



Title: Coordinate Geometry (COGO) Usage for DelDOT Projects

2/10/2016

This Engineering Instruction was developed to describe how the Delaware Department of Transportation (DelDOT) utilizes Coordinate Geometry (COGO) within the design workflow for establishing horizontal alignments, right-of-way limits, property boundaries, permanent and temporary easements.

In general, the phrase “*coordinate geometry*”, often abbreviated “*COGO*”, refers to a system of geometry where the position of points on a plane are described using the ordered pair of numbers (x,y). In the Civil Engineering and Surveying professions, the plane is the State Plane Coordinate System and the ordered pair of numbers is the Easting (x) and Northing(y) for the points. DelDOT requires the use of the NAD83 State Plane Coordinate System for **ALL** projects.

At DelDOT, the phrase “coordinate geometry”, often abbreviated “COGO”, includes not only the system of geometry as mentioned above, but the design tools and processes utilized to locate points via coordinate geometry on DelDOT projects.

DelDOT utilizes the COGO Classic command structure within the InRoads design software for locating the features mentioned above such as horizontal alignments, right-of-way line work, property boundaries, etc. The **COGO Classic Commands** can be found inside of the InRoads Help section or in the “*ICS/COGO Manual*” located on the DelDOT Design Resource Center under the **CADD > Manuals** section.

A general workflow for performing this work is included below:

- Open the InRoads Survey data File containing point data (.ALG)
- Create input file using COGO Classic Commands for horizontal alignments (.ICS)
- Import input files and verify location and accuracy of horizontal alignment data
- Generate alignment report verifying integrity of horizontal alignments (.RPT)
- Create input file using COGO Classic Commands for existing ROW and easements (.ICS)
- Import input files and verify location and accuracy of existing ROW and easement data
- Generate ROW report verifying integrity of existing ROW and easements (.RPT)
- Create input file using COGO Classic Commands for proposed ROW and easements (.ICS)
- Import input files and verify location and accuracy of proposed ROW and easement data
- Generate ROW report verifying integrity of proposed ROW and easements (.RPT)

It is important to note that although it is entirely possible to use graphical methods to locate the line work for the horizontal alignments, right-of-way limits, property boundaries and easements, **DelDOT requires that all of the above features be located via the InRoads COGO Classic command structure as described in the workflow above.** DelDOT will consider the use of similar methods in the event that design software products other than InRoads are being utilized.



To easily distinguish the difference between COGO point numbers, it is recommended that you use the following guidelines when creating COGO points of various types:

- 30000 – 39999 = Alignment points\*
- 40000 – 59999 = Existing Right-of-Way and property line points\*\*
- 60000 – 79999 = Proposed Right-of-Way and property line points
- 80000 – 89999 = Grades and Geometric points

\*Note: Prior to assigning numbers to COGO points, review the field survey geometry file (FS.alg) that has been provided by the Survey Section to insure that you are not creating duplicate point numbers. This can be done by checking the COGO Buffer in InRoads once the fs.alg file has been opened.

\*\*Note: If a project contains numerous parcels, it is recommended that the points be broken out by either a north/south or east/west system. An example would be all existing right-of-way or property line points west of your alignment be grouped in the 40000-49999 range and all existing right-of-way and property line points east of your alignment be grouped in the 50000-59999 range. This helps the Real Estate Section when reviewing plans as well as when preparing as acquired deeds.

When storing figures for right-of-way acquisition purposes (PE, TCE or FEE), make sure they are stored in a clockwise direction. This is stated on page 4 of the “Right-of-Way Plan/Design Checklist for R/W Verification” and again helps the Real Estate Section when reviewing plans and preparing as acquired deeds.

### **Items to Be Aware of When Creating COGO Input Files**

- 1) The use of the “STORE” command for individual points should be avoided when preparing the COGO input files. All points to be utilized in the establishment of the horizontal alignments, right-of-way limits, property boundaries and easements shall be derived from the points that exist in the survey data file, without exception. It may be necessary to redefine the elevations of the points collected in the survey phase to zero, for planar purposes, but this should be performed through the use of the “*define z*” command.
- 2) Due to the variations that may occur in the establishment of “true north” between the various sources of data (deeds, plats, plans, etc.) that is used to establish the horizontal alignments, right-of-way limits, property boundaries and easements, all property boundaries shall be established using the interior angle method as opposed to a transformed bearing method, without exception.
- 3) All input files should be “well-commented” to insure that the various Sections within DelDOT that will either be utilizing or reviewing the files have a clear understanding of what each section of the input file is intended to establish or create during the input process.



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Samples of input files and structure layout are provided below:

**Horizontal Alignment Input File Sample**

\* Filename: al.ics

\* Date Last Modified: 12-14-99

\* This file will create the Mainline Alignment for SR1 (Figure #10000).

output file 0 y:\sussex\014\road\2001303\cogo\al.rpt

\* Delete figures and coordinates from .alg file from previous imports.

delete figure [10000]

delete coordinates (10000-10050)

\* Set line style plotting to proposed Construction Baseline.

auto plot 0 0 !P\_Baseline - Construction

\* Set vertical elevations of existing monuments to zero for planar locating.

define z (8702) 0.0000

define z (8698) 0.0000

define z (5086) 0.0000

define z (2876) 0.0000

\* Establish alignment points for SR1.

locate angle 8702 8698 10000 90-00-00 16.1544

locate angle 8698 8702 10001 -90-00-00 16.1544

locate angle 5086 2876 10002 90-00-00 16.7640

locate angle 2876 5086 10003 -90-00-00 16.7640

tangent offset 10004 (4657) 10002 10003

locate angle 10002 10004 10005 180-00-00 808.047088774

locate angle 10003 10005 10006 -12-26-24.2 100.0000

locate angle 10006 10005 10007 180-00-00 400.0000

locate angle 10001 10000 10008 180-00-00 100.0000

points intersect 10009 10000 10001 10002 10003

fit curve 10000 10009 10004 10010 10011 10012 218.2969218

fit curve 10003 10005 10007 10013 10014 10015 867.134664

fit curve 10000 10009 10004 10016 10017 10018 218.2969218

fit curve 10003 10005 10007 10019 10020 10021 867.134664

\* Create figure #10000 for SR1 centerline alignment.

store figure 10000 (10008 10016 C10017L 10018 10019 C10020L 10021 10007)

\* Establish stationing values for SR1 alignment.

set alignment 10000 10008 1022.062

output file -1



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**Existing Right-of-Way Input File Sample**

\* Filename: eastrw.ics  
 \* Date Last Modified: 01-13-00  
 \* This file will create the Right-of-Way along the East Side of SR1.  
 output file 0 y:\sussex\014\road\2001303\cogo\al.rpt  
 delete figures [30000-39999]  
 delete coordinates (30000-39999)  
 set alignment 10000  
 \* Set line style plotting to existing Property Line.  
 auto plot 0 0 !Ex\_Property Line  
 \*  
 \* Establish Parcel No. 3-34-20.09-64.00 (Figure No. 30000)  
 locate from alignment 30000 2334.926 16.7640  
 locate from alignment 30001 2365.406 16.7640  
 locate angle 30001 30000 30002 90-25-00 45.7200  
 locate angle 30000 30001 30003 -89-35-00 45.7200  
 store figure 30000 (30000 30001 30003 30002 30000)  
 \*  
 \* Establish Parcel No. 3-34-20.09-63.00 (Figure No. 30001)  
 locate from alignment 30004 2395.886 16.7640  
 locate angle 30002 30003 30005 180-00-00 30.4800  
 store figure 30001 (30001 30003 30005 30004 30001)  
 \*  
 \* Establish Parcel No. 3-34-20.09-47.00 (Figure No. 30002)  
 locate from alignment 30006 2411.126 16.7640  
 locate from alignment 30007 2503.1756 16.7640  
 points intersect 30008 30006 30007 30005 30004 30.4800 15.2400  
 points intersect 30009 30006 30007 30008 30006 30.4800 86.65464  
 store figure 30002 (30006 30008 30009 30007 30006)  
 \*  
 \* Establish Parcel No. 3-34-20.09-97.00 (Figure No. 30003)  
 locate angle 30001 30000 30010 180-00-00 15.2400  
 locate angle 30000 30010 30011 180-00-00 30.4800  
 locate angle 30003 30002 30012 180-00-00 15.2400  
 locate angle 30002 30012 30013 180-00-00 30.4800  
 store figure 30003 (30010 30012 30013 30011 30010)  
 output file -1