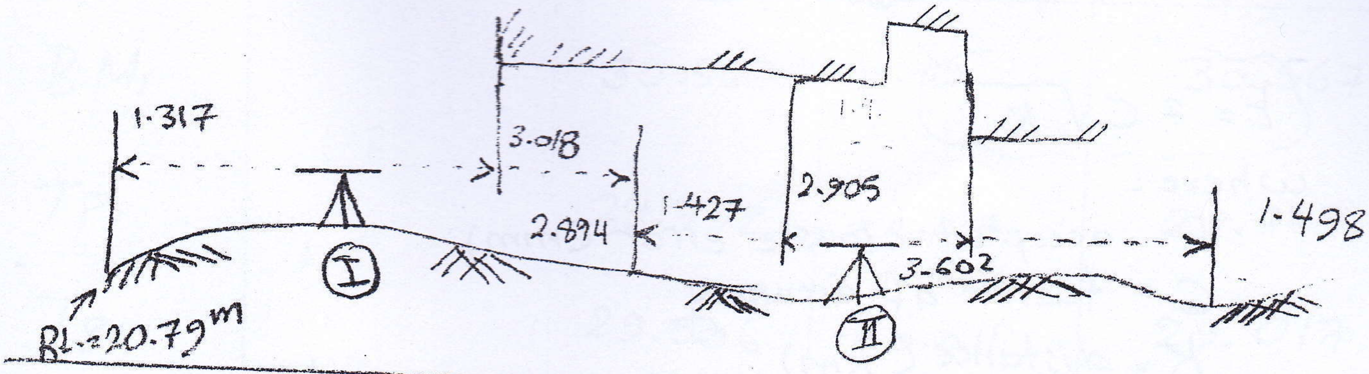
Inverted Staff



B.S.	I.S.	F.S.	R(+)	F(−)	RL	note
1.317		I			20.79	B.M.
	−3.018		4.335		25.125	Inverted staff
1.427		2.894		5.912	19.213	T.P.
	−2.905	II	4.332		23.545	Inverted staff
	−3.602		0.697		24.242	" "
		1.498		5.1	19.142	

$\sum B.S. = 2.744$ $\sum F.S. = 4.392$ $\sum R = 9.364$ $\sum F = 11.012$

$$\sum B.S - \sum F.S. = \sum R^{+} - \sum F^{-} = RL)_{Last} - RL)_{first}$$

$$-1.648 = -1.648 = -1.647 \text{ ---- o.k.}$$

(19.142, 20.79)

note: reading of staff = −ve value. This mean the inverted staff case.

Accepted closure error

$$\boxed{E = \mp C\sqrt{k}}$$

where:

E = accepted clousre error (mm)

C = factor of accuracy

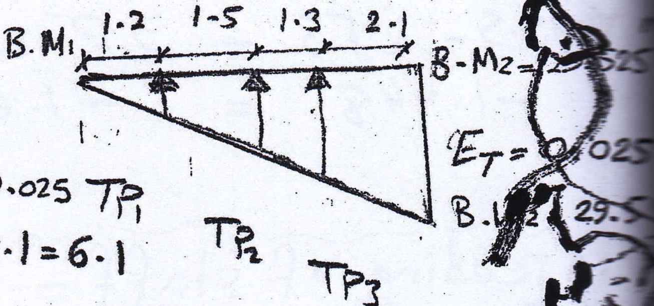
K = distance (km)

$E = 4\text{mm}\sqrt{k}$ or $E = 8.4\text{mm}\sqrt{k}$ or $E = 12\text{mm}\sqrt{k}$

$$\boxed{\text{Total Error}(E_T) = B.M._{cal.} - B.M._{given}}$$ or real

$$\boxed{\text{Error in Elev. for any position} = E_T * \frac{\text{Distance between this position and begining Po[int]}}{\text{Total distance}}}$$

Example①/ In differential levelling, the distance and R.L for points were listed in Table 1 as illustrated below. Calculate the closure error and the absolute R.L. for points. Assume the calculate R.L. for $B.M_2$ was 29.5^m whi[le] the real R.L for $B.M_2$ was 29.525.



Total error = $B.M_{cal} - B.M._{real}$

$= 29.5 - 29.525 = -0.025$

Total distance $= 1.2 + 1.5 + 1.3 + 2.1 = 6.1$

Error in $Tp_1 = 0.025 * \frac{1.2}{6.1} = 0.005^m$

" " $Tp_2 = 0.025 * \frac{2.7}{6.1} = 0.011\ m$

" " $TP_3 = 0.025 * \frac{4}{6.1} = 0.016m$

" " $B.M_2 = 0.025 * \frac{6.1}{6.1} = 0.025\ m$

Error in $B.M_1 = 0$
$\Rightarrow 0.025 * \frac{0}{6.1} =$

note: absolute R.L is Correct R.L = $R.L)_{calc} \pm$ Err[or in] Elev[. for] any [position]

Table 1.

this distance between position

point	Distance (Km)	R.L.	Error	Absolute R.L
$B.M_1$		30.567	0	30.567
	1.2			
T_{P_1}		29.772	+0.005	29.777
	1.5			
T_{P_2}		29.006	+0.011	29.017
	1.3			
T_{P_3}		28.701	+0.016	28.717
	2.1			
$B.M_2$		29.500	+0.025	29.525

<u>Example ②</u>/ The elevation for points were computed and listed in Table 2 as follow. Determine the clousre error and compute the absolute R.L. for these position. Assume the elevation of $B.M_2$ known and was 322.42 m.

Position	Distance from $B.M_1$ (Km)	Elevation	Error	absolute Error
$B.M_1$	0	322.42	0	322.42
$T.P_1$	3	295.17	−0.09	295.08
$T.P_2$	11	310.33	−0.33	310.00
$T.P_3$	13	341.28	−0.39	340.89
$B.M_2$	16	322.9	−0.48	322.42

Total Error = 322.9 − 322.42 = 0.48 m

Error in $B.M_1 = 0.48 * \frac{0}{16} = 0$ m

" " $T.P_1 = 0.48 * \frac{3}{16} = 0.09$ m

" " $T.P_2 = 0.48 * \frac{11}{16} = 0.33$ m

" " $T.P_3 = 0.48 * \frac{13}{16} = 0.39$ m

" " $B.M_2 = 0.48 * \frac{16}{16} = 0.48$ m

From three or four Bench marks, how can establish new bench mark for specified point. To solve this problem must be used weight way.

$$\boxed{R.L \text{ for new } B.M. = \frac{\sum_{i=1}^{n} (R.L_i \times w_i)}{\sum_{i}^{n} w_i}}, \text{ where } w = \frac{1}{Dist}$$

n = route num

Example / Calculate the R.L for new bench mark (T.B.M.) which is moved to it from three bench marks, the number of route and distance were illustrated in the table below.

Route	From station	R.L	Distance (k
I	$B.M_1$	32.107	3
II	$B.M_2$	32.158	6
III	$B.M_3$	32.172	7

$$R.L \text{ for new } B.M_1 = \frac{(\frac{1}{3} * 32.107) + (\frac{1}{6} * 32.158) + (\frac{1}{7} * 32.172)}{\frac{1}{3} + \frac{1}{6} + \frac{1}{7}}$$

$$= \underline{32.135} \text{ m}$$