# Spectra Geospatial Origin Roads

## User Guide

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# 1

# Roads

The Origin Roads software is a specialized application for surveying roads and similar linear objects.

The Roads software can be used to survey roads where the road design is defined in a road design file, or where you can build elements of a road (or other similar objects) by selecting one or two strings to stake relative to a primary stationing string. When staking one string you can also define a surface, if required.

When surveying with a road design file you can:

- Upload an existing road design consisting of an alignment with one or more related strings that define the road, or with related cross section templates.

  Supported file types are RXL, LandXML and GENIO. For more information on GENIO files, refer to the *Spectra Geospatial Origin GENIO Roads User Guide*.
- Key in an RXL road design definition including horizontal and vertical alignments, templates, and superelevation and widening records.
- Review the road definition.
- Stake out the road.

When surveying using strings and surfaces or two polylines you can:

- Stake single strings relative to a primary stationing string, for example traffic islands or curbs. Or stake two strings relative to a primary stationing string, for example the top and bottom edge of an embankment or construction earthworks.

  Strings can be lines, arcs or polylines that are keyed in to the job or they can be selected from any linked files that contain linework.
- Stake two polylines where you want station and offset and cut/fill to both polylines at the same time.

Generate a report for the as-staked road data to check data in the field, or to transfer data from the field to your client or to the office for further processing with office software.

## Using the Roads app

To use Roads, you must switch to the Roads app. To switch between applications, tap ☰ and tap the name of the app you are currently using, and then select the application to switch to.

> **TIP –** The Roads app includes the full **Cogo** menu from General Survey so that you can carry out coordinate geometry (cogo) functions without having to switch to General Survey. You can also access some of these cogo functions from the tap and hold menu in the map. For information on all available cogo functions, refer to the *Spectra Geospatial Origin General Survey User Guide*.

When starting a survey you are prompted to select the survey style you have configured for your equipment. To learn more about survey styles and related connection settings refer to the appropriate topics in the *Origin Help*.

To customize the terminology used in the software, tap ☰ and select **Settings** / **Language**. Select:

- **Use railroad terminology** if you are surveying a railroad and wish to use railroad-specific terminology.
- **Use chainage distance terminology** to use the term **Chainage** instead of **Station** for the distance along the road.

# 2

# Road workflows

The Origin Roads software supports two main workflows for staking roads and similar linear objects.

### Road design files

The **Road design file** workflow enables you to stake from a road design file that consists of an alignment (the road centerline) with either one or more related strings that define the road, or related cross section templates. All stationing is derived from the alignment.

Supported road design files are RXL files and LandXML files.

For more information on how to create and use these files, see Road design files, page 6.

### Strings and surfaces

The **Strings and surfaces** workflow enables you to stake strings as linear objects similar to roads, typically when you do not have a road design file. For example, you can stake traffic islands or curbs, or the cut and fill of any linear feature that has a top surface and a bottom surface, such as an embankment or construction earthworks.

Strings can be lines, arcs or polylines that are keyed in to the job or they can be selected from any linked files that contain linework, including DXF, IFC, or 12da files.

Select a string as the primary stationing string and then stake one or two strings with stationing relative to the primary stationing string. When staking one string you can also select a surface. When staking two strings a surface is created between the strings. Additional surfaces can also be selected.

For more information, see Strings and surfaces, page 24.

# Road design files

Road design files are single files that consists of an alignment (the road centerline) with one or more related strings that define the road, or with related cross section templates. All stationing is derived from the alignment.

Supported road design files are RXL files and LandXML files.

For information on how to create these files and use them in Origin Roads, see:

- RXL roads, page 7
- LandXML string roads, page 8

- LandXML cross section roads, page 19

**NOTE –** The Roads software supports LandXML roads where the horizontal alignment is defined by elements or points of intersection (PI's). However LandXML files with arcs defined by **spiral-arc-connectingSpiral-arc-spiral** are not supported.

# RXL roads

An RXL file is a Trimble RoadXML file that defines an alignment (the road centerline) with with related cross section templates that define the road. All stationing is derived from the alignment.

## Create an RXL file

RXL road files can be created using:

- Origin Roads software. See Define an RXL road, page 25.
- Survey Office software.
- A third-party design package such as Autodesk AutoCAD Land Desktop, Autodesk Civil 3D, Bentley InRoads, and Bentley GEOPAK.

## Add the RXL file to the Layer manager

1. In Origin Roads, tap ⧉ in the **Map** toolbar to open the **Layer manager** and select the **Map files** tab.
2. Tap **Add** and then select the RXL file from the Origin project folder on the controller, or from Trimble Connect if the project you are working in is a cloud project. Tap **Accept**.

   By default, the RXL file you have linked to the job is visible in the map, indicated by the check mark next to the file name ✔ .
3. To make items in the RXL file selectable, tap the file name in the **Map files** tab. A check mark inside a square ☑ indicates items in the file are selectable.
4. To close the **Layer manager**, tap **Accept**.

**NOTE –** The Roads software treats all road distances, including station and offset values, as grid distances. If a ground coordinate system is defined in the job, the grid coordinates are, in effect, also ground coordinates.

## Next steps

Once you have linked the RXL file to the job, you can:

- Review the road design, page 60
- Edit the definition of the road

- Stake the road, page 74

# LandXML string roads

A LandXML string road is a LandXML file that consists of an alignment (the road centerline) with one or more related strings that define the road. All stationing is derived from the alignment.

## Source LandXML string road files

LandXML cross section road files are created from various office software packages including Survey Office, Tekla Civil, Trimble Novapoint and Autodesk Civil 3D.

> **NOTE –** When defining the road in the office software, Spectra Geospatial recommends that you avoid vertical faces. When one string has the same offset as another, the Roads software can connect the strings in the wrong order when it joins the strings to display the cross sections. To avoid this issue, define one of the strings with a slight offset from the other. For more information, see Export LandXML string roads from your office software, page 9.

While the traditional LandXML string format does not include support for side slopes, Spectra Geospatial has extended the LandXML format to include support for side slopes. LandXML string files exported from Survey Office will have the side slopes defined. You can also use Origin Roads to define or modify side slopes for a LandXML string road created from any office software.

For tips on the best way to export LandXML string roads from your office software, see Export LandXML string roads from your office software, page 9.

## Add the LandXML string road to the Layer manager

1. In Origin Roads, tap ⧉ in the **Map** toolbar to open the **Layer manager** and select the **Map files** tab.
2. Tap **Add** and then select the LandXML string road file from the Origin project folder on the controller, or from Trimble Connect if the project you are working in is a cloud project. Tap **Accept**.

   By default, the file you have linked to the job is visible in the map, indicated by the check mark next to the file name ✓ .
3. If a file has invalid spiral geometry, a message explains that the horizontal alignment has been adjusted using the following rules:
   - For spirals the radii and lengths values in the file are retained but the end coordinates are adjusted to fit.
   - For arcs the radii values in the file are retained but the lengths and coordinates are adjusted to fit.

   Tap **OK** to dismiss the message.

4. To make items in the file selectable, tap the file name in the **Map files** tab. A check mark inside a square ☑ indicates items in the file are selectable.
5. To close the **Layer manager**, tap **Accept**.

## Edit the LandXML string road

**LandXML string roads** are ready to review and stakeout in Origin Roads when you export them from your office software. You can also edit the road to add items to or exclude items from the road in Origin Roads.

To edit the road, tap the LandXML string road in the map to select it and then tap **Edit**. For more information:

- To exclude strings or to include strings you have previously excluded or that were automatically excluded by the software, see Excluded and included strings in LandXML string roads, page 16.
- To convert the outermost left and/or right strings to side slopes, see Convert 3D strings to side slopes, page 17.
- To define or edit additional strings, see Define additional strings for LandXML string roads, page 17.
- To define or edit additional points, see Define additional points for LandXML string roads, page 18.

## Review the LandXML string road

To review the road, tap the LandXML string road in the map to select it and then:

- To review the geometric elements that define the horizontal and vertical alignments, tap **Edit** and then tap **Horizontal alignment** or **Vertical alignment**.
- To view the list of the strings that define the road, tap **Edit** and then tap **Strings**.
- To specify the station interval for lines and the station interval for arcs and transitions, tap **Options**. See Stations available for stakeout, page 91.

For more information, see Review the road design, page 60.

## Stake the LandXML string road

To stake out strings or stations that define the road, see Stake the road, page 74.

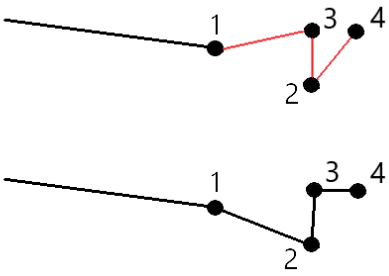
### Export LandXML string roads from your office software

Before exporting a LandXML string road for use in the Origin Roads software, note the following:

- Trimble Access Roads supports only one profile in a file. If you are exporting a horizontal alignment and it has multiple profiles, select only one profile to export. If you select more than one profile the software will use the first one in the file.

- Spectra Geospatial recommends that you avoid vertical faces. When one string has the same offset as another, the Origin Roads software can connect the strings in the wrong order when it joins the strings to display the cross sections. To avoid this issue, define one of the strings with a slight offset from the other.

  For example, consider the following image showing a cross section view of a curb and channel, where strings 2 and 3 in the upper diagram have the same offset and can, potentially, be connected incorrectly as shown by the red linework. In the lower diagram, where string 3 is defined at a slight offset from string 2, the strings will always be connected correctly as shown by the black linework.




## Export from Survey Office

**NOTE –** For best results when using LandXML string roads in the Origin Roads software, export files using Survey Office version 5.80 or later.

You can export a LandXML string road from Survey Office as:

- An alignment and associated corridor.
- An alignment and associated road surface model, where the breaklines define the road strings.

For either method you can also include point and non-road surfaces in the export.

## To export the road as an alignment and associated corridor

1. Start Survey Office and select a project.
2. Open the **Project explorer** in Survey Office and: select the alignment and the associated corridor you want to export.

   If the alignment has more than one profile, select the profile to use. Otherwise, only the first profile in the file can be used in Origin.

   To export more than one road, select each alignment and the associated corridor that makes up the road. The selected alignments and corridors are highlighted.
3. From the **Home** ribbon, select **Export**.
4. From the **Corridor** tab, select **LandXML exporter**.
5. If required, select the points and non-road surfaces to export.

6. From the **Settings** / **Surface description** field, select:
    - **1 - Points and breaklines** to ensure the road strings are created.
    - **Both 1 and 2** to include additional surfaces, for example additional subgrade or embankment.

    If you are exporting multiple surfaces in one file, then you need to make sure the appropriate horizontal alignment is specified in the surfaces.

    To do this, open the **Project explorer** in Survey Office, expand **Surfaces** and right-click the surface and select **Properties**. Scroll to the **Surface** group and make sure the **Horizontal alignment** field shows the horizontal alignment you wish to use. If required, select the preferred horizontal alignment.
7. Select **Export** to export the file.

For more information, refer to the *Survey Office Help*.

## To export the road as an alignment and associated road surface model

1. Start Survey Office and select a project.
2. In the map or the Project explorer in Survey Office, hold down the **CTRL** key and select the horizontal alignment and the surface.

    If the alignment has more than one profile, select the profile to use. Otherwise, only the first profile in the file can be used in Origin.
3. If there is only one vertical alignment associated with the selected horizontal alignment then the vertical alignment is automatically selected and will be exported.

    If there is more than one vertical alignment associated with the horizontal alignment, then do one of the following:
    - Make sure the vertical alignment you want to export is specified as the active vertical alignment. To do this:

        Open the **Project explorer** in Survey Office, right-click the horizontal alignment and select **Properties**. Scroll to the **Other** group and make sure the **Active vertical** field shows the vertical alignment you wish to use. If required, select the preferred vertical alignment.
    - Select the vertical alignment to export. To do this:

        Open the **Project explorer** in Survey Office, hold down the **CTRL** key and click to select the vertical alignment to export. The selected items are highlighted.
4. From the **Home** ribbon, select **Export**.
5. From the **Corridor** tab, select **LandXML exporter**.
6. If required, select the points and non-road surfaces to export.
7. From the **Settings** / **Surface description** field, select:

- **1 - Points and breaklines** to ensure the road strings are created.
- **Both 1 and 2** to include additional surfaces, for example additional subgrade or embankment.

If you are exporting multiple surfaces in one file, then you need to make sure the appropriate horizontal alignment is specified in the surfaces.

To do this, open the **Project explorer** in Survey Office, expand **Surfaces** and right-click the surface and select **Properties**. Scroll to the **Surface** group and make sure the **Horizontal alignment** field shows the horizontal alignment you wish to use. If required, select the preferred horizontal alignment.

8. Select **Export** to export the file.

For more information, refer to the *Survey Office Help*.

## Export from Tekla Civil

**NOTE –** For best results when using LandXML string roads in the Origin Roads software, export files using Tekla Civil version 19.30 or later.

## To export the road as a centerline with associated break lines

1. Start Tekla Civil and select a project.
2. To export a road as a break line file you must first copy the structure model to the construction model (**Worksite** / **Copy structure model to construction model**).
3. Select **File** / **Export file** / **Export to Inframodel file**.
4. Select the **Terrain and Map** tab.
5. Select the **Planning model** check box.
6. Select the **Geometry of the main line** check box and select the route.
7. From the **Surface and types** group box:
    a. Click **Surfaces** and select the surface of the structure to be exported.
    b. Select the **Lines** check box. Spectra Geospatial recommends that you ***do not*** export the triangle model.
8. Enter the file name and path.
9. Select **OK** to write the file.

## To export the road as a centerline with associated irregular lines:

1. Start Tekla Civil and select a project.
2. Select **File** / **Export file** / **Export to Inframodel file**.

3. Select the **Structure** tab.
4. From the **Alignments** group box:
    a. Click **Get selected** to export the current alignment, or click **Alignments** and select alignment(s) to export.
    b. Select the **Geometry** check box. Do not select the **Cross section** check box.
    c. Enter the **Station step** (interval).
5. From the **Surfaces** group box:
    a. Click **Surfaces** and select the surface of the structure to be exported.
    b. Select the **Stringline model** and make sure the **Triangle** check box is ***not*** selected.
6. Enter the file name and path.
7. Select **OK** to write the file.

For more information, refer to the *Tekla Civil Help*.

## Export from Trimble Novapoint

**NOTE –** For best results when using LandXML string roads in the Origin Roads software, export files using Trimble Novapoint version 21.00 or later.

1. Start Trimble Novapoint and select a project.
2. From the **Output** ribbon, select **Export to file**.
3. Select the features to export.
4. Select **LandXML** as the output format.
5. To export the road as a centerline with associated:
    - **break lines**, select **InfraBIM Breaklines** as the conversion rule (or your own modified conversion file).
    - **irregular lines**, select **Irregular lines** as the conversion rule (or your own modified conversion file).
6. Select **Finish** to export the file.

**TIP –** It is also possible to export LandXML files from Trimble Novapoint version 16.00 through 20.00. For more information, refer to the *Trimble Novapoint User Guide*.

## Export from Autodesk Civil 3D

Use the LandXML export function in Autodesk Civil 3D to export corridor baseline alignments, along with associated feature lines. The Origin Roads software reads the alignment and feature lines to create a road where the names of the feature lines are the name of the strings in the road. If required, you can include points and surfaces in the file.

If you haven't already done so, you will need to extract feature lines from the corridor key point codes before you export the LandXML file from Autodesk Civil 3D.

## Extracting corridor feature lines

**NOTE –** For complex projects containing multiple roads, you must use sites where each site has the alignment and associated feature lines for just ***one road***. If, when the roads were created, the alignments and feature lines were not placed in separate sites, you can create a new site for each road and then move these objects to the appropriate sites. Make sure that when you move the feature lines to a site they are the ones that are relevant to the alignment in that site. When exporting the LandXML file, you will select the site that contains the appropriate alignment and feature lines. To learn more about sites, refer to the Autodesk Civil 3D help.

1. Start Autodesk Civil 3D and open the corridor drawing.
2. From the **Home** ribbon, select **Create Feature Line From Corridor** from the **Feature Line** drop down list.
3. Select the corridor.
4. Select the feature lines.
5. Press **Enter**.
6. In the **Extract Corridor Feature Lines** window, select the feature lines to extract. For complex projects containing multiple corridors, select the site from the **Site** column.
7. Tap **Extract**.

## To export LandXML file from Civil 3D

1. From the **Output** ribbon, select **Export to LandXML**.
2. Select **Edit LandXML Settings**, and for the **Alignment Export Settings** set the **Export Cross Sections** option to **Off**.
3. Specify the alignment and feature line objects to export. If you moved the alignment and associated feature lines to a unique site (which is important for projects with multiple roads), select from that site.
4. Tap **OK** and enter a file name.
5. Tap **Save**.

For more information, refer to the *Autodesk Civil 3D Help*.

## Export from 12d Model

Use the Trimble LandXML roads export function in 12d Model to export strings as a LandXML string road that can be used in the Origin Roads software.

1. Start the 12d Model and open the file.
2. From the **Survey** ribbon, select **Trimble** and then select **Trimble LandXML roads**. The **Create Trimble LandXML Road File** panel appears.
3. In the **Job name** field, enter the name of the LandXML file you will create.
4. In the **Transition mapping** field, select the transition mapping file to use.

   You must explicitly map 12d transition types to LandXML transition types. For more information, refer to the **Transition Mapping File** section of the *12da Model help*.
5. Specify the layering used for stringlines in the selected **Stringlines model**. There are three options:
   - **None**: All strings in the selected Stringlines model are written to the LandXML file without layer grouping.

     In this case, clear the **Put all stringlines in a layer** check box and then select the model in the **Stringlines model** field in the **Simple** tab.
   - **Simple**: A centerline and string model are written to the LandXML file in a single layer.
   - **Advanced**: Multiple centerlines and strings are written to different layers in the LandXML file. For each alignment string there can be up to 10 layers, for example an entire subdivision can be uploaded by nominating the centreline for each road and adding the models for the final surface layers, boxing layers and so on.

   **Simple** configuration

   a. Select the **Put all stringlines in a layer** check box.

   b. Select the **Simple** tab.

   c. In the **Alignment string** field, select the centerline for the layer.

   d. To include the centerline in the layer, so that it will be cut as part of the road surface, select the **Include alignment in layer** check box.

   e. In the **Stringlines model** field, select the model of strings forming the road surface/layer.

      The **Layer name** field shows the name of the selected model and cannot be changed.

   **Advanced** configuration

   a. Select the **Put all stringlines in a layer** check box.

   b. Select the **Advanced** tab.

   c. In the **Alignment string** field, select the centerline for up to 10 layers.

   d. To include the centerline in the first layer, so that it will be cut as part of the road surface, select the **Include alignment in layer 1** check box.

   e. In the **Stringlines model 1** field, select the model of strings forming the road surface/layer.

      The **Layer name 1** field shows the name of the selected model and cannot be changed.

f. For each optional layer, select the stringlines model and layer name as required.

g. To create extra roads/centrelines right-click the row number in the grid box to insert an extra row and fill it out referring to the steps above for the first layer.

6. To create the LandXML file, click **Write**.

### Excluded and included strings in LandXML string roads

The software automatically excludes some strings when the LandXML string road is used in Origin Roads.

Alternatively, the LandXML string road may include some strings that you want to exclude. For example, for some LandXML string roads the centerline alignment does not form part of the road surface and must be excluded, or some roads may include strings that go back on themselves. Sometimes these strings are unrelated to the road design (for example, a fence line), and should be excluded. In other situations the string may be valid (for example, a curb return), and should remain part of the road. However this will mean that staking the string will result in staked points that have duplicate station values.

You can include any previously excluded strings as needed.

**NOTE –** Any changes made to the status of the strings in Origin Roads are written to the LandXML file.

## Automatically excluded strings

The Roads software automatically excludes the centerline when the alignment strings are defined by one of the following:

- break lines where there is a break line at **zero offset**.
- irregular lines where there is an irregular line at **zero offset**.
- irregular lines and the file includes a property record to exclude the centerline.

## To exclude strings from the road

1. In the map, tap the LandXML string road to select it and then tap **Edit**.
2. Tap **Exclude**.
3. From the list, select the strings to be excluded.

   Excluded strings have a checkmark by their name and are shown blue in the map. To aid selection, the name of any string that does go back on itself is listed in red text.

## To include excluded strings

To **include** a string that you have excluded or that the software has automatically excluded from a LandXML string road:

1. In the map tap **Edit**.
2. Tap **Exclude**.
3. Tap the string name in the list.

   The checkmark is removed, indicating the string is no longer excluded.

### Convert 3D strings to side slopes

For LandXML string roads, the outermost strings to the left and right of the centerline define a side slope. To use them as side slope strings in Origin Roads you must convert the 3D strings to side slope strings.

1. In the map, tap the LandXML string road to select it and then tap **Edit**.
2. Tap **Side slopes**.

   The software lists any strings that are the outermost string at some point along the road.

   > **NOTE –** A string listed in red text indicates the string goes back on itself and it should not be used with the road. Use the **Exclude** option to exclude the string from the road.

3. Tap the strings to convert, or tap **All**. The selected side slope strings are colored blue in the map.
4. Tap **Accept**.

If required, you can convert the side slope strings back to 3D strings. To do this, repeat the steps above and tap the strings to convert, or tap **None**.

### Define additional strings for LandXML string roads

1. In the map, tap the LandXML string road to select it and then tap **Edit**. Alternatively, tap ☰ and select **Define** / **LandXML road**, select the road to edit and then tap **Next**.

   > **TIP –** If the road you want to edit is not shown in the map, tap ⧉ in the map toolbar to open the **Layer manager** and select the **Map files** tab. Select the file and then make the appropriate layer(s) visible and selectable. The file must be in the current project folder.

2. Tap **Additional strings (Derived)**.
3. To add a new string:
   a. Tap **Add**.
   b. Enter the **String name** and select the **String type**.
      - **Dependent**: The string forms part of the road surface.
      - **Independent**: The string does not form part of the road surface. Independent strings are ideal for underground services, for example a fiber-optic cable.

Both string types are defined parallel to the existing string for the length of that string.

c. Tap **Accept**.

4. To define or edit the string, tap **Edit**.
   a. The **Horizontal and vertical geometry** item is selected. Tap **Edit**.
   b. Tap **Add**.
   c. In the **Derive from** field, tap to select the string that the additional string will be derived from. Tap the string in the map or tap **String** and select the string from the list. Tap **Accept**.
   d. Select the **String derivation** method and enter the values that define the string.
   e. Tap **Store**.
5. Tap **Accept** three times to return to the **Edit road** screen.
6. Tap **Store**.

Once you have defined an additional string, you can edit it, review it or stake it out.

## Define additional points for LandXML string roads

Use **Additional points** to define design features that are not part of the road design file, such as key positions for a drainage system, lamp posts, or road signs.

During stake out, you can stake additional points as needed. You can add an additional point by tapping any point in the job, or by tapping a point in any kind of linked file, including DXF, BIM, or CSV.

Alternatively, you can define additional points by editing the road. This can be useful when you want to use a large number of points contained in a separate file. To define additional points, import them from a CSV file or LandXML file. You can also key them in.

**NOTE –** When importing points from a CSV file, two formats are supported:

- Station and offset where each position in the file must be defined by a station and offset and, optionally, an elevation and code, in that order. See the following:

  1+000.000, 0.250, 20.345, ,
  1+000.000, -5.000, 25.345, End curb
  1+000.000, 4.500, , Lamp post
  1+000.000, 7.000, 25.294, Begin sound wall

- Northing and easting where each position in the file must be defined by a northing and easting and, optionally, an elevation and code, in that order. See the following:

  5000.000, 2000.000, 20.345, ,
  5000.000, 2100.000, 25.345, End curb
  5000.000, 2200.000, , Lamp post
  5000.000, 2300.000, 25.294, Begin sound wall

For both file formats, where points have null elevations you can choose to use the elevation of the vertical alignment at the station value of the point.

**TIP –** On import northing and easting coordinates in the CSV or LandXML file are converted to station and offset values relative to the road.

To add additional points to the selected road definition:

1. Tap **Additional points**.
2. To import points from a file:
    a. Tap **Import**.
    b. Tap 🗁 and select the file. Tap **Accept**.

    The imported points are listed in the **Additional points** screen.
3. To key in points:
    a. Tap **Add**.
    b. Enter the **Station** and **Offset** for the point.
    c. If required, enter the **Elevation** and **Code**.
    d. Tap **Store**.
    e. Continue adding points as required.
    f. When you are done, tap **Close**.

    **TIP –** To insert a point, tap the point you want the new point to follow and tap **Insert**.
4. Tap **Accept**.
5. Enter the other road components or tap **Store** to store the road definition.

## LandXML cross section roads

Most office software packages now export LandXML files as LandXML string roads. If you have an older LandXML file it may be a LandXML cross section road, that consists of an alignment (the road centerline) with related cross section templates. All stationing is derived from the alignment.

**TIP –** LandXML cross section roads cannot be used as XML files in the Origin Roads software. When you use the LandXML cross section road it will be converted to an RXL road, and the original LandXML file will be retained in the current project folder.

## Add the LandXML cross section road file to the Layer manager

To use a LandXML cross section road file in Origin Roads, you must select the LandXML cross section road file to use and then redefine it as an RXL road file.

## Add the LandXML road from the menu

1. In Origin Roads, tap ☰ and select **Define**.
2. Tap **LandXML road**.
3. Select the LandXML file. The file must be in the Origin project folder on the controller.
4. Tap **Next**.

   The **New road** screen appears. To continue, see Redefine the road as an RXL road below.

## Add the LandXML road from the map

a. In Origin Roads, tap ⧉ in the **Map** toolbar to open the **Layer manager** and select the **Map files** tab.

b. Tap **Add** and then select the LandXML cross section road file from the Origin project folder on the controller, or from Trimble Connect if the project you are working in is a cloud project. Tap **Accept**.

   By default, the file you have linked to the job is visible in the map, indicated by the check mark next to the file name ✓.

c. To make items in the file selectable, tap the file name in the **Map files** tab. A check mark inside a square ☑ indicates items in the file are selectable.

d. To close the **Layer manager**, tap **Accept**.

e. From the map, tap the alignment to select it and then tap **Define** to define a new LandXML road.

   The **New road** screen appears. To continue, see Redefine the road as an RXL road below.

## Redefine the road as an RXL road

1. Select the horizontal alignment, the profile alignment, and the surface that will define the road.
2. If the elevations defining the cross sections are:
   - absolute, select the **Absolute design cross-section elevations** check box to ensure the templates are resolved correctly.
   - relative to the alignment, clear the **Absolute design cross-section elevations** check box to ensure the templates are resolved correctly.

   For more information, see Cross section elevations, page 21.
3. The LandXML format does not support side slopes, but you can add these as follows:
   - If the last point in the cross section represents a **side slope**, select the **Set last cross section point as side slope** option to convert this point to a side slope. The slope value

from the second last point to the last point is then used to define the side slope.

- If the last point in each cross section represents a **side slope hinge position**, select the **Add side slope to last point in cross section** option and complete the fields to add cut and fill side slope values, including a cut ditch to this point. A side slope can be defined for both the left and right sides of the cross section.

4. Select the road cross section interpolation method. Select either:
   - Elevation
   - Cross slope

   For more information, see String interpolation, page 22.

   For **Interpolation by elevation** and **Interpolation by cross slope** examples, see Template positioning examples, page 49.
5. When selecting a LandXML file created from 12d Model where the transition type is **cubic** you will be prompted to select the applicable cubic type. This is because the cubic type is not identifiable in the file. Select either:
   - Cubic spiral
   - NSW cubic parabola
6. To save the edited road as an RXL road file, tap **Store**.

   The software returns to the map where the new road is selected, ready to review or stake.

## Edit the road definition

Once the road has been converted to an RXL road, you can edit the road definition as you can for an RXL road. For example, you can add additional points or strings.

To edit the road definition, tap **Define** and select a component to edit. See Define an RXL road, page 25.

To review the road definition, tap Review. See Review the road design, page 60.

## Stake the road

To stake out strings or stations that define the road, see Stake the road, page 74.

### Cross section elevations

When redefining a LandXML cross section road as an RXL road, if the elevations defining the cross sections are:

- absolute, select the **Absolute design cross-section elevations** check box to ensure the templates are resolved correctly.
- relative to the alignment, clear the **Absolute design cross-section elevations** check box to ensure the templates are resolved correctly.

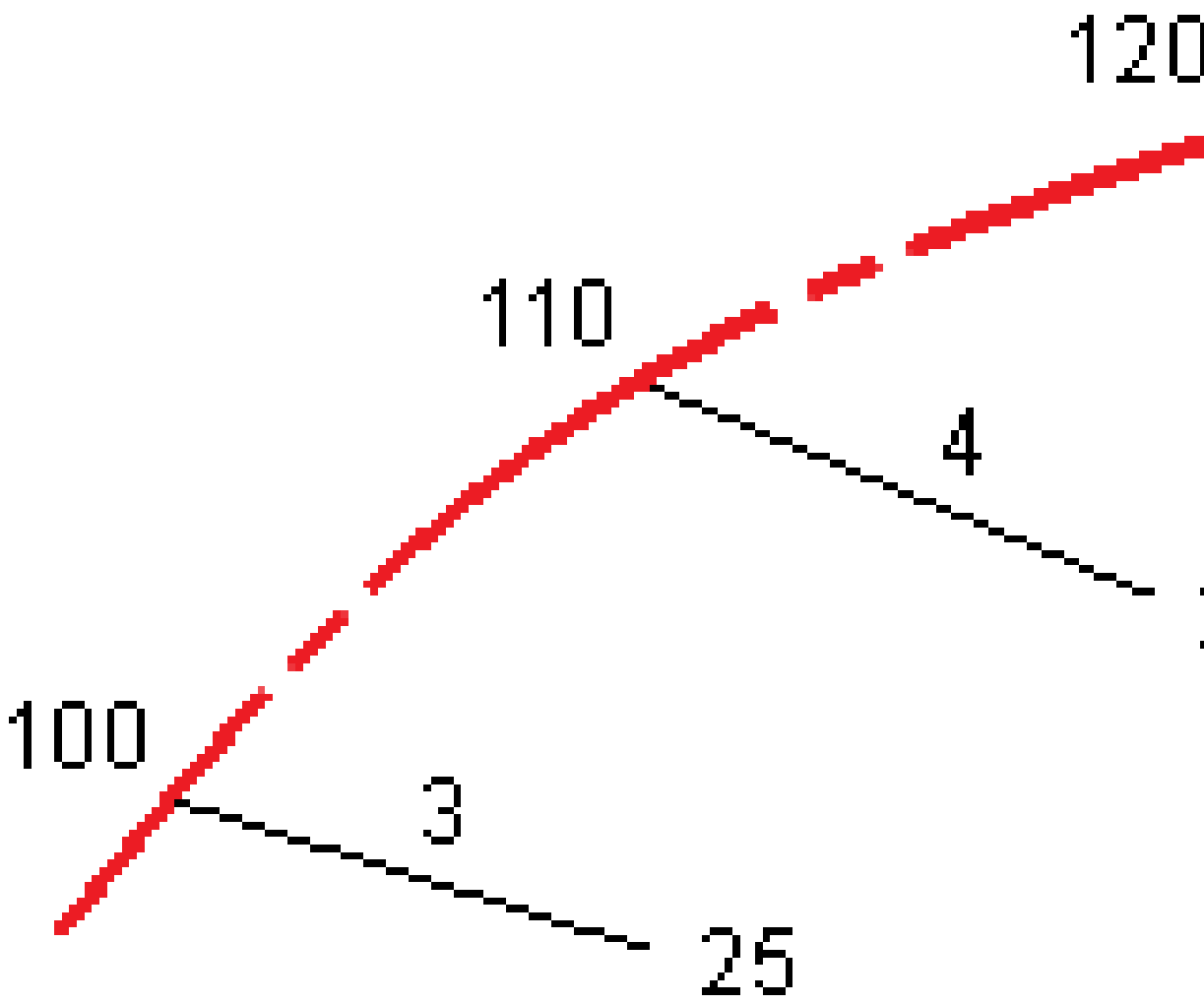
**TIP –**

- If you are unsure whether to select or clear the **Absolute design cross-section elevations** check box, open the file in a text editor and review the values.
- If you are still unsure, choose one setting and once the road is stored as an RXL file, tap Review and then tap in the map toolbar to view the road in the cross section view. If the cross section view does not look correct, for example if the cross section appears as a single vertical line rather than a horizontal line with cut/fill values at the side, then redefine the road as a new RXL, this time with a different **Absolute design cross-section elevations** setting.

## String interpolation

When the LandXML cross section road is redefined as an RXL road, the cross-sections are computed by determining where the cross-section line, formed at right angles to the alignment cuts the strings associated with the alignment. For interpolated stations the offset and elevation values for the position on an associated string is interpolated from the offset and elevation values of the previous and next positions on that string. This ensures the integrity of the design, especially on tight arcs.

See the following example, where the cross section at station 100 has a string offset from the alignment by 3 and an elevation of 25. The next cross section at station 120 has a string offset by 5 and an elevation of 23. The position on the string for the interpolated station 110 is interpolated as shown to give an offset of 4 and an elevation of 24.


120
110
4
100
3
25

# Strings and surfaces

Strings can be lines, arcs or polylines that are keyed in to the job or they can be selected from any linked files that contain linework.

Surfaces can be any surface in a BIM file, or they can be DTM or TTM surface files.

## Add map files using the Layer manager

1. In Origin Roads, tap ⧉ in the **Map** toolbar to open the **Layer manager** and select the **Map files** tab.
2. Tap **Add** and then select the map files from the Origin project folder on the controller, or from Trimble Connect if the project you are working in is a cloud project. Tap **Accept**.

   By default, any file you have linked to the job is visible in the map, indicated by the check mark next to the file name ✔ .
3. To make items in the file selectable, tap the file name in the **Map files** tab. A check mark inside a square ☑ indicates items in the file are selectable.
4. To close the **Layer manager**, tap **Accept**.

**NOTE –** The Roads software treats all road distances, including station and offset values, as grid distances. If a ground coordinate system is defined in the job, the grid coordinates are, in effect, also ground coordinates.

## Keying in strings

To key in to the job the lines, arcs or polylines you want to stake, use the **Key in** menu in the Origin General Survey software.

For more information, refer to the **Keying in data** section of the Spectra Geospatial Origin General Survey User Guide.

## Next steps

Once you have added the strings in the job, you can:

- Display the cut/fill to a surface during stakeout
- Stake the road, page 74

# 3

# Define an RXL road

To define a new road, you can key in the definition or select items in the map and then create the road from the selected items. When working from the map you can select points, lines, arcs, or polylines in the job or in DXF, SHP, or LandXML files.

Roads are stored as RXL files in the current project folder.

Once a road is defined, you can edit it as required.

## To define a road by keying in components

1. Tap ☰ and select **Define**. Alternatively, with nothing selected in the map, tap **Define**.
2. Tap **RXL road**.
3. Tap **New**.
4. Enter a name for the road.
5. To define a new road from an existing road definition, enable the **Copy existing road** switch and then select the file to copy from. The file must be in the current project folder.
6. To define a new road, specify the **Station interval for lines** and the **Station interval for arcs and transitions**, and then select the method you will use to key in each component.
    a. To define the **horizontal alignment** you can use the:
        - Length or coordinate entry method, page 28
        - End station entry method, page 30
        - Points of intersection (PI) entry method, page 31
    b. Select the transition type. See Transition types, page 32.
    c. To define the **vertical alignment** or the **vertical geometry of additional strings** you can use the:
        - Vertical points of intersection (VPI) entry method, page 41
        - Start and end point entry method, page 41
7. Tap **Accept**.

    The list of components that can be defined for the road appears.

    If the list of components shows only **Horizontal alignment**, **Vertical alignment**, and **Station equations**, tap **Options** and select the **Enable templates and additional points/strings** check box.

> **TIP –** To change the entry method or the transition type for the road, tap **Options**. However, once you have entered two or more elements defining the horizontal or vertical alignment definition, the entry method and transition type cannot be changed.

8. Select each component and define it as required.
9. Once you have defined the components for the road, tap **Store**.

   The road definition screen closes and the software shows the map.

> **TIP –** To configure the software to display the road selection screen when you tap **Store** instead of the map, in the **Select a file** screen, tap **Options** and select the **Display the road selection screen on escape** check box.

## To define the road from selected items in the map

1. If the items you want to select are not visible in the map, tap in the map toolbar to open the **Layer manager** and select the **Map files** tab. Select the file and then make the appropriate layer(s) visible and selectable.
2. In the map, tap the items that will define the horizontal alignment.

   The order in which items are selected and the direction of the lines, arcs, or polylines defines the direction of the horizontal alignment.

   If the items have elevations, then the elevations are used to define the vertical alignment.
3. Tap and hold in the map and select **Store road**.
4. Enter the road name, start station, the station interval for lines, and the station interval for arcs and transitions.
5. Tap **Accept**.

   To add other components such as templates and superelevation to the new road, tap and select **Define**. See To define a road by keying in components, page 25.

## Road scale factor

> **NOTE –** This functionality is a requirement for the Ministry of Transportation Quebec, Canada but may have application elsewhere.

The default **Road scale factor** is set to **1.00000000**. If required, in the list of components for the road definition, tap **Options** and change the **Road scale factor**.

The specified scale factor scales the road's horizontal alignment definition but retains the original station values. When you define the road, all values are entered and appear as unadjusted values. The scale factor is applied to the length/radius values defining each element/curve when computing the coordinates for the road definition. When surveying and reporting the road, the station values are not adjusted by the scale factor.

- For a road defined by entering end coordinates or end points, Spectra Geospatial recommends you do not change the scale factor after initial entry. Otherwise the scale factor rescales the alignment elements, and since the end coordinates/end point coordinates are not changed, a change in station values must occur.
- For a road defined by PI (Points of Intersection), Spectra Geospatial recommends you do not change the scale factor after initial entry. Otherwise the scale factor rescales the curve components, and since the PI coordinates are not changed a change in station values must occur.

# To key in the horizontal alignment

Use the steps below to key in the horizontal alignment for the selected road. To define the horizontal alignment by selecting items from the map, see To define the road from selected items in the map, page 26.

1. Tap **Horizontal alignment**.
2. Tap **Add**.

   The **Element** field is set to **Start point**.
3. To define the start point:
   a. Enter the **Start station**.
   b. In the **Method** field, select either:
      - **Key in coordinates** and then enter values in the **Start north** and **Start east** fields.
      - **Select point** and then select a point in the **Point name** field.

        The **Start north** and **Start east** fields will update with the values for the entered point.

        To edit the **Start north** and **Start east** values when they have been derived from a point, change the method to **Key in coordinates**.

   c. Tap **Store**.
4. To add elements to the alignment:
   a. Select the **Element** type and fill out the remaining fields.

      For more information, refer to the topic for the selected entry method.
   b. Tap **Store**.
   c. Continue adding elements as required.

      Each element is added after the previous element.
   d. When you are done, tap **Close**.

> **TIP –** To edit an element or to insert an element further up the list, you must first tap **Close** to close the **Add element** screen. You can then select the element to edit in the list and then tap **Edit**. To insert an element, tap the element that will come after the new element and then tap **Insert**.

5. Tap **Accept**.
6. Enter the other road components, or tap **Store** to store the road definition.

# Length or coordinate entry method

As you add each element to the alignment, fill out the fields required for the selected element type.

## Line elements

To add a line to the alignment, select **Line** in the **Element** field and then select the method to construct the line:

| If you select... | Then... |
|---|---|
| **Azimuth and length** | Enter the **Azimuth** and **Length** to define the line. The **End north** and **End east** fields automatically update. |
| **End coordinates** | Enter the **End north** and **End east** values to define the line. The **Azimuth** and **Length** fields automatically update. |
| **Select end point** | Enter the **Point name**. The **Azimuth**, **Length**, **End north** and **End east** fields automatically update. |

> **NOTE –** If this line is not the first line to be defined, the **Azimuth** field displays an azimuth calculated from the previous element.

To edit the azimuth, tap ▸ next to the **Azimuth** field and select **Edit azimuth**. If the element is non tangential the icon at the start of the element is shown in red.

## Arc elements

To add an arc to the alignment, select **Arc** in the **Element** field and then select the method to construct the arc:

| If you select... | Then... |
|---|---|
| **Radius and length** | Select the arc direction. Enter the **Radius** and **Length** to define the arc. The **End north** and **End east** fields automatically update. |
| **Delta angle and radius** | Select the arc direction. Enter the **Angle** and **Radius** to define the arc. The **End north** and **End east** fields automatically update. |
| **Deflection angle and length** | Select the arc direction. Enter the **Angle** and **Length** to define the arc. The **End north** and **End east** fields automatically update. |
| **End coordinates** | Enter the **End north** and **End east** values to define the arc. The **Arc direction**, **Radius**, and **Length** fields automatically update. |
| **Select end point** | Enter the **Point name**. The **Azimuth**, **Length**, **End north** and **End east** fields automatically update. |
| **End coordinates and center point** | Enter the **End north**, **End east**, **Center point north** and **Center point east** values to define the arc. If required, select **Large arc**. The **Azimuth**, **Arc direction**, **Radius**, and **Length** fields automatically update. |
| **Select end and center points** | Enter the **End point name** and **Center point name** values to define the arc. If required, select **Large arc**. The **Azimuth**, **Arc direction**, **Radius**, and **Length**, **End north** and **End east** fields update with the values entered. |

**NOTE –** For an arc defined by **Radius and length, Delta angle and radius** or **Deflection angle and length**, the **Azimuth** field shows the azimuth as calculated from the previous element. If the element is non tangential the icon at the start of the element is shown in red. To reload the original azimuth, tap ▶ next to the **Azimuth** field and select **Restore tangency**.

## Entry transition/exit transition elements

To add a transition to the alignment:

1. Select **Entry transition** or **Exit transition** in the **Element** field.
2. Select the arc direction.
3. Enter the **Start radius**, **End radius** and **Length** to define the transition.

   The **End North** and **End East** fields update automatically.

The **Azimuth** field displays the azimuth as calculated from the previous element. To edit the azimuth, tap ▸ next to the **Azimuth** field and select **Edit azimuth**. If the element is non tangential the icon at the start of the element is shown in red.

If the transition type is NSW cubic parabola the computed **Transistion Xc** value is displayed. If the transition is between two arcs the **Transistion Xc** displayed is the value computed for the common tangent point with the smaller of the two arcs.

# End station entry method

As you add each element to the alignment, fill out the fields required for the selected element type.

## Line elements

To add a line to the alignment:

1. Select **Line** in the **Element** field.
2. Enter the **Azimuth** and **End station** to define the line.

   The **End North** and **End East** fields update automatically.

**NOTE –** If this line is not the first line to be defined, the **Azimuth** field displays an azimuth calculated from the previous element.

To edit the azimuth, tap ▸ next to the **Azimuth** field and select **Edit azimuth**. A solid red circle is shown at the start of an element if adjoining elements are non tangential.

## Arc elements

To add an arc to the alignment, select **Arc** in the **Element** field and then select the method to construct the arc:

| If you select... | Then... |
|---|---|
| **Radius and end station** | Select the arc direction. Enter the **Radius** and **End station** to define the arc. |
| **Deflection angle and end station** | Select the arc direction. Enter the **Angle** and **End station** to define the arc. |

The **End North** and **End East** fields automatically update.

**NOTE –** The **Azimuth** field displays the azimuth as calculated from the previous element.

To edit the azimuth, tap ▸ next to the **Azimuth** field and select **Edit azimuth**. The icon preceding the element name is shown red if adjoining elements are non tangential or if adjoining elements defining a curve have different radii.

## Entry transition/exit transition elements

To add a transition to the alignment:

1. Select **Entry transition** or **Exit transition** in the **Element** field.
2. Select the arc direction.
3. Enter the **Start radius**, **End radius** and **Length** to define the transition.

   The **End North** and **End East** fields update automatically.

The **Azimuth** field displays the azimuth as calculated from the previous element. To edit the azimuth, tap ▸ next to the **Azimuth** field and select **Edit azimuth**. If the element is non tangential the icon at the start of the element is shown in red.

If the transition type is NSW cubic parabola the computed **Transistion Xc** value is displayed. If the transition is between two arcs the **Transistion Xc** displayed is the value computed for the common tangent point with the smaller of the two arcs.

# Points of intersection (PI) entry method

To add an element to the alignment:

1. Define the points of intersection.
2. Select the **Curve type**. If you select:
   - **Circular**, enter the **Radius** and **Arc length**.
   - **Transition|Arc|Transition**, enter the **Radius**, **Arc length**, **Transition length in** and **Transition length out**.
   - **Transition|Transition**, enter the **Radius**, **Transition length in** and **Transition length out**.
   - **None**, no further values are required.
3. Tap **Store**.

# Transition types

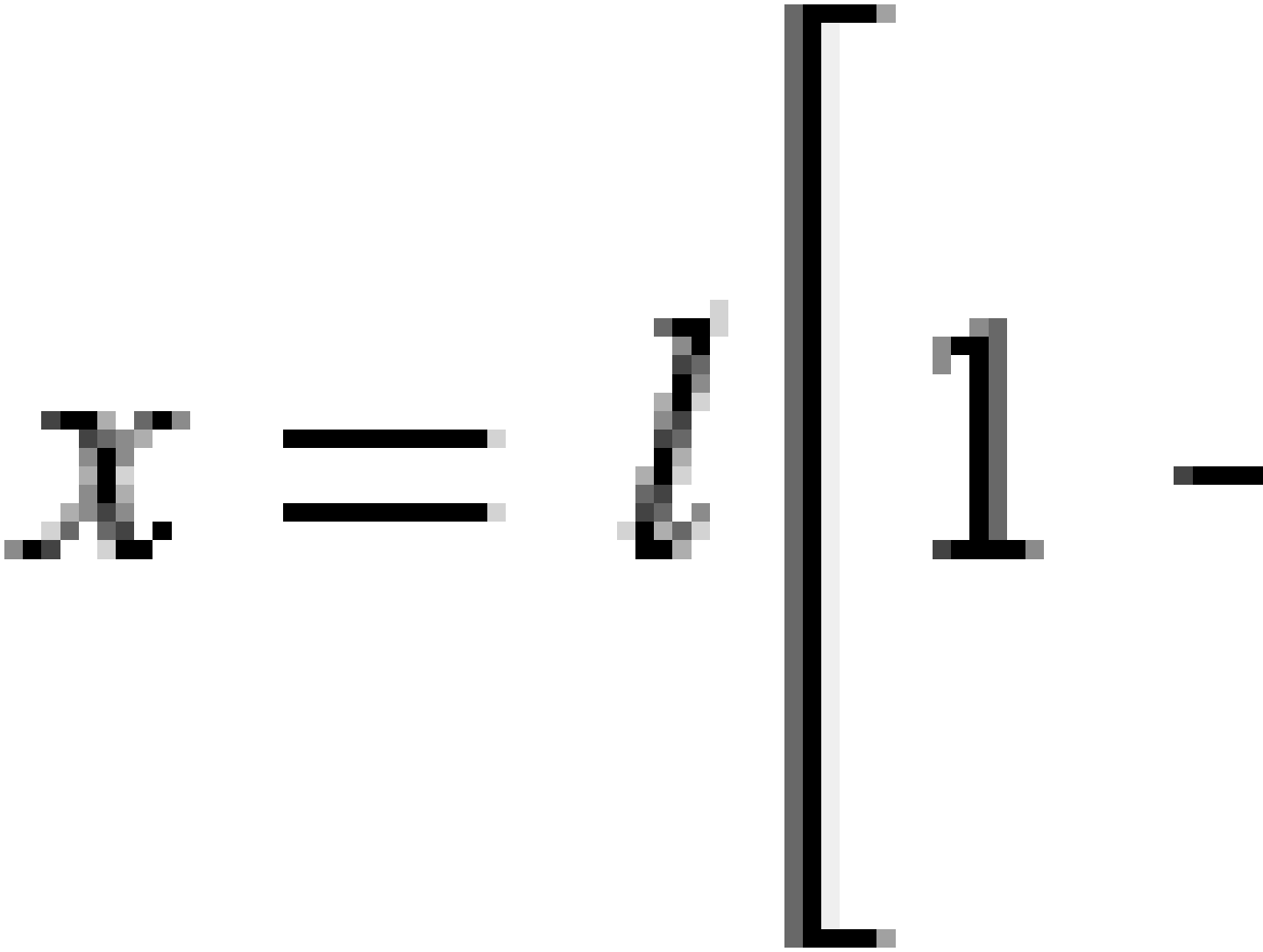
The software supports the following transition types.

| Method | Length | End station | PI |
|---|---|---|---|
| Clothoid spiral | * | * | * |
| Egg-shaped clothoid spiral | * | * | – |
| Cubic spiral | * | * | * |
| Bloss spiral | * | * | * |
| Korean cubic parabola | * | * | * |
| NSW cubic parabola | * | * | – |

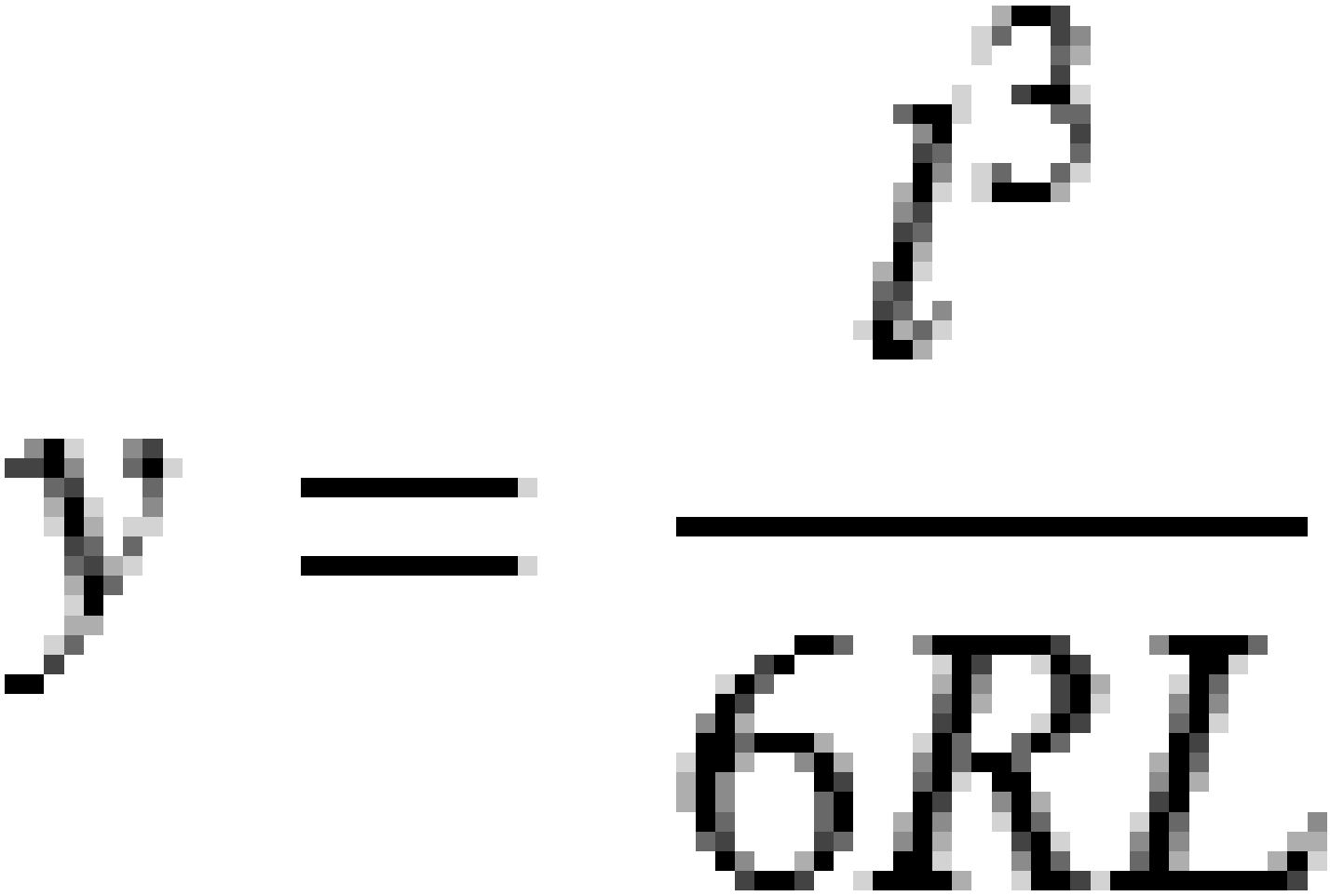
## Clothoid spiral

The clothoid spiral is defined by the length of the spiral and the radius of the adjoining arc. The formulae for the **x** and **y** parameters in terms of these two values are as follows:

Parameter **x**:



Parameter **y**:



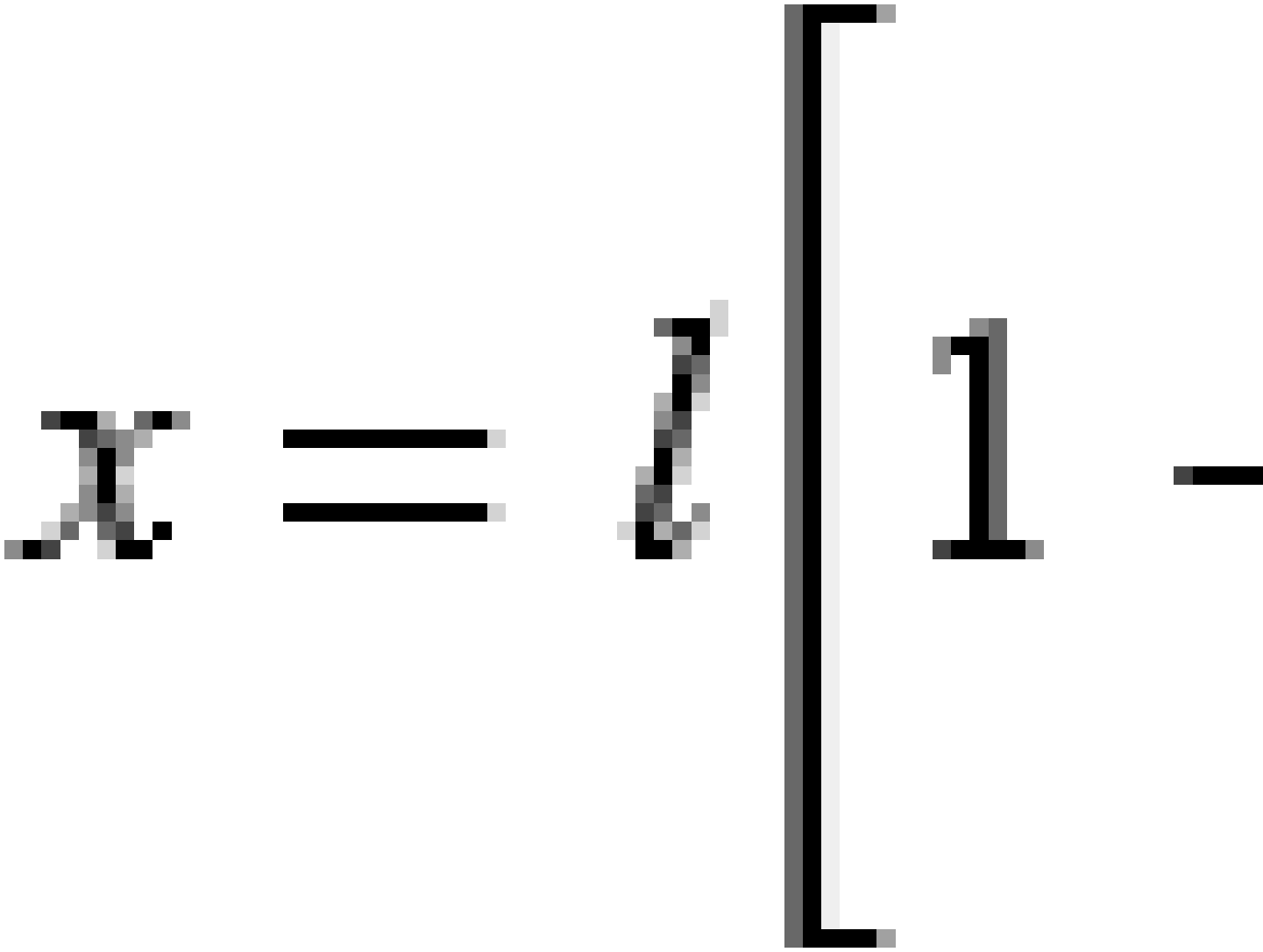
## Egg-shaped clothoid spiral

By editing the **Start / End radius** for an **Entry / Exit transition** from **Infinite** to a required radius it is possible to define an egg shaped clothoid. To return to an infinite radius, select **Infinite** from the pop-up menu.

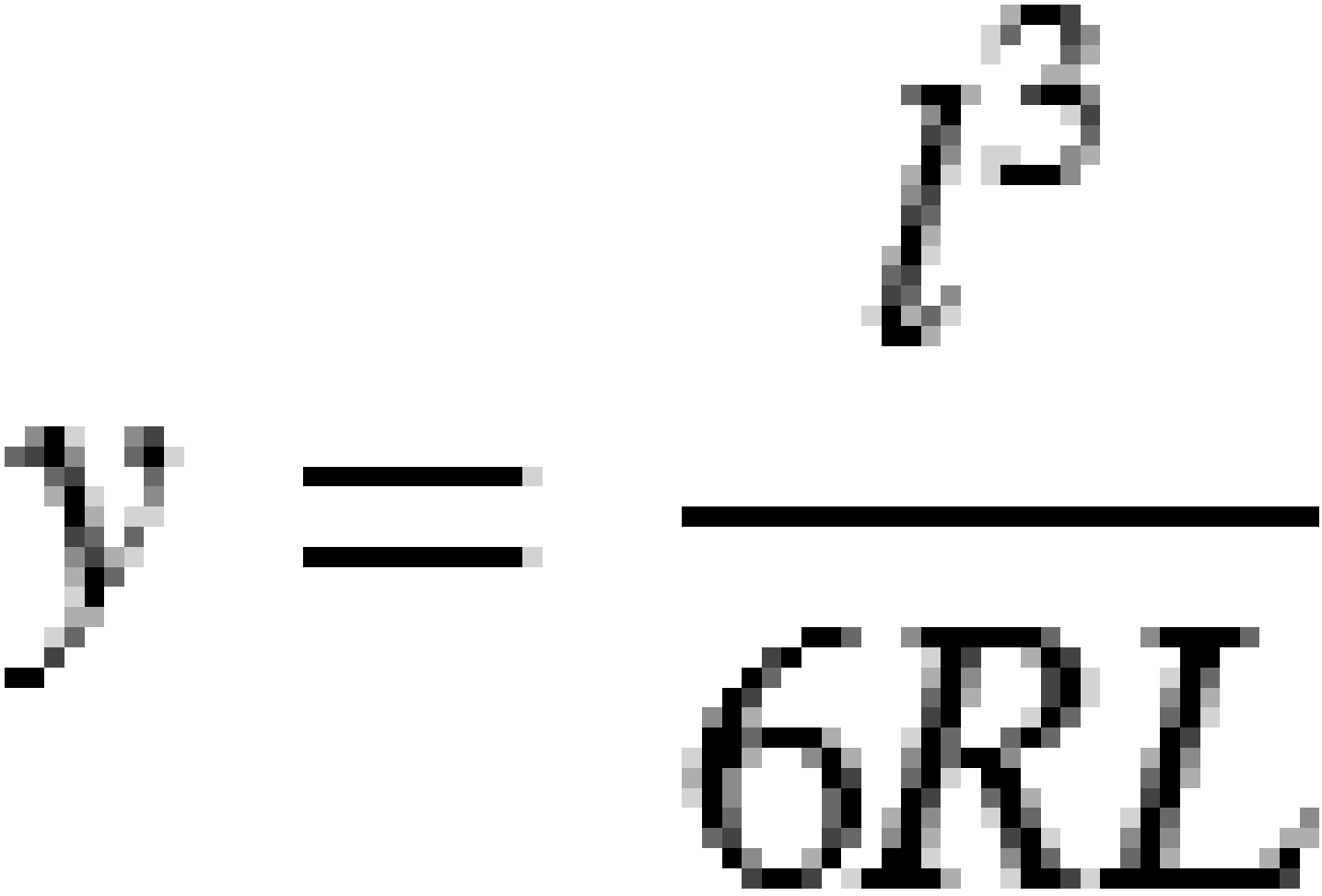
## Cubic spiral

The cubic spiral is defined by the length of the spiral and the radius of the adjoining arc. The formulae for the **x** and **y** parameters in terms of these two values are as follows:

Parameter **x**:



Parameter **y**:

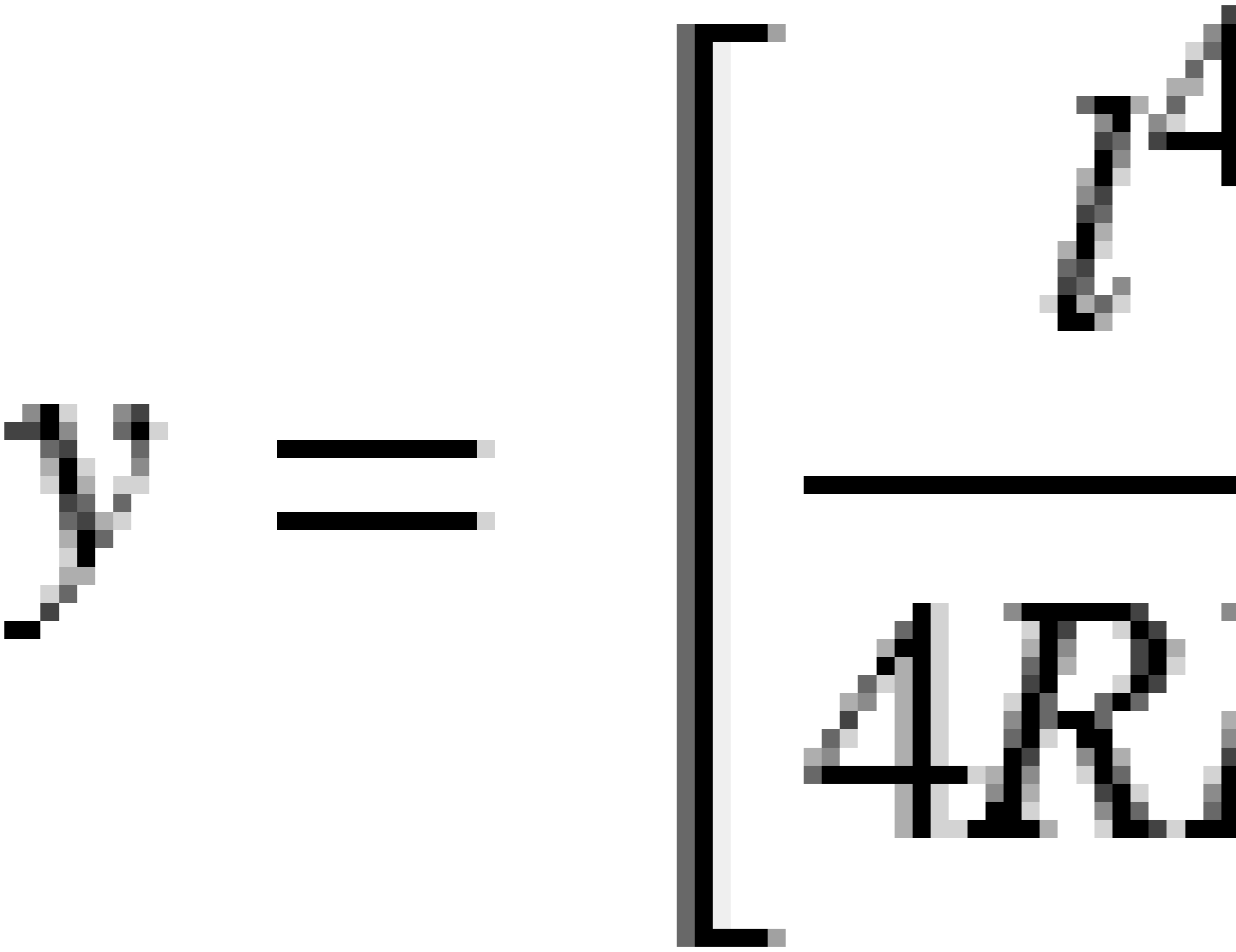


## Bloss spiral

Parameter **x**:

$$x = l\left[1 - \frac{l^6}{14R^2L^4} + \frac{l^7}{16R^2L^5} - \frac{l^8}{72R^2L^6} + \frac{l^{12}}{312R^4L^8} - \frac{l^{13}}{168R^4L^9} + \frac{l^{14}}{240R^4L^{10}} - \frac{l^{15}}{768R^4L^{11}} + \frac{l^{16}}{6528R^4L^{12}}\right]$$

Parameter **y**:

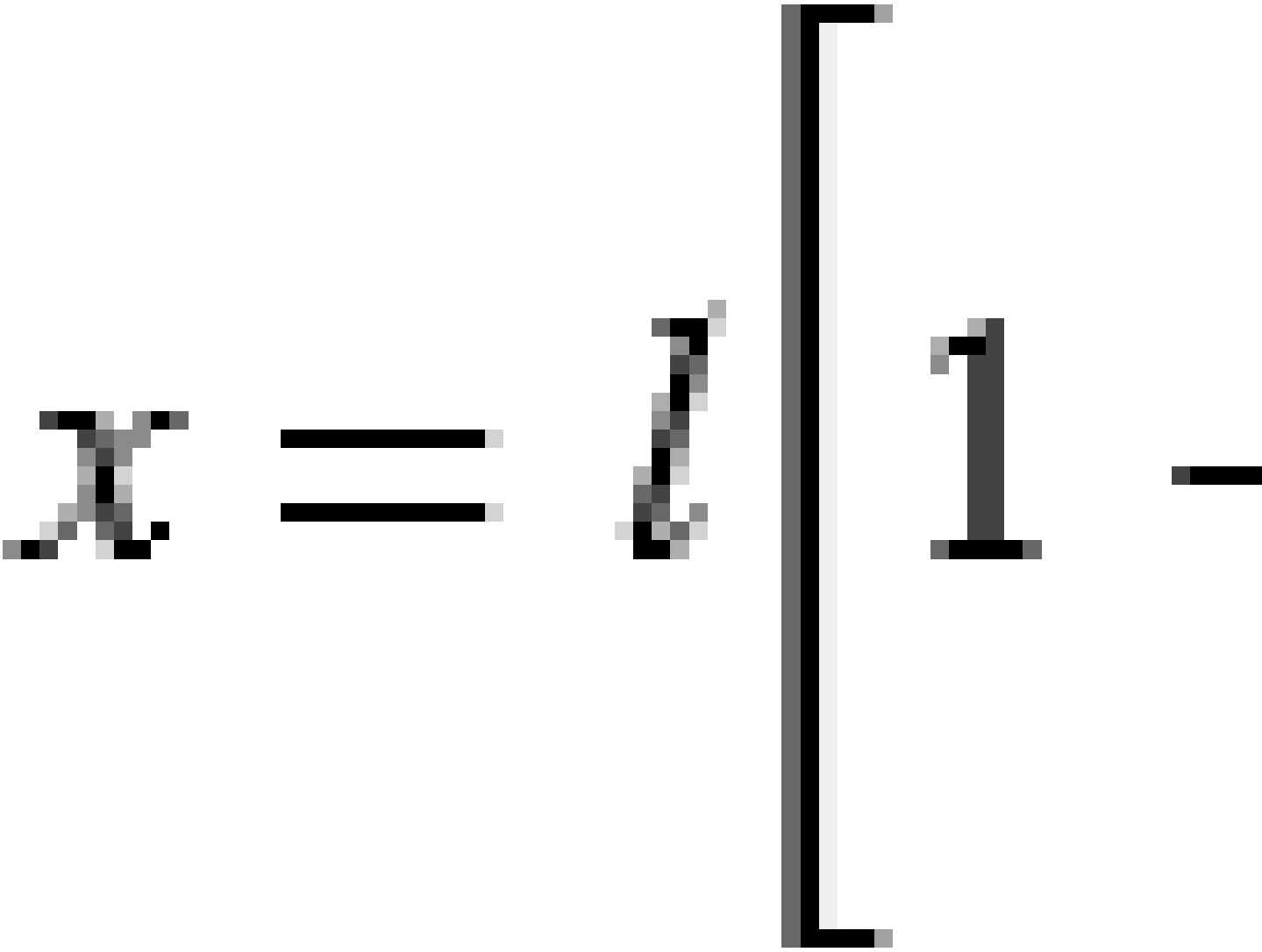


**NOTE –** The Bloss spiral can only be fully developed, that is, for an entry transition the start radius is infinite and similarly for an exit transition the end radius is infinite.

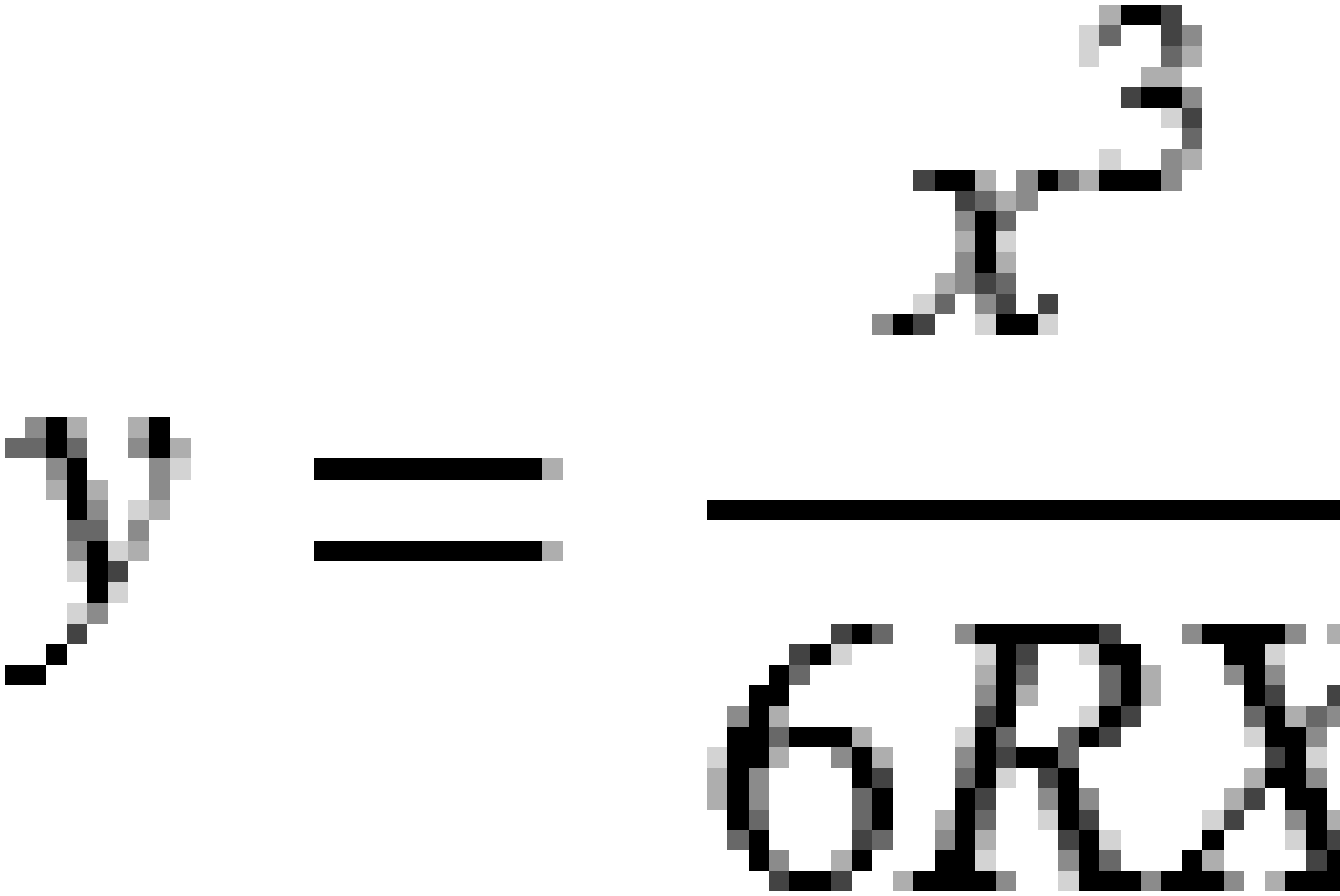
## Korean cubic parabola

This cubic parabola is defined by the length of the parabola and the radius of the adjoining arc. The formulae for the **x** and **y** parameters in terms of these two values are as follows:

Parameter **x**:



Parameter **y**:



**NOTE –** The Korean cubic parabola can only be fully developed, that is, for an entry transition the start radius is infinite and similarly for an exit transition the end radius is infinite.

## NSW cubic parabola

The NSW cubic parabola is a special parabola used for rail projects in New South Wales, Australia. It is defined by the length of the parabola and an **m** value. Refer to *NSW Government Technical Note ESC 210 Track Geometry and Stability*.

# To key in the vertical alignment

If you created the road definition by selecting items in the map, the elevations of those items are used to define the vertical alignment as a series of **Point** elements. The vertical alignment can be edited if required.

To key in the vertical alignment for the selected road definition:

1. Tap **Vertical alignment**.
2. Tap **Add**.

   The **Element** field is set to **Start point**.
3. To define the start point:
   a. Enter the **Station (VPI)** and the **Elevation (VPI)**.
   b. To change the way a slope value is expressed, tap **Options** and change the **Grade** field as required.
   c. Tap **Store**.
4. To add elements to the alignment:
   a. Select the **Element** type and fill out the remaining fields.

      For more information, refer to the topic for the selected entry method.
   b. Tap **Store**.
   c. Continue adding elements as required.

      Each element is added after the previous element.
   d. When you are done, tap **Close**.

   > **TIP –** To edit an element or to insert an element further up the list, you must first tap **Close** to close the **Add element** screen. You can then select the element to edit in the list and then tap **Edit**. To insert an element, tap the element that will come after the new element and then tap **Insert**.
5. Tap **Accept**.
6. Enter the other road components, or tap **Store** to store the road definition.

## Vertical points of intersection (VPI) entry method

To add an element to the alignment:

1. Select the **Element**. If you select:
    - **Point**, enter the **Station** and **Elevation** to define the VPI.
    - **Circular arc**, enter the **Station** and **Elevation** to define the VPI and enter the **Radius** of the circular arc.
    - **Symmetric parabola**, enter the **Station** and **Elevation** to define the VPI and enter the **Length** of the parabola.
    - **Asymmetric parabola**, enter the **Station** and **Elevation** to define the VPI and enter the **In length** and **Out length** of the parabola.

    The **Slope in** field shows the calculated slope value.

    The **Length**, **K factor**and **Slope out** fields update when the next element is added. The exact fields shown depend on the selected element.
2. Tap **Store**.

**NOTE –**

- A vertical alignment defined by VPIs must end with a point.
- When you edit an element, only the selected element is updated. All adjoining elements remain unchanged.

## Start and end point entry method

1. Select the **Element**. If you select:
    - **Point**, enter the **Station** and **Elevation** to define the start point.
    - **Circular arc**, enter the **Start station**, **Start elevation**, **End station**, **End elevation** and **Radius** to define the circular arc.
    - **Symmetric parabola**, enter the **Start station**, **Start elevation**, **End station**, **End elevation** and **K factor** to define the parabola.

    The other fields show calculated values. Depending on the selected element, these may include **Length**, **Slope in**, **Slope out**, **K factor** and **Sag / Summit** values.
2. Tap **Store**.

**NOTE –** When you edit an element, only the selected element is updated. All adjoining elements remain unchanged.

# To add templates

To define a template for the selected road definition:

1. Tap **Templates**.
2. To add a new template:
   a. Tap **Add**.
   b. Enter the template name.
   c. In the **Copy from** field, select whether to copy an existing definition from a road or another template, into the template.

      **TIP –** To create a template library, define a road that only contains templates.

   d. Tap **Add**.

      The graphical template view appears.
3. To add a string to the template:
   a. Tap **New**.
   b. Enter the **String name**.
   c. To create a gap in the template, select the **Create gap** check box.
   d. Select the **Method** and then define the string. See:

      Cross slope and offset

      Delta elevation and offset

      Side slope
   e. Tap **Store**.
4. Continue adding strings as required.

   Each string is added after the selected string.

   Use the **Start**, **Prev**, **Next** and **End** softkeys to view other strings in the template.
5. To save the template and return to the **Templates** screen, tap **Accept**.
6. Add or select a different template to edit, or tap **Accept** to return to the list of components for the selected road definition.
7. Enter the other road components, or tap **Store** to store the road definition.

## Cross slope and offset

1. Enter the **Cross slope** and **Offset** values.

   To change the way a cross slope value is expressed, tap **Options** and change the **Grade** field as required.

2. Select the **Apply superelevation** and **Apply widening** options as required.

   **NOTE –** When the pivot position is set to **Pivot left** or **Pivot right**, the algebraic difference in cross slope between the first template string with superelevation applied and the superelevation value is used to calculate the superelevation for all other template strings with superelevation applied.

3. Select **Apply super rollover** and then specify a **Max value** to limit shoulder rollover. For more information, see Understanding superelevation rollover, page 56.

## Delta elevation and offset

1. Enter the **Delta elevation** and **Offset** values.
2. Select the **Apply superelevation** and **Apply widening** options as required.

   **NOTE –** When the pivot position is set to **Pivot left** or **Pivot right**, the algebraic difference in cross slope between the first template string with superelevation applied and the superelevation value is used to calculate the superelevation for all other template strings with superelevation applied.

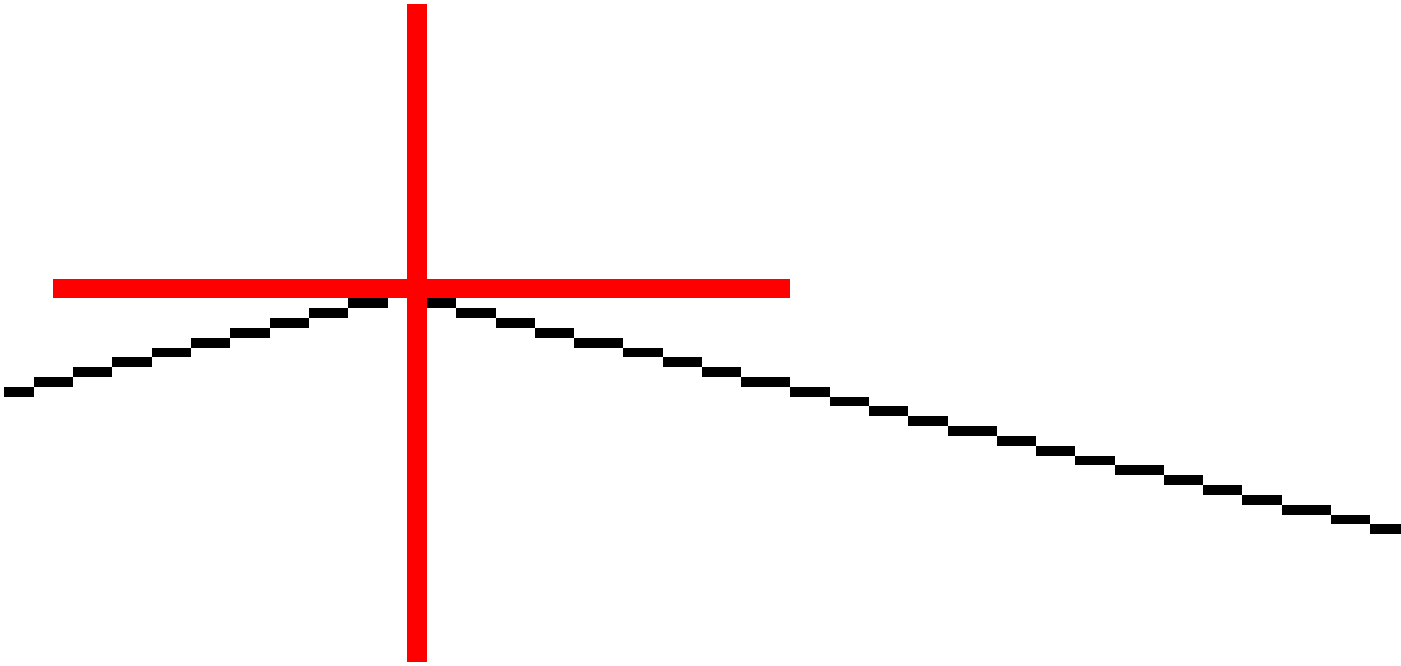
3. Select **Apply super rollover** and then specify a **Max value** to limit shoulder rollover. For more information, see Understanding superelevation rollover, page 56.

## Side slope

Enter the **Cut slope (1)**, **Fill slope (2)**, and **Cut ditch width (3)** values.

**NOTE –** Cut and fill slopes are expressed as positive values. You cannot add a string after a side slope.

To define a side slope with only a cut or fill slope, leave the other slope value field as '**?**'.



# To add template positions

After adding templates, you must specify the station at which the Roads software starts to apply each template. A template is applied at the start station and the values defining each string are then interpolated linearly (applied on a pro rata basis) from that point to the station where the next template is applied. See Template positioning examples, page 49.

To add template positions to the selected road definition:

1. Tap **Template positioning**. The **Apply template** screen appears.
2. To specify a new position at which template(s) should be applied:
    a. Tap **Add**.
    b. Enter the **Start station**.
    c. In the **Left template** and **Right template** fields, select the template to apply.

        To interpolate the template for this station from the previous and next templates in the road definition, select **<Interpolate>**.

        If you do not want to apply a template, for example to create a gap in the road definition, select **<None>**.
    d. Tap **Store**.
3. Continue adding positions where templates should be applied, as required.
4. When you are done, tap **Close**.
5. Tap **Accept**.
6. To select the interpolation method for calculating cross sections between template positions, select **Elevation** or **Cross slope**. Tap **Accept**.

    **TIP –** The **Road cross section interpolation by** field is added to the road **Options** screen. To change the interpolation method for the road, tap **Options** in the road components screen.
7. The software returns to the **Apply template** screen. Tap **Accept**.
8. Enter the other road components, or tap **Store** to store the road definition.

# To add superelevation and widening

Superelevation and widening values are applied at the start station, and values are then interpolated linearly (applied on a pro rata basis) from that point to the station where the next superelevation and widening values are applied.

To add superelevation and widening values to the selected road definition:

1. Tap **Superelevation & widening**.
2. Tap **Add**.
3. Enter the **Start station**.
4. In the **Pivot** field, select the position about which the template rotates. If you select:
    - **Pivot left**, the pivot position is the maximum offset, left of the alignment, of the last template string with superelevation applied.
    - **Pivot crown**, the pivot position is at the alignment.

- **Pivot right**, the pivot position is the maximum offset, right of the alignment, of the last template string with superelevation applied.

> **NOTE –** When the pivot position is set to **Pivot left** or **Pivot right**, the algebraic difference in cross slope between the first template string with superelevation applied and the superelevation value is used to calculate the superelevation for all other template strings with superelevation applied.

5. In the **Left super** and **Right super** fields, enter superelevation values for the left and right sides of the horizontal alignment.

   To change the way a superelevation value is expressed, tap **Options** and change the **Grade** field as required.

6. In the **Left widening** and **Right widening** fields, enter the widening values to be applied. Widening is expressed as a positive value.

   These values are applied to each string in the template that has the **Widening** check box selected.

7. Tap **Store**.
8. Continue adding records as required.
9. When you are done, tap **Close**.
10. Tap **Accept**.
11. Enter the other road components or tap **Store** to store the road definition.

# To add station equations

Use **Station equations** when the horizontal alignment has changed but you wish to retain the original station values.

1. Tap **Station equations**.
2. Tap **Add**.
3. In the **Back station** field, enter a station value.
4. In the **Ahead station** field, enter a station value. The **True station** value is calculated.
5. Continue adding records as required.
6. Tap **Store**.

   The values entered in the **Back station** and **Ahead station** fields are shown.

   The zone is indicated by a number after the colon in each field. The zone up to the first station equation is zone 1.

   The calculated **Progression** indicates whether the station value increases or decreases after the station equation. The default setting is **Increasing**. To change the **Progression** for the last station equation to **Decreasing**, define and store the last equation and then tap **Edit**.

7. When you are done, tap **Close**.

8. Tap **Accept**.
9. Enter the other road components, or tap **Store** to store the road definition.

# To define additional strings

Use **Additional strings** to define features that are related to but separate from the road, such as sound barriers or storm water drains. The additional string is defined by horizontal geometry comprising a series of lines that are defined relative to the horizontal alignment of the road and, if required, vertical geometry defined using all the options available when defining a vertical alignment for a road.

To add additional strings to the selected road definition:

1. Tap **Additional strings**.
2. Tap **Add**.
3. Enter the **String name**. Tap **Accept**.
4. To define the horizontal geometry of the string:
    a. Tap **Horizontal geometry**. If required, tap **Edit**.
    b. Tap **Add**.
    c. Enter the **Station** and **Offset** to define the start point. Tap **Store**.
    d. Enter the **End station** and **Offset** for the line. Tap **Store**.
    e. Continue adding lines to define the string as required.
    f. When you are done, tap **Close**.
5. Tap **Accept**.
6. To define the vertical geometry of the string:
    a. Tap **Vertical geometry**.
    b. Tap **Add**.
    c. Enter the **Station (VPI)** and **Elevation (VPI)** to define the start point. Tap **Store**.
    d. Add the required elements to the vertical geometry. See To key in the vertical alignment, page 40.
    e. When you are done, tap **Close**.
7. Tap **Accept**.
8. Add another string, or tap **Accept** to return to the list of components for the selected road definition.
9. Enter the other road components or tap **Store** to store the road definition.

# To define additional points

Use **Additional points** to define design features that are not part of the road design file, such as key positions for a drainage system, lamp posts, or road signs.

During stake out, you can stake additional points as needed. You can add an additional point by tapping any point in the job, or by tapping a point in any kind of linked file, including DXF, BIM, or CSV.

Alternatively, you can define additional points by editing the road. This can be useful when you want to use a large number of points contained in a separate file. To define additional points, import them from a CSV file or LandXML file. You can also key them in.

**NOTE –** When importing points from a CSV file, two formats are supported:

- Station and offset where each position in the file must be defined by a station and offset and, optionally, an elevation and code, in that order. See the following:

  1+000.000, 0.250, 20.345, ,
  1+000.000, -5.000, 25.345, End curb
  1+000.000, 4.500, , Lamp post
  1+000.000, 7.000, 25.294, Begin sound wall

- Northing and easting where each position in the file must be defined by a northing and easting and, optionally, an elevation and code, in that order. See the following:

  5000.000, 2000.000, 20.345, ,
  5000.000, 2100.000, 25.345, End curb
  5000.000, 2200.000, , Lamp post
  5000.000, 2300.000, 25.294, Begin sound wall

For both file formats, where points have null elevations you can choose to use the elevation of the vertical alignment at the station value of the point.

**TIP –** On import northing and easting coordinates in the CSV or LandXML file are converted to station and offset values relative to the road.

To add additional points to the selected road definition:

1. Tap **Additional points**.
2. To import points from a file:
   a. Tap **Import**.
   b. Tap 🗀 and select the file. Tap **Accept**.

      The imported points are listed in the **Additional points** screen.
3. To key in points:
   a. Tap **Add**.
   b. Enter the **Station** and **Offset** for the point.
   c. If required, enter the **Elevation** and **Code**.
   d. Tap **Store**.
   e. Continue adding points as required.
   f. When you are done, tap **Close**.

   **TIP –** To insert a point, tap the point you want the new point to follow and tap **Insert**.

4. Tap **Accept**.
5. Enter the other road components or tap **Store** to store the road definition.

# Template positioning examples

A template defines a cross section of the road at a point across the road to define how wide it is at different points. Add a template for each change in width. The template may consist of any number of strings.

A string is the linework connecting adjoining templates. Strings typically define the shoulder, edge of the pavement, curb, and similar features that make up a road. The string name is displayed during stakeout. You can define the string when you add the template.

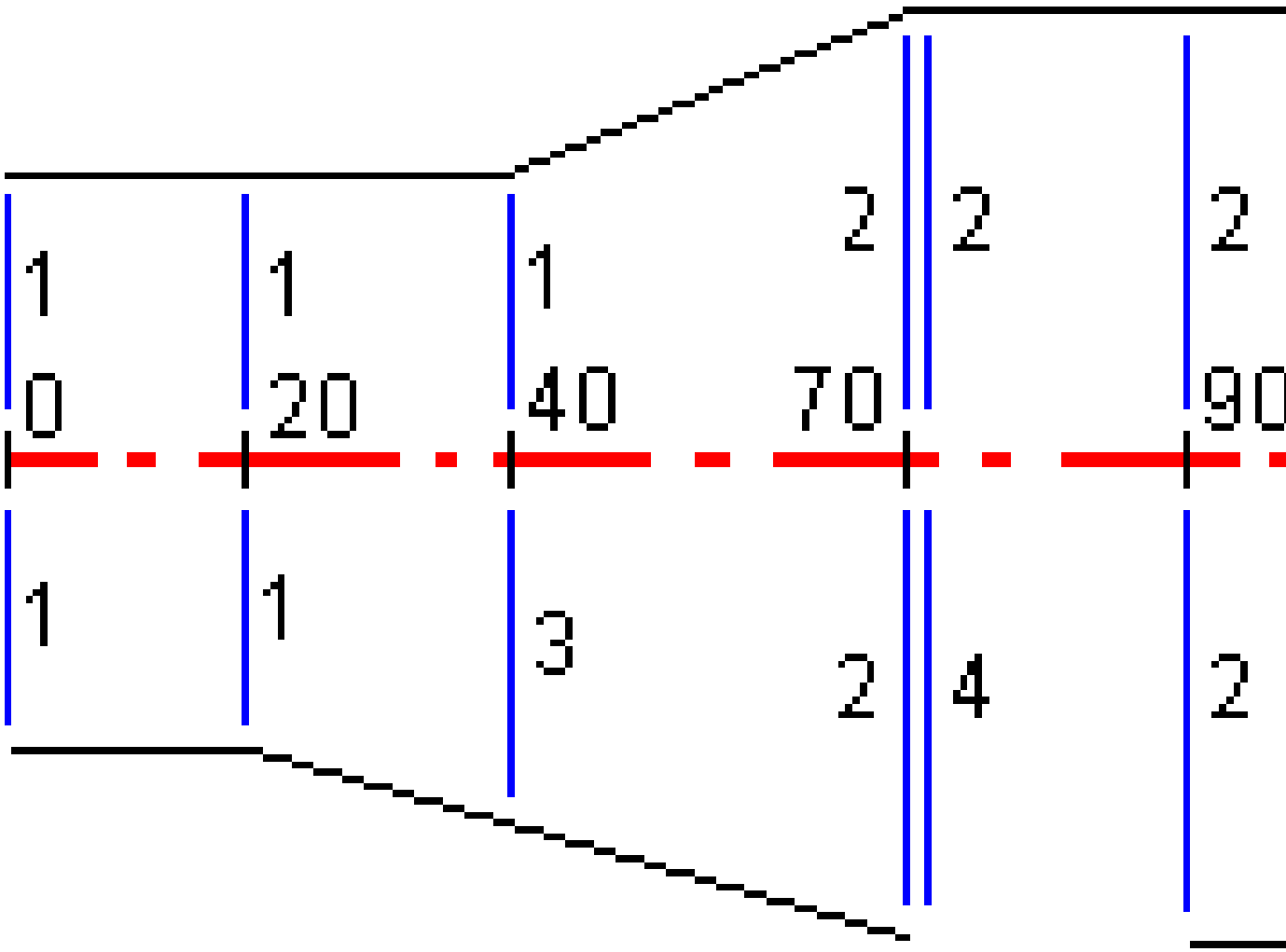
You can add gaps between strings where required. This is useful when the template does not start at the alignment. A gap is shown as a dashed line from the current string to the previous string. When measuring your position relative to the road, and if your position is in the gap, the **V.Dist** to the road value is null.

**NOTE –**

- If the design requires a gap in its definition, set the template field to **<None>**.
- No interpolation occurs between a null and a valid template.
- Templates are interpolated after superelevation and widening have been applied.

## Template assignment

This example explains how positioning of templates and use of interpolation can be used to control an RXL road definition:



Assign the templates at the specified start stations as shown in the following table:

| Start station | Left templates | Right templates |
|---|---|---|
| 0.000 | Template 1 | Template 1 |
| 20.000 | Template 1 | Template 1 |
| 40.000 | Template 1 | <Interpolate> 3 |
| 70.000 | Template 2 | Template 2 |
| 70.005 | Template 2 | <None> 4 |
| 90.000 | Template 2 | Template 2 |
| 120.000 | Template 2 | Template 2 |
| 120.005 | Template 1 | Template 2 |

### Right side of the road

On the right side, template 1 is assigned to stations 0 and 20. The road transitions from template 1 at station 20 to template 2 at station 70. Because a template must be assigned at station 40 on the left side, the system template <Interpolate> 3 must be assigned to the right side of the road to maintain correct interpolation.

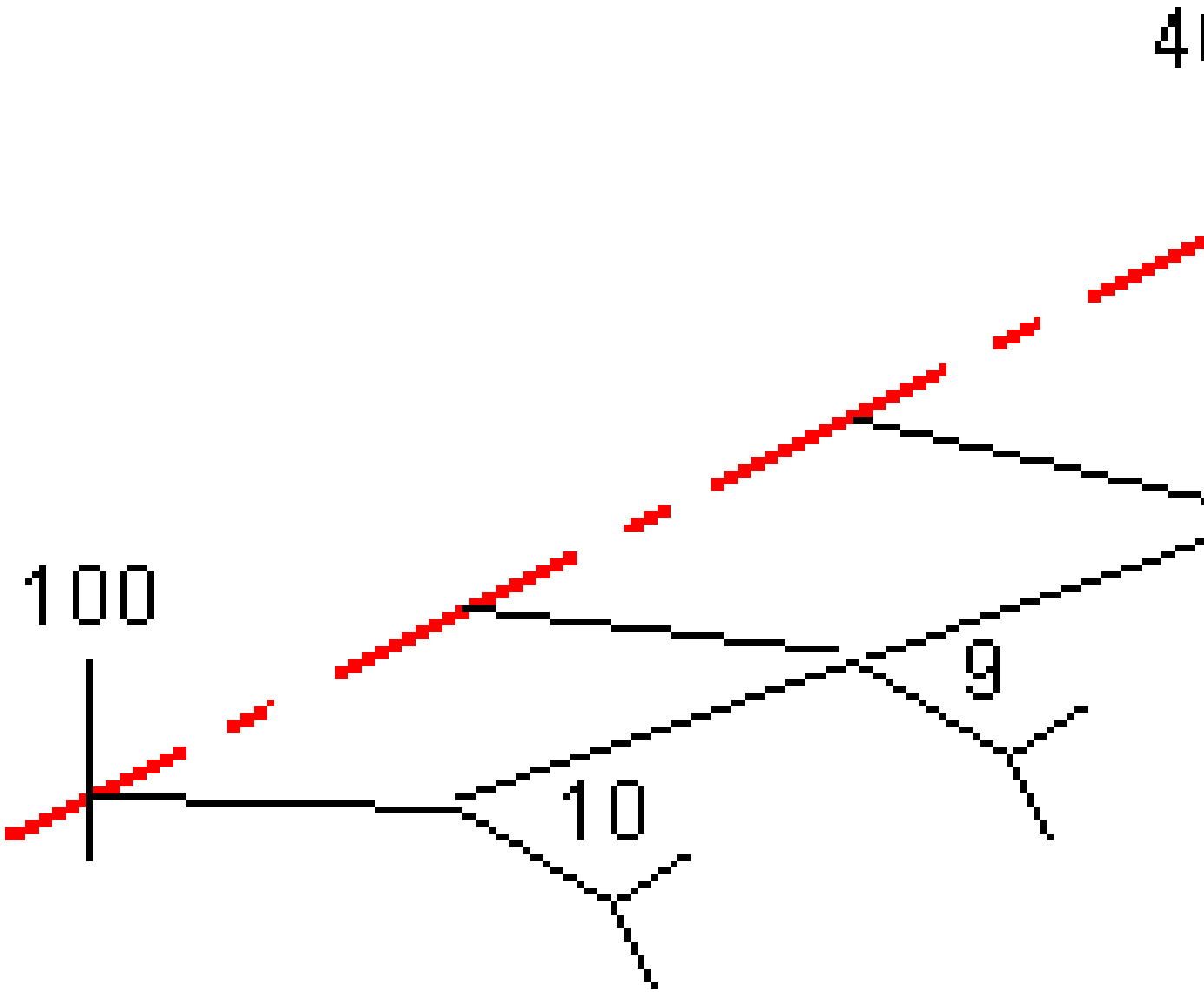
To correctly represent the gap between stations 70 and 90, the system template <None> 4 is assigned at a nominal distance after station 70 (5 mm). To complete the right side of the road, template 2 is assigned to stations 90, 120, and 120.005.

### Left side of the road

On the left side, template 1 is assigned to stations 0, 20, and 40. The road transitions from template 1 at station 40 to template 2 at station 70. To correctly represent the design, template 1 is assigned a nominal distance after station 120 (5 mm).

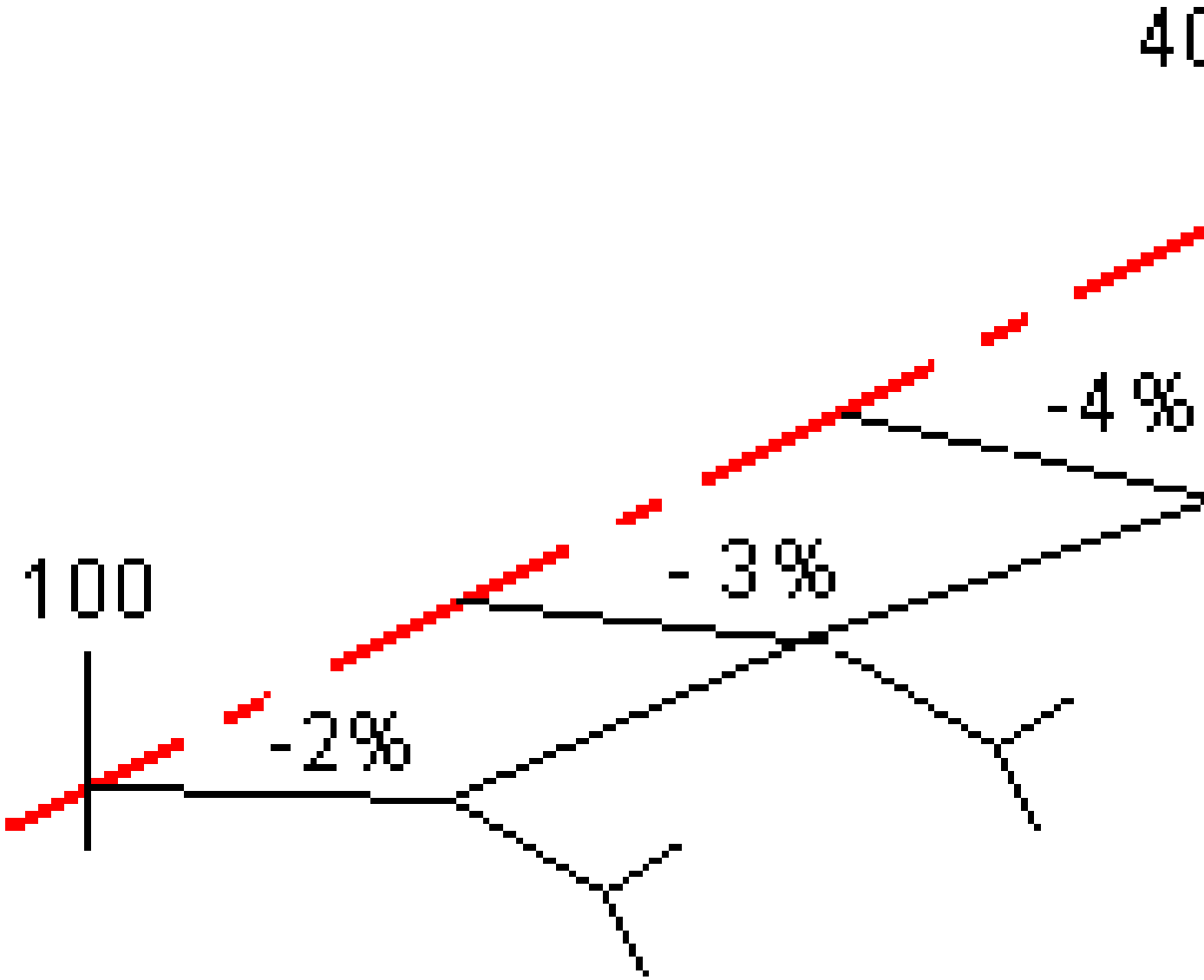
## Interpolation by elevation

See the following example where the template at station 100 has a string with an elevation of 10.0. The next template is assigned at station 400 and has a string with an elevation of 7.0. The cross section for stations 200 and 300 are interpolated as shown to provide even grading of elevation from station 100 to 400.



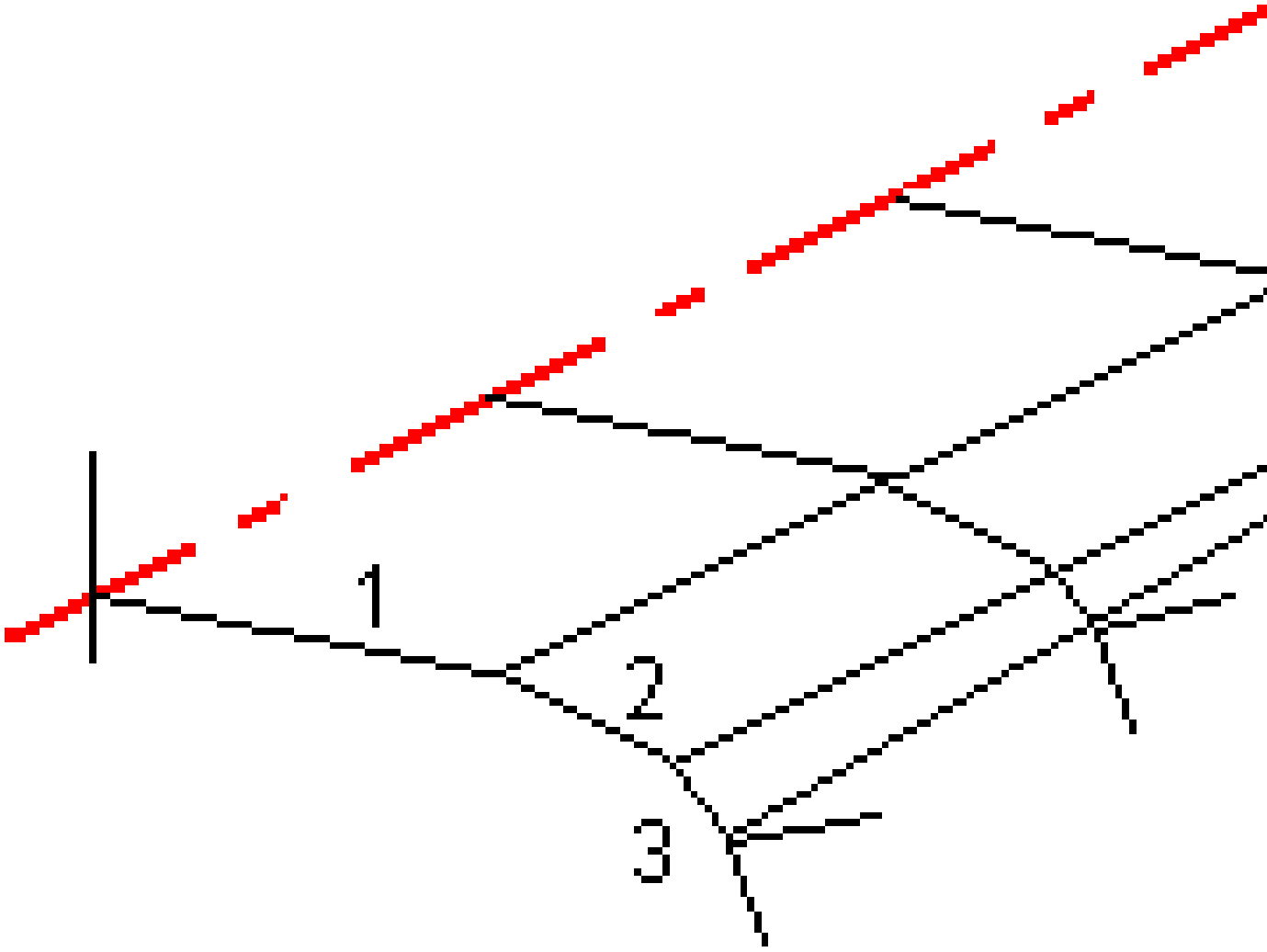

## Interpolation by cross slope

See the following example where the template at station 100 has a string defined by a crossfall of -2%. The next template is assigned at station 400 and has string defined by a crossfall of -5%. The cross section for stations 200 and 300 are interpolated as shown to provide even grading of cross slope from station 100 to 400.




## Interpolating between templates that have a different number of strings

For templates with an unequal number of strings, the template with the least strings has, in effect, a string defined with a zero offset added before the side slope string. The interpolation is then performed given an equal number of strings exist. In the example below, an additional string (3) has automatically been inserted.




By adding strings defined with a zero offset, you can further control the interpolation process to best represent the road design.

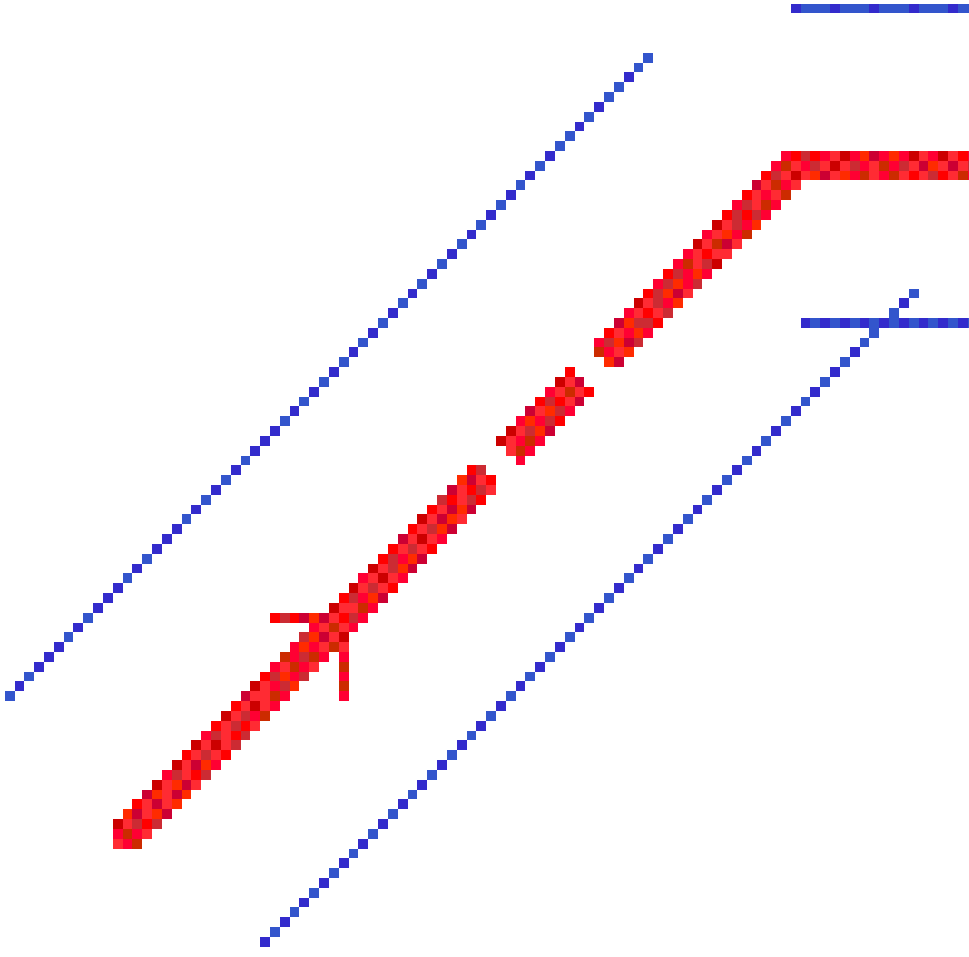
## Interpolation of side slopes

If consecutive templates contain side slopes of differing values intermediate stations have side slopes interpolated based on the slope value as a percentage.

For example, if the side slope value at station 600 is 50% (1:2) and at station 800 it is 16.67% (1:6) the side slope value at station 700 will be 50% + 16.7% / 2 = 33.33% (1:3).

# Non tangent horizontal alignment elements

The following diagram illustrates how, for an RXL road, cross sections connect when consecutive horizontal alignment elements are non tangential.



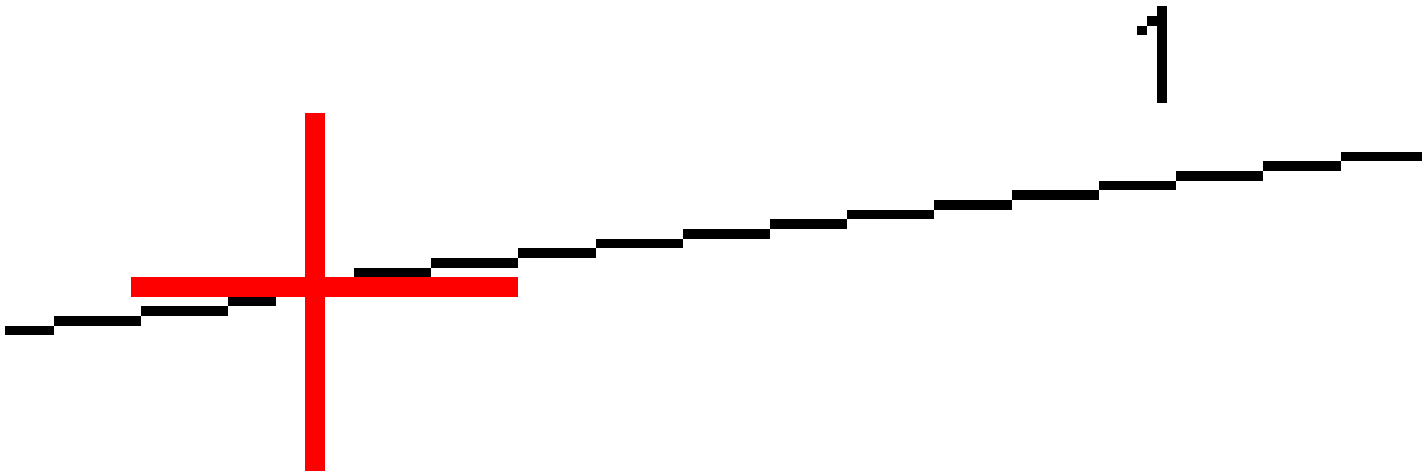
To understand how this affects the reported values when your current position is near the point of non tangency and you are measuring your position relative to a road or to a string, see Road navigation, page 62.

# Understanding superelevation rollover

You can add superelevation values when defining an RXL road.

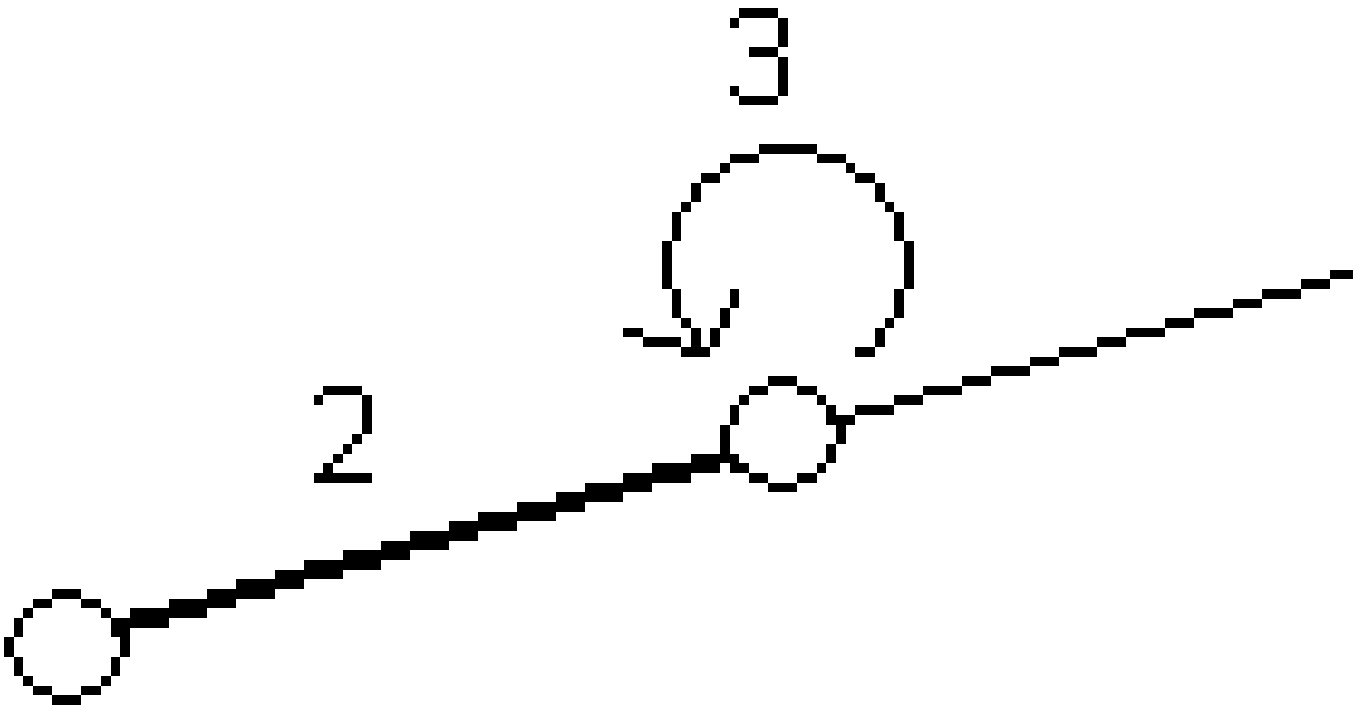
## Outside of curve (high side)

As shown below, the superelevation rollover value is the maximum algebraic difference in cross slope (3) between the carriageway or travel lane (1) where the carriageway is adjusted by superelevation and the shoulder (2) which is not adjusted by superelevation. If the station being staked includes superelevation that results in the difference in cross slope exceeding the specified maximum, the slope defining the shoulder is adjusted so that the algebraic difference in slope is not exceeded.




## Inside of curve (low side)

For the inside of a superelevated curve, the shoulder (2) uses its design value unless that value is less than the slope value of the superelevated carriageway (1). In that case, the superelevated value for the carriageway is used for the shoulder. This behavior happens only if you specified a maximum superelevation rollover value.




# To report the definition of an RXL road

To generate an HTM text report of the defined RXL road:

1. Select the road. In the map, tap the road to select it.

   To select the road from the list:

a. Tap ☰ and select **Define**.
b. Tap **RXL road**.
c. Select the road.

2. Tap **Edit**.
3. Tap **Report**.
4. To include only a part of the road definition in the report, select a different **Start station** and **End station**.
5. Tap **Accept**.

   The report appears in your browser. It shows the offset, coordinates, elevation, and code for each position in the cross section for the selected stations. The values reported are for the resolved cross sections, that is, they include any superelevation and widening values that may have been applied, and any interpolation between different templates.

   If the definition includes additional points these are included in the report in a separate section after the Road Cross-Section Points.

# 4

# Review the road design

You can review the road design at any time. From the road review screen you can also use the automated 3D drive feature. The 3D drive enables you to view the road in 3D to confirm the road definition and to visualize the road relative to other road definitions, such as a complex interchange or urban intersection.

To review the road in a road design file:

1. In the map, tap the road to select it.
2. Tap **Review**. The road is shown in the map.

   Black hollow circles represent any portion of the horizontal alignment that has no elevations and so is drawn on the ground plane.

   > **TIP –** To move the ground plane closer to the road, tap ⋮ and select **Settings** and then edit the ground plane elevation.

   Black solid circles represent the positions on the strings at each cross section.

   Gray lines represent the strings and connect the cross sections.

   To understand the rules for connecting cross sections in an RXL road, see Template positioning examples, page 49 and Non tangent horizontal alignment elements, page 55.
3. Tap a string or a station on a string.

   Alternatively, tap the **String** softkey to select a string from the list. The list shows only the strings that are at the start station or, if you have a position, the strings at the cross section at your current position. When a string is selected, tap the **Station** softkey to select a station from the list.

   Information about the selected item is shown alongside the map.
4. To select a different station or string, you can:
   - Tap the station on a string.
   - Tap the **Station** or **String** softkey to select a station or string from a list.
   - Press the up or down arrow key to select another station, or press the left or right arrow key to select another string.
   - Tap the **Sta-** or **Sta+** softkey.

   Use the map toolbar to navigate around the map and to change between views.
5. To view available cross sections, tap . Alternatively, assign the **Toggle Plan / Cross section** function to a function key on the controller so that you can switch between the plan and cross section views when reviewing and staking a road.

By default, each cross section is displayed so that it fills the screen, providing the best view of the cross section. To view cross sections relative to each other, tap the **Fixed scale** button so that it changes to . Each cross section is displayed with the scale fixed so that the widest cross section fills the screen.

The alignment is shown as a red cross. The black circles represent the strings. The larger blue circle represents the currently selected string. The linework preceding the selected string is shown as a bold blue line. Information about the selected item is shown alongside the map.

To view the cross section at a different station, you can:

- Press the up or down arrow key.
- Tap **Station** to key in a station or to select a station from the list.

To select a different string, you can:

- Tap the string.
- Press the left or right arrow key.
- Tap **String** to select a string from the list.

6. To return to the map, tap or press the **Tab** key.
7. To view an automated 3D drive through of the road:
   a. In the road review screen, tap **3D drive**.
   b. Tap ▶ to start the drive through.
   c. To pause the drive through and inspect a particular part of the road, tap ❚❚. To orbit the road while the drive through is paused, tap the screen and swipe in the direction to orbit.
   d. To move forward and back along the road, press the up and down arrow keys.
   e. To exit 3D drive, tap **Close**.
8. To exit the road review, tap **Close**.

**TIP –** When reviewing an RXL road:

- To review a position defined by a nominal station value, where the station does not have to coincide with a cross section, from the plan or cross section view tap **Station** and then key in a station value.
- To review a position defined by a nominal offset value, where the offset does not have to lie on a string, tap **String** and then key in an offset. The offset is computed from the alignment. The elevation for the resultant position is defined by interpolation of the cross section at the entered station and offset.

# Road navigation

During stakeout or when reviewing the road, the left of the screen shows the road in the map or cross section view.

The panel to the right of the **Review** screen shows information about the part of the road you have selected in the map or cross section view.

The panel to the right of the **Stakeout** navigation screen shows the navigation pane.

- The arrow points in the direction of the point that you intend to measure (the "target").
- The stakeout delta values at the bottom of the navigation pane indicate the distance to and the direction of the target.

When navigating to a point during stakeout, the information shown depends on whether you are performing a Conventional or GNSS survey, and the options you have configured in the **Stakeout options** screen.

- To change the displayed deltas during stakeout, tap **Options** in the stakeout navigation screen or tap and hold in the navigation pane. For more information, refer to the topic **Stakeout navigation deltas** in the Spectra Geospatial Origin General Survey User Guide.
- To view the as-staked point details before you store the point, enable the **View before storage** setting. For more information, refer to the topic **As-staked point details** in the Spectra Geospatial Origin General Survey User Guide.

## Map and cross section view

The stakeout navigation screen shows the map view or cross section view of the road.

### Map

The map shows:

- Horizontal alignment as a red line
- Other strings as black lines
- Construction offsets as green lines
- Skew offsets as dashed black lines

During stakeout the map shows a dashed green line drawn from the current position to the:

- horizontal alignment when measuring your position relative to the road and you are within 30 m of the alignment/string
- selected string when measuring your position relative to a string and you are within 5 m of the string

### Cross section view

To view the cross section of the road, tap in the map toolbar.

When viewing a road design file:

- The cross section view shows the strings and templates relative to the alignment. It also shows any surface added as well as the surface calculated from the road design.
- The cross section is orientated in the direction of increasing station. Your current position and the target are shown. If the target has construction offsets specified, the smaller single circle indicates the selected position and the double circle indicates the selected position adjusted for the specified construction offset(s). The construction offset(s) appear as green lines.
- The appropriate cut or fill side slope appears for the side of the road that you are currently on.

  **NOTE –** If you have set the **Design cut/fill** field to **Perpendicular** in the **Stakeout options** screen, the perpendicular cut/fill position is drawn on the design in the cross section view only when measuring positions relative to the road. Because the cross section view is not drawn to scale, the perpendicular position may appear slightly incorrect (ie. not exactly perpendicular).

- Tap and hold in the cross section view to define a cross slope or subgrade.
- To step through the templates for the road, tap the arrow keys. To set a fixed scale based on the widest template in the road, tap . To use a variable scale so that each template fills the cross section view, tap .

When viewing strings and surfaces:

- Strings have no relationships to each other until you select them.
- The cross section view shows only the surface used – it cannot show any calculated surface.

To return to the map, tap .

**TIP –** Assign the **Toggle Plan / Cross section** function to a function key on the controller so that you can switch between the plan and cross section views when reviewing and staking a road.

## Navigation pane

Before stakeout the software shows:

- Station (when staking a station on a string)
- String name (when staking a station on a string or measuring your position relative to a string)

  For an RXL road, the software uses the string name from the template definition. When the offset is 0.000 m, the string name defaults to CL.

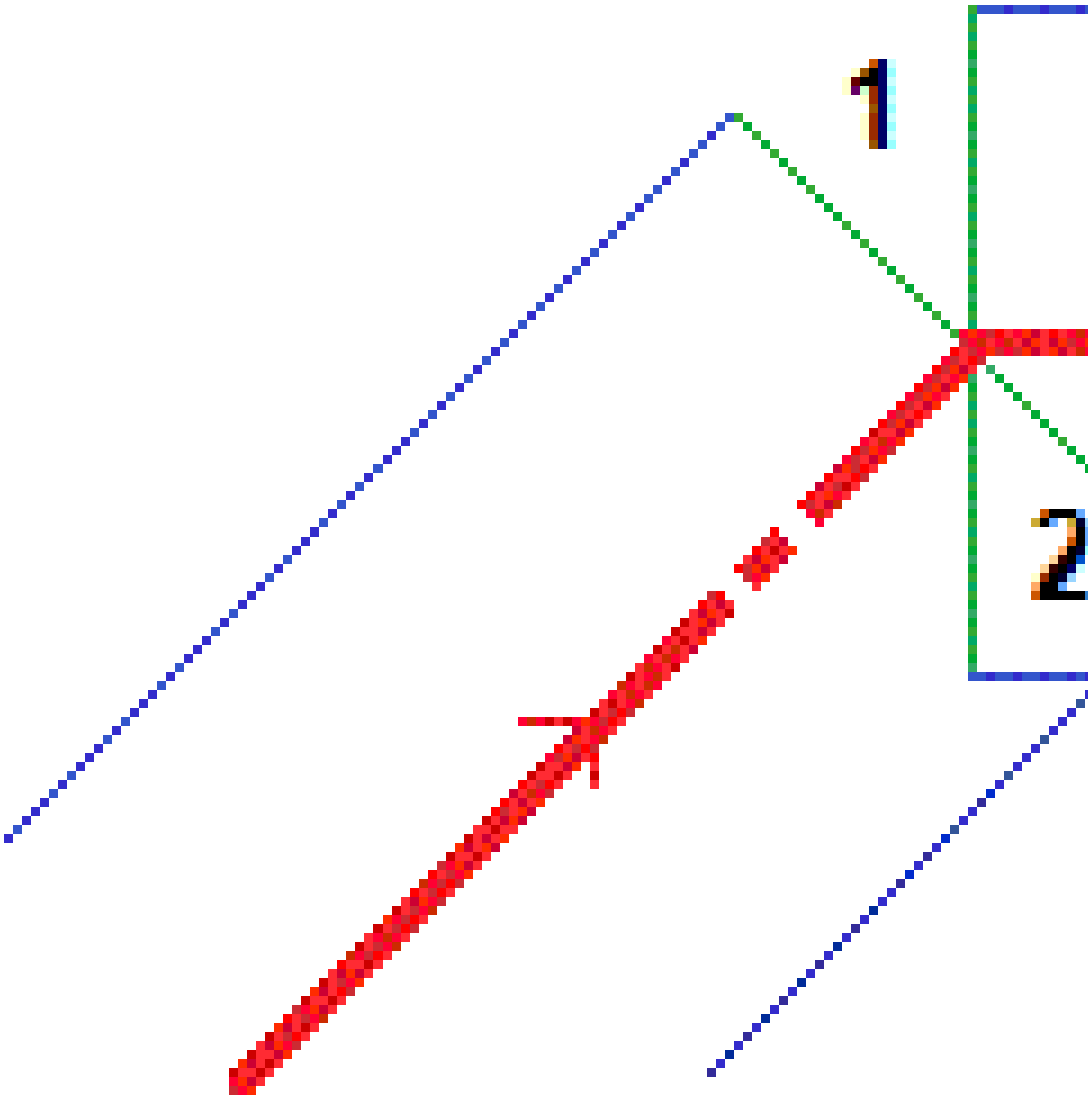
- Design elevation of the selected position (shown in red if edited)
- Construction offsets
- When staking a station on a string, the software also shows:
  - Type
  - Offset

    - Elevation (shown in red if edited)
- When staking a side slope, the software also shows the:
    - Design side slope values
    - Cut ditch width (RXL roads only)
- When staking a skew offset, the software also shows the:
    - Skew offset
    - Deflection angle/azimuth

During stakeout the software shows:

- Elevation of your current position (shown in blue)
- When staking a side slope, the software also shows:
    - Side slope value defined by your current position (shown in blue)
    - Design side slope value (shown in red if edited)
- **Off road** appears if your current position is before the start of the road or beyond the end of the road.
- **Undefined** appears when consecutive horizontal alignment elements are non tangential and your current position is beyond the end tangent point of the incoming element but before the start tangent point of the next element and you are on the outside of the road. See position 1 in the diagram below.
- When consecutive horizontal alignment elements are non tangential and your current position is before the end tangent point of the incoming element but after the start tangent point of the next element, and your position is on the inside of the road (see position 2 in the diagram below), the station, offset and vertical distance values are reported using the closest horizontal element to your

position to determine which portion of the road to use.



## Navigation stakeout deltas

The bottom of the navigation pane shows stakeout delta values that report your current position relative to the item being staked.

To change the displayed deltas during stakeout, tap **Options** in the stakeout navigation screen or tap and hold in the navigation pane.

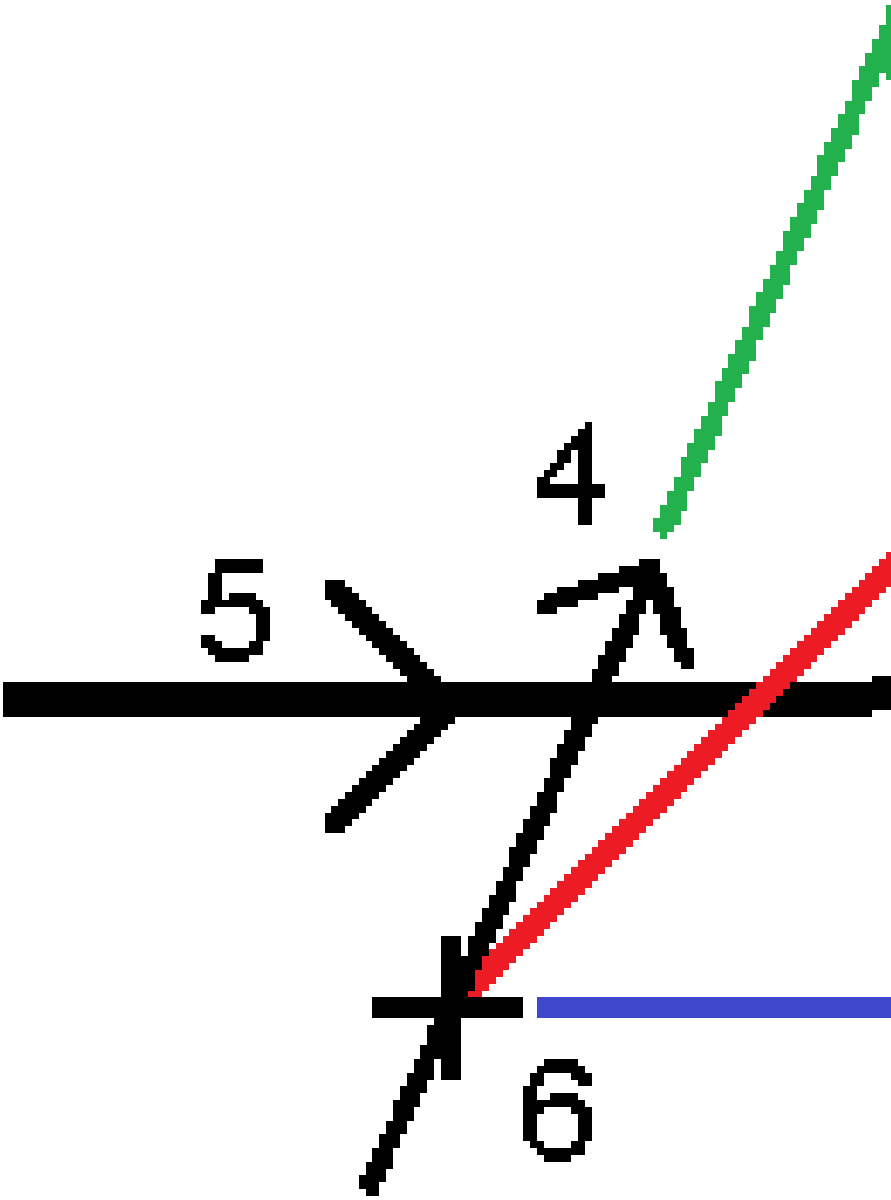
**NOTE –**

- If you are using a conventional instrument, the road values only appear after you take a distance measurement.
- If the road consists of only a horizontal and vertical alignment the **V.Dist** value reports the vertical distance to the vertical alignment.
- When using a road design file, if your position is in a gap, the **V. Dist** value is null. Gaps are shown as a dashed line in the cross section view. To see how to create a gap in a template, see To add templates, page 42.

## Understanding the navigation directions

During stakeout, hold the display screen in front of you as you walk forwards in the direction that the arrow is pointing. The arrow points in the direction of the point that you intend to measure (the "target").

As shown in the diagram below, the values in the **Go Forward/Go Backward (1)** and **Go Right/Go Left (2)** fields are relative to the cross-section of the point that you are staking out **(3)**. They are ***not*** relative to the current direction of travel **(4)**, or to the direction of increasing station **(5)** at your current position **(6)**.

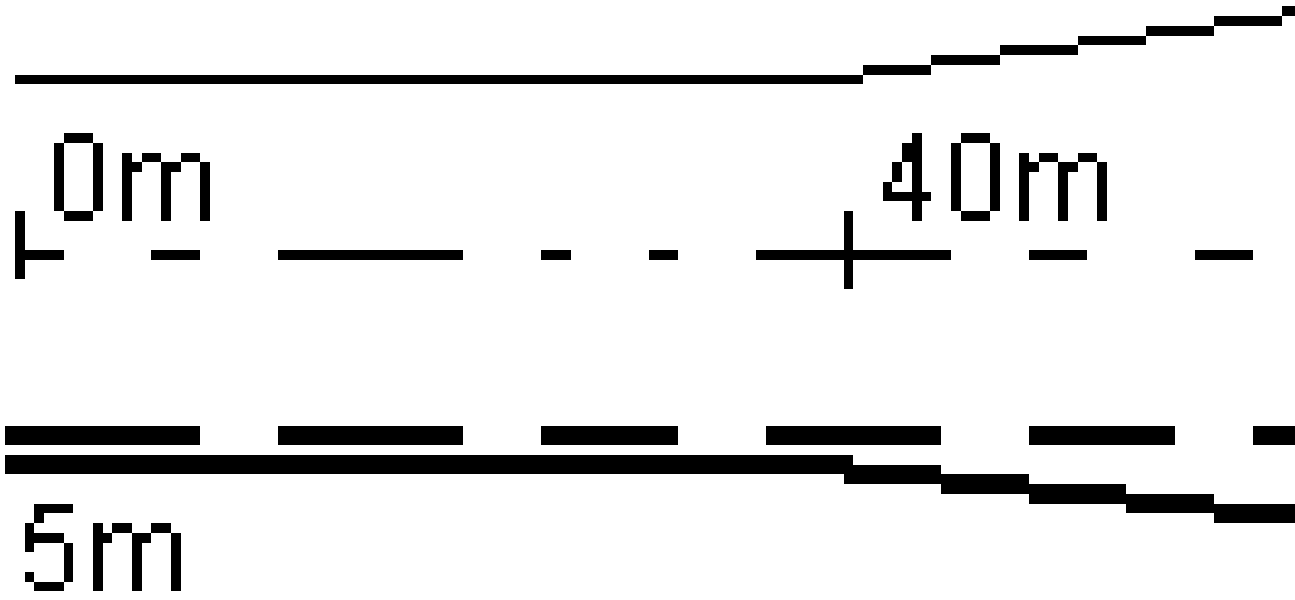


## Keyed in and selected offset/feature behavior

The behavior at stakeout differs depending on whether the offset/string was selected from the map or cross section view, selected from a list, or keyed in.

- If you select a string from the map or cross section view, or select a string from the list, the Go Right/Go Left value at stakeout updates to reflect any changes in geometry due to template changes or widening.
- If you key in a numeric offset value (effectively defining a string on the fly) that value is maintained for the entire length of the road.

Consider the following diagram:




If you select an offset/string that has an offset value of 5 m, the offset value updates to follow the solid line for subsequent stations. In this example, the offset changes from 5 m to 8 m between stations 40 m and 100 m and then is maintained at 8 m for subsequent stations.

If you key in 5 m for the offset, the offset follows the dashed line. That is, the offset of 5 m is maintained for subsequent stations.

## GNSS tilt sensor information

When using a GNSS receiver with a built-in tilt sensor, you can:

- Tap **eBubble** to display an electronic bubble
- Configure the survey style to prompt a warning when the pole is outside a specified **Tilt tolerance**
- To configure quality control, precision, and tilt settings, tap **Options**.

# Stakeout navigation display

The information shown when navigating to points during stakeout depends on whether you are performing a Conventional or GNSS survey, and the options you have configured in the **Stakeout options** screen.

To configure these options:

- In the survey style, tap ☰ and select **Settings / Survey styles / <Style name> / Stakeout**.
- During stakeout, tap **Options** in the stakeout navigation screen.

## Conventional surveys

Use the **Display** group to configure the appearance of the navigation display during stakeout:

- To show the large navigation arrow in the navigation screen, set the **Show stakeout graphics** switch to **Yes**.

  **TIP –** If you are using a controller with a smaller screen, or you want to fit more navigation deltas on the screen, set the **Show stakeout graphics** switch to **No**. The other fields in the **Display** group are hidden when the switch is set to **No**.

- Select the **Display mode**: The options are:
  - **Direction and distance** – the stakeout navigation display shows a large arrow pointing in the direction you have to move. When you are close to the point, the arrow changes to the in/out and left/right directions, relative to the instrument.
  - **In/out and left/right** – the stakeout navigation display shows in/out and left/right directions.

  **TIP –** By default the software automatically gives in/out and left/right directions from the **Target perspective** in a robotic survey, and from the **Instrument perspective** when connected to a servo instrument using a face plate or cable. To change this, change the settings in the **Servo/Robotic** group box. For more information, refer to the topic **Instrument configuration** in the *Spectra Geospatial Origin General Survey User Guide*.

- Use the **Distance tolerance** field to specify the allowable error in distance. If the target is within this distance from the point, the software indicates that the distance is correct.

- Use the **Angle tolerance** field to specify the allowable error in angle. If the conventional instrument is turned away from the point by less than this angle, the software indicates that the angle is correct.
- Use the **Grade** field to display the grade of a slope as an angle, percent, or ratio. The ratio can be displayed as **Rise:Run** or **Run:Rise**.
- When staking position relative to a road, from the **Design cut/fill** field, select whether to show the **Vertical** or **Perpendicular** cut/fill to the design.

  **NOTE –** The **Perpendicular** cut/fill position is drawn on the design in the cross section view. Because the cross section view is not drawn to scale, the perpendicular position may appear slightly incorrect (ie. not exactly perpendicular).

  **TIP –** For all other stakeout methods the **Vertical** cut/fill to the design is always shown.

- In the **Deltas** group, review the deltas shown for the current stakeout item. To change the deltas shown, tap **Edit**.

  Deltas are the information fields shown during navigation that indicate the direction and distance you need to travel to the item you want to stake out. For more information, refer to the topic **Stakeout navigation deltas** in the *Spectra Geospatial Origin General Survey User Guide*.

- To display the cut or fill relative to a surface during stakeout, enable the **Cut/Fill to surface** switch.

  a. In the **Surface** field, select the surface file from the current project folder. Only surface files that are set to visible or selectable in the **Layer manager** are listed.

  Alternatively, in the map select surfaces from BIM files. If you cannot select surfaces in the map, make sure the BIM file is set to selectable in the **Layer manager**. If the **Selection mode** button on the **BIM** toolbar is button is yellow , tap it and select **Surface selection - Individual faces** mode.

  **NOTE –** You can select **Surface selection - Whole object** mode, but when using **Whole object** mode the software selects both the top and bottom surface and calculates the cut/fill to whichever surface you are closest to.

  The **Surface** field indicates the number of surfaces you have selected in the map.

  To select a different surface from the map, double-tap in the map to clear the current selection and then select the new surface.

  b. If required, in the **Offset to surface** field, specify an offset to the surface. Tap to select whether the offset is to be applied vertical or perpendicular to the surface.

  c. To show the distance to the surface in the stakeout navigation screen, tap **Options**. In the **Deltas** group box, tap **Edit** and select the **V. Dist surface at current position** or the **Perp. Dist to surface at current position** delta. Tap **Accept**.

- If your Spectra Geospatial controller includes an internal compass, you can use it when staking out a position or navigating to a point. To use the internal compass, select the **Compass** check box. Spectra Geospatial recommends you ***disable*** the compass when you are near magnetic fields that may cause interference.

## GNSS surveys

Use the **Display** group to configure the appearance of the navigation display during stakeout:

- To show the large navigation arrow in the navigation screen, set the **Show stakeout graphics** switch to **Yes**.

  **TIP –** If you are using a controller with a smaller screen, or you want to fit more navigation deltas on the screen, set the **Show stakeout graphics** switch to **No**. The other fields in the **Display** group are hidden when the switch is set to **No**.

- Select the **Display mode**: The options are:
  - **Target centered** – the selected point stays fixed in the center of the screen
  - **Surveyor centered** – your position stays fixed in the center of the screen
- Choose a setting in the **Display orientation** field. The options are:
  - **Direction of travel** – the screen will orientate so that the top of the screen points in the direction of travel.
  - **North / Sun** – the small orientation arrow shows the location of North or the sun. The screen will orientate so that the top of the screen points toward North or the sun. When using the display, tap the **North/Sun** softkey to toggle the orientation between north and the sun.
  - **Reference azimuth**:
    - For a point the screen will orientate to the **Reference azimuth** for the job. The **Stake** option must be set to **Relative to azimuth**.
    - For a line or road the screen will orientate to the azimuth of the line or road.

  **NOTE –** If, when staking a point, the **Display orientation** is set to **Reference azimuth** and the **Stake** option is **not** set to **Relative to azimuth** the display orientation behavior will default to **Direction of travel**.

- Use the **Grade** field to display the grade of a slope as an angle, percent, or ratio. The ratio can be displayed as **Rise:Run** or **Run:Rise**.
- When staking positions relative to a road, from the **Design cut/fill** field, select whether to show the **Vertical** or **Perpendicular** cut/fill to the design.

  **NOTE –** The **Perpendicular** cut/fill position is drawn on the design in the cross section view. Because the cross section view is not drawn to scale, the perpendicular position may appear slightly incorrect (ie. not exactly perpendicular).

> **TIP –** For all other stakeout methods the **Vertical** cut/fill to the design is always shown.

- In the **Deltas** group, review the deltas shown for the current stakeout item. To change the deltas shown, tap **Edit**.

  Deltas are the information fields shown during navigation that indicate the direction and distance you need to travel to the item you want to stake out. For more information, refer to the topic **Stakeout navigation deltas** in the *Spectra Geospatial Origin General Survey User Guide*.

- To display the cut or fill relative to a surface during stakeout, enable the **Cut/Fill to surface** switch.

  a. In the **Surface** field, select the surface file from the current project folder. Only surface files that are set to visible or selectable in the **Layer manager** are listed.

  Alternatively, in the map select surfaces from BIM files. If you cannot select surfaces in the map, make sure the BIM file is set to selectable in the **Layer manager**. If the **Selection mode** button on the **BIM** toolbar is button is yellow , tap it and select **Surface selection - Individual faces** mode.

  > **NOTE –** You can select **Surface selection - Whole object** mode, but when using **Whole object** mode the software selects both the top and bottom surface and calculates the cut/fill to whichever surface you are closest to.

  The **Surface** field indicates the number of surfaces you have selected in the map.

  To select a different surface from the map, double-tap in the map to clear the current selection and then select the new surface.

  b. If required, in the **Offset to surface** field, specify an offset to the surface. Tap to select whether the offset is to be applied vertical or perpendicular to the surface.

  c. To show the distance to the surface in the stakeout navigation screen, tap **Options**. In the **Deltas** group box, tap **Edit** and select the **V. Dist surface at current position** or the **Perp. Dist to surface at current position** delta. Tap **Accept**.

- If your Spectra Geospatial controller includes an internal compass, you can use it when staking out a position or navigating to a point. To use the internal compass, select the **Compass** check box. Spectra Geospatial recommends you ***disable*** the compass when you are near magnetic fields that may cause interference.

> **NOTE –** If you are using IMU tilt compensation and the IMU is aligned, the heading from the receiver is always used to orient the GNSS cursor, the large stakeout navigation arrow and the close up screen. You must be facing the LED panel of the receiver for these to be orientated correctly.

By default the software displays navigation information to the point from your current position. To navigate using a cross-track line between the point to be staked out and a reference point, change the **Stake** method. For more information, refer to the topic **GNSS stake methods** in the *Spectra Geospatial Origin General Survey User Guide*.

# 6

# Stake the road

**CAUTION –** Do not change the coordinate system or calibration after you have staked out points, or computed offset or intersection points. If you do, the previously staked out or computed points will be inconsistent with the new coordinate system and any points computed or staked out after the change.

## Staking from a road design file

1. Make sure you are in Origin Roads. Tap ☰ and if the menu item below **Job data** shows **General Survey** or another app, tap that menu item and then select **Roads** and tap **Accept**.
2. In the map, tap the road and then tap **Stakeout**.

   Alternatively, tap ☰ and select **Stakeout**, if needed select the name of the survey style to use, and then tap **Roads**. In the Select file screen, select the road to stake. If there are many roads in the job, use the **Find file** field to help you select the road to stake. Tap **Next**.

   The **Road** form appears alongside the map, showing the name of the selected road.
3. If you have not yet started a survey, the software prompts you through the steps to start the survey.
4. Enter a value in the **Antenna height** or **Target height** field and make sure that the **Measured to** field is set correctly.
5. Enter the **Station interval for lines** and **Station interval for arcs and transitions** or accept the default value set when the road was defined.

   **Station interval** values are required when staking out a station on a string. These values are optional for other survey methods.
6. Tap **Next**.

   The stakeout selection screen appears, with the name of the road shown at the top.

   Select the stakeout method to use. For more information and next steps, refer the topic for the stakeout method you have selected. If you select:

   - **To the road**, see Stake positions relative to the road, page 76
   - **To the string** or **To the nearest string**, see Stake positions relative to a string, page 78
   - **Station on string**, see Stake stations on a string, page 80
   - **Skew offset**, see Stake a position at a skew offset, page 82

- **To an additional string**, see Stake to an additional string, page 85
- **Additional points**, see Stake additional points, page 87

**NOTE –** When staking a road design file:

- If the road consists of a horizontal alignment only, you can stake it out in only two dimensions.
- The horizontal and vertical alignments of the road may not start and end at the same station values. When they start and end at different station values, you can stake out points in three dimensions only if their stations lie within the horizontal alignment.

## Staking from strings and surfaces

1. Make sure you are in Origin Roads. Tap ☰ and if the menu item below Job data shows **General Survey** or another app, tap that menu item and then select **Roads** and tap **Accept**.
2. In the map, tap the string and then tap **Stakeout**.

   Alternatively, tap ☰ and select **Stakeout**, if needed select the name of the survey style to use, and then select **Strings and surfaces**.

   The **Strings and surfaces** form appears alongside the map.
3. If you have not yet started a survey, the software prompts you through the steps to start the survey.
4. Enter a value in the **Antenna height** or **Target height** field and make sure that the **Measured to** field is set correctly.
5. If you started from the map, the selected string is shown in the **Primary stationing string** field. To change or to select the **Primary stationing string**:
   - To select the **Primary stationing string** from the map, tap in the **Primary stationing string** field and then tap the string to use on the map.

     The **Primary stationing string** field shows the name of the string you selected.
   - To select the **Primary stationing string** from the list of strings in the job or linked to the job:
     a. Tap ▸ next to the **Primary stationing string** field.
     b. Select the string from the list. If needed, enter part of the string name in the **Name** field to filter the list of strings.
     c. Tap **Accept** to return to the **Strings and surfaces** form.

        The **Primary stationing string** field shows the name of the string you selected.
6. Enter the **Start station**.
7. Tap **Accept**.

   The stakeout selection screen appears, with the name of the **Primary stationing string** shown at the top.

Select the stakeout method to use. For more information and next steps, refer the topic for the stakeout method you have selected. If you select:

- **To the primary string**, see Stake positions relative to the primary string, page 77
- **To the string**or **To the nearest string**, see Stake positions relative to a string, page 78
- **To two strings**, see Stake the surface between two strings, page 88
- **Station on string**, see Stake stations on a string, page 80
- **Additional points**, see Stake additional points, page 87

# Stake positions relative to the road

**NOTE –** This stakeout method can be used when staking from a **road design file**. When staking **Strings and surfaces**, the equivalent stakeout method is To the primary string.

1. In the stakeout selection screen, select **To the road** from the **Stake** field, or double-tap an empty part of the map. This will clear any selected items in the map, leaving you ready to stake positions relative to the road.
2. To set stakes offset from the road, leaving the roadway clear for construction, define a construction offset.
3. To view the perpendicular cut/fill to the road, select **Options** and in the **Road** group box set the **Design cut/fill** field to **Perpendicular**.
4. Tap **Start**.

   The Road navigation, page 62 screen appears. Tap **Options** to configure preferences for the navigation display, grade, as-staked point details, or to view stakeout deltas relative to a digital terrain model (DTM).
5. Use the information in the Road navigation, page 62 screen to see your position relative to the road and navigate to the point to stake it out.

   If your current position is:

   - Within 30 m of the horizontal alignment, the plan view shows a dashed green line drawn at a right angle from your current position to the alignment.
   - More than 30 meters from the horizontal alignment, the software navigates you to a position on the horizontal alignment. This is calculated by projecting your current position at right angles to the horizontal alignment.
6. When the point is within tolerance, tap **Measure** to measure the point.
7. Tap **Store**.

   The software returns to the navigation screen.

### Next steps

- To continue measuring points along the road, tap the **Sta+** or **Sta-** softkey to select the next or previous station.

  If you have enabled the **Auto increment** field in the **Select station** screen then the next or previous station is automatically selected. See Stations available for stakeout, page 91.
- To change stakeout methods, and stake:
  - **To the road**, double-tap an empty part of the map.
  - **To a string**, tap the string in the map.
  - A **Station on a string**, tap the station on a string in the map.
- To exit this stakeout method, tap **Esc**.

# Stake positions relative to the primary string

**NOTE –** This stakeout method can be used when staking **Strings and surfaces**. When staking from a **road design file** the equivalent stakeout method is To the road.

1. In the stakeout selection screen, select **To the primary string** from the **Stake** field, or double-tap an empty part of the map. This will clear any selected items in the map, leaving you ready to stake positions relative to the primary string.
2. To set stakes offset from the road, leaving the roadway clear for construction, define a construction offset.
3. Tap **Start**.

   The Road navigation, page 62 screen appears. Tap **Options** to configure preferences for the navigation display, grade, as-staked point details, or to view stakeout deltas relative to a digital terrain model (DTM).
4. Use the information in the Road navigation, page 62 screen to see your position relative to the road and navigate to the point to stake it out.

   When in plan view, your current position will be displayed as a gray dashed line drawn at a right angle to the primary string.
5. When the point is within tolerance, tap **Measure** to measure the point.
6. Tap **Store**.

   The software returns to the navigation screen.

### Next steps

- To change stakeout methods, and stake:
  - **To the string**, tap Esc and then tap the string in the map.
  - **To two strings**, tap **Esc** and then select **To two strings** from the **Stake** field.

    - A **Station on a string**, tap **Esc** and then tap the station on a string in the map.
- To exit this stakeout method, tap **Esc**.

# Stake positions relative to a string

## When staking from a road design file

1. In the stakeout selection screen, tap the string in the map or select **To the string** in the **Stake** field and then tap ▶ to select a string from the list.

   When staking an RXL road, the strings in the list are determined by the templates assigned at your current position relative to the road.

   To stake out your position relative to the nearest string, select **To the nearest string** from the **Stake** field. This option enables the software to navigate you to the string nearest to your current position, so that as you move across the road the string you are staking relative to will automatically change to reflect your new position.

2. If required, add the following features:
    - To set stakes offset from the road, leaving the roadway clear for construction, define a construction offset.
    - To confirm the construction of the road surface, define a cross slope.
3. Tap **Start**.

   The Road navigation, page 62 screen appears. Tap **Options** to configure preferences for the navigation display, grade, as-staked point details, or to view stakeout deltas relative to a digital terrain model (DTM).

4. Use the information in the Road navigation, page 62 screen to see your position relative to the road and navigate to the point to stake it out.
    - If required, you can add or edit a side slope.
    - To stake the hinge position for a cut slope when measuring relative to a side slope, tap and hold in the plan or cross section view and select **Stake cut slope hinge**. This option is useful when the side slope includes a cut ditch.
    - If you are staking to a catch point with construction offsets, navigate to the catch point and then tap **Apply** to add the construction offsets. You are prompted to apply the offsets from your current position. If you are not on the catch position, select **No**, navigate to the catch position and then tap **Apply** again. To store the catch position and the construction offset, see Construction offsets, page 94.

   If your current position is within 5 m of the selected string, the plan view shows a dashed green line drawn at a right angle from your current position to the string. When staking with a calculated construction offset, the vertical and perpendicular cut/fill delta is reported.

5. When the point is within tolerance, tap **Measure** to measure the point.

6. Tap **Store**.

   The software returns to the navigation screen.

### Next steps

- To continue measuring points along the road, tap the **Sta+** or **Sta-** softkey to select the next or previous station.

  If you have enabled the **Auto increment** field in the **Select station** screen then the next or previous station is automatically selected. See Stations available for stakeout, page 91.

- To change stakeout methods, and stake:
  - **To the road**, double-tap an empty part of the map.
  - **To a string**, tap the string in the map.
  - A **Station on a string**, tap the station on a string in the map.
- To exit this stakeout method, tap **Esc**.

## When staking from strings and surfaces

1. In the stakeout selection screen, tap the string in the map, or select **To the string** in the **Stake** field and then tap ▶ to select the string from the list.

   To stake out your position relative to the nearest string, select **To the nearest string** from the **Stake** field. This option enables the software to navigate you to the string nearest to your current position, so that as you move across the road the string you are staking relative to will automatically change to reflect your new position.

2. To set stakes offset from the road, leaving the roadway clear for construction, define a construction offset.

3. Tap **Start**.

   The Road navigation, page 62 screen appears. Tap **Options** to configure preferences for the navigation display, grade, as-staked point details, or to view stakeout deltas relative to a digital terrain model (DTM).

4. Use the information in the Road navigation, page 62 screen to see your position relative to the road and navigate to the point to stake it out.

   If your current position is within 5 m of the selected string, the plan view shows a dashed green line drawn at a right angle from your current position to the string.

5. When the point is within tolerance, tap **Measure** to measure the point.

6. Tap **Store**.

   The software returns to the navigation screen.

### Next steps

- To continue measuring points along the road, tap the **Sta+** or **Sta-** softkey to select the next or previous station.

  If you have enabled the **Auto increment** field in the **Select station** screen then the next or previous station is automatically selected. See Stations available for stakeout, page 91.
- To change stakeout methods, and stake:
  - **To the primary string**, tap **Esc** and then select **To the primary string** from the **Stake** field.
  - **To the string**, tap **Esc** and then tap the string in the map.
  - **To two strings**, tap **Esc** and then select **To two strings** from the **Stake** field.
  - A **Station on a string**, tap **Esc** and then tap the station on a string in the map.

# Stake stations on a string

## When staking from a road design file

1. In the stakeout selection screen, tap the station on the string in the map.

   Alternatively in the stakeout form:

   a. Select **Station on string** in the **Stake** field.

   b. Tap ▶ next to the **String** field to select the string from the list. The strings in the list are determined by the templates assigned at your current position relative to the road.

   c. Tap next to the **Station** field and select the station.

   **TIP –**

   - If the road does not include a string at the offset you want to stake out, you can enter a nominal offset value in the **Offset** field and then select the station.
   - To customize the stations available for stakeout, tap next to the **Station** field to view the **Select station** screen. See Stations available for stakeout, page 91.
2. If required, add the following features:
   - To set stakes offset from the road, leaving the roadway clear for construction, define a construction offset.
   - To confirm the construction of the road surface, define a cross slope.
   - To stake points on surfaces other than the finished road surface, define a subgrade.
3. Tap **Start**.

The Road navigation, page 62 screen appears. Tap **Options** to configure preferences for the navigation display, grade, as-staked point details, or to view stakeout deltas relative to a digital terrain model (DTM).

4. Use the information in the Road navigation, page 62 screen to see your position relative to the road and navigate to the point to stake it out.

   If you are staking to a catch point with construction offsets, navigate to the catch point and then tap **Apply** to add the construction offsets. You are prompted to apply the offsets from your current position. If you are not on the catch position, select **No**, navigate to the catch position and then tap **Apply** again. To store the catch position and the construction offset, see Construction offsets, page 94.

5. If required, you can add or edit a side slope.
6. To stake the hinge position for a cut slope when measuring relative to a side slope, tap and hold in the plan or cross section view and select **Stake cut slope hinge**. This option is useful when the side slope includes a cut ditch.
7. To edit the **Design elevation**, press the **Space** key or tap ▶ next to the **Design elevation** delta and enter the new value. The original design elevation is automatically restored as soon as you change the design or the section of the design being staked, or once you exit stakeout. To restore the original elevation during stakeout after you have edited it, press the **Space** key or tap ▸ and then tap ▸ next to the **Design elevation** field and select **Reload original elevation**.
8. When the point is within tolerance, tap **Measure** to measure the point.
9. Tap **Store**.

   The software returns to the navigation screen.

### Next steps

- To continue measuring points along the road, tap the **Sta+** or **Sta-** softkey to select the next or previous station.

  If you have enabled the **Auto increment** field in the **Select station** screen then the next or previous station is automatically selected. See Stations available for stakeout, page 91.

- To change stakeout methods, and stake:
  - **To the road**, double-tap an empty part of the map.
  - **To a string**, tap the string in the map.
  - A **Station on a string**, tap the station on a string in the map.
- To exit this stakeout method, tap **Esc**.

## When staking from strings and surfaces

1. In the stakeout selection screen, tap the station on the string in the map.

   Alternatively in the stakeout form:

a. Select **Station on string** in the **Stake** field.

b. Tap ▶ next to the **String** field to select the string from the list. The strings in the list are determined by the templates assigned at your current position relative to the road.

c. Tap next to the **Station** field and select the station.

> **TIP –** To customize the stations available for stakeout, tap next to the **Station** field to view the **Select station** screen. See Stations available for stakeout, page 91.

2. To set stakes offset from the road, leaving the roadway clear for construction, define a construction offset.
3. Tap **Start**.

   The Road navigation, page 62 screen appears. Tap **Options** to configure preferences for the navigation display, grade, as-staked point details, or to view stakeout deltas relative to a digital terrain model (DTM).
4. Use the information in the Road navigation, page 62 screen to see your position relative to the road and navigate to the point to stake it out.
5. When the point is within tolerance, tap **Measure** to measure the point.
6. Tap **Store**.

   The software returns to the navigation screen.

### Next steps

- To continue measuring points along the road, tap the **Sta+** or **Sta-** softkey to select the next or previous station.

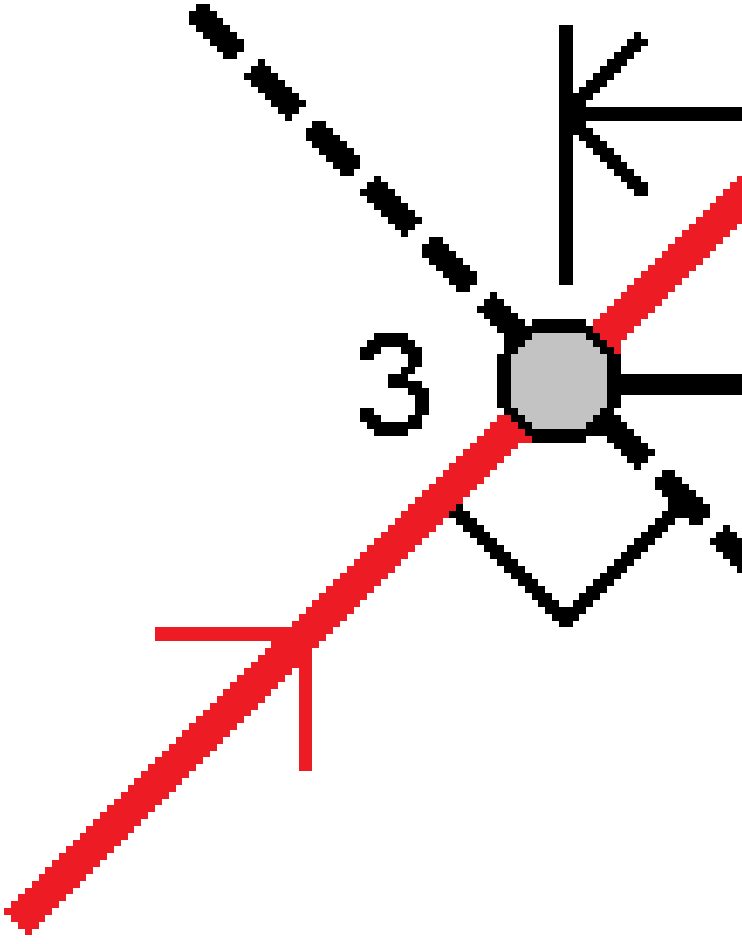
  If you have enabled the **Auto increment** field in the **Select station** screen then the next or previous station is automatically selected. See Stations available for stakeout, page 91.
- To change stakeout methods, and stake:
  - **To the primary string**, tap **Esc** and then select **To the primary string** from the **Stake** field.
  - **To the string**, tap **Esc** and then tap the string in the map.
  - **To two strings**, tap **Esc** and then select **To two strings** from the **Stake** field.
  - A **Station on a string**, tap **Esc** and then tap the station on a string in the map.

# Stake a position at a skew offset

> **NOTE –** This stakeout method can be used when staking from a **road design file**. It does not apply when staking **Strings and surfaces**.

Use the **Skew offset** stakeout method to stake out a position that is not defined at a right angle to the horizontal alignment, for example when staking culverts or bridge abutments.

The diagram below shows a point defined by skew forward and offset to the right. The point to stake **(1)** is defined from the station **(3)** by an offset **(5)** along the skew **(2)**. The skew can be defined by a forward or backward delta angle to a line **(6)** at right angles to the road being staked **(4)** or, alternatively, the skew can be defined by an azimuth.



## To stake out a position at a skew offset

1. In the stakeout selection screen, select **Skew offset** from the **Stake** field.
2. In the map, tap the station on the alignment that the skew offset will be applied from. Alternatively, tap next to the **Station** field to select the station from the list.

   **TIP –**

   - To customize the stations available for stakeout, tap next to the **Station** field to view the **Select station** screen. See Stations available for stakeout, page 91.
   - To stake out a skewed offset relative to a nominal station value (where the station does not have to coincide with a cross section), enter a nominal station value.

3. To define the skew offset:
   a. Enter the **Offset** and **Skew** values. Tap ▸ to change the offset or skew direction.
   b. To define the elevation for the point, select:
      - **Slope from string** to compute the elevation by a slope from the elevation on the string at the selected station
      - **Delta from string** to compute the elevation by a delta from the elevation on the string at the selected station.
      - **Key in** to key in the elevation.

        If the road only has a horizontal alignment, you must key in the elevation.

   c. Tap **Accept**.
4. To stake points offset from the road, leaving the roadway clear for construction, define a construction offset.

   See Construction offsets, page 94
5. Tap **Start**.

   The Road navigation, page 62 screen appears. Tap **Options** to configure preferences for the navigation display, grade, as-staked point details, or to view stakeout deltas relative to a digital terrain model (DTM).
6. Use the information in the Road navigation, page 62 screen to see your position relative to the road and navigate to the point to stake it out.
7. When the point is within tolerance, tap **Measure** to measure the point.
8. Tap **Store**.

   The software returns to the navigation screen.

### Next steps

- To continue measuring points along the road, tap the **Sta+** or **Sta-** softkey to select the next or previous station.

  If you have enabled the **Auto increment** field in the **Select station** screen then the next or previous station is automatically selected. See Stations available for stakeout, page 91.
- Tap **Esc** to exit this stakeout method.
- Change stakeout methods. To stake:
  - **To the road**, double-tap an empty part of the map.
  - **To a string**, tap the string in the map.
  - A **Station on a string**, tap the station on a string in the map.

# Stake to an additional string

**NOTE –** This stakeout method can be used when staking from a **road design file**. It does not apply when staking **Strings and surfaces**.

## To stake your position relative to an additional string

1. In the stakeout selection screen, tap the additional string in the map, or select **To an additional string** in the **Stake** field and then tap ▶ to select the string from the list.
2. If required, add the following features:
   - To set stakes offset from the road, leaving the roadway clear for construction, define a construction offset.
   - To confirm the construction of the road surface, define a cross slope.
3. Tap **Start**.

   The Road navigation, page 62 screen appears. Tap **Options** to configure preferences for the navigation display, grade, as-staked point details, or to view stakeout deltas relative to a digital terrain model (DTM).
4. Use the information in the Road navigation, page 62 screen to see your position relative to the road and navigate to the point to stake it out.
5. When the point is within tolerance, tap **Measure** to measure the point.
6. Tap **Store**.

   The software returns to the navigation screen.

### Next steps

- To continue measuring points along the road, tap the **Sta+** or **Sta-** softkey to select the next or previous station.

  If you have enabled the **Auto increment** field in the **Select station** screen then the next or previous station is automatically selected. See Stations available for stakeout, page 91.
- To change stakeout methods, and stake:
  - **To the road**, double-tap an empty part of the map.
  - **To a string**, tap the string in the map.
  - A **Station on a string**, tap the station on a string in the map.
- To exit this stakeout method, tap **Esc**.

## To stake a station on an additional string

1. Tap the station on the additional string in the map, or select **Station on additional string** in the **Stake** field and then tap ▸ to select the string from the list.

   To select a different station, tap the **Sta-** or **Sta+** softkey, or tap next to the **Station** field and select the station.
2. If required, add the following features:
   - To set stakes offset from the road, leaving the roadway clear for construction, define a construction offset.
   - To confirm the construction of the road surface, define a cross slope.
3. Tap **Start**.

   The Road navigation, page 62 screen appears. Tap **Options** to configure preferences for the navigation display, grade, as-staked point details, or to view stakeout deltas relative to a digital terrain model (DTM).
4. Use the information in the Road navigation, page 62 screen to see your position relative to the road and navigate to the point to stake it out.
5. To edit the **Design elevation**, press the **Space** key or tap ▶ next to the **Design elevation** delta and enter the new value. The original design elevation is automatically restored as soon as you change the design or the section of the design being staked, or once you exit stakeout. To restore the original elevation during stakeout after you have edited it, press the **Space** key or tap ▸ and then tap ▸ next to the **Design elevation** field and select **Reload original elevation**.
6. When the point is within tolerance, tap **Measure** to measure the point.
7. Tap **Store**.

   The software returns to the navigation screen.

### Next steps

- To continue measuring points along the road, tap the **Sta+** or **Sta-** softkey to select the next or previous station.

  If you have enabled the **Auto increment** field in the **Select station** screen then the next or previous station is automatically selected. See Stations available for stakeout, page 91.
- To change stakeout methods, and stake:
  - **To the road**, double-tap an empty part of the map.
  - **To a string**, tap the string in the map.
  - A **Station on a string**, tap the station on a string in the map.
- To exit this stakeout method, tap **Esc**.

# Stake additional points

Use the **Additional points** method to stake design features that are not part of the road design file, such as key positions for a drainage system, lamp posts, or road signs, without having to leave the Roads app and switch to General Survey. Additional points provide station and offset details from the primary alignment or string.

During stake out, you can stake additional points as needed. Tap any point in the job or tap a point in any kind of linked file, including DXF, BIM, or CSV.

1. In the stakeout selection screen:
   - When staking from a **road design file**, tap the additional point in the map.
   - When staking **strings and surfaces**, select **Additional points** in the **Stake** field and then tap the additional point in the map.

   The selected point is automatically copied to the job.
2. If required, add the following features:
   - To set stakes offset from the road, leaving the roadway clear for construction, define a construction offset.
   - To confirm the construction of the road surface, define a cross slope.
3. Tap **Start**.

   The Road navigation, page 62 screen appears. Tap **Options** to configure preferences for the navigation display, grade, as-staked point details, or to view stakeout deltas relative to a digital terrain model (DTM).
4. Use the information in the Road navigation, page 62 screen to see your position relative to the road and navigate to the point to stake it out.
5. To edit the **Design elevation**, press the **Space** key or tap ▶ next to the **Design elevation** delta and enter the new value. The original design elevation is automatically restored as soon as you

change the design or the section of the design being staked, or once you exit stakeout. To restore the original elevation during stakeout after you have edited it, press the **Space** key or tap ▶ and then tap ▶ next to the **Design elevation** field and select **Reload original elevation**.

6. When the point is within tolerance, tap **Measure** to measure the point.

7. Tap **Store**.

   The software returns to the navigation screen.

### Next steps

- To continue measuring points along the road, tap the **Sta+** or **Sta-** softkey to select the next or previous station.

  If you have enabled the **Auto increment** field in the **Select station** screen then the next or previous station is automatically selected. See Stations available for stakeout, page 91.

- To change stakeout methods, and stake:
  - **To the road**, double-tap an empty part of the map.
  - **To a string**, tap the string in the map.
  - A **Station on a string**, tap the station on a string in the map.
- To exit this stakeout method, tap **Esc**.

# Stake the surface between two strings

**NOTE –** This stakeout method can be used when staking **Strings and surfaces**. It does not apply when staking from a **road design file**.

To stake the surface between two strings:

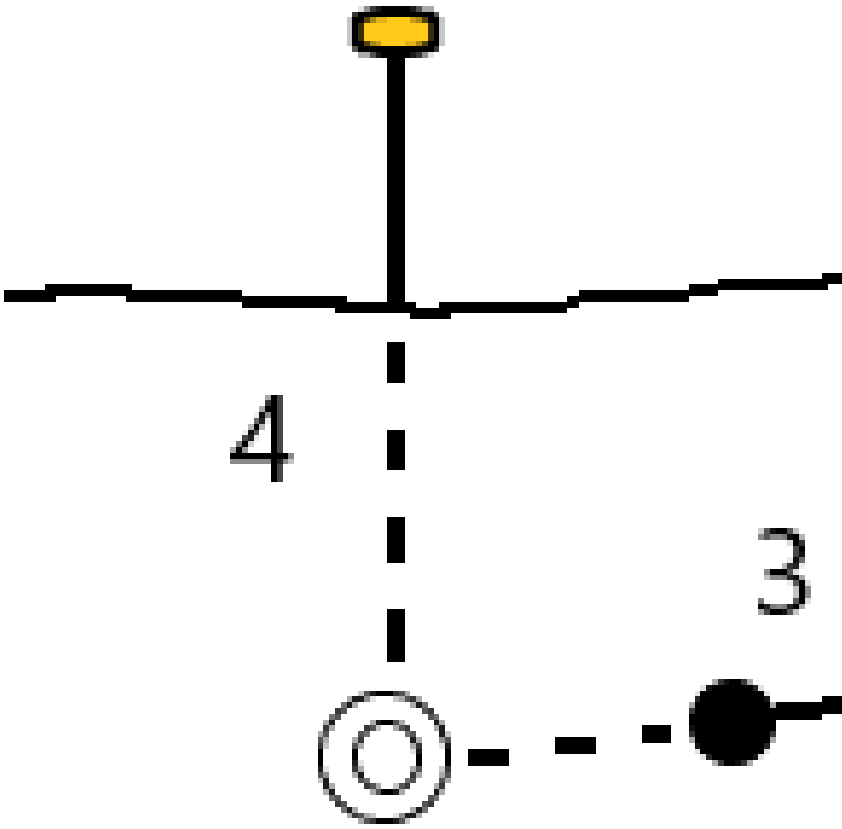
1. In the stakeout selection screen, select **To two strings** from the **Stake** field and then tap each string in the map, or tap ▶ to select each string from the list.
2. To set stakes offset from the road, leaving the roadway clear for construction, define a construction offset.
3. Tap **Start**.

   The Road navigation, page 62 screen appears. Tap **Options** to configure preferences for the navigation display, grade, as-staked point details, or to view stakeout deltas relative to a digital terrain model (DTM).
4. Use the information in the Road navigation, page 62 screen to see your position relative to the road and navigate to the point to stake it out.

The reported deltas include the:

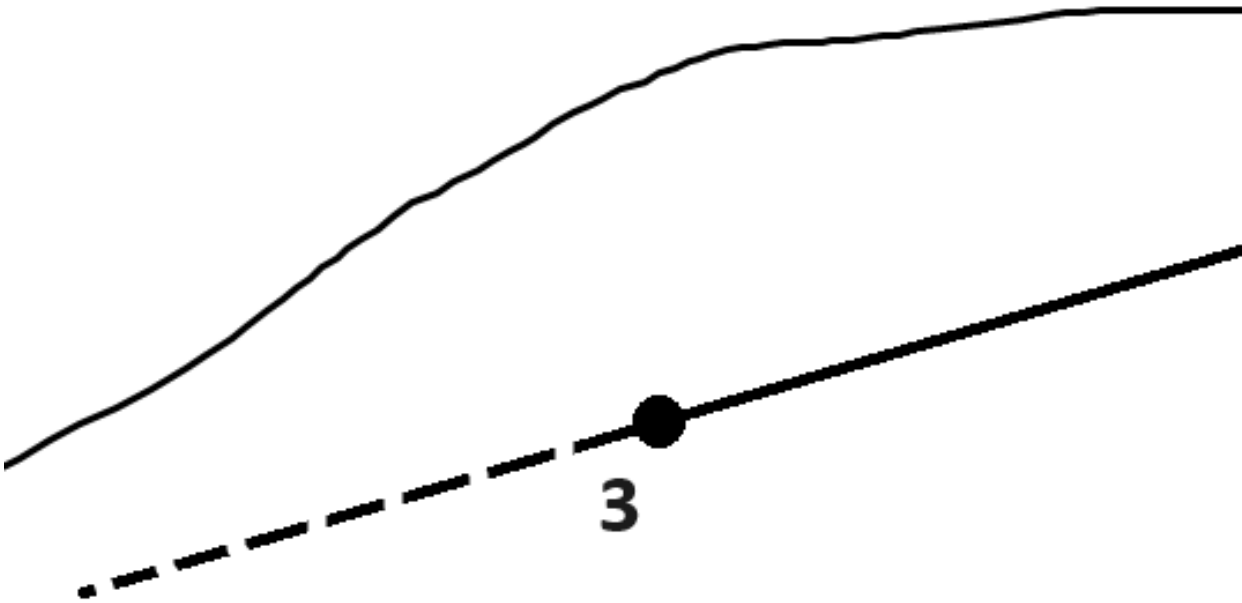
- **Station** and **Offset** values for your current position relative to the primary stationing string.
- **Go Left/Right** value to each string.
- **V.Dist** (vertical distance) to the surface between the two strings.
- **V.Dist** (vertical distance) to the primary stationing string.

  The diagram below shows the primary stationing string **(1)**, the two strings **(2, 3)**, and the **V.Dist** to the extension of the two strings **(4)**:




- **Perp Dist** (perpendicular distance) to the surface between the two strings.

The diagram below shows the primary stationing string **(1)**, the two strings **(2, 3)**, the **V.Dist** to the surface between the two strings (4), and the **Perp Dist** to the surface between the two strings **(5)**:




5. When the point is within tolerance, tap **Measure** to measure the point.
6. Tap **Store**.

   The software returns to the navigation screen.

## Next steps

- To continue measuring points along the road, tap the **Sta+** or **Sta-** softkey to select the next or previous station.

  If you have enabled the **Auto increment** field in the **Select station** screen then the next or previous station is automatically selected. See Stations available for stakeout, page 91.

- Tap **Esc** to exit this stakeout method.
- To change stakeout methods, and stake:
    - **To the primary string**, tap **Esc** and then select **To the primary string** from the **Stake** field.
    - **To the string**, tap **Esc** and then tap the string in the map.
    - **To two strings**, tap **Esc** and then select **To two strings** from the **Stake** field.
    - A **Station on a string**, tap **Esc** and then tap the station on a string in the map.

# Road stakeout options

Depending on the selected stakeout method, you can add more features to the road or edit existing features when staking out the road.

When staking from a road design file or from surfaces and strings:

- To customize the stations available for stakeout, see Stations available for stakeout, page 91.
- To set stakes offset from the road, leaving the roadway clear for construction, define a construction offset.
- To view stakeout deltas relative to a surface, see Additional stakeout deltas to a surface, page 103.
- To show the station and offset values of your current position relative to a reference alignment, see Reference alignments, page 103.

When staking from a road design file you can also:

- Navigate to and stake the catch point (the point where the design slope intersects with the ground). See Catch point, page 104.
- Add or edit a side slope. See Side slopes, page 108.
- Define a cross slope when you need to confirm the construction of a road surface. See Cross slopes, page 112.
- Define a subgrade when the cross section represents the finished road surface and you need to stake the points defining other surfaces in the road. See Subgrades, page 115.

## Stations available for stakeout

You can customize the stations available for stakeout when using the following methods:

- Station on string (from a road design file or from strings and surfaces)
- Skew offset (from a road design file)

To customize the stations available, select the stakeout method and then tap next to the **Station** field in the **Stakeout** screen. The **Select station** screen appears, listing the stations on the centerline.

## Station interval settings

Select the station interval **Method**:

- The **Relative** method gives station values relative to the selected start station. Enter the station to start from in the **Relative to station** field and then enter the value for the **Station interval**. This is useful when:
    - The design starts at 0.00 but you want to configure the station interval settings from a station that is not the start station of the design. For example, enter 500.00 in the **Relative to station** field and then enter 30.00 in the **Station interval** field to produce stations at 500.00, 530.00, 560.00, 590.00, and so on.
    - The design starts at a value that is not 0.00. For example, if the start station is 2.50 and the station interval is 10.00, enter 2.50 in the **Relative to station** field and then enter 10.00 in the **Station interval** field to produce stations at 2.50, 12.50, 22.50, 32.50, and so on.
- The **0 based** method is the default method and gives station values that are multiples of the station interval, regardless of the start station. For example, if the start station is 2.50 and the station interval is 10.00, the 0 based method produces stations at 2.50, 10.00, 20.00, 30.00 and so on.

If required, edit the **Station interval for lines** and **Station interval for arcs and transitions** or accept the default value set when the road was defined. A separate station interval value for arcs and transitions enables you to tighten the interval for curves and more accurately represent the design on the ground.

**TIP –** If you have configured different values for the **Station interval for lines** and the **Station interval for arcs and transitions**, then the list of available stations may include stations at different intervals.

In the **Auto increment** field:

- Select **Sta+** to automate the selection of the ***next*** station for stakeout.
- Select **Sta-** to automate the selection of the ***previous*** station for stakeout.
- Select **No** if you want to manually select the next station to stake.

Selecting **Sta+** or **Sta-** in the **Auto increment**field provides a faster, more streamlined workflow.

**NOTE – Station interval** settings (including **Method** and **Auto increment** settings) configured in the **Select station** screen are written to the road file so that the same settings are used if the file is shared with other survey crews. If the file is an ***IFC file***, the **Station interval** settings are written to a **Trimble Additional Properties (TAP)** file. The TAP file is stored in the same folder as the IFC file of the same name. If other survey crews are using the IFC file, then you must share the .tap file with the .ifc file to ensure all survey crews use the same settings.

## Available stations

To configure the types of stations shown in the station list, select the appropriate **Available Stations** check boxes.

Depending on the road type, you can select the following:

- **Computed Sections defined by the station interval**
- **Horizontal Curve** (key stations defined by the horizontal alignment)
- **Vertical Curve** (key stations defined by the vertical alignment)
- **Template** (stations where templates have been assigned)
- **Super/Widen** (stations where superelevation and widening has been assigned)

The station abbreviations used in the Roads software are:

| Station type | Abbreviation | Meaning |
|---|---|---|
| Start/end | S | Start station |
| | E | End station |
| Computed sections | CXS | Computed sections defined by the station interval |
| Vertical curve | VCS | Vertical curve start |
| | VCE | Vertical curve end |
| | VPI | Vertical point of intersection |
| | Hi | Vertical curve high point |
| | Lo | Vertical curve low point |
| Superelevation/Widening | SES | Superelevation start |
| | SEM | Superelevation maximum |
| | SEE | Superelevation end |
| | WS | Widening start |
| | WM | Widening maximum |
| | WE | Widening end |

| Station type | Abbreviation | Meaning |
|---|---|---|
| Horizontal curve | PI | Point of intersection |
| | PT | Point of tangent (Curve to tangent) |
| | PC | Point of curvature (Tangent to curve) |
| | TS | Tangent to transition |
| | ST | Transition to tangent |
| | SS | Transition to transition |
| | CS | Curve to transition |
| | SC | Transition to curve |
| Template assignment | T | Template assignment |
| Other | DXS | Design sections defined by the positions in the file |
| | STEQ | Station equation |

# Construction offsets

Construction offsets can be defined for any road design file, and for any string you are staking as a road.

To stake positions offset from the road so that the roadway is left clear for construction, define one or more construction offsets for the road. The construction offset is applied to all positions in the road.

When you define a construction offset for a road, the offset is:

- used for all roads of the same file format in the same job.
- used for all subsequent surveys of the road in the same job, until a different construction offset is defined.
- not used for the same road when it accessed from a different job.

To define a construction offset, enter values in the appropriate **Horizontal offset** and/or **Vertical offset** fields. Tap **Options** for advanced features.

In the plan or cross section view, a construction offset is indicated by a dashed green line, and a solid green circle indicates the selected position adjusted for the construction offsets.

## Horizontal construction offsets

When staking to a string or when staking stations on a string, you can define a horizontal construction offset where:

- A negative value offsets points to the left of the horizontal alignment.
- A positive value offsets points to the right of the horizontal alignment.

For all other strings, including side slope strings, you can define a horizontal construction offset where:

- A negative value offsets points toward the horizontal alignment (in).
- A positive value offsets points away from the horizontal alignment (out).

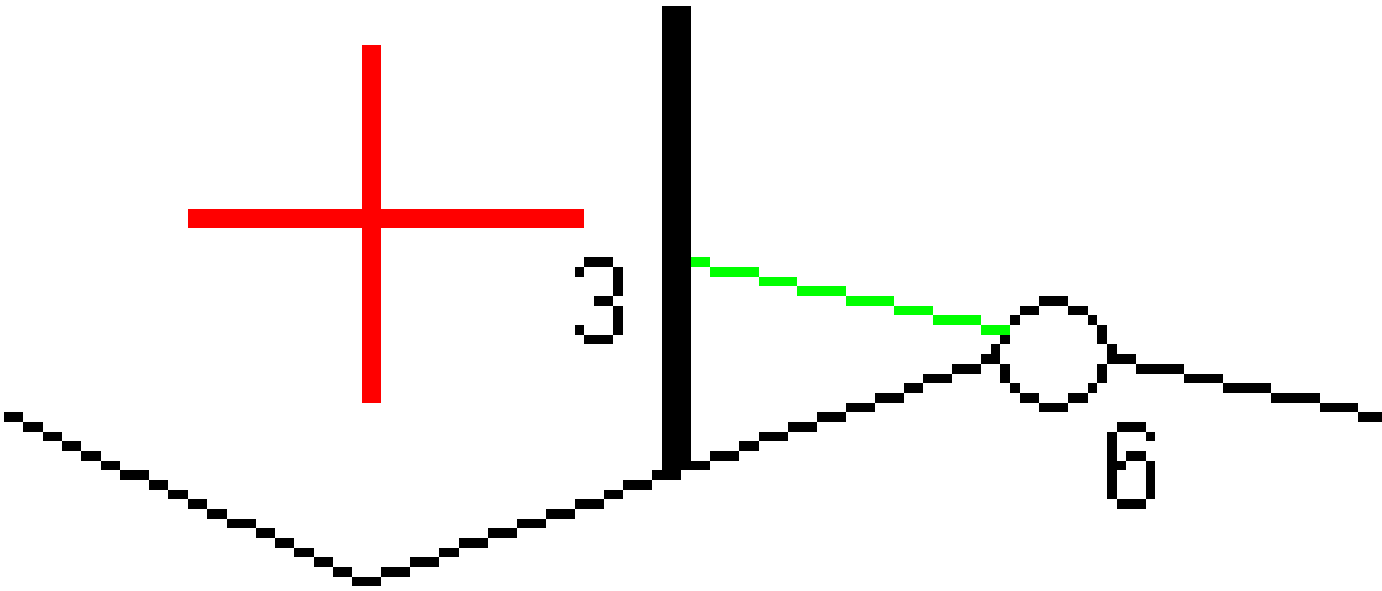
**NOTE –** When staking a side slope with construction offsets where you wish to store a position at the catch and the offset position, select the **Store both catch and construction offset** check box when defining the construction offset. See Catch point.

Tap **Options** to specify if the offset is to be applied:

- Horizontally
- At the slope of the line from the previous string to the current string in the cross section
- At the slope of the line from the current string to the next string in the cross section

The following diagram shows a **Horizontal offset (1)**, **Slope previous offset (2)** and **Slope next offset (3)** applied to a position:

- For the **Slope previous** option, the slope of the offset is defined by the slope of the line **(4)** before the position selected to stake **(5)**.
- For the **Slope next** option, the slope of the offset is defined by the slope of the line **(4)** after the position selected to stake **(6)**.
- The **Vertical offset** value in the diagram is 0.000.




**NOTE –** For points with zero offset, you cannot apply horizontal construction offsets at the slope value of the previous line.

When measuring positions relative to a string or when staking stations on a string, you can define a horizontal construction offset by your current position. To do this:

1. Tap **Options** and in the **Horizontal offset – calculated** group box, select **Yes**.
2. Navigate to the position you want to place the stake.

   The **Go left / Go right** navigation delta is replaced by the distance to the horizontal alignment when the horizontal offset is **Calculated**.
3. Measure and store the point.

   The calculated horizontal offset is reported in the **As staked deltas**.

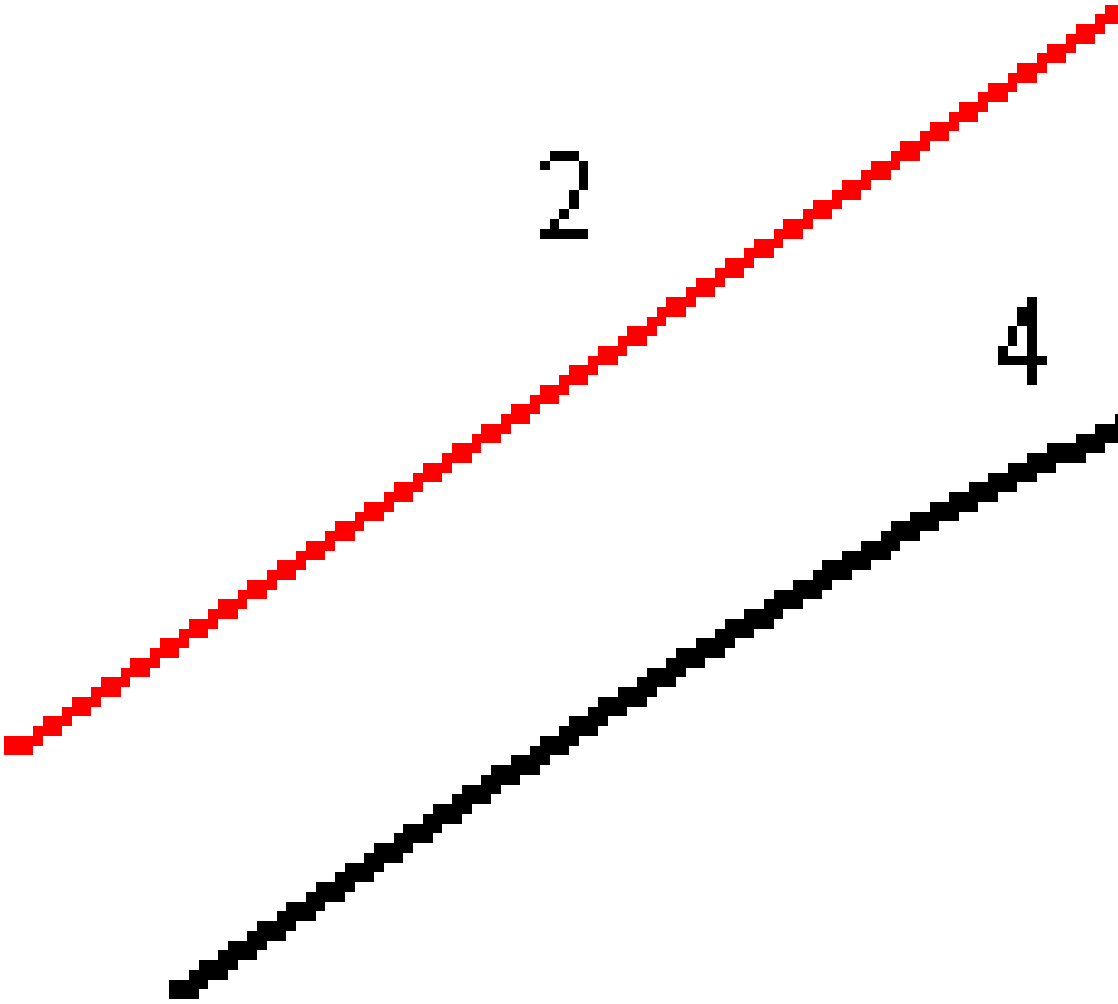
**NOTE –** This option is not available when the stake method is **To the nearest string** or, for LandXML roads if the horizontal offset is applied perpendicular to the string.

## LandXML roads

When staking stations on a string, tap **Options** to specify if the offset is to be applied:

- Perpendicular to the alignment for the string being staked
- Perpendicular to the string being staked

The following diagram shows a **Horizontal offset (1)** applied perpendicular to the alignment **(2)** and a **Horizontal offset (3)** applied perpendicular to the string **(4)**.




When staking stations on a string, you can define a horizontal offset by the distance from the selected position to the alignment. To do this:

1. Tap **Options** and set the **Horizontal offset – to the alignment** option to **Yes**.
2. Navigate to the target which will be at the alignment.
3. Measure and store the point.

   The calculated horizontal offset is reported in the **As staked deltas**.

This option is not available for side slope strings or if horizontal offset is applied perpendicular to the string.

## Vertical construction offsets

You can define a vertical construction offset where:

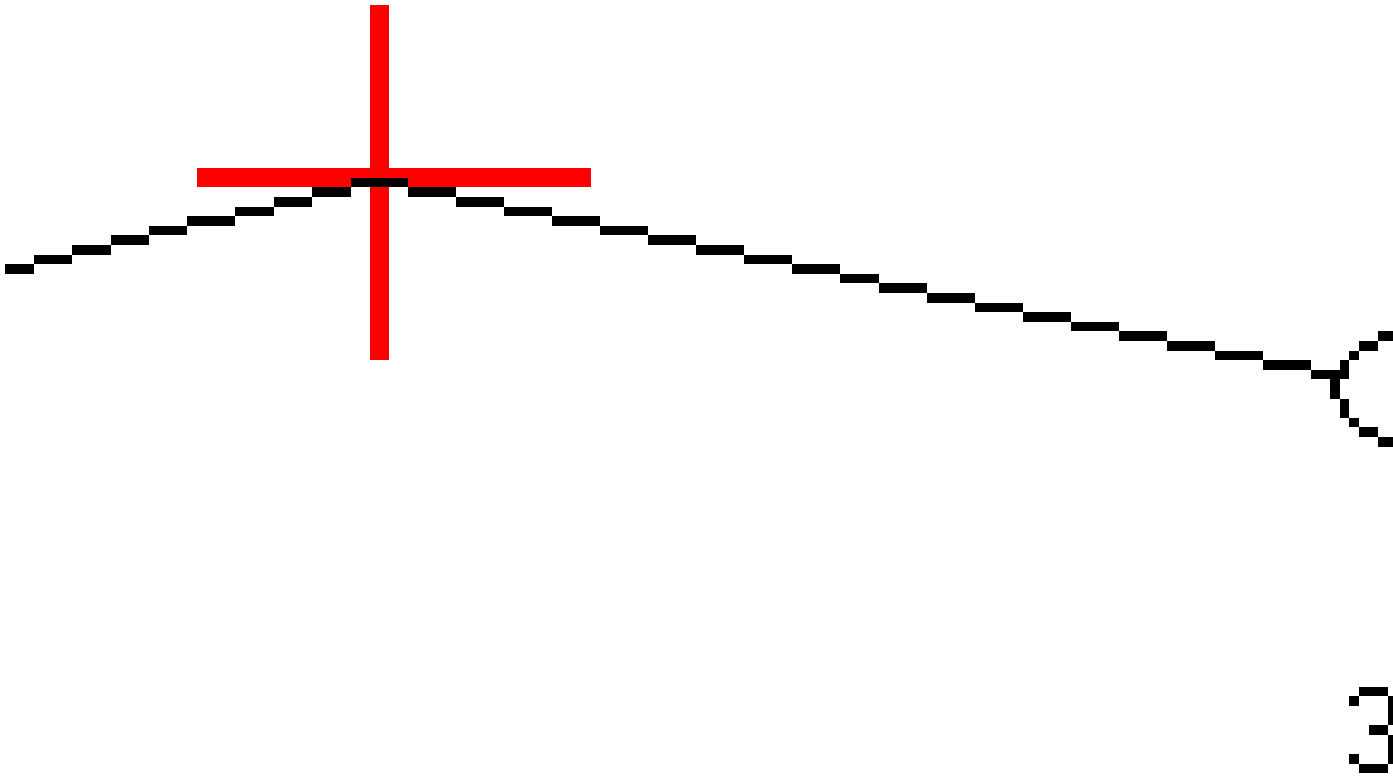
- A negative value offsets points vertically down.
- A positive value offsets points vertically up.

The **Vertical Offset** value is not applied to a surface.

Tap **Options** to specify if the offset is to be applied:

- Vertically
- Perpendicular to the element in the cross section before the point being staked

The following diagram shows a **Vertical offset** applied vertically **(1)** and a **Vertical offset** applied perpendicular **(2)** to the previous cross section element **(3)**.



## Station construction offsets

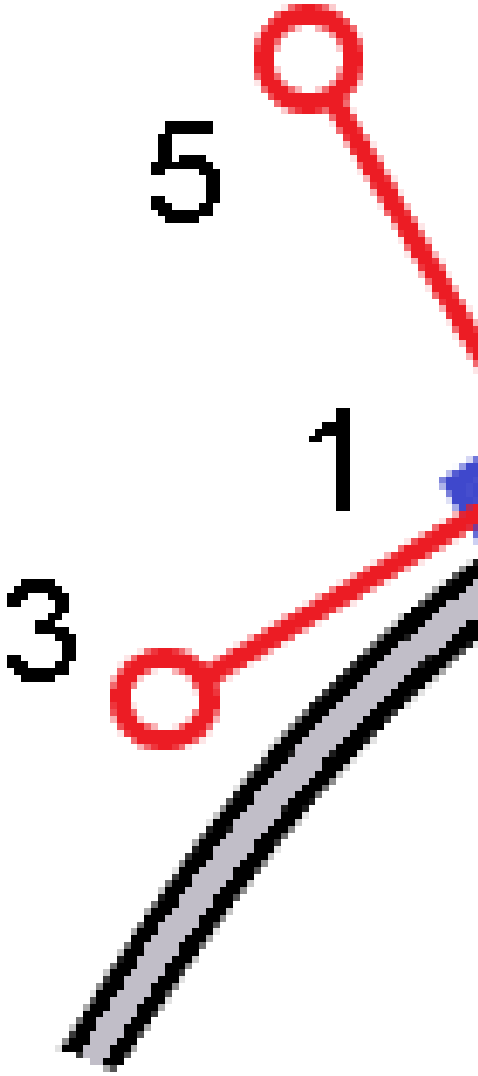
You can apply a station construction offset where:

- A positive value offsets the point in the direction of increasing station (Forward).
- A negative value offsets the point in the direction of decreasing station (Backward).

**NOTE –**

- You cannot apply a station construction offset to a side slope.
- The station construction offset is applied tangential to the string being staked.

Station construction offsets are useful for positioning sumps along a curved section of road, as shown in the following diagram. Because the sump **(1)** is typically positioned before the curb **(2)** and channel is in place, by offsetting the station forward **(3)** and backward **(4)** and horizontally left **(5)** and right **(6)**, the sump can be positioned with the correct orientation.



# Reference alignments

For any stakeout method, you can select a **reference alignment** so that the software shows the station and offset values of your current position relative to the reference alignment. This information is also saved in the job.

1. In the map or cross section view, tap and hold in the screen and tap **Select reference alignment**.
2. Select the road format.
3. Select the file. The **Road name** field shows the selected road name.
4. Tap **Accept**.

   During stakeout, a dashed line is drawn from your current position to the horizontal alignment of the reference alignment.
5. To stop using a reference alignment, tap and hold in the map or cross section view and tap **Select reference alignment**. In the list of road formats, select **<None>**.

# Additional stakeout deltas to a surface

Stakeout typically provides horizontal navigation and cut/fill relative to the road or string you are staking.

In addition you can display cut/fill to a selected surface. The surface can be a topographical surface, or it can be any surface in a BIM file.

1. Transfer a surface file to the appropriate project folder on the controller.
2. Make sure the file containing the surface is visible and selectable in the map.

   When staking a topographical surface, your current position, elevation of your current position, the surface elevation, and the distance above (cut) or below (fill) the surface appear in the map screen.
3. In the map, tap the road or string and then tap **Stakeout**.
4. Enable the **Cut/Fill to surface** switch.

   a. In the **Surface** field, select the surface file from the current project folder. Only surface files that are set to visible or selectable in the **Layer manager** are listed.

   Alternatively, in the map select surfaces from BIM files. If you cannot select surfaces in the map, make sure the BIM file is set to selectable in the **Layer manager**. If the **Selection mode** button on the **BIM** toolbar is button is yellow , tap it and select **Surface selection - Individual faces** mode.

   > **NOTE –** You can select **Surface selection - Whole object** mode, but when using **Whole object** mode the software selects both the top and bottom surface and calculates the cut/fill to whichever surface you are closest to.

   The **Surface** field indicates the number of surfaces you have selected in the map.

   To select a different surface from the map, double-tap in the map to clear the current selection and then select the new surface.

b. If required, in the **Offset to surface** field, specify an offset to the surface. Tap ▶... to select whether the offset is to be applied vertical or perpendicular to the surface.

c. To show the distance to the surface in the stakeout navigation screen, tap **Options**. In the **Deltas** group box, tap **Edit** and select the **V. Dist surface at current position** or the **Perp. Dist to surface at current position** delta. Tap **Accept**.

5. Stake out the road as usual.

> **NOTE –** When staking **To the primary string**, **To the road**, or **To the string**, the cut/fill is to the surface at your current position. When staking **To a station on a string**, the cut/fill displayed is the cut/fill to the surface at the selected station (including when using construction offsets).

When viewing the cross section, the surface is displayed at your current position as a green line. A circle on the surface indicates your position projected vertically to the surface. If the BIM model selection mode is **Surface selection - Whole object**, the cross section displays both the top and bottom surface. A circle on the surface indicates your position projected vertically to the surface.

**TIP –**

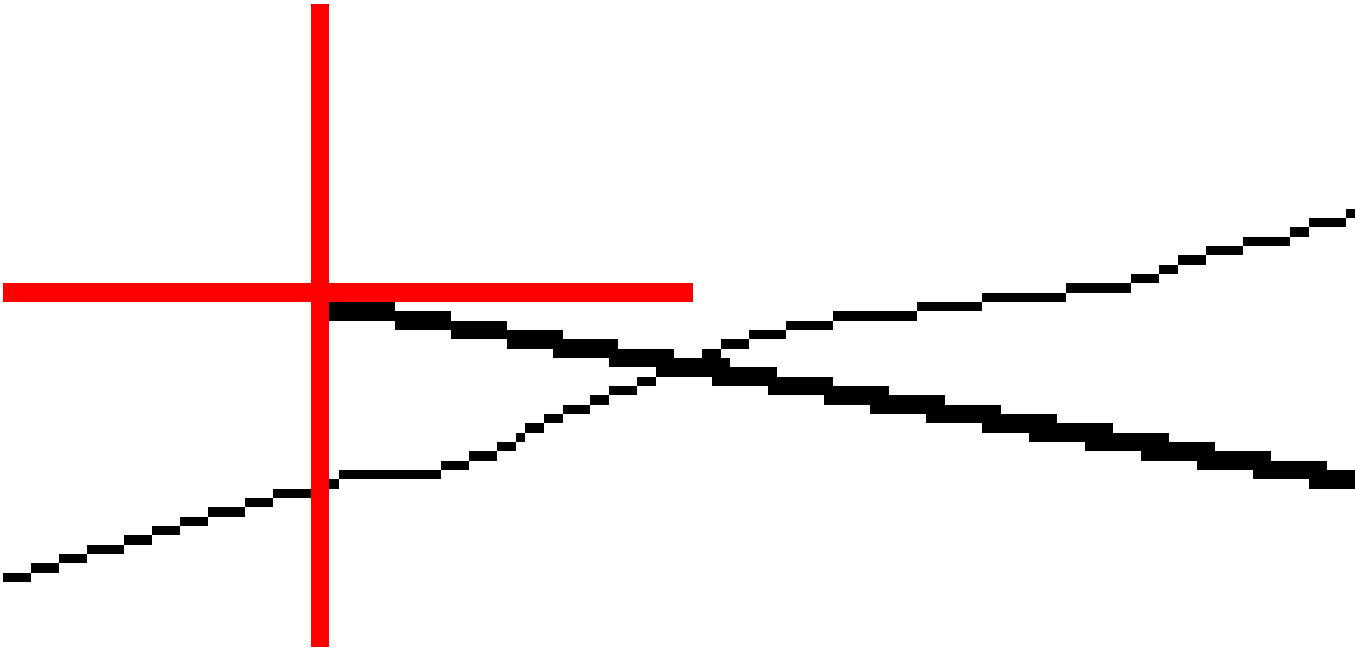
- To check layer thickness when constructing a road, define a surface for the previous layer and then when staking out the current layer, tap **Options** and in the **Deltas** group box, tap **Edit** and select one of the **V.Dist surface** deltas.
- To change the selected surface, tap **Esc** to return to the stakeout selection screen and select a different surface file. To select a different surface from the map, double-tap in the map to clear the current selection and then select the new surface.

# Catch point

> **NOTE –** The catch point applies only when staking from a **road design file**. A catch point does not apply when staking **Strings and surfaces**.

The catch point is the point where the design side slope intersects with the ground.

The actual intersection position of the side slope with the existing ground surface – the catch point – is determined iteratively (by repetition). The software calculates the intersection of a horizontal plane passing through the current position, and either the cut or fill side slope, as shown in the following diagram , where $x_n$ is the **Go Right/Left** value.



The plan view shows the calculated catch position. The calculated slope value (in blue) and the design slope value appears at the top of the screen.

The cross section is displayed looking in the direction of increasing station. Your current position and the calculated target are indicated. A line is drawn (in blue) from the hinge position to your current position to indicate the calculated slope.

Green lines indicate if the catch point has construction offsets specified. The smaller single circle indicates the calculated catch position and the double circle indicates the selected position adjusted for the specified construction offset(s). The construction offsets appear only after you have applied them.

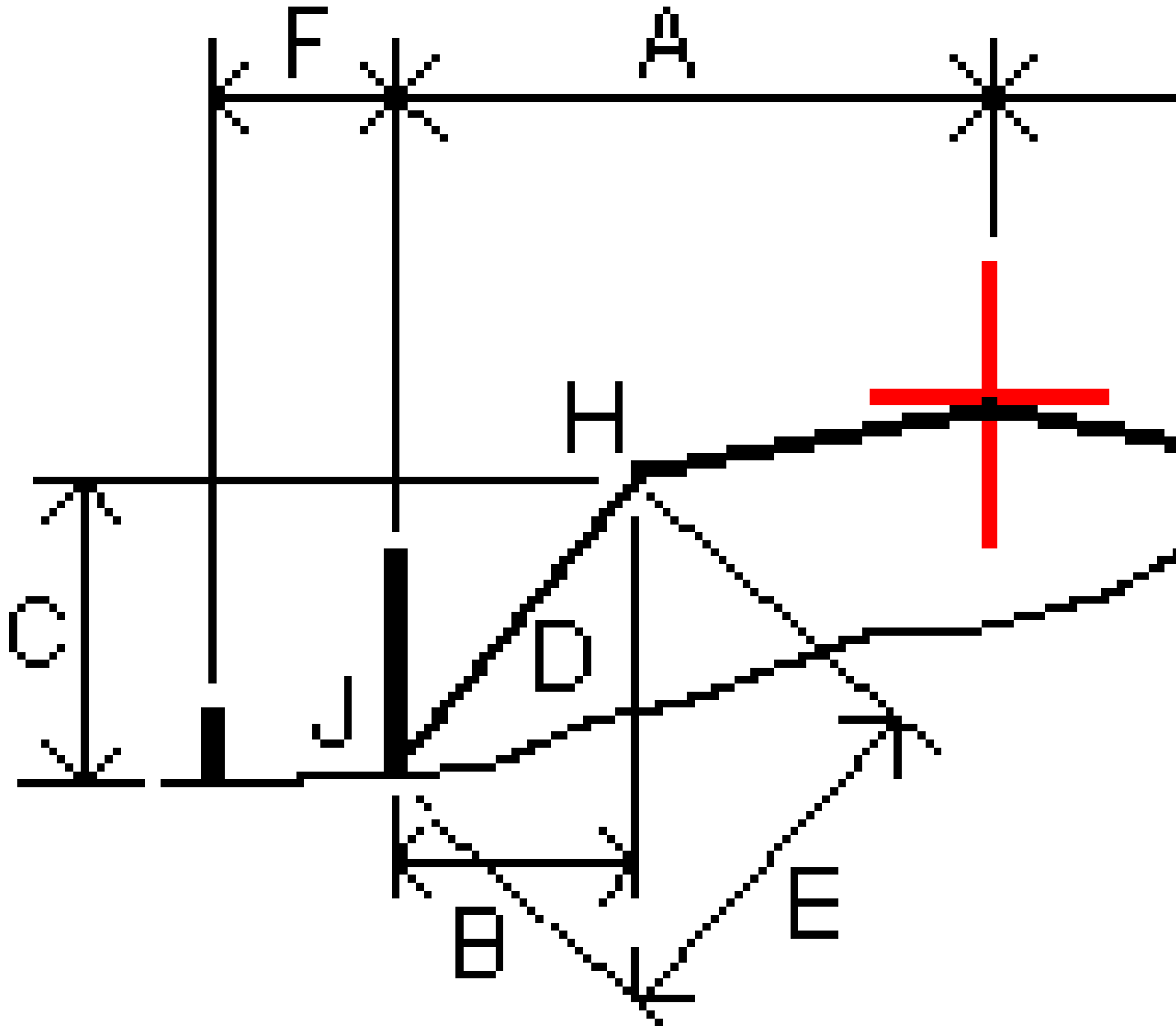
**NOTE –** For side slope offsets where the slope changes between templates, the software calculates the side slope for intermediate stations by interpolating the slope value.

## Catch point staked deltas

To view the **Catch point deltas report** screen, tap **Report** in the **Confirm staked deltas** screen or **Review job** screen.

The horizontal and vertical distances from the catch point to each string are shown, up to and including the horizontal alignment. If the template includes a cut ditch, the report includes the hinge position at the toe of the cut slope. The reported values exclude any construction offset specified.

See the diagram below:




Where:

| | | |
|---|---|---|
| A | = | Distance to horizontal alignment |
| B | = | Horizontal distance to hinge point |
| C | = | Vertical distance to hinge point |

| | | |
|---|---|---|
| D | = | Slope |
| E | = | Slope distance to hinge point |
| F | = | Horizontal construction offset |
| G | = | Ditch offset |
| H | = | Hinge point |
| J | = | Catch point |

**NOTE –**

- When you stake a fill side slope with a subgrade, the as staked deltas include the distance from the catch to the intersection of the subgrade with the side slope.
- The value in the **S.Dist to hinge + Constr off** field includes any construction offset values specified and reports the slope distance from the hinge to the as-staked position. The value is null (?) if there is no horizontal construction offset specified or the horizontal construction offset is applied horizontally.

# Side slopes

In some situations, you may need to temporarily add or edit the side slope. The side slope, and any edits to the side slope, are discarded after a position is measured or when you exit the stakeout screen.

**NOTE –** Side slopes can be used when staking from a **road design file**. Side slopes cannot be used when staking **Strings and surfaces**.

## Adding a side slope

You can add a side slope when staking a station on a string or measuring your position relative to a string. The current string is, by default, the hinge string but you can select a different string as the hinge string if required. You cannot add a side slope to the alignment.

1. At the stakeout screen, tap and hold in the map or cross section view and select **Add side slope**.
2. Complete the details defining the side slope.

**NOTE –** Adding a side slope at stakeout is available only for an RXL road.

## Editing a side slope

If the design cut or fill slope value or the cut ditch width value is not applicable, overwrite the value with a new one.

1. At the stakeout screen, tap and hold in the map or cross section view and select **Edit side slope**.
2. Complete the details defining the side slope.

In some situations, it may be preferable to adjust the cut or fill slope value to the value defined by the slope from the current string to the next string or from the previous string to the current string. In either the **Cut slope** field or the **Fill slope** field, select **Slope to next string** or **Slope from previous string**. The **Slope** field updates with the appropriate slope value.

The example below shows where you might select the **Slope to next string** or **Slope from previous string** option for a cut slope. A similar approach can be used for a fill slope.

**NOTE –** The next or previous string slope options are available:

- Only if a next or previous string exists.
- In the **Cut slope** field, the options are available only if the next or previous slope values are positive, that is, if they define a cut slope.
- In the **Fill slope** field, the options are available only if the next or previous slope values are negative, that is, if they define a fill slope.

Sometimes, particularly for LandXML road files, the side slope may specify only one slope value, where the other is null (?). If, when staking a side slope, the design and calculated side slope values at the top of the navigation screen are null, this indicates that the undefined slope value is required to stake the catch. Use the **Edit side slope** option to specify the slope value to enable the catch to be staked.

You can also:

- change the string name.
- select a different string as the hinge string, if required.

A side slope is shown in red if edited.

The diagram below shows a typical example of where you might use these options.

## Selecting a different string as the hinge string

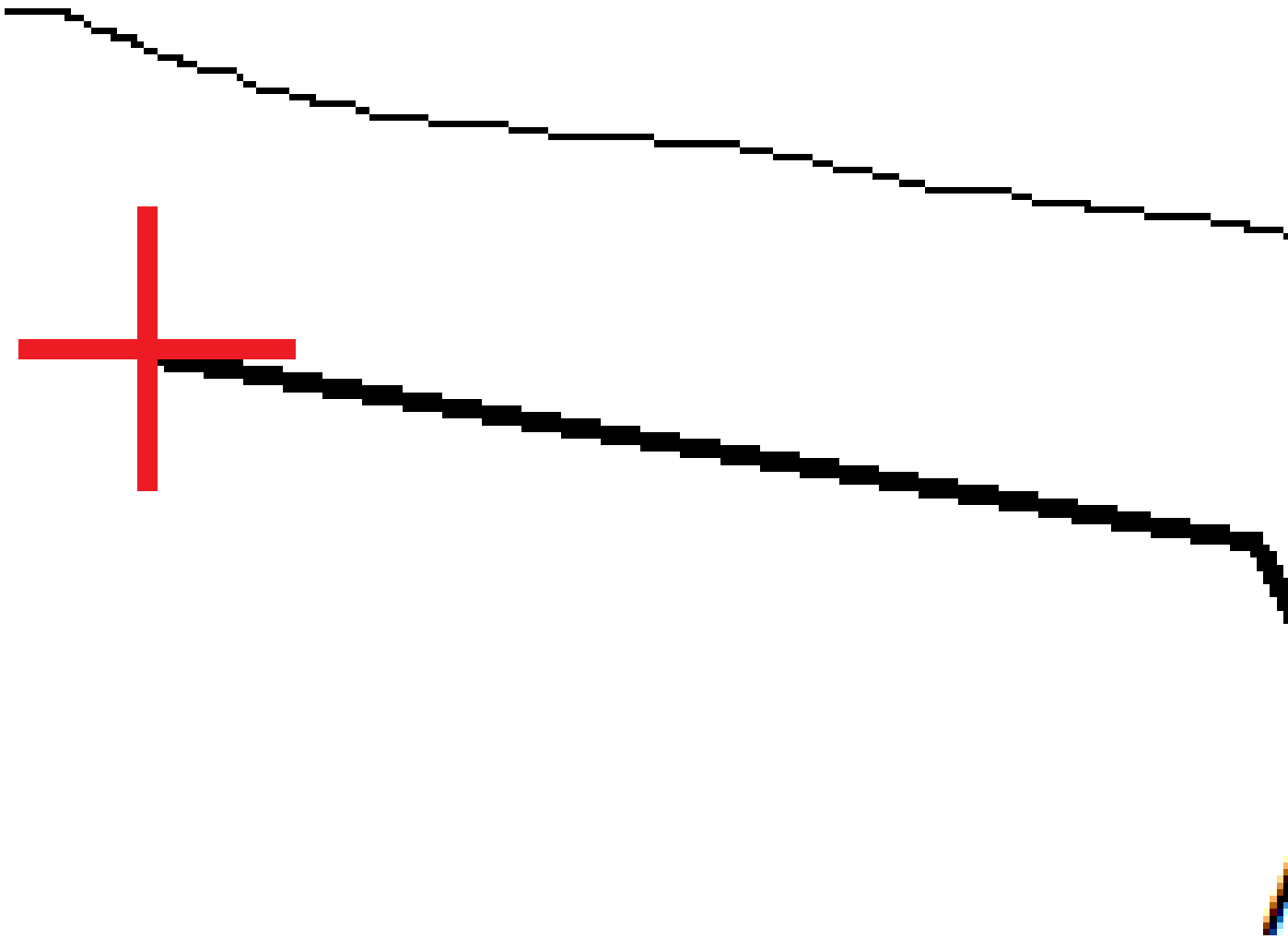
1. At the stakeout screen, tap and hold in the plan or cross section view and select **Edit Side Slope**.
2. From the **Hinge string** field tap the arrow and then select a string by one of these methods:
   - Tap a string on the screen
   - If appropriate for your controller, use the left/right arrow keys
   - Tap and hold on the screen and select the string from the list

   The current hinge string is shown as a solid blue circle.

## Example – select hinge string and edit side slope

The diagram below shows a typical example of where you might select a different string as the hinge string. In this example, the original design with the hinge at string **C** is in fill, resulting in an unwanted fill zone **(1)**. By

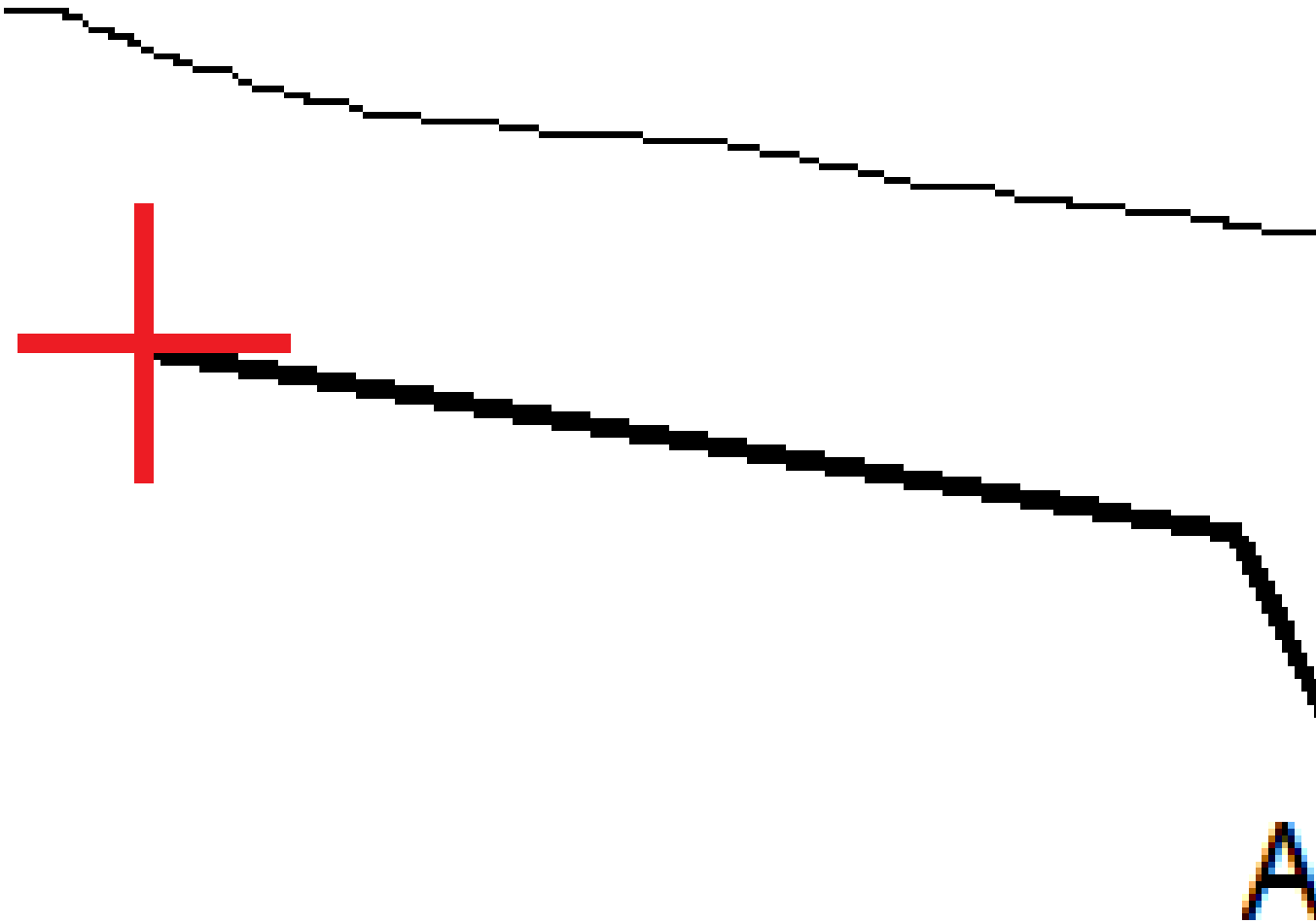
selecting string **B** as the hinge string, the new design is now in cut and the unwanted fill zone is avoided.



With string **B** selected as the hinge string, the cut slope can be defined by either retaining the design slope value or keying in another value. Alternatively, the cut slope can be defined by selecting one of the following:

- **Slope from previous string** option to define the cut slope as the slope from the previous string **A** to the new hinge string **B**, resulting in a catch position at **(2)**.

- **Slope to next string** option to define the cut slope as the slope from the new hinge string **B** to the next string **C**, resulting in a catch position at **(3)**.



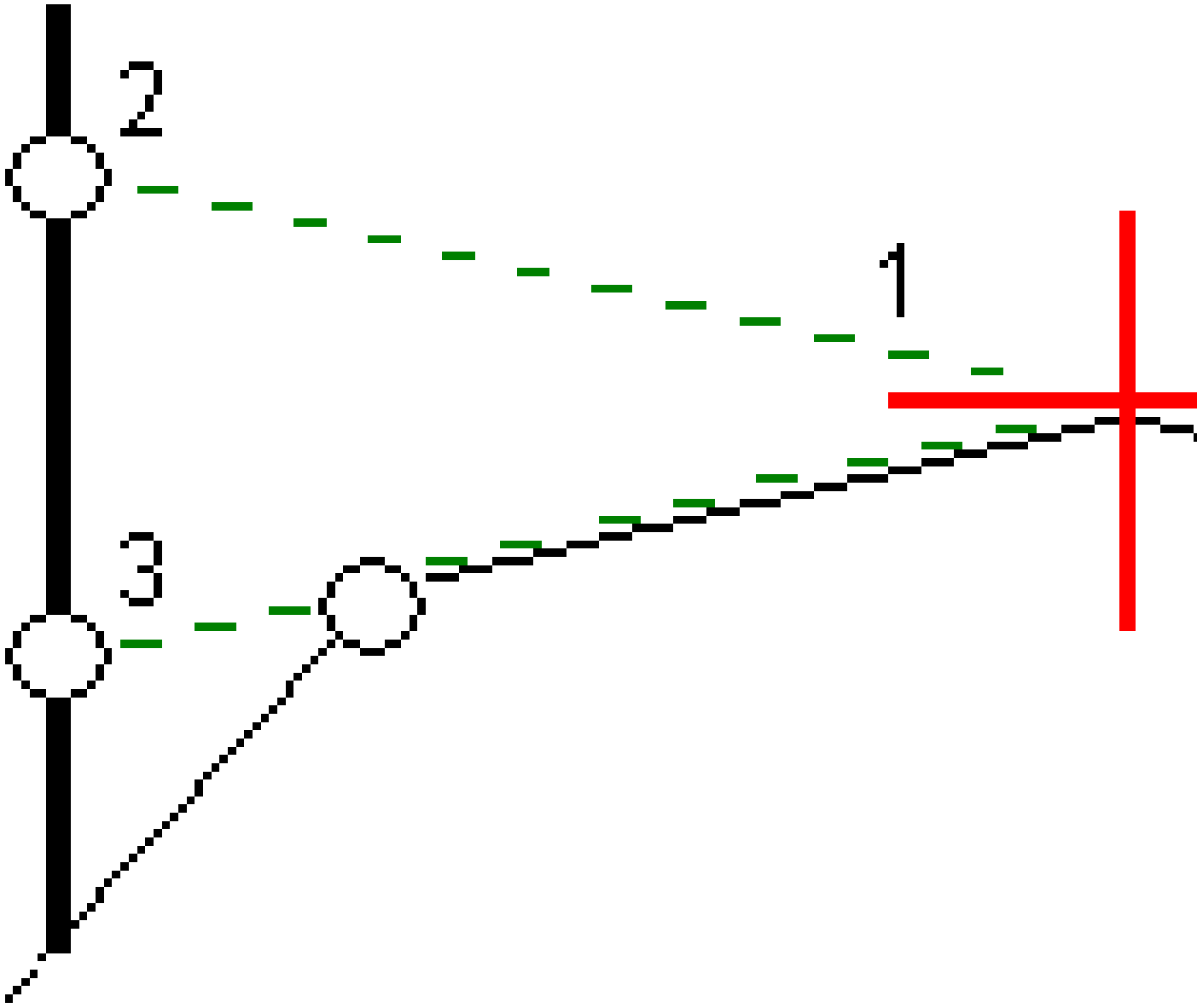
# Cross slopes

Define a cross slope when you need to confirm the construction of a road surface – typically the carriageway.

**NOTE –**

- Cross slopes can be used when staking from a **road design file**. Cross slopes cannot be used when staking **Strings and surfaces**.
- A cross slope must be defined in the cross section view.
- A cross slope cannot be defined when measuring your position relative to the road or when staking a side slope.

When using a cross slope, typically a wire **(1)** is stretched from one side of the road to the other fixed at position **(2)** on each stake. The wire is then checked to see that it lies on the formed road surface **(4)**. The process is then repeated for the other side of the road by fixing the wire to the stakes at position **(3)**. The cross slope can be offset vertically so that the wire is above the surface making it easier to confirm the construction. If the cross slope is offset, the measured distance from the wire to the surface should be consistent. The cross slope option reports the deltas, enabling the stake to be marked up with positions **(2)** and **(3)**.



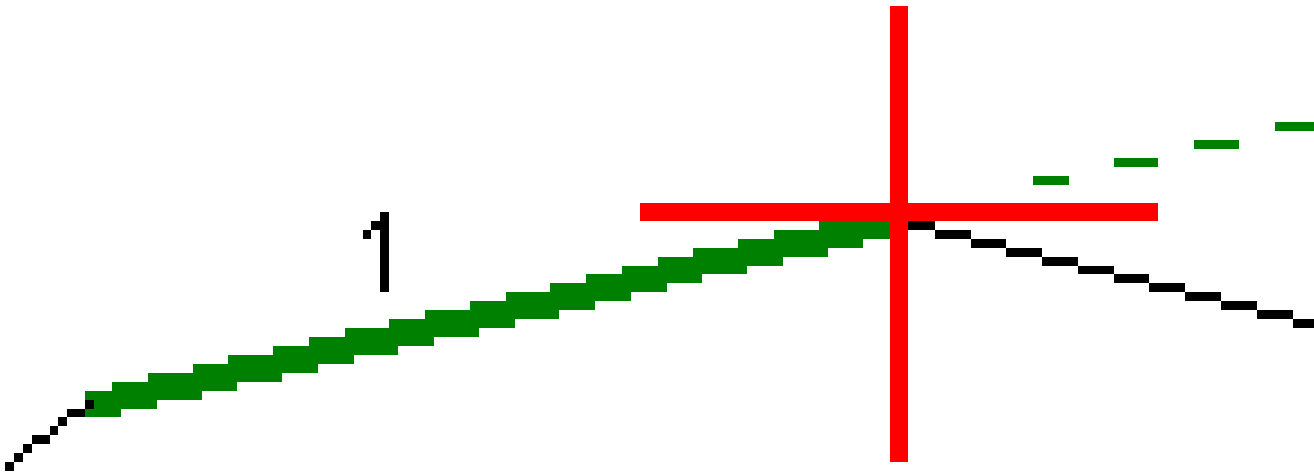

## To define a cross slope

1. From the cross section view, define a horizontal construction offset, typically at **Slope previous**, and enter a vertical offset if required.

   The smaller single circle **(8)** indicates the selected position and the double circle **(6)** indicates the selected position adjusted for the specified construction offsets. The construction offsets appear as green lines **(7)**.

2. From the plan or cross section view, tap **Cross slope** and follow the on-screen prompts to define the cross slope.

   The selected line **(1)** appears as a bold green line. A dashed green line **(2)** extends from the selected line to intersect with a vertical line **(4)** at the target stake **(3)**.




**NOTE –** You cannot define a cross slope by selecting a line that defines a side slope.

3. Tap **Accept**.
4. Tap **Start**.
5. Navigate to the target and then stake the position.
6. Use the **V.Dist. cross slope** value **(5)** to mark the stake with the second position.

### To stop using the cross slope

To de-activate the cross slope function, tap **Cross slope** and tap **Clear** and then tap **Close**.

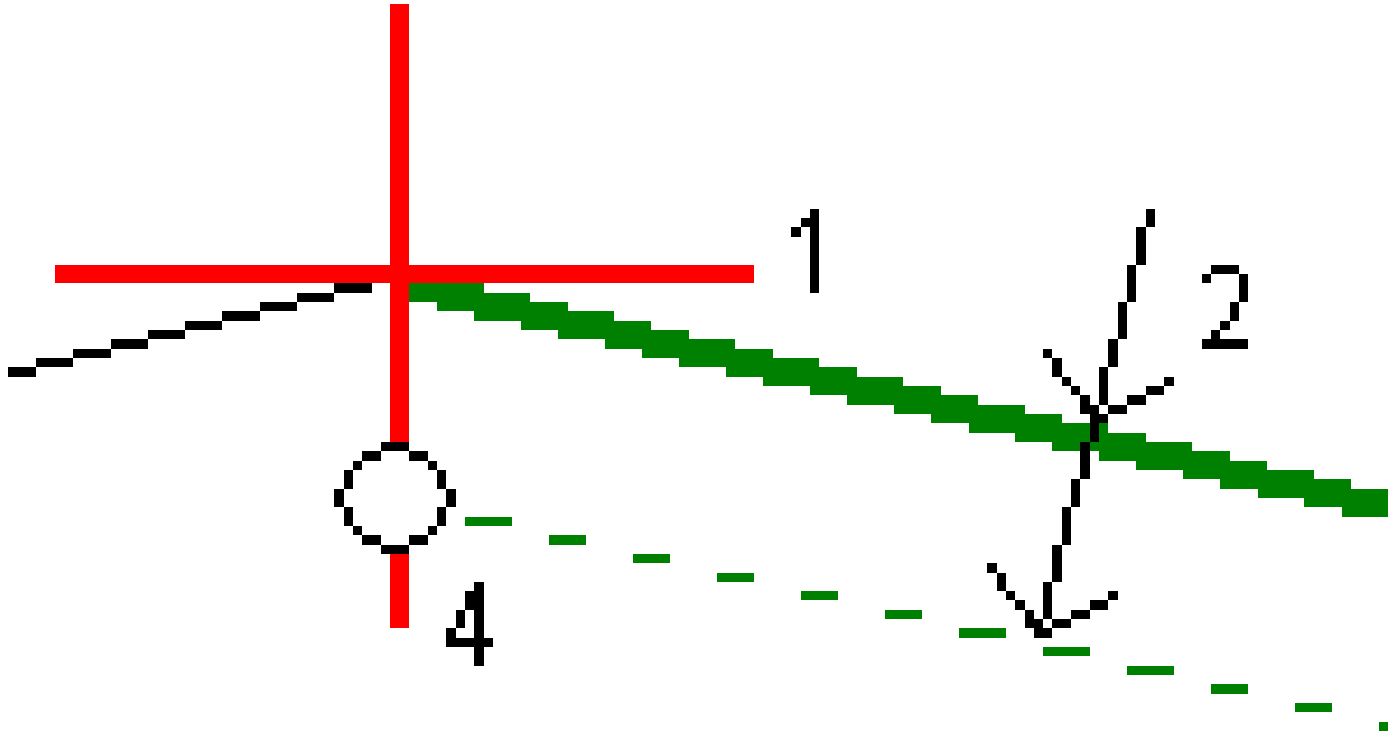
## Subgrades

Define a subgrade when the cross section represents the finished road surface and you need to stake the points defining other surfaces in the road – typically the subgrade.

**NOTE –**

- Subgrades can be used when staking from a **road design file**. Subgrades cannot be used when staking **Strings and surfaces**.
- You cannot define a subgrade from the **Stakeout method** screen or when measuring your position relative to a road or a string.

Subgrade points are computed by creating a temporary line that is parallel to, and offset from, a line between two strings in the cross section. The points can then be selected for stakeout:




## To define a subgrade

1. From the plan or cross section view, tap **Subgrade** and follow the on-screen prompts to define the subgrade.

The selected line **(1)** appears as a bold green line. The depth to subgrade **(2)** is from the selected line to the subgrade surface. A dashed green line **(3)** extends to intersect with all encountered lines in the cross section. If no intersection(s) are found, computed points are created at the same start and end offsets as that of the selected line. The single circles **(4)** indicate the computed positions.

**NOTE –** You cannot define a subgrade by selecting a line that defines a side slope.

2. Tap **Accept**.
3. Tap the position that you want to stake.
4. Navigate to the target and then stake the position.

### To stop using the subgrade

To de-activate the subgrade function, tap **Subgrade** and tap **Clear** and then tap **Close**.

# 7

# Precise elevations

If you are using a GNSS receiver for stakeout, then you don't need to maintain line of sight to a total station. Sometimes, however, you need to use a total station for better elevation control. In Origin Roads you can enable the **Precise elevation** option to get the best of both worlds: set up an integrated survey and use the GNSS for horizontal positioning and use the total station for vertical positioning.

Because you don't need the total station for horizontal positioning you can set it up on a high point with good visibility (no horizontal coordinates are needed) and use the **Station elevation** feature to tie into known point(s) to set the elevation control.

When using **Precise elevation**, the software provides horizontal navigation based on GNSS, and vertical navigation from the total station. When you store the staked point, three point records are stored: a GNSS position, a total station position, and a combined position.

## To configure the software to use precise elevation

1. In the integrated survey style you will use, select the **Precise elevation** check box.
2. To use precise elevations, you must switch to the Roads app. To switch between applications, tap ☰ and tap the name of the app you are currently using, and then select the application to switch to.

## To set up the conventional instrument

**TIP –** To set up the conventional instrument, position the instrument in a location with good visibility and safe from machinery. The elevation is determined by one or more **Station elevation** measurements to point(s) with a known elevation. You can set up the robotic total station on a known control point, but this is not required.

1. Position the conventional survey instrument and then tap ☰ and select **Stakeout** / **<integrated style name>** / **Station elevation**.
2. The RTK survey starts. Once the RTK survey has initialized, you can begin the station setup for the conventional survey.
3. Set the corrections associated with the instrument.

   If the **Corrections** form does not appear, tap **Options** from the **Station setup** screen to set the corrections. To make the **Corrections** form appear on startup, select the **Show corrections on startup** option.

4. Tap **Accept**.
5. If required, enter the **Instrument point name**, **Code**, and **Instrument height**. If the instrument is not set up on a known point with a known elevation, accept the default point name and 0.000 instrument height.
6. Tap **Accept**.
7. Enter the point name, code, and target details for the point with the known elevation.

   **TIP –** To select a point already in the job, such as a control point, tap ▸ next to the **Point name** field. Alternatively, you can key in a point. The point needs only a name and an elevation – horizontal coordinates are not required.

   **CAUTION –** If you are using IMU tilt compensation for the RTK part of the integrated survey, the tilt compensation is not applied to the conventional observations. Be sure to level the pole when the **Precise elevation** option is enabled when surveying a road using the Roads software, and when using conventional total station measurements.
8. Position the prism on the point with the known elevation and tap **Measure**. The elevation value is transferred to the instrument point. Once the measurement is stored, the **Point residuals** appear.
9. From the **Point residuals** screen, tap one of the following softkeys:
   - **+ Point**, to observe additional known points
   - **Details**, to view or edit point details
   - **Use**, to enable or disable a point
10. To view the station elevation result, tap **Results** in the **Point residuals** screen. To accept the result, tap **Store**.

## To start staking out

1. In the map, tap the road and then tap **Stakeout**.

   The software shows a message indicating that **Road stakeout precise elevation is enabled**.

   If you are using a GNSS receiver with IMU tilt compensation, the message warns that you must level the pole for as-staked observations, because tilt compensation is not applied to the conventional observations.
2. Tap **OK** to dismiss the message.
3. The road is ready to stake, using your preferred stakeout method.

   During stakeout, the software provides horizontal navigation based on GNSS, and vertical navigation from the total station.

   When you store the staked point, three point records are stored: a GNSS position, a total station position, and a combined position.

**NOTE –** If the robotic total station cannot measure to the target, the cut/fill and vertical distance values are shown as "?".

# 8

# Reports

Use the **Reports** function in the software to generate reports from survey data. Use these reports to check data in the field, or to transfer data from the field to your client or to the office for further processing with office software.

## Roads stakeout reports

> **TIP –** To display the **Confirm staked deltas** screen before you store a point, select the **View before storage** check box in the **Stakeout options** screen and then select the required format in the **Stakeout deltas format** field.

If you chose to install a **Language and Help Files** language pack when you installed the Origin software, stakeout report formats are installed to the controller in the language of your choice. If you did not choose to install a language pack you can install it at any time by running Spectra Geospatial Installation Manager.

The following stakeout report formats are installed with Origin Roads:

- **Road – Catch + offsets**

  Provides details of all the standard road staked deltas plus a list of the horizontal and vertical distances to each of the cross-section positions from the staked offset position. The reported horizontal and vertical distances include the applied horizontal and vertical construction offsets.

- **Road – Stake markup**

  Provides a simplified stakeout display that presents the vertical distance (cut/fill) to the road design position. Appropriate station and offset values and cross-section details (in the case of catch point staking) are reported, based on the road stakeout method.

- **Road – XS details**

  Provides all the standard road staked deltas details as well as a list of the cross-section elements (left and right) that define the design cross-section at the selected station.

Stylesheets for additional roading reports can be downloaded from the Software and utilities page of the Spectra Geospatial Help Portal.

# To generate a report

1. Open the job that contains the data to export.
2. Tap ☰ and select **Report**.
3. In the **File format** field, specify the type of file to create.
4. Tap 🗀 to open the **Select folder** screen.
    a. To create a new folder, select the folder where you want to store the new folder and then tap 🗀+.
    b. Select the folder you want to store the exported data to and then tap **Accept**.
5. Enter a filename.

    By default, the **File name** field shows the name of the current job. The filename extension is defined in the XSLT stylesheet. Change the file name and extension as required.
6. If more fields are displayed, complete them.

    You can use the XSLT stylesheets to generate files and reports based on parameters that you define. For example, when generating a Stakeout report, the **Stakeout horizontal tolerance** and the **Stakeout vertical tolerance** fields define acceptable stakeout tolerances. When generating the report you can stipulate the tolerances, then any stakeout delta greater than the defined tolerances appears in color in the generated report.
7. To automatically view the file after you create it, select the **View created file** check box.
8. To create the file, tap **Accept**.

Alternatively, export the job as a JobXML file and then use the **File and Report Generator utility** to create the report from the exported JobXML file, using the required XSLT stylesheet as the output format.

The File and Report Generator utility can be downloaded from the Software and utilities page of the Spectra Geospatial Help Portal.

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Spectra Geospatial Origin includes a number of open source libraries.

For more information, see Open source libraries used by Spectra Geospatial Origin.

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