

Level Monitoring System

Introduction

Level Monitoring System is a software package written by Mr. C. P. E. Agbachi for applying a least squares adjustment to levelling networks, with the additional facility to compare different data sets of a network for monitoring the heights of the points and producing a trend analysis.

The software was originally developed to run under DOS and is capable of accepting data direct from the Leica Digital Levels. As the software combined with the Leica Digital Levels provides a powerful monitoring combination, Mr. Agbachi approached Leica UK Ltd. It is however Leica policy to market software running on the Windows™ platform and Mr. Agbachi has re-written the Level Monitoring System software in the Windows™ environment.

Using the Level Monitoring System

Use of the software employs an easy to follow procedure. The Windows™ environment is preferred by Leica because it provides a recognisable and easy to use man machine interface. It is our experience that existing Windows™ users find new software packages presented on this platform can be learned rapidly because of familiarity with the environment, and that non Windows users soon learn their way around keeping the learning curve as shallow as possible. The Windows™ Level Monitoring System software is easy to learn and use, not only because of the environment, but because the process is sequential and logical.

Starting the Level Monitoring System software displays the familiar Windows™ format with the row of icons as shown under the heading Operation. To operate the software the icons are used from left to right and the steps selected in turn so that the process is performed in the correct order without the user having to think what to do next. Each stage of the process provides the user with all the information required so that the quality of the data can be assessed as and when necessary.

The software has been written in such a way that the computer performs the tasks that computers are good at whilst the operator only performs those tasks that are better done by humans. The data is input, reduced, processed and presented in a straight forward manner without the user having to be a statistician which makes the software a useful method of processing and adjusting levelling networks for control and monitoring.



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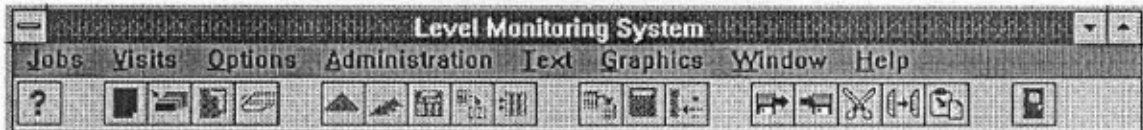


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Operation



The software is started by clicking the L M S icon in the Windows™ Program Manger which presents the opening screen with the following menu bar and row of icons.



The first four icons, after the "Help" icon, allow the project and working file to be selected.



Open the Job Index Database to create a new project if starting a new one.



Select the project to work on from the Job Database. All the files for a single project are held in a single compact file in the Level Monitoring System making archiving, backing up and data transfer a simple operation.



Click on this icon is to create a new data set within a project. For example; it could be the data set for the first site visit in a monitoring program, or one of the subsequent site visits.



Select the data set to be worked on. The comparison of data sets is controlled by the date of the scheme.

The next five icons control the entering of control points for the network; the input, editing and review of the data sets, including data input from a Leica Digital Level, and the options to print out hard copy records as and when required.



Click on this icon to enter the known height of nodes that are going to be used to "control" the network. This could be a single Bench Mark or a number of Bench Marks or points with known heights. This is also where points previously entered as control can be de-selected. At least one known [control] point is required for a given network.



Display the known points that will be used to control the selected network. These can be printed out if required.



Display the readings in an existing data set for each leg in the network, complete with the difference in height and summation of height differences. The data set can be scrolled through for reviewing or editing and remarks included if necessary. The information is displayed in the form of a field book and is a useful means of viewing the values recorded with a Leica Digital Level.



Import a new data set from a Leica Digital Level.



Sequential display of the levelled points, staff readings and height differences. The screen presented by clicking this icon allows the data to be easily viewed with the option to print out a hard copy for record purposes. The data is now ready for processing having been presented so that it can be viewed, the necessary control points selected and the fixed values input.

The following three icons control the actual processing of the data.



Clicking this icon displays a four line processing menu which should be selected in sequence to process the data set.

List of Data Set The data set is read and processed to calculate and display the difference between each point in the network. There is an option to print out the results of this calculation.

Controls in Network The data set is scanned to display the control points, with fixed values, that occur in the data set.

Nodes in Network The data set is read and processed to calculate and display the number of set-ups and the height differences for each node in the network. The results can be printed out. Any spurs not forming a closed loop are indicated by an asterisk. The nodes can be displayed showing the number of paths and the provisional heights for the nodes. This data can also be printed out.

Loops / Closures The closures for each loop in the network are calculated and displayed with the option to print out the results.



Clicking this icon displays a four line computation menu which again should be selected in sequence.

Compute The network is adjusted by the method of least squares.

Node Information The observed differences, residuals and height differences for each node in the network are displayed with the option to print out the results. The provisional height, correction and adjusted height for each point can also be reviewed and printed out. This information is available for every point in the network, not just the nodes.

Station Heights Summary of each point with it's adjusted height with the option to print out these values.

Edit Stations The Level Monitoring System deals with the calculation and adjustment of the Heights of the points forming a network. This option allows Eastings and Northings to be added to any point, or points, in the network, and for comments to be attached to them.



Clicking this icon displays a five line menu enabling the data set to be compared with the preceding and first data sets in the project. Comparison of data sets is controlled by the date attached to them when they are processed. If data sets other than the previous or first are required for comparison purposes this can easily be achieved by altering the date attribute of the data sets.

Base Visit Selects the first data set in the project.
The contents of the data set can be reviewed if required.

Last Visit Selects the previous data set in the project.
The contents of the data set can be reviewed if required.

Current Visit Selects the current data set in the project.
The contents of the data set can be reviewed if required.

Results The adjusted heights for the first, previous and current data sets for each point are displayed together with the differences between the current and first, and the current and previous, data sets.
Consideration is being given to presenting this information graphically.

Trend Analysis The adjusted heights together with the differences between the first and previous data sets are presented for each data set in the project. There is the option to print out this information.
Consideration is being given to presenting this information graphically.

The last six icons are made up of a block of five for file handling, cut, copy and past with the last isolated icon for exiting from the Level Monitoring System software.

Conclusion

The Level Monitoring System is a software package that turns the once complex task of level network adjustment, comparison of data sets and trend analysis into a straight forward operation that can be easily and rapidly performed on a "lap top" computer on site. The sample data provided by Mr. Agbachi consisted of 580 points making up 103 loops proving that the software is capable of handling large data sets as well as the more common smaller schemes. A strength of this software package is that once the nodes of the network have been adjusted by the method of least squares, the individual change points for the level lines running between the nodes are also adjusted to give a complete adjusted data set.

A handwritten signature in black ink, appearing to read 'Hugh Anderson', with a long horizontal line extending to the right.

Hugh Anderson, B.A.(Open), A.R.I.C.S., M.Inst.C.E.S.