Getting Started
for
Design

Version 8.0

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12d Model V8.0 Getting Started for Design Manual

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Disclaimer

12d Model is supplied without any express or implied warranties whatsoever.

No warranty of fitness for a particular purpose is offered.

No liabilities in respect of engineering details and quantities produced by 12d Model are accepted.

While every effort has been taken to ensure that the advice given in this manual and the program 12d Model is correct, no warranty is expressed or implied by 12d Solutions Pty Ltd.

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Preface

Why a ‘Getting Started for Design’ Manual ?

12d Model is supplied with a comprehensive on-line Reference manual which describes the function of each menu option in detail. It is a Reference manual however and makes no attempt to describe how to use 12d for production surveying and civil engineering work.

The *Getting Started for Design* manual is designed to show you how to work with the on-line help system, and then as the first section of Training, help you start to learn how to use 12d to achieve typical civil engineering tasks. The *Getting Started for Design* manual uses examples where possible to clarify usage. It complements rather than replaces the on-line Reference manual. In general, information in the on-line Reference manual will not be duplicated here.

The *Getting Started for Design* manual is available as a printed manual and as a PDF file on the *12d Model Training DVD.*

Training Material

The training tutorials assumes that a series of files are already on your hard disk. These tutorial files are automatically installed from the CD during installation of the *12d Model* software.

Getting Started for Surveying

There is also a *Getting Started for Surveying* which has the first seven chapters in common with the *Getting Started for Design* manual (on-line help and basic modelling) but then diverts to cover topics from the direction of a Surveyor whereas the *Getting Started for Design* manual continues on with alignment design techniques.

The *Getting Started for Surveying* manual is available as a printed manual and as a PDF file on the *12d Model Training DVD.*

Using the Practise and Small Versions of 12d Model

The Practise version of *12d Model* is limited to a maximum of 5,000 points. Following the procedures as stated in the Training Manual may create projects with more than 5,000 points.

Where appropriate, the text will suggest how to vary the input for each instruction so that the example feature can be completed within the limits of the *12d Model Practise* version.

The number of points used at any time in the Practise and small versions can be displayed by the option

Projects => Check base points

The easiest way to reduce the current point count is to delete any unwanted models with

Models => Delete

The installed icon on your desktop for running the practise version of 12d with these training files is labelled ‘12d v8.00 Practise Training’.

Please Note: Projects created by Practise versions of *12d Model* cannot be accessed by *Release* versions of 12d Model and vice-versa.

1 Installing 12d Model

The *12d Model 8 Installation CD* can be used to install the *Release* and *Practise* versions of 12d Model 8.

The Practise version is limited to a maximum of 5,000 points and creates projects that cannot be accessed by the Release versions of 12d Model and vice-versa.

However the *Practise* version can be used free of charge by 12D Solutions customers and registered *Practise* Users.

Installing the Release Version for Sites Not Running 12d Model 7 or 12d Model 8

For a **new** installation of the **Release** version of *12d Model 8*, the user is provided with

one dongle
one *12d Model 8 Installation* CD
an email or a floppy with the file *nodes.4d* on it with the V8 authorisation in it.

Because most new computers do not have a floppy disk drive, the *12d Model 8 nodes.4d* file will normally be emailed to you rather than sent on a floppy disk. Before installing *12d Model 8*, you must copy the *12d Model 8 nodes.4d* into a folder that can be accessed during the installation.

Please **do not change** the **name** of the ***nodes.4d*** file. The installation and 12d Model will only search for a file called *nodes.4d*. During the installation of *12d Model 8*, you will be asked to browse to the folder containing the *nodes.4d* file.

Please check that you have all three items before commencing the installation.

The ***notes*** for a new install of the *Release* version of *12d Model 8* are on the ***12d Model 8 Installation CD*** or can be downloaded from the 1*2d* web site *www.12d.com* under the *Updates* area.

Installing the Release Version for Sites Already Running 12d Model 7 or 12d Model 8

E**xisting** *12d Model 7* or *12d Model 8* users upgrading to *12d Model 8* are provided with

one *12d Model 8 Installation CD*
one *What's New in V8 DVD*
an email or a floppy with the file *nodes.4d* on it with the V8 authorisation in it.

The dongle you already have will work with the new version of *12d Model 8*.

Because most new computers do not have a floppy disk drive, the *12d Model 8 nodes.4d* file will normally be emailed to you rather than sent on a floppy disk. Before installing *12d Model 8*, you must copy the *12d Model 8 nodes.4d* into a folder that can be accessed during the installation.

Please **do not change** the **name** of the ***nodes.4d*** file. The installation and 12d Model will only search for a file called *nodes.4d*. During the installation of *12d Model 8*, you will be asked to browse to the folder containing the *nodes.4d* file.

The ***notes*** for upgrading to the *Release* version of *12d Model 8* are on the ***What's New in V8 DVD*** or can be downloaded from the 1*2d* web site *www.12d.com* under the *Updates* area.

Important Note

If *12d Model 8* is **already** running on your computer, please **uninstall** it before installing a new version of *12d Model 8*.

Installing the Practise Version:

For a **Practise** installation of 12d Model, all that is needed is:

one *12d Model Installation* CD
or *12d Model Practise* download from www.12d.com

The *Practise* version must be Registered with 12D Solutions once it is installed on a computer. A new Registration is required for each computer that the Practise version is run on.

The ***notes*** for installing the practise version of 12d Model are on the *12d Model 8 Installation CD* or can be downloaded from the 1*2d* web site *www.12d.com* under the *12d Model Practise* area.

2 Before You Begin the Training

2.1 Installing the Training Files

If you have installed Training from the 12d Model Installation CD, then the *Training* folder will have been automatically created for you but where the files reside on the disk depends on whether you installed the *Release* version or the *Practise* version of 12d Model.

The Training manual dialogue assumes that the working folder (i.e. shortcut) of your ‘12d Model 8 Training’ or ’12d Model 8 Practise Training’ icon is set to

c:\12djobs\8.0\Training   for the *Release* version of 12d Model

and

c:\12 Model 8 Practise\Training   for the *Practise* version of 12d Model

The training files can be installed in any sub-folder on your hard disk.

For convenience in this manual, is assumed that the training files are installed in

c:\12djobs\8.00\Training

but it is very rare in the Training Manual that you ever need to know exactly where on disk the data resides. All the required material is already in the "Training" folder.

2.2 12d Icons on your Desktop

It is recommended that you use the ‘12d Model 8 Training’ icon for the Release version or ’12d Model 8 Practise Training’ icon for the Practise version whilst initially working with this training manual. The reason for this is that the icon points directly to the folder containing the training files.

Be aware that there is a separate ‘12d Model 8’ icon recommended for 12d production work. The shortcut for this icon is generic and is set to

c:\12djobs   or   c:\12d Model 8 Practise   for the "12d Model 8 Practise" icon.

With a little extra button pushing to point to the right path, it is possible to access the ‘Training’ area from the ’12d Model 8’ icon

For convenience in this manual, is assumed that the ‘12d v8.00 Training’ icon is used.

2.3 Using the Practise Version

Remember that the *Practise* version of 12d Model is limited to a maximum of 5,000 points.

Following the procedures as stated in the Training Manual may create projects with more than 5,000 points. Where appropriate, the text will suggest how to vary the input for each instruction so that the example feature can be completed within the limits of the *12d Model Practise* version.

2.4 Overview of 12d File and Folder Structures

Before you begin using 12d, it is useful to understand how 12d uses the file and folder structure under Windows 2000, XP and Vista.

12d recognises long filenames up to 256 characters so you are not limited to the old DOS convention of 8.3 filenames. Whilst long filenames under Windows can contain spaces it is recommended that you use underscores ‘_’ in file and folder names created externally from 12d.

The 12d program and its support files are installed on your hard disk, typically into folder c:\Program Files\12d and various subfolders below. When the software was installed, the ‘12d Model 8’ program icon will have been setup to point to a working folder where your data files will be stored - typically c:\12djobs.

As each job you work on will have different files, it is strongly recommended that you keep each job in a separate subfolder. This is done manually and can be anywhere on your hard disk or network. For convenience, you may prefer to keep them all under one major folder e.g. c:\12djobs.

The tutorial is about designing a road and the training the files have been set up in a folder c:\12djobs\8.00\Training\8.00\Design\Getting Started Basic.

In the general case for production work however, if you were about to start work on a new job by the name 'Highway', you would begin by creating a new folder under 12djobs i.e. c:\12djobs\Highway. This is done either from the *12d Project Selection* panel, or before starting 12d using *Windows Explorer*. Either numeric or alpha characters may be used in folder names so you may prefer to use job numbers rather than names. Also under Windows, 12d is *not* case sensitive for folder names, so 'Highway' is seen as the same name as 'highway'.

If you just accept the 12d default working folder (c:\12djobs) as the place to put your data files, 12d will still operate correctly but it will become difficult over time for you to separate which files belong to which jobs once you have multiple jobs on the go.

2.5 The 12d Concept of 'Projects'

12d can have more than one project within the one Windows folder which can be worked on independently. For example, projects under 'Highway' might be 'Stage 1' and 'Stage 2' or 'Fred' and 'Bill'. Each project has its own data and configuration setup which controls the number of views, which models are on display etc.

New projects like these can be created from within 12d by pointing at the c:\12djobs\Highway folder and then typing a new project name. If this is done twice during separate 12d sessions, you will have created two unique projects. Internally, 12d handles this by creating two separate folders on disk in the Highway folder.

c:\12djobs\Highway\Stage_1.project

c:\12djobs\Highway\Stage_2.project

Because of this structure, the projects can be worked on independently. All internal files from one project are kept separate from the other internal files of another. However, all *input* and *output* files, *mtf* files, *chains*, *plots* and *reports* go into the folder containing the project (e.g. Highway) and are not held inside the project itself. Hence to prevent projects interfering with each other, it is best to create a separate folder and create each project in its own folder.

For example, create a folder "Highway\Stage1" and from within 12d, attach to that folder and then create the project "Stage 1". 12d then creates a subfolder "Stage_1.project:

c:\12djobs\Highway\Stage1\Stage_1.project

Once inside 12d, from within any one project, it is possible to import any or all data from another project so there is some flexibility on a major job to move/copy survey or design data between stages if staging is used and then have multiple users perform parallel development. Model and tin sharing could later be used to subsequently assemble staged project data at the completion of a major job. Within any one project, model names must be unique so some planning is necessary if parallel development streams are subsequently to be reassembled. Models can be renamed at any time. Models are discussed in See Chapter 4.11 (on page 43).

Provided no 12d user is currently accessing a particular project, it (the project folder) can be manipulated just like any folder i.e. copied, deleted etc. using Windows Explorer, obviously external from 12d. Such manipulation is very similar to how Windows Explorer might be used to copy and delete CAD files and folders. Copying and renaming is obviously a fast way of setting up a new development stream or new user.

However, information inside the project folder ***should not*** be manipulated except from within 12d Model since this will corrupt the project and data could be lost. For example, model names can only be renamed from within 12d Model.

At any one time, a 12d session can only access one project. It is possible to change from one project to another without exiting 12d.

The creation of at least one 'Project' under any job is compulsory within 12d. Thus even if there is no concept of staging within the 'Highway' project, you must still define a Project. In this case you might use the same name for both the Job and the Project or name the Project just 'proj'

If you need to manually place any files on disk for this project (e.g. survey files from a total station or CAD files to get data into 12d), it is recommended that you place them in the folder.

c:\12djobs\Highway

The user should never need to know about or manually access the files within the Project folder. To maintain the integrity of 12d, it is important that you never edit any of the ‘internal’ 12d files which are in (typically)

c:\12djobs\Highway\Stage_1.project

2.6 File Backup Procedures

To ensure that you can retrieve any job or project at any time from backup procedures, it is important that a complete ‘set’ of files is taken whenever backup is created. To backup the files associated with the ‘Highway’, you would typically backup all files and sub-folders in and below

c:\12djobs\Highway

There are configuration files used that may be used in the Highway job, that are supplied by 12D Solutions and are automatically installed from the 12d Model CD. These files are in

c:\Program Files\12d\12dmodel\8.00\set_ups

c:\Program Files\12d\12dmodel\8.00\library

There are other user configurable files that 12d may use and require to fully recreate all steps of a project. They are not supplied on the 12d installation CD. These files are typically in

c:\Program Files\12d\12dmodel\8.00\user

c:\Program Files\12d\12dmodel\8.00\user_lib

These folders may contain files that have been configured specifically for your site e.g. your corporate standard mapping, template and plot parameter files, your particular Total Station survey macros and any user defined macros etc. In general, such files are not project specific, however because these files are user configurable they may be changed at any time and hence particular project specific versions of them may be needed as part of the complete file set of a project.

In the above case, the folders shown are for 12d version 8.0. As implied, the files in these folders will never be changed automatically by the installation process when you reinstall a later version of 12d.

The above paths are indicative only. It is possible that folders have been setup at different places for your site. For more information on exactly where all library and user folders are located, refer to the following environment variables in Appendix A of the on-line Reference manual.

USER_4D

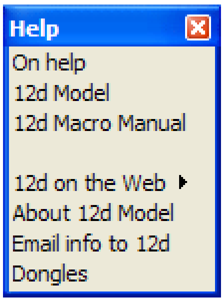
USER_LIB_4D

SET_UPS_4D

LIB_4D

3 12d Model Help

The 12d Help can be accessed by selecting *12d Model* on the *Help* menu item on the main 12d Model menu.



Help on Microsoft's help system
12d Model help
12d macro programming language help

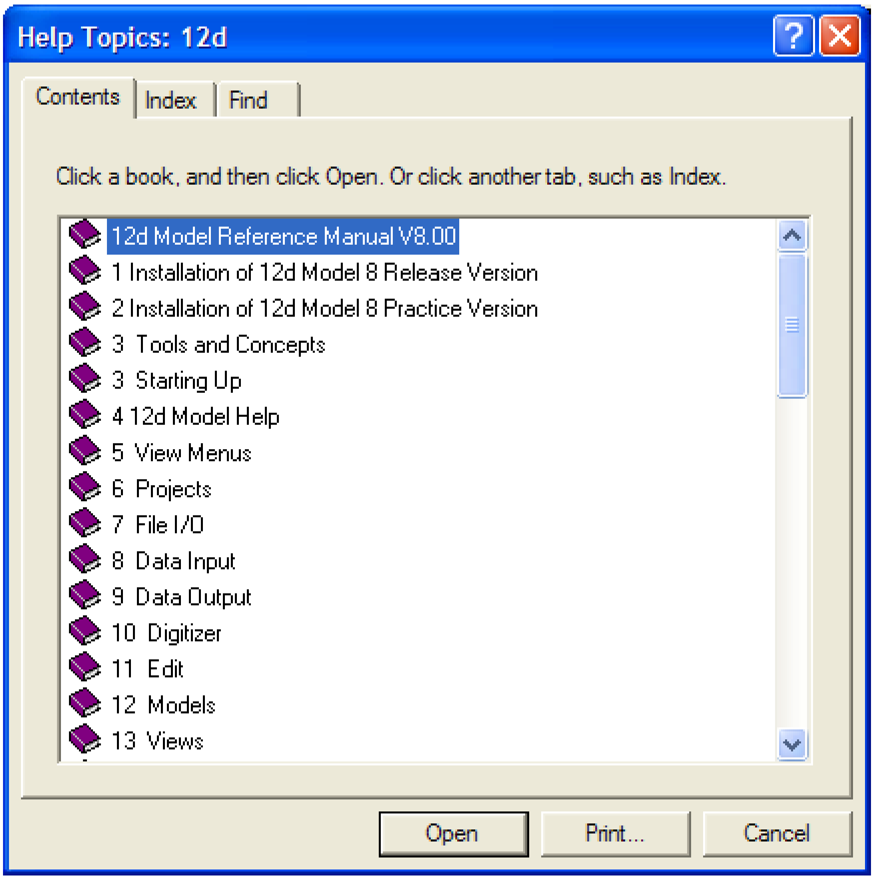
links to web site www.12d.com
12d Model modules authorized
email details of your 12d Model to 12D Solutions
dongle testing panel

Alternatively, individual topics for a panel or menu can be invoked by using the F1 key or the Help button on any 12d Model panel.

More information on the Help system will now be given.

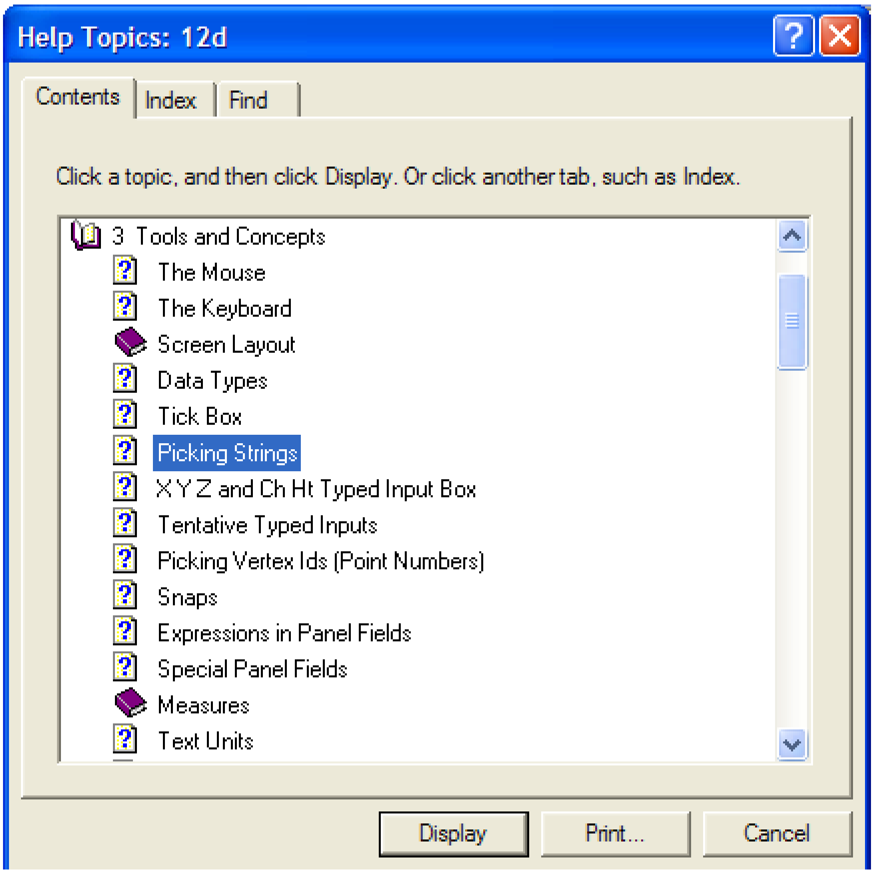
Contents

The **Contents** allows you to look at the overall structure of the Help and access any part of it.



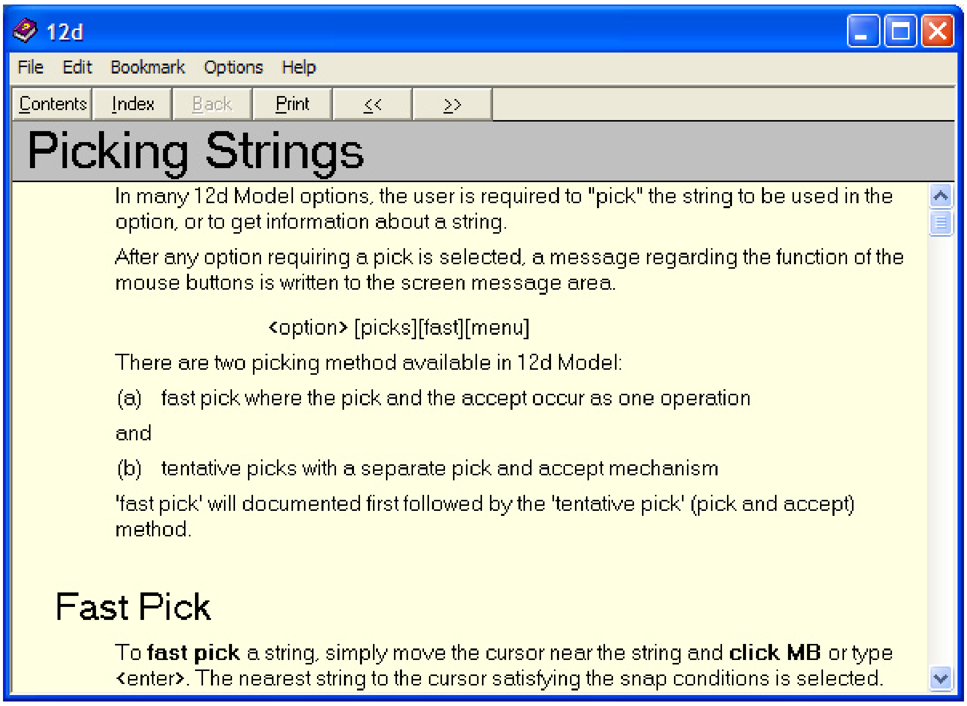
Warning - only *topics* in the Help can be accessed through the *Contents* list so any folders in the Content folders must be expanded until topics are displayed. *Topics* can be easily identified because they have a question mark beside them indicating that Help is available.

For example, double clicking on '*Tools and Concepts*' expands the next level of '*Tools and Contents*'.



Double clicking on the topic *'Picking Strings'* will then display the topic.

The *Contents* then disappear leaving Help open at the selected topic.

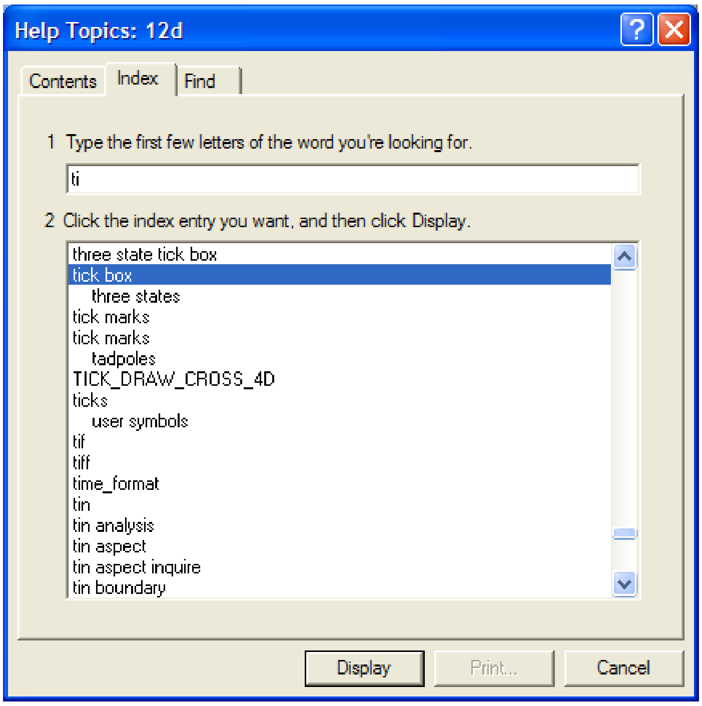


Double clicking on *'Contents'* on the top of the Help will bring the Contents listing back up.

Index

The *Index* option searches through all entries in the Index of the Help.

As the first few characters of the required entry are typed in, the matching index entries are displayed.



Double clicking on the displayed entries will go to the topic in the Help containing the selected index entry. If more than one topic includes the index entry, then the list of topics is displayed.

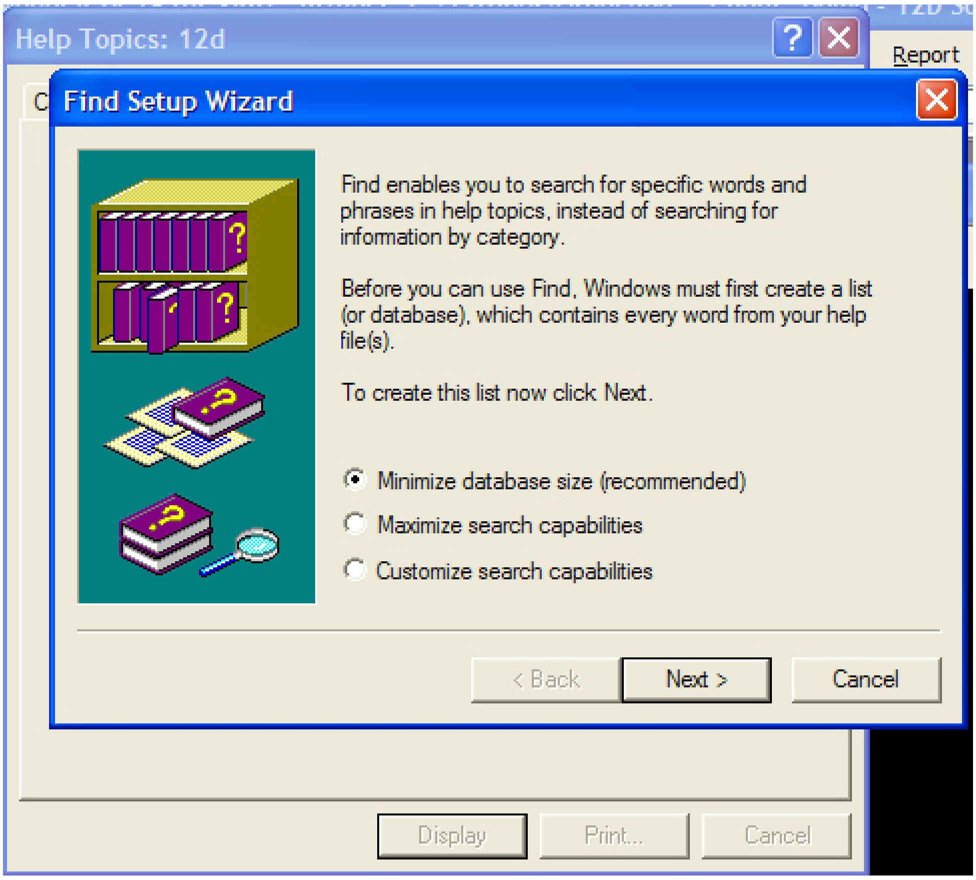
If the index has sub-indices, they can be searched by first typing in the main index followed by a comma, then a space and the first few characters of the sub-index.

Find

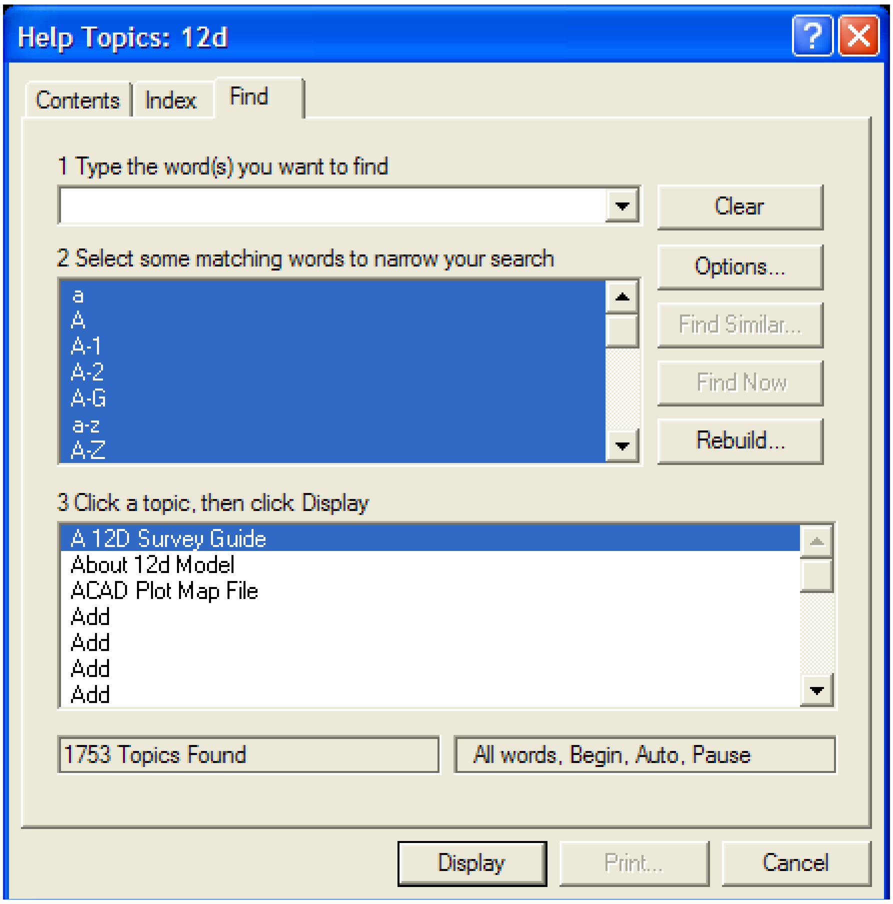
The most powerful searching method for the Help system is *Find*.

Simply click on the *Find* tab to search for words or phrases that may be contained in a Help topic.

If *Find* is being invoked for the first time, the 'Find Setup Wizard' runs to create an index of every word in the Help.

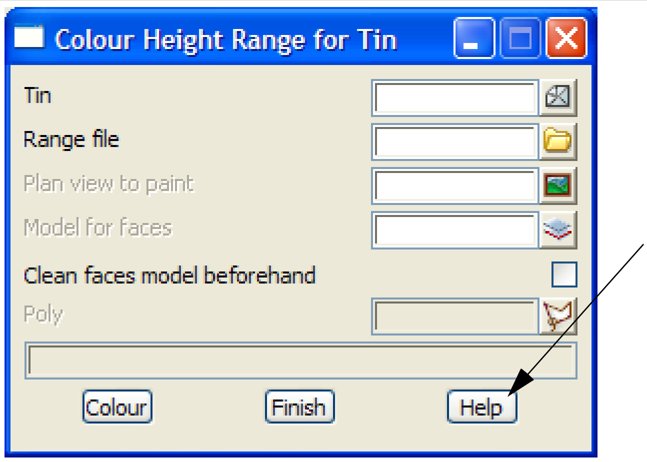


From then on, selecting the *Find* tab goes straight to the *Find* screen.



Panel Help Button

Every panel has a Help button which when selected goes to the *topic* describing that panel.



Help button to go directly to the Help topic for the panel.

F1 Key

Another method of invoking Help is by using the F1 key as follows:

> when a menu or panel is on the screen and has focus (the menu or panel title area will be highlighted), pressing F1 will bring up the help for that menu or panel.

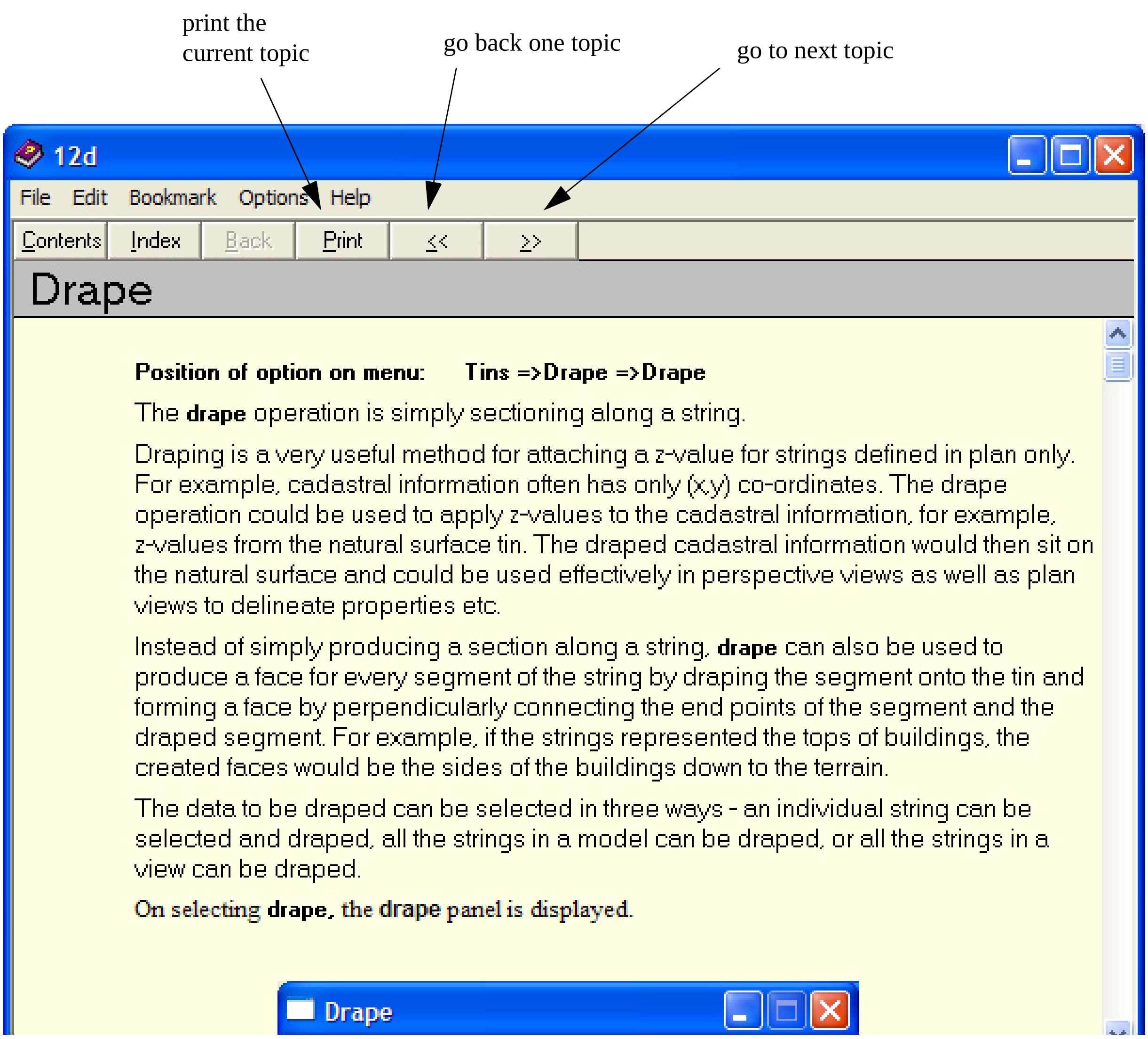
Warning - some of the items on the *Strings* menu automatically start up a string select and change the focus from the panel to a View. This means that pressing F1 will bring up the Help for the View and not the Help for the panel.

To get Help for such a panel, click on the panel to bring the focus back to the panel before pressing F1. The top of the panel will highlight showing that it has focus.

Navigating in Help

Once at a *topic* in the Help, the << and >> buttons at the top of the Help topic will go to the previous and next Help topics respectively.

Individual Help topics can be printed by clicking ***Print*** at the top of the Help page.



Because it is difficult to print large sections of Microsoft's Help system, a PDF file of the entire 12d Model Reference Manual has been created and can be used to print out large sections of the manual.

The 12d Model Reference Manual PDF file is on the 12d Model 8 Installation CD in the folder Documentation\Reference_Manual.

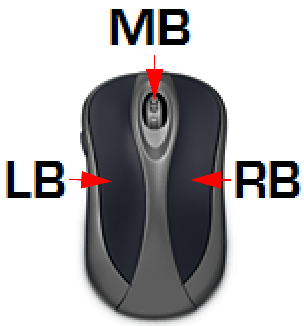
4 Basic Operations

4.1 The ‘Mouse’

12d works best with a three button mouse (preferable a wheel mouse). 12d will work with a (Microsoft) two button mouse but the lack of the middle button means that you have extra mouse clicks to perform.

All 12d Documentation uses the following notation for mouse functions.

LB = left mouse button	- used for picking screen items, menus etc.
MB = middle mouse button	- used to accept the highlighted item
RB = right mouse button	- used to pop up a list of alternatives



The left button is the ‘Select’ button – typically used to select graphic items or text. The middle button (or wheel) is the ‘Accept’ button, used to confirm a selection. The right button is the ‘Menu’ button. It is context sensitive and often displays a list of alternatives available at that instant.

With a two button mouse you achieve this functionality by clicking the right mouse button to pop up the ‘Pick Operations’ menu and then clicking LB on **Accept** or by simply pressing the <Enter> key

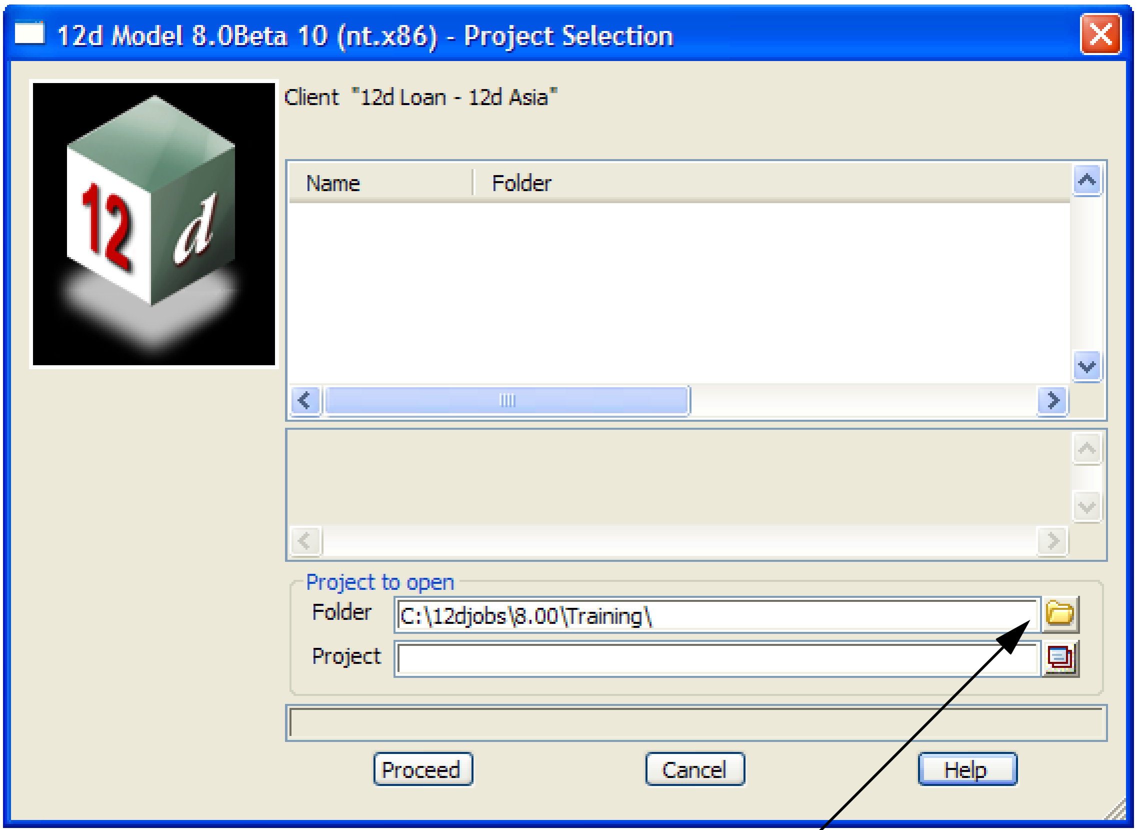
The term ‘clicking’ a button means pressing it down and releasing it again. The position of the mouse is taken at the time the button is <u>released</u>. In this tutorial manual, items that are selected by a mouse click are in **bold**.

As we get more experienced, we will also introduce the term ‘dragging’ the mouse for some advanced 12d operations. We do this by pressing down a button and <u>whilst still holding it down</u>, moving the mouse so that the screen cursor moves. Once a definite distance has been achieved, just a millimetre or two is sufficient, release the button. 12d notes the vector you defined and can use this information to detect the direction in which you dragged the mouse.

Finally, we will use the term ‘double clicking’. This is where we press the button twice in quick succession. This is often used for short-cuts.

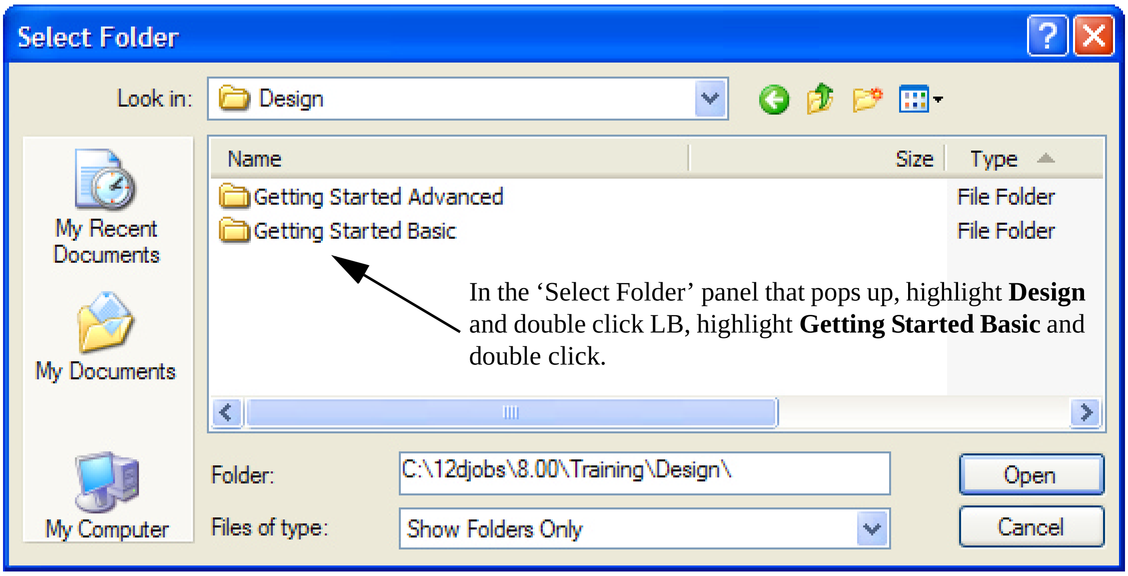
4.2 Starting Up - The Project Selection panel

If you installed 12d Model Training from the 12d Model Installation CD, then a ‘12d Model V8.0 Training’ icon will have been created on your desktop. Double clicking on this icon will take you directly into the 12djobs\8.00\Training folder.



Once you are inside 12d, the Project Selection panel will appear.

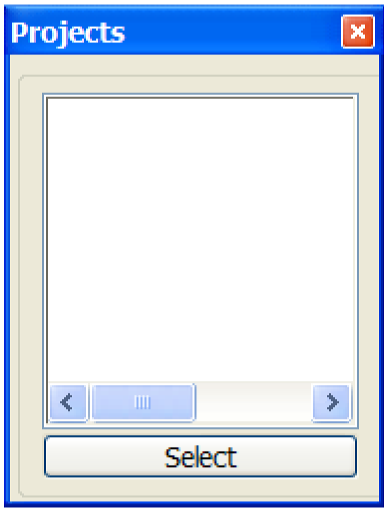
Firstly, click the LB over the *folder* icon at the right end of the Folder field to pop up a panel that allows you to see and point to your directory structure.

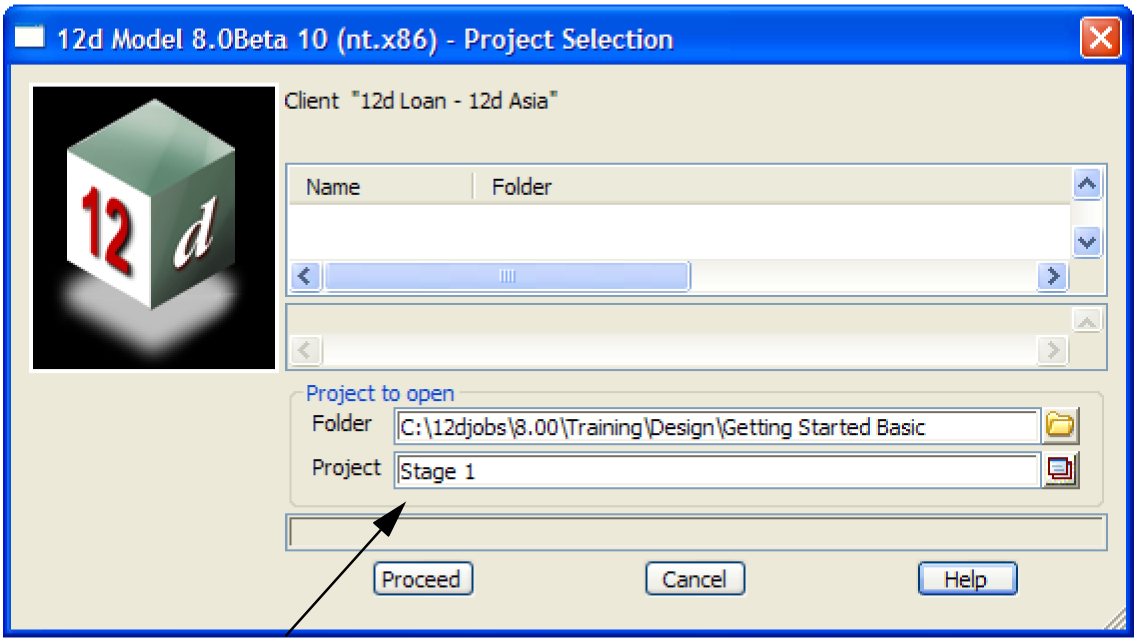


In the ‘Select Folder’ panel that pops up, highlight **Design** and double click LB, highlight **Getting Started Basic** and double click.

Click LB on **Open** to complete the selection and the list of projects in **Getting Started Basic** will be displayed.

Note the pop up list of projects will be empty because there are currently no projects in the folder **GettingStarted Basic**.





You must now supply a name for your new Project. Place the cursor into the Project field, click LB and type ‘Stage 1’.

To continue click LB on **Proceed**

Notes:

1. It is important to select names that are meaningful to your job as you may have several projects associated with a large or complex job.
2. You only need to create a new project once. To access this project in subsequent 12d sessions, double click the LB on the project name from the pop up list. 12d will normally pop up the list automatically. If needed, you can use the  button to open the list manually.

<u>**RULES FOR ENTERING DATA INTO PANELS**</u>

<u>Important: The cursor must be locked into the appropriate data entry field when typing data into a 12d panel. Often this will happen automatically. If you cannot see the cursor flashing in the data field in which you want to enter data, use the mouse to position the cursor anywhere over the data field and click the LB to lock the cursor into the field before typing any data. Terminate the data entry sequence by pressing the Enter key.</u>

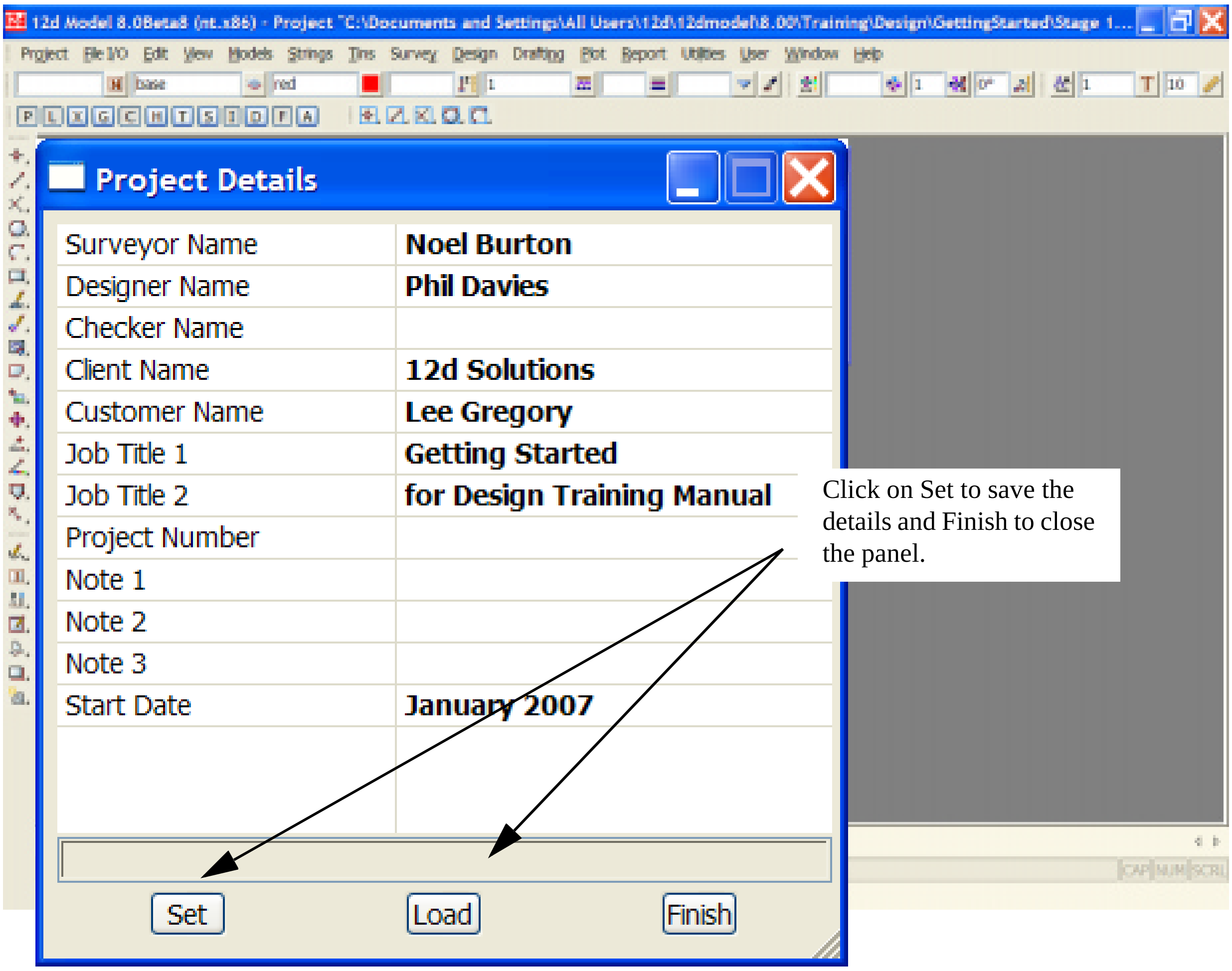
If you make a mistake, you can always select the erroneous entry by double clicking over it with the mouse

LB. The text should then appear highlighted. As you retype it, the old entry is deleted.

When filling in data in any 12d panel, it is not essential to terminate the entry of data by pressing the ‘Enter’ key. You can use the ‘Tab’ and ‘BackTab’ keys to move from field to field. You can also use the mouse to jump between fields. If you do press the Enter key to terminate the entry of data into a field, 12d will immediately validate the data in that field and supply an error message if appropriate

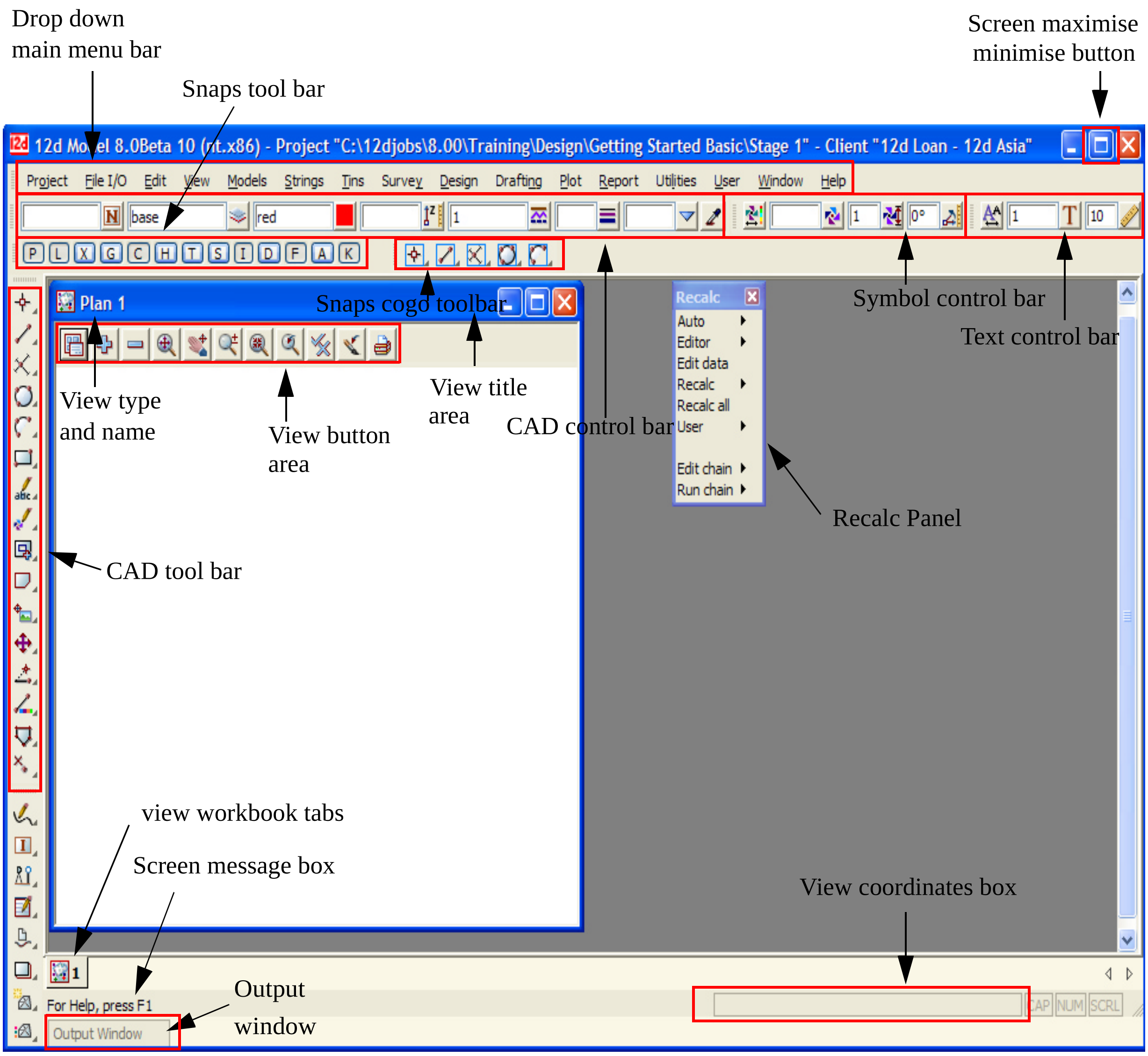
.
Once a project is selected, the graphics screen will display, with the Project Details panel open. Fill in the panel with the relevant required details.

Note that you must use the LB to click between fields and cannot use the ‘Enter’ or ‘Tab’ keys.



4.3 The Initial Screen Layout

The default background colour for a view is black. Black is the best colour for reducing eye strain, and for distinguishing colours displayed in the view. The names we use for the various parts of the screen are shown on the diagram below. Your screen may not appear exactly as shown as most components on the screen can be moved or turned off by user configuration options.

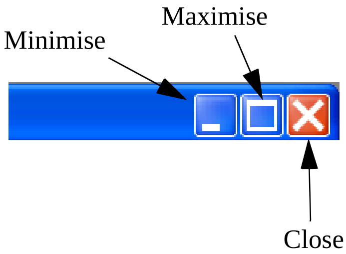


To make the *Getting Started* manuals easier to print on in-house printers, all of our illustrations have a white background colour.

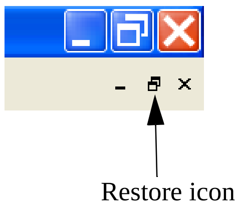
If your screen appears fragmented (as shown in the above view), it is because the main 12d window is not maximised. To bring the various parts of 12d together such that it appears more orderly, click LB on the ‘square’ Screen Maximise button in the top right hand corner of the window labelled ‘12d Model …Project “C:\12djobs\8.00\Training\Design\Getting Started Basic\Stage 1”.

Note that the View with the white background is headed ‘Plan 1’. Each View in 12d is assigned to a Window. Like all Windows, they can be Minimised, Maximised or Closed.

The ‘Plan 1’ View can be maximised by clicking LB on the square button in the top right hand corner of the view menu.

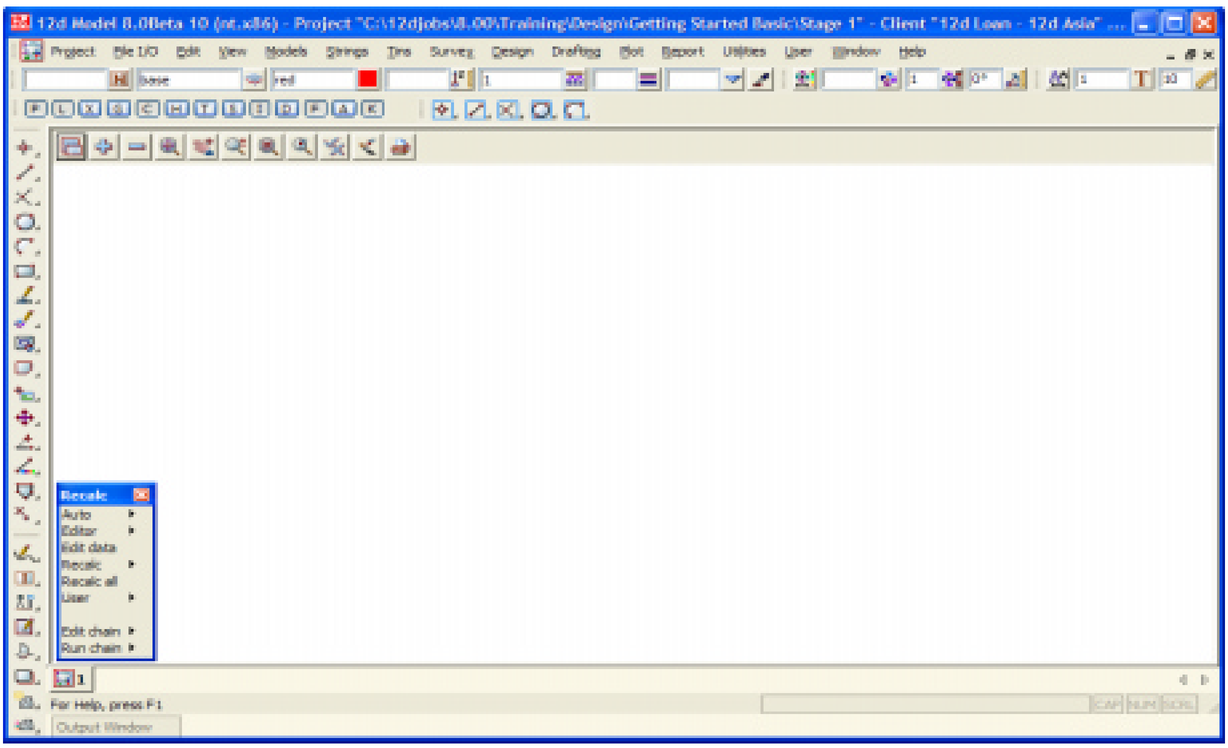


This then takes up the entire viewing area. Alternatively, you can double click LB on the plan view title area to maximise the view (The blue area to the left of the Minimise button). To reduce it back to its original size you can hit the restore icon.



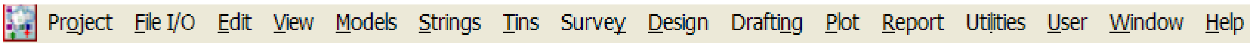
The ‘Recalc’ panel is used to quickly rerun design calculations and will be discussed later. We will move the panel down to the bottom left of the screen.

The view should then look as shown below.

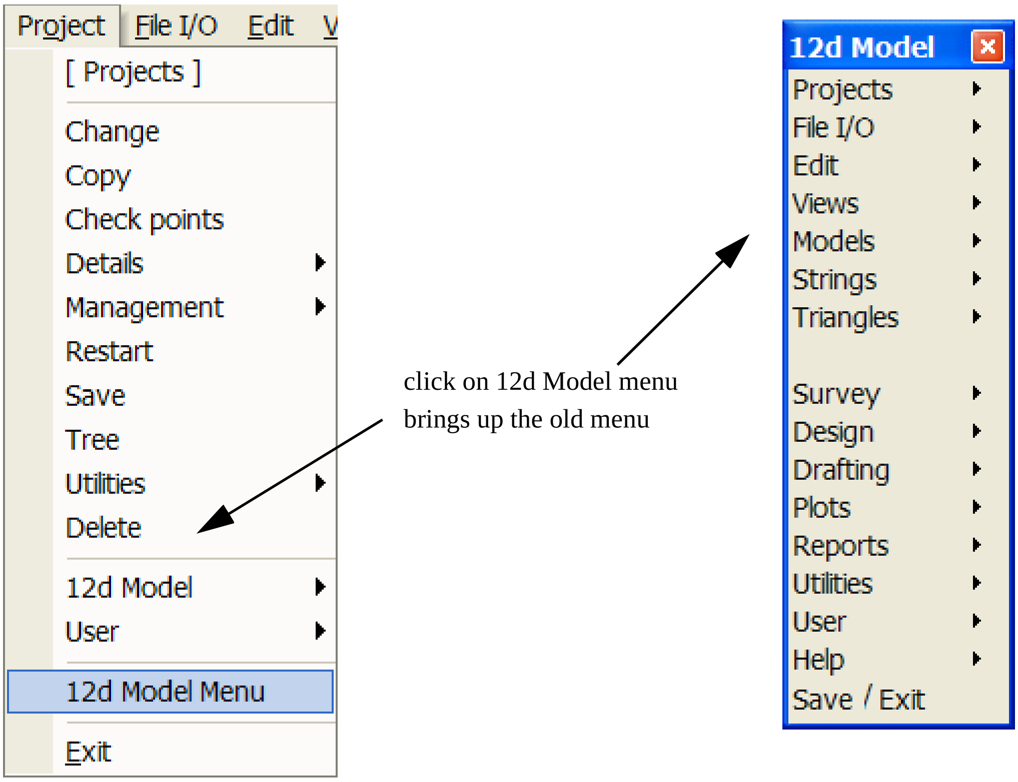


4.4 How to Find Your Way Around 12d Menus

12d options are run by a number of methods. The ‘Drop Down’ menu system from the bar running across the top of the screen is the main way we access 12d programs.



In addition to the ‘Drop Down’ Main menu system, there is a ‘12d Model’ menu which is maintained for compatibility reasons with earlier versions of the software. This is found at **Projects=>12d Model menu**.



12d has a unique graphical user interface (GUI) involving hundreds of menu items. These are logically grouped by function in a ‘Walk Right’ and ‘Tear Off’ menu system. ‘Walk Right’ menus are menus designed such that if you move the mouse cursor right on a menu item containing a right arrow, a further menu will pop up, usually on the right hand side. ‘Tear Off’ menus means that a menu can be torn off it’s parent menu and relocated elsewhere on the screen for clarity of operation. In general, it is possible to have multiple copies of the same ‘Tear Off’ menu on the screen at one time.

Notice that the order of items left-to-right on the ‘Drop Down’ Main menu bar is the same as the top-to-bottom order on the ‘Walk Right’ 12d Model menu. You can select menu items from either one of these sources – the end result is the same.

The ‘Drop Down’ menu bar conforms to normal Microsoft standards so it can be dragged and placed at any of the four sides of your desktop. It is probably most useable left at the top of your desktop.

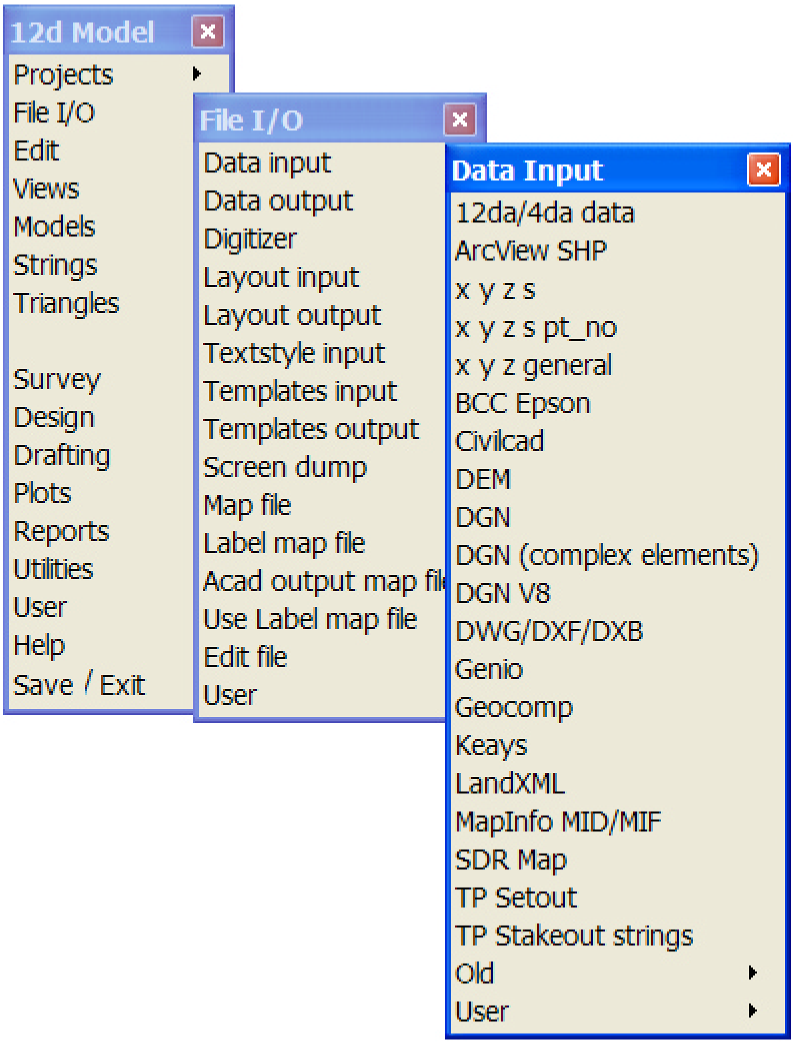
The following comments apply to ALL menus. To move any menu around on the screen, you ‘drag’ it by **depressing** the LB in the ‘blue’ coloured View Title area, anywhere <u>other</u> than over the ‘X’ in the top right hand corner. With the button still depressed, move the mouse to the desired location and release the button to repin the menu. The same procedures also apply when moving panels and views. When doing this just make sure that LB is clicked in the general heading area and not on a View button.

To ease the learning and usage process, a menu description system has been adopted in this manual that describes where to look to achieve a specific function. For instance, to import an AutoCAD DXF file of point and line data into 12d, you ‘Walk Right’ on the 12d Model menu or from the ‘Drop Down’ main menu bar, through two submenus and select DWG/DXF. This instruction is documented as…

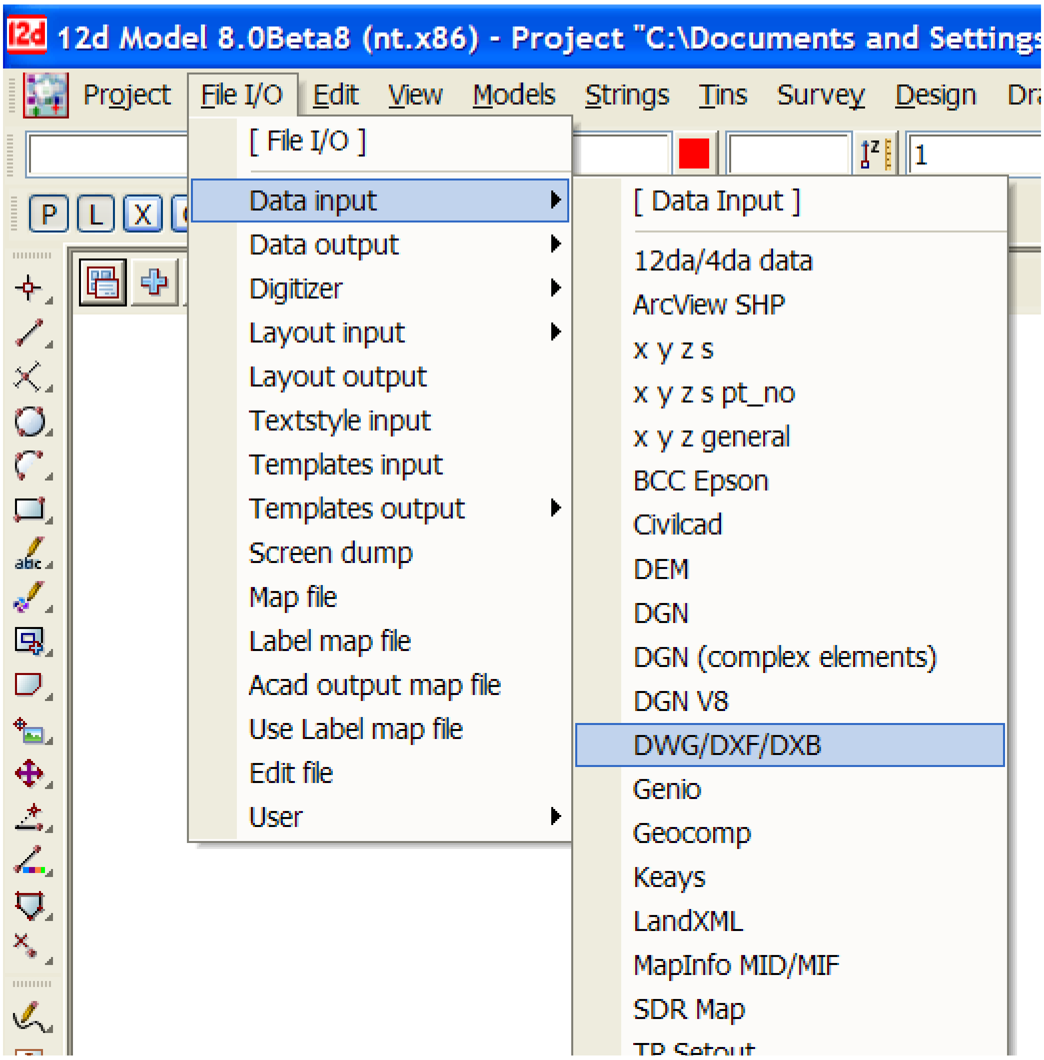
File I/O =>Data Input =>DWG/DXF/DXB

To display submenus from the 'Walk Right', you do not need to use the mouse buttons. Simply position the mouse cursor over the 12d Model menu and once 'File I/O' is highlighted, slide the mouse right over the arrow and the 'File I/O' menu will pop up. Slide further right on the 'Data Input' menu item and the 'Data Input' menu will pop up.

Your screen should appear as follows

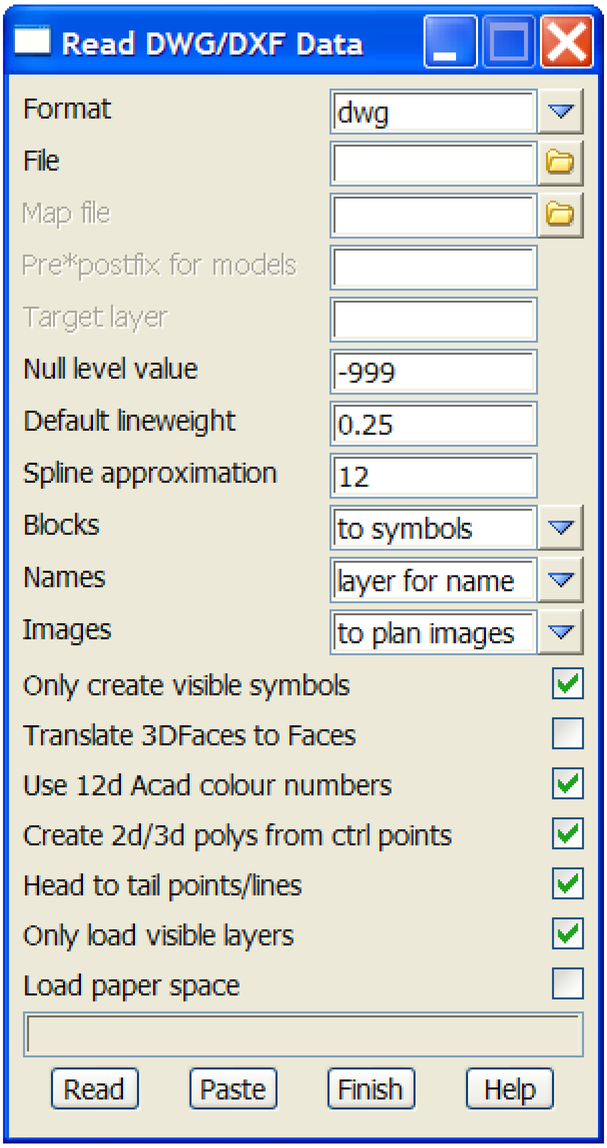


Alternatively, you can use the 'Drop Down' menu bar to get to the same point …


12d Model 8.0Beta8 (nt.x86) - Project "C:\Documents and Settings
Project
File I/O
Edit
View
Models
Strings
Tins
Survey
Design
[File I/O]
Data input
Data output
Digitizer
Layout input
Layout output
Textstyle input
Templates input
Templates output
Screen dump
Map file
Label map file
Acad output map file
Use Label map file
Edit file
User
[Data Input]
12da/4da data
ArcView SHP
x y z s
x y z s pt_no
x y z general
BCC Epson
Civilcad
DEM
DGN
DGN (complex elements)
DGN V8
DWG/DXF/DXB
Genio
Geocomp
Keays
LandXML
MapInfo MID/MIF
SDR Map

To get to this same point using the pull down system, you need to click LB on [File I/O] on the ‘Drop Down’ menu bar and then proceed as before on the walk rights as shown below.

Regardless of which menu selection method you used, place the cursor over the words ‘DWG/DXF/DXB’ and click the left mouse button (LB) once. The ‘Read DWG/DXF Data’ panel will appear.



The panel is placed on the screen at the location where the mouse cursor was when LB was clicked.

Once the panel is selected, the Walk Right menu system should collapse and be removed from the screen. If you move and repin any of the menus however, they will not collapse automatically.

If a menu is in the way, you can move it as stated above. Any menu can be removed by clicking LB on the ‘X’ button in the top right hand corner.

You would normally now start entering data into the panel. At this time, we will not proceed further with this panel. Shut down the panel by clicking LB on the  in the top right hand corner or clicking LB on **Finish** at the base of the panel.

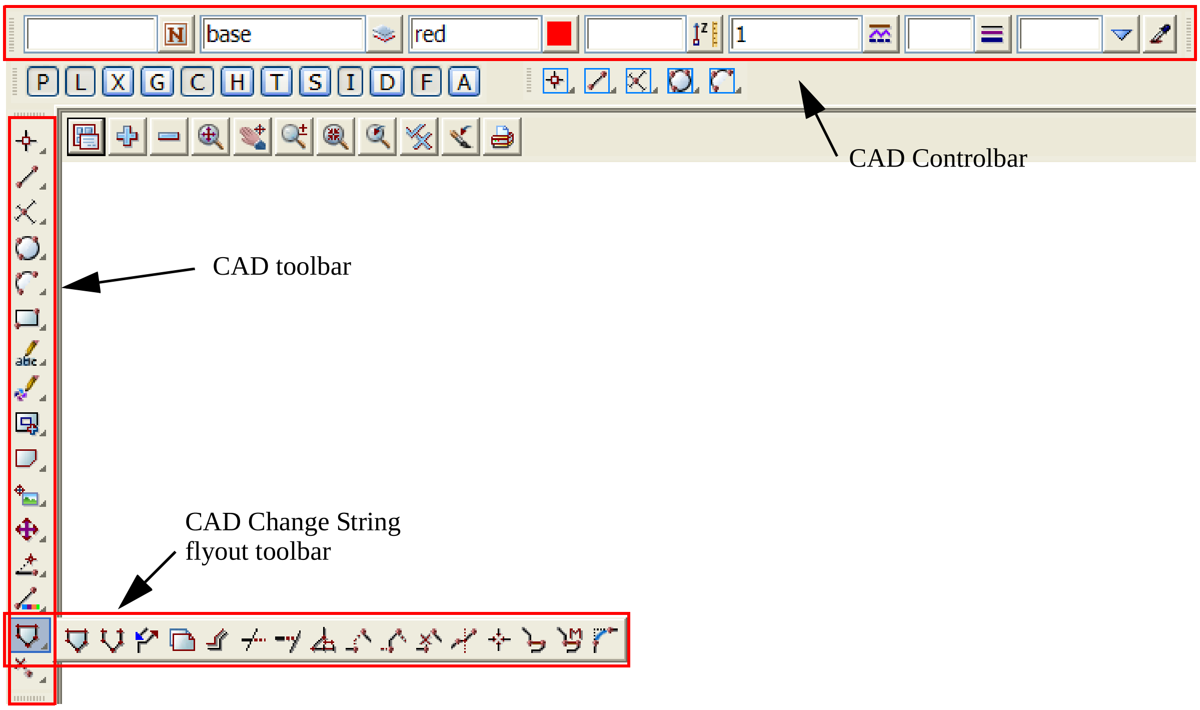
4.5 Toolbars and Controlbars

CAD Toolbar and CAD Contolbar

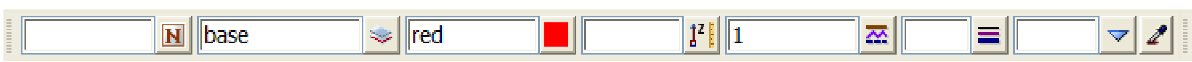
In 12d Model there are CAD options which are available under both the *Strings =>CAD* menu and on the *CAD Toolbar* on the left hand side of the 12d Model screen.

The **CAD** options create various elements using a number of methods. These options make use of **Tool bars** and **Control bars**. Tool bars just have icons on them but Control bars have icons and also controls such as a model box on them. The method groupings are shown on the toolbars (e.g. Points, Lines etc.).

The user can select an icon on the tool bar and a **Flyout** for all options of the grouping are displayed. This can be done by selecting the appropriate group symbol by holding down the left mouse button on the icon. This shows all the different options for that grouping in a flyout panel. Whilst still holding down the left mouse button, the user can move along the flyout toolbar to the appropriate option.



The elements created from the CAD options will have attributes as defined by the **Cad Control Bar**. This control bar is placed on the top left hand side of the screen under the main menu control bar on the creation of a project



The fields and buttons used in this control bar have the following functions.

Field Description	Type	Defaults	Pop-Up
	name box		names.4d names

name of string. If a valid name already exists in names.4d, the **[N]** *button can be used to bring up a choice box of available names. On selection of a valid name, the rest of the values in the control bar will be filled out. e.g. colour, linetype etc.*

model box cogo existing models

this field can be recognised by the model icon button on the right hand side of the field. The user can select an existing model by selecting the model icon. If a new model is to be used, the user simply types the model name into the field.

colour box red standard 12d colours

this field can be recognised by the colour icon button on the right hand side of the field. The user can select a 12d standard colour model by selecting the colour icon

height input Measures menu

this field allows a height or z value to be assigned to the created elements. If a valid value exists, this value will be applied to the created element. This is regardless if the z value was specified in an XYZ box.

If no value is specified, the level will be interpolated where possible. A value of **null** *can be entered into the height field as well so that created points will be given a null height value.*

linetype box 1 valid linestyles

this field can be recognised by the linestyle icon button on the right hand side of the field. The user can select a valid linestyle by selecting the linestyle icon

weight box

this field allows the user to type in a line weight for the cad item created

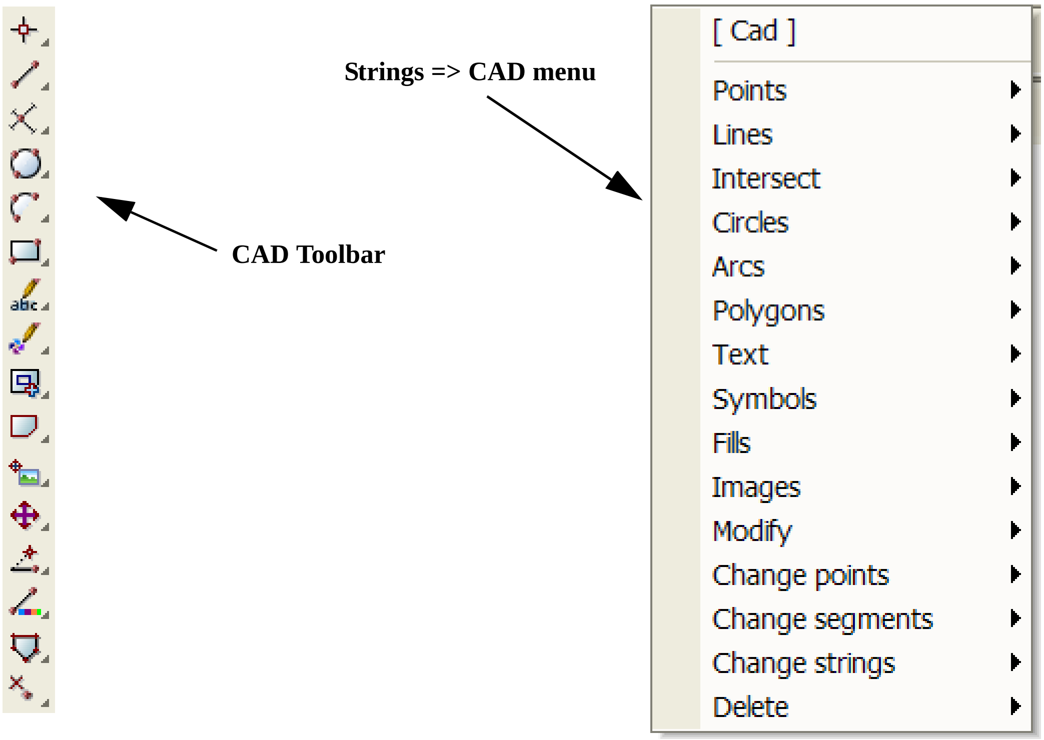
button

the Tinable field sets whether the vertices and segments are tinable (used in triangulations), not tinable (not used in triangulations) or only the vertices (points) are tinable.

button

the eye dropper allows the user to select an existing element which will define the cad control bar values.

The **CAD** options are available from the **CAD toolbar** or from the **CAD** menu under Strings.



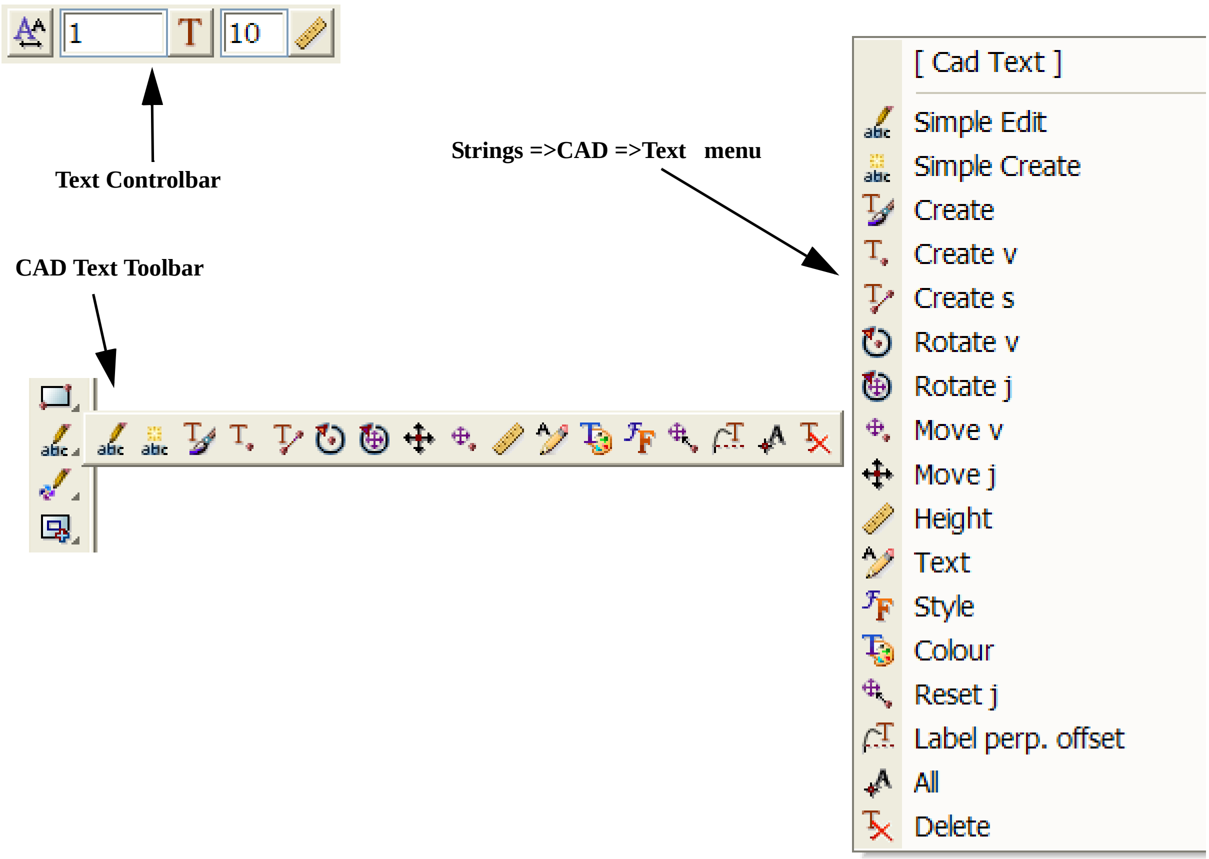
When options are chosen from the CAD Toolbar, help messages are written to the Screen Message Box at the bottom of the 12d Model screen. Since there is no panel or menu involved with the CAD toolbar options, there is nowhere for an F1 key to function for on-line help.

Hence all the CAD options are documented under each of the walk-right menus for the

Strings =>CAD menu.

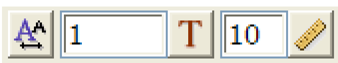
CAD Text Toolbar and Text Controlbar

The various **Text** options are:



Text can occur as a text string, on vertices of a 4d string, and on vertices and segments of a super string. Each type of text has a vertex (these are displayed when Vertices are toggled on in a plan view), a justification point, a rotation, an offset and a raise value. The vertex and justification point only coincide if the offset and raise values are both zero. All text on a 4d string must have the same height, colour, angle, offset and raise. Each part of the text on a super string vertex segment can be independently modified depending on the settings for the super string.

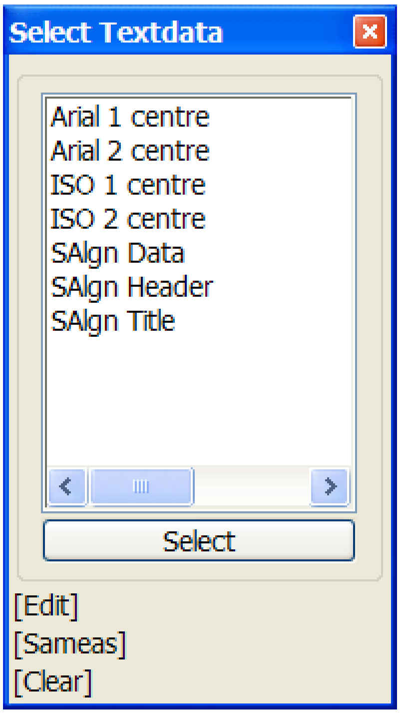
For text options, the created elements will have attributes as defined by the **Text Control Bar**. This control bar is placed at the top right of the screen under the main menu control bar on the creation of a project



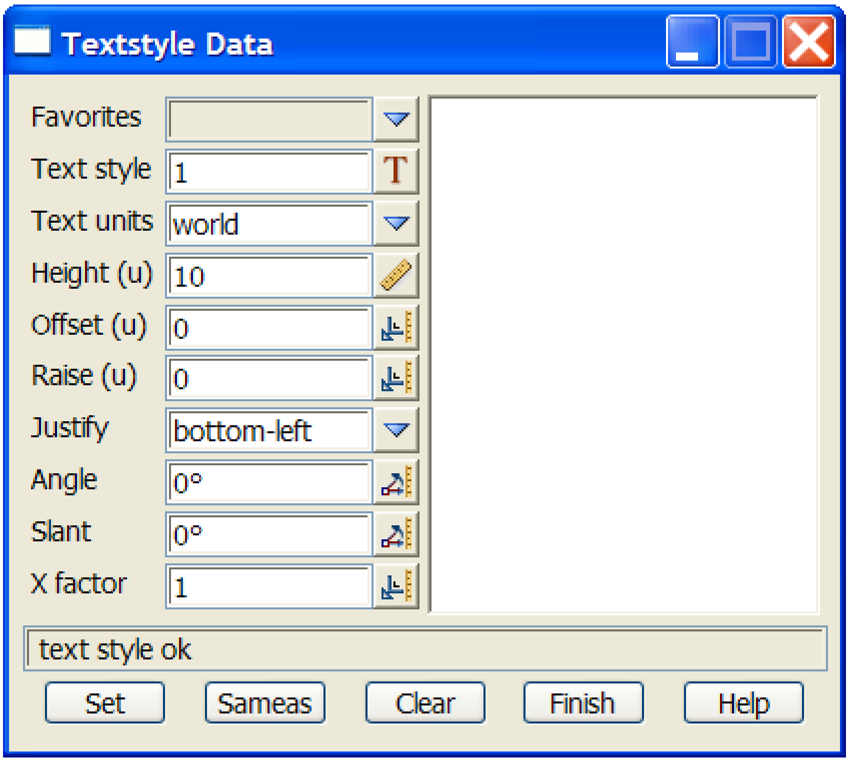
The fields and buttons used in this control bar have the following functions.

Field Description	Type	Defaults	Pop-Up
	Textstyle data box		

On pressing the button a list of available textdata with predefined names read from the ***texstyle_names.4d*** *file are displayed.*



If you require a different textsyle, the user can edit the current settings by selecting the edit button to bring up the **textstyle data** *panel. This allows for definition of textstyle, units, height offset raise etc.*



textstyle box 1 available textstyles

the user can select an existing textstyle by selecting the textstyle icon or entering a value into the input box to the left of the button.

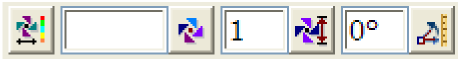
text height box 10

the user can measure a height by selecting the text height icon or entering a value into the input box to the left of the button. The value units are defaulted to world units. This can be changed in the textstyle data box

Symbol Controlbar

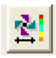
The ***Symbol Controlbar*** is normally at the top right of the 12d Model screen.

Symbol Control toolbar →

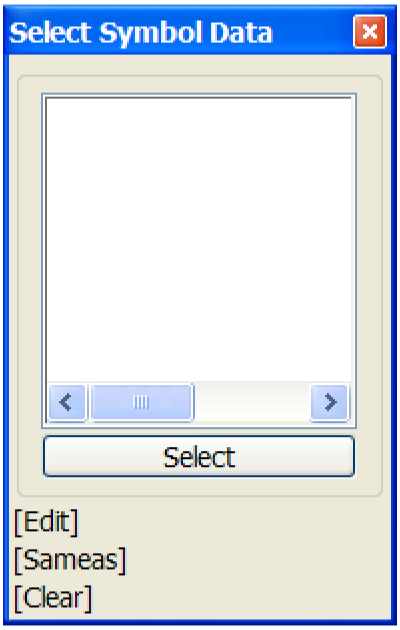


Users can define their own symbols to draw at vertices of 12d Model strings. The definition of symbols are stored in a file called symbols.4d.

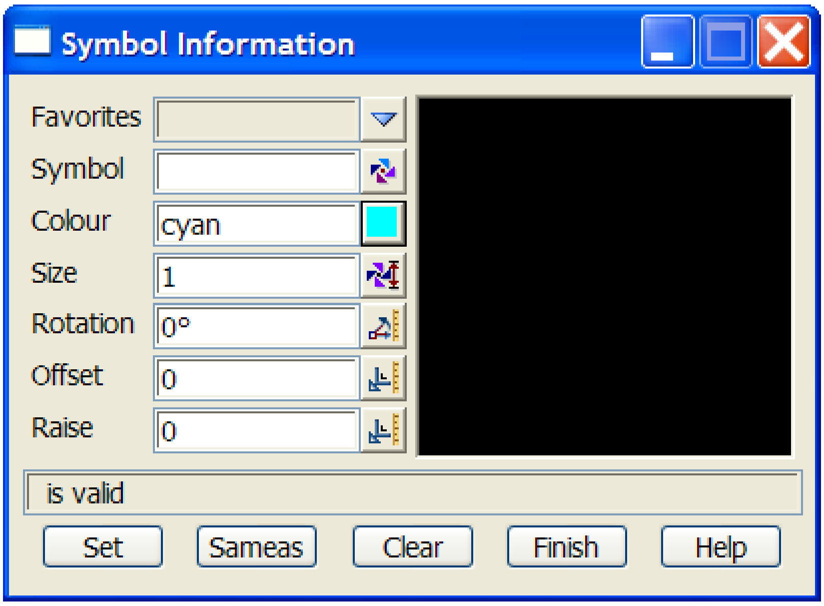
The fields and buttons used in this control bar have the following functions.

Field Description	Type	Defaults	Pop-Up
	Symbol data box		

On pressing the button a list of available symbols with predefined names read from the ***symbols.4d*** *file are displayed.*



If you require a different symbol, the user can edit the current settings by selecting the edit button to bring up the **Symbol Information** *panel. This allows for definition of symbol, colour, size, rotation, offset and raise.*



Snaps Toolbar

The ***Snaps Toolbar*** is normally at the top right hand corner of the 12d Model screen.

Snaps toolbar

Snaps are used when picking strings - see Chapter 7.4 ’Snap Settings’.

4.6 Status Bar

The Status Bar is an optional part of your desktop. It appears at the base of your desktop. The Status Bar contains the Screen Message Box and the View Coordinates Box. It is strongly recommended that you keep it turned ON.

If desired, the Status Bar may be turned OFF at any time. From the **View** drop down menu bar, click LB on **View**, untick the **Status Bar** checkbox. To turn it back ON, repeat the selection but this time tick the checkbox.

4.7 Screen Message Box

The Screen Message Box contains messages that help you interact with the 12d menus. For instance, when importing a DWG/DXF/DXB file as shown previously, you have to select a file name to read. Let us investigate the messages 12d gives us to help us with this simple operation.

If the DWG/DXF/DXB Data panel is not already showing, select it again as shown previously. Click in the ‘File’ name entry data field. Observe that the following response appears in the Screen Message Box

File [Caret][Same As][Menu] select a button

You interpret this help message as follows. 12d is asking you to supply a file name. The three sets of square brackets [ ] correspond to your response via the three mouse buttons, LB, MB and RB.

The LB message ‘Caret’ indicates the position of the cursor if you want to type an answer using the keyboard.

To type an answer, you must first make sure that the cursor is locked onto the field you wish to modify. The cursor must appear as a flashing vertical bar before 12d will accept any data from the keyboard. You can reposition the caret anywhere in the existing word by using the LB. You could then edit it by using the ‘Backspace’ key. Alternatively you can use the ‘Delete’ key to delete the character to the right of the cursor or the Arrow keys to move within the word. The ‘Home’ and ‘End’ keys take you to either end of the existing entry. To delete the entire entry, double click anywhere in the text to highlight it. Then press the delete key to erase the entry or just start typing to replace it.

The MB message ‘Same As’ indicates that you can point at any existing item on your desktop. This would not normally be used for a file name.

The RB message ‘Menu’ puts up a menu. At this time, no items are available. If another filename was copied to the windows clipboard then the ‘Paste’ would be highlighted.

Or finally, you can click LB on the folder icon to locate the required file

The Screen Message Box area changes dynamically with the position of the cursor on the screen so watch it closely for helpful messages.

4.8 View Coordinates Box

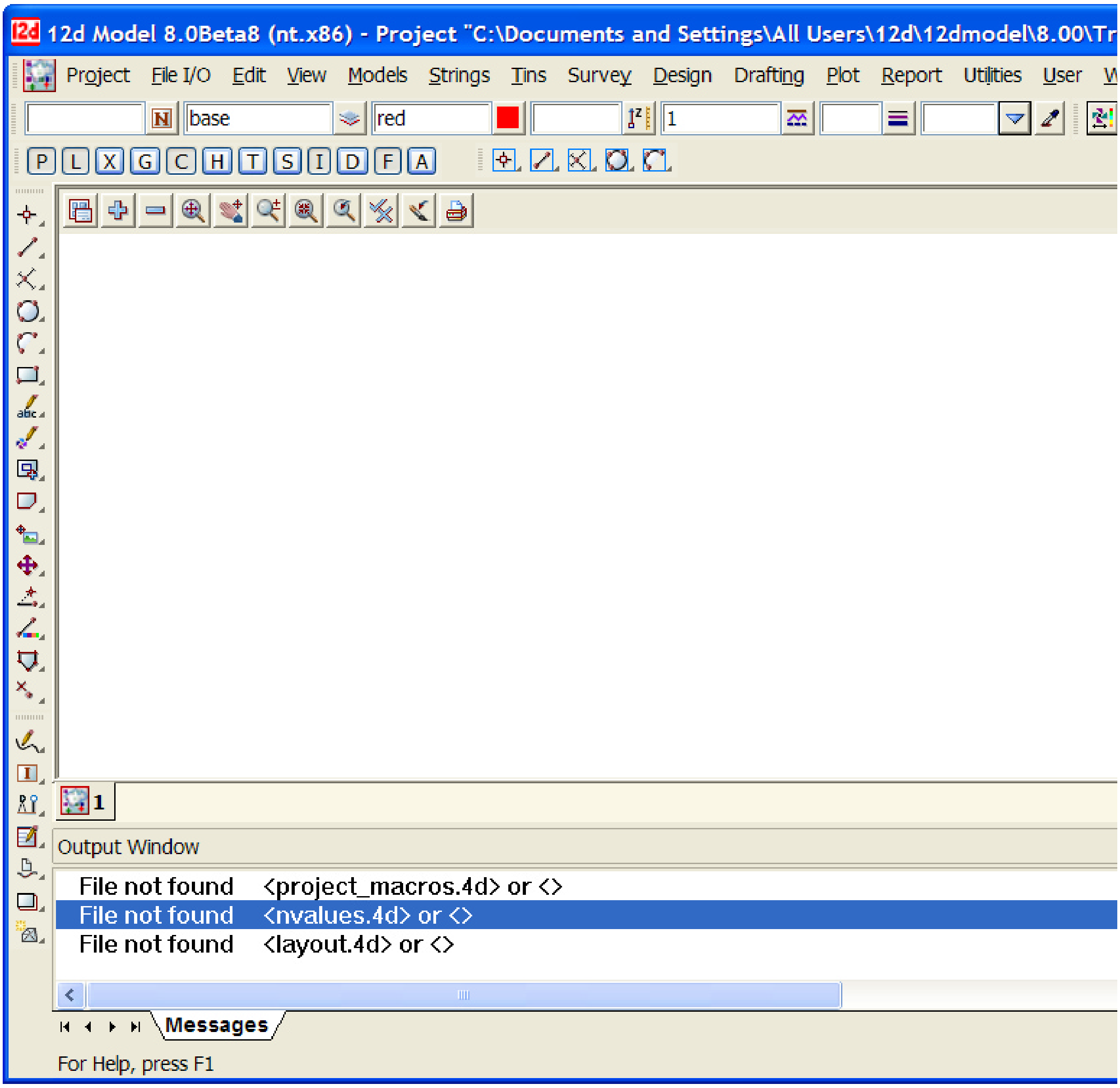
Note the location of the View Coordinates Box at the bottom right of the desktop. This box displays the X-Y coordinates of the cursor when in a Plan view and Chainage-Height when in a Section view.

4.9 The Output Window

Unlike previous versions, the Output Window by default no longer appears as a full desktop width white background window just above the Status Bar, but instead appears as a tab at the bottom left of the screen and flashes if there are any messages that need to be reviewed. This Window can be pinned to your desktop, but to maximise use of your desktop for 12d views etc., it is best to leave it as is. You can also convert the output window to a view, just like a 12d View.

To turn the Output Window OFF at any time, you need to access the menu bar that appears across the top of your desktop. From the Window Drop Down menu bar, click LB on **Window**, untick the **Output Window** checkbox. To turn it back ON, repeat the selection but this time tick the checkbox.

To make the Output Window appear as a normal Window on you desktop, place the cursor anywhere over the ‘white’ background area of the Output Window and click RB. In the pop up menu, click on the **Convert to Window** menu with the LB. The command Window will then appear somewhere on your desktop as a Window. It may be moved by clicking LB in the blue Output Window heading area, dragging the cursor to another part of your desktop and releasing the LB to pin it down.

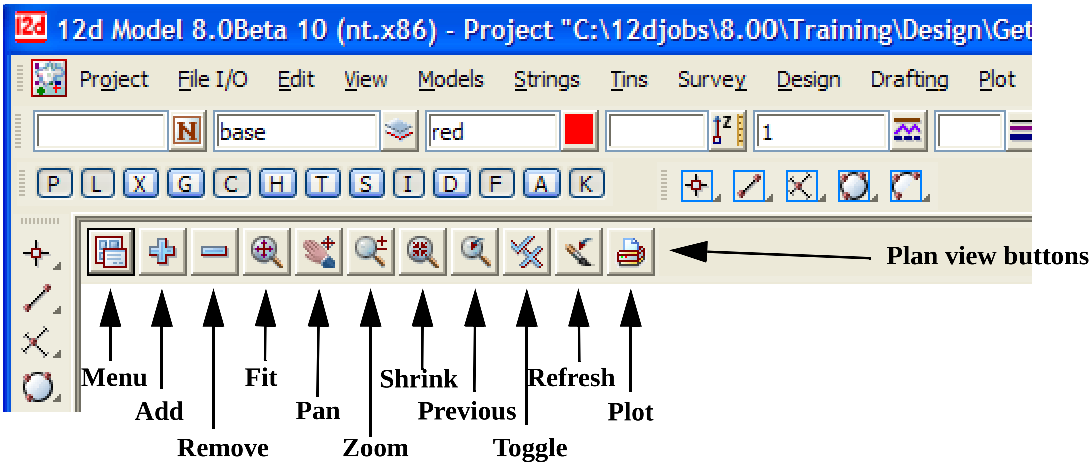


If you wish to close the "floating" Output Window just click on the  as you would with any other view.

There are three view types available in 12d. They are Plan, Section and Perspective. It is possible to have multiple plan, section and perspective views on the desktop at one time, each showing different information. There is no limit to the number of views you may create.

Each View has a View type and name such as ‘Plan 1’, ‘Section 2’ etc. The name appear in the View Title Area. This is the blue heading at the top of each view. Just below the name is the View Button Area which contains the most common View buttons (i.e. a subset of the complete list of view options). The View buttons appears horizontally after the view name. The View Button Area appears automatically with each view as the view is created and each view type has different view buttons that reflect it’s characteristics. The view name defaults to a number but can be over typed with any alphanumerics.

The view buttons on the Plan view are:



Each view also has its own menu (the view menu) which can be brought up by clicking the LB on the view button called ’**Menu**’.

The View menus can also be brought up in another special way:

> if you click the RB in the View Button Area or the View Title Area, you will also get the View menu to pop up. Clicking RB again in the View Button Area or the View Title Area will remove the view menu.

So by using the RB, view menus can be accessed even if the ’Menu’ item is not visible in the View Button Area.

The View menu contain options available for that particular view type. It is a superset of the buttons that appear on the horizontal View Button Area. If the View is made very small or moved off the right hand side of the desktop, the various buttons on the horizontal View Button Area will not be selectable as they will not be visible. In such case, you have to use the RB in the View Button Area to get access to the various View menu items.

Views may be created, resized, overlapped, moved and deleted as required. When you create a view, 12d will automatically supply it an ascending number for reference purposes e.g. ‘Section 2’. Views can overlap Menus and Panels that are already on the desktop.

Hence there are four menu systems in 12d, one for each view type (plan, section and perspective) and an overall main menu.

4.10 Basic View Operations

We will now practice some basic View operations

To create a new View, select **Views=>New=>Plan** from the main menu to create a view with the next view number.

Alternatively, you can use **Views=>Create=>Plan View.** Pick **Create** with the LB after first supplying a View name or accepting the ‘number’ supplied by 12d as the View name.

Once the View is on display, the following operations can be performed from the View Button Area at the ‘top’ of the View. To move a View to a new location on your desktop, depress the LB in the View Title Area – the ‘blue’ area showing the words ‘**Plan 1**’. Whilst you still have the mouse button depressed, drag the mouse and you will see the View move. ‘Pin’ the View again by releasing the LB.

Use the standard Windows features to change the size of the View. Place the cursor near any corner or midside of the existing plan view and when the drag arrows popup, depress and hold down the LB and drag the mouse to see the Window size change. Pin the new location of the corner by releasing the LB.

To delete a View just click LB on the ‘**X**’ button in the top right hand corner of the view. You can also delete a view by clicking LB on the Menu button in the View Button area to popup the View menu and then click LB on **Delete**.

For the purpose of the tutorial, leave one large Plan View ‘1’ on the desktop. We will subsequently demonstrate how the various views are linked. Information in a Plan view can also appear in Section and Perspective views for instance.

4.11 Introduction to Models

Models are a 12d concept also present in most CAD systems. It is similar for instance to the layering concept in IntelliCAD and AutoCAD, or level in Microstation. Basically each Model represents a repository for data. Each point or line that is created or imported into 12d is put into a Model. By turning Models ‘On’ and ‘Off’, it is possible to change the amount of information that is displayed. This control is provided in each View so it is possible to have different Models on display in different Views.

It is important to note that the data in the various models is always permanently stored in 12d. It is a user controlled convention to only show a subset of models at any one time.

There is no limit to the number of models used in any one 12d Project.

If you want multiple copies of a certain line (i.e. string), it is possible for instance to copy the line from one Model to another. The lines can then be displayed independently. If both Models were on at once, the information will appear as one line instead of two since the strings are coincident. It is possible to selectively snap to and edit either line in such a case.

At any time, individual Models can be **Renamed, Duplicated, Cleared** (removes all points and lines but the name of the model is retained) or **Deleted**.

Models can be temporarily **Removed** (from selection lists) and subsequently reinstated through the **Add** function.

It is also possible to copy models between projects (See **Models=>Utilities=>Copy Project Models**). These are advanced features of 12d that we need not concern ourselves with at this time.

4.12 Introduction to Strings

12d is very much a ‘strings’ rather than ‘points’ based system. In it’s simplest form, a string is a line between two points or vertices. In fact a single vertex is also a special type of string known as a ‘point string’. A string may be made up of multiple straight line segments connecting many points (vertices). Strings may contain curves and arcs as well as straight lines. Strings vary in complexity from 2d (x,y and constant z value) to multidimensional (e.g. an alignment string has both horizontal and vertical geometry independently defined). In general, as well as x, y and z values, strings have properties such as string name, string type, string colour, line style, and chainage. Strings also have a ‘point/line’ property that can be set such that they appear as ‘disconnected points’ or ‘connected lines’. From a design point of view, strings are much more useful than points.

4.13 Introduction to Panels

A panel is simply a means of supplying multiple answers to 12d in a concise manner. Once a panel appears on the desktop, you can use the mouse or the Tab and BackTab keys to position the cursor over any data field. Remember, when typing data from the keyboard, the cursor must be flashing in the data field for characters to be accepted.

When supplying data to a 12d panel, you do not need to terminate the entry of data into a field by pressing the *Enter* key. For instance, you can use the Tab and BackTab keys or the mouse to move to another field after entering data. If you do press the *Enter* key to terminate the entry of data into a field, 12d will immediately validate the data in that field and supply an error message if appropriate.

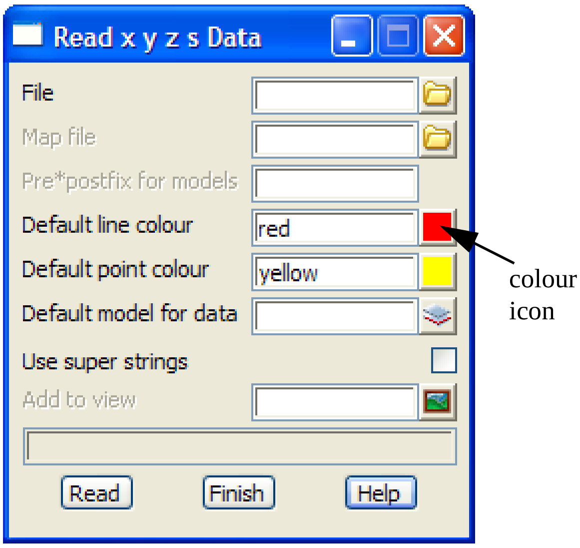
When validating 12d supplied or previously entered data in other words, where you do not need to change the data in a field - it is not necessary to place the cursor in the data field. Just press the *Enter* key to pass through each field in the panel in turn.

When typing data into a field, please observe that the ‘Delete’ key deletes a single character to the right of the cursor. The ‘Backspace’ key is also active. If you need to delete multiple characters, drag the LB across the characters to highlight them (or double click over a word) and press the ‘Delete’ key to delete them or start typing to replace them.

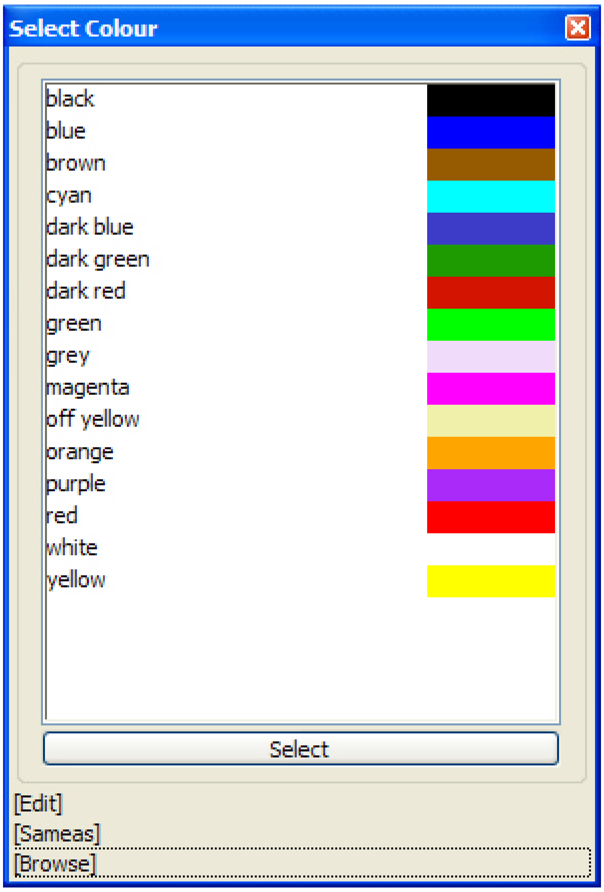
In general, 12d has been setup so that data can be selected from lists rather than typed from the keyboard. When entering data into a field, if there is a list of alternatives already known to 12d, pressing the LB at the icon the end of the field will display the list.

To practice this, bring up the ‘Read xyzs Data’ panel - .from the Main menu, click LB on

File I/O =>Data Input =>xyzs



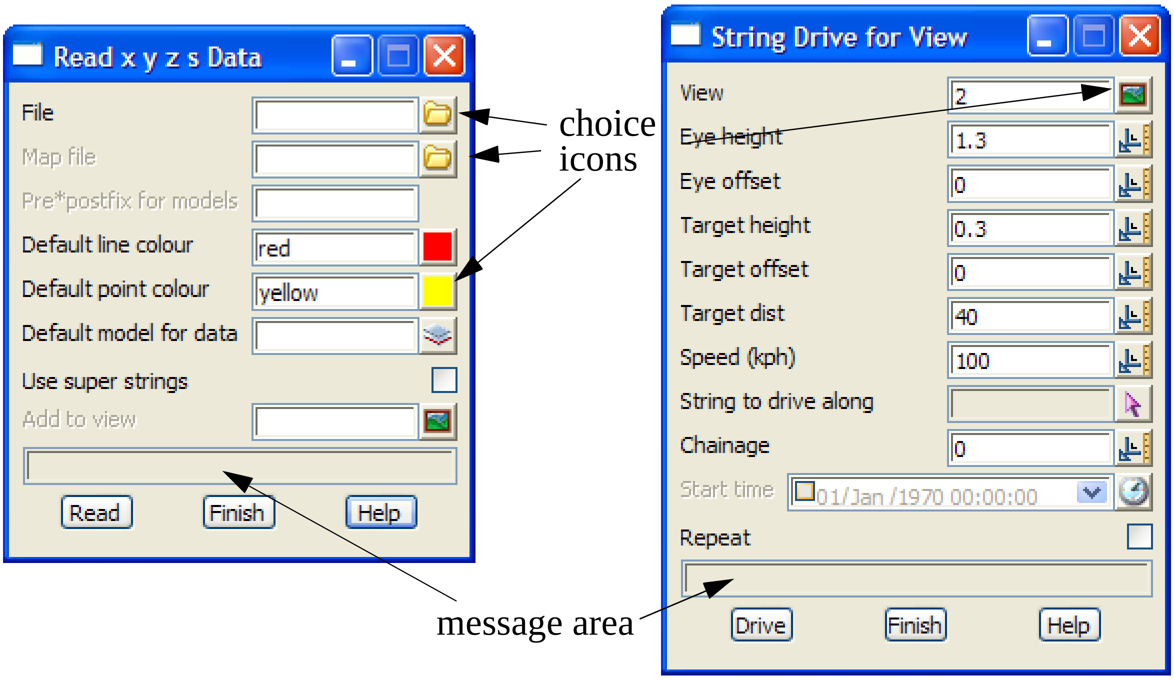
click LB on the colour icon to bring up the list of colours



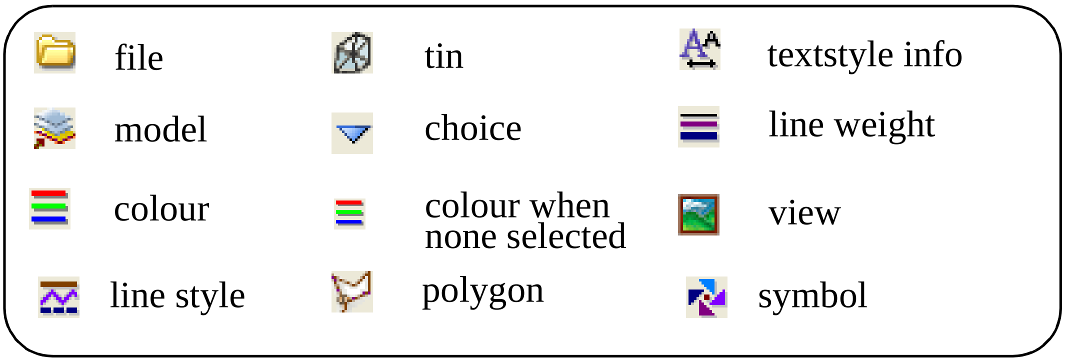
Set the ‘Default line colour’ in the above panel to ‘dark green’ by clicking LB on the colour icon (the little white box to the right of the word ‘white’ in the fourth data field). A list of available colours will pop up. Use the mouse to click LB on ‘dark green’ and then process it by clicking LB on the **Select** button at the base of the panel.

Alternatives: You can double click LB on ‘dark green’ to short-cut this sequence. You could also have used the down arrow key to work your way down through the list to highlight the word ‘dark green’ and then pressed the Enter key.

In a manner similar to the colour panel field just discussed, most panel fields have a pop-up list of choices available and the list is activated by clicking on the icon at the right hand end of the panel field. Some times there will be a special icon such as the ’colour’ icon in the previous example or the file box icon at the end of the ’File’ field of the Read DWG/DXF Data panel.



Other icons that may be used are:



Note the message area at the base of the panel (just above the **Read** button in the ’Read xyzs Data’ panel). Each panel has its own message area to help you interact with 12d. If 12d does not appear to be working the way you think it should, you will often get helpful information in the Panel Message area if you make a mistake. Look in the Screen Message Box as well as it is also updated when interacting with panels.

If a panel is in the way, you can move it as stated above. Any panel can be removed (shut down) by clicking LB on the ‘**X**’ button in the top right hand corner or by clicking on the **Finish** button.

If you want to keep a panel that is already filled in such that you can refer to it later, you may decide to temporarily minimise it by clicking LB on the ‘**-**‘ button. It can later be maximised again by clicking LB on the ‘overlapping windows’ button (where the ‘**-**‘ used to be).

As we don’t wish to proceed further with this panel click LB on **Finish** or click LB on the **‘X’** button in the top right hand corner of the panel.

5 Starting the Tutorial

Before starting your tutorial, it is assumed that your overall desktop layout is as shown in Chapter 4.3, i.e. one large plan view on display called ‘Plan 1’.

5.1 Importing Point Data into 12d

The easiest way to understand the use of Models and Panels is to import some data into 12d and see by example.

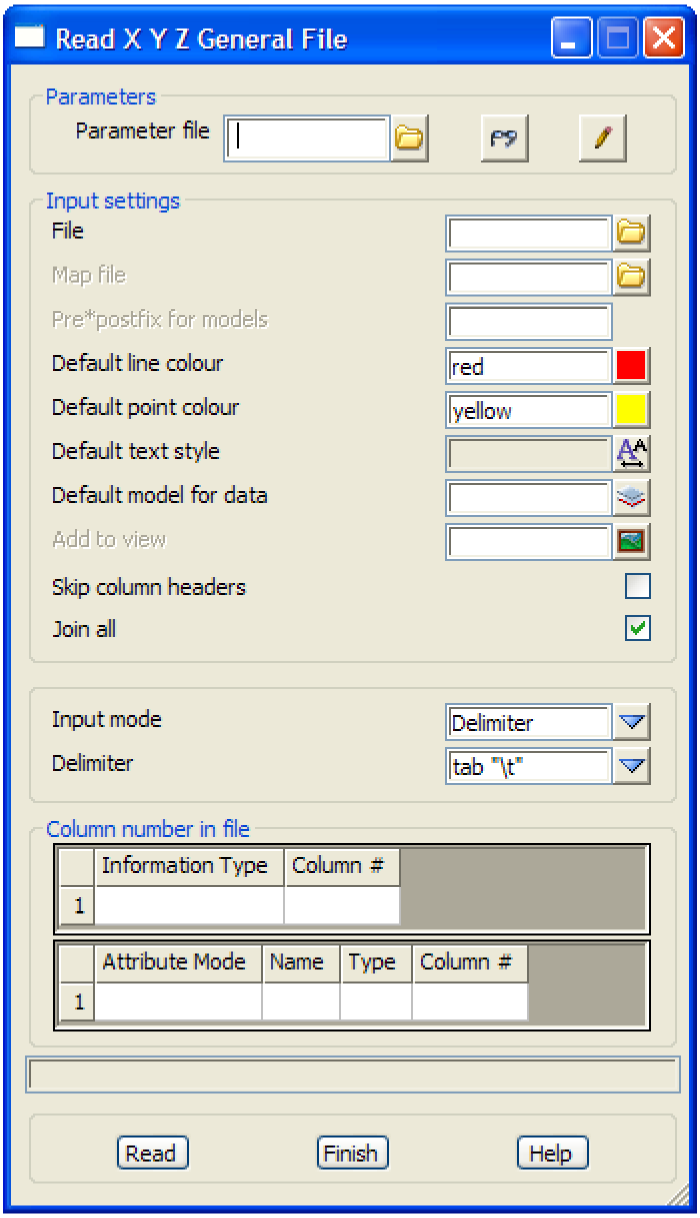
Point and Line data can be imported into 12d from a variety of sources. For the purposes of the tutorial, we will use the simplest of these - a simple ASCII file containing point number, x, y and z coordinates along with a code.

We will begin by reading in a Points file called ‘DETAIL SURVEY.dat’.

```
1,42518.873,36865.368,71.833,DR,1
2,42535.232,36859.942,69.805,DR,1
3,42556.394,36847.968,69.349,DR,1
4,42572.709,36848.796,67.75,DR,1
5,42592.277,36848.967,65.879,DR,1
6,42606.098,36848.526,64.818,DR,1
7,42612.6,36847.949,64.739,DR,1
8,42410.27,36954.217,72.574,DR,2
9,42419.677,36955.067,71.904,DR,2
10,42433.789,36954.863,70.552,DR,2
11,42446.673,36955.149,69.777,DR,2
12,42460.181,36955.284,68.955,DR,2
13,42474.806,36955.092,68.24,DR,2
```

The format is one point per line containing a point number, x, y and z coordinate, string name and string number all separated by commas.

To read in the file, click LB on **File I/O =>Data Input =>x y z general** from the Main menu.

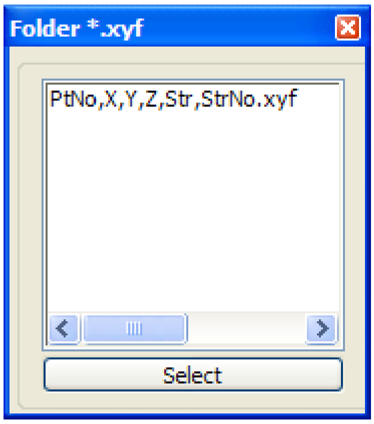


12d gives you the ability to fill in this panel once and then save the setup to a parameter file. This allows you, on subsequent occasions, to call up the parameter file and then you only need select the data to be read.

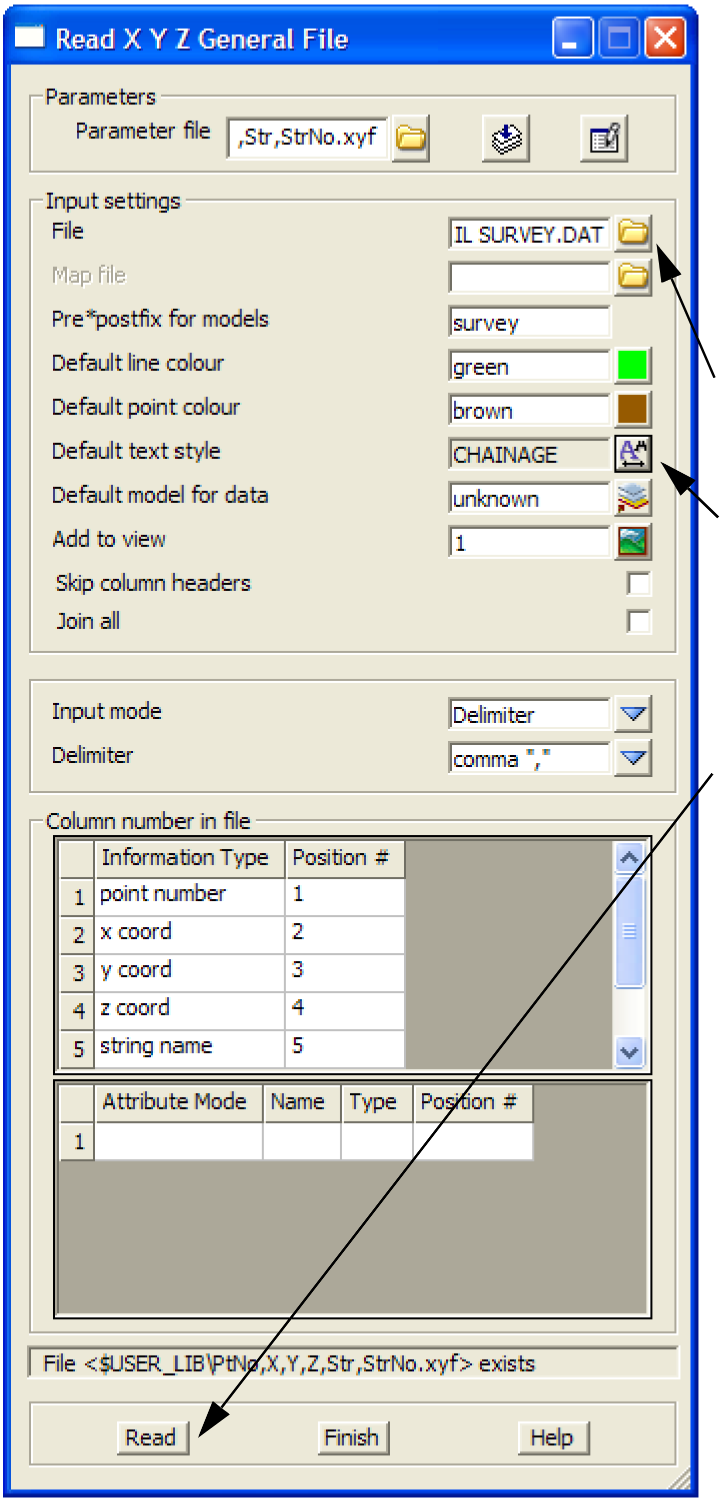
To make things easier we have already created a parameter file and stored it in the user library.

Click on the folder icon at the end of the ***Parameter file*** field.

A blank folder panel will pop up, but if you walk right on the [User Lib] directory at the bottom of the panel you will see the file PtNo,X,Y,Z,Str,StrNo.xyf



Double click on the file and click on the Read icon to read it into the ***Read X Y Z General File*** panel.



You will now notice that the panel fills in most of the fields once the paramater file is read in. However, you still need to set two fields yourself. Firstly, the parameter file is a general file to read in comma delimitered data with the Point Number, X Coord, Y Coord, Z Value, String Name and String Number format, so we therefore need to select the data to be read in.

Click on the folder icon next to the ***File*** field and select the file **DETAIL SURVEY.DAT**

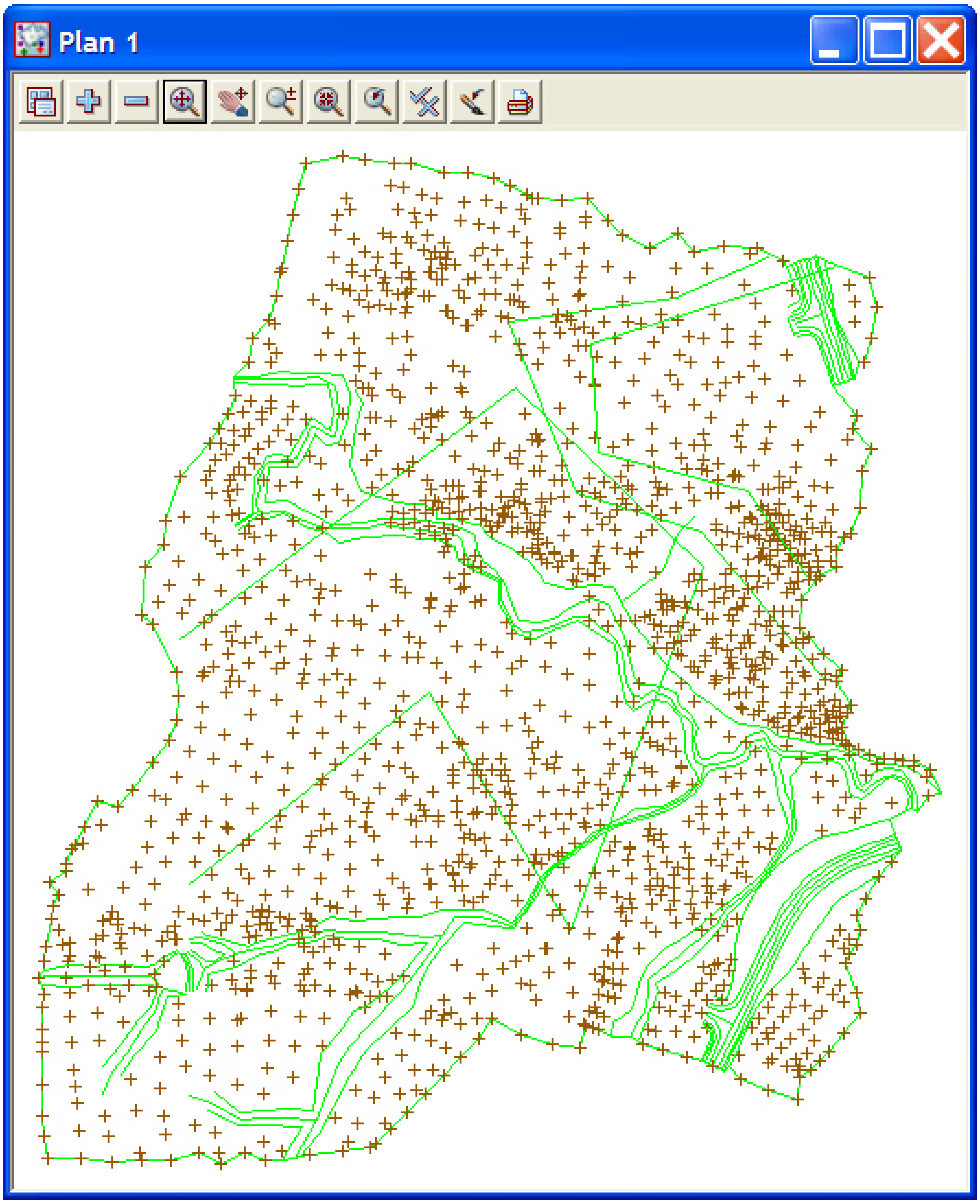
Next select the icon next to the ***Default text style*** field and select any textstyle. As we have no text in our data, the default textstyle is unimportant.

Finally click on the icon at the end of ***Add to view*** field and select 1. This will automatically add all the data in the ***Default model*** - unknown - onto view number 1.

Your finished panel should now look as shown.

Click on the Read button at the bottom of the panel to read the data into 12d.

Your Plan View should now look as follows



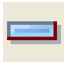
You will notice that all of the data has been imported into ‘Plan 1’ in the model ‘unknown’ and that the line-strings appear green in colour and the point-strings are brown as set in the import panel.

5.2 Plan View Operations

Now that we have some data, we can begin to look at some more of the Plan view features of 12d.

 **Menu**

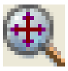
Bring up the Plan view Menu.

 **Adding/removing models** 

In the Plan View Button Area, you will observe a ‘+’ and ‘-‘. This is a shorthand technique for turning models on and off.

Remember in our View so far, we have just one model - ‘unknown’. At this stage it is on display.

Click on the ‘-’ sign button with LB. A list of available models to remove from the view pops up. Pick ‘unknown’ and click LB on ‘Select’. You will observe the lines and points (crosses) in model ‘unknown’ are removed from the view. The ‘+‘ works in a similar way to add models to the View. Practice adding and removing models from the view with the + and -. Remember, the models are not being deleted with the ‘-‘, merely removed from the current View. Leave the View with ‘unknown’ on display.

 **Fit**

After multiple pans and zooms, you sometimes wish to return to a point where all of your data appears in the view. This is equivalent to an AutoCAD Zoom-Extents. Click on Fit with LB to see all of your data.

 **Dynamic Pan**

This facility allows you to move the centre of the view but retain the current zoom factor. Click on Pan with LB. You then press down LB on a point in the View and then drag the mouse. The data in the view will move with the mouse until LB is released.

 **Zoom**

Select Zoom (to Zoom In) from the Plan View Button area with LB. Click LB on two diagonal points of a rectangle and then click LB once anywhere in the plan view. The information will appear enlarged based on the size of the rectangle.

MB Wheel Zoom

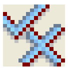
If your mouse has a wheel as part of the middle button, then it can be used to dynamically zoom in or out. Simply click LB in the plan view at the point you want to zoom about and then roll the wheel forward to zoom in and backwards to zoom out.

 **Shrink**

This is equivalent to Zoom Out. It works just like Zoom but in reverse.

 **Previous**

If you click LB on Previous, the view will appear as it was prior to the Zoom. 12d always keeps the details of the previous view setting available so that you can return to it quickly. Only one level of previous view settings is kept.



Toggle

There are multiple items under the Toggle Pop Up menu. At this time, we will try only one of them. Select **Grid** with the LB. A rectangular grid should appear. If you click LB on **Toggle =>Grid** again, the Grid will be removed from the display.
The appearance of the grid can be changed by clicking LB on the Menu button in the View Button Area and click LB on **Settings =>Grid.** You can change any of the settings in the panel. Try changing the grid spacing from 100 to 10 in both x and y directions and click LB on **Set.** You will notice that the Grid can be turned on and off from either the panel settings or the **Toggle =>Grid** switch. Click LB on **Finish** to terminate the panel.

Refresh

All the information on the view will be redrawn. This can also be achieved by clicking MB anywhere in the *View Title Area* or anywhere in the *View Button Area* except over the '+' or '-' buttons.

Plot

Bring up the Plan view Plot Menu.

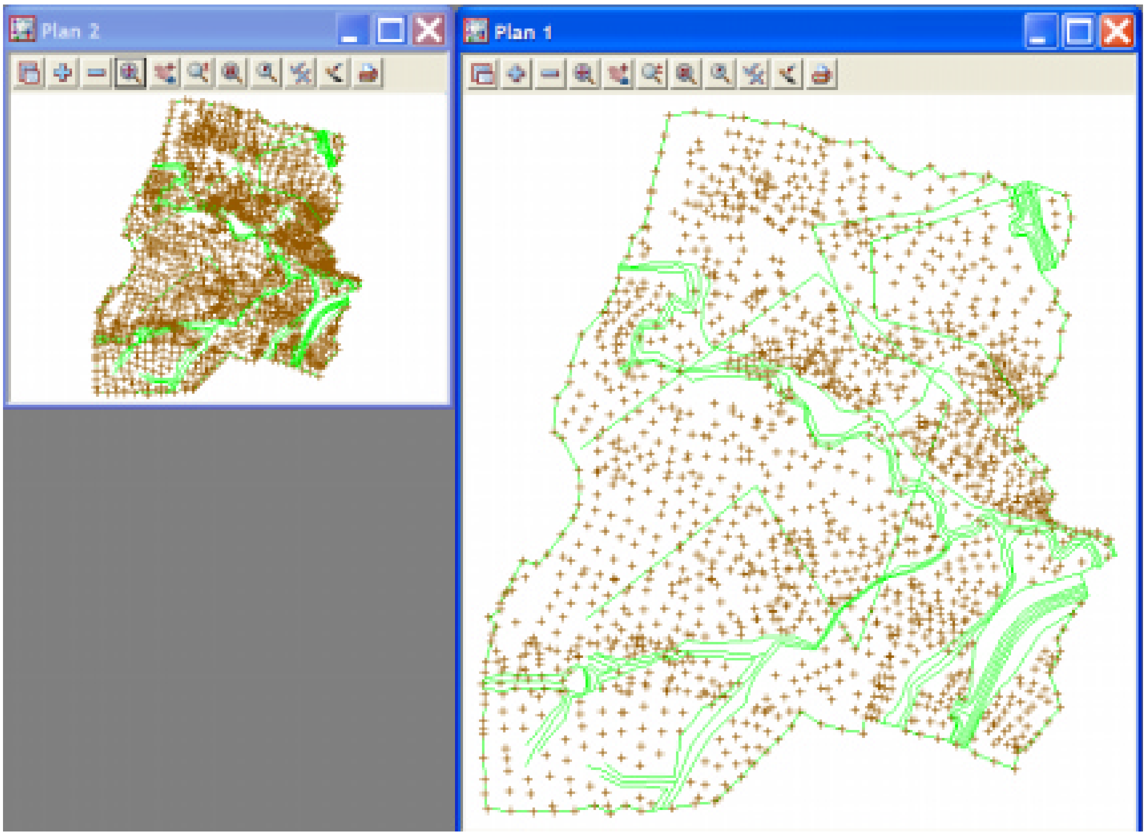
5.3 Birds-Eye Views and 'Throwing' Between Views

We saw in Chapter 4.10 'Basic View Operations' how to create a new View. To introduce some new concepts in 12d, we need a second small Plan view on the desktop. Firstly resize your existing 'Plan 1' view to take up around 2/3 of the right hand side of your desktop.

From the main menu, click LB on **Views=>New=>Plan** and place a small view about 50mm square in the top left hand corner of your desktop. This will create View 'Plan 2'. See Chapter 4.10 for full details on how to create and resize Views.

Note that when creating a View using **Views=>Create=>Plan View**, 12d pops up the 'New Plan View' panel. The View Name field will already have a 'number' in it supplied by 12d. 12d will always supply you a View number that is not currently in use. If you want, you can overtype the number suggested by 12d provided the number you type does not currently exist (it may have been created earlier and then been deleted. It is OK to reuse a previous number).

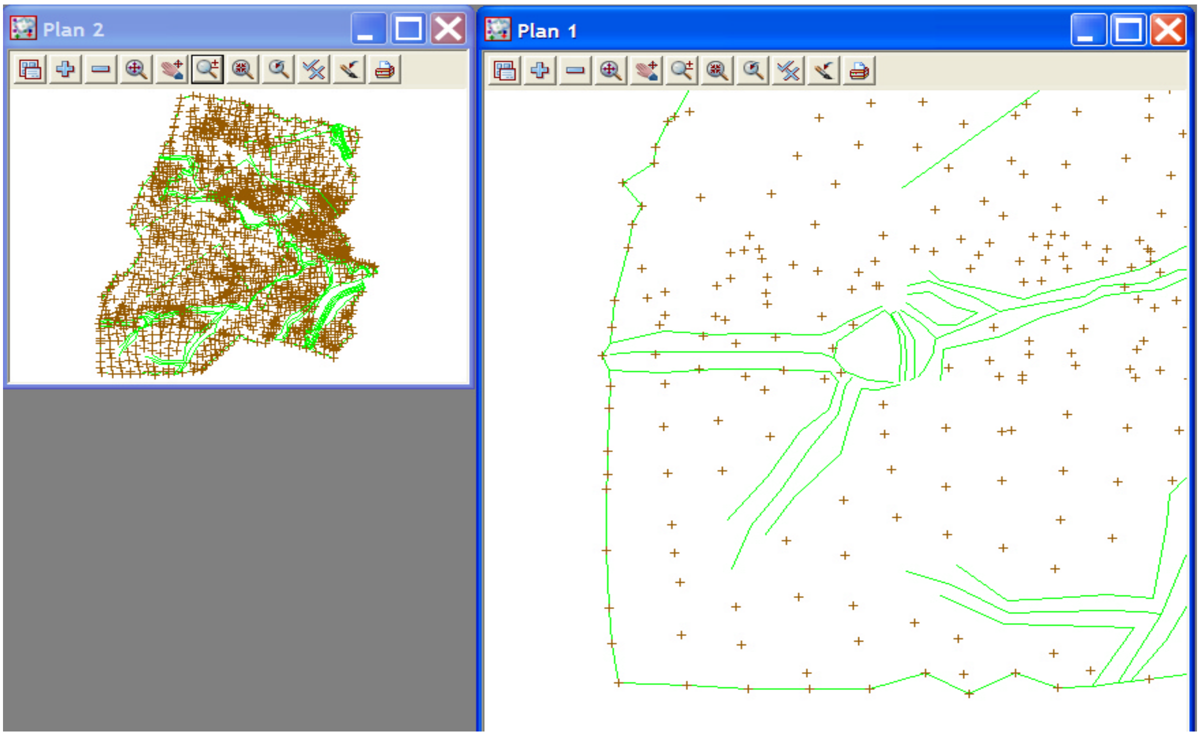
In the View 'Plan 2', use the '+' sign button to display the 'unknown' model. From the 'Plan 2' View Button area, click LB on **Zoom** and click a point in the lower left corner of the View 'Plan 2'. Before selecting the second point of the Zoom rectangle, move the cursor into the other View i.e. 'Plan 1'.



Select the second point of the Zoom rectangle in either View. After selecting the second point of the Zoom rectangle, you will notice the following prompt in the View Message Box

<View Zoom>[Select][Dynamc][Cancel]Select Destination View - RB to cancel D toggles dynamic

12d is prompting you to select the View you want 'zoomed'. Click LB in View 'Plan 1'. The zooming will then take effect in View 'Plan 1'.



Notice that using this technique, it is possible to achieve a birds-eye effect where the smaller View displays the complete model whilst the larger ‘working’ view is zoomed to an extent where it displays only the detail that you are currently working on. You would typically do all of your zooming in View ‘Plan 2’ but have the detail updated in View ‘Plan 1’. You could even do this with different models turned on. In the birds-eye view, you would typically only turn on sufficient detail to enable you to zoom on known features.

It is suggested you practice zooming and throwing between Views as this is a powerful concept in 12d and you should feel comfortable at using it.

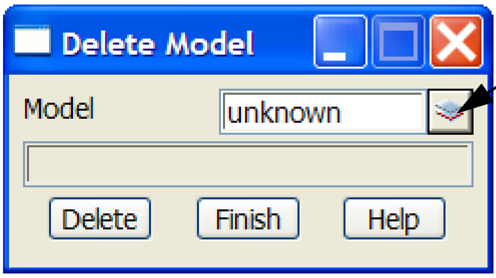
After completing this exercise, delete View ‘Plan 2’ as it is no longer needed. You will now see a second way to delete a View. Click LB in the View Menu button in the View Button Area of ’Plan 2’ and select **Delete** and **Yes** to confirm the deletion. The Delete View menu can also be brought up by clicking LB on the Menu button in the View Button Area of the View you wish to delete and select **Delete** and **Yes** to confirm the deletion.

It is suggested that you move View ‘Plan 1’ to the upper left corner of your desktop. Make the ‘Plan 1’ view fill the desktop by dragging the border. To do this, click and hold the LB somewhere near the lower right corner of the View to pick up the corner. Drag the mouse to stretch the View out to the lower right corner of your desktop and release the LB to set the new size of the view.

5.4 Deleting a Model

As we now wish to proceed to better ways of importing data into 12d, we need to delete the model 'unknown' as it is no longer required.

From the Main menu, click with LB on **Models=>Delete=>Delete a model**



Click LB on the Model field button to pop up a list of models to delete. Click on 'unknown' with LB.

Click LB on **Delete** and then **Yes** twice to confirm the deletion

5.5 Redraw - Fixing up a Modified or Erroneous View

Whenever data is removed from a View e.g. turning off the display of a model, the view does not automatically get refreshed. 12d typically removes a model by overdrawing the information using the background colour, usually 'black'. This operation can leave the view looking speckled and unclear.

You can force the view to refresh by clicking LB on the Refresh button, or click MB in the View Button Area anywhere other than over the '+' or '-' view buttons. The whole View will be repainted instantly to display the corrected information.

It is also possible that some of the menus may at times become corrupted. Windows is a very complex multitasking environment and the menus are stored in memory which is being updated continuously. If you ever get parts of your desktop that don't look correct, you can force your entire desktop (all menus, views etc.) to be refreshed by typing Control-R at any time. Alternatively you can refresh just any one Menu by clicking MB in the menu title area.

5.6 View Coordinates Box

Note the location of the View Coordinates Box at the bottom of the desktop. If you move the cursor around in the Plan View area, you will notice that the x and y values are changing continuously. The values shown are those at the tip of the cursor. They are updated with every cursor movement.

5.7 Work Book Mode

The 12d Desktop has various optional displays. One of those is Work Book Mode. In this mode, tabs are displayed on a bar just above the Status Bar at the bottom of your desktop. If you have the Output Window in the default position (across the base of your desktop), the tabs bar is displayed just above the Output Window.

Each tab corresponds to a 12d View. To set any 12d view as your active view just click LB on the appropriate Tab. Note that when a view is active, the View title highlights in blue.

5.8 Saving a Project

The changes to the Project you are working on are currently only stored in memory. To make the changes permanent and update your files on disk you need to Save the Project. This can be done at any time by clicking LB on **Save** from the Projects Menu (**Project =>Save)**.

12d will occasionally pop up a panel reminding you 'Do you want to save the project? Click on **Yes** with LB to force a Save to occur. The timing at which this message appears is set from the Main menu in **Project =>Management =>Defaults**. See the data field 'Save Interval (min)' under the 'System Settings' tab.

The default is every 15 minutes. You can set the time interval to zero to turn this feature off altogether.

If you ever crash out of 12d due to a power failure for instance, any changes since your last **Save** operation will be lost.

5.9 Exit

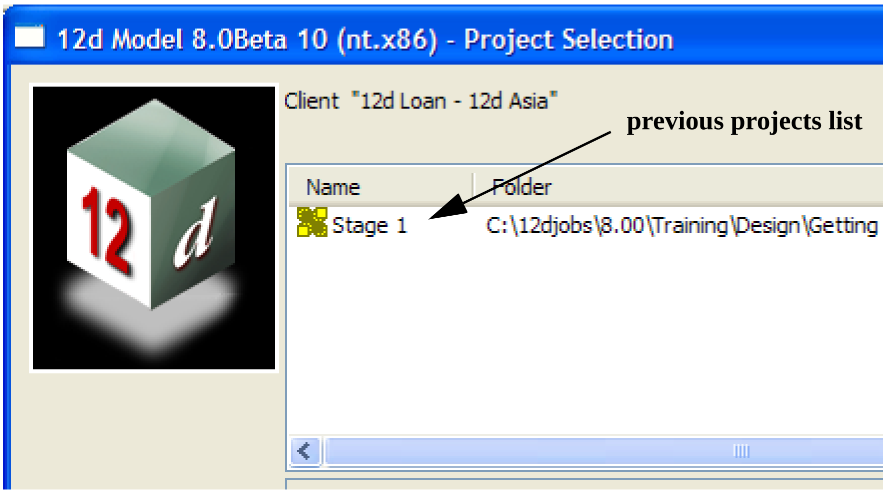
To terminate a 12d session, click LB on **Exit** from the Project menu (**Project =>Exit)**. If you try to Exit 12d after changes have been made to your Project, 12d will remind you of the changes by prompting you for a further **Save** operation.

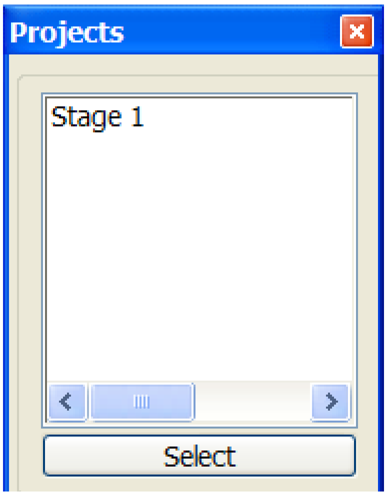
5.10 Restarting 12d with an Existing Project

When you restart 12d and return to an existing project, the appearance of the desktop will be just as you last left it. The number of Views, appearance of all models and user defined parameters are redisplayed using the settings that are stored with the Project data.

The next time you start 12d, the project 'Stage 1' will appear in the previous projects list.

Double clicking LB on 'Stage 1' in the list will take you into the project 'Stage 1'.





Alternatively, if you navigate to the folder containing the project ’Stage 1’, you will automatically get a pop up list of all available projects in that folder to select from.

Click LB on ‘Stage 1’ to highlight it and then click LB on the **Select** button. Alternatively, you can double click on **‘Stage 1’** to bypass the Select button.

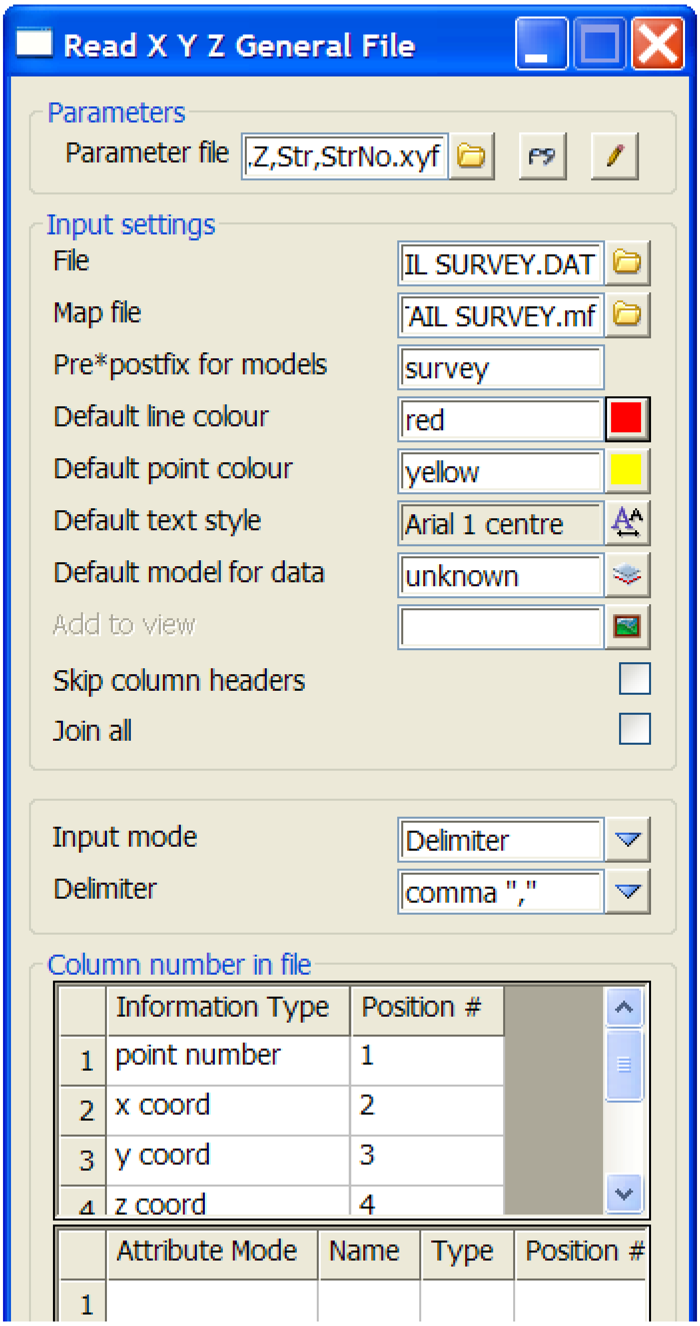
If you have trouble restarting 12d, remember you called this Project ‘Stage 1’. See Chapter 4.2 to remind yourself how to start 12d.

6 Basic Modelling

6.1 Use of the Mapping File (.mf) and Linestyles

We will now repeat the process of importing data into 12d but this time we will use a mapping file to make 12d place the information into a more convenient form for final design.

The previously created model has been deleted. We will import the file ‘DETAIL SURVEY.DAT’. To read in the file, click LB on **File I/O=>Data Input=>x y z general** from the Main menu.



In Chapter 5.1 we used the parameter file ‘PtNo,x,y,z,Str,StrNo.xyf’, Recall this file by clicking on the folder icon to the right of the **Parameter file** field and selecting it from the list. Click on the read button to fill in the panel.

You will still need to fill in some of the fields so click LB on the ’folder’ button at the right end of the **File** data field to popup a list of files. Double click LB on file ‘DETAIL SURVEY.dat’. This file has both points and strings with coding. A typical string code in the file is ‘CG’ for Change of grade.

This time, we will import the data using a mapping (mf) file. Use LB on the folder button for the **Map file** field. You will notice that the pop up box is empty. However, if you walk right on the **User Lib** menu at the bottom of the panel, you can select the ‘DETAIL SURVEY.mf’ file. We keep our map file, together with title blocks etc., in the library so that we can access them easily from all projects.

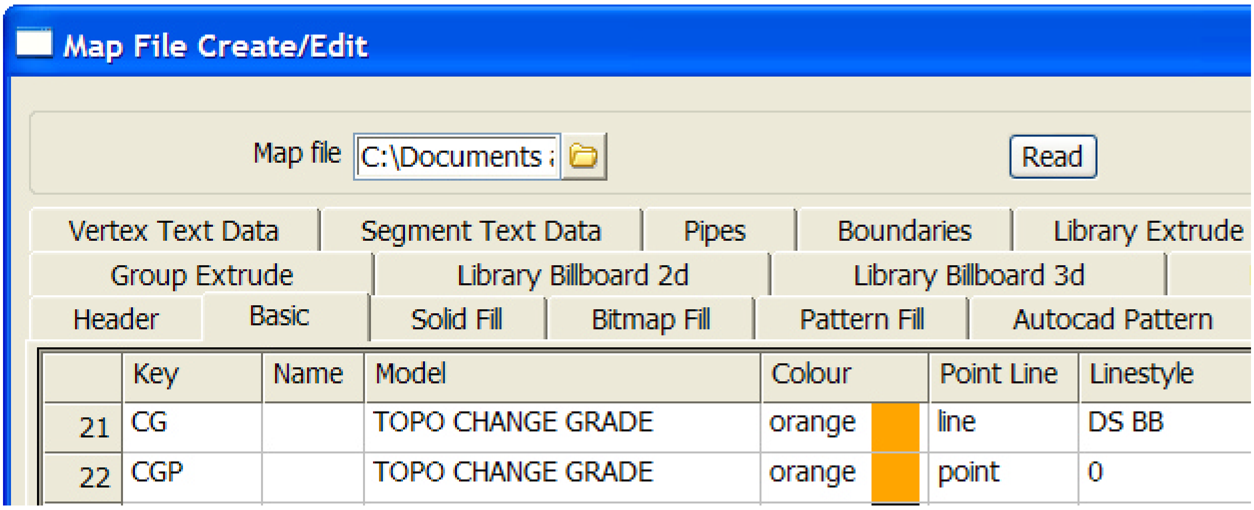
A model prefix ‘survey ’ is typed in to group the survey models away from the future design models. Ensure that you place a <space> after the ‘survey’ so that the model names do not run together.

Any data not coded correctly will be placed in the Default model ‘unknown’

Click on **Read** to read the data into 12d Model.

This time we are not automatically adding the data to a view as this feature only adds the ***Default model*** to the view. However, the mapping file gives us the opportunity to import the point and line data into particular models with their own linestyles and colours. To open the Mapping File click on the folder icon next to the ***Map file*** field and click on **[Edit]**.

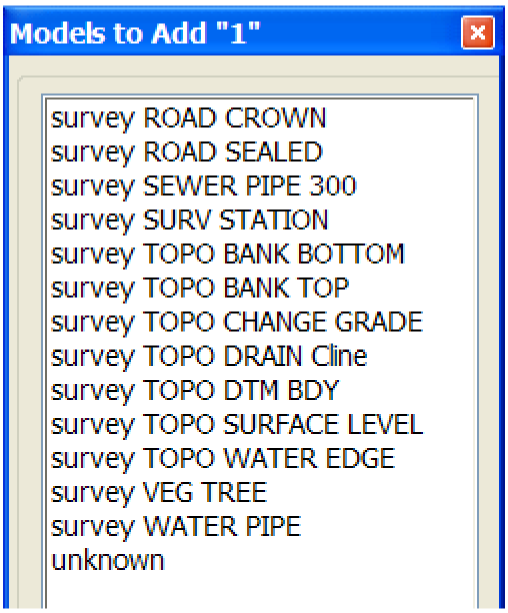
For instance, the entry in the mapping file for entity label ‘CG’ reads



The CG string will be imported with a string name of CG, be placed in the model ‘TOPO CHANGE GRADE’, appear as an orange line with a dashed line style (DS BB). This is a user defined linestyle that will be used in the final plotted drawings. Note that in this file all line styles are in upper case to make them compatible with the line styles typically used in CAD programs.

Click LB on **Finish** to exit the Map file panel.

To see the various features that have just been created, we now need to add multiple models to the view. The easiest way to do this is to click LB on the ‘+’ sign button in the View Button Area to pop up the Models to Add panel.



Click LB in the panel title area (over the words Models to Add), move the panel and repin it with LB so that it doesn’t collapse after each selection.

Now double click LB on each model in turn and watch them appear in view ‘Plan 1’. Leave the model ‘unknown’ inactive

Click LB on **‘X’** to shut down the panel.

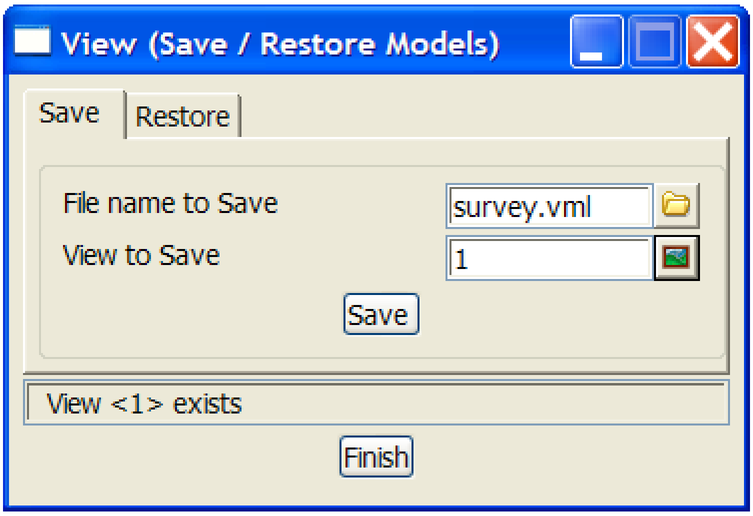
Clearly by using the mapping file, we have seen how the information in each model can now be manipulated independently.

6.2 Saving model listing to a file for future use

We will now perform a function that is only meaningful later on when we are manipulating TINs. First we need to click on the ‘Plan 1’ view tab such that Plan View 1 is now our focus. The heading in view ‘Plan 1’ should appear coloured bright blue and it should be to the forefront.

The current thirteen models on the view are exactly the models that are used to create the ’natural surface’ tin. We will now see how to record these models in a form that can be used in the future to restore those same models to another view.

From the Main menu click LB on **View=>Models Save/Restore**



Type in the file name **survey**. Pressing [Enter] will add the extension **.vml**

Click LB on the view icon then select view **1**

Click LB on **Save**

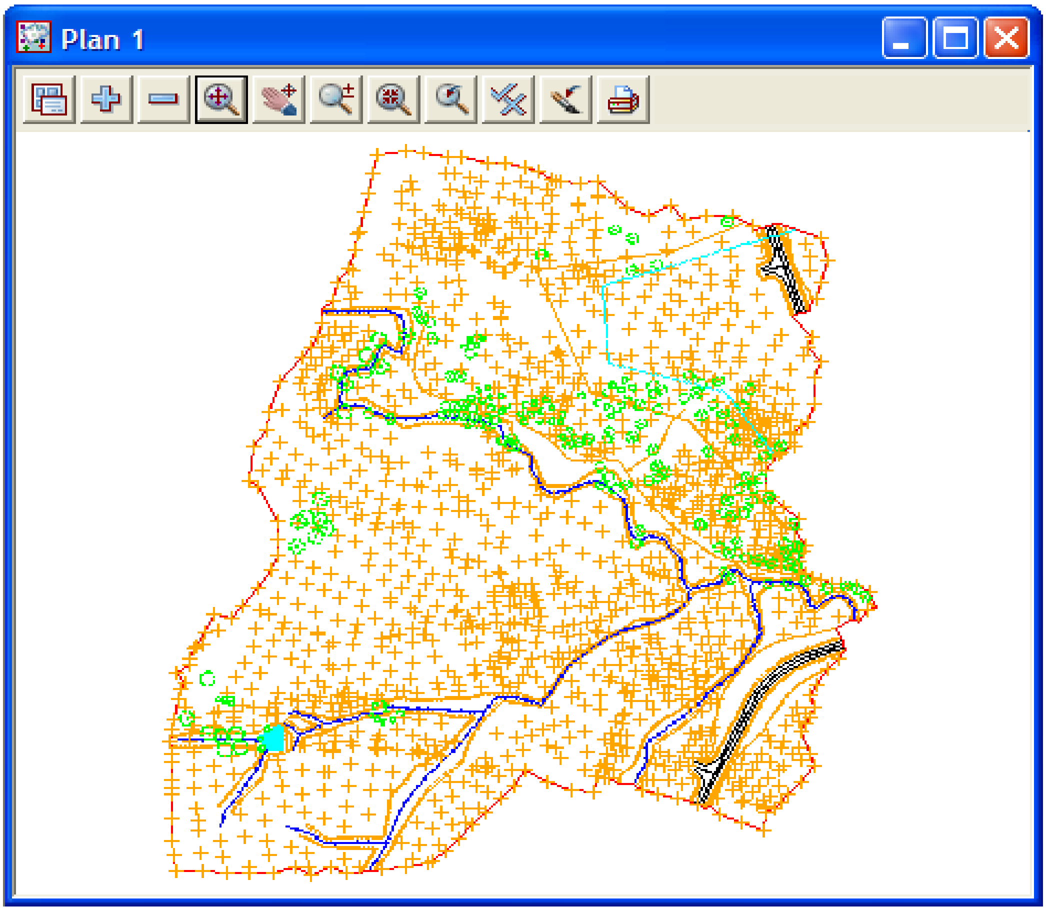
Click LB on **Finish** to exit the panel

This file can be read at any future time by use of the Restore option. This will add the same models to a view which need not necessarily view ’Plan1’.

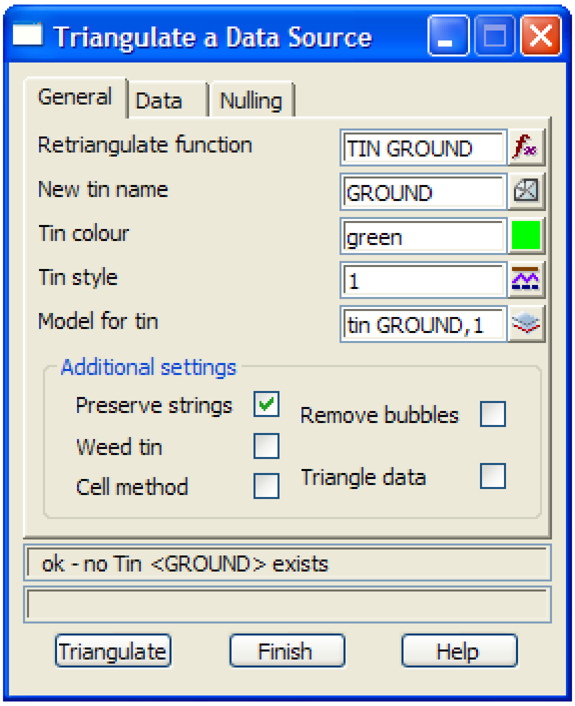
6.3 Triangulation

We will now use this point and line information to create a 3d surface or TIN (Triangulated Irregular Network). One of the concepts in 12d is that a TIN can be created from a single Model or a single View. In general, you will use Views to create models since you can control which models are on display in a View. <u>It is important to understand that when creating a TIN from a View, only those models on display in the View will be used in creating the TIN and only then if they are set to be tinable in the map file</u>. For instance, if you were forming a TIN to represent the natural surface, you could leave turned ON any models that represented underground surfaces prior to creating the TIN, because in the mapping file they would be set to be non tinable.

When using a mapping file to read in data, strings can be flagged as being tinable (Breaklines) or non-tinable. Only tinable strings are used in the triangulation. Breaklines are used to pick up the topographical features accurately. When forming triangles, 12d ensures that every breakline has the sides of one or more triangles along the entire breakline i.e. triangles <u>never</u> cross breaklines (unless the breaklines themselves cross).



For the purposes of the ongoing tutorial, please ensure that all models in view ‘Plan 1’ are on display prior to creating the TIN. ‘Plan 1’ should look as shown above.



From the Main menu, click LB on **Tins=>Create=>Triangulate data**

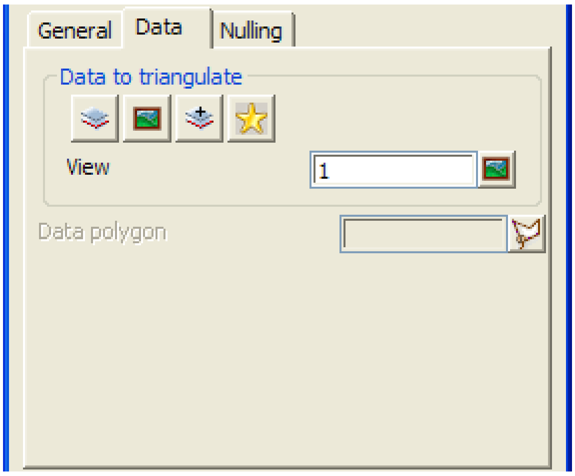
The following panel pops up.

Fill in the first tab of the panel as shown.

The **Retriangulate function** option is used to construct a function which, when recalculated, will run a retriangulation on the tin. Place the cursor in the data field with the LB and type 'TIN GROUND'

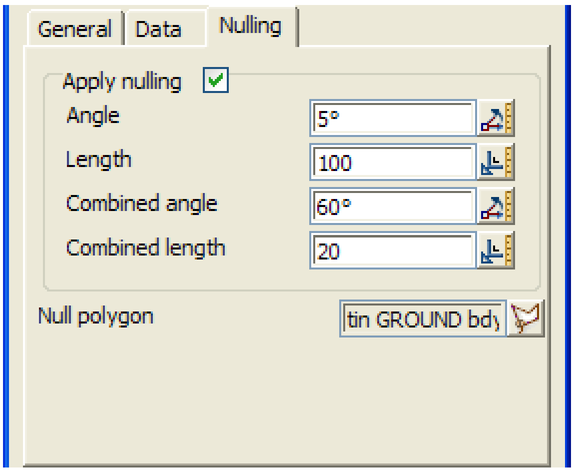
Each TIN requires a name. Position the cursor in the **New tin name** field and type in 'GROUND'. If you press the Enter key, this name will also be used to fill in the **Model for tin** field but with the prefix 'tin ' (see panel). The TIN name is subsequently used to refer to this specific TIN.

Position the cursor in the 'Model for Tin field' and type in the suffix ',1' after the name so that the model is displayed as the TIN is created. It is permissible to overtype this name but this is not recommended.



Click on the **Data** tab.

As we wish to triangulate all the data in plan view 1 and leave the mapping file to determine which data to use, click LB on the view icon. Select '1' from the list.



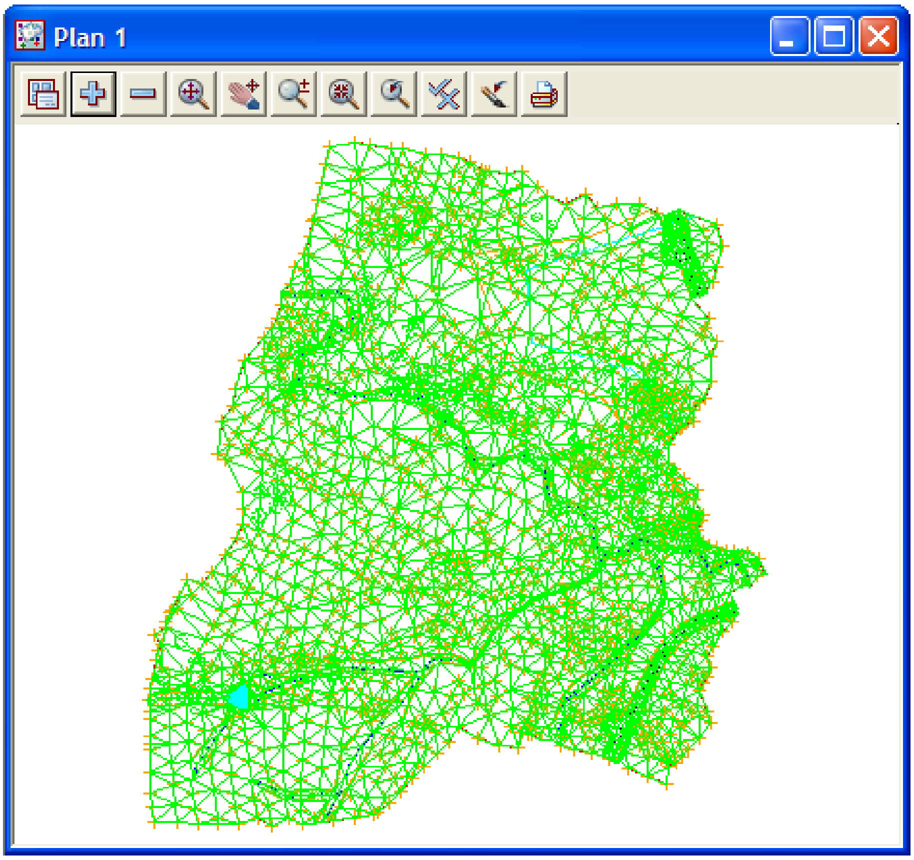
Click on the **Nulling** tab.

Click on the ***Apply Nulling*** check mark.

There are two options here, you can either set the parameters to null the external triangles or you can use a polygon to null all triangles outside this polygon. The DTMBDY string will be used as the boundary for the tin. Click LB on the **Null polygon** string icon then click LB on the DTMBDY string followed by clicking middle button (MB) to accept the string.

Click LB on **Triangulate** to create the TIN. There will be a short delay and then your TIN will be created and on display as shown below.

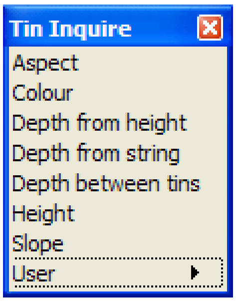
Click LB on **Finish** to terminate the panel.



Note that the TIN is clipped at the selected null polygon ensuring only the surveyed data is included. Now that we have a TIN we can display the TIN data in a variety of ways

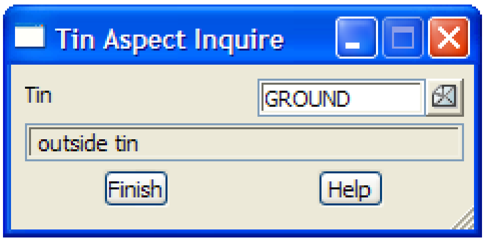
6.4 Tin inquire.

From the Main menu, click LB on **Tins=>Inquire** and the Tin Inquire panel pops up.

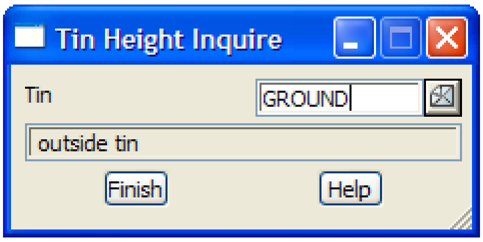


Click LB in the menu title area (where it says Tin Inquire), move the menu and Pin it with the LB. This operation is necessary to stop the menu from collapsing after the first menu pick.

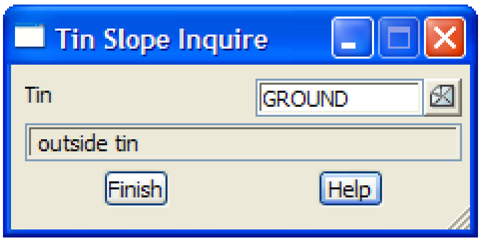
Click LB on **Aspect**, and the Tin Aspect Inquire panel will pop up.



Move the cursor over the *Tin* icon button at right end of the ‘Tin’ field and use the LB to pop up a list of Tins. Double click LB on **GROUND**. Then click LB in the menu title area (where it says Tin Aspect Inquire), move the panel to a clear area of your screen and pin it with the LB. Do <u>not</u> Click on the Finish button in the panel.



Repeat this procedure with both the **Height** and **Slope** menu items.



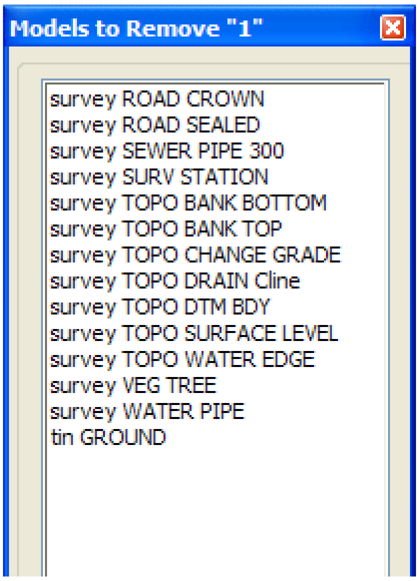
Once all three panels are on the screen, move the cursor anywhere over the TIN and observe what happens. When the cursor is positioned over any one triangle, the three point coordinates of the triangle are being used to linearly interpolate ‘on the fly’ to calculate the exact x,y,z coordinates of the cursor. Also the aspect and slope of the triangle is shown in the respective panels.

Click LB on **Finish** on all three panels to put them away. Also click LB on **‘X’** on the Tin Inquire menu to shut it down.

We will now look at the various ways information in TINs can be viewed.

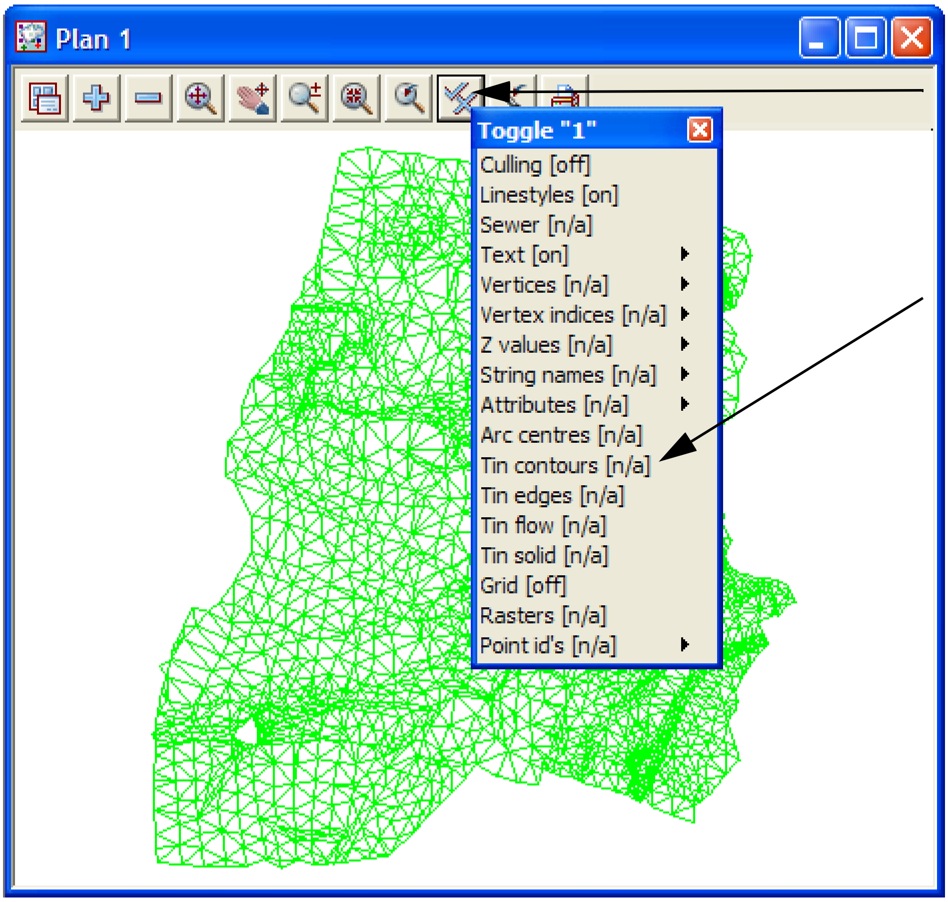
6.5 ‘Fast’ Contours

We now want to remove all of the models from the View except ‘tin GROUND’. From the View menu (in the View Button area), click LB on the ‘-‘ sign to pop up the Models to Remove panel.



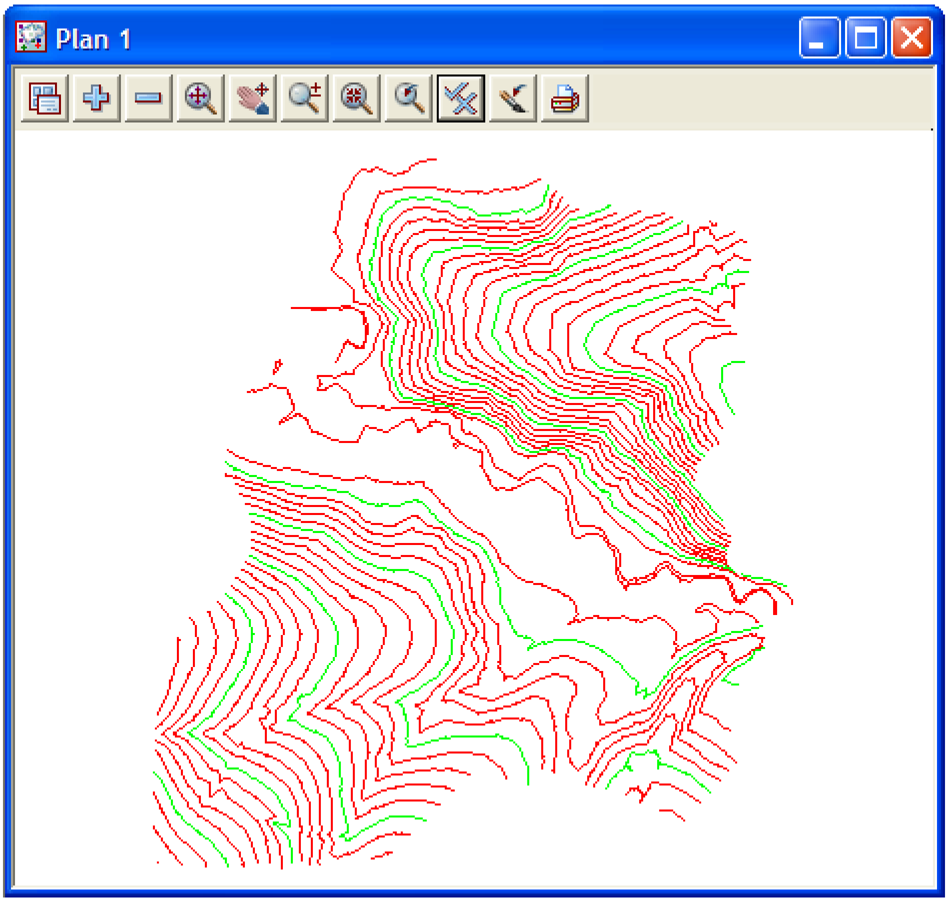
Click LB in the panel title area (over the words Models to Remove), move the panel and repin it with LB so that it doesn’t collapse after each selection.

Now click the LB on the first survey model. Drag the mouse down the list to highlight all the survey models and click on ‘Select’. Alternatively, you could double click LB on each model in turn ***except*** ‘tin natural surface’. Click LB on **‘X’** to shut down the panel.



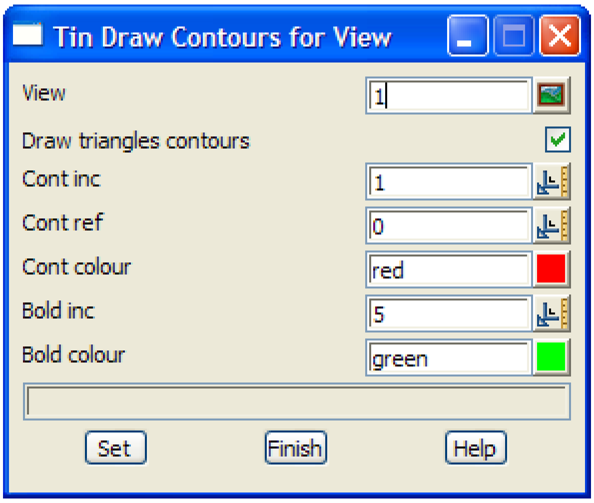
Now from the View buttons, click LB on the **Toggle** button to bring up the Toggle menu.

Then click LB on **Tin contours**. You should see the following red and green contour lines appear.



If you click **Toggle=>Tin contours** again, the View will revert to the 'green triangle' display.

The appearance of the contours can be changed by clicking LB on the Menu button in the View Button Area. Click LB on **Settings=>Tins=>Contours** and the following panel will pop up.



You can change any of the settings in the panel including colour. Click LB on the colour icon at the right end of the contour colour field to see a popup list of available colours. Select one by double clicking LB.

Try changing the contour increment (spacing) from 1 to 5 and the bold increment from 5 to 25. Click LB on **Set** to activate the changes**.** You will notice that the 'Fast' contours can be turned on and off from either the 'Draw triangles contours' tick box panel setting or the **Toggle=>Tin Contours** switch.

At the completion of experimenting it is suggested that you put the settings back to their default values (as above) at this time.

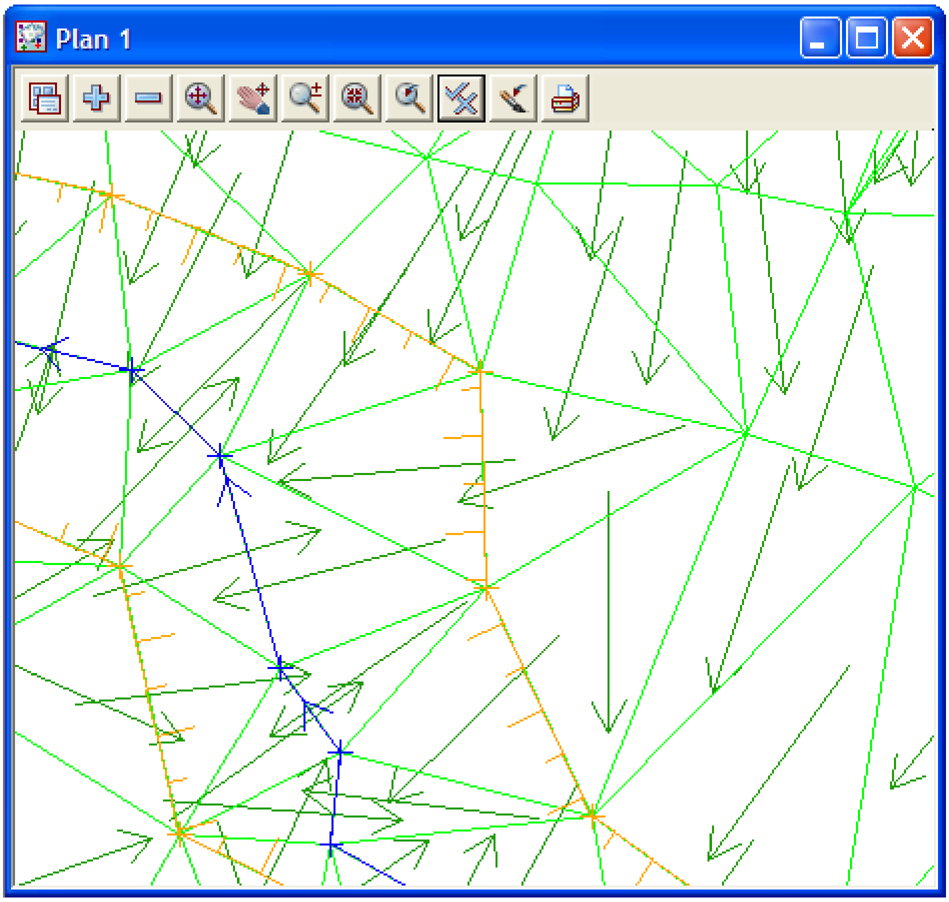
Click LB on **Finish** to terminate the panel. Your new settings will remain in effect indefinitely until changed.

6.6 ‘Fast’ Flow Arrows

It is recommended that you turn on the drainage models for this exercise. From the View menu (in the View Button area), click LB on the ‘+‘ sign button and double click LB on ‘survey TOPO BANK BOTTOM’, ‘survey TOPO BANK TOP’ and ‘survey TOPO DRAIN CLINE’. Make sure that the ‘tin GROUND’ model is also still turned on. The easiest way to confirm this is click LB on the ‘-‘ sign button in the View Button Area and look at the list of the models that could be turned off. Click LB on the **‘X’** button to terminate the list.

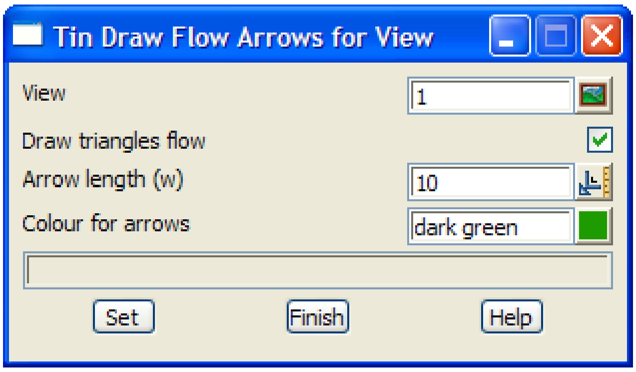
Now from the View menu, click LB on **Toggle=>Tin contours** then **Toggle=>Tin edges**. The purpose of this is to outline each triangle. Then click LB on **Toggle=>Tin flow**. You should now see an arrow appear at the centre of each triangle representing the direction of water flow.

Try zooming in on a section of the model for a closer look. When you have finished zooming, click on **Fit** to again fill the View window.



Click both **Toggle=>Tin edges** and **Toggle=>Tin flow** again and the View will revert to the ‘green triangle’ display.

The appearance of the flow arrows can be changed by clicking LB on the Menu button in the View Button Area. Click LB on **Settings=>Tins=>Flow Arrows** and the following panel will pop up.



You can change the size of the arrow heads and their colour. Click LB on the colour icon for the ‘Colour for arrows’ field to popup a list of available colours. Select one by double clicking LB.

Try changing the arrow length from 10 to 5 world coordinates (in this case metres).

Click LB on **Set** to activate the changes**.** You will notice that the Flow arrows can be turned on and off from either the ‘Draw triangles flow’ tick box panel setting or the **Toggle=>Tin Flow** switch.

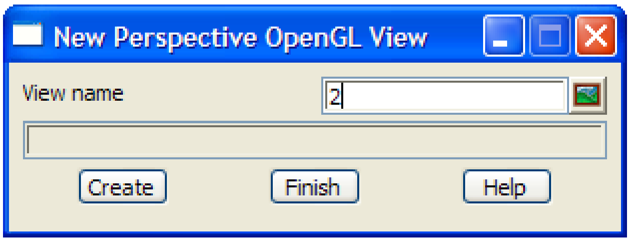
Click LB on **Finish** to terminate the panel. Your new settings will remain in effect indefinitely until changed (for this project only).

6.7 Perspective View

We will now look at the perspective view facilities in 12d to examine the surface we created above.

Firstly, move your existing Plan view off the right hand side of your screen. Do this by clicking LB at the left end of the View Title Area (over the words **Plan 1**). Move the cursor to the right of your screen and you will see the View move. ‘Pin’ the View again by clicking the LB such that just a small section of the View is on display.

Now create a new perspective view. Click LB on **Views=>New=>Perspective OpenGL** from the Main menu and a new view pops up. Alternatively by selecting **Views=>Create=>Perspective OpenGL view** from the Main menu, a panel pops up.

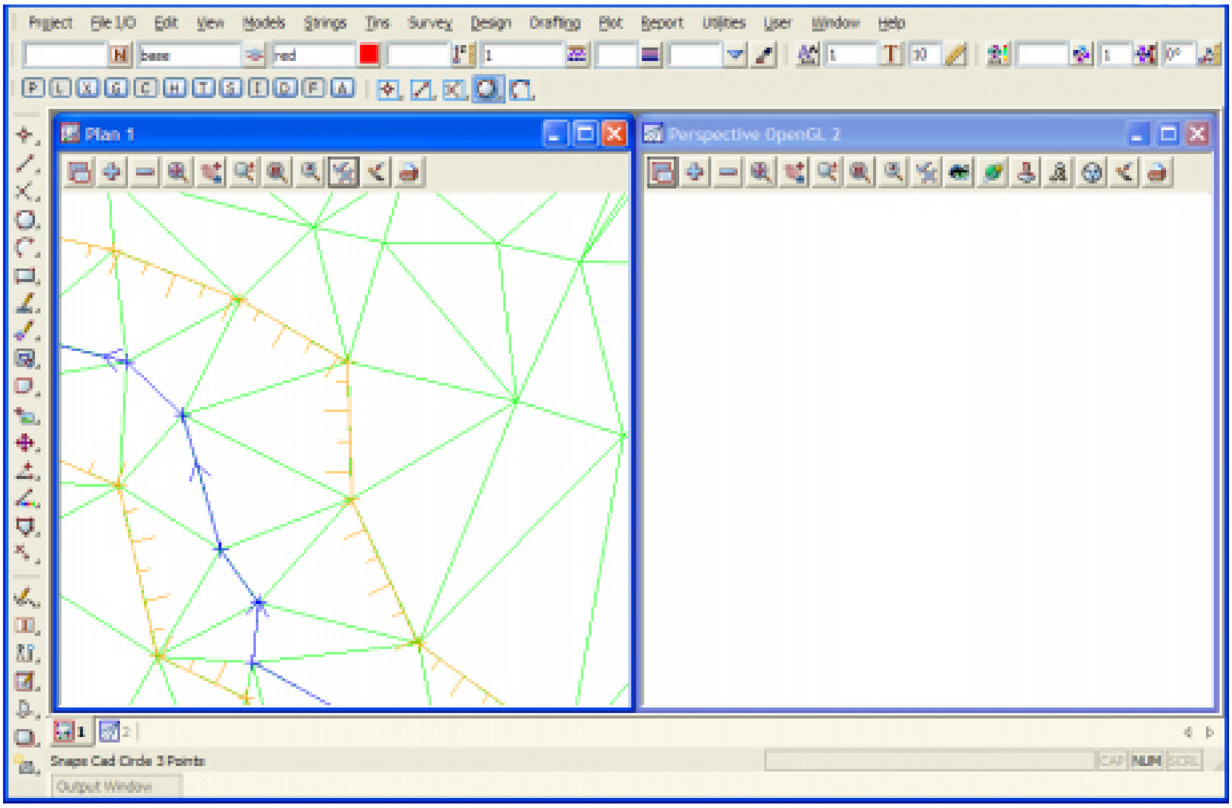


If necessary, put the cursor in the View name field, backspace over the existing entry (or use the Delete key) and type ‘2’.

Click LB on **Create.**

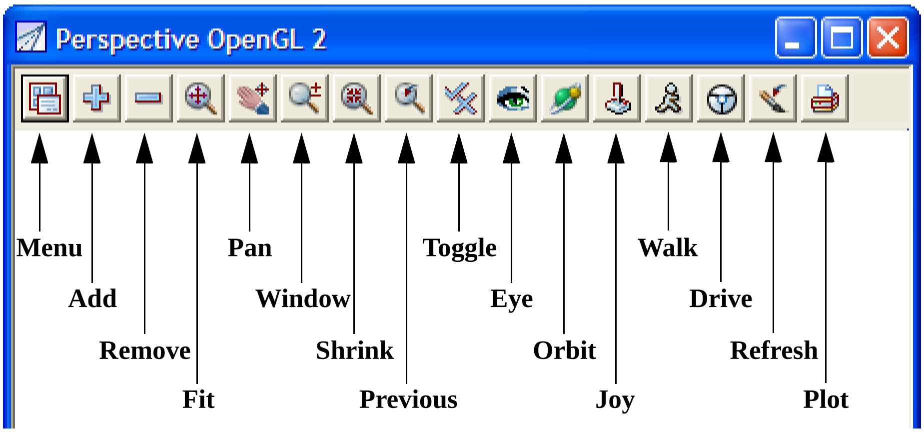
Note the new view is created immediately and is placed over the top of your existing windows.

You should use the standard windows features to ‘Tile’ the views. Click in the view title area for ‘plan view 1’ then select **Windows=>Tile Vertical**

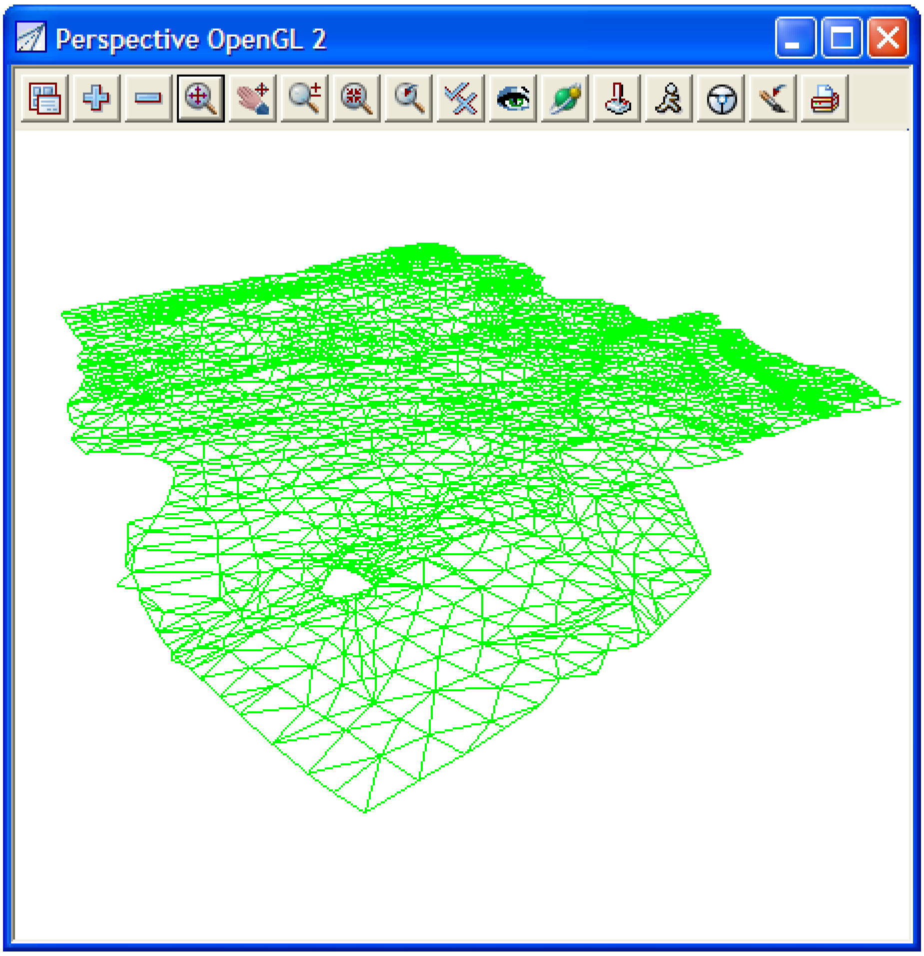


Your overall screen layout should now look something like this.

The view buttons on the Perspective view are:



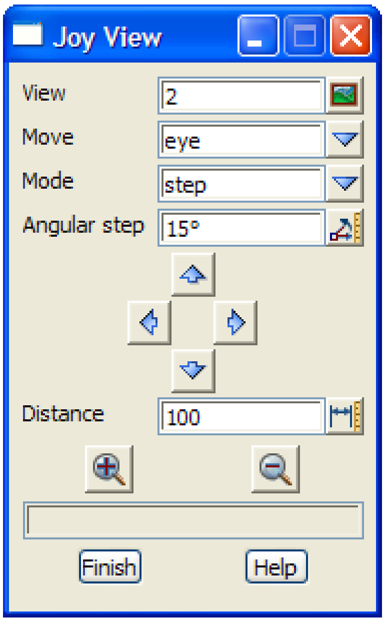
We now need to add the TIN to the perspective view. In the View Button Area of 'Perspective 2', click LB on the **'+'** sign button and double click LB on **tin GROUND.** Click LB on the **Fit** icon. Your Perspective view should now look as follows



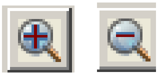
6.8 Joy Panel

The Joy (short for Joystick) provides a quick way of orientating your eye in relation to your data when manipulating a Perspective view.

The Joy panel is accessed from the View Buttons Area. Click LB on the *Joy* button in the View Button Area of ‘Perspective OpenGL 2’ and the **Joy View** panel appears.

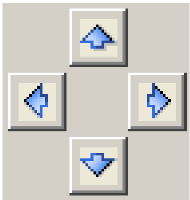


Try clicking LB on **In** and **Out** icons



and observe what is happening. You eye is moving inwards or outwards from the data.

Also try **Up, Down, Left** and **Right**. icons



If you get lost or zoom in too far, you can always start again by clicking LB on **Fit** in the View Button Area.

The angular step between each up or down step defaults to 15 degrees. You can change this if you want smaller increments by entering a new value in the Angular Step field.

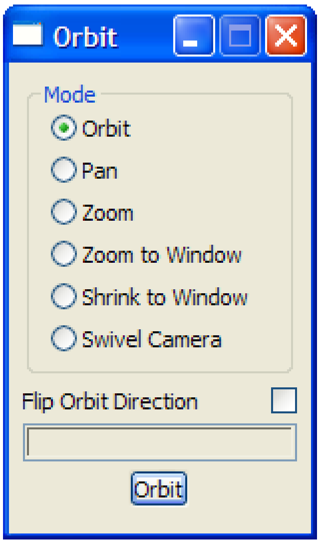
Similarly, the Distance changed on each In/Out movement defaults to 100 (metres in our case as all data is in metres).

The easiest way to reset a view so that you can see all of the data is to click LB on **Fit** from the View Button Area.

6.9 Orbit Panel

The Orbit is another way to orient your eye in relation to your data when manipulating a Perspective view.

The Orbit panel is accessed from the View Buttons Area. Click LB on the *Orbit* button in the View Button Area of ‘Perspective OpenGL 2’ and the **Orbit** panel appears.



With the ‘Orbit’ radio button selected use the LB to rotate the image in the perspective view.

You can use the middle button wheel at the same time to zoom in and out in the perspective view

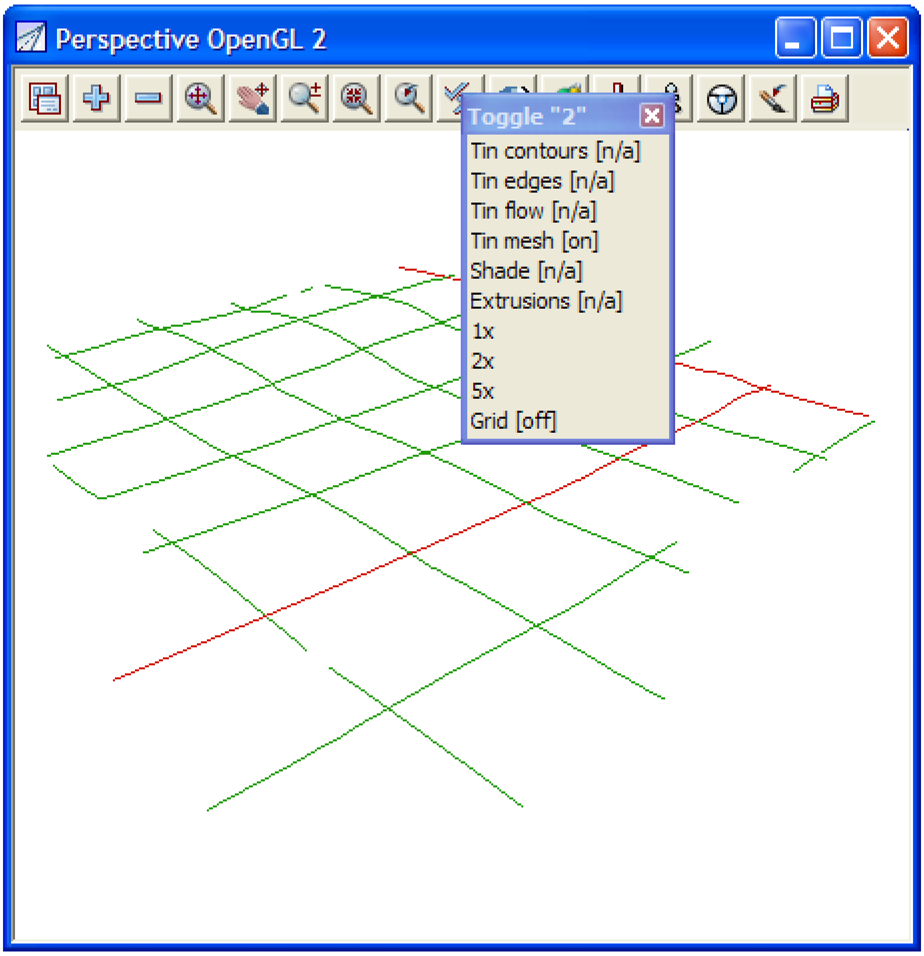
If you get lost or zoom in too far, you can always start again by clicking LB on **Fit** in the View Button Area.

The easiest way to reset a view so that you can see all of the data is to click LB on **Fit** from the View Button Area.

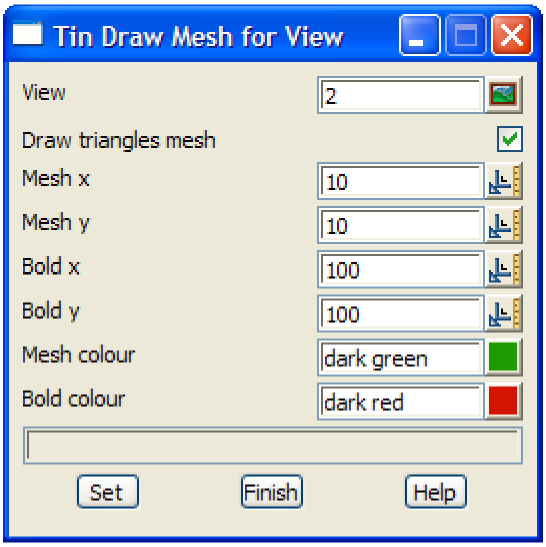
6.10 ‘Fast’ Meshes in Perspective view

We will now see how to quickly display the TIN in mesh form.

From the Perspective View menu, click LB on **Toggle=>Tin mesh**. You should see a coarse rectangular grid of red and green mesh lines appear.



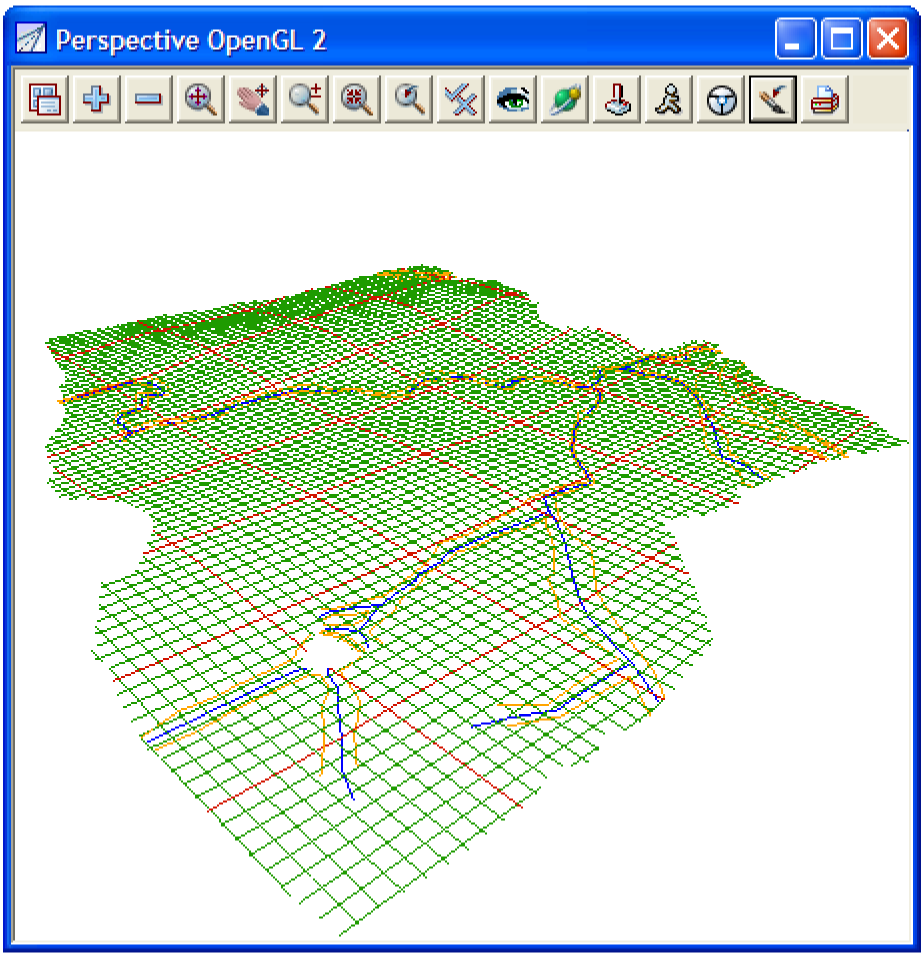
The appearance of the mesh can be improved by reducing the mesh spacing. Click LB on the Menu button in the View Button Area of the ‘Perspective OpenGL 2’ view and then click LB on **Settings=> Tins=>Mesh.** The following panel will pop up.



Change the settings to those shown in the panel. Change the mesh spacing from 100 to 10 in both x and y directions and bold x and y spacing from 1000 to 100. Click LB on **Set** to activate the settings.

You will notice that the Mesh can be turned ON and OFF from either the ‘Draw triangles mesh’ tick box in the panel or from the View menu via the **Toggle=>Tin Mesh** switch.

When toggled OFF the view will revert to displaying the green triangles. Your revised view should look as shown below.



Click LB on **Finish** to terminate the Mesh settings panel.

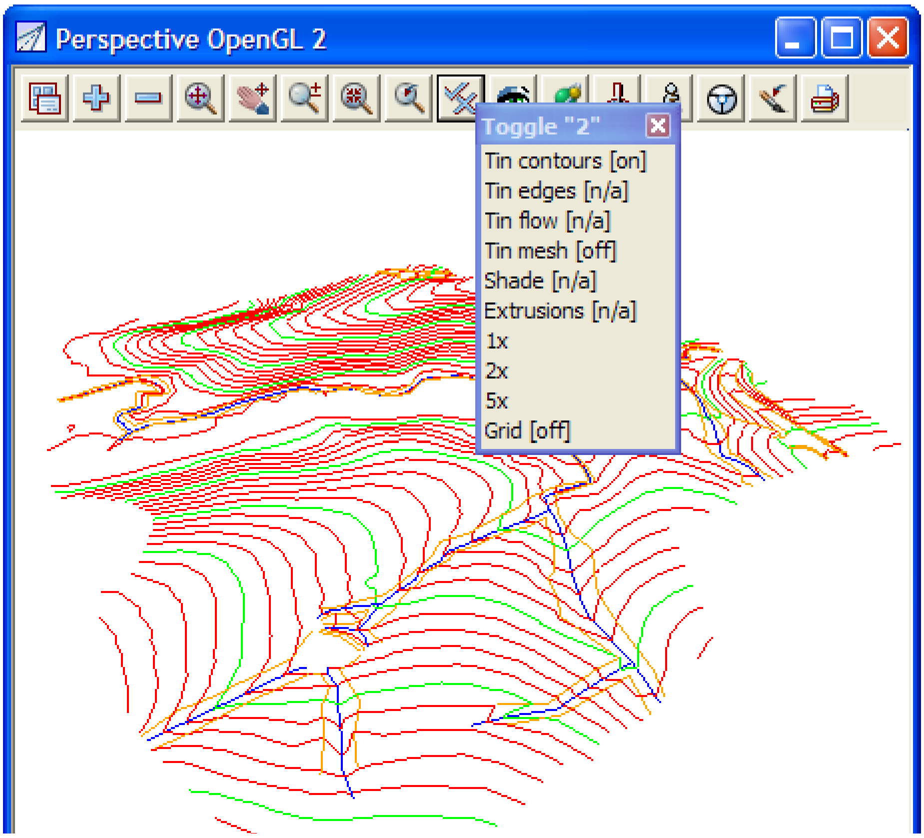
The effect of the creeks superimposed on the TIN is created by turning on the Drainage model. Click LB on the ‘+’ sign button in the View Button Area and double click LB on ‘survey TOPO BANK BOTTOM’, ‘survey TOPO BANK TOP’ and ‘survey TOPO DRAIN CLINE’.

Note that 12d always displays the models in the order that they are turned on with the '+' and '-' buttons. Thus to get the effect of survey DRAIN Cline (and any other models) superimposed on your TIN, you first turn all models off, then turn the TIN on first and then any other models to be superimposed last. Note that clicking LB on the Menu button in the View Button Area for 'Perspective OpenGL 2' and selecting **Models=>Remove all models** is a fast way to turn all models off.

The above perspective view orientation will stay as set indefinitely unless changed by further Joy or equivalent perspective view operations.

6.11 Contours in Perspective Views

Sometimes it is useful to display contours in perspective views. You do this from the Toggle button. Simply click LB on **Toggle=>Tin Contours** as before.



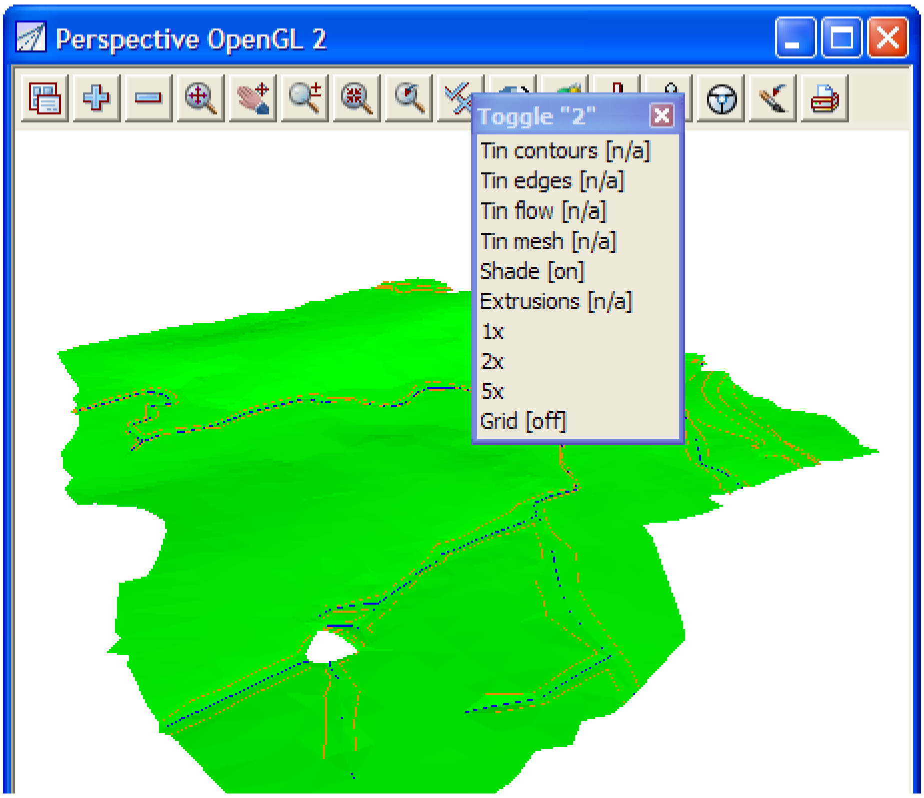
The contour spacing and colours of the Perspective view can be changed just as we did before in the Plan view. This time however you would click LB on the Menu button in the View Button Area of the ‘Perspective Open GL 2’ view. As before then click LB on **Settings=>Tins=>Contours.** See Chapter 6.5 for more details.

Click **Toggle=>Tin contours** again to revert to the ‘green triangles’ display.

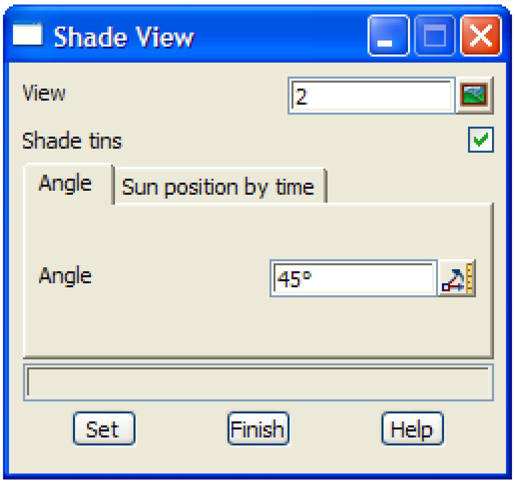
6.12 Shaded Views

It is also useful to view a perspective as a colour shaded view. 12d has the ability to define up to 10,000 colours and use these to create a flat shaded view. During the shade, 12d will find and use the 'colours.12d' file supplied with the tutorial. The angle that each triangle makes with the sun (a point light source at infinity) is used to click LB on a different shade of green. The angle of the Sun can be varied but 45 degrees (the default) gives the maximum contrast.

To quickly shade all the TINs on the perspective view, simply click LB on **Toggle=>Shade**.



To access the Shade View panel to modify the shade settings, click LB on the Menu button in the View Button Area of 'Perspective OpenGL 2 and then click LB on **Settings=>Shade.**



Clicking LB in the 'Shade tins' field tick box will toggle on and off the shading. A tick indicates the shade is activated.

Click LB on Set to create the shaded view. All TINs in the view will be shaded using the faces in order furthest to nearest the viewer. This has the effect of removing faces that are hidden from view.

Click LB on **Finish** to terminate the panel.

Now every time the view is refreshed or the view changed, the shaded view will reappear.

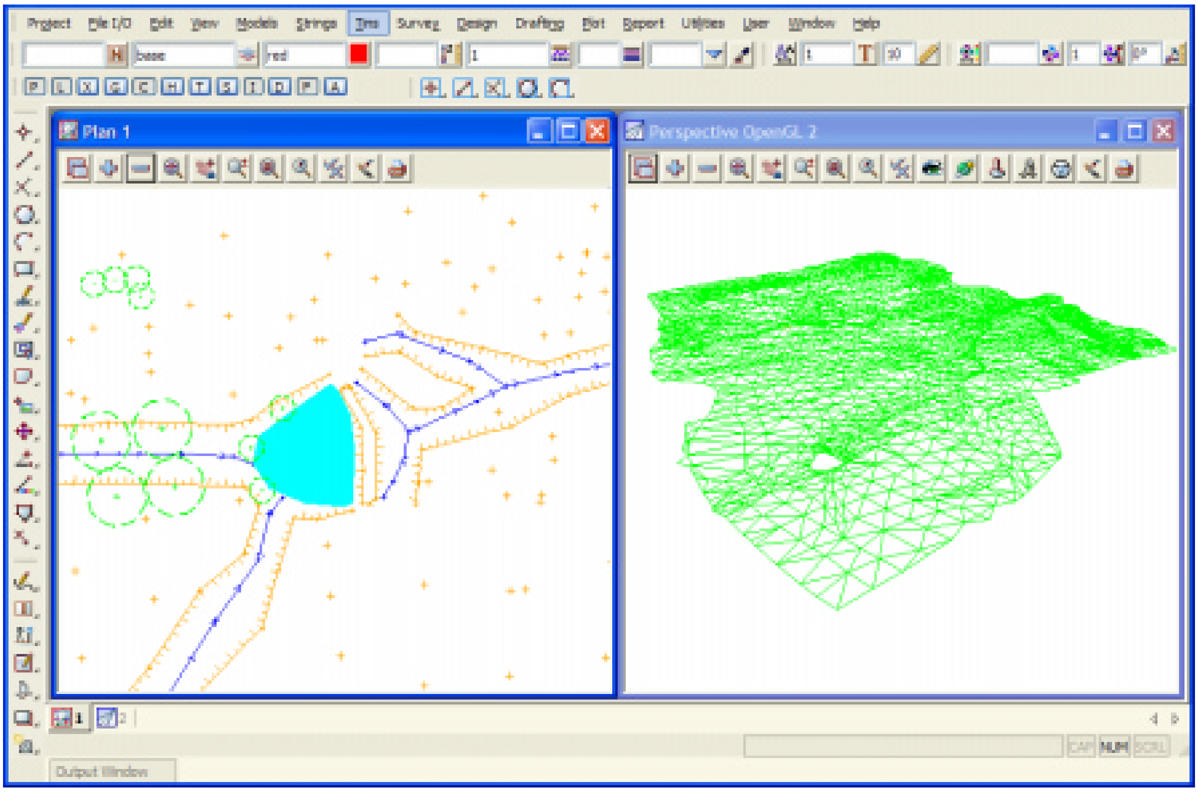
To get back to a 'green triangles' rather than a shaded view, click LB on **Toggle=>Shade** to toggle the shade off.

7 String Picking Concepts

We will now investigate picking concepts and how the mouse is used to interact with 12d when pointing to and selecting items on your screen. Initially, do all picking (i.e. mouse clicking) with the LB. This uses the 12d Model Tentative pick. Later we will look at Fast picking using MB.

In plan view ‘1’ turn on all the models except the triangulation (tin GROUND).

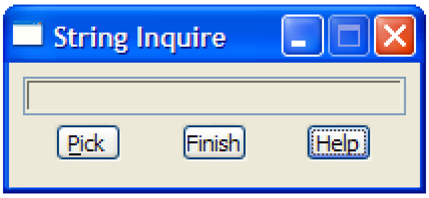
Zoom in to the left dam. Your overall screen layout including the ‘Plan 1’ view should now look as shown below.



Whilst the ‘string picking’ concepts are used throughout 12d, especially during construction of design features where we want to connect into existing geometry, we will learn about them by example through the relatively simple ‘String Inquire’ feature.

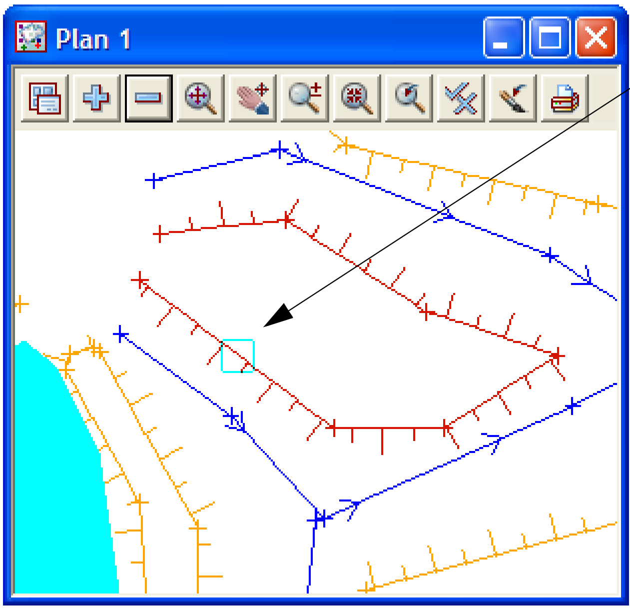
7.1 String Inquire

String Inquire is used to inquire and view the details of a typical line (i.e. string) that is already present in the View. From the Main menu, click LB on **Strings=>Inquire** to bring up the following panel.



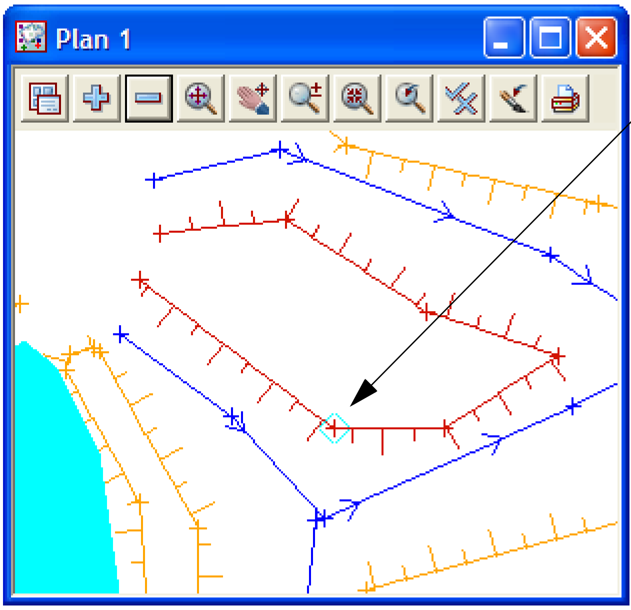
Click LB on **Pick** and then move the cursor anywhere over one of the bank strings and click LB.

NOTE: the *String Inquire* panel can also be brought up by pressing the F2 key. This has been defined in the standard 12d Model function key short cuts.



<u>If you placed the cursor over a line:</u>

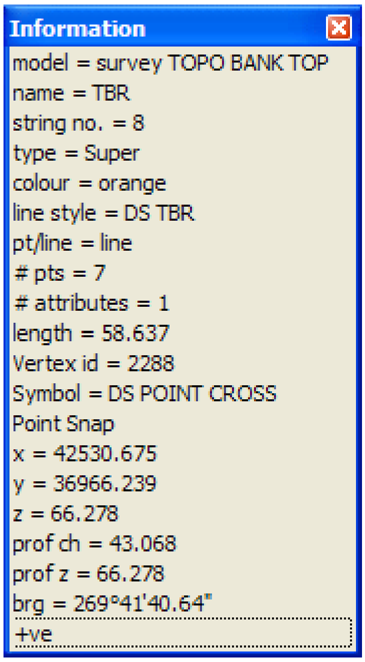
If your Snap settings are still set to their default values, you should see the line go yellow (shown here as red) and a yellow (shown cyan) square box appear at the last location of your cursor when you clicked LB.



<u>If you placed the cursor over a point connecting the line segments:</u>

If you happened to snap to a point on the line rather than the line itself, you will see the line go yellow (shown red) and a yellow (shown cyan) diamond appear at the last location of the cursor when you clicked LB.

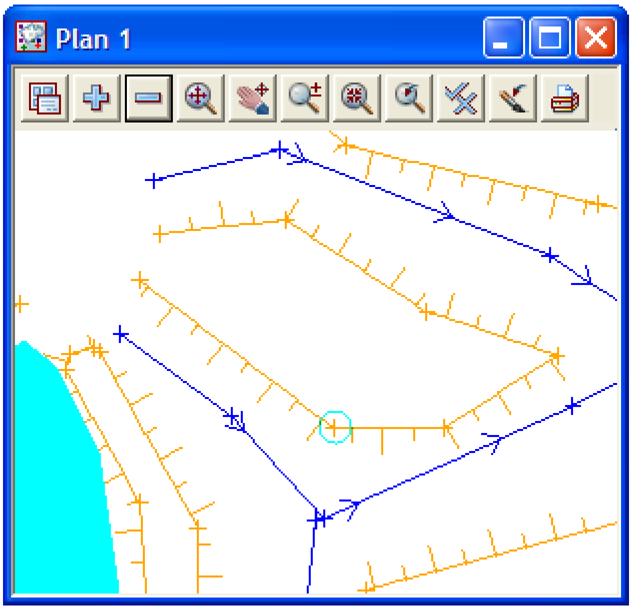
In either case, an Information panel will pop up as shown at right (provided the Info tickbox is set ON - see Chapter 7.4 'Snap Settings'). It advises such information as the name of the Model which contains the selected string (survey TOPO BANK TOP), the string name (TBR), the type of string (Super). The colour, line style and number of points in the line are also returned along with it's length.



The x and y coordinates are those of the cursor at the time of the string 'pick'.

In this case the panel shows that the string was accessed via a 'Point snap'.

If you haven't moved the cursor very far and now pick with the LB again, you will notice that the Information panel changes, the string goes back to its original brown colour and the cursor is now replaced with a yellow (shown cyan) circle.



This sequence may seem strange at first. What has happened is that the first pick located a string within snapping distance of the cursor so the string 'highlighted' in yellow and the Information panel for this string popped up. The pick location showed a diamond to indicate that a 'snap to the nearest point' had occurred. 12d is in effect asking you 'Is this the string you want?'. To reject the currently highlighted string, without moving your mouse, simply pick with LB again.

The second pick couldn't find any more strings to snap to (adjacent strings were outside snapping distance) and so no more information panels popped up. Instead, a circle showed at the pick location to indicate that a 'snap to the cursor' location had occurred i.e. the only thing that 12d could find at the pick location was the cursor.

The above sequence will only happen this way if the snap settings are in their default setting i.e. points, line and cursor ON. See below for more about snap settings.

Now if you try to click LB again on the same string, you will only get the yellow circle indicating a cursor snap. This happens even if you try to pick it multiple times.

The reason for this is that 12d only ever gives you one chance to snap to a string in any one picking sequence. Any strings already rejected during the pick sequence will be ignored. The purpose of this behaviour is so that if there are (say) three lines one on top of the other, it is possible to sequentially snap to each one in turn by looking at the Information panel details as you perform each LB mouse click. The fact that we could only snap to one string confirms that there is only one string present at this location.

A quick method of restarting a pick sequence when a string is highlighted, is to move the mouse (i.e. cursor) a short distance from the last pick point. All strings can then be picked again. The next section shows how the mouse buttons can also be used to restart a pick sequence.

To terminate the String Inquire i.e. this pick sequence, click LB on **Finish** in the String Inquire panel.

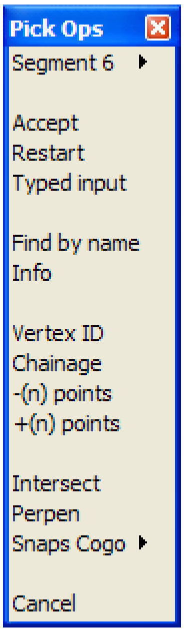
7.2 Use of Mouse Buttons and Enter Key when using Tentative Picking

The three mouse buttons and the Enter key all have a function when picking strings. Those functions are

LB - Left Button	Select the nearest string
MB - Middle button	Accept the current 'highlighted' string. This will also terminate the current pick sequence.
RB - Right button	Bring up the Pick Ops menu
Enter key	Accept the current 'highlighted' string. This will also terminate the current pick sequence. This is the same as MB and is very useful when you only have a two-button mouse.

7.3 Pick Operations Menu via the Right Mouse Button

We will now focus on the use of the RB. Repeat the above picking sequence (From the Main menu, click LB on **Strings**) but now after getting the yellow square cursor (i.e. picking the string), click the RB and the Pick Ops menu will pop up



Click with LB on **Restart**. This resets the pick sequence to start over as if the previous pick sequence had never occurred.

If you now try to click on the string with LB, you will notice that the string can now be picked again with the LB. The lesson here is that if you ever get confused during a picking sequence, the safest way to get operational again is to put up the Pick Ops menu, select **Restart** and start over from the beginning.

The **Accept** menu item needs special mention. During a picking sequence, once you have located the string you are after, you normally terminate the sequence by clicking the MB. This accepts the current string and terminates the pick sequence.

The **Accept** menu item has the same function as clicking the MB during the pick sequence i.e. it is used to indicate to 12d that the string found is the one that you wanted. If you are using a 2-button mouse, this is another way around the lack of the middle button (using the Enter key for accepting was described in the previous section). You can accept a string by using the RB to put up the Pick Ops menu and click LB on **Accept**. If you have a 3-button mouse, it is easier to use the MB to accept the string directly.

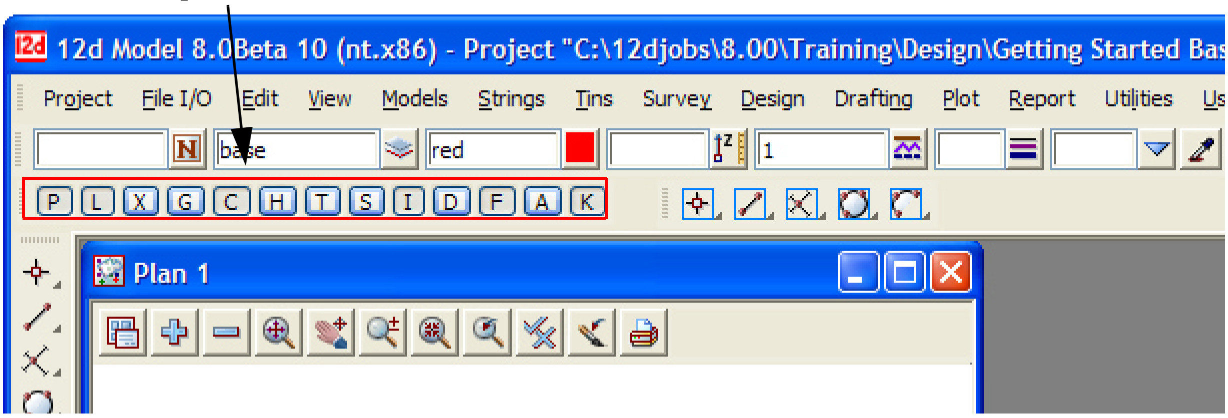
The **Info** menu item also has a special function. The Information panel that pops up when a string highlights is transitory. If you move the mouse cursor out of the panel, the information panel will disappear. This occurs even of you don't click any mouse buttons. The **Info** menu item is used to pop up the Information panel (again) of the currently highlighted string.

The **Cancel** menu item is used to terminate many of the operations that are recursive. For instance when creating a string, 12d assumes that it will involve multiple line segments so it stays in create mode after each segment is placed. After the last point on the string is placed, use the RB to pop up the Pick Ops menu and click LB on **Cancel** to terminate the creation.

7.4 Snap Settings

In the context of String Inquire, the snap settings are used to selectively choose from 12d data sets when inquiring on existing items. The snap settings can be toggled on and off from the snaps toolbar.

snaps toolbar



The snap settings can also be set from the Snaps menu under Utilities on the Main menu. Click with LB on **Snaps Ops** to pin up the Snaps Ops menu

You can select either *Snaps* or *Snaps (Vert)*.

As you use 12d you need to access the snap settings frequently, so it is convenient to leave the snaps menu on display at all times. To minimise menu clutter, the Snaps toolbar and Snaps (Vertical) are merely abbreviated forms of the full Snaps menu. They take up less room on your screen and hence are useful to the experienced user.

Snaps toolbar

The Snaps (Vertical) menu

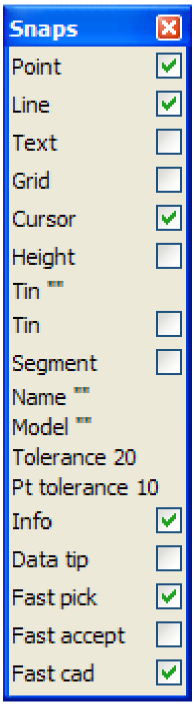
Point
Line
Te**x**t
Grid
Cursor
Height
Tin
Segment
Info
Data tip
Fast pick
Fast **a**ccept
Fast snaps cad accept

At any one time each snap setting is toggled either ON or OFF. For the Snaps toolbar and the Vertical snaps menu, the snap setting is ON when the button is depressed or appears clear and OFF when the button appears raised or blue. The settings shown are the default settings when starting 12d.

If you are new to 12d, it is easiest to use the full snaps menu until you get use to the abbreviations in the Snaps toolbar.

From the Main menu, click with LB on **Utilities=>Snaps=>Snaps**. Move the Snaps menu to the bottom left corner of your screen to get it out of the way.

On the Snaps menu, at any one time each snap setting is toggled either ON or OFF. If a tick appears, the snap setting is toggled ON. The settings shown are the default settings when starting 12d.



At this stage we will focus on 4 of the first 5 boxes: Point, Line, Grid and Cursor. Upon a successful snap, each snap type returns a unique appearance.

Point Snap - diamond
Snaps to the nearest point or end of line

Line Snap - square
Snaps to the nearest line

Grid Snap - circle
Snaps to the nearest grid intersection point

Cursor Snap – circle
Snaps to the mouse cursor (x,y) position. This is used when drawing freehand.

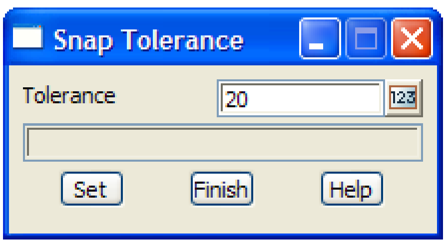
To change a snap setting, click LB in the snap setting box or on the text describing the snap (e.g. P). The setting will toggle ON or OFF.

As shown above, it is possible to have multiple snap settings on simultaneously. For instance, if you want to be able to select a line on either ‘the line’ or it’s ‘end points’, you need both Point and Line snap ON.

You can generally leave Cursor snap ON. Most times, if all other snaps fail or are not set, you want the mouse cursor position returned. This is useful when freehanding into 12d strings that are not connected to existing features e.g. the centreline of a new road. If you don’t have Cursor Snap ON, you will get a ‘Failed Snap’ error message whenever all other snap settings fail.

At the bottom of the Snaps menu is an ‘Information’ tickbox labelled Info. If this box is NOT ticked, the Information panel will NOT pop up as each string is selected.

Near the bottom of the *Snaps* menu is the menu item **Pt tolerance 10**. This figure indicates the current point snap tolerance setting is 10. To change the snap setting, click on **Pt tolerance 10** with LB and the following panel pops up



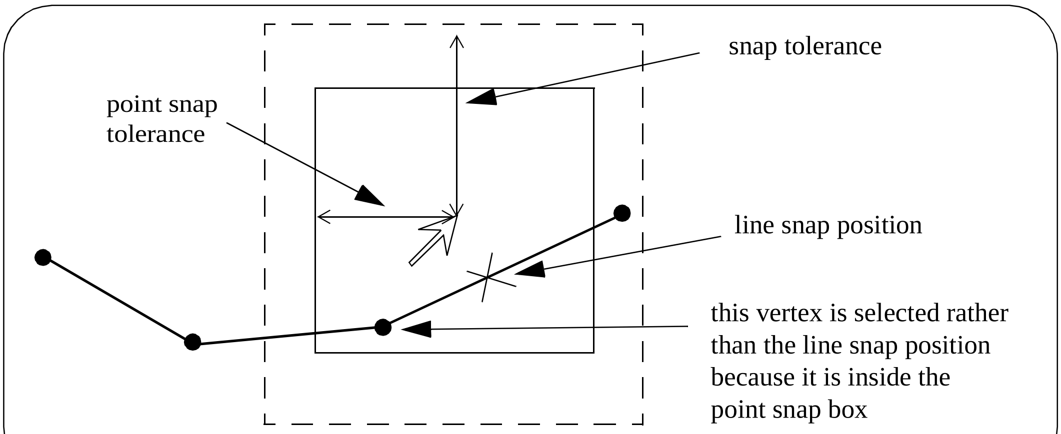
The point snap tolerance is measured in screen pixels. In 1024 resolution, a point snap tolerance of 10 represents about one hundredth of your screen width. If point snap is set, then the closest vertex within this distance of the cursor will be selected.

To change the tolerance, lock the cursor in the *Tolerance* field by highlighting (double clicking on) the existing text, press the Delete key and type a new Tolerance value. Click LB on **Set** to activate the new setting. Click on **Finish** to terminate the panel.

Similarly for the **Tolerance** menu item - click on **Tolerance** and the *Snap Tolerance* panel pops up

NOTE - When *Point* snap is set on, any vertex of a string within the point snap tolerance box around the cursor when LB is clicked, is considered for selection ***before any other type of snap is considered***. Centres of circles, centres of arcs and arc end points are considered to be vertices.

When *Line* snap is set on, the cursor only needs to be within the snap tolerance distance of any visible segment of a string when LB is clicked, and that string is considered for selection. Also arcs and circles are considered for selection.



Point Snap Box and Snap Box

In the area between the point snap box and the snap box, vertices and line snap positions are treated equally and the closest one to the cursor is selected.

To practice this further, do a **Fit** on your current View. Pick a feature in the view where lots of lines meet and without moving the mouse, do a series of ‘String Inquires’ by repeated use of the LB and observe how 12d will snap to adjacent items near to the mouse cursor. Note the cursor shapes returned that indicate that sometimes you are getting a ‘Point snap’ and sometimes a ‘Line snap’.

Remember points are just a special type of string..

7.5 Models and Snap Settings

Whilst it may appear obvious, it is important to remember that you can only snap to data that is currently on display. Models that are currently turned off will not participate in the selection process during snapping. If you find that you are snapping to unwanted items, consider turning off models that are irrelevant to your current operations

7.6 Fast Picking

To **fast pick** a string, simply move the cursor near the string and **click MB** or type <enter>. The nearest string to the cursor satisfying the snap conditions is selected.

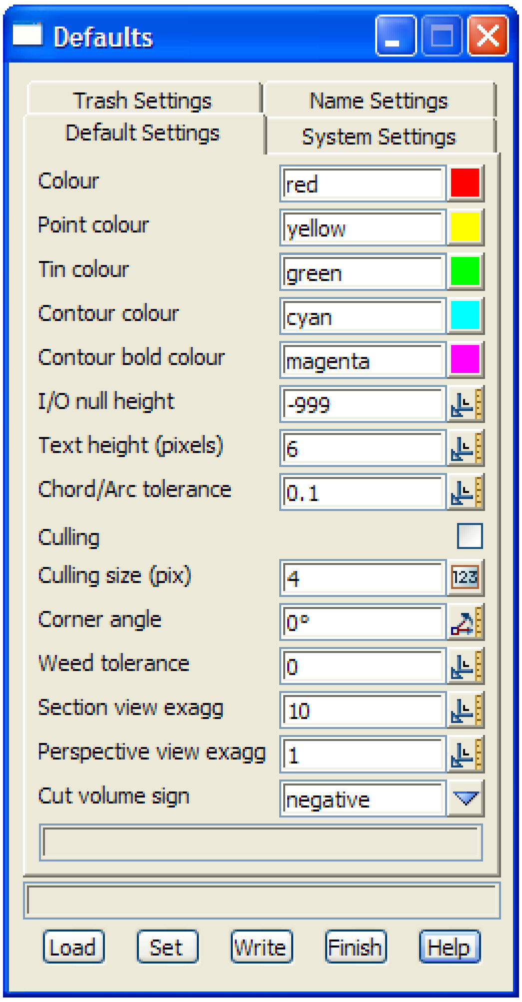
Hence using **MB** alone replaces a LB followed by an MB.

7.7 Modifying the String Highlighting Colour

12d has various default parameters for the display of data including the string highlighting colour. This is the colour a string is changed to whilst it is selected.

The default highlight colour is *white* but this is not be very useful if you want to draw strings in white, or if you use a white background colour. In either case, it is important to change the highlight colour to a colour other than the white.

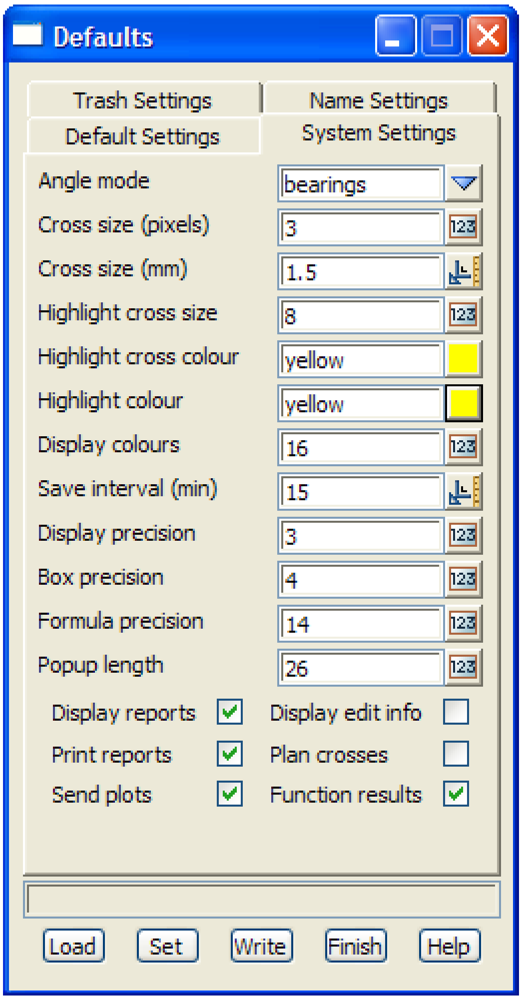
To check the highlight colour for the project, we select from the main menu **Project => Management => Defaults** and the **Defaults** panel pops up.



From this panel, the user can change various parameters for this project that 12d uses for calculations, display and data handling.

To change the default highlight colour, select the *Systems Settings* tab by clicking LB on the 'Systems Settings' tab.

The following should appear:



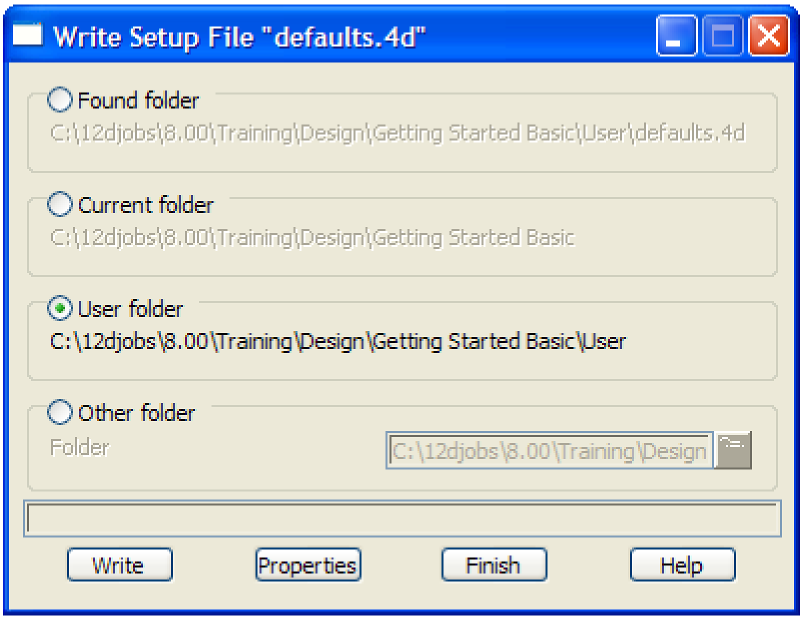
Note that the Highlight colour is set to yellow.

To change this, LB click on the colour icon adjacent to the Highlight colour input box and select another colour such as cyan from the colour choice box. Then press **Select** on the colour choice box panel. Colours can more quickly be selected from the choice box by double clicking LB on the desired colour - the Select button is not required.

To set the current values for the defaults press the **Set** button.

NOTE: When a new project is created, the values in the **Defaults** panel are loaded from the set-ups file *defaults.4d* which 12d Model looks for on start up in the standard 12d location (for more information on the search order, see Appendix J 'Set Ups' in the on-line Reference manual). For an existing project, all the values in the **Defaults** panel are saved with the project so if any have been changed in the project after the project was first created, then the defaults for the project will differ from those in the *defaults.4d* file.

If you wish to keep the current defaults for a project to use as the initial defaults for future new projects, you can save the file **defaults.4d** to a suitable location by clicking on the **Write** button to bring up the **Write Setup File "defaults.4d"**panel.



Specify where you wish the *defaults.4d* file to be saved and then click on **Write**. If you want the changes to apply to any new project you create be sure to save the changes to the **'User folder'** as shown above.

Click on **Finish** to close the **Save Setup File** panel, and then **Finish** on the **Defaults** panel.

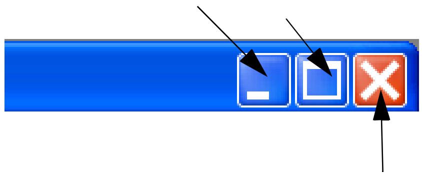
8 Creating Strings with CAD

We will now investigate creating strings using the CAD options. We will create points (one point strings), a 2 point line (single segment string) and a line string (multiple segments in the string).

First we will create a new plan view to work in.

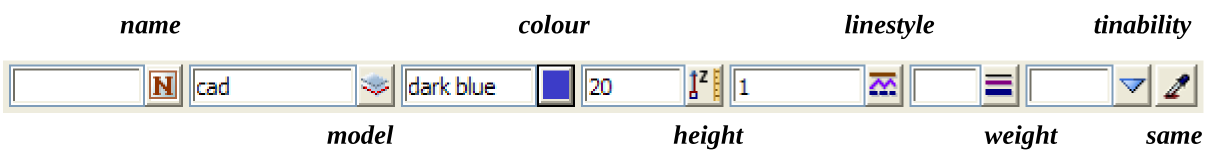
From the main menu, click LB on **Views=>New=>Plan**. This will create View ’Plan 3’.

Maximise the view by clicking on the *Maximise* icon on the top right hand corner of the view or by double clicking on the plan view title area.



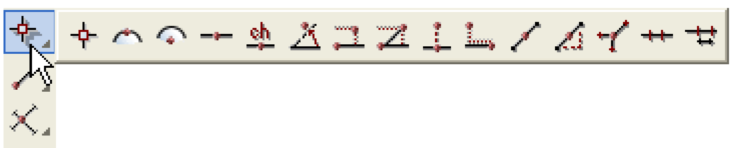
8.1 Creating Points

The CAD options to create points, lines etc. can be done by using the main menu system or by the use of the CAD **toolbar**, which is displayed on the left of the screen at start-up. Regardless of the method used to activate the CAD commands, the CAD **controlbar** as outlined on in Chapter 4.5 will be used to define the characteristics of the created elements. We will change the values in the **controlbar** as follows.



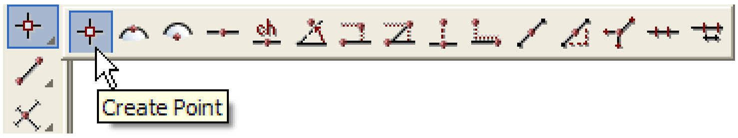
Click LB in the model field and type in ‘cad’. Click LB on the colour icon and choose the colour *dark blue* from the choice box by double clicking on *dark blue* in the pop-up list of colours. Enter ’20’ into the height box and leave the linestyle type as 1.

To create a point string (i.e. one vertex string) we will use the CAD **toolbar** flyout. Pick the points section of the toolbar by clicking LB over the create point symbol and keep LB depressed.

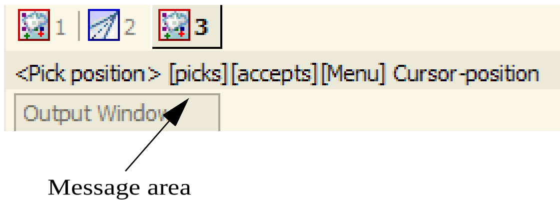


The points **flyout** menu is displayed which has all the options in the points section of the CAD creation tools. This is displayed as a horizontal bar consisting of all the icons that make up all the options in the points section of the CAD tools. Whilst holding down LB move the cursor over each of the icons and the **tooltip** function tells what each of the options does.

To select an option, keep the LB depressed until the cursor is placed over the specific option you want and then release the LB. We will select the **’Create Point’** option which is the first icon in the **flyout**.

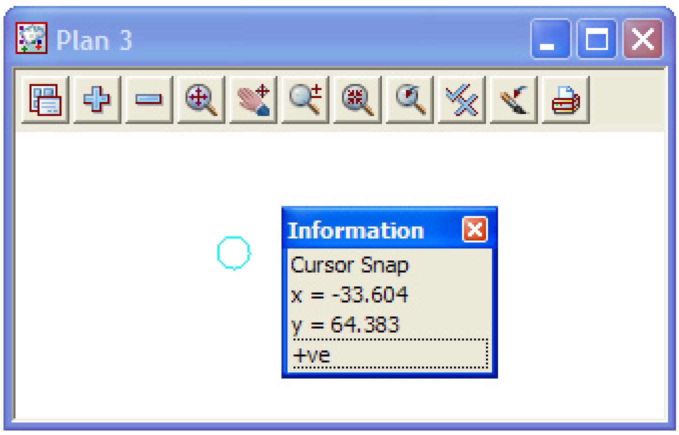


On selecting the **Create Point** option, or any other CAD option, the user is prompted for the relevant data in the screen message box located on the bottom left hand corner of the 12d Model application window

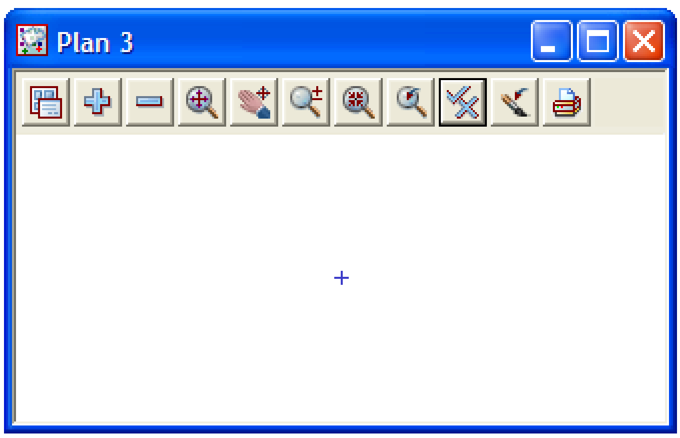


The user can select a position with the mouse and on accepting that point (Middle mouse button or enter) the point is created at the selected position. The model, colour, height etc. are defined in the **Cad Controlbar**.

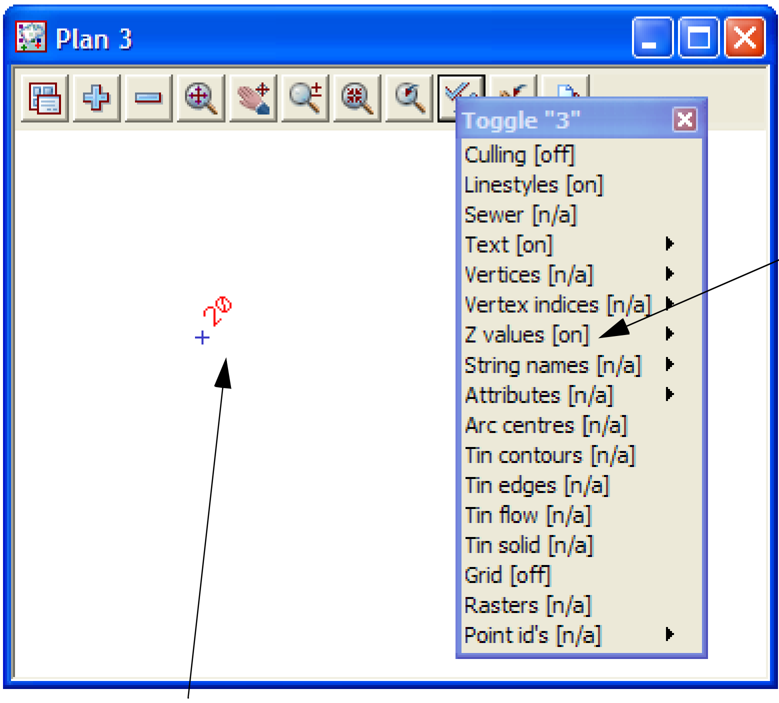
The snap mode will influence the mouse selection. For example if cursor snap is on, the user can choose a position not yet defined. If point snap is on and the selection snaps to an existing point, the option will place another point at that location. Ensure that the cursor snap is activated in the snaps **toolbar**. Click LB at a position roughly in the middle of the view.



Click MB to accept that position. The point is then created with the model ‘cad’ elements’ being added to the view automatically.



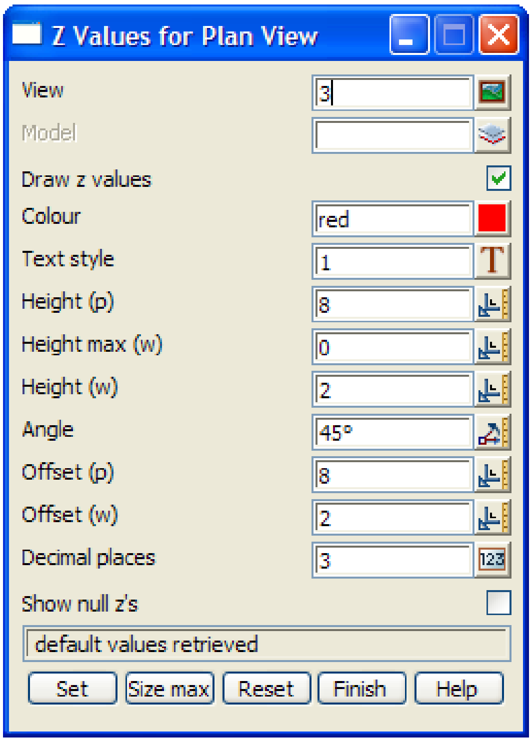
To see the height of the point we must toggle on the Z values. To do this click LB on the toggle button on the view menu to bring up the toggle menu. Then click LB on the 'Z values[n/a]' position. Don't walk right on the arrow near this position. This is to specify individual models to turn the Z values on or off. By clicking LB on the Toggle menu, you turn on (or off) all Z values in that view for all models.



Click LB over 'Z values'

The Z value is then shown near the point that we created.

The default colour for the height text is yellow. To change the colour of the height text so it clearer we can click LB on the menu icon from the view menu to bring up the plan view menu. From that menu we can click LB on **Settings=>Z values=>Single** to bring up the **Z values For Plan View** panel. From this panel, select the colour icon and then select the colour red by double clicking LB on the red colour. It should like as above:



Then press **Set** on the panel to set that colour. Finally press **Finish** to close the panel.

The change is made only for view 3. Any other points added to the view will now have their height text shown in the red colour.

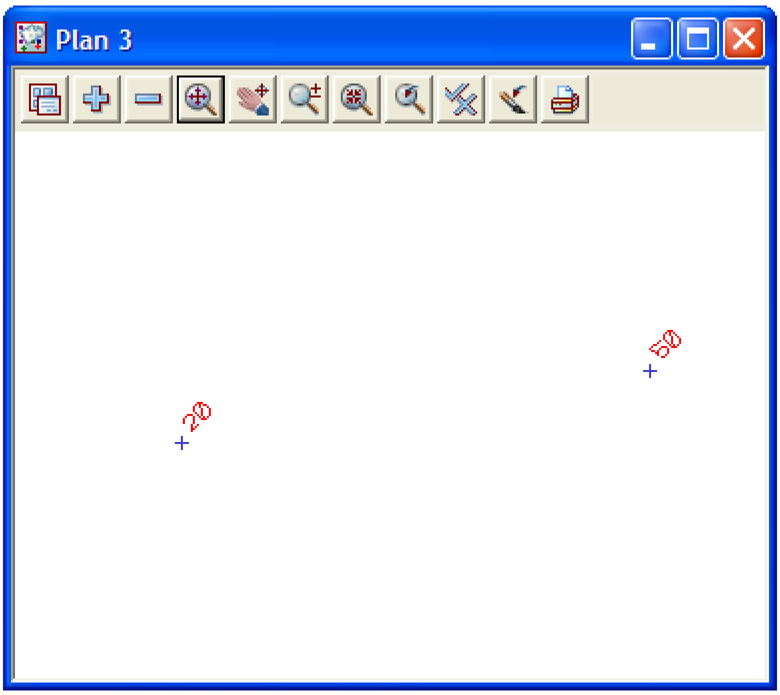
There are various ways of selecting a position when creating a point. Specification of a position can also be done by the direct input of the xyz coordinate of the point by pressing the space bar to bring up the enter XYZ panel or by typing of the value to bring up the XYZ panel. The user then enters the X, Y and Z value into the box separated by a space. e.g. 200 150 40. As we have already set a Z value in the CAD **controlbar,** you only have to specify a X and Y value into the box. **NOTE:** The Z value will default to the value entered into the CAD **controlbar** whether or not it is specified in the XYZ box. If no height value exists in the CAD **controlbar** or the XYZ box, then a value will be interpolated if possible, otherwise a 0 value will be assigned.

We will again create a point by using the CAD **toolbar**.

Firstly, change the Z value in the CAD **controlbar** to '50'. Then repeat the steps outlined above to choose the Create Point option. Instead of selecting a point with the mouse we will type in the coordinate values. To pop up the XYZ box, press the spacebar. Then type into the box, 200 100 and then press the enter key. We did not have to specify a Z value in XYZ box as it was already defined in the CAD **controlbar**. **NOTE:** A space must be placed between the X and Y values.

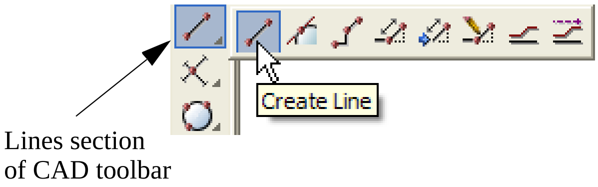
A new point is created. Click LB on the Fit icon on the view menu  to fit the data in the view.

It should now look like as shown below:



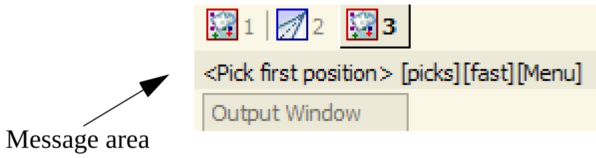
8.2 Creating Two Point Lines

We will now create a simple one segment line. To do this we will use the CAD **toolbar** flyout. Pick the lines section of the toolbar by clicking LB over the create line symbol and keep LB depressed.

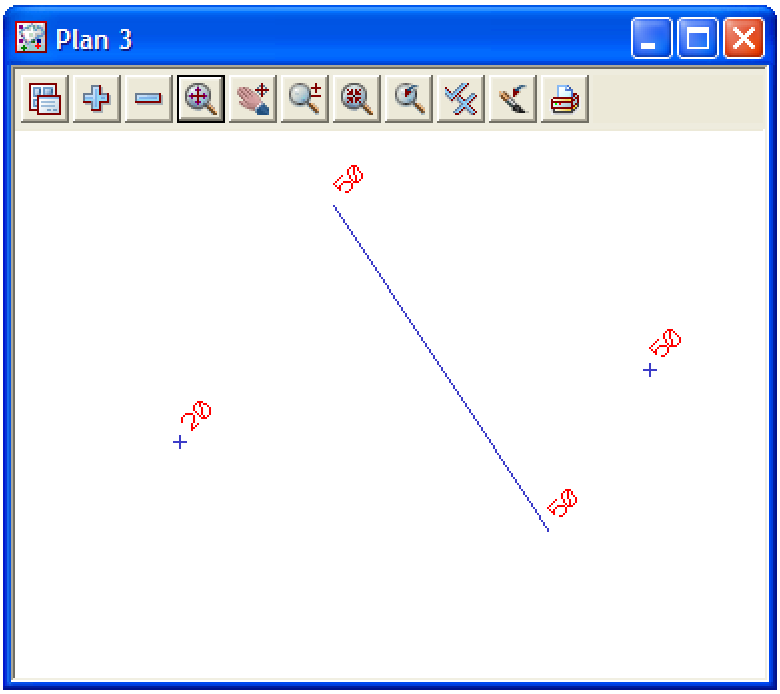


The lines **flyout** menu is displayed which has all the options in the lines section of the CAD creation tool. Select the **'Create Line'** option which is the first icon in the **flyout**.

On selecting the **Create Line** option, the user is prompted for the relevant data in the screen message box located on the bottom left hand corner of the 12d Model application window



We will pick a position with the mouse to define the start of the line. Pick a position with LB about halfway between the two existing points and then MB to accept. After accepting the start point, the user is told in the message area to pick the end of the line. You will also notice when you move the mouse around that a line is drawn 'rubber banding' to the cursor position. We now select a point going south east to define the end of the string with LB and MB to accept. The created string will be shown given the parameters given in the CAD **controlbar** at the time of construction.



8.3 Creating Line Strings

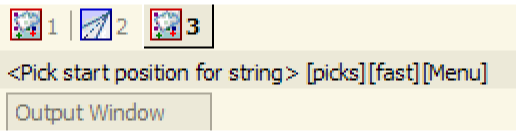
We will now create a multi-segment string. To do this, we will use the CAD menu from the main menu system rather than from the CAD toolbar

From the main menu, click LB on **Strings=>CAD=>Lines=>Line string**. The **Create Line String** option will now be running. **NOTE:** These options have no panel assigned to them.

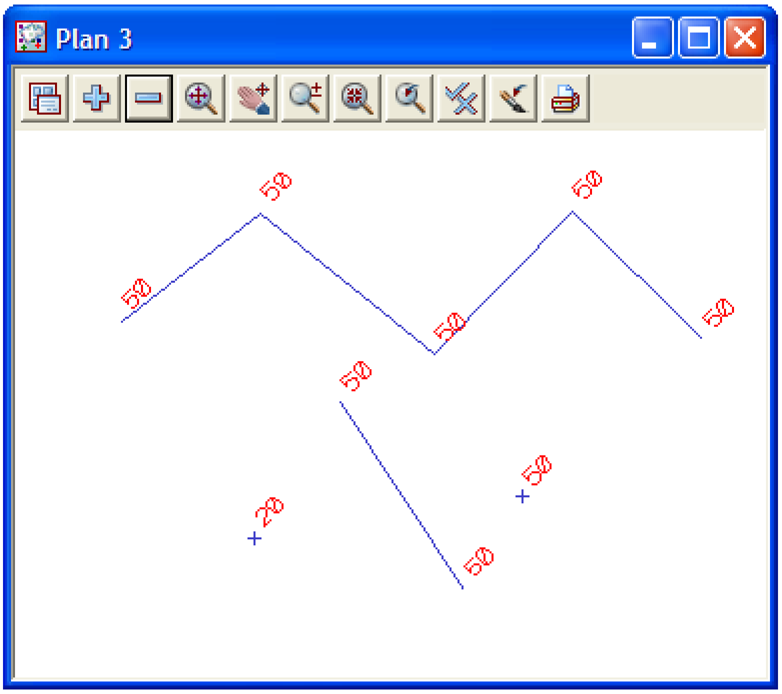
The same option can be started from the CAD toolbar as we did for the **Create Line** option except we choose the **Create Line String** icon from the flyout.

On selecting the **Create Line String** the user is prompted for the relevant data in the screen message box located on the bottom left hand corner of the 12d Model application window

Message area



We will pick a position with the mouse to define the start of the line. Pick a position with LB any where on the view and accept with MB. Then move the cursor to a new position and pick and accept a second point. Pick and accept a third point and so on. To finish the string simply press the Esc Key on the keyboard or alternatively RB and then select cancel from the **Pick Ops** menu. The string will be created using the parameters given in the CAD **controlbar** at the time of construction.



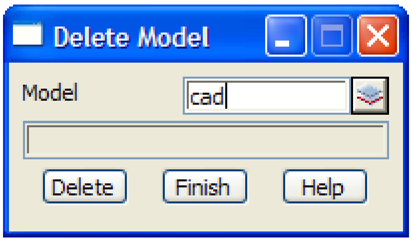
This has given a small introduction to the use of the CAD options. For a more detailed explanation of these tools see Chapter 14 'Strings' in the on-line reference manual and follow the links to the CAD options.

We will now finish this section by deleting the current view. As the view is maximised, select **View => Delete** and select view '3'. Alternatively, we could have restored the view and click LB on the '**X'** icon at the top right of the view. This should then leave two views, Plan 1 and Perspective 2. If either Plan 1 or Perspective 2 are left maximised, select the restore button on the top right hand side of that view to leave two views as at the start of this chapter.

Clear the value for the default height in the Cad Controlbar. Leaving the height there mat create problems when creating strings at a later stage. Also change the default model to one of the existing survey models as deleting the current model is not recommended.

Finally, we will delete the ’cad’ model. To do this we click LB on the *delete model* option from the main menu **Models=>Delete=>Delete a Model**. This brings up the **Delete Model** panel

.



Select the model icon with LB and then double click LB on ’cad elements’. Then click on the **Delete** button, and answer yes to any warnings (after reading them). This then deletes the model from the project.

9 Basic Road Design - Centreline String Creation and Editing

We will now begin our first Road Design with 12d. Before we can begin, we need to review other techniques for getting data into 12d.

By use of the Snap settings, we have seen how to snap to existing points and lines. This is useful when inserting strings into your model that must exactly join other strings already present. There are times however when we wish to place a feature in the model exactly by absolute or relative coordinate entry. We do this by typed input.

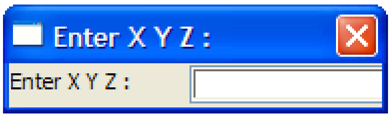
9.1 Typed Input

In general, whenever 12d is prompting you for a cursor pick in a Plan view, you have the option of either

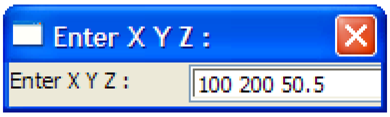
Clicking LB with the mouse to return the x and y coordinates OR

Typing the x, y (and maybe z) coordinates

To enter typed coordinates, you simply start typing, or click RB and select **Typed Input** from the pop up list. A 'Typed Input' panel will pop up as you begin typing.



If you wanted to enter the coordinates of the point (100,200,50.5) you would type



Just separate the values with a space between each item. Terminate the entry of data from the keyboard by pressing the Enter key. If you only supply two values and press Enter, 12d will assign a Z coordinate of zero.

If you ever accidentally touch a key when performing cursor input via the mouse, the 'Typed Input' panel will pop up. To remove it so that you can revert to cursor input, backspace over any digits that appear in the input window until the field is clear and press the Enter key. The panel will disappear.

Whilst there are also other ways of entering typed input e.g. by bearing-distance, relative xyz increments etc. we will not pursue these at this time.

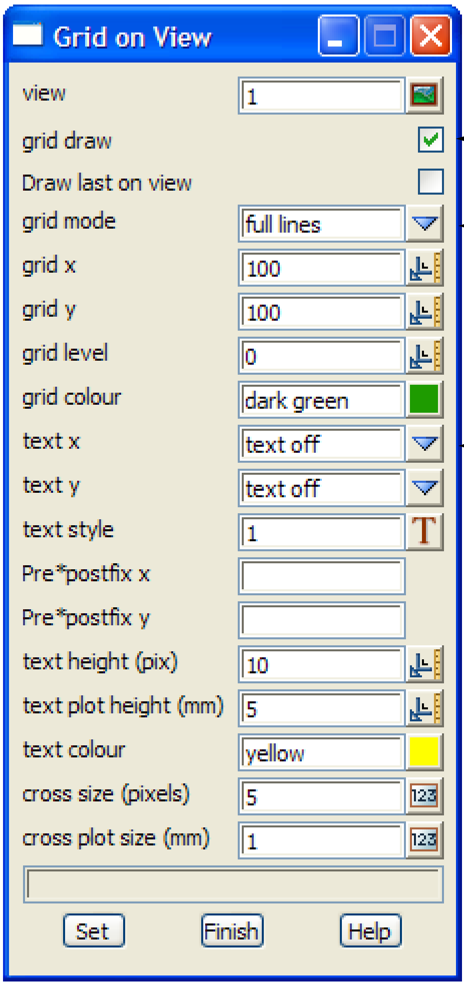
9.2 Using a Grid to Assist in Coordinate Entry

It is possible to turn on a grid and with the appropriate grid snap setting, snap to only the grid points when entering points and strings.

Before attempting to investigate the grid capability, let us clean up our display.

From the View 'Plan 1', click LB on the Menu button in the View Button area (or click RB in the View Button Area) and the View menu will pop up. Click LB on **Models=>Remove All Models**. In the View Button Area, click LB on the '+' sign button and select all **survey** models.

Now let us set our grid settings so that they are suitable for grid snap purposes. From the 'Plan 1' view, click LB on the Menu button in the View Button Area to pop up the View menu.Click LB on **Settings=>Grid** and the following panel pops up



Tick on the 'grid draw' box

Place the cursor on the choice button for the 'grid mode' field and click LB. You can set your grid to either 'full lines', 'crosses', 'marks' or 'marks and crosses'. Click LB on **full lines**.

Note the grid x setting. You can change this setting by placing the cursor into the 'grid x' field, press the Backspace key (or the Delete key and typing the required number). Repeat this with the 'grid y' field.

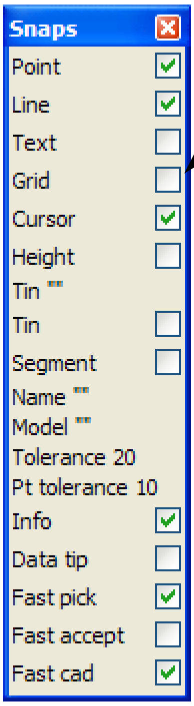
Place the cursor on the choice button for the 'text x' field and click LB. Click LB on **text off**. Repeat this with the 'text y' field.

The other settings can be left as is.

Click LB on **Set** to activate the change.

Snaps Toolbar

Snaps Menu



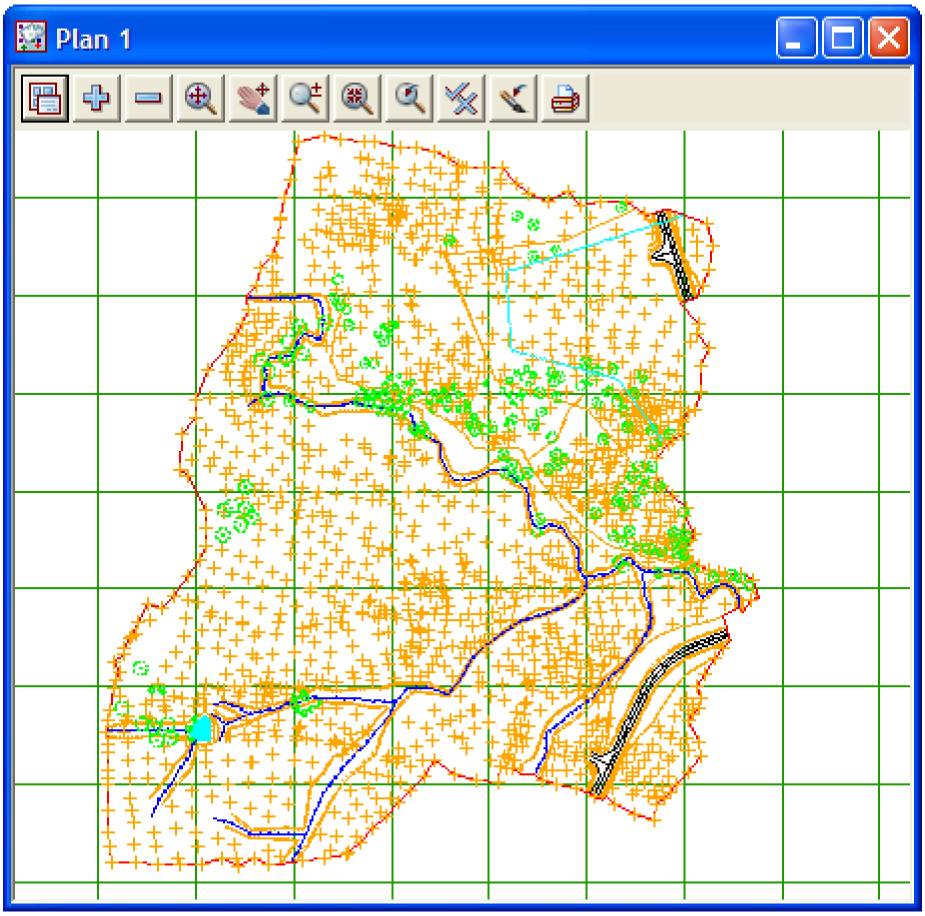
Toggle Grid snap on

To ensure that you snap to the grid, you need to set **Grid** snap ON. When creating new strings you would probably want Point and Line snap OFF so that you don't inadvertently snap to features in the view.

Any of the Snaps menus or toolbar can be used to toggle Grid snap on

If you want to use the Snaps menu and it is not already on display, click LB on **Utilities=>Snaps=>Snaps** from the Main menu.

If the grid is not already on display, in the View Button Area of 'Plan 1', click LB on **Toggle=>Grid** to turn on the grid. The 'Plan 1' view will refresh as follows



If we were now to start creating strings, with each menu pick we would snap to a grid intersection. The purpose of introducing this here is to show you how to use the grid.

We will not use the grid at this time however as it is more important that you learn how to freehand in string data and use typed input.

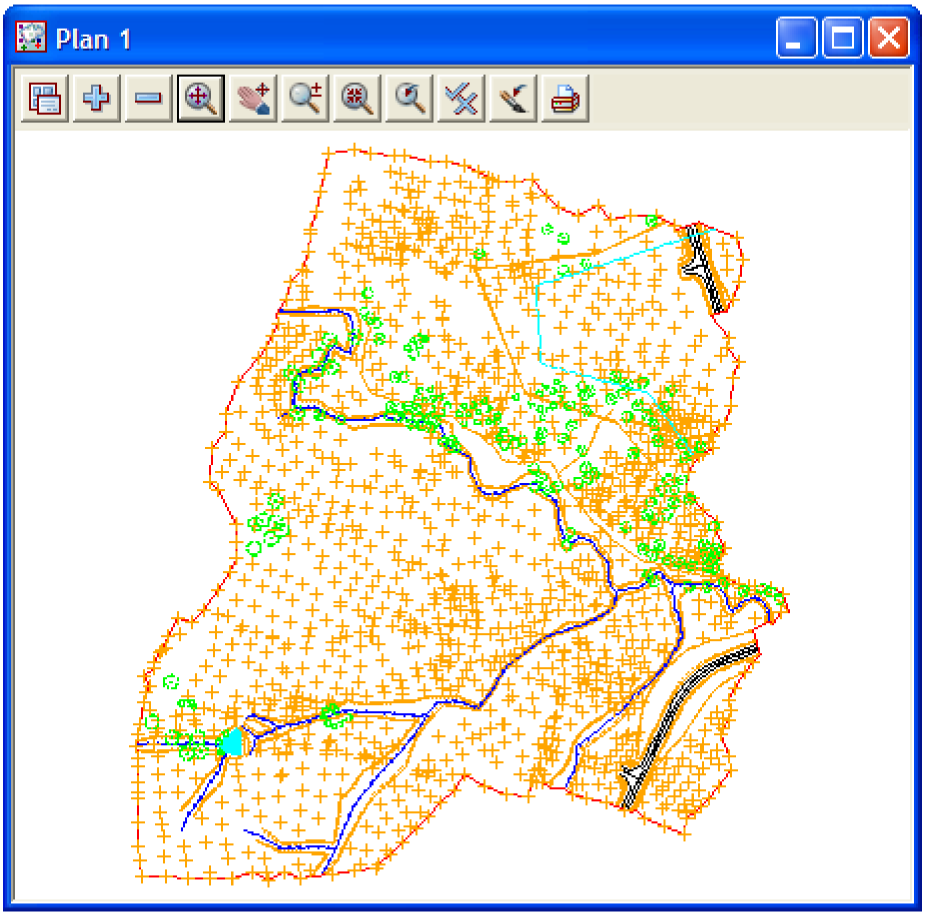
You can turn the grid off by clicking LB on **Toggle=>Grid** or unticking the ‘grid draw’ tick box in the grid settings panel. Click LB on **Finish** to terminate the grid settings panel.

Also from the Snap Settings menu, turn Grid Snaps OFF.

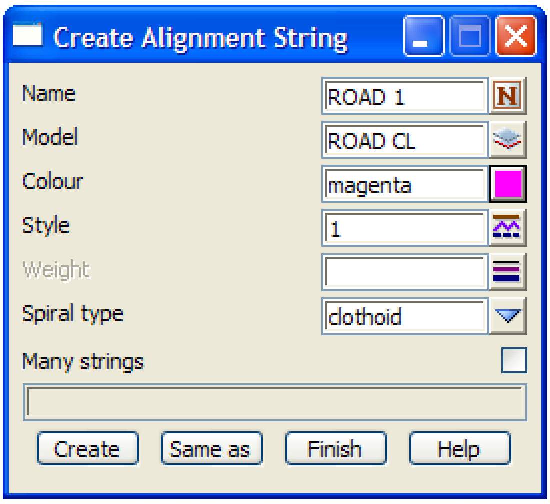
9.3 Horizontal Geometry (HG) Edit

From the Snap Settings menu, turn all Snaps OFF except *Point, Line, Cursor* and *Information*.

In View 'Plan 1', click LB on **Fit.** Your view should look as follows



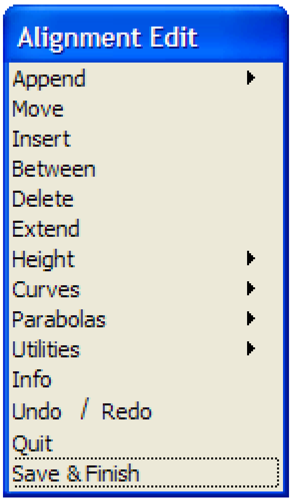
Now begin placing our new road centreline. From the Main menu, click LB on **Strings=> Create=> Alignments=>Alignment**. The *Create Alignment String* panel will appear.



Fill out the panel as shown. Put the cursor in the Name field and type 'ROAD 1'. In the Model field type 'ROAD CL'.

These settings tell 12d that our new road centreline is to be called 'ROAD 1' and it is to be placed in a new model called 'ROAD CL'.

Click LB on **Create** and the Alignment Edit menu will pop up.



It is suggested that you move the *Alignment Edit* menu to the left bottom of your screen to get it out of the way when creating your new centreline (Refer to the following screen as a guide). Click with LB somewhere over the words **'Alignment Edit'** to pick up the menu, move the cursor and pin the menu down by releasing LB.

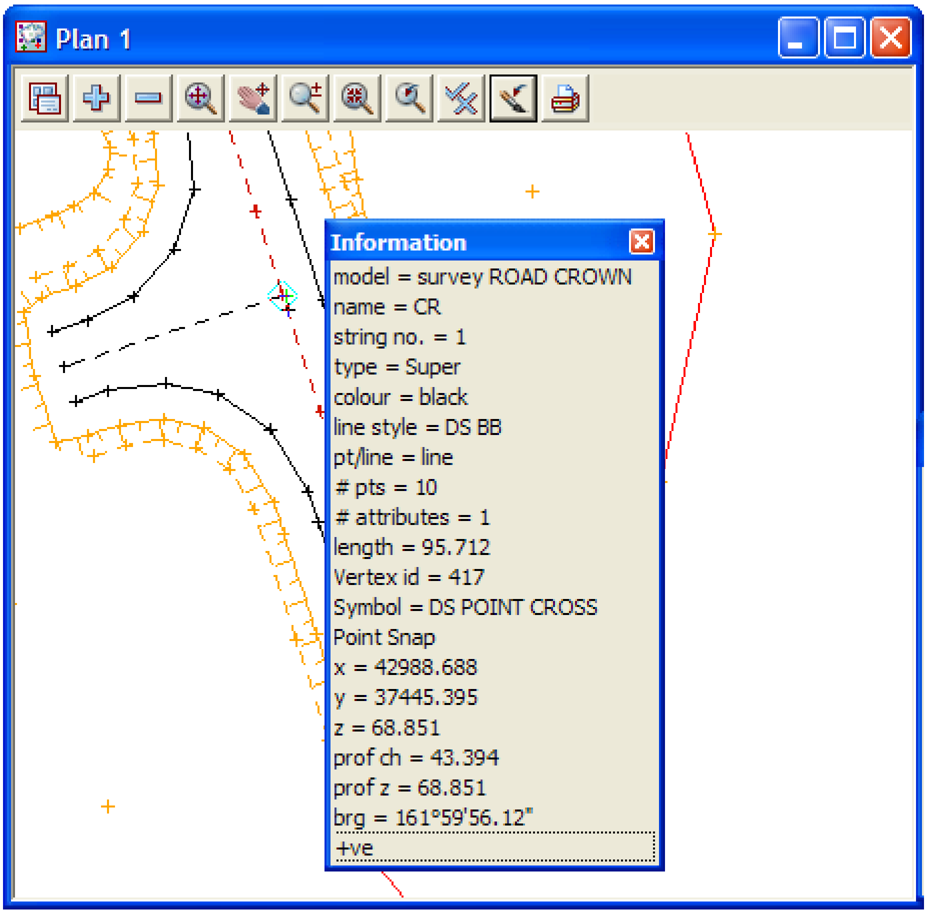
We will initially define the horizontal alignment of the road in the View 'Plan 1'. We need to tell 12d that we are defining Horizontal Intersection Points (HIPs).

Click LB on **Append=>HIPs**

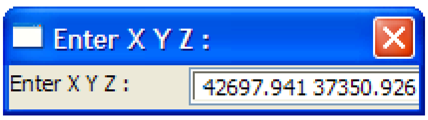
12d is waiting for you to select the starting point of your road. You can choose to either (1) select an existing point (2) enter coordinates exactly or (3) freehand in the points

We want to start by tying into the existing road so click at the intersection of the two roads in the top right of Plan 1. Accept this point

.



Type the X and Y coordinate in turn for the next two IP points:

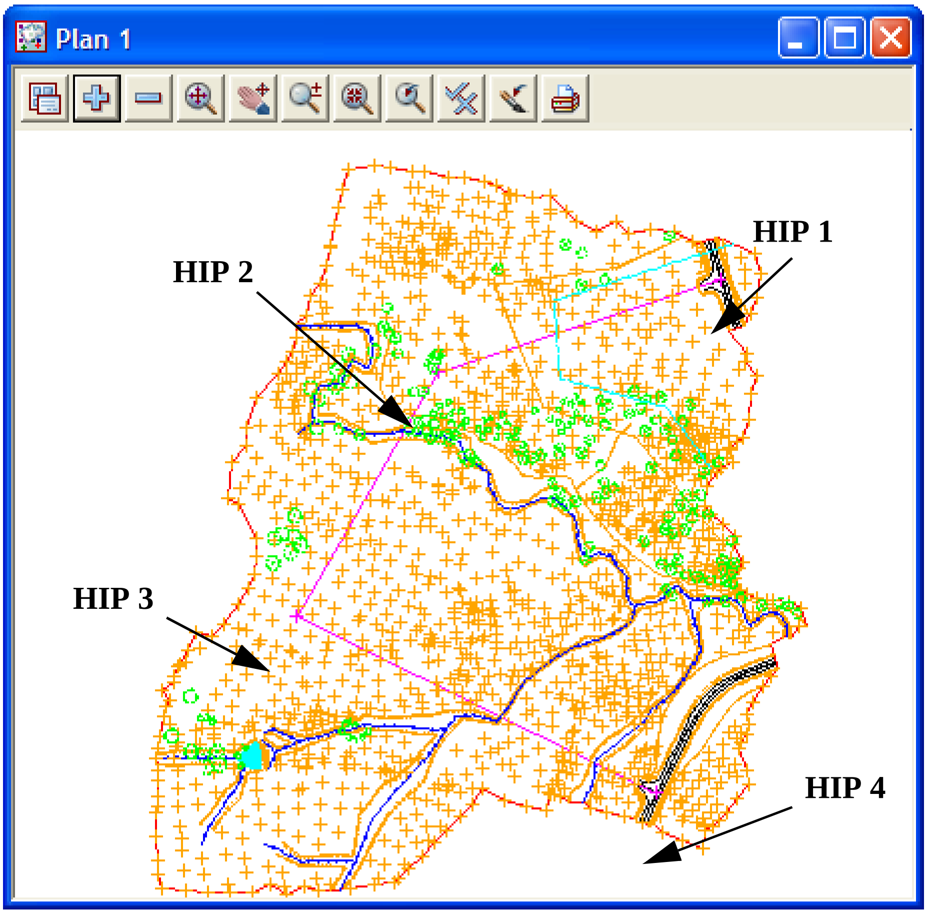


IP 2	IP 3
X = 42697.941	X = 42552.804
Y = 37350.926	Y = 37099.542

TERMINATING THE "RUBBER BAND"

The last IP point is intersects back onto the existing road a the south east of plan 1. Click on the intersection and accept the position. After the fourth HIP is defined, it will remain rubber banded to the cursor. Pressing the ***Esc*** key (<Esc>) terminates the String creation process and removes the rubber band. Your centreline should now comprise four points connected by three line segments.

Your view should now look as shown below.



Don't put the Alignment Edit menu away yet as we will need it further. Just leave it in view at the lower left of the screen. Remember this menu is referring explicitly to the Alignment we are currently creating - 'ROAD 1 => ROAD CL'.

We will now put in some horizontal curves between the HIPs. We will insert a curve of radius 200 at HIP 2 and a curve of radius 100 at HIP 3.

From the Alignment Edit menu, click LB on **Curves=>Radius.** The Screen Message Box area advises

<Select point to change radius>[picks][][Menu]

Click with LB in the vicinity of HIP 2. The point will highlight and the Screen Message box advises

<Select point to change radius>[picks][accepts][Menu]"road cl->smith st"

12d is asking you to confirm that this is the HIP where you wish to insert the radius. Click the MB to accept the highlighted point.

A panel will pop up prompting 'New Radius'. The cursor should already be locked into the data field.

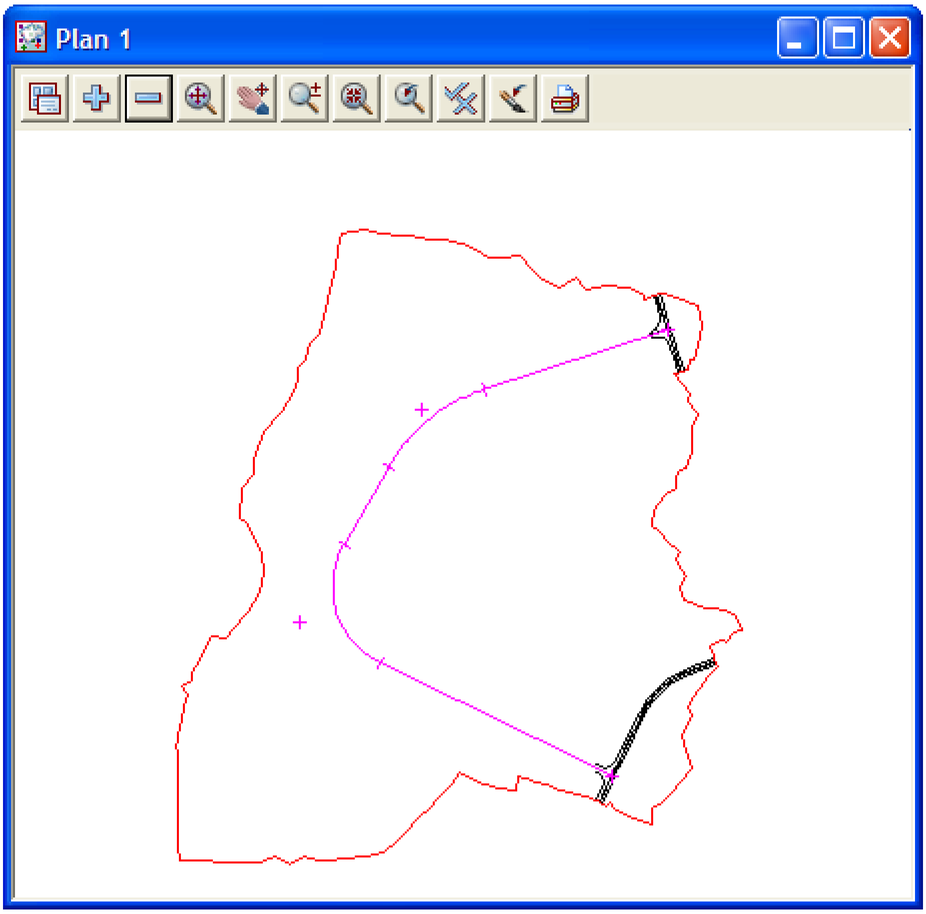
Backspace over the zero (or highlight the existing entry by double clicking LB), type 200 and then press the Enter key. Observe that a horizontal curve of radius 200 is now inserted and the tangents are removed. The IP is now marked with a magenta cross.

The insertion of curves is setup to handle multiple insertions. If you now position the cursor in the vicinity of HIP 3 and click with the LB, accept with MB, type 100 for the new radius and press Enter, a further radius will be inserted.

To terminate the radius insertion process, press the <*Esc*> key (or click RB to pop up the Pick Ops menu and click LB on **Cancel**).

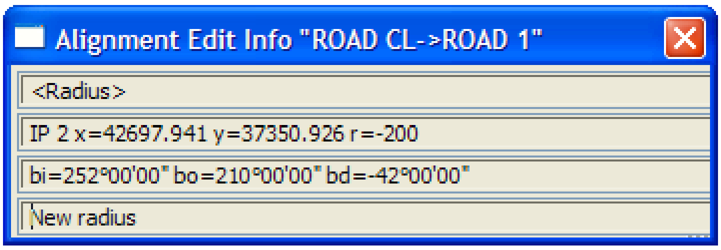
To make the road alignment easier to see, we will turn off all the survey models except the ‘survey ROAD CROWN’, ‘survey ROAD SEALED’ and ‘survey TOPO DTM BDY’.

Your plan view should now look as follows.



A feature of 12d at this time is the Information panel. This supplies you information about your string geometry. From the Alignment Edit menu, click LB on **Info** to pop up the Information Panel.

If necessary, move the panel away from your road centreline.



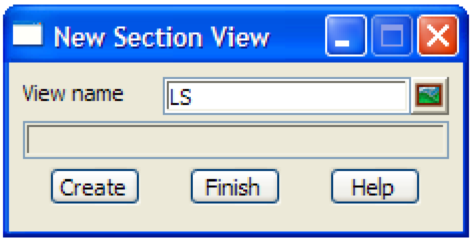
Move your cursor along the new road and you will see the information in the panel continuously changing. This panel shown was created by pointing at HIP 2. It gives you the coordinates of the HIP and the input and output tangent bearings. Point near the curve-tangent points and you will get further information about those points.

Click LB on **Info** again to toggle the Information panel OFF.

9.4 Section Views

To complete our new road, we now need to define its vertical geometry. To do this we first need to create a new section view.

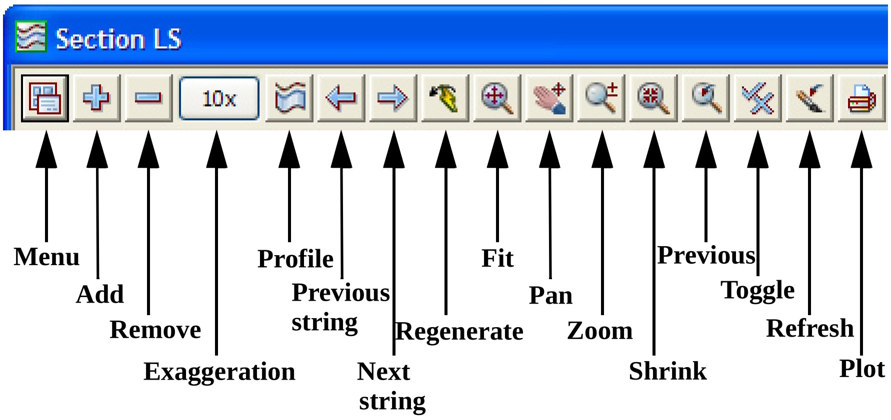
From the Main menu, click LB on **Views=>Create=>Section view**.



When the panel appears, highlight the current entry in the view name field by double clicking the LB, and type 'LS' for Long Section. Click LB on **Create** to create the view.

The new view will pop up as a window overlaying your other 12d windows. Firstly, minimise the perspective view '2'. Then click LB on the plan view title area and select **Windows=>Tile Vertical**

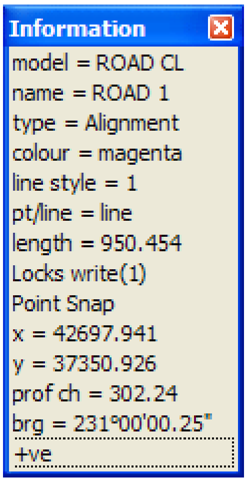
The view buttons on the Section view are:



The first Model to turn on in a section view is always the TIN. The reason for this is to establish the vertical geometry in the section view. Remember we gave the TIN a name called 'GROUND' and we placed it in a model called **tin GROUND**. Turn this model ON by clicking LB on the '+' sign in the View Button Area of 'Section LS'. The screen will still appear blank at this stage.

A section view always has the chainage of the selected string as its horizontal axis and the height of the string as its vertical axis. We need to tell 12d that we wish to construct a section view along our new road centreline 'ROAD 1'. We do this by selecting a string to profile as shown below. 12d then does a section through the TIN i.e. using the x and y coordinates of the selected string, it calculates z values from the TIN. 12d then uses the z values (heights) from the TIN and the string's chainage to construct the Section view.

For advanced users: If multiple TINs are present, any TINs in models added to the view are also sectioned as the string is profiled. Also the section view has a 'corridor width' so any other strings crossing the corridor will also appear provided their various models are turned on.



From the ‘Section LS’ View Button Area, click LB on **Profile** icon.

The Screen message Box advises

<Profile>[picks][][Menu]

12d is asking you which string you wish to profile. In the view ‘Plan 1’, click with LB on the magenta road centreline string. Provided your snap settings have at least ‘line snap’ ON, the string will highlight in yellow and the Information panel will display (see left).

Hints on the use of the Information Panel:

If you move the cursor outside of the Information panel after it has popped up, the Information panel will disappear. To get it back again, click RB whilst the string is still highlighted to put up the Pick ops menu. Click LB on **Info** and the Information panel will redisplay.

Sometimes the Information panel appears to ‘get in the way’ of your picking process.

At any time it can be toggled off to get it out of the way for the duration of a set of pick operations. You do this by unticking the ‘Info’ or ‘I’ tick box on the Snaps menu.

Alternatively, if you leave it turned on, moving the cursor out of the panel is the easiest way of removing it after each pick. At any time, the Information panel can be moved out of the way permanently in the normal manner. See Chapter 4.4 for more information on moving menus and panels.

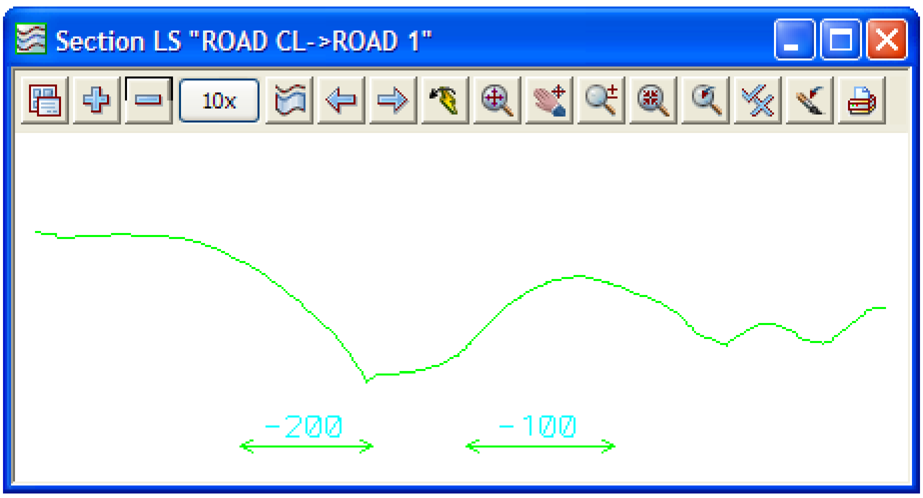
Once the Information panel is moved, subsequent uses of the panel will pop up at the new location during this selection set only. Now back to profiling.

Use the name and model in the Information panel to confirm that you indeed have highlighted the correct string. The Screen Message Box advises

<Profile>[picks][accepts][Menu]”ROAD CL->ROAD 1”

Click MB to accept the highlighted string. The section view will now be refreshed and will contain a green line corresponding to where your new road centreline cuts the TIN as defined in model **tin GROUND**

Your ‘Section LS’ view should now look as follows



The figures of 200 and 100 in the view correspond to the radii of the two horizontal curves defined along the centreline. The arrows show the extents of the curves in the section view.

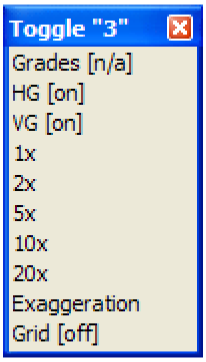
When we defined the string in the Plan view, we defined it in order starting near the top of the view and proceeded towards the bottom so by default, this is the direction of increasing chainage along the string. The negative sign in the radius indicates that a curve goes to the ‘left’ when going along the string in the direction of increasing chainage. Positive curves go to the ‘right’.

We will now observe some of the advanced features of 12d.

When the cursor is in the ‘Plan 1’ view you will notice that the View Coordinates Box at the bottom of the desktop shows the x and y coordinates of the cursor.

When the cursor is placed in the ‘Section LS’ view, the View Coordinates Box displays the chainage (ch) and height (ht) of the profiled string. The chainage has defaulted to start at zero at HIP 1, our starting point when we defined our road centreline.

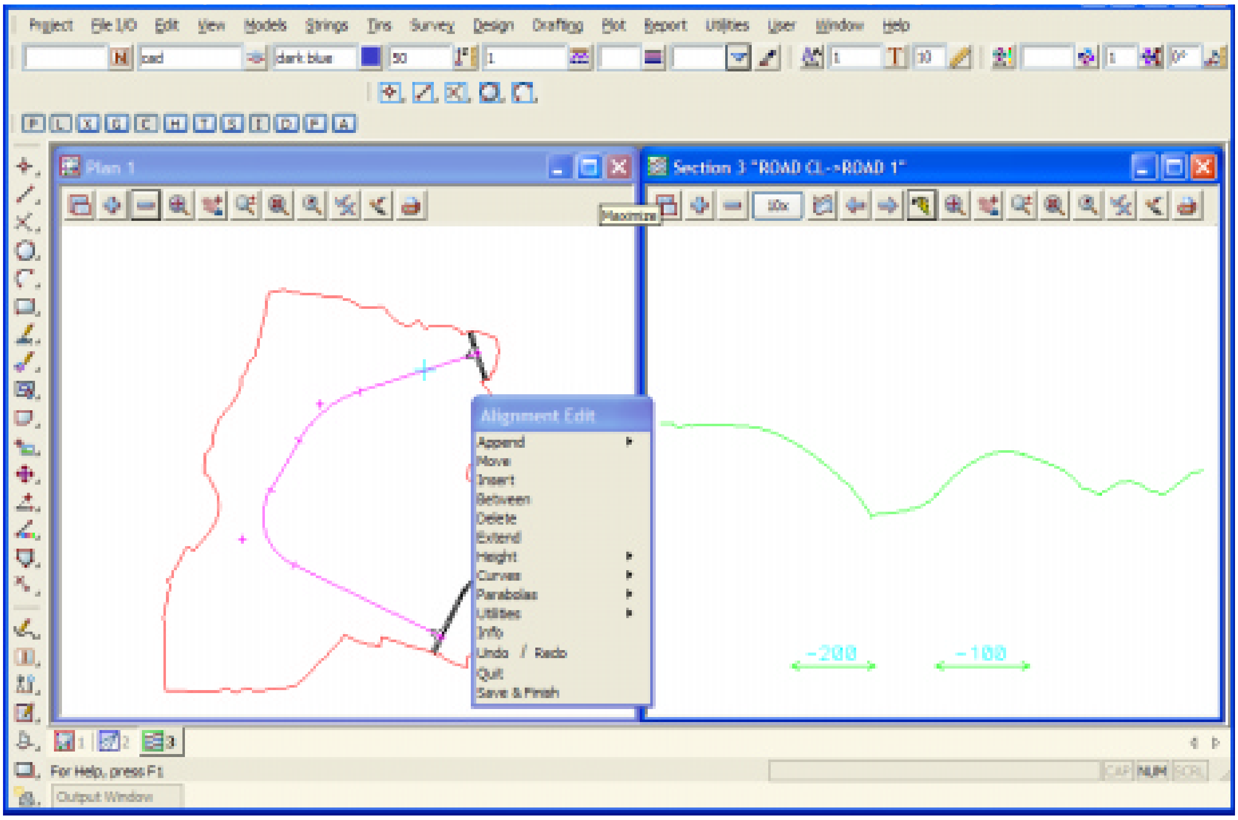
If you place the cursor in the ‘Section LS’ view and move the cursor backward and forward laterally via the mouse, you will see a yellow cross moving along the centreline in the ‘Plan 1’ view. 12d recognises that the same string is appearing in both views and links the information in the views accordingly. The yellow cross is positioned in the ‘Plan 1’ view based on the chainage (i.e. the position of the cursor laterally) along the string in the ‘Section LS’ view.



Section Views default to a vertical exaggeration of 10 to 1. You can change the exaggeration at any time by clicking on the ‘View exaggeration’ icon and selecting the required exaggeration.

If you require an exaggeration other than those listed, you can click on **Exaggeration** from the list and type in the reuired value.

From the View Button Area, click LB on **Fit** to fill the view at the new scale. Your overall screen should now appear as follows



9.5 Vertical Geometry (VG) Edit

We will now define our road's vertical geometry. We do this by defining Vertical Intersection Points (VIPs) and then placing vertical curves between the VIPs. As before, the Alignment Editor for our road centreline is still active.

To ensure that the complete road centreline, as defined in the Plan view, is also defined in elevation, and matches neatly with the existing roads, then we also need to turn on the '**survey ROAD CROWN'** model in the section view.

From the Alignment Edit menu, click LB on **Append=>VIPs**.

12d is asking you where you want to place the first VIP. Select and accept the intersection point in the '**survey ROAD CROWN'** model. Your first pick will not necessarily be the ROAD CROWN so be sure to cycle through the picks until you have the right point.   The line will rubber band from the previously placed VIP. Now select and accept the end of the existing road in the '**survey ROAD CROWN'** model. We have now placed 2 IP points which exactly match the existing road at the start of our design.

We will now add in two more IP points before tying into the existing road at the end of our design in a similar fashion.

Type the chainage and level in turn for the next two IP points, the same as we did with the X and Y coordinates of the HIP's

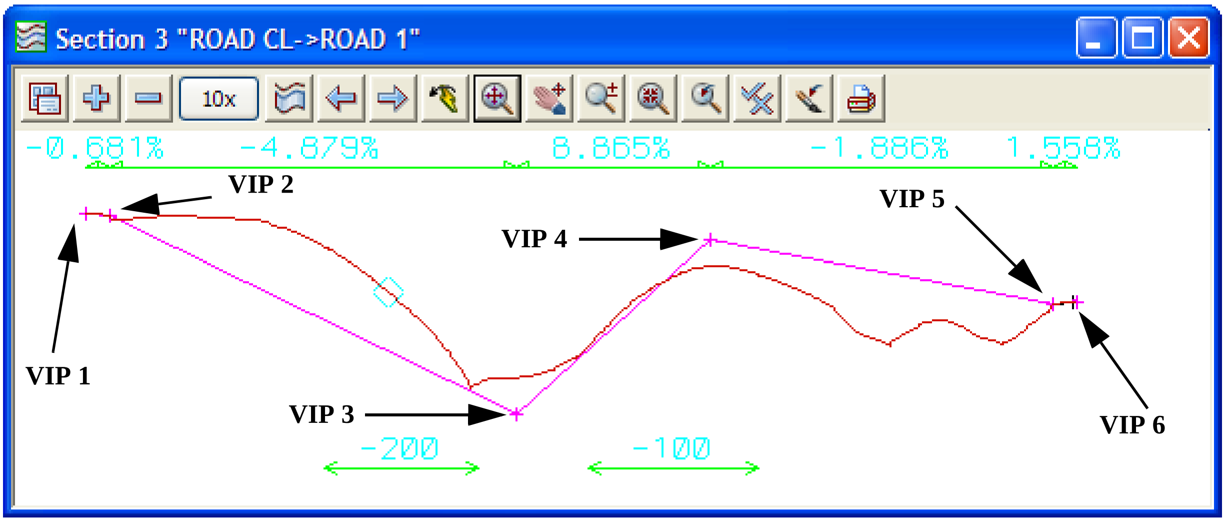
:

IP 3	**IP 4**
Ch = 412	Ch = 600
Rl = 49.667	Rl = 66.333

Tie the last two IP points into the existing road at the end of the design in the same manner as we did previously with the start of the design.

After the sixth point is placed, press <Esc> to terminate the rubber band (or click RB to pop up the Pick Ups menu and click LB on **Cancel**). Click LB on the *Refresh* button in the View Button Area to refresh the view.

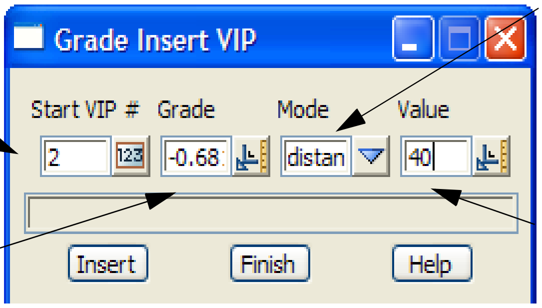
As the VIPs were placed, 12d has annotated the view showing the grades defined.



12d has many facilities to accurately place vertical geometry including typed input of grades and chainages. We are now going to insert a new IP point on the same grade as VIP 2 but 40 m from the intersection to allow us enough room to place a vertical curve. To do this we click on **Utilities => Grade Insert** in the *Alignment Edit* ***panel.***

As we wish to extend the grade from VIP 1 through VIP 2 our starting VIP # will be 2.

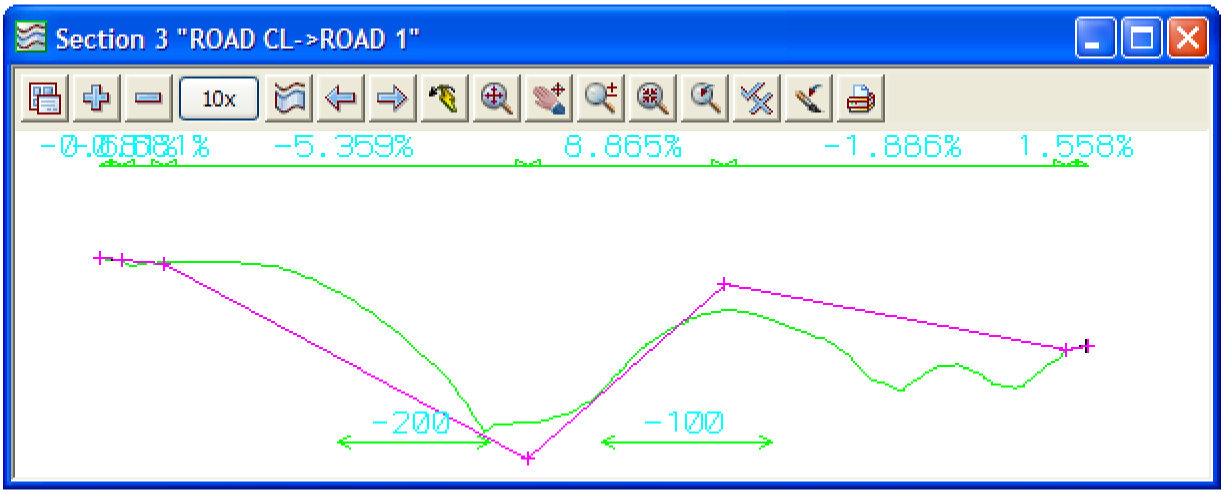
The **Mode** will be 'distance' as we want the new VIP to be 40m from the end of the existing road to allow enough room to add a vertical curve.



The grade will be the grade between VIP 1 and VIP 2 which we can read from the section view as -0.681

The distance as stated above will be 40m

Your view should now have an extra VIP as shown below

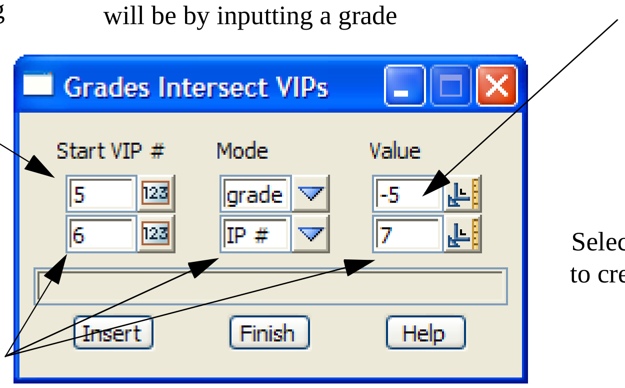


We will now insert another VIP to once again allow enough room to insert a vertical curve before finishing on the existing road at the end of our design. This time we will intersect two grades from existing VIP points. Click in **Utilities => Grades intersect.**

This time we will be starting from VIP 5

Our mode for the first intersection will be by inputting a grade

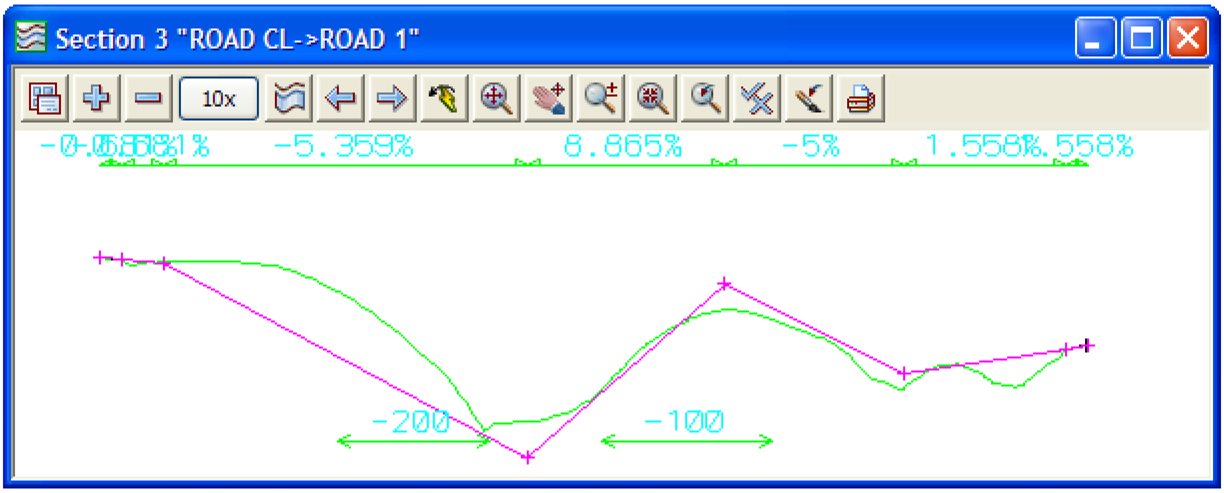
And the grade will be -5%



The second intersection will be using the grade of the existing road or the grade between VIP 6 and 7

Select **Insert,** then **Finish** to create the new VIP.

Your view should now have an extra VIP as shown below



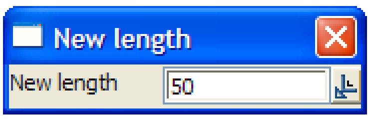
As we have inserted two new VIP's on the same grade as existing VIP's we end up with redundant VIP's which can now be deleted. Click on **Delete** and select and accept VIP 2. 12d will of course renumber the remaining VIP's and hence the second point to be deleted will be VIP 6.

We will now place some vertical curves in the design. We will use parabolas to define the vertical curves and place them via their length.

From the Alignment Edit menu, click LB on **Parabolas=>Length**. The Screen Message Box advises

<Select point to change length>[picks][][Menu]

Click with LB on VIP 2 and confirm it with MB. A panel will pop up prompting 'New Length'.



Position the cursor in the data field, press the Backspace key to remove any previous number, type 50 and then press the Enter key.

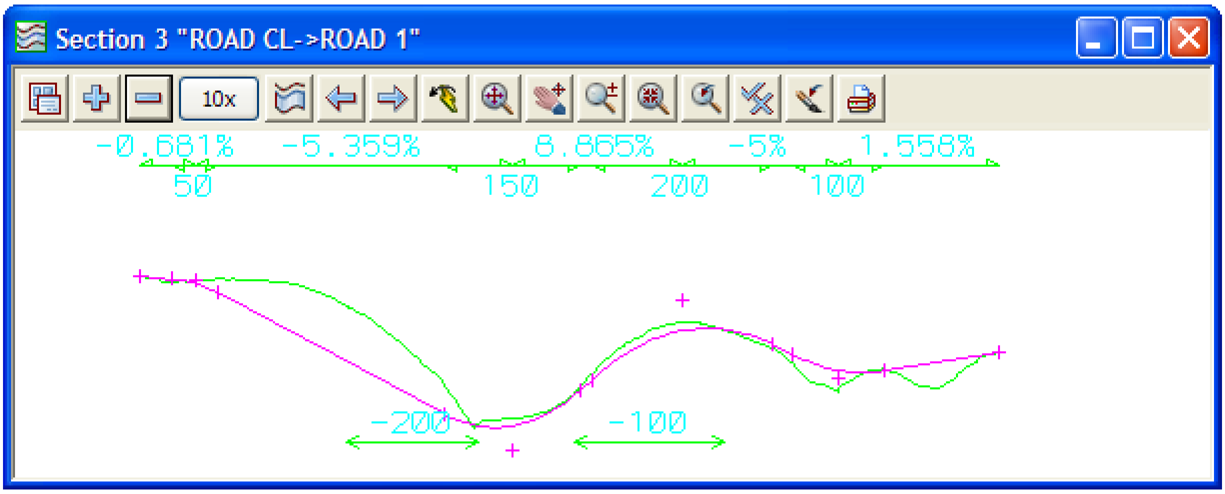
Note: A feature of Windows is that you can double click on any existing entry to highlight it. As you begin typing, the old entry will be replaced.

Observe that a vertical parabola of length 50 is now inserted and the tangents are removed. The VIP is now marked with a red cross.

The insertion of vertical parabolas is setup to handle multiple insertions. If you now point in the vicinity of VIP 3 and click with the LB, accept with MB, type 150 for the new length and press Enter, a further parabola will be inserted. You can inset the remaining parabolas in the same fashion with VIP 4 having a length of 200m and VIP 5 a length of 100m.

To terminate the parabola insertion process, press the Esc key or click RB to pop up the Pick Ops menu and click LB on **Cancel**. Click LB on the Refresh button in the View Button Area to refresh the view and revise the annotation.

Your ‘Section LS’ view should now look as follows.

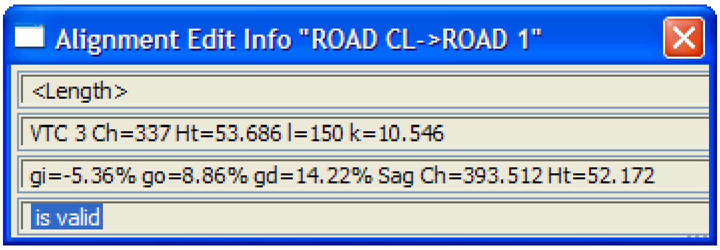


Note that the extent of the Vertical curves is annotated on the Section view.

We can now use the Information panel to show the details of our vertical geometry. From the Alignment Edit menu, click LB on **Info** to pop up the Information Panel.

If necessary, move the panel away from your Section view.

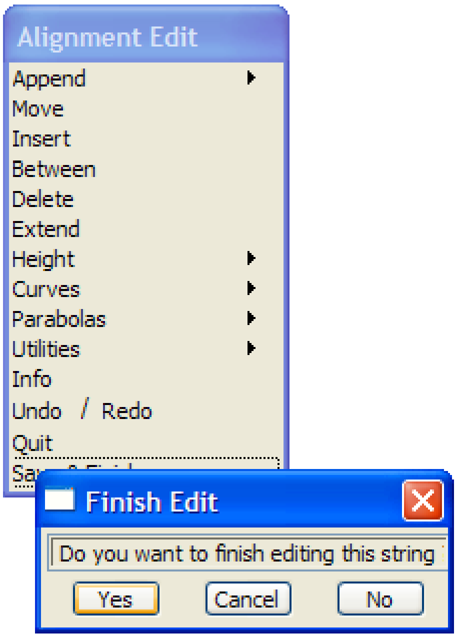
Move the cursor in the Section View along the Road centreline string. The data in the Information panel changes dynamically as the cursor is moved.



This panel results from placing the cursor near the first Vertical tangent to curve point, just to the left of VIP 2. Note that the chainage of the VTC is calculated.

Observe the information. It shows grade in, grade out, grade difference and the chainage and height of the Sag point. It also shows the length and ‘k factor’ associated with this curve.

We have now finished defining our horizontal and vertical geometry and wish to exit from the Alignment Editor. To do so, select *Save & Finish* from the bottom of the *Alignment Edit* menu and then *Yes* from the *Finish Edit* panel.



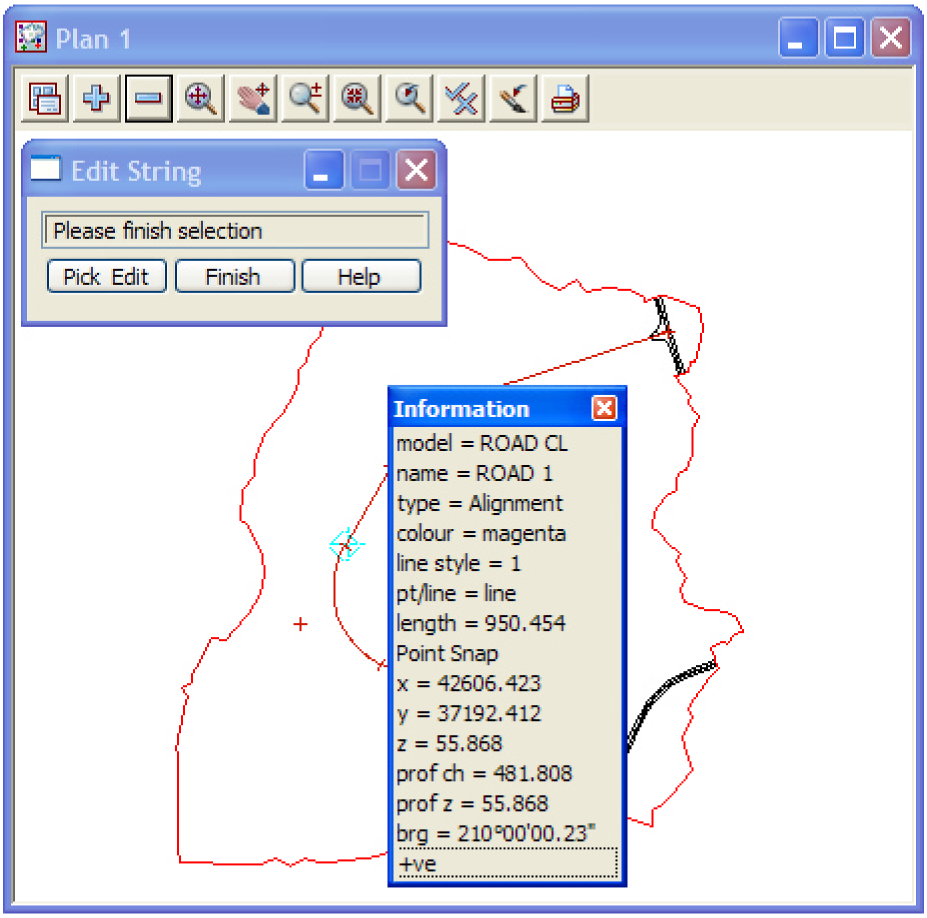
WARNING: Do **not** select *Quit* from the Alignment Editor. *Quit* will throw away all the changes made to the string since the Alignment Editor was started.

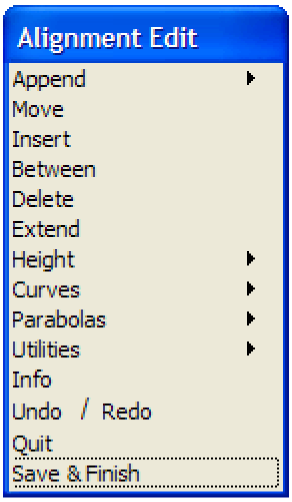
NOTE: We don't have to exit from the Alignment Editor for the string "ROAD 1". We could simply leave the Alignment Edit menu on the screen and return to it later.

9.6 Editing an Existing String

Now that we have left the Alignment editor, we need to know how to go back into the editor to make future modifications to the alignment string. In fact, what we now do applies to editing any existing string, not just an alignment string.

To edit an existing string, simply click LB on the option **Strings =>Editor** which brings up the **Edit String** panel. Now pick and accept the string you want to edit, in this case, the string "ROAD 1". The appropriate editor for the selected string will then be started.





The Alignment Edit panel will then reopen and you can modify the alignment as necessary.

10 Road Templates

The road design is calculated by passing a template along the alignment. The interface between the new template and the existing terrain will also be calculated.

This is the simplest way that 12d can perform a road design.

12d has the concept of a basic road template. Templates are always defined for half of the road. When used on the left, the template is applied on the left hand side of the road. When used on the right, the template is applied to the right hand side of the road.

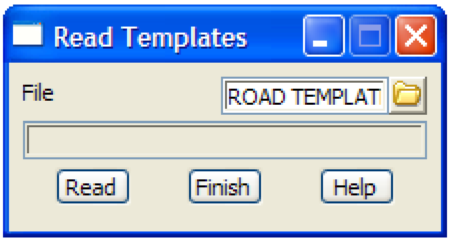
Each template has various parts to it. There is a fixed part that is always used in applying the template. Then there is a Cut/Fill part that is variable. As many links in this part are used as is necessary to reach the intersection with the natural surface. If after using all of the Cut/Fill links, the road profile still has not intersected with the surface, a final Cut/Fill slope is used to try to calculate the intersection. All parts of the template are optional.

10.1 Creation of Basic Templates

Template creation is a mechanical process of filling widths and slopes into panels. Template data is stored in files. A typical use of templates files is to store standard templates as required by a particular road authority. These can then be read in and modified to suit each particular job as required - quicker than starting from scratch each time.

For the purpose of the tutorial, we will use an existing template to save time. Previously stored template values will be read in from file ‘ROAD TEMPLATES.tpl’. This is one of the files supplied on the tutorial disk.

From the Main menu, click LB on **File I/O=>Templates input**. The Read Templates panel pops up.



Place the cursor on the folder icon for the ‘File’ field and click LB to pop up a list of template files. Double click LB on ROAD TEMPLATES.tpl in the ***User Library***

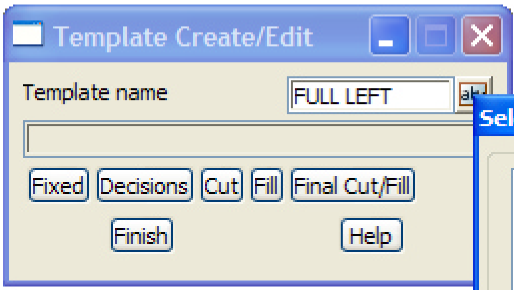
Click LB on **Read** to read in the template file. Click LB on **Finish** to terminate the panel.

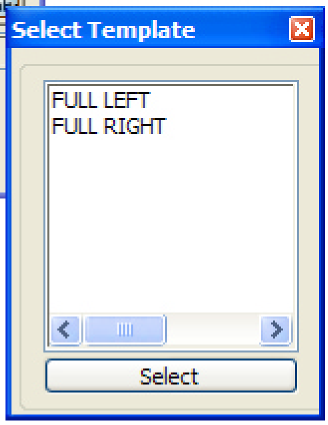
Our Template file contains two templates, called **FULL LEFT** and **FULL RIGHT**. The various parts of the template just read will now be displayed. These are just arbitrary names that have been assigned to these particular templates. There can be many templates in just one file, and in general any template can be applied either side of the centreline. In this case we will use the convention to have ‘left’ and ‘right’ suffixes "**l**" and "**r**" in the names and to use these templates on the left and right respectively.

An alternative to creating a left and right template is discussed in Chapter 10.3.

We will now investigate template **FULL LEFT**.

From the Main menu, click LB on **Design=>Templates=>Create/edit**.





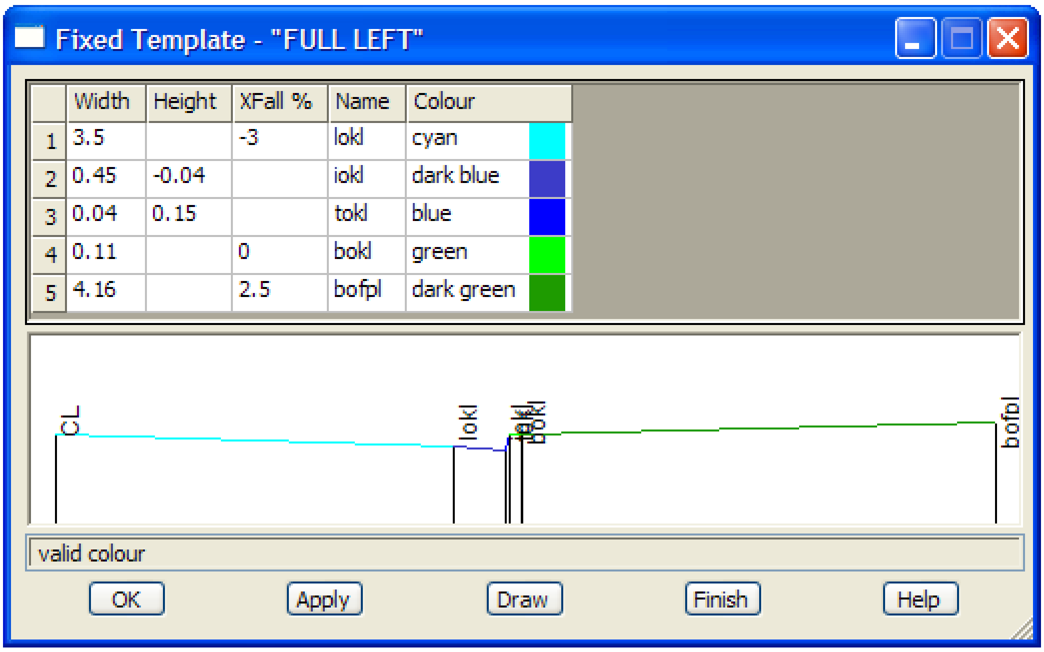
Double click LB on **FULL LEFT**

In the template panel that pops up, place the cursor on the  button for the ‘template name’ field and click the LB to pop up a list of templates.

Each template has up to five parts. We will only use **Fixed**, **Cut** and **Final Cut/Fill**. This means that in a fill situation, the final fill batter will join onto the fixed part of the road template since we are not defining a variable fill template. If a template panel contains blank fields, 12d will ignore such fields in its processing of the various template parts.

<u>Fixed Part of Template</u>

From the Template Create/Edit panel, click LB on **Fixed** and the fixed template panel pops up.



A large amount of links can be defined. We will use just five.

Note that each link in the ‘left’ template has been assigned a suffix ‘l’.

The template defines a carriage way width of 3.5 metres at 3% crossfall to the kerb line ‘lokl’. This is followed by a kerb and channel, ‘iokl’, ‘tokl’ and ‘bokl’ and then out to the back of the footpath ‘bofpl’. The sign convention is <u>+ve is up and -ve is down</u>. Each width defines a link from the previous link so the order is important i.e. links are defined relative to one another, <u>not</u> from the template centreline. As you will see later, this is one of the features that makes 12d so powerful - the ability to use string handling to automatically perform total road redesign after any geometry or template link changes.

These template link values could now be changed. At completion click LB on **Apply** to test out any changes. Click LB on **OK** to implement and terminate the panel.

Variable Part of Template

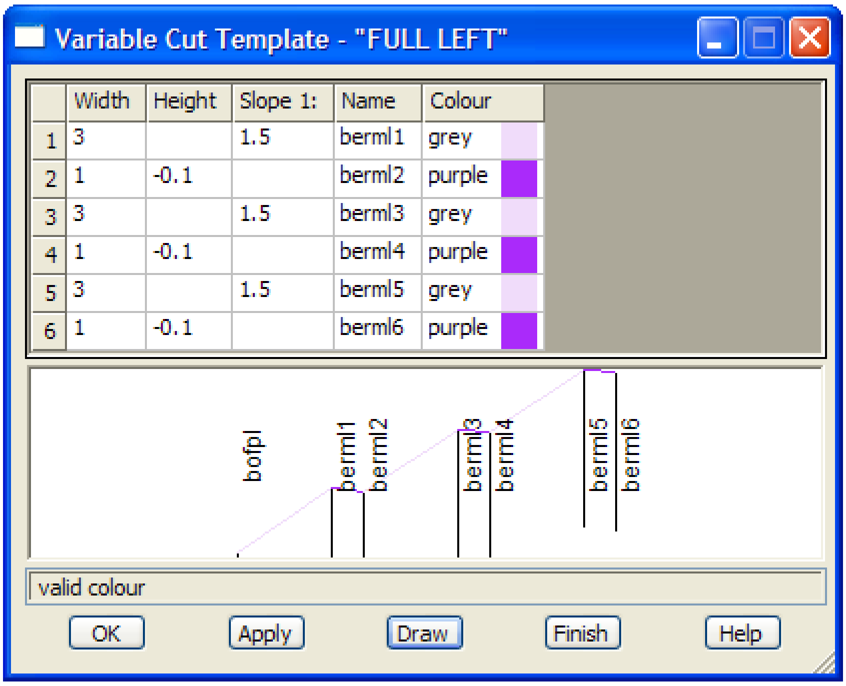
Note that the links in the ‘variable’ part of the template connect onto the ‘fixed’ part i.e. the first variable link follows immediately after and connects to the last fixed link. The fixed part always appears so it is normal to put kerbing etc. in the fixed part.

The variable ‘cut’ part only appears if the fixed part of the template ends in a ‘cut’ region. Thus it is normal to put benching in the variable part of the template when battering is required.

Similar rules apply to the variable ‘fill’ part of the template.

Variable Cut Template

From the Template Create/Edit panel, click LB on **Cut** and the Variable ‘cut’ template panel pops up.



Again a large amount of links can be defined here. We will use six to define our battered slope.

Slopes are defined by giving a horizontal width x where the slope is 1 vertical in x horizontal.

The sign convention for slope in a cut template is <u>+ve is upwards</u>

Unique names are given for each link in the template. Note the "**l**" suffix in each link name

These values could now be changed. At completion click LB on **Draw** to preview the template. Click LB on **Apply** to test out any changes. Click LB on **OK** to implement any changes or **Finish** to terminate the panel.

Variable Fill Template

Whilst we are not using one here, this section is included to define the rules of usage.

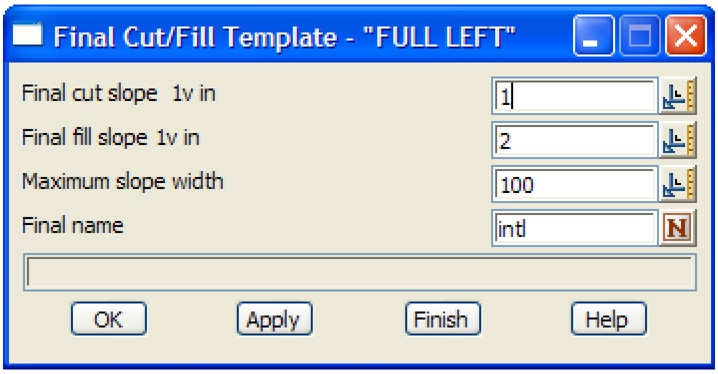
By leaving the panel blank, 12d understands that the variable fill template feature is not to be used.

The sign convention for slope in a Fill template is <u>+ve is downwards</u>

Final Cut/Fill Template

From the Template Create/Edit panel, click LB on **Final Cut/Fill** and the Final Cut/Fill template panel pops up

.

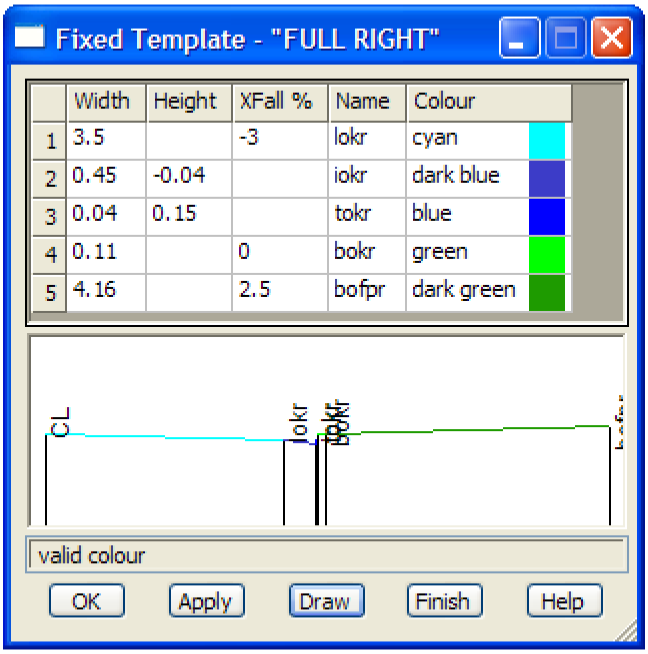


After the variable part of the template, 12d will use the final cut and fill slopes defined to calculate the intersection with the natural surface. This only occurs if the variable part hasn't yet reached the natural surface. 12d will examine a corridor up to 100 metres from the previous link to achieve this. An interface string named 'intl' will be placed on the TIN at the intersection. Again note the suffix "**l**"

These values could now be changed. At completion click LB on **Apply** to test out any changes. Click LB on **OK** to implement any changes and terminate the panel.

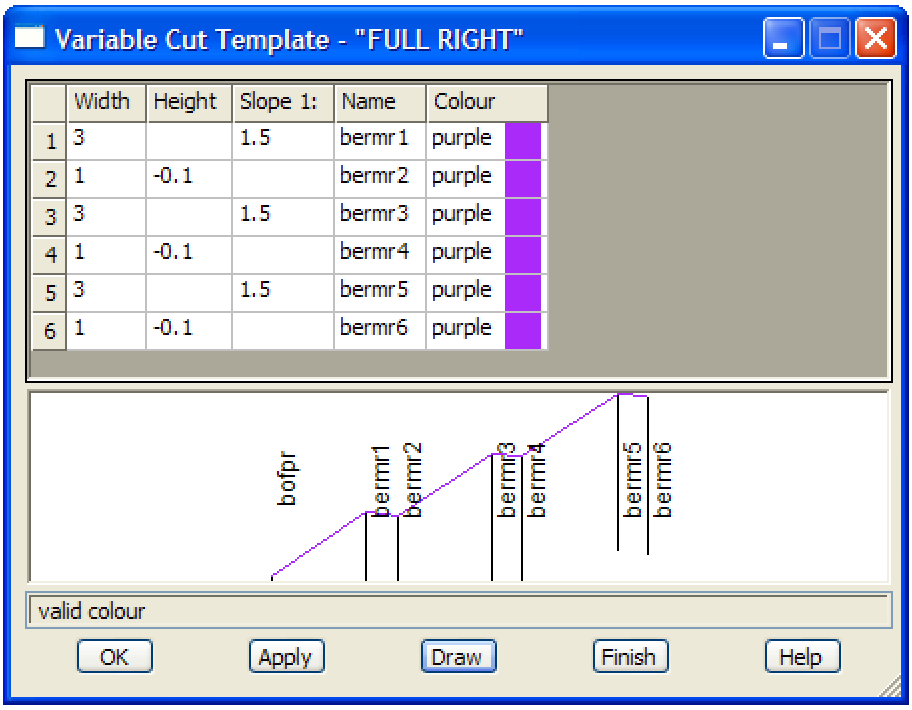
In the Template Create/Edit panel, click LB on **Finish** to terminate the panel.

Note that apart from the suffix l or r, the **FULL RIGHT** template is identical to **FULL LEFT**.

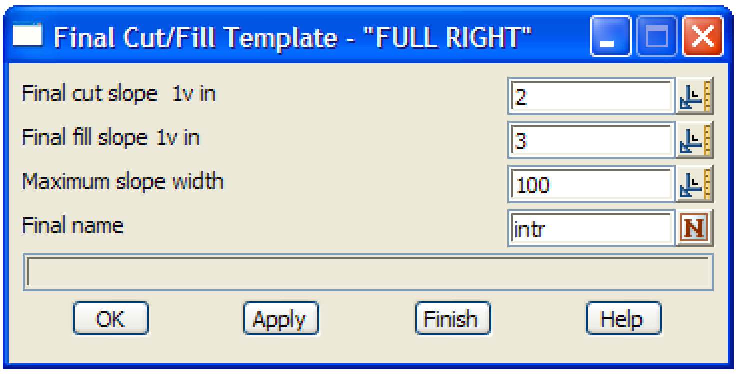


The links in the left and right templates are identical except that links in the **FULL LEFT** template have a suffix of 'l' and those on the **FULL RIGHT** template have a suffix of 'r'.

This ensures that links on either side of the centreline have unique names – essential for string modifiers and applying boxing as we shall see later



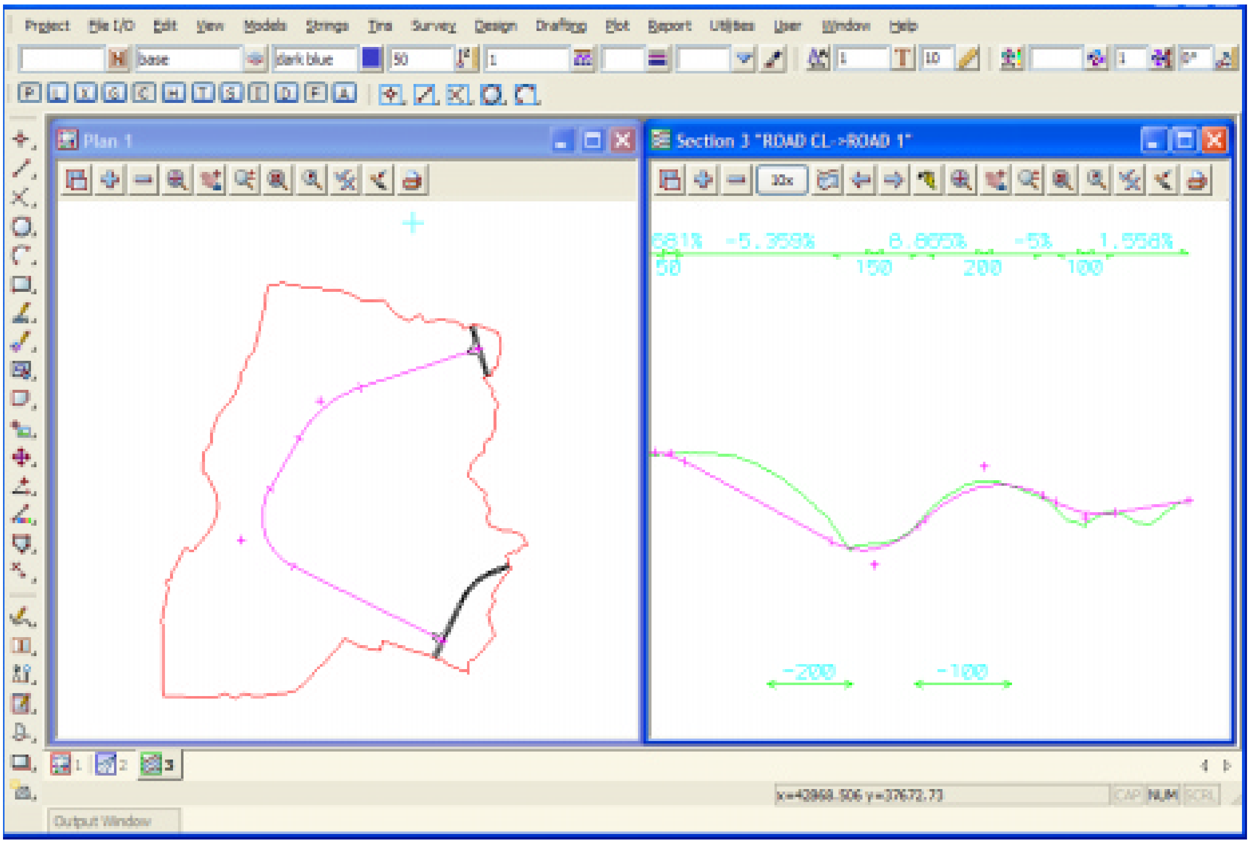
Variable Cuts for right side have suffix ‘r’.



The interface name **intr** has suffix ‘r’.

10.2 Applying Templates

Before we apply the template to the road centreline, let us rearrange our views so that we can see what is happening more clearly.



The design can be applied in two ways.

The simplest way is to create an **Apply function** which uses the templates for the length of the alignment without any modifications such as widening or superelevation. This is also useful for users who don't have the Alignment module.

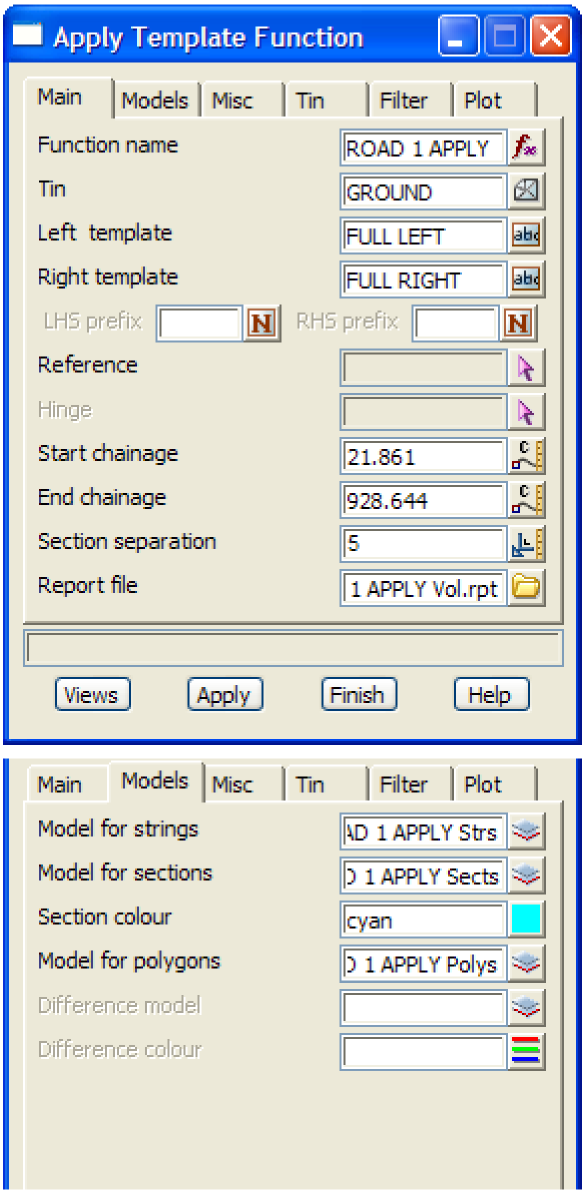
The other more typical way for most design applications is to create an 'MTF' file (Many Template File) which allocates and allows modifications of templates. This is then processed using the **Apply Many Function**.

Chapter 19 "Many Template Files" deals with the use of the 'MTF File'.

We will now create an **Apply** function to apply the template to the road centreline.

From the Main menu, click LB on **Design=>Apply=>Apply**.

The **Apply Template Function** panel pops up.



Fill in the panel as shown.

A function name is needed so that the process of applying this particular template to this piece of centreline can be referred to later in any redesign. In the 'Function name' field, type **ROAD 1 APPLY** and then press **Enter**. On the ***Models*** tab the Model names will be automatically filled in after you press **Enter.** This is based on the function name. In the 'Tin' field, click LB on the tin icon to pop up a list of available TINs. Double click LB on **GROUND**

In the Left and Right template fields, click LB on button to pop up a list of templates. Double click LB on **FULL LEFT** and **FULL RIGHT** respectively.

As we already have existing road at the start and end of our design we do not want to start and end the template at the beginning or end of the alignment string. Type in the chainages shown to ensure the design matches up with the existing road surface.

The default 'Section separation' is 10 metres. For the purposes of the tutorial, set this to 5. For the **Practise Version** use a section separation of 50.

Click on the ***Models*** tab and note that the model names are already filed in. If they are not go back to the ***Main*** tab and press **Enter** after the 'Function name'.

The other tabs we don't need to worry about at this stage.

<u>Note:</u> If desired, use the shorthand suffix notation of **,1** after each model name to force View 1 to be updated automatically as the template is applied. If this is not done, the strings and sections will still be updated but will not be on view. In such case they can be turned ON manually from the View Button area with the '+' sign button after the template is applied.

The only other data we need to supply is to indicate to 12d the road centreline (i.e. the reference string) along which the chainage is defined and where we want to apply our template. Return to the **Main** and click on the **Reference** button.

The Screen Message Box advises

<Select reference string>[picks][][Menu]

In any of the views, click LB on the magenta road centreline string. It is easiest to do this in the 'Plan 1' view. Click MB to confirm the pick.

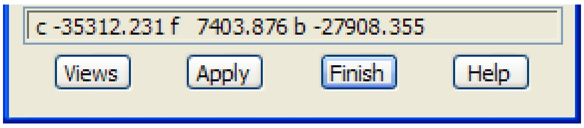
<u>Explanatory Note</u>: 12d permits the chainage of a road to be defined by a string called the Reference string. The template is always applied at right angles to the Reference string. To cater for complex projects, the centreline of the template is not necessarily located on the Reference string. Another string called the Hinge string is used for this purpose. The Hinge string and the Reference string do not necessarily coincide.

In simple projects such as our new road, the Reference string and the Hinge string coincide. By default, 12d assumes the Hinge string defaults to the Reference string so we do not need to click the Hinge button in this case.

When the panel is complete, apply the template by clicking LB on **Apply**

There is now a short delay whilst 12d performs the calculation. The message box at the base of the panel will advise the current chainage as the template is applied. As the calculation completes, the view 1 will be updated with the new road strings and cross sections.

The panel message box now displays the cut, fill and balance volumes resulting from the application of the template. The default convention is negative for cut and positive for fill. Interpret these as follows



c -35312.231- cubic meters of cut
f 7403.846- cubic metres of fill
b -27908.355- balance in cubic metres showing surplus of cut over fill

Clearly we have too much cut at this stage. We will subsequently improve the design to minimise this.

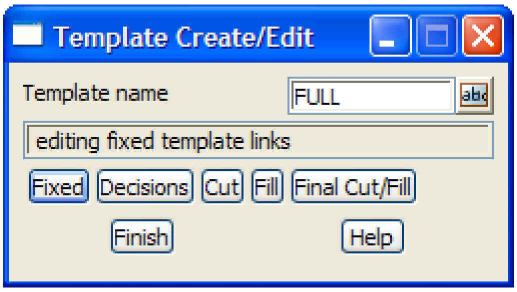
Click LB on **Finish** to terminate the panel.

10.3 Alternative template creation

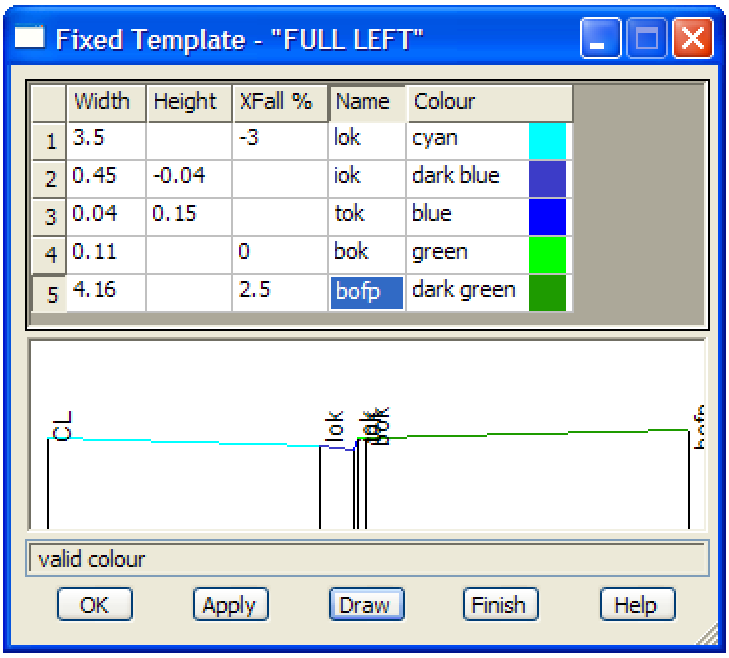
12d can use just the one template for both sides of the road. The templates would be set up with no suffix after the link names

From the Main menu, click LB on **Design=>Templates=>Create/edit**

Type in the template name **FULL**.



Select **Fixed**

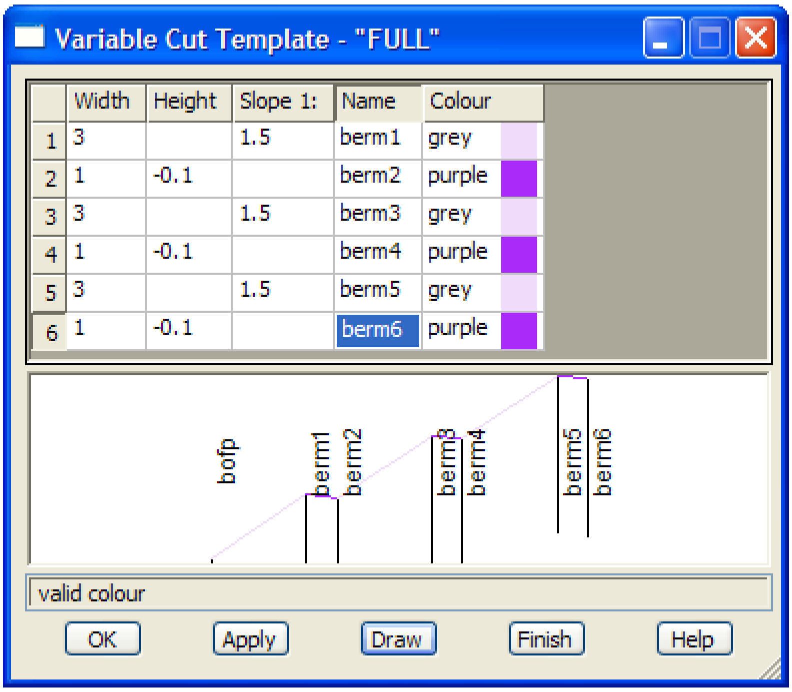


Type in the values as shown in the table on the left.

Note no suffix "l" or "r"

Select **Draw**

Select **OK** to implement any changes and finish panel



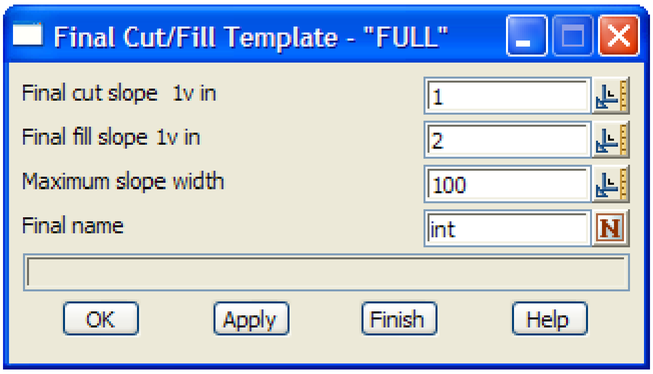
Select **Cut**

Type in the values as shown in the table on the left.

Note no suffix "l" or "r"

Select **Draw**

Select **OK** to implement any changes and finish panel



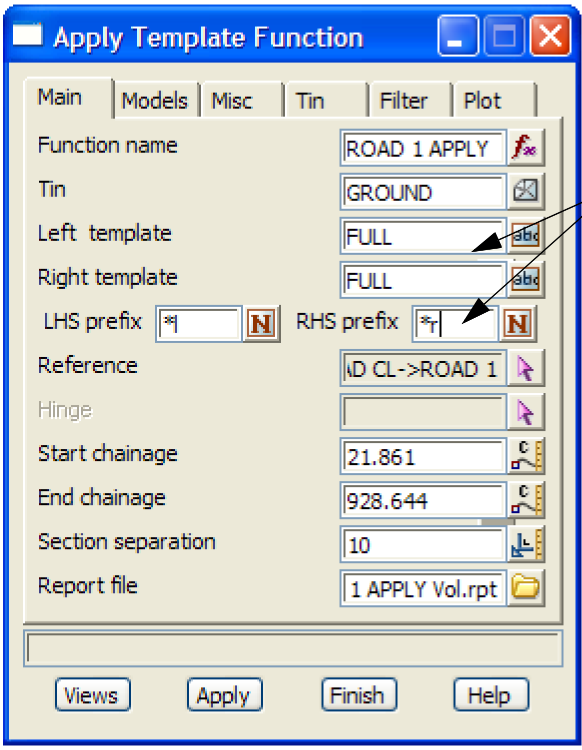
Select **Final Cut/Fill**

One template is defined

Note no suffix "l" or "r"

Select **OK** to implement any changes and finish panel

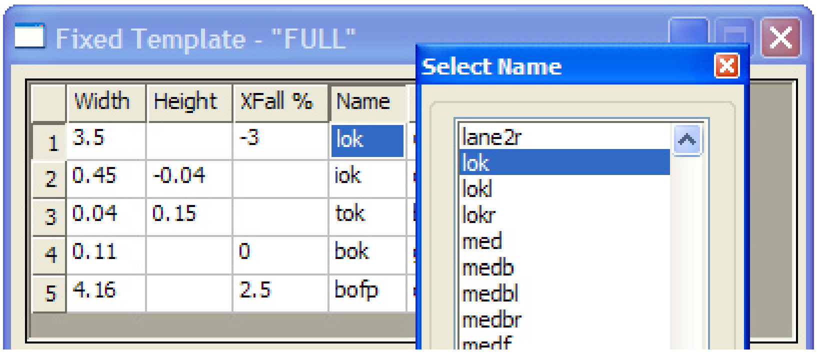
From the Main menu, click LB on **Design=>Apply=>Apply**. The **Apply Template Function** panel pops up.



The panel is filled in the same as shown in chapter 10.2 with the exception of the 'left' and 'right' template names which are both **FULL** and the entry of the 'LHS prefix' ***l** and the 'RHS prefix' ***r**

This action will suffix all road string names with ***l** for the left side strings and ***r** for the right side strings

The advantage of this method is the reduction in number of templates created.



The advantage of the previous system is the ability to pick strings from the view to match names which is useful when modifying templates and boxing

Each method has its own merits and the user can adopt either system with the same end results

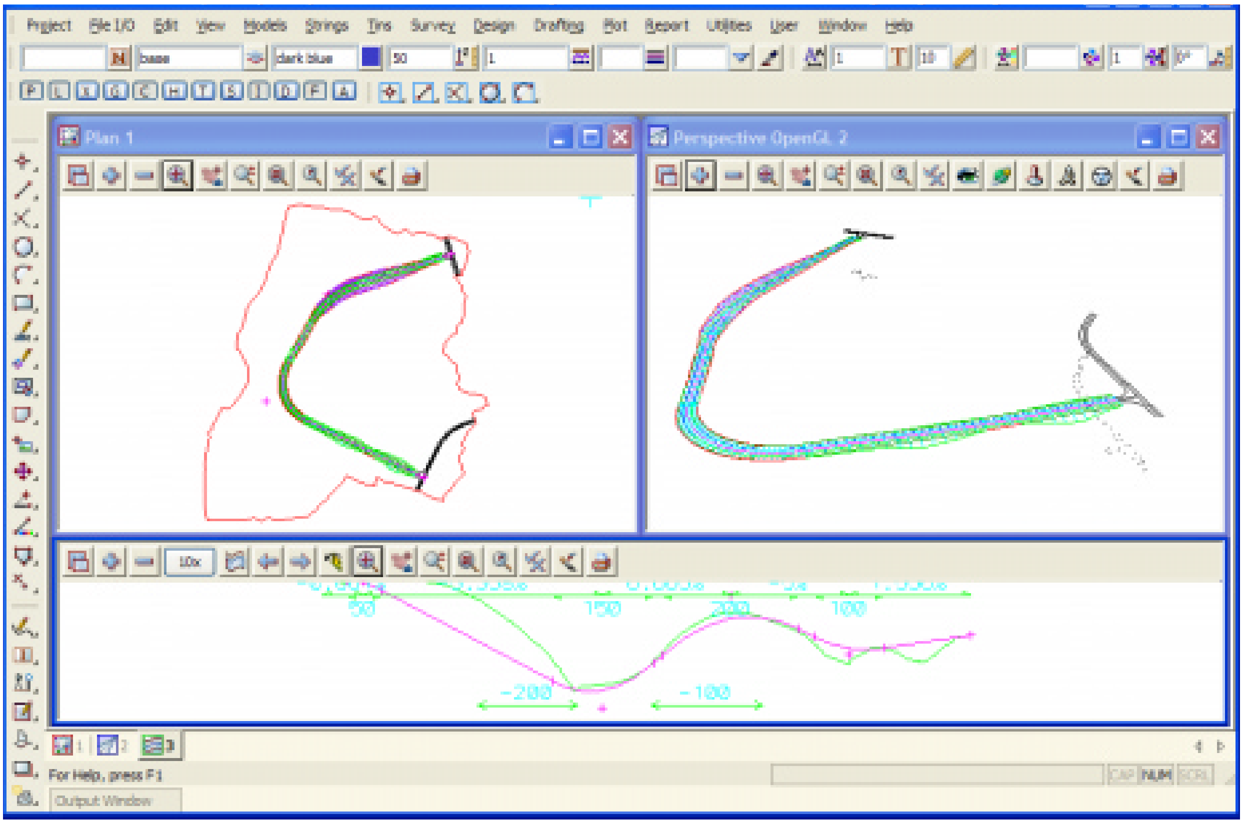
11 Viewing and Assessing the Design

Turn off all models excapt ‘survey ROAD CROWN’ and ‘survey ROAD SEALED’ in the perspective view.

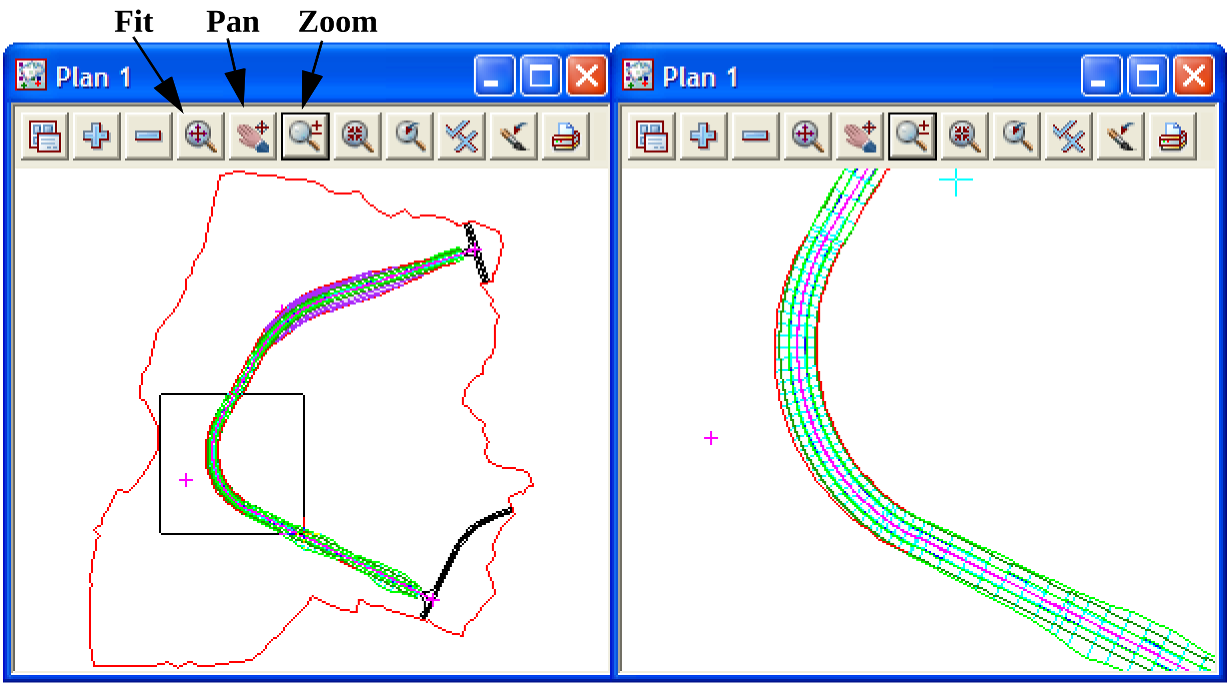
We can now turn on the new design models **ROAD 1 APPLY Strs** and **ROAD 1 APPLY Sects** in the plan and perspective views. The centreline model **ROAD CL** should be also turned on in the perspective view

Set the screen up as per the example below

.



To begin assessing the design, click LB on **Zoom** in the ‘Plan 1’ view as shown below



Note that the interface strings between the road template and the existing terrain are coloured red in cut areas and green in areas of fill. This can be confirmed by placing the cursor in the ‘LS’ view and moving the cursor backwards and forwards across the view (to change the chainage of the cursor). Observe the corresponding movement of the yellow cross in both the ‘Plan 1’ view and the ‘Perspective OpenGL 2’ view.

Also note the various coloured strings that have been inserted in ‘Plan 1’. From the main menu, click LB on **Strings => Inquire** and do inquiries on the various strings in ‘Plan 1’. Make sure that your Point and Line snaps are set ON. Place the cursor in an area near the road, click LB repeatedly and observe what happens. With each click a new string is selected. As the information panel pops up each time, note the various string names and the fact that each one now has a profile chainage (prof ch) and profile Z coordinate (prof z). These are now three dimensional strings and can be observed in the ‘Perspective OpenGL 2’ view.

You will observe that the cross sections are also strings with their own unique names that are used when referring to cross sectional views. For instance ‘design 130’ refers to the section string at chainage 130.0

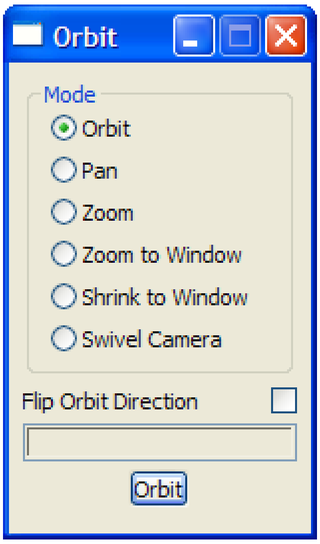
Whilst the View is zoomed try panning along the road to assess the interaction of the template with the existing terrain. From the ‘Plan 1’ View Button Area, click LB on the **Pan** button. Position the cursor on the centreline of the road near one edge of the view and press LB down. Drag the cursor across the view and the image will pan with the cursor until LB is released. Keep positioning the cursor on the road centreline each time and press clicking LB down and move down the road whilst in the zoomed state. Press the <Esc> key or RB to cancel **Pan**.

11.1 Perspective View Operations

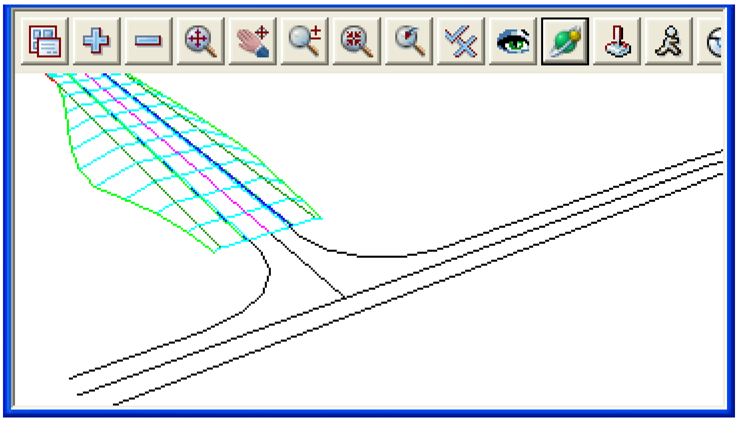
In Chapter 6.8 we saw how the Orbit panel could be used to orientate your eye in relation to your data in a perspective view. We will now use this facility again to observe our design.

The Orbit panel is accessed by clicking LB on **Orbit** in the View Button Area of ‘Perspective Open GL 2’.

If necessary, move the panel away from the perspective view so that all of ‘Perspective Open GL 2’ is in view. Make sure that models ‘ROAD 1 APPLY Strs’, ‘ROAD 1 APPLY Sects’ and the ’survey ROAD CROWN and SEALED’ are turned on.



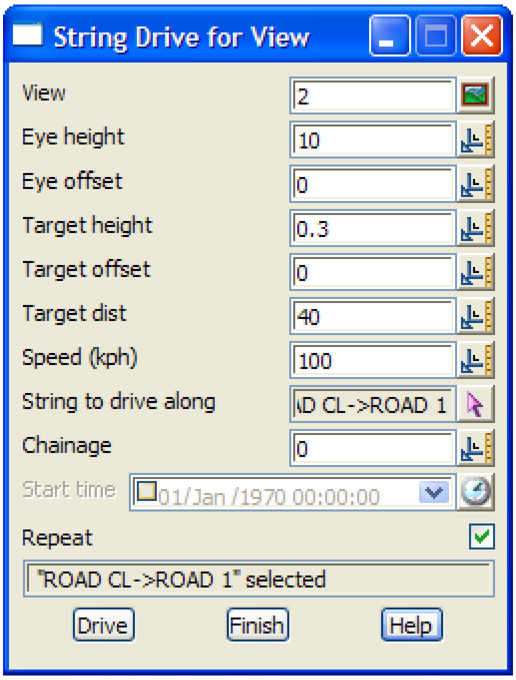
Try clicking LB in the perspective view and using the mouse wheel roatate the image and zoom in and out to get a view of the intersection at the end of the design



You will notice that this facility gives you a good feel for the design you have created. You will see perspective views similar to that shown above.

11.2 String Drive

String Drive allows you to nominate a string and a speed with which to drive down the road and 12d will automate the process. We will drive down the centre of the road with our eye height 10.0 metres above the road.



The string drive facility is accessed from the Perspective view. In the View Button Area of ‘Perspective OpenGL 2’, click LB on the Drive button and the String Drive panel will pop up.

Set the ‘Eye height’ to 10 metres. The default values for the other items are OK. Note that the speed is set for 100 kph.

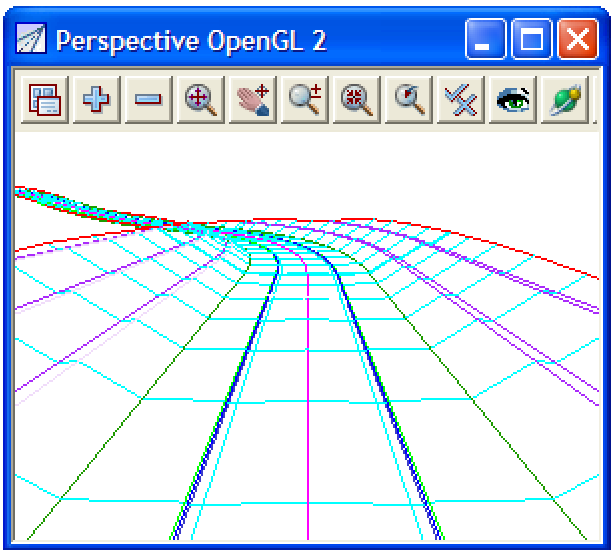
To repeat the drive once the end of the string is reached tick on the ‘Repeat’ check box

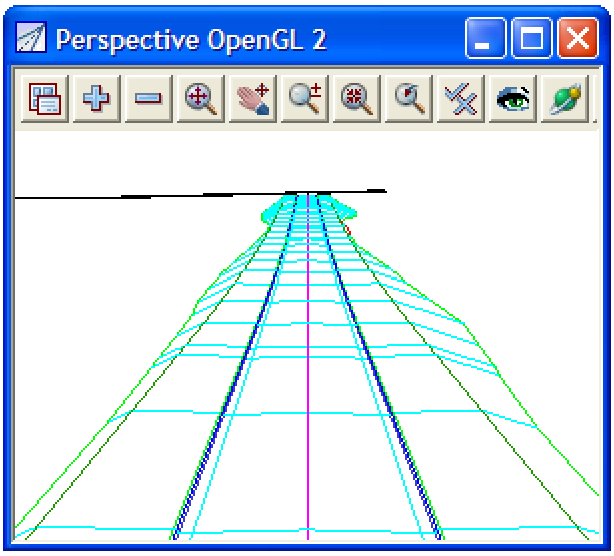
Click LB on the **String to drive along** icon and then click LB on the centreline of the road. The easiest way to do this is to pick it from the ‘Section LS’ view. Click MB to confirm the selected string.

Note that when 12d asks you to select a string, it can be picked from <u>any</u> view without consequence.

Click LB on **Drive** to begin the string drive process. The image in ‘Perspective Open GL 2’ will now change to that at chainage zero, looking down the centreline.

The image will repaint automatically multiple times as the drive proceeds. Each image will be calculated such that the viewer appears to be travelling down the road at 100 kph. The following are two typical images.





Observe the green cross on the centreline in both these views. This represents the ‘target’ point which in our case is 40 metres distant. This is also present in all other views. Observe its location in the ‘Section LS’ view. The ‘eye point’ is shown with a red cross and the ‘target point’ with a green cross. These points move as the drive progresses.

You can stop the drive at any time by pressing the ESC (Escape) key. To resume the drive click LB on **Drive**.

Once the drive has finished, you can replay it again by resetting the chainage to 0 (or any legitimate value along the road) and clicking LB on **Drive** again. Note that both the eye and target points must be on the string at all times for the **Drive** to work.

It is possible to enter negative values for both the ‘Target distance’ and ‘Speed’. A negative ‘Target distance’ (-40) is equivalent to ‘looking out the back window of the truck as you drive down the road’. Set the chainage to 40 to start.

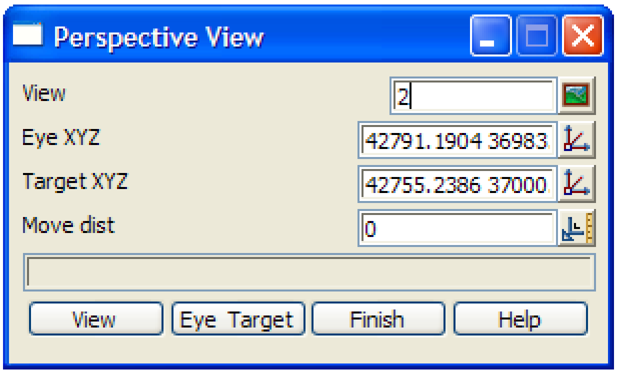
Similarly, a negative ‘Speed’ (-100) can be used to drive back up the road in the opposite direction (i.e. in the direction of decreasing chainage). To do this you need to set the ‘Chainage’ to somewhere near the end of the road (say 870) before you start the drive and also set the ‘Target distance’ to -40.

Click LB on **Finish** to terminate the string drive.

11.3 Defining a New Perspective View using Eye and Target points

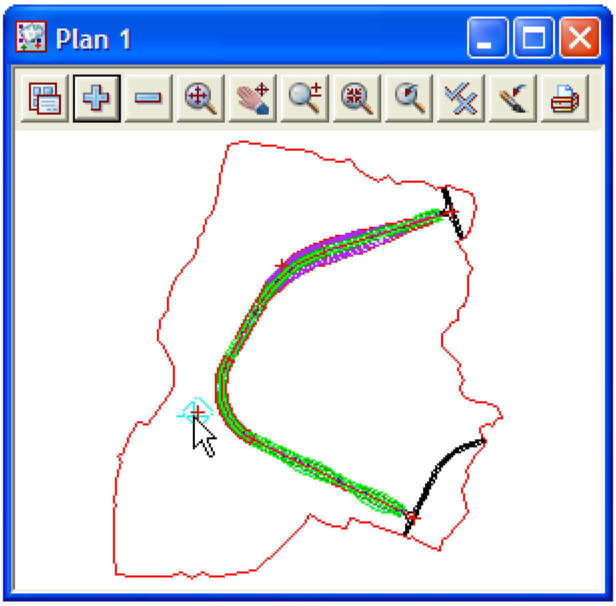
Sometimes it is desirable to locate your perspective view exactly. For example, you wish to locate your eye at a particular point and look in a particular direction.

To do this, click LB on the **Eye** button in the View Button Area of ‘Perspective Open GL 2’ and the Perspective View panel pops up.



Ignore the current values in the panel. They are left over from our string drive.

Click LB on **Eye Target**. 12d asks you to locate your first point on the view line. Make sure that your Point and Line snaps are ON.



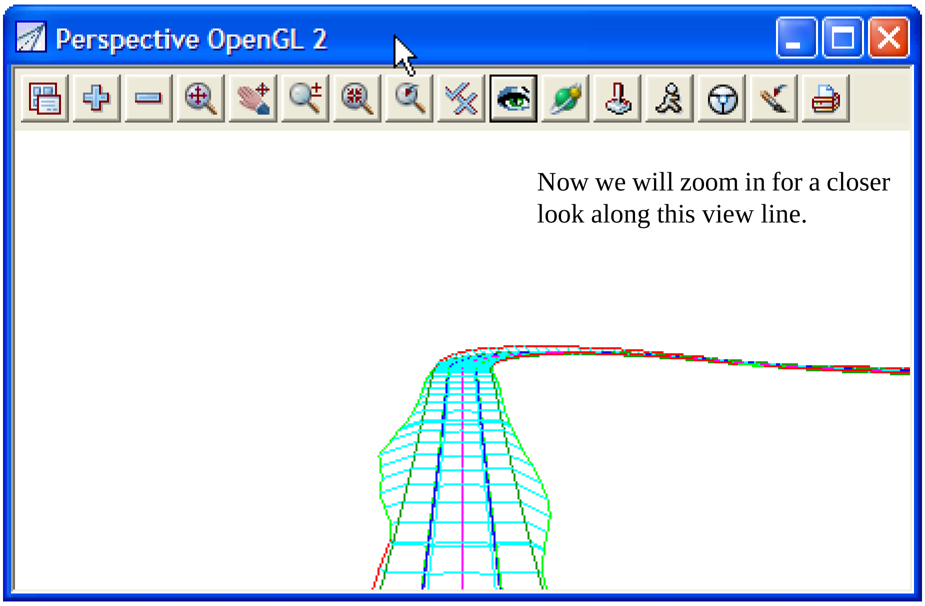
In ‘Plan 1’ click LB on **Fit** to fill the view. Select the first point by clicking LB on the intersection of the existing road at the end of our design. Confirm the point with MB.

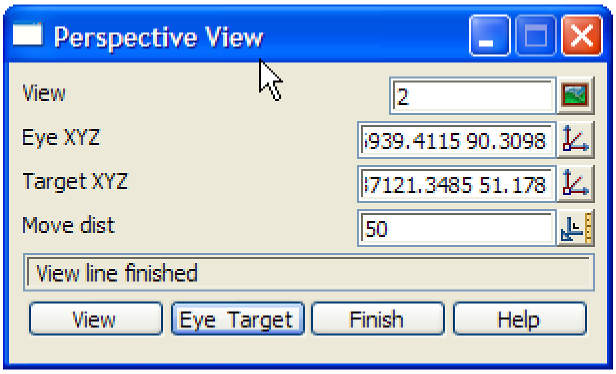
An ‘Enter height’ panel will pop up with a value in it corresponding to the existing terrain (around 60). Since we wish to look down slightly on the design we will enter a higher z value.

Double click on the existing entry to highlight it and type 95. Press the Enter key.

12d then prompts you for the second point on the view line. Click LB approximately in the centre of the road as shown. Confirm with MB. This time when the ‘Enter height’ panel pops up, just press the Enter key to accept the value.

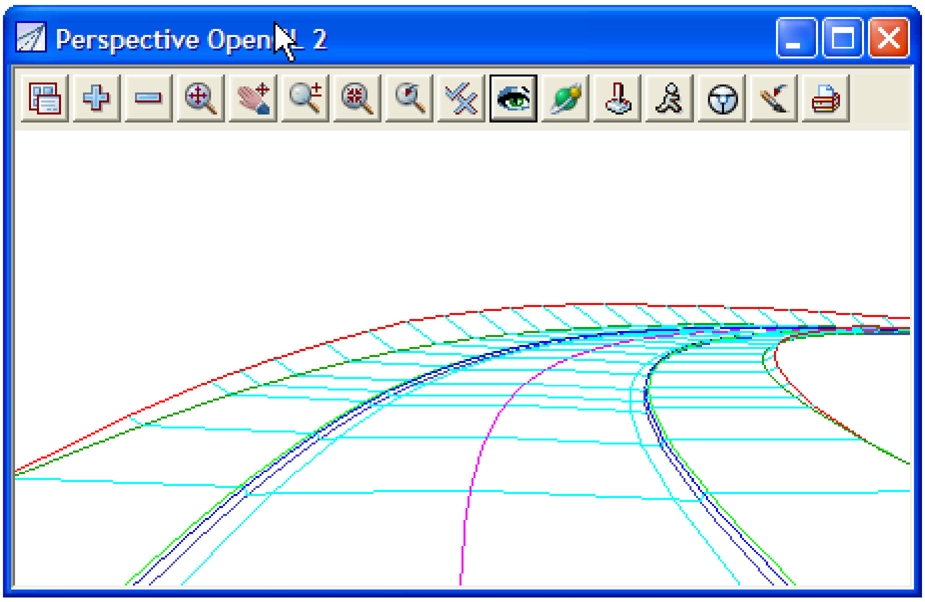
Your ‘Perspective Open GL 2’ should now look as shown below.





In the Perspective View panel, lock the cursor in the Move distance field by double clicking the existing entry with the LB and type 50.

Now every time that you click LB on **View**, the view will be advanced 50 metres along the view line. If you zoom in five times you will see a view like the one below.



Clearly this facility gives you the opportunity to orientate your eye point accurately in any perspective view.

Click LB on **Finish** to terminate the panel.

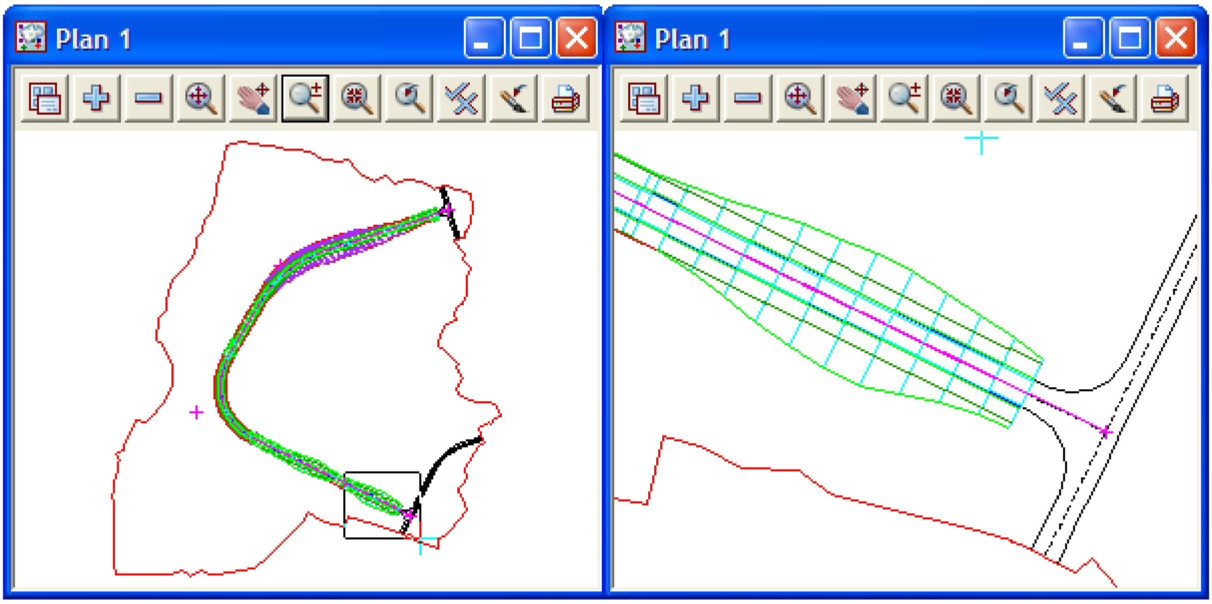
That completes a brief look at some of the facilities in 12d that can be used to verify your design parameters visually using perspectives. We will now look at more traditional ways of displaying design data - long sections and cross sections

12 Design Long Sections

12.1 Section Profiles

We will now focus on the sectioning facilities available in 12d. As we already have our Section LS view displaying our road centreline, there are also many other ways in which information can be viewed.

In subsequent operations we will be picking strings. To help make this easier from our Plan 1 view we need to zoom it as before. **Zoom** in on the area shown so that each string is visible in the Plan view.



We will now section a series of strings that were created during our road design.

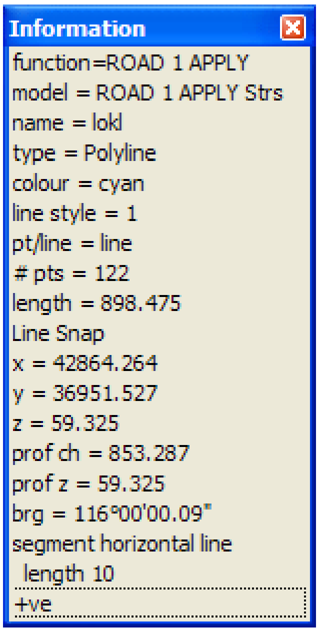
In the Section LS View Button Area, click LB on the Menu button to bring up the View menu. Walk right on **Profile=>Many strings**.

(Note: This option can also be selected by clicking RB on the *Profile* button to bring up the Profiling menu. Click LB on **Many strings**.)

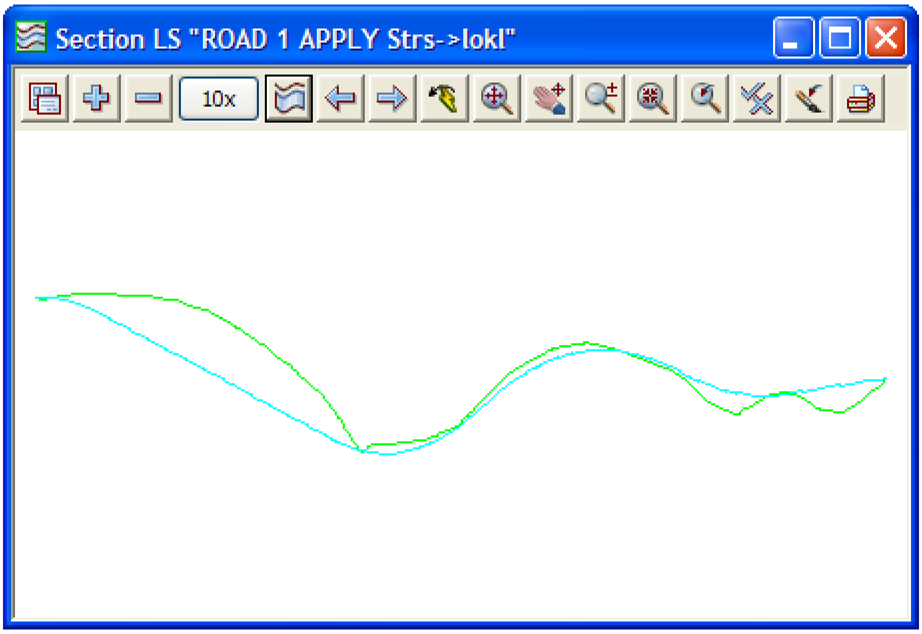
The Screen Message Box advises

<Profile>[picks][][Menu]

12d is asking you which string you wish to profile. In the zoomed Plan 1 view, click with LB on the cyan string just above the magenta centreline. The string should highlight and the Information panel will display (see right). Click MB to confirm the string selected.



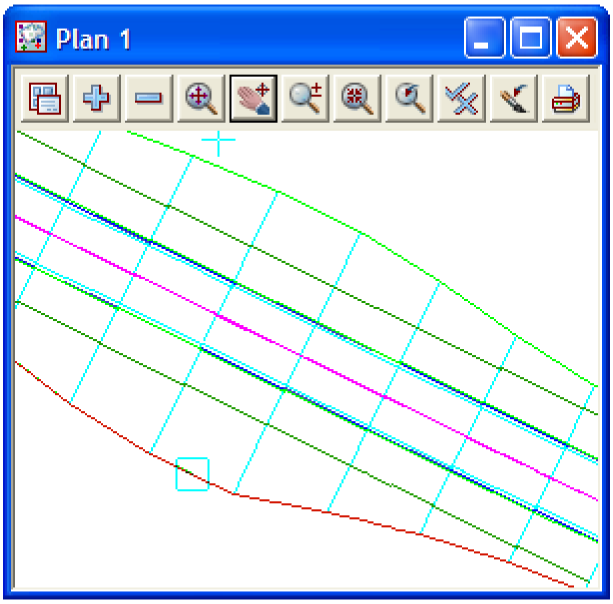
The string will now appear in the Section 4 view.

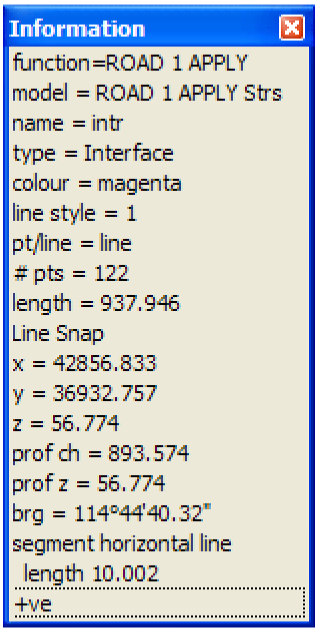


The Screen Message Box is immediately prompting you for another string.

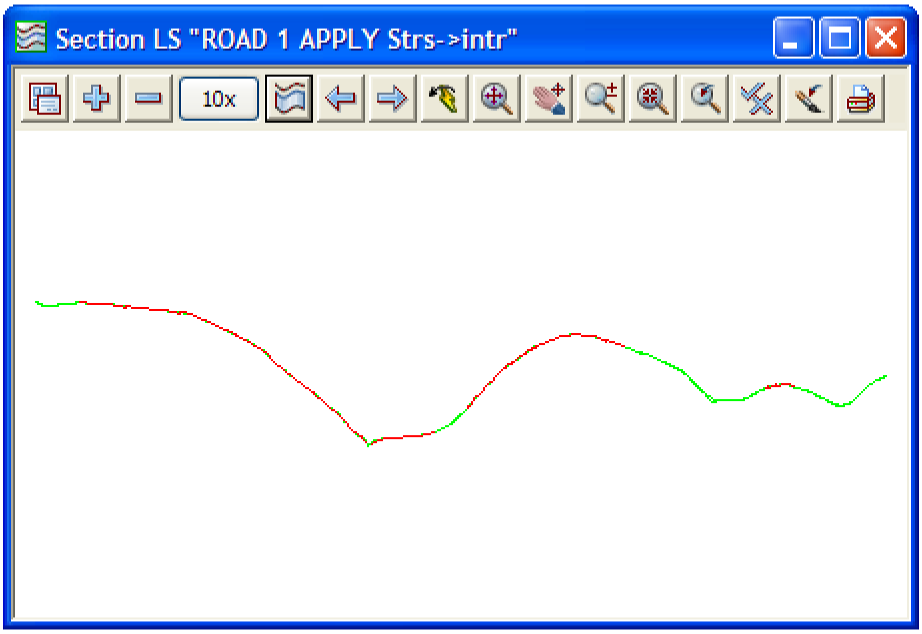
<Profile>[picks][][Menu]

In the 'Plan 1' view click LB on the *intr* interface string between the road formation and the existing terrain. This is the red-green string (shown highlighted below). Click MB to confirm the selected string.





The Section 4 view will refresh as below.

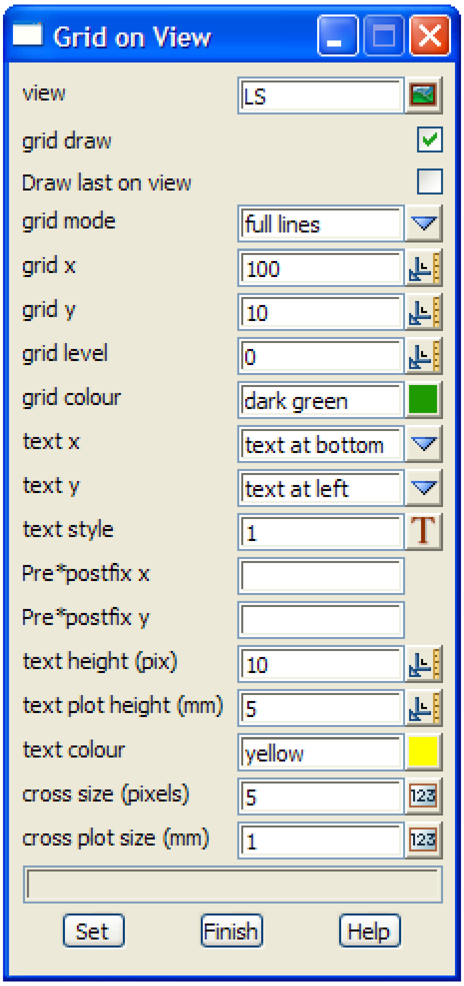


With this technique you can rapidly look at the profiles of any string in the view.

To terminate the **Profile=>Many strings** feature, press the <Esc> key or click RB whilst the cursor is anywhere in the Section LS view to bring up the *Pick Ops* menu and click LB on **Cancel.**

Whilst the various strings have been profiled, clearly they are being scaled to fit the size of the Section view. To begin to get a feel for the scale of these strings, we can turn on a grid.

Firstly, let us make sure our grid settings are suitable. From the Section LS view, click LB on the Menu button in the View Button Area to pop up the View menu. Click LB on **Settings=>Grid** and the following panel pops up



Click LB on the 'grid draw' field to tick the tick box. This activates the grid.

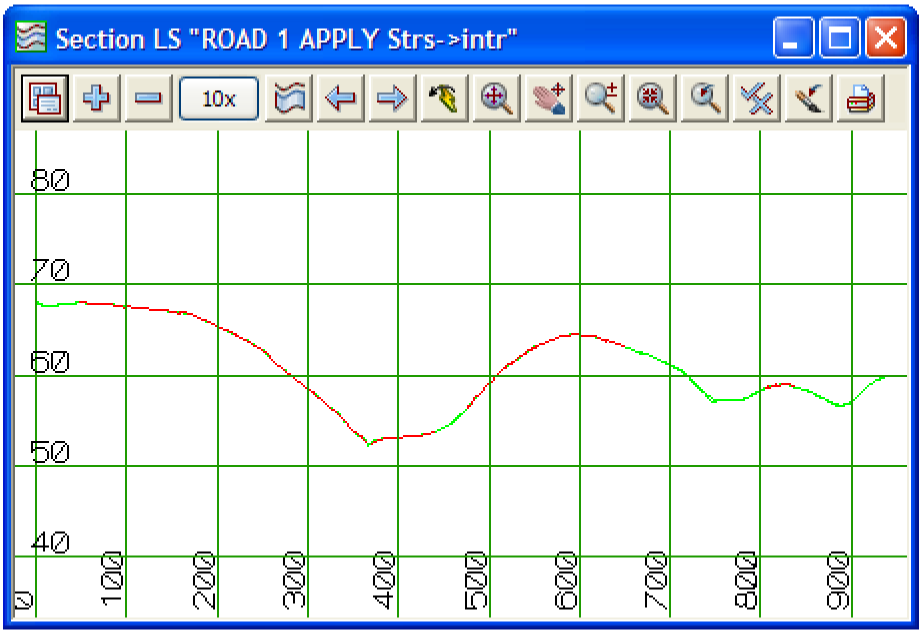
Note the grid y setting. If it is set to 100, move the cursor into the grid y field by clicking with the LB at the right end of the '100', press the Backspace key followed by Enter (or double click with LB anywhere on the 100 and type 10 and Enter).

Click LB on **Set** to activate the change.

Click LB on **Finish** to terminate the panel.

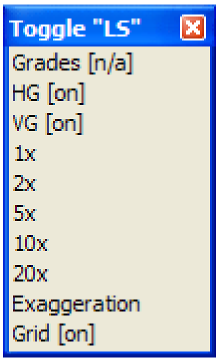
Note that you can turn the grid on with the above tick box or alternatively in the View Button Area of Section 4, you could have clicked LB on **Toggle=>Grid**

The Section 4 view will refresh as follows

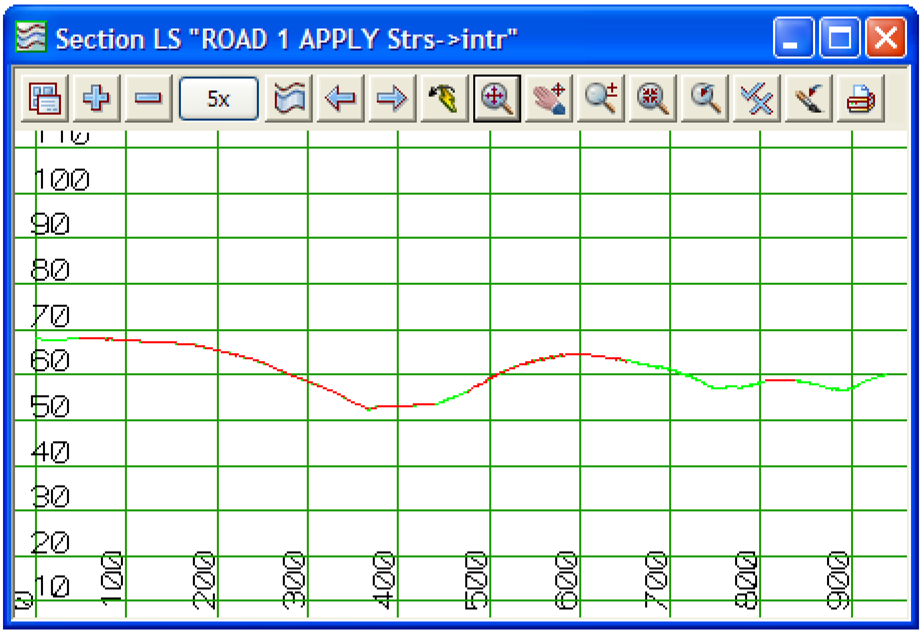


Depending upon what other information you wanted to display or create in this sectional view, the vertical scale may be too great. There are a variety of ways of changing the vertical scale.

The default vertical scale uses an exaggeration of 10 to 1. This can readily be changed by clicking LB on **Toggle** from the View Button Area to pop up the Togge menu.



Click LB on **5x** to change the vertical exaggeration 5 to 1. In the View Button Area, click LB on **Fit** to fill the view.



13 Design Cross Sections

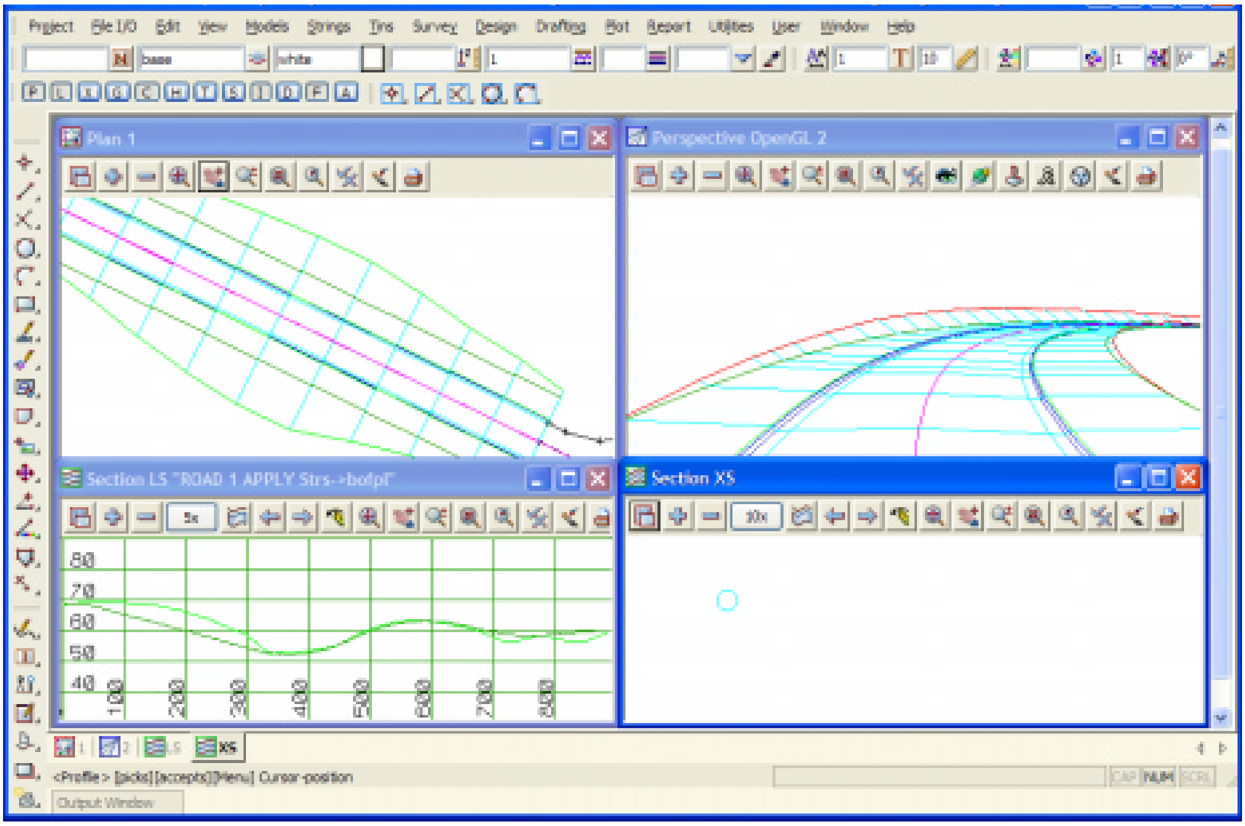
12d has many facilities for displaying and plotting design cross sections. We will look at one of these called Model profiles. This name is derived from the fact that when we passed the template down our road, we created and stored our cross sections in a model. Model profile allows us to display this data by profiling the cross sections one at a time.

We now need a Section view in which to display the cross sections. As we still need our existing ‘Section LS’ view for our long sections, we will create another Section view.

From the Main menu, click LB on **Views=>Create=>Section view**. When the ‘New Section View’ panel appears, place the cursor in the View name field, press the Delete key and type ‘XS’. Click LB on **Create** to create a view which will now be referred to as ‘Section XS’.

As before, you need to drag the border to resize the view. Stretch the Section view out so that it is approximately the same size as the ‘Section LS’ view we created earlier. Click and hold LB over the name ‘Section XS’ and drag the view to the bottom right of your desktop as shown below. Pin it by releasing the LB. The View will initially be blank as no models are turned on.

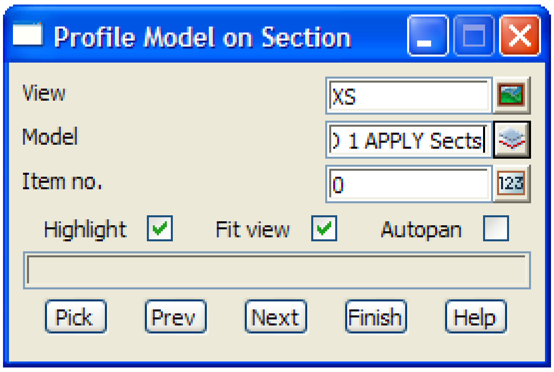
Make sure that Point and Line snaps are set ON. Your overall desktop layout should now look something like this.



13.1 Model Profiles

In the ‘Section XS’ View Button Area, click LB on the Menu button to put up the View menu. Click LB on **Profile=>Model strings**. The Profile Model panel will display.

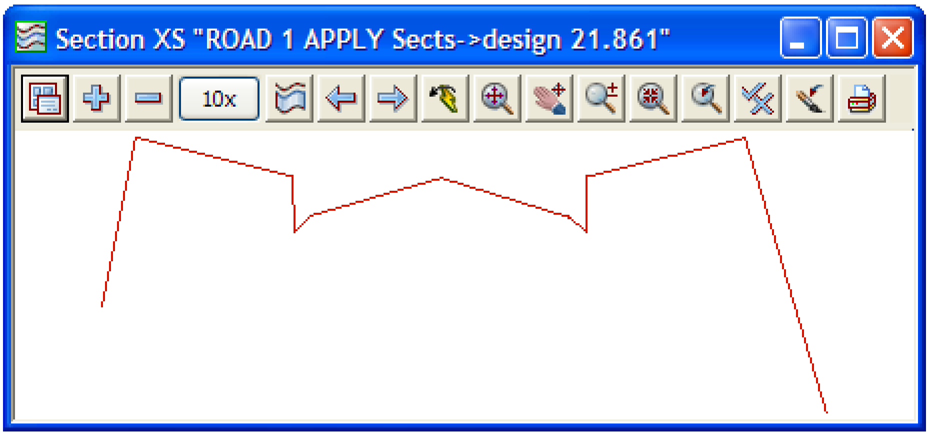
If necessary, move the panel away from your ‘Section XS’ view so that it does not obstruct the view.



Place the cursor on the *model* icon for the Model field and click LB. A list of available models will pop up. Double click LB on **ROAD 1 APPLY Sects.**

Now click LB on Next and observe the ‘Section XS’ view. The first design cross section will now be on display and highlighted (red).

Your ‘Section XS’ view will look as follows



This is the cross section through your road at chainage 21.861 (the first section along our design).

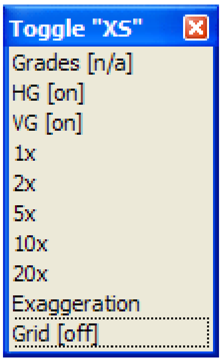
Now each time you click LB on **Next**, the next cross section along the road will be displayed. Try doing this a few times and observe what happens. Observe that the view is refreshed each time so that the cross section fully fills the window.

Try clicking LB on the Highlight tick box to turn highlighting OFF. You will notice that the cross section string displays its normal colour (cyan) rather than the highlighted colour (red). If you refresh your ‘Section XS’ view, the string will temporarily display red even if highlighting is ON.

The **Item no.** field in the Profile Model panel just gives the item number in the model of the profiled string. It will increment/decrement as the Next and Previous buttons are selected. Be aware that you can overtype the ‘item no.’ field in the Profile Model panel, clicking on Next/Previous will increment/ decrement that number and jump directly to the cross section that is that item number in the model.

As we asked for cross sections at 5 metre intervals when we generated the road, that is the increment that will be used. There will also be additional cross sections at tangent points etc.

We will now improve the legibility of our view. From the View Button Area of ‘Section XS’, click LB on **Toggle**. Move and pin the menu to one side so that it stays visible.



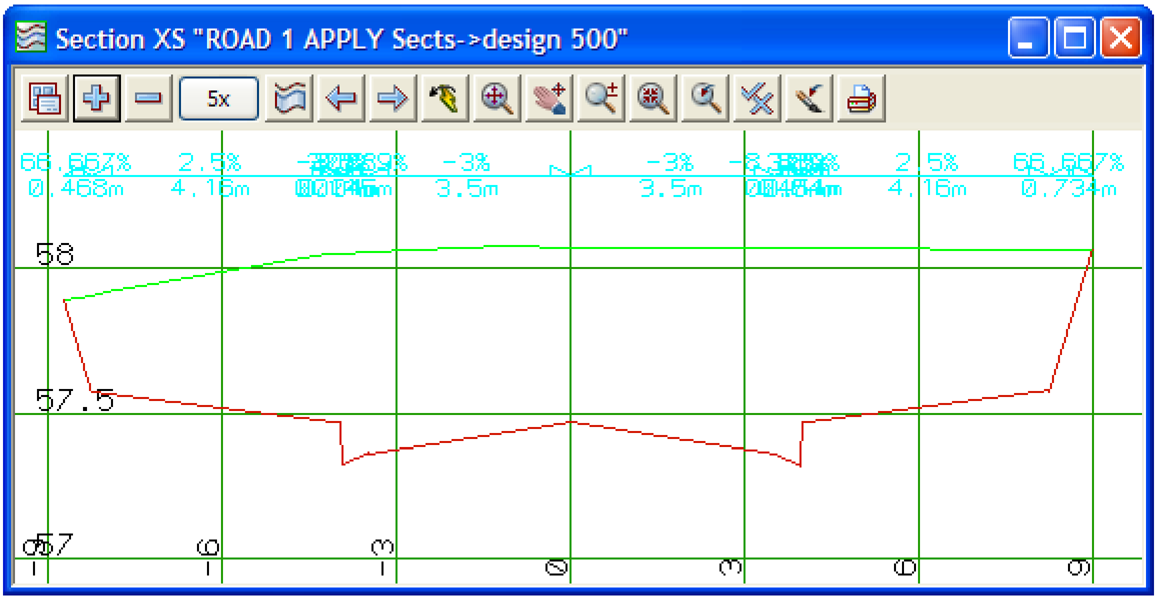
Click LB on **Grid** to turn the grid on. The spacing of the grid will default to 100 in both x and y directions. Set the grid x spacing to 3 and the y spacing to 0.5 metre. (See the previous (Chapter 12.1) in ‘Section Profiles’ for how to access and change your grid settings).

Click LB on **5x** to change your vertical exaggeration to 5 to 1.

Click LB on **Grades** to annotate the section.

From the View Button Area of ‘Section XS’, click LB on the **‘+’** sign button and turn on model **tin GROUND**. This will display the natural surface (the green string) on the cross section. The cross section string is red.

Your view should now look as follows



Zoom in on the text area to see it more clearly. When finished click LB on **Fit** to return to the normal scale.

From the ‘Profile Model on Section XS’ panel, try clicking LB on **Next** multiple times and observe your road sections.

If preferred, you can ‘untick’ the **Fit View** tick box in the Profile Model panel and the scale will remain as set as you go from section to section. This can be useful when you have the grid turned on. If your sections are on a longitudinal slope, the sections may ‘walk’ off the view as you go from section to section. Normally you will want the **Fit View** tick box turned on so leave it that way when finished.

Note that the various views are still linked. To see this properly, you will need to turn off unnecessary models in your ‘Plan 1’ view. In the View Button Area of ‘Plan 1’, click LB on ‘-‘ and click LB on **ROAD 1 APPLY Strs.**

Put the cursor back in your ‘Section XS’ view and move the cursor backwards and forwards laterally. You will see a red cross in the plan view moving along the section string of the section you are currently viewing in ‘Section XS’.

Another way of selecting the model of strings and the first string to profile for the *Profile Model on Section* panel is to actually pick the string. This is what the **Pick** button is for on the panel.   To try it, in the Profile Model panel click LB on **Pick**. Then move the cursor to the ‘Perspective 2’ view and click LB on any one of the cyan cross section strings. Click MB to accept the string chosen. The ‘Section XS’ view will refresh with the chosen cross section and the model containing the selected string is written to the **Model** field on the panel.

You can combine **Prev** and **Next** commands with **Pick**s to move around your sections.

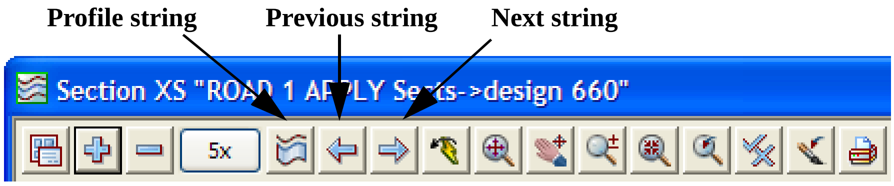
Click LB on **Finish** to terminate the Profile Model panel.

13.2 Quick Model Profile for the Section View

There is also a quick method for profiling model strings.

If a string is profiled using the standard **Profile** button in the View Button Area, the model containing the profiled string is automatically recorded.

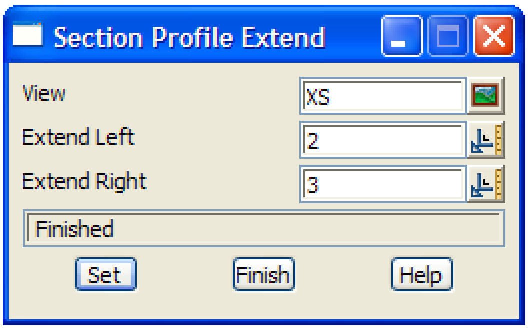
Clicking LB on the **Previous String** and the **Next String** buttons in the View Button Area of the section view then profiles the previous/next string in the model in the same away s the *Prev* and *Next* buttons on the *Profile Model on Section* panel. The profile sections are automatically fitted to the section view but are not highlighted.



13.3 Extend the Profile in the Section View

It is possible to see more of your natural surface than is currently on display. To see how this works we will extend our view 2 metres on the left and 3 metres on the right.

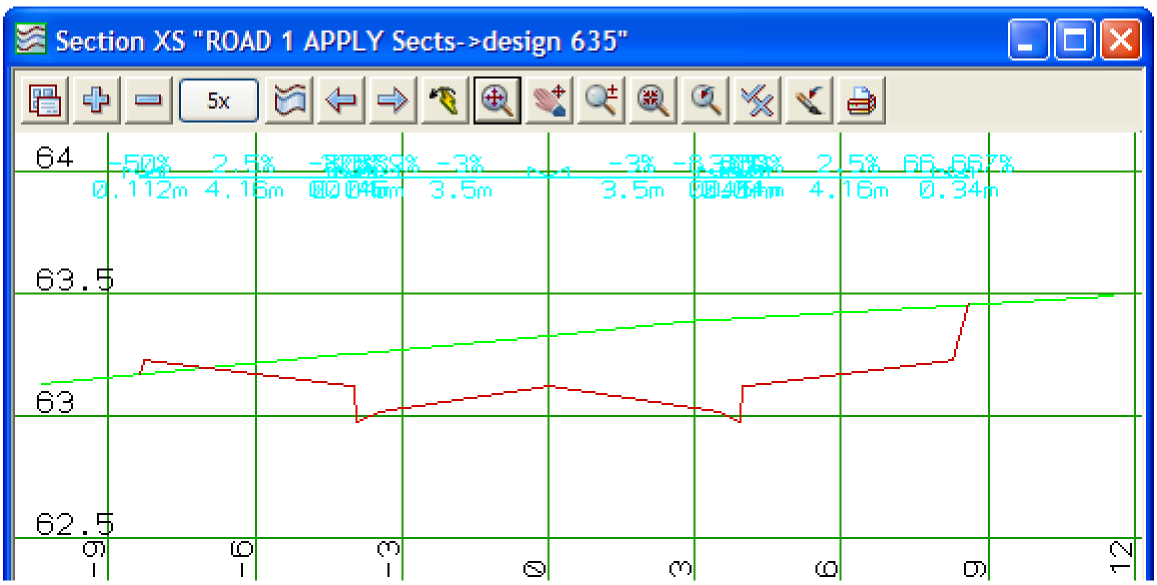
In the ‘Section XS’ View Button Area, click LB on the Menu button to bring up the View menu. Click LB on **Settings=>Extend**. The Section Profile Extend panel will pop up.



Place the cursor in the Extend Left field and type 2 and press the <Enter> key. Then type 3 for the right extension.

Click LB on **Set** to activate the settings. Click LB on **Finish** to terminate the panel.

To see the new settings in action click LB on **Fit** in the View Button Area. As shown below, the view now extends beyond the extremes of the road profile. This can be useful in checking how the new design encroaches on other existing constraints. Remember that it is possible to turn on any other models in this view and 12d will show where the strings in these models cross this particular section. We will investigate this further in the next Chapter.



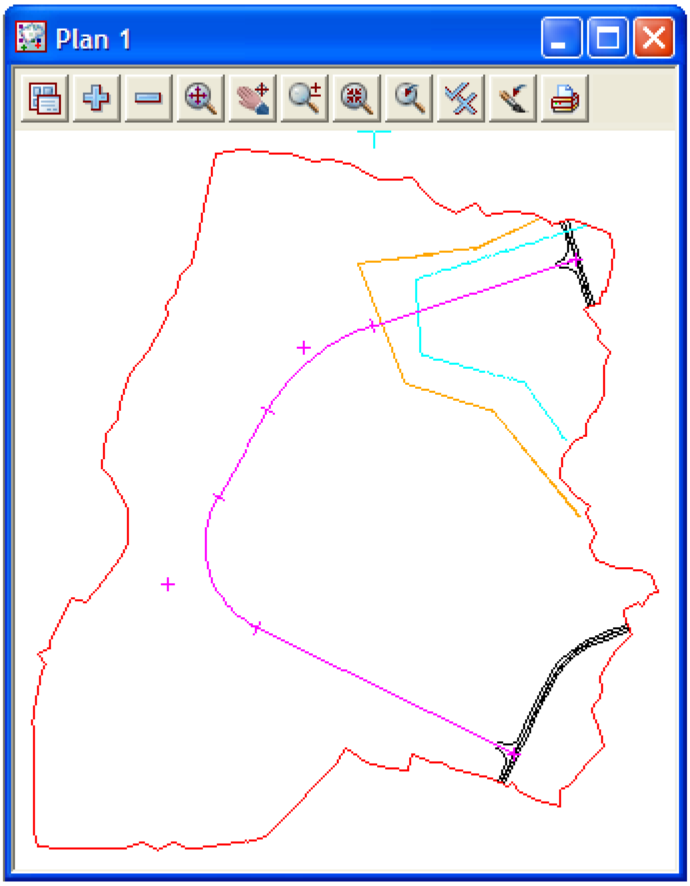
14 Services Interference

12d provides facilities that permit you to check for interference between existing constraints such as underground services and your new road design. Any underground pipes or cabling for instance can be included as strings in your overall terrain model. It is then possible to check the clearances in any of the 12d views.

14.1 Addition of Services to the Terrain

Most of the breaklines and points that we imported at the start of our design were on the natural surface, however there was also some underground features, namely two strings that represent a 100 mm water pipe and a 300mm diameter underground sewer.

These strings are mapped as super strings with an associated diameter when we import them into 12d, however they could be converted to pipe strings inside 12d .



In plan view ‘1’, turn on the models ‘survey SEWER PIPE 300’ and ‘survey WATER PIPE’. Turn off the road sections model ‘ROAD 1 APPLY Sects’.

The cyan line is the 100 mm water pipe and the orange line is the 300mm sewer.

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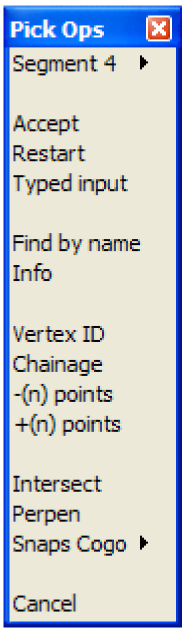
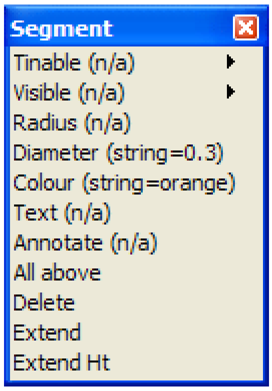
To check the diameter of each string go to **Strings => Inquire** and select one of the pipe string segments. The information panel pops up, but it gives us no information about the diameter. To see the diameter information, click the RB anywhere on the screen. Walkright on the **Segment** menu and the diameter of the string is shown. You can click on this or any of the other options to make changes to the string properties.

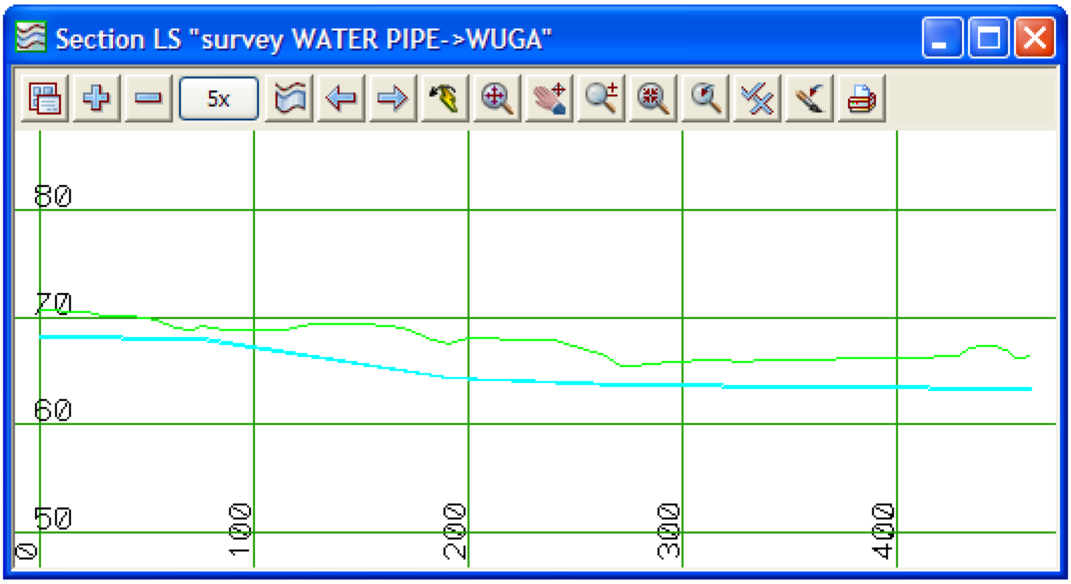




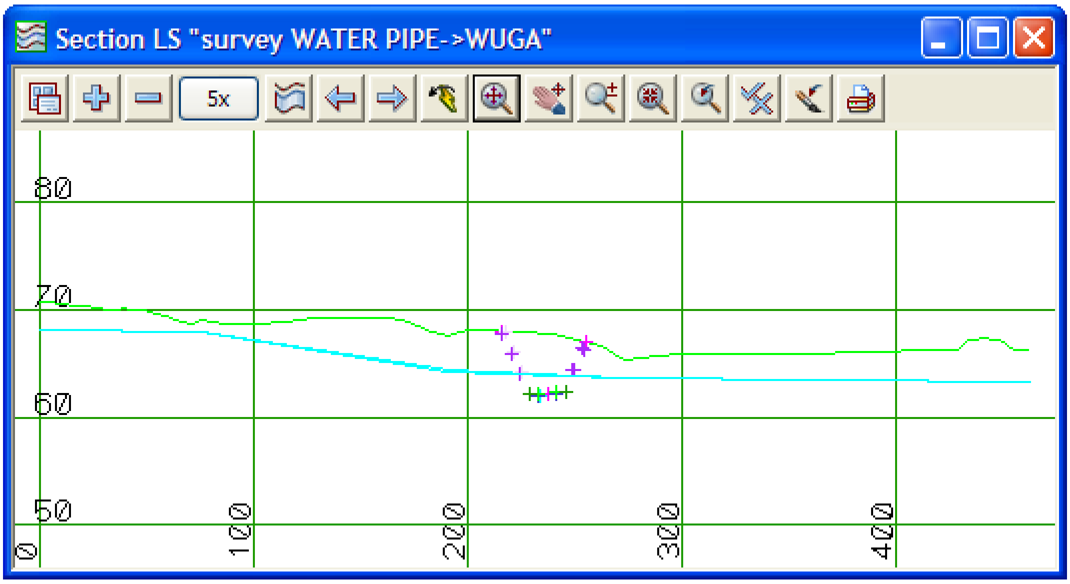
14.2 Profiling the Services

It is possible to get a quick picture of the services just imported by profiling them as we saw earlier.

From the View Button Area in ‘Section LS’ click LB on **Profile**. Put the cursor over the cyan 100 mm pipe string in the ‘Plan 1’ view and click LB. Then click MB to accept the highlighted string. Your ‘Section LS’ view will appear as follows.



This is a longitudinal section through the pipe showing the depth below natural surface. If we turn on the design strings, ROAD 1 APPLY Strs, in the section view, we can instantly see that we have a problem.

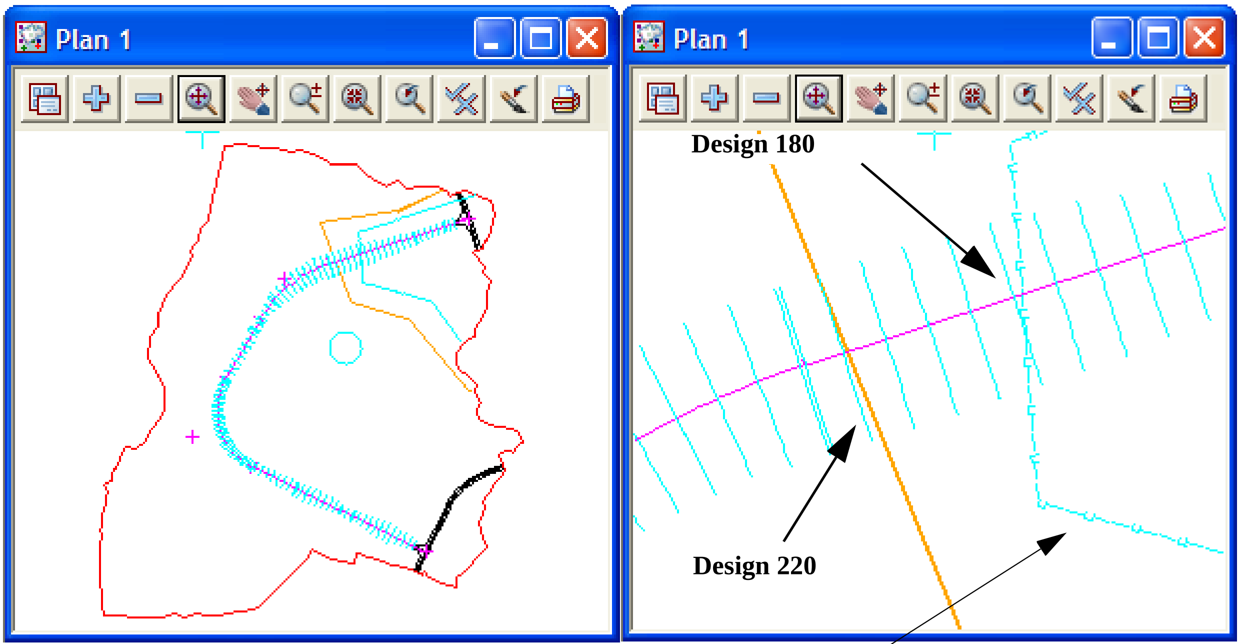


The points on the screen represent the design strings at right angles to the profiled water pipe and hence we can see that the water pipe is above the road design.

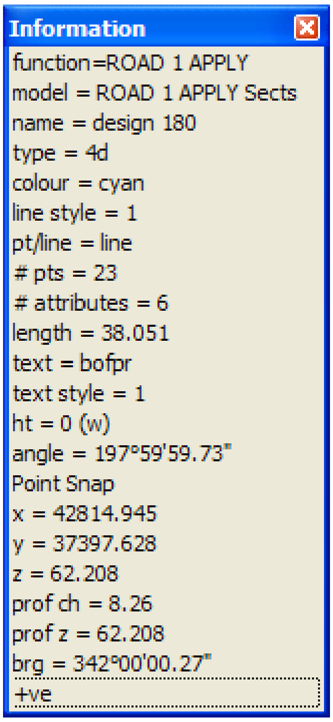
14.3 View Services in Cross Section

We will now look at our underground services in cross section in the ‘Section XS’ view.

First we need to modify our ‘Plan 1’ view to make it more usable. Click LB on the **‘+’** sign button in ‘Plan 1’ and turn on **ROAD 1 APPLT Sects**. Then Zoom in on ‘Plan 1’ view so that we can pick cross section strings in the vicinity of where the underground services cross our new road. **Zoom** in on the area shown. You will notice that the pipe strings now appear as two parallel lines i.e. they have a diameter in Plan.



Note that in ‘Plan 1’ the water pipe has been given a linestyle and hence does not show as a "pipe" in the plan. This was simply controlled by the linestyle given in the Map File when we imported that data.

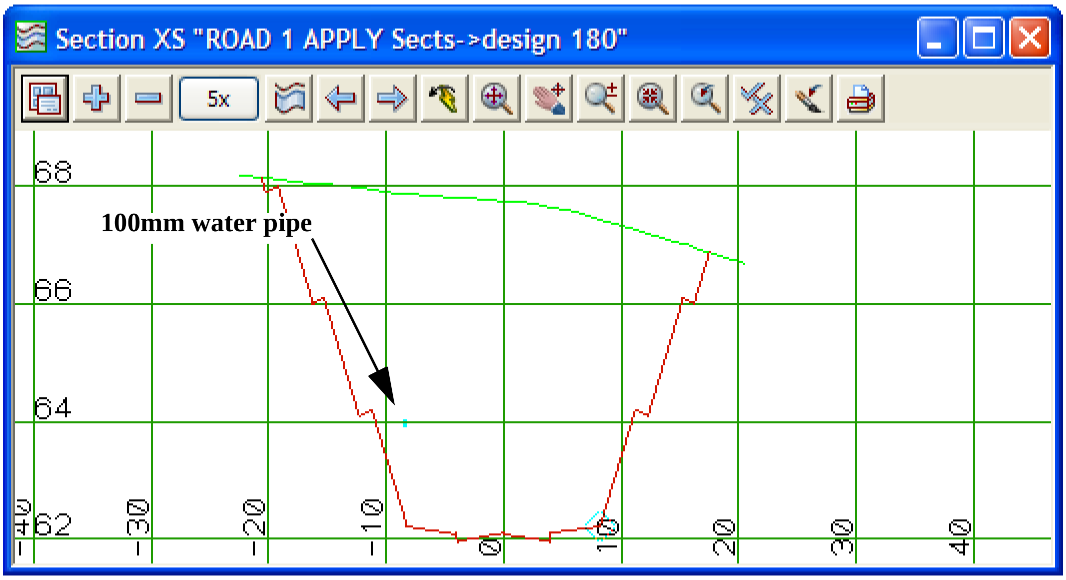


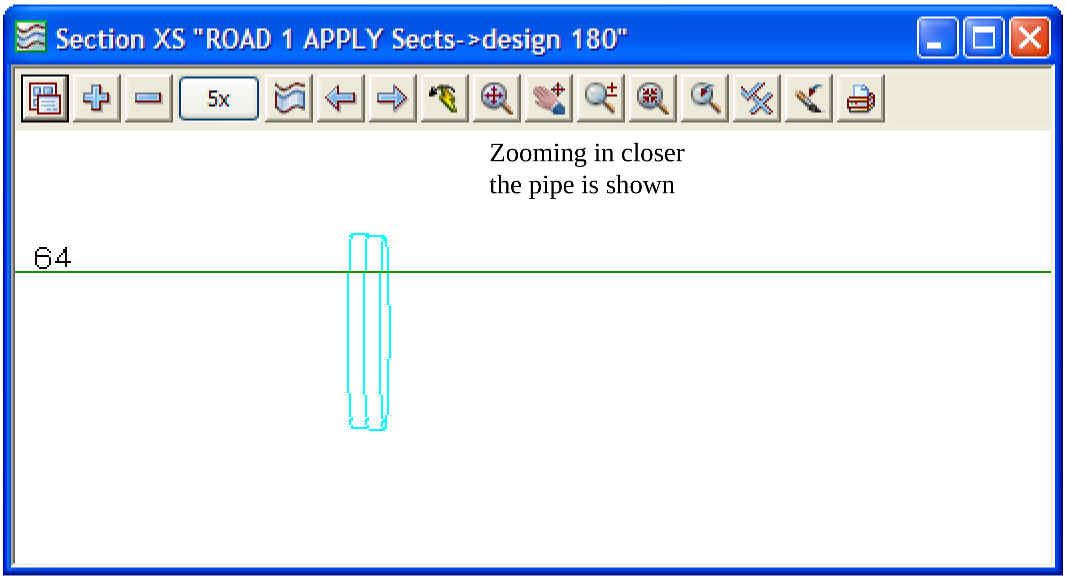
Now we need to set up ‘Section XS’ to display the appropriate cross section.

In the View Button Area of ‘Section XS’, click LB on **Profile** and point to the cross section string in the ‘Plan 1’ view that is <u>closest to where the cyan string crosses the road centreline</u>. This is section **design 180.** Look for the name ‘design 180’ in the pop up Information panel (shown at right). Click MB to accept the highlighted string. The ‘Section XS’ view will be refreshed with the new profiled cross section.

Now turn on the models **survey SEWER PIPE 300** and **survey WATER PIPE** You should now see a small cyan dot on the view at level 64. This is where the 100 mm water pipe crosses the section.

Your 'Section LS' view should now look as follows:





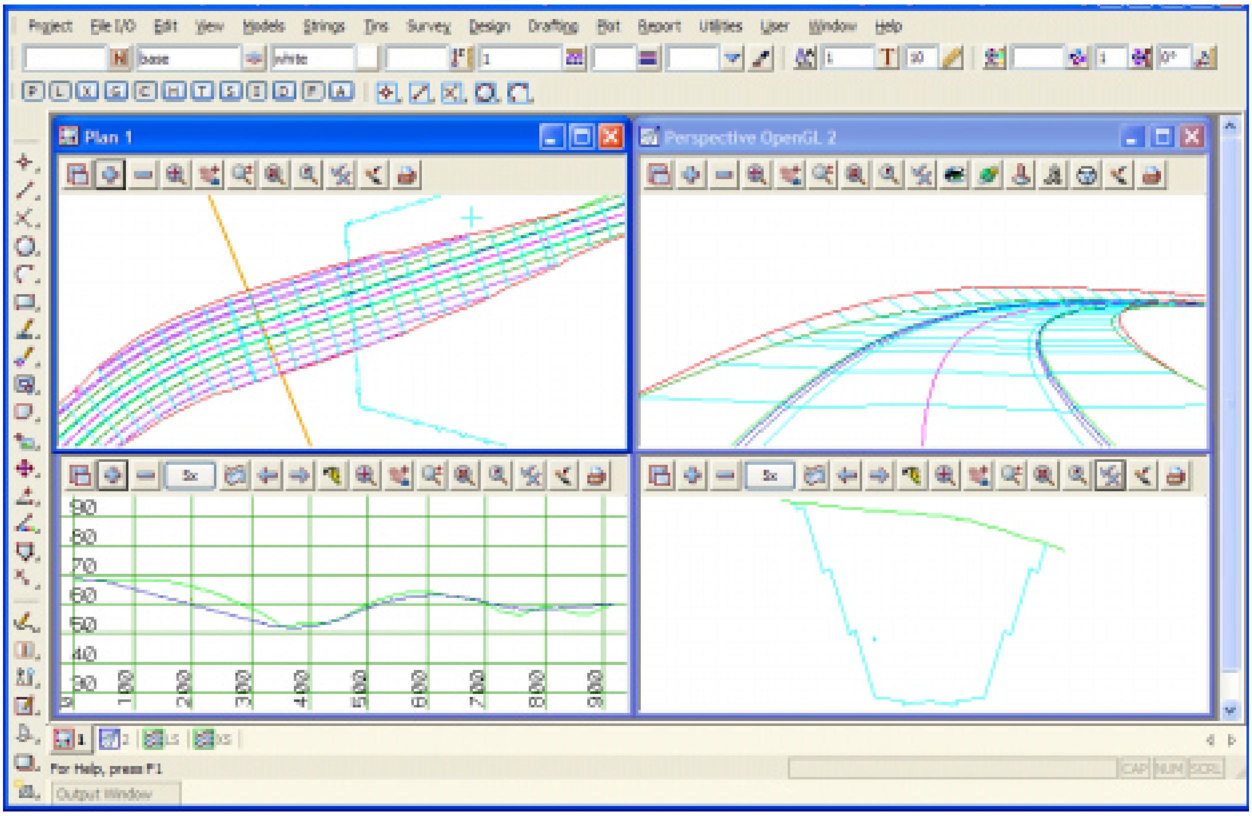
14.4 Viewing Interference with Services in Long Section

We can also check for interference in the long section. The invert of kerb string is the lowest point in the fixed portion of our road cross section. We will now profile this string and look where the services appear in our long section to check for interference. Turn on the model 'ROAD 1 APPLY Strs' in plan view 1.

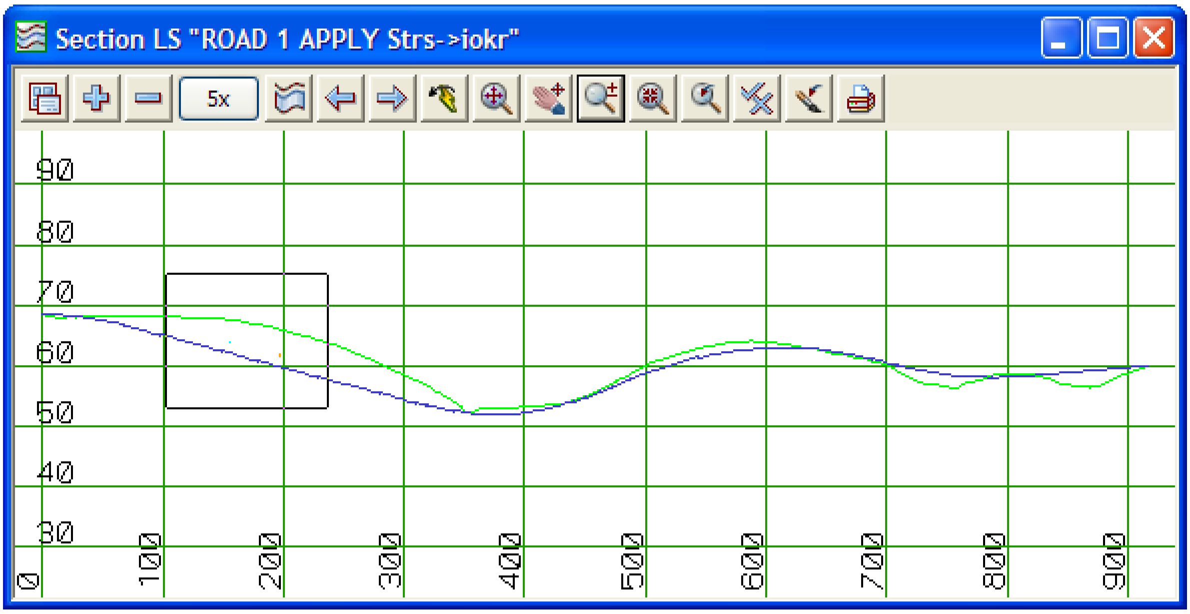
From the View Button Area in 'Section LS' click LB on **Profile**. Put the cursor over the dark blue 'iokr' string in the 'Plan 1' view and click LB. Unless you zoom right in, you may need to press the LB several times to cycle through the selections until you get the 'iokr' string. Remember to keep looking in the info panel to ensure you have the correct string, then click MB to accept the highlighted string.

In the same section view, click LB on the '+' sign button and add the models **survey SEWER PIPE 300** and **survey WATER PIPE** to your view. You should see some orange and cyan dots added to the section view as it refreshes.

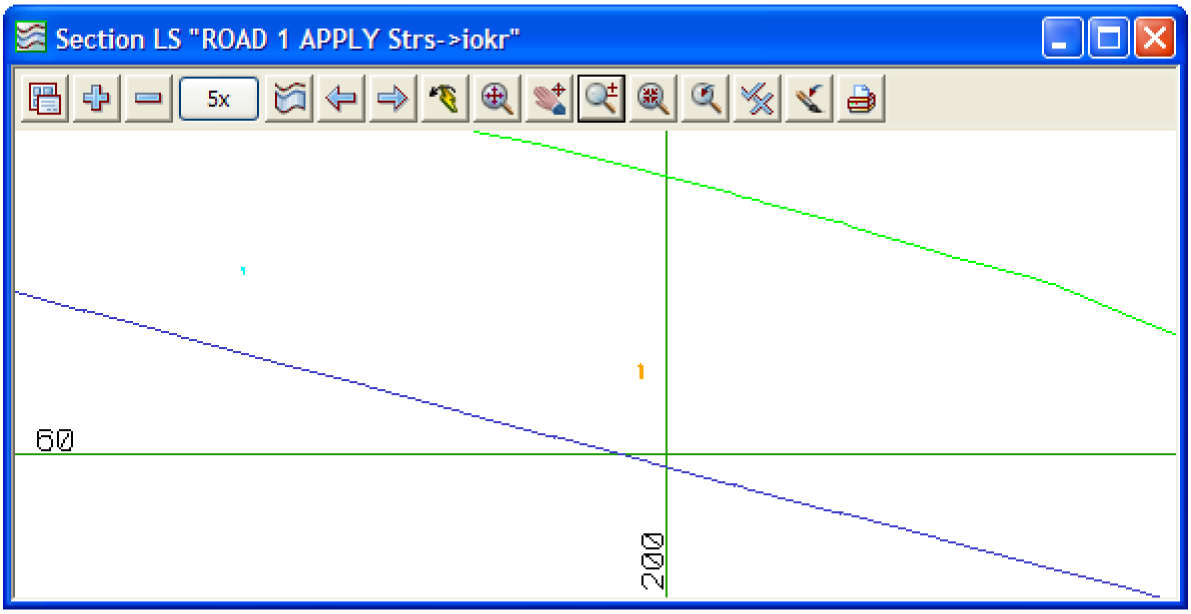
Your overall screen should now look something like



To see how the services appear in cross section, zoom in on that area as shown below.



First note that the ‘pipes’ appear in the section views. The reason that they appear as ovals and not circles is that we have a vertical exaggeration of 5 to 1 set on the view.

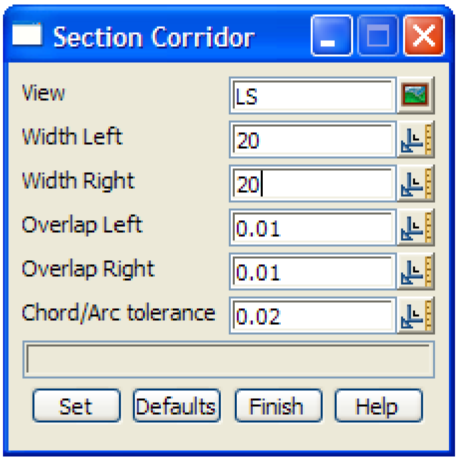


14.5 Setting Corridors

Rather than seeing just a ‘thin slice’ where the pipe crosses the section, 12d has the concept of setting a corridor width along a profiled string. Then whenever you profile a string in a section view, everything that appears within the corridor width will be included in the view. We will set a corridor width of 20 metres either side of the string being profiled to see this more clearly.

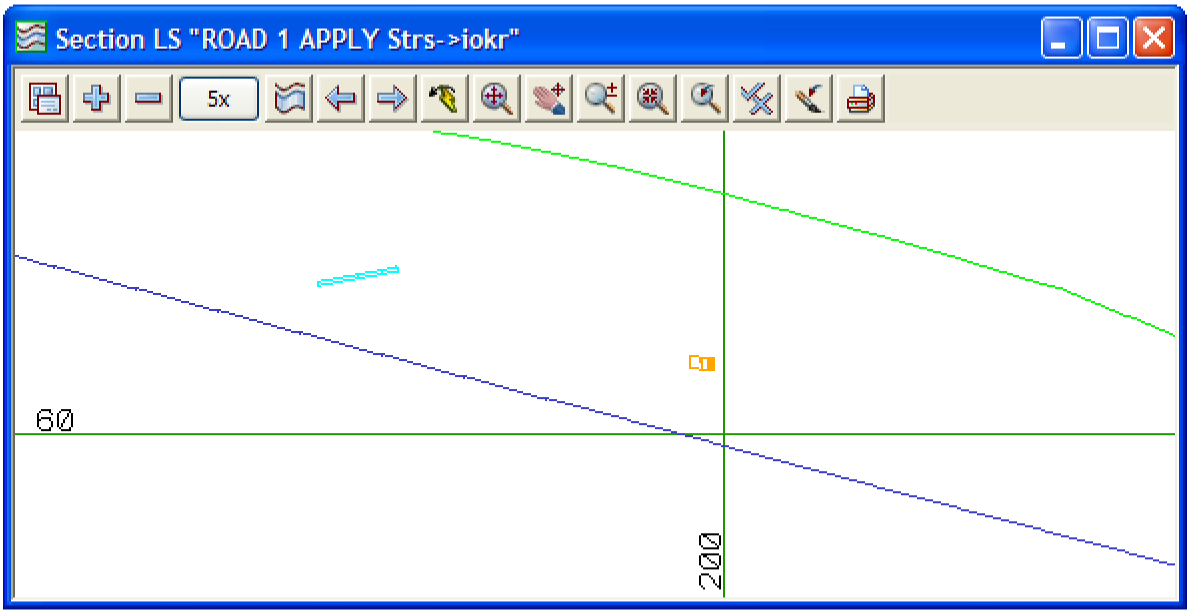
In the ‘Section LS’ View Button Area, click LB on the Menu button to pop up the View menu. Click LB on **Settings=>Corridor** and the Section Corridor panel will pop up.

Double click the LB in the Width Left field and type 20. Press the Tab key to go down a field and type 20 for the Width Right. This has now defined a corridor 40 metres wide.



Click LB on **Set** and the view will be updated. Click LB on **Finish** to terminate the panel.

The ‘Section LS’ view should now look as follows.



Whilst it may not appear obvious, the cyan string now appears in the view as a tube. This is because much of the pipe appears in the 40 metre corridor is shown in the view. Sections are shown on the pipe corresponding to where the various cross section batter strings project onto the pipe. Try **Zooming** in on the pipe for a closer view. Click **Fit** when finished Zooming.

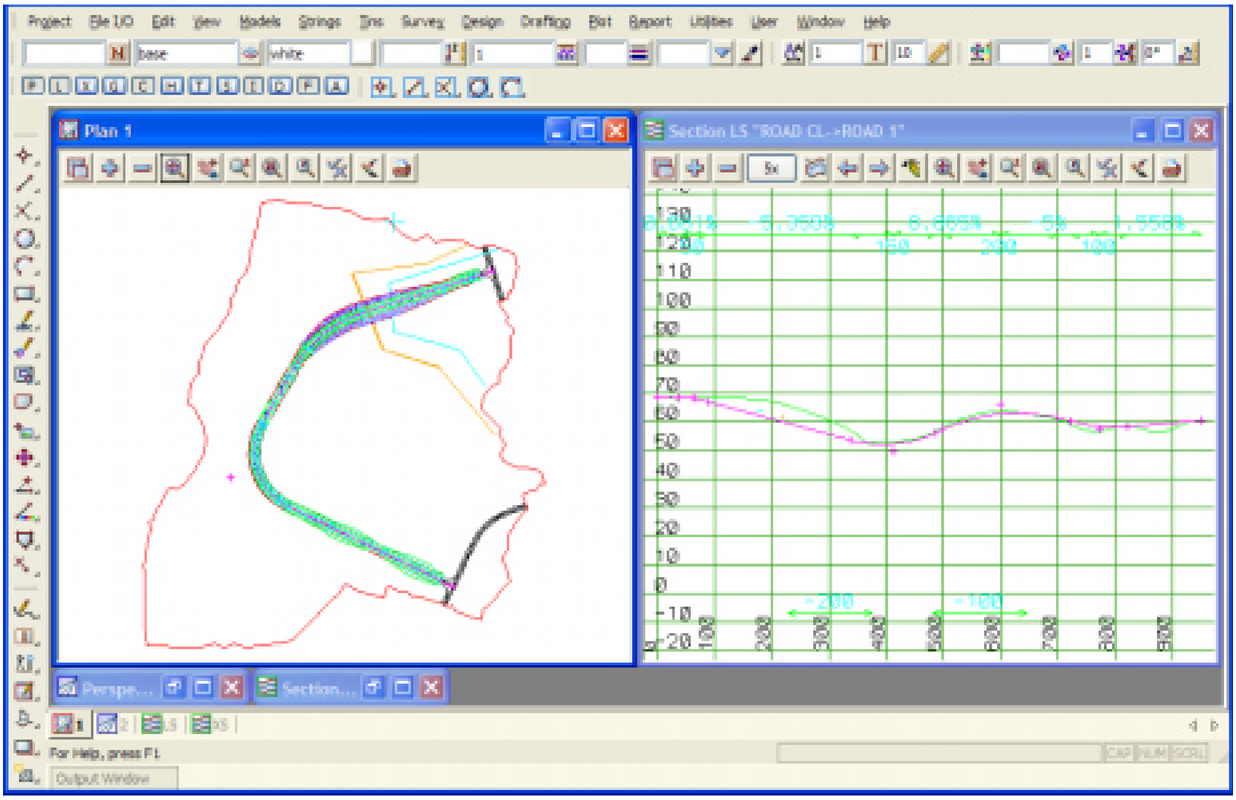
Remember that once a corridor for a view is set, it continues to remain set until changed, regardless of which strings are subsequently profiled.

15 Modification of Design Parameters

We will now perform a typical redesign operation and see how efficiently 12d handles such tasks. We will modify the vertical geometry of our road centreline to pass over rather than through our services. To do this we first need to rearrange the information on display in our views.

Minimise all views except ‘Plan 1’ and ‘Section LS’ then tile them vertically. In the ’Plan 1’ view, ensure that the **ROAD 1 APPLY Sects and Strs** are turned on. In ‘Section LS’ ensure that the alignment string is profiled and that the **survey SEWER PIPE 300** and **survey WATER PIPE models are turned on.**

Your overall screen layout should now look something like this



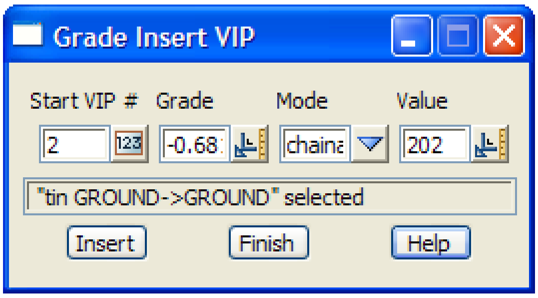
If the ‘Alignment Edit’ menu is not on display you need to reactivate it. Remember at any one time this menu is only active with one alignment. The Alignment we are editing here is called **ROAD 1**. If the Alignment Edit menu is already on display you can skip this next step. To get the Alignment Edit menu on display and active with our road centreline, move to the Main menu, click LB on **Strings=>Editor** or press function key 6 (F6).

The Edit String panel will then pop up asking you to select the string to be edited. In the ‘Plan 1’ view, click LB on the magenta string corresponding to our road centreline. The string will highlight and the Information panel will pop up. Click MB to accept the highlighted string and the Alignment Edit menu will pop up. Move the Alignment Edit menu to the lower left area by clicking and holding LB over the words **Alignment Edit**, moving the cursor and pinning it down by releasing the LB.

15.1 Modify Vertical Geometry

We are now ready to begin modifying the road geometry. We will raise the level of the road in the vicinity of the pipes by inserting a new VIP into the alignment.

From the Alignment Edit menu click LB on **Utilities => Grade insert**.

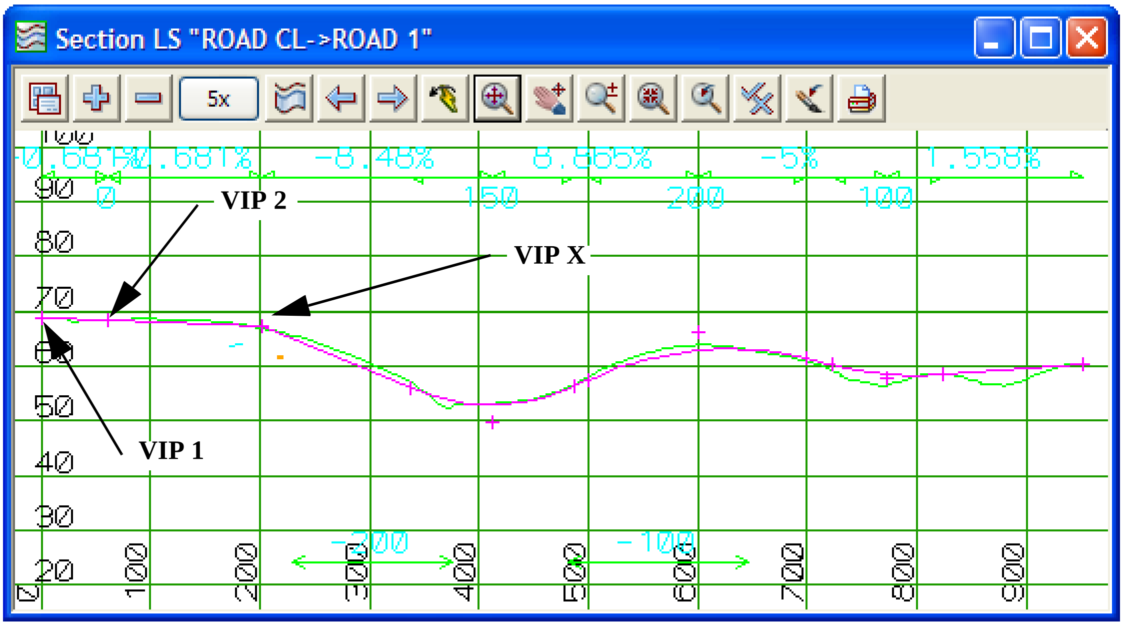


Fill in the panel as shown

We will insert a new VIP on the same grade as VIP1 to VIP 2 and at a chainage of 202.

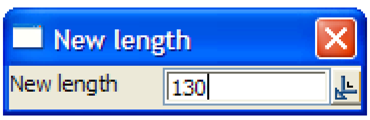
Click on **Insert** once you have filled in the panel.

The ‘Section 2’ view should now look as follows



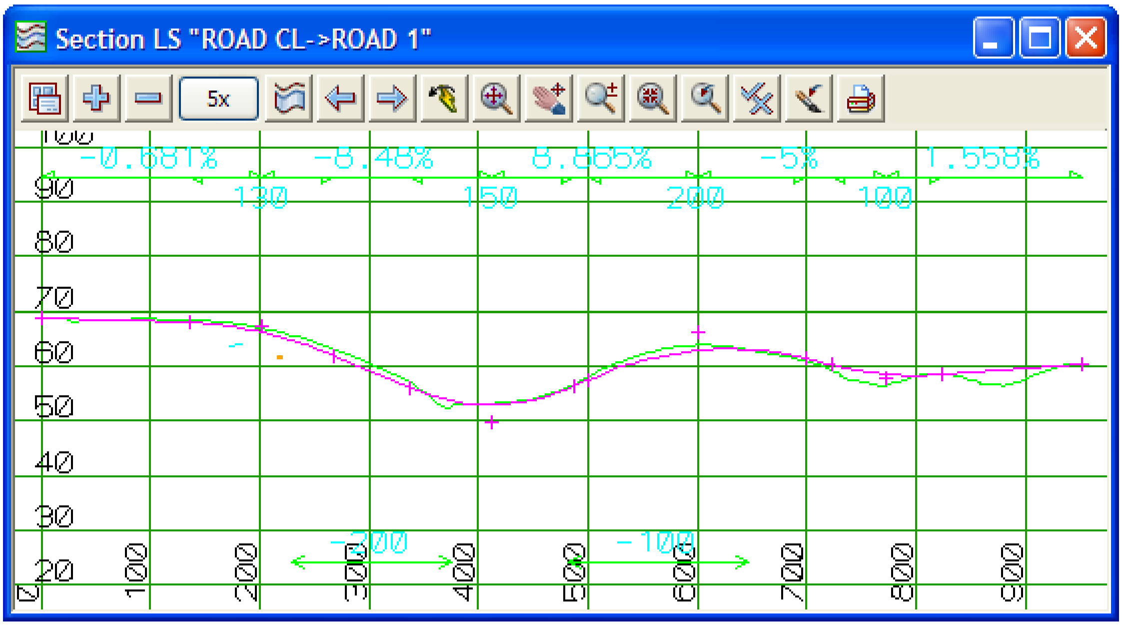
We will now insert a curve at this new VIP X.

From the Alignment Edit menu click LB on **Parabolas=>Length**. Point to VIP X and click LB and confirm it with MB. A panel will pop up prompting ‘New length’. Type in the value shown.



Press the Enter key to terminate data entry. A vertical curve will appear in the view. Click LB on **Fit** to ensure that all information in the view is updated.

As VIP 2 is on grade between VIP 1 and VIP 3 it is not needed and hence we can delete it from the section view. Click on **Delete** in the ‘Alignment Edit’ panel and select VIP 2. The ‘Section LS’ view should now look as follows



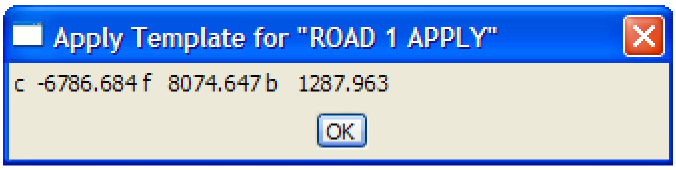
15.2 Recalc after Modifying Vertical Geometry

We will investigate one of the most powerful features of 12d. You will remember that earlier we defined a template to be passed down our road centreline. When we filled in the template panel we gave the template function a name - we called it ‘ROAD 1 APPLY’. The purpose of that name will now be shown.

We can now refer to the template function by name and get it to reprocess the series of steps it needed to calculate the road geometry from a single menu click!

From the main menu, click LB on **Utilities=>Recalc=>Recalc=>ROAD 1 APPLY.** You can also walk right on **Recalc** in the ***Recalc*** Panel and select the function ‘ROAD 1 APPLY’.

You will notice that 12d goes into a heavy compute operation. After a few seconds, the various plan and perspective views are all updated and now display the redesigned road. At the end of the calculation, the Apply Template panel will pop up



12d advises you of the new cut and fill volumes associated with this recalculation.

Click LB on **OK** to remove the panel.

If we now repeated any of the operations we did earlier such as the ‘string drive’ down the road or the profiling of sections, we would be looking at the revised data. It is strongly suggested you try this in your own time to convince yourself that all of the data have in fact changed!

During a recalc, you will notice that the view ‘Section XS’ has gone blank. This is intentional as the data that was displayed became obsolete. If you want to see the new data, simply repeat the steps we did earlier to profile any of the cross section strings. Note that the views only go blank when you place the cursor in the view. This is a reminder that the data on display was obsolete and can no longer be displayed (depending upon the changes you made prior to the recalc, the strings being profiled may no longer exist!).

It is worth noting that if we had used multiple templates and restricted each template application by chainage to only part of the road, we may have needed multiple template functions to achieve our full road design. This is more typical of what happens in a real world situation. In such case, it is possible to process all template application functions in sequence with a single menu click.

You would do this from the Main menu by clicking LB on **Utilities=>Recalc=>Recalc all** or click on **Recalc all** in the ***Recalc*** Panel.

Important: Each time you perform a recalc, all of the string data that is calculated by 12d is automatically deleted and replaced by new data. This is unlike most other processes in 12d where if you repeat an operation such as importing a string or creating a string manually, you end up with multiple copies of coincident strings.

We saw above how we can modify vertical geometry and get 12d to automatically recalculate our revised road design. We can also change the horizontal geometry and get 12d to update our section view. We will now perform a series of more complex changes that are typical of the redesign steps required in a real world situation

15.3 Inserting Spiral Transition Curves into the Horizontal Alignment

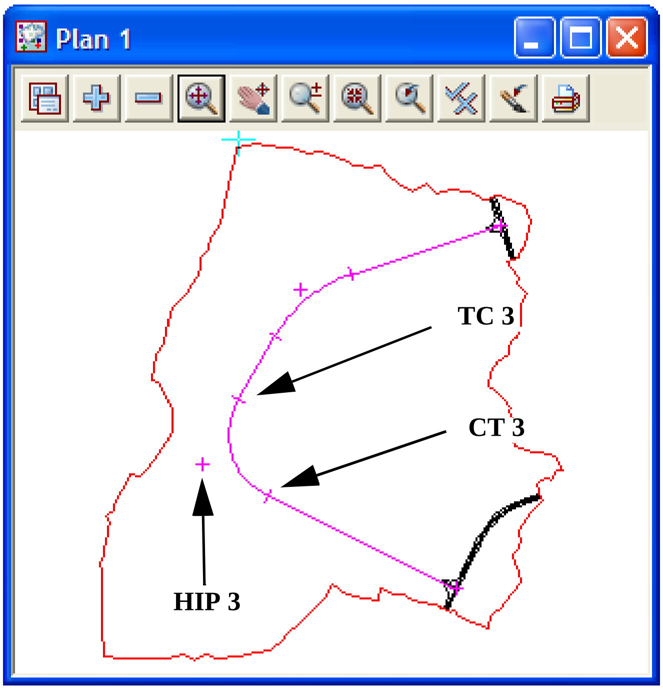
Spiral transition curves are inserted <u>after</u> normal constant radius curves have already been inserted i.e. the IP must have a non-zero radius before a spiral can be inserted at the tangent point.

The main horizontal curve at HIP 3 is currently a constant radius curve of 100m radius connecting adjoining tangents. We will introduce clothoid spiral transition curves at either end of the constant radius curve to allow the introduction of superelevation into the pavement surface.

Turn of the ROAD 1 Apply sections and strings.

From the Alignment Edit menu, click LB on **Curves=>Spiral** and the Screen message box advises

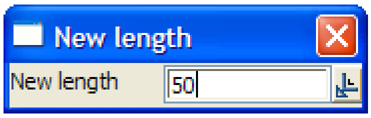
<Select point to change length>[picks][][Menu]



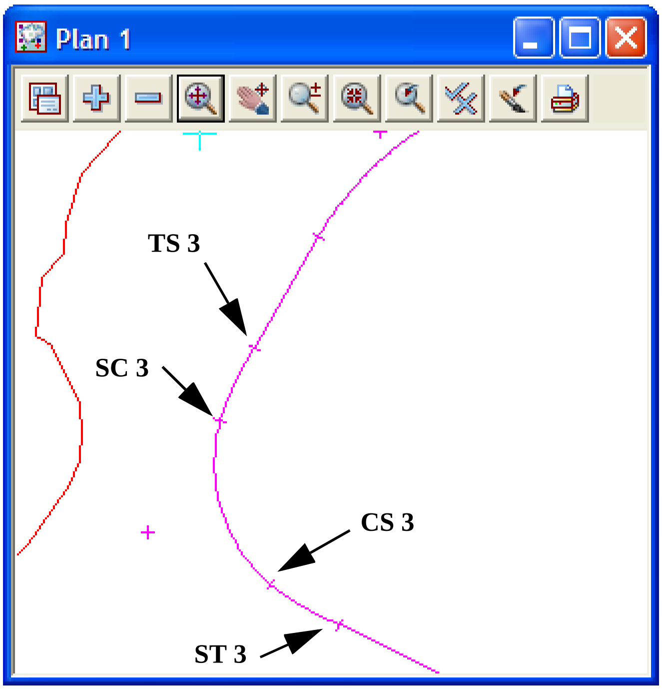
Place the cursor near Tangent-Curve point TC 3 and click LB. Click MB to confirm the selection. Press the Enter key and a box will pop up asking for the length of spiral to be inserted.

Type the value shown followed by the Enter key.

Place the cursor near Curve-Tangent point CT 3 and click LB. Click MB to confirm the selection. Enter the same spiral length as before



The modified geometry should now look as follows



From the Alignment Edit menu click LB on **Info** to put up the Information panel. Move the cursor near the points at either end of the spiral curves and observe the data displayed.

Note the various new points that have been created to replace the Tangent-Curve TC 3 and Curve-Tangent CT 3 points shown above.

The new points are

Tangent-Spiral TS 3

Spiral-Curve SC 3

Curve-Spiral CS 3

Spiral-Tangent ST 3

Click LB on **Info** again to toggle off the Information panel.

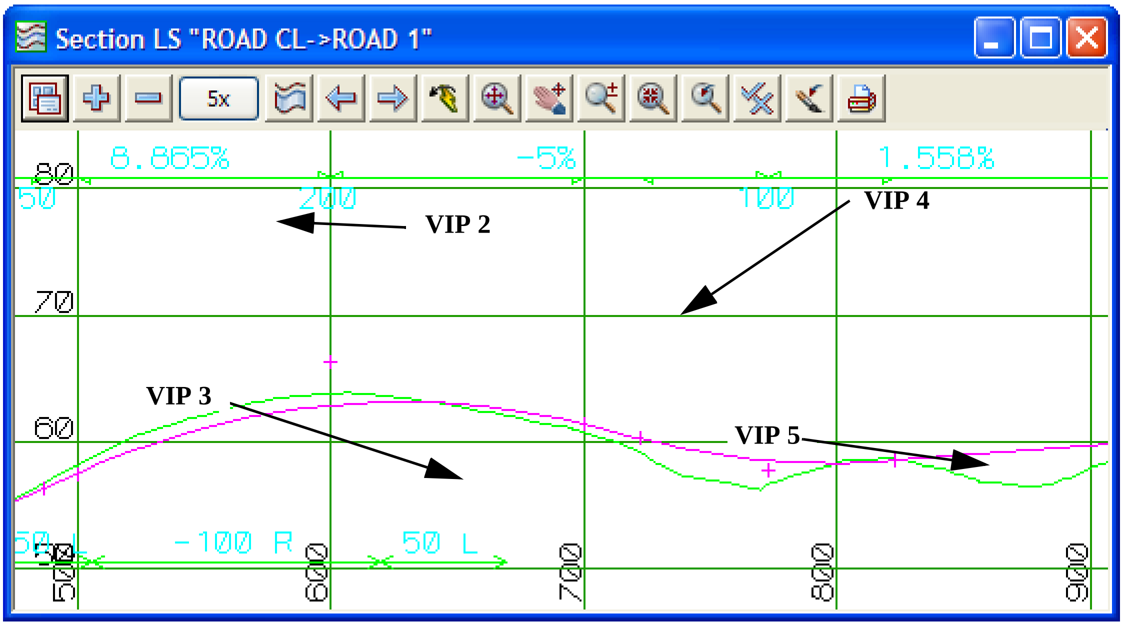
15.4 Changing the Annotations

We need to see the impact of our new Horizontal alignment in profile.

To update the ‘Section LS’ view to reflect the changes to our horizontal alignment, from the View menu click LB on **Regen**.

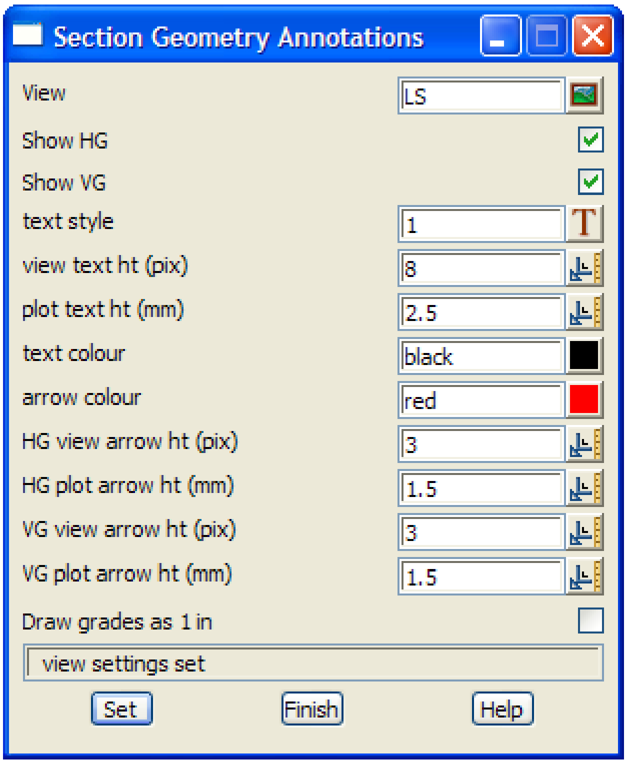
The green ‘natural surface’ line corresponding to the revised centreline will change

.



Observe that in the Horizontal geometry annotation at the base of the view, a letter R has been appended to the -100 to show that it is a Radius and the Spirals have an L appended to the 50 to indicate Length.

You will note that as we are adding more detail and text to the Section View, the various items of text in the annotation now overlap. You can make the annotation more readable by reducing your text height. From the View menu of ‘Section 2’, click LB on **Settings=>Geom annot.**



Place the cursor in the ‘view text height’ field and change the height from 10 pixels to 8.

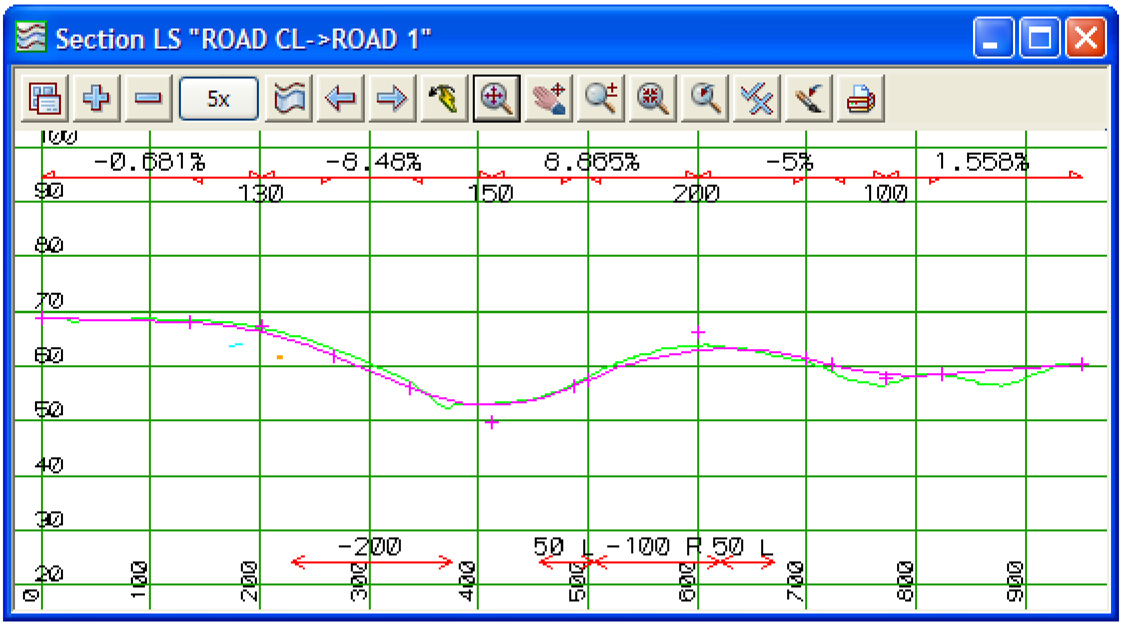
In this manual I have set the colour to black, but you can use any colour.

I have also changed the arrows to red, but once again you can use any colour.

Click LB on **Set** to activate the change.

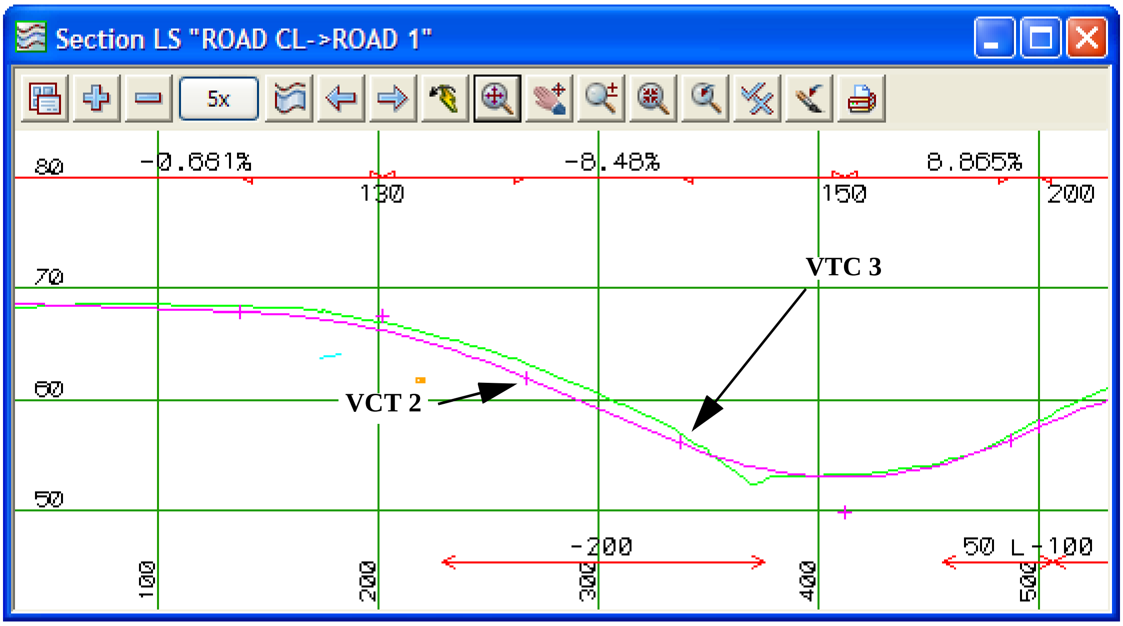
Click LB on **Finish** to terminate the panel.

The annotations in the section view should now look as shown below



15.5 Modifying a Vertical curve by Moving the Tangent Points

We will now look at how we can pick up points with the cursor and use the mouse to visually place curves. First **Zoom** in on the area shown in the above view.

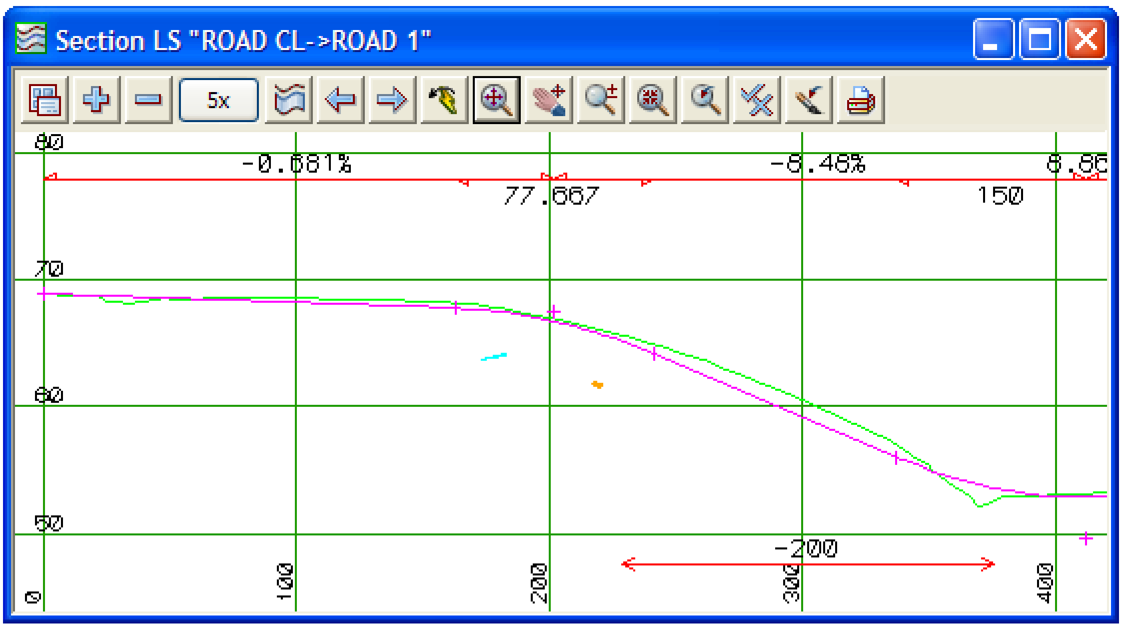


<u>VCT 2</u>

From the Alignment Edit menu click LB on **Move.** Place the cursor on point VCT 2 (Vertical Curve to Tangent point) as shown above and click LB. Click MB to confirm the selection. Then move the cursor to the left and right and observe what happens. Through excessive movement of the cursor it is possible to create a vertical curve that interferes with its adjoining vertical curve. Whilst 12d will permit you to make such a change, the template function will not proceed when you attempt to create the road. <u>To ensure that the template function can work, it is essential that your vertical geometry is meaningful</u>.

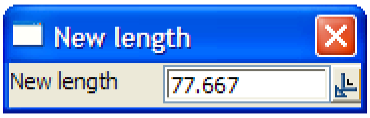
Move the cursor to the right slightly to minimise the length of tangent between adjoining curves i.e. minimise the distance from VCT 2 to VTC 3 (Vertical Tangent to Curve point). Pin the tangent point down by clicking LB. Click LB on **Fit** to fill the view.

View ‘Section 2’ should now look similar to this



Note that in our case the length of the vertical curve is now 77.667. Your case need not be exactly the same since the mouse is being used to 'eyeball' in the tangent point. You can pick up the tangent point and move it multiple times if need be.

Hint: After practising moving TP's with the mouse, you should reset your VC so that it exactly matches the above settings. Click LB on **Parabolas=>Length** from the Alignment menu, click LB on the curve you just modified and MB to confirm the selection.



Type '77.667' and press Enter. Click LB on **Fit** to refresh the view.

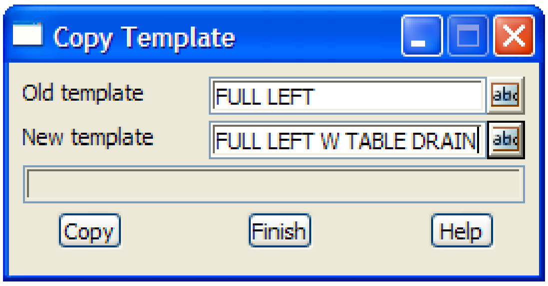
Important: It is desirable that you have both the horizontal and vertical geometry defined exactly as shown above as this information is used in the Advanced Road Design (Template modifiers) function later in the tutorial.

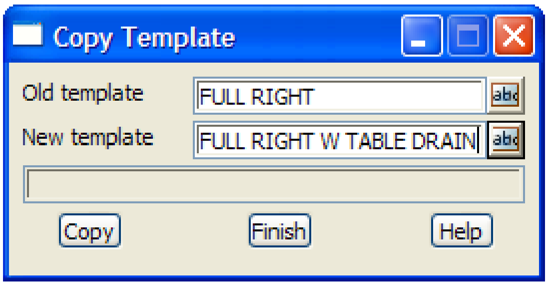
15.6 Increasing the Width of Pavement and Introducing a Table Drain

The following steps are designed to show you how to modify template values and how to introduce new links in a template. We will make a copy of your existing templates and then edit the copies to make the template changes. This way your original templates are left unchanged should you need them again

PERFORMING TEMPLATE CHANGES MANUALLY

From the main menu, click LB on **Design=>Templates=>Copy** and the Template Copy panel will pop up.





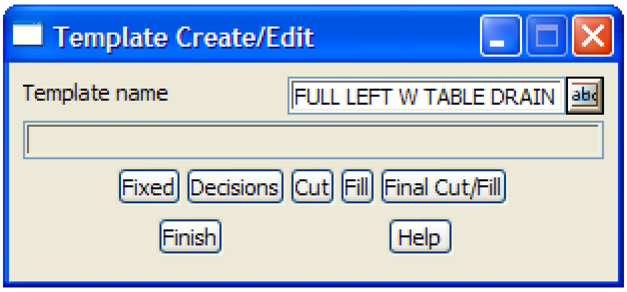
In the Copy Template panel, click on the **Old template** icon and select the **FULL LEFT** template.

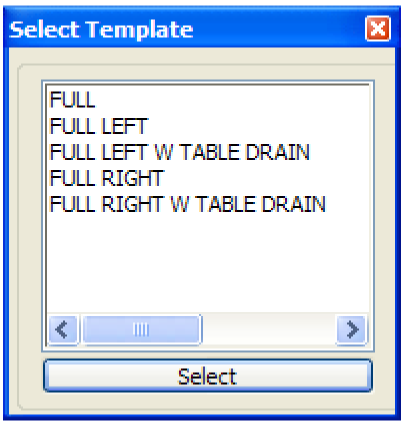
In the New template name field type the name 'FULL LEFT W TABLE DRAIN'. Click LB on **Copy**.

Repeat the process and copy **FULL RIGHT** to 'FULL RIGHT W TABLE DRAIN'. Click LB on **Finish** to terminate the Copy Template panel.

From the main menu, click LB on **Design=>Templates=>Create/Edit** and the Template panel will pop up.

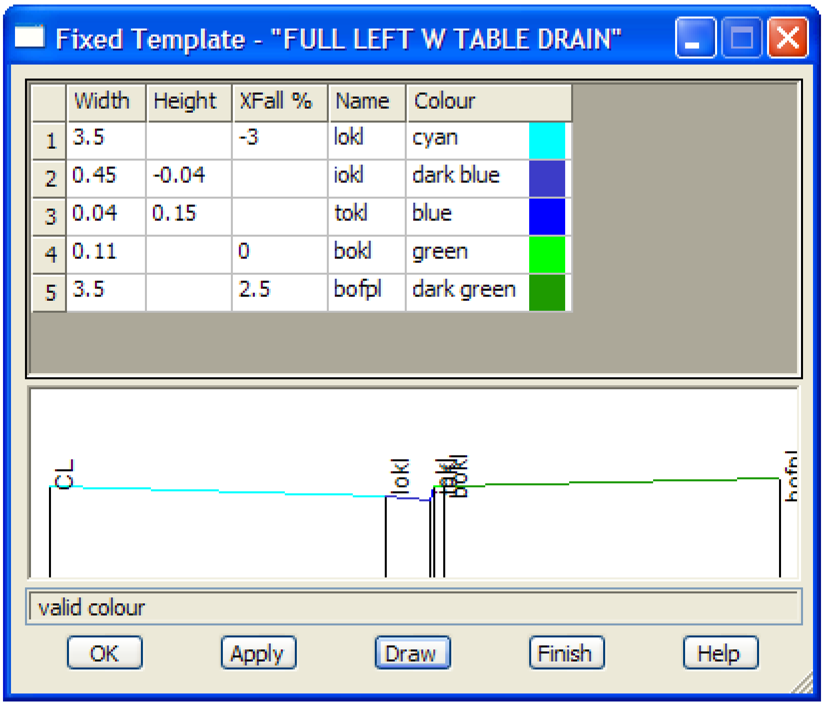
In the template panel that pops up, click on the icon and select the **FULL LEFT W TABLE DRAIN** template.





We will confine our changes to the fixed part of the template. Click LB on **Fixed.**

The Fixed Template panel pops up. The panel displays the template links we used earlier in the tutorial.

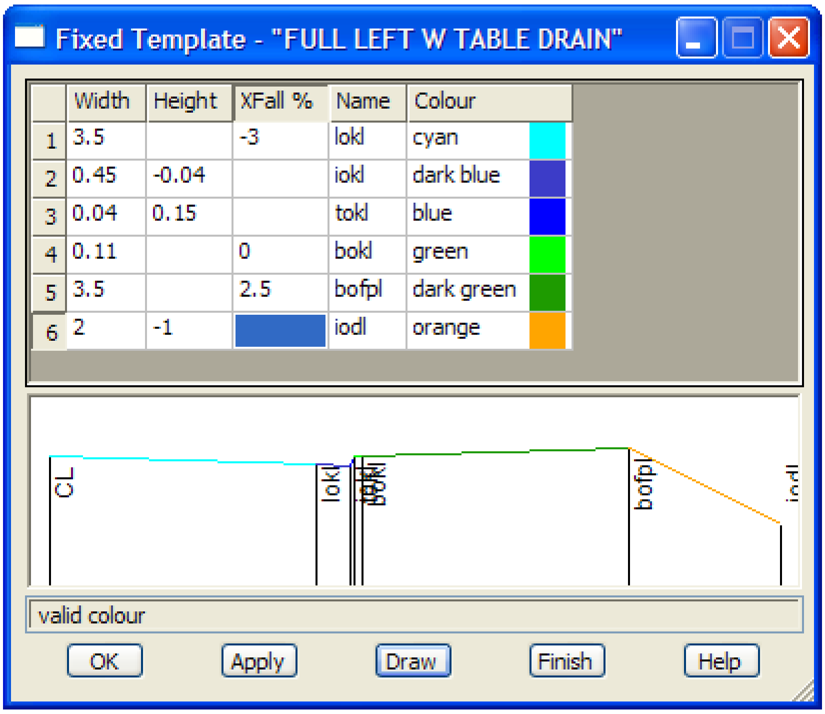


Position the cursor over the ‘Width’ entry on line 5 and click LB to lock the cursor into the field. decrease the footpath width from 4.16 to 3.5 metres.

Press on the Enter key 5 times so that a new line appears in the template.

We will now modify the template by inserting a table drain at the back of the footpath

The finished panel should look as follows - remember to add the suffix ‘l’ to the invert of drain name.



Click LB on **Draw** to preview the changes. Click LB on **Apply** to test the changed settings. If you have made any syntax errors, they will appear in the message line at the base of the panel (where it shows valid colour)

Click LB on **OK** to implement the settings and terminate the Fixed Template panel.

We now need to repeat the above changes for the template on the right side of the road.

The changes you need to make on the right are identical to those on the left except that all link names have a suffix of r (for right) instead of l (for left). Thus the invert of drain link will have the suffix ‘r’.

That completes the changes to our templates. Click on **Finish** to close the ***Template Create/Edit*** panel.

15.7 Recalc after Modifying the Template and Other Geometry Changes

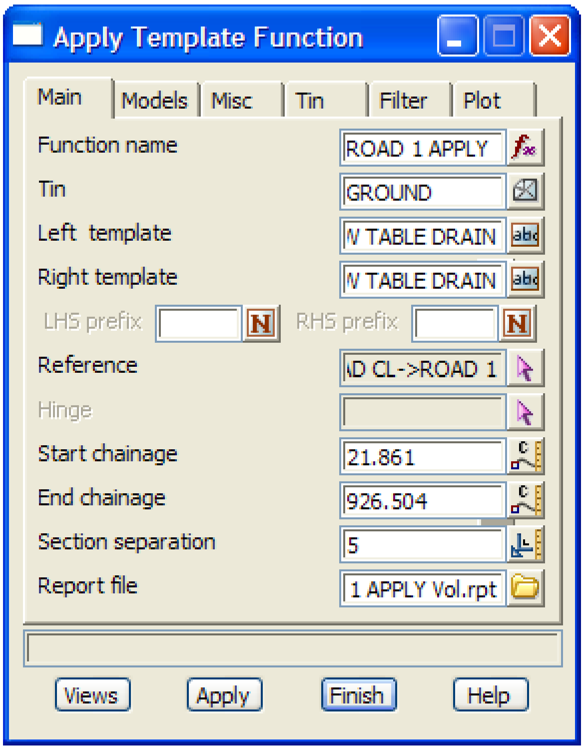
Clearly we have now made significant design changes to the template and to the geometry of the road centreline. We need to get 12d to update the views to reflect these changes. Regardless of how complex the changes are, all we have to do normally to perform a complete redesign is run the recalc function.

Since we have changed the names of our templates however, we must make minor edits to our apply function to point to the new templates.

Before recalculating the changes, turn on the **ROAD 1 APPLY Sects and Strs** models in ‘Plan 1’ view.

From the main menu, click LB on **Utilities=>Recalc=>Editor=>ROAD 1 APPLY**

The Apply Templates panel will pop up with the values in each field already filled in. 12d remembers the values you entered earlier. You can now make any required changes.



In the ‘Left template’ field select the **FULL LEFT W TABLE DRAIN** template.

In the ‘Right template’ selct the **FULL RIGHT W TABLE DRAIN** templete

As we have modified the length of the road by makes the various changes, we need to update the **End Chainage**. You can either type the new chainage in or use the measure icon to pick the new chainge from the plan view.

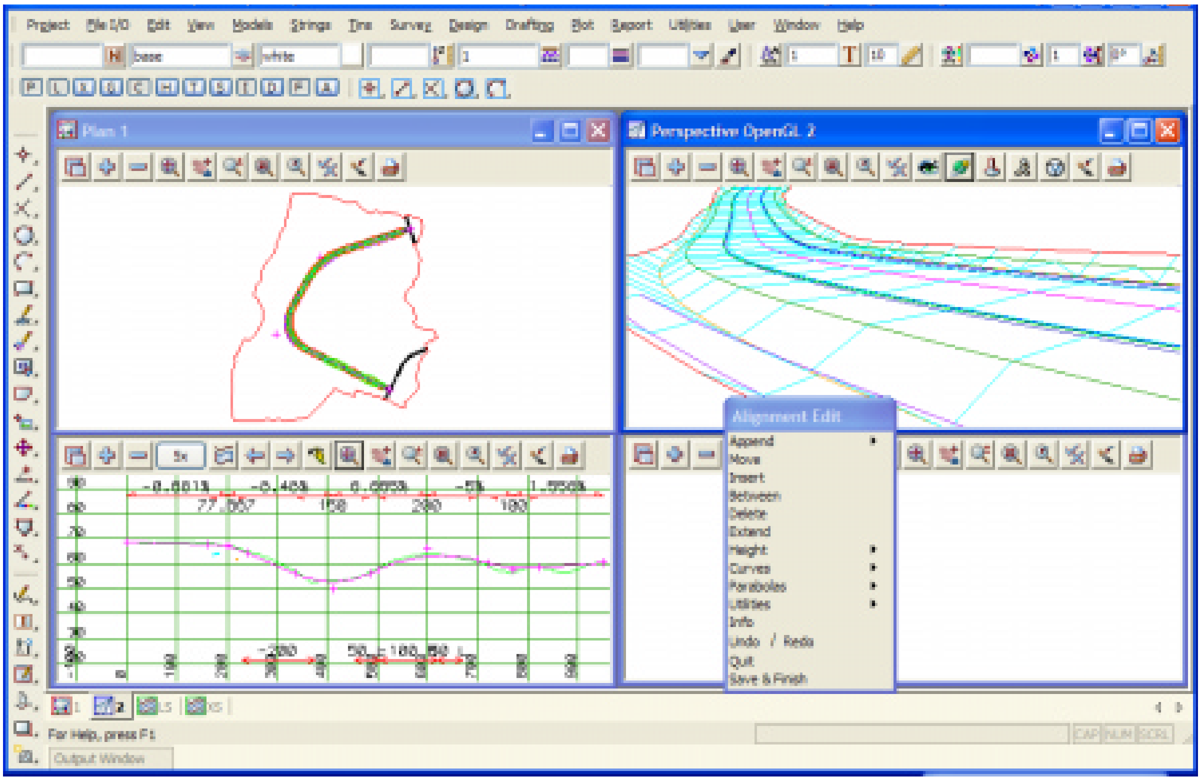
When complete, reapply the function with the new templates by clicking LB on **Apply** then **Finish**

This time the cut and fill volumes are smaller and more closely balanced.

Note how the entire lower end of the road has now moved in ‘Plan 1’. Also in the ‘Perspective 2’, you will now see the open channel v drain running through the areas of cut. In the areas of fill, the drain will blend into the final fill slope.

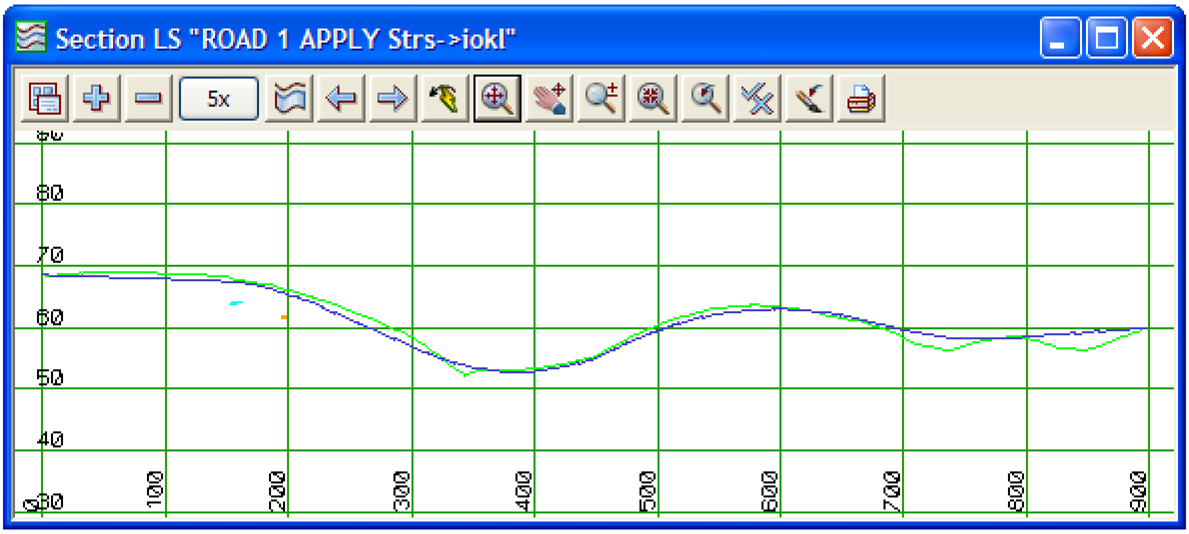
At the end of the calculation, the revised cut, fill and balance volumes appear in the message line.

Your overall screen layout should now look as follows



Now profile the invert of kerb string to confirm that the road now lies above the services.

From the View Button Area of ‘Section LS’, click LB on **Profile** and LB on the **iokr** string from ‘Plan 1’ view. You may have to zoom to pick the right string



Clearly the road now lies above the services.

Finally click LB on **Save & Finish** in the Alignment Edit panel. Click LB on ‘Yes’ to confirm

16 Using 12d on Typical Projects Involving Volume Calcs

16.1 General Cut and Fill Calculations

12d has many features that enable accurate cut and fill calculations to be performed. The easiest way to manipulate data for volume calculations is via surfaces (i.e. TINs). For instance, a simple way to calculate the cut and fill volumes on an earthworks project is to create a TIN of the natural surface and a TIN of the finished design surface and get 12d to calculate the volume between the TINs.

We will now demonstrate how to do this with a practical example - designing a pad footing for a commercial building.

16.2 Pad Footing Design Prerequisites

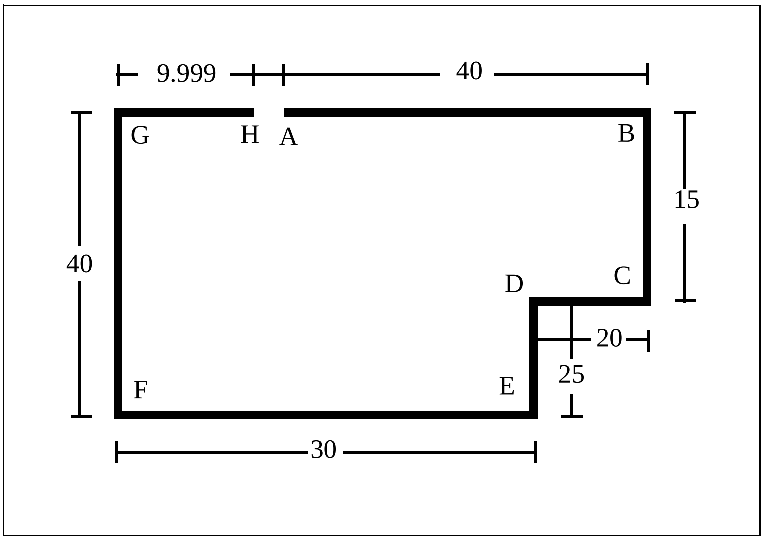
Note that if you are jumping to this Chapter of the Training manual rather than working through it sequentially, the only prerequisite for this Chapter is that the TIN ‘natural surface’ must already exist. This TIN was created in Chapter 6.3. All other data related to Pad Footing design is created from scratch.

Alternatively, you can import the 12da ascii file **Chapter 16.12da** which contains all the models, strings and tins created to date.

16.3 Pad footing Design using the Interface Function

The Interface function is the simplest form of geometry construction within 12d Model. Generally, it is applicable whenever the batter lines are at a constant slope from top to bottom (no benching) and the constant slope applies in all directions (i.e. a constant batter slope at right angles to the alignment string).

The definition of our pad footing is started in a similar manner to our earlier road design, by constructing an alignment string corresponding to the shape of our pad footing. We will begin with a pad footing shaped in plan as shown below.



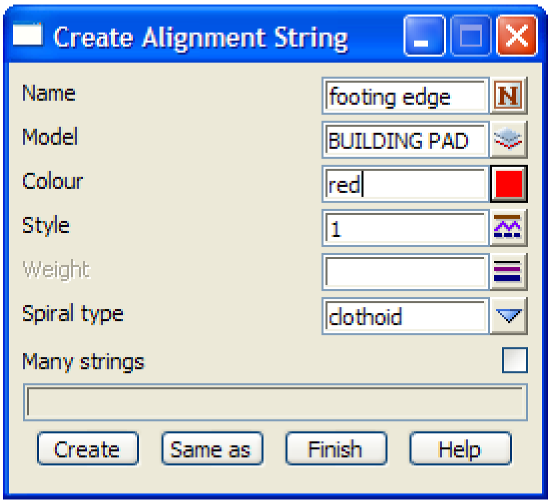
We will generate this string in order A,B,C,…H. The reason we do not start at a corner r is so that we can insert curves at the corner IPs later. Curves can only fit between adjacent tangents.

Also to avoid confusion when snapping to the start and end points, we will leave a small gap of 0.001m between points H and A.

Begin generating the pad footing outline from the Main menu by clicking LB on

Strings=>Create=>Alignment=>Alignment

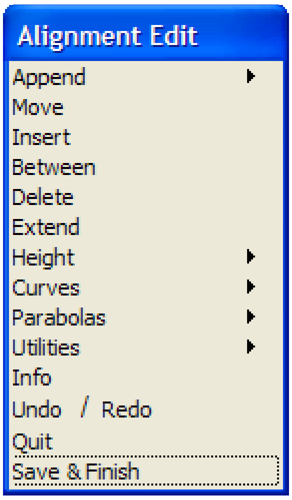
The Create Alignment String panel will appear.



Fill out the panel as shown.

These settings tell 12d that the pad footing outline is be called ‘footing edge’ and is to be placed in a new model called ‘BUILDING PAD’.

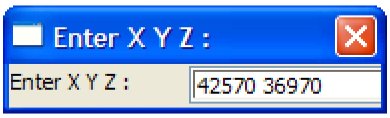
Click LB on **Create** and the Alignment Edit menu will pop up. Move it out of the way if necessary.



We will initially define the horizontal geometry of the pad footing. From the Alignment Edit menu, click LB on **Append=>HIPs.**

Now place the cursor anywhere in the ‘Plan 1’ view and start typing as shown below. Alternatively, you can press the RB to pop up the ‘Pick Ops’ menu and click LB on ‘Typed input’.

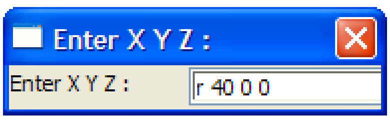
Note the XYZ entry panel pops up with the cursor already locked into the data entry field.



Type the following coordinates with a space between each number. Terminate data entry by pressing the Enter key.

You have just entered a valid point in space corresponding to point A on our pad footing outline. Note that a red rubber band is now connected to the cursor. We could now enter the next point via the mouse or several other means.

We will supply the remaining coordinates of each point on the pad footing outline by entering relative movements (to the last point placed). To enter the second point just start typing ‘r 40 0 0 as shown below. Alternatively, we need to tell 12d we are using typed input again. Place the cursor anywhere in the ‘Plan 1’ view and press the RB. From the ‘Pick Ops’ menu that pops up, click LB on ‘Typed input’ again.



Type the numbers shown, each separated by a space, followed by the Enter key.

This is a relative movement from the last point of 40 in X, zero in Y and Z.

Don’t be concerned about the rubber band joined to your cursor whilst you are doing this. It may appear to be in the wrong place at times whilst you are selecting items from menus etc.

We need to repeat this sequence multiple times. Remember to terminate each line by pressing the Enter key.

r 0 -15 0

r -20 0 0

r 0 -25 0

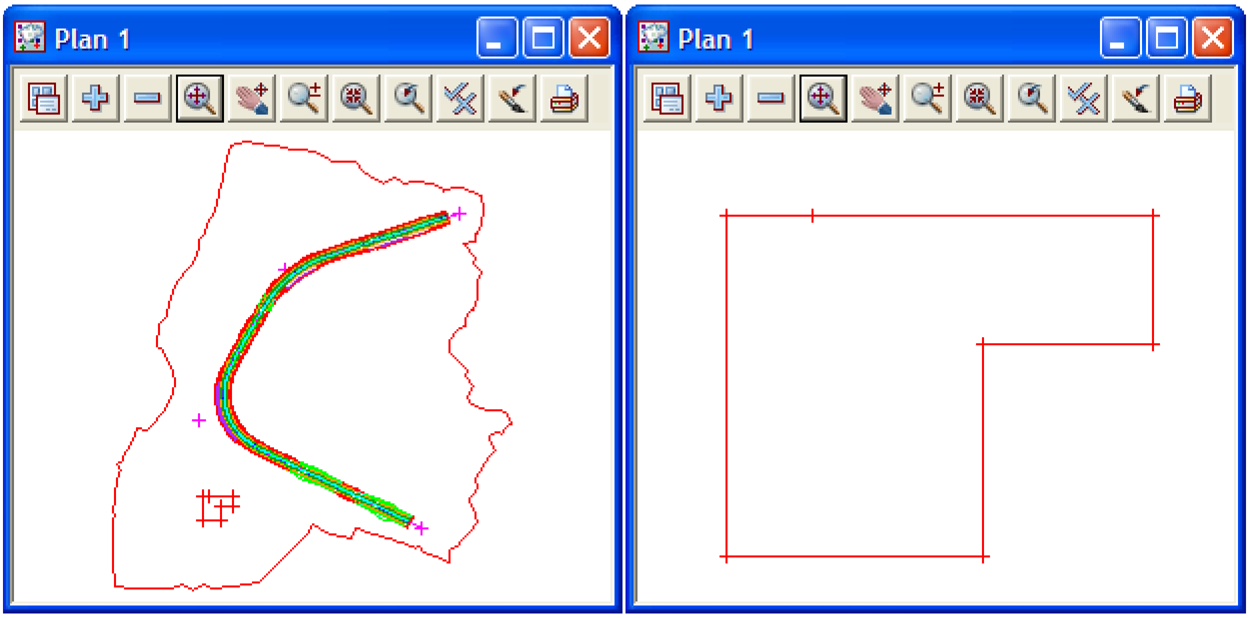
r -30 0 0

r 0 40 0

r 9.999 0 0

After the last line is entered, press <Esc> to terminate the creation process (or click RB to pop up the 'Pick Ops' menu and click LB on **Cancel**).

To see the string you just created zoom in on the pad footing area as shown below.



We will now insert small radii at each IP to ensure smooth curves between tangents. This will ensure that the finished earthworks have a satisfactory appearance.

From the Alignment Edit menu, click LB on **Curves=>Radius**

Click LB on any one of the six corner IPs and confirm the selection with the MB. In the 'New radius' panel that pops up, place the cursor in the data entry field, type the value 3 and then press the Enter key. This will insert a radius of 3m between the tangents that meet at the intersection point.

The screen Message box is still advising

<Select point to change radius>[picks][][Menu]"

Now just repeat the process by clicking LB on each of the other five points in turn, clicking MB to confirm the selection and typing the radius of 3, or by using fast picking, clicking MB on each of the other five points in turn and typing the radius of 3.

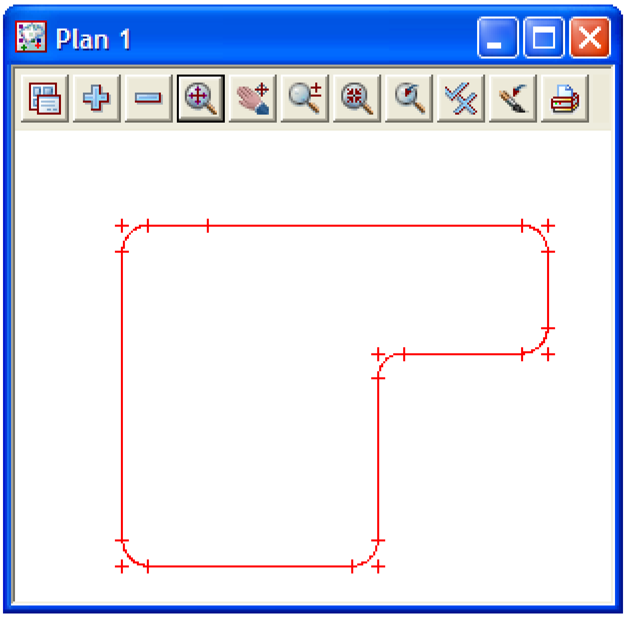
You do <u>not</u> need to leave the Alignment editor after you have completed this operation.

If you do terminate the editor, you need to click LB on **Finish** to make your changes permanent or click LB on **Quit** to cancel any changes that have been made.

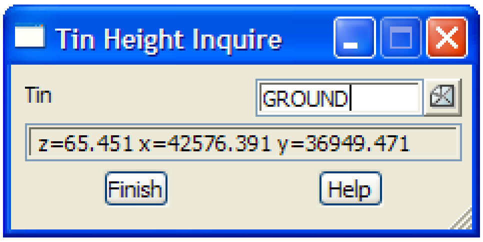
If after leaving the Alignment Editor you need to reactivate it, you can quickly start the Editor again by picking function key 6 (F6) to bring up the panel 'Edit String' (or by clicking LB on **Strings=>Editor**), pointing to the alignment string and clicking LB to select and MB to confirm the selection.

The curves you just entered should now appear as shown below

.



We now need to define the vertical geometry of our pad footing. Firstly, we need to get an idea of the approximate Z values to be used for our pad footing elevation.



From the Main menu, click LB on **Tins=>Inquire=>Height** and the following panel pops up.

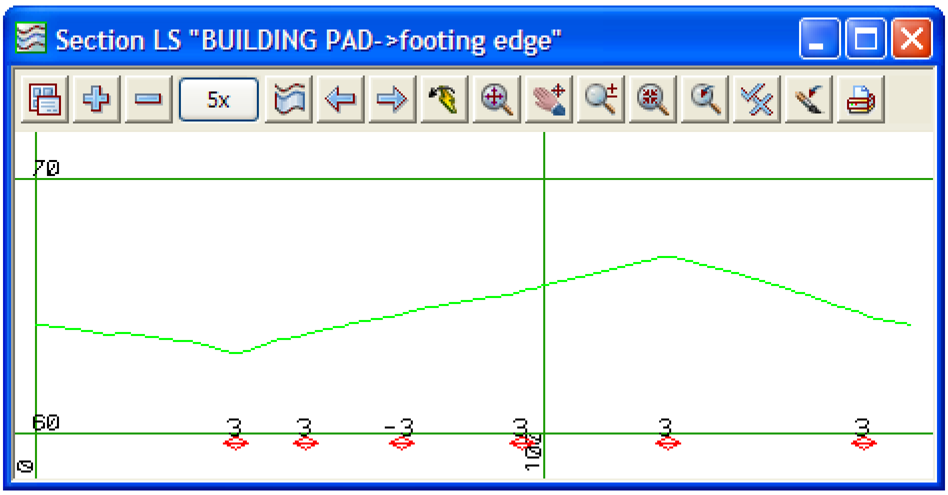
Click RB in the ‘Tin’ field and click LB on **GROUND** from the pop up list.

Now place the cursor in the ‘Plan 1’ view inside the pad footing and note that the Z values range from about 63 to 67. To roughly balance cut and fill let us make an initial guess to set the pad footing at height Z=64.

Click LB on **Finish** to terminate the Tin Height Inquire panel.

We now need to select a Section view for the purpose of displaying our pad footing string in profile. We will use our ‘Section LS’ view. From the View menu of ‘Section LS’, click LB on Profile and then click LB on the red string in Plan 1 corresponding to our pad footing outline. Click MB to accept the highlighted string

.



Note that the ‘Plan 1’ and ‘Section LS’ views are now linked. If you move the cursor left-right in the

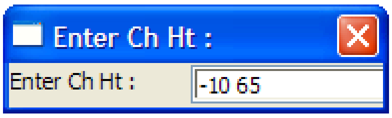
‘Section LS’ view the corresponding position in the ‘Plan 1’ view is marked with a yellow cross.

Also observe the View Coordinates Box at the bottom of the screen. When the cursor is in the ‘Section LS’ view, the message box shows chainage and height (e.g. ch=72.541 ht=64.929).

Note that the extremes of the profiled string range from chainage 0 to about 172. Thus to ensure that the entire string has defined vertical geometry, we will start at chainage -10 and finish at chainage 180. Seeing as the whole string is to be set horizontally at Z=65, we only need two points to define the vertical geometry.

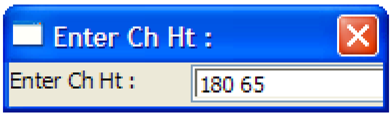
From the Alignment edit menu, click LB on **Append=>VIPs**.

Place the cursor anywhere in the ‘Section LS’ view and start typing.



Type the numbers shown separated by a space, followed by the Enter key.

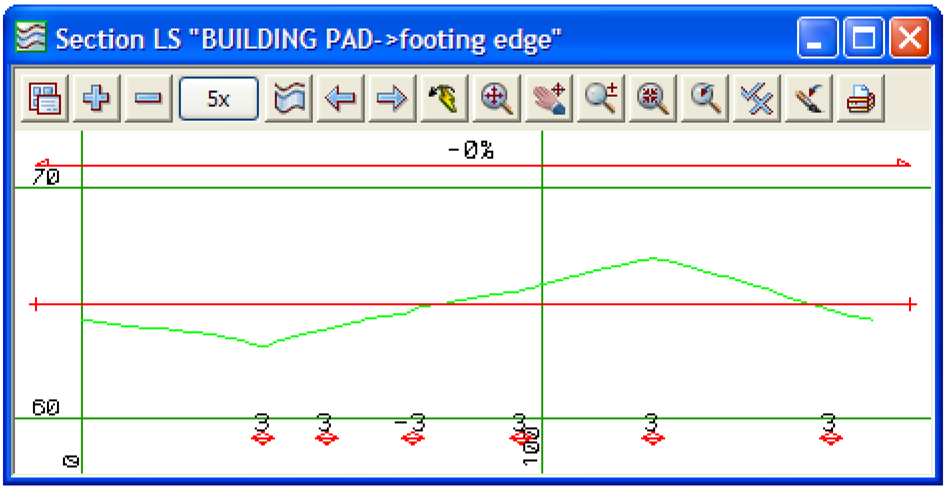
This should have placed a point at chainage -10 (i.e. before the start of your ‘footing edge’ string) and it should now be rubber banded to your cursor. To place the final point place the cursor anywhere in the ‘Section LS’ view and start typing



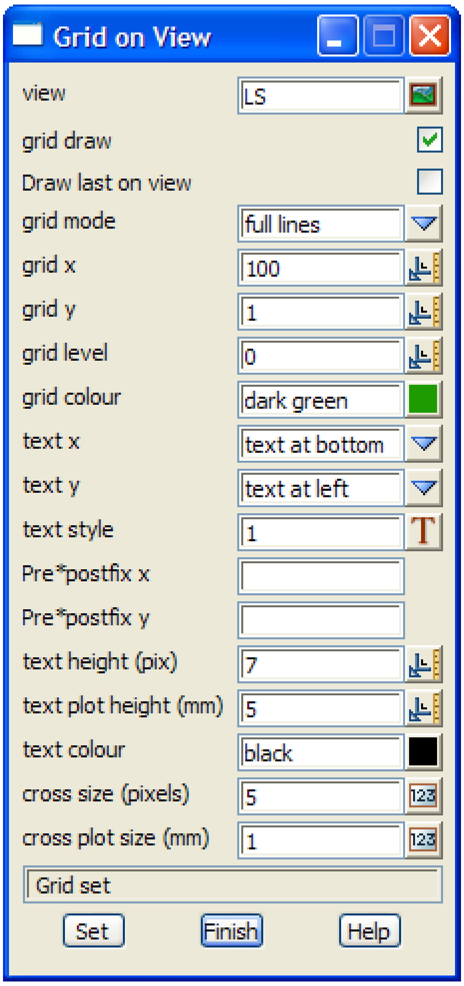
Type the numbers shown. Again terminate data entry with the Enter key.

To terminate the string entry process, press <Esc> (or click RB to pop up the ‘Pick Ops’ menu and click LB on **Cancel)**.

Refresh the ‘Section LS’ view by clicking MB in the View Button Area. You should now see a red horizontal line on your Section view.



You should already have your grid lines turned on to assist in the evaluation of your decision making. However we need to change the horizontal spacing to get a better idea of the vertical geometry.



In the ‘Section LS’ View Button Area click LB on Menu to put up the View menu. Click LB on **Settings=>Grid.** The Grid settings panel will appear

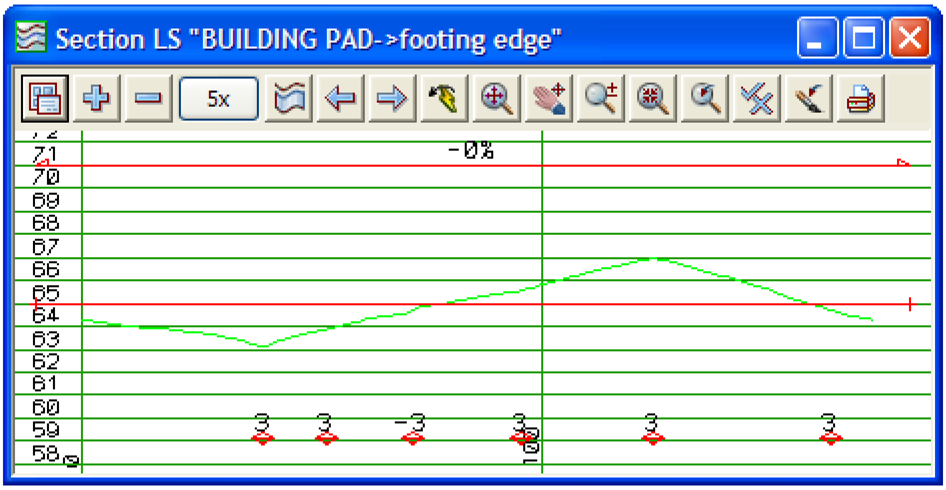
Click LB in the ‘grid draw’ tick box to turn the grid ON.

The current ‘grid y’ setting is 10. Lock the cursor into the ‘grid y’ field with LB and use the Backspace key to set the value to 1.

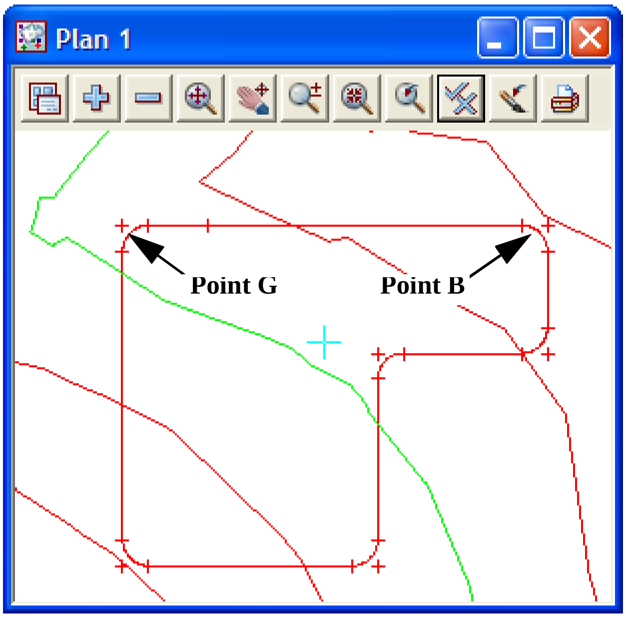
Click LB on **Set** to activate the new setting.

Click LB on **Finish** to terminate the panel.

Your ‘Section LS’ view should now look as follows. The red line corresponds to your ‘footing edge’ string.



To see how the pad footing aligns with the natural surface, click LB on the '+' sign button in the 'Plan 1' view and double click LB on **tin GROUND**. From the View menu for 'Plan 1', click LB on **Toggle=>Tin contours**. Your view should now look as follows



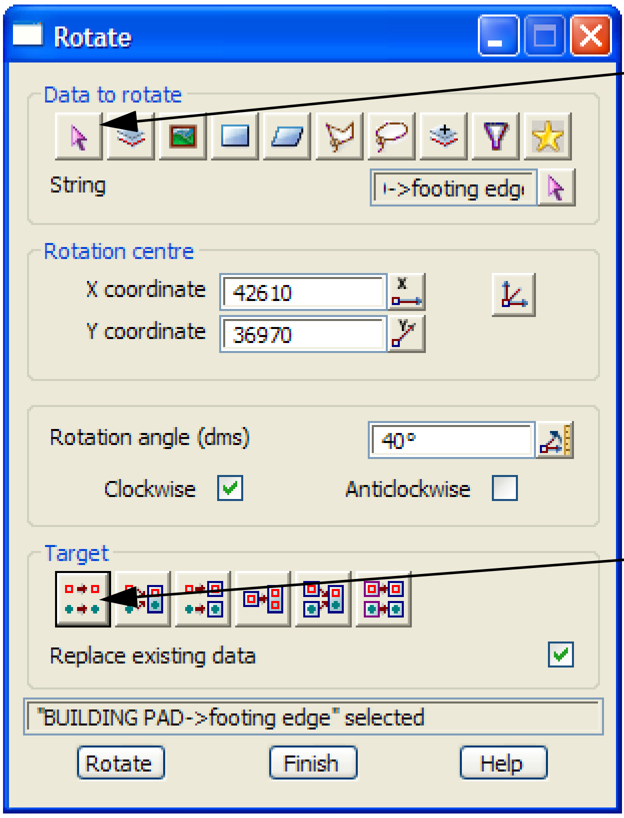
Let us assume that it is important to have side BG aligned as closely as possible with the natural surface contours.

To achieve this we will rotate our pad footing clockwise by 40 degrees about point B (top right corner) so that side BG is close to parallel with the natural surface contours in the vicinity of point B.

It is important to note that we must shutdown the Alignment Editor before we can perform the rotation (the Alignment Editor locks the strings open in the database. We need to shut the open database before we can perform any operation on it such as a string rotation).

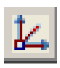
From the Alignment Edit menu, click LB on **Save & Finish** and **Yes** to confirm the completion of all edit operations.

From the Main menu, click LB on **Utilities=>H-Z=>Rotate.** The Rotate Model panel will appear.



Click LB on the string data source icon then select the **building pad** string from the view.

Click LB on the **Rotation Centre** icon and select point B



Set the rotation angle to 40 degrees clockwise

Click on the **Replace existing data** target icon

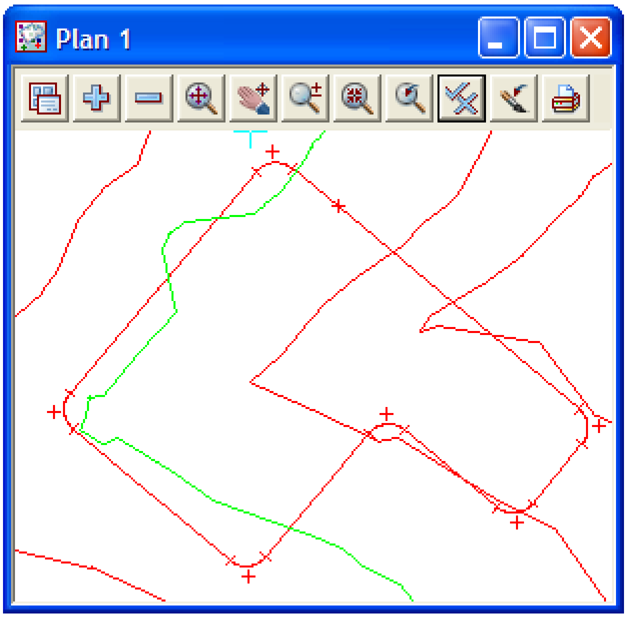
Click LB on **Rotate** to activate the rotation.

Click LB on **Finish** to terminate the panel.

Your ‘footing edge’ string should now appear rotated.

To centralise the pad footing in the ‘Plan 1’ view, click LB on **Pan** and press down LB in the centre of the building pad and drag it to the centre of the view. Release LB and press <Esc> to terminate the Pan.

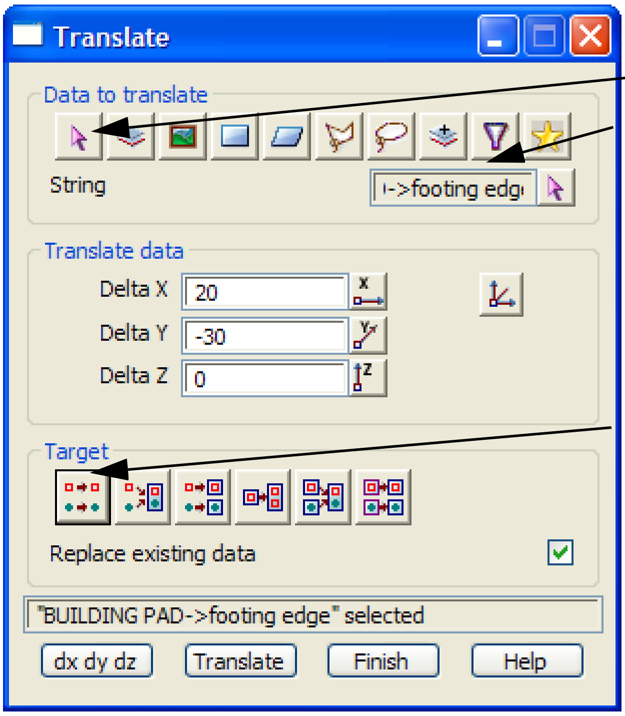
Your revised ‘Plan 1’ view should look as follows



We will now translate the ‘footing edge’ string +20m in the X direction and -30m in the Y direction to get our pad footing away from the valley and more onto the ridge of the natural surface contours.

From the Main menu, click LB on **Utilities=>H-Z=>Translate**. The Translate Model panel will appear.

We could select the string as the Data Source in the Translate panel as we did in the Rotate example but this time we’ll use the model Data Source to demonstrate how it works.



Click LB on the String data source icon. Pick and accept the footing edge string.

Type in the ‘Delta X’ of **20**

Type in the ‘Delta Y’ of **-30**

Type in the ‘Delta Z’ of **0**

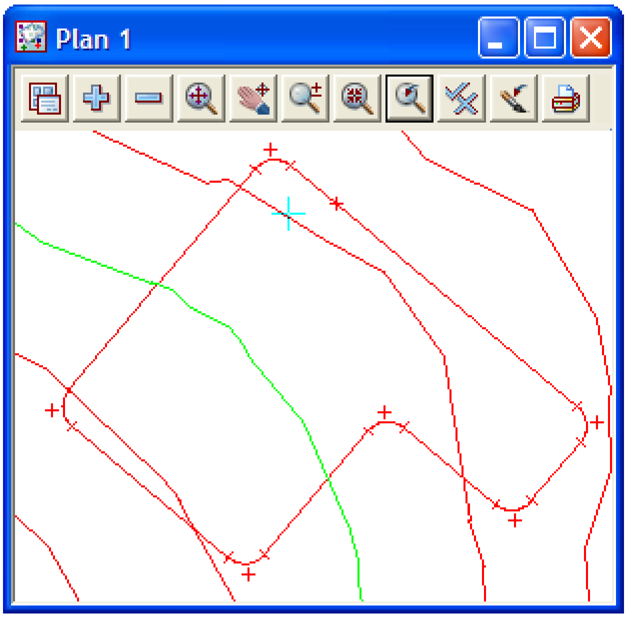
Click on the **Replace existing data** target icon

Click LB on **Translate** to activate the settings.

Click LB on **Finish** to terminate the panel.

Your ‘footing edge’ string should now have moved downwards and to the right.

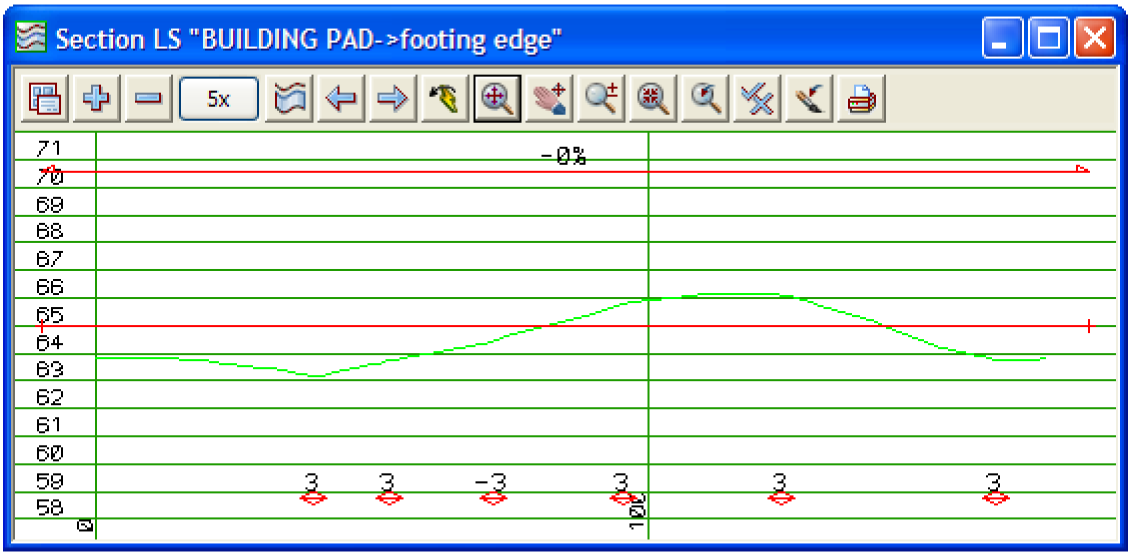
To centralise the pad footing in the ‘Plan 1’ view, click LB on **Pan** and depress LB in the centre of the building pad and then drag the image to the middle of the screen. Release LB Click LB.



Your revised ‘Plan 1’ view should look as follows.

To update your ‘Section LS’ view to reflect the revised geometry all you need do is click LB on **Regen icon** 

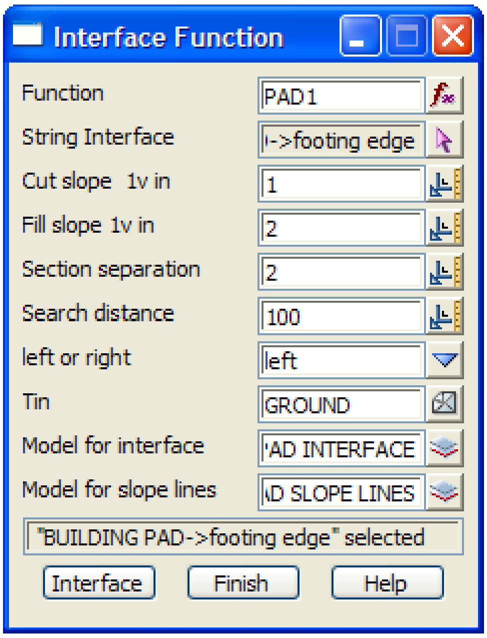
Your ‘Section LS’ view should now look as follows.



We can now have our first trial run to see how well our pad footing fits in with the existing natural surface.

From the Main menu, click LB on **Design=>Apply=>Interface**

The Interface Function panel appears.



We need to give our interface function a name so that we can refer to it later. Type in the name **PAD1**.

Select the pad string as the 'String Interface'

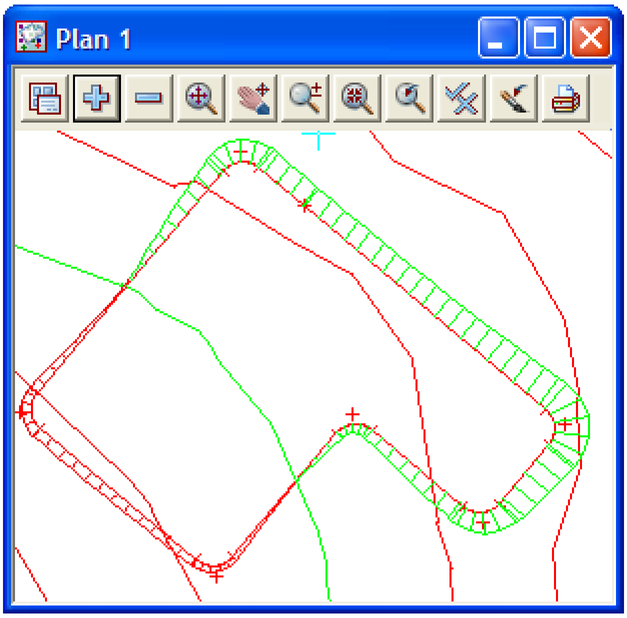
The default 'Section separation' is 10 metres. Set this to 2 metres.

As our pad 'footing edge' string has been generated in a clockwise manner (from starting point A to B to C etc.), we are looking to calculate the intersection of our batter lines with the **GROUND** TIN on the **left** of the string (left as we proceed in a positive direction along the string. Positive direction is always in the direction of increasing chainage).

Click LB on the 'Tin' button and double click LB on **GROUND** from the popup list.

Finally supply the name **PAD INTERFACE** to the "Model for interface' field. The interface string corresponding to where our batter lines meet the **GROUND** TIN are placed in model **PAD INTERFACE**. (Optional) Slope lines are placed in model **PAD SLOPE LINES**.

To cause the interface string to be calculated click LB on **Interface**. After a short delay, the panel message box advises 'finished interface'. Click LB on **Finish** to terminate the panel.



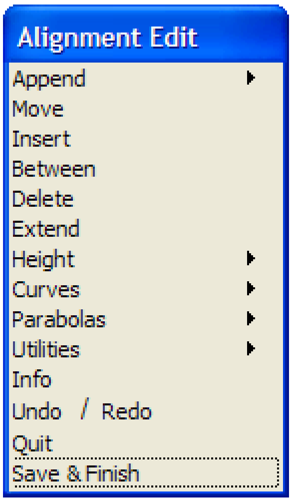
You will not see any immediate change in your 'Plan 1' view until you turn on the appropriate models that have been created by the interface function.

To see the interface that has been calculated, click LB on the '+' sign button in the 'Plan 1' view to pop up a list of models. Double click LB on models **PAD INTERFACE** and **PAD SLOPE LINES.**

We will now observe a very powerful design feature of 12d Model. We will make some major changes to our pad footing and see how quickly 12d can redo its calculations with a minimum of effort.

First, we will change the shape of our alignment. Remember that we rotated our pad footing 40 degrees. We will now change point D by moving it 10m towards point C. Because of the rotation, line D-C is at a bearing of 130 degrees.

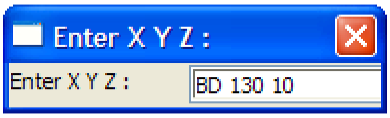
We need to get the Alignment editor up again. From the Main menu, click LB on **Strings=>Editor** or just push **F6**. Place the cursor over the red alignment ‘footing edge’ string and click LB to select and MB to confirm the selection. The Alignment Edit menu appears



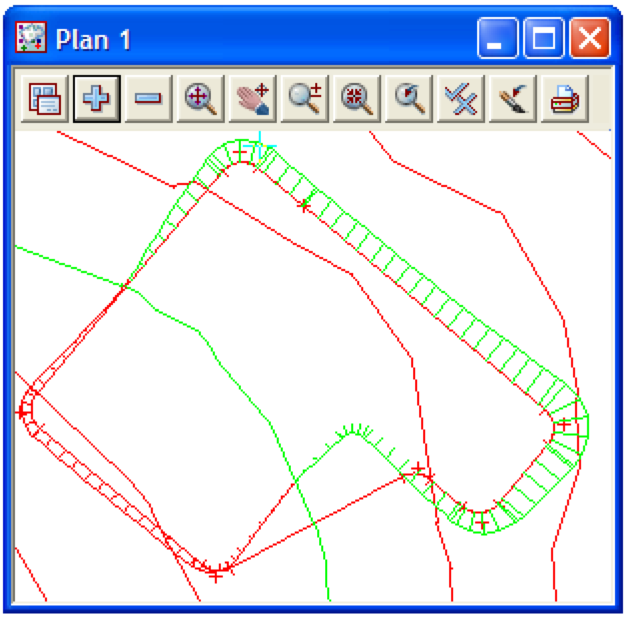
Click LB on **Move** and place the cursor over Point D and select it with LB. Confirm the selection with MB.

You will notice that the point is now attached to the cursor and can be readily moved via the mouse.

To position the point exactly we will use a special version of typed input to define the new location of Point D. Place the cursor anywhere in the ‘Plan 1’ view and press the RB. From the ‘Pick Ops’ menu that pops up, click LB on ‘Typed input’.



Type in the following values followed by the Enter key.



This defines the movement in terms of ‘bearing and distance’. In plan, we are moving the point (relative to its existing location) 10.0m along a bearing of 130 degrees whilst maintaining a Z value of 65.0. For a more full description of this data entry facility, see ‘X Y Z Typed Input Box’ in the Tools and Concepts chapter in the 12d Reference manual.

It is important at this stage to shut down the Alignment Editor as one of the subsequent move operations requires the database to be closed.

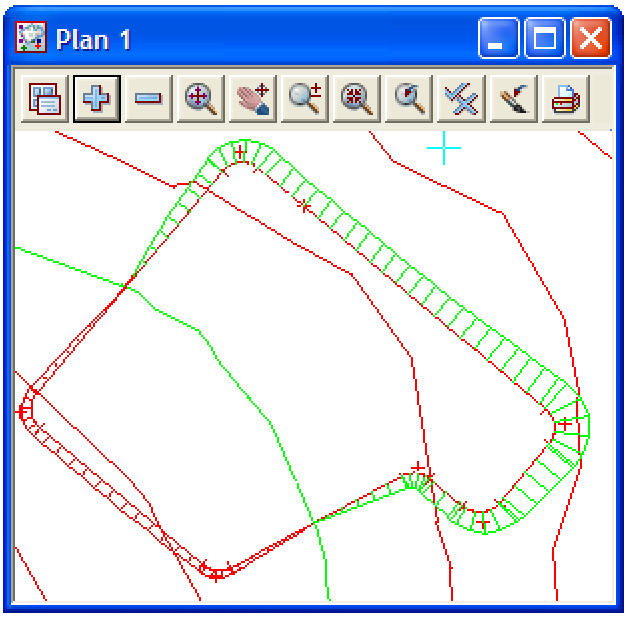
From the Alignment Edit menu, click LB on **Save & Finish** to close edit operations on the ‘footing edge’ string. The ‘footing edge’ string should now look as shown at left.

Note that the information in the ‘Plan 1’ view now shows the ‘new’ position of the ‘footing edge’ alignment string but still displays outdated versions of the batter strings and the interface string.

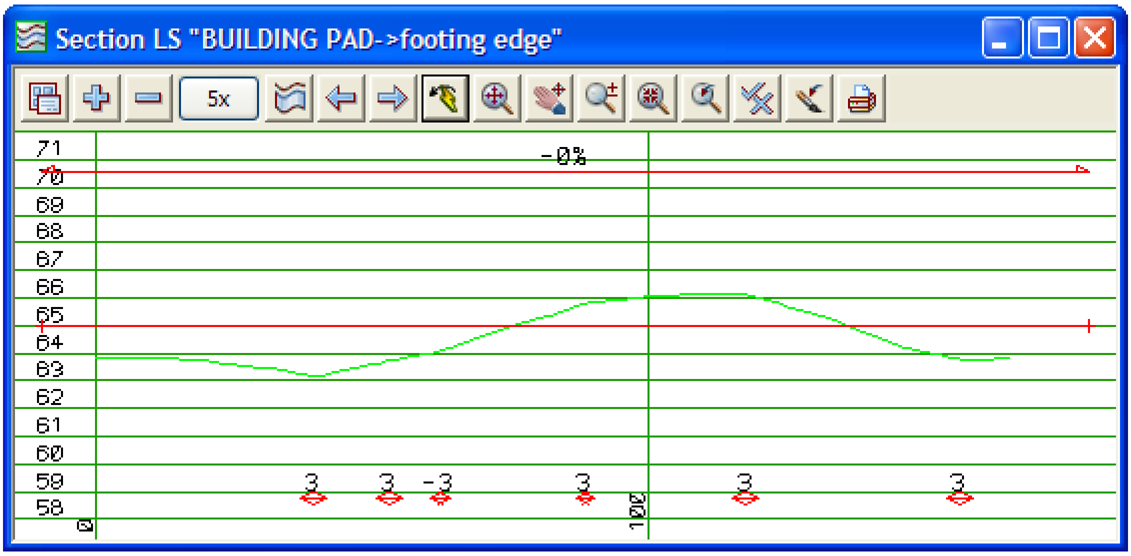
To update these strings so that the view is correct, we need to reapply our interface function.

The easiest way to do this is to go to **Utilities => Recalc => Recalc => PAD1.** 12d will now recalc the pad interface using the same properties set in the **Interface Function** panel previously.

You should now see your ‘Plan 1’ view updated as shown below.



To update your ‘Section LS’ view again to reflect the revised geometry all you need do is click LB on **Regen icon.** Your ‘Section LS’ view should now look as follows.

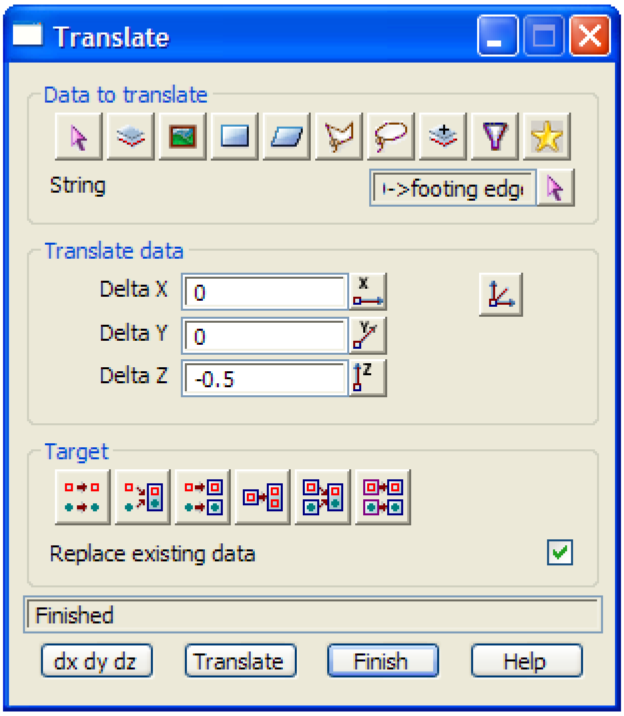


Note the ‘red’ line, the profiled string, is at Z=65.

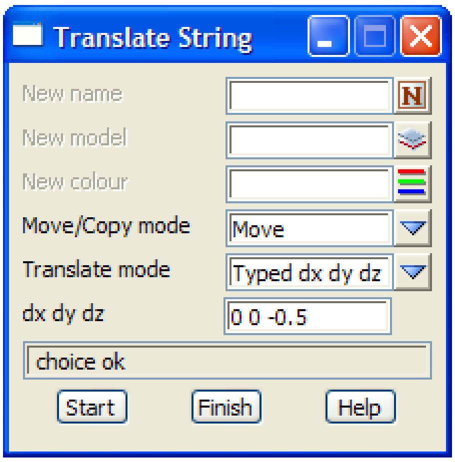
For the next operation to succeed, it is <u>essential</u> that the string database is closed. If the Alignment Editor is still operational, i.e. the Alignment Edit panel is still visible, click LB on **Save & Finish** to shut it down.

By reference to the ‘Plan 1’ view, it is apparent that our first guess at Z=65 for our footing is a little too high. Let us now lower this to say Z=64.5 to increase our cut and reduce our fill at the site. To do this, we only need do the following.

We can use the Translate option as before using **Utilities=>H-Z=>Translate**



or from the Main menu, click LB on **Strings=>Strings Edit=>Translate**



The Translate String panel appears.

Click LB in the ‘Move/Copy mode’ choice icon and click LB on **Move**.

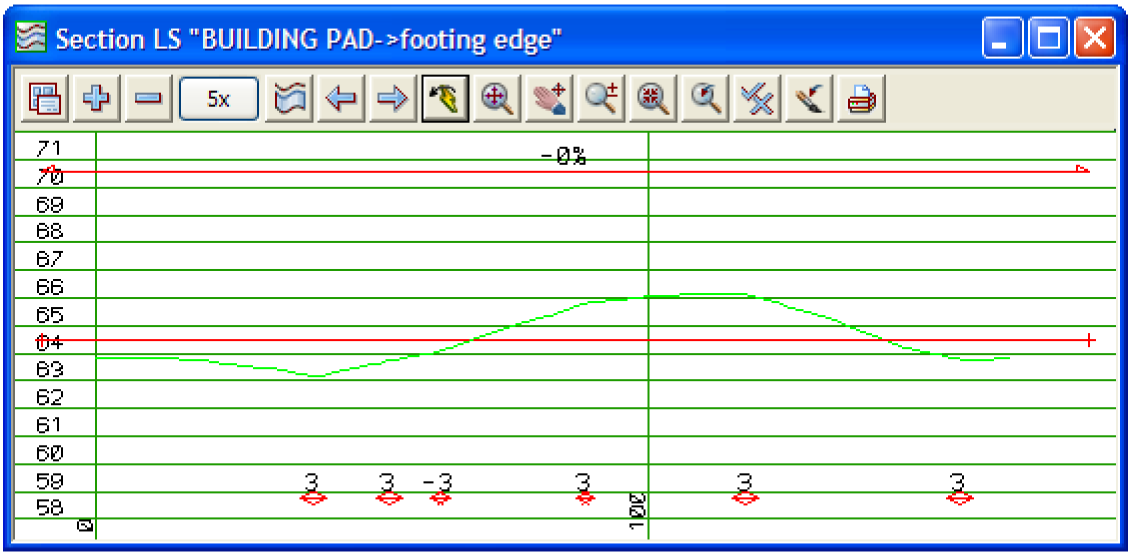
Place the cursor in the ‘Translate mode’ field and click LB on the choice icon to popup a list of modes. Click LB on **Typed dx dy dz**.

Place the cursor in the ‘x y z’ field and type **0 0   -0.5**

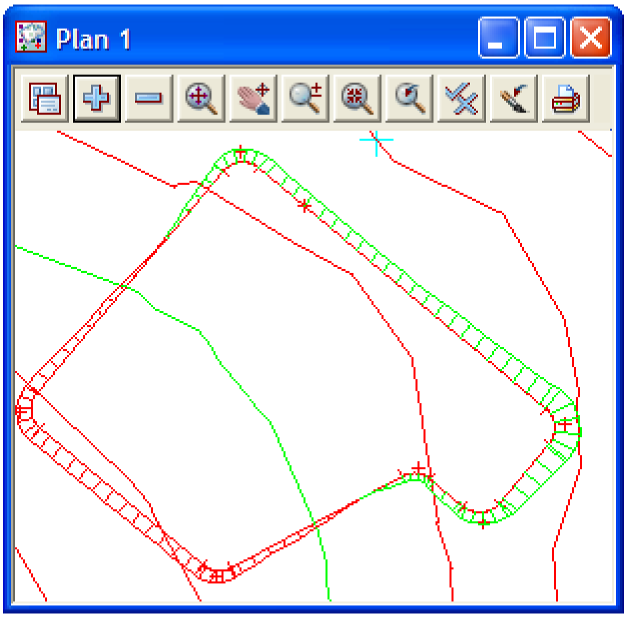
Click LB on **Start**.

Place the cursor over the ‘footing edge’ string and select it with LB. Confirm the selection with MB. The entire string is now translated to be at height Z=64.5.

To update your ‘Section LS’ view again to reflect the revised geometry all you need do is click LB on **Regen.** Your ‘Section LS’ view should now look as follows.



To recalculate our interface string (again), we reapply our interface function as before. Rerun the function **PAD1** from the Recalc menu (see **Utilities=>Recalc**)



You should now see your ‘Plan 1’ view updated as shown at left.

Note that the area of cut (red) is now increased and the area of fill (green) is reduced.

16.4 Volume Calculations from Surfaces Created with the Interface Function.

Now that we have batter, alignment and interface strings, it is a simple matter to create TINs of our finished design surface and subsequently calculate volumes.

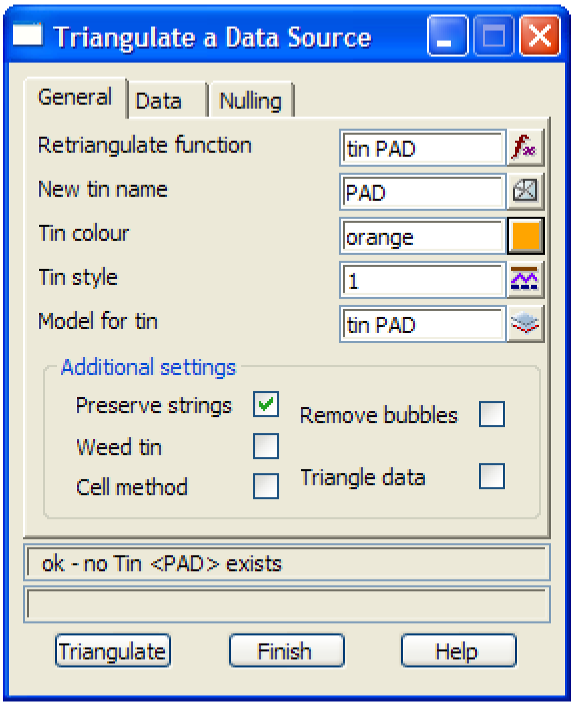
16.5 Creating a TIN of the Finished Quick Pad Footing Surface

To ensure that only the correct strings are used in the creation of our finished TIN, the first step is to turn OFF all models and then selectively turn ON the appropriate pad footing strings and sections models.

The fastest way to do this is to click LB on the *Menu* button in the View Button Area of the ‘Plan 1’ view to popup the View menu and click LB on **Models=>Remove all models**. Then place the cursor over the ‘+’ sign button in the ‘Plan 1’ view and double click LB on **BUILDING PAD**, **PAD INTERFACE** and **PAD SLOPELINES**.

Since these are the only models on display in View ‘Plan 1’, we can confidently build our TIN by triangulating the view.

From the main menu, click LB on **Tins=>Create=>Triangulate data**



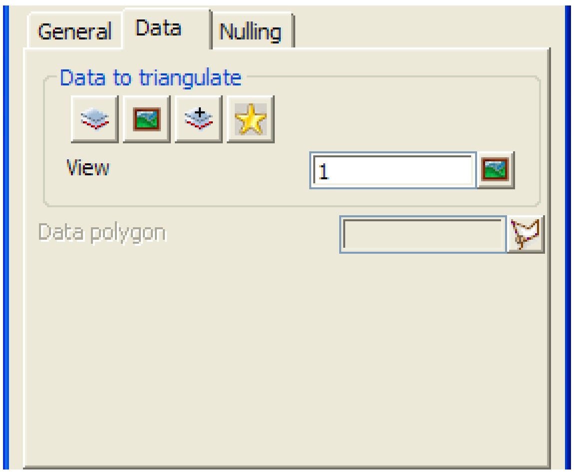
Give the triangulation the function name **tin PAD**

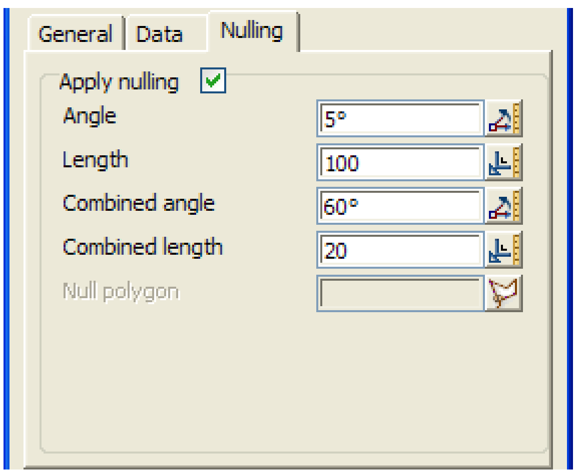
Position the cursor in the ‘New tin name’ field and type in ‘PAD’ and press the Enter key. This name will also be used to fill in the ‘Model for tin’ field but with the prefix ‘tin ’.

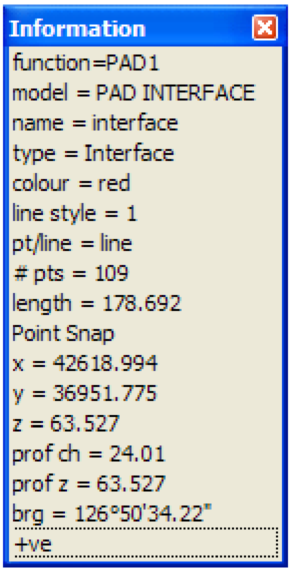
Click LB on the colour icon and select ’orange’.

Click on the **Data** tab and set the ‘Data to triangulate’ to View **1**.

Click on the **Nulling** tab. To ensure that the pad TIN is restricted to within the bounds of the interface string defining where our pad footing intercepts the natural surface, click LB on the ‘Null polygon’ button and select with LB the red-green closed ‘interface string’ surrounding the pad footing.







Make sure that the string you select has the correct string name ‘interface’ and is of type ‘interface’ as shown in the panel at left. If necessary, keep clicking LB until you get this string. Once you have it, click MB to confirm the selection.

Then click LB on **Triangulate** to create the TIN.

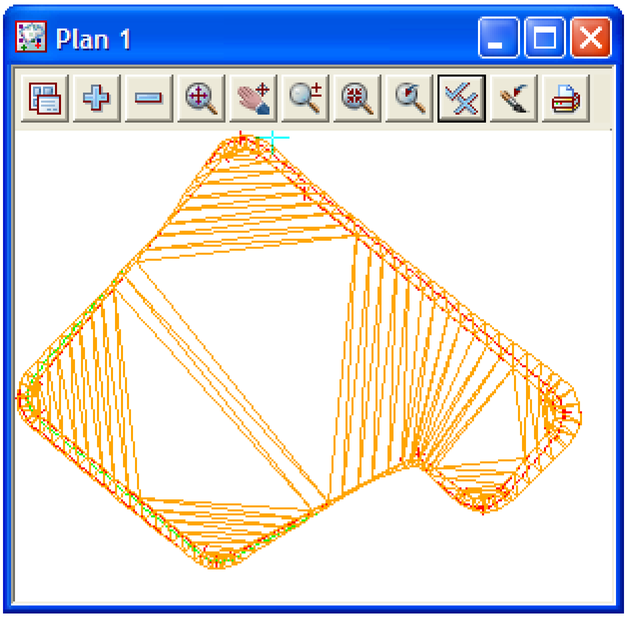
To display the TIN, click LB on the ‘+’ sign button in the ‘Plan 1’ view and double click LB on **tin PAD** from the pop up list.

The TIN on the view will currently be displayed with contours and not triangles

To see the triangles, click on the toggle icon and turn off ’Tin contours’.

The finished TIN should appear as shown below.

Note that by using the ‘Null polygon’ feature, any triangles that might have formed outside the interface polygon have been ‘nulled’ (effectively removed) from the TIN. Whilst such triangles may or may not exist, they are of no consequence to the user. Only those triangles on display will participate in any subsequent TIN or volume calculations.



16.6 Volume Calculations Between Surfaces

Now that as we now have two TINS, ‘GROUND’ and ‘PAD’, we can get 12d to calculate the volume between the TIN surfaces. 12d provides two methods of calculating such volumes:

End Area: Here parallel sections are taken at a constant user defined angle from the X axis (angles are measured anticlockwise from the X axis) with sections a user defined distance apart. When calculating end area volumes, the quality of the answer is highly dependant on the values chosen for the angle of the sections and the distance between sections.

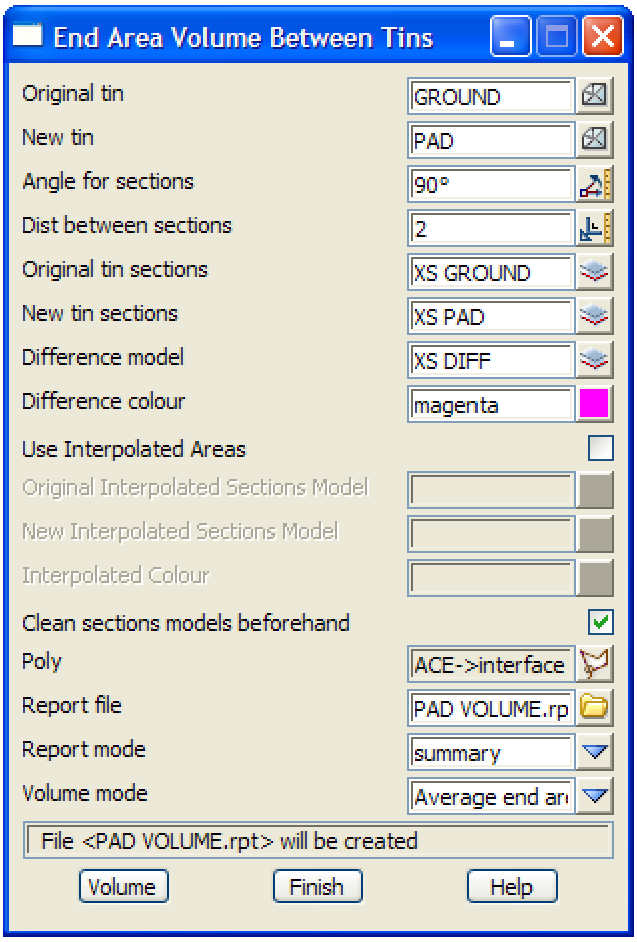
Exact: In this method exact volumes are calculated by summing the volumes of the various ‘prisms’ between the triangulated surfaces. This method is ‘exact’ in that it is as accurate as the TINs themselves. Depending upon the overlap between ‘triangles’ in each TIN, each triangle may be split up into multiple prisms. All prisms are accounted for hence the term ‘exact’.

We will use both methods and compare any differences.

16.7 End Area Volume Calculations

To enable string selection to be easier, first turn off Pad TIN. Click LB on the '-' sign button in the 'Plan 1' view and double click LB on **tin PAD** from the pop up list.

To calculate volumes between TINs using end areas, from the Main menu, click LB on **Design=>Volumes=>End Area=>Tin to tin**



Fill the panel in as shown. Place the cursor on the tin icon for the 'Original tin' field and click LB to popup a list of the available TINs. Double click LB on **GROUND**. Repeat the process for 'New tin' and set it to **PAD**

Leave the angle for sections at 90 degrees. This will make the sections at 90 degrees to the X axis i.e. parallel to the Y axis.

Set the 'Distance between sections' to 2m as this is a relatively small site.

Enter three new model names - **XS GROUND**, **XS PAD** and **XS DIFF** for 'Original', 'New' and 'Difference' sections respectively. The cross sections corresponding to each of these profiles will then be stored. Entering a name in the 'Difference model' causes a series of sections to be created that correspond to the difference between the Original and Final cross sections. Note that all these model fields are optional.

Set the Difference colour to **magenta**.

Tick the checkbox to clean out the section models before running the option

A closed polygon can be defined to restrict the extents within which the calculations will be performed. If a string is selected that is not closed then the first and last points of the string are automatically joined to form a closed polygon.

We can use the 'interface polygon' for this purpose i.e.use the string which is the intersection of the pad footing with the existing ground. Click LB on the **Poly** icon then select the string icon. Select the red-green interface polygon in the 'Plan 1' view with LB. Confirm the selection with MB.

By entering a name in the 'Report file' field, a report can be created showing the details of the end area volumes. Enter **PAD VOLUME** and press return. The suffix **.rpt** is appended by 12d. Set the report mode to **summary** as we don't need to see the volumes for each section. This would only be used if an alignment is used for the section creation.

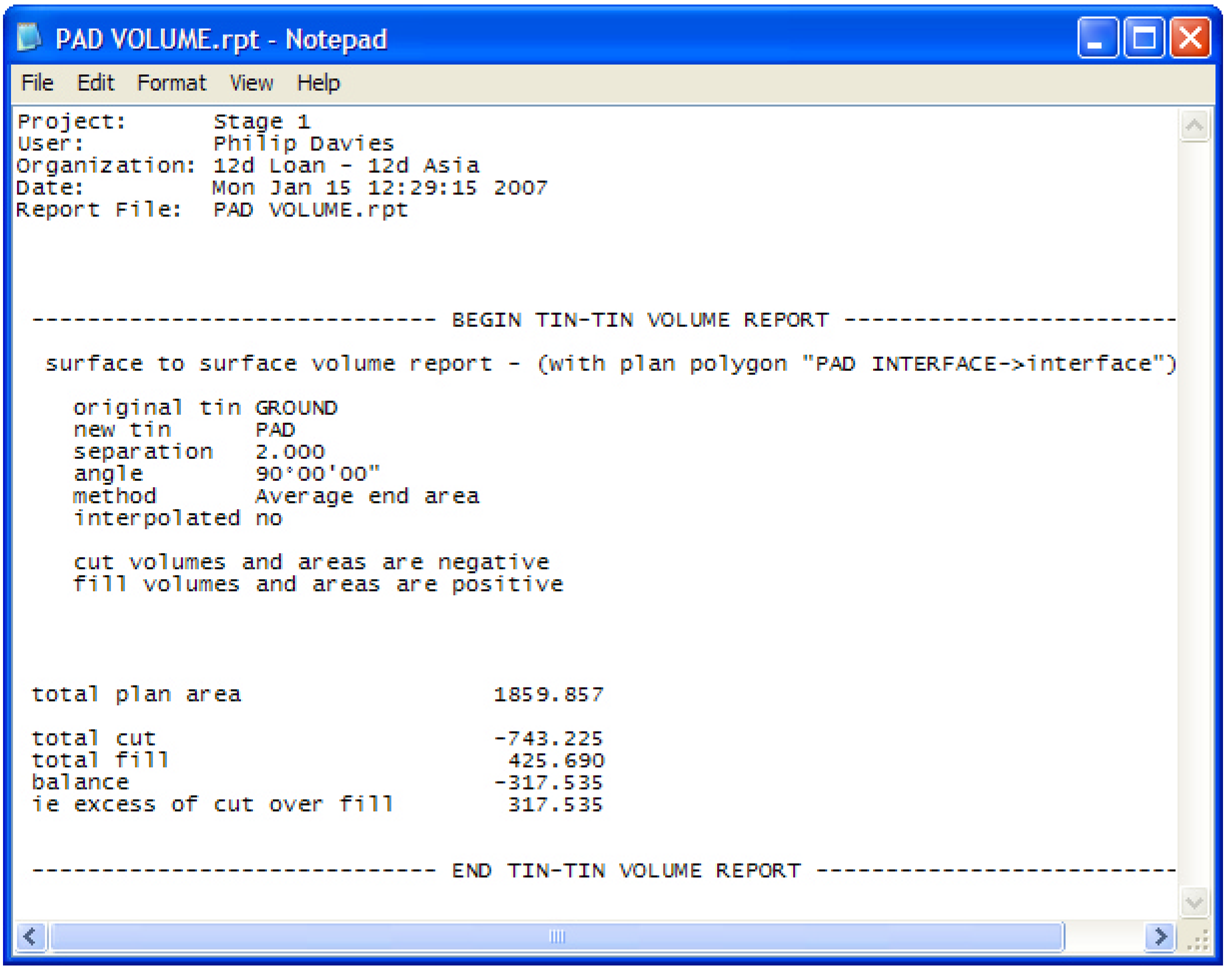
Click LB on **Volume** to cause the end area volumes to be calculated.

If a name is entered in the 'Report file' field, 12d will immediately jump to the Editor and display the report. A sample report is shown on the following page. Click LB on **File=>Exit** to terminate the Editor and return to 12d.

Note that once the calculation is finished, the Cut, Fill and Balance volumes are displayed in the Panel's message line.

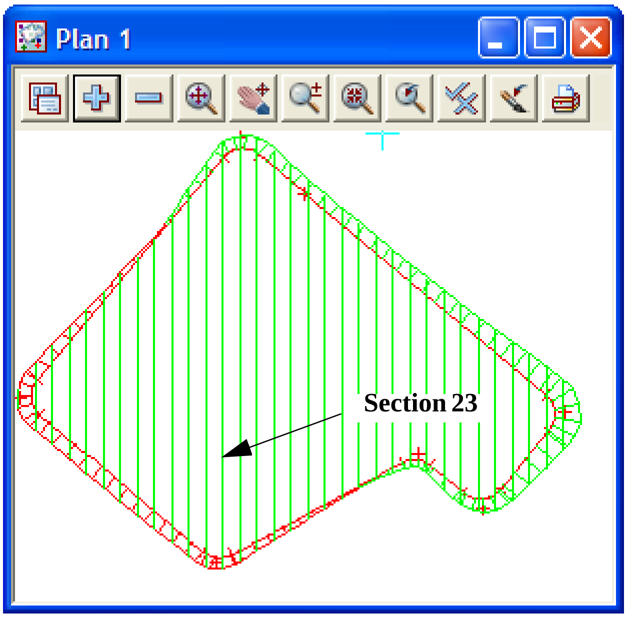
Click LB on **Finish** to terminate the panel.

NOTE: We used a polygon for the End Area volumes but a polygon does not have to be used. If no polygon is used then the volume calculations are restricted to the regions where both TINS exist.



```
PAD VOLUME.rpt - Notepad
File  Edit  Format  View  Help
Project:      Stage 1
User:         Philip Davies
Organization: 12d Loan - 12d Asia
Date:         Mon Jan 15 12:29:15 2007
Report File:  PAD VOLUME.rpt



 ----------------------------- BEGIN TIN-TIN VOLUME REPORT ------------------------

  surface to surface volume report - (with plan polygon "PAD INTERFACE->interface")

    original tin GROUND
    new tin      PAD
    separation   2.000
    angle        90°00'00"
    method       Average end area
    interpolated no

    cut volumes and areas are negative
    fill volumes and areas are positive



 total plan area                  1859.857

 total cut                        -743.225
 total fill                        425.690
 balance                          -317.535
 ie excess of cut over fill        317.535


 ----------------------------- END TIN-TIN VOLUME REPORT --------------------------
```

It is possible to view the sections that were calculated during the end area calculations.



From the View Button Area of the ‘Plan 1’ view, click LB on the ‘-’ sign button and turn off model **tin PAD** and then click LB on the ‘+’ sign button and turn on model **XS GROUND.**

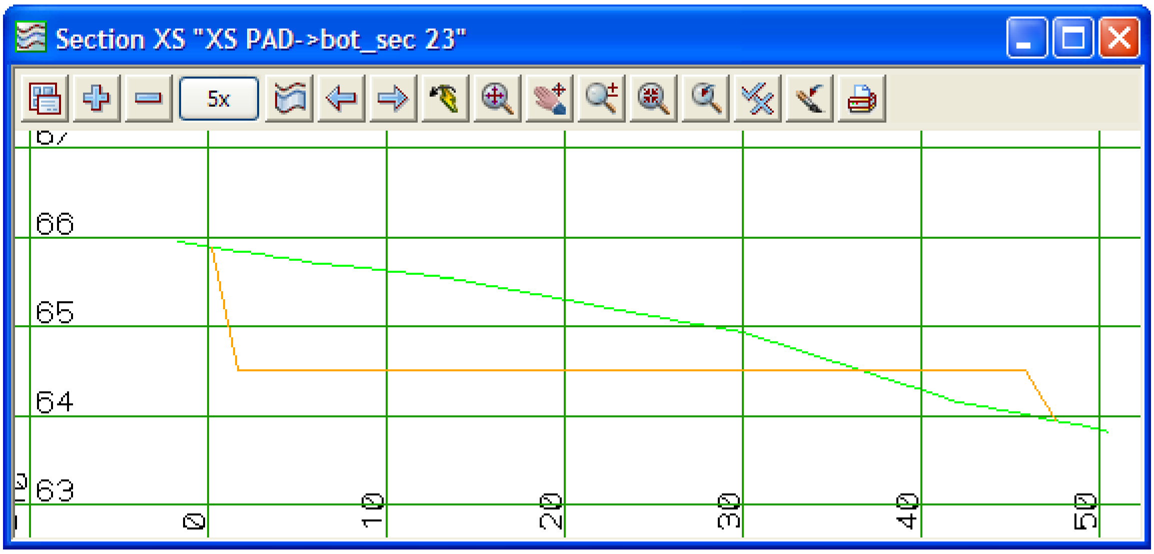
Note that the various cross section strings display in green.

We can now profile any of these cross section strings. We will use view ‘Section XS’ for this purpose.

From the View Button Area for the 'Section XS' view, click LB on **Profile** and then click LB on section '23' as shown. Click MB to confirm the selection.

The following view shows the profile of cross section no '23'.

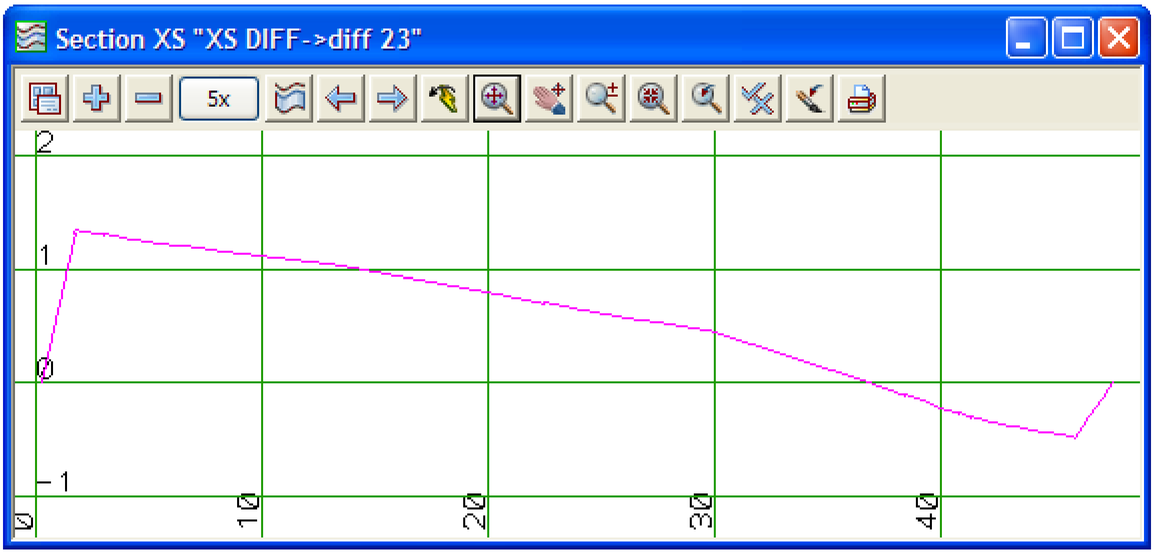
In this view the **XS PAD** model has also been turned on. Hence the section shows both the **original sections** (from TIN 'GROUND') and **final sections** (from TIN 'PAD'). The area between these two strings is a typical section used in the end area calculations. Note that it has both cut and fill.



The view has been created with a vertical exaggeration of '5'. A grid (10m horizontal by 1m vertical) has been overlaid on the view to assist interpretation. This section will now be used to demonstrate what the difference model is. Observe the typical Z values.

Place the cursor in view 'Section XS' and note the chainage and height values displayed. The Z values shown are the real world values. At any one chainage across the section it is possible to subtract the Z value of the 'PAD' TIN from the Z value of the 'GROUND' TIN. If the resulting Z difference was plotted on the same section, a view as shown below results. This is the 'difference model' of sections.

The following view was created by turning on model **XS DIFF** in the 'Plan 1' view and profiling the **difference sections** string at section '23' from the 'Section XS' view. Note that when doing this it is best to turn off all models in the view 'Section XS'. Click LB on **Fit** to fill the view.



Note that the grid now displays the difference model Z values. If you now place the cursor in the 'Section

XS' view and observe the typical chainage and height values displayed in the XYZ message bar, the values are centred around Z=0. Thus in a Section view it is not meaningful or possible to display the model of **difference sections** together with either the **original sections** or **final sections** models.

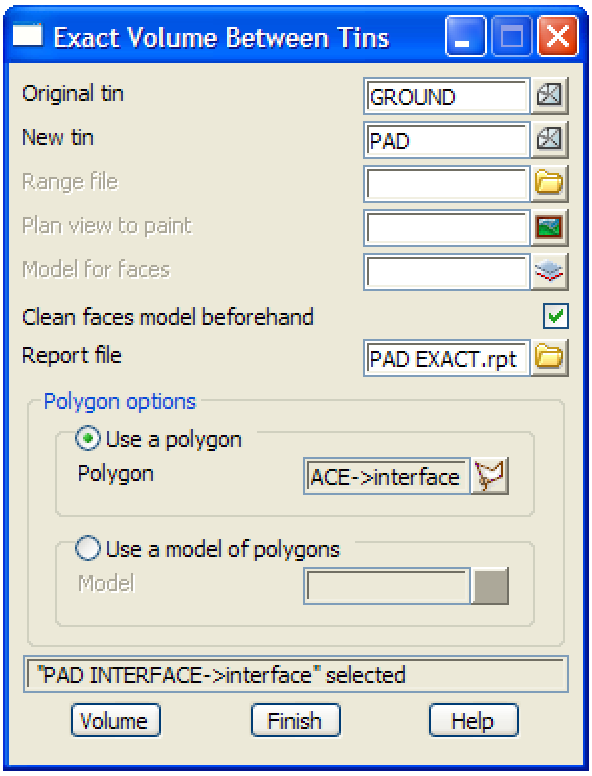
The 'difference model' is a cross section schematic where a positive Z ordinate represents cut and a negative Z ordinate represents fill. The datum for change from cut to fill is at Z=0.

16.8 Exact Volume Calculations

Now go back to the 'Plan 1' view and turn off the model **XS DIFF**.

The only models that should be turned on in the 'Plan 1' view are **BUILDING PAD**, **PAD SLOPE LINES** and **PAD INTERFACE**. Click LB on **Fit** to fill the view.

To calculate exact volumes between TINs, from the Main menu, click LB on **Design=>Volumes=>Exact=>Tin to tin**

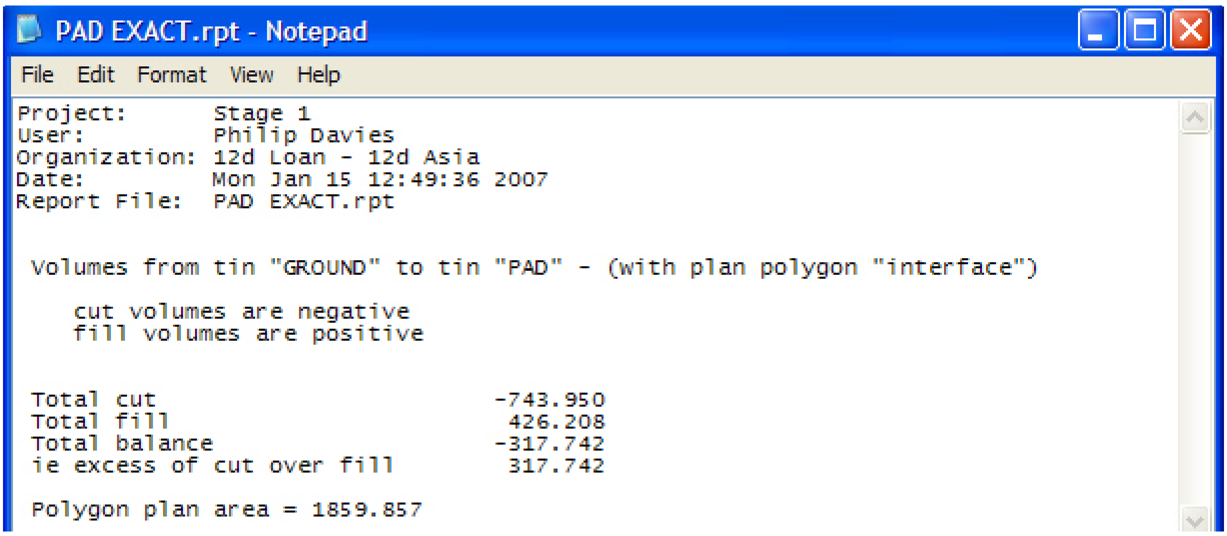


Fill the panel in as shown. Place the cursor on the tin icon for the 'Original tin' field and click LB to popup a list of the available TINs. Double click LB on **GROUND**. Repeat the process for 'New tin' and set it to **PAD**.

By entering a name in the 'Report file' field, a report can be created showing the details of the end area calculations. Enter **PAD EXACT** and press enter. The suffix **.rpt** is appended by 12d.

Click LB on the **Poly** icon and then select String icon. Select the red-green interface polygon in the 'Plan 1' view with LB. Confirm the selection with MB.

Click LB on **Volume** to initiate the calculation. The report will be calculated and immediately display. The following is a typical report



PAD EXACT.rpt - Notepad

File Edit Format View Help

```
Project:      Stage 1
User:         Philip Davies
Organization: 12d Loan - 12d Asia
Date:         Mon Jan 15 12:49:36 2007
Report File:  PAD EXACT.rpt


 Volumes from tin "GROUND" to tin "PAD" - (with plan polygon "interface")

    cut volumes are negative
    fill volumes are positive


 Total cut                         -743.950
 Total fill                         426.208
 Total balance                     -317.742
 ie excess of cut over fill         317.742

 Polygon plan area = 1859.857
```

Note the cut, fill and balance volumes display at the base of the panel.

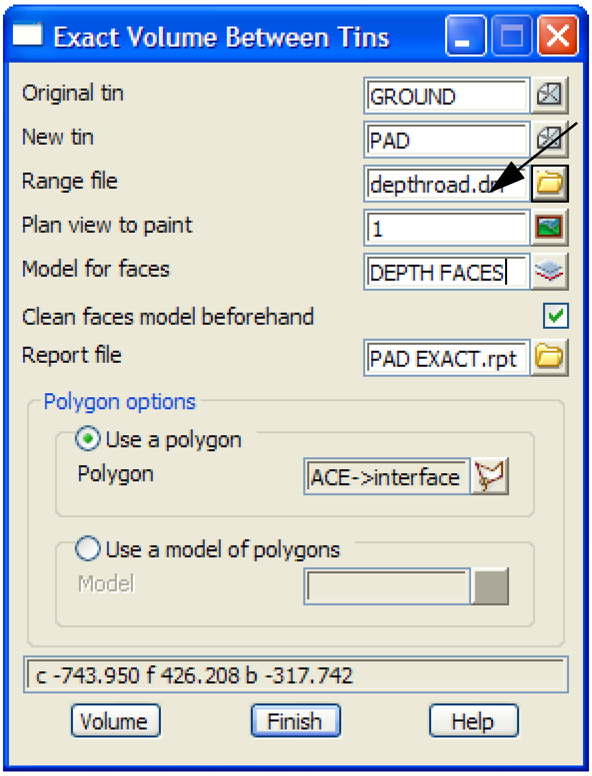
Click LB on **Finish** to terminate the panel.

We used a polygon for the exact volumes but like the End Area volumes, a polygon does not have to be used. If no polygon is used then the volume calculations are restricted to the regions where both TINS exist.

16.9 Displaying 'depths' of Cut and Fill using Colour Shading

If the above exact volumes calculation is repeated but this time the panel is filled in as shown, it is possible to get the plan view to shade in with different colours corresponding to different depths of cut and fill. Set the TIN fields as shown

.



Place the cursor on the **folder** icon for the 'Range file' field and click LB to pop up a list of range files. Double click LB on **depthroad.drf** in the **User Lib** folder.

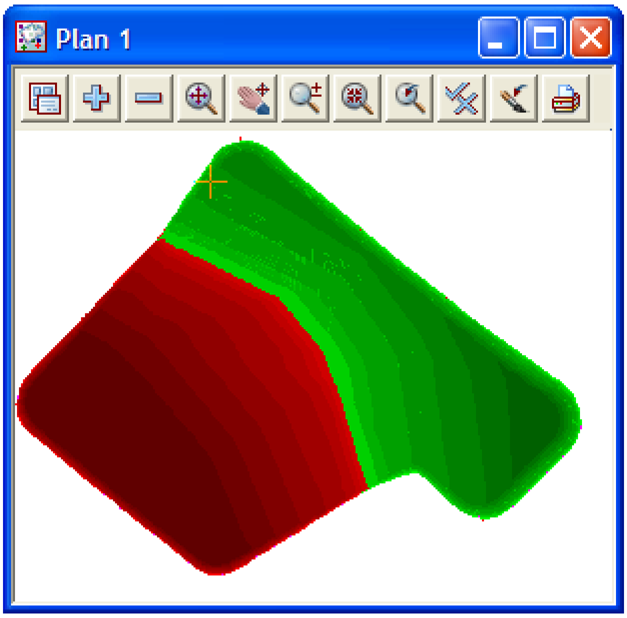
The 'Plan view to paint' should be set to **1**

Enter the new model name **DEPTH FACES** in the 'Model for faces' field.

Click LB on **Volume** to recalculate the volumes.

Now as the volumes are calculated, the 'Plan 1' view will have its various faces coloured in.

The red area displays cut and the green area displays fill. The darker shades show areas of greatest cut and fill.



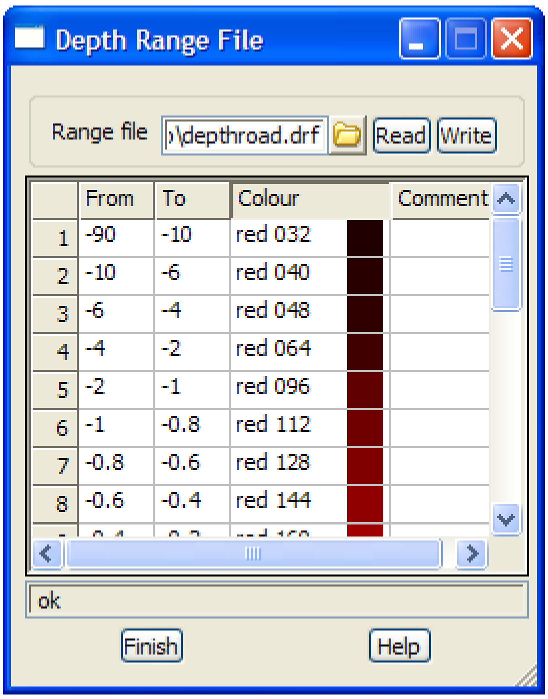
If you refresh the view you will notice that the shaded image disappears and the view reverts to whatever models you had turned on prior to performing the volume calculation.

As required, you can turn on model **DEPTH FACES** where you now have a permanent copy of the shaded faces. This model can be manipulated just like any other model in 12d.

This image can be exported or plotted as desired. When the data is transferred to AutoCAD, Microstation or another rendering package, the face data will be retained and hence can be manipulated further if required.

The quality of the finished image is a function of the number of ranges specified in the **depthroad.drf** file. Each range has a colour associated with it. This file is a normal ASCII file and can be edited with a text editor or from within 12d Model using the Depth Range File panel.

If you place the cursor near the name **depthroad.drf**, in the ‘Exact Volumes Between Tins’ panel, click LB on the *folder* icon to pop up the list of names again and then select **[Open],** the Depth Range File panel will pop up with the file displayed ready for editing.

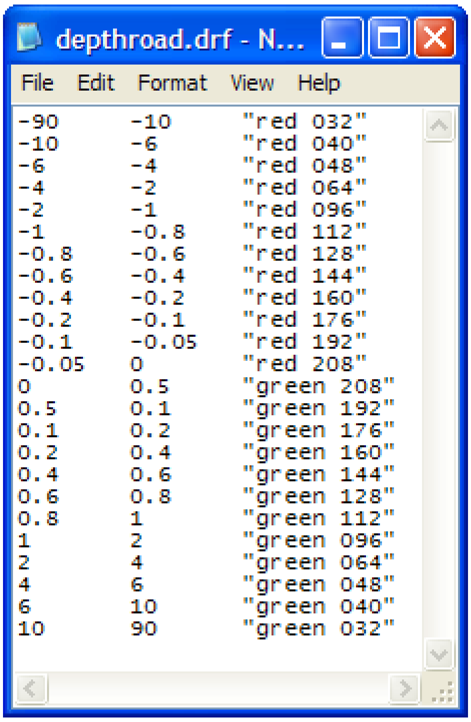


The "From’ field is the ‘starting depth’ and the ’To’ field is the ’finishing depth’.

Cut depths are negative.

If any modifications are made, then the file must be written out by clicking LB on the **Write** button.

The file can also be edited in the system text editor. If you place the cursor near the name **depthroad.drf**, in the ‘Exact Volumes Between Tins’ panel, click LB on the *folder* icon to pop up the list of names again and then select **[Edit file],** the 12d text editor will pop up with the file displayed ready for editing.


depthroad.drf - N...

File Edit Format View Help

```
-90     -10     "red 032"
-10     -6      "red 040"
-6      -4      "red 048"
-4      -2      "red 064"
-2      -1      "red 096"
-1      -0.8    "red 112"
-0.8    -0.6    "red 128"
-0.6    -0.4    "red 144"
-0.4    -0.2    "red 160"
-0.2    -0.1    "red 176"
-0.1    -0.05   "red 192"
-0.05   0       "red 208"
0       0.5     "green 208"
0.5     0.1     "green 192"
0.1     0.2     "green 176"
0.2     0.4     "green 160"
0.4     0.6     "green 144"
0.6     0.8     "green 128"
0.8     1       "green 112"
1       2       "green 096"
2       4       "green 064"
4       6       "green 048"
6       10      "green 040"
10      90      "green 032"
```

The format is ‘starting depth’, ’finishing depth’, ’colour’. Cut depths are negative. Any colour can be used. For a full list of the colours available, see the **colours.4d** file. This file also is user definable. Terminate the edit session by shutting the Window **[X]** or choosing **File=>Exit** from the pull down menu. then click ‘finish’ to terminate the panel.

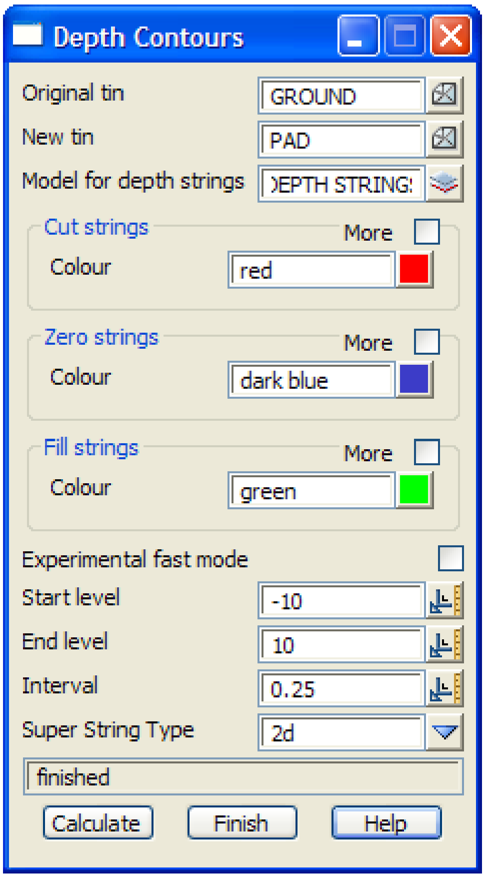
Important Notes:

1. If a depth range file is used then the reported volumes only included specified in the depth range file. So if the depth range file does not cover the entire range for the two tins, then the reported volumes will not equal be the total volumes between the two tins.
2. The depth faces do not have to be created. The plan view will still be coloured as the volumes are calculated but the colours will disappear when any part of the view is refreshed.
3. For the practise and smaller versions of 12d Model, the faces will need to be deleted before saving the project.

16.10 Displaying 'depth contours' of Cut and Fill

To ensure that we can see the depth contours clearly after they are created, begin by turning OFF all models. Click LB on the Menu button in the View Button Area of the 'Plan 1' view to pop up the View menu and click LB on **Models=>Remove all models**.

To calculate depth contours between the TINs, from the Main menu, click LB on **Tins=>Contour=>Depth contours**

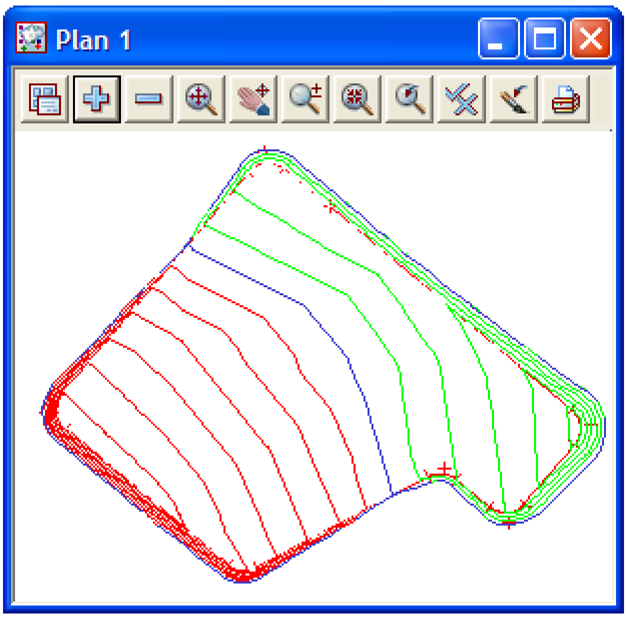


Fill the panel in as shown. Click LB on the tin icon for the 'Original tin' field to popup a list of the available TINs. Double click LB on **GROUND**. Repeat the process for 'New tin' and set it to **PAD**.

Use the colour icon to pop up lists of colours and select the colours as shown. These colours are recommended since they are consistent with the depth ranges used above.

Set the contour interval to 0.25m

Click LB on **Calculate** to produce the depth contours. Click LB on **Finish** to terminate the panel.



To see the contours, from the View Button Area of the 'Plan 1' view, click LB on the '+' add model button and turn on models **DEPTH STRINGS**, **BUILDING PAD** and **PAD INTERFACE**

These contours are valid 2d strings just like any other contours created by 12d Model and hence can be used further by 12d, plotted or exported to a CAD system as required.

16.11 Comparison of 'End Area' verses 'Exact' Volume Calculations

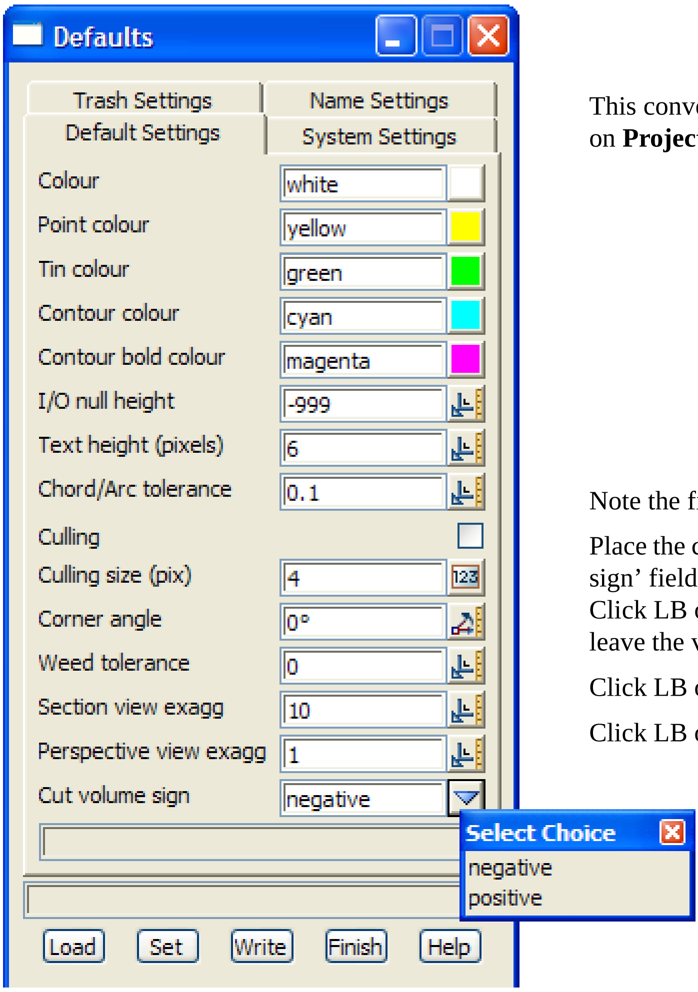
In the above models, the end area calculation for balance of volumes was 317.535 m3 verses 317.742 m3 for the exact calculation, a negligible difference.

On a large site, you may notice a significant discrepancy between your answers from both these methods. Clearly, the end area calculations are the more important if you have to allow for mass haul considerations. In such case, try performing your end area calculations with a smaller 'distance between sections'. Also try to orientate your sections at right angles to the major direction of cut/fill movement. These steps will minimise errors inherent in the end area method.

Finally it is possible to perform end area calculations such that all sections are at right angles to an arbitrary string, just as you would with template generated sections in normal road design. See **Design=>Volumes=>End Area=>String Tin to tin** for how to do this.

16.12 Sign Conventions for Cut and Fill

The entire tutorial on volume calculations so far has been performed assuming the convention that Cut volumes are negative. This is a user definable convention however. If preferred, Cut volumes can be made positive.



This convention is set from the Main menu. Click LB on **Project => Management => Defaults**

Note the field near the bottom of the panel.

Place the cursor on the *choice* icon for the 'Cut volume sign' field and click LB to pop up a list of alternatives. Click LB on either **positive** or **negative**. At this time, leave the value negative.

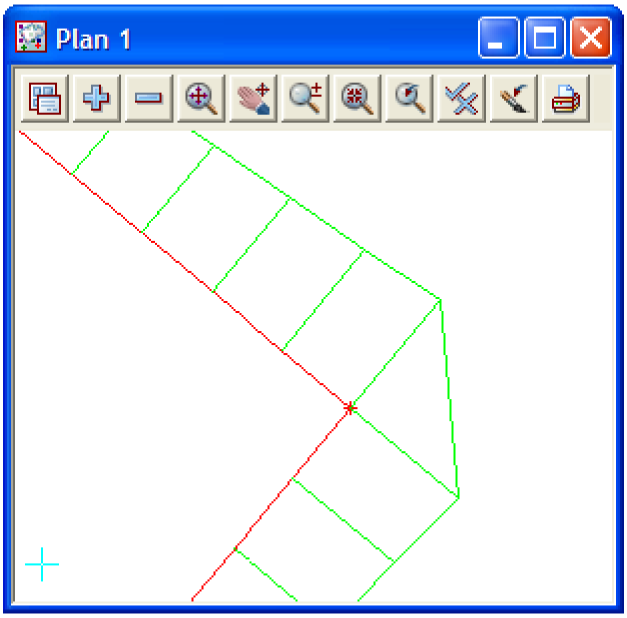
Click LB on **Set** to activate any changes.

Click LB on **Finish** to terminate the panel.

16.13 Traps to be Wary of When Designing Footings

1. Treatment at corners when radii are NOT being used

The example above used a fillet radius at each corner point on the ‘footing edge’ alignment string. If you don’t use a radius at each IP point that involves a change in direction (such as at a corner), the interface string created during the template application will, by default, not generate any extra points at the change in direction.



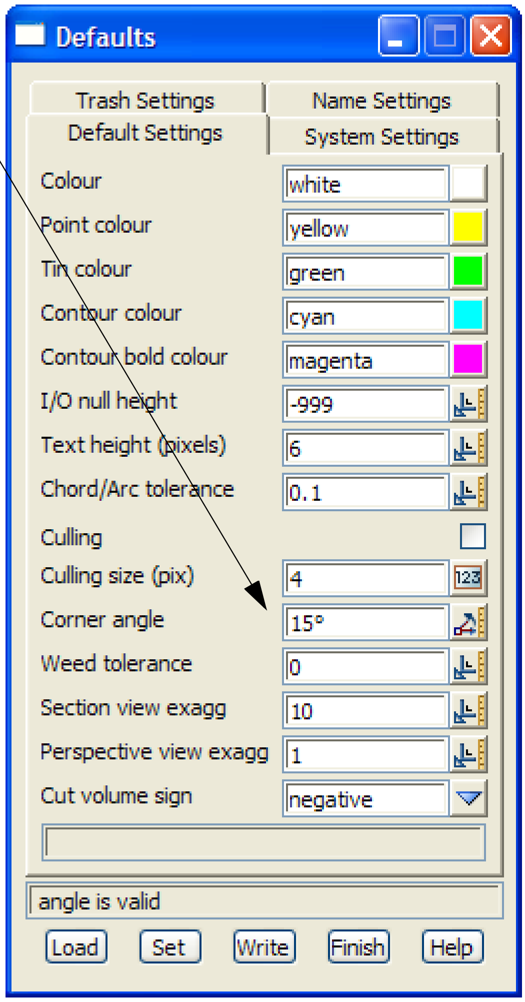
This causes the following effect at a corner point (section strings are shown).

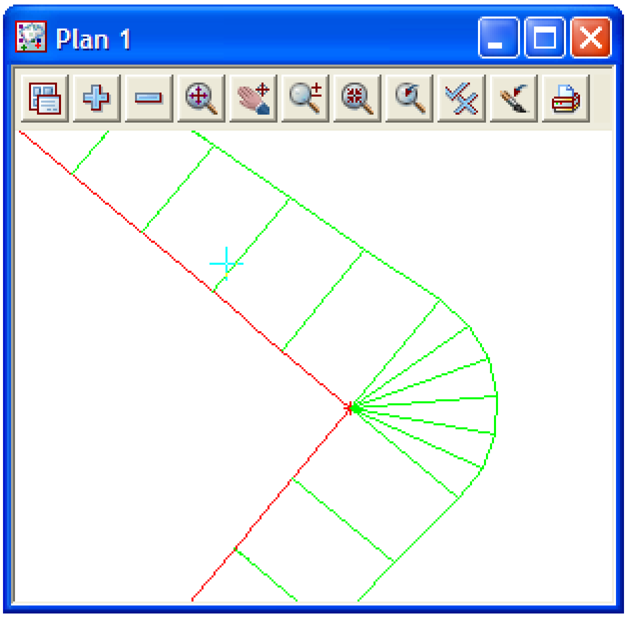
This situation can be changed by specifying a ‘corner angle’. If say a corner angle of 15 degrees is used, you will get 6 facets at a right angular change in direction rather than 1.

The corner angle value is set from the main menu by clicking LB on **Project => Management => Defaults (Default Settings tab).** See fifth item from the bottom of the panel.

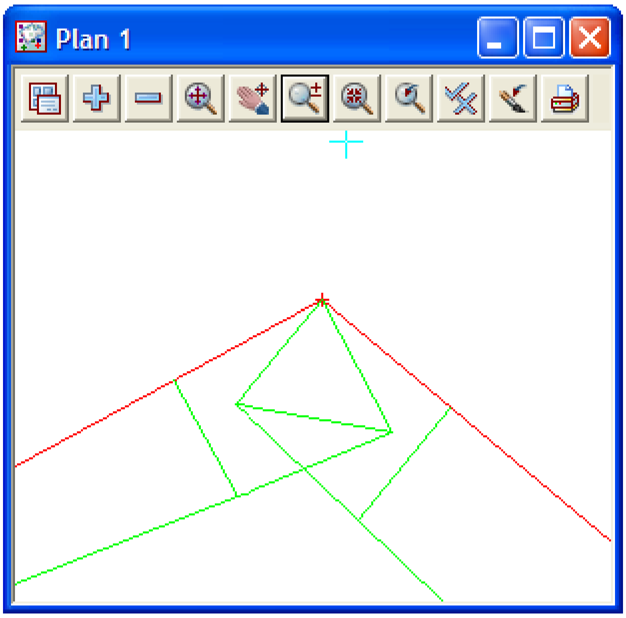
Change the ‘Corner angle’ to 15 degrees as shown. It normally defaults to zero.

If the Interface was recalced, the corner would now appear as below





2. Internal angles



When an alignment string suffers excessive changes in direction such as when the internal angle gets to be less than 90 degrees, it is sometimes possible to get the situation where batters ‘cross’ over one another.

Observe the shape of the interface string - beware of this effect. If you calculate volumes from such strings, you will clearly get erroneous answers.

The solution to this problem is to choose appropriate batter slopes and return angles such that this does not happen.

Alternatively, before you create your TIN you may have to edit the offending strings and take out the overlapping portions and also delete the incorrect sections.

17 Plotting

17.1 Overview

This chapter is arranged so that relevant sections appear in blocks for easy reference.

The layout of this chapter is as follows:

Chapter 17.10 relates to long section plotting.

Chapter 17.12 relates to cross section plotting.

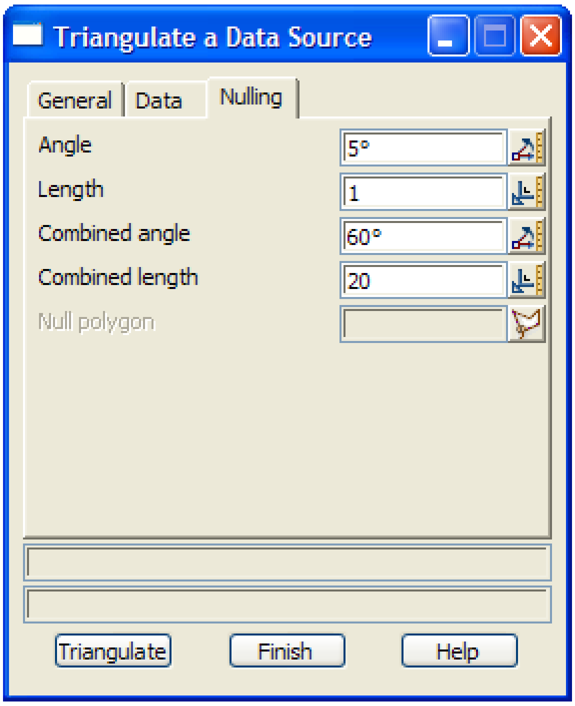
Chapter 17.14 relates to plan plotting using plot frames.

For user convenience, each plotting section is self contained (requiring some duplication).

The data used for the plotting has been built up by working through the Getting Started manual. If you have not worked through the Getting Started Manual to this point then, you can import the 12d Ascii file **Chapter 17.12da**, which will bring you up to this point.

17.2 Triangulating the Road

In order to calculate the volumes and display the quantities in the long section plots we need to create a surface of the road.



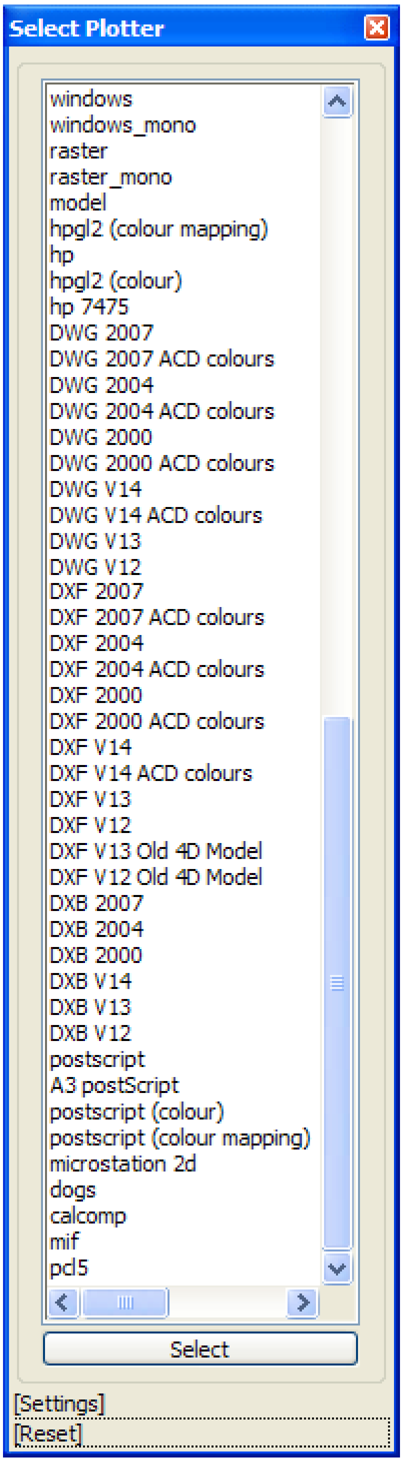
Create the TIN ‘DESIGN’ for the road by turning all the models off the view ’Plan 1’ and adding just the **ROAD 1 APPLY Sects** and **Strs** models.

Create the TIN ’**DESIGN**’ using ***Tins=>Create=>Triangulate data*** with data source *View* and view ’Plan 1’. When you create the road design using the Apply function, 12d also creates a number of polygons that capture the various elements. You could use the polygon that encases the road as your ‘Null polygon’ or alternatively you can set the 'Length’ field to 1m and 12d will null out all the triangles outside the interface strings.

PRACTISE VERSION: To keep the number of points below 5,000, the road data has been created with sections at a 25m interval rather than 5m. This means that the pictures are not exactly as they appear in the manual when running with the Practise version.

17.3 Plot devices

12d can generate plots to various devices. Firstly, it supports a full interface to Windows so it can create plots on any device that is supported by Microsoft Windows.



12d also supports various popular plotting devices in their native format so it can plot directly to Hewlett Packard pen, inkjet and laserjet printers/plotters. 12d supports Postscript, HPGL2 and PCL5 plotters directly and plotters that emulate these devices.

We also talk about the concept of ‘plotting to CAD’ where we treat CAD as just another plot device. This process generates a native CAD file which can subsequently be read in by your CAD system, manipulated further if required and then plotted from your CAD system. We can plot to AutoCAD 2007 (DWG, DXF or DXB) or Microstation V8 (DGN).

The list on the left shows the standard ‘plotter types’ available for 12d users.

When selecting a device type to plot to, the popup list of ‘plotter types’ available is customisable so the list can include line items such as ‘Mary’s inkjet – 2nd floor’. You could remove line items or plotter types that are irrelevant to your organisation.

When transferring your 12d data to CAD, the list can also have multiple line items that further customise the transfer. For instance, when you pick ‘DXF 2007’ (the default transfer mechanism), data is transferred to AutoCAD such that colour numbers are maintained. As colour 2 in 12d is green but colour 2 in AutoCAD is yellow for instance, you will see colour changes when you transfer data to AutoCAD without customisation.

One of the line options typically implemented is ‘DXF 2007 ACD colours’ so that green in 12d stays as green when transferred to AutoCAD, etc.

Another line item might be ‘DXF 2007 Check plot’ so that all colours in 12d transfer to AutoCAD with one colour (for one pen).

Another line item could be ‘DXF 2007 Customised transfer’. This is where you decide that red lines in 12d such as cross sections are always to become green lines in AutoCAD because your current CAD standard is that green lines always plots as a 0.25 pen and you want your cross sections to always appear 0.25 wide.

Finally, we also talk about ‘plotting to a model’ so one of the plot device types is ‘model’. This is a technique for previewing a plot. See Chapter 17.6 below for more information on ‘Previewing plots’.

All of this customisation of the available ‘plotter types’ is implemented via the **plotters.4d** file which is documented in the 12d Reference manual in Appendix N, ’Plotters and Plotting’.

17.4 General Plotting Issues

Plot parameters:

The appearance of finished plots is user definable. There are a large number of plot parameters that govern what is included on the plot and how it appears. Plots are created from plot parameter files (known as ppf files). Each parameter has a default value so that even if you perform a plot without supplying a ppf, you will still get a plot. Part of the customisation of 12d is deciding which parameters you require to achieve your drawing standard. Once the standard is achieved you will find that you can use the same ppf files from job to job with minimal or no changes. One advantage of this approach is that regardless of the skills of the operator, a common presentation standard of plotted documentation is achieved.

The training data gives you samples of typical ppf's to achieve common engineering standards for plan, long and cross section plots. It is recommended that users new to 12d take a copy of these and use them as a starting point for their own customisation.

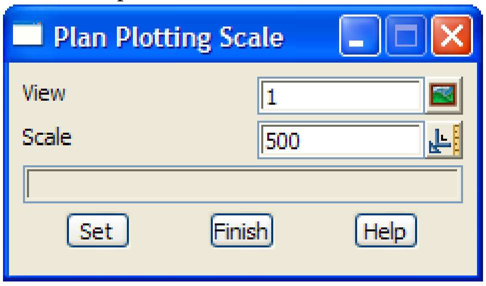
Text:

Whilst some plotting in 12d is (What you see is what you get), 12d will in general adopt final sizes for text that are different from what you see on your screen. Text that is just large enough to be read on your screen would be much too large when plotted on say an A1 sheet. Thus all text on the screen has a default size and probably a different default size when plotted to a device. The size of plotted text is typically set in a ppf file as discussed above. Once this is set for a particular users corporate standard and sheet size, it rarely needs changing so is largely transparent to the user.

For screen text that has no plot parameter equivalent defining it's plotted size, there is an overall governing parameter that relates screen text to plotted text. This parameter is set from **Plot => Plotting Setup => Pixels to mm**. You can set this as you require. The default value is 0.5. This means that screen text that is say 10 pixels high will plot at 5 mm high.

Text that is created in paper units don't require any editing prior to plotting. To ensure the text appears at the same size as the proposed plot we change the Plot scale to the required value to match the final plot

To set the plot scale select the Menu icon in the relevant view and then select **Settings=>Plotting scale**



Type in the plot scale required

When plotting direct from 12d to a plot device such as an inkjet printer, it is possible to map 12d colours to pen (line thickness) size.

Fonts:

12d supports most AutoCAD .shp files as well as Windows True Type fonts. The standard install supplies you with sufficient fonts to get started – typically ISO, ISOEQ, GOTHIC, HELV, HELVL, MONO, ITALICC, SCRIPT, ROMANC and ROMANS. See files **textstyl.4d** and **fonts.4d** for more information.

Plot files and queues:

In general, whenever 12d creates a finished plot file for a hard copy device, it will only place the file in the local project folder (one level up from the .project folder). The exception to this is when plotting to the Microsoft Windows interface. In such case Windows takes over the control of the file and sends it to the device automatically.

Thus in general, plot files are not automatically submitted to any plot queue. It is the users responsibility to then place the plot in an appropriate queue, decide when it will be plotted, decide on the number of copies etc.

It is possible to have Windows run a background batch file that will automatically place any plot files in a plot queue.

Similarly, when the plot device is a CAD system, the CAD file will be written to the local project folder. After writing the CAD file, the user can then issues an Alt-Tab command to transfer Windows control from 12d to their CAD system, and then opens the file.

17.5 Windows Based Plotting

In the list of ‘plotter types’ shown above, there is **windows** and **windows_mono**. These devices interface directly with Microsoft Windows (version 98 onwards). This allows you to plot direct to any Windows device on the network. All plot queue issues are handled direct by Windows. The plot file is deleted at the end of the plot.

17.6 Previewing Plots

To save wasting paper, we strongly recommend that all plots be previewed before sending them to their final device.

We do this by writing the plot file to a model which is stored in the normal 12d database just like any other string data. As plot files are simple 2d files in an X-Y plane, such data is readily displayed in any plan view. We can then preview the plot in any Plan view by turning on the model of plotted data. The units used for plot files in 12d are the industry standard units for plotting - millimetres. For this reason it is important that you turn <u>all other models</u> off when previewing plot files. If you don’t, your plot may well be mixed in with real world coordinate data. This will make the plot appear very small and probably in the extreme lower left corner of your screen, near the origin.

It is possible to do a ‘plot of a plot’. This is sometimes useful when you want to make minor changes to (say) a long section plot, maybe add some new text. Remember that all plots are in millimetres so that if you add text to such a plot, you do it at full size. Create text 5 high if you want it to plot at 5 mm on the finished sheet.

After doing such changes, you then click LB on **Plot=>Plot** from the View Title Area. In the Scale 1: field, type in 1000. This will keep your second plot in millimetres. If you then preview the second plot, you should see the final plot with the changes implemented. To then reissue the final plot, simply change the Plotter type to the desired device and reclick the **Plot** button.

If after doing a plot, you decide that you need to change something and redo the plot, it is important that you clean out the old plot before you reissue the plot command again. The reason for this is that 12d just treats plot data like any other data in the database. Plots can be cleaned by simply ticking the relevant check box at the time of creating the plot. See Chapter 17.12.2 and Chapter 17.14.4 for managing previewed plots for cross and plan plots respectively.

17.7 Overview of Plotting

We will look at six of the many types of plots available.

1. Quick Plan plots
2. Quick Section plots
3. Quick Perspective plots
4. Sheets of Long Sections
5. Sheets of Cross Sections
6. Sheets of Plan plot frames

Each of these plot types will now be discussed in detail.

Apart from these six plot types, there are also others such as Drainage plots, Sewer plots and Pipeline plots which will not be discussed in this Chapter.

To preview our plots in 12d Model we need a Plan view that is not displaying any data. Before continuing, create a new one with the name 'Preview' using **View=>Create=>Plan view**.

We will use view 'Plan Preview' for the purpose of previewing plots.

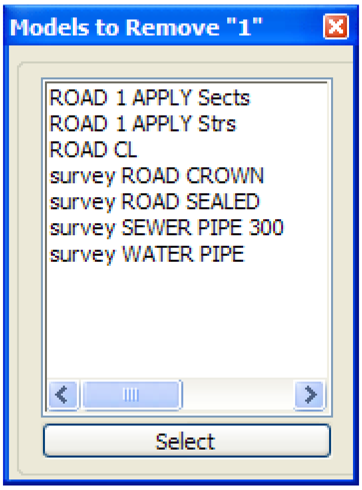
17.8 Quick plots

The key purpose of these type of plots are for occasions where the scale of the plot is less important than the contents. For example, if you needed to table a drawing at a meeting showing a certain detail, all that is needed is that you get the detail up on your screen and zoom in on it until you see the extents of your area of interest. You then create a plot and you will get exactly what you saw on the screen.

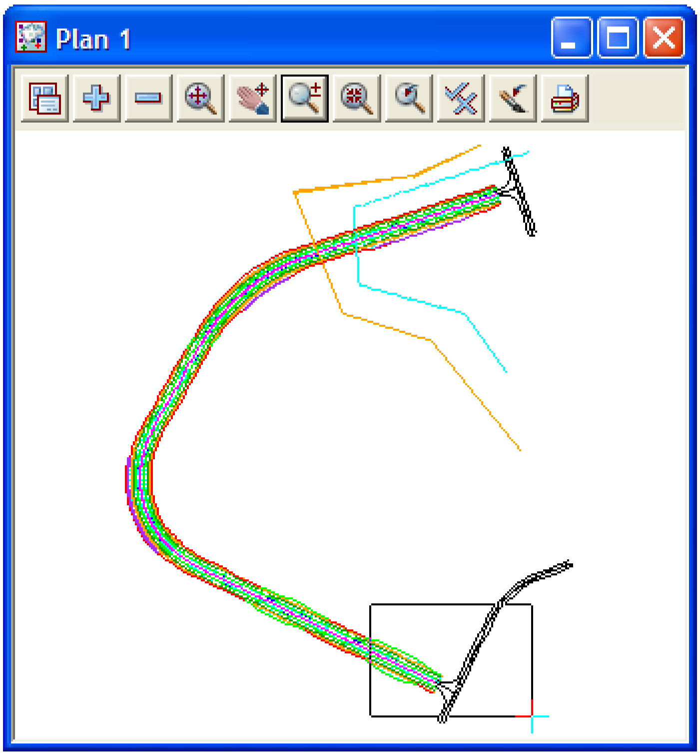
17.8.1 Quick Plan Plots

Before we start we need to get some standard data up on display.

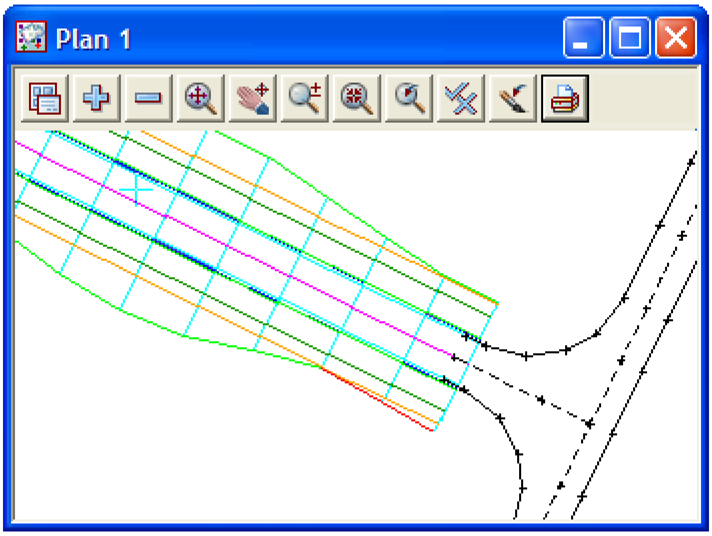
Ensure that in View 'Plan 1' just the models shown below are in the view:



Your ‘Plan 1’ view should look as shown below.



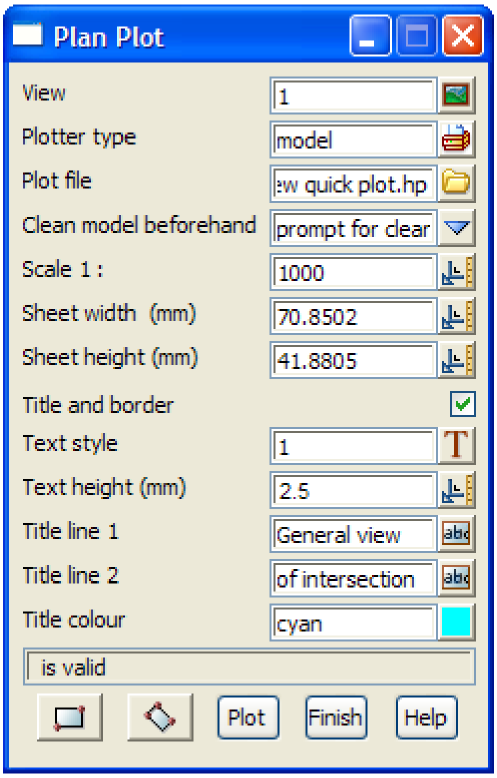
Zoom in on the intersection area as shown. Let us assume that this is our area of interest.



We will now plot the zoomed data on display in View ‘Plan 1’.

If you want the finished plot to assume the general shape of say, an A1 sheet, drag the edges of your view until the height/width ratio of the screen resembles the sheet i.e. wider then it is high.

From the View Button Area for View ‘Plan 1’, click LB on the printer icon ir the view buttons area and select **Plot**.



Fill in the panel as shown. Make sure that the plotter type is **model** so that we can preview the plot.

Type in **preview quick plot** for the model name

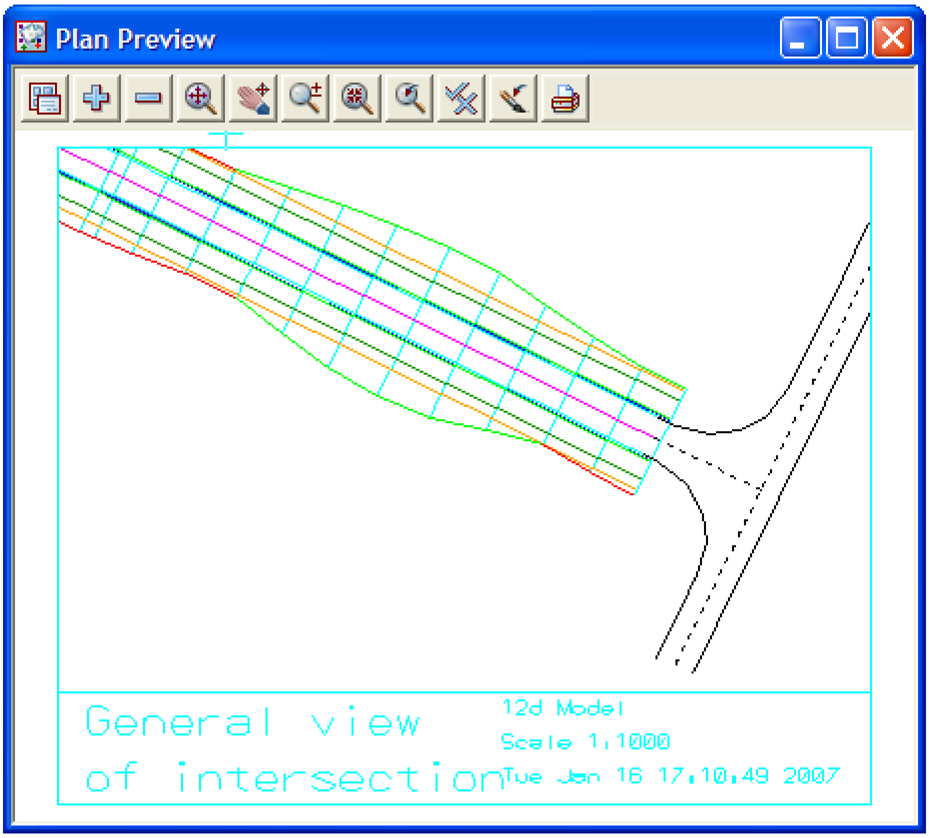
Select **prompt for clean** as clean model mode

In the scale field, type 1000 and press the Enter key. The aspect ratio of the 'Plan 1' view will determine the sheet **width** and **height** returned. It is possible to type in any one of these three numbers and 12d will calculate the other two. For instance to fill an A1 sheet where you are not interested in the scale of the plot, type in a width of 841. The easiest method is to use the rectangle option at the bottom of the panel to draw a rectangle around the data. Try to keep the proportions as close to a sheet of paper as possible.

By default, a simple title and border are created. Leave the box ticked and type in two lines of text as shown. These lines will appear at the bottom left of the plot, in the title box area.

Click LB on the **Plot** button.

Now go to View 'Plan Preview' and use the '+' sign to turn on model **preview quick plot**.



Your finished plot should look as shown.

Firstly, ensure your POINT snap is ON. If you do a string inquire (F2) on the cyan string at the bottom left corner of the plot, observe the X and Y coordinates returned. The bottom left corner of the plot is at the origin X=0 and Y=0.

The point to note is that the plots are in millimetre units but when they are plotted to a model to preview and work with inside 12d Model, the plot data has been multiplied by 1000.0. Hence the 40mm title block was of size 40 units in the plan view, not 0.040 as you would first think.

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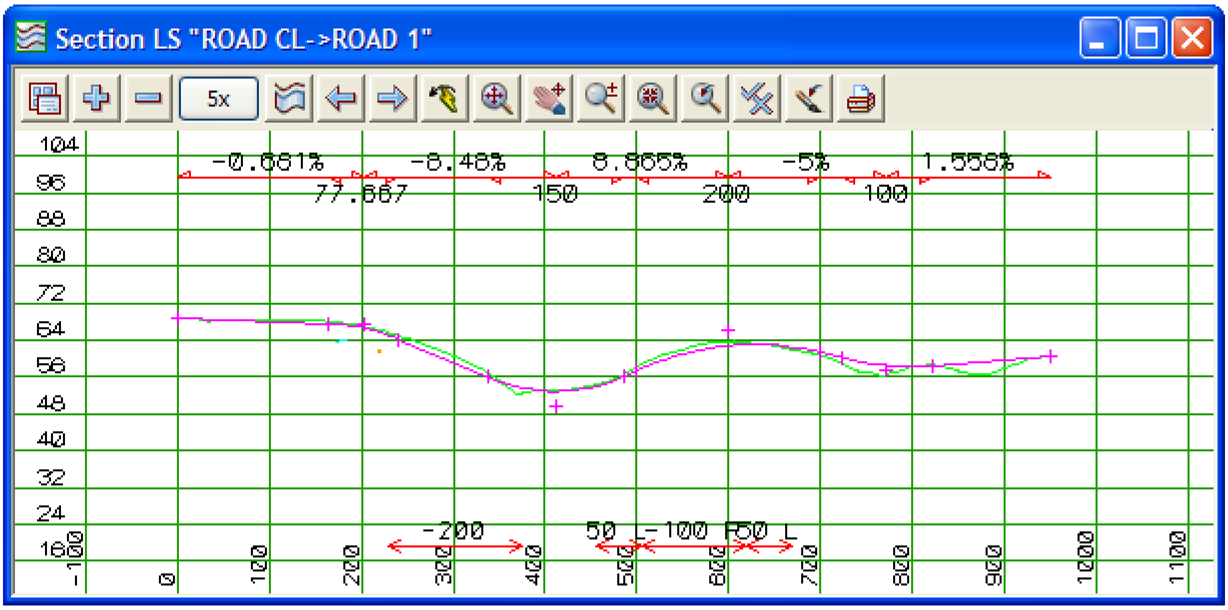
17.8.2 Quick Section Plots

This is very similar to the Quick Plan plot we have just finished.

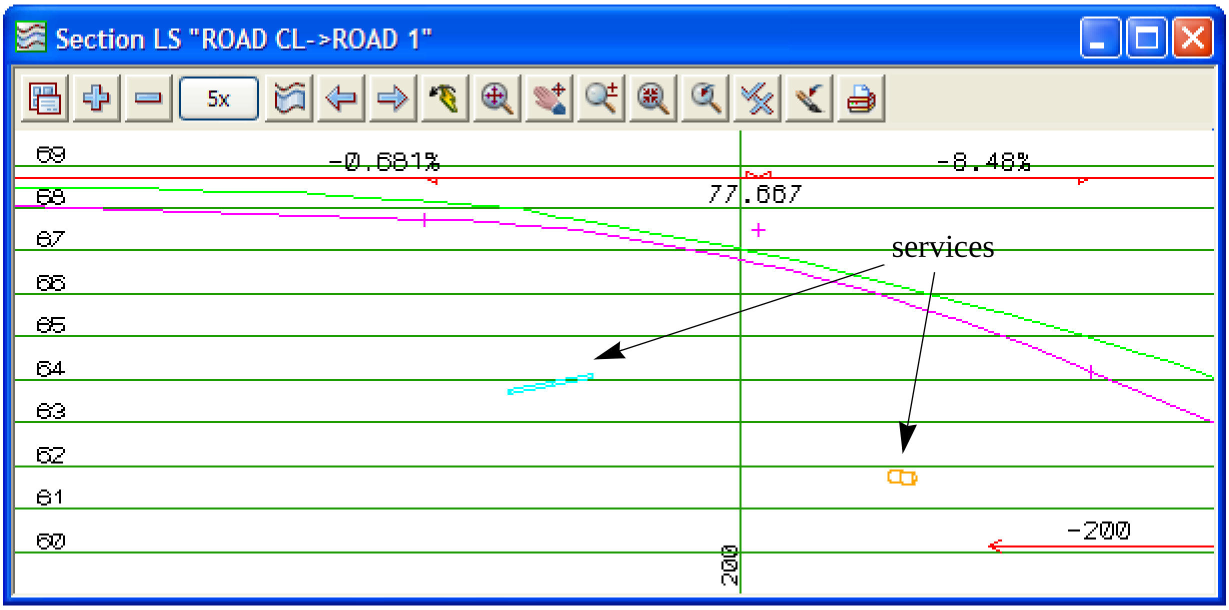
We will investigate this facility by profiling our ‘ROAD 1’ centreline string in view ‘Section LS’. From the View Title Area of view ‘Section LS’, click LB on the **Profile** button and select the magenta centreline string on display in view ‘Plan 1’. Make sure you select the alignment string and not a 3d string. It can often be easier to pick the IP points rather than the string itself.

If you turn on the models for the pipes, **survey SEWER PIPE 300** and **survey WATER PIPE** and ensure that your grid is still toggled on, then your section view should be as shown below.

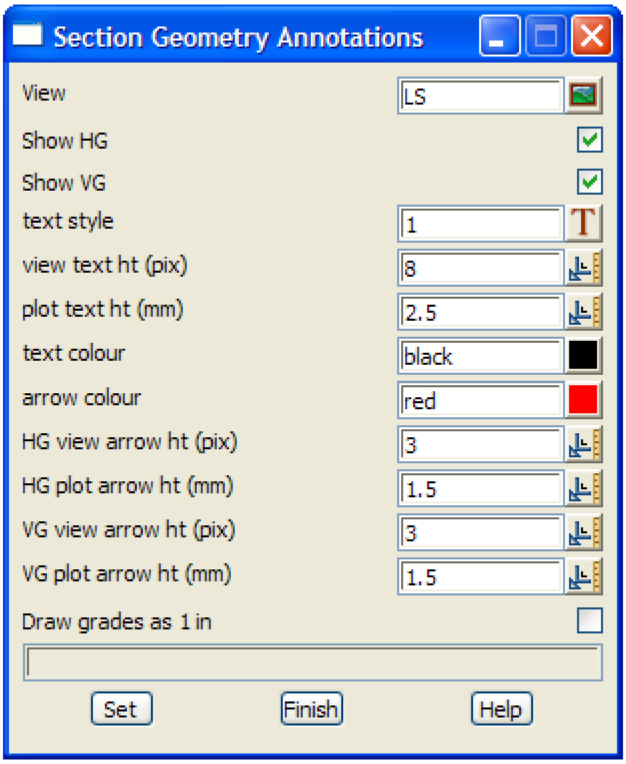
Zoom in on the portion of the profile where the services cross under the road.



You should now see the following. Note the services under the road. Also note that even though we asked for the vertical grid to be 1 m apart, the grid will only display in full at this separation when the view is uncluttered. If 12d thinks the view will be too cluttered when you are Zoomed out, it will only display some of the requested grid lines as seen above.



From the View Title Area of view ‘Section LS’, click LB on **Menu=>Settings=>Geom annot**

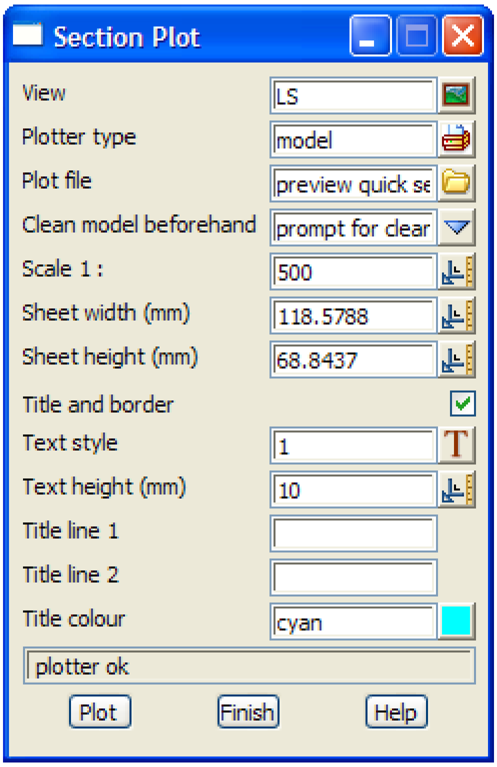


Note that you can set the screen text height in pixels independently of how the same text will appear in height on the finished plot.

Click LB on **Set** and **Finish**.

We will now create the Section view plot. From the View Button Area for View ‘Section LS’, click LB on **Plot=>Plot**

Fill in the panel as shown. Make sure that the plotter type is **model** so that we can preview the plot.



Fill in the panel as shown. Make sure that the plotter type is **model** so that we can preview the plot.

Type in **preview quick section** for the model name

Select **prompt for clean** as clean model mode

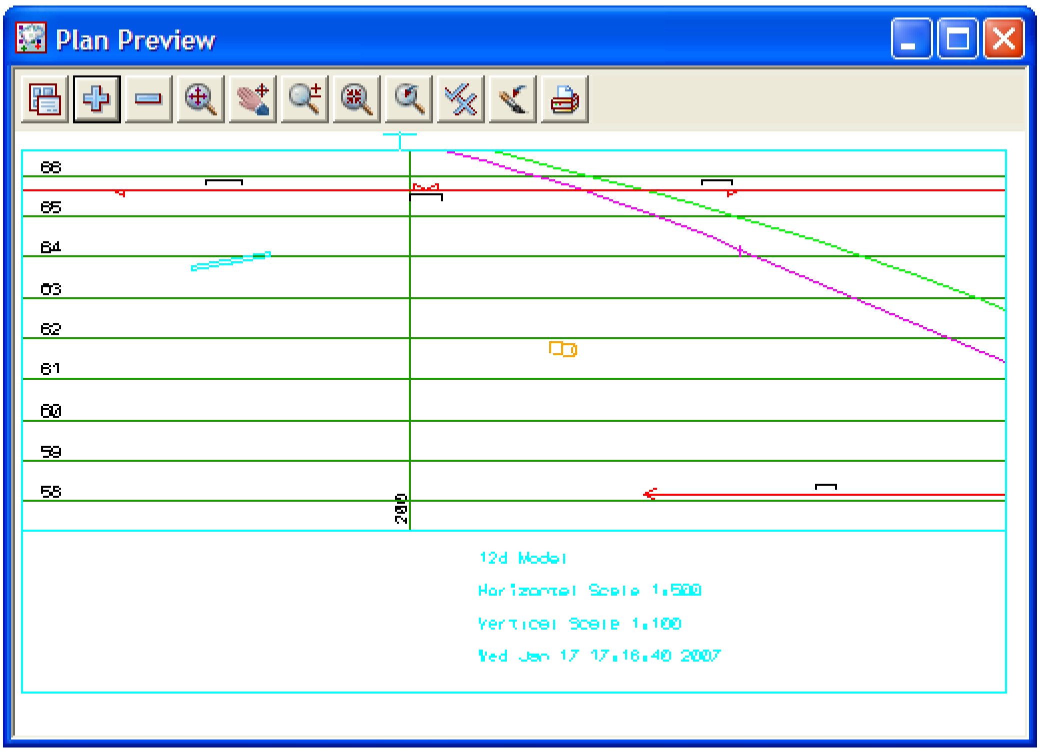
In the scale field, type 500 and press the Enter key. The aspect ratio of the ‘Section LS’ view will determine the sheet **width** and **height** returned. It is possible to type in any one of these three numbers and 12d will calculate the other two. For instance to fill an A1 sheet where you are not interested in the scale of the plot, type in a width of 841.

By default, a simple title and border are created. Leave the box ticked. This time leave the Title lines blank.

We can set the textstyle to ISO to get the title text to appear with that font.

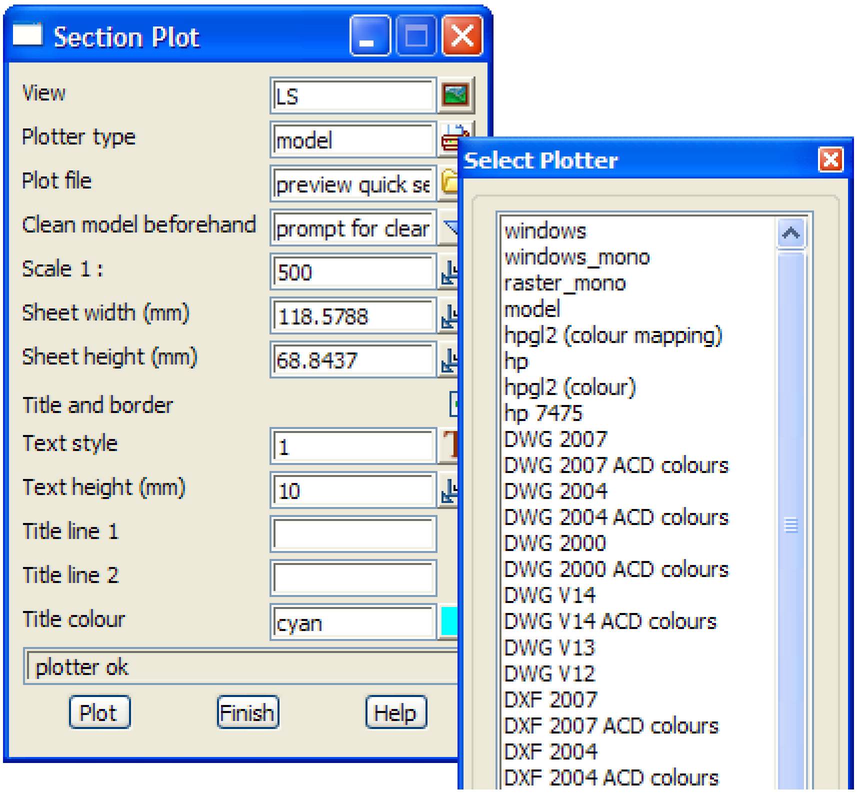
Click LB on the **Plot** button.

Now go to View ‘Plan Preview’ and use the ‘-’ sign to turn OFF model **preview quick plot** and then turn ON model **preview quick section**.



Note that whilst the plot is in general, the plotted text may have a different height to that in the Section view.

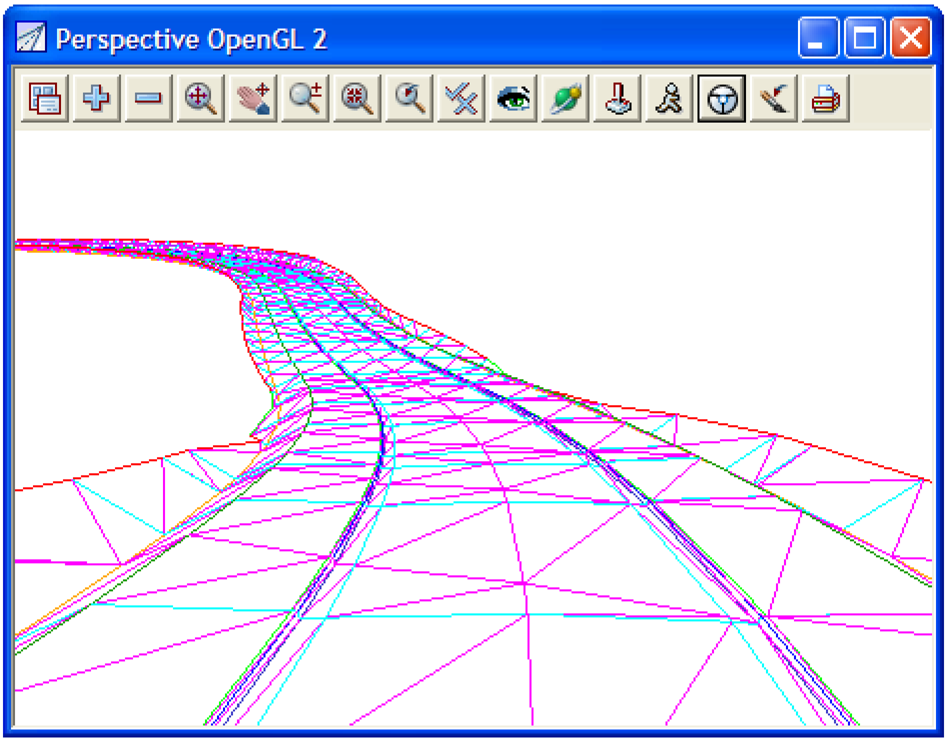
If the plot is satisfactory, the user can send the plot to a device. Simply select an appropriate device from the plotter icon and then Click LB on the **Plot** button.



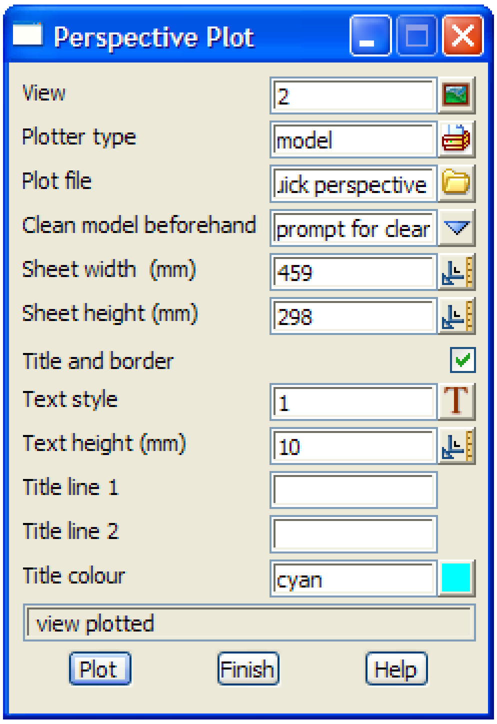
17.8.3 Quick Perspective Plots

This is very similar to the Plan and Section plots above. The **Orbit, Joystick**, **String Drive** or **String Walk** options can be used together with the **Zoom** options to establish the extents of what you can see. To get a plot of this is very similar to the above except with regard to the plot size. The plot size can only be established by trial and error.

To start off, just use any of the above tools to get some data on display in your ‘Perspective OpenGL 2’ view. In our case we turned on tin ‘DESIGN’ after doing a String Drive. Let us assume that this is the data we wish to plot



Click LB on **Plot=>Plot** from the View Button Area of View ‘Perspective OpenGL 2’.



In the ‘Plot file’ field, type in **preview quick perspective**.

Select **prompt for clear** as clean model mode

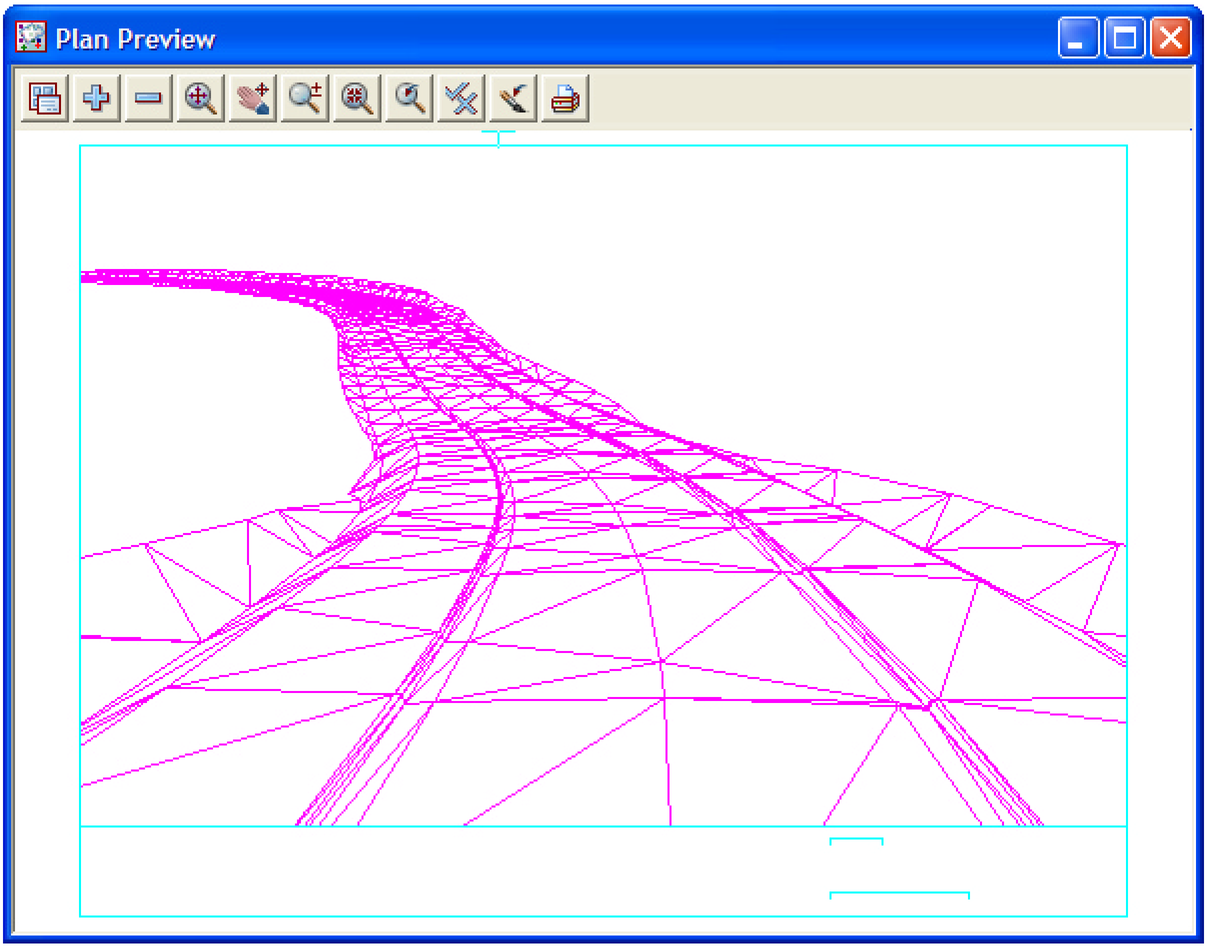
Note that the sheet width and height are already returned.

If your plot is too large, you need to reduce the physical width and height of your ‘Perspective OpenGL 2’ Window to make the plot smaller. Drag the margins of the view as appropriate.

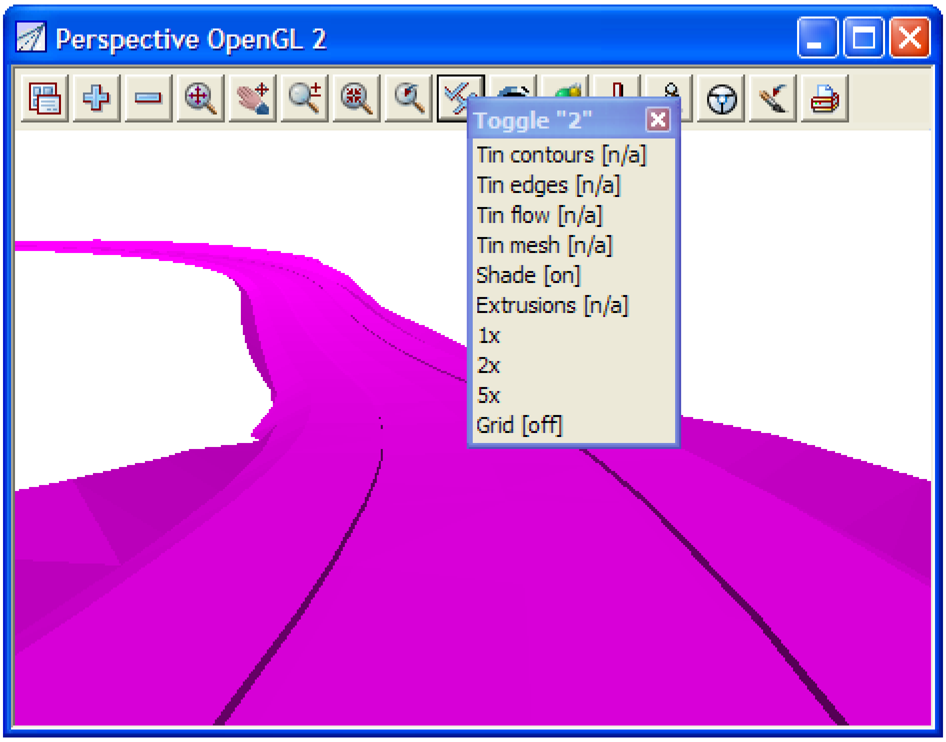
After you have changed the size of the view, place the cursor in the ‘View’ field (after the 2) and press the Enter key. The sheet size will be updated.

Click LB on the **Plot** button to generate the plot.

Now go to View ‘Plan Preview’ and turn OFF model **preview quick section** and turn ON model **preview quick perspective**. Your previewed plot should look as follows.

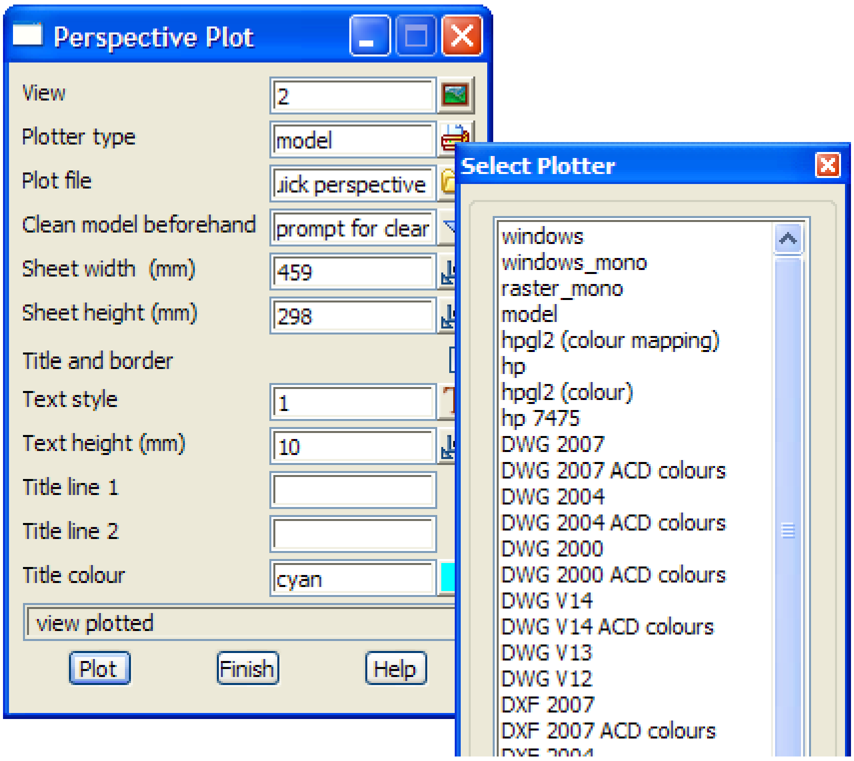

Plan Preview

In view ‘Perspective OpenGL 2’ **Toggle=>Shade**. Your view should now look as shown.



If the plot was repeated, shading will now appear in the finished plot. In view ‘Perspective OpenGL 2’, use **Toggle=>Shade** again to toggle it OFF when finished.

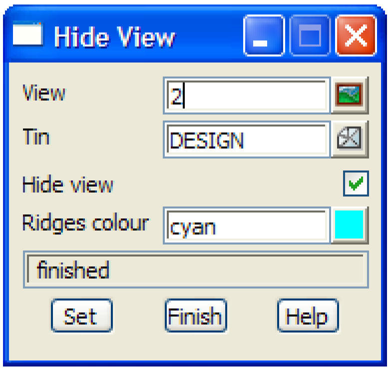
If the plot is satisfactory, the user can send the plot to a device. Simply select an appropriate device from the plotter icon and then Click LB on the **Plot** button.



17.8.4 Quick Hidden Line Perspective

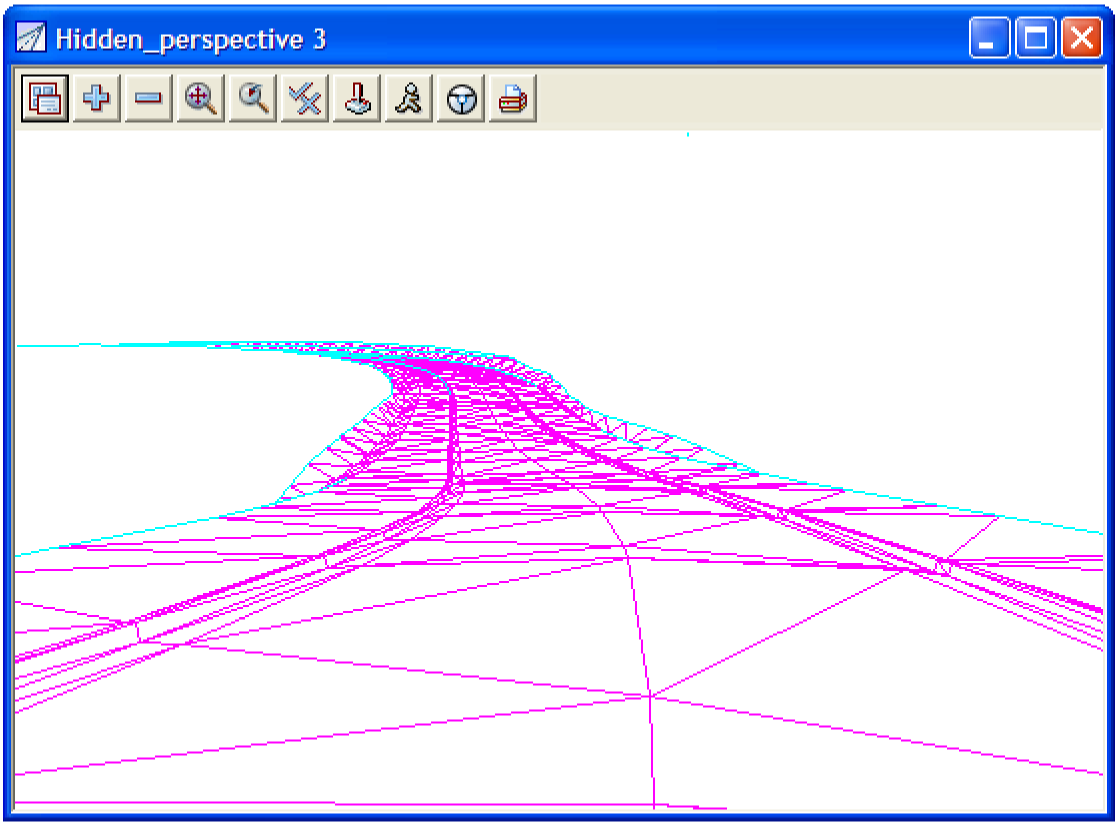
This is very similar to the Perspective plot above. This facility just allows you to create a hidden line perspective plot of any information that sits on the selected TIN.

From the View Button Area of View ‘Perspective OpenGL 2’, click LB on **Menu=>Settings=>Hide**.



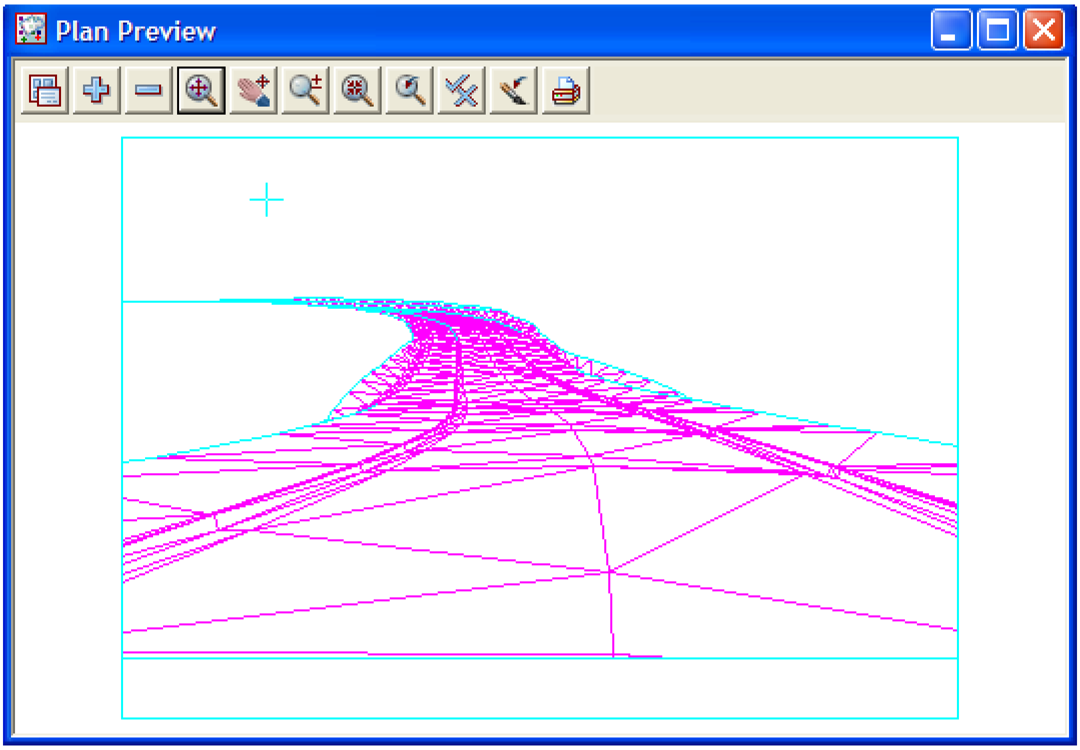
Select TIN **DESIGN** and tick the ‘Hide view’ tick box.

Click LB on **Set** and **Finish**.

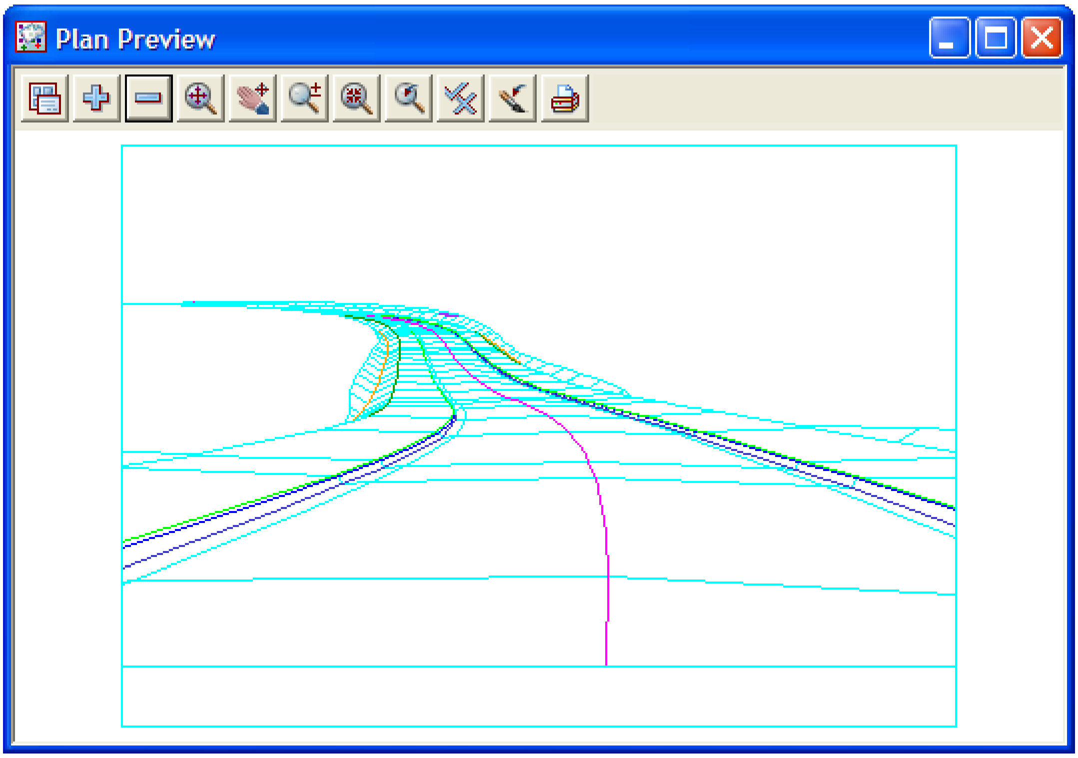


Click LB on **Plot=>Plot** from the View Button Area of View ‘Hidden_perspective 3’ and repeat the process explained above to generate the plot. Instead of name **preview quick perspective** use **preview quick hide** as the name of the model.

Now go to View ‘Plan Preview’ and turn OFF model **preview quick perspective** and turn ON model **preview quick hide**. Your previewed plot should look as follows.



NOTE: Although we have only plotted the TIN on the hidden line view, we can actually add any data that sits on the TIN and hidden lines will be removed. The TIN itself does not have to be on the view.



17.9 Plotting Using Plot Parameters

Often a higher quality plot is required than what the plots already described can produce.

This is especially true for long sections and cross section plots where many pages of plots are required and the layout includes large amounts of additional information such as the labelling of chainages, heights, depths, alignment geometry and services.

In early versions of 12d Model, the way more complex plots could be produced was controlled using text files called plot parameter files (ppf’s for short).

PPF’s consist of a large number of parameters and values which gives the user tremendous flexibility on the way the plots look but the disadvantage was that the PPF’s could only be created and modified using a text editor.

Since the release of 12d Model V6.0, new interactive PPF editors were introduced to allow the user to create and modify the plot parameters without needing a text editor.

This made the use of plot parameters more accessible to all users.

The interactive PPF editors store and edit information in a binary format which can’t be read by a text editor.

17.10 Plotting sheets of Long sections

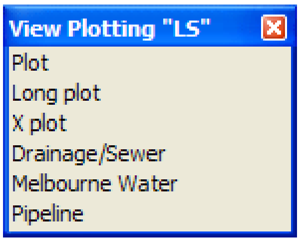
First you need a Section view. We will use view ‘Section LS’ to illustrate the plotting of long sections that involve multiple sheets.

In your chosen view you need to profile the Alignment string that you wish to plot. Make sure that view ‘Section LS’ has the ‘ROAD 1’ string profiled.

Also make sure that the vertical exaggeration of view ‘Section LS’ is set to [2].

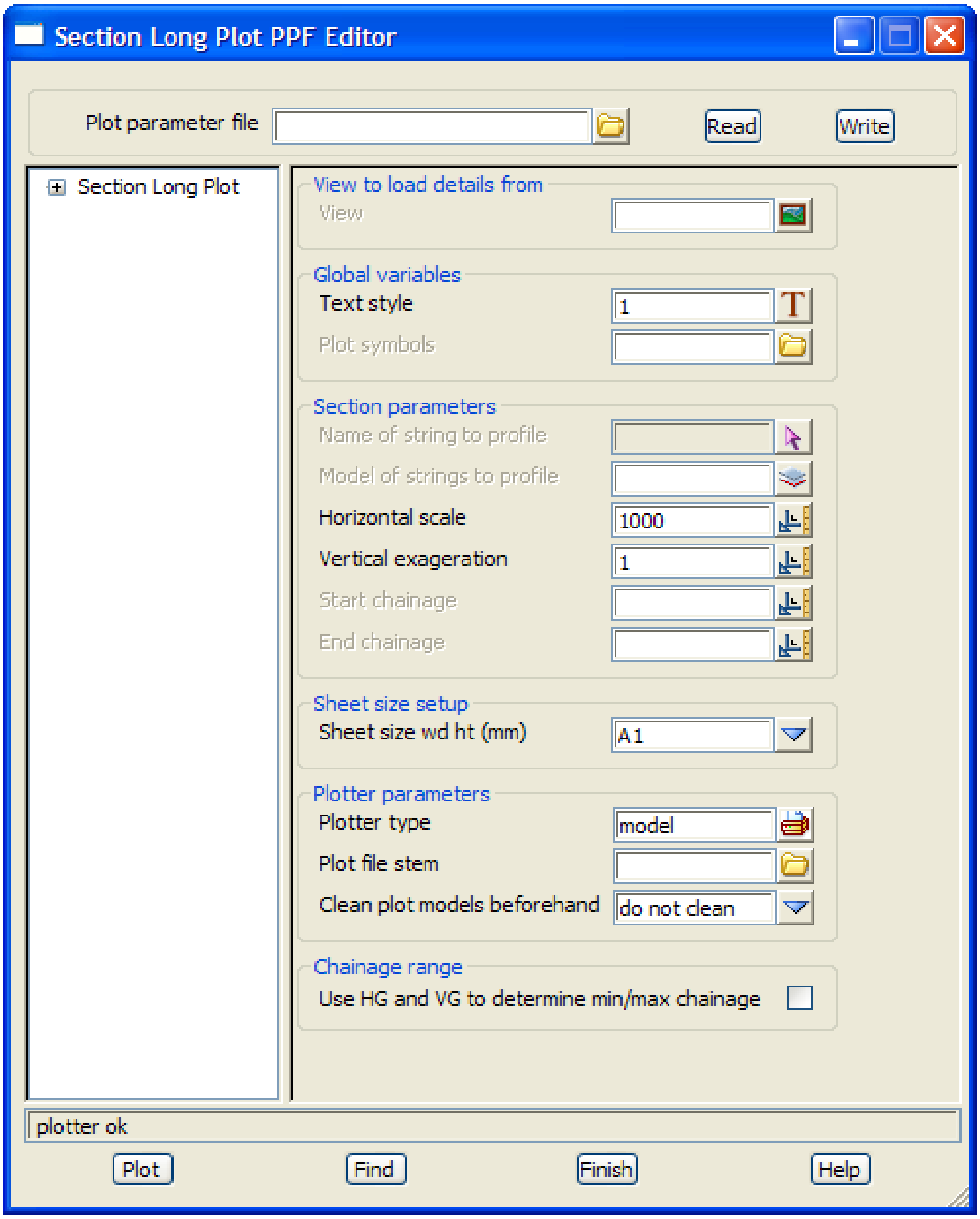
In the View Title Area of view ‘Section LS’, click LB on **Toggle=>Grid** to turn the grid OFF.

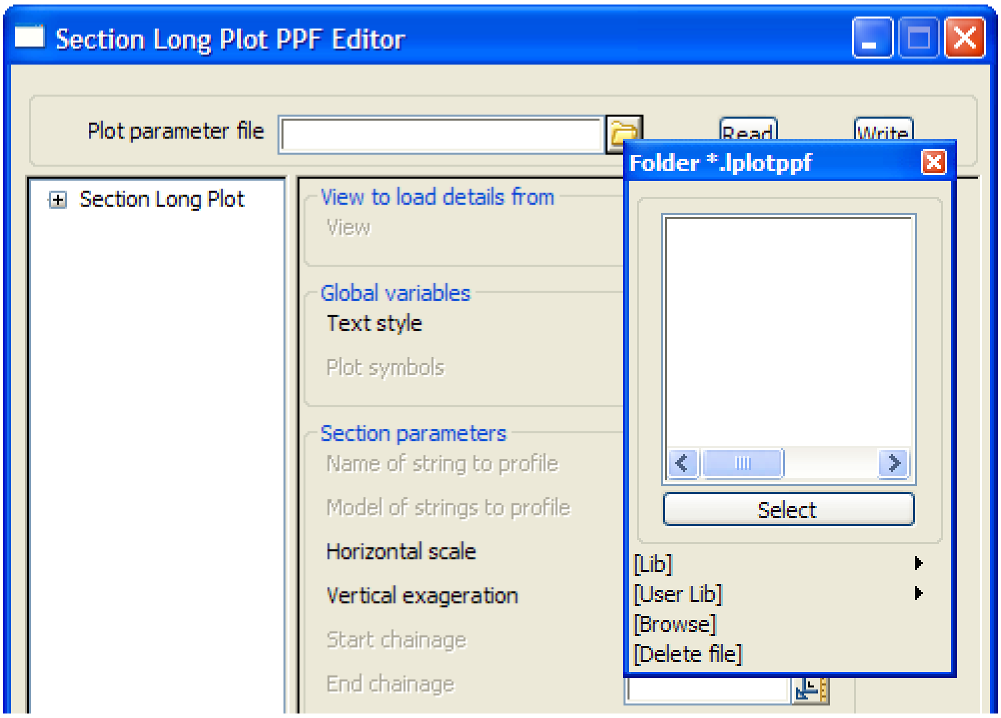
To run the ‘Long Section Plot PPF Editor’ either click LB on the Printer icon in view ‘Section LS’



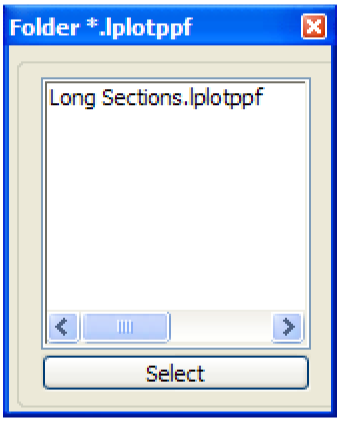
Select **Long plot**

Or by clicking LB on the Main menu option **Plot=>Plot and PPF editors=>Long Sections**. If this method is chosen then the *Section view* number is not be automatically filled in and must be given by the user.





In the **Plot parameter file** box located at the top of the panel, LB click on the folder icon to bring up the folder choice box.

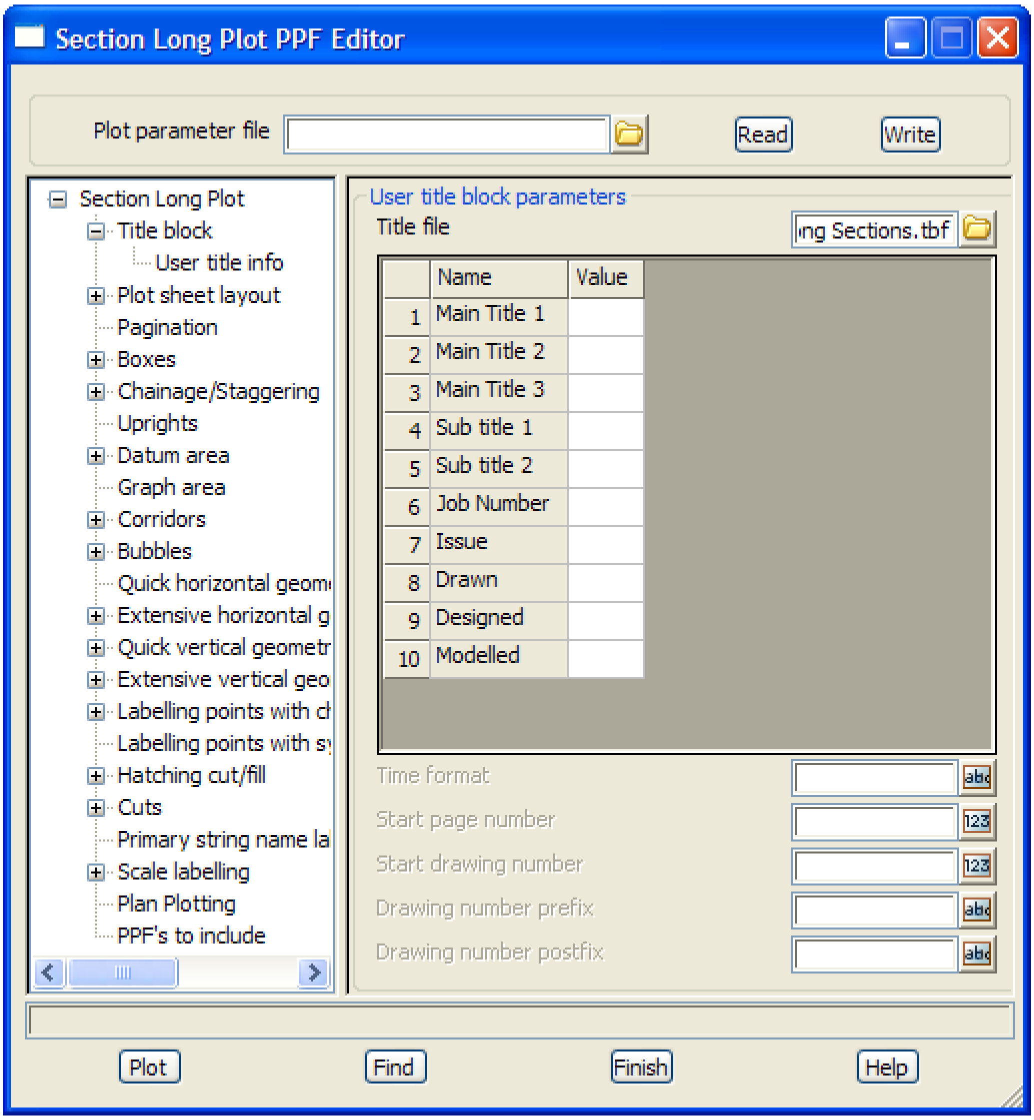


Walk right on the User Library menu (**[User Lib]**) and select the file **Long Sections.lplotppf** by double clicking LB on the file name in the choice box. This file is a binary PPF file. Complete the sequence by pressing the **Read** button adjacent to the **Plot parameter file** box. This loads all the plot parameters into the current panel.

Select the section view from which the plot is to be generated from by LB click on the view icon button adjacent to the **View to load details from** box near the top of the panel. Select view **LS**. **Note:** If a value is typed then the user must then press the enter key to accept the view.

The parameters can be edited by moving through the various levels of the PPF editor by using the tree structure shown on the left of the panel. The tree structure can be expanded by LB click on a **+** symbol (node) to show underlying levels which may consist of various other nodes. To shrink underlying levels, LB click on the **-** symbol.

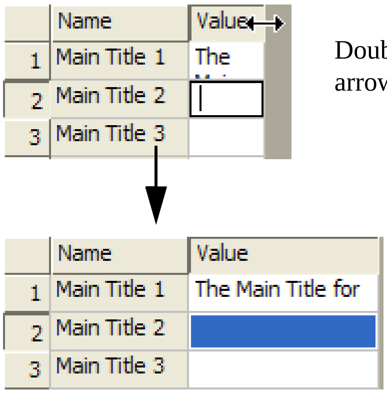
LB click on the **Section Long Plot** node (+ symbol) to expand the tree. Then LB click on the **Title block** node (+ symbol) to expand to the **User title info** level. Once expanded, the user can go from one level to another by simply LB click on the level they require (i.e. the text heading of the level). Going from level to level you we see the relevant parameters for that level. The **User title info** level should be selected which will look as follows.



The parameters on the right of the panel include the user title block parameters. The title file given in the ppf file has been read into the grid with the names of the title user text shown in the name column, and the value column shown blank. If valid values are entered into the grid, they will be automatically substituted into the title block at the time of plotting.

This panel can be resized by moving the mouse to the extremities of the panel and whilst holding down the LB near the edge, moving the outline to the required size just like resizing any view. Resize the panel in both the horizontal and vertical so that it takes up most of the screen. **Note** Like any panel it can be minimised by using the standard windows minimise button.

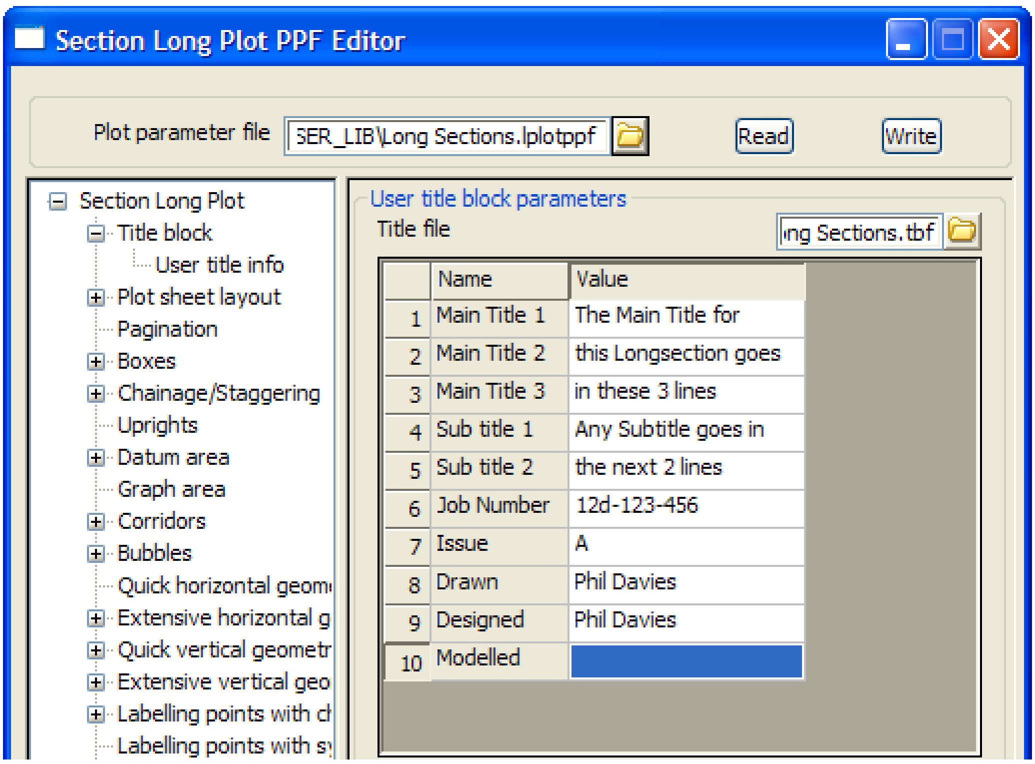
We will enter a few values into the grid to show how the user text will be substituted into the title box at the time of plotting. LB click in the value filed adjacent to the **Main Title 1** name field, then type some data. As the default size for the column has been set to the width of the column heading, it will be necessary to resize the column to see all of the typed text. To do this, move the cursor over the vertical dividing line of the grid, near the right hand end of the 'Value' column heading. You will see a resizing arrow appear. Double click LB whilst this arrow appears and the column will be resized to show all the text.



Double click LB when the resizing arrow appears.

The column is resized to the width of largest value in the column

Complete the rest of the grid as follows:

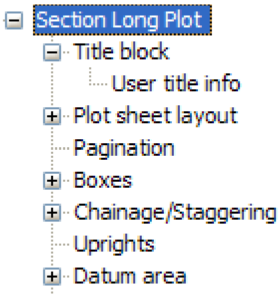


Note that all the value fields do not have to be filled out.

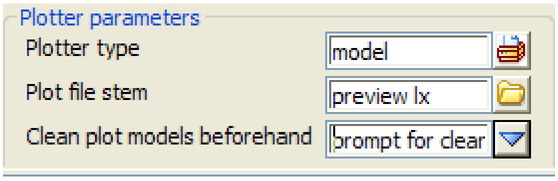
At any stage of the editing process, the user can write a binary PPF file that can be read into a panel at a later time. This is helpful if you want to close the **Long plot and PPF editor** panel but want to save the changes. Simply type a file name into the Plot Parameter File box at the top of the **Long plot and PPF editor** and press the enter key. This assigns the relevant file extension. Then press the **Write** button at the top of the panel.

To read an existing PPF file, the user can choose the file from the Plot Parameter File box, then press the **Read** button. This loads any existing parameters into the grid.

As you often need to plot your drawings several times before you get it right, 12d allows the plot models to be automatically cleaned prior to creating the new plots

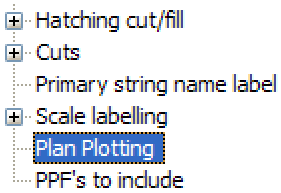


Return to 'Section long plot ' part of the panel

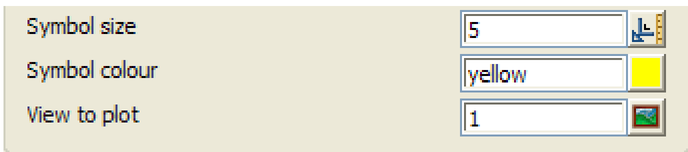


Select **prompt for clean** as the choice for 'Clean models before hand'. This gives the user the option to clean at the time of creating the plot

To add a Plan plot to out Long Section click on the 'Plan Plotting' near the bottom of the main listing



Click LB on **Plan Plotting**

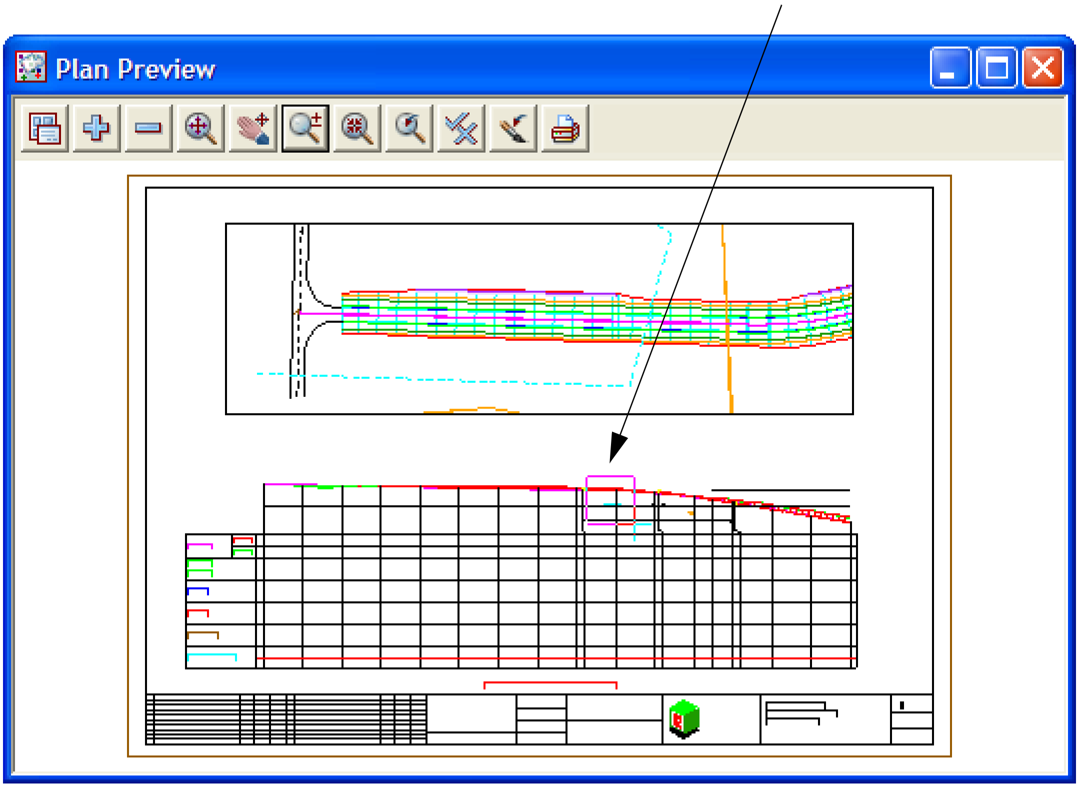


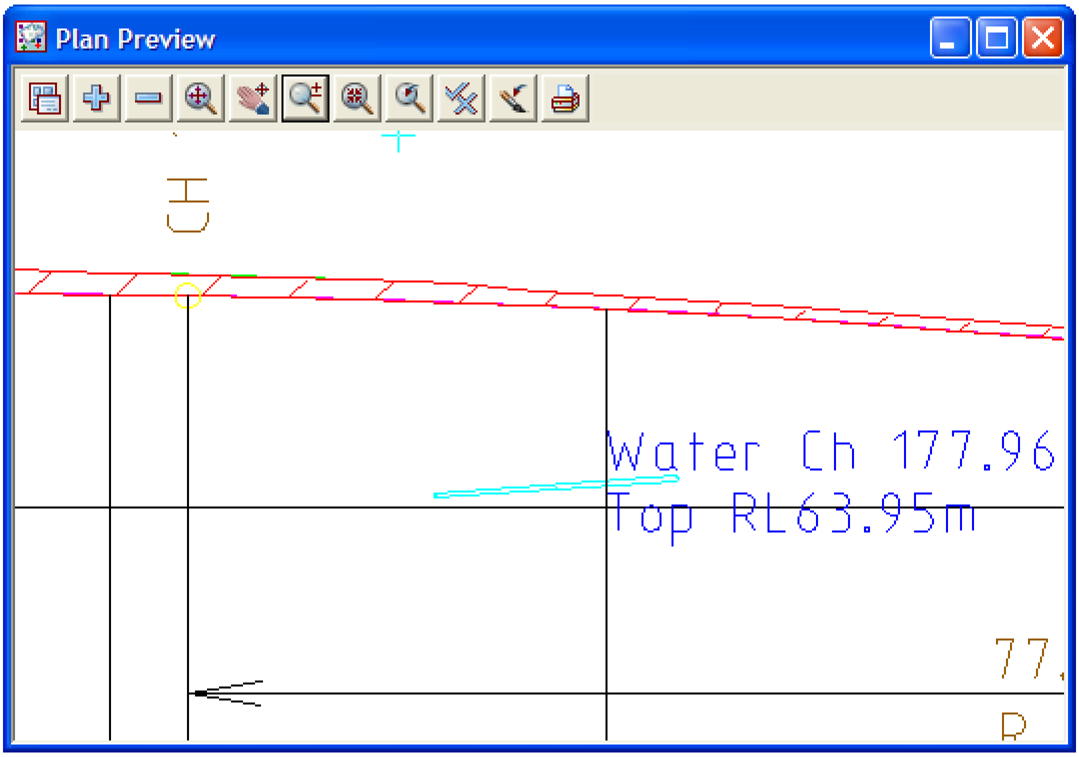
Select view icon then select view **1**

Now select **Plot** to create the plot models.

12d will realise that it needs four sheets to complete the job. The supplied plot file name was **preview lx**. Since Pagination was turned ON, 12d will create sheets **preview lx 1, preview lx 2........** As we plotted to a 'Model', we will get models **preview lx 1, preview lx 2........** etc. If we plotted to DXF, we would get files **preview lx 1.dxf, preview lx 2.dxf........** etc.

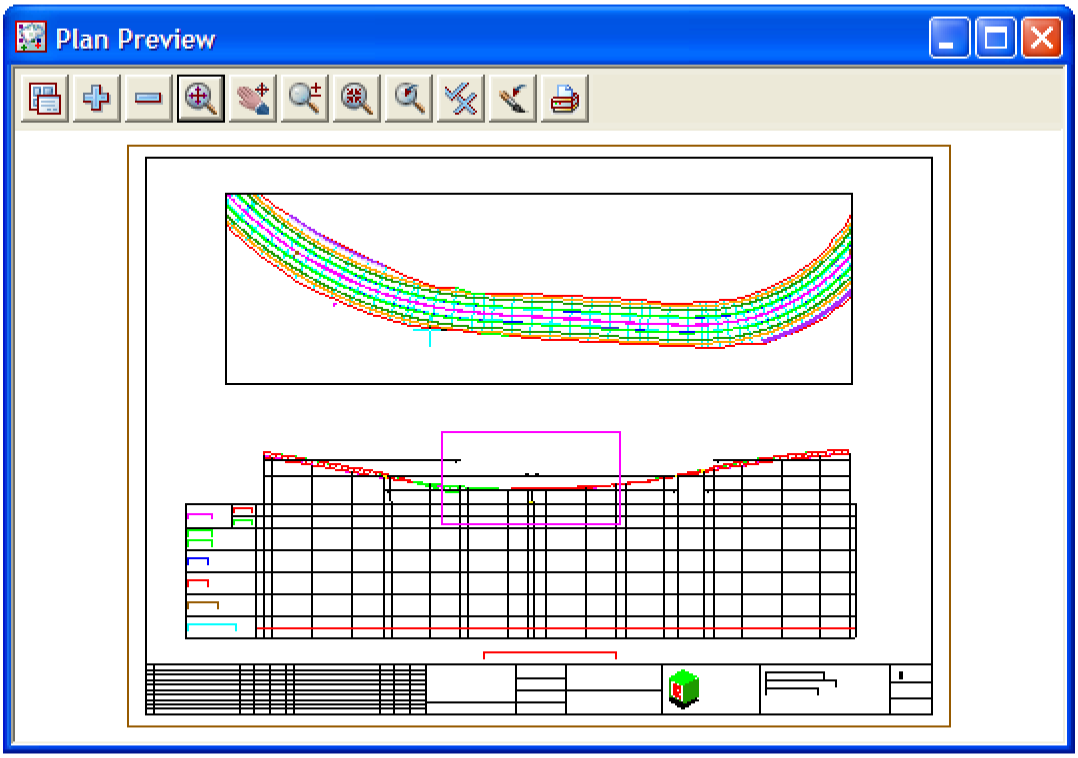
In view ‘Plan Preview’, turn OFF model **preview quick hidden** and turn on model **preview lx 1**. Your first sheet should appear as shown below. **Zoom** in on the area where the services appear.





Note that 12d has automatically worked out where these services cross under the road centreline and drawn the pipe to scale (the pipes appear sections, because we have a wide corridor set for View ‘Section LS’), and annotated each pipe. All of this happens automatically by turning on the appropriate models of services in view ‘Section LS’. The ppfs recognise reserved names assigned to the services.

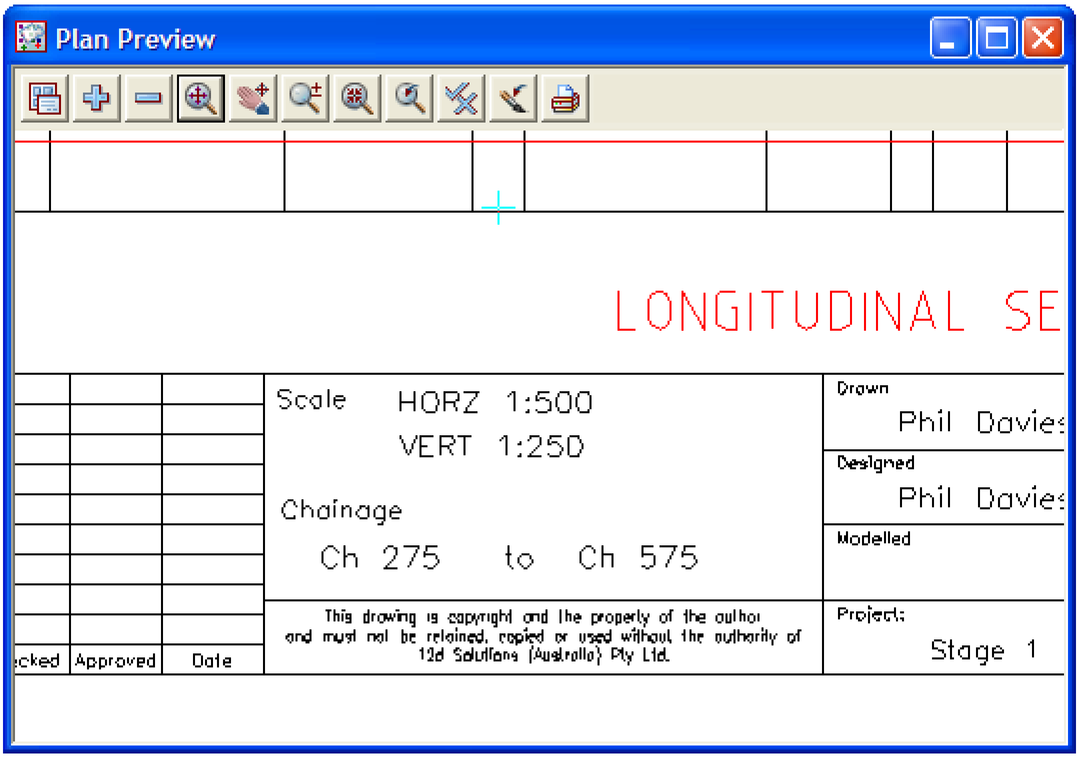
In view ‘Plan Preview’, turn OFF model **preview lx 1** and turn ON model **preview lx 2**. Your second sheet should appear as shown below.



Zoom in on the low point of the road as shown above.

Note the sag point has been annotated automatically. Also note the labels in the boxes area and the Horizontal and Vertical geometry annotation. All of this is completely user definable.

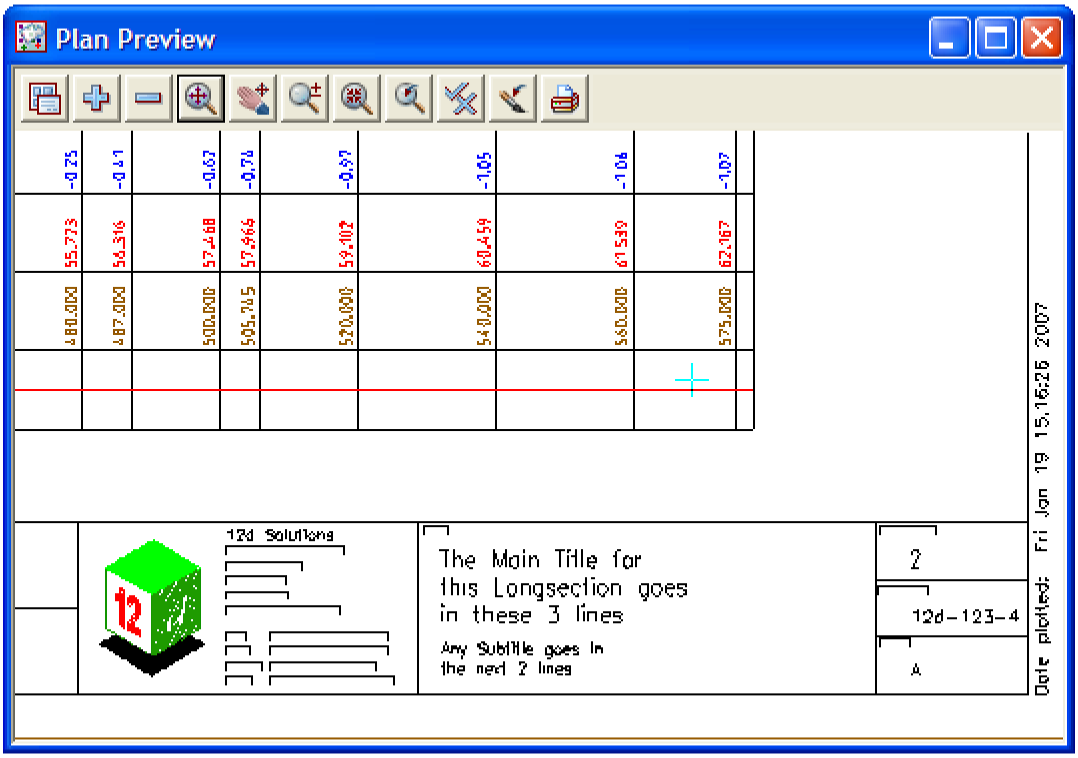
If you **Pan** around to the centre of the Title block, you will notice that 12d has automatically calculated and inserted text showing the chainage range appearing on each sheet. It has also substituted the user text values entered into the **Long Plot and PPF editor** panel into the appropriate places in the title block.



In general, the text in the Title block is entered in a panel once per project. It can be entered for long-section plots and reused for cross-section and plan plots.

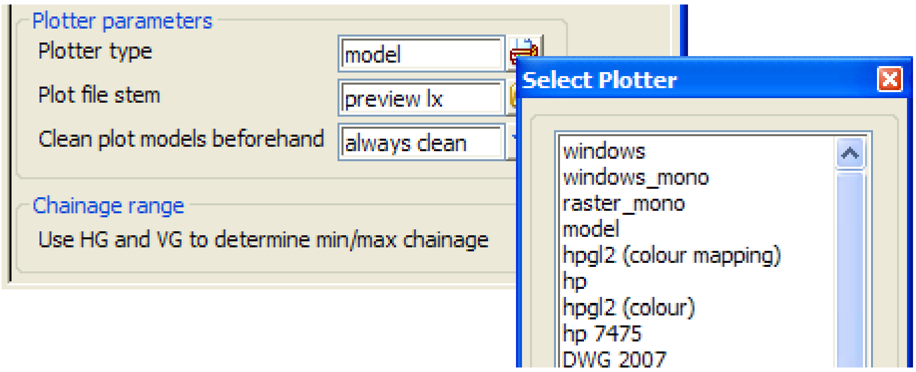
If you Pan to the right-hand end of the title block, you will observe that 12d has inserted such items as Drawing numbers (which automatically increment with each sheet), Job numbers, Company Logos and Plot date.

All of this has happened automatically during the generation of the plot.



You are now in a position to make changes to your plot parameters and repeat the plot.

If the plot is satisfactory, the user can send the plot to a device. Simply select an appropriate device from the plotter icon and then Click LB on the **Plot** button.



17.10.1 Automatic Labelling of Crossing Services on Long Sections

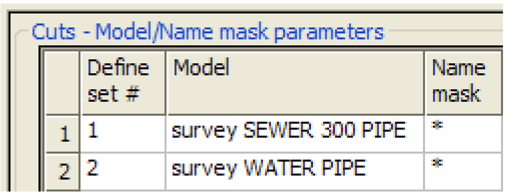
In the above plots you will notice that services appeared on the long section wherever the services were in the road corridor and labelled when the services crossed the profiled string, in our case the road centreline. We will now look at what plot parameters caused this labelling to happen. With the plot parameter files supplied with the training data, the following models contain the services.

survey SEWER PIPE 300
survey WATER PIPE

This is a user defined convention only. You can have any names you like for this purpose.

When 12d creates a long section plot, it will search for any strings in the above models. Masks (optionally using wild cards) can be used in the match on the string name so that only certain strings in the model are recognised.

To view the parameters that control the plotting of crossing services, go to the **cuts** section of the **Long Plot and PPF editor**):



The top level of the cuts section defines multiple sets of model/mask combinations. The user can select a whole model or certain strings from that model by specifying a mask. In this example, any strings from the EXISTING SERVICES STORMWATER model that end in 'drain' will be included in the **cuts** plotting.

The levels under the cuts section relate to the chainage, height, label and symbol information that is to be placed on the plot.

Cuts - Chainage parameters

	Use set #	Position	X (mm)	Y (mm)	Angle (dms)	Colour	Size (mm)	Textstyle	Pre-text
1	1	above cut string height value	4	1	0	brown	3.5	ISO	Sewer Ch
2	2	above cut string height value	4	1	0	blue	3.5	ISO	Water Ch

Cuts - Height parameters

	Use set #	Mode	Position	X (mm)	Y (mm)	Angle (dms)	Colour	Size (mm)
1	1	use height of cut point	above cut string height value	4	-4	0	brown	3.5
2	2	use height of cut point	above cut string height value	4	-4	0	blue	3.5

Cuts - Symbol parameters

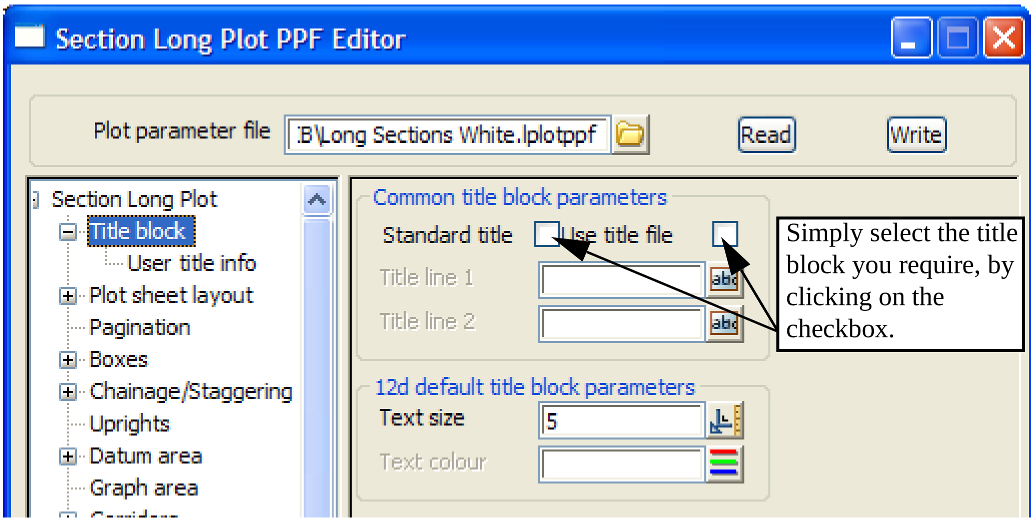
	Use set #	Mode	Symbol	Position	X (mm)	Y (mm)	Angle (dms)	Colour	Size (mm)
1	1	cross (0)		above cut string height value	0	0	45	green	3

The user defined standard for symbol labelling services (as defined above) is to place a green cross at the invert point of the pipe and place a label alongside this (as defined above).

In our case, view 'Section LS' contained the profile of the Long section we want to plot. Because we turned on the above service models in view 'Section LS', the finished plot also included the actual pipe strings as well. If you have a Vertical Exaggeration on the view other than 1, the pipe will appear as an ellipse rather than a circle.

17.11 Miscellaneous Long Section Plotting

The example we have used had a user defined title file. However, the user can select not to plot the user defined title block and use the standard 12d model title block. You may also elect not to use any.

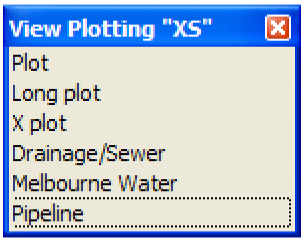


17.12 Plotting Sheets of Cross Sections

In your view ‘Section XS’, profile any valid cross section from the model of cross sections called **ROAD 1 APPLY Sects**. From the View Title Area for view ‘Section XS’, click LB on the **Profile** button and click LB on any cyan cross section string you can see in any view. Confirm the selection with MB.

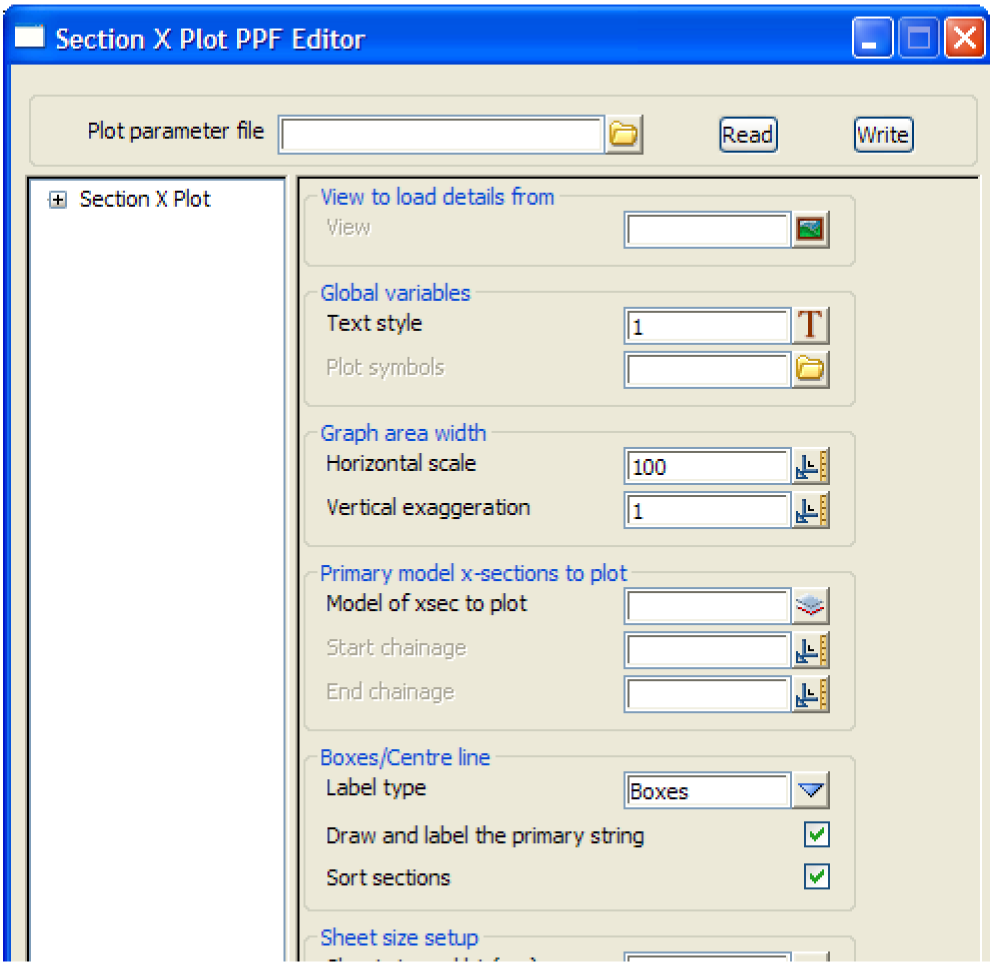
Also make sure that the vertical exaggeration of view ‘Section XS’ is set to **[5]**. The large range of cut and fill in the training data files will reduce the number of sections per sheet if you have the vertical exaggeration set any larger than 1.

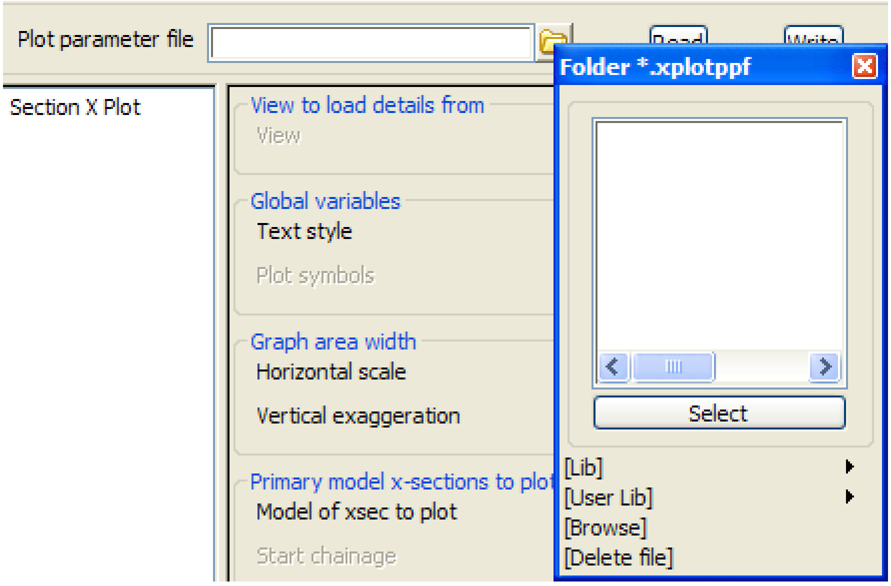
To run the ‘Section X Plot PPF Editor’, from the View Button Area for View ’Section XS’ click LB on Printer Icon and select **‘X plot**’



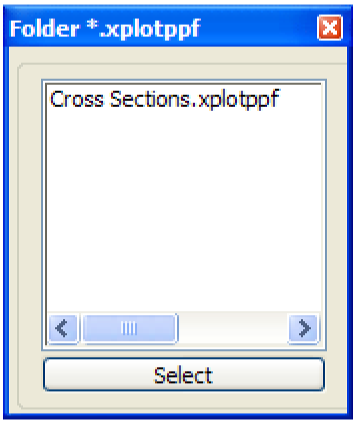
Select **x plot**

Alternatively you can click on option **Plot=>Plot and PPF editors=>Cross Sections**.





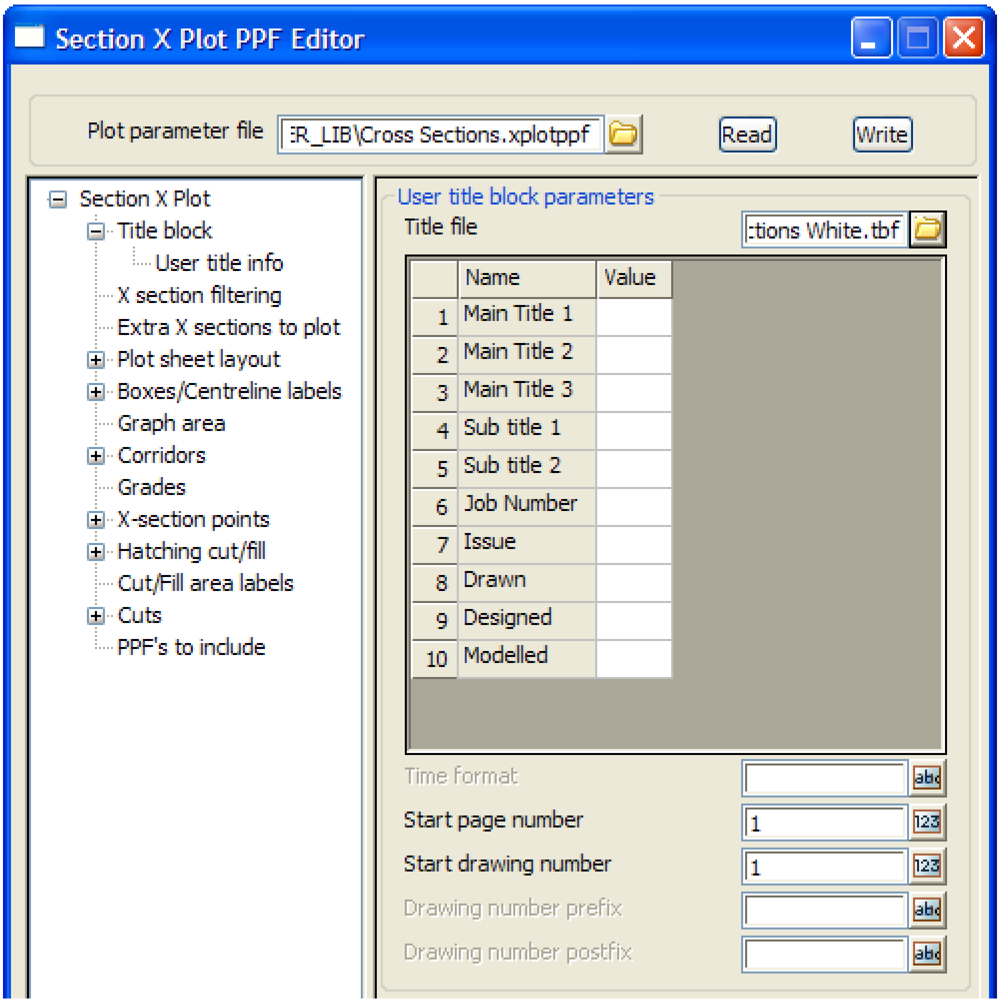
In the **Plot parameter file** box located at the top of the panel, LB click on the folder icon to bring up the folder choice box.



Walk right on the User Library menu (**[User Lib]**) and select the file **Cross Sections.xplotppf** by double clicking LB on the file name in the choice box. This file is a binary PPF file. Complete the sequence by pressing the **Read** button adjacent to the **Plot parameter file** box. This loads all the plot parameters into the current panel.

Select the section view from which the plot is to be generated from by LB click on the view icon button adjacent to the **View to load details from** box near the top of the panel. Select view **XS**. **Note:** If a value is typed then the user must then press the enter key to accept the view.

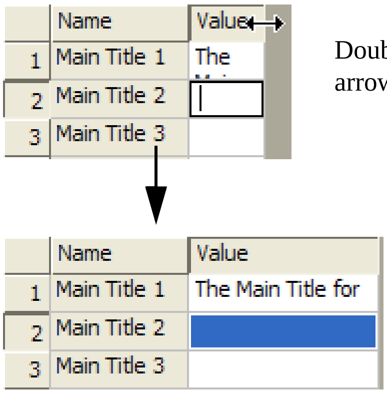
Go to the **User title info** level by navigating the tree control as described previously. The level should be selected which will look as follows.



The parameters on the right of the panel include the user title block parameters. The title file given in the ppf file, has been read into the grid with the names of the title user text shown in the name column, and the value column shown blank. If valid values are entered into the grid, they will be substituted into the title block at the time of plotting automatically.

This panel can be resized by moving the mouse to the extremities of the panel and whilst holding down the LB near the edge, moving the outline to the required size just like resizing any view. Resize the panel in both the horizontal and vertical so that it takes up most of the screen. **Note** Like any panel it can be minimised by using the standard windows minimise button.

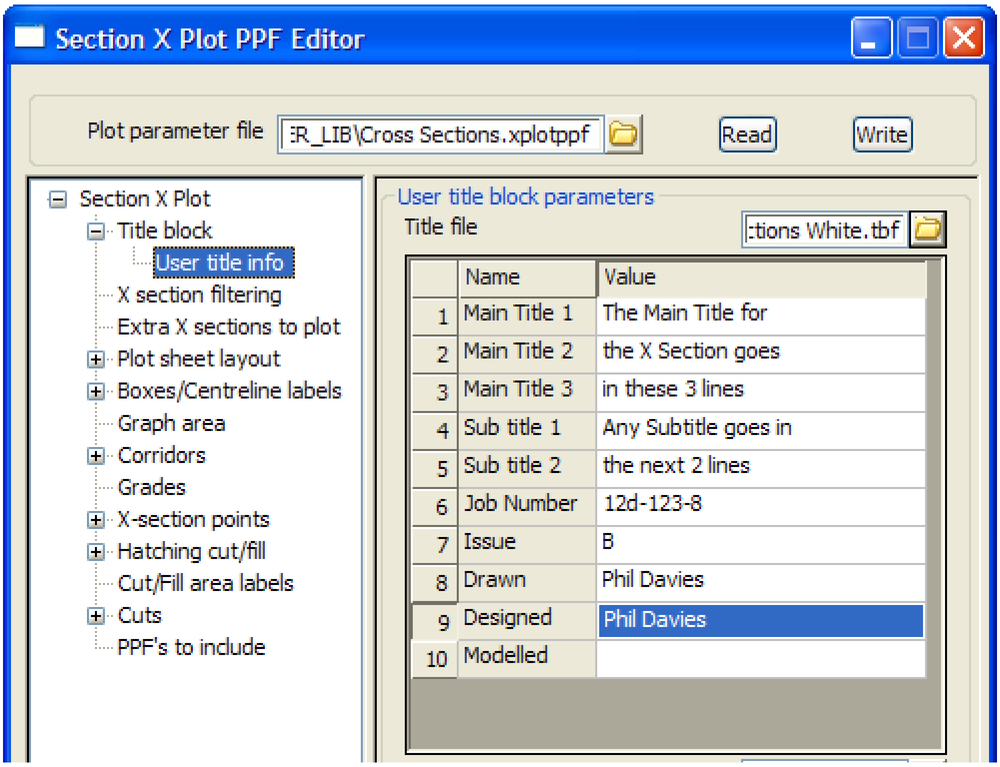
We will enter a few values into the grid to show how the user text will be substituted into the title box at the time of plotting. LB click in the value filed adjacent to the **Main Title 1** name field, then type some data. As the default size for the column has been set to the width of the column heading, it will be necessary to resize the column to see all of the typed text. To do this, move the cursor over the vertical dividing line of the grid, near the right hand end of the 'Value' column heading. You will see a resizing arrow appear. Double click LB whilst this arrow appears and the column will be resized to show all the text.



Double click LB when the resizing arrow appears.

The column is resized to the width of largest value in the column

Complete the rest of the grid as follows:

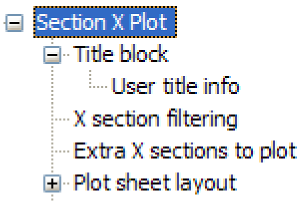


Note that all the value fields do not have to be filled out.

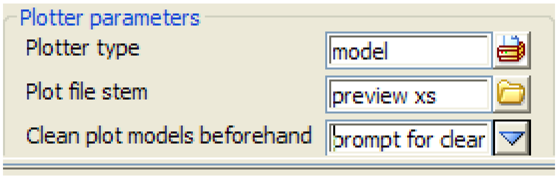
At any stage of the editing process, the user can write a binary PPF file that can be read into a panel at a later time. This is helpful if you want to close the **Section X plot and PPF editor** panel but want to save the changes. Simply type a file name into the Plot Parameter File box at the top of the **Section X plot and PPF editor** and press the enter key. This assigns the relevant file extension. Then press the **Write** button at the top of the panel.

To read an existing PPF file, the user can choose the file from the Plot Parameter File box, then press the **Read** button. This loads any existing parameters into the grid.

Prior to plotting



Return to ‘Section X Plot ’ part of the panel



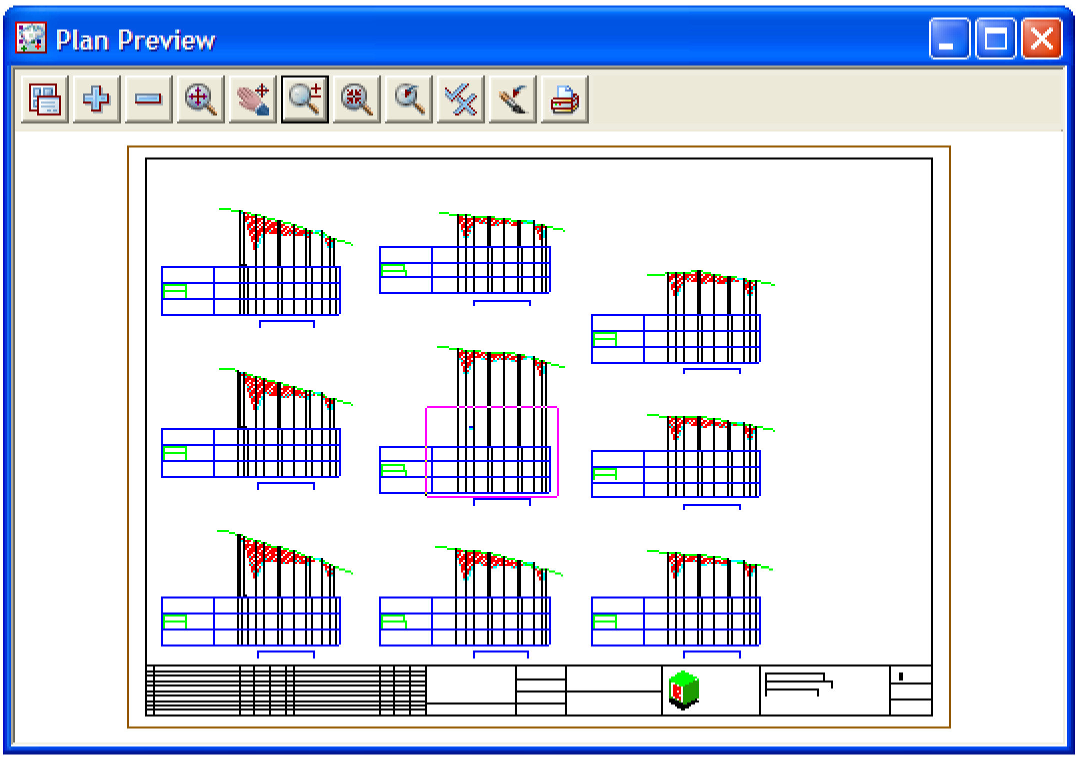
Select **prompt for clean** as the choice for ‘Clean models before hand’. This gives the user the option to clean at the time of creating the plot

To generate a plot simply press the **Plot** button at the bottom of the panel.

Select **Yes** to confirm cleaning any existing plot models

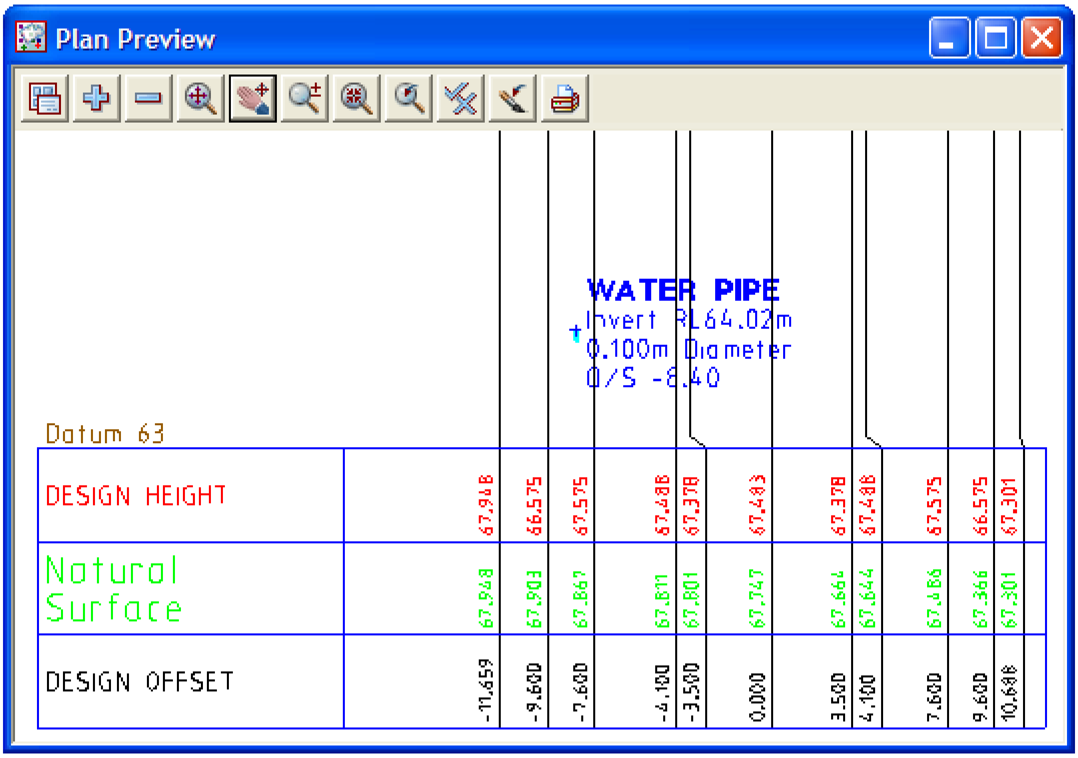
12d will realise that it needs multiple sheets to complete the job. We supplied the plot file stem **xs**. 12d will automatically create as many sheets as it needs to in the sequence As we plotted to a ‘Model’, we will get models **preview xs 1, preview xs 2** etc. If we plotted to DXF, we would get files **preview xs 1.dxf, preview xs 2.dxf** etc.

In view ‘Plan Preview’, turn OFF all models then turn on the model **preview xs 1.** You’ll notice round objects below the road as shown below.



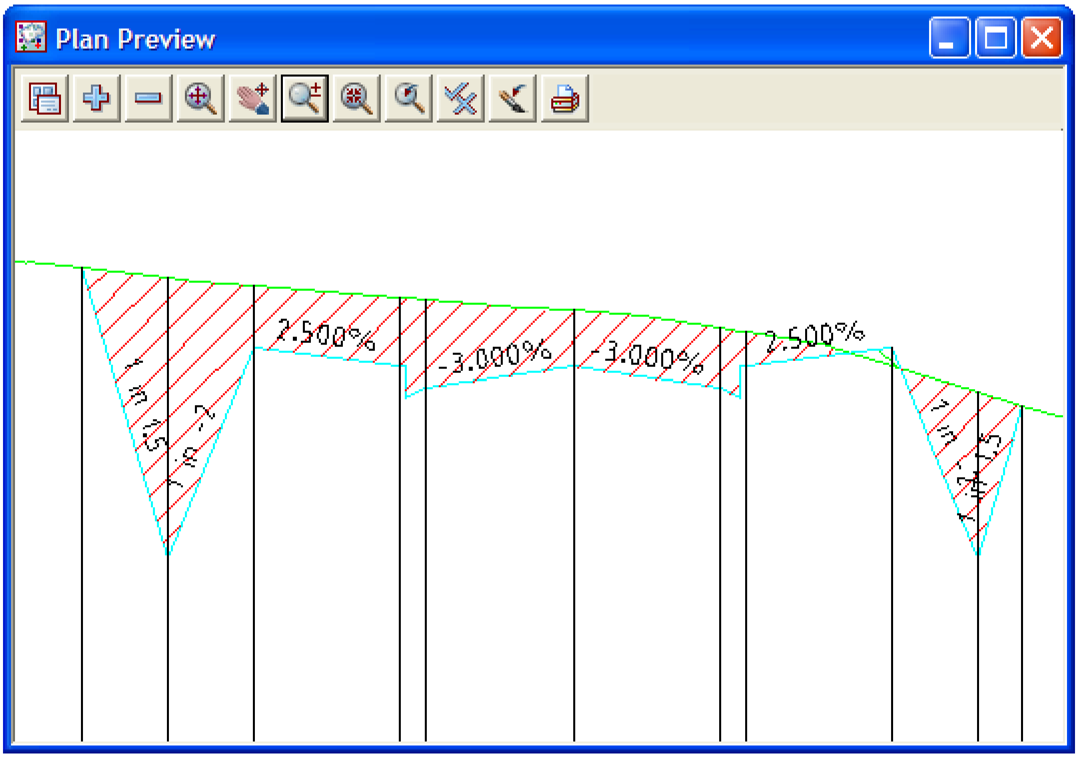
Zoom in as shown on the one of the cross section.

Note the annotation in the boxes area. This is all user definable via plot parameters. Note the water string being labelled automatically where it crosses the road cross section.



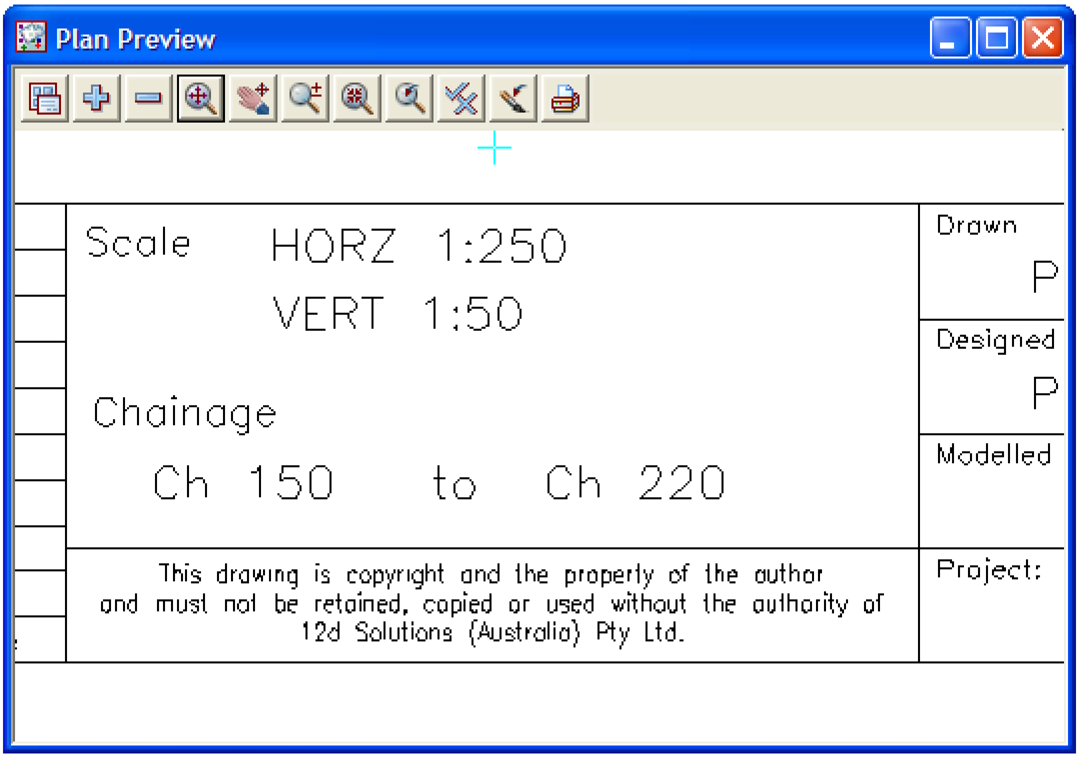
You will notice that 12d starts each sheet by assembling cross sections in the bottom left corner and working upwards. When it can no longer fit more sections in that ‘column’, it will move to the right and, starting at the bottom of the sheet work upwards again. When it fills a sheet, it will automatically go to the next sheet. All cross sections are presented in increasing chainage order.

Now **Zoom** in on the road surface at the same x section and note the labelling of the grades.



Finally, **Zoom** in at the base of the sheet and observe the Title block text

12d knew that it could only fit a certain chainage range of cross sections on the sheet and so it automatically included the start and end chainages for the sheet in the title block.



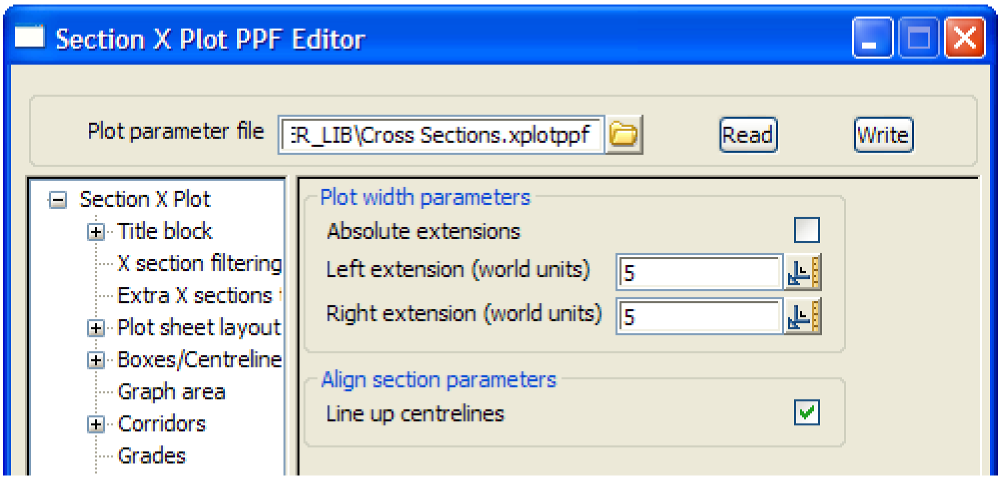
The other sheets will contain similar sections.

17.12.1Extending the Natural Surface Beyond the Cross Section

Note that 12d uses the extend concepts when plotting.

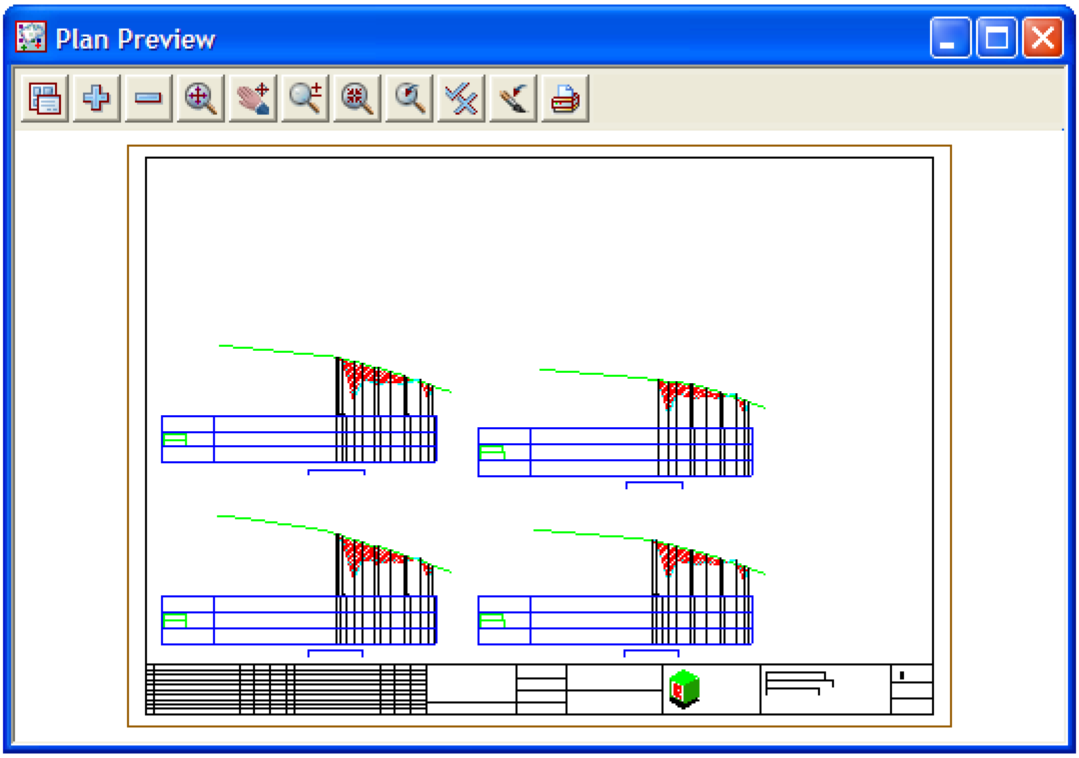
When plotting cross sections, 12d uses some of the parameters of the Section View where the cross section is being profiled. For instance the vertical exaggeration of the 'Section XS' view determines the vertical scale of the finished plot.

View 'Section XS' has an extend parameter that determines the extent of what you see on the screen. This parameter is however not used for plotting. The amount of the extend required in final plots is set separately in the **Section X Plot PPF Editor** panel under **Plot sheet layout**



If you were to set the LHS extension to 30 m, you get the following type of cross section plot.

This technique can be useful at times, particularly at locating services away from the cross section.

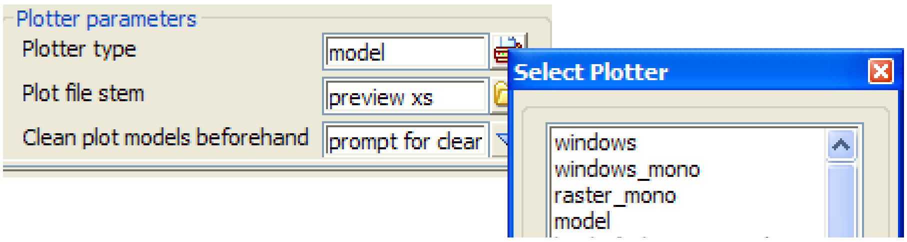


17.12.2 Previewing Cross section and Managing Cross Section Plot Files

To preview a plot, just turn on the model containing the previewed plot in view 'Plan Preview'. It is highly likely that you will need to change some of your plot parameters and repeat the plot and preview process several times before your plots are as you want them.

You can make changes to your plot parameters and repeat the plot as many times as necessary.

Once the plot is satisfactory, the user can send the plot to a device. Simply select an appropriate device from the plotter icon and then Click LB on the **Plot** button.



17.12.3 Automatic Labelling of Crossing Services on Cross Sections

The "Automatic Labelling of Crossing Services on Long Sections" on page 217 also applies to automatic labelling of crossing services on Cross sections in an identical manner. Examples of this are seen in the above Cross section plots.

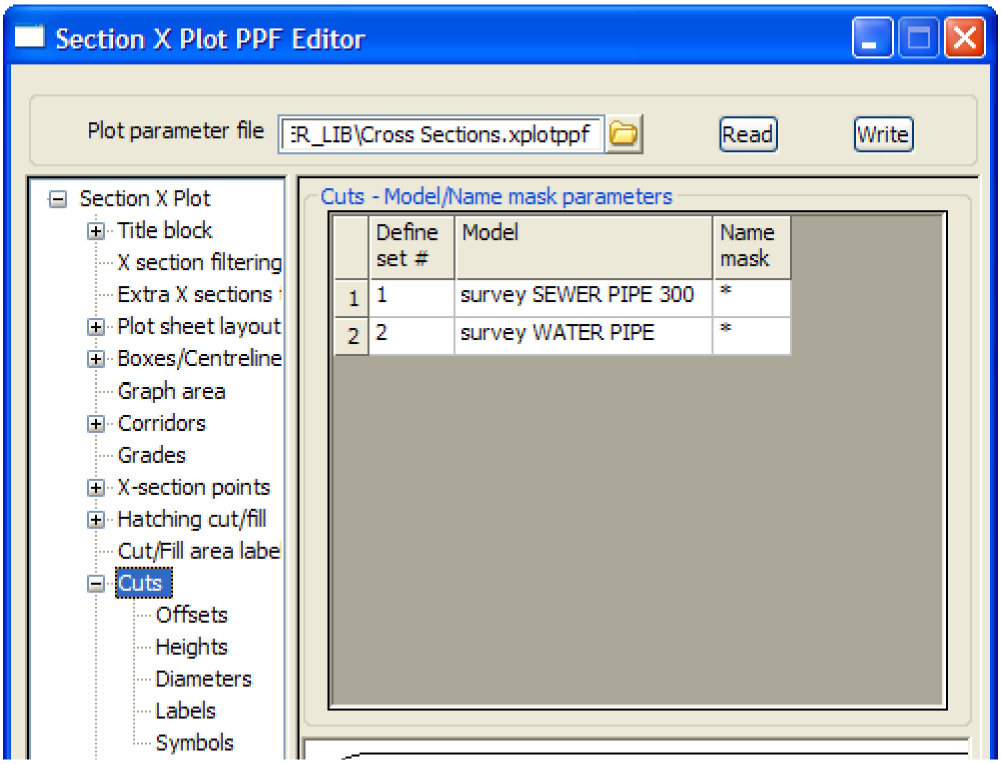
With the plot parameter files supplied with the training data, the following models are used for services.

survey SEWER PIPE 300
survey WATER PIPE

This is a user defined convention only. You can use any names you like for this purpose.

When 12d creates a long section plot, it will search for any strings in the above models. Masks (optionally using wild cards) can be used in the match on the string name so that only certain strings in the model are recognised.

To view the parameters that control the service plotting, go to the **cuts** section of the **X Plot and PPF editor**):



The top level of the cuts section defines multiple sets of model/mask combinations. The user can stipulate a whole model or certain strings from that model by specifying a mask.

The levels under the cuts section relate to the offsets, height, label and symbol information that is to be placed on the plot.

Cuts - Offset parameters

	Use set #	Position	X (mm)	Y (mm)	Angle (dms)	Colour	Size (mm)	Textstyle	Pre-text	Post-text	Justification
1	1	at cut string height	2	-10	0	orange	3.5	ISO	O/S		bottom-left
2	2	at cut string height	2	-10	0	blue	3.5	ISO	O/S		bottom-left

Cuts - Height parameters

	Use set #	Mode	Position	X (mm)	Y (mm)	Angle (dms)	Colour	Size (mm)	Textstyle	Pre-text
1	1	use height of cut point	at cut string height	2	0	0	orange	3.5	ISO	Invert RL
2	2	use height of cut point	at cut string height	2	0	0	blue	3.5	ISO	Invert RL

Cuts - Diameter parameters

	Use set #	Position	X (mm)	Y (mm)	Angle (dms)	Colour	Size (mm)	Textstyle	Pre-text	Post-text	Justification
1	1	at cut string height	2	-5	0	orange	3.5	ISO		m Diameter	bottom-left
2	2	at cut string height	2	-5	0	blue	3.5	ISO		m Diameter	bottom-left

Cuts - Label parameters

	Use set #	Position	Mode	X (mm)	Y (mm)	Angle (dms)	Colour	Size (mm)	Textstyle	Pre-t
1	1	at cut string height	do not include cut string name	2	5	0	orange	3.5	HELV	SEW
2	2	at cut string height	do not include cut string name	2	5	0	blue	3.5	HELV	WAT

Cuts - Symbol parameters

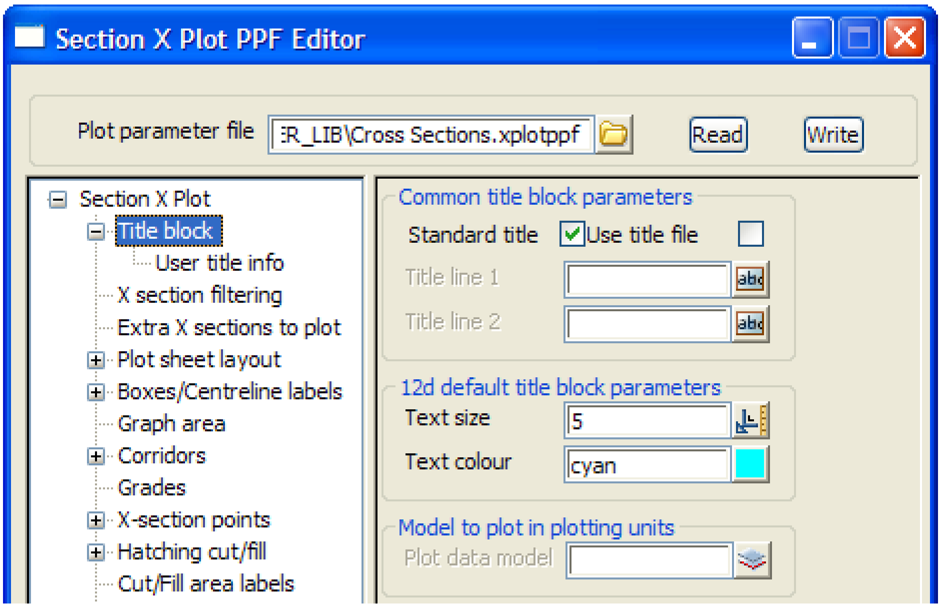
	Use set #	Mode	Symbol	Position	X (mm)	Y (mm)	Angle (dms)	Colour	Size (mm)
1	1	cross (0)		at cut string height	0	0	0	orange	1
2	2	cross (0)		at cut string height	0	0	0	blue	1

The user defined standard for symbol labelling services (as defined above) is to place a cross at the invert point of the pipe and place a label alongside this (as defined above).

In our case, view ‘Section XS’ contained the model of sections we want to plot. If we turn on the above service models in view ‘Section XS’, the finished plot will also include the actual pipe strings as well. If you have a Vertical Exaggeration on the view other than 1, the pipe will appear as an ellipse rather than a circle.

17.13 Miscellaneous Cross Section Plotting

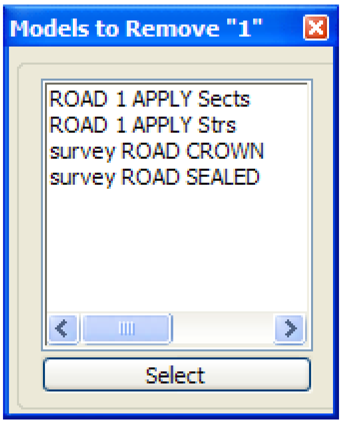
The example we have used had a user defined title file. However, the user can select not to plot the user defined title block and use the standard 12d model title block. You may also elect not to use any.

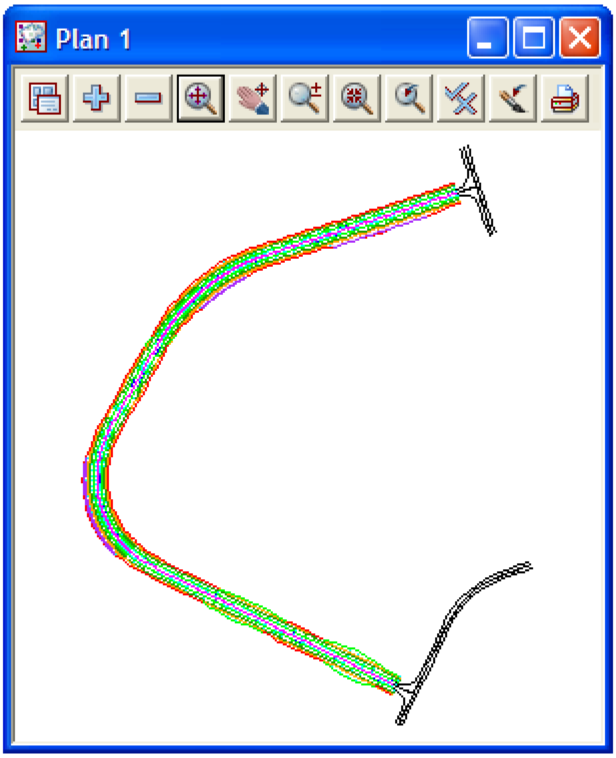


17.14 Plan Plotting Using Plot Frames

Plot frames are a set of tools within 12d that permit a series of plan plots to be readily generated and regenerated as required. The plot frames are superimposed over data in that view and the various frames 'plotted'. All plots are clipped to size by the plot frames and will contain only the data that is on display in the plan view being processed. The user decides to plot one or more frames individually or plot a complete set.

We now need to assemble the data we want to plot in a view. We will use view 'Plan 1' for this purpose. Make sure that the following models are turned on in view 'Plan 1'.





Your view ‘Plan 1’ should look as follows.

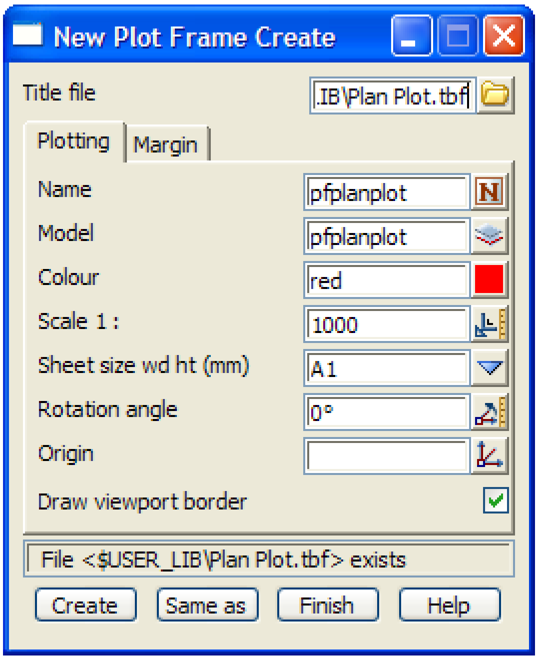
We want to create plot frames that encompass the various roads in the view. We will probably need more than one plot frame. In our case, each plot frame will represent an A1 sheet.

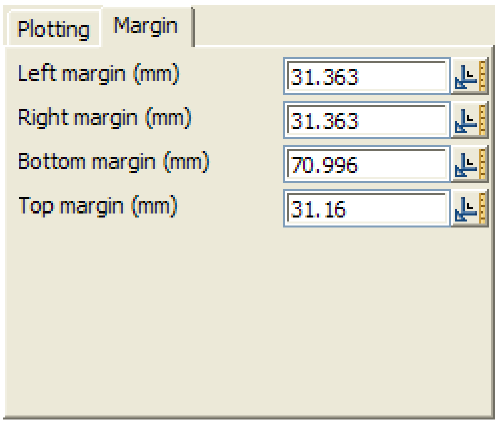
17.14.1Creating Plot Frames

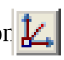
We will create our first plot frame.

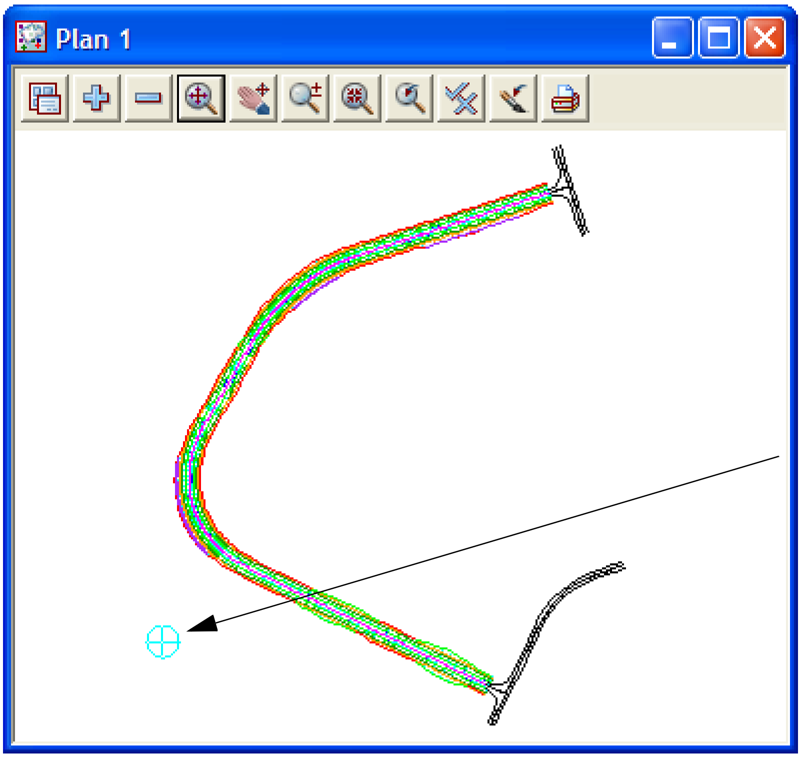
User defined plot frames can be placed over the data in the view. These frames show both the sheet size and plot area borders.

From the ‘Plot Frames’ menu **Plot =>Plot frames**=>**Create**
From the User Library, choose the title file **Plan Plot.TPs** and the panel will be filled out as follows:





Click LB on the Origin icon 

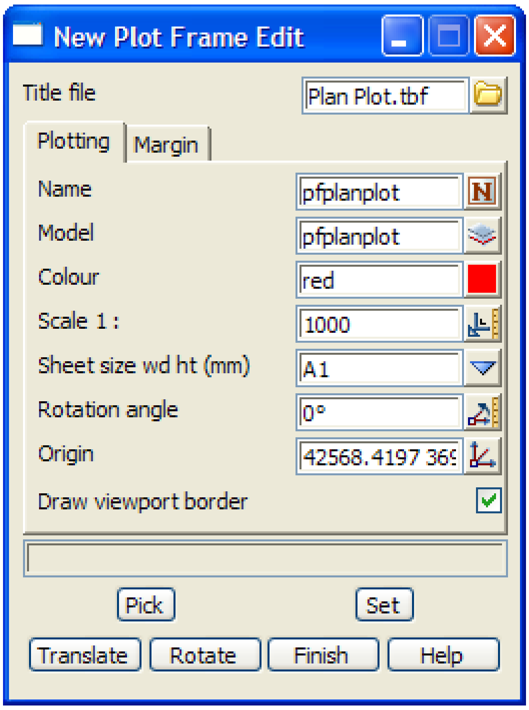


Make sure that your Point and Line snaps are OFF and select a point in the bottom left of the view as shown by the cyan circle.

Confirm the selection with MB. The X and Y coordinates should appear in the field.

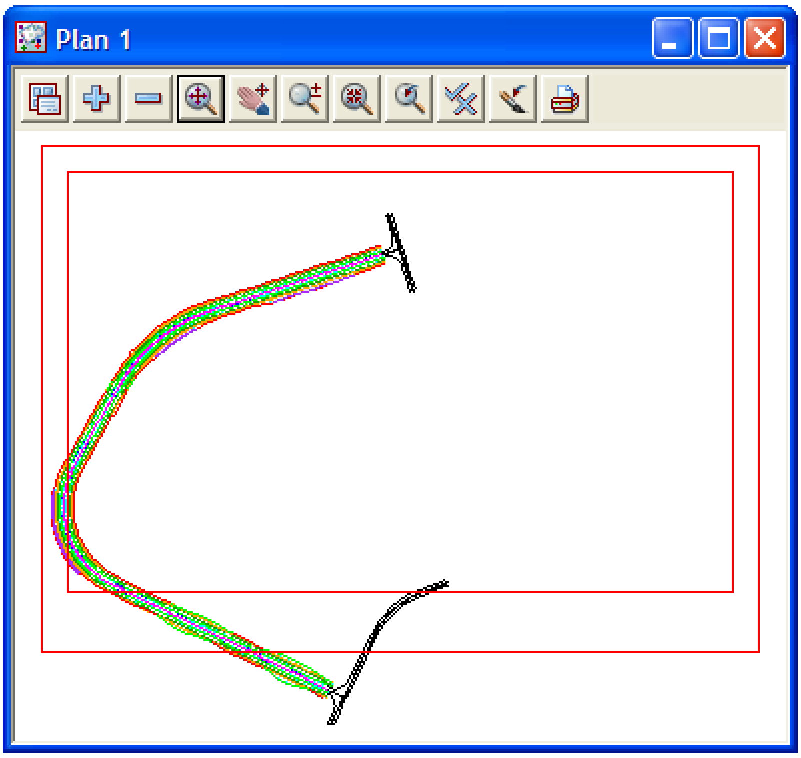
Then select the **Create** button.

12d will transform the panel into the 'New Plot Frame Edit' panel (so that you only get one chance at creating that plot frame). It can be edited later if there is an error.



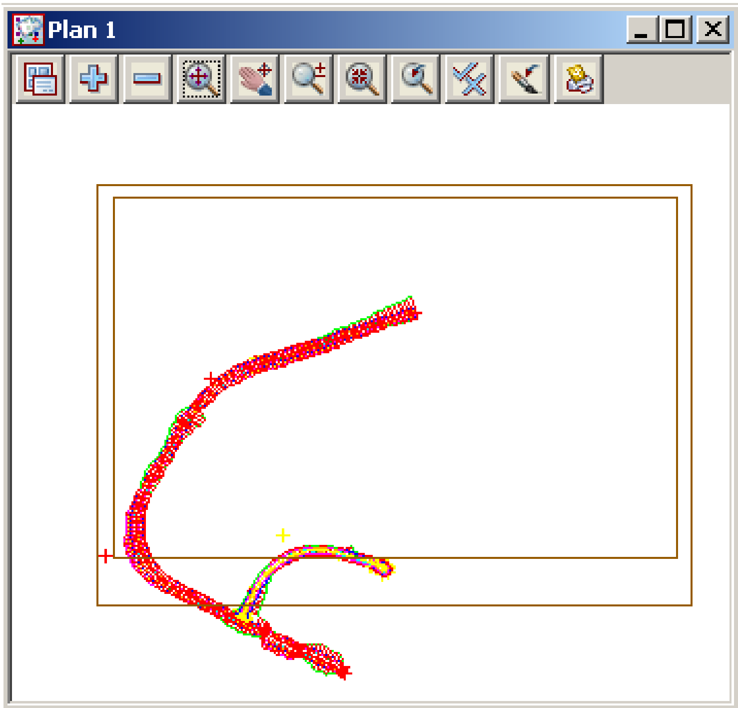
You will notice that the Edit panel is very similar to the Create panel.

To see our plot frame, you need to use the '+' in the 'Plan 1' view to turn on model **pfplanplot**. Do a **Fit** on the view.



Clearly our first guess at the scale is incorrect. We need to scale down our plot frame.

In the 'New Plot Frame Edit' panel, opposite the 'Scale 1:' field, change the 1000 to **500** and click LB on the **Set** button.



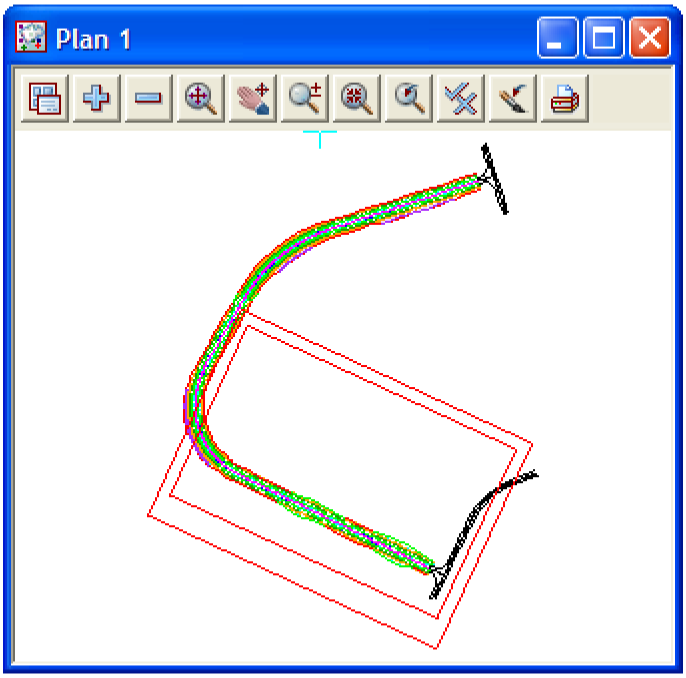
Click LB on **Fit** to fill the view.

For the next operation, make sure that your Point and Line snaps are OFF as we don't want to snap to anything.

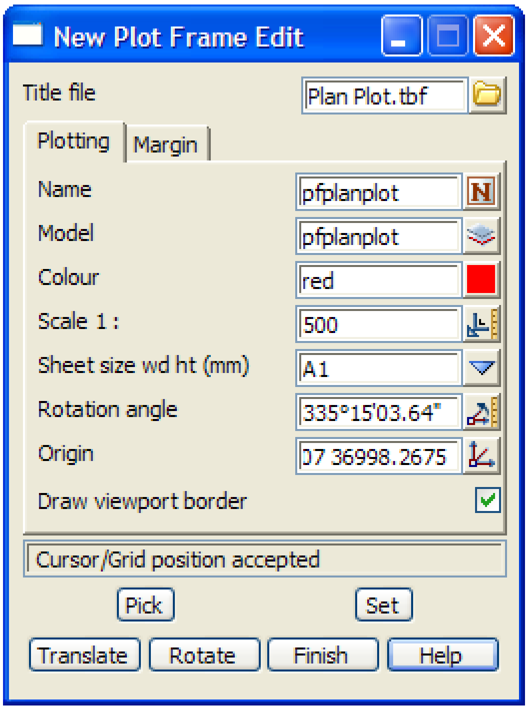
In the 'Plot Frame Edit' panel, click LB on **Rotate**. Move the cursor into the 'Plan 1' view and notice that you can rotate the plot frame about it's insertion point. When you have the cursor positioned appropriately, click LB and MB to confirm the selection.

Similarly, click LB on the **Translate** button and move the plot frame in view 'Plan 1'. You will notice that the rotation angle is maintained as you move the cursor. When you have the cursor positioned appropriately, click LB and MB to confirm the selection.

The final position of your plot frame pf1 should look as shown below.



You are trying to arrange the sheet to maximise the amount of information shown on it i.e. minimise the number of sheets.



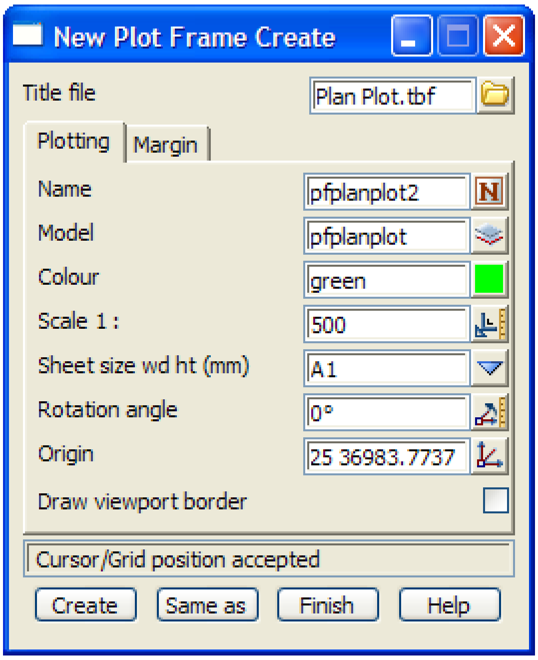
Notice that the rotation angle and origin now have non-zero values.

That finishes the development of our first plot frame.

Click LB on **Set** and **Finish**.

Now make sure that your Point snaps are ON (so that we can pick a plot frame at it's corner).

Click LB on **Plot =>Plot frames**=>**Create** again.



The panel will initially come up blank.

Click LB on the **Same as** button, position the cursor near any one of the corners of the ‘pfplanplot’ plot frame and click LB to select it. When it highlights, click MB to confirm the selection.

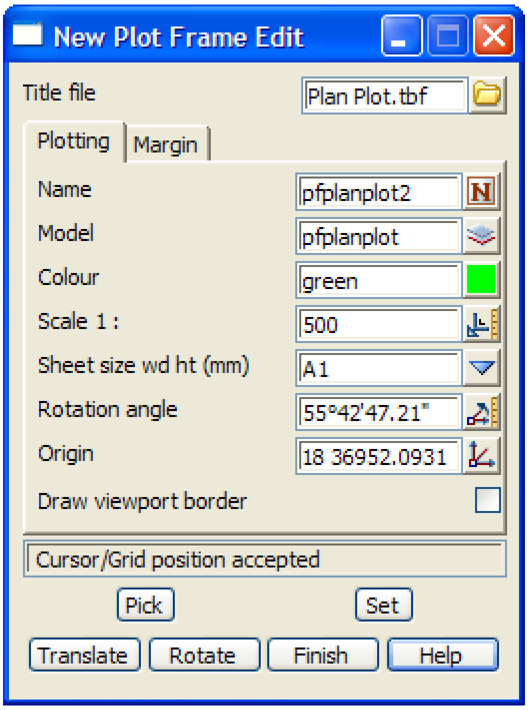
Change pfplanplot to **pfplanplot2**

Change the Colour from red to **green**

Click LB on the **Create** button.

12d will transform the panel into the ‘Plot Frame Edit’ panel

For the next operation, make sure that your Point and Line snaps are OFF as we don’t want to snap to anything.

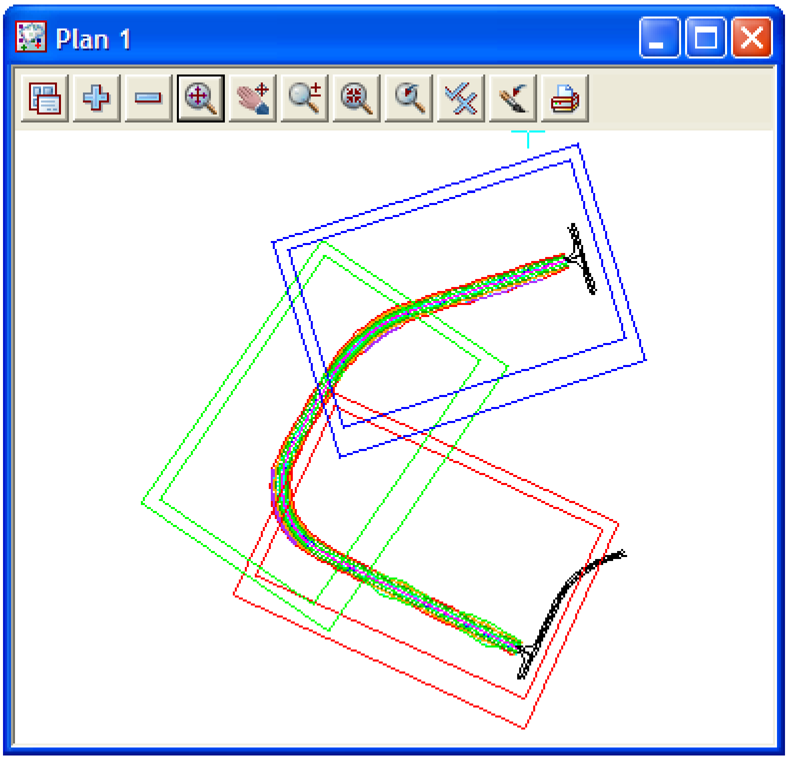


As before, click LB on **Rotate**. Move the cursor into the ‘Plan 1’ view and rotate the plot frame about it’s insertion point. When you have the cursor positioned appropriately, click LB and MB to confirm the selection.

Then click LB on the **Translate** button and move the plot frame in view ‘Plan 1’. You will notice that the rotation angle is maintained as you move the cursor. When you have the cursor positioned appropriately, click LB and MB to confirm the selection.

Click LB on **Set** and **Finish**.

You will need to do the same thing one more time to create a third plot frame.



The finished position of your plot frames should look as shown.

17.14.2Using the Plot Frame Editor

If you ever want to make changes to one of your plot frames and the panel is not currently on display, you can use the Plot Frame editor to do this. Make sure that your Point snaps are ON (so that you can pick a plot frame at it’s corner).

Click LB on **Plot =>Plot frames**=>**Editor**

Position the cursor near any one of the corners of the plot frame you wish to edit and click LB to select it. When it highlights, click MB to confirm the selection. The ‘Plot Frame Edit’ panel will appear as seen earlier.

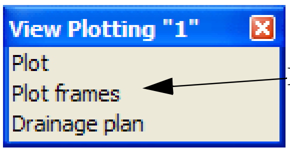
To shut down the ‘New Plot Frame Edit’ panel click LB on **Finish**.

17.14.3Create Plot using Plot Frame PPF Editor

Plotting using the plot frame ppf editor can be started using the plan view plotting icon

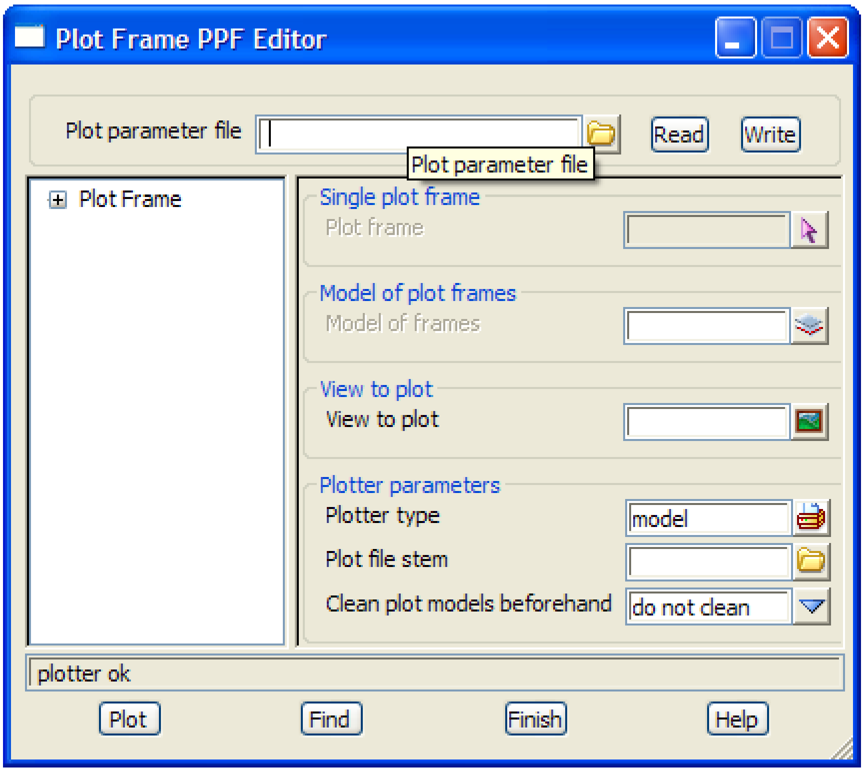
LB click on plotting icon

This brings up the **View Plotting** panel

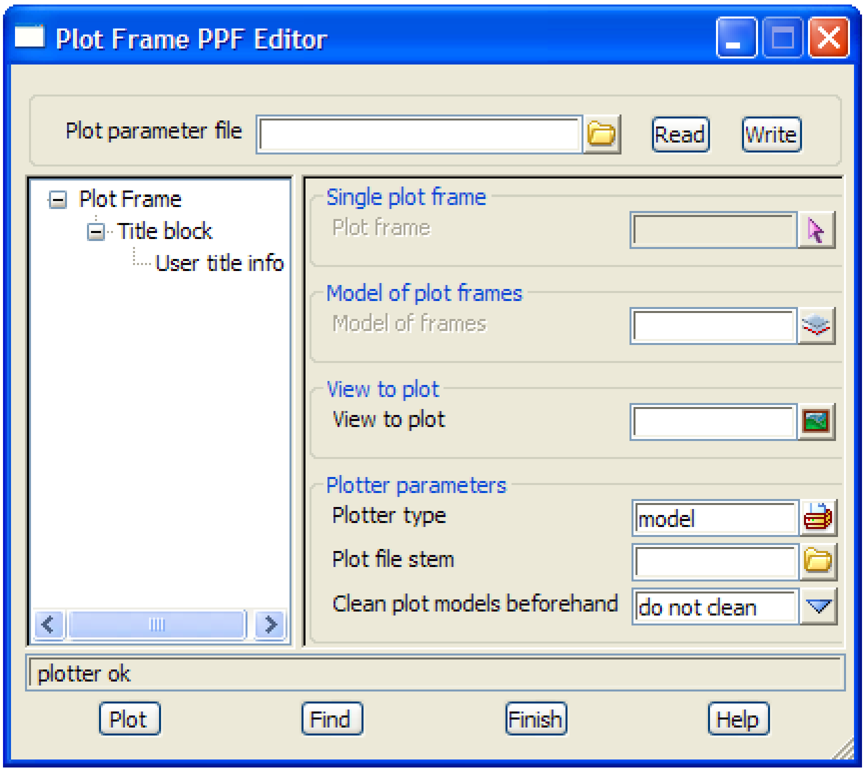


LB click on Plot frames

This then brings up the **Plot frame PPF Editor** panel.

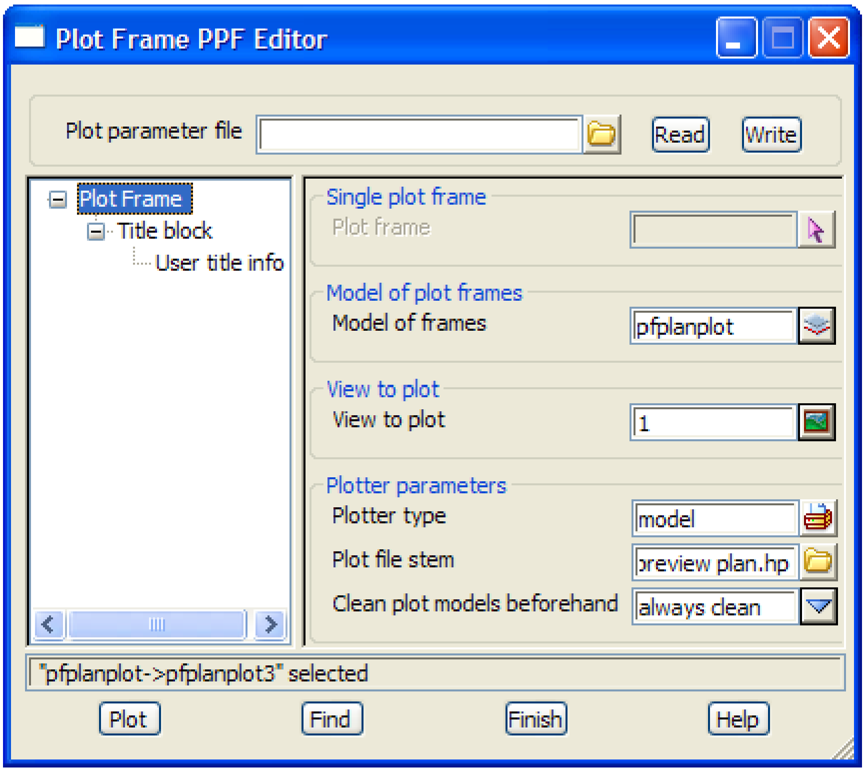


This panel has a tree structure, much like the Windows explorer type functionality. The + symbol near the "Plot Frame" text in the left of the panel indicates that there are levels below. To access lower levels, simply LB click on the + symbol to expand the tree. Expand the tree so there are no more + symbols and every level is shown.



To go from one level to another, simply LB click on the text headings on the tree structure. Click LB on the

"Plot Frame" level. Fill the fields to the right of the tree using the relevant icon buttons where possible e.g. select the model **pfplanplot** from the model choice box. The fields should look as follows:

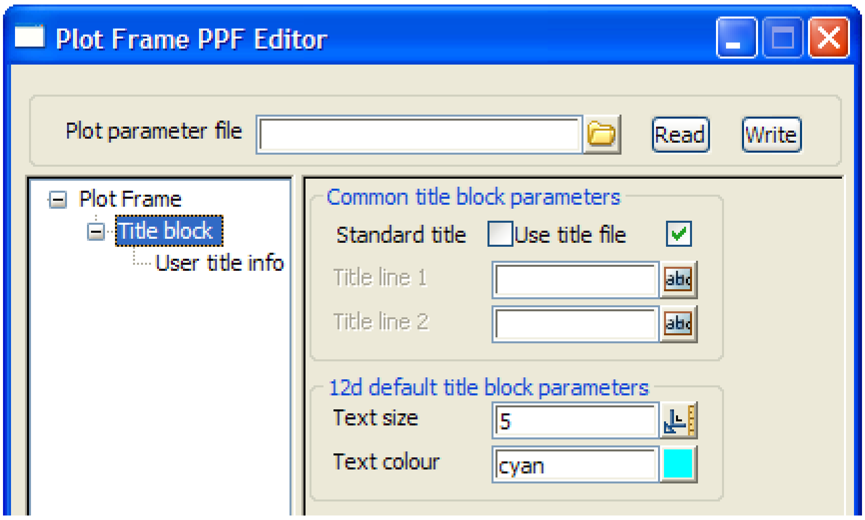


The plotter type to select is model, as we want to inspect the plot before sending it to the actual plotter.

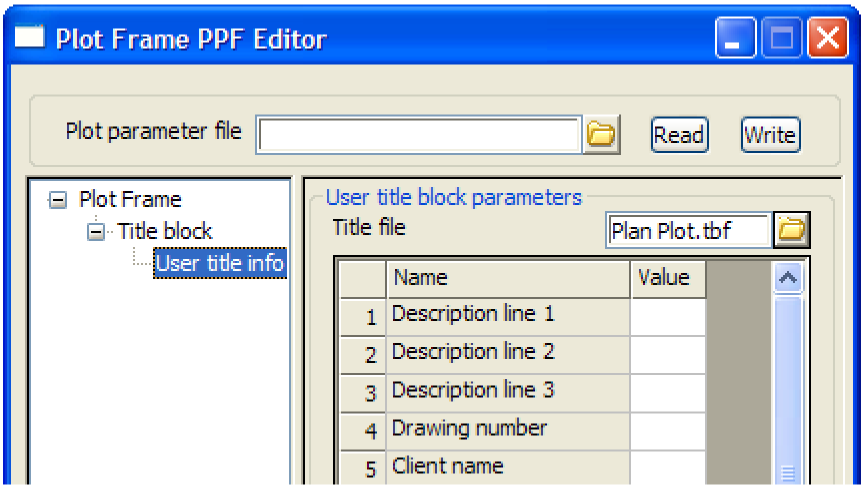
In our example, we want to plot more than one Plot frame so we have chosen the Model of plot frames method. If we wanted to plot a single plot frame, we can select the frame using the Single plot frame selection tool.

Type in "preview plan" as the plot file stem. The plot stem specified will form the prefix for the plot name. This is important for plotting of a number of plot frames. For this example we have 3 plot frames so the 3 plot files produced will be "preview plan 1", "preview plan 2" and "preview plan 3".

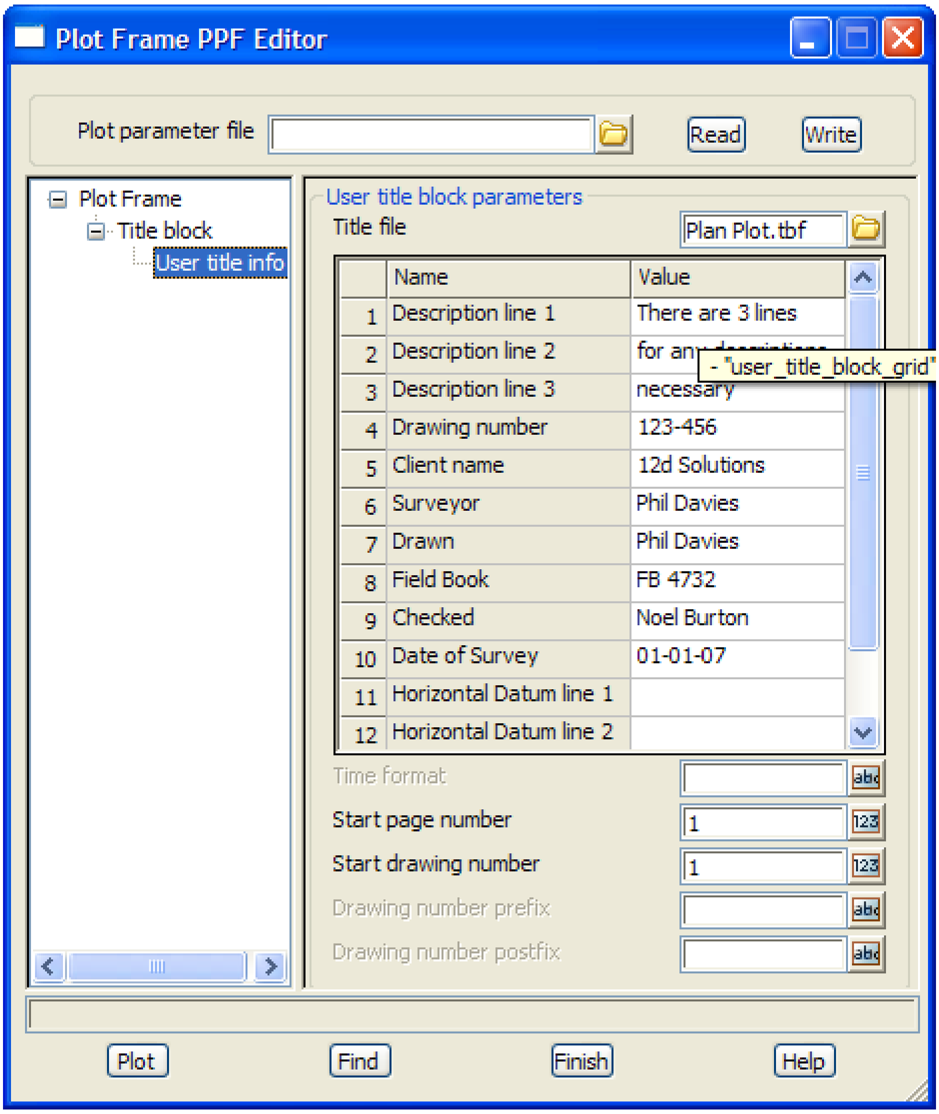
Click LB on the "Title block" heading. Tick the Use title file checkbox as follows. This specifies that a Title file will be used for the plotting.



Click LB on the "User title info" heading. From the User Library choose the **Plan Plot.tbf** file.



Once selected, a valid title file will populate the grid with user defined title file aliases. These are prompts for title box text and once filled out, will be substituted into the title block. Fill out the value part of the grid as follows. Fill out the form to suit your requirements.



This panel can be resized by moving the mouse to the extremities of the panel and whilst holding down the

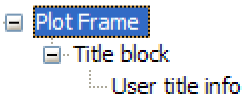
LB near the edge, moving the outline to the required size just like resizing any view. Resize the panel in both the horizontal and vertical so that it takes up most of the screen. **Note** Like any panel it can be minimised by using the standard windows minimise button.

Note that all the value fields do not have to be filled out.

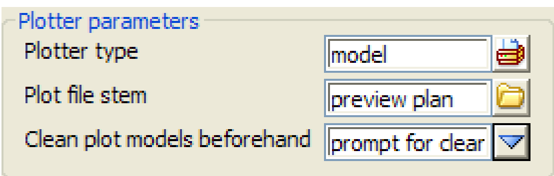
At any stage of the editing process, the user can write a binary PPF file that can be read into a panel at a later time. This is helpful if you want to close the **Plot frame PPF Editor** panel but want to save the changes. Simply type a file name into the Plot Parameter File box at the top of the **Plot frame PPF Editor** and press the enter key. This assigns the relevant file extension. Then press the **Write** button at the top of the panel.

To read an existing PPF file, the user can choose the file from the Plot Parameter File box, then press the **Read** button. This loads any existing parameters into the grid.

Prior to plotting



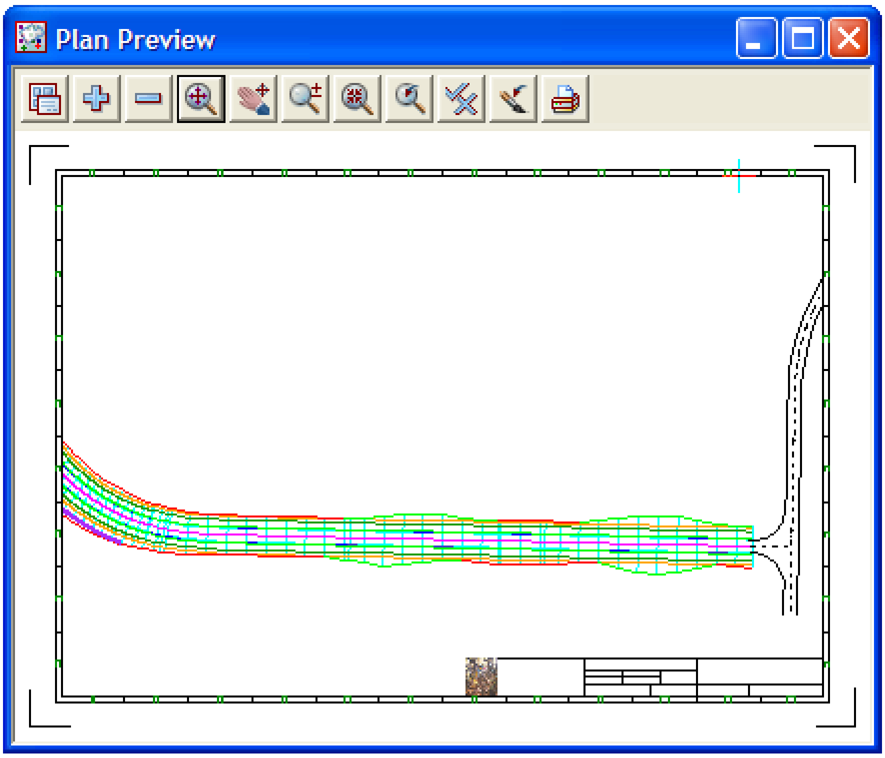
Return to 'Plot frame' part of the panel



Select **prompt for clean** as the choice for 'Clean models before hand'. This gives the user the option to clean at the time of creating the plot

To generate a plot press the **Plot** button at the bottom of the panel followed by pressing **Yes** to confirm cleaning the plot models.

In view 'Plan Preview', turn OFF all models then turn on the model **preview plan 1**.

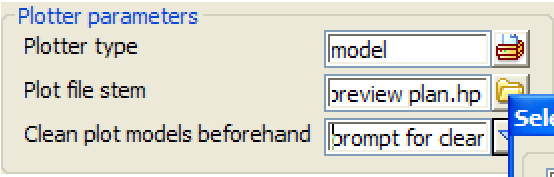


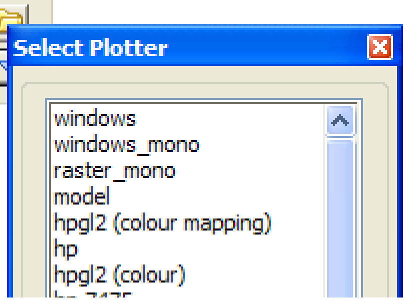
17.14.4Previewing Plan plots and Managing Plan Plot Files

To preview a plot, just turn on the model containing the previewed plot in view ‘Plan 1’ e.g **preview plan 1**. It is highly likely that you will need to change some of your plot parameters and repeat the plot and preview process several times before your plots are as you want them.

You are now in a position to make changes to your plot parameters and repeat the plot(s).

When you are happy with the plot, you can change the plotter option in the Plot Frame PPf editor to the desired plotter. Double click on the appropriate plotter to select.



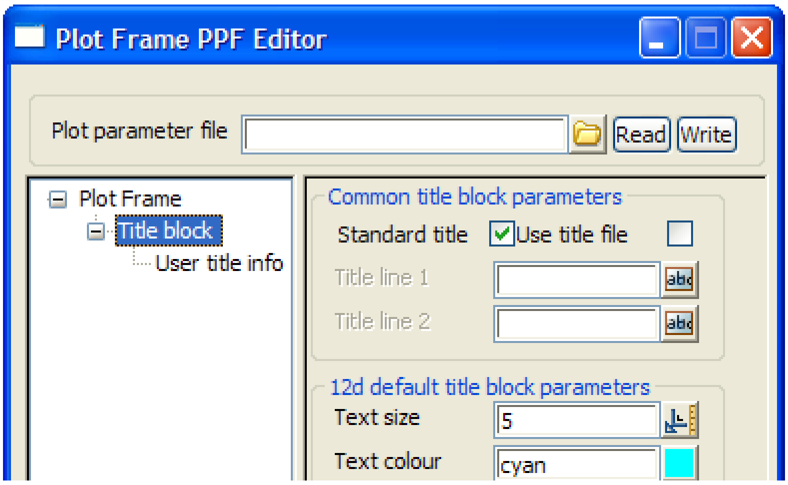


Selection of the windows plotter options will utilise the current printers/plotter set up in windows.

Press the plot button to send the plot file to the selected device.

17.15 Miscellaneous Plot Frame Plotting

The example we have used had a user defined title file. However, the user can select not to plot the user defined title block and use the standard 12d model title block. You may also elect not to use any.

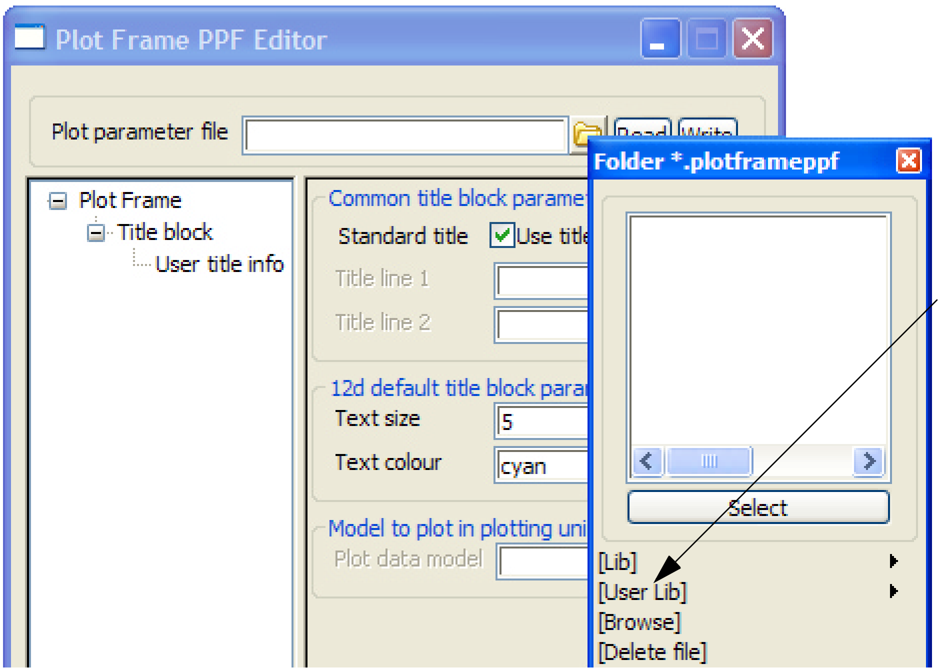


17.15.1 Saving PPF files for use with other projects

For a particular company or organisation, various styles/specifications may have to be consistent for all plots. If a standard PPF is created for a company this can be saved to the **User_lib** directory for easy access for any project. Then for more specific changes, such as the user text (that is substituted into a title file) the new value can be entered and a PPF saved again. e.g. The designers name may be changed and the PPF saved with a filename "designers_name" for example.

At any stage of the editing process, the user can write a binary PPF file that can be read into a panel at a later time. This is helpful if you want to close the panel but want to save the changes. Simply type a file name into the Plot Parameter File box at the top of the editor and press the enter key. This assigns the relevant file extension. Then press the **Write** button at the top of the panel. The write process will by default put the file produced into the current project folder

.



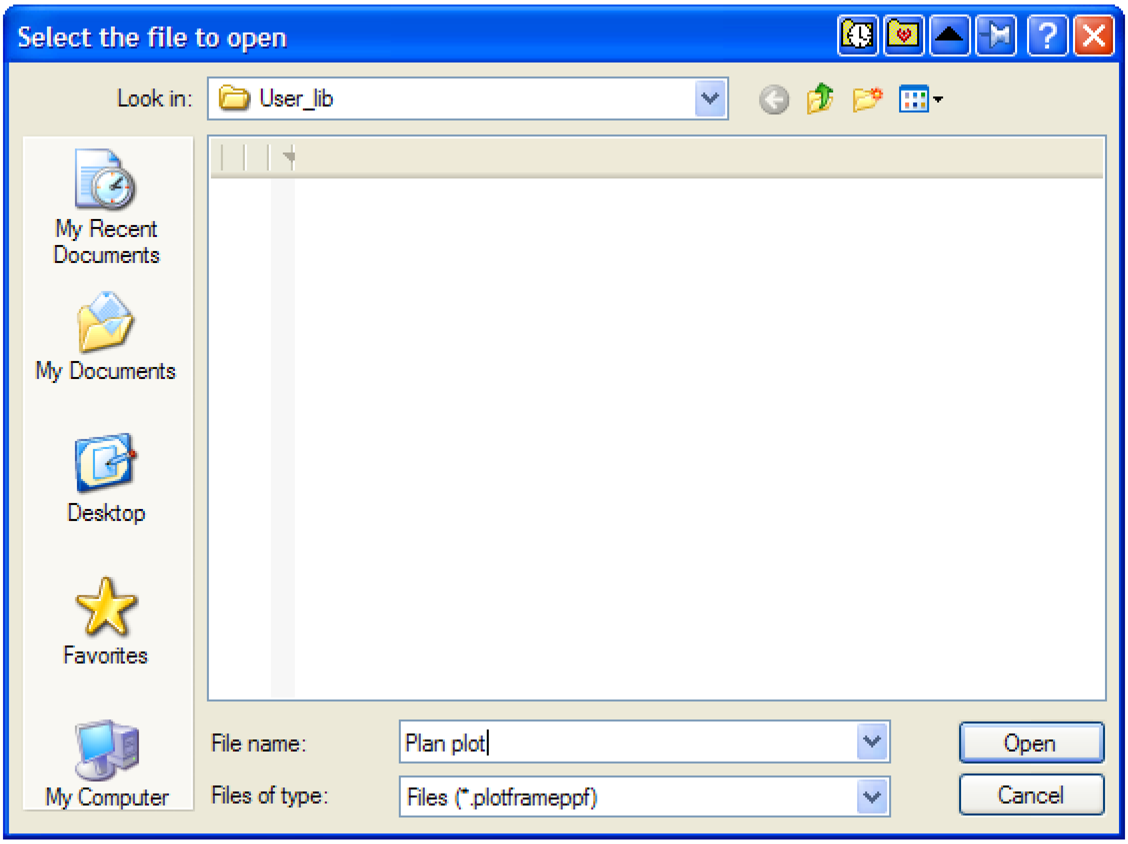
If the user wants to save it to a **User_Lib** directory for example, they must click on **[User_lib]** to open that folder

Type in the file name **Plan plot**

Select **Open**

The file name is placed in the ‘Plot parameter file’ text box.

Select **Write** to save the file



17.16 Continuing with the Tutorials

This concludes the tutorials covered by the Getting Started manual.

However, there is an *Advanced Alignment Design* manual which follows on from the *Getting Started* manual.

The training tutorials in the *Advanced Alignment Design* manual cover design for intersections, detailed roads, cul-de-sacs etc. using advanced techniques such as Apply Many, MTFs and Kerb Returns.

The *Advanced Alignment Design* manual is distributed as a PDF file on the 12d Model Installation CD.

There is also a *Getting Started for Surveyors* manual which covers material relevant to a Surveyor.

The *Getting Started for Surveyors* manual is also distributed as a PDF file on the 12d Model Installation CD.

18 Geometry Summary to Date

This tutorial continues on from the *Getting Started Manual*.

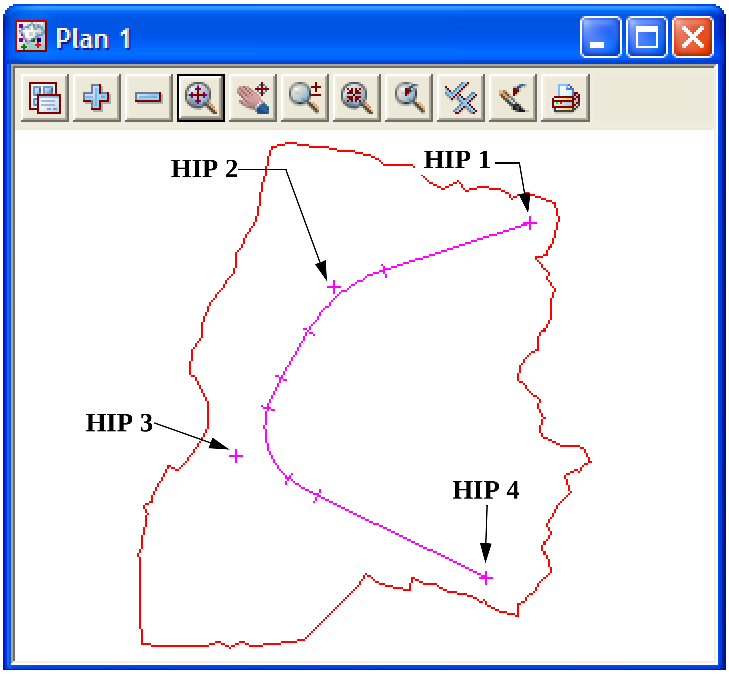
For the next stage of the tutorial it is important that your data accurately matches the road defined in the previous 17 chapters as we will be importing data to interact with the existing design. To ensure this we have created a new project called ***Stage 2*** found in the **C:\12djobs\8.00\Training\Design\Getting Started Advanced** directory.

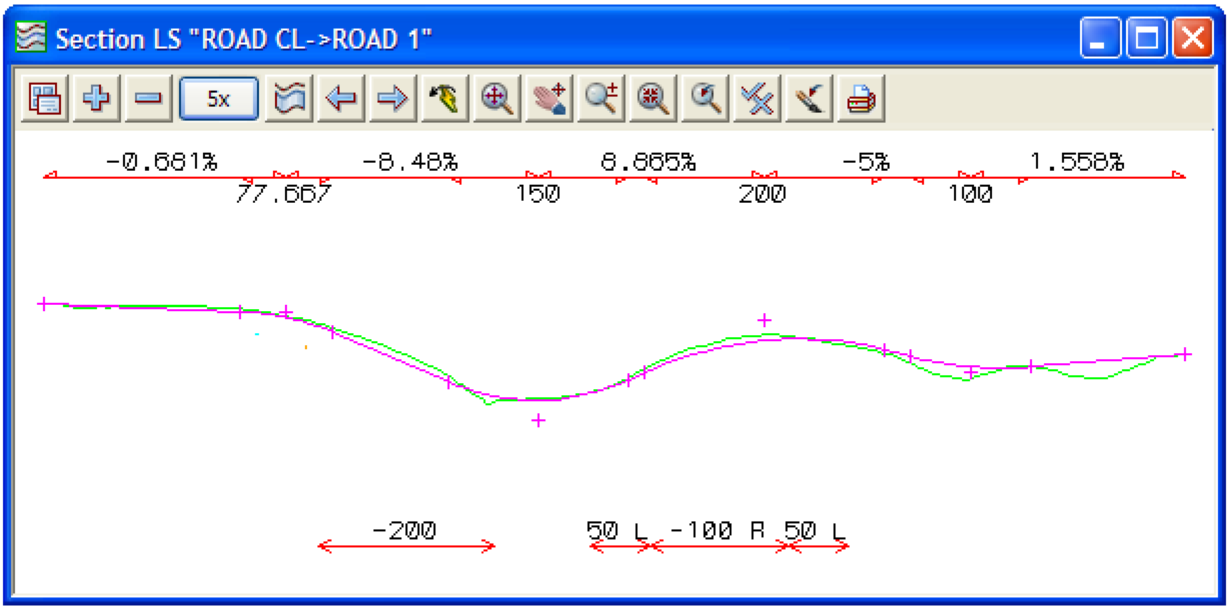
You will need to start this project in order to continue with this manual.

This project has already followed the steps of the Getting Started manual to create the triangulation, the horizontal and vertical alignment and the templates.

18.1 Verifying your Manually Entered Road Centreline Data

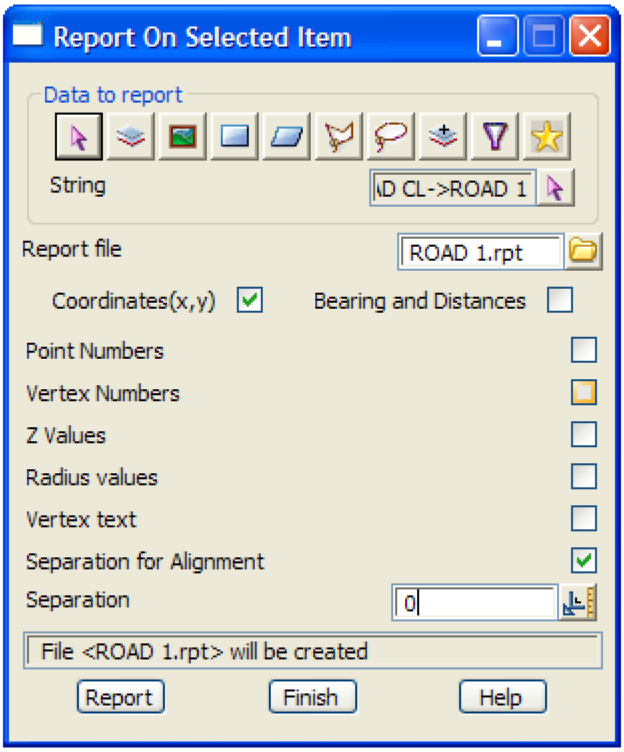
The final road centreline definition is repeated here so that you can verify your data if necessary.





The following has been extracted from a standard 12d report using option ***Report => Strings => Coord/ Brg-Dst***

.



Click LB on String icon

Click LB on alignment string in view ‘Plan 1’ then MB to accept

Type in the report file name **ROAD 1** [Enter]. The extension **.rpt** will appear after the name

Tick the check box for **Separation for Alignment**

Type in separation of **0.** This will only report on the tangent points

Click LB on **Report** to proceed. Click LB on **Finish** to terminate the panel.

Project: Stage 1
User: Philip Davies
Organization: 12d Solutions
Date: Wed Jan 24 13:52:16 2007
Report File: ROAD 1.rpt

Horizontal Alignment Report for string <ROAD 1> in model <ROAD CL>

IP Number	IP Coordinates X	Y	Radius	Leading Spiral	Trailing Spiral

1	42988.6880	37445.3950			
2	42697.9410	37350.9260	-200.0000		
3	42552.8040	37099.5420	-100.0000	50.0000	50.0000
4	42922.9470	36919.0110			

--- IP Details ---

IP 1

coordinate = 42988.6880 37445.3950
chainage = 0.0000

IP 2

coordinate = 42697.9410 37350.9260
centre = 42832.7595 37184.4386
radius = -200.0000
length = 146.6077
intersect angle = 42°00'00"

start tangent

coordinate = 42770.9563 37374.6500
length = 76.7728
chainage = 228.9365
bearing = 252°00'00"

end tangent

coordinate = 42659.5545 37284.4388
length = 76.7728
chainage = 375.5442
bearing = 210°00'00"

IP 3

coordinate = 42552.8040 37099.5420
total length = 214.0610
intersect angle = 94°00'00"

leading spiral

length = 50.0000
TS coordinate = 42619.4539 37214.9827
TS chainage = 455.7453
SC coordinate = 42598.2020 37169.8772
SC chainage = 505.7453
bearing = 210°00'00"
long tangent = 133.2995
short tangent = 64.1399
long tangent 2 = 33.4431
short tangent 2 = 16.7665
shift = 1.0393
K = 24.9480

arc

centre = 42694.4824 37142.8573
radius = -100.0000
length = 114.0610
intersect angle = 65°21'08"

trailing spiral

length = 50.0000
ST coordinate = 42672.6128 37041.1073
ST chainage = 669.8063
CS coordinate = 42629.7716 37066.6176
CS chainage = 619.8063
bearing = 116°00'00"
long tangent = 133.2995
short tangent = 64.1399
long tangent 2 = 33.4431
short tangent 2 = 16.7665
shift = 1.0393
K = 24.9480

IP 4

coordinate = 42922.9470 36919.0110
chainage = 948.3287

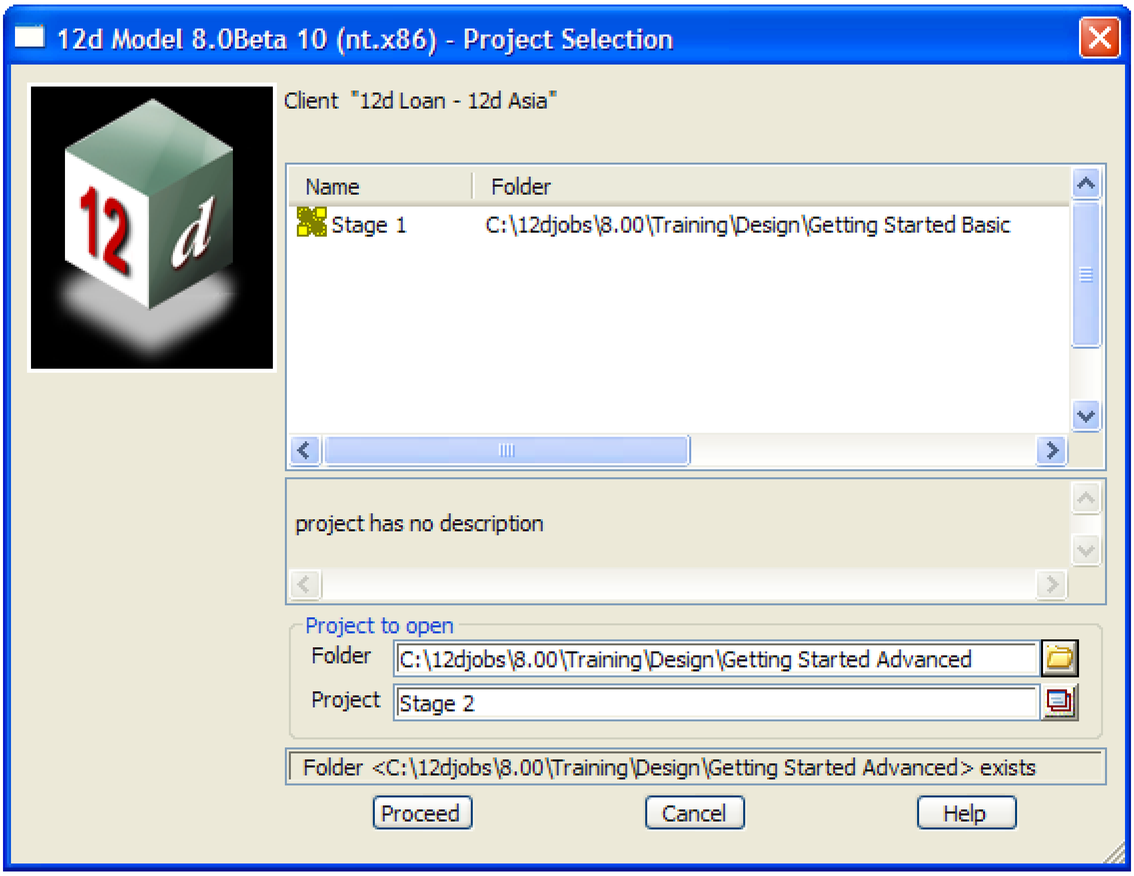
Vertical Alignment Report for string <ROAD 1> in model <ROAD CL>

	Chainage	Level	VC Length	
1	-0.0000	68.8510		
2	202.0000	67.4752	77.6672	parabola
3	412.0000	49.6670	150.0000	parabola
4	600.0000	66.3330	200.0000	parabola
5	772.6020	57.7029	100.0000	parabola
6	950.4539	60.4740		

18.2 Open the Final Road Design Project

As an alternative to proceeding through the tutorial in sequence exactly as specified to get to this point, we have created a new project called ***Stage 2*** with the road design already setup for you.

Restart 12d and select **Stage 2** from the **C:\12djobs\8.00\ Training\Design\Getting Started Advanced** directory.



You will not be able to select the Project from the box and will need to browse to the correct directory using the **Folder** icon.

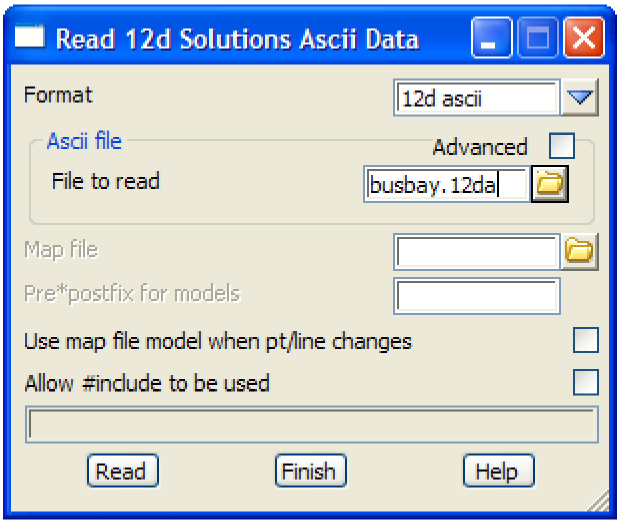
You should now be ready to start the more advanced design functions inside 12d

19 Many Template Files

19.1 Importing String Data in 12D ASCII Format

Subsequent sections of the tutorial rely on the presence of certain strings adjoining or near to our existing road centreline. Rather than entering these manually, we will read them in from files. The three files are supplied on the 12d tutorial CD in 12d ASCII format. Please refer to the previous chapter for more information on the 12d ASCII format.

The first string to be imported is called ‘busbay’.



Click LB on

File I/O=>Data Input=>12d/4d data

from the main menu.

Use LB on the folder icon for the *Ascii file* field to pop up a list of files to import. Click LB on **busbay.12da**

Click LB on **Read** to proceed.

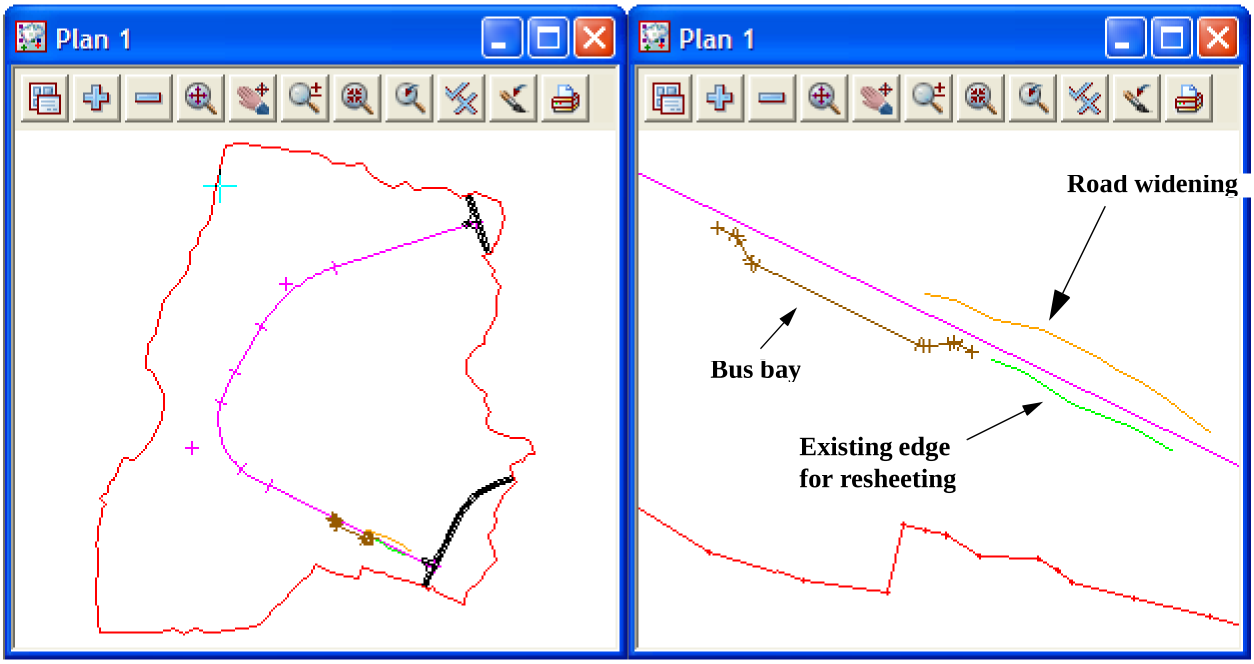
Repeat the sequence with files **roadwidening.12da** and **resheeting.12da**. Click LB on **Finish** to terminate the panel.

To see these various strings, from the ‘Plan 1’ view, click LB on the ‘+’ sign button and double click LB on each model name in turn. See the table below for a list of the model names that you must turn on.

The details of the strings and their model names is as follows

File	Name	Model	Colour	String type	Purpose
resheeting.12da	existing edge	resheeting	green	3d	Edge of existing pavement
busbay.12da	lip of kerb	busbay	brown	alignment	Busbay kerb
roadwidening.12da	invert of culvert	roadwidening	orange	2d	Limit Road widening

From the ‘Plan 1’ View, **Zoom** in for a closer look at these strings as shown below.



Note that the .12da format already contained the string colour, model name etc. i.e the data was predefined. All we had to do was supply the filename.

For the moment we do not need any of these strings on display. They will be used later as our template application skills improve.

From the ‘Plan 1’ view, click LB on the ‘-‘ sign and click LB on model **busbay** to turn it OFF**.** Repeat this for models **roadwidening** and **resheeting**.

Sidenote: As well as reading the .12da format, 12d permits the writing out of any string in .12da format. You do this with **File I/O=>Data Output=>12d/4d data**. This facility enables you to exchange and backup complex string data in an open documented manner. The 12D ASCII format caters for all 12d Model string types including 2d, 3d, 4d, pipe, pipeline, alignment and super strings.

19.2 Template Modifiers

To cater for the multiple template configurations required in complex road design, 12d offers a number of powerful features. Firstly, an unlimited number of templates may be used in any one alignment with each template applying over a predefined chainage interval. 12d then permits each template to be altered via commands, hence the concept of template modifiers.

The basic template facilities we have used in the tutorial to date are fine for designing rural roads in non-congested areas. However many roads must be designed to align within and match to existing constraints.

The template modifier facility was created to cater for road design where templates are continually varying and templates need to be stopped and restarted to step around constraints such as intersections and slip roads. Template modifiers also cater for most road widening situations such as bus bays and traffic islands and permit left and right templates to be manipulated independently.

The facilities to modify a template by instruction are extremely flexible. Remember, each template is made up of four basic parts - a fixed portion, variable cut, variable fill and final cut/fill. The fixed and variable parts of the template are defined in terms of links i.e. offset distances between adjoining strings. This makes it particularly easy to increase the width of any one link. An example of a link might be the ‘width of pavement’. A very important feature of 12d is that <u>whenever a link is changed, for instance to widen a kerb line, the kerb string and all strings outside of the kerb line move with the revised width.</u> Each link in the template can be modified independently by changing the width or changing the slope.

In the case of width adjustment, the width can be defined as relative (added to the current width) or absolute. Between any two chainages, widths can vary in a linear or cubic manner. Widths can also be varied by extending out to an existing string or having the width taken as the distance between two existing strings. This facility permits 12d to efficiently manage redesign to match existing road surfaces. The region between any two template definitions is always linearly interpolated. Gaps are permitted.

A similar set of facilities is permitted to change slopes between chainages. This permits for instance, the introduction of superelevation on curves.

The facility in 12d to use template modifiers is known as **Apply Many** i.e. the application of many templates.

19.3 The Many Template File (mtf)

Template modifiers is a concept that begins by taking a basic template and, through a series of instructions, modifies the template at each appropriate chainage.

There are two ways of creating template modifier instructions. They can be specified interactively from inside 12d Model typically by pointing using the mouse cursor, or supplied to 12d in the form of commands in an ASCII file. The file of commands is known as the ‘Many Templates File’ or mtf file for short. Even if the instructions are given interactively, they are still saved as an ASCII mtf file.

An existing mtf file can be modified either interactively or by editing the ASCII mtf file. You decide at the time which is the best method for what you are about to do.

The approach of saving the commands readily permits reruns as the final design evolves through iteration which is important since a detailed design is rarely correct on the first try.

The mtf file also has the benefit that it can be printed out and used as a hard copy audit trail of the commands used to create the design.

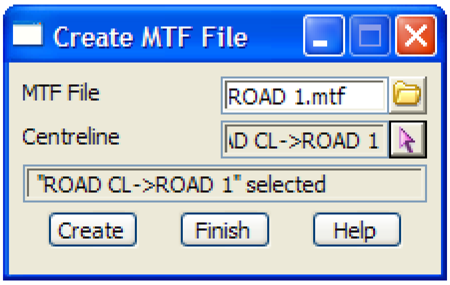
The rest of this chapter goes through in detail the steps of creating and editing an mtf file using the 12d interactive editor. We will focus only on the use of the 12d interactive editor as this is the preferred method for new users.

Initially, we will only make sufficient changes to make our ‘many templates file’ match our earlier design where we applied a single template. See the chapter ‘Modification of Design Parameters’ for our most recent single template rerun. We should be able to match that run exactly even though we are now using a completely different approach.

19.4 Creating the Apply Many Template Function

Whilst 12d gives you a lot of flexibility in the order in which you do things, it is best to create an MTF file before creating your function that ‘applies’ the same MTF file. Certainly it is essential to have the MTF file of commands saved to memory before you can run the function.

To create a brand new ‘many templates file’, from the Main menu, click LB on **Design=>MTF=>Create**.

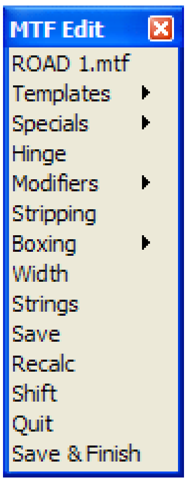


The following panel will pop up

Place the cursor in the MTF File field and type ‘ROAD 1’ and press Enter. The suffix .mtf will be added to the name entered.

click LB on the ‘Centreline’ pick icon the click LB on the alignment string in any of the views. Click MB to accept

This option links the mtf file to the alignment string prior to creating the design function. When picking a chainage the cursor automatically knows which alignment string to measure from, which simplifies the command



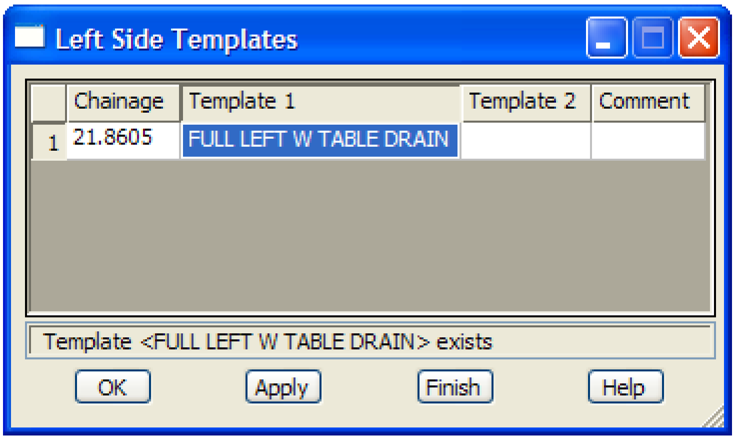
Click LB on **Create** and the 12d interactive MTF editor will pop up for your new .mtf file. Move and pin this menu at the bottom left hand corner of your screen.

We’ll now systematically work through the various MTF commands.

Firstly, for both sides of the road, we need to specify the names of the templates to be used and the chainages over which the templates are to be applied.

From the MTF Edit menu, click LB on **Templates=>Left Side**

The Left Side Templates panel pops up with all fields blank.



First we need to lock the cursor into the Chainage field on line 1 by clicking LB over the field. Next hit the RB, this then takes the template panel into the measure chainage application and is asking you to measure the starting chainage of your template. When you move into the plan view a dynamic measure line is activated. Select the end of the existing road pavement at the start of our design. You should have a chainage of 21.8605

In the 'Template 1' field, click RB then select 'Browse'. Double click LB on **FULL LEFT W TABLE DRAIN**.

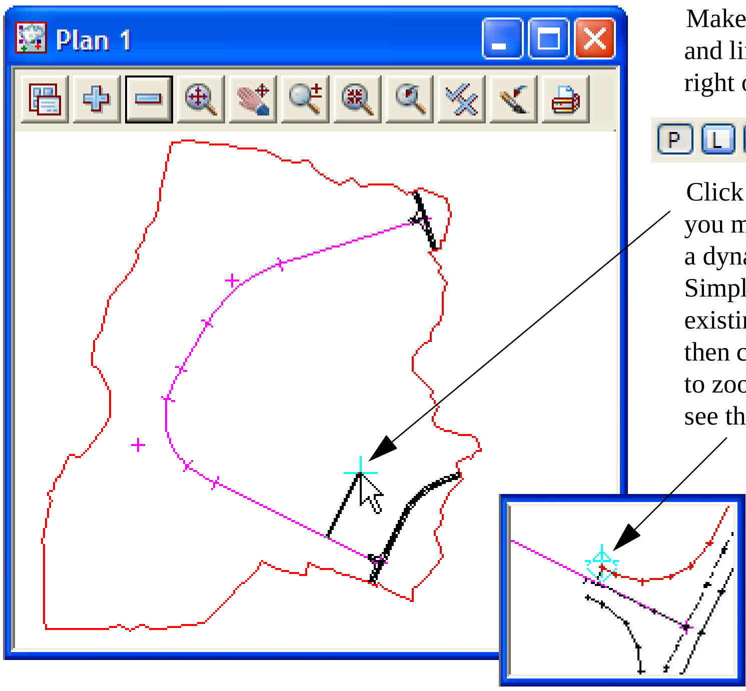
This tells 12d that on the left side of the road we wish to apply this template starting at chainage 21.8605. Leave the rest of line 1 blank.

To create the second line for entry click LB in the 'Comment' cell and [Enter] twice to create a new row

On line 2 we now need to specify the chainage at which the template on the left side is to stop. If we knew the chainage, we can lock the cursor in the field with the LB and type the value. More likely however is that we do not necessarily know the exact chainage. We can do a string inquire from 12d, snap to the end of the existing road that our design will tie into, note down the chainage and then type it in.

However, the better way is to repeat what we did when establishing the starting chainage.

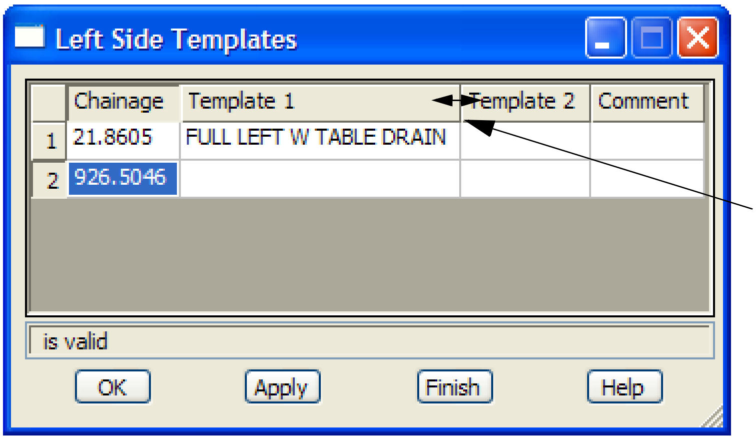
If you missed it in the starting chainge then we will explain it in more detail here.



Make sure that your point snaps are ON and line snaps OFF (we want to snap right onto the end of the line).

Click RB in the Chainage cell. When you move the cursor in to the plan view a dynamic measure line is activated. Simply click LB on the end point of the existing road on the left of our design then click MB to accept. You may need to zoom in further to better be able to see the end of the existing road.

You should now see the number 926.5046 in the chainage field. 12d has typed it in for us!



Your completed panel should look as shown.

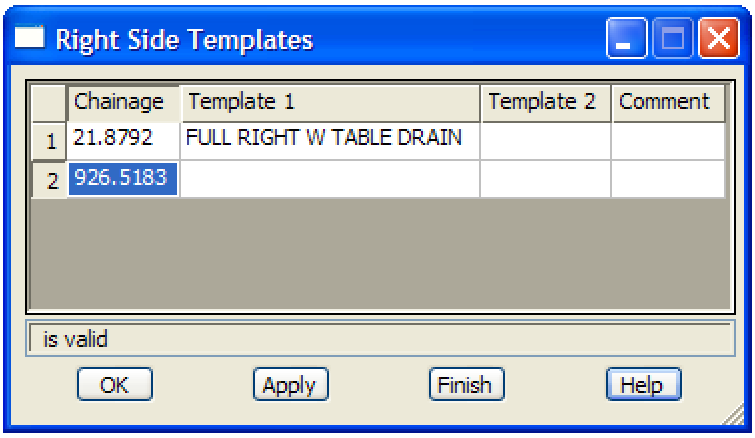
If any of the data is not fully readable, you can click LB on the gap between the headings and then double click LB.

In summary, the above layout tells 12d that on the left side of the road we wish to apply template 'FULL LEFT W TABLE DRAIN' starting at chainage 21.8605 and ending at chainage 926.5046. Note that the 'Template 1' field on line 2 <u>must</u> be blank to achieve this.

Note that if you were to enter a template name on line 2, 12d would interpret this as the template to be applied <u>starting</u> at chainage 926.5046. We do not want this.

Click LB on **Apply** to test our template commands and check for syntax errors. Any errors are reported in the message line at the base of the panel. Click LB on **OK** to terminate the panel.

A similar set of instructions is required on the right hand side of our road. From the MTF Edit menu, click LB on **Templates=>Right Side**



Repeat the procedure for the right side of the road. Note that on the right side of the road we use template 'FULL RIGHT W TABLE DRAIN'.

As before, click LB on **Apply** and **OK** to terminate the panel.

That is all the edits we wish to make at this stage so from the MTF Edit menu, click LB on **Save**.

<u>We leave the MTF Editor open for the following options</u>

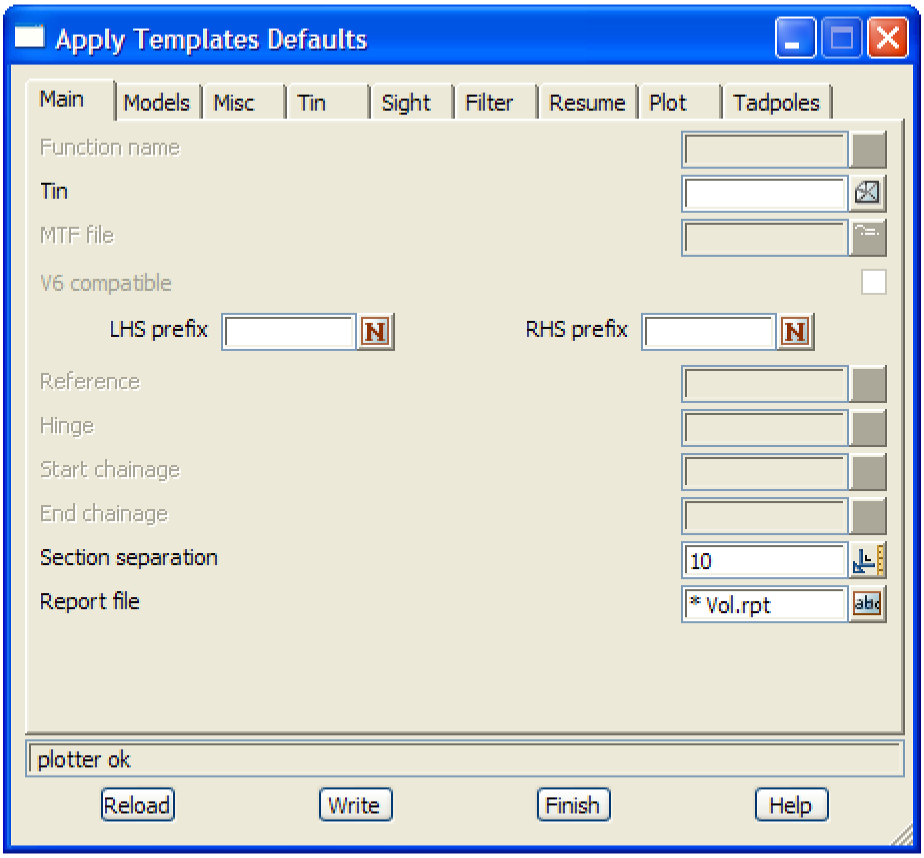
Note: If the chainage in line 2 above is greater than the end chainage of the string, the apply simply stops at the end of the string. Thus it is possible to just type in a very large chainage (99999) rather than the exact end chainage shown above if you want your template to end at the end of the design string.

Note that the right side template is basically the same geometry as the left side. The reason we use two templates is so that the string names generated on each side of the road are unique. This is important later when applying boxing.

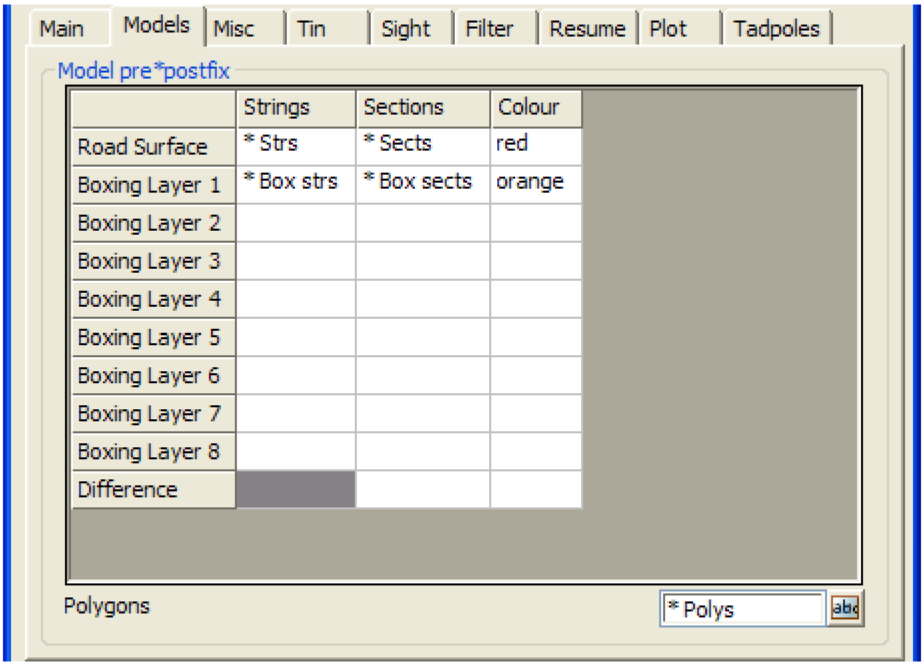
To apply the many templates file to our road centreline, we need to create a new function. This is very similar to how we applied our earlier single template.

As the 'Apply Many' function panel has a large amount of user input we can set up a default file to automate the filling in of the panel

To do this select option **Design=>Apply=>Apply Many Defaults**



On the ***Main Tab*** ensure that the LHS and RHS prefix has no value in the field. If there is a character showing, delete it. This is only used if we are using the same template on both the left and right hand side of the road. However, we have created unique templates for the left and right with individual link names in each template.

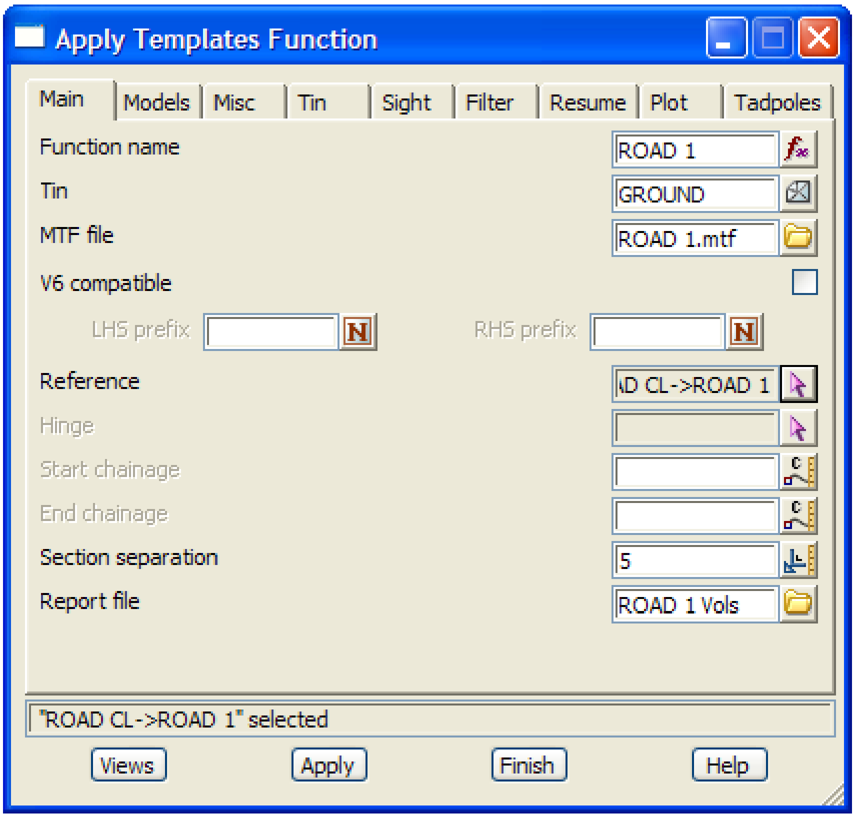


On the ***Models Tab*** ensure that the Road and Boxing sections and strings are setup as shown.

Click LB on **Write. You will be asked where you want to write the file to, it is best to add the file to the User Library so that it is used with every project.** Select the ***User folder*** radio button and click **Write** and **Finish.**

From the Main menu, click LB on **Design=>Apply=>Apply Many** and the following panel will pop up

A unique function name must be supplied so that we can refer to and rerun the function later as required.



In the 'Function name' field type 'ROAD 1' **then press [Enter]** .

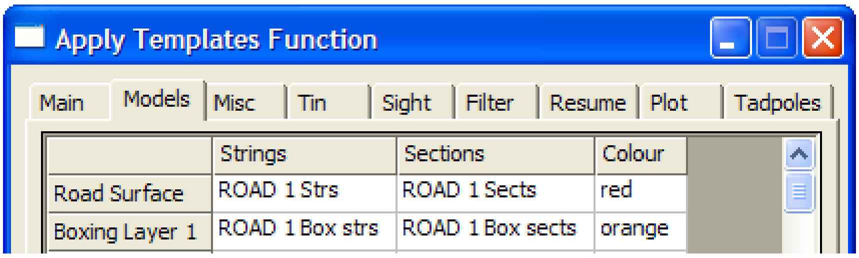
This will activate the default file and fill in the majority of the panel

Some parts of the panel will need to be filled in / changed so we work from the top down

In the 'Tin' field, click LB on the tin icon to pop up a list of available TINs. Double click LB on **GROUND**

In the 'Templates file' field, click LB on the folder icon to pop up a list of .mtf templates. Double click LB on **ROAD 1.mtf**

The default section separation is 10 metres. For the purposes of the tutorial, set this to 5 or 50 for the practise version. This tells 12d to calculate sections at every 5m (or 50m) as well as at all special points such as tangent points.



The models for the road strings, sections, polygons and boxing on the **Models** tab are read from the default file.

Note: Boxing is not calculated at this stage so the models created will be empty

We will not use the LHS or RHS Prefix box

The only other data we need to change is to indicate to 12d the road centreline (i.e. the reference string) along which the chainage is defined. Do this by clicking LB on the **Reference** button in the **Main** tab.

The Screen Message Box advises

<Select reference string>[picks][][Menu]

In any of the views, click LB on the magenta road centreline string. It is easiest to do this in the 'Plan 1' view. Click MB to confirm the pick.

When the panel is complete, apply the template by clicking LB on **Apply**. The road will be instantly designed.

After the mtf file has been applied, observe the cut, fill and balance volume quantities at the base of the panel. These are the exact same volume quantities we experienced when we last applied our single template (see the chapter ‘Modification of Design Parameters’. We have used the mtf file to achieve an equivalent design to applying a fixed template.

Reminder of the rules for the Reference and Hinge strings: The chainage of a road is defined along a string called the Reference string. The template is always applied at right angles to the Reference string. The centreline of the template is located on the Hinge string. The Hinge string and the Reference string do not necessarily coincide. In our case they do. Since the Hinge string defaults to the Reference string, we only need to pick the Reference string.

We will now begin modifying our mtf file to cater for more complex design changes. Note that the changes we are about to make are not necessarily sound engineering judgements. All cross fall and widening dimensions have been exaggerated to make them easily visible. The changes have been chosen to demonstrate as many features of the software as possible within the confines of our limited data set and single road centreline.

Be aware of the following template rules:

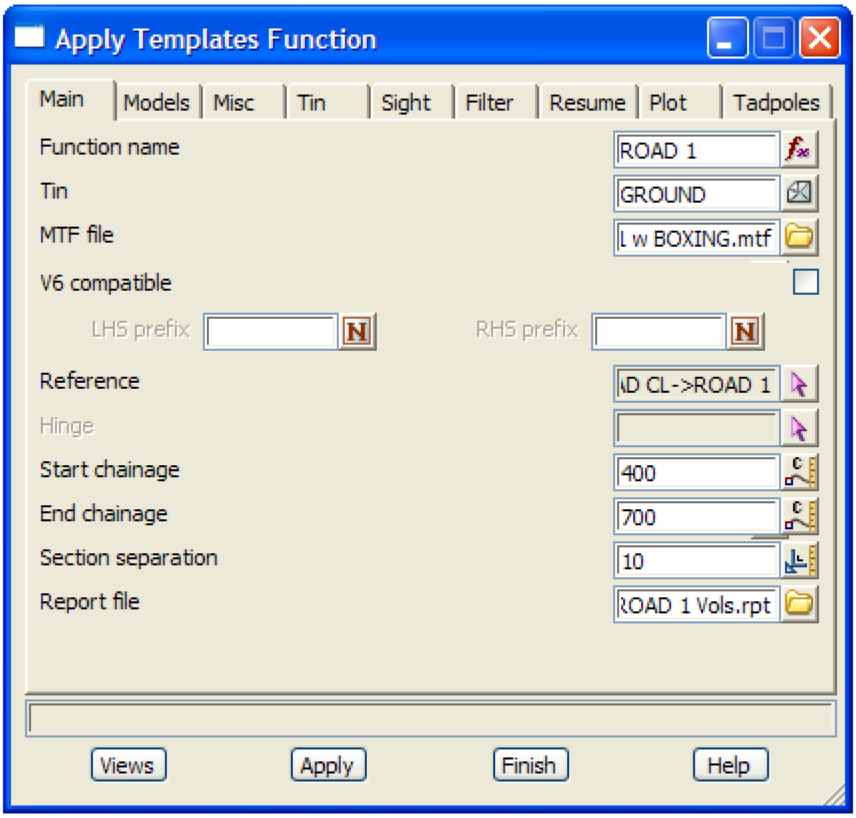
A link from a template is modified between a start and end chainage.

Template modifier effects are cumulative. More than one modifier may exist for a link at any given chainage.

If no modifier exists for a link at a given chainage, the link reverts back to the template definition given by the left_side or right_side

19.5 Note for the Practise Version of 12d

It is possible to keep within the 5000 point limit of the Practise version and still apply the template as described. You can change the ‘Section separation’ to say 50m instead of 10m with some loss of detail. It is also possible to leave the section separation at 10m, but restrict the amount of road being produced in any one run to keep under the 5000 point limit. Use the ‘Start chainage’ and ‘End chainage’ fields on the Apply Templates Function panel to do this. For example



By appropriately limiting the chainage range, the modelling for the rest of the chapter can be achieved using a ‘Section separation’ of 10.

Note the chainage range. Run the apply several times with different ranges and note the various effects. Each time you press the Apply button, the ‘old’ cross sections and strings are deleted so your points total will reduce accordingly. The new cross sections and strings added will then increase your points total.

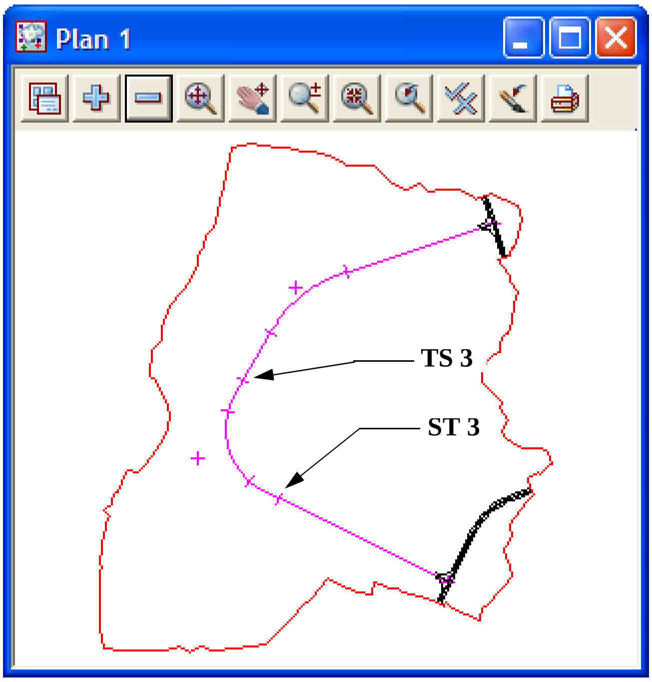
20 Template Modifiers

20.1 Widening the Pavement and Shoulder on a Section of Road

Our first task is to widen the pavement over a part of our road. We will do this around the major constant radius curve in our road including the adjacent spiral transition curves.

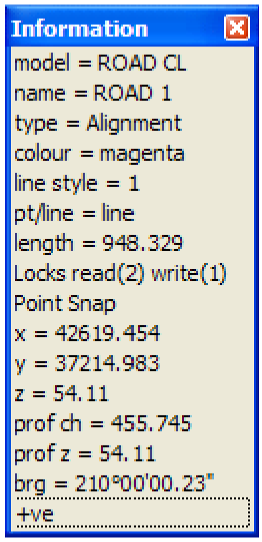
We will utilise the string inquire facility to snap on to the TS and ST points around HIP 3 to get the chainages at the tangent points. These chainages can also be measured ‘on the fly’ within the modifier options.

Firstly we need to ensure that only model **ROAD CL, survey ROAD CROWN, survey ROAD SEALED** and **survey TOPO DTM BDY** are active in view ‘Plan 1’. Turn off any other models



Select function key F2 to bring up the *String Inquire* panel (F2 is a short-cut for picking **String=>Inquire**). Make sure that you only have your points and cursor snap settings ON (turn line snap OFF).

Position the cursor over the TS 3 point and click LB.



Provided you receive a successful ‘point snap’ to the TS 3 point (the cursor returns the yellow diamond) observe the chainage along ‘ROAD 1’ returned in the Information panel. The profile chainage (prof ch) value is **455.745** (third last item in panel). Click MB to confirm the point.

As the next point you want (the ST 3 point) is also on the same string, you just need to ‘Restart’ the selection process. The easiest way to do this is to just move the cursor (mouse) a small distance. Alternatively you can click RB to pop up the Pick Ops menu and click LB on **Restart**.

Position the cursor over the ST 3 point and click LB. Observe the chainage of **669.806** Click MB to confirm the point.

These chainage values are important as most template modification commands involve the specification of chainages as the means for defining the extents as to where the modifications are to begin and end.

We will now increase the pavement width by 1m on the outside (RHS) of the curve using an absolute cubic taper. We do this by specifying that the width of the ‘lokr’ link is to change in absolute value from 3.5m to 4.5m between a starting and finishing chainage along the road design centreline. The ‘lokr’ link is the distance from the ‘next innermost string’ to the ‘lokr’ string. As there is no other string in this case (the lokr string is the one closest to the road centreline), the ‘lokr’ link in this case is the distance from the ‘hinge’ string to the ‘lokr’ string. The hinge string defaults to the road design centreline.

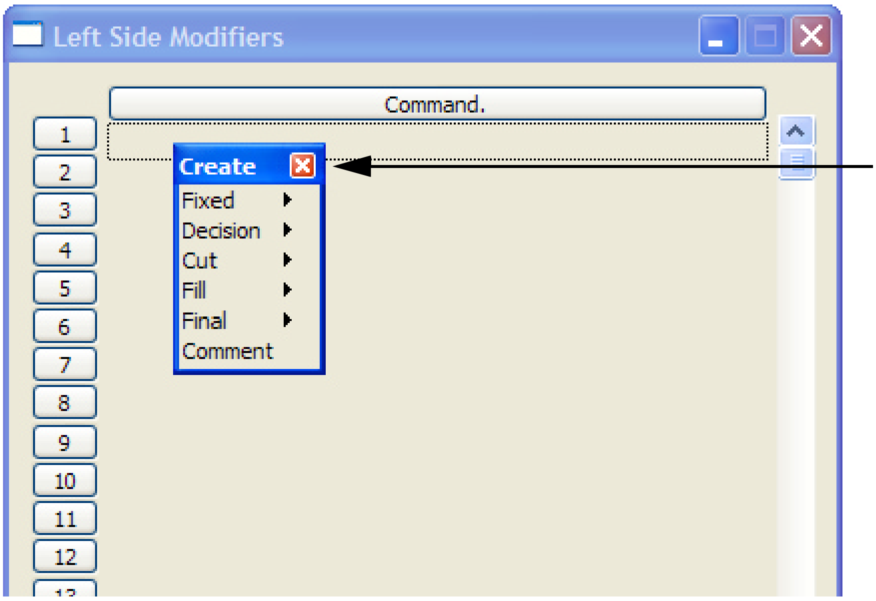
Modifiers can be either absolute or relative. As we are specifying an 'absolute' modifier, the width of the link specified totally replaces any previously implied value (from the template) for that link.

We will start the tapering process 28 metres before the TS 3 point and finish it 8 metres into the spiral transition (i.e. a taper over 36m in total starting at chainage 427.745 and finishing at 463.745). The exit taper will be a mirrored copy of the entry taper (start at chainage 661.806 and finish at 697.806). The full 4.5 metre width will apply around the constant radius curve and the balance of the transition spirals.

Finally, on the inside (LHS) of the curve, we will increase the footpath width from 3.5 to 5 metres using a relative linear variation over a distance of 50 metres. The increase will begin 58 metres before the TS 3 point and finish 58 metres after the ST 3 point. The full 5 metres width will apply from 8 metres before the TS 3 point to 8 metres after the ST 3 point. Because we are using a 'relative' modifier, the value specified is added to the current width of the 'bofpl' link. The current width is calculated from the original template definition.

Firstly turn on the model **ROAD 1 Strs** in view 'Plan 1'

From the MTF Edit menu, click LB on **Modifiers=>Left Side**

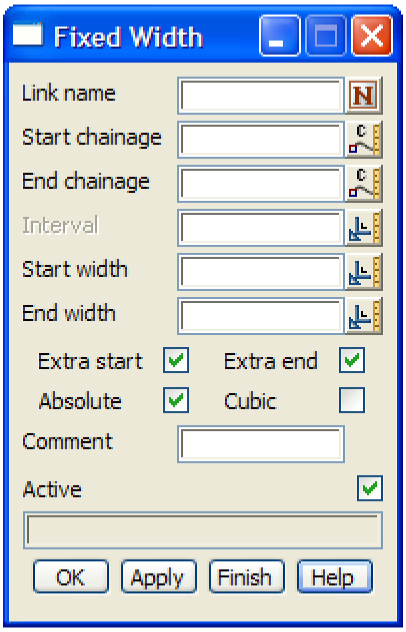


The Left Side Templates panel pops up with all fields blank.

Place the cursor in the central grey area opposite line 1 and click LB. The *Create* modifiers panel pops up.

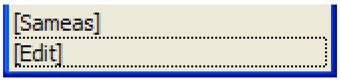
Click LB on **Fixed=> Width**

The Fixed width panel pops up. We now need to fill out this panel with the information to modify the ‘bofpl’ link on the left side with a relative modifier of +2.5m i.e. that link is to become 2.5m wider than it currently is between the specified chainages.

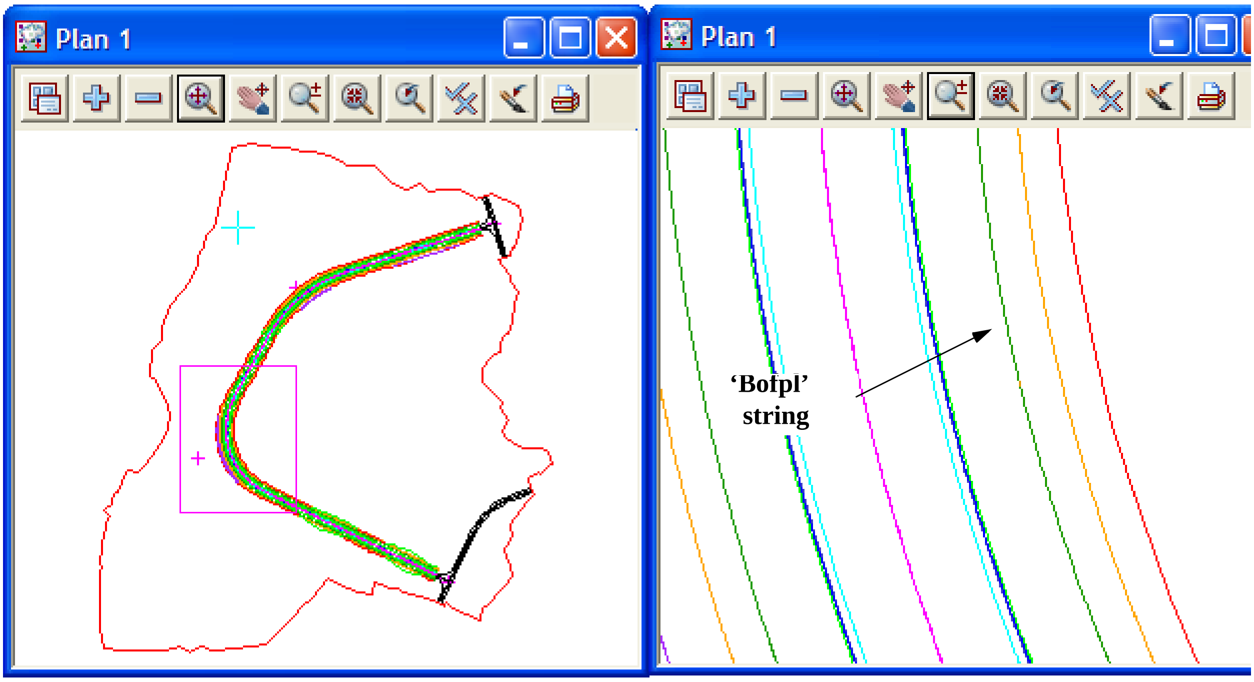


Click LB on the Name icon 

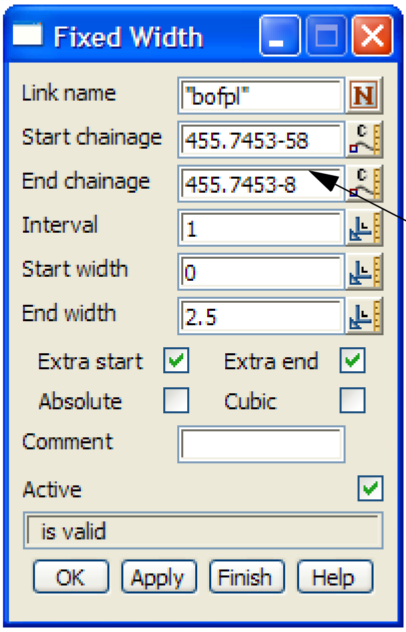
Select from the bottom of the panel ‘Same as’ so that you can point at the string that is generated by the ‘bofpl’ template link without necessarily



Make sure that your line snaps are ON. Zoom in on the ‘Plan 1’ view as shown and click LB on the ‘bofpl’ string (the dark green string on the left hand side of the road)



Make sure that the string you want is the one that has highlighted in red. Click MB to accept the string.



The bofpl link name appears. Note that if you knew that the link you wanted to modify was the 'bofpl' link, you could have just typed in the name rather than point at it. The "double quotes" around names are optional. They are essential if the name contains spaces.

Fill in the chainages by selcting the icon picking the tangent points and subtracting the chainage as shown.

Move the cursor into view 'Plan 1' and, using the dynamic measure line, click LB on the TS3 point. Click MB to accept

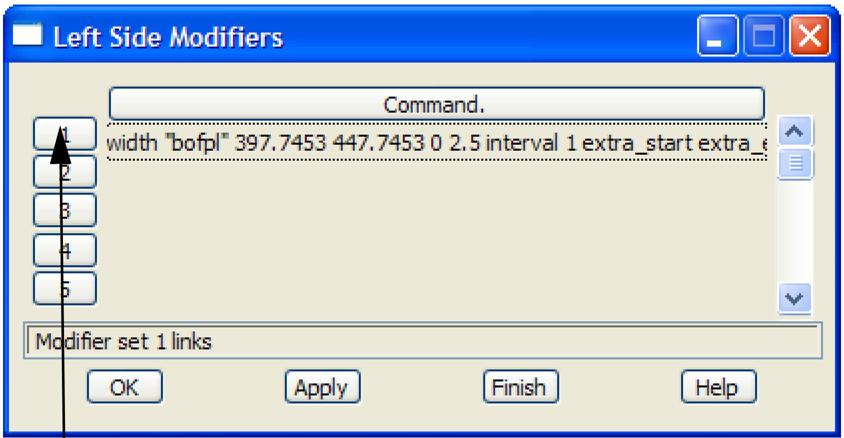
Be sure to input the mathematical expression "-" to subtract the required chainage from the tangent point..

Set the interval to 1, to give better detail as you move through the curve and set the 'Active' check box to on. This can be used to toggle off the modifier rather than deleting it.

Enter the start and end widths as shown.

Untick the 'Absolute' check box since the width change we require is 'Relative'. Click LB on **Apply** and **OK**.

The Left Side Modifiers panel pops up as you press the OK button. It displays the latest footpath link modification filled in on line 1.

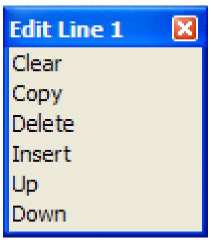


We now need to create two more lines that are very similar to the line we have just created so we can use the 12d editing tools to duplicate and modify the new lines (rather than create them from scratch)

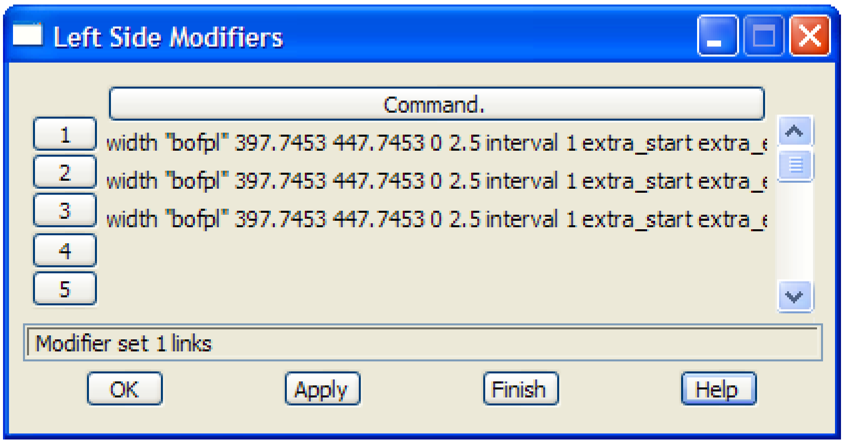
Place the cursor over the 'Line 1' button and press RB.

Click LB on **Copy**

Again, keeping the cursor over the 'Line 1' button, press RB.

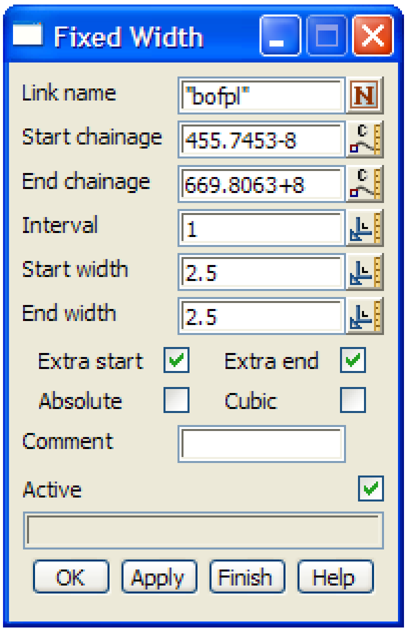


Click LB on **Copy**



You now need to edit lines 2 and 3. First click LB on the line 2 Command area.

The Fixed Width modifier panel pops up.

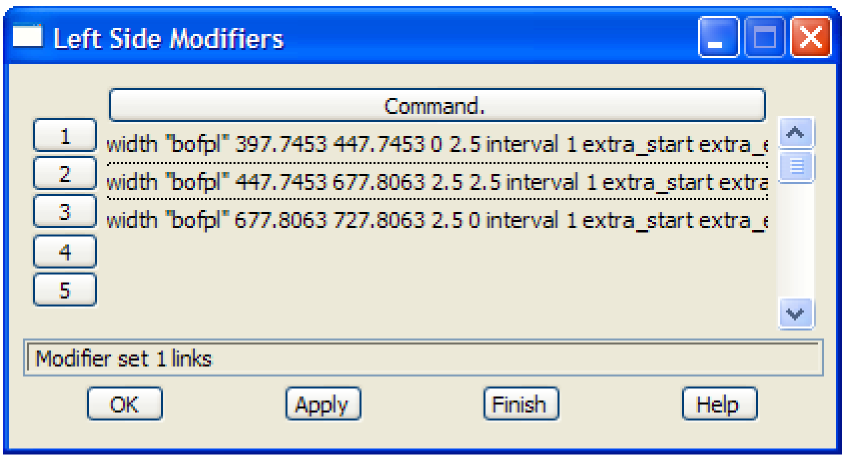


Use the tools shown earlier to change this to look as shown at left.

You can use the standard Windows cut and paste facilities for instance to shift chainage values between fields. Double click an item to highlight it, cut it with (Ctrl X) or copy it with (Ctrl C), click LB to locate the cursor where you want to place it (or double click to highlight an item you wish to replace) and paste the new entry with (Ctrl V).

Set the start width to 2.5. When finished click LB on **Apply** and **OK**.

Now edit line 3. Click LB on the line 3 Command area.



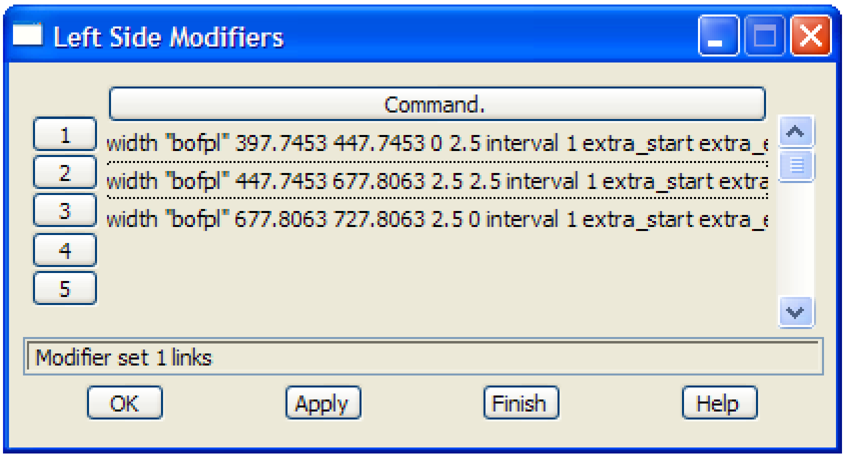
The Fixed Width modifier panel pops up again.

Make the changes shown to the chainages.

Set the End width to 0.

When finished click LB on **Apply** and **OK**.

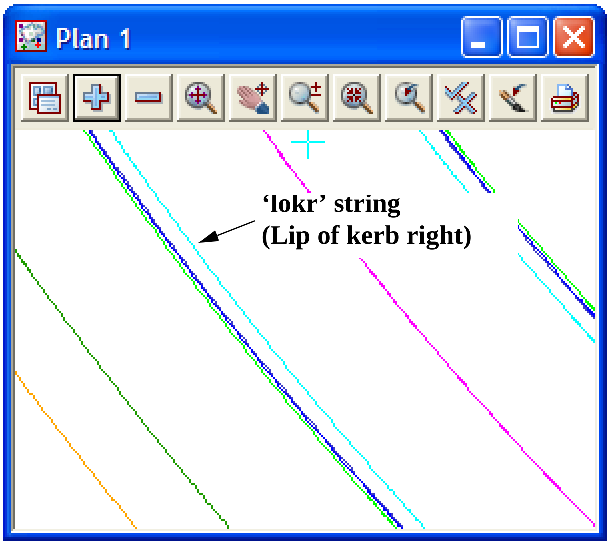
The Left Side Modifiers panel redisplays showing the latest link information.



These are the finished commands required to widen out the footpath link on the inside of the bend by an extra 2.5m.

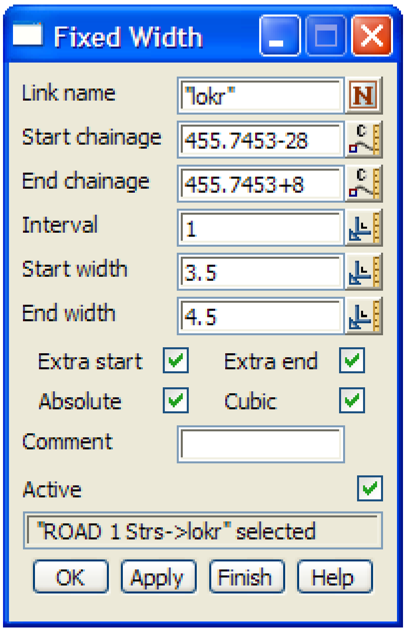
When finished click LB on **Apply** and **OK**.

You can then make a very similar set of changes on the right side. From the MTF Edit menu, click LB on **Modifiers=>Right side**



You will need three lines in the Right Side Modifiers panel, each using a fixed width modifier.

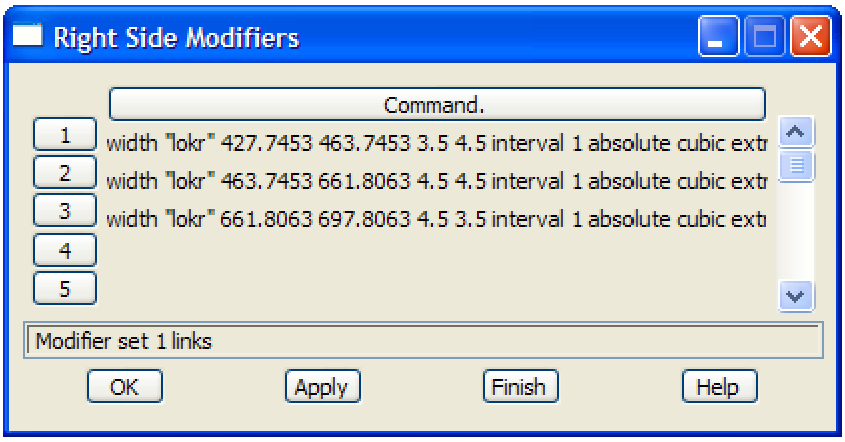
For each line in turn click LB on **Fixed=> Width**



These are the commands required to taper out the 'lip of kerb right' link on the outside of the bend from 3.5m to 4.5m.

Make sure you tick the absolute and cubic checkboxes.

When finished click LB on **Apply** and **OK**.



The finished Right Side Modifiers panel should look as follows

These are the finished commands required to widen out the ‘lip of kerb right’ link on the outside of the bend by an extra 1m using an absolute adjustment of from 3.5m to 4.5m. The taper sections will use a cubic taper.

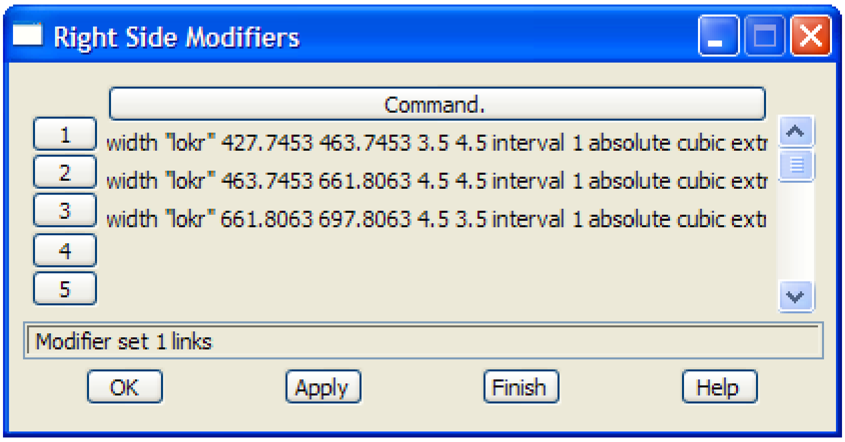
When finished click LB on **Apply** and **OK**.

20.2 Incorporating Superelevation on Curves

The template we are applying specifies that the main pavement section of our road has a 3% cross fall from the road crown to each kerb line. We will now introduce superelevation of a full 3% to the outside ‘lokr’ string into our pavement design. This will apply around the full constant radius and transition spirals curves. This will require a cross fall template modification to the right side pavement. The left side can remain as already defined at 3% cross fall.

The transition to full superelevation will be linear (it can be cubic) and begin 28 metres before point TS 3 (chainage 427.745). Full superelevation will occur at point TS 3 (chainage 455.745). The exit conditions from point ST 3 will be identical but in reverse and apply from chainage 669.806 to 697.806.

From the MTF Edit menu, click LB on **Modifiers=>Right Side**



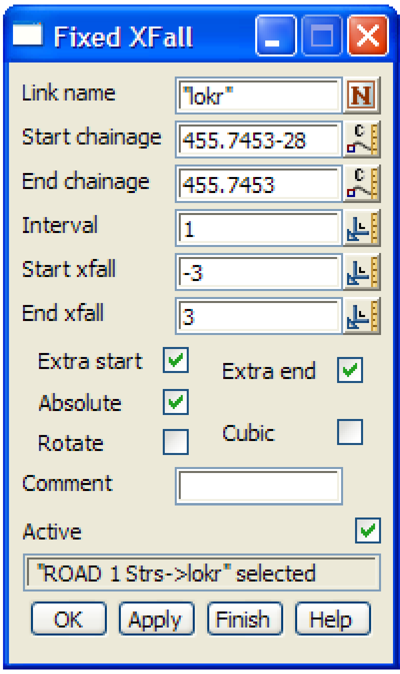
The Right Side modifiers panel pops up. Note that the previously defined modifiers appear. Your options at this point are that you can edit any of these or add further new modifier commands.

We will create new commands but before we do, it is a good idea to add a comment line to make it easier to read at a later stage. Place the cursor in the central grey area opposite line 4 and click LB. The 'Create modifiers' panel pops up.

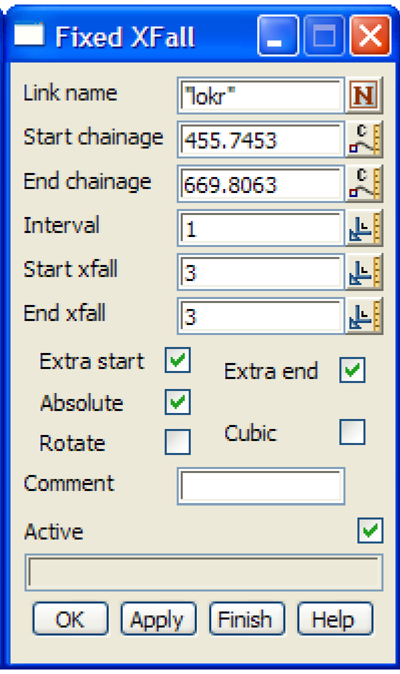
Click LB on **Comment**. In the *Modify Comment* panel, type "SUPER ELEVATION". If you had a lot of super elevation to do in a big project you could add the chainage values also.

Click on line 5 and from the 'Create modifiers' panel, click LB on **Fixed=> XFall**

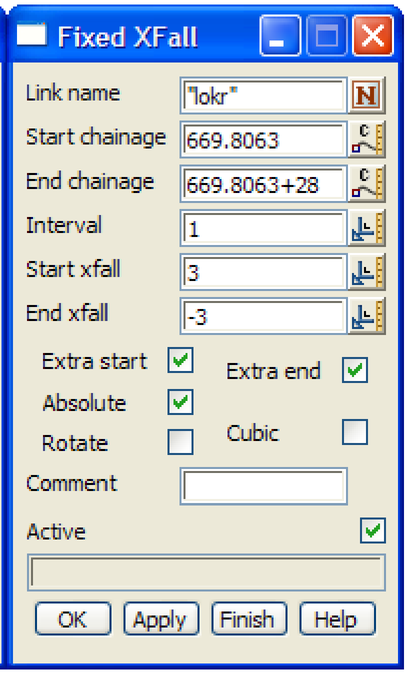
The Fixed XFall panel pops up. To achieve the transition required you will need three lines in the Right Side Modifiers panel, each using a fixed XFall modifier. You will need to click LB on **Fixed=> Xfall** three times to create the next three lines in the file



Line 5:

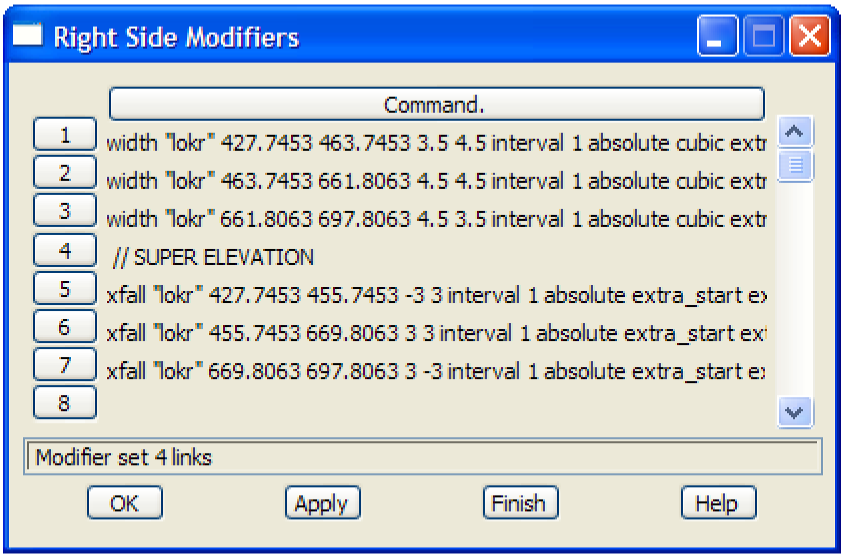


Line 6:



Line 7:

When you are finished with each panel click LB on **Apply** and **OK**



The finished Right Side Modifiers to perform this superelevation change should look as shown in lines 5, 6 and 7.

When finished click LB on **Apply** and **OK**.

This is a good time to save your edits. From the MTF Edit menu, click LB on **Save**.

Over the stated chainages, this defines the variation to the cross fall of the fixed link ‘lokr’ from the beginning of the previous fixed link (the hinge string in this case) to the string ‘lokr’.

A very important feature of 12d is underlining this template modifier command. 12d always linearly interpolates between templates. This is not to be confused with how a link can be modified between any two chainages - cross falls and widths can generally be varied in either a linear or cubic manner.

Thus to achieve a linear variation of cross fall i.e. superelevation, one only needs to define the template geometry at either end of the superelevation. Regardless of the complexity of the road and template geometry and the number of sections involved, 12d will do all of the calculation for you!

20.3 Widening the Road Out to an Existing Constraint

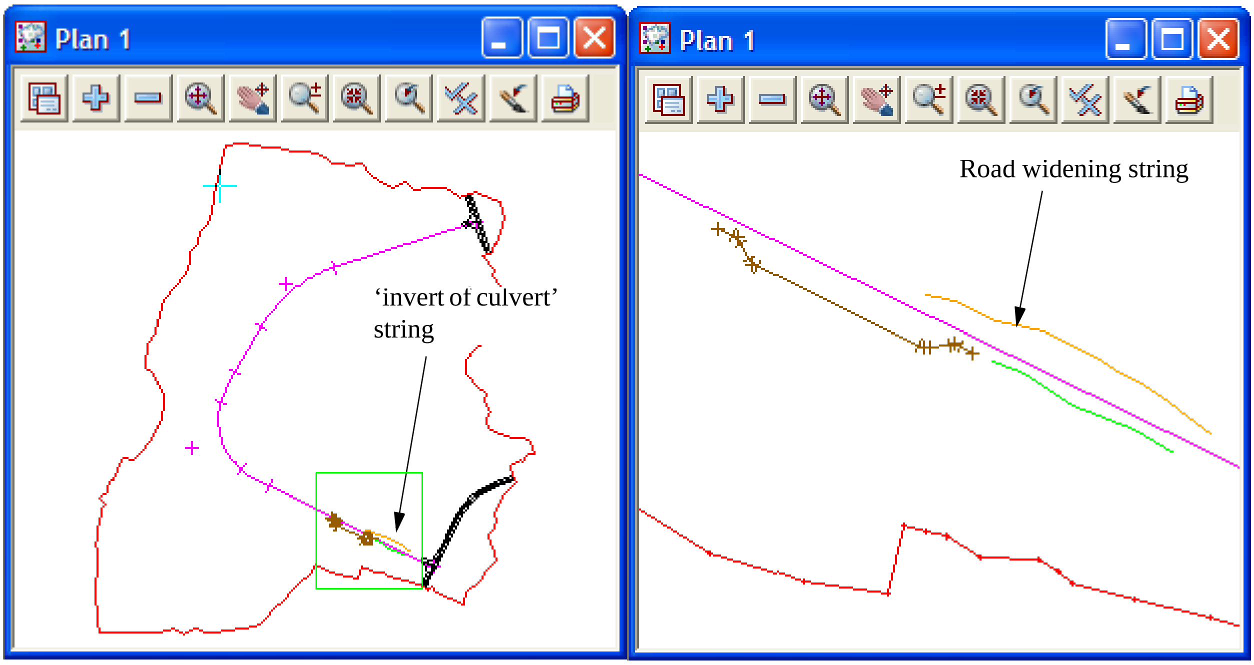
So far we have specified widening commands that change our template links to predetermined values. We will now specify widening in terms of other strings already present in our project.

Earlier we imported a 2D string called ‘invert of culvert’ in a model ‘roadwidening’. This string would typically represent the invert of a culvert or a similar constraint that was to be used to govern the extent of any road widening. It might be the existing edge of bitumen.

We will now use the template modifier features of 12d to widen our left lip of kerb line out to a theoretical line that is parallel with the ‘invert of culvert’ string but (say) 1.2m on the road centreline side of it. That is, we are using a constant offset from a known string. We will do this for only a limited section of the road, obviously within the length of the ‘invert of culvert’ string.

Whilst we are using a constant offset here, we could have specified a linearly tapering offset or even a cubically varying offset.

It is important to realise that the ‘invert of culvert’ is merely a plan 2D string (no Z values). Whilst the road will be widened in this area, the road section cross falls (as specified in the template) will be maintained. Thus the Z values of the left hand lip of kerb line will be calculated by extrapolation from our existing ‘left’ template, plus any other template modifier effects that might be present.

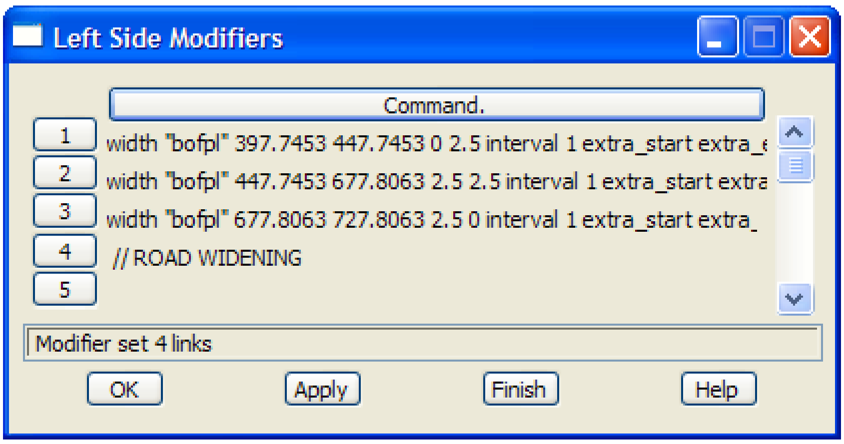


To begin operations, turn off the model **ROAD 1 Strs** in view ‘Plan 1’ then turn on models **busbay**, **road widening** and **resheeting.**

In ‘Plan 1’ view menu zoom in to the area around the ‘invert of culvert’ as shown above.

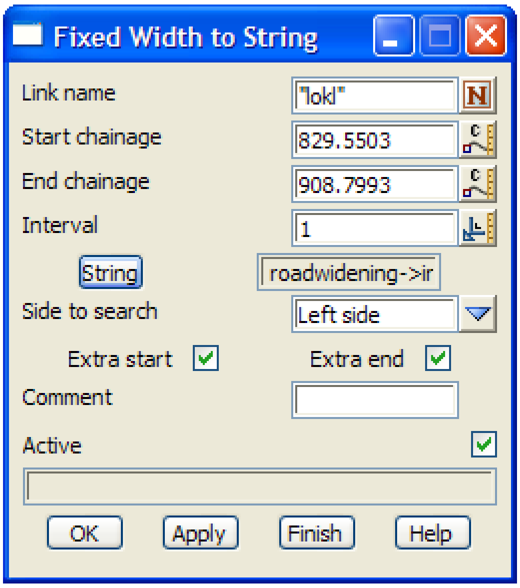
From the ‘Plan 1’ view menu click LB on **Toggle=>Vertices** so that you can see the various points on the ‘invert of culvert’ string.

From the MTF Edit menu, click LB on **Modifiers=>Left Side.** The Left Side Modifiers panel pops up. Note that the previously defined modifiers appear. Add the comment 'ROAD WIDENING" to line 4



We will create two new commands. Firstly, place the cursor in the central grey area opposite line 5 and click LB. The Create modifiers panel pops up.

Click LB on **Fixed=>Width to string**



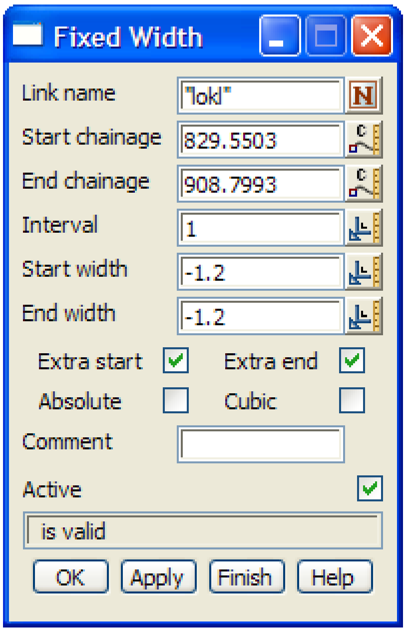
Select the name of the link as previously shown

Use the 'measure chainage' icon to pick the start and end chainage, by picking on the start and end of the 'invert of culvert' string.

Click LB on the **String** button and select the 'invert of culvert' string in model 'roadwidening'.

When finished click LB on **Apply** and **OK**.

Back in the Left Side Modifiers panel, place the cursor in the central grey area opposite line 6 and click LB. The 'Create Modifiers' panel pops up. Click LB on **Fixed=>Width**

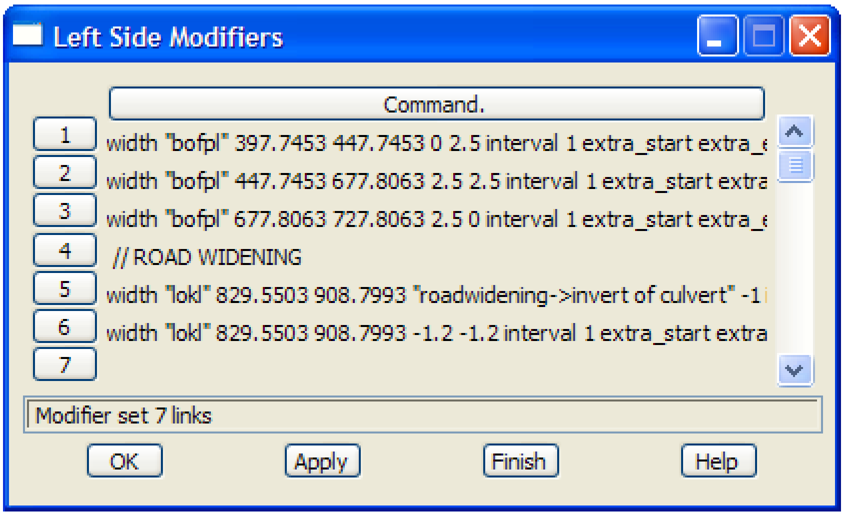


Select the name of the link as previously shown

Use the 'measure chainage' icon to pick the start and end chainage, by picking on the start and end of the 'invert of culvert' string.

Uncheck the Absolute check box. We want it to be a relative adjustment of 1.2m towards the centreline. It is negative since we are reducing the 'current' link distance by 1.2m

When finished click LB on **Apply** and **OK**.



The Left Side Modifiers panel should now look as shown above.

When finished click LB on **Apply** and **OK**.

To ensure that your new changes are saved, from the MTF Edit menu, click LB on **Save**.

Note that in general, the effect of MTF commands are cumulative. Thus by having multiple commands modifying the one link over a set chainage, it is possible to achieve very complex modifications. You need to break such modifications into their component parts and then specify them one at a time as we have done above.

Some care is needed with the order of the modifier commands in the MTF file. For instance, it would not make sense to do a <u>relative</u> modification and then have that followed by an <u>absolute</u> modification. The reverse is fine however as we saw above. We performed an absolute modification by widening out to a string and then followed it with a relative modification by reducing the previous widening by 1.2m.

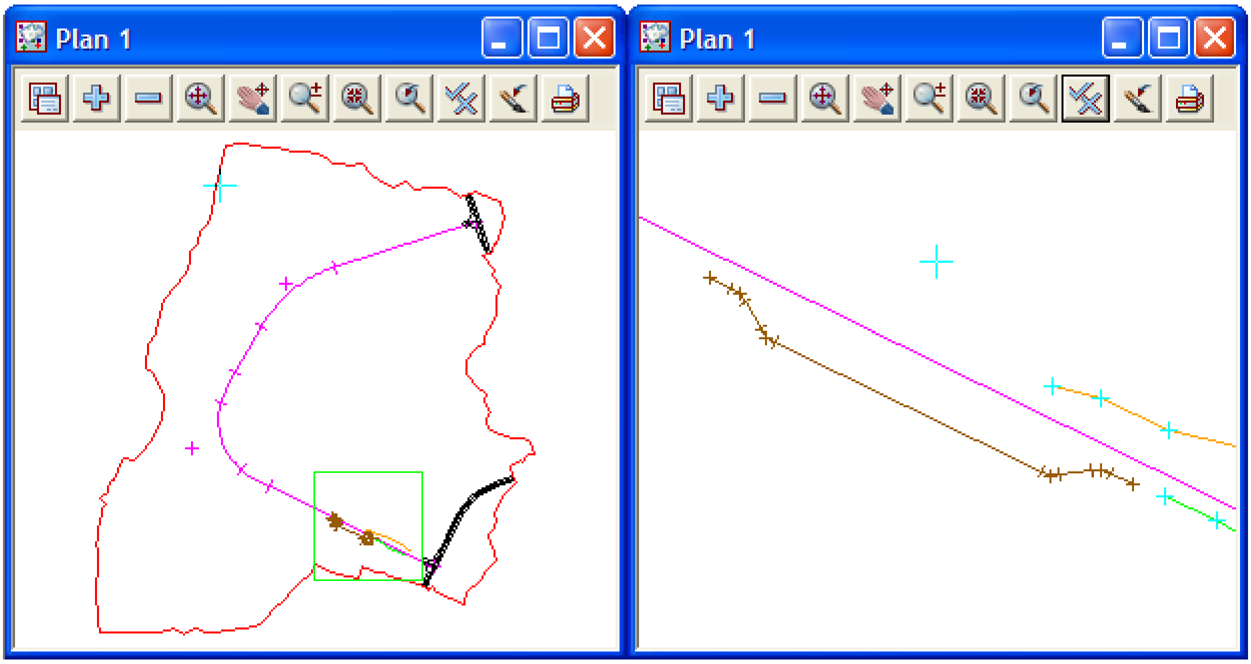
It is important to realise that this whole road widening operation is very flexible and not limited to the pavement surface. For instance, instead of widening the ‘lokl’ string out to the ‘invert of culvert’ string, we could have widened the ‘bofpl’ string out. In such a case all strings on the <u>inside</u> of the shoulder string such as the ‘lokl’ string would remain as is i.e. as defined by the ‘FULL LEFT W TABLE DRAIN’ template. The ‘iodl’ string which is on the <u>outside</u> of the shoulder string, would be widened.

The rules for changing both width and grade of template links are:

1. <u>All</u> template links are maintained after any changes are performed. If you start with 5 fixed links, you will still have 5 links regardless of how many modifications are made.
2. Any links that are <u>not</u> changed by MTF modifier commands will always adopt the value as specified in the template definition. When specifying a width modification for instance over a set chainage range, the width of the link will revert back to it’s template definition immediately after the end chainage of the modification.

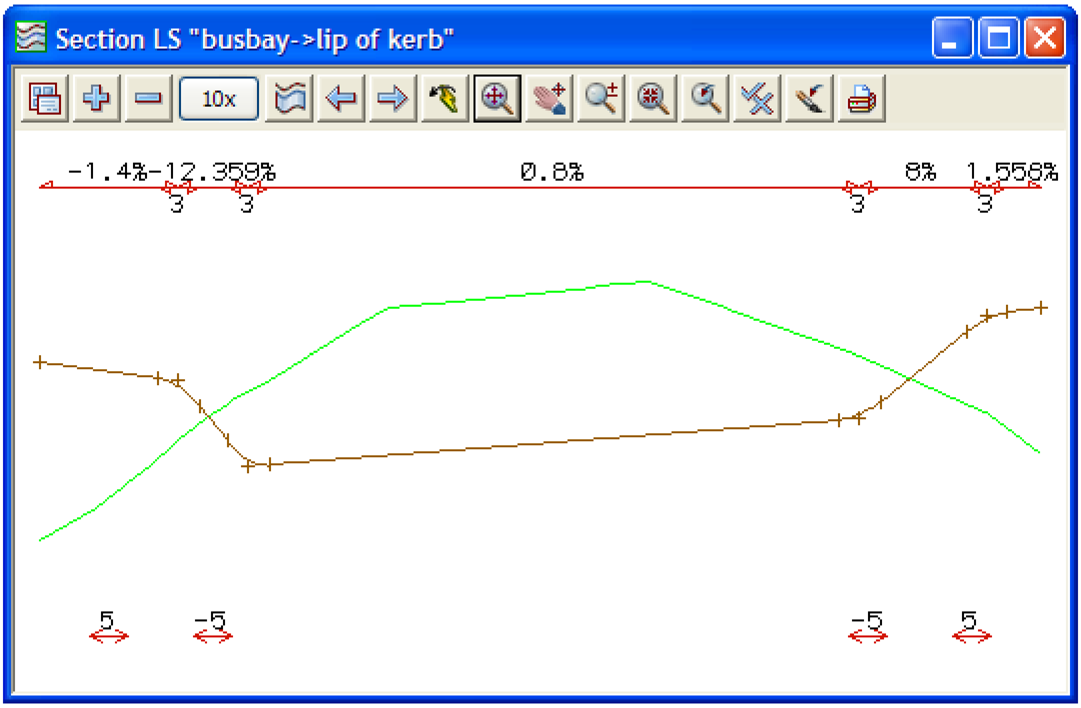
20.4 Incorporating a Bus Bay in the Road

One of the strings we imported earlier was called ‘lip of kerb’ in model ‘busbay’. First we need to zoom in to the ‘busbay’ string.



The ‘lip of kerb’ string is a full alignment string and hence has meaningful vertical geometry. The vertical geometry of such a string is normally created in exactly the same way that we defined our ‘ROAD 1’ road centreline. In this case, the vertical geometry came in with the horizontal geometry when we imported the string. The vertical geometry of the bus bay kerb has been designed so that it is depressed i.e. it is below the normal kerb line.

An approximate idea of the geometry can be seen in the ‘Section LS’ view below where the ‘lip of kerb’ string has been profiled. The model **tin GROUND** was added to the view.

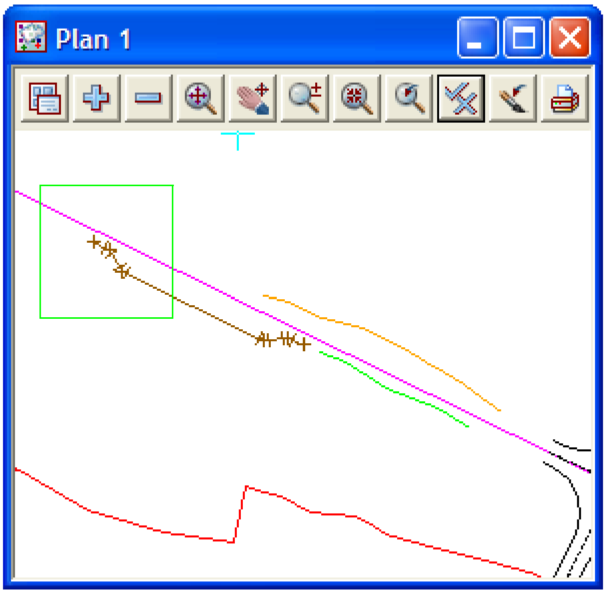


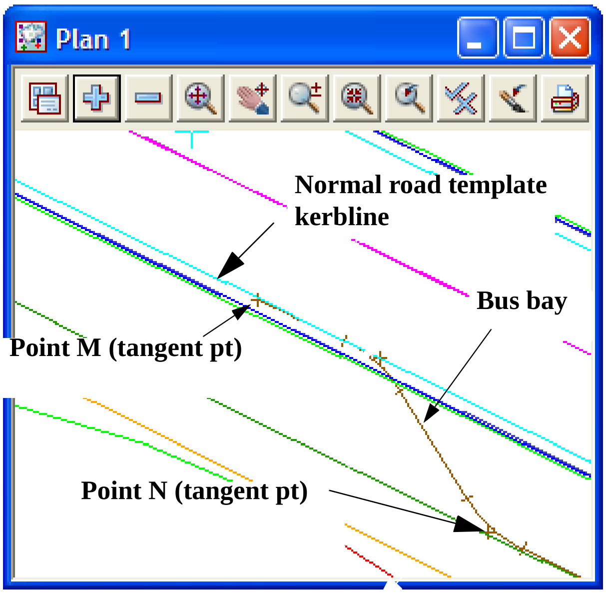
We will use this 'lip of kerb' string to widen the road as before but this time we will be using the vertical geometry of the string to determine the kerb line. Thus the pavement cross fall in the vicinity of the bus bay will be determined by defining the slope of the 'lokr' link to be that slope from the previous link (in this case the 'ROAD 1' design road centreline as there is no previous link) to the bus bay kerb. The width of the 'lokr' link in the vicinity of the bus bay will also be defined as the distance from the previous link (road centreline again) to the bus bay kerb. A smooth transition will be used at either end of the bus bay to return the pavement cross fall to our standard template value of 3%.

Sidenote: In the next Chapter, we introduce a median strip into our road. In this example, it is intentional that this bus bay widening is being applied outside of the range of the median strip to simplify the definition. If we were inserting this bus bay in a region where the median strip applied, the cross fall and widening definition of the 'lokr' link would be more complex opposite the median as the previous link would be the 'invmedian' string rather than the road centreline. Always remember that these template modifier definitions are specifying changes to individual 'link' distances and cross falls. All links outside of the link being changed will move accordingly.

As before, the key information we need to know to create the template modifier commands are the starting and finishing chainages of the tangent points where the bus bay fits in with the 'normal' road kerb line. We will get 12d to measure these chainages exactly.

Zoom in further on the left hand end of the 'lip of kerb' string as shown below. After zooming, click LB on the '+' sign button and turn on the **ROAD 1 Strs** model. Toggle off the vertices.



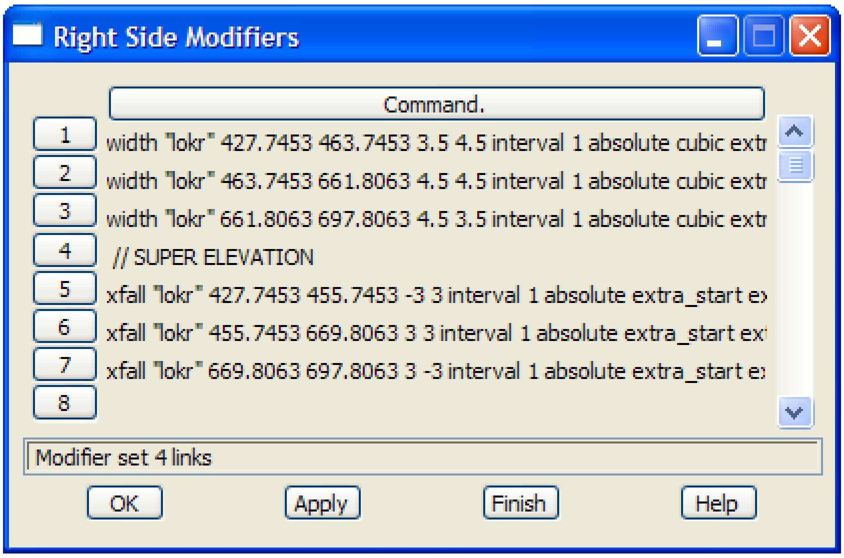


Note that the ends of the bus bay 'lip of kerb' string are collinear with the cyan 'lokr' string corresponding to our normal template right hand kerb line. Thus to ensure a smooth transition of templates, all we need to do is start and stop our road widening at the tangent points where the bus bay 'lip of kerb' string matches up to the 'lokr' string.

The first chainages we need are at points M and N (see above). We need these points so that we can stipulate extra cross section points between M and N to ensure that we get a smooth transition in the highly curved regions of the bus bay. Remember our normal cross sections have only been stipulated at 5m centres. In this region we will ask for cross sections at 1m centres.

The next step will be easier if you turn off the road design strings temporarily. Click LB on the '-' sign in 'Plan 1', and turn off **ROAD 1 Strs**. Refresh the view by clicking MB in the View Button Area of 'Plan 1'. The 'lip of kerb' string should now be clearly visible.

From the MTF Edit menu, click LB on **Modifiers=>Right Side**



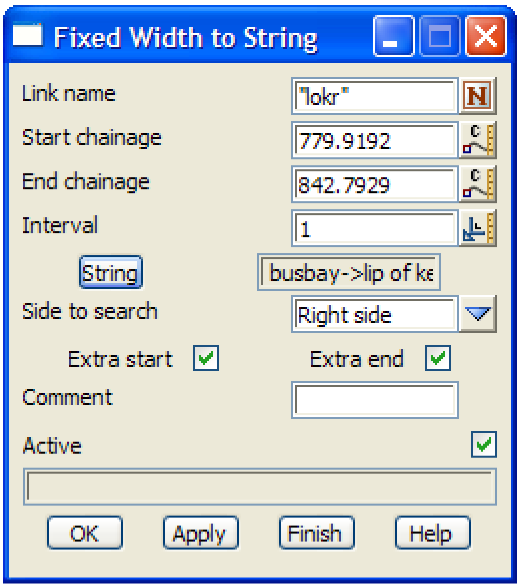
The Right Side Modifiers panel pops up. Note that the previously defined modifiers appear. Your options at this point are that you can edit any of these or add further new modifier commands.

To specify the busbay, we will need two new commands: one for width and one for cross fall, start by adding in another comment "BUSBAY".

Place the cursor in the central grey area opposite line 9 and click LB. The ‘Fixed Width to String’ panel pops up.

Click LB on **Fixed=> Width to string**

The ‘Fixed Width to String’ panel pops up.



Type in the link name **lokr**

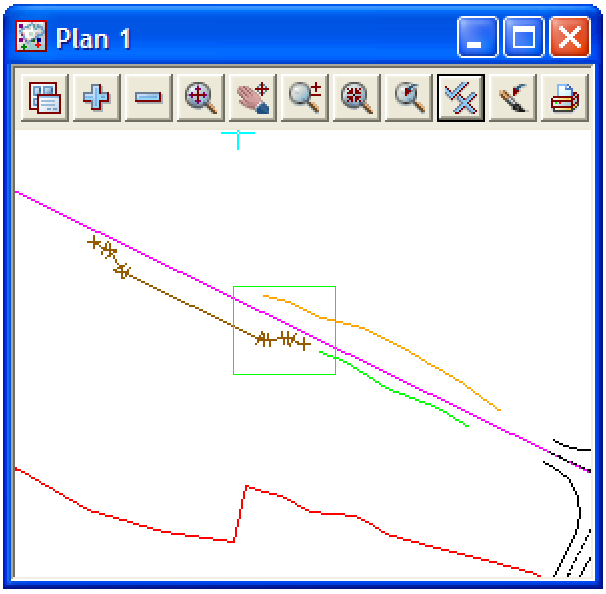
To find the ‘exact’ start chainage for the modifier select the ‘More Information’ icon

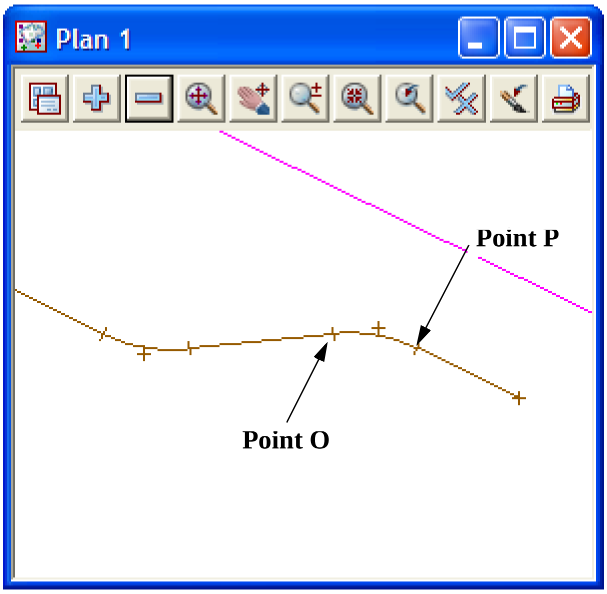
Use the ’measure chainage’ icon to pick the start and end chainage, by picking on Point M (in the previous diagram) and Point P (in the next diagram)

We can generate closer spacing of the sections along this modifier. This will give a better fit to the string. Type in **1** for the ‘Interval’

Click LB on the **String** button and select the ‘lip of kerb’ string in model ‘busbay’.

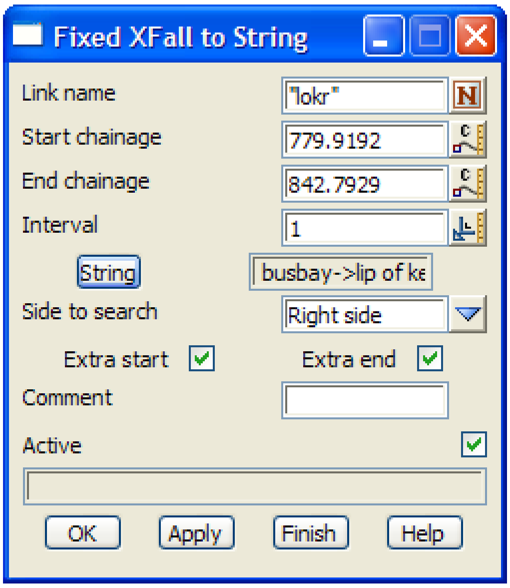
When finished click LB on **Apply** and **OK**.





Back in the Right Side Modifiers panel, place the cursor in the central grey area opposite line 10 and click LB. The Create modifiers panel pops up. Click LB on **Fixed=>Xfall to string**.

The ‘Fixed XFall to String’ panel pops up.



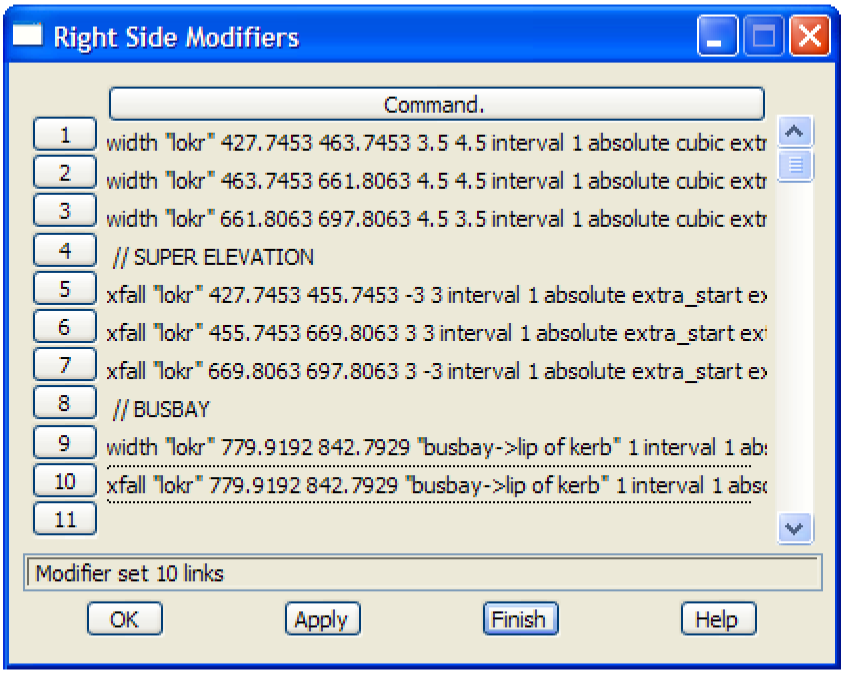
Type in the link name **lokr**

Use the ’measure chainage’ icon to pick the start and end chainage, by picking on Point M and Point P.

We can generate closer spacing of the sections along this modifier. This will give a better fit to the string. Type in **1** for the ‘Interval’

Click LB on the **String** button and select the ‘lip of kerb’ string in model ‘busbay’.

When finished click LB on **Apply** and **OK**



That completes our Right Side Modifiers.

The Right Side Modifiers panel should now look as shown.

Click LB on **Apply** and **OK**.

To ensure that your new changes are saved, from the MTF Edit menu, click LB on **Save** and click on **Yes** to save the changes.

20.5 Resheeting a Road

We will now introduce a further template modifier feature that permits 12d to perform resheeting calculations. Whilst 12d currently has features to optimise resheeting operations, it also has a facility to modify the cross fall of a road surface such that it most closely matches the existing surface. This is done by surveying the existing edge of pavement, introducing that three dimensional string into 12d and then defining the cross fall of the road to pick up the existing edge points. We will now do this and at the same time, widen this section of new road to make it a constant 3.5m width (assumes the existing pavement edge deviates in plan along the road giving a varying pavement width).

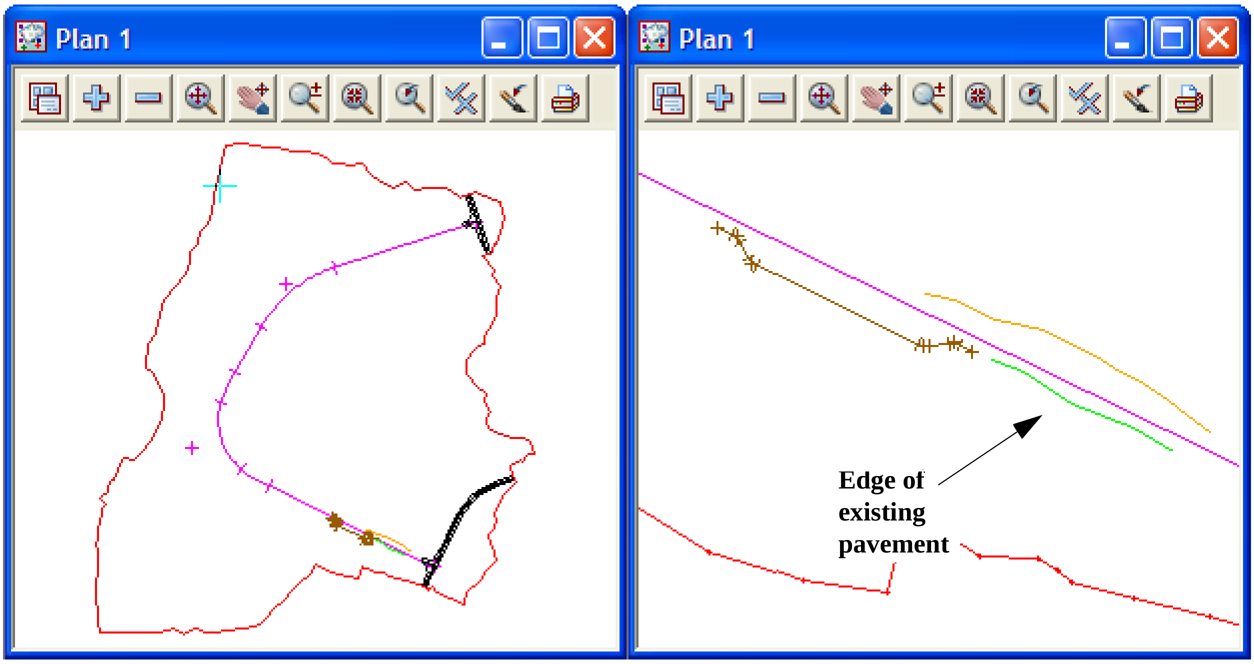
Whilst we could also have surveyed the existing ‘road crown’ and used that as our road centreline, for the purpose of the tutorial, we will use our existing ‘ROAD 1’ design string as our road centreline. Thus our new road will have cross falls defined by the slope between the ROAD 1 design alignment and our existing pavement edge.

<u>Note on resheeting operations</u>: Whilst we are not demonstrating it here, a further feature of 12d permits width and crossfall links to be defined as the distance and slope respectively between any <u>two</u> strings. Those strings could be the existing road crown and existing pavement edge. It is also possible to translate both of these strings by (say) 100mm vertically to define the finished pavement surface.

A 3D string (i.e. a string with levels) called ‘existing edge’ in model ‘resheeting’ has already been imported.

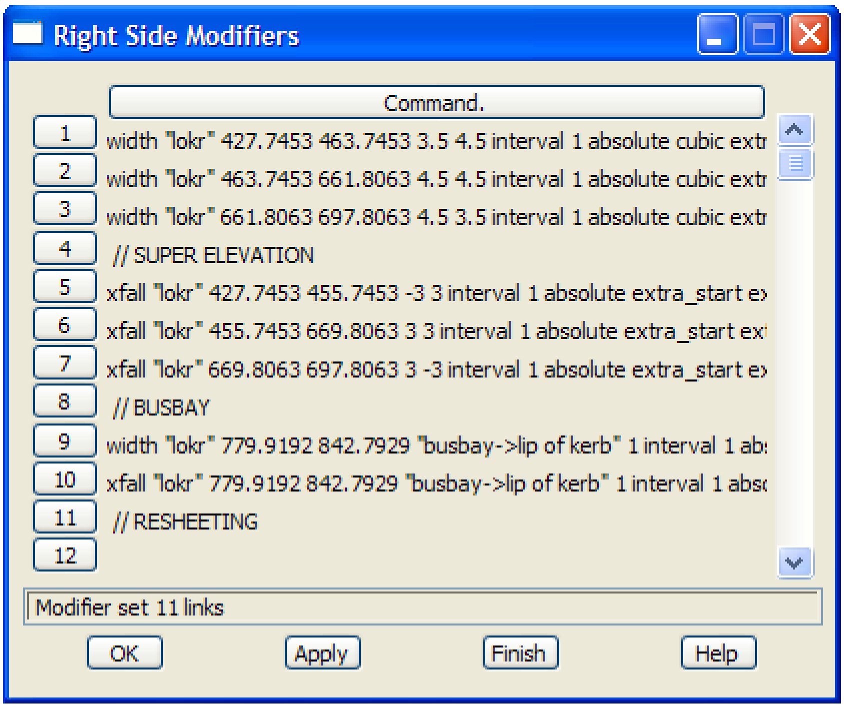
From the ‘Plan 1’ view click LB on Fit. Then Zoom in as shown below. From the ‘Plan 1’ view click LB on **Toggle=>Vertices** so that you can see the various points on the ‘existing edge’ string. (or if you can’t see the Toggle menu item, place the cursor in the View Button Area of ‘Plan 1’ and click RB to pop up the View menu. Click LB on **Settings=>Toggle=>Vertices**). Turn on the **Line Snap**.

.



From the Main menu, click on **Strings=>Inquire** to perform a String Inquiry. Click on the green ‘existing edge’ string. Note that in the information panel that pops up, the string is a 3d string and it has meaningful profile Z values (observe a prof z value around 58).

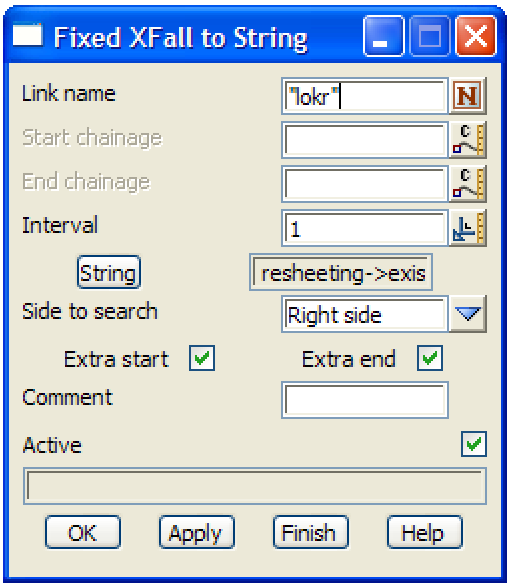
From the MTF Edit menu, click LB on **Modifiers=>Right Side**. Add the comment "RESHEETING"



To set the cross fall of the ‘lokr’ link to be the same as the cross fall to the ‘existing edge’ string, we will need a new Xfall to String command.

Place the cursor in the central grey area opposite line 12 and click LB. The ‘Create modifiers’ panel pops up.

Click LB on **Fixed=> XFall to string**. The Fixed XFall to String panel pops up.

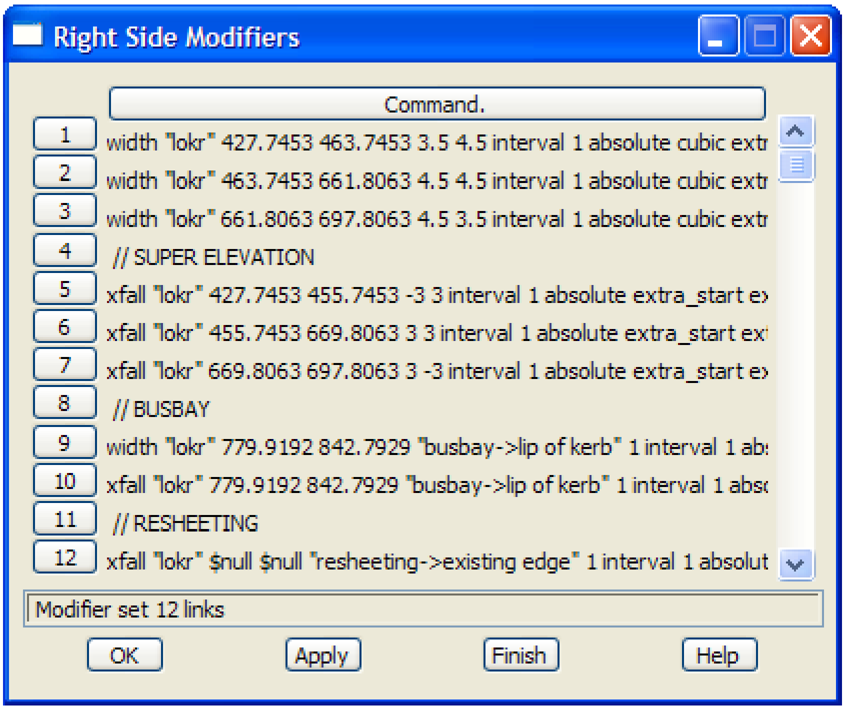


Type in the link name **lokr**

On this occasion we won't bother to give a start and end chainage as 12d can read the chainages from the start and end of the string we select.

Click LB on the **String** button and select the 'existing edge' string in model 'resheeting'.

When finished click LB on **Apply** and **OK**



The Right Side Modifiers panel should now look as shown above

Click LB on **Apply** and **OK**.

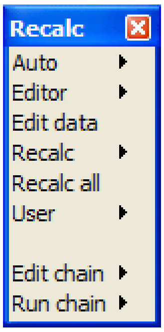
To ensure that your new changes are saved, from the MTF Edit menu, click LB on **Save**.

That completes enough Template Modifier commands for now. So that we can see any subsequent changes during the redesign of our road, turn the road design strings back on. Click LB on the '+' sign button in 'Plan 1' and double click LB on **ROAD 1 Strs** and **ROAD 1 Sects**. Toggle off the vertices.

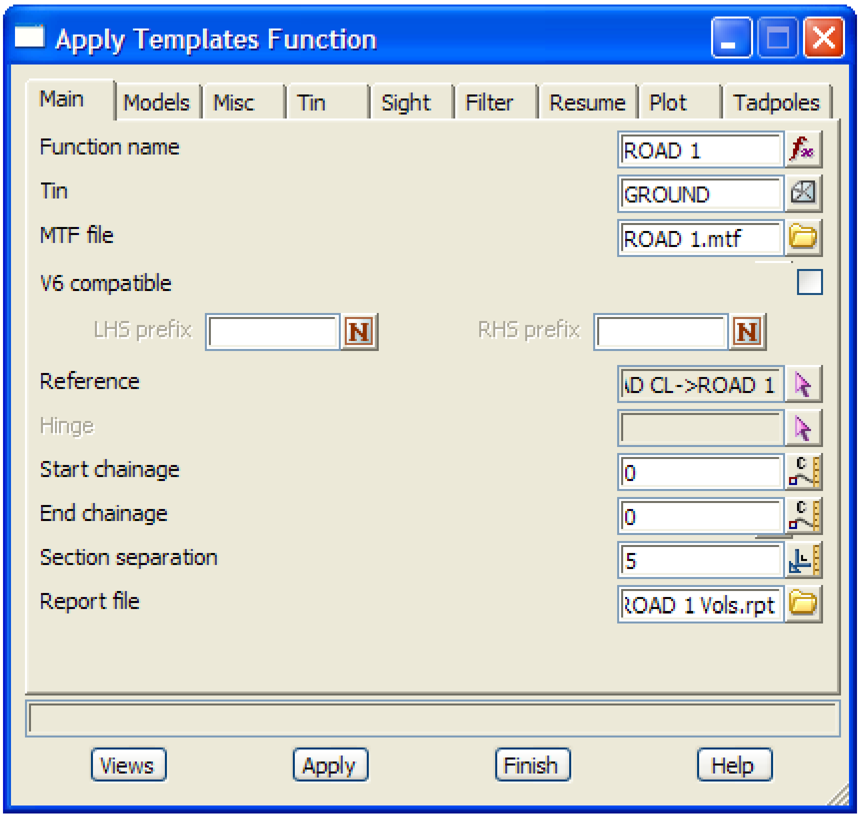
Click LB on **Fit** to fill the view.

20.6 Re-Applying the Modified mtf File (second time)

To re run the Apply Templates Function click LB on **Design=>Apply=>Apply Many** and the Apply Templates Function panel will pop up, or…



If the Recalc panel is on display, you can also pull up the same panel by walking right on **Editor=>ROAD 1** from the Recalc menu.



Click on the icon in the ***Function name***field and a list of available functions will pop up. Click on **ROAD 1.** This was the name we gave our first Apply Many attempt. The various answers we gave last time should reappear.

Nothing should need changing.

If you didn't set up the mtf file you can use file **ROAD1.mtf** from the 'Template files' choice list

Click LB on **Apply** to process the Apply Many function.

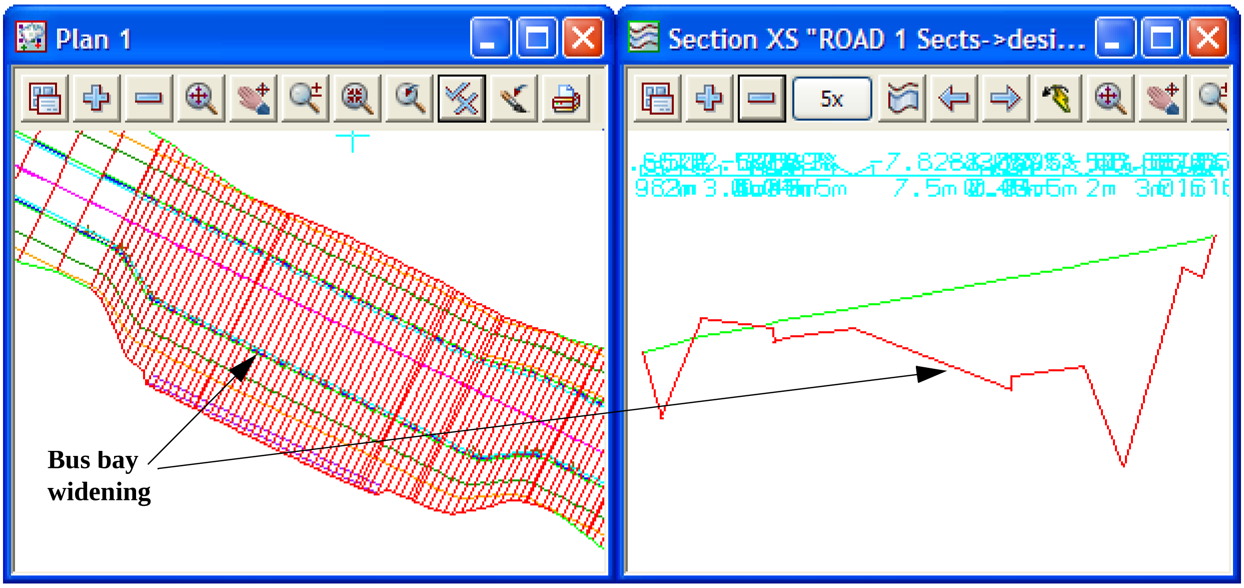
All of the strings in the **ROAD 1 Strs, ROAD 1 Sects** and **ROAD 1 Polys** models will be deleted and replaced by recalculated strings. This happens each time you run the Apply Many function so you don't have to delete any of the old strings manually.

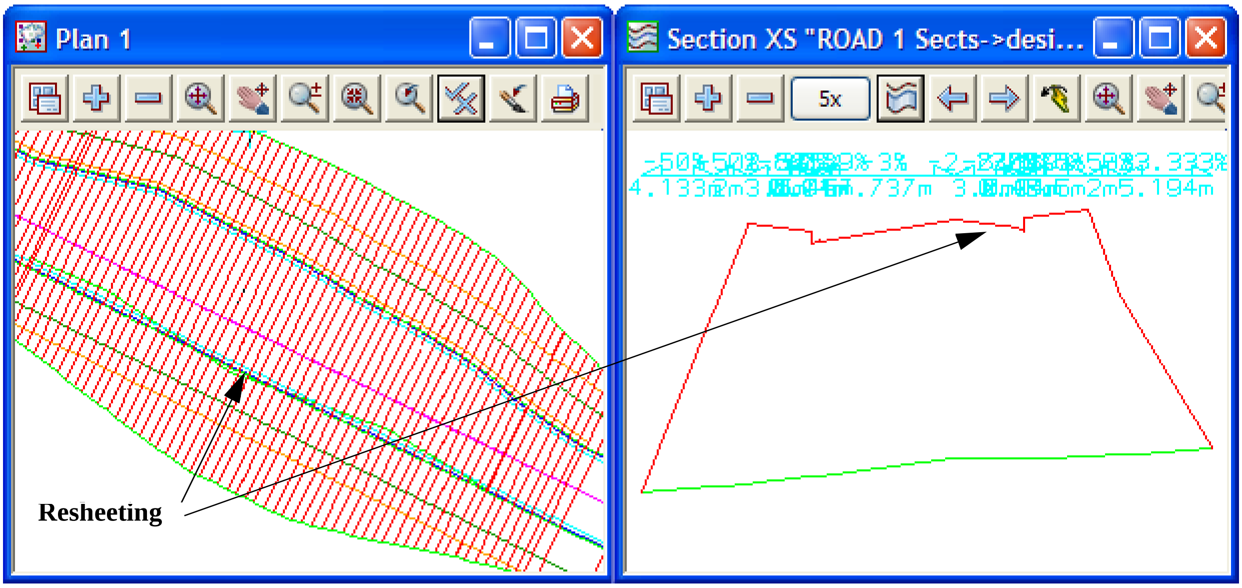
The new strings will appear after a short processing delay.

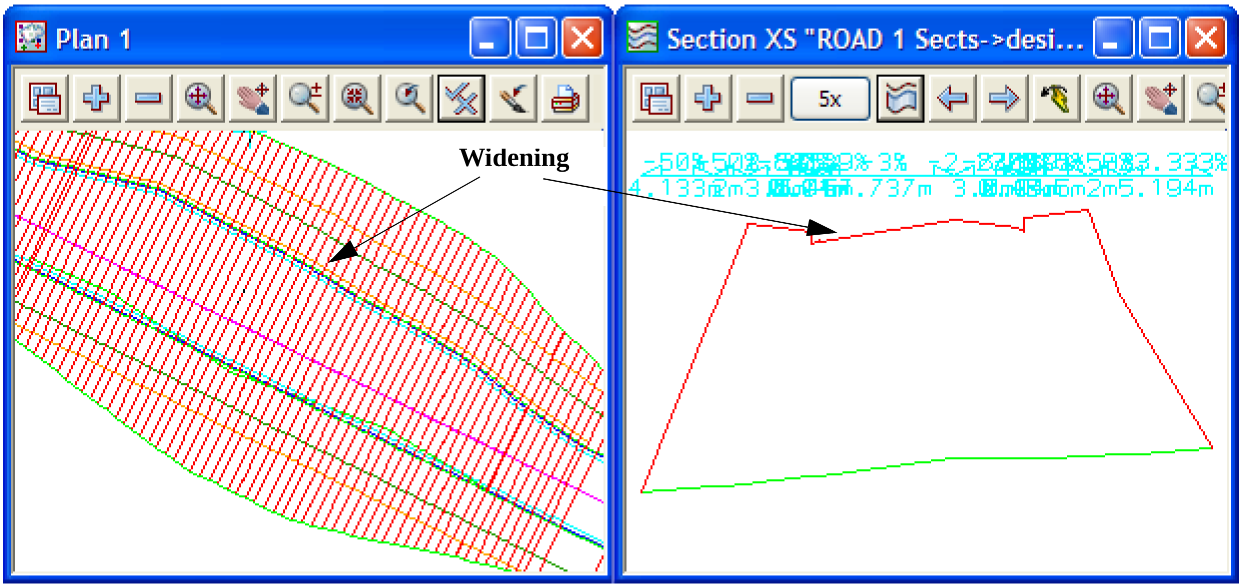
Note the revised cut, fill and balance calculations at the base of the panel. These volumes have been calculated from the combined effects of our revised road geometry.

Zoom and **Pans** can then be used in the Plan view to have a closer look at the revised road design.

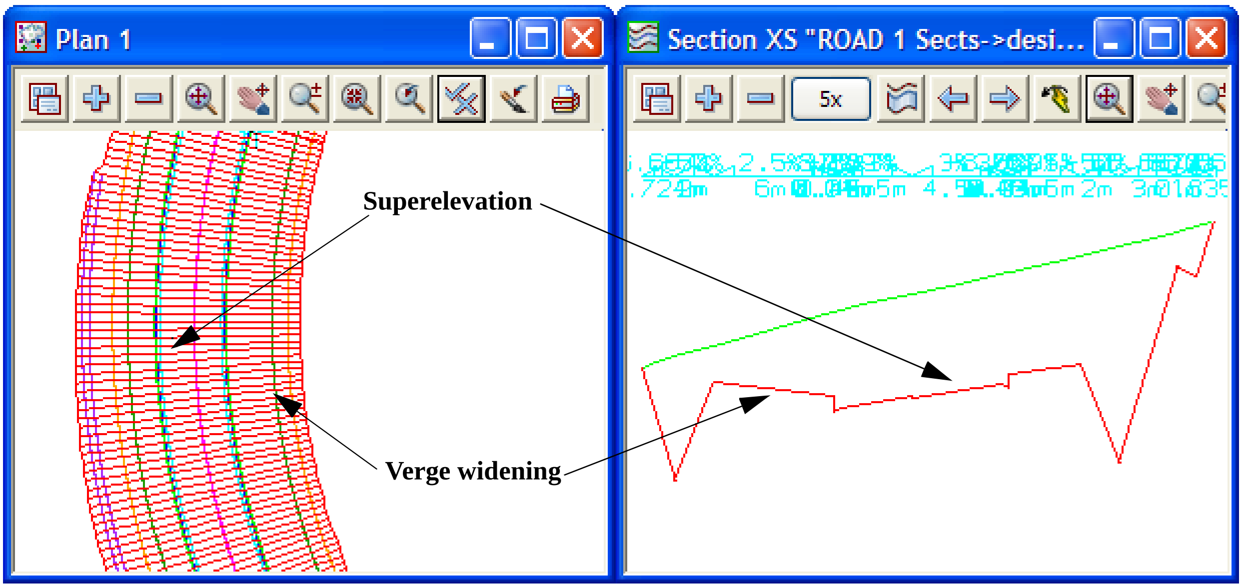
Zoom in around the widening strings near the end of the road







Zoom in to the curve with superelevation and widening applied



We will now make further changes to our road.

Note how we are incrementally building up and applying these changes. As the designer, you decide how many changes you make before reapplying them. It is usually wisest to only make a few changes at a time, get them right, and then proceed on to the next ones. In this manner, if things go wrong with your design, you only need focus on your latest changes.

21 Median Strip

21.1 Inserting a Median Strip along the Road Centreline

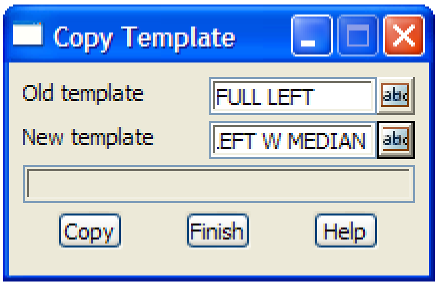
Whilst there are a variety of ways of doing this, we will initially do it by duplicating and modifying our existing template to include the median geometry. This example illustrates the starting and stopping of templates when adjoining templates have a different number of links. These templates can typically be 0.1mm apart at a particular chainage (to ensure that volume calculations are not impacted). It also shows the use of ‘hinge modifiers’ when applying templates to allow the actual point of application of the template to be displaced from the theoretical point of application as defined by the hinge string.

It is useful at this time to review 12d’s rules for template file application.

1. If one template stops at the same chainage that another template begins, then the two templates must have the same number of fixed and variable links. The templates will be varied linearly from the stopping template to the starting template over one section separation distance.
2. If there is a linear variation between two templates, the two templates must have the same number of fixed and variable links.
3. If two templates do not have the same number of links, they must be separated by a gap i.e. by a region with no template. This gap can be 0.1mm wide so as not to affect volume calculations.

21.2 **Creating the Median template links**

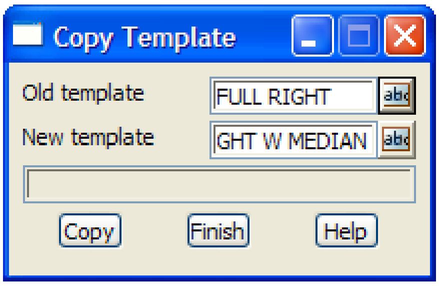
We begin setting up our median strip by duplicating the existing ‘FULL LEFT’ template.



From the main menu click LB on **Design=>Templates=>Copy**

Click LB on the ‘More Information’ icon 

for the ‘Old template’ field to pop up a list of templates. Click LB on ‘FULL LEFT’. Press the Enter key and type the new name ‘FULL LEFT W MEDIAN’. Click LB on **Copy** to force the duplication.

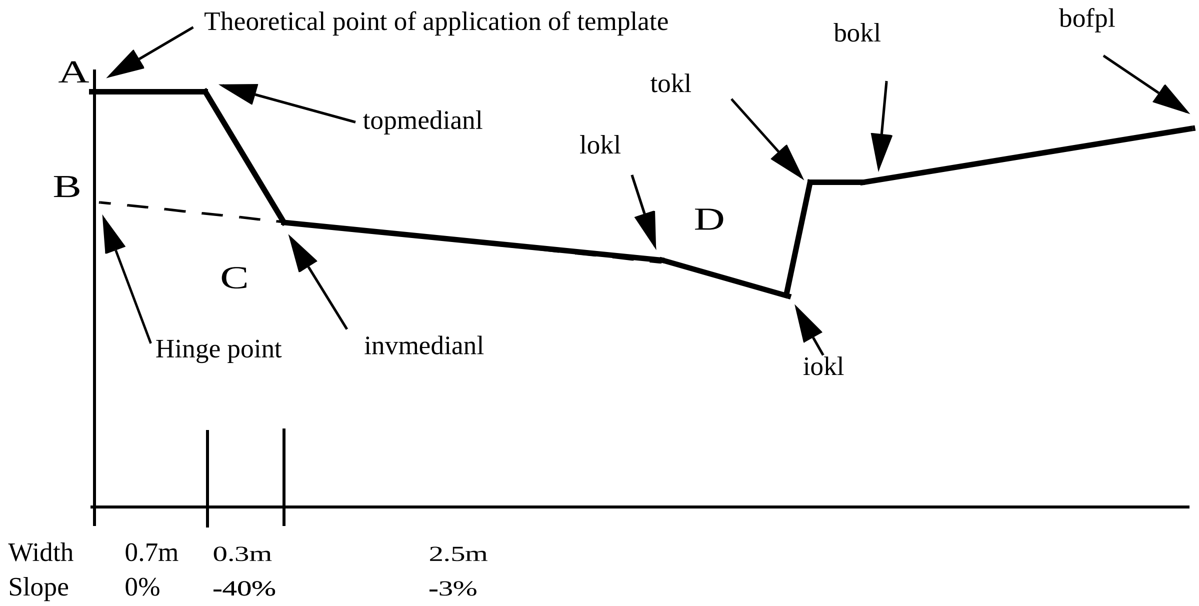


Repeat the copy process for the ‘FULL RIGHT W MEDIAN’ template that is used on the right side of our road.

Click LB on **Finish** to complete the panel.

<u>STANDARD RIGHT TEMPLATE WITH SUFFIX r SHOWN</u>

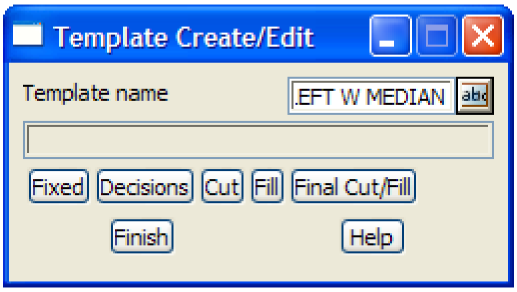
(STANDARD LEFT TEMPLATE IS SIMILAR BUT WITH SUFFIX l)



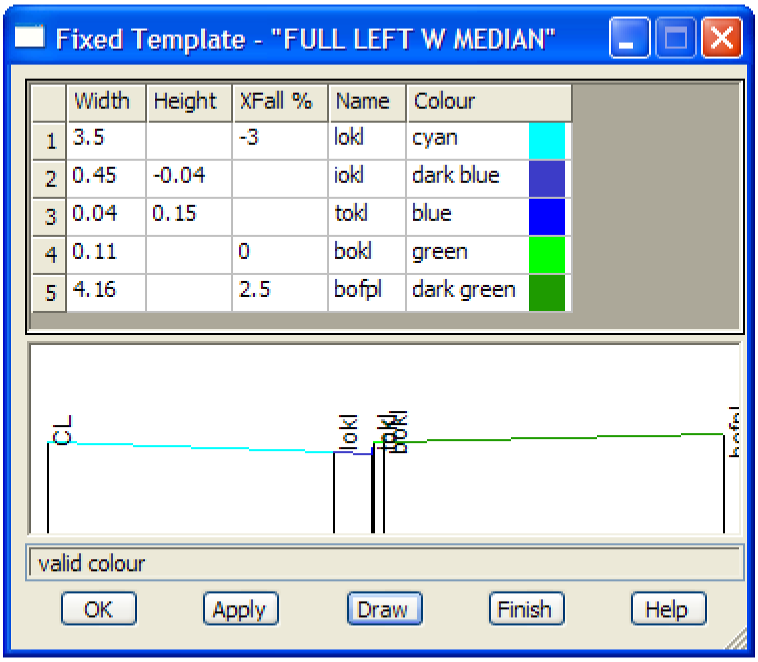
The dark line shows template ’FULL LEFT W MEDIAN’. Template ’FULL LEFT’ is identical but without the median i.e. the 3.5 m pavement width extends from B to D at 3% cross fall.

Distance AB is 0.090m. The adopted hinge point for the application of all templates will be at point B. This requires template ’FULL RIGHT W MEDIAN’ to be applied with a hinge modifier vertical offset distance of 0.090m

From the main menu, click LB on **Design=>Templates=>Create/edit**



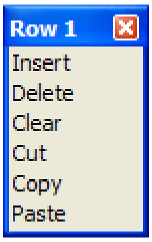
Click LB on the ‘More Information’ icon for the ‘Template name’ field and select template ‘FULL LEFT W MEDIAN’ with LB. Click LB on **Fixed** to edit the details of the fixed links in this template.



	Width	Height	XFall %	Name	Colour
1	3.5		-3	lokl	cyan
2	0.45	-0.04		iokl	dark blue
3	0.04	0.15		tokl	blue
4	0.11		0	bokl	green
5	4.16		2.5	bofpl	dark green

The template will initially appear as follows

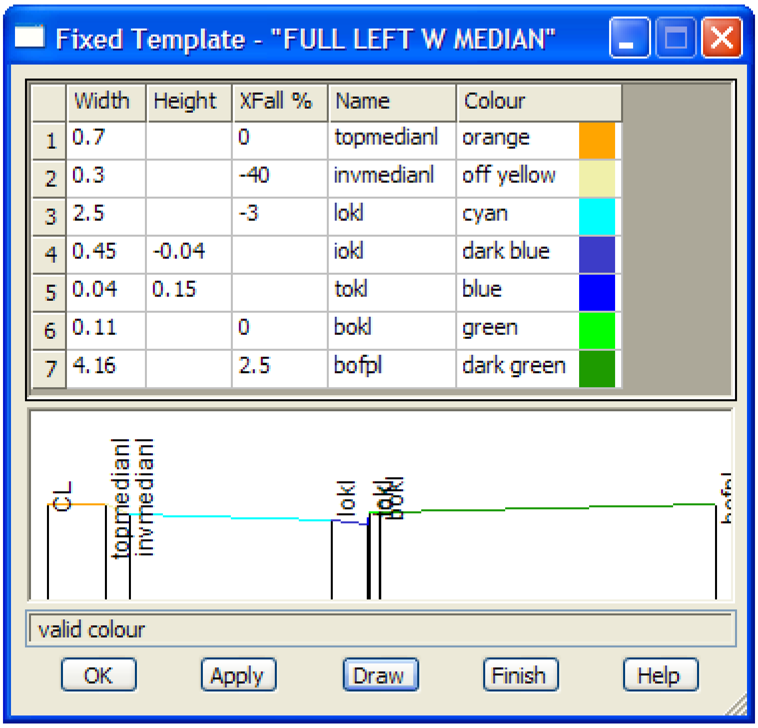
Position the cursor on line 1 over the number **1** at the left hand end and click RB.



In the popup, click LB on **Insert**. A blank line will be inserted at line 1 and all existing lines pushed down one line.

Repeat the process so that two blank lines have been inserted at lines 1 and 2.

Now fill in the panel as shown for lines 1 and 2.

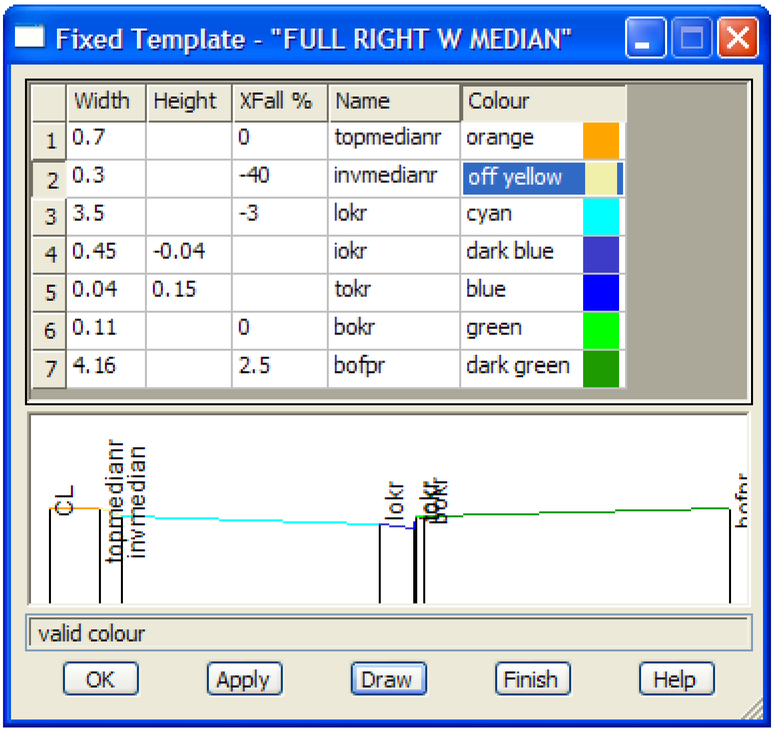


	Width	Height	XFall %	Name	Colour
1	0.7		0	topmedianl	orange
2	0.3		-40	invmedianl	off yellow
3	2.5		-3	lokl	cyan
4	0.45	-0.04		iokl	dark blue
5	0.04	0.15		tokl	blue
6	0.11		0	bokl	green
7	4.16		2.5	bofpl	dark green

Finally, on line 3, make sure that you reduce the width of the carriageway from 3.5m to 2.5m wide.

This is so that the 1.0m wide median is inserted into the overall road geometry without widening the outer kerb lines etc. Lines 4 through 7 (renumbered, as shown above) are unchanged. Note that by changing the link distances in this way, the old strings remain the same distance from the template centreline as before.

Click LB on **Apply** and **OK**



Repeat the whole process for the right side template 'FULL RIGHT W MEDIAN'.

Note that all values are the same as the left side. The only difference is in the naming of the links – suffix of 'l' on the left and a suffix of 'r' on the right.

Click LB on **Apply** and **OK**

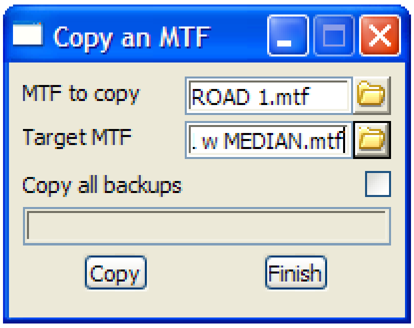
Click LB on **Finish** to exit the 'Template Create/Edit' panel

21.3 Use of Hinge point modifiers

In the template diagram, the 'theoretical' point of application of template 'FULL LEFT' is at Point B. Because of the way we have defined it, the 'theoretical' point of application of template 'FULL LEFT W MEDIAN' is at Point A. To ensure that these two templates are applied in a manner in which they match up in adjoining sections, a hinge modifier must be introduced for template 'FULL LEFT W MEDIAN'. The hinge point (i.e. the point of application of the template) for 'FULL LEFT W MEDIAN' must be raised by 0.090m or else the template will be applied too low into the profile causing an unwanted step in our road.

We will start the median strip at chainage 700 and stop it at chainage 850. The hinge modifier command is used to change the location of the hinge point. In particular, as we only wish to move the hinge point vertically (it could be moved laterally as well) we must use the 'height' modifier within the Hinge Modifier command.

Before we do this we will make a copy of the existing ROAD 1.mtf so that we can refer back to it at a later date. To make a copy of the template file, go to **Design => MTF => Copy MTF.**

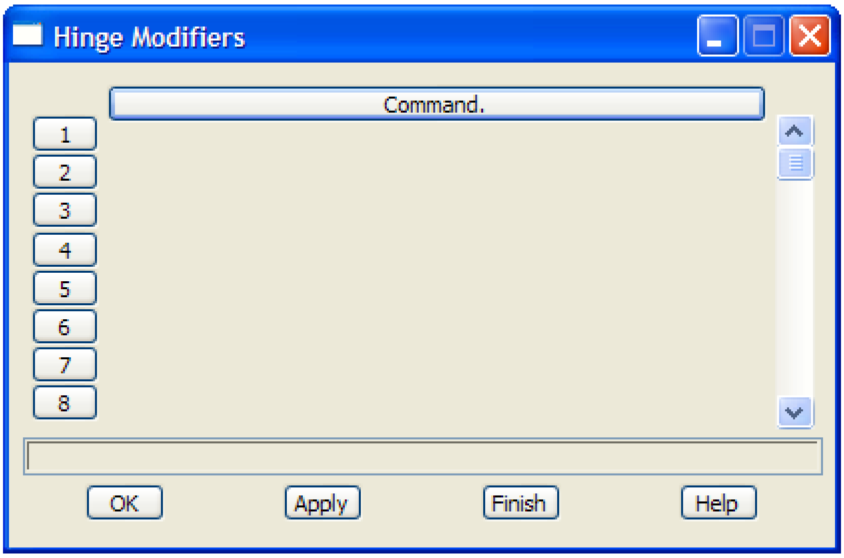


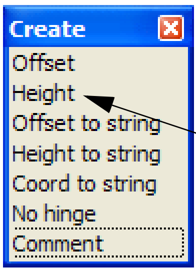
Select the ROAD 1.mtf file from the ***MTF to copy*** icon.

Type in **ROAD 1 w MEDIAN** for the ***Target MTF***.

Click on **Copy** to make a copy of the ROAD 1. mtf file.

Open the new mtf file for editing by clicking on **Design => MTF => Edit => ROAD 1 w MEDIAN.mtf**. To make changes to the Hinge modifier, in the ***MTF edit*** panel click on **Hinge**.





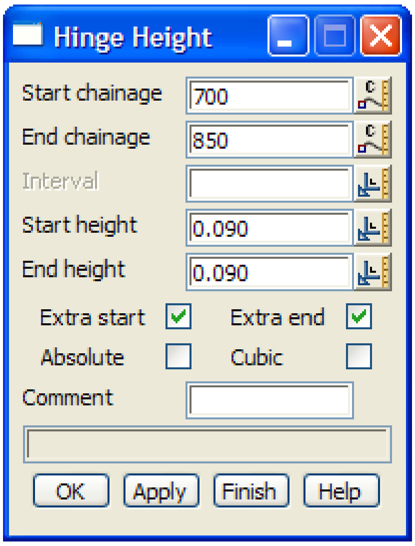
The Hinge Modifier panel pops up with all fields blank.

Place the cursor in the central grey area opposite line 1 and click LB.

The 'Create' modifier panel pops up.

Click LB on **Height**

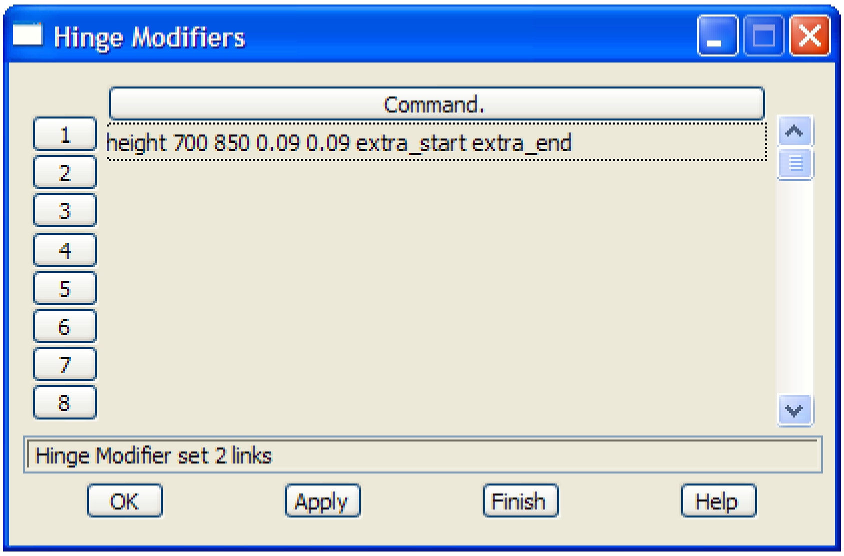
The Height panel pops up.



Fill in the panel as shown.

Uncheck the Absolute check box as our heights are relative to our design centreline.

Click LB on **Apply** and **OK**



The finished Hinge Modifier panel should look as shown above

Click LB on **Apply** and **OK**

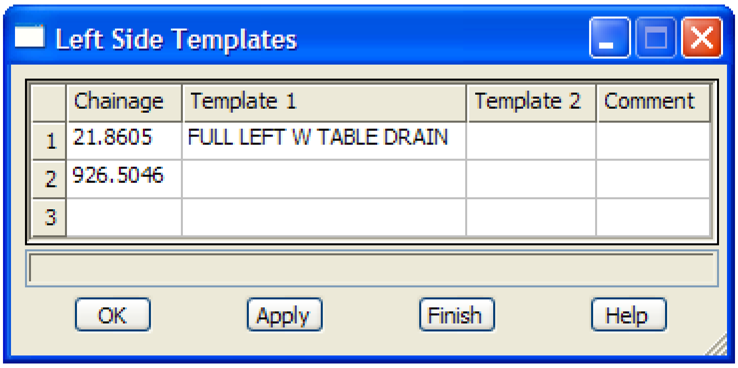
Note that this modification is to the hinge point and hence applies to all templates applied on both sides of the road.

21.4 Setting up the Application of the Median Template

In addition to changing our hinge point, we must now stipulate that on the left side of the road, we will use template 'FULL LEFT W MEDIAN' within the above chainage ranges and on the right side of the road the template 'FULL RIGHT W MEDIAN'.

The latest changes to the left_side and right_side definitions are now as shown below

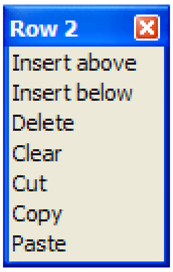
From the MTF Edit menu, click LB on **Templates=>Left Side**



The Left Side Templates panel pops up with the commands created previously on display.

First we need to use the template modifier 'edit' commands to 'push' line 2 down one line.

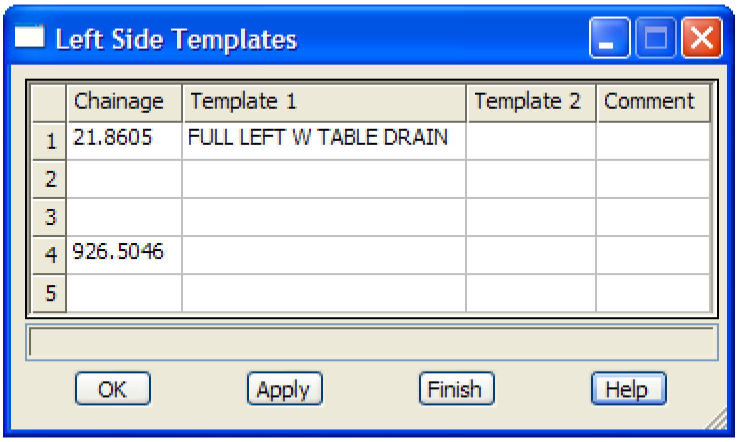
Place the cursor over the line number button '2' (at the left end of line 2) and click RB. This pops up the line editor menu.



Click LB on **Insert above.**

This will insert a blank line before line 2. 'Old' Line 2 will now appear as 'new' line 3.

Repeat this to add another new line



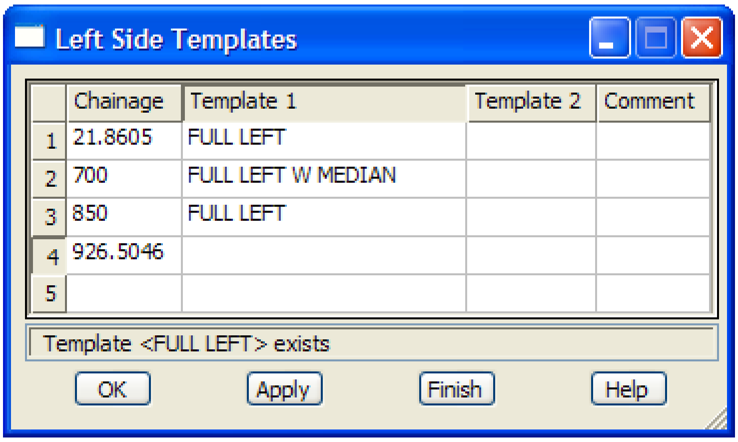
Your Left Side Templates editor panel should now appear as shown left

We now need to insert chainages on lines 2 and 3 corresponding to where we want the median to start and end, but first change the template in line 1 to 'FULL LEFT' - we do this as we modified full left and not FULL LEFT W TABLE DRAIN and hence the number of links are still the same.

In the chainage field for Line 2 type 700.

In the 'Template 1' field opposite line 2, click RB and double click LB on **FULL LEFT W MEDIAN**. This tells 12d that on the left side of the road we wish to start using this template at chainage 700.

At chainage 850, we need to return to the template **FULL LEFT** so in line 3 type in 850 for the ***Chainage*** and select **FULL LEFT** for ***Template 1.***

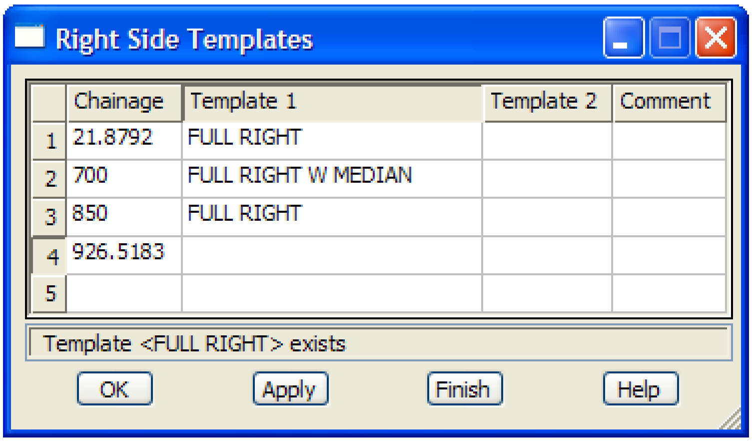


The finished panel should now appear as shown left

When finished click LB on **Apply** and **OK**

To ensure that your new changes are saved, from the MTF Edit menu, click LB on **Save**.

You then need to make a very similar set of changes on the right side. From the MTF Edit menu, click LB on **Templates=>Right side**



The finished panel should appear as shown left

When finished click LB on **Apply** and **OK**

To save your latest changes and exit from the MTF Edit menu, click LB on **Save & Finish** then select Yes to confirm.

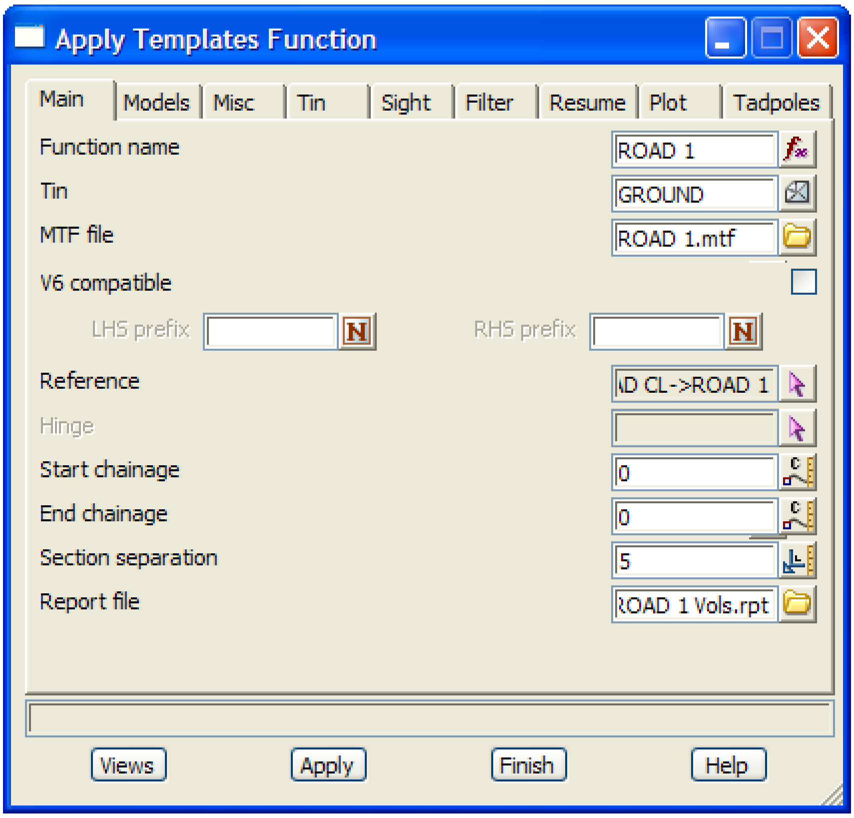
So that we can see any subsequent changes during the redesign of our road, make sure that the road design strings are turned on. Click LB on the ‘+’ sign button in ‘Plan 1’ and double click LB on **ROAD 1 Strs** and **ROAD 1 Sects.** Click LB on **Fit** to fill the view.

21.5 Re-Applying the Modified mtf File (third time)

That completes the Template Modifier commands to insert a median strip.

We will now apply this latest version of our changed ‘many template file’.

If the Apply Templates Function panel is not already on display, from the Main menu, click LB on **Design=>Apply=>Apply Many** and the Apply Templates Function panel will pop up.



Click LB on the icon for the ‘Function name’ field to pop up a list of available functions. Click LB on **ROAD 1**. This was the name we gave our first Apply Many attempt. The various answers we gave last time should reappear.

Note that the ***MTF File*** field is set to use ROAD 1.mtf, however we wish to apply the MTF file containing the Median Strip and hence we need to select this mtf file. Click on the folder icon, nd from the pop up list, select **ROAD 1 W MEDIAN.mtf**.

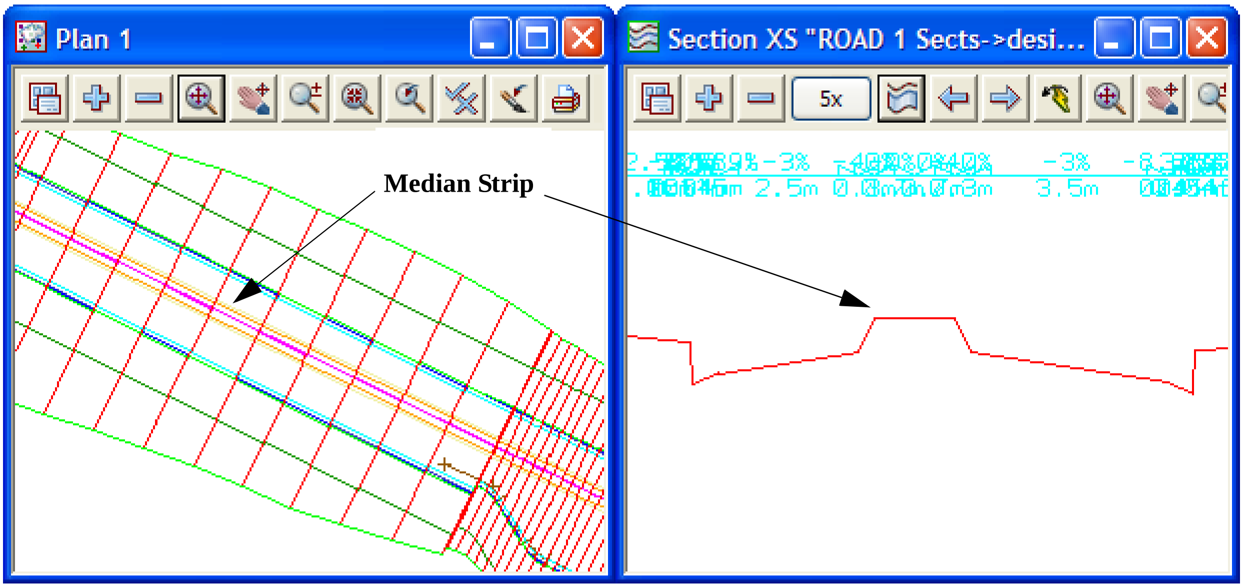
Click LB on **Apply** to process the mtf file.

As before, all of the strings in the design strings, sections and polygons models will be deleted and replaced by recalculated strings. This happens each time you run the Apply Many function so you don’t have to delete any of the old strings manually.

Note the revised cut, fill and balance calculations at the base of the panel. These volumes have been calculated from the combined effects of our revised road geometry.

Click LB on **Finish** to terminate the panel.

Zoom and **Pans** can then be used in the Plan view to have a closer look at the median



22 Boxing

22.1 Overview

Boxing in the context of 12d is the excavation required to form up the subgrade of a road. Generating boxing means creating the strings and sections that represent the surface of the boxing excavation. A boxing surface TIN can then be created from these strings and boxing quantities calculated.

Boxing is defined in terms of boxing rules which are stored in a boxing file. Each boxing rule specifies the width and depth of boxing in terms of the geometry of the road template links. The beauty of this system is that if you (say) widen the lip of kerb link i.e. the road surface at a bus bay, by default the boxing widens accordingly to match the road surface. This happens automatically and only has to be changed by exception. In most cases, this is exactly the behavior road designers are looking for.

This clever design feature means that boxing is quite simple to implement. The easiest way to generate boxing is to complete the design of the surface of your road first and then implement boxing afterwards.

Applying boxing is very similar to applying a template. Boxing can be applied as part of the MTF ‘Apply Many’ process or it can be applied in a standalone manner. Most users prefer to use the former of these two ways. Boxing is then specified and stored as just another part of your MTF file.

In general, there are two steps to boxing – defining it and then applying it. Boxing is easy to apply. However, defining boxing is more complex than applying it. This is generally not a problem as often within an organization, only one specialist person need be involved in setting up all of your boxing rules. Boxing rules often don’t change from client to client or project to project for a particular client. Thus once these rules are setup, they don’t need much attention. All you as a 12d user needs to know is the names of the various boxing rules and how to apply them.

This chapter will focus on applying boxing that is already defined.

The Boxing (.bf) File

A boxing file is a simple ASCII file and always has the suffix ‘.bf’. A boxing file will contain one or more ‘Boxing Rules’. Thus all the rules for a particular client or project can be stored in one file for convenience. Boxing files can be copied from project to project etc just like mapping files. They can also be stored in the user library on a server so that all users can access the one master boxing file.

The easiest way to learn about boxing is simply to use it. We will now use several existing ‘Boxing Rules’ to generate longitudinal boxing strings and boxing sections.

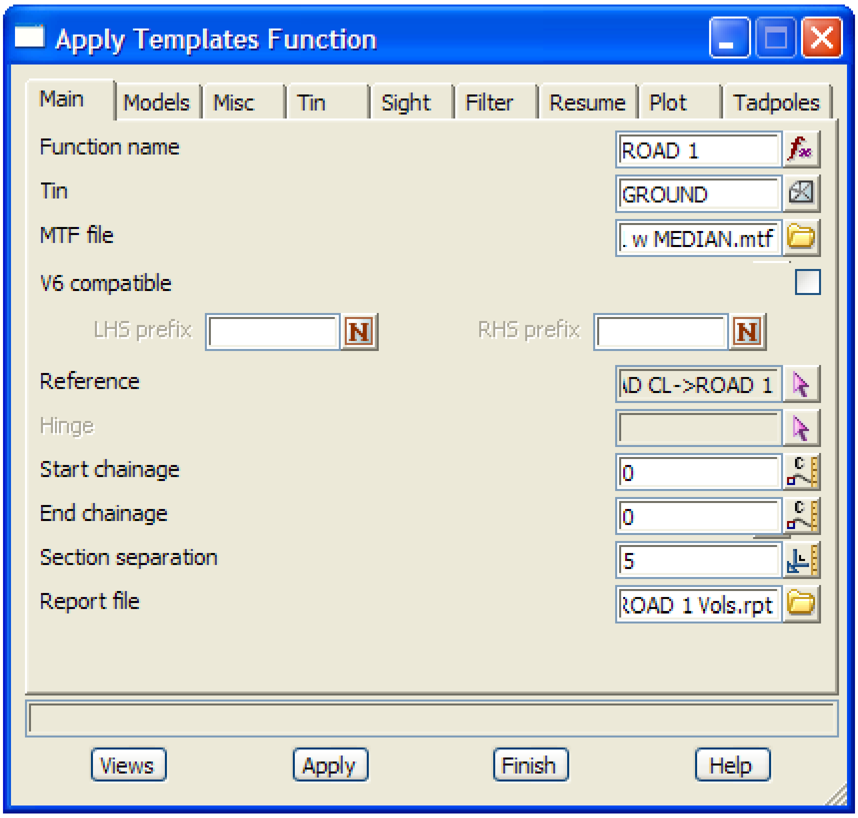
22.2 Applying Boxing from the ‘Apply Many’ Command

In the Chapter 20 *Template Modifiers*, we designed the road ‘ROAD 1’ using the mtf file ‘ROAD 1.mtf’. We will make a copy of this mtf file and then add the boxing and rerun the ‘Apply many’ using this new mtf file. Observe that the ROAD 1.mtf was before the median was added but it still contains all of our road widening and bus bay. We will use this file as a starting point for implementing boxing.

Next we need the ‘Recalc’ menu on display. This should be torn off by clicking LB on **Utilities=>Recalc=>[Recalc]** and positioned somewhere on the left hand side of your screen.

From the Recalc menu, click LB on **Editor=>ROAD 1**.

The Apply Templates Function panel will pop up with the values that were set last time we ran this function.



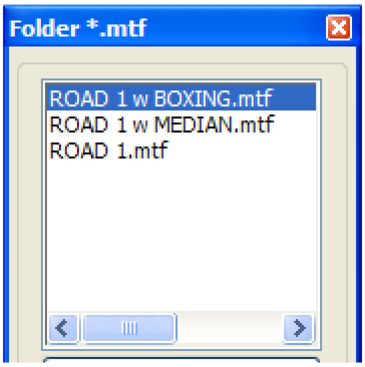
Change the ***MTF file*** from **ROAD 1 w MEDIAN.mtf** to **ROAD 1.mtf** to ensure that we no longer have the median strip in our design.

To see the results of this file, click LB on the **Apply** button at the base of the panel. Your ‘Plan 1’ view should now show the revised strings and sections along ROAD 1.

We now want to make a copy of ‘ROAD 1.mtf’ and store it’s contents in a new file ‘ROAD 1 w BOXING.mtf’ (Road 1 with boxing). We will then implement our boxing changes into this new file and rerun the revised design.

To generate boxing strings and sections, we make use of the previously created models **ROAD 1 Box strs** and **ROAD 1 Box sects** as shown in the ***Models*** tab of the **Apply Templates Function**.

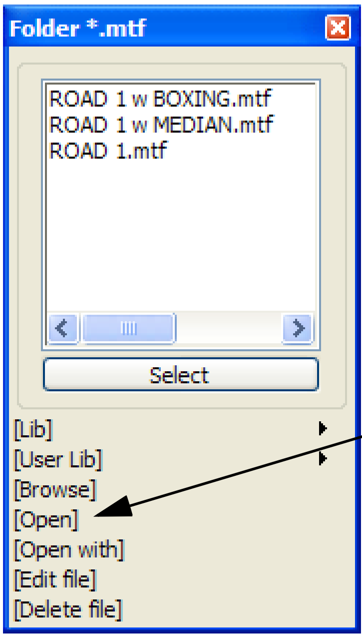
To make a copy of the MTF file, click on **Design=>MTF=>Copy MTF.** Select the **ROAD 1.mtf** file as the ***MTF to copy*** and type **ROAD 1 w BOXING** in the ***Target MTF*** field. Click on **Copy**.



We now want to make interactive changes to file ‘ROAD 1 w BOXING.mtf’ to implement boxing along the entire road.

In the Apply Templates Function ‘ROAD 1’ panel, opposite the Templates file field, click LB on the **folder** icon and click LB on ‘ROAD 1 w BOXING.mtf’ to highlight that file. Click LB on the **Select** button to place the name back in the Templates file field (or just double click LB on ‘ROAD 1 w BOXING.mtf’ to highlight and select).

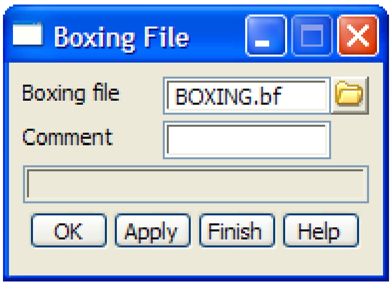
It is essential that you edit file ‘ROAD 1 w BOXING.mtf’, not ‘ROAD 1.mtf’. Make sure that the name **ROAD 1 w BOXING.mtf** is visible in the ‘Templates file’ field before proceeding further.



In the *Templates file* field of the Apply Templates Function panel, click LB on the **folder** icon to bring up the Directory *.mtf list and then click LB on **[Open]**.

The MTF Edit menu for ROAD 1 w BOXING.mtf will appear.

From the MTF Edit menu, click LB on **Boxing=>File**



From the User Library of the popup panel, select the name **BOXING.bf**. This is the file that contains our various boxing rules.

Click LB on **Apply** and **OK**.

Generally, we apply boxing on the left side only. <u>Boxing is always applied from left to right and typically spans the entire width of the road</u>. It is permissible to refer to links on the right hand side from boxing applied on the left so there is very little reason to ever specify boxing on the right side.

From the MTF Edit menu, click LB on **Boxing=>Left side**

The boxing rules we are going to apply is full boxing down the entire length of the road.

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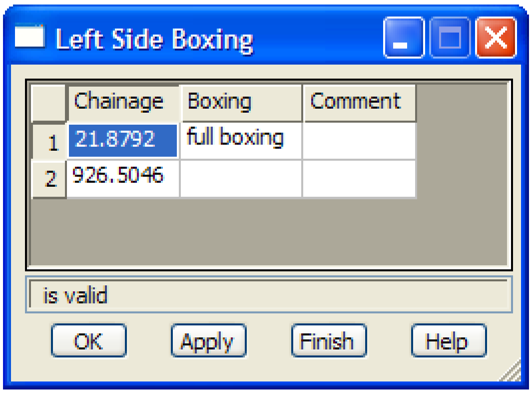
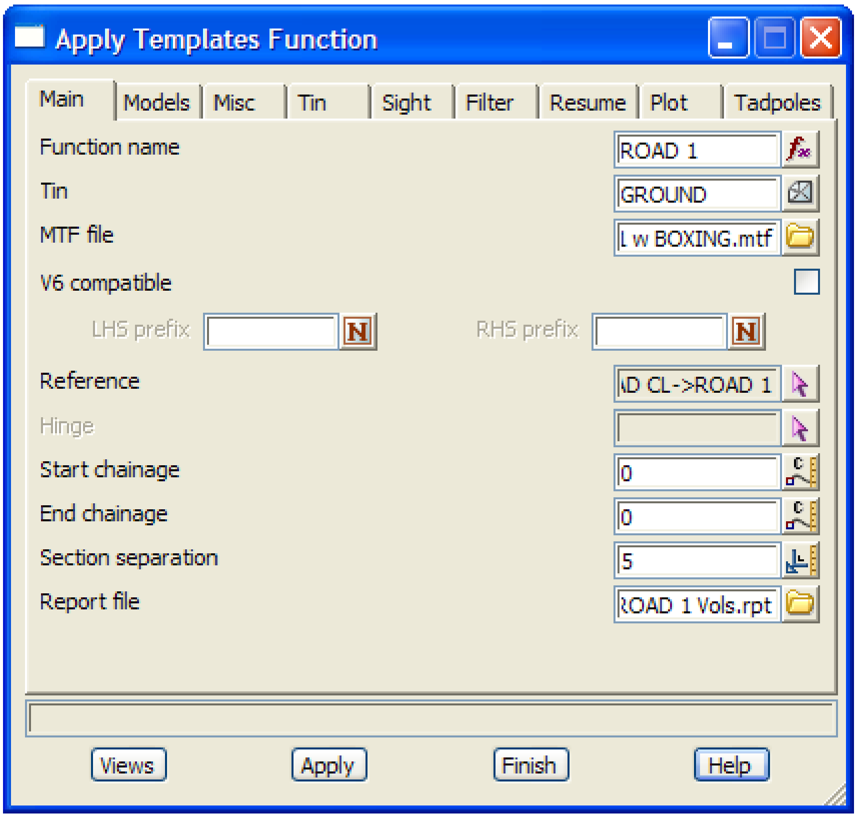


Fill in the panel as shown.

This is interpreted as starting at Chainage 21.8792, use ‘full boxing’ until the end of the road (Ch 926.5046). Note that the chainages given are the chainages of the first and last full cross section, spanning the full width of the road.

Click LB on **Apply** and **OK** to close down the panel.

From the MTF Edit menu, click LB on **Save & Finish** and **Yes** to shut down the MTF Edit session.

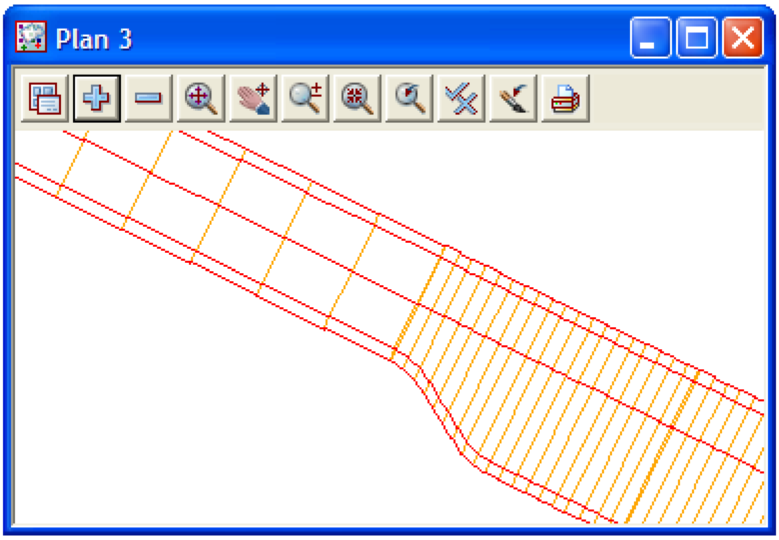


From the Apply Templates Function panel for function ‘ROAD 1’, click LB on the **Apply** button at the base of the panel.

The ROAD 1 Strs and ROAD 1 Sects should be recalculated but this time with boxing.

We will assume that you have your ROAD 1 Strs and ROAD 1 Sects turned on in View ‘Plan 1’.

You should now be able to add in models **ROAD 1 Box Strs and ROAD 1 Box sects** in view ‘Plan 1’ and you should see your boxing strings and sections overlaying your surface longitudinal strings and cross sections. The box strings are coloured red and the box sections are coloured orange.



To see these strings in isolation, create a new view with **View=>New=>Plan** and turn on models **ROAD 1 Box Strs and ROAD 1 Box sects.**

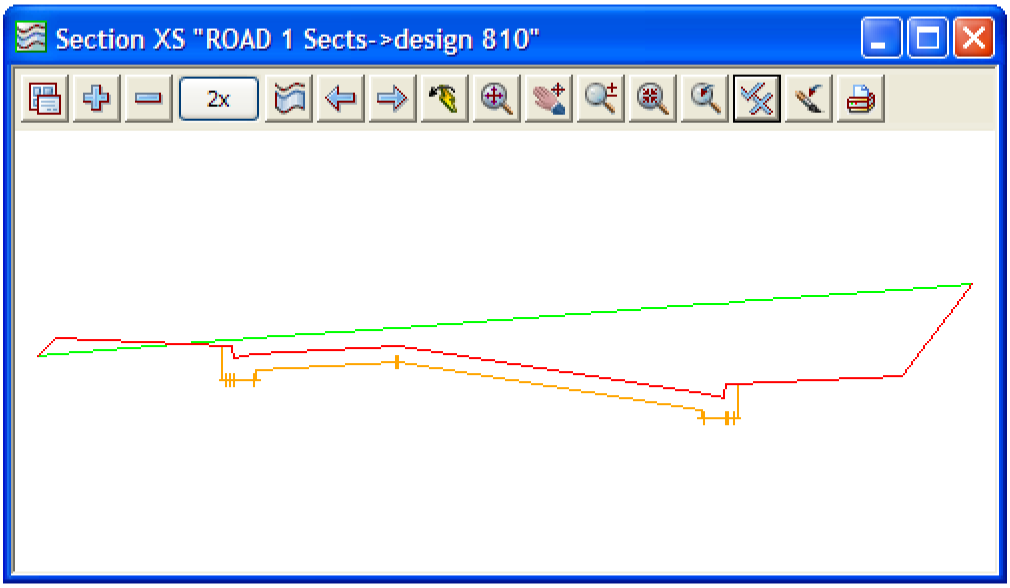
Keep this view ‘Plan 3’ for future use

22.3 Reviewing your Boxing by Cross Section

It is assumed that you have a ‘Section XS’ view which is used to profile cross sections. We should be able to profile any cross section and see the corresponding boxing section.

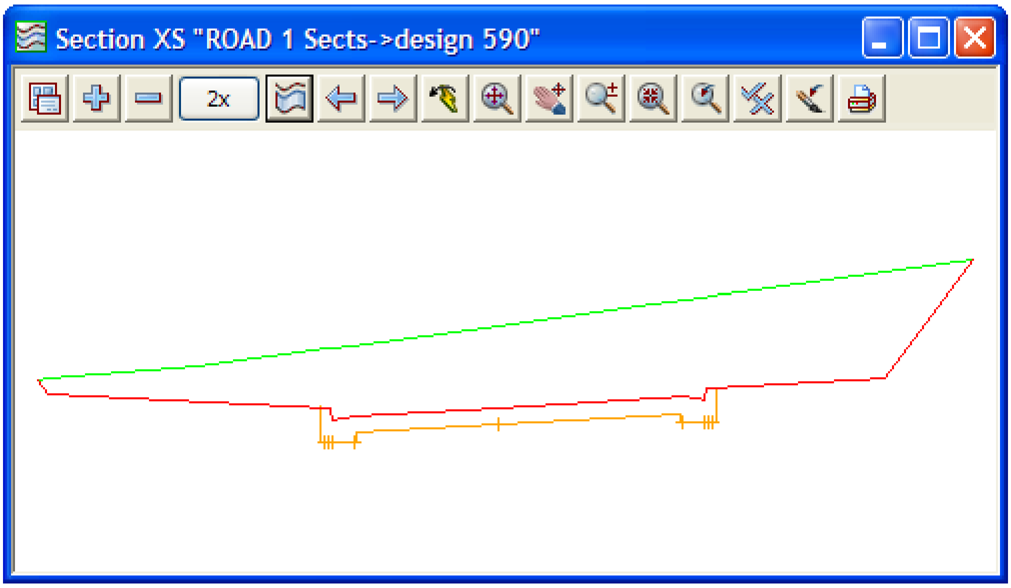
Firstly, click LB on the ‘+’ sign button and add model **ROAD 1 Box sects** to View ‘Section XS’. Set the vertical exaggeration back to 2x.

If you click LB on the **Profile** button and then point to a red cross section string in the bus bay area, you should see the cross section profiled with the orange boxing section beneath the surface. The boxing string is visible because it falls within the corridor of the cross section string being profiled.



Note how the right hand carriageway has been widened and graded to the bus bay string and the boxing string has in general followed this same geometry. This happens by default to make your life easy as a road designer!

The following view shows a profiled cross section at Chainage 590 on the left hand curve where superelevation is implemented. Again observe how the boxing runs parallel to the surface strings.



22.4 More Complex Boxing Issues

In the above example, the boxing rules in file 'BOXING.bf' have been set up to link in closely with the templates we are using. These are defined in the templates file 'ROAD TEMPLATES.tpl'. The interaction can be summarised:-

Left Template	*Right Template*	*Boxing rule*
FULL LEFT	FULL RIGHT	full boxing
FULL LEFT w MEDIAN	FULL RIGHT w MEDIAN	boxing_u_median

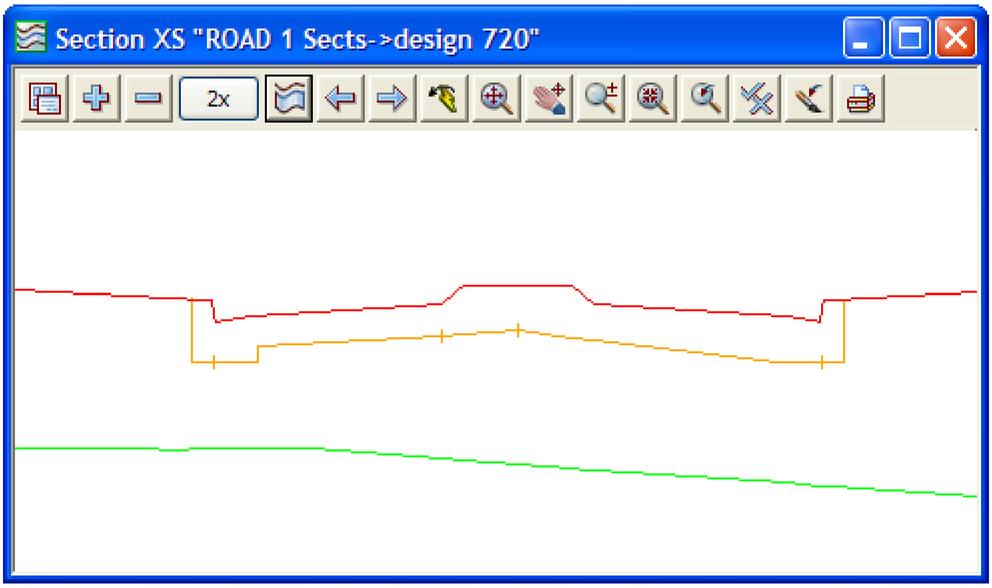
If we created a template for intersections then we would need to also use the appropriate boxing found in the BOXING.bf file:-

FULL LEFT w KERB	none	boxing u intersection left
none	FULL RIGHT w KERB	boxing u intersection right
LEFT KERB ONLY	RIGHT KERB ONLY	boxing_u_kerb_returns

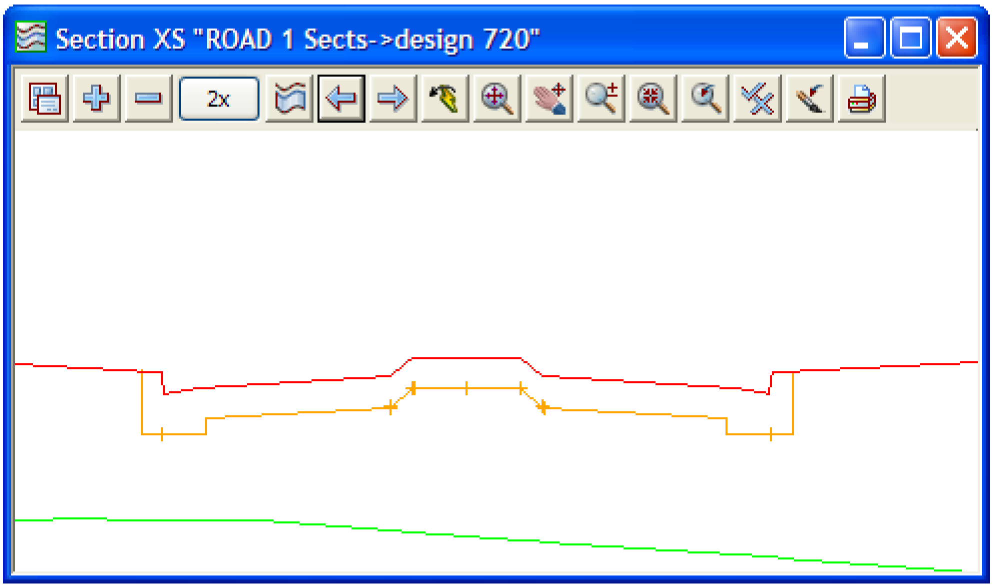
Note: This interaction is essential. If at any time you change the link names in your template, you will need to change your boxing definitions to match.

The second line of the above table specifies the templates which include the median strip down the centre of the road. If you were to recalc the function 'ROAD 1' but this time use MTF file 'ROAD 1 w MEDIAN.mtf' (after editing it to include the boxing as shown above), you will observe that the boxing has been setup to go under the median.

This is shown in the following view.



This is the reason that a further boxing rule had to be created to cater for boxing under the median strip. If you had used ‘full boxing’, the boxing section would have ‘stepped up’ under the median as shown below, which is probably not what you want to happen.



23 Creating A Surface of the Road Formation

Assuming that the design is now finished, we could create a 'Road Formation' TIN by combining the design strings from these various road elements into one TIN.

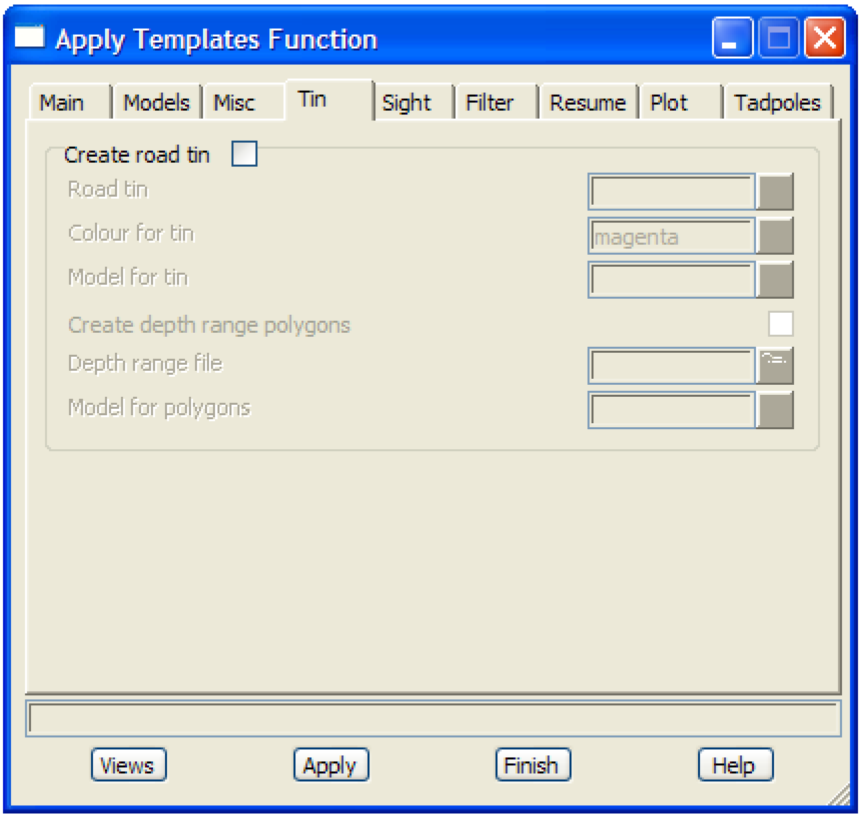
As a reminder, TIN is just an abbreviation for a surface. It stands for 'Triangular Irregular Network'. The steps to create the Road Formation TIN are

1. Assemble the appropriate design string models in a View
2. Create a TIN from all of the strings that are on display in the View
3. Null out superfluous triangles
4. Create a TIN Boundary

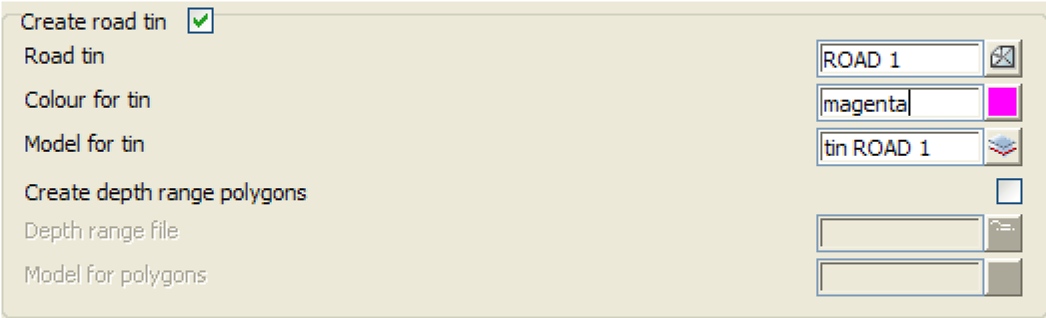
For each road element we must turn on the design strings that have been created during the design process. These are typically the longitudinal strings and cross sections. This is certainly a legitimate method for creating the triangualtion of the road surface, but 12d can do it all automatically for you in the **Apply Many** function.

From the ***Recalc*** panel click on **Editor => ROAD 1** to bring up the ***Apply Templates Function*** panel. In this panel so far we have concentrated on the first two tabs, ***Main*** and ***Models***. We willl now look at two more tabs, the ***Tin*** and the ***Filter*** tab.

Click on the ***Tin*** tab.



When you click on the **Create road tin** check box, 12d unlocks the fields below. Fill in the panel as shown below. Notice that when you type in the **Road tin** name, if you press the enter key, 12d will automatically fill in the **Model for tin** field.



If we now pressed the **Apply** button, then 12d would create the triangulation, however there are a few things that you need to be aware of.

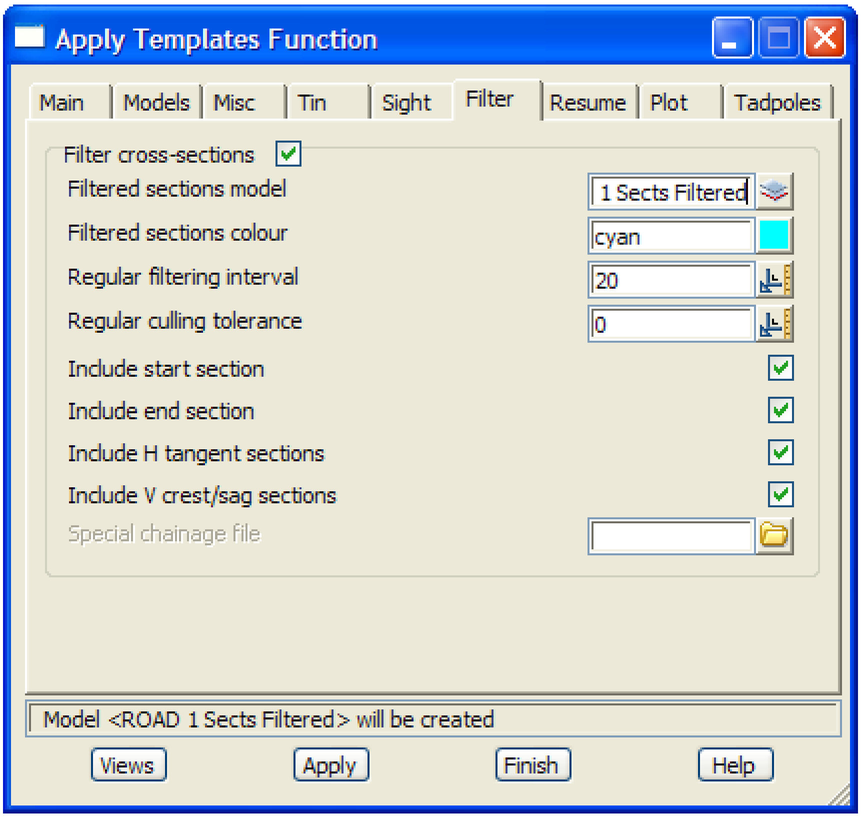
The spacing of cross sections may have introduced minor errors as a result of adjoining cross sections being joined by simple 3d strings (straight lines).

Each alignment string in 12d has a concept of a chainage interval. The chainage interval defaults to 10m. 12d also considers a property that is present for curved alignment strings called the 'chord/arc tolerance'. This defaults to 0.1m. If your cross sections are far enough apart and your chord/arc tolerance and/or chainage interval are large enough, 12d will generate extra points automatically along an alignment string as the TIN is created. These extra points are generated to minimise errors associated with not having enough points around a curved alignment string. The extra points will not be created unless needed.

To help with the accuracy of the triangulation we will rerun the 'ROAD 1' apply many function at a chainage spacing of 2 metres. Go to the ***Main*** tab, set the **Section separation** to 2. This will solve the triangulation problem however, it would create sections every 2 metres and hence when it comes time to create the cross section plots, we would need to run the function again with another section separation.

To solve this issue, 12d Model also gives you the ability to create a second set of cross sections at a separate interval, and it is these sections that we use in the plotting.

Click on the ***Filter*** tab.



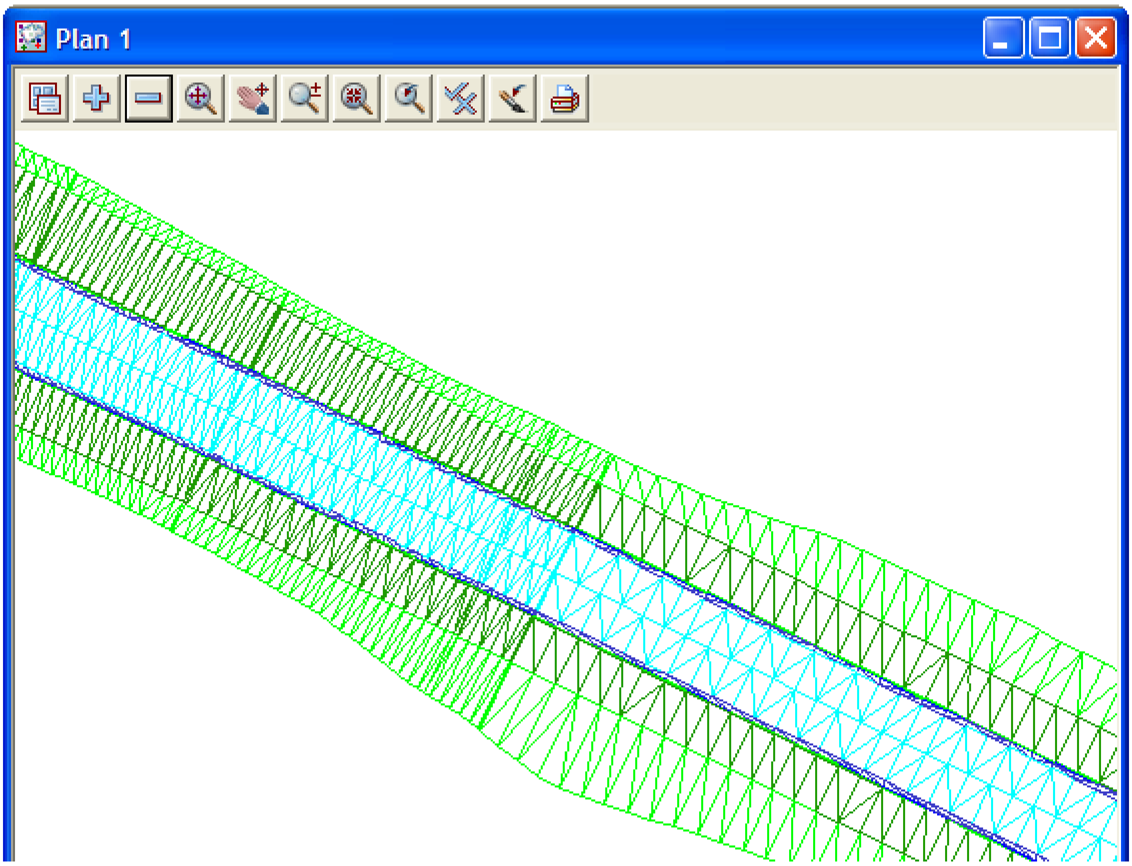
Click on the **Filter cross-sections** check box to unlock the other fields.

Select the **ROAD 1 Sects** model from the list and add the word '**Filtered**' to the end. This will create a new model to place the filtered sections into, while leaving the original sections at a 2m spacing.

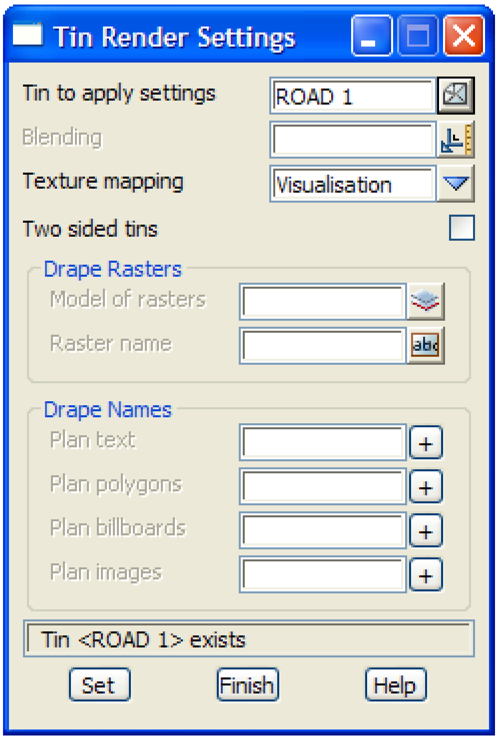
Leave the other fields with their default values.

You can now click on **Apply** to create the triangulation and filter the sections.

In view ‘Plan 1’, turn off all the models and turn on the triangulation, **tin ROAD 1.** You may need to toggle of the contours.



The first thing you should notice is that, regardless of the colour selected in the ***Apply Templates Function*** panel, 12d Model actually colours the triangulation based on the colour of each link given in the template. What this allows us to do is to create a visualisation of our design right from the time we apply the templates to our road.



While visualisation is well beyond the scope of this course, if you have the **Visualisation** module, to quickly show you what 12d has done, go to **View => Visualisation => Tin render settings.** The ***Tin Render Settings*** panel displays.

Fill in the panel as shown.

The **Texture mapping** file, **Visualisation**, is a simple ascii file which associates the colour of the triangles to a particular texture.

Open up view ***Perspective OpenGL 2*** and turn on **tin ROAD 1**. Toggle on the shade function to see the effect.

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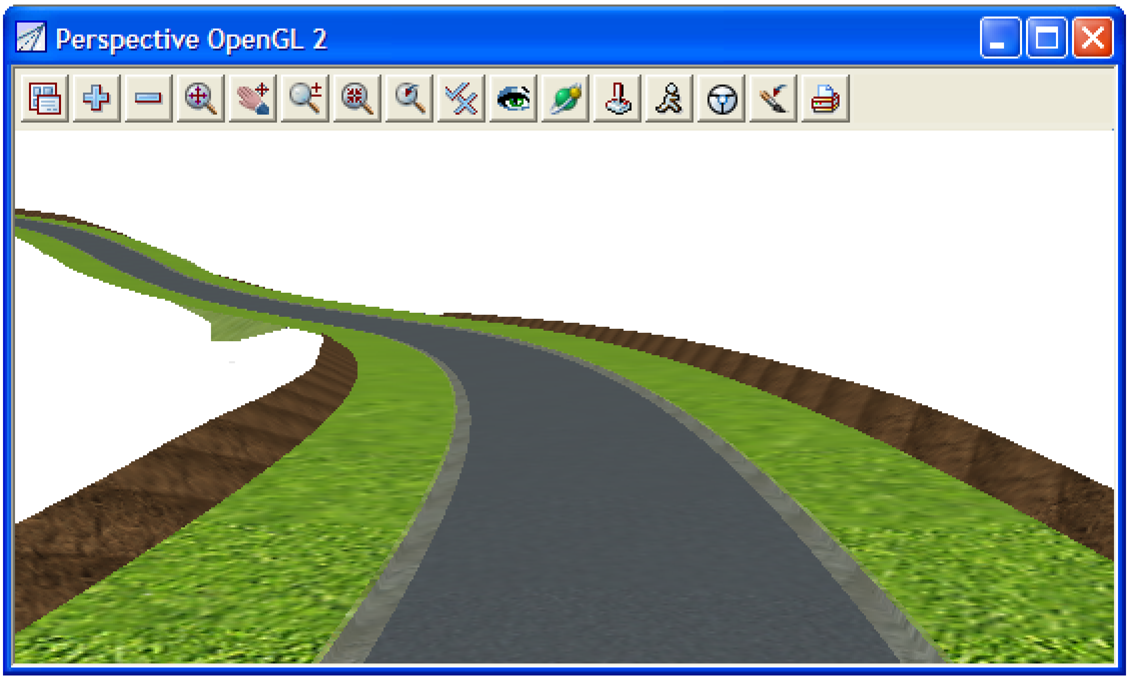

In view ***Plan 1***, turn off all the models and turn on **ROAD 1 Sects Filtered and ROAD 1 Strs.** Note that the cross sections are shown at every 20m and at the tangent points. We would then use the model **ROAD 1 Sects Filtered** when plotting the cross sections

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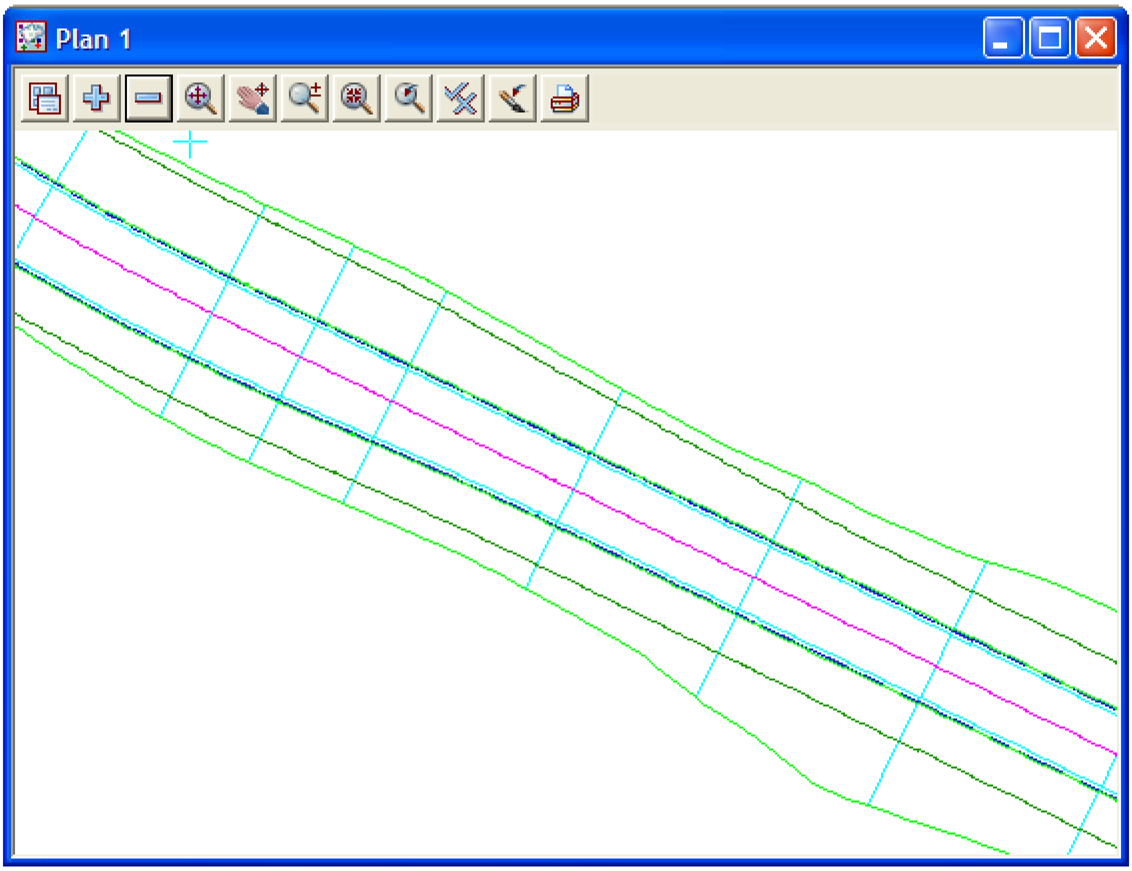


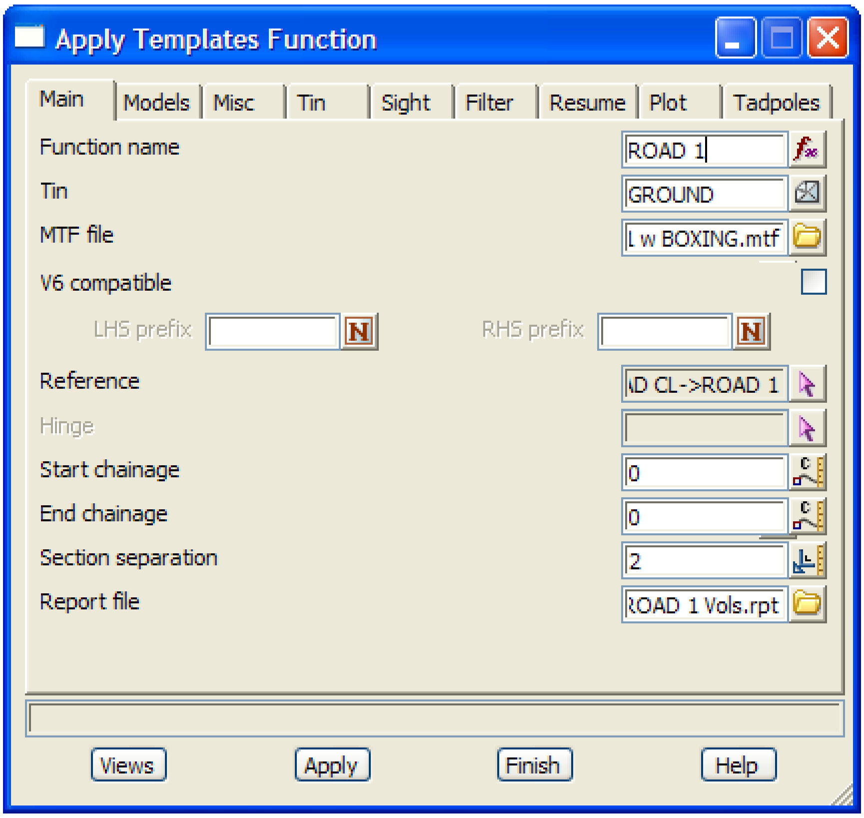
24 Road Design Volume and Area Calculations

24.1 Volume Calculations During Apply Functions

During any Apply function, 12d reports on the cut and fill volumes calculated. By default, just the summary cut, fill and balance volumes are reported at the bottom of the panel.

You can optionally get a detailed report of the volumes calculated as the Apply executes.

We will rerun the ‘ROAD 1’ function as we last left it but this time we will look at the volume report.



From the main menu, click LB on **Utilities=>Recalc=>Editor=>ROAD 1**

In the ‘Report file’ field, the file name was provided by the default settings created prior to running the function for the first time The suffix **.rpt** is added.

Click LB on the **Apply** button.

To see the report click LB on the ‘Folder’ icon to the right of the ‘Report file’ field, then click LB on **[Open].** The 12d editor will pop up.

Note that the report includes every cross section so it includes every discontinuity you specified in your MTF file.

24.2 Volume Calculations Between Surfaces in Road Design

Now that we have two TINS, 'GROUND' and 'ROAD 1', it is possible to get 12d to calculate the volume between the TIN surfaces. 12d provides two methods of calculating such volumes:

End Area. Volumes are calculated by considering the area of each cross section which is at right angles to the design centreline and multiplying it by the user defined distance separating each cross section. When calculating end area volumes the quality of the answer is highly dependant on the distance between each sections, particularly if the centreline is curved.

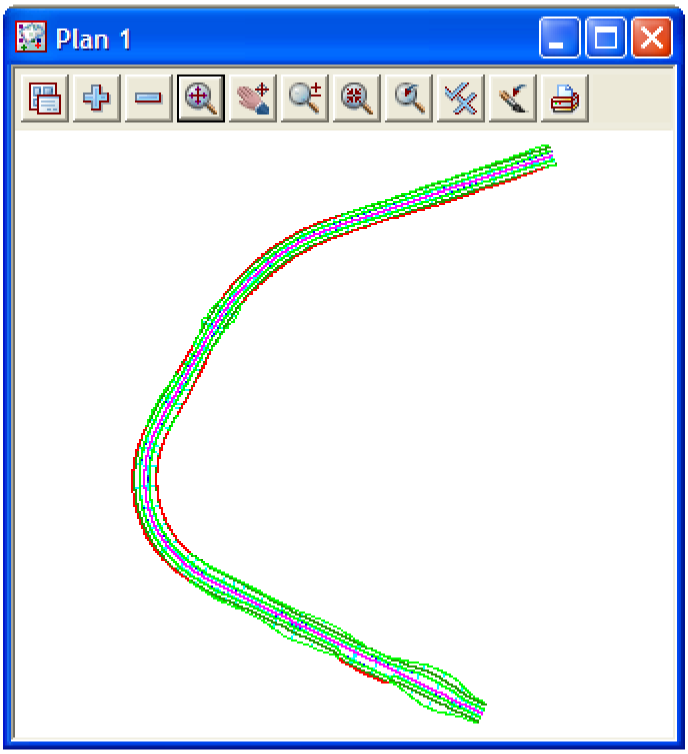
Exact. In this method exact volumes are calculated by summing the volumes of the various 'prisms' between the triangulated surfaces. This method is 'exact' in that it is as accurate as the TINs themselves. Depending upon the overlap between 'triangles' in each TIN, each triangle may be split up into multiple prisms. All prisms are accounted for hence the term 'exact'.

We will use both methods and compare any differences.

Whilst it is not essential, it is usual to have a boundary polygon when calculating quantities. The volume calculation is then limited to those triangles or cross sections that fall within the polygon.

24.3 Cut and Fill Calculations

In your 'Plan 1' view, click RB in the View Title Area (blue) and click LB on **Models=>Remove all models**.



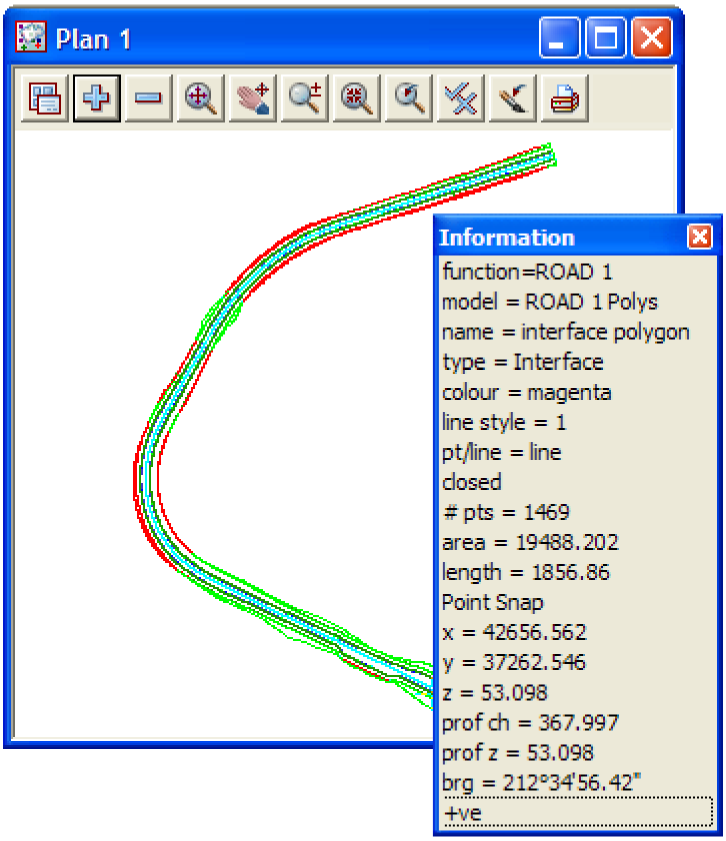
Then use the '+' sign button to turn on models **ROAD 1 Strs** and **ROAD 1 Sects**.

If you look at the interface string in model **ROAD 1 Strs**, you will notice that some parts of it are red and some green. The red sections indicate where the road batter meets the natural surface in a 'cut' situation. The green indicates a 'fill' situation. This convention allows us to differentiate between cut and fill when we view data in plan.

24.4 Process Volumes - Using the Interface polygon

By definition, the end area method only gives reasonable answers when considering a single piece of road. To ensure any volume comparisons we do are meaningful, we will limit the calculation to be within the extents of the ‘ROAD 1’ interface polygon.

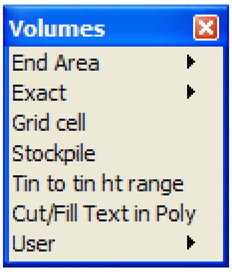
In view ‘Plan 1’ turn off all models then turn on model **ROAD 1 Polys**



The ‘interface polygon’ is shown highlighted. We will use this polygon to limit the extents of the calculation for both methods.

24.5 End Area Volume Calculations

All volume calculations are generated from the Volumes menu which can be torn off by clicking LB on **Design=>Volumes=>[Volumes].**



We will use view ‘Plan 1’ which should be displaying our **ROAD 1 Polys** model as shown above. We will also use view ‘Plan 3’ which should be showing our centreline model **ROAD CL** so remove the boxing models.

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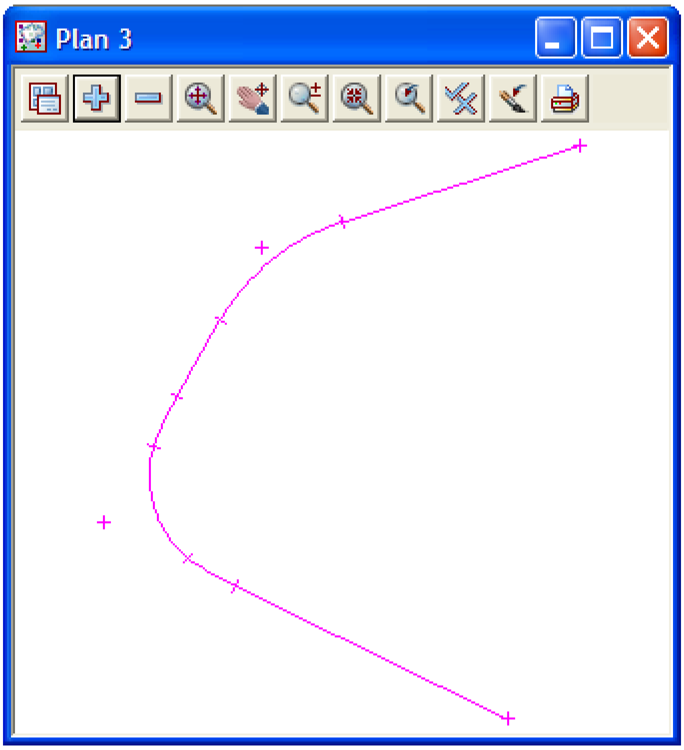
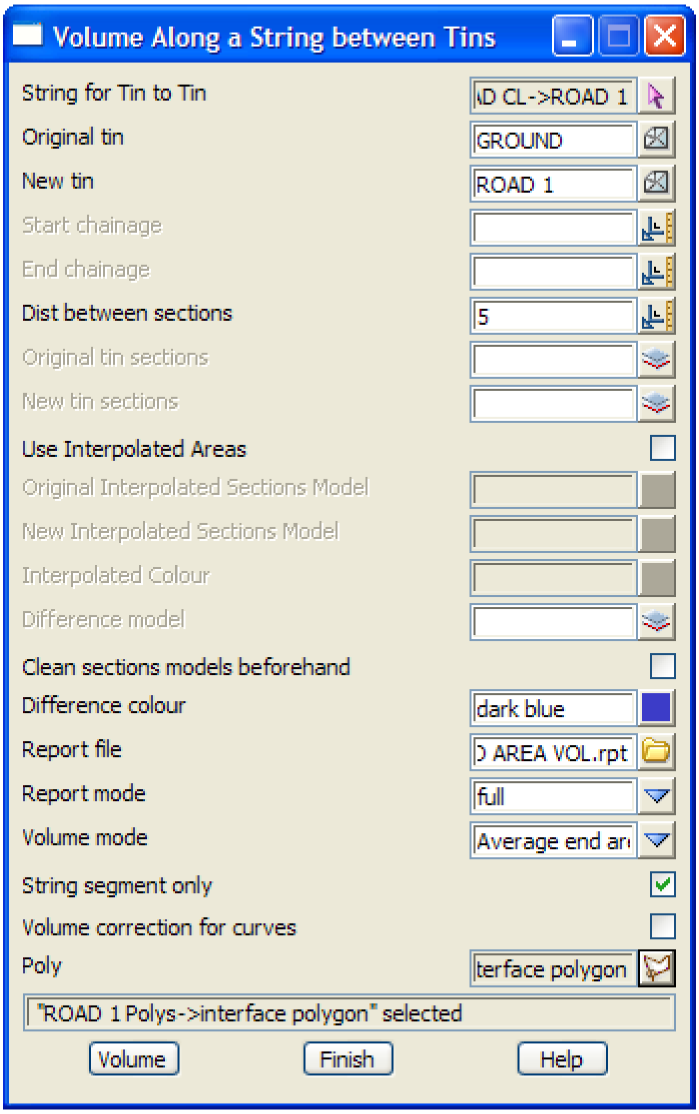


To calculate volumes between TINs using end areas, from the Volumes menu, click LB on **End Area=>String tin to tin**

Fill the panel in as shown.



Click on the **String for Tin to Tin** button and click on the magenta 'ROAD 1 centreline' in view 'Plan 3'.

Place the cursor on the TIN icon for the 'Original tin' field and click LB to popup a list of the available TINs. Double click LB on **GROUND**. Repeat the process for 'New tin' and set it to **ROAD 1**.

Set the 'Distance between sections' to 5m initially. It will be refined later if needed

By entering a name in the 'Report file' field, a report can be created showing the details of the end area calculations.

Enter **END AREA VOL** and press return. The suffix **.rpt** is appended by 12d.

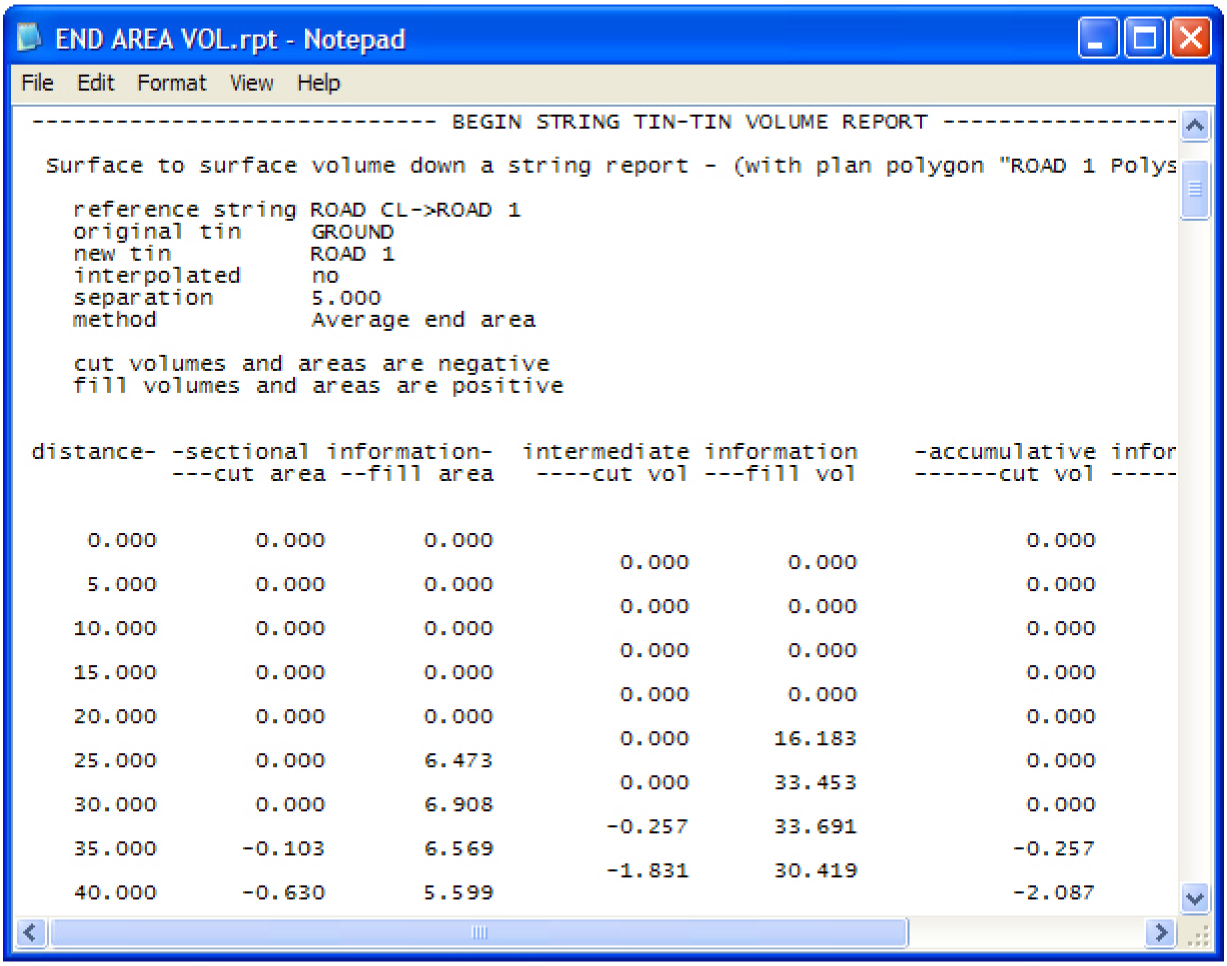
Set the report mode to **full** if you want to see the calculations associated with each cross section.

It is compulsory to define a closed polygon to restrict the extents within which the calculations will be performed. We can use the 'interface polygon' for this purpose i.e. the intersection of the 'ROAD 1' function with the 'GROUND ' tin.

Click LB on the **Poly** icon then click LB on the 'String' pick icon. Click LB on the polygon in the 'Plan 1' view with LB. Confirm the selection with MB

Click LB on **Volume** to cause the end area volumes to be calculated.

If a name is entered in the 'Report file' field, 12d will immediately jump to the Editor and display the report. A sample report is shown on the following page.




```
----------------------------- BEGIN STRING TIN-TIN VOLUME REPORT -----------------

 Surface to surface volume down a string report - (with plan polygon "ROAD 1 Polys

   reference string ROAD CL->ROAD 1
   original tin     GROUND
   new tin          ROAD 1
   interpolated     no
   separation       5.000
   method           Average end area

   cut volumes and areas are negative
   fill volumes and areas are positive


distance- -sectional information- intermediate information    -accumulative infor
          ---cut area --fill area  ----cut vol ---fill vol    ------cut vol -----


    0.000       0.000       0.000                                     0.000
                                         0.000       0.000
    5.000       0.000       0.000                                     0.000
                                         0.000       0.000
   10.000       0.000       0.000                                     0.000
                                         0.000       0.000
   15.000       0.000       0.000                                     0.000
                                         0.000       0.000
   20.000       0.000       0.000                                     0.000
                                         0.000      16.183
   25.000       0.000       6.473                                     0.000
                                         0.000      33.453
   30.000       0.000       6.908                                     0.000
                                        -0.257      33.691
   35.000      -0.103       6.569                                    -0.257
                                        -1.831      30.419
   40.000      -0.630       5.599                                    -2.087
```

Click LB on **File=>Exit** to terminate the Editor and return to 12d.

Note that once the calculation is finished, the Cut, Fill and Balance volumes are displayed in the panel's message line. Click LB on **Finish** to terminate the panel.

24.6 Comparison of End Area Volumes with a Template Apply Function

You should not expect to get exactly the same cut and fill volumes from the End Area Volumes report as the Apply Template Function report.

The reason for this is that the End Area Volumes report generates parallel cross sections at whatever interval you ask for – in our case 5m intervals.

The Apply Templates Function volume calculations also uses cross sections but we have not taken account the fact that the cross sections are not parallel when going around curves. On the Apply Functions, there is a field for *Volume correction for curves* which will apply Pappus' Theorem for correction areas involving non-parallel sections. This will give more accurate results for the Apply Functions.

However, running the End Area Volumes with parallel sections and a very small distance between sections will give the most accurate results for any end area methods.

24.7 Exact Volume Calculations

Firstly make sure that model **ROAD 1 Polys** is turned on in your 'Plan 1' view**.** Click LB on **Fit** to fill the view.

To calculate exact volumes between TINs, from the Volumes menu, click LB on

Exact=>Tin to tin

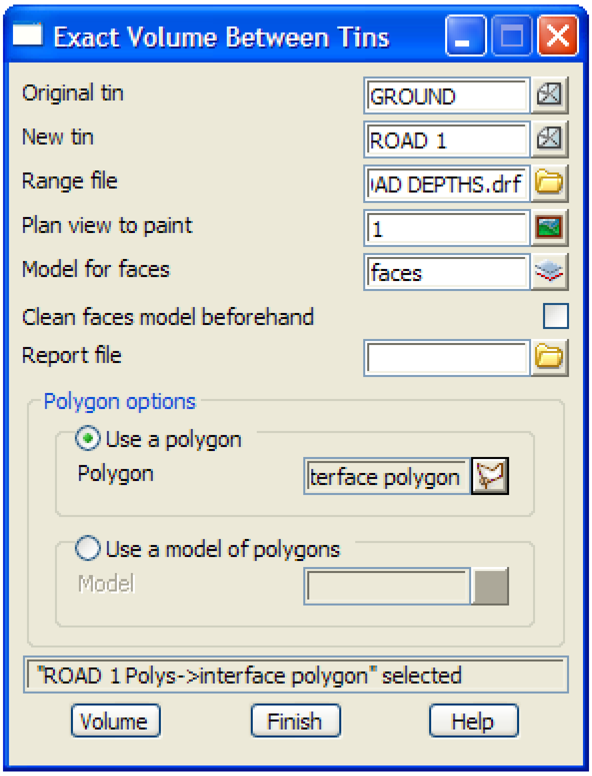
Fill the panel in as shown. Place the cursor on the '+' sign button for the 'Original tin' field and click LB to popup a list of the available TINs. Double click LB on **GROUND**. Repeat the process for 'New tin' and set it to **ROAD 1**.

By entering a name in the 'Report file' field, a summary report can be created showing the details of the end area calculations. Enter **EXACT VOL** and press the Enter key. The suffix **.rpt** is appended.

Click LB on **Volume** to initiate the calculation. A summary report will be calculated and immediately displayed.

24.8 Displaying 'depths' of Cut and Fill using Colour Shading

We will now rerun the 'Exact Volume Between Tins' panel again but this time with different parameters.



This time we will use a Range file. Select file **ROAD DEPTH.drf** from the User Library in the popup list.

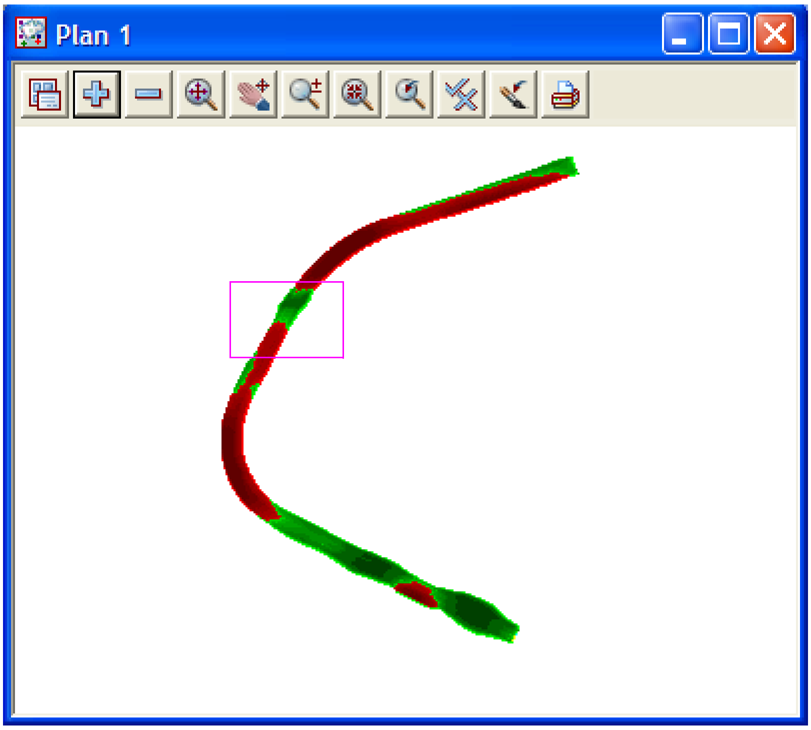
We will display the results in view 'Plan 1'.

To keep a permanent copy of the face colourings we need to supply a 'Model for faces'. Type in **faces**.

Make sure that you remove the entry in the Report file.

Select the 'Use a polygon' radio button Click LB on the **Polygon** icon then click LB on the 'String' pick icon. Click LB on the polygon in the 'Plan 1' view with LB. Confirm the selection with MB.

Click LB on **Volume** to rerun the calculation. This time 12d will read the values in the Range file and colour in view ‘Plan 1’ in shades of red and green corresponding to the depths of cut and fill respectively.

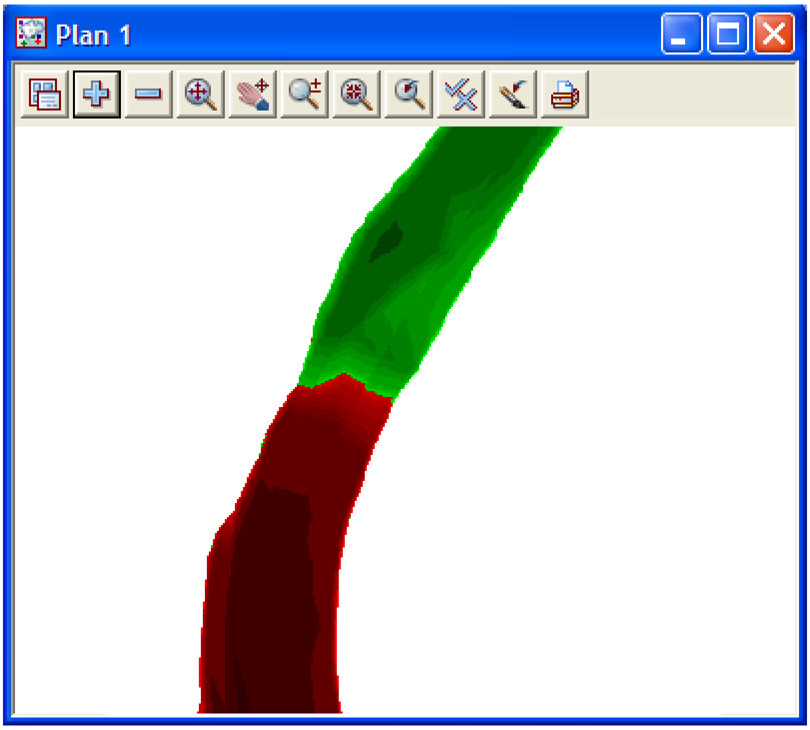


If you refresh the view you will notice that the shaded image disappears and the view reverts to whatever models you had turned on prior to performing the volume calculation.

Use the ‘+’ sign button to add model **faces** to view ‘Plan 1’. You now have a permanent copy of the shaded faces. This model can be manipulated just like any other model in 12d.

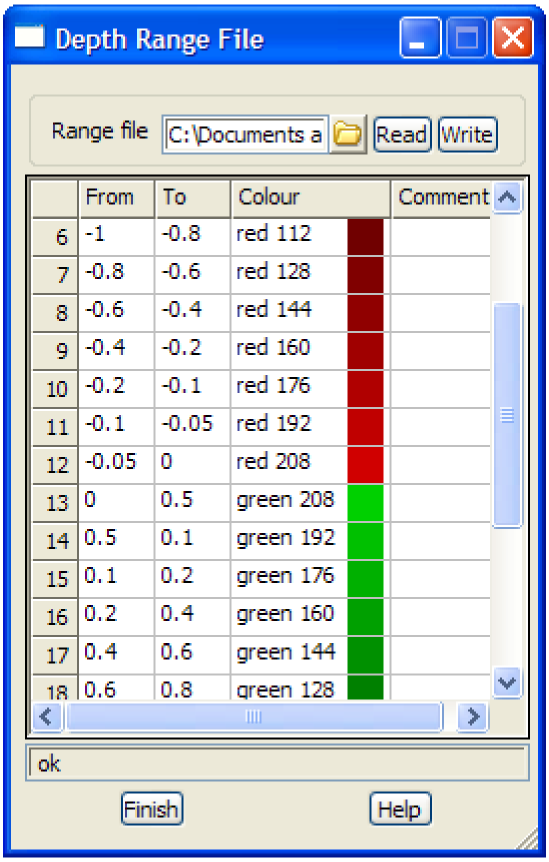
This image can be exported or plotted as desired. When the data is transferred to AutoCAD, Microstation or other rendering packages, the face data will be retained and hence can be manipulated further if required.

Zoom in as above to get a closer look at the shading.



The darker shades show the areas of greatest depth of cut and fill.

The quality of the finished image is a function of the number of ranges specified in the **range** file. Each range has a colour associated with it. This file is a normal ASCII file and can be edited. If you place the cursor near the name **ROAD DEPTHS.drf**, in the panel, click LB on the ‘More Information’ icon to pop up the list of names again and then select **[Open],** the 12d editor will pop up with the Range file displayed ready for editing.



The format is ‘starting depth’,‘finishing depth’ and ‘colour’. Cut depths are negative. This file is user definable.

Any colour can be used. For a full list of the colours available, see the **colours.4d** file.

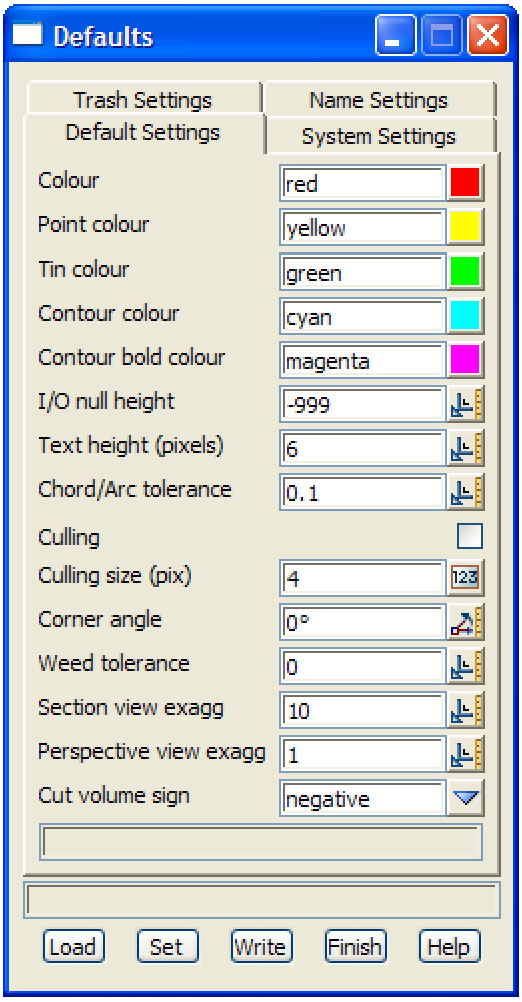
To exit the panel select **Finish**

If we were to rerun the panel and ask for the report again but this time, generate it in conjunction with the use of the Range file, 12d will split up the cut and fill volumes by vertical depth i.e. it will calculate cut and fill volumes for a range of depths. The depths used are determined by those specified in the Range file.

Thus by prudent use of depths in your range file, you have the ability to split up your volumes into parallel depth layers. If you have varying substrata in a job, this can be a useful way of extracting quantities by material type.

24.9 Sign Conventions for Cut and Fill

The entire tutorial on volume calculations so far has been performed assuming the default convention that <u>Cut volumes are negative</u>. This is a user definable convention however. If preferred, Cut volumes can be made positive.



This convention is set from the Main menu. Click LB on **Project => Management => Defaults.**

Click LB on the **Default Settings** tab.

The values shown are the system default settings.

Note the field near the bottom of the panel.

Place the cursor on the '+' sign button for the 'Cut volume sign' field and click LB to pop up a list of alternatives. Click LB on either **positive** or **negative**. At this time, leave the value negative.

Click LB on **Set** to activate any changes.

Click LB on **Finish** to terminate the panel.

24.10 Surface Areas of Pavement and Formation

12d has various facilities to assist with area calculations. The only prerequisite is that a closed string (polygon) is required around any area that 12d is to calculate. If a string is 'open', the starting and end points will be considered as joined for the purposes of the calculation.

We will use the strings created from our template calculation to get the plan and slope areas of our road surface. This should give us an indication of the bitumen required to seal our road.

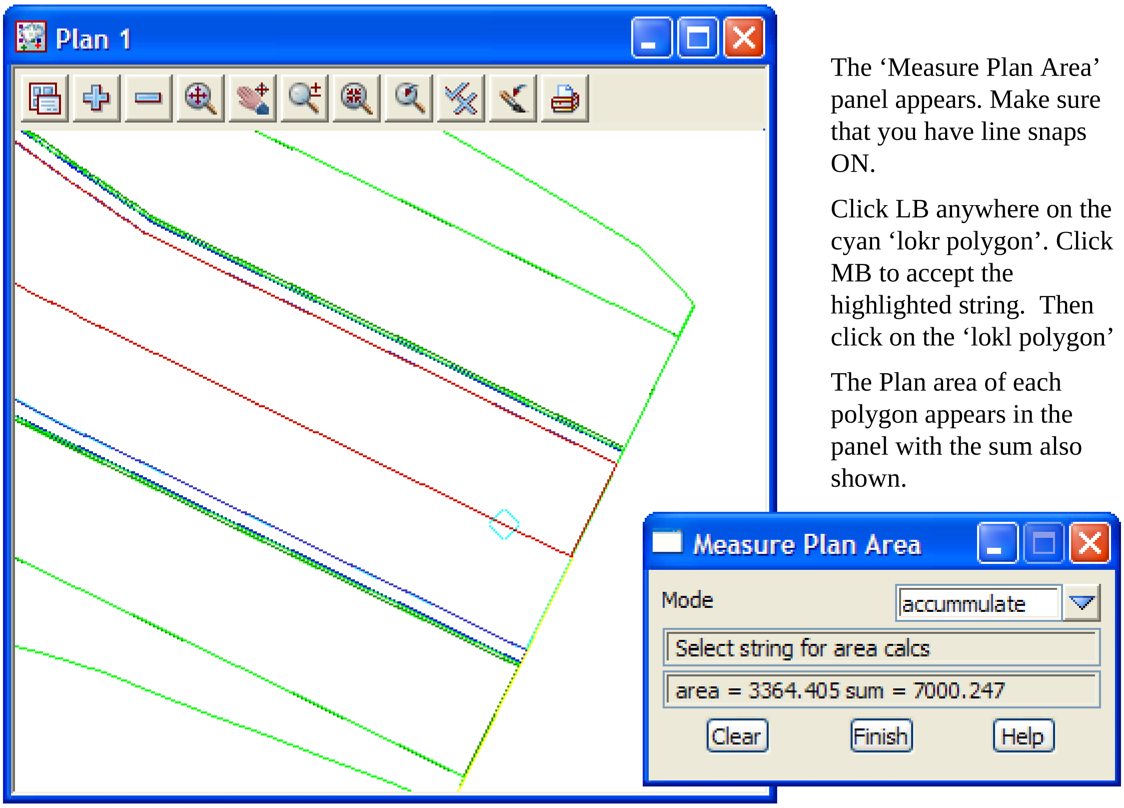
Plan areas are calculated by projecting the area of the string chosen onto the XY plane.

Surface areas are calculated by summing the areas of the various sloping triangular surfaces of a TIN. A polygon is required to restrict the summation to only those triangles in the TIN that fall within the polygon.

Plan Areas:

In the 'Plan 1' view, make sure that your **ROAD 1 Polys** model is on display.

From the Main menu, click LB on **Utilities=>Measure=>Plan area**



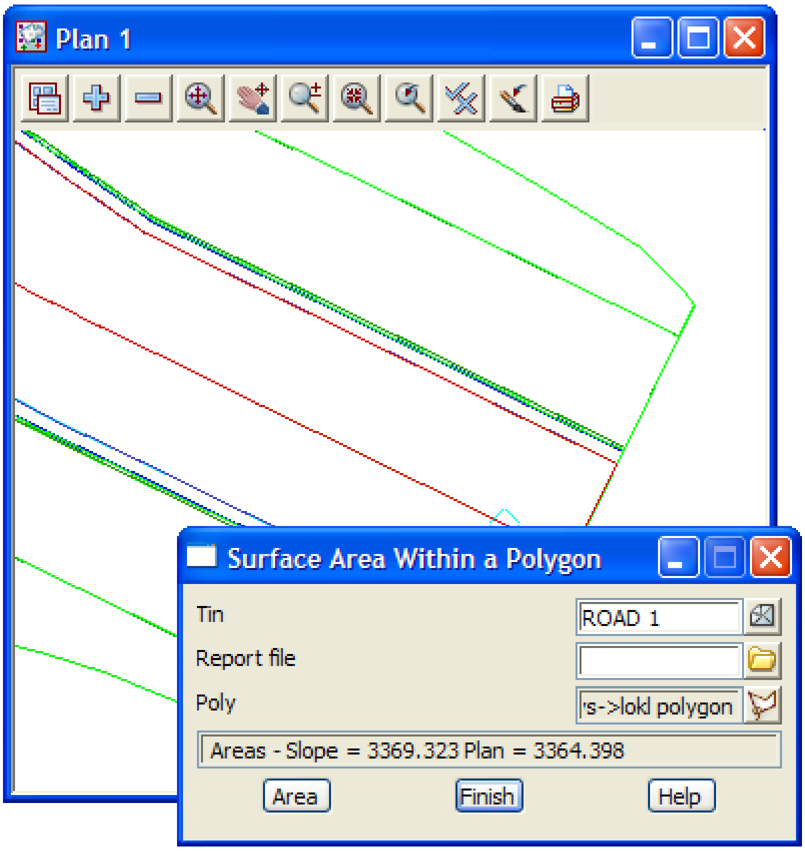
The 'Measure Plan Area' panel appears. Make sure that you have line snaps ON.

Click LB anywhere on the cyan 'lokr polygon'. Click MB to accept the highlighted string. Then click on the 'lokl polygon'

The Plan area of each polygon appears in the panel with the sum also shown.

Surface Areas:

From the main menu, click LB on **Utilities=>Measure=>Surface area**



The ‘Surface Area Within a Polygon’ panel appears.

Make sure that you have line snaps ON.

Click LB on the TIN icon then select **ROAD 1**

Click LB on ‘Poly’ icon then selcet the ‘String’ pick icon.

Click LB anywhere on the magenta ‘lokr polygon’. Click MB to accept the highlighted string.

Click LB on **Area.**

The slope and plan area appears in the panel.

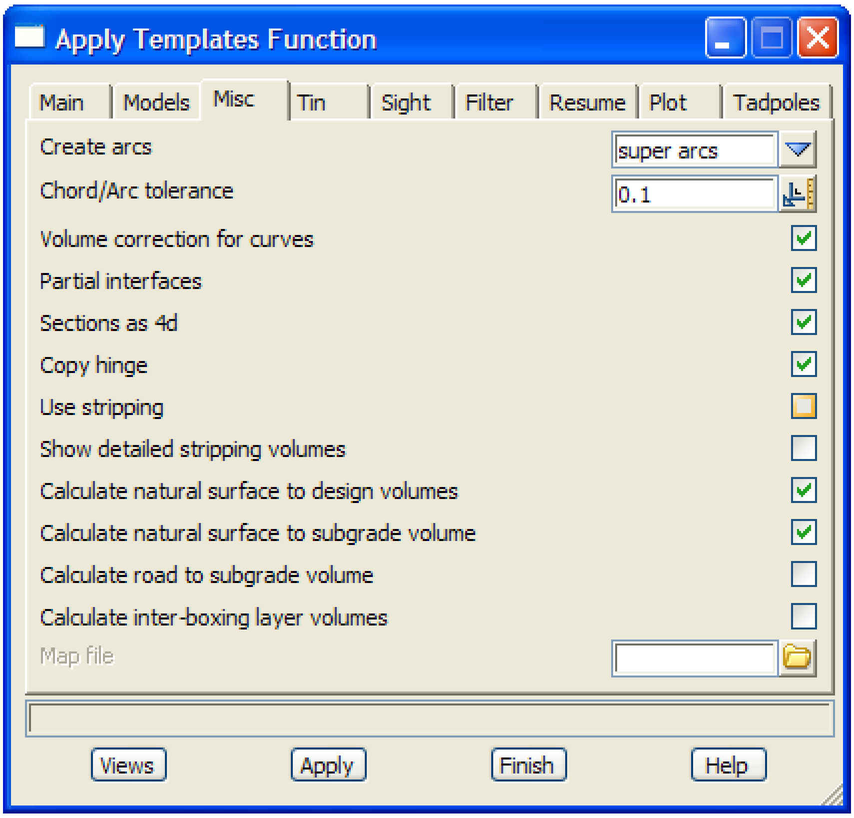
A report can be created if required

If you were to repeat this but pick the ‘Edge polygons’, you would get the surface areas of your battered slopes. These can be used to take off plantation quantities on road reserves.

Click LB on **Finish** to terminate the panel.

24.11 Volumes of Boxing Quantities

In the ***Apply Template Function*** panel, ensure that you are using the **ROAD 1 w BOXING.mtf** file, then click on the ***Misc*** tab.



The last five checkboxs on the ***Misc*** tab determine which volumes are reported in the volumes report.

If you require the volumes to give more information concerning the stripping then check on **Show detailed stripping volumes.**

It would be normal that you require the volumes between the natural surface and the design, however if you do not require this, you would uncheck **Calculate natural surface to design volumes.** In a situation such as this you may want the volumes between the natural surface and the bottom layer of the boxing, or the subgrade. Therefore, you should check on the **Calculate natural surface to subgrade volume**.

Other volumes that you can report on would be from the finished design surface to the subgrade (**Calculate road to subgrade volume**) and the volume of each layer of boxing (**Calculate inter-boxing layer volumes**). You can click on any or all of the volume options.

Click on Apply to run the function and calculate the various volumes. You can check the report, by clicking on the folder icon in the ***Report file*** on the ***Main*** tab, and clicking on **[Open].**

24.12 Stripping Depths and Volumes

Setting a stripping depth and getting 12d to calculate the quantities of stripping material is a byproduct of the **Apply** or **Apply Many** functions. If a non-zero stripping depth is specified at any chainage, the cut and fill calculations at that chainage are performed with respect to the section through the TIN reduced in height by the stripping depth.

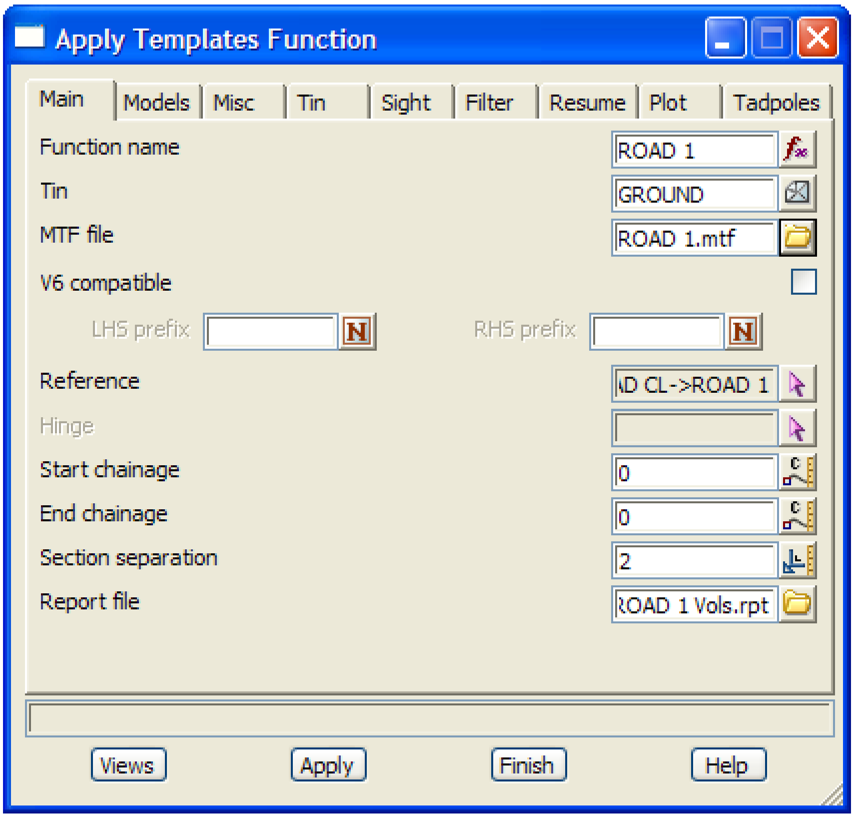
Note however that the design strings from the **Apply** or **Apply Many** function are always generated by battering into the unstripped surface.

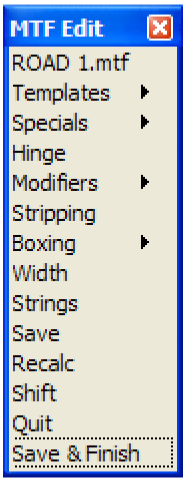
The stripping volume is the volume between the stripped and unstripped surface.

Even if you specify stripping in the MTF file, stripping as a concept can be toggled on or off from the 'Use Stripping' check box in the Apply Templates function.

We will now investigate this further by modifying our design of 'ROAD 1' to include a stripping depth of 0.2m for the entire length of the road.

We will use the 'ROAD 1' function with the MTF file **ROAD 1.mtf**. We will use this file as a starting point for implementing stripping.





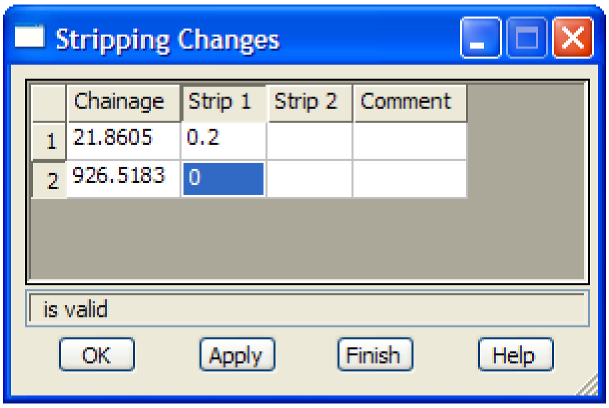
From the main menu, click LB on **Utilities=>Recalc=>Editor=>ROAD 1**

The Apply Templates Function panel will pop up with the values that were set last time we ran this function.

Make sure you use the mtf file **ROAD 1.mtf**

To edit the mtf file click LB on the'Templates file' 'More information' icon and click LB on **[Open]**. The MTF Editor will appear.

From the MTF Edit menu, click LB on **Stripping**



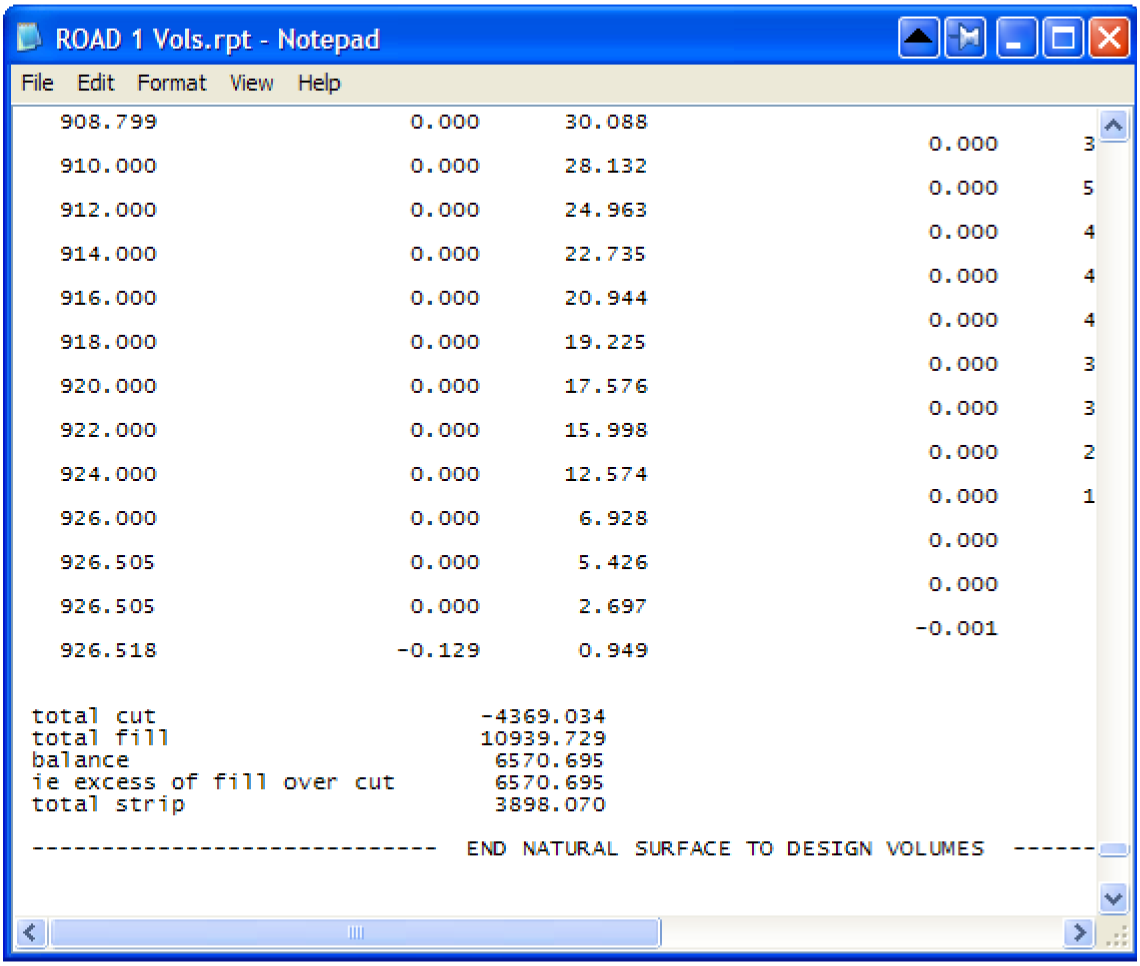
Fill out the panel as shown.

Type in the start chainage or use the dynamic measure to select the chainage from view ‘Plan 1’. Give a stripping depth of **0.2**

For the end chainage use the dynamic measure option and type in the stripping depth of **0**

It is essential to set the stripping depth back to zero at Chainage 926.5183.

Select **OK** to exit the stripping panel, then select **Save and Finish** to exit the MTF editor. On the ***Apply Template Function*** panel click on **Apply** to rerun the design with stripping.



Select **File=>Exit** to exit the report

25 Merging the New Road with the Existing Terrain (Fencing)

25.1 Overview

To create a TIN of our 'final surface', we need to merge the finished 'road design' strings with parts of the 'natural surface' strings – the parts that are outside our Road Formation boundary.

The steps to create the Final TIN of the merged data set can be summarized as follows.

1. Use the Road Formation boundary polygon to make a copy of all of the 'natural surface' data that is <u>outside</u> the polygon. This operation is called fencing.
2. Create a new Plan View and turn on all of the remaining natural surface strings you created in the step above (the ones <u>outside</u> the polygon).
3. Add the appropriate design strings to the View
4. Create a TIN from all of the strings that are on display in the View
5. Null out superfluous triangles

25.2 Use of Polygons Resulting from the Application of Templates

We previously described how the polygons that get created automatically during an Apply function on a simple road can be useful for calculating areas, colouring in regions of a TIN, fencing etc.

25.3 Fencing

The process of constructing data sets or subsets in 12d utilises a technique called 'Fencing'. After Fencing is complete, data subsets are then typically merged to create new surfaces.

Fencing is a pwerful option which will be explained in the following example. In the context of our training data, we will use Fencing to clip out and remove various parts of the strings that were used to create the GROUND tin. The parts that are to be removed are all of those that cross or fall within the Road Formation boundary polygon. Strings in this context includes all points and lines.

If we replace these parts of the Natural Surface strings with the strings that represent our Road Formation, we can then merge these two data subsets into a new 'Final' surface. The various steps to do this are now explained in detail:-

25.3.1 Create the 'Road Formation' TIN and the Boundary Polygon

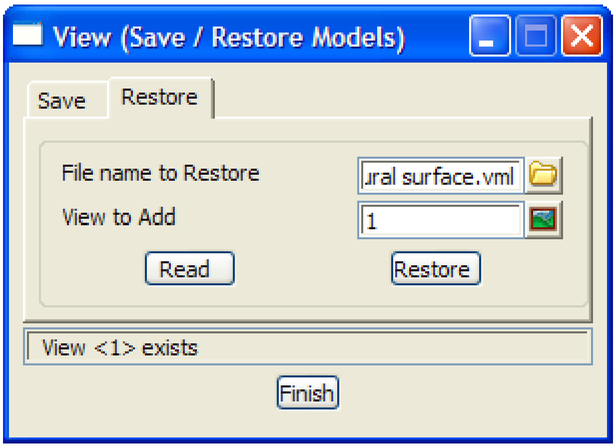
Create the 'Road Formation' TIN and the Boundary polygon around the Road Formation TIN as shown in Chapters 23. This polygon will be referred to as the Road Formation boundary polygon

25.3.2 Assemble all of the strings that constitute your 'GROUND' TIN in a View

The easiest way to implement Fencing is to have two plan views up – one containing the data you wish to fence and the other containing just the fence itself. We will use views 'Plan 1' and 'Plan 3' for this purpose.

Firstly, turn off all models in view 'Plan 1'. Click RB in the View Title Area (blue) and click LB on **Models=>Remove all models**

Now we need to turn on all models that were used to build the ‘natural surface’ TIN. The models used in this tin were written out to a file in Chapter 6.2



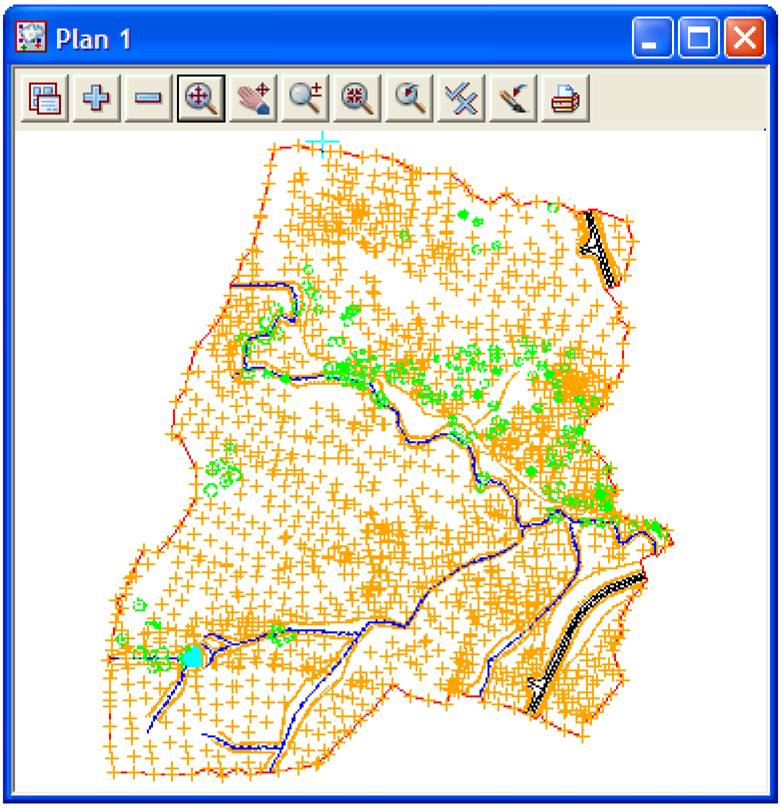
From the main menu, click LB on **View=>Models save/restore**

Click LB on the **Restore** tab.

Select the file **natural surface.vml**

In the ‘View to Add’ field, click LB on **1**

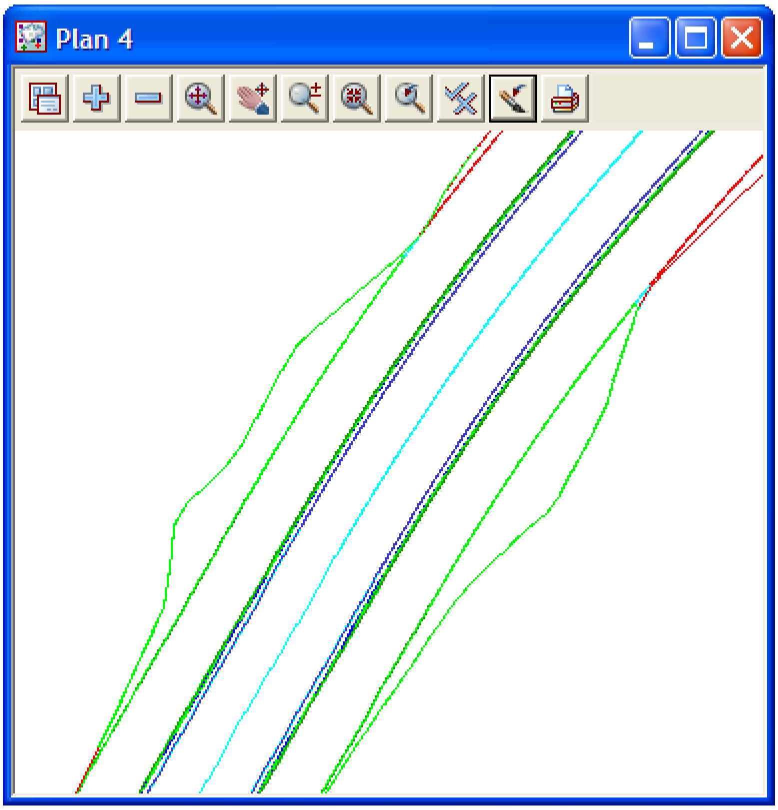
Click LB on **Read** and **Restore** and **Finish**



There should be 11 models turned on in view ‘Plan 1’.

Your view should look as shown.

In view 'Plan 3', turn OFF all models and turn ON **ROAD 1 Polys**

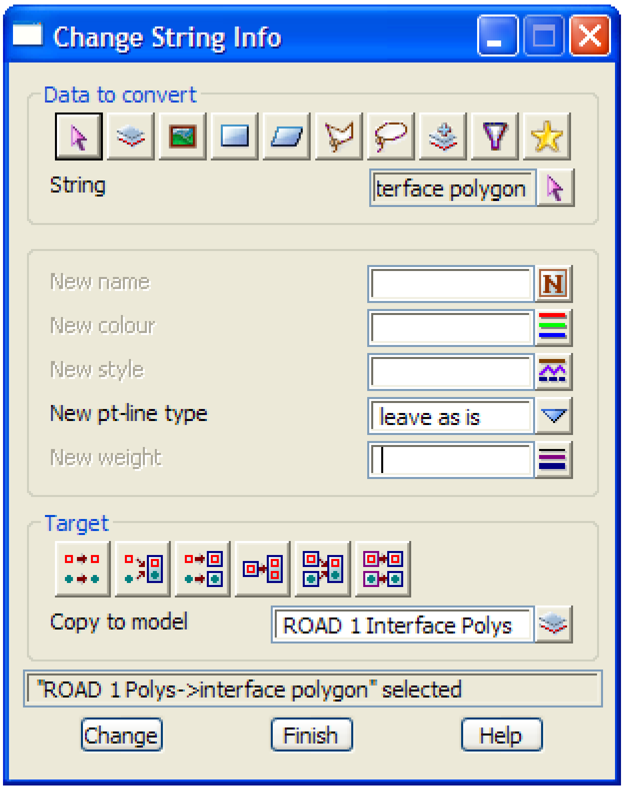


The **ROAD 1 Polys** model contains all the individual polygons created during the triangulation of the road. In fact if you zoom in on the data it looks very similar to the **ROAD 1 Strs** model.

All we require is the interface polygon. This polygon defines the outermost parts of our road design. It also lies exactly on the natural surface.

To make it easier to select this polygon when fencing the data, we will copy the interface polygon to a new model.

Click on ***Utilities*** => ***A - G*** => ***Change***.



Select the **String** icon from the ***Data to convert*** box and select the **interface polygon**

We can leave the properties of the string as they are so there is no need to fill any of this data in.

In the ***Target*** box select the ***Model*** icon in the ***Copy to model*** field and select the **ROAD 1 Polys** model. Add the word **Interface** to the model name as shown.

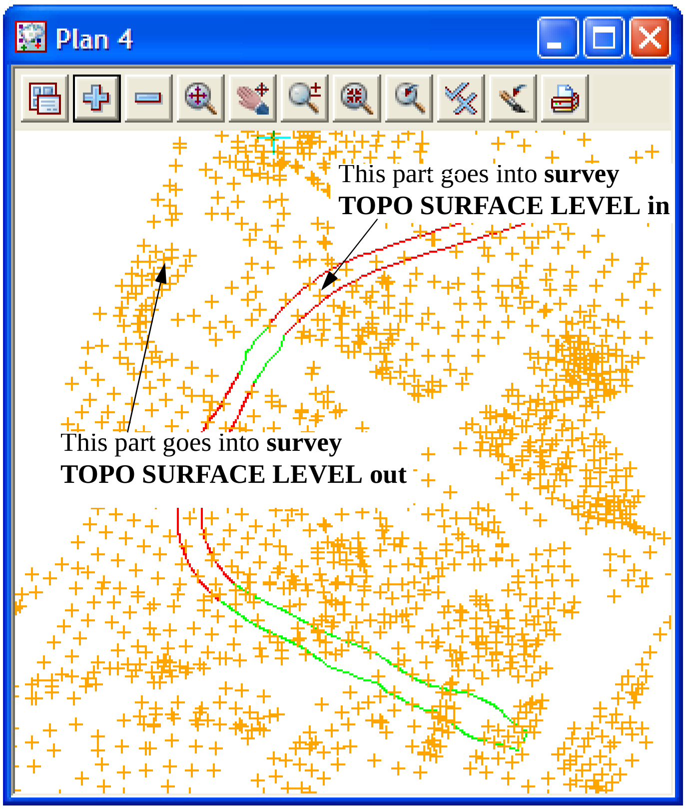
Click on ***Change*** then ***Finish.***

Turn OFF the model **ROAD 1 Polys** in view 'Plan 3' and turn ON **ROAD 1 Interface Polys**

25.3.3 Use the Road Formation Boundary to Create a 'hole' in your 'natural surface' Data

We will now use the Road Interface polygon to clip out all the 'GROUND' data that is inside the polygon to create a 'hole'.

12d has several ways to do this.



The easiest way is through the use of the 'fence stem' facility that uses wild cards to manipulate models by name.

To assist with an explanation of how this will happen, turn on model **survey TOPO SURFACE LEVEL** in the 'Plan 3' view.

Various strings in model**TOPO SURFACE LEVEL** (and all the other models in our 'GROUND' TIN) cross our interface polygon. We can use a tool in 12d to split each string where it crosses the boundary

By default, the parts of the strings in model **survey TOPO SURFACE LEVEL** that are <u>inside</u> the polygon will be duplicated and placed in a model called **survey TOPO SURFACE LEVEL in.**

More importantly for our purposes, the parts of the strings in model **survey TOPO SURFACE LEVEL** that are <u>outside</u> the polygon will be duplicated and placed in a model called **survey TOPO SURFACE LEVEL out.**

It is important to note that model **survey TOPO SURFACE LEVEL** will remain intact. 12d <u>never</u> modifies your data. Thus if you make a mistake and the fencing fails, you can always delete any new models created and go back to your original untouched data for a further attempt.

We will now see how this works in practice. In view 'Plan 3' turn OFF model **survey TOPO SURFACE LEVEL**. The only data on display in view 'Plan 3' should be our interface polygon.

From the main menu, click LB on **Utilities=>Fence=>Fence stem**

Click on the **View** icon.

Select view **1** as the view to fence.

At the right of the ‘Polygon for fence’ field, click on the ‘More Information’ icon. Click on the String pick icon, then click on the Road Formation boundary polygon in view ‘Plan 3’

In the ‘Prefix for fence inside’ field, remove the ***.in** entry. We don’t need any of the strings <u>inside</u> the Road Formation boundary polygon for the final surface.

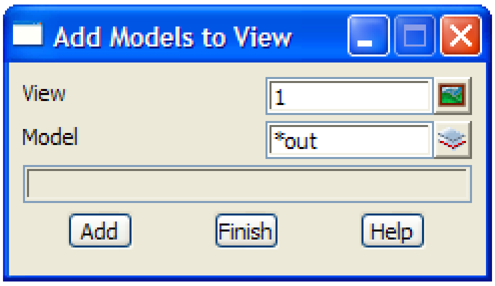
Leave the ***.out** entry as is.

Click LB on **Fence** and **Finish** to execute the fencing operation.

We now need to turn OFF all models that are on display in view ‘Plan 1’ and then turn ON all models that end in ‘out’ i.e. ***.out**

In view ‘Plan 1’, click RB in the View Title Area (blue) and click LB on **Models=>Remove all models.**

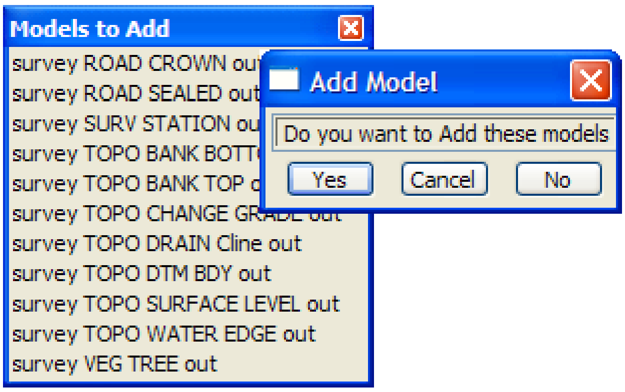
In view ‘Plan 1’, click RB in the View Title Area (blue) and click LB on **Models=>Add model. [Note, <u>don’t</u> walk right on add model]**



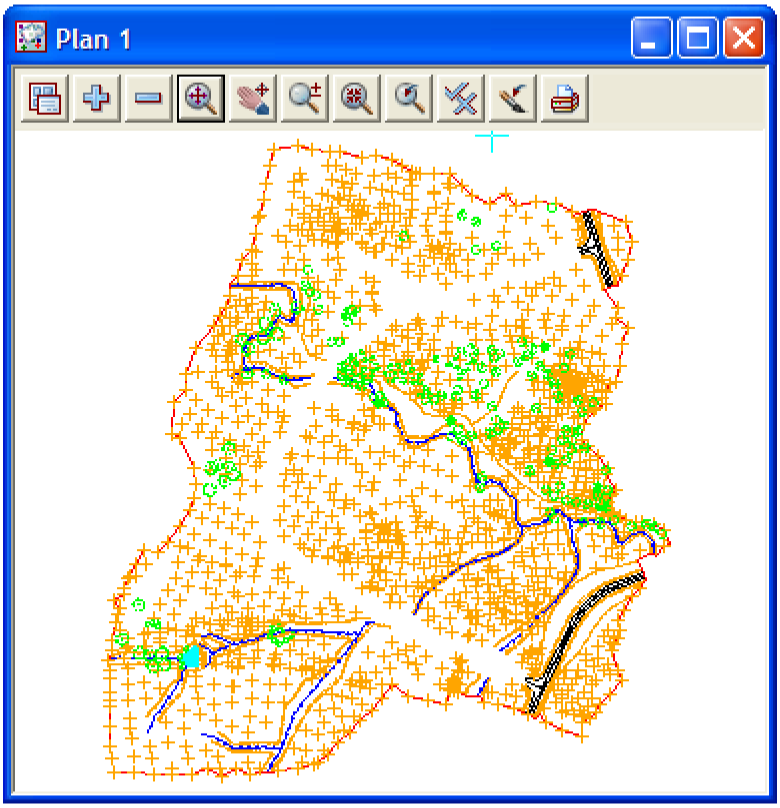
Select view **1**

Type ***.out** as shown. This will select every model in your database that ends with ‘out’.

Click LB on **Add**.



A list of all models that end in ***.out** appears. Click LB on **Yes** to confirm the list.



Your view ‘Plan 1’ should now look as shown.

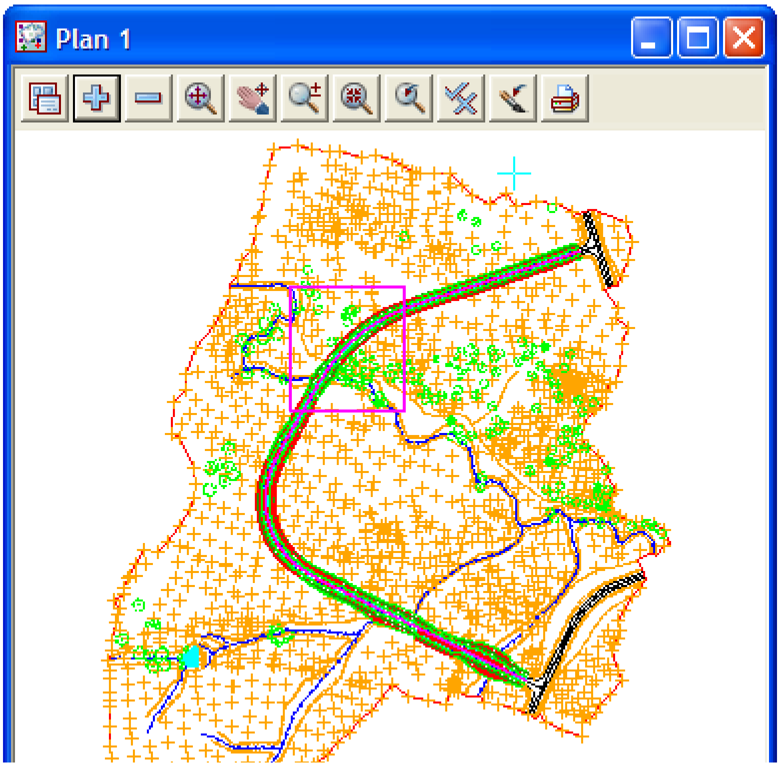
Note the ‘hole’ in the data where the road design strings will fit.

The data currently on display represents that part of the natural surface that stays intact after the road is built.

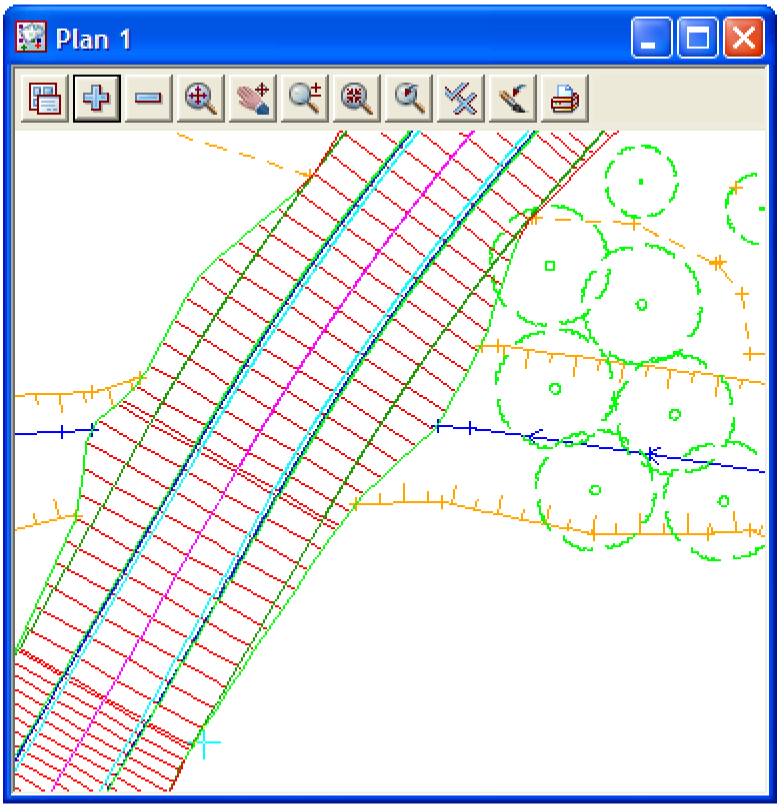
25.3.4 Turn on the ‘design strings’ that represent the Road Formation to fill the ‘hole’.

Turn on models **ROAD 1 Sects** and **Strs** which should fit neatly within the ‘hole’. Visually check that this is so before proceeding.

View ‘Plan 1’ should now not have any ‘holes’.



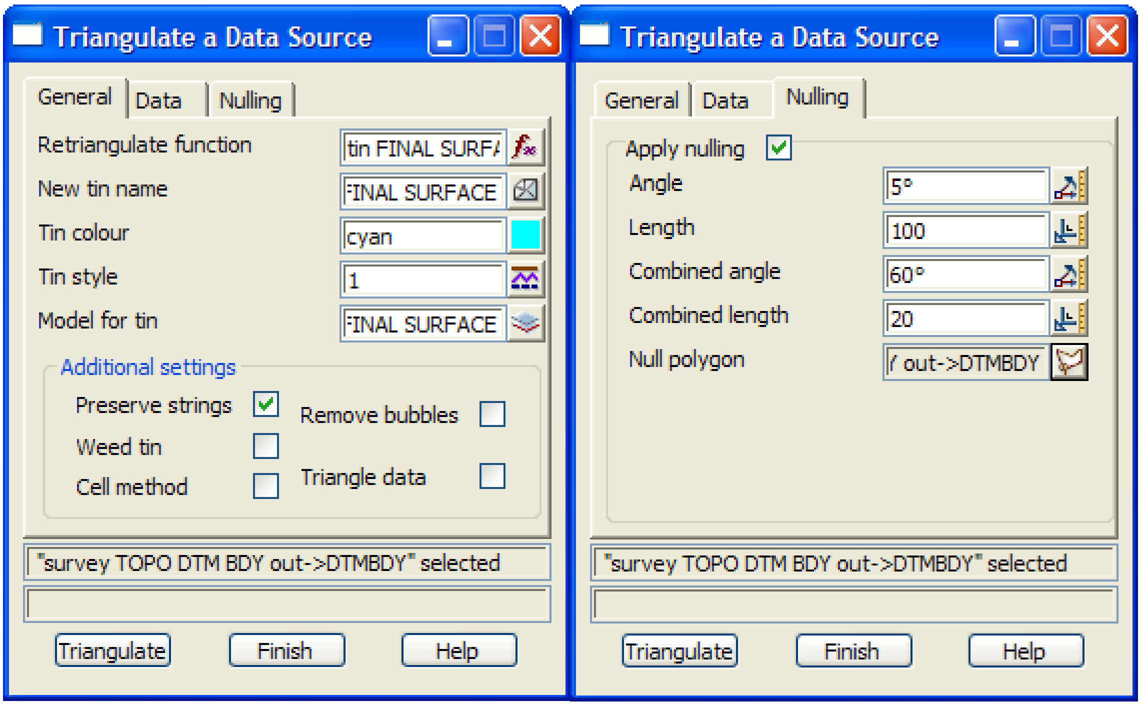
Zoom in around the creek area and observe that all strings have been clipped exactly where they cross the interface boundary polygon with no gaps present.



That completes the preliminary steps associated with fencing operation. We now need to create a TIN of this merged data.

25.4 Merge These Two Data Sets by Creating a TIN of the Finished Surface

We now have on display in view 'Plan 1' all of the strings that are needed to form up our final design surface. The TIN we create from these strings will be called 'final surface'.



From the main menu, click LB on **Tins=>Create=>Triangulate data**

Fill in the panel as shown.

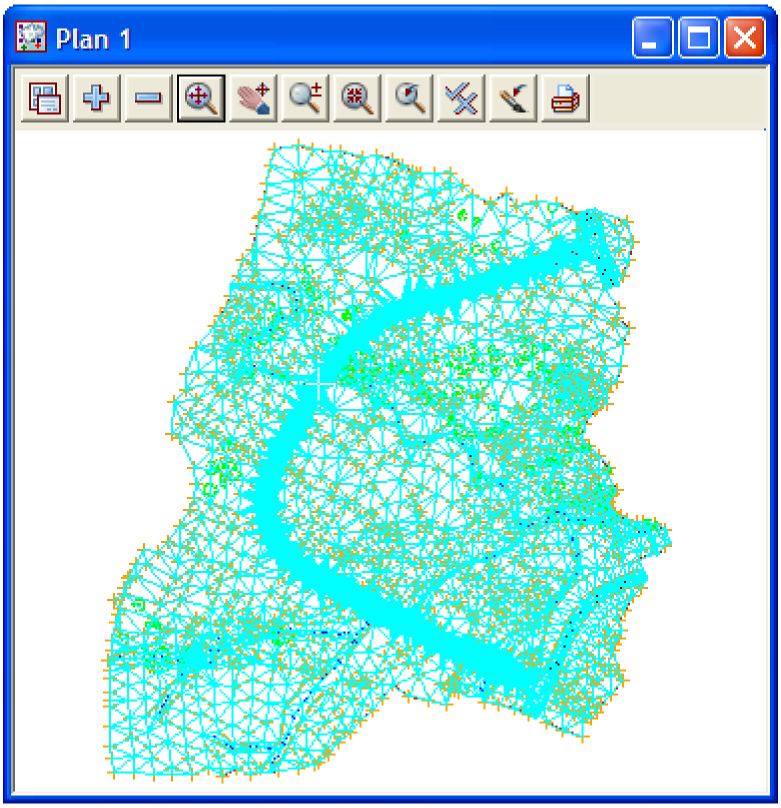
Give the function the name **tin FINAL SURFACE**

After typing **FINAL SURFACE** in the ***New tin name field***, press the Enter key. You should see the field 'Model for tin' updated with the name **tin FINAL SURFACE**.

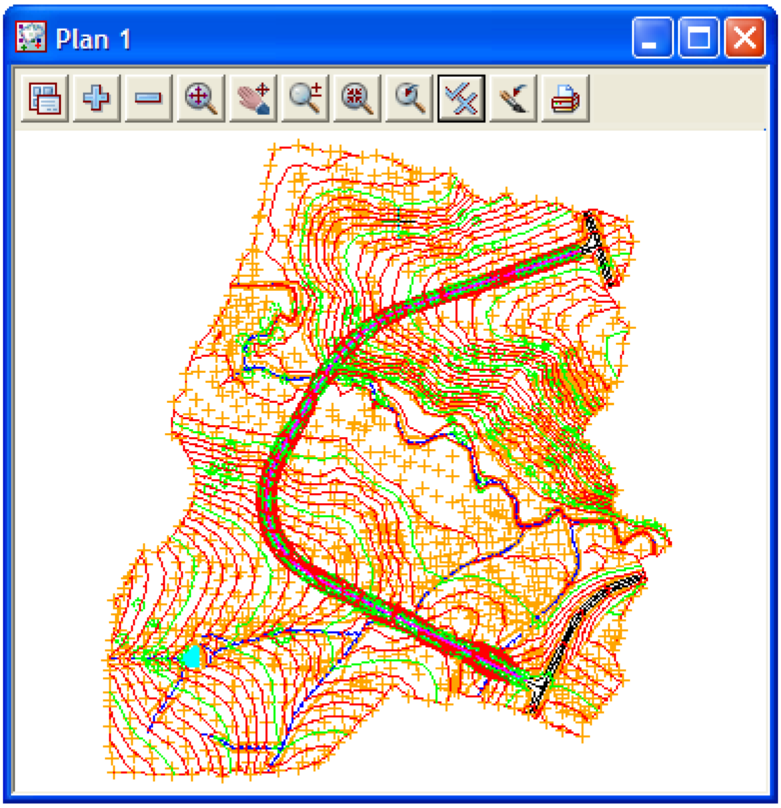
From the ***Data*** tab, select the **View to triangulate** as view **1**

Click on the ***Nulling*** tab, click on the ***Apply Nulling*** check box, then select the **Null polygon** button. Click LB on the outer red 'survey TOPO DTM BDY out' polygon we can see in view 'Plan 1'. Click MB to confirm the selection.

Click LB on the **Triangulate** button. Click LB on **Finish**.



If you turn on model **tin FINAL SURFACE** in view ‘Plan 1’ you should see the finished TIN as shown.



To view finished contours

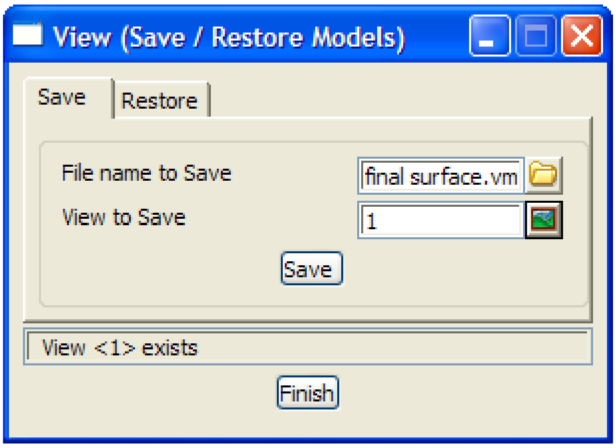
Click LB on **Toggle=>Tin contours [on].**

The ‘FINAL SURFACE’ TIN appears in ‘quick’ contour form.

25.5 Write Out a Final Surface.vml File for later use

It is important that we don't include the TIN itself in this model list. In view 'Plan 1', turn OFF model **tin FINAL SURFACE**.

From the main menu, click LB on **View=>Model save/restore**



Click LB on the **Save** tab.

In the 'File name to Save' field, type in **final surface** and press the Enter key. The suffix **.vml** is added (view model list).

Select view **1** (where these models are currently on display).

Click LB on **Save** and **Finish.**

25.6 Conclusion

This concludes the tutorials covered by the *Getting Started for Design* manual.

There is also a *Getting Started for Surveying* manual which covers material relevant to Surveying. The Getting Started for Surveying manual is also distributed as a PDF file on the 12d Model Installation CD.