## The SURPAC "Lite" Module Applications

## Co-ordinate File Editing

- Defining the Co-ordinate File System using a variety of World Systems, e.g.
    - Southern African "Lo" Grid Systems (Clarke 1880 (Modified) Ellipsoid)
    - South African "WG" Grid System (WGS 84 Ellipsoid)
    - Namibian "Bessel" System (Bessel 1841 Ellipsoid (GL Metres and Int. Metres)
    - U.K. National Grid System, OSGB36, (Airy 1830 Ellipsoid)
    - U.K. National GPS Network, ETRS89, (WGS 84 (GRS80) Ellipsoid)
    - Irish National Grid (Airy 1830 (Modified) Ellipsoid)
    - Universal Transverse Mercator, UTM, (Various Ellipsoids)
    - Co-ordinate axes are automatically designated as [Y, X, Z], or [E, N, H]
- Data in a Co-ordinate File consist of :-
    - *Point Number,*
    - *Point Y - ordinate (or Easting),*
    - *Point X - ordinate (or Northing),*
    - *Point Peg Height,*
    - *Point Auxiliary Height*
    - *Point Description,*
    - *Point Field Book Page number*
    - *Point Calculation Page number*
- Manual Adding/Editing/Deletion of Points
- Importing of Point Co-ordinate Data from :-
    - ASCII [Y, X, Z] Files (various formats)
    - ASCII [Latitude, Longitude] Files (various formats)
    - DXF Files
    - Other SURPAC Co-ordinate Files
    - A wide range of Electronic Loggers and Total Stations (Direct download, or from ASCII File)
        - The currently supported Total Stations and/or Electronic Loggers are :-
            - *The Psion Organiser using the "Handi-Data Solutions Booker Ver 5 software,*
            - *The Psion Workabout, using the "Handi-Data Solutions Booker Ver 6.1", or higher,*
            - *The Leica/Wild GIF10 data logger,*

- *The Leica TC 605/805/905 Series Total Station,*
- *The Leica TCR 303/305/307 Series Total Station,*
- *The Nikon DTM-400 Series Total Station,*
- *The Nikon NPL-300/350/500/700 Series Total Station,*
- *The Pentax PCS-300 Series Total Station,*
- *The Sokkia SET2C/SET3C Series Total Station,*
- *The Sokkia SET2100/SET3100/SET4100 Series Total Station,*
- *The Sokkia SET2110/SET3110/SET4110 Series Total Station,*
- *The Sokkia SET300, SET500, SET600 Total Station,*
- *The Topcon GTS-200/210 Series Total Station,*
- *The Topcon GTS-500/700 Series Total Station.*

- **Exporting of Point Co-ordinate Data to :-**
  - **ASCII [Y, X, Z] Files (various formats)**
  - **ASCII [Latitude, Longitude] Files (various formats)**
  - **A wide range of Electronic Loggers and Total Stations**
  - **the Windows Clipboard**
- **Establishing/Editing of Point Description information**

## General CAD Construction/Editing

- **Plot all, or selected Points from the current Co-ordinate File**
- **Display and Name Points using a variety of built-in symbols, Sizes and/or Colours**
- **Construct/Edit Lines using various Line Styles, Thicknesses and/or Colours**
- **Construct/Edit Arcs and Circles using various Line Styles, Thicknesses and/or Colours**
- **Write/Edit Text Items using various Fonts, orientations, sizes and Colours**
- **Display Contours created in the SURPAC Contour CAD programme**
- **Display Centre Line Data from the SURPAC Horizontal Alignment programme**
- **Auto Hatch closed polygons using a variety of Hatch Styles**
- **Import Graphic Images (BMP, JPEG, GIF, ICO, WMF or EMF formats)**
- **Create Graphic Image of Sheet, or portion of the Sheet (BMP format)**
- **Display/Plot the Sheet at any Orientation, or Scale**
- **Auto Display Grid Mesh and/or North Point**
- **Using simple mouse or keyboard commands, the on-screen view of a CAD Sheet may be :-**
  - **Zoomed Up,**
  - **Zoomed Down,**
  - **Zoomed to a defined window,**

- Zoomed to the defined Plotting scale,
- Zoomed to a User defined scale,
- Rotated positively or negatively,
- Panning or scrolling the display.

- Use various drawing Construction/Edit functions such as :-
  - Line Bisect,
  - Line Dimension,
  - Line Generate (using Polar Data),
  - Line Intersect,
  - Line Logical draw,
  - Line Replicate,
  - Line Sketch,
  - Line Trim/Snap,
  - Line Subdivide,
  - Draw Arrows, Rectangles, Arcs or Circles
  - Auto Display Line Direction and/or Distance,
  - Calculate Areas by auto Line location or Point definition.

- Use various Text Writing/Editing functions, such as :-
  - Write a Text Item at any Font, Direction, Size, WTH ratio or Colour
  - Dynamic Copy Text Items
  - Dynamic Move Text Items
  - Dynamic Re-Size and Re-Orient Text Items
  - Edit or Delete existing Text Items
  - Import Text Items from an ASCII File

- Use various Graphic Editing functions, such as :-
  - Import Graphic Images (BMP, JPEG, GIF, ICO, WMF or EMF formats)
  - Create Graphic Image of Sheet, or portion of the Sheet (BMP format)
  - Flip an Image (Horizontal, Vertical or both)
  - Set Images to be in front of, or behind, drawing information
  - Move an Image
  - Re-Size an Image
  - Shift an Image
  - Transform an Image (to fit current System position and size)
  - Use a Transformed Image to Digitize Points and Lines
  - Adjust Image Brightness and/or Contrast

- Use the SURPAC "Frame" function to :-
  - Copy defined a block of Data from Position 1 to Position 2, or Sheet 1 to Sheet 2
  - Move a defined block of Data from Position 1 to Position 2
  - Delete a defined block of Line/Text data

- Align a defined block of Text Items (Left/ Centre/ Right Justify, plus horizontal spacing)
- Rotate a defined block of Data
- Zoom Up, or Zoom Down, a defined block of Data
- Store and recall Data Blocks from disk for repeated Sheet application

- Import Line, Arc, Circle, Hatch and Text data from DXF Files
- Import Line, Arc, Circle, Hatch and Text data from other SURPAC CAD Files
- Import Line, Arc, Circle, Hatch and Text data from TopoCAD CAD/GIS Files
- Import Spline Contours and Contour Labelling
- Print Sheet to A0 - A4 Printer (Inkjet or Pen)
- Create a DXF file of Sheet data
- Create an HPGL file of Sheet data

## Joins (Sides)

- Using 2D [Y, X] values, providing [Horizontal Direction & Distance]
- Using 3D [Y, X, Z] values, providing [Horizontal Direction & Distance plus Vertical Angle & Height Difference]
- Calculations may be in Normal, Radial or Sequential Join mode.

## Polars

- Manual Input, or direct reduction from a SURPAC Observation File
- Plane Data Calculations :-
  - 2D [Hor. Direction & Distance] providing [Y, X] values
  - 3D [Hor. Direction, Slope Distance & Vertical angle] providing [Y, X, Z] values
- Field Data Calculations :-
  - 2D [Oriented Direction, Reduced Distance] providing [Y, X] values
  - 3D [Oriented Direction, Reduced Distance & Height Diff] providing [Y, X, Z] values
- Each Set-Up in the defined Observation File is oriented using one or more orientation observations, and the T- t corrections are applied. Distances are reduced for Scale Enlargement, Sea Level, Projection Factor and Slope. Vertical Angles are corrected for Curvature and Refraction.
- Calculation may be in Normal, Radial or Sequential Polar mode

## Reverse Polars

- Calculate an unknown Set-Up Point [Y, X, Z] by observing to one, or more, distant known

Points (such as Trig. Stations) and observing and measuring to a close known Point. Data are extracted from a User defined SURPAC Observation File.

## Two Sides and the Included Angle

Calculate and check an unknown Set-Up Point [Y, X, Z] by observing and measuring to two known Points. Data are extracted from a User defined SURPAC Observation File.

## Intersections

Intersection of a new Point by "Direction and Direction" from two known Points
Trilateration of a new Point by Distance and Distance" from two known Points
Intersection of a new Point by "Direction and Distance" from two known Points
Calculate the Tangent Point from a Point to a defined Circle
Calculate Circular Curve information from given data
Fit a Circular Curve through 3 defined Points

## Area Calculations

Calculate Area and Data from Co-ordinates
Calculate Area from Co-ordinates with Co-ordinate checking from entered Polar data
Calculate Area from entered Polar data, without Co-ordinate checking
Calculate two new Points to create a defined fixed Area
Calculate a new Point using a given Pivot Point and a defined fixed Area

## Point Off-Line Calculations

Computes and displays the Off-Line positions of all Points lying within a prescribed distance of a defined base line. Users may view the Off-Line data from the line connecting two terminals, or from a Least Squares Line of Best Fit that, uses all Points located to determine the fit.

Existing Points may be re-computed at their On-Line positions, or new Points maybe computed a these positions and the original Points maintained.

## Road Apex Calculations

[Y, X] values for a new Point are computed at a User defined Road Apex position. Input requirements are the left and right Road Widths and their Directions.

## Line Running and Adjusting

[Y, X] values of Points are calculated along a defined base line. The base line is determined by its User defined terminal Points. Line distances between new Points may be singular or repeated. Line mis-closure data is displayed after all data are entered.

## Splay point Calculations

[Y, X] values for two new Points are computed at the defined Splay positions, one either side of the Apex Point. Input requirements are the left and right Road Directions and the Splay Distance.

## Data Traverse Calculations

Calculates and adjusts a simple Traverse using plane data. The programme is designed for use in calculating Point co-ordinates by means of starting from a known Point on a General Plan (for example) then using the plan Directions and Distances to compute traverse legs through a series of Points whose co-ordinate are required. The last leg used must close onto the first, or another, known Point. T3 different modes of adjustment are available to the User.

## Field Traverse Calculations

Calculates and adjusts a series of Traverse Points, using adjusted data extracted from a User defined SURPAC Observation File.

Each Set-Up in the Traverse is oriented using one, or more, interior and/or exterior orientations. The T- t corrections are also applied.

Traverse Distances are reduced for Scale Enlargement, Sea Level, Projection Factor and Slope. Vertical Angles are corrected for Curvature and Refraction.

If observed, the mean of forward and back distances and vertical height differences are used.

Traverse may be 2D (Y, X) or 3D (Y, X, Z).

Three adjustment alternatives are offered to adjust the Traverse mis-closure.

*NB : The SURPAC Planimetric Least Squares Adjustment programme may also be used for computing Traverses.*

## Printing a Co-ordinate/Peg File

- Co-ordinate File information is sent to the Printer. For Cadastral Surveys, the output may be organized by Category (Points Placed, Points Found etc.), or the list may be a simple alphanumeric one.
- Various other options exist which allow for selected sub-sets of the list to be printed.

## Printing Setting Out Sheets

- Setting Out and/or Checking Sheets may be generated using either A4, or A5 format.
- Setting Out data may be derived from either the current Co-ordinate file, or from a User defined Horizontal Alignment file (Centre Line file).
- Setting out format may be in horizontal order, within a specified radius, or Line Running pages may be generated between Point terminals.
- Checking Sheets may automatically be linked to Co-ordinate file data to provide a list of [dY, dX] values between theoretical values and as observed values.

## Basic Co-ordinate/Distance/Area Conversions

- Carries out various standard Conversions using either built in, or User defined factors.
- Distances, Co-ordinates and/or Areas may be converted.
- For co-ordinate data, transformed Points maybe saved in a Co-ordinate file, or in ASCII file format.

## Transforming Gauss Conform to/from Geographical values

- This set of Transformation programmes supports the following Systems and/or Ellipsoids :-
  - Various Southern African "Lo" Systems using the Clarke 1880 (Modified) Ellipsoid,
  - South African "WG" System using the WGS 84 Ellipsoid,

- Namibian "Bessel" System using the Bessel 1841 Ellipsoid (GL Metres and Int. Metres),
- U.K. National Grid System, OSGB36, using the Airy 1830 Ellipsoid,
- U.K. National GPS Network, ETRS89, using the WGS 84 (GRS80) Ellipsoid,
- Irish National Grid using the Airy 1830 (Modified) Ellipsoid,
- Universal Transverse Mercator, U.T.M., using Various Ellipsoids.
- Geographical [Latitude, Longitude] to Transverse Mercator [Y, X] (or [E, N]) transformations
- Transverse Mercator [Y, X] (or [E, N]) to Geographical [Latitude, Longitude] transformations
- Transverse Mercator [Y, X] (or [E, N]) System 1 to System 2 (Belt 1 to Belt 2) transformations
- Transverse Mercator [Y, X] (or [E, N]) System to U.T.M. [E, N] Zone transformations
- U.T.M. [E, N] Zone to Transverse Mercator [Y, X] (or [E, N]) System transformations
- U.T.M. [E, N] Zone 1 to U.T.M. [E, N] Zone 2 transformations

## Standard Helmert Transformations

- This programme is capable of handling any planar, orthogonal System to System transformation.
- The programme uses a Parametric non-weighted (1st Order) Least Squares adjustment technique. Developed in-house, this technique uses the rigorous least squares adjustment of residuals determined from the weighted centres of gravity of the two sets of Control Points.
- The minimum requirement is two common points co-ordinate in both systems.
- For transformations (or super-positions) with more than two common points, the transforming parameters are determined by the means of a Least Squares best fit.
- The transformation is always carried out from some other system, to the system as defined by the current Co-ordinate File
- The Common Point data from which the transformation is being carried out, may be manually entered, or read from another Co-ordinate File
- There are a number of Options that may be made once a system to system transformation has been made, viz :-
  - You may DELETE a common point, or a number of common points from the transformation and then re-run the transformation.
  - You may ADD a further common point, or a number of further common points, to the transformation and then re-run the transformation.
  - You may EDIT any point in the transformation by re-entering its co-ordinates and then re run the transformation.
- The transforming parameters of a previous transformation may be entered directly to allow immediate transformation of non-common points. These values may be entered manually, or read from an ASCII file. This file may be re-generated immediately after carrying out a transformation.
- Once correct, the transformation of non-common points may be carried out. These transformed points may be stored in the current Co-ordinate file.

## Locate and Mean Point Groups in a Co-ordinate File

- A Point Group is defined as two, or more, Points in a Co-ordinate File that lie within a prescribed distance of one another. The programme will search through the current Co-ordinate File, using an alphanumeric order, looking for Points that create a Point Group. A Point Group can consist of between 2 to 14 Points in size.

- This programme incorporates a number of useful functions. For example :-

    - It may be used to search for and Display the Values of a Point that may have been surveyed two, or more, times and Saved in the Co-ordinate File under different Names.

    - It may be used to Mean all the Points in a Point Group and then save these meaned value in the Co-ordinate File, using a default Name or a User entered Name.

    - It may be used to Adopt either the first, or the second located Point in a Point Group and then save this Point's values in the Co-ordinate File , using a default Name or a User entered Name.

    - It may be used to Delete all Points in a Point Group, other than the Point selected as the required Point representing the Point Group.


## Point Comparisons using Different Co-ordinate Files

- This programme provides the facility of comparing any two SURPAC Co-ordinate Files.

- The displayed programme Screen makes allowance for defining the two required files and for selecting the mode to be used for comparing the two files.

- The Files may be compared by using the Point Names to identify common Points. When a matching Point is found, the programme will compare the co-ordinates of the Point in each of the two Files and calculate the polar values derived from the co-ordinate differences (if any).

- The Files may also be compared by matching co-ordinates . You must set a logical limit within which the programme must search for a matching Point. For each Point in File No.1, the programme will search for the closest Point, within the defined search radius, in File No. 2. When a Point is found, the programme will calculate the polar values derived from the co-ordinate differences of the two Points (if any).


## Single Point Fixing (Resections, Intersections and Trilaterations)

- The mathematical principle of this programme is the rigorous Least Squares adjustment by the variation of co-ordinates. The "Schreiber's Elimination" technique is used to minimize the variance-covariance matrix.

- This programme will handle any type of single Point fix using any combination of Triangulation and/or Trilateration, as well as a Height determination for the Free point, such as :-

-  **Point Trilateration [Y, X], or [E, N]**

-  **Point Resection [Y, X], or [E, N]**

-  **Point Resection [Y, X, Z], or [E, N, H]**

-  **Point Resection [Z], or [H]**

-  **Point Intersection [Y, X], or [E, N]**

-  **Point Intersection [Y, X, Z], or [E, N, H]**

-  **Point Intersection [Z], or [H]**

- **The current Co-ordinate File is used to extract the co-ordinates of the User defined Fixed Points used in the determination of the [Y, X]  (or [E, N] ) co-ordinates (and/or the Height, if required), of the new Point.**

- **The Observation data (Horizontal angles, Distances, Vertical angles, Target heights and Instrument heights) are extracted from a User defined General Observation File.**

- **The programme allows for the abstracting and combining of Multiple Arcs . Up to 8 Arcs (or faces) are allowed for a given Set-up. Each arc may include up to 30 sighted points. The observations are displayed showing the abstracting in the conventional survey manner, including the Mean and the Standard Deviation. The meaned values of the Horizontal angles, the Vertical angles and Distances are used in the Single Point Fix calculation.**

- **For a Trilateration calculation, the programme will use any combination of Forward and/or Backward measured Distances to compute the new Point. The minimum number of distances is 3. The programme will search through the General Observation File , or defined portion of the File and extract all measured lines to and/or from, the new Point. All Distances will then be reduced and used to carry out a simultaneous Least Squares fix and adjustment of the Point's [Y, X] (or [E, N]) ordinates.**

- **The Network File Editor includes an "Active" column, which can be set to Active or Non-Active, for all the data lines displayed for a Single Point Fix calculation.**

- **A Data Line that is defined as Active is available and will be used in the calculation of the new Point. An Active Data Line will have a Green Tick displayed in its "Active" column.**

- **A Data Line defined as Non-Active is data that exists, but which will not be used for the current calculation. A Non-Active Data Line will have a Red Cross displayed in its "Active" column, and the Observation information will be displayed in red Italic text. A Data Line's Active status can be changed using a single mouse click.**

- **The output, of a calculation consists of :-**

  - **the final co-ordinates of the new Point,**

  - **the orientation correction, in the case of a resection,**

  - **a comparison of observed quantities with final quantities and a list of observational residuals,**

  - **the standard deviation of unit weight for the observation set,**

  - **the standard error-ellipse parameters,**

  - **a list of [Y, X]  (or [E, N] ) ordinate axis cuts for each ray,**

  - **a list of input data for the height fix (if required) and the computed height differences**

**along with their adjustments and final values.**