# Leica TS03/TS07

Tunnel App
**Version 1.0**
**English**

- when it has to be **right**

Leica Geosystems

# Introduction

☞ To use the product in a permitted manner, please refer to the detailed safety directions in the available User Manual.

**Trademarks**

- Windows is a registered trademark of Microsoft Corporation in the United States and other countries
- *Bluetooth*® is a registered trademark of Bluetooth SIG, Inc.

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**Validity of this manual**

This manual applies to the Tunnel app of FlexField running on the TS03/TS07. The app allows measuring and staking of tunnels.

**Symbols**

The symbols used in this manual have the following meanings:

| Type | Description |
|---|---|
| ☞ | Important paragraphs which must be adhered to in practice as they enable the product to be used in a technically correct and efficient manner. |

**Leica Geosystems address book**

On the last page of this manual, you can find the address of Leica Geosystems headquarters. For a list of regional contacts, please visit **http://leica-geosystems.com/contact-us/sales_support**.

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|---|---|
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| --- | --- |
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# 1 Overview

## 1.1 Functions

**Description**

The Tunnel app is an onboard software program for tunnel measurements on TS03/TS07 instruments.

**Functions**

- Data management
  Data are, for example, control points, horizontal alignment, vertical alignment and design sections. Data must be saved on the instrument. After inputting the data, they can be verified.
- Stake measurements
  Check cut and fill, stakeout cross sections, measure cross sections, stakeout and profile scan
- Browse and delete the measurement results
- Data transfer
  Upload of original data and download of stakeout measurement results for the horizontal and vertical alignment

**Features**

- Data input on the instrument or data upload from PC software
- Input of all data of the horizontal alignment at once.
- Input of multiple design sections into one measurement
- Support of various data output formats

**Data capacity**

| Type | Known points | Measurement points |
|---|---|---|
| TS03/TS07 | ≤ 100000 | ≤ 60000 |

☞ The program can be trialled 15 times. After 15 trials, it is necessary to enter the licence code.

## 1.2 Common Keys and Terms

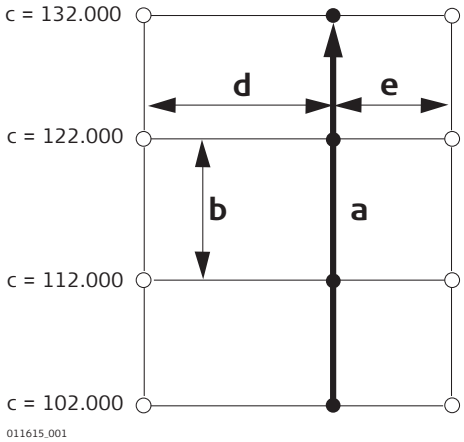
**Common key functions**

| Key | Description |
|---|---|
| | **ESC** key. Quits a screen or edit mode without saving changes. Returns to next higher level.<br><br>Pressing **ESC** short: Returns to next higher level. Quits a screen or edit mode without saving changes.<br><br>Pressing **ESC** long: Returns to the **Main Menu**. Quits a screen or edit mode without saving changes. |
| **Exit** | To exit the screen or program. |
| **OK** or **Yes** | To exit the screen or program. |
| **Exit** or **No** | To cancel the current operation. |

**Common terms**

| Term | Description |
|---|---|
| Direction | Forward direction of the tunnel centreline. The chainage of the centreline increases in this forward direction. |

| Term | Description |
|---|---|
| Right | On the right side of the centreline when looking in the direction of increasing chainage.<br>Values are positive. |
| Left | On the left side of the centreline when looking in the direction of increasing chainage.<br>Values are negative. |




a Centrline
b Increment
c Chainage
d Left of centreline
e Right of centreline

# 2 Defining the Road

## 2.1 Overview

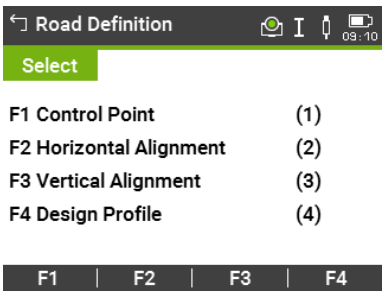
**Description**

**Road Definition** is used to browse and edit the known data, including the control point, horizontal alignment, vertical alignment and cross sections.

☞ Import horizontal alignments, vertical alignments or cross sections from an USB stick or an SD card.

**Access**

1. Select **Apps** from the **Main Menu**.
2. Select **Tunnel** from the **Programs Menu**.
3. Complete app pre-settings.
4. In **Road Definition**, select **Road Definition**.




## 2.2 Control Point

☞ Upload control point data to the instrument using an USB stick or an SD card.

**Description**

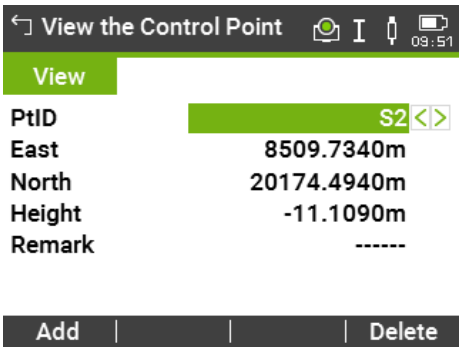
Control points including various levels of known plane points are used to set the station and the orientation.

**Access**

Select **F1 Control Point** in **Road Definition**.

**View the Control Point**

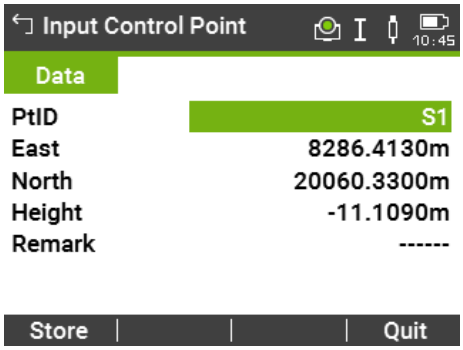
To browse and delete existing control point.




| Key | Description |
|---|---|
| **Add** | To enter a new control point. The **Input Control Point** screen opens. |

| Key | Description |
|---|---|
| **Delete** | To delete the displayed control point. |

**Input Control Point**




| Key | Description |
|---|---|
| **Store** | To store the data.<br>☞ Check the data carefully in the **View the Control Point** screen. |

**Description of fields**

| Field | Option | Description |
|---|---|---|
| **PtID** | Editable field | Point ID of the point. Input is mandatory. * is not allowed as part of the point ID. |
| **East** | Editable field | Easting coordinate of the point. |
| **North** | Editable field | Northing coordinate of the point. |
| **Height** | Editable field | Height coordinate of the point. |
| **Remark** | Editable field | This text is stored with the coordinates. |

## 2.3 Horizontal Alignment

☞ Import horizontal alignments using an USB stick or an SD card.

**Horizontal Alignment**

The horizontal alignment defines the road axis of a project. Horizontal alignments are comprised of the elements:

- straights (tangents)
- curves (arcs)
- spirals (clothoid or cubic parabola)

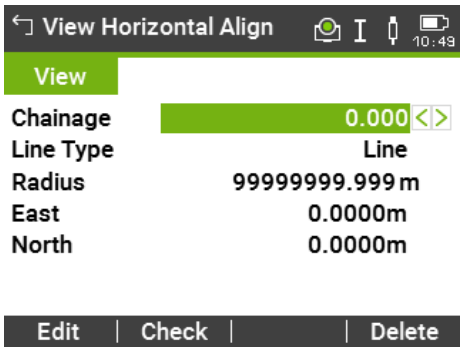
Each element involved is defined by individual horizontal design elements such as chainage, Easting, Northing, radius and parameter A.

**Access**

Select **F2 Horizontal Alignment** in **Road Definition**.

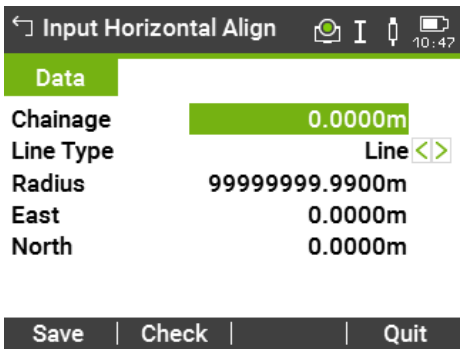
**View Horizontal Align**

To browse and delete existing elements of the horizontal alignments.

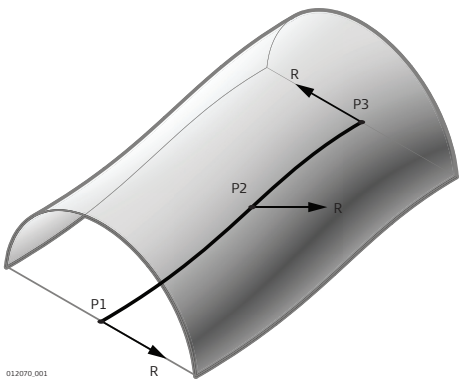



| Key | Description |
|---|---|
| **Add** | To add a new horizontal alignment. The **Input Horizontal Align** screen opens. |
| **Check** | To check the horizontal alignment for smoothness or errors. The **Horizontal Alig. Check Res.** screen opens. The duration of checking depends on the number of elements in the horizontal alignment. To correct an error, select the element, then press **Add** and correct the current data. |
| **Delete** | To delete the selected element from the horizontal alignment. |

**Input Horizontal Align**




| Key | Description |
|---|---|
| **Save** | To save the displayed values. |
| **Check** | To check the horizontal alignment for smoothness or errors. |




P1 Start point
P2 Point along the centreline
P3 End point
R Radius of the curve

**Description of fields**

| Field | Option | Description |
|---|---|---|
| **Chainage** | Editable field | The chainage along the centreline where the new element is added.<br>☞ Entering elements following the increasing chainage simplifies the checking procedure.<br>☞ Checking, measuring or staking require at least two valid elements.<br>☞ The maximum chainage is 4294000.000 m = K4294 +000.000 m. |
| **Line Type** | **Line**, **Curve** or **Clothoid** or **End Point** | The line style of the alignment before the new element. |
| **Radius** | Editable field | The radius of the curve. When the radius of the curve is infinite, enter 99999999.999 or -99999999.999.<br>• Positive radius = Right-handed arcs<br>• Negative radius = Left-handed arcs |
| **East** | Editable field | The Easting coordinate of the element. |
| **North** | Editable field | The Northing coordinate of the element. |

Required radius entries depending on the selected line type:

| Line Type | Radius |
|---|---|
| Start point | ±99999999.999 or ±R |
| Curve | ±R (radius of curve) |
| Clothoid | ±R (radius of curve) |
| Line | 99999999.999 |
| End point | ±99999999.999 or ±R |

## 2.4 Vertical Alignment

☞ Import vertical alignments using an USB stick or an SD card.

**Vertical alignment**

The vertical alignment gives information about the pattern of heights of the road axis as it is defined in the horizontal alignment.

A vertical alignment is comprised of the elements:

- tangents (straight segments)
- curves
- parabolas.

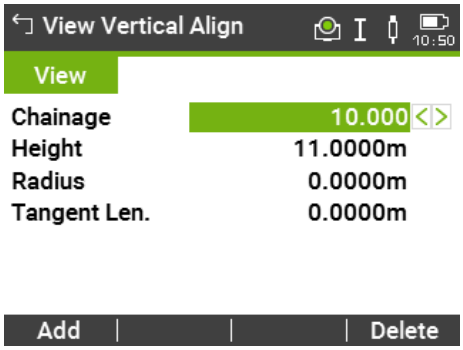
Each element involved is defined by individual vertical design elements such as chainage, Easting, Northing, radius and parameter P.

**Access**

Select **F3 Vertical Alignment** in **Road Definition**.

## View Vertical Align

To browse and delete existing elements of the vertical alignments.

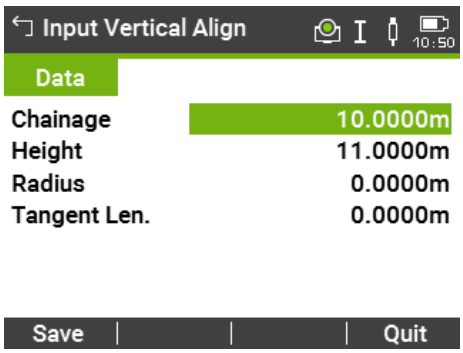



| Key | Description |
|---|---|
| **Add** | To add a new vertical alignment. The **Input Vertical Align** screen opens. |
| **Delete** | To delete the selected element from the vertical alignment. |

## Input Vertical Align

The vertical alignment is defined by **P**oints of **V**ertical **I**ntersection. PVIs are tangent or geometrical points.

- Vertical alignments with symmetrical curves are defined by the PVI chainage, the elevation of PVI and the total length of curve, where the tangent length is half the total length of the VC.
- Vertical Alignments with non-symmetrical curves are defined by the PVI chainage, the elevation of the PVI and both tangent lengths.

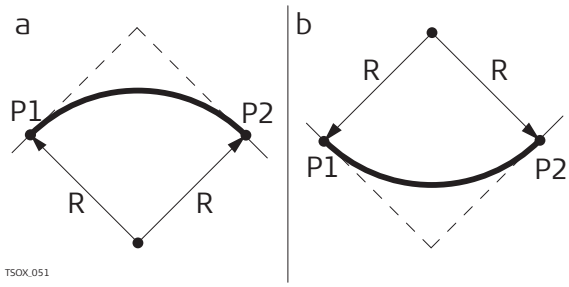



| Key | Description |
|---|---|
| **Save** | To save the displayed values. |

### Description of fields

| Field | Option | Description |
|---|---|---|
| **Chainage** | Editable field | The chainage along the centreline where the new element is added. |

☞ Entering PVIs following the increasing milage simplifies the checking procedure.

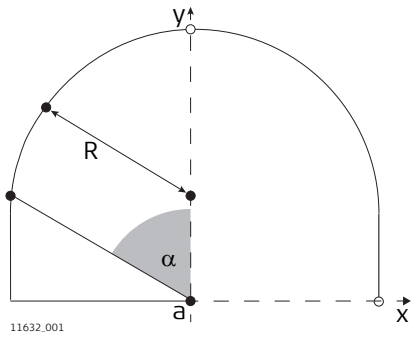
| Field | Option | Description |
|---|---|---|
| | | ☞ Start point and end point of the vertical alignment must be located at the straight slope segment of the vertical curve. The corresponding tangent length and radius is 0.000.<br>☞ Checking, measuring or staking require at least two valid PVIs.<br>☞ The maximum milage is 4294000.000 m = K4294 +000.000 m. |
| **Height** | Editable field | Elevation of the new PVI. |
| **Radius** | Editable field | The vertical curve radius of the PVI.<br>• Positive radius = Convex curves<br>• Negative radius = Concave curves<br>  <br><br>a Convex<br>b Concave<br>P1 Start point<br>P2 End point<br>R Radius |
| **Tangent Len.** | Editable field | Length of the straight element as slope distance. |

## 2.5 Design Profile

☞ Import design profiles using an USB stick or an SD card.

**Design profile**

The design profile is a set of data describing and determining the contour of the tunnel.

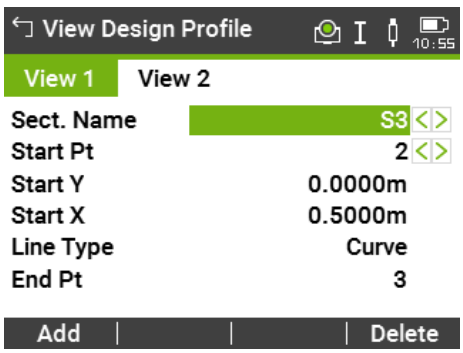



a Centreline
R Radius
x X axis of local coordinate system
y Y axis of local coordinate system
α Centre angle

**Access**

Select **F4 Design Profile** in **Road Definition**.

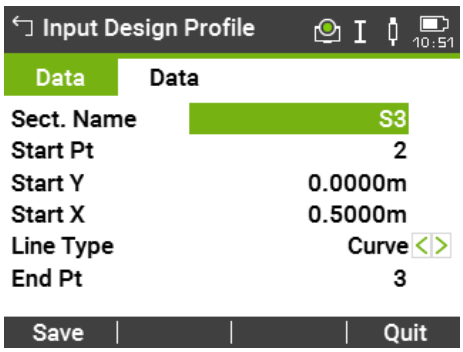
**View Design Profile**




| Key | Description |
|---|---|
| **Add** | To add a new design section. The **Input Design Profile** screen opens. |
| **Delete** | To delete the selected design section. |

**Input Design Profile**

Enter lines and arcs in of clockwise direction.




| Key | Description |
|---|---|
| **Save** | To save the displayed values. |

**Description of fields**

| Field | Option | Description |
|---|---|---|
| **Sect. Name** | Editable field | The name of the design profile. |
| **Start Pt** | Editable field | The point ID where the design profile starts. |

| Field | Option | Description |
|---|---|---|
| **Start Y** | Editable field | The Y coordinate of the start point in the local coordinate system. |
| **Start X** | Editable field | The X coordinate of the start point in the local coordinate system. |
| **Line Type** | **Line** or **Curve** | The line style of the profile. Available are: **Line** and **Sect. Name**. |
| **End Pt** | Editable field | The point ID where the design profile ends. |
| **End Y** | Editable field | The Y coordinate of the end point in the local coordinate system. |
| **End X** | Editable field | The X coordinate of the end point in the local coordinate system. |
| **Cent.Angle** | Editable field | Centre value of the arc section in radians |
| **Radius** | Editable field | The radius of the tunnel design. |

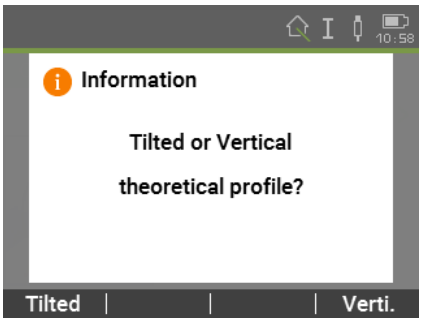
# 3 Staking Out

## 3.1 Accessing Stakeout

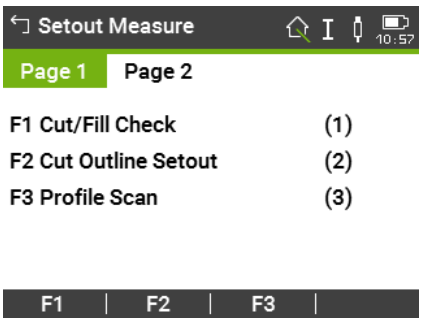
**Description**

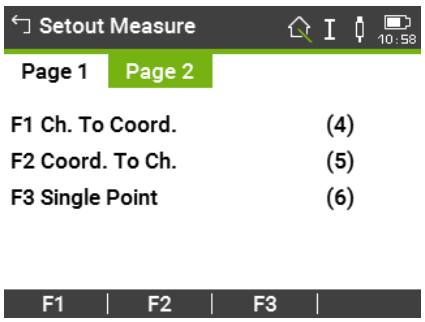
**Setout Measure** is used to check cut/fill, stake cut outlines and to scan profiles.

**Access**

1. Select **Apps** from the **Main Menu**.
2. Select **Tunnel** from the **Programs Menu**.
3. Complete app pre-settings.
4. In **Tunnel**, select **Setout Measure**.
5. 


| | |
|---|---|
| **Tilted** | The mileage of cut/fill check will consider the influence of line longitudinal. |
| **Verti.** | Does not consider the influence of line longitudinal. Under normal circumstances. Select for standard applications. |

6. 




| | |
|---|---|
| **Page 1**<br>**F1 Cut/Fill Check** | To verify required cut and fill. |
| **F2 Cut Outline Setout** | To define the outline of the stakeout. |
| **F3 Profile Scan** | To measure cross sections of stations and non-stations along the profile. |

| | |
|---|---|
| **Page 2**<br>**F1 Ch. To Coord.** | To convert the chainage, offset from the centreline and elevation from the centreline into coordinates. |
| **F2 Coord. To Ch.** | To convert the coordinates of a point of the centreline into chainage, offset from the centreline and elevation from the centreline. |
| **F3 Single Point** | To stakeout individual points based on chainage, offset from the centreline and elevation from the centreline. |

## 3.2 Checking Cut and Fill

**Access**

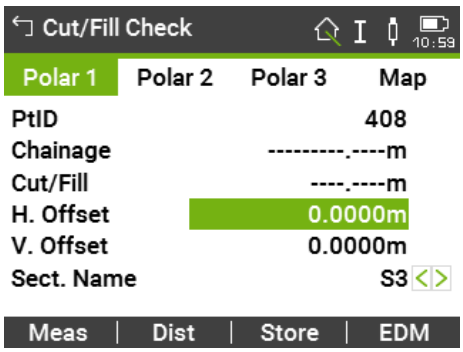
1. Select **F1 Cut/Fill Check** in **Setout Measure**.

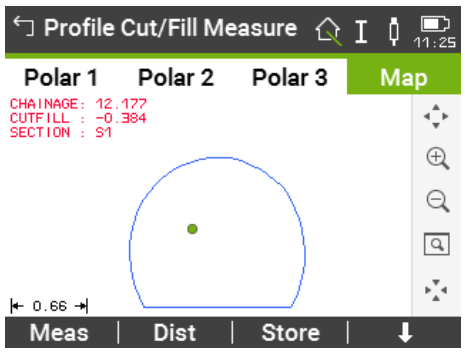
**Cut/Fill Check**

To verify required cut and fill.

☞ **EDM Mode**: **Non-Prism** must be used.

The map is an interactive display feature embedded in the firmware. The map provides a graphical display of the survey elements which allows for a better overall understanding of how the data being used and measured relates to each other. Refer to the Leica TS03/TS07 User Manual for more information.




| Field | Option | Description |
|---|---|---|
| **PtID** | Editable field | Point ID of the point. |
| **Chainage** | Display only | Selected chainage to measure. |
| **Cut/Fill** | Display only | The amount for cut or fill.<br>• Positive value = Fill/overbreak<br>• Negative value = Cut/underbreak |
| **H. Offset** | Editable field | Perpendicular offset.<br>• Positive value = Cut/fill point is to the right<br>• Negative value = Cut/fill point is to the left |
| **V. Offset** | Editable field | Height offset.<br>• Positive value = Cut/fill point is higher<br>• Negative value = Cut/fill point is lower |

| Field | Option | Description |
|---|---|---|
| **Sect. Name** | Selectable list | Section name of corresponding measured position. |
| **Ele. Offset** | Display only | The difference in height between design elevation and measured elevation.<br>• Positive value = Measured point is higher than design<br>• Negative value = Measured point is lower than design |
| **CtrLine Off.** | Display only | The offset value from the measured centerline and the design.<br>• Positive value = Point is located on the right side<br>• Negative value = Point is located on the left side |

## 3.3 Cut Outline Stakeout

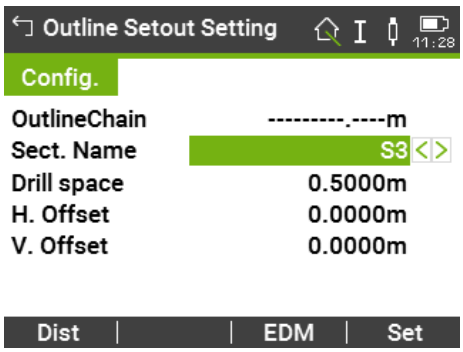
**Access**

Select **F2 Cut Outline Setout** in **Setout Measure**.

**Outline Setout Setting**

To define the outline of the stakeout.

☞ Some settings must be defined before staking out cross section, including section name, drill hole spacing and tunnel heading mileage.

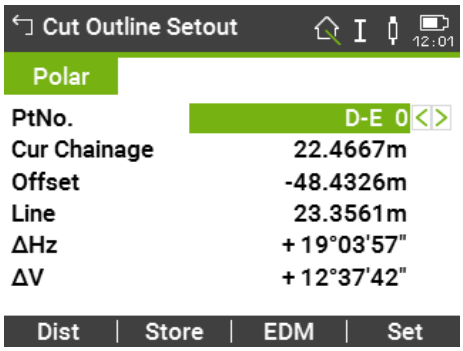



| Key | Description |
|---|---|
| **Set** | To enter the **Outline Setout Setting** screen. |

**Description of fields**

| Field | Option | Description |
|---|---|---|
| **Outline-Chain** | Display only | Current working face of the chainge. The value is calculated from the inverse computed distance. Target at the working face, press **Set**. The program automatically calculates this value. |
| **Sect. Name** | Selectable list | The name of the corresponding section of current working face. |
| **Drill space** | Editable field | The distance between adjacent drill hole. |

## Cut Outline Setout




### Description of fields

| Field | Option | Description |
|---|---|---|
| **PtNo.** | Selectable list | The point to be staked.<br>The point ID is a combination of section name and drill hole spacing defined in **Cut Outline Setout**. Example: AB 0 is the first point of the line AB of the design section, AB 1 is the second point of the line AB of the design section. |
| **Cur Chainage** | Display only | The chainage along the centreline where the point is staked. |
| **Offset** | Display only | Horizontal offset. The deviation in x-axis direction between the measured point and the stakeout point of the design section.<br>• Positive value = Stake out point is to the right of the measured point<br>• Negative value = Stake out point is to the left of the measured point |
| **Line** | Display only | Arc distance between the measured point and the stakeout point |
| **ΔV** | Display only | Height offset. The deviation in y-axis direction between the measured point and the stakeout point of the design section.<br>• Positive value = Stake out point is higher than the measured point<br>• Negative value = Stake out point is lower than the measured point |
| **ΔHz** | Display only | Angle offset. Horizontal angle difference between the measured point and the stakeout point of the design section.<br>• Positive value = Stake out point is to the right of the measured point<br>• Negative value = Stake out point is to the left of the measured point |

## Outline stakeout step-by-step

| | |
|---|---|
| 1. | Select the point to be staked. |
| 2. | Rotate the telescope according to the horizontal and vertical angle deviation. |
| 3. | Press **Meas Pt** to calculate the deviation of the current point. |

4. Repeat step 2. and 3. until the accuracy requirements are met.

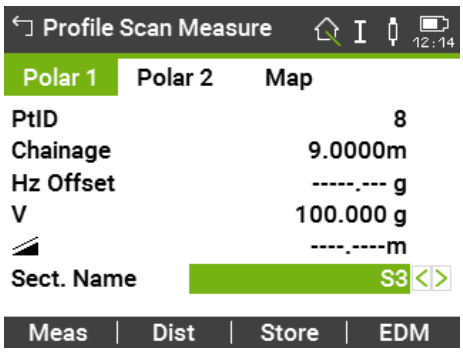
## 3.4 Profile Scan

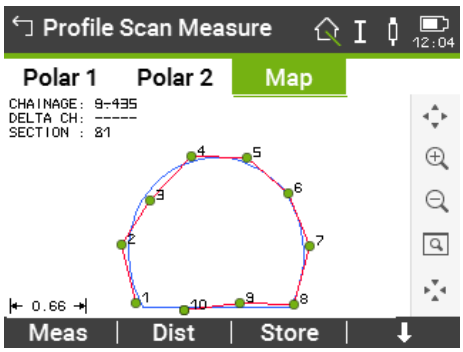
**Access**

Select **F3 Profile Scan** in **Setout Measure**.

**Profile Scan Measure**

To measure cross sections on defined chainages along the tunnel alignment.




**Description of fields**

| Field | Option | Description |
|---|---|---|
| **PtID** | Editable field | The point ID of the point. |
| **Chainage** | Editable field | Selected chainage to measure. |
| **Hz Offset** | Display only | Longitudinal offset.<br>• Positive value = Design point is further away than the measured point.<br>• Negative value = Design point is closer than the measured point. |
| **V** | Display only | Vertical angle to the station on the cross section. |
| ◢ | Display only | Slope distance to the point. |
| **Sect. Name** | Selectable list | Section name of corresponding measured position. |
| **North** | Display only | Northing coordinate of the point. |
| **East** | Display only | Easting coordinate of the point. |
| **Height** | Display only | Height coordinate of the point. |

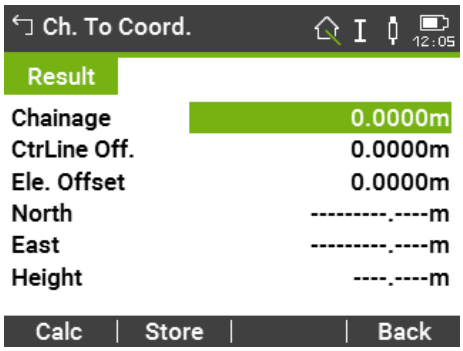
## 3.5 Chainage to Coordinates

**Access**

Select **F1 Ch. To Coord.** in **Setout Measure**.

**Ch. To Coord.**

To convert the chainage, offset from the centreline and elevation from the centreline into coordinates.




| Key | Description |
|---|---|
| **Calc** | To compute coordinates from the values entered. |
| **Store** | To save the results. |
| **Back** | To return to **Setout Measure**. |

**Description of fields**

| Field | Option | Description |
|---|---|---|
| **Chainage** | Editable field | The chainage at which the point of the centreline must be converted into coordinates. |
| **CtrLine Off.** | Editable field | The offset of the centreline of which point coordinates must be computed.<br>• Positive value = Offset to the right<br>• Negative value = Offset to the left |
| **Ele. Offset** | Editable field | The height offset of the centreline of which point coordinates must be computed.<br>• Positive value = Higher<br>• Negative value = Lower |
| **East** | Display only | Easting coordinate of the point in the local coordinate system. |
| **North** | Display only | Northing coordinate of the point in the local coordinate system. |
| **Height** | Display only | Height coordinate of the point in the local coordinate system. |

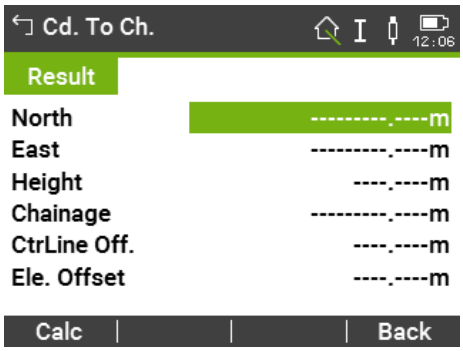
## 3.6 Coordinates to Chainage

**Access**

Select **F2 Coord. To Ch.** in **Setout Measure**.

**Cd. To Ch.**

To convert the coordinates of a point of the centreline into chainage, offset from the centreline and elevation from the centreline.




| Key | Description |
|---|---|
| **Calc** | To compute a chainage from the values entered. |
| **Back** | To return to **Setout Measure**. |

**Description of fields**

| Field | Option | Description |
|---|---|---|
| **East** | Editable field | Easting coordinate of the point in the local coordinate system. |
| **North** | Editable field | Northing coordinate of the point in the local coordinate system. |
| **Height** | Editable field | Height coordinate of the point in the local coordinate system. |
| **Chainage** | Display only | The chainage at the centreline computed from the coordinates entered. |
| **CtrLine Off.** | Display only | The offset from the centreline computed from the coordinates entered.<br>• Positive value = Offset to the right<br>• Negative value = Offset to the left |
| **Ele. Offset** | Display only | The height offset from the centreline computed from the coordinates entered..<br>• Positive value = Higher<br>• Negative value = Lower |

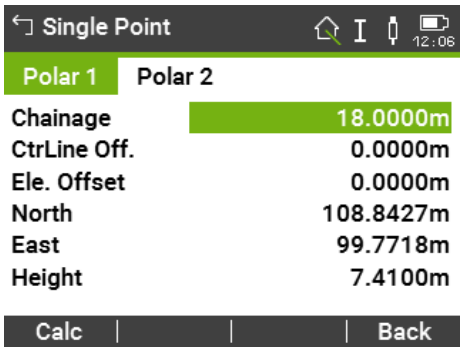
## 3.7 Single Point Stakeout

**Access**

Select **F3 Single Point** in **Setout Measure**.

**Single Point**

To stakeout individual points based on chainage, offset from the centreline and elevation from the centreline.




| Key | Description |
|---|---|
| **Calc** | To compute coordinates from the values entered. |
| **Back** | To return to **Setout Measure**. |
| **Meas Pt** | To stake the point. |

**Description of fields**

| Field | Option | Description |
|---|---|---|
| **Chainage** | Editable field | The chainage at which a point must be staked. |
| **CtrLine Off.** | Editable field | The offset of the stakeout point from the centreline.<br>• Positive value = Offset to the right<br>• Negative value = Offset to the left |
| **Ele. Offset** | Editable field | The height offset of the stakeout point from the centreline.<br>• Positive value = Higher<br>• Negative value = Lower |
| **East** | Display only | Easting coordinate of the point in the local coordinate system. |
| **North** | Display only | Northing coordinate of the point in the local coordinate system. |
| **Height** | Display only | Height coordinate of the point in the local coordinate system. |
| **PtID** | Display only | The point number of the stakeout point. |
| **hr** | Editable field | Height of the reflector. |
| **Hz Offset** | Display only | Angle offset.<br>• Positive value = Stake out point is to the right of the measured point<br>• Negative value = Stake out point is to the left of the measured point |
| **Back** | Display only | Distance offset between measured point and stakeout point seen in the direction of the telescope.<br>• Positive value = Stake out point is further away from the instrument<br>• Negative value = Stake out point is closer to the instrument |

| Field | Option | Description |
|---|---|---|
| **Left** | Display only | Distance offset between measured point and stakeout point in the orthogonal direction to the telescope.<br>• Positive value = Stake out point is further left<br>• Negative value = Stake out point is further right |
| **Cut/Fill** | Display only | Height offset<br>• Positive value = Stake out point is higher than the measured point<br>• Negative value = Stake out point is lower than the measured point |

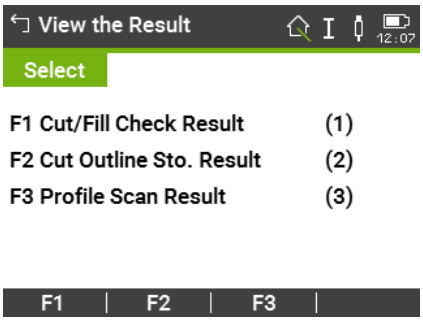
# 4 Viewing Results

**Description**

**Result View** is used to browse the results of **F1 Cut/Fill Check Result**, **F2 Cut Outline Sto. Result**, **F3 Profile Scan Result**.

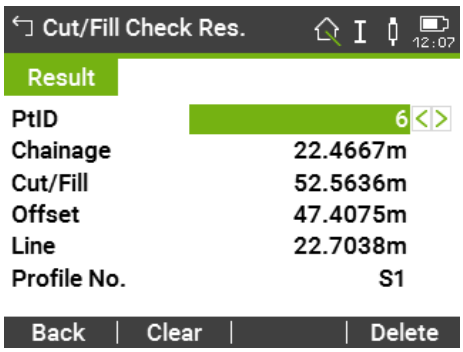
The results can only be viewed and deleted. Editing is not allowed.

**Access**

1. Select **Apps** from the **Main Menu**.
2. Select **Tunnel** from the **Programs Menu**.
3. Complete app pre-settings.
4. In **Tunnel**, select **Result View**.
5. 


| | |
|---|---|
| **F1 Cut/Fill Check Result** | To view results from " Cut/Fill Check Res.". |
| **F2 Cut Outline Sto. Result** | To view results from " Outline Setout Res.". |
| **F3 Profile Scan Result** | To view results from " Profile Measure Res.". |

**Cut/Fill Check Res.**

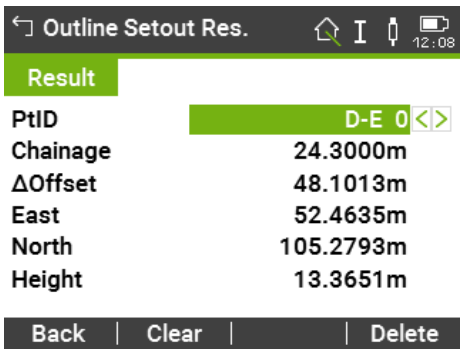



| Key | Description |
|---|---|
| **Back** | To return to **View the Result**. |
| **Clear** | To delete all results of **F1 Cut/Fill Check Result** from the selected job. |
| **Delete** | To delete the displayed result. |

**Description of fields**

| Field | Option | Description |
|---|---|---|
| **PtID** | Selectable list | Point ID of the point. |
| **Chainage** | Display only | Chainage at which the measurements were taken. |
| **Cut/Fill** | Display only | The amount for cut or fill.<br>• Positive value = Fill/overbreak<br>• Negative value = Cut/underbreak |
| **Offset** | Display only | Perpendicular offset.<br>• Positive value = Cut/fill point is to the right<br>• Negative value = Cut/fill point is to the left |
| **Line** | Display only | The offset value from the measured centre-line and the design.<br>• Positive value = Point is located on the right side<br>• Negative value = Point is located on the left side |
| **Profile No.** | Display only | The number of the measured profile. |

**Outline Setout Res.**



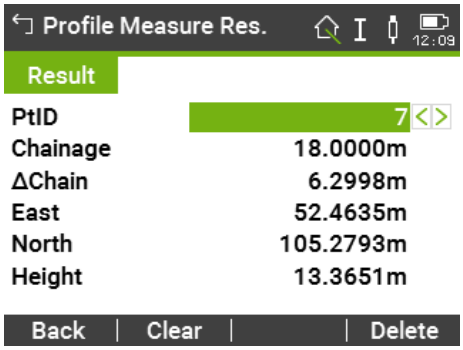

| Key | Description |
|---|---|
| **Back** | To return to **View the Result**. |
| **Clear** | To delete all results of **F2 Cut Outline Sto. Result** from the selected job. |
| **Delete** | To delete the displayed result. |

**Description of fields**

| Field | Option | Description |
|---|---|---|
| **PtID** | Selectable list | Point ID of the point. |
| **Chainage** | Display only | Chainage at which the measurements were taken. |
| **ΔOffset** | Display only | Total difference in East, North and Height between staked point and design corrdi-nates. |
| **North** | Display only | Northing coordinate of the staked point. |
| **East** | Display only | Easting coordinate of the staked point. |

| Field | Option | Description |
|---|---|---|
| **Height** | Display only | Height coordinate of the staked point. |

**Profile Measure Res.**




| Key | Description |
|---|---|
| **Back** | To return to **View the Result**. |
| **Clear** | To delete all results of **F3 Profile Scan Result** from the selected job. |
| **Delete** | To delete the displayed result. |

**Description of fields**

| Field | Option | Description |
|---|---|---|
| **PtID** | Selectable list | Point ID of the point. |
| **Chainage** | Display only | Chainage at which the measurements were taken. |
| **ΔChain** | Display only | Total difference in East, North and Height between measured point and chainage corr-dinates. |
| **North** | Display only | Northing coordinate of the measured point. |
| **East** | Display only | Easting coordinate of the measured point. |
| **Height** | Display only | Height coordinate of the measured point. |

# 5 Data Transfer

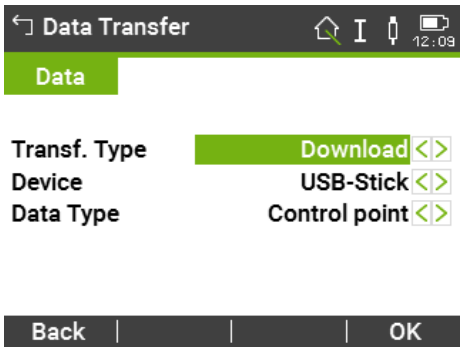
**Description**

**Data Transfer** is used to upload or download the tunnel definition and stake-out results using the USB stick.

**Access**

1. Select **Apps** from the **Main Menu**.
2. Select **Tunnel** from the **Programs Menu**.
3. Complete app pre-settings.
4. In **Tunnel**, select **Data Transfer**.

**Data Transfer**




| Key | Description |
|---|---|
| **Back** | To return to **View the Result**. |
| **OK** | To transfer the data. |

**Description of fields**

| Field | Option | Description |
|---|---|---|
| **Transf. Type** | **Download** or **Upload** ☞ | For an upload from the USB stick: Create a folder called TUNNEL on the USB stick. All files must be called Tunnel. *. For example a flat curve file must be called Tunnel.HLN. |
| **Device** | **USB-Stick** or **SD Card** | The medium used for the data transfer. |
| **Data Type** | | Data type to be transferred. |
| | **Control point** | For upload and download<br>Control points of the tunnel |
| | **Horizon. align.** | For upload and download<br>Horizontal alignment for the tunnel |
| | **Vertical align.** | For upload and download<br>Vertical alignment for the tunnel |
| | **Design Profile** | For upload and download<br>Design profile of the tunnel |
| | **Cut/Fill ChkRes** | For download<br>Cut or fill check results |

| Field | Option | Description |
|---|---|---|
| | **Outline Stk Res** | For download<br>Stakeout results from the tunnel outline |
| | **Profile ScanRes** | For download<br>Measured cross sections of stations and non-stations along the profile. |

# 6 Post-Processing

## 6.1 Working with Tunnel Office

**Installation on a computer**

Tunnel Office is available for download in myWorld for customers who have purchased the onboard Tunnel app.

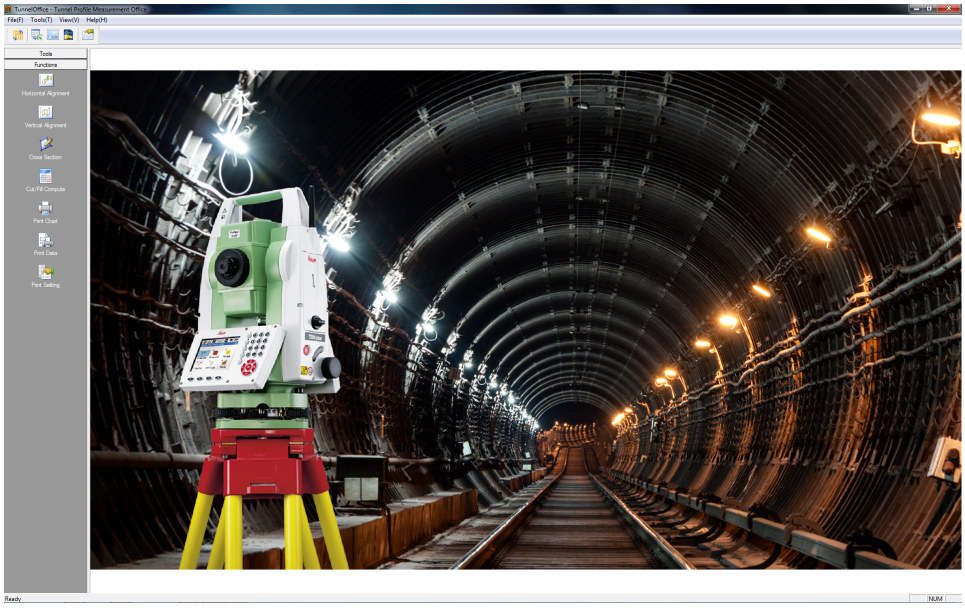
Tunnel Office can be installed on computers with MS Windows XP, Vista and Windows 7/8/10 operating systems.

1. Double click the TunnelOffice.exe.
2. Follow the on-screen instructions.

**Description**

Tunnel Office is used to:

- Define and view a horizontal alignment design
- Define and view a vertical alignment design
- Define and view a cross section design
- Print out graphics and data




## 6.2 Menu Bar

**File**

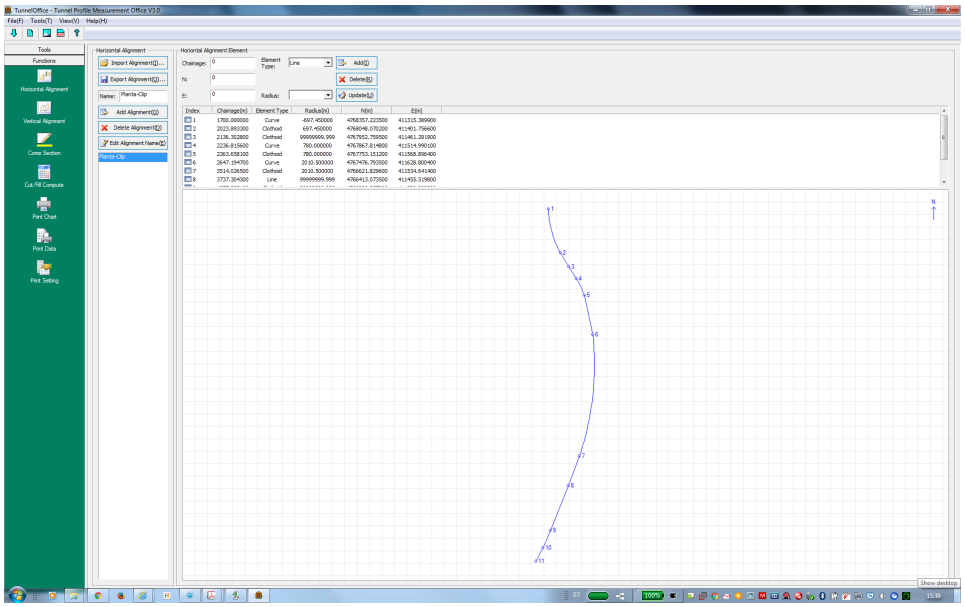
Options:

- Print the tunnel cross section chart and data.
- Export the tunnel cross section data as Excel file.
- Export the tunnel cross section chart as image.
- Export the tunnel cross section data as dxf file.

## 6.3 Functions

**Horizontal Alignment**

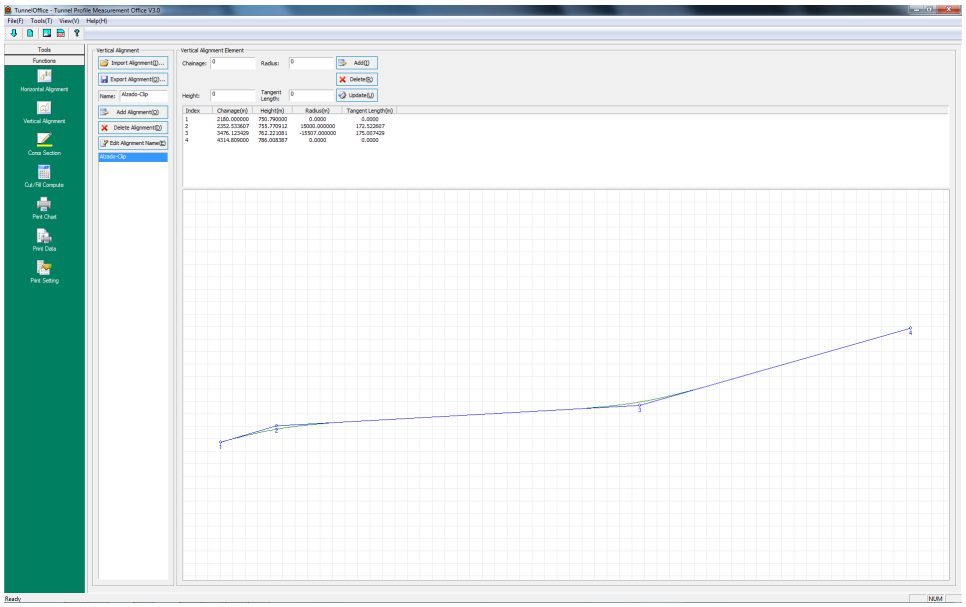
A horizontal alignment is a set of data defining the top view design of the centreline.

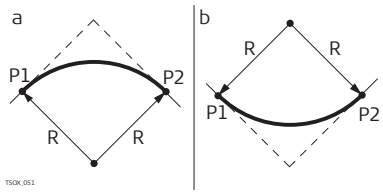


| Button or field | Description |
|---|---|
| **Horizontal Alignment** | |
| **Import Alignment** | To open an existing alignment. LandXML format is supported. |
| **Export Alignment** | To save the alignment entered in Tunnel Office to a file. |
| **Name** | Name for the alignment<br>• For add new alignment, enter a name and click **Add Alignment**.<br>• To edit the name of an alignment, click on the name in the name box and make the modifications. When finished, click the **Edit Alignment Name**. |
| **Horizontal Alignment Element** | |
| **Chainage** | The chainage along the centreline where the new element is added. |
| **N** | North coordinate of the point at the defined chainage. Characters and spaces are not allowed. |
| **E** | East coordinate of the point at the defined chainage. Characters and spaces are not allowed. |
| **Element Type** | The line style of the alignment before the new element. Available are: **Line**, **Curve**, **Clothoid** and **End**. |
| **Radius** | The radius of the curve or clothoid. Characters and spaces are not allowed.<br>The sign indicates the direction of the curve or clothoid looking in the direction of increasing chainage.<br>• For right turn: Select + from the list.<br>• For left turn: Select - from the list.<br>• For a straight: Use no sign in this field. |

## Vertical Alignment

A vertical alignment is a set of data defining the elevation of the centreline.

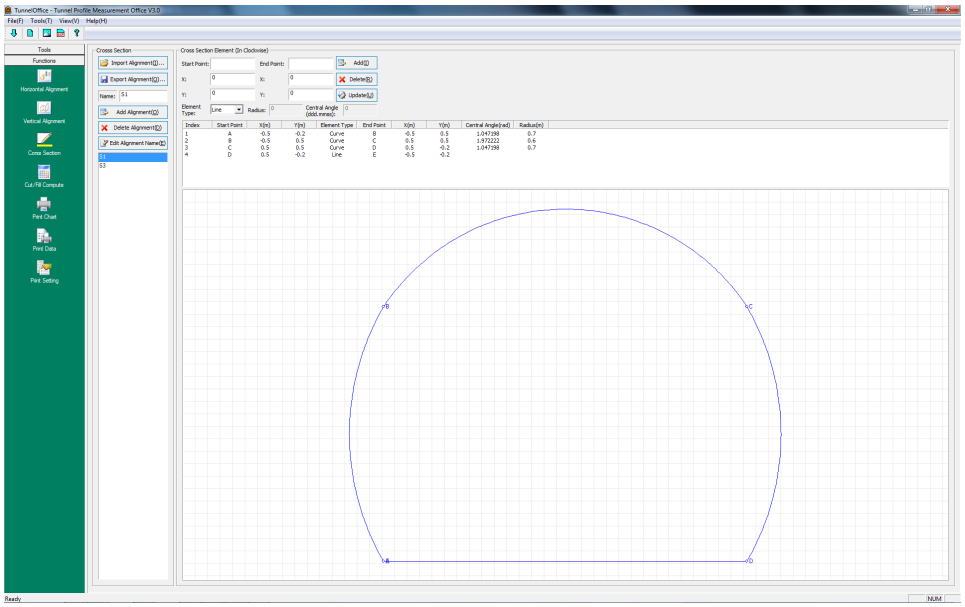


| Button or field | Description |
|---|---|
| **Vertical Alignment** | |
| **Import Alignment** | To open an existing alignment. LandXML format is supported. |
| **Export Alignment** | To save the alignment entered in Tunnel Office to a file. |
| **Name** | Name for the alignment<br>• For add new alignment, enter a name and click **Add Alignment**.<br>• To edit the name of an alignment, click on the name in the name box and make the modifications. When finished, click the **Edit Alignment Name**. |
| **Vertical Alignment Element** | |
| **Chainage** | The chainage along the centreline where the new element is added. |
| **Height** | Elevation at the defined chainage |
| **Radius** | The vertical curve radius of the point.<br>• Positive radius = Convex curves<br>• Negative radius = Concave curves |
| |  <br>a Convex<br>b Concave<br>P1 Start point<br>P2 End point<br>R Radius |
| **Tangent** | Length of the straight element as slope distance.<br>☞ The end of the long straight and radius with tangential slope segment is 0. |

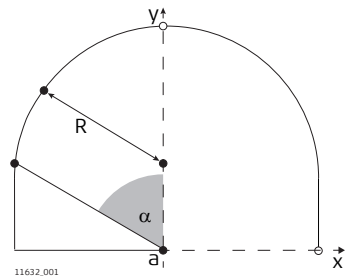
## Cross Section

A cross section is a set of data describing and determining the contour of the tunnel.

When editing cross section data, the plot is updated immediately.

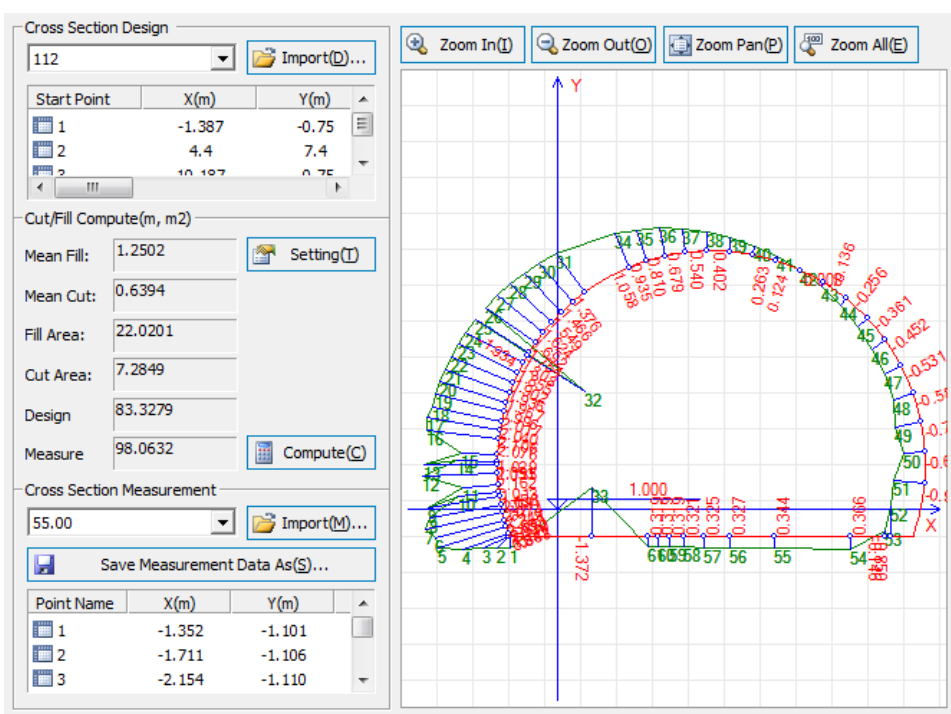


| Button or field | Description |
|---|---|
| **Cross Section** | |
| **Import Alignment** | To open an existing cross section from a LandXML, *.tln or *.dxf file.<br>☞ The units in the *. dxf file must be meters. In the CAD program, draw from the CAD coordinate origin. Start with the line and arc segments at the closed section of tunnel design in clockwise direction. Save in AutoCAD R11/R12 DXF format, with the maximum decimal units precision. Delete all auxiliary lines and check that all the entities are perfectly closed before saving as DXF file.<br>☞ Execute the command specific to your CAD program to remove unused items, for example block definitions and layers. |
| **Export Alignment** | To save the cross section entered in Tunnel Office to a file. |
| **Name** | Name for the cross section<br>• For add new cross section, enter a name and click **Add Alignment**.<br>• To edit the name of a cross section, click on the name in the name box and make the modifications. When finished, click the **Edit Alignment Name**. |
| **Cross Section Element** | |
| | A local coordinate system must be used. Origin is the centerline point at the milage. |

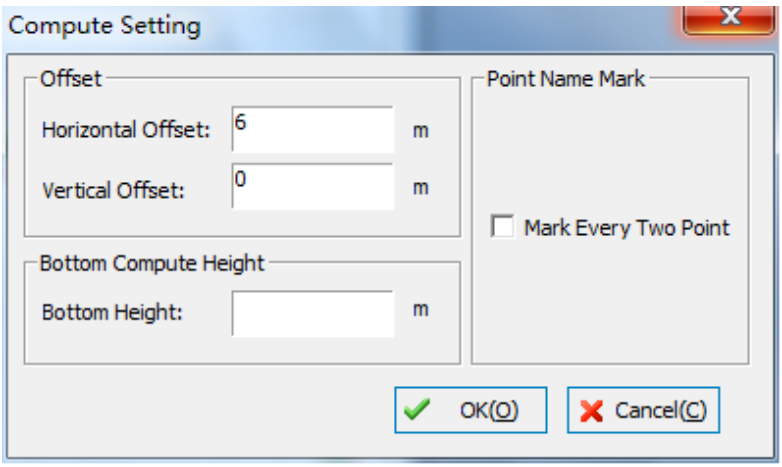
| Button or field | Description |
|---|---|
| |  <br>a Centreline<br>R Radius<br>x X axis of local coordinate system<br>y Y axis of local coordinate system<br>α Centre angle |
| **Start point** | The point ID where the design profile starts. |
| **End point** | The point ID where the design profile ends. |
| **X** | The X coordinate of the start or end point in the local coordinate system. |
| **Y** | The Y coordinate of the start or end point in the local coordinate system. |
| **Element Type** | The line style of the profile. Available are: **Line** and **Curve**. |
| **Radius** | The radius of the tunnel design. |
| **Central angle (ddd.mmss)** | The centre angle α.<br>Enter in degrees.minutessecond. For example: 12°25'36'' = 12.2536<br>In the cross section plot, the angle is shown in radians. |

## Cut/Fill Compute

Calculate the cut and fill as difference between tunnel design and measured data.



| Button or field | Description |
|---|---|
| **Cross Section Design** | |
| **Import** | To open a design cross section. |
| **Cross Section Measurement** | |
| **Import** | To import the *.obs file which includes the measured data downloaded from the instrument.<br>In the drop-down list, select a chainage for the calculations. |
| **Cut/Fill Compute** | |
| **Settings** | Used to offset the measured cross section so that unexcavated part is excluded from the calculation. |




**Offset**

The offset effects the curve position. The tunnel section line has an offest relative to the center line. The tunnel section has a coordinate system relative to the center line.

- Positive offset = Measured cross section right or up
- Negative offset = Measured cross section left or down

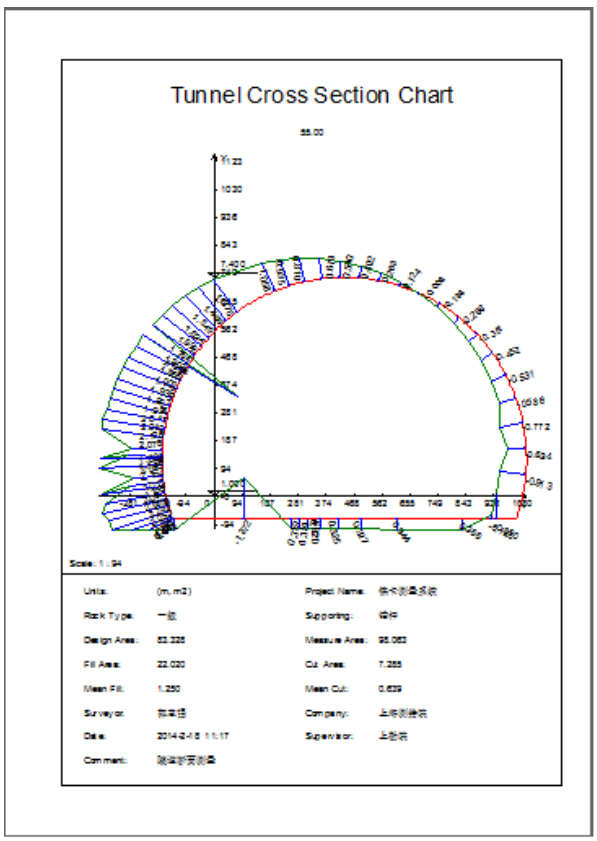
**Point Name Mark**

Used for marking points in the graph. If the measured points are too close to each other, the points overlap in the graph and when printed. Select to mark only every second point.

| Button or field | Description | |
|---|---|---|
| | **Bottom Compute Height** | To analyse the overbreak and to exclude unexcavated parts from the calculation.<br>Enter the lowest elevation relative to the coordinates origin.<br>After the excavation of up steps, enter the lowest elevation, so that excavation sections with lower elevation are not considered. |
| **Save current measurement data** | To save measured data to a selected file. | |
| **Compute** | To analyse and calculate the overbreak. Before a calculation can be done, import the data, select a section and define the calculation settings. | |

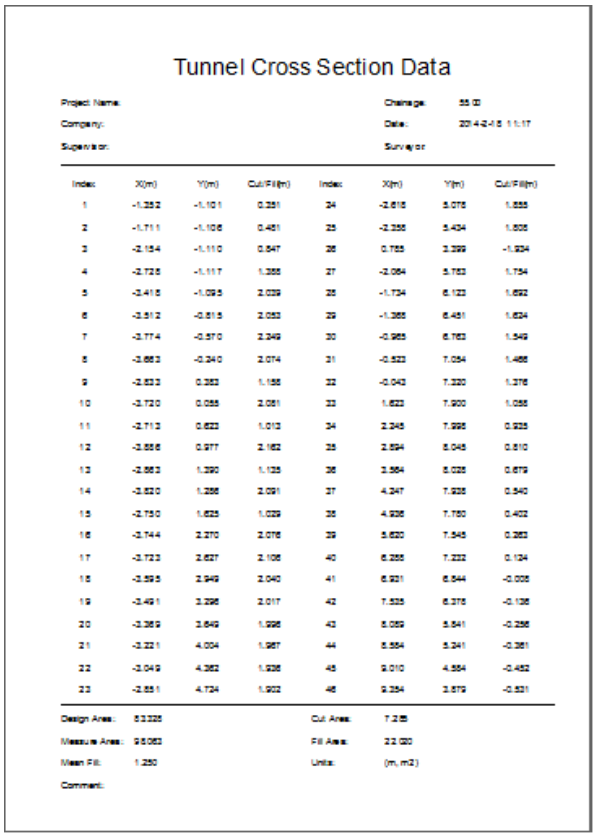
**Print Chart**

To print the graph of the cross section including analysis results.




**Print Data**

To print the data of the cross section as table. The data includes the index with the according local coordinates and the cut/fill.



Tunnel Cross Section Data

Project Name: Chainage: 55.00
Company: Date: 2014-2-15 11:17
Supervisor: Surveyor

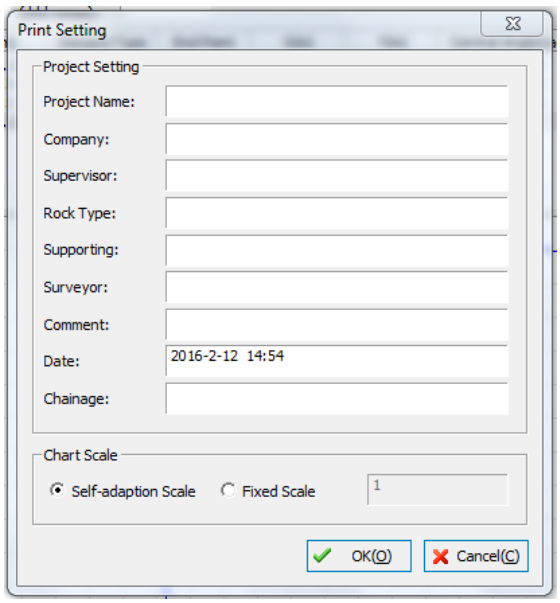
| Index | X(m) | Y(m) | Cut/Fill(m) | Index | X(m) | Y(m) | Cut/Fill(m) |
|---|---|---|---|---|---|---|---|
| 1 | -1.252 | -1.101 | 0.351 | 24 | -2.616 | 5.078 | 1.555 |
| 2 | -1.711 | -1.106 | 0.451 | 25 | -2.355 | 5.434 | 1.505 |
| 3 | -2.154 | -1.110 | 0.547 | 26 | 0.755 | 3.399 | -1.934 |
| 4 | -2.725 | -1.117 | 1.355 | 27 | -2.064 | 5.753 | 1.754 |
| 5 | -3.415 | -1.095 | 2.039 | 28 | -1.734 | 6.123 | 1.692 |
| 6 | -3.512 | -0.815 | 2.053 | 29 | -1.365 | 6.451 | 1.634 |
| 7 | -3.774 | -0.570 | 2.249 | 30 | -0.965 | 6.763 | 1.549 |
| 8 | -3.663 | -0.240 | 2.074 | 31 | -0.523 | 7.054 | 1.466 |
| 9 | -3.533 | 0.353 | 1.158 | 32 | -0.043 | 7.320 | 1.376 |
| 10 | -3.720 | 0.055 | 2.051 | 33 | 1.623 | 7.900 | 1.055 |
| 11 | -3.713 | 0.623 | 1.013 | 34 | 2.345 | 7.995 | 0.935 |
| 12 | -3.556 | 0.977 | 2.162 | 35 | 2.894 | 8.045 | 0.810 |
| 13 | -3.563 | 1.390 | 1.125 | 36 | 3.564 | 8.025 | 0.679 |
| 14 | -3.530 | 1.356 | 2.091 | 37 | 4.347 | 7.935 | 0.540 |
| 15 | -3.750 | 1.625 | 1.029 | 38 | 4.936 | 7.750 | 0.402 |
| 16 | -3.744 | 2.270 | 2.076 | 39 | 5.620 | 7.545 | 0.263 |
| 17 | -3.723 | 2.627 | 2.106 | 40 | 6.355 | 7.222 | 0.124 |
| 18 | -3.595 | 2.949 | 2.040 | 41 | 6.931 | 6.844 | -0.005 |
| 19 | -3.491 | 3.296 | 2.017 | 42 | 7.535 | 6.375 | -0.136 |
| 20 | -3.369 | 3.649 | 1.996 | 43 | 8.059 | 5.841 | -0.256 |
| 21 | -3.221 | 4.004 | 1.987 | 44 | 8.554 | 5.241 | -0.381 |
| 22 | -3.049 | 4.362 | 1.936 | 45 | 9.010 | 4.554 | -0.452 |
| 23 | -2.851 | 4.724 | 1.922 | 46 | 9.354 | 3.879 | -0.531 |

Design Area: 53.325 Cut Area: 7.255
Measure Area: 95.063 Fill Area: 22.020
Mean Fill: 1.250 Units: (m, m2)
Comment:

## Print Settings

Enter project information, for example the project name and rock type. The information is added in the header of graphic prints.

☞ To print data or graph of a specific chainage, enter the chainage in the field **Chainage**.



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- when it has to be **right**