



**higher education
& training**

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

MARKING GUIDELINE

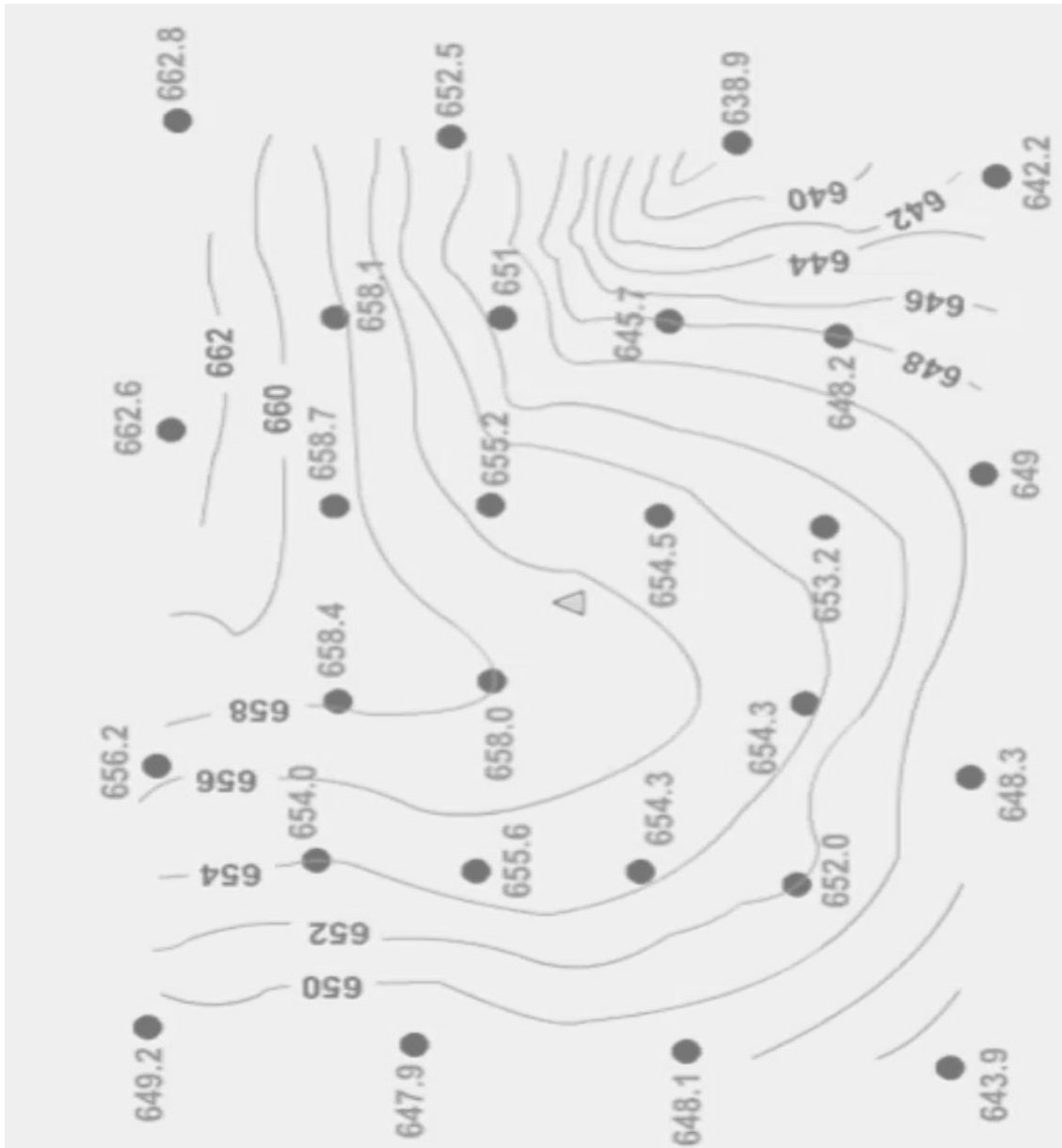
NATIONAL CERTIFICATE

BUILDING AND STRUCTURAL SURVEYING N6

17 November 2020

This marking guideline consists of 7 pages.

QUESTION 1



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QUESTION 2

Given information:

Chainage of PI = 51 chains + 9.35 m = 1029.35

Intersection angle $\Delta = 32:40:00$

Radius of curvature 17.5 chains = $17.5 \times 20 = 350$ m

$\Delta/2 = 16:20:00 \checkmark$

Tangent length, $T = R \tan (\Delta/2)$
 $= (350)\tan(16:20:00)$
 $= 102.57$ m $\checkmark$

Arch length, $A = \pi \Delta R / 180$
 $= \pi \times 32:40:00 \times 350 / 180$
 $= 199.63$ m $\checkmark$

Chainage of beginning of curve, $BC = PI - T$
 $= 1029.35 - 102.57$
 $= 926.78$ m $\checkmark$

Chainage of end of curve, $EC = BC + A$
 $= 926.78 + 199.63$
 $= 1126.33$ m $\checkmark$

Deflection Angles, Θ

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For a = 13.22 m	For a = 20 m	For a = 6.33 m
$\Theta = 1:04:56 \checkmark$	$\Theta = 1:38:13 \checkmark$	$\Theta = 0:31:05 \checkmark$

CHAINAGE	CHORD DISTANCE	DEFLECTION ANGLE	OFFSET ANGLE
BC 926.78			00:00:00 $\checkmark$
	13.22	1:04:56	
940			1:04:56 $\checkmark$
	20.00	1:38:13	
960			2:43:09 $\checkmark$
	20.00	1:38:13	
980			4:21:22 $\checkmark$
	20.00	1:38:13	
1000			5:59:35 $\checkmark$
	20.00	1:38:13	
1020			7:37:48 $\checkmark$
	20.00	1:38:13	
1040			9:16:01 $\checkmark$
	20.00	1:38:13	
1060			10:54:14 $\checkmark$
	20.00	1:38:13	
1080			12:32:27 $\checkmark$
	20.00	1:38:13	
1100			14:10:40 $\checkmark$
	20.00	1:38:13	
1120			15:48:53 $\checkmark$
	6.33	0:31:05	
EC 1126.33			16:19:58 $\checkmark$

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QUESTION 3

3.1

BEACON	Y	X	YX (+)	XY (-)
A	-7 259.25	+ 6 527.93		
B	-7 281.52	+ 6 524.69	-47 364 355.88 $\frac{1}{2} \checkmark$	-47 533 252.85 $\frac{1}{2}$
C	-7 282.24	+ 6 529.69	-47 546 068.33 $\frac{1}{2} \checkmark$	-47 514 358.51 $\frac{1}{2}$
D	-7 297.36	+ 6 527.49	-47 534 748.78 $\frac{1}{2} \checkmark$	-47 649 498.62 $\frac{1}{2}$
E	-7 301.21	+ 6 553.97	-47 826 678.52 $\frac{1}{2} \checkmark$	-47 658 575.26 $\frac{1}{2}$
F	-7 263.83	+ 6 559.40	-47 891 556.87 $\frac{1}{2} \checkmark$	-47 606 923.91 $\frac{1}{2}$
A	-7 259.25	+ 6 527.93	-47 417 773.77 $\frac{1}{2} \checkmark$	-47 616 324.45 $\frac{1}{2}$
		Σ	-285 581 182.15 $\frac{1}{2} \checkmark$	-285 578 933.60 $\frac{1}{2}$

$$\begin{aligned}
 A &= \frac{1}{2} (\Sigma yx - \Sigma xy) \\
 &= \frac{1}{2} (-285\,581\,182.15 - (-285\,578\,933.60)) \checkmark \\
 &= -2\,248.55/10\,000 \checkmark \\
 &= \mathbf{0.225\,Ha} \checkmark
 \end{aligned}$$

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3.2

Station	Y	X	Calculation	Distance & Direction
BM 2298	-83534.372	+2847246.415	$\tan \theta = \Delta Y / \Delta X$	$\Theta = 43:47:41.06 \checkmark$
Trig 37	-82776.288	+2848037.083	$\Theta = \tan^{-1} (\Delta Y / \Delta X)$	
$\Delta Y, \Delta X$	+758.084 $\checkmark$	+790.668 $\checkmark$	$= \tan^{-1}(758.084/790.668) \checkmark$ $= 43:47:41.06 \checkmark$	
			$S = \sqrt{\Delta Y^2 + \Delta X^2}$ $\sqrt{758.081^2 + 790.668^2} \checkmark$ $= 1095.373\,m \checkmark$	$S = 1095.373 \checkmark$
CHECKS				
			ΔY	ΔX
			$\Delta Y = S \cdot \sin \Theta$ $= 1095.373 \sin(43:47:41.06)$ $= +758.084 \checkmark$	$\Delta X = S \cdot \cos \Theta$ $1095.373 \cos(43:47:41.06)$ $= +790.668 \checkmark$

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3.3	Station	Y	X	CHECKS	
	n			Θ	S
	CHEST	+46812.349	+1946287.347	$\Theta = \tan^{-1} \Delta X / \Delta Y + 90^\circ \checkmark$	$\Theta =$
	S, Θ	S=1512.348, $\Theta = 118:15:37$		$\tan(716.063/1332.085)+90$	43:47:41.06
	$\Delta Y, \Delta X$	$\Delta Y = S \cdot \sin \Theta$ $\checkmark$ $= 1512.348 \sin 118:15:37$ $= +1332.085 \checkmark$	$\Delta X = S \cdot \cos \Theta$ $\checkmark$ $= 1512.348 \cos 118:15:37$ $= -716.063 \checkmark$	$\checkmark$ $\Theta = 118:15:37 \checkmark$	
	Col 4	+48144.434 $\checkmark$	+1945571.284 $\checkmark$		

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QUESTION 4

4.1	Correction		+	-
	Temperature	$\alpha L(T_m - T_s)$	$(1.1 \times 10^{-5})(669.567)(36-20)$ $0.118 \checkmark$	
	Sag	$w^2 L^3 / 24 T^2$		$0.017^2 (669.576/7)^3 / (24 \times 7.2^2)$ $= 0.203 \checkmark$
	Slope	$L(1 - \cos \theta)$		$669.576(1 - \cos 6:32:22)$ $= 4.356 \checkmark$
	Sea Level	LH/R		$(669.576)(1868.55)/6364 \times 10^3$ $= 0.197 \checkmark$
	Sum of Correction		+0.118 $\checkmark$	-4.756 $\checkmark$
	Overall Correction		-4.638 $\checkmark$	
	Corrected Distance		669.567 - 4.638 $= 664.929 \text{ m } \checkmark$	

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4.2	4.2.1	$V = L/2 [A_1 + A_n + 2(\text{Sum of other Areas})] \checkmark$	
		$= 20/2 [27.33 + 0 + 2(22.62 + 17.11 + 13.63 + 9.22)] \checkmark$	
		$= 10 [27.33 + 125.16] \checkmark$	
		$= 1524.9 \text{ m}^3 \checkmark \checkmark$ (Full marks if unit is written)	
			(5)

4.2.2 $V = 2d/6 [A_1 + A_n + 2(\text{Sum of areas on odd stations}) + 4(\text{Sum of areas on even stations})] \checkmark$

$$= 2 \times 20/6 [0 + 15.49 + 2(6.32 + 12.01) + 4(3.10 + 9.88)] \checkmark$$

$$= 6.67[15.49 + 36.66 + 51.92] \checkmark$$

$$= 1524.9 \text{ m}^3 \checkmark \checkmark \text{ (Full marks if unit is written)}$$

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QUESTION 5

5.1 Check for angular error

Included angle	Correction	Corrected Angle	Join	Oriented Direction
A = 86:30:02	-5"	86:29:57		
			AB	140:11:40
B = 80:59:34	-5"	80:59:29		
			BC	41:11:09
C = 91:31:29	-5"	91:31:24		
			CD	312:42:33
D = 100:59:15	-5"	100:59:10		
			DA	233:41:43

Theoretical sum of included angles = $(2n-4) \times 90^\circ = (2 \times 4 - 4) = 360:00:00$

$\therefore$ Total error = $360:00:20 - 360:00:00 = +20''$

$\therefore$ Total correction = $-20''$

Assuming constant correction at individual angles

Correction per angle = $-20''/4 = -5''$

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5.2

Station	Join	ΔY	ΔX	Station	Y	X
A				A	+1000.0	+1000.0
140:11:40	AB	+119.97	-143.96			
187.4 m						
B				B	+1119.97	+856.0
41:11:09	BC	+252.01	+288.01			
382.7 m						
C				C	+1371.98	+1144.0
312:42:33	CD	-77.96	+71.97			
106.1 m						
D				D	+1294.02	+1216.0
233:41:43	DA	-293.98	-215.99			
364.8 m						
A				A	+1000.04	+1000.03
1041.00		+0.04	+0.03			

Errors of +0.04 and +0.03 negligible

Checks = $\sum \Delta Y = 0$ and $\sum \Delta X = 0$. No Bowditch's adjustment necessary

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TOTAL: 100