Chapter 6 - Defining Horizontal Alignments

InRoads provides a number of options to create new alignments and modify existing ones. This chapter examines the most common methods for defining horizontal geometry.

Chapter Objectives:

- Outline the typical work flow for creating horizontal geometry.
- Explain how to create new geometry placeholders.
- Discuss the Horizontal Curve Set commands.
- Describe the Horizontal Element tools.
- Explain how to import an alignment from a graphic element.
- Give an overview of Cogo commands.
- Discuss some of the useful tools in the Geometry Utilities menu.

Creating Geometry

There are multiple methods for creating horizontal geometry in InRoads. These methods include: Horizontal Curve set commands, Horizontal Element commands, Importing various text files, Importing from graphics, various Cogo commands, and Creating parallel/offset alignments.

Section Objectives:

- Discuss InRoads Options that affect geometry.
- Describe how to add data to the Cogo Buffer.
- Describe the Horizontal Curve Set PI commands.
- Describe the Horizontal Curve Set Define Curve command.
- Describe the Horizontal Curve Set stationing commands.
- Give an overview of the Horizontal Element commands.
- Describe Importing an alignment from graphics.
- Give an overview of the Cogo commands.

Options

A review of the geometry options from *InRoads Options* relative to geometry are found from the menu bar under **Tools > Options** [Geometry] tab.

- options	
Tolerances Factors Abl	breviations Rail Sight Distance
Precision General	Units and Format Geometry
Plotting Height:	0.00 Help
Seed Alignment Name:	1
Seed Point Name:	1
Curve Definition	
	Always Confirm
Horizontal: Arc	-
Vertical: Parabolic	-
Measure: Along Arc	Along Chord
Degree of Curve Length:	100.00
Unit Station Length:	100.00
Define Transitions By:	Length
Spiral Definition:	Clothoid 👻
.ICS Coordinate Sequence:	Northing/Easting -
Vertical Angle Reference:	Zenith
Angular Mode:	Bearings 🔹
Point Names During Edits:	Do Not Assign 🔹
Default Access Modes	
R	ead-Only Read-Write
monzontal Alignments:	•
-	

Dialog Items

- *Plotting Height:* The elevation for drawing horizontal geometry
- *Seed Alignment Name:* Initial name assigned to newly created geometry unless specified otherwise.
- Seed Point Name: Initial name assigned to new cogo points.
- Curve Definition: -
 - *Horizontal:* Arc or Chord definitions
 - Vertical: Parabolic or Circular
 - *Measure:* -Along arc or along chord for curve definition
 - Degree of Curve Length: Specifies central angle that subtends this distance
 - Unit Station Length: Distance between major station intervals
- Define Transitions: Defines spiral transitions by Length or Spiral constant
- Spiral Definition: Defines default method for defining spiral transitions
- *ICS Coordinate Sequence:* Defines input order of Northing/Easting's for ICS batch input files.
- Vertical Angle Reference: Defines vertical angle measurement in ICS files.

- Angular Mode: Specifies orientation for angles
- *Point Name During Edits:* Defines whether names are assigned to geometry points during creation or editing.
- **Default Access Modes-** Specifies if the access to the geometry data is read only or read/ write.
 - *Horizontal Alignments* Used to specify if the horizontal alignments are read only or read/write.
 - Cogo Buffer Used to specify if the Cogo Buffer is read only or read/write.

About geometry point names

Alignment key-points (PC, PI, PT, CC, etc) exist in one of three states:

- Unnamed
- Named
- Cogo Points

Review Horizon	tal Alignment				
Geometry Project:	12345_Design 💌	Mode			Close
Horizontal Alignment	SH 86 🔹 🛉	C Lurve Sets (•	Alignment 1 Eleme	ent	Save As
	Project Name: 1234	5_Design 6 Design Alignmen	+o	^	Append
Horizontal Al	ignment Name: SH 8	6 6 ored SH 86			Display
	Style: ALG_ Input Factor: 1 00	PRO na	imed point		Print
	Input Factor. 1.00	STATION	NORTHING	EASTING	Help
Element: Line P Tang	ear OB (1000) PC () ent Direction:	100+00.00 111+08.62 N 88^19'40" E	1558417.74 1558450.09	3267409.40 3268517.55	Select
Т	angent Length:	1108.62	innamed po	oint	First
Element: Circ	ular PC () PI () CC () PT ()	111+08.62 113+47.31 115+85.98	1558450.09 1558457.06 1537339.09 1558458.63	3268517.55 3268756.14 3269133.91	< Previous Next >
<	III				Last

Reviewing an alignment displays the geometry point name. The above screenshot shows both named and unnamed points.

If *Point Name During Edits* is set to *Named* on the *Options > Geometry* menu; alignment keypoints are generated with a name based on the next available ID as specified in the Seed Point Name field. The specified seed point name can be alpha, numeric, or alphanumeric characters. The assigned name is also reserved in the Cogo buffer. However the point is not written to the Cogo Buffer automatically.

Writing the active alignment keypoints to the Cogo Buffer

Select Geometry > Horizontal Curve Set > Events

Horizontal Events				
Define By: Single Point	v.			Apply
Add As C. Station and Offset	Locate By	10		Close
 Northing and Easting 	Easting 0.0	0	-	Help
Cogo Point Alignment Point to Cogo				
Seed Name: 200 Description: Proposed align	- Station		Offsets First:	
Style: ALG_PRO	100+00.00 Stop	+	0.00 Second	+
Add Vertical Event Points	366+60.50	+	0.00	+
Events M., Station Offs	et Northing	Easting	Elevation	Style
1	E dit.) elete	Report
	- (set);-			

In the above example, all alignment key-points that were not previously assigned a name are written to the Cogo buffer beginning with the ID number of 200.

Results			_ 🗆 🔀
200 201 202 203 204 205 206 207 208 209 210 ◀ □□	$\begin{array}{c} 1558450.09\\ 1537339.09\\ 1558458.63\\ 1558457.58\\ 1558467.58\\ 1558402.30\\ 1558117.51\\ 1547356.90\\ 1557965.30\\ 1557965.30\\ 1557901.57\\ 1585933.56\end{array}$	3268517.55 3269133.91 3268994.82 3270345.09 3270364.85 3270987.32 3272329.96 3270047.57 3272956.51 3276471.06 3284404.53	Close Save As Append Display Print Help

Note:	The command Geometry > Utilities > Assign Names can be used to add, del	lete,
	or rename geometry points.	

Typical Workflow

A predefined workflow for creating geometry is not dictated by InRoads. However, a common workflow might be:

- 1. Create or open an existing geometry project
- 2. Create horizontal alignments (or Cogo points)
- 3. Assign stationing for alignments

- 4. Define alignment station equations, if any
- 5. Define alignment key-points (unique points of interest)
- 6. Review alignments
- 7. View created alignments
- 8. Display stationing for alignments
- 9. Annotate created alignments
- 10. Graphics clean-up

Creating New Geometry

In order to create a new alignment, you must first have a geometry project loaded. If you need to create a new one, choose File > New > Geometry set the *Type* to Geometry Project and enter a *Name* and *Description*.

Mew New		- • 💌
Surface Geometry	/	
Туре:	Geometry Project 🔹	Apply
Name:	DES12345	Help
Description:	SH 86 and SH 119 Project	
Style:		
Curve Definition:		
Name	Description	
Default		
	Close	

Once the geometry project is loaded (and active), you may create a new alignment name. Select File > New > Geometry (if you have closed the dialog) and set the *Type* to Horizontal Alignment. Enter the *Name*, *Description* and select a *Style*.

Apply after filling in the appropriate information, then you may proceed with either the *Horizontal Curve Set* or *Horizontal Element* tools to enter the alignment data.

Horizontal Curve Set commands

The Horizontal Curve Set commands make up an easy way to create alignments. They consist of five primary commands described below, and may be access from a toolbar (shown) or from the pulldown under Geometry > Horizontal Curve Set.



Add PI – Add PI is used to create a PI that begins a new alignment, or to add a PI onto either end of an existing alignment.

Insert PI – Insert PI is used to add a PI to an existing alignment between two existing PIs.

Move PI – Move PI is used to change the location of an existing PI.

Delete PI – **Delete PI** is used to remove a PI from an existing alignment. For removing more than one PI, you must choose and **Accept** each one individually. To remove all PIs associated with an alignment, but leave the alignment name, right-click on the alignment name in the Explorer menu and choose **Empty**.

Defining Horizontal Curves

Define Horizontal Curve Set – is used to create a curve between alignment tangents or to revise an existing curve definition. The Previous and Next buttons can used to step sequentially through the alignment. The Select button can be used to graphically identify an alignment location for editing. As alignment components are selected, they highlight in the MicroStation view.

Horizontal Pl			1.0	Apply
Define By: Known	PI Coordinat	tes		Class
Direction Back:	N 88	'19'40'' E	+	Close
Length Back:	1347.	31		Undo
Point Name:			- 1	Curve Calc
Northing:	15584	457.06	+	Design Calc.
Easting:	32687	756.14		Help
Direction Ahead:	N 891	37'22'' E		
_ength Ahead:	1913.	63	-ф-	
Horizontal Curve Curve Set Type: Define Transitions By: Leading Transition:	 SCS Length Clothoid 	⊂ SCSCS ⊂ Constan	0.00	+
Horizontal Curve Curve Set Type: Define Transitions By: Leading Transition: Radius 1:	 SCS Length Clothoid 	⊂ SCSCS ⊂ Constan	0.00	+
Horizontal Curve Curve Set Type: Define Transitions By: Leading Transition: Radius 1: Compound Transition:	SCS Length Clothoid	C SCSCS C Constan ▼	0.00	
Horizontal Curve Curve Set Type: Define Transitions By: Leading Transition: Radius 1: Compound Transition: Radius 2:	SCS Length Clothoid	C SCSCS C Constan	0.00	
Horizontal Curve Curve Set Type: Define Transitions By: Leading Transition: Radius 1: Compound Transition: Radius 2: Trailing Transition:	SCS Length Clothoid Clothoid Clothoid	C SCSCS C Constan	0.00 21120.00 0.00 0.00	
Horizontal Curve Curve Set Type: Define Transitions By: Leading Transition: Radius 1: Compound Transition: Radius 2: Trailing Transition: Define By: • Radius	SCS Length Clothoid Clothoid Clothoid	Constan	0.00 21120.00 0.00 0.00 0.00	
Horizontal Curve Curve Set Type: Define Transitions By: Leading Transition: Radius 1: Compound Transition: Badius 2: Trailing Transition: Define By: © Radius © Tanger	SCS Length Clothoid Clothoid Clothoid Clothoid Clothoid clothoid nt to Spiral	C SCSCS C Constan	0.00 21120.00 0.00 0.00 0.00	
Horizontal Curve Curve Set Type: Define Transitions By: Leading Transition: Radius 1: Compound Transition: Badius 2: Trailing Transition: Define By: Radius C Tanger C Spiral to	SCS Length Clothoid Clothoid Clothoid Clothoid clothoid clothoid ot angent	Constan	0.00 21120.00 0.00 0.00 0.00	
Horizontal Curve Curve Set Type: Define Transitions By: Leading Transition: Radius 1: Compound Transition: Radius 2: Trailing Transition: Define By: © Radius C Tanger C Spiral to C Point o	SCS Length Clothoid Clothoid Clothoid Clothoid Clothoid ot to Spiral o Tangent n Curve	C SCSCS C Constan	0.00 21120.00 0.00 0.00 0.00 1558450 3268517	

The *Radius 1:* field is for input of the radius of a single circular curve. Leading and Trailing Transition fields are for the input of spiral curve radii.

The *Curve Calculator* is used to compute curve data for circular or spiral curves. In addition to deflection angle, one other curve criteria must be defined and locked prior to selecting the Compute button. The curve solutions can be passed to the parent dialog by selecting OK.

Curve	
Radius: 21120.00	
DOC: 0º16'17''	
Length 477.35	
Angle: 1°17'42"	
Chord: 477.34	
Tangent: 238.69	
External: 1.35	
Ordinate: 1.35	
Compute: Simple Curve	
Active Curve Definition: Arc	
Compute	

The *Design Calculator* is used to compute or look up curve data to meet design criteria.

Design Calcul	ators			×
Table Lookups				
Method:	ookup Speed		• ОК	
Curve Design				
Speed:	ĺ	50	Help	
Maximum e:		4.00%		
Maximum f:		14.00%		
Radius:		930.00	ΞI	
Select Table B	Entry			
Speed	Maximun	n e Maximum f	Radius	
50	4.00	14.00	930.00	
50	6.00	14.00	835.00	
50	8.00	14.00	760.00	
50	10.00	14.00	695.00	
50	12.00	14.00	645.00	
Table Name: C:\Workspace	e\Workspace4	CDOT_XM\Standards-	Global\InRoads\Desig]
	Prefe	rences Cance	e	

Setting the Beginning Station

The default station at the beginning of a newly created alignment is 0+00. To change it, select **Geometry > Horizontal Curve Sets > Stationing**. Set the beginning station of the active alignment by keying in the desired new station and choosing **Apply**. The options for *Vertical Alignments* should be considered carefully. *Do Not Update* will leave there stationing as is, *Synchronize Starting Stations* will update their stationing to match that of the horizontal and *Maintain Station Difference* will keep any difference in the current starting stations, such as when the vertical alignment does not start at the beginning of the horizontal.

🐂 Stationing				- • 💌
Horizontal Alignment:	SH 86	•	+	Apply
Starting Station:	203+80.28			Import
Name:				Report
Northing:	1556706.0	7	÷	
Easting:	3277567.4	9		Close
Vertical and Superel	evation Alig	nments		Help
 Synchronize Start Maintain Station 	ting Stations Difference	i		
Station Equations				
Back Station		Ahead Static	n	
	New	Edit		Delete

Note: InRoads does not require you to key in the '+' when entering a station. It will add the plus sign for you based on your preferences.

Equations

If there are inequalities in your alignment, you may assign station equations. These equations can be either gap or overlap equations. To assign an equation, select **Geometry > Horizontal Curve Sets > Stationing**. At the bottom of the dialog, choose **New**. In the resulting box, enter the **Back Station** and the **Ahead Station**, with the ahead station prefixed with an equation name. When choosing a name for the equation, remember that from this point in the alignment forward, stationing will be referred to by this name preceding the station so the shorter the name, the easier it will be for key-ins, etc.

🕌 Stationing						
Horizontal Alignment:	SH 86	•	+	Apply		
Starting Station:	203+80.28			Import		
Name:				Report		
Northing:	1556706.0	7	ŧ	Close		
Easting:	3277567.4	9		Close		
 Vertical and Superel Do Not Update 	evation Alig	nments		Help		
Synchronize Start	ting Stations	🔚 Add Sta	tion	Equations		×
Maintain Station I	Difference	Mode:	(By Station		Apply
Station Equations			(By Northing/Easting		Close
Back Station		Back Statio	n:	220+85.39	+	Help
		Northing:	[1556257.72		nop
		Easting:	[3279212.60]	
		Ahead Stati	on: [a221+00.00]	
	New	Add Hor	izont	al Event Point		
		Add Vert	tical	Event Point		

You can have multiple equations in one alignment if necessary.

Horizontal Event Points

Horizontal Event points are points associated with an alignment that are not actually a part of the geometry of the alignment the way a PC, PT, or PI are. They are used for points that need to be annotated with stations and offsets, for points where you need special sections cut or for points where you want to be certain Roadway Designer drops a template.

Define B	Vi Cinala Da	int			Г	Applu	
	, joingle Fu	ri,	Lanata Du		_	Арру	
C Sta	tion and Offset		Northing: F	557461 16		Close	
Marthing and Easting			++++++++++++++++++++++++++++++++++++++		+	Help	
I. NO	thing and Easting		Easting:	3274998.84			
C Cog	jo Point						
C Alig	nment Point to Cog	0					
See	d Name:		Station		- Offsets		
Dec			Start.		First:		
Des			100+00.00		0.00		
Style	ALG_EXIST	7	Stop		Second:		
	Vertical Event Poi	nts	366+77.96		0.00	+	
-							
Events							
Met	Station	Offset	Northin	e Easting	Elevation	Style	
S+O	177+03.38	-53.90	1557461.16	3274998.84	-0.00	ALG_EXIST	
INTE.	177703.30	-00.00	100/401.10	3214330.04	-0.00	ALU_EAIST	
						>	
<						1 (130)	

Select Geometry > Horizontal Curve Sets > Events.

Horizontal Event Points may be added as either *Station and Offset* (they move with the alignment if it is relocated or re-stationed) or as *Northing and Easting* (they remain fixed by coordinate values. The station and offset values relate back to the alignment and update as the alignment shifts). This dialog can also be used to create Cogo points or to assign Cogo points at alignment vertices.

Horizontal Elements



The *Horizontal Element* tools allow you to create alignments without knowing the PI information. They may be accessed from the toolbar shown above, or from the pulldown under **Geometry > Horizontal Elements**.

There are several advantages to this method. One of the greatest advantages of the horizontal element alignments is that they do not have to be continuous. For example, you can create elements that have the most constraints, leaving gaps between them, and then join them together with unconstrained tangents and curves.

Another advantage is the ease with which reverse and compound curves can be created, as well as curves greater than 180 degrees.

When creating elements, you have three basic placement options for linear elements and the same three options for circular elements. These options are just for placement; once an element is placed and accepted, it is treated the same as any other element no matter the placement method.

- **Fixed** placement is used when you know exactly where the element is going to be located and you, in effect, lock it in place using a combination of coordinates, pass-through points, bearings or radii. When using the fixed placement options, the resulting elements are not tangent or coincident with any existing elements. This placement option is used to place standalone elements.
- Floating placement is used to establish elements coincident and tangent to an existing element with a pass-through point and a radius (for curves) and with a pass-through point or a bearing for lines. They force the alignment to be coincident and tangent at the end where they join and will lengthen or shorten the element they are being attached to as necessary to meet the criteria specified. They will only ensure tangency and coincidence at the end where they are attached to an existing element. The floating placement options will not connect two existing elements.
- Free placement is used to connect two existing elements. It ensures coincidence and tangency at both ends where it connects to the existing elements. The existing elements may lengthen or shorten as necessary, but will not change locations.

To create a horizontal element alignment, first give the alignment a name description and style, then use a combination of the fourteen commands to define the alignment. (The fifteenth command is for checking and correcting problems with the integrity of the alignment, described below.)

Check Integrity

The **Check Integrity** command on the **Horizontal Element** toolbar allows you to check the coincidence and tangency of horizontal alignments. The **Element** tools allow you to place the different components of the alignment in whatever order you wish, therefore it is not uncommon for the elements to be "out of order". This is one of the situations where **Check Integrity** can help, since you cannot only check the integrity, but make changes to the elements to correct integrity problems.



Туре	Northing	Easting @	Direction @ S	Northing	Easting @	Direction @ E	Length	Radius	Inte	Inte	Ele	~	Apply
Linear	1558417.74	3267409.40	N 88^19'40" E	1558450.09	3268517.55	N 88^19'40" E	1108.62			OK	OK		
Circular	1558450.09	3268517.55	N 88^19'40" E	1558458.63	3268994.82	N 89^37'22" E	477.35	21120.00	0K.	OK	OK		Close
Linear	1558458.63	3268994.82	N 89^37'22" E	1558467.52	3270345.09	N 89^37'22" E	1350.30		OK	OK	OK		
Circular	1558467.52	3270345.09	N 89^37'22" E	1558402.30	3270987.32	S 78^01'29" E	646.78	3000.00	OK	OK	OK		Make Firs
Linear	1558402.30	3270987.32	S 78^01'29" E	1558117.51	3272329.96	S 78^01'29" E	1372.51		OK	OK	OK		The second second
Circular	1558117.51	3272329.96	S 78^01'29" E	1557965.30	3272956.51	S 74^39'57" E	644.86	11000.00	OK	OK	OK		Move Bac
Linear	1557965.30	3272956.51	S 74^39'57" E	1557001.57	3276471.06	S 74^39'57" E	3644.29		OK	OK	OK		
Circular	1557001.57	3276471.06	S 74^39'57" E	1556963.86	3276609.90	S 74^56'26" E	143.87	-30000.00	OK	OK	OK		Move Forw
Linear	1556963.86	3276609.90	S 74^56'26" E	1556729.58	3277480.62	S 74^56'26" E	901.69		OK	OK	OK		-
Circular	1556729.58	3277480.62	S 74^56'26" E	1556704.22	3277574.27	S 74^45'19" E	97.01	30000.00	OK	OK	OK		Transpose
Linear	1556704.22	3277574.27	S 74^45'19" E	1555971.14	3280264.16	S 74^45'19" E	2788.00		OK	OK	OK		1
Circular	1555971.14	3280264.16	S 74^4519"E	1555932.44	3280558.39	N 89^44'24" E	297.67	-1100.00	OK	OK	OK		Join
Linear	1555932.44	3280558.39	N 89^44'24" E	1555938.50	3281893.49	N 89^44'24" E	1335.11		OK	OK	OK		0.14
Circular	1555938.50	3281893.49	N 89^44'24" E	1555892.44	3282372.46	S 78^45'12" E	481.99	2400.00	OK	OK	OK		Delete
Linear	1555892.44	3282372.46	S 78^45'12" E	1555752.85	3283074.41	S 78^45'12" E	715.70		OK	OK	OK		Hada
Circular	1555752.85	3283074.41	S 78^45'12" E	1555635.97	3283610.73	S 76^39'24" E	548.94	15000.00	OK	OK	OK		Undo
Linear	1555635.97	3283610.73	S 76^39'24" E	1554528.80	3288278.58	S 76^39'24'' E	4797.36		OK	OK	OK	-	Links
Tircular	1554528.80	3288278 58	S 76^39'24" F	1554398 30	3288732 21	S 71^14'44" F	472 20	5000.00	OK .	0K	OK .	1	нер
<					10								

Importing alignments From graphics

If alignments are already defined graphically or in an electronic text file, they may be imported into InRoads without having to re-enter the data.

Alignments that has already been drawn graphically may be imported using File > Import > Geometry > From Graphics.

🕌 Import Geor	netry	- • ×
From Graphics	ICS Vertical from Surface	
Type:	Horizontal Alignment 🔹	Apply
Geometry		
Name:	1	
Description:		
Style:	ALG_EXISTING -	Help
Horizontal Cu	rve Definition: Arc 🔹	
Vertical Curv	e Definition: Parabolic 🔹	
Target Geometry Pro Horizontal Ali Use Fence Join Elemer All Selected Attribute Tag	ject: Default gnment: Default Resolve Gaps and Nontangencie nts No Duplicate Cogo Points Hements Added to Single Alignment s	15
Use Tag I	Data	
Project:	Active	
Name Cor	No Overwrite 🔹	
	Close	

You can import Horizontal Alignments, Horizontal and Vertical Alignments, Cogo Points or Event Points. If the alignment has curves, it is typically best to toggle on **Resolve Gaps and Nontangencies**. If the alignment was drawn as a series of lines and/or arcs that have not been complex chained, toggle on **All Selected Elements Added to Single Alignment** (you must first define a Fence or Selection Set of the elements, and the elements will import in the order of creation, even though they're added to the same alignment).

After specifying the *Name* (which defaults if you don't supply one), the *Description* and the *Style*, choose **Apply**. If you have first created a Selection Set or defined a fence, you will be asked to Accept the contents. If you have not, you'll be asked to identify the element. In either case, after accepting, an alignment or alignments will be added to the geometry project listed in the *Target* section.

Cogo Commands - Overview

Coordinate geometry commands are delivered with InRoads. There is no need to exit, start, or launch another product to access them. These commands provide an alternative method for creating horizontal alignments. One of the main differences in creating the Cogo alignments (sometimes referred to as figures) and other alignments is that Cogo alignments require that the points be established first, then joined together to form the alignments.

Once created, Cogo points and alignments are, in most cases, interchangeable with other horizontal points and alignments. There are a few key differences, however:

- Cogo points are always numbered as you go (beginning with the seed number established in **Tools > Options > Geometry** or with the next available number.
- Cogo points can stand alone, such as when locating a fire hydrant or signs.

There are several toolbars devoted to coordinate geometry described here. These same commands may be found under the Geometry heading on the pull-down menu.

Cogo Point commands



Use the *Cogo Points* commands to create, edit, copy, delete, or navigate to Cogo points. These commands can be accessed through tool bars or by selecting Geometry pull-down menu.

Cogo Traverse commands



	Direction	-	Course			Apply
nsert Point:	To Cogo Buffer	•				Close
			Direction:	N 77^11'45'' E	+	
			Distance Type:	Horizontal Distance		Stules
			Horizontal Dist.:	253.08	+	Styles
			Horizontal Offset:	0.00	+	
			Vertical Type:	Vertical Distance]	Help
- Uccupied P	pint	- 1	Vertical Distance:	0.00	+	
- NJ amas:		- 11	Foresight Point			
Name: Northing:	1557457.43					
Northing: Easting:	3274885.71	- +	Name:	1		
Northing: Easting: Elevation:	1557457.43 3274885.71 -0.00	+	Name: Description:	1		

The *Traverse* commands can be used to generate Cogo points from known locations by inputting distance and bearing to the point being constructed (Direction Traverse). It may also be used for locating points by Angle or Deflection. Additionally, alignments and radial points can be created based on the statues of the Insert Point.

Cogo Intersection Commands

ocate	×		
A O	°0 \		
Interse	ction		
Гуре:	Direction/Direction	•	Apply
Direction 1			Close
Name:	120		
Northing:	1557064.58	+	Help
Easting:	3274711.66	_	
Direction:	N 61^07'25'' E	+	
Offset:	0.00	+	
Direction 2			
Name:	121		
Northing:	1556961.39	+	
Easting:	3275097.05		
Direction:	N 16^11'21''W	+	
Offset:	0.00	+	

The Intersection commands can be used to generate point locations based on known points, alignments, stationing, and/or offsets.

Name:	Pieper Parcel	+	Apply
Description:	Existing ownership		Close
Style:	RW_Property-Bndry-	·	Stules
Alignment De	efinition:		
[12012112	22 123 120)	~	Help
[12012112	22 123 120)	×	Clear
- Graphical I	nput (r	× ×	Clear
-Graphical I	nput	Stop	Clear
- Graphical II	nputStart [Stop Cent	Clear

Create/Edit Alignment by Cogo Points

Alignments are created by chaining existing Cogo points together using the *Create/Edit Alignment* command. It is not necessary to create the alignment name prior to using this command; it may be entered here, along with a *Description* and *Style*. The points defining the alignment are listed in the Alignment Definition. The alignment can be defined graphically by selecting the Start button or the definition (or edits) can be keyed into the Alignment Definition field.

See the Bentley Help or InRoads Reference Guide for additional information on InRoads Cogo.

Section Summary:

- The data on the Options > Geometry tab is preset to CDOT standards. With the possible exception of Plotting Height and Seed names, this data should be left as is.
- Most of the commands that are used to create alignments do not add the geometry point generated to the Cogo buffer automatically. However, they can be added afterwards.
- New geometry is not written to the hard drive until the geometry project is saved.
- There are no dialog boxes associated with the Horizontal Curve Set PI commands. Prompts for these commands are displayed in the lower left corner of the MicroStation window.
- Use the Curve Calculator and the Design Calculator to compute the radius for curves.
- The beginning station and station equations for an alignment are defined using the Horizontal Curve Set > Stationing command.
- The Horizontal Curve Set > Events command is used to add stations "of importance" to the alignment and alignment points to the Cogo Buffer.
- Event points can also be used by other commands like Roadway Designer and Create Cross Sections to calculate data at those stations.
- Horizontal Element tools can be used to create unconnected alignment elements within a single alignment.
- The Horizontal Element Check Integrity tool can be used on alignments created by any method. It is especially useful for trouble shooting alignments imported from graphics.
- Cogo commands are primarily used by the ROW/Survey specialty group.

Geometry Utilities

Geometry utilities act upon existing geometry to modify that geometry or create new geometry.

Section Objectives:

- Discuss the Transpose Alignment command.
- Discuss the Inverse command.
- Discuss the Transform Geometry command.
- Discuss the

Transposing Alignments

Transposing an alignment reverses the direction of that alignment. Tangent sections are reversed and left-hand curves become right-hand curves. The beginning stationing value is retained; however, any station equations previously defined are deleted. Associated vertical alignments are also reversed. You may find the need to transpose an alignment if it was surveyed in a direction opposite from the direction you wish to design (up-stream vs. down stream). Other instances may be if you create an alignment by importing from graphics. InRoads will generate the alignment in the direction the MicroStation graphic was drawn which is not necessarily in the direction of 'up-station'. Or you may simply create an alignment in the wrong direction using any of the InRoads geometry commands.

The transpose alignment command is found under the pull-down menu:

Geometry > Utilities > Transpose

The command executes once the alignment (s) for transform are chosen and Apply is selected. The user will have to redisplay any associated stationing or annotation of the transformed alignment(s).

Transposing an alignment

- 1. Use the review tools to evaluate the horizontal alignments and determine the direction they are running.
 - **Note:** Alignments created by exporting an electronic fieldbook assume the direction of the data collection.
- 2. Select Geometry > Utilities > Transpose.
- 3. Select the desired alignment and **<D> Apply**.

Alignment: Side Road		Apply
Selected:	[Close
Side hoad		Filter
		Help

- 4. **Review** the alignment to verify the transposition.
- 5. **Save** the geometry project.

Inversing Between Alignments - Overview



Another useful geometry utility is **Geometry > Utilities > Inverse Direction**. This command can be used to interactively inverse between data points identified graphically.

Enabling the geometry point snap will lock data points to defined alignment or Cogo keypoints. Executing a second graphic data point will post the inversed data to the MicroStation file.

Points/Alia	nments			Analy
C Paints	in on to	Selected		Арру
Alignme	nts	Alternate B		Close
Transform:				Filter
	+	1		Undo
Transfo	rm Entire Project	Ē		Least Squares.
/lethod	Eustom	•		Нер
Rotation				
Mode:	By Angle	-	Scale	
Angle:	22^00'00"	+	Horizontal: 1.0000	
			Vertical: 1.0000	
Original Po	nt		Destination Point	
Name:			Name:	
Northing:	1555884.03		Northing: 1555784	1.03
Easting:	3279671.70	+	Easting: 3279771	.70 +
Elevation:	0.00		Elevation: 0 00	
	10.00		Jacob	
NU2-MARKET	Artavity Artavity Outernit	بلا معرفی دومی دومی		
	$\langle I \rangle$	21.01	S Ella	

Transforming Geometry - Overview

Entire geometry projects, individual alignments, or Cogo points can be transformed by moving, scaling, or rotating selected items. The transform command is found under the pull-down menu

Geometry > Utilities > Transform

Shown above is the transformation of alignment Alternate B. The alignment has been moved 100 feet east and 100 feet north as indicated in the delta coordinate values defined in Original Point & Destination Point fields. Additionally the alignment has been rotated 22 degrees clockwise. The point of rotation is about the coordinates defined in the Original Point fields.

Note: This command does not create a copy of the specified alignment. It will transform the original alignment specified. Use the **Geometry** > **Copy Geometry** command prior to use if a copy is desired.

Offset Alignments - overview

Choose Geometry > Utilities > Parallel Horizontal Alignment

🚔 Parallel Horizonta	I Alignment		
Mode: Specify 	Specify		
Interactive	By Station	Close	
Interactive	By Element	Lindo	
		Help	
From	[
	SH 86	•	
Station Limits			
Start:	203+80.28	- ф -	
Stop:	260+43.16	-#-	
Offset:	0.00	+	
T-			
Alignment Name:	_		
Description:	_		
Stude -			
June.	ALG_EXIST	ING 🔻	
Copy Event Points	s		

Items to examine are:

Mode - There are three modes; Specify, Interactive By Station, and Interactive By Element.

- *Specify* This option uses the data in the From area of the dialog box to determine the length and location of the new alignment.
- *Interactive By Station* This option identifies the length and location of the new alignment based on data clicks made in the MicroStation View window. This option can use partial elements at the beginning and end of the new alignment.
- Interactive By Element This option also identifies the length and location of the new alignment based on data clicks made in the MicroStation View window. However, this option uses the full length of all elements identified.

From - This area is used to identify the source, length, and offset of the new alignment within the dialog box.

- *Horizontal Alignment* This drop down menu is used to specify the source of the offset alignment.
- *Station Limits* This option is used to specify the length of the new alignment in relation to the source alignment. When toggled off the full length of the source alignment is used.
- *Offset* This option determines the location to the left or right for the new alignment. Positive offsets are to the right, negative offsets are to the left of the source alignment.

To - This area is used to specify the attributes of the new alignment.

- *Name* The name for the new alignment is entered here. If left blank, the Seed Name from the Options dialog box is used.
- **Description** The description for the new alignment is entered here. If left blank, no description is attached to the alignment.

- *Style* This drop down menu specifies the style for the new alignment.
- *Copy Event Points* When on, event points from the source that are within the extents of the new alignment are added to the new alignment.



Note: The new alignment's stationing is equated to the source alignment.

Section Summary:

- The Transpose command is used to change the direction of the alignment. The elements remain in their original locations, but the end of the element is now the beginning.
- The Inverse command computes the distance and bearing between two alignment points.
- The Transform command is used to change an alignment from one measurement system to another.
- The Parallel Horizontal Alignment is used to copy all or part of an alignment a specified distance from its source.

Chapter Summary:

- New geometry is created in the hierarchial order as it is defined in the geometry project.
- The Horizontal Curve Set commands are the most common method used for creating new horizontal alignments
- Import from Graphics is used to make geometry from MicroStation elements.
- Horizontal Element and Cogo commands can be used to create solutions where inconsistencies occur using other methods.
- Use the Parallel horizontal Alignment command to create the basis for offset control lines.

Appendix A - ICS Geometry Input

Text files may be imported in several formats, one of the easiest is to create an .ics file (Interactive Coordinate geometry Subsystem). This file type was first used with a product of the same name many years ago, but is still in use with InRoads today. It takes the format of commands along with the input for those commands.

For example a text file of coordinates can be formatted in an .ics file by adding a Store command at the top and formatting the file similar to the one shown below.

🧊 retainii	ng wall.ics - Notepad		
Fie Edit	Format View Help		
;	Example .ics file		
	Coordinates of retai	ning wall	
STORE	1 934399.33 2 934231.94 3 934231.94 4 934143.68 5 932352.65 6 934050.02	1836109.02 1836247.39 1836247.39 1836320.34 1833973.84 1836386.24	4
1			

Choose File > Import > Geometry > ICS. Browse to find the file, and then choose Apply.

Import Geometry	
From Graphics ASCII INR ICS Vertice	al from Surface
File Name:	Apply
C:\Projects\12345\Design\InRoads\sample.ics	Browse
	Preview
	Help
Close	

The cogo points will be added to the active geometry project. You may then use **Geometry** > **Utilities** > **Create/Edit Alignment** to join the points, forming an Alignment and **Geometry** > **Horizontal Curve Sets** > **Define Curves** to add curves to the alignment. You can also accomplish these same tasks within the .ics file. See the Bentley Help topic *Alpha Cogo*.

InRoads contains an alphanumeric interface for running Interactive Coordinate Geometry Subsystem (ICS) commands. This interface is also referred to as Cogo Classic and can be used to run batch runs of geometry commands.

ICS can be accessed through the Windows start menu by selecting:

sample.ics - Bentley Cogo Classic - 2004 Edition	_ _ D×
HIE Edit View Tools Help	
store 1000 3339.577 3225.237	
1000 3339.58 3225.24	0.00 Default
locate direction 1000 1001 N25-56-26.4E 46.806	
	0.00 Default
locate angle 1000 1001 1002 212 47'55.3" 196.801	0.00.0.5
	0.00 Vetault
100ate angle 1001 1002 1003 205 37 27.1" 27.817	0 00 Default
locato apglo 1882 1882 1886 222^27'EO O'' 60 707	0.00 Derault
1004 3455 88 3480 86	0 00 Default
locate angle 1003 1004 1005 205^24'32 3" 248.527	o.oo briddit
1005 3233.64 3592.11	0.00 Default
locate angle 1004 1005 1006 208^24'10.5" 47.488	
1006 3186.18 3590.62	0.00 Default
locate angle 1005 1006 1007 240^34'12.5" 142.520	
1007 3120.10 3464.34	0.00 Default
locate angle 1006 1007 1008 145^52'21.2" 98.809	
1008 3033.06 3417.57	0.00 Default
locate angle 1007 1008 1009 215^31'58.3" 38.494	
1009 3016.06 3383.03	0.00 Default
locate angle 1008 1009 1010 264"38'35.3" 36.027	
	0.00 Default
10cate angle 1009 1010 1011 195 46'57.3" 122.322	0.00 D.C
1011 3104.40 3330.89	0.00 Vetault
boundary (1999-1911 1999)	1007 1008 1000 1010
1811 1888	
	v
	_
) 	
	NUM //

Start > All Programs > Bentley > InRoads Group XM > Cogo Classic

ICS Command Summary

Control Commands

CREATE PROJECT name description

LOAD PROJECT name

SAVE PROJECT fname

AUDIT FILE mode file.ext

mode: 0 - opens an existing file of the specified name so that data can be added to the end of the file

1 - opens a new file of the name specified

-1 - closes the existing file

OUTPUT FILE mode file.ext

mode: 0 - records all input and output records in the output file

1 - suppresses recording of input and only records output

-1 - closes the existing file

AUTO PLOT preference /z /!fnam

This command turns on the graphic auto plot lock and sets the active preference for automatically plotting points and figures in the design file. Issuing the command again with fnum equal to 0 will turn the auto plot lock off in the graphic environment.

Example: AUTO PLOT 0 !ALIGN1 # turns auto plot lock on and # sets the active preference to ALIGN1

AUTO PLOT 0 # turns off auto plot lock

Parameter Commands

SET HEIGHT HtFS1 hi1 htBS1 /htFS2 /hi2 /htBS2

SET PARAMETER dir

0 =north azimuth 1 =bearing

SET PROTECTION set prot

0 = Point Protection ON 1 = Point Protection OFF

SET REFERENCE

Sets the vertical angle reference: v = horizon z = zenith

SET SEQUENCE seq

Sets the coordinate sequence: x = x,y,z = n,e,e

SET TOLERANCE dtol /atol

Sets a distance tolerance dtol and angle tolerance atol for the

following conditions:

- Colinearity of points on tangents
- Curve and spiral symmetry
- Curve and spiral tangency with subtangents
- Figure continuity at tangent points

Report Commands

ANGLES pBS pOC desFS

Computes and reports angles from pBS at pOC to points in desFS.

AREA DIRECTION des

Computes and reports the area and boundary courses of the closed figure defined by des.

DESCRIBE ALIGNMENT Hfg /x /sBEG /sEND

Lists the following alignment data for Hfg at interval x:

- coordinates and station of PC, PI, PT, CC
- distances and directions of tangents
- PI deflection angles

- curve data

DESCRIBE VERT ALIGN sBEG /sEND

Describes the active vertical alignment, including points of vertical inflection, curvature, tangency, high and low points, and grades.

DISTANCE des

Computes and reports distances between points in des.

INVERSE DIRECTION des

Computes and reports distances and directions between points in des.

LIST COORDINATES des /mode

Lists the coordinates of each point in des.

LIST FIGURES des

Lists the figures and figure descriptions in des.

TRAVERSE ANGLES des

Computes and reports the lengths and the interior angles of lines in the traverse defined in des.

STATIONS AND OFFSETS desAL2 /x /sBEG /sEND

Computes and lists the stations and offsets of points in desAL2 from the active horizontal alignment.

Point Commands

STORE n c1 c2 /z/p /!fnam -OR- p c1 c2 /z /-cno /!fnam

Stores point n with coordinates c1, c2, and z. If optional p is specified, n takes its value. If optional -cno is specified as -1, -2, or -3 the coordinate c1, c2, or z is modified, respectively.

DELETE COORDINATES des

Deletes points in des from the .tdp project file.

DEFINE Z p z

Defines the elevation of point p.

POINT DESCRIPTION des *description

Defines the alpha description for the known point(s) in des.

Figure Commands

STORE FIGURE nfg des /pAL sAL

Defines the figure nfg in the .tdp file as the list of points in des.

DELETE FIGURE fg

Deletes the figure descriptions (but not points) from the .tdp project file.

FIGURE DESCRIPTION des *description

Defines the alpha description for the known figure(s) in des.

Locate Commands

ANGLE RESECTION p1 p2 p3 ang1 ang2 /n

EXTEND ARC pPC pCC nPT [arc]

LEVEL RUN pBS rBS

LOCATE ANGLE pBS pOC nFS ang [dis] /vaFS /[off] /vaBS pVB

LOCATE DEFLECTION pBS pOC nFS defl [dis] /vaFS /[off] /vaBS /pVB

LOCATE DIRECTION p n dir [dis] /va /[off]

LOCATE FROM ALIGNMENT n sn /[off] /rod

Locates a point n along the active alignment at station sn at an optional offset off and rod reading rod.

rod = rod reading if Level Run is active

rod = elevation if Level Run is non-active

LOCATE LINE p1 p2 n [dis] /va /[off] /Mdis

TANGENT n1 pCC1 [r1] n2 pCC2 [r2] /dir /ext

TANGENT OFFSET n pOF p1 p2

Transformation Commands

COMPUTE TRANSFORM desFROM desTO

This command is initially used to set the rotation/translation values to be used in the transformation process. The "desFROM" values are two points that are located in the relative coordinate system. The "desTO" values are two points in the rotated/translated coordinate system that directly correspond with the two points in the relative coordinate system. The relationship between these two sets of points is that the measured distance must be exactly the same between each set of points (no scaling allowed).

TRANSFORM COORDINATES des

This command can be executed at any time, on any set of points/figures, AFTER the Compute Transform command has been processed. This command works with points or figures.

Divide Commands

DIVIDE ARC pPC pPT pCC div /n

Divides a clockwise arc with center pCC into div equal segments between pPC and pPT. Stores the resultant coordinates as n, n+1, etc.

DIVIDE FIGURE des div /n

Divides the figure des into div equal parts. Stores the resultant coordinates as n, n+1, etc.

DIVIDE LINE p1 p2 div /n

Divides line p1 p2 into div equal parts. Stores the resultant coordinates as points n, n+1, etc.

Intersect Commands

ARC ARC INTERSECT n pCC1 [r1] pCC2 [r2] pID ARC LINE DIRECTION n pCC [r] p dir pID /[off] ARC LINE POINTS n pCC [r] p1 p2 pID /[off] CURVE SPIRAL n [r] pCC pID pTS dirBT [ls] [dc] CURVE SPIRAL POINTS n [r] pCC pID pTS pSIT pSC DIRECTION INTERSECT n p1 dir1 p2 dir2 /[off1] /[off2] /va1 /va2 FIGURE ARC INTERSECT n fg pCC r pID /[offg] FIGURE FIGURE INTERS n fg1 fg2 pID /[off1] /[off2] FIGURE LINE INTERSECT n fg p dir pID /[offg] /[off] LINE SPIRAL n p1 p2 pID pTS dirBT [ls] [dc] LINE SPIRAL n p1 p2 pID pTS dirBT [ls] [dc] POINTS DIRECTION INTER n p1 p2 p3 dir /[off1] /[off2] /va POINTS INTERSECT n p1 p2 p3 p4 /[off1] /[off2] SPIRAL SPIRAL n pTS1 dirBT1 [ls1] [dc1] pTS2 dirBT2 [ls2] [dc2] /pID SPIRAL SPIRAL POINTS n pTS1 dirBT1 [ls1] [dc1] pTS2 pSIT pSC2 /pID

Curve Commands

FIT CURVE pBT pPI pAT nPC nCC nPT /[r] -OR- pPC pOC pPT

Alignment Commands

SET ALIGNMENT Hfg /pAL /sAL /Vfg

Activates a horizontal alignment and optionally defines the stationing.

CLEAR ALIGNMENT

Clears the active alignment, and makes the active alignment Cogo.

POINTS ON ALIGNMENT x /n /[off] /sBEG /sEND /odd

Locates and lists coordinates of points n, n+1, etc. at each interval x along the active alignment at an optional offset off between sBEG and sEND with odd defining station lock on or off.

odd = 1 - Station Lock on

odd = 0 - Station Lock off

FIT ALIGNMENT nTS pBT pPI [dc] [ls1] [ls2] defl sign

Parallel Commands

PARALLEL LINE p1 p2 [off] /n1 n2

Locates points parallel with the line p1 p2 at an offset distance off, and stores them as n1 and n2.

PARALLEL FIGURE des /[off] /n /nfg /dz

Locates a new parallel figure to des at an offset distance off, and stores points of the new figure as n, n+1, etc. and the new figure as nfg with an elevation difference of dz.

For an open figure: For a closed figure:

+off = to the right +off = external

-off = to the left - off = internal

COGO Parameter Abbreviations

Parameter	Description	Parameter	Description
ang	angle	р	known point
atol	angle tolerance	pAL	point on the alignment
arc	arc distance	pAT	point of the ahead tangent
-AL	alignment	pBS	point of the backsight
c1,c2	coordinates 1 and 2	pBT	point of the back tangent
cid	spiral curve identification;	pID	known point that indicates
	this parameter is not used by		which intersection is to be
	Simple Spiral, key in any		chosen; positive is near,
	number from 0 to 999.		negative is far from the pID
Cno	the field number of a coord	pOC	occupied point OR point on
	to change in an existing	Î	the curve
	point		
CC	center of curve	pOF	point that perpendicularly
			offsets the pt to be
			calculated
Dc	degree of curve	nVB	point of the vertical
2.		p , 2	backsight
defl	deflection angles	PC	point of curvature
delta	delta angle	PI	point of intersection
des	point or figure description	PT	point of tangency
desc	alpha description	r#	curve radius
dir	direction	rBS	rod reading of the backsight
dirBT	direction to the back tangent	rod	rod reading or elevation
dis	distance	S	station
div	number of divisions	sAL	station on the alignment
dtol	distance tolerance	sBEG	beginning station
dz	elevation difference	sEND	ending station
ext	externality	seq	coordinate sequence (x or n)
fg	figure	sign	sign of angle
fnam	feature name	sn	station
fname	file name	SC	spiral to curve point
fnum	feature number	SIT	point of spiral intersection
-FS	foresight	TS	tangent to spiral point
Gdis	geodetic distance	va	vertical angle
Hfg	horizontal figure	vaBS	vertical angle to backsight
hi#	height of instrument	vaFS	vertical angle to foresight
ht#	height of target	Vfg	vertical figure
ls#	spiral arc length	Х	station distance
Mdis	measured distance	Z	elevation
mode	input/output mode	n	unknown point
name	name of file	nfg	unknown figure
odd	station lock on/off	off	offset
offg	offset from figure		

[] - parameters shown in the square brackets utilize the Input Combined Grid Factor

Abbreviation	Command	Comment
an r	angle resection	
an	angles	
aai	arc arc intersect	
a d	area directions	
a f	audit file	
ald	arc line direction	
alp	arc line points	
a p	auto plot	assigns feature name/number to all of
		the following commands, i.e.:
		a p house
		store 1 100 200 300
		2 101 202 303
		loc ang 1 2 30 100
са	clear alignment	
cgf	combined grid factor	
c pr	create project	
csp	curve spiral points	
c s	curve spiral	
c t	compute transform	
def z	define z	
del c	delete coordinate	
del f	delete figure	
des a	describe alignment	
des v	describe vertical	
di a	divide arc	
di f	divide figure	
di i	direction intersect	
di l	divide line	
dis	distances	
exi	exit	
ext a	extent arc	
f ar i	figure arc intersect	
fal	fit alignment	
fc	fit curve	
fd	figure description	
ffi	figure figure intersect	
fli	figure line intersect	
i d	inverse direction	
i f	input file	
1 a	locate angle	
1 c	list coordinate	
l de	locate deflection	
1 di	locate direction	

Abbreviations for the ICS input commands

l fi	list figure	"list figure (point des, i.e. 1-4) -1"
		lists all figures that points in the
		parentheses are located in.
l fr a	locate from alignment	
11	locate line	
l pa	load parameters	
l pr	load project	
lr	level run	
lsp	line spiral points	
ls	line spiral	
o f	output file	
pa f	parallel figure	
pa l	parallel line	
pl c	plot curve	
pl l	plot line	
pl p	plot point	
pl s	plot shape	
po de	point description	
po di i	point direction intersect	
po i	points intersect	
po o a	points on alignment	
sa pa	save parameters	
sa pr	save project	
se a	set alignment	
se d	set display	"set display 0" turns scrolling off and
		"set display 1" turns scrolling
		On
se h	set height	
se pa	set parameters	
se r	set reference	
se s	set sequence	
se t	set tolerance	
sp s	spiral spiral	
sp s p	spiral spiral points	
s a o	station and offset	
s f	store figure	
S	store	
t a	traverse angle	
t c	transform coordinates	
t o	tangent offset	
t	tangent	