

10. General Concepts

The **Data Acquisition** toolset provides user-friendly functions that compile disparate data sources employed in the civil design process. The primary goal of the Data Acquisitions toolset is the creation of an existing surface DTM. The tools are available for users of the following civil products: MX, InRoads, GEOPAK, PowerSurvey, and PowerCivil for North America.

All Data Acquisition data is stored in the active DGN Model and can be exported to various file formats as required.

Recommendations for Usage:

1. It is strongly recommended that all Data Acquisition usage occur in the DAseed.dgn Model. Some tools require the 3D Model to operate as expected.

Data Acquisition compiles information from the following sources:

Field Data Formats:

- Trimble Link (.job)
- Trimble DC (.dc)
- LandXML 1.2
- SMI V6 & V7 (.raw)
- ASCII

Digital Elevation Model Raster Files:

- DTED
- ERDAS IMG
- Spot Dimap
- USGS DEM
- USGS STDS
- GeoTiff

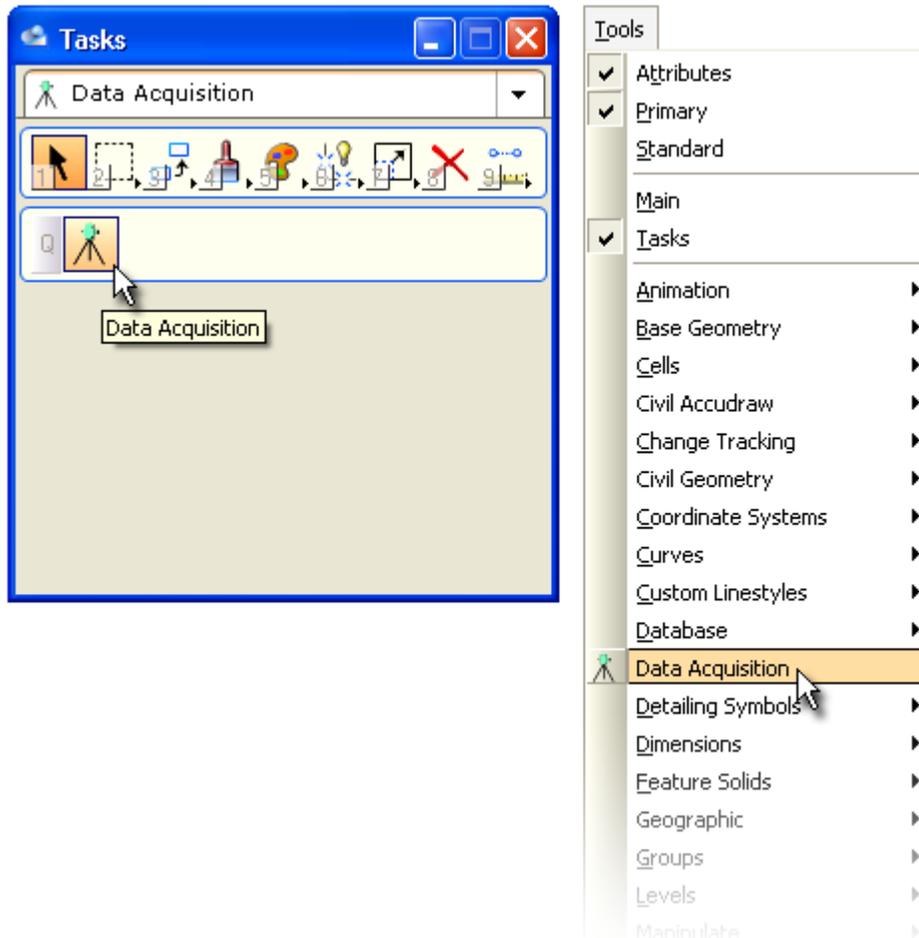
Terrain Model Formats:

- GEOPAK TIN
- LandXML 1.2
- LIDAR XYZ files
- LIDAR LAS files
- Microstation Point Cloud element (**Note:** This option is available with the V8i SELECTseries 2 products.)

Chapter 10 Data Acquisition

Interface

Data Acquisition tools are invoked from the Tasks navigation pane or from the Tools menu. The interface opens to a **Data Tree** and a **Details Panel**.



Note: The panels can be docked, docked and pinned, or remain floating per your preference.

Data Tree

The Data Tree organizes information into logical groupings for ease of selection and superior visibility.

- Right-click on tree elements (*branches*) to access related commands.

Details Panel

The Details Panel presents information associated with whichever item is currently selected in the Data Tree.

Drag and Drop Functionality

Files (of the formats listed above) can be imported by dragging from Windows Explorer and dropping into the Data Tree.

Create a New Field Book

To create a new field book, right-click on the *Field Books* branch of the Data Tree then click *New* on the menu.

Note: To change the name of a field book, select the field book in the Data Tree then open the *Element List* tab of the Details Panel. Select the field book name in the Name cell of the Details Panel, delete the existing text, enter the new name, and strike the Enter key. The new name will appear in both the Data Tree and the Name cell of the Details Panel Element List.

Note: If you drag and drop a file with an ambiguous file extension, you will be prompted to identify that file's format. Choose from the available options on the Data Format dialog and click Accept.

Data Acquisition uses three (3) types of Linear Feature: Dynamic Link, Point List, and Graphic. These linear feature types are hierarchical. A Dynamic Link type can be converted to a Point List or a Graphic type. A Point List type can be converted to a Graphic type.

Linear Features, automatically generated through the use of one of the Linking Methods (Field Code, Consecutive, or Non-Consecutive), are created as "Dynamic Link" linear features and have a property type of Generated By Linking. These linear features are constructed based on the combination of linking and/or field codes and the order in which field points are collected. If a linear feature is started, it will link all subsequent points with same field code until it encounters another start or an end depending on the Linking Method used.

Dynamic Link: Creation is described above. All points within these linear features are of the same field code and the linking of these points is in the order they were collected in the field. Starting, stopping, and changing of geometry of these linear features is controlled by a combination of linking and/or field codes. Editing consists of modifying linking and/or field codes or moving the location of the survey point features.

Point List: These linear features are generated by a list of points that can be of any field code. These have a property type of Generated By Point List. The order of the points in the linear feature is not dependant on the order they were collected in the field, but is solely dependent on the order they appear in the list.

Chapter 10 Data Acquisition

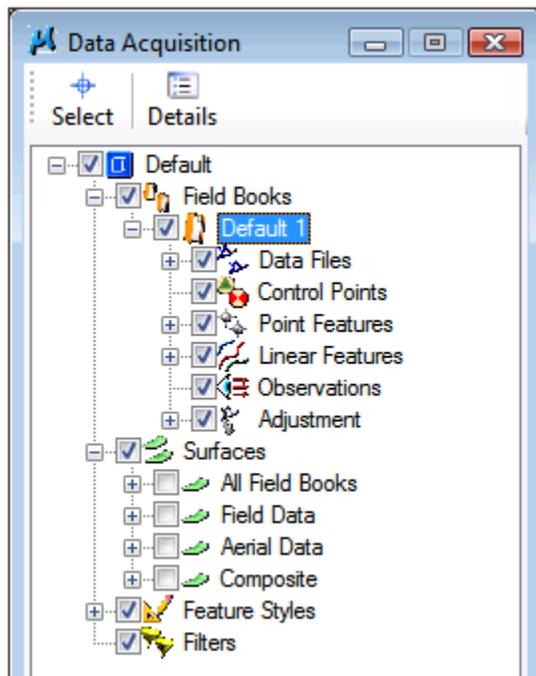
The Geometry of this type is still controlled by the link codes but not where the linear feature starts and ends. This is controlled by the point list. Editing consists of modifying linking and/or field codes or moving the location of the survey point features in addition to modifying or managing the order of the points in the list.

Graphic: A graphic linear feature can be any Microstation graphical element and is not tied to any survey point features. These have a property type of Graphic. Editing consists of using any Microstation edit tool. The symbolization of these linear features can be controlled by the assigned feature, but assigning a specific feature is an option – not a requirement.

Surface triangles created from the raw data files – The surface is generated automatically based on the surface settings of the imported point features and linear features.

Review and Edit Data

10.1 Data Tree



Top Row Buttons

- **Select** – Used to graphically select Data Acquisition point and linear features; selected feature properties are provided in the Details Panel.
- **Details** – Opens the Details Panel.

10.1.1 Default Branch

- I. **Default** – At the top of the tree is the name of the active DGN model. All data imported is stored in this model.

A. Survey Data Branches in the Data Tree

When populated with data, the Data Tree contains one or more branches. Each branch is accompanied by a checkbox that enables/disables the visualization of the branch and sub-branches.

- **Field Books** – expands to show all of the field survey data loaded into the project – To create a new field book, right-click on the Field Books branch.
- **Data Files** – expands to show all of the raw survey data files currently loaded into the project – Each data file expands to show setups and observations. See the **Survey Raw Data** section of the Workflow help topic for more information.
- **Control Points** – lists the control points that exist in the project
- **Point Features** – lists points loaded from survey raw data files – The Point Features branch expands to show a list of individual feature names.
- **Linear Features** – lists linear features loaded from survey raw data files – The Linear Features branch expands to show a list of individual feature names.
- **Observations** – shows all observations contained in the project
- **Adjustment** – check the Alignment box to apply **Least Squares Adjustment**. When active, the least squares adjustment properties are shown in the **Detail Panel**.

Point and Linear Features Expansion

By expanding the Point Features or Linear Features branch, you can view data by individual *feature style* definition.

- **Point Features** branch displays different feature types that have been assigned to points in the Field Book. When you select one of these sub-branches, the Details Panel presents only points that have been assigned to the selected feature definition.
- **Linear Features** branch can be similarly expanded and operates in much the same way.

B. Surfaces Branch

Expand the Surfaces branch to see all of the surfaces stored in the active DGN Model. The surfaces may come from a variety of sources.

The All Field Books branch, by default, is the surface built by triangulating all the data from all of the field books contained in the active DGN Model. It is created automatically anytime there is raw survey data contained in the Data Tree.

Chapter 10 Data Acquisition

Expand any surface in the tree to access more detailed information about the active DGN Model.

Composing Elements

- **Point Features** – lists the DA Field Book points that contribute to the surface
- **Linear Features** – lists the DA Field Book linear features that contribute to the surface
- **Composing Surfaces** – (*varies based on method of surface creation*) If this surface was created by merging/appending other surfaces, then this branch lists the surfaces that were used in the merge; if not, the branch lists no data.
- **Features** – provides access to symbology settings (by selecting the feature and editing the setting in the details panel) for each surface feature – Each branch is accompanied by a checkbox that controls the visibility of the branch and sub-branches; set the symbology for each type in the **Details Panel**.
- **Spots** – random surface points
- **Break lines** – break line elements
- **Triangles**
- **Holes** – a void in the surface whereby underlying surfaces can control the triangulation
- **Major Contours**
- **Minor Contours**
- **Boundaries** – the external boundary of the surface
- **Island** – a triangulated area inside of a hole
- **Void** – an area defined by a closed shape that demarcates a region of missing data or obscure areas – No point or break data located within the void area is utilized, and no triangles are created inside the void areas. The Void coordinates are included in the triangulation and void lines between successive void coordinates are inserted as drape lines on the surface. Therefore, they do not change the slope or elevations of the surface.
- **Break Void** – A Break Void utilizes the vertex elevations of the graphical element, while the void lines between successive void coordinates are inserted as break lines; therefore, break voids change the slope and elevations of the TIN surface.
- **Drape Void** – Drape Void elements are treated as strictly 2-dimensional and are inserted post-triangulation. The area within the Drape Void is an aperture through the surface over which the void is draped. The graphical element elevations (if they exist) are not included in the triangulation. The void vertices and lines are draped onto the surface. The addition of a Drape Void should not change the surface grading external to that void.
- **Drape Boundary** – an exterior surface boundary that determines its elevations by draping on the underlying surface

C. Feature Styles Branch

The Feature Styles branch, when expanded, is a read-only view of the currently accessed style file.

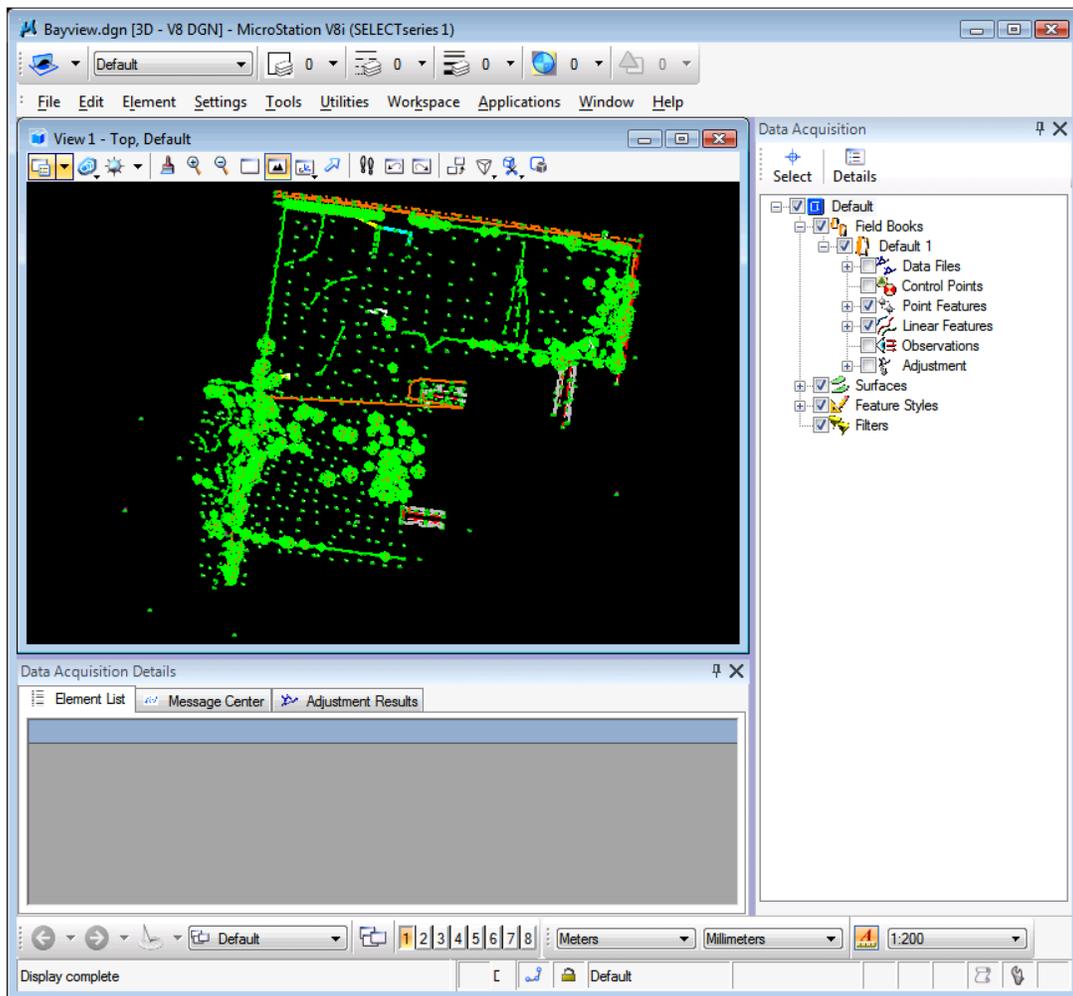
The style file is set within the Design File Settings (or, optionally, via a configuration variable) and can be either a GEOPAK SMD file (which must be first saved as a XML file), an InRoads XIN file (the survey features from within the XIN are used), or a MX PSS file.

Each feature corresponds to a survey field code. Drill down each feature style to see the currently used visualization settings for each code.

Note: Styles that display in RED text are styles that were used in the survey data but were not found in the specified SMD/XIN/PSS file. Add the missing features to the native style database and reattach the style file to your Data Acquisition seed file.

10.2 Details Panel

The Details Panel adjusts to show details for the selected branch in the **Data Tree**.

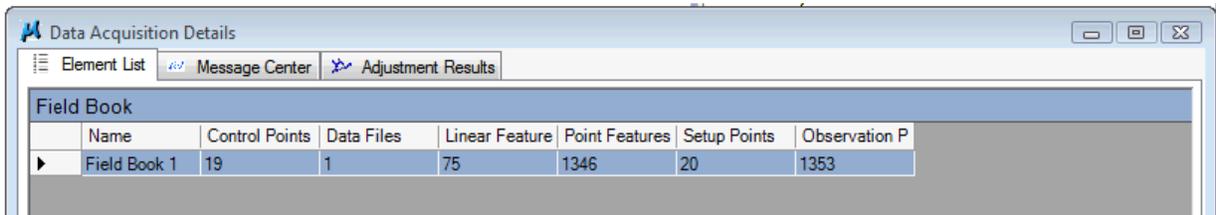


Chapter 10 Data Acquisition

10.2.1 Field Books

You can view/edit the information for the field books in the project. If an individual field book is selected, then only that book is shown.

Note: Only certain fields are editable based on the data type of the fields to maintain data integrity.



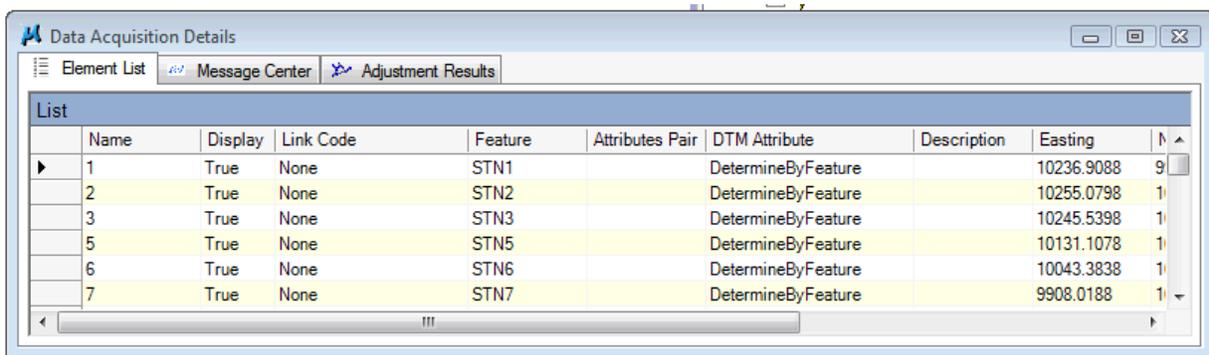
The screenshot shows the 'Data Acquisition Details' window with the 'Field Book' tab selected. The window has three tabs: 'Element List', 'Message Center', and 'Adjustment Results'. The 'Field Book' tab displays a table with the following data:

Name	Control Points	Data Files	Linear Feature	Point Features	Setup Points	Observation P
Field Book 1	19	1	75	1346	20	1353

10.2.2 Point Features

When the Point Features branch is selected in the Data Tree, the Display Panel lists all of the points in the project for review/edit.

Note: This is **point** information; if the **observation** raw data is desired, then you must select the Observations branch.



The screenshot shows the 'Data Acquisition Details' window with the 'List' tab selected. The window has three tabs: 'Element List', 'Message Center', and 'Adjustment Results'. The 'List' tab displays a table with the following data:

Name	Display	Link Code	Feature	Attributes Pair	DTM Attribute	Description	Easting	N
1	True	None	STN1		DetermineByFeature		10236.9088	9
2	True	None	STN2		DetermineByFeature		10255.0798	1
3	True	None	STN3		DetermineByFeature		10245.5398	1
5	True	None	STN5		DetermineByFeature		10131.1078	1
6	True	None	STN6		DetermineByFeature		10043.3838	1
7	True	None	STN7		DetermineByFeature		9908.0188	1

Expand the Point Features branch and select a single feature style to show only points of that type. For example, when the feature BLDS is selected, only points with feature BLDS are shown in the list as illustrated below.

10.2.3 Linear Features

When the Linear Features branch is selected in the Data Tree, the Display Panel shows all the Linear Features derived from the survey raw data for review/editing.

The screenshot shows the 'Data Acquisition Details' window with the 'List' tab selected. The table below represents the data shown in the list:

Name	Display	DTM Attribute	Feature	Attributes Pair	Description	Creation Type	VBA Macro	Length
EB01	True	DetermineByFeature	EB01			GeneratedByL		146.531
CLF02	True	DetermineByFeature	CLF02			GeneratedByL		351.078
EF03	True	DetermineByFeature	EF03			GeneratedByL		343.208
TOE04	True	DetermineByFeature	TOE04			GeneratedByL		42.0448
CULV05	True	DetermineByFeature	CULV05			GeneratedByL		8.9399
WALL06	True	DetermineByFeature	WALL06			GeneratedByL		2.1484

Expand the Linear Features Branch and select a specific feature style to list only the Linear Features of that type in the Details Panel.

10.2.4 Surfaces

When the Surfaces branch is selected in the Data Tree, the Display Panel shows information about the surfaces in the project for review/edit. Selecting a single surface branch shows details for that surface only.

The screenshot shows the 'Data Acquisition Details' window with the 'List' tab selected. The table below represents the data shown in the list:

Name	Dissolve Type	Side Length	Triangles	Breaklines	Major Contour	Minor Contour	High Range	Low Range
All Field Books	None	20	2508	60	5	1	10260.4681; 1	9818.623
Surface 2	None	20	0	0	20	5	0.0000; 0.000	0.0000; 0

Surfaces > Composing Elements > Point Features

When the Point Features branch is selected in the Data Tree, the Display Panel shows the points that contribute to the surface model for review/edit.

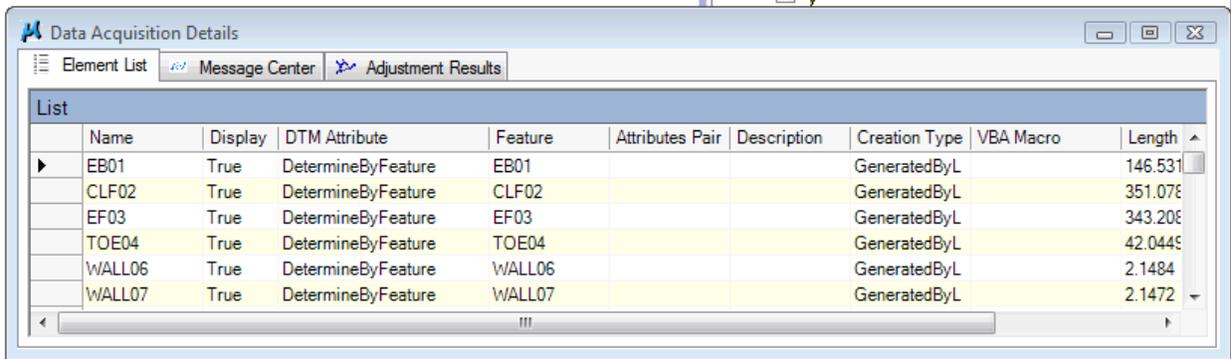
The screenshot shows the 'Data Acquisition Details' window with the 'List' tab selected. The table below represents the data shown in the list:

Name	Display	Link Code	Feature	Attributes Pair	DTM Attribute	Description	Easting	N
101	True	Start	EB01		DetermineByFeature		10260.4681	1
102	True	None	EB01		DetermineByFeature		10258.1932	1
103	True	None	EB01		DetermineByFeature		10253.9061	1
104	True	None	EB01		DetermineByFeature		10250.5673	1
105	True	None	EB01		DetermineByFeature		10246.9958	1
106	True	Start	CLF02		DetermineByFeature		10258.7636	1

Surfaces > Composing Elements > Linear Features

Chapter 10 Data Acquisition

When the Linear Features branch is selected in the Data Tree, the Display Panel shows the linear features that contribute to the surface model for review/edit.



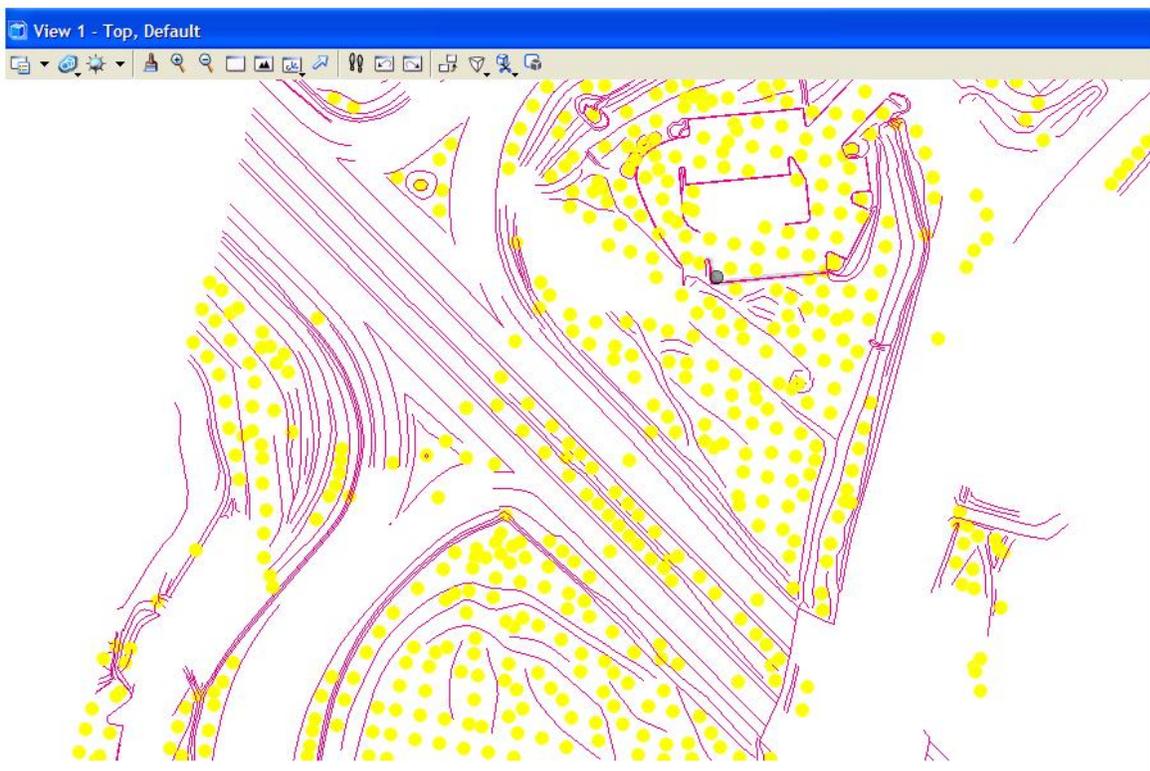
The screenshot shows a software window titled "Data Acquisition Details" with a tabbed interface. The "List" tab is active, displaying a table of linear features. The table has columns for Name, Display, DTM Attribute, Feature, Attributes Pair, Description, Creation Type, VBA Macro, and Length. The data is as follows:

Name	Display	DTM Attribute	Feature	Attributes Pair	Description	Creation Type	VBA Macro	Length
EB01	True	DetermineByFeature	EB01			GeneratedByL		146.531
CLF02	True	DetermineByFeature	CLF02			GeneratedByL		351.078
EF03	True	DetermineByFeature	EF03			GeneratedByL		343.208
TOE04	True	DetermineByFeature	TOE04			GeneratedByL		42.0449
WALL06	True	DetermineByFeature	WALL06			GeneratedByL		2.1484
WALL07	True	DetermineByFeature	WALL07			GeneratedByL		2.1472

10.3 Extract Graphics

10.3.1 Create Surfaces by Extract Graphics

3D graphic data may be supplied as a result of various processes. This image is an example of typical data resulting from a photogrammetric process.



To create a surface from 3D graphic elements:

- A. Create an empty surface by right-clicking the Surface branch in the Data Tree then choosing *Create Surface* from the menu and *Empty Surface* from the submenu.
- B. Expand the newly created surface's branch in the Data Tree.
- C. Use MicroStation's *Element Selection* functionality to select every instance of a particular graphic feature (spot or breakline or void etc.).
- D. In the Data Tree, expand the Features branch and right-click on the Surface Feature corresponding to the selected DGN 3D graphical data. For example, if you selected breaklines in the workspace, you would then right-click on Breaklines in the Data Tree. In the image above, the selected items were breaklines, so the right-click and import were performed on the Breaklines branch.
- E. On the pop-up, click Import Selection.
- F. Repeat the select and import process for all other Surface feature types you wish to import from the graphical data: Spots, Triangles, Holes, Boundaries, etc. Each type of feature must be imported separately.

Note: *If you wish to employ graphic information stored in a DGN file other than the DGN file that contains your Data Acquisition project, then you must attach the source file of your graphics as a reference (File > Reference > Attach References). There is no provision in this version to extract 2D graphics with text indicators of the elevation.*

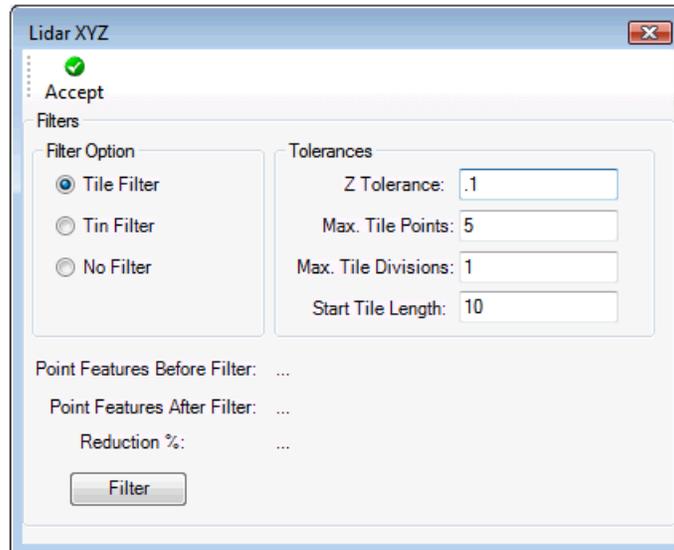
10.3.2 Creating Surfaces from LIDAR

Surfaces can be created from both LIDAR XYZ and LAS files through separate, though similar, processes.

- **LIDAR XYZ** – LIDAR data that has been processed from the raw binary files into a points file containing only a single surface, usually the existing ground surface
- **LIDAR LAS** – the binary file that usually contains point data with multiple classifications

A. Create a New Surface from LIDAR XYZ

1. In the Data Tree, right-click on the **Surfaces** branch then select **Create Surface** from the menu
2. Choose **Import External Surface** from the menu and **Import LiDAR XYZ** from the submenu.
3. Navigate to the desired file then double-click it.
4. Set the desired filtering options and appropriate filtering tolerances then click Accept.



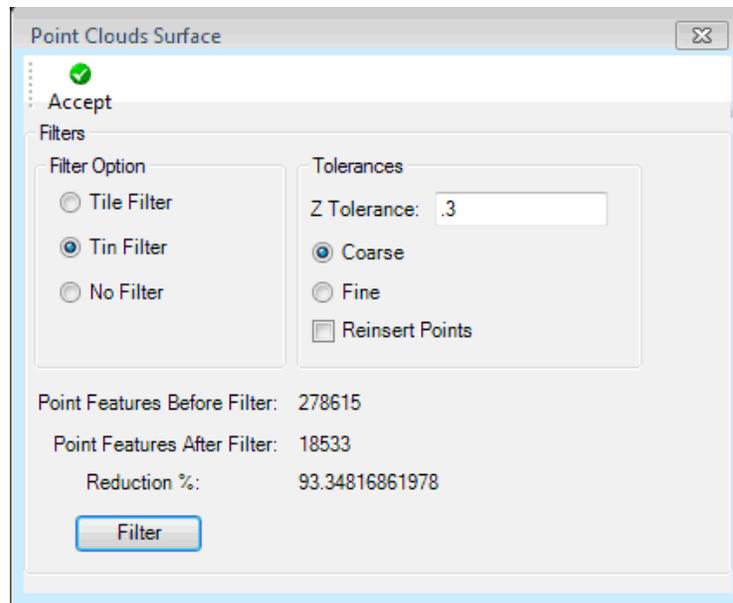
Filter Options:

- **Tile Filter** – The tiling algorithm is a recursive divide and conquer algorithm that divides the LIDAR data set into tiles. A best fit plane is calculated for each tile, and LIDAR points are removed if they fall within the user set Z tolerance to the plane.
- **TIN Filter** – The TIN algorithm filters LIDAR points if they fall within the user set Z tolerance of the triangle planes. The TIN algorithm first tiles the LIDAR points into tiles with a maximum of 2 million points and then repetitively triangulates each tile filtering out points.
- **No Filter** – No filtering is applied

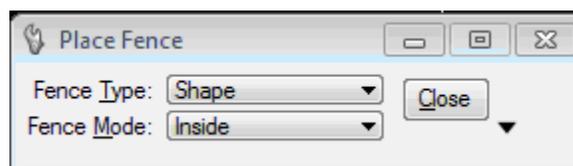
Filter button – generates a report showing the amount of reduction in the number of point features before data is imported as a surface

B. Create a New Surface from LIDAR LAS File

1. In the **Point Cloud Presentation** change the Style to **Classification** and turn all levels off except **Gound**.
2. In the Data Tree, right-click on the **Surfaces** branch then select **Create Surface** on the menu.
3. Choose **Import From Point Clouds**



5. Set the desired filtering options and appropriate filtering tolerances then click Accept.
 6. Click the Filter button to generate a report showing the amount of reduction in the number of point features before data is imported as a surface.
 7. Click the Accept bar to import the selected surface according to the specified parameters.
- C.** You can also do a selected area of a point cloud to create a tin model by using the Microstation **Place Fence** tool and using the **Shape** fence type to place an area that you would like and then run back through the **Create a New Surface from LIDAR LAS File** process again.



10.3.3 Surface Operations

When you right-click on a surface's branch in the Data Tree, a variety of operations may be performed on that surface.

1. **Delete**-Removes the surface from the project
2. **Create Graphics**-The surface features (triangles, contours, etc.) currently displayed are permanently written to the DGN.

Chapter 10 Data Acquisition

Note: The Surface Feature display toggles visualize the features as transient graphics. Closing Data Acquisition will cancel the visualization of these features.

- 3. Clip by Polygon**-The *Clip by Polygon* function trims a portion of the surface. Options are Internal and External:
 - *Clip Internal* removes everything within the shape.
 - *Clip External* removes elements outside of the shape.
- 4. Append/Merge External Surface**-Appends or merges an external surface into the currently selected surface without the need to first import this external file into a separate surface.

See the **Append/Merge** help for additional information on how appending and merging works.

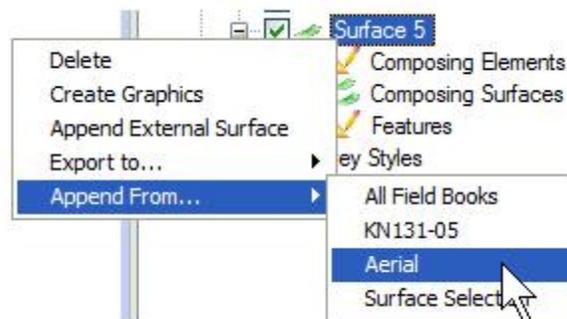
The external surface can be any of the supported surface types. See **Creating Surfaces** help page for a list. The external surface is read directly into the existing surface as either appended or merged as specified.

Merging or Appending Surfaces-Both the Merge and Append functions combine two surfaces into a single surface; the difference is that Merge is a destructive operation while Append is not.

Two Methods to Create a Merged/Appended Surface:

a. Merge/Append Internal Surfaces

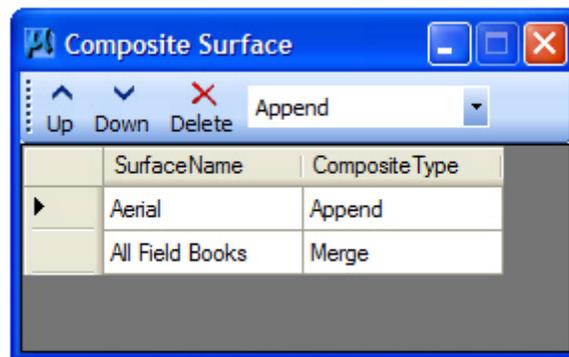
- 1) Create a new, empty surface to contain the merged/appended data:
- 2) Right-click on the Surfaces branch of the Data Tree and select Create Surface from the menu then choose Empty Surface from the submenu. This creates an empty surface with a default name.
- 3) Right-click on the new surface and choose ***Append From***.
- 4) Select the base surface. This is usually the largest surface or the one that acts as lowest level of information to be superseded or augmented by more detailed information.



5) Right-click again to merge or append additional surfaces.

- b. Merge/Append External Surfaces**-The process is identical to the internal surface process except that, instead of using surfaces already stored in the DGN, you must select external files with formats supported by Data Acquisition. The external surface can be any of the supported surface type. The external surface is either appended to or merged with the existing surface.

Changing Merge/Append Order-Surfaces are processed from the top of the surface list to the bottom. Each surface in the surface list is merged/appended to the result of the merge/append operations performed on the items above, thus there may be occasions where the order of surface merging needs to be adjusted. To do so:



1. Right-click on the surface name in the Data Tree and choose **Rearrange Surfaces** from the menu.
2. On the Composite Surface dialog:
 - a. Select a surface and click the Up arrow to raise the selected surface's position in the surface list.
 - b. Select a surface and click the Down arrow to lower that surface's position in the surface list.
 - c. Select a surface and click Delete to eliminate the surface.
 - d. Expand the drop-down and choose whether you wish the surfaces to be Appended or Merged.

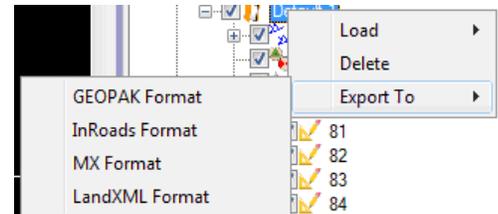
10.4 Exporting to COGO

When you have finished processing data, you may wish to export the point and linear features to a coordinate geometry database and continue the design process with the native product's design tools.

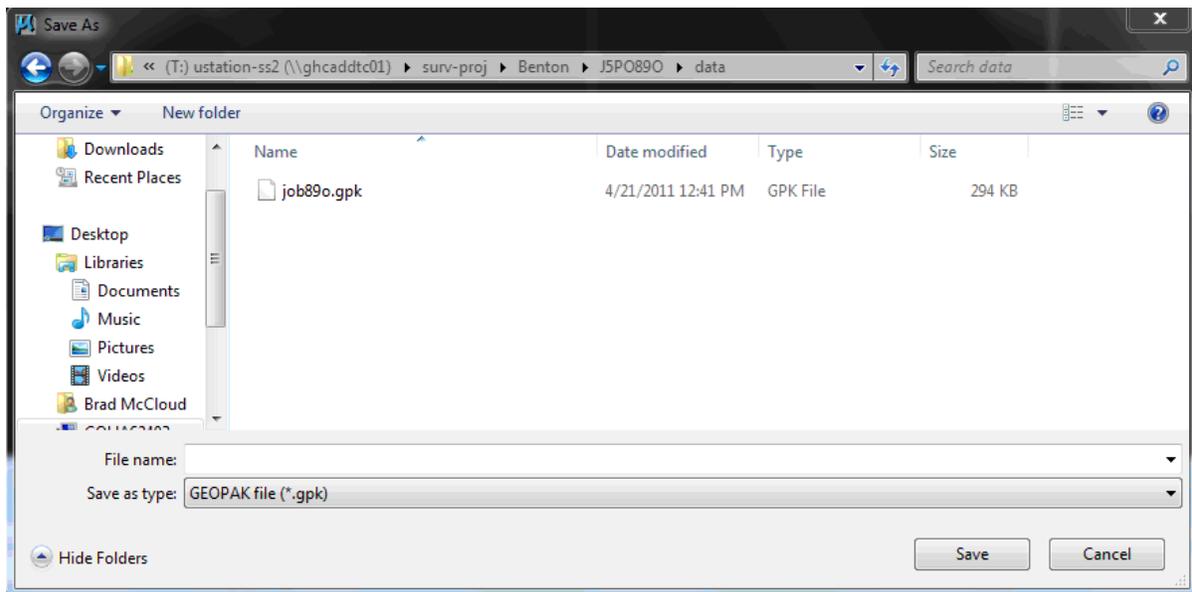
The points and lines can be exported to:

- GEOPAK cogo file (GPK)
- LandXML version 1.2

Export to COGO In the Data Tree, right-click on the desired field book, choose *Export To* from the menu and select the desired output format from the submenu.



This will open the **Save As** dialog box. Make sure it is browsed out to the right folder, name it and then hit save.



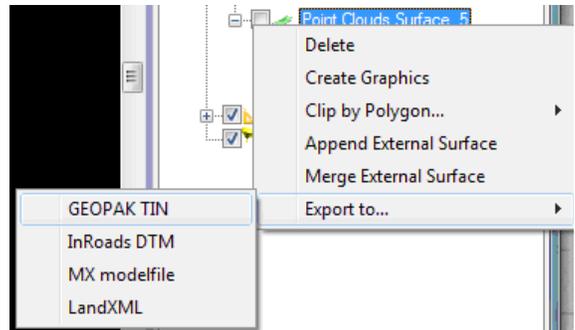
10.5 Exporting a Surface

When you have finished surface creation and editing, you may wish to export the Surface to one of Bentley's native surface formats OR to LandXML.

The Surfaces can be exported to:

- GEOPAK (TIN)
- LandXML version 1.2

Export a Data Acquisition Surface In the Data Tree, right-click on the desired surface, choose Export To from the menu and select the desired output format from the submenu.



This will open the **Save Document As** dialog. Make sure it is browsed out to the right folder, name it in the **Name** and **File Name** field and then hit save.

