Université d'Ottawa
Faculté de génie

Département de
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Faculty of Engineering

Department of
Civil Engineering

CVG 2171 (Surveying and Measurements)
Mid-Term Exam (March 3rd, 2015)

Duration: 1 hr. 20 min
Closed Book Examination **Professor: A. Skaff**
Electronic calculators are permitted

1. (10 points)

   A 100-ft steel tape weighs 2 lb., has a cross-section area of 0.006 in^2, and is 100.00 ft. long when standardized at 68°F and 12 lb. pull and supported throughout its entire length. A distance is measured in the field with this tape and found to be 688.32 ft. If, at time of measurement, the pull on the tape was 20 lb., the temperature was 88°F and if the tape was supported only at its ends, what is the correct distance measured? Assume all full tape lengths except the last one.

2. (10 points)

   Prepare a set of level notes for the data shown below and make the customary arithmetic check. The elevation of BM 77 is 131.275 m.

Station	**BS (m)**	**FS (m)**
BM 77	2.720	
TP1	0.503	2.892
TP2	0.212	3.056
BM 78	1.246	3.302
TP3	2.169	1.257
TP4	2.695	0.678
BM 79		0.202

3. (10 points)

In the traverse ABCDEA, the following lengths and bearings were measured:

Course	**Length** (m)	**Bearing**
AB	133.25	N38°42'W
BC	183.17	N45°24'E
CD	163.89	S62°34'E
DE	179.94	--
EA	--	S75°00'W

Compute the length of EA and the bearing of DE.

HINT: Find the length and bearing of AD first by considering transverse ABCDA.

Good luck,

USEFUL EQUATIONS

$$C_1 = \frac{(l - l^1)}{l^1} L$$

$$C_t = K(T_1 - T) L$$

$$C_p = (P_1 - P)\frac{L}{AE}$$

$$C_s = -\frac{w^2 L_s^3}{24P_1^2} = -\frac{W^2 L_s}{24P_1^2}$$

$$\text{HI} = Elev. + BS$$

$$Elev. = \text{HI} - FS$$

departure = $L \sin \alpha$

latitude = $L \cos \alpha$

$$\tan\ azimuth\ (or\ bearing)\ AB = \frac{departure\ AB}{latitude\ AB}$$

$$length\ AB = \frac{departure\ AB}{\sin\ azimuth\ (or\ bearing)\ AB}$$

$$= \frac{latitude\ AB}{\cos\ azimuth\ (or\ bearing)\ AB}$$

$$= \sqrt{(departure\ AB)^2 + (latitude\ AB)^2}$$

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	COURSE — COURS	DATE
	CVG 2171	March 3, 2015

1.

Corrections must be made for pull, Temperature & Sag.

- Correction for pull:

$$C_p = (P_1 - P)\frac{L}{AE} = (20-12)\times\frac{688.32}{0.006\times 29\times 10^6} = 0.03\ ft$$

- Correction for temperature:

$$C_t = k(T_1 - T)L = 0.0000065(88-68)\times 688.32 = 0.09\ ft$$

- Correction for Sag:

$$C_s = -\frac{\omega^2 L_s^3}{24 P_1^2} \quad ; \quad \omega = \frac{2}{100} = 0.02\ lb/ft$$

$$C_{s_1} = -\frac{(0.02)^2\times(100)^3}{24\times(20)^2}\times 6 = -0.25\ ft$$

$$C_{s_2} = -\frac{(0.02)^2\times(88.32)^3}{24\times(20)^2} = -0.03\ ft$$

$\therefore\ C_s = -0.25 - 0.03 = -0.28\ ft.$

Correct Distance Measured:

$$688.32 + 0.03 + 0.09 - 0.28 = \underline{\underline{688.16\ ft}}$$ ANS.

2.

Station	BS (m)	HI (m)	FS (m)	Elevation (m)
BM 77	2.720			131.275
TP 1	0.503	133.945	2.892	131.103
TP 2	0.212	131.606	3.056	128.550
BM 78	1.246	123.762	3.302	125.460
TP 3	2.169	126.706	1.257	125.449
TP 4	2.695	127.618	0.678	126.940
BM 79		129.635	0.202	129.433 ✓

CHECK: $\Sigma BS = 9.545$, $\Sigma FS = 11.387$

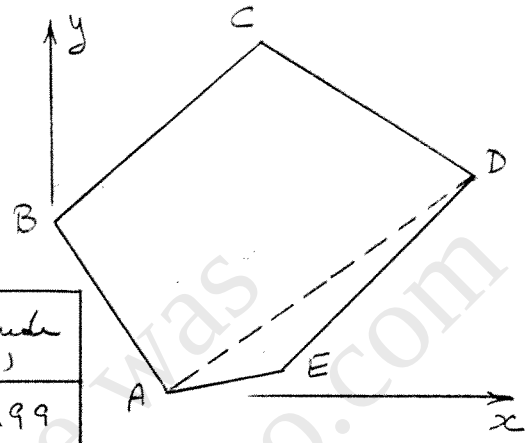
∴ Elevation of BM 79 : $131.275 + (9.545 - 11.387) = 129.433$ m.

checks. ✓

3.

Find the length and Bearing of line AD.

∴ Consider traverse ABCDA:



Course	Length (m)	Bearing	Departure (m)	Latitude (m)
AB	133.25	N38°42'W	-83.31	103.99
BC	183.17	N45°24'E	130.42	128.61
CD	163.89	S62°34'E	145.46	-75.51
DA	157.09	S45°47.6'W	-192.57	-157.09

Σ Dep. = +192.57 m; Σ Lat. = 157.09 m

∴ Dep. of DA = -192.57m Lat. of DA = -157.09m.

∴ Dep. of AD = +192.57 m, and Lat. of AD = 157.09 m.

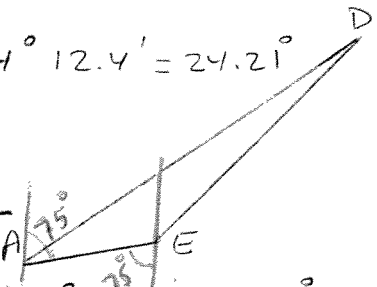
$$\text{Length of AD} = \sqrt{(192.57)^2 + (157.09)^2} = 248.52\text{ m}.$$

$$\text{Bearing of AD} = \tan^{-1}\frac{192.57}{157.09} = N\,50^\circ\,47'\,38''E = N50^\circ47'6E$$

Now, Consider $\triangle$ ADE:

$\angle DAE = 75^\circ 00' - 50^\circ 47.6' = 24^\circ 12.4' = 24.21^\circ$

AD = 248.52m and DE = 179.94m.



$$\frac{AD}{\sin E} = \frac{DE}{\sin A}\ ;\ \text{i.e.}\ \frac{248.52}{\sin E} = \frac{179.94}{\sin(24^\circ 12.4')}$$

$$\therefore \angle E = \sin^{-1}\frac{248.52\times\sin(24^\circ 12.4')}{179.94} = 34.49^\circ \text{ or } 145.51^\circ$$

Chose 145.51°

$\therefore \angle ADE = 180^\circ - 145.51^\circ - 24.21^\circ = 10.28^\circ = 10^\circ 16.8'$

$$\frac{AD}{\sin 10.28^\circ} = \frac{179.94}{\sin 24.21^\circ}, \quad \therefore AE = EA = 78.31\text{ m}$$

and Brg DE = 50°24.6' - 10°16.8' = S40°7.8'W } ANS.

} ANS.