

NORTH CAROLINA Department of Transportation

Location & Surveys DTM Manual

JUNE, 2002

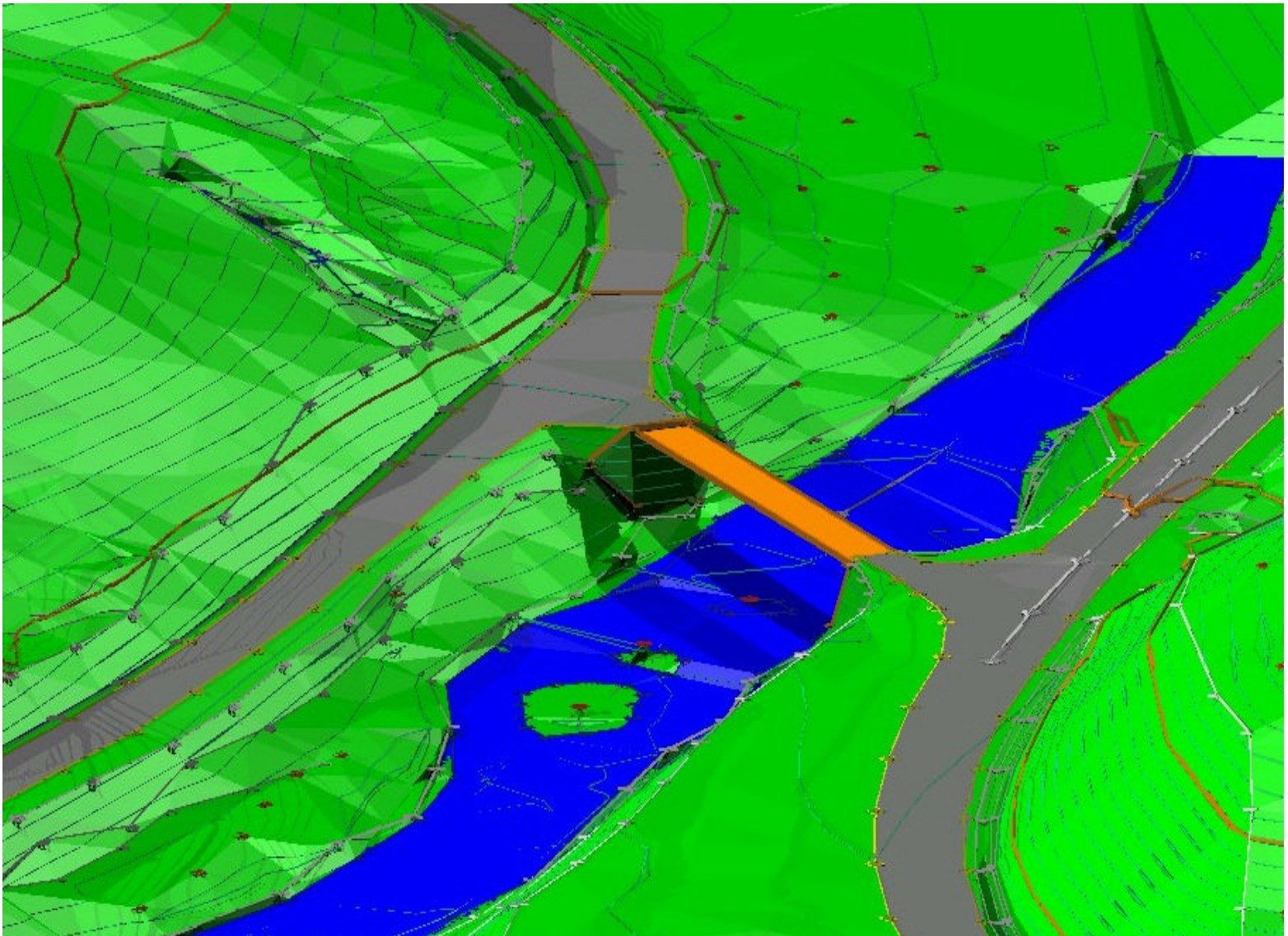


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PRODUCT SUPPORT

VERSION

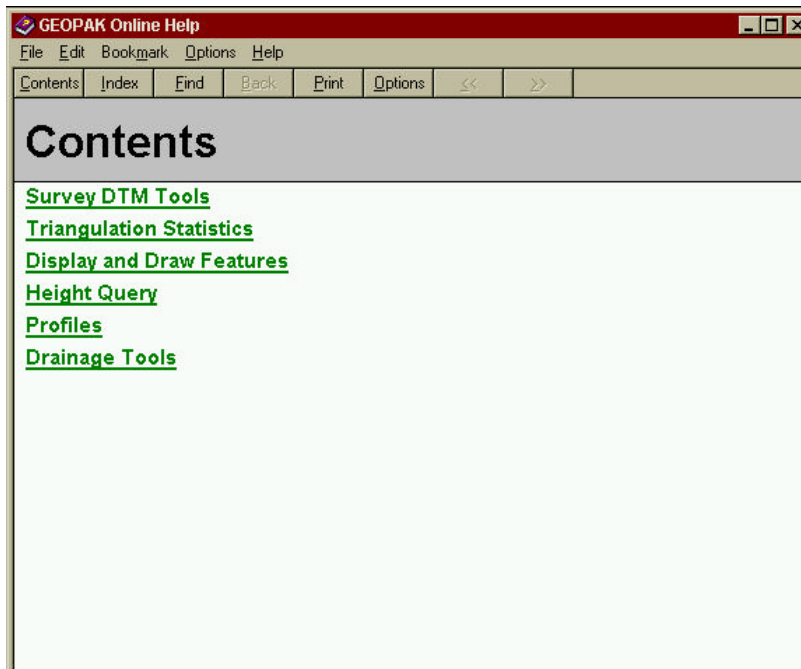
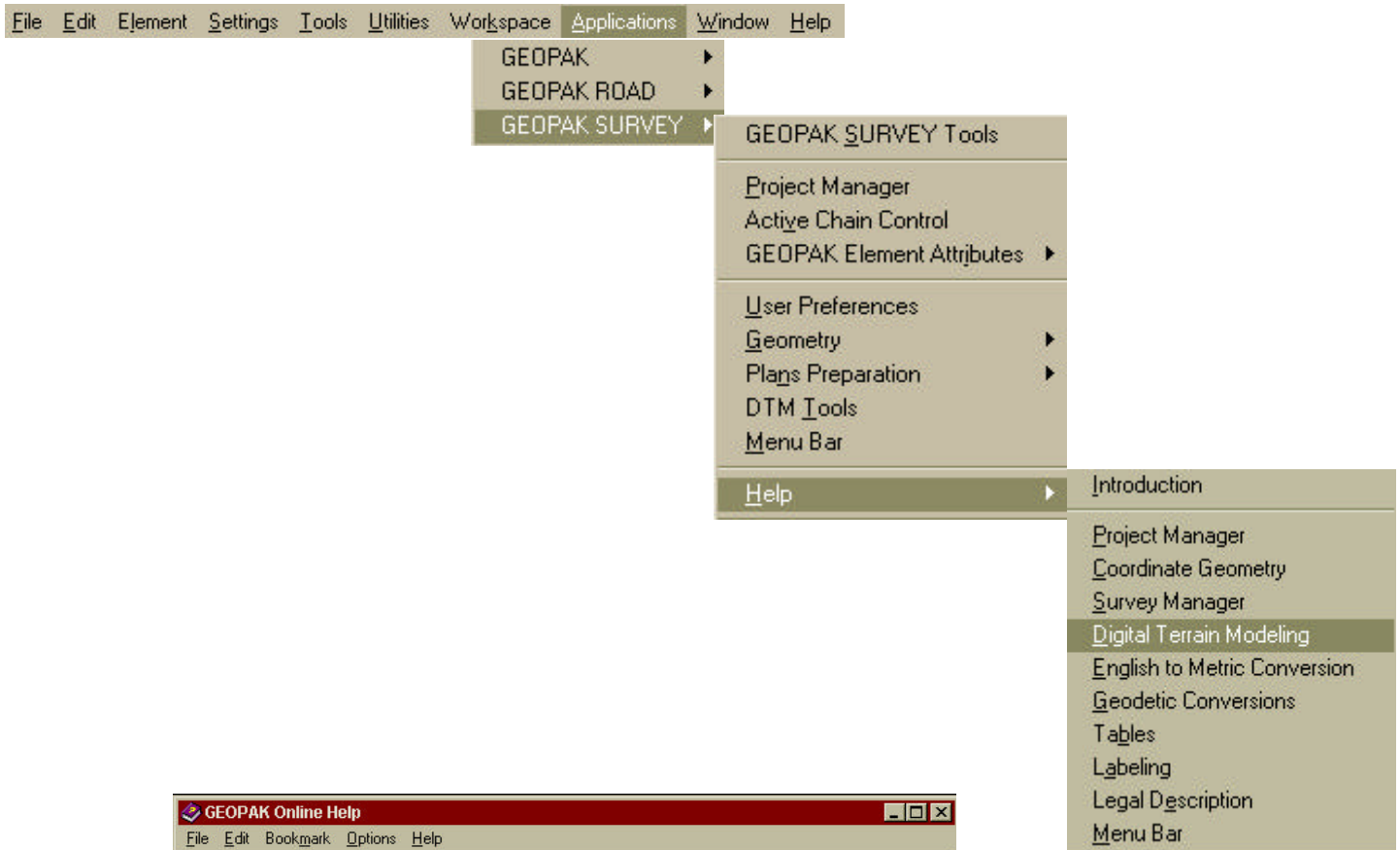
| | | |
|-------------------------|------------------|--------|
| PLATFORM | WINDOWS NT | 4.0 |
| CADD SOFTWARE | MICROSTATION | J |
| COORDINATE GEOMETRY | GEOPAK | 2001 |
| DATA COLLECTOR | HUSKY FS/2 DOS | 3.3 |
| DATA COLLECTOR SOFTWARE | TDS "SURVEY PRO" | 4.3.11 |

REVISIONS

DATE

| | |
|-------------------------|------------|
| Pages 9 & 11 | 01/13/98 |
| Pages 1-2,5-6, & 10 | 04/28/98 |
| Revised for Geopak98 | 05/99 |
| Page 18,II,1 | 01/20/2000 |
| Page 19,1 | 01/20/2000 |
| Page 22,2 | 01/20/2000 |
| Page 2,12 | 03/30/2001 |
| Revised for Geopak 2001 | 06/2002 |

This manual was put together to help the Location & Surveys Unit. It is not intended to replace [GEOPAK HELP](#). Please browse this section. For Further information, please consult the “Location & Surveys HYRDO-GUIDELINE” Manual.



LOCATION & SURVEYS

DTM MANUAL

History: The Location & Surveys Unit has a distinct role in pre-construction. That role is to be the **EYES & EARS** for the rest of the departments. All other Units have placed their full confidence in our ability to collect, edit & format our data for each Unit to use. The data could be for a small bridge job where an existing bridge would be replaced with a culvert, or a major widening / relocation job with 10 or 12 lanes of traffic. In recent years more & more demands have been placed on our Unit. We have more than doubled our work load while ever raising our standards for accuracy. In order for Location & Surveys to meet and exceed the demands that we now have, then we must **standardize** an ever increasing part of our work. That part is called **DTM's, Digital Terrain Modeling.**

In order for other Units to use our work we **must** accept the task of delivering a product, (a 3d design file) in a standard format! The guidelines listed below are to help us do so. We understand the theory, "If it is not easy to do in the field, it probably will not get done." However, we need to use a format that **EVERYONE** (from the mountains to the coast) can use. There will be times that it is **very** difficult to collect DTM data this way, and sometimes **impossible**. Nevertheless, the end result will be a **standard** finished product.

When we receive a request to collect both Planimetric & DTM data, these standards will be easier to use in the field than in the past. We would transmit two design files; One, a Planimetric 2d design file (pml), and the other, a 3d design file (dtl) with Breaklines and Random points on their proper levels. We understand that when only DTM's are requested it would be easier to collect everything as a regular Breakline or Regular point, however, we can not deviate from our DTM standards.

The standards listed below are to be followed! There will be no reason to send in a DTM file with EP's on level 51 & using white dashed lines to identify them. If you are in doubt on what attributes to give to a feature, answer "YES" or "NO" to the questions on the following pages.

I: Is the item a Breakline?

No, goto "II" (page 8)

Yes, Would the Breakline be also for planimetrics?

No, goto "A" (page 7)

Yes, Is the Breakline a Major or a Minor Structure?

No, goto "1" (page 6)

Yes, Is the Breakline a Major Structure?

No, goto "a"

Yes, Is the Breakline a BRIDGE:

HW, WW, End Wall?

No, The Breakline is a bridge deck; collect the Breakline using the feature code: **3101**; BRIDGE, TUNNEL etc. and leave on level 5.

Yes, Collect data using the feature code **3119** & *move* the Breaklines to level 51 in the DTM design file

a) It is a Minor Structure; Is it a pipe?

No, goto "b" (page 6)

Yes, Collect the Pipe using the proper feature code: (**32****, **42****, **52****) *But do NOT show them in the DTM file.*

- b) Is it a Pipe WW, HW?
- No, Then it is a paved ditch; Use this feature in your DTM files *only* when it is nonstandard. Use feature code: 3123; PAVED DITCH and *move* to level 51.
 - **When it is a standard “V”, paved ditch show the bottom as a Drainline, feature code: **4003**; DRAINLINE
 - The DRAINLINE feature will *not* show in the Planimetric file.
 - Yes, Collect data using feature code: **3120**; PIPE HW, WW and *move* the Breaklines to level 51 in the DTM design file.

1. Is the Breakline an EP?
- No, goto 2
 - Yes, Collect the Breakline using the proper feature code: **(3001-3005)** & *do not* change the level. Keep the EP’s on level 3.
2. Is the Breakline at the waterline?
- No, It is a Breakline that would be included in a Planimetric file, but is *not* a Major structure, a Minor structure, an Edge of water or an EP. Collect the Breakline using the proper feature code: **(3604)** for WDS_LINE, **3410** for FENCE_LINE, etc.), And *move* the Breaklines to level 51 in the DTM design file.
 - Yes, Collect the edge of water (creek stream, river, shoreline, etc.) Using the feature code **3620**; STREAM, BODY OF WATER. *Do not* change the level. Keep the Breaklines on level 10.

- A: The Breakline would **not** be used in a Planimetric file;
 Is the Breakline below the waterline? (a creek or river channel)
- No, goto “c”
 - Yes, Collect the below water Breakline using the feature code **4007; UNDERWATER BREAKLINE.**
- c) Is the Breakline on the Top of Rail or @ the Crown of a Road?
- No, goto “d”
 - Yes, Is the Breakline on Top of Rail?
 - No, Collect the Crown of a Road using the feature code: **3008; CROWNLINE**
 - Yes, Collect the Top of Rail using the feature code: **4006; TOP OF RAIL**
- d) Is the Breakline located at a **ridge** or a **drain**? (ditch)
- No, Then it is considered a “Regular Breakline”. Collect the Breakline using the feature code: **4005; BREAKLINE**
 - Yes, goto “e”
- e) Is the Breakline at a ridge?
- No, Then it is considered a “Drainline”. Collect the Breakline using the feature code: **4003; DRAINLINE**
 - Yes, Then it is considered a “Ridgeline”. Collect the Breakline using the feature code: **4002; RIDGELINE**

II: It is a Point; Would the Point be also for Planimetrics?
No, goto "A"
Yes, It is a Point feature that would be used in a Planimetric design file.
Collect the Random DTM points using the proper feature code:
(**3501** for POWER_POLE, **3601** for TREE, etc.) And *move* the
Point to level 47 in the DTM design file.

A: Is the Point below the waterline?
No, goto "a"
Yes, Then it is a below water random Point. Use the
feature code: **4008**; U/W REGULAR POINT

a) Is the Point on top of a Hill, Knoll, or in a Depression?
No, Then it is a Regular Point. Use the feature
code: **4001**; REGULAR POINT
Yes, It is a Spot elevation. Use the feature code:
4000; SPOT ELEVATION

LOCATION & SURVEYS DTM SYMBOLOGY

| <u>LEVEL</u> | <u>ITEM DESCRIPTION</u> | <u>CO</u> | Ft 119 CHA. OR | | | <u>FEATURE CODE</u> |
|--------------|---|-----------|-------------------|-----------|--|---------------------|
| | | | <u>WT</u> | <u>LS</u> | | |
| 3 | ROADS | | | | | |
| | *EOP | 4 | 1 | 0 | | 3001 |
| | EOT | 18 | 1 | 0 | | 3002 |
| | EOP Other | 32 | 1 | 0 | | 3003 |
| | *Curbs | 4 | 3 | 0 | | 3004 |
| | Soil or Gravel Rd. | 4 | 2 | 2 | | 3005 |
| 5 | MAJOR STRUCTURES (DO NOT EXTRACT, TURN THIS LEVEL OFF) | | | | | |
| | Bridge Deck, Tunnels, Box Culverts | 6 | 3 | 0 | | 3101 |
| 10 | HYDROGRAPHY | | | | | |
| | *Stream, Body of Water | 1 | 1 | 0 | | 3620 |
| | # Swamp | 2 | 1 | K | | 3622 |
| 20 | Point Symbols for Breaklines | | | | | |
| | * Breakline | 0 | 0 | A | | 4005 |
| | * Ridgeline | 2 | 0 | A | | 4002 |
| | * Drainline | 1 | 0 | A | | 4003 |
| | * EOP | 4 | 0 | A | | 3001-3005 |
| | * Crownline | 32 | 0 | A | | 3008 |
| 44 | RAILROAD | | | | | |
| | Top of Rail | 7 | 1 | 3 | | 4006 |
| 47 | DTM POINTS | | | | | |
| | Regular point | 3 | 0 | A | | 4001 |
| | ** Any other Regular point needed | ? | ? | ? | | ---- |
| 48 | DTM POINTS | | | | | |
| | *Spot Elevation | 0 | 1 | B | | 4000 |

*** See Page 11

**** See Page 11

* See Page 11

LOCATION & SURVEYS DTM SYMBOLOGY

| <u>LEVEL</u> | <u>ITEM DESCRIPTION</u> | <u>CO</u> | Ft 119 CHA. OR | | <u>FEATURE CODE</u> |
|--------------|---|-----------|-------------------|-----------|---------------------|
| | | | <u>WT</u> | <u>LS</u> | |
| 49 | HYDROGRAPHY Underwater Breakline (Creek Channel) | 9 | 1 | 6 | 4007 |
| 50 | HYDROGRAPHY Underwater Regular Point (Random Points in Pond, Creek, etc.) | 9 | 1 | A | 4008 |
| 51 | BREAKLINES | | | | |
| | Breakline | 0 | 1 | 3 | 4005 |
| | Ridgeline | 2 | 2 | 0 | 4002 |
| | Drain Line | 1 | 1 | 0 | 4003 |
| | Tidal Ditch (Bottom of Ditch) | 1 | 1 | 3 | 4004 |
| | *Crownline | 32 | 1 | 1 | 3008 |
| | *** Bridge Wing Wall, Head Wall, End Wall | 6 | 3 | 0 | 3119 |
| | *** Pipe: Head & End Walls | 6 | 3 | 0 | 3120 |
| | *** Paved Ditch or Gutter | 6 | 1 | 3 | 3123 |
| | **** Any other Regular Breakline | ? | ? | ? | --- |
| | *** See Page 11 | | | | |
| | **** See Page 11 | | | | |
| | * See Page 11 | | | | |

PHOTOGRAMMETRY DTM SYMBOLOGY

| <u>LEVEL</u> | <u>ITEM DESCRIPTION</u> | <u>CO</u> | <u>WT</u> | <u>LS</u> |
|--------------|---|-----------|-----------|-----------|
| 21 | BREAKLINES (From Stereo) | 5 | 1 | 2 |
| 11 | DTM POINTS (From Stereo) (These are zero, "0" length lines) | 3 | 3 | 0 |
| 13 | DTM POINTS (From Stereo) (These are zero, "0" length lines) | 0 | 5 | 1 |

EXCEPTIONS & SPECIAL CASES

In the DTM design file, ONLY these levels are to be used:

[3,5,10,20,44,47,48,49,50,51&63]

Turn off level 5, this is bridge deck and should not be extracted

Turn off level 20,63, these are default symbols and point numbers

Any data on other levels is to be deleted.

You can not have a “SPOT” and a “BREAKLINE” on the same level. You will need to move SWAMP (feature code 3622) from level 10 to level 50 for Underwater Spot.

* These are Default point symbols that are placed at the ends of lines.
Do not use levels 20 when you extract Points or Breaklines

** Any other point such as a: tree, power pole, manhole, etc. that you need in your DTM file, you are to move to level 47. You do not need to change the symbol as it was located in the field.

Example: If you have a tree that you need to put in your DTM file to strengthen that area, simply move that symbol from level 11 to level 47. Again except for the levels listed above there is to be **no** other data in the DTM design file!

Any data on levels: 1,2,4,7-9,12,14-19,22-43,45,46,52-62 is to be deleted. This will remove any doubt from anyone processing this file.

*** Use the “topo” feature code and move Head, Wing, & End Walls to level 51. This will allow a “true” representation of the area while keeping bridge decks turned off.

**** Any other Breakline such as: a woods line, fence line, dam, etc. that you need in your DTM file, you are to move to level 51. Do not change the line symbology as it was located in the field.

Example: If you have a fence line, (that **IS** a Breakline), that you need to put in your DTM file to strengthen that area, simply move that line from level 8 to level 51. Again except for the levels listed above there is to be **no** other data in the DTM design file!

* **There is either an Elevation placed on level 60 Or a Comment placed on level 61 in the .dtl file. DELETE THESE BEFORE THE FILE IS TRANSMITTED!**

If DTM (.dtl) design files are sent in with **any** deviation from the above symbology they **WILL** be sent back to the field office!

DTM PROCEDURES

Now that you have a good **field** DTM file you need to process and check it using GEOPAK. Here is a check list to help you.

A DTM, (dtl) file can contain multiple levels with crossing Breaklines, (e.g. EP's on lvl. 3 that go under a bridge deck on lvl. 5, etc.). You will need to check the "non-ground" DTM's independently.

There are two ways you can process DTM's to create a .dat file.

#1 (See Page 13) You can use GEOPAK SURVEY MANAGER & create a .dat file at the same time you create the planimetric design file. Survey Manager will use the DTM attributes set in the NCDOT?.SMD file. The feature can have a:

- ◆ Do Not Include in DTM
- ◆ Include only as Spot in DTM
- ◆ Include as Spot and Break in DTM
- ◆ Include as Void in DTM

*See the feature code sheet for the list of codes that are used.

#2 (See Page 18) You can create a design file with the correct symbology by moving elements to the correct DTM level and extracting by levels under DTM>> EXTRACT

You can use **either** way, but we are responsible for two items:

One: A 3d design, (dtl) file that has the correct attributes. (Elements with correct X, Y, Z position on the proper level & the correct symbology)

Two: A .tin (tnl) file that has the triangle information of the earth's **surface** that is requested. The .tin file will include Bridge Head Walls and Wing Walls, but not the bridge deck itself. See the DTM Symbology sheets for other features that are **or** are not to be included.

Along with checking the accuracy of **our** field data, the Location & Surveys Unit is also responsible for checking PEF design files. For this reason this manual will cover **both** ways. When we check PEF design files we will need to use "**EXTRACT by LEVELS**".

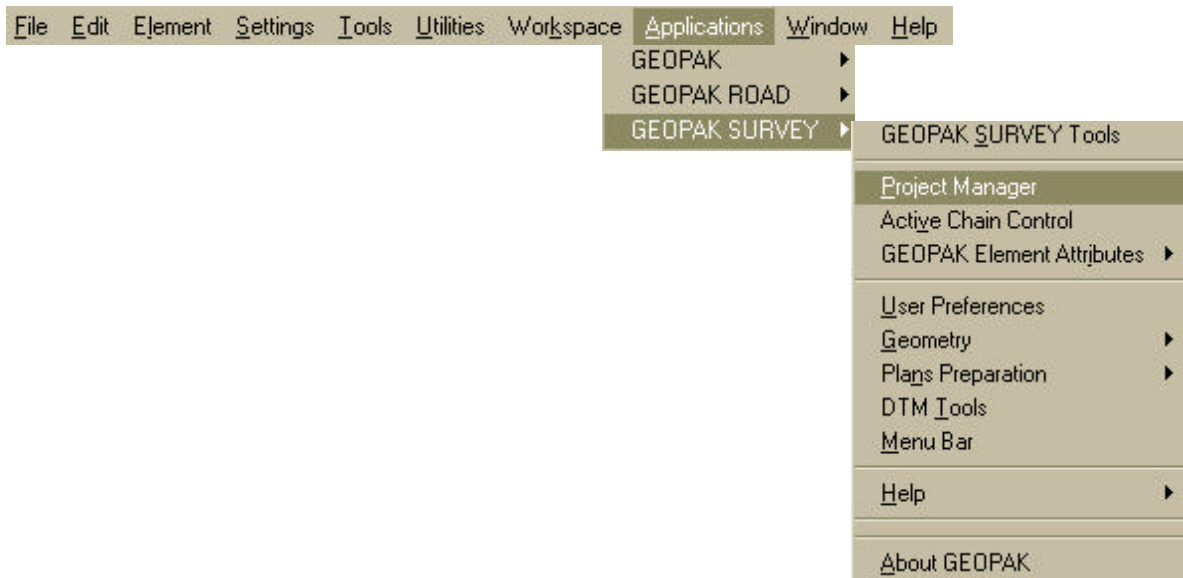
(USING GEOPAK 98 & TDS software on Husky FS/2)

Example:

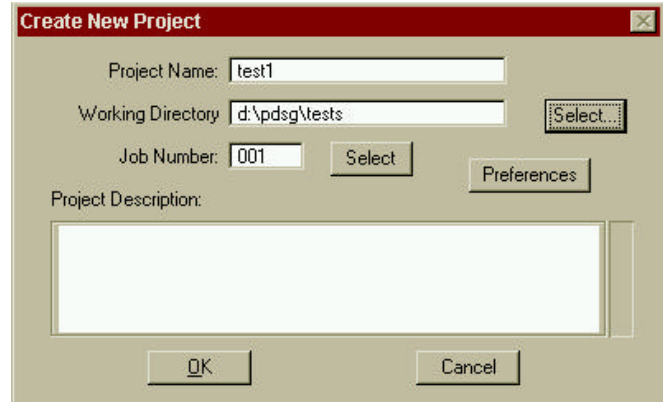
“b5000.cgr” is a field file that has EP’s on lvl. 3, bridge decks on lvl. 5, & Breaklines on lvl. 51. (Not to mention points.) You can “**double code**” features in the field.

Example: There is a fence line that runs along the ridge of a hill. Key-in the feature code “**bl*3410 *bl*4002**” this will start two line features; a Fence line on level 8 and a Ridge-line on level 51. You will need to delete planimetric features in the DTM (dtl) file & DTM features in the planimetric (pml) file. The .dat file will **not** have the bridge decks. You will need to “snap” to the corners of the bridge deck to check their elevation. **Pipes** will no longer be shown in the DTM file.

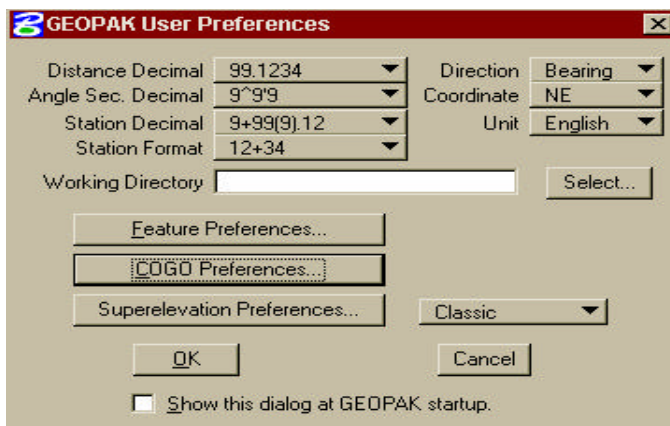
- I: Open the design file: “b5000_ls_dtl_020411.dgn” using *file Manager*.
- II: Create a “.dat” file.
This is for GEOPAK DTM’s **not** our old conversion .dat file.
- 1. On the command bar choose:
Applications>>GEOPAK SURVEY>>PROJECT MANAGER>>



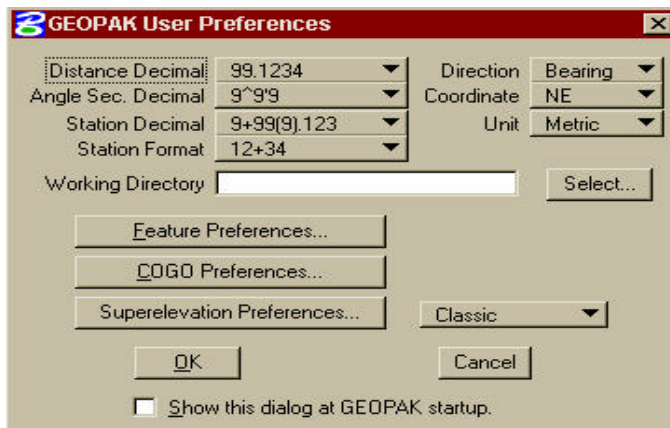
2. To create a new Project, under Project Manager menu bar, choose New:



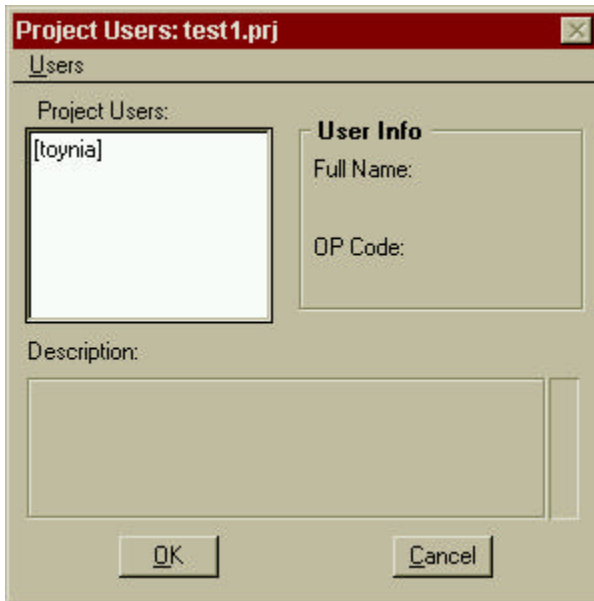
***** Note: The “Preferences” should already be set to: (for English)**



(for Metric)



3. Create a new user and the Project menu will appear:
Choose SURVEY, Select the File Name and **OK**.



Project Users: test1.prj

Users

Project Users:
[toynia]

User Info
Full Name:
OP Code:

Description:

OK Cancel



New User

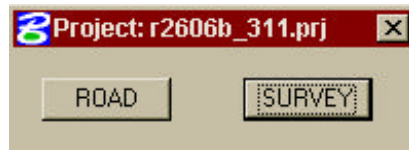
Name: john

Full Name: john doe

OP Code: jd

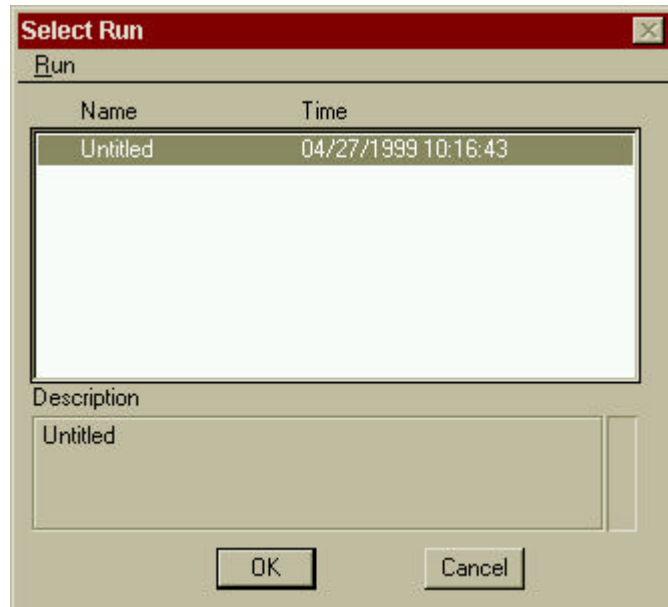
Description:

OK Cancel



Project: r2606b_311.prj

ROAD SURVEY



Select Run

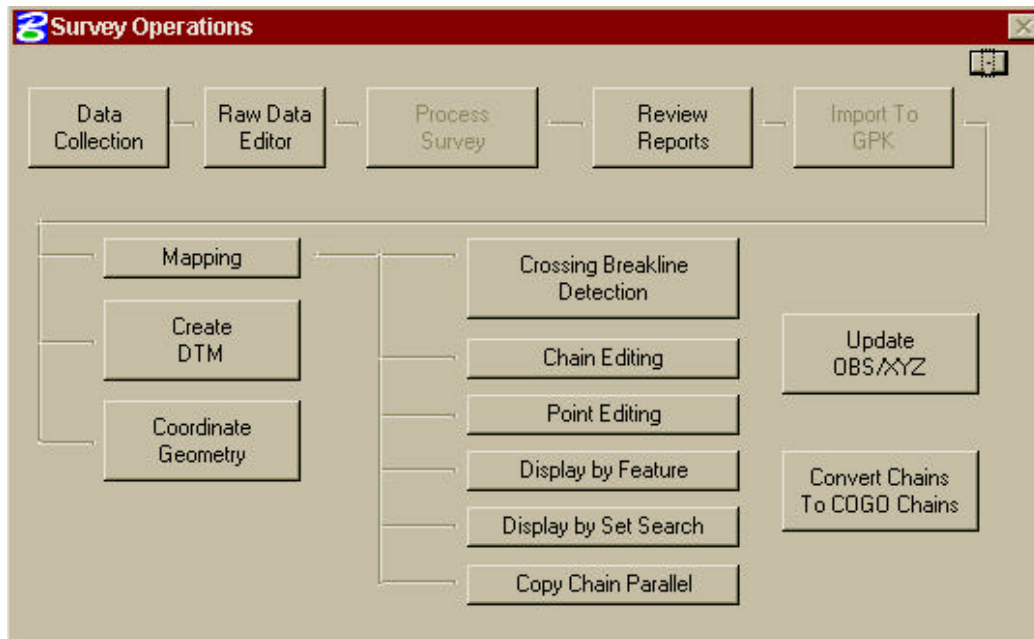
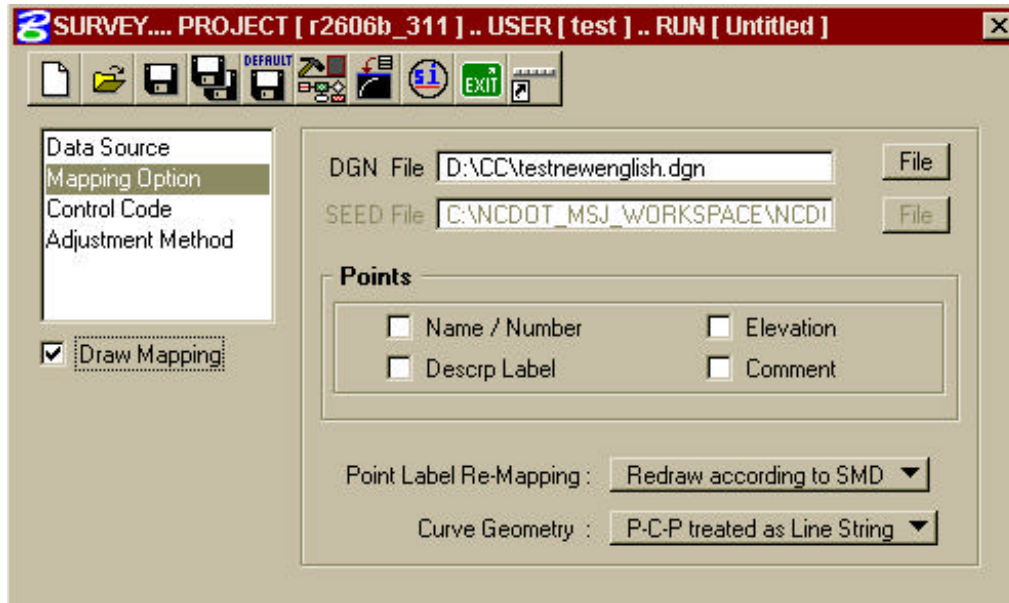
Run

| Name | Time |
|----------|---------------------|
| Untitled | 04/27/1999 10:16:43 |

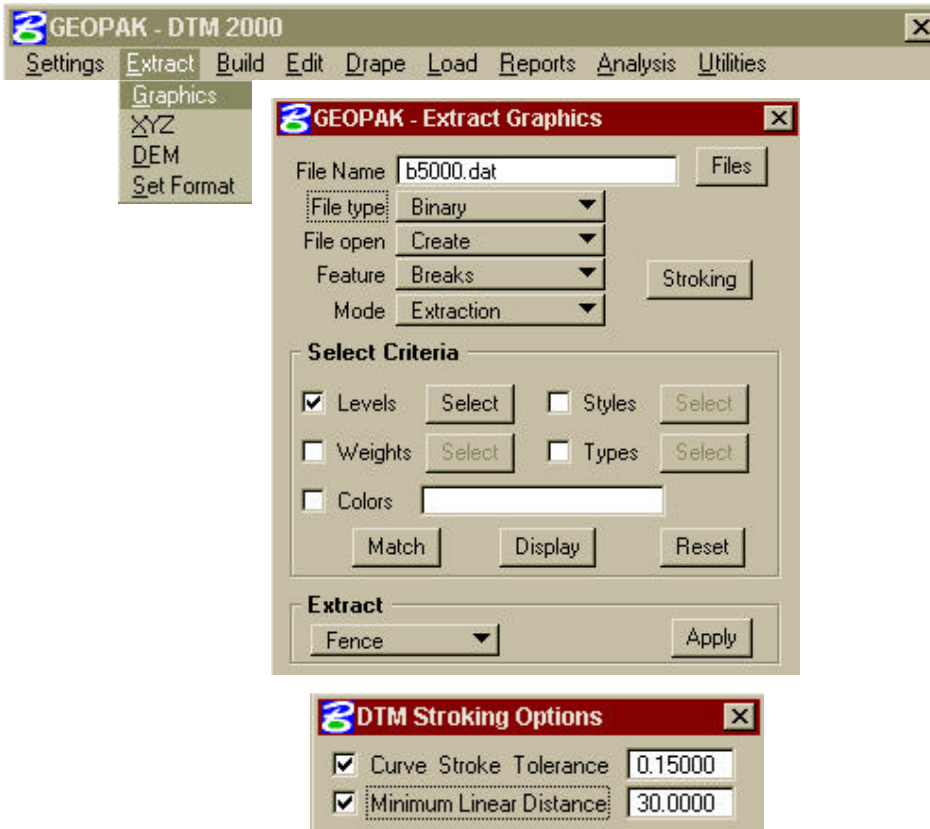
Description
Untitled

OK Cancel

The Survey Box will come up. Fill in the needed information, the NCDOT?.SMD file will be filled in for you, and Process Survey Data using Network Least Squares. After you “Process Survey” then “Import To Database”. When this process is finished you will be able to do any of the “highlighted” functions.



4. When you are ready, choose “**Create DTM**”. This will prompt you for a “.dat” file. Fill out the name & **Process**



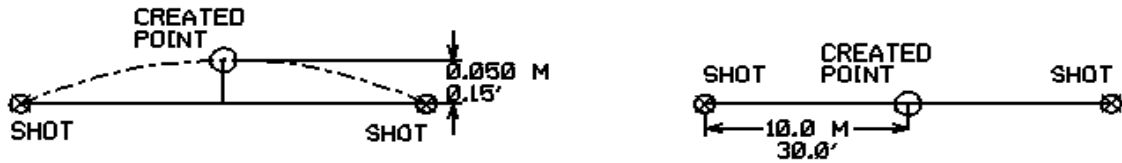
These are suggestions for English: “Curve Stroke Tolerance” & the “Min. Linear Distance” they can & will vary. Please note these on the transmittal.

After you have created the “.dat” file you will need to create Triangles, (see pg. 21) and check the data by displaying **Contours**. (see pg. 25) Check for Crossing **Breaklines**, (see pg. 23) and use **Drainage DTM Tools**, (see pg. 27)

SUGGESTED “Arc Stroke Tolerance” & the “Min. Linear Distance”

| | | |
|----------|-------|----------------|
| Metric: | 0.050 | 10.00 (Meters) |
| English: | 0.15’ | 30.00’ (Feet) |

The length of the chord segments can be determined by setting the **Arc Stroke Tolerance**. This distance is used to interpolate new shots from the curved break lines. This value is used as a perpendicular minimum distance from chords generated along the arc. Chords are drawn along the arc and the perpendicular distance is measured from the middle of each chord to the arc. (see figure on following page) If this distance is larger than the Arc Stroke Tolerance, the process is repeated with a shorter chord length. This process is repeated until the end of the curve is reached. The flatter the curve, the fewer number of points will be calculated. The steeper the curve, the greater number of points that will be calculated.



Activate the Stroke Linear toggle if you wish to identify portions of linear elements. The **Minimum Linear Distance** is utilized to interpolate new shots from the linear elements. For instance, if survey data was taken approximately every 50 master units and this distance was set to 25 master units, then a new shot would be interpolated every 25 master units. In this example, twice as many shots would be used to create the DTM in the linear sections of the break lines. Still utilizing our original median nose, the following graphic depicts the generated triangles when the Stroke Linear toggle is activated and the Min. Linear Distance is set to 25. Interpolated vertices have been added whenever the distance between survey vertices is greater than 25 master units.

This is for **“EXTRACTING by LEVELS” (USING GEOPAK 2001)**

Example:

“b5000_ls_dtl_020411.dgn” is a 3d design file that has EP’s on lvl. 3, bridge decks on lvl. 5, & Breaklines on lvl. 51. (Not to mention points.) Create a “.dat” file called: “b5000.dat” (for regular features). The .dat file will **not** have the bridge decks. You will need to “snap” to the corners of the bridge deck to check their elevation.

I: Open “b5000_ls_dtl_020411.dgn” using *File Manager*.

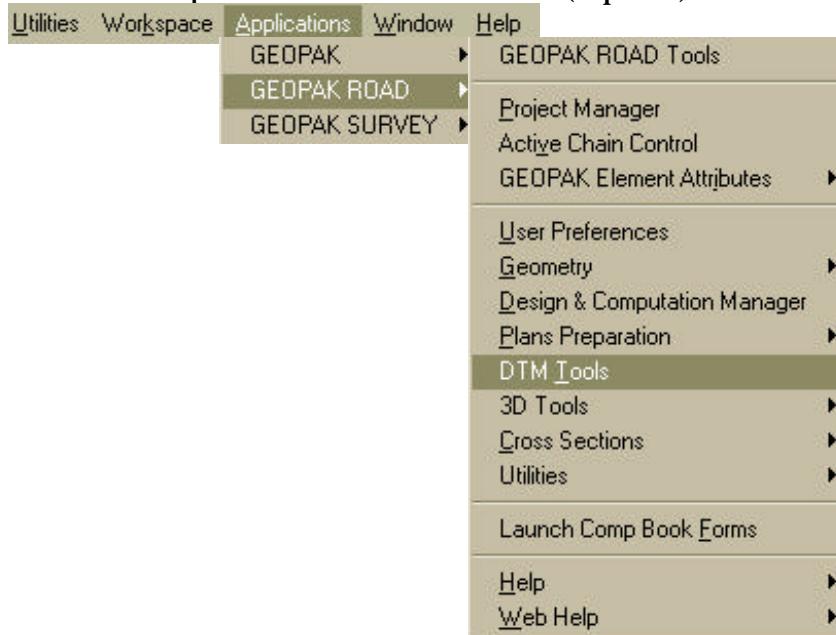
II: Create a “.dat” file.

This is for GEOPAK DTM’s **not** our old conversion .dat file.

1. On the command bar choose:

Applications >>GEOPAK ROAD >>DTM Tools>>

Then press DTM Menu button (top left)



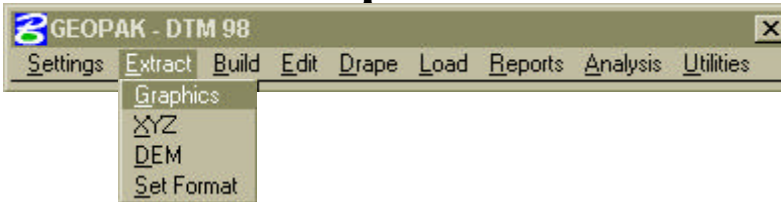


You will need to set the Stroke Tolerances **before** you extract the DTM's.

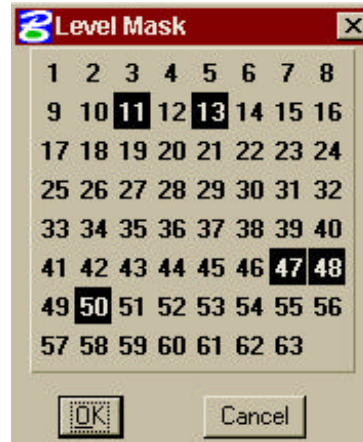
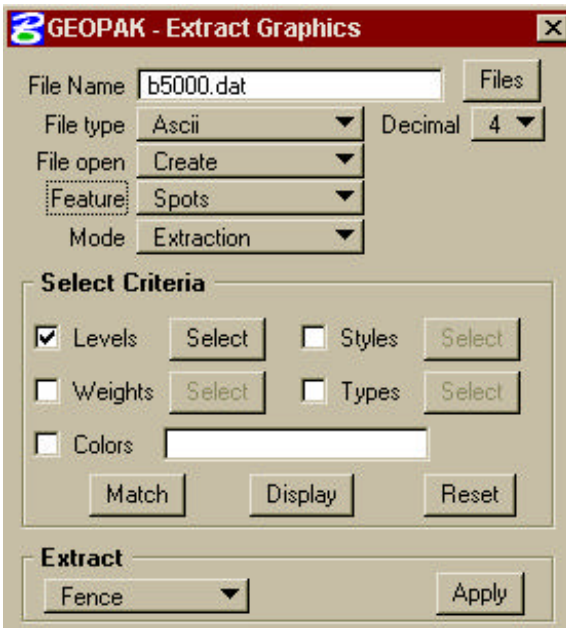
SUGGESTED “Arc Stroke Tolerance” & the “Min. Linear Distance”
 Metric: 0.050 10.00 (Meters)
 English: 0.15' 30.00' (Feet)

2. On the GEOPAK DTM command bar choose:

Extract>>Graphics>>



This is for Random Points:



3. Under the Extract Parameters pallet:
 - a) Fill in the *File Name* with the correct path & the desired file name. Example: b5000.dat (This will be a new file)
 - b) *File Type:* **Ascii** *Open:* **Create**
 - c) *Decimal:* **4**
 - d) *Feature Type:* **Spots**
 - e) *Mode:* **Extraction**

Select Criteria

X Levels

Select: **All levels that have Random Points**

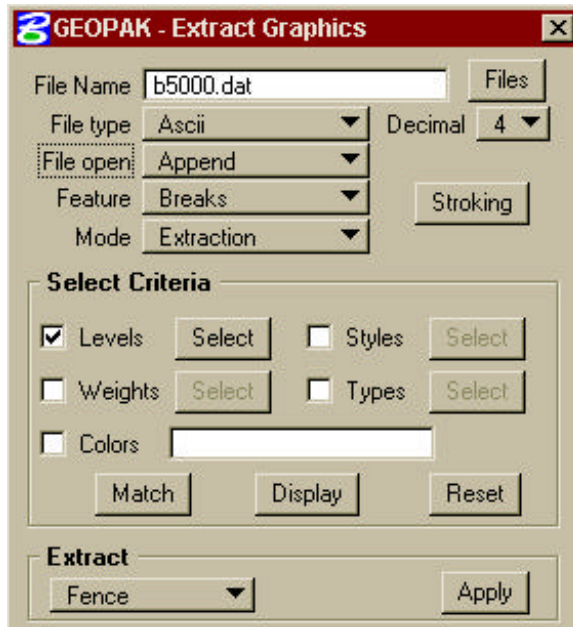
f) Extract

Fence *

Apply

* Check the Fence area & the Fence Lock. (example: Overlap)

This is for Breaklines:



4. Make these changes Under the Extract Parameters pallet:

a) -----

b) File Type: ----- Open: **Append**

c) Decimal: -----

d) Feature Type **Breaks**

e) Mode: -----

Select Criteria

X Levels

Select: **All levels that have "Ground" Breaklines**

f) **Fence ***

Apply

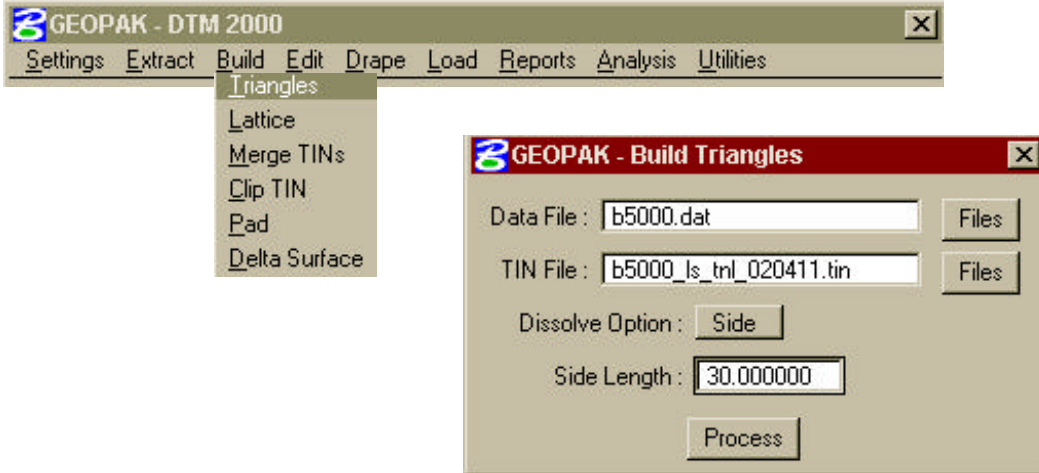
* Check the Fence area & the Fence Lock. (example: Overlap)

The GEOPAK .dat file is an Ascii file listing points, X,Y,Z.

| | |
|---------------------|---------------------------------|
| 1 (Spot Point) | 1 485069.001 264906.690 249.168 |
| 1 (Spot Point) | 1 485082.293 264845.329 248.737 |
| 2 (Begin Breakline) | 2 485084.950 264825.962 249.781 |

| | |
|---------------------|---------------------------------|
| 3 (End Breakline) | 3 485090.389 264802.754 250.371 |
| 2 (Begin Breakline) | 2 485090.389 264802.754 250.371 |
| 3 (End Breakline) | 3 485086.146 264772.499 249.179 |
| | etc. |

III: Build Triangles using the “.dat” file.

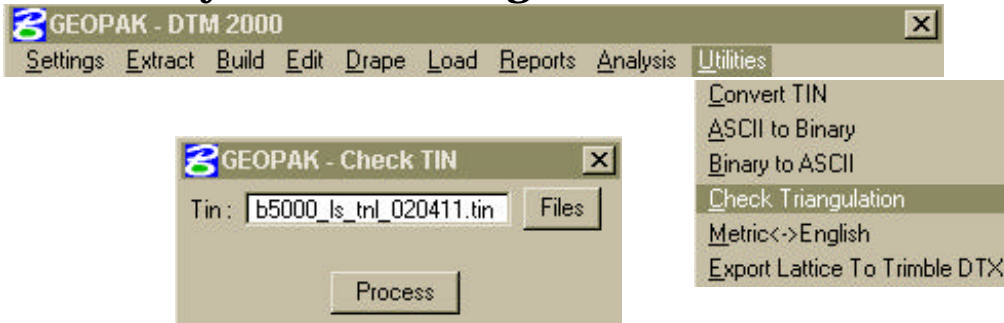


1. Under the GEOPAK DTM command bar choose:
Build>>Triangles>>
2. Under the BUILD TRIANGLES pallet:
 - a) Fill in the .dat filename b5000.dat
 - b) Fill in the tin filename Example: b5000_ls_tnl_020411.tin
(this will create a .tin file)
 - c) **x** *Minimize Inserted Break Points*
 - d) *Dissolve Option:* **Side**
 - e) *Side Length:* **30** (Length of *interior* triangle legs;
change as needed)

Process

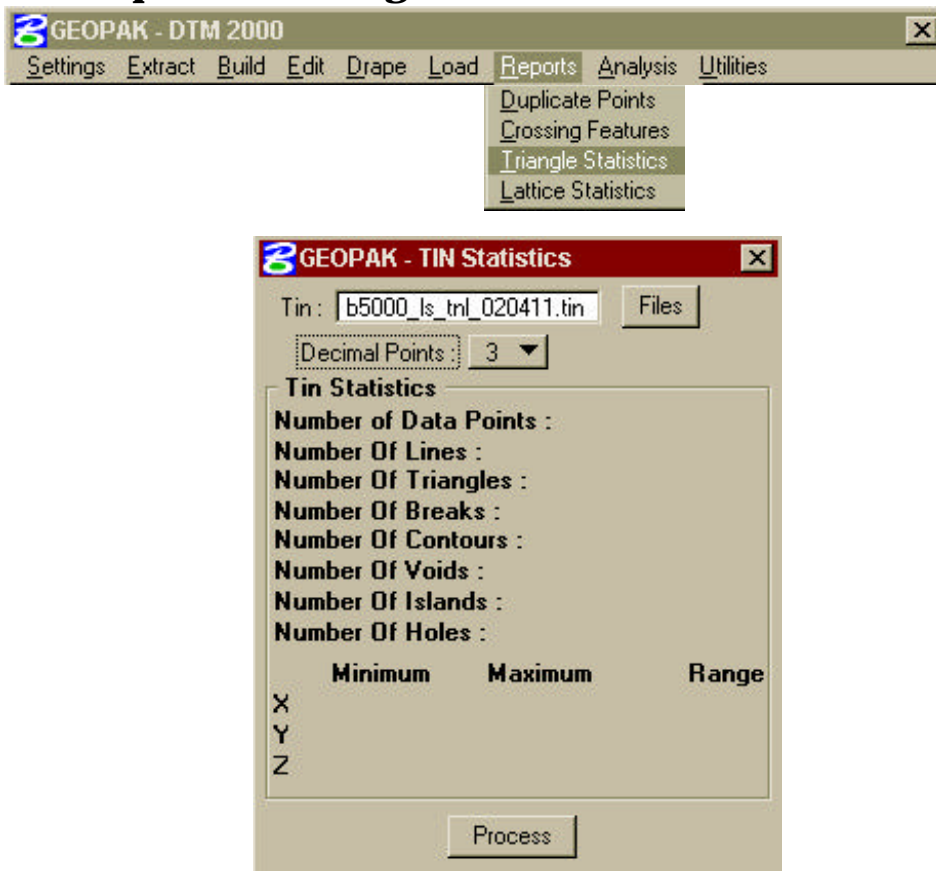
IV: Check the Triangles using the “.tin” (tnl) file.

1. On the GEOPAK DTM bar choose:
Utility>>Check Triangulation>>



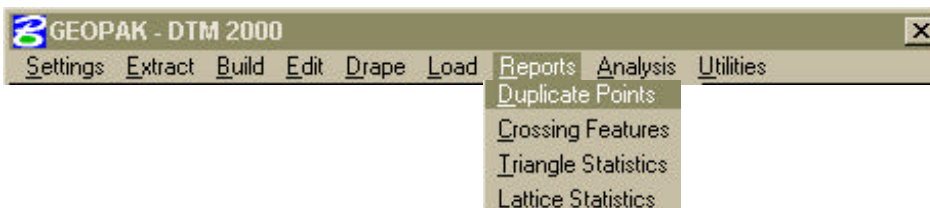
- a) Under the CHECK TRIANGLES pallet choose the correct *.tin* file and **Process**
If correct, a message will appear: “Triangulation Valid”

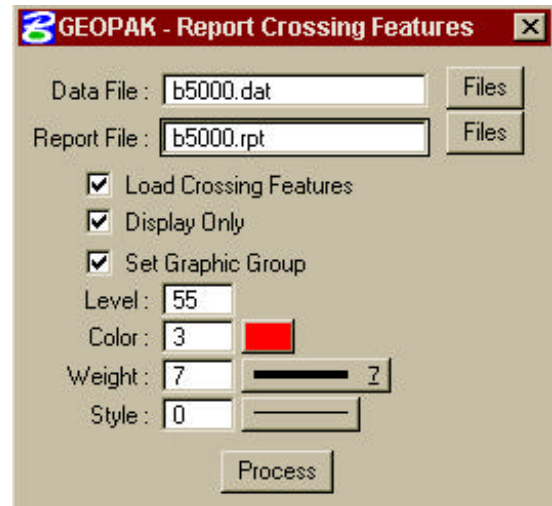
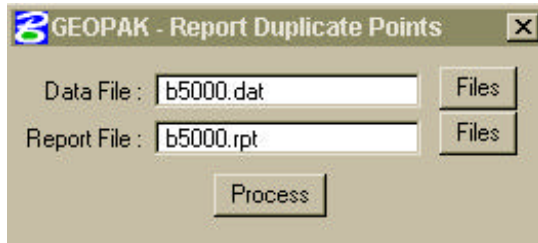
2. On the GEOPAK DTM bar choose:
Reports>>Triangle Statistics>>



- a) Under the TRIANGLE STATISTICS pallet choose the correct *.tin* (*.tnl*) file and **Process**
It will show the Minimum, Maximum & a Range of X, Y, Z.
Pay close attention to the “Z” Range!

3. On the GEOPAK DTM bar choose:
Report>>Duplicate Points>>





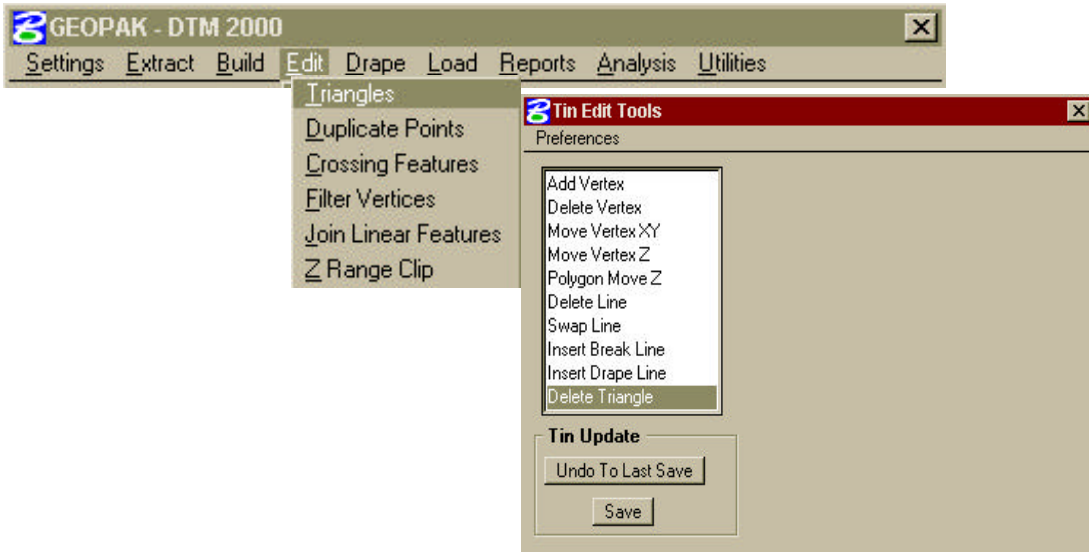
Choose the correct *.dat* file & the *.rpt* file that the report will be in and **Process**

***** NOTE: GEOPAK WILL SHOW THE SAME REPORT FILE NAME WHEN YOU PROCESS THE SECOND REPORT***
THIS WILL OVERWRITE THE PREVIOUS FILE!!!**

4. On the GEOPAK DTM bar choose:
Report>>Crossing Features>>
Choose the correct *.dat* file & the new *.rpt* file that the report will be in. Also choose the symbology that you want to see for the crossing Breaklines and **Process**. Should you have crossing breaklines, all sho

GEOPAK does not apply the side length that you “key-in” to the interior triangles. GEOPAK connects all interior data points regardless of triangle length keyed in. When you triangulate areas that do not connect, GEOPAK will connect them *for* you in the “.tin” file. This *will* cause problems when you display the contours and see contour lines where you did not collect data in the field!!! For now you will need to delete the “bogus” contour lines before you check the others.

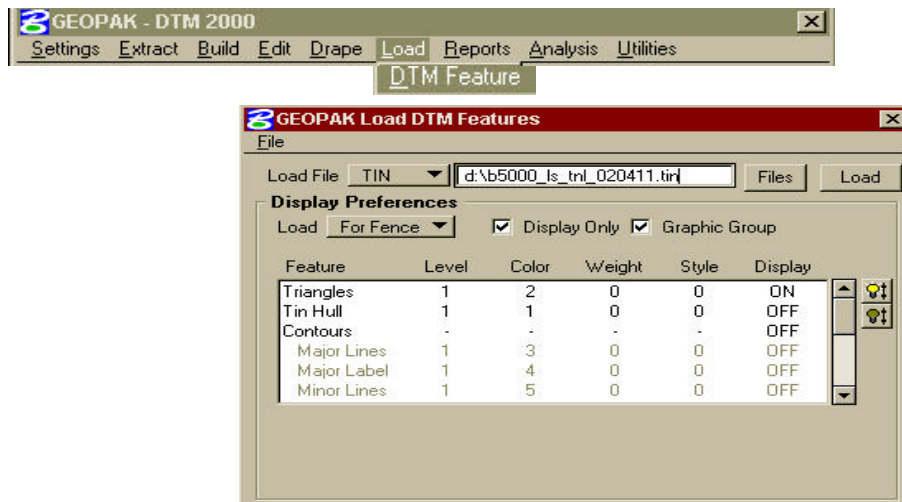
Under Edit, you can use Edit Lines and delete the interior side of an exterior triangle and then save the “.tin” (tnl) file.



Warning: You will find an **“Triangles”** command under Edit on the DTM menu bar. This will **not** allow you to delete “exterior triangles” GEOPAK created. The errors you will get when you try “to **“Delete Triangle”** will be: “POINT IN VOID”, “TRIANGLE CAN NOT BE DELETED”, or “POINT EXTERNAL TO TIN HULL”. There is also a **“Clip”** command under Build on the DTM menu. You can clip, (interior or exterior) boundaries to create “mini” .tin files, but you can not merge “.tin” files that do not connect! So **both** of these options will **NOT** work for what Location & Surveys needs to do.

5. **Load >> DTM Features >>**

In the **Load DTM Features** pallet; Select the proper “.tin” file and choose **“Triangles”** in the feature window. Next turn on the display switch for the Triangles using the “light bulb” toggles to the right of the features window and set the symbology you want on bottom of the window and **Load**. You do not need to write them to your design file. (.dtl)

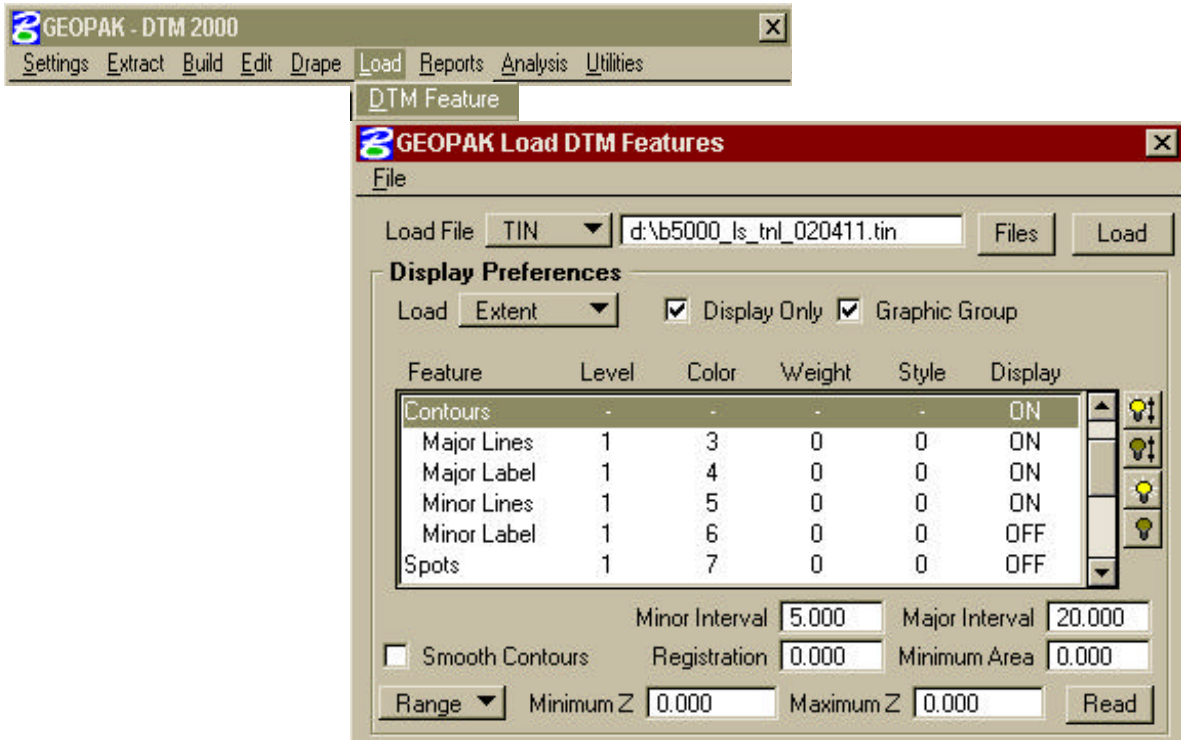


If you want to write the triangles into the design file turn “**Set Graphic Group**” on & “**Display Only**” off. Checking “Set Graphic Group” allows you to delete all triangles at one time.

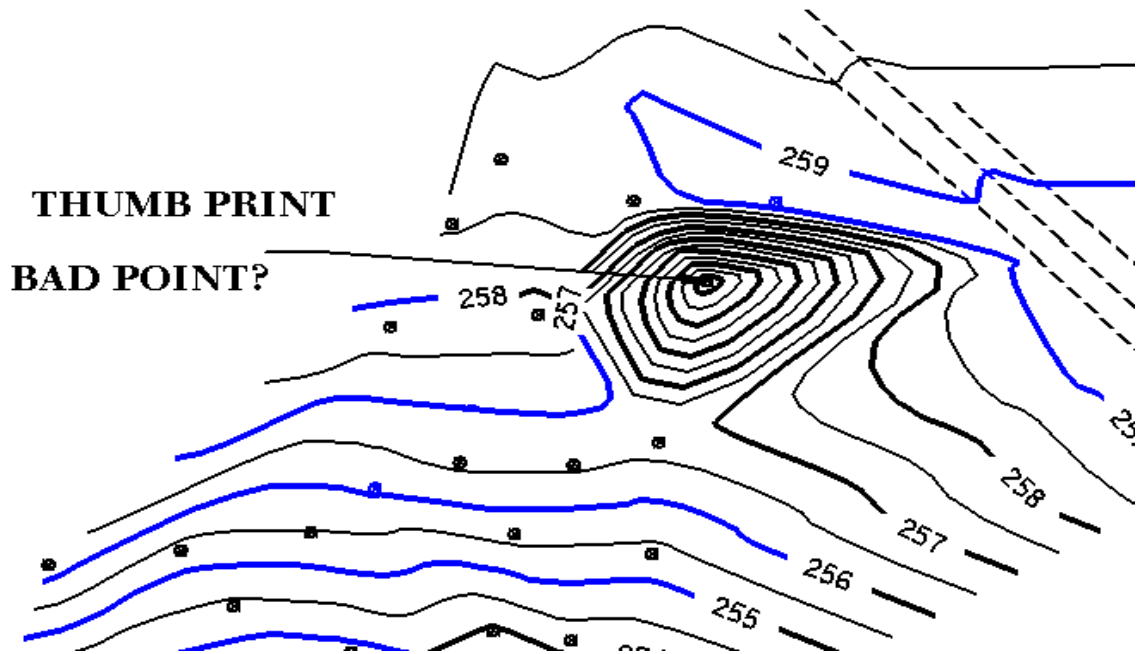
Note: You must have “Graphic Group” lock on in MicroStation.

6. **Load >> DTM Feature >>**

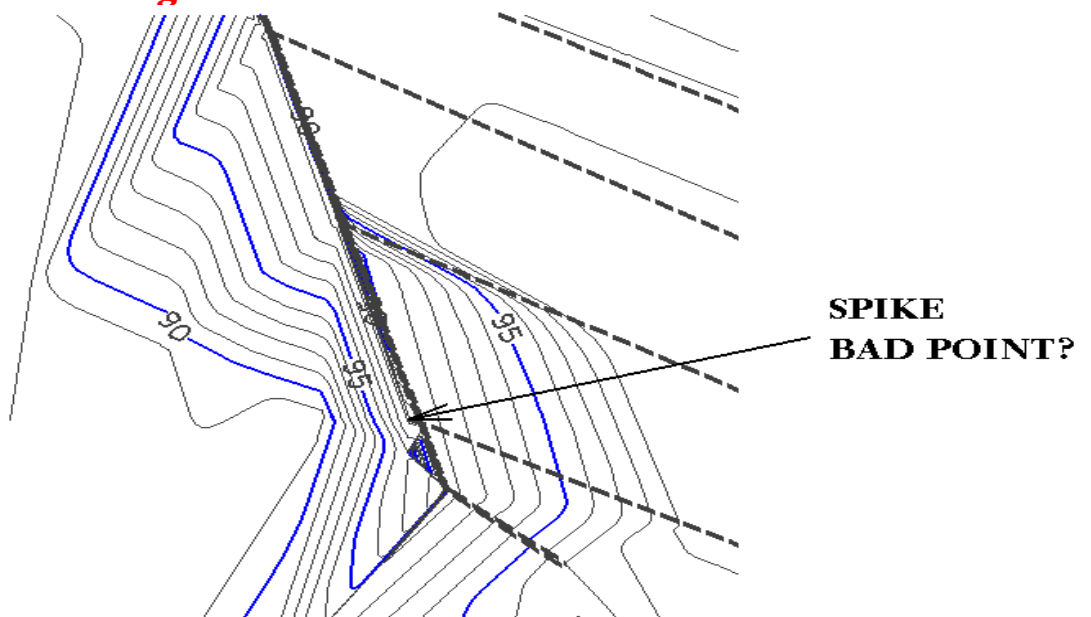
In the **Load DTM Features** pallet; Select the proper “.tin” file. Before you can display the contours you must **Read**. This will show the *Range* of elevation. Highlight “**Contours**” in the feature window and turn on the display of each type of contour wanted with the light bulb icon to the right of the window. Set the Major & Minor contour interval. This will vary on the terrain. Depending on the contour interval, you can get overlapping contours using the *Smooth Contours* option. This is graphically, *not* internally. It is recommended that you use “**Display Only**” first to adjust the contour interval, text height, and symbology. Once you are satisfied with your settings, Toggle off “**Display Only**”: Choose the symbology you want and **Load**



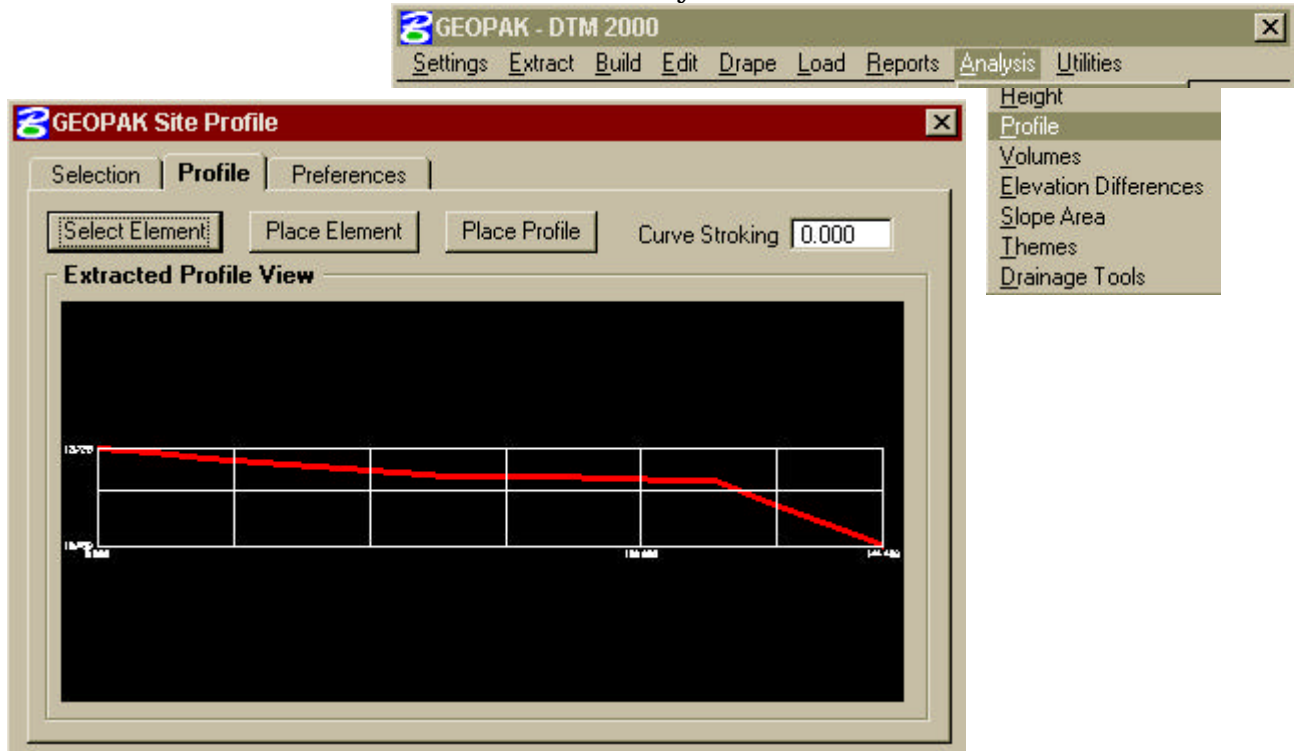
CHECKING DTM's



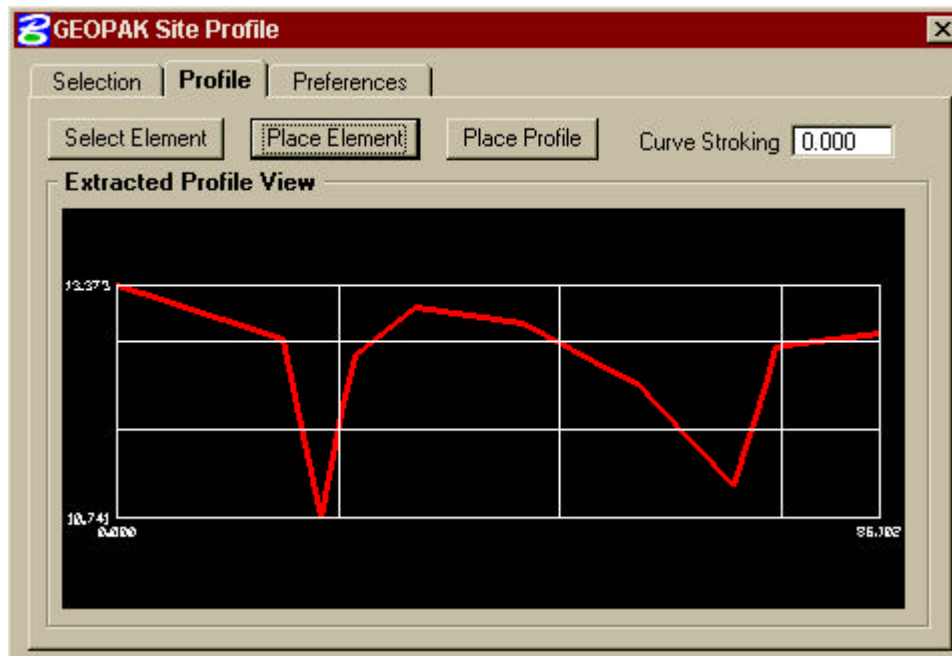
Check the contour lines and look for anything **different**. Such as erratic lines in a plowed field or road, or a “thumb print”, (shown above) where contour lines are irregular. “Spikes”, (shown below) may occur when contour lines connect to one shot with different elevations. These are usually caused from a **bad rod height**.



Breaklines, such as the crown line and edge of pavement lines, should be viewed through the profile tool to check that the breakline information was collected correctly.



The profile tool can also be used to cut random cross sections to check the DTM's collected around roads and creek.



Other Options for checking DTM's

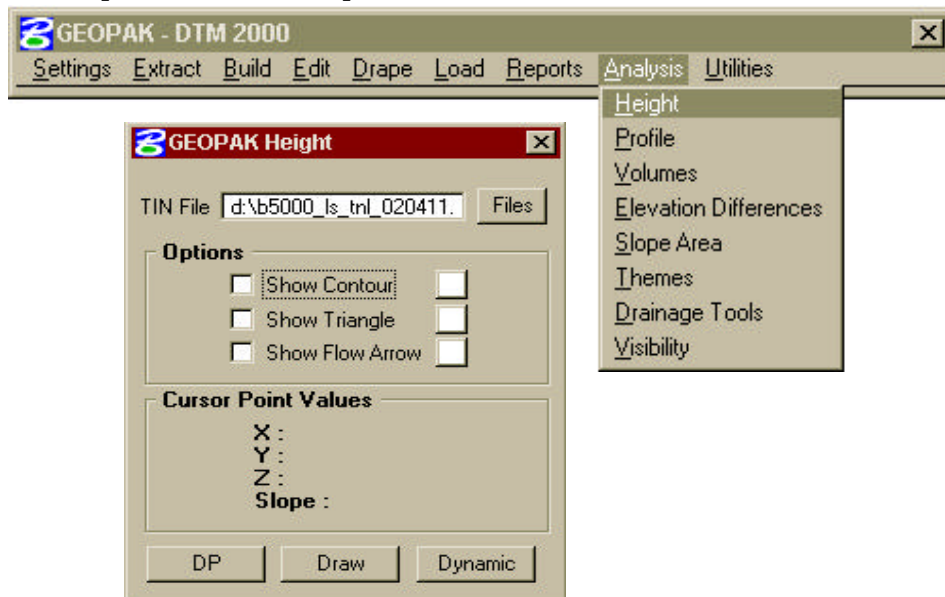
Analysis >> Drainage Tools >>

There are several tool boxes that can help you in the checking process. “**Delineate Sump Lines**” and “**Delineate Ridge Lines**” will help along with the “**Delineate High Points**” & “**Delineate Low Points**”. The “**Trace**” options will help you to check the flow of streams and creeks. Remember to delete **all** of these checks before the file is transmitted.



Analysis >> Height >>

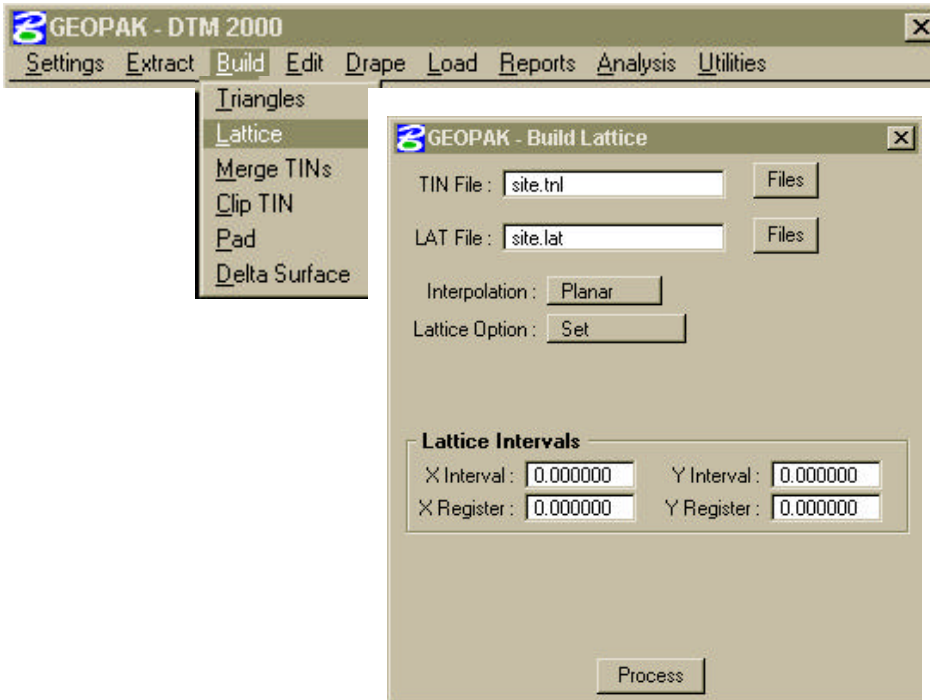
In the **Height** tool pallet; Select the proper “.tin” (.tnl) file and data point within the tin Hull. This option will show the X, Y, Z, Slope & Aspect at the data point location.



Build >> Lattice >>

You can build a lattice “.lat” file that will place points within the hull of the triangles. You can then **“Load” “DTM Features”** the .lat file & then rotate the views to show the ground surface.

Warning!!! Depending upon the size of the area this can take up **a lot** of memory, 10meg. easily. When you display the .lat file it will take a **long** time, up to 10 minutes...Keyin the “.lat” file and
Process



If you have “curb & gutter” areas to check *Keyin* a small “X, Y” interval
Example: (0.1)Metric, (0.3’) English in the X & Y. This will show the “curb & gutter” in the model.

EDITING DTMs

There are several procedures to follow for processing survey data to obtain a final DTM, however we will discuss only two. One way is to let the (.smd) file sort through the collected data and determine what is and what is not to be considered in the DTM. This method is the easiest but limits the flexibility of choosing which topo features need to be included in the DTM (e.g. Bridge Decks and Top of Rails). This procedure is described on pages 12 -17. The other way is to obtain a 3D design file (.dtm or dtl) and create the needed (.dat) file by **extracting by levels**. This method is a little more rigorous but is necessary to achieve maximum efficiency in the “*field to finish*” procedure. This procedure is described on pages 18 - 21.

The 3D design file (*.dtm* or *dtl*) is the control file for creating the (*.dat*, *.tin*, *.lat*, *.etc.* ...). Therefore it seems necessary to edit DTMs by editing this Microstation design file. Using this as the control file also makes it easier to merge additional data, to edit Breaklines, to modify points, and to massage the whole DTM by graphically manipulating elements using Microstation commands (*move*, *copy*, *tentative*, *modify*, *extend*, *AZ=*, *LV=*, *.etc.* ...). It is possible to edit the (*.tin* or *tnl*) files or the (*.dat*) file, but this is a one time deal. If there is additional data needed or other major problems found in the DTM all edits must be redone after reprocessing. If at all possible, edit the *.RW5* file and reprocess the file again. This will allow you to reproduce the DTM design file if needed.

Editing the 3D design file using Microstation commands is an acquired skill. Try experimenting with a 3D design file using the different commands above. Try moving some point symbols, modifying some Breaklines, changing active elevation (*AZ=*), changing levels (*LV=*), and extending lines. Pay close attention to what the *data* and *tentative* buttons do to the location of modified elements in conjunction with the active elevation. Use the following command to check your results
(X, Y, Z or E, N, Elev.) : *set tpmode locate*

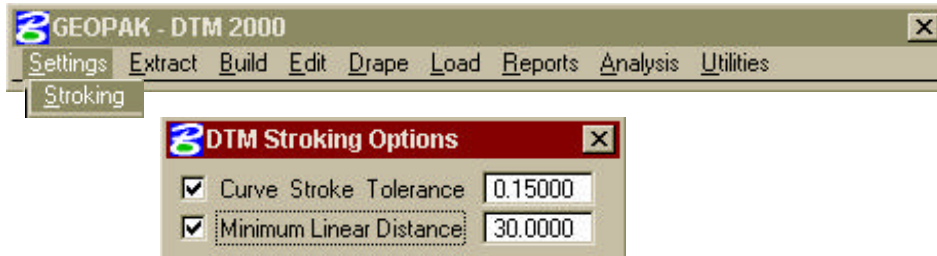
When you are satisfied that your DTM file is “valid”, ***check it again!*** Before you transmit the 3d design file you will want to “clean it up”.

1. Compress the design file. (Microstation compress)
2. “Fit all” in top view & save settings.

View each level and delete what is not from the field. The DTM file should contain Breaklines, Ridgelines, Drainlines, Regular points, etc., No Contour lines, Water Drainage lines, or Triangles! Since this standard is Unit wide, you do not need to attach a note in the file as you have had to do in the past. Other departments will know that any EP’s collected will be on level 3 & level 3 ONLY!!!

Location & Surveys will be transmitting “.tin”(tnl) files. The tnl and dtl will be forwarded to Photogrammetry or the Roadway Design Unit. This “**tnl**” file should represent the surface of the earth. The “**tnl**” that is sent in should not represent structures such as bridge decks. The file should include under water elements.

You will need to fill out the transmittal stating **(1) Stroke Tolerance**, **(2) Minimum Linear Distance** and **(3)** which **Dissolve Option** you used along with the **(4) Side Length**. This can vary from job to job.



⇒ The **Naming Conventions** for Location & Surveys are as follows:

For a DTM file; Example: **b5000_ls_dtl_020411.dgn**
For a tin file; Example: **b5000_ls_tnl_020411.tin**

DEFINITIONS

| | |
|------------------------|--|
| <i>REGULAR POINT</i> | A collection of random points with no implied relationship between each other. |
| <i>SPOT ELEVATIONS</i> | Basically the same as regular points, the only difference since the points are usually taken at Local High & Low points. (Top of hills, Bottom of depressions, etc.) |
| <i>BREAK LINES</i> | A collection of points having an implied Linear relationship. If connected, they would create a line that follows a sudden change in a surface slope. Triangle lines will not cross the Breakline. (Top of ridge, Bottom of ditch, etc.) |
| <i>DTM file (dtl)</i> | A 3d design file that contains (x, y, z) intelligence. It can include: Regular Points, Spot Elevations, and Breaklines. A DTM file is a graphical representation of "Real Ground" terrain. |
| <i>.tin file (tnl)</i> | A binary file that contains triangle intelligence. The (x, y, z) position of the end of the triangle points along with the slope and aspect of each triangle. |
| <i>.lat file</i> | Lattice models are grid meshes that are draped over triangulated data. |
| <i>.dat file</i> | The .dat file is a file that contains the number of vertices at the point, and the X, Y, Z of the vertices in the dtl file. The data in the .dat file is either binary or ASCII format. |