12d® Model™

12d A File Format

Version 11

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12d A File Format

This document is the 12d A File Fromat taken from the Reference Manual for the software product 12d Model.

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No warranty of fitness for a particular purpose is offered.

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Preface

Introduction

12d Model is an interactive graphics program designed to process survey data, quickly build terrain, conceptual and detail design models.

Data is easily read in, triangulated and contoured to build an initial terrain model. Roads, platforms, channels or other design features can be added interactively and a merged model containing the initial terrain and the new design features formed to produce conceptual design models.

All Models can be examined in plan, section or perspective views. The number and type of views displayed on the screen is totally user defined.

By using a mouse and flexible on-screen menus, 12d Model is easy to use and requires a minimum of training.

To allow the interchanging of data between different survey and civil design packages, 12d Solutions maintain and have publish a text format, called ***12da*** (short for ***12d Archive***) for all the data stored in 12d Model. The *12d A* format is documented as an Appendix in the *12d Model Reference* manual.

This document is the *12d A File Format* Appendix from the ***12d Model Reference*** manual.

1 12d Archive File Format

The ***12d Archive*** file format (called 12d ascii in Version 10 and earlier) is a text file definition from 12d Solutions which is used for reading and writing out string data from 12d Model. 12d Archive files normally end in '.12da' and are often referred to as 12da files.

Unlike the earlier 12d Ascii files in Version 9, from Version 10 onwards the 12d Archive file is a **Unicode** file.

This document is for the ***12d Archive file*** format used in ***12d Model*** *Version 11*.

For General Comments about 12da, see 1.1 General Comments about a 12da File

For the 12da definitions:

Attributes	1.2 Attributes
Commands	1.3 Commands
Each string type	1.4 12da Definition for each String Type
Tin	1.3.7 Tin
Super Tin	1.3.8 Super Tin

For documenation on the ***12d XML*** file format, see 37 12d XML File Format.

1.1 General Comments about a 12da File

Unicode - 12d Archive file is a Unicode 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 names 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 string name.

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

Continue to the next section 1.2 Attributes or return to 1 12d Archive File Format.

1.2 Attributes

Many *12d* ***Model*** objects (models and elements such as individual strings and tins) can have an unlimited number of named **attributes** of type integer (numbers), real and text.

The attributes for an object are given in an ***attributes block*** which consists of the keyword **attributes** followed by the definitions of the *individual attributes* enclosed in start and end curly braces { and }. That is, an ***attributes_block*** is

attributes {

attribute_1

attribute_2

...

attribute_n

}

where the attribute definitions for the individual attributes *attribute_i* consists of

attribute_type ***attribute_name*** ***attribute_value***

where

attribute_type is integer, real or text

attribute_name is the unique attribute name for the object.

If the attribute name includes spaces then the text of the name must be enclosed in double quote character (")

and

attribute_value is the appropriate value of the integer, real or a text.

Within an object, the attribute names are case sensitive and must be unique. That is, for attribute names, upper and lower case alphabet characters are considered to be different characters.

If the *text* for a text attribute includes spaces then the text must be enclosed in double quote characters ("). It the text is blank, it is given as "".

An example of and ***attribute block*** defining four attributes named "pole id", "street", "pole height" and "pole wires" is:

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

Continue to the next section 1.3 Commands or return to 1 12d Archive File Format.

1.3 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**.

For the definition of the commands in the 12da file *see*:

1.3.1 Model
1.3.2 Colour
1.3.3 Style
1.3.4 Breakline
1.3.5 Null
1.3.6 String
1.3.7 Tin
1.3.8 Super Tin

Or return to 1 12d Archive File Format.

1.3.1 Model

There are two formats for the **model** command:

(a) model command when there are no attributes for the model

model *model_name*

All elements (strings, tins, plot frames etc) following until the next **model** keyword are placed in the model *model_name*. This can be overridden for an element by a **model** command inside the element definition.

The default model name used for elements when no model name has been specified is ***data***.

(b) model command when there are model attributes

If the model includes attributes, the following form of the *model* command must be used.

model {

name *model_name*

attributes_block

}

where the *attributes_block* is defined in 1.2 Attributes.

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
  }
}
```

Continue to the next section 1.3.2 Colour or return to 1.3 Commands or 1 12d Archive File Format.

1.3.2 Colour

The format of the **colour** command is:

colour *colour_name*

When reading a 12da file, there is a ***current colour,*** which has the default value of ***red***, and when a **colour** command is read, the ***current colour*** is set to *colour_name.*

When strings are read in a 12da file, they are given the *current colour*.

This can be overridden for a string by a *string colour command* inside the string command defining that string. For the definition of the string command, see 1.3.6 String.

Continue to the next section 1.3.3 Style or return to 1.3 Commands or 1 12d Archive File Format.

1.3.3 Style

The format of the **style** command is:

style *linestyle_name*

When reading a 12da file, there is a ***current linestyle,*** which has the default value of ***1***, and when a **style** command is read, the ***current linestyle*** is set to *linestyle_name.*

When strings are read in a 12da file, they are given the *current linestyle*.

This can be overridden for a string by a *string style command* inside the string command defining that string. For the definition of the string command, see 1.3.6 String.

Continue to the next section 1.3.4 Breakline or return to 1.3 Commands or 1 12d Archive File Format.

1.3.4 Breakline

The format of the **breakline** command is:

breakline *breakline_type*

where *breakline_type* is *point* or *line*.

When reading a 12da file, there is a ***current breakline type,*** which has the default value of ***point***, and when a **breakline** command is read, the ***current breakline type*** is set to *breakline_type.*

When strings are read in a 12da file, they are given the *current breakline type*.

This can be overridden for a string by a *string breakline command* inside the string command defining that string. For the definition of the string command, see 1.3.6 String.

Continue to the next section 1.3.5 Null or return to 1.3 Commands or 1 12d Archive File Format.

1.3.5 Null

The format of the **null** command is:

null *null_value*

When reading a 12da file, there is a ***current null value,*** which has the default value of ***-999***, and when a **null** command is read, the ***current null value*** is set to *null_value.*

When strings are read in a 12da file and the string has z-values equal to *null_value*, then the z-value is replaced by the ***12d Model*** null value.

This can be overridden for a string by a *null_value command* inside the string command defining that string. For the definition of the string command, see 1.3.6 String.

Continue to the next section 1.3.6 String or return to 1.3 Commands or 1 12d Archive File Format.

1.3.6 String

The format of the **string** command is:

string *string_type* {

attributes_block

string_command_1

string_command_2

...

string_command_n

}

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

So if a ***string type,*** or possibly information inside the string is not recognised, the 12da reader has a chance of being able to jump over the string by looking for the end curly brace }.

Inside the braces are **string commands** as keyword pairs defining 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 unrecognised *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 the current value for **model**, **colour**, **style** or **breakline** *commands* but the override is only for that particular string.

Not all string types can have an *attributes_block*.

For some string types (e.g. super string) 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 the curly braces **{** and **}**. For example attributes for all *string types* and (x,y,z) data for a super string.

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

For the definition for each *string type* and the allowed *string commands* and extra data that is required for that *string type, see* 1.4 12da Definition for each String Type.

Note: if the string does not have any attributes then the ***attributes_block*** can be left out entirely (see 1.2 Attributes for the definition of *attributes_block*).

Continue to the next section 1.3.7 Tin or return to 1.3 Commands or 1 12d Archive File Format.

1.3.7 Tin

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

```
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:

// The attributes style, faces, null_length, null_angle, null_combined_value
// and null_combined_angle are special attributes that has extra information used by
// 12d Model to create the tin. These special attributes should not be deleted.
//
// The attributes in 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 12a definition
```

Continue to the next section 1.3.8 Super Tin or return to 1.3 Commands or 1 12d Archive File Format.

1.3.8 Super Tin

Super Tins, which consists of a number of **tins** (***t**riangulated **i**rregular **n**etworks*), can be written out and read in from a 12da.

```
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 12a definition
```

Note that the tins that make up the super tin must exist in ***12d Model*** for the super tin to be fully defined.

Continue to the next section 1.4 12da Definition for each String Type or return to 1.3 Commands or 1 12d Archive File Format.

1.4 12da Definition for each String Type

For the 12da definition of each string type, see:

1.4.1 Arc String
1.4.2 Circle String
1.4.3 Drainage String
1.4.4 Face String
1.4.5 Feature String
1.4.6 Interface String
1.4.7 Plot Frame String
1.4.8 Super String
1.4.9 Super Alignment String
1.4.10 Text String

And for the superceded strings, see:

1.4.11 2d String
1.4.12 3d String
1.4.13 4d String
1.4.16 Alignment String
1.4.14 Pipe String
1.4.17 Pipeline String
1.4.15 Polyline String

Or return to 1 12d Archive File Format.

1.4.1 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
}
```

Continue to the next section 1.4.2 Circle String or return to 1.4 12da Definition for each String Type or 1 12d Archive File Format.

1.4.2 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
}
```

Continue to the next section 1.4.3 Drainage String or return to 1.4 12da Definition for each String Type or 1 12d Archive File Format.

1.4.3 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
```

Continue to the next section 1.4.4 Face String or return to 1.4 12da Definition for each String Type or 1 12d Archive File Format.

1.4.4 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
       "          "           "
  }
}
```

Continue to the next section 1.4.5 Feature String or return to 1.4 12da Definition for each String Type or 1 12d Archive File Format.

1.4.5 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
}
```

Continue to the next section 1.4.6 Interface String or return to 1.4 12da Definition for each String Type or 1 12d Archive File Format.

1.4.6 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
}
```

Continue to the next section 1.4.7 Plot Frame String or return to 1.4 12da Definition for each String Type or 1 12d Archive File Format.

1.4.7 Plot Frame String

Plot frames can be written out and read in from a 12da 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
}
```

Continue to the next section 1.4.8 Super String or return to 1.4 12da Definition for each String Type or 1 12d Archive File Format.

1.4.8 Super String

Because the super string is so versatile, its 12da 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.

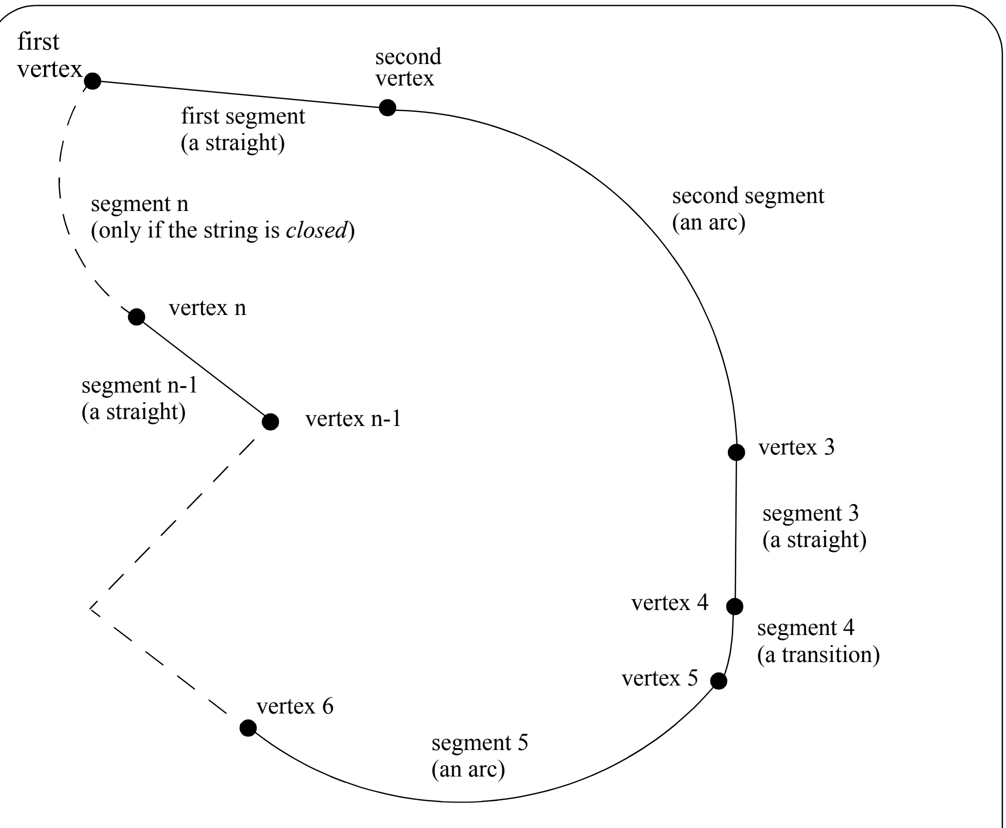
Hence in the 12da format, there is a *closed* flag for the super string:

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 12da 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

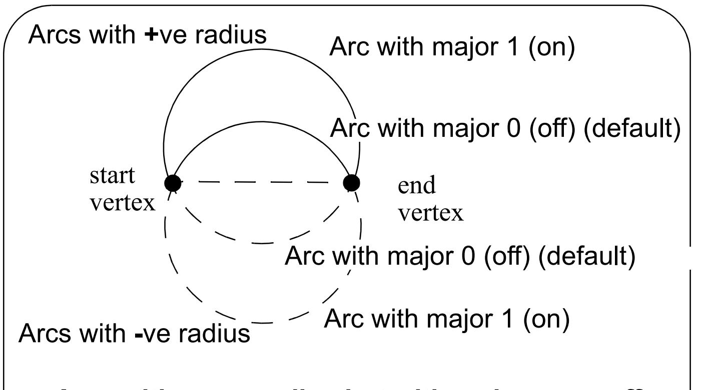
No parameters are needed for defining a straight segment. The *straight* block is simply:

```
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

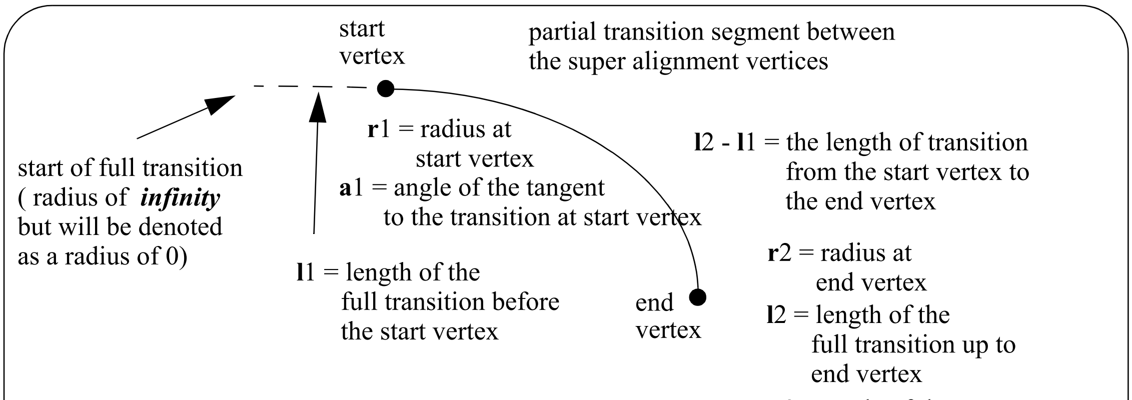
Since a radius can not be zero, a radius of infinity is denoted by *zero*.

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).



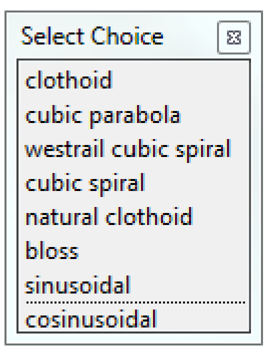
Example of a Leading Partial Transition with Positive Radii
i.e. radius increases along the transition

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
                    }
        }
```

Continue to the next section 1.4.9 Super Alignment String or return to 1.4 12da Definition for each String Type or 1 12d Archive File Format.

1.4.9 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 12da file.

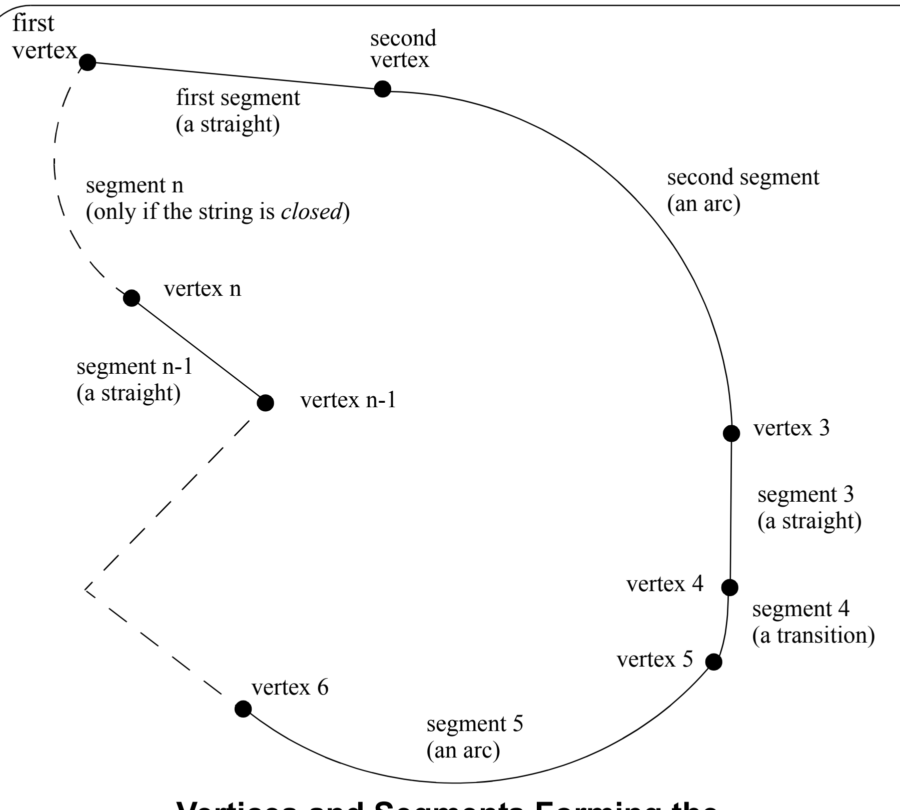
For a ***super alignment***, the horizontal and vertical geometry are also defined separately and with construction definitions but the construction definition can be much more complex than just IP's. For example, an arc could be defined as being tangential to two offset elements, or constrained to go 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 12da 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 12da 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 12da definition of the *super alignment* 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 1.2 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

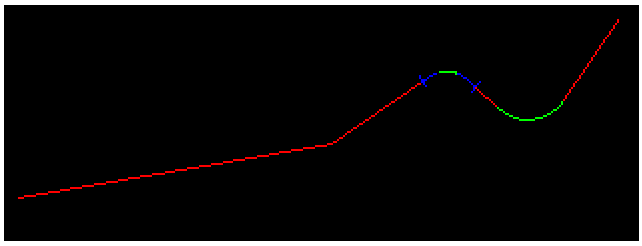
2nd HIP
HIP only

3rd HIP
HIP with arc and leading and trailing transitions

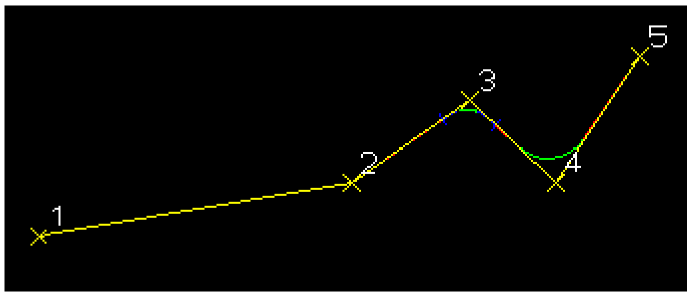
4th HIP
HIP with arc only

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

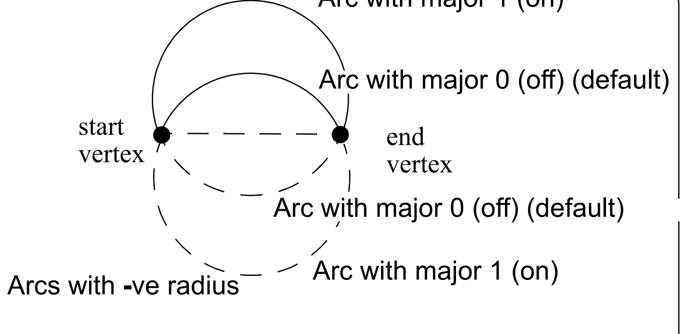
No parameters are needed for defining a straight segment. The *straight* block is simply:

```
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

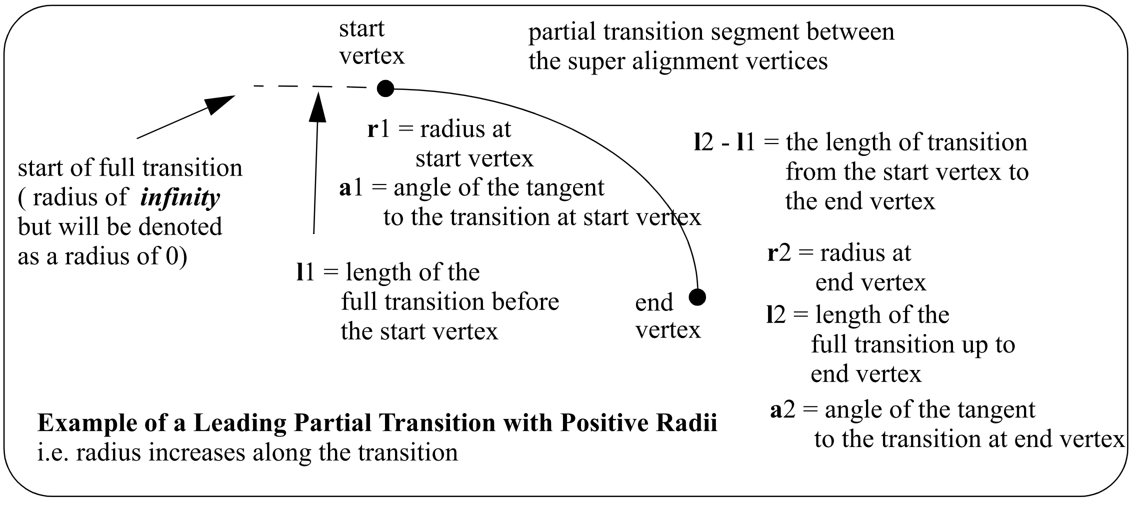
Since a radius can not be zero, a radius of infinity is denoted by *zero*.

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

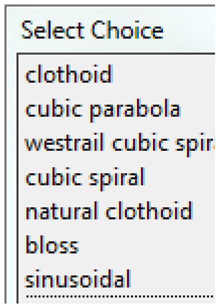
The parameters for the *spiral* block are:

```
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 ver-
```

```
tical 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 ver-
tical 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 ver-
tical 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 ver-
tical 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 ver-
tical 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

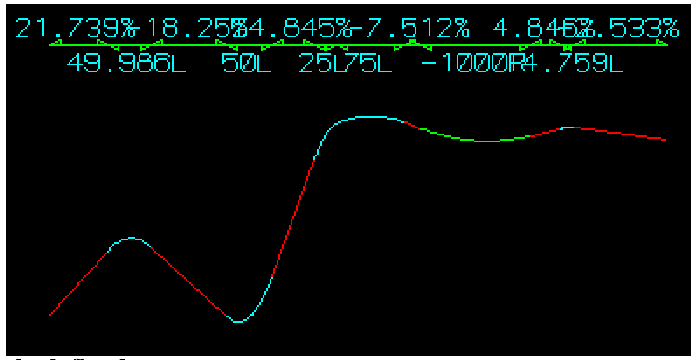
4th VIP
Asymmetric parabola defined
by two lengths

5th VIP
Arc with radius

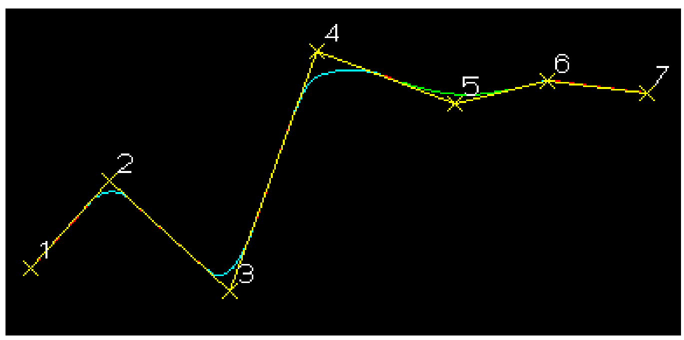
6th VIP
Parabola defined
by effective radius

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
}
```

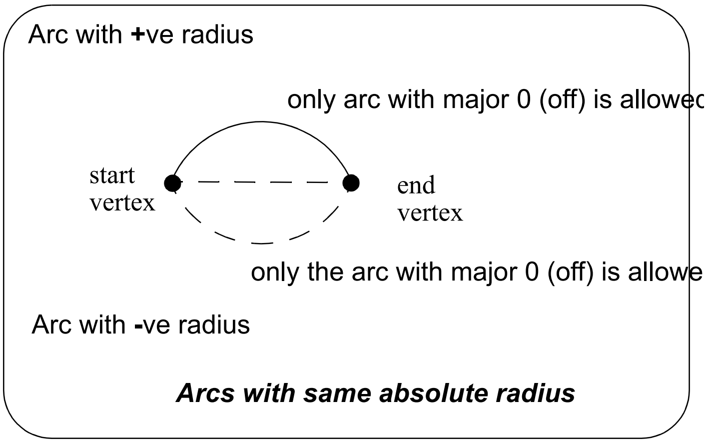
(b) Arc

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.

So the *arc* block is:

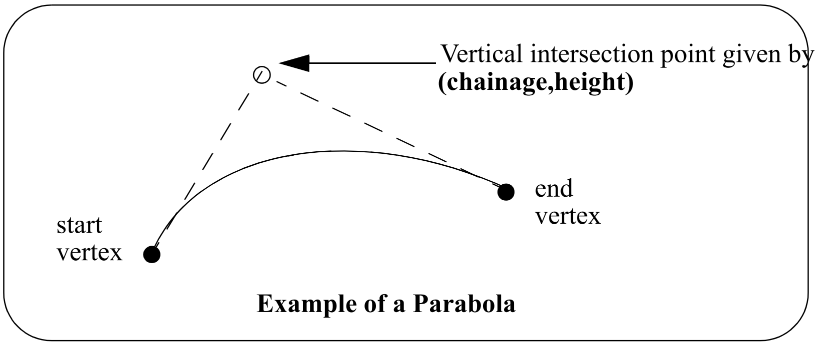
```
arc {
  radius value     // radius of the arc (+ve is above the line connecting vertices)
  major  value     // this is ignored since only minor arcs are used
}
```



(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



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
}
```

Continue to the next section 1.4.10 Text String or return to 1.4 12da Definition for each String Type or 1 12d Archive File Format.

1.4.10 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"
}
```

The string types in the following sections have been superceded.

Continue to the next section 1.4.11 2d String or return to 1.4 12da Definition for each String Type or 1 12d Archive File Format.

1.4.11 2d String

The 2d string has been superceded and has been replaced by the super string (see 1.4.8 Super 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
       "          "
       "          "
  }
}
```

Continue to the next section 1.4.12 3d String or return to 1.4 12da Definition for each String Type or 1 12d Archive File Format.

1.4.12 3d String

The 3d string has been superceded and has been replaced by the super string (see 1.4.8 Super 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
      "          "          "
      "          "          "
  }
}
```

Continue to the next section 1.4.13 4d String or return to 1.4 12da Definition for each String Type or 1 12d Archive File Format.

1.4.13 4d String

The 4d string has been superceded and has been replaced by the super string (see 1.4.8 Super 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.
       "         "          "         "
  }
}
```

Continue to the next section 1.4.14 Pipe String or return to 1.4 12da Definition for each String Type or 1 12d Archive File Format.

1.4.14 Pipe String

The pipe string has been superceded and has been replaced by the super string (see 1.4.8 Super 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
      "        "        "
      "        "        "
  }
}
```

Continue to the next section 1.4.15 Polyline String or return to 1.4 12da Definition for each String Type or 1 12d Archive File Format.

1.4.15 Polyline String

The polyline string has been superceded and has been replaced by the super string (see 1.4.8 Super 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 12da 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
       "          "          "
       "          "          "
  }
}
```

Continue to the next section 1.4.16 Alignment String or return to 1.4 12da Definition for each String Type or 1 12d Archive File Format.

1.4.16 Alignment String

The alignment string has been superceded and has been replaced by the super alignment (see 1.4.9 Super 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
       "          "         "          "
  }
}
```

Continue to the next section 1.4.17 Pipeline String or return to 1.4 12da Definition for each String Type or 1 12d Archive File Format.

1.4.17 Pipeline String

The pipeline string has been superceded and has been replaced by the super alignment (see 1.4.9 Super Alignment 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
       "        "        "        "
  }
}
```

Return to 1.4 12da Definition for each String Type or 1 12d Archive File Format.