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.

All other trademarks are the property of their respective owners.

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**.

myWorld

myWorld@Leica Geosystems (**https://myworld.leica-geosystems.com**) offers a wide range of services, information and training material.

With direct access to myWorld, you are able to access all relevant services whenever it is convenient for you.

Service	Description
myProducts	Add all products that you and your company own and explore your world of Leica Geosystems: View detailed information on your products and update your products with the latest software and keep up-to-date with the latest documentation.
myService	View the current service status and full service history of your products in Leica Geosystems service centres. Access detailed information on the services performed and download your latest calibration certificates and service reports.
mySupport	Create new support requests for your products that will be answered by your local Leica Geosystems Support Team. View the complete history of your support requests and view detailed information on each request in case you want to refer to previous support requests.
myTraining	Enhance your product knowledge with Leica Geosystems Campus - Information, Knowledge, Training. Study the latest online training material on your products and register for seminars or courses in your country.

Service	Description
myTrustedServices	Add your subscriptions and manage users for Leica Geosystems Trusted Services, the secure software services, that assist you to optimise your workflow and increase your efficiency.

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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

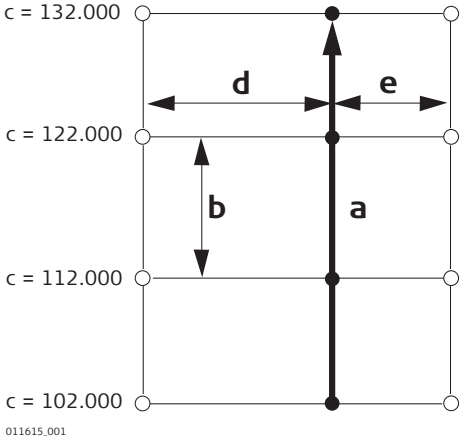
Common key functions

Key	Description
	**ESC** key. Quits a screen or edit mode without saving changes. Returns to next higher level. Pressing **ESC** short: Returns to next higher level. Quits a screen or edit mode without saving changes. 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. Values are positive.
Left	On the left side of the centreline when looking in the direction of increasing chainage. Values are negative.



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

2 Defining the Road

2.1 Overview

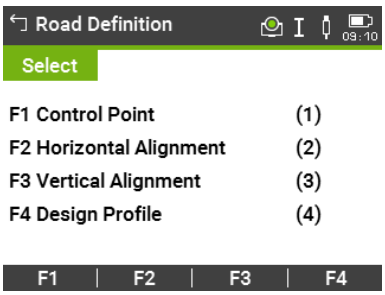
Description

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

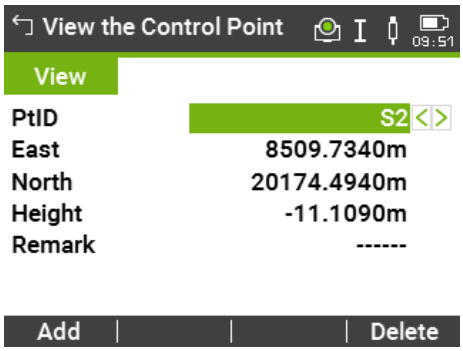
Control points including various levels of known plane points are used to set the station and the orientation.

Access

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

View the Control Point

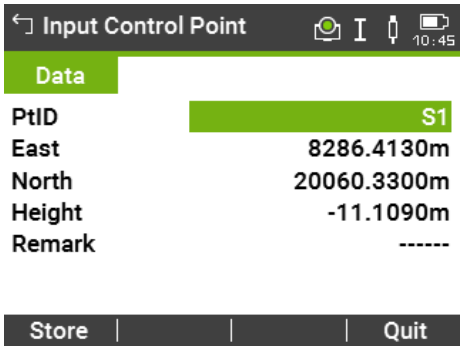
To browse and delete existing control point.



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. ☞ 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)

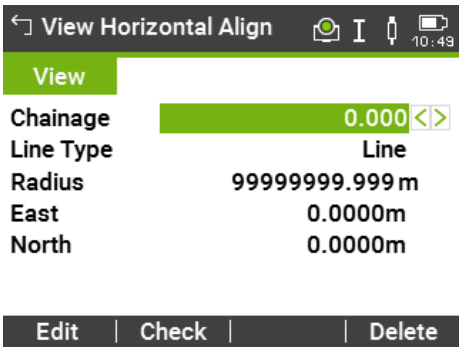
Each element involved is defined by individual horizontal design elements such as chainage, Easting, Northing, radius and parameter A.

Access

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

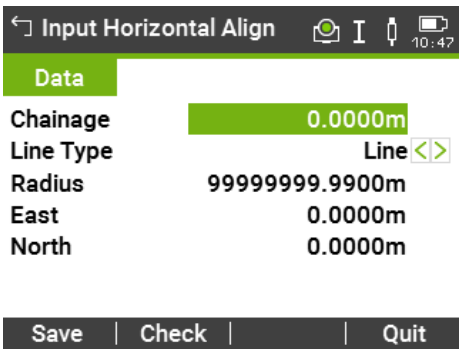
View Horizontal Align

To browse and delete existing elements of the horizontal alignments.

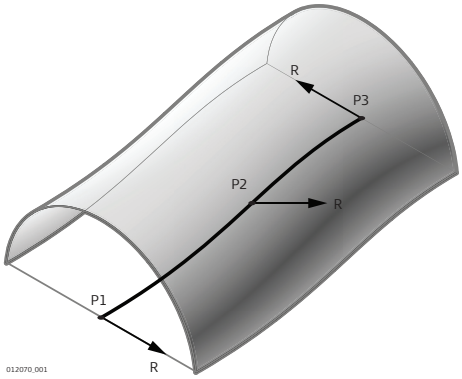


Key	Description
Add	To add a new horizontal alignment. The **Input Horizontal Align** screen opens.
Check	To check the horizontal alignment for smoothness or errors. The **Horizontal Alig. Check Res.** screen opens. The duration of checking depends on the number of elements in the horizontal alignment. 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. ☞ Entering elements following the increasing chainage simplifies the checking procedure. ☞ Checking, measuring or staking require at least two valid elements. ☞ 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. • Positive radius = Right-handed arcs • 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.

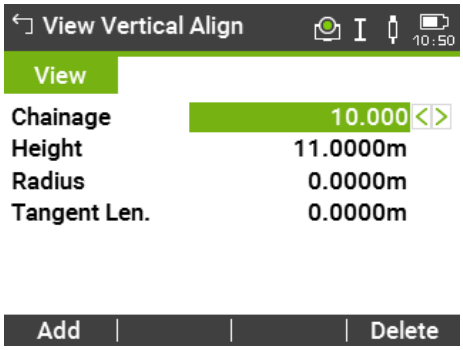
Each element involved is defined by individual vertical design elements such as chainage, Easting, Northing, radius and parameter P.

Access

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

View Vertical Align

To browse and delete existing elements of the vertical alignments.

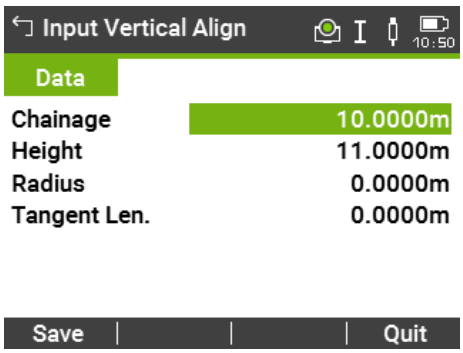


Key	Description
Add	To add a new vertical alignment. The **Input Vertical Align** screen opens.
Delete	To delete the selected element from the vertical alignment.

Input Vertical Align

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

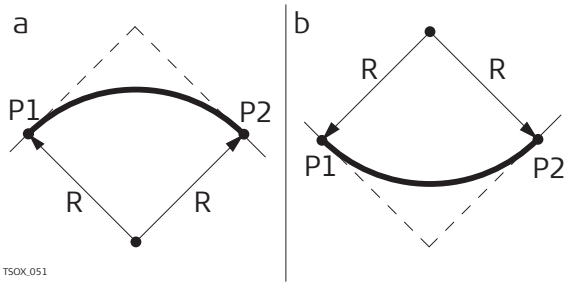
- Vertical alignments with symmetrical curves are defined by the PVI chainage, the elevation of PVI and the total length of curve, where the tangent length is half the total length of the VC.
- Vertical Alignments with non-symmetrical curves are defined by the PVI chainage, the elevation of the PVI and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

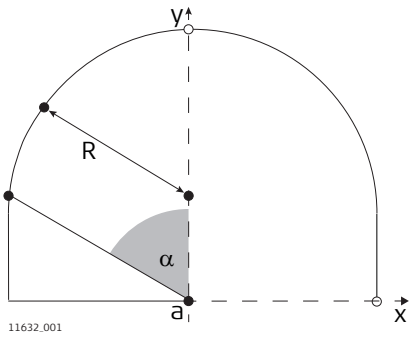
Field	Option	Description
		☞ Start point and end point of the vertical alignment must be located at the straight slope segment of the vertical curve. The corresponding tangent length and radius is 0.000.
		☞ Checking, measuring or staking require at least two valid PVIs.
		☞ The maximum milage is 4294000.000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

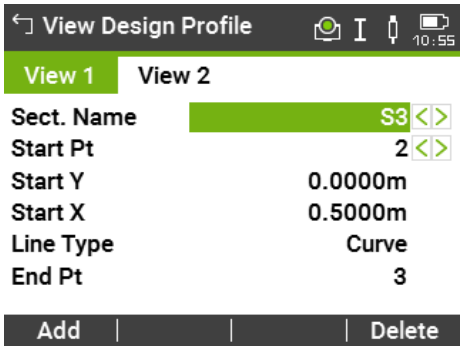


a Centreline
R Radius
x X axis of local coordinate system
y Y axis of local coordinate system
α Centre angle

Access

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

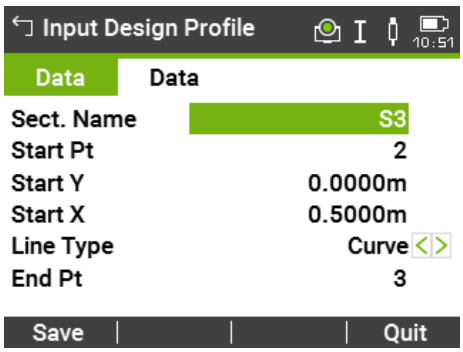
View Design Profile



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

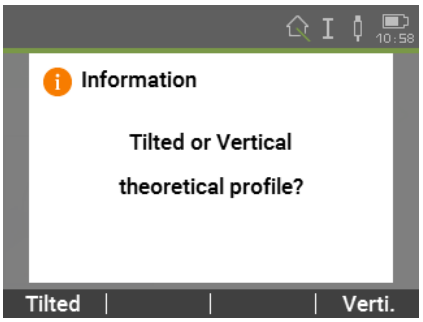
Description

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

Access

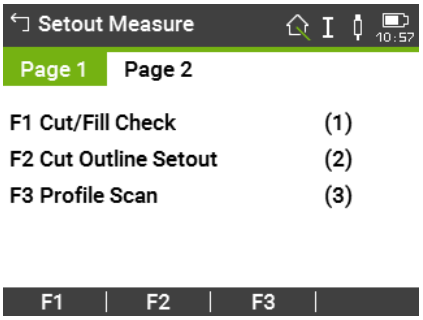
1. Select **Apps** from the **Main Menu**.

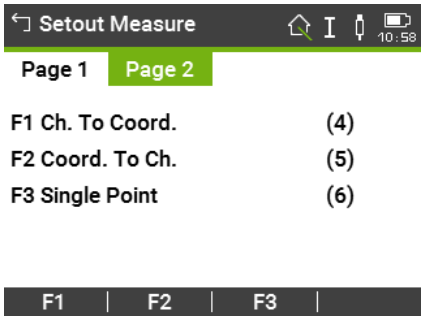
2. Select **Tunnel** from the **Programs Menu**.

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
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 **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

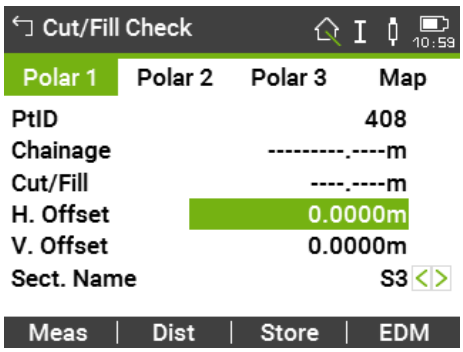
1. Select **F1 Cut/Fill Check** in **Setout Measure**.

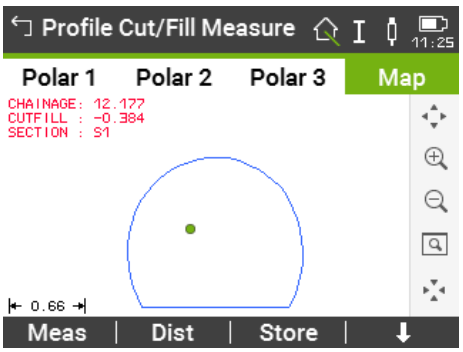
Cut/Fill Check

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. • Positive value = Fill/overbreak • Negative value = Cut/underbreak
H. Offset	Editable field	Perpendicular offset. • Positive value = Cut/fill point is to the right • Negative value = Cut/fill point is to the left
V. Offset	Editable field	Height offset. • Positive value = Cut/fill point is higher • 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. • Positive value = Measured point is higher than design • Negative value = Measured point is lower than design
CtrLine Off.	Display only	The offset value from the measured centerline and the design. • Positive value = Point is located on the right side • Negative value = Point is located on the left side

3.3 Cut Outline Stakeout

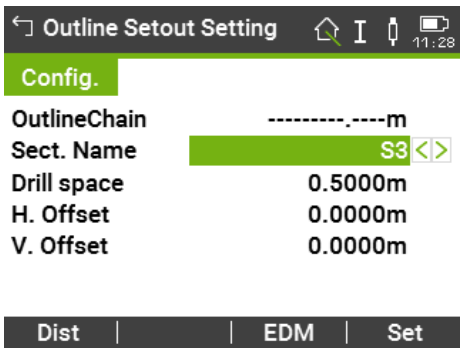
Access

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.

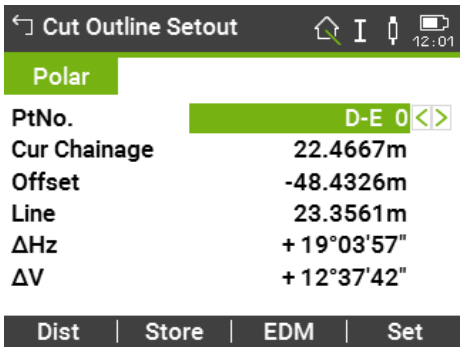


Key	Description
Set	To enter the **Outline Setout Setting** screen.

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. 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. • Positive value = Stake out point is to the right of the measured point • 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. • Positive value = Stake out point is higher than the measured point • 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. • Positive value = Stake out point is to the right of the measured point • 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.

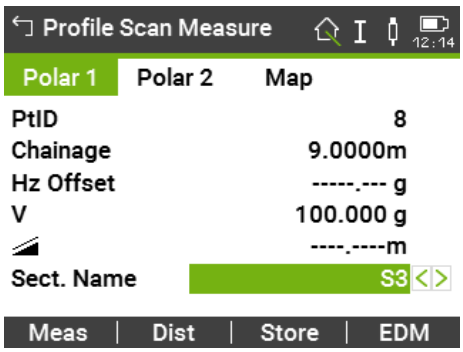
3.4 Profile Scan

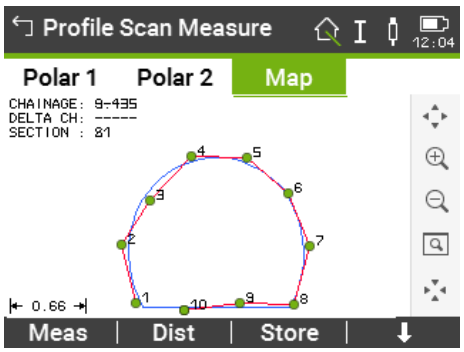
Access

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. • Positive value = Design point is further away than the measured point. • 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.

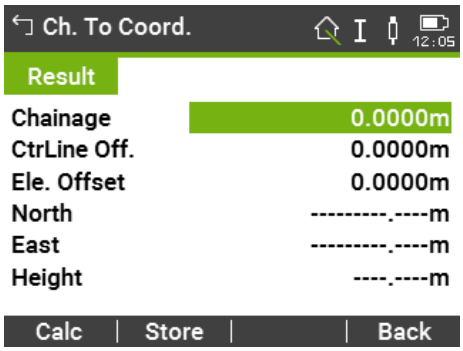
3.5 Chainage to Coordinates

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. • Positive value = Offset to the right • Negative value = Offset to the left
Ele. Offset	Editable field	The height offset of the centreline of which point coordinates must be computed. • Positive value = Higher • 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.

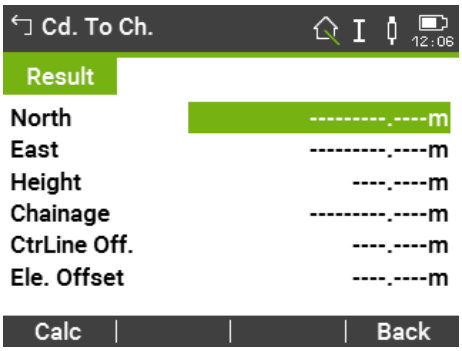
3.6 Coordinates to Chainage

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. • Positive value = Offset to the right • Negative value = Offset to the left
Ele. Offset	Display only	The height offset from the centreline computed from the coordinates entered.. • Positive value = Higher • Negative value = Lower

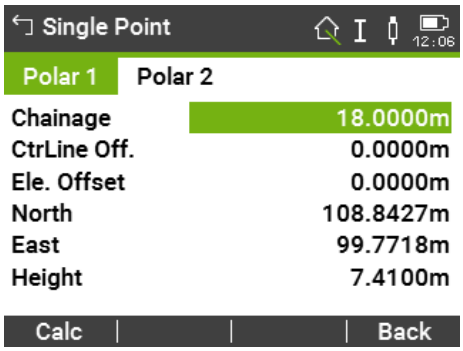
3.7 Single Point Stakeout

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. • Positive value = Offset to the right • Negative value = Offset to the left
Ele. Offset	Editable field	The height offset of the stakeout point from the centreline. • Positive value = Higher • 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. • Positive value = Stake out point is to the right of the measured point • 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. • Positive value = Stake out point is further away from the instrument • 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. • Positive value = Stake out point is further left • Negative value = Stake out point is further right
Cut/Fill	Display only	Height offset • Positive value = Stake out point is higher than the measured point • Negative value = Stake out point is lower than the measured point

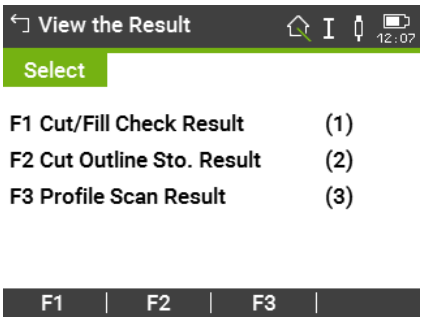
4 Viewing Results

Description

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

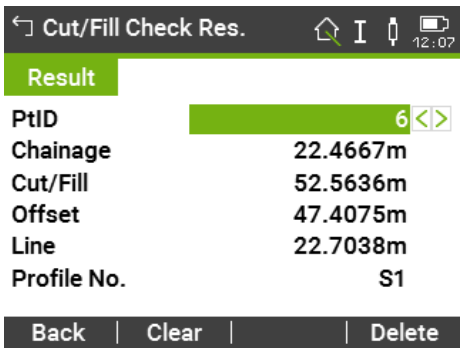
The results can only be viewed and deleted. Editing is not allowed.

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.

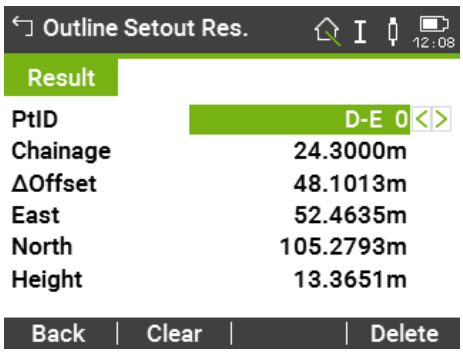


Key	Description
Back	To return to **View the Result**.
Clear	To delete all results of **F1 Cut/Fill Check Result** from the selected job.
Delete	To delete the displayed result.

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. • Positive value = Fill/overbreak • Negative value = Cut/underbreak
Offset	Display only	Perpendicular offset. • Positive value = Cut/fill point is to the right • Negative value = Cut/fill point is to the left
Line	Display only	The offset value from the measured centre-line and the design. • Positive value = Point is located on the right side • Negative value = Point is located on the left side
Profile No.	Display only	The number of the measured profile.

Outline Setout Res.



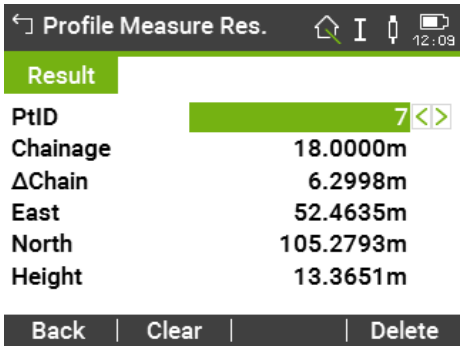
Key	Description
Back	To return to **View the Result**.
Clear	To delete all results of **F2 Cut Outline Sto. Result** from the selected job.
Delete	To delete the displayed result.

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 coordinates.
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

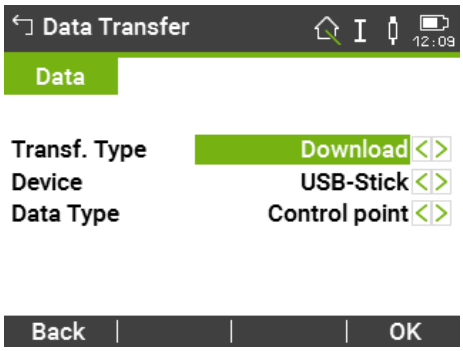
Description

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 Control points of the tunnel
	Horizon. align.	For upload and download Horizontal alignment for the tunnel
	Vertical align.	For upload and download Vertical alignment for the tunnel
	Design Profile	For upload and download Design profile of the tunnel
	Cut/Fill ChkRes	For download Cut or fill check results

Field	Option	Description
	Outline Stk Res	For download Stakeout results from the tunnel outline
	Profile ScanRes	For download 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.

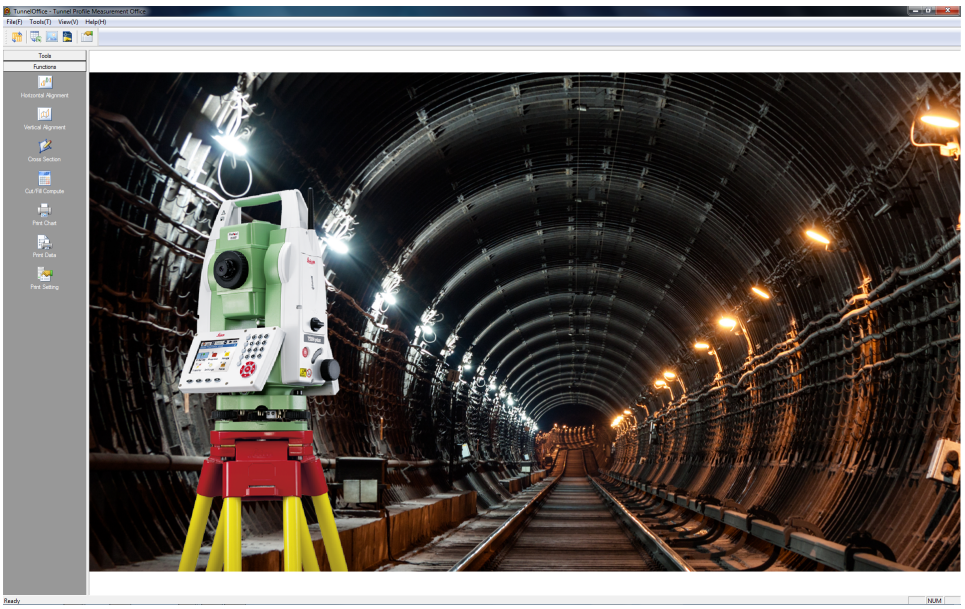
Tunnel Office can be installed on computers with MS Windows XP, Vista and Windows 7/8/10 operating systems.

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

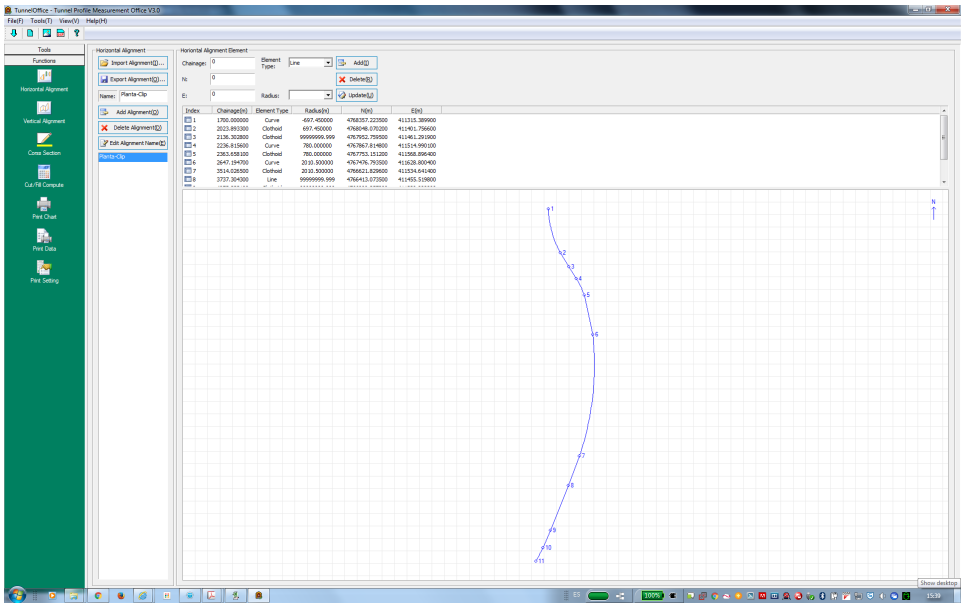
Options:

- 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

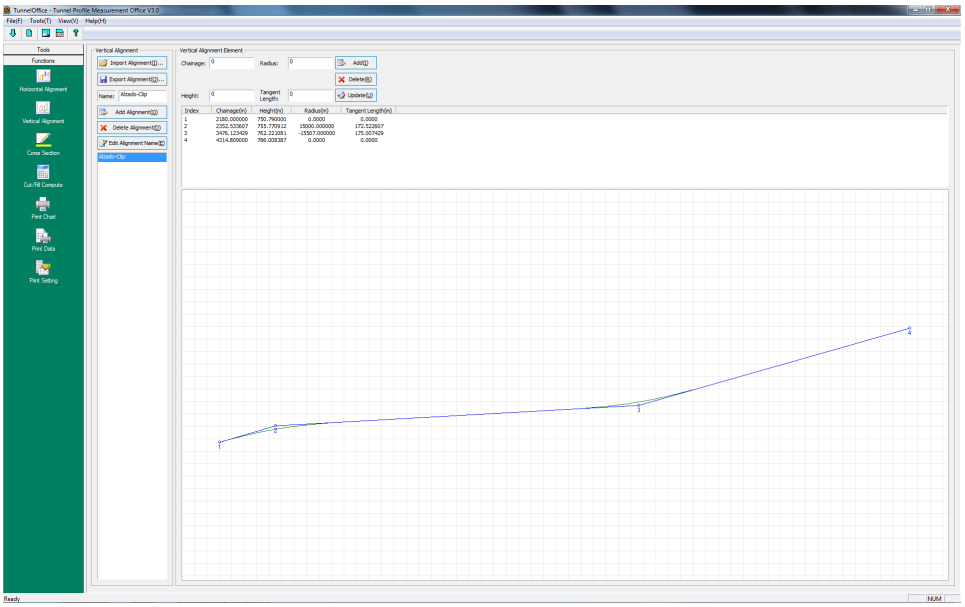
A horizontal alignment is a set of data defining the top view design of the centreline.

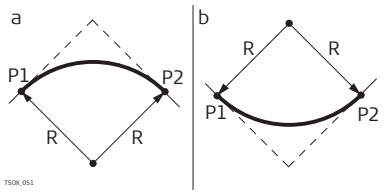


Button or field	Description
Horizontal Alignment	
Import Alignment	To open an existing alignment. LandXML format is supported.
Export Alignment	To save the alignment entered in Tunnel Office to a file.
Name	Name for the alignment • For add new alignment, enter a name and click **Add Alignment**. • To 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. The sign indicates the direction of the curve or clothoid looking in the direction of increasing chainage. • For right turn: Select + from the list. • For left turn: Select - from the list. • 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.

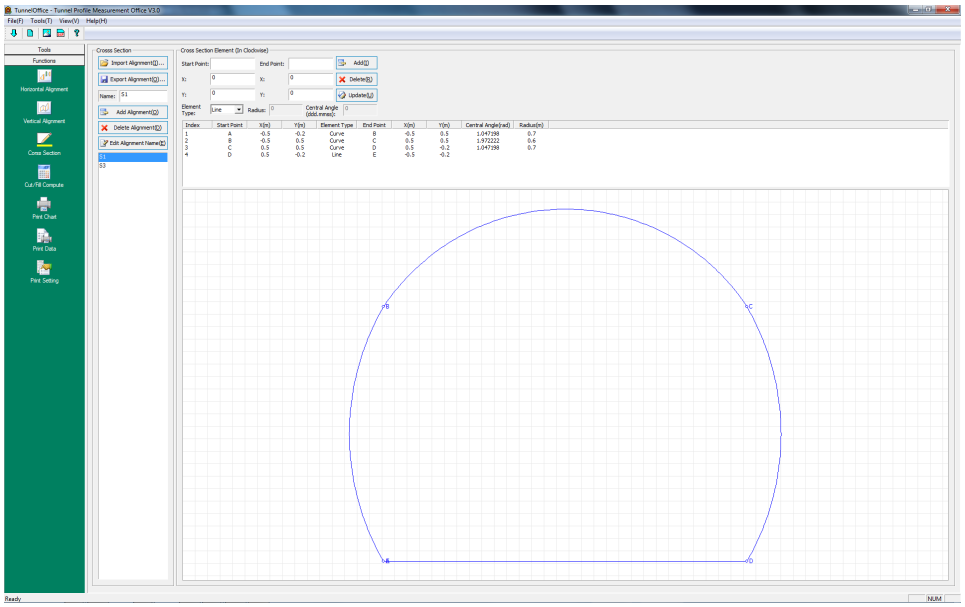


Button or field	Description
Vertical Alignment	
Import Alignment	To open an existing alignment. LandXML format is supported.
Export Alignment	To save the alignment entered in Tunnel Office to a file.
Name	Name for the alignment • For add new alignment, enter a name and click **Add Alignment**. • To edit 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. • Positive radius = Convex curves • Negative radius = Concave curves
	 a Convex b Concave P1 Start point P2 End point R Radius
Tangent	Length of the straight element as slope distance. ☞ The end of the long straight and radius with tangential slope segment is 0.

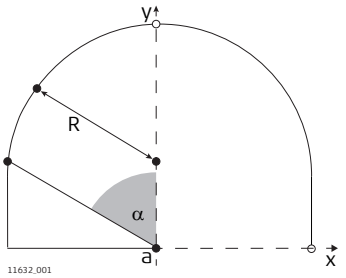
Cross Section

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.

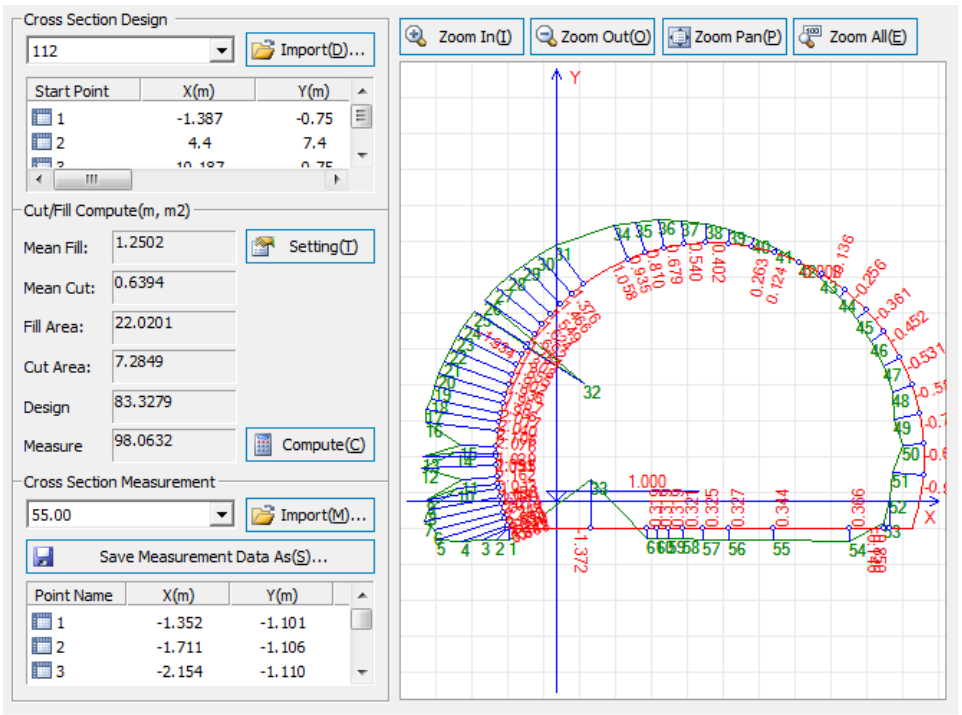


Button or field	Description
Cross Section	
Import Alignment	To open an existing cross section from a LandXML, *.tln or *.dxf file. ☞ The units in the *. dxf file must be meters. In the CAD program, draw from the CAD coordinate origin. Start with the line and arc segments at the closed section of tunnel 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. ☞ 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 • For add new cross section, enter a name and click **Add Alignment**. • 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.

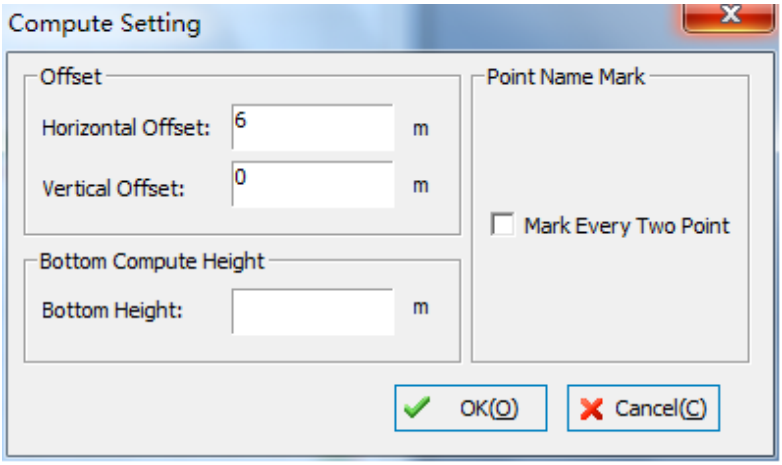
Button or field	Description
	 a Centreline R Radius x X axis of local coordinate system y Y axis of local coordinate system α Centre angle
Start point	The point ID where the design profile starts.
End point	The point ID where the design profile ends.
X	The X coordinate of the start or end point in the 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. Enter in degrees.minutessecond. For example: 12°25'36'' = 12.2536 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. 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

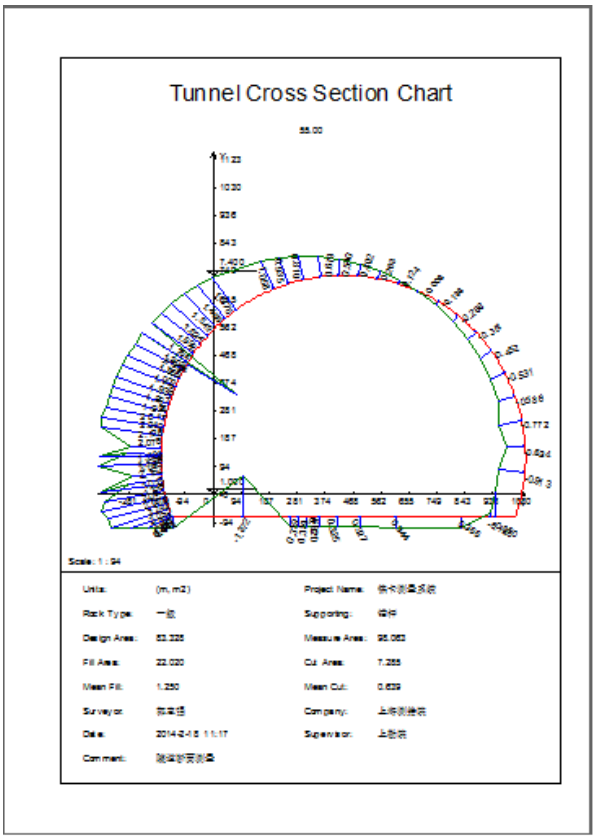
Point Name Mark

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. Enter the lowest elevation relative to the coordinates origin. 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.	

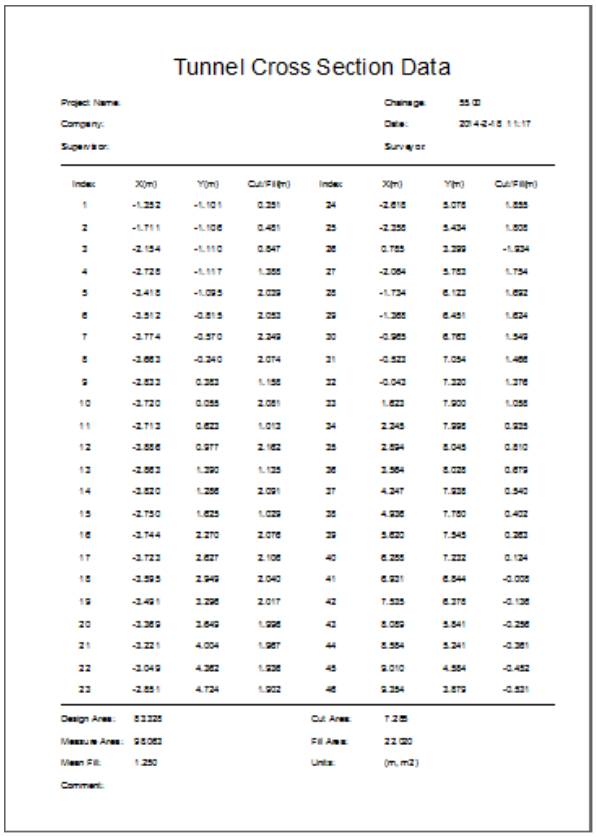
Print Chart

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

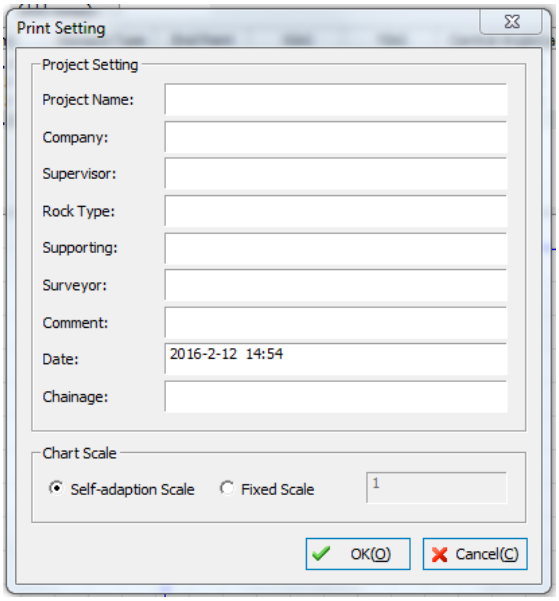
Index	X(m)	Y(m)	Cut/Fill(m)	Index	X(m)	Y(m)	Cut/Fill(m)
1	-1.252	-1.101	0.251	24	-2.615	5.075	1.555
2	-1.711	-1.106	0.451	25	-2.255	5.434	1.505
3	-2.154	-1.110	0.647	26	0.755	3.299	-1.934
4	-2.725	-1.117	1.265	27	-2.064	5.753	1.754
5	-3.415	-1.095	2.039	28	-1.734	6.123	1.692
6	-3.512	-0.815	2.053	29	-1.365	6.451	1.634
7	-3.774	-0.570	2.249	30	-0.965	6.763	1.549
8	-2.663	-0.240	2.074	31	-0.523	7.054	1.466
9	-2.833	0.263	1.156	32	-0.043	7.320	1.276
10	-2.720	0.055	2.051	33	1.622	7.900	1.056
11	-2.712	0.622	1.013	34	2.345	7.998	0.935
12	-2.556	0.977	2.162	35	2.894	8.045	0.810
13	-2.563	1.390	1.125	36	3.564	8.026	0.679
14	-2.630	1.256	2.091	37	4.247	7.926	0.540
15	-2.750	1.625	1.029	38	4.926	7.760	0.402
16	-2.744	2.270	2.076	39	5.620	7.545	0.263
17	-2.723	2.627	2.106	40	6.255	7.222	0.124
18	-2.595	2.949	2.040	41	6.931	6.544	-0.005
19	-2.491	3.296	2.017	42	7.535	6.376	-0.136
20	-2.369	3.649	1.996	43	8.059	5.841	-0.256
21	-2.221	4.004	1.987	44	8.554	5.241	-0.381
22	-2.049	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: 53.335
Measure Area: 95.063
Mean Fill: 1.250
Cut Area: 7.255
Fill Area: 22.020
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**

Leica Geosystems