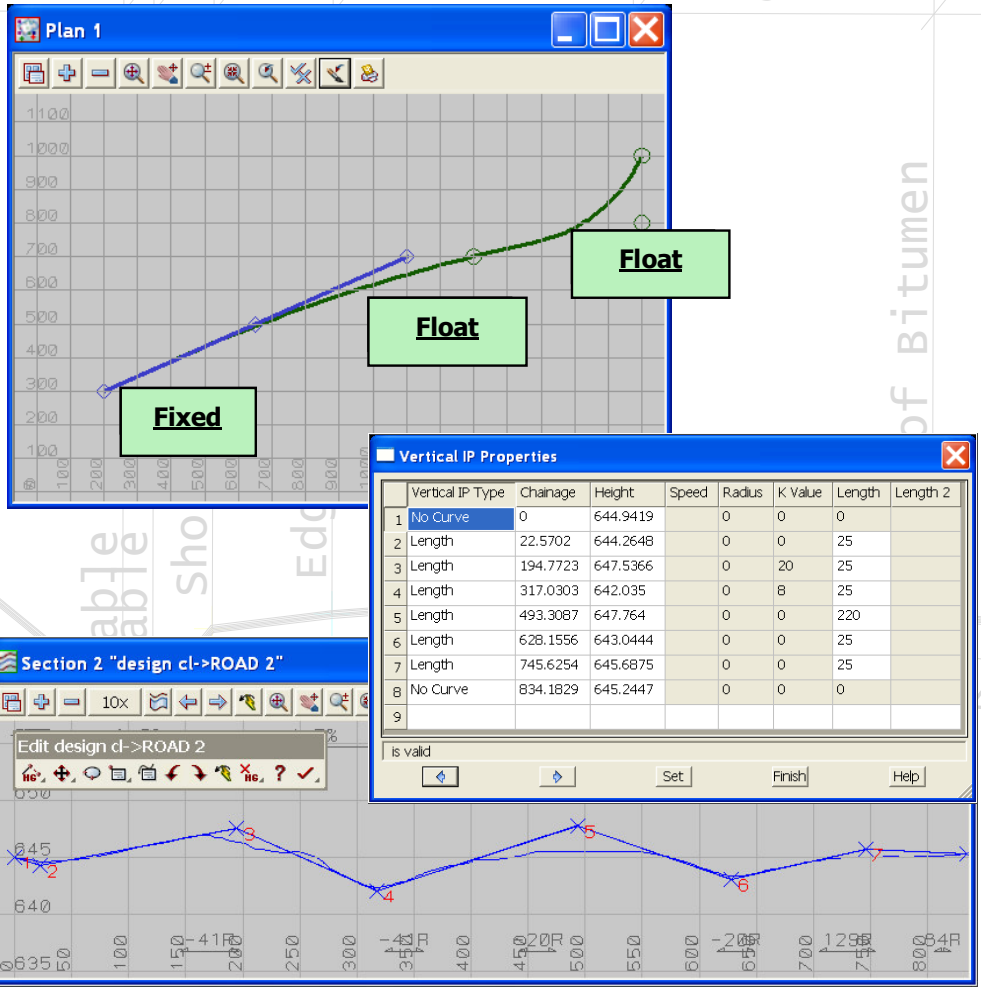
12d Model Course Notes



Training Notes

ELEMENTS OF SUPER ALIGNMENT DESIGN

12d Model Course Notes

Disclaimer

Finally, these notes have benefited from the feedback of others, and so indirectly have you. If you felt that any part of these notes were difficult to understand, not clear, or would benefit from more examples, or if you have any other comments at all, then please let me know. My email is tingold@exds.com.au

These course notes are available as a download from www.exds.com.au

Rodney Burns – February 2011.

Table of Contents

1 Why Alignment Strings?

1.1 Alignment strings are special

Alignment strings are usually used to design road centrelines, kerb returns etc.

Alignment strings are different from other types of strings because:

- The horizontal geometry is designed independent from the vertical geometry.
- The plan position of the string does not alter the vertical design
  (for example you could move horizontal points and the vertical design would not change).
- The horizontal design and the vertical design can be of different lengths.
- You can drag the vertical design elements in the section view.
- The string can hold complex geometry both horizontal Transition spirals and vertical Parabolas which cannot be produced on other string types.

1.2 Traditional Alignment Design (IP Design)

When road centreline design was done by hand, the designer would use a long straight edge and a pencil to draw the straight parts of the road onto a plot of the survey. The straights would run between 'Horizontal Intersection Points or 'H.I.P.s'

Curves would be drawn between the straights using Railway Curves. The points where the curve touched the straight was called the tangent point (T.P.). At this point the curve and the straight are tangential to each other, having the same bearing.
This 'traditional' method of design using 'I.P.'s has been available in 12d Model for many years.

1.3 Element Based Design (Parametric Design)

The drawback to using the I.P. method for alignment design is that the only way you can define a curve (maybe a kerb return) is by using three I.P. points to create two straights, then to create a curve between the straights. This works fine until the position of the curve needs to be edited. It is easier to delete the curve and start again.

Element Based Design allows you to define the curve by many more options. Eg. Three points, or by a centre, radius, and the start and end points. There are no I.P.s required for this method of design and editing a single element can be considerable easier to make design amendments.

1.4 Super Alignment

12d Model's 'Super Alignment' allow you to use both I.P. based design and Element based design in the same alignment string.
As an example you can design the horizontal geometry using I.P.s then use Elements to design the vertical geometry. Or go to the next level and start to mix your I.P. and Element parts in either sections of the geometry (Horizontal and Vertical), providing users more flexibility and tools for designing.

2 Creating a Super Alignment

2.1 Create a New Super Alignment

To create a New Super Alignment there are two methods, using the menu structure or a toolbar.

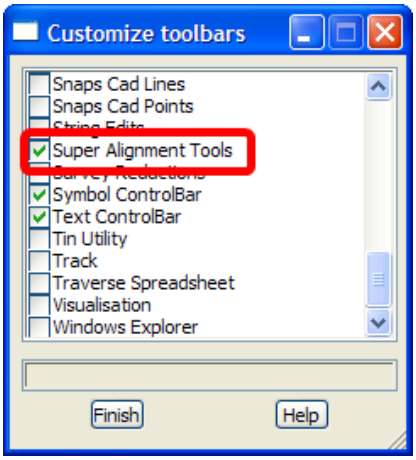
To use the Menu Structure, use: **Strings => Create => Super Alignments => Super Alignment**

The second method is to turn on the Super Alignment Toolbar.

Use: **View => Toolbars**

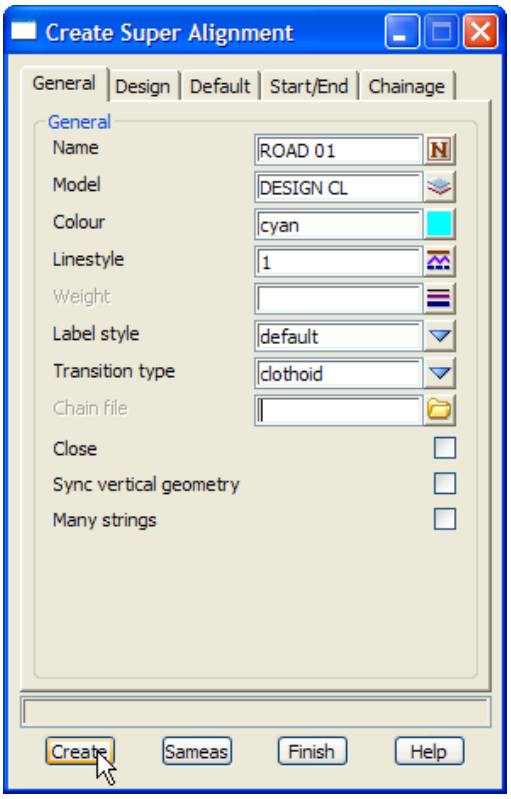
Tick on the **Super Alignment Tools**, Toolbar and click Finish.

The Toolbar will appear in the top left corner of your project, then you can move and place the toolbar anywhere around your workspace, and this will be saved with the project.



Edit
This option will only edit Super Alignment Strings

Create
This opens the create Super Alignment Panel



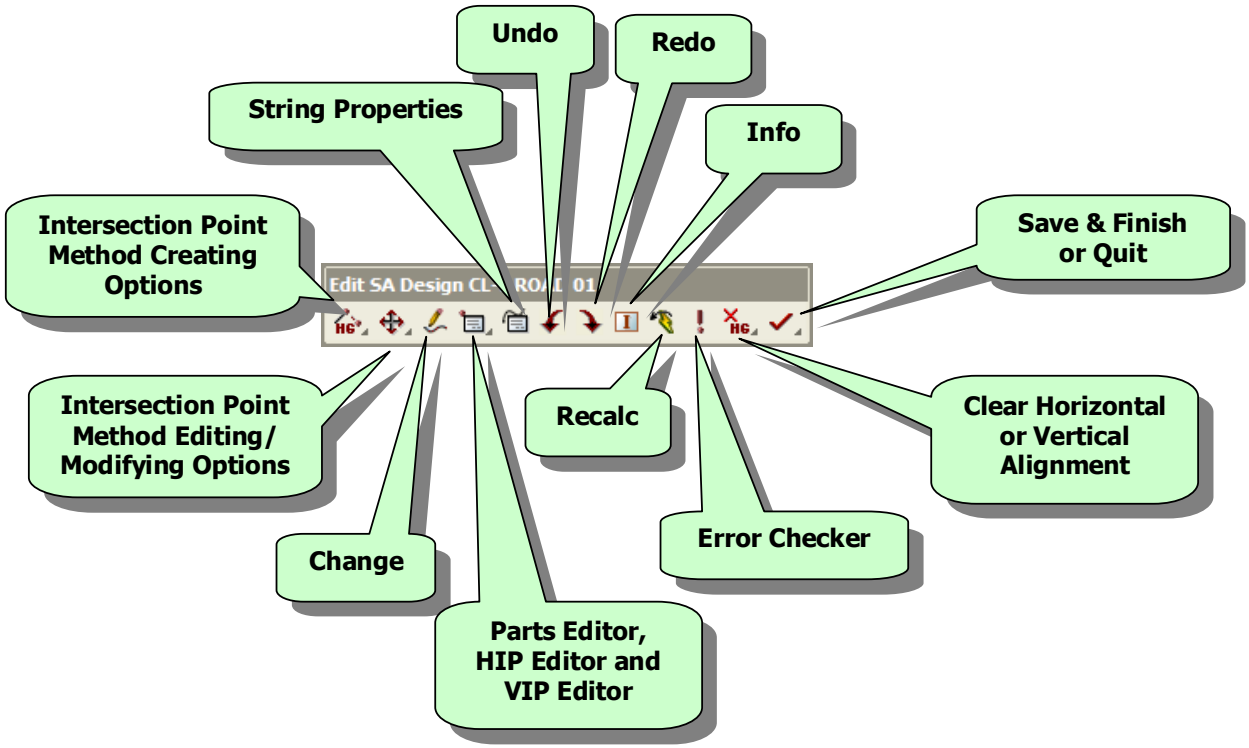
Fill out the panel with the required Name, Model etc.

Then press **Create** to open the Super Alignment Editor

2.2 Super Alignment Editor

Below shows all the options for Super Alignment Editor.

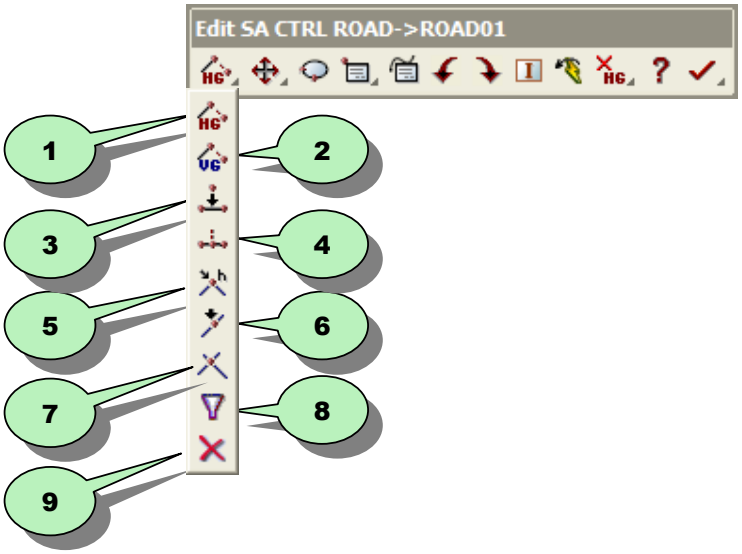
NOTE: Please remember the 'Control Z' keyboard option doesn't work for Super Alignments, only the Undo and Redo buttons shown below on the Toolbar work.



3 Tools for Designing by IP method

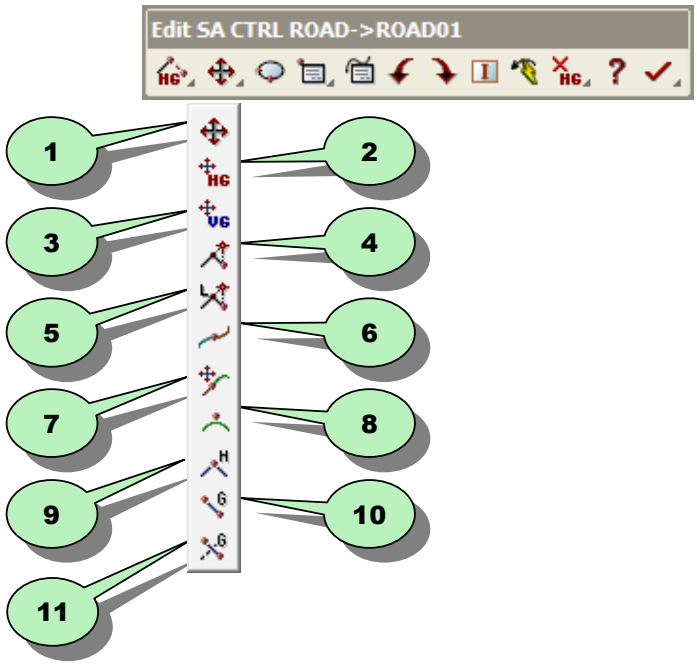
3.1 Add / Remove Options

The first set of icons is to be used for IP method design only. They can be obtained by a single click on the add/remove button. Which then allows you to place Intersection Points both Horizontally and Vertically, using the following options.



1. **Append HIP** - Horizontal Intersection Point.
2. **Append VIP** - Vertical Intersection Point.
3. **Insert IP** - between existing IP's both horizontal and vertically.
4. **Between IP** - maintains current horizontal bearing or vertical grade.
5. **Insert VIP Height** - places a VIP to a determined height.
6. **Insert VIP Grade** - enables you to place a new VIP at a Grade and distance.
7. **Intersect VIP Grades** - enables you to intersect two VIP's by entering grades.
8. **Filter IPs** – removes Horizontal and Vertical Intersection points not required for geometric definition.
9. **Delete** - enables you to delete Horizontal and Vertical IP points.

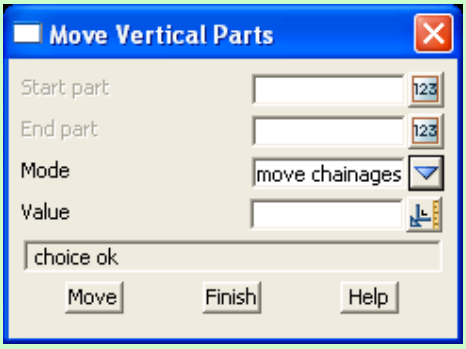
3.2 IP (and some Element) Change Options



1. **Move IP** - enables you to move Horizontal and Vertical IP points by curser

2. **Move Horizontal Parts** – this dialog box will appear, with which you are able to nominate IP numbers to move (or total alignment if desired), the horizontal plane in which to move the IP's
eg. X or Y and the value you wish to move the parts by.

3. **Move Vertical Parts** – similarly, this dialog box will appear, with which you are able to move Vertical IP points in a section view either by chainage or height



Note: By placing the same IP number for both Start and End part of a move, you are able to move individual IP's both Horizontally and Vertically.

4. **Extend** – The extend will work differently in the Horizontal and Vertical design. If used in the Horizontal the Straight selected will be extended with a set bearing, the proceeding or following straight will have it's bearing altered only. Similarly in the Vertical plane when selected on one grade, this is set and extended and the proceeding or following grade will change accordingly.

5. **Extend By Length** – The extend by length option allows users to manually enter the horizontal or vertical distance they wish to move an IP by. By selecting on the horizontal straight or vertical grade the user is able to extend, lengthen the part using a (+) number or shorten the part using a (-) number.

6. **Tangent Wizard** – The tangent wizard will increase (both Horizontally & Vertically) the length of a curve, so as to produce a back-to-back tangent. The IP selected (with an existing curve) will increase until the TP point from a nearest curve is reached, producing back to back curves.

7. **Move Tangent** – Can be used for both Horizontal and Vertical curves, uses are able to select TP locations and can slide curves and parabolas, back and forth as needed.

8. **Change Curve** – To be used to place both Horizontal and Vertical curves to an alignment. Horizontally it will place a curve at a nominated radius. Vertically it will place a curve (parabola) by length nominated.

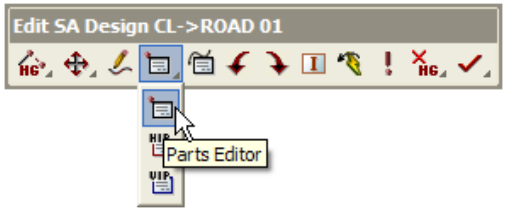
9. **Change Height** – The Change Height option operates on VIP points in the section view. You are able to select a VIP point, it's known Z value can then be amended in the Height panel provided.

10. **Change Grade** – By selecting on a known grade within the section, we are able to adjust the grade via typed input. This amendment will change the grade from the VIP to the left of selection and amend the Z value of the next VIP point to the right, this will also change the proceeding grade in the process.

11. **Change Grade 2** – As per the above Change Grade, this option will also allow you to input a required grade, but will maintain the proceeding grade as set by you. It effectively extends the proceeding set grade, adjusting the VIP point both by Chainage and Z value until it can calculate your desired Grade nominated.

4 Tools for Parametric Design (Element Method)

To create Fixed, Floating or Free Parts for Element Design, use the Parts Editor panel as shown in the following example.



5 The various "Elements" used in Design

5.1 Fixed Elements

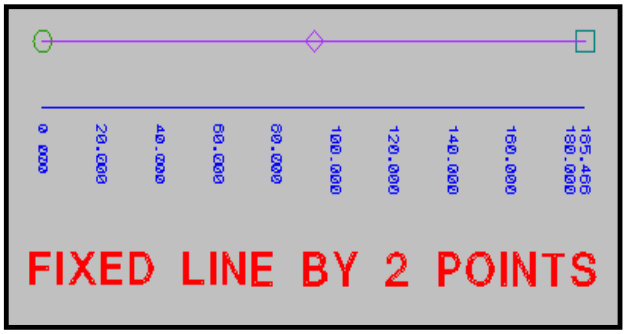
Fixed Elements are parts of the alignment that are locked in.

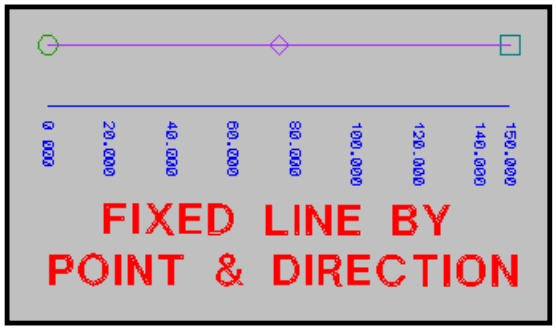
A straight between two points and a curve through three points are both Fixed Elements. There is no debate about where they lie once the points are chosen.

A Fixed Straight could also be defined by choosing a point and specifying a bearing. While the length of the straight is unknown, there is no debate about where it lies.

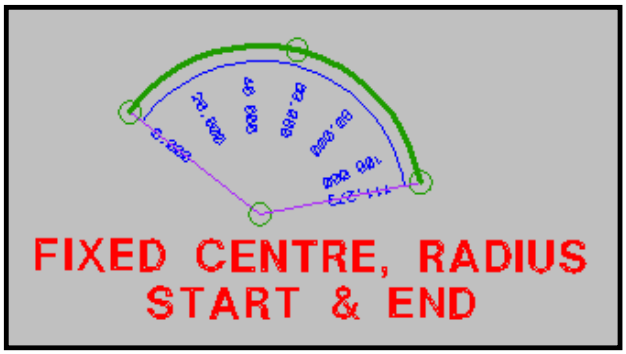
TYPICAL FIXED ELEMENTS	
Straights	**Curves**
- Two points	- Three points
- Point and bearing	- Centre, radius, start & end points.

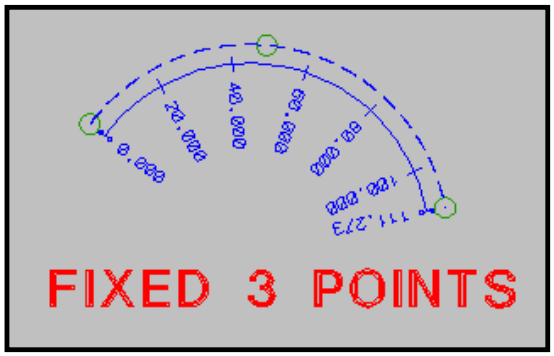
Examples of Fixed Lines.





Examples of Fixed Arcs.



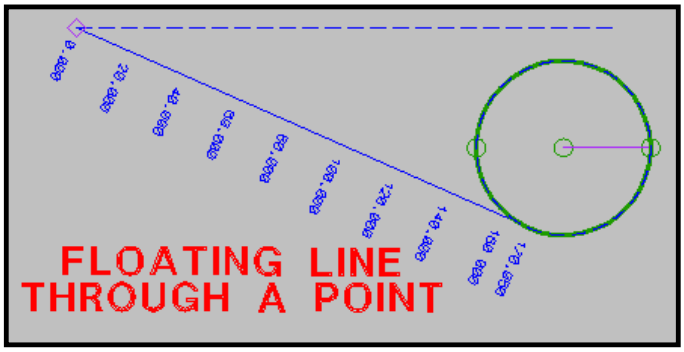


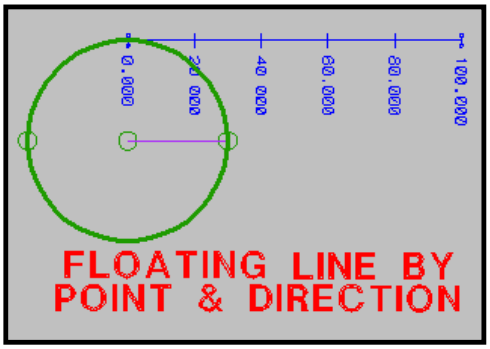
5.2 Floating Elements

Floating elements are parts that need to join on to ONE fixed part of the alignment.

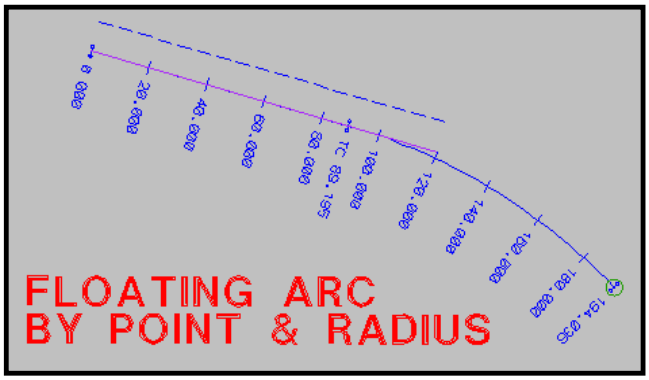
TYPICAL FLOATING ELEMENTS			
Straights:		**Curves:**	
- You choose **one point**. The straight must pass through the point	**12d Calculates ONE tangent point**. The straight passes through the T.P.	- **You choose two points**. The curve must pass through the two points.	**12d Calculates ONE tangent point**. The curve passes through the T.P.
- You choose a **bearing**.	**12d Calculates ONE tangent point**. The straight passes through the T.P. and has the bearing you chose.	- **You choose one point and a radius**. The curve must pass through the point and have the radius you choose.	**12d Calculates ONE tangent point**. The curve passes through the T.P. and uses the point and radius that you chose.
In all cases you do not provide enough information to accurately position the straight or curve. **12d Model** must calculate **ONE tangent point**, before the curve or straight can be created.			

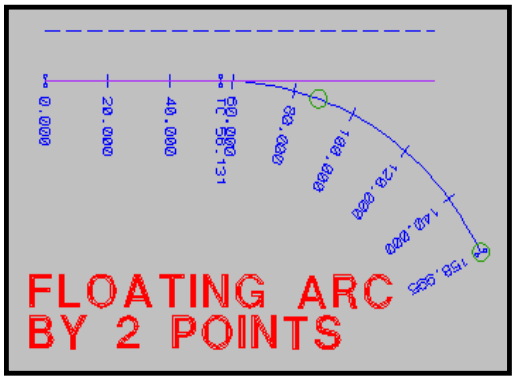
Examples of Floating Lines.





Examples of Floating Arcs.



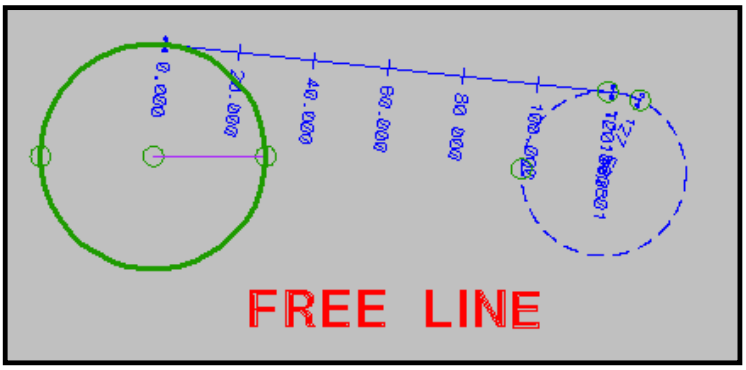


5.3 Free Elements

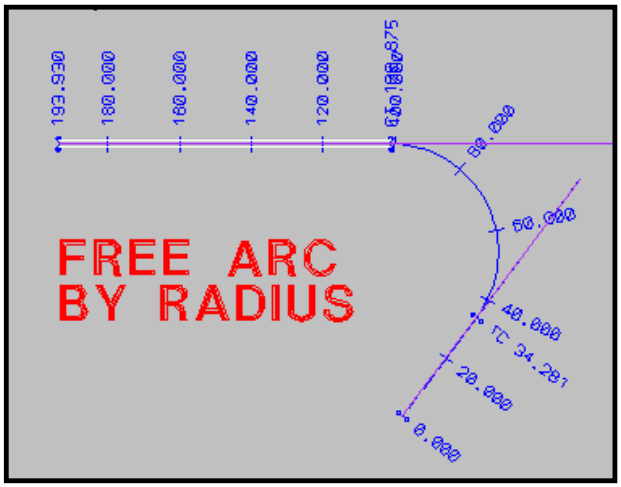
Free elements are parts that need to join onto TWO fixed parts of the alignment.

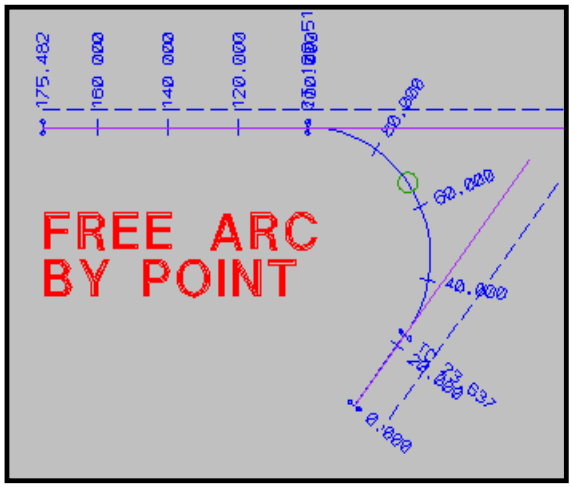
Free Elements			
Straights:		Curves:	
- No points	**12d Calculates TWO tangent points.**	- One point	**12d Calculates TWO tangent points.**
		- Centre, radius, start & end points.	
In all cases **12d Model** must calculate **TWO tangent points**, before the curve or straight can be created.			

Examples of a Free Line.

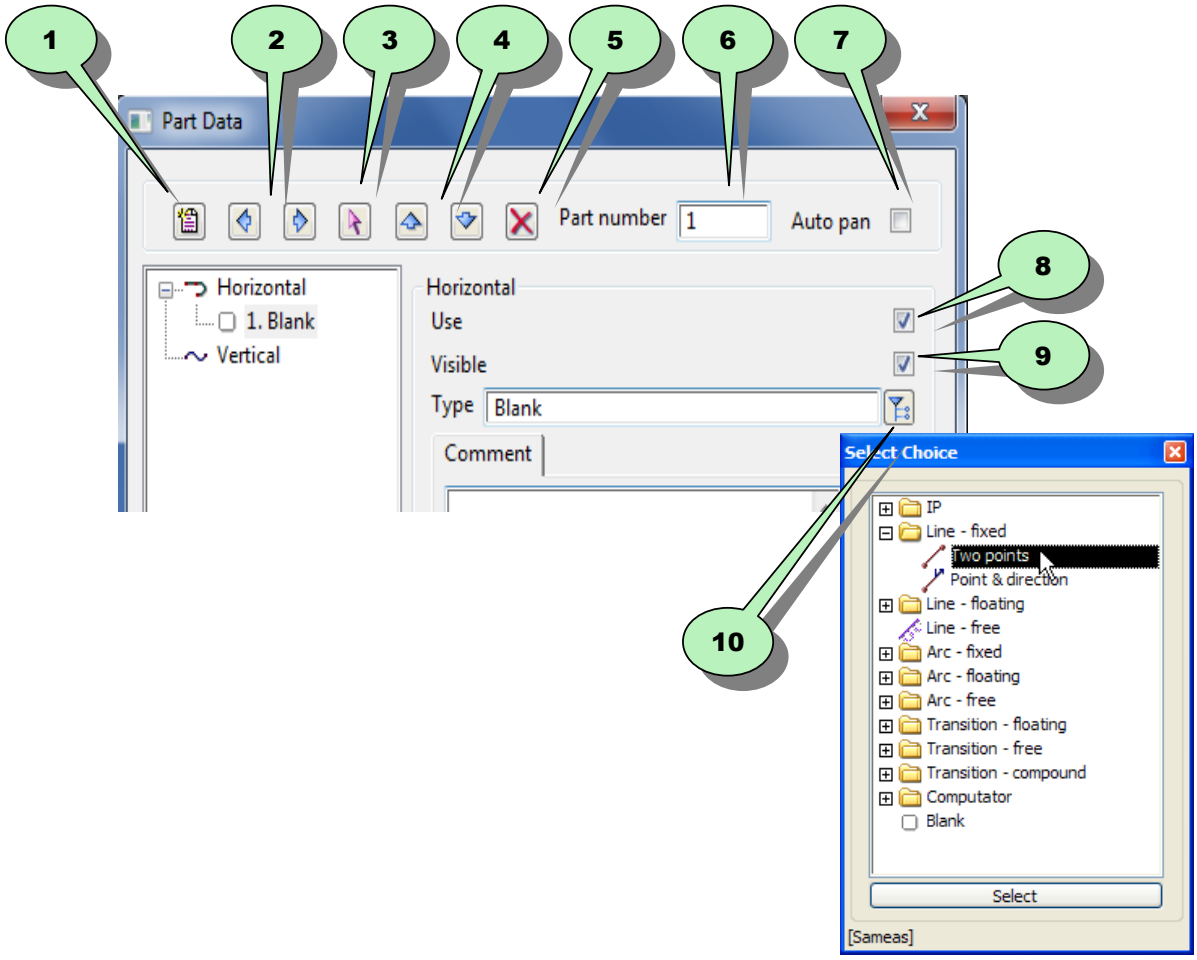


Examples of a Free Arc.



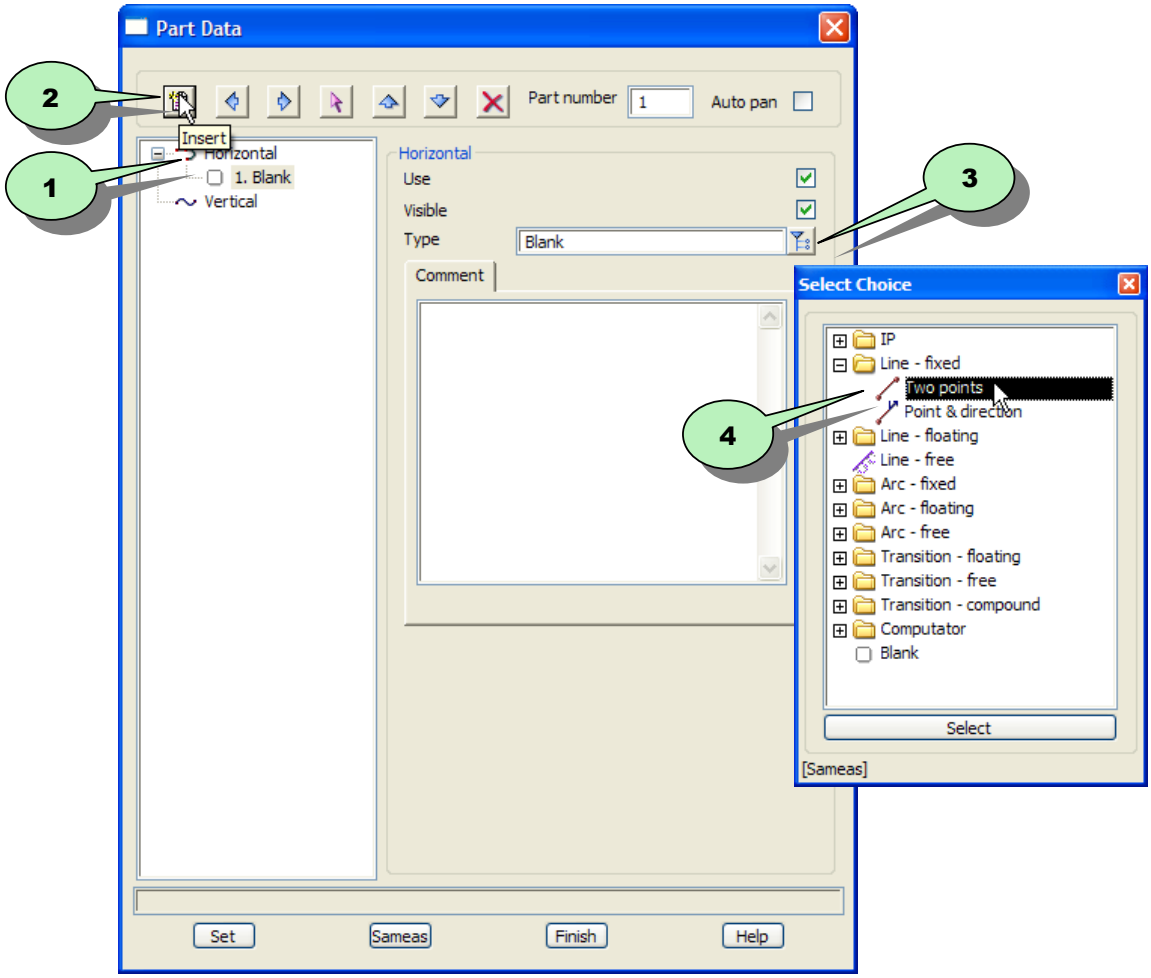


6 The Elements Part menu



1. **Insert** – Add Horizontal or Vertical Parts (Geometry).
2. **Previous/Next** – Move up and down through the design parts.
3. **Pick** – Select a part to edit and move directly to its position.
4. **Move Up/Down** – Move a selected part to change the order of the design or geometry and how it is calculated.
5. **Delete** – Remove a part from the design geometry.
6. **Part Number** – Shows the current Part number being highlighted. Users can type a new part number into the field to move to that element.
7. **Auto Pan** – Updates the selected Plan View to show the current Part being modified or highlighted.
8. **Use Part** – If ticked, this part is used to calculate the geometry of the alignment.
9. **Visible Part** – If ticked, this part is visible and will have chainages calculated along its length.
10. **Parts Type** – This button allows users to select the required part for their alignment design. Including, IP's, Fixed, Floating and Free elements, various Transitions and Computators.

7 Example of placing an Element Part



1. Highlight **Horizontal** 

2. Then press **Insert** 

3. Select the **Type** Button
4. Select **Line – fixed**, then the **Two Points**

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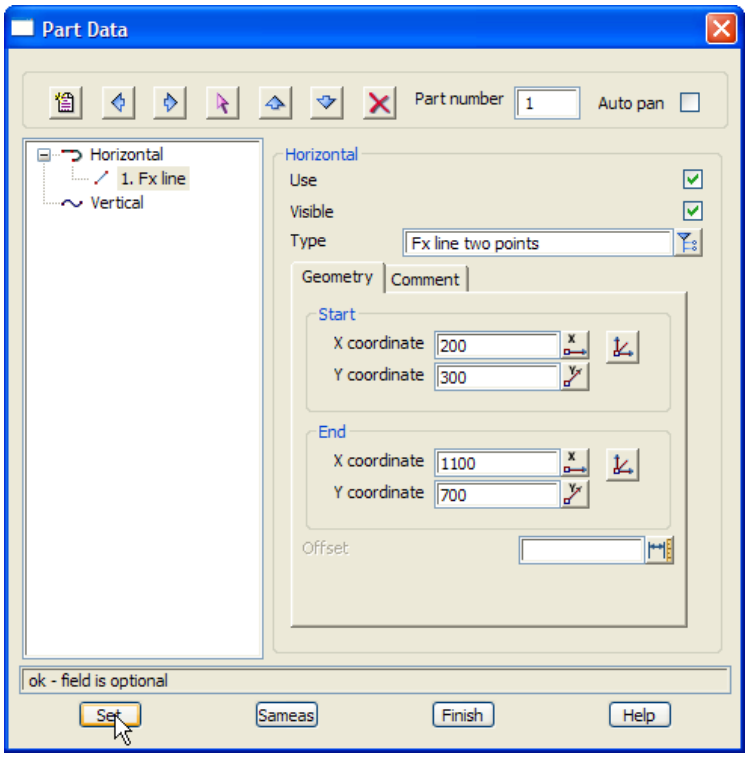
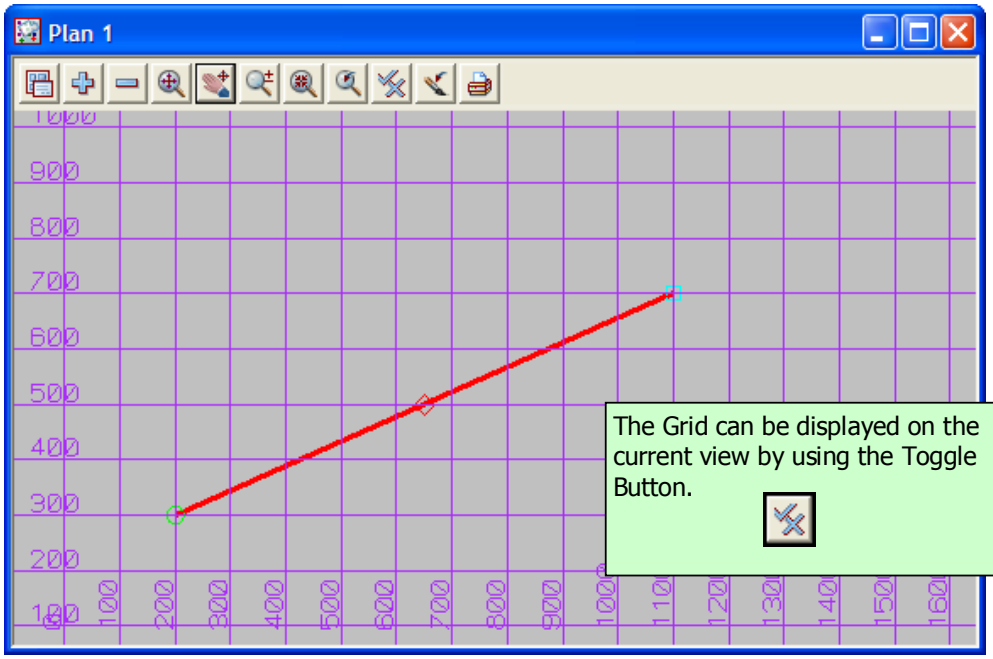


Enter the **Start & End** coordinates for the line as shown.

Hit the **Set** Button to save the coordinates for the line.

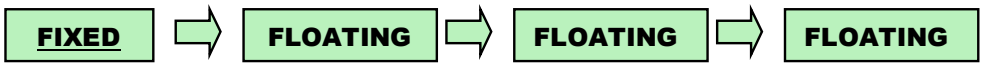
The Part of the Super Alignment is created and displayed below…



The Grid can be displayed on the current view by using the Toggle Button.

8 Design Tricks for Element Design

There are two most common methods of design using the Element tools. Using one of the combinations shown below. Users find the have less problems with their parts (or geometry) not solving correctly.



Notes: _____

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Note: If you are designing using Elements (Parts). 12d will want to solve the geometry (horizontal and vertical) for you and that providing insufficient or excessive geometry may cause the Super Alignment not to solve correctly.