PLSS Homework Lesson #1

(1) The Baseline, Standard Parallels, and Townships in the PLSS are all monumented by stakes placed on a True (line) (curve) of Latitude. Normally, monuments are placed every ½ mile. An inverse between these found monuments would be a chord, rather than a curve length. East-West section lines not on a Township Boundary are not normally monumented on a True Latitudenal Curve.

Much like staking a curve for highway, the surveyor needs to know how sharp the curve is. By looking at a globe, one can see the latitude lines are more curved closer to the poles and least curved at the equator. The way to compute how sharp the curve is, is to compute the linear convergence of meridians at that location on the globe. This is enough to do a Tangent offset stakeout, but we also need angular Convergence in order to use the better method of secant offset stakeout.

Problems 1 & 2 are designed to show you the difference in these convergences at differing locations on the globe. Also to show the difference between the amount in a six mile Township and a twenty four mile quadrangle.

- Every six miles the error is distributed in the west sections.
- Every twenty four miles, there is so much error, its time to start fresh.

Example problem #1 and #2

- Find linear and angular convergency between two meridians. First for a Township 6 miles on a side, Then for a quadrangle 24 miles on a side. Compute for parallel of Latitude to be staked is 40° North.

① Linear convergence = 0.0202 (d)(L)(Tan latitude)

d = miles between converging meridians
L = miles between Latitudenal lines
★ Answer is in Chains

② Angular convergence = $\frac{\text{linear convergence in chains}}{\frac{80 \text{ chains per mile}}{\text{miles between Latitude lines}}}$ Arctan

③ Township 6 x 6 at 40° N.

0.0202 (6)(6)(Tan 40°) = 0.610 chains

$\left(\frac{0.610 \text{ chains}}{\frac{80}{6}}\right)$ Arctan = 0° 04' 22"

④ Quadrangle 24 x 24 at 40° N.

0.0202 (24)(24)(Tan 40°) = 9.763 chains

$\left(\frac{9.763 \text{ chains}}{\frac{80}{24}}\right)$ Arctan = 0° 17' 29"

Problem #3 – The Length of 1 degree Latitude is about 69 miles

The Length of 1 degree Longitude is about 69 miles only at the equator. Meridians of longitude converge toward the poles.

So, Length of 1° Longitude = 69 (cos Latitude)

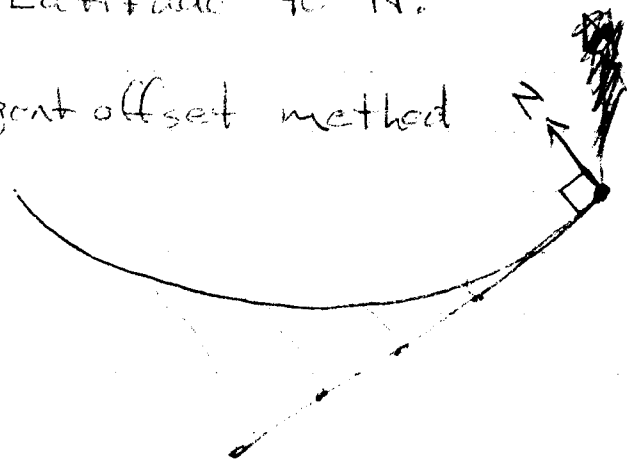
Example: Find length of 1° Longitude at a Latitude of 40° N.

69 (cos 40) = 52.857 miles

Problem #4 Example

Find Tangent offsets every ½ mile, over 6 miles at Latitude 40° N.

Tangent offset method



Find North, Turn 90°, set every ½ mile, set up every ½ mile and turn 90° and measure offset distance + place stake.

① Find linear convergence = 0.610 chains
from page 2

② Offset from Tangent to parallel is ½ linear convergence in same distance

– convert to feet = $0.610 \text{ ch} \left(\frac{66 \text{ ft}}{1 \text{ ch}}\right) = 40.26 \text{ ft}$.

So, offset at 6 miles = $\frac{40.26}{2} = 20.13$ ft.

③ Then $-\left(\frac{d^2}{36}\right)$(offset at 6 miles) = offset at any point in feet

d = miles along the line

offset ½ mile = $\left(\frac{.5^2}{36}\right)(20.13) = 0.14$ ft.

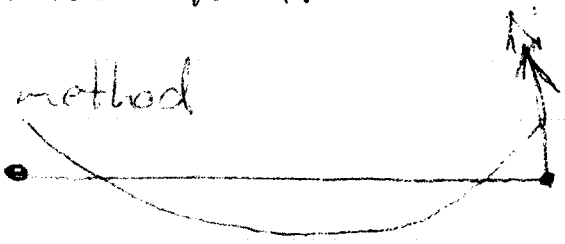
offset 1 mile = $\left(\frac{1^2}{36}\right)(20.13) = 0.56$ ft.

And so on

Problem #5 Example

Find Secant offsets every ½ mile, over 6 miles, at Latitude 40° N.

Secant method



Find north, Turn to next Azimuth, not 90°, set stake every ½ mile, adjust to new Azimuth at each setup. Measure offset from secant to parallel.

① Find all Tangent offsets P.4

② use Tangent offsets to find Secant offsets. (See other notes)

Example:

SC_0 = Secant offset at 0 miles (at beginning)
SO_0 = Tangent offset at 3 miles − Tanoff 2miles
$SO_0 = a_3 - a_2$

$$a_2 = \left(\frac{2^2}{36}\right)(20.13) = 2.24$$

$$a_3 = \left(\frac{3^2}{36}\right)(20.13) = 5.03$$

$$SO_0 = 5.03 - 2.24 = 2.79 \text{ ft.}$$

③ Find Azimuths of the secant line at 1 mile Intervals — see next Page and other notes

Problem #5 Example continued

B_0 = Bearing at 0 miles

B_0 = 90° − Angular convergence in 3 miles

$B_0 = 90° - \theta_3$

Angular converge in 6 miles, from back on page 2, = 0° 04' 22"

$\theta_3 = \frac{0° 04' 22"}{2} = 0° 02' 11"$

$B_0 = 90° - 0° 02' 11"$

$B_0 = 89° 57' 49"$ Northeast or SW

And so on

Problems 6-9

- See BLM manual of Surveying instructions 1973 edition online
  - Table of contents
    - → subdivision of sections

- Problems 10 and 11
  - These are covered in your Text reading — Brown's Boundary Control
    - ☆ There is a misprint in 6th edition

Six Diagrams of Sections on Last Page

This Assignment forces you to learn the system.

Step 1) Is the section in the Western Column of the Township such that convergence will affect it?

Step 2) If answer to #1 above is yes, then is the shaded parcel in question in the western 20 chains such that convergence will affect the area and description?

Step 3) Calculate Township and Range

Step 4) Calculate convergence if answer in #2 above is yes

Step 5) Calculate Area, Dimensions, and write descriptions

Example - Section 31

(1) yes, western column
(2) yes, one parcel affected, but one is not.

(3) Township = 5 Tiers north of BL
Tiers are another name for [redacted]
a Township or 6 miles
Section 31 is at bottom of a Township
So - Township 6 North contains this section

Range = 29 miles from 3rd Guide Meridian
Guide Meridians every 24 miles
Ranges every 6 miles

3 x 24 = 72 miles + 29 miles = 101 miles
101 ÷ 6 = 16.83 rest 16 and into 17 West
So - Range [redacted] 17 West contains this section

(4) linear Convergence = 0.0202 (L)(d) (Tan mean Lat of Quad)
* needed only for the western panel
d = 6 miles because all convergence in township goes in this last 20 chains of western sections
L = miles from nearest standard parallel to South
[redacted]

L to North line of Parcel = 6.5 miles
(A standard parallel is at 4 Tiers North of BL)
L to South line of parcel = 1/8 mile less than 6.5
= 6.375 miles

Example Section 31 continued

Mean Latitude of Quadrangle = 38°59'45"

- The Parcel is within the second Quad North, So the middle of the Quad is 24+12 North of BL. = 36 miles north of BL

- From BLM 1973 manual or reference sheet provided, The Latitude of the BL for the 3rd Principal Meridian is 38°28'27"

- 1° Latitude = 69 miles

  so $\frac{36}{69}$ = 31'18" further North

- 38°28'27" + 0°31'18" = 38°59'45"

☆ Convergence N. Line = 0.0202(6.5)(6)(Tan 38°59'45")
= 0.638 chains

☆ Convergence S. Line = 0.0202(6.375)(6)(Tan 38°59'45")
= 0.626 chains

(5)

So – Western Parcel in Section 31

Dimensions = 10 × (20 − 0.638) / (20 − 0.626) × 10 = 10 × 19.362 / 19.374 × 10

Area = $10\left(\frac{19.362 + 19.374}{2}\right)$ = 193.68 ch² = 19.368 Acres

Description = The N½ of Lot 3 of the SW¼ Section 31, Township 6 North, Range 17W, 3rd PM

Example Section 31 Continued

Eastern Parcel in Section 31

Dimensions = 10 X 20 chains
Area = 200 ch² = 20 Acres

Description = S ½, SE ¼, NE ¼, Sect. 31,
Township 6 N, Range 17 W, 3rd P.M.