

Survey Work Flow

While each survey project is unique and may pose its own particular adjustments to procedures, the following is provided as a general guideline for orderly project conduct and execution.

1. Evidence Gathering

Collecting and compiling available records containing pertinent information associated to the lands of the survey project area.

- Compile copies of assessor's maps and aerial photomaps.
- Acquire names and addresses of possible affected parties.
- Acquire deeds and plats for affected properties.
- Acquire title records and abstracts (may include deeds of record, title certification, etc.).
- Compile evidence from recorded surveys.
- Gather highway plans in the affected area.
- Field books from previous surveys in the area.
- Gather right-of-way deeds.
- Search records for available survey control.
- Attain copies of USGS quad maps for the project area.
- Acquire copies of aerial photography for the area.
- Attain corner certification records.
- Acquire descriptions, plats and notes from original government surveys.
- Attain copies of survey plats and notes that have been made by county surveyors and private surveyors over the time frame from the original surveys to current date.
- Acquire geodetic control data for the project area. Evidence may have to be expanded to include other resources and other data such as unrecorded devices that may be provided from affected parties, private surveys that have been performed in the area, title policies for affected lands, limits of incorporation, etc.

2. Preliminary Field Survey

The field survey work to inspect the project location and affected parcels. Physical evidence may be recovered as well as initial measurements made.

- During field reconnaissance and contacts with affected parties, witness evidence may be taken and locations of existing monuments and evidence of possession may be recovered.
- Search and recover monuments called for in written conveyances acquired from title research. Locate accessories where monument evidence may not be found.

EPG 238.3.1.31 Land survey ties

The Location Survey includes ties between the highway survey alignment and corners of the U.S. Public Land Survey System. A legal land survey corner is defined as one that is witnessed or monumented by a professional land surveyor. Location survey plans, with certification and seal, of these witnessed or monumented corners and reference ties, are filed with the county recorder of deeds. All existing corners within the right-of-way corridor must be referenced. The appropriate state land surveyor form is also completed by the surveyor for submitting to the State Land Surveyor. The survey must be tied to all existing corners of each ¼ section through which the survey passes. Ties must be sufficient to ensure that at least one public corner per section, and all other pertinent public corners are referenced to the highway survey alignment. The ties between the highway survey alignment and the land survey corner monument include the station and angle at the highway survey alignment, and the distance to the monument. Bound notebooks or data collectors are used for recording the field notes and observations. The description of the land survey corner monuments must be complete and definite; e.g., 4" x4" (100 mm x 100 mm) Limestone, 1/2" (12 mm) Steel Pin, or 1" (25 mm) Axle, S 1/4 cor. of Sec. 6, T56N, R14W. The project development engineer is advised early in the survey concerning the location and number of corner monuments that need to be re-established or witnessed so this work can be completed prior to submittal of plans to the Right of Way Division.

EPG 238.2.1.12 Subdivision or lot ties

The survey includes ties between the survey tangent line, and the legal land survey corner monuments that may be recorded subdivision or lot corner monuments. At least two ties are required in each subdivision or lot. The best ties are to the subdivision corner monuments nearest the highway survey line. The ties are measured and recorded in bound notebooks, similar to the requirements for land survey corner monuments. The ties include a complete and definite description of the monument being tied. The project development engineer is advised early in the survey concerning the corner monuments that need to be re-established or witnessed, so that this work can be completed and the information added to the plans prior to submittal of the plans to Right of Way.

EPG 238.2.1.13 Reestablishing corner monuments

The county surveyor or a registered land surveyor may witness or reestablish survey corner monuments. Establishment of reference monuments for corners that MoDOT might destroy will require the submittal of “temporary” corner forms to the Department of Natural Resources. These monuments are considered a reference monument set for the purpose of reestablishment of a permanent monument in the previous corner position when the project is complete. Corners that are in or near roadways or in other unsafe areas like medians will require establishment of permanent reference monuments in a suitable area on the right-of-way between the ditch slope and the utility easement. Standard monuments for replacing corners are to be used.

3. Evidence and Survey Analysis

The compilation and analysis of gathered evidence and results of field measurements includes the following:

- Perform mathematical checks of control survey traverses. Check all measurement and observation data.
- Execute appropriate data adjustments. Perform additional measurements if necessary.
- Confirm compliance with the survey tolerances found in minimum standards.
- Perform computations for any necessary public land corner reestablishment.
- Prepare public corner certification documents.
- Execute field survey needed for any public corner reestablishment.
- File the certification documents with the State Land Surveyor.

4. Final Field Survey

The measuring and placing of the right-of-way monuments and the development of the location survey plan includes the following.

- Check layout computations for point locations of right-of-way corridor breaks.
- Review prior documents, measurements and check computations. Prepare the location survey plan and record.
- Perform a staking survey prior to acquisition in the area of each parcel. Staking survey should include placing permanent monuments at locations of right-of-way breaks and permanent easements as well as temporary monuments at the corners of temporary easements.
- Place a [witness post](#) at Location Survey monument locations on right-of-way. It is not necessary to place witness posts on any easement point unless it is at a Location Survey monument.

- Confirm land descriptions are written by referral, with calls to the right-of-way survey plan, the monuments and the survey.

GEOPAK TOOLS TO AID IN THE ANALYSIS OF SURVEY DATA

COGO KEY-IN COMMANDS AND INVERSE DIALOG BOX

Mathematical Functions

2.1 Evaluate

The **EVALUATE** command computes the result of a mathematical expression. Command syntax for the **EVALUATE** command is:

EVALUATE <expression>

ARITHMETIC OPERATORS		
OPERATOR	ACTION	EXAMPLE
-	Subtraction, minus	EV -3 -3
+	Addition	EV 4 + 7
*	Multiplication	EV 2 * 3
/	Division	EV 1 / 2
^	Power	EV 2 ^ 4
!	Factorial	EV 3!
()	Parenthetical Grouping	EV (2 + 3)!

The use of trigonometric and logarithmic mathematical functions are supported by the **EVALUATE** command. All trigonometric functions are expressed in degrees. The following comprises a list of supported mathematical functions:

ABS (x)	Absolute value: x
COS (x)	Cosine of x
ACOS (x)	Arc cosine of x
COSH (x)	Hyperbolic cosine of x
SIN (x)	Sine of x
ASIN (x)	Arc sine of x
SINH (x)	Hyperbolic sine of x
TAN (x)	Tangent of x
ATAN (x)	Arc tangent of x
ATAN2 (x,y)	Arc tangent (x,y) quadrant considered
TANH (x)	Hyperbolic tangent of x
INT (x)	Integer value of x truncated
EXP (x)	Natural antilogarithm of x: e^x
LOG (x)	Natural logarithm of x: $\log x$
LOG10 (x)	Common logarithm of x: $\log_{10}x$
SQRT (x)	Square root of x

Examples:

EV SIN(45) returns 0.7071

EV LOG10(34.5678) returns 1.5387

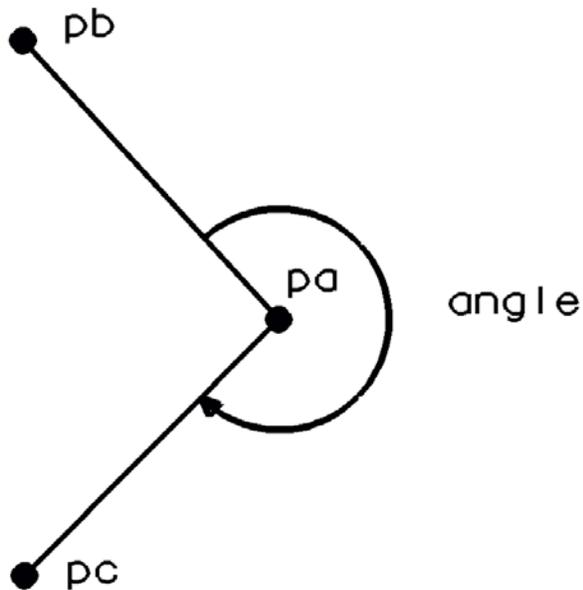
EV EXP(4) returns 54.5982

EV 5*SIN(34.56) returns 2.8363

EV 678.90 - 230.56 returns 448.3400

2.2 Angle At

The **Angle At** command will measure an angle in a clockwise direction between lines formed by points **pa** (occupied point) to **pb** (backsight) and **pa** to **pc** (foresight).



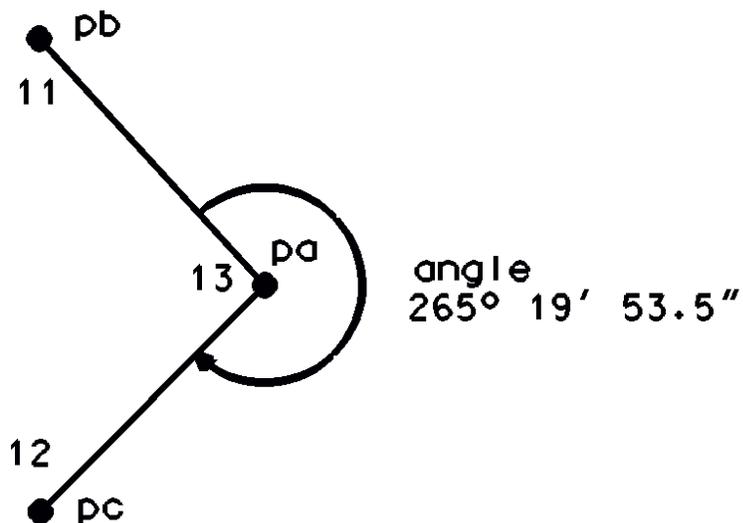
Command Line Syntax

ANGLE AT pa pb TO pc

Example:

ANG AT 13 11 TO 12

Angle at 13 from 11 to 12 (clockwise) = 265° 19' 53.50"



2.3 Sectionalized Lands

GEOPAK is capable of storing standard sectional land sections with two methods.

The first one is to store the section defined by **4** outside corner of the section: **SW corner, NW corner, NE corner** and **SE corner** in any order of travel around (clockwise) the section.

The second is if the section includes the quarter corners then **8** points will be stored: the **SW corner, WEST 1/4, NW corner, NORTH 1/4, NE corner, EAST 1/4, SE corner** and **SOUTH 1/4**. The starting point may be any corner or quarter corner, keeping the above sequence.

Duplication of the first point to close the parcel is permitted. The section is stored using a name with a maximum of 9 alphanumeric characters.

Command Line Syntax

Store **SECT**ion **name** **list**

Examples:

S SEC 10-52-42 31 32 33 34

S SEC 10T10R5 40 37 81 20 33 56 134 76 40

Once you have stored your parcel you can store parcels by aliquot parts as per property description using the key in store parcel.

Store Parcel Name Legal. . .

STORE PARCEL name legal (LESS list) (EAS list) (AND legal..) (AND ..)

Where: legal is any combination of **1/4, 1/2, LESS** and **EAS** required to describe the parcel. The optional **AND** allows two or more legals under the same parcel and owner.

Examples:

1. **NW 1/4 OF NE 1/4 OF SEC 10-52-42**

2. **S 1/2 OF NE 1/4 LESS E 20 OF SEC 10-52-42**

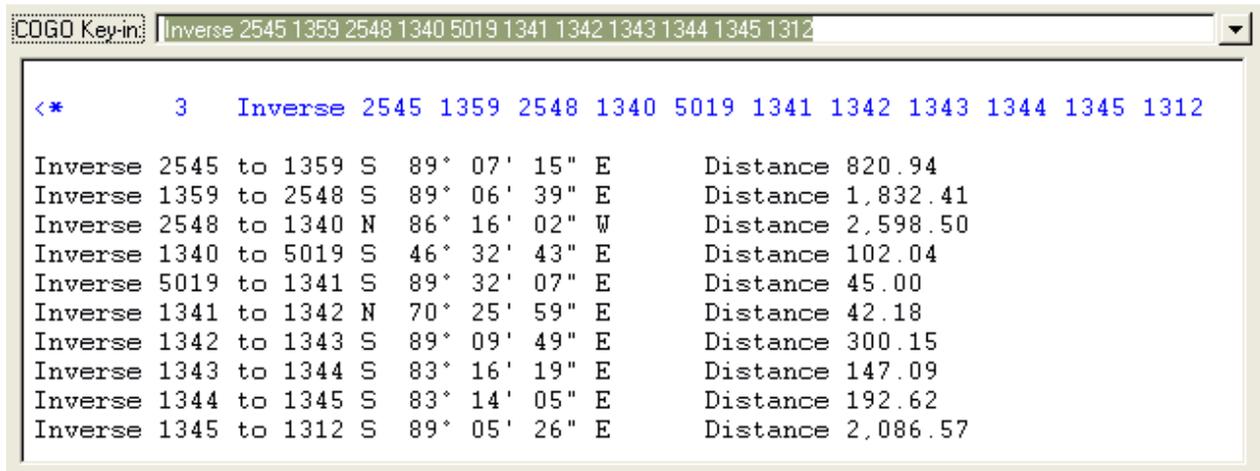
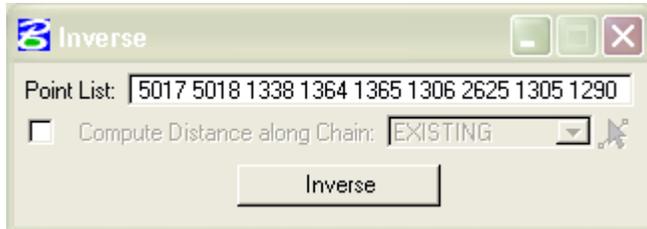
3. **E 200 OF SE 1/4 EAS S 30 OF SEC 10-52-42**

4. **W 100 OF NW 1/4 AND W 100 OF NW 1/4 OF SW 1/4 AND SW 1/4 OF SW 1/4 LESS S 20 OF SEC 10-52-42**

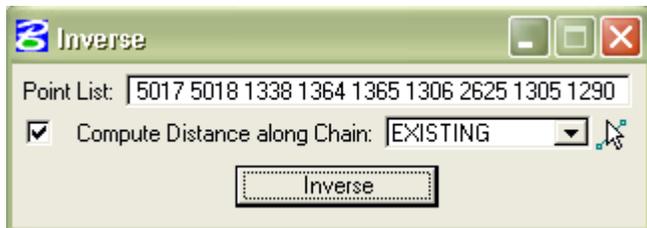
5. **NE 1/4 OF NE 1/4 OF SEC 10-52-42 AND SE 1/4 OF SE 1/4 OF SEC 3-52-42**

2.4 Inverse

The **Inverse** command computes and displays the distance and direction between each pair of specified points. The Point list can consist of a minimum of two points, but can also contain more. GEOPAK generates the distance and direction between each two points. Order is important and the direction is computed from the first point to the second point. If the points are separated by a space, i.e., 101 105, only the distance and direction between 101 and 105 is computed. However, if a hyphen is utilized, i.e., 101-105, then the distance and direction between each consecutive pair of points is computed, i.e., 101 to 102, 102 to 103, 103 to 104, and 104 to 105.



If the **Compute Distance Along Chain** toggle is active, the point is projected onto the specified chain and the distance is computed along the chain, rather than linearly from point to point. This is a great way to check the alignment against the found right-of-way points.



COGO Key-in: Inverse Along EXISTING 2545 1359 2548 1340 5019 1341 1342 1343 1344 1345 1312 1291 1347 1339

<* 5 Inverse Along EXISTING 2545 1359 2548 1340 5019 1341 1342 1343 1344 1345 1312 1291

Point	X	Y	Station/Region	Offset	Distance
2545	2,800,935.45	333,932.64	78+79.70 1	0.00	820.94
1359	2,801,756.29	333,920.05	87+00.64 1	-0.00	820.94
2548	2,803,588.48	333,891.61	105+33.04 1	0.00	1,832.41
1340	2,800,995.49	334,060.78	79+37.76 1	-129.05	2,595.28
5019	2,801,069.56	333,990.60	80+12.91 1	-60.01	75.14
1341	2,801,114.56	333,990.24	80+57.90 1	-60.33	44.99
1342	2,801,154.30	334,004.36	80+97.42 1	-75.07	39.52
1343	2,801,454.42	333,999.98	83+97.57 1	-75.30	300.15
1344	2,801,600.49	333,982.75	85+43.89 1	-60.31	146.32
1345	2,801,791.77	333,960.06	87+35.50 1	-40.55	191.61
1312	2,803,878.08	333,926.94	***	Undefined	Undefined
1291	2,803,910.37	333,927.07	***	Undefined	Undefined
1347	2,800,972.96	333,801.82	79+19.21 1	130.24	Undefined
1339	2,801,067.24	333,870.63	80+12.42 1	59.98	93.21

ERROR: *** No projection found for point(s).

You can copy the information within the command output window and save it to a word document to store with your text files.

