

# **“The USPLSS for Missouri and Arkansas”**

**Friday, March 19, 2021**

**Dr. Richard L. Elgin, PS, PE  
Archer-Elgin Engineering & Surveying  
Rolla, Missouri**

**9:00am – 11:30 am**

**The early USPLSS  
Review**

**Some Lines**

**Some Corners**

**The Original Surveys**

**Building the USPLSS**

**Standard Lines**

**Township Extérieurs**

**Subdividing the Township**

**Protraction**

**12:15pm – 3:15 pm**

**Reestablishing Lost Corners**

**The Three Kinds**

**Standard v. Closing**

**How Many are There?**

**Rules**

**Calculations on the USPLSS**

**Proportioning Coordinates**

**Example Calculations**

# About Richard Elgin, PhD, PS, PE

## Rolla, Missouri

A second generation surveyor, Dr. Elgin was raised in St. James, Missouri and in his late parents' surveying business located in nearby Rolla. After high school Dick joined the Army, went through helicopter flight school, was made a Warrant Officer, and spent 1969 in Vietnam flying the Hughes OH6A Light Observation helicopter "LOH" and the ubiquitous UH-1 "Huey." He flew with the Americal Division and was decorated for service. He remains active in veterans affairs. Following the Army he received the BSCE and MSCE degrees from the Missouri University of Science and Technology (S&T) and his PhD from the University of Arkansas. Leaving Arkansas he joined the faculty of the Department of Civil Engineering at S&T as an Assistant Professor (1980-1984) and is now Adjunct Professor (retired), having taught surveying courses for many, many years. From 1984 until 2008 Dick was the owner and President of Elgin Surveying & Engineering, Inc. Semi-retired, Dick currently works for Archer-Elgin Engineering, Surveying and Architecture. He is a former member of the Missouri Board for Architects, Professional Engineers, Professional Land Surveyors and Professional Landscape Architects; a Past-President of the Missouri Society of Professional Surveyors; a member of both S&T's and the University of Arkansas' Academy of Civil Engineers; a member of S&T's Order of the Golden Shillelagh; and on the Board of Directors of S&T's Alumni Association. With Drs. David Knowles and the late Joe Senne, Dick coauthored the Celestial Observation Handbook and Ephemeris and codeveloped the "ASTRO" celestial observation software products. With David Knowles, he coauthored Legal Principles of Boundary Location for Arkansas and The U.S. Public Land Survey System for Arkansas. Dick is the author of The U.S. Public Land Survey System for Missouri and Riparian Boundaries for Arkansas. Dick was Arkansas' surveying and mapping expert in a state riparian boundary dispute with Mississippi, decided by the U.S. Supreme Court. See *Arkansas v. Mississippi*, 471 U.S. 377 (1985). He is an avid collector and researcher of early American surveying equipment, and owns one of the largest private collections of such equipment in the United States. He and his wife enjoy touring by bicycle, RV or in their perfectly restored 1976 Alfa Romeo GT 1600 Junior or 1967 Austin Cooper 1275 S or 1962 Austin Healey Sprite.



Some History of the USPLSS

**USPLSS**

Land Ordinance of May, 1785

The Seven Ranges, 1785-1787

Ohio, the USPLSS Test Best, 1800-1816

The First Four Principal Meridians, 1803-1818

The Louisiana Purchase, 1804

The 5th Principal Meridian  
I.P. Set 10/1815

Missouri GLO dates: 1815-1860

Arkansas GLO dates: 1815-1849

To Review

**USPLSS**

Some Lines:

Principal Meridian

Base Line

Standard Parallel or Standard Line or Correction Line

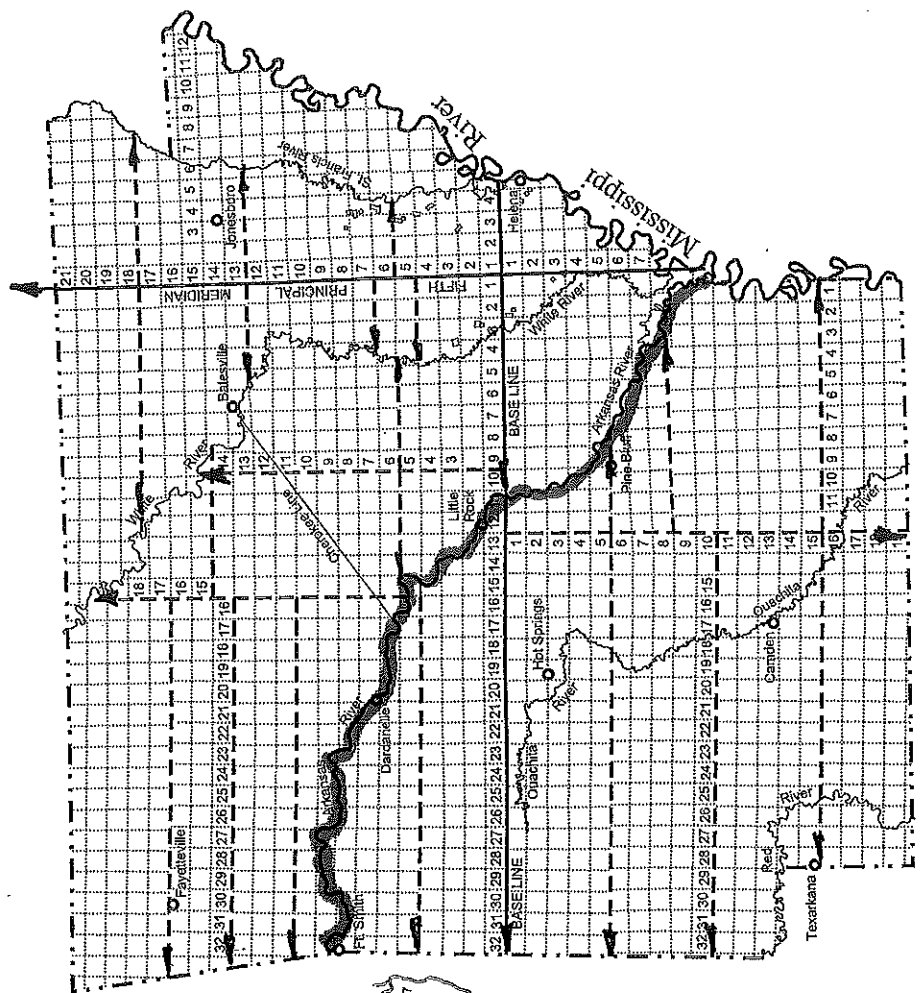
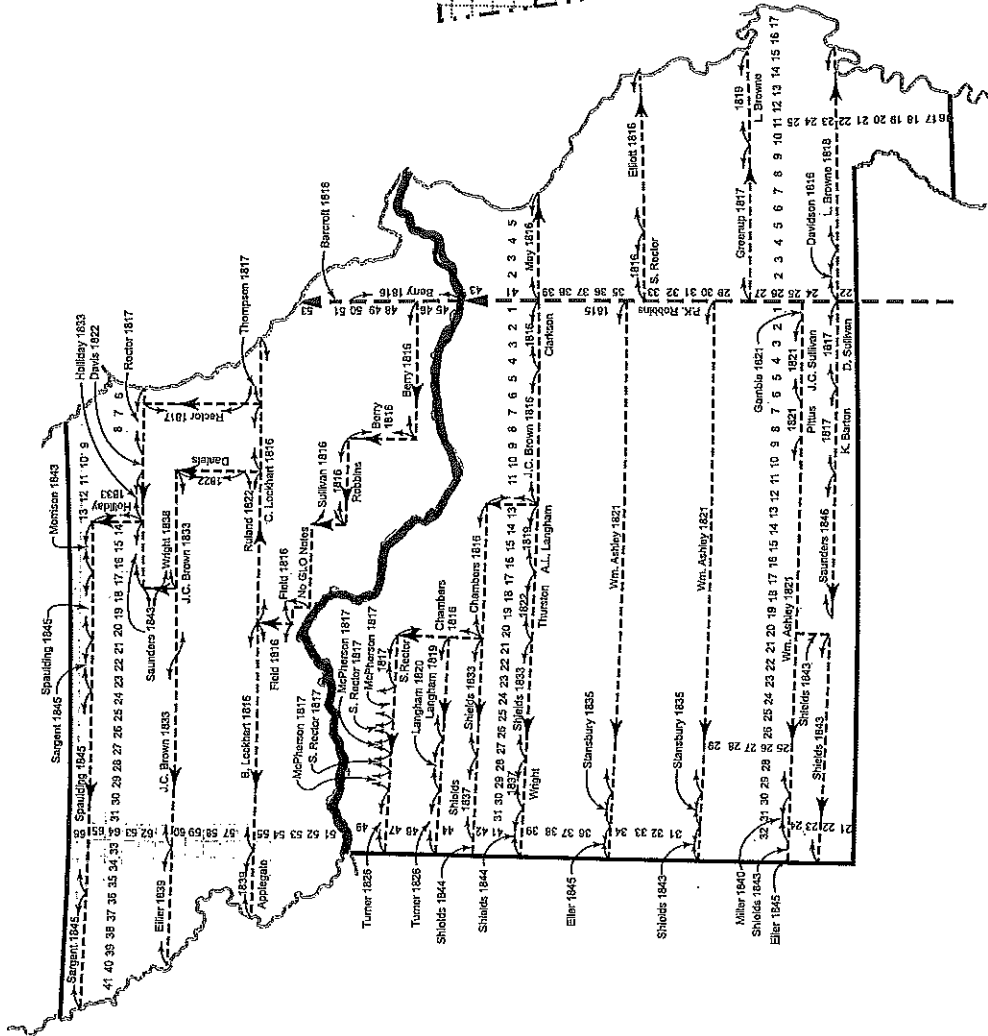
“Guide Meridian” or Auxiliary Principal Meridian

**USPLSS**

Township Line

Range Line

Section Line



THE STANDARD LINES and AUXILIARY PM'S

Meander Line

USPLSS

True Line

Random Line

Some Corners:

**USPLSS**

**Standard Corner**

**Closing Corner**

**Corner Set on True Line**

**Corner Set by Offset**



Existent Corner

**USPLSS**

Obliterated Corner

Lost Corner

The Original Surveys:

**USPLSS**

Instructions

Tiffin's Instructions of 1815

The Chain

The Compass

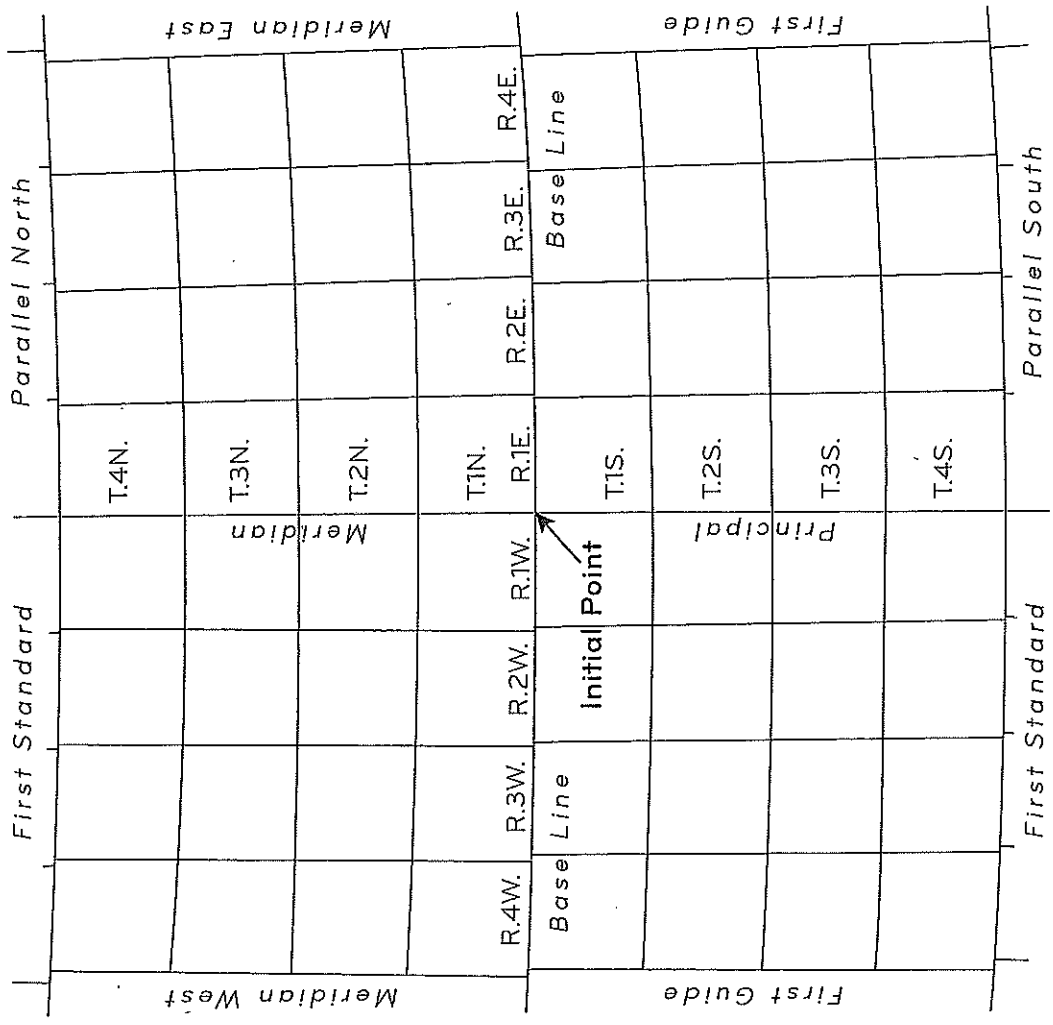
Building the USPLSS in Missouri and Arkansas

**USPLSS**

**The Standard Lines**

**The Township Exteriors**

**Subdividing the Townships**



FROM BLM MANUAL  
 Not Used in Missouri or Arkansas

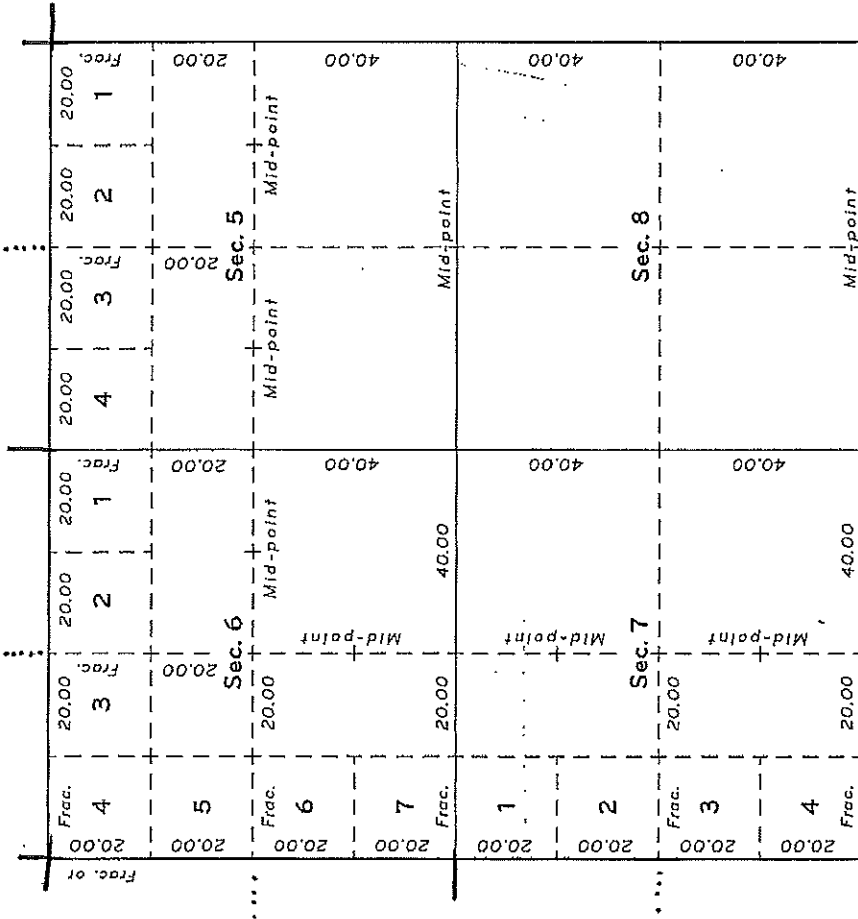
## Protraction.

# USPLSS

- 1.) Creation of aliquot parts and lots, usually in fractional sections on the GLO plat.
- 2.) Created from field-measured dimensions.
- 3.) An on-paper subdivision created on the GLO plat. Not monumented in the field.
- 4.) No protraction methods mentioned in Tiffin's Instructions.
- 5.) Protraction schemes are very uniform in Missouri and fairly uniform in Arkansas. Study the plat. In some instances, look at the patent.
- 6.) Protraction and the protracted distances are important because every township in Missouri and Arkansas has been protracted. This is not true in all states surveyed later.

FROM BLM MANUAL

Not Correct for  
Missouri or  
Arkansas



Showing regular subdivision of sections.

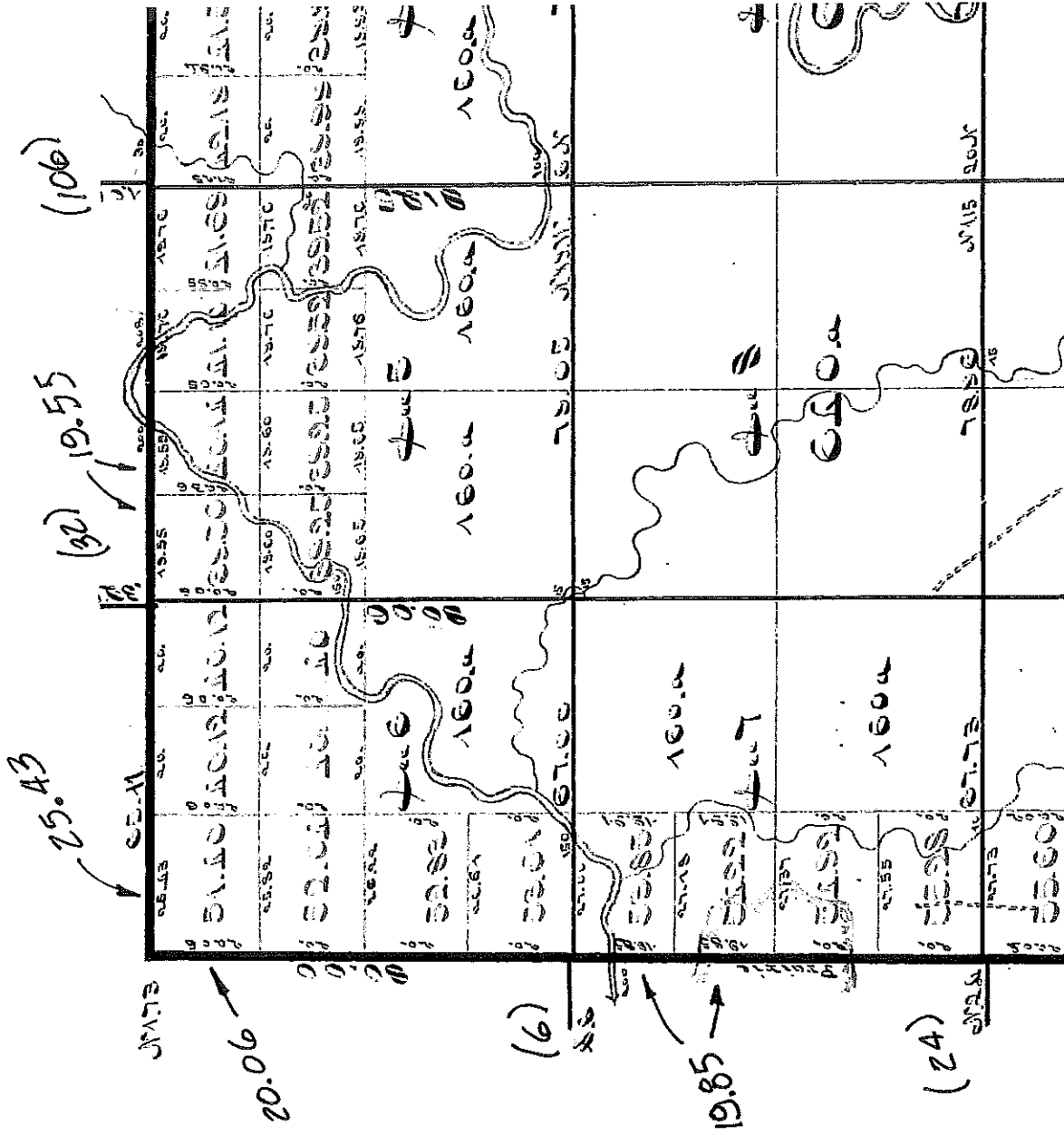
S. 89° 50' W.		N. 0° 16' W.	
4	35.96	3	40.42
5	36.00	4	40.70
6	36.36	5	40.98
7	36.32	6	40.98
N. 89° 52' W. 78.20		80.56	
626.51		80.56	
80		80	
80		80	

Showing areas.

20.00		20.00		20.00		20.00	
4	17.88	3	20.00	2	20.42	1	20.56
5	17.96	4	20.27	5	20.00	6	20.00
6	18.04	5	20.00	7	20.00	8	20.00
18.12		20.00		20.00		20.00	
18.20		20.00		20.00		20.00	

Showing calculated distances.





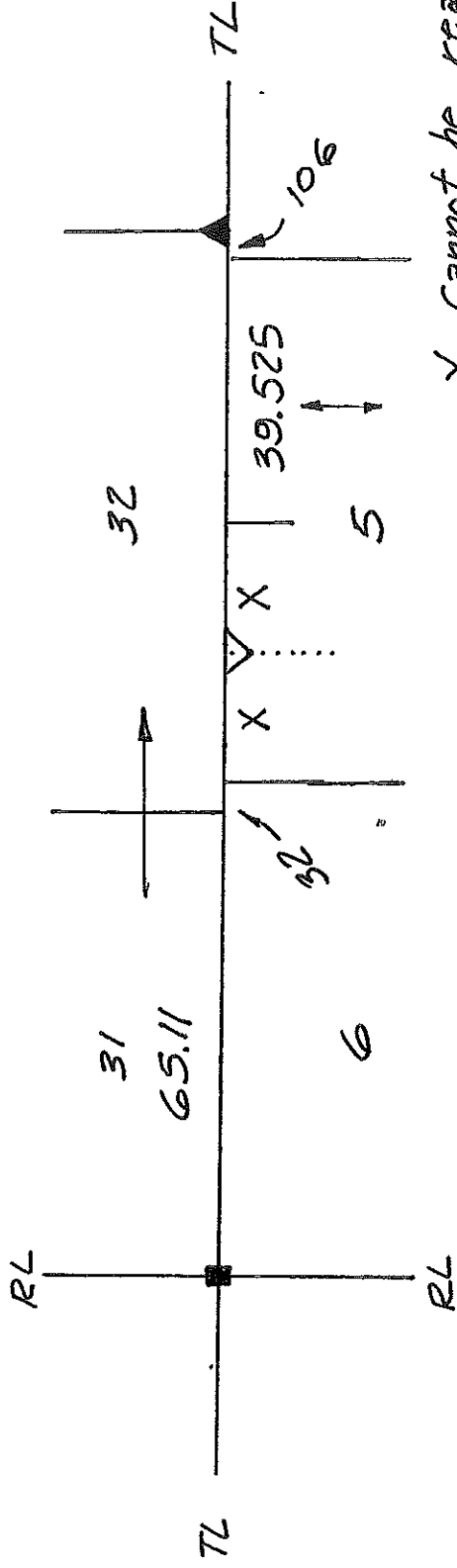
Township 19 North, Range 24 West

(Arkansas)



# WHY IS PROTRACTION IMPORTANT?

FROM THE PREVIOUS ARKANSAS GLO PLAT:



X cannot be read.  
(Must Know)

$$X = (80.00 - 1.06 - 39.525 - 0.32) / 2 = 19.5475 \text{ chains}$$

Proportioning West to East the proportioning fraction will be:

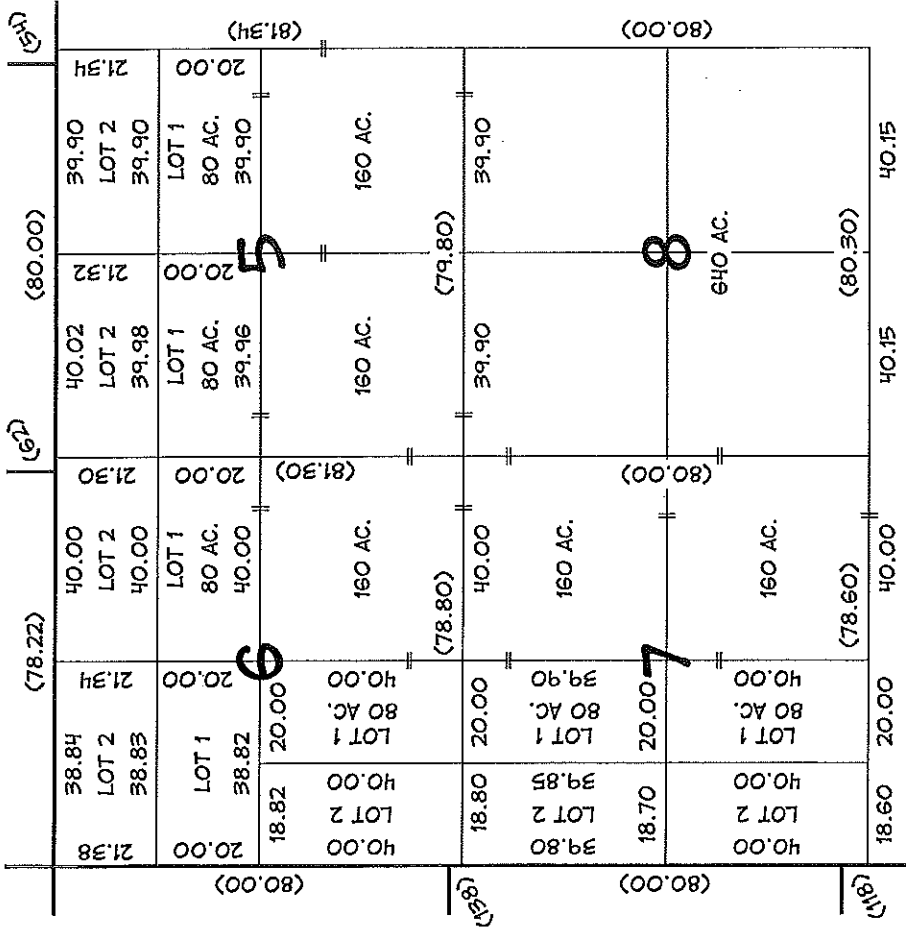
$$\frac{65.11 + 0.32 + 19.5475}{65.11 + 80.00} = \frac{84.9775}{145.11} = 0.58560747$$

This factor times the  $\Delta$  coordinates

Protracting Missouri

**USPLSS**

**Notes**



--- DENOTES LINES MADE PARALLEL BY THE PROTRACTION

DIMENSIONS IN PARENTHESES WERE FIELD-MEASURED.  
ALL OTHER DIMENSIONS WERE PROTRACTED.

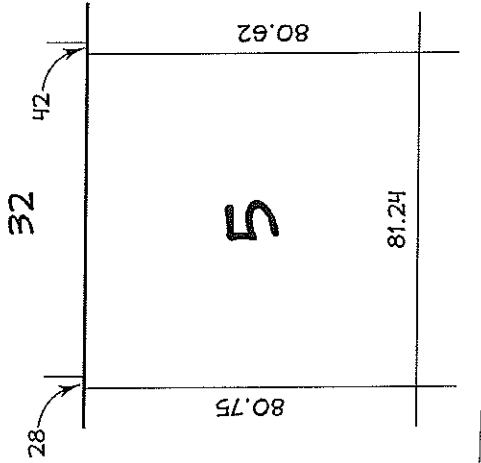
NOMINAL ACREAGES ARE SHOWN (AS TYPICALLY ARE SHOWN ON GLO PLATS). OTHER LOT ACREAGES ARE NOT SHOWN HEREON DUE TO VARIABLE METHODS USED BY GLO. SEE TEXT IN THIS AND CHAPTER 6.

# TYPICAL PROTRACTION SCHEME MISSOURI

Protraction of Northern Row Fractional Section

From: "The U.S. Public Land Survey System for Missouri" by Elgin, 4th edition, copyright 2019

Dimensions from GLO field notes



Protracted Section

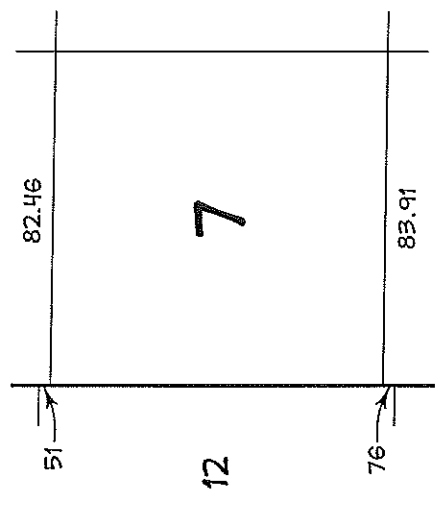
32

20.75	39.24 LOT 2 81.67 AC 39.59	20.69	40.62 LOT 2 83.90 AC 40.62	20.62
20.00	LOT 1 79.53 AC 39.94	20.00	LOT 1 81.24 AC 40.62	20.00
40.00	161.12 AC	40.00	162.48 AC	40.00
40.62		40.62		40.62
Acreages Computed				

Protraction of Western Column Fractional Section

From: "The U.S. Public Land Survey System for Missouri" by Elgin, 4th edition, copyright 2019

Dimensions from GLO field notes



Protracted Section

22.46	20.00	40.00	40.00
38.73 LOT 2 88.76 AC	39.38 LOT 1 78.46 AC	39.08	158.76 AC
23.17	20.00	40.00	40.00
40.00 LOT 2 94.16 AC	40.00 LOT 1 80.00 AC	40.00	160.00 AC
23.91	20.00	40.00	40.00
Acreages Computed			

12

Protracting Arkansas

**USPLSS**

**Notes**



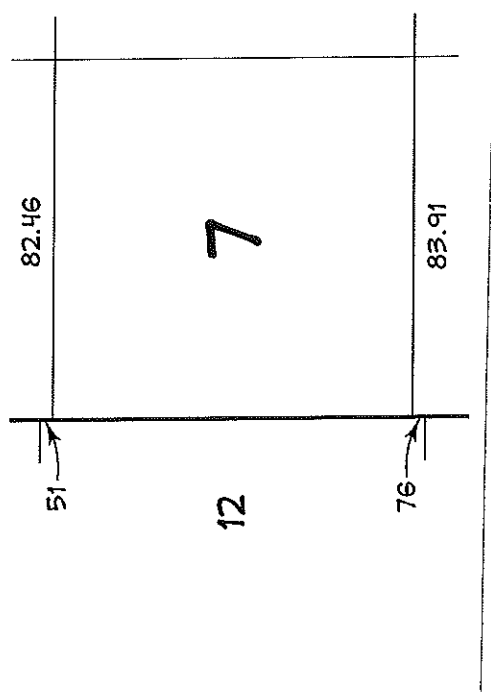




Protraction of Western Column Fractional Section

From: "The U.S. Public Land Survey System for Arkansas" by Elgin & Knowles, copyright 2011

Dimensions from GLO field notes



Protracted Section

19.365	22.46 H.C. A.C.	20.00	20.00 H.C. A.C.	40.00	40.00 160 AC
19.365	22.81 H.C. A.C.	19.53	19.69 H.C. A.C.	40.00	40.00 160 AC
20.00	23.17 H.C. A.C.	20.00	20.00 H.C. A.C.	40.00	40.00 160 AC
20.00	23.54 H.C. A.C.	20.00	20.00 H.C. A.C.	40.00	40.00 160 AC

12

**Reestablishing Lost Corners**

**USPLSS**

**Three Kinds of Corners**

**Existent Corner**

**Obliterated Corner**

**Lost Corner**

**All Three Defined in:**

**RSMO Chapter 60**

**BLM Glossary of Terms and Manuals**

**Guided by:**

**Statute Law**

**Case Law**

**Administrative Law**

Lost Corners

**USPLSS**

“Lost Corner,” a corner whose position cannot be determined, beyond reasonable doubt; either from traces of the original marks or from acceptable evidence or testimony that bears upon the original position;

RSMo Chapter 60

**LOST CORNER** – A corner whose position cannot be determined, beyond reasonable doubt, either from the traces of the original marks or from acceptable evidence or testimony that bears on the original position, and whose location can be restored only by reference to one or more interdependent corners.

**BLM Glossary**

But...

**USPLSS**

“The restoration and utilization of the existent corners of the United States public land survey is a prime objective of every survey. Every means shall be undertaken to determine the position of the original corner before deciding that the corner is lost.”

RSMo, 60:311

Standard Corners v. Closing Corners:

**USPLSS**

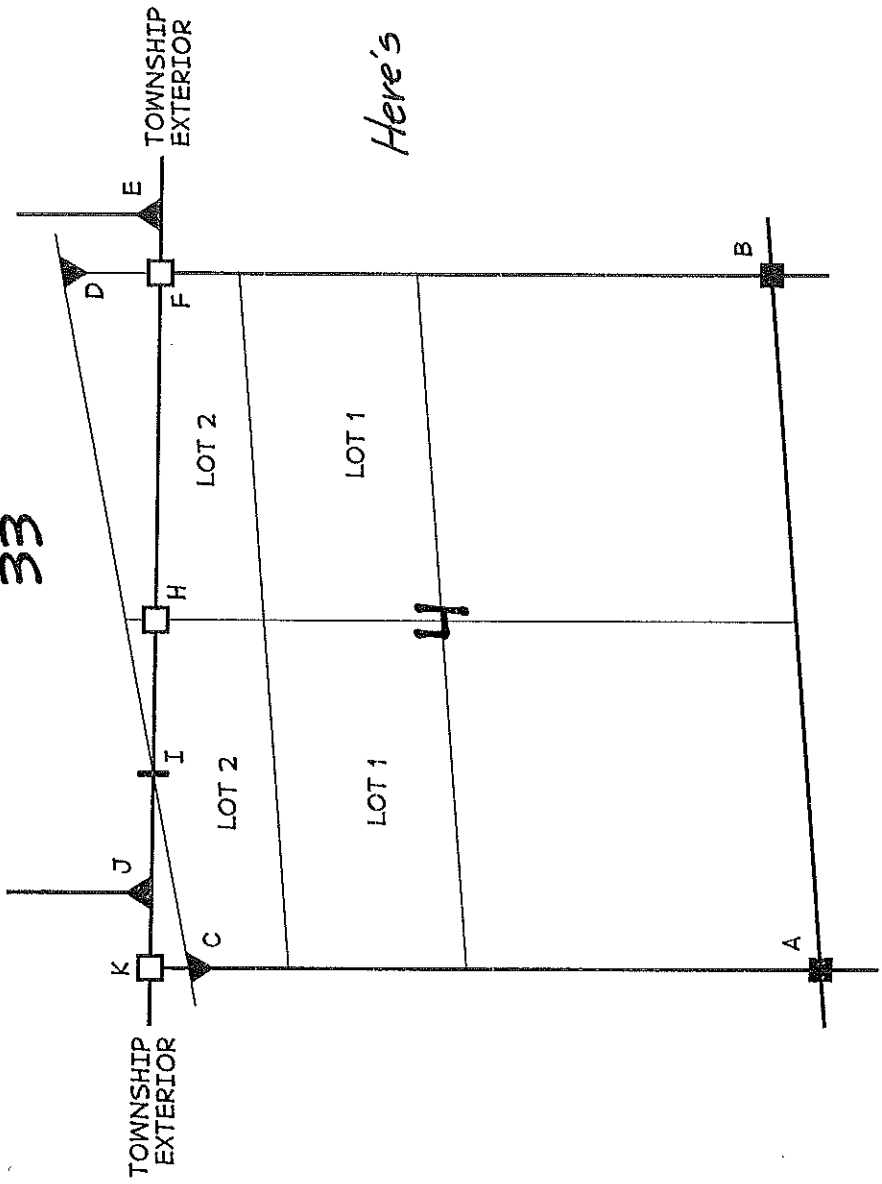
What's the difference?

How were they set?

What weight?

Why does it matter?

33



*Here's the potential trouble.*

FIGURE IS EXAGGERATED

EXISTENT CORNERS

What Does BLM Manual (2009) say?

## **USPLSS**

494 pages

10 Chapters

Chapter VII “Resurveys and Restoration” (17 pages)

Not written for USPLSS per Tiffin (MO & AR).

Not written for double corners on each township exterior.

However, Section 7-46 addresses blank quarter corner.

Chapter VII is only 17 pages long.

Chapter VIII, Water Boundaries is 99 pages long.

GLO/BLM “Manuals of Instruction” published in  
1855, 1871, 1881, 1890, 1894, 1902, 1930, 1947,  
1973, 2009

**USPLSS**

“Restoration of Lost and Obliterated Corners” first published in 1883.  
This edition best describes reestablishment  
procedures for Arkansas and Missouri.

To reestablish lost corners for

Arkansas

1883 “Restoration” manual  
Fully described in Chapter 5  
of Elgin & Knowles’ “Arkansas”  
USPLSS manual.

Missouri

RSMO Chapter 60 (2020):  
Statute law is “modern”  
version of 1883 manual.  
Fully described in Chapter 5  
of Elgin’s “Missouri” USPLSS  
manual.

The example problems herein apply these procedures.



OK, Finally, Methods to Reestablish Lost Corners

**USPLSS**

But first...

The following rules for the reestablishment of lost corners shall be applied only when it is determined that the corner is lost: (The rules utilize proportional measurement which harmonizes surveying practice with legal and equitable considerations. This plan of relocating a lost corner is always employed unless it can be shown that the corner so located is in substantial disagreement with the general scheme of the original government survey as monumented. In such cases the surveyor shall use procedures that produce results consistent with the original survey of that township.)

...Existing original corners shall not be disturbed. Consequently, discrepancies between the new and record measurements shall not in any manner affect the measurements beyond the existent corners; but the differences shall be distributed proportionately within the several intervals along the line between the corners;

RSMo, 60:315

The Reestablishment of Lost Corners

**USPLSS**

OK, how many different corners are there?

1.) Quarter Corner, interior of township

2.) Quarter Corner, closing section

3.) Section Corner, interior of township

4.) Corner on township exterior

5.) Corner on Standard Parallel

6.) Corner to four townships

1/13

Example Calculations

Missouri and Arkansas

These example problems were taken from “The U.S. Public Land Survey System for Missouri” (by Dr. Richard Elgin). There are four editions of the book. The 4th Edition is the latest (printed 2019). It is the best, being hardbound and printed in color. It is available from MSPS. Or, these examples were taken from “The U.S. Public Land Survey System for Arkansas” (by Drs. Elgin and Knowles). There is one edition of that book (softbound, printed in black and white, 2011). It is available from the Arkansas State Surveyors Office.

Answers are given on the last sheet of this problems set.

There are additional example problems given in both books.

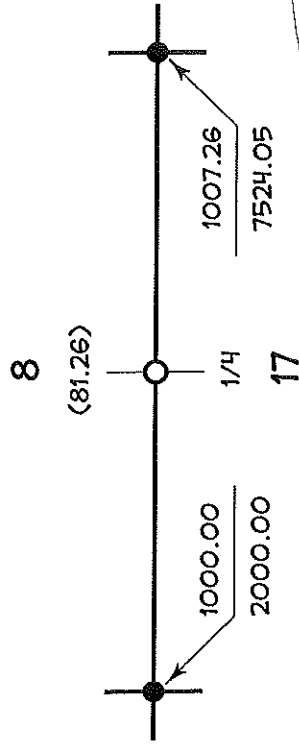
These example problems are specific to Missouri and Arkansas. These sketches and solutions may not be correct for other states.

This set of problems are copyright, 2021, Dr. Richard Elgin.

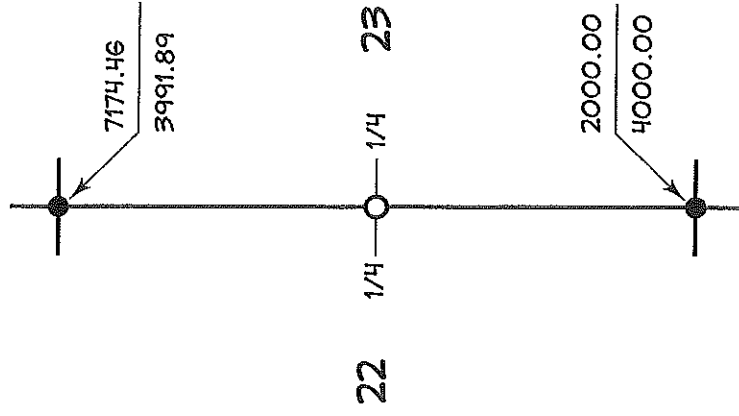
Lost Quarter Corner, Interior of Township

2/13

1.) Dimensions:



2.) Dimensions:



Dr. Richard L. Elgin, PS, PE

Rolla, MO

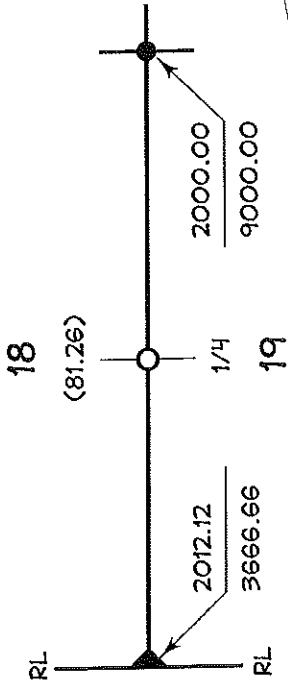
elgin@rollanet.org

©2021

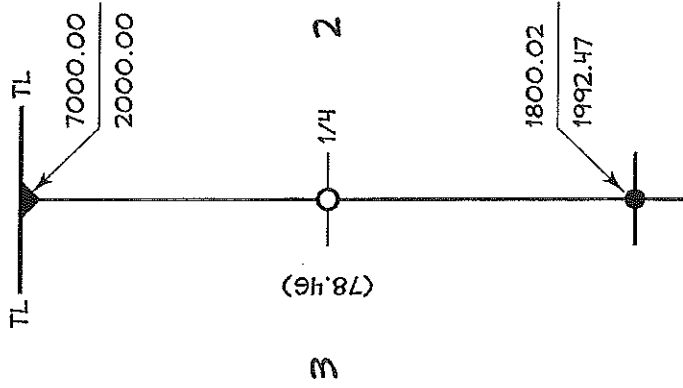
3/13

# Lost Quarter Corner, Closing Section

3.) Dimensions:



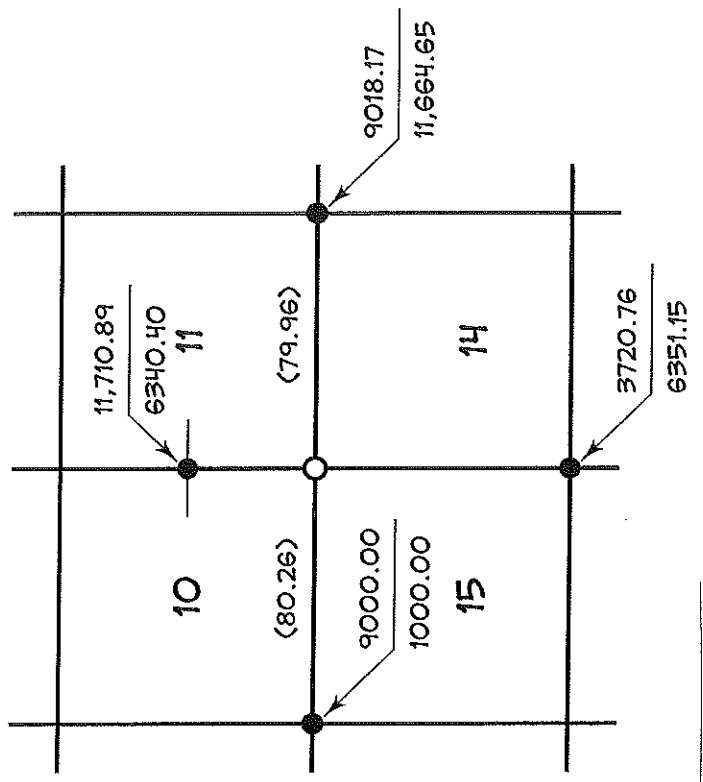
4.) Dimensions:



Lost Section Corner, Interior of Township

4/13

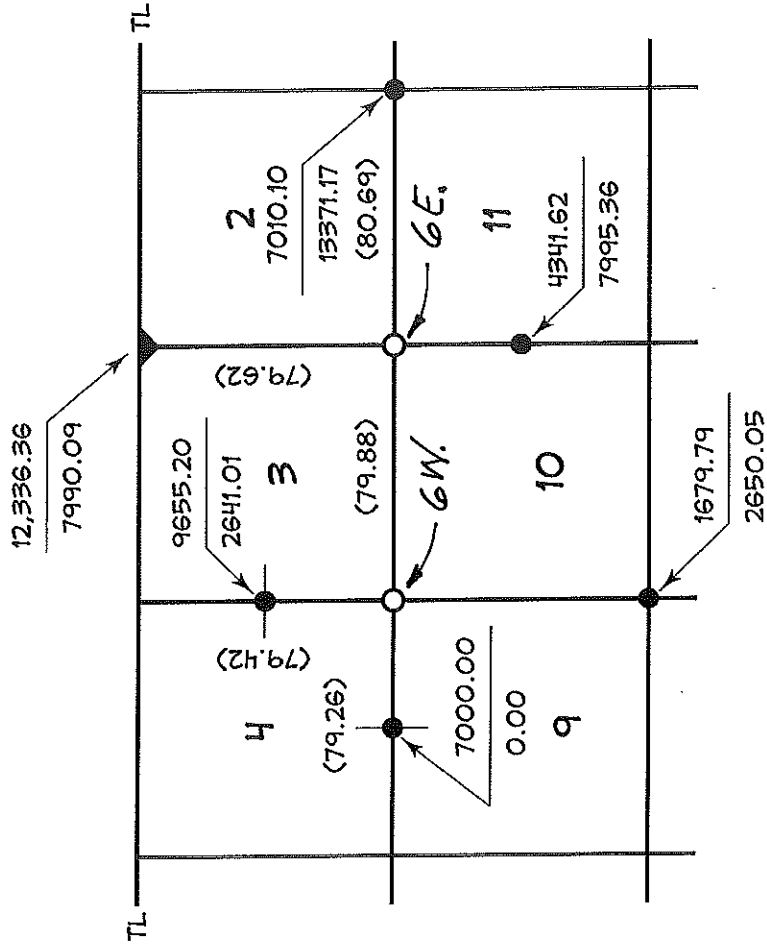
5.) Dimensions:



Lost Section Corner, Interior of Township

5/13

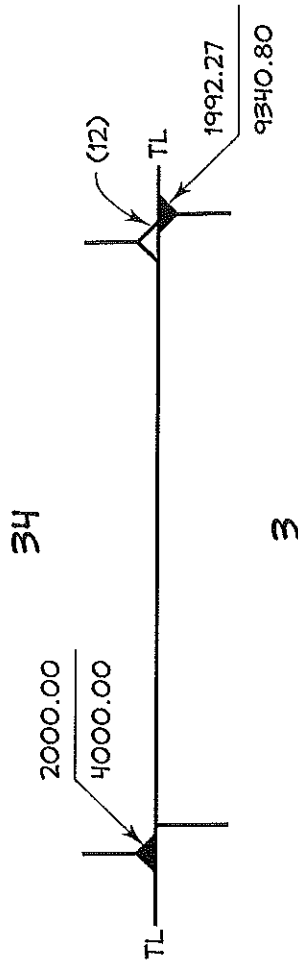
6.) Dimensions:



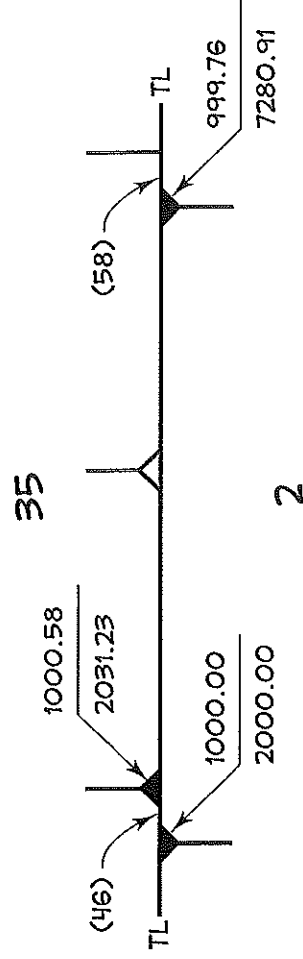
Lost Corner on Township Exterior  
Closing Corners Accepted

6/13

7.) Dimensions:



8.) Dimensions:

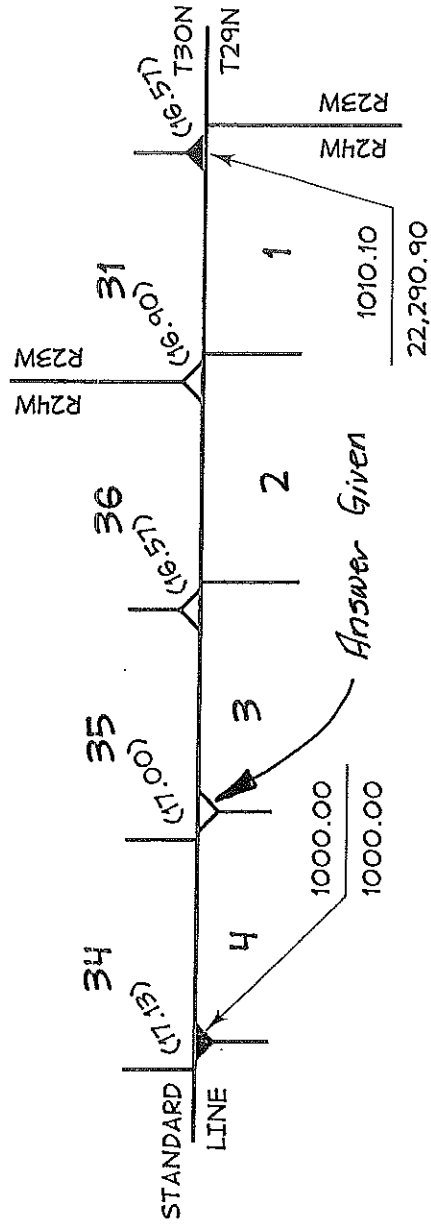




Lost Corner on Standard Line  
Closing Corners Accepted

7/13

9.) Dimensions:

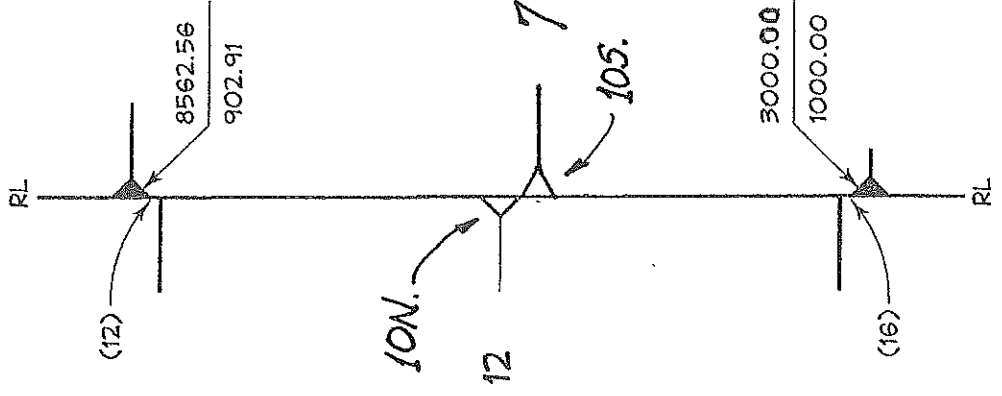


Lost Corner on Township Exterior  
Closing Corners Accepted

8/13

10.)

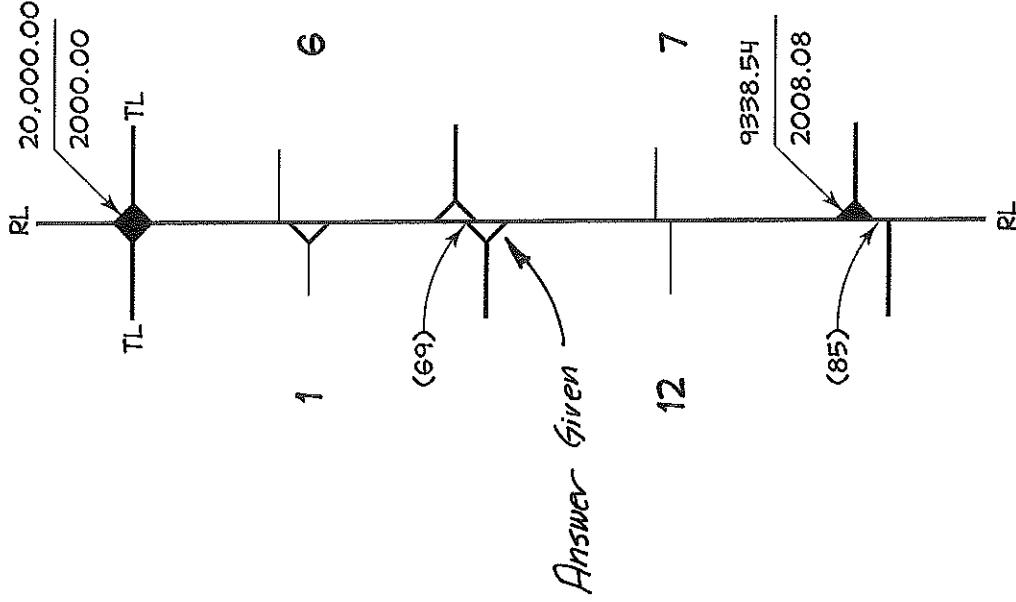
Dimensions:



Lost Corner on Township Exterior  
Closing Corners Accepted

9/13

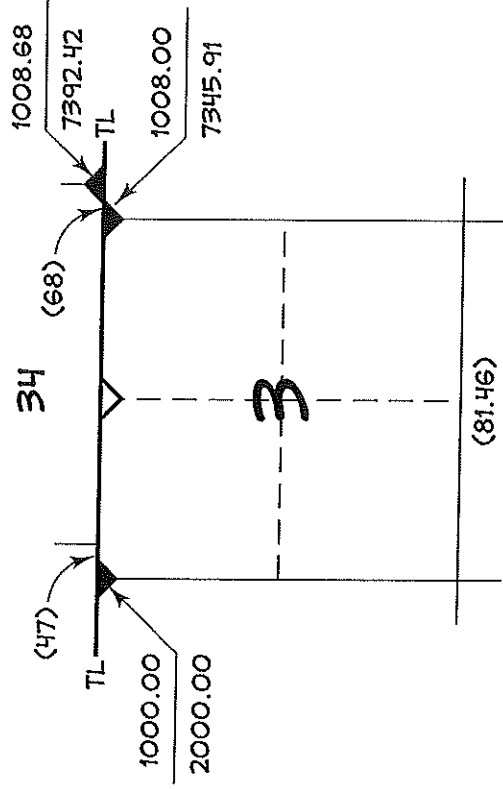
11.) Dimensions:



The Blank Quarter Corner

10/13

12.) Dimensions:



Dr. Richard L. Elgin, PS, PE

Rolla, MO

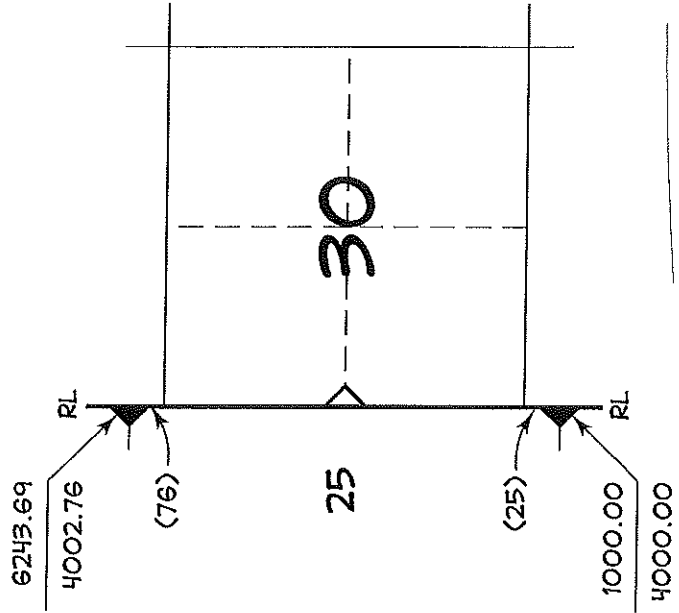
elgin@rollanet.org

©2021

The Blank Quarter Corner

11/13

13.) Dimensions:

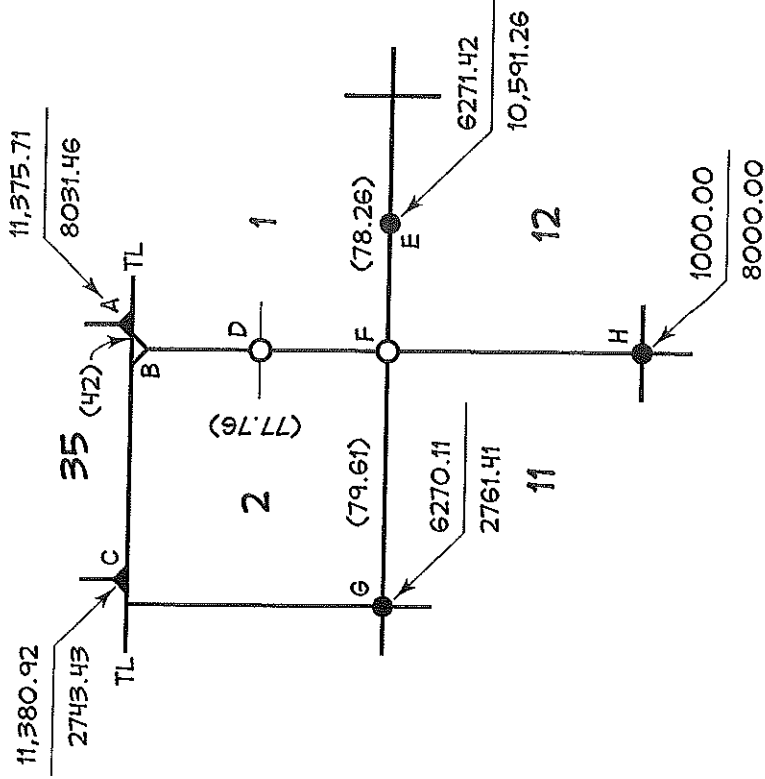


Note: Did not include an example "offset" problem in this set, but there are examples in both my AR and MO books.

Combination Problem:

12/13

*AN EXTRA*



CORNER	METHOD	NORTHING	EASTING
B	Single Proportion AC	11,375.74	8003.70
F	Double Proportion HB, GE	6261.53	8010.98
D	Single Proportion FB	8892.30	8007.23

Dr. Richard L. Elgin, PS, PE

Rolla, MO

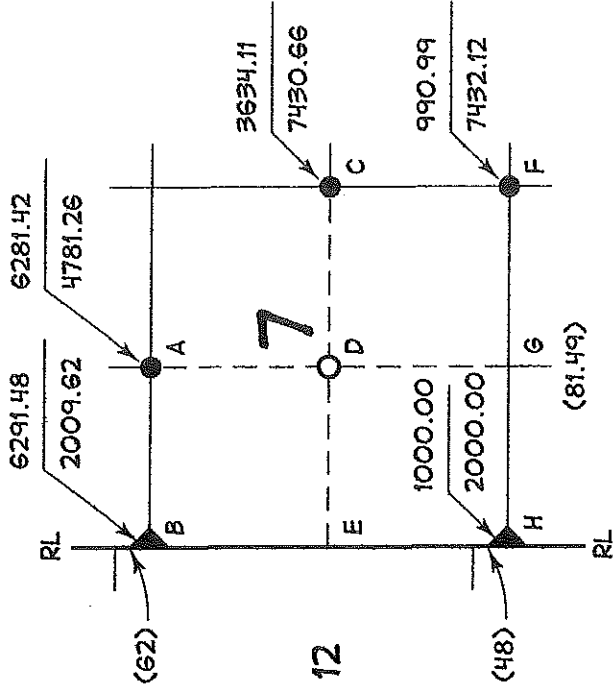
elgin@rollanet.org

©2021

12.1/13

The Center of Section

ANOTHER EXTRA



CORNER	METHOD	NORTHING	EASTING
E	Single Proportion BH	3650.38	2004.82
G	Single Proportion HF	995.41	4765.72
D	Intersect AG, EC	3642.08	4773.50

Answers to Previous Example Problems

13/13

Problem	North	East
1.	1003.63	4762.03
2.	4587.23	3995.95
3.	2005.97	6374.68
4.	4451.04	1996.31
5.	9047.51	6342.31
6W.	6996.73	2646.85
6E.	7015.00	7981.96
7.	1992.27	9332.80
8.	1000.17	4675.24
9.	1002.66	6614.63
10N.	5782.67	951.43
10S.	5771.58	951.62
11.	14,640.80	2004.06
12.	1003.92	4617.01
13.	3638.23	4001.39

Dr. Richard L. Elgin, PS, PE

Rolla, MO

elgin@rollanet.org

©2021