



Trimble Access™ LandXML Roads

User Guide



Version 2022.10
Revision B
December 2022

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Introduction to Roads


Trimble Access Roads software is a specialized application for surveying roads. Use the Roads software to:

- Upload an existing road definition.
- Key in an RXL road definition including horizontal and vertical alignments, templates, and superelevation and widening records.
- Review the road definition.
- Stake out the road.
- Generate a report for the 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.

TIP – Use the **Cogo** menu to 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 *Trimble Access 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 *Trimble Access Help*.

To switch between applications, tap the application icon in the status bar and then select the application to switch to. Alternatively, tap  and tap the name of the app you are currently using, and then select the application to switch to.

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.

LandXML roads

LandXML road files can contain one or more alignments with associated road definition information.

The Roads software supports **LandXML cross section roads** and **LandXML string roads**.

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.

TIP – For information on using LandXML files in General Survey, refer to the topic **LandXML files** in the *Trimble Access General Survey User Guide*.

LandXML cross section roads

LandXML cross section roads are LandXML roads where the alignment(s) have associated cross sections.

LandXML cross section roads can be exported from various software packages. LandXML cross section roads are stored as RXL files in Trimble Access Roads. The original LandXML file remains in the project folder but is no longer used.

For more information, see [LandXML cross section roads](#).

LandXML string roads


LandXML string roads are LandXML roads where the alignment(s) have associated strings that are defined by break lines, irregular lines, or lines and arcs when exported from various software packages, including Trimble Business Center, Tekla Civil, Trimble Novapoint, Autodesk Civil 3D, and 12d Model.

LandXML string roads are supported in their native LandXML format, unlike LandXML cross section roads, which the Trimble Access Roads software converts to RXL roads before you can use them.

For more information, see [LandXML string roads](#).

Viewing LandXML roads in the map


In the map, the horizontal alignment for a LandXML road is shown as a red line.

If the road is not shown in the map, tap  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.

In the map, tap the alignment to select it. The horizontal alignment is shown as a blue line.

When you select an alignment, available actions depend on the file format:

- For a **LandXML cross section road**, tap:
 - **Define** to define or edit the road.
 - **Review** to review the road.
 - **Stakeout** to stake the road.
- For a **LandXML string road**, tap:
 - **Edit** to edit the road (the road is already fully defined when exported from office software).
 - **Review** to review the road.
 - **Stakeout** to stake the road.

To show or hide roads or other linked files in the map, tap  to open the **Layer manager** and select the **Map files** tab. Tap a file to make it visible or to hide it. This is useful for reviewing a road relative to related secondary roads, particularly at interchanges and intersections.


Reviewing the LandXML road definition

NOTE – This topic applies to LandXML cross section roads that have been converted to RXL files as well as LandXML string roads.

You can review the definition of a road at any time. View the road in 3D to visually confirm the road definition and to visualize the road relative to other road definitions, such as a complex interchange or urban intersection.

1. In the map, tap the road.
2. Tap **Review**.

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.


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 plan of the road, tap  or press the **Tab** key.
7. To view an automated 3D drive through of the road:
 - a. When viewing the plan or cross section in the map, 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**.

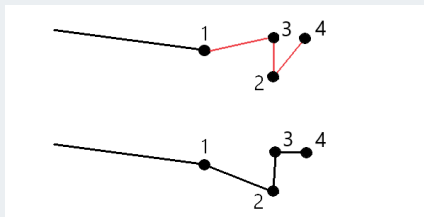
LandXML string roads

LandXML string roads are predefined ready to review and stakeout when you export them from your office software. See:

- [To export LandXML string roads from Trimble Business Center, page 9](#)
- [To export LandXML string roads from Tekla Civil, page 11](#)
- [To export LandXML string roads from Trimble Novapoint, page 12](#)
- [To export LandXML string roads from Autodesk Civil 3D, page 12](#)

Unlike LandXML cross section roads, LandXML string roads are not stored as RXL roads, and **remain XML files** when used in the Trimble Access Roads software.

NOTE – When defining the road in the office software, Trimble 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 example, consider the following image showing a cross section view of a kerb 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.



NOTE – If a file has invalid spiral geometry the horizontal alignment is 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.

Advantages of LandXML string roads

LandXML string roads are very similar to GENIO string roads but offer a number of advantages:

- There is no need to select the strings to define the road as the road definition is complete and ready for review and stakeout.
- String names are not limited to 4 characters.
- LandXML files can include more than one road.
- LandXML files can include more than one surface.
- Support for LandXML string files is better when exporting from Trimble Business Center, and when displaying files or staking with Trimble Access Roads.

While the traditional LandXML string format does not include support for side slopes, Trimble has extended the LandXML format to include support for side slopes. LandXML string files exported from Trimble Business Center will have the side slopes defined. Side slopes can also be defined or modified in the Trimble Access Roads software.

Editing LandXML string roads

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.

For the selected LandXML string road, you can:

- Review the geometric elements that define the horizontal and vertical alignments.
- Tap **Options** and specify the station interval for lines and the station interval for arcs and transitions.
- View the list of the strings that define the road.

WARNING – 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.

- **Define or edit additional strings.**
- **Define or edit additional points.**
- **Exclude strings.**
- **Convert the outermost left and/or right strings to side slopes.**

To export LandXML string roads from Trimble Business Center

NOTE – For best results when using LandXML string roads in the Trimble Access Roads software, export files using Trimble Business Center version 5.80 or later.

You can export a LandXML string road from Trimble Business Center 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 Trimble Business Center and select a project.
2. Open the **Project explorer** in Trimble Business Center and select the alignment and the associated corridor you want to export. 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 Trimble Business Center, 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 *Trimble Business Center Help*.

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

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

To export LandXML string roads from Tekla Civil

NOTE – For best results when using LandXML string roads in the Trimble Access 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. Trimble 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*.

To export LandXML string roads from Trimble Novapoint

NOTE – For best results when using LandXML string roads in the Trimble Access 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*.

To export LandXML string roads from Autodesk Civil 3D

Use the LandXML export function in Autodesk Civil 3D to export corridor baseline alignments, along with associated feature lines. The Trimble Access 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

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.

TIP – For complex projects containing multiple corridors, it is best to use sites where each site

has the feature lines for just one corridor. 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 associated feature lines to a unique site, 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*.

To define additional strings

NOTE – This function applies to **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.

To define additional points

NOTE – This function applies to **LandXML string roads**.

Use **Additional points** to define design features like key positions for a drainage system or road cross sections.

You can key in points or import them from a CSV file or LandXML file.

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. 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.


To exclude strings

NOTE – This function applies to **LandXML string roads**.

For some LandXML string roads, the centerline alignment does not form part of the road surface and must be excluded. In addition, 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.

To **exclude** strings from the road:

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 **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.

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 **include** a string for these roads, in the map tap **Edit** and then tap the **Exclude** softkey. Tap the string name in the list. The checkmark is removed, indicating the string is no longer excluded.

NOTE – Any changes made to the status of the strings are written to the LandXML file.

To convert 3D strings to side slopes

For some LandXML cross section roads and LandXML string roads, the outermost strings to the left and right of the centerline define a side slope.

LandXML cross section roads

The LandXML cross section 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.

LandXML string roads

To convert 3D strings to side slope strings:

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 **Side slopes**.

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

WARNING – 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**.

LandXML cross section roads

LandXML cross section roads must be defined in the Trimble Access Roads software. To do this, select the LandXML file and then select the horizontal alignment, the profile alignment, and the surface in the LandXML file that comprise the road definition. When you store the road it is converted to an RXL road. Select the new RXL road to review and stake.



NOTE – When the LandXML road is converted to an RXL road, the original LandXML file remains in the current project folder.

To define a LandXML cross section road


You can define a LandXML cross section road from the map or from the menu. When you store the road it is converted to an RXL road. Select the new RXL road to review and stake.

NOTE – When the LandXML road is converted to an RXL road, the original LandXML file remains in the current project folder.

To select the LandXML road from the map

1. Tap  in the map toolbar to open the **Layer manager** and select the **Map files** tab.
2. Select the LandXML file to see the list of available horizontal alignments in the file. To make the alignment visible in the map, tap the name of the horizontal alignment you want to define the road and then tap it again to make it selectable  in the map. Tap **Accept**.
3. 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 [To define the new road](#) below.

To select the LandXML road from the menu

1. Tap  and select **Define**.
2. Tap **LandXML road**.
3. Select the LandXML file. The file must be in the current project folder.
4. Tap **Next**.
The **New road** screen appears. To continue, see [To define the new road](#) below.

To define the new 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.
3. The LandXML format does not support side slopes, but you can add these. See [To convert 3D strings to side slopes, page 16](#).
4. Select the road cross section interpolation method. Select either:
 - Elevation
 - Cross slope

For **Interpolation by elevation** and **Interpolation by cross slope** examples, refer to the **Template positioning examples** topic in the [Trimble Access Help](#).

5. When selecting a LandXML file 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:

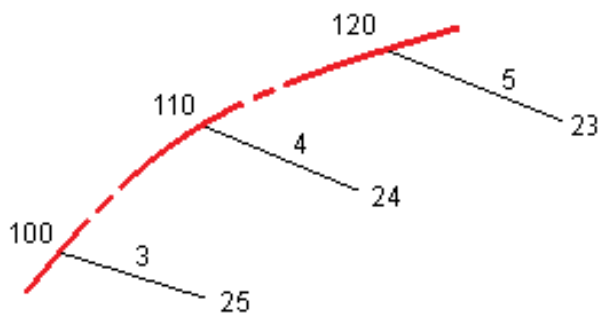
Staking out a LandXML road

- Cubic spiral
 - NSW cubic parabola
6. To save the edited road as an RXL road file, tap **Store**. You are returned to the map where the new road is selected, ready to review or stake. To edit the road definition, tap **Define** and select a component to edit. For more information, refer to the **RXL road definition** topics in the [Trimble Access Help](#).

String interpolation

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.




Staking out a LandXML 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.

To stake a **LandXML cross section road** it must first be defined and then stored as an RXL file in Trimble Access Roads. To stake it out, simply select the new RXL road to stake. The original LandXML file remains in the project folder but is no longer used. For more information, see [To define a LandXML cross section road, page 17](#) and the topic **Staking out an RXL road** in the *Trimble Access RXL Roads User Guide*.

To stake a **LandXML string road**:

1. In the map, tap the road and then tap **Stakeout**. Alternatively, tap  and select **Stakeout**, tap **Stakeout roads** and select the road to stake then tap **Next**.

Use the **Filter alignments by name match** field to help you select the alignment to stake. This option is only available when selecting the road to stake from the menu.

If the road you want to stake out 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. If you have not yet started a survey, the software prompts you through the steps to start the survey.
3. Enter a value in the **Antenna height** or **Target height** field and make sure that the **Measured to** field is set correctly.
4. Enter the **Station interval for lines** and **Station interval for arcs and transitions** or accept the default value set when the alignment was defined.

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

5. Tap **Options** to:
 - Configure preferences for **Grade**, **As-staked point details**, and **Display**.
 - Enable [staking out relative to a digital terrain model \(DTM\)](#).

6. Tap **Next**.

The road is ready to stake, using your preferred stakeout method. For more information, refer to the topic for the selected method. See:

[To stake out positions relative to the road, page 19](#)

[To stake out positions relative to a string, page 20](#)

[To stake out a station on a string, page 21](#)

[To stake out additional strings, page 23](#)

[To stake out additional points, page 24](#)

NOTE –

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

To stake out positions relative to the road

1. In the **Stake** field, select **Position on road**, 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 stake points 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**.
5. Use the [plan or cross section view](#) to see your position relative to the road.

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.

When using a Trimble SX12 scanning total station in **TRK** mode with the *laser pointer enabled*, the **Stakeout** screen shows the **Mark point** softkey instead of the **Measure** softkey. Tap **Mark point** to put the instrument into **STD** mode. The laser pointer stops flashing and moves to position itself at the EDM location. When you tap **Accept** to store the point, the instrument automatically returns to **TRK** mode and the laser pointer resumes flashing. To remeasure and update the stakeout deltas, tap **Measure** after you tap **Mark point** and before you tap **Accept**.

7. Tap **Store**.

The software returns to the navigation screen.

You can then:

- Continue measuring points along the road.
- 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.

To stake out positions relative to a string

1. 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. Using this method means you don't have to select a string. Instead the software will navigate you to the string nearest to your current position, meaning 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 stake points 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**.

4. Use the [plan or cross section view](#) to navigate relative to the string. See [Stakeout navigation, page 34](#).

- 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 [RXL, LandXML, & 12da road construction offsets, page 27](#).

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.

When using a Trimble SX12 scanning total station in **TRK** mode with the *laser pointer enabled*, the **Stakeout** screen shows the **Mark point** softkey instead of the **Measure** softkey. Tap **Mark point** to put the instrument into **STD** mode. The laser pointer stops flashing and moves to position itself at the EDM location. When you tap **Accept** to store the point, the instrument automatically returns to **TRK** mode and the laser pointer resumes flashing. To remeasure and update the stakeout deltas, tap **Measure** after you tap **Mark point** and before you tap **Accept**.


6. Tap **Store**.


The software returns to the navigation screen.

You can then:

- Continue measuring points along the road.
- 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.

To stake out a station on a string

TIP – To customize the stations available for stakeout, tap  next to the **Station** field to view the **Select station** screen. Tap **Edit** to modify the station interval and the types of available stations. See [Stations available for stakeout, page 26](#).

1. Tap the station on the string in the map, or 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. Nominal offsets apply only to LandXML roads defined by cross sections.

2. If required, add the following features:

- To stake points 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**.

4. Use the [plan or cross section view](#) to navigate to the point. See [Stakeout navigation, page 34](#).

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 [RXL, LandXML, & 12da road construction offsets, page 27](#).

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 elevation, press the **Space** key or tap  and enter the new elevation value. To restore the original elevation after editing, press the **Space** key or tap  and then tap  and select **Reload original elevation**.

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

When using a Trimble SX12 scanning total station in **TRK** mode with the *laser pointer enabled*, the **Stakeout** screen shows the **Mark point** softkey instead of the **Measure** softkey. Tap **Mark point** to put the instrument into **STD** mode. The laser pointer stops flashing and moves to position itself at the EDM location. When you tap **Accept** to store the point, the instrument automatically returns to **TRK** mode and the laser pointer resumes flashing. To remeasure and update the stakeout deltas, tap **Measure** after you tap **Mark point** and before you tap **Accept**.

9. Tap **Store**.

The software returns to the navigation screen.

You can then:

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

To stake out additional strings

To stake your position relative to an additional string

1. 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 stake points 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**.
4. Use the [plan or cross section view](#) to navigate relative to the string. See [Stakeout navigation, page 34](#).
5. When the point is within tolerance, tap **Measure** to measure the point.

When using a Trimble SX12 scanning total station in **TRK** mode with the *laser pointer enabled*, the **Stakeout** screen shows the **Mark point** softkey instead of the **Measure** softkey. Tap **Mark point** to put the instrument into **STD** mode. The laser pointer stops flashing and moves to position itself at the EDM location. When you tap **Accept** to store the point, the instrument automatically returns to **TRK** mode and the laser pointer resumes flashing. To remeasure and update the stakeout deltas, tap **Measure** after you tap **Mark point** and before you tap **Accept**.

6. Tap **Store**.

The software returns to the navigation screen.

You can then:

- Continue measuring points along the road.
- 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.

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.
2. If required, add the following features:
 - To stake points 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](#). (This applies to dependent additional strings only.)
3. Tap **Start**.
4. Use the [plan or cross section view](#) to navigate to the point. See [Stakeout navigation, page 34](#).
5. To edit the elevation, press the **Space** key or tap > and enter the new elevation value. To restore the original elevation after editing, press the **Space** key or tap > and then tap > and select **Reload original elevation**.
6. When the point is within tolerance, tap **Measure** to measure the point.
When using a Trimble SX12 scanning total station in **TRK** mode with the *laser pointer enabled*, the **Stakeout** screen shows the **Mark point** softkey instead of the **Measure** softkey. Tap **Mark point** to put the instrument into **STD** mode. The laser pointer stops flashing and moves to position itself at the EDM location. When you tap **Accept** to store the point, the instrument automatically returns to **TRK** mode and the laser pointer resumes flashing. To remeasure and update the stakeout deltas, tap **Measure** after you tap **Mark point** and before you tap **Accept**.
7. Tap **Store**.
The software returns to the navigation screen.
You can then:
 - Continue measuring points along the road.
 - 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.

To stake out additional points

1. Tap the additional point in the map, or select **Additional points** in the **Stake** field and then tap **Select** to select the additional point from the list.
2. If required, add the following features:
 - To stake points 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**.
 4. Use the [plan or cross section view](#) to navigate to the point. See [Stakeout navigation, page 34](#).
 5. To edit the elevation, press the **Space** key or tap > and enter the new elevation value. To restore the original elevation after editing, press the **Space** key or tap > and then tap > and select **Reload original elevation**.
 6. When the point is within tolerance, tap **Measure** to measure the point.

When using a Trimble SX12 scanning total station in **TRK** mode with the *laser pointer enabled*, the **Stakeout** screen shows the **Mark point** softkey instead of the **Measure** softkey. Tap **Mark point** to put the instrument into **STD** mode. The laser pointer stops flashing and moves to position itself at the EDM location. When you tap **Accept** to store the point, the instrument automatically returns to **TRK** mode and the laser pointer resumes flashing. To remeasure and update the stakeout deltas, tap **Measure** after you tap **Mark point** and before you tap **Accept**.

7. Tap **Store**.

The software returns to the navigation screen.

You can then:

- Continue measuring points along the road.
- 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.

To show the station and offset relative to a reference alignment


For any stakeout method, you can select a reference alignment for which 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 plan or cross section view, tap and hold in the screen and tap **Select reference alignment**.
2. Select the road format.
3. Select the file.
4. Select the road if required.
5. Tap a string in the road to select it.
6. Tap **Accept**.
7. During stakeout, a dashed line is drawn from your current position to the horizontal alignment of the reference alignment.
8. To stop using a reference alignment, tap and hold in the plan or cross section view and tap **Select reference alignment**. In the list of road formats, select **<None>**.

Stations available for stakeout

You can customize the stations available for stakeout in an RXL, LandXML, or 12da road when staking a:

- Station on string
- Skew offset

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. Tap **Edit** to modify the station interval and the types of available stations.

Station interval settings

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.

Select the station interval **Method**:

- The **0 based** method is the default method and gives station values that are multiples of the station interval. 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.
- The **Relative** method gives station values relative to the start station. For example, if the start station is 2.50 and the station interval is 10.00, the **Relative** method produces stations at 2.50, 12.50, 22.50, 32.50, and so on.

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.

Available stations

To configure the types of available stations, 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:

Abbreviation	Meaning
CS	Curve to transition
CXS	Computed sections defined by the station interval
DXS	Design sections defined by the positions in the file
Hi	Vertical curve high point
Lo	Vertical curve low point

Abbreviation	Meaning
PC	Point of curvature (Tangent to curve)
PI	Point of intersection
PT	Point of tangent (Curve to tangent)
RE	Road end
RS	Road start
SC	Transition to curve
SEE	Superelevation end
SEM	Superelevation maximum
SES	Superelevation start
SS	Transition to transition
ST	Transition to tangent
STEQ	Station equation
T	Template assignment
TS	Tangent to transition
VCE	Vertical curve end
VCS	Vertical curve start
VPI	Vertical point of intersection
WE	Widening end
WM	Widening maximum
WS	Widening start

RXL, LandXML, & 12da road construction offsets

To stake positions offset from an RXL, LandXML, or 12da road, leaving the roadway clear for construction, define one or more construction offsets for the road. The construction offset is applied to all positions in the road.

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.

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.

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).

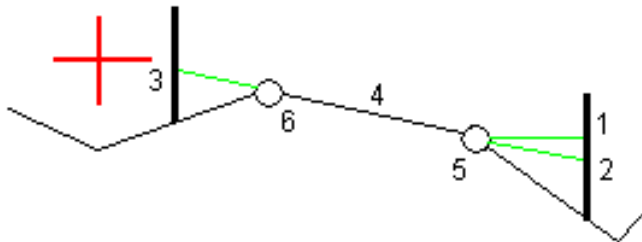
NOTE – When staking a side slope with construction offsets where you wish to store a position at the catch and the offset position, select the **Store both catch and construction offset** check box when defining the construction offset. See [Catch point](#).

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**.

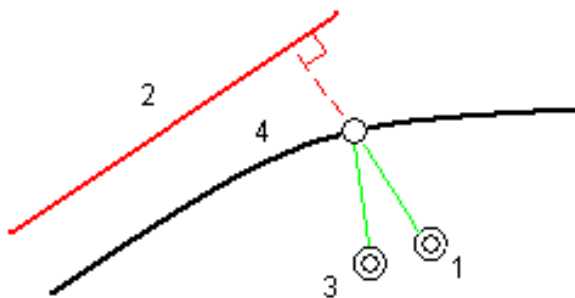
NOTE – This option is not available when the stake method is **To the nearest string** or, for LandXML roads if the horizontal offset is applied perpendicular to the string.

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:

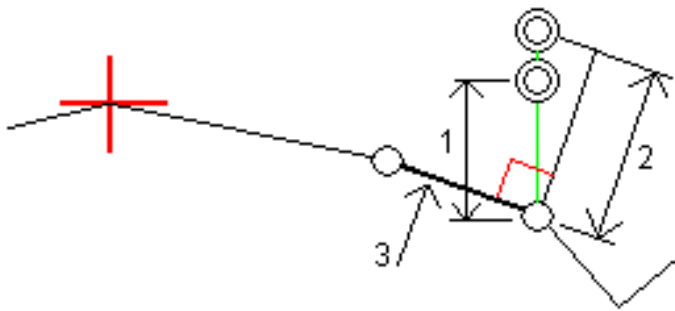
- A negative value offsets points vertically down.
- A positive value offsets points vertically up.

The **Vertical Offset** value is not applied to a DTM 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:

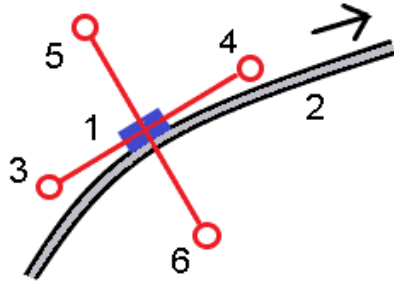
- A positive value offsets the point in the direction of increasing station (Forward).
- A negative value offsets the point in the direction of decreasing station (Backward).

NOTE –

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

Staking out a LandXML road


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.



Stakeout features for all road types

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

Plan and cross section view

To switch between the plan view and the cross section view, 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.

Plan view

The plan view shows:

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

Before stake out

Before stakeout the plan view shows:

- Construction offsets as green lines
- Skew offsets as dashed black lines

Alongside the plan view, 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)

Stakeout features for all road types

- 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

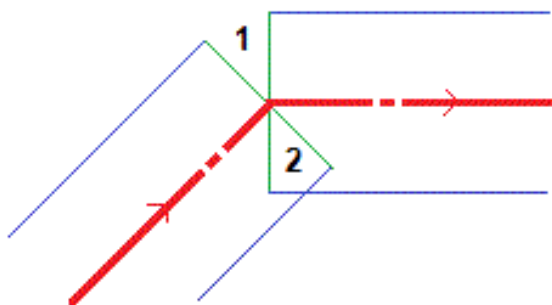
During stakeout

During stakeout the plan view 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

Alongside the plan view, 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.



Cross section view

The cross section that appears 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.

When you view the cross section, 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**.

Current position information

The base of the plan view or cross section view reports your current position relative to the item being staked.

To select the delta display:

- Tap and hold on the navigation deltas.
- Tap **Options**.

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.Distance** value reports the vertical distance to the vertical alignment.
- 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.

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

During stakeout the software helps you to navigate to the selected position on the road. The display orientation assumes you are moving forwards at all times.

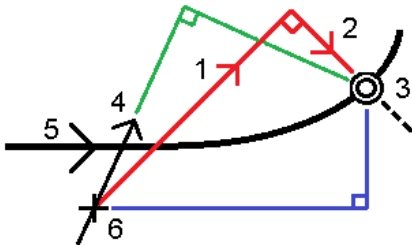
Stakeout display orientation

Select the display orientation when defining your survey style or, when in a survey, from the **Options** softkey. The options are:

- Direction of travel – the screen will orientate so that the top of the screen points in the direction of travel.
- North – the screen will orientate so that the north arrow points up the screen.
- Reference azimuth – the screen will orientate to the azimuth of the road.

Understanding the navigation directions

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).

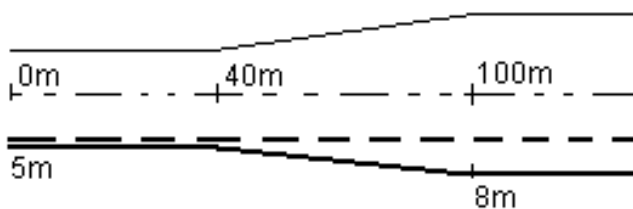


Keyed in and selected offset/feature behavior

The behavior at stake out differs depending on whether the offset/string was selected graphically, selected from a list, or keyed in.

- If you graphically select a string 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.

To navigate to the point in a conventional survey

If you are using the **Direction and distance** mode:

1. 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").
2. When you get to within 3 meters (10 feet) of the point, the arrow disappears, and the in/out and left/right directions appear, with the instrument as a reference point. Follow the instructions below to navigate in this mode.

If you are using the **In/out and left/right** mode:

1. The first display shows which way the instrument should be turned, the angle that the instrument should display and the distance from the last point staked to the point currently being staked.
2. Turn the instrument (two outline arrows will appear when it is on line), and direct the person holding the pole on line.

If you are using a servo instrument, and the **Servo auto turn** field in the survey style is set to **HA & VA**, or **HA only** the instrument automatically turns to the point. If you are working robotically, or when the **Servo auto turn** field in the survey style is set to **Off**, the instrument does not turn automatically.

3. If the instrument is not in **TRK** mode, tap **Measure** to take a distance measurement.
4. The display shows how far the person holding the pole should move towards or away from the instrument.
5. Direct the person holding the pole, and take another distance measurement.
6. Repeat steps 2–5 until the point has been located (when four outline arrows are displayed), then mark the point.
7. If a measurement to the target is within the angular and distance tolerances, tap **Store** at any time to accept the current measurement. If the instrument is in **TRK** mode and you require a higher precision distance measurement, tap **Measure** to take an **STD** measurement and then tap **Store** to accept that measurement. To discard the **STD** measurement and return the instrument to **TRK** mode, tap **Esc**.

If you are operating a robotic instrument remotely from the target:

- the instrument automatically tracks the prism as it moves
- the instrument continuously updates the graphical display
- the graphical display is reversed and the arrows are shown from the target (prism) to the instrument

To navigate to the point in a GNSS survey


1. 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").
2. When you get to within 10 feet (3 meters) of the point, the arrow disappears and a bull's-eye target appears.

When the bull's-eye target is displayed, do not change your orientation. Keep facing in the same direction and only move forwards, backwards, left or right.

3. Continue moving forwards until the cross, representing your current position, covers the bull's-eye target, representing the point. Mark the point.

To stake out relative to a DTM

You can display the cut/fill to a digital terrain model (DTM) during stakeout, where the horizontal navigation is relative to the road but the displayed cut/fill delta value is from your current position to a selected DTM.

1. At the stakeout screen, tap the **Options** softkey.
2. In the **DTM** group box, select the DTM.
3. If required, in the **Offset to DTM** field, specify an offset to the DTM. Tap  and select whether the offset is to be applied vertical or perpendicular to the DTM.
4. In the **Deltas** group box, tap **Edit** and, if required, select the **V. Dist DTM** delta or the **Perp. Dist to DTM** delta. Tap **Accept**.
5. Stake out the road as usual.

NOTE – When a horizontal construction offset is applied, the cut/fill value reported is to the DTM at the position selected for stakeout and not to the DTM at your current position.

When viewing the cross section, the DTM is displayed at your current position as a green line. A circle on the DTM indicates your position projected vertically to the surface.

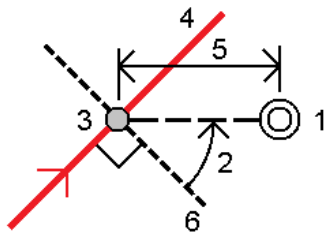
TIP – To check layer thickness when constructing a road, define a DTM for the previous layer and then when staking out the current layer, tap **Options** and in the **Deltas** group box, tap **Edit** and select the **V.Dist DTM** delta.

To stake out a skew offset

Use this 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.

Example skew offset

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 **Stake** field, select **Skew offset** and then in the map, tap the station on the alignment that the skew offset will be applied from. Alternatively, tap > to select the station from the list.
TIP – 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.
2. 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**.
3. To stake points offset from the road, leaving the roadway clear for construction, define a construction offset.
See [RXL, LandXML, & 12da road construction offsets, page 27](#)
4. Tap **Start**.
5. Use the **plan view** to navigate to the point. See [Stakeout navigation, page 34](#).
6. When the point is within tolerance, tap **Measure** to measure the point.

When using a Trimble SX12 scanning total station in **TRK** mode with the *laser pointer enabled*, the **Stakeout** screen shows the **Mark point** softkey instead of the **Measure** softkey. Tap **Mark point** to put the instrument into **STD** mode. The laser pointer stops flashing and moves to position itself at the EDM location. When you tap **Accept** to store the point, the instrument automatically returns to **TRK** mode and the laser pointer resumes flashing. To remeasure and update the stakeout deltas, tap **Measure** after you tap **Mark point** and before you tap **Accept**.

Side slopes

In some situations, you may need to add or edit the side slope.

NOTE – The side slope, and any edits to the side slope, are discarded after a position is measured or when you exit the stakeout screen.

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 **plan 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. However, when defining a GENIO road you can add a new string and then edit its type to be an **Interface 5D string**, which effectively adds a side slope.

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 **plan 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.

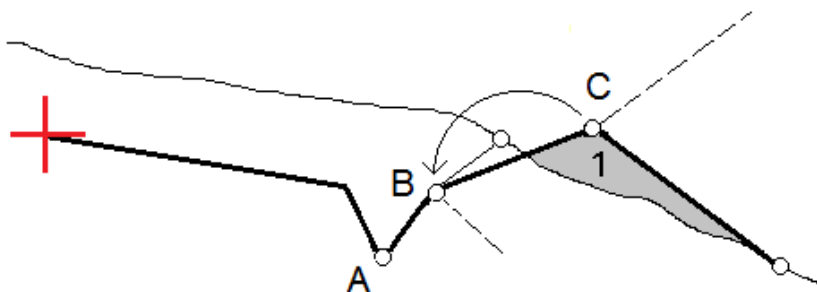
Selecting a different string as the hinge string

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.

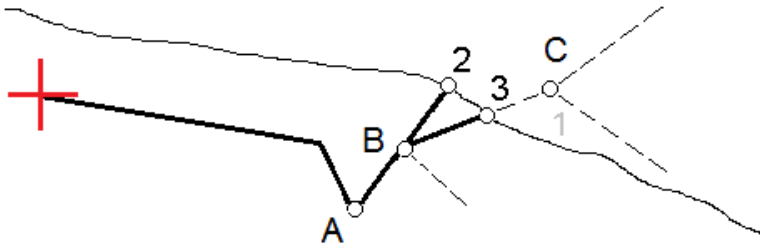
Example – select hinge string and edit side slope

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:

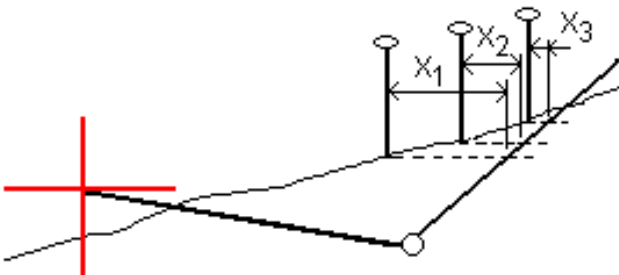
- **Slope from previous string** option to define the cut slope as the slope from the previous string **A** to the new hinge string **B**, resulting in a catch position at **(2)**.
- **Slope to next string** option to define the cut slope as the slope from the new hinge string **B** to the next string **C**, resulting in a catch position at **(3)**.



Catch point

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.

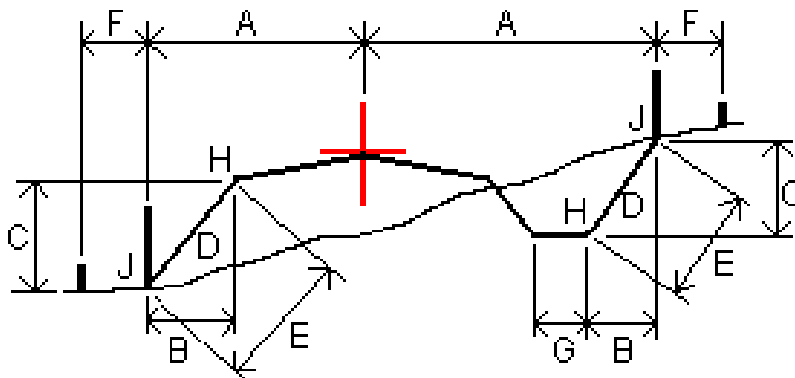
NOTE – For side slope offsets where the slope changes between templates, the software calculates the side slope for intermediate stations by interpolating the slope value.

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

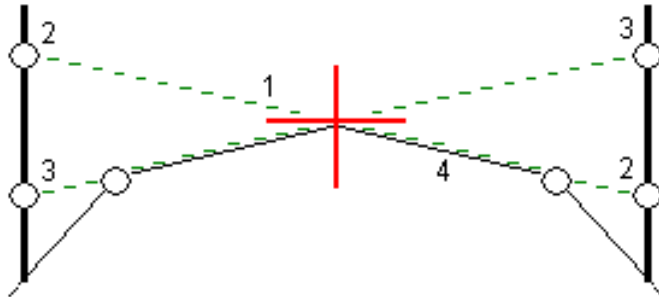
NOTE –

- 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.

Cross slopes

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

Refer to the following diagrams:



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).

NOTE –

- 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.

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 offset(s) appear as a green line (7).

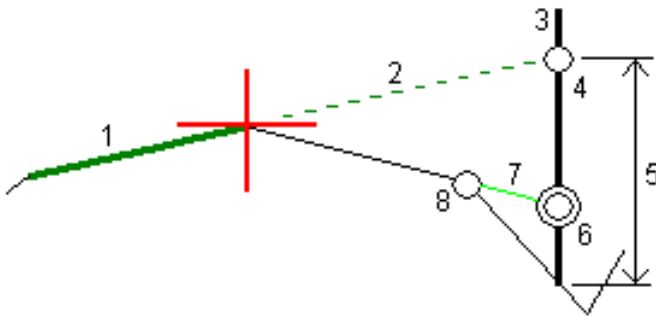
2. From the plan or cross section view, tap **Cross slope** and follow the on-screen prompts to define the cross slope.

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.Distance cross slope** value (5) to mark the stake with the second position.

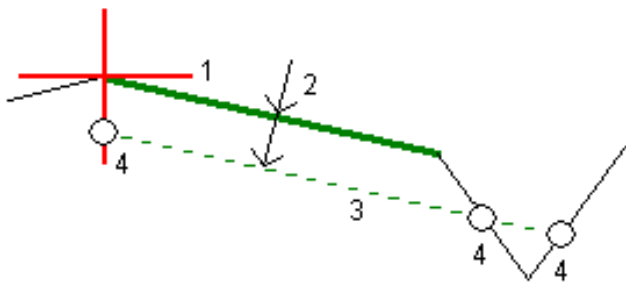
NOTE – To de-activate the cross slope function, tap **Cross slope** and tap **Clear** and then tap **Close**.



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.

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:



NOTE – You cannot define a subgrade from the **Stakeout method** screen or when measuring your position relative to a road or a string.

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.

Stakeout features for all road types

4. Navigate to the target and then stake the position.
5. To de-activate the subgrade function, tap **Subgrade** and tap **Clear** and then tap **Close**.

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

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.

When staking out roads, in addition to the usual translated stakeout reports provided by Trimble Access, the following stakeout reports are available:

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.

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.

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 select an existing folder or create a new one.
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 style sheet. Change the file name and extension as required.

6. If more fields are displayed, complete them.

Reports

You can use the XSLT style sheets 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 ASCII File Generator utility to create the report from the exported JobXML file, using the required XSLT style sheet as the output format. To download the utility, go to [Trimble Access Downloads](#) and click **Trimble File and Report Generator Utility**.

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