



T h e o L t

TheoLt r8  
User Guide  
&  
Operators Manual  
for  
Surveying in AutoCAD &  
Bricscad

## CONTENTS

General	4	Arc to line	49
Installation & Authorisation	5	Outline wall	50
Configuring for first use	7	Points on a line	52
Trouble-shooting the system	10	Fit to brace	53
Quick start	11	Measure brace & fix	54
Suggested start-up procedure	12	Fit closed	55
Projects in TheoLt	17	Close and distribute	56
Control Tab	19	Close 2 walls / Edit wall length	57
Default orientation	20	Fixed point/ Fixed line	58
Reference orientation	23	Join walls/ Draw Brace	59
Resection	24	Layer Group	60
Position Verification	25	Room Manger	61
Control Station list	26	Plan builder	63
Adjusted Network Control	27	Working with blocks and features	64
Traversing with TheoNetAdjust: Field procedure	31	Customising features for use with DistToPlan	70
Importing control	34	The view tab	74
Draw tab	35	3D views in AutoCAD for façade survey	75
The history panel	36	Two point intersection	76
Working with DistToPlan arx tools	37		
DistToPlan Commands	38		
Sketch & Measure	39		
Rectangular room	42	Appendix 1: TheoLt settings	79
Align	43	Appendix 2: DistToPlan Command list	82
Roomplan	44	Appendix 3: TheoLt and DistToPlan layers list	85
Square feature	48	Appendix 4: TheoLt Core Supported Instruments	87

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## General

TheoLt provides an interface between survey measurement tools and a CAD platform for the purpose of achieving survey tasks in CAD. Depending on user options TheoLt is supplied with themed suites of AutoCAD custom commands for use in the preparation of survey. The tool-sets are designed to enhance the effectiveness of AutoCAD as both a draughting tool and as a data collection platform for TST and Disto® measurement. The commands make use of existing practice in measurement as far as possible so that when adapted for a given measurement sequence repeated sets can be deployed. The insertion of scaleable doors, windows, height annotation and area information (in TheoLt Building Survey for example) all use automated layer management to maximise the editing scope when presenting data. The procedures for orientation, resection and instrument controls are carried out by the base module: TheoLt core. Familiarisation with how TheoLt core handles raw survey data is recommended before making use of the extended functions.

## TheoLt Product Range

The TheoLt CAD survey tool set is available in the following forms. Each component requires separate authorisation. A single installation will load the components which are activated by authorisation.

1. **TheoLt Core:** TST and Disto Instrument and CAD interface for AutoCAD, AutoCAD Lt, IntelliCAD and Bricscad with full orientation, data logging and basic 3D drawing functions.
2. **TheoLt Pro:** as core but with least squares network adjustment, robotic control and contour modules
3. **DistToPlan Basic:** a minimum tool set for building survey with the Disto.
4. **TheoLt Building survey (TBS) :** as core but with DistToPlan tools for AutoCAD and Bricscad
5. **TheoLt Building survey Pro :** as pro but with DistToPlan tools for AutoCAD and Bricscad
6. **TheoLt DistToPlan:** as TBS but for Disto only
7. **TheoLt Contour:** 3d contour and surface generation for AutoCAD/Bricscad
8. **TheoOffice:** Post process GSI tool set for AutoCAD, AutoCADLT, IntelliCAD and Bricscad

## Installation

On installation the required system files are installed according to user option

### Product Options

*TheoLt Core*: Communication between TST and Disto® to AutoCAD with basic orientation function.

*TheoLt Pro*: as above but with motor dive, contouring and network adjustment functions.

*DistoPlan*: AutoCAD building Survey drawing tools with communication with Disto® Only

*TheoLt Building Survey (TBS)*: : AutoCAD building Survey drawing tools with communication with Disto® and TST

### AutoCAD version

TheoLt core and Pro have full functionality with AutoCAD and AutoCAD LT versions. As far as is practical TheoLt is compatible with historic AutoCAD releases but with some reduction in arx functionality commensurate with the Autodesk current version policy at the release date of the TheoLt version used.

### Bricscad compatibility

The programme extensions available in AutoCAD for TheoLt Building Survey are broadly present in the Bricscad version there are some differences and where this is so this is indicated as Bricscad variant of the software in this manual, TheoLt Core support Bricscad version 9 to date and the Building Survey Suite functions from version 10 to present.

The entire TheoLt range is installed from a single setup during which the various modules may be selected.

TheoLt is distributed in 2 formats:

CD

Web Download

When using the CD, selecting "Install TheoLt" from the list of options starts the same installation process as the web download.

The name of the web installation file is: <http://www.theolt.com/downloads>

To start this installation, double-click the *TheoLtRXX.exe* file.

The [Next] button steps through the installation.

The first stage is to agree to the license. To confirm this, click [Yes]

Confirm the installation Folder. The default is

C:\Program Files\Latimer CAD Limited\TheoLt RXX

Click [Next].

Select the installation type:

Select the correct CAD type / version.

The modules will be enabled during the installation into AutoCAD  
Confirm the installation options by clicking [Next].  
The files are installed. Click [Finish].  
Once installed the software will need authorisation.

## Authorisation

On first use TheoLt will prompt for the required authorisation by running the Latimer CAD Authorisations Panel. Note the system ID and contact your vendor to obtain the appropriate key(s)

MAKE A NOTE OF YOUR AUTHORISATION DETAILS HERE:

SYSTEM ID:

THEOLT BASE MODULE AUTHORISATION:

THEOLT BASE MODULE PRO AUTHORISATION:

THEOCONTOUR:

DISTTOPLAN:

---

## Installation of DistToPlan and TheoContour into AutoCAD

For all versions of TheoLt except the base module, an additional step may be required to load TheoLt into AutoCAD.

To complete this:

- Start AutoCAD.

- At the command prompt, type Appload.

In the displayed dialog box, browse to the installation folder.

The default is C:\Program Files\Latimer CAD Limited\TheoLt

- Select the file *theodisto.arx*. Click [Load].

- Select the relevant menu for display to match the required survey type. Click [Ok].

- Click [Ok]. to close the appload window.

If required the process should be repeated for *theocontour.arx*

The start-up process of TheoLt allows aspects of the current configuration to be viewed:

- Configured Instruments
- Configured Settings File.

The start-up dialog is displayed for a user defined time (the default is 10 seconds).

The [Close] button may be clicked at any point to continue the start-up with the displayed settings.

The time for which the dialog is displayed may be altered by selecting a different value from the 'Show this dialog for'.

*Note: Setting the length of time for which the dialog is displayed to a short time may not allow the user to re-lengthen the time again as the dialog will disappear before the time out is reset. Therefore is advisable to keep the time out to approximately 10 seconds and use the [Close] button to reduce the start-up time.*

### Instruments:

TheoLt may be configured to use two instruments (a Total Station Theodolite and a Distance Meter). The configured Instruments are listed. Either Instrument may be disabled by un-ticking the relevant tick-box. The instruments will be re-enabled when TheoLt is next started.

*Note: Disabling both instruments allows quick access to the settings section of TheoLt for reconfiguring the instruments.*

## Configuring for first use

**Set up on 1<sup>st</sup> use:** TheoLt will need to be configured to work with your survey instrument(s) and with the system version of AutoCAD. Before proceeding please implement the required settings at (see XX) and check the communication between TheoLt, AutoCAD and the survey instrument.

Before TheoLt can be used, there is a minimum configuration that must be completed:

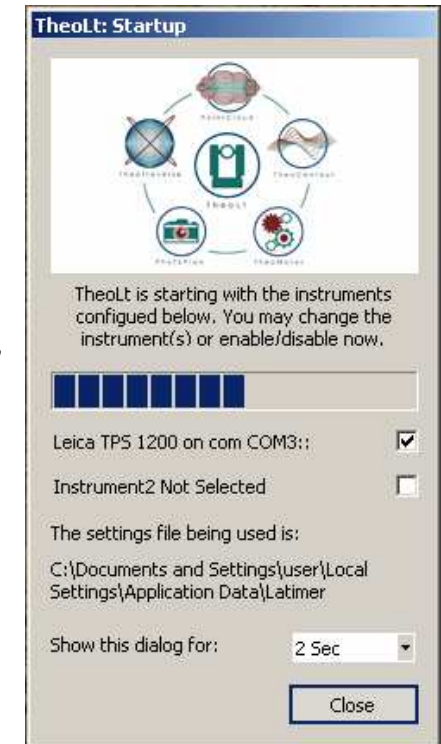
- Select the AutoCAD Version
- Select the Instrument in Use

### Procedure for configuration:

Start TheoLt.

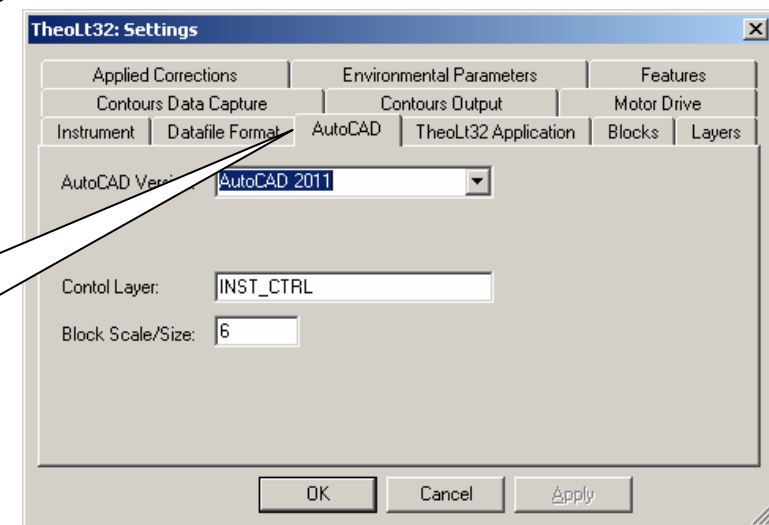
Select the AutoCAD Version:

- Start TheoLt, uncheck both instruments in the start-up dialog.



Under the settings tab the spanner button will open the settings panel.

Select the AutoCAD tab to set the AutoCAD version from the pull down list.



Select the [Settings] tab.  
 Select [Display Options / Settings] Icon.  
 Select the [AutoCAD] tab:

The Drop-Down menu contains a list of the AutoCAD versions currently supported by TheoLt.  
 Select the correct version. The Control Layer indicates the Layer within the AutoCAD drawing on which blocks representing station positions will be placed.

Selecting the Instrument:  
 Select the [Instrument] tab:

TheoLt allows a total station and a Disto® to be connected simultaneously. The 2 drop-down menus contain a list of the instrument interfaces currently supported by TheoLt.

Select the correct Total Station interface for your instrument.

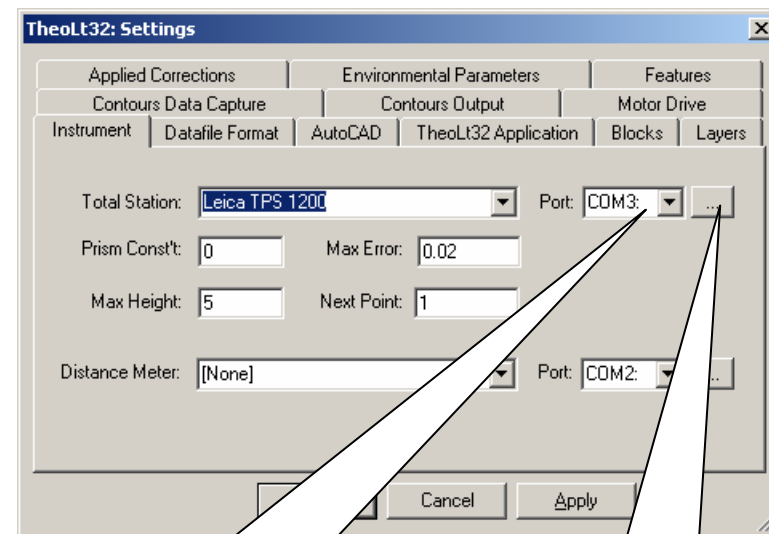
*Note: Due to frequent changes of instrument model designation, the exact instrument name may not be listed. Most instruments are supported via an interface for a similar instrument from the same manufacturer. [ For example the Leica TCR series of instrument shares a common interface with the Leica 'Flexline TS' series]. Contact TheoLt support for advice if your instrument is not listed.*

The communication parameters are defaulted. Confirm the COM (RS232) port being used to connect the instrument to the PC. This connection may be a physical cable to a physical COM port on the PC or a virtual Port created by a Bluetooth or USB connection.

*Note: TheoLt is only able to address COM ports 1 to 8. Any port will need to reside within this range. The Port field allows the selection of the COM port to be used.*

The application will need to be restarted to effect a change of COM port.

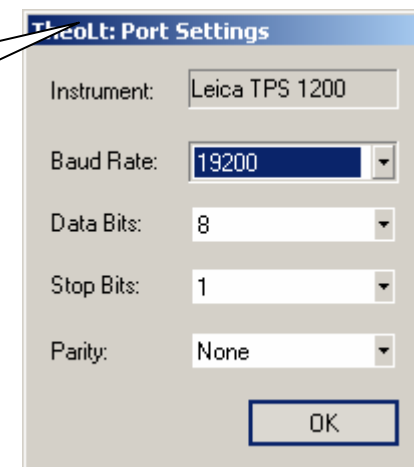
Select [...] to open a panel which can be used to match the com port settings on the computer with those on the instrument.



Select the Com port for the instrument here. Check the port number in Windows Control panel, System, Device Manager, Com ports. The port number must be between 1 and 8.

The port settings are accessed here.

The port settings can be edited to match the instrument using the port settings panel.





Note: *The instrument will have to be set up to send data via RS232, and have communication settings in agreement with TheoLt. TheoLt will need to be closed and restarted for instrument settings to effect changes to the comms settings.*

Repeat for the Distance Meter selection and COM port. [Apply] the Settings. [OK] to close the dialog box. [Close] TheoLt.  
After re-starting, TheoLt will be ready to use.

### Testing configuration

Once the minimum configuration has been completed, TheoLt may be used:

- Connect the instrument to the PC.

- Start AutoCAD

- Once AutoCAD is loaded, start TheoLt.

- As TheoLt starts, confirm the correct Instruments are listed.

- Select the [Control] tab. Select the [Insert Station Position Icon].

If the interface to AutoCAD is configured correctly the command line will respond with a number of commands:

```
Command: COMMANDLINE
```

```
Command: _filedia
```

```
Enter new value for FILEDIA <1>: 0
```

```
Command: _script
```

```
Enter script file name <C:\Documents and Settings\user\My
```

```
Documents\Drawing1.scr>: C:\DOCUME~1\user\LOCALS~1\Temp\THDF.scr
```

```
Command: theostationcreate
```

```
Station to create: STA100
```

```
Created new station: STA100.
```

```
Location for Station:
```

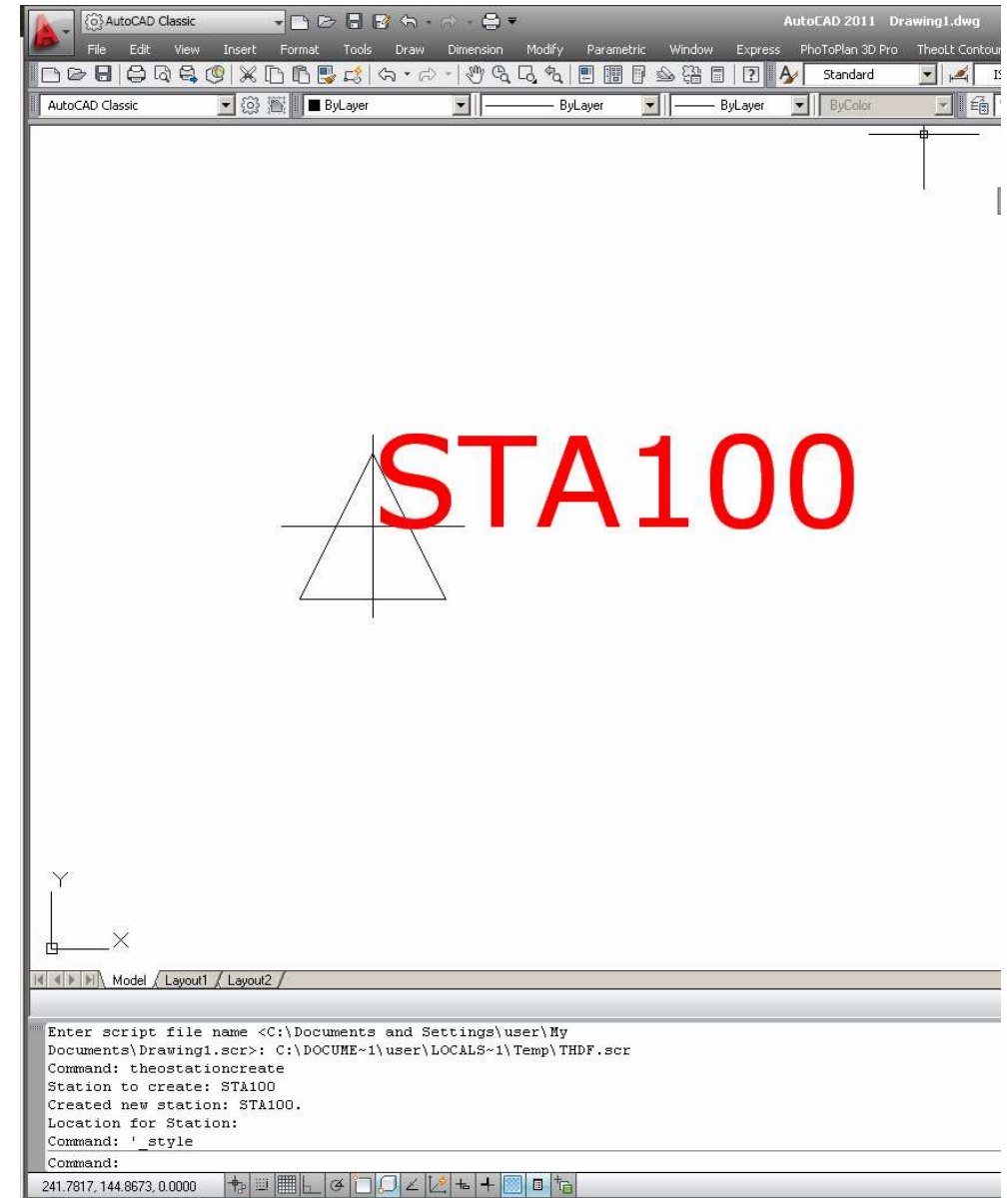
```
Command: '_style
```

```
Command: _filedia
```

```
Enter new value for FILEDIA <0>: 0
```

Position the block in the drawing using the AutoCAD cursor. This action confirms the correct configuration of the AutoCAD version.

Communication with the instrument will be confirmed in the TheoLt history panel, with the observation data fed to the command line.



## Trouble-shooting the system

Issue	Set to:	Required status:	See
Dynamic input	Off	Dynmode=0	AutoCAD Setvar
Dynamic UCS	Off		
Command line	On	'commandlinehide' or Ctrl+9 keys	
Multiple drawing session	Off		
'Saveas' loses file dialogue	1	Filedia=1	AutoCAD Setvar
Stn and Ref Block sizes ignore block scale	Unitless,	Block insert units in conflict with block size save set at 'Unitless' to DWT	Format, Units, Insertion Scale
Version mismatch	Check TheoLt is set to your version of AutoCAD. The 'vertical' AutoCAD products should use the interface for the core version or 'vanilla' equivalent.		TheoLt settings
AutoCAD file search path	Add <i>theoltblocks</i> to AutoCAD support path		AutoCAD 'options'
Lost pull-down menu	Menubar=1		
Lost menu	Menuload		
DistToPlan Toolbar not displayed	Toggle AutoCAD work spaces		
TheoDisto fails to load	Set support path settings to include TheoLt		
Station block fails to inserts at 0,0 after AutoCAD	Re-install <i>theodisto.arx</i> , restart system		
	Set working path away from C:\		TheoLt settings
Windows permissions			
Windows security settings	'Never Notify'	In 'User Account Control' Settings	Control panel, User Accounts

### Test the Interface to the Instrument:

On the Instrument Interface window, click the [All] button. This instrument should attempt a measurement. If no measurement is achieved, check the instrument settings to ensure that one is possible.

Consider the following:

- That the instrument is level.

- That the instrument is in reflectorless mode

- That the target is valid (good surface and range).

- That if the instrument does not have a reflectorless mode that it is pointing at a valid prism.

After the observation is made, the data will prompt the orientation panel to open and, on completion of the dialogue, appear in the History Panel.

This action confirms the correct configuration of the Instrument

If using a Leica Disto® Distance meter: The [2nd] button should be pressed following the Bluetooth link being established. To confirm the correct configuration:

Disto® Plus: Take a measurement and then press the [Enter] button. A6:

Take a measurement and then press the [Bluetooth] button

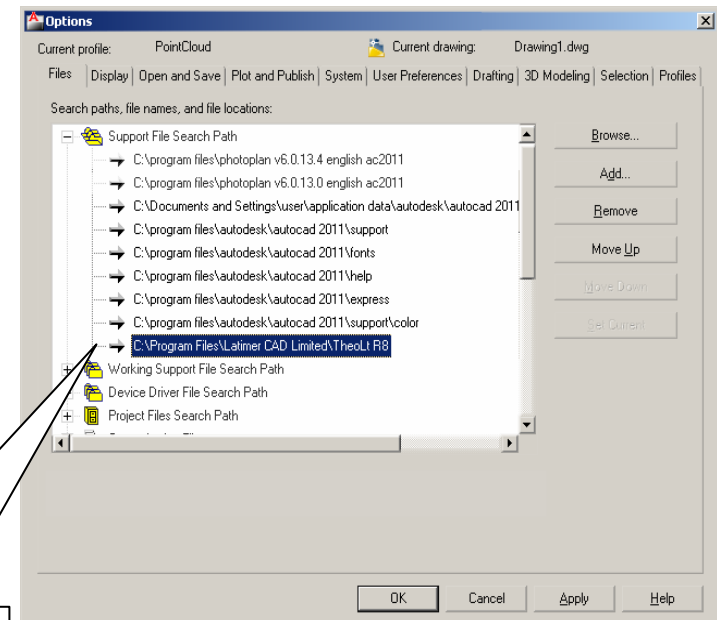
**Diagnostic Arx version reporting** If the TheoLt pro and DistToPlan functions are required to be active the correct AutoCAD extension programme *theoDisto arx* will need to be a loaded application in AutoCAD. The loaded version is reported by the command *theodver* entered at the AutoCAD command line:

Command: `theodver`

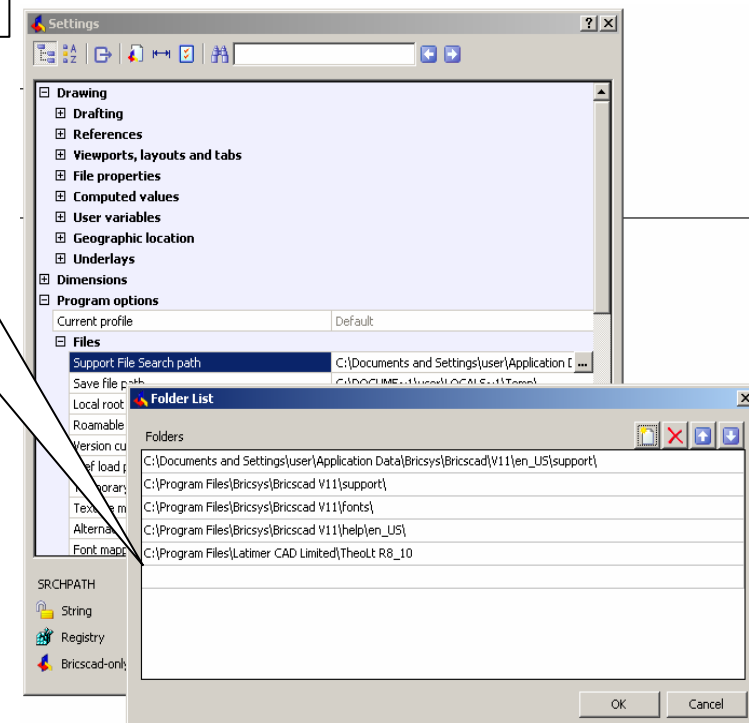
DistToPlan (TheoDisto for TBS) ARX Version 8.13

DistToPlan Product Release 8.13

**The instrument settings** can be tested but connecting the instrument to the appropriate system COM port, setting the instrument to export data (see manufactures advice on this) and with AutoCAD open using TheoLt to send data to AutoCAD using the 'All' trigger button, if no orientation is present TheoLt will respond by opening the orientation panel. With an orientation completed (a default orientation can be used for testing) the instrument data will appear in the history panel and the AutoCAD command line.



In AutoCAD add the path to the TheoLt install folder in the Support file search path field.



In Bricscad add the path to the TheoLt install folder in the Support file search path field.

## Suggested Start-up procedure

### Surveying with TheoLt: basic procedure.

**1 Prepare drawing** Open AutoCAD and have the drawing you want to add to current.

Check the drawing to make sure your position agrees with it: know 'where you are' in the drawing. Identify the stations you will be using both on the ground and in the drawing.

**2 Set up instrument** Set up your instrument, centre it and level it. Measure and record the height of instrument from the ground (not the top of the peg) to the instrument centre mark. Connect the tablet to the instrument and check the instrument level again. Make sure the tablet bag and instrument cases are closed after use to prevent dirt getting in.

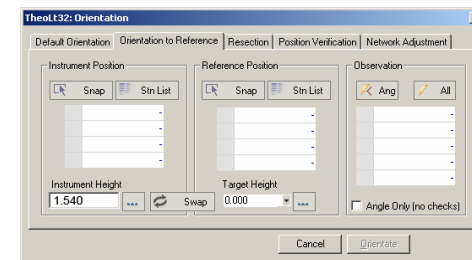
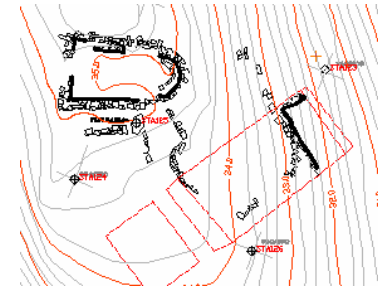
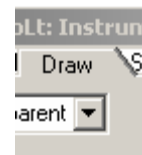
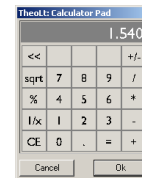
**3 Orientate** An orientation is required before points can be measured so open TheoLt.

Send a point to TheoLt and the orientation panel will be prompted. Enter the occupied and reference positions, the instrument and target heights, take the shot, check it and accept the orientation.

Check TheoLt is in the draw tab with the transparent tool set, select an AutoCAD layer, select the line tool and off you go!

**4 Survey** Saving the drawing saves the work.

Use the control tab and follow the on-screen prompts following measurement to set out more stations as required.



## TheoLt Core: the Instrument control panel

TheoLt core comprises the instrument control panel common throughout the TheoLt survey tool family. On opening the application a start up screen is shown with a countdown bar which shows the progress of the comms set up. The instrument control panel will open after a pause to allow Bluetooth comms connection.

### Function of the panel

The panel provides the interface between the survey instrument and AutoCAD

### Operation of the instrument control panel

The control panel is kept on top of the AutoCAD session. It allows access to the instrument data and the survey operations needed for orientation etc.

The Instrument control panel has 2 parts

- a tabbed interface to access, control and orientation data, drawing tools, settings, contouring functions, view options and project tools.
- a data panel which accepts height of target entry, acts as a trigger for data acquisition and displays a stack of the instrument data history ( set at 10 observations by default)

The 2 parts can be separated or docked together on activation of the 'allow docking' option in TheoLt settings, *TheoLt 32 application* tab.

The panel can be minimised and resized for screen clarity if needed.

### Operation of instrument via the instrument control panel

There are 3 trigger buttons available which serve the following functions:

'Int' (Intersection) opens a table which stores all observations taken with the table open from the current position to target positions for plotting by intersection. The table is closed by selecting the 'Int' button again. (For procedure on using the table see *2 point intersection*)

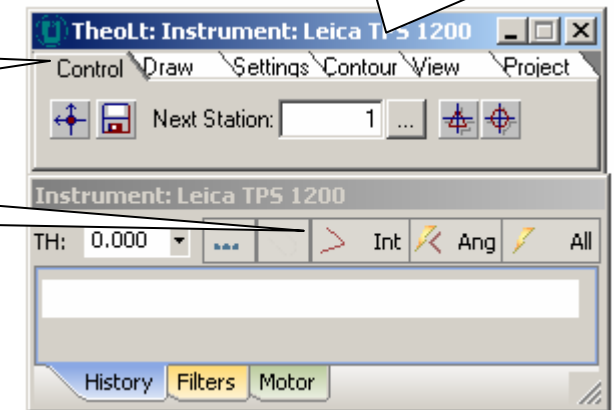
'Ang' Angle only observations, triggers an angle only ob. Angle only observation may only be used in association with an appropriately applied filter in the filters tab.( For procedure on use of filters and angle only shots see *Filters* p16)

'All' Triggers angle and distance observation from the instrument.

The tabs switch TheoLt between modes including access to the settings.

Observations may be by intersection, angle alone or angle and distance together.

A right click in the title bar will open a context menu which includes a *restart instruments* option.



The history tab brings the observation record to the front and will allow data to be sent to the AutoCAD command line

### History panel (see also p35)

The history panel displays the recorded instrument data in list form. The observation type is indicated in the panel by symbol. The last observation is shown at the top of the list.

The history indicates full 3D, distance only and direction measurement. The Angular unit for the display can be set to either decimal or DMS in TheoLt settings.

**Operation:** Selecting an observation in the history list will send it to the AutoCAD command line as a co-ordinate with respect to the current orientation ( or in the case of the Disto<sup>®</sup> a distance only value relative to the last distance measured by direction key.)

*Note that if you are using a Disto as a 2<sup>nd</sup> coms device TheoLt will require an orientation procedure to be completed before data is sent to the command line. DistToPlan variants of the software do not have this requirement. Setting the Disto as the 1<sup>st</sup> device will skip this requirement.*

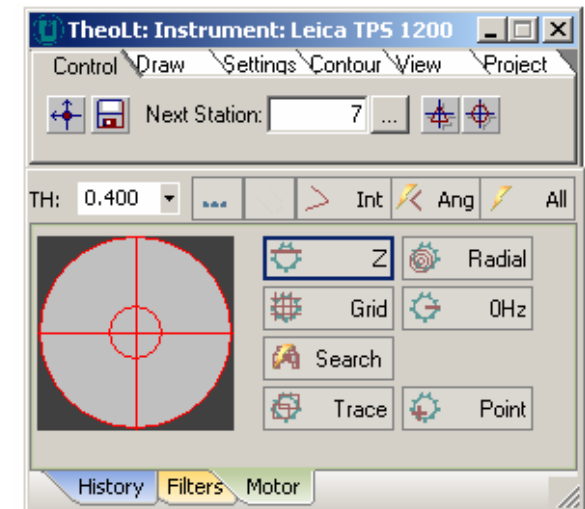
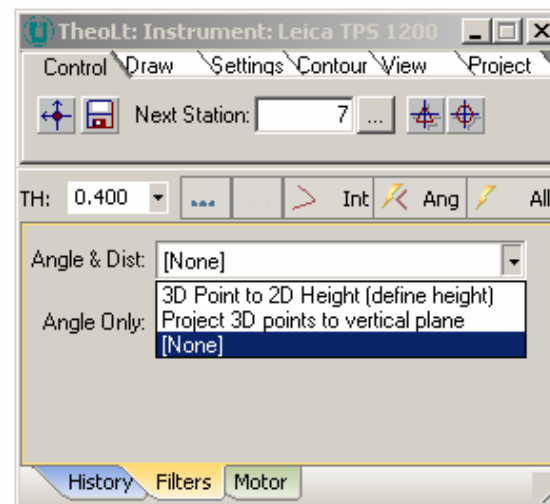
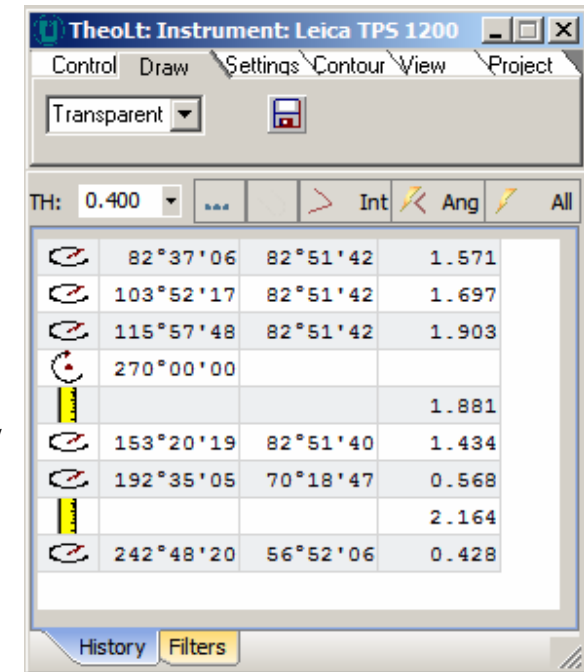
### Instrument history panel tabs

Depending on the version deployed there are 3 tabs available at the bottom of the panel:

History: the default tab displays the instrument data on capture

Filters: Allows angle only measurement for intersection with a plane.

Motor: Enables Leica 1100, 1200 and Viva motorised instruments (subject to Leica hardware licence) to be remotely driven to set out AutoCAD objects, operate simple scans etc



## Target Height (TH)

**Function:** To enable the use of a vertical offset from the target point. (For example when a prism is mounted on a pole and the ground height is to be recorded)

### Operation

The height of target can be entered by selecting from a last 5 used list, entering the value in the field or by entry from the popup calculator pad accessed from the three dots button.

Any change in of the height of Target must be applied with a click on the tick symbol which becomes active when the field is edited.

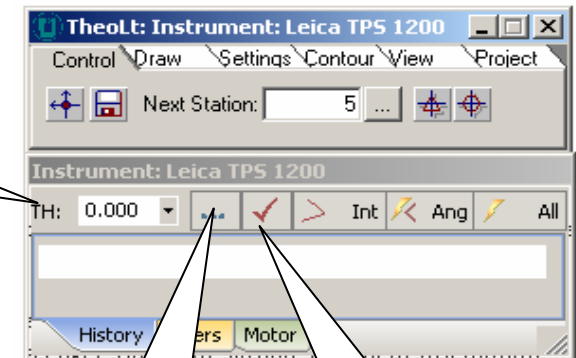
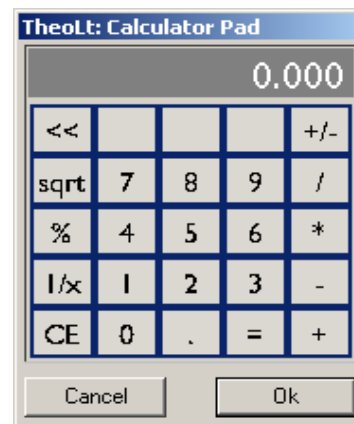
A zero value is always available for reflectorless survey. A negative value may be entered with the appropriate sign for inverted staff measurement.

### Procedure:

The height of target set in the instrument control panel will be used for all observations. Any operation (e.g. Orientation to reference, resection etc) using a target height will update the target height in the Instrument Control panel.

If the height field is edited and is not applied TheoLt will respond with a confirmation request on receipt of the next instrument observation.

The target height is entered here. A pull-down list of the last used heights is saved  
Zero is fixed in the list.



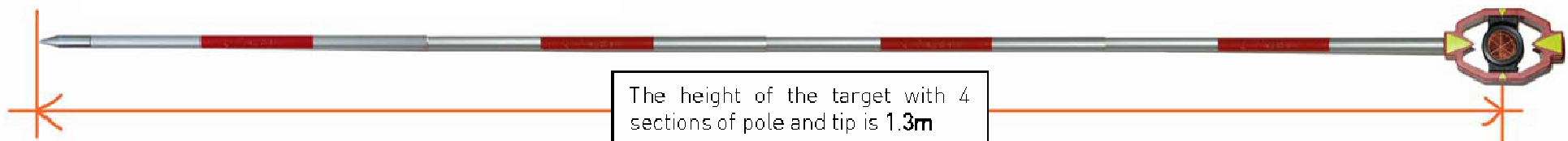
Key pad entry of the target height is available from this button. The default or last used value should be

The target height is entered with a click on the tick here.

### Priority of field entry for height of target

There are a number of instances where TheoLt will offer entry of the height of target other than in the control panel.

The value for the height of instrument is always used as set in the most recently used dialog. The instrument control panel value will always be used unless over-ridden at station set-out or orientation.



## Filters

**Function:** to allow use of angle only observations for plotting by intersection with a plane or by plotting to a clipped height for (2D plots)

The instrument filters allow specific observation types to be modified. The 2 observation types are:

- Angle and distance

- Angle only

### **Angle & distance filter: projecting 3D point to 2d height:**

This allows all 3D observations to be converted to 2D as they are made (for example during the measurement of a building plan)

### **Angle & distance filter: Projecting 3D point to vertical plane:**

This allows all 3D observations to be projected onto a vertical plane defined by 2 points. All observations are projected perpendicularly to the plane (as opposed to Angle only observations which are plotted at the intersection of the observation and the plane.)

**Project to XY,** if this is selected the plane may be projected to the X-Y world co-ordinate plane in AutoCAD. If de-selected the points are plotted at the true 3D position on the plane.

### **Angle only filter: project Intersection with Vertical Plane:**

This allows all Angle Only observations to be intersected with a vertical plane defined by 2 points.

The [Project to X-Y] if selected the plane may be projected to the X-Y world coordinate plane in AutoCAD. If de-selected, the points are plotted at the true 3D position on the plane.

### **Angle only filter- remote elevation:**

For each observation the vertical angle is used to calculate the height (z value) over the last full 3D (Angle and distance) point observed. i.e. when an Angle Only observation is received, the X and Y values of the last Angle and Distance observation is taken in conjunction with the vertical angle of the new observation to plot a point directly over the 1<sup>st</sup> one.

### **Angle only filter: Horizontal offset**

For each Angle Only observation the Horizontal angle is combined with the Distance and Vertical angle Measurements from the last full 3D (Angle and Distance) point observed.

### **Angle only filter: H and V Angle offset**

For each Angle Only observation the Horizontal and vertical angles are combined with the Distance Measurement from the last full 3D (Angle and Distance) point observed.



## Projects in TheoLt

### Function of the Project tab

To organise the data for adjustment, separation of pre- and post- adjust data, station numbering, room handling and QA verification TheoLt will create and store data files in a specific folder. The advantage of working with TheoLt Project folder is that entire data sets can be moved easily to and from field systems for data backup and integration. On first use a TheoLt project can be set or the 'default' project accepted.

- New site = new project

- New set up =new orientation

- By default the arx enabled versions of TheoLt will prompt AutoCAD to save the current drawing in the project folder.

- Work can be divided between projects and brought together using the project folder.

Projects are folders containing the survey data, orientation records, station lists, verification reports and calculation data which are required for operations such as QA, network calculation and grouped data processing ( such as room handling in building survey or post processing of radial observation by network adjustment) created as subfolders under a project path folder.

By default on start up TheoLt opens in the Project tab (this setting can be modified if desired: see TheoLt settings) a project can be created or selected to organise the survey data files.

### Default settings

TheoLt will open in the Project tab by default as a procedural aid. The last used project will be offered as the current project unless action is taken, (The 'start in project tab' behaviour can be changed in TheoLt settings)On installation a default project and project path are set; these locations can be modified to user requirement in settings (see Settings) For simplicity of data transfer the arx enabled versions of TheoLt will prompt AutoCAD to save the current drawing in the project folder this function can be disabled at the settings option in TheoLt Building Survey in AutoCAD

Each project contains:

- Project name

- Project description

- Project originator/author

- Date created

- Starting position number

- Last used Station position number

- A list of the station positions used

- A list of the orientations used in the project

- The position verification data for the project

- Optional: User formatted text data files(s)

- Optional: Unformatted raw instrument data file(s)

- Pro versions: Network adjustment reports, pre- and post- adjust station lists

Note: When editing a project the Starting Station/Reference number may be set. This allows each project to use a set station number range. For example: Project 1 may use Station Position numbers from 100 upwards; Project 2 may use Station Position numbers from 500 upwards

## Using the project manager

**Function** For maintaining station list integrity and controlling the saved project information.

## Operation

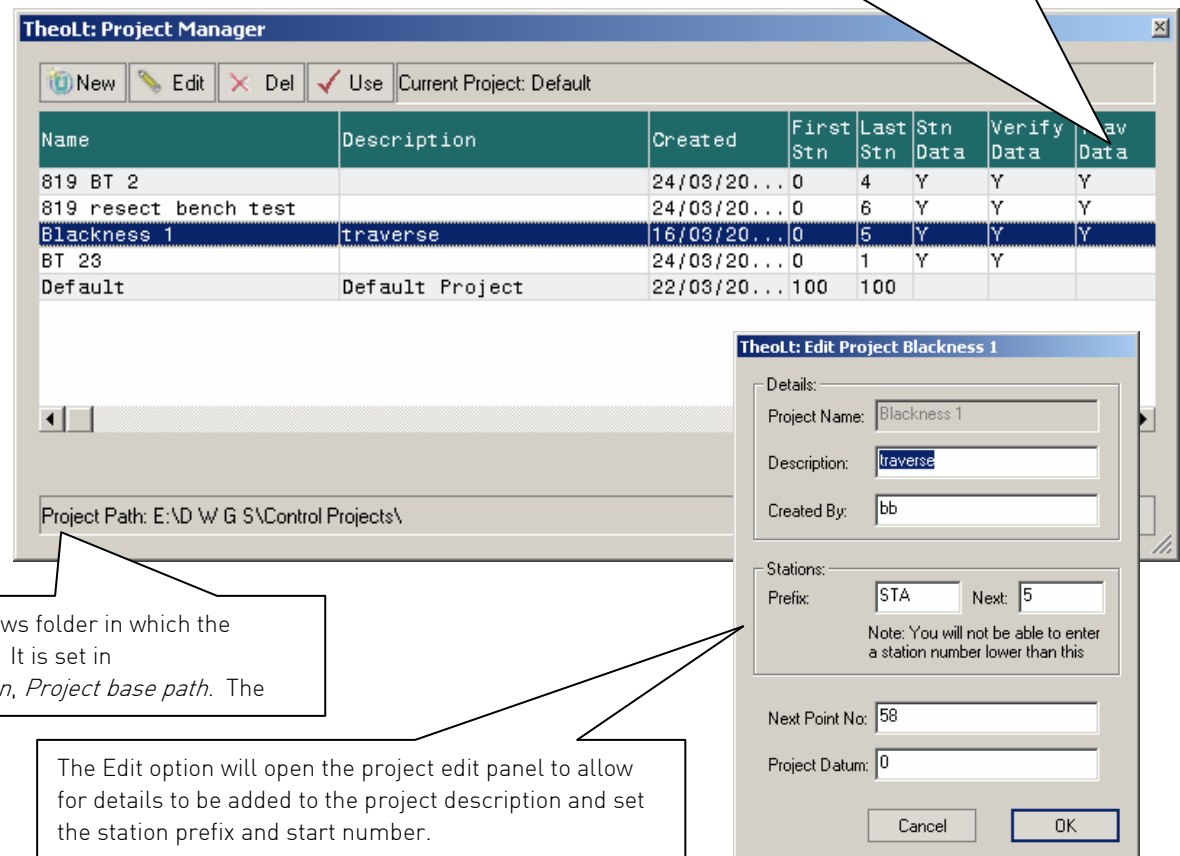
With the tab selected the TheoLt symbol button will open the Project Manger panel where the project list can be viewed.

An existing project can be selected by picking it in the list and selecting the 'Use' option or a new one created.

Project identity information can be added or amended with the 'Edit' tool

Folders which have been removed from the project path (using Windows explorer) can be removed from the list using the 'Del' option.

If network data is present in the project it will be indicated in the 'Trav Data' column.



The project path is the windows folder in which the project folders will be saved. It is set in Settings, *TheoLt23 Application, Project base path*. The

The Edit option will open the project edit panel to allow for details to be added to the project description and set the station prefix and start number.

## Control Tab

### Function of the Control tab

By selecting the control tab the controls for determining the origin, position and orientation of the measurement process are accessed.

### Operation of the Control tab

With the control tab selected all instrument data is treated as control data and TheoLt will respond to measurement data with requests for appropriate action to achieve control measurements.

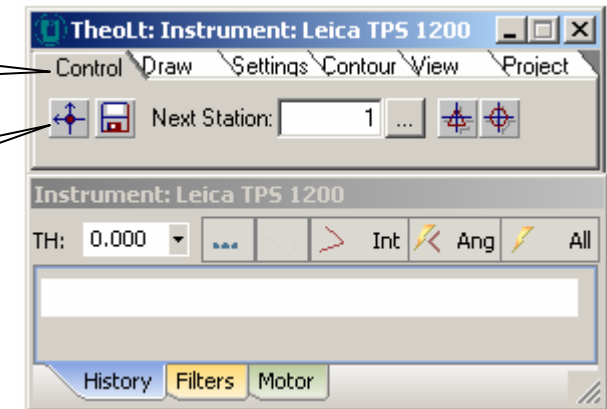
The tab displays 5 options. From left to right these are:

- Orientation
- Insert station list
- Amend next station number
- Insert Station symbol by AutoCAD pick
- Insert Reference position symbol by AutoCAD pick

The control tab is exited by either completing an orientation procedure or by selecting another tab (i.e. Draw)

The Control tab gives access to the station functions.

The orientation functions are accessed from the orientation button.



### Orientation options

On selection of the orientation option the orientation panel will open. This panel has 6 tabs (depending on the version of TheoLt deployed)

- Default orientation (including restore last orientation)
- Orientation to reference
- Resection
- Control stations
- Position verification
- Network adjustment



## Default orientation

**Function:** to insert a starting station into AutoCAD with an arbitrary co-ordinate value. Default orientation inserts a station block in the current AutoCAD drawing at the default position and assumes the horizontal angle of zero derived from the first instrument measurement to be 'North'.

**Operation:** The command is actioned by use of the 'orientate' button.

The arbitrary start position may be defined by the user by editing the E,N and H fields followed by the 'Set Default Position' the new value will be set as the default.

The survey drawing may be aligned to an existing object (such as a building façade) in AutoCAD so that the WCS is convenient to the model by using the 'Align with Plane' orientation option.

*Note the Default orientation cannot be undone once the station type is determined on action of the 'orientate' button. Errors at this stage (e.g. wrong Stn. Number, wrong Inst height) can only be rectified by starting a new project and repeating the operation.*

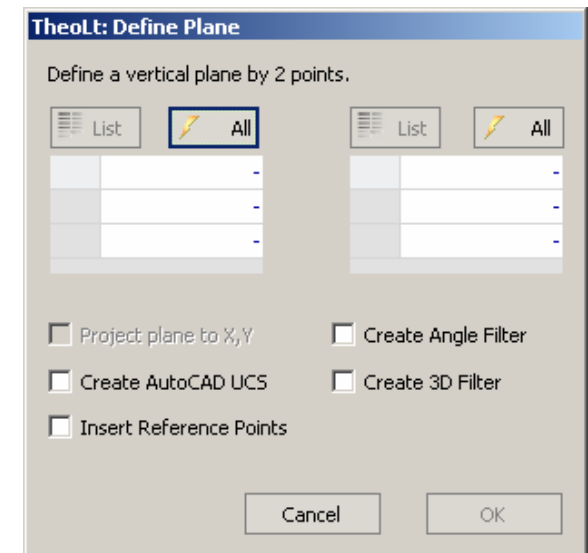
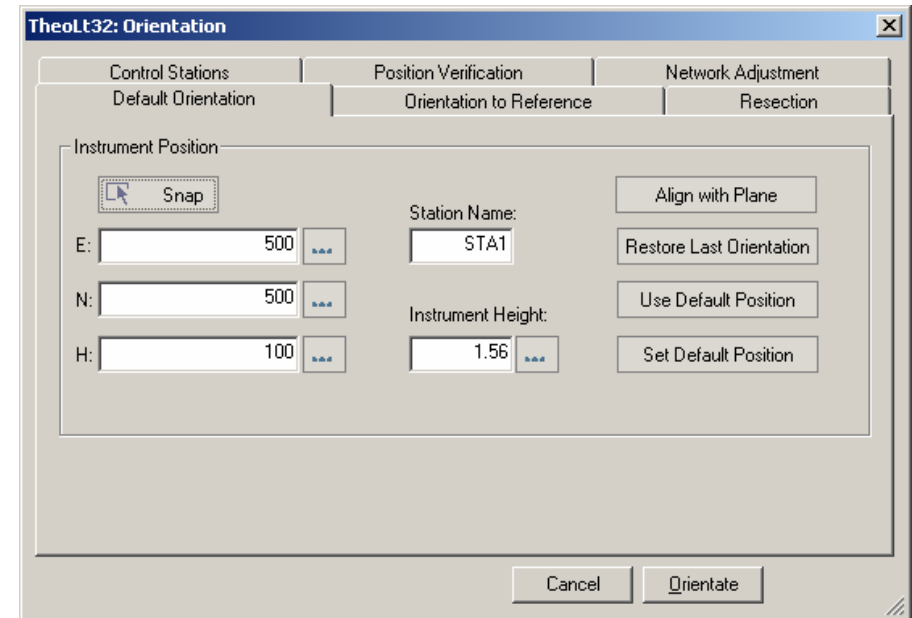
## Align with plane method

When starting a survey it may be desirable to align the principal axis of the building to the WCS of the drawing. This can be achieved by selecting the 'Align with Plane' option and selecting 2 points in turn (for example) on the building façade, TheoLt will then align the job accordingly. If the first point is taken on the left of the façade and the 2<sup>nd</sup> on the right the orientation will be correct for an AutoCAD 'front' view of the façade.

## Restore last orientation

When survey work is interrupted (for example to change a battery or if a Bluetooth link is lost) work can be resumed by resetting the orientation by using the Restore last Orientation option.

*Note: in the event of any instrument displacement the 'Restore last Orientation' option should NOT be used to re-establish orientation: the instrument should be re-levelled and a new orientation to reference or resection used.*



### About the TheoLt *station* and *reference* blocks.

The block used for marking station positions in the AutoCAD drawing file is specific to TheoLt it is installed in the *TheoLt blocks* folder (See *Settings, AutoCAD settings*, for options) The block has the following attributes which are automatically assigned on use:

- Station prefix
- Station ID (hidden)
- Station number
- Station insertion point
- Text insertion point

In addition the block is inserted on its native layer *Inst\_Cntl*. The block s can be inserted Manually by snapping to a drawing object or by typing the co-ordinate position into the command line.

By insertion using the station list table at orientation.

By insertion of a station list from a data file using the '*Import Control*' table.

The reference block has identical properties to the station block and is included as symbol for marking points which are not occupied (i.e. resection targets on a wall) as a visual cue.

### Station naming

Station naming is principally controlled by *TheoLt Project manager* under the *edit* option. In addition the station number is set at the counter in the control tab. 'On the fly' edits allow station prefixes to be appended (up to a 5 characters limit). Illegal station name edits (e.g. in conflict with existing station identities in the project) are rejected by blocking the station type selection.

Station names can be edited at:

The station name field at **Default Orientation**.

Station creation under the Control Tab or Network table at the **Control Type** prompt.

At the **Control Stations** table prior to occupation, reference to network or reference to orientation.

At Orientation by resection on creation of the station at the **Confirm Station Name** panel.

*Note: an attempt to duplicate a used station ID (this may differ from the station name, see Control Stations table) will prevent completion of the Control type panel. This can be resolved by extending the station prefix to fore the desired number.*

### Fixed and Unfixed station properties

In **TheoLt Project Manger** the prefix for all stations in the project is set here. Additional remark characters may be added at station creation up to 5 in total.

*Tip, if reverse counting is envisaged set the prefix to 2 of the 3 required characters and fill in the 3<sup>rd</sup> as stations are created.*

The Prefix is case sensitive.

The Station Number counter will start from 1 by default.

The Station Number counter controls the number. It is possible to set the next station number here provided it is not already allocated in the project.

The Station Prefix can be appended here. The number can be appended with an alpha suffix; the number is editable at the counter only.

The Station Type cannot be entered if an illegal Station name has been attempted.

The counter will be reset to the last value if the station is cancelled.

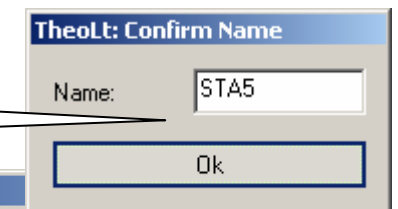
On election of the Control Symbol type TheoLt will prompt for the station condition in the network adjustment calculation. The condition can be left as unfixed and set as fixed in the Network Table if desired.

In TheoLt Pro fixed stations will not be adjusted in network computation. 2 fixed stations are required in a network to achieve adjustment. Stations assigned as 'Unfixed' will be subject to correction.

For users not wishing or unable to take advantage of network adjustment (Net adjust is a *Pro* option) this prompt can be disabled in TheoLt settings.

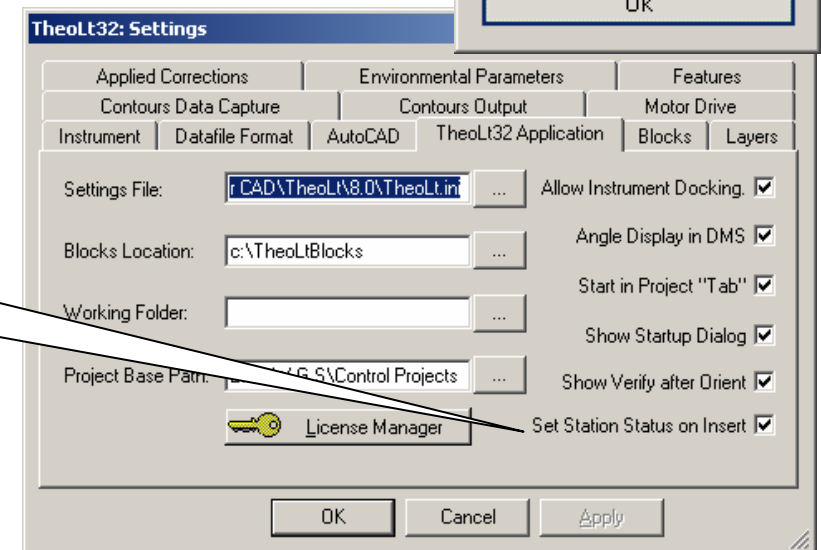


At resection the station name can be edited here. The Control type is set as a Station.



In settings the Station Status prompt can be turned off. If the station status is not set at insert it will need to be set for each station on opening the network table.

Users of non Pro editions may wish to skip the dialogue by un-checking the option.



(For more on network adjustment of stations see **Adjusted network control with TheoLt pro**. below)

## Orientation to reference

**Function:** To achieve an orientation based on a point of occupation and a point of reference. The distance and bearing between the two points is measured and the result compared against the computed distance derived from the given values.

**Operation:** The station positions are marked in AutoCAD with the appropriate block and the stations of occupation and reference are selected either from the drawing or from the station list.

With the 2 positions entered and the appropriate heights of instrument and target heights recorded the measurement data is used to achieve orientation with a report of the displacement between the set out and recorded distances expressed as either 2D or 3D misclosure.

When all fields are completed the orientation is written to AutoCAD, the data file and the position verification table by use of the '*orientate*' button.

The **select station panel** is accessed via the Stn List button; it displays the stations available in the project.

The required station is selected by a single click on the data row and actioned with the OK button.

A prompt for the height of instrument/target will follow.

The panel has options for inserting the selected station into the current drawing and also for adding a station by manual input.

TheoLt32: Orientation

Control Stations | Position Verification | Network Adjustment

Default Orientation | Orientation to Reference | Resection

Instrument Position: Snap Stn List

Reference Position: Snap Stn List

Instrument Height: 1.56

Target Height: 0.000

Swap

Observation: Ang All

Checking: 3D

Cancel Orientate

TheoLt: Select Station

Name	East	North	Height
Stn_A7	500.000	500.000	100.000
STA2a	1035.552	993.761	99.385
STA3	1096.688	1052.903	98.114
STA4	998.938	1028.595	99.754
STA1	1000.000	1000.000	100.000

New Insert Stn Insert Ref

Cancel OK

## Orientation by resection

**Function:** To plot and orientate an unknown position of occupation by reference to 2 or more points of known position.

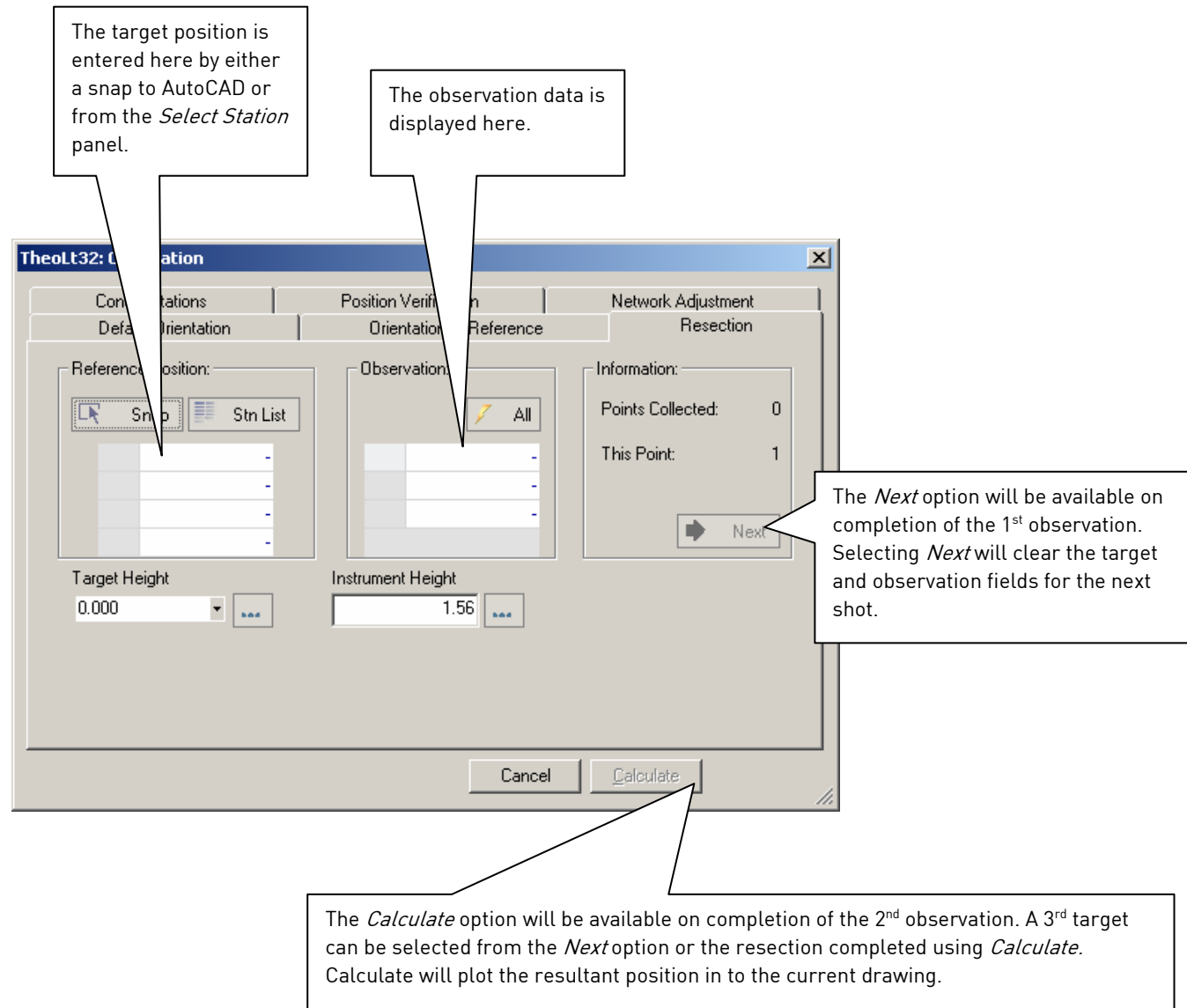
**Operation** The station positions are marked in AutoCAD with the appropriate block and the first reference station is selected either from the drawing or from the station list.

The instrument is aimed at the reference point, the measurement taken and the 'next point' option will be available.

When the 'next point' option is selected a new measurement panel appears and the process is repeated for the 2nd target.

With 2 measurement sets complete the both the 'Next point' and 'Calculate' option will be available.

On selection of 'calculate' the location of the instrument is calculated, a station block inserted in the AutoCAD drawing. If a third or further reference is required the 'Next point' option should be used until the set is complete.





## Position verification

### Function:

Used for cross checking the position and orientation of the instrument using known Reference or Station Control blocks (at any time) Exporting the report allows quality control documentation.

The function can be set to open after ordination (settings, Theolt32 tab, *show verify after orient* check box).

The table can be added to with additional orientation shots for confirmation of precision if desired. The table will record blunders and is a useful check on 2 observation resections where swapped targets can be undetected in the CAD plot.

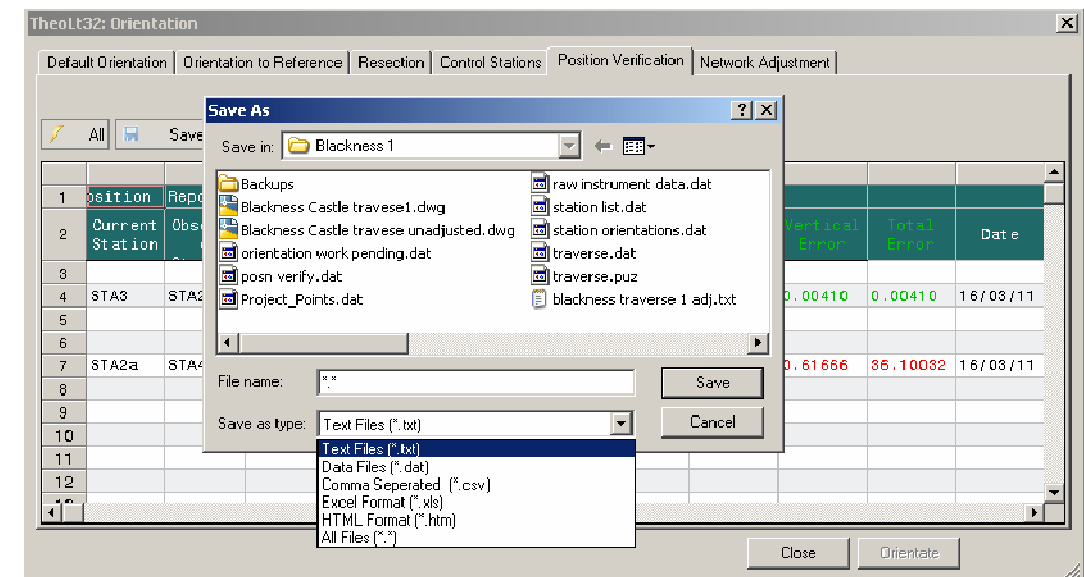
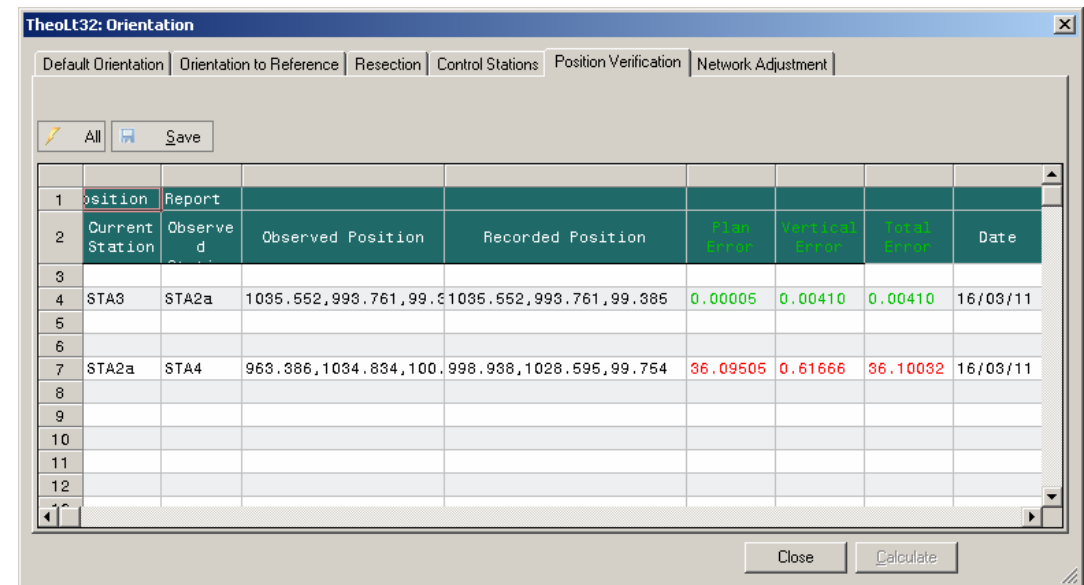
### Operation:

Selecting the Position verification tab opens the table.

New observations are added using the *All* button. there are no station details to enter in this panel as the current occupation data is used. Orientations with results out side the project tolerance\* are displayed in red.

The *Save* option writes out the table data in a selection of formats: txt, dat, csv, xls, html

\*the project tolerance is set at *Max Error* in settings, instrument tab



## Control stations List

### Function:

The Control Stations panel will allow

- stations and their associated observations to be removed from the project and network,
- station level (height ) values to be edited and fixed independently from network observations,
- deleted stations to be restored with suppressed observations for analysis.

The available stations in the project may be viewed, appended and the station names edited (provided they have not been used in the project). Level (Height or Z) values set in this panel will be fixed In Network Adjustment and not subject to distribution of height error on computation.

### Operation:

Selecting the Control Stations tab brings up the table.

New stations can be added to the list using the *Add* function which brings up an editable panel for the station data.

Stations which have been occupied or in use as targets are marked with a tick and may not be edited other than by level.

Revised Height information may be introduced to the station positions by editing the '*Level*' field; the edited value will persist and it will not be included in the distributed error calculation for z.

The values are applied by entering a tick (with a double click) in the '*Level?*' field it will be forced as a fixed height in the computation.

Data edited in the table is saved to the project data base on exiting the tab automatically.

The '*Save as*' function will export the station list as a data file in .txt,.dat,.csv,.xls,.htm formats.

The screenshot shows the 'TheoLt32: Orientation' dialog box with the 'Control Stations' tab selected. The 'Current Project' is 'Blackness 1' and 'Last Occ Str:' is empty. There are 'Add' and 'Save As' buttons. Below is a table with 14 rows and 8 columns: ID, Name, Position (X, Y, Z), Used (checkbox), Del (checkbox), Lvl? (checkbox), and Level (value). Rows 3-7 contain data for stations STA1, STA2, STA3, STA4, and STA7. Rows 8-14 are empty. The 'Used' column has green checkmarks for rows 3-7. The 'Lvl?' column has empty checkboxes for rows 3-7. The 'Level' column has values 100.000, 99.754, 98.114, 99.385, and 100.000 for rows 3-7 respectively. At the bottom are 'Cancel' and 'Orientate' buttons.

ID	Name	Position	Used	Del	Lvl?	Level	
1	Control List						
2	ID	Name	Position	Used	Del	Lvl?	Level
3	STA1	STA1	1000.000 1000.000 100.000 -	✓			100.000
4	STA2	STA4	998.938 1028.595 99.754 -	✓			99.754
5	STA3	STA3	1096.688 1052.903 98.114 -	✓			98.114
6	STA4	STA2a	1035.552 993.761 99.385 -	✓			99.385
7	STA7	Stn A7	500.000 500.000 100.000 -	✓			100.000
8							
9							
10							
11							
12							
13							
14							

### Station numbering: permitted numbers.

For compatibility with previous TheoLt project structure, station numbering is controlled by reference to a station ID. The ID may not be duplicated as a station name; this can occur when station numbering is allocated in reverse order as the station ID is incremented upwards. To avoid this, the station name can be altered. (For example: If STA 3 is rejected use STAa 3). TheoLt will not progress if a duplicate ID is attempted.

If reverse numbering is anticipated, a useful way of adding stations is to use an incomplete prefix at project creation and complete it at station creation.

## Adjusted network control with TheoLt pro

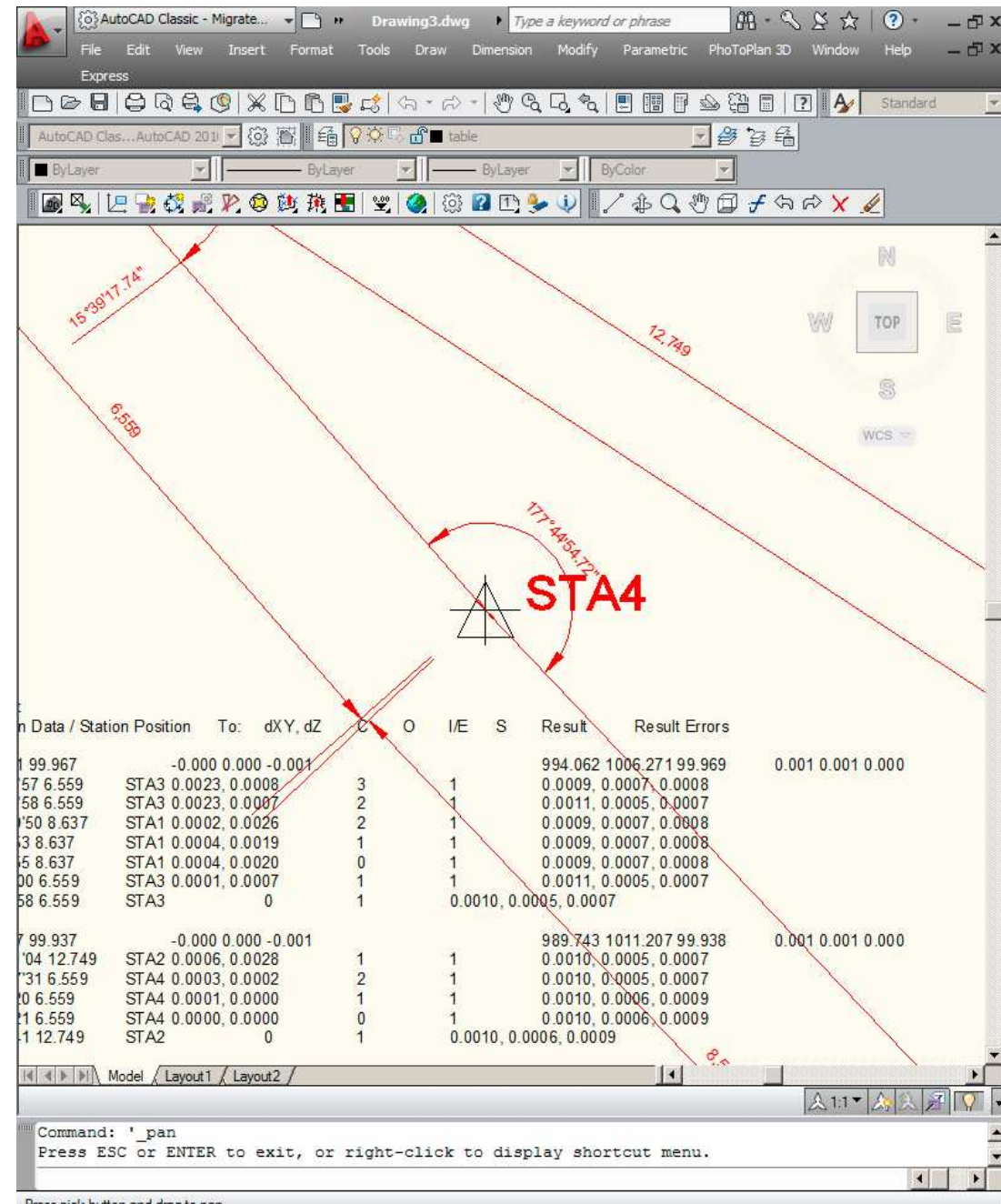
### Key concepts

TheoLt pro includes a real-time least squares method network solution. This enables the surveyor to establish fully adjusted control data based on real-time user monitored site measurement.

The Network adjust function is actioned using the tab on the orientation dialog panel.

There are 5 key concepts:

- The active Network Adjustment table
- Least squares distributed error
- Graphical data review in AutoCAD
- Real-time shot by shot quality check
- Adjustment, Station and observation reporting



## The Network Adjustment table

The Network Adjustment function will operate with the current project station list; it will prompt for the addition of new station data should the network list be incomplete. The data display can be resized. The table will appear in the order of station creation. The table is active in that it will display the condition of the observation sets as measured relative to the station set out data. The observations are colour coded according to their condition: the default tolerance is set at 10mm.

Green within tolerance

Brown: close to tolerance limit

Red: exceeding tolerance.

With the table open all measurements are treated as active network data. The project tolerance is set at *Max Error* in settings, instrument tab.

## Fixed and Unfixed stations

TheoLtr8pro requires 2 fixed stations in order to compute a network. Fixed stations will be unaffected by the adjustment process. The station status can be set on creation or at any stage prior to calculation. The fixed stations may be unselected and alternates used if desired to test the distribution of the misclosure under different constraints.

## Station data sets

For TheoLt to compute the network each station requires 3 data components to be completed.

Orientation data

Set out fore station data

At least 1 set of observations to all set out stations

AND the orientation reference (taken IN the NetAdjust panel)

TheoLt32: Orientation

Default Orientation

Orientation to Reference

Resection

Control Stations

Position Verification

Network Adjustment

Current Project: Blackness 1

Last Occ Strn: Stn A7

Last Occ Ht: 0

All

Save As

Data Rpt

View

Rebuild

Calc

Apply

1	Network Adjustment													
2	Name	Observation Data / Station Position			To:	dXY, dZ			C	O	I/E	S	Result	Result Error
3														
4	STA3	1096.688	1052.903	98.114		0.001	-0.001	0.002			✓		1096.68	0.000 0.000 0.000
5		232°12'59	270°56'43	85.073	STA2a	0.0017,	0.0029			3	✓	1		
6		232°12'59	270°56'44	85.072	STA2a	0.0019,	0.0025			2	✓	1		
7		247°34'55	271°02'13	110.234	STA1	0.0037,	0.0074			3	✓	1		
8		67°34'60	88°57'28	110.233	STA1	0.0062,	0.0028			2	✓	1		
9		67°34'60	88°57'27	110.233	STA1	0.0062,	0.0033			1	✓	1		
10		67°35'08	88°57'28	110.234	STA1	0.0105,	0.0028			0	✗	1		
11		52°12'55	89°03'02	85.072	STA2a	0.0010,	0.0033			1	✓	1		
12		52°12'55	89°02'60	85.073	STA2a					0	✓	1		
13														
14	STA2a	1035.552	993.761	99.385		-					✓		-	-
15		257°02'14	90°56'42	85.073	STA3	0.0008,	0.0033			3	✓	2		
16		77°02'03	269°03'03	85.073	STA3	0.0037,	0.0029			2	✓	2		
17		257°02'14	90°56'51	85.073	STA3	0.0008,	0.0004			1	✓	2		
18		257°02'12	90°56'50	85.073	STA3	0.0000,	0.0000			0	✓	2		
19		311°02'22	270°56'36	36.100	STA1	0.0007,	0.0016			3	✓	2		
20		311°02'19	270°56'47	36.100	STA1	0.0012,	0.0004			2	✓	2		
21		344°39'36	270°17'01	50.538	STA4	0.0001,	0.0032			3	✓	2		
22		344°39'34	270°17'01	50.538	STA4	0.0004,	0.0032			2	✓	2		
23		164°39'38	89°42'50	50.538	STA4	0.0006,	0.0010			1	✓	2		
24		164°39'38	89°42'50	50.538	STA4	0.0006,	0.0010			0	✓	2		
25		131°02'26	89°03'03	36.101	STA1	0.0009,	0.0021			1	✓	2		
26		131°02'26	89°03'02	36.100	STA1	0.0001,	0.0023			0	✓	2		
27														
28	STA4	998.938	1028.595	99.754		-							-	-
29	STA1	1000.000	1000.000	100.000		-							-	-
30		87°52'16	269°18'15	28.617	STA4	0.0006,	0.0050			2	✓	1		
31		189°57'13	269°02'43	36.100	STA2a	0.0001,	0.0056			2	✓	1		
32		9°57'12	90°56'52	36.100	STA2a	0.0002,	0.0012			1	✓	1		
33		267°52'17	90°41'10	28.617	STA4	0.0004,	0.0002			1	✓	1		
34		9°57'13	90°56'45	36.100	STA2a					0	✓	1		
35		267°52'20	90°41'09	28.617	STA4					0	✓	1		
36														

Close

Orientate

Measurements may be taken on both faces of the instrument and may be 'one way' reflectorless observations to reference targets (e.g. to be used as reference stations for future resections).

*Note: Leica 1200 series instruments with a single face control panel reverse the recorded horizontal angle reading on face 2 when data is sent from the instrument: this is effect is avoided if data is called from TheoLt using the All button in the table.*

### Data quality check

*Calc* can be used to check data conformity at any time. The Calc function will analyse the data and present an up date of the adjusted station positions at any time during data capture as a check on the quality of work and as a proof of data conformity. *View* will plot the current network observation data to the current DWG. On use of *view* the instrument observation data is plotted, as a ray, in a discrete layer, updated on each use of the view command.

### Data safety and reporting

Project data backup, and export for sub-networks are managed by the options available on completion of calculation actioned by the 'Apply' option. Backup and reporting are available in a variety of formats at anytime during data capture. The Apply options allow the network data to be stored as **raw data** (using the TheoLt data file *see settings, datafile* ), **pre and post adjusted station lists** and **DWG**. New projects with the adjusted data as fixed stations can be created for the use of sub-networks for minor control of detail survey if required.

### Primary (Network) orientation (including orientation to GPS derived data)

The 2 required fixed stations will determine the orientation of the network. If 2 stations have been established from GPS only one should be fixed. The second may be used for orientation but should NOT be assigned a fixed status nor included in the network loop as if more than one GPS derived position is included a distribution of a disproportionate error across Total Station measurement will occur.

### Orientation procedure at Station Occupation

Orient to reference or resection used. Once the orientation is complete fore-stations should be set out with the appropriate target heights assigned.

### Station observation sets

Once orientation and setting out stations is complete a complete observation set is required. A single round including the backsight and all set out stns will suffice but multiple rounds will improve precision. TheoLt NetAdjust will automatically prompt for station ID and target height.

### Checking progress

Calc and view will update the table and DWG respectively. The calc will display the current state of the network distribution of error in RED. An indication of a complete station data set comprises an '**O**' **column** value indicating observation status and a concomitant '**S**' **column** value indicating station set status to the required targets.

### **Dealing with corrupted station locations and orientation (other than stations derived by resection)**

If the instrument is dis-levelled when setting out a station it is possible to set out a forward station with a corrupted location. To recover from this the station of occupation should be re-levelled and re-oriented and the station set out in error removed from the calculation using the Control Stations table. A new station at the correct location should be established with a new name. It is possible to correct the station name prior to occupation by using the *Control stations* tab,

### **Adding reference points for resection**

One way shots can be included in the network. They should be added using the control tab procedure outside the NetAdjust tab. Target heights for reflectorless shots should be set to zero. Once set out the targets should be re-observed to complete a station data set.

### **Closing procedure-(including the closing angle)**

On re-occupation of the 1<sup>st</sup> station on the loop the closing angles are measured. The procedure is the same as for any other station occupation. Orientation should be established and a complete data set is required.

### **Extension of Network**

Any station can be re-occupied and new stations added to extend the network

### **Save, Report, Calculate:**

On completion of the observations Back up and review the collected data BEFORE proceeding with the adjustment. Remember this is a network so there will be no prompt for the status of a loop closed or other wise:

- write out a report which will save the precision data of the observation sets.

- save the data as a pre-adjust file

- view the network diagram in AutoCAD to check for missing legs, if there are any these should be addressed BEFORE applying the adjustment.

Once you are satisfied you have secured the unadjusted observation data select 'Calc' and the table will be reformatted to include the adjusted positions of the stations.

## Traversing with TheoNetAdjust: Field procedure

### Set up a Project

Create a new project, (see p 17) check that the project parameters are as required and make the project current.

The project is selected from the table and confirmed with the 'Use' tick.

If you need to know more about a given project select it and use the 'edit' function to reveal its properties.

*Note that projects can only be deleted by removing the appropriate folder from the system. The del function will only hide the project from the list in the current TheoLt session. The root folder for projects is set in the TheoLt settings tab, spanner button, under TheoLt 32 Application settings, 'project base path'.*

**Open an AutoCAD drawing** and save it to the project path: this drawing will be the plot of the network. If the application *TheoDisto.arx*\* is loaded in the current drawing session you may collect radial observation data from each station on occupation and include them in the adjustment on completion of the network.

*\*The AutoCAD extended applications (Theocontour, Theodisto,) are installed as part of the 'pro' option in the programme root directory and will need to be loaded in AutoCAD on first use.*

### Choose orientation tool at 1<sup>st</sup> station

Switch to the Control tab. Open the orientation panel. You now have choices dependant on several factors, viz:

**Arbitrary orientation:** If you are setting up for the first time on a new site you may wish to use arbitrary station values: perform a default orientation (first setting the Az=0 on the TST at a convenient angle for fitting your survey on screen in CAD). Remember to insert the instrument height correctly.

### If Using OSNG Data from Smartstation/GPS

You will need to add the co-ordinate data of 2 OSNG stations to the project station list. The list is available in the Orient to Reference dialogue. Key in the coordinates in the 'New (Manual) Station' panel accessed from the 'New' button in the station list panel. Only one of the GPS derived stations should be assigned a 'fixed' status, the other will be used as the opening reference station.

### Orient to reference/back sight.

Carry out the orientation taking care to enter the instrument and target heights correctly.

**Set out foresight station:** In the NetAdjust panel or under the control tab set out the foresight station(s) recording their target heights correctly.

**Add a station observation set to the Network Adjustment table.** In the Network Adjustment panel, you will be prompted as to the status of the new stations. Choose 'Fixed' for the starting station and the foresight, 'Unfixed' for any GPS reference other than a single starting station. Take round(s) to the stations. On observation to

each target you will now be prompted to confirm the station ID and the target height. Only the opening station and the first foresight should be fixed. Now, with the Network Adjustment panel open, take your sets (see 3 'Taking the Sets') to this station. You will see the measurements being added to the list.

### **Advance to foresight**

On occupation of the next station on the network carry out an orient to reference to the previously occupied station. Set out the next foresight station and add it to the survey. The observation to the new station will prompt a station type dialogue: the status should be set to 'unfixed'. With the orientation complete and all new stations set out.

### **Extend the network**

More stations can be added by following the sequence from 'Set out foresight Stn' to 'Advance to foresight' above.

### **Taking the sets.**

TheoNetAdjust will auto detect the target station and prompt for confirmation of the target height for each station found in your round. On completion of the first round (on face 1) transit to face 2 on the last target and repeat the round on face 2. Note that you will get running feedback on the quality of the rounds shot by shot. The observation count will increment in the observation data/.station position column of the network table. The quality of the shots is indicated in the colour coded dxy/dz column. Poor shots should be flagged by a double click in the I/E (include/exclude in computation) column marked as a red cross in the table.

*Note a 'round' of observations is a completed sequence of shots to the required stations on one face, a 'set' is at least 1 round on 1 face ,inclusive of the orientation and station set-out observations. Because TheoLt uses a network adjustment method you are not restricted to back sight foresight observations: you may include as many different stations as you wish in the observation set.*

### **Progress the loop:**

Repeat the orient to reference sequence at each occupation, stepping forward one station at a time until you have closed the loop, Use the 'view' option to update the CAD plot of the network in the current drawing file.

*Note that the lines on the diagram represent observations; the arrow head indicates the direction of measurement.*

### **Closing the loop:**

On measurement back to a previously occupied station you will be prompted for the height of target: if you have reset the target over the point enter the new target height and take the closing rounds.

*The view command will confirm the state of the network but will NOT reveal the missing closing angle unless inspected closely, the completed network will need shots to and from each station the shot rays shown should not be mistaken for fully complete station data sets.*



### Apply the distributed correction

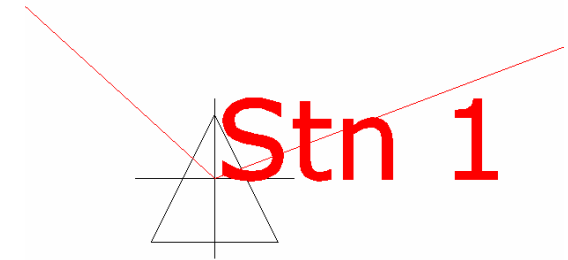
The distributed station displacements are displayed in the dxy/dz column. If you are happy with the distribution select *Apply* and choose an option:

1. **Create new project** which will fix the adjusted values in a new project folder
2. **Adjust station positions** in both the table AND the current drawing file
3. **Adjust station positions** and detail: provided the correct ARX application is active in AutoCAD the radial observations from each station will be adjusted to scale and orientation based on the station new positions achieved by the network distribution of error.

**Option 1** will allow import of the station data into a new dwg using the TheoLt import option as fixed stations, for distribution to other members of a survey team to ensure network consistency in a multi drawing project.

**Options 2 and 3** will create a new drawing with the adjusted data by default.

After calculation the view option will plot the adjusted station positions as shown. If the distributed error is excessive do not apply the calculation but remove the observations indicated as of excessive error by a double click in the I/E (include/exclude in computation) column marked as a red cross in the table, re run the calculation and check the result. If there is insufficient data available to compute the network no calculation will be achieved.



The common insertion point for text and control block indicates the *theodisto.arx* is active at station creation.



The offset common insertion points for text and control block indicates the *theodisto.arx* is NOT active at station creation.

## IMPORTING CONTROL

Control data can be imported in a variety of formats; TheoLt will import its own *station list.dat* files, on selection, automatically into the current project, station list and the current drawing file.

Be sure to create/set a new project and have an open drawing file.

The file is selected from the browser and the available formats are shown. The native *station list.dat* file will load on selection other types will require formatting using the *Import Control table*.

For all other formats:

- Select the [Control] Tab.

- Select [Import Control] button

- Click the [Browse] [...] buttons to select the station text file.

- The file will appear in the lower window in a single column (all grey).

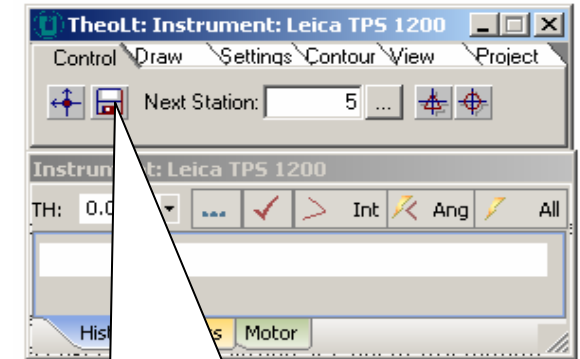
To select the Column delimiter (in this file, a comma), ensure the Data Delimiter is empty. The file should spread to multiple columns as shown.

The column headings need to be assigned by a right click in the appropriate column heading by selection from the menu: the minimum required fields are:

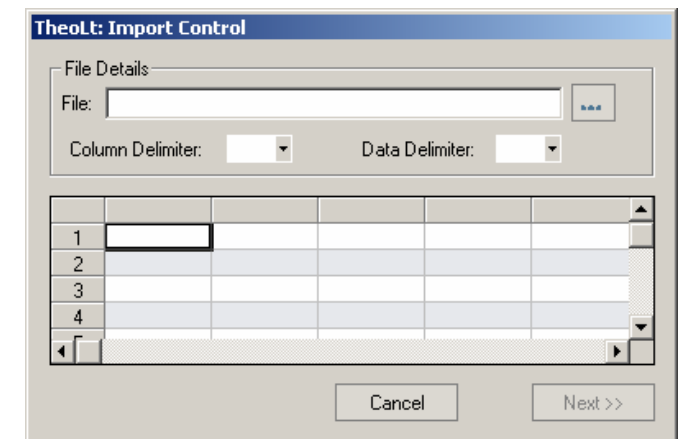
- Target Stn,
- Easting,
- Northing
- Height.

As each column is assigned, the background will change from grey.

On clicking the [next] option the stations will be imported into both the project station list, the current drawing as station blocks and listed in the Station List windows for orientation.



In the control tab this button will open the import control function.



## The Draw Tab

**Function:** To enable plotting instrument data into AutoCAD as points, lines or symbol entities. The Draw tab has a number of tools available to achieve basic drawing functions in AutoCAD.

**Drawing Modes:** The pull down list of modes will 'filter' the instrument data according to selection.

**Transparent :** This is the default mode as it simply sends the data to the command line for use with AutoCAD commands like 'line', 'point' base and copy point for copy etc.

When using draw modes other than transparent the AutoCAD command line must be clear of all entries, any unresolved commands will interrupt the action of the drawing modes.

*Note: AutoCAD 'Polyline' will not accept 3D data for the second point as it is a 2D command and TheoLt sends full 3D data to the command line. If 2D data is required select the appropriate mode from the drawing modes in TheoLt.*

**2D line:** Plots a 2D line bases on the Z of the 1<sup>st</sup> point in the line

**3D line** Plots a 3D line with a 2D echo

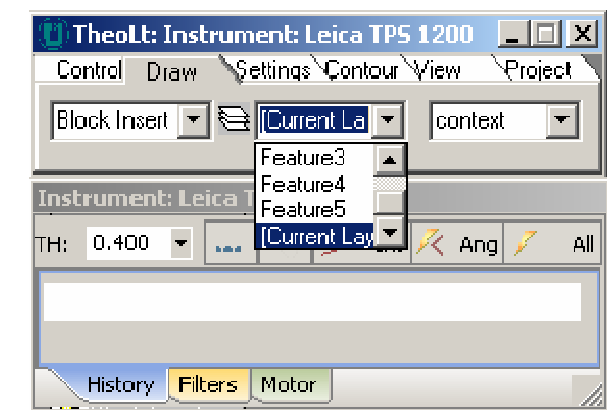
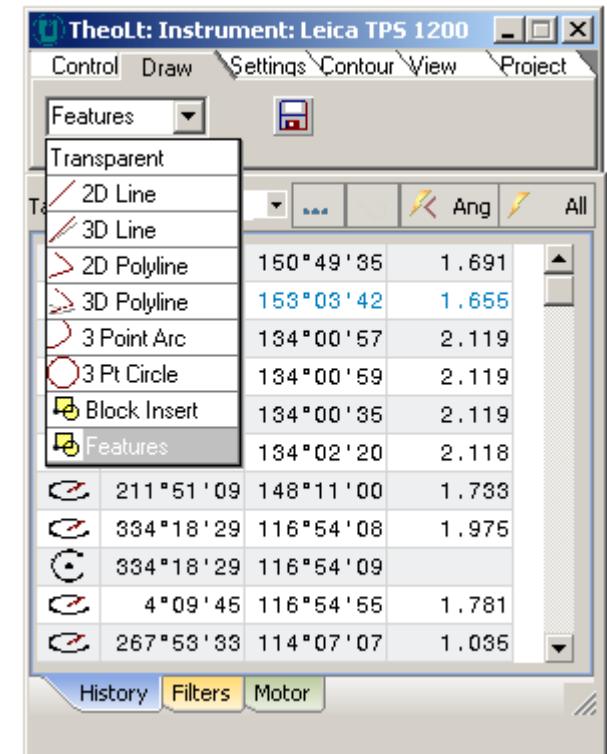
**2D poly line:** plots a 2D polyline based on the Z value of the 1<sup>st</sup> point (substitute for AutoCAD poly line)

**3 point Arc.** Plots a 2D arc in 3D space based on a local UCS placed on the 3 points measured,

**3 point Circle.** Plots a Circle in 3D space based on a local UCS places on the 3 points,

**Block insert.** Places a block at the point of measurement, the block and layer are selectable from the pull-down lists.

**Features.** Opens the features panel (see 'working with blocks and features' )



## The history panel

(see also p 14)

**Function:** To provide a live review of instrument data and quick access to the measurement stack for use in the AutoCAD command line.

Data is identified by symbol as

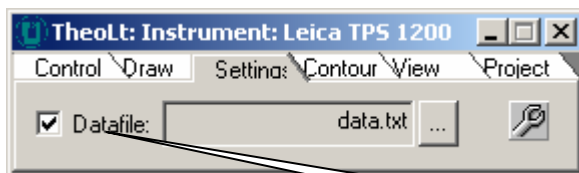
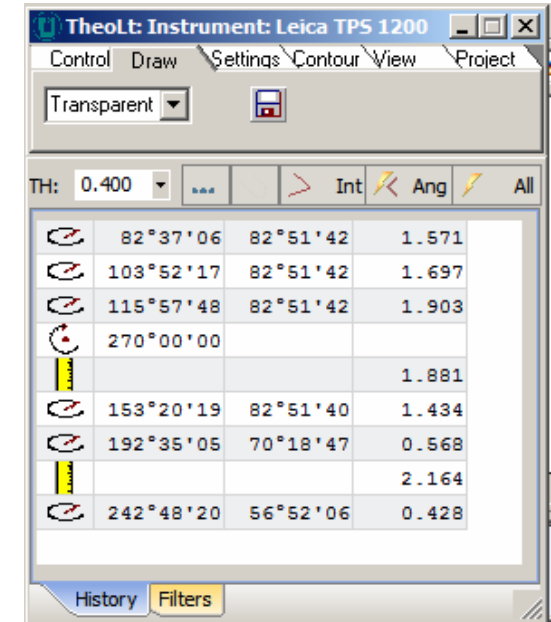
3D angle and distance,

Distance only

Angle only

The angle data is displayed as decimal degrees or DMS according to user selection at settings, TheoLt32 Application tab' Angle Display in DMS check box.

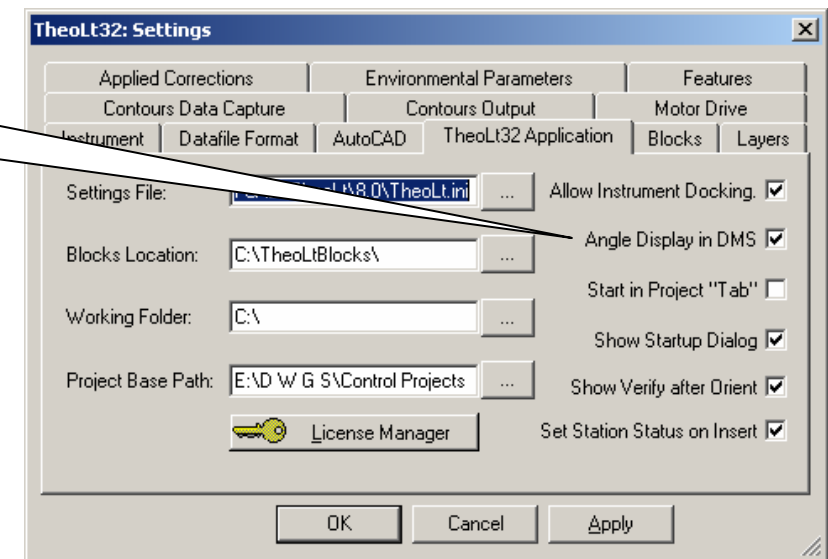
**Operation:** The observation data in the history panel can be sent to the command line of the current drawing with a single pick.



*Note that the history stack is not stored on closing TheoLt but is available as a data file in the project folder provided the Data file checkbox is selected.*

If the raw data needs to be saved beyond the current session it can be stored as a data file if selected here.

The angle display can be switched from Decimal degrees to DMS here.



The history panel is a very effective route for adapt entry in to AutoCAD with the Disto and as 'redo' tool for missed AutoCAD command entry.

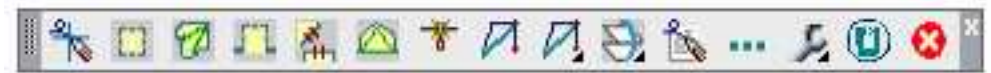
## Working with DistToPlan arx tools

Authorised users of TheoLt for building Survey (TBS) will have access to the AutoCAD/BricsCAD extended toolsets: this is a series of CAD tools developed for building survey drawing production. They are operable (in most cases) by either Disto ('Distance mode') or TST ('points mode') and include a block library prepared for fitting by survey measurement.

The tools are added to AutoCAD as an ARX programme extension and are installed as show on Page 6 and 11 of this manual.

Using instrument data in the command line to drive AutoCAD is effective for those commands which respond to the data but *TheoLt features* use of prepared attributed blocks which can speed up the insertion process by determining the insertion point, XX YY scaling rotation etc

The tools are loaded in to AutoCAD/Bricscad and accessible by toolbar or menu commands.



The Bricscad version of the toolbar has a slightly different layout to the AutoCAD version but the commands are equivalent.

Block symbols, furniture, doors windows stair etc are accessed from the TheoLt *Features palette* as shown on p61 and 62



## DistToPlan commands

Sketch & Measure  
Rectangular room

Room plan  
Square feature  
Align  
Arc to line  
Outline wall

Points on a line  
Fit to brace  
Measure brace & fix  
Measure brace & fix  
flyout

fit closed outline  
close & distribute  
close 2 walls  
edit wall length  
fix point  
fix line  
join walls  
draw brace

Layer group flyout

Room manager  
station manager  
Plan builder

Add journal note  
Show Keypad  
Start comms  
Cancel

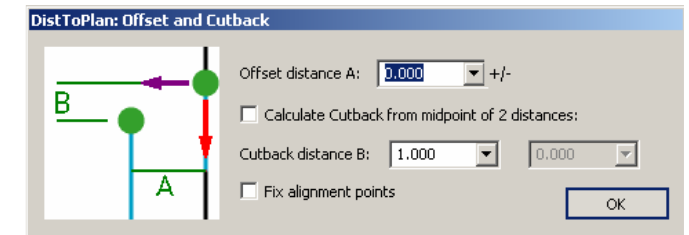
## Function

Quick start outline plan.  
Builds rectangles from width, breadth and diagonal measurements.  
Multi modal command: uses left, right, tie and brace.  
Builds indents into a wall.  
Room fitting tool based on wall thicknesses.  
Fits an arc to endpoints of a base line by 2 diagonals.  
Corner closing line for TST measure of wall faces.

Breaks a line into nodes.  
Adds diagonal measurement.  
Builds plan lines by active triangulation or intersection of diagonals.

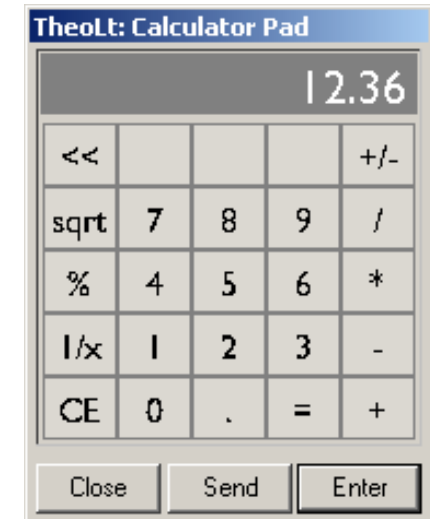
Forces misclosure.  
Distributes misclosure.  
Forces corner.  
Revises wall length.  
Prior to adjustment 2 fixed points on the room perimeter are required.  
They can be selected as points or as a single line.  
Extends wall lines to fit.  
Plots annotated diagonal line.

Groups room data.  
Lists active stations (TST function).  
Opens features palette.  
Fixed external reference to the current drawing.  
Direct to command line entry for numeric data, opens on top of AutoCAD  
Opens TheoLt.  
Stops DistToPlan commands.



The **align** command uses the offset and cutback panel for distance entry.

The calculator **keypad** feeds hand measured distances direct to the command line.



## Sketch & Measure command



**Function:** to get room plan outlines done by drawing a sketch and then measuring it. By tracing the room outline in AutoCAD and then applying the measurement to the sketch a plan can be swiftly completed. DistToPlan will re-scale the sketch as the measurements are applied.

### Operation

1. **Ensure the current drawing is in WCS. Pick the command.** (theosketchmeasure) It is operated from the tool bar,

Notice that the command opens the Sketch options panel and starts a 'graduated cross-hair pointer in AutoCAD. The gridded cross-hair is to assist in scaling your sketch: the grid steps are set at 1m by default to get the sketch in a scalable range ready for measurement.

Zoom in so that the cross hair spacing is at a size you are happy with (in other words so that the sketch will be roughly to size, it doesn't have to be exact...]

The default setting for the grid is 1m this may be changed in the Grid Step field in the panel. The grid step is only a guide and the precision of the sketch need not be absolute.

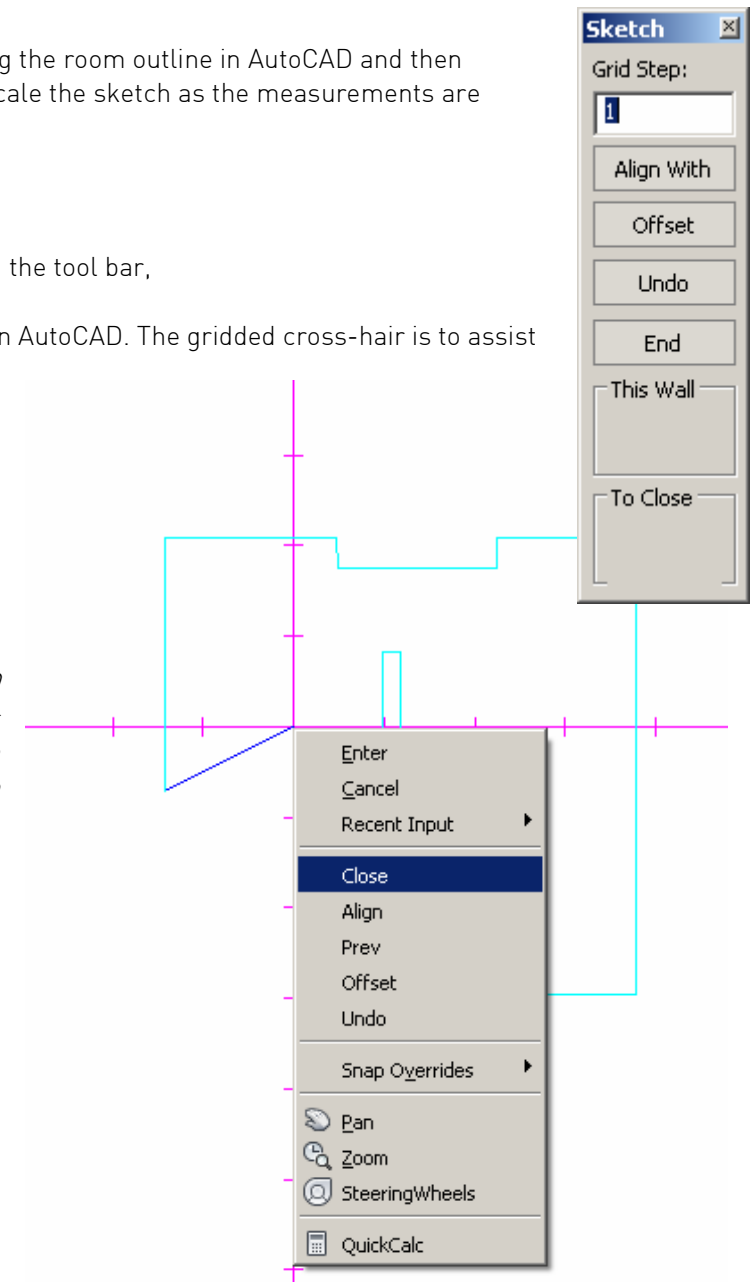
*Note: When using the sketch tool keep within the command as using other standard AutoCAD command will force the sketch to close and break the measurement sequence. The command is designed to be completed in the following sequence: Trace the line and finish with 'End' from the panel or 'close' from the right click context menu or 'C' at the command line and then proceed to use the Measure panel.*

2. **Sketch the plan.** The sketch tool operates with a 'rubber band' graphic. The sketch will snap to the end points of room lines where appropriate: The AutoCAD command line responds with:

Command: theosketchmeasure Layer Group: [None]. Room: [None]. Station: [None]  
Pick point [Close/Align/Prev/Offset/Undo]:

### 3. Measure the plan.

On closing the sketch the Pen Panel will prompt for with the 'Measure' option. Measurements are matched to the sketch



In measure mode a pick box replaces the cursor and on selection of a line on the sketch a direction arrow will be shown: The direction arrow indicates the direction of adjustment that will be applied.

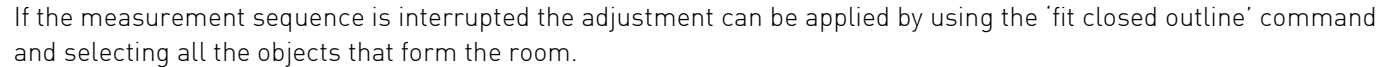
Distances are applied in response to the command line request:

Measured distances by Disto can be added directly or by clicking the TheoLt history panel. As the measurements are added the sketch is annotated with the measurements.

Braces can be added at any time by selecting the 'Add Brace' option, picking the wall line for the start and of the brace. On insertion of a brace DistToPlan may prompt a misclosure message. If the error between the brace and the drawing is accepted with the 'yes' option the brace measurement is included in the overall adjustment of the room. This means the room shape will change (e.g. go out of square on adjustment) If 'no' is selected the brace will not change the room shape (i.e it remains square) but the brace will be included in the least squares "fit room" process. The error is detailed on the Disto\_Errors layer.

Further braces can be added as required. Provided the measurement sequence is not interrupted the whole figure will be adjusted on selecting 'done'

If the measurement sequence is un-interrupted the 'Done' option in the Measure panel will initiate the adjustment of the measured room perimeter.



The top screenshot shows the 'Measure' tool interface. It includes a 'Measure' button, an 'Add brace' button, an 'Opening' button, a 'Fix Line' button, a 'Fix Pt' button, and a 'To do:' section with 'To Do: 0' and 'Fixed: 0'. A 'Done' button is at the bottom. The middle screenshot shows the tool being used to measure a wall angle, with a 'Wall Angle: 180.00' displayed. The bottom screenshot shows the tool being used to measure a room's area, with a 'Room: 180.00' displayed.



Node	State	X	Y	Z	E(X)	E(Y)	E(Z)
1	Overdetermined	134.968	174.625	-0.000	0.000	0.000	0.000
2	Overdetermined	136.836	174.604	-0.000	0.000	0.000	0.000
3	Overdetermined	136.836	176.166	-0.000	0.000	0.000	0.000
4	Overdetermined	137.035	176.166	-0.000	0.000	0.000	0.000
5	Overdetermined	137.035	174.605	-0.000	0.000	0.001	0.000
6	Overdetermined	138.640	174.605	-0.000	0.000	0.001	0.000
7	Overdetermined	138.640	172.422	-0.000	0.000	0.001	0.000
8	Overdetermined	140.176	172.422	-0.000	0.000	0.001	0.000
9	Overdetermined	140.174	177.422	0.000	0.000	0.001	0.000
10	Overdetermined	138.638	177.423	0.000	0.000	0.001	0.000
11	Overdetermined	138.638	177.083	0.000	0.000	0.000	0.000
12	Overdetermined	136.886	177.083	0.000	0.000	0.000	0.000
13	ControlPoint	136.868	177.427	0.000			
14	ControlPoint	134.968	177.427	0.000			

Adjustment is dependent on 2 fixed points or a fixed wall being identified on the perimeter.

*Note: The fixed points must not be adjacent to the point of misclosure.*

The adjusted results are plotted on the *Disto\_Walls* layer and the unadjusted lines retained on the layer *Disto\_History*.

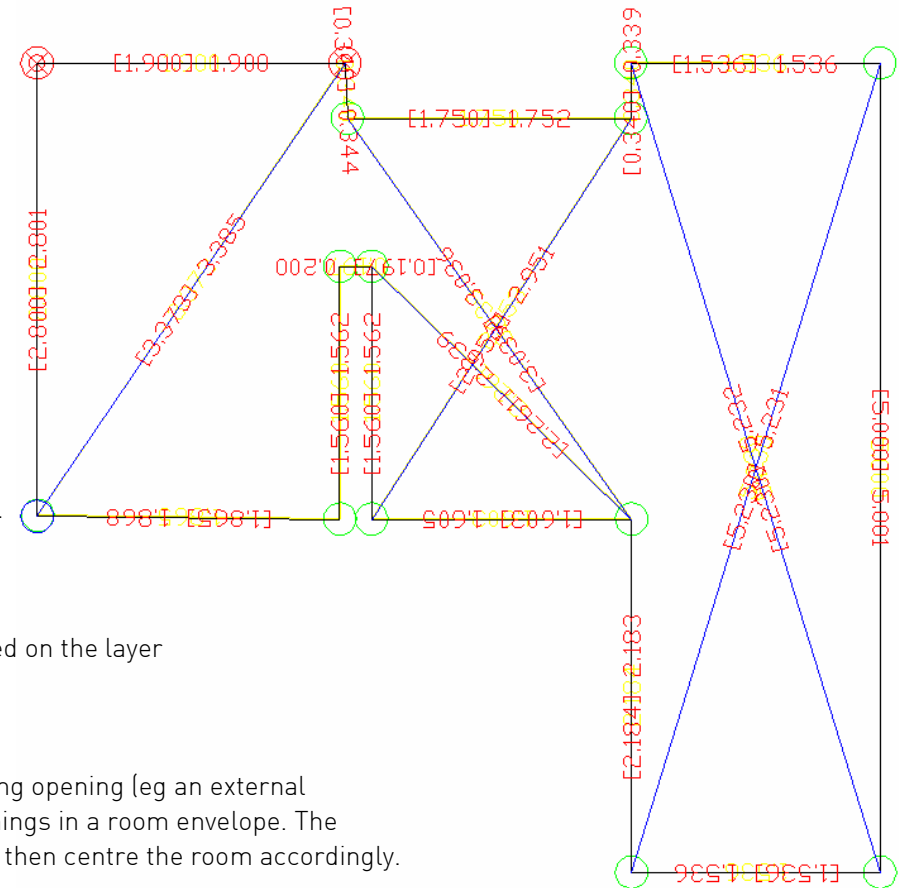
### 'Opening' option

The opening command is used as a positioning aid for placing the room outline on n existing opening (eg an external wall line with window openings typically measured by TST). It is not a tool for plotting openings in a room envelope. The command will prompt for the wall line and window returns from an external envelope and then centre the room accordingly.

### Align Option

Aligns the cursor to a selected line to position a sketch accordingly

**Offset option in sketch** The Offset option is used as a positioning aid for placing a wall line relative to an existing line. It will allow wall thickness to be plotted relative to existing wall lines.



## Rectangular room command



**Function:** to get room plan plans done by developing rectangles as the base geometry prior to completion by use of the rectangular feature command.

### Operation

**Pick the command.** (THEODROOM) It is operated from the tool bar, the AutoCAD command line will respond with:

Enter Length of Room:

When the distance is entered the next prompt is:

Enter Width of Room:

When this value is entered a further prompt requests a brace:

Enter Diagonal of Room. <Enter> to ignore:

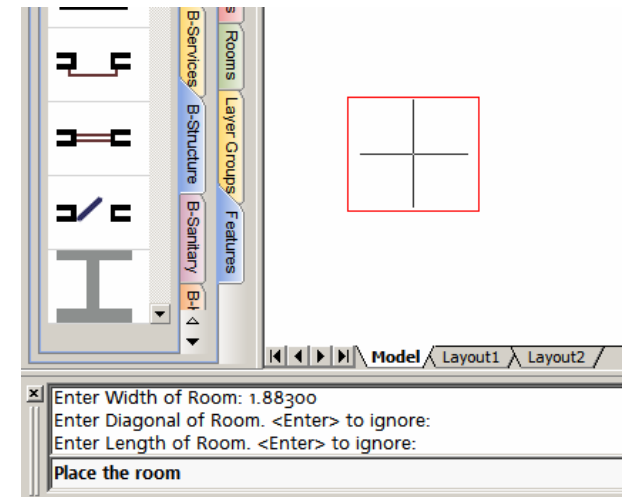
Which can be skipped. The sequence is repeated for averaging if required, if not the requests can be skipped with an enter reply. The command line dialogue will then request:

Place the room

a temporary graphic of the rectangle is attached to the cursor in the graphics area; it can be paced with a pick. The command line will now request alignment of the rectangle; this should be cancelled with 'esc' for the first room as there are no object to align it to!

Moving to the next room the command can be repeated and the 'align' applied on placing the room in the drawing.

The *align* command is also available as a stand alone command which can be used on any selection of objects.



## Align command



**Function:** to fit two rooms together to form a contiguous plan by aligning wall lines.

**Operation:** The command is available by itself or as a prompted command on completion of the room outline commands, *sketch & measure*, *rectangular room* etc..

**Pick the command.** (theodalign) It is operated from the tool bar, the AutoCAD command line will respond with:

Select room objects:

On selection the command line will report:

Select Reference Point for alignment. <esc> to cancel align:

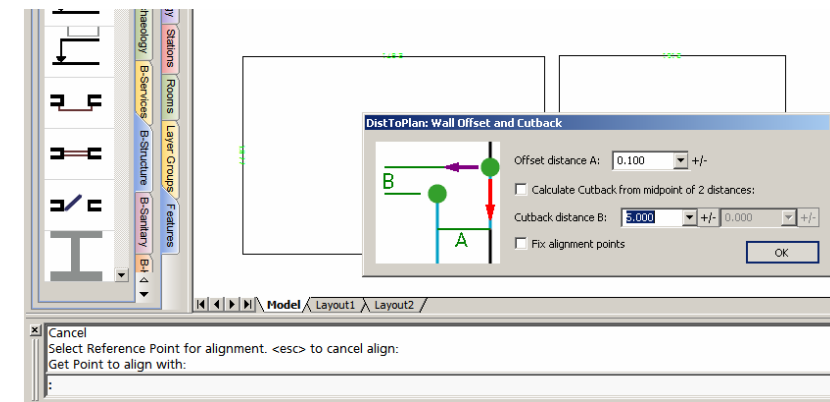
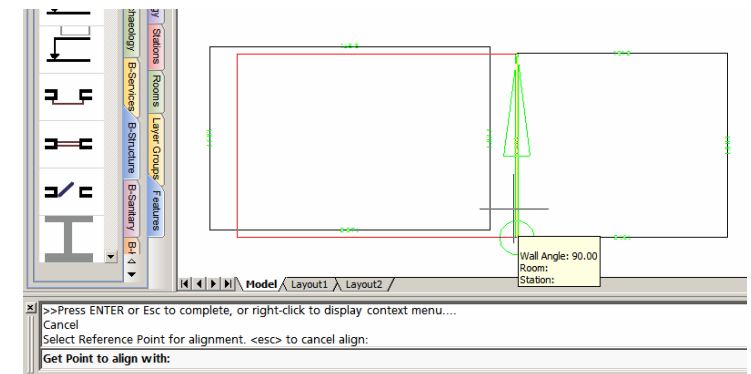
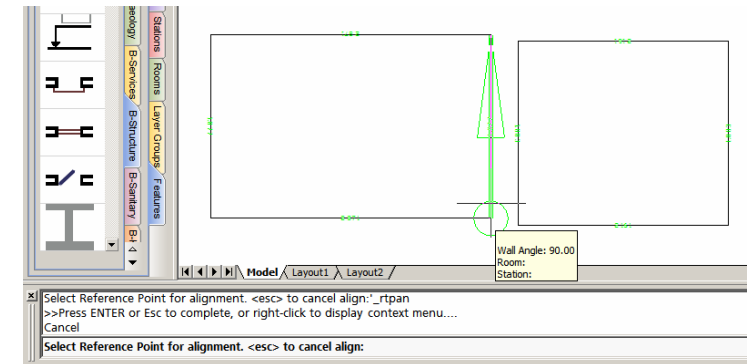
a temporary graphic will appear in the graphics area when the cursor is held over the wall lines of the selected room, the graphic indicates the reference point and orientation of the selection, it will snap to end and mid points of lines. The reference point is picked with a click near the desired point on a wall line and the command line will prompt:

Get Point to align with:

a temporary graphic will appear in the graphics area when the cursor is held over the wall lines of the wall to be aligned with, its behaviour is the same as for the reference selection, match the wall lines required for the alignment and pick on the target line: the *Offset & Cutback* panel will appear:

The thickness of the wall is entered into the panel (with the field active it will accept data from the Disto) as *Distance 'A'*. A staggered offset is achieved by adding a value to Distance 'B', if the rooms are to be joined parallel in both directions then select the zero value for 'B'. On picking the 'ok' button the alignment is completed.

*Note: the same Offset & Cutback panel is used to position features selected from the Plan builder panel (see Working with blocks and features)*



## Roomplan command



**Function:** to generate outline plans of rooms using direction data from either the Disto or from manual input. The command includes least squares adjustment which, provided sufficient data is available, will distribute misclosure and fit geometry accordingly.

*NOTE this command is modal: it will operate in one of 2 modes, 'Angle' and 'diagonal' care should be taken to ensure the correct mode is selected BEFORE entering data. Angle mode corresponds to the Disto direction arrows and diagonal is used for developing geometry by intersection of braces.*

**Operation:** Pick the command. (theodiregular) It is operated from the tool bar, the AutoCAD command line will respond with:

Enter base wall length [Continue\_Existing]:

When the distance is entered the first line is placed in the graphics area using the auto prompted *align* command to position the line as required. A request to identify the start point for the next line is made:

Select the end of the wall to work from:

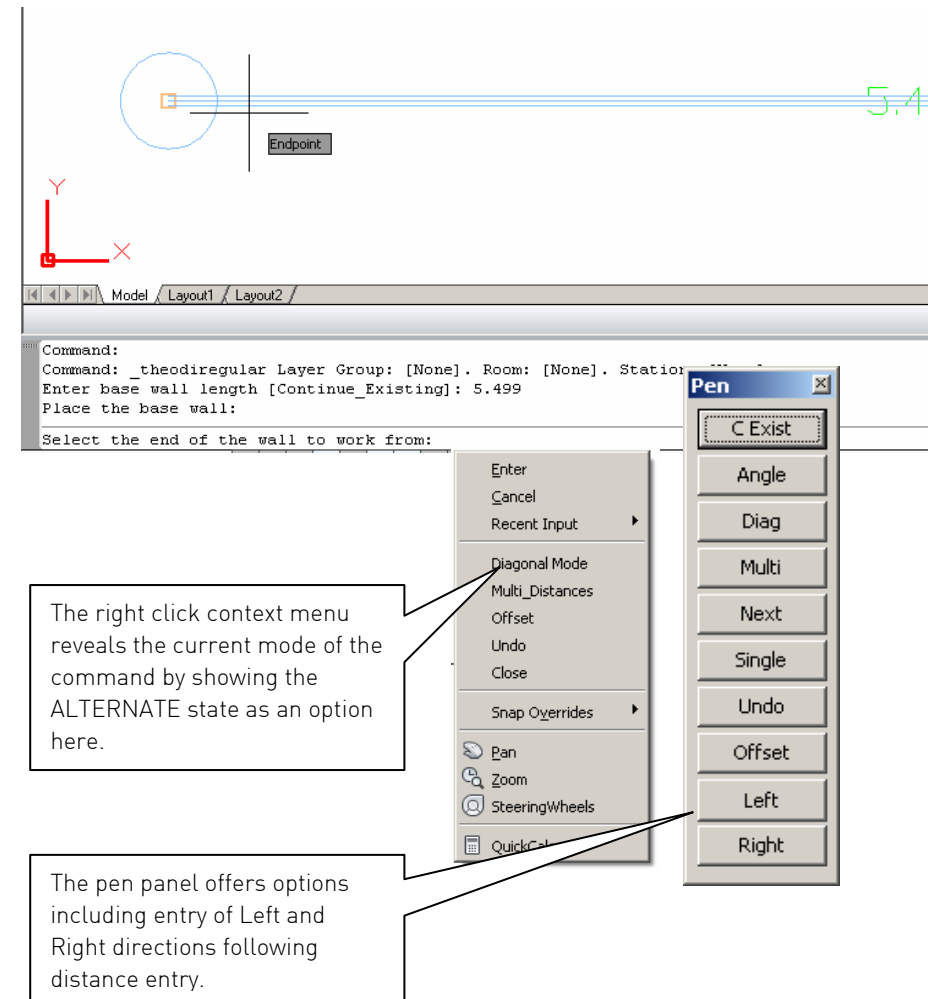
A temporary graphic will highlight the selection and the distance for the next wall is entered.

*Note: the mode is revealed by the context menu shown on a right click in the graphics area: the UNSELECTED is displayed as a toggle option. 'UP- Down left- right' directions for the line are 'Angle' mode.*

With the distance entered the direction **relative to the direction of measurement** is required, the direction can be entered as an angle value at the command line, as a pick from the pen panel or as a pick from the context menu.

Mode=Angle. Enter wall length [Diagonal Mode/Multi\_Distances/Offset]: 5  
Enter relative angle of Wall [0 =Ahead/90 =Left/270 =Right/180 =Opening/Undo]: 270  
Room Misclosure:7.432 (x=5.499, y=5.000)

The distance to the end point of the start line is reported in the command line as the lines are measured.



## Adjustment at 'close'

When the last distance is entered select 'Close' and the room perimeter will be offered for adjustment on response to the message: 'Do you wish to end with the current line then check and adjust?'

If 'yes' is selected the *Measure panel* will open and a line in the perimeter fixed by use of the 'Fix Line' option. Once a line or 2 points are fixed 'Done' will action the adjustment.

### Report of all Node Data

Node	State	X	Y	Z	E(X)	E(Y)	E(Z)
1	Overdetermined	166.307	92.432	-0.000	0.028	0.012	0.001
2	Overdetermined	166.307	93.929	-0.000	0.028	0.025	0.001
3	Overdetermined	164.306	93.929	-0.000	0.025	0.025	0.001
4	Overdetermined	164.306	95.426	-0.000	0.025	0.024	0.001
5	Overdetermined	166.304	95.426	-0.000	0.001	0.024	0.001
6	ControlPoint	166.304	97.423	0.000			
7	ControlPoint	156.304	97.423	0.000			
8	Overdetermined	156.305	92.434	-0.000	0.004	0.014	0.002

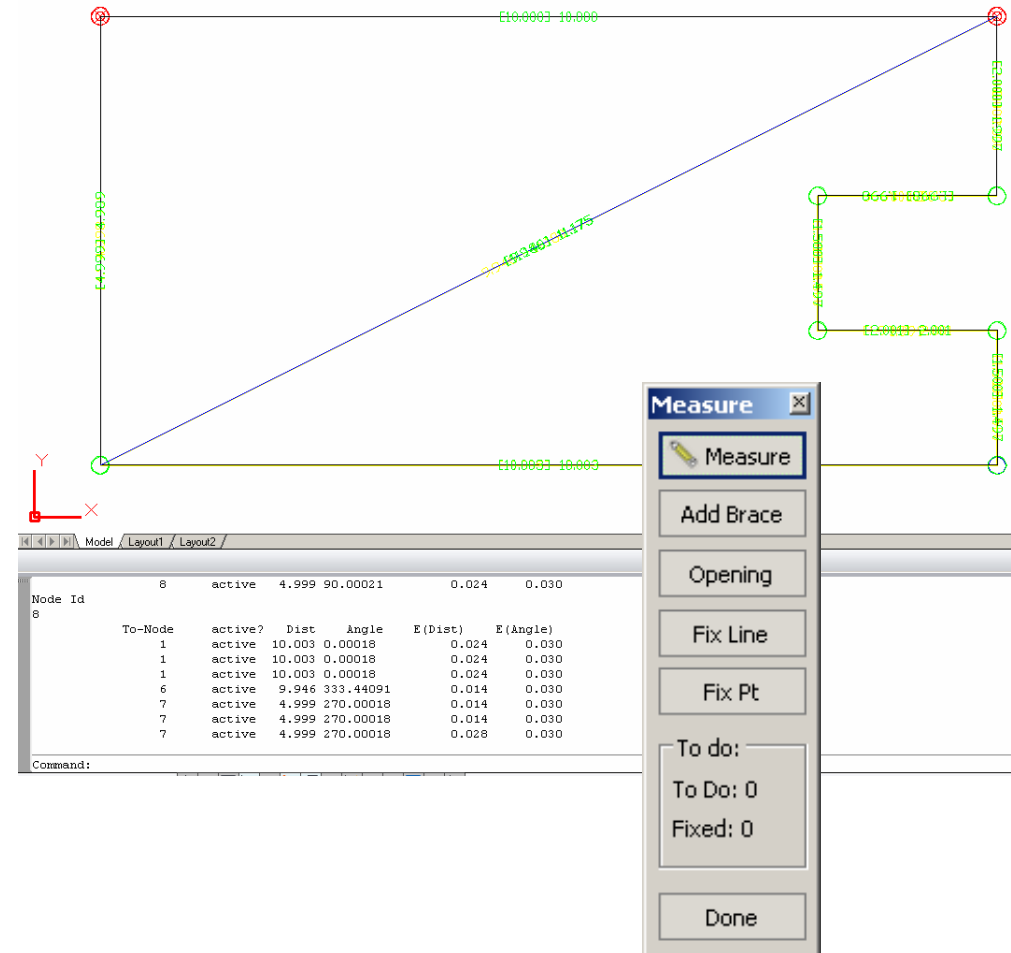
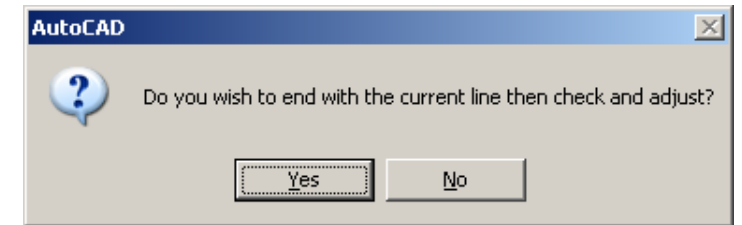
The adjusted distances are plotted on a separate layer and a report on the transformation is made in the command line. For computation requires 2 fixed points (or a line) the fixed points should not include the points of closure.

If the command sequence is interrupted the adjustment can be operated by use of the command *theofitclosed* and selecting the object to be adjusted.

Adding a brace can be achieved by opening the sketch &measure command, picking tin the graphics area, and switching to the measure panel with *esc*.

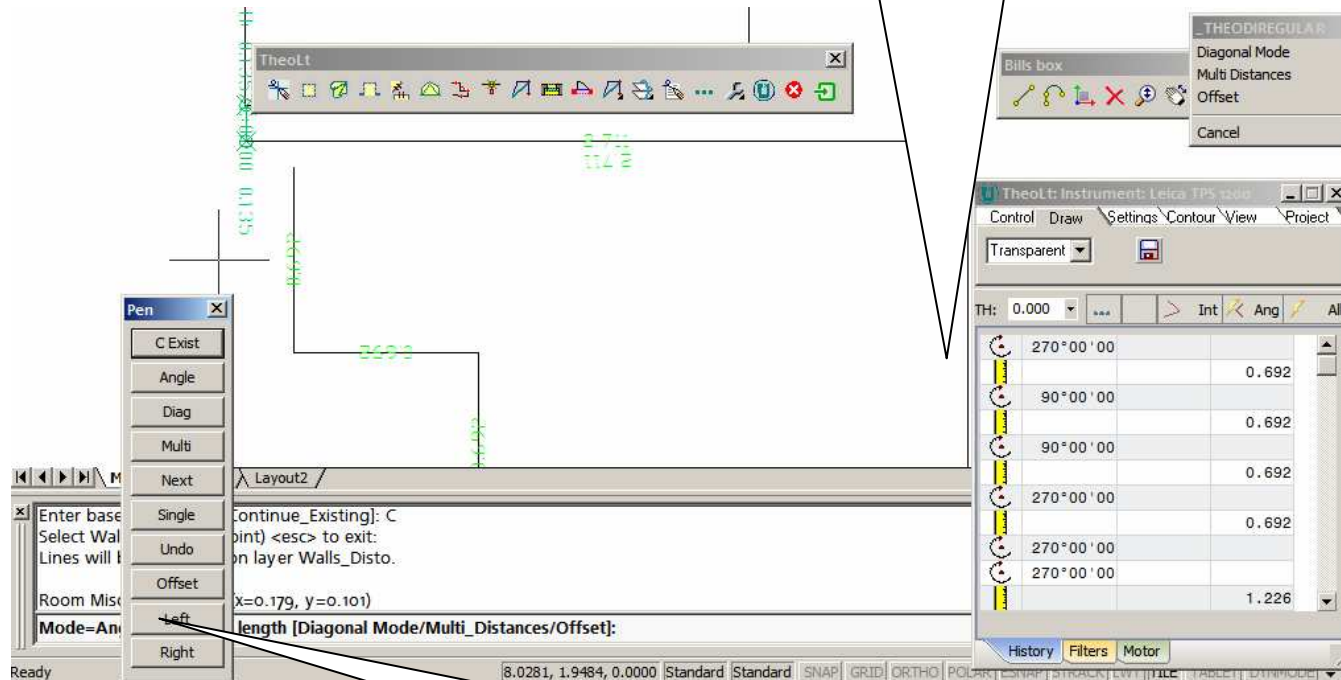
## Adjustment report

A report can be prepared by copying and pasting out of the AutoCAD command line. The measurement data will also be recorded as a TheoLt data file in the project folder.



## Using the Disto Direction keys in 'Angle' mode

The direction keys on the Disto can be used with the 'Angle' mode in the *Roomplan* (theodirregular) command. Following the command line prompts first the distance and then the angle (direction) is sent. The direction keys are operated as a 2<sup>nd</sup> function, the Disto display will indicate the state with a 2<sup>nd</sup> icon in the top right of the display.



theodirregular

Mode=Angle. Enter wall length [Diagonal Mode/Multi\_Distances/Offset]: 2.71100

Enter relative angle of Wall [0 =Ahead/90 =Left/270 =Right/180 =Opening /Undo]: 270

Room Misclosure:3.834 (x=2.711, y=2.711)

Mode=Angle. Enter wall length [Diagonal Mode/Multi\_Distances/Offset/Undo/Close]: 2.53200

Enter relative angle of Wall [0 =Ahead/90 =Left/270 =Right/180 =Opening /Undo]: 270

The room measure pen panel has an alternate direction button.

The Disto display shows the state of the keys with an icon in the top right.



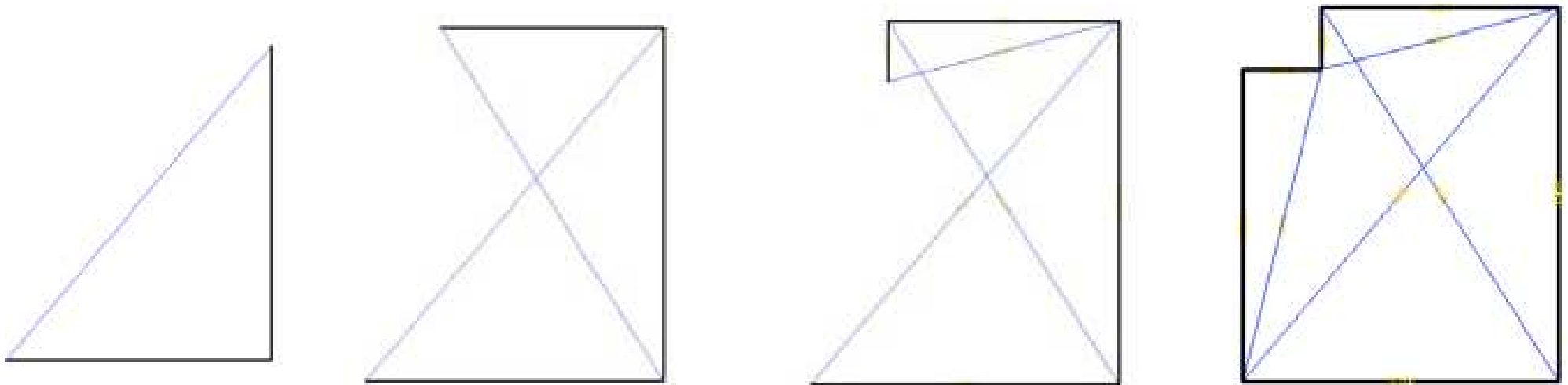
### Diag mode

The room geometry is built up from the baseline by triangles as they are measured. The preview graphic aids the placement of the measured lines by offering alternate geometries (e.g. left and right of the baseline) when available. The plan may be constructed by direction of wall with right-angled corners if so desired by using the appropriate pen key on the panel.

To accommodate common measurement practice the room plan command will plot wall lines in one of 2 modes: *Diagonal* or *Angle*. The command will start in the last used mode. The current mode is indicated in the command line when the second distance is prompted. Diagonal mode plots wall line based on closed triangles. The command can be used for single triangles but is configured to prompt for the building of the room plan by basing the next triangle on the previously measured one.

The procedure for plotting by triangulation (diag mode) is as follows

- ◆ Enter base wall length and place it: Ensure AutoCAD snap to endpoint is ON.
- ◆ Select the end to work from. This is the end you will measure the next wall from.
- ◆ Measure the next wall and the diagonal.
- ◆ The unfixed endpoint will be displayed as a temporary graphic: move the cursor to see the options possible for closing the triangle Preview the fit by moving the cursor Snap the diagonal back to the base. Close with esc.



Once the first triangle is placed diagonal mode prompts for the last measured wall as the base for the next triangle. The room plan is built up with each new triangle based on the last measured wall.

## Square feature command

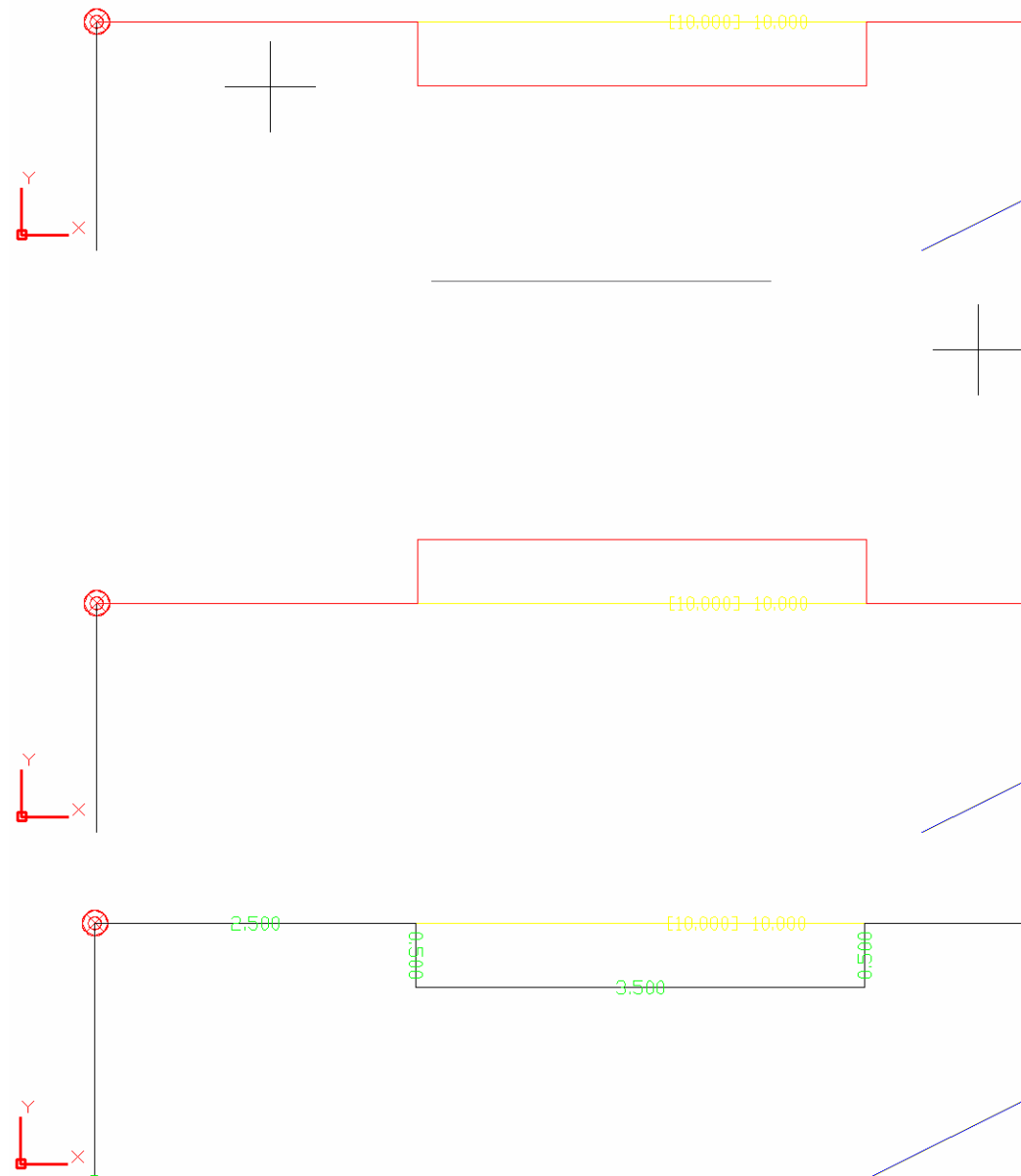


**Function:** to develop detail in a room plan outline with indents, alcoves and returns etc.

**Operation:** The command will prompt for selection of a wall line; pick the line near the end pint from which measurement will commence. Follow the data entry sequence prompted on the command line and the select the side of the line for the indent.

```
Command: _theodsqfeatue Layer Group: [None]. Room: [None].  
Station: [None]  
Select Wall (near starting end point) [Points_Mode]:  
Enter distance along wall: <0.000>: 2.5  
Enter feature length at wall: 3.5  
Enter feature length at extent <3.500>:  
Enter feature (perpendicular) depth: .5  
Select location of feature:  
Draw line across feature? [Yes/No]: N
```

*Note this command can be used to plot chamfered indents (such as bay windows) by using an appropriate distance for the 'feature length at extent' request.*





## Arc to line command



**Function:** to plot an arc from distance measurements by intersection.

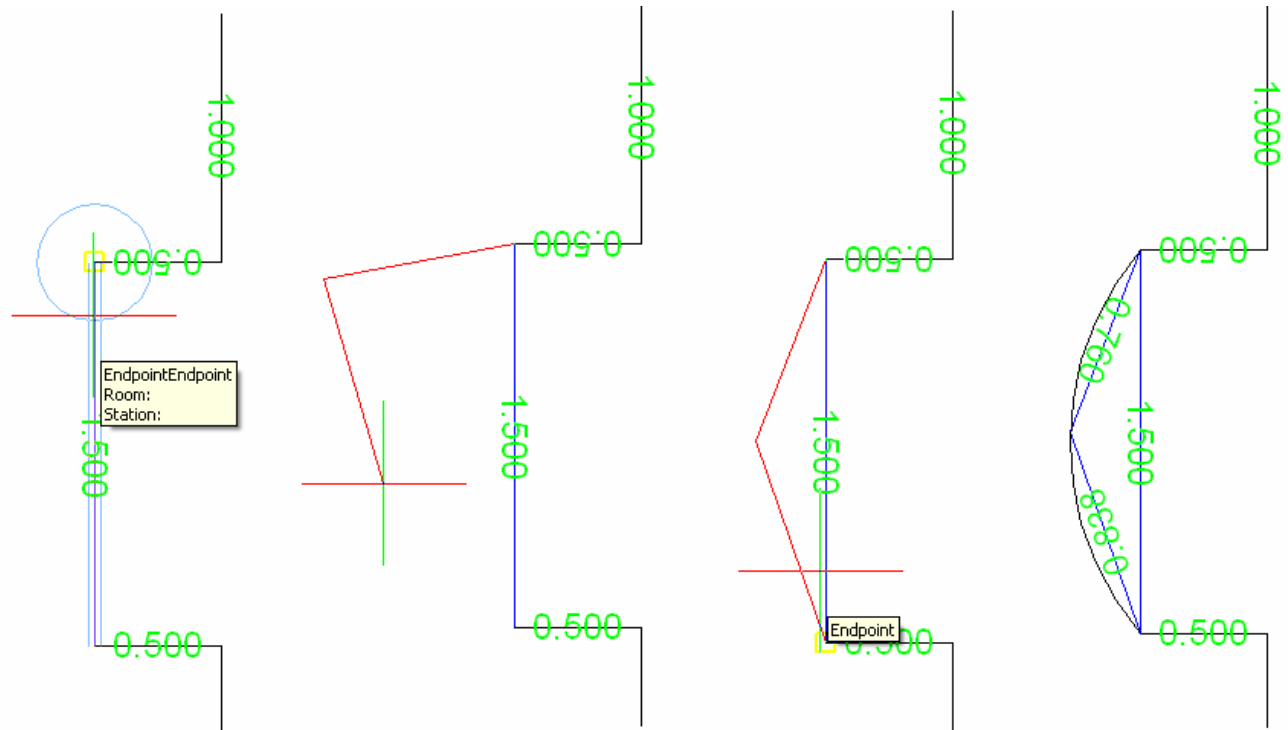
**Operation:** The command will prompt for selection of a wall line; pick the line to convert. Follow the data entry sequence prompted on the command line and then select the side of the line for the arc.

```
: theodline2arc
Select Wall for Arc:
Enter length of first diagonal:
Second point:
Enter length of second diagonal:
Second point:
Pick endpoint of the first diagonal:
Pick endpoint of second diagonal:
Confirm side:
: _arc
ENTER to use last
point/Center/Follow/<Start of arc>:
Angle/Center/Direction/End/Radius/<Second
point>:
End point:
```

The arc is plotted in the current wall layer and the measured tie lines and the chord line are placed on layer *Braces Disto* for data separation.

If the ties do not intersect the command will report the failure on the command line at the confirm side stage:

Confirm side:Unable to solve, incorrect lengths reported



## Outline wall command



**Function:** plots a wall line through TST measured points.

The command places a wall line in the plan; the wall line will close corners and generate the wall based on a minimum of 2 points per wall-face. The command will automatically project wall lines to close corners. The command is designed to get room plan plans fast by reflectorless TST. 2 points on each wall face are shot and the intersection of the wall line is automatically plotted as the corners. The lines are plotted in 3D passing through the measured points. They are plotted in the current layer. The intersections for corners are calculated by projection to the current UCS. For 2D work the lines can be flattened or a TheoLt 2D filter can be used.

### Operation

1. **Pick the command.** THEOOUTLINE It is operated from the tool bar button or the pull down menu , select 'points mode'

This command operates in 2 point mode by default and can be switched to one of 3 modes.

2 point

Perp

Return

The command defaults to '2 point' mode after completion of a 'return'. The modes are accessible by either command line entry or by selection from a context menu. A further 'close' option will be available as the lines are plotted.

2. **Start the wall line.** The commands starts in 2 point mode, shoot 2 points on the 1<sup>st</sup> wall face and the 2 on the second, the corner between them will be closed as the 2<sup>nd</sup> point on the 2<sup>nd</sup> wall face is measured. A typical sequence is:

```
: THEOOUTLINE Layer Group: [None]. Room: [None]. Station: STA417
Pick reference point 1 [Continue_Existing]: _non *995.26623,1001.39367,102.31657
Pick reference point 2: _non *995.29473,998.46013,102.27976
Mode=2 Point. Pick 1st point [Perp/Return]: _non *995.62514,998.29269,102.26721
Pick reference point 2: _non *998.54914,998.32110,102.31789
Mode=2 Point. Pick 1st point [Perp/Return/Close]: P
Mode set to Perp
Mode=Perp. Pick Point [2Point/Return/Close]: _non *999.32366,998.99566,102.00011
Mode=Perp. Pick Point [2Point/Return/Close]: 2P
Mode set to 2 Points
Mode=2 Point. Pick 1st point [Perp/Return/Close]: _non *999.32370,998.99564,102.00010
Pick reference point 2: _non *999.57725,998.99486,101.88968
Mode=2 Point. Pick 1st point [Perp/Return/Close]: R
Creating Return
Mode set to 2 Points
```

```

Mode=2 Point. Pick 1st point [Perp/Return/Close]: _non
*999.85462,998.46253,102.00367
Pick reference point 2: _non *1001.32601,998.47234,102.20282
Mode=2 Point. Pick 1st point [Perp/Return/Close]: _non
*1001.50693,998.53862,102.24471
Pick reference point 2: _non *1001.47444,1001.58822,102.28590
Mode=2 Point. Pick 1st point [Perp/Return/Close]: _non
*1001.39921,1001.63480,102.28117
Pick reference point 2: _non *999.59884,1001.63569,101.77969
Mode=2 Point. Pick 1st point [Perp/Return/Close]: P
Mode set to Perp
Mode=Perp. Pick Point [2Point/Return/Close]: _non
*999.55066,1000.99736,101.72265
Mode=Perp. Pick Point [2Point/Return/Close]: 2P
Mode set to 2 Points
Mode=2 Point. Pick 1st point [Perp/Return/Close]: _non
*999.55066,1000.99736,101.72263
Pick reference point 2: _non *999.30000,1000.98619,101.73385
Mode=2 Point. Pick 1st point [Perp/Return/Close]: R
Mode=2 Point. Pick 1st point [Perp/Return/Close]: C

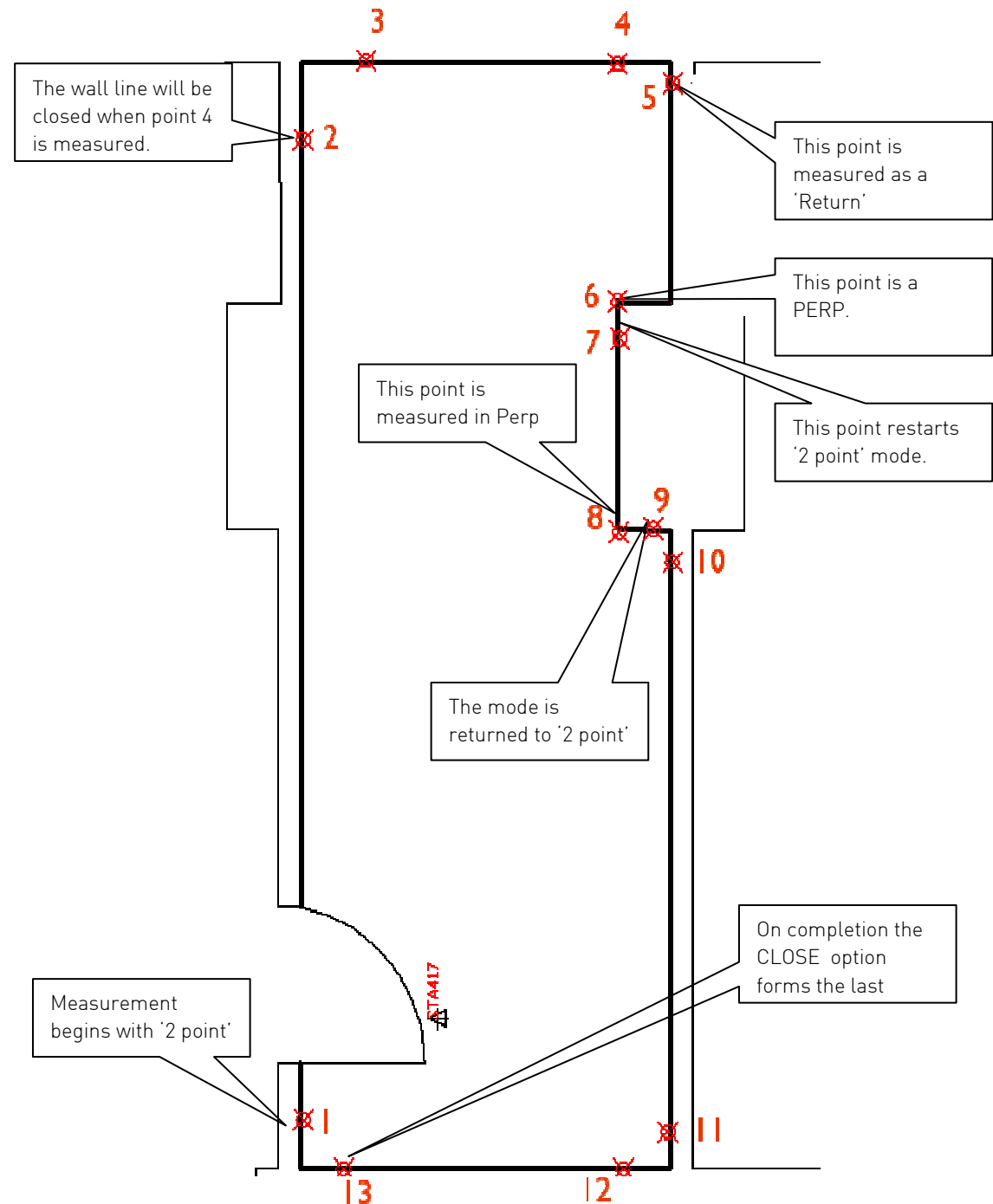
```

Depending on the direction (inward a or outward) of the hidden corner, PERP and RETURN will plot lines at right angles to the measured face.

A 'Perp' measurement will begin on a corner and a RETURN measurement AFTER one.

CLOSE will return the wall line to intersect with the starting line and exit the command.

*Note that '2 point' needs to be reselected after using 'Perp' and that it is automatically reset after closing a 'Return' corner.*



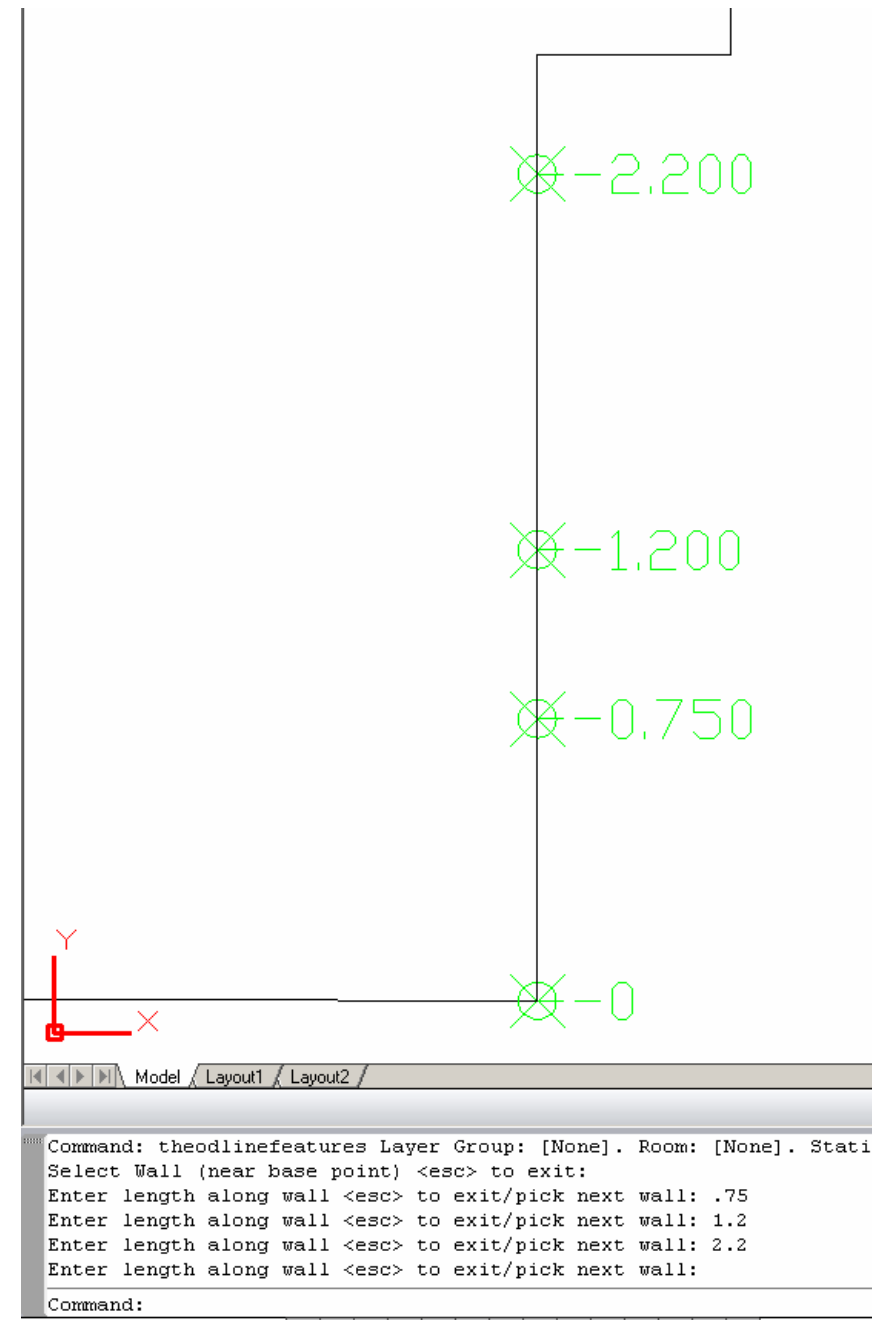
## Points on a line command



**Function:** to break a measure line into segments for fitting features.

**Operation:** The command will prompt for selection of a wall line; pick the line near the end point from which measurement will commence. Follow the data entry sequence prompted on the command line.

```
Command: theodlinefeatures Layer Group: [None]. Room: [None]. Station: [None]
Select Wall (near base point) <esc> to exit:
Enter length along wall <esc> to exit/pick next wall: 1.5
Enter length along wall <esc> to exit/pick next wall: 2.6
```



## Fit to brace command



**Function:** to add a brace or tie to the plan.

**Operation:** The command will open the 'Measure' panel and prompt for selection of a start point for the brace; pick the line near the end point from which measurement will commence and drag the arrow hed to the end point of the brace. Follow the data entry sequence prompted on the command line.

The screenshots illustrate the following steps:

- Initial State:** A room outline is shown with dimensions. The 'Measure' panel is open, and the 'Add Brace' button is highlighted.
- Start Point Selection:** The user selects a start point on the room outline. The 'Measure' panel shows 'To do: 0' and 'Fixed: 0'.
- End Point Selection:** The user selects an end point on the room outline. The 'Measure' panel shows 'To do: 0' and 'Fixed: 0'.

The 'Measure' panel on the right side of the screenshots contains the following controls:

- Measure** (button)
- Add Brace** (button)
- Opening** (button)
- Fix Line** (button)
- Fix Pt** (button)
- To do:**
  - To Do: 0
  - Fixed: 0
- Done** (button)

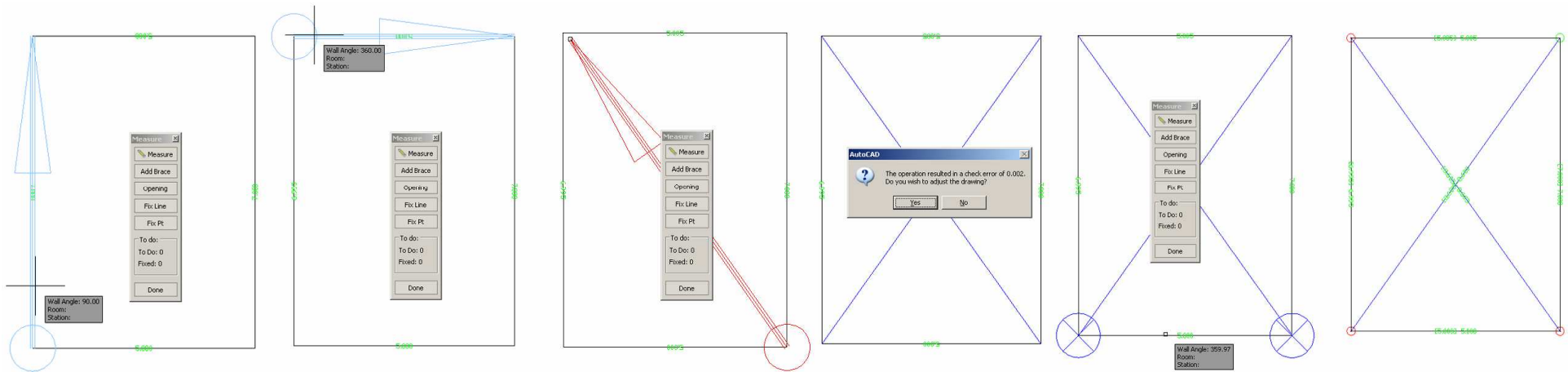
The brace will be included in the adjustment if it is fitted within the permitted tolerance: see *Fit closed outline* for further information on the settings for this.

## Measure brace & Fix command



**Function:** to add measurements, fix points or lines and run adjustment on a room plan (this command is also run sequentially with *Sketch & measure*, *Room plan* and *fit closed outline* commands on completion of a room outline)

**Operation:** The command will open the 'Measure' panel and prompt for selection wall lines to be measured:



Measure:

Pick Wall/Brace (Near Fixed) [Measure/Opening/Brace/Point/Line/Quit]:

Enter wall length <6.982>: 7

Cannot move fixed point/line

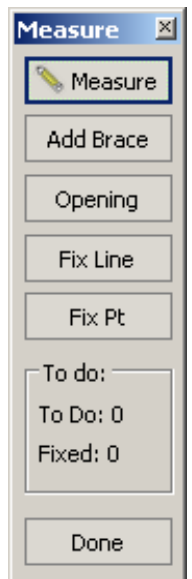
Room Misclosure:0.000 (x=0.000, y=0.000)

Measure:

Pick Wall/Brace (Near Fixed) [Measure/Opening/Brace/Point/Line/Quit]:

The command line will prompt for selection of wall line, addition of brace is an option and when done a line or 2 points should be fixed to enable adjustment.

On completion the room outline can be adjusted using either *fit closed outline* or *close & distribute*



## Fit closed outline



**Function:** to apply adjustment of misclosure by least squares of the wall lines and report shifts by layer.

**Operation:** this command is operated sequentially with *sketch & measure* and *room plan commands*. When used from the toolbar icon the command will prompt for the selection of wall lines to be adjusted. 2 fixed points or a fixed line are needed for the adjustment to operate. The command will ignore text and the Disto History layer objects. The command will apply a least squares distribution of the closing error within the tolerance set at DistToPlan *options & settings*. The adjustment is applied and a blue circle displayed to indicate the misclosure gap(s). The command line will report the effect of the adjustment starting with a summary table displaying the residual of the calculation as E(X) and E(Y).

Command: theofitclosed

Select room objects:

Select objects: Specify opposite corner: 14 found

Select objects:

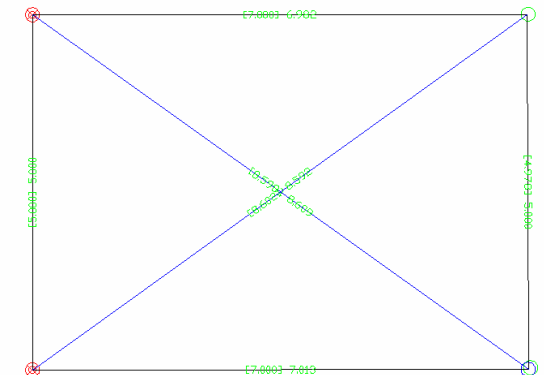
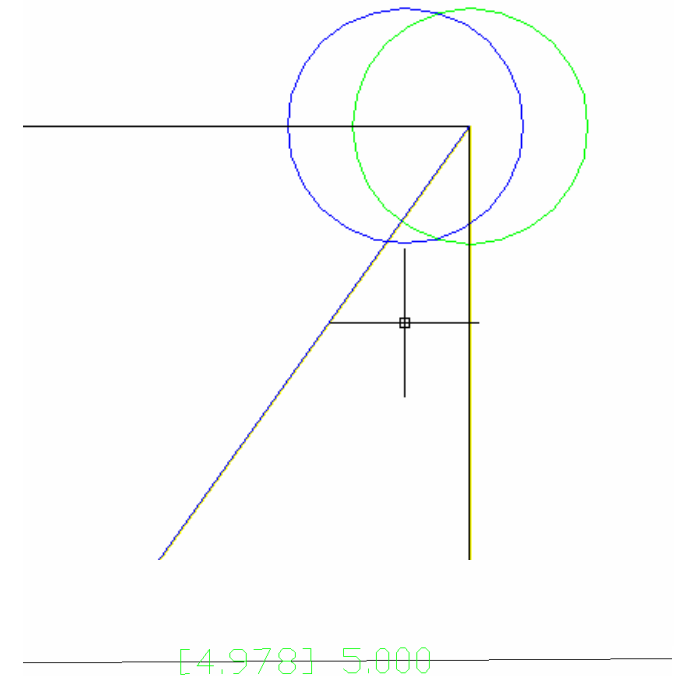
Report of all Node Data

Node	State	X	Y	Z	E(X)	E(Y)	E(Z)
1	Overdetermined	28.869	179.860	0.000	0.001	0.002	0.000
2	Overdetermined	23.870	179.830	0.000	0.001	0.002	0.000
3	ControlPoint	23.877	172.847	0.000			
4	ControlPoint	28.877	172.848	0.000			

This is followed by a table of the shifts node by node.

Node Id 1	To-Node	active?	Dist	Angle	E(Dist)	E(Angle)
	2	active	4.978	179.63925	0.004	0.003
	2	active	4.978	179.63925	0.004	0.003
	2	active	4.978	179.63925	0.004	0.003
	2	active	4.978	179.63925	0.004	0.003
	2	active	4.978	179.63925	0.006	0.003
	4	active	7.000	89.93453	0.004	0.003
	4	active	7.000	89.93453	0.004	0.003
	4	active	7.000	89.93453	0.004	0.003
	4	active	7.000	89.93453	0.004	0.003
	4	active	7.000	89.93453	0.004	0.003

In AutoCAD the command will plot the wall lines as adjusted geometry with updated distance values and place the unadjusted values on in brackets on the line. The fixed points are marked in red, adjusted in green and the misclosure in blue.



## Close & distribute command



**Function:** to apply adjustment of misclosure by proportional distance distribution (Bowditch style) report shifts by layer.

**Operation:** The command will prompt for the selection of an endpoint on a line at the misclosure: the lines of the room outline (provided they are un-cut by features; the command is best used prior to detailing) will be refitted to an average distribution of the gap to the wall lengths.

Braces will not be included in the adjustment.

```
Command: theoCloseDistrib
Select point on perimeter to close:
Distributing errors for closed room on layer Walls_Disto.
Room Misclosure:0.069 (x=0.068, y=0.004)
Distributing errors across 4 walls.
```

A warning is posted in the command line if the misclosure exceeds the tolerance:

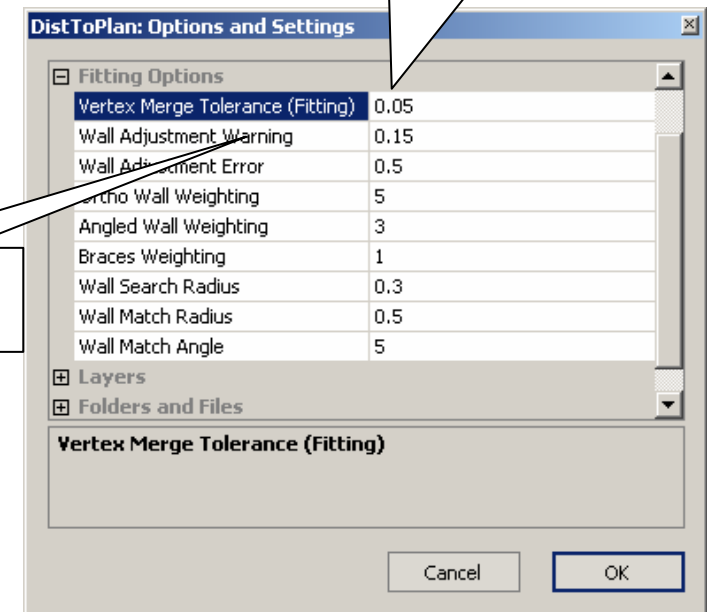
```
Command: theoCloseDistrib
Select point on perimeter to close:
Distributing errors for closed room on layer Walls_Disto.
Room Misclosure:0.961 (x=0.907, y=0.319)
Distributing errors across 4 walls.
Warning: Wall line adjusted by 0.408. Please check measurements
Warning: Wall line adjusted by 0.154. Please check measurements
Warning: Wall line adjusted by 0.470. Please check measurements
Warning: Wall line adjusted by 0.154. Please check measurements
Warning: Brace line adjusted by 1.268. Please check
measurements
```

The adjusted distances are shown following the unadjusted.

5.000 / 4.998

The maximum misclosure that can be corrected is set here: 5cm.  
If the misclosure is greater than this value the adjustment is not applied.

The error message for fitting  
braces is triggered at: 15cm





### Close 2 walls command



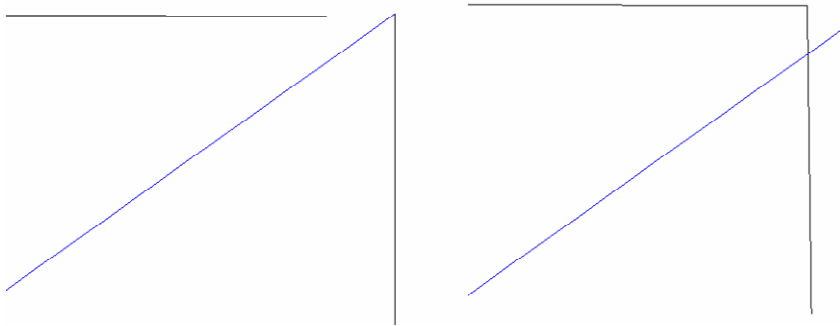
**Function:** Closes 2 wall lines by intersection, if there is no possible intersection the lines remain un-adjusted.

**Operation:** The command will prompt for the selection of the 2 lines to be joined.

Command: theoclose2walls

Select Wall 1:

Select Wall 2:



The lines will rotate about the closed ends to join, note that braces are not affected by this command.

### Edit wall length command



**Function** (theoeditwall) to refit a room perimeter by editing the length of a wall

**Operation:** The command will prompt for the selection of the wall line and the new distance value. On entry of the new value the wall is adjusted and the room perimeter refitted accordingly.

Command: theoeditwall Layer Group: [None]. Room: [None]. Station: [None]

Select Wall (near fixed point):

Enter wall length <5.000>: 5.234

Room Misclosure:0.000 (x=0.000, y=0.000)

Select Wall (near fixed point):

Enter wall length <7.000>: 7.015

Room Misclosure:0.000 (x=0.000, y=0.000)

Select Wall (near fixed point):

### Fixed point command



**Function** (theodfixedpoint ) fixes the end point of a wall line to remove it from adjustment. Provide a reference point for adjustment. The fixed point will be marked with a red circle in the AutoCAD graphics area

**Operation:** The command is available from the *Measure pen panel* or from the toolbar icon. Selection is previewed by a temporary graphic over the points.

Command: theodfixedpoint

Select fixed point:

The point can be unfixed by deleting the circle marker in AutoCAD

*Note: For the least squares adjustment to distribute the misclosure on a room perimeter a fixed point should not be an end point at the misclosure gap*

### Fixed line command



**Function** (theodfixedline ) fixes the end points of a wall line to remove it from adjustment. Provide a reference point for adjustment. The fixed points will be marked with a red circle in the AutoCAD graphics area

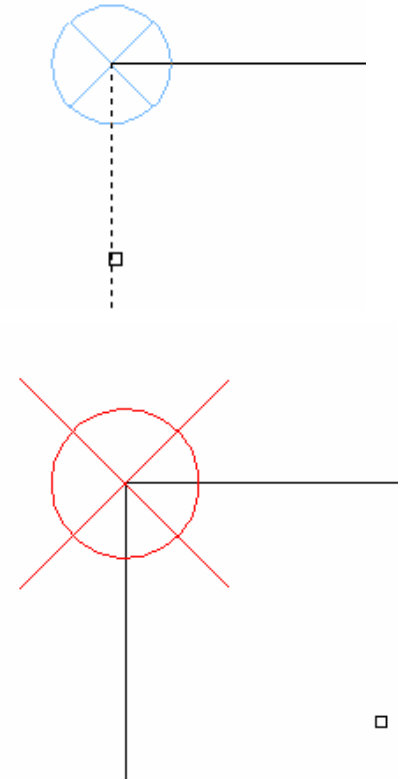
**Operation:** The command is available from the *Measure pen panel* or from the toolbar icon. Selection is previewed by a temporary graphic over the points.

Fix Line:

Pick Wall/Brace (Near Fixed) [Measure/Opening/Brace/Point/Line/Quit]:

The line can be unfixed by deleting the circle markers in AutoCAD

*Note: For the least squares adjustment to distribute the misclosure on a room perimeter an end point of the line not be at the misclosure gap*



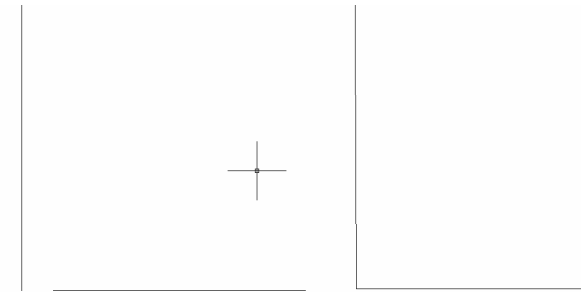
## Join walls command



**Function:** Moves the endpoint of a wall line to join with a selected line. The command works with an open room perimeter, the line lengths remain constant, if no fit is possible a move is applied (as opposed to a move and rotate if a fit is possible).

**Operation:** The command prompts for 2 end points: the 2nd endpoint picked will be moved to the 1st endpoint picked the first line will remain stationary. The second line will move with adjoining lines following if possible.

```
Command: theojoinwalls
Select Wall 1 (fixed):
Select Wall 2 (will move):
Room Misclosure:0.000 (x=0.000, y=0.000)
```



## Draw brace command

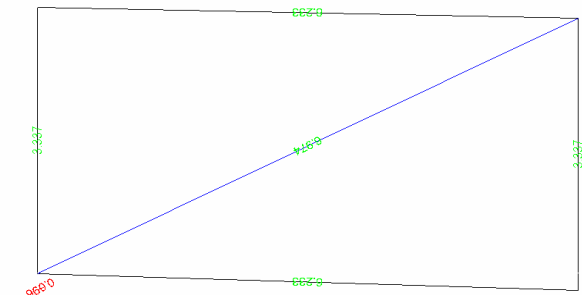
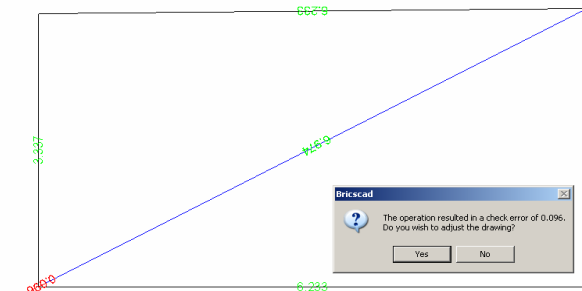


**Function:** Adds a brace to a room outline. The room will be adjusted by intersection if the fit is possible. The misclosure is reported on fit.

**Operation:** Pick the command (theodbrace) and enter the measured distance and then pick the endpoints of the brace: it will shift the room outline to fit the brace. The line is plotted in the layer *braces\_Disto*. The adjustment is recorded on the layer *Error\_Annotation\_Disto*. The command can be accessed from the *Measure pen panel* also.

```
: theodbraceLayer Group: [None]. Room: [None]. Station: [None]
Enter Length of Brace: 7.0720
Pick start of Brace (Fixed point):
Pick Angle/Endpoint. Use _End snap to adjust existing line: Brace closure error: 0.002

Room Misclosure:0.000 (x=0.000, y=0.000)
```



## Layer Group Command



**Function:** to organise information by layer to enable (for example) data separation by floor. The layer manager can be used to quickly hide or show a selected layer group.

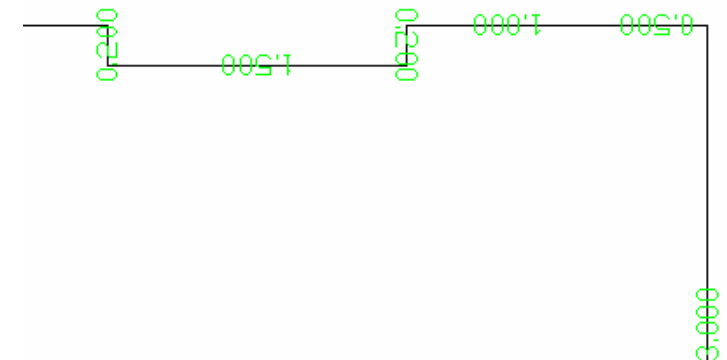
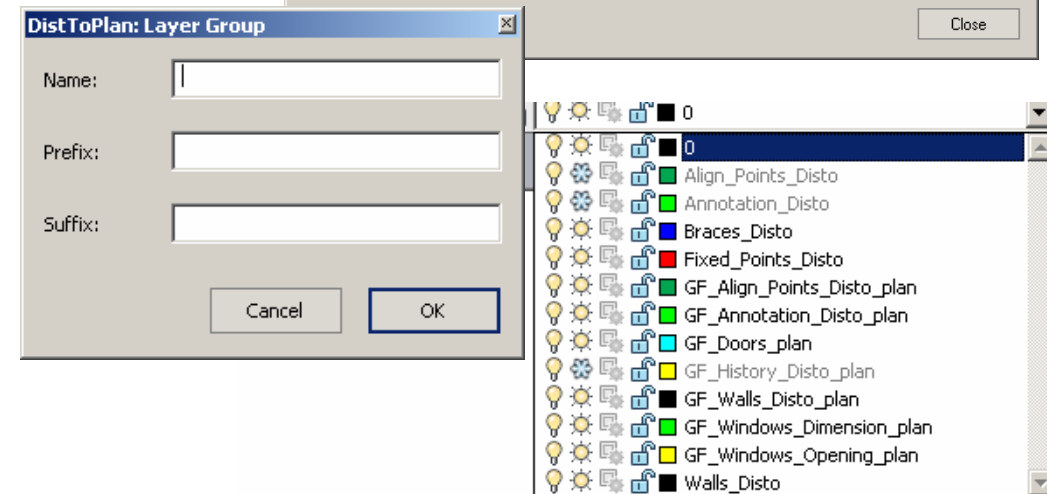
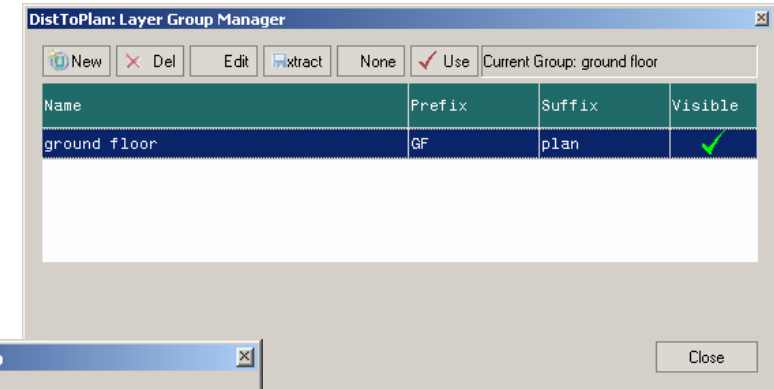
Layers or organised by prefix and suffix to allow for 2 levels of grouping if required.

**Operation:** the command is selected for the toolbar. The *Layer Group Manager* panel will open and the new group added using the 'new' button and filling the required fields. The layer group command is also shown on the plan builder.


Once the group is set all subsequent actions in Auto CAD will be assigned to the group until a new group is added or 'None' is selected in the *Layer Group Manager* panel.

Command: theodgroupmgr  
Setting Layers.

*Note: The default layer names associated wit the DistToPlan command functions is maintained by use of the layer manager but the suffix and prefixes are customised.*



## Room manager command

 **Function:** the room manger is a live monitor of CAD data for the purpose of organising measured room data for block adjustment. Rapid selection tool by group enabling alignment of entire room data sets. Height data by room can be adjusted

**Operation:** The room manger can be enabled/disabled in DistToPlan settings, once enabled it is active for every drawing session with *DistToPlan.arx* loaded. When a new room outline is detected a prompt panel will direct the capture of each room as a group.

### Working with the room manger

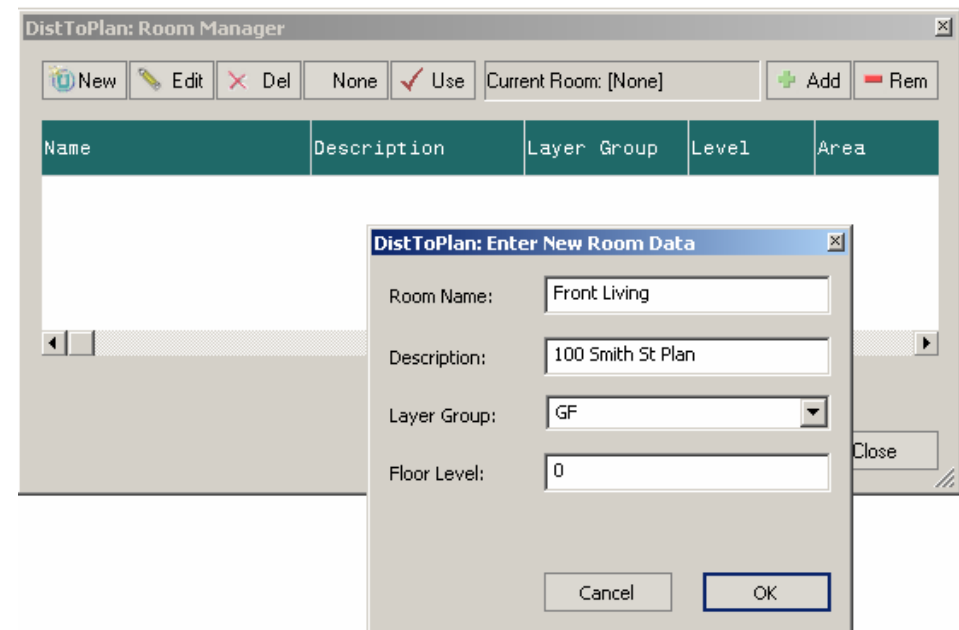
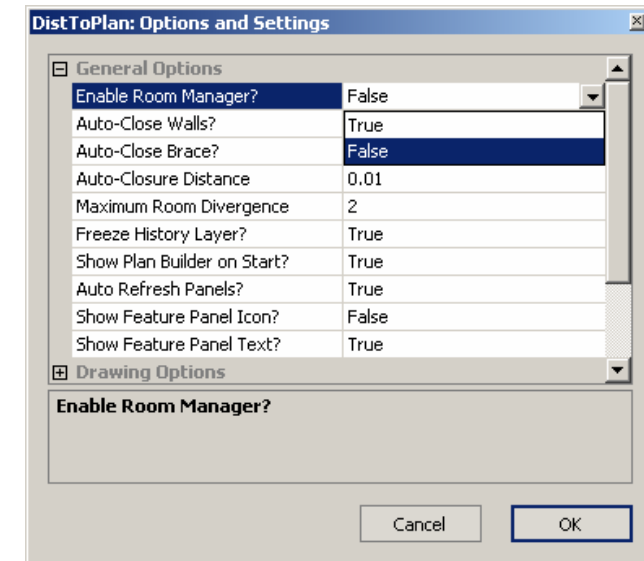
The room manager must be enabled before collecting plan information. Once enabled it will remain active for all subsequent AutoCAD sessions until disabled.

A room name needs to be assigned along with a layer group and level. This information will be tagged to all objects added to the drawing once the room has been made current with the 'Use' tick button. The *Room Manager* can be referred to at any time during drawing so that objects may be assigned to their appropriate grouping.

*Re-assigning objects once they have been saved in the DWG can be achieved by use of the 'add' and 'remove' commands in the manager; the 'remove' command should be used first.*

### Begin a new room

A new room is begun by clicking in the 'new' button and opening the DistToPlan *Enter New Room Data* panel or by selecting 'Start new room' from the panel prompted by selection of a room-plan command. Enter the required data here. On 'OK' the room is added to the Room Manager table and made current.



With the Room Manager enabled use of the 'Align' and 'Fit Closed Outline' commands will prompt selection by room. By selecting the available rooms singly or together all entities in the selected room(s) will be handled as a single entity for the action of the command, thus an entire room can be aligned with another.

The *Select Rooms* panel will appear when an appropriate command is invoked, by selecting the room in the table all objected recorded in that room are grouped for alignment.

```
Command: list
Select objects: 1 found
```

The 'Objects' option on the select Rooms pane will return the command line to the select objects prompt in the standard AutoCAD manner. The selection is cleared by use of *regen* in AutoCAD.



## Plan builder



**Function:** The Plan Builder is a way organising workflow with DistToPlan: it prompts the user through a list of actions to avoid missing tasks. Plan builder incorporates:

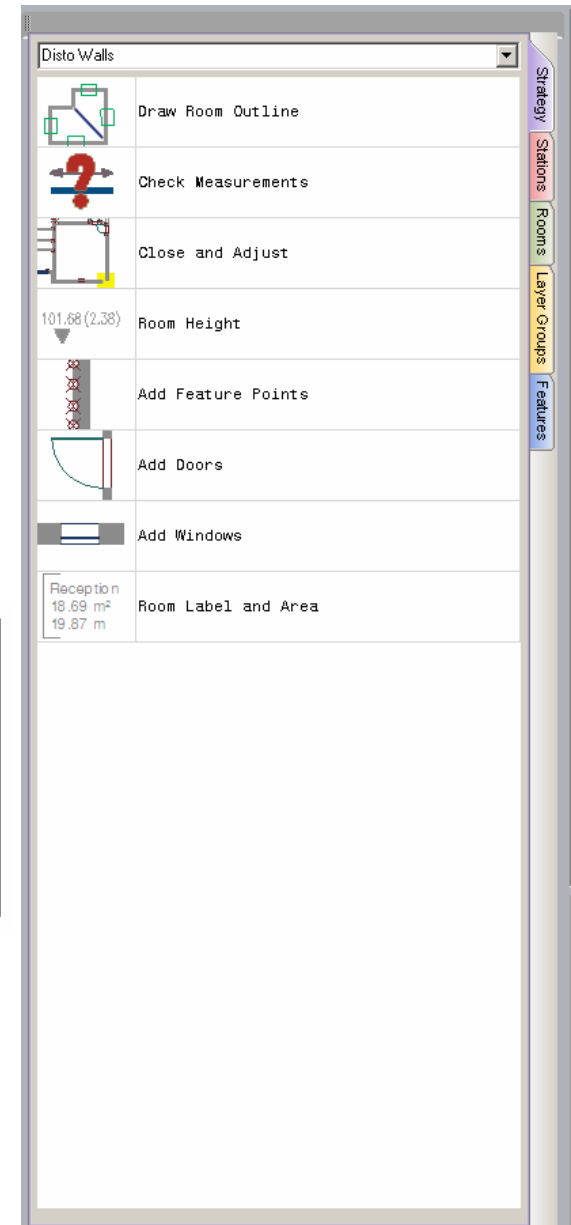
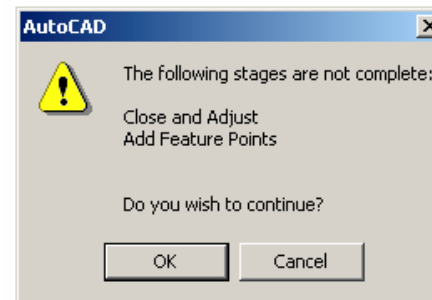
- ◆ Strategy Panels; for organising work flow
- ◆ Layer Group Manager, for organising layers
- ◆ Room Manager, for managing separate rooms as groups
- ◆ Station Manager (if using in conjunction with TheoLt Building Survey)
- ◆ The Feature Library; for inserting TheoLt Features / AutoCAD Blocks

On a room by room basis, if a step is skipped a message will remind the user:

Once the measurement strategy is selected the plan builder will guide the user through the steps needed to successfully complete the plan of the room including the annotation and alignment required. A system administrator will be able to define the components included in the measurement strategies available as a standardised method. The plan builder opens a task palette that offers the strategy for measurement: as each step is completed the palette will indicate the status of the task.

The room manager is incorporated into the plan builder for rapid selection of grouped data

**Operation:** The plan builder is opened from a toolbar button, the options are made available though the palette panel. The features tab will open a sub panel for access to the features libraries.



## Working with blocks and features

### General:

The addition of repeat objects in to the drawing, using TheoLt is possible by 3 routes:

Creation of an object by AutoCAD command (also as assisted by a TheoLt Draw tool) such as 'line', 'insert' 'copy' 'grip stretch' etc.

Insertion of block by instrument data from the core panel

Insertion of block by use of the Features palette

Using instrument data in the command line to drive AutoCAD is effective for those commands which respond to the data but *TheoLt features* use of prepared attributed blocks which can speed up the insertion process by determining the insertion point, XX YY scaling rotation etc

### Condition of block.

There are some constraints on the block which can be used: the Disto send metric adapt by default so that the drawing units in any drawing containing Disto data will be on the basis of 1DU=1m. This can be dealt with by working with unitless blocks scaled accordingly.

**Size:** the block should be sized to 1mx1m

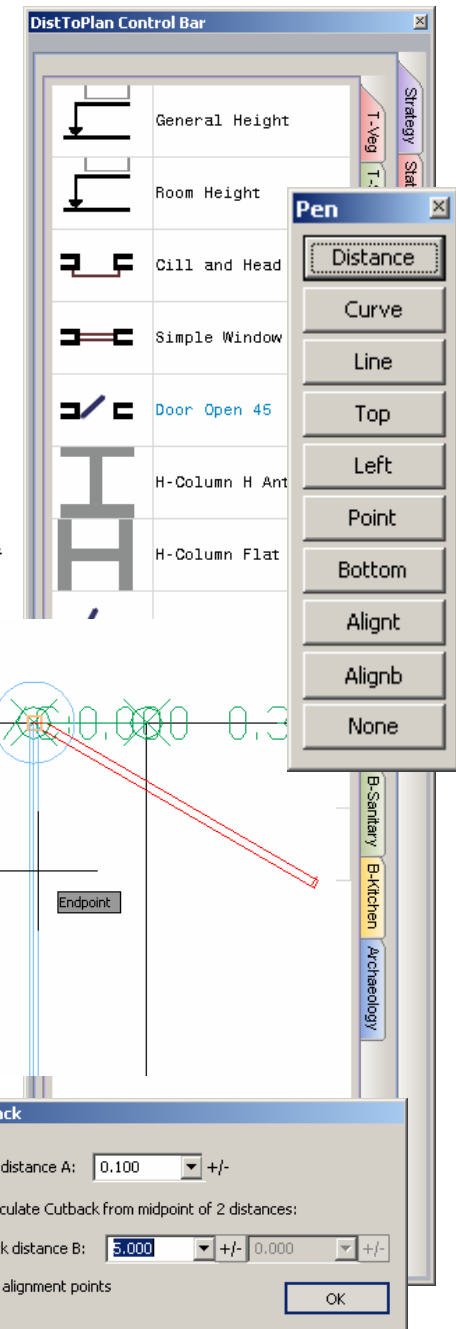
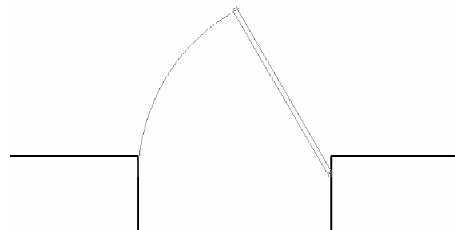
**Base point** for insertion should be 0,0,0

**Layers** the block can be assigned to a layer on insertion using the TheoLt tools

**Units** = unitless

**Dynamic blocks** will be inserted but the dynamic features are not translated: if dynamic blocks are needed use the AutoCAD 'insert' method.

**Polylines** will not be displayed as a temp graphic for insertion orientation.





## Using TheoLt features to fit a door into a plan with TheoDisto.arx



The panel is opened from the 'Planbuilder' icon in the tool bar or by entering '*Theoplanbuilder*' the command line.

With the panel open in the AutoCAD workspace select the features tab and then the sub-tab 'B-Structure: a library of blocks is now available.

With a room out-line present in the drawing select the door block required from the panel.

On selection a 'Pen' panel will popup, select **distance** (for Disto users, Point for TST users) the popup can now be closed.

The command line will respond, with a series of prompts ending with a request for the door width:

```
Door Width [Points mode]:
```

```
Enter the width.
```

```
The next prompt is:
```

```
Get feature insert point:
```

Which requires the selection of the end point of the wall line the door is to be placed on, on selection the offset and cutback dialogue will pop up to allow entry of the door position on the wall line.

Distance 'A' is the distance INTO the wall the hinge point will be placed. Distance 'B' is the distance along the wall the block will be placed.

The final stage is to select the swing direction using the cursor to select the side of the swing.

Pick on the opposite side of the open swing.

The door is fitted and the wall lines are cut and closed.

## Referencing media to the drawing

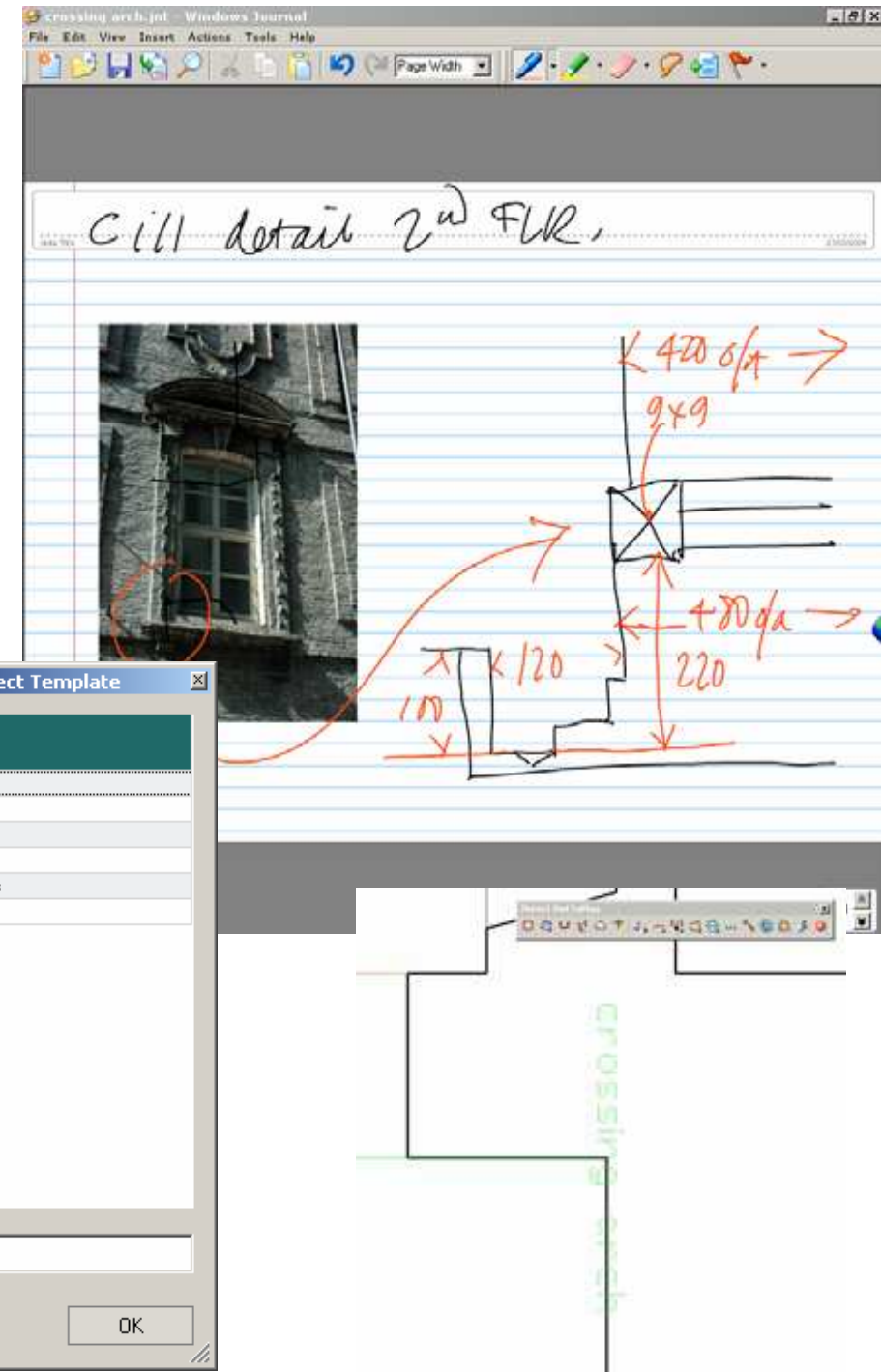
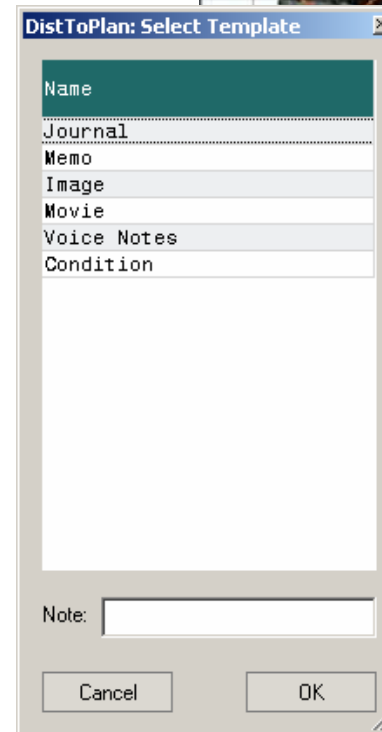


**Function:** to attach external reference data to the current drawing file at a measured location

**Operation:** a template is required by use of the command *thetemplatemgr* so that an attachment can be made of data from a text, image, audio or movie file. The command is operated by selection from the DistToPlan Select template panel.

Tablet PC users can use a journal note to append the drawing file with sketched notes: it is saved in the folder for the current project using the name given for the description prompted for at the AutoCAD command line. The drawing should be in WCS for this operation. If a file already exists with the same name the name is appended with an incremented number. The DWG annotation is hyperlinked to the journal note: if cntl is held down and the text selected the appropriate note will open.

On use the AutoCAD Command line will prompt for the attachment points ( 2 are required) and the template for the note selected from the 'Select Template' panel. Journal or other file notes may be used to attach sketches, photos and hand written notes to a drawing session in support of the survey. The journal file will be time stamped. The DWG annotation is placed on the layer '*hyperlinks*'. The Journal note/file should be saved before closing and can be opened again from the drawing hyperlink if needed. The hyperlink is marked in the DWG with its description (in green) and a line showing the point of attachment.



## Setting DistToPlan form templates



**Function:** to prepare data for attachment to a drawing file `theotemplatemgr`.  
The templates and forms are held within a single folder.

**Operation:** The command is opened from the TheoLt Building survey pull down menu under *settings*

On installation TheoLt sets a folder titled *Templates* in the TheoLt blocks folder. In DistToPlan options, under folders and files the path should be set to: `c:\TheoLtblocks\Templates`.

### To create / edit a template.

Open the command `theotemplatemgr`

Each Template requires:

1. A name:
2. Description:
3. File Type: The file extn. 3 characters. This file type is also used to identify files that arrive in the Bluetooth inbox.
4. Template File: This is the master file that will be copied to create the new form. In the above example "Image" there is no Template as this type is for identifying transferred images. In the example "Condition", the file "Building Condition Survey Active Form.pdf" is copied to create a new document in the project folder.
5. Block: This is the AutoCAD drawing file / block used to represent the form within the drawing. The block requires 3 Attributes to be defined and I recommend editing one of the sample supplied to create a new file.

The screenshot shows the **DistToPlan: Template Manager** window and a **templates.dat - Notepad** window.

**DistToPlan: Template Manager** window:

Name	Description	File Type	Block
Journal	Journal Note	jnt	context.dwg
Memo			0
Image	Image	jpg	Image Insert.dwg
Movie	Movie	MP4	Movie Insert.dwg
Voice Notes	Voice Notes	amr	Sound Insert.dwg
Condition	Condition Report Form	pdf	Notes Insert Base.dwg

**templates.dat - Notepad** window:

```
[Templates]
Template 0=Journal
Template 1=Memo
Template 2=Image
Template 3=Movie
Template 4=Voice Notes
Template 5=Condition
Template 6=

[Journal]
Description=Journal Note
Type=jnt
Block=context.dwg
Filename=template.jnt

[Memo]
Description=Survey Memo
Type=pdf
Block=Notes Insert Base.dwg
Filename=Memo Form.pdf

[TextMemo]
Description=
Type=
Block=
Filename=

[Image]
Description=Image
Type=jpg
Block=Image Insert.dwg
Filename=

[Movie]
Description=Movie
Type=MP4
Block=Movie Insert.dwg
Filename=

[Voice Notes]
Description=Voice Notes
Type=amr
Block=Sound Insert.dwg
Filename=

[Condition]
Description=Condition Report Form
Type=pdf
Block=Notes Insert Base.dwg
Filename=Building Condition Survey Active Form.pdf
```

To insert a form manually into a drawing, enter the command: `theoaddjournal`

## Bluetooth inbox monitor

External documents may be attached, via a Bluetooth device (Mobile phone, camera, Dictaphone etc.) to the drawing file as hyperlinks, DistToPlan may monitor the Bluetooth Inbox folder for incoming documents. These documents may then be automatically copied to the project folder and inserted into the current document as hyperlinks (TheoLt form templates). For this to function DistToPlan must be configured to the Bluetooth Inbox folder. Once the correct folder is configured, AutoCAD will need to be re-started. The Bluetooth monitor only recognizes files of pre-configured types. As a file is received its file extn is compared to the extns configured in the Templates. These types are set using the Template Manager.

## Key pad command

**Function:** DistToPlan is supplied with a numeric keypad for entry of taped distances and quick calculation, for instance of cutback distances.



**Operation:** The keypad will send the entry to the AutoCAD command line. The calculator retains the last value sent on opening; if a new value is needed entry line must be cleared by use of CE (clear entry). The enter key will follow the sent value with a return to action the value in AutoCAD, the send option will allow subsequent comment to be added to the command line if required.

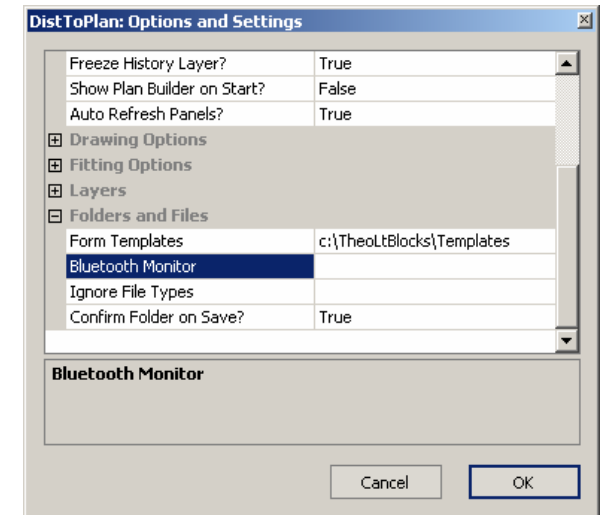
## Start comms command



**Function:** (theostarttheo) To start communication with the Disto by restarting the Bluetooth connection.

**Operation:** The command can be operated from the tool bar icon, as a right click in the TheoLt tile bar or from a desktop shortcut. The command can be used if the Bluetooth comms have been broken (e.g. if the Disto has powered down or if the system has been suspended.)

*"Note: it is possible to open multiple instances of TheoLt. Only the first instance will be able to address the communications ports. Always check that a single instance is running. "*



## Cancel command



**Function:** to stop DistToPlan commands and reset the AutoCAD command line for the next command.

**Operation:** (theocancel) the command is operated form the tool bar button. Additionally the command will clear 'grips' selection in both AutoCAD and Bricscad

## Customising features for use with DistToPlan

The settings for editing/creating features for the palette are in TheoLt settings, features tab. The Folders available are shown on the left panel and the features in the selected folder on the right.

### Feature requirements

- ◆ An **AutoCAD block** sized to 1m square with the base point (of 0,0,0) at the bottom left of the block.
- ◆ A **32x32 pixel Gif image** file for the icon in the panel
- ◆ **Selection of Points mode (TST) or Distance mode ([Disto] or both**
- ◆ **Command line prompts for sizing.** If the block needs to be scaled in 2 axes this will need a prompt for the value to be entered in the command line

The *define feature panel* shows the settings for the selected block. The settings grouped. The group is expanded from the +/- button

### Panel 1: Feature Details

*Observation count* is for TS, the number will determine how many points will be used to fix the feature.

*Allow distance mode:* if set to true this will allow Disto working. If set to false distance mode will be disabled when inserting the feature: i.e. enabling points (TS) mode

*Data file name:* if a text file is to be logged the file name is set here. If left blank no file is written.

*Icon file name,* optional, set from the browse option.

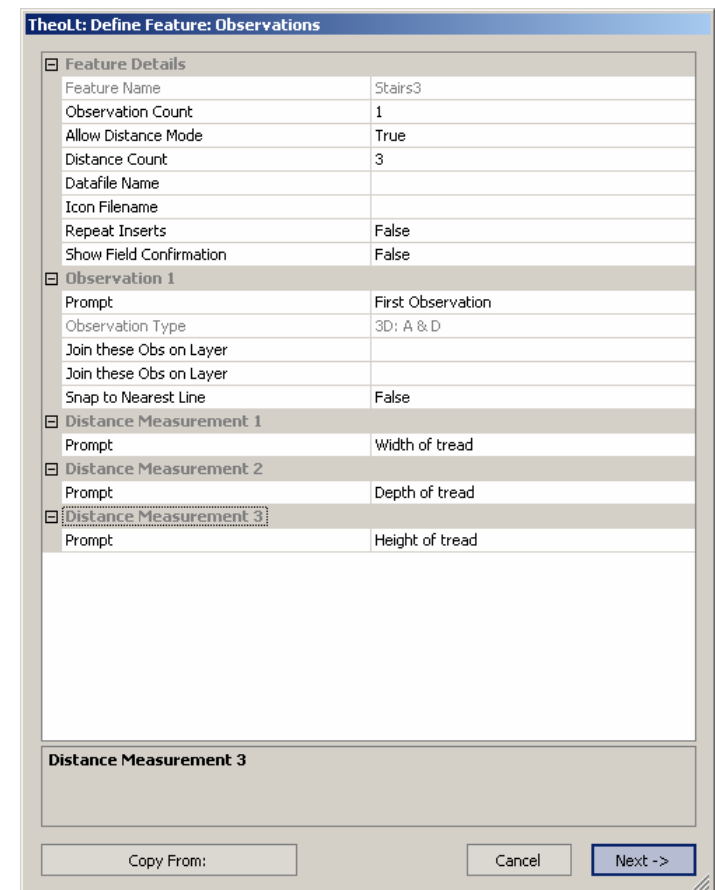
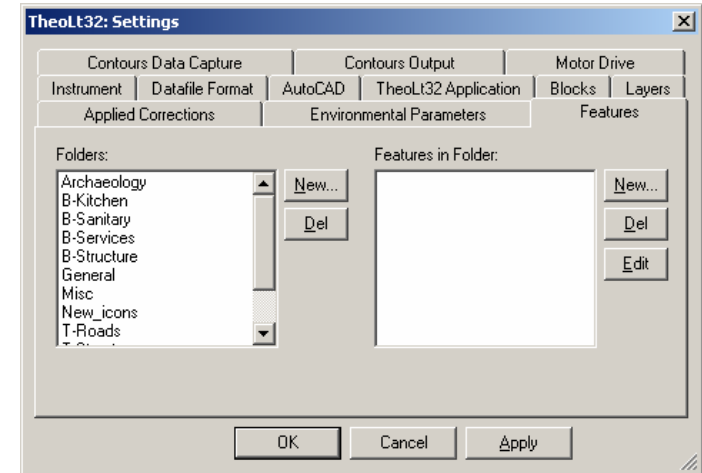
*Repeat inserts,* if set to true the feature will be repeated automatically until interrupted by *esc* in the command line.

*Show field confirmation* if set to true a feature attribute form will be presented on insertion

### Observation 1

*Prompt:* the command line request for data is set here. For example 'Left side' for the 1<sup>st</sup> observation to fix the block.

*Observation type:* can be set to: 3D A&D (angle and distance) Observation 1 will be 3D (A&D) by default.



*Join these obs on layer:* the layer name for the joined lines can be set if required.

*Snap to nearest line:* if set to true the block will be snapped perpendicular to the nearest line.

*Distance measurement 1:* the command line request in Distance mode is set here (for example 'width of door or 'depth of cill')

## Panel 2: Define Feature Data

### Field details

*Field count 1:* the number of fields to be written to the data file and or used as block attributes is set here.

*"Level layer"* for TST observation the level can be placed in a layer as set here. If empty the level is not placed.

*Feature level value:* allows selection of the height as relative to datum or instrument height.

*Set local datum to level:* enables relative heighting,.

### Field 1

*Prompt:* the command line request is set here

*Description:* allows explanatory text to be displayed in the editor.

*Default value:* sets default for the prompted value

*Distance mode default value:* sets default for the prompted value by Disto

*Read only:* if set to true the field value cannot be changed

*Mandatory:* if set to true an empty field will not be accepted.

*Store value list:* if set true a last used list is available for the field

*Mask:* allows entry of fixed field parameters to limit entry of illegal characters.

TheoLt: Define Feature: Data	
<b>Feature Details</b>	
Fieldcount	1
Feature Name	Stairs3
"Level" Layer	
Feature "Level" Value	
Set local Datum to level	
<b>Field 1</b>	
Prompt	Number of treads
Description	
Default Value	
Distance Mode Default Value	13
Read Only	False
Mandatory	False
Store Value List	False
Mask	

Field 1

<- Back      Next ->

### Panel 3: Define Feature Block Block details

*Block file name:* The block to be inserted is set here. The block can be located with the browser. On selection it will be copied into the feature folder.

*Layer name:* The layer the block is to be inserted in. If left blank the block is inserted on the current layer.

*x breaks line:* if 'snap to line' is enabled for 2 observations the line will be cut on insertion of the block.

*x breaks wall:* if 'xbreaks line' is selected this option can be set to cut a double wall line to form an opening.

*Bridge the break layer:* sets the layer for an opening line

### Insert by observation (points mode)

*Insert point obs:* in point mode sets insertion point observation

*Scale x, y, z :* allows the scale to be set independently by axis on observation

*Offset x, y, z :* allow a perpendicular offset by observation

### Insert by distance

As point mode but by distance only

### Step and repeat

*Repeat count:* as set in panel 2

*Repeat by dividing measurement:* if set to true the block is fitted to an overall length, if false it is offset for each observation.

*Repeat observation:* sets second observation for repetition

*Repeat x, y z Measurement:* sets the repeated block size measurements

### Block attributes

*Attribute count:* if non zero will open attribute editor.

**TheoLt: Define Feature: Block**

<b>Block Details</b>	
Feature Name	Stairs3
Block Filename	Stairs1.dwg
Layer Name:	
X Breaks Line	False
X Breaks Wall	False
Bridge the break Layer	
<b>Insert by Observation</b>	
Insert Point Obs	First Observation
Scale X Obs	[Default]
Scale Y Obs	[Default]
Scale Z Obs	[Default]
Offset X Obs	[Default]
Offset Y Obs	[Default]
Offset Z Obs	[Default]
Rotation Obs	[Default]
<b>Insert by Distance</b>	
X Insert Offset	[Default]
Y Insert Offset	[Default]
Z Insert Offset	[Default]
Scale X Measurement	[Default]
Scale Y Measurement	[Default]
Scale Z Measurement	[Default]
Relative Rotation	0
<b>Step and Repeat</b>	
Repeat Count	Number of treads
Repeat by dividing measurement?	False
Repeat Obs	[Default]
Repeat X Measurement	Depth of tread
Repeat Y Measurement	Width of tread
Repeat Z Measurement	Height of tread
<b>Block Attributes</b>	
Attribute Count	0

<- Back      Finish      Next Block ->



## DistToPlan Settings



Command: theoptions.

The settings relating to the AutoCAD functions of DistToPlan are accessed from the spanner button on the tool bar. The settings are in a table format with expandable fields grouped under 5 main headings:

General Options

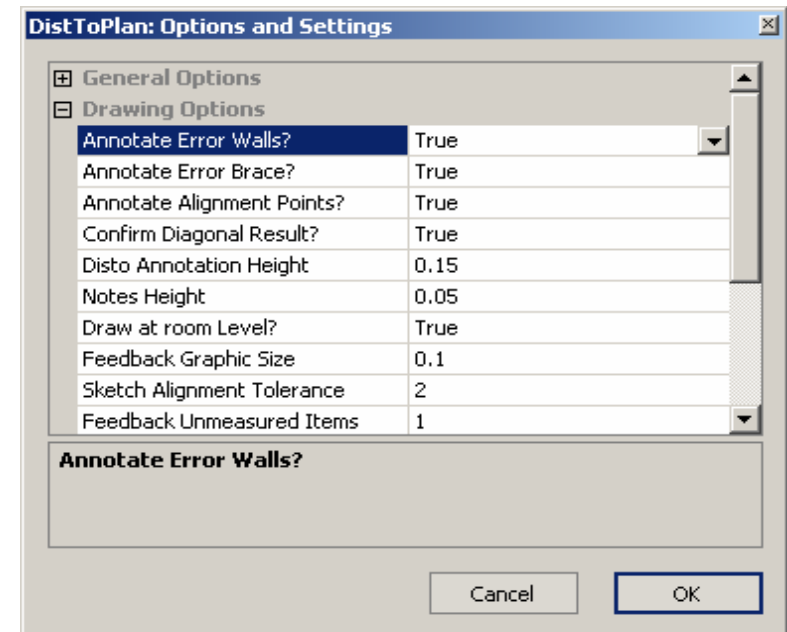
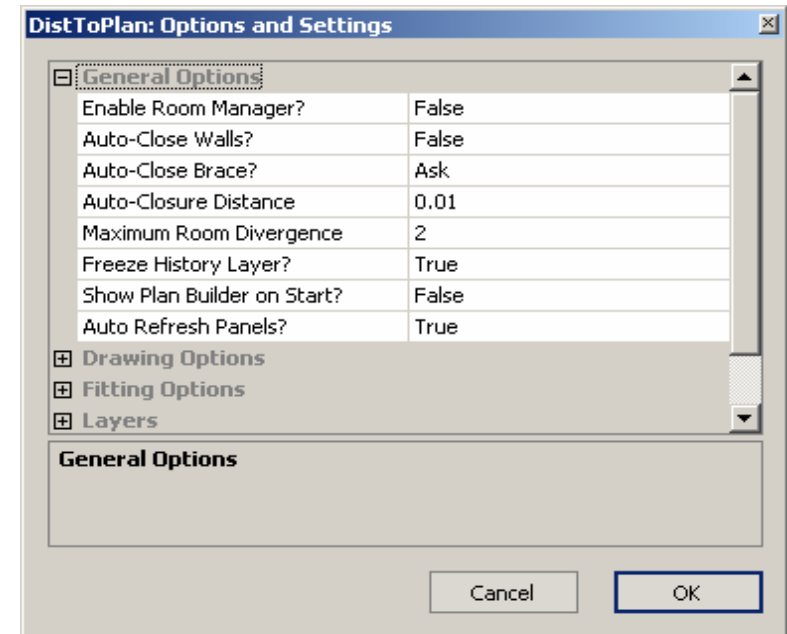
Drawing options

Fitting options (see also 'fit close and adjust')

Layers

Folders and files

Clicking in the appropriate field will bring up an options button where appropriate alternate values are available other wise numeric values can be edited to suit user requirements. A slider bar will expose more settings where needed. A key setting is the room manager enable option. If the workflow makes use of linked objects for grouped editing the room manger must be used.



## The view tab

The view tab provides 4 prepared view controls for the current AutoCAD session

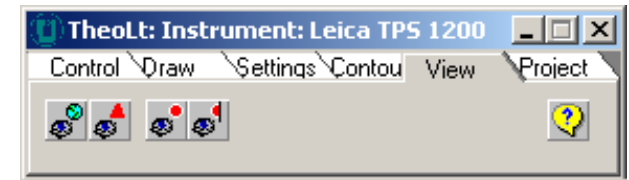
The commands from left to right are:

**Plan World:** Same as AutoCAD plan command. Restores a top view and zooms to the drawing extents

**Centre Instrument in Window :** Keep the current view orientation, panning the view so that the current station position is centre of the display.

**View from Instrument to Last Point :** Uses the AutoCAD command to create a perspective view “looking” from the instrument position to the last taken observation.

**Section through Last Point :** Creates a view perpendicular to the line drawn along the last observation. The view is created from the “left” side of the observation line when looking from the instrument.



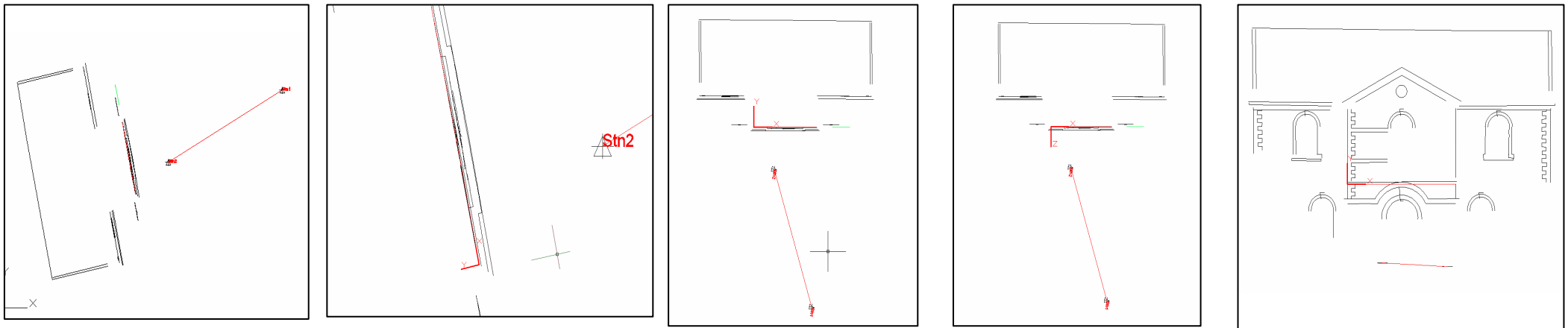
### 3D views in AutoCAD for façade survey

TheoLt sends 3D data to AutoCAD which is plotted in the lines and layers of your choice. It is useful to be able to view the drawing as a façade. One method to achieve this is to use AutoCAD's UCS (User Co-ordinate System) command to set up a façade UCS and view it square on:

1. Place a polyline across the plan by snapping to the ends of a measured line (because this will guarantee the UCS will be true level)
2. Use the UCS command 'e' ( for entity) option to fix a UCS to the poly line: pick the poly line when prompted.
3. Use 'Plan' to get a plan view of the new UCS
4. Rotate the UCS about the required axis by 90 deg to point Z at the viewer of the façade. Watch the UCS icon to see what happening.( this is the default vaule in AutoCAD to its accepted by 'enter': the command is 'UCS' , X , 90, enter
5. Use' plan' to get a plan view of the new UCS
6. Use UCSICON command to set 'Noorigin' to get the icon out of the way. Save the UCS ('S' option at UCS command) for future use.
7. Enjoy your facade view!

TheoLt will plot lines true to the instrument orientation in AutoCAD regardless of the UCS and view ports in model space can be used to run plan and elevation drawings at the same time. The façade UCS is useful when preparing views of the data for elevation drawings.

Using the AutoCAD 'View' command to save views is advised as a short cut to saved elevation views. Once the façade view is as desired it can be named for future use.



From Left to right: 1:the plan view in WCS (World Co-ordinate System), 2:the new UCS fitted to the polyline, 3Plan view of the 1<sup>st</sup> UCS.4: :the X axis rotation of the UCS and 5: 'plan' view of the façade UCS.

## TWO POINT INTERSECTION

Feature available in Pro version only.

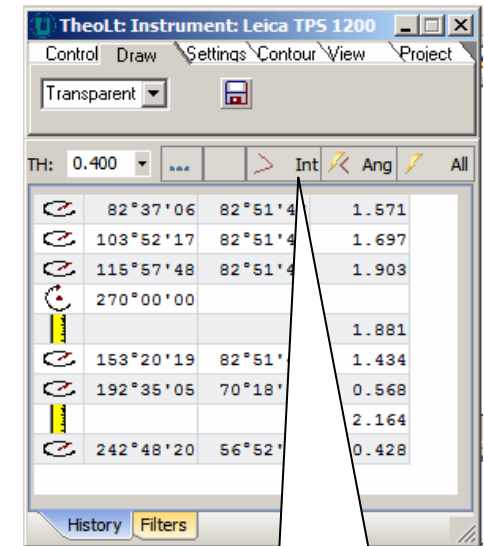
TheoLt can be used to capture point data based on 2 point intersection (as an alternative to reflectorless distance polar observation for photo-control etc).

### Procedure: first station:

1. Set up a project for the work, occupy 1<sup>st</sup> station, Orientate,
2. Open the intersection table with the 'Int' button in the instrument panel (Note the 'int' button is a toggle, on closing the panel the current project observation data is saved ready for use.).
3. Sight target.
4. Note that the table opens with a blank target number. Enter the 1st number and it will increment automatically. The number can be edited (alpha-numeric input accepted). The Add function can be used to add a new empty line ready for an observation if required.
5. Record angles by use of the 'Ang' button on the intersection panel in TheoLt
6. Face 1 and face 2 Observations are possible; care must be taken to select the target number correctly in the table as the auto advance may not match the desired observation sequence.
7. Complete the set to all targets from 1<sup>st</sup> station.
8. Unless working from existing control, set out 2<sup>nd</sup> station.

### Procedure: Second and subsequent stations:

1. Occupy 2<sup>nd</sup> station and orient.
2. In the draw tab, open the intersection table.
3. Enter the 1<sup>st</sup> target in the point number column; it will be highlighted as the selected target.
4. Sight Target.
5. Observe angles with the 'ang' button in the intersection table.
6. Check the result of the intersection in the real-time '*resultant position*' column. TheoLt will auto detect errors in targeting by the colour coded data in the 'errors' column.
7. The table will auto-advance to the next target number. You may also select the required target by picking in the 'Intersect point' column.
8. Multiple observations (face 1, face 2) are possible, care must be taken to select the target number correctly in the table as the auto advance may not match the desired observation sequence.
9. The observation can be re-taken by re-selecting the intersection point number and accepting the prompted overwrite warning message.
10. The intersected rays can be inspected by using the 'view' button on the table which will send the ray diagram to the current AutoCAD drawing in the layer 'TheoLt\_Intersection\_Diagram'. The intersected results can be sent to the current layer in AutoCAD individually by selecting the appropriate row (*send*) or as a group (*send all*), subject to an appropriate AutoCAD command (point, multiple point, insert block etc).



The 'int' toggle button opens and closes the intersection panel

### The Intersection of observations table.

The table displays the results as the intersections are achieved. Colour coding is used to indicate the precision of the results.

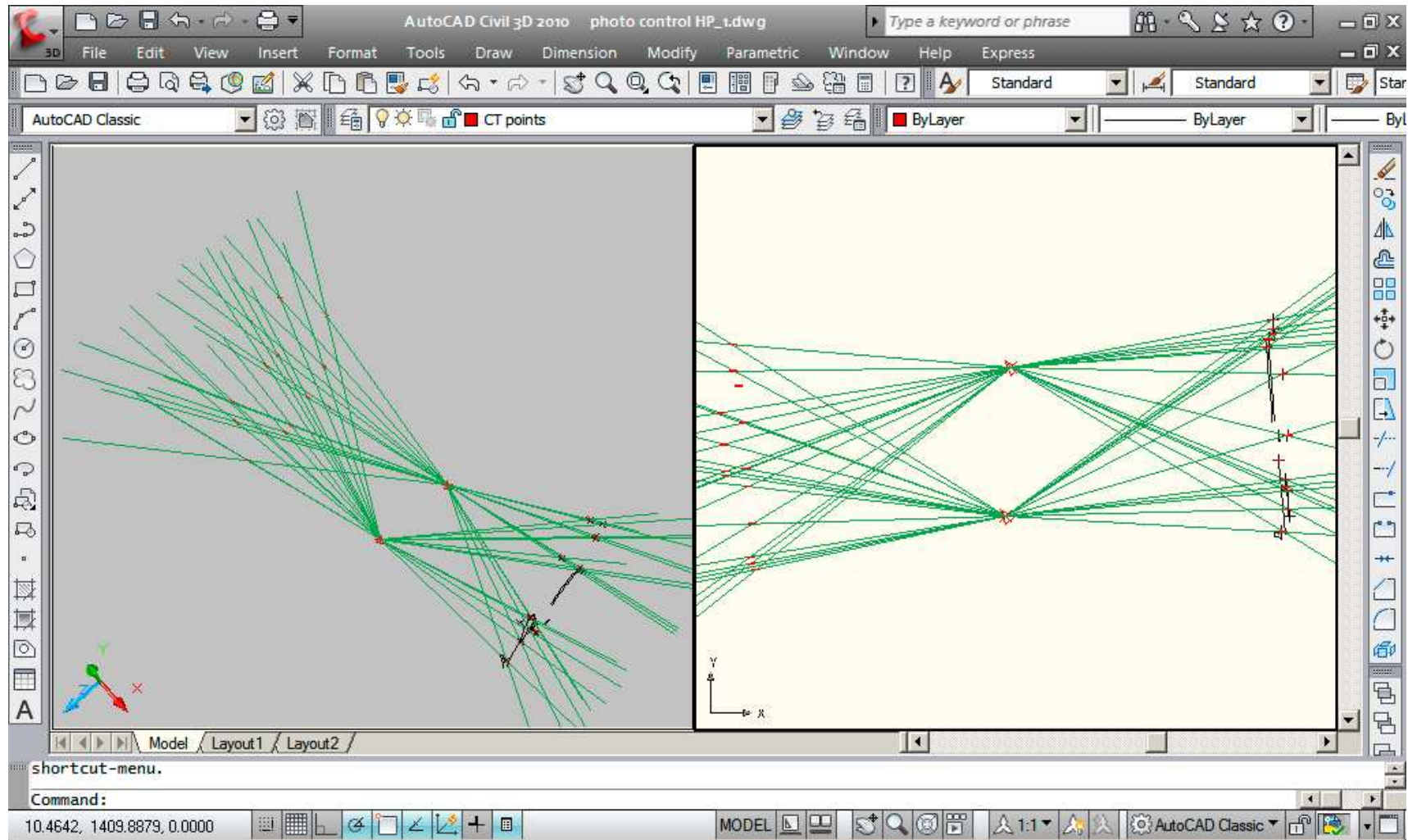
Intersection of Observations													
1	Intersect												
2	Point #	Resultant Position			Error(s)			Station	Observation			Station	Observation
3	1	1002.937	993.893	102.181	0.000	0.000	-0.011	STA414	163°19'59	80°04'05		STA415	209°21'43 78°53'44
4	2	1002.391	993.238	102.180	0.000	0.000	-0.005	STA414	166°57'18	80°26'42		STA415	213°59'14 78°54'56
5	3	1002.668	993.550	104.390	0.000	0.000	-0.004	STA414	165°11'09	70°07'20		STA415	211°43'37 67°56'46
6	4	1006.379	998.128	104.828	-0.008	0.007	-0.005	STA414	134°42'23	64°53'47		STA415	181°58'12 68°16'33
7	5	1006.149	998.301	101.327	0.000	0.000	-0.002	STA414	134°47'56	83°15'37		STA415	181°21'23 83°58'51
8	6	1006.483	998.273	104.804	-0.004	0.003	-0.003	STA414	133°40'14	64°58'47		STA415	181°10'29 68°29'29
9	7	1006.640	998.462	105.750	0.000	0.000	-0.003	STA414	132°14'44	60°39'07		STA415	180°08'27 64°53'31
10	8	1003.752	994.646	108.642	-0.000	0.001	-0.000	STA414	157°57'58	52°32'35		STA415	203°30'19 51°34'42
11	9	1005.153	996.380	109.426	0.000	0.000	-0.009	STA414	146°36'37	48°07'39		STA415	192°04'01 50°13'35
12	10	1003.646	995.030	99.715	0.000	0.000	-0.003	STA414	337°33'01	87°26'13		STA415	22°04'14 87°51'56
13	11	1003.028	994.024	103.051	-0.000	0.000	-0.000	STA414	162°39'58	75°47'56		STA415	208°30'05 74°22'48
14	12	1001.826	992.921	100.390	0.000	0.000	-0.002	STA414	169°59'25	89°03'03		STA415	217°24'02 88°25'52
15	13	1006.473	998.506	100.556	0.000	0.000	-0.002	STA414	132°38'48	87°50'59		STA415	180°04'44 87°49'14
16	200	991.051	1011.138	99.359	0.000	0.000	0.010	STA414	135°01'59	85°18'34		STA415	240°25'01 86°13'08
17	201	988.980	1008.598	100.497	0.000	0.000	0.008	STA414	297°07'07	88°23'03		STA415	43°57'14 87°41'50
18	202	988.561	1008.063	100.508	0.000	0.000	0.006	STA414	293°39'39	88°20'49		STA415	40°06'05 87°35'40
19	203	986.550	1005.574	100.797	0.000	0.000	0.009	STA414	279°30'49	87°12'29		STA415	21°03'50 85°50'48
20	204	987.578	1006.825	101.839	0.000	0.000	0.008	STA414	286°11'42	81°51'19		STA415	30°44'59 79°39'01
21	205	989.984	1009.804	101.843	0.000	0.000	0.007	STA414	305°29'17	80°54'52		STA415	52°22'44 80°28'06
22	206	990.962	1011.347	103.108	0.000	0.000	0.006	STA414	315°35'21	74°22'22		STA415	60°20'42 75°13'44
23	207	986.229	1005.484	104.836	0.000	0.000	0.005	STA414	278°58'48	69°48'59		STA415	19°38'57 64°19'47
24	208	987.847	1008.488	106.408	0.000	0.000	0.007	STA414	294°29'18	61°58'14		STA415	38°35'53 59°00'54
25	209	988.472	1009.294	106.418	0.000	0.000	0.009	STA414	299°22'18	61°22'27		STA415	43°56'35 59°32'21
26	210	991.253	1011.690	107.379	0.009	-0.008	-0.008	STA414	318°03'38	55°25'46		STA415	62°14'55 57°57'07
27	211	986.216	1005.500	106.715	0.000	0.000	0.008	STA414	279°02'39	62°42'58		STA415	19°41'26 56°09'54
28	212	987.347	1007.958	110.768	0.000	0.000	0.011	STA414	291°17'14	48°34'15		STA415	34°37'12 44°26'14
29	213	988.848	1009.809	110.749	0.004	-0.002	-0.004	STA414	302°32'46	46°55'26		STA415	47°06'44 45°49'05
30													

⏪ ⏩

⚡ All ⚡ Ang ➕ Add

💾 Save As 👁 View ✓ Send ✓ Insert All

The AutoCAD view of intersected observations.



Instrument class limitation for real-time (angle only) data acquisition.

*Please note that 'live' angle only data is NOT available on Leica TCR300 and 400 series instruments and that the streamed angle only data from the 100 and 1200 series instruments is only available to the TheoLt interface on demand from TheoLt: the send option ('rec') does not operate transparently for angle only measurement in all classes of Leica TPS instruments.*

## Appendix 1: TheoLt settings



The settings for TheoLt Core are accessed via the settings tab and the spanner button. The settings panel is divided into 12 subject tabs:

	Field	Variable	Unit	Default
<b>Instrument</b>				
	Total Station	Selected from drop down list		
	Distamnece Meter	Selected from drop down list		
	Com port	1-8		
	Prism constant	Only used where not available as set on instrument	mm	0
	Max Height	Target/instrument height limit	m	5
	Max Error	Maximum computable msiclosure	m	0.02
	Next point	Point numbering start		1
<b>Data file format</b>				
	Available fields	Selected from list		
	Fields used	Selected from list		
	Field separator	Selected from drop down list		
	Write raw data file	On/off		
<b>AutoCAD</b>				
	AutoCAD version	Selected from drop down list (Includes non AutoCAD platforms)		
	Control Layer	User Editable		INST_CTRL
	Block scale size		Unitless	6
<b>TheoLt 32 application</b>				
	Settings file	Windows explorer Browseable		
	Blocks location			C:\TheoLtBlocks\
	Working folder			C:\
	Project base path			
	Licence manager	Opens authorisations panel		
	Allow docking	Check box		off
	Angle display in DMS	Check box		on
	Start in project tab	Check box		off
	Show start-up dialog	Check box		on
	Show verify after orient	Check box		on
	Set station status on insert	Check box		

<b>Blocks</b>				
	Block list	Selected from list		
	Add			
	Remove			
	Edit	Opens field mapping panel for selected block		
<b>Layers</b>				
	Layer list	Selected from list		
	Add			
	Remove			
	Edit			
<b>Contours data capture</b>				
	Captured points layer	Selected from drop down list		
	Breaklines layer	Selected from drop down list		
<b>Contours output*</b>				
	Contour Lines Layer	User Editable		
	Interval		m	0.25
	Index Lines Layer	User Editable		
	Interval		m	1
	Index Text Layer	User Editable		
	Line smoothing	Selected from drop down list		Splined Polylines
<b>Motor Drive</b>				
	Target colour	24 colour palette selectable		red
	Background Colour	24 colour palette selectable		grey
	Motor speed at measurement point :Slow	User Editable	m/s	
	Motor speed at measurement point :Fast	User Editable	m/s	
<b>Applied corrections</b>				
	Enable Environmental Adjustments	Check box		
	Apply projection	Selected from drop down list		
	Refraction correction	Selected from drop down list		
	Scale factor	Windows explorer Browseable		1
	Apply Curvature Correction	Check box		
<b>Environmental parameters</b>				
	Relative humidity	User Editable	%	
	Barometric pressure	User Editable	Mb	
	Temperature	User Editable	c	



Features	Height above nean sea level	User Editable	m	
	Folders	Selected from list		
	Features in Folder	Selected from list		
	New	Opens define feature panel		
	Del	Deletes selected field		
	Edit	Opens define feature panel for selected block		

\* Further settings are included in TheoContour arx controls

## Appendix 2: DistToPlan Command list

TheoDisto ARX command list

Drawing	
theoSketch	Sketch a closed outline
theoMeasure	Measurement tools
theoSketchMeasure	Sketch and measure combined
theofitclosed	Fit a closed outline (least squares)
theodstart	Pick a start point for theodwall command
theodwall	Draw a wall from the selected start point
theodbrace	Draw a brace (diagonal)
theojoinwalls	Moves one wall to the end of another
theoclose2walls	Adjust the 2 picked walls to a single intersection point keeping the lengths
theoclose3walls	
theoCloseDistrib	Distributes linear error throughout a closed outline
theoOpenDistrib	Distributes linear error throughout a series of lines
theoRoomHgt	Measure room height and insert block
theoRelativeHgt	Measure a height
theodroom	Draw a rectangular room using length, width and (optional) diagonal
theodalgn	Aligns one set of data to another using wall lines
theodsqfeatue	Cuts a “square” feature into a wall line
theodlinefeatures	Divides a wall line using measurements back to a single ref point
theodline2arc	Converts a wall line to an arc using 2 brace measurements.
theodiregular	Construct an outline using right angle corners or diagonals for non-rt angles
theodFeature	Insert a theolt “feature”
theodeditwall	Edit a wall length
theodfixedpoint	Fix one end of a line
theodfixline	Fix both end of a line
theovertrect	Draw a vertical rectangle with 2 (3D) points.
theo3ptrect	Draw a rectangle with 3 (3D) points

theo3dmultiline                      Draw a multi-line

## Data Management

theoRoomCreate	Create a room
theoGroupCreate	Create a layer group
theoStationAddItems	Add entites to a station
theoStationRemoveItems	Remove entities from a station
theoRoomAddItems	Add entites to a room
theoRoomRemoveItems	Remove entities from a room
theoClearLayer	Remove all entieis from a specific layer
theosetstation	Set the current occupied station
theodhlightstation	Hi-light all the entities on a specific station
theodsetlayergroup	Set the current layer group
theodhidelayergroup	Hide the specified layer group
theodshowlayergroup	Show the specified layer group
theodsetroom	Set the current room
theodhlightroom	Hi-light all the entities in a specific room
theodclearhiroom	Clear the room hilight
theodroommgr	Display the room manager window
theodgroupmgr	Display the layer group manager window
theodsetroomcl	Command line version of set room
theodhlightroomcl	Command line version
theodclearhiroomcl	Command line version
theocreatelayers	Create all the layers controled for the current layer group
theodclearhistation	Clear the station hilight
theostationmgr	Display the station list window
theostationcreate	Create a new station
theoreferencecreate	Create a new reference station
theoupdateallstationpositions	Read and update all the stations in the drawing from the project station list data file.

<b>Settings</b>	
Theotemplatemg	Create and edit file type templates (for bluetooth and journal commands)
theoptions,	Display the options window
theodcalc	Display the calculator window
theodVer	Display the version of the arx file
<b>Misc</b>	
startBlueToothMonitor	Start the bluetooth inbox file monitor
theoassignbyfile	Read an x,y,z file to assign entities to stations
theocheckunassigned	Displays all entities not assigned to stations
theotextvalueshift	Shift the numeric values of selected text by a specified amount.
theoaddlinelevels	Add level (Z) annotation to the ends of selected lines
theoroomdata	Insert a room data block (feature)
theoinsertlink	Insert a linked file (used by bluetooth monitor and journal files)
theoCancel	Cancel a command
theoplanbuilder	Display the “Plan builder” window (docking panel)
theostarttheo	Start the theolt comms module
theoaddjournal	Add a journal / templated file
theoreadprojectpoints,	Read and display all points in the current project

### Appendix 3: TheoLt and DistToPlan layers list

DistToPlan	Layers for Disto building plan data separation. DistToPlan will add these layers according to the commands used.
Walls_Disto	Room outline
History_Disto	Unadjusted lines ( frozen on default)
Annotation_Disto	Dimension Text on wall line
Braces_Disto	
Feedback Fixed points	
Walls_Disto	
Adjusted_Disto	
Walls_Openings_Disto	
Braces_Disto	
Error_Lines_Disto	
Error_Annotation_Disto	
Annotation_Disto	
Annotation_Adjusted_Disto	
History_Disto	Frozen on creation
Feature_Points_Disto	
Align_Points_Disto	
Fixed_Points_Disto	
Hyperlinks	
Heights	
Windows_Dimension	
Windows_Opening	
Windows_Frame	
Doors_Dimension	
Doors	
DoorOpening	

TheoLt Layers	Layers for TST data seperation
INST_CNTL	
INST_ID	
TheoLt_network_Diagram	
TheoLt_network_Diagram_Adjusted	

Features layers	Layers for inserted blocks (supplied default blocks only)
<i>T SURF group:</i>	
DETAIL	
DETAIL CROSS	
CHANGE OF SURFACE	
CHANGE OF SURFACE CROSS	

## Appendix 4: TheoLt Core Supported Instruments

All instruments are required to operate in Serial Communications mode over RS232 protocol.

<i>Instrument</i>	<i>Notes</i>	<i>Instrument</i>	<i>Notes</i>
<b>Wild:</b>		<b>Trimble:</b>	
TC1000		3600 Geodimeter CU	Serial comms are not possible with CUs other than the Geodimeter unit.
T1000+Disto	Using Disto 'GSI' only	5600 Geodimeter CU	
T1000+Dior			
T1000-6K+Disto	Using Disto 'GSI' only		
T1000-6K+Dior			
T1600+Disto	Using Disto 'GSI' only		
		<b>Topcon</b>	
<b>Leica</b>		GPT-1000	
T460D+Disto	Using Disto 'GSI' only	GPT-6000	
TM1100+Disto		GPT-2006	
TM1100+Dior			
TC400/500			
TCA1100		<b>Sokkia</b>	
		SET330r	
Builder RM	H circle is reversed with browser button in measure mode!	SET630r	
TPS 300		SET2	
TPS 400		SET3	
TPS 300/400 Bluetooth	With appropriate Bluetooth adaptor		
TPS 700		<b>Nikon</b>	
TPS 700 Auto		Nikon NPL	
TPS 800		Nikon 700	
TPS 1100	V angle locked after Dist by default. Can be set from 'Hold after Dist to 'running' in Configure, General Settings, Units & Formats, Angle tab.		
TPS 1100 Bluetooth		<b>Zeiss</b>	
TPS 1200	Face 2 observations on single control panel instruments will send a reverse angle if sent from the instrument. The angles are OK if called from TheoLt	Zeiss ELTA3	
Flexline TS	Common interface to TPS instruments		
		<b>Leica Disto</b>	
<b>MDL</b>		Memo	Requires comms cable
MDL LaserACE 300		Plus	
		A6	
			Bluetooth Interface
		D3aBT	
		D8	
		3D	To be announced Autumn/2011





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