

## Leveling

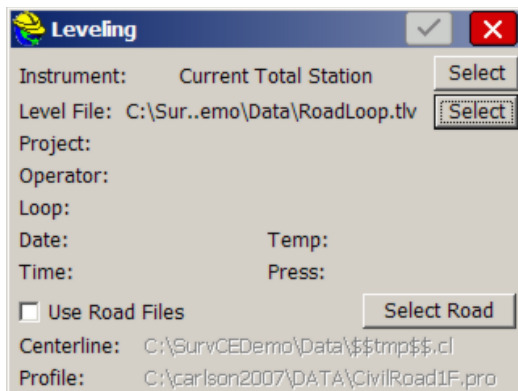
This routine allows you to run trigonometric level loops using a total station or digital level loops using a digital level. There are also manual entry modes available for both types of level loops.

The raw data collected for a total station is slope distance, zenith angle and prism height. For digital levels, the vertical difference and if available, the horizontal distance is stored in the raw data file. The calculation routines assume there is only one loop per level file.

A benchmark is required at the beginning of the loop (BM+) and a benchmark is required at the end of the loop (BM-). After the BM+, measurements back to a known elevation (TP-) and measurements forward to establish an elevation (TP+) are alternated. Any number of side shots to points (SS-) or stations (STA-) is allowed while traversing. Spurs (series of TP+ and TP- measurements off the main loop) are allowed and will be adjusted correctly. A spur after the BM- is allowed.

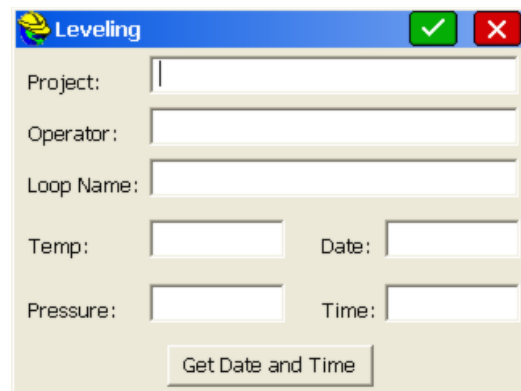
The opening dialog is where you set up the level loop. If road files are used, an additional tab in the leveling measurement screen will be made available for entering station and offset data.

To use a digital level instead of the current total station, click the Select button to the right of the Instrument and choose from the available options, which include Manual 3-Wire, Manual 1-Wire, Manual Digital Level and Sokkia SDL. Manual Total Station entry can also be done by choosing **Manual Total Station** on the **EQUIP** tab.



The screenshot shows the 'Leveling' dialog box with the following fields and buttons:

- Instrument: Current Total Station (with a 'Select' button)
- Level File: C:\Sur..emo\Data\RoadLoop.tv (with a 'Select' button)
- Project: (empty text field)
- Operator: (empty text field)
- Loop: (empty text field)
- Date: (empty text field) Temp: (empty text field)
- Time: (empty text field) Press: (empty text field)
- Use Road Files (with a 'Select Road' button)
- Centerline: C:\SurvCEDemo\Data\\$\$tmp\$\$\$.cl
- Profile: C:\carlson2007\DATA\CivilRoad1F.pro



The screenshot shows the 'Leveling' dialog box with the following fields and buttons:

- Project: (empty text field)
- Operator: (empty text field)
- Loop Name: (empty text field)
- Temp: (empty text field) Date: (empty text field)
- Pressure: (empty text field) Time: (empty text field)
- Get Date and Time (button)

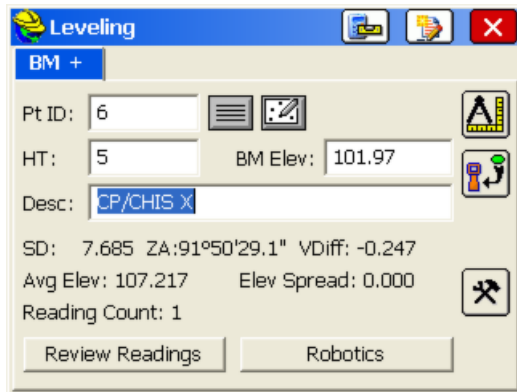
Click the **Select** button to the right of the Level File to open an existing loop or start a new loop. The user will be prompted to enter loop data, such as project name and operator, when creating a new loop.

Click the **Use Road Files** toggle to enable the use of the selected files. If **Use**

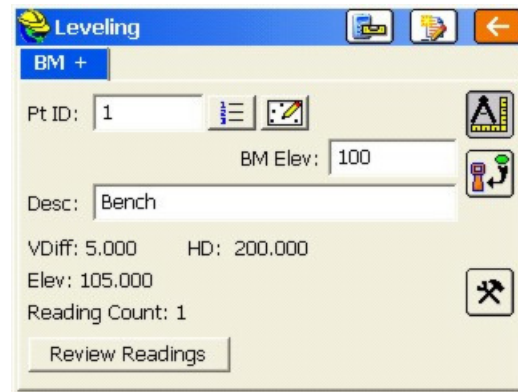
Use the **Select Road** button to choose the horizontal and vertical alignments you wish to associate.

**Road Files** is turned off, the STA+ tab will not be shown.

After the loop has been opened or created, select the Green Check button (OK) to advance to the measuring screens. The first reading of the loop must be a benchmark (plus) reading to establish the instrument height. Enter the point ID or known benchmark elevation, the prism height (trig levels), and a description. The press the **Read** icon or **Enter** to measure. Once the reading has been taken, select the **Store** icon to keep it. You can take as many readings on a single point in any face that you like. You can also review the readings, and disable any that you don't like prior to storing.









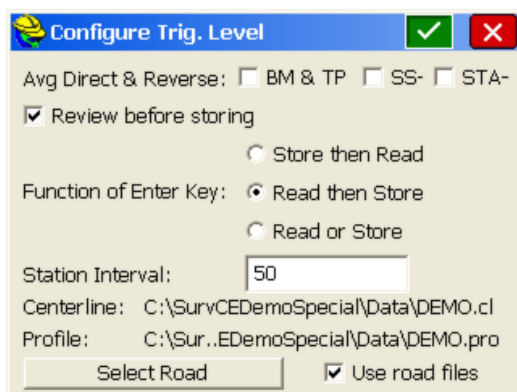
**Trig Leveling**



**Conventional Leveling**

Some of the fields below only apply to one of the Leveling types. See screen shots above to see which apply.

- **Pt ID:** Use this field to retrieve the elevation from an existing point in the coordinate file.
- **HT:** Use this to enter the prism height. If using a digital level, this field will be gray, and will be populated with the rod reading from the level.
- **BM Elev:** Enter a known elevation for the benchmark. This field will auto-populate if a point ID is selected.
- **Desc:** Enter the point description.
- **Review Readings:** This allows you to enable or disable specific readings prior to storing.
- **Robotics:** Use this to control the robot.
-   **Read:** Use this icon to take a reading.
-   **Store:** Use this icon to store the reading.
-   **Configure:** Use this icon to setup direct and reverse settings and review options.

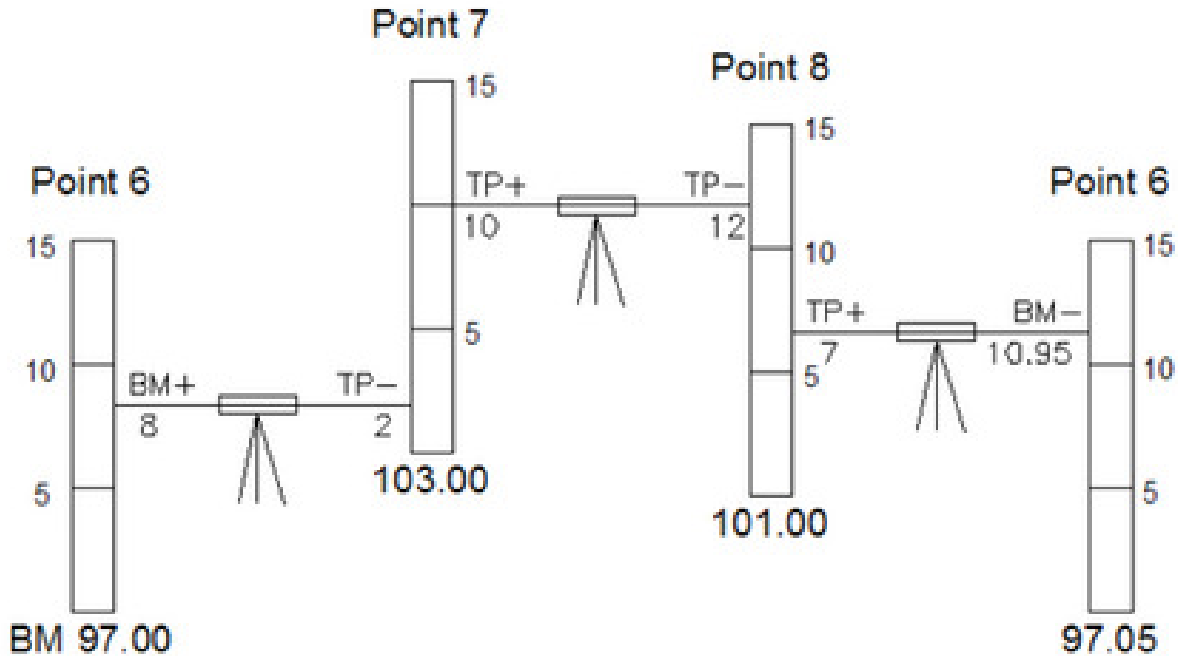


• **Avg Direct & Reverse:** This option will allow you to determine which readings take direct and reverse pairs. (only applies to Trig Leveling)

• **Review before storing:** This toggle forces the **Review Readings** dialog prior to storing. This is the same dialog that comes up when the **Review Reading** button is pressed except the Review Reading dialog has a Store Point button that stores the shown measurements

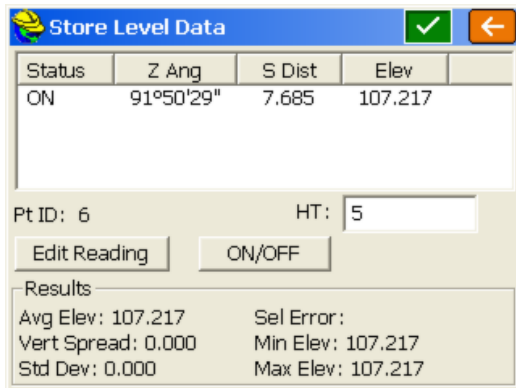
### Manual 1-Wire Example

If you select the 1-Wire method of Leveling, the graphic below may be helpful in selecting the options to conduct a simple level loop:



You "+" to your "backsight" and you "-" up to your foresight, and you name the points as you go. You start by referencing a benchmark, and you close the loop by referencing the starting point or a second benchmark.

After entering the example, pressing the **Edit Levels** icon shows all the measurements made. All the horizontal distances (HD) are shown as 100 because 1-wire leveling does not provide a horizontal distance. Giving all the segments the same distance causes the level adjustment to give all the segments the same weight.



Status	Z Ang	S Dist	Elev
ON	91°50'29"	7.685	107.217

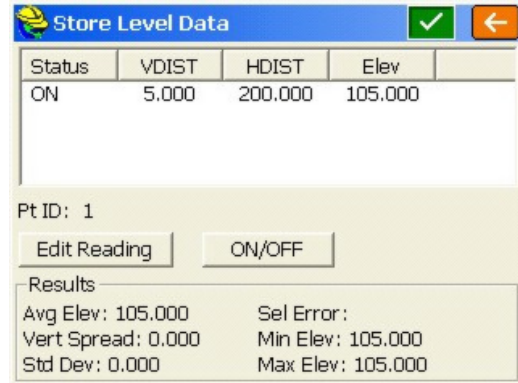
Pt ID: 6      HT: 5

Edit Reading      ON/OFF

Results

Avg Elev: 107.217	Sel Error:
Vert Spread: 0.000	Min Elev: 107.217
Std Dev: 0.000	Max Elev: 107.217

**Trig Leveling**



Status	VDIST	HDIST	Elev
ON	5.000	200.000	105.000

Pt ID: 1

Edit Reading      ON/OFF

Results

Avg Elev: 105.000	Sel Error:
Vert Spread: 0.000	Min Elev: 105.000
Std Dev: 0.000	Max Elev: 105.000

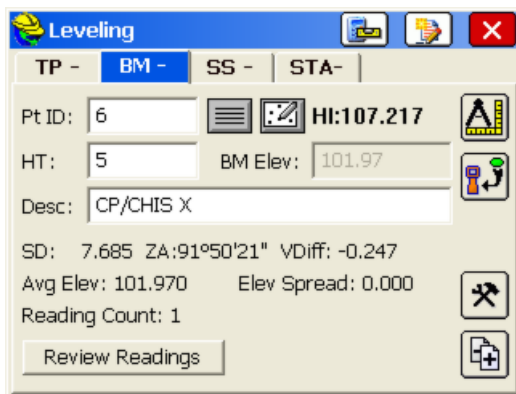
**Conventional Leveling**

The **Status** field shows if the measurement is turned on or off. Measurements that are off will not be used in any calculations. Elev shows the calculated elevation which will be the elevation at the total station or level on a plus shot (BM+ or TP+) or the elevation at the rod on a minus shot (BM-, TP-, SS- or STA-).

Any measurement can be highlighted by clicking on the measurement. A measurement must be selected before using **Edit Reading** or the **ON/OFF** button.

All the values in the Results section are about the elevation calculations. The **Sel Error** field shows how different the calculated elevation of the currently selected measurement is from the mean of all the measurements that are on.

Once a benchmark (plus) reading has been taken and stored, the **Minus Reading** dialog will be shown. This dialog allows you to read the minus reading to a turning point (TP), benchmark (BM), sideshot (SS), or a sideshot on an alignment (STA). Turning points advance the setup while sideshots do not. A reading to the benchmark in the minus screen will end the loop.



Leveling

TP - **BM -** SS - STA-

Pt ID: 6      HI: 107.217

HT: 5      BM Elev: 101.97

Desc: CP/CHIS X

SD: 7.685    ZA: 91°50'21"    VDiff: -0.247

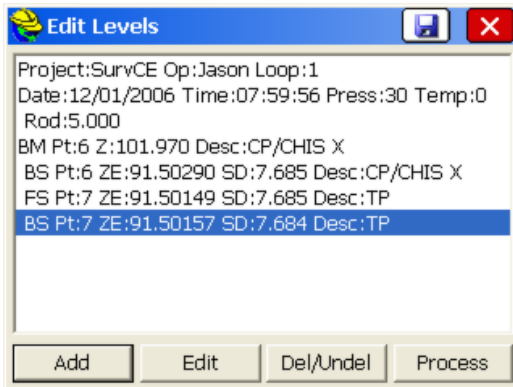
Avg Elev: 101.970    Elev Spread: 0.000

Reading Count: 1

Review Readings

- 

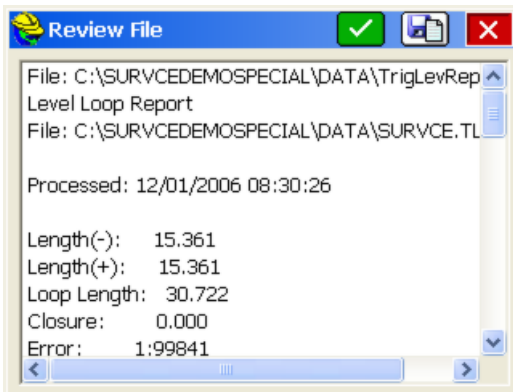
**Level Reading Mode:** This icon switches the interface between taking plus or minus readings.



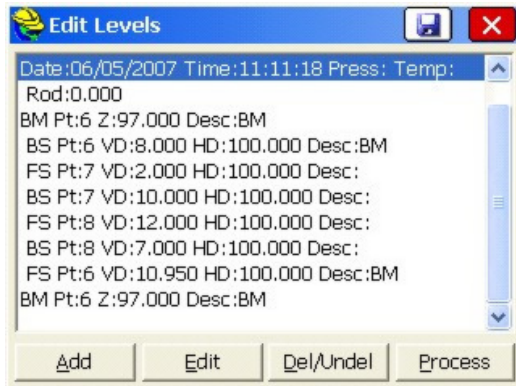
At any time during the loop, you can edit a reading using the **Edit Levels** icon to the left of the red X (Cancel) button.

Once the minus reading on a benchmark has been recorded, you can then process the loop using the **Process** icon which is shown inside the **Edit Level** routine.

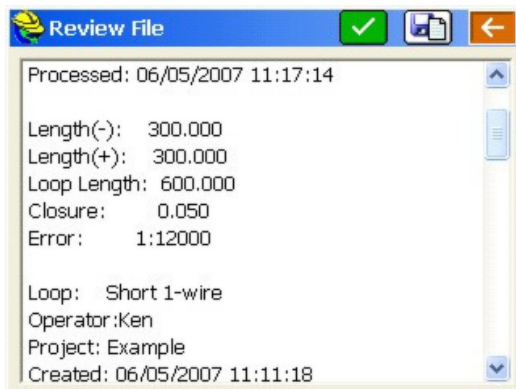
Once you've processed the loop, a **Review File** dialog will be displayed. At this point you can choose to save the report or proceed to the **Processing Options** screen.



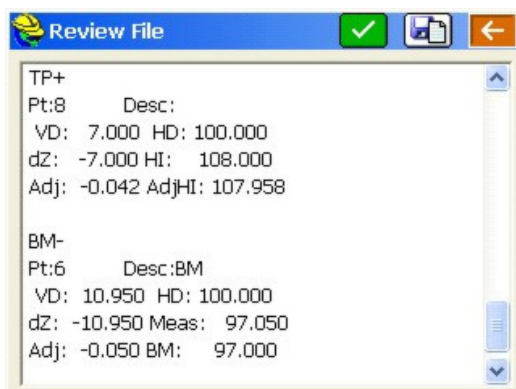
The Processing Options screen allows you to update all existing points in the coordinate file with the leveled elevations. It also allows you to overwrite the point descriptions using what was entered during the level loop and will compute coordinates for any points that were defined by station and offset.



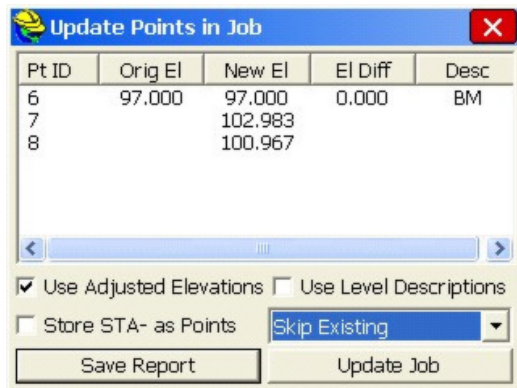
Pressing the **Process** icon shows the results.



Scrolling to the end shows the adjustments that will be applied to the last two measurements.



Pressing the green check icon brings up the **Update Points in Job** dialog.



Pt ID	Orig EI	New EI	EI Diff	Desc
6	97.000	97.000	0.000	BM
7		102.983		
8		100.967		

Use Adjusted Elevations    Use Level Descriptions

Store STA- as Points   Skip Existing

**Save Report** will put the information shown in the **Update Points in Job** dialog into a text file for your records.

Update Job saves the new elevations to the points in the job. **Skip Existing** will not replace a point's elevation if it already exists but **Replace Existing** will.