GEOPAK – Horizontal Geometry

General

GEOPAK contains a robust set of tools for creating, editing, and managing horizontal geometry features such as points, curves, spirals, chains, profiles, and parcels. The foundation of all the GEOPAK geometry tools is the **Coordinate Geometry** dialog or **COGO**. All elements created with COGO or any other geometry tools are stored in the COGO GPK file. The GPK file can be shared between all users on a given project.

All the horizontal geometry tools can be used simultaneously and in conjunction with each other. Even though these tools are separated in the GEOPAK environment, it does not mean that they cannot be used together. Each of the tools share one thing in common. They all store geometry elements in the COGO GPK file.

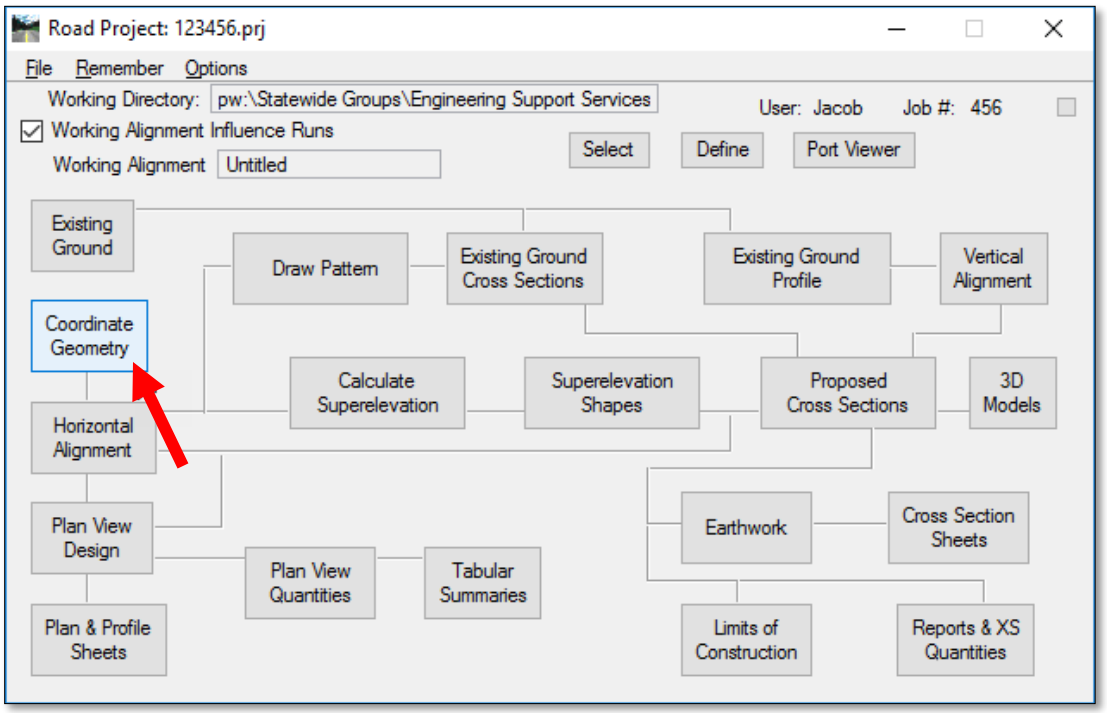
Seven different geometry element types can be stored in the COGO GPK file. They include points, lines, curves, spirals, chains, profiles, and parcels. Points are the simplest element types. Lines are defined by a distance and a bearing between two points. The curve and spiral element types refer to horizontal geometry only. Chains are a collection of points, curves, and spirals which define a horizontal alignment. Parcels are chains that close, or end, at the beginning point.

The elements stored in the GPK file can be visualized in MicroStation with COGO. COGO supports temporary and permanent visualization. If the COGO elements are temporarily visualized, when the COGO dialog is closed, the elements will be removed from the MicroStation design file. If permanent visualization is used, the displayed COGO elements will remain in the design even after closing the COGO dialog.

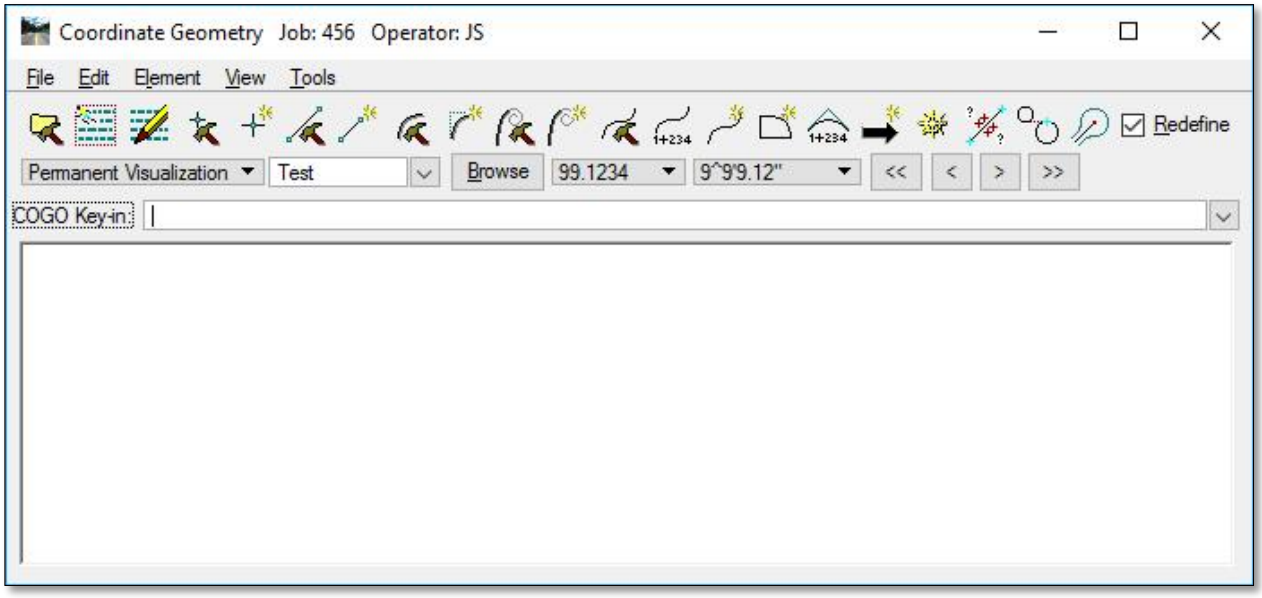
This workflow is for existing alignments. Please refer to the OpenRoads Basics training for further information regarding proposed alignments.

Coordinate Geometry (COGO)

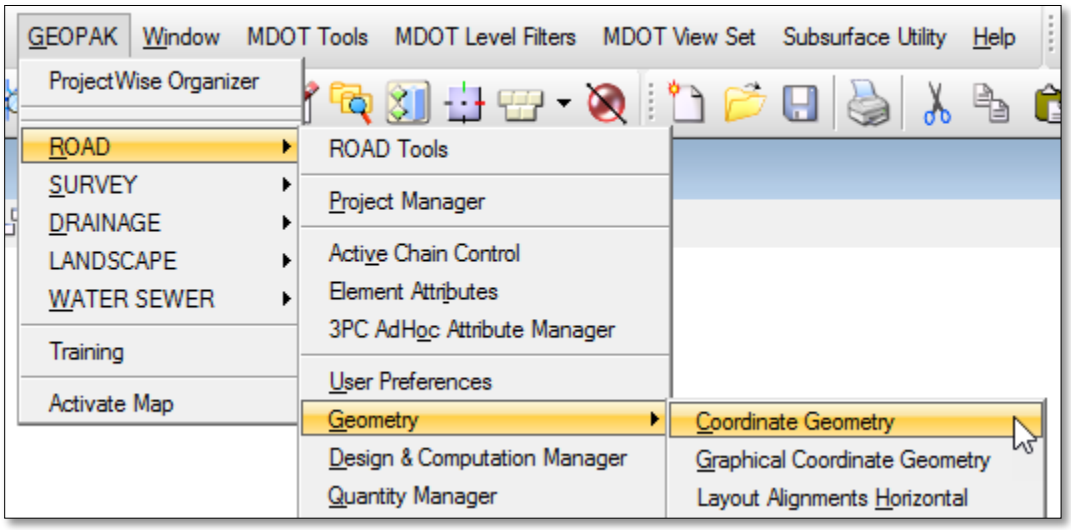
Coordinate Geometry, or COGO, is the base for all geometry tools in GEOPAK. COGO can be accessed through the GEOPAK Project Manager (**GEOPAK → Road → Project Manager**). Accessing COGO through the Project Manager will automatically bring in the GPK file assigned to the selected project. The Project Manger dialog box must remain open while using the COGO tools. See Workflow – GEOPAK_1 – Project Manager for further information setting up Project Manager for a project.



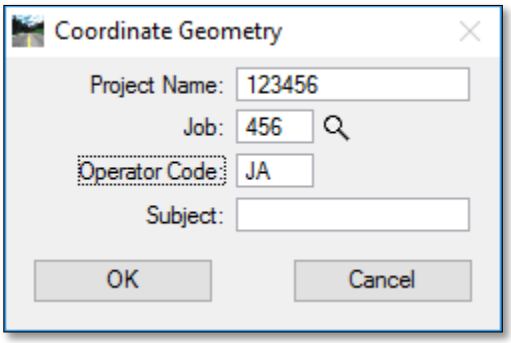
Select Coordinate Geometry to open the COGO dialog.



COGO can also be accessed through **GEOPAK → Road → Geometry → Coordinate Geometry**. Accessing COGO outside of the Project Manager requires the user to manually search and attach the GPK. GEOPAK will only browse for the GPK within the folder containing the active DGN file, for that reason, it is recommended to access the COGO through the Project Manager.



1. If a GPK file already exists for the project, select the magnifying glass to select a GPK file and proceed to **Step 3**.
2. If a GPK does not exist, populate the **Coordinate Geometry** Dialog as follows:
   - **Project Name:** Enter the MDOT Job Number
   - **Job:** Enter the last three digits of the job number
   - **Operator Code:** Enter the users initials
   - **Subject:** Leave blank



3. Select **OK** to complete the setup and open COGO.

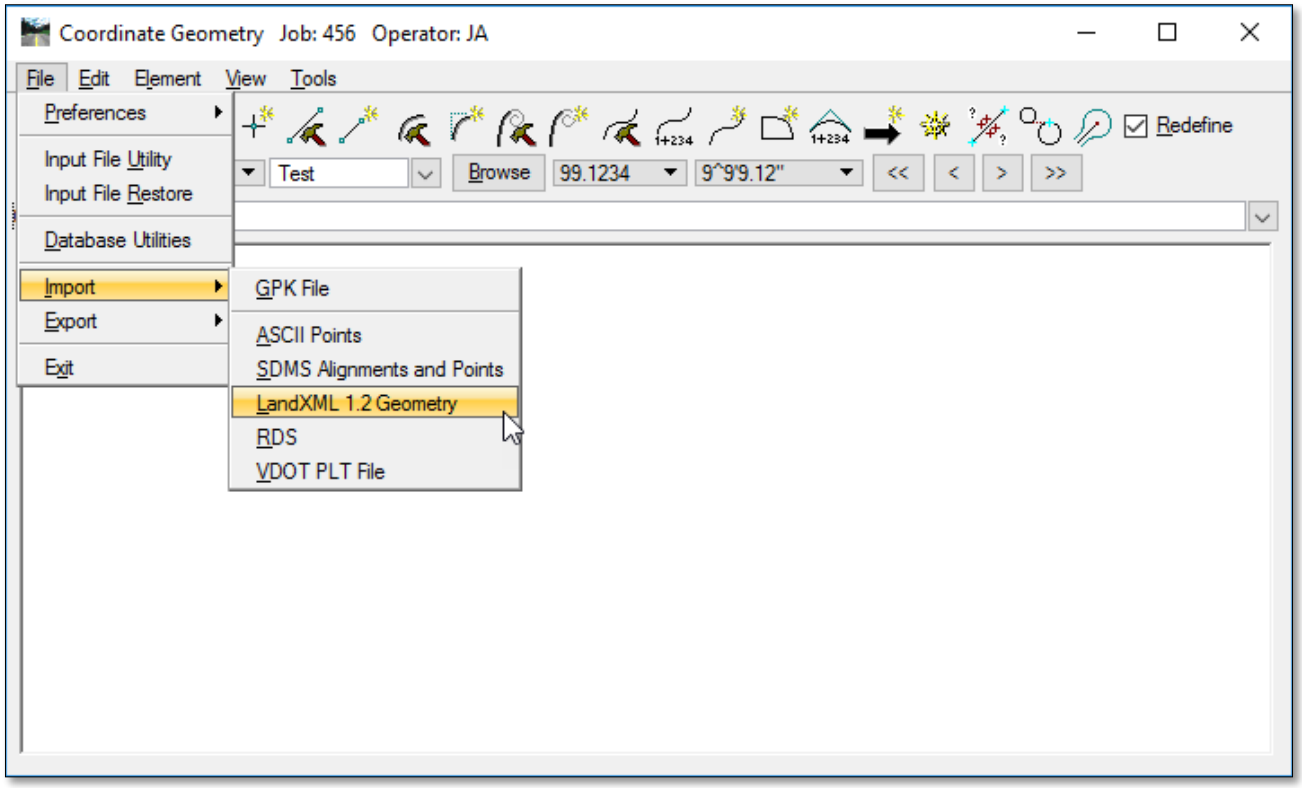
NOTE: If the entered GPK file does not exist, the user will be prompted to select **YES** to create the new GPK file.

Importing Survey Alignments into COGO

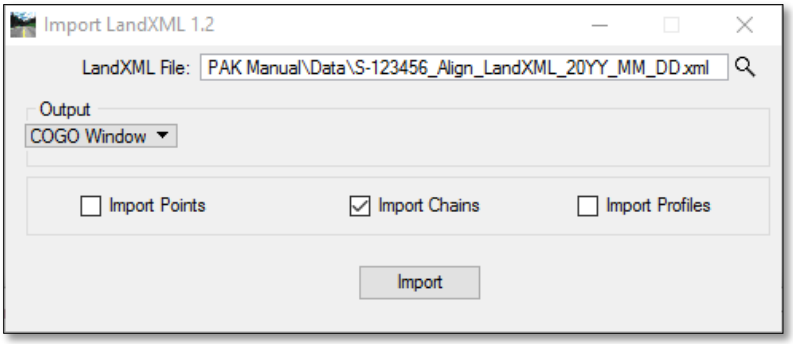
COGO allows the designer to import the geometry provided by survey into the project GPK file. This is required when the designer utilizes a survey alignment or must display the them at different scales in the plan set.

1. Open Coordinate Geometry as noted in the section **Coordinate Geometry (COGO)**.

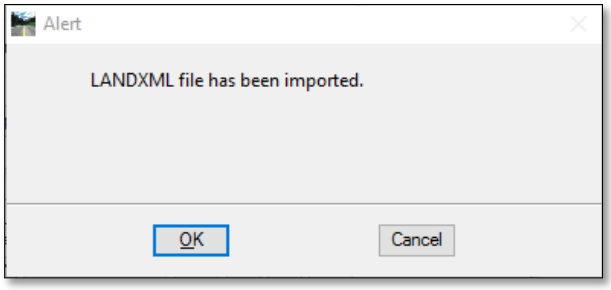
2. With the COGO dialog box open select **File → Import → LandXML 1.2 Geometry**



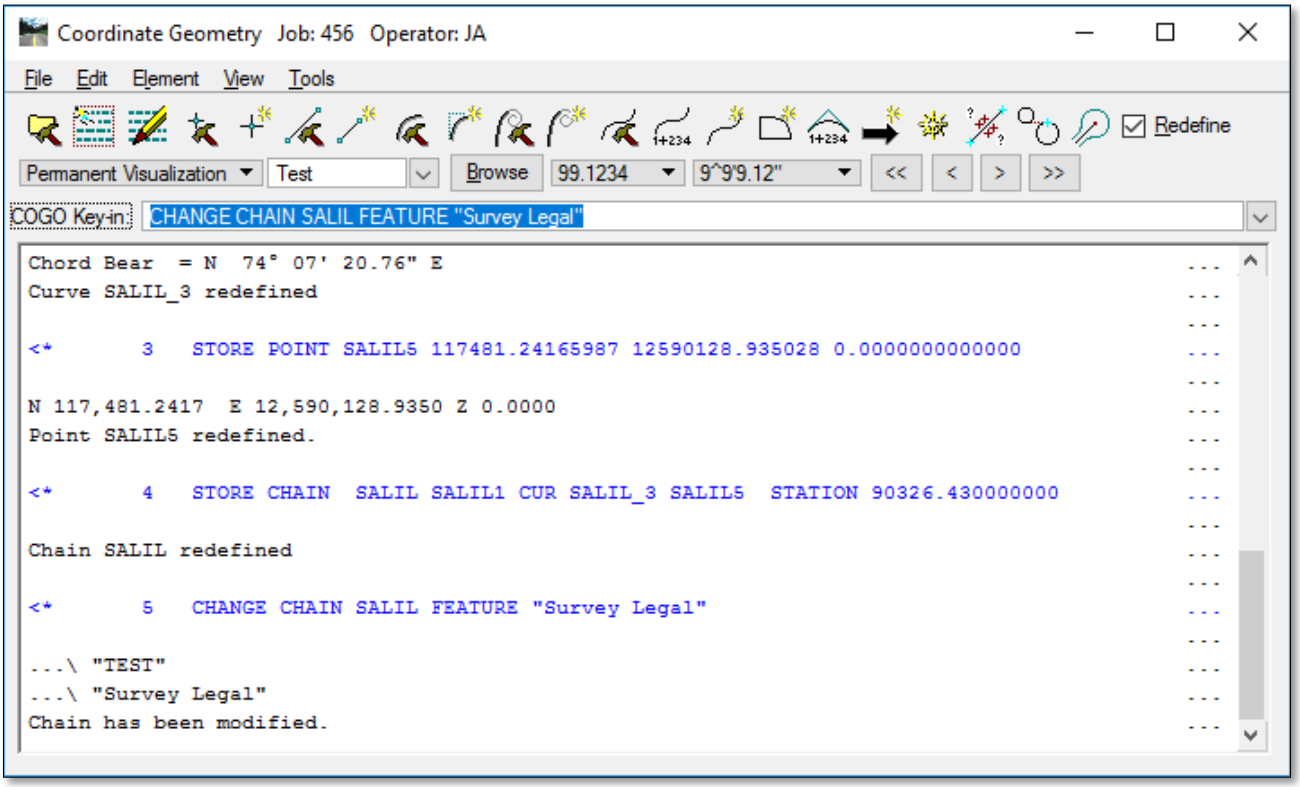
3. In the **Import LandXML 1.2** dialog, select the desired LandXML file using the magnifying glass and check **Import Chains** only. In the Output dropdown, select **COGO Window** and select **Import**.



4. A confirmation dialog will open if the import was successful. Select **OK** to dismiss.



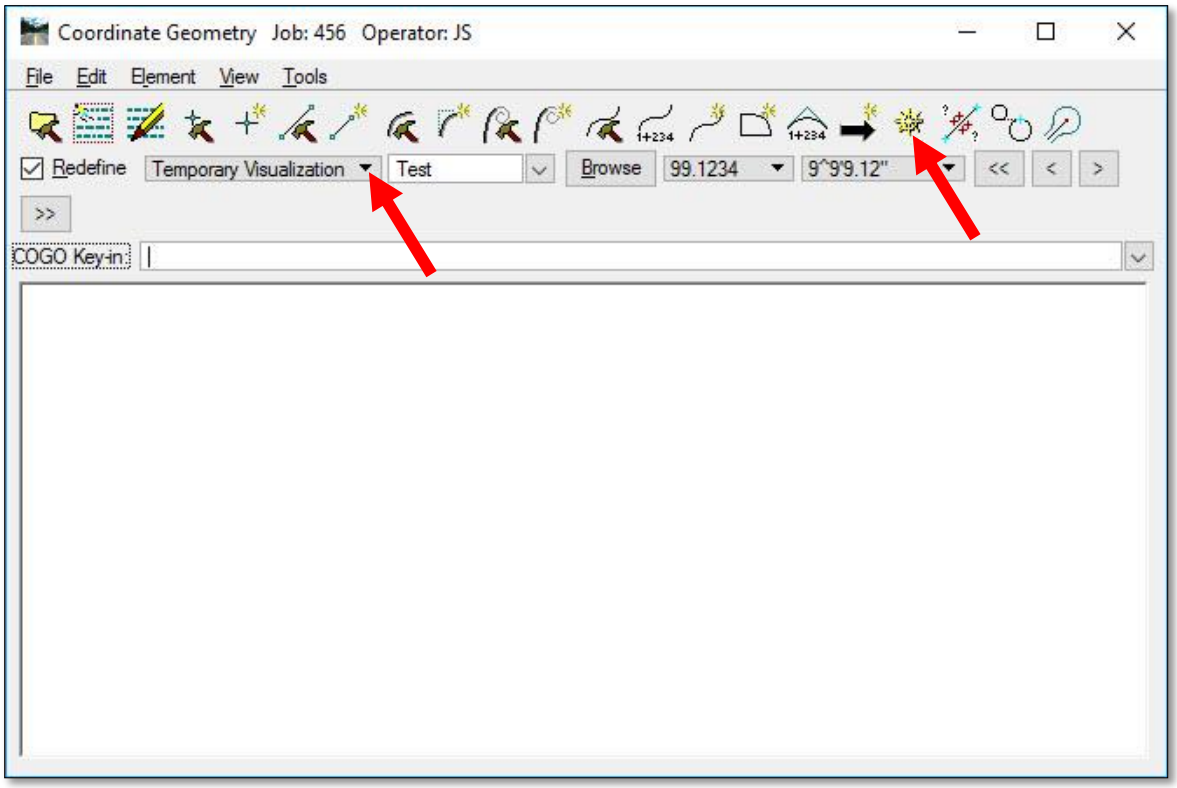
5. The imported LandXML information is saved into the GPK file as chains and will be displayed in the COGO dialog box on import.



COGO Navigator

The **Navigator** tool in COGO allows the user to review and visualize any stored COGO elements in the GPK file including horizontal alignments, vertical alignments and points, among others.

1. Set the visualization option in COGO to **Temporary Visualization**. Then select the **Navigator** icon to access the **Navigator** tool.



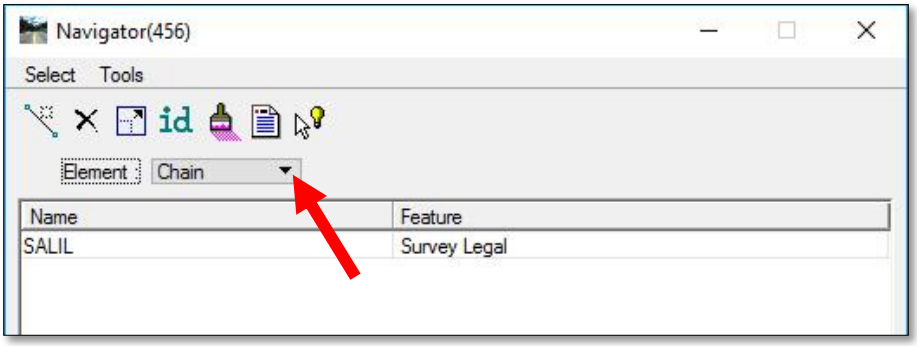
Visualization Options – this dropdown has the following options:

- **Permanent Visualization** – Allows visualized elements to remain after the COGO dialog box has been closed.
- **Temporary Visualization** – Visualized elements will be erased after the COGO dialog box has been closed.
- **Disable Visualization** – This option will not allow elements to be visualized from the COGO.

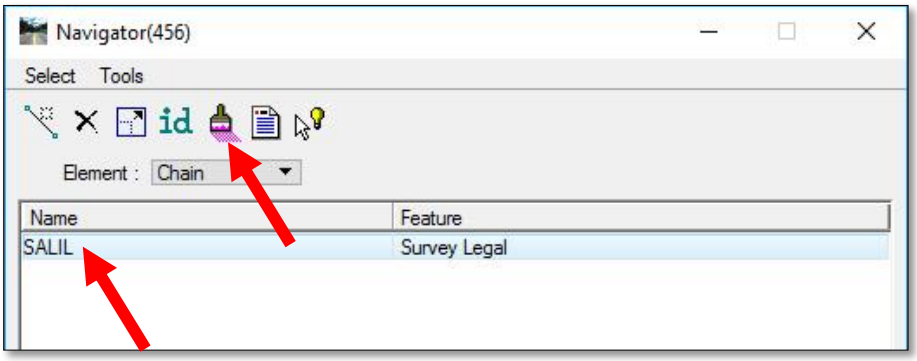
COGO Chain Visualization

Horizontal geometry is stored in the GPK file as a chain and can be displayed in a MicroStation file using COGO Navigator. When COGO elements are visualized, they are drawn on specific levels in the design file. They include those levels beginning with COGO_DEFAULT. A level exists for each element type.

1. To visualize a desired COGO chain in a MicroStation file, select the **Navigator** icon as described in the previous section from the COGO window. In the **Element** dropdown, select **Chain** to view the chains that are stored in the GPK file.



2. Select the desired chain in the Navigator dialog, then select the **Visualize** icon.



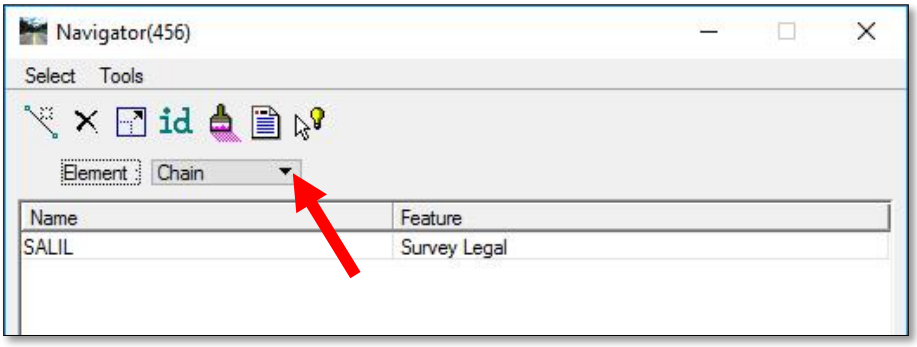
3. The chain should now be displayed in the MicroStation design file. If the chain is not visible execute the **Fit View** command. Also, make sure the **COGO_DEFAULT_CHAINS** level is on.

   NOTE: This function should only be used to display the location of the desired chain. To display an alignment for Plan Production Purposes, refer to the **Plan View Layout – Horizontal Geometry** section of this document.

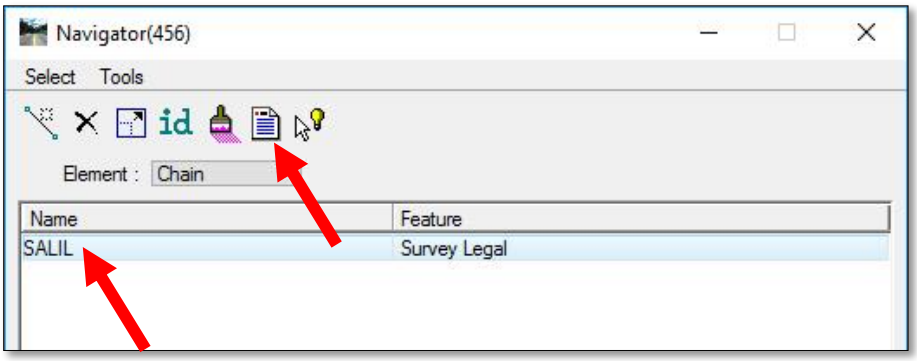
Print / Describe a COGO Chain

The Print/Describe function of a COGO chain allows the complete description of a chain to be displayed in text format in the COGO window. Information includes all point, line, curve and spiral data.

1. To describe a desired COGO chain in a MicroStation file, select the **Navigator** icon from the COGO window. In the **Element** dropdown, select **Chain** to view the chains that are stored in the GPK file.

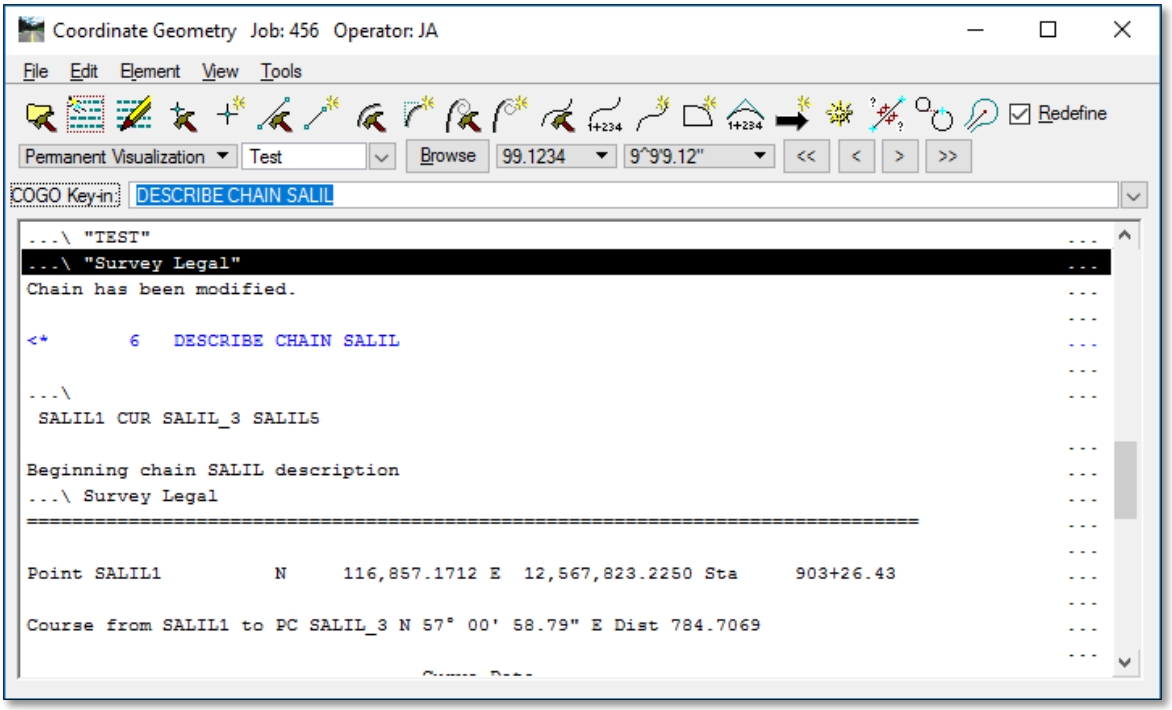


2. Select the desired chain in the Navigator dialog, then select the **Print/Describe** icon.



NOTE: Take note of the **Feature** type for the alignment that will be selected. This will be used later during the **Design and Computation Manager** section.

3. The chain data is listed in the COGO display window. When station equations are present GEOPAK divides the chain into regions. Regions allow GEOPAK to find stations that may exist in multiple locations on a chain. To obtain a hardcopy print of the data displayed in the COGO display window, first highlight the data to be printed. Then right-click on the highlighted text in the display window and select **Print** from the menu.

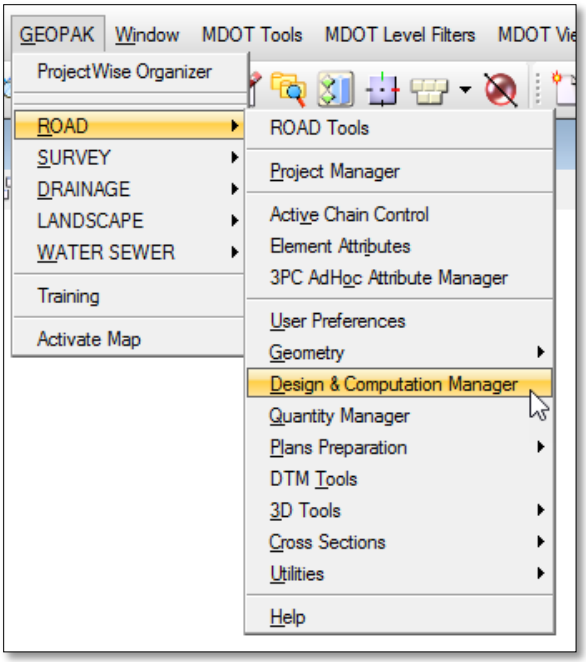


Plan View Layout – Horizontal Geometry

In the previous sections, guidance on how to describe and visualize horizontal geometry using COGO and COGO Navigator was provided. The tools in that section, however, will not allow a designer to display horizontal alignments per MDOT standards for plan production purposes. To display horizontal alignments for plan production, the **Design & Computation Manager** must be utilized.

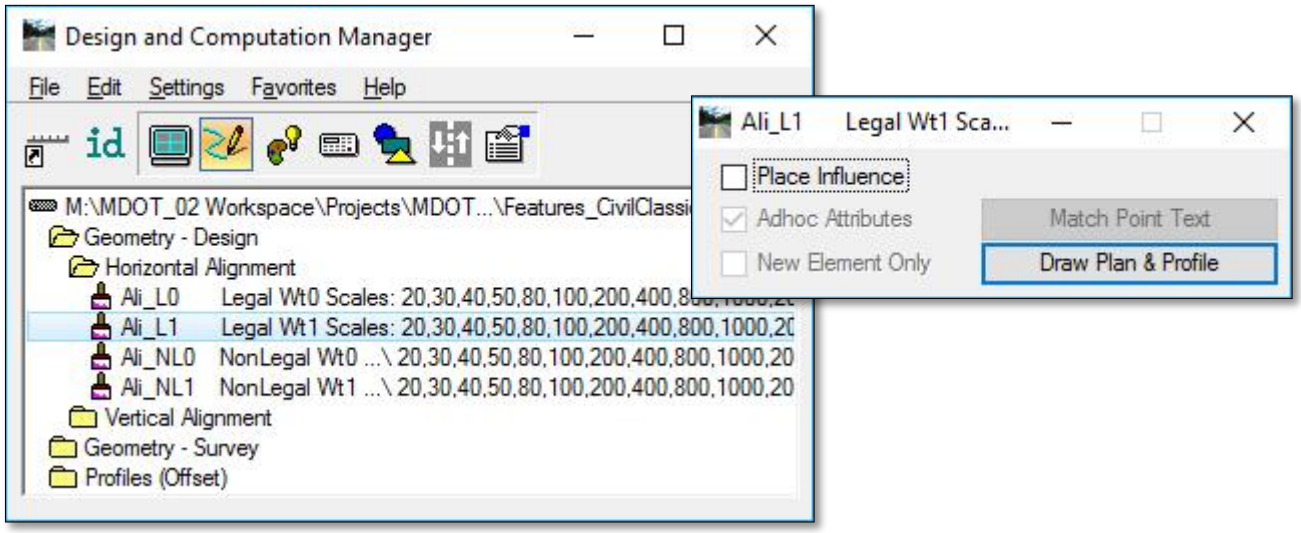
Design & Computation Manager (D&C Manager)

D&C Manager can be accessed through the MicroStation menu by choosing **GEOPAK → Road → Design & Computation Manager**. It can also be accessed through the **GEOPAK Road Tools** and in the Road Project dialog in the Project Manager by selecting **Design & Computation Manager: Design & Computation Manager**.



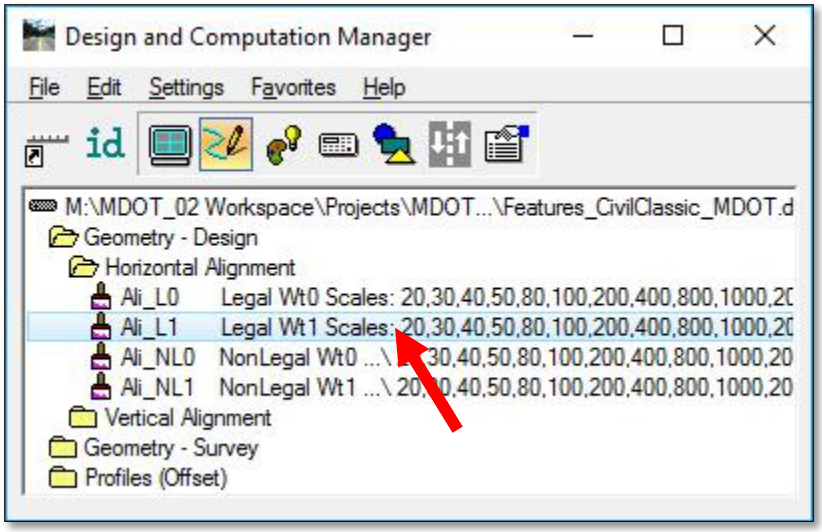
NOTE: It is advisable to open the desired project with the Project Manager prior to opening D&C Manager to ensure the correct GPK is being referenced for plan view layout.

The following two windows are utilized for displaying data:

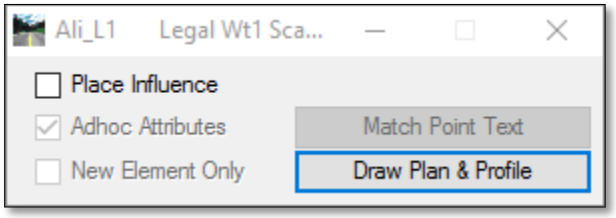


Displaying COGO Alignment Data

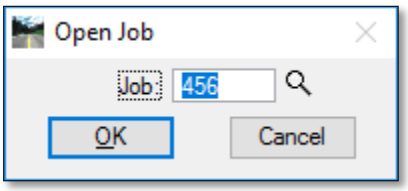
1.) Under **Geometry – Design→ Horizontal Alignment** select the type of feature for the alignment (legal or non-legal as shown in the **COGO Navigator** and the desired weight)



2.) In the second dialog, select **Draw Plan & Profile.** Leave **Place Influence** unchecked.



3.) Prior to opening **D&C Manager**, it is advisable to have the **Project Manager** opened for the desired project to ensure the proper GPK file is being referenced. If the Project Manager is not opened, the following dialog will prompt the user to select a GPK file. Select the desired GPK file by using the magnifying glass icon. If the desired GPK is not listed, close D&C Manager and open the project using Project Manager prior to opening **D&C Manager**.

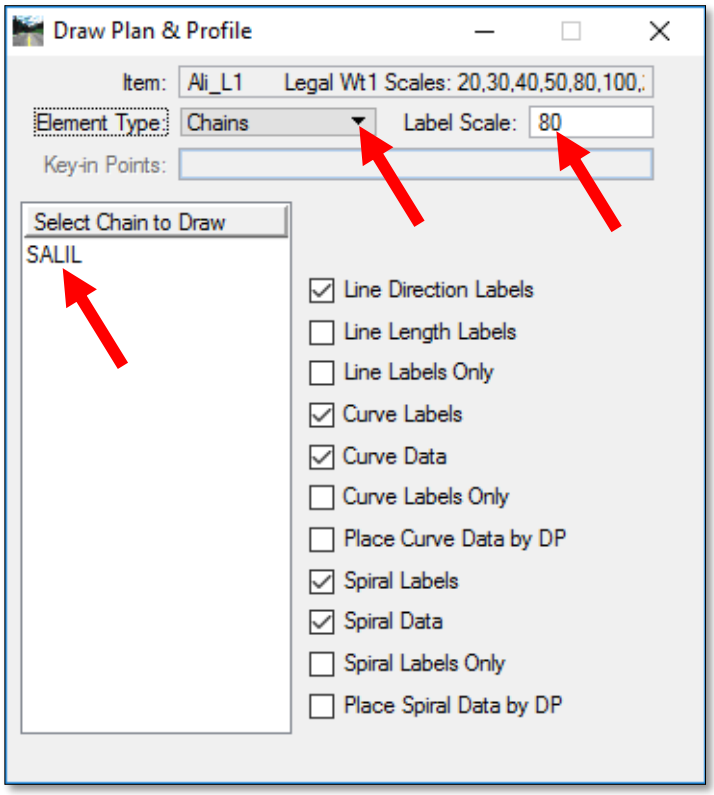


4. In the Draw Plan & Profile dialog, change the **Element Type** to **Chains.**

5. Enter the desired scale for the alignment to be displayed in **Label Scale**. The checkbox options are set by default in the feature and meet MDOT Drafting Standards.

6. Select the desired chain **once** in the **Select Chain to Draw** window. The chain and the chain data will be drawn into the design file. If the elements are not visible, execute a Fit View command. If elements are still not visible, ensure the appropriate levels are turned on.

   Note: Click only **once** on the desired chain. The elements will be drawn into the design file each time the chain is selected.

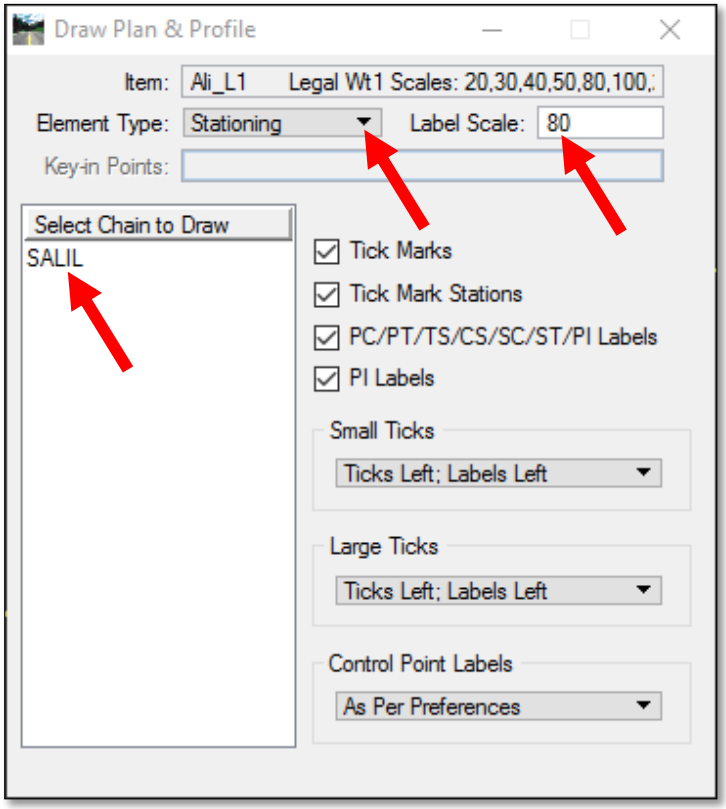


7. After displaying the chain, change the **Element Type** to **Stationing**.

8. Ensure the **Label Scale** is still set at the desired scale.

9. Select the desired chain in the **Select Chain to Draw** location. The desired alignment and stationing should now be drawn in the design file.

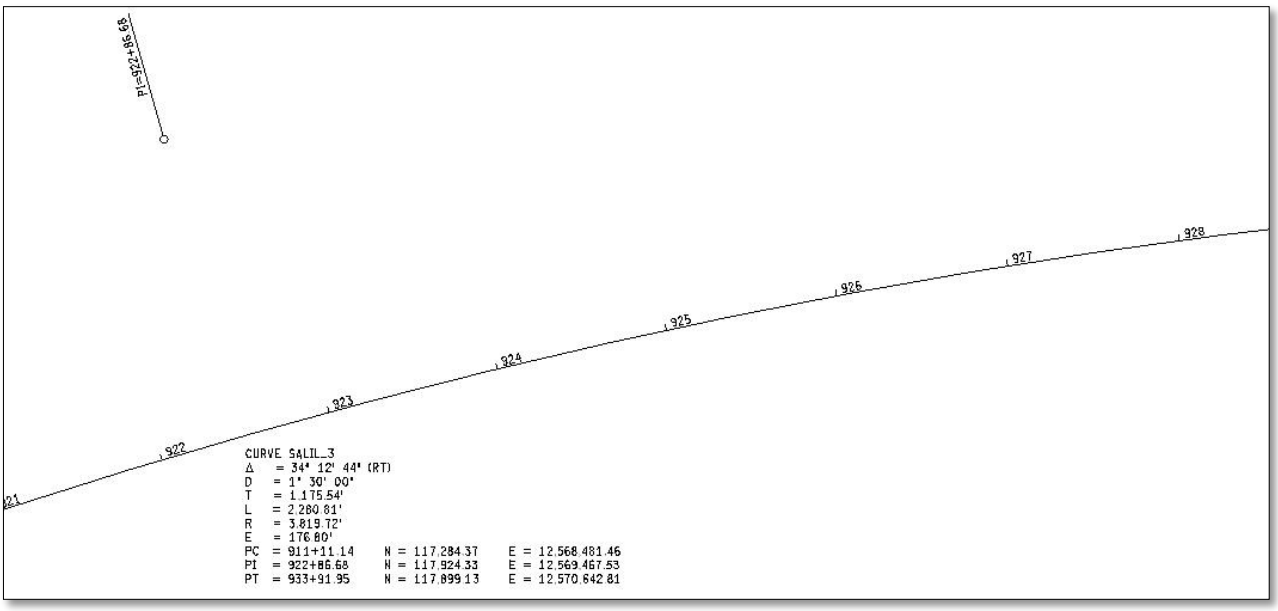
   Note: The stationing and tick marks drawn in the stationing portion are not annotative. Repeat this process in a different file or model for each label scale required on the project.



10. Dismiss the Draw Plan & Profile dialog.

11. Review the results in the design file.

    NOTE: The chain and stationing information plotted into the design file are simple MicroStation elements and are not dynamically linked to the chain in COGO. If the chain is modified in COGO, these elements must be deleted from the design file and redrawn.



Technical Support

Please email any questions, issues or problems associated with this document to:

MDOT-EngineeringSupportTraining@Michigan.gov

Additional Design Services Help and Support can also be obtained through the following email resources:

MDOT-BridgeDesignSupport@Michigan.gov – For help with bridge design software, cells, levels, and workspace tools.
MDOT-Drainage-Utility@Michigan.gov – For help with GEOPAK Drainage, drainage cells and other subsurface utility modeling tools.
MDOT-CaddSupport@Michigan.gov – For help with cells, levels, line styles, dimensions, and other CADD and workspace tools.
MDOT-RoadwayModelingSupport@Michigan.gov – For help with roadway modeling, modeling templates, civil cells and workspace tools.
MDOT-Survey_Support@Michigan.gov – For help with survey data, workflows and processes.