Ferrovia

by CGS Labs

Point Cloud (BricsCAD) Tutorial

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Point Cloud (BricsCAD)

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INTRODUCTION

This step-by-step instruction will lead you through the workflow procedure in order to get familiar with the point cloud and rail reconstruction, using BricsCAD and Ferrovia. At the beginning, BricsCAD commands will be used to get the upper edge of the existing rail from the point cloud. Once you get the lines, the Ferrovia software automatically calculates and draw the alignment with the BestFit method.

1. POINT CLOUD

The user can import and edit Point Cloud, using the BricsCAD function.

1.1 Import Point Cloud

1. Open a new drawing in BricsCAD.

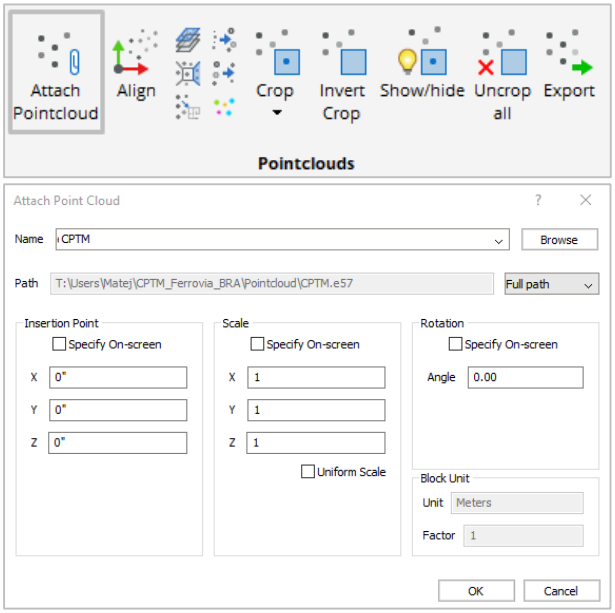
2. Save the drawing.

3. Run the Attach Pointcloud command. if the scan contains multiple files, the user can choose to import one or multiple files or a complete folder. BricsCAD supports formats like: e57, las, pts, ptx, rcp and rcs.

4. Select the Point Cloud file and then select the unit from the drop-down menu. Confirm the parameters in the dialog box.

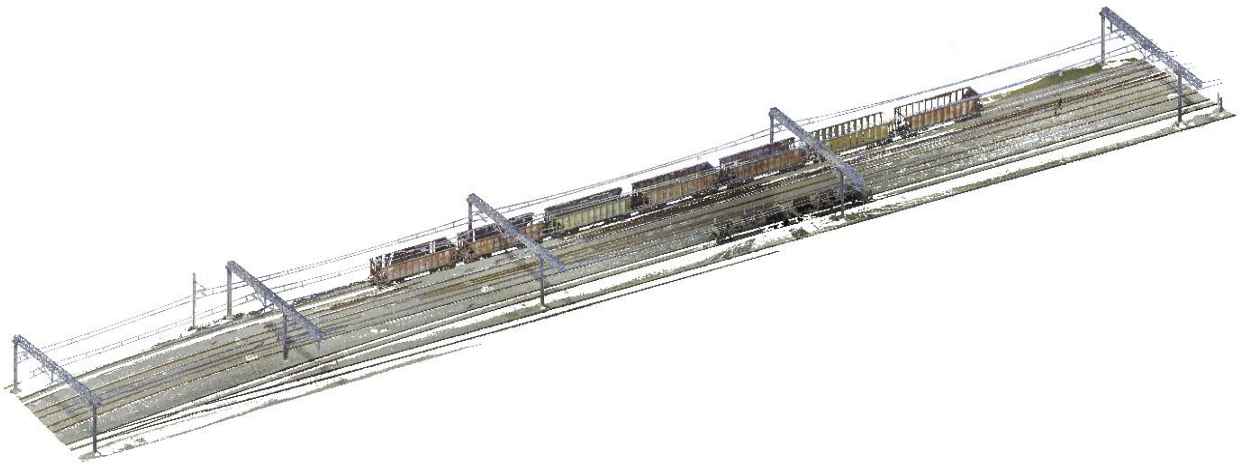
5. Uncheck all checkboxes in the Attach Point Cloud dialog box and click OK.

6. In the Status bar, it will state Point cloud preprocessing. This processing is done in the background.



7. When the pre-processing is done, a message will appear. The points will be automatically displayed in the drawing. If not, the user should set the visual style to realistic.

Point cloud quick overview: This is a terrestrial scanned point cloud (laser scanner position is visible). There are also shadows, where point cloud density is very low.



1.2 Edit the Point Cloud

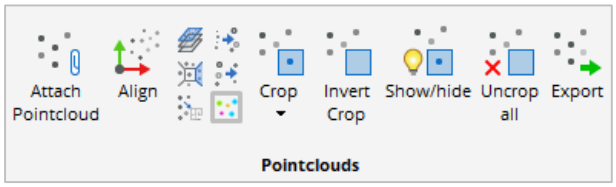
This chapter will describe some of the options for editing the point cloud in BricsCAD software.

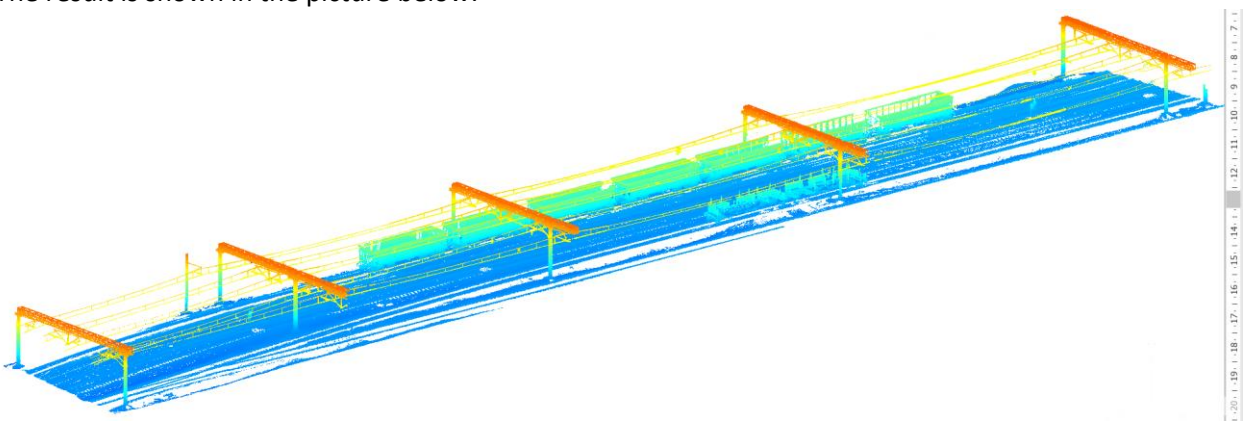
Point Cloud Color Maps

1. Run the Pointcloudcolormap command.

2. Select Elevation option.

3. Select Spectrum option.
The result is shown in the picture below:



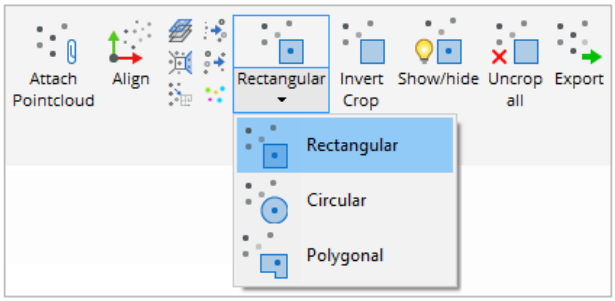


Point Cloud Crop

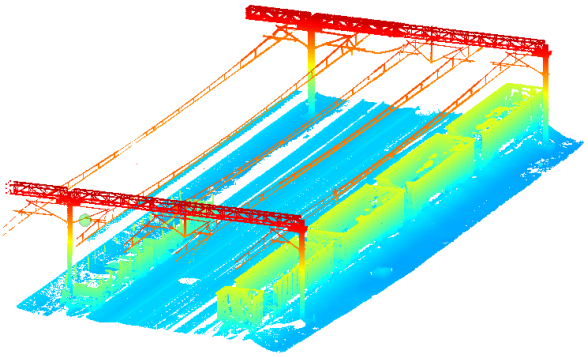
We can crop parts that we don't need in the drawing. Because extra points can make our model bigger and software works slower. It is important that we know that the data that we cropped, they just aren't displayed, not lost.

1. Run the Pointcload crop – Rectangular command.

2. Select Inside or Outside.

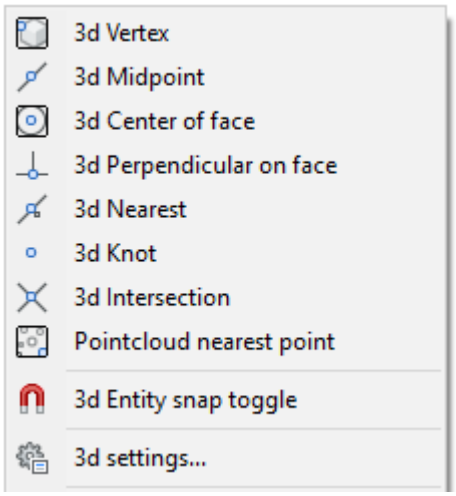


Cropped model is shown on the figure on the right.



Snapping on a Point Cloud

If you want to snap to a Point Cloud you should enable that option.



In BricsCAD there is no (semi)automation tool for feature (line) detection/extraction. Detect floors works for buildings, not for infrastructure (longitudinal) objects.

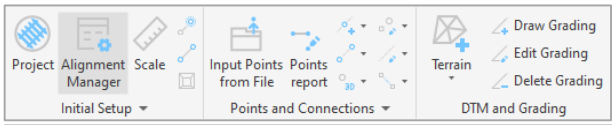
So we need to acquire (vectorising) the rails manually. We can help ourselves with classifications of point cloud (Pointcloud Colormap), which can help us to detect/define the rails

2. ALIGNMENT

2.1 Define new alignment

When we have the (3D) polylines of rails (for this tutorial we vectorised only two rails that represent one alignment), only then the work with Ferrovia starts. For further design we don't need point cloud anymore, so we temporary disable the view.

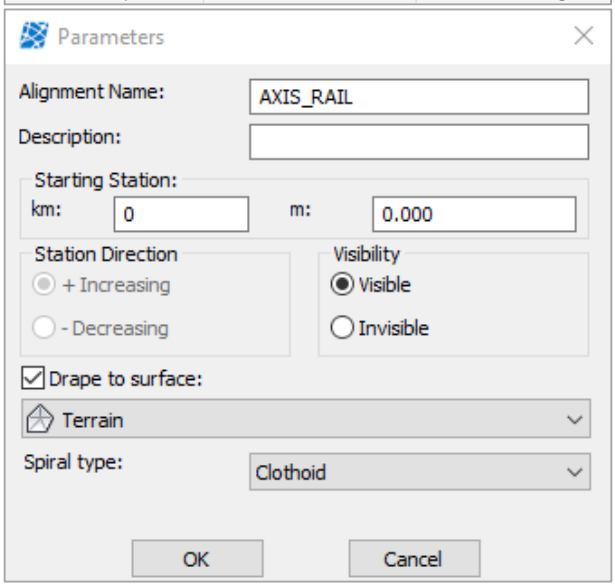
1. Click on the Alignment manager icon in the Layout ribbon to define a new alignment name.



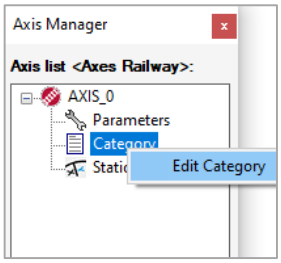
2. In the Parameters sub setting define new alignment name and starting station. Station direction on alignment can increase or decrease.

If you have more than one alignment, you can make a selected one invisible. This means that all layers related to a selected alignment can be automatically switched off. In the drop down menu select the spiral type.

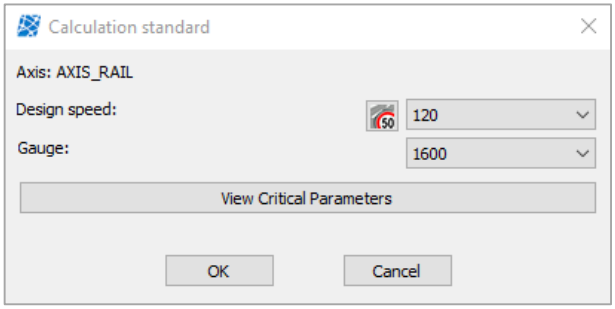
3. When you have defined all the parameters, confirm by pressing OK button.



4. When parameters for new alignment are defined, set the design speed for alignment in Category subsetting and define design speed influences on alignment design parameters.

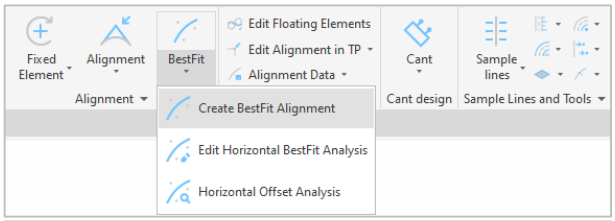


If you press the button  you can define different speeds for different areas along the alignment. At least select the gauge.



2.2 Crate BestFit alignment

1. Run the Create BestFit Alignment command.



2. First, specify that the BestFit alignment will be created from two strings of input objects.

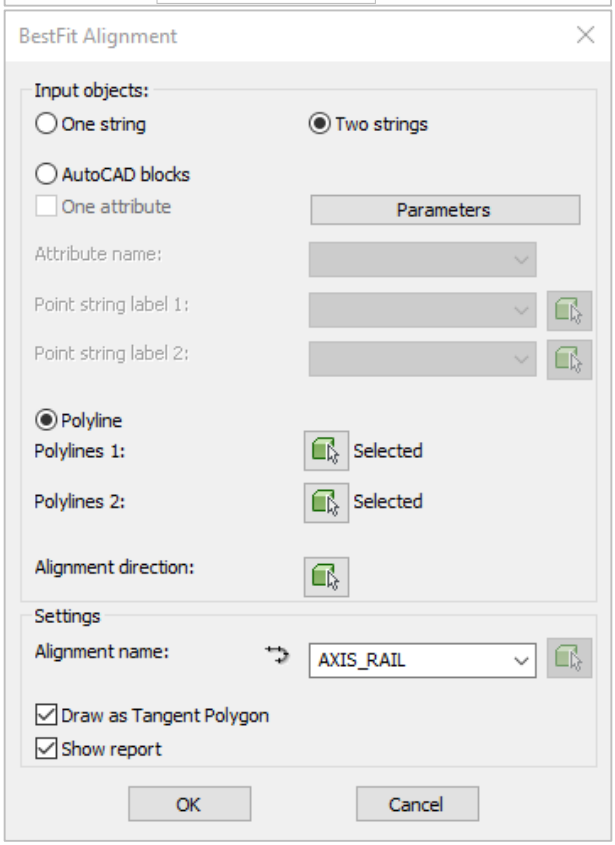
3. Then select Polyline and continue with the selection of the value of polylines that will be used for creating the BestFit alignment.

Press the button to select the Polylines 1 and select the polylines that represent the right railway edge. Then repeat the operation to define the Polylines 2, but in that case, select the polylines that represent the left roadway edges.

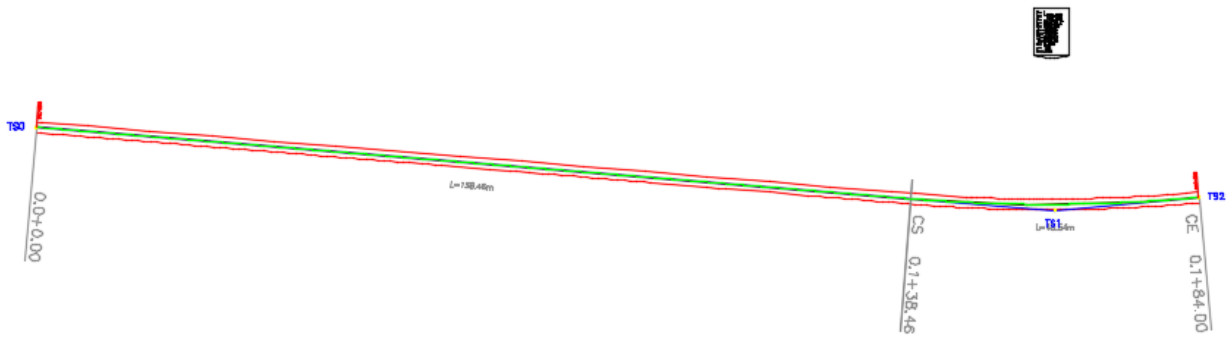
4. Select the alignment name from the drop-down menu.

5. Confirm by pressing the OK.

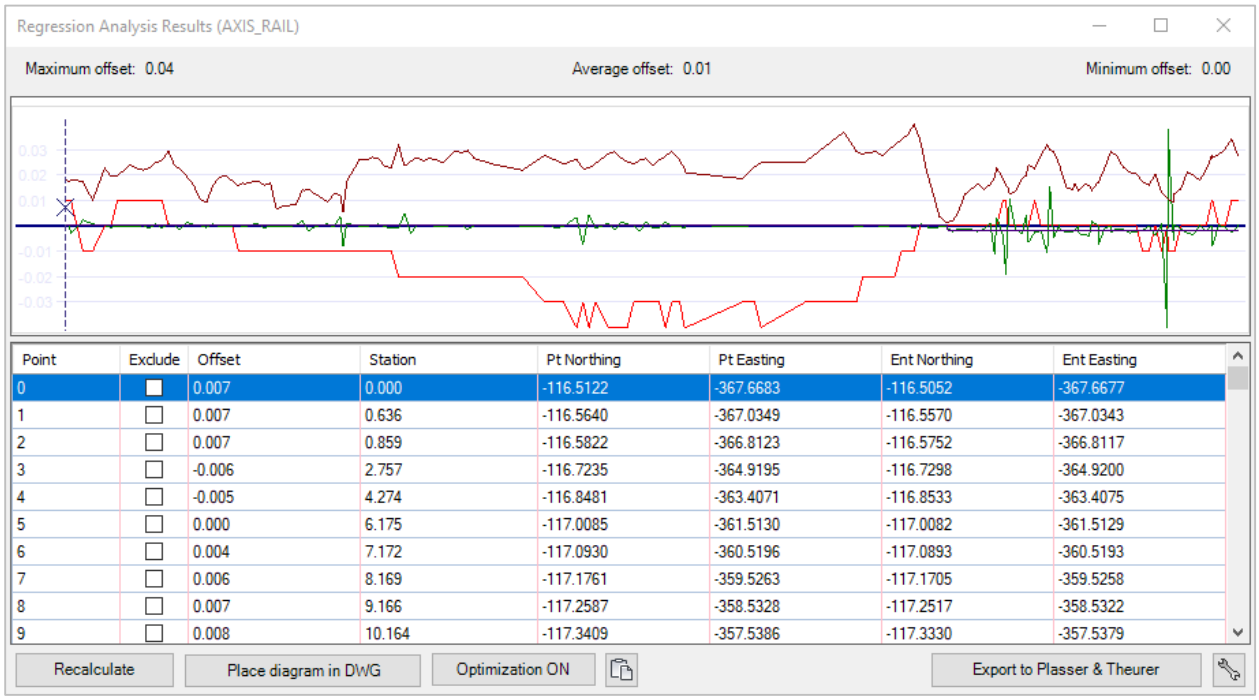
NOTE! If the command reports a message that the creation of BestFit alignment isn't possible, the problem may be that there are double polylines somewhere. Then use the autocad command Overkill and run the BestFit Alignment again.



We get alignment for those 2 rails, defined with main elements (tangent polygon). In this case a tangent and a curve. We also get curve parameters.



Function calculates the regression analysis, and returns the regression report, where we can check the results (how certain railway geometry fits on our vectorized polylines/rails).



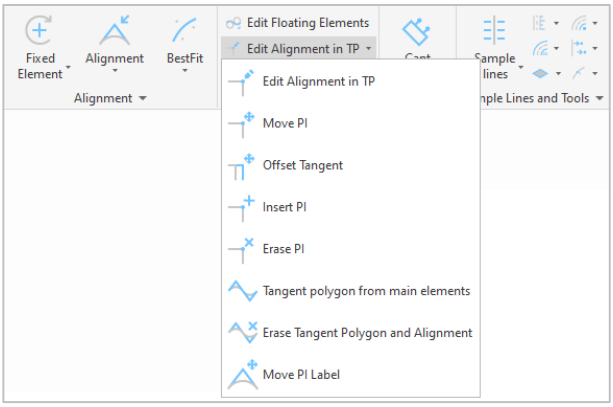
Point	Exclude	Offset	Station	Pt Northing	Pt Easting	Ent Northing	Ent Easting
0	☐	0.007	0.000	-116.5122	-367.6683	-116.5052	-367.6677
1	☐	0.007	0.636	-116.5640	-367.0349	-116.5570	-367.0343
2	☐	0.007	0.859	-116.5822	-366.8123	-116.5752	-366.8117
3	☐	-0.006	2.757	-116.7235	-364.9195	-116.7298	-364.9200
4	☐	-0.005	4.274	-116.8481	-363.4071	-116.8533	-363.4075
5	☐	0.000	6.175	-117.0085	-361.5130	-117.0082	-361.5129
6	☐	0.004	7.172	-117.0930	-360.5196	-117.0893	-360.5193
7	☐	0.006	8.169	-117.1761	-359.5263	-117.1705	-359.5258
8	☐	0.007	9.166	-117.2587	-358.5328	-117.2517	-358.5322
9	☐	0.008	10.164	-117.3409	-357.5386	-117.3330	-357.5379

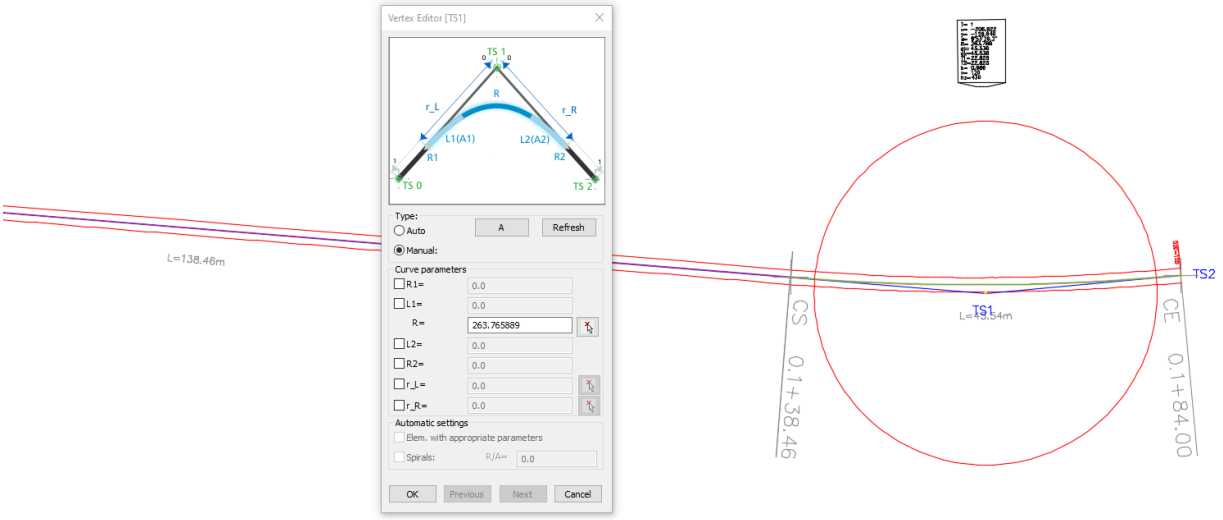
2.3 Editing the alignment

Using the tools from the alignment section you can easily edit the Alignment any time.

For example: Click on Edit alignment and select the tangent polygon. Select manual entry for the type and then enter new curve parameters. When finished, press OK.

Then click on the Move PI icon and select the PI point in the drawing and move it to a different location.

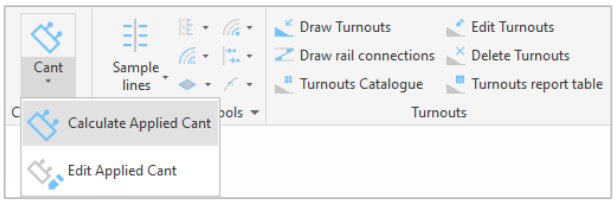




3. CALCULATE APPLIED CANT

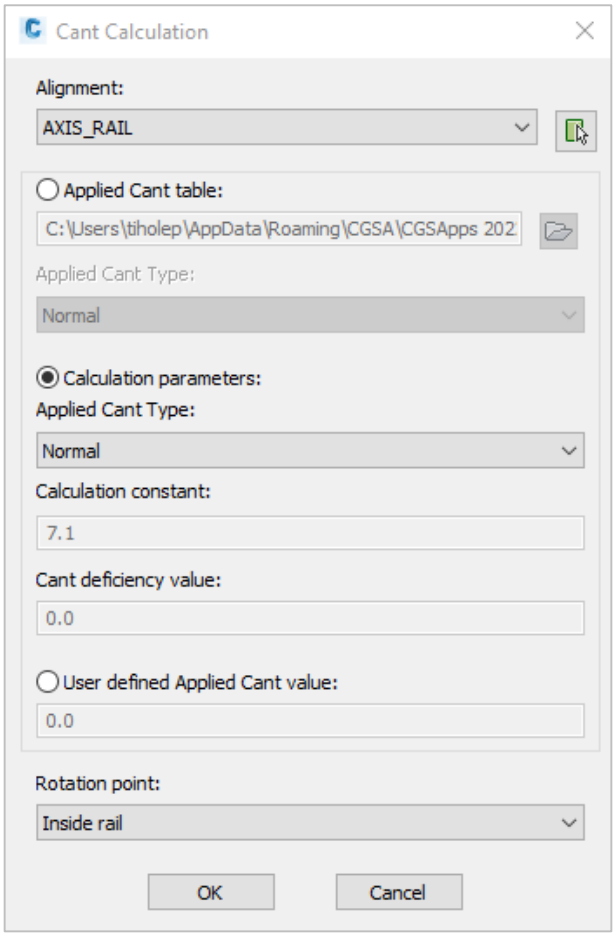
When we are done with alignment geometry, we can continue with calculating cant.

1. Run the Calculate Applied Cant command.



This command reads alignments calculation speed and calculates applied cant for each curve accordingly. Calculate applied cant is not necessary, if we create a tangent polygon with the command Draw tangent polygon. In this case the command calculates applied cant automatically. We simply skip that step.

2. Set parameters in the dialog box for calculating applied cant values:
 - Set current alignment. Specify applied cant calculation method (three options).
 - Applied Cant table: applied cant values are obtained from LRA_CantTable.xml file
 - Calculation parameters: applied cant values are calculated with calculation equation parameters.
 - User defined Applied Cant values. Specify Rotation point (Inside rail, Outside rail, Rail track alignment)



3. Confirm by pressing the OK.

4. CREATE SAMPE LINES

Continue with defining Sample lines on the alignment. Ferrovia offers a variety of tools for designing Sample lines.

1. Click on Sample lines icon.

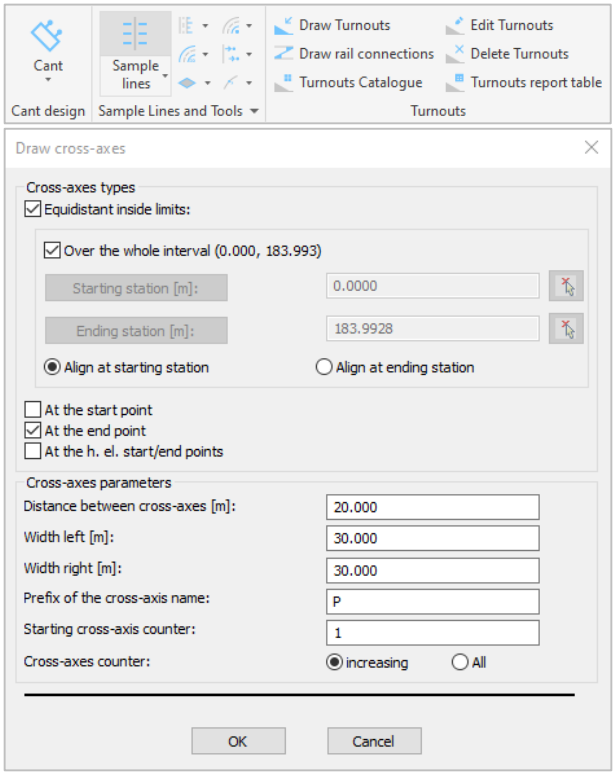
Draw cross-axes dialog box appears. Sample lines are created equidistantly along the whole alignment (check Over the whole interval).

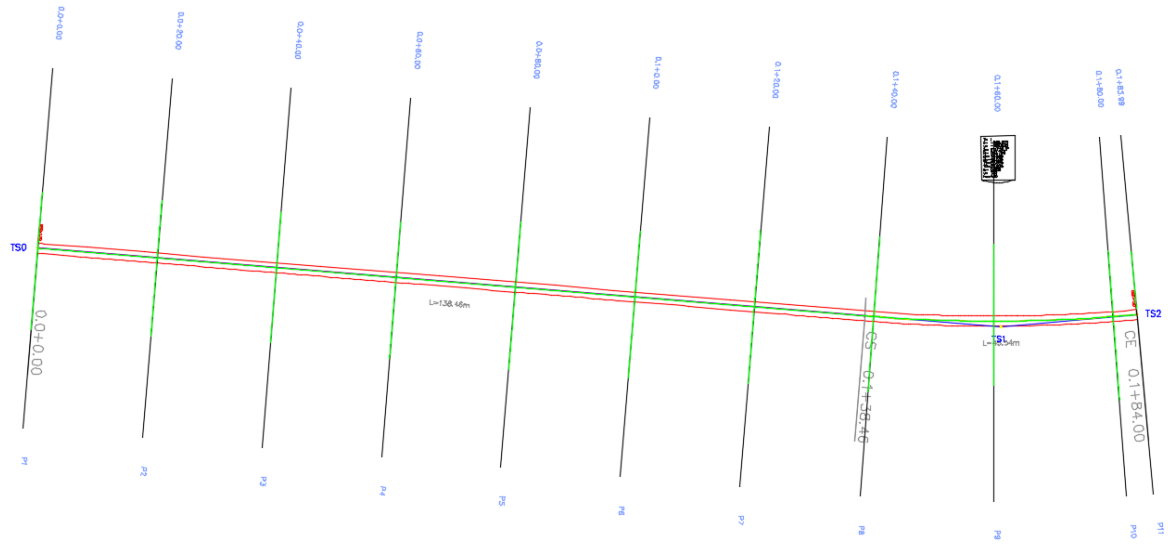
Specify whether sample line is created at the start/end station and in horizontal elements' start/end points.

2. Define Distance between sample lines and Width left/right.

3. Define Prefix of sample line name and Starting counter.

4. Confirm with OK.





5. PROFILE

First, you need to insert the terrain in profile view and then you can continue with drawing tangent.

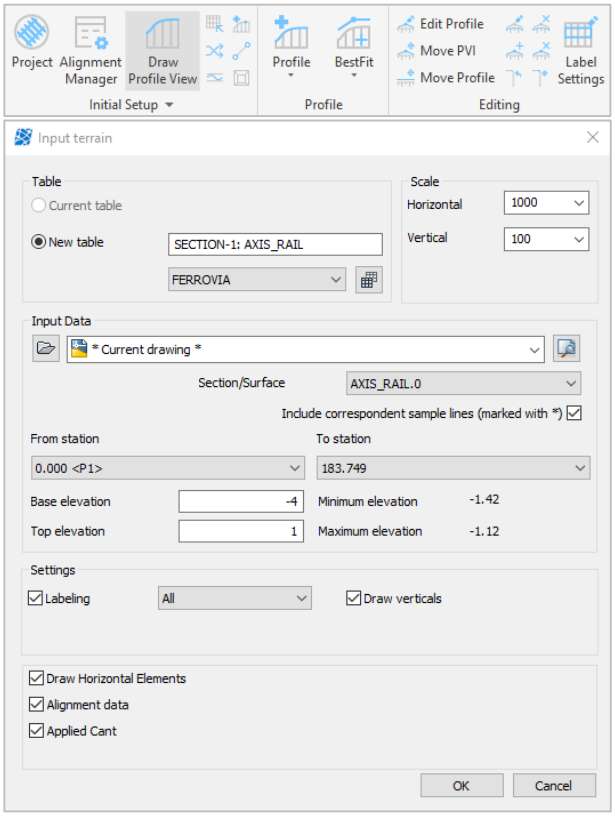
5.1 Draw a profile view

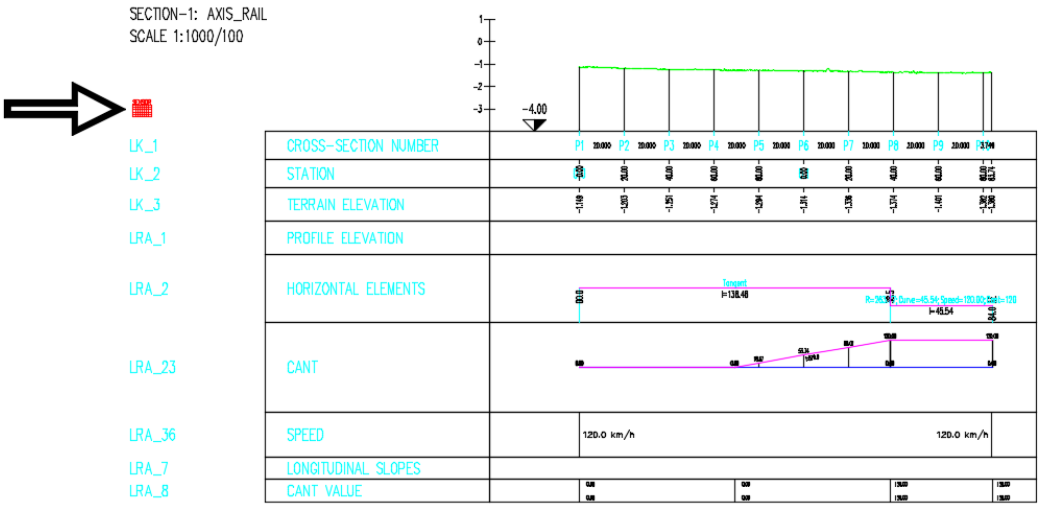
This command reads the data from the source DWG file or LON file, which contains the profile's terrain data and draws the appropriate terrain line. It also enables the user the schematic drawing of horizontal road elements to the active profile.

1. Click on Draw Profile View command.

2. Select Ferrovia table type, for source data use *Current drawing* or select another drawing to which your alignment design was saved if you started to draw profile in a new drawing.

3. Press OK and define the location of profile view in the drawing.





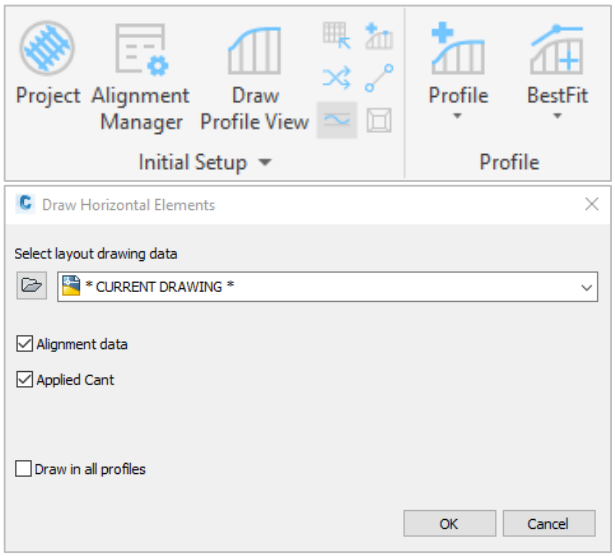
Draw alignment geometry

In case you did not check the option »Draw Horizontal Elements« when defining alignment parameters, you have to draw alignment geometry additionally.

1. Click on the Profile tab and run the Draw alignment geometry command.

2. In dialog box specify layout file (input data), and check all the possible options.

3. Confirm by clicking OK.

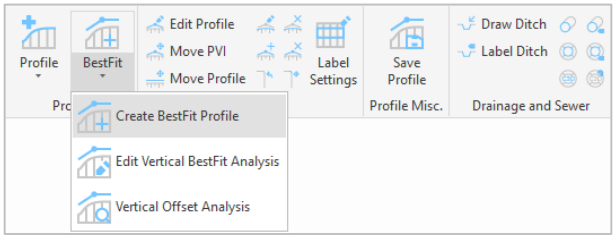


5.2 Draw a profile

In a profile view, you can insert tangents by selecting vertex points interactively. The other option is defining parameters in a dialog box after selecting the first tangent point in the drawing.

1. Click on the Create BestFit Profile command.

The command enables to calculate offset of a selected input object and to create the vertical alignment. Input object can represent one or two sets of survey points as AutoCAD blocks or polylines.



2. Specify that the BestFit alignment will be created from two strings of input objects.

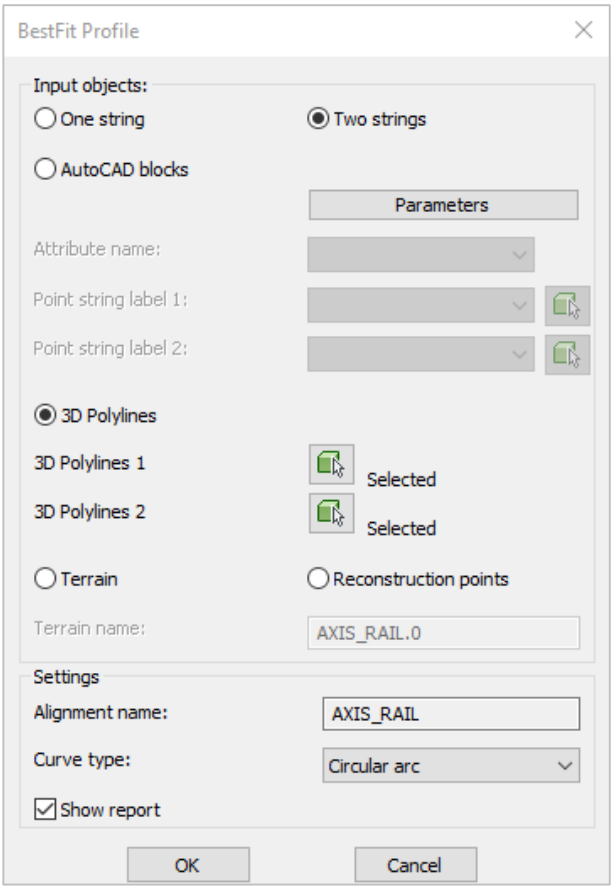
3. Check the box at the 3D polylines.

4. Select 3D Polylines 1 and 3D Polylines 2 in the drawing.

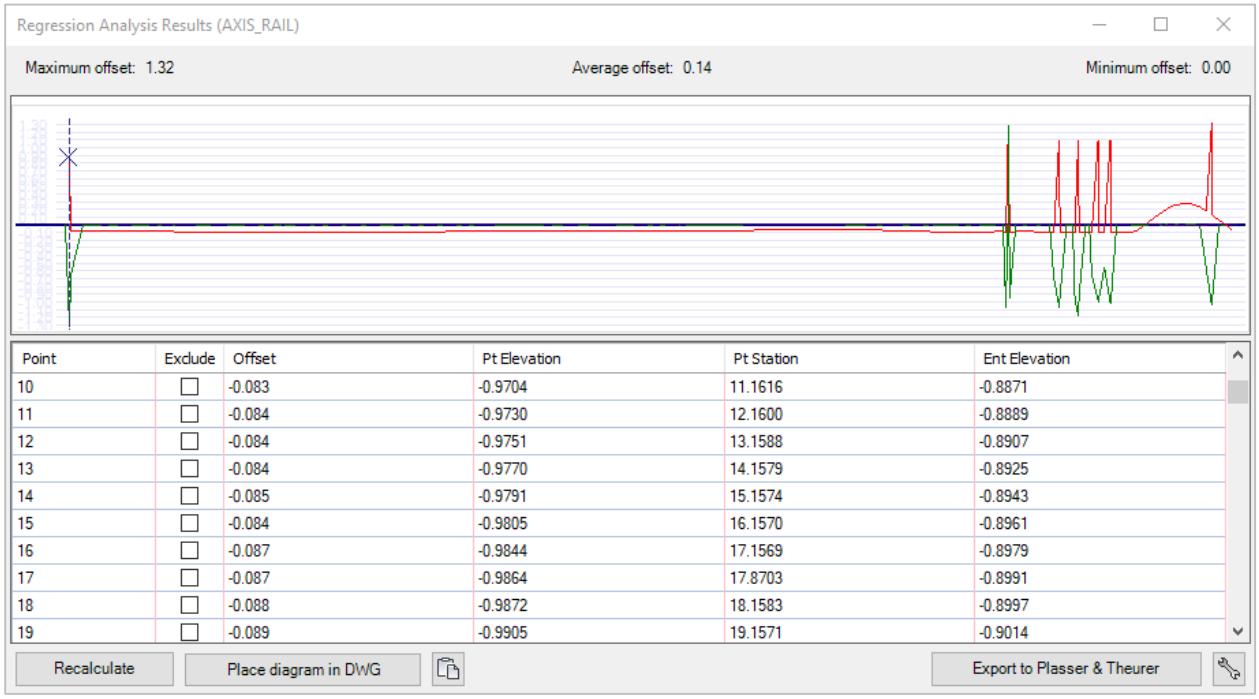
5. Select the curve type from the drop-down.

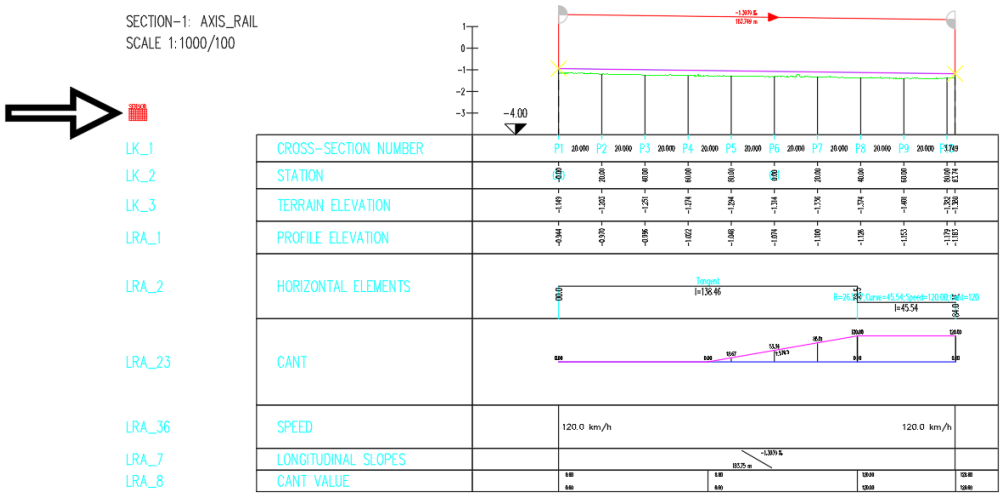
6. To enables to draw horizontal offset report, including regression analysis result tick the Show report check box.

7. Confirm by pressing the OK.



The figure below shows the results of the offset analysis. The program allows checking for each point in the input data set, its offset from the selected Ferrovia axes. Calculation settings are not allowed in the dialog, but it's possible to manage with the diagram settings.





6. CROSS – SECTION VIEW

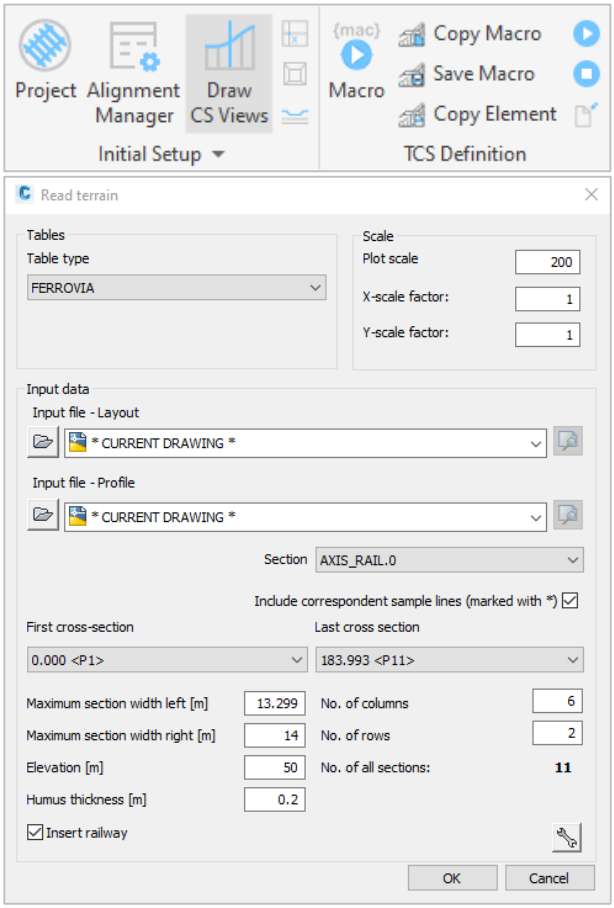
1. Click on Draw CS Views icon.

2. Choose Ferrovia table type, for source data use *Current drawing*, or select another drawing if you started to draw cross section views in a new drawing.

3. Define horizontal and vertical scale of tables inserted.

4. Select the first and the last cross-section in selected sections/segments.

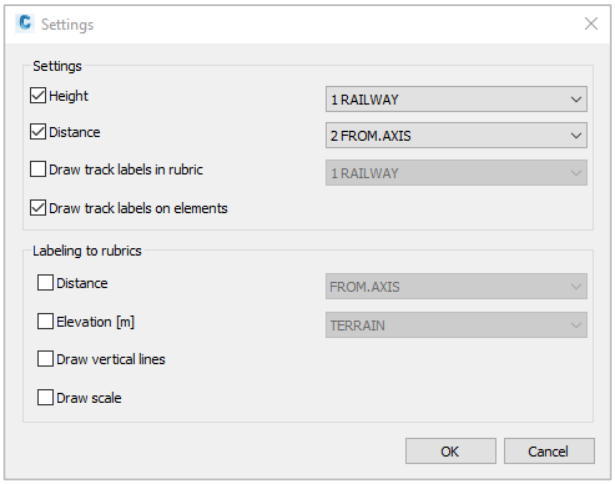
5. If the button Insert railway is checked, the railway will be inserted automatically in the cross sections.

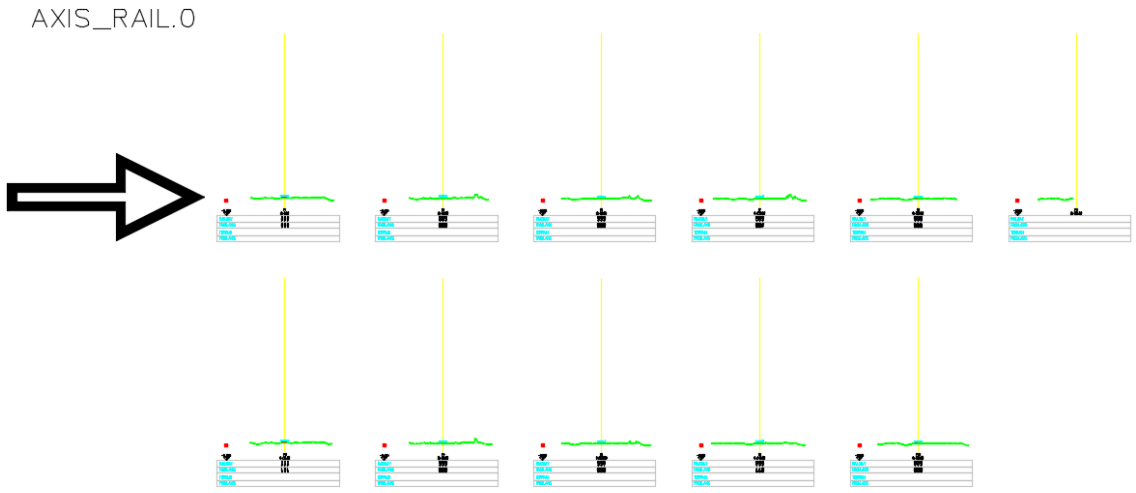


6. Click on the Setting button.

7. Uncheck the boxes at distance, elevation and draw vertical lines. When finished, press the OK.

8. Confirm all the parameters by pressing the OK.

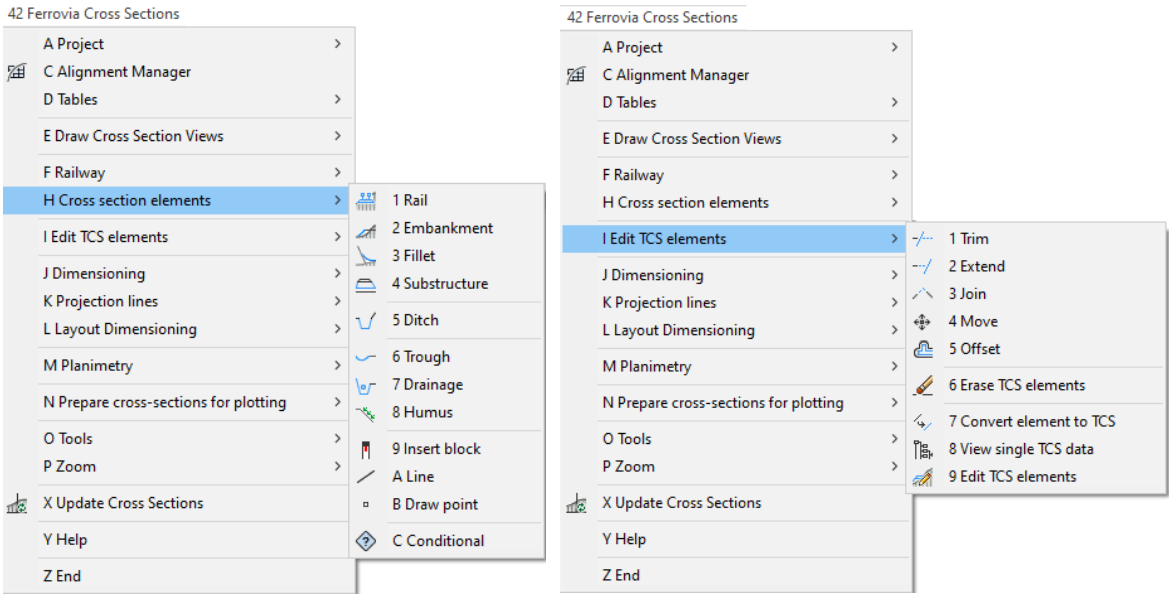




7. DRAW TCS ELEMENTS

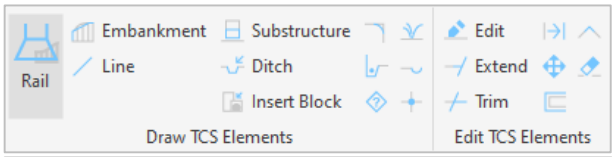
Ferrovia provides capabilities for designing and editing railway cross sections in a detailed way with almost no geometry limitations to the final project design.

The typical cross section elements (TCS) group of commands contains commands for inserting individual TCS elements such as embankments, substructure, ditches, fillets, etc. It is possible to insert TCS elements such as blocks, lines, points, etc.



7.1 Draw rail

1. Click on the Cross Sections tab and click on the Rail icon.



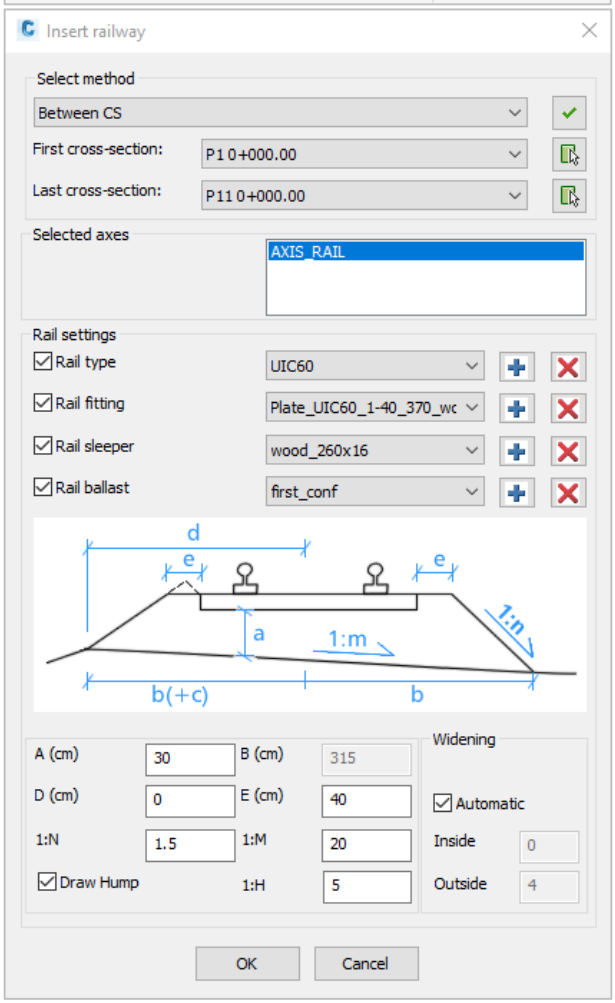
It opens a new dialog box, named Insert railway.

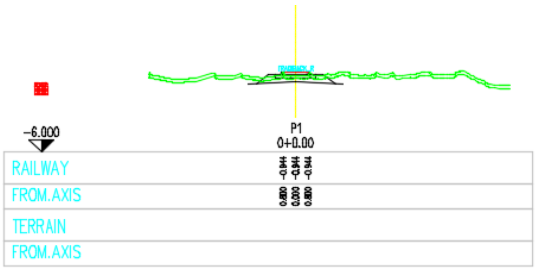
2. At the top of the dialog press tick button to select all cross sections.

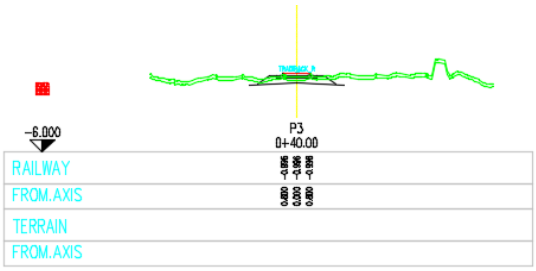
Then define following parameters:

- rail type.
- rail fitting,
- rail sleeper,
- rail ballast

3. Check the box at Automatic Widening and Draw Hum and then click on the OK icon.







7.2 Draw embankment

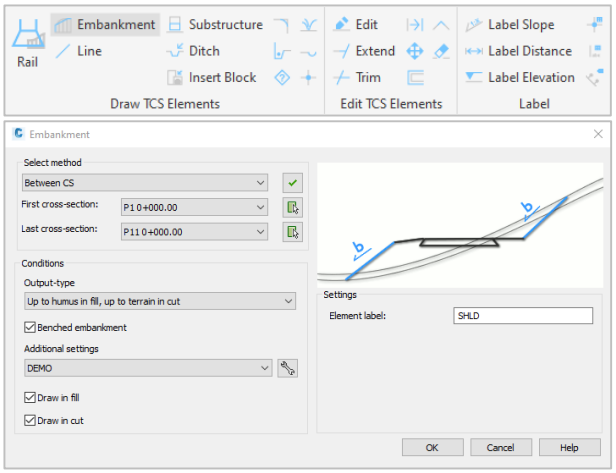
1. Click on the Cross Sections tab and select the Embankment icon.

2. Press the tick button to select all cross sections.

3. From the drop-down menu select Up to hummus in fill, up to terrain in cut, check Draw in fill and Draw in cut and confirm by clicking OK.

4. Click on the left edge of the rail.

Then repeat the same procedure on the right side. Once again click on the embankment icon. Since the parameters remain the same just press OK and click on the right edge of the rail.



8. EDIT TCS ELEMENTS

With this command group it is possible to edit designed cross sections. Only Ferrovia commands should be used, not standard AutoCAD/BricsCAD editing commands.

8.1 Edit TCS elements

Assume that thickness of the substructure should be changed from 40 cm to 60 cm.

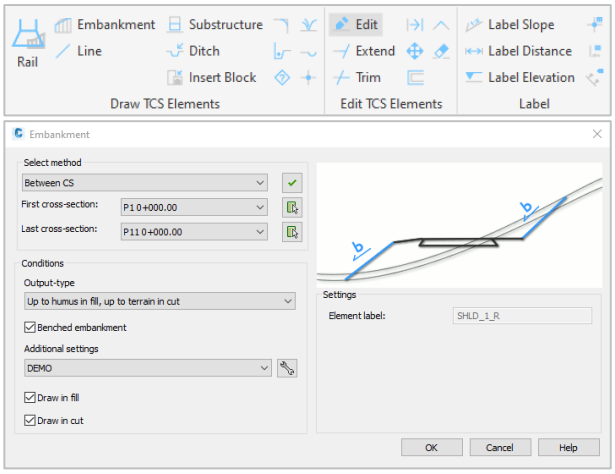
1. Click on the Cross sections tab and select the Edit command.

2. Select the embankment in the drawing.

3. Press the tick button to select all cross sections.

4. Define new name.

5. Confirm by pressing OK.



8.2 Other commands

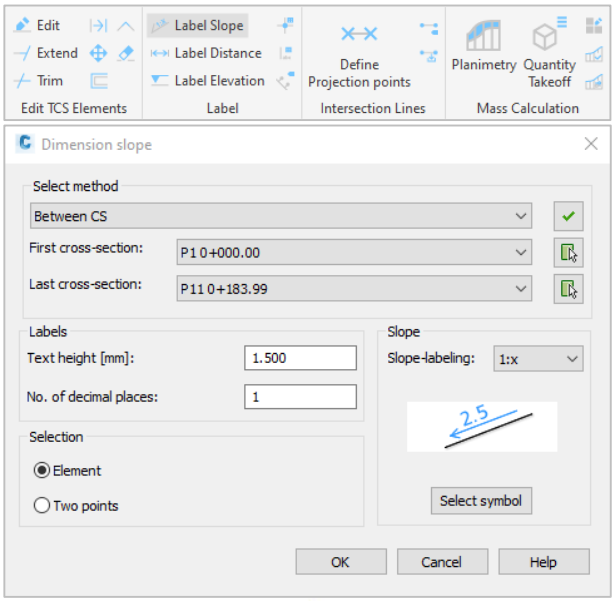
There are also bunch of commands, available for editing TCS elements:

- **Trim**: to trim selected TCS elements
- **Extend**: to extend selected TCS elements
- **Erase**: to erase selected TCS elements
- **Move**: to move selected TCS elements
- **Offset**: to parallel copying selected TCS elements
- **Join**: to join selected TCS elements

9. LABEL TCS ELEMENTS

9.1 Label slope

1. Click on the Cross Sections tab and select the Label Slope icon.

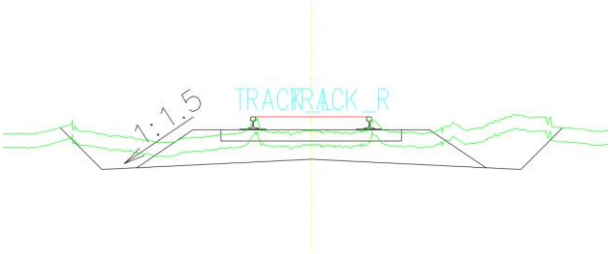


2. Press the tick button to select all cross sections.

3. Define the following parameters:
   Text height [mm]
   No. of decimal places:
   Selection: check *Element.*
   Slope labelling: %.

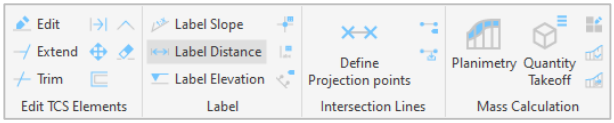
3. Confirm by pressing OK.

4. In the drawing select the element, the slope of which you want to label.



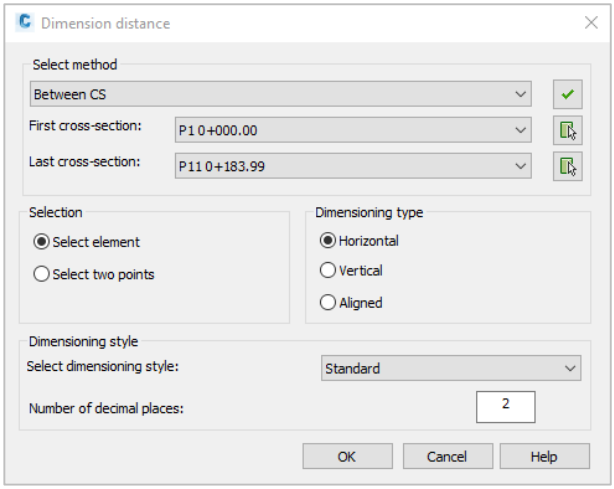
9.2 4.2 Label distance

1. Select the Cross Sections tab and click on the Label Distance icon.



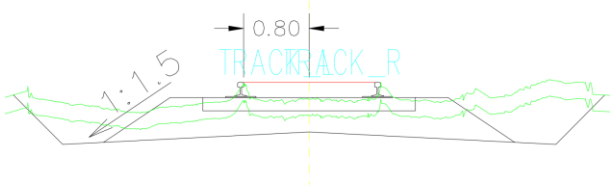
2. Press the tick button to select all cross sections.

Define the following parameters:
Dimensioning type: check *Horizontal.*
Dimensioning style: Standard
Number of decimal places: 2



3. Confirm by pressing OK.

4. In the drawing select the element, the dimension of which you want to label.

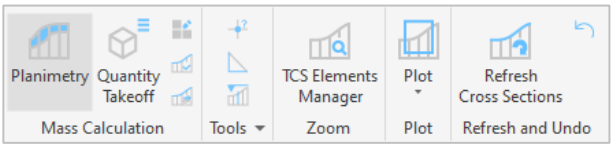


10. PLANIMETRY

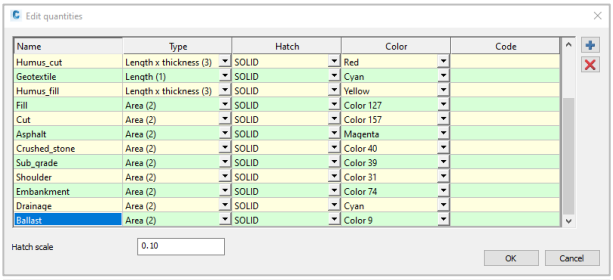
Based on constructed cross-sections, it is possible to precisely calculate the cut, the fill and other volumes. The calculation is based on the so-called planimetry polygon lines that represent borders of planimetry quantities.

1.1 Ballast

1. Click on the Cross Sections tab and select the Planimetry icon.



2. In the dialog box press the tick button to select all cross sections and define the type of the planimetry quantity.



3. Click on the button next to the list of materials. It opens a new dialog, where you add and edit quantities.

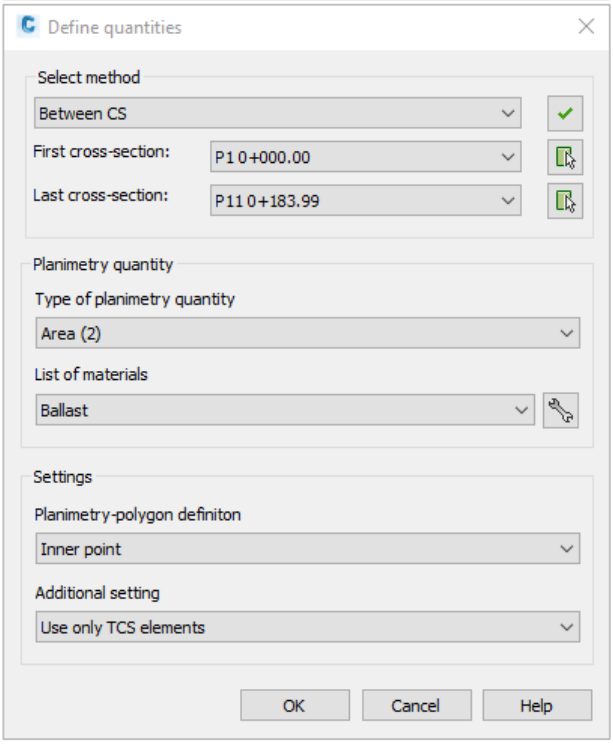
4. Press the plus button and define new quantity. Enter the name Ballast and select the colour from the drop-down menu.

5. When finished, press OK.

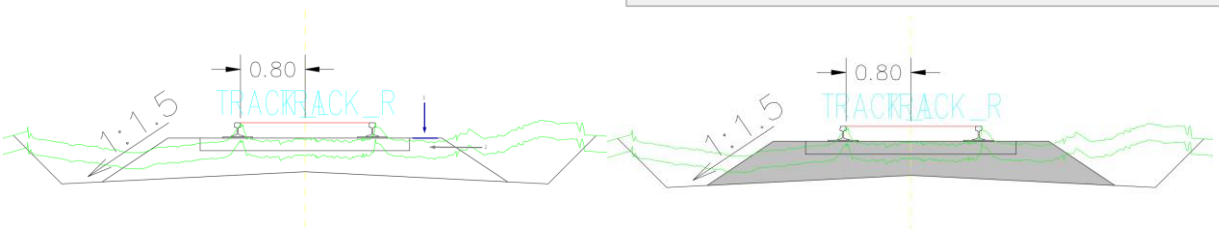
6. Select a new defined material from the list.

7. Select Inner point for the Planimetry-polygon definition and then define the additional settings.

8. Confirm by pressing OK.



9. Click on the line, which represents the upper edge of the Ballast and then select any point in the planimetry-polygon area.



11. QUANTITY TAKE - OFF

The command calculates the quantities by sections as well as for the whole area. The results can be saved to a file and/or displayed in the drawing.

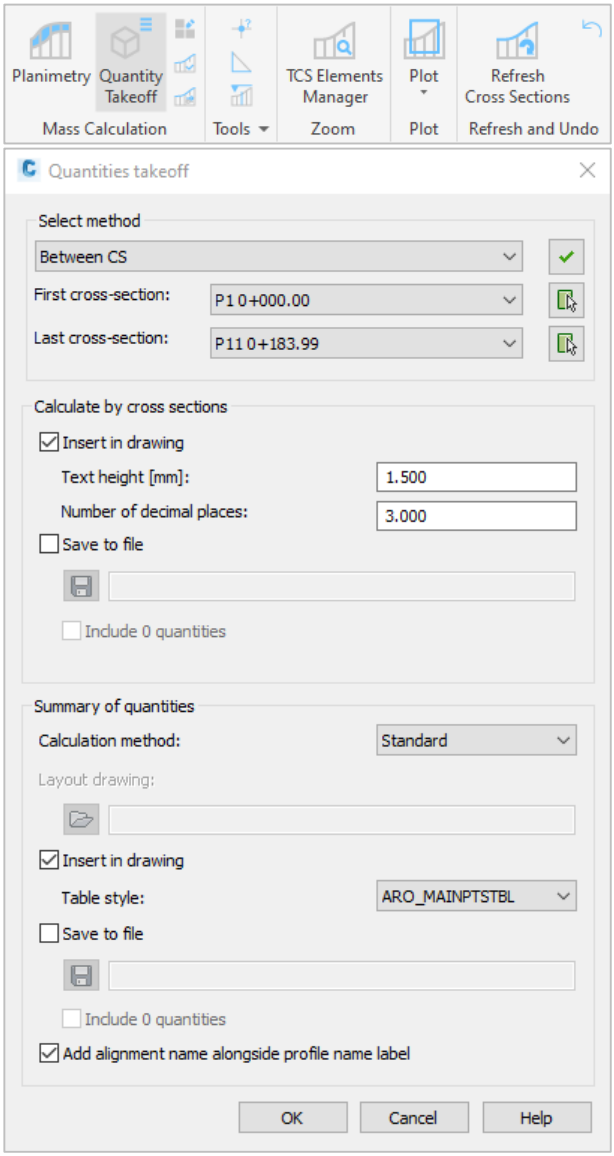
1. Click on the Cross Sections tab and select the Quantity take-off icon.

2. Press the tick button to select all cross sections.

3. Check insert and select the location for planimetry labels in the drawing.

4. For summary of quantities calculation, check insert in drawing option and define an insertion point of quantity table in the drawing.

5. Confirm by pressing OK.



12. BIM MODEL

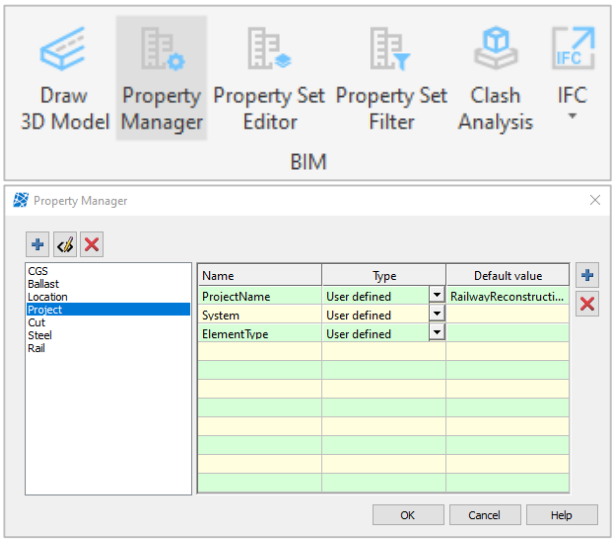
12.1 Property Sets

If you want to create a BIM model, you should first define property sets. You can define them with Property Manager command.

1. Run the Property manager command.

2. Press the Plus button to define new property set. After that select that new defined Property Set on the left and define attributes. You can add attributes by pressing the plus button on the right.

3. When you have finished, confirm by pressing OK.



12.2 Create 3D Solid model

1. Create 3D Solid model with Draw 3D Model command.

2. In Layout/alignment enter the alignment drawing, in Profile enter the drawing of the profile and in Cross sections enter the drawing of the cross-sections of the railway. Data sources can be either in one group or in separate DWG-drawings.

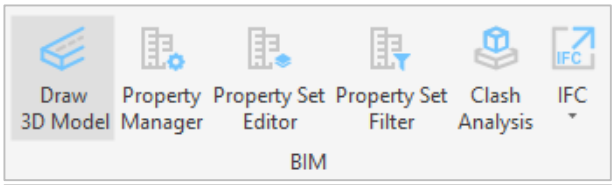
3. In the Select alignment select the main alignment and define the starting and ending cross section.

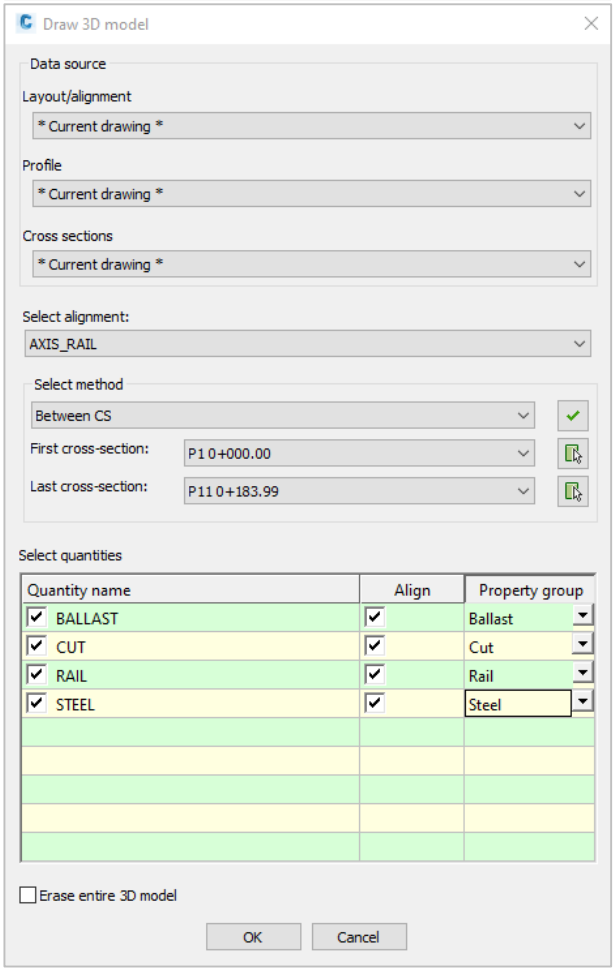
4. Check planimetry quantities you want to create a 3D solid model from.

5. Check Align to connect the consecutive planimetry polygons along the alignment. Otherwise it connects the adjacent planimetry polygons with sectional straight lines.

6. Select Property Sets from the drop-down menu.

7. Confirm by pressing OK.





12.3 Property Set Editor

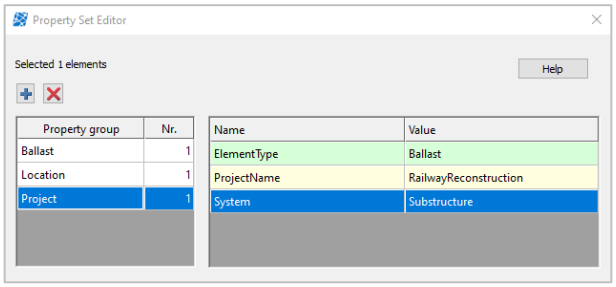
Property Set Editor user interface enables users to assign, add, change or remove property set data to a single or multiple 3D solid elements, selected in the drawing.

1. Run the Property Set Editor command.

2. Select an element in the drawing and its property sets and attributes will be displayed in the dialog box.

3. Press plus button to add new property sets (3 property sets can be attached to one element).

4. Change the value of the attributes in the right table, by simply clicking in the cells.



12.4 Property Set Filter

Property Set Filter enables users to quickly find 3D solid objects with the drawing by listing material definitions assigned to 3D solid objects and manipulate these objects as:

- select 3D solid in drawing,
- isolate 3D solids with selected material definition and
- hide 3D solids with selected material definition.

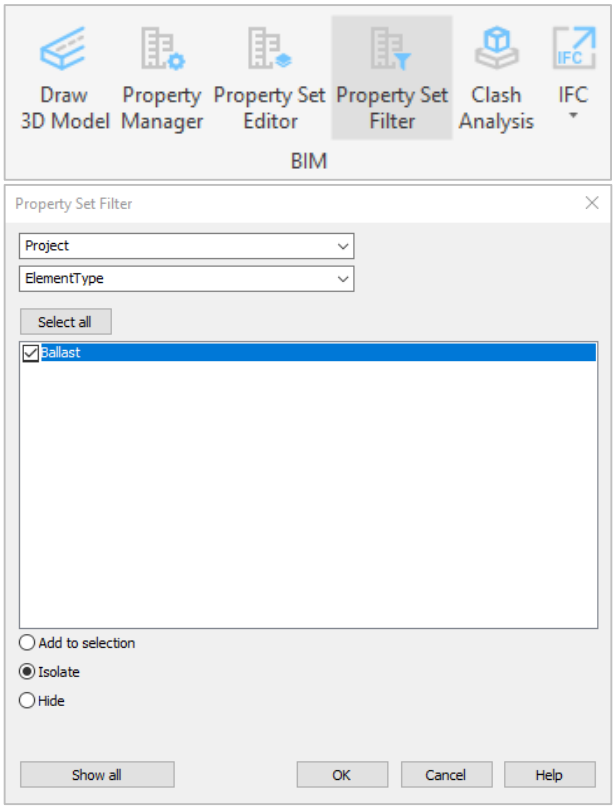
1. Run the Property Set Filter command.

2. Define a search set.

3. Select if you want to add those elements to existing selection or if you want to isolate or hide them.

4. Confirm by pressing OK.

According to the parameters shown in the figure on the right, all elements of the Ballast type are isolated in the drawing.



13. IFC export

1. Run the IFC export command.

IFC export dialog box opens.

2. Select the IFC schema. You can choose between IFC4.1 and IFC2x3.

3. Select path to save the IFC.

4. Define project and building name.

5. Click on the Plus button and select the objects to export.

6. Confirm by pressing OK.