



# 12d A File Format

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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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# 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 published 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 **12d Model 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 **12d Model 9**, from **12d Model 10** onwards the 12d Archive file is a **Unicode** file.

This document is for the **12d Archive file** format used in **12d Model 15**.

For General Comments about 12da, see [1.1 General Comments about a 12da File](#)

For the 12da definitions:

Attributes	<a href="#">1.3 Attributes</a>
Commands	<a href="#">1.4 Commands</a>
Each string type	<a href="#">1.5 12da Definition for each String Type</a>
Tin	<a href="#">1.4.7 Tin</a>
Super Tin	<a href="#">1.4.8 Super Tin</a>
Trimesh	<a href="#">1.4.9 Trimesh</a>

For the definitions of transitions and spirals available in **12d Model**, see [1.2 Available Transition Types](#).

For documentation on the **12d XML** file format, see [40 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 and Super Tins

Models, tins, styles (linestyles), textstyles and colours 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.

The names for models, tins and super tins **can not** be blank.

The names for models, tins and super tins can contain upper and lower alpha characters which are stored, but for comparisons, the model names, tin names and super tin names are case insensitive. For example the model name "Fred" will be stored as "Fred" but "FRED" is considered to be the *same* model name as "Fred".

Within a project, each model name must be unique amongst all the model names in the project.

For tins and super tins, the name of a tin or a super tin must be unique amongst the combined list of tin names and super tin names.

## Object Tree Names for Models and Tins

**12d Model** supports hierarchical (tree) names for models, tins and super tins, and the forward slash (/) is used to separate the different levels of the tree.

As for model and tins names themselves, each level name can include the characters **a** to **z**, **A** to **Z**, **0** to **9** (alphanumeric characters) and **space**. Leading and trailing spaces are ignored. The level names can be up to 255 characters in length.

For example, an object tree model name can be:

***Stage 1/Water/Drainage***

## 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.

### Attribute Names

Attribute names 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.

Attributes names **can not** be blank.

Attribute names are case sensitive. That is, the attribute name "Fred" is different to "FRED".

### Names of Linestyles (Styles), Textstyles and Colours

Linestyles (styles), textstyles and colours 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.

The names for linestyles, textstyles or colours **can not** be blank.

The names for linestyles, textstyles and colours can contain upper and lower alpha characters which are stored, but for comparisons, the linestyle names, textstyle names and colour names are case insensitive. For example the linestyle name "Bypass" will be stored as "Bypass" but "BYPASS" is considered to be the *same* linestyle name as "Bypass".

Within a project, each colour name must be unique amongst all the colour names in the project, each linestyle name must be unique amongst all the linestyle names in the project, and each textstyle name must be unique amongst all the textstyle names.

### Times

The format of times such as **time\_created** or **time\_update** is:

*DD-MMM-YYYY hh:mm:ss*

and

*DD* in the day of the month

*MMM* is the first three character of the month (Jan for January, etc.)

*YYYY* in the year

*hh* in the hour in the 24-hour clock

*mm* in the number of minutes

*ss* in the number of seconds

For example, 10-Jun-2020 23:22:55

Note that the time format for 12da is different from the one of 12dxml.

### Archive Version and Export Comments

When writing a 12d Archive file (12da/12daz/12dxml/12xmlz), comments about the project, settings used to control the contents of the file are written at the header of the file.

Beginning with V14 C2k, one critical comment is

archive\_version "aa.bb.cc.ddd"

The first 3 parts (aa.bb.cc) describe the version of the database written.

When any change is made to the underlying database of 12d is made, the (aa.bb.cc) is updated to reflect a change.

The final part (d) is used when there is a change in the archive definition, that is not related to a database change.

Typically, this number will almost always be 0.

The archive\_version is related to what you see in the title area of the program. Using V14 C2k as the example:

- aa the release version of 12d (being 14)
- bb the major number of 12d (2 for C2)
- cc the minor number of 12d (11 for K)

As a general rule

- aa the release version of 12d (being 14, 15 etc)
- bb the major number of 12d (being 0 for Alpha/Beta, 1 for C1, 2 for C2, etc)
- cc the minor number of 12d (being 1 for A, 2 for B, 11 for K, etc)

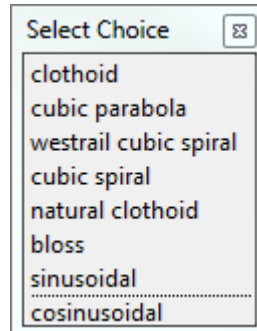
12da example:

```
// archive_version "15.00.00.473"  
// decimal_places 8  
// null -999  
// do_null true  
// output_times true  
// output_ids false  
// output_point_ids true  
// output_attribute_ids true  
// output_super_string_uids true  
// output_sa_parts true  
// output_drawables true  
// output_new_pipes true  
// dereference false  
// project false  
// output_project_description false  
// output_compact_clouds true  
// output_full_tin true  
// output_model_paths false  
// output_hex_floats false  
// output_tin_hex_floats true  
// model_attributes_mode 0
```

Continue to [1.2 Available Transition Types](#) or return to [1 12d Archive File Format](#).

## 1.2 Available Transition Types

The transition that are available inside **12d Model** are called:



and these are defined as:

**clothoid** is the **clothoid spiral approximation** used by Australian road authorities and Queensland Rail

**cubic parabola** (or **NSW cubic parabola**) is a special transition curve used by NSW Railways. It is not a spiral.

**westrail cubic spiral** (or **westrail-cubic**) is a clothoid spiral approximation used by Westrail (WA railways).

**cubic spiral** (or **spiral**) is a low level spiral approximation. Mainly only used in surveying textbooks.

**natural clothoid** (or LandXML clothoid) is the full Euler clothoid spiral. This is not currently used by any Authority in Australia or New Zealand.

**bloss** is a Bloss curve. Not a spiral.

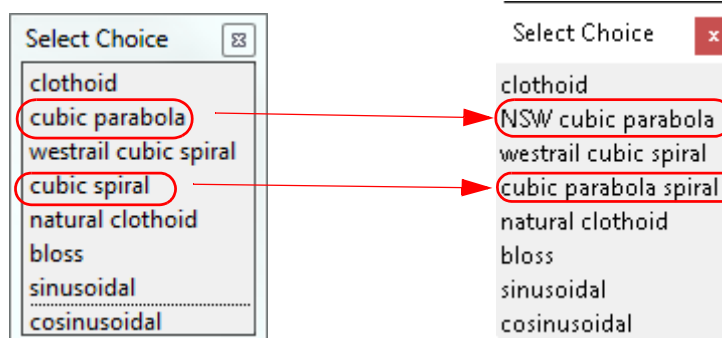
**sinusoidal** is a sinusoidal curve. Not a spiral.

**cosinusoidal** is a cosinusoidal curve. Not a spiral.

Although these are the names stored internally inside **12d Model** and match the standard ones used in Australia, unfortunately there is no universal definition of what names match which transitions.

So to make it clearer, especially because of the confusion about the term "cubic parabola", in some **12d Model** options the pop-up displays different names. This is especially true for options using a transition mapping file (trans\_map file) to map the transition names used inside **12d Model** to those used in another software package.

In the alternate transition pop-up, "**cubic parabola**" is displayed as "**NSW cubic parabola**" and "**cubic spiral**" is displayed as "**cubic parabola spiral**" to help users realise that the word "cubic parabola" is confusing and could refer to the NSW Rail cubic transition and what is sometimes called the "cubic parabola" approximation to the clothoid spiral.



Continue to [1.3 Attributes](#) or return to [1 12d Archive File Format](#).

## 1.3 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\_j* 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 ("). If the text is blank, it is given as "".

An example of an **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 [1.4 Commands](#) or return to [1 12d Archive File Format](#).

## 1.4 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 one 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:

[1.4.1 Model](#)

[1.4.2 Colour](#)

[1.4.3 Style](#)

[1.4.4 Breakline](#)

[1.4.5 Null](#)

[1.4.6 String](#)

[1.4.7 Tin](#)

[1.4.8 Super Tin](#)

[1.4.9 Trimesh](#)

Or return to [1 12d Archive File Format](#).

## 1.4.1 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 [1.3 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 [1.4.2 Colour](#) or return to [1.4 Commands](#) or [1 12d Archive File Format](#).



## 1.4.2 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 [1.4.6 String](#).

Continue to [1.4.3 Style](#) or return to [1.4 Commands](#) or [1 12d Archive File Format](#).

## 1.4.3 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 [1.4.6 String](#).

Continue to [1.4.4 Breakline](#) or return to [1.4 Commands](#) or [1 12d Archive File Format](#).

## 1.4.4 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 [1.4.6 String](#).

Continue to [1.4.5 Null](#) or return to [1.4 Commands](#) or [1 12d Archive File Format](#).

## 1.4.5 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 [1.4.6 String](#).

Continue to [1.4.6 String](#) or return to [1.4 Commands](#) or [1 12d Archive File Format](#).



## 1.4.6 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 in 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 [1.5 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 [1.3 Attributes](#) for the definition of *attributes\_block*).

Continue to [1.4.7 Tin](#) or return to [1.4 Commands](#) or [1 12d Archive File Format](#).

## 1.4.7 Tin

*Tins* (triangulated *irregular networks*) can be written out and read in from a 12da.

Each tin has text name, **tin\_name**, of up to two hundred alphanumeric characters and spaces and although the tin names are stored with upper or lower case alphabet characters, for comparisons of the tin names, the names are considered to be case insensitive.

Within a project, the name of a tin or a super tin must be unique amongst the combined list of tin names and super tin names.

There are two formats for a tin - one that lists **all the triangles**, including the nulled (invisible) triangles in the tin, and the other that only lists the **visible triangles** that make up the tin.

See

[1.4.7.1 All Triangles in the Tin - Visible and Invisible](#)

[1.4.7.2 Visible Triangles Only](#)

### 1.4.7.1 All Triangles in the Tin - Visible and Invisible

This format writes out all the triangles in the tin, including the invisible and construction triangles.

This format take more disk space but cannot be misinterpreted because it includes all the points, triangles and all the neighbouring triangles for each edge of a triangle.

It is also the best method for writing out **large tins** as it is much faster to read in and create a tin.

The keyword for the full format for a **tin** element is **full\_tin** and it is defined by:

```
full_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
}

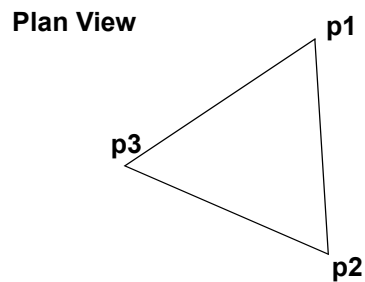
// end of attributes block

// Points Block
//
// This gives the coordinates of the points that will be vertices of the triangles
// in the tin, including the first four points that are construction points
// that are on the four corners of a rectangle that surrounds the actual data.
//
// The points are implicitly numbered by the order in the list (starting at point 1).
//
// The Points Block is MANDATORY

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

// Triangles Block
//
// This gives the triangles that make up the tin.
// 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 but the order of the points in the
// triangle is important.
// The vertices of each triangle must be listed in a clockwise order when looking at the tin
// from above.

```



// 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

```

// The first edge of triangle k is from Point Tk-1 to Point Tk-2.

// The second edge of triangle k is from Point Tk-2 to Tk-3.

// The third edge of triangle k is from Point Tk-3 to Tk-1.

// **Note:** Construction Triangles

// Any triangle that contains any of the first four points

//(construction points) is a **construction triangle** and is usually

// not displayed.

// **Neighbours Block**

//

// For each triangle, this gives for each edge the number of the triangle that is

// the neighbour of that edge of the triangle.

// The order of the entries in the neighbours block must match the order of the

// triangles in the Triangles Block. So there is exactly one entry for each triangle.

//

// The Neighbours Block is **MANDATORY**

```

neighbours {
  t1_e1_nb_tr  t1_e2_nb_tr  t1_e3_nb_tr
  t2_e1_nb_tr  t2_e2_nb_tr  t2_e3_nb_tr
  "    "    "

```

```

    tn_e1_nb_tr  tn_e2_nb_tr  tn_e3_nb_tr
}                // end of neighbour block

// where tk_e1_nb_tr  tk_e2_nb_tr  tk_e3_nb_tr are the triangle numbers from the
// Triangles block of the neighbouring triangle for each edge of the k'th triangle
// For each triangle, the order of the neighbouring triangles must match the order
// that the edges are defined for the triangle in the triangles block
// Note: the neighbour value of 0 is used for the outside triangles that contain
// exactly two of the points 1, 2, 3 or 4 and so have edges that have no neighbouring triangle

// Nulling Block
//
// Triangles can be visible or nulled (invisible)
// Whether a triangle is null or visible is individually given where:
// 1 means the triangle is null, and
// 2 means the triangle is visible.

// The order of the entries in the nulling block must be the same as the order of the
// triangles in the Triangles Block.

// The Nulling Block is MANDATORY
//

// Triangles can be visible or nulled (invisible)
nulling {
    V1 V2 V3 ... V15 V16
    V17 Cv18 C19 ... V31 V32
    "  "  "
    Vn-2 Vn-1 Vn
}                // end of nulling 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 is 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
```



### 1.4.7.2 Visible Triangles Only

The format to write out only the visible triangles in a tin is a simple format for most software packages to write. However because the null regions are not explicitly given, more processing time is required to read the tin back in and construct all the null regions.

The keyword denoting the format where just the visible triangles of a **tin** element are written out is **tin** and its definition is:

```
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

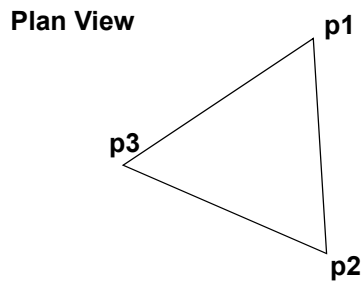
//



```
// Coordinates 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
// This gives the triangles that make up the tin.
// 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 but the order of the points in the
// triangle is important.
// The vertices of each triangle must be listed in a clockwise order when looking at the tin
// from above.
```



```
// 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 is 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 [1.4.8 Super Tin](#) or return to [1.4 Commands](#) or [1 12d Archive File Format](#).

## 1.4.8 Super Tin

*Super Tins*, which consists of a number of **tins** (*triangulated irregular networks*), can be written out and read in from a 12da.

Each super tin has text name, **tin\_name**, of up to two hundred alphanumeric characters and spaces and although the tin names are stored with upper or lower case alphabet characters, for comparisons of the tin names, the names are considered to be case insensitive.

Within a project, the name of a tin or a super tin must be unique amongst the **combined** list of tin names and super tin names.

```

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 the **12d Model project** for the super tin to be fully defined.

Continue to [1.4.9 Trimesh](#) or return to [1.4 Commands](#) or [1 12d Archive File Format](#).

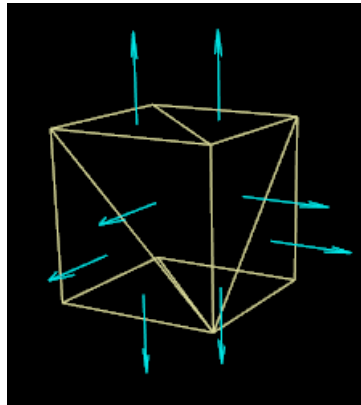
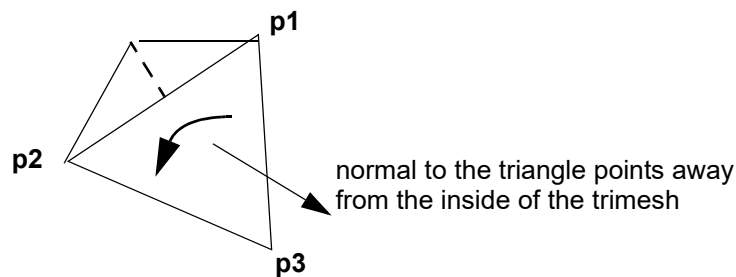
## 1.4.9 Trimesh

A trimesh is made up of 3D triangles and can be described by giving the list of  $m$  vertices in the trimesh and the three vertices that make up each of the  $n$  triangular faces. The normal to each triangle face points to the "outside" of the trimesh.

The order of the points  $p1$ ,  $p2$  and  $p3$  in the triangle triple is important and must be such that the direction of the normal vector to each triangle points away from the inside of the trimesh.

That is, the normal vector of the triangle which is given by the cross product of the two vectors  $p1p2$  and  $p1p3$  points away from the inside of the trimesh.

Hence when looking towards the triangle from the outside, the points  $p1$ ,  $p2$  and  $p3$  are in a **counter clockwise** order around the triangle.



The 12da definition of a trimesh is:

```
primitive_3d {
    name primitive_3d_namer           // name of the primitive_3d
    colour primitive_3d_name_colour    // colour of the primitive_3d
                                        // the primitive_3d has a base colour that is the
                                        // default colour for the primitive

    time_created text                  // optional - time primitive first created
    time_updated text                  // optional - time primitive last modified
}
```

// Attributes Block:

// The attributes in this block and the Attributes block itself are optional.

```

attributes {
//          attributes
}
// end of attributes block

```

// Trimesh Block

// At a minimum, the trimesh block contains information on the vertices and faces that make up the trimesh.

```

trimesh_3d {
//          vertices_block
//          faces_block
//          edges_block      // optional for checking only
//          info_block      // optional
      blend real_number    // optional - blend value for the trimesh
//          vertex_infos_block // optional
//          vertex_flags_block // optional
//          edge_infos_block  // optional
//          edge_flags_block  // optional
//          face_infos_block  // optional
//          face_flags_block  // optional

}
// end of trimesh_3d block

```

//

// Vertices Block

// of the points at the vertices of the triangle faces that make up the trimesh.

// The vertices are implicitly numbered by the order in the list (starting at point 1).

//

```

vertices {
// x y z for each vertex in the trimesh
  x-value y-value z-value // vertex 1
  " " " " // vertex 2

```



```

    "    "    "
} // end of vertices block

```

// The *faces\_block* is MANDATORY and consists of the triangles//  
 // Each triangle in the trimesh is given as a triplet of the vertex that make up  
 // the triangle (the vertex numbers are the implicit position of the vertices  
 // given in the Vertices Block.  
 // The order of the faces in the faces block is important for many calculations, mesh  
 // properties, geometric structures  
 //  
 // The Faces Block is MANDATORY

```

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

```

// The *edges\_block* is OPTIONAL and consists of the edges//  
 // Each edge in the trimesh is given as a pair of the vertex that make up  
 // the edge (the vertex numbers are the implicit position of the vertices  
 // given in the Edges Block.  
 // The order of the edges in the edges block is important for many calculations, mesh  
 // properties, geometric structures. The correct order can only be formed inside  
 // **12d Model**. For manual construction of the 12da file for trimesh, the user should  
 // leave out the *edges\_block*.  
 //  
 // The Edges Block is OPTIONAL

```

edges { // vertices making up each triangle
T1-1  T1-2  / // vertex numbers of the 2 vertices of first edge.
T2-1  T2-2 // vertex numbers of the 2 vertices of second edge.
"      "
"      "
} // end of edges block

} // end of trimesh_3d block

```



```

    }                                     // end of primitive_3d 12a definition

// Info block contain four field: flag, key, colour and name
    info {                               // vertices making up each triangle
    flag // integer, 12d Model internal use only.
    key // integer from 0 to 255, 12d Model internal use only.
    colour // 12d Model colour.
    name // string name.
    }                                     // end of faces block

// Info block of primitive_3d is OPTIONAL
// vertex_infos, edge_infos and face_infos block of primitive_3d are OPTIONAL and consists of
// info_blocks
    vertex_infos {                       // making up info blocks
    flag-1 key-1 colour-1 name-1         // first info.
    flag-2 key-2 colour-2 name-2         // second info.
    " "
    " "
    }                                     // end of vertex_infos block

// vertex_flags, edge_flags and face_flags block of primitive_3d are OPTIONAL and consists of
// sequences of indexes for info block. The size of vertex_flags should equals the number of vertices
// in the trimesh; and the same for edge_flags, face_flags. If the index is 0 it means there is no
// information on the current vertex (edge, face).
    vertex_flags {                       // making up info blocks
    index-1                               // info index of the first vertex.
    index-2                               // info index of the second vertex.
    " "
    " "
    }                                     // end of vertex_flags block

// for example if the trimesh has two kinds of vertex info
    vertex_infos {                       // making up info blocks
    0 0 green "no name"                  // first info.
    0 1 blue "no name"                  // second info.
    " "
    " "
    }                                     // end of vertex_infos block

// and 5 points.
    vertex_flags {                       // making up info blocks
    2                                     // info index of the first vertex.
    0                                     // info index of the second vertex.

```

```
1 // info index of the third vertex.  
2 // info index of the fourth vertex.  
0 // info index of the fifth vertex.  
} // end of vertex_flags block
```

Then the trimesh has two blue points (number 1 and 4), one green point (number 3), and two points without colour (number 2 and 5).

Continue to [1.5 12da Definition for each String Type](#) or return to [1.4 Commands](#) or [1 12d Archive File Format](#).

## 1.5 12da Definition for each String Type

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

- [1.5.1 Arc String](#)
- [1.5.2 Circle String](#)
- [1.5.3 Water String \(Drainage String\)](#)
- [1.5.4 Face String](#)
- [1.5.5 Feature String](#)
- [1.5.6 Interface String](#)
- [1.5.7 Plot Frame String](#)
- [1.5.8 Super String](#)
- [1.5.9 Super Alignment String](#)
- [1.5.10 Text String](#)

And for the superceded strings, see:

- [1.5.11 2d String](#)
- [1.5.12 3d String](#)
- [1.5.13 4d String](#)
- [1.5.16 Alignment String](#)
- [1.5.14 Pipe String](#)
- [1.5.17 Pipeline String](#)
- [1.5.15 Polyline String](#)

Or return to [1 12d Archive File Format](#).

## 1.5.1 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 [1.5.2 Circle String](#) or return to [1.5 12da Definition for each String Type](#) or [1 12d Archive File Format](#).

## 1.5.2 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 [1.5.3 Water String \(Drainage String\)](#) or return to [1.5 12da Definition for each String Type](#) or [1 12d Archive File Format](#).

### 1.5.3 Water String (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 {                               // node/pit/manhole - one pit record for each node/pit/manhole
                                          // in the order along the string
    name          text              // node name
    type          text              // node type
    road_name     text              // road name
    road_chainage  chainage         // road chainage
    diameter      value            // node diameter
    floating      yes|no           // is node floating or not
    chainage      node_chainage     // internal use only
    ip           value            // internal use only
    ratio        value            // internal use only
    x            x-value          // x-value of top of node
    y            y-value          // y-value of top of node
    z            z-value          // z-value of top of node
  }
  pit_v2 {                             // node/pit/manhole - one pit record for each node/pit/manhole
                                          // in the order along the string
                                          // is an alternative to node with version 14 features

```

```

name          text          // node name
type          text          // node type
road_name     text          // road name
road_chainage chainage      // road chainage
diameter      value         // node diameter
floating      yes|no        // is node floating or not
chainage      node_chainage // internal use only
ip            value         // internal use only
ratio         value         // internal use only
x             x-value       // x-value of top of node
y             y-value       // y-value of top of node
z             z-value       // z-value of top of node
base_extended none/width/length // extended direction of the node base
base_angle_mode choices     //
base_angle    angle         //
base_height   value         //
riser_enabled true/false    //
riser_diameter value        //
riser_width   value        //
riser_extended none/width/length // extended direction of the riser
riser_offset_x value        //
riser_offset_y value        //
riser_colour  colour        //
base_thickness_top value          //
riser_thickness_front value //
riser_thickness_back value //
riser_thickness_left value //
riser_thickness_right value //
}
pipe { // one link record for each link connecting nodes/pits/manholes
// in the order they occur along the string
name          text          // link name
type          text          // link type
diameter      value         // link 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 link in units of "1v in"
        cover             value          // cover of the of link
        diameter          value          // diameter of the of link
        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 link connects to sewer
        y                 y-value        // y value of where link 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 [1.5.4 Face String](#) or return to [1.5 12da Definition for each String Type](#) or [1 12d Archive File Format](#).

## 1.5.4 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 [1.5.5 Feature String](#) or return to [1.5 12da Definition for each String Type](#) or [1 12d Archive File Format](#).

## 1.5.5 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 [1.5.6 Interface String](#) or return to [1.5 12da Definition for each String Type](#) or [1 12d Archive File Format](#).

## 1.5.6 Interface String

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

// keyword  
// **mode** = -1 cut  
// 0 surface  
// 1 fill

Continue to [1.5.7 Plot Frame String](#) or return to [1.5 12da Definition for each String Type](#) or [1 12d Archive File Format](#).

## 1.5.7 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 [1.5.8 Super String](#) or return to [1.5 12da Definition for each String Type](#) or [1 12d Archive File Format](#).

## 1.5.8 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). see [1.2 Available Transition Types](#).

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.

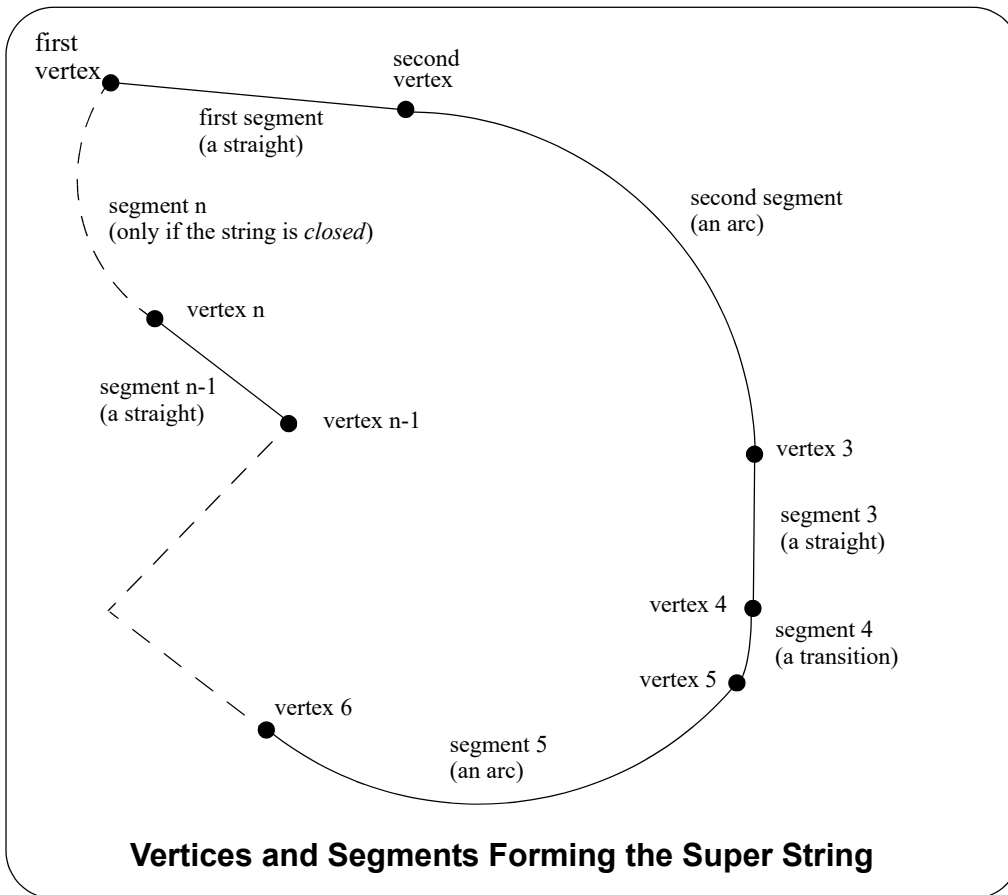
Hence in the 12da format, there is a *closed* flag for the super string:

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  $n$ th bit will be read in and stored. If the string is then closed, the  $n$ th bit of data will be used for the extra segment.



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 x, y and z

*data\_2d* or *data\_3d*. See [1.5.8.1 Blocks Defining the Position of the Vertices in x, y and z](#).

- (b) blocks defining the geometry of the segments

*radius\_data* and *major\_data* or *geometry\_data*.

See [1.5.8.2 Blocks Defining the Geometry of the Segments](#).

- (c) a superseded block defining vertices and segment geometry data

See [1.5.8.3 Block Defining Both the Vertices and Segments - Superseded](#).

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

These include blocks for colour of each segment, vertex ids, round pipe diameters, culvert widths and heights etc.

See [1.5.8.4 Other Blocks](#).

The definition for the blocks of each type now follows.

### 1.5.8.1 Blocks Defining the Position of the Vertices in x, y and z

#### 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

```

Without any more information, the segments will default to being straight lines.

If some of the segments in the super string are not straights (arcs, transitions or offset transitions) then either the *radius\_data* and *major\_data* blocks, OR the *geometry\_data* block must also be used.

#### 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
    "        "        "
    "        "        "
}

```

Without any more information, the segments will default to being straight lines.



If some of the segments in the super string are not straights (arcs, transitions or offset transitions) then either the *radius\_data* and *major\_data* blocks, OR the *geometry\_data* block must also be used.

### 1.5.8.2 Blocks Defining the Geometry of the Segments

If the segments only includes arcs and straights, then the *radius\_data* and *major\_data* blocks can be used. See [1.5.8.2.1 Straights and Arcs Only for the Segments](#)

If the segments include transitions or offset transitions, then the *geometry\_data* block **must** be used. See [1.5.8.2.2 Straights, Arcs, Transitions and Offset Transitions for the Segments](#)

#### 1.5.8.2.1 Straights and Arcs Only for the Segments

If either *data\_2d* or *data\_3d* was used to defined the points at the ends of the segments and some of the segments are arcs and there are no transitions, then the radius information for the segments is given in the *radius\_data* and *major\_data* blocks.

There must be a value for each segment and if a segment is a straight, a radius of zero (0) is used.

```
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
}
```

#### 1.5.8.2.2 Straights, Arcs, Transitions and Offset Transitions for the Segments

If either *data\_2d* or *data\_3d* was used to defined the points at the ends of the segments and some of the segments are transitions, then the geometry for each segment **must** be given in 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:

1. straight

See [1.5.8.2.2.1 Straight](#)

2. arc

See [1.5.8.2.2.2 Arc](#)

3. transition with no offset

See [1.5.8.2.2.3 Spiral - spiral and non-spiral transitions without offsets](#). Also see [1.2 Available Transition Types](#).

4. transitions with or without offsets

See [1.5.8.2.2.4 Curve block - Transition and Offset Transitions](#). Also see [1.2 Available Transition Types](#).

### 1.5.8.2.2.1 Straight

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

```

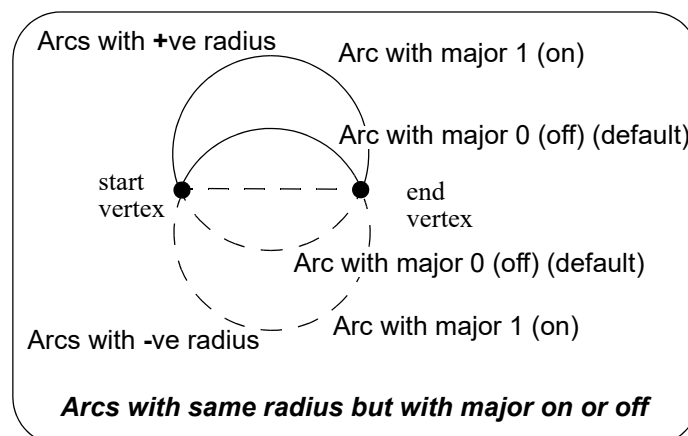
straight {                   // no parameters are needed for a straight
}

```

### 1.5.8.2.2.2 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.



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).
}
```

### 1.5.8.2.2.3 Spiral - spiral and non-spiral transitions without offsets

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

**l1** length of the full transition up to the start vertex  
**r1** radius of the transition at the start vertex  
**a1** angle in decimal degrees of the tangent to the transition at the start vertex  
**l2** length of the full transition up to the end vertex  
**r2** radius at the end vertex  
**a2** angle in decimal degrees of the tangent to the transition at the end vertex

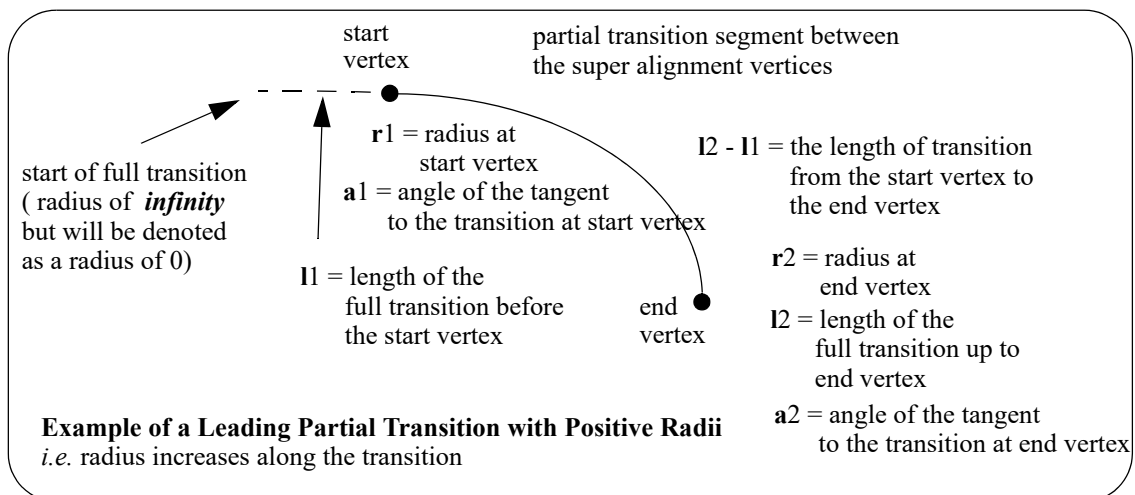
Since a radius can not be zero, a radius of infinity is denoted by *zero*.

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  $r1 = 0$  and  $l1 = 0$ . Similarly if a trailing transition is a full transition then  $r2 = 0$  and  $l2 = 0$ .

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 coordinates 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).



The parameters for the *spiral* block are:

```
spiral {
    type value // type can be clothoid, cubic parabola, westrail-cubic,
               // cubic spiral, natural clothoid, blossom,
               // blossom, 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

}

```

#### 1.5.8.2.2.4 Curve block - Transition and Offset Transitions

The curve block can be used in place of the spiral block and covers transitions with both zero not zero offsets.

An **offset transition** is a fixed perpendicular offset (**offset\_real**) of a base transition where the base transition is a Euler spiral (or a certain approximation to it) or some other specially defined curve. The base transition has a start point where the absolute radius of the curve is infinity and then has a continuously decreasing absolute radius as you continue along the curve (this may be in a forward or reverse direction).

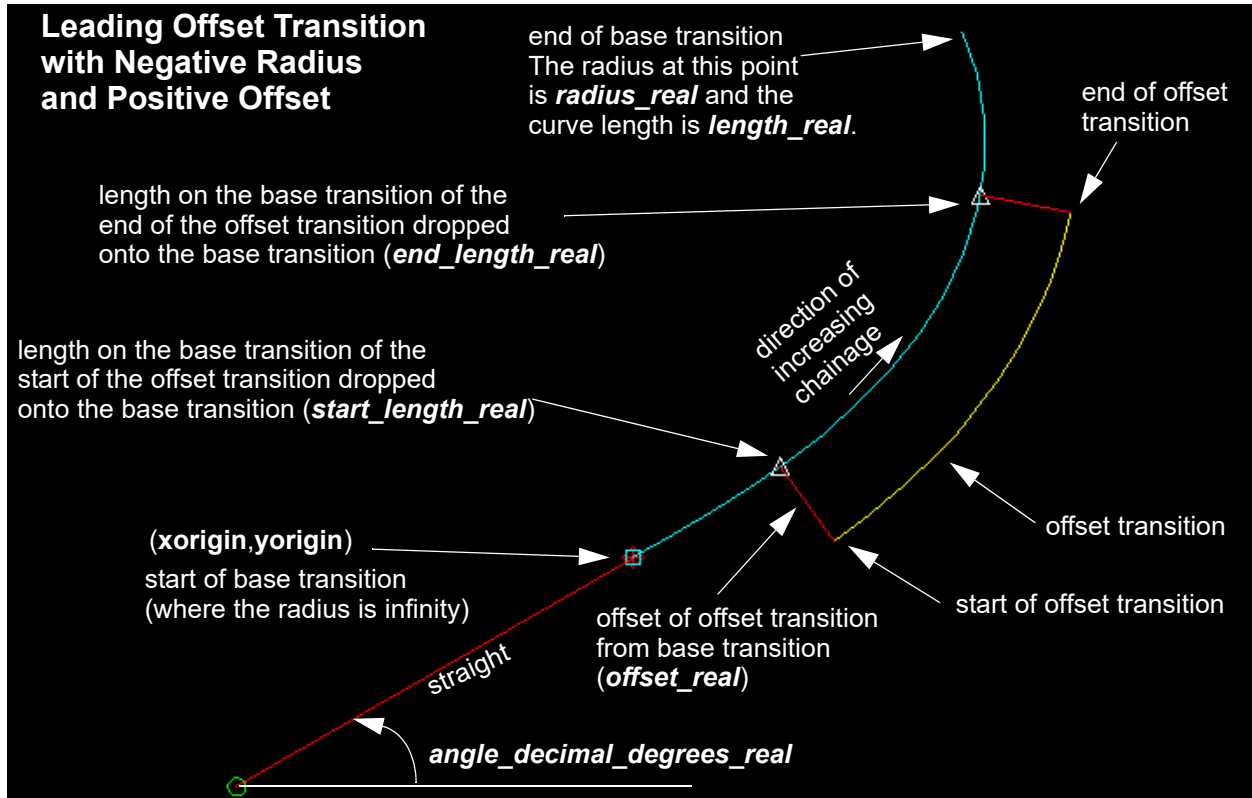
The **base transition** is defined by giving its starting point (**xorigin, yorigin**) where the radius is infinity and the angle of the tangential line at the start point is **angle\_decimal\_degrees\_real** and the fact that the radius **radius\_real** occurs at a given curve length **length\_real** along the base transition.

The **offset transition** is a fixed offset (**offset\_real**) from the base transition and goes from a start point that is specified by giving the length on the base transition where the start point drops perpendicularly onto the base transition (**start\_length\_real**) and to the end point that is specified by length on the base transition where the end point drops perpendicularly onto the base transition (**end\_length\_real**). The offset can be positive or negative.

If you are travelling along the curve in a forward direction (increasing chainage) then the base transition is said to be a **leading transition** if the absolute radius decreases as you go along the curve, and a **trailing transition** if the absolute radius increases.

The **end radius** can be **positive** or **negative**.

If you are travelling along the curve in a forward direction then for a leading transition, if the **end radius** is **positive** then the curve curls to the right, and for a negative end radius, the curve curls to the left.



**Note:** when the offset is zero, the offset transition is a standard transition which is then the same as the curves in the *spiral* block.

The *curve* block covers both spiral and non-spiral transitions with a zero or non zero offset.

The parameters for the *curve* block are:

```

curve {
    type      transition_type      // any of the transitions supported in 12d Model
    leading   1 or 0                  // 1 denotes a leading transition, 0 a trailing transition
    xorigin   value                  // (xorigin,yorigin) is the origin of the base transition
    yorigin   value                  // That is, where the radius is infinity
    radius    value                  // radius is the radius at the end of the base transition
                                                // If radius is positive, the curve goes to the right when
                                                // travelling in decreasing absolute radius

    length    value                  // length is the curve length to the end of the base transition
    start     value                  // start is the curve length on the base transition where the
                                                // end of the offset transition drops perpendicularly onto the
                                                // base transition

    end       value                  // end is the curve length on the base transition where the
                                                // start of the offset transition drops perpendicularly onto the
                                                // base transition

    angle     value                  // angle in decimal degrees is the angle of the tangent of the
                                                // base transition at the origin of the base transition.
                                                // It is measured in decimal degrees in a counter clockwise
                                                // direction from the positive x-axis

    offset    value                  // offset is the perpendicular offset distance of the offset

```

```

// transition from the base transition.
// For a leading transition, a positive value offsets from the
// base transition to the right and a negative value offsets it
// to the left, as you travel in a forward direction.

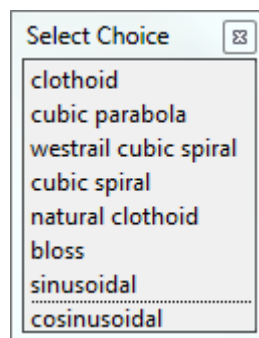
    mvalue    value

}

```

### Notes

1. The **spiral** block covers both spiral and non-spiral transitions without offsets.
1. The **curve** block covers both spiral and non-spiral transitions with and without offsets.
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.

### 1.5.8.3 Block Defining Both the Vertices and Segments - Superseded

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
    "        "        "        "        "
    "        "        "        "        "
}

```

A radius of zero (0) is used to denote a *straight* segment.

This block is now superseded although it may still exist in older 12da files.



## 1.5.8.4 Other Blocks

See

- [1.5.8.4.1 Colour](#)
- [1.5.8.4.2 Vertex Id's \(Point Numbers\)](#)
- [1.5.8.4.3 Pipe Diameters](#)
- [1.5.8.4.4 Culvert Dimensions](#)
- [1.5.8.4.5 Justification for Pipe or Culverts](#)
- [1.5.8.4.6 Tinability](#)
- [1.5.8.4.7 Visibility](#)
- [1.5.8.4.8 Vertex Text and Vertex Annotation](#)
- [1.5.8.4.9 Segment Text and Segment Annotation](#)
- [1.5.8.4.10 Symbols](#)
- [1.5.8.4.11 Vertex Attributes](#)
- [1.5.8.4.12 Segment Attributes](#)

### 1.5.8.4.1 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
}
```

### 1.5.8.4.2 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
}
```

### 1.5.8.4.3 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
}

```

#### 1.5.8.4.4 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
                          }
}

```

Note that one super string cannot have both pipe diameters and culvert dimensions.

#### 1.5.8.4.5 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)

```

#### 1.5.8.4.6 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

```



```

        tivable flag for first vertex           // 1 for tivable
        tivable flag for second vertex        // 0 for not tivable
        ...
        tivable flag for last vertex

segment_tivable_data {                       // keyword
        tivable flag for first segment       // 1 for tivable
        tivable flag for second segment     // 0 for not tivable
        ...
        tivable flag for last segment
}

```

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

#### 1.5.8.4.7 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
}

```

#### 1.5.8.4.8 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
    }
}

```

#### 1.5.8.4.9 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
    }
}

```

#### 1.5.8.4.10 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
    }
}

```

#### 1.5.8.4.11 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
    }
}

```

#### 1.5.8.4.12 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 [1.5.9 Super Alignment String](#) or return to [1.5 12da Definition for each String Type](#) or [1.12d Archive File Format](#).

## 1.5.9 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.

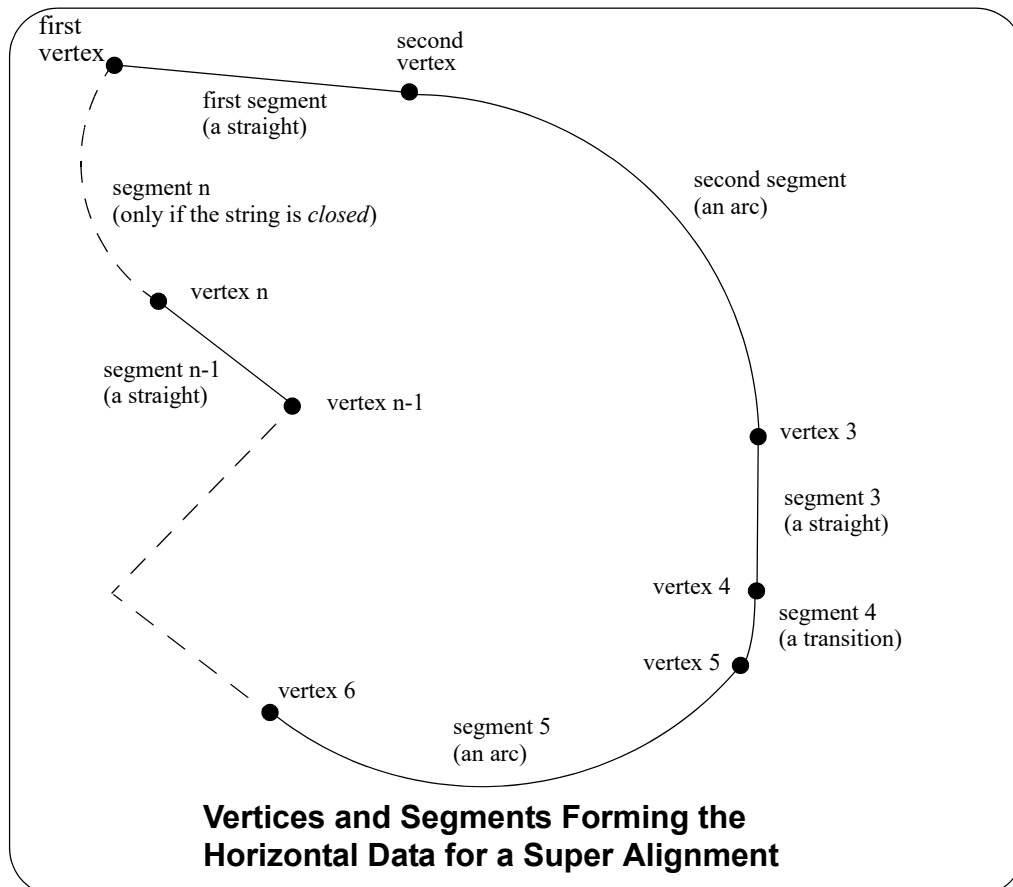
For a *super alignment*, the horizontal and vertical geometry are also defined separately and with construction definitions but the construction definition can be much more complex than just IP's. For example, an arc could be defined as being tangential to two offset elements, or constrained to go through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



**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 then 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, blossom, 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 [1.3 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 [1.5.9.1 Horizontal Geometry](#)  
*vertical geometry* [1.5.9.2 Vertical Geometry](#)

### 1.5.9.1 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 [1.5.9.1.1 Horizontal\\_parts](#)  
*horizontal\_data* [1.5.9.1.3 Horizontal\\_data](#)



### 1.5.9.1.1 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.

### 1.5.9.1.2 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 coordinate of the horizontal intersection point
    y value // y coordinate 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 coordinate of the HIP
    y value // y coordinate 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 coordinate of the HIP
    y value // y coordinate 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

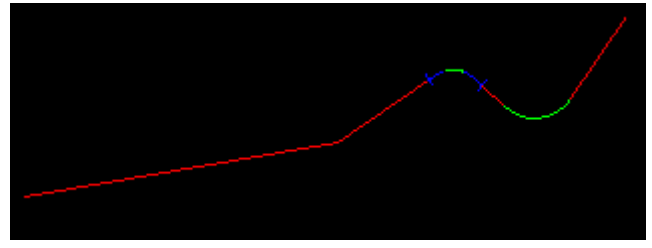
2nd HIP  
HIP only

3rd HIP  
HIP with arc and  
leading and trailing  
transitions

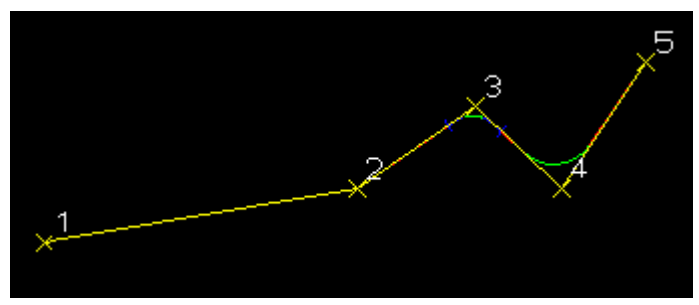
4th HIP  
HIP with arc only

5th HIP  
HIP only

Plan View of Super Alignment



Super Alignment Being Edited



Horizontal Parts with IP Methods Only

### 1.5.9.1.3 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) a partial transition, an offset transition or a partial offset 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        // coordinates of the first vertex
    x2-value    y2-value        // coordinates of the second vertex
    "           "
    "           "
    xn-value    yn-value        // coordinates 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 the same as for the **`geometry_data`** block in a super string. See [1.5.8.2 Blocks Defining the Geometry of the Segments](#).

### 1.5.9.2 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 [1.5.9.2.1 Vertical\\_parts](#)  
*vertical\_data* [1.5.9.2.3 Vertical\\_data](#)

#### 1.5.9.2.1 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.

### 1.5.9.2.2 Vertical\_parts When 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 coordinate of the VIP
    y value // height coordinate 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 coordinate of the VIP
    y value // height coordinate 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 coordinate of the VIP
    y value // height coordinate 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 coordinate of the VIP
    y value // height coordinate 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 coordinate of the VIP
  y value // height coordinate 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 coordinate of the VIP
  y value // height coordinate 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

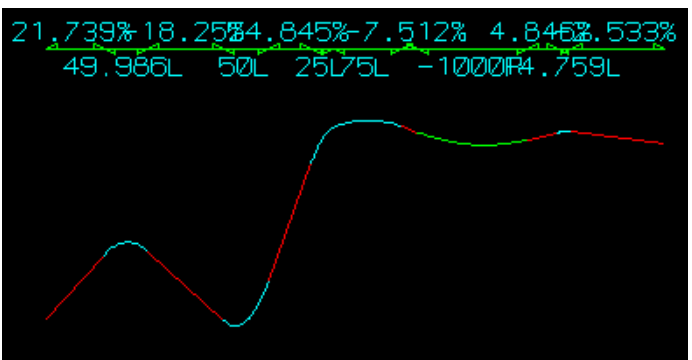
4th VIP  
Asymmetric parabola defined  
by two lengths

5th VIP  
Arc with radius

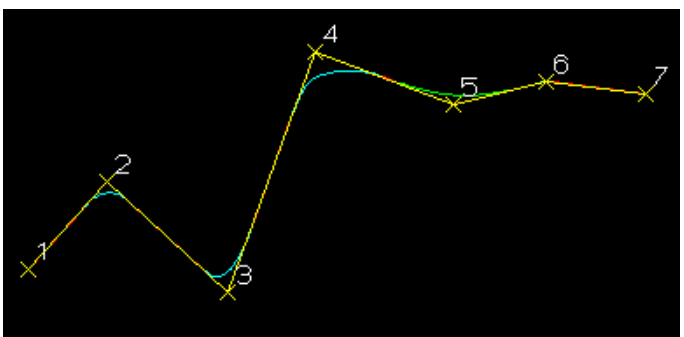
6th VIP  
Parabola defined  
by effective radius

7th VIP  
VIP only

Section View of Super Alignment



Vertical Geometry Being Edited



Vertical Parts with IP Methods Only

### 1.5.9.2.3 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       // coordinates of the first vertex
    ch2-value  ht2-value       // coordinates of the second vertex
    "          "
    "          "
    chn-value  htn-value       // coordinates 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:

```

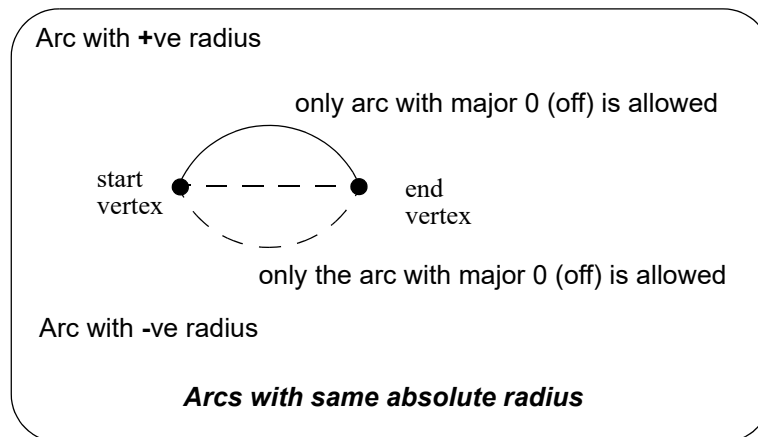
straight {                 // no parameters are needed for a straight
}

```

(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:

```

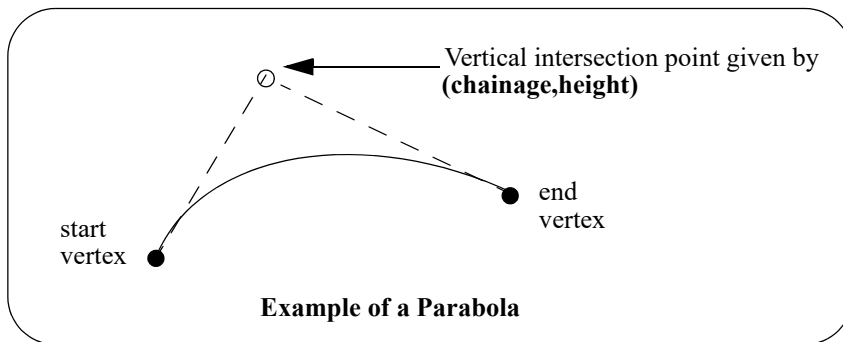
arc {
    radius value // radius of the arc (+ve is above the line connecting vertices)
    major value // this is ignored since only minor arcs are used
}

```

(c) Parabola

There can be a parabola between adjacent vertices. The parabola is defined by giving the coordinates 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 [1.5.10 Text String](#) or return to [1.5 12da Definition for each String Type](#) or [1 12d Archive File Format](#).

## 1.5.10 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 [1.5.11 2d String](#) or return to [1.5 12da Definition for each String Type](#) or [1 12d Archive File Format](#).

## 1.5.11 2d String

The 2d string has been superseded and has been replaced by the super string (see [1.5.8 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 [1.5.12 3d String](#) or return to [1.5 12da Definition for each String Type](#) or [1 12d Archive File Format](#).

## 1.5.12 3d String

The 3d string has been superseded and has been replaced by the super string (see [1.5.8 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 [1.5.13 4d String](#) or return to [1.5 12da Definition for each String Type](#) or [1 12d Archive File Format](#).

## 1.5.13 4d String

The 4d string has been superseded and has been replaced by the super string (see [1.5.8 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 {
    x-value  y-value  z-value  text           // keyword
    "        "        "        "           // text can not be blank
    "        "        "        "           // use "" for no text.
  }
}
```

Continue to [1.5.14 Pipe String](#) or return to [1.5 12da Definition for each String Type](#) or [1 12d Archive File Format](#).



## 1.5.14 Pipe String

The pipe string has been superseded and has been replaced by the super string (see [1.5.8 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 [1.5.15 Polyline String](#) or return to [1.5 12da Definition for each String Type](#) or [1 12d Archive File Format](#).

## 1.5.15 Polyline String

The polyline string has been superseded and has been replaced by the super string (see [1.5.8 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 [1.5.16 Alignment String](#) or return to [1.5 12da Definition for each String Type](#) or [1 12d Archive File Format](#).

## 1.5.16 Alignment String

The alignment string has been superceded and has been replaced by the super alignment (see [1.5.9 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 spill 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 spill 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 [1.5.17 Pipeline String](#) or return to [1.5 12da Definition for each String Type](#) or [1 12d Archive File Format](#).

## 1.5.17 Pipeline String

The pipeline string has been superseded and has been replaced by the super alignment (see [1.5.9 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 spill1 left-transition-length spill2 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 [1.5 12da Definition for each String Type](#) or [1 12d Archive File Format](#).

## 1.5.18 LAS Cloud String

```
string las_cloud_data {
    name                    // name
    colour                  // colour
    time_created text     // optional - time first created
    time_updated text     // optional - time last modified
    data_block or ref_data_block
}
```

The data block contains:

```
<data>
    category_block
    format_block
    range_block
    points_block
</data>
```

The category block contains **categories** tag and a list of boolean value (true or false).

```
categories {
    boolean_value boolean_value ... boolean_value
}
```

The range block contains four integer values.

```
range {
    xmin xmin_value
    xmax xmax_value
    ymin ymin_value
    ymax ymax_value
}
```

The format block is.

```
format format_name
```

Where *format\_name* must come from the list

v10\_p0 v10\_p1

v11\_p0 v11\_p1

v12\_p0 v12\_p1 v12\_p2 v12\_p3

v13\_p0 v13\_p1 v13\_p2 v13\_p3

v14\_p0 v14\_p1 v14\_p2 v14\_p3 v14\_p4 v14\_p5 v14\_p6 v14\_p7 v14\_p8 v14\_p9 v14\_p10

The points block must match the format given in the format block. For each format type vX\_pY where X comes from the set: 10 11 12 13 14 and Y comes from the set 0 1 2 3 4 5 6 7 8 9 10; there are two choice of points data: **points\_vX\_pY** and **compact\_points\_vX\_pY**.

```
points_vX_pY {
    point_pY
```

```

    point_pY
    ...
    ...
    point_yY
}
compact_points_vX_pY {
    compact_point_pY
    compact_point_pY
    ...
    ...
    compact_point_yY
}

```

The point\_p0 block is.

```

p {
    x x_coordinate
    y y_coordinate
    z z_coordinate
    i intensity           \\ integer between 0 and 65535
    rn return_number     \\ integer between 0 and 7
    rc return_count      \\ integer between 0 and 7
    sd scan_direction    \\ integer between 0 and 1
    fe flight_line_edge  \\ integer between 0 and 1
    cl classification    \\ integer between 0 and 255
    sr scan_rank_angle   \\ integer between -128 and 127
    ud user_data         \\ integer between 0 and 255
    id point_source_id   \\ integer between 0 and 65535
}

```

The compact\_point\_p0 block is the same as point\_p0 but without any inner tag.

```

p {
    x_coordinate
    y_coordinate
    z_coordinate
    intensity           \\ integer between 0 and 65535
    return_number      \\ integer between 0 and 7
    return_count       \\ integer between 0 and 7
    scan_direction     \\ integer between 0 and 1
    flight_line_edge   \\ integer between 0 and 1
    classification     \\ integer between 0 and 255
}

```



```

    scan_rank_angle      \\ integer between -128 and 127
    user_data            \\ integer between 0 and 255
    point_source_id      \\ integer between 0 and 65535
}

```

The `point_p1` block is the same as `point_p0` but with a time at the end.

```

p {
  x x_coordinate
  y y_coordinate
  z z_coordinate
  i intensity          \\ integer between 0 and 65535
  rn return_number     \\ integer between 0 and 7
  rc return_count      \\ integer between 0 and 7
  sd scan_direction    \\ integer between 0 and 1
  fe flight_line_edge  \\ integer between 0 and 1
  cl classification    \\ integer between 0 and 255
  sr scan_rank_angle   \\ integer between -128 and 127
  ud user_data         \\ integer between 0 and 255
  id point_source_id   \\ integer between 0 and 65535
  t gps_time           \\ real number
}

```

The `compact_point_p1` block is the same as `point_p1` but without any inner tag.

```

p {
  x_coordinate
  y_coordinate
  z_coordinate
  intensity          \\ integer between 0 and 65535
  return_number      \\ integer between 0 and 7
  return_count       \\ integer between 0 and 7
  scan_direction     \\ integer between 0 and 1
  flight_line_edge   \\ integer between 0 and 1
  classification     \\ integer between 0 and 255
  scan_rank_angle    \\ integer between -128 and 127
  user_data          \\ integer between 0 and 255
  point_source_id    \\ integer between 0 and 65535
  gps_time           \\ real number
}

```

The `point_p2` block is the same as `point_p0` but with a colour (64bit integer) at the end.

```

p {

```



```

x x_coordinate
y y_coordinate
z z_coordinate
i intensity          \\ integer between 0 and 65535
rn return_number    \\ integer between 0 and 7
rc return_count     \\ integer between 0 and 7
sd scan_direction   \\ integer between 0 and 1
fe flight_line_edge \\ integer between 0 and 1
cl classification   \\ integer between 0 and 255
sr scan_rank_angle  \\ integer between -128 and 127
ud user_data        \\ integer between 0 and 255
id point_source_id  \\ integer between 0 and 65535
c las_colour        \\ 64 bit integer
}

```

The compact\_point\_p2 block is the same as point\_p2 but without any inner tag.

```

p {
  x_coordinate
  y_coordinate
  z_coordinate
  intensity          \\ integer between 0 and 65535
  return_number     \\ integer between 0 and 7
  return_count      \\ integer between 0 and 7
  scan_direction    \\ integer between 0 and 1
  flight_line_edge  \\ integer between 0 and 1
  classification    \\ integer between 0 and 255
  scan_rank_angle   \\ integer between -128 and 127
  user_data         \\ integer between 0 and 255
  point_source_id   \\ integer between 0 and 65535
  las_colour        \\ 64 bit integer
}

```

The point\_p3 block is the same as point\_p1 but with a colour (64bit integer) at the end.

```

p {
  x x_coordinate
  y y_coordinate
  z z_coordinate
  i intensity          \\ integer between 0 and 65535
  rn return_number    \\ integer between 0 and 7
  rc return_count     \\ integer between 0 and 7

```

```

sd scan_direction          \\ integer between 0 and 1
fe flight_line_edge       \\ integer between 0 and 1
cl classification         \\ integer between 0 and 255
sr scan_rank_angle        \\ integer between -128 and 127
ud user_data              \\ integer between 0 and 255
id point_source_id        \\ integer between 0 and 65535
t gps_time                \\ real number
c las_colour              \\ 64 bit integer
}

```

The compact\_point\_p3 block is the same as point\_p3 but without any inner tag.

```

p {
  x_coordinate
  y_coordinate
  z_coordinate
  intensity                \\ integer between 0 and 65535
  return_number            \\ integer between 0 and 7
  return_count             \\ integer between 0 and 7
  scan_direction           \\ integer between 0 and 1
  flight_line_edge         \\ integer between 0 and 1
  classification           \\ integer between 0 and 255
  scan_rank_angle          \\ integer between -128 and 127
  user_data                \\ integer between 0 and 255
  point_source_id          \\ integer between 0 and 65535
  gps_time                 \\ real number
  las_colour               \\ 64 bit integer
}

```

The point\_p4 block is the same as point\_p1 but with a wave data at the end (not yet implemented).

The compact\_point\_p4 block is the same as point\_p4 but without any inner tag.

The point\_p5 block is the same as point\_p3 but with a wave data at the end (not yet implemented).

The compact\_point\_p5 block is the same as point\_p5 but without any inner tag.

The point\_p6 block is.

```

p {
  x x_coordinate
  y y_coordinate
  z z_coordinate
  i intensity                \\ integer between 0 and 65535
  rn return_number            \\ integer between 0 and 15
  rc return_count             \\ integer between 0 and 15
}

```

```

cf classification_flags    \\ integer between 0 and 15
sc scanner_channel        \\ integer between 0 and 3
sd scan_direction         \\ integer between 0 and 1
fe flight_line_edge       \\ integer between 0 and 1
cl classification         \\ integer between 0 and 255
ud user_data              \\ integer between 0 and 255
sr scan_rank_angle        \\ integer between -128 and 127
id point_source_id        \\ integer between 0 and 65535
t gps_time                \\ real number
}

```

The compact\_point\_p6 block is the same as point\_p6 but without any inner tag.

```

p {
  x_coordinate
  y_coordinate
  z_coordinate
  intensity                \\ integer between 0 and 65535
  return_number            \\ integer between 0 and 15
  return_count             \\ integer between 0 and 15
  classification_flags     \\ integer between 0 and 15
  scanner_channel          \\ integer between 0 and 3
  scan_direction           \\ integer between 0 and 1
  flight_line_edge         \\ integer between 0 and 1
  classification           \\ integer between 0 and 255
  user_data                \\ integer between 0 and 255
  scan_rank_angle          \\ integer between -128 and 127
  point_source_id          \\ integer between 0 and 65535
  gps_time                 \\ real number
}

```

The point\_p7 block is the same with point\_p6 with a las colour (64bit integer) at the end.

```

p {
  x x_coordinate
  y y_coordinate
  z z_coordinate
  i intensity              \\ integer between 0 and 65535
  rn return_number         \\ integer between 0 and 15
  rc return_count          \\ integer between 0 and 15
  cf classification_flags  \\ integer between 0 and 15
  sc scanner_channel       \\ integer between 0 and 3

```

```

sd scan_direction          \\ integer between 0 and 1
fe flight_line_edge       \\ integer between 0 and 1
cl classification         \\ integer between 0 and 255
ud user_data              \\ integer between 0 and 255
sr scan_rank_angle        \\ integer between -128 and 127
id point_source_id        \\ integer between 0 and 65535
t gps_time                \\ real number
c las_colour              \\ 64bit integer
}

```

The compact\_point\_p7 block is the same as point\_p7 but without any inner tag.

```

p {
  x_coordinate
  y_coordinate
  z_coordinate
  intensity                \\ integer between 0 and 65535
  return_number           \\ integer between 0 and 15
  return_count            \\ integer between 0 and 15
  classification_flags    \\ integer between 0 and 15
  scanner_channel         \\ integer between 0 and 3
  scan_direction          \\ integer between 0 and 1
  flight_line_edge        \\ integer between 0 and 1
  classification         \\ integer between 0 and 255
  user_data               \\ integer between 0 and 255
  scan_rank_angle         \\ integer between -128 and 127
  point_source_id         \\ integer between 0 and 65535
  gps_time                \\ real number
  las_colour              \\ 64bit integer
}

```

The point\_p8 block is the same with point\_p7 with a near infrared (integer between 0 and 255) at the end.

```

p {
  x x_coordinate
  y y_coordinate
  z z_coordinate
  i intensity            \\ integer between 0 and 65535
  rn return_number       \\ integer between 0 and 15
  rc return_count        \\ integer between 0 and 15
  cf classification_flags \\ integer between 0 and 15
  sc scanner_channel     \\ integer between 0 and 3
}

```

```

sd scan_direction          \\ integer between 0 and 1
fe flight_line_edge       \\ integer between 0 and 1
cl classification         \\ integer between 0 and 255
ud user_data              \\ integer between 0 and 255
sr scan_rank_angle       \\ integer between -128 and 127
id point_source_id       \\ integer between 0 and 65535
t gps_time                \\ real number
c las_colour              \\ 64bit integer
ir near_infrared         \\ integer between 0 and 255
}

```

The compact\_point\_p8 block is the same as point\_p8 but without any inner tag.

```

p {
  x_coordinate
  y_coordinate
  z_coordinate
  intensity                \\ integer between 0 and 65535
  return_number            \\ integer between 0 and 15
  return_count             \\ integer between 0 and 15
  classification_flags     \\ integer between 0 and 15
  scanner_channel         \\ integer between 0 and 3
  scan_direction          \\ integer between 0 and 1
  flight_line_edge        \\ integer between 0 and 1
  classification         \\ integer between 0 and 255
  user_data               \\ integer between 0 and 255
  scan_rank_angle        \\ integer between -128 and 127
  point_source_id        \\ integer between 0 and 65535
  gps_time                \\ real number
  las_colour              \\ 64bit integer
  near_infrared           \\ integer between 0 and 255
}

```

The point\_p9 block is the same as point\_p6 but with a wave data at the end (not yet implemented).

The compact\_point\_p9 block is the same as point\_p9 but without any inner tag.

The point\_p10 block is the same as point\_p8 but with a wave data at the end (not yet implemented).

The compact\_point\_p10 block is the same as point\_p10 but without any inner tag.

The ref\_data block contains:

```

ref_data {
  category_block // same as category in data block
  file_name las_ref_file_name
}

```

```
    range_block      // same as range in data block  
}
```

Return to [1.5 12da Definition for each String Type](#) or [1 12d Archive File Format](#).