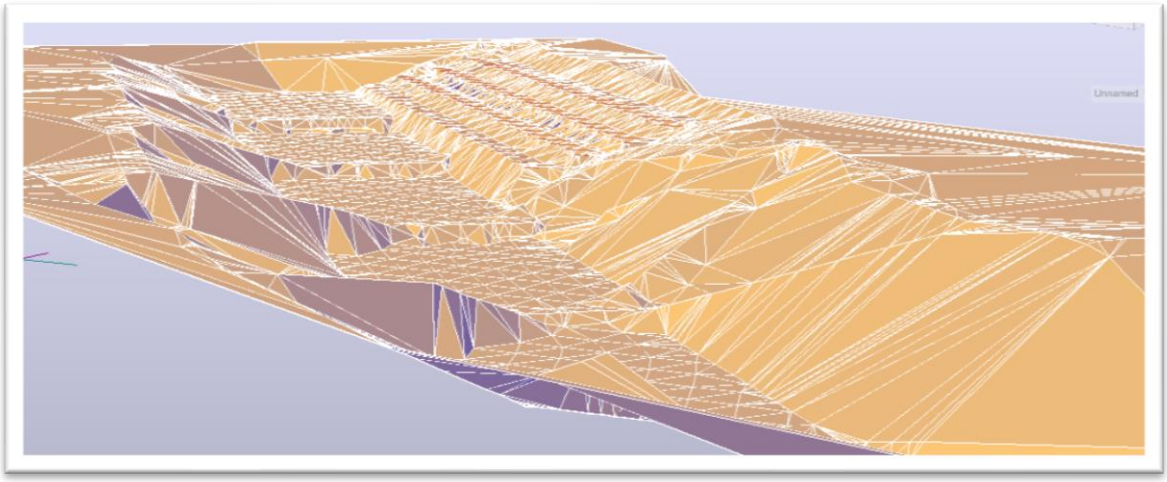
6D Proptech Pte Ltd

6D Surface Modelling

A program to manage earth works in a construction project



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Contents

6D Surface Modelling Documentation

1 Introduction:

1. 6D Surface Modelling creates Digital Elevation Models (DEM) from multiple input point files on AutoCAD graphic editor. All purpose multi-level pads can be generated on the terrain on different layers with different slope parameters of CUT and FILL. An AutoCAD should have been already installed on your system - The Interface opens an instance of AutoCAD

2 Use of this program

2. The program can be used for mining applications where mass volumes of earth works are handled.
3. Useful for normal building level pads, foundation excavations, drains, canals, earthen dams, embankments, bridge approaches, mining, road formations and so on.
4. Surface foundation of any engineering structures and understanding this enables accurate project planning.
5. Designed to integrate with any ERP system.
6. Graded surfaces/ level pads/ level play grounds and so on can be perfectly generated with defined edges.
7. Program can generate coordinates for Cut and Fill elements to transfer layout to the ground.
8. Point files with predefined CSV format are mandatory to design the project program.
9. Configure Tasks with the output elements to extract Bill of Quantities/WBS.
10. Publish the BOQ to 6D ERP to perform scheduling, budgeting and project management.
11. Several output files generate suiting to project requirement.
12. Output files can be viewed in several formats like PDF, DWG, DWF and DXF

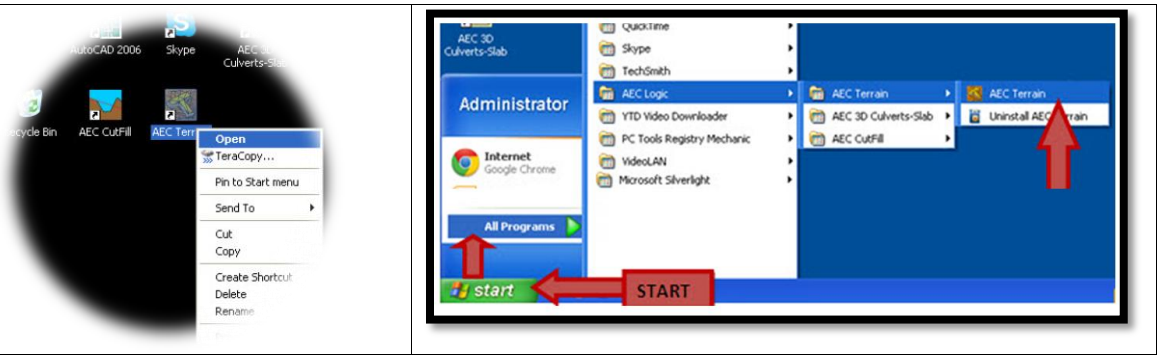
3 Feature Highlights

13. Easy to as tools on AutoCAD.
14. Earth work calculations are made on the fly while Terrain is modeled.
15. Generates multiple TIN Surfaces from multiple point files.
16. Contours can be generated at any desired intervals and automatically sets colors from highest to the lowest contours.
17. Predefined 3D land features can be added to your program and set them to show on your project.
18. Finished TIN surface is generated when a particular area is to be graded on an irregular surface to a certain level.
19. While founding engineering structures, extended excavations and fill influence lines could be verified for practical positioning.
20. Breaklines feature fine-tunes Cut Fill edge lines.
21. Cross sections, profiles and plans can be generated on the fly.
22. Volume of thickened surface can be obtained from the application

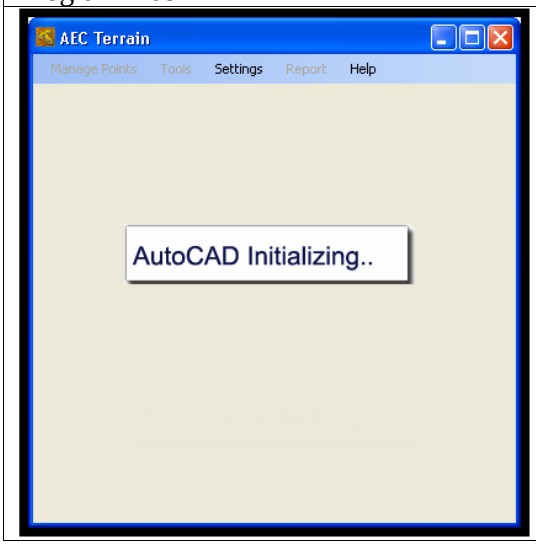
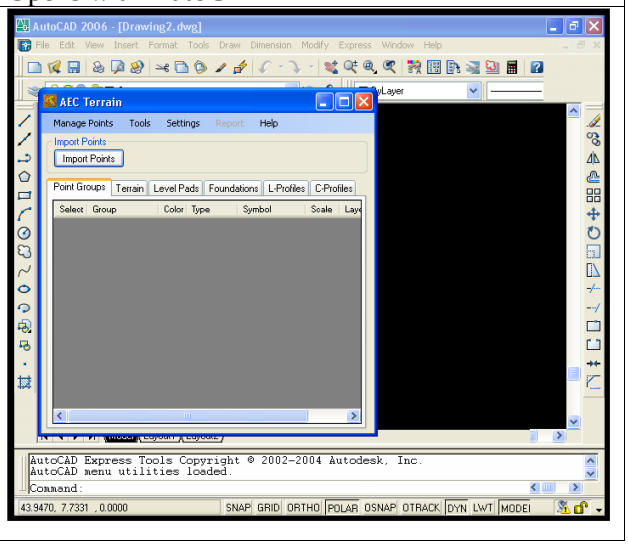
4 Program Launch

4.1 How to Launch Program

23. Double click on the shortcut '6D Surface Modelling' from your system Desktop or **Program Files >> 6D Proptech >> 6D Surface Modelling.** This would launch the application along with AutoCAD as shown under.



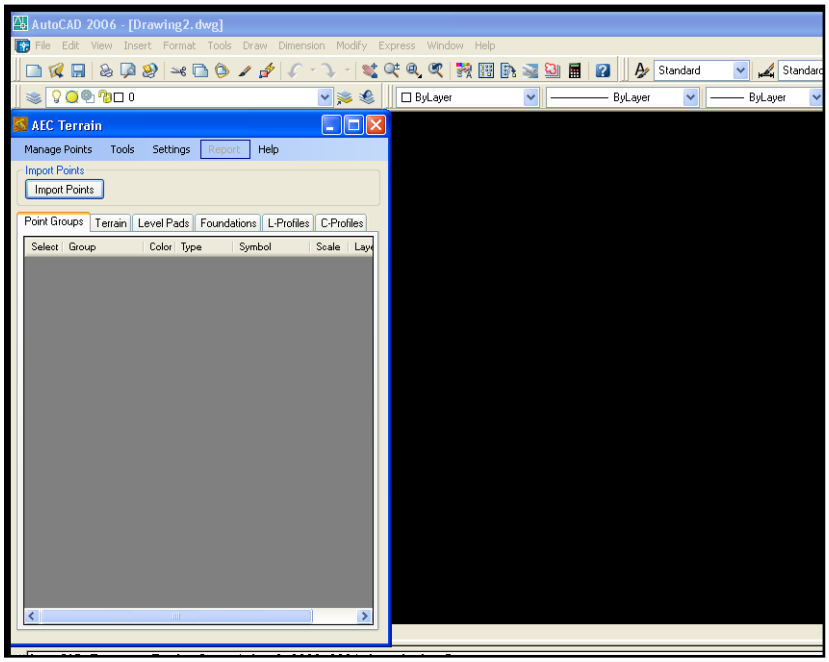
24. Note that it may take few minutes while the AutoCAD is initialized first time internally by the system. It is suggested that you may manually open an instance of an AutoCAD. 6D Terrain will open another instance faster with the existing instance. Remember to close the previous AutoCAD instance, that was opened manually, to avoid user swapping confusion, nonetheless it does not matter to the program even if not closed.

Program Flash	Opens with AutoCAD
	

4.2 Program Interface

25. 6D Surface Modelling Interface contains the following components
26. Top Menu : Creating Points, Tools , Reports and Help
27. File List Box area: for adding and deleting data input point files and formats
28. Functional Tabs: For data processing, designing interacting with AutoCAD are done in these functional tabs. Detailed explanation is given in the subsequent topics.

29. AutoCAD is the graphical interface to plot points, draw alignment lines, boundaries, cross-sections, contours, TIN surfaces and so on.



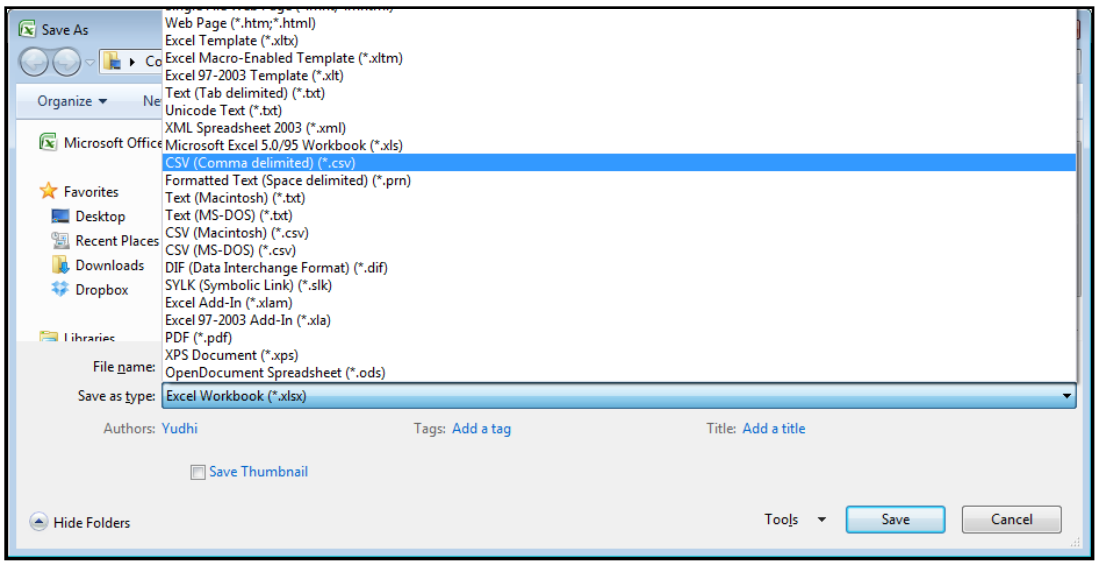
5 Input File Management

5.1 Point data External Input files

30. Input data point files with predefined CSV/Excel format are mandatory to run the program. Understanding the format of data, order of data arrangement, number of data fields controls the program processes. Therefore, it is very important that the user needs to be carefully understanding each of these steps to reap best benefits out of the product and its features.

5.1.1 CSV/Excel Files

31. A comma-separated values (CSV) file stores tabular data (numbers and text) in plain-text form.
32. If you have Coordinates of X, Y and Z (Or Northing(Y), Easting(X) and Elevation(Z)) in Excel Format, then save this file AS (SAVE AS) .CSV file in the Open file dialog or use the Excel file as it is . Read following topics to know more about NEZ/YXZ formatting.



5.2 Point data and AutoCAD

5.2.1 AutoCAD Point Coordinates

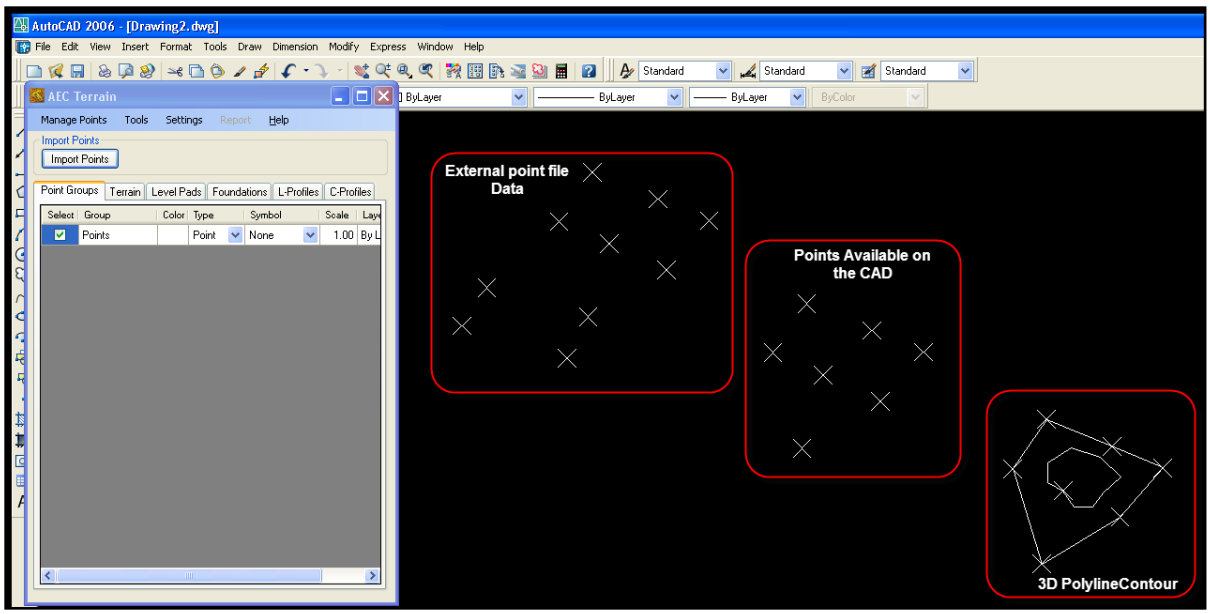
33. AutoCAD works on X, Y and Z coordinates in that order. Apart from external data point files, we can also add points from the AutoCAD Editor and append points to your project. These points could be generated from bare points, polylines (contours) or lines and 3D poly lines and so on. Your project may contain all these points on which you may need to work.

5.2.2 Surveyor Point Data

34. Remember that in Surveyor language coordinates are measured from the ground in N,E & Z coordinates in that order. Northing (Y) is always measured first and in Engineers Drawing the X coordinate (Easting) is considered first.
35. Therefore the user is expected to know the coordinate system in the order that both surveyors and engineers understand to implement project on site and at office.

5.2.3 AutoCAD Vs Surveyor Comparison

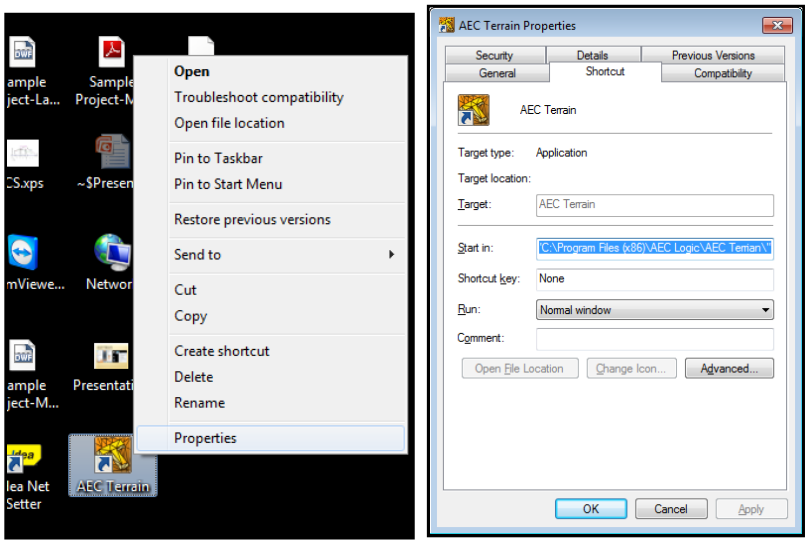
36. Let us recap that;
    Northing = Y Coordinate
    Easting = X Coordinate
    Elevation = Z Coordinate
    The Description is optional in input files to indicate group of the points.

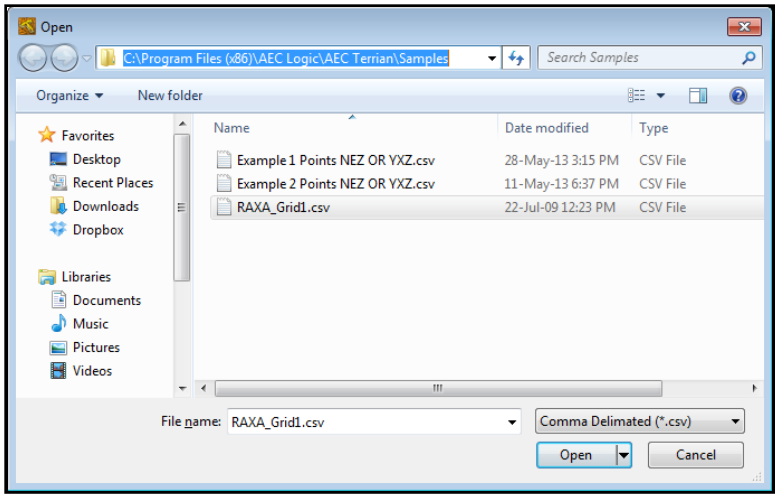


6 Sample Project

37. The Program provides two example input files for the user to practice and understand the program. The examples are well designed to explain the user with several program features.
38. It is recommended that the user may practice using input files from ***Example 1 Points NEZ OR YXZ*** *and* ***Example 2 Points NEZ OR YXZ*** files available at the following program installation path (modify as installed by the user) >>
C:\Program Files (x86)\6D Proptech\6D Surface Modelling\Samples This is explained in detail in the relevant topics below.

39. *Alternatively the program path can be found by Right click the Shortcut Icon on the Desktop >> Properties >> 6D Surface Modelling Properties Dialog >> Start in text box.*

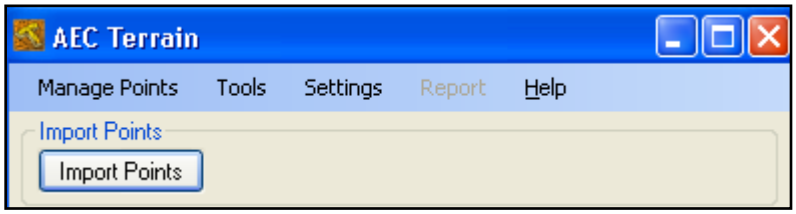


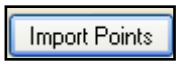


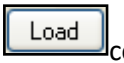
7 Handling Point Files and Points - Step by Step Process

7.1 Creating Points

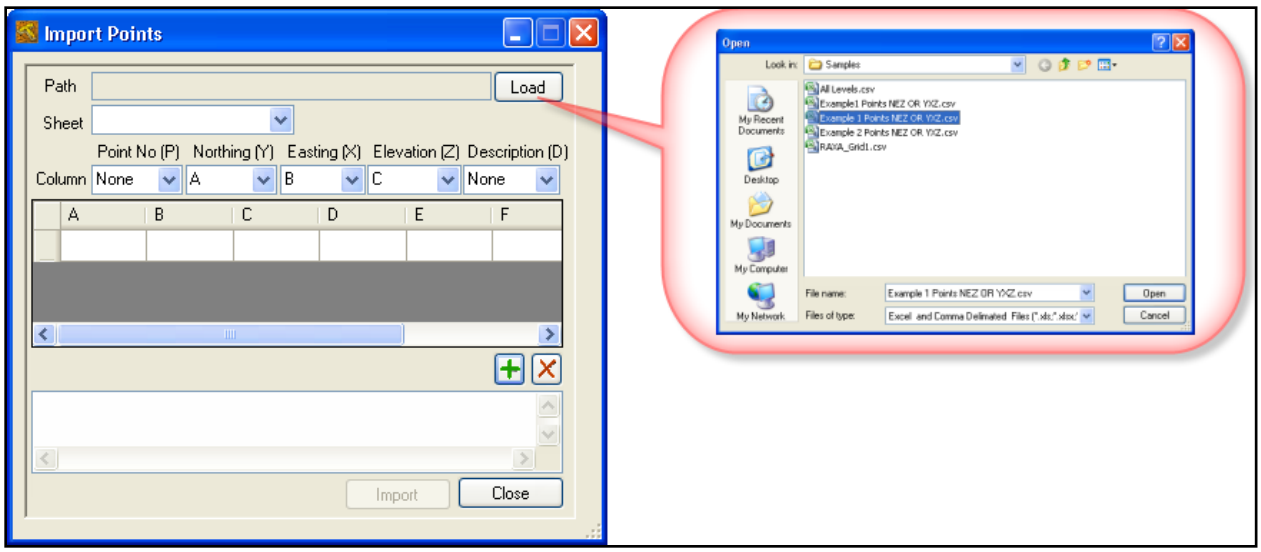
40. *Import points*: Here we Import **Input Points Files** in NEZ(YXZ)/ENZ(XYZ) … and so on... Formats. Click on *Import Points*. Click on *Load* for CSV file/ Excel file. Browse to the required file location. (File should be in CSV format/Excel format, that is, *.csv/.xls* extension). The CSV file shown below is available in Sample Files at Program Files >> 6D Proptech >> 6D Surface Modelling >> Samples >> Example 2 Points NEZ OR YXZ.



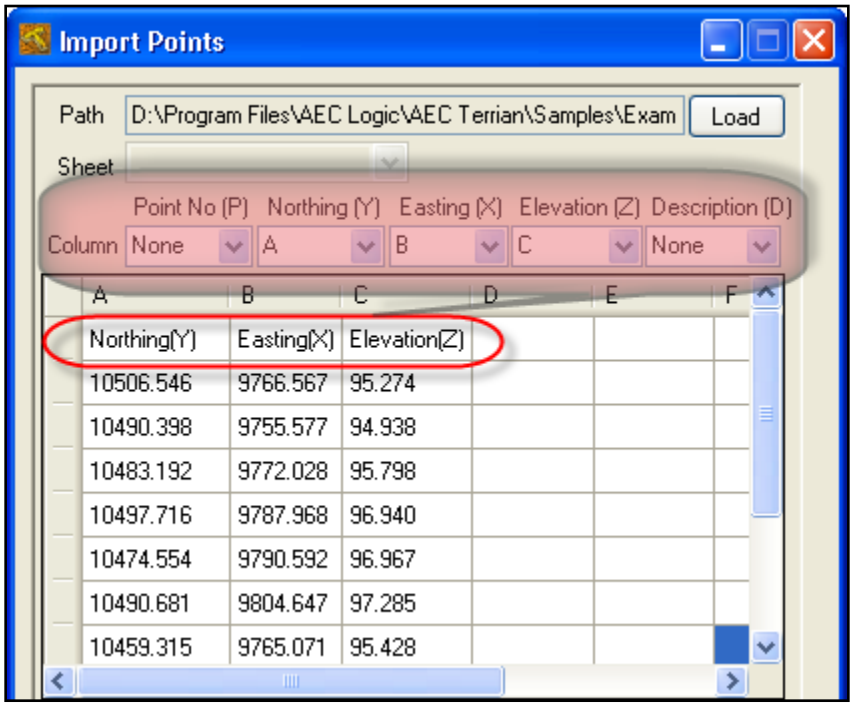
Click 

command button then click on 

command button to load Input Points File whether the Points file is in CSV or Excel Format. Select ***Example 1 Points NEZ OR YXZ*** **then click on** 



41. Map the points file as per the required format Ex: Northing(Y), Easting(X) and Elevation (Z) format in the column as shown in the below image.



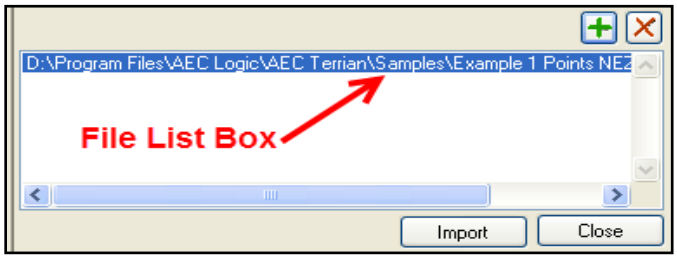
Click  command button to load input file. Click on Import to load the input points file

42. Experiment with this **Input CSV file** to understand more of the program. The file is available in Samples folder as explained above with name ***Example 1 Points NEZ OR YXZ***

Example 1 Points NEZ OR YXZ.csv - Microsoft Excel

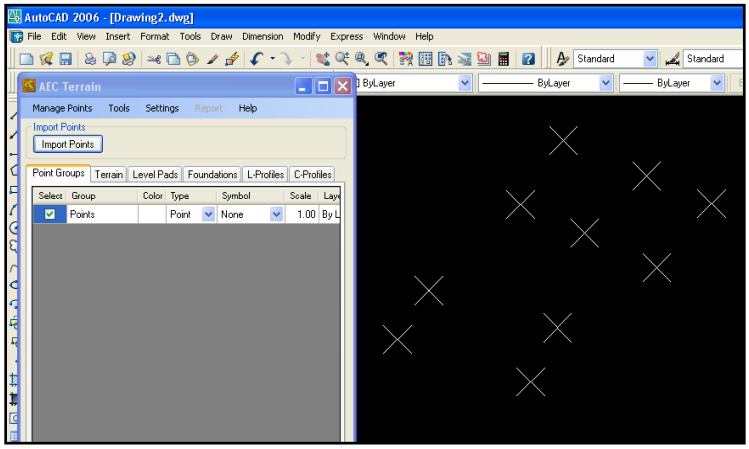
	A	B	C
1	Northing(Y)	Easting(X)	Elevation(Z)
2	10506.546	9766.567	95.274
3	10490.398	9755.577	94.938
4	10483.192	9772.028	95.798
5	10497.716	9787.968	96.940
6	10474.554	9790.592	96.967
7	10490.681	9804.647	97.285
8	10459.315	9765.071	95.428
9	10445.682	9758.116	94.969
10	10468.748	9731.981	93.930
11	10456.337	9723.915	93.247

43. Select the Point file said above to include in the **File List Box.** Click on *Import*.



7.2 Plotting Points on AutoCAD

44. *Import Points (OR plot on AutoCAD)*: After the file management (adding and deleting files); click this command to post/plot points on to the AutoCAD Editor form the point files shown in the **File List Box** .



Example 1 Points NEZ OR YXZ.csv - Microsoft Excel

	A	B	C
1	Northing(Y)	Easting(X)	Elevation(Z)
2	10506.546	9766.567	95.274
3	10490.398	9755.577	94.938
4	10483.192	9772.028	95.798
5	10497.716	9787.968	96.940
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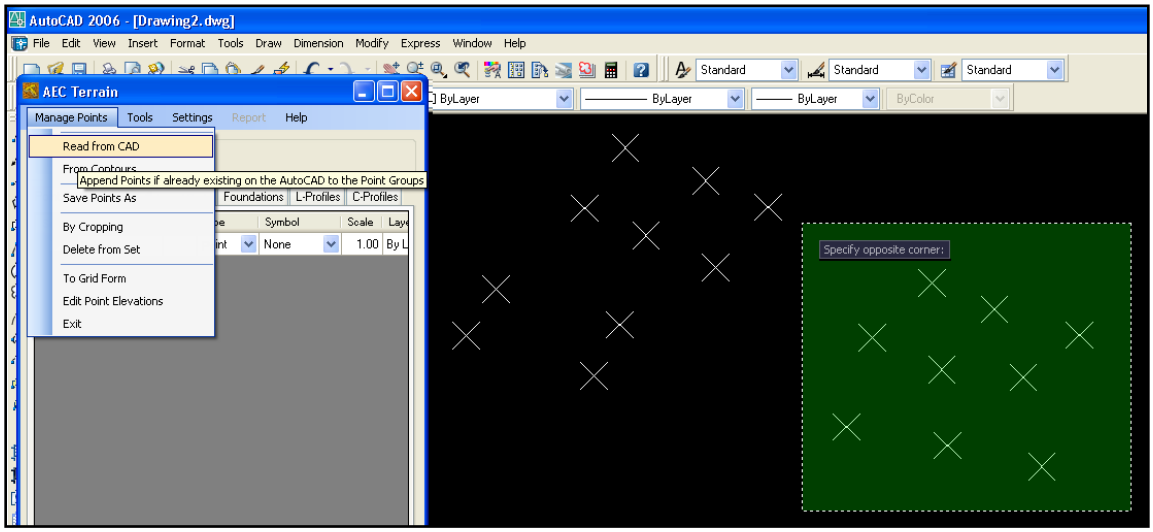
9	10445.682	9758.116	94.969
10	10468.748	9731.981	93.930
11	10456.337	9723.915	93.247

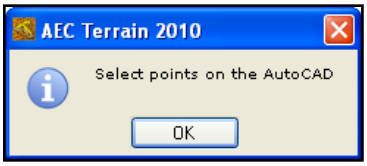
7.3 Adding More Points from AutoCAD.

45. Sometimes we may be having some points on the AutoCAD which may be required for our project. To add these points to the set of project points we can add them by using the following command.

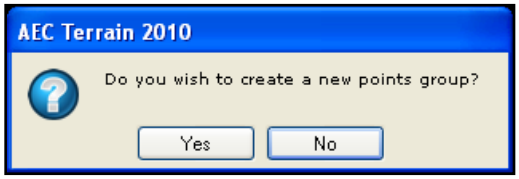
7.3.1 Read Points From AutoCAD

46. *Read from CAD*: Bare points available on the AutoCAD are appended to the existing list of points. This command creates New Points Group. Clicking the command prompts the user to Select points on the AutoCAD Editor with the dialog box as under

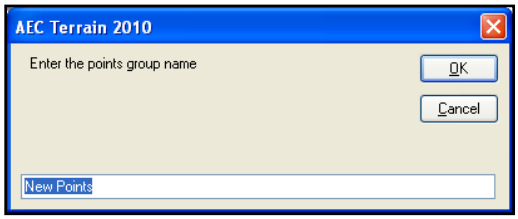




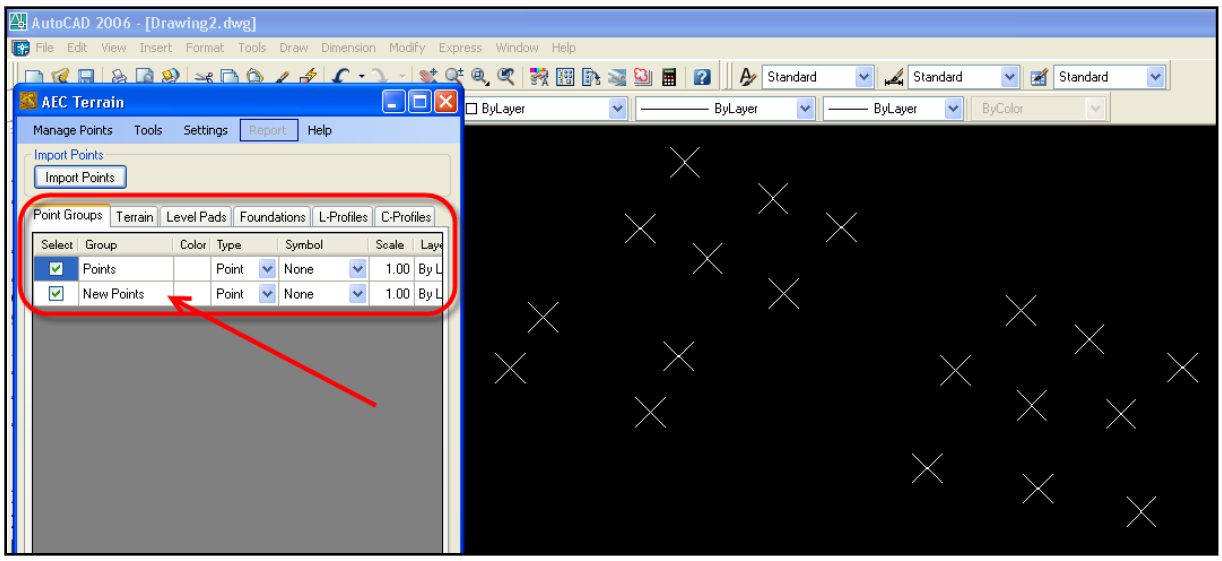
Click on "YES" if you want to create a new group, or else click "NO" to skip group name



Enter the Group name that you wish to create.

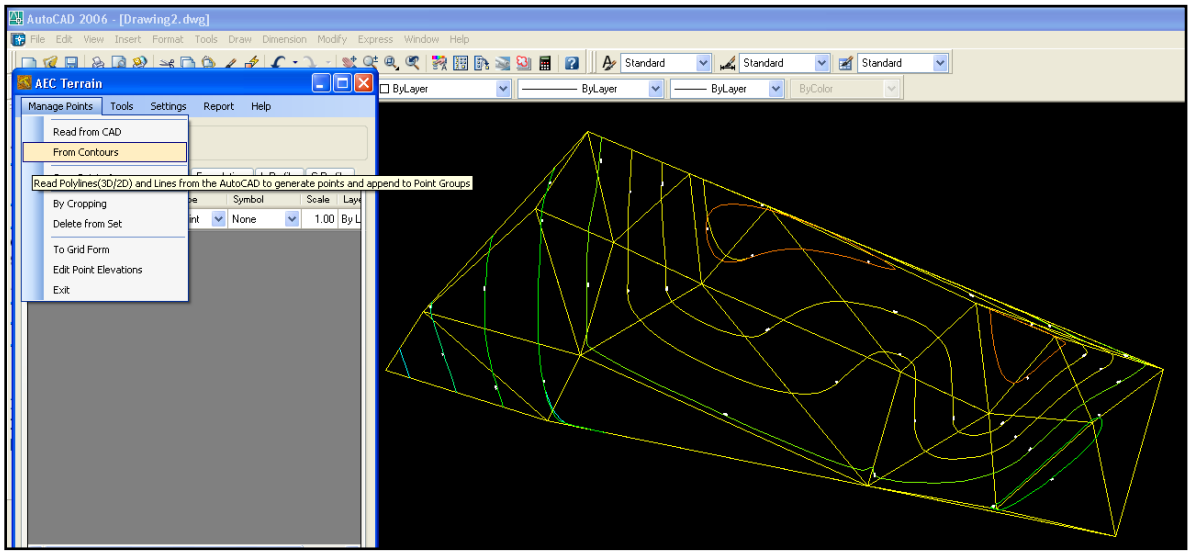


Points Read from CAD are listed under 'New Points' Group under **Points Group** Tab

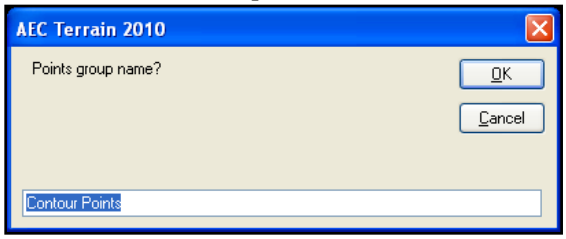


7.3.2 Read Points From AutoCAD Contours

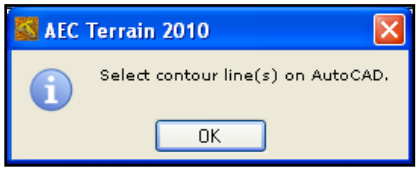
47. *From* Contours: Similarly as above we may be also having some more points in the form of contours on the AutoCAD file which may be required for our project. To add these points to the set of project points we add them by using the following command. Program reads polylines (or contours 2D/3D) and Lines from the AutoCAD to generate points to append to New Point Groups.



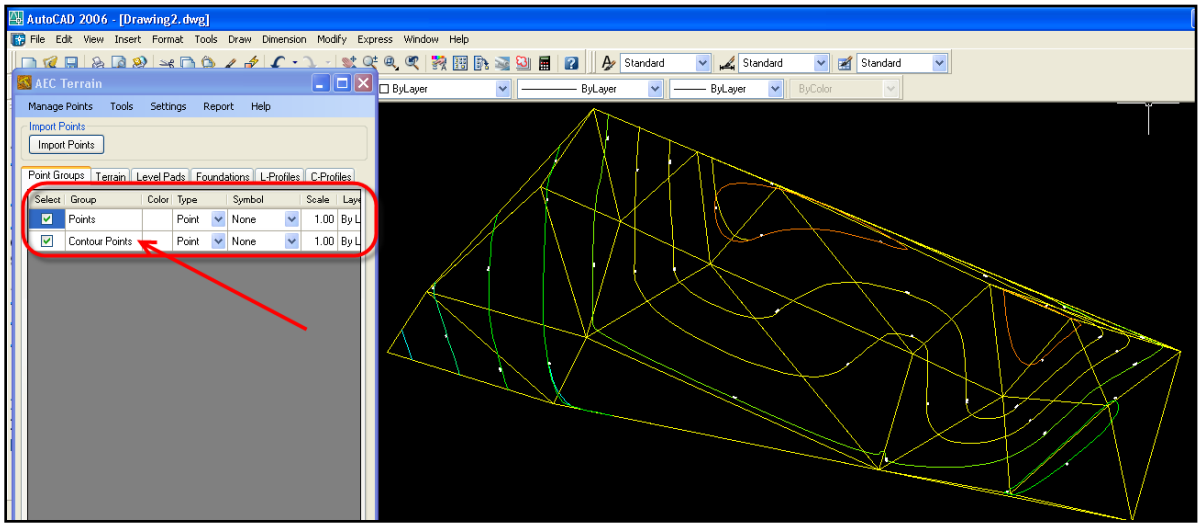
Give the Points Group name.



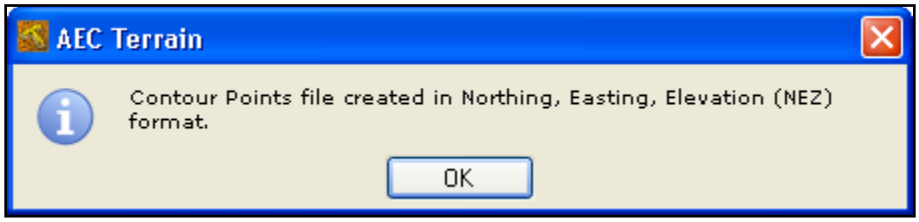
Select the Contour line(s) on AutoCAD.



Contour points group will be added in the Point groups section.

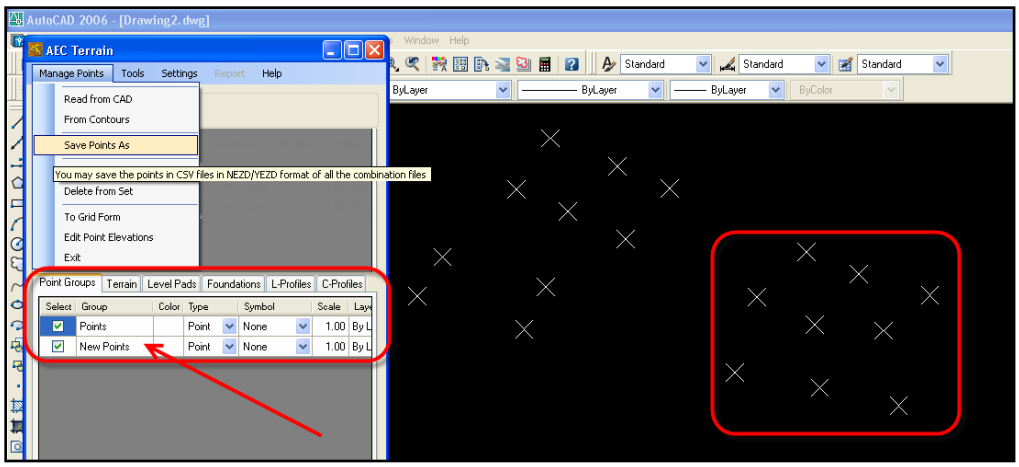


Contour points file created in Northing, Easting, Elevation (NEZ) format.

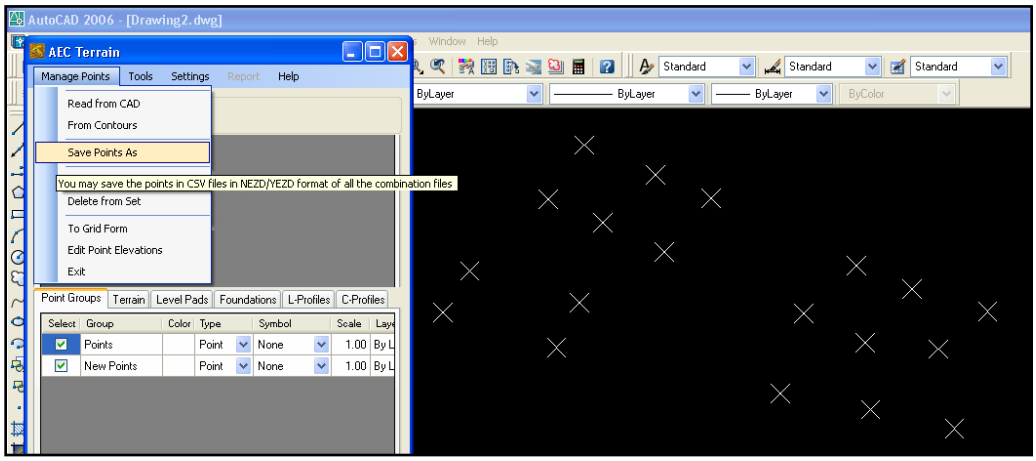


7.4 Saving Manipulated Points to File

48. Save *Points As*: You can save the project points to CSV files in NEZD/YXZD format of all the combination files. Note that the writing back to the system feels is always in NEZD/NEZ format (used by Surveyors for understanding by site executives)



6D Surface Modelling>>Manage Points>>Save Points As



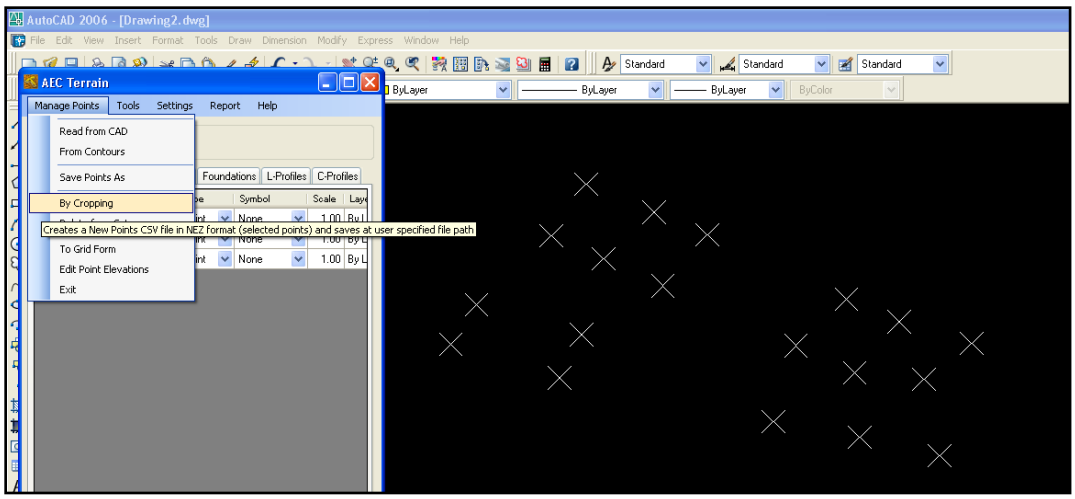
Additional points which are created manually. Two Point files will be combined and will be saved as user defined name, such as, **Contour Points File_NEZD_YXZD_1** to the file location indicated by the user. The newly Saved as file with points looks as under

Contour Points File_NEZD_YXZD_1.csv - Microsoft Excel

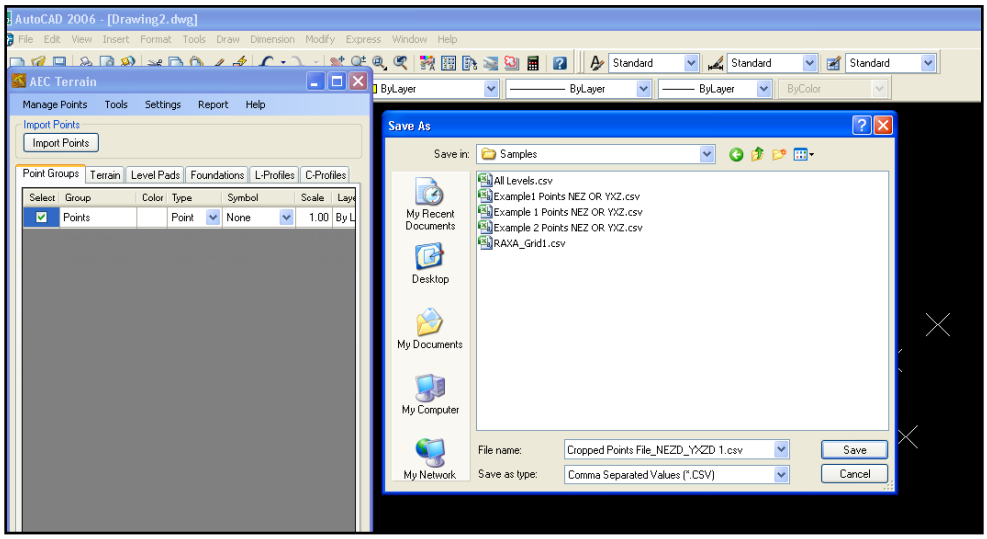
	A	B	C	D
1	Northing(Y)	Easting(X)	Elevation(Z)	Description(D)
2	10506.546	9766.567	95.274	Points
3	10490.398	9755.577	94.938	Points
4	10483.192	9772.028	95.798	Points
5	10497.716	9787.968	96.940	Points
6	10474.554	9790.592	96.967	Points
7	10490.681	9804.647	97.285	Points
8	10459.315	9765.071	95.428	Points
9	10445.682	9758.116	94.969	Points
10	10468.748	9731.981	93.930	Points
11	10456.337	9723.915	93.247	Points
12	10421.359	9877.752	95.274	New Points
13	10427.112	9852.576	94.969	New Points
14	10432.029	9825.505	95.428	New Points
15	10463.395	9865.081	97.285	New Points
16	10447.268	9851.026	96.967	New Points
17	10470.430	9848.402	96.940	New Points
18	10455.906	9832.462	95.798	New Points
19	10445.249	9872.844	94.938	New Points
20	10456.503	9887.754	95.274	New Points

7.5 Cropping Points From SET of Points

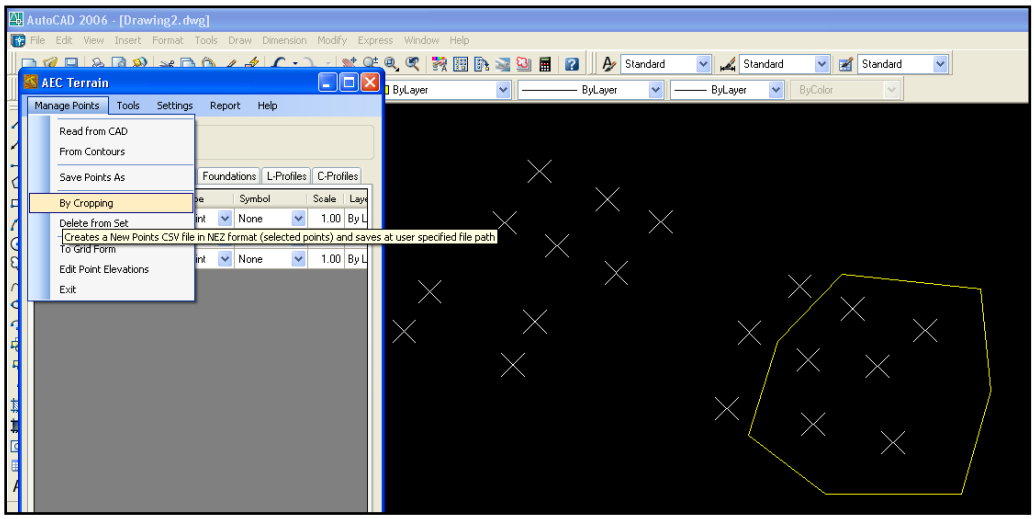
49. In huge projects where several functional users are involved needing to work on differently terrain zones by different professionals at a time, we need to regionalize the point files from the global project points (for example an irrigation project involving few hundred hectare of land development). For this we may be needing to crop those regionalized points for work distribution. The individual points can always be re-plotted to one single largest-project-point-file after processing. We do this by way of cropping from the super set in to subsets.
50. By *Cropping*: Creates new points CSV file in NEZ format (selected points) and saves at user specified file path. By default the path is same as source file path. User may change according to his planning to do with the cropped points.

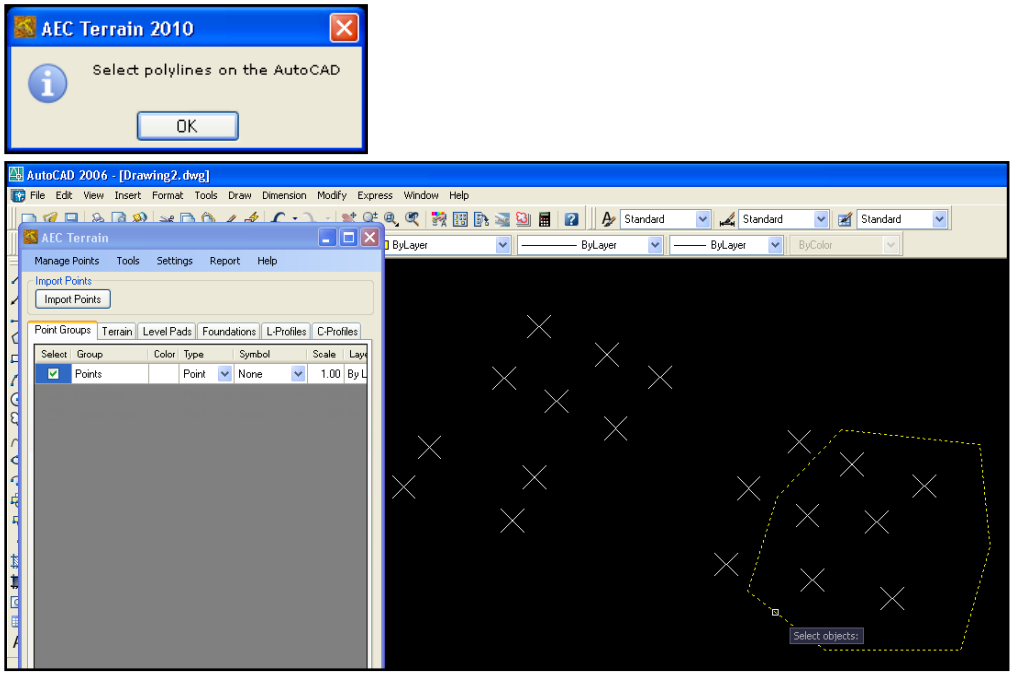


Cropped points file saving location >>



Draw a Polyline around the region of the points to be Cropped.





Cropped Point file in CSV format looks as under.

Set of Points for Cropping

Contour Points File_NEZD_YXZD_1.csv - Microsoft Excel

	A	B	C	D
1	Northing(Y)	Easting(X)	Elevation(Z)	Description(D)
2	10506.546	9766.567	95.274	Points
3	10490.398	9755.577	94.938	Points
4	10483.192	9772.028	95.798	Points
5	10497.716	9787.968	96.940	Points
6	10474.554	9790.592	96.967	Points
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10	10468.748	9731.981	93.930	Points
11	10456.337	9723.915	93.247	Points
12	10421.359	9877.752	95.274	New Points
13	10427.112	9852.576	94.969	New Points
14	10432.029	9825.505	95.428	New Points
15	10463.395	9865.081	97.285	New Points
16	10447.268	9851.026	96.967	New Points
17	10470.430	9848.402	96.940	New Points
18	10455.906	9832.462	95.798	New Points
19	10445.249	9872.844	94.938	New Points
20	10456.503	9887.754	95.274	New Points

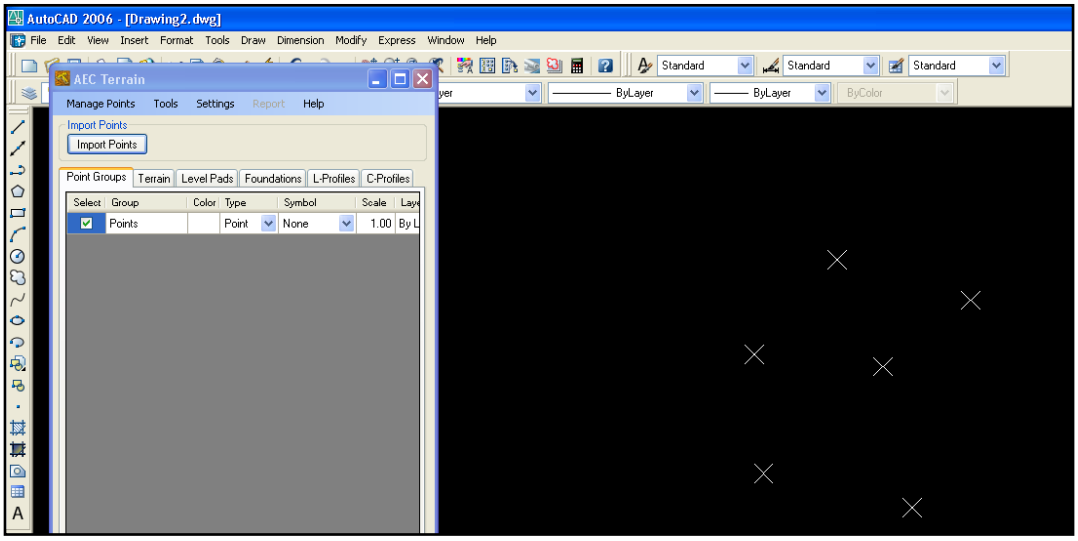
Set of Points Cropped

Cropped Points File_NEZD_YXZD 1.csv - Microsoft Excel

	A	B	C
1	Northing(Y)	Easting(X)	Elevation(Z)
2	10421.359	9877.752	95.274
3	10427.112	9852.576	94.969
4	10463.395	9865.081	97.285
5	10447.268	9851.026	96.967
6	10445.249	9872.844	94.938
7	10456.503	9887.754	95.274

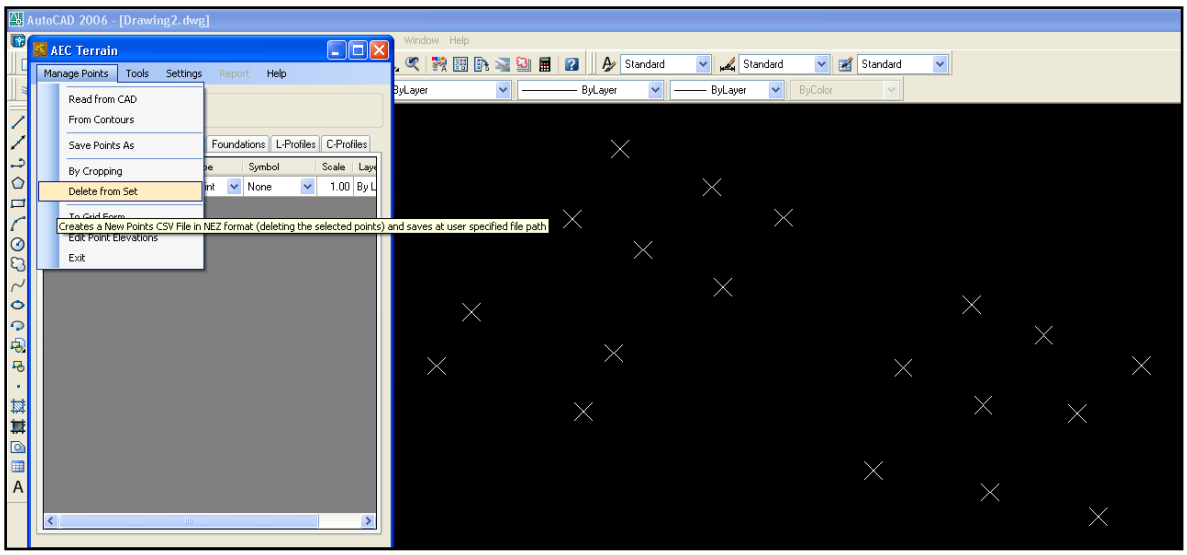
The Dialog below shows the path of the copped point file. Remember this path for further handling the data points

The Cropped points if plotted again on the AutoCAD, the screen looks as under.

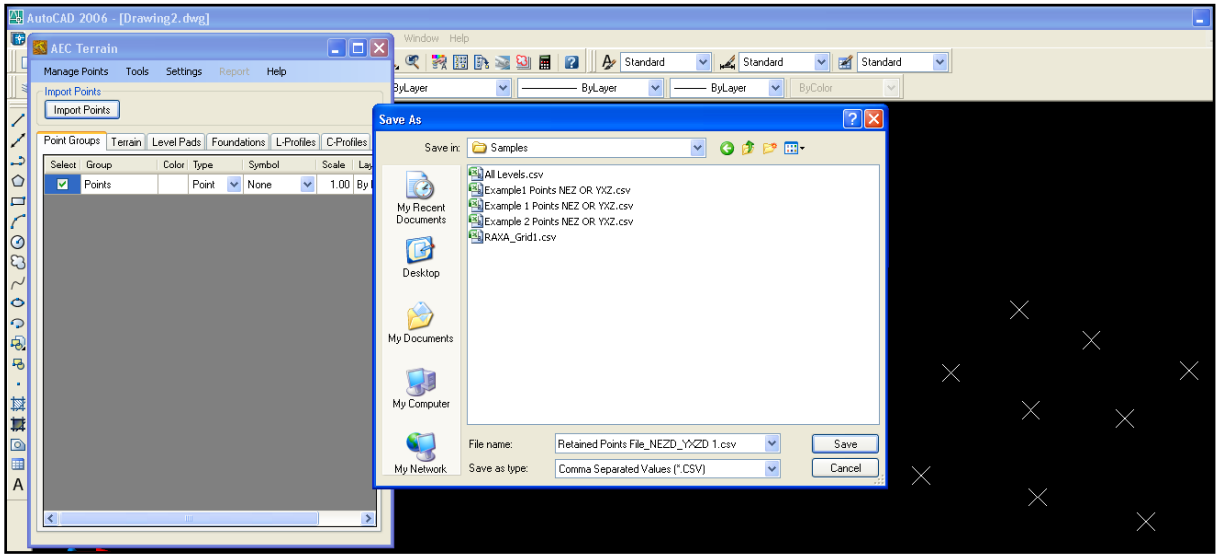


7.6 Deleting Points from Set of Points

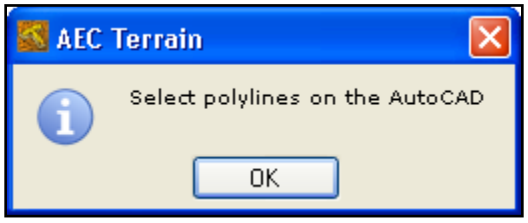
51. Sometimes the huge project data file may contain unnecessary data points on which we may not process our engineering works. For example a pond area in a bridge project may not require doing any processing of terrain or contouring or any other earthwork manipulations. Keeping these points may slowdown our work every time for the program to process. To do this we delete some set of points from the superset.
52. *Delete from Set*: Creates new CSV file in NEZ format (after Deleting the points selected) and saves at user specified file path.

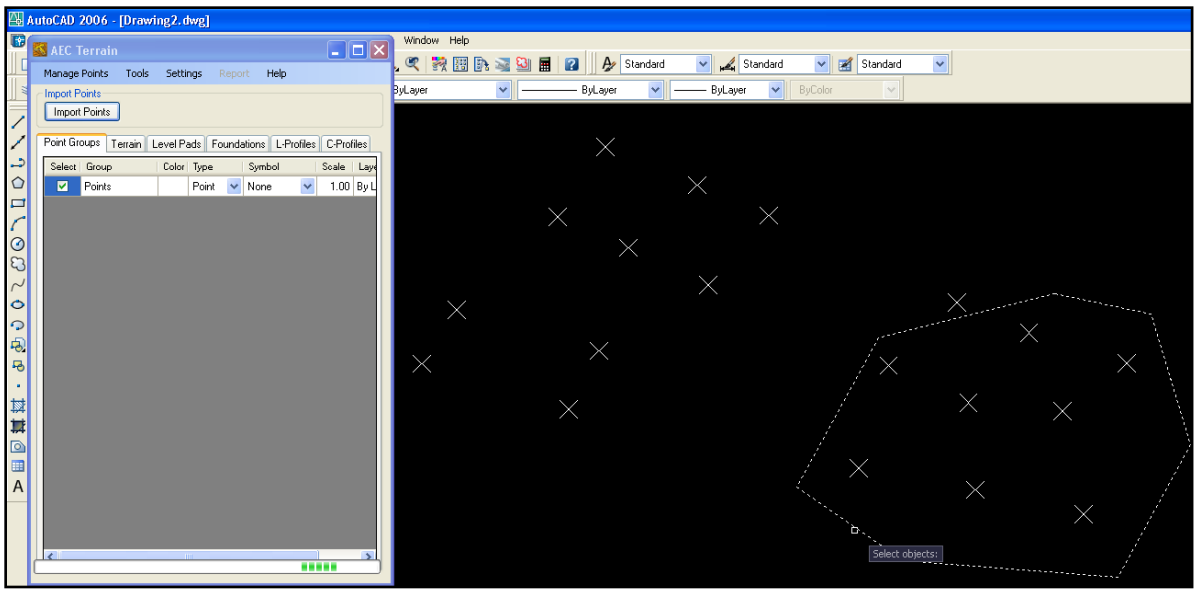


File path being asked by the system to Save

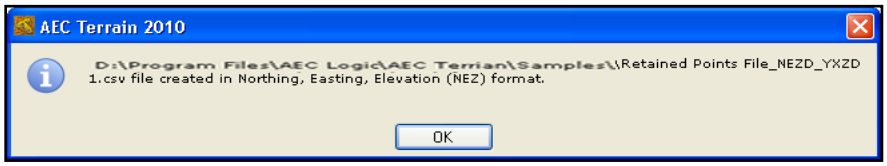


Draw the Polyline where the points are to be deleted. Then 6D Surface Modelling dialogue box appears, click on OK, select the polylines on the AutoCAD.





Deleted points file set will be saved as **Retained Points File_NEZD_YXZD 1**.csv in the Input folder or in the last saved folder.



Set of Points before Deleting

Contour Points File_NEZD_YXZD_1.csv - Microsoft Excel

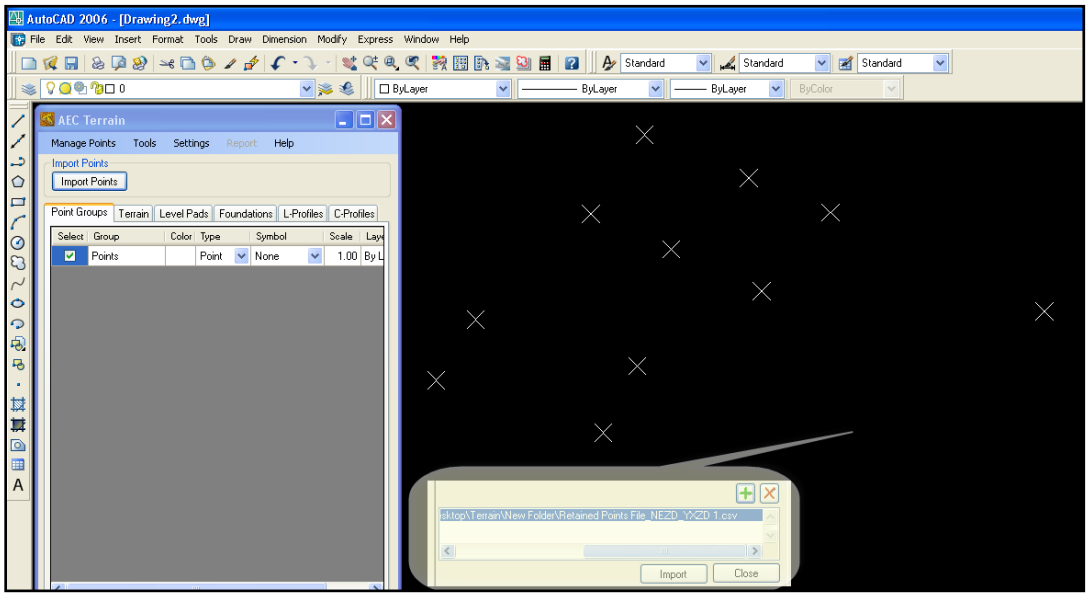
	A	B	C	D
1	Northing(Y)	Easting(X)	Elevation(Z)	Description(D)
2	10506.546	9766.567	95.274	Points
3	10490.398	9755.577	94.938	Points
4	10483.192	9772.028	95.798	Points
5	10497.716	9787.968	96.940	Points
6	10474.554	9790.592	96.967	Points
7	10490.681	9804.647	97.285	Points
8	10459.315	9765.071	95.428	Points
9	10445.682	9758.116	94.969	Points
10	10468.748	9731.981	93.930	Points
11	10456.337	9723.915	93.247	Points
12	10421.359	9877.752	95.274	New Points
13	10427.112	9852.576	94.969	New Points
14	10432.029	9825.505	95.428	New Points
15	10463.395	9865.081	97.285	New Points
16	10447.268	9851.026	96.967	New Points
17	10470.430	9848.402	96.940	New Points
18	10455.906	9832.462	95.798	New Points
19	10445.249	9872.844	94.938	New Points
20	10456.503	9887.754	95.274	New Points

Set of Points after deletion

Retained Points File_NEZD_YXZD 1.csv - Microsoft Excel

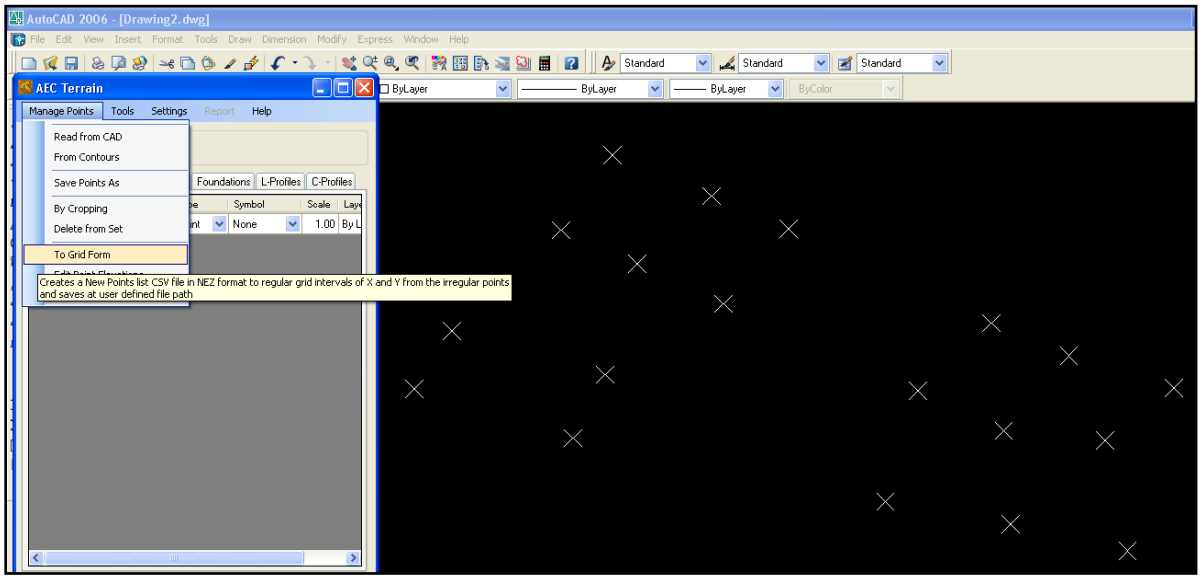
	A	B	C
1	Northing(Y)	Easting(X)	Elevation(Z)
2	10506.546	9766.567	95.274
3	10490.398	9755.577	94.938
4	10483.192	9772.028	95.798
5	10497.716	9787.968	96.940
6	10474.554	9790.592	96.967
7	10490.681	9804.647	97.285
8	10459.315	9765.071	95.428
9	10445.682	9758.116	94.969
10	10468.748	9731.981	93.930
11	10456.337	9723.915	93.247
12	10470.430	9848.402	96.940

Delete the Contour Points File and then import the Retained Points file, there you will observe the difference.

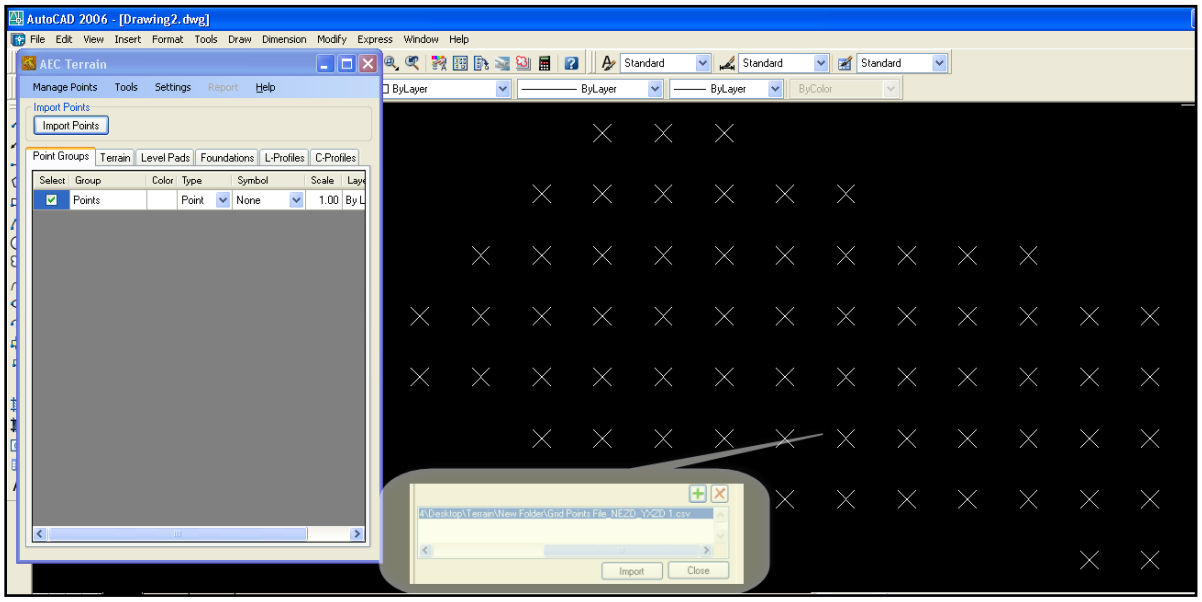


7.7 Generate Points to GRID form

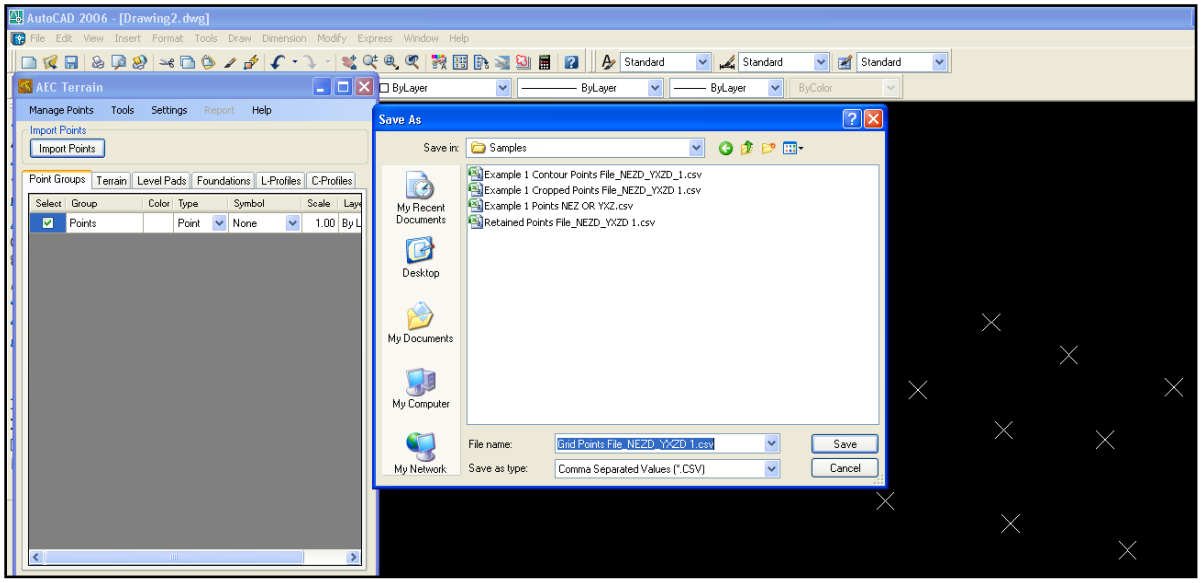
53. In practice during the recent induction of Total station the surveys are conducted on random points without any specific rows and columns or any order unlike in olden times. Suppose we require to transfer finished point to the site executives to mark at regular grid for special structures and land improvements where high precision is required.
54. To *Grid* View: Creates new set of points in regular grid intervals of X and Y from the irregular points and saves these points in NEZ format at user specified file path. Irregular points imported to AutoCAD graphic editor looks as under.



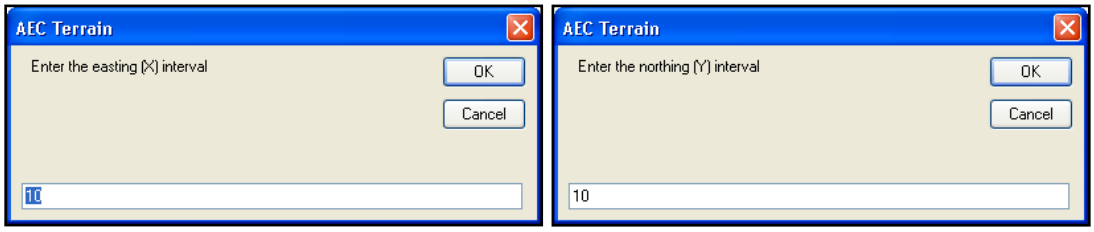
Let us generate Contours from the above irregular points so imported as under. This is for comparison with that of regular grid points.



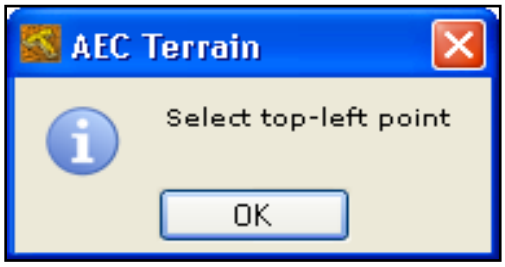
The points are written and will be saved to the user defined path as below after responding to the system dialogs as under.



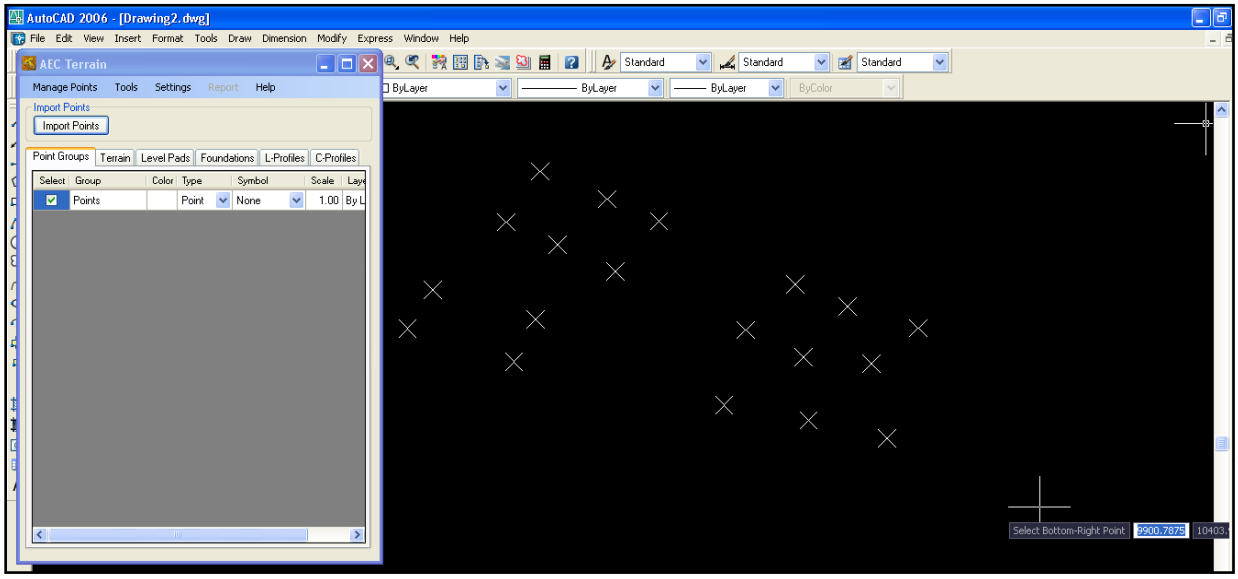
Enter the Easting (X) interval as 10 and click OK, and also enter Northing (Y) interval as 10 and click OK on the following dialogs

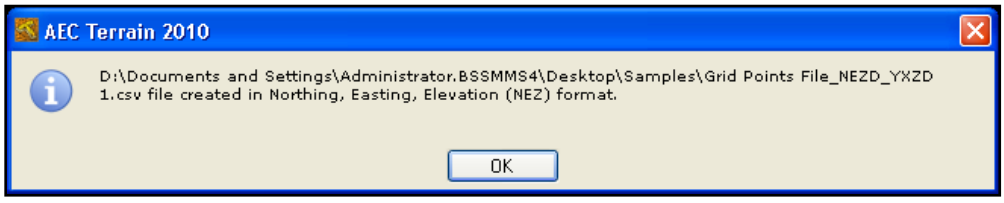


Select Top left point in the AutoCAD drawing, in the same way select the Bottom –right point in the AutoCAD drawing to form GRID



Select the point on the AutoCAD screen. Grid Points file will be saved in the user specified file path.



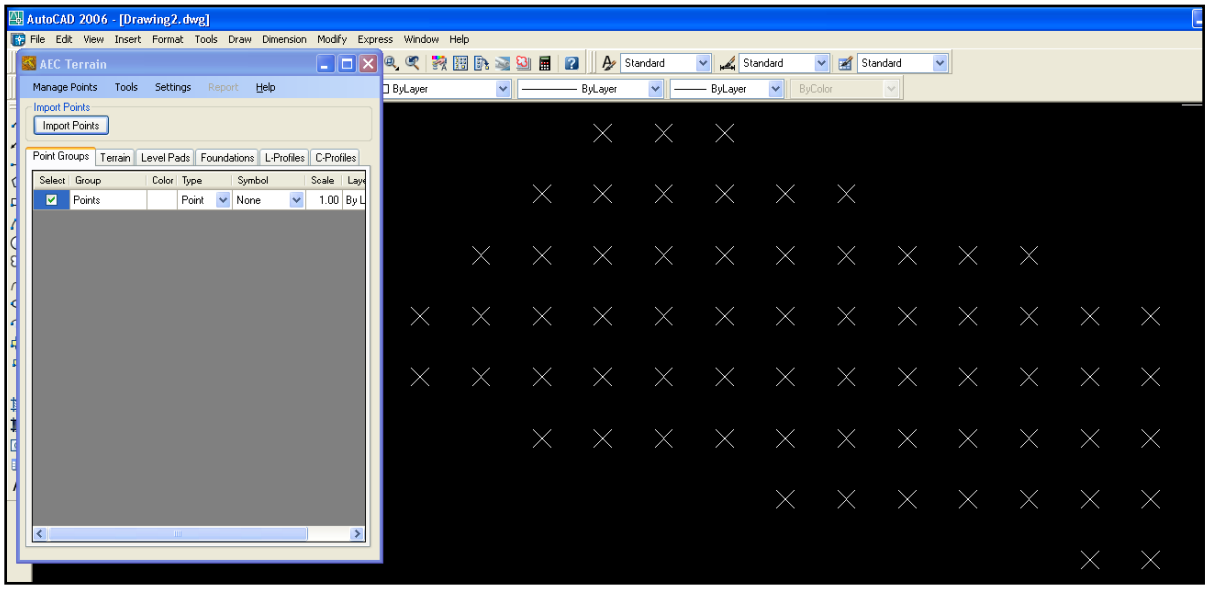


Open the Grid Points File_NEZD_YXZD 1.csv file which is located in the Input folder.

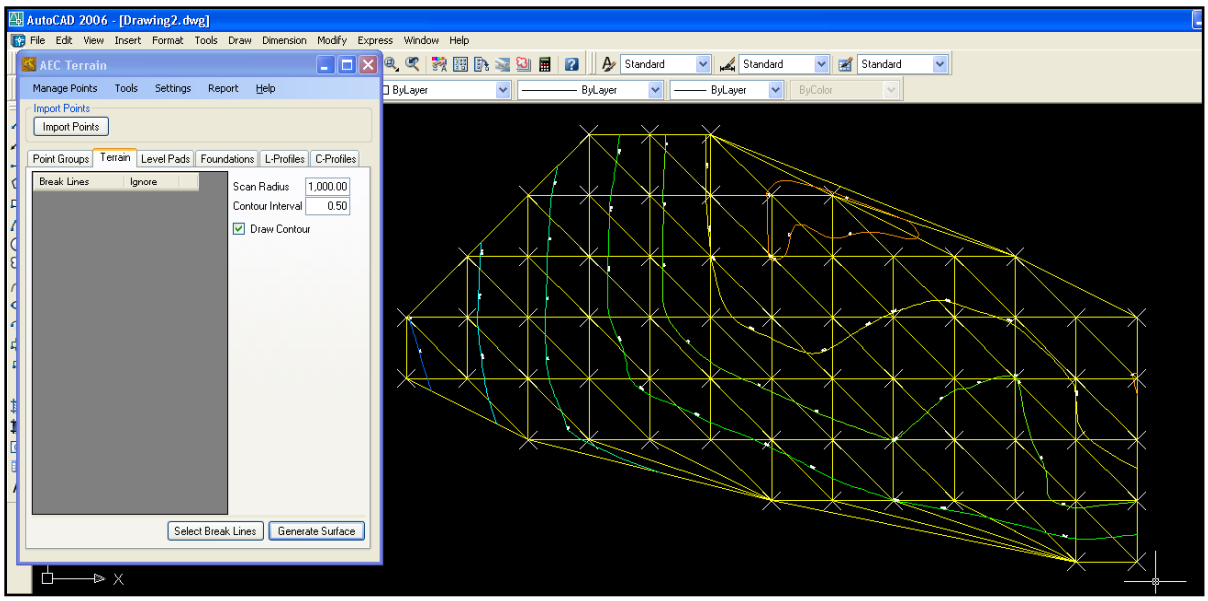
Grid Points File_NEZD_YXZD 1.csv - Microsoft Excel

	A	B	C
1	Northing(Y)	Easting(X)	Elevation(Z)
2	10458.791	9733.097	93.808
3	10468.791	9733.097	93.980
4	10458.791	9743.097	94.369
5	10468.791	9743.097	94.426
6	10478.791	9743.097	94.405
7	10448.791	9753.097	94.745
8	10458.791	9753.097	94.850
9	10468.791	9753.097	94.873
10	10478.791	9753.097	94.852
11	10488.791	9753.097	94.817
12	10448.791	9763.097	95.116
13	10458.791	9763.097	95.329
14	10468.791	9763.097	95.327
15	10478.791	9763.097	95.329
16	10488.791	9763.097	95.312
17	10498.791	9763.097	95.198
18	10448.791	9773.097	95.239
19	10458.791	9773.097	95.606
20	10468.791	9773.097	95.900

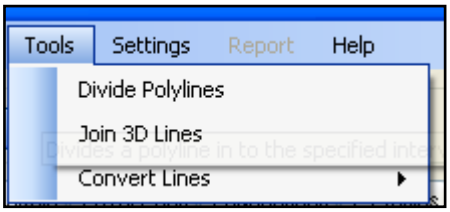
Re-importing the above points will plot on AutoCAD in the following manner in regular GRID form.



Re-Contouring the regular grid points looks as under. It may be observed that there is no difference on behavior of the contours either on regular or irregular points.

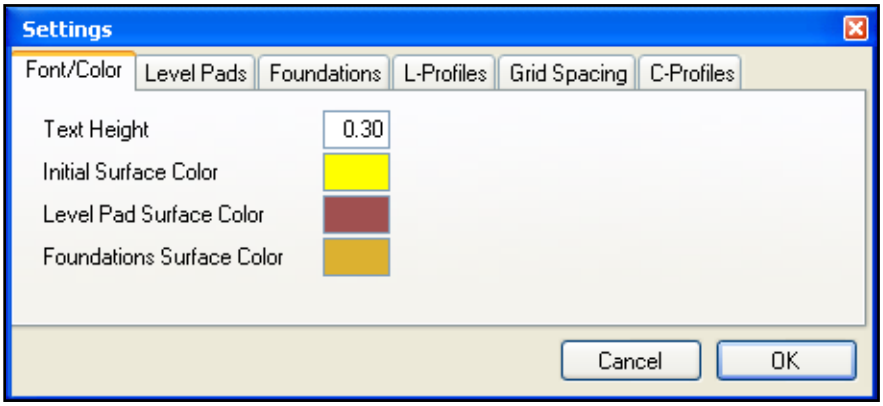


8 Tools >>



8.1 Customizing Default Output Parameters

55. Font/Color Tab:



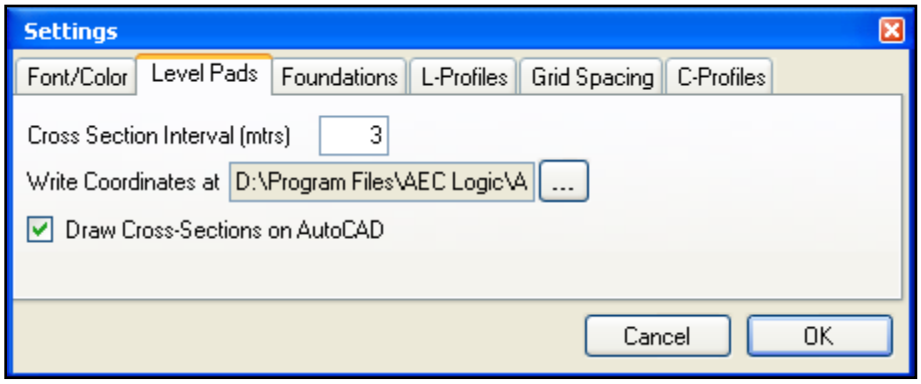
a) Text Height: System by default sets this as 0.3 m since the contours are at 1 meter intervals and close look at the contours will give better view. Depending on the user functionality this may be set at higher or lower values.

b) Initial Surface Color: Set as desired color. System sets by default green as initial color indicating original surface

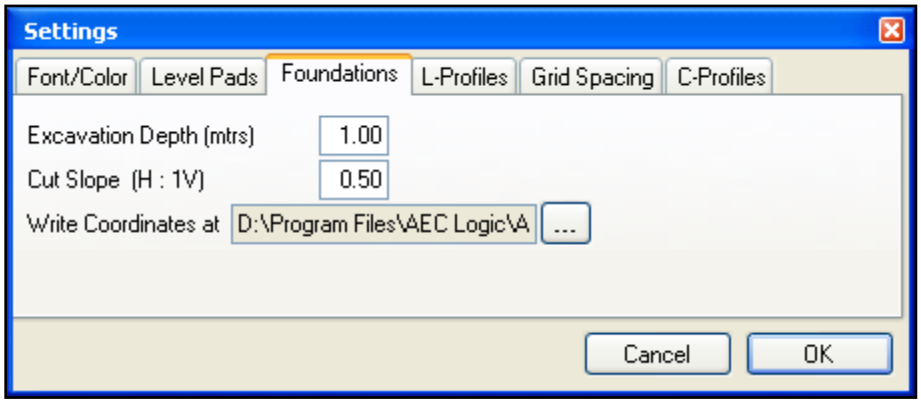
c) Level Pad Surface Color: This may be set as required by the users to suit their requirements

d) Foundation Surface Color: This may be set as required by the users to suit their requirements

56. Level Pads Tab: You may require in your project to make foundation pits at several places on the terrain and the settings so required may be entered here for the Program to draw. Enter the Cross section intervals as per the convenience, show the project file path for the Coordinates file (CSV File) to be written in NEZ format. If you want the Cross sections in the AutoCAD drawings then do check the box.



57. Foundations Tab: You may require in your project to make foundation pits at several places on the terrain and the settings so required may be entered here for the application to draw.
    (a) Excavation Depth: By Default the 6D Surface Modelling shall make your Foundation depths at this setting until you set a new value.
    (b) Cut Slope: The Application assumes the slope set here for generating the surfaces until you set a new value
    (c) You may need to write the coordinates of your new foundation surface to a file location for further managing. Define the default path for writing them to that location.

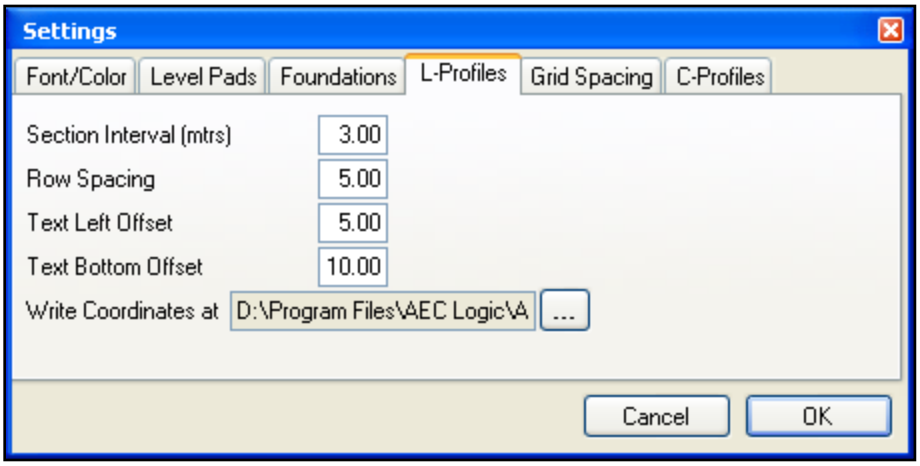


58. L-Profiles Tab: You may need your program to draw your surface profiles with a graphic grid behind. The default values to create such graphic grid profiles are set here.
    (a) Section Interval (meters): You may need your program to capture information at every predefined interval (for example 10, 20, 30 …. etc). This value is set here. The Program by default creates sections on the surface at this interval.

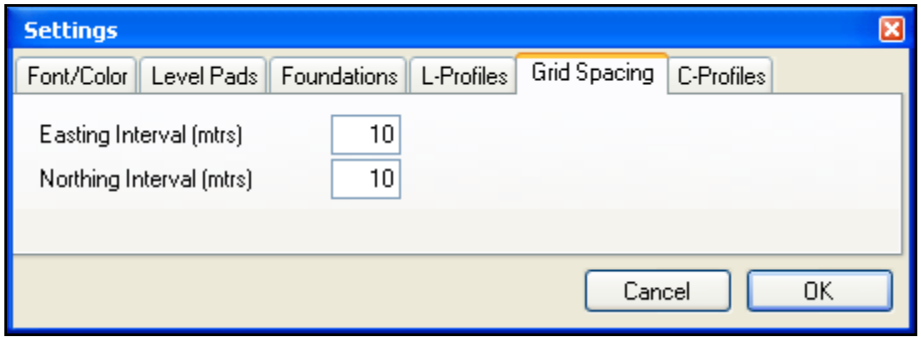
(b) Row Spacing (meters): The graph shall have a horizontal intervals (If this is set at value 1 then in the example image above values like 256, 257, 258…. at 1 meter intervals is shown) by which the levels are shown. This depends on the terrain min and max levels and the detailing that you need to see.

(c) Text Left Offset: This value shall appear for the Rows away from the graph area by this offset value.

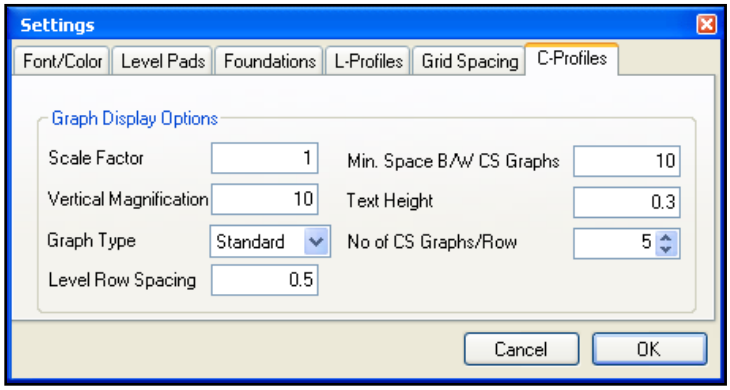
(d) Text Bottom Offset: Distance versus Levels are shown at the bottom of the graph and these values are to be shown by an offset value below the graph.



59. Grid Spacing Tab: The values when set here drives the program to to create grid at these values during creating Points to Grid

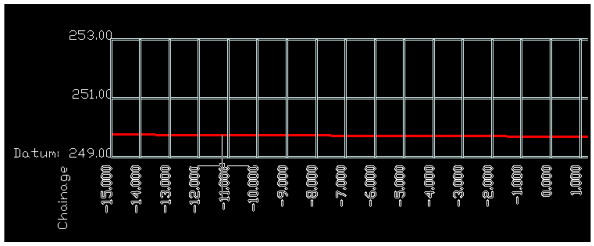


60. C-Profiles Tab:

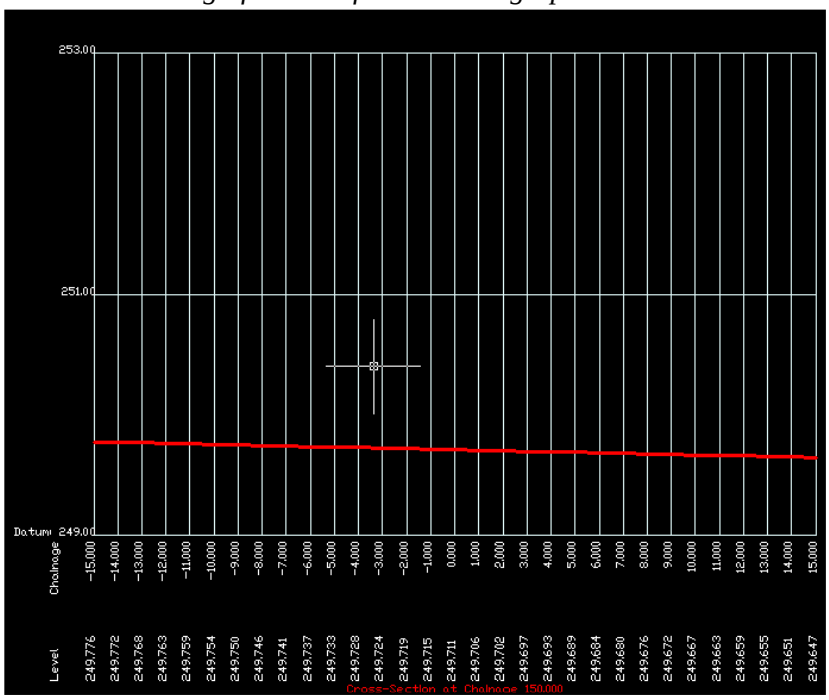


a) Scale Factor: The Program performs drawing the entities based on this scale setting. By default the setting is 1 and the user can conveniently set as per project requirements.
b) Vertical Magnification: The Program performs drawing the entities with vertical magnification by this value. This is simple multiplication of Y scale with respect to the X scale. This is performed independent of the Scale factor defined above. By default the setting is 1, indicating that this setting is used the drawing shall be drawn to a scale having real time scale. If the project requires that vertical differences are minor and difficult to comprehend the user can set a different value, usually 5-10 and as per project requirements.

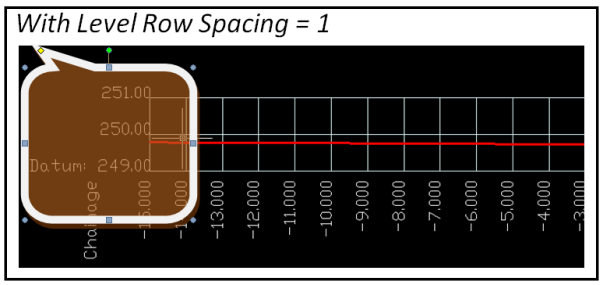
With Vertical magnification = 1 the graph looks like this

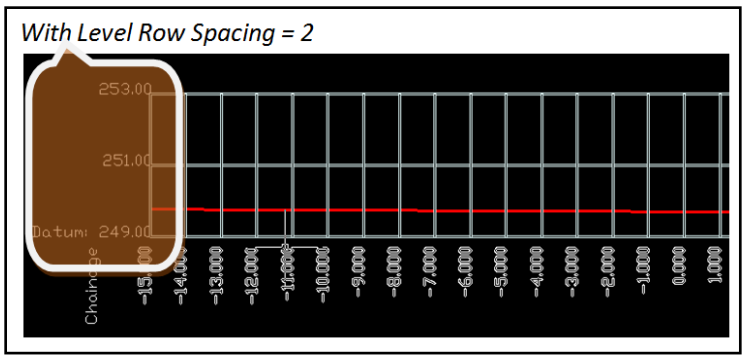


With Vertical magnification of 5 the above graph looks like under

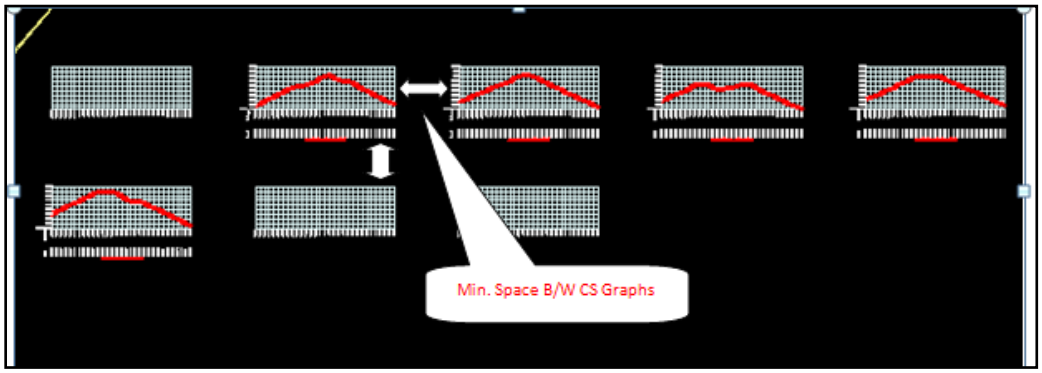


c) Level Row Spacing: Program writes/plots datum levels in graph at this spacing. For example case we have the level intervals are 249, 250, 251 and so on at 1 meter intervals. If we change this value to 2 meter intervals we will have 249, 251, 253 and so on.





d) Min. Space B/W CS Graphs: The Spacing between two Cross Sections. This setting plots in either X or Y directions at the specified spacing.

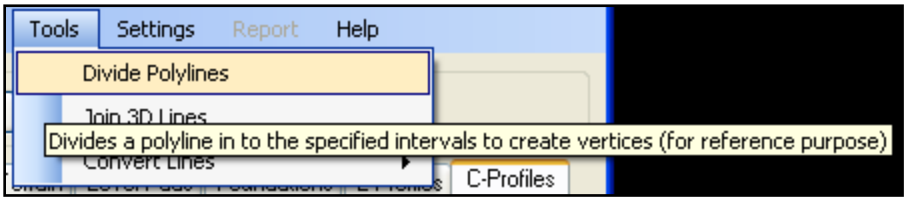


e) Text height: Text height used in the entire graph shall have this value. User may change as per the project requirements.

f) Nr of CS graphs/Row: Program plots this number of Cross Sections per row. For the example case we have 5 plots in each row as shown in the output drawing file above.

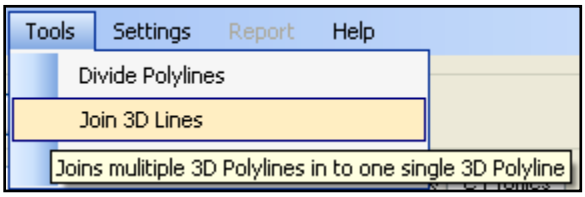
8.2 Line Manipulations

8.2.1 Tools >> Divide Polylines:



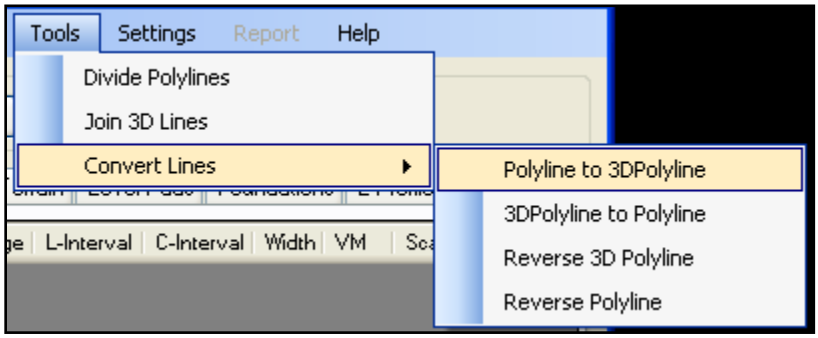
61. We may need to develop cross sections along a path on a terrain or may need to have to do so along set of 3D polylines already available from drawings. Division of polylines may be required to indicate setting a fence object/array object along a polyline on those divided points. Or creation of nodes as said above.

8.2.2 Tools >> Join 3D lines:



62. AT times we may have 3D polylines available in our drawing in broken state and we may require them to be joined for managing further. This feature would enable us to join the selected 3D polylines, if contiguous, to make as single 3D polyline.

8.2.3 Tools >> Convert Lines:

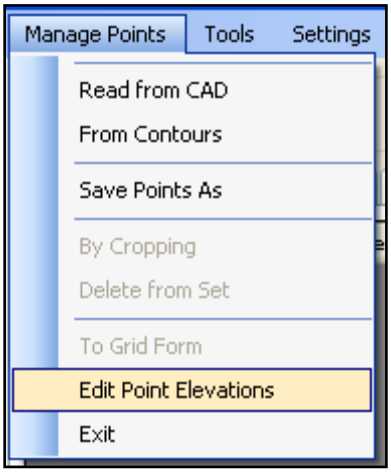


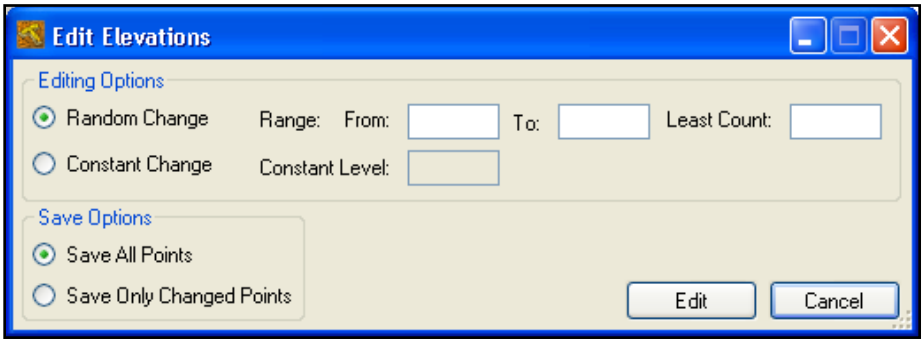
63. Sometimes we may be having some AutoCAD entities in different fashion than required for us. In such places we may use the following commands to manipulate them as required.
    g) Polyline to 3DPolyline:Here we can convert the polylines to 3Dpolyline
    h) 3DPolyline to Polyline: Here we can convert the 3Dpolyline to polylines
    i) Reverse 3DPolyline: Here we can the reverse the 3D polyline. Sometimes we need to define a starting point of a project feature already drawn, but in reverse order.
    j) Reverse Polyline: Here we can the reverse the polyline. Sometimes we need to define a starting point of a project feature already drawn, but in reverse order.

8.3 Point Manipulations

64. Tools >> Edit Point Elevations: This manipulations required to imply for inaccessible areas in project location, but can be approximated by editing to give virtual effect.

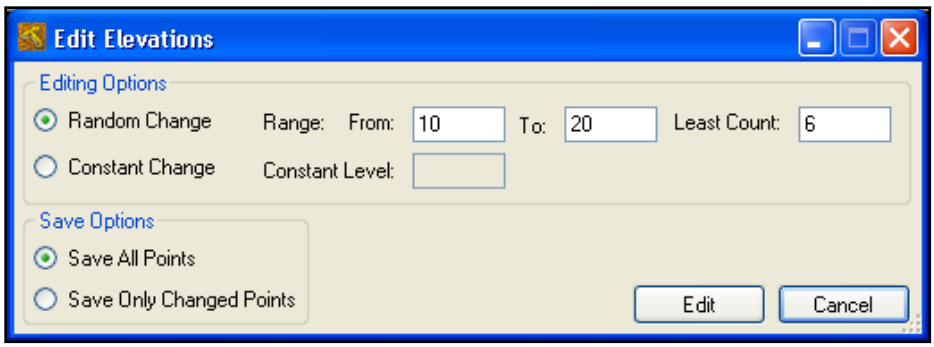
65. You may need to edit some elevations for certain area where by approximation could only be possible. Those area points shall be modified with random values or with a constant value. For such creation of elevation changes we use the following dialog. Use menu command at Manage Points >> Edit Point Elevations.





Example 1 Points NEZ OR YXZ.csv - Microsoft Excel

	A	B	C
1	Northing(Y)	Easting(X)	Elevation(Z)
2	10506.546	9766.567	95.274
3	10490.398	9755.577	94.938
4	10483.192	9772.028	95.798
5	10497.716	9787.968	96.940
6	10474.554	9790.592	96.967
7	10490.681	9804.647	97.285
8	10459.315	9765.071	95.428
9	10445.682	9758.116	94.969
10	10468.748	9731.981	93.930
11	10456.337	9723.915	93.247



Set of Points before Editing the Elevation	Set of Points after Editing the Elevation

Example 1 Points NEZ OR YXZ.csv - Microsoft Excel

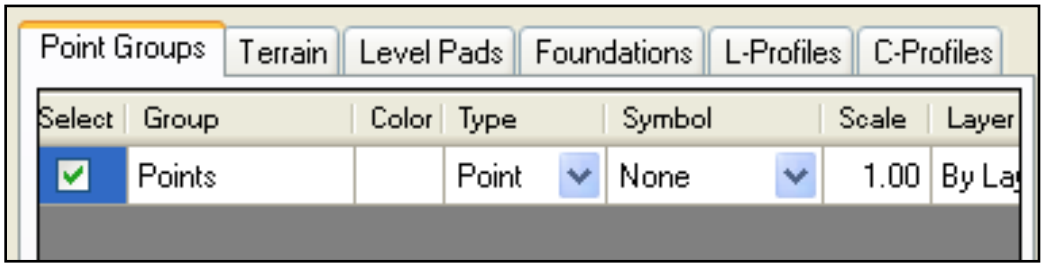
	A	B	C
1	Northing(Y)	Easting(X)	Elevation(Z)
2	10506.546	9766.567	95.274
3	10490.398	9755.577	94.938
4	10483.192	9772.028	95.798
5	10497.716	9787.968	96.940
6	10474.554	9790.592	96.967
7	10490.681	9804.647	97.285
8	10459.315	9765.071	95.428
9	10445.682	9758.116	94.969
10	10468.748	9731.981	93.930
11	10456.337	9723.915	93.247

Edited Points File_NEZD_YXZD 1.csv - Microsoft Excel

	A	B	C	D	E
1	Point	Northing	Easting	Elevation	Description
2	1	10506.546	9766.567	113.274	Points
3	2	10490.398	9755.577	112.938	Points
4	3	10483.192	9772.028	107.798	Points
5	4	10497.716	9787.968	115.440	Points
6	5	10474.554	9790.592	108.967	Points
7	6	10490.681	9804.647	115.285	Points
8	7	10459.315	9765.071	95.428	Points
9	8	10445.682	9758.116	94.969	Points
10	9	10468.748	9731.981	93.930	Points
11	10	10456.337	9723.915	93.247	Points

9 Managing Project Components

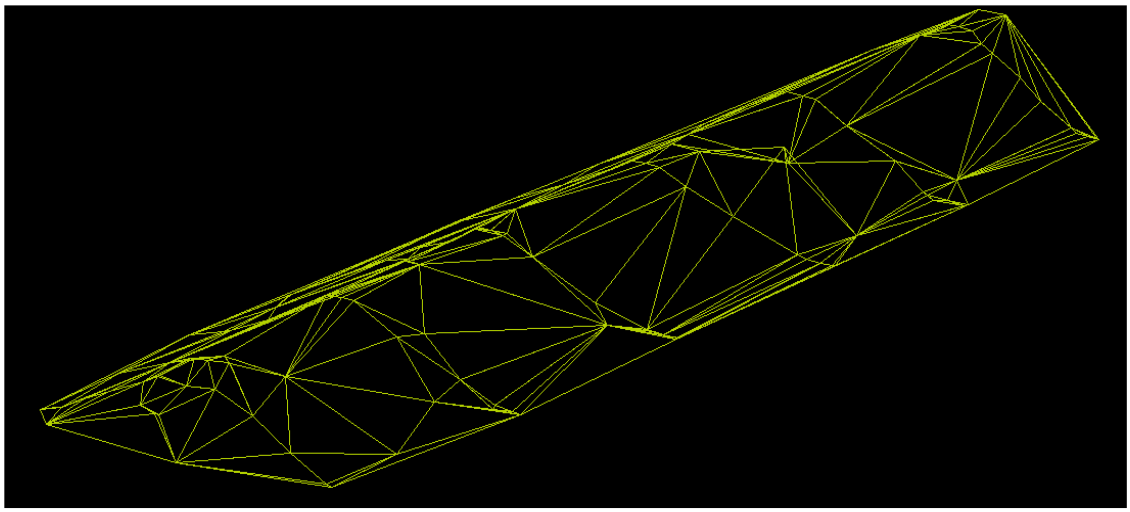
66. Main Form >> **Point Groups** Tab: Already explained under *Handling Point Files and Points* Chapter



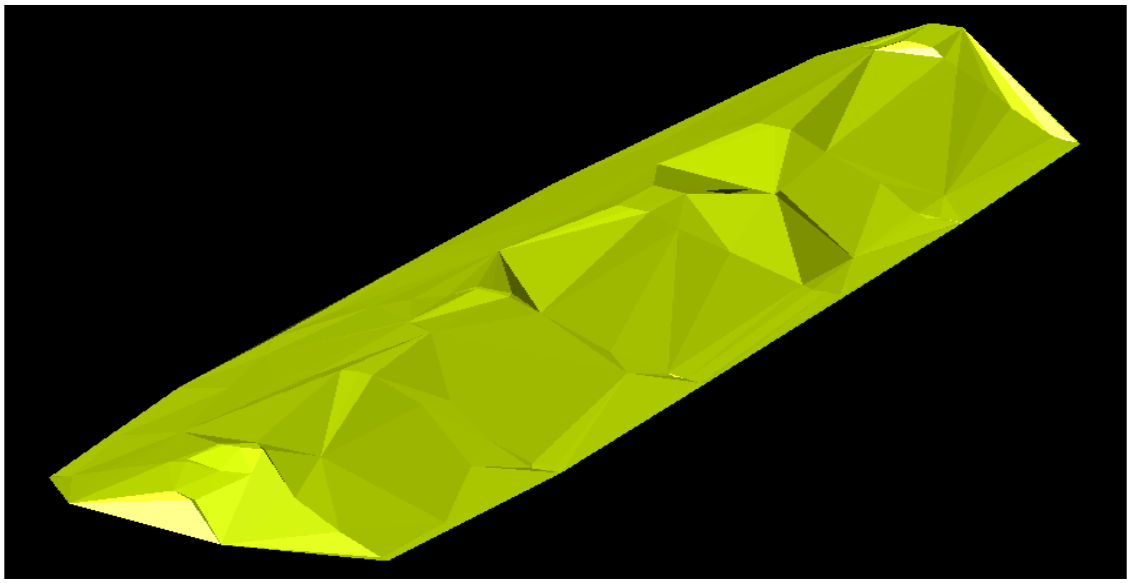
9.1 Definitions

9.1.1 Terrain Tab

67. TIN Surface: Triangulated Irregular Network (TIN): A representation of a surface derived from irregularly spaced sample points and breakline features. The TIN model represents a surface as a set of contiguous, non-overlapping triangles using **Delaunay Triangulation**. Within each triangle the surface is represented by a plane. The triangles are made from a set of points called mass points. These mass points shall be the input through CSV/Excel Files.

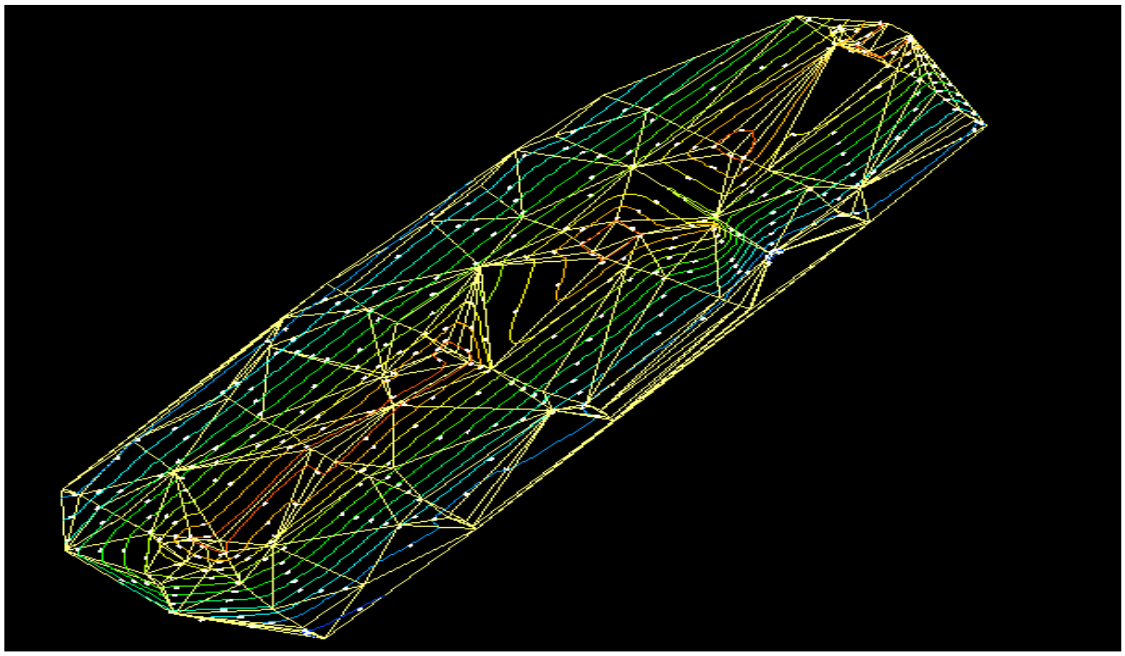


68. On AutoCAD editor the shaded Terrain looks as shown in the image below.



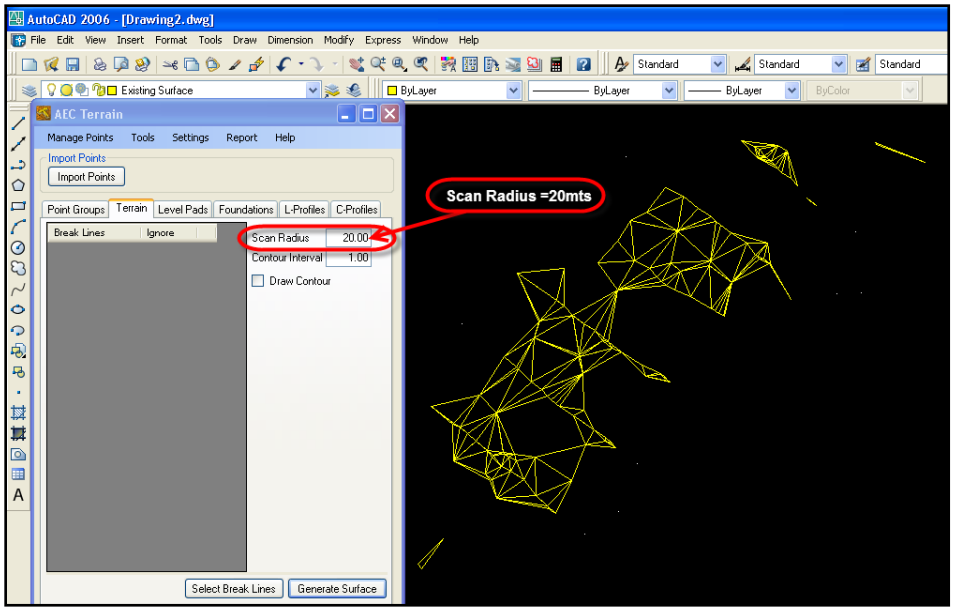
69. Contours: In cartography, a contour line (often just called a "contour") joins points of equal elevation (height) above a given level, such as mean sea level. A contour map is a map illustrated with contour lines, for example a topographic map, which thus shows valleys and hills, and the

steepness of slopes. The contour interval of a contour map is the difference in elevation between successive contour lines.

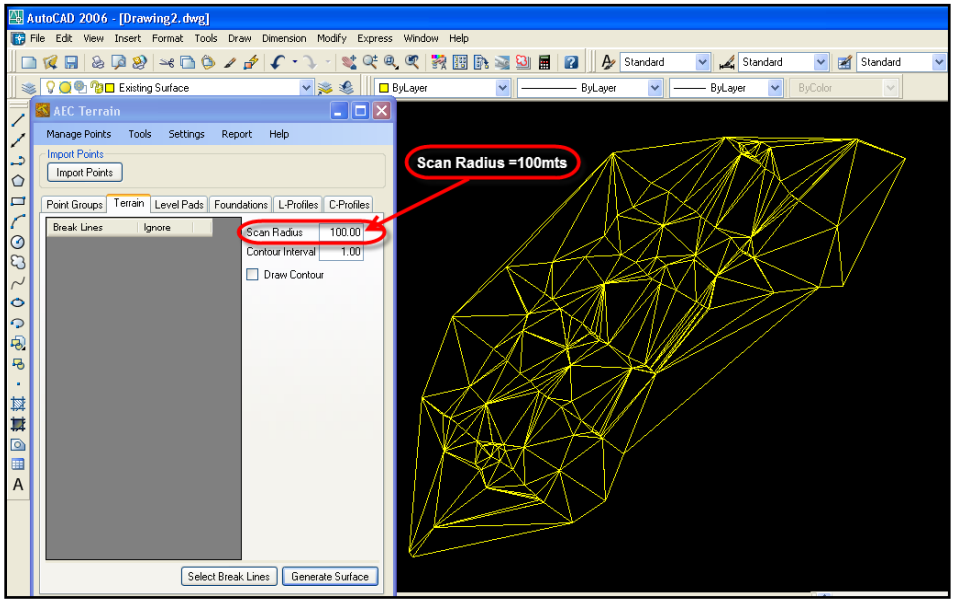


70. Scan Radius: Scan radius will direct the program to pick points falling with in such radius to generate TIN surface. If the points are away from the scan radius they would not join the adjacent surface and kept isolated.

71. Let us take the scan radius as 20 meters and 100 meters the images looks as below. With Scan radius 20 meter the program joins the points with in such radius and forms the TIN surface. Any points away from this radius value will not be surfaced. This means that the surface formation will not take place beyond this radius. Triangulation will not occur joining points or surface away from this value.

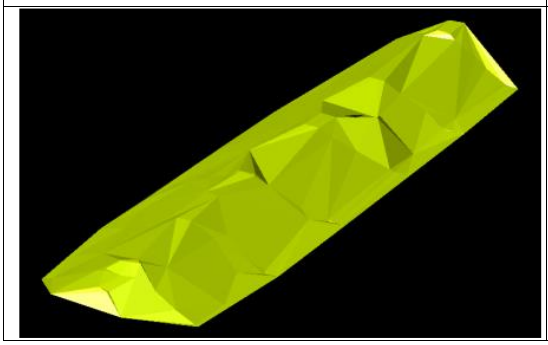
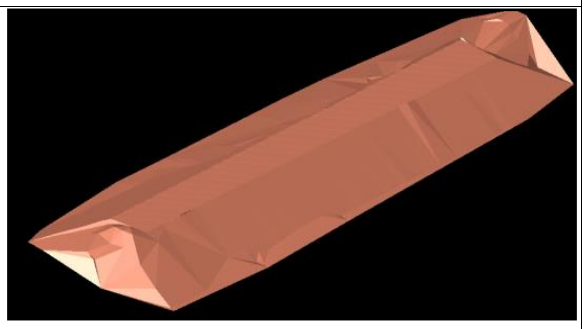


72. With Scan Radius of 100 m we have the TIN Surface generated as below.



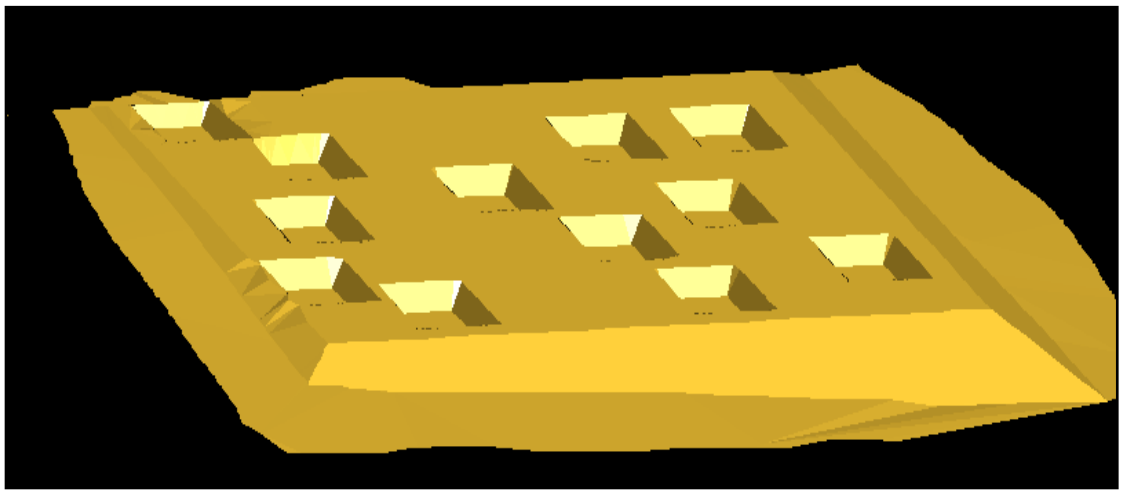
9.1.2 Level Pads Tab

73. Level Pads tab: Graded Surfaces/Level Play Grounds: When a particular area is to be graded on a irregular surface to a certain level, for example to construct a building or a road or to be excavated, the new surface is generated to such level with in the demarcation. The newly generated Level surface is called Level Pad

Before the level Pads drawn	After the level Pads drawn
	

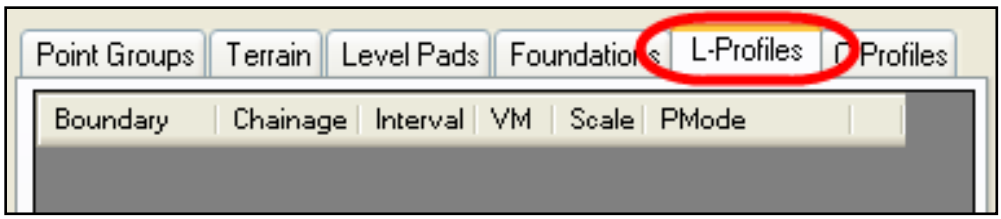
9.1.3 Foundations Tab

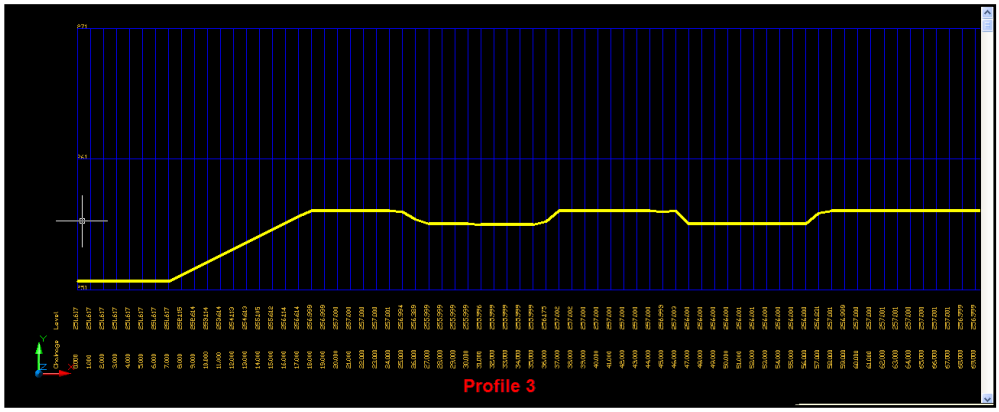
74. Foundations tab: To found engineering structures like buildings, culverts, bridges and similar structures in to the ground, extend and level of excavation need to be verified to fit on to the terrain for several practical setting. This feature enables such requirement and reports volume of excavations.



9.1.4 L-Profiles Tab

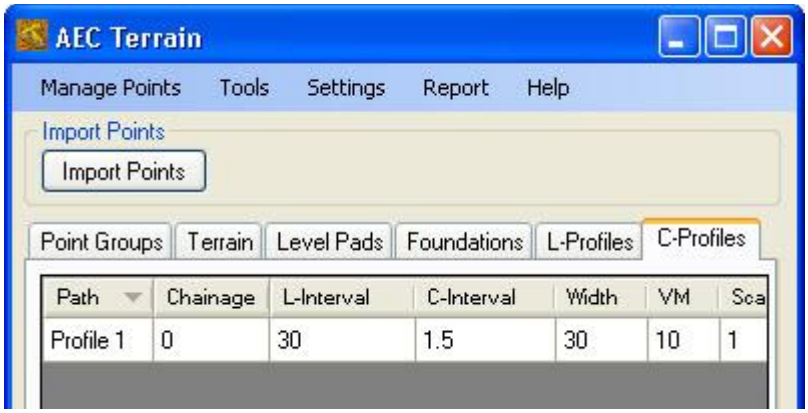
75. Profiles tab: We may need to draw profiles along a straight line, circular paths and so on. We need to find the surface profile of the ground along such paths. 6D Surface Modelling draws such profile along the defined path.





9.1.5 C-Profiles Tab

76. The following procedure is explained for Cross Sections form Terrain (from Point file data).
    a) Cross Sections are generated with the following parameters.



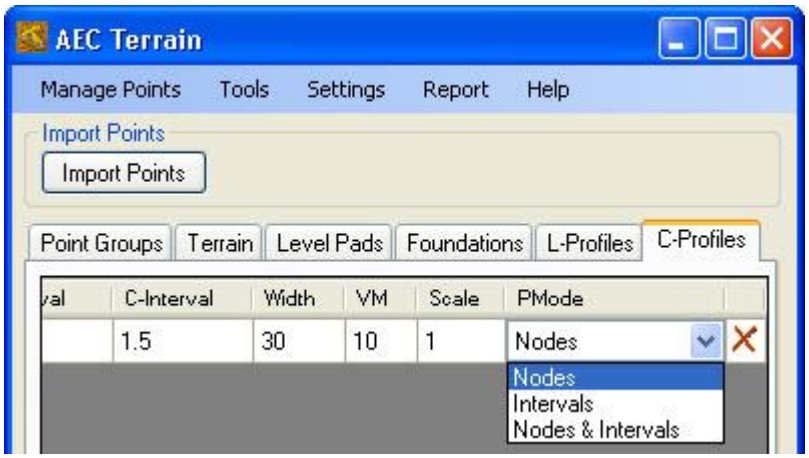
i. L-Interval: Longitudinal Intervals along the defined path/alignment for example 0, 30, 60, 90 … and so on

ii. C-Interval: Cross Intervals across the defined path /alignment; for example 0, 1, 2, 3 or 0, 5, 10, 15 and so on. These intervals are for picking up coordinates across the profile path for a width specified above. These intervals depend on the accuracy of

the data expected to be used by the user. For the example case we have an interval of 1 meter.

iii. **Cross Section Width**: Cross-sections shall be extended to this value half on either side (Left and right). Fri the example case we have a width of 30 meter; meaning thereby that -15 meter on the left and +15 meter on the right shall be read from the terrain and plots these values. The output file below in CSV format indicates these values.

b) **Path Segmentation**: The program plots the Cross sections at regular intervals, for example, 10, 20, 30, 40 ….. and so on. If path segmentation is defined with Nodes, then the program also generates Cross sections at such nodes and/or Intervals. The path segmentation has three options: The Program segments the Path and plots/reads/writes the values (NEZ/YXZ) for each point and plots the values for you.



i. **Nodes**: The Center Line of the Path could be having Nodes. For example the polyline path may be drawn with several vertices indicating centre chainages of each pier locations in a bridge project or Curve control points on a road or canal project. Level position of these node points are also needed to be shown with exact value of elevation picked up from the terrain. In normal course these node points are avoided when only Intervals option is selected.

ii. **Intervals**: In general all programs perform picking level intervals at specified Longitudinal Chainages (in the example case we have 20 meter chainages-Interval Length)

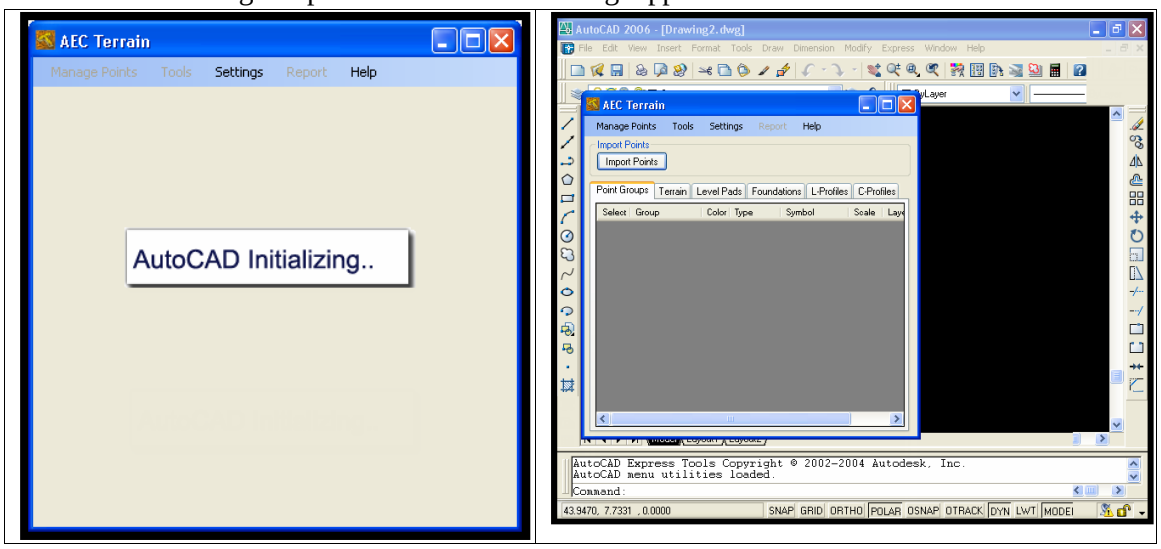
iii. **Nodes and Intervals**: Under this option the levels are picked up by the program at each node and every interval as specified. Node values are important for bridge projects and curves to have closure values.

9.2 Processes

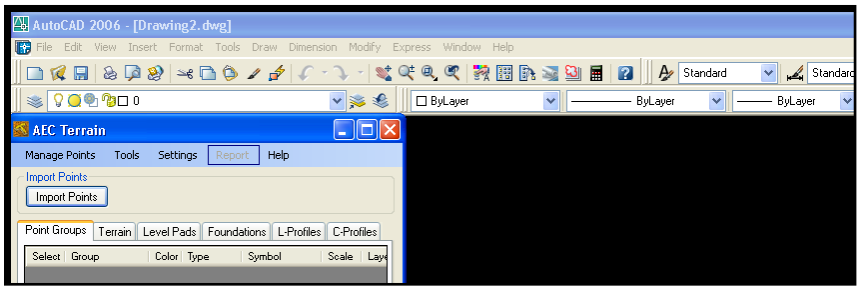
9.2.1 Terrain Generation

9.2.1.1 Input file

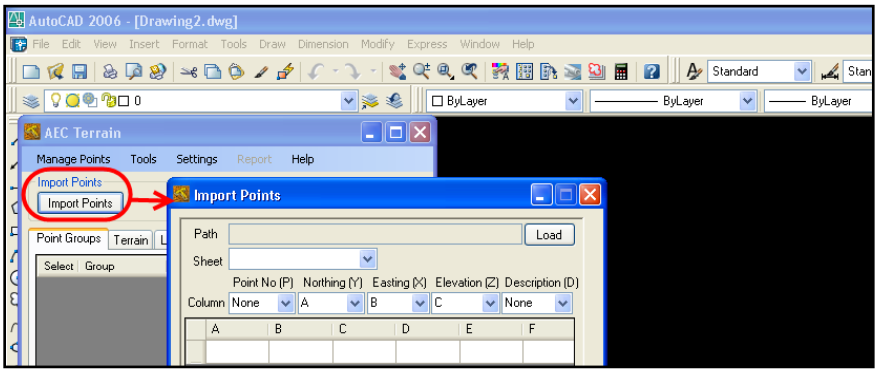
77. 6D Surface Modelling>>Open the Surface Modelling Application.



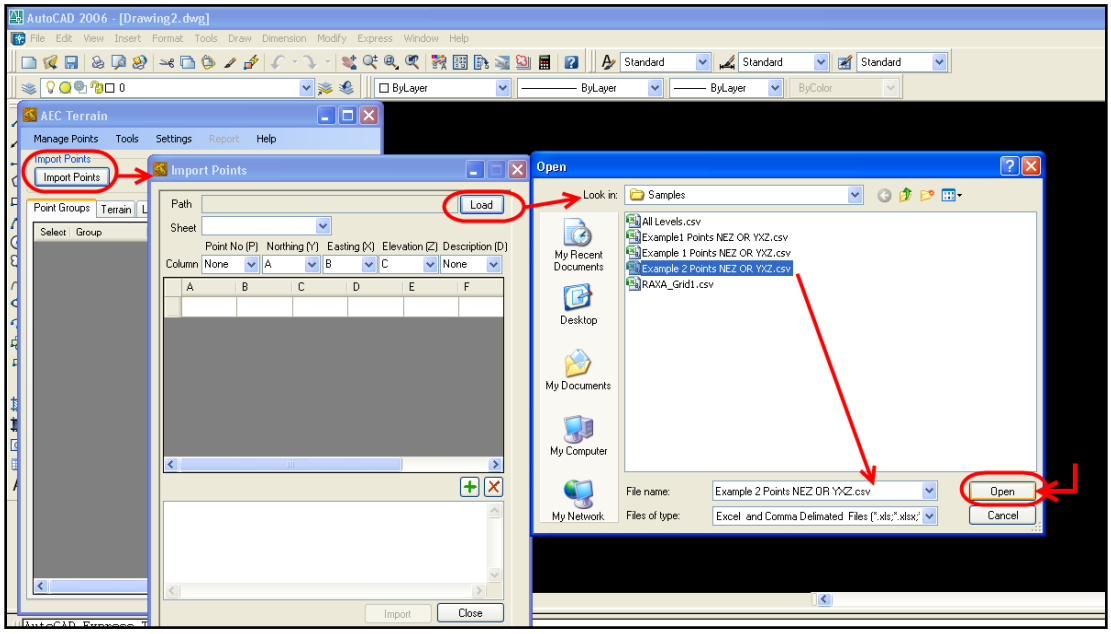
78. Import Points >> This command prompts for points file either in CSV/Excel format. Let us now practice with the ***Example 2 Points NEZ OR YXZ*** files available at the following program installation path (modify as installed by the user) >>
C:\Program Files (x86)\6D Proptech\6D Surface Modelling\Samples



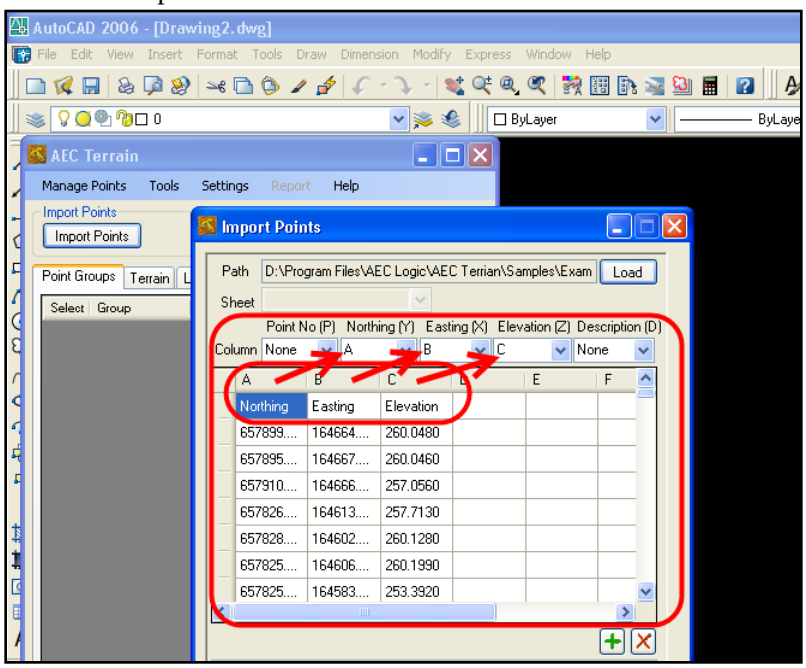
79. Click Load >>



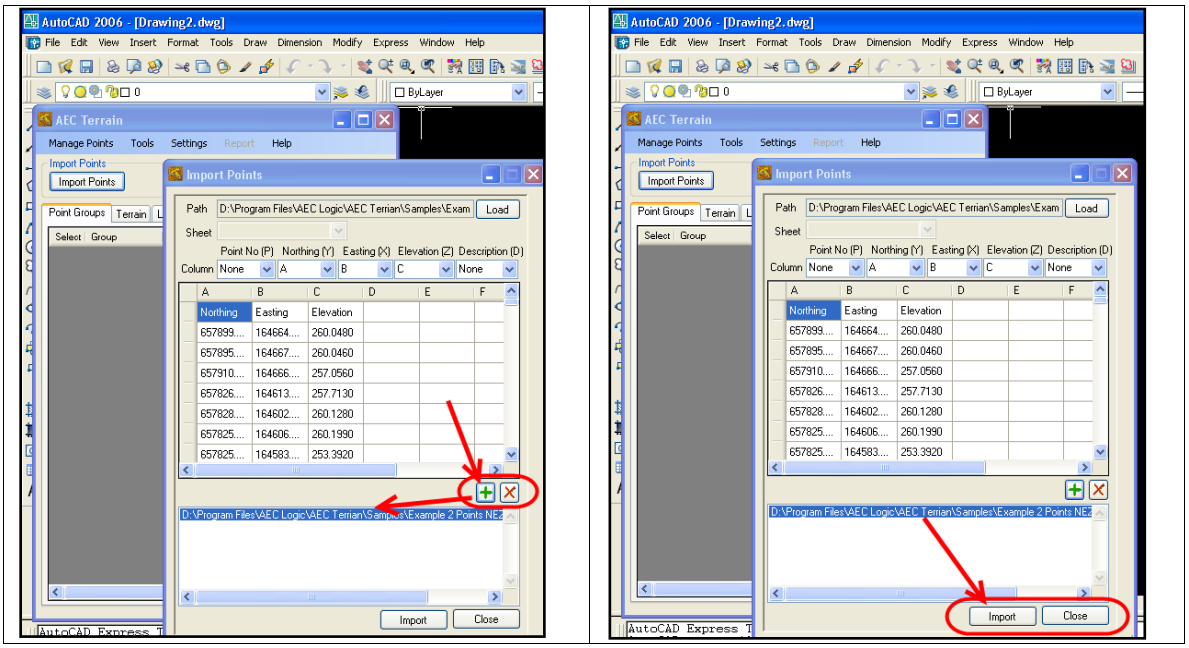
80. Select ***Example 2 Points NEZ OR YXZ.csv file***. Then Click on **Open** Command.

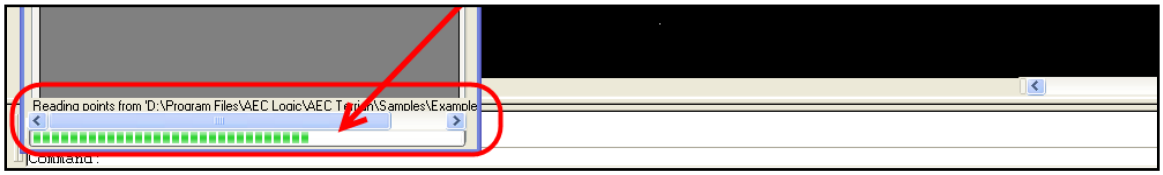


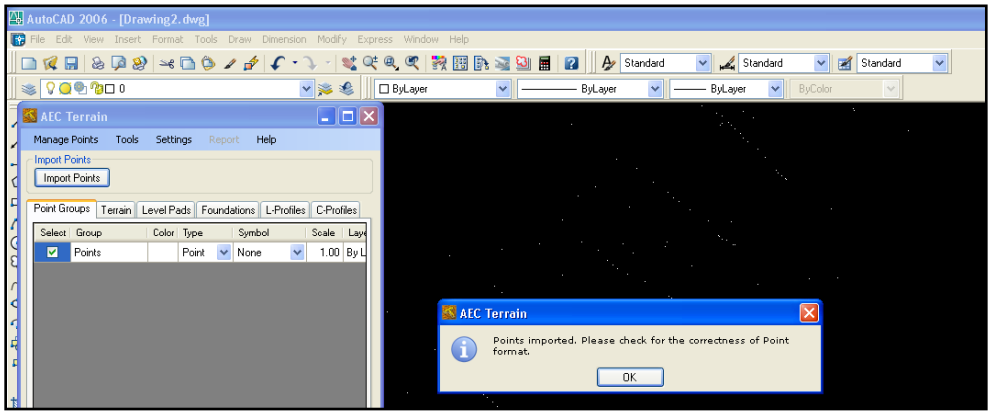
81. Points are imported as under.

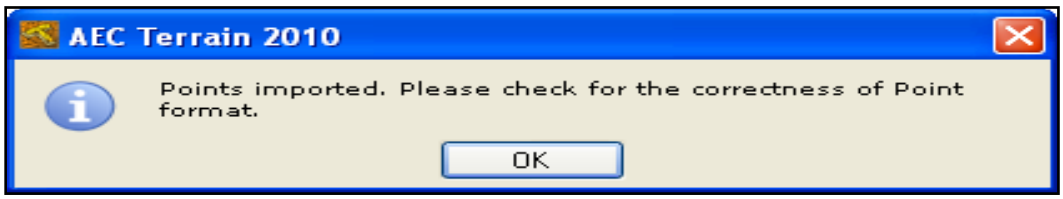


82. Add the File to the project >> Click + button







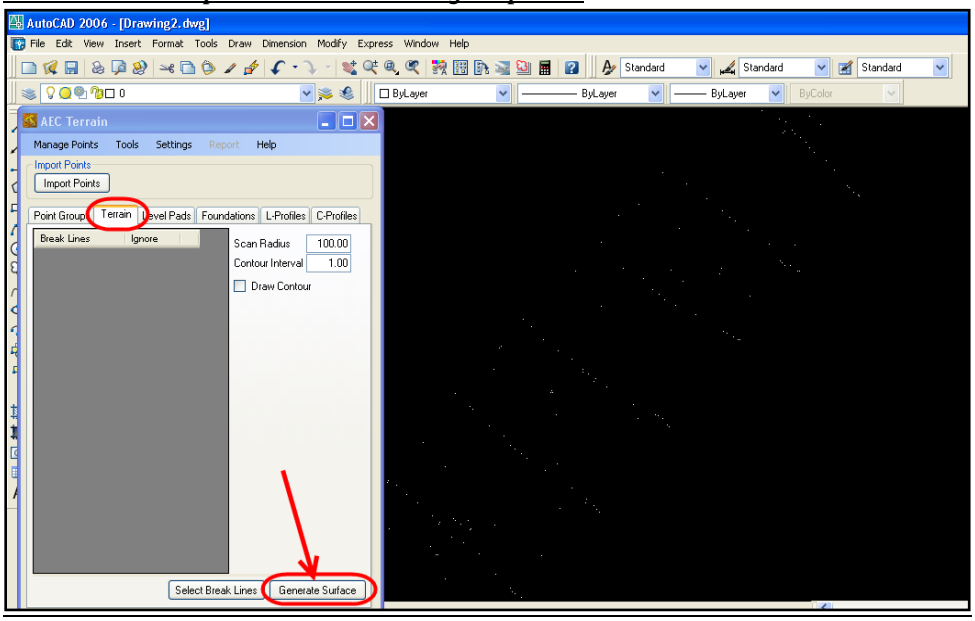


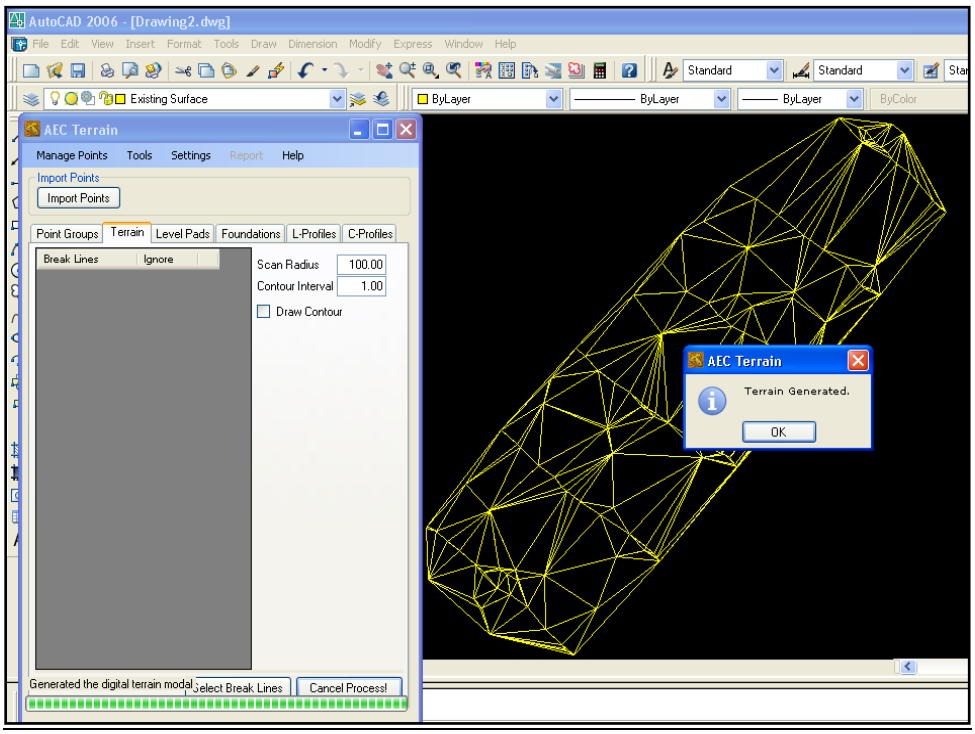
9.2.1.2 Generate Surface Modelling

83. Go to **Terrain tab**, set the **Scan Radius** and the **Contour Interval**. If you want to see the contours in the AutoCAD drawing then **check** the **Draw Contour** box. After the selection is done

click on Generate **Surface Command**. Then Click on Ok. Terrain Generated dialog prompts.

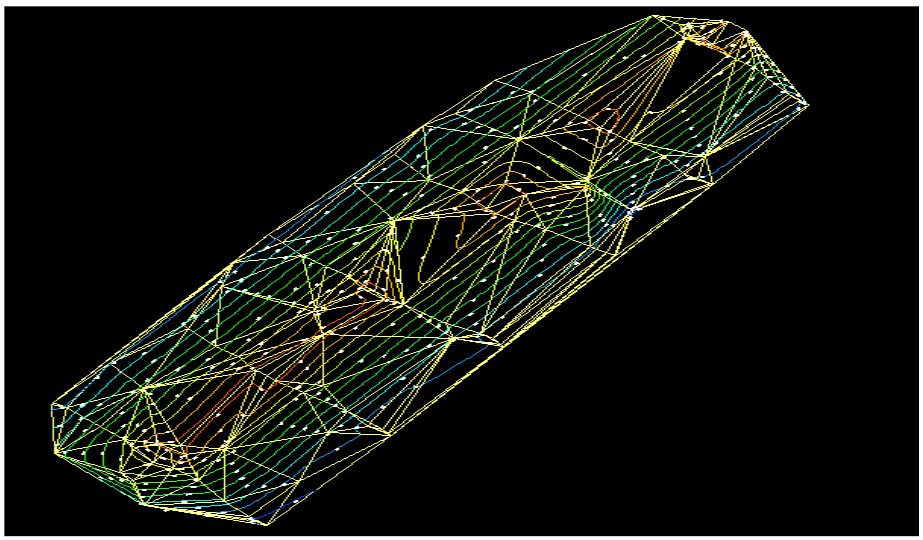
Note: DO NOT Tamper with AutoCAD during this process





9.2.1.3 Generate Contours

84. For drawing Contours set scan radius and contour intervals to direct the program drawing contours while generating terrain.

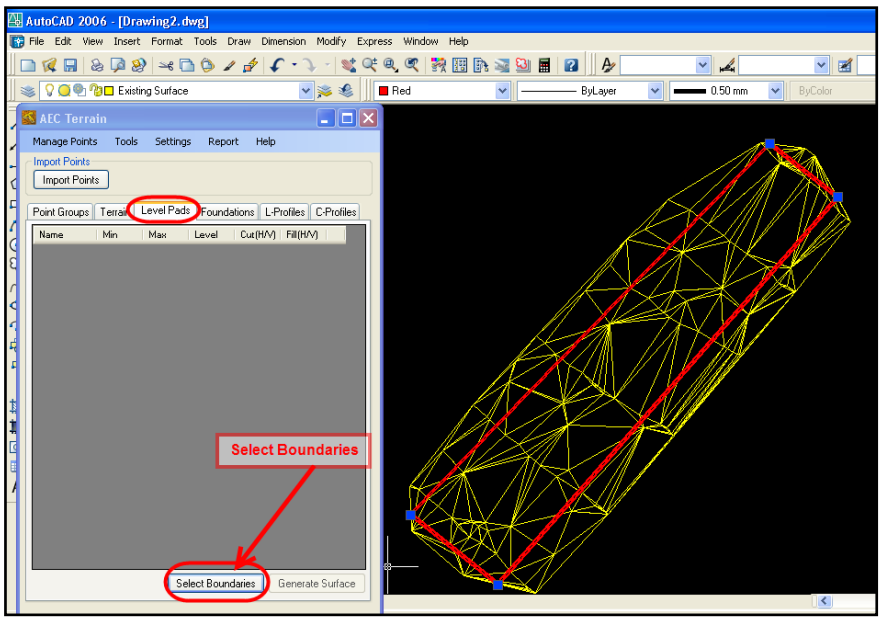


85. Scan Radius: Scan radius will direct the program to pick points falling with in such radius to generate TIN surface. If the points are away from the scan radius they would not join the adjacent surface and kept isolated.

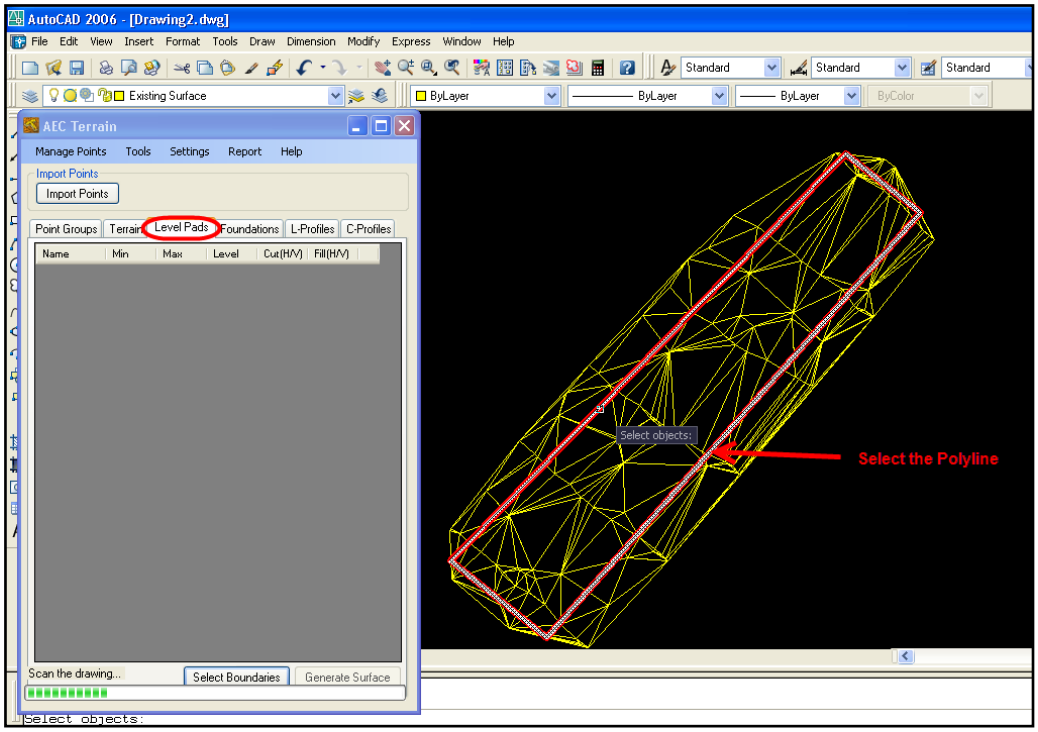
Note: For more details see definitions under Terrain tab.

9.2.2 Level Pads Generation

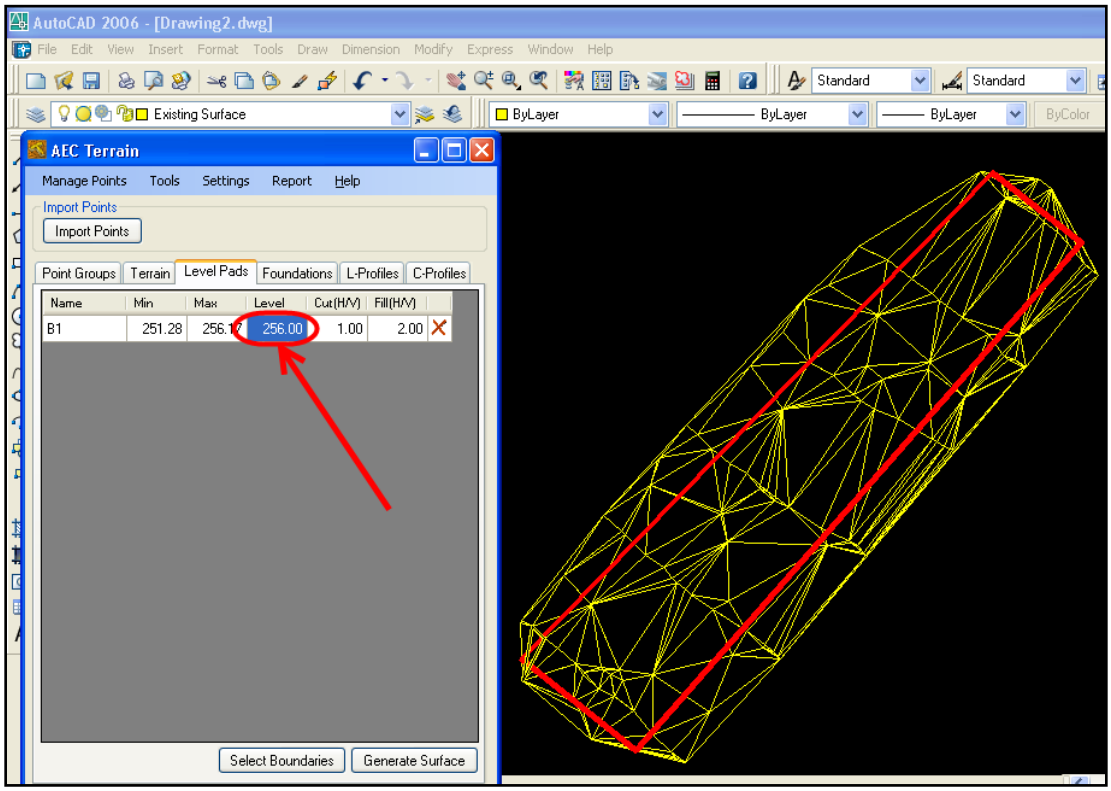
86. Level Pads>> Draw **Closed Polyline**(s) around an area/region where you propose to draw level pads. Multiple pads can also be drawn by multiple selection of closed polylines. ***Note: The Polyline should fall within the extent of the point files/TIN surface boundary.***



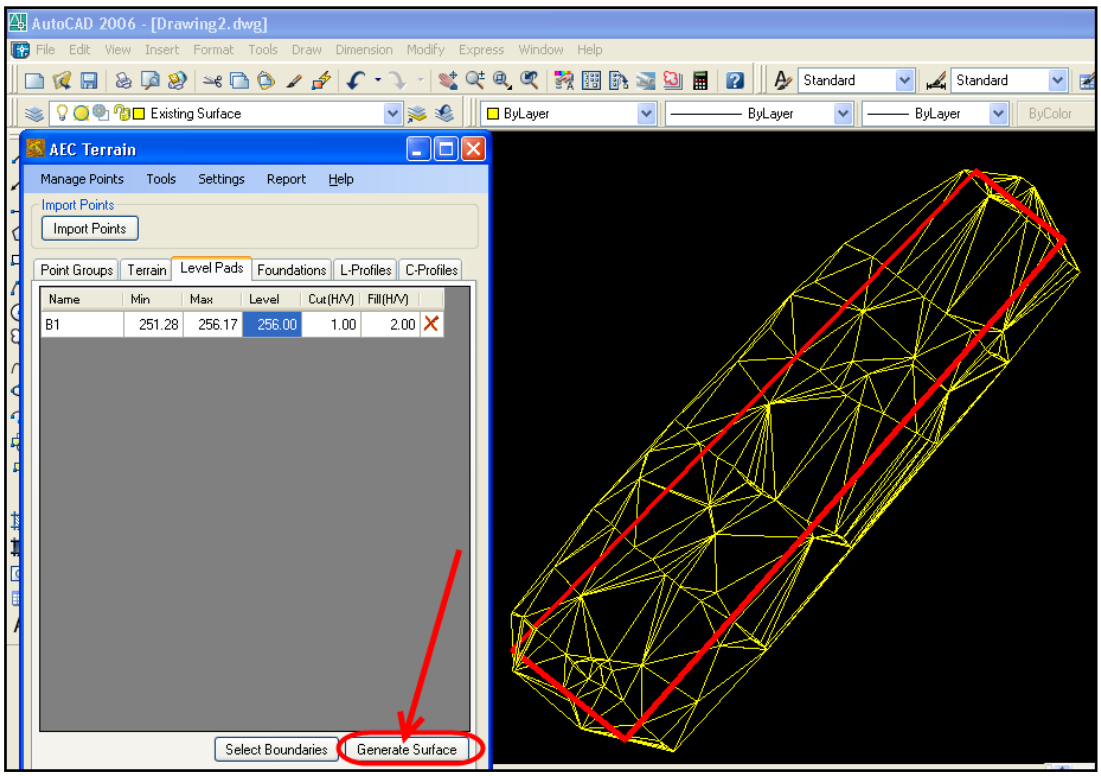
87. Select the Polyline(s) so drawn for the proposed level pads.



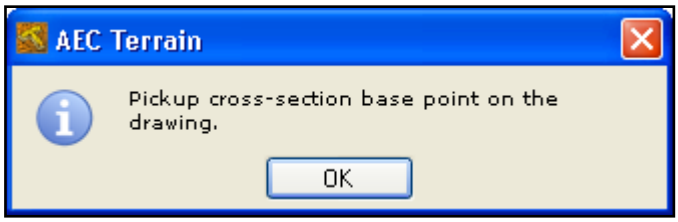
88. The Boundary lines (Selected closed polylines) shall be listed in the Data Grid with captured data from the AutoCAD, like minimum and maximum levels with naming as B1, b2 B3 and so on.. as boundaries. These boundaries can be renamed as the user wishes them to be.

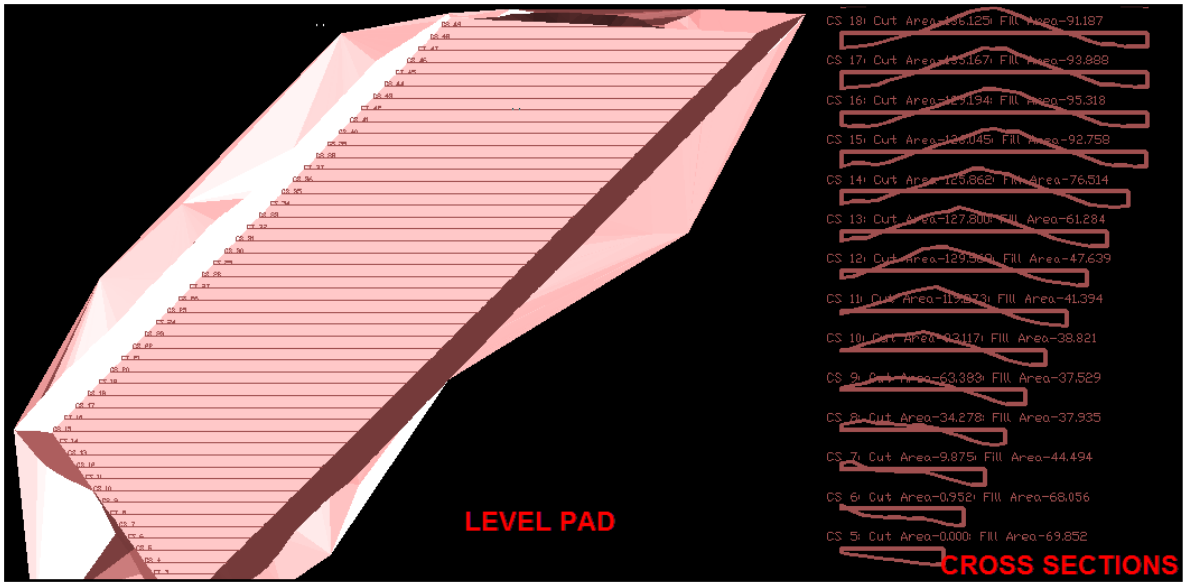


89. Set the proposed final Level as per the project requirement. Then Click on Generate Surface



90. The program draws cross sections along on the level pad flat surface and slopes with chainage marking for computations checks. Indicate a point on the AutoCAD to draw these Cross-sections when prompted by the program.





91. Level Pads file (containing the final surface points) will be saved in the Input folder. A CSV file is written to the folder path containing coordinates in NEZ format. This file when plotted again would make a flat TIN surface as shown in the image below. Click on OK

92. The CSV file format Looks as under

N	E	Z
657826.8	164613.8	257.713
657828.0	164602.5	260.128
657825.5	164606.8	260.199
657825.6	164583.6	253.392
657827.9	164606.2	260.258
657850.0	164593.3	250.894
657843.2	164599.6	254.374
657867.4	164642.4	260.269
657870.3	164638.9	260.319
657858.0	164631.5	260.385
657871.0	164613.5	251.191
657831.4	164632.5	252.050
657860.4	164606.7	252.092
657844.2	164631.7	256.288

After the Generation of the Level Pads Cut-fill volume report is shown below.

Report

1 of 4 100% Find | Next

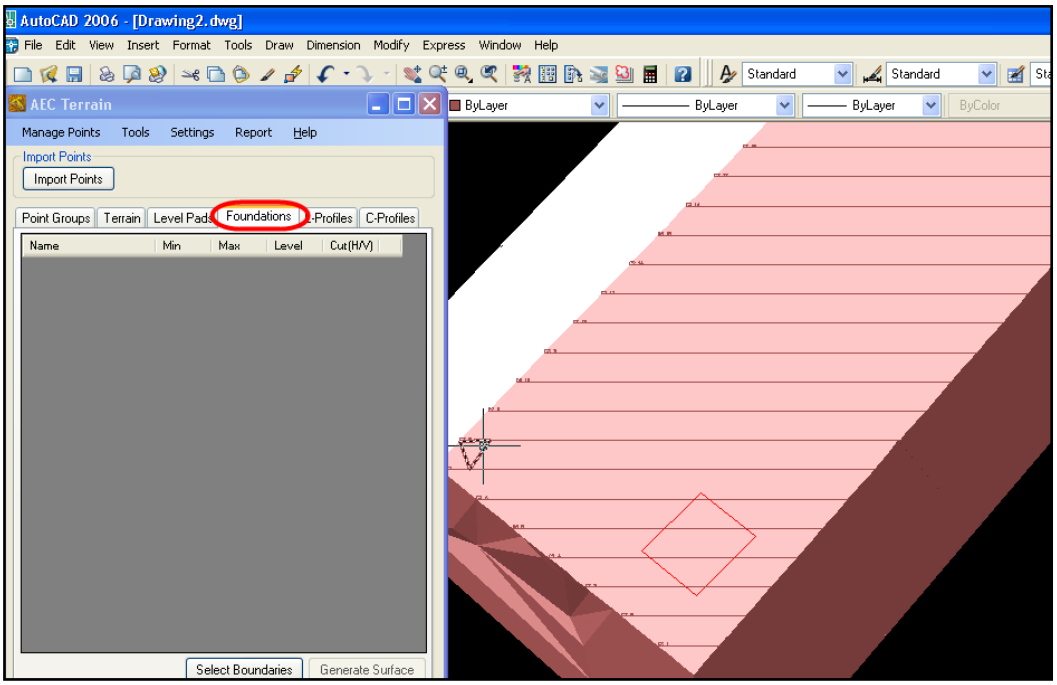
rptLevelPAD

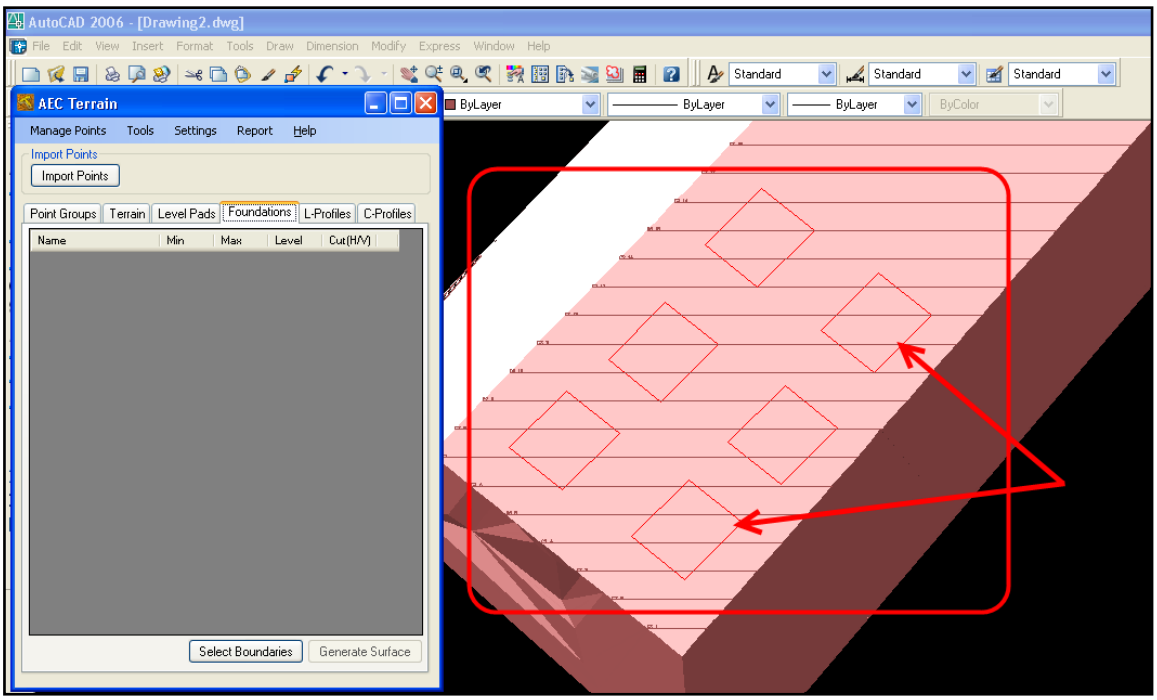
Level Pads Cut-Fill Area Report

Boundary	CrossSection	Cut Area (Sqm)	Fill Area (Sqm)
B1	CS 0	0.000	0.000
B1	CS 1	0.000	22.392
B1	CS 2	0.000	25.513
B1	CS 3	0.581	13.133
B1	CS 4	21.768	9.491
B1	CS 5	43.275	8.667
B1	CS 6	60.657	13.090
B1	CS 7	63.813	27.591
B1	CS 8	61.184	28.429
B1	CS 9	60.671	27.231
B1	CS 10	61.810	26.011
B1	CS 11	65.465	24.986
B1	CS 12	69.385	23.552
B1	CS 13	69.522	23.123
B1	CS 14	65.158	22.536
B1	CS 15	61.964	21.867

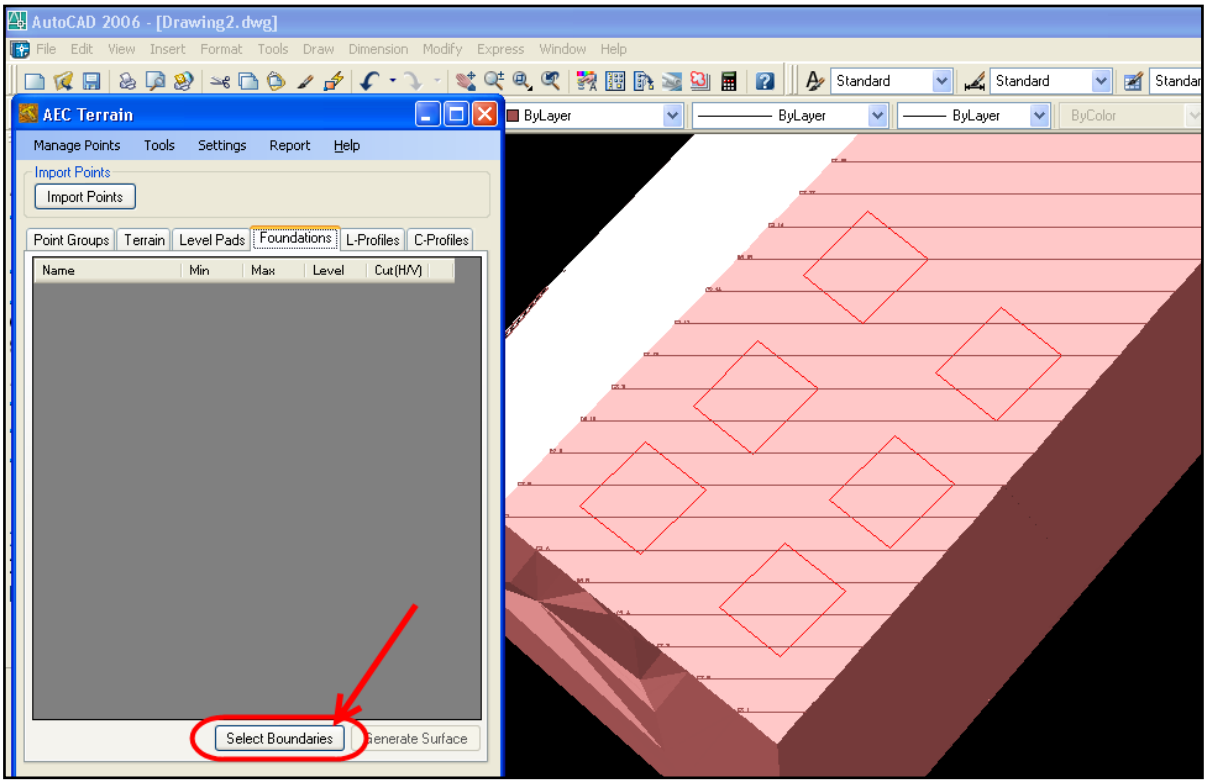
9.2.3 Foundations Modeling

93. Foundation tab >> Draw the Polyline(s) for the Foundations desired in the fashion as explained below.

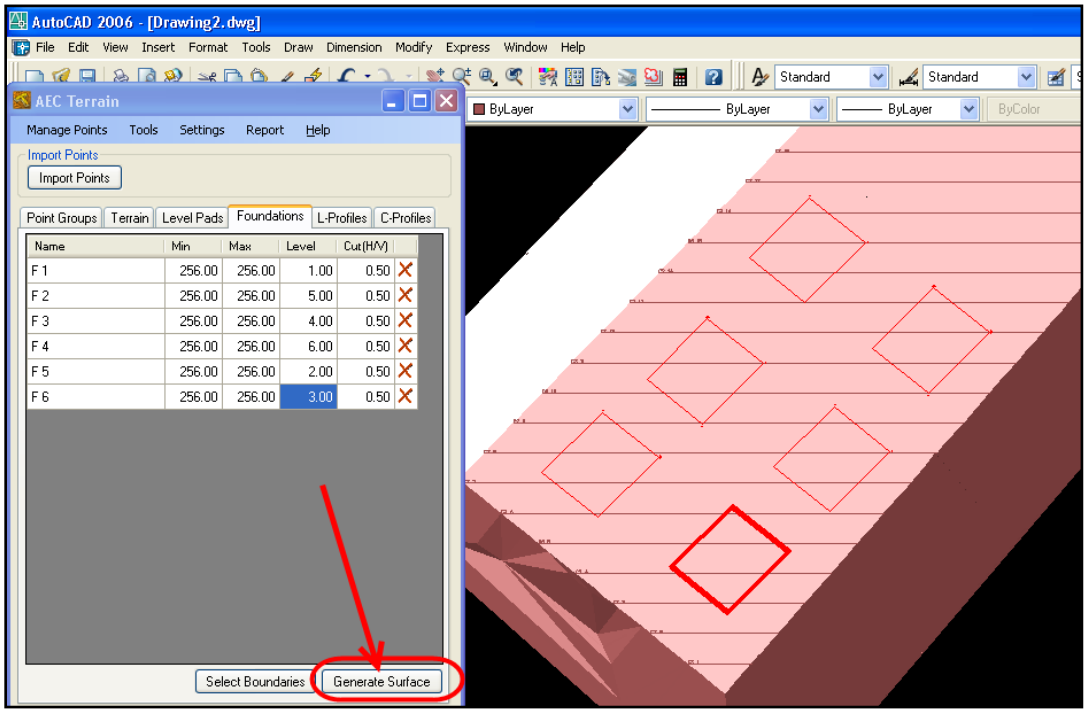




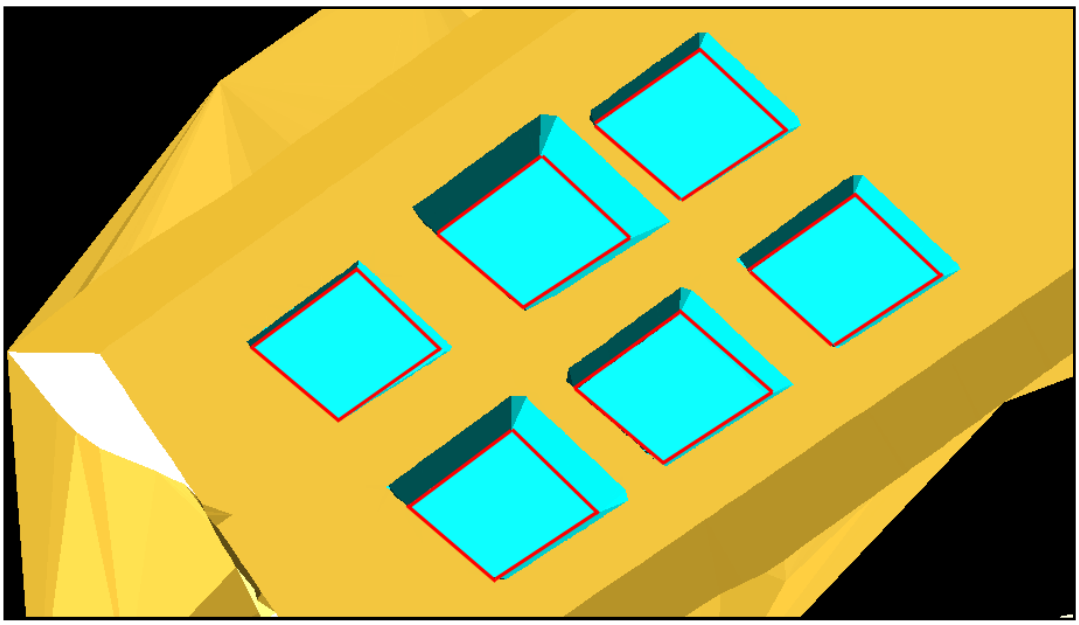
94. Click on Select Boundaries



95. Select foundation Boundary Polyline(s), Then Click OK to select the polylines in the AutoCAD drawing.



96. Set the levels for the foundation as desired. Then click on Generate Surface. Interference of the adjacent footings shall be taken care by the program.



After the generation of the Foundations, Foundation Excavation report is shown below

Report

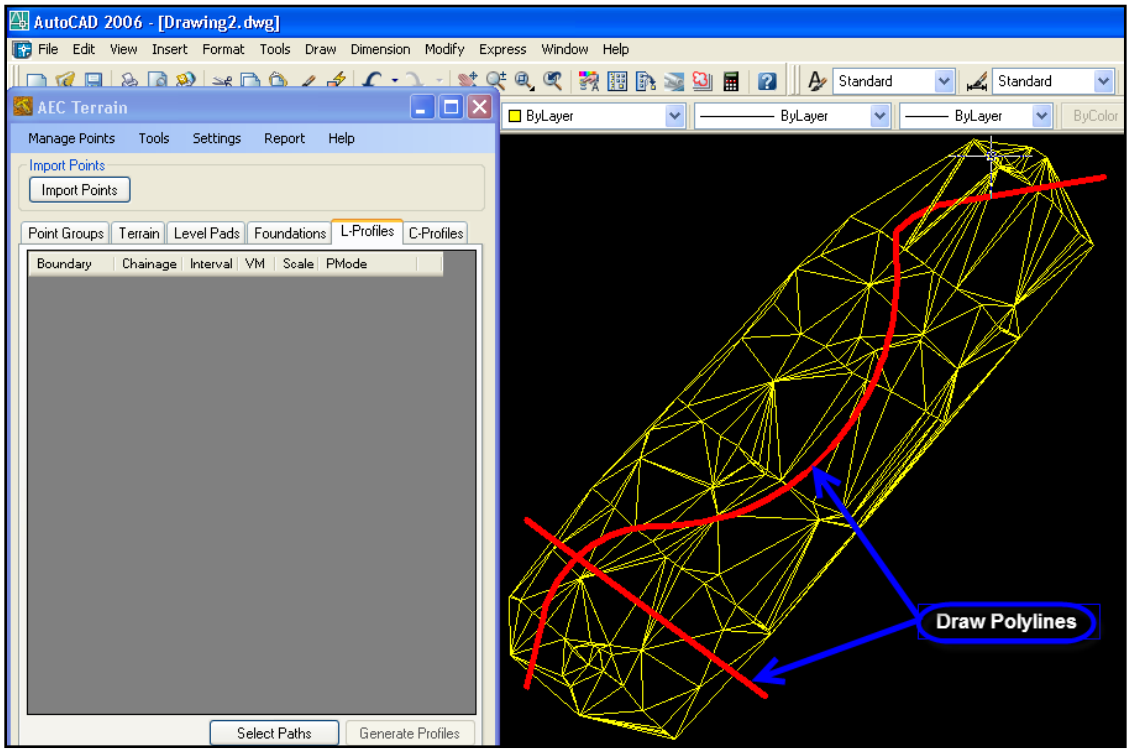
1 of 1 100%

Foundation Excavation Volume Report

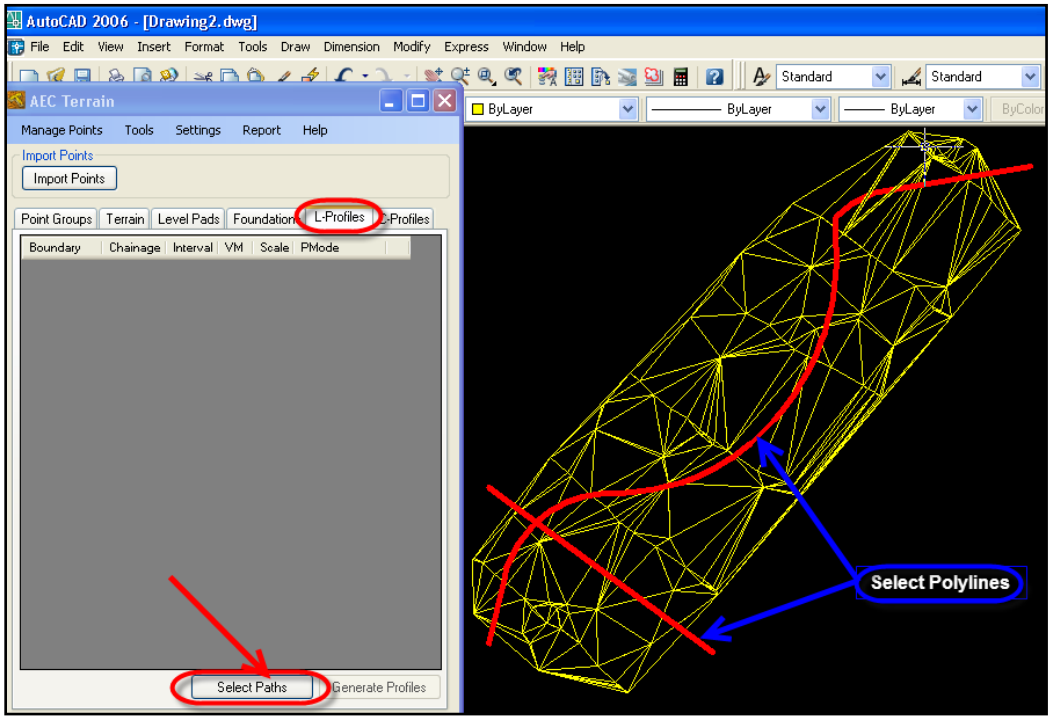
Reference	Depth	Area (sqm)	Cut Slope (H:1V)	Volume (cum)
F 1	1	60.75	0.5	68.933
F 2	5	60.75	0.5	541.949
F 3	4	60.75	0.5	390.156
F 4	6	60.75	0.5	719.496
F 5	2	60.75	0.5	155.705
F 6	3	60.75	0.5	262.002
		364.5		2138.241

9.2.4 L-Profiles Generation

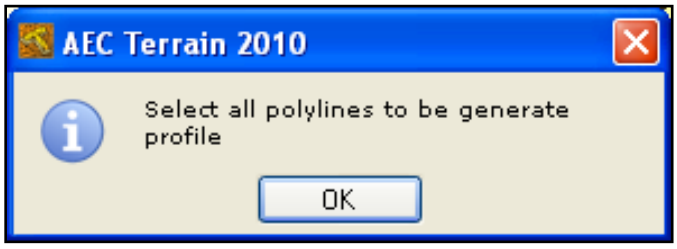
97. 6D Surface Modelling>>Profiles>> Draw a Polyline Path along the path where a profile of the terrain is desired.



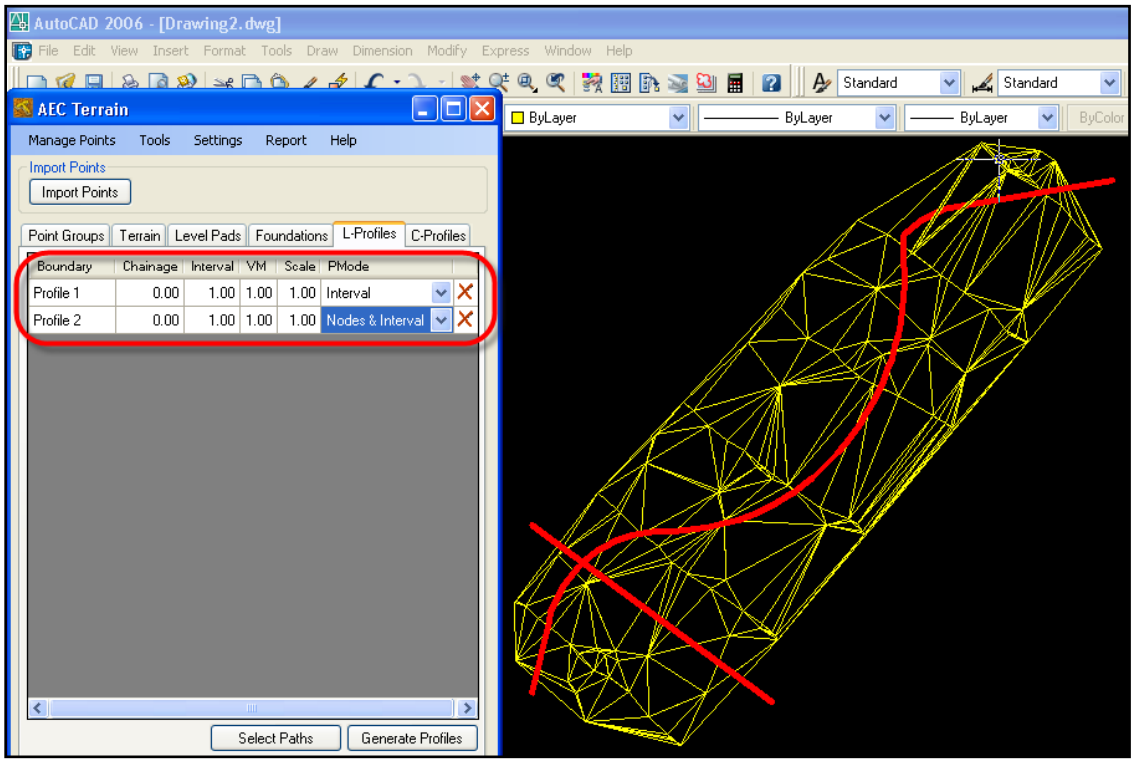
98. Select the Paths where the polylines are draw.



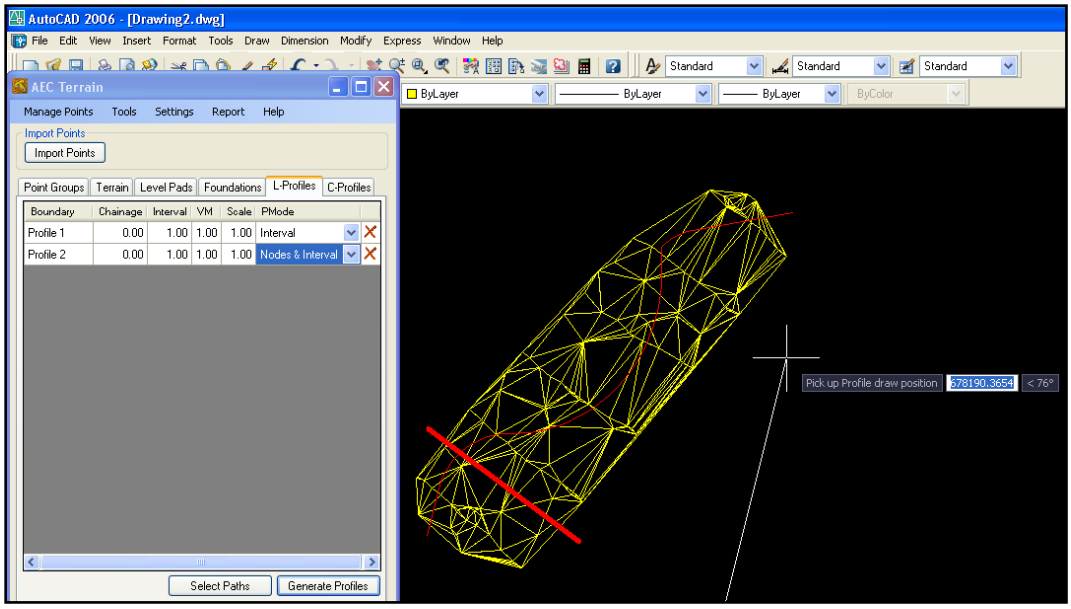
99. Select all Polylines to be generate Profile. Click OK

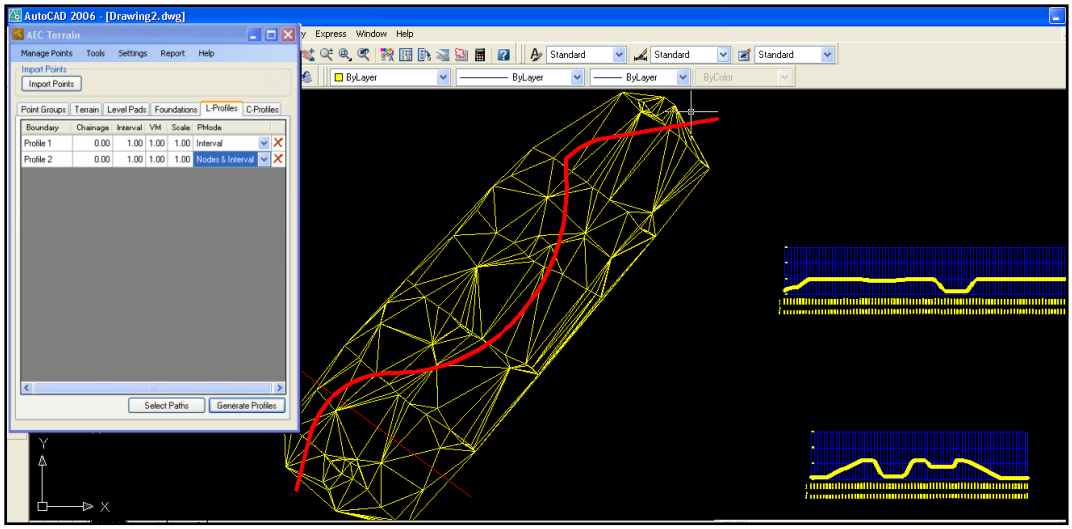


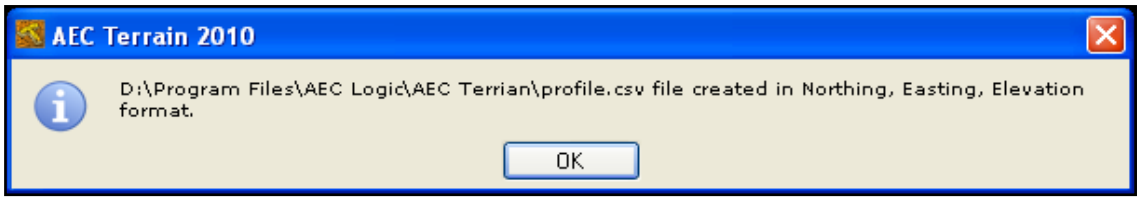
100. Profiles data generated. Select the Profile Mode (PMode) as Interval or Nodes or Both Nodes & Interval. Here we can set the Chainage, Interval and VM and Scale. After the setting is done click on Generate paths.



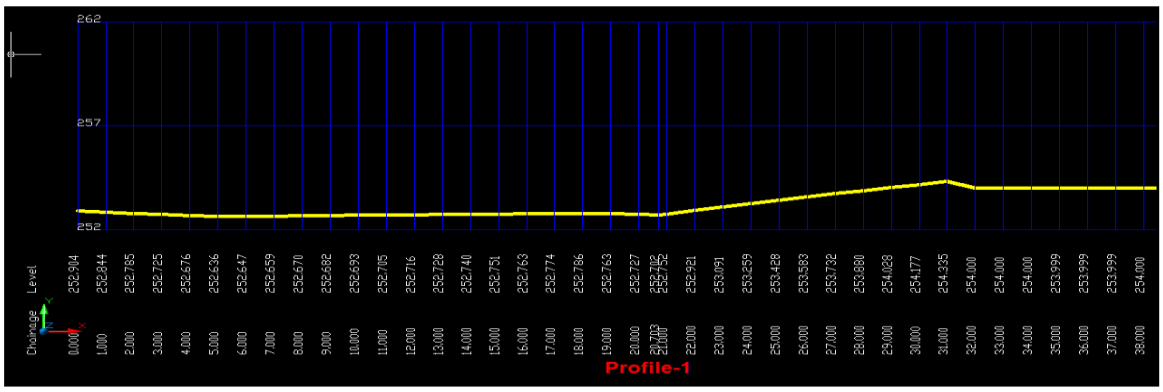
101. Pick up profile draw position in the AutoCAD drawing

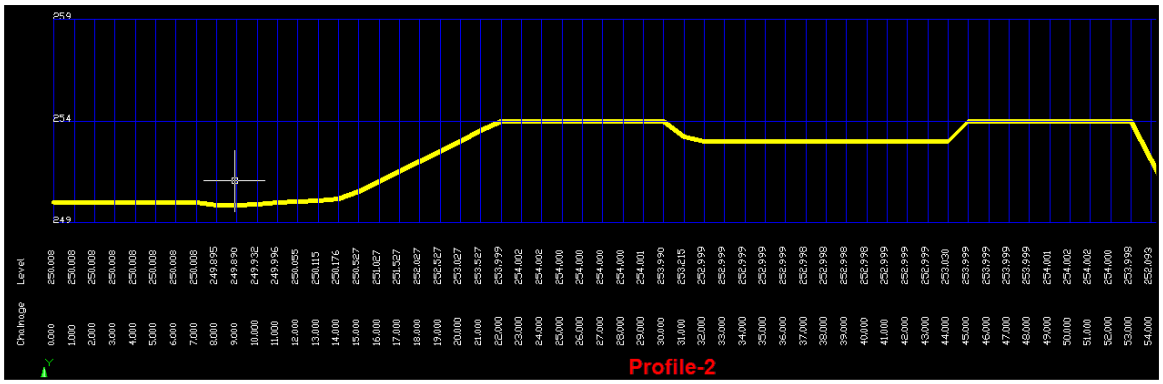






102. Profile Drawing.





The data CSV output files for the profile generation are as shown as under.

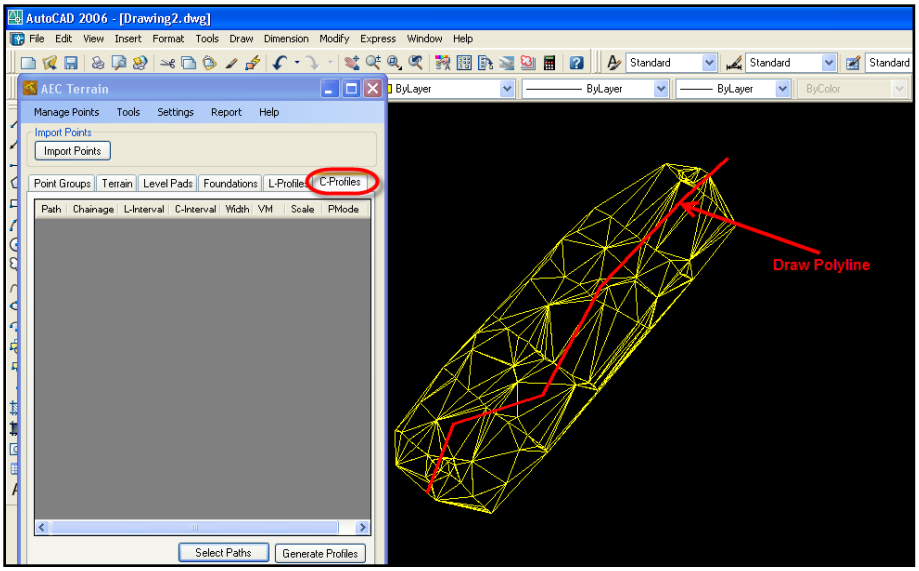
profile.csv - Microsoft Excel

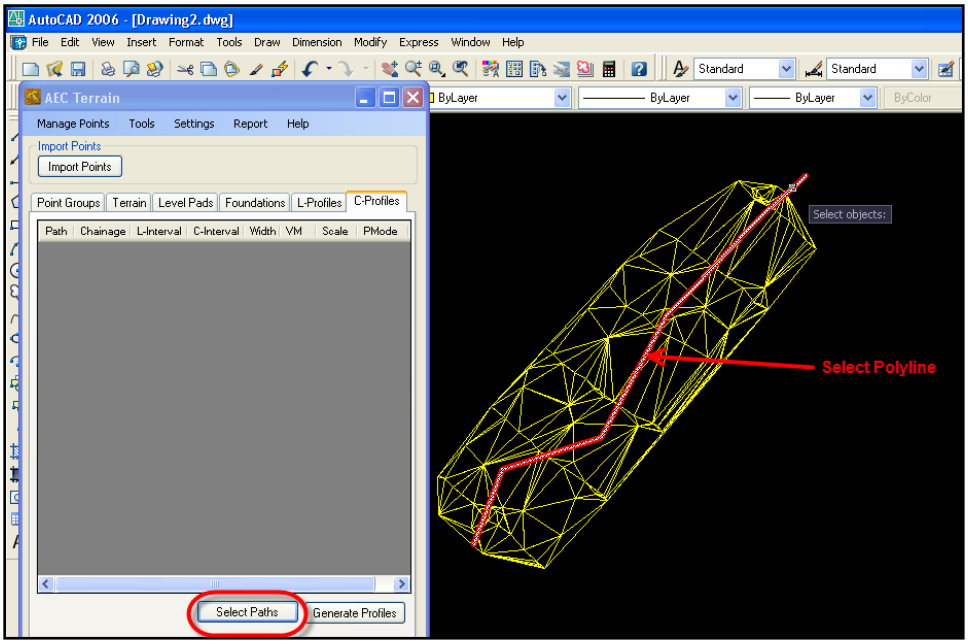
	A	B	C	D	E
1	Profile 1				
2	Point	Northing	Easting	Level	Chainage
3	1	657949.1	164838.7	252.9038	0
4	2	657797.3	164569.6	252.8442	1
5	3	657798.2	164570	252.7846	2
6	4	657799.2	164570.4	252.7253	3
7	5	657800.1	164570.7	252.6761	4
8	6	657801	164571.1	252.6356	5
9	7	657802	164571.5	252.6472	6
10	8	657802.9	164571.9	252.6587	7

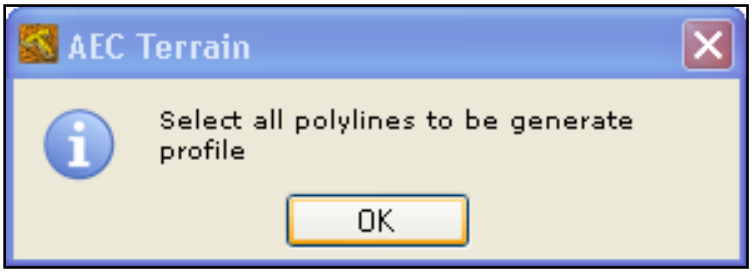
11	Profile 2				
12	Point	Northing	Easting	Level	Chainage
13	1	657926.3	164838	250.008	0
14	2	657926.3	164839	250.008	1
15	3	657926.3	164840	250.008	2
16	4	657926.3	164841	250.008	3
17	5	657926.3	164842	250.008	4
18	6	657926.3	164843	250.008	5
19	Profile 3				
20	Point	Northing	Easting	Level	Chainage
21	1	657899.9	164838.1	252.1975	0
22	2	657899.9	164862.3	252.1975	24.279
23	3	657828.9	164606	254.0004	58.649
24	4	657849.9	164619.3	254	83.478
25	5	657837.8	164674.3	249.779	139.874

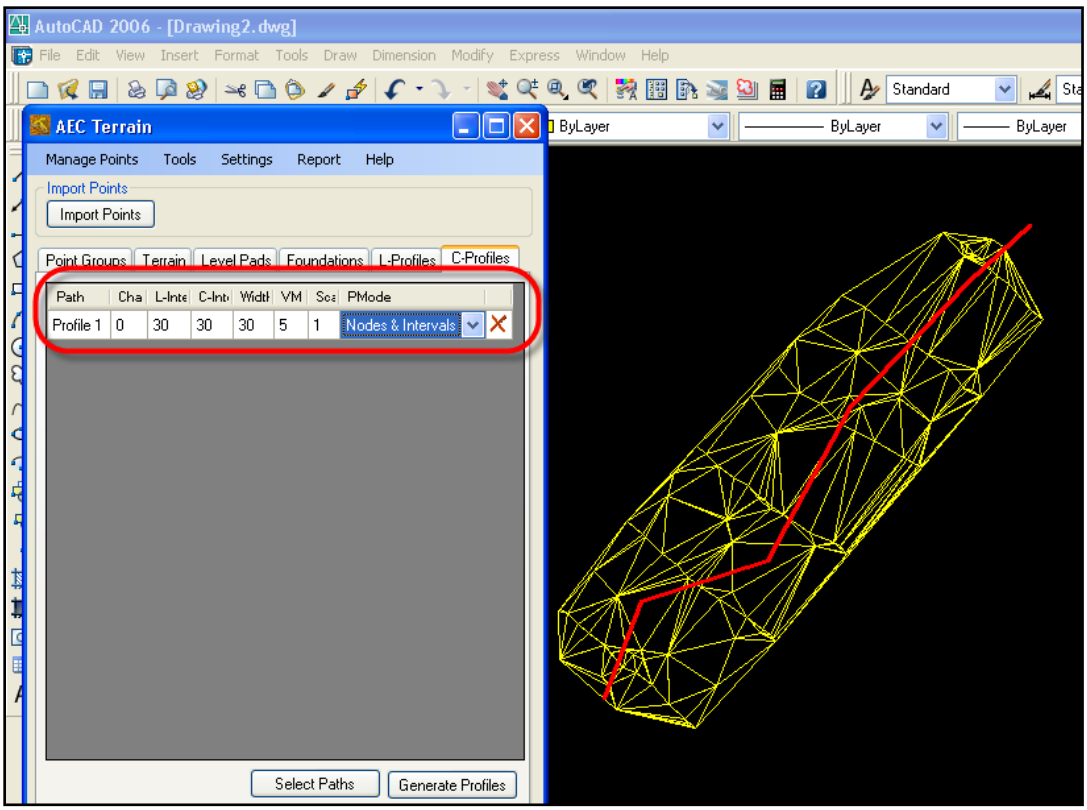
9.2.5 C-Profiles Generation

103. Draw a polyline path that you propose to generate cross profiles.
104. Select path line **shown in red color below** (Selected Line should be a Polyline)

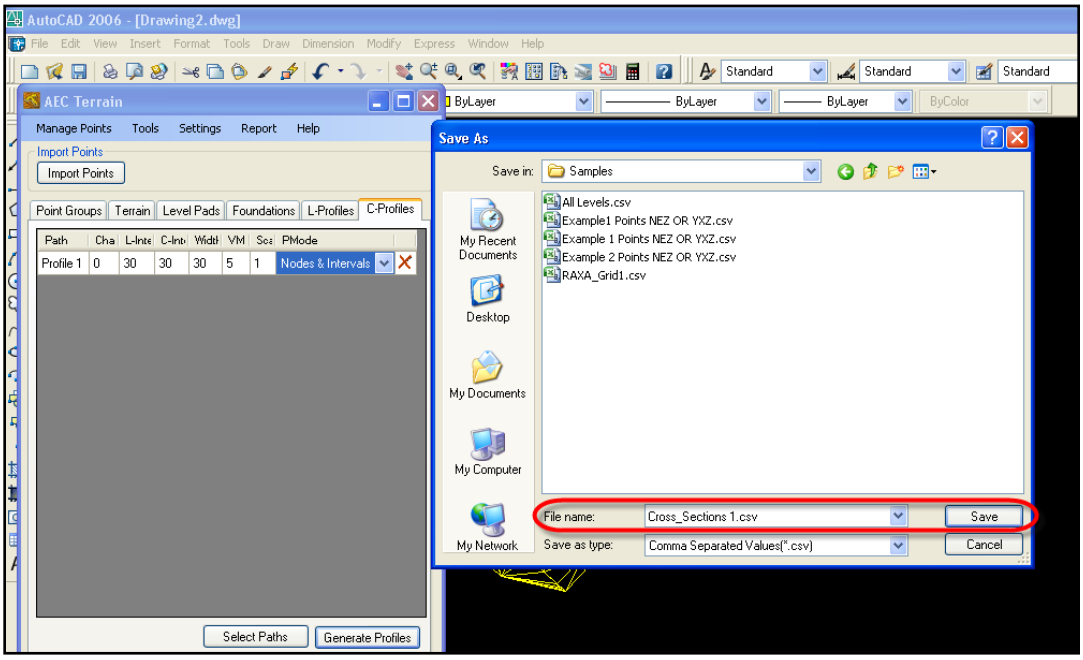

AutoCAD 2006 - [Drawing2.dwg]
AEC Terrain
Manage Points
Tools
Settings
Report
Help
Import Points
Point Groups
Terrain
Level Pads
Foundations
L-Profile
C-Profiles
Path
Chainage
L-Interval
C-Interval
Width
VM
Scale
PMode
Select Paths
Generate Profiles
Draw Polyline


AutoCAD 2006 - [Drawing2.dwg]
AEC Terrain
Manage Points
Tools
Settings
Report
Help
Import Points
Point Groups
Terrain
Level Pads
Foundations
L-Profiles
C-Profiles
Path
Chainage
L-Interval
C-Interval
Width
VM
Scale
PMode
Select Paths
Generate Profiles
Select objects:
Select Polyline


AEC Terrain
Select all polylines to be generate profile
OK

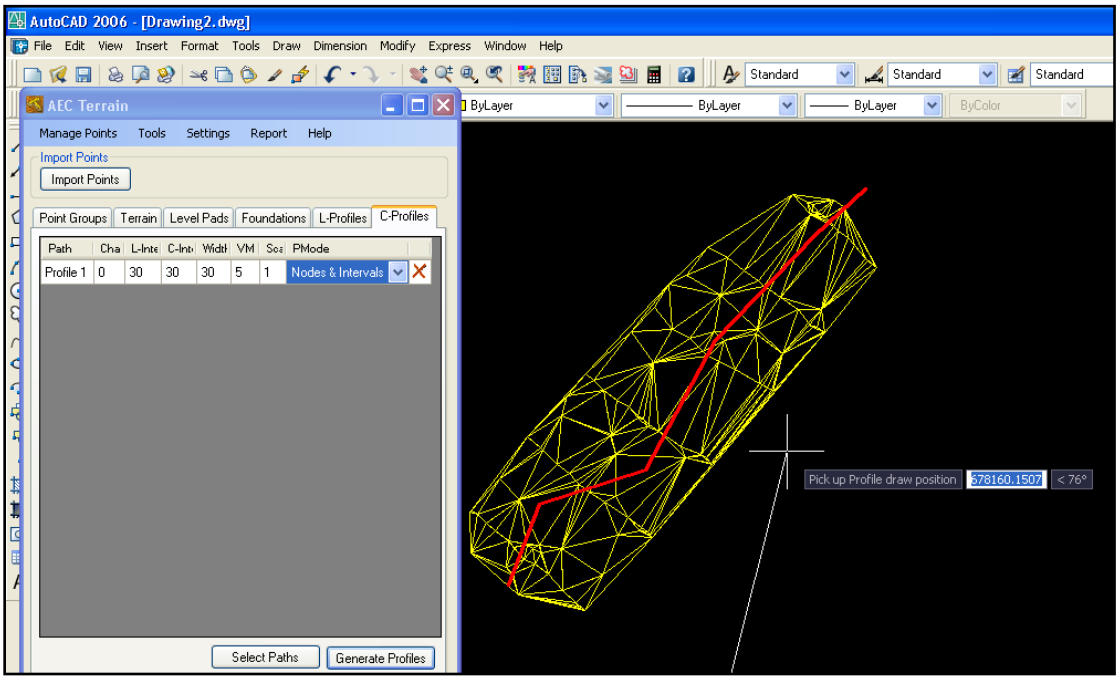


105. Save the Output Cross section file at desired project folder location. The file contains the coordinates of all the generated from the terrain.

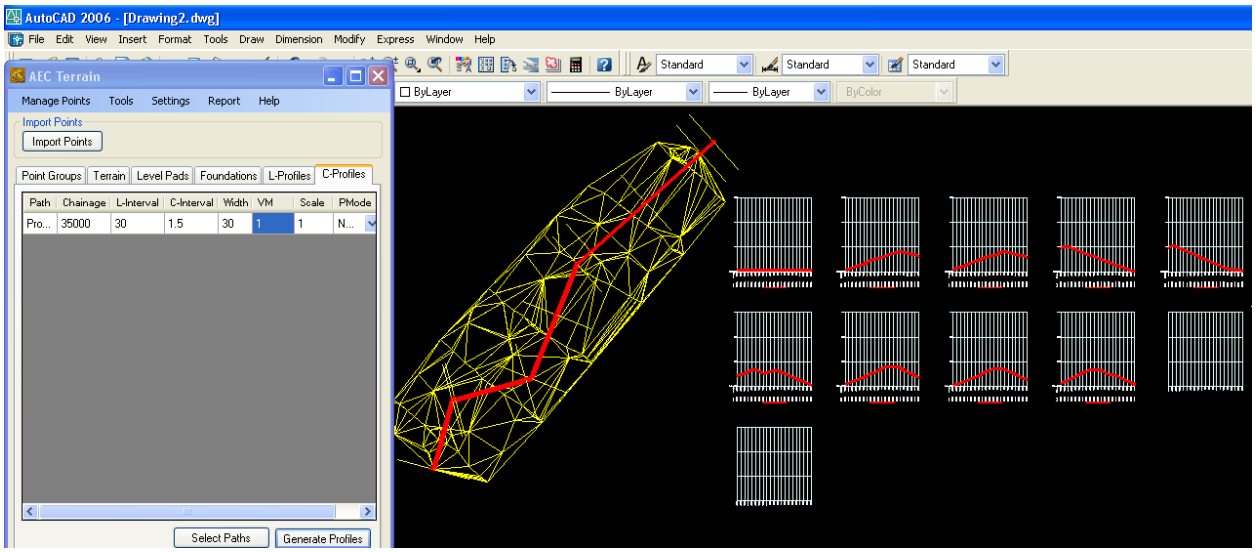


106. Program Prompts draw position on the AutoCAD screen

107. Pick up a position on the AutoCAD editor (when program prompts) to place the cross sections so generated



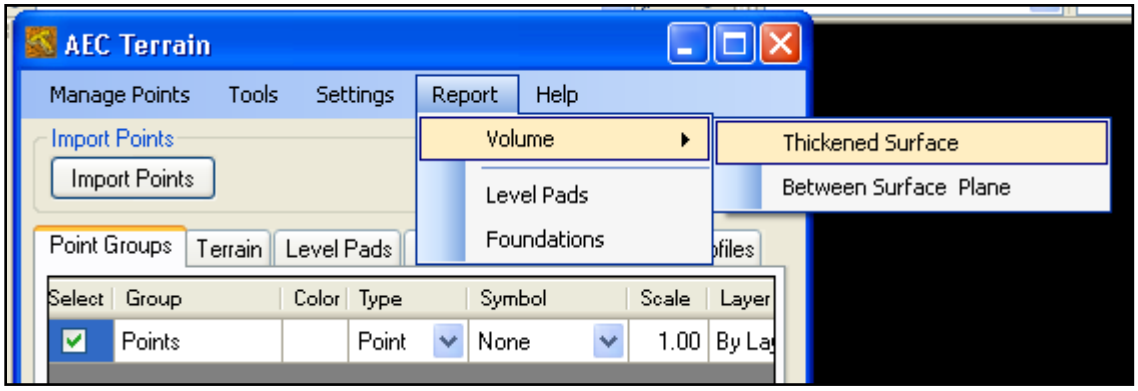
108. Cross sections are generated for the chosen path

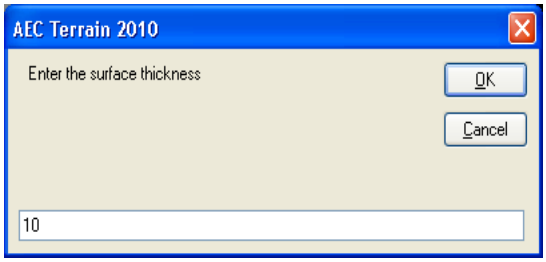


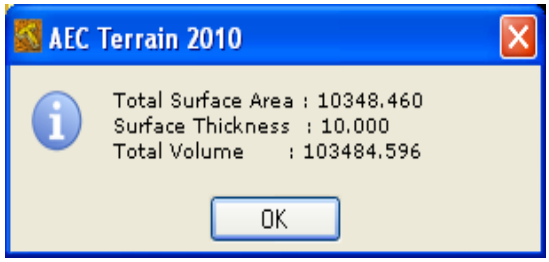
10 Reports

10.1 Volume of Thickened Surface

109. Let us take some example of an area with a point file with us and import them in to the AutoCAD, draw the TIN surface as shown below. The Thickened surface volume for 10 meter height is shown as under.

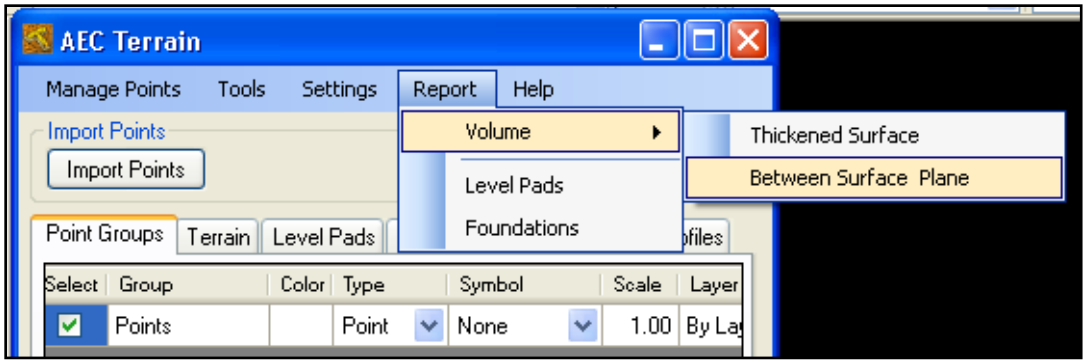


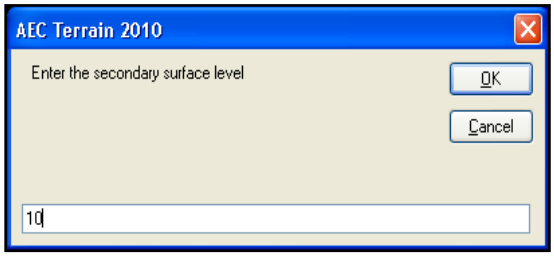


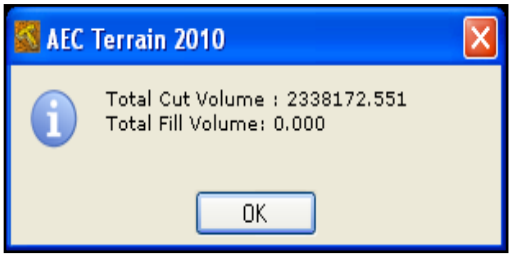


10.2 Volume between Surface & Plane

110. Volume between the surface and a plane is calculated by the program and the example values are shown below for the above said surface.

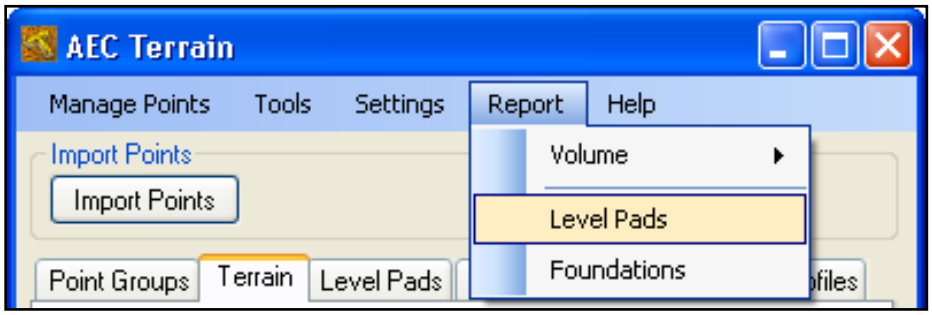


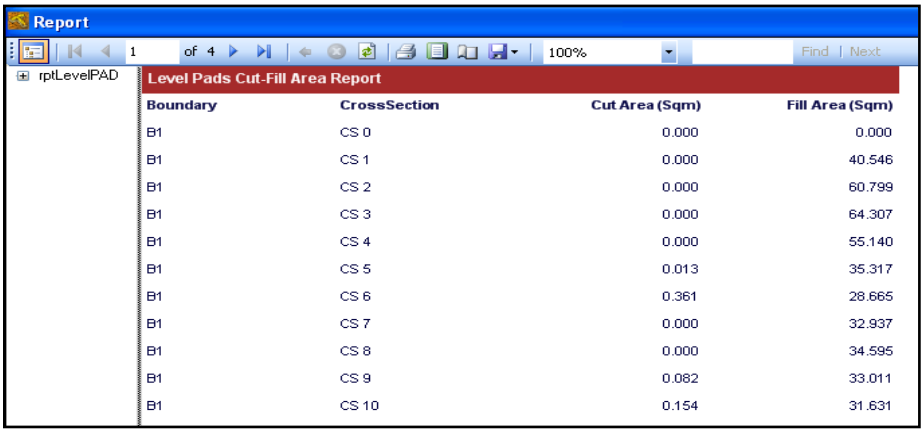




10.3 Level Pads Cut Fill Area:

111. Cut fill area Report for the Level pad shown below.

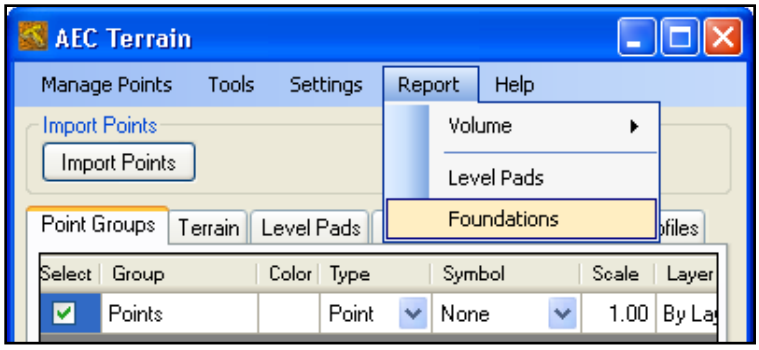


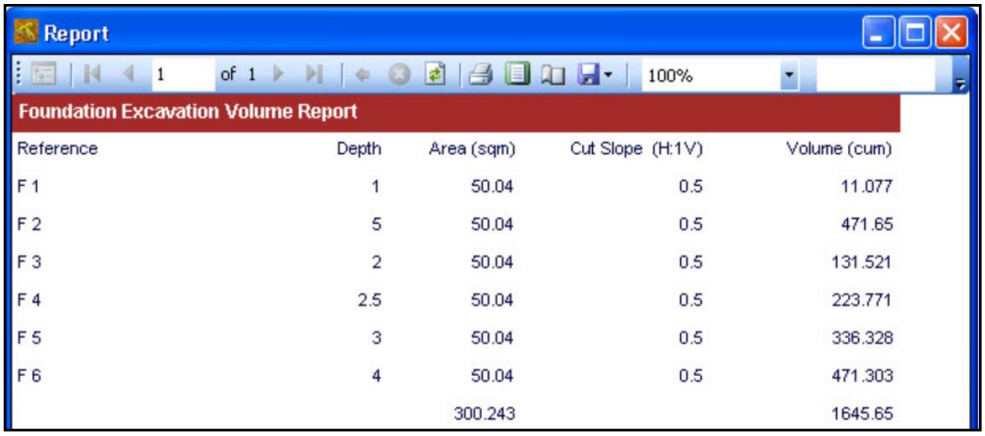


Boundary	CrossSection	Cut Area (Sqm)	Fill Area (Sqm)
B1	CS 0	0.000	0.000
B1	CS 1	0.000	40.546
B1	CS 2	0.000	60.799
B1	CS 3	0.000	64.307
B1	CS 4	0.000	55.140
B1	CS 5	0.013	35.317
B1	CS 6	0.361	28.665
B1	CS 7	0.000	32.937
B1	CS 8	0.000	34.595
B1	CS 9	0.082	33.011
B1	CS 10	0.154	31.631

10.4 Foundation Cut Fill Volumes

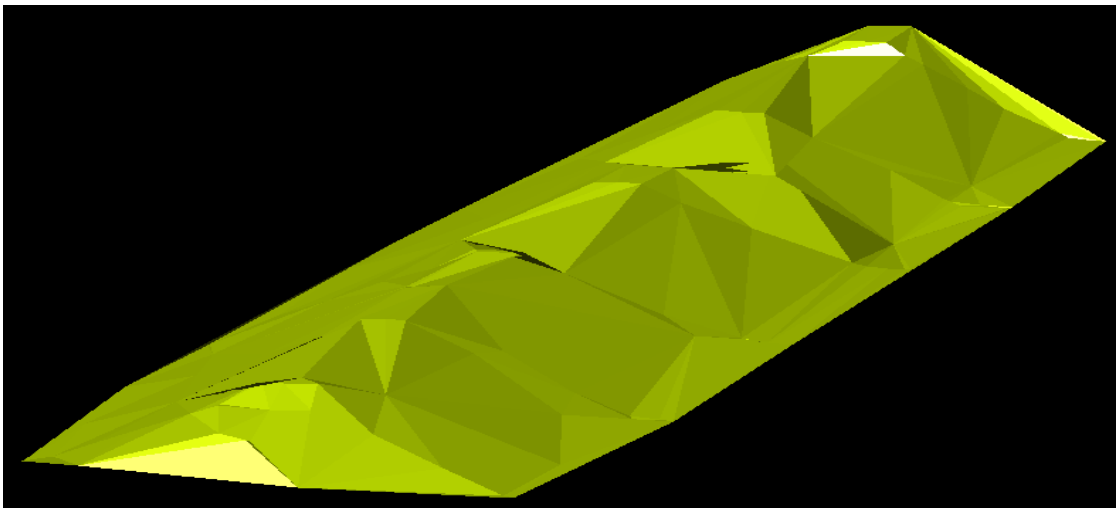
112. Volume Report for the Foundations shown below.

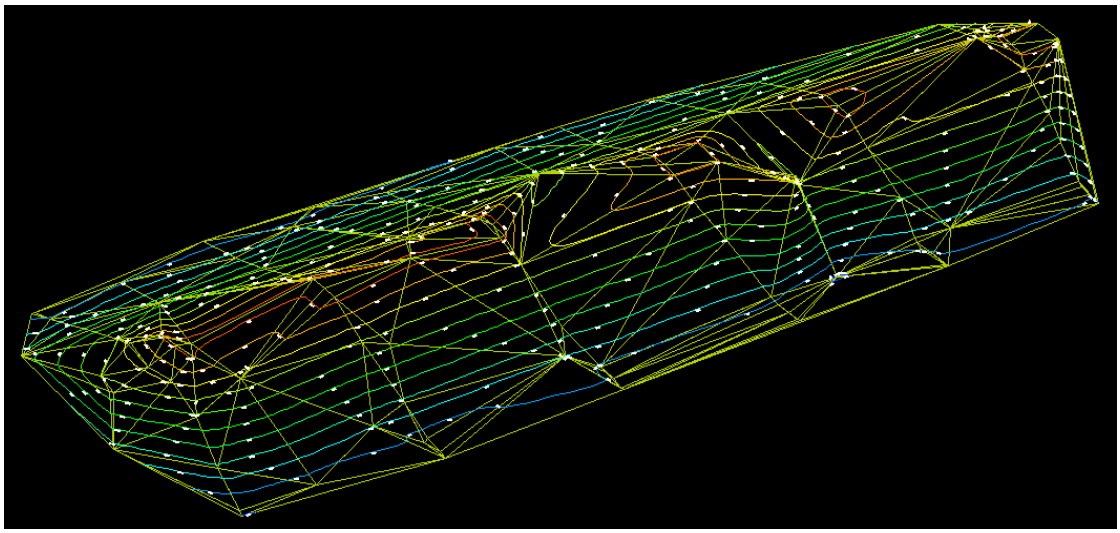


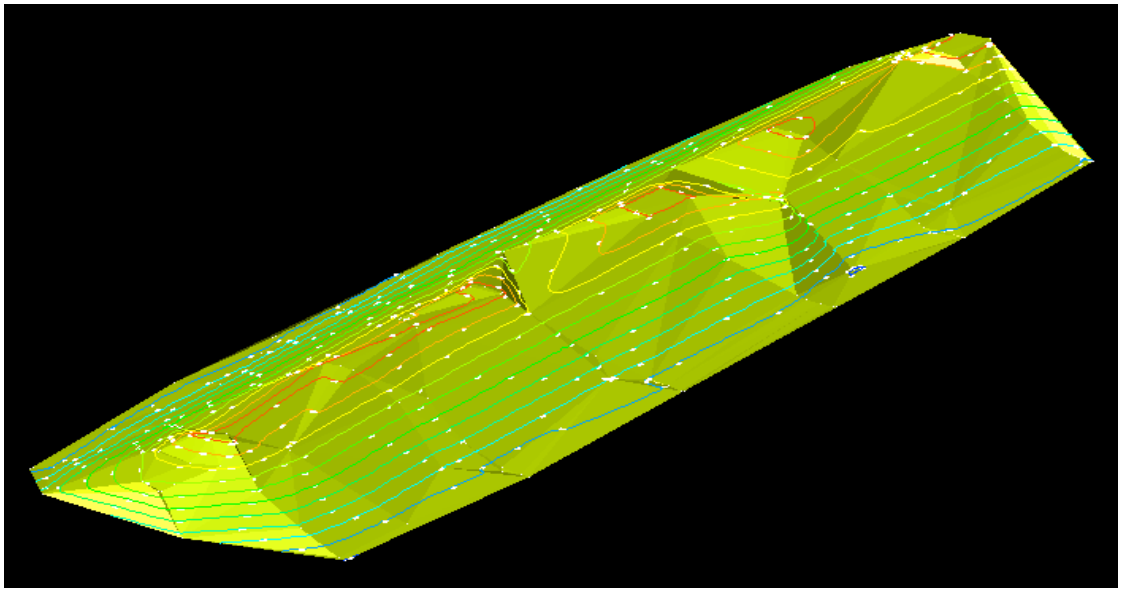


11 3D View of Components

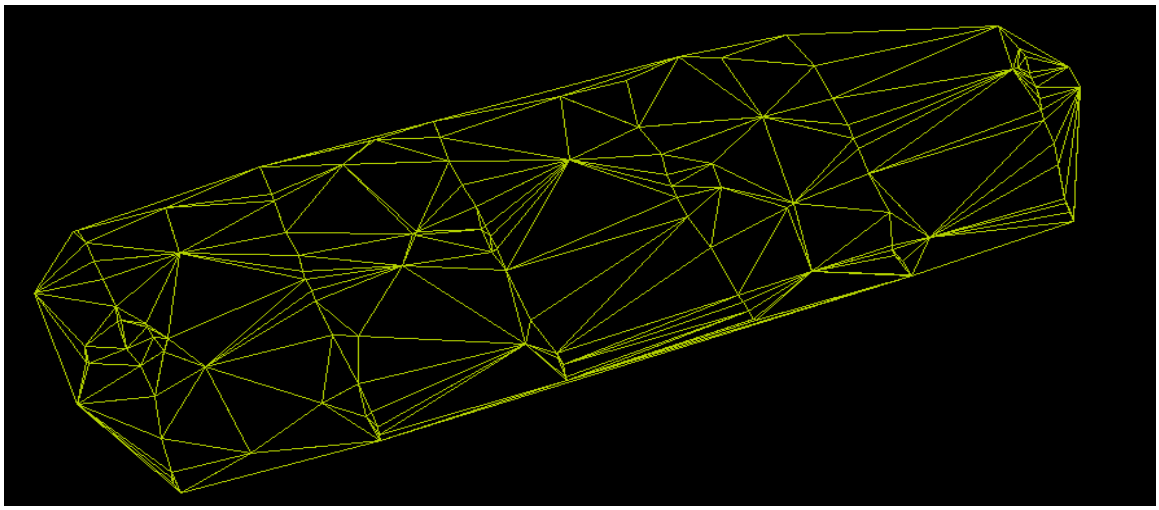
11.1 3D-modeling/ Digital Elevation Mode:



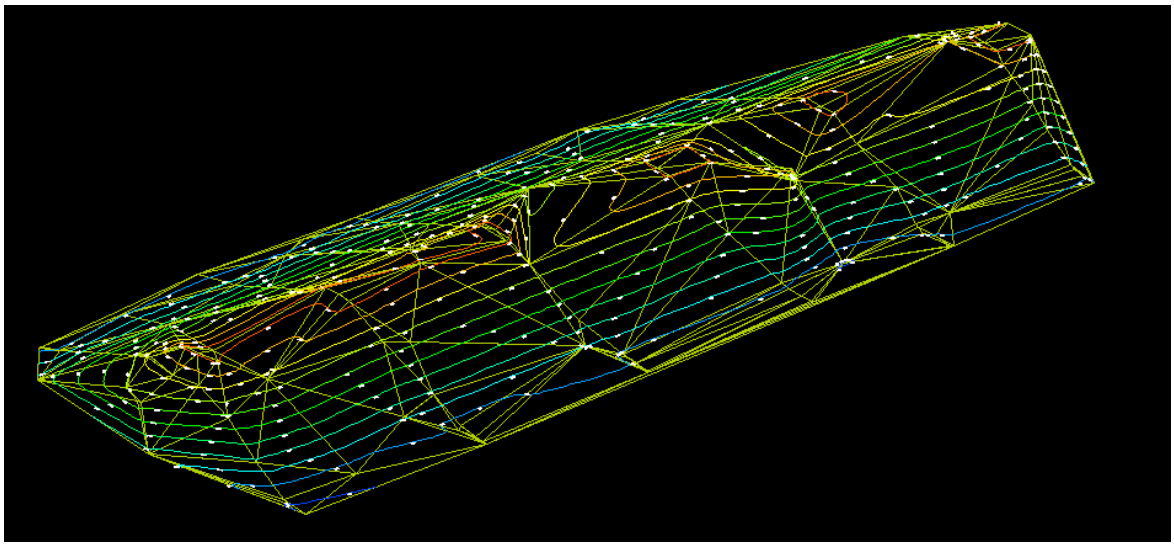




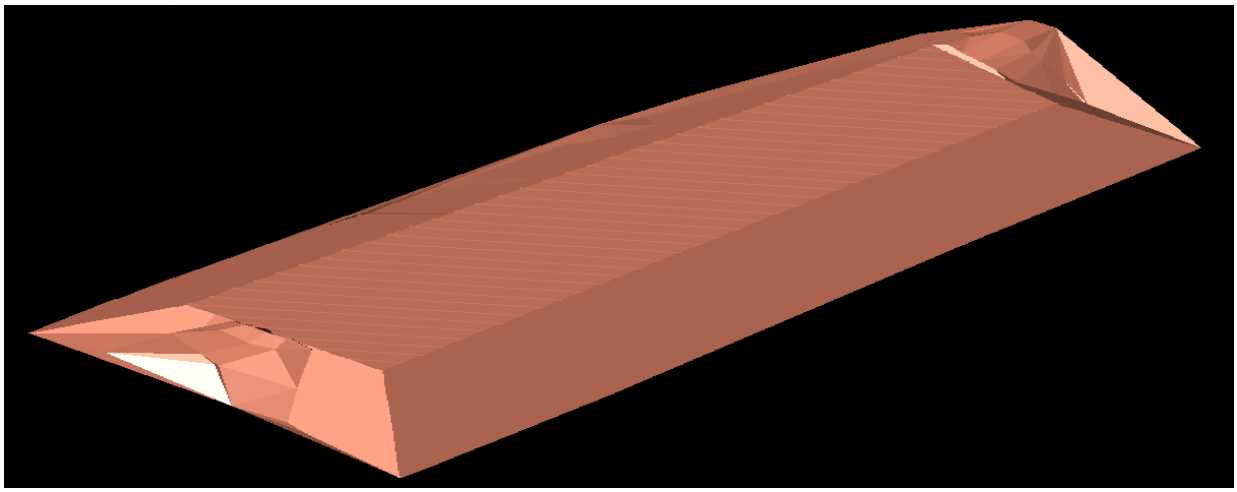
11.2 Triangular Irregular Network (TIN):



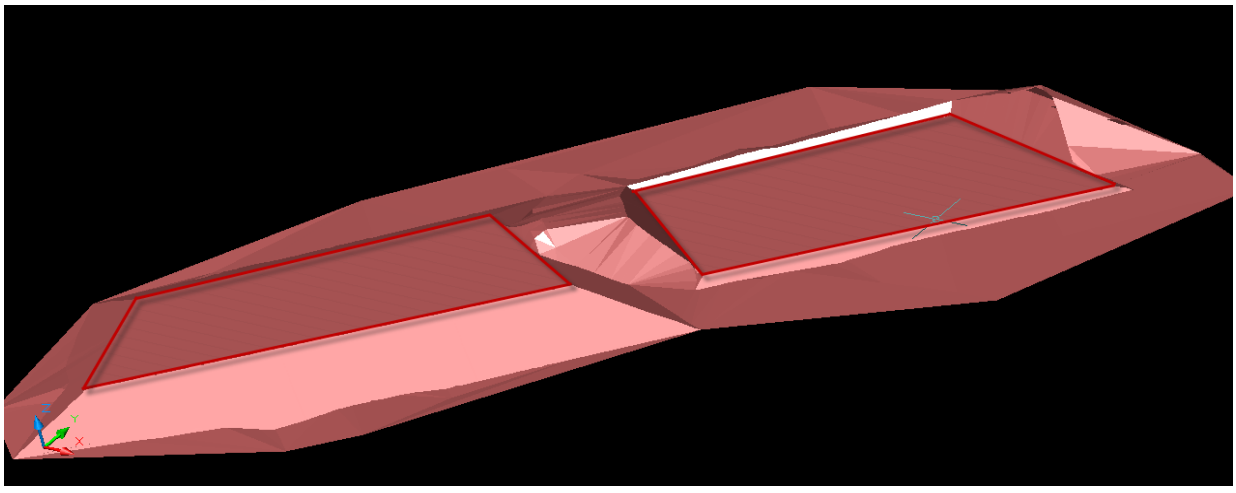
11.3 Contours



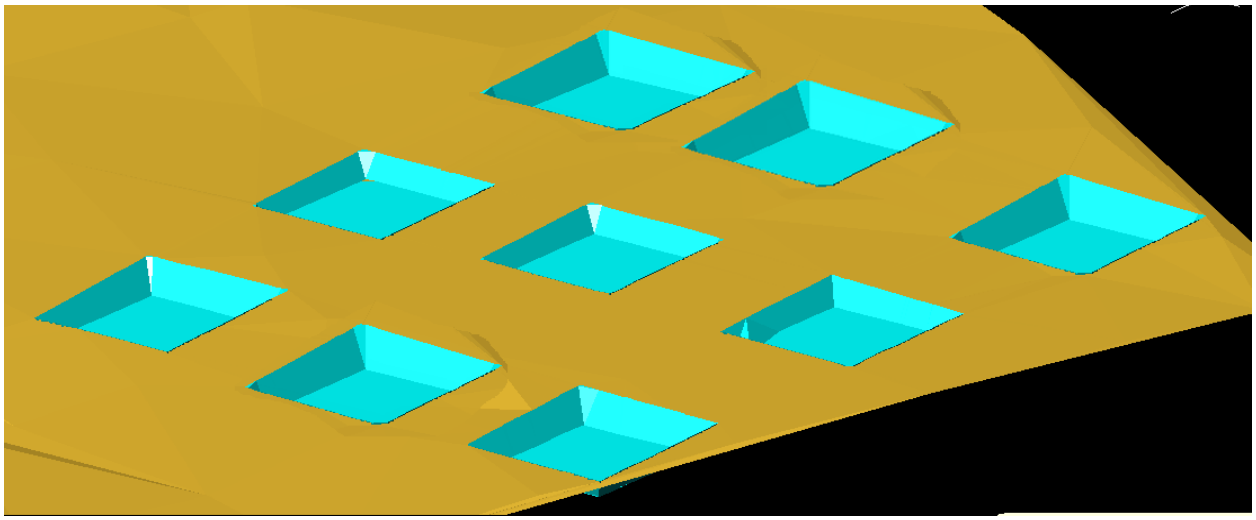
11.4 Level pads



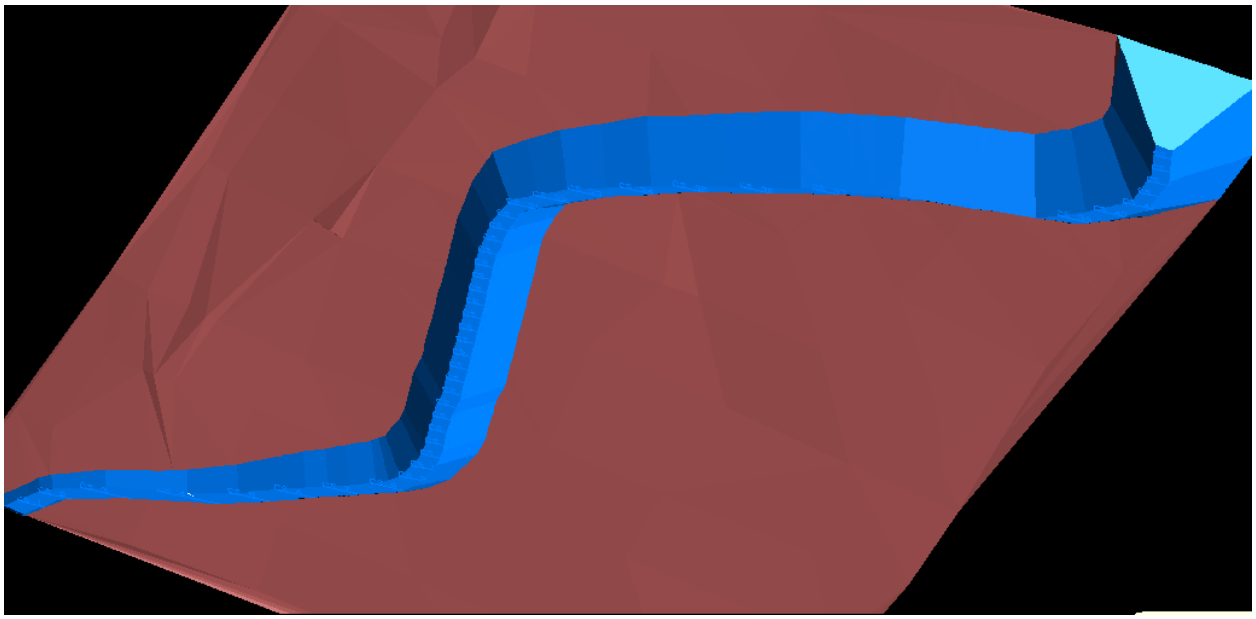
11.5 Multi-level pads:



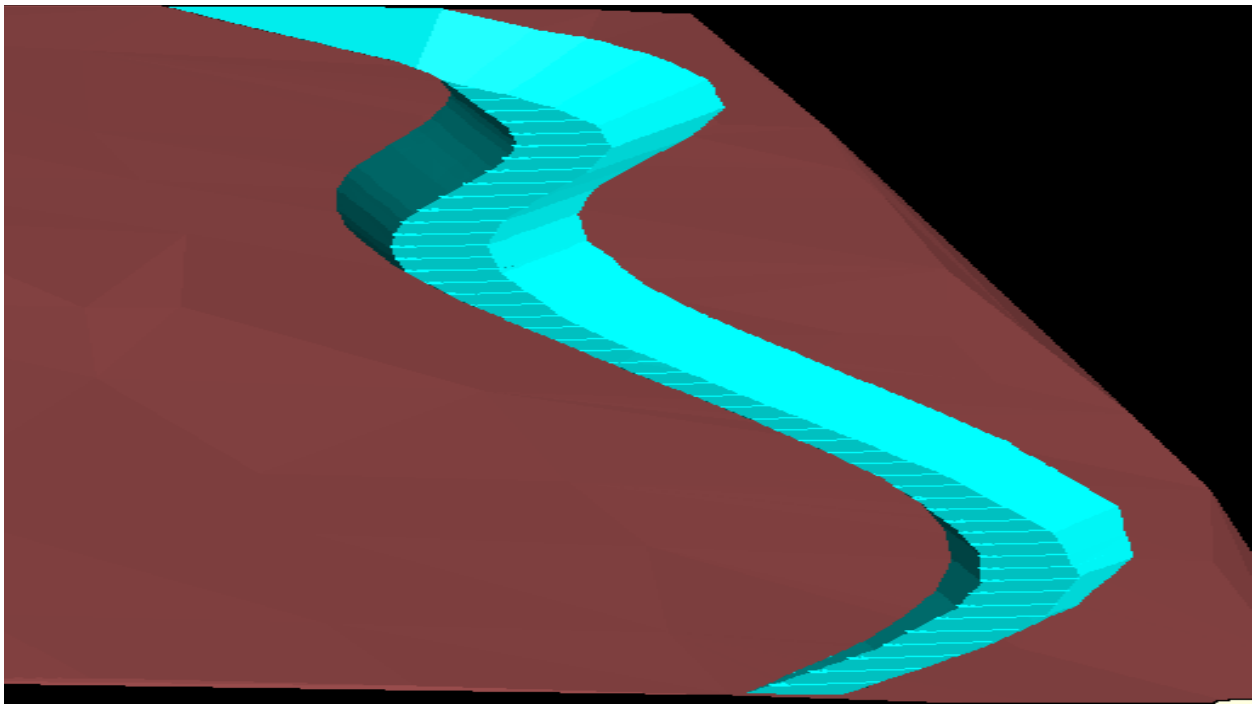
11.6 Foundation excavations



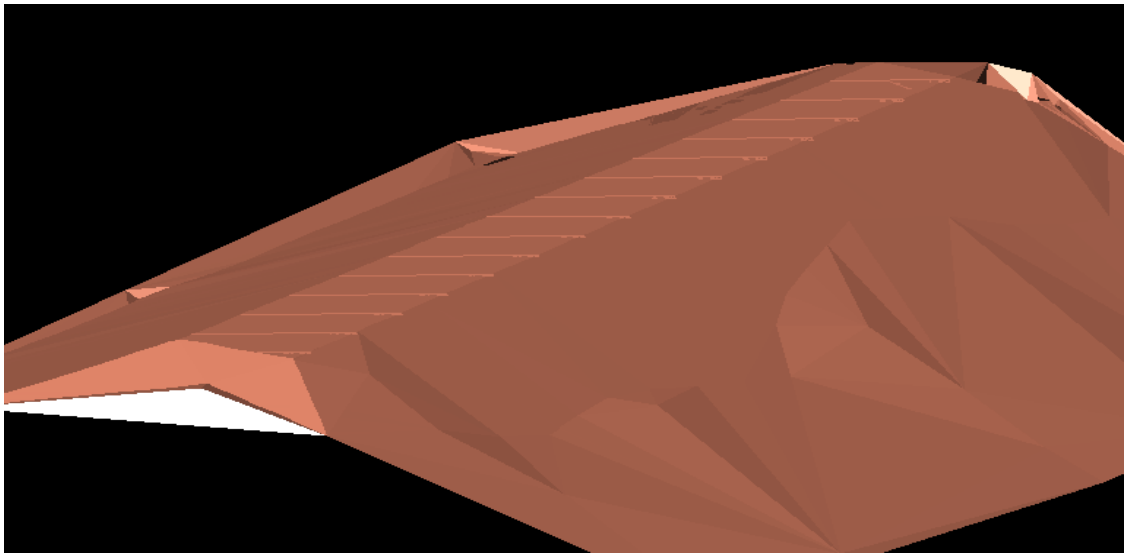
11.7 Drains



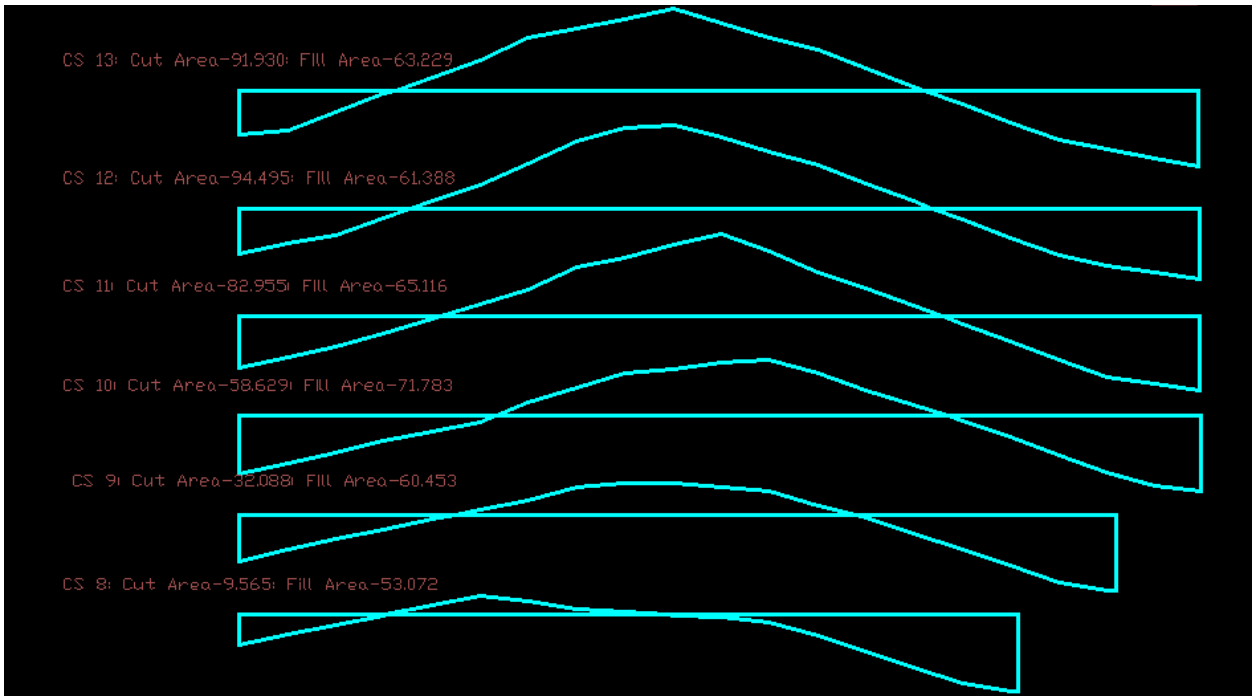
11.8 Canals



11.9 Earthen dams, Embankment

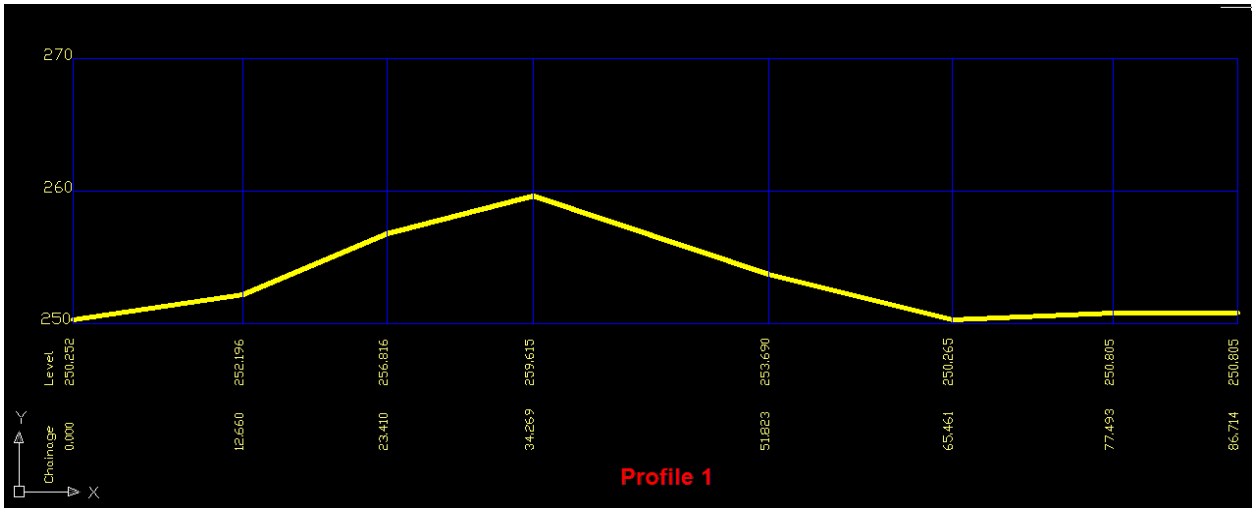


11.10 Level Pad/Area Grading Sections

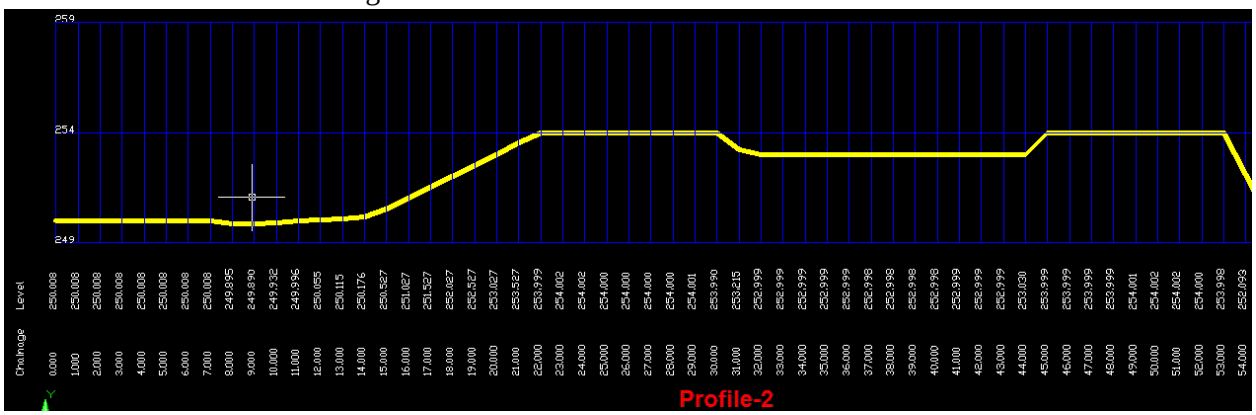


11.11 Profiles

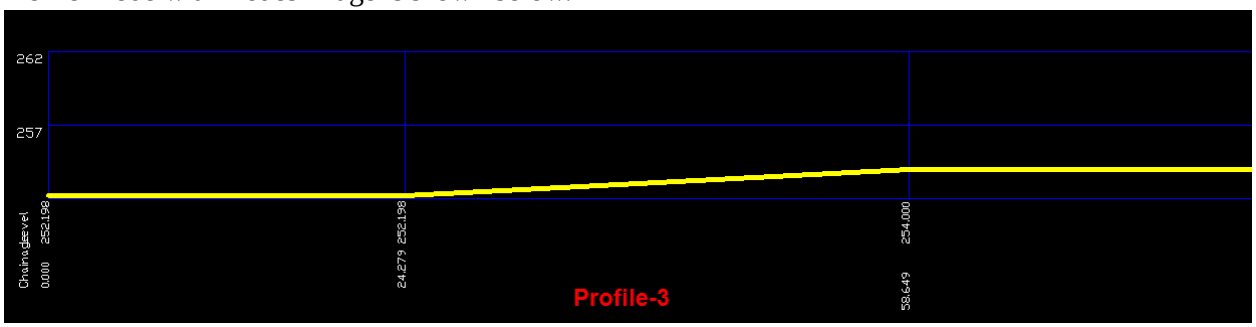
Profile Mode with both the combination of Nodes & Interval image is shown below.



Profile Mode with Interval image is shown below.



Profile Mode with Nodes image is shown below.



11.12 Cross Section/Cross Profile: