.5	175	18	18.5							
	II	323	4.0	35.0	4.0	31.0	4.0	33.0	14.3	4.0	18.0	4.0	15.0	4.0	16.5	323	4.0	24.8	278	31	52.8							
五華山B	III	89	42	41.0	42	43.5	42	45.3	26.9	42	27.5	42	28.8	42	28.2	89	42	36.8	0	0	0.0							
	VI	127	34	08.0	33	02.0	34	05.0	30.7	33	53.5	33	49.5	33	51.5	127	33	58.3	37	51	21.5							
	VII	160	41	03.0	41	05.0	41	04.0	34.0	40	58.0	40	59.5	40	58.5	160	41	01.4	70	58	24.6							
	XI	265	0	42.5	0	36.2	0	39.4	8.5	01	0.0	01	06.0	01	03.0	265	0	51.2	175	18	14.4							
	II	8	15	06.8	15	02.5	15	4.7	18.8	14	51.4	14	55.5	14	53.5	8	14	59.1	278	32	22.3							
五華山B	III	135	16	01.0	16	03.0	16	02.0	31.5	15	52.0	15	47.0	15	49.5	135	15	55.8	0	0	0.0	0	0	0.0				
	VI	173	07	31.0	07	32.0	07	31.5	35.3	07	24.0	07	25.0	07	24.5	173	07	28.0	37	51	32.2	37	51	27.2				
	VII	206	14	30.0	14	33.5	14	31.8	2.6	14	17.2	14	16.0	14	16.6	206	14	24.2	70	58	28.4	70	58	21.7				
	XI	310	34	10.8	34	13.0	34	11.9	13.0	34	15.5	34	18.5	34	17.0	310	34	14.5	175	18	18.7	175	18	16.9				
	II	53	4.8	32.4	4.8	31.0	4.8	31.7	23.3	4.8	21.0	4.8	24.0	4.8	22.5	53	4.8	27.1	278	32	31.3	278	32	18.2				



# 角度測量記錄

(複測法)

日期 29年3月8日

天氣 晴

測區

儀器 Hildebrand 105544

觀測者 程元慶

記錄者 紀增壽

測站	觀測點	I. 望遠鏡位置正						II. 望遠鏡位置反						III之平均值	還原平均值	改正平均值	附註	
		遊標 A			遊標 B			遊標 A			遊標 B							平均值
		°	'	"	°	'	"	°	'	"	°	'	"					
I 西樺村	II 白泥坡	0	0	0	0	45	0	23										
	XIII 東寺塔	131	37	30	38	0	37	45										
	XIII	298	7	45	8	30	8	8										
		298					7	45										
	5倍角=658						7	45										
	1倍角=131° 37' 32.5"																	
日期	29年3月20日																	
天氣	晴																觀測者 } 高俊南 記錄者 }	
II 白泥坡	III 大白廟	0	1	0	0	0	0	30										
	XIII 東寺塔	65	36	15	35	15	36	45										
	XIII	295	54	30	53	30	54	0										
		295					53	30										
	10倍角=655° 53' 30"																	
1倍角=65° 35' 21.0"																		

五華山B<sup>7</sup>座標之計算:

已知方位  $\gamma_{五A}^{III} = 25^\circ 5' 52.0$

已測角  $\angle III五A五B = 49^\circ 55' 24.0$

$\gamma_{五A}^{五B} = 75^\circ 1' 16.0$

已測距離  $S = 五A-五B = 2,669$  公尺

$\log S = 0.426 32$

$\log(\sin)\gamma_{五A}^{五B} = 9.984 99$

$0.411 31$

$S \sin \gamma_{五A}^{五B} = +2,578$

$\gamma_{五A} = +1700,840$

$\gamma_{五B} = +1703,418$

$\log S = 0.426 32$

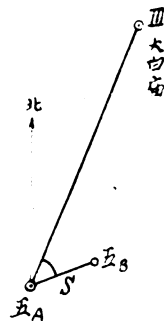
$\log(\cos)\gamma_{五A}^{五B} = 9.412 43$

$9.838 75$

$S \cos \gamma_{五A}^{五B} = +0,690$

$X_{五A} = -732,540$

$X_{五B} = -731,850$



方位  $\gamma_{五B}^{III}$  及距離 五B-III 之計算:

	Y	X
III	+2776.981	+1565.007
五B	+1703.418	-731.850

$\Delta Y = +1073,563$      $\Delta X = +2296,857$

$\log \Delta Y = 3.030 8275$

$\log \Delta X = 3.361 1340$

$\log \tan \gamma = 9.669 6935$

$\gamma = 25^\circ 3' 5.86$

$\log \sin \gamma = 9.626 7864$

$\log \cos \gamma = 9.957 0930$

$\log(\frac{\Delta Y}{S}) = \log \frac{\Delta Y}{\sin \gamma} = 3.404 0411$

$= \log \frac{\Delta X}{\cos \gamma} = 3.404 0410$

$(五B-III) = 2535,368$  公尺

XI南室'點之歸心計算:

已測角:  $\angle X五B XI = 32^\circ 34' 13.5$

$\angle 五B X X_{Ex} = 85^\circ 44' 6.0$

$\angle X_{Ex} XI 五B = 82^\circ 33' 27.1$

$200^\circ 51' 46.6$

$\phi = 360^\circ - 200^\circ 51' 46.6 = 159^\circ 8' 13.4$

偏角  $\delta = \frac{e}{S} \sin \phi \cdot \rho$

$\log e = 0.352 57$

$\log \sin \phi = 9.551 61$

$\log \rho = 5.314 43$

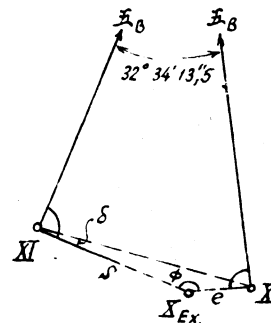
$\log \frac{1}{S} = 6.761 45$

$\log \delta = 1.980 06$

$\delta = 95.5 = 1' 35.5$

偏角  $e = 2,252$  公尺

距離  $(XI-X_{Ex}) = S = 1732$  公尺 (約數)



已測方向:

測站	觀測點	方向
XI	III	0° 0' 0.0
	X <sub>Ex</sub>	129° 56' 40.9

歸心計算後之方向:

XI	III	0° 0' 0.0
	X	129° 55' 5.4

# 三角網平差計算

已測之方向角:

<u>五華山 B</u>		<u>VI 叙綉密路(新)</u>		<u>VIII 蘇家村</u>		<u>XI 柳堤</u>	
III ... (1) =	0° 0' 0.0	VII ... (18) =	0° 0' 0.0	IX ... (28) =	0° 0' 0.0	XII ... (38) =	0° 0' 0.0
VI ... (2)	37 51 27.2	(XIV ... (19)	54 30 12.2	五B ... (29)	131 2 38.1	(五* ... (39)	47 20 30.9
VII ... (3)	70 58 21.7	五B ... (20)	97 48 32.2	(XIV ... (30)	133 26 2.2	五B ... (40)	47 23 13.8
VIII ... (5)	92 54 57.4	(五* ... (21)	97 49 35.9	VII ... (31)	231 28 38.7	X ... (41)	129 55 5.4
IX ... (6)	108 35 12.2	II ... (22)	132 57 22.5	<u>IX 南天台</u>		<u>XII 慧建庵</u>	
X ... (8)	142 44 3.4	III ... (23)	183 14 41.8	X ... (32) =	0° 0' 0.0	II ... (42) =	0° 0' 0.0
XI ... (10)	175 18 16.9	<u>VII 大樹營</u>		五B ... (33)	70 1 32.7	(I ... (43)	22 8 1.0
XII ... (12)	198 18 46.8	VIII ... (24) =	0 0 0.0	(XIV ... (34)	82 58 6.0	(五* ... (44)	57 18 13.0
II ... (4)	278 32 18.2	(五* ... (25)	57 36 28.9	VIII ... (35)	103 18 19.1	五B ... (45)	57 20 31.4
<u>III 大白廟(新)</u>		五B ... (26)	57 37 35.9	<u>IX 南鸞</u>		XI ... (46)	166 56 31.5
VI ... (15) =	0° 0' 0.0	VI ... (27)	106 42 0.0	五B ... (36) =	0° 0' 0.0	<u>II 白泥坡</u>	
五B ... (16)	56 42 4.7			IX ... (37)	75 49 57.6	III ... (47) =	0° 0' 0.0
II ... (17)	109 43 50.1					五B ... (49)	45 30 47.0
						XII ... (52)	87 56 44.3

規約方程式共十個 即三角方程式八個與邊方程式兩個。

三角方程式:

(a) 五B (2)-(1) = 37° 51' 27.2	(b) 五B (3)-(2) = 33° 6' 54.5	(c) 五B (5)-(3) = 21° 56' 35.7	(d) 五B (6)-(5) = 15° 40' 14.8
III (16)-(15) = 56 42 4.7	VI (20)-(18) = 97 48 32.2	VII (26)-(24) = 57 37 35.9	VIII (27)-(28) = 131 2 38.1
VI (23)-(20) = 95 26 9.6	VII (27)-(26) = 49 4 24.1	VIII (31)-(29) = 100 26 0.6	IX (35)-(33) = 33 16 46.4
179 59 41.5	179 59 50.8	180 0 12.2	179 59 39.3
ω = -18.5	ω = -9.2	ω = +12.2	ω = -20.7
-v <sub>1</sub> + v <sub>2</sub> - v <sub>5</sub> + v <sub>6</sub> - v <sub>10</sub> + v <sub>13</sub> - 18.5 = 0 ----- (a)		-v <sub>3</sub> + v <sub>5</sub> - v <sub>24</sub> + v <sub>26</sub> - v <sub>29</sub> + v <sub>31</sub> + 12.2 = 0 ----- (c)	
-v <sub>2</sub> + v <sub>3</sub> - v <sub>18</sub> + v <sub>20</sub> - v <sub>26</sub> + v <sub>27</sub> - 9.2 = 0 ----- (b)		-v <sub>5</sub> + v <sub>6</sub> - v <sub>28</sub> + v <sub>29</sub> - v <sub>33</sub> + v <sub>35</sub> - 20.7 = 0 ----- (d)	
(e) 五B (8)-(6) = 34° 8' 51.2	(f) 五B (12)-(10) = 23° 0' 29.9	(g) 五B (14)-(12) = 80° 13' 31.4	(h) 五B (1)-(14) = 81° 27' 41.8
IX (33)-(32) = 70 1 32.7	XI (40)-(38) = 47 23 13.8	XII (45)-(42) = 57 20 31.4	II (49)-(47) = 45 30 47.0
X (37)-(36) = 75 49 57.6	XII (44)-(43) = 109 36 0.1	II (52)-(44) = 42 25 57.3	III (17)-(16) = 53 1 45.4
180 0 21.5	179 59 43.8	180 0 0.1	180 0 14.2
ω = +21.5	ω = -16.2	ω = +0.1	ω = +14.2
-v <sub>6</sub> + v <sub>8</sub> - v <sub>32</sub> + v <sub>33</sub> - v <sub>36</sub> + v <sub>37</sub> + 21.5 = 0 ----- (e)		-v <sub>12</sub> + v <sub>14</sub> - v <sub>42</sub> + v <sub>45</sub> - v <sub>49</sub> + v <sub>52</sub> + 0.1 = 0 ----- (g)	
-v <sub>10</sub> + v <sub>12</sub> - v <sub>38</sub> + v <sub>40</sub> - v <sub>45</sub> + v <sub>46</sub> - 16.2 = 0 ----- (f)		+v <sub>1</sub> - v <sub>14</sub> - v <sub>36</sub> + v <sub>17</sub> - v <sub>47</sub> + v <sub>49</sub> + 14.2 = 0 ----- (h)	

邊方程式:

以五B 為中心點:  $\frac{\sin(23-29)\sin(27-26)\sin(31-29)\sin(35-33)\sin(37-36)\sin(41-40)\sin(46-45)\sin(52-49)}{\sin(16-15)\sin(20-18)\sin(26-24)\sin(29-28)\sin(33-32)\sin(37-36)\sin(41-40)\sin(46-45)\sin(52-49)} = 1$

以 VI 為中心點 (四角形 III VI 五B II):  $\frac{\sin(16-15)\sin(20-18)\sin(26-24)\sin(29-28)}{\sin(17-14)\sin(2-1)} = 1$

$$\angle III V B = 180^\circ - (10-8) - (41-40) = 64^\circ 53' 54.9''$$

$$\angle III VI = 180^\circ - (17-15) - (23-22) = 19^\circ 58' 50.6''$$

$$\angle VI II B = 180^\circ + (49-47) + (17-15) + (23-22) = 25^\circ 31' 56.4''$$

角度	log sin	每秒之表差	角度	log sin	每秒之表差
(23-20)	9.998 6207	+1.7	(16-15)	9.922 1127	+13.8
(28-26)	9.878 2626	+18.3	(20-18)	9.995 1537	-2.9
(31-29)	9.992 7593	-3.9	(26-24)	9.926 6392	+13.3
(35-33)	9.739 3544	+32.0	(29-28)	9.877 4903	-18.3
(37-36)	9.986 5859	+5.3	(33-32)	9.973 0568	+7.7
(41-40)	9.996 2995	+2.8	$\angle III V B$	9.956 9165	+9.9
(46-45)	9.974 0773	-7.5	(40-38)	9.866 8456	+19.3
(52-49)	9.829 1250	+23.0	(45-42)	9.925 2642	+13.5
(17-16)	9.902 5157	+15.8	(49-47)	9.853 3393	+20.7

$$\text{分子} = 9.297 6004$$

$$\text{分母} = 9.297 6183$$

$$\text{分子} - \text{分母} = -0.000 0179$$

$$\begin{aligned} &+ 1.7(v_{23} - v_{20}) + 18.3(v_{27} - v_{26}) - 3.9(v_{31} - v_{29}) + 32.0(v_{35} - v_{33}) + 5.3(v_{37} - v_{36}) + 2.8(v_{41} - v_{40}) - 7.5(v_{46} - v_{45}) \\ &+ 23.0(v_{52} - v_{49}) + 15.8(v_{17} - v_{16}) - 13.8(v_{16} - v_{15}) + 2.9(v_{20} - v_{18}) - 13.3(v_{26} - v_{24}) + 18.3(v_{29} - v_{28}) - 7.7(v_{33} - v_{32}) \\ &+ 9.9(v_{10} - v_8 + v_{41} - v_{40}) - 19.3(v_{20} - v_{38}) - 13.5(v_{45} - v_{42}) - 20.7(v_{49} - v_{47}) - 17.9 = 0 \\ &- 57.9(v_{17} - v_{15} + v_{23} - v_{23}) - 11.8(v_2 - v_{14}) + 13.8(v_{16} - v_{15}) + 7.5(v_{17} - v_{15}) - 4.41(v_{49} - v_{47} + v_{17} - v_{15} + v_{23} - v_{22}) \\ &- 27.0(v_2 - v_1) + 5.43 = 0 \end{aligned}$$

整理之並將各項除以 10.

$$\begin{aligned} &-0.49 v_8 + 0.49 v_{10} + 1.38 v_{15} - 2.96 v_{16} + 1.58 v_{17} - 0.29 v_{18} + 0.12 v_{20} + 0.17 v_{23} + 1.33 v_{24} \\ &- 3.16 v_{26} + 1.83 v_{27} - 1.83 v_{28} + 2.22 v_{29} - 0.39 v_{31} + 0.77 v_{32} - 3.97 v_{33} + 3.20 v_{35} - 0.53 v_{36} \\ &+ 0.53 v_{37} + 1.93 v_{38} - 3.20 v_{40} + 1.27 v_{41} + 1.35 v_{42} - 0.60 v_{45} - 0.75 v_{46} + 2.07 v_{47} - 4.37 v_{49} \\ &+ 2.30 v_{52} - 17.9 = 0 \quad \text{----- (i)} \\ &+ 2.70 v_1 - 3.88 v_2 + 1.18 v_{14} + 8.07 v_{15} + 1.38 v_{16} - 9.45 v_{17} + 10.20 v_{22} - 10.20 v_{23} + 4.41 v_{27} \\ &- 4.41 v_{49} + 5.43 = 0 \quad \text{----- (j)} \end{aligned}$$

規約方程式之係數表

		$v_1$	$v_2$	$v_3$	$v_4$	$v_5$	$v_6$	$v_7$	$v_8$	$v_9$	$v_{10}$	$v_{11}$	$v_{12}$	$v_{13}$	$v_{14}$	$v_{15}$	$v_{16}$	$v_{17}$	$v_{18}$	$v_{19}$	$v_{20}$	$v_{21}$	$v_{22}$	$v_{23}$	$v_{24}$		
$k_1$	a	-1	+1									-1	+1														
$k_2$	b		-1	+1																	-1	+1				-1	
$k_3$	c			-1	+1																					-1	+1
$k_4$	d				-1	+1																					
$k_5$	e					-1	+1																				
$k_6$	f							-1	+1																		
$k_7$	g									-1	+1																
$k_8$	h	+1										-1	+1														
$k_9$	i																										
$k_{10}$	j	+2,70	-3,88																								

		$v_{27}$	$v_{28}$	$v_{29}$	$v_{31}$	$v_{32}$	$v_{33}$	$v_{35}$	$v_{36}$	$v_{37}$	$v_{38}$	$v_{40}$	$v_{41}$	$v_{42}$	$v_{45}$	$v_{46}$	$v_{47}$	$v_{49}$	$v_{52}$	$w$	
$k_1$	a																				-18,5
$k_2$	b	+1																			-9,2
$k_3$	c			-1	+1																+12,2
$k_4$	d		-1	+1			-1	+1													-20,7
$k_5$	e					-1	+1		-1	+1											+24,5
$k_6$	f										-1	+1			-1	+1					-16,2
$k_7$	g													-1	+1						+0,1
$k_8$	h																-1	+1			+14,2
$k_9$	i	+1,83	-1,83	+2,22	-0,39	+0,77	-3,97	+3,20	-0,53	+0,53	+1,93	-3,20	+1,27	+1,35	-0,60	-0,75	+2,07	-4,37	+2,30		-17,9
$k_{10}$	j																				+54,3

法方程式係數之計算

$a_i$		$d_i$		$i^2$		$j^2$		$g_i$		$j^2$		$a_j$		$h_j$		$j^2$		$i^2$	
15. -1,38	28. +1,83	8. 0,980	32. 0,593	42. -1,35	15. 1,904	33. 15,761	35. 10,240	44. -1,35	16. 2,296	15. 65,125	16. 1,904	1. -2,70	1. +2,70	15. +11,137	16. -4,085	17. -14,931	17. -14,931	17. -14,931	17. -14,931
16. -2,96	29. +2,22	10. 0,980	33. 15,761	45. -0,60	15. 1,904	33. 15,761	35. 10,240	45. -0,60	16. 2,296	16. 1,904	16. 1,904	2. -3,38	2. +3,38	16. -4,085	17. -14,931	17. -14,931	17. -14,931	17. -14,931	17. -14,931
16. -2,96	29. +2,22	15. 1,904	35. 10,240	49. +4,37	16. 2,496	36. 0,281	37. 0,281	49. +4,37	17. +1,58	17. 89,303	17. 89,303	15. -2,07	15. -2,07	16. -1,38	16. -1,38	16. -1,38	16. -1,38	16. -1,38	16. -1,38
20. +0,12	33. +3,97	16. 2,496	36. 0,281	49. +4,37	17. 2,496	37. 0,281	37. 0,281	49. +4,37	17. +1,58	17. 89,303	17. 89,303	15. -2,07	15. -2,07	16. -1,38	16. -1,38	16. -1,38	16. -1,38	16. -1,38	16. -1,38
23. +0,17	35. +3,20	18. 0,084	38. 3,725	49. +4,37	18. 0,084	38. 3,725	38. 3,725	49. +4,37	17. +1,58	17. 89,303	17. 89,303	15. -2,07	15. -2,07	16. -1,38	16. -1,38	16. -1,38	16. -1,38	16. -1,38	16. -1,38
23. +0,17	35. +3,20	20. 0,014	40. 10,240	52. +2,30	20. 0,014	40. 10,240	40. 10,240	52. +2,30	17. +1,58	17. 89,303	17. 89,303	15. -2,07	15. -2,07	16. -1,38	16. -1,38	16. -1,38	16. -1,38	16. -1,38	16. -1,38
[a <sub>i</sub> ]=-4,29	[d <sub>i</sub> ]=+11,22	23. 0,029	41. 1,613	52. +2,30	23. 0,029	41. 1,613	41. 1,613	52. +2,30	17. +1,58	17. 89,303	17. 89,303	15. -2,07	15. -2,07	16. -1,38	16. -1,38	16. -1,38	16. -1,38	16. -1,38	16. -1,38
		24. 1,769	42. 1,823	52. +2,30	24. 1,769	42. 1,823	42. 1,823	52. +2,30	17. +1,58	17. 89,303	17. 89,303	15. -2,07	15. -2,07	16. -1,38	16. -1,38	16. -1,38	16. -1,38	16. -1,38	16. -1,38
		26. 9,986	45. 0,360	52. +2,30	26. 9,986	45. 0,360	45. 0,360	52. +2,30	17. +1,58	17. 89,303	17. 89,303	15. -2,07	15. -2,07	16. -1,38	16. -1,38	16. -1,38	16. -1,38	16. -1,38	16. -1,38
		27. 3,349	46. 0,563	52. +2,30	27. 3,349	46. 0,563	46. 0,563	52. +2,30	17. +1,58	17. 89,303	17. 89,303	15. -2,07	15. -2,07	16. -1,38	16. -1,38	16. -1,38	16. -1,38	16. -1,38	16. -1,38
		28. 3,349	47. 4,285	52. +2,30	28. 3,349	47. 4,285	47. 4,285	52. +2,30	17. +1,58	17. 89,303	17. 89,303	15. -2,07	15. -2,07	16. -1,38	16. -1,38	16. -1,38	16. -1,38	16. -1,38	16. -1,38
		29. 4,928	49. 19,097	52. +2,30	29. 4,928	49. 19,097	49. 19,097	52. +2,30	17. +1,58	17. 89,303	17. 89,303	15. -2,07	15. -2,07	16. -1,38	16. -1,38	16. -1,38	16. -1,38	16. -1,38	16. -1,38
		31. 0,152	52. 5,290	52. +2,30	31. 0,152	52. 5,290	52. 5,290	52. +2,30	17. +1,58	17. 89,303	17. 89,303	15. -2,07	15. -2,07	16. -1,38	16. -1,38	16. -1,38	16. -1,38	16. -1,38	16. -1,38
		38. 782	74. 152	52. +2,30	38. 782	74. 152	74. 152	52. +2,30	17. +1,58	17. 89,303	17. 89,303	15. -2,07	15. -2,07	16. -1,38	16. -1,38	16. -1,38	16. -1,38	16. -1,38	16. -1,38
		[c <sub>i</sub> ]=+112,934		52. +2,30	[c <sub>i</sub> ]=+112,934			52. +2,30	17. +1,58	17. 89,303	17. 89,303	15. -2,07	15. -2,07	16. -1,38	16. -1,38	16. -1,38	16. -1,38	16. -1,38	16. -1,38
				52. +2,30				52. +2,30	17. +1,58	17. 89,303	17. 89,303	15. -2,07	15. -2,07	16. -1,38	16. -1,38	16. -1,38	16. -1,38	16. -1,38	16. -1,38
				52. +2,30				52. +2,30	17. +1,58	17. 89,303	17. 89,303	15. -2,07	15. -2,07	16. -1,38	16. -1,38	16. -1,38	16. -1,38	16. -1,38	16. -1,38
				52. +2,30				52. +2,30	17. +1,58	17. 89,303	17. 89,303	15. -2,07	15. -2,07	16. -1,38	16. -1,38	16. -1,38	16. -1,38	16. -1,38	16. -1,38
				52. +2,30				52. +2,30	17. +1,58	17. 89,303	17. 89,303	15. -2,07	15. -2,07	16. -1,38	16. -1,38	16. -1,38	16. -1,38	16. -1,38	16. -1,38
				52. +2,30				52. +2,30	17. +1,58	17. 89,303	17. 89,303	15. -2,07	15. -2,07	16. -1,38	16. -1,38	16. -1,38	16. -1,38	16. -1,38	16. -1,38
				52. +2,30				52. +2,30	17. +1,58	17. 89,303	17. 89,303	15. -2,07	15. -2,07	16. -1,38	16. -1,38	16. -1,38	16. -1,38	16. -1,38	16. -1,38
				52. +2,30				52. +2,30	17. +1,58	17. 89,303	17. 89,303	15. -2,07	15. -2,07	16. -1,38	16. -1,38	16. -1,38	16. -1,38	16. -1,38	16. -1,38
				52. +2,30				52. +2,30	17. +1,58	17. 89,303	17. 89,303	15. -2,07	15. -2,07	16. -1,38	16. -1,38	16. -1,38	16. -1,38	16. -1,38	16. -1,38
				52. +2,30				52. +2,30	17. +1,58	17. 89,303	17. 89,303	15. -2,07	15. -2,07	16. -1,38	16. -1,38	16. -1,38	16. -1,38	16. -1,38	16. -1,38
				52. +2,30				52. +2,30	17. +1,58	17. 89,303	17. 89,303	15. -2,07	15. -2,07	16. -1,38	16. -1,38	16. -1,38	16. -1,38	16. -1,38	16. -1,38
				52. +2,30				52. +2,30	17. +1,58	17. 89,303	17. 89,303	15. -2,07	15. -2,07	16. -1,38	16. -1,38	16. -1,38	16. -1,38	16. -1,38	16. -1,38
				52. +2,30				52. +2,30	17. +1,58	17. 89,303	17. 89,303	15. -2,07	15. -2,07	16. -1,38	16. -1,38	16. -1,38	16. -1,38	16. -1,38	16. -1,38
				52. +2,30				52. +2,30	17. +1,58	17. 89,303	17. 89,303	15. -2,07	15. -2,07	16. -1,38	16. -1,38	16. -1,38	16. -1,38	16. -1,38	16. -1,38
				52. +2,30				52. +2,30	17. +1,58	17. 89,303	17. 89,303	15. -2,07	15. -2,07	16. -1,38	16. -1,38	16. -1,38	16. -1,38	16. -1,38	16. -1,38
				52. +2,30				52. +2,30	17. +1,58	17. 89,303	17. 89,303	15. -2,07	15. -2,07	16. -1,38	16. -1,38	16. -1,38	16. -1,38	16. -1,38	16. -1,38
				52. +2,30				52. +2,30	17. +1,58	17. 89,303	17. 89,303	15. -2,07	15. -2,07	16. -1,38	16. -1,38	16. -1,38	16. -1,38	16. -1,38	16. -1,38
				52. +2,30				52. +2,30	17. +1,58	17. 89,303	17. 89,303	15. -2,07	15. -2,07	16. -1,38	16. -1,38	16. -1,38	16. -1,38	16. -1,38	16. -1,38
				52. +2,30				52											

解法方程式:

$k_1$	$k_2$	$k_3$	$k_4$	$k_5$	$k_6$	$k_7$	$k_8$	$k_9$	$k_{10}$	$w$	$-s$	驗算
+6,000	-2,000	0	0	0	0	0	-2,000	-4,290	-23,470	-18,500	+44,260	0,000
	+6,000	-2,000	0	0	0	0	0	+5,400	+3,880	-9,200	-2,080	0,000
	(-0.667)	(0)	(0)	(0)	(0)	(0)	(-0.667)	(-1.430)	(-7.823)	(-6.167)	(+14.753)	
		+6,000	-2,000	0	0	0	0	-7,100	0	+12,200	-7,100	0,000
		(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	
			+6,000	-2,000	0	0	0	+11,220	0	-20,700	+7,480	0,000
			(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	
				+6,000	0	0	0	-4,670	0	+21,500	-20,830	0,000
				(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	
					+6,000	-2,000	0	-6,270	0	-16,200	+18,470	0,000
					(0)	(0)	(0)	(0)	(0)	(0)	(0)	
						+6,000	-2,000	+4,720	+5,590	+0,100	-12,410	0,000
						(0)	(0)	(0)	(0)	(0)	(0)	
							+6,000	-1,900	-18,130	+14,200	+3,830	0,000
							(-0.667)	(-1.430)	(-7.823)	(-6.167)	(+14.753)	
								+112,934	+18,788	-17,900	-110,932	0,000
								(-3.007)	(-16.781)	(-13.228)	(+31.640)	
								+427,044	+54,300	-468,002	0,000	
								(-91,808)	(-72,366)	(+173,132)		
								0	-19,800	0,000		
									(-57,041)	(+136,467)		
+5,333	-2,000	0	0	0	0	-0.667	+3,970	-3,943	-15,367	+12,673	-0.001	-2,000
	+6,000	-2,000	0	0	0	0	-7,100	0	+12,200	-7,100	0,000	0
	(-0.750)	(0)	(0)	(0)	(0)	(-0.250)	(+1,489)	(-1,479)	(-5.763)	(+4.752)		(-0.750)
		+6,000	-2,000	0	0	0	+11,220	0	-20,700	+7,480	0,000	0
		(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
			+6,000	0	0	0	-4,670	0	+21,500	-20,830	0,000	0
			(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
				+6,000	-2,000	0	-6,270	0	-16,200	+18,470	0,000	0
				(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
					+6,000	-2,000	+4,720	+5,590	+0,100	-12,410	0,000	0
					(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
						+5,333	-3,330	-25,953	+8,033	+18,583	-0.001	-2,000
						(-0.083)	(+0.496)	(-0.423)	(-1.011)	(+1.584)		(-0.250)







+4,486	-1,958	-24,431	+4,200	+17,703	0,000	-2,292	-0,778	-0,291	-0,109	-0,036	-0,750	-2,000
+77043	+1,531	+7,853	-84,467	+0,002	-3,132	+3,086	-2,318	+8,623	-1,202	-5,284	+2,630	
- (-0,855)	(-10,663)	(+1,833)	(+7,727)		(-1,000)	(-0,340)	(-0,127)	(-0,048)	(-0,016)	(-0,327)	(0,873)	
+325,975	-23,423	-279,653	-0,001	-25,195	-4,600	-1,725	-0,645	-0,215	+2,096	+5,590		
(-133,052)	(+22,873)	(+96,411)		(12,482)	(-4,237)	(-1,585)	(-0,594)	(-0,146)	(-4,385)	(-10,892)		
	+262,121	+273,491	0,000	-24,036	-14,762	+1,589	-12,697	+14,532	-18,188	-5,300		
	(-3,932)	(-16,574)		(+2,145)	(+0,728)	(+0,272)	(+0,102)	(+0,036)	(+0,702)	(+1,572)		
+76,188	-9,132	+9,686	-76,740	+0,002	-4,132	+2,746	-2,445	+8,575	-1,218	-5,611	+1,757	-1,958
+192,923	-0,550	-183,242	-0,001	-37,677	-8,837	-3,310	-1,239	-0,411	-1,989	-5,302	-24,431	
(-1,095)	(+1,161)	(-9,198)		(-0,495)	(+0,329)	(-0,293)	(+1,028)	(-0,146)	(-0,673)	(+0,211)	(-0,235)	
-266,053	+256,917	0,000	-21,891	-14,034	+1,861	-12,595	+14,566	-17,486	-3,428	+4,200		
(-1,231)	(+9,756)		(+0,525)	(-0,349)	(+0,311)	(-1,090)	(+0,155)	(+0,713)	(-0,223)	(+0,244)		
+191,828	+0,611	-192,440	-0,001	-38,172	-8,508	-3,603	-0,211	-0,557	-2,662	-5,091	-24,666	-9,132
-267,284	+266,673	0,000	-21,366	-14,383	+2,172	-13,685	+14,721	-16,773	-3,651	+4,449	+9,686	
(-0,002)	(+0,014)		(+0,122)	(+0,027)	(+0,011)	(+0,001)	(+0,002)	(+0,008)	(+0,016)	(+0,079)	(+0,029)	
-267,286	+267,287	+0,001	-21,244	-14,356	+2,183	-13,684	+14,721	-16,765	-3,635	+4,528	+9,715	+0,611
=-[uv]			+6,000	+5,333	+5,250	+5,238	+5,236	+6,000	+5,333	+4,486	+76,188	+191,828
			+3,5407	+2,6912	-0,4158	+2,6124	-2,8115	+2,7942	+0,6816	-1,0093	-0,1275	-0,0032
			=k <sub>1</sub>	=k <sub>2</sub>	=k <sub>3</sub>	=k <sub>4</sub>	=k <sub>5</sub>	=k <sub>6</sub>	=k <sub>7</sub>	=k <sub>8</sub>	=k <sub>9</sub>	=k <sub>10</sub>

驗大: -267,286 應等于 [wk] 及 -[uv].

号数	w	k	wk	v <sup>2</sup> (v之計算見下頁)									
1.	-18,5	+3,5407	-65,5030	1.	20,7845	15.	14,0101	27.	6,0418	38.	9,2416		
2.	-9,2	+2,6912	-24,7590	2.	0,7430	16.	24,2359	28.	5,6596	40.	10,2528		
3.	+12,2	-0,4158	-5,0278	3.	9,6534	17.	1,3924	29.	7,5350	41.	0,0262		
4.	-20,7	+2,6124	-54,0767	5.	9,1688	18.	7,0439	31.	0,1340	42.	0,7293		
5.	+21,5	-2,8115	-60,4473	6.	29,4198	20.	0,7482	32.	7,3658	45.	4,1412		
6.	-16,2	+2,7942	-45,2660	8.	7,2146	22.	0,0011	33.	24,1867	46.	8,3521		
7.	+0,1	+0,6816	+0,0682	10.	8,5264	23.	12,6667	35.	4,8576	47.	0,5344		
8.	+14,2	-1,0093	-14,3321	12.	4,4605	24.	0,0605	36.	8,2944	49.	1,2544		
9.	-17,9	-0,1275	+2,2823	14.	2,8460	26.	7,3116	37.	8,2944	52.	0,1513		
10.	+54,9	-0,0032	-0,1738		92,8170		67,4204		72,3693		34,6833		
			[wk]=-267,2802		67,4204		72,3693		34,6833				
					72,3693		34,6833						
					34,6833								
					[uv]=+267,2899								

改正數  $v$  之計算:

	1	2	3	5	6	8	10	12	14	15	16	17	18	20	22	23	24	26	
a	$k_1 = +3.5407$	$-3.541$	$+3.541$																
b	$k_2 = +2.6912$	$-2.691$	$+2.691$																
c	$k_3 = -0.4458$	$+0.446$	$-0.446$																
d	$k_4 = +2.6124$	$-2.612$	$+2.612$																
e	$k_5 = -2.8115$	$+2.812$	$-2.812$																
f	$k_6 = +2.7942$			$-2.794$	$+2.794$														
g	$k_7 = +0.6816$			$-0.682$	$+0.682$														
h	$k_8 = -1.0093$			$+1.009$	$-1.009$														
i	$k_9 = -0.1275$			$+0.126$	$-0.126$														
j	$k_{10} = -0.0032$			$-0.009$	$+0.012$														
	$v =$	$-4.559$	$+0.862$	$+3.107$	$-3.028$	$+5.924$	$-2.686$	$-2.920$	$+2.112$	$+1.687$	$-0.004$	$-0.004$	$-0.004$	$-0.026$	$-0.004$	$+0.130$	$-0.004$	$-0.004$	$-0.004$
a	$k_1 = +3.5407$																		
b	$k_2 = +2.6912$	$+2.691$																	
c	$k_3 = -0.4458$		$+0.446$	$-0.446$															
d	$k_4 = +2.6124$		$-2.612$	$+2.612$															
e	$k_5 = -2.8115$		$+2.812$	$-2.812$															
f	$k_6 = +2.7942$																		
g	$k_7 = +0.6816$																		
h	$k_8 = -1.0093$																		
i	$k_9 = -0.1275$																		
j	$k_{10} = -0.0032$																		
	$v =$	$+2.458$	$-2.379$	$+2.745$	$-0.366$	$+2.714$	$-4.918$	$+2.204$	$+2.880$	$-2.880$	$-3.040$	$+3.202$	$-0.162$	$-0.854$	$-2.035$	$+2.890$	$+0.731$	$-1.120$	$+0.387$

每一觀測方向之中誤差:

$$m_{\pm} = \sqrt{\frac{[v^2]}{n}} = \pm 5.76$$

方向角 之子數	目標	測得之方向角	v	改正後之方向角	方向角 之子數	目標	測得之方向角	v	改正後之方向角
<b>五華山B</b>					<b>VII 蘇家村</b>				
1.	III	0° 0' 20"	-456	359° 59' 55.44"	28	IX	0° 0' 0.0"	-2.58	359° 59' 57.62"
2.	VI	37° 51' 27.2"	+0.86	37° 51' 28.06"	29	五B	131° 2' 38.1"	+2.45	131° 2' 40.85"
3.	VII	70° 58' 21.7"	+3.11	70° 58' 24.81"	(30)	XIV	133° 26' 2.2"	+2.27	133° 26' 4.99"
5.	VIII	92° 54' 57.4"	-3.03	92° 54' 54.37"	31	VII	231° 28' 38.7"	-0.87	231° 28' 38.33"
6.	IX	108° 35' 12.2"	+5.62	108° 35' 17.62"	<b>IX 南朱台</b>				
8.	X	142° 44' 3.4"	-2.69	142° 44' 0.71"	32	I	0° 0' 0.0"	+2.71	0° 0' 2.71"
10.	XI	175° 18' 16.9"	-2.92	175° 18' 13.98"	33	五B	70° 1' 32.7"	-4.92	70° 1' 27.78"
12.	XII	198° 48' 46.8"	+2.11	198° 48' 48.91"	(34)	XIV	82° 58' 6.0"	-2.20	82° 58' 3.8"
14.	II	278° 32' 18.2"	+1.69	278° 32' 19.89"	35	VII	103° 18' 19.1"	+2.20	103° 18' 21.30"
<b>II 大白廟(新)</b>					<b>X 南宮</b>				
15.	VI	0° 0' 0.0"	-3.74	359° 59' 56.26"	36	五B	0° 0' 0.0"	+2.88	0° 0' 2.88"
16.	五B	56° 42' 4.7"	+4.92	56° 42' 9.62"	37	IX	75° 49' 57.6"	-2.88	75° 49' 54.72"
17.	II	109° 43' 50.1"	-1.18	109° 43' 48.92"	<b>XI 柳堤(新)</b>				
<b>VII 叙細宮路(新)</b>					38	III	0° 0' 0.0"	-3.06	359° 59' 56.96"
18.	VII	0° 0' 0.0"	-2.65	359° 59' 57.35"	(39)	五B	47° 20' 30.9"	+3.2	47° 20' 34.1"
(19)	XIV	54° 30' 12.2"	-1.7	54° 30' 10.5"	40	五B	47° 23' 13.8"	+3.20	47° 23' 17.00"
20.	五B	97° 49' 32.2"	-0.87	97° 49' 33.37"	41	I	129° 55' 5.4"	-0.16	129° 55' 5.24"
(21)	五B	97° 49' 35.9"	-0.8	97° 49' 35.1"	<b>XII 蘇建庵</b>				
22.	II	132° 57' 22.5"	-0.03	132° 57' 22.47"	42	I	0° 0' 0.0"	-0.85	359° 59' 59.15"
23.	III	183° 14' 4.8"	+2.55	180° 14' 45.38"	(43)	I	22° 8' 1.0"	-1.4	22° 7' 59.6"
<b>VII 大樹營</b>					(44)	五B	57° 18' 13.0"	-2.0	57° 18' 11.0"
24.	VIII	0° 0' 0.0"	+0.25	0° 0' 0.25"	45	五B	57° 20' 31.4"	-2.03	57° 20' 29.37"
(25)	五B	57° 36' 28.9"	-2.1	57° 36' 26.2"	46	II	166° 56' 31.5"	+2.89	166° 56' 34.39"
26.	五B	57° 37' 35.9"	-2.70	57° 37' 33.20"	<b>II 南泥坡</b>				
27.	VI	106° 42' 0.0"	-2.46	106° 42' 2.46"	47	III	0° 0' 0.0"	+0.73	0° 0' 0.73"
					49	五B	45° 30' 47.0"	-1.12	45° 30' 45.88"
					52	II	87° 56' 44.3"	+0.39	87° 56' 44.69"

註: 附以 \* 之各觀測值並未參照三角網平差。其改正數係參照相對二方向角之改正數按比例法算出者。

終結驗算：

(a)  $\Delta$  五<sub>B</sub>ⅣⅤ

$$\begin{aligned} (2)-(1) &= 37^\circ 51' 32.62 \\ (16)-(15) &= 56 \quad 42 \quad 13.36 \\ (23)-(22) &= \frac{85 \quad 26 \quad 14.02}{180^\circ \quad 0' \quad 0.00} \end{aligned}$$

(e)  $\Delta$  五<sub>B</sub>ⅨⅩ

$$\begin{aligned} (8)-(6) &= 34^\circ 8' 43.09 \\ (33)-(32) &= 70 \quad 1 \quad 25.07 \\ (37)-(36) &= \frac{75 \quad 49 \quad 51.84}{180^\circ \quad 0' \quad 0.00} \end{aligned}$$

(b)  $\Delta$  五<sub>B</sub>ⅥⅦ

$$\begin{aligned} (3)-(2) &= 33^\circ 6' 56.75 \\ (20)-(19) &= 97 \quad 48 \quad 33.98 \\ (27)-(26) &= \frac{44 \quad 4 \quad 29.26}{179^\circ \quad 54' \quad 59.99} \end{aligned}$$

(f)  $\Delta$  五<sub>B</sub>ⅪⅫ

$$\begin{aligned} (12)-(10) &= 23^\circ 0' 34.43 \\ (40)-(38) &= 47 \quad 33 \quad 20.04 \\ (44)-(43) &= \frac{104 \quad 36 \quad 5.02}{179^\circ \quad 59' \quad 59.99} \end{aligned}$$

(c)  $\Delta$  五<sub>B</sub>ⅦⅧ

$$\begin{aligned} (5)-(3) &= 21^\circ 56' 29.56 \\ (26)-(24) &= 57 \quad 37 \quad 32.95 \\ (31)-(29) &= \frac{100 \quad 25 \quad 57.48}{179^\circ \quad 59' \quad 59.99} \end{aligned}$$

(g)  $\Delta$  五<sub>B</sub>ⅫⅠ

$$\begin{aligned} (14)-(12) &= 80^\circ 13' 30.98 \\ (45)-(42) &= 57 \quad 20 \quad 30.22 \\ (52)-(49) &= \frac{42 \quad 25 \quad 58.81}{180^\circ \quad 0' \quad 0.01} \end{aligned}$$

(d)  $\Delta$  五<sub>B</sub>ⅧⅨ

$$\begin{aligned} (6)-(5) &= 15^\circ 40' 23.25 \\ (29)-(28) &= 131 \quad 2 \quad 43.23 \\ (35)-(33) &= \frac{33 \quad 16 \quad 53.52}{180^\circ \quad 0' \quad 0.00} \end{aligned}$$

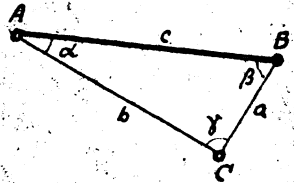
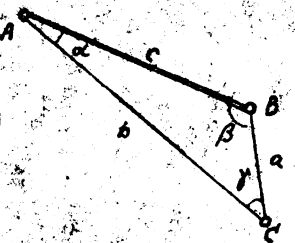
(h)  $\Delta$  五<sub>B</sub>ⅢⅣ

$$\begin{aligned} (1)-(14) &= 81^\circ 27' 55.55 \\ (49)-(47) &= 45 \quad 30 \quad 45.15 \\ (17)-(16) &= \frac{53 \quad 1 \quad 39.30}{180^\circ \quad 0' \quad 0.00} \end{aligned}$$

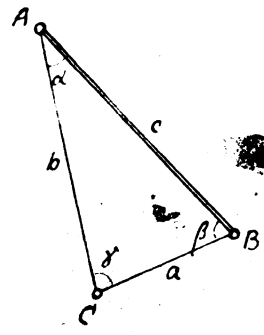
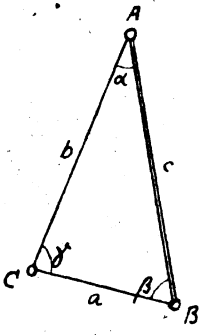
# 縱橫線計算

	已知点: A = 五華山 B = Ⅲ大白廟(新) 所求点: C = Ⅵ叙綏公路(新)		
	座標 $Y_a = +1703,418^m$ $X_a = -731,850$ $Y_b = +2776,981$ $X_b = +1565,007$ 邊長 $C = 2535,368^m$ $\log C = 3.4040410$	已測角 $\alpha = 37^\circ 51' 32.62$ $\beta = 56^\circ 42' 13.36$ $\gamma = 85^\circ 26' 14.02$ 方位角 $V_a^b = 25^\circ 3' 5.86$ $V_b^c = 62^\circ 54' 38.48$ $V_c^a = 148^\circ 20' 52.50$	$a = 1560,956$ $\log a = 3.1933906$ $\log \sin \alpha = 9.7874711$ $\log C = 3.4040410$ $\operatorname{colog} \sin \gamma = 0.0013785$ $\log \sin \beta = 9.9221247$ $\log b = 3.3275442$ $b = 2125,907$
$\log b = 3.3275442$ $\log \sin V_a^c = 9.9495353$ $3.2770795$ ${}^b \sin V_a^c = +1892,690$ $Y_a = +1703,418$ $Y = +3596,108$	$\log a = 3.1933906$ $\log \sin V_b^c = 9.7199606$ $2.9133512$ $a \sin V_b^c = +819,127$ $Y_b = +2776,981$ $Y = +3596,108$	$\log b = 3.3275442$ $\log \cos V_a^c = 9.6583728$ $2.9859170$ $b \cos V_a^c = +968,093$ $X_a = -731,850$ $X = +236,243$	$\log a = 3.1933906$ $\log \cos V_b^c = 9.9300573n$ $3.1234479n$ $a \cos V_b^c = -1328,764$ $X_b = +1565,007$ $X = +236,243$
<b>結果</b>	$Y = +3596,108$	$X = +236,243$	
	已知点: A = 五華山 B = Ⅵ叙綏公路(新) 所求点: C = Ⅶ大樹營		
	座標 $Y_a = +1703,418$ $X_a = -731,850$ $Y_b = +3596,008$ $X_b = +236,244$ 邊長 $C = 2125,907$ $\log C = 3.3275442$	已測角 $\alpha = 33^\circ 6' 56.75$ $\beta = 97^\circ 48' 33.98$ $\gamma = 49^\circ 4' 29.26$ 方位角 $V_a^b = 62^\circ 54' 38.48$ $V_b^c = 96^\circ 1' 35.23$ $V_c^a = 145^\circ 6' 4.50$	$a = 1537,196$ $\log a = 3.1867292$ $\log \sin \alpha = 9.7374570$ $\log C = 3.3275442$ $\operatorname{colog} \sin \gamma = 0.1217280$ $\log \sin \beta = 9.9959532$ $\log b = 3.4452254$ $b = 2787,567$
$\log b = 3.4452254$ $\log \sin V_a^c = 9.9975933$ $3.4428187$ ${}^b \sin V_a^c = +2772.162$ $Y_a = +1703,418$ $Y = +4475,580$	$\log a = 3.1867292$ $\log \sin V_b^c = 9.7574932$ $2.9442224$ $a \sin V_b^c = +879,473$ $Y_b = +3596,108$ $Y = +4475,581$	$\log b = 3.4452254$ $\log \cos V_a^c = 9.0211382n$ $2.4663616n$ $b \cos V_a^c = -292,654$ $X_a = -731,850$ $X = -1024,509$	$\log a = 3.1867292$ $\log \cos V_b^c = 9.9139009$ $3.1006301$ $a \cos V_b^c = -1260,753$ $X_b = +236,243$ $X = -1024,500$
<b>結果</b>	$Y = +4475,580$	$X = -1024,509$	

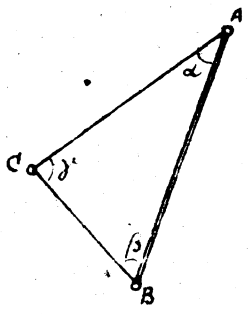
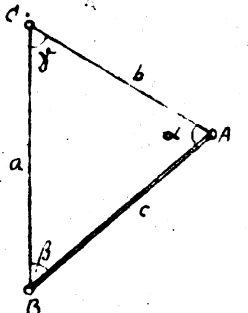
# 縱橫線計算

	已知点: A=五華山 B=VIII大樹營 所求点: C=VIII蘇家村	座標 $Y_a = +1703.418$ $X_a = -731.850$ $Y_b = +4475.580$ $X_b = +1024.509$ 邊長 $C = 2787.567$ $\log C = 3.4452254$	已測角: $\alpha = 21^\circ 56' 29.56$ $\beta = 57^\circ 37' 32.95$ $\gamma = 100^\circ 25' 57.49$ 方位角: $V_a^b = 96^\circ 1' 35.23$ $V_a^c = 117^\circ 58' 4.79$ $V_b^c = 219^\circ 24' 2.28$	$a = 1059.112$ $\log a = 3.0249420$ $\log \sin \alpha = 9.5724771$ $\log C = 3.4452254$ $\operatorname{colog} \sin \gamma = 0.0072395$ $\log \sin \beta = 9.9266353$ $\log b = 3.3791002$ $b = 2393.868$
	$\log b = 3.3791002$ $\log \sin V_a^c = 9.9460638$ $3.3251640$ $b \sin V_a^c = +2114.287$ $Y_a = +1703.418$ $Y = +3817.705$	$\log a = 3.0249420$ $\log \sin V_b^c = 9.7932610$ $2.8181430$ $a \sin V_b^c = +657.874$ $Y_b = +4475.580$ $Y = +3817.706$	$\log b = 3.3791002$ $\log \cos V_a^c = 9.6711528$ $3.0502530$ $b \cos V_a^c = -1122.673$ $X_a = -731.850$ $X = -1854.523$	$\log a = 3.0249420$ $\log \cos V_b^c = 9.8941424$ $2.9190844$ $a \cos V_b^c = -830.012$ $X_b = -1024.509$ $X = -1854.521$
	<b>結果</b> $Y = +3817.706$ $X = -1854.522$	$Y = +3817.706$ $X = -1854.522$	$X = -1854.522$	*
		已知点: A=五華山 B=VIII蘇家村 所求点: C=IX南天台	座標 $Y_a = +1703.418$ $X_a = -731.850$ $Y_b = +3817.706$ $X_b = -1854.522$ 邊長 $C = 2393.868$ $\log C = 3.3791002$	已測角: $\alpha = 15^\circ 40' 23.25$ $\beta = 131^\circ 2' 43.23$ $\gamma = 33^\circ 16' 53.52$ 方位角: $V_a^b = 117^\circ 58' 4.79$ $V_a^c = 133^\circ 39' 28.04$ $V_b^c = 166^\circ 55' 21.56$
$\log b = 3.5172039$ $\log \sin V_a^c = 9.8595446$ $3.3767485$ $b \sin V_a^c = +2380.940$ $Y_a = +1703.418$ $Y = +4084.359$		$\log a = 3.0713261$ $\log \sin V_b^c = 9.3546197$ $2.4259458$ $a \sin V_b^c = +266.653$ $Y_b = +3817.706$ $Y = +4084.359$	$\log b = 3.5172039$ $\log \cos V_a^c = 9.8389387$ $3.3561406$ $b \cos V_a^c = -2270.600$ $X_a = -731.850$ $X = -3002.450$	$\log a = 3.0713261$ $\log \cos V_b^c = 9.9885881$ $3.0899142$ $a \cos V_b^c = -1147.927$ $X_b = -1854.522$ $X = -3002.449$
<b>結果</b> $Y = +4084.359$ $X = -3002.449$		$Y = +4084.359$ $X = -3002.449$	$X = -3002.449$	*
<b>結果</b> $Y = +4084.359$ $X = -3002.449$		$Y = +4084.359$ $X = -3002.449$	$X = -3002.449$	*

## 縱橫線計算

	<p>已知点: A=五華山B</p> <p style="text-align: center;">座標</p> $Y_a = +1703,418$ $X_a = -731,805$ $Y_b = +4084,359$ $X_b = -3002,449$ <p style="text-align: center;">邊長</p> $C = 3290,061$ $\log C = 3.5172039$	<p>B=X南天台</p> <p style="text-align: center;">已測角</p> $\alpha = 34^\circ 8' 43,09$ $\beta = 70 1 25,07$ $\gamma = 75 49 51,84$ <p style="text-align: center;">方位角</p> $V_a^b = 133 38 28,04$ $V_a^c = 167 47 11,13$ $V_b^c = 243 37 2,97$	<p>所求点: C=X南窩</p> $a = 1904,632$ $\log a = 3.2798112$ $\log \sin \alpha = 9.7491901$ $\log C = 3.5172039$ $\operatorname{colog} \sin \gamma = 0.0134172$ $\log \sin \beta = 9.9730509$ $\log b = 3.5036720$ $b = 3189,128$ $\log a = 3.2798112$ $\log \cos V_b^c = 9.6477366_m$ $2.9275478_m$ $a \cos V_b^c = -846,346$ $X_b = -3002,449$ $X = -3848,795$
	$\log b = 3.5036720$ $\log \sin V_a^c = 9.3254169$ $2.8290989$ ${}^b a \sin V_a^c = +674,682$ $Y_a = +1703,418$ $Y = +2378,100$ <p style="text-align: center;">結果</p>	$\log a = 3.2798112$ $\log \sin V_b^c = 9.9522341_m$ $3.2320453_m$ $a \sin V_b^c = -1706,260$ $Y_b = +4084,359$ $Y = +2378,099$ $Y = +2378,099$	$\log b = 3.5036720$ $\log \cos V_a^c = 9.9900571_m$ $3.4937291_m$ $b \cos V_a^c = -3116,945$ $X_a = -731,850$ $X = -3848,795$ $X = -3848,795$
	<p>已知点: A=五華山B</p> <p style="text-align: center;">座標</p> $Y_a = +1703,418$ $X_a = -731,805$ $Y_b = +2378,099$ $X_b = -3848,795$ <p style="text-align: center;">邊長</p> $C = 2912,685$ $\log C = 3.5036719$	<p>B=X南窩</p> <p style="text-align: center;">已測角</p> $\alpha = 32^\circ 34' 13,27$ $\beta = 64 53 58,49$ $\gamma = 82 31 48,24$ <p style="text-align: center;">方位角</p> $V_a^b = 167 47 11,13$ $V_a^c = 200 21 24,40$ $V_b^c = 282 53 12,64$	<p>所求点: C=XI柳堤(新)</p> $a = 1731,514$ $\log a = 3.2384259$ $\log \sin \alpha = 9.7310525$ $\log C = 3.5036719$ $\operatorname{colog} \sin \gamma = 0.0037014$ $\log \sin \beta = 9.9569201$ $\log b = 3.4642935$ $b = 2912,685$ $\log a = 3.2384259$ $\log \cos V_b^c = 4.5483560$ $2.5867809$ $a \cos V_b^c = +386,172$ $X_b = -3848,715$ $X = -3462,623$
	$\log b = 3.4642935$ $\log \sin V_a^c = 9.5414106_m$ $3.0037041_m$ ${}^b a \sin V_a^c = -1013,221$ $Y_a = +1703,418$ $Y = +690,197$ <p style="text-align: center;">結果</p>	$\log a = 3.2384259$ $\log \sin V_b^c = 9.9889210_m$ $3.2273469_m$ $a \sin V_b^c = -1687,901$ $Y_b = +2378,100$ $Y = +690,199$ $Y = +690,199$	$\log b = 3.4642935$ $\log \cos V_a^c = 9.9719919_m$ $3.4362857_m$ $b \cos V_a^c = -2730,772$ $X_a = -731,850$ $X = -3462,622$ $X = -3462,622$

# 縱橫線計算

	<p>已知点: A=五華山 B</p> <p style="text-align: center;">座 標</p> $Y_a = +1703.418$ $X_a = -731.805$ $Y_b = +690.199$ $X_b = -342.622$ 邊 長 $C = 2912.685$ $\log C = 3.4642435$	<p>B=II 柳溪(湖) 所求点: III 梨建庵</p> <p style="text-align: center;">已 測 角</p> $\alpha = 23^\circ 0' 34.93$ $\beta = 47^\circ 23' 20.04$ $\gamma = 109^\circ 36' 50.2$ 方 位 角 $V_a^b = 200^\circ 21' 24.70$ $V_a^c = 223^\circ 21' 59.33$ $V_b^c = 332^\circ 58' 43.6$	$a = 1208.568$ $\log a = 3.0822712$ $\log \sin \alpha = 9.5920513$ $\log c = 3.4642435$ $\text{colog} \sin \gamma = 0.0259264$ $\log \sin \beta = 9.8668576$ $\log b = 3.3570775$ $b = 2275.504$
$\log b = 3.3570775$ $\log \sin V_a^c = 9.8367432$ $3.1938207$ $b \sin V_a^c = -1562.503$ $Y_a = +1703.418$ $Y = +140.915$	$\log a = 3.0822712$ $\log \sin V_b^c = 9.6575243$ $2.7397955$ $a \sin V_b^c = -549.282$ $Y_b = +690.199$ $Y = +140.917$	$\log b = 3.3570775$ $\log \cos V_a^c = 9.8615203$ $3.2185978$ $b \cos V_a^c = -1654.237$ $X_a = -731.850$ $X = -2386.087$	$\log a = 3.0822712$ $\log \cos V_b^c = 9.9497568$ $3.0320280$ $a \cos V_b^c = +1076.535$ $X_b = -3462.622$ $X = -2386.087$
結 果	$Y = +140.916$	$X = -2386.087$	
	<p>已知点: A=五華山 B</p> <p style="text-align: center;">座 標</p> $Y_a = +1703.418$ $X_a = -731.805$ $Y_b = +140.916$ $X_b = -2386.087$ 邊 長 $C = 2275.504$ $\log C = 3.3570775$	<p>B=III 梨建庵 所求点: C=II 白泥坡</p> <p style="text-align: center;">已 測 角</p> $\alpha = 80^\circ 13' 30.98$ $\beta = 57^\circ 20' 30.22$ $\gamma = 42^\circ 25' 58.80$ 方 位 角 $V_a^b = 223^\circ 21' 59.33$ $V_a^c = 303^\circ 35' 30.51$ $V_b^c = 346^\circ 1' 24.11$	$a = 3323.518$ $\log a = 3.5215981$ $\log \sin \alpha = 9.9936191$ $\log c = 3.3570775$ $\text{colog} \sin \gamma = 0.1708715$ $\log \sin \beta = 9.9252626$ $\log b = 3.4532116$ $b = 2839.302$
$\log b = 3.4532116$ $\log \sin V_a^c = 9.9206455$ $3.3738571$ $b \sin V_a^c = -2365.141$ $Y_a = +1703.418$ $Y = -661.723$	$\log a = 3.5215981$ $\log \sin V_b^c = 9.3829219$ $2.9045200$ $a \sin V_b^c = -802.638$ $Y_b = +140.916$ $Y = -661.722$	$\log b = 3.4532116$ $\log \cos V_a^c = 9.7429384$ $3.1961500$ $b \cos V_a^c = +1570.905$ $X_a = -731.850$ $X = +839.055$	$\log a = 3.5215981$ $\log \cos V_b^c = 9.9869508$ $3.5085489$ $a \cos V_b^c = +3225.142$ $X_b = +2386.087$ $X = +839.055$
結 果	$Y = -661.723$	$X = +839.055$	



# 縱橫線計算

	已知点: A=五樂山 B=II白泥坡 所求点: C=III大白廟(新)			
	座標 $Y_a = +1703,418$ $X_a = -731,805$ $Y_b = -661,723$ $X_b = +839,055$	已測角: $\alpha = 81^\circ 27' 35,55$ $\beta = 45^\circ 30' 45,15$ $\gamma = 53^\circ 01' 39,30$ 方位角: $V_a^b = 303^\circ 35' 30,31$ $V_a^c = 25^\circ 03' 5,86$ $V_b^c = 78^\circ 04' 45,16$	$a = 3514,498$ $\log a = 3.545\ 8632$ $\log \sin \alpha = 9.995\ 1577$ $\log C = 3.453\ 2116$ $\text{colog} \sin \gamma = 0.097\ 4939$ $\log \sin \beta = 9.853\ 3355$ $\log b = 3.404\ 0410$ $b = 3535,367$	
	邊長 $C = 2839,302$ $\log C = 3.453\ 2116$			
	結果 $Y = +2776,981$	$Y = +2776,981$	$X = +1565,008$	
	$\log b = 3.404\ 0410$ $\log \sin V_a^c = 9.626\ 7864$ $3.030\ 8274$ $\sin V_a^c = +1073,563$ $Y_a = +1703,418$ $Y = +2776,981$	$\log a = 3.545\ 8632$ $\log \sin V_b^c = 9.990\ 5316$ $3.536\ 3948$ $a \sin V_b^c = +3438,704$ $Y_b = -661,723$ $Y = +2776,981$	$\log b = 3.404\ 0410$ $\log \cos V_a^c = 9.957\ 0930$ $3.361\ 1340$ $b \cos V_a^c = +2296,857$ $X_a = -731,850$ $X = +1565,007$	$\log a = 3.545\ 8632$ $\log \cos V_b^c = 9.315\ 0446$ $2.860\ 7028$ $a \cos V_b^c = +725,954$ $X_b = +839,055$ $X = +1565,009$
	已知点: A=	B=	所求点: C=	
	座標 $Y_a =$ $X_a =$ $Y_b =$ $X_b =$	已測角: $\alpha =$ $\beta =$ $\gamma =$ 方位角: $V_a^b =$ $V_a^c =$ $V_b^c =$	$a =$ $\log a =$ $\log \sin \alpha =$ $\log C =$ $\text{colog} \sin \gamma =$ $\log \sin \beta =$ $\log b =$ $b =$	
	邊長 $C =$ $\log C =$			
$\log b =$ $\log \sin V_a^c =$	$\log a =$ $\log \sin V_b^c =$	$\log b =$ $\log \cos V_a^c =$	$\log a =$ $\log \cos V_b^c =$	
$a \sin V_a^c =$ $Y_a =$ $Y =$	$a \sin V_b^c =$ $Y_b =$ $Y =$	$b \cos V_a^c =$ $X_a =$ $X =$	$a \cos V_b^c =$ $X_b =$ $X =$	
結果	$Y =$			

# 三角補點, LI 西填村<sup>7</sup>

## 之計算及平差

已知點之座標:

五華山	$y = +1700.840$	$x = -732.540$
XII 慧建庵	+ 140.916	- 2386.087
II 白泥坡	- 661.723	+ 839.055
III 大白廟	+ 2776.981	+ 1565.007

測得角: (見第29頁)

$\angle I II III = 69^\circ 32' 2.0$
$\angle III I II = 136^\circ 16' 19.0$
$\angle III II I = 154^\circ 11' 39.0$

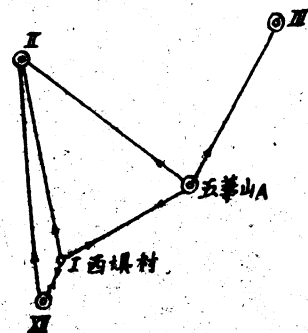
已測方向角:

測站 XII (見第25頁)

II	$359^\circ 59' 59.2$
I	$22^\circ 7' 59.6$

測站 III (見第28頁)

I	$0^\circ 0' 0.0$
II	$71^\circ 44' 59.5$
III	$153^\circ 13' 2.8$



I 點近似座標 (y), (x) 之計算:

	已知點: A = II 白泥坡 B = XII 慧建庵	測得角 $\beta = 22^\circ 8' 0.4$ $\gamma = 154^\circ 11' 39.0$ $(\alpha = 3^\circ 40' 20.6)$ 方位角 $\nu_a^b = 166^\circ 1' 29.1$ $\nu_a^c = 162^\circ 21' 8.5$ $\nu_b^c = 8^\circ 9' 29.5$	所求點: C = I 西填村 $a = 489.01$ $\log a = 2.6893153$ $\log \sin \alpha = 8.8065286$ $\log c = 3.5215981$ $\text{colog} \sin \gamma = 0.3611886$ $\log \sin \beta = 9.5760706$ $\log b = 3.4588573$ $b = 2876.45$
	座標 $y_a = -661.723$ $x_a = +839.055$ $y_b = +140.916$ $x_b = -2386.087$ 邊長 $c = 3323.518$ $\log c = 3.5215981$	測得角 $\log b = 3.4588573$ $\log \cos \nu_a^c = 9.9790651 n$ $3.4379224 n$ $b \cos \nu_a^c = -2741.084$ $x_a = +839.055$ $(x) = -1902.039$	方位角 $\log a = 2.6893153$ $\log \sin \nu_b^c = 9.1520030$ $1.8413183$ $a \sin \nu_b^c = +69.393$ $y_b = +140.916$ $(y) = +210.309$
結果 $(y) = +210.309$ $(x) = -1902.039$			

近似方位角 ( $\nu_I^{II}$ ) 之計算:

五A	$y = +1700.840$	$x = -732.540$	$\log \Delta y = 3.1733410$
I	$(y) = +210.309$	$(x) = -1902.039$	$\log \Delta x = 3.0679998$
	$\Delta y = +1490.530$	$\Delta x = +1169.499$	$\log \text{tg}(\nu) = 0.1053412$
			$(\nu_I^{II}) = 51^\circ 52' 53.7$

方向係數之計算:

測站	目標	近似方位 ( $\nu$ )	距離 $S$	方向係數 (改正數 $\delta y, \delta x$ 以公尺為單位)		$-\frac{\partial}{\partial S}$	$-\frac{\partial}{\partial S}$
				$\partial = +6,26$	$\partial y = +19,65$		
I 西堤村	II	342° 21' 8,5	2,876 <sup>公尺</sup>	$\partial = +6,26$	$\partial y = +19,65$	-2,18	-6,83
	五A	51 52 53,7	1,894	-16,23	+12,74	+8,56	-6,73
	III	188 9 29,5	0,489	+2,93	-20,42	-5,99	+4,76

糾差方程之設立:

測站	目標	方位角( $\nu$ )	測得方位角 $\alpha$	$D = (\nu) - \alpha$	$-l = D - z_0$
I	II	342° 21' 8,5	0° 0' 0,0	342° 20' 68,5	+5,6
	五A	51 52 53,7	69 32 2,0	342 20 51,7	-11,2
	III	188 9 29,5	205 48 21,0	342 20 68,5	+5,6
				188,7 : 3 = 62,9	
				$z_0 = 342° 21' 2,9$	
五A	I	231° 52' 53,7	0° 0' 0,0	(231° 52' 53,7)	+0,9
	II	303 37 55,8	71 44 54,5	231 52 56,3	-3,5
	III	25 5 52,0	153 13 2,8	231 52 49,2	+3,6
				105,5 : 2 = 52,8	
				$z_0 = 231° 52' 52,8$	
III	II	346° 1' 29,1	359° 1' 50,1	346° 1' 29,9	0
	I	8 9 29,5	22 7 1,1	346° 1' 29,9	0
				$z_0 = 346° 1' 29,9$	

糾差方程式:

$$\left. \begin{aligned} v_I^I &= +5,6 - 2,18 \delta x - 6,83 \delta y - z_I \\ v_I^{II} &= -11,2 + 8,56 \delta x - 6,73 \delta y - z_I \\ v_I^{III} &= +5,6 - 5,99 \delta x + 4,76 \delta y - z_I \end{aligned} \right\} \text{測站 I}$$

$$[v] = 0 \quad z_I = +0,13 \delta x + 9,40 \delta y$$

$$\left. \begin{aligned} v_{II}^I &= +0,9 + 8,56 \delta x - 6,73 \delta y - z_{II} \\ v_{II}^{II} &= -3,5 \quad -z_{II} \\ v_{II}^{III} &= +3,6 \quad -z_{II} \end{aligned} \right\} \text{測站 五A}$$

$$[v] = 0 \quad z_{II} = v_{II}^I : 2$$

$$\left. \begin{aligned} v_{III}^I &= 0 - 5,99 \delta x + 4,76 \delta y - z_{III} \\ v_{III}^{II} &= 0 \quad -z_{III} \end{aligned} \right\} \text{測站 III}$$

$$[v] = 0 \quad z_{III} = v_{III}^I$$

(註:  $z = z - z_0$ , 其中  $z = \nu - \alpha$ )

須去 $z$ , 得下列各式:

測站 I

1.  $v_I^I = +5,6 - 2,18 \delta x - 6,83 \delta y$  1
2.  $v_I^{II} = -11,2 + 8,56 \delta x - 6,73 \delta y$  1
3.  $v_I^{III} = +5,6 - 5,99 \delta x + 4,76 \delta y$  1

測站 五A

4.  $v_{II}^I = +0,9 + 8,56 \delta x - 6,73 \delta y$   $\frac{1}{2}$

測站 III

5.  $v_{III}^I = 0 - 5,99 \delta x + 4,76 \delta y$   $\frac{1}{2}$

法方程式係數之計算:

序數	A	B	-L	AA	AB	AL	BB	BL	LL
1.	-2.31	-16.23	+5.6	+5.34	+37.49	-12.92	+263.42	-90.88	+31.36
2.	+8.43	-16.13	+11.2	+71.06	-135.98	-9.50	+280.19	+189.66	+125.44
3.	-6.12	+32.36	+5.6	+37.45	-198.04	-12.92	+263.11	+181.22	+31.36
4.	+5.70	-4.49	+0.6	+16.25	-12.75	+1.71	+10.08	-1.35	+0.18
5.	-3.00	+20.88	0	+4.50	-31.32	0	+217.99	0	+0
[Σ]				+134.60	-340.60	-139.94	+1798.79	+269.65	+188.34

法方程式之解:

$\delta x$	$\delta y$	$\delta x$	$\delta y$
+134.60	+340.60	+1798.79	-340.60
	+1798.79		+269.65
	(-861.87)		(-354.11)
	+188.34		(-64.49)
	(-145.49)		+188.34
			(-40.42)
$p_y = +936.92$	-84.46	$p_x = +70.11$	-88.88
	+42.85		+147.92
	(-7.60)		(-112.67)
	[p <sub>vv</sub> ] = +35.25		[p <sub>vv</sub> ] = +35.25

$$\delta y = + \frac{84.46}{936.92} = +0.09 \text{ dm}$$

$$\delta x = + \frac{88.88}{70.11} = +1.27 \text{ dm}$$

$$(y) = +210.309$$

$$(x) = -1902.039$$

$$y = +210.318$$

$$x = -1901.912$$

v 之計算:

序數	-L	A $\delta x$	B $\delta y$	v	p <sub>vv</sub>
1.	+5.6	-2.93	-1.46	+1.21	1.74
2.	-11.2	+10.71	-1.45	-1.94	3.76
3.	+5.6	-7.76	+2.91	+0.75	0.56
4.	+0.6	+7.24	-0.40	+7.44	27.71
5.	0	-3.81	+1.88	-1.93	1.86
				[p <sub>vv</sub> ] =	35.36

每觀測值之中併差:

$$\mu = \sqrt{\frac{[p_{vv}]}{n-u}} = \sqrt{\frac{35.3}{5-3}} = \pm 4.2$$

座標之中併差:

$$m_y = \frac{\mu}{\sqrt{p_y}} = \frac{4.2}{\sqrt{937}} = \pm 0.13 \text{ dm}$$

$$m_x = \frac{\mu}{\sqrt{p_x}} = \frac{4.2}{\sqrt{70}} = \pm 0.50 \text{ dm}$$

結果: I 西堤村' 点

$$y = +210.318 \pm 0.013 \text{ 公尺}$$

$$x = -1901.912 \pm 0.050 \text{ 公尺}$$

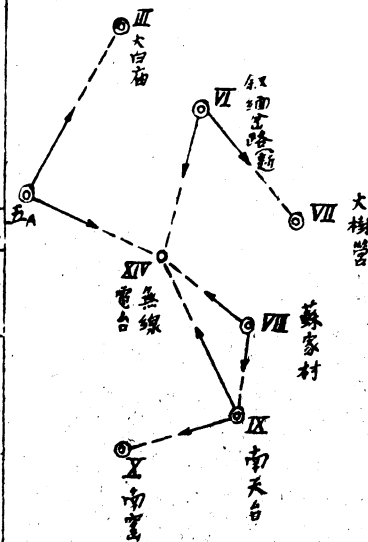
# 三角補點 XIV 無線電台<sup>7</sup>

## 之計算及平差 (圖解法)

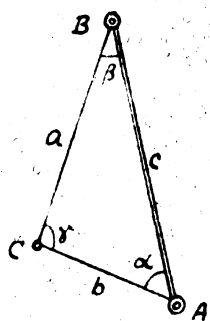
已知點座標:

五華山 A	$y = +1700,840$ 公尺	$x = -732,540$ 公尺
VI 叙繩公路(新)	+3596,108	+236,243
VII 蘇家村	+3817,706	-1854,522
IX 南天台	+4084,359	-3002,449

測站	目標	乙測方向	夾角	已知方位	由各測站至 XIV 之方位
五 <sub>A</sub>	III	153° 13' 2.8	91° 17' 34.5	$\nu_{五A}^{III} = 25° 5' 52.0$	$\nu' = 116° 23' 26.5$
	XIV	244 30 37.3			
VI	VII	359 59 57.3	54 30 13.2	$\nu_{VI}^{VII} = 145 6 4.5$	199 36 17.7
	XIV	54 30 10.5			
VIII	IX	359 59 57.6	133 26 7.3	$\nu_{VIII}^{IX} = 166 55 21.5$	300 21 28.8
	XIV	133 26 4.9			
IX	X	0 0 2.7	82 58 1.1	$\nu_{IX}^X = 243 37 3.0$	326 35 4.1
	XIV	82 58 3.8			



XIV 點近似座標之計算:



已知點: A = VIII    B = VI

所求點: C = XIV

座標  
 $y_a = +3817,706$   
 $y_b = +3596,108$   
 $y_b - y_a = -221,598$   
 $x_a = -1854,522$   
 $x_b = +236,243$   
 $x_b - x_a = +2090,765$

$\log(y_b - y_a) = 2.3455659n$   
 $\log(x_b - x_a) = 3.3203052$   
 $\log \tan \nu_a^b = 9.0252607n$   
 $\nu_a^b = 353° 56' 59.5$   
 $\log \sin \nu_a^b = 9.0228349n$   
 $\log \cos \nu = 9.9975742$   
 $\log c = \log \frac{y_b - y_a}{\sin \nu_a^b} = 3.3227310$   
 $\log c = \log \frac{x_b - x_a}{\cos \nu_a^b} = 3.3227310$

$\nu_c^b = \nu_{VI}^{XIV} = 199° 36' 17.7$   
 $\nu_a^b = 173° 56' 59.5$   
 $\beta = \nu_{VI}^{XIV} - \nu_a^b = 25° 39' 18.2$   
 $\nu_a^b = 353° 56' 59.5$   
 $\nu_a^c = \nu_{VIII}^{XIV} = 300° 21' 28.8$   
 $\alpha = \nu_a^b - \nu_{VIII}^{XIV} = 53° 35' 30.7$   
 $\delta = 100° 45' 11.2$

$\log c = 3.3227310$

3.3304249

3.3304249

$\log \sin \gamma = 9.9923061$

$\log \sin \alpha = 9.9056931$

$\log \sin \beta = 9.6364396$

3.3304249

$\log a = 3.2361180$

$\log b = 2.9668645$

$\log b = 2.9668645$

$\log a = 3.2361180$

$\log b = 2.9668645$

$\log a = 3.2361180$

$\log \sin \nu_a^c = 9.9314525n$

$\log \sin \nu_b^c = 4.5257342n$

$\log \cos \nu_a^c = 9.7036365$

$\log \sin \nu_b^c = 9.9740642n$

2.9028111n

2.7018522n

2.6705010

3.2101821n

$b \sin \nu_a^c = -744.444$

$a \sin \nu_b^c = -577.897$

$b \cos \nu_a^c = +468.275$

$a \sin \nu_b^c = -1622.490$

$y_a = +3817,706$

$y_b = +3596,108$

$x_a = -1854,522$

$x_b = +236,243$

$(y) = +3018,210$

$(y) = +3018,211$

$(x) = -1386,247$

$(x) = -1386,247$

結果:

$(y) = +3018,210$

$(x) = -1386,247$

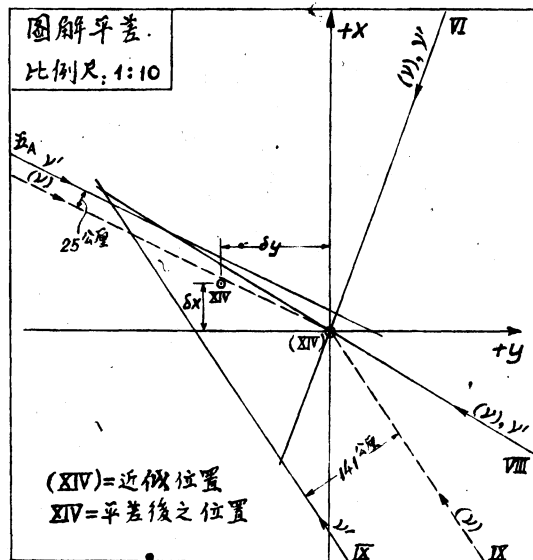
近似方位角之計算：(ν)

測站	$\Delta y$	$\Delta x$	$\log \operatorname{tg}(\nu) = \log \Delta y - \log \Delta x$	(ν)
五A	$(y_{XIV}) = +3018,210$	$(x_{XIV}) = -1386,247$	3.119 7078	116° 23' 29",7
	$y_{五A} = +1700,840$	$x_{五A} = -732,540$	2.815 3831n	
	+1317,370	-653,707	0.304 3247n	
VI				199° 36' 17",7
VIII				300° 21' 28",8
IX	$(y_{XIV}) = +3018,210$	$(x_{XIV}) = -1386,247$	3.027 8179n	326° 35' 19",1
	$y_{IX} = +4084,359$	$x_{IX} = -3002,449$	3.208 4956	
	-1066,149	+1616,202	9.819 3223n	

測站	$\delta = \nu' - (\nu)$	與 XIV 之距離 S	綫改正數 = $\frac{\delta S}{f}$
五A	-3",5	1,46 公里	-25 公厘
VI	0,0	1,72	0
VIII	0,0	0,93	0
IX	-15,0	1,94	-141

XIV 無線電台

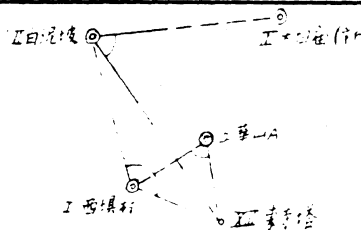
$$\begin{aligned}
 (y) &= +3018,210 & (x) &= -1386,247 \\
 \delta y &= -0,144 & \delta x &= +0,061 \\
 \underline{y} &= +3018,066 & \underline{x} &= -1386,186
 \end{aligned}$$



# 三角補點 $\angle XIII$ 東寺塔<sup>7</sup> 之計算及平差 (圖解法)

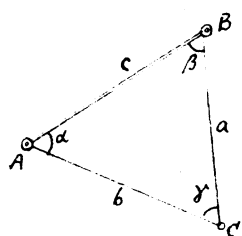
已知點之座標:

五華山 A	$y = +1700.840$ 公尺	$x = -732.540$ 公尺	$\angle I \text{ 五 } XIII = 59^\circ 5' 10.8''$
I 西棋村	+ 210.318	-1901.912	$\angle II \text{ XIII} = 131^\circ 37' 32.5''$
II 白泥坡	- 661.723	+ 839.055	$\angle III \text{ XIII} = 65^\circ 35' 21.0''$



$\angle XIII$  近似座標之計算:

已知點: A = I    B = 五A    所求點: C = XIII



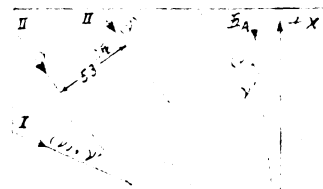
座標	$\log(y_b - y_a) = 3.1733384$	已測角:
$y_a = +210.318$	$\log(x_b - x_a) = 3.0679527$	$\alpha = 62^\circ 5' 33.5''$
$y_b = +1700.840$	$\log \operatorname{tg} \nu_a^b = 0.1053857$	$\beta = 58^\circ 5' 10.8''$
$y_b - y_a = +1490.522$	$\nu_a^b = 51^\circ 53' 4.0''$	$\gamma = 59^\circ 9' 15.7''$
$x_a = -1901.912$	$\log \sin \nu_a^b = 9.8958464$	方位角:
$x_b = -732.540$	$\log \cos \nu_a^b = 9.7904608$	$\nu_a^c = 51^\circ 53' 4.0''$
$x_b - x_a = +1169.372$	$\log c = \log \frac{y_b - y_a}{\sin \nu_a^b} = 3.2774920$	$\nu_b^c = 113^\circ 58' 37.5''$
	$\log c = \log \frac{x_b - x_a}{\cos \nu_a^b} = 3.2774919$	$\nu_c^b = 173^\circ 47' 53.2''$

$\log c = 3.2774920$	$3.3407474$	$3.3407474$
$\log \sin \gamma = 9.9367446$	$\log \sin \alpha = 9.9463076$	$\log \sin \beta = 9.9288287$
$3.3407474$	$\log a = 3.2870550$	$\log b = 3.2695761$

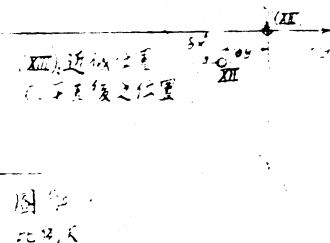
$\log b = 3.2695761$	$\log a = 3.2870550$	$\log b = 3.2695761$	$\log a = 3.2870550$
$\log \sin \nu_a^c = 9.9608074$	$\log \sin \nu_b^c = 9.0335529$	$\log \cos \nu_a^c = 9.6089230$	$\cos \nu_b^c = 7.997 \dots$
$3.2303835$	$2.3206079$	$2.8784991$	$2.2 \dots$
$b \sin \nu_a^c = +1699.744$	$a \sin \nu_b^c = +209.222$	$b \cos \nu_a^c = -755.961$	$a \cos \nu_b^c = -1925. \dots$
$y_a = +210.318$	$y_b = +1700.840$	$x_a = -1901.912$	$x_b = -732.540$
$(y) = +1910.062$	$(y) = +1910.062$	$(x) = -2657.873$	$(x) = -2657.873$
結果:	$(y) = +1910.062$	$(x) = -2657.873$	

近似方位 ( $\nu_{II}^{XIII}$ ) 之計算:

$(y_{XIII}) = +1910.062$	$(x_{XIII}) = -2657.873$	$\log(y_{XIII} - y_{II}) = 3.4102347$
$y_{II} = -661.723$	$x_{II} = +839.055$	$\log(x_{XIII} - x_{II}) = 3.5436867$
$(y_{XIII}) - y_{II} = +2571.785$	$(x_{XIII}) - x_{II} = -3496.928$	$\log \operatorname{tg}(\nu_{II}^{XIII}) = 9.8665480$
		$(\nu_{II}^{XIII}) = 143^\circ 40' 3.7''$



已知方位 $\nu_{II}^{III} = 78^\circ 4' 45.2''$	$\delta = \nu' - (\nu) = +2.5''$
已測角 $\angle \text{五} \text{ XIII} = 65^\circ 35' 21.0''$	II-XIII 之距離 $= S = 4.34$ 公尺
$\nu_{II}^{XIII} = 143^\circ 40' 6.2''$	緯改正數 $= \frac{\delta S}{s} = 53$ 公厘
$(y) = +1910.062$	$(x) = -2657.873$
$\delta y = -0.035$	$\delta x = -0.020$
$\angle XIII$ 東寺塔 $y = +1910.027$	$x = -2657.893$



# 三角補點 L XV 護國門

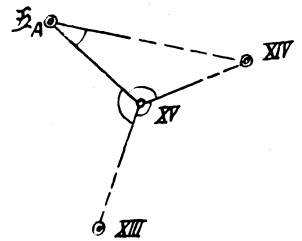
之計算及平差 (圖解法)

已知點之座標:

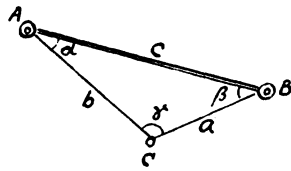
五華山 A  $y = +1700.840$  公尺  $x = -732.540$  公尺  
 XIV 無線電台  $+3018.066$   $-1386.186$   
 XIII 東寺塔  $+1910.027$   $-2657.893$

已測角

$\angle XIV \text{ 五}_A \text{ XIV} = 29^\circ 24' 2.4''$   
 $\angle \text{五}_A \text{ XIV XIV} = 105^\circ 4' 37.7''$   
 $\angle XIV \text{ XV XIII} = 130^\circ 29' 49.8''$   
 $\angle XIII \text{ XV 五}_A = 124^\circ 25' 32.5''$



L XV 點近似座標之計算:



已知點: A = 五A  
 B = XIV  
 所求點: C = XV

座標  
 $y_a = +1700.840$   
 $y_b = +3018.066$   
 $y_b - y_a = +1317.226$   
 $x_a = -732.540$   
 $x_b = -1386.186$   
 $x_b - x_a = -653.646$

$\log(y_b - y_a) = 3.1196603$   
 $\log(x_b - x_a) = 2.8153426 n$   
 $\log \text{tg } \gamma_a^b = 0.3043177 n$   
 $\gamma_a^b = 116^\circ 23' 31.0''$   
 $\log \sin \gamma_a^b = 9.9521986$   
 $\log \cos \gamma_a^b = 9.6478810$   
 $\log c = \log \frac{y_b - y_a}{\sin \gamma_a^b} = 3.1674617$   
 $\log c = \log \frac{x_b - x_a}{\cos \gamma_a^b} = 3.1674616$

已測角:  
 $\alpha = 29^\circ 24' 2.4''$   
 $\gamma = 105^\circ 4' 37.7''$   
 $(\beta = 45^\circ 31' 19.9'')$   
 方位角:  
 $\gamma_a^b = 116^\circ 23' 31.0''$   
 $\gamma_a^c = 145^\circ 47' 33.4''$   
 $\gamma_b^c = 250^\circ 52' 11.1''$

$\log c = 3.1674617$

$3.1826750$

$3.1826750$

$\log \sin \gamma = 9.9847867$

$\log \sin \alpha = 9.6910054$

$\log \sin \beta = 9.8534073$

$3.1826750$

$\log a = 2.8736804$

$\log b = 3.0360823$

$\log a = 2.8736804$

$\log b = 3.0360823$

$\log a = 2.8736804$

$\log b = 3.0360823$

$\log \sin \gamma_b^c = 9.9753289 n$

$\log \sin \gamma_a^c = 9.7498832$

$\log \cos \gamma_b^c = 9.5154986 n$

$\log \cos \gamma_a^c = 9.9175096 n$

$2.8490093 n$

$2.7859655$

$2.3891790 n$

$2.9535919 n$

$a \sin \gamma_b^c = -706.332$

$b \sin \gamma_a^c = +610.894$

$a \cos \gamma_b^c = -245.007$

$b \cos \gamma_a^c = -898.653$

$y_b = +3018.066$

$y_a = +1700.840$

$x_b = -1386.186$

$x_a = -732.540$

$(y) = +2311.734$

$(y) = +2311.734$

$(x) = -1631.193$

$(x) = -1631.193$

結果:

$(y) = +2311.734$

$(x) = -1631.193$

近似方位 ( $\gamma_{XV}^{XIII}$ ) 之計算:

XIII  $y = +1910.027$   $x = -2657.893$   $\log \Delta y = 2.6039026 n$

XV  $(y) = +2311.734$   $(y) = -1631.193$   $(\log \Delta X = 3.0114436$

$\Delta y = -401.707$   $\Delta X = -1026.700$   $\log \text{tg}(\gamma) = 9.5924590 n$

$(\gamma) = 201^\circ 22' 5.3''$

$(\gamma_{XV}^{五A}) = 334^\circ 47' 33.4''$

$\delta = \gamma' - (\gamma) = -4.4''$

已測角  $\angle XIII \text{ XV 五}_A = 124^\circ 25' 32.5''$

XIII-XV 之距離 = 1.10 公里

$\gamma'_{XV}^{XIII} = 201^\circ 22' 0.9''$

綫改正數 =  $\frac{\delta S}{\rho} = 23$  公厘

$(y) = +2311.734$

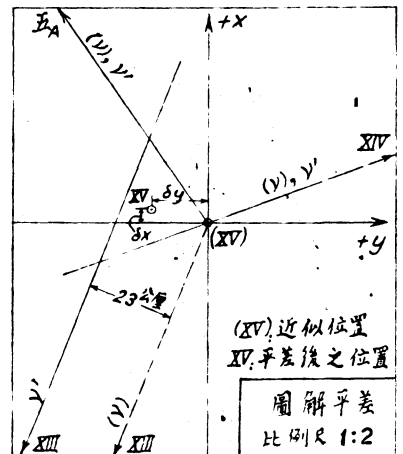
$(x) = -1631.193$

$\delta y = -0.015$

$\delta X = +0.003$

XV 護國門  $y = +2311.719$

$x = -1631.190$



(XV) 近似位置  
 XV 平差後之位置

圖解平差  
 比例尺 1:2



# 三角補點 [XVI 南城缺]

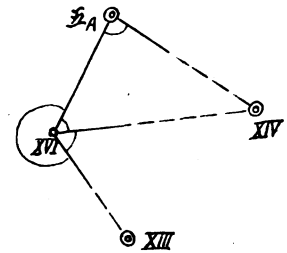
之計算及平差 (圖解法)

已知點之座標:

五華山 A  $y = +1700,840$  公尺  $x = -732,540$  公尺  
 XIV 無線電台  $+3018,066$   $-1386,186$   
 XIII 東寺塔  $+1910,027$   $-2657,893$

已測角:

$\angle \text{五}_A \text{XVI XIV} = 54^\circ 40' 37.4''$   
 $\angle \text{XIV XVI XIII} = 65^\circ 28' 28.9''$   
 $\angle \text{XIII XVI 五}_A = 239^\circ 50' 53.7''$   
 $\angle \text{XIV 五}_A \text{XVI} = 88^\circ 11' 6.2''$



[XVI] 點近似座標之計算:

<p>A = 五A B = XIV C = XVI</p>	<p>座標</p> <p><math>y_a = +1700,840</math>  <math>x_a = -732,540</math>  <math>y_b = +3018,066</math>  <math>x_b = -1386,186</math></p> <p>邊長</p> <p><math>\log c = 3.1674617</math></p>	<p>已測角</p> <p><math>\alpha = 88^\circ 11' 6.2''</math>  <math>\gamma = 54^\circ 40' 37.4''</math>  <math>(\beta = 37^\circ 8' 16.4'')</math></p> <p>方位角</p> <p><math>\gamma_a^0 = 116^\circ 23' 31.0''</math>  <math>\gamma_a^c = 204^\circ 34' 37.2''</math>  <math>\gamma_b^c = 259^\circ 15' 14.6''</math></p>	<p><math>\log a = 2.2556036</math>  <math>\log \sin \alpha = 9.9997821</math>  <math>\log c = 3.1674617</math>  <math>\text{colog} \sin \gamma = 0.0883598</math>  <math>\log \sin \beta = 9.7808466</math>  <math>\log b = 3.0366681</math></p>
<p><math>\log a = 3.2556036</math>  <math>\log \sin \gamma_b^c = 9.9923164 n</math>  <math>3.2479200 n</math>  <math>a \sin \gamma_b^c = -1769,783</math>  <math>y_b = +3018,066</math>  <math>(y) = +1248,283</math></p> <p>結果</p>	<p><math>\log b = 3.0366681</math>  <math>\log \sin \gamma_a^c = 9.6190055 n</math>  <math>2.6556736 n</math>  <math>b \sin \gamma_a^c = -452,557</math>  <math>y_a = +1700,840</math>  <math>(y) = +1248,283</math></p> <p>(y) = +1248,283</p>	<p><math>\log a = 3.2556036</math>  <math>\log \cos \gamma_b^c = 9.2705728 n</math>  <math>2.5261764 n</math>  <math>a \cos \gamma_b^c = -335,874</math>  <math>x_b = -1386,186</math>  <math>(x) = -1722,060</math></p> <p>(x) = -1722,060</p>	<p><math>\log b = 3.0366681</math>  <math>\log \cos \gamma_a^c = 9.9587565 n</math>  <math>2.9954246 n</math>  <math>b \cos \gamma_a^c = -989,520</math>  <math>x_a = -732,540</math>  <math>(x) = -1722,060</math></p>

近似方位 ( $\nu_{\text{XVI}}$ ) 之計算:

XIII  $y = +1910,027$   $x = -2657,893$   $\log \Delta y = 2.8206900$   
 XVI  $+1248,283$   $-1722,060$   $\log \Delta x = 2.9711984 n$   
 $\Delta y = +661,744$   $\Delta x = -935,833$   $\log \text{tg}(\nu_{\text{XVI}}) = 9.8494916 n$   
 $(\nu_{\text{XVI}}) = 144^\circ 44' 6.7''$

$(\nu_{\text{五}_A}) = 24^\circ 34' 37.2''$

已測角  $\angle \text{XIII XVI 五}_A = 239^\circ 50' 53.7''$

$\nu_{\text{XIII}} = 144^\circ 43' 43.5''$

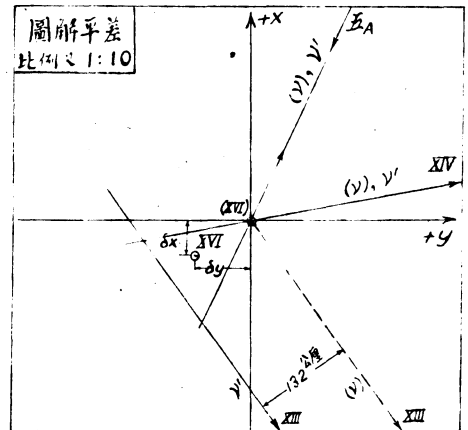
$\delta = \nu' - (\nu) = -23.2''$   $\text{XIII} - \text{XVI}$  之距離 =  $S = 1.17$  公里

緯改正數 =  $\frac{\delta S}{\rho} = -132$  公厘

$(y) = +1248,283$   $(x) = -1722,060$

$\delta y = -0,077$   $\delta x = -0,049$

XVI 南城缺  $y = +1248,206$   $x = -1722,109$

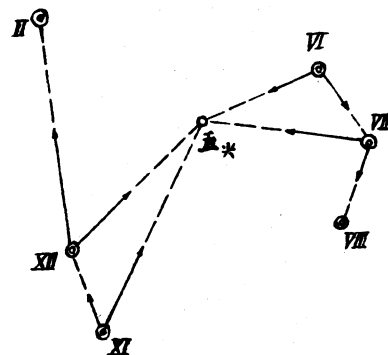


# 三角補點「五華山」

之計算及平差 (圖解法)

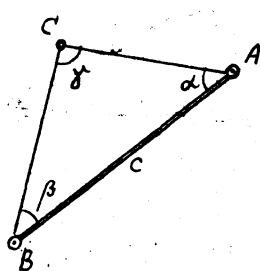
已知點之座標:

VI 叙細密路(新)	$y = +3596.108$ 公尺	$x = +236.243$ 公尺
VII 大樹營	+4475.580	-1024.509
XI 柳堤(新)	+690.199	-3462.622
XII 慧建庵	+140.916	-2386.087



測站	目標	已測方向	夾角	已知方位	由各測站至「五華」之方位
VI	VII 五*	359° 59' 57.4 97 49 35.1	97° 49' 37.7	$\gamma_{VI}^{VII} = 145^{\circ} 6' 4.5$	$\gamma_{VI}^{\text{五}^*} = 242^{\circ} 55' 42.2$
VII	VIII 五*	0 0 0.3 57 36 26.2	57 36 25.9	$\gamma_{VII}^{VIII} = 218 24 2.3$	276 0 28.2
XI	XII 五*	359 59 57.0 47 20 34.1	47 20 37.1	$\gamma_{XI}^{XII} = 332 58 4.4$	20 18 41.5
XII	II 五*	359 59 59.2 57 18 11.0	57 18 11.8	$\gamma_{XII}^I = 346 1 29.1$	43 19 40.9

「五華」近似座標之計算:



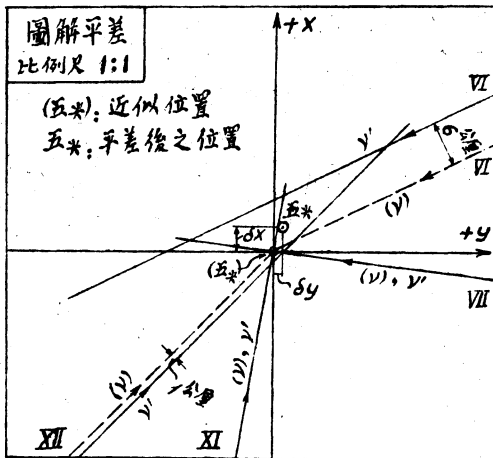
已知點: A = VII, B = XI		所求點: C = 五*
座標	$\log(y_b - y_a) = 3.578 1096_n$	$\gamma_a^c = 276^{\circ} 0' 28.2$
$y_a = +4475.580$	$\log(x_b - x_a) = 3.387 0538$	$\gamma_a^b = 237 12 53.9$
$y_b = +690.199$	$\log \tan \gamma_a^b = 0.19 + 0558$	$\alpha = \gamma_a^c - \gamma_a^b = 38 47 34.3$
$y_b - y_a = -3785.381$	$\gamma_a^b = 237^{\circ} 12' 53.9$	$\gamma_b^a = 57 12 53.9$
$x_a = -1024.509$	$\log \sin \gamma_a^b = 9.924 6452_n$	$\gamma_b^c = 20 18 41.5$
$x_b = -3462.622$	$\log \cos \gamma_a^b = 9.733 5893$	$\beta = \gamma_b^a - \gamma_b^c = 36 54 12.4$
$x_b - x_a = +2438.113$	$\log c = \log \frac{y_b - y_a}{\sin \gamma_a^b} = 3.653 4644$	$\gamma = 104 18 13.3$
	$\log c = \log \frac{x_b - x_a}{\cos \gamma_a^b} = 3.653 4645$	

$\log c = 3.653 4645$	$3.667 1408$	$3.667 1408$
$\log \sin \gamma = 9.986 3237$	$\log \sin \alpha = 9.796 9258$	$\log \sin \beta = 9.778 4901$
$3.667 1408$	$\log a = 3.464 0666$	$\log b = 3.445 6309$
$\log a = 3.464 0666$	$\log b = 3.445 6309$	$\log a = 3.464 0666$
$\log \sin \gamma_b^c = 9.540 4850$	$\log \sin \gamma_a^c = 9.997 6081_n$	$\log \cos \gamma_b^c = 9.972 1190$
$3.004 5516$	$3.443 2390_n$	$3.436 1856$
$a \sin \gamma_b^c = +1010.536$	$b \sin \gamma_a^c = -2774.847$	$a \cos \gamma_b^c = +2730.145$
$y_b = +690.199$	$y_a = +4475.580$	$x_b = -3462.622$
$(y) = +1700.735$	$(y) = +1700.733$	$(x) = -732.477$
結果:	$(y) = +1700.734$	$(x) = -732.477$

近似方位 (V) 之計算:

測站	$\Delta Y$	$\Delta X$	$\log \operatorname{tg}(V) = \log \Delta y - \log \Delta X$	(V)
VI	$(Y_{五*}) = +1700,734$	$(X_{五*}) = -732,477$	$3.2776949n$	$242^{\circ} 55' 42",8$
	$Y_{VI} = +3596,108$	$X_{VI} = +236,243$	$2.9861983n$	
	$\Delta Y = -1895,374$	$\Delta X = -968,720$	$0.2914966$	
VII				$276^{\circ} 0' 28",2$
XI				$20^{\circ} 18' 41",5$
XII	$(Y_{五*}) = +1700,734$	$(X_{五*}) = -732,477$	$3.1930739$	$43^{\circ} 19' 41",0$
	$(Y_{XII}) = +140,916$	$X_{XII} = -2386,087$	$3.2184331$	
	$\Delta Y = +1559,818$	$\Delta X = +1653,610$	$9.9746408$	

測站	$\delta = \nu' - (V)$	與 $(五*)$ 之距離 $S$	線改正數 $= \frac{\delta S}{P}$
VI	$+0",6$	2,13 公里	+6 公厘
VII	0	2,78	0
XI	0	2,91	0
XII	$-0",1$	2,27	+1

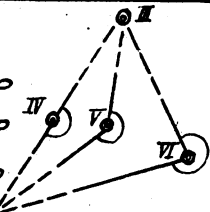


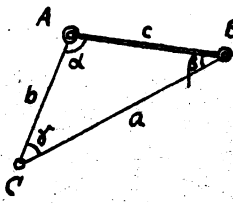
五華山\*

$$\begin{aligned}
 (y) &= +1700,734 & (x) &= -732,477 \\
 \delta y &= +0,001 & \delta x &= +0,004 \\
 \underline{y} &= +1700,735 & \underline{x} &= -732,473
 \end{aligned}$$

# 三角補點 XVII 圓山亭

## 之計算及平差 (圖解法)

<p>已知座標:</p> <p>IV 基線西端 <math>Y = +2254.207</math>    <math>X = +692.904</math></p> <p>V 基線東端    <math>+2550.355</math>            <math>+641.466</math></p> <p>VI 叔編岔路(新) <math>+3596.108</math>            <math>+236.243</math></p> <p>XVII 點近似座標 (y), (x) 之計算:</p>	<p>已測角:</p> <p><math>\angle IVI = 184^{\circ}20'17''.60</math></p> <p><math>\angle VII = 217^{\circ}35'24''.00</math></p> <p><math>\angle VIII = 295^{\circ}09'38''.70</math></p> 
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	已知點 A = IV	B = VI	所求點 C = XVII
	座標	座標	已知方位:
$Y_b = +3596.108$	$Y_b = +2254.207$	$Y_b = +3596.108$	$V_{IV}^I = 30^{\circ}56'24''.72$
$Y_a = +2254.207$	$Y_a = +2254.207$	$Y_b - Y_a = +1341.901$	$V_{VI}^I = 326^{\circ}20'52''.50$
$Y_b - Y_a = +1341.901$	$X_b = +236.243$	$X_b = +236.243$	已測角:
$X_b = +236.243$	$X_a = +692.904$	$X_a = +692.904$	$\angle IVI = 184^{\circ}20'17''.60$
$X_a = +692.904$	$X_b - X_a = -456.661$	$X_b - X_a = -456.661$	$\angle VII = 217^{\circ}35'24''.30$
$X_b - X_a = -456.661$	$\log(Y_b - Y_a) = 3.1277202$	$\log(X_b - X_a) = 2.6595940$	$V_a^c = V_{IV}^I + \angle VII = 215^{\circ}16'42''.32$
$\log(Y_b - Y_a) = 3.1277202$	$\log(X_b - X_a) = 2.6595940$	$\log \rho_a^b = 0.4861262$	$V_b^c = V_{VI}^I - \angle VIII = 263^{\circ}30'30''.20$
$\log \rho_a^b = 0.4861262$	$\log \sin V_a^b = 108^{\circ}47'38''.12$	$\log \sin V_a^b = 9.9762047$	
$\log \sin V_a^b = 108^{\circ}47'38''.12$	$\log \sin V_b^a = 9.5080785$	$\log \cos V_a^b = 9.5080785$	
$\log \sin V_b^a = 9.5080785$	$\log \cos V_b^a = 3.1515155$	$\log \cos V_b^a = 3.1515155$	
$\log \cos V_b^a = 3.1515155$	$\log C = 3.1515155$	$\log C = 3.1515155$	

$\alpha = V_b^c - V_a^c = 106^{\circ}29'04''.20$	$\log C = 3.1515155$	$3.2788789$	$3.2788789$
$\beta = V_a^c - V_b^c = 25^{\circ}17'07''.92$	$\log \sin \alpha = 9.8726366$	$\log \sin \beta = 9.9817717$	$\log \sin \gamma = 9.6305596$
$\gamma = 48^{\circ}13'47''.88$	$3.2788789$	$\log a = 3.2606506$	$\log b = 2.9094385$
$\log b = 2.9094385$	$\log a = 3.2606506$	$\log b = 2.9094385$	$\log a = 3.2606506$
$\log \sin V_a^c = 9.7615898 (n)$	$\log \sin V_b^c = 9.9972065 (n)$	$\log \cos V_a^c = 9.9118792 (n)$	$\log \cos V_b^c = 2.0533040 (n)$
$2.6710283 (n)$	$3.2578571 (n)$	$2.8213177 (n)$	$2.3139546 (n)$
$b \sin V_a^c = -468,844$	$a \sin V_b^c = -1810,744$	$b \cos V_a^c = -662,701$	$a \cos V_b^c = -206,041$
$Y_a = +2254.207$	$Y_b = +3596.108$	$X_a = +692.904$	$X_b = +236.243$
$(Y) = +1785,363$	$(Y) = +1785,364$	$(X) = +30,203$	$(X) = +30,202$

結果: (Y) = +1785,364    (X) = +30,202

近似方位 ( $V_T^I$ ) 之計算:

$(Y_{VII}) = +1785,364$      $(X_{VII}) = +30,202$      $\log(Y_{VII} - Y_T) = 2.8836564$

$Y_T = +2550,355$      $X_T = +641,466$      $\log(X_{VII} - X_T) = 2.7862288$

$(Y_{VII} - Y_T) = -764,991$      $(X_{VII} - X_T) = -611,264$      $\log \rho_T^I = 0.0974276$

$(V_T^I) = 231^{\circ}22'24''.58$

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已知方位  $V_T^I = 13^{\circ}47'14''.20$

已測角  $\angle VII = 217^{\circ}35'24''.00$

$V_T^I = 231^{\circ}22'39''.20$

$(Y) = +1785,364$

$\delta y = +0,007$

XVII 圓山亭  $Y = +1785,371$

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$\delta = V_T^I - (V) = +13''.60$

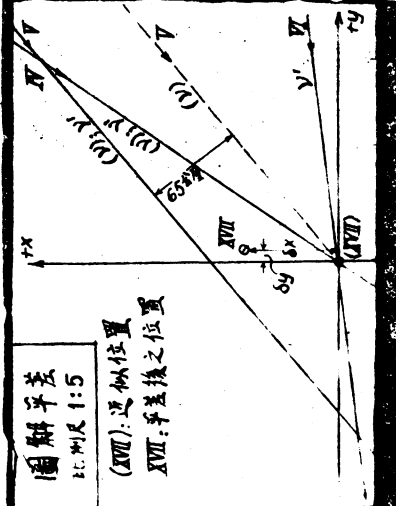
T-VII 之距離 =  $S = 985$  呎

線改正數 =  $\frac{\delta S}{P} = +65$  呎

$(X) = +30,202$

$\delta X = +0,063$

$X = +30,265$



# 三角補點 [XVIII 西城缺]

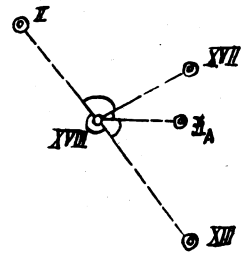
之計算及平差 (圖解法)

已知點之座標:

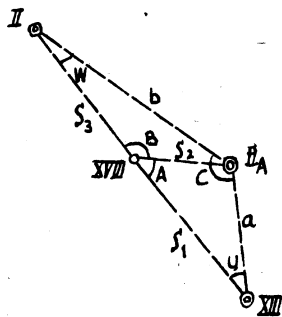
II 白泥坡	$y = -661,723$	$x = +839,055$
XVII 圓山亭	$+1785,371$	$+30,265$
五華山 <sub>A</sub>	$+1709,840$	$-732,540$
XIII 東寺塔	$+1910,027$	$-2657,893$

已測角:

$\angle I XVII XVII = 100^\circ 59' 19.5$
$\angle XVII XVII II_A = 31^\circ 44' 10.5$
$\angle II_A XVII XIII = 50^\circ 07' 45.0$
$\angle XIII XVIII II = 177^\circ 08' 45.0$



XVII 點近似座標 (Y), (X) 之計算 (換方交算法):



$$\begin{aligned} \tan \lambda &= \frac{y_{II_A} - y_{XIII}}{x_{II_A} - x_{XIII}} \\ \tan \lambda &= \frac{y_{II_A} - y_I}{x_{II_A} - x_I} \\ \angle C &= \angle II_A - \angle I \\ a &= \frac{y_{II_A} - y_{XIII}}{\sin \lambda} = \frac{x_{II_A} - x_{XIII}}{\cos \lambda} \\ b &= \frac{y_{II_A} - y_I}{\sin \lambda} = \frac{x_{II_A} - x_I}{\cos \lambda} \end{aligned}$$

$\angle A = 50^\circ 07' 45.00$

$\angle B = 132^\circ 43' 30.00$

$\angle W + \angle U = 360^\circ - (A + B + C)$   
 $\tan \frac{U-W}{2} = \tan \frac{U+W}{2} \cot(\lambda + 45^\circ)$

$\tan \lambda = \frac{a}{b} \cdot \frac{\sin A}{\sin B}$

$\frac{1}{2}(U+W) + \frac{1}{2}(U-W) = U$

$\frac{1}{2}(U+W) - \frac{1}{2}(U-W) = W$

$s_1 = \frac{a}{\sin A} \sin(A+U)$

$s_3 = \frac{b}{\sin B} \sin(B+W)$

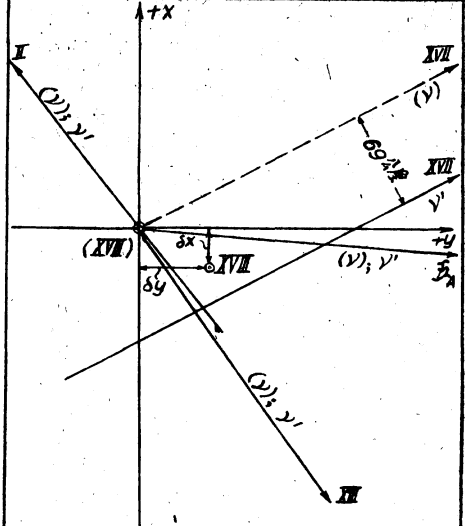
$s_2 = \frac{a}{\sin A} \sin U = \frac{b}{\sin B} \sin W$

$y_{II_A} = +1700,840$	$y_{II_A} - y_{XIII}$	2.3205347 (N)
$y_{XIII} = +1910,027$	$x_{II_A} - x_{XIII}$	3.2845104
$y_{II_A} - y_{XIII} = -209,187$	$\tan \lambda_{II_A}$	9.0360243 (N)
$x_{II_A} = -732,540$	$y_{II_A} - y_I$	3.3733834
$x_{XIII} = -2657,893$	$x_{II_A} - x_I$	3.1963406 (N)
$x_{II_A} - x_{XIII} = +1925,353$	$\tan \lambda_I$	0.1770428 (N)
$y_{II_A} = +1700,840$	$y_{II_A} - y_{XIII}$	2.3205347 (N)
$y_I = -661,723$	$1 : \sin \lambda_{II_A}$	0.9665240 (N)
$y_{II_A} - y_I = +2362,563$	a	3.2870587
$x_{II_A} = -732,540$	$1 : \cos \lambda_{II_A}$	0.0025483
$x_I = +839,055$	$x_{II_A} - x_{XIII}$	3.2845104
$x_{II_A} - x_I = -1571,595$	$y_{II_A} - y_I$	3.3733834
$\lambda_{II_A} = 353^\circ 47' 57.17$	$1 : \sin \lambda_I$	0.0795581
$\lambda_I = 123^\circ 37' 55.76$	b	3.4529415
$\angle C = 129^\circ 49' 58.59$	$1 : \cos \lambda_I$	0.2566008 (N)
$\angle A = 50^\circ 07' 45.00$	$x_{II_A} - x_I$	3.1963406 (N)
$\angle B = 132^\circ 43' 30.00$	a	3.2870587
$A+B+C = 312^\circ 41' 13.59$	$1 : \sin A$	0.1149264
$U+W = 47^\circ 18' 46.41$	$a : \sin A$	3.4019851
$\frac{U+W}{2} = 23^\circ 39' 23.20$	$b : \sin B$	3.5868796
$\frac{U-W}{2} = 5^\circ 14' 55.71$	$1 : \sin B$	0.1339381
$U = 28^\circ 54' 18.91$	b	3.4529415
$W = 18^\circ 24' 27.49$	$\frac{a}{\sin A} : \frac{b}{\sin B} = \tan \lambda$	9.8151055
$\lambda = 33^\circ 09' 22.15$	$\cot(\lambda + 45^\circ)$	9.3216185
$\lambda + 45^\circ = 78^\circ 09' 22.15$	$\tan \frac{U+W}{2}$	9.6415365
	$\tan \frac{U-W}{2}$	8.9631550

$$\begin{aligned} \nu_{XIII}^{XVII} &= \nu_{XIII}^{I_A} - U \\ \nu_I^{XVII} &= \nu_I^{I_A} + W \\ X_{XVII} &= X_{XIII} + S_1 \cos \nu_{XIII}^{XVII} \\ &= X_I + S_3 \cos \nu_I^{XVII} \\ Y_{XVII} &= Y_{XIII} + S_1 \sin \nu_{XIII}^{XVII} \\ &= Y_I + S_3 \sin \nu_I^{XVII} \end{aligned}$$

$A+U = 79^\circ 2' 3.91$	$S_1$	對數	3.3939823
$B+W = 151^\circ 7' 57.49$	$\sin(A+U)$		9.9919972
$(A+U)+(B+W)+C = 360^\circ$	$a: \sin A$		3.4019851
$\nu_{XIII}^{I_A} = 353^\circ 47' 57.17$	$\sin U$		9.7766472
$U = 28^\circ 54' 18.91$	$S_2$		3.1786323
$\nu_{XIII}^{XVII} = 324^\circ 53' 38.26$	$\sin W$		9.5917527
$\nu_I^{I_A} = 123^\circ 37' 55.76$	$b: \sin B$		3.5868796
$W = 18^\circ 24' 27.49$	$\sin(B+W)$		9.6837526
$\nu_I^{XVII} = 142^\circ 2' 23.25$	$S_3$		3.2706322

$X_{XVII} - X_{XIII}$	對數	$Y_{XIII} = +1910.027$
$\cos \nu_{XIII}^{XVII}$	3.3067829	$Y_{XVII} - Y_{XIII} = -1424.686$
$S_1$	9.9128006	$(Y) = +485.341$
$\sin \nu_{XIII}^{XVII}$	3.3939823	$Y_I = -661.723$
$Y_{XVII} - Y_{XIII}$	9.7597369n	$Y_{XVII} - Y_I = +1147.064$
$X_{XVII} - X_I$	3.1537192n	$X_{XVII} = -2657.893$
$\cos \nu_I^{XVII}$	3.1673998n	$X_{XVII} - X_{XIII} = +2026.669$
$S_3$	9.8967676n	$(X) = -631.224$
$\sin \nu_I^{XVII}$	3.2706322	$X_I = +839.055$
$Y_{XVII} - Y_I$	9.7889556	$X_{XVII} - X_I = -1470.279$
	3.0595878	



(XVIII): 近似位置  
XVII: 平差後之位置

圖解平差  
比例尺 1:5

近似方位  $(\nu_{XVII}^{XVII})$  之計算:

$Y_{XIII} = +1785.371$        $X_{XIII} = +30.265$   
 $(Y_{XIII}) = +485.341$        $(X_{XIII}) = -631.224$   
 $Y_{XVII} - (Y_{XIII}) = +1300.030$        $X_{XVII} - (X_{XIII}) = +661.224$   
 $\log(Y_{XVII} - Y_{XIII}) = 3.1139534$   
 $\log(X_{XVII} - X_{XIII}) = 2.8205226$   
 $\log \operatorname{tg} \nu_{XIII}^{XVII} = 0.2934208$   
 近似方位  $\nu_{XIII}^{XVII} = 322^\circ 2' 23.25$   
 已測角  $\angle XVII \text{ XIII } I = 100^\circ 59' 19.50$   
 $\nu_{XIII}^{XVII} = 63^\circ 1' 42.75$   
 $(Y) = +485.341$   
 $\delta Y = +0.047$   
 XVII 西城缺  $Y = +485.388$

$\nu_{XIII}^{XVII} = 63^\circ 1' 54.58$   
 $\delta = \nu_{XIII}^{XVII} - \nu_{XIII}^{XVII} = -11.83$  公厘  
 XVII - XIII 之距離 =  $S = 1.21$  公里  
 總改正數 =  $\frac{\delta S}{S} = -69$  公厘  
 $(X) = -631.224$   
 $\delta X = -0.026$   
 $X = -631.250$

# 成 果 表

號 數	點 名	Y (橫 綫)	X (縱 綫)	備 註
	五華山A	+1700,840 <sup>公尺</sup>	- 732,540 <sup>公尺</sup>	
	五華山B	+1703,418	- 731,850	
	五華山尖	+1700,735	- 732,473	
I	西堤村	+ 210,318	-1901,912	
II	白泥坡	- 661,723	+ 839,055	
III	大白廟(新)	+2776,981	+1565,007	
IV	基線西點	+2254,207	+ 692,904	
V	基線東點	+2550,355	+ 641,466	
VI	叙鍾公路(新)	+3596,108	+ 236,243	
VII	大樹營	+4475,580	-1024,509	仍用舊三角點之位置
VIII	蘇家村	+3817,706	-1854,522	
IX	南天台	+4084,359	-3002,449	仍用舊三角點之位置
X	南 窩	+2378,099	-3848,795	
XI	柳 堤(新)	+ 690,199	-3462,622	
XII	慈 建庵	+ 140,916	-2386,087	
XIII	東 寺塔	+1910,027	-2657,893	
XIV	無線電台	+3018,066	-1386,186	
XV	護國門	+2311,719	-1631,190	
XVI	南城缺	+1248,206	-1722,109	
XVII	圓山亭	+1785,371	+ 30,265	仍用舊交會點之位置
XVIII	西城缺	+ 485,388	- 631,250	

## 附 誌

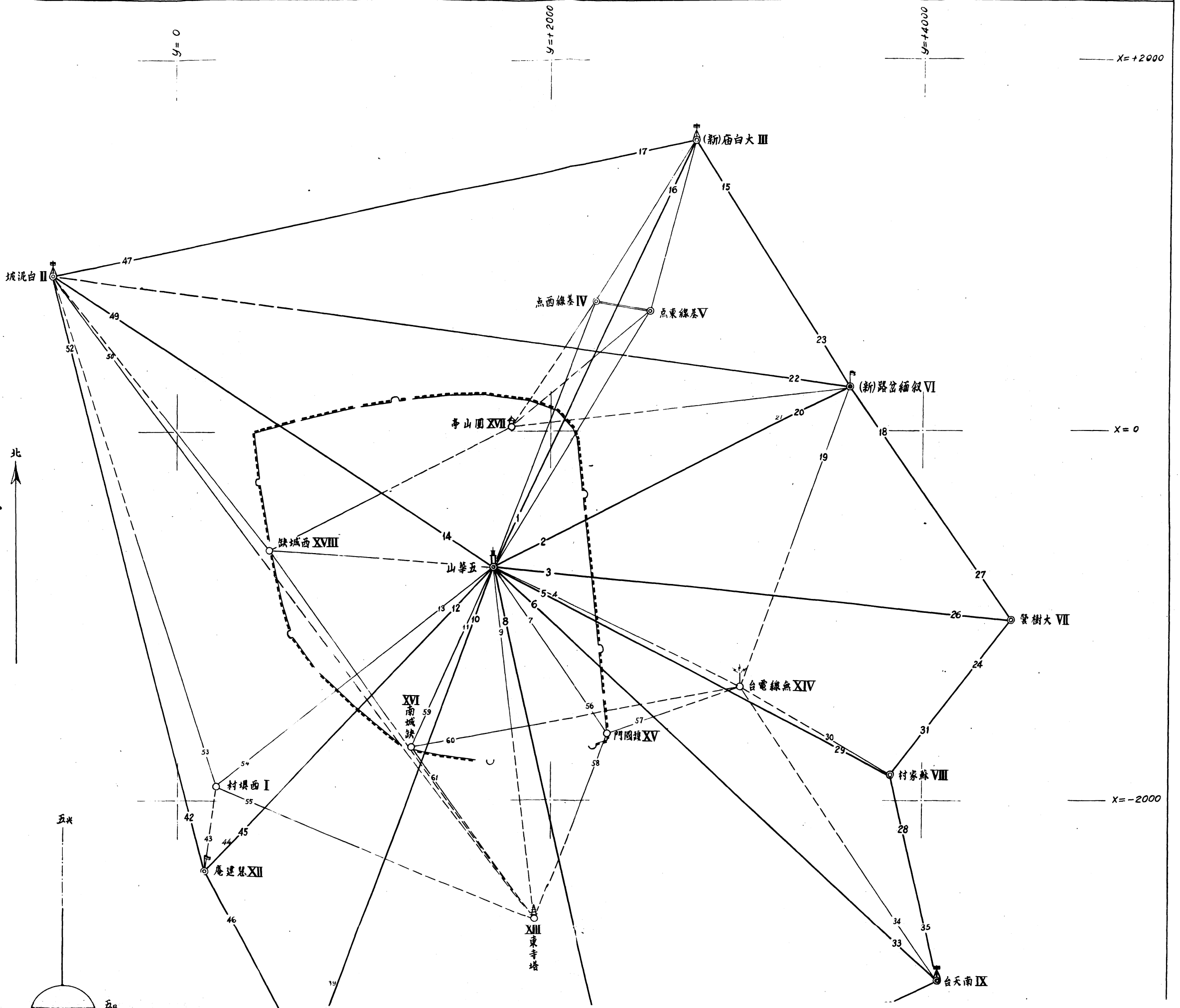
- 一. 三角網之基線係借用二十八年十月間工務局所測算之基線網,今將其計算手簿一併抄印,以備參攷。
- 二. 三角網施測期間,係在二月,適值風季,晨十時後,濃霧始消,而大風繼起,瞭望台上之「五華山A」搖動頗烈,乃設法于台之上層,另置「五華山B」點,(見三角點說明表,第1頁)搖動雖大減,而施測結果,尚覺不能十分滿意,惟以之控制五百分之一之地籍圖,其精度已甚足矣。
- 三. 角度測量採測圓法(Satzmessung)及複測法(Repetitionsmessung)二種,用蔡司二號及三號經緯儀時採前法,用Hildebrand經緯儀時則採後法。
- 四. 三角網以最小二乘方法平差,至三角補點,除「L.西堤村」外,均用圖解法平差,以省時間。
- 五. 三角網施測時,承 國立同濟大學先後撥借經緯儀數架,始克完成,特此附誌謝忱。

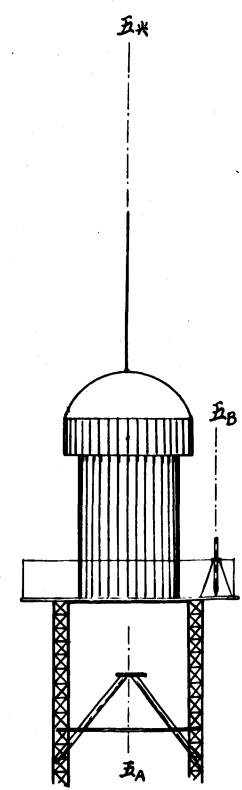
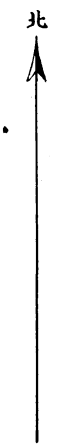


# 昆明三區三角網

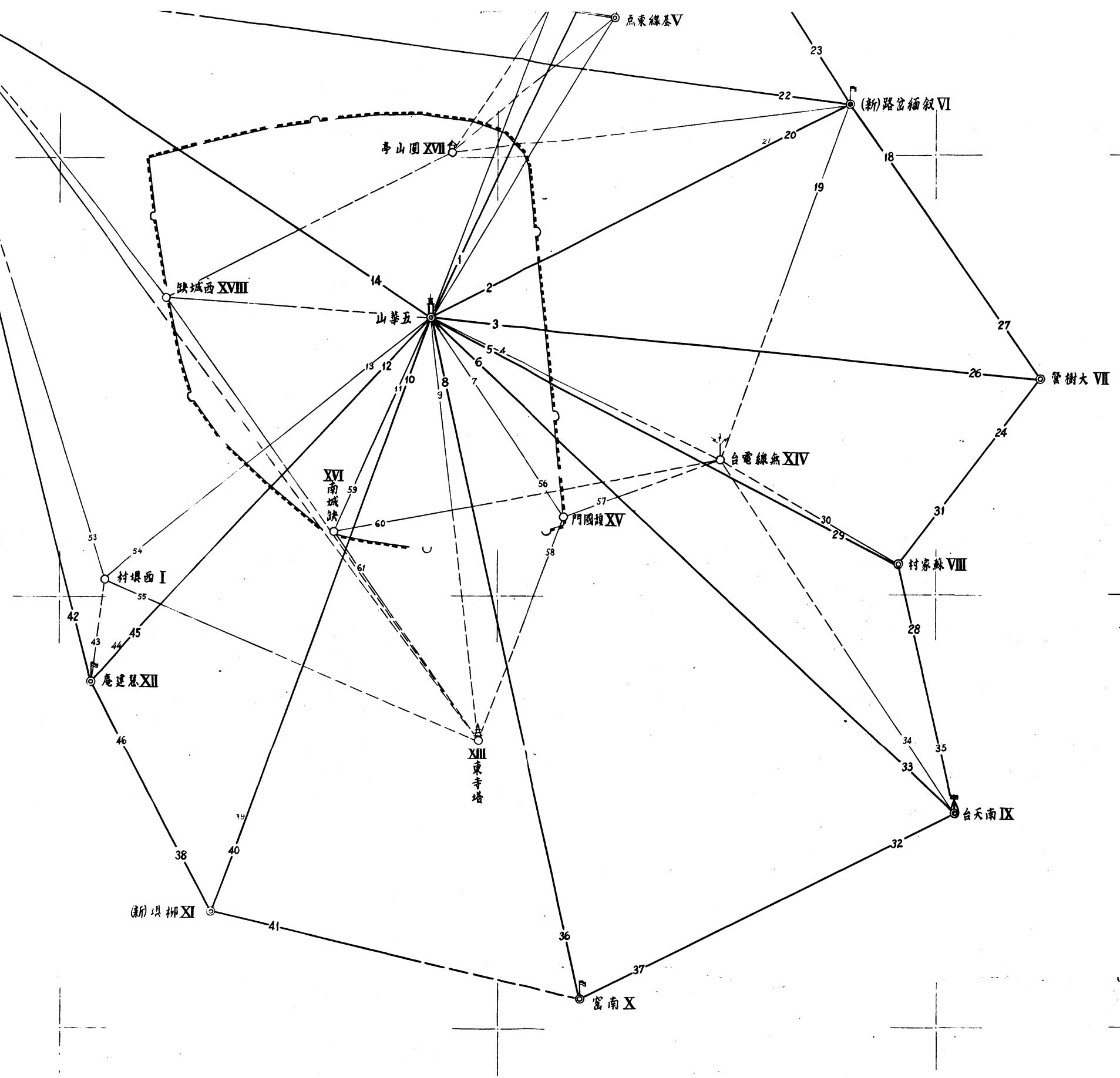
民國二十九年

昆明市政府市區土地測量隊





點山華五  
(1:20)



李慶海藏書

