I 12d Ascii File Format

The 12d Ascii file format (called 4D Ascii in Version 4 and earlier) is a text file definition from 12D Solutions which is used for reading and writing out string data from 12d Model. 12d Ascii files normally end in '.12da'

This document is for the 12d Ascii file format used in *12d Model Version 9*.

For General Comments about 12da, go to the section		"General Comments about 12d Ascii File"
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General Comments about 12d Ascii File

//

Anything written on a line after **//** is ignored. This is used to place comments in the file.

Blank lines

Unless they are part of a text string, blank lines are ignored.

Spaces

Unless enclosed in quotes ("), more than one consecutive space or tab is treated as one space. Except when it is the delimiter after a //, an end of line (<enter>) is also considered a space.

Spaces and special characters in text strings

Any text string that includes spaces and any characters other than a to z, A to Z or 0 to 9 (alphanumeric), must be enclosed in double quotes. In text strings, double quotes " and backslash \ must be preceded by a \. For example, \" and \\ define a " and a \ respectively in a text string.

Names of models, tins, styles, colours and attributes

Models, tins, styles (linestyles), colours and attributes can include the characters a to z, A to Z, 0 to 9 (alphanumeric characters) and space. Leading and trailing spaces are ignored. The names can be up to 255 characters in length. If the name includes spaces, the name must be enclosed in double quotes (").

The names for models, tins, styles, colours or attributes can not be blank.

The names for models, tins, styles and colours can contain upper and lower alpha characters which are stored, but the set of model names, tin names, style names, colour names or attribute names for an object *must be unique when case is ignored*. For example, the model name "Fred" will be stored as "Fred" but "FRED" is considered to be the *same* model name as "Fred".

String names

String names can include the characters a to z, A to Z, 0 to 9 (alphanumeric characters), space, decimal point (.), plus (+), minus (-), comma (,), open and closed round brackets and equals (=). Leading and trailing spaces are ignored. String names can be up to 255 characters in length. If the string name includes anything other than alphanumeric characters, then the name must be enclosed in double quotes (").

String can contain upper and lower alpha characters which are retained but case is ignored when selecting by string name. That is, the string name "Fred" will be stored as "Fred" but "FRED" is not considered to be a different name.

String names do not have to be unique and can be blank.

Please continue to the next section “Attributes” .

Attributes

Many 12d Model objects (such as individual strings, models and tins) can have an unlimited number of named **attributes** of type integer (numbers), real and text. Within an object, the attribute names must all be different.

The attributes for an object are given inside the curly braces of the **object** definition. The attributes are preceded by the **attributes** keyword followed by the *named attributes* enclosed in curly braces **{** and **}**.

The format for each named attribute is

```
attribute_type      attribute_name      attribute_value
```

where	attribute_type	is integer, real or text
	attribute_name	is the unique attribute name for the object
and	attribute_value	is the either a number, a real or a text string.

That is the attributes are defined in a block:

```
attributes {
  integer          att_name          number
  real             att_name          value
  text             att_name          text
}
```

The *text* for a text attribute can be blank an if so, is defined as "".

An example of defining attributes is:

```
attributes {
  text             "pole id"          "QMR-37"
  text              street            "477 Boundary St"
  real             "pole height"       5.25
  integer          "pole wires"        3
}
```

Please continue to the next section “Commands” .

Commands

Commands consist of a ***keyword*** followed by a space and then a ***value*** (a keyword and its value is often referred to as a ***keyword pair***). A *value* must always exist.

keyword *value* // a keyword pair

There can be more than on command keyword pair per line as long as each keyword pair is separated by a space. In fact, the *keyword* can be on one line and the *value* on the next line.

Although the names of commands are only shown in lower case in these notes, commands are case insensitive and all combinations of case are recognised as the same command. That is 'model', 'MODEL' and 'ModeL' are all recognised as the command 'model'.

The commands in the 12d Ascii file are:

model *model_name* // system default *data*

All strings following until the next **model** keyword are placed in the model *model_name*. This can be overridden for a string by a **model** command inside the string definition.

If the model includes attributes, the following *model* definition must be used.

model {
name *model_name*
...
}

All 12d Model *models* can have an unlimited number of named attributes of type integer (numbers), real and text. Within a model, the attribute names must all be different.

The definition for a model with attributes is the **model** keyword followed by information enclosed in curly braces **{** and **}.** The keyword *name* followed by the *model_name* ***must*** be included inside the curly braces.

name *model_name*

The attributes for the model are also specified inside the curly braces of the **model** definition. As described previously, the attributes are preceded by the **attribute** keyword followed by the named attributes enclosed in curly braces **{** and **}**.

Hence the *model* definition with attributes is:

```
model {
  name       model_name
  attributes {
    attribute_type   attribute_name    attribute_value
    attribute_type   attribute_name   attribute_value
     ...
    attribute_type   attribute_name   attribute_value
  }
}
```

For example:

```
model {
  name      "telegraph poles"
  attributes {
    text          "pole id"          "QMR-37"
    text          "street"           "477 Boundary St"
    real          "pole height"       5.25
    integer       "pole wires"        3
  }
```

}

colour *colour_name* // system default *red*

All strings following until the next **colour** keyword have colour *colour_name*. This can be overridden for a string by a **colour** command in the string definition.

style *style_name* // system default *1*

All strings following until the next **style** keyword have style *style_name*. This can be overridden for a string by a **style** command in the string definition.

breakline *point* or *line* // system default *line*

All strings following that requires a breakline point-line type until the next **breakline** keyword, have this point-line type. This may be overridden for the string by a **breakline** in the string definition.

null *value* // system default *-999*

All z-values equal to *value* in strings following until the next **null** keyword, are considered to be null z-values.

string *string_type* **{**
...
}

The *string_type* is compulsory and must be followed by all the string information enclosed in curly braces **{** and **}**.

Thus if a string type or possibly information inside the string is not recognised, the 12d Ascii reader has a chance of being able to jump over the string by looking for the end marker **}**.

Inside the braces are **string commands** as keyword pairs defining some information for the string.

There can be more than one *string command* keyword pair per line as long as each keyword pair is separated by a space. In fact, the *keyword* can be on one line and the *value* on the next line.

Any unrecognized *string commands* are ignored.

The *string command keyword pairs* include **model**, **colour**, **style** and **breakline** which are all *optional* inside the string definition. However if any of them exist inside a string definition, then the *string command keyword* overrides any **model**, **colour**, **style** or **breakline** *commands* but only for that particular string.

For some string types (e.g. 2d, 3d, pipe) there is more data required than just the *string command* keyword pairs.

This extra data is contained is blocks consisting of a *keyword* followed by the required information enclosed in curly braces **{** and **}**. For example attributes for all string types and (x,y) data for a 2d string.

For all string types, if there is not enough recognised information to define the string, the string is ignored.

The definition of each *string type* and the allowed *string commands* and extra data for that string type will be given after the next section on string attributes.

string attributes

All 12d Model strings can have an unlimited number of named **attributes** of type integer (numbers), real and text. Within a string, the attribute names must all be different.
The attributes for a string are given inside the curly braces of the **string** definition. As described previously, the attributes are preceded by the **attributes** keyword followed by the named attributes enclosed in curly braces **{** and **}**.

Please continue to the next section “12d Ascii Definition for each String Type” .

12d Ascii Definition for each String Type

For the 12da definitions of	*2d string* go to	"2d String"
	3d string	"3d String"
	4d string	"4d String"
	Alignment string	"Alignment String"
	Arc string	"Arc String"
	3d string	"4d String"
	drainage string	"Drainage String"
	face string	"Face String"
	feature string	"Feature String"
	interface string	"Interface String"
	pipe string	"Pipe String"
	polyline string	"Polyline String"
	text string	"Text String"
	super string	"Super String"
	super alignment string	"Super Alignment String"

2d String

```
string 2d {
  z  value   chainage  start_chainage
  model  model_name  name  string_name
  colour  colour_name   style  style_name
  breakline  point or line
  data {                                        // keyword
    x-value   y-value
      "        "
      "        "
  }
}
```

3d String

```
string 3d {
  chainage  start_chainage
  model  model_name   name  string_name
  colour  colour_name   style  style_name
  breakline  point or line
  data {                                        // keyword
    x-value   y-value   z-value
      "         "         "
      "         "         "
  }
}
```

4d String

```
string 4d {
  angle  value   offset  value   raise  value
```

```
    worldsize value or papersize value or screensize value
    chainage start_chainage
    model model_name   name string_name
    colour colour_name   style style_name
    breakline point or line
    textstyle text  slant degrees  xfactor value
    justify  "top|middle|bottom-left|centre|right"
    data {                                          // keyword
      x-value   y-value    z-value    text          // text can not be blank
        "         "          "         "            // use "" for no text.
        "         "          "         "
    }
}
```

Alignment String

In an alignment string the horizontal and vertical geometry are given separately and both can only be defined by the intersection point method (IP's).

For the horizontal geometry, the (x,y) position of the horizontal intersection points (HIPs) are given in the order that they appear in the string, plus the circular radius and left and right transition lengths on each HIP.

Hence a horizontal intersection point is given by either

```
x-value   y-value   radius        // circular curve, no transition
```

or

```
x-value  y-value  radius  spil1  left-transition-length  spil2  right-transition-length
```

radius, left-transition-length, right-transition-length can be zero (meaning they don't exist).

For the vertical geometry, the (chainage,height) position of the vertical intersection points (VIPs) are given in increasing chainage order, plus either the radius of the circular arc or the length of the parabolic curve on each VIP.

Hence for a vertical intersection point is given by either

```
ch_value   z-value   length  parabola
```

or

```
ch_value   z-value    radius  circle
```

where

the word *parabola* is optional. *length* and *radius* can be zero, meaning that the parabola or arc doesn't exist.

```
string alignment {
  model model_name   name string_name
  colour colour_name   style style_name
  chainage start_chainage   interval value
  draw_mode value              // 1 to draw crosses at HIPs and VIPs, 0 don't draw
  spiral_type text             // spiral_type covers both spiral and non-spiral transitions.
                               // For an alignment string, the supported transition types
                               // are clothoid, cubic parabola, westrail-cubic, cubic spiral
                               // More transition are supported in the super alignment
                               //
  hipdata {                    //  some hips must exist and precede the VIP data
    x-value  y-value   radius                       // or
    x-value  y-value   radius   spil1 left-transition-length   spil2  right-transition-length
       "        "         "       "   "                          "        "
  }
  vipdata {                                         // vips optional
    ch_value   z-value   parabolic-length           // or
    ch_value   z-value   parabolic-length  parabola // or
    ch_value   z-value   radius            circle
       "          "         "        "
  }
}
```

Arc String

```
string arc {
  model model_name  name string_name
  colour colour_name  style style_name
  chainage start_chainage  interval value  radius value
  xcentre value  ycentre value  zcentre value
  xstart value  ystart value  zstart value
  xend value  yend value  zend value
}
```

Circle String

```
string circle {
  model model_name  name string_name
  colour colour_name  style style_name
  chainage start_chainage  interval value  radius value
  zcentre  value  xcentre value  ycentre value
}
```

Drainage String

```
string drainage {
  chainage  start_chainage
  model  model_name  name string_name
  colour  colour_name  style style_name
  breakline point or line
  attributes {
    text  Tin  finished_surface_tin
    text  NSTin  natural_surface_tin
    integer  "_floating"  1|0                 // 1 for floating, 0 not floating
  }
  outfall   outfall_value                     // z-value at the outfall
  flow_direction   0|1                        // 0 drainage line is defined from downstream
                                              // to upstream

  data {                                      // key word - geometry of the drainage string
    x-value    y-value    z-value    radius  bulge
      "        "        "
      "        "        "
  }
  pit {                             // pit/manhole - one pit record for each pit/manhole
                                    // in the order along the string
      name          text                      // pit name
      type          text                      // pit type
      road_name     text                      // road name
      road_chainage     chainage              // road chainage
      diameter          value                 // pit diameter
      floating      yes|no                    // is pit floating or not
      chainage      pit_chainage              // internal use only
     ip             value                     // internal use only
      ratio         value                     // internal use only
      x             x-value                   // x-value of top of pit
      y             y-value                   // y-value of top of pit
      z             z-value                   // z-value of top of pit
  }
```

```
pipe {                                  // one pipe record for each pipe connecting pits/manholes
                                        // in the order they occur along the string
    name            text                    // pipe name
    type            text                    // pipe type
    diameter        value                   // pit diameter
    us_level        value                   //
    ds_level        value                   //
    us_hgl          value                   //
    ds_hgl          value                   //
    flow_velocity       value               //
    flow_volume         value               //
}
property_control {
  name              text                    // lot name
  colour            colour_name
  grade             value                   // grade of pipe in units of "1v in"
  cover             value                   // cover of the of pipe
  diameter          value                   // diameter of the of pipe
  boundary          value                   // boundary trap value
  chainage          chainage                // internal use only
  ip                value                   // internal use only
  ratio             value                   // internal use only
  x                 x-value                 // x value of where pipe connects to sewer
  y                 y-value                 // y value of where pipe connects to sewer
  z                 z-value                 // internal use only

  data {                                // key word - geometry of the property control
  x-value     y-value     z-value      radius   bulge
    "           "           "
    "           "           "
}
house_connection {   // warning - house connections may change in future versions
  name              text                    // house connection name
  hcb               integer                 // user given integer
  colour            colour_name
  grade             value                   // grade of connection in units of "1v in"
  depth             value
  diameter          value
  side              left or right
  length            value
  type              text                    // connection type
  material          text                    // material type
  bush              text                    // bush type
  level             value
  adopted_level     value
  chainage          chainage                // internal use only
  ip                value                   // internal use only
  ratio             value                   // internal use only
  x                 x-value                 // x value of where pipe connects to sewer
  y                 y-value                 // y value of where pipe connects to sewer
  z                 z-value                 // internal use only
}

}               // end of drainage-sewer data
```

Face String

```
string face {
  model  model_name   name   string_name
  colour  colour_name   style   style_name
  chainage start_chainage     breakline point or line
  hatch_angle value
  hatch_distance value
  hatch_colour colour
  edge_colour colour
  fill_mode 0 or 1
  edge_mode 0 or 1
  data {                                        // keyword
     x-value    y-value    z-value
       "          "          "
  }
}
```

Feature String

```
string feature {
  model  model_name   name   string_name
  colour  colour_name   style   style_name
  chainage start_chainage   interval value   radius value
  zcentre  value   xcentre value   ycentre value
}
```

Interface String

```
string interface {
  chainage start_chainage
  model model_name   name string_name
  colour colour_name   style style_name
  breakline point or line
  data {                                        // keyword
    x-value    y-value    z-value      mode
       "          "          "           "      // mode = -1 cut
        "          "          "          "      //         0 surface
  }                                             //         1 fill
}
```

Pipe String

```
string pipe {
  diameter value   chainage start_chainage
  model model_name   name string_name
  colour colour_name   style style_name
  breakline point or line
  data {                                        // keyword
    x-value   y-value   z-value
       "          "          "
       "          "          "
  }
}
```

Pipeline String

This is the same as an alignment string except that it has the additional keywords

diameter, which gives the diameter of the pipeline in world units

and

length of the typical pipe making up the pipeline (used for deflections).

```
string pipeline {
  model model_name   name string_name
  colour colour_name   style style_name
  diameter diameter   length pipe-length
  chainage start_chainage   interval value
  spiral_type text             // spiral_type covers both spiral and non-spiral transitions
                               // supported by 12d. For an alignment string, the
                               // supported transition types are clothoid, cubic parabola,
                               // westrail-cubic, cubic spiral. Other transition types
                               // are supported in the super alignment
  hipdata {                    // some hips must exist and precede vips
   x-value  y-value   radius                              // or
   x-value  y-value   radius   spil1  left-transition-length   spil2   right-transition-length
      "       "         "        "      "                        "         "
  }
  vipdata {                                                 // vips optional
    ch-value    z-value    parabolic-length                 // or
    ch-value    z-value    parabolic-length       parabola  // or
    ch-value    z-value    radius    circle
       "          "          "         "
  }
}
```

Polyline String

The definition of a closed string has been refined for polyline and super strings. For other string types, closing a string simply meant having the first vertex the same as the last vertex. Hence the vertex was duplicated.

For a polyline string, being closed is a property of the string and no extra vertex is needed - the first and the last vertices are not the same and the polyline string knows there is an additional segment from the last vertex back to the first vertex.

In the 12d ascii format, there is a new *closed* flag for the polyline string:

closed *true* or *false*

where *true* can be 1 or T or t or Y or y (or words starting with T, t, Y or y))
and *false* is 0 or F or f or N or n (or words starting with F, f, N or n.

```
string polyline {
  chainage start_chainage
  model model_name   name string_name
  colour colour_name   style style_name
  breakline point or line
  closed true or false

  data {                                                    // keyword
    x-value    y-value    z-value    radius   bulge_flag
      "          "          "
      "          "          "
  }
}
```

Text String

```
string  text {
  x value   y value   z value
  model model_name   name string_name   colour colour_name
  text text_value
  angle value   offset value   raise value
  textstyle textstyle_name   slant degrees   xfactor value
  worldsize value or papersize value or screensize value
  justify  "top|middle|bottom-left|centre|right"
}
```

Super String

Because the super string is so versatile, its 12d Ascii format looks complicated but it is very logical and actually quite simple.

In its most primitive form, the super string is simply a set of (x,y) values as in a 2d string, or (x,y,z) values as in a 3d string, or (x,y,z,radius,bulge_flag) as for a polyline string or even lines, arcs and transitions (spirals and non-spiral transitions).

Additional blocks of information can extend the definition of the super string. For example, text, pipe diameters and visibility.

Some of the properties of the super string extend what were constant properties for the entire string in other string types. For example, *breakline* type for the string extends to *tinability* of *vertices* and *segments*. One colour for the string extends to individual colours for each segment.

Other properties such as vertex id's (point numbers), visibility and culvert data are entirely new.

For user attributes, the super string still has the standard user attributes defined for the entire string, but user attributes for each vertex and segment are also supported.

The definition of a closed string has been refined for polyline and super strings. For other string types, closing a string simply meant having the first vertex the same as the last vertex. Hence the vertex was duplicated.

For a super string, being closed is a property of the string and no extra vertex is needed. That is, the first and the last vertices are not the same for a closed super string and the super string knows there is an additional segment from the last vertex back to the first vertex.

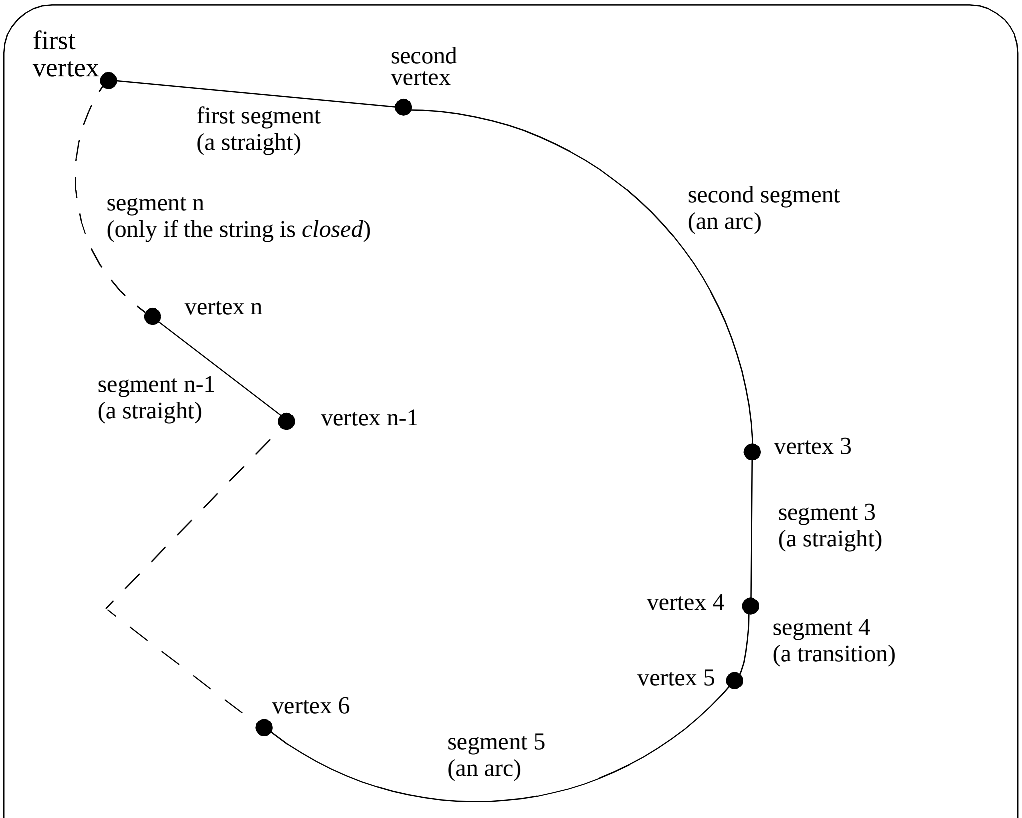
Hence in the 12d ascii format, there is a *closed* flag for the super string:

closed *true* or *false*

where *true* can be 1 or T or t or Y or y (or words starting with T, t, Y or y))
and *false* is 0 or F or f or N or n (or words starting with F, f, N or n.

Thus if a string has *n* vertices, then an open string has *n-1* segments joining the vertices and a closed string has *n* segments since there is an additional segment from the last to the first vertex.

With the additional data for vertices and segments in the super string, the data is in vertex or segment order. So for a string with *n* vertices, there must be *n* bits of vertex data. For segments, if the string is open then there only needs to be *n-1* bits of segment data but for closed strings, there must be *n* bits of data. For an open string, *n* bits of segment data can be specified and the *nth* bit will be read in and stored. If the string is then closed, the *nth* bit of data will be used for the extra segment.



Vertices and Segments Forming the Super String

The full 12d Ascii definition of the super string is:

```
string super {
  chainage start_chainage
  model model_name   name string_name
  colour colour_name   style style_name
  breakline point or line
  closed true or false
  interval {
    chord_arc   value          // chord-to-arc tolerance for curves
    distance    value          // chainage interval to break the geometry up
  }

  block of info {
  }
  block of info {
  }
  block of info {
  }
}
```

The blocks of info can be broken up into four types.

(a) blocks defining the position of the vertices in z, y and z

data_2d **or** *data_3d*

(b) blocks defining the geometry of the segments

radius_data and *major_data* **or** *geometry_data*

(c) a superseded block defining vertices and segment geometry

data

(d) extra information for the vertices and/or segments

pipe diameters - *diameter_value or diameter_data*
culvert dimensions - *culvert_value or culvert_data*
pipe/culvert justification - *justify*
colour - *colour or colour_data*
vertex ids (point numbers) at each vertex- *point_data*
tinability - *breakline or vertex_tinability_data and segment_tinability_data*
visibility - *vertex_visible_data and segment_visible_data*
vertex text and annotation - *vertex_text_data and vertex_annotation_data*
segment text and annotation - *segment_text_data and segment_annotation_data*
symbols at vertices - *symbol_value or symbol_data*
vertex attributes - *vertex_attribute_data*
segment attributes - *segment_attribute_data*
extrudes
image data
holes

The definition for the blocks of each type now follows.

(a) Blocks Defining the Position of the Vertices

For (x, y) Values with a Constant z

If there is only (x,y) values at each vertex (like a 2d string):

```
data_2d {                                          // keyword
            x-value   y-value
               "         "
               "         "
}
```

and if there is a non-null constant z for the string

```
z    value
```

For (x,y,z) Values

If there is (x,y,z) values at each vertex (like a 3d string):

```
data_3d {                                          // keyword
   x-value   y-value   z-value
      "         "         "
      "         "         "
}
```

(b) Blocks Defining the Geometry of the Segments

Straights and Arcs Only for the Segments

If data_2d or data_3d was used, it is possible to add radius and bulge_flag data:

```
radius_data {                                      // keyword
              radius for first segment
              radius for second segment
```

```
                    ...
              radius for last segment
}

major_data {                                    // keyword
          bulge flag for first segment
          bulge flag for second segment
                    ...
          bulge flag for last segment
}
```

Straights, Arcs and Transitions (Spiral and non-Spiral Transitions) for the Segments

If data_2d or data_3d was used, it is possible to specify if the segments are straight, arcs or transitions using a *geometry_data* block.

```
geometry_data {
  segment_info_1 {
    information on the first segment
  }
  segment_info_2 {
    information on the second segment
  }
      "   "
      "   "
  segment_info_n-1 {      // the last segment if it is open
    information on the (n-1) segment
  }
  segment_info_n {        // the last segment if it is closed
    information on the n-th segment
  }
}
```

where the *segment_info* blocks are from the following:

(a) Straight

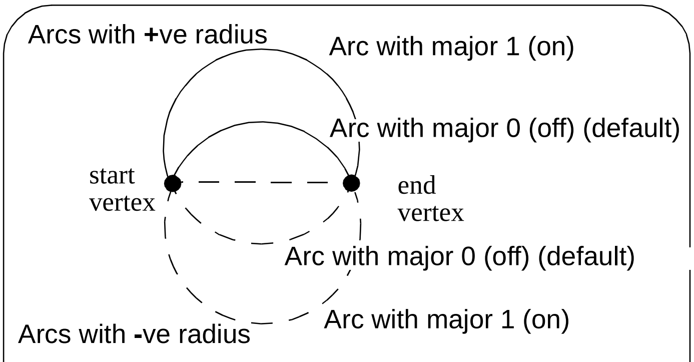
No parameters are needed for defining a straight segment. The *straight* block is simply:

```
straight {              // no parameters are needed for a straight
}
```

(b) Arc

There are four possibilities for an arc of a given radius placed between two vertices.

We use *positive* and *negative* radius, and a flag *major* which can be set to 1 (on) or off (0) to differentiate between the four possibilities.



Arcs with same radius but with major on or off

So the *arc* block is:

```
arc {
  radius  value     // radius of the arc (+ve is above the line connecting the vertices)
  major   0 or 1    // 0 is the smaller arc, 1 the larger arc).
}
```

(c) Spiral - this covers both spiral and non-spiral transitions

There can be a partial transition between adjacent vertices. The partial transition is defined by the parameters

- **l**1 length of the full transition up to the start vertex
- **r**1 radius of the transition at the start vertex
- **a**1 angle in decimal degrees of the tangent to the transition at the start vertex
- **l**2 length of the full transition up to the end vertex
- **r**2 radius at the end vertex
- **a**2 angle in decimal degrees of the tangent to the transition at the end vertex

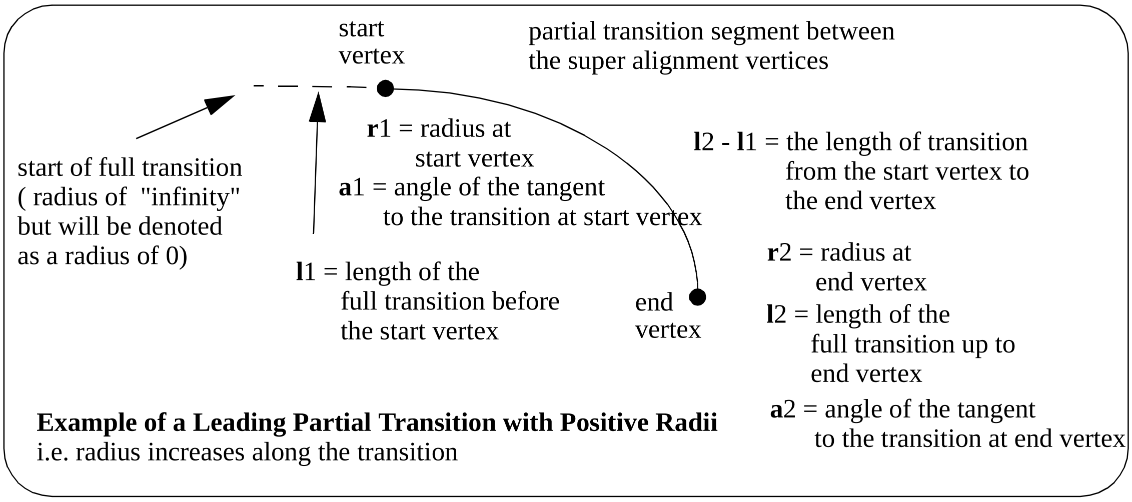
Since a radius can not be zero, a radius of infinity is denoted by *zero*.

The transition is said to be a *leading* transition if the absolute value of the radius is increasing along the direction of the transition (the transition will *tighten*). Otherwise it is a *trailing* transition.

If a leading transition is a full transition then **r**1 = 0 and **l**1 = 0. Similarly if a trailing transition is a full transition then **r**2 = 0 and **l**2 = 0.

For a partial transition, if the coordinates of the start of the full transition are needed then they can be calculated from l1,r1,a1, l2,r2,a2 and the co-ordinates of the start and end vertices.

Note that the radii can be positive or negative. If the radii's are positive then a leading transition will curl to the right (and will be above the line joining the start and end vertices).



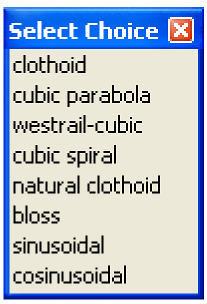
Example of a Leading Partial Transition with Positive Radii
i.e. radius increases along the transition

The parameters for the *spiral* block are:

```
spiral {
  type      value        // type can be clothoid, cubic parabola, westrail-cubic,
                         // cubic spiral, natural clothoid, bloss,
                         // bloss, sinusoidal, cosinusoidal
  leading   1 or 0       // 1 denotes a leading transition, 0 a trailing transition
  l1        value        // length of the full transition at start vertex
  r1        value        // radius at the start vertex
  a1        value        // angle in decimal degrees of the tangent to the transition
                         // at the start vertex
  l2        value        // length of the full transition at end vertex
  r2        value        // radius at end vertex
  a2        value        // angle in decimal degrees of the tangent to the transition
                         // at the end vertex
}
```

Notes

1. The ***spiral*** block covers both spiral and non-spiral transitions.
2. The transitions/spirals supported by 12d Model are:



Clothoid - spiral approximation used by Australian road authorities and Queensland Rail.

Cubic parabola – special transition curve used by NSW railways. Not a spiral.

Westrail cubic – spiral approximating used by WA railways.

Cubic spiral – low level spiral approximation. Only ever used in surveying textbooks.

Natural Clothoid – the proper Euler spiral. Not used by any authority.

Bloss – special transition used by Deutsche Bahn. Not a spiral.

Sinusoidal - special transition. Not a spiral.

Cosinusoidal - special transition. Not a spiral.

(c) Block Defining the Vertices and Segments

For compatibility with the polyline, the *data* block gives the (x,y,z,radius,bulge) values at each vertex of the string and so defines both the vertices and the geometry of the segments in the one block.

```
data {                                                  // keyword
         x-value     y-value    z-value     radius   bulge
            "          "          "
            "          "          "
}
```

(d) Other Blocks

Pipe Diameters

There can be one pipe diameter value for the entire super string or the pipe diameter varies for each segment of the super string.

```
diameter_value  value
```

or

```
diameter_data {                                         // keyword
         pipe diameter for first segment
         pipe diameter for second segment
                        ...
         pipe diameter for last segment
}
```

Culvert Dimensions

There can be one culvert width and height for the entire super string or the culvert width and height vary for each segment of the super string.

```
culvert_value {
   width    value
   height   value
}
```

or

```
culvert_data { properties {width   value     // width and height for first segment
                           height  value
                          }
               properties {width   value     // width and height for second segment
                           height  value
                          }
                       ...
               properties {width   value     // width and height for last segment
                           height  value
                          }
}
```

Justification for Pipe or Culverts

There can be only one justification for the pipe or culvert for the entire super string.

```
justify   justification            // bottom or invert
                                   // top or obvert
```

// centre (default)

Colour

There can be one colour for the entire super string which is given by the `colour` command at the beginning of the string definitions (before the blocks of information) or the colour varies for each segment of the super string and is specified in a colour_data block.

```
colour_data {                                    // keyword
              colour for first segment
              colour for second segment
                 ...
                colour for last segment
}
```

Vertex Id's (Point Numbers)

Each vertex can have a vertex id (point number). This is not the order number of the vertex in the string but is a separate id which is usually different for every vertex in every string. The vertex id can be alphanumeric.

```
point_data {                                     // keyword
              vertex id or first vertex          // alphanumeric
             vertex id for second vertex
                 ...
              vertex id for last vertex
}
```

Tinability

For a *super string*, the concept of breakline has been extended to a property called **tinable** which can be set independently for each vertex and each segment of the super string.

If a vertex is tinable, then the vertex is used in triangulations. If the vertex is not tinable, then the vertex is ignored when triangulating.

If a segment is tinable, then the segment is used as a side of a triangle during triangulation. This may not be possible if there are *crossing* tinable segments.

```
vertex_tinable_data {                            // keyword
                  tinable flag for first vertex  //  1  for tinable
                 tinable flag for second vertex  // 0  for not tinable
                          ...
                tinable flag for last vertex


segment_tinable_data {                           // keyword
                tinable flag for first segment   //  1   for tinable
               tinable flag for second segment   //  0   for not tinable
                    ...
               tinable flag for last segment
}
```

Note that even if a segment is set to tinable, is can only be used if both its end vertices are also tinable.

Visibility

For a *super string*, the concept of visibility and invisibility for vertices and segments has been introduced.

```
vertex_visible_data {                                   // keyword
                  visibility flag for first vertex      //  1  for visible
                  visibility flag for second vertex     //  0  for invisible
                          ...
                  visibility flag for last vertex
}

segment_visible_data {                                  // keyword
                  visibility flag for first segment     // 1  for visible
                  visibility flag for second segment    // 0  for invisible
                          ...
                  visibility flag for last segment
}
```

Vertex Text and Vertex Annotation

There can be the same piece of text for every vertex in the super string or a different text for each vertex of the super string. How the text is drawn is specified by vertex annotation values. Note that in vertex annotations, all vertices must be either worldsize or all vertices papersize. That is, worldsize and papersize can not be mixed - the first one found is used for all vertices.

```
vertex_text_value       text
```
or

```
vertex_text_data {                                      // keyword
                  text for first vertex                 // text string, enclose
                  text for second vertex                // by "" if there are any
                    ...                                 // spaces in the text string
                  text for last vertex
}

vertex_annotate_value {                                 // keyword
                  angle value   offset value   raise value
                  textstyle textstyle_name   slant degrees   xfactor value
                  worldsize value or papersize value or screensize value
                  justify   "top|middle|bottom-left|centre|right"
                  colour colour_name
}
```
or

```
vertex_annotate_data {                                  // keyword
          properties {  angle value   offset value   raise value
                          textstyle textstyle   slant degrees   xfactor value
                        worldsize value or papersize value or screensize value
                          justify   "top|middle|bottom-left|centre|right"
                          colour colour_name
          }
          properties  {    text properties second vertex
          }
          properties  {       ...
          }
          properties  {    text properties for last vertex
          }
}
```

Segment Text and Segment Annotation

There can be the same piece of text for every segment in the super string or a different text for each segment of the super string. How the text is drawn is specified by segment annotation values. Note that in segment annotations, all segments must be either worldsize or all segments papersize. That is, worldsize and papersize can not be mixed - the first one found is used for all segments. However, vertex text and segment text do not both have to be papersize or worldsize.

```
segment_text_value        text
```
or
```
segment_text_data {                                   // keyword
                   text for first segment             // text string, enclose
                   text for second segment            // by "" if there are any
                     ...                              // spaces in the text string
                  text for last segment
 }

segment_annotate_value {                              // keyword
                  angle value  offset value  raise value
                  textstyle textstyle  slant degrees  xfactor value
                  worldsize value or papersize value or screensize value
                  justify  "top|middle|bottom-left|centre|right"
                  colour colour_name
 }
```
or
```
segment_annotate_data {                               // keyword
          properties { angle value  offset value  raise value
                           textstyle textstyle  slant degrees  xfactor value
                  worldsize value or papersize value or screensize value
                     justify  "top|middle|bottom-left|centre|right"
                     colour colour_name
          }
          properties  {  text properties second segment
          }
          properties  {   ...
          }
          properties  {   text properties for last segment
          }
 }
```

Symbols

There can be the same symbol (defined as a linestyle) for every vertex in the super string or a different symbol for each vertex of the super string. If a symbol does not have a colour, then it uses the string colour or the segment colour.

```
 symbol_value {                                       // keyword
                  style linestyle_name  colour colour_name  size value
                  rotation value                        // in dms
                  offset value  raise value
 }
```
or
```
symbol_data {                                         // keyword
          properties { style linestyle_name  colour colour_name  size value
                  style linestyle  colour colour  size value
                  rotation value                        // in dms
                  offset value  raise value
          }
          properties  {   symbol and properties for second vertex
          }
          properties  {   ...
```

```
                    }
                    properties  {  symbol and properties for last vertex
                    }
          }
```

Vertex Attributes

Each vertex can have one or more user defined named attributes.

```
          vertex_attribute_data {                         // key word
                    attributes {   attribute_type   attribute_name   attribute_value
                                   attribute_type   attribute_name   attribute_value
                                        ...
                                   attribute_type   attribute_name   attribute_value
                    }
                    attributes {   named attributes for second vertex
                    }
                    attributes {   ...
                    }
                    attributes {   named attributes for last vertex
                    }
          }
```

Segment Attributes

Each segment can have one or more user defined named attributes.

```
          segment_attribute_data {                        // keyword
                    attributes {   attribute_type   attribute_name   attribute_value
                                   attribute_type   attribute_name   attribute_value
                                      ...
                                   attribute_type   attribute_name   attribute_value
                    }
                    attributes {   named attributes for second segment
                    }
                    attributes {   ...
                    }
                    attributes {   named attributes for last segment
                    }
          }
```

Super Alignment String

In an *alignment* string, only the intersection point method (IP's) could be used to construct the horizontal and vertical geometry. The IP definition is actually a *constructive* definition and the tangents points and segments between the tangent points (lines, arcs, transitions etc.) are calculated from the IP definition. For an alignment string, only the IP definitions are included in the 12d ascii file.

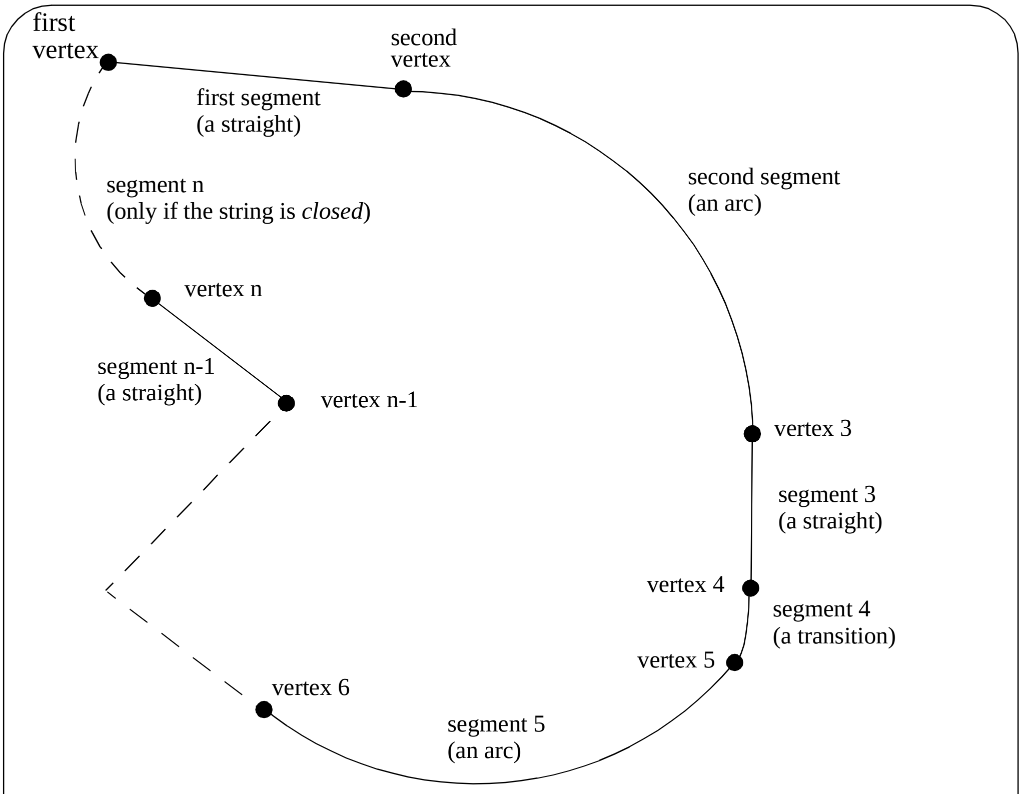
For a ***super alignment***, the horizontal and vertical geometry are also defined separately and with construction definitions but the construction definition can be much more complex than just IP's. For example, an arc could be defined as being tangential to two offset elements, or constrained to go through a given point.

If the horizontal construction methods are consistent then the horizontal geometry can be solved, and the horizontal geometry expressed in terms of consecutive segments (lines, arcs, transitions) that are easily understood and drawn.

Similarly if the vertical construction methods are consistent then the vertical geometry can be solved, and the vertical geometry expressed in terms of consecutive segments (lines, arcs, parabolas) that are easily understood and drawn.

Unlike the *alignment*, the *super alignment* stores ***both*** the ***construction methods*** (the ***parts***) and the resulting ***vertices*** and ***segments*** (lines, arcs, transitions etc.) that make up the horizontal and vertical geometry (the ***data***).

For many applications such as uploading to survey data collectors or machine control devices, only the ***horizontal data*** and the ***vertical data*** are required, not the *construction* methods (i.e. the ***horizontal*** and ***vertical parts***). When reading the 12d Ascii of a *super alignment*, only the ***horizontal*** and ***vertical data*** needs to be read in and the constructive methods (the ***horizontal*** and ***vertical parts***) can be skipped over.



Vertices and Segments Forming the Horizontal Data for a Super Alignment

Notes

1. Just using the horizontal and vertical data is valid ***as long as the super alignment geometry is consistent*** (and solves) and the horizontal and vertical parts can be created.

   There are flags in the 12d Ascii of the super alignment to say that the horizontal and vertical geometry is consistent and solves.

2. Segments meeting at a common vertex do not have to be tangential although for most road and rail applications, they should be.

The full 12d Ascii definition of the *super alignmen*t is:

```
string super_alignment {
//
  name            string_name
  chainage        start_chainage
  colour          colour_name
  style           style_name
  breakline       point or line
  closed          true or false
  spiral_type     transition_type        // the spiral_types are clothoid,
                                         // cubic parabola, westrail-cubic, cubic spiral,
                                         // natural clothoid, bloss, sinusoidal and
                                         // cosinusoidal. Note that some spiral_type's
                                         // are non-spiral transitions

  valid_horizontal   true or false       // if true then the horizontal geometry
                                         // is consistent and solves
  valid_vertical     true or false       // if true then the horizontal geometry
                                         // is consistent and solves

  block of info {
               }
  block of info {
               }
  block of info {
               }

}                                        // end of super alignment
```

where the block of info can be one of more of:

attributes, horizontal_parts, horizontal_data, vertical_parts, vertical_data.

The *attributes* block has been described in the earlier section “Attributes” .

The structure of the blocks *horizontal_parts*, *horizontal_data which define the horizontal geometry, and vertical_parts* and *vertical_data* which define the vertical geometry will now be described in more detail.

For information on *horizontal geometry,* go to “Horizontal Geometry”
vertical geometry “Vertical Geometry”

Horizontal Geometry

The horizontal geometry is described by two blocks - the *horizontal_parts* block and the *horizontal_data* block.

The ***horizontal_parts*** block contains the ***methods*** to construct the horizontal geometry such as float (fillet) an arc of a certain radius between two given lines or create a transition (spiral or non-spiral transition) between a line and an arc.

If the horizontal construction methods are consistent, then they can be solved to form a string made up of lines, arcs and transitions. The ***horizontal_data*** block is simply a list of the vertices and segments (lines, arcs etc.) that make up the ***solved*** geometry.

If the geometry in the *horizontal_parts* can be solved and produces a valid *horizontal_data* block, then the flag *valid_horizontal* in the super_alignment block is set to *true*.

```
valid_horizontal    true or false   //true if the horizontal geometry can be solved and
                                    // hence create a valid horizontal_data
horizontal_parts {/                 / methods for creating the horizontal geometry
    ....
}
horizontal_data {                   // the horizontal segments that make up the solved geometry
   ....
}
```

For information on *horizontal_parts,* go to the section "Horizontal_parts"
horizontal_data "Horizontal_data"

Horizontal_parts

The *horizontal_parts* block describes the methods used to construct the horizontal geometry of the super alignment. The parts that make up the horizontal geometry are defined in chainage order from the start to the end of the super alignment.

```
horizontal_parts {      // methods for creating the horizontal geometry
   blocks defining the sequential parts
   making up the horizontal geometry
}
```

Apart from the special case of parts defined by horizontal intersection points and their accompanying transitions and arcs, the other parts in the *horizontal_parts* block are not documented.

Horizontal_parts for defined by IP Method Only

For a horizontal intersection point (HIP) with no transitions or arc defined at that HIP, the part is defined by:

```
ip {
      id   value    // part id - a number that is unique for each horizontal and vertical part,
                    // and the value of part id is a multiple of 100
      x    value    // x co-ordinate of the horizontal intersection point
      y    value    // y co-ordinate of the horizontal intersection point
}
```

For a horizontal intersection point (HIP) with an arc but no transitions defined at that HIP, the part is defined by

```
arc {
      id   value    // part id - a number that is unique for each horizontal and vertical part,
                    // and the value of part id is a multiple of 100
```

```
        r     value     // radius of the arc at the HIP
        x     value     // x co-ordinate of the HIP
        y     value     // y co-ordinate of the HIP
}
```

For a horizontal intersection point (HIP) with an arc and transitions defined at that HIP, the part is defined by

```
spiral {
        id    value     // part id - a number that is unique for each horizontal and vertical part,
                        // and the value of part id is a multiple of 100
        r     value     // radius of the arc at the HIP
        l1    value     // length of the leading transition at the HIP
        l2    value     // length of the trailing transition at the HIP
        x     value     // x co-ordinate of the HIP
        y     value     // y co-ordinate of the HIP
}
```

Note that the *transition* used in the ***spiral*** block is given by *spiral_type* in the super_alignment block.

Hence a super alignment with horizontal geometry defined by IP methods only would consist of a horizontal_parts section with only the above ip, arc and spiral blocks in it.

```
horizontal_parts {

  ip_spiral_arc {
                values              // values defining the ip_spiral_arc block
                "
                values
          }
     ....
  ip_spiral_arc {
                values              // values defining the ip_spiral_arc block
                "
                values
}
```

For example,

```
horizontal_parts {
  ip {
        id 100
        x 42606.66161172
        y 37239.28824481
  }

  ip {
      id 200
      x 43134.36832349
      y 37330.26705997
  }

 spiral {
      id 300
       r 50
       l1 30
       l2 40
       x 43336.6595
       y 37469.2563
 }

 arc {
      id 400
     r 75
     x 43481.15324268
     y 37331.6431906
 }

 ip {
     id 500
     x 43627.02308964
     y 37544.94343852
  }
}
```

1st HIP
HIP only

Unique Part id
incrementing by 100

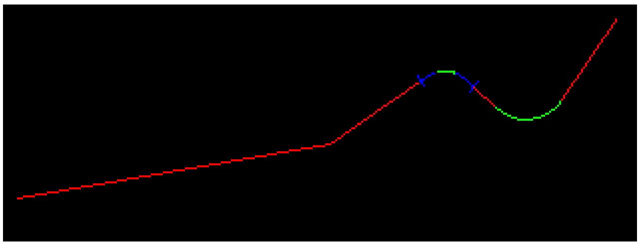
2nd HIP
HIP only

3rd HIP
HIP with arc and leading and trailing transitions

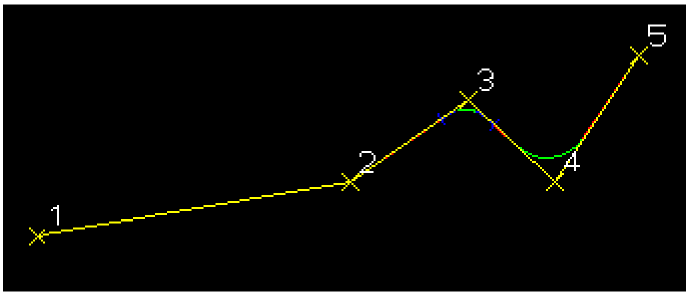
4th HIP
HIP with arc only

5th HIP
HIP only

Plan View of Super Alignment



Super Alignment Being Edited



Horizontal Parts with IP Methods Only

Horizontal_data

The *horizontal_data* block contains the ***solved*** horizontal geometry of the super alignment.

The *solved horizontal geometry* is made up of a series of (x,y) vertices given in a *data_2d* block followed by a *geometry_data* block specifying the geometry of the segments between adjacent vertices. The segment can be a straight line, an arc, a transition (e.g. a spiral) or a partial transition.

If the horizontal geometry has n vertices, then there will be (n-1) segments for an *open* super alignment or n segments if the super alignment is *closed*.

The format of the *horizontal_data* block is:

```
horizontal_data {
  name          ""
  chainage      value
  breakline     line or point
  colour        colour
  style         linestyle
  closed        0 or 1              // 0 if the string is open, 1 if it is closed
```

```
interval {
  chord_arc     value          // chord-to-arc tolerance for curves
  distance      value          // chainage interval to break the geometry up
}

data_2d {
           x1-value   y1-value          // co-ordinates of the first vertex
           x2-value   y2-value          // co-ordinates of the second vertex
              "          "
              "          "
           xn-value   yn-value          // co-ordinates of the n-th vertex
}

geometry_data {
  segment_info_1 {
    information on the first segment
  }
  segment_info_2 {
    information on the second segment
  }
      "   "
      "   "
  segment_info_n-1 {          // the last segment if it is open
    information on the (n-1) segment
  }
  segment_info_n {            // the last segment if it is closed
    information on the n-th segment
  }
}
```

where the *segment_info* blocks are from the following:

(a) Straight

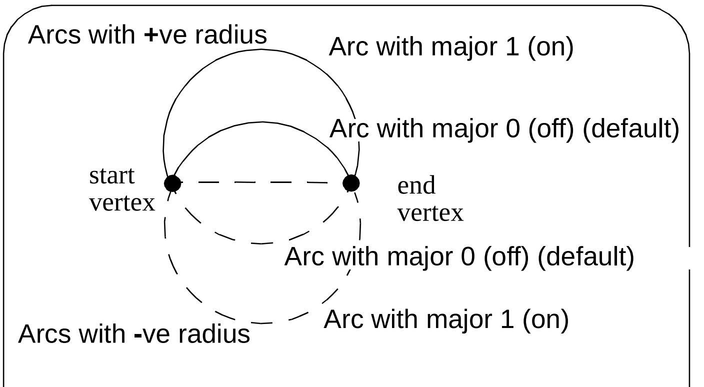
No parameters are needed for defining a straight segment. The *straight* block is simply:

```
straight {                    // no parameters are needed for a straight
}
```

(b) Arc

There are four possibilities for an arc of a given radius placed between two vertices.

We use *positive* and *negative* radius, and a flag *major* which can be set to 1 (on) or off (0) to differentiate between the four possibilities.



Arcs with same radius but with major on or off

So the *arc* block is:

```
arc {
  radius  value      // radius of the arc (+ve is above the line connecting the vertices)
  major   0 or 1     // 0 is the smaller arc, 1 the larger arc).
}
```

(c) Spiral - this covers both spiral and non-spiral transitions

There can be a partial transition between adjacent vertices. The partial transition is defined by the parameters

- **l**1 length of the full transition up to the start vertex
- **r**1 radius of the transition at the start vertex
- **a**1 angle in decimal degrees of the tangent to the transition at the start vertex
- **l**2 length of the full transition up to the end vertex
- **r**2 radius at the end vertex
- **a**2 angle in decimal degrees of the tangent to the transition at the end vertex

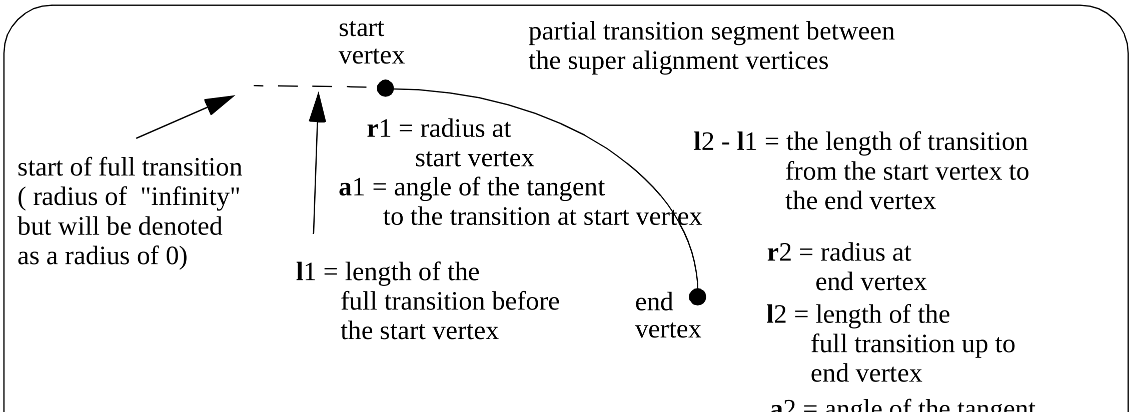
Since a radius can not be zero, a radius of infinity is denoted by *zero*.

The transition is said to be a *leading* transition if the absolute value of the radius is increasing along the direction of the transition (the transition will *tighten*). Otherwise it is a *trailing* transition.

If a leading transition is a full transition then **r**1 = 0 and **l**1 = 0. Similarly if a trailing transition is a full transition then **r**2 = 0 and **l**2 = 0.

For a partial transition, if the coordinates of the start of the full transition are needed then they can be calculated from l1,r1,a1, l2,r2,a2 and the co-ordinates of the start and end vertices.

Note that the radii can be positive or negative. If the radii's are positive then a leading transition will curl to the right (and will be above the line joining the start and end vertices).



Example of a Leading Partial Transition with Positive Radii
i.e. radius increases along the transition

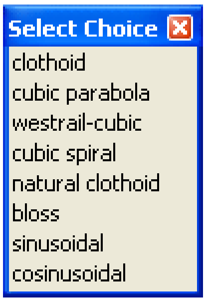
The parameters for the *spiral* block are:

```
spiral {
  type      transition_type     // any of the transitions supported in 12d
  leading   1 or 0              // 1 denotes a leading transition, 0 a trailing transition
  l1        value               // length of the full transition at start vertex
  r1        value               // radius at the start vertex
  a1        value               // angle in decimal degrees of the tangent to the transition
                                // at the start vertex
  l2        value               // length of the full transition at end vertex
```

```
    r2        value              // radius at end vertex
    a2        value              // angle in decimal degrees of the tangent to the transition
                                 // at the end vertex
  }
```

Notes

1. The ***spiral*** block covers both spiral and non-spiral transitions.
2. The transitions/spirals supported by 12d Model are:



Clothoid - spiral approximation used by Australian road authorities and Queensland Rail.

Cubic parabola – special transition curve used by NSW railways. Not a spiral.

Westrail cubic – spiral approximating used by WA railways.

Cubic spiral – low level spiral approximation. Only ever used in surveying textbooks.

Natural Clothoid – the proper Euler spiral. Not used by any authority.

Bloss – special transition used by Deutsche Bahn. Not a spiral.

Sinusoidal - special transition. Not a spiral.

Cosinusoidal - special transition. Not a spiral.

Vertical Geometry

The *vertical* geometry is described by two blocks - the *vertical_parts* block and the *vertical_data* block.

The ***vertical_parts*** block contains the ***methods*** to construct the vertical geometry such as float (fit) a parabola of a certain length between two given lines.

If the vertical construction methods are consistent, then they can be solved to form a string made up of lines, parabolas and arcs. The ***vertical_data*** block is simply a list of the vertices and segments (lines, parabolas and arcs) that make up the *solved* geometry.

If the geometry in the *vertical_parts* can be solved and produces a valid *vertical_data* block, then the flag *valid_vertical* in the super_alignment block is set to *true*.

```
valid_vertical   true or false///true if the vertical geometry can be solved and
                                // hence create a valid vertical_data
vertical_parts {                // methods for creating the vertical geometry
    ....
}
vertical_data {                 // the vertical geometry
    ....
}
```

For information on *vertical_parts,* go to the section "Vertical_parts"
vertical_data "Vertical_data"

Vertical_parts

The *vertical_parts* block describes the methods used to construct the vertical geometry of the super alignment. The parts that make up the vertical geometry are defined in chainage order from the start to the end of the super alignment.

```
vertical_parts {                // methods for creating the vertical geometry
   blocks defining the sequential parts
   making up the vertical geometry
}
```

Apart from the special case of parts defined by vertical intersection points and their accompanying parabolas and arcs, the other parts in the *vertical_parts* block are undocumented.

Vertical_parts for defined by IP Method Only

For a vertical intersection point (VIP) with no parabola or arc defined at that VIP, the part is defined by:

```
ip {
      id    value    // part id - a number that is unique for each horizontal and vertical part,
                     // and the value of part id is a multiple of 100
      x     value    // chainage co-ordinate of the VIP
      y     value    // height co-ordinate of the VIP
}
```

For a vertical intersection point (VIP) with a parabola defined by a k value at that VIP, the part is defined by

```
kvalue {
      id    value    // part id - a number that is unique for each horizontal and vertical part,
                     // and the value of part id is a multiple of 100
      k     value    // k-value of the parabola at the VIP
```

```
        x    value    // chainage co-ordinate of the VIP
        y    value    // height co-ordinate of the VIP
}
```

For a vertical intersection point (VIP) with a parabola defined by length at that VIP, the part is defined by

```
length {
        id   value    // part id - a number that is unique for each horizontal and vertical part,
                      // and the value of part id is a multiple of 100
        l    value    // length of the parabola at the VIP
        x    value    // chainage co-ordinate of the VIP
        y    value    // height co-ordinate of the VIP
}
```

For a vertical intersection point (VIP) with a parabola defined by an effective radius at that VIP, the part is defined by

```
radius {
        id   value    // part id - a number that is unique for each horizontal and vertical part,
                      // and the value of part id is a multiple of 100
        r    value    // effective radius of the parabola at the VIP
        x    value    // chainage co-ordinate of the VIP
        y    value    // height co-ordinate of the VIP
}
```

For a vertical intersection point (VIP) with an asymmetric parabola defined by the start and end lengths at that VIP, the part is defined by

```
length {
        id   value    // part id - a number that is unique for each horizontal and vertical part,
                      // and the value of part id is a multiple of 100
        l1   value    // start length of the asymmetric parabola at the VIP
        l2   value    // end length of the asymmetric parabola at the VIP
        x    value    // chainage co-ordinate of the VIP
        y    value    // height co-ordinate of the VIP
}
```

For a vertical intersection point (VIP) with an arc defined by a radius at that VIP, the part is defined by

```
arc {
        id   value    // part id - a number that is unique for each horizontal and vertical part,
                      // and the value of part id is a multiple of 100
        r    value    // radius of the arc at the VIP
        x    value    // chainage co-ordinate of the VIP
        y    value    // height co-ordinate of the VIP
}
```

Hence a super alignment with vertical geometry defined by IP methods only would consist of a vertical_parts section with only the above ip, parabola and arc blocks in it.

```
vertical_parts {

  ip_parabola_arc {
                 values              // values defining the ip_parabola_arc block
                 "
```

```
                        values
        }
            ....
        ip_parabola_arc {
                        values                  // values defining the ip_parabola_arc block
                        "
                        values
        }
    }
```

For example,

```
vertical_parts {
  ip {
    id 600
    x -50.8459652
    y 159.79764161
  }
  kvalue {
    id 700
    k 1.25
    x 38.4627
    y 179.2126
  }
  length {
    id 800
    l 50
    x 172.61694837
    y 154.72967932
  }
  asymmetric {
    id 900
    l1 25
    l2 75
    x 270.0182
    y 208.1493
  }
  arc {
    id 1000
    r 1000
    x 424.2402
    y 196.5637
  }
  radius {
    id 1100
    r 200
    x 526.7263
    y 201.5302
  }
  ip {
    id 1200
    x 637.69216273
    y 198.71894484
  }
}
```

1st VIP
VIP only

Unique Part id
incrementing by 100

2nd VIP
Parabola defined
by k value

3rd VIP
Parabola defined
by length

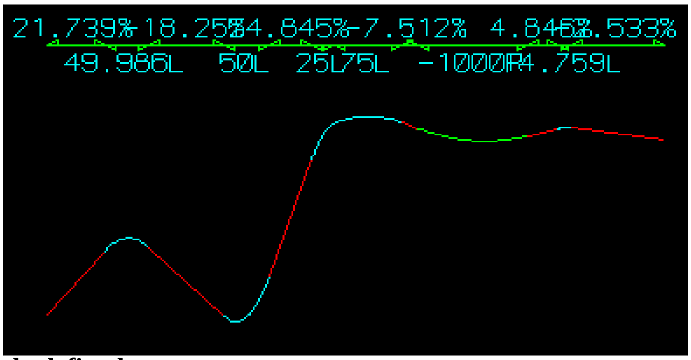
4th VIP
Asymmetric parabola defined
by two lengths

5th VIP
Arc with radius

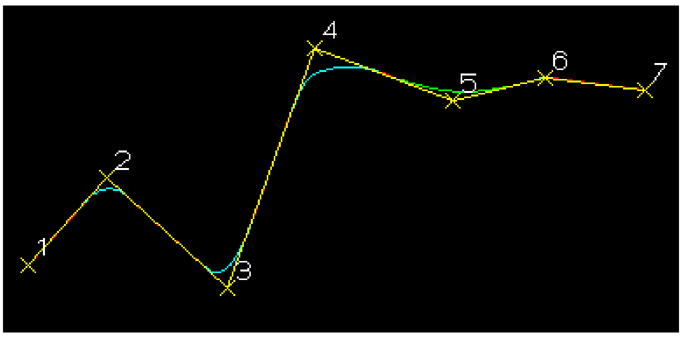
6th VIP
Parabola defined
by effective radius

7th VIP
VIP only

Section View of Super Alignment



Vertical Geometry Being Edited



Vertical Parts with IP Methods Only

Vertical_data

The *vertical_data* block contains the *solved* vertical geometry of the super alignment.

The *solved vertical geometry* is made up of a series of (chainage,height) vertices given in a *data_2d* block followed by a *geometry_data* block specifying the geometry of the segments between adjacent vertices. The segment can be a straight line, a parabola or an arc.

If the vertical geometry has n vertices, then there will be (n-1) segments for an *open* super alignment or n segments if the super alignment is *closed*.

The format of the *vertical_data* block is:

```
vertical_data {
  name       ""
  chainage   value
  breakline  line or point
  colour     colour
  style      linestyle
  closed     0 or 1                // 0 if the string is open, 1 if it is closed
  interval {
    chord_arc    value             // chord-to-arc tolerance for curves
    distance     value             // chainage interval to break the geometry up
  }

  data_2d {
           ch1-value  ht1-value          // co-ordinates of the first vertex
           ch2-value  ht2-value          // co-ordinates of the second vertex
              "          "
              "          "
           chn-value  htn-value          // co-ordinates of the n-th vertex
  }

  geometry_data {
    segment_info_1 {
      information on the first segment
    }
    segment_info_2 {
      information on the second segment
    }
        "    "
        "    "
    segment_info_n-1 {             // the last segment if it is open
      information on the (n-1) segment
    }
    segment_info_n {               // the last segment if it is closed
      information on the n-th segment
    }
  }
```

where the *segment_info* blocks are from the following:

(a) Straight

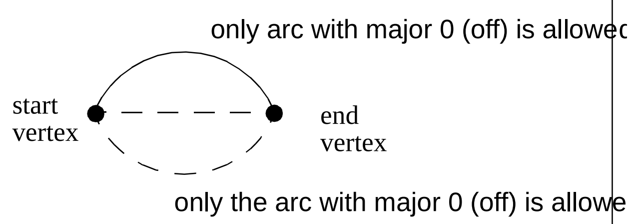
No parameters are needed for defining a straight segment. The *straight* block is simply:

```
straight {                         // no parameters are needed for a straight
}
```

(b) Arc

Since vertical geometry can't go backwards in chainage value, the majors arcs can not be used and hence there are only possibilities for an arc of a given radius placed between two vertices.

We use *positive* and *negative* radius to differentiate between the four possibilities.



Arcs with same absolute radius

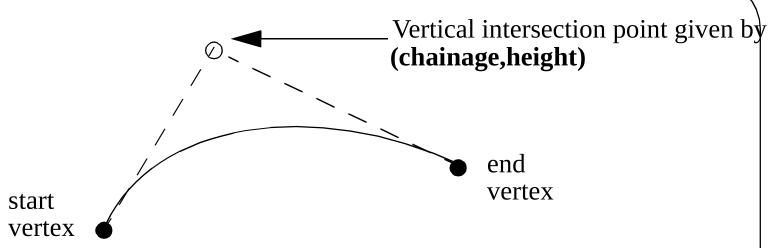
So the *arc* block is:

```
arc {
  radius value      // radius of the arc (+ve is above the line connecting vertices)
  major  value      // this is ignored since only minor arcs are used
}
```

(c) Parabola

There can be a parabola between adjacent vertices. The parabola is defined by giving the co-ordinates of the vertical intersection point for the parabola

chainage chainage of the VIP of the parabola
height height of the VIP of the parabola



Example of a Parabola

The parameters for the *parabola* block are:

```
parabola {
  chainage    value       // chainage of the VIP of the parabola
  height      value       // height of the VIP of the parabola
}
```

Please continue to the next section “12d Ascii Definition for Tins”

12d Ascii Definition for Tins

Tins (***t***riangulated ***i***rregular ***n***etworks) and *Super Tins* can be written out and read in from a 12d Ascii file.

For the 12da definitions of *tins* go to the section "Tins"
super tins "Super Tins"

Tins

```
tin {
  name   tin_name        // MANDATORY name of the tin when created in 12d Model

  time_created text            // optional - time tin first created
  time_updated text            // optional - time tin last modified


// Attributes Block:

// This is mainly information used by 12d Model to create the tin.
// The attributes this block and the Attributes block itself are optional.
//   When a tin is read into 12d Model from a 12da file, the style is used
//   as the Tin style.

  attributes {
         text "style"           text         // name of line style for the tin
         integer "faces         0/1          // 0 non triangle data, 1 triangle data
         real "null_length"     value        // values for null by angle/length
         real "null_angle"      value        // angle in radians
         real "null_combined_length"  value
         real "null_combined_angle"   value  // angle in radians
//             any other attributes
  }                                          // end of attributes block


// Points Block
//
// Co-ordinates of the points at the vertices of the triangles
// The points are implicitly numbered by the order in the list (starting at point 1).
//
// The Points Block is MANDATORY

  points {                      // x y z for each point in the tin
    x-value  y-value  -value    // point 1
       "        "       "       // point 2
       "        "       "
  }                             // end of points block

// Triangles Block
//
//   Each triangle is given as a triplet of the point numbers that make up
//     the triangle vertices (the point numbers are the implicit position of the points
//     given in the Points Block.
// The order of the triangles is unimportant
//
```

```
// The Triangles Block is MANDATORY

  triangles {                       // points making up each triangle
    T1-1    T1-2    T1-3            // point numbers of the 3 vertices of first triangle.
    T2-1    T2-2    T-33            // point numbers of the 3 vertices of second triangle.
      "       "
      "       "
  }                     // end of triangles block


// Base Colour
//    The tin has a base colour that is the default colour for all triangles

  colour  tin_base_colour           // optional - base colour of the tin

// Colours Block
//
// Triangles can be given colours other than the base colour by including
// a colours block. The colour for each triangle in then individually given
// (-1 means base colour). The order is the same as the order of the triangles in
// the Triangles Block.
//
// If all the triangles are the base colour, then simply omit the Colours Block

  colours {
    C1    C2    C3                  // colour for each triangle given in triangle order
    C4   C5   C6   C7               // colour "-1" means use the base tin colour.
      "    "    "
      "    "    "
  }                     // end of colours block

// Input Block
//
// More information about how the tin was created by 12d Model.
// None of this information is needed when reading a tin into 12d Model.
// This block can be omitted

  input {                                        // data for reconstructing tin from strings
    preserve_strings    true/false               // if true, preserve breaklines etc.
    remove_bubbles      true/false               //
    weed_tin            true/false
    triangle_data       true/false
    sort_tin            true/false
    cell_method         true/false

    models {
      "model_name_1"                // name of the first model making up the tin
      "model_name_2"                // name of the second model making up the tin
      "    "    "
      "    "    "
    }                               // end of models block


  }                                 // end of input block
}                                   // end of tin ascii definition
```

Super Tins

```
super_tin {
  name   tin_name          // MANDATORY name of the super tin

  time_created text        // optional - time super tin first created
  time_updated text        // optional - time super tin last modified


// Attributes Block:

// This is mainly information used by 12d Model to create the super tin.
// The attributes in this block and the Attributes block itself are optional.
//   When a super tin is read into 12d Model from a 12da file, the style is used
//   as the Super Tin style.

  attributes {
        text "style"       text        // name of line style for the tin
//              any other attributes
  }                                    // end of attributes block


// Super Tin Colour
//     The super tin has a base colour

  colour  tin_base_colour      // optional - base colour of the super tin

// Tins Block
//
// This is the list of tins that make up the super tin.
// This block is MANDATORY

  tins {                               // list of tins for the super tin
    "tin_name_1"             // name of the first tin making up the super tin
    "tin_name_2"             // name of the second tin making up the super tin
    "   "   "
    "   "   "
  }                          // end of tins block

}                            // end of super tin ascii definition
```

Please continue to the next section “12d Ascii Definition for Plot Frames” .

12d Ascii Definition for Plot Frames

Plot frames can be written out and read in from a 12d Ascii file.

```
string plot_frame {
  name             frame_name
  title_file       filename
  border           0 or 1
  viewport         0 or 1
  user_title_file  0 or 1
  title_1          text
  title_2          text
  plot_file        filename
  text_size        mm
  sheet_code       text
  width            value
  height           value
  scale            value
  rotation         value
  xorigin          value
  yorigin          value
  left_margin      mm
  right_margin     mm
  top_margin       mm
  bottom_margin    mm
  plotter          text
  colour           colour
  textstyle        textstyle_name
}
```