SUMMARY

The North Seeking Gyro is an excellent instrument for establishing a geodetic meridian in a tunnel. The gyro is faster and easier than dropping wires. When a gyro traverse is used to project a line in deep tunnel construction, it is believed the gyro line is more accurate than a line projected by dropping wires. One word of caution--those who operate a gyro should be well-trained in its operation and the recording and reduction of data gathered with the gyro.

REFERENCES

Rinner K., Prof. Dr. 1970, Test Measurements with Wild GAK 1 Gyro Attachment: Vermessungsteche Rundschau, Vol. 5, pp. 185-188

Schwendener, H.R., The Gyroscopic Attachment as a Convenient Instrument for Determining Azimuth, Wild Heerbrugg, Oct. 1967 reprint

FITTING TANGENT CIRCULAR CURVES THROUGH AS-BUILT SPIRAL RIGHTS-OF-WAY

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BIOGRAPHICAL SKETCH

Jack A. Savlan is a cadastral surveyor with the Bureau of Land Management. Having received his B.S. degree from Oregon Institute of Technology in 1982, he has since been working in Arizona and New Mexico. Some of his experiences include original cadastral surveys upon the Navajo lands, and resurveys of townships. Highway geometry remains an area of active interest.

ABSTRACT

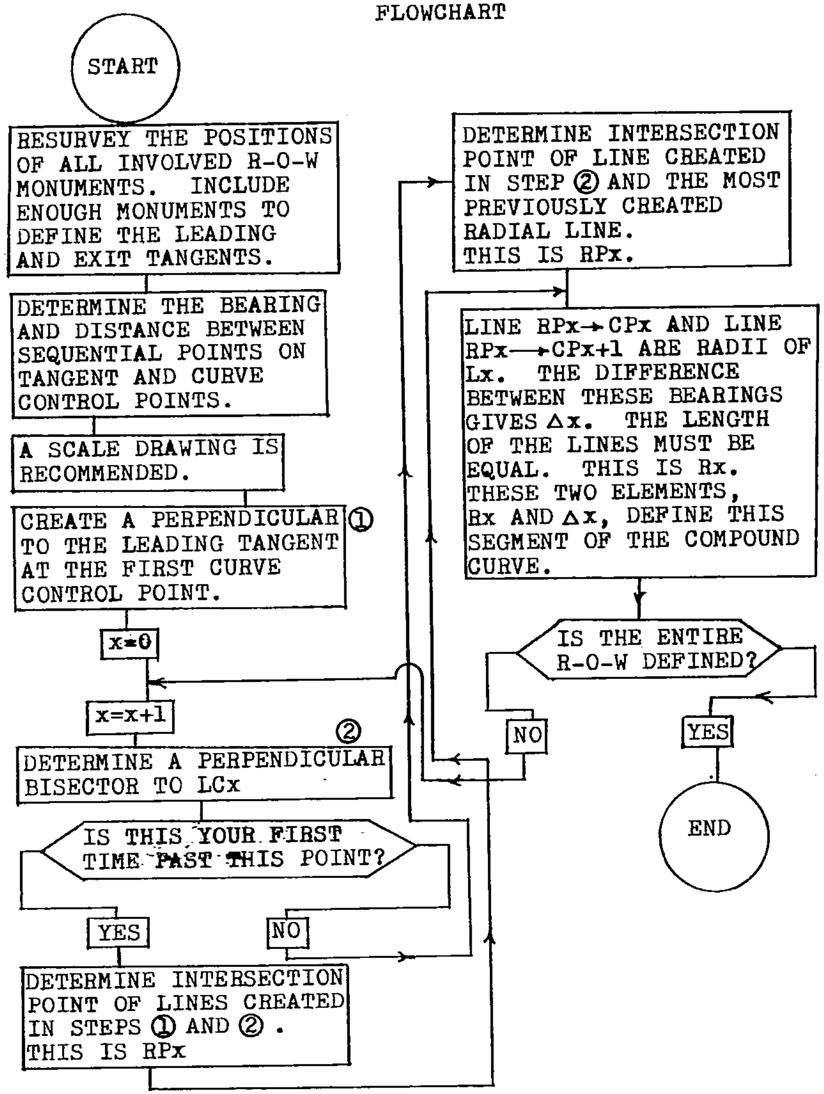
Several mathematicians have written high powered algorithums for determining area adjacent to spiral curves. Indeed these methods are effective when highway data and ground conditions closely match. Too frequently though, positions of spiral right-of-way monuments do not remotely resemble written record. Defining necessary curve data by creating a new centerline spiral from scattered right-of-way points is rigorous and sometimes impossible. How then can a boundary surveyor competently determine the area of an adjacent parcel? The following solution is an instructional guide for fitting a series of tangent circular curves through a series of scattered right-of-way monuments.

INTRODUCTION

For monuments to control, they must be called on the appropriate plat, field notes, or deed. Called monuments are controlling over record distance, bearing, and area. Uncalled monuments only control when harmonious with other elements. If highway monuments are not called, the asphalt may be considered intent, and centerline controls. Only where no on ground improvement exists may mathematical dimensions control. Monuments are subordinate to senior rights, clearly stated contrary intentions, and original rectangular surveyed lines.

How should a resurveyor handle conflict between highway centerline, right-of-way monuments, and plat? Every case is a new ball game. How was the land acquired? Was the plat created for acquistion, or as-built? Were right-of-way monuments set before acquisition, during construction, or as an afterthought?

FLOWCHART

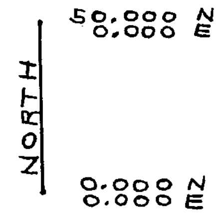


RP=Radius Point
CP=Curve Control Point
L=Curve
R=Radius
LC=Long Chord
Δ=Central Angle

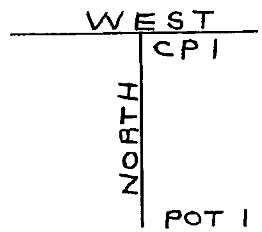
SAMPLE EXAMPLE

Resurveying a highway right-of-way, boundary monuments are found at the following relative positions. POT1=0.000N, 0.000E; CP1=50.000N, 0.000E; CP2=347.311N, 29.816E; CP3=676.866N, 359.371E; CP4=706.682N, 656.682E, POT2= 706.682N, 800.000E. Coordinates are in units of feet.

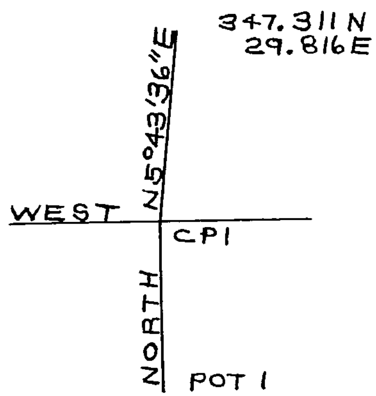
Step 1
Sketch POT1, CP1, and inverse for bearing



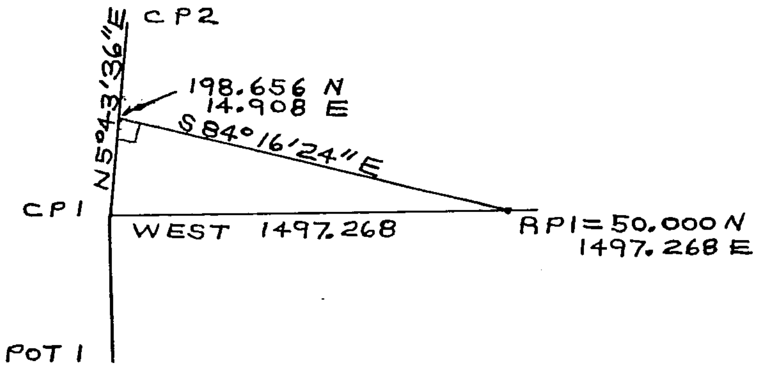
Step 2
Strike a perpendicular at CP1 and determine bearing. This is the first radial line.



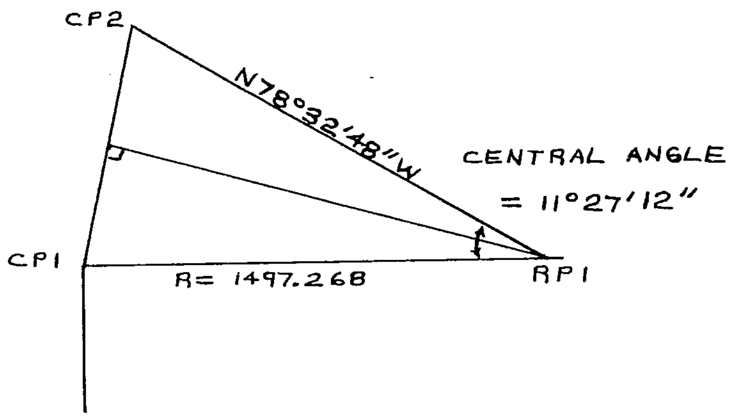
Step 3
Plot CP2. Inverse to CP1. This is the long chord of the first curve.



Step 4
From the long chord created in step 3, strike a perpendicular bisector to intersection with the line created in step 2. Determine the coordinates of intersection. This is the first radius point. Inverse between CP1 and RP1 for radial length of first curve.



Step 5
Inverse between CP2 and RP1. This determines the second radial line. Compute the angle between the first and second radial lines. This is the first central angle. The first curve is now defined. R=1497.268 ft. Central Angle=11°27'12"



Step 6
Basically repeating steps 3 through 5.

Step 6A
Plot next control point. Determine bearing to last control point.

Step 6B
Strike a perpendicular bisector from this long chord to intersection with the most previous radial line.

Step 6C
Determine these coordinates for next radius point.

Step 6D
Inverse between this radius point and the control point of step 6A. This determines bearing and length of the next radial line.

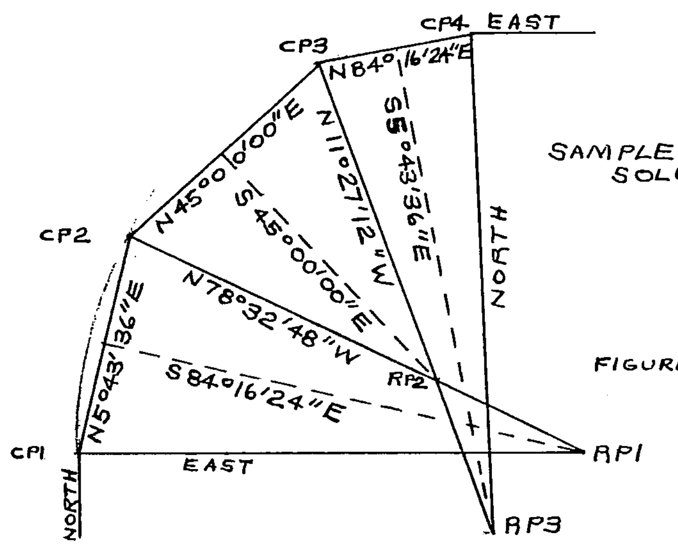
Step 6E
Determine central angle from difference between this and most previous radius bearing. This next curve segment is now defined.

Step 6F
Return to step 6A for each successive curve control point.

$R_1 = 1497.268$ $\quad$ $R_2 = 421.686$ $\quad$ $R_3 = 1497.268$

$\Delta_1 = 11°27'12"$ $\quad$ $\Delta_2 = 67°05'36"$ $\quad$ $\Delta_3 = 11°27'12"$

$RP_1 = 50.000$ N, 1497.268 E $\quad$ $RP_2 = 263.577$ N, 443.105 E $\quad$ $RP_3 = 790.576$ S, 656.681 E



SAMPLE EXAMPLE SOLUTION

FIGURE 1

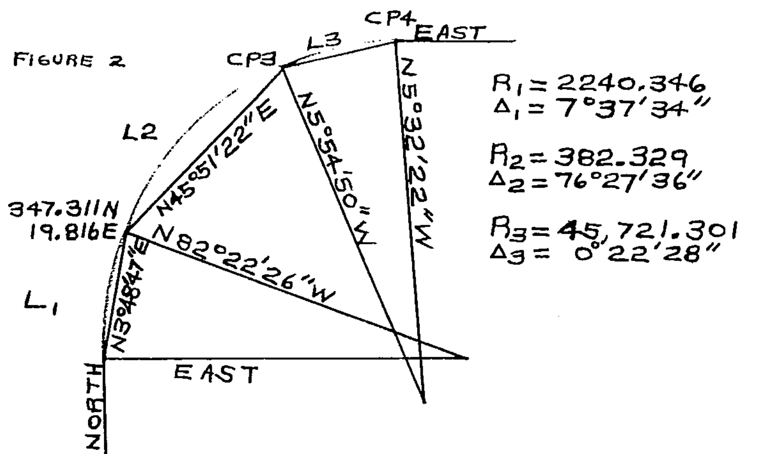
SPECIAL CONSIDERATIONS

The described method works well when all right-of-way monuments are near record position. But what happens when a monument is found well away from record? Imagine a motor vehicle with no shock absorbers traveling a dirt road. All is well until a sizable bump is incountered. The vehicle continues to bounce, and is unable to track properly.

In much the same way, the flowcharted method of R-O-W definition needs to be watched carefully after running through an oddly positioned monument.

Following is the same example as before, but with the effect of CP2 having been found 10 ft. west of its record position in figure 1.

FIGURE 2



Notice how after the "bump" the compound curve changes. In a more extreme case, an undesired point of reverse curvature could be created.

As the final leg of the example is a defined tangent, and not a curve, our R-O-W definition gives a very poor solution. Not only are the defined curves not very representative of the intent of the original survey, but the last radii is not perpendicular with the defined exit tangent, a necessary condition for credibility.

A simple solution is to utilize the described method from both the leading and exit tangents and approach the "bump" from both directions. This will form a cusp at the odd monument, but is certainly a more reasonable solution.

Following is the "simple solution" for dealing with the above example's odd positioning of CP2.

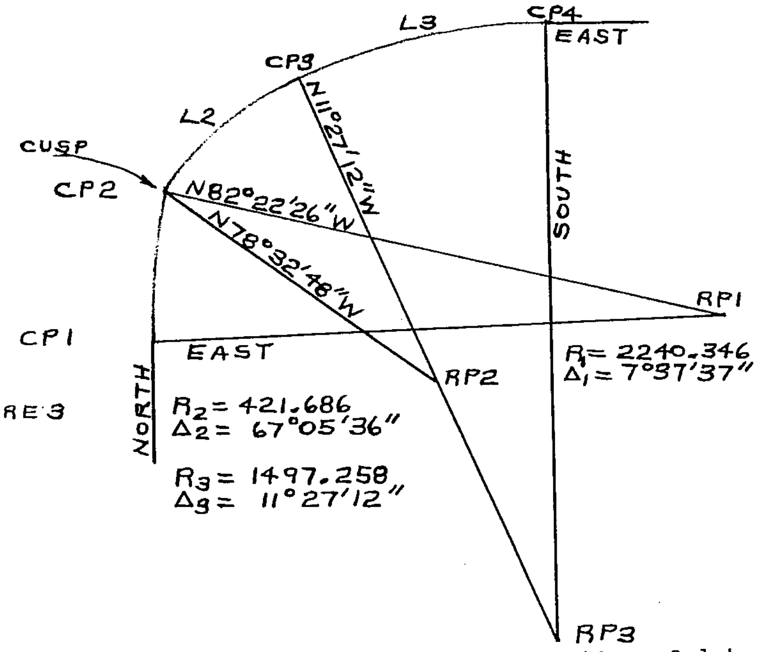


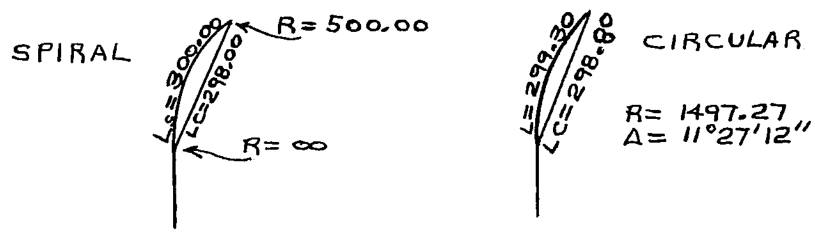
FIGURE 3

Notice that the above solution is a combination of data from figures 1 and 2.

How can the odd monument be determined? Most times this will not be immediately apparent. Visual extrinsic evidence such as a wild hook in a R-O-W fenceline may give a clue. Comparison with the highway plat is also a tool. When these methods fail, the resurveyor may experiment with each R-O-W monument as his cusp point. When the most reasonable solution is decided, the right-of-way is defined.

AREA COMPARISONS

Sometimes the intent of the highway surveyor was to create a spiral right-of-way. How does area adjacent to a spiral curve compare with area adjacent to the equivalent circular curve? Each case must be studied independently. But, in example, comparing L1 from figure 1 with the equivalent spiral curve



the spiral segment equals 2239 square feet while the circular segment equals 1489 square feet. This difference is 50%, but only 0.02 acres.

If the entire example of figure 1, CP1 to CP4, was replaced by leading and exit spirals with dimensions of that above, and a central circular curve R=500.00, $\Delta=55^{\circ}33'28''$, the spiral system would have a segment area of 154,506 $ft.^2$ The area of the compound curve in figure 1 is 157,100 $ft.^2$ This difference is only 2% or 0.06 acres.

CONCLUSION

Every solution method must be chosen by its application. The described method for right-of-way definition by circular curves is not different. In those situations where land value is extremely high, boundaries unusually critical, and plats call for spiral rights-of-way, use of this method could be found inappropriate. For many situations though, this method is adequate. Only the land surveyor himself can make the decision.

THE PROFESSIONAL MINE SURVEYOR

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ABSTRACT

Few states have a registration process for a Professional Mine Surveyor, yet a mine surveyor holds a very important position. In many states, a Mine Surveyor must hold registration as both a Surveyor and Engineer to legally certify all documents required in his work.

The mine surveyor of today has assumed the role of yesterday's mine engineer who, in many instances, has become a production analyst. The work of the mine surveyor can have a direct impact on the health, safety, and welfare of the corporation and employees. He can be responsible for the quantative measurements, reserve calculations, and equipment recommendations.

This paper will describe and analyze the broad role of the Professional Mine Surveyor.

INTRODUCTION

The International Society for Mine Surveying defines "Mine Surveying" as a branch of mining science and technology. It includes all measurements, calculations, and mapping which serve the purpose of ascertaining and documenting information at all stages from prospecting to exploitation and utilization of mineral deposits by surface and underground methods.