GDL Reference Guide

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Introduction

This manual is a complete reference to the GRAPHISOFT's proprietary scripting language, GDL (Geometric Description Language). The manual is recommended for those users who wish to expand on the possibilities presented by the construction tools and object libraries in GRAPHISOFT software. It gives a detailed description of GDL, including syntax definitions, commands, variables, etc.

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General Overview

GDL is a parametric **programming language**, similar to BASIC. It describes 3D solid objects like doors, windows, furniture, structural elements, stairs, and the 2D symbols representing them on the floor plan. These objects are called **library parts**.

Starting Out

The needs of your design, your background in programming and your knowledge of descriptive geometry will all probably influence where you start in GDL.

Do not start practicing GDL with complicated objectives in mind. Rather, try to learn GDL through experimenting step by step with all of its features to best utilize them to your advantage. Follow the expertise level recommendations below.

If you are familiar with a programming language like BASIC, you can get acquainted with GDL by observing existing scripts. You can also learn a lot by opening the library parts shipped with your software and taking a look at the 2D and 3D GDL scripts. Additionally, you can save floor plan elements in GDL format and see the resulting script.

If you are not familiar with BASIC, but have played with construction blocks, you can still find your way in GDL through practice. We advise trying the simplest commands right away and then checking their effect in the 3D window of the library part.

Several books and materials have been published on GDL and object library development.

- *"Object Making with ARCHICAD"* is the perfect guide for beginners.
- *"Creating GDL Objects"* e-Guide gives a basic overview of the object creation methods.
- David Nicholson Cole's *"GDL Cookbook"* is the most popular course book for entry level and advanced GDL programmers for a long time.
- A more recent learning material is *"GDL Handbook"* by Andrew Watson for novice and experienced users as well.
- *"GDL Advanced Technical Standards"* contains GRAPHISOFT's official standards for professional library developers; this document can be downloaded after registration from GRAPHISOFT's website: *http://www.graphisoft.com/support/developer/*. For guidelines of basic development, see the section called "Basic Technical Standards" in this manual.

Scripting

Library Part Structure

Every library part described with GDL has **scripts**, which are lists of the actual GDL commands that construct the 3D shape and the 2D symbol. Library parts also have a description for quantity calculations.

Master script commands will be executed before each script.

The **2D script** contains parametric 2D drawing description. The binary **2D data** of the library part (content of the 2D symbol window) can be referenced using the FRAGMENT2 command. If the 2D script is empty, the binary 2D data will be used to display the library part on the floor plan.

The **3D script** contains a parametric 3D model description. The binary **3D data** (which is generated during an import or export operation) can be referenced using the BINARY command.

The **Properties script** contains components and descriptors used in element, component and zone lists. The **binary properties data** described in the **components** and **descriptors** section of the library part can be referenced using the BINARYPROP command. If the properties script and the master script are empty, the binary properties data will be used during the list process.

The **User Interface script** allows the user to define input pages that can be used to edit the parameter values in place of the normal parameter list.

In the **Parameter script**, sets of possible values can be defined for the library part parameters.

The parameter set in the **Parameters** section are used as defaults in the library part settings when placing the library part on the plan.

In the **Forward Migration script** you can define the conversion logic which can convert placed instances of older elements.

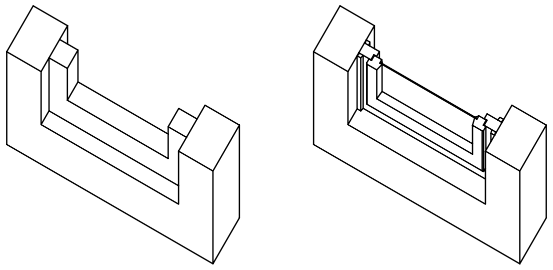
In the **Backward Migration script** you can define a backward conversion to an older version of an element.

The **Preview picture** is displayed in the library part settings dialog box when browsing the active library. It can be referenced by the PICTURE and PICTURE2 commands from the 3D and 2D script.

ARCHICAD provides a helpful environment to write GDL scripts, with on-the-fly visualization, syntax and error checking.

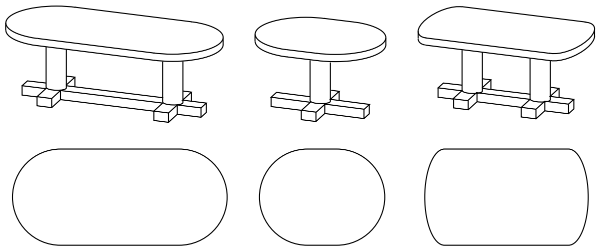
Analyze, Deconstruct and Simplify

No matter how complex, most objects you wish to create can be broken down into building blocks of simple geometric shapes. Always start with a simple analysis of the desired object and define all the geometric units that compose it. These building blocks can then be translated into the vocabulary of the GDL scripting language. If your analysis was accurate, the combination of these entities will form the desired object. To make the analysis, you need to have a good perception of space and at least a basic knowledge of descriptive geometry.


Window representations with different levels of sophistication

To avoid getting discouraged early on in the learning process, start with objects of defined dimensions and take them to their simplest but still recognizable form. As you become familiar with basic modeling, you can increase the level of sophistication and get closer to the ideal form. *Ideal* does not necessarily mean complicated. Depending on the nature of the architectural project, the ideal library part could vary from basic to refined. The window on the left in the above illustration fits the style of a design visualization perfectly. The window on the right gives a touch of realism and detail which can be used later in the construction documents phase of the project.

Elaboration



Depending on your purpose, your custom parametric objects may vary in elaboration. Custom objects for internal studio use may be less refined than the ones for general use or for commercial distribution.

If your symbols have little significance on the floor plan, or if parametric changes do not need to appear in 2D, then you can omit parametric 2D scripts.

Even if parametric changes are intended to be present in 2D, it is not absolutely necessary to write a parametric 2D script. You can perform parametric modifications in the 3D Script window or use the 3D top view of the modified object as a new symbol and save the modified object under a new name. Parametric changes to the default values will result in several similar objects derived from the original.

The most complex and sophisticated library parts consist of parametric 3D descriptions with corresponding parametric 2D scripts. Any changes in the settings will affect not only the 3D image of the object, but also its floor plan appearance.

Entry Level

These commands are easy to understand and use. They require no programming knowledge, yet you can create very effective new objects using only these commands.

Simple Shapes

Shapes are basic geometric units that add up to a complex library part. They are the construction blocks of GDL. You place a shape in the 3D space by writing a command in the GDL script.

A shape command consists of a keyword that defines the shape type and some numeric values or alphabetic parameters that define its dimensions.

The number of values varies by shape.

In the beginning, you can omit using parameters and work with fixed values only.

You can start with the following shape commands:

In 3D:

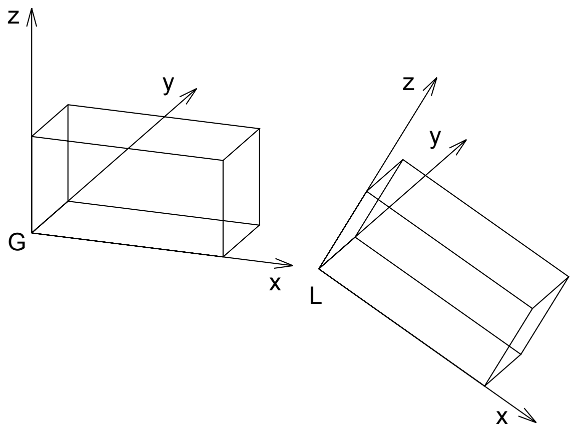
`BLOCK`, `CYLIND`, `SPHERE`, `PRISM`

In 2D:

`LINE2`, `RECT2`, `POLY2`, `CIRCLE2`, `ARC2`

Coordinate Transformations

Coordinate transformations are like moving your hand to a certain place before placing a construction block. They prepare the position, orientation and scale of the next shape.



```
BLOCK 1, 0.5, 0.5
ADDX 1.5
ROTY 30
BLOCK 1, 0.5, 0.5
```

The 3D window of the library part will optionally show you the home (G = global) and the current (L = local) position of the coordinate system for any object present.

The simplest coordinate transformations are as follows:

In 3D:

`ADDX`, `ADDY`, `ADDZ`, `ROTX`, `ROTY`, `ROTZ`

In 2D:

`ADD2`, `ROT2`

The commands starting with ADD will move the next shape, while the ROT commands will turn it around any of its axes.

Intermediate Level

These commands are a bit more complex, not because they expect you to know programming, but simply because they describe more complex shapes or more abstract transformations.

In 3D:

`ELLIPS`, `CONE`

`POLY_`, `LIN_`, `PLANE`, `PLANE_`

`PRISM_`, `CPRISM_`, `SLAB`, `SLAB_`, `CSLAB_`, `TEXT`

In 2D:

`HOTSPOT2`, `POLY2_`, `TEXT2`, `FRAGMENT2`

These commands usually require more values to be defined than the simple ones. Some of them require status values to control the visibility of edges and surfaces.

Coordinate Transformations

In 3D:

On top of the entry level transformations

`MULX`, `MULY`, `MULZ`, `ADD`, `MUL`, `ROT`

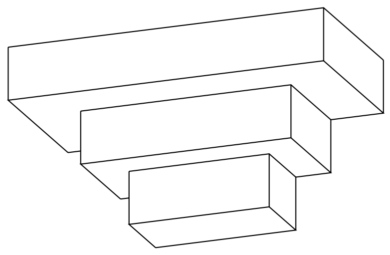
In 2D:

On top of the entry level transformations

`MUL2`

Example:

```
PRISM 4, 1, 3, 0,
        3,  3,
        -3, 3,
        -3, 0
ADDZ -1
MUL 0.666667, 0.666667, 1
PRISM 4, 1, 3, 0,
        3,  3,
        -3, 3,
        -3, 0
ADDZ -1
MUL 0.666667, 0.666667, 1
PRISM 4, 1, 3, 0,
        3,  3,
        -3, 3,
        -3, 0
```



The transformations starting with MUL will rescale the subsequent shapes by distorting circles into ellipses or spheres into ellipsoids. If used with negative values, they can be used for mirroring. The commands in the second row affect all three dimensions of space at the same time.

Advanced Level

These commands add a new level of complexity either because of their geometric shape, or because they represent GDL as a programming language.

In 3D:

`BPRISM_`	`BWALL_`	`CWALL_`	`XWALL_`
`CROOF_`	`FPRISM_`	`SPRISM_`	
`EXTRUDE`	`PYRAMID`	`REVOLVE`	`RULED`
`SWEEP`	`TUBE`	`TUBEA`	`COONS`
`MESH`	`MASS`		
`LIGHT`	`PICTURE`		

There are shape commands in this group which let you trace a spatial polygon with a base polygon to make smooth curved surfaces. Some shapes require material references in their parameter list.

By using cutting planes, polygons and shapes, you can generate complex arbitrary shapes out of simple shapes. The corresponding commands are `CUTPLANE`, `CUTPOLY`, `CUTPOLYA`, `CUTSHAPE` and CUTEND.

In 2D:

`PICTURE2`, `POLY2_A`, `SPLINE2`, `SPLINE2A`

Flow Control and Conditional Statements

`FOR - TO - NEXT`

`DO - WHILE`, `WHILE - ENDWHILE`

`REPEAT - UNTIL`

`IF - THEN - ELSE - ENDIF`

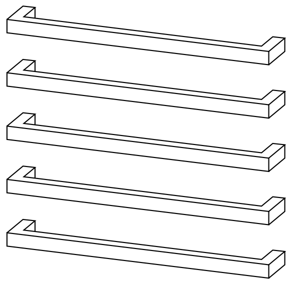
`GOTO`, `GOSUB`

`RETURN`, `END / EXIT`

These commands should be familiar to anyone who has ever programmed a computer, but they are basic enough that you can understand them without prior programming experience.

They let you make repetitive script parts to place several shapes with little scripting, or let you make decisions based on prior calculations.

```
FOR i = 1 TO 5
    PRISM_ 8, 0.05,
            -0.5,  0,     15,
            -0.5,  -0.15, 15,
            0.5,   -0.15, 15,
            0.5,   0,     15,
            0.45,  0,     15,
            0.45,  -0.1,  15,
            -0.45, -0.1,  15,
            -0.45, 0,     15
    ADDZ 0.2
NEXT i
```



Parameters

At this stage of your expertise, you can replace fixed numeric values with variable names. This makes the object more flexible. These variables are accessible from the library part's Settings dialog box while working on the project.

Macro Calls

You are not limited to the standard GDL shapes. Any existing library part may become a GDL shape in its entirety. To place it, you simply call (refer to) its name and transfer the required parameters to it, just as with standard shape commands.

Expert Level

By the time you have a good understanding of the features and commands outlined above, you will be able to pick up the few remaining commands that you may need from time to time.

Note

The memory capacity of your computer may limit the file length of your GDL scripts, the depth of macro calls and the number of transformations.

You will find additional information on the above GDL commands throughout the manual. HTML format help files are also available with your software, giving a quick overview of the available commands and their parameter structure.

3D GENERATION

3D modeling is based on floating point arithmetics, meaning that there is no limit imposed on the geometric size of the model. Whatever size it is, it retains the same accuracy down to the smallest details.

The 3D model that you finally see on the screen is composed of geometric primitives. These primitives are stored in the memory of your computer in binary format, and the 3D engine generates them according to the floor plan you created. The metamorphosis between the architectural floor plan elements and the binary 3D data is called 3D conversion.

The primitives are the following:

- all the **vertices** of your building components
- all the **edges** linking the vertices
- all the surface **polygons** within the edges

Groups of these primitives are kept together as bodies. The bodies make up the 3D model. All of the features of 3D visualization - smooth surfaces, cast shadows, glossy or transparent materials - are based on this data structure.

The 3D Space

The 3D model is created in three-dimensional space measured by the x, y and z axes of a master coordinate system whose origin is called the **global origin**.

In Floor Plan view, you can see the global origin in the lower left corner of the worksheet if you open the program without reading a specific document. In addition, the global origin defines the zero level of all the stories referred to in a floor plan document.

When you place an object into the design, the floor plan position will define its location along the x and y axes of this master coordinate system. The location along the z axis can be set in the Object Settings dialog box or directly adjusted when placed in 3D. This location will be the base and the default position of the **local coordinate system** of the object. The shapes described in the script will be positioned with reference to this local coordinate system.

Coordinate Transformations

Every GDL shape is linked to the current position of the local coordinate system. For example, blocks are linked to the origin. The length, width and height of the block are always measured in a positive direction along the three axes. Thus, the BLOCK command requires only three parameters defining its dimensions along the axes.

How can you generate a shifted and rotated block? With the parameter structure of the BLOCK there is no way to do this. It does not have parameters for shift and rotation.

The answer is to move the coordinate system to the correct position before issuing the BLOCK command. With the coordinate transformation commands, you can pre-define its position and rotation around the axes. These transformations are not applied to the shapes already generated and are only effective on subsequent shapes.

The GDL Interpreter

When a GDL script is executed, the GDL interpreter engine will detect the location, size, rotation angle, user defined parameters and the mirrored state of the library part. It will then move the local coordinate system to the right position, ready to receive the GDL commands from the script of the library parts. Every time a command for a basic shape is read by the interpreter, it will generate the geometric primitives that make up that particular shape.

When the interpreter has finished, the complete binary 3D model will be stored in the memory, and you can perform 3D projections, fly-through renderings or sun studies on it.

ARCHICAD contains a pre-compiler and an interpreter for GDL. Interpretation of a GDL script uses the pre-compiled code. This feature increases speed of the analysis. If the GDL script is modified, a new code is generated.

Data structures converted from other file formats (e.g., DXF, Zoom, Alias Wavefront) are stored in a binary 3D section of the library parts. This section is referenced by the BINARY command from the GDL script.

The GDL Script Analysis

Users have no control over the order in which library parts placed on the floor plan are analyzed. The order of GDL script analysis is based on the internal data structure; moreover, Undo and Redo operations as well as modifications may influence that order. The only exceptions to this rule are special GDL scripts of the active library, whose names begin with "**MASTER_GDL**" or "**MASTEREND_GDL**".

Scripts whose name begins with "MASTER_GDL" are executed before starting a list process and after loading the active library.

Scripts whose name begins with "MASTEREND_GDL" are executed when the active library is to be changed (Load Libraries, Open a project, New project, Quit).

These scripts are not executed when you edit library parts. If your library contains one or more such scripts they will all be executed in an order that is not defined.

MASTER_GDL and MASTEREND_GDL scripts can include attribute definitions, initializations of GDL user global variables, 3D commands (effective only in the 3D model), value list definitions (see the VALUES command) and GDL extension-specific commands. The attributes defined in these scripts will be merged into the current attribute set (attributes with same names are not replaced, while attributes originated from GDL and not edited in the program are always replaced).

GDL Syntax

This chapter presents the basic elements of GDL syntax, including statements, labels, identifiers, variables and parameters. Typographic rules are also explained in detail.

Rules of GDL Syntax

GDL is not case sensitive; uppercase and lowercase letters are not distinguished, except in strings placed between quotation marks. The logical end of a GDL script is denoted by an `END / EXIT` statement or the physical end of the script.

Statements

A GDL program consists of statements. A statement can start with a keyword (defining a GDL shape, coordinate transformations or program control flow), with a macro name, or with a variable name followed by an '=' sign and an expression.

Line

The statements are in lines separated by line-separators (end_of_line characters).

A comma (,) in the last position indicates that the statement continues on the next line. A colon (:) is used for separating GDL statements in a line. After an exclamation mark (!) you can write any comment in the line. Blank lines can be inserted into a GDL script with no effect at all. Any number of spaces or tabs can be used between the operands and operators. The use of a space or tab is obligatory after statement keywords and macro calls.

Label

Any line can start with a label which is used as a reference for a subsequent statement. A label is an integer number or a constant string between quotation marks, followed by a colon (:). A string label is case sensitive. Labels are checked for single occurrence. The execution of the program can be continued from any label by using a `GOTO` or `GOSUB` statement.

Characters

The GDL text is composed of the lower and uppercase letters of the English alphabet, any number and the following characters:

```
<space> _(underline) ~ ! : , ; . + - * / ^ = < > <= >= # ( ) [ ] { } \ @ & |(vertical
bar) " ' ` ´ “ ” ’ ‘ <end_of_line>
```

STRINGS

Any string of Unicode characters that is placed between quotation marks (", ', “, ’, `, ´), or any string of characters without quotation marks that does not figure in the script as an identifier with a given value (macro call, attribute name, file name). Strings without quotation marks will be converted to all caps, so using quotation marks is recommended. The maximum length allowed in a string is 255 characters.

The '\' character has special control values. Its meaning depends on the next character.

\\	'\' char itself
\n	new line
\t	tabulator
\new line	continue string in next line without a new line
\others	not correct, results in warning

Example:

```
"This is a string"
`washbasin 1'-6"*1'-2`
'Do not use different delimiters’
```

IDENTIFIERS

Identifiers are special character strings:

- they are not longer than 255 characters;
- they begin with a letter of the alphabet or a '_' or '~' character;
- they consist of letters, numbers and '_' or '~' characters;
- upper- and lowercase letters are considered identical.

Identifiers can be GDL keywords, global or local variables or strings (names). Keywords and global variable names are determined by the program you’re using GDL in; all other identifiers can be used as variable names.

VARIABLES

GDL programs can handle numeric and string variables (defined by their identifiers), numbers and character strings.

There are two sets of variables: local and global.

All identifiers that are not keywords, global variables, attribute names, macro names or file names are considered local variables. If left uninitialized (undefined), their value will be 0 (integer). Local variables are stacked with macro calls. When returning from a macro call, the interpreter restores their values.

Global variables have reserved names (*for the list of global variables see the section called "Global Variables"*). They are not stacked during macro calls, enabling the user to store special values of the modeling and to simulate return codes from macros. The user global variables can be set in any script but they will only be effective in subsequent scripts. If you want to make sure that the desired script is analyzed first, set these variables in the MASTER_GDL library part. All elements will always read these values set by the Master GDL first, unless their own scripts (caller object or called macro) modify those values. There is no user global data exchange between the different interpretation instances. The other global variables can be used in your scripts to communicate with the program. By using the "=" command, you can assign a numeric or string value to local and global variables.

Parameters

Identifiers listed in a library part's parameter list are called parameters. Parameter identifiers must not exceed 31 characters in length. And the maximum number of parameters must not exceed 1024. Within a script, the same rules apply to parameters as to local variables.

Parameters of text-only GDL files are identified by letters A to Z.

Simple Types

Variables, parameters and expressions can be of two simple types: numeric or string.

Numeric expressions are constant numbers, numeric variables or parameters, functions that return numeric values, and any combination of these in operations. Numeric expressions can be integer or real. Integer expressions are integer constants, variables or parameters, functions that return integer values, and any combination of these in operations which results in integers. Real expressions are real constants, variables or parameters, functions that return real values, and any combination of these (or integer expressions) in operations which results in reals. A numeric expression being an integer or a real is determined during the compilation process and depends only on the constants, variables, parameters and the operations used to combine them. Real and integer expressions can be used the same way at any place where a numeric expression is required, however, in cases where a combination of these may result in precision problems, a compiler warning appears (comparison of reals or reals and integers using relational operators '=' or '<>', or boolean operators AND, OR, EXOR; IF or GOTO statements with real label expressions).

String expressions are constant strings, string variables or parameters, functions that return strings, and any combination of these in operations which result in strings.

Derived Types

Variables and parameters can also be arrays, and parameters can be value lists of a simple type.

Arrays are one- or two-dimensional tables of numeric and/or string values, which can be accessed directly by indexes.

Value lists are sets of possible numeric or string values. They can be assigned to the parameters in the value list script of the library part or in the MASTER_GDL script, and will appear in the parameter list as a pop-up menu.

CONVENTIONS USED IN THIS BOOK

[aaa]

Square brackets mean that the enclosed elements are optional (if they are bold, they must be entered as shown).

{n}

command version number

...

Previous element may be repeated

|

Exclusive or relation between parameters of a command

variable

Any GDL variable name

prompt

Any character string (must not contain quote character)

bold_string

UPPERCASE_STRING

special characters

Must be entered as shown

other_lowercase_string_in_parameter_list

Any GDL expression

COORDINATE TRANSFORMATIONS

This chapter tells you about the types of transformations available in GDL (moving, scaling and rotating the coordinate system) and the way they are interpreted and managed.

About Transformations

In GDL, all the geometric elements are linked strictly to the local coordinate system. GDL uses a right-handed coordinate system. For example, one corner of a block is in the origin and its sides are in the x-y, x-z and y-z planes.

Placing a geometric element in the desired position requires two steps. First, move the coordinate system to the desired position. Second, generate the element. Every movement, rotation or stretching of the coordinate system along or around an axis is called a transformation. Transformations are stored in a stack; interpretation starts from the last one backwards. Scripts inherit this stack; they can insert new elements onto it but can only delete the locally defined ones. It is possible to delete one, more or all of the transformations defined in the current script. After returning from a script, the locally defined transformations are removed from the stack.

2D TRANSFORMATIONS

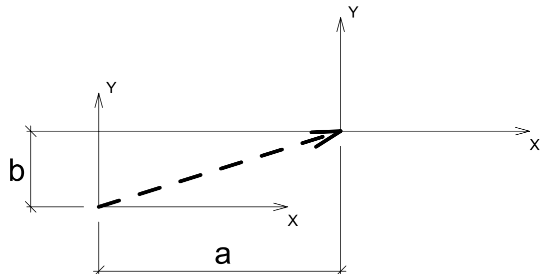
These are the equivalents in the 2D space of the `ADD`, `MUL` and `ROTZ` 3D transformations.

ADD2

```
ADD2 x, y
```

Example:

```
ADD2 a, b
```



MUL2

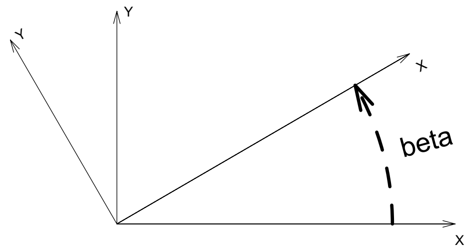
```
MUL2 x, y
```

ROT2

`ROT2` `alpha`

Example:

```
ROT2 beta
```



3D Transformations

ADDX

`ADDX` `dx`

ADDY

`ADDY` `dy`

ADDZ

`ADDZ` `dz`

Moves the local coordinate system along the given axis by dx, dy or dz respectively.

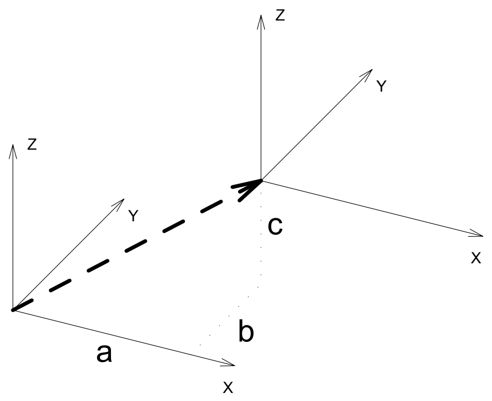
ADD

`ADD` `dx, dy, dz`

Replaces the sequence ADDX dx: ADDY dy: ADDZ dz.

Example:

```
ADD a, b, c
```



It has only one entry in the stack, thus it can be deleted with DEL 1.

MULX

MULX `mx`

MULY

MULY `my`

MULZ

MULZ `mz`

Scales the local coordinate system along the given axis. Negative mx, my, mz means simultaneous mirroring.

MUL

MUL `mx, my, mz`

Replaces the sequence MULX mx: MULY my: MULZ mz. It has only one entry in the stack, thus it can be deleted with DEL 1.

ROTX

ROTX `alphax`

ROTY

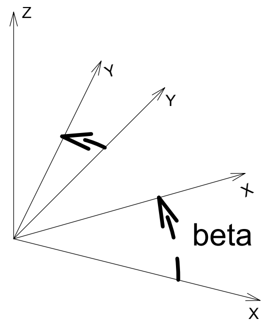
ROTY `alphay`

ROTZ

```
ROTZ alphaz
```

Rotates the local coordinate system around the given axis by alphax, alphay, alphaz degrees respectively, counterclockwise.

Example:



```
ROTZ beta
```

ROT

```
ROT x, y, z, alpha
```

Rotates the local coordinate system around the axis defined by the vector (x, y, z) by alpha degrees, counterclockwise. It has only one entry in the stack, thus it can be deleted with DEL 1.

XFORM

```
XFORM a11, a12, a13, a14,
      a21, a22, a23, a24,
      a31, a32, a33, a34
```

Defines a complete transformation matrix. It is mainly used in automatic GDL code generation. It has only one entry in the stack.

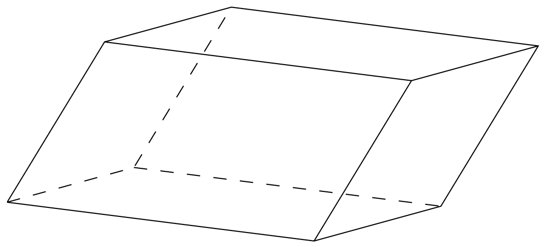
x' = a11 * x + a12 * y + a13 * z + a14

y' = a21 * x + a22 * y + a23 * z + a24

z' = a31 * x + a32 * y + a33 * z + a34

Example:

```
A=60
B=30
XFORM 2, COS(A), COS(B)*0.6, 0,
      0, SIN(A), SIN(B)*0.6, 0,
      0, 0, 1, 0
BLOCK 1, 1, 1
```



Managing the Transformation Stack

DEL

DEL n [, begin_with]

Deletes n entries from the transformation stack.

If the begin_with parameter is not specified, deletes the previous n entries in the transformation stack. The local coordinate system moves back to a previous position.

If the begin_with transformation is specified, deletes n entries forward, beginning with the one denoted by begin_with. Numbering starts with 1. If the begin_with parameter is specified and n is negative, deletes backward.

If fewer transformations were issued in the current script than denoted by the given n number argument, then only the issued transformations are deleted.

DEL TOP

DEL TOP

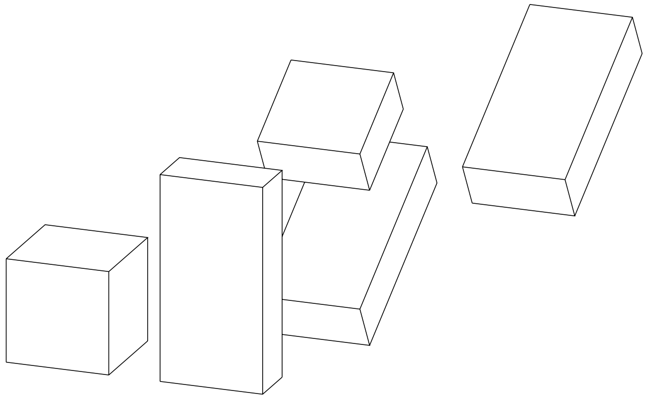
Deletes all current transformations in the current script.

NTR

NTR ()

Returns the actual number of transformations.

Example:



```
BLOCK 1, 1, 1
ADDX 2
ADDY 2.5
ADDZ 1.5
ROTX -60
ADDX 1.5
BLOCK 1, 0.5, 2
DEL 1, 1              ! Deletes the ADDX 2 transformation
BLOCK 1, 0.5, 1
DEL 1, NTR() - 2      ! Deletes the ADDZ 1.5 transformation
BLOCK 1, 0.5, 2
DEL -2, 3             ! Deletes the ROTX -60 and ADDY 2.5 transformations
BLOCK 1, 0.5, 2
```

3D Shapes

This chapter covers all the 3D shape creation commands available in GDL, from the most basic ones to the generation of complex shapes from polylines. Elements for visualization (light sources, pictures) are also presented here, as well as the definition of text to be displayed in 3D. Furthermore, the primitives of the internal 3D data structure consisting of nodes, vectors, edges and bodies are discussed in detail, followed by the interpretation of binary data and guidelines for using cutting planes.

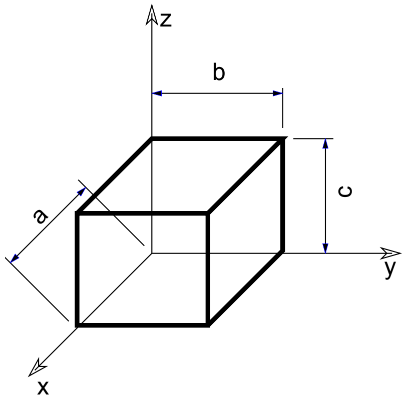
Basic Shapes

BLOCK

```
BLOCK a, b, c
```

BRICK

```
BRICK a, b, c
```



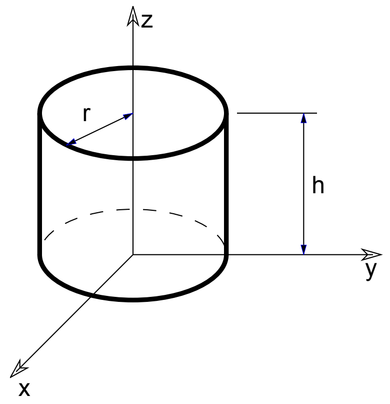
The first corner of the block is in the local origin and the edges with lengths a, b and c are along the x-, y- and z-axes, respectively. Zero values create degenerated blocks (rectangle or line).

Restriction of parameters:

```
  a >= 0, b >= 0, c >= 0
  a + b + c > 0
```

CYLIND

`CYLIND` `h, r`



Right cylinder, coaxial with the z-axis with a height of h and a radius of r.

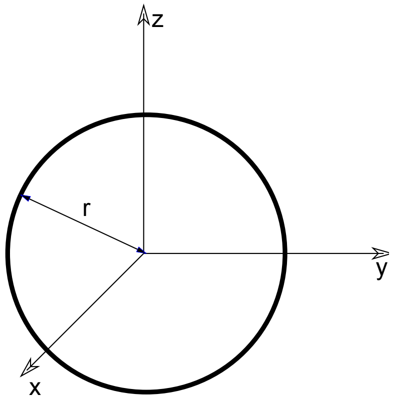
If h=0, a circle is generated in the x-y plane.

If r=0, a line is generated along the z axis.

SPHERE

`SPHERE` `r`

A sphere with its center at the origin and with a radius of r.



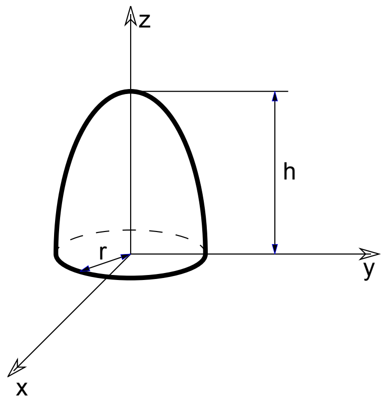
ELLIPS

ELLIPS h, r

Half ellipsoid. Its cross-section in the x-y plane is a circle with a radius of r centered at the origin. The length of the half axis along the z-axis is h.

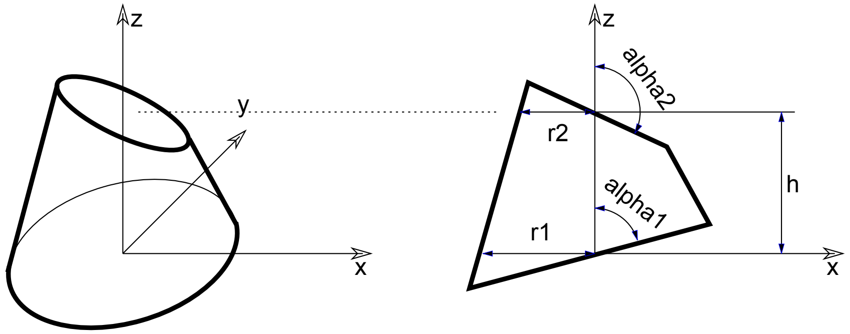
Example: Hemisphere

```
ELLIPS h, r
```



CONE

CONE h, r1, r2, alpha1, alpha2



Frustum of a cone where alpha1 and alpha2 are the angles of inclination of the end surfaces to the z axis, r1 and r2 are the radii of the end-circles and h is the height along the z axis.

If h=0, the values of alpha1 and alpha2 are disregarded and an annulus is generated in the x-y plane.

alpha1 and alpha2 are in degrees.

Restriction of parameters:

```
  0 < alpha1 < 180° and 0 < alpha2 < 180°
```

Example: A regular cone

```
CONE h, r, 0, 90, 90
```

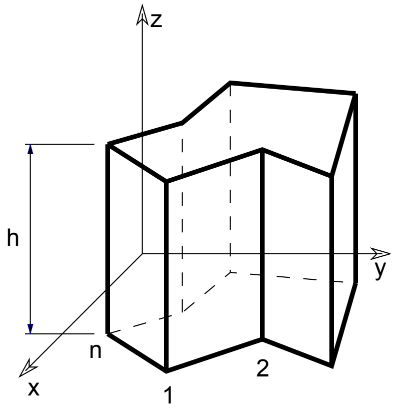
PRISM

PRISM n, h, x1, y1, ..., xn, yn

Right prism with its base polygon in the x-y plane (see the parameters of the POLY command and the POLY_ command). The height along the z-axis is abs(h). Negative h values can also be used. In that case the second base polygon is below the x-y plane.

Restriction of parameters:

```
  n >= 3
```



PRISM_

PRISM_ `n, h, x1, y1, s1, ..., xn, yn, sn`

Similar to the PRISM command, but any of the horizontal edges and sides can be omitted.

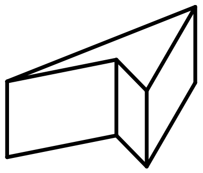
Restriction of parameters:

```
n >= 3
```

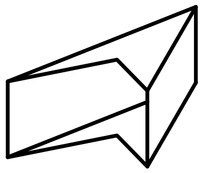
`si:` status code that allows you to control the visibility of polygon edges and side surfaces. You can also define holes and create segments and arcs in the polyline using special constraints.

See Status Codes for details.

Example 1: Solid and hollow faces



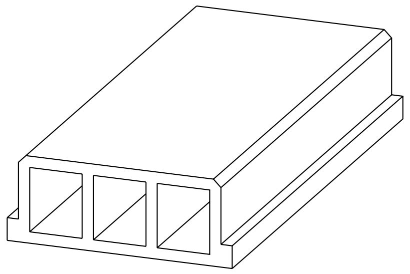
```
PRISM_ 4,1,
    0,0,15,
    1,1,15,
    2,0,15,
    1,3,15
```



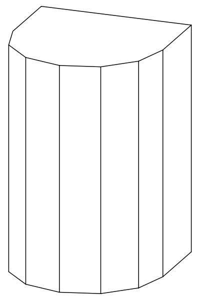
```
PRISM_ 4,1,
    0,0,7,
    1,1,5,
    2,0,15,
    1,3,15
```

Example 2: Holes in the polygon

```
ROTX 90
PRISM_ 26, 1.2,
    0.3,   0,    15,
    0.3,   0.06, 15,
    0.27,  0.06, 15,
    0.27,  0.21, 15,
    0.25,  0.23, 15,
    -0.25, 0.23, 15,
    -0.27, 0.21, 15,
    -0.27, 0.06, 15,
    -0.3,  0.06, 15,
    -0.3,  0,    15,
    0.3,   0,    -1,     !End of contour
    0.10,  0.03, 15,
    0.24,  0.03, 15,
    0.24,  0.2,  15,
    0.10,  0.2,  15,
    0.10,  0.03, -1,     !End of first hole
    0.07,  0.03, 15,
    0.07,  0.2,  15,
    -0.07, 0.2,  15,
    -0.07, 0.03, 15,
    0.07,  0.03, -1,     !End of second hole
    -0.24, 0.03, 15,
    -0.24, 0.2,  15,
    -0.1,  0.2,  15,
    -0.1,  0.03, 15,
    -0.24, 0.03, -1      !End of third hole
```

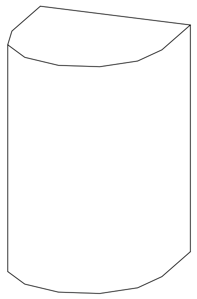


Example 3: Curved surface



j7 = 0

```
R=1
H=3
PRISM_ 9, H,
        -R,          R,           15,
        COS(180)*R, SIN(180)*R, 15,
        COS(210)*R, SIN(210)*R, 15,
        COS(240)*R, SIN(240)*R, 15,
        COS(270)*R, SIN(270)*R, 15,
        COS(300)*R, SIN(300)*R, 15,
        COS(330)*R, SIN(330)*R, 15,
        COS(360)*R, SIN(360)*R, 15,
        R,           R,           15
```



j7 = 1

```
R=1
H=3
PRISM_ 9, H,
        -R,          R,           15,
        COS(180)*R, SIN(180)*R, 64+15,
        COS(210)*R, SIN(210)*R, 64+15,
        COS(240)*R, SIN(240)*R, 64+15,
        COS(270)*R, SIN(270)*R, 64+15,
        COS(300)*R, SIN(300)*R, 64+15,
        COS(330)*R, SIN(330)*R, 64+15,
        COS(360)*R, SIN(360)*R, 64+15,
        R,           R,           15
```

CPRISM_

```
CPRISM_ top_material, bottom_material, side_material,
        n, h,
        x1, y1, s1, ..., xn, yn, sn
```

Extension of the PRISM_ command. The first three parameters are used for the material name/index of the top, bottom and side surfaces. The other parameters are the same as above in the PRISM_ command.

Restriction of parameters:

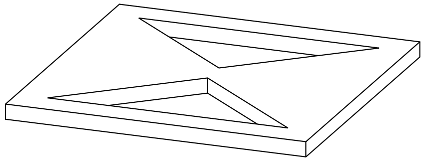
```
n >= 3
```

See also the section called "Materials".

`si:` status code that allows you to control the visibility of polygon edges and side surfaces. You can also define holes and create segments and arcs in the polyline using special constraints.

See Status Codes for details.

Example: Material referencing a predefined material by name, index and global variable



```
CPRISM_ "Mtl-Iron", 0, SYMB_MAT,
        13, 0.2,
        0, 0, 15,
        2, 0, 15,
        2, 2, 15,
        0, 2, 15,
        0, 0, -1,            !end of the contour
        0.2, 0.2, 15,
        1.8, 0.2, 15,
        1.0, 0.9, 15,
        0.2, 0.2, -1,        !end of first hole
        0.2, 1.8, 15,
        1.8, 1.8, 15,
        1.0, 1.1, 15,
        0.2, 1.8, -1         !end of second hole
```

CPRISM_{2}

```
CPRISM_{2} top_material, bottom_material, side_material,
        n, h,
        x1, y1, alpha1, s1, mat1,
        ...
        xn, yn, alphan, sn, matn
```

CPRISM_{2} is an extension of the CPRISM_ command with the possibility of defining different angles and materials for each side of the prism. The side angle definition is similar to the one of the CROOF_ command.

alphai: the angle between the face belonging to the edge i of the prism and the plane perpendicular to the base.

mati: material reference that allows you to control the material of the side surfaces.

CPRISM_{3}

```
CPRISM_{3} top_material, bottom_material, side_material, mask,
           n, h,
           x1, y1, alpha1, s1, mat1,
           ...
           xn, yn, alphan, sn, matn
```

CPRISM_{3} is an extension of the CPRISM_{2} command with the possibility of controlling the global behavior of the generated prism.

mask: controls the global behavior of the generated prism.

`mask` = $j_1 + 2*j_2 + 4*j_3$, where each j can be 0 or 1.

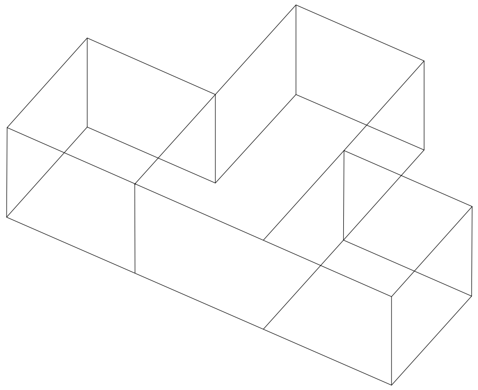
j_1: top edge in line elimination.

j_2: bottom edge in line elimination.

j_3: side edge in line elimination.

Example:

```
PEN 1
mat = IND (MATERIAL, "Mtl-Aluminium")
FOR i=1 TO 4 STEP 1
  IF i = 1 THEN mask = 1+2+4
  IF i = 2 THEN mask = 1
  IF i = 3 THEN mask = 2
  IF i = 4 THEN mask = 4
  CPRISM_{3} mat, mat, mat, mask,
      5, 1,
      0, 0, 0, 15, mat,
      1, 0, 0, 15, mat,
      1, 1, 0, 15, mat,
      0, 1, 0, 15, mat,
      0, 0, 0, -1, mat
  BODY -1
  DEL TOP
  IF i = 1 THEN ADDY 1
  IF i = 2 THEN ADDX -1
  IF i = 3 THEN ADDX 1
NEXT i
```



CPRISM_{4}

```
CPRISM_{4} top_material, bottom_material, side_material, mask,
          n, h,
          x1, y1, alpha1, s1, mat1,
          ...
          xn, yn, alphan, sn, matn
```

CPRISM_{4} is an extension of the CPRISM_{3} command with the possibility of using inline material definition, that means materials defined in GDL script locally also can be used next to materials defined in global material definitions.

BPRISM_

```
BPRISM_ top_material, bottom_material, side_material,
        n, h, radius,
        x1, y1, s1,
        ...
        xn, yn, sn
```

A smooth curved prism, based on the same data structure as the straight CPRISM_ element. The only additional parameter is radius.

Derived from the corresponding CPRISM_ by bending the x-y plane onto a cylinder tangential to that plane. Edges along the x axis are transformed to circular arcs; edges along the y axis remain horizontal; edges along the z axis will be radial in direction.

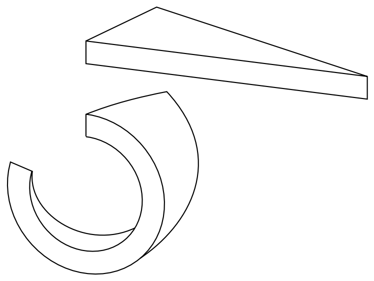
See the BWALL_ command for details.

si: status code that allows you to control the visibility of polygon edges and side surfaces. You can also define holes and create segments and arcs in the polyline using special constraints.

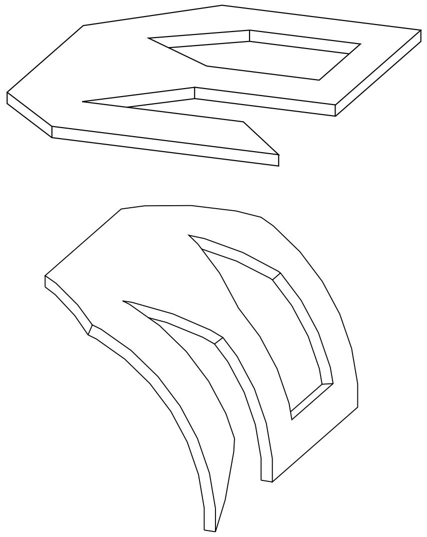
See Status Codes for details.

Example: Curved prisms with the corresponding straight ones

```
BPRISM_ "Glass", "Glass", "Glass",
        3,   0.4, 1,        ! radius = 1
        0,   0,   15,
        5,   0,   15,
        1.3, 2,   15
```



```
BPRISM_ "Concrete", "Concrete", "Concrete",
        17,   0.3,  5,
        0,    7.35, 15,
        0,    2,    15,
        1.95, 0,    15,
        8,    0,    15,
        6.3,  2,    15,
        2,    2,    15,
        4.25, 4,    15,
        8,    4,    15,
        8,    10,   15,
        2.7,  10,   15,
        0,    7.35, -1,
        4,    8.5,  15,
        1.85, 7.05, 15,
        3.95, 5.6,  15,
        6.95, 5.6,  15,
        6.95, 8.5,  15,
        4,    8.5,  -1
```



FPRISM_

```
FPRISM_ top_material, bottom_material, side_material, hill_material,
        n, thickness, angle, hill_height,
        x1, y1, s1,
        ...
        xn, yn, sn
```

Similar to the PRISM_ command, with the additional hill_material, angle and hill_height parameters for forming a ramp on the top.

hill_material: the side material of the ramp part.

angle: the inclination angle of the ramp side edges.

Restriction: 0 <= angle < 90.

If angle = 0, the hill side edges seen from an orthogonal view form a quarter circle with the current resolution (see the RADIUS command, the RESOL command and the TOLER command).

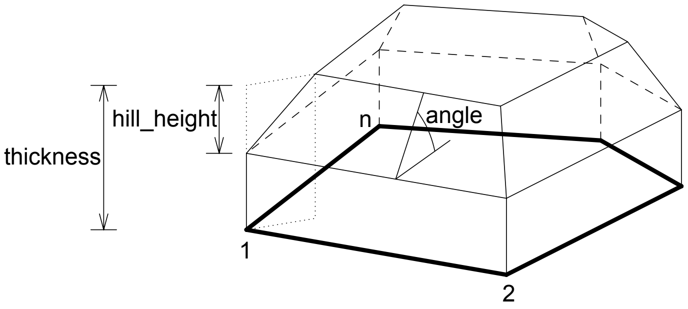
hill_height: the height of the ramp. Note that the thickness parameter represents the whole height of the prism.

si: status code that allows you to control the visibility of polygon edges and side surfaces. You can also define holes and create segments and arcs in the polyline using special constraints.

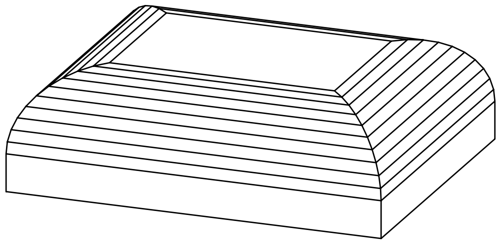
Restriction of parameters:

```
n >= 3, hill_height < thickness
```

See Status Codes for details.

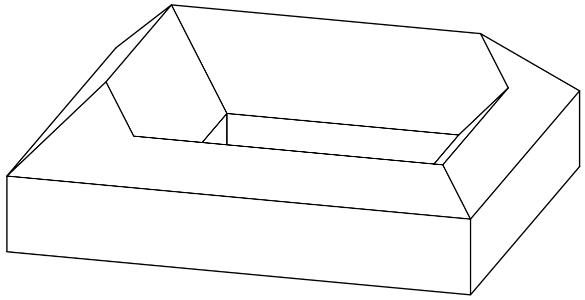


Example 1: Prism with curved ramp



```
RESOL 10
FPRISM_ "Roof Tile", "Brick-Red", "Brick-White", "Roof Tile",
        4, 1.5, 0, 1.0,         !angle = 0
        0, 0, 15,
        5, 0, 15,
        5, 4, 15,
        0, 4, 15
```

Example 2: Prism with straight ramp



```
FPRISM_ "Roof Tile", "Brick-Red", "Brick-White",
        "Roof Tile",
        10, 2, 45, 1,
        0, 0, 15,
        6, 0, 15,
        6, 5, 15,
        0, 5, 15,
        0, 0, -1,
        1, 2, 15,
        4, 2, 15,
        4, 4, 15,
        1, 4, 15,
        1, 2, -1
```

HPRISM_

```
HPRISM_ top_mat, bottom_mat, side_mat,
        hill_mat,
        n, thickness, angle, hill_height, status,
        x1, y1, s1,
        ...
        xn, yn, sn
```

Similar to FPRISM_, with an additional parameter controlling the visibility of the hill edges.

`status:` controls the visibility of the hill edges:

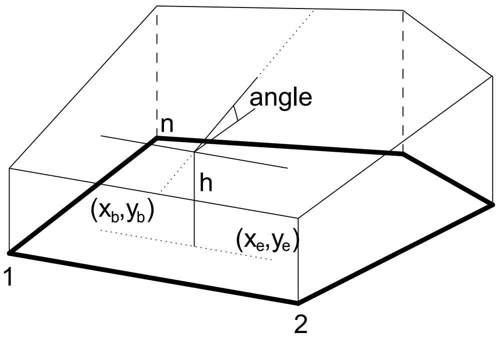
`0:` hill edges are all visible (FPRISM_)

`1:` hill edges are invisible

SPRISM_

```
SPRISM_ top_material, bottom_material, side_material,
        n, xb, yb, xe, ye, h, angle,
        x1, y1, s1,
        ...
        xn, yn, sn
```

Extension of the CPRISM_ command, with the possibility of setting the upper polygon non-parallel with the x-y plane. The upper plane definition is similar to the plane definition of the CROOF_ command. The height of the prism is defined at the reference line. Upper and lower polygon intersection is forbidden.



xb, yb, xe, ye: reference line (vector) starting and end coordinates.

angle: rotation angle of the upper polygon around the given oriented reference line in degrees (CCW).

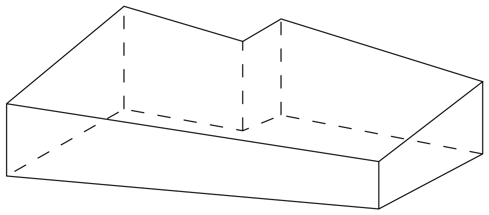
si: status code that allows you to control the visibility of polygon edges and side surfaces. You can also define holes and create segments and arcs in the polyline using special constraints.

See Status Codes for details.

Note: All calculated z coordinates of the upper polygon nodes must be positive or 0.

Example:

```
SPRISM_ 'Grass', 'Earth', 'Earth',
        6,
        0, 0, 11, 6, 2, -10.0,
        0,   0,   15,
        10,  1,   15,
        11,  6,   15,
        5,   7,   15,
        4.5, 5.5, 15,
        1,   6, 15
```



SPRISM_{2}

```
SPRISM_{2} top_material, bottom_material, side_material,
        n,
        xtb, ytb, xte, yte, topz, tangle,
        xbb, ybb, xbe, ybe, bottomz, bangle,
        x1, y1, s1, mat1,
        ...
        xn, yn, sn, matn
```

Extension of the SPRISM_ command, with the possibility of having an upper and lower polygon non-parallel with the x-y plane. The definition of the planes is similar to the plane definition of the CROOF_ command. The top and bottom of the prism is defined at the reference line. Upper and lower polygon intersection is forbidden.

xtb, ytb, xte, yte: reference line (vector) of the top polygon starting and end coordinates.

topz: the 'z' level of the reference line of the top polygon.

tangle: rotation angle of the top polygon around the given oriented reference line in degrees (CCW).

xbb, ybb, xbe, ybe: reference line (vector) of the bottom polygon starting and end coordinates.

bottomz: the 'z' level of the reference line of the bottom polygon.

bangle: rotation angle of the bottom polygon around the given oriented reference line in degrees (CCW).

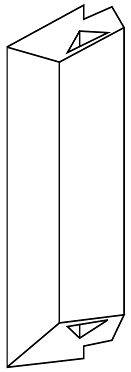
si: status code that allows you to control the visibility of polygon edges and side surfaces. You can also define holes and create segments and arcs in the polyline using special constraints.

See Status Codes for details.

mati: material reference that allows you to control the material of the side surfaces.

Example:

```
SPRISM_{2} 'Grass', 'Earth', 'Earth',
        11,
        0, 0, 11, 0, 30, -30.0,
        0, 0, 0, 11, 2, 30.0,
        0,  0, 15, IND (MATERIAL, 'C10'),
        10, 1, 15, IND (MATERIAL, 'C11'),
        11, 6, 15, IND (MATERIAL, 'C12'),
        5,  7, 15, IND (MATERIAL, 'C13'),
        4,  5, 15, IND (MATERIAL, 'C14'),
        1,  6, 15, IND (MATERIAL, 'C10'),
        0,  0, -1, IND (MATERIAL, 'C15'),
        9,  2, 15, IND (MATERIAL, 'C15'),
        10, 5, 15, IND (MATERIAL, 'C15'),
        6,  4, 15, IND (MATERIAL, 'C15'),
        9,  2, -1, IND (MATERIAL, 'C15')
```



SPRISM_{3}

```
SPRISM_{3} top_material, bottom_material, side_material, mask,
        n,
        xtb, ytb, xte, yte, topz, tangle,
        xbb, ybb, xbe, ybe, bottomz, bangle,
        x1, y1, s1, mat1,
        ...
        xn, yn, sn, matn
```

Extension of the SPRISM_{2} command with the possibility of controlling the global behavior of the generated prism.

mask: controls the global behavior of the generated prism.

`mask = j`$_1$` + 2*j`$_2$` + 4*j`$_3$, where each j can be 0 or 1.

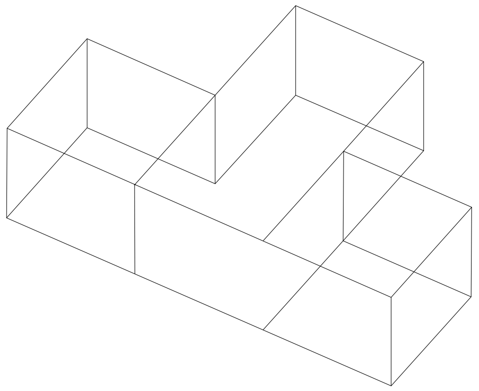
`j`$_1$`:` top edge in line elimination.

`j`$_2$`:` bottom edge in line elimination.

`j`$_3$`:` side edge in line elimination.

Example:

```
PEN 1
mat = IND (MATERIAL, "Mtl-Aluminium")
FOR i=1 TO 4 STEP 1
  IF i = 1 THEN mask = 1+2+4
  IF i = 2 THEN mask = 1
  IF i = 3 THEN mask = 2
  IF i = 4 THEN mask = 4
  SPRISM_{3} mat, mat, mat, mask,
      5,
      0, 0, 1, 0, 1, 0,
      0, 0,  1,  0, 0, 0,
      0, 0, 15, mat,
      1, 0, 15, mat,
      1, 1, 15, mat,
      0, 1, 15, mat,
      0, 0, -1, mat

  BODY -1
  DEL TOP
  IF i = 1 THEN ADDY 1
  IF i = 2 THEN ADDX -1
  IF i = 3 THEN ADDX 1
NEXT i
```



SPRISM_{4}

```
SPRISM_{4} top_material, bottom_material, side_material, mask,
        n,
        xtb, ytb, xte, yte, topz, tangle,
        xbb, ybb, xbe, ybe, bottomz, bangle,
        x1, y1, s1, mat1,
        ...
        xn, yn, sn, matn
```

SPRISM_{4} is an extension of the SPRISM_{3} command with the possibility of using inline material definition, that means materials defined in GDL script locally also can be used next to materials defined in global material definitions.

SLAB

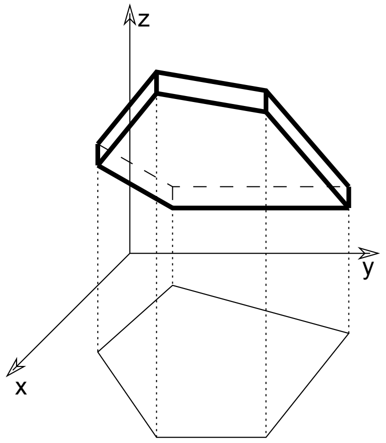
`SLAB` `n, h, x1, y1, z1, ..., xn, yn, zn`

Oblique prism. The lateral faces are always perpendicular to the x-y plane. Its bases are flat polygons rotated about an axis parallel with the x-y plane. Negative h values can also be used. In that case the second base polygon is below the given one.

No check is made as to whether the points are really on a plane. Apices not lying on a plane will result in strange shadings/ renderings.

Restriction of parameters:

```
n >= 3
```



SLAB_

`SLAB_` `n, h, x1, y1, z1, s1, ..., xn, yn, zn, sn`

Similar to the SLAB command, but any of the edges and faces of the side polygons can be omitted. This statement is an analogy of the PRISM_ command.

`si:` status code that allows you to control the visibility of polygon edges and side surfaces. You can also define holes and create segments and arcs in the polyline using special constraints.

See Status Codes for details.

CSLAB_

```
CSLAB_ top_material, bottom_material, side_material,
        n, h,
        x1, y1, z1, s1, ..., xn, yn, zn, sn
```

Extension of the SLAB_ command; the first three parameters are used for the material name/index of the top, bottom and side surfaces. The other parameters are the same as above in the SLAB_ command.

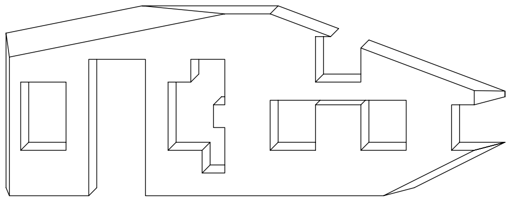
`si:` status code that allows you to control the visibility of polygon edges and side surfaces. You can also define holes and create segments and arcs in the polyline using special constraints.

See Status Codes for details.

CWALL_

```
CWALL_ left_material, right_material, side_material,
        height, x1, x2, x3, x4, t,
        mask1, mask2, mask3, mask4,
        n,
        x_start1, y_low1, x_end1, y_high1, frame_shown1,
        ...
        x_startn, y_lown, x_endn, y_highn, frame_shownn,
        m,
        a1, b1, c1, d1,
        ...
        am, bm, cm, dm
```

`Left_material, right_material, side_material:` Material names/indices for the left, right and side surfaces. (The left and right sides of the wall follow the x axis.)



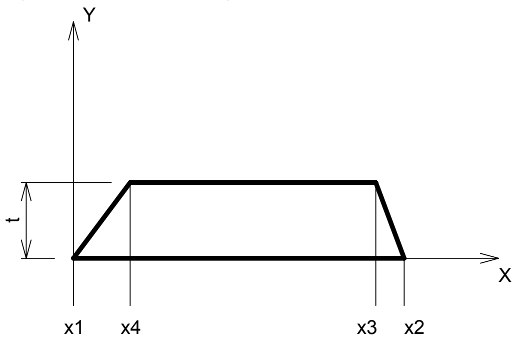
The reference line of the wall is always transformed to coincide with the x axis. The sides of the wall are in the x-z plane.

`height:` The height of the wall relative to its base.

`x1, x2, x3, x4:` The projected endpoints of the wall lying on the x-y plane as seen below. If the wall stands on its own, then x1 = x4 = 0, x2 = x3 = the length of the wall.

`t:` the thickness of the wall.

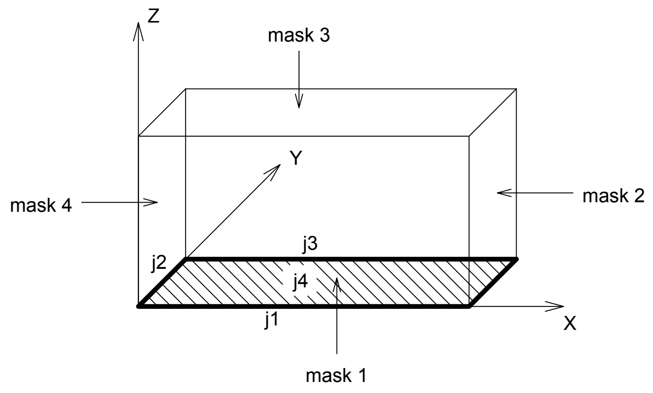
`t < 0:` if the body of the wall is to the right of the x axis,
`t > 0:` if the body of the wall is to the left of the x axis,
`t = 0:` if the wall is represented by a polygon and frames are generated around the holes.



`mask1, mask2, mask3, mask4:` Control the visibility of edges and side polygons.

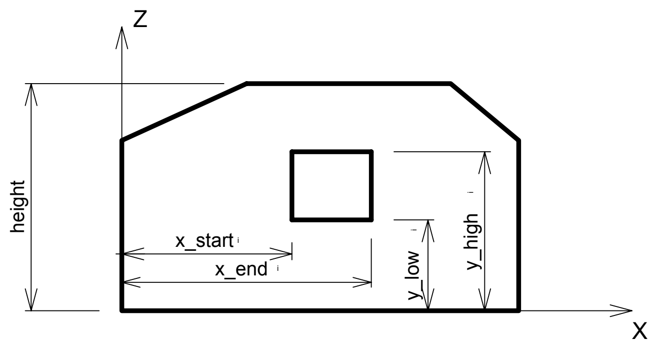
`mask1, mask2, mask3, mask4 =` j_1 `+ 2*`j_2 `+ 4*`j_3 `+ 8*`j_4, where each j can be 0 or 1.

The j1, j2, j3, j4 numbers represent whether the vertices and the side are present (1) or omitted (0).



`n:` the number of openings in the wall.

`x_starti, y_lowi, x_endi, y_highi:` coordinates of the openings as shown below.

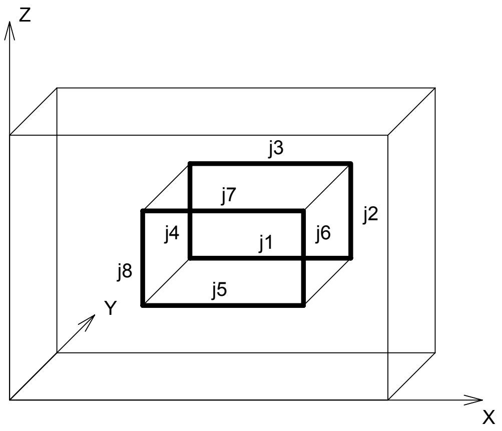


`frame_showni:`

`1:` if the edges of the hole are visible,

`0:` if the edges of the hole are invisible,

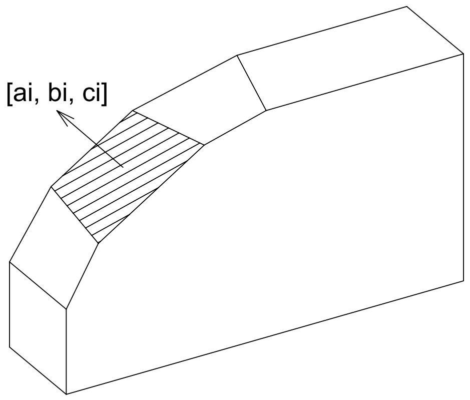
`< 0:` control the visibility of each of the opening's edges separately: frame_showni = -(1*j1 + 2*j2 + 4*j3 + 8*j4 + 16*j5 + 32*j6 + 64*j7 + 128*j8), where j1, j2, ..., j8 can be either 0 or 1. The numbers j1 to j4 control the visibility of the edges of the hole on the left-hand side of the wall surface, while j5 to j8 affect the edges on the right-hand side, as shown on the illustration below.



An edge that is perpendicular to the surface of the wall is visible if there are visible edges drawn from both of its endpoints.

m: the number of cutting planes.

ai, bi, ci, di: coefficients of the equation defining the cutting plane [ai*x + bi*y + ci*z = di]. Parts on the positive side of the cutting plane (i.e., ai*x + bi*y + ci*z > di) will be cut and removed



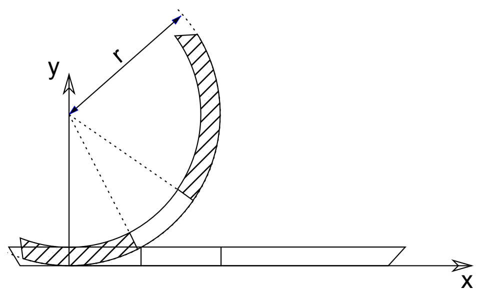
BWALL_

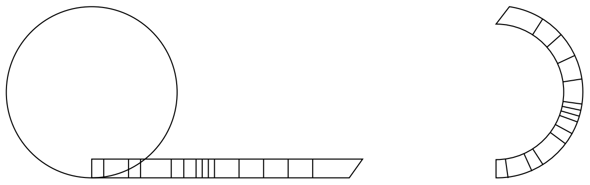
```
BWALL_ left_material, right_material, side_material,
        height, x1, x2, x3, x4, t, radius,
        mask1, mask2, mask3, mask4,
        n,
        x_start1, y_low1, x_end1, y_high1, frame_shown1,
        ...
        x_startn, y_lown, x_endn, y_highn, frame_shownn,
        m,
        a1, b1, c1, d1,
        ...
        am, bm, cm, dm
```

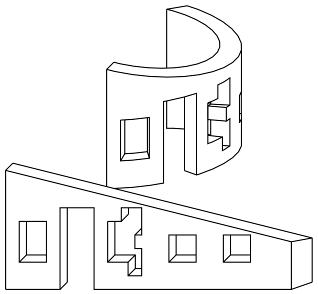
A smooth curved wall based on the same data structure as the straight wall CWALL_ element. The only additional parameter is radius. Derived from the corresponding CWALL_ by bending the x-z plane onto a cylinder tangential to that plane. Edges along the x axis are transformed to circular arcs, edges along the y axis will be radial in direction, and vertical edges remain vertical. The curvature is approximated by a number of segments set by the current resolution (see the RADIUS command, the RESOL command and the TOLER command).

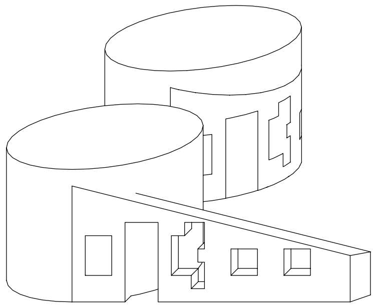
See also the CWALL_ command for details.

*Example 1: a BWALL_ and the corresponding CWALL_*



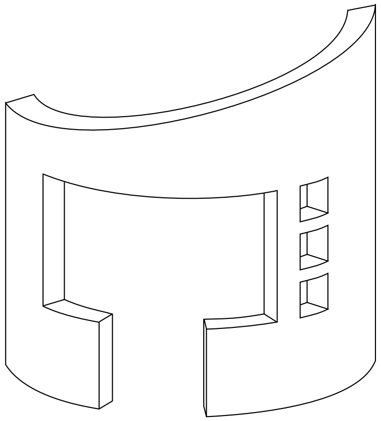






Example 2:

```
ROTZ -60
BWALL_ 1, 1, 1,
        4, 0, 6, 6, 0,
        0.3, 2,
        15, 15, 15, 15,
        5,
        1, 1, 3.8, 2.5, -255,
        1.8, 0, 3, 2.5, -255,
        4.1, 1, 4.5, 1.4, -255,
        4.1, 1.55, 4.5, 1.95,-255,
        4.1, 2.1, 4.5, 2.5, -255,
        1, 0, -0.25, 1, 3
```



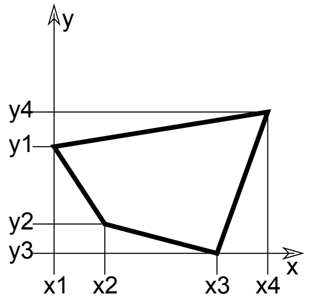
XWALL_

```
XWALL_ left_material, right_material, vertical_material, horizontal_material,
        height, x1, x2, x3, x4,
        y1, y2, y3, y4,
        t, radius,
        log_height, log_offset,
        mask1, mask2, mask3, mask4,
        n,
        x_start1, y_low1, x_end1, y_high1,
        frame_shown1,
        ...
        x_startn, y_lown, x_endn, y_highn,
        frame_shownn,
        m,
        a1, b1, c1, d1,
        ...
        am, bm, cm, dm,
        status
```

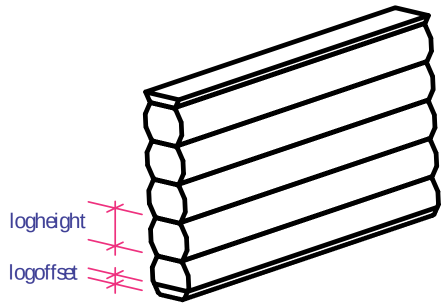
Extended wall definition based on the same data structure as the BWALL_ element.

vertical_material, horizontal_material: name or index of the vertical/horizontal side materials.

y1, y2, y3, y4: the projected endpoints of the wall lying in the x-y plane as seen below.



log_height, log_offset: additional parameters allowing you to compose a wall from logs. Effective only for straight walls.

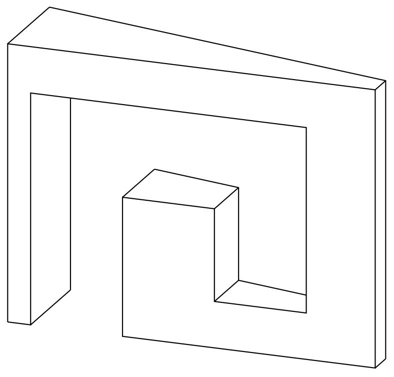


`status:` controls the behavior of log walls

`status = j1 + 2*j2 + 4*j3 + 32*j6 + 64*j7 + 128*j8 + 256*j9`, where each j can be 0 or 1.

- `j1:` apply right side material on horizontal edges,
- `j2:` apply left side material on horizontal edges,
- `j3:` start with half log,
- `j6:` align texture to wall edges,
- `j7:` double radius on bended side,
- `j8:` square log on the right side,
- `j9:` square log on the left side.

Example:



```
XWALL_ "Surf-White", "Surf-White", "Surf-White", "Surf-White",
        3.0,
        0.0, 4.0, 4.0, 0.0,
        0.0, 0.0, 0.3, 1.2,
        1.2, 0.0,
        0.0, 0.0,
        15, 15, 15, 15,
        3,
        0.25, 0.0, 1.25, 2.5, -255,
        1.25, 1.5, 2.25, 2.5, -255,
        2.25, 0.5, 3.25, 2.5, -255, 0
```

XWALL_{2}

```
XWALL_{2} left_material, right_material, vertical_material, horizontal_material,
          height, x1, x2, x3, x4,
          y1, y2, y3, y4,
          t, radius,
          log_height, log_offset,
          mask1, mask2, mask3, mask4,
          n,
          x_start1, y_low1, x_end1, y_high1,
          sill_depth1, frame_shown1,
          ...
          x_startn, y_lown, x_endn, y_highn,
          sill_depthn, frame_shownn,
          m,
          a1, b1, c1, d1,
          ...
          am, bm, cm, dm,
          status
```

Extended wall definition based on the same data structure as the XWALL_ element.

silldepthi: logical depth of the opening sill. If the j9 bit of the frame_showni parameter is set, the wall side materials wraps the hole polygons, silldepthi defining the separator line between them.

frame_showni:

1: if the edges of the hole are visible,

0: if the edges of the hole are invisible,

`< 0:` control the visibility of each of the opening's edges separately: frame_showni = -(1*j1 + 2*j2 + 4*j3 + 8*j4 + 16*j5 + 32*j6 + 64*j7 + 128*j8 + 256*j9 + 512*j10), where j1, j2, ..., j10 can be either 0 or 1. There are two additional values to control the material wrapping. The meaning of the j1, j2, ..., j8 values are the same as at the CWALL_ and XWALL_ commands. The j9 value controls the material of the hole polygons. If j9 is 1, the hole inherits the side materials of the wall. The j10 value controls the form of the separator line between the hole materials on the upper and lower polygons of the hole in case of a bent wall. If the j10 value is 1, the separator line will be straight, otherwise curved.

XWALL_{3}

```
XWALL_{3} left_material, right_material, vertical_material, horizontal_material,
        height, x1, x2, x3, x4,
        y1, y2, y3, y4,
        t, radius,
        log_height, log_offset,
        mask1, mask2, mask3, mask4,
        n,
        x_start1, y_low1, x_end1, y_high1,
        sill_depth1, frame_shown1,
        ...
        x_startn, y_lown, x_endn, y_highn,
        sill_depthn, frame_shownn,
        m,
        a1, b1, c1, d1,
        ...
        am, bm, cm, dm,
        status
```

XWALL_{3} is an extension of XWALL_{2} command with the possibility of hiding all edges of the log wall.

`status:` controls the behavior of log walls

`status` = $j_1 + 2*j_2 + 4*j_3 + 32*j_6 + 64*j_7 + 128*j_8 + 256*j_9 + 512*j_{10}$, where each j can be 0 or 1.

j_1: apply right side material on horizontal edges,

j_2: apply left side material on horizontal edges,

j_3: start with half log,

j_6: align texture to wall edges,

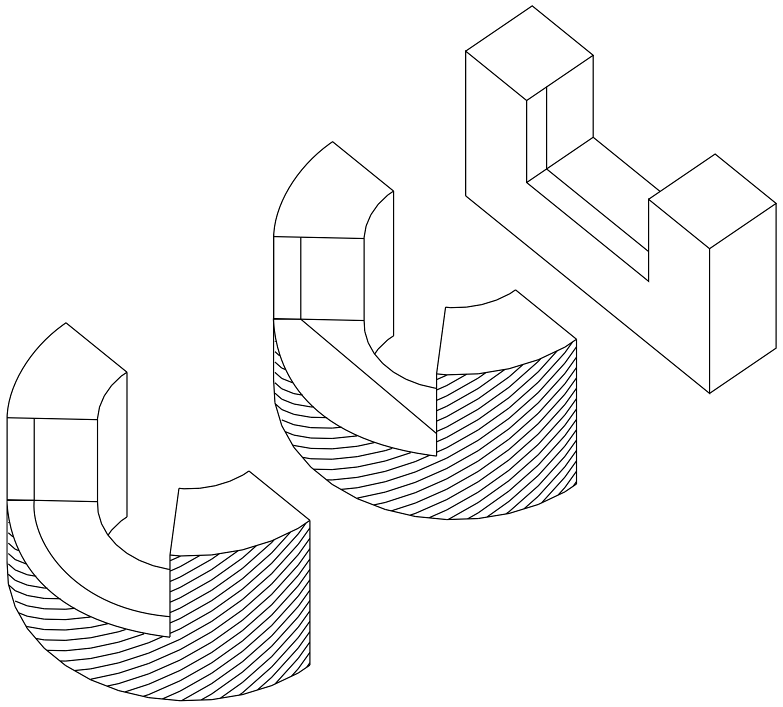
j_7: double radius on bended side,

j_8: square log on the right side,

j_9: square log on the left side,

`j10:` hide all edges of log wall.

Example:



```
ROTZ 90
xWALL_{2} "C13", "C11", "C12", "C12",
        2, 0, 4, 4, 0,
        0, 0, 1, 1,
        1, 0,
        0, 0,
        15, 15, 15, 15,
        1,
        1, 0.9, 3, 2.1, 0.3, -(255 + 256),
        0,
        0
DEL 1
ADDX 2
xWALL_{2} "C13", "C11", "C12", "C12",
        2, 0, 2 * PI, 2 * PI, 0,
        0, 0, 1, 1,
        1, 2,
        0, 0,
        15, 15, 15, 15,
        1,
        1.6, 0.9, 4.6, 2.1, 0.3, -(255 + 256),
        0,
        0
ADDX 4
xWALL_{2} "C13", "C11", "C12", "C12",
        2, 0, 2 * PI, 2 * PI, 0,
        0, 0, 1, 1,
        1, 2,
        0, 0,
        15, 15, 15, 15,
        1,
        1.6, 0.9, 4.6, 2.1, 0.3, -(255 + 256 + 512),
        0,
        0
```

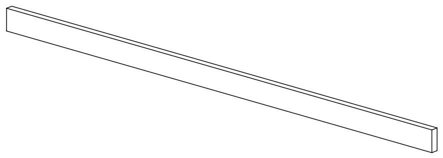
BEAM

```
BEAM left_material, right_material, vertical_material,
        top_material, bottom_material,
        height,
        x1, x2, x3, x4,
        y1, y2, y3, y4, t,
        mask1, mask2, mask3, mask4
```

Beam definition. Parameters are similar to those of the XWALL_ element.

top_material, bottom_material: top and bottom materials.

Example:



```
BEAM 1, 1, 1, 1, 1,
        0.3,
        0.0, 7.0, 7.0, 0.0,
        0.0, 0.0, 0.1, 0.1, 0.5,
        15, 15, 15, 15
```

CROOF_

```
CROOF_ top_material, bottom_material, side_material,
        n, xb, yb, xe, ye, height, angle, thickness,
        x1, y1, alpha1, s1,
        ...
        xn, yn, alphan, sn
```

A sloped roof pitch with custom angle ridges.

top_material, bottom_material, side_material: name/index of the top, bottom and side material.

n: the number of nodes in the roof polygon.

xb, yb, xe, ye: reference line (vector).

`height:` the height of the roof at the reference line (lower surface).

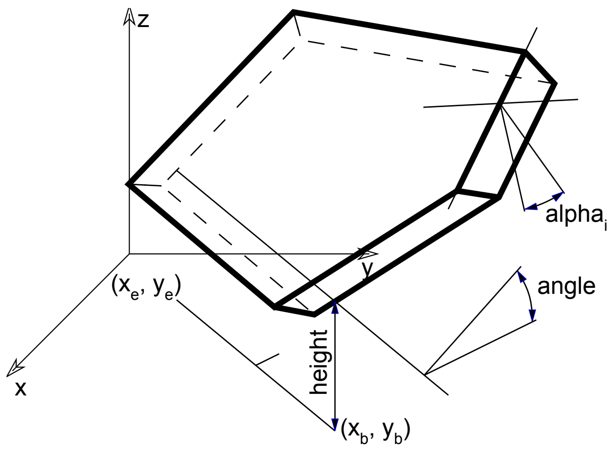
`angle:` the rotation angle of the roof plane around the given oriented reference line in degrees (CCW).

`thickness:` the thickness of the roof measured perpendicularly to the plane of the roof.

`xi, yi:` the coordinates of the nodes of the roof's lower polygon.

`alphai:` the angle between the face belonging to the edge i of the roof and the plane perpendicular to the roof plane, -90° < alphai < 90°. Looking in the direction of the edge of the properly oriented roof polygon, the CCW rotation angle is positive. The edges of the roof polygon are oriented properly if, in top view, the contour is sequenced CCW and the holes are sequenced CW.

`si:` status code that allows you to control the visibility of polygon edges and side surfaces. You can also define holes and create segments and arcs in the polyline using special constraints.

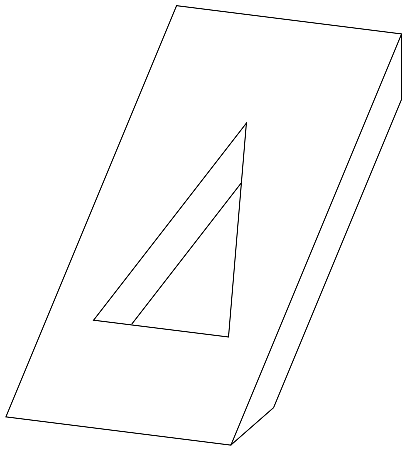


See Status Codes for details.

Restriction of parameters:

```
n >= 3
```

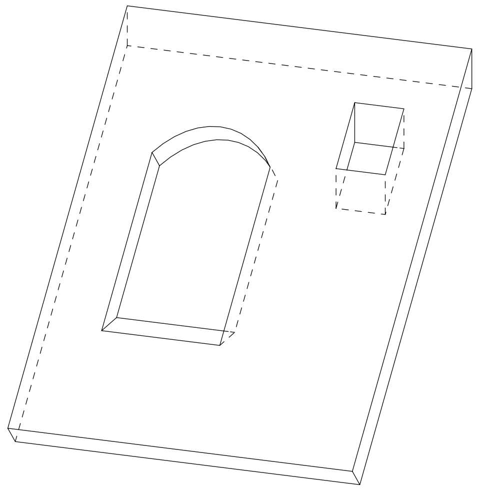
Example 1:



```
CROOF_ 1, 1, 1, ! materials
        9,
        0, 0,
        1, 0, ! reference line (xb,yb)(xe,ye)
        0.0,  ! height
        -30,  ! angle
        2.5,  ! thickness
        0,  0,  -60, 15,
        10, 0,  0,   15,
        10, 20, -30, 15,
        0,  20, 0,   15,
        0,  0,  0,   -1,
        2,  5,  0,   15,
        8,  5,  0,   15,
        5,  15, 0,   15,
        2,  5,  0,   -1
```

Example 2:

```
L=0.25
r=(0.6^2+L^2)/(2*L)
a=ASN(0.6/r)
CROOF_ "Roof Tile", "Pine", "Pine",
        16, 2, 0, 0,
        0, 0, 45, -0.2*SQR(2),
        0,    0,     0,   15,
        3.5,  0,     0,   15,
        3.5,  3,     -45, 15,
        0,    3,     0,   15,
        0,    0,     0,   -1,
        0.65, 1,     -45, 15,
        1.85, 1,     0,   15,
        1.85, 2.4-L, 0,   13,
        1.25, 2.4-r, 0,   900,
        0,    2*a,   0,   4015,
        0.65, 1,     0,   -1,
        2.5,  2,     45,  15,
        3,    2,     0,   15,
        3,    2.5,   -45, 15,
        2.5,  2.5,   0,   15,
        2.5,  2,     0,   -1
```



CROOF_{2}

```
CROOF_{2} top_material, bottom_material, side_material,
        n, xb, yb, xe, ye, height, angle, thickness,
        x1, y1, alpha1, s1, mat1,
        ...
        xn, yn, alphan, sn, matn
```

Extension of the CROOF_ command with the possibility of defining different materials for the sides.

`mati:` material reference that allows you to control the material of the side surfaces.

CROOF_{3}

```
CROOF_{3} top_material, bottom_material, side_material, mask,
          n, xb, yb, xe, ye, height, angle, thickness,
          x1, y1, alpha1, s1, mat1,
          ...
          xn, yn, alphan, sn, matn
```

Extension of the CROOF_{2} command with the possibility of controlling the global behavior of the generated roof.

mask: controls the global behavior of the generated roof.

mask = j_1 + 2*j_2 + 4*j_3, where each j can be 0 or 1.

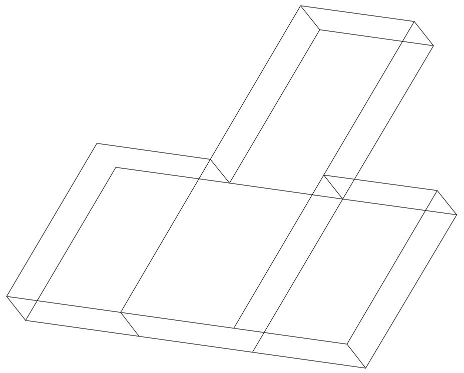
j_1: top edge in line elimination.

j_2: bottom edge in line elimination.

j_3: side edge in line elimination.

Example:

```
PEN 1
mat = IND (MATERIAL, "Mtl-Aluminium")
FOR i=1 TO 4 STEP 1
  IF i = 1 THEN mask = 1+2+4
  IF i = 2 THEN mask = 1
  IF i = 3 THEN mask = 2
  IF i = 4 THEN mask = 4
  CROOF_{3} mat, mat, mat, mask,
      5,  0, 1,  2,  1, 3,   -45,  0.3,
      0,  0,  0,  15, mat,
      1,  0,  0,  15, mat,
      1,  1,  0,  15, mat,
      0,  1,  0,  15, mat,
      0,  0,  0,  -1, mat
  BODY -1
  DEL TOP
  IF i = 1 THEN ADD 0,1,1
  IF i = 2 THEN ADDX -1
  IF i = 3 THEN ADDX 1
NEXT i
```



CROOF_{4}

```
CROOF_{4} top_material, bottom_material, side_material, mask,
          n, xb, yb, xe, ye, height, angle, thickness,
          x1, y1, alpha1, s1, mat1,
          ...
          xn, yn, alphan, sn, matn
```

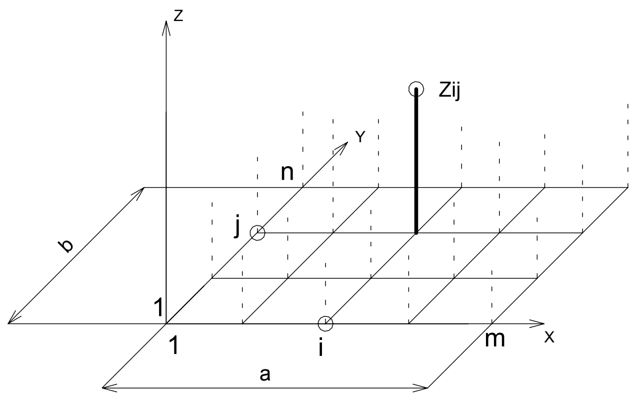
CROOF_{4} is an extension of the CROOF_{3} command with the possibility of using inline material definition, that means materials defined in GDL script locally also can be used next to materials defined in global material definitions.

MESH

```
MESH a, b, m, n, mask,
        z11, z12, ..., z1m,
        z21, z22, ..., z2m,
        ...
        zn1, zn2, ..., znm
```

A simple smooth mesh based on a rectangle with an equidistant net. The sides of the base rectangle are a and b; the m and n points are along the x and y axes respectively; zij is the height of the node.

Masking:



mask:

mask = j_1 + 4*j_3 + 16*j_5 + 32*j_6 + 64*j_7, where each j can be 0 or 1.

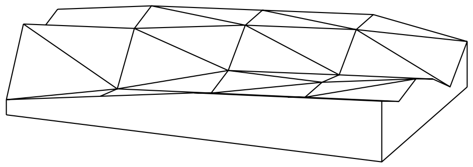
j_1: base surface is present,

`j3`: side surfaces are present,
`j5`: base and side edges are visible,
`j6`: top edges are visible,
`j7`: top edges are visible, top surface is not smooth.

Restriction of parameters:

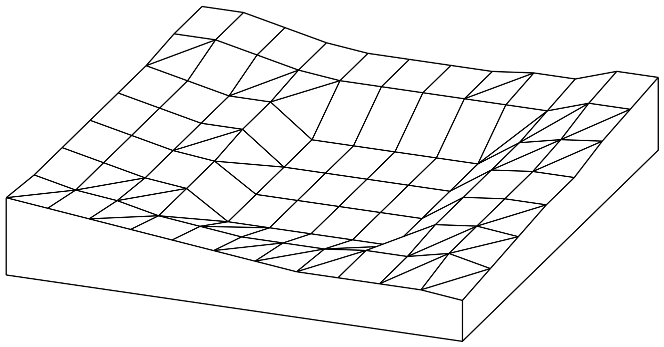
```
m >= 2, n >= 2
```

Example 1:



```
MESH 50, 30, 5, 6, 1+4+16+32+64,
        2, 4, 6, 7, 8,
        10, 3, 4, 5, 6,
        7, 9, 5, 5, 7,
        8, 10, 9, 4, 5,
        6, 7, 9, 8, 2,
        4, 5, 6, 8, 6
```

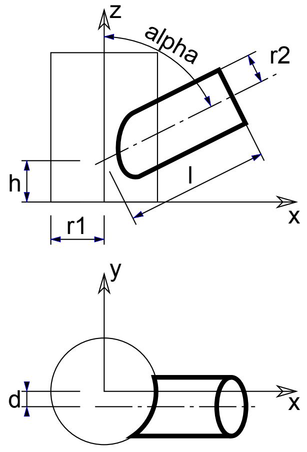
Example 2:



```
MESH 90, 100, 12, 8, 1+4+16+32+64,
        17,16,15,14,13,12,11,10,10,10,10, 9,
        16,14,13,11,10, 9, 9, 9,10,10,12,10,
        16,14,12,11, 5, 5, 5, 5, 5,11,12,11,
        16,14,12,11, 5, 5, 5, 5, 5,11,12,12,
        16,14,12,12, 5, 5, 5, 5, 5,11,12,12,
        16,14,12,12, 5, 5, 5, 5, 5,11,13,14,
        17,17,15,13,12,12,12,12,12,12,15,15,
        17,17,15,13,12,12,12,12,13,13,16,16
```

ARMC

ARMC `r1, r2, l, h, d, alpha`



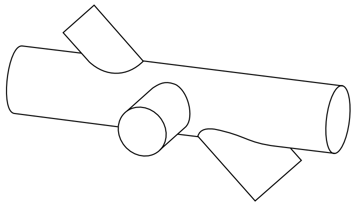
A piece of tube starting from another tube; parameters according to the figure (penetration curves are also calculated and drawn). The alpha value is in degrees.

Restriction of parameters:

```
r1 >= r2 + d
r1 <= l*sin(alpha) - r2*cos(alpha)
```

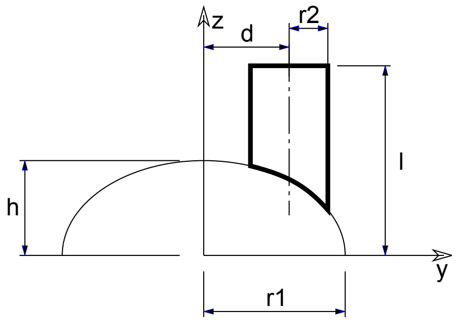
Example:

```
ROTY 90
CYLIND 10,1
ADDZ 6
ARMC 1, 0.9, 3, 0, 0, 45
ADDZ -1
ROTZ -90
ARMC 1, 0.75, 3, 0, 0, 90
ADDZ -1
ROTZ -90
ARMC 1, 0.6, 3, 0, 0, 135
```



ARME

ARME l, r1, r2, h, d



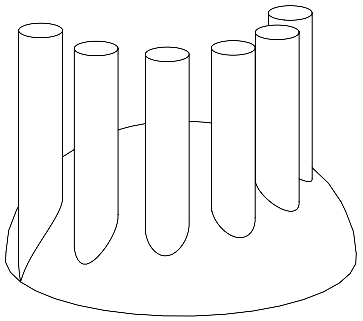
A piece of tube starting from an ellipsoid in the y-z plane; parameters according to the figure (penetration lines are also calculated and drawn).

Restriction of parameters:

```
r1 >= r2+d
l >= h*sqrt(1-(r2-d)2/r12)
```

Example:

```
ELLIPS 3,4
FOR i=1 TO 6
    ARME 6,4,0.5,3,3.7-0.2*i
    ROTZ 30
NEXT i
```



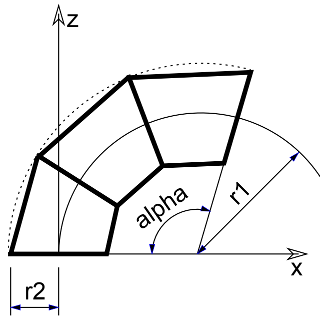
ELBOW

ELBOW r1, alpha, r2

A segmented elbow in the x-z plane. The radius of the arc is r1, the angle is alpha and the radius of the tube segment is r2. The alpha value is in degrees.

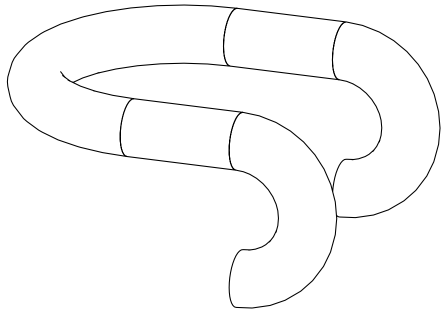
Restriction of parameters:

```
r1 > r2
```



Example:

```
ROTY 90
ELBOW 2.5, 180, 1
ADDZ -4
CYLIND 4, 1
ROTZ -90
MULZ -1
ELBOW 5, 180, 1
DEL 1
ADDX 10
CYLIND 4, 1
ADDZ 4
ROTZ 90
ELBOW 2.5, 180, 1
```



PLANAR SHAPES IN 3D

The drawing elements presented in this section can be used in 3D scripts, allowing you to define points, lines, arcs, circles and planar polygons in the three-dimensional space.

HOTSPOT

HOTSPOT `x, y, z [, unID [, paramReference [, flags [, displayParam [, customDescription]]]]]`

A 3D hotspot in the point (x, y, z).

unID: the unique identifier of the hotspot in the 3D script. It is useful if you have a variable number of hotspots.

paramReference: parameter that can be edited by this hotspot using the graphical hotspot based parameter editing method.

displayParam: parameter to display in the information palette when editing the paramRefrence parameter. Members of arrays can be passed as well.

customDescription: custom description of the displayed parameter in the information palette. When using this option, displayParam must be set as well (use paramReference for default).

See Graphical Editing Using Hotspots for using HOTSPOT.

HOTLINE

HOTLINE `x1, y1, z1, x2, y2, z2, unID`

A status line segment between the points P1 (x1,y1,z1) and P2 (x2,y2,z2).

HOTARC

`HOTARC` `r, alpha, beta, unID`

A status arc in the x-y plane with its center at the origin from angle alpha to beta with a radius of r.

Alpha and beta are in degrees.

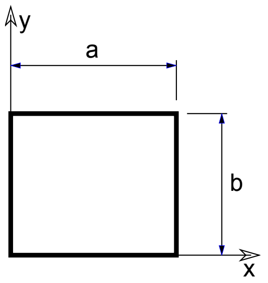
LIN_

`LIN_` `x1, y1, z1, x2, y2, z2`

A line segment between the points P1 (x1,y1,z1) and P2 (x2,y2,z2).

RECT

`RECT` `a, b`



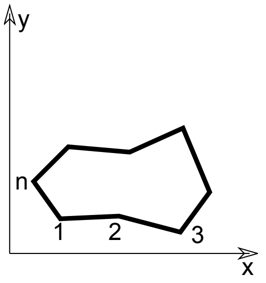
A rectangle in the x-y plane with sides a and b.

Restriction of parameters:

```
  a >= 0, b >= 0
```

POLY

`POLY` `n, x1, y1, ..., xn, yn`



A polygon with n edges in the x-y plane. The coordinates of nodei are (xi, yi, 0).

Restriction of parameters:

```
n >= 3
```

POLY_

POLY_ `n, x1, y1, s1, ..., xn, yn, sn`

Similar to the normal POLY statement, but any of the edges can be omitted.

si: status code that allows you to control the visibility of polygon edges and side surfaces. You can also define holes and create segments and arcs in the polyline using special constraints.

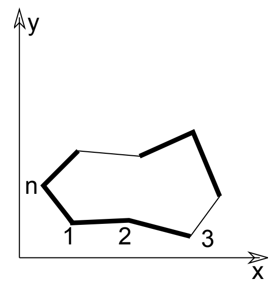
`si = 0:` the edge starting from the (xi,yi) apex will be omitted,

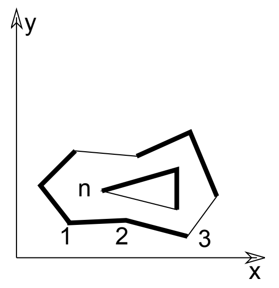
`si = 1:` the edge will be shown,

`si = -1:` is used to define holes directly.

Additional status codes allow you to create segments and arcs in the planar polyline using special constraints.

See the section called "Additional Status Codes" for details.





Restriction of parameters:

```
n >= 3
```

PLANE

PLANE `n, x1, y1, z1, ..., xn, yn, zn`

A polygon with n edges on an arbitrary plane. The coordinates of nodei are (xi, yi, zi). The polygon must be planar in order to get a correct shading/rendering result, but the interpreter does not check this condition.

Restriction of parameters:

```
n >= 3
```

PLANE_

PLANE_ `n, x1, y1, z1, s1, ..., xn, yn, zn, sn`

Similar to the PLANE command, but any of the edges can be omitted as in the POLY_ command.

Additional status codes allow you to create segments and arcs in the planar polyline using special constraints.

See the section called "Additional Status Codes".

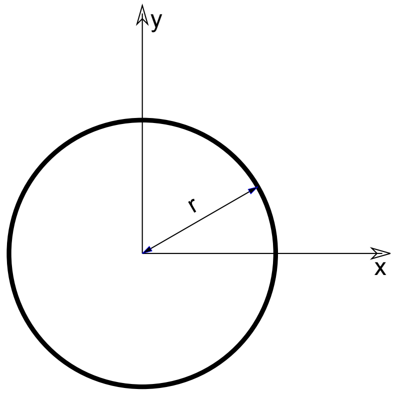
Restriction of parameters:

```
n >= 3
```

CIRCLE

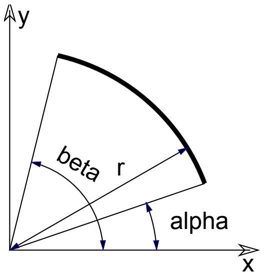
CIRCLE `r`

A circle in the x-y plane with its center at the origin and with a radius of r.



ARC

ARC `r, alpha, beta`



An arc (in Wireframe mode) or sector (in other modes) in the x-y plane with its center at the origin from angle alpha to beta with a radius of r. alpha and beta are in degrees.

Shapes Generated from Polylines

These elements let you create complex 3D shapes using a polyline and a built-in rule. You can rotate, project or translate the given polyline. The resulting bodies are a generalization of some previously described elements like `PRISM_` and `CYLIND`.

Shapes generated from a single polyline:

- `EXTRUDE`
- `PYRAMID`
- `REVOLVE`

Shapes generated from two polylines:

- `RULED`
- `SWEEP`
- `TUBE`
- `TUBEA`

The first polyline is always in the x-y plane. Points are determined by two coordinates; the third value is the status (see below). The second polyline (for RULED, SWEEP, TUBE and TUBEA) is a space curve. Apices are determined by three coordinate values.

Shape generated from four polylines:

- `COONS`

Shape generated from any number of polylines:

- `MASS`

General restrictions for polylines

- Adjacent vertices must not be coincident (except RULED).
- The polyline must not intersect itself (this is not checked by the program, but hidden line removal and rendering will be incorrect).
- The polylines may be either open or closed. In the latter case, the first node must be repeated after the last one of the contour.

Masking

Mask values are used to show or hide characteristic surfaces and/or edges of the 3D shape. The mask values are specific to each element and you can find a more detailed description in their corresponding sections/chapters.

`mask:`

mask = $j_1 + 2*j_2 + 4*j_3 + 8*j_4 + 16*j_5 + 32*j_6 + 64*j_7$, where each j can be 0 or 1.

j1, j2, j3, j4 represent whether the surfaces are present (1) or omitted (0).

j5, j6, j7 represent whether the edges are visible (1) or invisible (0).

j_1: base surface.
j_2: top surface.
j_3: side surface.
j_4: other side surface.
j_5: base edges.
j_6: top edges.

`j7:` cross-section/surface edges are visible, surface is not smooth.

To enable all faces and edges, set mask value to 127.

Status

Status values are used to state whether a given point of the polyline will leave a sharp trace of its rotation path behind.

0: latitudinal arcs/lateral edges starting from the node are all visible.

1: latitudinal arcs/lateral edges starting from the node are used only for showing the contour.

-1: for EXTRUDE only: it marks the end of the enclosing polygon or a hole, and means that the next node will be the first node of another hole.

Additional status codes allow you to create segments and arcs in the polyline using special constraints.

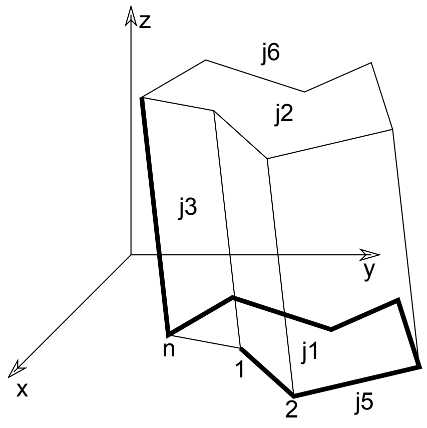
See the section called "Additional Status Codes" for details.

To create a smooth 3D shape, set all status values to 1. Use status = 0 to create a ridge.

Other values are reserved for future enhancements.

EXTRUDE

```
EXTRUDE n, dx, dy, dz, mask,
        x1, y1, s1,
        ...
        xn, yn, sn
```



General prism using a polyline base in the x-y plane.

The displacement vector between bases is (dx, dy, dz). This is a generalization of the PRISM command and the SLAB command. The base polyline is not necessarily closed, as the lateral edges are not always perpendicular to the x-y plane. The base polyline may include holes, just like PRISM_. It is possible to control the visibility of the contour edges.

n: the number of polyline nodes.

mask: controls the existence of the bottom, top and (in case of an open polyline) side polygon.

`mask` = $j_1 + 2*j_2 + 4*j_3 + 16*j_5 + 32*j_6 + 64*j_7 + 128*j_8$, where each j can be 0 or 1.

j_1: base surface is present,

j_2: top surface is present,

j_3: side (closing) surface is present,

j_5: base edges are visible,

j_6: top edges are visible.

j_7: cross-section edges are visible, surface is articulated,

j_8: cross-section edges are sharp, the surface smoothing will stop here in OpenGL and rendering.

si: status of the lateral edges or marks the end of the polygon or of a hole. You can also define arcs and segments in the polyline using additional status code values:

`0`: lateral edge starting from the node is visible,

`1`: lateral edges starting from the node are used for showing the contour,

`-1`: marks the end of the enclosing polygon or a hole, and means that the next node will be the first vertex of another hole.

Additional status codes allow you to create segments and arcs in the planar polyline using special constraints.

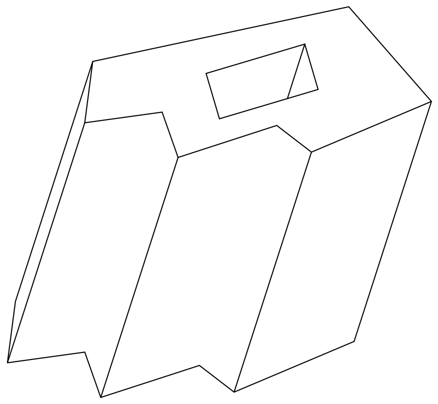
See the section called "Additional Status Codes" for details.

Restriction of parameters:

`n > 2`

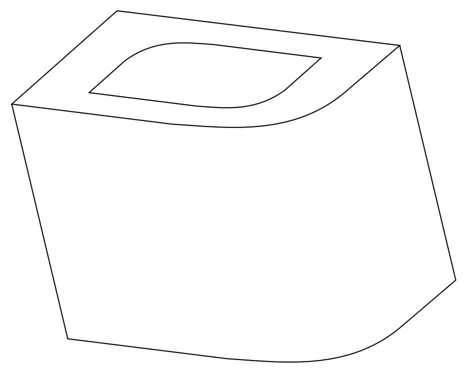
Example 1:

```
EXTRUDE 14, 1, 1, 4, 1+2+4+16+32,
        0, 0, 0,
        1, -3, 0,
        2, -2, 1,
        3, -4, 0,
        4, -2, 1,
        5, -3, 0,
        6, 0, 0,
        3, 4, 0,
        0, 0, -1,
        2, 0, 0,
        3, 2, 0,
        4, 0, 0,
        3, -2, 0,
        2, 0, -1
```



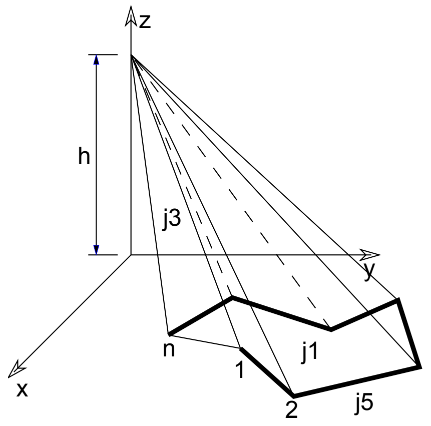
Example 2:

```
A=5: B=5: R=2: S=1: C=R-S : D=A-R : E=B-R
EXTRUDE 28, -1, 0, 4, 1+2+4+16+32,
        0, 0, 0,
        D+R*sin(0),  R-R*cos(0), 1,
        D+R*sin(15), R-R*cos(15), 1,
        D+R*sin(30), R-R*cos(30), 1,
        D+R*sin(45), R-R*cos(45), 1,
        D+R*sin(60), R-R*cos(60), 1,
        D+R*sin(75), R-R*cos(75), 1,
        D+R*sin(90), R-R*cos(90), 1,
        A, B, 0,
        0, B, 0,
        0, 0, -1,
        C, C, 0,
        D+S*sin(0),  R-S*cos(0), 1,
        D+S*sin(15), R-S*cos(15), 1,
        D+S*sin(30), R-S*cos(30), 1,
        D+S*sin(45), R-S*cos(45), 1,
        D+S*sin(60), R-S*cos(60), 1,
        D+S*sin(75), R-S*cos(75), 1,
        D+S*sin(90), R-S*cos(90), 1,
        A-C,B-C,0,
        R-S*cos(90), E+S*sin(90), 1,
        R-S*cos(75), E+S*sin(75), 1,
        R-S*cos(60), E+S*sin(60), 1,
        R-S*cos(45), E+S*sin(45), 1,
        R-S*cos(30), E+S*sin(30), 1,
        R-S*cos(15), E+S*sin(15), 1,
        R-S*cos(0),  E+S*sin(0), 1,
        C, C, -1
```



PYRAMID

PYRAMID `n, h, mask, x1, y1, s1, ..., xn, yn, sn`



Pyramid based on a polyline in the x-y plane. The peak of the pyramid is located at (0, 0, h).

`n:` number of polyline nodes.

`mask:` controls the existence of the bottom and (in the case of an open polyline) side polygon.

`mask` = $j_1 + 4*j_3 + 16*j_5$, where each j can be 0 or 1.

j_1: base surface is present,

j_3: side (closing) surface is present,

j_5: base edges are visible.

`si:` status of the lateral edges.

`0:` lateral edges starting from the node are all visible,

`1:` lateral edges starting from the node are used for showing the contour.

Additional status codes allow you to create segments and arcs in the planar polyline using special constraints.

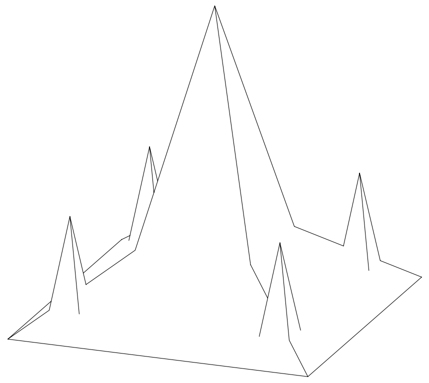
See the section called "Additional Status Codes" for details.

Restriction of parameters:

```
h > 0 and n > 2
```

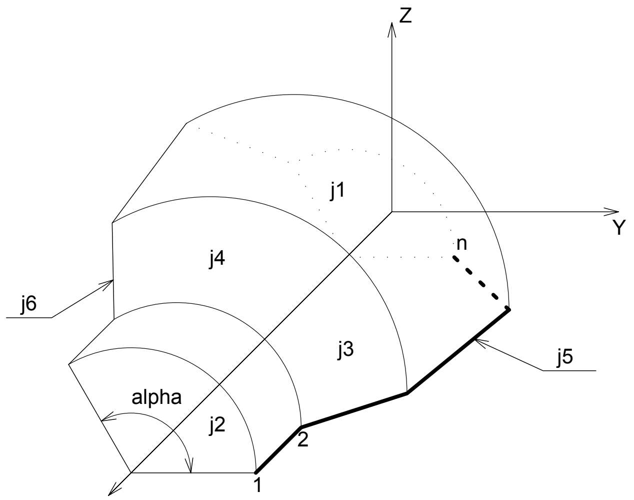
Example:

```
PYRAMID 4, 1.5, 1+4+16,
        -2, -2, 0,
        -2, 2, 0,
        2, 2, 0,
        2, -2, 0
PYRAMID 4, 4, 21,
        -1, -1, 0,
        1, -1, 0,
        1, 1, 0,
        -1, 1, 0
for i = 1 to 4        ! four peaks
    ADD -1.4, -1.4, 0
    PYRAMID 4, 1.5, 21,
            -0.25, -0.25, 0,
            0.25, -0.25, 0,
            0.25, 0.25, 0,
            -0.25, 0.25, 0
    DEL 1
    ROTZ 90
next i
del 4
```



REVOLVE

REVOLVE n, alpha, mask, x1, y1, s1, ..., xn, yn, sn



Surface generated by rotating a polyline defined in the x-y plane around the x axis. The profile polyline cannot contain holes.

`n:` number of polyline nodes.

`alpha:` rotation angle in degrees

`mask:` controls the existence of the bottom, top and (in the case of alpha < 360°) side polygons.

`mask = j`$_1$` + 2*j`$_2$` + 4*j`$_3$` + 8*j`$_4$` + 16*j`$_5$` + 32*j`$_6$` + 64*j`$_7$` + 128*j`$_8$` + 256*j`$_9$, where each j can be 0 or 1.

`j`$_1$`:` closing disc at first point is present,
`j`$_2$`:` closing disc at last point is present,
`j`$_3$`:` base closing side (in profile plane) is present,
`j`$_4$`:` end closing side (in revolved plane) is present,
`j`$_5$`:` base edges (in profile plane) are visible,
`j`$_6$`:` end edges (in revolved plane) are visible,
`j`$_7$`:` cross-section edges are visible, surface is articulated,
`j`$_8$`:` horizontal edge in line elimination,
`j`$_9$`:` vertical edge in line elimination.

`si:` status of the latitudinal arcs.

`0:` latitudinal arcs starting from the node are all visible, `1:` latitudinal arcs starting from the node are used for showing the contour,

`2:` when using ARCHICAD or Z-buffer Rendering Engine and setting Smooth Surfaces, the latitudinal edge belonging to this point defines a break. This solution is equivalent to the definition of additional nodes. The calculation is performed by the compiler. With other rendering methods, it has the same effect as using 0.

Additional status codes allow you to create segments and arcs in the planar polyline using special constraints.

See the section called "Additional Status Codes" for details.

Restriction of parameters:

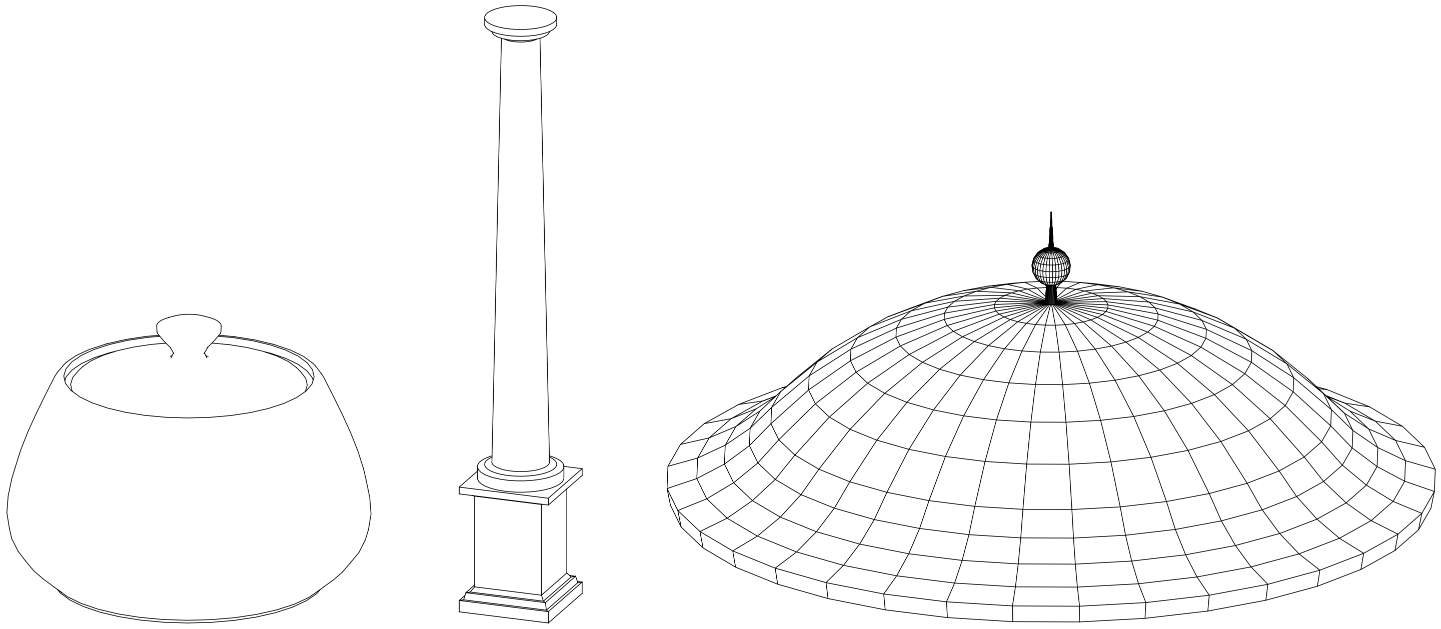
`n >= 2`

y_i `>= 0.0`

y_i `= 0.0 and` y_{i+1} `= 0.0 cannot stand at the same time`

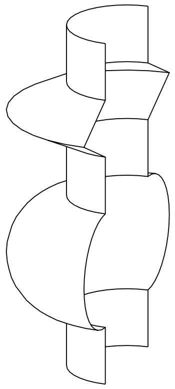
`(i.e., the y value of two neighboring nodes cannot be zero at the same time).`

Example 1:



```
ROTY -90
REVOLVE 22, 360, 1+64,
        0, 1.982, 0,
        0.093, 2,     0,
        0.144, 1.845, 0,
        0.220, 1.701, 0,
        0.318, 1.571, 0,
        0.436, 1.459, 0,
        0.617, 1.263, 0,
        0.772, 1.045, 0,
        0.896, 0.808, 0,
        0.987, 0.557, 0,
        1.044, 0.296, 0,
        1.064, 0.030, 0,
        1.167, 0.024, 0,
        1.181, 0.056, 0,
        1.205, 0.081, 0,
        1.236, 0.096, 0,
        1.270, 0.1,   0,
        1.304, 0.092, 0,
        1.333, 0.073, 0,
        1.354, 0.045, 0,
        1.364, 0.012, 0,
        1.564, 0,     0
```

Example 2:



workaround without status code 2:

```
ROTY -90
REVOLVE 26, 180, 16+32,
        7, 1, 0,
        6.0001, 1,      1,
        6,      1,      0,
        5.9999, 1.0002, 1,
        5.5001, 1.9998, 1,
        5.5,    2,      0,
        5.4999, 1.9998, 1,
        5.0001, 1.0002, 1,
        5,      1,      0,
        4.9999, 1,      1,
        4.0001, 1,      1,
        4,      1,      0,
        3+cos(15),  1+sin(15),  1,
        3+cos(30),  1+sin(30),  1,
        3+cos(45),  1+sin(45),  1,
        3+cos(60),  1+sin(60),  1,
        3+cos(75),  1+sin(75),  1,
        3,      2,      1,
        3+cos(105), 1+sin(105), 1,
        3+cos(120), 1+sin(120), 1,
        3+cos(135), 1+sin(135), 1,
        3+cos(150), 1+sin(150), 1,
        3+cos(165), 1+sin(165), 1,
        2,      1,      0,
        1.9999, 1,      0,
        1,      1,      0
```

the same result with status code 2:

```
ROTY -90
REVOLVE 18, 180, 48,
        7, 1, 0,
        6, 1, 2,
        5.5, 2, 2,
        5, 1, 2,
        4, 1, 2,
        3+cos(15), 1+sin(15), 1,
        3+cos(30), 1+sin(30), 1,
        3+cos(45), 1+sin(45), 1,
        3+cos(60), 1+sin(60), 1,
        3+cos(75), 1+sin(75), 1,
        3, 2, 1,
        3+cos(105), 1+sin(105), 1,
        3+cos(120), 1+sin(120), 1,
        3+cos(135), 1+sin(135), 1,
        3+cos(150), 1+sin(150), 1,
        3+cos(165), 1+sin(165), 1,
        2, 1, 2,
        1, 1, 0
```

REVOLVE{2}

```
REVOLVE{2} n, alphaOffset, alpha, mask, sideMat,
        x1, y1, s1, mat1, ..., xn, yn, sn, matn
```

Advanced version of REVOLVE. The profile polygon will always be closed and may have holes. The start angle and the face materials are controllable.

alphaOffset: rotation start angle.

alpha: rotation angle length in degrees, may be negative.

mask: controls the existence of the bottom, top and (in the case of alpha < 360°) side polygons.

`mask = 4*`j_3` + 8*`j_4` + 16*`j_5` + 32*`j_6` + 64*`j_7` + 128*`j_8` + 256*`j_9, where each j can be 0 or 1.

j_3: base closing side (in profile plane) is present,
j_4: end closing side (in revolved plane) is present,
j_5: base edges (in profile plane) are visible,
j_6: end edges (in revolved plane) are visible,
j_7: cross-section edges are visible, surface is articulated,
j_8: horizontal edge in line elimination,
j_9: vertical edge in line elimination.

sideMat: material of the closing faces.

mati: material of the face generated from the i-th edge.

REVOLVE{3}

```
REVOLVE{3} n, alphaOffset, alpha, betaOffset, beta, mask, sideMat,
        x1, y1, s1, mat1, ..., xn, yn, sn, matn
```

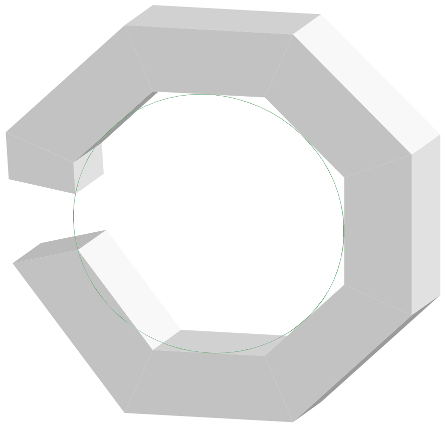
REVOLVE{3} is an extension of the REVOLVE{2} command with the possibility of defining two snap position. During the revolution the path of each point of the base polyline is a circular arc, which is approximated by a polyline. With REVOLVE{3} two snap location can be defined where polyline exactly fits the circle. With REVOLVE{2} this two snap locations are at the beginning and the end of the revolution. With REVOLVE{3} the end points are not necessarily on the circle but simply cut at end planes.

betaOffset: Angle defining the first snap location. The defined angle need not be in the range of revolution.

beta: Angle defining the second snap location relative to the first snap location. May be negative. The defined angle need not be in the range of revolution.

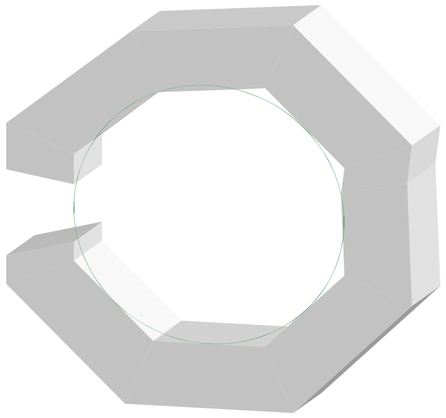
Example:

revolve{2} snap positions at ends



```
resol 8
revolve{2} 4,
  10, 335,    ! alphaOffset, alpha
  444, 2,
  0, 4, 2, 2,
  3, 4, 2, 2,
  3, 6, 2, 2,
  0, 6, 2, 2
! reference circle
resol 72
revolve{2} 4,
  0, 360,    ! alphaOffset, alpha
  444, 0,
  -0.01, 3.99, 2, 0,
  0, 3.99, 2, 0,
  0, 4, 2, 0,
  -0.01, 4, 2, 0
```

revolve{3} custom snap positions



```
resol 8
revolve{3} 4,
  10, 335,    ! alphaOffset, alpha
  67.5, 100,  ! betaOffset, beta
  444, 2,
  0, 4, 2, 2,
  3, 4, 2, 2,
  3, 6, 2, 2,
  0, 6, 2, 2
! reference circle
resol 72
revolve{2} 4,
  0, 360,    ! alphaOffset, alpha
  444, 0,
  -0.01, 3.99, 2, 0,
  0, 3.99, 2, 0,
  0, 4, 2, 0,
  -0.01, 4, 2, 0
```

REVOLVE{4}

```
REVOLVE{4} n, alphaOffset, alpha, betaOffset, beta, mask, sideMat,
        x1, y1, s1, mat1, ..., xn, yn, sn, matn
```

REVOLVE{4} is an extension of the REVOLVE{3} command with the possibility of hiding all edges.

mask: controls the existence of the bottom, top and (in the case of alpha < 360°) side polygons.

mask = $4*j_3 + 8*j_4 + 16*j_5 + 32*j_6 + 64*j_7 + 128*j_8 + 256*j_9 + 512*j_{10}$, where each j can be 0 or 1.

j_3: base closing side (in profile plane) is present,
j_4: end closing side (in revolved plane) is present,
j_5: base edges (in profile plane) are visible,
j_6: end edges (in revolved plane) are visible,
j_7: cross-section edges are visible, surface is articulated,
j_8: horizontal edge in line elimination,
j_9: vertical edge in line elimination,
j_{10}: hide all edges of revolve.

REVOLVE{5}

```
REVOLVE{5}n, alphaOffset, alpha, betaOffset, beta, mask, sideMat,
        x1, y1, s1, mat1, ..., xn, yn, sn, matn
```

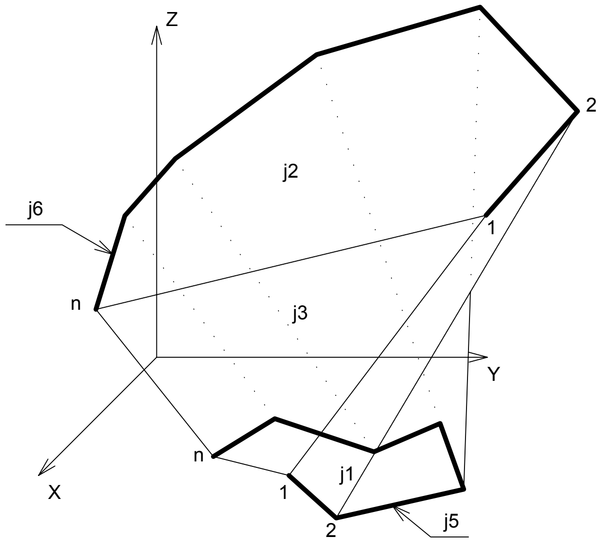
REVOLVE{5} is an extension of the REVOLVE{4} command with the possibility of using inline material definition, that means materials defined in GDL script locally also can be used next to materials defined in global material definitions.

RULED

```
RULED n, mask,
        u1, v1, s1, ..., un, vn, sn,
        x1, y1, z1, ..., xn, yn, zn
```

RULED{2}

```
RULED{2} n, mask,
        u1, v1, s1, ..., un, vn, sn,
        x1, y1, z1, ..., xn, yn, zn
```



RULED is a surface based on a planar curve and a space curve having the same number of nodes. The planar curve polyline cannot have any holes. Straight segments connect the corresponding nodes of the two polylines.

This is the only GDL element allowing the neighboring nodes to overlap.

The second version, RULED{2}, checks the direction (clockwise or counterclockwise) in which the points of both the top polygon and base polygon were defined, and reverses the direction if necessary. (The original RULED command takes only the base polygon into account, which can lead to errors.)

n: number of polyline nodes in each curve.

ui, vi: coordinates of the planar curve nodes.

xi, yi, zi: coordinates of the space curve nodes.

mask: controls the existence of the bottom, top and side polygon and the visibility of the edges on the generator polylines. The side polygon connects the first and last nodes of the curves, if any of them are not closed.

mask = $j_1 + 2*j_2 + 4*j_3 + 16*j_5 + 32*j_6 + 64*j_7$, where each j can be 0 or 1.

j_1: base surface is present,

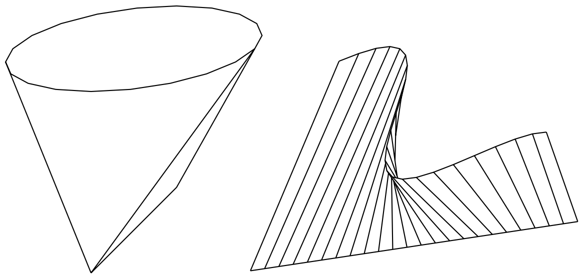
j_2: top surface is present (not effective if the top surface is not planar),

`j3:` side surface is present (a planar quadrangle or two triangles),
`j5:` edges on the planar curve are visible,
`j6:` edges on the space curve are visible,
`j7:` edges on the surface are visible, surface is not smooth.

`si:` status of the lateral edges.
`0:` lateral edges starting from the node are all visible,
`1:` lateral edges starting from the node are used for showing the contour.

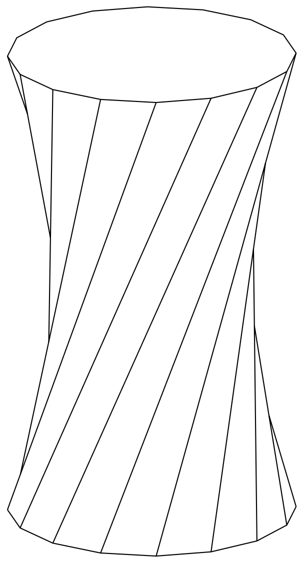
Restriction of parameters:

```
n > 1
```



Example:

```
R=3
RULED 16, 1+2+4+16+32,
        cos(22.5)*R,  sin(22.5)*R,  0,
        cos(45)*R,    sin(45)*R,    0,
        cos(67.5)*R,  sin(67.5)*R,  0,
        cos(90)*R,    sin(90)*R,    0,
        cos(112.5)*R, sin(112.5)*R, 0,
        cos(135)*R,   sin(135)*R,   0,
        cos(157.5)*R, sin(157.5)*R, 0,
        cos(180)*R,   sin(180)*R,   0,
        cos(202.5)*R, sin(202.5)*R, 0,
        cos(225)*R,   sin(225)*R,   0,
        cos(247.5)*R, sin(247.5)*R, 0,
        cos(270)*R,   sin(270)*R,   0,
        cos(292.5)*R, sin(292.5)*R, 0,
        cos(315)*R,   sin(315)*R,   0,
        cos(337.5)*R, sin(337.5)*R, 0,
        cos(360)*R,   sin(360)*R,   0,
        cos(112.5)*R, sin(112.5)*R, 10,
        cos(135)*R,   sin(135)*R,   10,
        cos(157.5)*R, sin(157.5)*R, 10,
        cos(180)*R,   sin(180)*R,   10,
        cos(202.5)*R, sin(202.5)*R, 10,
        cos(225)*R,   sin(225)*R,   10,
        cos(247.5)*R, sin(247.5)*R, 10,
        cos(270)*R,   sin(270)*R,   10,
        cos(292.5)*R, sin(292.5)*R, 10,
        cos(315)*R,   sin(315)*R,   10,
        cos(337.5)*R, sin(337.5)*R, 10,
        cos(360)*R,   sin(360)*R,   10,
        cos(22.5)*R,  sin(22.5)*R,  10,
        cos(45)*R,    sin(45)*R,    10,
        cos(67.5)*R,  sin(67.5)*R,  10,
        cos(90)*R,    sin(90)*R,    10
```



SWEEP

```
SWEEP n, m, alpha, scale, mask,
        u1, v1, s1, ..., un, vn, sn,
        x1, y1, z1, ..., xm, ym, zm
```

Surface generated by a polyline sweeping along a polyline space curve path.

The plane of the polyline follows the path curve. The space curve has to start from the x-y plane. If this condition is not met, it is moved along the z axis to start on the x-y plane.

The cross-section at point (xi, yi, zi) is perpendicular to the space curve segment between points (xi-1, yi-1, zi-1) and (xi, yi, zi).

SWEEP can be used to model the spout of a teapot and other complex shapes.

n: number of polyline nodes.

m: number of path nodes.

alpha: incremental polyline rotation on its own plane, from one path node to the next one.

scale: incremental polyline scale factor, from one path node to the next one.

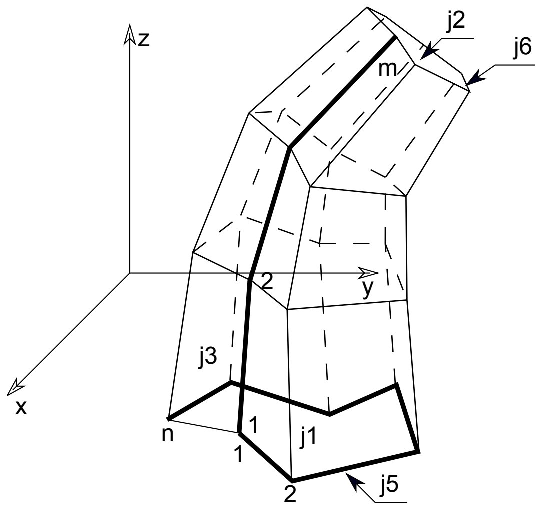
ui, vi: coordinates of the base polyline nodes.

xi, yi, zi: coordinates of the path curve nodes.

mask: controls the existence of the bottom and top polygons' surfaces and edges.

mask = $j_1 + 2*j_2 + 4*j_3 + 16*j_5 + 32*j_6 + 64*j_7$, where each j can be 0 or 1.

j_1: base surface is present,
j_2: top surface is present,
j_3: side surface is present,
j_5: base edges are visible,
j_6: top edges are visible,
j_7: cross-section edges are visible, surface is articulated.



si: status of the lateral edges.

`0:` lateral edges starting from the node are all visible,

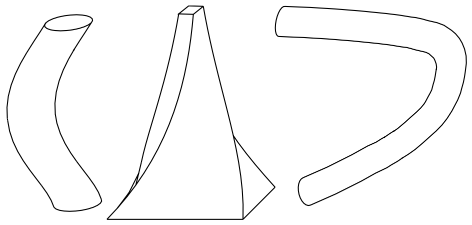
`1:` lateral edges starting from the node are used for showing the contour.

Additional status codes allow you to create segments and arcs in the planar polyline using special constraints.

See the section called "Additional Status Codes" for details.

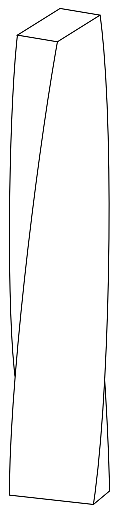
Restriction of parameters:

```
n > 1
m > 1
z1 < z2
```



Example:

```
SWEEP 4, 12, 7.5, 1, 1+2+4+16+32,
        -0.5, -0.25, 0,
        0.5, -0.25, 0,
        0.5, 0.25, 0,
        -0.5, 0.25, 0,
        0, 0, 0.5,
        0, 0, 1,
        0, 0, 1.5,
        0, 0, 2,
        0, 0, 2.5,
        0, 0, 3,
        0, 0, 3.5,
        0, 0, 4,
        0, 0, 4.5,
        0, 0, 5,
        0, 0, 5.5,
        0, 0, 6
```



TUBE

```
TUBE n, m, mask,
        u1, w1, s1,
        ...
        un, wn, sn,
        x1, y1, z1, angle1,
        ...
        xm, ym, zm, anglem
```

Surface generated by a polyline sweeping along a space curve path without distortion of the generating cross-section. The internal connection surfaces are rotatable in the U-W plane of the instantaneous U-V-W coordinate system.

`V axis:` approximates the tangent of the generator curve at the corresponding point.

`W axis:` perpendicular to the V axis and pointing upward with respect to the local z axis.

`U axis:` perpendicular to the V and W axes and forms with them a right-hand sided Cartesian coordinate system.

If the V axis is vertical, then the W direction is not correctly defined. The W axis in the previous path node is used for determining a horizontal direction.

The cross-section polygon of the tube measured at the middle of the path segments is always equal to the base polygon (u1, w1, ..., un, wn).

Section polygons in joints are situated in the bisector plane of the joint segments. The base polygon must be closed.

`n:` number of the polyline nodes.

`m:` number of the path nodes.

`ui, wi:` coordinates of the base polyline nodes.

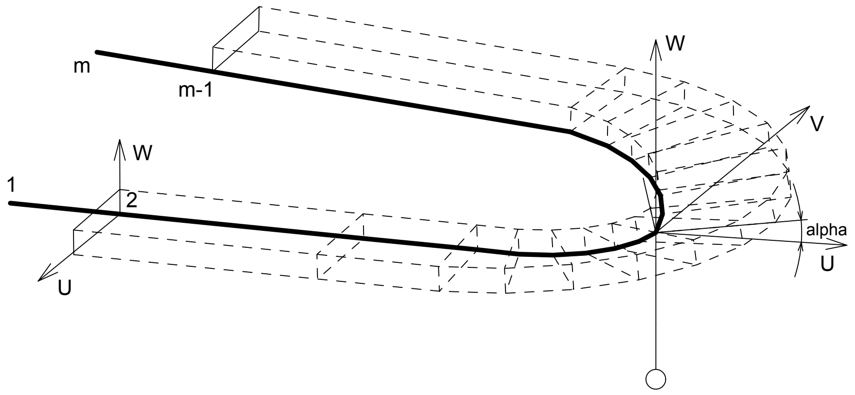
`xi, yi, zi:` coordinates of the path curve nodes.

`anglei:` rotation angle of the cross-section.

`mask:` controls the existence of the bottom and top polygons' surfaces and edges.

`mask` = $j_1 + 2*j_2 + 16*j_5 + 32*j_6 + 64*j_7 + 128*j_8$, where each j can be 0 or 1.

j_1: base surface is present,
j_2: end surface is present,
j_5: base edges (at x2, y2, z2) are visible,
j_6: end edges (at xm-1, ym-1, zm-1) are visible,
j_7: cross-section edges are visible, surface is articulated,
j_8: cross-section edges are sharp, the surface smoothing will stop here in OpenGL and rendering.



`si:` status of the lateral edges.

`0:` lateral edges starting from the node are all visible,
`1:` lateral edges starting from the node are used for showing the contour.
`2:` when using ARCHICAD or Z-buffer Rendering Engine and setting Smooth Surfaces, the lateral edge belonging to this point defines a break. This solution is equivalent to the definition of additional nodes. The calculation is performed by the compiler. With other rendering methods, it has the same effect as using 0.

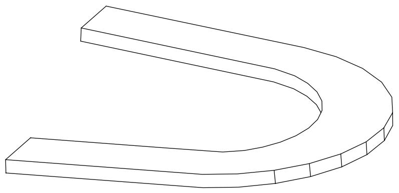
Additional status codes allow you to create segments and arcs in the planar polyline using special constraints.

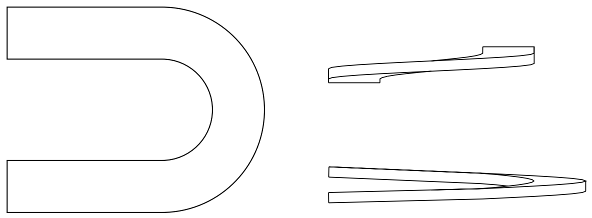
Note: The path comprises two points more than the number of generated sections. The first and the last points determine the position in space of the first and the last surfaces belonging to the TUBE. These points only play a role in determining the normal of the surfaces, they are not actual nodes of the path. The orientation of the surfaces is the same as that of the surfaces that would be generated at the nodes nearest to the two endpoints, if the TUBE were continued in the directions indicated by these.

Restriction of parameters:

```
n > 2 and m > 3
```

Example 1:

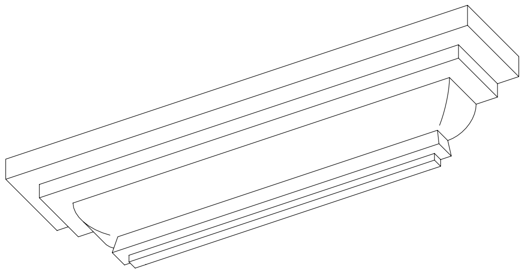




```
TUBE 4, 18, 16+32,
        2.0, 0.0, 0,
        0.0, 0.0, 0,
        0.0, 0.4, 0,
        2.0, 0.4, 0,
        -1, 0, 0, 0,
        0, 0, 0, 0,
        4, 0, 0.1, 0,
        6, 0, 0.15, 0,
        6+4*sin(15), 4 - 4*cos(15), 0.2, 0,
        6+4*sin(30), 4 - 4*cos(30), 0.25, 0,
        6+4*sin(45), 4 - 4*cos(45), 0.3, 0,
        6+4*sin(60), 4 - 4*cos(60), 0.35, 0,
        6+4*sin(75), 4 - 4*cos(75), 0.4, 0,
        10, 4, 0.45, 0,
        6+4*sin(105), 4 - 4*cos(105), 0.5, 0,
        6+4*sin(120), 4 - 4*cos(120), 0.55, 0,
        6+4*sin(135), 4 - 4*cos(135), 0.6, 0,
        6+4*sin(150), 4 - 4*cos(150), 0.65, 0,
        6+4*sin(165), 4 - 4*cos(165), 0.7, 0,
        6, 8, 0.75, 0,
        0, 8, 1, 0,
        -1, 8, 1, 0
```

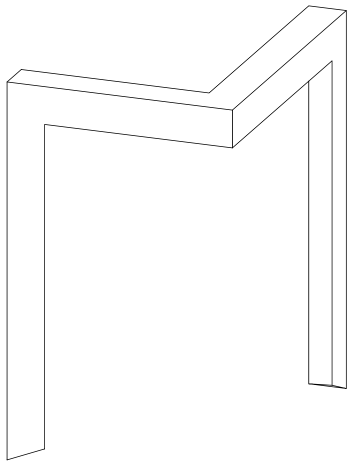
Example 2:

```
TUBE 14, 6, 1+2+16+32,
        0, 0,0,
        0.03, 0,0,
        0.03, 0.02, 0,
        0.06, 0.02, 0,
        0.05, 0.0699, 0,
        0.05, 0.07, 1,
        0.05, 0.15, 901,
        1, 0, 801,
        0.08, 90, 2000,
        0.19, 0.15, 0,
        0.19, 0.19, 0,
        0.25, 0.19, 0,
        0.25, 0.25, 0,
        0, 0.25, 0,
        0, 1, 0, 0,
        0, 0.0001, 0, 0,
        0, 0, 0, 0,
        -0.8, 0, 0, 0,
        -0.8, 0.0001, 0, 0,
        -0.8, 1, 0, 0
```



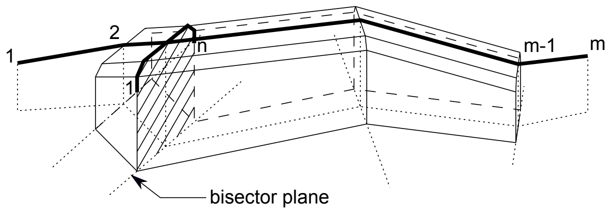
Example 3:

```
TUBE 3, 7, 16+32,
        0, 0, 0,
        -0.5, 0, 0,
        0, 0.5, 0,
        0.2, 0, -0.2, 0,
        0, 0, 0, 0,
        0, 0, 5, 0,
        3, 0, 5, 0,
        3, 4, 5, 0,
        3, 4, 0, 0,
        3, 3.8, -0.2, 0
```



TUBEA

```
TUBEA n, m, mask,
        u1, w1, s1,
        ...
        un, wn, sn,
        x1, y1, z1,
        ...
        xm, ym, zm
```



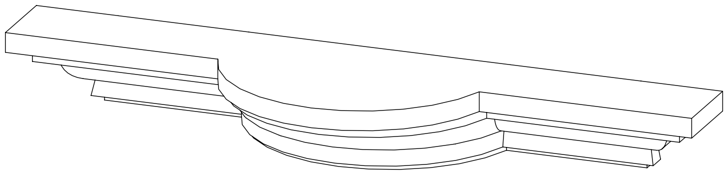
TUBEA is a surface generated by a polyline sweeping along a space curve path with a different algorithm than that of the TUBE command.

The section polygon generated in each joint of the path curve is equal with the base polygon (u1, w1, ..., un, wn) and is situated in the bisector plane of the projections of the joint segments to the local x-y plane. The base polygon can be opened: in this case the section polygons will be generated to reach the local x-y plane as in the case of REVOLVE surfaces.

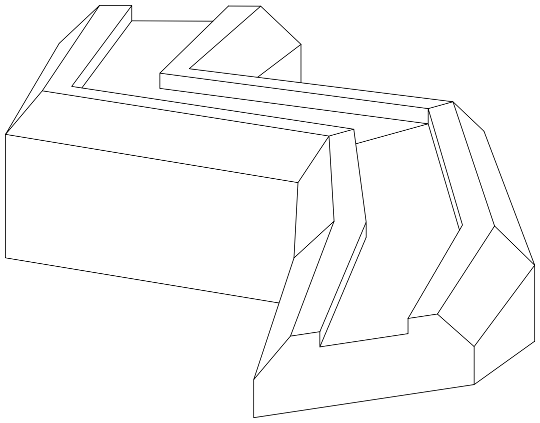
The cross section of the tube measured at the middle of the path segments can be different from the base polygon.

Additional status codes allow you to create segments and arcs in the planar polyline using special constraints.

See the section called "Additional Status Codes" for details.



Example:



```
TUBEA 9, 7, 1 + 2 + 16 + 32,
        -1, 1, 0,
        0, 2, 0,
        0.8, 2, 0,
        0.8, 1.6, 0,
        0.8001, 1.6, 1,
        3.2, 1.6, 0,
        3.2, 2, 0,
        4, 2, 0,
        5, 1, 0,
        0, -7, 0,
        0, 0, 0,
        4, 0, 1,
        9, 3, 2.25,
        9, 10, 2.25,
        14, 10, 2.25,
        20, 15, 5
```

COONS

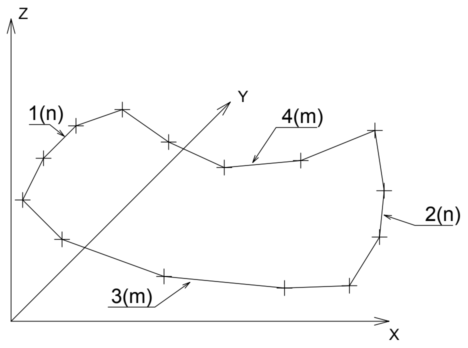
```
COONS n, m, mask,
        x11, y11, z11, ..., x1n, y1n, z1n,
        x21, y21, z21, ..., x2n, y2n, z2n,
        x31, y31, z31, ..., x3m, y3m, z3m,
        x41, y41, z41, ..., x4m, y4m, z4m
```

A Coons patch generated from four boundary curves.

mask:

mask = 4*j_3 + 8*j_4 + 16*j_5 + 32*j_6 + 64*j_7, where each j can be 0 or 1.

j_3: edges of the 1st boundary (x1, y1, z1) are visible,
j_4: edges of the 2nd boundary (x2, y2, z2) are visible,
j_5: edges of the 3rd boundary (x3, y3, z3) are visible,
j_6: edges of the 4th boundary (x4, y4, z4) are visible,
j_7: edges on surface are visible, surface is not smooth.

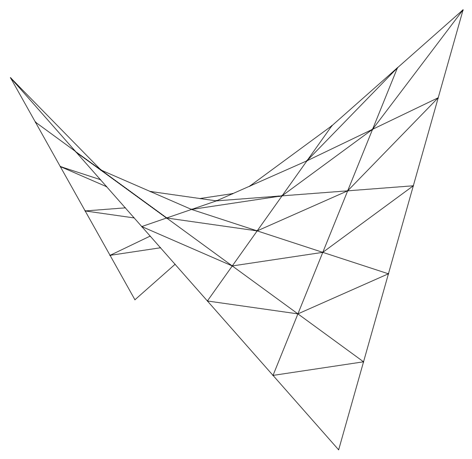


Restriction of parameters:

```
n > 1, m > 1
```

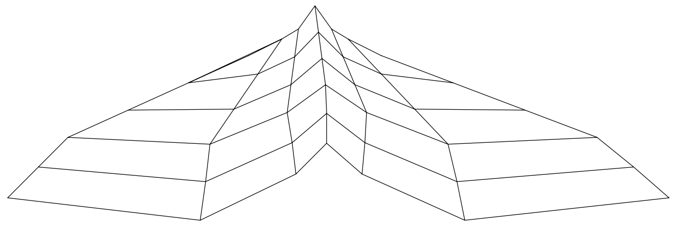
Example 1:

```
COONS 6, 6, 4+8+16+32+64,
        ! 1st boundary, n=6
        0, 0, 5,
        1, 0, 4,
        2, 0, 3,
        3, 0, 2,
        4, 0, 1,
        5, 0, 0,
        ! 2nd boundary, n=6
        0, 5, 0,
        1, 5, 1,
        2, 5, 2,
        3, 5, 3,
        4, 5, 4,
        5, 5, 5,
        ! 3rd boundary, m=6
        0, 0, 5,
        0, 1, 4,
        0, 2, 3,
        0, 3, 2,
        0, 4, 1,
        0, 5, 0,
        ! 4th boundary, m=6
        5, 0, 0,
        5, 1, 1,
        5, 2, 2,
        5, 3, 3,
        5, 4, 4,
        5, 5, 5
```



Example 2:

```
COONS 7, 6, 4+8+16+32+64,
        ! 1st boundary, n=7
        1, 2, 0,
        0.5, 1, 0,
        0.2, 0.5, 0,
        -0.5, 0, 0,
        0.2, -0.5, 0,
        0.5, -1, 0,
        1, -2, 0,
        ! 2nd boundary, n=7
        6, 10, -2,
        6.5, 4, -1.5,
        5, 1, -1.2,
        4, 0, -1,
        5, -1, -1.2,
        6.5, -4, -1.5,
        6, -10, -2,
        ! 3rd boundary, m=6
        1, 2, 0,
        2, 4, -0.5,
        3, 6, -1,
        4, 8, -1.5,
        5, 9, -1.8,
        6, 10, -2,
        ! 4th boundary, m=6
        1, -2, 0,
        2, -4, -0.5,
        3, -6, -1,
        4, -8, -1.5,
        5, -9, -1.8,
        6, -10, -2
```



MASS

```
MASS top_material, bottom_material, side_material,
        n, m, mask, h,
        x1, y1, z1, s1,
        ...
        xn, yn, zn, sn,
        xn+1, yn+1, zn+1, sn+1,
        ...
        xn+m, yn+m, zn+m, sn+m
```

The equivalent of the shape generated by the Mesh tool in ARCHICAD.

top_material, bottom_material, side_material: name/index of the top, bottom and side materials.

n: the number of nodes in the mass polygon.

m: the number of nodes on the ridges.

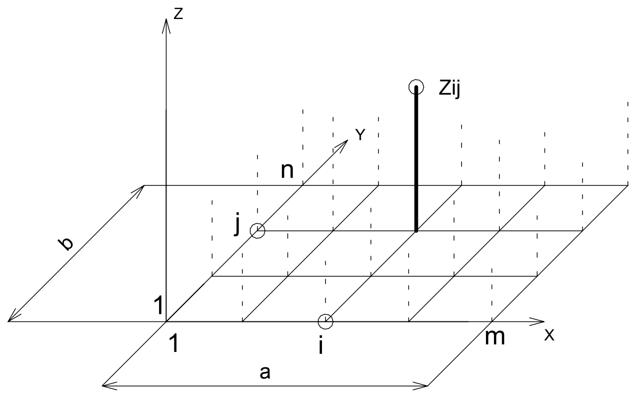
h: the height of the skirt (can be negative).

xi, yi, zi: the coordinates of the nodes.

mask:

mask = j_1 + 4*j_3 + 16*j_5 + 32*j_6 + 64*j_7 + 128*j_8, where each j can be 0 or 1.

j_1: base surface is present,
j_3: side surfaces are present,
j_5: base and side edges are visible,
j_6: triangulation edges are visible,
j_7: triangulation edges are visible, top surface is not smooth,
j_8: all ridges will be sharp, but the surface is smooth.



`si:` similar to the PRISM_ command. Additional status codes allow you to create segments and arcs in the planar polyline using special constraints.

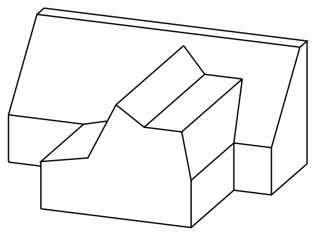
See the section called "Additional Status Codes" for details.

Restriction of parameters:

```
n >= 3, m >= 0
```

Example:

```
MASS "Surf-White", "Surf-White", "Surf-White",
        15, 12, 117, -5.0,
        0, 12, 0, 15,
        8, 12, 0, 15,
        8, 0, 0, 15,
        13, 0, 0, 13,
        16, 0, 0, 13,
        19, 0, 0, 13,
        23, 0, 0, 13,
        24, 0, 0, 15,
        24, 12, 0, 15,
        28, 12, 0, 15,
        28, 20, 8, 13,
        28, 22, 8, 15,
        0, 22, 8, 15,
        0, 20, 8, 13,
        0, 12, 0, -1,
        0, 22, 8, 0,
        28, 22, 8, -1,
        23, 17, 5, 0,
        23, 0, 5, -1,
        13, 13, 1, 0,
        13, 0, 1, -1,
        16, 0, 7, 0,
        16, 19, 7, -1,
        0, 20, 8, 0,
        28, 20, 8, -1,
        19, 17, 5, 0,
        19, 0, 5, -1
```



MASS{2}

```
MASS{2} top_material, bottom_material, side_material,
          n, m, mask, h,
          x1, y1, z1, s1,
          ...
          xn, yn, zn, sn,
          xn+1, yn+1, zn+1, sn+1,
          ...
          xn+m, yn+m, zn+m, sn+m
```

Extension of the MASS command with an additional mask bit and the possibility of hiding all top edges of the mass.

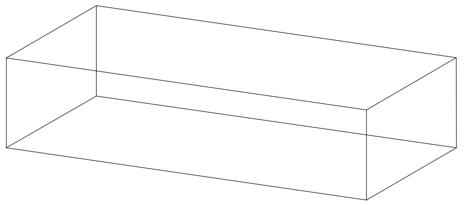
mask:

mask = j_1 + 4*j_3 + 16*j_5 + 32*j_6 + 64*j_7 + 128*j_8 + 256*j_9 + 512*j_{10}, where each j can be 0 or 1.

j_1: base surface is present,
j_3: side surfaces are present,
j_5: base and side edges are visible,
j_6: top edges are visible,
j_7: top edges are visible, top surface is not smooth,
j_8: all ridges will be sharp, but the surface is smooth.
j_9: edges participate in line elimination.
j_{10}: all top edges will be hidden.

Example:

```
PEN 1
mat = IND (MATERIAL, "Mtl-Aluminium")
FOR i=1 TO 2 STEP 1
  MASS{2} mat, mat, mat,
    5,  0,  1+4+16+32+64+256,   -1,
    0,  0,  0,   15,
    2,  0,  0,   15,
    2,  2,  0,   15,
    0,  2,  0,   15,
    0,  0,  0,   -1
  BODY -1
  ADDX 2
NEXT i
```



POLYROOF

```
POLYROOF defaultMat, k, m, n,
        offset, thickness, applyContourInsidePivot,
        z_1, ..., z_k,
        pivotX_1, pivotY_1, pivotMask_1,
        roofAngle_11, gableOverhang_11, topMat_11, bottomMat_11,
        ...
        roofAngle_1k, gableOverhang_1k, topMat_1k, bottomMat_1k,
        ...
        pivotX_m, pivotY_m, pivotMask_m,
        roofAngle_m1, gableOverhang_m1, topMat_m1, bottomMat_m1,
        ...
        roofAngle_mk, gableOverhang_mk, topMat_mk, bottomMat_mk,
        contourX_1, contourY_1, contourMask_1, edgeTrim_1, edgeAngle_1, edgeMat_1,
        ...
        contourX_n, contourY_n, contourMask_n, edgeTrim_n, edgeAngle_n, edgeMat_n
```

The command creates a possibly multi-level roof in which the geometry is controlled by multiple parameters, most importantly the roof angles and two polygons: a pivot polygon and a contour polygon. At the pivot polygon, the roof is slanted at the roof angle. It ascends until it either reaches the height of the next level or until it is eliminated by its sides encountering one another. It also descends downwards, until it reaches the contour polygon, which cuts off parts of the roof outside of it. The contour polygon can also be used to cut holes in the roof.

`defaultMat:` the numeric index of the "inner" material of the roof. This material becomes visible at gables and at cut surfaces, e.g., if the roof is cut by a plane.

`k:` the number of levels.

`m:` the number of pivot polygon vertices.

`n:` the number of contour polygon vertices.

`offset:` an offset for the thickness of the roof.

`thickness:` the thickness of the roof.

`applyContourInsidePivot:` if set to 0, the outer contour polygon is only applied below the pivot polygon plane. If set to 1, the outer contour polygon is applied both above and below the pivot polygon plane. The 0 setting may be used to prevent the contour polygon from cutting off gables that lean outwards.

`z_i:` the Z coordinate of a level.

`pivotX_i, pivotY_i:` coordinates of the pivot polygon vertices.

`pivotMask_i:`

`0:` marks a normal vertex,
`-1:` marks the end of the current pivot subpolygon (outer contour or hole). Data for such a vertex must be a copy of the data for the first vertex of the subpolygon. A polygon must always be closed with a mask value of -1, even if there are no holes inside it.

`roofAngle_i:` angle of slant for a pivot edge on a given level. If the angle >= 90, that part of the roof becomes a gable.

`gableOverhang_i:` at the sides of a gable, the roof can extend over a lower level of itself. The amount of this can be controlled by this parameter, which has effect only on gables (roofAngle >= 90) that are at least on the second level of the roof.

`topMat_i, bottomMat_i:` the numeric index of the materials for the top and bottom of the roof.

`contourX_i, contourY_i:` coordinates of the contour polygon vertices.

`contourMask_i:`

`0:` marks a normal vertex,
`-1:` marks the end of the current contour subpolygon (outer contour or hole). Data for such a vertex must be a copy of the data for the first vertex of the subpolygon. A polygon must always be closed with a mask value of -1, even if there are no holes inside it.

`edgeTrim_i:` specifies the way the edge is trimmed by the contour polygon. Possible values are:

`0:` Vertical,

`1:` Perpendicular to roof plane,
`2:` Horizontal,
`3:` Custom angle to roof plane.

`edgeAngle_i:` the custom angle of the edge to the roof plane. It has effect only if edgeTrim is set to 3 (custom angle to roof plane).

`edgeMat_i:` numeric index of the material at the edge the roof, where the contour cuts it

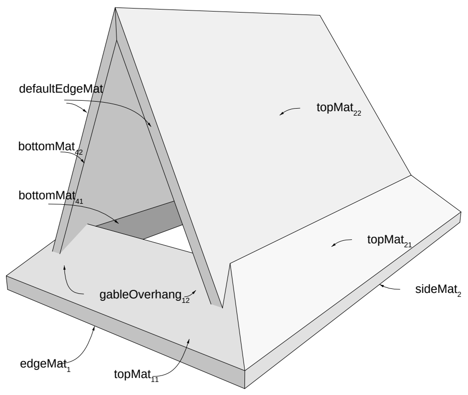


Figure 1: Materials

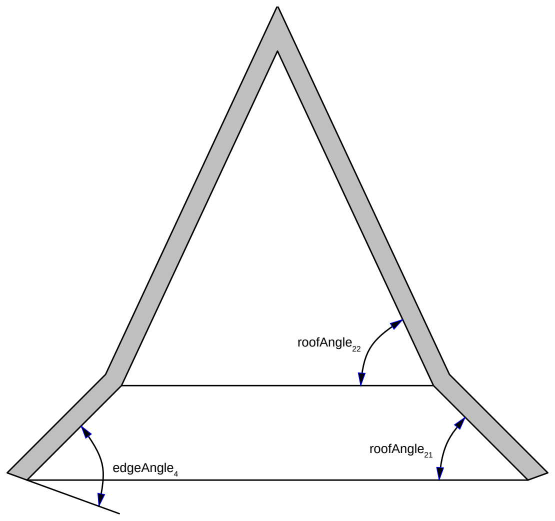


Figure 2: Angles

Example:

```
POLYROOF "Paint-01",
        2, 5, 5,
        0, 0.2, 0,
        ! Start of z values
        2.7,
        3.2,
        ! Start of pivot polygon
        2, 8, 0,
        45, 0, ind(material, "Paint-01"), ind(material, "Paint-01"),
        90, 0.5, ind(material, "Paint-01"), ind(material, "Paint-01"),
        2, 3, 0,
        45, 0, ind(material, "Paint-01"), ind(material, "Paint-01"),
        65, 0, ind(material, "Paint-01"), ind(material, "Paint-01"),
        10, 3, 0,
        45, 0, ind(material, "Paint-01"), ind(material, "Paint-01"),
        65, 0, ind(material, "Paint-01"), ind(material, "Paint-01"),
        10, 8, 0,
        45, 0, ind(material, "Paint-01"), ind(material, "Paint-01"),
        65, 0, ind(material, "Paint-01"), ind(material, "Paint-01"),
        2, 8, -1,
        45, 0, ind(material, "Paint-01"), ind(material, "Paint-01"),
        90, 0.5, ind(material, "Paint-01"), ind(material, "Paint-01"),
        ! Start of contour polygon
        1.5, 8.5, 0, 0, 0, ind(material, "Paint-01"),
        1.5, 2.5, 0, 0, 0, ind(material, "Paint-01"),
        10.5, 2.5, 0, 0, 0, ind(material, "Paint-01"),
        10.5, 8.5, 0, 0, 0, ind(material, "Paint-01"),
        1.5, 8.5, -1, 0, 0, ind(material, "Paint-01")
```

Output: see Figure 1

POLYROOF{2}

```
POLYROOF{2} defaultMat, k, m, n,
        offset, thickness, totalThickness, applyContourInsidePivot,
        z_1, ..., z_k,
        pivotX_1, pivotY_1, pivotMask_1,
        roofAngle_11, gableOverhang_11, topMat_11, bottomMat_11,
        ...
        roofAngle_1k, gableOverhang_1k, topMat_1k, bottomMat_1k,
        ...
        pivotX_m, pivotY_m, pivotMask_m,
        roofAngle_m1, gableOverhang_m1, topMat_m1, bottomMat_m1,
        ...
        roofAngle_mk, gableOverhang_mk, topMat_mk, bottomMat_mk,
        contourX_1, contourY_1, contourMask_1, edgeTrim_1, edgeAngle_1, edgeMat_1,
        ...
        contourX_n, contourY_n, contourMask_n, edgeTrim_n, edgeAngle_n, edgeMat_n
```

POLYROOF{2} is an extension of the POLYROOF command with the possibility of defining the total thickness of the roof. This parameter should be considered together with offset and thickness, when the generation of a slice of the roof is desirable. In this case the thickness and the offset should be set to the thickness of the slice and to the distance between the top planes of the slice and the complete roof respectively.

totalThickness: the total thickness of the roof.

POLYROOF{3}

```
POLYROOF{3} defaultMat, mask, k, m, n,
          offset, thickness, totalThickness, applyContourInsidePivot,
          z_1, ..., z_k,
          pivotX_1, pivotY_1, pivotMask_1,
          roofAngle_11, gableOverhang_11, topMat_11, bottomMat_11,
          ...
          roofAngle_1k, gableOverhang_1k, topMat_1k, bottomMat_1k,
          ...
          pivotX_m, pivotY_m, pivotMask_m,
          roofAngle_m1, gableOverhang_m1, topMat_m1, bottomMat_m1,
          ...
          roofAngle_mk, gableOverhang_mk, topMat_mk, bottomMat_mk,
          contourX_1, contourY_1, contourMask_1, edgeTrim_1, edgeAngle_1, edgeMat_1,
          ...
          contourX_n, contourY_n, contourMask_n, edgeTrim_n, edgeAngle_n, edgeMat_n
```

POLYROOF{3} is an extension of the POLYROOF{2} command with the possibility of controlling the global behavior of the generated roof.

`mask:` controls the global behavior of the generated roof.

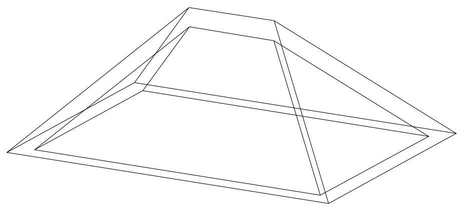
`mask = `j_1` + 2*`j_2, where each j can be 0 or 1.

j_1: edges participate in line elimination.

j_2: Make all edges invisible.

Example:

```
pen 1
mat = IND (MATERIAL, "Mtl-Aluminium")
a = -0.4242640691048 : b =  4.424264068326
c =  6.424264068326
POLYROOF{3} mat,1, 2,  5,  5,
  0, 0.3, 0.3,  1, 0, 1,
  a, b, 0, 45, 0, mat, mat, 90, 0, mat, mat,
  a, a, 0, 45, 0, mat, mat, 90, 0, mat, mat,
  c, a, 0, 45, 0, mat, mat, 90, 0, mat, mat,
  c, b, 0, 45, 0, mat, mat, 90, 0, mat, mat,
  a, b, -1,45, 0, mat, mat, 90,  0, mat, mat,
  -0.8, -0.8,  0,  2,  0, mat,
  6.8, -0.8,  0,  2,  0, mat,
  6.8,  4.8,  0,  2,  0, mat,
  -0.8,  4.8,  0,  2,  0, mat,
  -0.8, -0.8, -1,  2,  0, mat

a = 0.1514718617904 : b = 3.848528136652
c = 5.848528136652 : q = 0.5757359305057
w = 5.424264067936 :  e = 3.424264056692
POLYROOF{3} mat,1, 1,  5,  5,
  0,   0.3,  0.3,  1, 0.5757359312847,
  a, b, 0, 45,  0, mat, mat,
  a, a, 0, 45,  0, mat, mat,
  c, a, 0, 45,  0, mat, mat,
  c, b, 0, 45,  0, mat, mat,
  a, b, -1, 45,  0, mat, mat,
  q, q,   0,  0,  0, mat,
  w, q,   0,  0,  0, mat,
  w, e,   0,  0,  0, mat,
  q, e,   0,  0,  0, mat,
  q, q,  -1,  0,  0, mat
```



POLYROOF{4}

```
POLYROOF{4} defaultMat, mask, k, m, n,
          offset, thickness, totalThickness, applyContourInsidePivot,
          z_1, ..., z_k,
          pivotX_1, pivotY_1, pivotMask_1,
          roofAngle_11, gableOverhang_11, topMat_11, bottomMat_11,
          ...
          roofAngle_1k, gableOverhang_1k, topMat_1k, bottomMat_1k,
          ...
          pivotX_m, pivotY_m, pivotMask_m,
          roofAngle_m1, gableOverhang_m1, topMat_m1, bottomMat_m1,
          ...
          roofAngle_mk, gableOverhang_mk, topMat_mk, bottomMat_mk,
          contourX_1, contourY_1, contourMask_1, edgeTrim_1, edgeAngle_1, edgeMat_1,
          ...
          contourX_n, contourY_n, contourMask_n, edgeTrim_n, edgeAngle_n, edgeMat_n
```

POLYROOF{4} is an extension of the POLYROOF{3} command with the possibility of using inline material definition, that means materials defined in GDL script locally also can be used next to materials defined in global material definitions.

EXTRUDEDSHELL

```
EXTRUDEDSHELL topMat, bottomMat, sideMat_1, sideMat_2, sideMat_3, sideMat_4,
        defaultMat,
        n, offset, thickness, flipped, trimmingBody,
        x_tb, y_tb, x_te, y_te, topz, tangle,
        x_bb, y_bb, x_be, y_be, bottomz, bangle,
        preThickenTran_11, preThickenTran_12, preThickenTran_13, preThickenTran_14,
        preThickenTran_21, preThickenTran_22, preThickenTran_23, preThickenTran_24,
        preThicakenTran_31, preThickenTran_32, preThickenTran_33, preThickenTran_34,
        x_1, y_1, s_1,
        ...
        x_n, y_n, s_n
```

Surface created by first extruding a polyline, then adding thickness to it.

topMat, **bottomMat**, **sideMat_1**, **sideMat_2**, **sideMat_3**, **sideMat_4**: Materials on the top, bottom and four sides of the object.

defaultMat: the numeric index of the "inner" material of the object. This material becomes visible at cut surfaces, e.g., if the object is cut by a plane.

n: number of profile base polyline vertices.

offset: an offset for the thickness of the shell. Cannot be negative.

thickness: the thickness of the shell.

flipped:

1: if the shell should be flipped,
0: otherwise.

trimmingBody:

1: if the shell is to be closed for trimming purposes,
0: otherwise.

x_tb, y_tb, x_te, y_te, topz, tangle: Specify the top plane of the extrusion. The meaning of the parameters is the same as for the SPRISM_{2} command.

x_bb, y_bb, x_be, y_be, bottomz, bangle: Specify the bottom plane of the extrusion. The meaning of the parameters is the same as for the SPRISM_{2} command.

preThickenTran_i: a transformation executed before thickening. See the XFORM command for the meaning of parameters.

x_i, y_i, s_i: X and Y coordinates and status values for the base profile polyline. See the EXTRUDE command for details. The visibility of the sides cannot be controlled with the status.

EXTRUDEDSHELL{2}

```
EXTRUDEDSHELL{2} topMat, bottomMat, sideMat_1, sideMat_2, sideMat_3, sideMat_4,
        defaultMat,
        n, status, offset, thickness, flipped, trimmingBody,
        x_tb, y_tb, x_te, y_te, topz, tangle,
        x_bb, y_bb, x_be, y_be, bottomz, bangle,
        preThickenTran_11, preThickenTran_12, preThickenTran_13, preThickenTran_14,
        preThickenTran_21, preThickenTran_22, preThickenTran_23, preThickenTran_24,
        preThicakenTran_31, preThickenTran_32, preThickenTran_33, preThickenTran_34,
        x_1, y_1, s_1,
        ...
        x_n, y_n, s_n
```

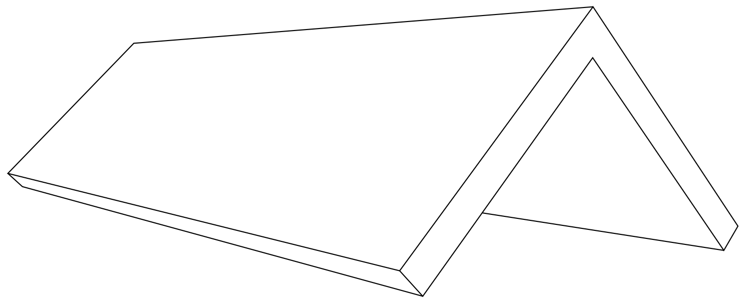
EXTRUDEDSHELL{2} is an extension of the EXTRUDEDSHELL command with the possibility of hiding edges between original and thickened surface.

status: Status bits:

`status = j`$_1$, where each j can be 0 or 1.

`j`$_1$`:` Make edges invisible between original and thickened surface.

Example:



```
EXTRUDEDSHELL "Paint-02", "Surf-Stucco Yellow",
        "Surf-Stucco Yellow", "Surf-Stucco Yellow", "Surf-Stucco Yellow",
        "Surf-Stucco Yellow", "Surf-Stucco Yellow",
        3,   0.00,   0.30,      0, 0,
        ! 2 slant planes
        0.00,   0.00,   0.00,   1.00,   0.00,   0.00,
        0.00,   0.00,   0.00,   1.00, -10.00,   0.00,
        ! transformation matrix
        0.00,   0.00,   1.00,   0.00,
        1.00,   0.00,   0.00,   0.00,
        0.00,   1.00,   0.00,   0.00,
        ! profile polyline
        2.00,   0.00,     15,
        0.00,   2.00,     15,
        -2.00,   0.00,     15
```

EXTRUDEDSHELL{3}

```
EXTRUDEDSHELL{3} topMat, bottomMat, sideMat_1, sideMat_2, sideMat_3, sideMat_4,
        defaultMat,
        n, status, offset, thickness, flipped, trimmingBody,
        x_tb, y_tb, x_te, y_te, topz, tangle,
        x_bb, y_bb, x_be, y_be, bottomz, bangle,
        preThickenTran_11, preThickenTran_12, preThickenTran_13, preThickenTran_14,
        preThickenTran_21, preThickenTran_22, preThickenTran_23, preThickenTran_24,
        preThicakenTran_31, preThickenTran_32, preThickenTran_33, preThickenTran_34,
        x_1, y_1, s_1,
        ...
        x_n, y_n, s_n
```

EXTRUDEDSHELL{3} is an extension of the EXTRUDEDSHELL{2} command with the possibility of using inline material definition, that means materials defined in GDL script locally also can be used next to materials defined in global material definitions.

REVOLVEDSHELL

```
REVOLVEDSHELL topMat, bottomMat, sideMat_1, sideMat_2, sideMat_3, sideMat_4,
        defaultMat,
        n, offset, thickness, flipped, trimmingBody, alphaOffset, alpha,
        preThickenTran_11, preThickenTran_12, preThickenTran_13, preThickenTran_14,
        preThickenTran_21, preThickenTran_22, preThickenTran_23, preThickenTran_24,
        preThickenTran_31, preThickenTran_32, preThickenTran_33, preThickenTran_34,
        x_1, y_1, s_1,
        ...
        x_n, y_n, s_n
```

Surface created by rotating a polyline defined in the x-y plane around the x axis, then adding thickness to it.

topMat, bottomMat, sideMat_1, sideMat_2, sideMat_3, sideMat_4: Materials on the top, bottom and four sides of the object.

defaultMat: the numeric index of the "inner" material of the object. This material becomes visible at cut surfaces, e.g., if the object is cut by a plane.

n: number of profile base polyline vertices.

offset: an offset for the thickness of the shell. Cannot be negative.

thickness: the thickness of the shell.

flipped:

`1:` if the shell should be flipped,
`0:` otherwise.

`trimmingBody:`
`1:` if the shell is to be closed for trimming purposes,
`0:` otherwise.

`alphaOffset:` the sweep start angle.

`alpha:` the sweep angle length in degrees, may be negative.

`preThickenTran_i:` a transformation executed before thickening. See the XFORM command for the meaning of parameters.

`x_i, y_i, s_i:` X and Y coordinates and status values for the base profile polyline. See the EXTRUDE command for details. The visibility of the sides cannot be controlled with the status.

REVOLVEDSHELL{2}

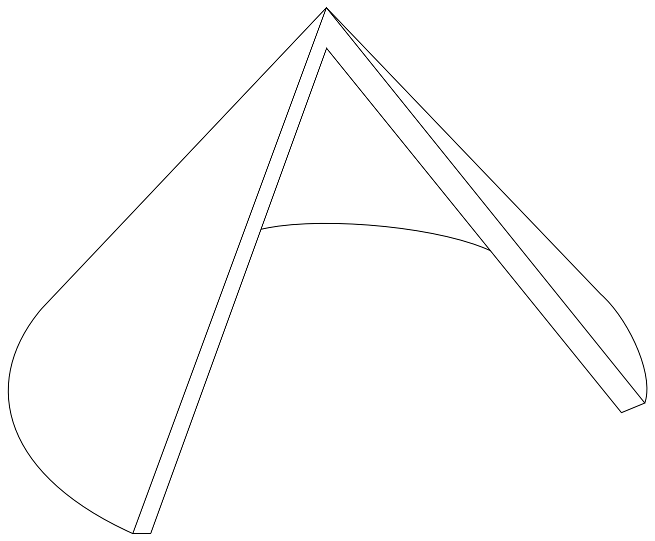
```
REVOLVEDSHELL{2} topMat, bottomMat, sideMat_1, sideMat_2, sideMat_3, sideMat_4,
        defaultMat,
        n, status, offset, thickness, flipped, trimmingBody, alphaOffset, alpha,
        preThickenTran_11, preThickenTran_12, preThickenTran_13, preThickenTran_14,
        preThickenTran_21, preThickenTran_22, preThickenTran_23, preThickenTran_24,
        preThickenTran_31, preThickenTran_32, preThickenTran_33, preThickenTran_34,
        x_1, y_1, s_1,
        ...
        x_n, y_n, s_n
```

REVOLVEDSHELL{2} is an extension of the REVOLVEDSHELL command with the possibility of hiding edges of surfaces, and edges between original and thickened surface.

`status:` Status bits:
`status = ` $j_1 + 2*j_2$, where each j can be 0 or 1.
j_1: Make edges invisible between original and thickened surface.
j_2: Make edges invisible on surfaces.

Example:

```
REVOLVEDSHELL "Paint-02", "Surf-Stucco Yellow",
        "Surf-Stucco Yellow", "Surf-Stucco Yellow", "Surf-Stucco Yellow",
        "Surf-Stucco Yellow", "Surf-Stucco Yellow",
        2,   0.00,   0.30,      0,  0, 0.00, 270.00,
        ! transformation matrix
        0.00,   0.00,  -1.00,   0.00,
        0.00,   1.00,   0.00,   0.00,
        1.00,   0.00,   0.00,   0.00,
        ! profile polyline
        4.00,   0.00,      2,
        0.00,   4.00,      2
```



REVOLVEDSHELL{3}

```
REVOLVEDSHELL{3} topMat, bottomMat, sideMat_1, sideMat_2, sideMat_3, sideMat_4,
        defaultMat,
        n, status, offset, thickness, flipped, trimmingBody, alphaOffset, alpha,
        preThickenTran_11, preThickenTran_12, preThickenTran_13, preThickenTran_14,
        preThickenTran_21, preThickenTran_22, preThickenTran_23, preThickenTran_24,
        preThickenTran_31, preThickenTran_32, preThickenTran_33, preThickenTran_34,
        x_1, y_1, s_1,
        ...
        x_n, y_n, s_n
```

REVOLVEDSHELL{3} is an extension of the REVOLVEDSHELL{2} command with the possibility of using inline material definition, that means materials defined in GDL script locally also can be used next to materials defined in global material definitions.

REVOLVEDSHELLANGULAR

```
REVOLVEDSHELLANGULAR topMat, bottomMat,
        sideMat_1, sideMat_2, sideMat_3, sideMat_4, defaultMat,
        n, offset, thickness, flipped, trimmingBody, alphaOffset, alpha,
        segmentationType, nOfSegments,
        preThickenTran_11, preThickenTran_12, preThickenTran_13,
        preThickenTran_14,
        preThickenTran_21, preThickenTran_22, preThickenTran_23,
        preThickenTran_24,
        preThickenTran_31, preThickenTran_32, preThickenTran_33,
        preThickenTran_34,
        x_1, y_1, s_1,
        ...
        x_n, y_n, s_n
```

An angular variant of the REVOLVEDSHELL command. Parameters are the same with the addition of the following extra parameters:

segmentationType: Must be either 1 or 2.

- `1:` means that 360 degrees of revolution is split into nOfSegments segments,
- `2:` means that the actual revolution angle (given by the alpha parameter) is split into nOfSegments segments.

nOfSegments: Number of segments, see segmentationType parameter above.

REVOLVEDSHELLANGULAR{2}

```
REVOLVEDSHELLANGULAR{2} topMat, bottomMat,
        sideMat_1, sideMat_2, sideMat_3, sideMat_4, defaultMat,
        n, status, offset, thickness, flipped, trimmingBody, alphaOffset, alpha,
        segmentationType, nOfSegments,
        preThickenTran_11, preThickenTran_12, preThickenTran_13,
        preThickenTran_14,
        preThickenTran_21, preThickenTran_22, preThickenTran_23,
        preThickenTran_24,
        preThickenTran_31, preThickenTran_32, preThickenTran_33,
        preThickenTran_34,
        x_1, y_1, s_1,
        ...
        x_n, y_n, s_n
```

REVOLVEDSHELLANGULAR{2} is an extension of the REVOLVEDSHELLANGULAR command with the possibility of hiding edges of surfaces, and edges between original and thickened surface.

status: Status bits:

status = j_1 + 2*j_2, where each j can be 0 or 1.

j_1: Make edges invisible between original and thickened surface.

j_2: Make edges invisible on surfaces.

REVOLVEDSHELLANGULAR{3}

```
REVOLVEDSHELLANGULAR{3} topMat, bottomMat,
        sideMat_1, sideMat_2, sideMat_3, sideMat_4, defaultMat,
        n, status, offset, thickness, flipped, trimmingBody, alphaOffset, alpha,
        segmentationType, nOfSegments,
        preThickenTran_11, preThickenTran_12, preThickenTran_13,
        preThickenTran_14,
        preThickenTran_21, preThickenTran_22, preThickenTran_23,
        preThickenTran_24,
        preThickenTran_31, preThickenTran_32, preThickenTran_33,
        preThickenTran_34,
        x_1, y_1, s_1,
        ...
        x_n, y_n, s_n
```

REVOLVEDSHELLANGULAR{3} is an extension of the REVOLVEDSHELLANGULAR{2} command with the possibility of using inline material definition, that means materials defined in GDL script locally also can be used next to materials defined in global material definitions.

RULEDSHELL

```
RULEDSHELL topMat, bottomMat,
        sideMat_1, sideMat_2, sideMat_3, sideMat_4, defaultMat,
        n, m, g,
        offset, thickness, flipped, trimmingBody,
        preThickenTran_11, preThickenTran_12, preThickenTran_13, preThickenTran_14,
        preThickenTran_21, preThickenTran_22, preThickenTran_23, preThickenTran_24,
        preThickenTran_31, preThickenTran_32, preThickenTran_33, preThickenTran_34,
        firstpolyX_1, firstpolyY_1, firstpolyS_1,
        ...
        firstpolyX_n, firstpolyY_n, firstpolyS_n,
        secondpolyX_1, secondpolyY_1, secondpolyS_1,
        ...
        secondpolyX_m, secondpolyY_m, secondpolyS_m,
        profile2Tran_11, profile2Tran_12, profile2Tran_13, profile2Tran_14
        profile2Tran_21, profile2Tran_22, profile2Tran_23, profile2Tran_24
        profile2Tran_31, profile2Tran_32, profile2Tran_33, profile2Tran_34
        generatrixFirstIndex_1, generatrixSecondIndex_1,
        ...
        generatrixFirstIndex_g, generatrixSecondIndex_g
```

Surface created by connecting two polylines.

topMat, bottomMat, sideMat_1, sideMat_2, sideMat_3, sideMat_4: Materials on the top, bottom and four sides of the object.

defaultMat: the numeric index of the "inner" material of the object. This material becomes visible at cut surfaces, e.g., if the object is cut by a plane.

n: number of vertices for first profile base polyline.

m: number of vertices for second profile base polyline.

g: number of generatrices.

offset: an offset for the thickness of the shell. Cannot be negative.

thickness: thickness of the shell.

flipped:

`1:` if the shell should be flipped,
`0:` otherwise

`preThickenTran:` a transformation executed before thickening. See the XFORM command for the meaning of parameters.

`trimmingBody:`
`1:` if the shell is to be closed for trimming purposes,
`0:` otherwise

`firstpolyX, firstpolyY, firstpolyS:` X and Y coordinates and status values for the first base profile polyline. See the REVOLVE command for details.

`secondpolyX, secondpolyY, secondpolyS:` X and Y coordinates and status values for the second base profile polyline. See the REVOLVE command for details.

`profile2Tran:` a transformation executed on the second profile. Use this transformation to position the second profile relative to the first one. See the XFORM command for the meaning of parameters.

`generatrixFirstIndex, generatrixSecondIndex:` pairs of indexes, one from the first polyline and one from the second polyline. The vertexes with the given indexes will be connected with a line.

RULEDSHELL{2}

```
RULEDSHELL{2} topMat, bottomMat,
        sideMat_1, sideMat_2, sideMat_3, sideMat_4, defaultMat,
        n, m, g, status,
        offset, thickness, flipped, trimmingBody,
        preThickenTran_11, preThickenTran_12, preThickenTran_13, preThickenTran_14,
        preThickenTran_21, preThickenTran_22, preThickenTran_23, preThickenTran_24,
        preThickenTran_31, preThickenTran_32, preThickenTran_33, preThickenTran_34,
        firstpolyX_1, firstpolyY_1, firstpolyS_1,
        ...
        firstpolyX_n, firstpolyY_n, firstpolyS_n,
        secondpolyX_1, secondpolyY_1, secondpolyS_1,
        ...
        secondpolyX_m, secondpolyY_m, secondpolyS_m,
        profile2Tran_11, profile2Tran_12, profile2Tran_13, profile2Tran_14
        profile2Tran_21, profile2Tran_22, profile2Tran_23, profile2Tran_24
        profile2Tran_31, profile2Tran_32, profile2Tran_33, profile2Tran_34
        generatrixFirstIndex_1, generatrixSecondIndex_1,
        ...
        generatrixFirstIndex_g, generatrixSecondIndex_g
```

RULEDSHELL{2} is an extension of the RULEDSHELL command with the possibility of hiding edges of surfaces, and edges between original and thickened surface.

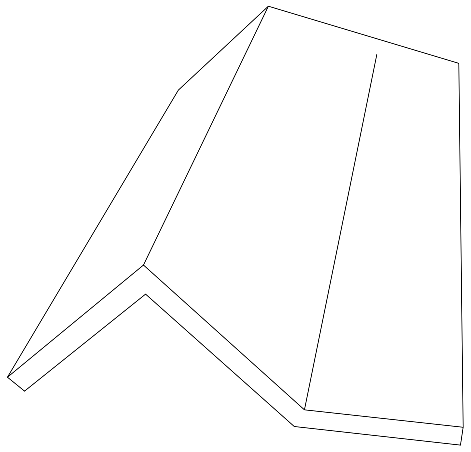
status: Status bits:

`status` = $j_1 + 2*j_2$, where each j can be 0 or 1.

j_1: Make edges invisible between original and thickened surface.

j_2: Make edges invisible on surfaces.

Example:



```
RULEDSHELL "Paint-14", "Paint-14",
        "Paint-14", "Paint-14", "Paint-14", "Paint-14", "Paint-14",
        4,      3,      3,
        0.00,   0.30,      0, 0,
        ! transformation matrix
        1.00,   0.00,   0.00,   0.00,
        0.00,   0.00,  -1.00,   0.00,
        0.00,   1.00,   0.00,   0.00,
        ! profile 1 polyline
        0.00,   0.00,      2,
        2.00,   2.00,      2,
        4.00,   0.00,      2,
        6.00,   0.00,      2,
        ! profile 2 polyline
        0.00,   0.00,      2,
        2.00,   2.00,      2,
        6.00,   1.00,      2,
        ! transformation matrix
        1.00,   0.00,   0.00,   0.00,
        0.00,   1.00,   0.00,   0.00,
        0.00,   0.00,   1.00, -10.00,
        ! generatrices
        1,      1,
        2,      2,
        4,      3
```

RULEDSHELL{3}

```
RULEDSHELL{3} topMat, bottomMat,
        sideMat_1, sideMat_2, sideMat_3, sideMat_4, defaultMat,
        n, m, g, status,
        offset, thickness, flipped, trimmingBody,
        preThickenTran_11, preThickenTran_12, preThickenTran_13, preThickenTran_14,
        preThickenTran_21, preThickenTran_22, preThickenTran_23, preThickenTran_24,
        preThickenTran_31, preThickenTran_32, preThickenTran_33, preThickenTran_34,
        firstpolyX_1, firstpolyY_1, firstpolyS_1,
        ...
        firstpolyX_n, firstpolyY_n, firstpolyS_n,
        secondpolyX_1, secondpolyY_1, secondpolyS_1,
        ...
        secondpolyX_m, secondpolyY_m, secondpolyS_m,
        profile2Tran_11, profile2Tran_12, profile2Tran_13, profile2Tran_14
        profile2Tran_21, profile2Tran_22, profile2Tran_23, profile2Tran_24
        profile2Tran_31, profile2Tran_32, profile2Tran_33, profile2Tran_34
        generatrixFirstIndex_1, generatrixSecondIndex_1,
        ...
        generatrixFirstIndex_g, generatrixSecondIndex_g
```

RULEDSHELL{3} is an extension of the RULEDSHELL{2} command with the possibility of using inline material definition, that means materials defined in GDL script locally also can be used next to materials defined in global material definitions.

ELEMENTS FOR VISUALIZATION

LIGHT

```
LIGHT red, green, blue, shadow,
        radius, alpha, beta, angle_falloff,
        distance1, distance2,
        distance_falloff [[,] ADDITIONAL_DATA name1 = value1,
        name2 = value2, ...]
```

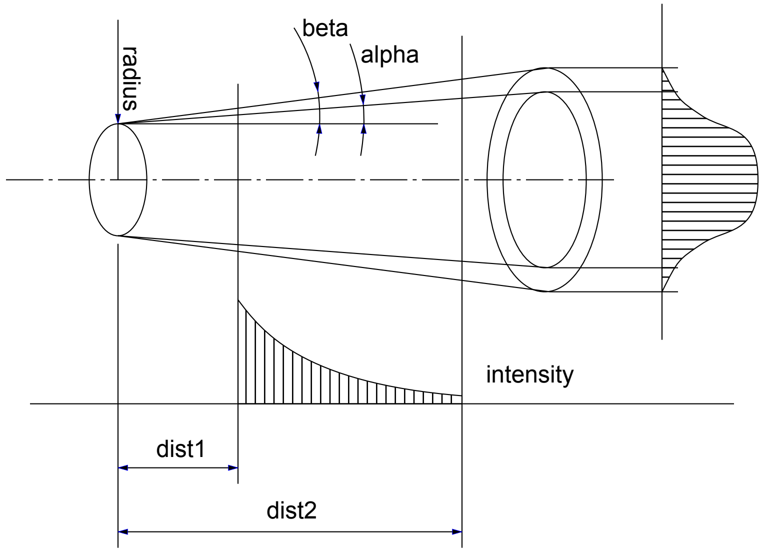
A light source radiates [red, green, blue] colored light from the local origin along the local x axis. The light is projected parallel to the x axis from a point or circle source. It has its maximum intensity within the alpha-angle frustum of a cone and falls to zero at the beta-angle frustum of a cone. This falloff is controlled by the angle_falloff parameter. (Zero gives the light a sharp edge, higher values mean that the transition is smoother.) The effect of the light is limited along the axis by the distance1 and distance2 clipping values. The distance_falloff parameter controls the decrease in intensity depending on the distance. (Zero value means a constant intensity; bigger values are used for stronger falloff.)

GDL transformations affect only the starting point and the direction of the light.

shadow: controls the light's shadow casting.

 `0:` light casts no shadows,

 `1:` light casts shadows.



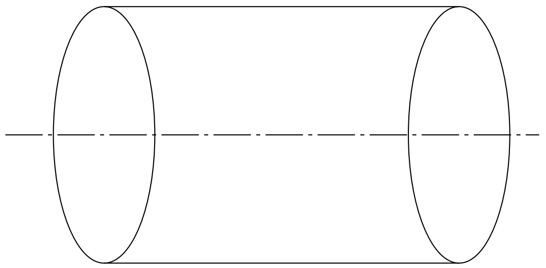
Restriction of parameters:

```
alpha <= beta <= 80°
```

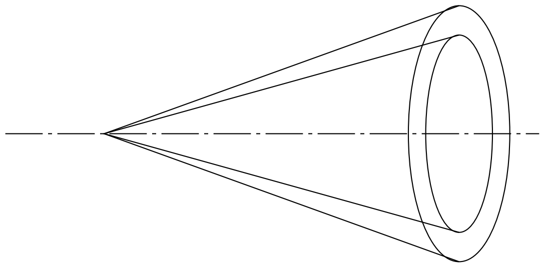
The following parameter combinations have special meanings:

`radius = 0, alpha = 0, beta = 0:` A point light, it radiates light in every direction and does not cast any shadows. The shadow and angle_falloff parameters are ignored, the values shadow = 0, angle_falloff = 0 are supposed.

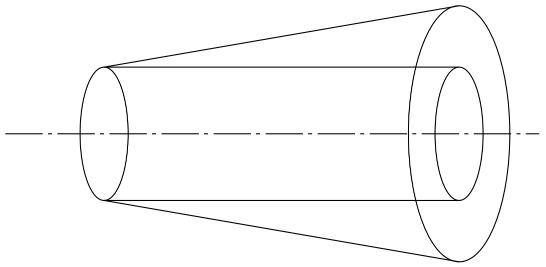
`radius > 0, alpha = 0, beta = 0:` A directional light with parallel beams.



`r = 0, alpha > 0, beta > 0:` A directional light with conic beams.



`r > 0, alpha = 0, beta > 0:` A directional light with parallel beam and conic falloff.



Light definitions can contain optional additional data definitions after the ADDITIONAL_DATA keyword. Additional data has a name (namei) and a value (valuei), which can be an expression of any type, even an array. If a string parameter name ends with the substring "_file", its value is considered to be a file name and will be included in the archive project.

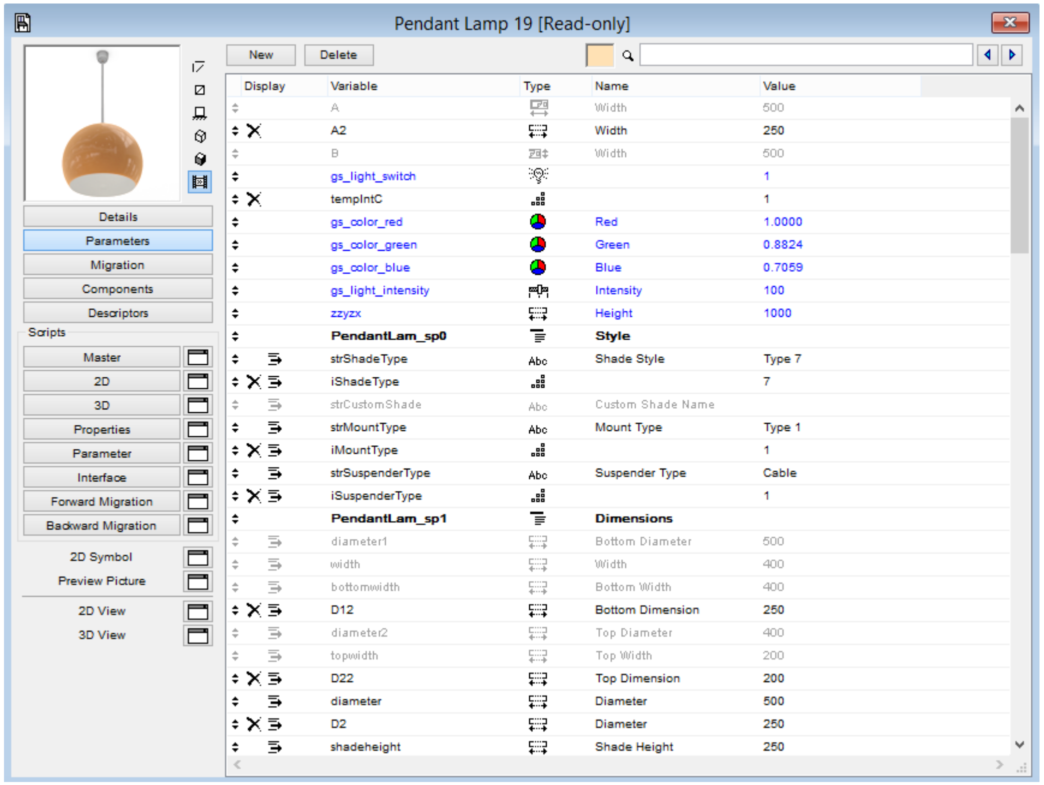
Different meanings of additional data can be defined and used by the executing application.

Example 1:

```
LIGHT 1.0,0.2,0.3,    ! RGB
        1,              ! shadow on
        1.0,            ! radius
        45.0, 60.0,     ! angle1, angle2
        0.3,            ! angle_falloff
        1.0, 10.0,      ! distance1, distance2
        0.2             ! distance_falloff
```

Example 2:

The library part dialog box for lights in ARCHICAD:



Display	Variable	Type	Name	Value
	A		Width	500
✕	A2		Width	250
	B		Width	500
	gs_light_switch			1
✕	tempIntC			1
	gs_color_red		Red	1.0000
	gs_color_green		Green	0.8824
	gs_color_blue		Blue	0.7059
	gs_light_intensity		Intensity	100
	zzyzx		Height	1000
	PendantLam_sp0		**Style**	
	strShadeType	Abc	Shade Style	Type 7
✕	iShadeType			7
	strCustomShade	Abc	Custom Shade Name	
	strMountType	Abc	Mount Type	Type 1
✕	iMountType			1
	strSuspenderType	Abc	Suspender Type	Cable
✕	iSuspenderType			1
	PendantLam_sp1		**Dimensions**	
	diameter1		Bottom Diameter	500
	width		Width	400
	bottomwidth		Bottom Width	400
✕	D12		Bottom Dimension	250
	diameter2		Top Diameter	400
	topwidth		Top Width	200
✕	D22		Top Dimension	200
	diameter		Diameter	500
✕	D2		Diameter	250
	shadeheight		Shade Height	250

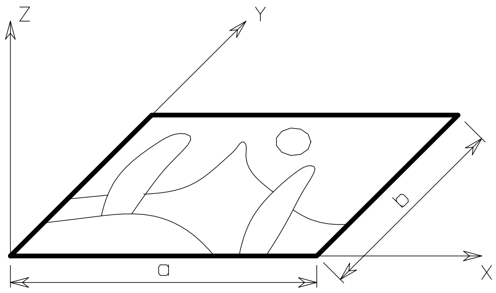
Part of the corresponding GDL script:

```
if gs_light_switch > 0 then
    LIGHT gs_light_intensity/100*gs_color_red, \
   gs_light_intensity/100*gs_color_green, \
   gs_light_intensity/100*gs_color_blue, ! RGB
           ...
endif
```

PICTURE

`PICTURE` `expression, a, b, mask`

A picture element for photorendering.



A string type expression means a file name, a numeric expression or the index of a picture stored in the library part. A 0 index is a special value that refers to the preview picture of the library part. Other pictures can only be stored in library parts when saving the project or selected elements containing pictures as GDL Objects.

Indexed picture reference cannot be used in the MASTER_GDL script when attributes are merged into the current attribute set. The image is fitted on a rectangle treated as a RECT in any other 3D projection method.

`mask:` alpha + distortion

`alpha:` alpha channel control.

`0:` do not use alpha channel; picture is a rectangle,

`1:` use alpha channel; parts of the picture may be transparent.

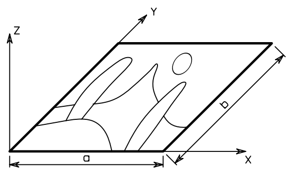
`distortion:` distortion control.

`0:` fit the picture into the given rectangle,

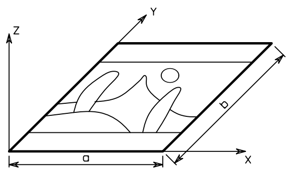
`2:` fit the picture in the middle of the rectangle using the natural aspect ratio of the picture,

`4:` fill the rectangle with the picture in a central position using natural aspect ratio of the picture.

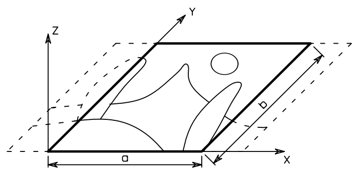
distortion=0



distortion=2



distortion=4



3D Text Elements

TEXT

TEXT `d, 0, expression`

A 3D representation of the value of a string or numeric type expression in the current style.

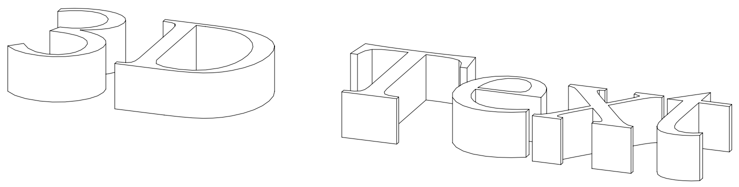
See the [SET] STYLE command and the DEFINE STYLE command.

`d:` thickness of the characters in meters.

In the current version of GDL, the second parameter is always zero.

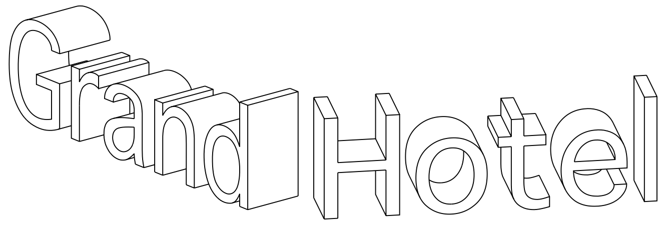
Note: For compatibility with the 2D GDL script, character heights are always interpreted in millimeters in DEFINE STYLE statements.

Example 1:



```
DEFINE STYLE "aa" "New York", 3, 7, 0
SET STYLE "aa"
TEXT 0.005, 0, "3D Text"
```

Example 2:



```
name = "Grand"
ROTX 90
ROTY -30
TEXT 0.003, 0, name
ADDX STW (name)/1000
ROTY 60
TEXT 0.003, 0, "Hotel"
```

RICHTEXT

```
RICHTEXT x, y,
        height, 0, textblock_name
```

A 3D representation of a previously defined TEXTBLOCK. For more details, *see the TEXTBLOCK command.*

`x, y:` X-Y coordinates of the richtext location.

`height:` thickness of the characters in meters.

`textblock_name:` the name of a previously defined TEXTBLOCK.

In the current version of GDL, the 4th parameter is always zero.

PRIMITIVE ELEMENTS

The primitives of the 3D data structure are VERT, VECT, EDGE, PGON and BODY. The bodies are represented by their surfaces and the connections between them. The information to execute a 3D cutaway comes from the connection information.

Indexing starts with 1, and a BASE statement or any new body (implicit BASE statement) resets indices to 1. For each edge, the indices of the adjacent polygons (maximum 2) are stored. Edges' orientations are defined by the two vertices determined first and second.

Polygons are lists of edges with an orientation including the indices of the edges. These numbers can have a negative prefix. This means that the given edge is used in the opposite direction. Polygons can include holes. In the list of edges, a zero index indicates a new hole. Holes must not include other holes. One edge may belong to 0 to 2 polygons. In the case of closed bodies, the polygon's orientation is correct if the edge has different prefixes in the edge list of the two polygons.

The normal vectors of the polygons are stored separately. In the case of closed bodies, they point from the inside to the outside of the body. The orientation of the edge list is counterclockwise (mathematical positive), if you are looking at it from the outside. The orientation of the holes is opposite to that of the parent polygon. Normal vectors of an open body must point to the same side of the body.

To determine the inside and outside of bodies they must be closed. A simple definition for a closed body is the following: each edge has exactly two adjacent polygons.

The efficiency of the cutting, hidden line removal or rendering algorithms is lower for open bodies. Each compound three-dimensional element with regular parameters is a closed body in the internal 3D data structure.

Contour line searching is based on the status bits of edges and on their adjacent polygons. This is automatically set for compound curved elements but it is up to you to specify these bits correctly in the case of primitive elements.

In the case of a simplified definition (vect = 0 or status < 0 in a PGON) the primitives that are referred to by others must precede their reference. In this case, the recommended order is:

```
VERT (TEVE)
EDGE
(VECT)
PGON (PIPG)
COOR
BODY
```

Searching for adjacent polygons by the edges is done during the execution of the BODY command.

The numbering of VERTs, EDGEs, VECTs and PGONs is relative to the last (explicit or implicit) BASE statement.

Status values are used to store special information about primitives. Each single bit usually has an independent meaning in the status, but there are some exceptions.

Given values can be added together. Other bit combinations than the ones given below are strictly reserved for internal use. The default for each status is zero.

VERT

VERT `x, y, z`

A node in the x-y-z space, defined by three coordinates.

VERT{2}

VERT `x, y, z, hard`

Extension of the VERT command including a possibility to declare a node to be hard vertex. A hard vertex defines a break when rendering smooth surfaces.

x, y, z: coordinates of the node.

hard:
- `1:` if the vertex should define a break when rendering smooth surfaces
- `0:` otherwise

TEVE

TEVE `x, y, z, u, v`

Extension of the VERT command including a texture coordinate definition. Can be used instead of the VERT command if user-defined texture coordinates are required instead of the automatic texture wrapping (*see the COOR command*).

x, y, z: coordinates of a node.

u, v: texture coordinates of the node (u, v) coordinates for each vertex of the current body must be specified and each vertex should have only one texture coordinate. If VERT and TEVE statements are mixed inside a body definition, (u, v) coordinates are ineffective.

Note: The (u, v) texture coordinates are only effective in photorenderings, and not for vectorial fill mapping.

VECT

VECT `x, y, z`

Definition of the normal vector of a polygon by three coordinates. In case of a simplified definition (vect=0 in a PGON), these statements can be omitted.

EDGE

EDGE `vert1, vert2, pgon1, pgon2, status`

Definition of an edge.

vert1, vert2: index of the endpoints. The vert1 and vert2 indices must be different and referenced to previously defined VERTs.

pgon1, pgon2: indices of the neighboring polygons. Zero and negative values have special meanings:
- `0:` terminal or standalone edge,
- `< 0:` possible neighbors will be searched for,

status: Status bits:

$status = j_1 + 2*j_2 + 4*j_3 + 8*j_4 + 16*j_5 + 32*j_6 + 64*j_7 + 262144*j_{19}$, where each j can be 0 or 1.

j_1: invisible edge,

`j2`: edge of a curved surface.

Reserved status bits for future use:

`j3`: first edge of a curved surface (effective only when j2=1),
`j4`: last edge of a curved surface (effective only when j2=1),
`j5`: the edge is an arc segment,
`j6`: first segment of an arc (effective only when j4=1),
`j7`: last segment of an arc (effective only when j4=1),
`j19`: render sharp edge between 2 curved polygons (effective only when j2=1).

PGON

`PGON` `n, vect, status, edge1, edge2, ..., edgen`

Polygon definition.

`n:` number of edges in the edge list.

`vect:` index of the normal vector. It must refer to a previously defined VECT.

Note: If vect = 0, the program will calculate the normal vector during the analysis.

`edge1, edge2, ..., edgen:` these indices must refer to previously defined EDGEs. A zero value means the beginning or the end of a hole definition. A negative index changes the direction of the stored normal vector or edge to the opposite in the polygon. (The stored vector or edge does not change; other polygons can refer to it using the original orientation with a positive index.)

`status:` Status bits:

`status` = $j_1 + 2*j_2 + 16*j_5 + 32*j_6 + 64*j_7 + 4*j_3 + 8*j_4$, where each j can be 0 or 1.

`j1`: invisible polygon,
`j2`: polygon of a curved surface,
`j5`: concave polygon,
`j6`: polygon with hole(s),
`j7`: hole(s) are convex (effective only when j6=1),

Reserved status bits for future use:

`j3`: first polygon of a curved surface (effective only when j2=1),
`j4`: last polygon of a curved surface (effective only when j2=1).

If the status value is negative, the engine will calculate the status of the polygon (like concave polygon or polygon with hole).

n = 0 is allowed for special purposes.

PGON{2}

`PGON{2}` `n, vect, status, wrap, edge_or_wrap1, ..., edge_or_wrapn`

The first three parameters are similar to the ones at the PGON command.

`wrap:` wrapping mode + projection type.

`0:` the global wrapping mode is applied,

`> 0:` the meaning is the same as it is in the COOR command.

`edge_or_wrap1, ..., edge_or_wrapn:` The number and meaning of these parameters are based on the wrap definition:

`edge1, ..., edgen:` if wrap is 0; in this case `edgen` means the same as at the PGON command, and globally defined texture mapping will be applied;

`x1, y1, z1, x2, y2, z2, x3, y3, z3, x4, y4, z4, edge1, ..., edgen:` if wrapping mode isn't 0 in wrap; in this case `xi, yi, zi` coordinates defining the coordinate system of the texture mapping for the polygon;

`edge1, u1, v1, ..., edgen, un, vn:` if wrapping mode is 0 but projection type isn't 0 in wrap; in this case `ui, vi` texture space coordinates are the same as at the TEVE command; the mapping will affect the currently defined polygon only.

PGON{3}

`PGON{3}` `n, vect, status, wrap_method, wrap_flags, edge_or_wrap1, ..., edge_or_wrapn`

The parameters are similar to the the PGON{2} command, except `wrap`, which is split into two parameters `wrap_method` and `wrap_flags`. The meaning of these is the same as in the COOR{2} command.

PIPG

```
PIPG expression, a, b, mask, n, vect, status,
     edge1, edge2, ..., edgen
```

Picture polygon definition. The first four parameters are the same as in the PICTURE command; the remaining ones are the same as in the PGON command.

COOR

`COOR` `wrap, vert1, vert2, vert3, vert4`

Deprecated. See the COOR{3} command.

Local coordinate system of a BODY for the fill and texture mapping.

`wrap:` wrapping mode + projection type

`Wrapping modes:`

`1:` planar box (deprecated),

`2:` box,
`3:` cylindrical,
`4:` spherical,
`5:` same as the cylindrical fill mapping, but in rendering the top and the bottom surface will get a circular mapping,
`6:` planar,
`7:` NURBS based, the vertices' texture coordinates are from their surface parameters, only in case of NURBS bodies.

`Projection types:`

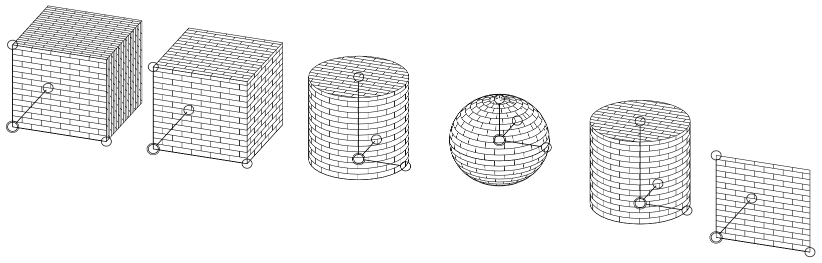
`256:` the fill always starts at the origin of the local coordinate system,
`1024:` quadratic texture projection (recommended),
`2048:` linear texture projection based on the average distance,
`4096:` linear texture projection based on normal triangulation.

Note: The last three values are only effective with custom texture coordinate definitions (*see the TEVE command*).

`vert1:` index of a VERT, representing the origin of the local coordinate system.

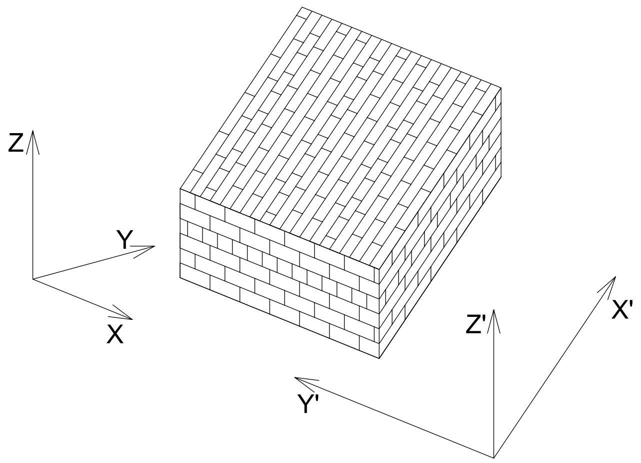
`vert2, vert3, vert4:` indices of VERTs defining the three coordinate axes.

Use a minus sign (-) before VERT indices if they are used only for defining the local coordinate system.



Example: For custom texture axes:

```
CSLAB_ "Brick-White", "Brick-White", "Brick-White",
        4, 0.5,
        0, 0, 0, 15,
        1, 0, 0, 15,
        1, 1, 1, 15,
        0, 1, 1, 15
BASE
VERT 1, 0, 0 !#1
VERT 1, 1, 1 !#2
VERT 0, 0, 0 !#3
VERT 1, 0, 1 !#4
COOR 2, -1, -2, -3, -4
BODY 1
```



COOR{2}

COOR{2} `wrap_method, wrap_flags, vert1, vert2, vert3, vert4`

Deprecated. See the COOR{3} command.

Similar to the COOR command, changing `wrap` to two parameters `wrap_method` and `wrap_flags`, and also extending the possibilities of it.

wrap_method: Wrapping methods are the same as described in the the COOR command.

wrap_flags: Wrapping flags

`wrap_flags = 4*j`$_3$` + 8*j`$_4$` + 16*j`$_5$` + 32*j`$_6$` + 64*j`$_7$` + 128*j`$_8$, where each j can be 0 or 1.

`j`$_3$`:` quadratic texture projection (recommended),

`j`$_4$`:` linear texture projection based on the average distance,

`j`$_5$`:` linear texture projection based on normal triangulation,

`j`$_8$`:` translate the origin of the texture coordinate system closest to the global origin in the direction of the X, Y or Z axis respectively. For example, `j6` makes the origin translating in the direction of the X axis (along `v2 - v1` vector) so that it will be the orthogonal projection of the global origin to the line of the X axis. That is, if all `j6`, `j7` and `j8` are `1`, the origin is translated into the global origin (same as if projection type is `256` in the the COOR command).

Note: The `j3`, `j4` and `j5` flags are only effective if `wrap_method` is `0` and only one of them can be `1`. The `j6`, `j7` and `j8` flags are only effective if `wrap_method` is not `0`. These can be `1` at the same time in any combination.

vert1, vert2, vert3, vert4: like in the COOR command.

COOR{3}

```
COOR{3} wrapping_method, wrap_flags,
        origin_X, origin_Y, origin_Z,
        endOfX_X, endOfX_Y, endOfX_Z,
        endOfY_X, endOfY_Y, endOfY_Z,
        endOfZ_X, endOfZ_Y, endOfZ_Z
```

Compatibility: introduced in ARCHICAD 20.

Similar to the COOR{2} command. Can be used with array parameter input (see WALL_TEXTURE_WRAP global in the section called “Wall parameters - available for Doors/Windows, listing and labels” for more).

The coordinate system of the projection body is included in the COOR{3} command itself, no need to define additional vertexes in the current BODY. Compatible with NURBS bodies (no non-NURBS primitives are needed to set up the texture coordinate system).

wrap_method: Wrapping methods are the same as described in the the COOR command.

wrap_flags: Wrapping flags

`wrap_flags = 4*j`$_3$` + 8*j`$_4$` + 16*j`$_5$` + 32*j`$_6$` + 64*j`$_7$` + 128*j`$_8$, where each j can be 0 or 1.

`j`$_3$`:` quadratic texture projection (recommended),

`j`$_4$`:` linear texture projection based on the average distance,

`j`$_5$`:` linear texture projection based on normal triangulation, `j8`: translate the origin of the texture coordinate system closest to the global origin in the direction of the X, Y or Z axis respectively. For example, `j6` makes the origin translating in the direction of the X axis (along `v2 - v1` vector) so that it will be the orthogonal projection of the global origin to the line of the X axis. That is, if all `j6`, `j7` and `j8` are `1`, the origin is translated into the global origin (same as if projection type is `256` in the the COOR command).

Note: The `j3`, `j4` and `j5` flags are only effective if `wrap_method` is `0` and only one of them can be `1`. The `j6`, `j7` and `j8` flags are only effective if `wrap_method` is not `0`. These can be `1` at the same time in any combination.

`origin_X, origin_Y, origin_Z:` node in the x-y-z space, defined by three coordinates, texture origin.

`endOfX_X, endOfX_Y, endOfX_Z:` node in the x-y-z space, defined by three coordinates, texture mapping X direction.

`endOfY_X, endOfY_Y, endOfY_Z:` node in the x-y-z space, defined by three coordinates, texture mapping Y direction.

`endOfZ_X, endOfZ_Y, endOfZ_Z:` node in the x-y-z space, defined by three coordinates, texture mapping Z direction.

Example: COOR{3} and equivalent COOR{2} parametrisation

```
COOR{3} wrapping_method, wrap_flags,
        origin_X, origin_Y, origin_Z,
        endOfX_X, endOfX_Y, endOfX_Z,
        endOfY_X, endOfY_Y, endOfY_Z,
        endOfZ_X, endOfZ_Y, endOfZ_Z

! COOR{2} equivalent
BASE
VERT    origin_X, origin_Y, origin_Z,
VERT    endOfX_X, endOfX_Y, endOfX_Z
VERT    endOfY_X, endOfY_Y, endOfY_Z
VERT    endOfZ_X, endOfZ_Y, endOfZ_Z
COOR{2} wrapping_method, wrap_flags, -1, -2, -3, -4
```

BODY

`BODY` `status`

Composes a body defined with the above primitives.

`status:` Status bits:

`status = j`$_1$` + 2*j`$_2$` + 4*j`$_3$` + 32*j`$_6$` + 64*j`$_7$, where each j can be 0 or 1.

`j`$_1$`:` closed body (deprecated),

`j`$_2$`:` body including curved surface(s) (deprecated),

`j`$_3$`:` surface model: when the body is cut, no surface originates on the cutting plane,

`j`$_6$`:` body always casts shadow independently from automatic preselection algorithm,

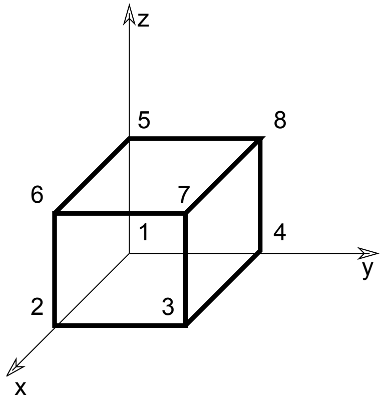
`j`$_7$`:` body never casts shadow.

If neither j6 nor j7 are set, the automatic shadow preselection is performed.

See the SHADOW command.

If the status value is negative, the engine will calculate the status of the body.

Example:



1: Complete description

```
VERT 0.0, 0.0, 0.0    !#1
VERT 1.0, 0.0, 0.0    !#2
VERT 1.0, 1.0, 0.0    !#3
VERT 0.0, 1.0, 0.0    !#4
VERT 0.0, 0.0, 1.0    !#5
VERT 1.0, 0.0, 1.0    !#6
VERT 1.0, 1.0, 1.0    !#7
VERT 0.0, 1.0, 1.0    !#8
EDGE 1, 2, 1, 3, 0    !#1
EDGE 2, 3, 1, 4, 0    !#2
EDGE 3, 4, 1, 5, 0    !#3
EDGE 4, 1, 1, 6, 0    !#4
EDGE 5, 6, 2, 3, 0    !#5
EDGE 6, 7, 2, 4, 0    !#6
EDGE 7, 8, 2, 5, 0    !#7
EDGE 8, 5, 2, 6, 0    !#8
EDGE 1, 5, 6, 3, 0    !#9
EDGE 2, 6, 3, 4, 0    !#10
EDGE 3, 7, 4, 5, 0    !#11
EDGE 4, 8, 5, 6, 0    !#12
VECT 1.0, 0.0, 0.0    !#1
VECT 0.0, 1.0, 0.0    !#2
VECT 0.0, 0.0, 1.0    !#3
PGON 4, -3, 0, -1, -4, -3, -2     !#1    !VERT1,2,3,4
PGON 4, 3, 0, 5, 6, 7, 8          !#2    !VERT5,6,7,8
PGON 4, -2, 0, 1, 10, -5, -9      !#3    !VERT1,2,5,6
PGON 4, 1, 0, 2, 11, -6, -10      !#4    !VERT2,3,6,7
PGON 4, 2, 0, 3, 12, -7, -11      !#5    !VERT3,4,7,8
PGON 4, -1, 0, 4, 9, -8, -12      !#6    !VERT1,4,5,8
BODY 1                                   !CUBE
```

2: (no direct reference to the polygons or the vectors, they will be calculated)

```
VERT 0.0, 0.0, 0.0      !#1
VERT 1.0, 0.0, 0.0      !#2
VERT 1.0, 1.0, 0.0      !#3
VERT 0.0, 1.0, 0.0      !#4
VERT 0.0, 0.0, 1.0      !#5
VERT 1.0, 0.0, 1.0      !#6
VERT 1.0, 1.0, 1.0      !#7
VERT 0.0, 1.0, 1.0      !#8
EDGE 1, 2, -1, -1, 0    !#1
EDGE 2, 3, -1, -1, 0    !#2
EDGE 3, 4, -1, -1, 0    !#3
EDGE 4, 1, -1, -1, 0    !#4
EDGE 5, 6, -1, -1, 0    !#5
EDGE 6, 7, -1, -1, 0    !#6
EDGE 7, 8, -1, -1, 0    !#7
EDGE 8, 5, -1, -1, 0    !#8
EDGE 1, 5, -1, -1, 0    !#9
EDGE 2, 6, -1, -1, 0    !#10
EDGE 3, 7, -1, -1, 0    !#11
EDGE 4, 8, -1, -1, 0    !#12
PGON 4, 0, -1, -1, -4, -3, -2    !#1
!VERT1,2,3,4
PGON 4, 0, -1, 5, 6, 7, 8        !#2
!VERT5,6,7,8
PGON 4, 0, -1, 1, 10, -5, -9     !#3
!VERT1,2,5,6
PGON 4, 0, -1, 2, 11, -6, -10    !#4
!VERT2,3,6,7
PGON 4, 0, -1, 3, 12, -7, -11    !#5
!VERT3,4,7,8
PGON 4, 0, -1, 4, 9, -8, -12     !#6
!VERT1,4,5,8
BODY -1                                !CUBE
```

BASE

BASE

Resets counters for low-level geometric elements (VERT, TEVE, VECT, EDGE, PGON and PIPG) statements. Implicitly issued after every compound element definition.

NURBS Primitive Elements

The primitives of 3D data structure of NURBS bodies are the NURBSCURVE2D command, the NURBSCURVE3D command, the NURBSSURFACE command, the NURBSVERT command, the NURBSEDGE command, the NURBSTRIM command, the NURBSTRIMSINGULAR command, the NURBSFACE command, the NURBSLUMP command, and the NURBSBODY command.

Solid NURBS bodies are represented by the boundary NURBS faces of the solid region(s), laminar surface NURBS bodies are represented by the NURBS faces themself, wire NURBS bodies are represented by the NURBS edges. A NURBS body can have solid, laminar and wire part at the same time, a NURBS body itself is not classified into solid/surface/wire categories.

Nurbs primitives can not be used in planar face bodies and non-NURBS primitives can not be used in NURBS bodies. A non-NURBS primitive statement causes the NURBS body under construction to be finished and a new non-NURBS body to be started (implicit BODY and NURBSBODY statements).

Similarly a NURBS primitive statement causes the non-NURBS body under construction to be finished and a new NURBS body to be started. A compound statement (BRICK, CYLIND, PRISM, etc.) or a MODEL statement causes either NURBS or non-NURBS body under construction to be finished. If a NURBSBODY statement closes a non-NURBS body or a BODY statement closes a NURBS body, the given status value will have no effect.

Indexing of NURBS primitives starts from 1. Indexing of NURBS primitives and non-NURBS primitives (VERT, TEVE, EDGE, VECT, PGON, PIPG) are handled separately. The BASE statement resets counter for NURBS body primitives also. All primitives referenced by another primitive should be defined before the referencing one (e.g. vertices and 3D curve of edge should be defined before the edge).

The NURBSCURVE2D, NURBSCURVE3D and NURBSSURFACE statements create only geometrical elements in the NURBS body which will not be visible themselves. A NURBS edge defines its geometrical support by referencing a 3D NURBS curve, similarly a NURBS trim references a 2D NURBS curve and a NURBS face references a NURBS surface as its geometrical support (the edge, trim and face may not extend to the whole geometrical support, see details at each command description).

The NURBS edge, its 3D curve, its trims, and the 2D curves of the trims are always oriented consistently. The NURBS face and its surface are always oriented consistently.

The NURBS faces may be organized into NURBS lumps. A lump defines a solid region bounded by one or more shells. A shell is a closed and connected set of faces which separates the space into two regions. A lump has an outer shell which separates the lump from the infinity and may have void shells which separate the lump from inner cavities.

Consistent orientation of faces in a shell is not necessary, two neighbouring face can refer to the same edge in the same direction. But shells of lump must have consistent orientations, the back side of a shell should look toward the interior of the lump, for this the lump can refer to the faces with negative prefix for reversed orientation.

Faces which are not part of a lump will be treated as laminar surfaces, even if the faces form a closed shell. Edges which are not part of a face will be treated as wire edges. One NURBS body can contain solid lumps, laminar faces and wire edges at the same time.

The 2-manifold property is not required for NURBS bodies, a NURBS edge may be connected to more than two faces (by more than two trims). Even a shell of a NURBS lump can have more than two faces at an edge as long as the shell still separates the space into two regions (this means even number of faces of a given shell on each edge).

The RADIUS, RESOL and TOLER statements have no effect on the smoothness of the NURBS faces and edges. The smoothness of NURBS primitives is calculated automatically and may be limited for a NURBS body by the parameters of the NURBSBODY command (see details at NURBSBODY).

For correct texture setting for NURBS, see the the COOR{3} command.

NURBS Face trimming

A NURBS surface is a two dimensional sheet in the three dimensional space and is defined by a geometrical function mapping a rectangle to the space. The geometry of a NURBS face is always a part of a NURBS surface but may be more complex than that. This is made possible by trims.

A trim defines a cut on the domain rectangle of the surface, a cut with a two dimensional NURBS curve. This implies a cut on the three dimensional sheet of the surface. This cut lies along the bounding NURBS edge of the face and the geometry of the cut along the surface sheet must be consistent with the geometry of the NURBS edge.

A NURBS face has contours just like a traditional PGON, but the contours are not lists of NURBS edges but NURBS trims because the trims have the information needed to cut the face properly. (The 2d curve of trims may be computed from the 3d curve of the edge but it may be inaccurate or even ambiguous in case of surfaces with self-intersection or singularities or in case of erroneous data.)

NURBS Geometry Commands

The following commands describe geometrical parts of NURBS elements: curves and surface.

NURBSCURVE2D

```
NURBSCURVE2D degree, nControlPoints,
        knot_1, knot_2, ..., knot_m,
        cPoint_1_x, cPoint_1_y, weight_1,
        cPoint_2_x, cPoint_2_y, weight_2,
        ...,
        cPoint_n_x, cPoint_n_y, weight_n
```

NURBSCURVE3D

```
NURBSCURVE3D degree, nControlPoints,
        knot_1, knot_2, ..., knot_m,
        cPoint_1_x, cPoint_1_y, cPoint_1_z, weight_1,
        cPoint_2_x, cPoint_2_y, cPoint_2_z, weight_2,
        ...,
        cPoint_n_x, cPoint_n_y, cPoint_n_z, weight_n
```

2 and 3 dimensional NURBS curves with given degree, knotvector, controlpoints and weigths.

degree: degree of NURBS curve, one less than order of curve (order = degree + 1), positive

nControlPoints: number of control points (n), greater than the degree of the curve (not less than the order)

knot_i: index i knot value

- number of knot values (m, the size of knot vector) is given by the following: m = degree + 1 + n
- knots are in non-descending order (knot_i <= knot_{i+1})
- equal knot values are allowed, with multiplicity up to degree, or with multiplicity up to degree+1 for the first and last knot.

cPoint_i_x, cPoint_i_y, cPoint_i_z: coordinates of index i control point

weight_i: weigth of index i control point, positive

Periodic curves are not handled separately, but described as floating (not clamped) NURBS curves which are geometrically closed and have appropriately continuous connection at the the ends. This is ensured by repeating sufficient number of control points and knot-intervals at the end:

- the last degree many control points are duplicates of the first degree many control points (not in reverse order),
- the first twice-the-degree number of knot-differences (knot_1-knot_0, knot_2-knot_1, ...) are the same as the last ones in the knot vector (these are the knots which are in connection with the first (or last) degree many control points).

The usable domain of a curve is the closed interval between knot_{degree + 1} and knot_{m - degree}.

NURBSSURFACE

```
NURBSSURFACE degree_u, degree_v, nu, nv,
       knot_u_1, knot_u_2, ..., knot_u_mu,
       knot_v_1, knot_v_2, ..., knot_v_mv,
       cPoint_1_1_x, cPoint_1_1_y, cPoint_1_1_z, weight_1_1,
       cPoint_1_2_x, cPoint_1_2_y, cPoint_1_2_z, weight_1_2,
       ...,
       cPoint_1_nv_x, cPoint_1_nv_y, cPoint_1_nv_z, weight_1_nv,
       cPoint_2_1_x, cPoint_2_1_y, cPoint_2_1_z, weight_2_1,
       ...,
       cPoint_nu_nv_x, cPoint_nu_nv_y, cPoint_nu_nv_z, weight_nu_nv
```

3-dimensional NURBS surface with u-v parameter space, given degree, knotvectors in u and v directions and given controlpoint, weigth net. Degrees are one less than orders of surface (order_u = degree_u + 1), degrees are positive.

degree_u: degree of surface in the u parameter direction

degree_v: degree of surface in the v parameter direction

nu, nv: number of control points in u and v directions, greater than degree (not less than order) of then surface in given direction

knot_u_i, knot_v_i: index i knot value in u and v directions

- their number (the size of knot vector) is given by the following: mu = degree_u + 1 + nu
- knots are in non-descending order (knot_u_i <= knot_u_{i+1}, knot_v_i <= knot_v_{i+1})
- equal knot values are allowed, with multiplicity up to degree, or with multiplicity up to degree+1 for the first and last knot.

cPoint_i_j_x, cPoint_i_j_y, cPoint_i_j_z: control point on the control point net, index i in the u direction, index j in the v direction

weight_i_j: weight for control point cPoint_ij, positive

Surfaces may be periodic in either (u or v) direction or in both directions. Periodic surfaces are not handled separately, but described as floating (not clamped) NURBS surfaces which are geometrically closed and have appropriately continuous connection at the the ends. This is ensured the same way as in case of curves.

The usable domain of a surface is the cross product of the closed intervals between knot_u_{degree_u + 1}, knot_u_{mu - degree_u} and knot_v_{degree_v + 1}, knot_v_{mv - degree_v} respectively.

NURBS Topology Commands

The following commands describe topological parts of NURBS elements.

NURBSVERT

NURBSVERT `x, y, z, hard, tolerance`

Vertex, a node of a NURBS body. Different from any vertex created by the VERT command, indexed separately from those. Can be used in NURBS bodies only, excluding planar-face bodies.

x, y, z: coordinates of vertex

hard:

`1:` if the vertex should define a break when rendering smooth surfaces,
`0:` otherwise.

tolerance: maximum geometrical distance between NURBS vertex and other entities (NURBS edge, NURBS face) which are topologically connected to it. If negative, tolerance will be some predefined default.

NURBSEDGE

NURBSEDGE `vert1, vert2, curve, curveDomainBeg, curveDomainEnd, status, tolerance`

Edge of a NURBS body. Different from any edge created by the EDGE command, indexed separately from those. Can be used in NURBS bodies only, excluding planar-face bodies.

vert1, vert2: gdl-index of begin and end NURBS vertices

- vert1 and vert2 can be equal. In this case the edge is a loop edge (and its curve is closed or has a closed part)
- vert1 and vert2 can be zero for a ring edge (which has no vertices and its curve is closed or has a closed part)

curve: gdl-index of NURBS curve for the geometry of edge. Positive index, orientation of edge always coincide with orientation of the curve.

curveDomainBeg, curveDomainEnd: definition of the part of curve which geometrically represents the edge. The curveDomainEnd must be greater than curveDomainBeg, they must not coincide, and both value must be in the usable domain of the curve.

status: status control of the edge:

$status = j_1 + 2*j_2 + 4*j_3$, where each j can be 0 or 1.
j_1: invisible edge (may be set only if j2 is not set).
j_2: edge only visible if contour (may be set only if j1 is not set).
j_3: smooth edge (edge does not define a break when rendering smooth surfaces).

If both j1 and j2 are set, the edge will produce an error causing the whole NURBS-body to vanish.

tolerance: maximum geometrical distance between NURBS edge and other entities (NURBS face) which are topologically connected to it. If negative, tolerance will be some predefined default.

The curve evaluated at each endpoint should coincide with the position of the appropriate vertex. The edge can be a ring edge with no vertex. In this case the edge restricted to [curveDomainBeg, curveDomainEnd] must be closed, i.e. it evaluates equally at each endpoints. Any number of edges can be attached to a vertex. The color of a NURBS edge is defined by the last `PEN` statement.

NURBSTRIM

`NURBSTRIM` `edge, curve, curveDomainBeg, curveDomainEnd, tolerance`

NURBSTRIMSINGULAR

`NURBSTRIMSINGULAR` `vertex, curve, curveDomainBeg, curveDomainEnd, tolerance`

A bounding edge of a face. Used for trimming a face in the parameter space of the surface of the face. NURBSTRIMSINGULAR is used along singular sides of the surface (which side is contracted to one point on the surface). Connects the face to an edge (or to a vertex in singular case).

`edge:` gdl-index of NURBS edge to which this trim is attached. Positive index, edge and trim are always oriented consistently.

`vertex:` gdl-index of NURBS vertex to which this trim is attached (singular case).

`curve:` gdl-index of a 2D NURBS curve. Positive index, curve and trim are always oriented consistently. It is defined on the domain (u-v parameter space) of the surface of the face.

`curveDomainBeg, curveDomainEnd:` definition of the part of curve which geometrically represents the trim. The curveDomainEnd must be greater than curveDomainBeg, they must not coincide, and both value must be in the usable domain of the curve.

`tolerance:` maximum geometrical distance between 2D curve of NURBS trim and other entities (other NURBS trims) which are topologically connected to it. If negative, tolerance will be some predefined default.

The curve restricted to [curveDomainBeg, curveDomainEnd] interval should completely lie within the usable domain of the surface of the face (with given tolerance). For NURBSTRIMSINGULAR the 2D curve must lie along a singular side of the usable domain (u-v parameter space) of the surface of the face.

The composition of the restricted 2D curve and the surface gives a 3D curve which should coincide with the restricted 3D curve of the edge. Therefore the 2D curve evaluated at curveDomainBeg and curveDomainEnd should coincide with the position of the appropriate vertex. In the singular case the composition of the 2D curve and the surface gives a 3D point, which should coincide with the given vertex.

Indexing of singular and non-singular trims is common.

Any number of trims can refer to each edge (so indirectly any number of face can be attached to an edge). The edge can be non-2-manifold.

Two trims on one edge may belong to the same face, in this case edge is called a seam edge. For example a mantle of a cylinder can be one face with a seam edge.

NURBSFACE

```
NURBSFACE n, surface, tolerance,
        trim1, trim2, ..., trimn
```

Face of a NURBS body. Different from any polygon created by the PGON command, indexed separately from those. Can be used in NURBS bodies only, excluding planar-face bodies.

`n:` number of bounding edges (including optional hole-separator zeros).

`surface:` gdl-index of a NURBS surface supporting the face. Positive index, orientation of face is always identical to the orientation of surface.

`trimi:` gdl-index of NURBS trim bounding the face.

- The trims are listed in a counter-clocwise (mathematical positive) order on the surface for the outer contour loop and clockwise (negative) for hole contour loop(s).
- May be zero, which indicates end of contour (hole-separator).
- Negative index means trim and the contour (of face) have opposite orientation.

`tolerance:` if negative, tolerance will be some predefined default.

The trims must connect at common vertices: the end vertex of a trim is the same as the begin vertex of the next trim in the face. (The vertices of a trim are the vertices of the edge of the trim for a non-singular trim.)

The consecutive trims - as 2D curves - also connect in the domain (parameter space) of the face, defining one or more closed contour loops on it. The first loop is always an outer loop which separates an infinite outer and a finite inner region on the plane. The potential subsequent loops are hole contours.

The 2D curve of each trim should completely lie inside the usable domain of the surface of the face and should not intersect itself or curves of other trims of the face. Each trim must be used in only one face.

The material and section attributes of a face are determined by the last MATERIAL and `SECT_ATTRS` (or SECT_FILL) statements respectively. The color of the edges inside the face created for polygonal segmentations is defined by the last `PEN` statement. This is practically visible on silhouettes coming from the internal of this face.

NURBSLUMP

```
NURBSLUMP n, face1, face2, ..., facen
```

Defines a solid part - a geometrically connected subset - of a solid NURBS body.

`n:` number of bounding faces (including optional void-separator zeros).

`facei:` gdl-index of NURBS face bounding the lump

- May be zero, indicating the end of shell and the beginning of another shell (void-separator).

- Negative index means face is used in opposite direction. For positive index the backward side of the face correspond to the interior of the lump, for negative index the front side looks to the interior.

The boundary of a lump may fall to several closed shells: one outer shell which separates the lump from the infinite outer region of the space; and zero or more inner - void - shells which separate the lump from cavity regions. The faces of one shell must compose a continuous part of the face list. These different parts for different shells must be separated by a 0 value. The first shell must be the outer shell. The faces of a shell must connect at common edges, but no ordering is assumed in the list.

Note that the faces of a shell may be connected to other faces which are not in the shell or are in another shell (because edges can have more than two faces). Each face must be used in only one lump. Neither shell of a lump can be open - open bodies have no lumps and no shells.

NURBSBODY

`NURBSBODY` `shadowStatus, smoothnessMin, smoothnessMax`

Composes a NURBS body defined with the above NURBS primitives.

`shadowStatus:` status for shadow control:

`shadowStatus = 32*j`$_6$ `+ 64*j`$_7$, where each j can be 0 or 1.

`j`$_6$`:` NURBS body always casts shadow independently from automatic preselection algorithm,

`j`$_7$`:` NURBS body never casts shadow.

If neither j6 nor j7 are set, the automatic shadow preselection is performed. See the SHADOW command.

`smoothnessMin, smoothnessMax:` limits of automatically calculated smoothness parameter for tessellation of the surfaces and curves of body. The automatically calculated parameter will be always in the range 0 to 1 inclusive, so that smoothnessMin <= 0 means no lower limit and smoothnessMax >= 1 means no upper limit. If smoothnessMin > smoothnessMax, values will not affect the automatically calculated smoothness.

Any non-NURBS primitive statement (VERT, TEVE, EDGE, VECT, PGON, PIPG, BODY) or any compound statement (BRICK, CYLIND, PRISM, REVOLVE, etc.) causes the NURBS body under construction to be finished (implicit NURBSBODY statement). In this case smoothness limits will not be set and shadowStatus will be zero (status parameter of BODY statement will not be passed).

POINT CLOUDS

POINTCLOUD

`POINTCLOUD` `"data_file_name"`

Generates a point cloud in the 3D model. A point cloud is a set of 3D points with color and other possible metadata stored per each point.

`data_file_name:` the name of the loaded library part containing the point cloud data. Must be a string expression.

Point clouds are not displayed by the Internal 3D Engine. The 2D is projected, using cutplanes to filter the unnecessary points.

CUTTING IN 3D

CUTPLANE

```
CUTPLANE [x [, y [, z [, side [, status]]]]]
[statement1 ... statementn]
CUTEND
```

CUTPLANE{2}

```
CUTPLANE{2} angle [, status]
[statement1 ... statementn]
CUTEND
```

CUTPLANE{3}

```
CUTPLANE{3} [x [, y [, z [, side [, status]]]]]
[statement1 ... statementn]
CUTEND
```

Creates a cutting plane and removes the cut parts of enclosed shapes. CUTPLANE may have a different number of parameters.

If CUTPLANE has the following number of parameters:

0: x-y plane;

1: cutting plane goes across x axis, angle is between cutting plane and x-y plane;

2: cutting plane is parallel to z axis, crosses x axis and y axis at the given values;

3: cutting plane crosses the x, y and z axes at the given values;

4: the first three parameters are as above, with the addition of the side value as follows:

side: definition of the side to cut.

`0:` removes parts above cutting plane (default),

`1:` removes parts below cutting plane; in case of x-y, x-z, y-z, removes the parts in the negative direction of the axis.

status: status control of the cut surfaces. If the status is not given the status is set to 1+2 automatically.

status = j_1 + 2*j_2 + 4*j_3 + 256*j_9, where each j can be 0 or 1.

j_1: use the attributes of the body for the generated polygons and edges.

j_2: generated cut polygons will be treated as normal polygons.

j_3: generated cut edges will be invisible.

`j9`**:** vertices on the cutting plane are treated as removed.

The cut (without the side parameter) removes parts above the cutting plane. If the first three parameters define the x-y, x-z or y-z plane (for example, 1.0, 1.0, 0.0 defines the x-y plane), the parts in the positive direction of the third axis are removed.

Any number of statements can be added between CUTPLANE and CUTEND. It is also possible to include CUTPLANEs in macros. CUTPLANE parameters refer to the current coordinate system.

Transformations between CUTPLANE and CUTEND have no effect on this very cutting plane, but any successive CUTPLANEs will be transformed. Therefore, it is recommended to use as many transformations to set up the CUTPLANE as necessary, then delete these transformations before you define the shapes to cut.

If transformations used only to position the CUTPLANE are not removed, you may think that the CUTPLANE is at a wrong position when, in reality, it is the shapes that have moved away.

Pairs of CUTPLANE-CUTEND commands can be nested, even within loops. If the final CUTEND is missing, its corresponding CUTPLANE will be effective on all shapes until the end of the script.

Note 1: If CUTPLANE is not closed with CUTEND, all shapes may be entirely removed. That's why you always get a warning message about missing CUTENDs.

CUTPLANEs in macros affect shapes in the macro only, even if CUTEND is missing.

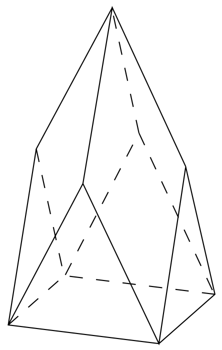
If a macro is called between CUTPLANE and CUTEND, the shapes in the macro will be cut.

Note 2: If you use CUTPLANE{2} with more than two parameters, then this will act like CUTPLANE.

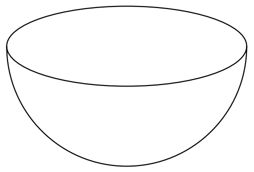
Note 3: Prefer using CUTPLANE{3} instead of CUTPLANE. If you use CUTPLANE with 5 parameters, then the 4th parameter will be omitted. For CUTPLANE{3}, this parameter has effect independently from the 5th parameter.

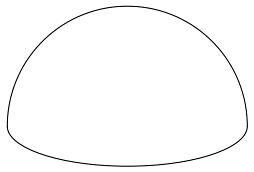
Example 1:

```
CUTPLANE 2, 2, 4
CUTPLANE -2, 2, 4
CUTPLANE -2, -2, 4
CUTPLANE 2, -2, 4
ADD -1, -1, 0
BRICK 2, 2, 4
DEL 1
CUTEND
CUTEND
CUTEND
CUTEND
```



Example 2:

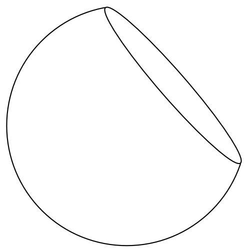




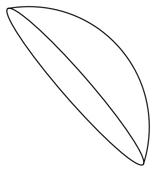
```
CUTPLANE
SPHERE 2
CUTEND
```

```
CUTPLANE 1, 1, 0, 1
SPHERE 2
CUTEND
```

Example 3:

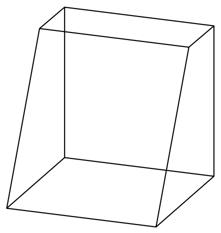


```
CUTPLANE 1.8, 1.8, 1.8
SPHERE 2
CUTEND
```

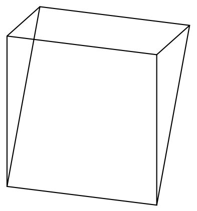


```
CUTPLANE 1.8, 1.8, 1.8, 1
SPHERE 2
CUTEND
```

Example 4:



```
CUTPLANE 60
BRICK 2, 2, 2
CUTEND
```



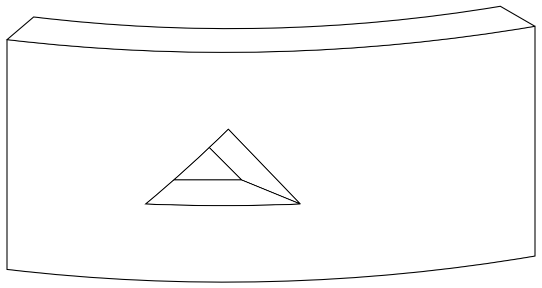
```
CUTPLANE -120
BRICK 2, 2, 2
CUTEND
```

CUTPOLY

```
CUTPOLY n,
        x1, y1, ..., xn, yn
        [, x, y, z]
[statement1
statement2
...
statementn]
CUTEND
```

Similarly to the CUTPLANE command, parameters of CUTPOLY refer to the current coordinate system. The polygon cannot be self-intersecting. The direction of cutting is the Z axis or an optional (x, y, z) vector can be specified. Mirroring transformations affect the cutting direction in an unexpected way - to get a more straightforward result, use the CUTFORM command.

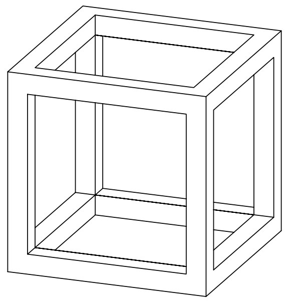
Example 1:



```
ROTX 90
MULZ -1
CUTPOLY 3,
        0.5, 1,
        2, 2,
        3.5, 1,
        -1.8, 0, 1
DEL 1
BPRISM_ "Brick-Red", "Brick-Red", "Brick-White",
        4, 0.9, 7,
        0.0, 0.0, 15,
        6.0, 0.0, 15,
        6.0, 3.0, 15,
        0.0, 3.0, 15
CUTEND
```

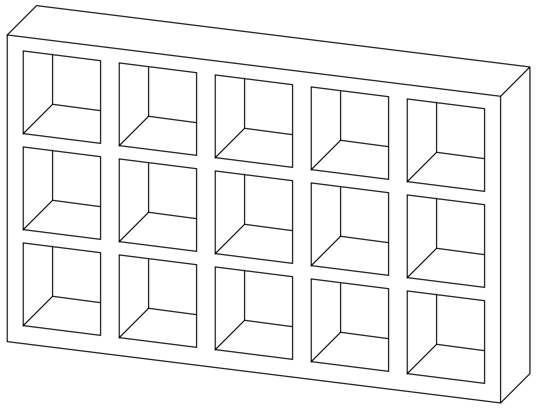
Example 2:

```
a=1.0
d=0.1
GOSUB "rect_cut"
ROTX 90
GOSUB "rect_cut"
DEL 1
ROTY -90
GOSUB "rect_cut"
DEL 1
BLOCK a, a, a
CUTEND
CUTEND
CUTEND
END
"rect_cut":
    CUTPOLY 4,
            d, d,
            a-d, d,
            a-d, a-d,
            d, a-d
    RETURN
```



Example 3:

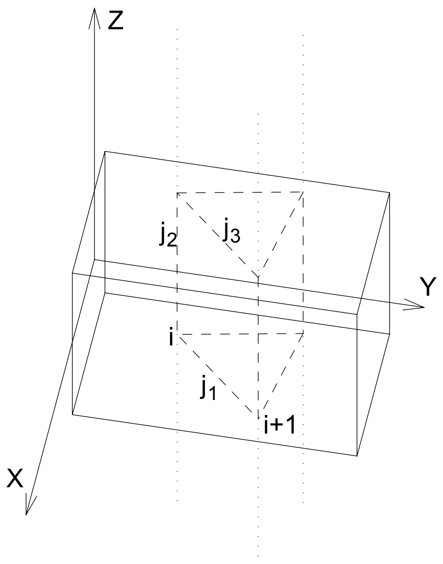
```
ROTX 90
FOR i=1 TO 3
    FOR j=1 TO 5
        CUTPOLY 4,
                0, 0, 1, 0,
                1, 1, 0, 1
        ADDX 1.2
    NEXT j
    DEL 5
    ADDY 1.2
NEXT i
DEL NTR()-1
ADD -0.2, -0.2, 0
BRICK 6.2, 3.8, 1
FOR k=1 TO 15
    CUTEND
NEXT k
DEL TOP
```



CUTPOLYA

```
CUTPOLYA n, status, d,
        x1, y1, mask1, ..., xn, yn, maskn [,
        x, y, z]
[statement1
statement2
...
statementn]
CUTEND
```

Similar to the CUTPOLY command, but with the possibility to control the visibility of the edges of the generated polygons. The cutting form is a half-infinite tube with the defined polygonal cross-section. If the end of the cutting form hangs down into the body, it will cut out the corresponding area.



`status:` controls the treatment of the generated cut polygons.

`1:` use the attributes of the body for the generated polygons and edges,

`2:` generated cut polygons will be treated as normal polygons.

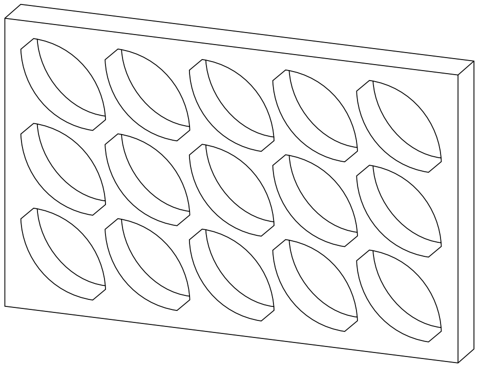
`d:` the distance between the local origin and the end of the half-infinite tube.

`0:` means a cut with an infinite tube.

`maski:` similar to the PRISM_ command.

`maski = `j_1` + 2*`j_2` + 4*`j_3` + 64*`j_7, where each j can be 0 or 1.

Example:



```
ROTX 90
FOR i=1 TO 3
    FOR j=1 TO 5
        CUTPOLYA 6, 1, 0,
                1, 0.15, 5,
                0.15, 0.15, 900,
                0, 90, 4007,
                0, 0.85, 5,
                0.85, 0.85, 900,
                0, 90, 4007
        ADDX 1
    NEXT j
    DEL 5
    ADDY 1
NEXT i
DEL NTR()-1
ADD -0.2, -0.2, 0
BRICK 5.4, 3.4, 0.5
FOR k=1 TO 15
    CUTEND
NEXT k
DEL TOP
```

CUTSHAPE

```
CUTSHAPE d [, status]
[statement1 statement2 ... statementn]
CUTEND
```

status: controls the treatment of the generated cut polygons. If not specified (for compatibility reasons) the default value is 3.

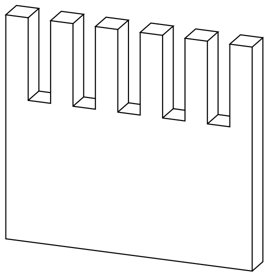
status = j_1 + 2*j_2, where each j can be 0 or 1.

j_1: use the attributes of the body for the generated polygons and edges,

j_2: generated cut polygons will be treated as normal polygons.

Example:

```
FOR i = 1 TO 5
    ADDX 0.4 * i
    ADDZ 2.5
    CUTSHAPE 0.4
    DEL 2
    ADDX 0.4
NEXT i
DEL TOP
BRICK 4.4, 0.5, 4
FOR i = 1 TO 5
 CUTEND
NEXT i
```



CUTFORM

```
CUTFORM n, method, status,
        rx, ry, rz, d,
        x1, y1, mask1 [, mat1],
        ...
        xn, yn, maskn [, matn]
```

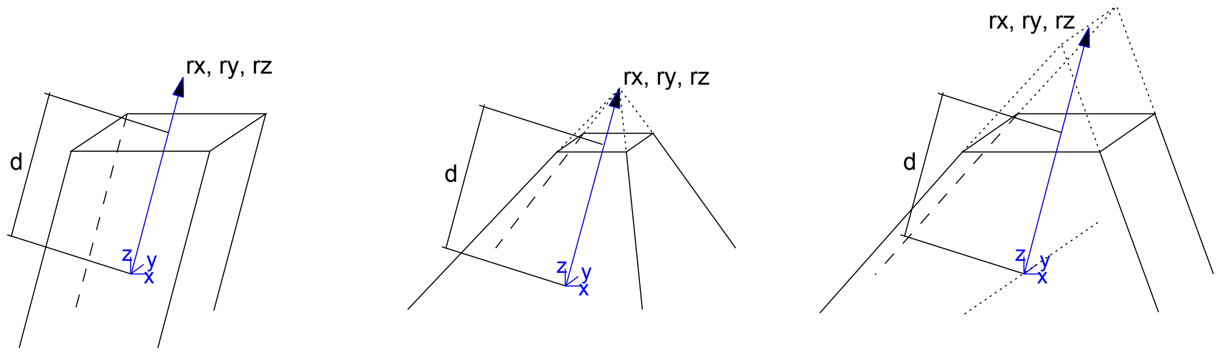
Similar to the CUTPOLYA command, but with the possibility to control the form and extent of the cutting body.

method: controls the form of the cutting body.

1: prism shaped,

2: pyramidal,

`3:` wedge-shaped cutting body. The direction of the wedge's top edge is parallel to the Y axis and its position is in rx, ry, rz (ry is ignored).



`status:` Controls the extent of the cutting body and the treatment of the generated cut polygons and new edges.

`status` = $j_1 + 2*j_2 + 8*j_4 + 16*j_5 + 32*j_6 + 64*j_7 + 128*j_8 + 256*j_9$, where each j can be 0 or 1.

j_1: use the attributes of the body for the generated polygons and edges,

j_2: generated cut polygons will be treated as normal polygons,

j_4: define the limit of the cut (with j5),

j_5: define the limit of the cut (with j4):

j_6: generate a boolean intersection with the cutting body rather than a boolean difference. (can only be used with the CUTFORM command),

j_7: edges generated by the bottom of the cutting body will be invisible,

j_8: edges generated by the top of the cutting body will be invisible,

j_9: cutting shape has custom side materials (mati).

`j4 = 0 and j5 = 0:` finite cut

`j4 = 0 and j5 = 1:` semi-infinite cut

`j4 = 1 and j5 = 1:` infinite cut

`rx, ry, rz:` these three coordinates define the direction of cutting if the cutting form is prism-shaped; these three coordinates define the top point of the pyramid if the method of cutting is pyramidal; rx-rz coordinates define the end edge of the wedge and ry is ignored if the cutting from is wedge-shaped

`d:` defines the distance along rx, ry, rz to the end of the cut. If the cut is infinite, this parameter has no effect. If the cut is finite, then the start of the cutting body will be at the local coordinate system and the body will end at a distance of d along the direction defined by rx, ry, rz.

If the cut is semi-infinite, then the start of the cutting body will be at a distance of d along the direction defined by rx, ry, rz, and the direction of the semi-infinite cut will be in the opposite direction defined by rx, ry, rz.

`mask:` defines the visibility of the edges of the cutting body.

`mask = `j_1` + 2*`j_2` + 4*`j_3` + 8*`j_4` + 16*`j_5` + 64*`j_7, where each j can be 0 or 1.

j_1: the polygon will create a visible edge upon entry into the body being cut (except when cutting solid body with wedge-shaped cutform, see below),

j_2: the lengthwise edge of the cutting form will be visible,

j_3: polygon will create a visible edge upon exiting the body being cut (except when cutting solid body with wedge-shaped cutform, see below),

j_4: the bottom edge of the cutting form will be visible,

j_5: the top edge of the cutting form will be visible,

j_7: controls the viewpoint dependent visibility of the lengthwise edge.

In case of cutting solid body with wedge-shaped cutform the values for visibility of entry-edges and exit-edges (`j1` and `j3`) are swapped. This behavior is kept for compatibility reasons.

`mati:` side material of the cutting shape (when status j9 = 1)

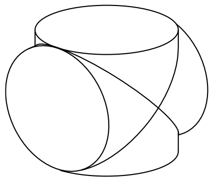
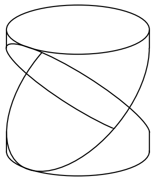
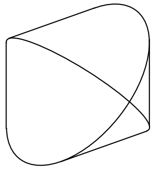
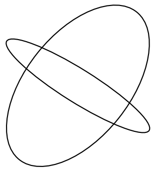
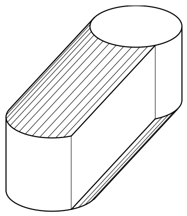
CUTFORM{2}

```
CUTFORM{2} n, method, status,
        rx, ry, rz, d,
        x1, y1, mask1 [, mat1],
        ...
        xn, yn, maskn [, matn]
```

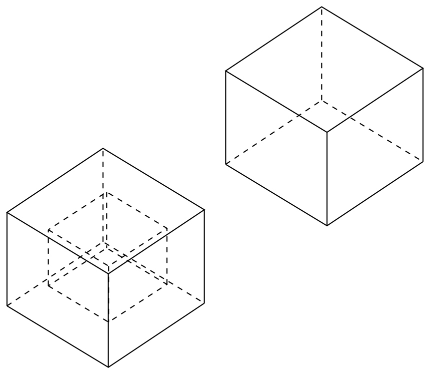
CUTFORM{2} is an extension of the CUTFORM command with the possibility of using inline material definition, that means materials defined in GDL script locally also can be used next to materials defined in global material definitions.

Solid Geometry Commands

GDL is capable of performing specialized 3D operations between solids represented by groups. These operations can be one of the following:

`ADDGROUP`	forming the Boolean union of two solids	
`SUBGROUP`	forming the Boolean difference of two solids	
`ISECTGROUP`	forming the Boolean intersection of two solids	
`ISECTLINES`	calculating the intersection lines of two solids	
`SWEEPGROUP`	sweeping a solid along a vector	

A GDL solid is composed of one or more lumps that appear as separated bodies in the model. A lump has exactly one outer shell and may contain voids. (Voids can be described as "negative" inner shells inside a lump.) The solid in the drawing below is composed of two lumps in such a way that one of them contains a void.



GDL bodies such as BLOCK, SPHERE, etc., appear as outer shells in groups. By means of the following construction the user is capable of putting more than one shell in a solid (note the BODY -1 statement):

```
GROUP "myGroup"
    BLOCK 1,1,1
    BODY -1
    ADDX 1
    BLOCK 1,1,1
ENDGROUP
```

The above solid contains two lumps; each of them is composed of one shell. Voids can be defined by means of primitives, or can occur as a result of a Boolean difference (e.g. subtracting a small cube from the middle of a big one).

See also the section called "Primitive Elements".

Although group operations are intended to work with solid objects, they can be applied to surfaces, wireframes or hybrid models, too. (Hybrid models are basically surfaces that may contain edges without neighboring faces.) The result of the operations on such models are summarized in the following tables:

Table 1. Union (base » tool)

	solid base	surface base	wireframe base	hybrid base
solid tool	solid result	surface result (merging)	wireframe result (merging)	hybrid result (merging)
surface tool	surface result (merging)	surface result (merging)	hybrid result (merging)	hybrid result (merging)
wireframe tool	wireframe result (merging)	hybrid result (merging)	wireframe result (merging)	hybrid result (merging)
hybrid tool	hybrid result (merging)	hybrid result (merging)	hybrid result (merging)	hybrid result (merging)

Table 2. Difference (base\tool)

	solid base	surface base	wireframe base	hybrid base
solid tool	solid result	surface result	wireframe result	hybrid result
surface tool	surface base (no effect)	surface base (no effect)	hybrid base (no effect)	hybrid base (no effect)
wireframe tool	wireframe base (no effect)	hybrid base (no effect)	wireframe base (no effect)	hybrid base (no effect)
hybrid tool	hybrid base (no effect)	hybrid base (no effect)	hybrid base (no effect)	hybrid base (no effect)

Table 3. Intersection (base « tool)

	solid base	surface base	wireframe base	hybrid base
solid tool	solid result	surface result	wireframe result	hybrid result
surface tool	surface result	empty result	empty result	empty result
wireframe tool	wireframe result	empty result	empty result	empty result
hybrid tool	hybrid result	empty result	empty result	empty result

Table 4. Intersection lines (base « tool)

	solid base	surface base	wireframe base	hybrid base
solid tool	wireframe result	wireframe result	empty result	wireframe result
surface tool	wireframe result	empty result	empty result	empty result
wireframe tool	empty result	empty result	empty result	empty result
hybrid tool	wireframe result	empty result	empty result	empty result

Table 5. Sweeping

solid	surface	wireframe	hybrid
valid result	surface base (no effect)	wireframe base (no effect)	hybrid base (no effect)

Surfaces can be explicitly generated by using the MODEL SURFACE command, or implicitly by leaving out non-neighboring face polygons from the model. Wireframes are produced either by using the MODEL WIRE statement or by defining objects without face polygons. Hybrid models can only be generated indirectly by leaving out neighboring face polygons from the model.

In the majority of the cases the required model is solid. GDL bodies appear as shells in group definitions, so in order to achieve fast and reliable operation, the geometric correctness of the generated shells is a critical issue. Handling degenerated objects loads the GDL engine and causes the desired operation to take more time to complete. The main rule to be considered regarding the efficient use of GDL group operations can be summarized as follows: model by conforming to existing physical presence of spatial objects. In practice this can be expressed by the following guidelines:

- Avoid self-intersecting objects.
- Avoid self-touching objects (apply small gaps).
- Avoid zero-sized portions of objects (apply small thickness).

According to the above, these rules are to be followed for shells (defined by bodies), not for solids (defined by groups). (The solid produced by the script in the Group construction above is modeled properly, since the constituent shells touch each other but the shells, themselves, are geometrically correct.)

GROUP - ENDGROUP

```
GROUP "name"
    [statement1 ... statementn]
ENDGROUP
```

Group definition. All bodies between the corresponding GROUP - ENDGROUP statements will be part of the "name" group. Groups are not actually generated (placed), they can be used in group operations or placed explicitly using the PLACEGROUP command. Group definitions cannot be nested, but macro calls containing group definitions and PLACEGROUP commands using other groups can be included.

Group names must be unique inside the current script. Transformations, cutplanes outside the group definition have no effect on the group parts; transformations, cutplanes used inside have no effect on the bodies outside the definition. Group definitions are transparent to attribute DEFINEs and SETs (pens, materials, fills); attributes defined/set before the definition and those defined/set inside the definition are all effective.

ADDGROUP

```
ADDGROUP (g_expr1, g_expr2)
ADDGROUP{2} (g_expr1, g_expr2, edgeColor, materialId, materialColor [, operationStatus])
ADDGROUP{3} (g_expr1, g_expr2, edgeColor, materialId, materialColor [, operationStatus])
```

SUBGROUP

```
SUBGROUP (g_expr1, g_expr2)
SUBGROUP{2} (g_expr1, g_expr2, edgeColor, materialId, materialColor [, operationStatus])
SUBGROUP{3} (g_expr1, g_expr2, edgeColor, materialId, materialColor [, operationStatus])
```

ISECTGROUP

```
ISECTGROUP (g_expr1, g_expr2)
ISECTGROUP{2} (g_expr1, g_expr2, edgeColor, materialId, materialColor [, operationStatus])
ISECTGROUP{3} (g_expr1, g_expr2, edgeColor, materialId, materialColor [, operationStatus])
```

g_expr1: identifier of the base group.

g_expr2: identifier of the tool group.

edgeColor: the color of the new edge when it differs from 0.

materialId: the material of the new face when it differs from 0.

materialColor: the color of the new face when the materialId is 0 and it differs from 0.

operationStatus: status control of the operation.

operationStatus = $j_1 + 2*j_2$, where each j can be 0 or 1.

j_1: generated new edges will be invisible.

j_2: cut polygons of the result inherit material and texture projection from the corresponding polygons of the tool group.

ISECTLINES

ISECTLINES `(g_expr1, g_expr2)`

Group operations: addition, subtraction, intersection, intersection lines. The return value is a new group, which can be placed using the PLACEGROUP command, stored in a variable or used as a parameter in another group operation. Group operations can be performed between previously defined groups or groups result from any other group operation. g_expr1, g_expr2 are group type expressions. Group type expressions are either group names (string expressions) or group type variables or any combination of these in operations which result in groups. Note that the operations ADDGROUP, ISECTGROUP and ISECTLINES are symmetric in their parameterization while the order of parameter matters for SUBGROUP.

PLACEGROUP

PLACEGROUP `g_expr`

Placing a group is the operation in which bodies are actually generated. Cutplanes and transformations are effective, the group expression is evaluated and the resulting bodies are stored in the 3D data structure.

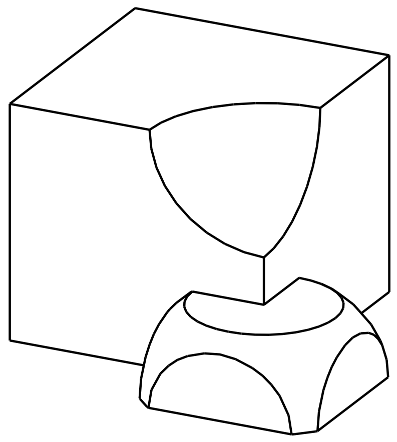
KILLGROUP

KILLGROUP `g_expr`

Clears the bodies of the specified group from the memory. After a KILLGROUP operation the group becomes empty. The names of killed groups cannot be reused in the same script. Clearing is executed automatically at the end of the interpretation or when returning from macro calls. For performance reasons this command should be used when a group is no longer needed.

Example:

```
GROUP "box"
    BRICK 1, 1, 1
ENDGROUP
GROUP "sphere"
    ADDZ 1
    SPHERE 0.45
    DEL 1
ENDGROUP
GROUP "semisphere"
    ELLIPS 0.45, 0.45
ENDGROUP
GROUP "brick"
    ADD -0.35, -0.35, 0
    BRICK 0.70, 0.70, 0.35
    DEL 1
ENDGROUP
! Subtracting the "sphere" from the "box"
result_1=SUBGROUP("box", "sphere")
! Intersecting the "semisphere" and the "brick"
result_2=ISECTGROUP("semisphere", "brick")
! Adding the generated bodies
result_3=ADDGROUP(result_1, result_2)
PLACEGROUP result_3
KILLGROUP "box"
KILLGROUP "sphere"
KILLGROUP "semisphere"
KILLGROUP "brick"
```



SWEEPGROUP

SWEEPGROUP `(g_expr, x, y, z)`

Returns a group that is created by sweeping the group parameter along the given direction. The command works for solid models only.

SWEEPGROUP{2} `(g_expr, x, y, z)`

The difference between SWEEPGROUP and SWEEPGROUP{2} is that in the former case the actual transformation matrix is applied again to the direction vector of the sweeping operation with respect to the current coordinate system. (In the case of SWEEPGROUP, the current transformation is applied to the direction vector twice with respect to the global coordinate system.)

SWEEPGROUP{3} `(g_expr, x, y, z, edgeColor, materialId, materialColor, method)`
This version adds a new method selection to SWEEPGROUP{2} and works for surface models also.

edgeColor: the color of the new edge when it differs from 0.

materialId: the material of the new face when it differs from 0.

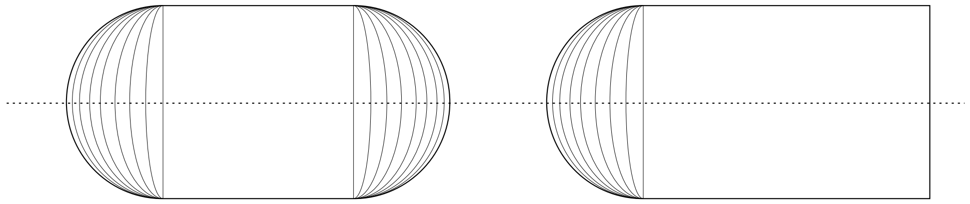
materialColor: the color of the new face when the materialId is 0 and it differs from 0.

method: controls the ending shape of the resulting body.
`0:` same as SWEEPGROUP{2}, both ends come from the originating body,
`1:` the start comes from the originating body, the sweep end is flat

SWEEPGROUP{4} `(g_expr, x, y, z, edgeColor, materialId, materialColor, method, status)`
This version adds a new status parameter to SWEEPGROUP{3}.

status: Controls attributes of the result.
`status = 2*`j_2, where each j can be 0 or 1.
j_2: Keep per-polygon texture mapping parameters on the sweeped result (see the PGON command for details).

Example:



```
GROUP "the_sphere"
    SPHERE 1
ENDGROUP
PLACEGROUP SWEEPGROUP{2} ("the_sphere", 2, 0, 0)
ADDX 5
PLACEGROUP SWEEPGROUP{3} ("the_sphere", 2, 0, 0, 4, 0, 4, 1)
del 1
```

CREATEGROUPWITHMATERIAL

CREATEGROUPWITHMATERIAL `(g_expr, repl_directive, pen, material)`
Returns a group that is created by replacing all pens and/or materials in group g_expr.

g_expr: group expression identifying the base group.

repl_directive:

`repl_directive = j`$_1$` + 2*j`$_2$` + 4*j`$_3$` + 8*j`$_4$, where each j can be 0 or 1.

j$_1$: replace pen,

j$_2$: replace material,

j$_4$: make edges invisible.

pen: replacement pen index.

material: replacement material index.

BINARY 3D

BINARY

BINARY `mode [, section, elementID]`

Special command to include inline binary objects into a GDL macro. A set of vertices, vectors, edges, polygons, bodies and materials is read from a special section of the library part file. These are transformed according to the current transformations and merged into the 3D model.

The data contained in the binary section is not editable by the user.

mode: defines pencolor and material attribute definition usage.

`0:` the current PEN and MATERIAL settings are in effect,

`1:` the current PEN and MATERIAL settings have no effect. The library part will be shown with the stored colors and material definitions. Surface appearance is constant,

`2:` the stored PEN and MATERIAL settings are used, non-defined materials are replaced by current settings,

`3:` the stored PEN and MATERIAL settings are used, non-defined materials are replaced by the stored default attributes.

section: index of the binary part, from 1 to 16.

`0:` you can refer simultaneously to all the existing binary parts,

`1:` Only these sections can be saved from within GDL, BINARY commands without the section argument will also refer to this,

`2-16:` can be used by third party tools.

elementID: ID of an element of this binary part. This parameter is generated during the import process.

If you open files with a different data structure (e.g., DXF or ZOOM) their 3D description will be converted into binary format.

You can save a library part in binary format from the main Library Part editing window through the Save as... command. If the Save in binary format checkbox is marked in the Save as... dialog box, the GDL text of the current library part will be replaced with a binary description.

Hint: Saving the 3D model after a 3D cutaway operation in binary format will save the truncated model. This way, you can create cut shapes.

You can only save your library part in binary format if you have already generated its 3D model.

By replacing the GDL description of your library part with a binary description you can considerably reduce the 3D conversion time of the item. On the other hand, the binary 3D description is not parametric and takes more disk space than an algorithmic GDL script.

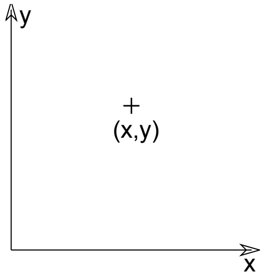
2D SHAPES

This chapter presents the commands used for generating shapes in 2D from simple forms such as lines and arcs to complex polygons and splines, and the definition of text elements in 2D. It also covers the way binary data is handled in 2D and the projection of the shape created by a 3D script into the 2D view, thereby ensuring coherence between the 3D and 2D appearance of objects. Further commands allow users to place graphic elements into element lists created for calculations.

DRAWING ELEMENTS

HOTSPOT2

```
HOTSPOT2 x, y [, unID [, paramReference [, flags [, displayParam [, "customDescription"]]]]]
```



unID: the unique identifier of the hotspot in the 2D Script. Useful if you have a variable number of hotspots.

paramReference: parameter that can be edited by this hotspot using the graphical hotspot based parameter editing method.

displayParam: parameter to display in the information palette when editing the paramRefrence parameter. Members of arrays can be passed as well.

customDescription: custom description string of the displayed parameter in the information palette. When using this option, displayParam must be set as well (use paramReference for default).

See Graphical Editing Using Hotspots for information on using HOTSPOT2.

HOTLINE2

```
HOTLINE2 x1, y1, x2, y2, unID
```

Status line definition between two points. Status line is a line which is recognized by the intelligent cursor but it is not visible in itself. Can have a unique ID for associative dimensioning purpose.

HOTARC2

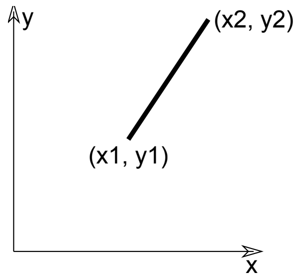
`HOTARC2 x, y, r, startangle, endangle, unID`

Status arc definition with its centerpoint at (x, y) from the angle startangle to endangle, with a radius of r. Status arc is an arc which is recognized by the intelligent cursor but it is not visible in itself. Can have a unique ID for associative dimensioning purpose.

LINE2

`LINE2 x1, y1, x2, y2`

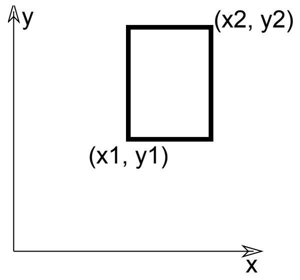
Line definition between two points.



RECT2

`RECT2 x1, y1, x2, y2`

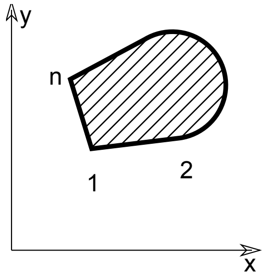
Rectangle definition by two nodes. The two points are on the diagonal of the rectangle, the sides are parallel to current X and Y axes.



POLY2

`POLY2 n, frame_fill, x1, y1, ..., xn, yn`

An open or closed polygon with n nodes.



Restriction of parameters:

`n >= 2`

`n:` number of nodes.

`x1, y1, ..., xn, yn:` coordinates of each nodes.

`frame_fill:`

`frame_fill = `j_1` + 2*`j_2` + 4*`j_3, where each j can be 0 or 1.

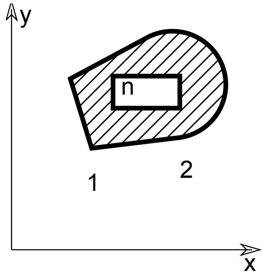
j_1: draw contour

j_2: draw fill

j_3: close an open polygon

POLY2_

POLY2_ `n, frame_fill, x1, y1, s1, ..., xn, yn, sn`



Similar to the POLY2 command, but any of the edges can be omitted. If `si = 0`, the edge starting from the (xi,yi) apex will be omitted. If `si = 1`, the vertex should be shown. `si = -1` is used to define holes directly. You can also define arcs and segments in the polyline using additional status code values.

Restriction of parameters:

```
n >= 2
```

n: number of nodes.

x1, y1, ..., xn, yn: coordinates of each nodes.

frame_fill:

`frame_fill` = $j_1 + 2*j_2 + 4*j_3 + 8*j_4 + 32*j_6 + 64*j_7$, where each j can be 0 or 1.

j_1: draw contour,
j_2: draw fill,
j_3: close an open polygon,
j_4: local fill orientation,
j_6: fill is cut fill (default is drafting fill),
j_7: fill is cover fill (only if j6 = 0, default is drafting fill).

si: Status values:

`si` = $j_1 + 16*j_5 + 32*j_6$, where each j can be 0 or 1.

j_1: next segment is visible,
j_5: next segment is inner line (if 0, generic line),
j_6: next segment is contour line (effective only if j5 is not set),
`-1`: end of a contour.

Default line property for POLY2_ lines is 0 (generic line), the LINE_PROPERTY command has no effect on POLY2_ edges. Additional status codes allow you to create segments and arcs in the planar polyline using special constraints.

See the section called "Additional Status Codes" for details.

POLY2_A

```
POLY2_A n, frame_fill, fill_pen,
        x1, y1, s1, ..., xn, yn, sn
```

POLY2_B

```
POLY2_B n, frame_fill,
        fill_pen, fill_background_pen,
        x1, y1, s1, ..., xn, yn, sn
```

Advanced versions of the POLY2_ command, with additional parameters: the fill pen and the fill background pen. All other parameters are similar to those described at the POLY2_ command.

`fill_pen:` fill pencolor number.

`fill_background_pen:` fill background pencolor number.

Additional status codes allow you to create segments and arcs in the planar polyline using special constraints.

See the section called "Additional Status Codes" for details.

POLY2_B{2}

```
POLY2_B{2} n, frame_fill,
        fill_pen, fill_background_pen,
        fillOrigoX, fillOrigoY, fillAngle,
        x1, y1, s1, ..., xn, yn, sn
```

Advanced version of the POLY2_B command where the hatching origin and direction can be defined.

`frame_fill:`

`frame_fill` = $j_1 + 2*j_2 + 4*j_3 + 8*j_4 + 16*j_5 + 32*j_6 + 64*j_7$, where each j can be 0 or 1.

j_1: draw contour

j_2: draw fill

j_3: close an open polygon

j_4: local fill orientation

j_5: global fill origin (effective only if j4 is set)

j_6: fill in cut category (distinctive with j7, drafting category if none is set)

j_7: fill in cover category (distinctive with j6, drafting category if none is set).

`fillOrigoX:` X coordinate of the fill origin.

`fillOrigoY:` Y coordinate of the fill origin.

`fillAngle:` direction angle of fill.

Additional status codes allow you to create segments and arcs in the planar polyline using special constraints.

See the section called "Additional Status Codes" for details.

POLY2_B{3}

```
POLY2_B{3} n, frame_fill,
        fill_pen, fill_background_pen,
        fillOrigoX, fillOrigoY,
        mxx, mxy, myx, myy, x1, y1, s1, ..., xn, yn, sn
```

Advanced version of the POLY2_B command, where the orientation of the fill can be defined using a matrix.

frame_fill:

`frame_fill` $= j_1 + 2*j_2 + 4*j_3 + 8*j_4 + 16*j_5 + 32*j_6 + 64*j_7 + 128*j_8$, where each j can be 0 or 1.

j_1-j_7: similar as for previous POLY2_ commands,

j_8: use sloped fill.

mxx, mxy, myx, myy: if j8 is set, this matrix defines the orientation of the fill.

Additional status codes allow you to create segments and arcs in the planar polyline using special constraints.

See the section called "Additional Status Codes" for details.

POLY2_B{4}

```
POLY2_B{4} n, frame_fill,
        fill_pen, fill_background_pen,
        fillOrigoX, fillOrigoY,
        mxx, mxy, myx, myy,
        gradientInnerRadius,
        x1, y1, s1, ..., xn, yn, sn
```

Advanced version of POLY2_ B{3}, where the inner radius of radial gradient fill can be set.

gradientInnerRadius: inner radius of the gradient in case radial gradient fill is selected for the polygon.

POLY2_B{5}

```
POLY2_B{5} n, frame_fill, fillcategory, distortion_flags,
        fill_pen, fill_background_pen,
        fillOrigoX, fillOrigoY,
        mxx, mxy, myx, myy,
        gradientInnerRadius,
        x1, y1, s1, ..., xn, yn, sn
```

Advanced version of POLY2_ B{4}, where fill distortion can be controlled in an enhanced way.

frame_fill:

`frame_fill = j1 + 2*j2 + 4*j3`, where each j can be 0 or 1.

`j1:` draw contour

`j2:` draw fill

`j3:` close an open polygon.

`fillcategory:`

`0:` Draft,

`1:` Cut,

`2:` Cover.

`distortion_flags:`

`distortion_flags = j1 + 2*j2 + 4*j3 + 8*j4 + 16*j5 + 32*j6 + 64*j7`, where each j can be 0 or 1.

The valid value for distortion_flags is between 0 and 127. Don't use value out of this range.

`j1:` the fill origin's X coordinate is the global origin's X coordinate, meaningful only when j4 is set. The fillOrigo is the origin (0,0) projected on the line of the (mxx, mxy) vector,

`j2:` the fill origin's Y coordinate is the global origin's Y coordinate, meaningful only when j4 is set,

`j3:` create circular distortion using the innerRadius parameter,

`j4:` use local orientation, use the distortion matrix (mij parameters),

`j5:` (effective for symbol fills only) reset the pattern's X size to the defined X vector's length (mxx, mxy),

`j6:` (effective for symbol fills only) reset the pattern's Y size to the defined Y vector's length (myx, myy),

`j7:` (effective for symbol fills only) keep proportion of symbol fill pattern; effective only if one of j5 and j6 is set.

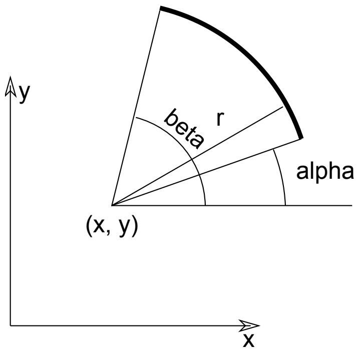
`innerRadius:` radius for circular fill distortion; the origin of the base circle will be placed on the Y fill axis in the (0, -innerRadius) position.

ARC2

`ARC2` `x, y, r, alpha, beta`

An arc with its centerpoint at (x, y) from the angle alpha to beta, with a radius of r.

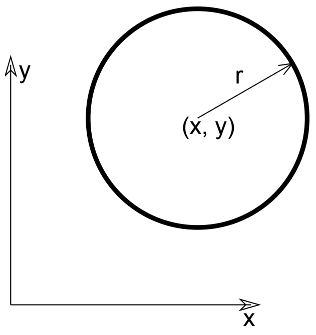
Alpha and beta are in degrees.



CIRCLE2

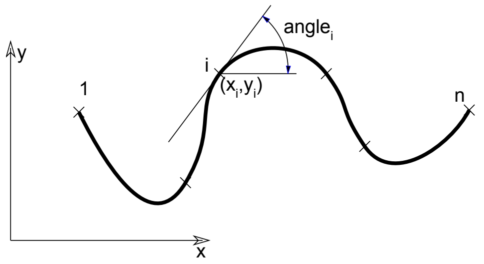
```
CIRCLE2 x, y, r
```

A circle with its center at (x, y), with a radius of r.



SPLINE2

```
SPLINE2 n, status, x1, y1,
        angle1, ..., xn, yn, anglen
```



Spline, with n control points. The tangent of the spline in the control point (xi, yi) is defined by anglei, the angle with the x axis in degrees.

Restriction of parameters:

`n >= 2`

`si:` Status values:

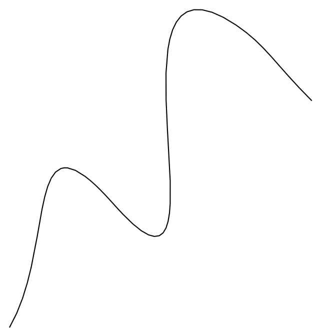
`0:` default,

`1:` closed spline; the last and first nodes of the spline will become connected, thus closing the spline,

`2:` automatically smoothed spline; the angle parameter value of the nodes between the first and the last node is not used when generating the spline. An internal autosmoothing algorithm is used.

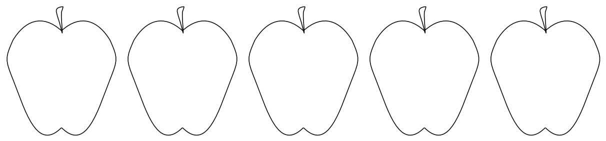
Example 1:

```
SPLINE2 5, 2,
        0,   0,  60,
        1,   2,  30,
        1.5, 1.5, -30,
        3,   4,  45,
        4,   3, -45
```



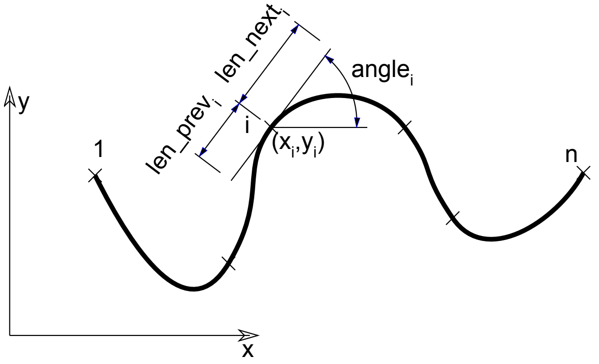
Example 2:

```
n = 5
FOR i = 1 TO n
    SPLINE2 4, 0,
            0.0, 2.0, 135.0,
            -1.0, 1.8, 240.0,
            -1.0, 1.0, 290.0,
            0.0, 0.0,  45.0
    MUL2 -1.0, 1.0
    SPLINE2 4, 0,
            0.0, 2.0, 135.0,
            -1.0, 1.8, 240.0,
            -1.0, 1.0, 290.0,
            0.0, 0.0,  45.0
    DEL 1
    SPLINE2 4, 0,
            0.0, 2.0, 100.0,
            0.0, 2.5,   0.0,
            0.0, 2.4, 270.0,
            0.0, 2.0, 270.0
    ADD2 2.5, 0
NEXT i
```



SPLINE2A

```
SPLINE2A n, status, x1, y1, angle1, length_previous1, length_next1,
        ...
        xn, yn, anglen, length_previousn,
        length_nextn
```



Extension of the SPLINE2 command (Bézier spline), used mainly in automatic 2D script generation because of its complexity.

For more details, *see "Lines / Drawing Splines" in the Documentation chapter of the ARCHICAD Help*.

si: Status values:

`0:` default,

`1:` closed spline; the last and first nodes of the spline will become connected, thus closing the spline,

`2:` automatically smoothed spline; the angle, length_previous$_i$ and length_next$_i$ parameter values of the nodes between the first and the last node are not used when generating the spline. An internal autosmoothing algorithm is used.

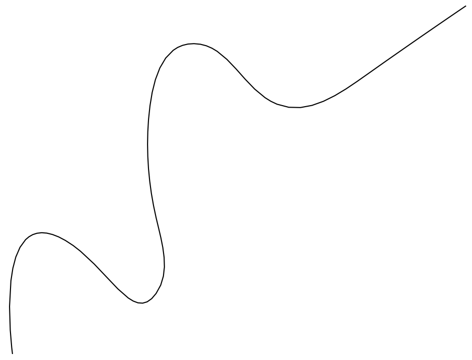
xi, yi: control point coordinates.

length_previousi, length_nexti: tangent lengths for the previous and the next control points.

anglei: tangent direction angle.

Example:

```
SPLINE2A 9, 2,
        0.0, 0.0, 0.0, 0.0, 0.0,
        0.7, 1.5,  15, 0.9, 1.0,
        1.9, 0.8,  72, 0.8, 0.3,
        1.9, 1.8, 100, 0.3, 0.4,
        1.8, 3.1,  85, 0.4, 0.5,
        2.4, 4.1, 352, 0.4, 0.4,
        3.5, 3.3, 338, 0.4, 0.4,
        4.7, 3.7,  36, 0.4, 0.8,
        6.0, 4.6,   0, 0.0, 0.0
```



PICTURE2

PICTURE2 expression, a, b, mask

PICTURE2{2}

PICTURE2{2} expression, a, b, mask

Can be used in 2D similarly to the PICTURE command in 3D. Unlike in 3D, the mask values have no effect on 2D pictures.

A string type expression means a file name, a numerical expression means an index of a picture stored in the library part. A 0 index is a special value, it refers to the preview picture of the library part. For PICTURE2{2} mask = 1 means that exact white colored pixels are transparent.

Other pictures can only be stored in library parts when saving the project or selected elements containing pictures as GDL objects.

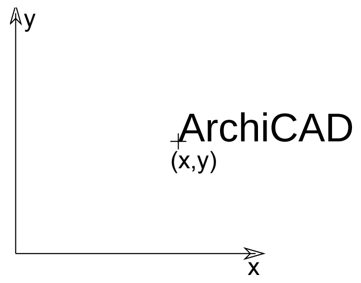
TEXT ELEMENT

TEXT2

TEXT2 x, y, expression

The value of the calculated numerical or string type expression is written in the set style at the x, y coordinates.

See also the [SET] STYLE command and the DEFINE STYLE command.



RICHTEXT2

RICHTEXT2 `x, y, textblock_name`

Place a previously defined TEXTBLOCK.

For more details, *see the TEXTBLOCK command.*

`x, y:` X-Y coordinates of the richtext location.

`textblock_name:` the name of a previously defined TEXTBLOCK

Binary 2D

FRAGMENT2

FRAGMENT2 `fragment_index, use_current_attributes_flag`
FRAGMENT2 `ALL, use_current_attributes_flag`

The fragment with the given index is inserted into the 2D Full View with the current transformations. If `ALL` is specified, all fragments are inserted.

`use_current_attributes_flag:` defines whether or not the current attributes will be used.

`0:` the fragment appears with the color, line type and fill type defined for it,

`1:` the current settings of the script are used instead of the color, line type and fill type of the fragment.

3D Projections in 2D

PROJECT2

PROJECT2 `projection_code, angle, method`

PROJECT2{2}

```
PROJECT2{2} projection_code, angle, method [, backgroundColor,
        fillOrigoX, fillOrigoY, filldirection]
```

Creates a projection of the 3D script in the same library part and adds the generated lines to the 2D parametric symbol. The 2nd version PROJECT2{2}, together with a previous `[SET] FILL` command, allows the user to control the fill background, origin and direction of the resulting drawing from the 2D script. The `SET FILL 0` shortcut to get an empty fill does not work in this case, you need to reference an actual empty fill.

`projection_code:` the type of projection.

- `3:` Top view,
- `4:` Side view,
- `5:` Side view 2,
- `6:` Frontal axonometry,
- `7:` Isometric axonometry,
- `8:` Monometric axonometry,
- `9:` Dimetric axonometry,
- `-3:` Bottom view,
- `-6:` Frontal bottom view,
- `-7:` Isometric bottom view,
- `-8:` Monometric bottom view,
- `-9:` Dimetric bottom view.

`angle:` the azimuth angle set in the 3D Projection Settings dialog box.

`method:` the chosen imaging method. If invalid or none is set, the default is hidden lines (2).

- `1:` wireframe,
- `2:` hidden lines (analytic),
- `3:` shading,
- `16:` addition modifier: draws vectorial hatches (effective only in hidden line and shaded mode),
- `32:` addition modifier: use current attributes instead of attributes from 3D (effective only in shading mode),
- `64:` addition modifier: local fill orientation (effective only in shading mode),
- `128:` addition modifier: lines are all inner lines (effective only together with 32). Default is generic,
- `256:` addition modifier: lines are all contour lines (effective only together with 32, if 128 is not set). Default is generic,
- `512:` addition modifier: fills are all cut (effective only together with 32). Default is drafting fills,
- `1024:` addition modifier: fills are all cover (effective only together with 32, if 512 is not set). Default is drafting fills.

`BackgroundColor:` background color of the fill.

`fillOrigoX:` X coordinate of the fill origin.

`fillOrigoY:` Y coordinate of the fill origin.

`filldirection:` direction angle of fill.

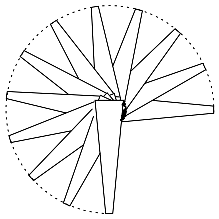
Note: the [SET] FILL command is effective for PROJECT2{2}

Compatibility note: using PROJECT2 with method bit 32 not set and method bit 3 set (shading), the model being cut with the CUTPOLYA command without status bit 2 set (generating cut polygons) resulting cut polygon attributes can be different. Cut polygons will be generated with attributes defined by the SECT_FILL command in the 3D script.

Example:

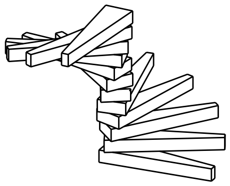
2D

```
PROJECT2 3, 270, 2

LINE_TYPE "DASHED"
ARC2 0, 0, A-B/3, 0, E

E = 270
A = 1
B = 0.2

ROT2 E
ADD2 A-B/3, 0
LINE2 0, 0, -0.05, -0.1
LINE2 0, 0,  0.05, -0.1

DEL 2
```



3D

```
n = 12
E = 270
D = 0.2
A = 1
B = 0.2

FOR i=1 TO n
    prism  4, D,
         -B/3, -B/2,
         -B/3,  B/2,
        A-B/3,  B/8,
        A-B/3, -B/8
    ADDZ D
    ROTz E/(n-1)
NEXT i

DEL n*2
```



PROJECT2{3}

```
PROJECT2{3} projection_code, angle, method, parts [, backgroundColor,
        fillOrigoX, fillOrigoY, filldirection][[,]
        PARAMETERS name1=value1, ..., namen=valuen]
```

Creates a projection of the 3D script in the same library part and adds the generated lines to the 2D parametric symbol. The third version, PROJECT2{3}, adds the possibility to define which parts of the projected model are required and to control separately the attributes of the cut and view part, including the line type. You can also generate the projection with actual parameters set in the command.

`method:` the chosen imaging method. If invalid or none is set, the default is hidden lines (2).

`1:` wireframe,
`2:` hidden lines (analytic),
`3:` shading,
`16:` addition modifier: draws vectorial hatches (effective only in hidden line and shaded mode),
`32:` addition modifier: use current attributes instead of attributes from 3D (effective only in shading mode),
`64:` addition modifier: local fill orientation (effective only in shading mode),
`128:` addition modifier: lines are all inner lines (effective only together with 32). Default is generic.
`256:` addition modifier: lines are all contour lines (effective only together with 32, if 128 is not set). Default is generic.
`512:` addition modifier: fills are all cut (effective only together with 32). Default is drafting fills.
`1024:` addition modifier: fills are all cover (effective only together with 32, if 512 is not set). Default is drafting fills.
`2048:` addition modifier: modifiers 16, 32, 64, 128, 256, 512, 1024 and fill attribute parameters are effective only for the view part of the projection. By default they are effective for all parts.
`4096:` addition modifier: modifiers 16, 32, 64, 128, 256, 512, 1024 and fill attribute parameters are effective only for the cut part of the projection. By default they are effective for all parts.
`8192:` addition modifier: cut fills are slanted.
`16384:` addition modifier: enables transparency for transparent surfaces. Note that transparency in this case means full transparency for surfaces with transmittance greater than 50, everything else is non-transparent.

Known limitation: lines of the cut part cannot be treated separately, only all lines together can be set to be inner or contour.

`parts:` defines the parts to generate. The 1+2+4+8+16+32 value means all parts.

$parts = j_1 + 2*j_2 + 4*j_3 + 8*j_4 + 16*j_5 + 32*j_6$, where each j can be 0 or 1.

The j1, j2, j3, j4, j5, j6 numbers represent whether the corresponding parts of the projected model are present (1) or omitted (0):

j_1: cut polygons (with default fill attributes defined by SECT_FILL) (effective only in shading mode),
j_2: cut polygon edges,
j_3: view polygons,

`j4`: view polygon edges,
`j5`: project 3D hotspots as static 2D hotspots,
`j6`: project 3D hotlines and hotarcs (including related 3D hotspots converted to static 2D hotspots).

PROJECT2{4}

```
PROJECT2{4} projection_code, angle,
       useTransparency, statusParts,
       numCutplanes,
       cutplaneHeight1, ..., cutplaneHeightn,

       method1, parts1,
       cutFillIndex1,
       cutFillFgPen1, cutFillBgPen1,
       cutFillOrigoX1, cutFillOrigoY1, cutFillDirection1,
       cutLinePen1, cutLineType1,
       projectedFillIndex1,
       projectedFillFgPen1, projectedFillBgPen1,
       projectedFillOrigoX1, projectedFillOrigoY1,
       projectedFillDirection1,
       projectedLinePen1, projectedLineType1,
       ...
       method(numCutplanes+1)), parts(numCutplanes+1),
       cutFillIndex(numCutplanes+1),
       cutFillFgPen(numCutplanes+1), cutFillBgPen(numCutplanes+1),
       cutFillOrigoX(numCutplanes+1), cutFillOrigoY(numCutplanes+1),
       cutFillDirection(numCutplanes+1),
       cutLinePen(numCutplanes+1), cutLineType(numCutplanes+1),
       projectedFillIndex(numCutplanes+1),
       projectedFillFgPen(numCutplanes+1), projectedFillBgPen(numCutplanes+1),
       projectedFillOrigoX(numCutplanes+1), projectedFillOrigoY(numCutplanes+1),
       projectedFillDirection(numCutplanes+1),
       projectedLinePen(numCutplanes+1), projectedLineType(numCutplanes+1)
```

Compatibility: introduced in ARCHICAD 20.

Creates a projection of the 3D script in the same library part and adds the generated lines to the 2D parametric symbol. The fourth version, PROJECT2{4}, adds the possibility to define multiple cutting planes parallel to the X-Y plane, and to control the attributes of the cut and projected parts of the slices, including the line type, pens and fills. The number of cutplanes can be zero, creating exactly one uncut slice (numCutplanes+1).

`useTransparency:` can be 0 (no transparency) or positive integer (1: transparency enabled).

`statusParts:` defines the status parts to generate (hotlines, hotspots, hotarcs). The 1+2 value means all parts. Setting is applied for all slices.
`statusParts = ` j_1 ` + 2*`j_2, where each j can be 0 or 1.

The j1, j2 numbers represent whether the corresponding status parts of the projected model are present (1) or omitted (0):

j_1: project 3D hotspots as static 2D hotspots,
j_2: project 3D hotlines and hotarcs (including related 3D hotspots converted to static 2D hotspots).

`numCutplanes:` the number of defined cutplanes. Can be zero, but preferably more.

`cutplaneHeighti:` the position of each individually defined cutplane. Measured as length perpendicularly from the X-Y plane of the object.

`method:` the chosen imaging method. If invalid or none is set, the default is hidden lines (2).
`0:` the current slice is not part of the projection,
`1:` wireframe,
`2:` hidden lines (analytic),
`3:` shading,
`4:` hidden lines with polygon: the polygon does not eliminate any polygon or line belonging to parts created with shading method, but will cover/eliminate polygons and lines belonging to other wireframe/hidden line parts. Set it to Air Space for best result. Such exploded polygons will behave in 2D according to slice order (will cover, but not eliminate shaded parts).
`16:` addition modifier: draws vectorial hatches (effective only in hidden line modes and shaded mode),
`32:` addition modifier: use current attributes instead of attributes from 3D (effective only in shading mode and hidden line with polygon mode),
`64:` addition modifier: local fill orientation (effective only in shading mode and hidden line with polygon mode),
`128:` addition modifier: lines are all inner lines (effective only together with 32). Default is generic.
`256:` addition modifier: lines are all contour lines (effective only together with 32, if 128 is not set). Default is generic.
`512:` addition modifier: fills are all cut (effective only together with 32). Default is drafting fills.
`1024:` addition modifier: fills are all cover (effective only together with 32, if 512 is not set). Default is drafting fills.
`2048:` addition modifier: modifiers 16, 32, 64, 128, 256, 512, 1024 and fill attribute parameters are effective only for the view part of the projection. By default they are effective for all parts.
`4096:` addition modifier: modifiers 16, 32, 64, 128, 256, 512, 1024 and fill attribute parameters are effective only for the cut part of the projection. By default they are effective for all parts.
`8192:` addition modifier: cut fills are slanted.

`16384:` addition modifier: enables transparency for transparent surfaces. Note that transparency in this case means full transparency for surfaces with transmittance greater than 50, everything else is non-transparent.

`partsi:` defines the parts to generate. The 1+2+4+8+64 value means all parts.

`partsi` = j_1 + $2*j_2$ + $4*j_3$ + $8*j_4$ + $64*j_7$, where each j can be 0 or 1.

The j1, j2, j3, j4, j7 numbers represent whether the corresponding parts of the projected model are present (1) or omitted (0):

j_1: cut polygons (with default fill attributes defined by SECT_FILL) (effective only in shading mode),
j_2: cut polygon edges,
j_3: view polygons,
j_4: view polygon edges,
j_7: project pointclouds.

`cutFillIndexi:` fill type index of the cut part of the current slice.

`cutFillFgPeni:` fill pen of the cut part of the current slice.

`cutFillBgPeni:` fill background pen of the cut part of the current slice.

`cutFillOrigoXi:` X coordinate of the cut fill origin of the current slice.

`cutFillOrigoYi:` Y coordinate of the cut fill origin of the current slice.

`cutFillDirectioni:` direction angle of the cut fill of the current slice.

`cutLinePeni:` pen index of cut lines of the current slice.

`cutLineTypei:` line type of cut lines of the current slice.

`projectedFillIndexi:` fill type index of the projected part of the current slice.

`projectedFillFgPeni:` fill pen of the projected part of the current slice.

`projectedFillBgPeni:` fill background pen of the projected part of the current slice.

`projectedFillOrigoXi:` X coordinate of the projected fill origin of the current slice.

`projectedFillOrigoYi:` Y coordinate of the projected fill origin of the current slice.

`projectedFillDirectioni:` direction angle of the projected fill of the current slice.

`projectedLinePeni:` pen index of projected lines of the current slice.

`projectedLineTypei:` line type of projected lines of the current slice.

DRAWINGS IN THE LIST

These commands only take effect when a list of elements is created.

When the library part is a special property type library part and is in some way associated to a library part (Object, Door, Window or Light) placed on the floor plan, including the following commands in its 2D script will refer to the 2D and 3D part of that library part. This is a virtual reference that is resolved during the listing process, using the 2D or 3D script of the currently listed element.

DRAWING2

```
DRAWING2 [expression]
```

Depending on the value of the expression, creates a drawing of the library part (expression = 0, default) or the label of the element (expression = 1) associated with the Property Object containing this command.

DRAWING3

```
DRAWING3 projection_code, angle, method
```

DRAWING3{2}

```
DRAWING3{2} projection_code, angle, method [, backgroundColor,
        fillOrigoX, fillOrigoY, filldirection]
```

Similarly to PROJECT2, creates a projection of the 3D script of the library part associated with the property library part containing this command. All parameters are similar to those of PROJECT2 and PROJECT2{2}.

method: New method flags in DRAWING3{2}

- `3:` shading,
- `32:` use current attributes instead of attributes from 3D,
- `64:` local fill orientation.

DRAWING3{3}

```
DRAWING3{3} projection_code, angle, method, parts [, backgroundColor,
        fillOrigoX, fillOrigoY, filldirection][[,]
        PARAMETERS name1=value1, ..., namen=valuen]
```

Similarly to PROJECT2, creates a projection of the 3D script of the library part associated with the property library part containing this command. All parameters are similar to those of PROJECT2, PROJECT2{2} and PROJECT2{3}.

method: New method flags in DRAWING3{3}

- `2048:` addition modifier: modifiers 16, 32, 64, 128, 256, 512, 1024 and fill attribute parameters are effective only for the view part of the projection. By default they are effective for all parts,

`4096:` addition modifier: modifiers 16, 32, 64, 128, 256, 512, 1024 and fill attribute parameters are effective only for the cut part of the projection. By default they are effective for all parts,
`8192:` addition modifier: cut fills are slanted.
`16384:` addition modifier: enables transparency for transparent surfaces. Note that transparency in this case means full transparency for surfaces with transmittance greater than 50, everything else is non-transparent.

GRAPHICAL EDITING USING HOTSPOTS

Hotspot-based interactive graphical editing of length and angle type GDL parameters.

`HOTSPOT` `x, y, z [, unID [, paramReference [, flags [, displayParam [, "customDescription"]]]]]`
`HOTSPOT2` `x, y [, unID [, paramReference [, flags [, displayParam [, "customDescription"]]]]]`

`unID:` unique identifier, which must be unique among the hotspots defined in the library part.

`paramReference:` parameter that can be edited by this hotspot using the graphical hotspot based parameter editing method.

`displayParam:` parameter to display in the information palette when editing the paramRefrence parameter. Members of arrays can be passed as well.

`customDescription:` custom description string for the displayed parameter in the information palette. When using this option, displayParam must be set as well (use paramReference for default). The value set for the moving type hotspot will be displayed only. It is recommended to set the same description for all moving hotspots having the same base hotspot.

Examples of valid arguments:

`D, Arr[5], Arr[2*I+3][D+1], etc.`

`flags:` hotspot's type + hotspot's attribute:

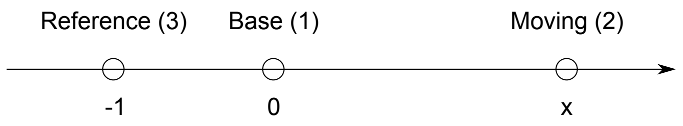
`type:`

`1:` length type editing, base hotspot,
`2:` length type editing, moving hotspot,
`3:` length type editing, reference hotspot (always hidden),
`4:` angle type editing, base hotspot,
`5:` angle type editing, moving hotspot,
`6:` angle type editing, center of angle (always hidden),
`7:` angle type editing, reference hotspot (always hidden).

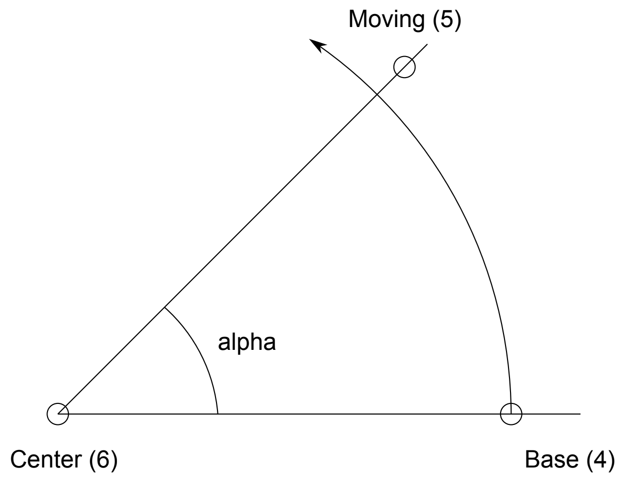
`attribute:` Can be zero or:

`attribute = 128*`j_8` + 256*`j_9` + 512*`j_{10}` + 1024*`j_{11}, where each j can be 0 or 1.
j_8: hide hotspot (meaningful for types: 1,2,4,5),
j_9: editable base hotspot (for types: 1,4),
j_{10}: reverse the angle in 2D (for type 6),
j_{11}: use paramReference value as meters in paper space.

To edit a length type parameter, three hotspots must be defined with types 1, 2 and 3. The positive direction of the editing line is given by the vector from the reference hotspot to the base hotspot. The moving hotspot must be placed along this line at a distance determined by the associated parameter's value, measured from the base hotspot.



To edit an angle type parameter, in 3D four hotspots must be defined with types 4, 5, 6 and 7. The plane of the angle is perpendicular to the vector that goes from the center hotspot to the reference hotspot. The positive direction in measuring the angle is counter-clockwise if we look at the plane from the reference hotspot. In 2D the plane is already given, so the reference hotspot is ignored, and the positive direction of measuring the angle is by default counter-clockwise. This can be changed to clockwise by setting the 512 attribute flag for the center hotspot (type 6). To be consistent, the vectors from the center hotspot to the moving and the base hotspots must be perpendicular to the vector from the center to the reference hotspot. The moving hotspot must be placed at an angle determined by the associated parameter measured from the base hotspot around the center hotspot.



If several sets of hotspots are defined to edit the same parameter, hotspots are grouped together in the order of the execution of the hotspot commands. If the editable attribute is set for a base hotspot, the user can also edit the parameter by dragging the base hotspot. Since the base hotspot is supposed to be fixed in the object's coordinate frame (i.e. its location must be independent of the parameter that is attached to it), the whole object is dragged or rotated along with the base point. (As the parameter's value is changing, the moving hotspot will not change its location.)

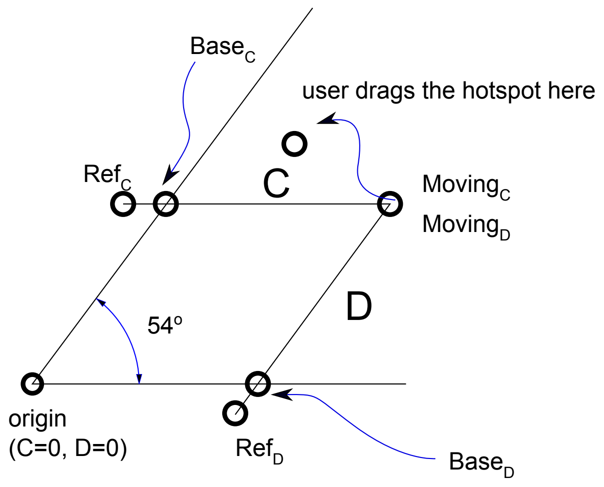
Two length type sets of hotspots can be combined to allow editing of two parameters with only one dragging. If two are combined, the motion of the hotspot is no longer constrained to a line but to the plane determined by the two lines of each set of length editing hotspots. In 3D, the combination of three sets of length editing hotspots allows the hotspot to be placed anywhere in space. The two lines must not be parallel to each other, and the three lines must not be on the same plane. A combined parameter editing operation is started if, at the location of the picked point, there are two editable hotspots (moving or editable base) with different associated parameters. If parameters are designed for combined editing, the base and reference hotspots are not fixed in the object's coordinate frame, but must move as the other parameter's value changes.

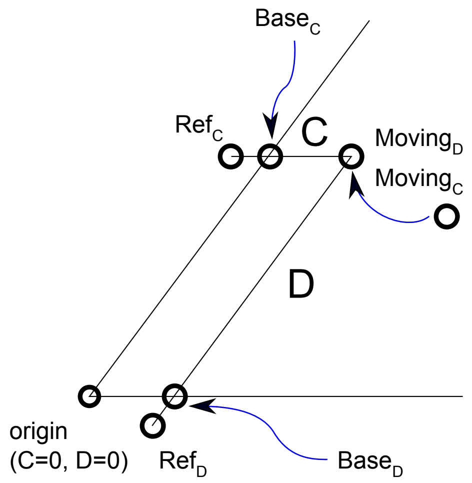
See illustration and example 2.

Example 1: Angle editing in 2D

```
LINE2 0, 0, A, 0
LINE2 0, 0, A*COS(angle), A*SIN(angle)
ARC2 0, 0, 0.75*A, 0, angle
HOTSPOT2 0, 0, 1, angle, 6
HOTSPOT2 0.9*A, 0, 2, angle, 4
HOTSPOT2 0.9*A*COS(angle), 0.9*A*SIN(angle), 3,
angle, 5
```

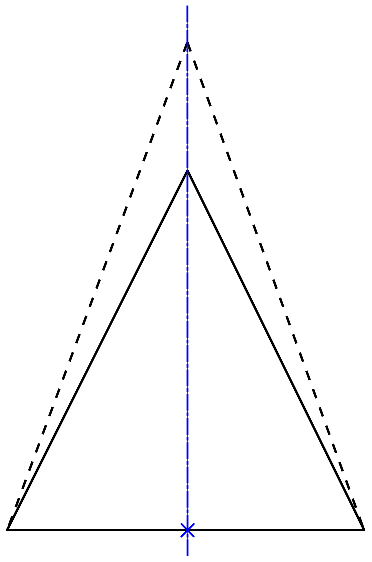
Example 2: Combined length type editing with 2 parameters in 2D





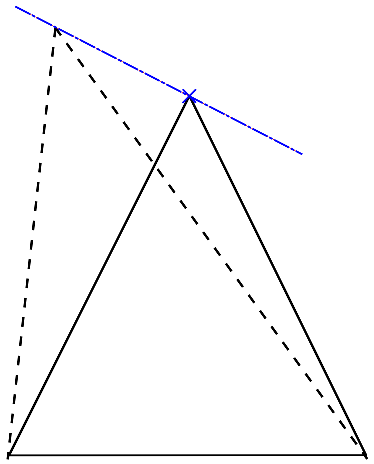
```
! sideX, sideY parameters
RECT2 0, 0, A, B
RECT2 0, 0, sideX, sideY
HOTSPOT2 sideX, 0, 1, sideY, 1
HOTSPOT2 sideX, -0.1, 2, sideY, 3
HOTSPOT2 sideX, sideY, 3, sideY, 2
HOTSPOT2 0, sideY, 4, sideX, 1
HOTSPOT2 -0.1, sideY, 5, sideX, 3
HOTSPOT2 sideX, sideY, 6, sideX, 2
```

Example 3: Simple length type editing with 1 parameter



```
!2D SCRIPT:
HOTSPOT2 -1, 0, 1
HOTSPOT2 1, 0, 2
HOTSPOT2 0, 0, 3, corner_y, 1+128
HOTSPOT2 0, -1, 4, corner_y, 3
HOTSPOT2 0, corner_y, 5, corner_y, 2
LINE2 -1, 0, 1, 0
LINE2 -1, 0, 0, corner_y
LINE2 1, 0, 0, corner_y
!3D SCRIPT:
HOTSPOT -1, 0, 0, 1
HOTSPOT -1, 0, 0.5, 2
HOTSPOT 1, 0, 0, 3
HOTSPOT 1, 0, 0.5, 4
HOTSPOT 0, 0, 0, 5, corner_y, 1+128
HOTSPOT 0, -1, 0, 6, corner_y, 3
HOTSPOT 0, corner_y, 0, 7, corner_y, 2
HOTSPOT 0, 0, 0.5, 8, corner_y, 1+128
HOTSPOT 0, -1, 0.5, 9, corner_y, 3
HOTSPOT 0, corner_y, 0.5, 10, corner_y, 2

PRISM_ 4, 0.5,
    -1, 0, 15,
    1, 0, 15,
    0, corner_y, 15,
    -1, 0, -1
```

Example 4: Combined length type editing with 2 parameters:



```
!2D SCRIPT:
HOTSPOT2 -1, 0, 1
HOTSPOT2 1, 0, 2
HOTSPOT2 corner_x, 0, 3, corner_y, 1+128
HOTSPOT2 corner_x, -1, 4, corner_y, 3
HOTSPOT2 corner_x, corner_y, 5, corner_y, 2
HOTSPOT2 0, corner_y, 6, corner_x, 1+128
HOTSPOT2 -1, corner_y, 7, corner_x, 3
HOTSPOT2 corner_x, corner_y, 8, corner_x, 2
LINE2 -1, 0, 1, 0
LINE2 -1, 0, corner_x, corner_y
LINE2 1, 0, corner_x, corner_y
```

```
!3D SCRIPT:
HOTSPOT -1, 0, 0, 1
HOTSPOT -1, 0, 0.5, 2
HOTSPOT 1, 0, 0, 3
HOTSPOT 1, 0, 0.5, 4
HOTSPOT corner_x, 0, 0, 5, corner_y, 1+128
HOTSPOT corner_x, -1, 0, 6, corner_y, 3
HOTSPOT corner_x, corner_y, 0, 7, corner_y, 2
HOTSPOT 0, corner_y, 0, 8, corner_x, 1+128
HOTSPOT -1, corner_y, 0, 9, corner_x, 3
HOTSPOT corner_x, corner_y, 0, 10, corner_x, 2
HOTSPOT corner_x, 0, 0.5, 11, corner_y, 1+128
HOTSPOT corner_x, -1, 0.5, 12, corner_y, 3
HOTSPOT corner_x, corner_y, 0.5, 13, corner_y, 2
HOTSPOT 0, corner_y, 0.5, 14, corner_x, 1+128
HOTSPOT -1, corner_y, 0.5, 15, corner_x, 3
HOTSPOT corner_x, corner_y, 0.5, 16, corner_x, 2
PRISM_ 4, 0.5,
    -1, 0, 15,
    1, 0, 15,
    corner_x, corner_y, 15,
    -1, 0, -1
```

STATUS CODES

Status codes introduced in the following pages allow users to create segments and arcs in planar polylines using special constraints.

Planar polylines with status codes at nodes are the basis of many GDL elements: `POLY2_`, `POLY2_A`, `POLY2_B`, `POLY2_B{2}`, `POLY2_B{3}`, `POLY2_B{4}`, `POLY2_B{5}`, `POLY_`, `PLANE_`, `PRISM_`, `CPRISM_`, `BPRISM_`, `FPRISM_`, `HPRISM_`, `SPRISM_`, `SLAB_`, `CSLAB_`, `CROOF_`, `EXTRUDE`, `PYRAMID`, `REVOLVE`, `SWEEP`, `TUBE`, `TUBEA`

Status codes allow you:

- to control the visibility of planar polyline edges
- to define holes in the polyline
- to control the visibility of side edges and surfaces
- to create segments and arcs in the polyline

STATUS CODE SYNTAX

si: The si number is a binary integer (between 0 and 127) or -1.

`si` = $j_1 + 2*j_2 + 4*j_3 + 8*j_4 + 64*j_7$ `[+ a_code]` , where each j can be 0 or 1.

The j1, j2, j3, j4 numbers represent whether the vertices and the sides are present (1) or omitted (0):

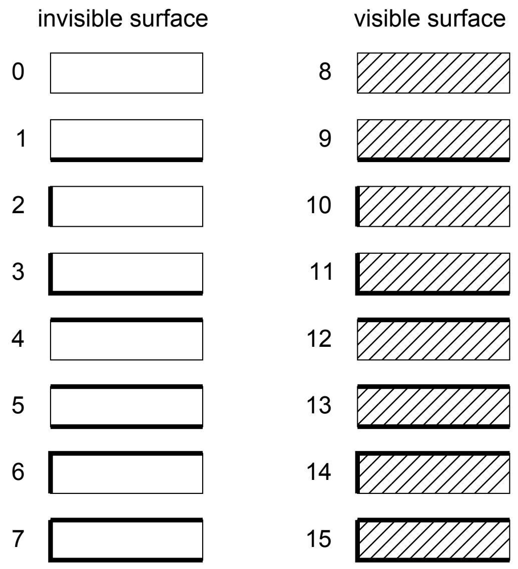
j_1: lower horizontal edge,
j_2: vertical edge,
j_3: upper horizontal edge,
j_4: side face,
j_7: special additional status value effective only when j2=1 and controls the viewpoint dependent visibility of the current vertical edge,
`a_code`: additional status code (optional), which allows you to create segments and arcs in the polyline,

`j2=0`: the vertical edge is always invisible

`j2=1 and j7=1`: the vertical edge is only visible when it is a contour observed from the current direction of view

`j2=1 and j7=0`: the vertical edge is always visible

Possible status values (the heavy lines denote visible edges):



`si=-1` is used to define holes directly into the prism. It marks the end of the contour and the beginning of a hole inside of the contour. It is also used to indicate the end of one hole's contour and the beginning of another. Coordinates before that value must be identical to the coordinates of the first point of the contour/hole. If you have used the -1 mask value, the last mask value in the parameter list must be -1, marking the end of the last hole.

The holes must be disjoint and internal intersections are forbidden in the polygon for a correct shading/rendering result.

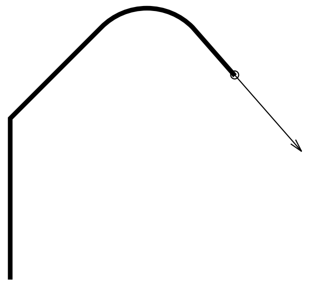
ADDITIONAL STATUS CODES

The following additional status codes allow you to create segments and arcs in the polyline using special constraints. They refer to the next segment or arc. Original status code(s) are only effective where they are specified (a "+s" is included after the additional code).

Note

Resolution of arcs is controlled by directives described in the section called “Directives for 3D and 2D Scripts”. In case of the POLY2_ command, if the resolution is greater than 8, it generates real arcs; otherwise all generated arcs will be segmented.

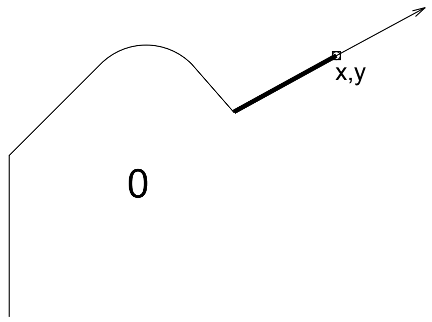
Previous part of the polyline: current position and tangent is defined



Segment by absolute endpoint

```
x, y, s
```

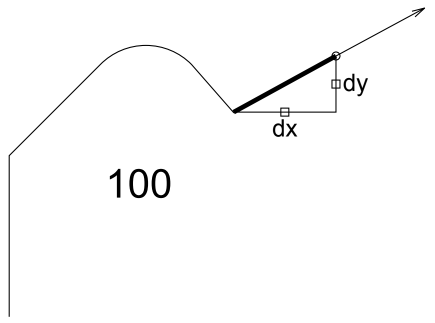
where 0 < s < 100



Segment by relative endpoint

```
dx, dy, 100+s,
```

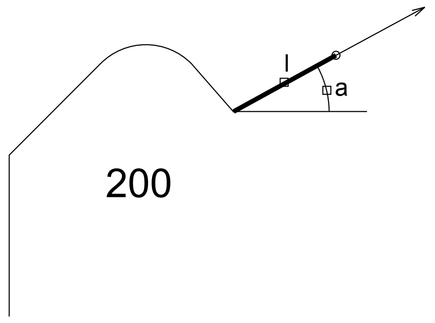
where 0 < s < 100



Segment by length and direction

```
l, a, 200+s,
```

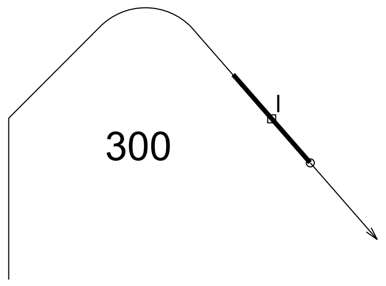
where 0 < s < 100



Tangential segment by length

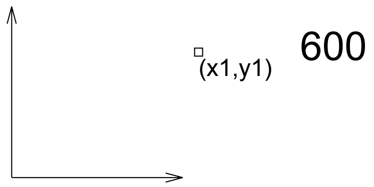
```
l, 0, 300+s,
```

where 0 < s < 100



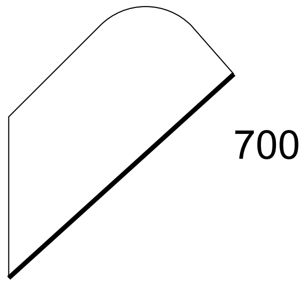
Set start point

```
x1, y1, 600,
```



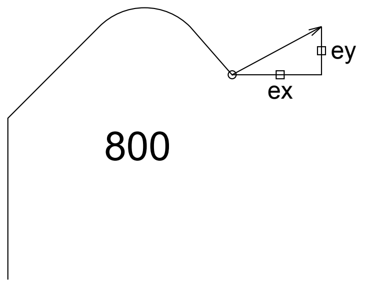
Close polyline

```
0, 0, 700,
```



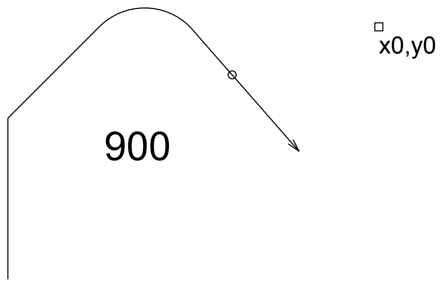
Set tangent

```
ex, ey, 800,
```



Set centerpoint

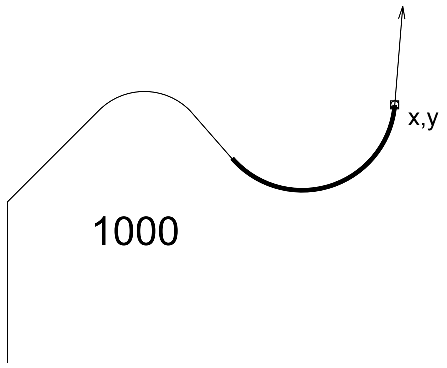
`x0, y0, 900,`



Tangential arc to endpoint

`x, y, 1000+s,`

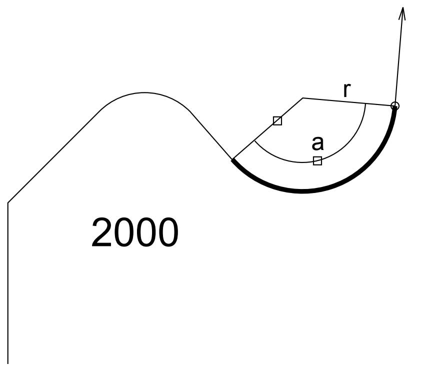
where 0 < s < 100



Tangential arc by radius and angle

`r, a, 2000+s,`

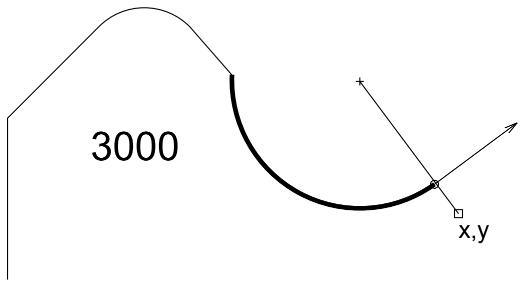
where 0 < s < 100



Arc using centerpoint and point on the final radius

`x, y, 3000+s,`

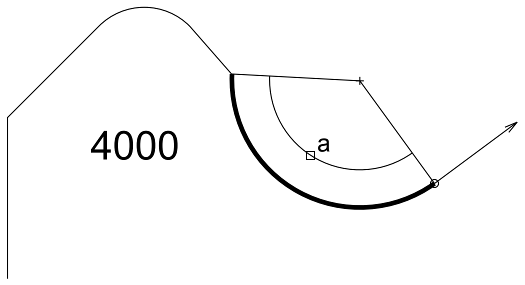
where 0 < s < 100



Arc using centerpoint and angle

`0, a, 4000+s,`

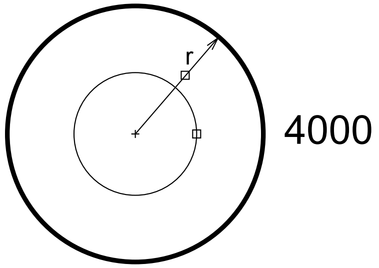
where 0 < s < 100



Full circle using centerpoint and radius

`r, 360, 4000+s,`

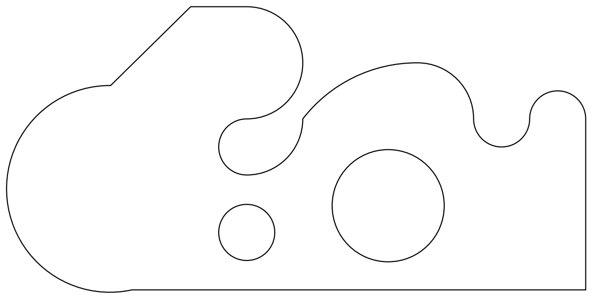
where 0 < s < 100

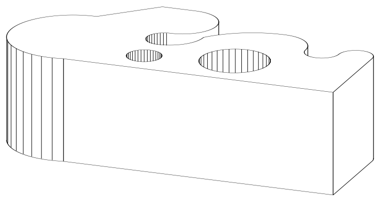


In this case the s status refers to the whole circle.

All angle values are in degrees. Omitted coordinates marked by 0 (for codes 300, 700, 4000) can have any value.

Example 1:

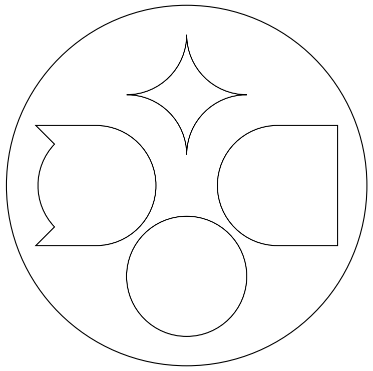




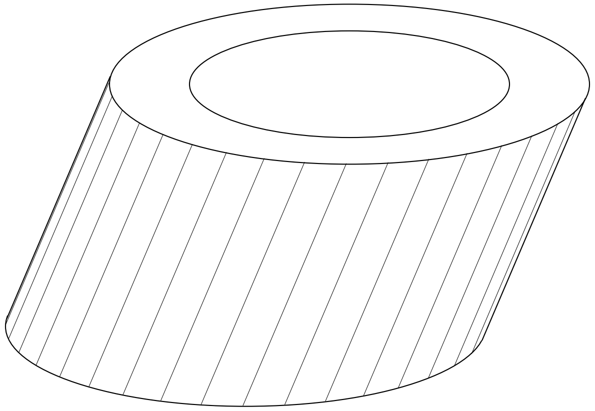
```
EXTRUDE 21, 0, 0, 3, 1+2+4+16+32,
        0, 0, 0,
        7,   0,    0,
        7,   3,    1,
        6,   3,    1000, ! tangential arc to endpoint
        5,   3,    1001, ! tangential arc to endpoint
        1,   90,   2000, ! tangential arc by radius and angle
        2,   3,    1001, ! tangential arc to endpoint
        1,   3,    900,  ! set centerpoint
        1,   2,    3000, ! arc using startpoint, centerpoint and point on final radius
        1,   2.5,  900,  ! set centerpoint
        0, -180, 4001,   ! arc using start point, centerpoint and angle
        1,   5,    1000, !tangential arc to endpoint
        -1,  0,    100,  ! segment by (dx, dy)
        2,   225,  200,  ! segment by (len, angle)
        -1,  0,    800,  ! set tangent
        -1,  0,    1000, ! tangential arc to endpoint
        0,   0,    -1,   ! end of contour
        1,   1,    900,  ! set centerpoint
        0.5, 360,  4000, ! full circle by centerpoint and radius
        3.5, 1.5,  900,  ! set centerpoint
        1, 360, 4001     ! full circle by centerpoint and radius
```

Example 2:

```
EXTRUDE 2+5+10+10+2, 0, 0, 3, 1+2+4+16+32,
        0,    0,   900,
        3, 360, 4001,
        2.5,  -1,  0,
        2.5,  1,   0,
        1.5,  1,   1,
        1.5,  -1,  1001,
        2.5,  -1,  -1,
        0,    2.5, 600,
        0,    -1,  800,
        1,    1.5, 1001,
        -1,   0,   800,
        0,    0.5, 1001,
        0,    1,   800,
        -1,   1.5, 1001,
        1,    0,   800,
        0,    2.5, 1001,
        0,    2.5, 700,
        -1.5, 0,   900,
        -2.5, 0,   600,
        -2.5, 1,   3000,
        -2.5, 1,   0,
        -1.5, 1,   0,
        -1.5, -1,  1001,
        -2.5, -1,  0,
        SQR(2)-1, 45, 200,
        -2.5, 0,   3000,
        -2.5, 0,   700,
        0,    -1.5, 900,
        1, 360, 4000
```

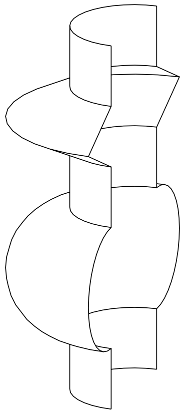


Example 3:



```
EXTRUDE 3, 1, 1, 3, 1+2+4+16+32,
        0, 0, 900,
        3, 360, 4001,
        2, 360, 4000
```

Example 4:



```
ROTY-90
REVOLVE 9, 180, 16+32,
        7, 1, 0,
        6, 1, 0,
        5.5, 2, 0,
        5, 1, 0,
        4, 1, 0,
        3, 1, 900, ! set centerpoint
        0, 180, 4001, ! arc using startpoint, centerpoint and angle
        2, 1, 0,
        1, 1, 0
```

ATTRIBUTES

In the first part of this chapter, directives influencing the interpretation of GDL statements are presented. Directives may define the smoothness used for cylindrical elements, representation mode in the 3D view or the assignment of an attribute (color, material, text style, etc.) for the subsequent shapes. Inline attribute definition is covered in the second part. This feature allows you to assign to your objects customized materials, textures, fill patterns, line types and text styles that are not present in the current attribute set of your project.

DIRECTIVES

The influence of directives on the interpretation of the subsequent GDL statements remains in effect until the next directive or the end of the script. Called scripts inherit the current settings: the changes have local influence. Returning from the script resets the settings as they were before the macro call.

Directives for 3D and 2D Scripts

LET

```
[LET] varnam = n
```

Value assignment. The LET directive is optional. The variable will store the evaluated value of n.

RADIUS

```
RADIUS radius_min, radius_max
```

Sets smoothness for cylindrical elements and arcs in polylines.

A circle with a radius of r is represented:

- if r < radius_min, by a hexagon,
- if r >= radius_max, by a 36-edged polygon,
- if radius_min < r < radius_max, by a polygon of (6+30*(r-radius_min)/(radius_max-radius_min)) edges.

Arc conversion is proportional to this.

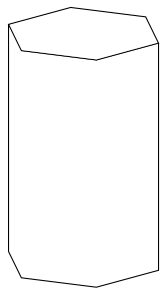
After a RADIUS statement, all previous RESOL and TOLER statements lose their effect.

Restriction of parameters:

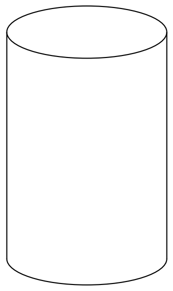
```
  r_min <= r_max
```

Example:

```
RADIUS 1.1, 1.15
CYLIND 3.0, 1.0
```



```
RADIUS 0.9, 1.15
CYLIND 3.0, 1.0
```



RESOL

`RESOL` `n`

Sets smoothness for cylindrical elements and arcs in polylines. Circles are converted to regular polygons having n sides.

Arc conversion is proportional to this.

After a RESOL statement, any previous RADIUS and TOLER statements lose their effect.

Restriction of parameters:

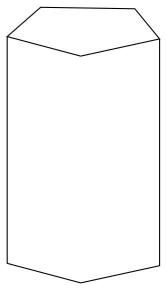
```
  n >= 3
```

Default:

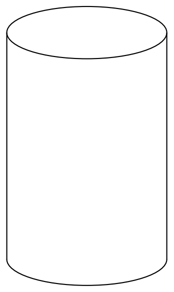
```
RESOL 36
```

Example:

```
RESOL 5
CYLIND 3.0, 1.0
```



```
RESOL 36
CYLIND 3.0, 1.0
```



TOLER

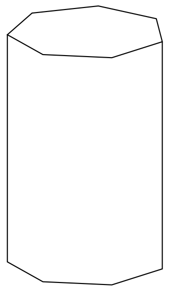
TOLER d

Sets smoothness for cylindrical elements and arcs in polylines. The error of the arc approximation (i.e., the greatest distance between the theoretical arc and the generated chord) will be smaller than d.

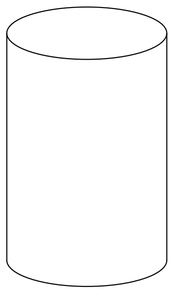
After a TOLER statement, any previous RADIUS and RESOL statements lose their effect.

Example:

```
TOLER 0.1
CYLIND 3.0, 1.0
```



```
TOLER 0.01
CYLIND 3.0, 1.0
```



Note

The RADIUS, RESOL and TOLER directives set smoothness for cylindrical 3D elements (CIRCLE, ARC, CYLIND, SPHERE, ELLIPS, CONE, ARMC, ARME, ELBOW, REVOLVE) and arcs in 2D polylines using curved edges.

See the section called "Additional Status Codes".

PEN

PEN n

Sets the color.

Restriction of parameters:

```
  0 < n <= 255
```

Default:

```
PEN 1
```

if there is no PEN statement in the script.

(For library parts, default values come from the library part's settings. If the script refers to a non-existing index, PEN 1 becomes the default setting.)

LINE_PROPERTY

`LINE_PROPERTY` `expr`

Defines the property for all subsequently generated lines in the 2D script (`RECT2`, `LINE2`, `ARC2`, `CIRCLE2`, `SPLINE2`, `SPLINE2A`, `POLY2`, `FRAGMENT2` commands) until the next LINE_PROPERTY statement. Default value is generic.

`expr:` possible values:

- `0:` all lines are generic lines,
- `1:` all lines are inner,
- `2:` all lines are contour.

[SET] STYLE

```
[SET] STYLE name_string
[SET] STYLE index
```

All the texts generated afterwards will use that style until the next SET STYLE statement.

The index is a constant referring to a style stack in the internal data structure (negative indices mean indices in the data structure of inline materials (previously defined in the GDL script)). This stack is modified during GDL analysis and can also be modified from within the program. The use of the index instead of the style name is only recommended with the prior use of the `IND` function.

Default:

```
SET STYLE 0
```

(application font, size 5 mm, anchor = 1, normal face) if there is no SET STYLE statement in the script.

Directives Used in 3D Scripts Only

MODEL

```
MODEL WIRE
MODEL SURFACE
MODEL SOLID
```

Sets the representation mode in the current script.

MODEL WIRE: only wireframe, no surfaces or volumes. Objects are transparent.

MODEL SURFACE, MODEL SOLID: The generation of the section surfaces is based on the relation of the boundary surfaces, so that both methods generate the same 3D internal data structure. Objects are opaque.

The only distinction can be seen after cutting away a part of the body:

MODEL SURFACE: the inside of bodies will be visible, MODEL SOLID: new surfaces may appear.

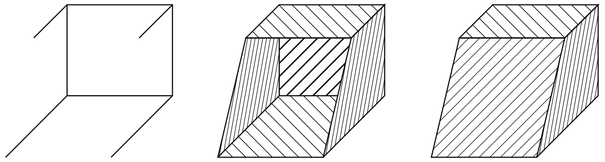
Default:

MODEL SOLID

Example: To illustrate the three modeling methods, consider the following three blocks:

```
MODEL WIRE
BLOCK 3,2,1
ADDY 4
MODEL SURFACE
BLOCK 3,2,1
ADDY 4
MODEL SOLID
BLOCK 3,2,1
```

After cutting them with a plane:



[SET] MATERIAL

```
[SET] MATERIAL name_string
[SET] MATERIAL index
```

All the surfaces generated afterwards will represent that material until the next MATERIAL statement. Surfaces in the `BPRISM_`, `CPRISM_`, `FPRISM_`, `HPRISM_`, `SPRISM_`, `CSLAB_`, `CWALL_`, `BWALL_`, `XWALL_`, `CROOF_`, `MASS`, bodies are exceptions to this rule.

The index is a constant referring to a material stack in the internal data structure (negative indices mean indices in the data structure of inline materials (previously defined in the GDL script)). This stack is modified during GDL analysis and can also be modified from within the program. The use of the index instead of the material name is only recommended with the prior use of the `IND` function.

index 0 has a special meaning: surfaces use the color of the current pen and they have a matte appearance.

Default:

```
MATERIAL 0
```

if there is no MATERIAL statement in the script.

(For Library parts, default values are read from the Library part's settings. If the script refers to a non-existing index, MATERIAL 0 becomes the default setting.)

SECT_FILL

```
SECT_FILL fill, fill_background_pen,
        fill_pen, contour_pen
```

or

SECT_ATTRS

```
SECT_ATTRS fill, fill_background_pen,
        fill_pen, contour_pen [, line_type]
```

Defines the attributes used for the cut part of the 3D elements in the Section/Elevation window and the PROJECT2{3} command (for compatibility reasons previous versions of the PROJECT2 command are not affected).

`fill:` fill name or index number.

`fill_background_pen:` fill background pencolor number.

`fill_pen:` fill pencolor number.

`contour_pen:` fill contour pencolor number.

`line_type:` line type of polygon edges.

SHADOW

```
SHADOW casting [, catching]
```

Controls the shadow casting of the elements in PhotoRendering and in vectorial shadow casting.

`casting:` ON, AUTO or OFF

`ON:` all the subsequent elements will cast shadows in all circumstances,
`OFF:` none of the subsequent elements will cast shadows in any circumstance,
`AUTO:` shadow casting will be determined automatically

Setting SHADOW OFF for hidden parts will spare memory space and processing time.

Setting SHADOW ON ensures that even tiny details will cast shadows.

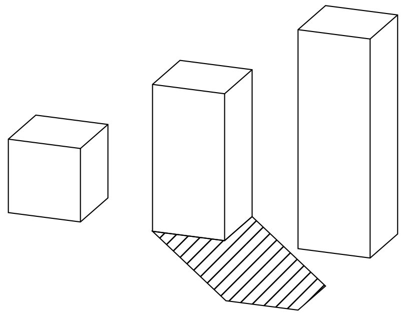
`catching:` ON or OFF

This optional parameter controls the appearance of shadows (from other bodies) on surfaces.

If shadow casting isn't specified, the default will be AUTO.

Example:

```
SHADOW OFF
! horizontal surface
PRISM 4, 0.2,
      0, 0,
      6, 0,
      6, 6,
      0, 6

ADDX 0.5
ADDY 2.5

BRICK 1, 1, 1
ADDX 2
SHADOW ON
BRICK 1, 1, 2
ADDX 2
SHADOW OFF
BRICK 1, 1, 3

DEL 4
```



Directives Used in 2D Scripts Only

DRAWINDEX

`DRAWINDEX` `number`

Defines the drawing order of 2D Script elements. Elements with a smaller drawindex will be drawn first.

Restriction of parameters:

```
 0 < number <= 50
```

(In the current version of GDL only the 10, 20, 30, 40 and 50 DRAWINDEX values are valid. Other values will be rounded to these.)

If no DRAWINDEX directive is present, the default drawing order is the following:

1 Figures

2 Fills

3 Lines

4 Text elements

[SET] FILL

```
[SET] FILL name_string
[SET] FILL index
```

All the 2D polygons generated afterwards will represent that fill until the next SET FILL statement.

The index is a constant referring to a fill stack in the internal data structure. This stack is modified during GDL analysis and can also be modified from within the program. The use of the index instead of the fill name is only recommended with the prior use of the `IND` function.

Default:

```
SET FILL 0
```

i.e., empty fill, if there is no SET FILL statement in the script.

[SET] LINE_TYPE

```
[SET] LINE_TYPE name_string
[SET] LINE_TYPE index
```

All the 2D lines generated afterwards will represent that line type (in lines, arcs, polylines) until the next SET LINE_TYPE statement. The index is a constant that refers to a line type stack in the internal data structure. This stack is modified during GDL analysis and can also be modified from the program. The use of the index instead of the line type name is only recommended with the prior use of the `IND` function.

Default:

```
SET LINE_TYPE 1
```

i.e., solid line, if there is no SET LINE_TYPE statement in the script.

INLINE ATTRIBUTE DEFINITION

Attributes in can be created using the material, fill and line type dialog boxes. These floor plan attributes can be referenced from any GDL script. Attributes can also be defined in GDL scripts. There are two different cases:

- Attribute definition in the MASTER_GDL script. The MASTER_GDL script is interpreted when the library that contains it is loaded in the memory. The MASTER_GDL attributes are merged into the floor plan attributes; attributes with the same names are not replaced. Once the MASTER_GDL is loaded, the attributes defined in it can be referenced from any script.
- Attribute definition in library parts. The materials and textures defined this way can be used in the script and its second generation scripts. Fills and line types defined and used in the 2D script have the same behavior as if they were defined in the MASTER_GDL script.

The Check GDL Script command in the script window helps to verify whether the material, fill, line type or style parameters are correct.

When a material, fill, line type or style is different in the 3D interpretation of the library part from the intended one, but there is no error message, this probably means that one or more of the parameter values are incorrect. The Check GDL Scripts command will help you with detailed messages to find these parameters.

Materials

DEFINE MATERIAL

```
DEFINE MATERIAL name type,
        surface_red, surface_green, surface_blue
        [, ambient_ce, diffuse_ce, specular_ce, transparent_ce,
         shining, transparency_attenuation
         [, specular_red, specular_green, specular_blue,
          emission_red, emission_green, emission_blue, emission_att]]
        [, fill_index [, fillcolor_index, texture_index]]
```

Note: This command can contain additional data definition.

See the section called "Additional Data" for details.

Any GDL script can include material definitions prior to the first reference to that material name. This material can only be used for 3D elements in its own script and its second generation scripts.

`name:` name of the material.

`type:` type of the material. The actual number (n) of parameters that define the material is different, depending on the type. The meaning of the parameters and their limits are explained in the examples' comments.

`0:` general definition, n=16,
`1:` simple definition, n=9 (extra parameters are constants or calculated from given values),
`2-7:` predefined material types, n=3. The three values are the RGB components of the surface color. Other parameters are constants or calculated from the color.
`2:` matte,
`3:` metal,
`4:` plastic,
`5:` glass,
`6:` glowing,
`7:` constant,
`10:` general definition with fill parameter, n=17,
`11:` simple definition with fill parameter, n=10,

`12-17:` predefined material types with fill parameter, n=4,
`20:` general definition with fill, color index of fill and index of texture parameters, n=19,
`21:` simple definition with fill, color index of fill and index of texture parameters, n=12,
`22-27:` predefined material types with fill, color index of fill and index of texture parameters, n=6.
`20-27:` Special meanings for types 20-27: If the pen number is zero, vectorial hatches will be generated with the active pen. Zero value for a texture or fill index allows you to define materials without a vectorial hatch or texture.

Example 1: Materials with solid colors

```
DEFINE MATERIAL "water" 0,
        0.5284, 0.5989, 0.6167,! surface RGB [0.0..1.0]
        1.0,                   ! ambient coefficient [0.0..1.0]
        0.5,                   ! diffuse coefficient [0.0..1.0]
        0.5,                   ! specular coeff. [0.0..1.0]
        0.9,                   ! transparent coeff. [0.0..1.0]
        2.0,                   ! shining [0.0..100.0]
        1,                     ! transparency atten. [0.0..4.0]
        0.5284, 0.5989, 0.6167,! specular RGB [0.0..1.0]
        0, 0, 0,               ! emission RGB [0.0..1.0]
        0.0                    ! emission atten. [0.0..65.5]
DEFINE MATERIAL "asphalt" 1,
        0.1995, 0.2023, 0.2418,! surface RGB [0.0..1.0]
        1.0, 1.0, 0.0, 0.0,
        !      ambient, diffuse, specular, transparent
        !      coefficients [0.0..1.0]
        0,               ! shining [0..100]
        0                ! transparency attenuation [0..4]
DEFINE MATERIAL "matte red" 2,
        1.0, 0.0, 0.0    ! surface RGB [0.0..1.0]
```

Example 2: Material with fill

```
DEFINE MATERIAL "Brick-Red" 10,
        0.878294, 0.398199, 0.109468,
        0.58, 0.85, 0.0, 0.0,
        0,
        0.0,
        0.878401, 0.513481, 0.412253,
        0.0, 0.0, 0.0,
        0,
        IND(FILL, "common brick")    ! fill index
```

Example 3: Material with fill and texture

```
DEFINE MATERIAL "Yellow Brick+*" 20,
        1, 1, 0,          ! surface RGB [0.0 .. 1.0]
        0.58, 0.85, 0, 0,
        !      ambient, diffuse, specular, transparent
        !      coefficients [0.0 .. 1.0]
        0,                ! shining [0.0 .. 100.0]
        0,                ! transparency attenuation [0.0 .. 4.0]
        0.878401, 0.513481, 0.412253, ! specular RGB [0.0 .. 1.0]
        0, 0, 0,          ! emission RGB [0.0 .. 1.0]
        0,                ! emission attenuation [0.0 .. 65.5]
        IND(FILL, "common brick"), 61,
        IND(TEXTURE, "Brick")
        !      Fill index, color index, texture index
```

DEFINE MATERIAL BASED_ON

```
DEFINE MATERIAL name [,] BASED_ON orig_name [,] PARAMETERS name1 = expr1 [, ...]
        [[,] ADDITIONAL_DATA name1 = expr1 [, ...]]
```

Material definition based on an existing material. Specified parameters of the original material will be overwritten by the new values, other parameters remain untouched. Using the command without actual parameters results in a material exactly the same as the original, but with a different name. Parameter values of a material can be obtained using the REQUEST{2} ("Material_info", ...) function.

`orig_name:` name of the original material (name of an existing, previously defined GDL or floor plan material).

`namei:` material parameter name to be overwritten by a new value. Names corresponding to parameters of material definition:

`gs_mat_surface_r, gs_mat_surface_g, gs_mat_surface_b:` (surface RGB [0.0..1.0])

`gs_mat_ambient:` (ambient coefficient [0.0..1.0])

`gs_mat_diffuse:` (diffuse coefficient [0.0..1.0])
`gs_mat_specular:` (specular coefficient [0.0..1.0])
`gs_mat_transparent:` (transparent coefficient [0.0..1.0])
`gs_mat_shining:` (shininess [0.0..100.0])
`gs_mat_transp_att:` (transparency attenuation [0.0..4.0])
`gs_mat_specular_r, gs_mat_specular_g, gs_mat_specular_b:` (specular color RGB [0.0..1.0])
`gs_mat_emission_r, gs_mat_emission_g, gs_mat_emission_b:` (emission color RGB [0.0..1.0])
`gs_mat_emission_att:` (emission attenuation [0.0..65.5])
`gs_mat_fill_ind:` (fill index)
`gs_mat_fillcolor_ind:` (fill color index)
`gs_mat_texture_ind:` (texture index)

`expri:` new value to overwrite the specified parameter of the material. Value ranges are the same as at the material definition.

Example:

```
n = REQUEST{2} ("Material_info", "Brick-Face", "gs_mat_emission_rgb",
        em_r, em_g, em_b)
em_r = em_r + (1 - em_r) / 3
em_g = em_g + (1 - em_g) / 3
em_b = em_b + (1 - em_b) / 3
DEFINE MATERIAL "Brick-Face light" [,] BASED_ON "Brick-Face" \
        PARAMETERS gs_mat_emission_r = em_r,
        gs_mat_emission_g = em_g, gs_mat_emission_b = em_b
SET MATERIAL "Brick-Face"
BRICK a, b, zzyzx
ADDX a
SET MATERIAL "Brick-Face light"
BRICK a, b, zzyzx
```

DEFINE TEXTURE

`DEFINE TEXTURE` `name expression, x, y, mask, angle`

Any GDL script can include texture definition prior to the first reference to that texture name. The texture can be used only in the script in which it was defined and its subsequent second generation scripts.

`name:` name of the texture.

`expression:` picture associated with the texture. A string expression means a file name, a numerical expression an index of a picture stored in the library part. A 0 index is a special value which refers to the preview picture of the library part.

x: logical width of the texture.

y: logical height of the texture.

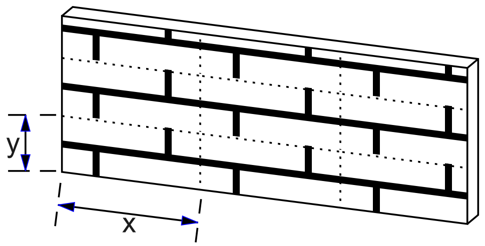
mask:

`mask = j`$_1$` + 2*j`$_2$` + 4*j`$_3$` + 8*j`$_4$` + 16*j`$_5$` + 32*j`$_6$` + 64*j`$_7$` + 128*j`$_8$` + 256*j`$_9$, where each j can be 0 or 1.

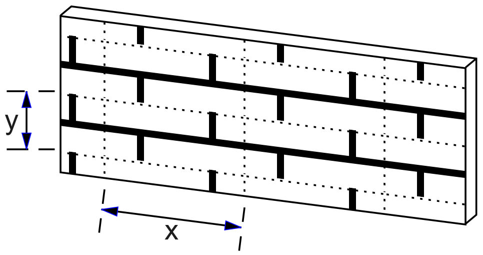
Alpha channel controls (j1... j6):

j$_1$: alpha channel changes the transparency of texture,
j$_2$: Bump mapping or surface normal perturbation. Bump mapping uses the alpha channel to determine the amplitude of the surface normal,
j$_3$: alpha channel changes the diffuse color of texture,
j$_4$: alpha channel changes the specular color of texture,
j$_5$: alpha channel changes the ambient color of texture,
j$_6$: alpha channel changes the surface color of texture,

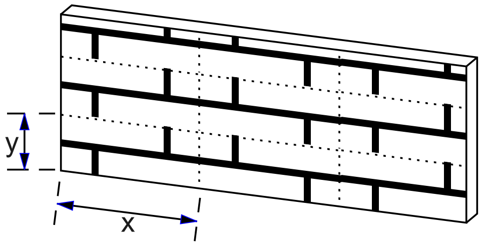
Connection controls (j7... j9): (If the value is zero, normal mode is selected.)



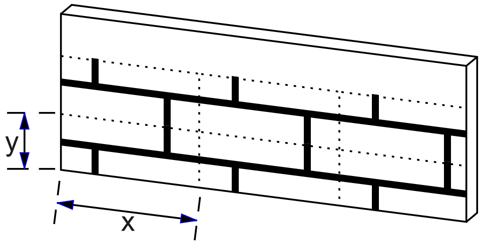
j$_7$: the texture will be shifted randomly,



j$_8$: mirroring in x direction,



`j9`: mirroring in y direction.



`angle:` angle of the rotation.

Example:

```
DEFINE TEXTURE "Brick" "Brick.PICT", 1.35, 0.3, 256+128, 35.0
```

Fills

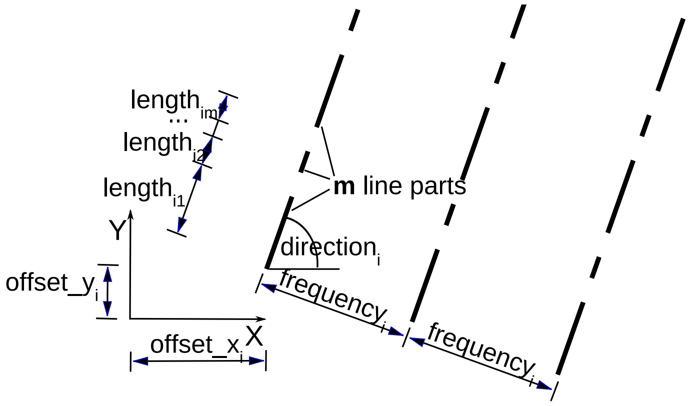
DEFINE FILL

```
DEFINE FILL name [[,] FILLTYPES_MASK fill_types,]
        pattern1, pattern2, pattern3, pattern4,
        pattern5, pattern6, pattern7, pattern8,
        spacing, angle, n,
        frequency1, direction1, offset_x1, offset_y1, m1,
        length11, ..., length1m,
        ...
        frequencyn, directionn, offset_xn,
        lengthn1, ..., lengthnm
```

Note 1: This command can contain additional data definition.

See the section called "Additional Data" for details.

Any GDL script may include fill definitions prior to the first reference to that fill name. The fill defined this way can be used only in the script in which it was defined and its subsequent second generation-scripts.



name: name of the fill.

fill_types:

`fill_types = j1 + 2*j2 + 4*j3`, where each j can be 0 or 1.

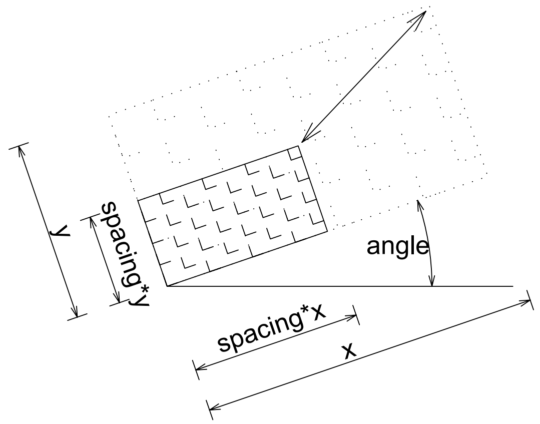
`j1:` cut fills,

`j2:` cover fills,

`j3:` drafting fills.

If the j bit is set, the defined fill can be used corresponding to its specified type. Default is all fills (0).

pattern definition: pattern1, pattern2, pattern3, pattern4, pattern5, pattern6, pattern7, pattern8: 8 numbers between 0 and 255 representing binary values. Defines the bitmap pattern of the fill.



spacing: hatch spacing - defines a global scaling factor for the whole fill. All values will be multiplied by this number in both the x and y direction.

angle: global rotation angle in degrees.

n: number of hatch lines.

frequencyi: frequency of the line (the distance between two lines is spacing * frequencyi).

diri: direction angle of the line in degrees.

offset_xi, offset_yi: offset of the line from the origin.

mi: number of line parts.

lengthij: length of the line parts (the real length is spacing * lengthij). Line parts are segments and spaces following each other. First line part is a segment, zero length means a dot.

The bitmap pattern is only defined by the pattern1... pattern8 parameters and is used when the display options for Polygon Fills are set to "Bitmap Pattern". To define it, choose the smallest unit of the fill, and represent it as dots and empty spaces using a rectangular grid with 8x8 locations. The 8 pattern parameters are decimal representations of the binary values in the lines of the grid (a dot is 1, an empty space is 0).

The vectorial hatch is defined by the second part of the fill definition as a collection of dashed lines repeated with a given frequency (frequencyi). Each line of the collection is described by its direction (directioni), its offset from the origin (offset_xi, offset_yi) and the dashed line definition which contains segments and spaces with the given length (lengthij) following each other.

Note 2: Only simple fills can be defined with the DEFINE FILL command. There is no possibility to define symbol fills with this command.

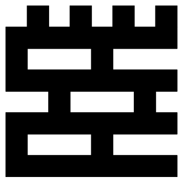
Example:

```
DEFINE FILL "brick" 85, 255, 136, 255,
        34, 255, 136, 255,
        0.08333, 0.0, 4,
        1.0, 0.0, 0.0, 0.0, 0,
        3.0, 90.0, 0.0, 0.0, 2,
        1.0, 1.0,
        3.0, 90.0, 1.5, 1.0, 4,
        1.0, 3.0, 1.0, 1.0,
        1.5, 90.0, 0.75, 3.0, 2,
        1.0, 5.0
```

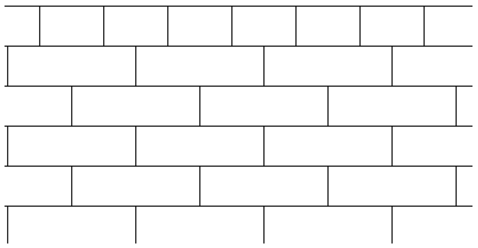
Bitmap pattern:

```
Pattern:          Binary value:
pattern1 = 85     01010101  • • • •
pattern2 = 255    11111111 ••••••••
pattern3 = 136    10001000 •   •
pattern4 = 255    11111111 ••••••••
pattern5 = 34     00100010   •   •
pattern6 = 255    11111111 ••••••••
pattern7 = 136    10001000 •   •
pattern8 = 255    11111111 ••••••••
```

View:



Vectorial hatch:

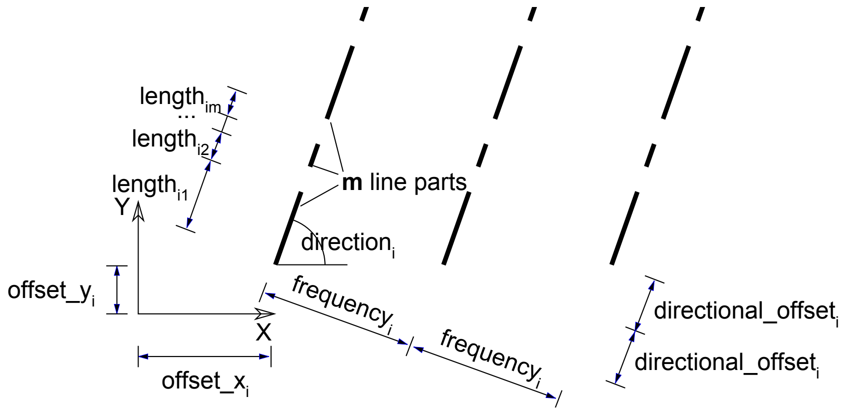


DEFINE FILLA

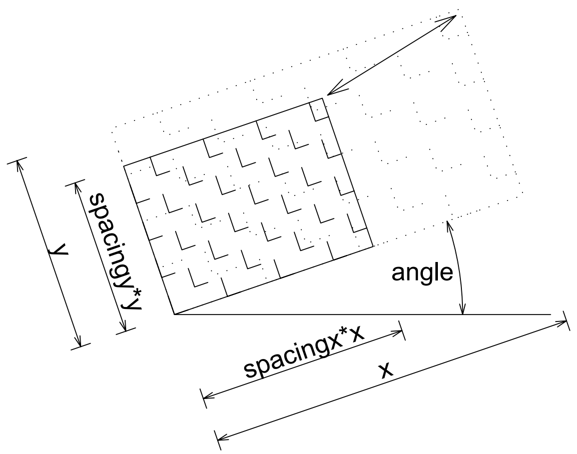
```
DEFINE FILLA name [,] [FILLTYPES_MASK fill_types,]
        pattern1, pattern2, pattern3, pattern4,
        pattern5, pattern6, pattern7, pattern8,
        spacing_x, spacing_y, angle, n,
        frequency1, directional_offset1, direction1,
        offset_x1, offset_y1, m1,
        length11, ..., length1m,
        ...
        frequencyn, directional_offsetn, directionn,
        offset_xn, offset_yn, mn,
        lengthn1, ..., lengthnm
```

Note: This command can contain additional data definition.

See the section called "Additional Data" for details.



An extended DEFINE FILL statement.



`spacing_x, spacing_y:` spacing factor in the x and y direction, respectively. These two parameters define a global scaling factor for the whole fill. All values in the x direction will be multiplied by spacing_x and all values in the y direction will be multiplied by spacing_y.

`directional_offseti:` the offset of the beginning of the next similar hatch line, measured along the line's direction. Each line of the series will be drawn at a distance defined by frequencyi with an offset defined by directional_offseti. The real length of the offset will be modulated by the defined spacing.

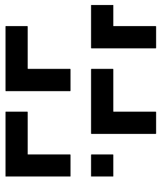
Example:

```
DEFINE FILLA "TEST" 8, 142, 128, 232,
        8, 142, 128, 232,
        0.5, 0.5, 0, 2,
        2, 1, 90, 0,
        0, 2, 1, 1,
        1, 2, 0, 0, 0,
        2, 1, 3
FILL "TEST"
POLY2 4, 6,
        -0.5, -0.5, 12, -0.5,
        12, 6, -0.5, 6
```

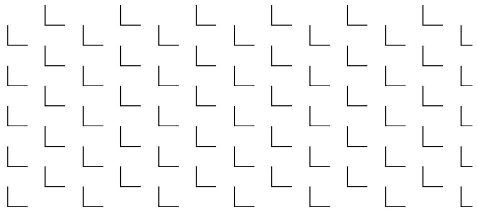
Bitmap pattern:

```
Pattern:       Binary value:
pat1 = 8       00001000      •
pat2 = 142     10001110  •   •••
pat3 = 128     10000000  •
pat4 = 232     11101000  ••• •
pat5 = 8       00001000      •
pat6 = 142     10001110  •   •••
pat7 = 128     10000000  •
pat8 = 232     11101000  ••• •
```

View:



Vectorial hatch:



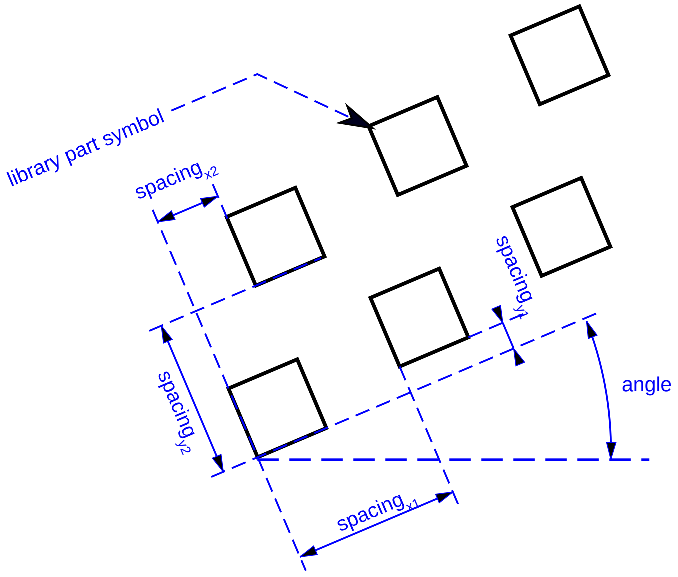
DEFINE SYMBOL_FILL

DEFINE SYMBOL_FILL name [,][**FILLTYPES_MASK** fill_types,]

```
        pat1, pat2, pat3, pat4, pat5, pat6, pat7, pat8,
        spacingx1, spacingy1, spacingx2, spacingy2,
        angle, scaling1, scaling2, macro_name [,] PARAMETERS [name1
        = value1, ..., namen = valuen]
```

Note: This command can contain additional data definition.

See the section called "Additional Data" for details.



An extended DEFINE FILL statement, which allows you to include a library part drawing in a fill definition. The usage of macro_name and the parameters are the same as for the CALL command.

spacingx1, spacingx2: horizontal spacings.

spacingy1, spacingy2: vertical spacings.

scaling1: horizontal scale.

scaling2: vertical scale.

macro_name: the name of the library part.

DEFINE SOLID_FILL

```
DEFINE SOLID_FILL name [[,] FILLTYPES_MASK fill_types]
```

Defines a solid fill.

Note: This command can contain additional data definition.

See the section called "Additional Data" for details.

DEFINE EMPTY_FILL

```
DEFINE EMPTY_FILL name [[,] FILLTYPES_MASK fill_types]
```

Defines an empty fill.

Note: This command can contain additional data definition.

See the section called "Additional Data" for details.

DEFINE LINEAR_GRADIENT_FILL

```
DEFINE LINEAR_GRADIENT_FILL name [[,] FILLTYPES_MASK fill_types]
```

Define linear gradient fill.

DEFINE RADIAL_GRADIENT_FILL

```
DEFINE RADIAL_GRADIENT_FILL name [[,] FILLTYPES_MASK fill_types]
```

Define radial gradient fill.

DEFINE TRANSLUCENT_FILL

```
DEFINE TRANSLUCENT_FILL name [[,] FILLTYPES_MASK fill_types]
        pat1, pat2, pat3, pat4, pat5, pat6, pat7, pat8,
        percentage
```

Define a fill, which shows the background and foreground colors in mixture defined by the given percentage value.

`percentage`: percentage of foreground color opacity; 0 displays background color only (like empty fill), 100 displays the foreground color only (like solid fill).

DEFINE IMAGE_FILL

```
DEFINE IMAGE_FILL name image_name [[,] FILLTYPES_MASK fill_types]
        part1, part2, part3, part4, part5, part6, part7, part8,
        image_vert_size, image_hor_size, image_mask, image_rotangle
```

Define a fill based on an image pattern.

`image_name`: name of the pattern image loaded in the current library.

`image_vert_size`, `image_hor_size`: model size of the pattern.

`image_mask`: tiling directive

`image_mask = 1024*`j_{11}` + 2048*`j_{12}, where each j can be 0 or 1.

For more information about laying out images on a surface see the DEFINE TEXTURE command.

`j11:` mirroring in x direction
`j12:` mirroring in y direction

`image_rotangle:` rotation angle of the pattern from the normal coordinate system.

Line Types

DEFINE LINE_TYPE

```
DEFINE LINE_TYPE name spacing, n,
        length1, ..., lengthn
```

Note 1: This command can contain additional data definition.

See the section called "Additional Data" for details.

Any GDL script may include line type definitions prior to the first reference to that line-type name. The line type defined this way can be used only for 2D elements in the script in which it was defined and its subsequent second generation scripts.

`name:` name of the line type.

`spacing:` spacing factor.

`n:` number of the line parts.

`lengthi:` length of the line parts (the real length is spacing * lengthi). Line parts consist of segments and spaces. First line part is a segment, zero length means a dot.

Note 2: Only simple line types - i.e. consisting only of segments and spaces - can be defined with this command, defining symbol line types can be done with the DEFINE SYMBOL_LINE command.

Example:

```
DEFINE LINE_TYPE "line - - ." 1,
        6, 0.005, 0.002, 0.001, 0.002, 0.0, 0.002
```

DEFINE SYMBOL_LINE

```
DEFINE SYMBOL_LINE name dash, gap, macro_name PARAMETERS [name1 = value1,
        ...
        namen = valuen]
```

Note: This command can contain additional data definition.

See the section called "Additional Data" for details.

An extended DEFINE LINE statement, which allows you to include a library part drawing in a line definition. The usage of macro_name and the parameters are the same as for the CALL command.

`dash:` scale of both line components.

`gap:` gap between each component.

Text Styles and Text Blocks

DEFINE STYLE

`DEFINE STYLE` `name font_family, size, anchor, face_code`

Recommended to be used with the `TEXT2` and `TEXT` commands.

GDL scripts may include style definitions prior to the first reference to that style name. The style defined this way can be used only in the script in which it was defined and its subsequent second generation scripts.

`name:` name of the style.

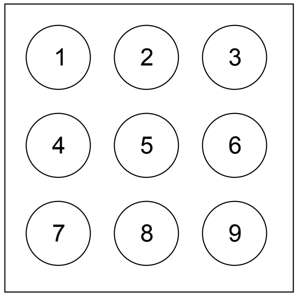
`font_family:` name of the used font family (e.g., Garamond).

`size:` height of the "l" character in millimeters in paper space or meters in model space.

If the defined style is used with the TEXT2 and TEXT commands, size means character heights in millimeters.

If used with PARAGRAPH strings in the RICHTEXT2 and RICHTEXT commands, size meaning millimeters or meters depends on the fixed_height parameter of the TEXTBLOCK definition, while the outline and shadow face_code values and the anchor values are not effective.

`anchor:` code of the position point in the text.



face_code: a combination of the following values:

`face_code` = $j_1 + 2*j_2 + 4*j_3$, where each j can be 0 or 1.

j_1: bold,
j_2: italic,
j_3: underline,

If face_code = 0, then style is normal.

DEFINE STYLE{2}

DEFINE STYLE{2} `name font_family, size, face_code`

New version of style definition, recommended to be used with `PARAGRAPH` definitions.

name: name of the style.

font_family: name of the used font family (e.g., Garamond).

size: height of the characters in mm or m in model space.

face_code: a combination of the following values:

`face_code` = $j_1 + 2*j_2 + 4*j_3 + 32*j_6 + 64*j_7 + 128*j_8$, where each j can be 0 or 1.

j_1: bold,
j_2: italic,
j_3: underline,
j_6: superscript,
j_7: subscript,
j_8: strikethrough.

If face_code = 0, then style is normal.

If the defined style is used with the TEXT2 command, size means character heights in millimeters, while the superscript, subscript and strikethrough face_code values are not effective. If used with PARAGRAPH strings in the RICHTEXT2 and RICHTEXT commands, size meaning millimeters or meters depends on the fixed_height parameter of the TEXTBLOCK definition.

PARAGRAPH

```
PARAGRAPH name alignment, firstline_indent,
        left_indent, right_indent, line_spacing [,
        tab_position1, ...]
    [PEN index]
    [[SET] STYLE style1]
    [[SET] MATERIAL index]
    'string1'
    'string2'
    ...
    'string n'
    [PEN index]
    [[SET] STYLE style2]
    [[SET] MATERIAL index]
    'string1'
    'string2'
    ...
    'string n'
    ...
ENDPARAGRAPH
```

GDL scripts may include paragraph definitions prior to the first reference to that paragraph name. The paragraph defined this way can be used only in the script in which it was defined and its subsequent second generation scripts. A paragraph is defined to be a sequence of an arbitrary number of strings (max 256 characters long each) with different attributes: style, pen and material (3D). If no attributes are specified inside the paragraph definition, actual (or default) attributes are used. The new lines included in a paragraph string (using the special character '\n') will automatically split the string into identical paragraphs, each containing one line. Paragraph definitions can be referenced by name in the TEXTBLOCK command. All length type parameters (firstline_indent, left_indent, right_indent, tab_position) meaning millimeters or meters depends on the fixed_height parameter of the TEXTBLOCK definition.

`name:` name of the paragraph. Can be either string or integer. Integer identifiers works only with the TEXTBLOCK_ command

`alignment:` alignment of the paragraph strings. Possible values:

- `1:` left aligned,
- `2:` center aligned,
- `3:` right aligned,
- `4:` full justified.

`firstline_indent:` first line indentation, in mm or m in model space.

left_indent: left indentation, in mm or m in model space.

right_indent: right indentation, in mm or m in model space.

line_spacing: line spacing factor. The default distance between the lines (character size + distance to the next line) defined by the actual style will be multiplied by this number.

tab_positioni: consecutive tabulator positions (each relative to the beginning of the paragraph), in mm or m in model space. Tabulators in the paragraph strings will snap to these positions. If no tabulator positions are specified, default values are used (12.7 mm). Works only with '\t' special character.

stringi: part of the text. Can be either constant string or string type parameter.

TEXTBLOCK

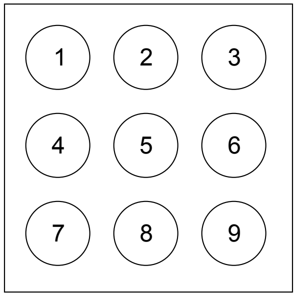
```
TEXTBLOCK name width, anchor, angle, width_factor, charspace_factor, fixed_height,
        'string_expr1' [, 'string_expr2', ...]
```

Textblock definition. GDL scripts may include textblock definitions prior to the first reference to that textblock name. The textblock defined this way can be used only in the script in which it was defined and its subsequent second generation scripts. A textblock is defined to be a sequence of an arbitrary number of strings or paragraphs which can be placed using the RICHTEXT2 command and the RICHTEXT command. Use the REQUEST ("TEXTBLOCK_INFO", ...) function to obtain information on the calculated width and height of a textblock.

name: name of the textblock, string type value.

width: textblock width in mm or m in model space, if 0 it is calculated automatically.

anchor: code of the position point in the text.



angle: rotation angle of the textblock in degrees.

width_factor: Character widths defined by the actual style will be multiplied by this number.

charspace_factor: The horizontal distance between two characters will be multiplied by this number.

fixed_height: Possible values:

1: the placed TEXTBLOCK will be scale-independent and all specified length type parameters will mean millimeters,

0: the placed TEXTBLOCK will be scale-dependent and all specified length type parameters will mean meters in model space.

string_expri: means paragraph name if it was previously defined, simple string otherwise (with default paragraph parameters).

TEXTBLOCK_

```
TEXTBLOCK_ name width, anchor, angle, width_factor, charspace_factor, fixed_height, n,
        'expr_1' [, 'expr_2', ..., 'expr_n']
```

Similar to the TEXTBLOCK command. The meaning of all the parameters are the same, with the following additions:

expr_i: paragraph names can be either string or integer types within one textblock.

n: number of listed expr_i names

Additional Data

Attribute definitions can contain optional additional data definitions after the ADDITIONAL_DATA keyword. The additional data must be entered after the previously defined parameters of the attribute command. An additional data has a name (namei) and a value (valuei), which can be an expression of any type, even an array. If a string parameter name ends with the substring "_file", its value is considered to be a file name and will be included in the archive project. Different meanings of additional data can be defined and used by the executing application.

Additional data definition is available in the following commands:

```
DEFINE MATERIAL parameters [[,] ADDITIONAL_DATA name1 = value1, name2 = value2, ...]
DEFINE MATERIAL name [,] BASED_ON orig_name [,] PARAMETERS name1 = expr1 [, ...]
        [[,] ADDITIONAL_DATA name1 = expr1 [, ...]]
DEFINE FILL parameters [[,] ADDITIONAL_DATA name1 = value1, name2 = value2, ...]
DEFINE FILLA parameters [[,] ADDITIONAL_DATA name1 = value1, name2 = value2, ...]
DEFINE SYMBOL_FILL parameters
        [[,] ADDITIONAL_DATA name1 = value1, name2 = value2, ...]
DEFINE SOLID_FILL name [[,] FILLTYPES_MASK fill_types]
        [[,] ADDITIONAL_DATA name1 = value1, name2 = value2, ...]
DEFINE EMPTY_FILL name [[,] FILLTYPES_MASK fill_types]
        [[,] ADDITIONAL_DATA name1 = value1, name2 = value2, ...]
DEFINE LINEAR_GRADIENT_FILL name [[,] FILLTYPES_MASK fill_types]
        [[,] ADDITIONAL_DATA name1 = value1, name2 = value2, ...]
```

```
DEFINE RADIAL_GRADIENT_FILL name [[,] FILLTYPES_MASK fill_types]
        [[,] ADDITIONAL_DATA name1 = value1, name2 = value2, ...]
DEFINE TRANSLUCENT_FILL name [[,] FILLTYPES_MASK fill_types]
        pat1, pat2, pat3, pat4, pat5, pat6, pat7, pat8,
        percentage [[,] ADDITIONAL_DATA name1 = value1, name2 = value2, ...]
DEFINE IMAGE_FILL name image_name [[,] FILLTYPES_MASK fill_types]
        part1, part2, part3, part4, part5, part6, part7, part8,
        image_vert_size, image_hor_size, image_mask, image_rotangle
        [[,] ADDITIONAL_DATA name1 = value1, name2 = value2, ...]
DEFINE LINE_TYPE parameters [[,] ADDITIONAL_DATA name1 = value1, name2 = value2, ...]
DEFINE SYMBOL_LINE parameters
        [[,] ADDITIONAL_DATA name1 = value1, name2 = value2, ...]
```

EXTERNAL FILE DEPENDENCE

FILE_DEPENDENCE

```
FILE_DEPENDENCE "name1" [, "name2", ...]
```

You can give a list of external files on which your GDL script depends on. File names should be constant strings.

All files specified here will be included in the archive project (like constant macro names used in CALL statements and constant picture names used in various GDL commands). The command works on this level only: if the specified files are library parts, their called macro files will not be included.

The command can be useful in cases when external files are referenced at custom places in the GDL script, for example: ADDITIONAL_DATA file parameters, data files in file operations.

NON-GEOMETRIC SCRIPTS

In addition to the 3D and 2D script windows that define the appearance of the GDL Object, further scripts are available for adding complementary information to it. These are the Properties Script used for quantity calculations, the Parameter Script that includes the list of possible values for different parameters, and the User Interface Script for creating a custom interface for parameter entry, Forward Migration Script and Backward Migration Scripts to define how to migrate an old instance forward to the actual element or how to migrate the element backward to an older one. The commands available for all these script types are detailed on the following pages.

THE PROPERTIES SCRIPT

Library parts have a GDL window reserved for the Properties script. This script allows you to make library part properties dependent on parameters, and, through a directive, define their place in the final component list. By using a few commands, it is possible to define in the script local descriptors and components. Descriptors and components from external databases can also be referenced. Code lengths cannot exceed 32 characters.

In the Properties script, you can use any GDL command that does not generate a shape.

DATABASE_SET

```
DATABASE_SET set_name [, descriptor_name, component_name, unit_name, key_name,
        criteria_name, list_set_name]
```

Database set definition or Database set selection. If this command is placed in a MASTER_GDL script, it will define a Database set containing Descriptor, Component, Unit, Key, Criteria and List Scheme files.

This Database set name can then be referenced from Properties Scripts using the same command with only the set_name parameter as a directive, by selecting the actual Database set that REF COMPONENTs and REF DESCRIPTORs refer to. The default Database set name is "Default Set", and will be used if no other set has been selected. The default Database set file names are: DESCDATA, COMPDATA, COMPUNIT, LISTKEY, LISTCRIT, LISTSET. All these names get translated in localized ARCHICAD versions.

Scripts can include any number of DATABASE_SET selections.

set_name: database set name.

descriptor_name: descriptor data file name.

component_name: component data file name.

unit_name: unit data file name.

key_name: key data file name.

`criteria_name:` criteria file name.

`list_set_name:` list Scheme file name.

DESCRIPTOR

`DESCRIPTOR` `name [, code, keycode]`

Local descriptor definition. Scripts can include any number of DESCRIPTORs.

`name:` can extend to more than one line. New lines can be defined by the character '\n' and tabulators by '\t'. Adding '\' to the end of a line allows you to continue the string in the next line without adding a new line. Inside the string, if the '\' character is doubled (\\), it will lose its control function and simply mean '\'. The length of the string (including the new line characters) cannot exceed 255 characters: additional characters will be simply cut by the compiler. If you need a longer text, use several DESCRIPTORs.

`code:` string, defines a code for the descriptor.

`keycode:` string, reference to a key in an external database.

The key will be assigned to the descriptor.

REF DESCRIPTOR

`REF DESCRIPTOR` `code [, keycode]`

Reference by code and keycode string to a descriptor in an external database.

COMPONENT

`COMPONENT` `name, quantity, unit [, proportional_with, code, keycode, unitcode]`

Local component definition. Scripts can include any number of COMPONENTs.

`name:` the name of the component (max. 128 characters).

`quantity:` a numeric expression.

`unit:` the string used for unit description.

`proportional_with:` a code between 1 and 6. When listing, the component quantity defined above will be automatically multiplied by a value calculated for the current listed element:

`1:` item,
`2:` length,
`3:` surface A,
`4:` surface B,
`5:` surface,

`6:` volume.

`code:` string, defines a code for the component.

`keycode:` string, reference to a key in an external database. The key will be assigned to the component.

`unitcode:` string, reference to a unit in an external database that controls the output format of the component quantity. This will replace the locally defined unit string.

REF COMPONENT

`REF COMPONENT` `code [, keycode [, numeric_expression]]`

Reference by code and keycode string to a component in an external database. The value to multiply by in the component database can be overwritten by the optional numeric expression specified here.

BINARYPROP

`BINARYPROP`

Binaryprop is a reference to the binary properties data (components and descriptors) defined in the library part in the Components and Descriptors sections.

DATABASE_SET directives have no effect on the binary data.

SURFACE3D

`SURFACE3D` `()`

The Surface 3D () function gives you the surface of the 3D shape of the library part.

Warning: If you place two or more shapes in the same location with the same parameters, this function will give you the total sum of all shapes' surfaces.

VOLUME3D

`VOLUME3D` `()`

The Volume 3D () function gives you the volume of the 3D shape of the library part.

Warning: If you place two or more shapes in the same location with the same parameters, this function will give you the total sum of all shapes' volumes.

POSITION

`POSITION` `position_keyword`

Effective only in the Component List.

Changes only the type of the element the following descriptors and components are associated to. If there are no such directives in the Properties script, descriptors and components will be listed with their default element types.

`position_keyword:` keywords are the following:

```
  WALLS
  COLUMNS
  BEAMS
  DOORS
  WINDOWS
  OBJECTS
  CEILS
  PITCHED_ROOFS
  LIGHTS
  HATCHES
  ROOMS
  MESHES
```

A directive remains valid for all succeeding DESCRIPTORs and COMPONENTs until the next directive is ascribed. A script can include any number of directives.

Example:

```
DESCRIPTOR "\tPainted box.\n\t Properties:\n\
\t\t - swinging doors\n\
\t\t - adjustable height\n\
\t\t - scratchproof"
REF DESCRIPTOR "0001"
s = SURFACE3D () !wardrobe surface
COMPONENT "glue", 1.5, "kg"
COMPONENT "handle", 2*c, "nb" !c number of doors
COMPONENT "paint", 0.5*s, "kg"
POSITION WALLS
REF COMPONENT "0002"
```

DRAWING

`DRAWING`

DRAWING: Refers to the drawing described in the 2D script of the same library part. Use it to place drawings in your bill of materials.

The Parameter Script

Parameter lists are sets of possible numerical or string values. They can be applied to the parameters as defined in the Parameter Script of the Library Part, in the ARCHICAD_LibraryMaster object or the MASTER_GDL script. Type compatibility is verified by the GDL compiler.

The Parameter Script will be interpreted each time a value list type parameter value is to be changed, and the possible values defined in the script will appear in a pop-up menu. For numerical parameters pop-up menu item values can be defined as strings using the VALUES{2} command.

VALUES

```
VALUES "parameter_name" [,]value_definition1 [, value_definition2, ...]
VALUES "fill_parameter_name" [[,] FILLTYPES_MASK fill_types,] value_definition1
   [, value_definition2, ...]
```

Defines a value restriction for a parameter. The command has a special syntax for fill type parameters. If used on an array parameter, the restriction will be applied to all items individually.

parameter_name: name of an existing parameter

fill_parameter_name: name of an existing fillpattern type parameter

fill_types:

fill_types = j_1 + 2*j_2 + 4*j_3, where each j can be 0 or 1.

j_1: cut fills,

j_2: cover fills,

j_3: drafting fills.

Can be used for fill-pattern type parameters only. The fill popup for this parameter will contain only those types of fills which are specified by the bits set to 1. Default is all fills (0).

value_definitioni: value definition, can be:

expression: numerical or string expression, or

CUSTOM: keyword, meaning that any custom value can be entered, or

RANGE: range definition, with optional step

```
RANGE left_delimiter[lower_limit], [upper_limit]right_delimiter [STEP step_start_value,
step_value]
```

left_delimiter: [, meaning >=, or (, meaning >; lower_limit: lower limit expression; upper_limit: upper limit expression; right_delimiter:], meaning <=, or), meaning <; step_start_value: starting value; step_value: step value.

VALUES{2}

```
VALUES{2} "parameter_name" [,]num_expression1, description1,
   [, num_expression2, description2, ...]
VALUES{2} "parameter_name" [,]num_values_array1, descriptions_array1
   [, num_values_array2, descriptions_array2, ...]
```

`parameter_name`: name of an existing angle, length, real, or integer type parameter

`num_expressioni`, `num_values_arrayi`: simple value definition for a numerical parameter, or array expression containing multiple numerical values. Available only for VALUES{2}

`descriptioni`, `descriptions_arrayi`: description string of the numerical value i, or array expression containing multiple description strings of the values defined by num_values_arrayi (array dimensions must match). Available only for VALUES{2}

Example 1: Simple value lists

```
VALUES "par1" 1, 2, 3
VALUES "par2" "a", "b"
VALUES "par3" 1, CUSTOM, SIN (30)
VALUES "par4" 4, RANGE(5, 10], 12, RANGE(,20] STEP 14.5, 0.5, CUSTOM
```

Example 2: Read all string values from a file for use in a value list

```
DIM sarray[]
! file in the library, containing parameter data
filename = "ProjectNotes.txt"
ch1 = OPEN ("text", filename, "MODE=RO, LIBRARY")
i = 1
j = 1
sarray[1] = ""
! collect all strings
DO
    n = INPUT (ch1, i, 1, var)
    IF n > 0 AND VARTYPE (var) = 2 THEN
        sarray[j] = var
        j = j + 1
    ENDIF
    i = i + 1
WHILE n > 0
CLOSE ch1
! parameter popup with strings read from the file
VALUES "RefNote" sarray
```

PARAMETERS

```
PARAMETERS name1 = expression1 [,
        name2 = expression2, ...,
        namen = expressionn]
```

namei: the name of the parameter.

expressioni: the new value of the parameter.

Using this command, the parameter values of a Library Part can be modified by the Parameter Script.

The modification will only be effective for the next interpretation. Commands in macros refer to the caller's parameters. If the parameter is a value list, the value chosen will be either an existing value, the custom value, or the first value from the value list.

In addition, the global string variable GLOB_MODPAR_NAME contains the name of the last user-modified parameter.

LOCK

```
LOCK "name1" [, "name2", ..., "namen"]
```

Locks the named parameter(s) in the settings dialog box. A locked parameter will appear grayed in the dialog box and its value cannot be modified by the user.

namen: string expression, name of the parameter to be locked.

```
LOCK ALL ["name1" [, "name2", ..., "namen"]]
```

Locks all parameters in the settings dialog box, except those listed after the ALL keyword.

HIDEPARAMETER

```
HIDEPARAMETER "name1" [, "name2", ..., "namen"]
```

Hides the named parameter(s) and its child parameters in the settings dialog box. A parameter hidden using this command in the parameter script will automatically disappear from the parameter list.

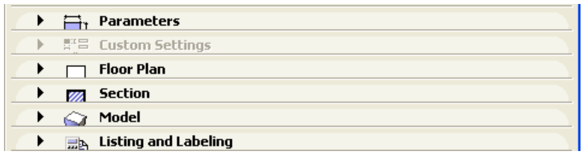
namen: string expression, name of the parameter to be hidden.

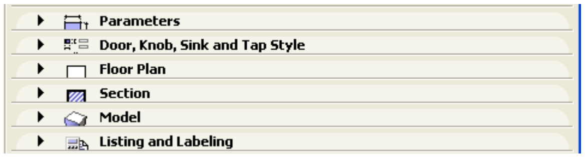
```
HIDEPARAMETER ALL ["name1" [, "name2", ..., "namen"]]
```

Hides all parameters and its child parameters in the settings dialog box, except those (and their children) listed after the ALL keyword.

THE USER INTERFACE SCRIPT

Using the following GDL commands, you can define a custom interface for a Library Part's Custom Settings panel in the settings dialog box. If you click the *Set as default* button in the Library Part editor, the custom interface will be used by default in the Object's (Door's, Window's, etc.) settings dialog box. Parameters with custom control are not hidden automatically on the original parameter list, but they can be hidden manually in the library part editor.





The origin of the coordinate system is in the top-left corner. Sizes and coordinate values are measured in pixels.

UI_DIALOG

UI_DIALOG `title [, size_x, size_y]`

Defines the title of the dialog box. The default title is 'Custom Settings'. Currently, the size of the available area is fixed at 444 x 296 pixels, and the size_x and size_y parameters are not used.

Restriction: The Interface Script should contain only one UI_DIALOG command.

UI_PAGE

UI_PAGE `page_number [, parent_id, page_title [, image]]`

Page directive, defines the page that the interface elements are placed on. Default page numbering starts at 1, but any starting number is usable. If there is no UI_PAGE command in the Interface Script, each element will be displayed on the first page by default. Moving between pages can be defined in different ways:

- The easiest way is to let ARCHICAD do it: in the object editor, press the "Hierarchical Pages" button in the User Interface Script window, and fill in the optional parameters of the UI_PAGE command. In this case the page_number of the page selected from the tree is passed to the library part through the "gs_ui_current_page" parameter. No need to set a value list for the paging parameter: ARCHICAD collects and sorts all valid page ID-s from the UI_PAGE command's parameters by pre-reading the object's ui script.
- Another method is to use two buttons created with the UI_NEXT and UI_PREV commands, placing them on every page to manipulate the value of the "gs_ui_current_page" parameter. See the UI_BUTTON command for more information.
- In case the new hierarchical page setup is not required, to create dynamic page handling, use the the UI_INFIELD{3} command. Set a value list for "gs_ui_current_page" parameter, and place a popup using its values on every page.

`page_number:` the page number, a positive integer. Following interface elements are placed on this page.

parent_id: positive integer, the parent id of the page. The special value -1 value means root parent. Only evaluated if "Hierarchical Pages" is set.

page_title: title string of the page, appears on the top of the page and the tree view popup of the pages. Only evaluated if "Hierarchical Pages" is set.

image: file name or index number of a picture stored in the library part. If specified and not empty or 0, this icon associated to the page is displayed on the top of the page and in tree view popup of the pages, next to the title. Only evaluated if "Hierarchical Pages" is set.

Warning: In the simple way of paging, any break of continuity in the page numbering forces the insertion of a new page without buttons, and therefore there will be no possibility to go to any other page from there. This restriction can be circumvented using the UI_CURRENT_PAGE command.

UI_CURRENT_PAGE

UI_CURRENT_PAGE `index`

Definition of the current tabpage to display.

Warning: Jumping to a non-existent page forces the insertion of a new page without buttons and controls, and therefore there is no possibility to go to any other page from there.

index: valid index of the UI_PAGE to display.

UI_BUTTON

UI_BUTTON `type, text, x, y [, width, height, id [, url]]`

Button definition on current page. Buttons can be used for various purposes: moving from page to page, opening a web page or performing some parameter-script defined action. Buttons can contain text.

type: type of the button as follows:

- `UI_PREV:` if pressed, the previous page is displayed,
- `UI_NEXT:` if pressed, the next page is displayed,
- `UI_FUNCTION:` if pressed, the GLOB_UI_BUTTON_ID global variable is set to the button id specified in expression,
- `UI_LINK:` if pressed, the URL in expression is opened in the default web browser,

text: the text that should appear on the button.

x, y: the position of the button.

width, height: width and height of the button in pixels. If not specified (for compatibility reasons) the default values are 60 pixels for width and 20 pixels for height.

id: an integer unique identifier.

url: a string containing a URL.

UI_PREV and UI_NEXT buttons are disabled if the previous/next page is not present. If these buttons are pushed, the gs_ui_current_page parameter of the library part is set to the index of the page to show - if there's a parameter with this name.

Example:

```
! UI script
UI_CURRENT_PAGE gs_ui_current_page
UI_BUTTON UI_FUNCTION, "Go to page 9", 200,150, 70,20, 3
UI_BUTTON UI_LINK, "Visit Website", 200,180, 100,20, 0,
        "http://www.graphisoft.com"
! parameter script
if GLOB_UI_BUTTON_ID = 3 then
        parameters gs_ui_current_page = 9, ...
endif
```

UI_PICT_BUTTON

```
UI_PICT_BUTTON type, text, picture_reference,
        x, y, width, height [, id [, url]]
```

Similar to the UI_BUTTON command. But this type of buttons can contain pictures.

picture_reference: file name or index number of the picture stored in the library part. The index 0 refers to the preview picture of the library part. Pixel transparency is allowed in the picture.

text: has no effect for picture buttons.

UI_SEPARATOR

```
UI_SEPARATOR x1, y1, x2, y2
```

Generates a separator rectangle. The rectangle becomes a single (vertical or horizontal) separator line if x1 = x2 or y1 = y2

x1, y1: upper left node coordinates (starting point coordinates of the line).

x2, y2: lower right node coordinates (endpoint coordinates of the line).

UI_GROUPBOX

```
UI_GROUPBOX text, x, y, width, height
```

A groupbox is a rectangular separator with caption text. It can be used to visually group logically related parameters.

text: the title of the groupbox.

x, y: the position of upper left corner.

width, height: width and height in pixels.

UI_PICT

UI_PICT `picture_reference, x, y [, width, height [, mask]]`

Picture element in the dialog box. The picture file must be located in one of the loaded libraries.

picture_reference: file name or index number of the picture stored in the library part. The index 0 refers to the preview picture of the library part.

x, y: position of the top left corner of the picture.

width, height: optional width and height in pixels; by default, the picture's original width and height values will be used.

mask: alpha + distortion.

See the PICTURE command for full explanation.

UI_STYLE

UI_STYLE `fontsize, face_code`

All the UI_OUTFIELDs and UI_INFIELDs generated after this keyword will represent this style until the next UI_STYLE statement.

fontsize: one of the following font size values:

`0:` small,
`1:` extra small,
`2:` large.

face_code: similar to the DEFINE STYLE command, but the values cannot be used in combination.

`0:` normal,
`1:` bold,
`2:` italic,
`4:` underline.

UI_OUTFIELD

UI_OUTFIELD `expression, x, y [, width, height [, flags]]`

Generates a static text.

expression: numerical or string expression.

x, y: position of the text block's top left corner.

width, height: width and height of the text box. If omitted, the text box will wrap around the text as tight as possible for the given font.

flags:

`flags = j1 + 2*j2 + 4*j3`, where each j can be 0 or 1.

j_1: horizontal alignment (with j2),

j_2: horizontal alignment (with j1):

`j1 = 0, j2 = 0`: Aligns to the left edge (default),

`j1 = 1, j2 = 0`: Aligns to the right edge,

`j1 = 0, j2 = 1`: Aligns to the center,

`j1 = 1, j2 = 1`: Not used,

j_3: grayed text.

UI_INFIELD

```
UI_INFIELD "name", x, y, width, height [,
        method, picture_name,
        images_number,
        rows_number, cell_x, cell_y,
        image_x, image_y,
        expression_image1, text1,
        ...
        expression_imagen, textn]
```

UI_INFIELD{2}

```
UI_INFIELD{2} name, x, y, width, height [,
        method, picture_name,
        images_number,
        rows_number, cell_x, cell_y,
        image_x, image_y,
        expression_image1, text1,
        ...
        expression_imagen, textn]
```

UI_INFIELD{3}

```
UI_INFIELD{3} name, x, y, width, height [,
        method, picture_name,
        images_number,
        rows_number, cell_x, cell_y,
        image_x, image_y,
        expression_image1, text1, value_definition1,
        ...
        [picIdxArray, textArray, valuesArray,
        ...]
        expression_imagen, textn, value_definitionn]
```

UI_INFIELD{4}

```
UI_INFIELD{4} "name", x, y, width, height [,
        method, picture_name,
        images_number,
        rows_number, cell_x, cell_y,
        image_x, image_y,
        expression_image1, text1, value_definition1,
        ...
        [picIdxArray, textArray, valuesArray,
        ...]
        expression_imagen, textn, value_definitionn]
```

Generates an edit text or a pop-up menu for the parameter input. A pop-up is generated if the parameter type is value list, material, fill, line type or pencolor.

If the optional parameters of the command are present, value lists can be alternatively displayed as thumbnail view fields. Different thumbnail control types are available. They display the specified images and associated texts and allow the selection of one single item at a time, just like in a pop-up menu.

In the version 1 and 2 infield, the thumbnail items and the value list items are associated by indices.

The version 3 and version 4 infield defines value association which binds the thumbnail items to value list items of the associated parameter. If a value defined in a thumbnail item isn't present in the parameter's value list, it won't be displayed in the control. Identical sized arrays can be used for lines of definition as well.

The Interface Script is rebuilt with the new value after any parameter is modified.

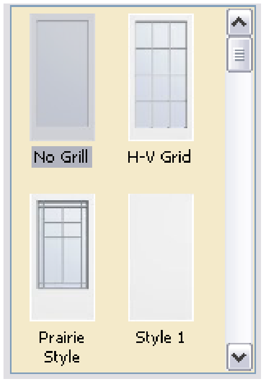
`name:` parameter name as string expression (all 4 command versions), with parameter name option for UI_INFIELD{2} and UI_INFIELD{3}, and parameter name as text array value option for UI_INFIELD{4}.

x, y: the position of the edit text, pop-up or control.

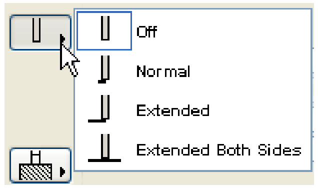
width, height: width and height in pixels.

method: the type of the control.

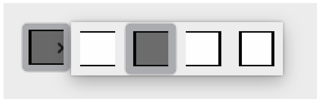
1: List view control.



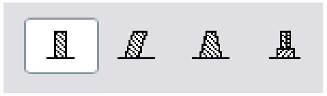
2: Popup menu control.



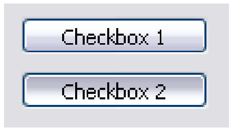
3: Popup icon radio control (arrow on picture).



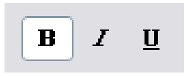
4: Push icon radio control.



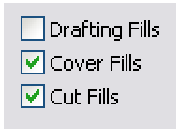
`5`: Pushbutton with text.



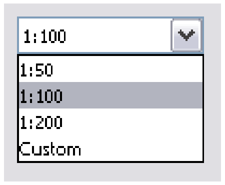
`6`: Pushbutton with picture.



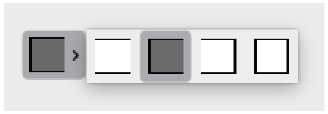
`7`: Checkbox with text.



`8`: Popup list with text.



`9`: Popup icon radio control (arrow next to picture).



`picture_name`: name of the common image file containing a matrix of concatenated images, or empty string.

`images_number`: number of images in the matrix, for boolean parameters it can be 0 or 2.

`rows_number`: number of rows of the matrix.

`cell_x, cell_y`: width and height of a cell within the thumbnail view field, including image and text.

`image_x, image_y`: width and height of the image in the cell.

`expression_imagei:` index of image number i in the matrix, or individual file name. If a common image file name was specified, indices must be used here. Combination of indices and individual file names does not work.

`texti:` text in cell number i.

`value_definitioni:` value definition which matches the cell with a value list item by value:
`expression:` numerical or string expression, or
`CUSTOM:` keyword, meaning that any custom value can be entered.

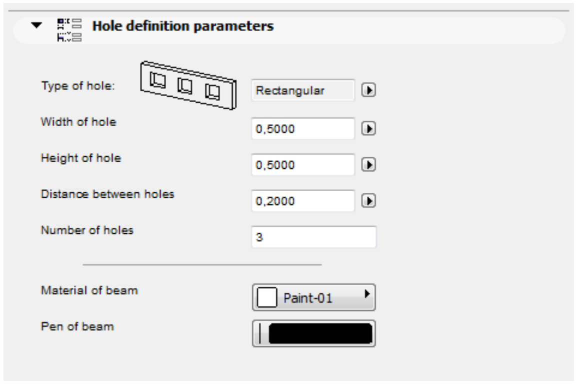
`picIdxArray:` Dynamic array of picture names (strings) or indexes (integers) in cells. Do not use mixed types in array

`textArray:` Dynamic array of texts in cells

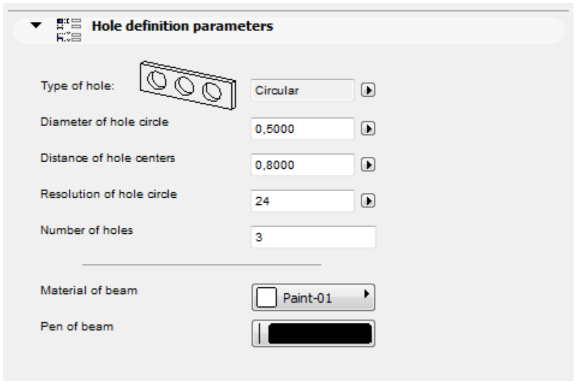
`valueArray:` Dynamic array of parameter values in cells

Example 1:

```
IF c THEN
    UI_DIALOG "Hole definition parameters"
    UI_OUTFIELD "Type of hole:",15,40,180,20
    UI_INFIELD "D",190,40,105,20
    IF d="Rectangular" THEN
        UI_PICT "rect.pict",110,33,60,30
        UI_OUTFIELD "Width of hole",15,70,180,20
        UI_INFIELD "E", 190,70,105,20
        UI_OUTFIELD "Height of hole",15,100,180,20
        UI_INFIELD "F", 190,100,105,20
        UI_OUTFIELD "Distance between holes",15,130,180,20
        UI_INFIELD "G", 190,130,105,20
    ELSE
        UI_PICT "circle.pict",110,33,60,30
        UI_OUTFIELD "Diameter of hole circle",15,70,180,20
        UI_INFIELD "J", 190,70,105,20
        UI_OUTFIELD "Distance of hole centers", 15,100,180,20
        UI_INFIELD "K", 190,100,105,20
        UI_OUTFIELD "Resolution of hole circle", 15,130,180,20
        UI_INFIELD "M", 190,130,105,20
    ENDIF
    UI_OUTFIELD "Number of holes",15,160,180,20
    UI_INFIELD "I", 190,160,105,20
ENDIF
UI_SEPARATOR 50,195,250,195
UI_OUTFIELD "Material of beam", 15,210,180,20
UI_INFIELD "MAT", 190,210,105,20
UI_OUTFIELD "Pen of beam", 15,240,180,20
UI_INFIELD "P", 190,240,105,20
```


Hole definition parameters

Type of hole:	Rectangular
Width of hole	0,5000
Height of hole	0,5000
Distance between holes	0,2000
Number of holes	3
Material of beam	Paint-01
Pen of beam	


Hole definition parameters

Type of hole:	Circular
Diameter of hole circle	0,5000
Distance of hole centers	0,8000
Resolution of hole circle	24
Number of holes	3
Material of beam	Paint-01
Pen of beam	

Example 2:

```
! Parameter Script:
VALUES "myParameter" "Two", "Three", "Five", CUSTOM

! Interface Script:
px = 80
py = 60
cx = px + 3
cy = py + 25

UI_INFIELD{3} "myParameter", 10, 10, 4 * cx + 21, cy + 5,
        1, "myPicture", 6,
        1, cx, cy, px, py,
        1, "1 - one", "One",
        2, "2 - two", "Two",
        3, "3 - three", "Three",
        4, "4 - four", "Four",
        5, "5 - five", "Five",
        6, "custom value", CUSTOM
```

Example 3:

```
! Parameter Script:
VALUES "myParameter" "Two", "Three", "Five", CUSTOM

! Interface Script:
px = 80
py = 60
cx = px + 3
cy = py + 25

paramNameVar = "myParameter"
UI_INFIELD{4} paramNameVar, 10, 10, 4 * cx + 21, cy + 5,
        1, "myPicture", 6,
        1, cx, cy, px, py,
        1, "1 - one", "One",
        2, "2 - two", "Two",
        3, "3 - three", "Three",
        4, "4 - four", "Four",
        5, "5 - five", "Five",
        6, "custom value", CUSTOM
```

Example 4:

```
! Master Script
dim picIdxValuesUI[]
dim textValuesUI[]
dim parameterValues[]

if myTypeParameter = 1 then
    picIdxValuesUI[1] = 6
    picIdxValuesUI[2] = 7
    picIdxValuesUI[3] = 8

    textValuesUI[1] = "6 - six"
    textValuesUI[2] = "7 - seven"
    textValuesUI[3] = "8 - eight"

    parameterValues[1] = "Six"
    parameterValues[2] = "Seven"
    parameterValues[3] = "Eight"
else
    picIdxValuesUI[1] = 6
    picIdxValuesUI[2] = 7

    textValuesUI[1] = "6 - six"
    textValuesUI[2] = "7 - seven"

    parameterValues[1] = "Six"
    parameterValues[2] = "Seven"
endif
```

```
! Parameter Script:
VALUES "myTypeParameter" 1, 2
VALUES "myStringParameter" "Two", "Three", "Five", parameterValues, CUSTOM

! Interface Script:
px = 80
py = 60
cx = px + 3
cy = py + 25

paramNameVar = "myStringParameter"
UI_INFIELD{4} paramNameVar, 10, 10, 4 * cx + 21, cy + 5,
        1, "myPicture", 6,
        1, cx, cy, px, py,
        1, "1 - one", "One",
        2, "2 - two", "Two",
        3, "3 - three", "Three",
        4, "4 - four", "Four",
        5, "5 - five", "Five",
        picIdxValuesUI, textValuesUI, parameterValues,
        9, "custom value", CUSTOM
```

UI_CUSTOM_POPUP_INFIELD

```
UI_CUSTOM_POPUP_INFIELD "name", x, y, width, height,
        storeHiddenId, treeDepth,
        groupingMethod, selectedValDescription,
        value1, value2, valuesArray1, .... valuen, valuesArrayn
```

UI_CUSTOM_POPUP_INFIELD{2}

```
UI_CUSTOM_POPUP_INFIELD{2} name, x, y, width, height,
        storeHiddenId, treeDepth,
        groupingMethod, selectedValDescription,
        value1, value2, valuesArray1, .... valuen, valuesArrayn
```

Compatibility: introduced in ARCHICAD 20.

Generates a popup for a value list of a parameter defined in the User Interface script to avoid using the Parameter script.

Suitable for lists which can not be requested in Parameter script. *For the parameter script restrictions see the section called "REQUEST Options".*

`name:` parameter name as string expression for UI_CUSTOM_POPUP_INFIELD or parameter name with optional actual index values if array for UI_CUSTOM_POPUP_INFIELD{2}.

`x, y:` the position of the edit text, pop-up.

`width, height:` width and height in pixels.

`storeHiddenId, treeDepth:` to set up automatic or manual trees.

`storeHiddenId = 0, treeDepth = 0:` works only with array parameters.

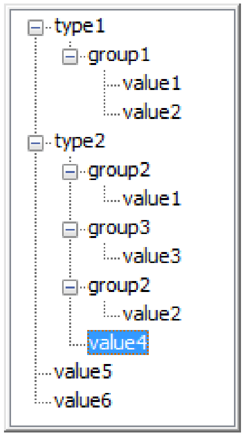
The "treeDepth" parameter is set automatically by the second dimension (number of columns) of the array.

`storeHiddenId = 1, treeDepth > 0:` works only with single parameters.

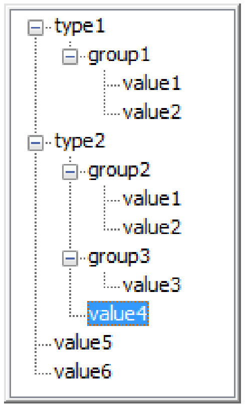
There must be **n * (1 + treeDepth)** values defined (first one for the stored ID and the rest for defining the custom tree).

`groupingMethod:` grouping method for sorting the tree.

`1:` does not sort the groups and values under the same parent.



`2:` sorts the groups and values under the same parent.

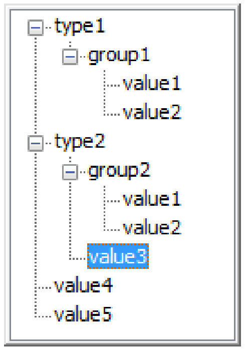


selectedValDescription: the text written in the field, if empty string the text will be the stored ID of the selected item.

valuei, valuesArrayi: define tree values one-by-one and/or with a one dimension array.

Example:

```
UI_CUSTOM_POPUP_INFIELD "stParameterName", x, y, width, height,
    1, 3, 2, "",    ! storeHiddenId, treeDepth, groupingMethod, selectedValDescription
    "hiddenID1",    "type1",    "group1",   "value1",
    "hiddenID2",    "type1",    "group1",   "value2",
    "hiddenID3",    "type2",    "group2",   "value1",
    "hiddenID4",    "type2",    "group2",   "value2",
    "hiddenID5",    "type2",    "",         "value3",
    "hiddenID6",    "",         "",         "value4",
    "hiddenID7",    "",         "",         "value5"
```



UI_RADIOBUTTON

UI_RADIOBUTTON `name, value, text, x, y, width, height`

UI_RADIOBUTTON{2}

UI_RADIOBUTTON{2} `"name", value, text, x, y, width, height`

Version {2} compatibility: introduced in ARCHICAD 20.

Generates a radio button of a radio button group. Radio button groups are defined by the parameter name. Items in the same group are mutually exclusive.

name: parameter name or name as string expression for UI_RADIOBUTTON and parameter name as string expression (or text array indexed value) for UI_RADIOBUTTON{2}.

value: parameter is set to this value if this radio button is set.

text: this text is displayed beside the radio button.

x, y: the position of the radio control.

width, height: width and height in pixels.

Example:

```
UI_RADIOBUTTON "ceilingPlan", 0, `Floor Plan`, 10, 140, 100, 20
UI_RADIOBUTTON "ceilingPlan", 1, `Ceiling Plan`, 10, 160, 100, 20
```

UI_LISTFIELD

`UI_LISTFIELD` `fieldID, x, y, width, height [, iconFlag [, description_header [, value_header]]]`

Generates a control for the parameter input as a scrollable list containing an arbitrary number of rows, with the following columns: icon, description and input field for the parameter value. Lines of the list can be defined with the UI_LISTITEM command. UI_LISTFIELD and UI_LISTITEM definitions can be scripted in an arbitrary order. Empty listfields (with no list items) are not displayed.

`fieldID:` the unique identifier of the listfield. This ID also used in the UI_LISTITEM commands specifies the listfield the listitems belong to. Duplicates within a user interface script are not allowed.

`x, y:` position of the listfield's top left corner.

`width, height:` width and height in pixels.

`iconFlag:`

`iconFlag = 0`**:** icon column is not generated for this listfield.

`iconFlag = 1`**:** icon column is generated for this listfield (default value if not specified).

If the Custom Settings panel has only one control and this control is a listfield, the x, y, width, height parameters have no effect. In this case the width of the listfield equals to the width of the Custom Settings panel.

`description_header:` the title of the Description column.

`value_header:` the title of the Value column.

If both description_header and value_header are empty strings or not specified, the listfield is generated without a header. If the strings contain at least one space, the listfield is generated with an empty header.

UI_LISTITEM

`UI_LISTITEM` `itemID, fieldID, "name" [, childFlag [, image [, paramDesc]]]`

UI_LISTITEM{2}

`UI_LISTITEM{2}` `itemID, fieldID, name [, childFlag [, image [, paramDesc]]]`

Appends a listitem to the listfield defined by the fieldID parameter.

`itemID:` the unique identifier of the listitem. Listitems can be scripted in an arbitrary order and are sorted by itemID. Duplicate listitem IDs within a listfield are not allowed.

`fieldID:` the unique identifier of the listfield containing this listitem.

`name:` parameter name as string expression for UI_LISTITEM or parameter name with optional actual index values if array for UI_LISTITEM{2}.

`childFlag:`

`childFlag = 0:` the listitem is a groupitem (default value if not specified).

`childFlag = 1:` the listitem is a childitem. The parent item is the first groupitem above.

`image:` file name or index number of the picture stored in the library part. If valid, it is displayed as an icon in the first column of the listfield in the associated listitem's row.

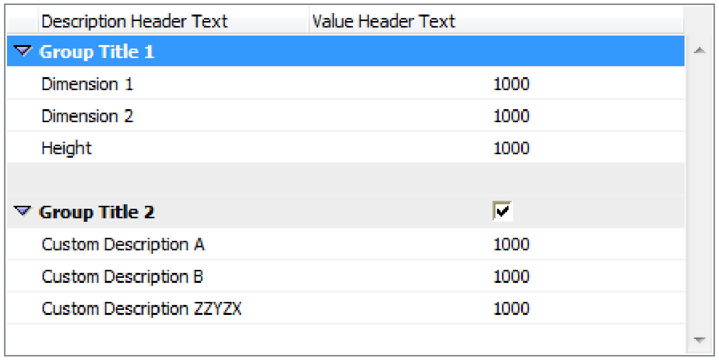
`paramDesc:` the visible name of the listitem in the Description column. If left empty, the description is automatically filled up from the parameter list description of the Library Part. If there is no description there, the name of the parameter is displayed instead.

If "name" string is empty, the listitem is a group with bold fonttype. If both "name" string and paramDesc are empty, the listitem is a separator. The HIDEPARAMETER command is ineffective for list items, the script should not add the item instead of using it. The LOCK command can be used and it is effective for list items.

For a listfield it is recommended to define different itemIDs for different parameters, groups and separators.

Example:

```
! List with header without icon column

ui_listfield 1, 10, 35, 432, 220, 0, "Description Header Text", "Value Header Text"

ui_listitem 1, 1, "", 0, "", "Group Title 1" ! Group Line
ui_listitem 2, 1, "A", 1
ui_listitem 3, 1, "B", 1
ui_listitem 4, 1, "ZZYZX", 1

ui_listitem 5, 1, "" !separator
ui_listitem 6, 1, "AC_show2DHotspotsIn3D", 0, "", "Group Title 2" ! Group Parameter Line
ui_listitem 7, 1, "A", 1, "", "Custom Description A"
ui_listitem 8, 1, "B", 1, "", "Custom Description B"
ui_listitem 9, 1, "ZZYZX", 1, "", "Custom Description ZZYZX"
```



Description Header Text	Value Header Text
Group Title 1	
Dimension 1	1000
Dimension 2	1000
Height	1000
Group Title 2	✓
Custom Description A	1000
Custom Description B	1000
Custom Description ZZYZX	1000

UI_CUSTOM_POPUP_LISTITEM

```
UI_CUSTOM_POPUP_LISTITEM itemID, fieldID, "name", childFlag, image, paramDesc,
storeHiddenId, treeDepth,
groupingMethod, selectedValDescription,
value1, value2, valuesArray1, .... valuen, valuesArrayn
```

UI_CUSTOM_POPUP_LISTITEM{2}

```
UI_CUSTOM_POPUP_LISTITEM{2} itemID, fieldID, name, childFlag, image, paramDesc,
storeHiddenId, treeDepth,
groupingMethod, selectedValDescription,
value1, value2, valuesArray1, .... valuen, valuesArrayn
```

Compatibility: introduced in ARCHICAD 20.

Similar to the "UI_CUSTOM_POPUP_INFIELD" and the "UI_CUSTOM_POPUP_INFIELD{2}"

Generates a listitem with popup for a value list of a parameter defined in the User Interface script to avoid using the Parameter script.

Suitable for lists which can not be requested in Parameter script. *For the parameter script restrictions see the section called "REQUEST Options".*

itemID: the unique identifier of the listitem. Listitems can be scripted in an arbitrary order and are sorted by itemID. Duplicate listitem IDs within a listfield are not allowed.

`fieldID:` the unique identifier of the listfield containing this listitem.

`name:` parameter name as string expression for UI_CUSTOM_POPUP_LISTITEM or parameter name with optional actual index values if array for UI_CUSTOM_POPUP_LISTITEM{2}.

`childFlag:`

`childFlag = 0:` the listitem is a groupitem (default value if not specified).

`childFlag = 1:` the listitem is a childitem. The parent item is the first groupitem above.

`image:` file name or index number of the picture stored in the library part. If valid, it is displayed as an icon in the first column of the listfield in the associated listitem's row.

`paramDesc:` the visible name of the listitem in the Description column. If left empty, the description is automatically filled up from the parameter list description of the Library Part. If there is no description there, the name of the parameter is displayed instead.

`storeHiddenId, treeDepth:` to set up automatic or manual trees.

`storeHiddenId = 0, treeDepth = 0:` works only with array parameters.

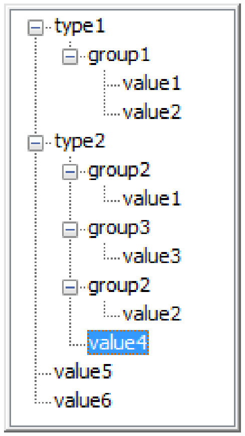
The "treeDepth" parameter is set automatically by the second dimension (number of columns) of the array.

`storeHiddenId = 1, treeDepth > 0:` works only with single parameters.

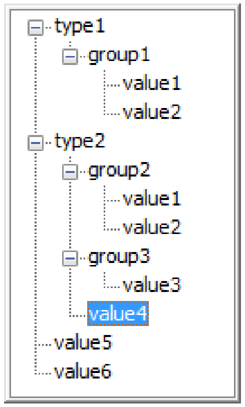
There must be **n * (1 + treeDepth)** values defined (first one for the stored ID and the rest for defining the custom tree).

`groupingMethod:` grouping method for sorting the tree.

`1:` does not sort the groups and values under the same parent.



`2:` sorts the groups and values under the same parent.

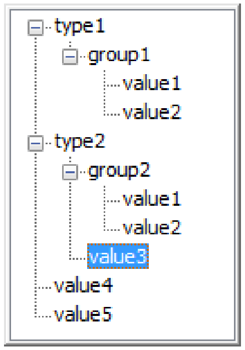


`selectedValDescription:` the text written in the field, if empty string the text will be the stored ID of the selected item.

`valuei, valuesArrayi:` define tree values one-by-one and/or with a one dimension array.

Example:

```
UI_CUSTOM_POPUP_LISTITEM itemID, fieldID, "stParameterName", 0, "", "",
    1, 3, 2, "",    ! storeHiddenId, treeDepth, groupingMethod, selectedValDescription
    "hiddenID1",    "type1",     "group1",    "value1",
    "hiddenID2",    "type1",     "group1",    "value2",
    "hiddenID3",    "type2",     "group2",    "value1",
    "hiddenID4",    "type2",     "group2",    "value2",
    "hiddenID5",    "type2",     "",          "value3",
    "hiddenID6",    "",          "",          "value4",
    "hiddenID7",    "",          "",          "value5"
```



UI_TOOLTIP

```
UI_BUTTON type, text, x, y, width, height [, id [, url]] [ UI_TOOLTIP tooltiptext ]
UI_PICT_BUTTON type, text, picture_reference,
        x, y, width, height [, id [, url]] [ UI_TOOLTIP tooltiptext ]
UI_INFIELD "name", x, y, width, height [, extra parameters ... ]
        [ UI_TOOLTIP tooltiptext ]
UI_INFIELD{2} name, x, y, width, height [, extra parameters ... ]
        [ UI_TOOLTIP tooltiptext ]
UI_INFIELD{3} name, x, y, width, height [, extra parameters ... ]
        [ UI_TOOLTIP tooltiptext ]
UI_INFIELD{4} "name", x, y, width, height [, extra parameters ... ]
        [ UI_TOOLTIP tooltiptext ]
```

```
UI_CUSTOM_POPUP_INFIELD "name", x, y, width, height , extra parameters ...
        [ UI_TOOLTIP tooltiptext ]
UI_CUSTOM_POPUP_INFIELD{2} name, x, y, width, height , extra parameters ...
        [ UI_TOOLTIP tooltiptext ]
UI_RADIOBUTTON name, value, text, x, y, width, height [ UI_TOOLTIP tooltiptext ]
UI_OUTFIELD expression, x, y, width, height [, flags] [ UI_TOOLTIP tooltiptext ]
UI_PICT expression, x, y [, width, height [, mask]] [ UI_TOOLTIP tooltiptext ]
UI_LISTFIELD fieldID, x, y, width, height [, iconFlag [, description_header [, value_header]]]
        [ UI_TOOLTIP tooltiptext ]
UI_LISTITEM itemID, fieldID, "name" [, childFlag [, image [, paramDesc]]]
        [ UI_TOOLTIP tooltiptext ]
UI_LISTITEM{2} itemID, fieldID, name [, childFlag [, image [, paramDesc]]]
        [ UI_TOOLTIP tooltiptext ]
UI_CUSTOM_POPUP_LISTITEM itemID, fieldID, "name", childFlag , image , paramDesc,
        extra parameters ...
        [ UI_TOOLTIP tooltiptext ]
UI_CUSTOM_POPUP_LISTITEM{2} itemID, fieldID, name, childFlag , image , paramDesc,
        extra parameters ...
        [ UI_TOOLTIP tooltiptext ]
```

Defines the tooltip for the control on the user interface page. Tooltips are available for buttons, infields, outfields, listfields, listitems and pictures if they are not disabled by the user in the running context (e.g., in the Help menu of ARCHICAD).

The listfield's tooltip appears in all included listitems if an item has none declared. The own tooltip of the listitem will take effect over the tooltip of the listfield (if existing) inline.

tooltiptext: the text to display as tooltip for the control.

UI_COLORPICKER

```
UI_COLORPICKER "redParamName", "greenParamName", "blueParamName", x0, y0 [, width [, height]]
```

UI_COLORPICKER{2}

```
UI_COLORPICKER{2} redParamName, greenParamName, blueParamName, x0, y0 [, width [, height]]
```

Color picker dialog to set the r, g, b components of a color and store them into the given parameters. These values can later be used in the LIGHT command.

redParamName, greenParamName, blueParamName: parameter names as string expression for UI_COLORPICKER or parameter names with optional actual index values if array for UI_COLORPICKER{2}

x0, y0: position of the color picker's top left corner.

width, height: width and height in pixels.

UI_SLIDER

UI_SLIDER `"name", x0, y0, width, height [, nSegments [, sliderStyle]]`

UI_SLIDER{2}

UI_SLIDER{2} `name, x0, y0, width, height [, nSegments [, sliderStyle]]`

Generates a slider control for an integer parameter defined with a range. For integer parameters with undefined range lower and upper limit values are -32768 (minimum signed short) and 32767 (maximum signed short).

name: parameter name as string expression parameter or name with optional actual index values for UI_SLIDER{2}.

x0, y0: position of the slider.

width, height: slider width and height in pixels. If the width > height the slider is horizontal, in the opposite case it is vertical.

nSegments: optional number of segments on the slider. If 0, no segments are displayed, if omitted or negative, the number of segments are calculated from the range upper and lower limit values and the step defined for the parameter.

sliderStyle: optional slider style (default is 0)

- `0:` slider points to the bottom (horizontal sliders) or to the right (vertical sliders).
- `1:` slider points to the top (horizontal sliders) or to the left (vertical sliders).

The Forward Migration Script

If an element is changed completely in a newer library, compatibility can be maintained by defining the migration logic. For more detailed information, please take a look at the section called “Forward Migration script”.

Example:

```
actualGUID = FROM_GUID

! ==============================================================================
! Subroutines
! ==============================================================================

    _startID    = "AAAA-AAAA-...AAA"
    _endID      = "BBBB-BBBB-...BBB"
gosub "migrationstepname_FWM"

! ==============================================================================
! Set Migration GUID
! ==============================================================================

setmigrationguid actualGUID

! ==============================================================================
end ! end ! end ! end ! end ! end ! end ! end ! end ! end ! end ! end ! end ! en
! ==============================================================================

! ==============================================================================
! migrationstepname
! ==============================================================================
"migrationstepname_FWM":
    if actualGuid = _startID then
        newParameter = oldParameter
        parameters newParameter = newParameter
        actualGuid = _endID
    endif
return
```

`FROM_GUID` is the global variable holding the main ID of the original object which the migration is run on.
In case the script succeeds, the instance gets substituted by the new element with the updated parameters.

SETMIGRATIONGUID

`SETMIGRATIONGUID` `guid`

The command tells the running environment, which element will be the matching migration element for the current object. If the returned ID belongs to the current element, the migration of the object gets complete.

STORED_PAR_VALUE

STORED_PAR_VALUE `("oldparname", outputvalue)`

Retrieves the value of a parameter, which is present in the migrated object, and present or deleted in the new version object. This command form is suggested for those parameters present in the new object as well. To get the value of an old array Parameter, the outputvalue parameter must be initialized as an array (with the dim command).

`oldparname:` string expression, name of the parameter in the old parameter list.

`outputvalue:` output variable to store the value of the parameter.

Return value: 1 on success, 0 otherwise (for example, if there is no parameter with that name in the parameter list of the old object). During checking the script the return value is always 0, because the old Parameters section is not known.

DELETED_PAR_VALUE

DELETED_PAR_VALUE `("oldparname", outputvalue)`

Retrieves the value of a parameter, which is present in the migrated object, and present or deleted in the new version object. This command form is suggested for those parameters deleted from the new object. To get the value of an old array Parameter, the outputvalue parameter must be initialized as an array (with the dim command).

`oldparname:` string expression, name of the parameter in the old parameter list.

`outputvalue:` output variable to store the value of the parameter.

Return value: 1 on success, 0 otherwise (for example, if there is no parameter with that name in the parameter list of the old object). During checking the script the return value is always 0, because the old Parameters section is not known.

THE BACKWARD MIGRATION SCRIPT

Via the Backward Migration script you can define the backward conversion logic converting new object instances to older ones. For more and detailed information, please take a look at the section called “Backward Migration script”.

Example:

```
targetGUID = TO_GUID

! ==============================================================================
! Subroutines
! ==============================================================================

gosub "migrationstepname_BWM"

! ==============================================================================
! Set Migration GUID
! ==============================================================================

setmigrationguid targetGUID

! ==============================================================================
end ! end ! end ! end ! end ! end ! end ! end ! end ! end ! end ! end ! end ! en
! ==============================================================================


! ==============================================================================
! migrationstepname
! ==============================================================================
"migrationstepname _BWM":
    if targetGUID # "" then
        bMigrationSuccess = 1
        if bMigrationSuccess = 1 then
            oldParameter = newParameter
            parameters oldParameter = oldParameter
        else
            targetGuid = ""
        endif
    endif
return
```

`TO_GUID` is the global variable holding the main ID of the target element in the conversion.
Use the SETMIGRATIONGUID command for setting targetGUID.

NEWPARAMETER

`NEWPARAMETER` `"name", "type" [, dim1 [, dim2]]`

Adds a new parameter to the parameters of a library part in the Backward Migration Script. The parameter creation happens only after the full interpretation of the script. If a parameter with the given name already exists in the parameters list, an error occurs.

`name:` string expression, name of the parameter to be created.

`type:` string expression, type of the parameter. Possible values are:

```
Integer
Length
Angle
RealNum
LightSwitch
ColorRGB
Intensity
LineType
Material
FillPattern
PenColor
String
Boolean
```

`dim1, dim2:` dim1 is the first dimension of the parameter, 0 if not set. dim2 is the second dimension of the parameter, 0 if not set.

`dim1 = 0, dim2 = 0:` the parameter is a scalar parameter,
`dim1 > 0, dim2 = 0:` the parameter is a 1 dimensional array,
`dim1 > 0, dim2 > 0:` the parameter is a 2 dimensional array,

Restriction of parameters:

```
If dim2 > 0, then dim1 > 0.
```

EXPRESSIONS AND FUNCTIONS

All parameters of GDL shapes can be the result of calculations. For example, you can define that the height of the cylinder is five times the radius of the cylinder, or prior to defining a cube, you can move the coordinate system in each direction by half the size of the cube, in order to have the initial origin in the center of the cube rather than in its lower left corner. To define these calculations, GDL offers a large number of mathematical tools: expressions, operators and functions.

EXPRESSIONS

You can write compound expressions in GDL statements. Expressions can be of numerical and string type. They are constants, variables, parameters or function calls and any combination of these in operators. Round bracket pairs (( )) (precedence 1) are used to override the default precedence of the operators.

Simple type variables can be given numerical and string values, even in the same script, and can be used in numerical and string type expressions respectively. Operations resulting in strings CANNOT be used directly as macro names in macro calls, or as attribute names in material, fill, line type or style definitions. Variables given a string value will be treated as such and can be used wherever string values are required. If later in the script the same variable is given a numerical value, it will be usable in numerical expressions only until it is given a string value again. Where possible, in the precompilation process the type of the expressions is checked.

GDL supports one and two dimensional arrays. Variables become arrays after a declaration statement, in which their dimensions are specified.

DIM

```
DIM var1[dim_1], var2[dim_1][dim_2], var3[ ],
        var4[ ][ ], var5[dim_1][ ],
        var5[ ][dim_2]
```

After the DIM keyword there can be any number of variable names separated by commas. var1, var2, ... are the array names, while the numbers between the brackets represent the dimensions of the array (numerical constants). Variable expressions cannot be used as dimensions. If they are missing, the array is declared to be dynamic (one or both dimensions).

Library part parameters can also be arrays. Their actual dimensions are specified in the library part dialog. Parameter arrays do not have to be declared in the script and they are dynamic by default. When referencing the library part using a CALL statement, the actual values of an array parameter can be an array with arbitrary dimensions.

The elements of the arrays can be referenced anywhere in the script but if they are variables, only after the declaration.

```
var1[num_expr] or var1
var2[num_expr1][num_expr2] or var2[num_expr1] or var2
```

Writing the array name without actual indices means referencing the whole array (or a line of a two-dimensional array) which is accepted in some cases (CALL, PRINT, LET, PUT, REQUEST, INPUT, OUTPUT, SPLIT statements). For dynamic arrays there is no limitation for the actual index value. During the interpretation, when a non-existing dynamic array element is given a value, the necessary quantity of memory is allocated and the missing elements are all set to 0 (numerical).

Warning! This may cause an unexpected out of memory error in some cases. Each index - even of a possibly wrong, huge value - is considered valid, since the interpreter is unable to detect the error condition. A non-existing dynamic array element is 0 (numerical).

Arrays having a fixed dimension are checked for the validity of the actual index on the fixed dimension. Array variables with fixed length cannot accept dynamic array values in assignments. However, dynamic arrays that are given whole array values will take on those values. This also applies to some statements where whole array references can be used as return parameters. (REQUEST, INPUT, SPLIT).

Array elements can be used in any numerical or string expression. They can be given string or numerical values.

Indices start with 1, and any numerical expression can be used as an index.

Array elements can be of different simple types (numerical, string, group). The type of the whole array (main type) is the type of its first element ([1] or [1][1]). Parameter and global variable arrays cannot be of mixed type.

VARDIM1

VARDIM1 (expr)

VARDIM2

VARDIM2 (expr)

These functions return as integers the actual dimension values for the (array) expression specified as a parameter. They must be used if you want to handle correctly all actual elements of a dynamic array or an array parameter. If no element of a dynamic array was previously set, the return value is 0. For one-dimensional arrays VARDIM2 returns 0.

Example 1: Examples for numeric expressions:

```
Z
5.5
(+15)
-x
a*(b+c)
SIN(x+y)*z
a+r*COS(i*d)
5' 4"
SQR (x^2 + y^2) / (1 - d)
a + b * sin (alpha)
height * width
```

Example 2: Examples for string expressions:

```
"Constant string"
name + STR ("%m", i) + "." + ext
string_param <> "Mode 1"
```

Example 3: Examples for expressions using array values:

```
DIM tab[5], tab2[3][4] ! declaration
tab[1] + tab[2]
tab2[2][3] + A
PRINT tab
DIM f1 [5], v1[], v2[][]
v1[3] = 3     ! v1[1] = 0, v1[2] = 0, array of 3 elements
v2[2][3] = 23 ! all other elements(2 X 3) = 0
PRINT v1, v2
DIM f1 [5], v1[], v2[][]
FOR i = 1 TO VARDIM1(f1)
    f1[i] = i
NEXT i
v1 = f1
v2 [1] = f1
PRINT v1, v2
```

PARVALUE_DESCRIPTION

PARVALUE_DESCRIPTION (parname [, ind1 [, ind2]])

This function returns the parameter value description string of a numerical parameter specified using the VALUES command statement. If no description is specified, the returned value is an empty string.

parname: name of the parameter

ind1, ind2: actual indices if the parameter is an array.

OPERATORS

The operators below are listed in order of decreasing precedence. The evaluation of an expression begins with the highest precedence operator and from left to right.

Arithmetical Operators

`^ (or **)`	Power of	precedence 2
`*`	Multiplication	precedence 3
`/`	Division	precedence 3
`MOD` `(or %)`	Modulo (remainder of division) x MOD y = x - y * INT (x/y)	precedence 3
`+`	Addition	precedence 4
`-`	Subtraction	precedence 4

Note

+ (addition) can also be applied to string expressions: the result is the concatenation of the strings. The result of the '/' (Division) is always a real number, while the result of the other operations depends on the type of the operands: if all operands are integer, the result will be integer, otherwise real.

Relational Operators

`=`	Equal	precedence 5
`<`	Less than	precedence 5
`>`	Greater than	precedence 5
`<=`	Less than or equal	precedence 5
`>=`	Greater than or equal	precedence 5
`<> (or #)`	Not equal	precedence 5

Note

These operators can be used between any two string expressions also (string comparison is case sensitive). The result is an integer, 1 or 0. There is not recommended to use the '=' (Equal), '<=' (Less than or equal), '>=' (Greater than or equal), '<>' (or #) (Not equal) operators with real operands, as these operations can result in precision problems.

Boolean Operators

AND (or &)	Logical and	precedence 6
OR (or |)	Logical inclusive or	precedence 7
EXOR (or @)	Logical exclusive or	precedence 8

Note

Boolean operators work with integer numbers. In consequence, 0 means *false*, while any other number means *true*. The value of a logical expression is also integer, i.e., 1 for *true* and 0 for *false*. It is not recommended to use boolean operators with real operands, as these operations can result in precision problems.

FUNCTIONS

Arithmetical Functions

ABS

ABS (x)

Returns the absolute value of x (integer if x integer, real otherwise).

CEIL

CEIL (x)

Returns the smallest integral value that is not smaller than x (always integer). (e.g., CEIL(1.23) = 2; CEIL (-1.9) = -1).

INT

INT (x)

Returns the integral part of x (always integer). (e.g., INT(1.23) = 1, INT(-1.23) = -2).

FRA

FRA (x)

Returns the fractional part of x (integer 0 if x integer, real otherwise). (e.g., FRA(1.23) = 0.23, FRA(-1.23) = 0.77).

ROUND_INT

ROUND_INT (x)

Returns the rounded integer part of x. The 'i = ROUND_INT (x)' expression is equivalent with the following script:

IF x < 0.0 THEN i = INT (x - 0.5) ELSE i = INT (x + 0.5)

SGN

`SGN` `(x)`

Returns +1 integer if x positive, -1 integer if x negative, otherwise 0 integer.

SQR

`SQR` `(x)`

Returns the square root of x (always real).

Circular Functions

These functions use degrees for arguments (COS, SIN, TAN) and for return values (ACS, ASN, ATN).

ACS

`ACS` `(x)`

Returns the arc cosine of x. (-1.0 <= x <= 1.0; 0° <= ACS(x) <= 180°).

ASN

`ASN` `(x)`

Returns the arc sine of x. (-1.0 <= x <= 1.0; -90° <= ASN(x) <= 90°).

ATN

`ATN` `(x)`

Returns the arc tangent of x. (-90° <= ATN(x) <= 90°).

COS

`COS` `(x)`

Returns the cosine of x.

SIN

`SIN` `(x)`

Returns the sine of x.

TAN

TAN (x)

Returns the tangent of x.

PI

PI

Returns Ludolph's constant. (p = 3.1415926...).

Note: All return values are real.

Transcendental Functions

EXP

EXP (x)

Returns the x th power of e (e = 2.7182818).

LGT

LGT (x)

Returns the base 10 logarithm of x.

LOG

LOG (x)

Returns the natural logarithm of x.

Note: All returned values are real.

Boolean Functions

NOT

NOT (x)

Returns false (=0 integer) if x is true (<>0), and true (=1 integer) if x is false (=0)(logical negation).

Note: Parameter value should be integer.

Statistical Functions

MIN

MIN `(x1, x2, ..., xn)`

Returns the smallest of an unlimited number of arguments.

MAX

MAX `(x1, x2, ..., xn)`

Returns the largest of an unlimited number of arguments.

RND

RND `(x)`

Returns a random value between 0.0 and x (x > 0.0) always real.

Bit Functions

BITTEST

BITTEST `(x, b)`

Returns 1 if the b bit of x is set, 0 otherwise.

BITSET

BITSET `(x, b [, expr])`

expr can be 0 or different, the default value is 1. Sets the b bit of x to 1 or 0 depending on the value of the specified expression, and returns the result. Parameter value should be integer, returned value is integer.

Special Functions

Special functions (besides global variables) can be used in the script to communicate with the executing program. They either ask the current state and different preferences settings of the program, or refer to the current environment of the library part. Request calls can also be used to communicate with GDL extensions.

REQ

REQ `(parameter_string)`

Asks the current state of the program. Its parameter - the question - is a string. The GDL interpreter answers with a numeric value. If it does not understand the question, the answer is negative.

`parameter_string:` question string, one of the following:

- `"GDL_version":` version number of the GDL compiler/interpreter. Warning: it is not the same as the ARCHICAD version.
- `"Program":` code of the program (e.g., 1: ARCHICAD),
- `"Serial_number":` the serial number of the keyplug,
- `"Model_size":` size of the current 3D data structure in bytes,
- `"Red_of_material name"`
- `"Green_of_material name"`
- `"Blue_of_material name":` Defines the given material's color components in RGB values between 0 and 1,
- `"Red_of_pen index"`
- `"Green_of_pen index"`
- `"Blue_of_pen index":` Defines the given pen's color components in RGB values between 0 and 1,
- `"Pen_of_RGB r g b":` Defines the index of the pen closest to the given color. The r, g and b constants' values are between 0 and 1.

REQUEST

```
REQUEST (question_name, name | index, variable1 [, variable2, ...])
```

The first parameter represents the question string while the second represents the object of the question (if it exists) and can be of either string or numeric type (for example, the question can be "Rgb_of_material" and its object the material's name, or "Rgb_of_pen" and its object the index of the pen). The other parameters are variable names in which the return values (the answers) are stored.

The return value of the requests is always the number of successfully retrieved values (integer), while the type of the retrieved values is defined by each request in part. In the case of a badly formulated question or a nonexistent name, the return value will be 0.

For the list of available options see the section called "REQUEST Options".

IND

```
IND (MATERIAL, name_string)
IND (FILL, name_string)
IND (LINE_TYPE, name_string)
IND (STYLE, name_string)
IND (TEXTURE, name_string)
```

This function returns the current index of the material, fill, line type or style and texture attribute. The main use of the resulting number is to transfer it to a macro that requires the same attribute as the calling macro.

The functions return an attribute index (integer) value. The result is negative for inline definitions (inside the script or from Master_GDL file) and positive for global definitions (from the project attributes).

See also the section called "Inline Attribute Definition".

APPLICATION_QUERY

APPLICATION_QUERY (extension_name, parameter_string, variable1, variable2, ...)

GDL allows a way for the individual applications to provide specific request functions in their context. These query options aren't defined in the GDL syntax; consult the GDL developer documentation of the given application for specific options. *See also the section called "Application Query Options".*

LIBRARYGLOBAL

LIBRARYGLOBAL (object_name, parameter, value)

Fills value with the current model view option parameter value of the library global object defined by object_name if available. A library global setting is available if the global object is currently loaded in the library, or was loaded earlier and its setting was saved in the current model view option combination.

Returns 1 if successful, 0 otherwise.

object_name: name of library global object. Must be a string constant. Warning: If string variables or parameters are used as object names, then the 2d and 3d view of objects querying this library global object will not refresh automatically.

parameter: name of requested parameter.

value: filled with the requested parameter value.

Example:

```
success = LIBRARYGLOBAL ("MyGlobalOptions", "detLevel2D", det)
if success > 0 then
    text2 0, 0, det
else
    text2 0, 0, "Not available"
endif
```

String Functions

STR

STR (numeric_expression, length, fractions)

STR `(format_string, numeric_expression)`

The first form of the function creates a string from the current value of the numeric expression. The minimum number for numerical characters in the string is length, while fractions represents the numbers following the floating point. If the converted value has more than length characters, it is expanded as required. If it has fewer characters, it is padded on the left (length > 0) or on the right (length < 0).

In the second form, the format_string can either be a variable or a constant. If the format is empty, it is interpreted as meters, with an accuracy of three decimals (displaying 0s).

Restriction of parameters:

```
  length >= -100, length <= 100
  fractions <= 20, fractions < length
```

Example:

```
a=4.5
b=2.345
TEXT2 0, 2, STR(a, 8, 2)   ! 4.50
TEXT2 0, 1, STR(b, 8, 2)   ! 2.34
TEXT2 0, 0, STR(a*b, 8, 2) ! 10.55
```

STR{2}

STR{2} `(format_string, numeric_expression [, extra_accuracy_string])`

Extension of the second form of STR. If the extra accuracy flags are set in the format_string, the STR{2} function will return the corresponding extra accuracy string in the 3rd parameter.

`format_string:` "%[0 or more flags][field_width][.precision] conv_spec"

`flags:` (for m, mm, cm, e, df, di, sqm, sqcm, sqf, sqi, dd, gr, rad, cum, l, cucm, cumm, cuf, cui, cuy, gal):

`(none):` right justify (default),

`-:` left justify,

`+:` explicit plus sign,

`(space):` in place of a + sign,

`'*0':` extra accuracy Off (default),

`'*1':` extra accuracy .5,

`'*2':` extra accuracy .25,

`'*3':` extra accuracy .1,

`'*4':` extra accuracy .01,

`'*5':` rounding to .5 within displayed decimal range, no returned extra accuracy string, (used for area calculations),

`'*6'`: rounding to .25 within displayed decimal range, no returned extra accuracy string, (used for area calculations),
`'*7'`: fills the fractional part of numeric_expression into the extra_accuracy_string in case of fi or ffi, while the returned expression of the function does not contain the fractional parts,
`'#'`: don't display 0s (for m, mm, cm, ffi, fdi, fi, df, di, sqm, sqcm, sqf, sqi, dd, fr, rad, cum, l, cucm, cumm, cuf, cui, cuy, gal),
`'0'`: display 0 inches (for ffi, fdi, fi),
`'~'`: hide 0 decimals (effective only if the '#' flag is not specified) (for m, mm, cm, fdi, df, di, sqm, sqcm, sqf, sqi, dd, fr, rad, cum, l, cucm, cumm, cuf, cui, cuy, gal),
`'^'`: do not change decimal separator and digit grouping characters (if not specified, these characters will be replaced as set in the current system).
`'[1*j1+2*j2+4*j3]'`: display 0 feet and 0 inches before fractions, effective if the '0' flag is not specified (for ffi, fdi, fi)
`j1`: display 0 inches before fractions (1'-0 3/4")
`j2`: display 0 inches (1'-0")
`j3`: display 0 feet before fractions (0 3/4")

`field_width`: unsigned decimal integer, the minimum number of characters to generate.

`precision`: unsigned decimal integer, the number of fraction digits to generate.

`conv_spec`: (conversion specifier):
`e`: exponential format (meter),
`m`: meters,
`mm`: millimeters,
`cm`: centimeters,
`ffi`: feet & fractional inches,
`fdi`: feet & decimal inches,
`df`: decimal feet,
`fi`: fractional inches,
`di`: decimal inches,
`pt`: points,
for areas:
`sqm`: square meters,
`sqcm`: square centimeters,
`sqmm`: square millimeters,
`sqf`: square feet,
`sqi`: square inches,

for angles:

`dd:` decimal degrees,
`dms:` degrees, minutes, seconds,
`gr:` grads,
`rad:` radians,
`surv:` surveyors unit,

for volumes:

`cum:` cubic meters,
`l:` liters,
`cucm:` cubic centimeters,
`cumm:` cubic millimeters,
`cuf:` cubic feet,
`cui:` cubic inches,
`cuy:` cubic yards,
`gal:` gallons.

Example:

```
nr = 0.345678
TEXT2 0, 23, STR ("%m", nr)       !0.346
TEXT2 0, 22, STR ("%#10.2m", nr) !35
TEXT2 0, 21, STR ("%.4cm", nr)   !34.5678
TEXT2 0, 20, STR ("%12.4cm", nr) !  34.5678
TEXT2 0, 19, STR ("%.6mm", nr)   !345.678000
TEXT2 0, 18, STR ("%+15e", nr)   !+3.456780e-01
TEXT2 0, 17, STR ("%ffi", nr)    !1'-2"
TEXT2 0, 16, STR ("%0.16ffi", nr) !1'-1 5/8"
TEXT2 0, 15, STR ("% .3fdi", nr) ! 1'-1.609"
TEXT2 0, 14, STR ("% -10.4df", nr) ! 1.1341'
TEXT2 0, 13, STR ("%0.64fi", nr) !13 39/64"
TEXT2 0, 12, STR ("%+12.4di", nr)!+13.6094"
TEXT2 0, 11, STR ("%#.3sqm", nr) !346
TEXT2 0, 10, STR ("%+sqcm", nr)  !+3,456.78
TEXT2 0,  9, STR ("% .2sqmm", nr)! 345,678.00
TEXT2 0,  8, STR ("%-12sqf", nr) !3.72
TEXT2 0,  7, STR ("%10sqi", nr)  ! 535.80
TEXT2 0,  6, STR ("%.2pt", nr)   !0.35
```

```
alpha = 88.657
TEXT2 0,  5, STR ("%+10.3dd", alpha) !+88.657°
TEXT2 0,  4, STR ("%.1dms", alpha)   !88°39'
TEXT2 0,  3, STR ("%.2dms", alpha)   !88°39'25"
TEXT2 0,  2, STR ("%10.4gr", alpha)  ! 98.5078G
TEXT2 0,  1, STR ("%rad", alpha)     !1.55R
TEXT2 0,  0, STR ("%.2surv", alpha)  !N 1°20'35" E

nr  = 1'-0 3/4"
TEXT2 0, -1, STR ("%[1].16ffi", nr) !1'-0 3/4"
nr = 1'-0"
TEXT2 0, -2, STR ("%[5].16ffi", nr) !1'
nr = 0 3/4"
TEXT2 0, -3, STR ("%#[7].16ffi", nr) !0 3/4"

nr = 0.34278
TEXT2 0, 0, STR ("%*5 .4m", nr)  !0.3430

! split to integral and fractional parts
extra_accuracy_string = ""
nr  = 1'-0 3/4"

TEXT2 0, -3, STR{2}("%*7.16ffi", nr,  extra_accuracy_string) !1'-
TEXT2 0, -4, extra_accuracy_string        !3/4"
```

SPLIT

SPLIT (string, format, variable1 [, variable2, ..., variablen])

Splits the string parameter according to the format in one or more numeric or string parts. The split process stops when the first non-matching part is encountered. Returns the number of successfully read values (integer).

string: the string to be split.

format: any combination of constant strings, %s, %n and %^n -s. Parts in the string must fit the constant strings, %s denotes any string value delimited by spaces or tabs, while %n or %^n denotes any numeric value. If the '^' flag is present, current system settings for decimal separator and digit grouping characters are taken into consideration when matching the actual numerical value.

variablei: names of the variables to store the split string parts.

Example:

```
ss = "3 pieces 2x5 beam"
n = SPLIT (ss, "%n pieces %nx%n %s", num, ss1, size1, ss2, size2, name)
IF n = 6 THEN
    PRINT num, ss1, size1, ss2, size2, name ! 3 pieces 2 x 5 beam
ELSE
    PRINT "ERROR"
ENDIF
```

STW

STW (string_expression)

Returns the (real) width of the string in millimeters displayed in the current style. The width in meters, at current scale, is STW (string_expression) / 1000 * GLOB_SCALE.

Example:

```
DEFINE STYLE "own" "Gabriola", 180000 / GLOB_SCALE, 1, 0
SET STYLE "own"
string = "abcd"
width = STW (string) / 1000 * GLOB_SCALE
n = REQUEST ("Height_of_style", "own", height)
height = height / 1000 * GLOB_SCALE
TEXT2 0,0, string
RECT2 0,0, width, -height
```

STRLEN

STRLEN (string_expression)

Returns the (integer) length of the string (the number of characters)

STRSTR

STRSTR `(string_expression1, string_expression2[, case_insensitivity])`

Returns the (integer) position of the first appearance of the second string in the first string. If the first string doesn't contain the second one, the function returns 0.

`case_insensitivity`:

- `0 or not set:` Case sensitive
- `1:` Case insensitive

Example 1:

```
szFormat = ""
n = REQUEST ("Linear_dimension", "", szFormat)
unit = ""
IF STRSTR (szFormat, "m")  > 0 THEN unit = "m"
IF STRSTR (szFormat, "mm") > 0 THEN unit = "mm"
IF STRSTR (szFormat, "cm") > 0 THEN unit = "cm"
TEXT2 0, 0, STR (szFormat, a) + " " + unit !1.00 m
```

Example 2:

```
STRSTR ("abcdefg", "BCdEf") = 0
STRSTR ("abcdefg", "BCdEf", 0) = 0
STRSTR ("abcdefg", "BCdEf", 1) = 2
```

STRSUB

STRSUB `(string_expression, start_position, characters_number)`

Returns a substring of the string parameter that begins at the position given by the start_position parameter and its length is characters_number characters.

Example:

```
string = "Flowers.jpeg"
len = STRLEN (string)
iDotPos = STRSTR (string, ".")
TEXT2 0, -1, STRSUB (string, 1, iDotPos - 1) !Flowers
TEXT2 0, -2, STRSUB (string, len - 4, 5)     !.jpeg
```

STRTOUPPER

STRTOUPPER (string_expression)

Returns a string converted to uppercase.

Example:

```
_oldString = "flower"
_newString = STRTOUPPER (_oldString)    ! _newString will be "FLOWER"
```

STRTOLOWER

STRTOLOWER (string_expression)

Returns a string converted to lowercase.

Example:

```
_oldString = "FLOWER"
_newString = STRTOLOWER (_oldString)    ! _newString will be "flower"
```

CONTROL STATEMENTS

This chapter reviews the GDL commands available for controlling loops and subroutines in scripts and introduces the concept of buffer manipulation designed to store parameter values for further use. It also explains how to use objects as macro calls and how to display calculated expressions on screen.

FLOW CONTROL STATEMENTS

FOR - TO - NEXT

FOR `variable_name = initial_value` **TO** `end_value [` **STEP** `step_value ]` **NEXT** `variable_name`

`FOR` is the first statement of a FOR loop.

`NEXT` is the last statement of a FOR loop.

The loop variable varies from the initial_value to the end_value by the step_value increment (or decrement) in each execution of the body of the loop (statements between the FOR and NEXT statements). If the loop variable exceeds the value of the end_value, the program executes the statement following the NEXT statement.

If the STEP keyword and the step_value are missing, the step is assumed to be 1.

Note: Changing the step_value during the execution of the loop has no effect.

A global variable is not allowed as a loop control variable.

Example 1:

```
FOR i=1 TO 10 STEP 2
    PRINT i
NEXT i
```

Example 2:

```
! The two program fragments below are equivalent:

! 1st
a = b
1:
IF c > 0 AND a > d OR c < 0 AND a < d THEN 2
PRINT a
a = a + c
GOTO 1

! 2nd
2:
FOR a = b TO d STEP c
    PRINT a
NEXT a
```

The above example shows that step_value = 0 causes an infinite loop.

Only one NEXT statement is allowed after a FOR statement. You can exit the loop with the GOTO command and to return after leaving, but you cannot enter a loop skipping the FOR statement.

DO - WHILE

```
DO [statment1
    statement2
    ...
    statementn]
WHILE condition
```

The statements between the keywords are executed as long as the condition is true.

The condition is checked after each execution of the statements.

WHILE - ENDWHILE

```
WHILE condition DO
    [statement1
    statement2
    ...
    statementn]
ENDWHILE
```

The statements between the keywords are executed as long as the condition is true.

The condition is checked before each execution of the statements.

REPEAT - UNTIL

```
REPEAT [statement1
    statement2
    ...
    statementn]
UNTIL condition
```

The statements between the keywords are executed until the condition becomes true.

The condition is checked after each execution of the statements.

Example: The following four sequences of GDL commands are equivalent

```
! 1st
FOR i = 1 TO 5 STEP 1
    BRICK 0.5, 0.5, 0.1
    ADDZ 0.3
NEXT i

! 2nd
i = 1
DO
    BRICK 0.5, 0.5, 0.1
    ADDZ 0.3
    i = i + 1
WHILE i <= 5

! 3rd
i = 1
WHILE i <= 5 DO
    BRICK 0.5, 0.5, 0.1
    ADDZ 0.3
    i = i + 1
ENDWHILE

! 4th
i = 1
REPEAT
    BRICK 0.5, 0.5, 0.1
    ADDZ 0.3
    i = i + 1
UNTIL i > 5
```

IF - GOTO

```
IF condition THEN label
IF condition GOTO label
IF condition GOSUB label
```

Conditional jump statement. If the value of the condition expression is 0 (logical 'false'), the command has no effect, otherwise execution continues at the label. THEN, GOTO or THEN GOTO are equivalent in this context.

Example:

```
IF a THEN 28
IF i > j GOTO 200+i*j
IF i > 0 GOSUB 9000
```

IF - THEN - ELSE - ENDIF

```
IF condition THEN statement [ELSE statement]
IF condition THEN
    [statement1
    statement2
    ...
    statementn]
[ELSE
    statementn+1
    statementn+2
    ...
    statementn+m]
ENDIF
```

If you write only one command after keywords THEN and/or ELSE in the same row, there is no need for ENDIF. A command after THEN or ELSE in the same row means a definite ENDIF.

If there is a new row after THEN, the successive commands (all of them until the keyword ELSE or ENDIF) will only be executed if the expression in the condition is true (other than zero). Otherwise, the commands following ELSE will be carried out. If the ELSE keyword is absent, the commands after ENDIF will be carried out.

Example:

```
IF a = b THEN height = 5 ELSE height = 7
IF needDoors THEN
    CALL "door_macro" PARAMETERS
    ADDX a
ENDIF
IF simple THEN
    HOTSPOT2 0, 0
    RECT2 a, 0, 0, b
ELSE PROJECT2 3, 270, 1
IF name = "Sphere" THEN
    ADDY b
    SPHERE 1
ELSE
    ROTX 90
    TEXT 0.002, 0, name
ENDIF
```

GOTO

GOTO `label`

Unconditional jump statement. The program executes a branch to the statement denoted by the value of the label (numerical or string). Variable label expressions can slow down interpretation due to runtime jumping address determination.

Example:

```
GOTO K+2
```

GOSUB

GOSUB `label`

Internal subroutine call where the label is the entry point of the subroutine. Label value can be any numerical or string expression. Variable label expressions can slow down interpretation due to runtime jumping address determination.

RETURN

RETURN

Return from an internal subroutine.

END / EXIT

```
END [v1, v2, ..., vn]
EXIT [v1, v2, ..., vn]
```

End of the current GDL script. The program terminates or returns to the level above. It is possible to use several ENDs or EXITs in a GDL file. If the optional list of values is specified, the current script will pass these return values to its caller.

See the description of receiving returned parameters at the CALL command.

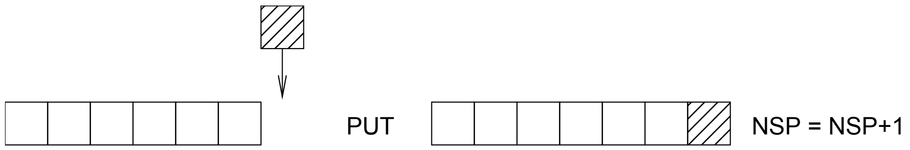
BREAKPOINT

```
BREAKPOINT expression
```

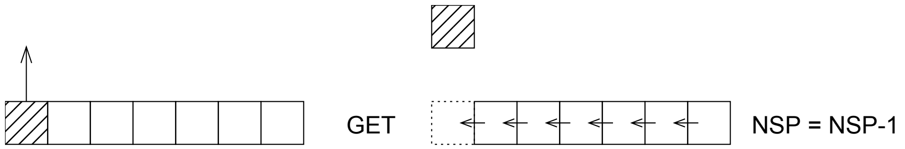
With this command, you can specify a breakpoint in the GDL script. The GDL debugger will stop at this command if the value of the parameter (a numeric expression) is true (1) and the Enable Breakpoints option of the debugger is checked. In normal execution mode, the GDL interpreter simply steps over this command.

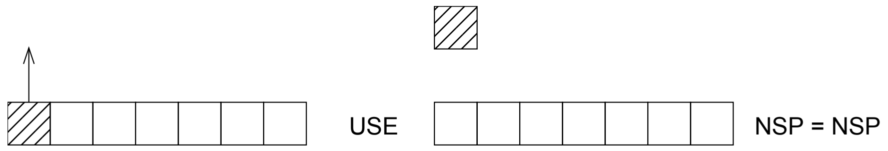
Parameter Buffer Manipulation

The parameter buffer is a built-in data structure that may be used if some values (coordinates, for example) change after a definite rule that can be described using a mathematical expression. This is useful if, for instance, you want to store the current values of your variables.



The parameter buffer is an infinitely long array in which you can store numeric values using the PUT command. `PUT` stores the given values at the end of the buffer. These values can later be used (by the `GET` and `USE` commands) in the order in which they were entered (i.e., the first stored value will be the first one used). A GET(n) or USE(n) command is equivalent with n values separated by commas. This way, they can be used in any GDL parameter list where n values are needed.





PUT

PUT expression [, expression, ...]

Store the given values in the given order in the internal parameter buffer.

GET

GET (n)

Use the next n values from the internal parameter buffer and then disregard them.

USE

USE (n)

Use the next n values from the internal parameter buffer without deleting them. Following USE and GET functions can use the same parameter sequence.

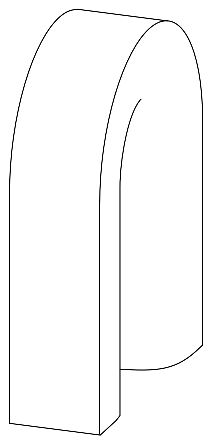
NSP

NSP

Returns the number of stored parameters in the internal buffer.

Example: Using the parameter buffer:

```
r=2: b=6: c=4: d=10
n=12

s=180/n
FOR t=0 TO 180 STEP s
    PUT r+r*COS(T), c-r*SIN(t), 1
NEXT t
FOR i=1 TO 2
    EXTRUDE 3+NSP/3, 0,0,d, 1+16,
            0, b, 0,
            2*r, b, 0,
            USE(NSP),
            0, b, 0
    MULY -1
NEXT i
DEL 1
ADDZ d
REVOLVE 3+NSP/3, 180, 0,
        0, b, 0,
        2*r, b, 0,
        GET(NSP),
        0, b, 0
```



The full description:

```
r=2: b=6: c=4: d=10
FOR i=1 TO 2
    EXTRUDE 16, 0,0,d, 1+16,
            0, b, 0,
            2*r, b, 0,
            2*r, c, 1,
            r+r*COS(15), c-r*SIN(15), 1,
            r+r*COS(30), c-r*SIN(30), 1,
            r+r*COS(45), c-r*SIN(45), 1,
            r+r*COS(60), c-r*SIN(50), 1,
            r+r*COS(75), c-r*SIN(75), 1,
            r+r*COS(90), c-r*SIN(90), 1,
            r+r*COS(105), c-r*SIN(105), 1,
            r+r*COS(120), c-r*SIN(120), 1,
            r+r*COS(135), c-r*SIN(135), 1,
            r+r*COS(150), c-r*SIN(150), 1,
            R+R*COS(165), c-r*SIN(165), 1,
            0, b, 1,
            0, b, 0
    MULY -1
NEXT i
DEL 1
```

```
ADDZ d
REVOLVE 16, 180, 0,
        0, b, 0,
        2*r, b, 0,
        2*r, c, 1,
        r+r*COS(15), c-r*SIN(15), 1,
        r+r*COS(30), c-r*SIN(30), 1,
        r+r*COS(45), c-r*SIN(45), 1,
        r+r*COS(60), c-r*SIN(50), 1,
        r+r*COS(75), c-r*SIN(75), 1,
        r+r*COS(90), c-r*SIN(90), 1,
        r+r*COS(105), c-r*SIN(105), 1,
        r+r*COS(120), c-r*SIN(120), 1,
        r+r*COS(135), c-r*SIN(135), 1,
        r+r*COS(150), c-r*SIN(150), 1,
        r+r*COS(165), c-r*SIN(165), 1,
        0, b, 1,
        0, b, 0
```

MACRO OBJECTS

Although the 3D objects you may need can always be broken down into complex or primitive elements, sometimes it is desirable to define these complex elements specifically for certain applications. These individually defined elements are called macros. A GDL macro has its own environment which depends on its calling order. The current values of the `MODEL, RADIUS, RESOL, TOLER, PEN, LINE_TYPE, MATERIAL, FILL, STYLE, SHADOW` options and the current transformation are all valid in the macro. You can use or modify them, but the modifications will only have an effect locally. They do not take effect on the level the macro was called from. Giving parameters to a macro call means an implicit value assignment on the macro's level. The parameters A and B are generally used for resizing objects.

CALL

```
CALL macro_name_string [,]
    PARAMETERS [ALL][name1=value1, ..., namen=valuen][[,]
    RETURNED_PARAMETERS r1, r2, ...]
```

`macro_name_string:` string, the name of an existing library part

Macro names cannot be longer than 31 characters. Macro names can be string constants, string variables or parameters. String operations cannot be used with a macro call as a macro name. Warning: If string variables or parameters are used as macro names, the called macro may not be included in the archive project. To let GDL know about the dependency, use the FILE_DEPENDENCE command for each possible macro name. The macro name must be put between quotation marks (",',`,´,”,’,“,‘), unless it matches the definition of identifiers, i.e., it begins with a letter or a '_' or '~' character and contains only letters, numbers and the '_' and '~' characters. Otherwise, the quotation marks used in the CALL command must be the same at the beginning and at the end, and should be different from any character of the macro name. Macro name itself also can be used as a command, without the CALL keyword.

PARAMETERS: the actual parameter list of the macro can follow

The parameter names of the called macro can be listed in any sequence, with both an '=' sign and an actual value for each. You can use string type expressions here, but only give a string value to string type parameters of the called macro. Array parameters have to be given full array values. If a parameter name in the parameter list cannot be found in the called macro, you will get an error message. Parameters of the called macro that are not listed in the macro call will be given their original default values as defined in the library part called as a macro.

ALL: all parameters of the caller are passed to the macro

If this keyword is present, there is no need to specify the parameters one by one. For a parameter of the macro which cannot be found in the caller, the default value will be used. If parameter values are specified one by one, they will override the values coming from the caller or parameters of the called macro left to be default.

RETURNED_PARAMETERS: a variable list can follow to collect the returned parameters of the macro

At the caller’s side, returned values can be collected using the RETURNED_PARAMETERS keyword followed by a variable list. The returned values will be stored in these variables in the order they are returned in the called macro. The number and the type of the variables specified in the caller and those returned in the macro must match. If there are more variables specified in the caller, they will be set to 0 integers. Type compatibility is not checked: the type of the variables specified in the caller will be set to the type of the returned values. If one of the variables in the caller is a dynamic array, all subsequent values will be stored in it. *See the syntax of returning parameters at the END / EXIT command.*

```
CALL macro_name_string [,]PARAMETERS
   value1 or DEFAULT [, ..., valuen or DEFAULT]
```

This form of macro call can be used for compatibility with previous versions. Using this syntax the actual parameter values have to be specified one by one in the order they are present in the called library part, no value can be missed, except from the end of the list. Using the DEFAULT keyword in place of a parameter actual value means that the actual value will be the default value stored in the library part. For the missing values defaults will be used automatically (the number of actual values n can be smaller than the number of parameters). When interpreting this kind of macro call there is no need to find the parameters by name to assign them the actual value, so even though it is more uncomfortable to use than the previous ones, a better performance can be achieved.

```
CALL macro_name_string [, parameter_list]
```

This form of macro call can be used for compatibility with previous versions. Can be used with simple GDL text files as well as any library part, on the condition that its parameter list contains only single-letter numerical parameters (A ... Z). No string type expressions or arrays are allowed with this method. The parameter list is a list of simple numerical values: the value of parameter A will be the first value in the list, the value of parameter B will be the second value, and so on. If there are less than A ... Z values specified in the parameter list, for the missing values 0 will be used automatically. If the (library part) macro does not have a single-letter parameter corresponding to the value, interpretation will continue by skipping this value, but you will get a warning from the program.

Example:

```
CALL "leg" 2, , 5 ! A = 2, B = 0, C = 5 leg 2, , 5
CALL "door-1" PARAMETERS height = 2, a = 25.5,
        name = "Director"
CALL "door-1" PARAMETERS      ! use parameter default values
```

Output in an Alert Box or Report Window

PRINT

PRINT `expression [, expression, ...]`

Writes all of its arguments in a dialog box or the Report Window, depending on Work Environment (see the section called “GDL warnings”). Arguments can be strings or numeric expressions of any number in any sequence, separated by commas.

Example:

```
PRINT "loop-variable:", i
PRINT j, k-3*l
PRINT "Beginning of interpretation"
PRINT a * SIN (alpha) + b * COS (alpha)
PRINT "Parameter values: ", "a = ", a, ", b = ", b
PRINT name + STR ("%m", i) + "." + ext
```

File Operations

The following keywords allow you to open external files for reading/writing and to manipulate them by putting/getting values from/to GDL scripts. This process necessarily involves using special Add-On extensions. Text files can be handled by the section called “GDL Text I/O Add-On”. Add-Ons for other file types can be developed by third parties.

See also the section called “GDL Text I/O Add-On”.

OPEN

OPEN `(filter, filename, parameter_string)`

Opens a file as directed. Its return value is a positive integer that will identify the specific file, -2 if the add-on is missing, -1 if the file is missing. If positive, this value, the channel number, will be the file's reference number in succeeding instances. To include the referenced file in the archive project, use the FILE_DEPENDENCE command with the file name.

`filter:` string, the name of an existing extension.

`filename:` string, the name of the file.

`parameter_string:` string, it contains the specific separation characters of the operational extension and the mode of opening. Its contents are interpreted by the extension.

INPUT

```
INPUT (channel, recordID, fieldID, variable1 [, variable2, ...])
```

The number of given parameters defines the number of values from the starting position read from the file identified by the channel value. The parameter list must contain at least one value. This function puts the read values into the parameters as ordered. These values can be of numeric or string type, independent of the parameter type defined for storage.

The return value is the number of the successfully read values. When encountering an end of file character, -1 is returned.

`recordID, fieldID:` the string or numeric type starting position of the reading, its contents are interpreted by the extension.

VARTYPE

```
VARTYPE (expression)
```

Returns 1 if the type of the expression is numerical, 2 if it is a string.

Useful when reading values in variables with the INPUT command, which can change the type of the variables according to the current values. The type of these variables is not checked during the compilation process.

OUTPUT

```
OUTPUT channel, recordID, fieldID, expression1 [, expression2, ...]
```

Writes as many values into the file identified by the channel value from the given position as there are defined expressions. There has to be at least one expression. The type of values is the same as those of the expressions.

`recordID, fieldID:` the string or numeric type starting position of the writing; its contents are interpreted by the extension.

CLOSE

```
CLOSE channel
```

Closes the file identified by the channel value.

Using Deterministic Add-Ons

The following keywords allow you to call GDL add-ons which provide a deterministic function, i.e. the result of a given operation depends on the specified parameters only. This process necessarily involves using special Add-On extensions. For example polygon operations can be executed via the PolyOperations add-on. Add-Ons for other operations can be developed by third parties.

See also the section called "Polygon Operations Extension".

INITADDONSCOPE

`INITADDONSCOPE` `(extension, parameter_string1, parameter_string2)`

Opens a channel as directed. Its return value is a positive integer that will identify the specific connection. This value, the channel number, will be the connection's reference number in succeeding instances.

`extension:` string, the name of an existing extension.

`parameter_string1:` string, its contents are interpreted by the extension.

`parameter_string2:` string, its contents are interpreted by the extension.

PREPAREFUNCTION

`PREPAREFUNCTION` `channel, function_name, expression1 [, expression2, ...]`

Sets some values in the add-on as a preparation step for calling a later function.

`function_name:` the string or numeric identifier of the function to be called; its contents are interpreted by the extension.

`expression:` parameters to be passed for the preparation step.

CALLFUNCTION

`CALLFUNCTION` `(channel, function_name, parameter, variable1 [, variable2, ...])`

The function named *function_name* in the add-on specified by *channel* is called. The parameter list must contain at least one value. This function puts the returned values into the parameters as ordered. The return value is the number of the successfully set values.

`channel:` channel value, used to identify the connection.

`function_name:` the string or numeric identifier of the function to be called; its contents are interpreted by the extension.

`parameter:` input parameter; its contents are interpreted by the extension.

`variablei:` output parameter.

CLOSEADDONSCOPE

`**CLOSEADDONSCOPE** channel`

Closes the connection identified by the channel value.

MISCELLANEOUS

GDL can also handle a number of operations on external files through special Add-On applications. The commands used to achieve this are described in this chapter and illustrated with an example.

GLOBAL VARIABLES

The global variables make it possible to store special values of the model. This allows you to access geometric information about the environment of the GDL macro. For example, you can access the wall parameters when defining a window which has to fit into the wall. Global variables are not stacked during macro calls.

For doors, windows, labels and property library parts there is one more possibility to communicate with ARCHICAD through fix named, optional parameters. These parameters, if present on the library part's parameter list, are set by ARCHICAD. *See the list of fix named parameters and more details in the section called "Fix named optional parameters".*

Parameter script compatibility

View or project dependent global variables should not be used in parameter scripts (or master scripts run as parameter script) to avoid the parameter script run occasions and the resulting parameter values becoming context dependent, inconsistent within the planfile.

Compatibility up to ARCHICAD 19: Such globals accidentally used in parameter script generate GDL warnings.

Compatibility starting from ARCHICAD 20: Such globals used in parameter script generate GDL warnings, and will contain a static default value only (type-matching).

Legend

✓	works without restriction
⚠	works (with additional warning)
⛔	contains dummy default value (with additional warning)

Table 6. Parameter script compatibility of view dependent globals

Compatibility/Default in Parameter Script	**ARCHICAD 18**	**ARCHICAD 19**	**ARCHICAD 20**	
	Parameter Script	Parameter Script	Parameter Script	Default
GLOB_CONTEXT	✓	⚠	⛔	2
GLOB_VIEW_TYPE	-	⚠	⚠	-
GLOB_SCALE	✓	⚠	⛔	100
GLOB_DRAWING_BGD_PEN	✓	⚠	⛔	19
GLOB_FRAME_NR	✓	⚠	⛔	-1

Table 7. Parameter script compatibility of view dependent globals

Compatibility/Default in Parameter Script	**ARCHICAD 18**	**ARCHICAD 19**	**ARCHICAD 20**	
	Parameter Script	Parameter Script	Parameter Script	Default
GLOB_FIRST_FRAME	✓	⚠	⛔	0
GLOB_LAST_FRAME	✓	⚠	⛔	0
GLOB_EYEPOS_X	✓	⚠	⛔	-5.0
GLOB_EYEPOS_Y	✓	⚠	⛔	-5.0
GLOB_EYEPOS_Z	✓	⚠	⛔	1.7
GLOB_TARGPOS_X	✓	⚠	⛔	0.0
GLOB_TARGPOS_Y	✓	⚠	⛔	0.0
GLOB_TARGPOS_Z	✓	⚠	⛔	1.7

Table 8. Parameter script compatibility of project dependent globals

Compatibility/Default in Parameter Script	ARCHICAD 18	ARCHICAD 19	ARCHICAD 20	
	Parameter Script	Parameter Script	Parameter Script	Default
GLOB_NORTH_DIR	✓	⚠	⛔	90
GLOB_PROJECT_LONGITUDE	-	⚠	⛔	0
GLOB_PROJECT_LATITUDE	✓	⚠	⛔	0
GLOB_PROJECT_ALTITUDE	✓	⚠	⛔	0
GLOB_PROJECT_DATE	✓	⚠	⛔	[0; 0; 0; 0; 0; 0]
GLOB_WORLD_ORIGO_OFFSET_X	✓	⚠	⛔	0
GLOB_WORLD_ORIGO_OFFSET_Y	✓	⚠	⛔	0
GLOB_CUTPLANES_INFO	✓	⚠	⛔	[1.0; 3.0; -0.1; -0.1]

Table 9. Parameter script compatibility of project dependent globals

Compatibility/Default in Parameter Script	**ARCHICAD 18**	**ARCHICAD 19**	**ARCHICAD 20**	
	Parameter Script	Parameter Script	Parameter Script	Default
GLOB_STRUCTURE_DISPLAY	✅	⚠️	⛔	0
GLOB_ISSUE_SCHEME	✅	✅	✅	-
GLOB_CHANGE_SCHEME	✅	✅	✅	-
LAYOUT_REVISION_HISTORY	✅	✅	✅	-
LAYOUT_CHANGE_HISTORY	✅	✅	✅	-
LAYOUT_CURRENTREVISION_OPEN	✅	⚠️	⛔	FALSE

Table 10. Parameter script compatibility of project dependent globals

Compatibility/Default in Parameter Script	**ARCHICAD 18**	**ARCHICAD 19**	**ARCHICAD 20**	
	Parameter Script	Parameter Script	Parameter Script	Default
GLOB_HSTORY_ELEV	✅	⚠️	⛔	0
GLOB_HSTORY_HEIGHT	✅	⚠️	⛔	3.1
GLOB_CSTORY_ELEV	✅	⚠️	⛔	0.0
GLOB_CSTORY_HEIGHT	✅	⚠️	⛔	3.1
GLOB_CH_STORY_DIST	✅	⚠️	⛔	0.0
GLOB_SUN_AZIMUTH	✅	⚠️	⛔	240.0
GLOB_SUN_ALTITUDE	✅	⚠️	⛔	35.0

General environment information

GLOB_SCRIPT_TYPE type of current script

- *1 - properties script*
- *2 - 2D script*
- *3 - 3D script*
- *4 - user interface script*
- *5 - parameter script*
- *6 - master script*
- *7 - forward migration script*
- *8 - backward migration script*

GLOB_VIEW_TYPE type of current view (view dependent, do not use in parameter script).

- *2 - 2D (Floor Plan)*
- *3 - 3D*
- *4 - Section*
- *5 - Elevation*
- *6 - 3D Document*
- *7 - Detail*
- *8 - Layout*
- *9 - Calculation*

Use the exact needed values. Using ranges are not recommended due to possible future value extensions.

GLOB_PREVIEW_MODE type of current preview (view dependent, do not use in parameter script)

- *0 - None*
- *1 - Dialog*
- *2 - Listing*

Use the exact needed values. Using ranges are not recommended due to possible future value extensions.

GLOB_FEEDBACK_MODE indicates editing in progress (view dependent, do not use in parameter script)

0 - off, 1 - editing feedback mode

GLOB_SEO_TOOL_MODE indicates solid element operations in progress (view dependent, do not use in parameter script)

0 - off, 1 - solid element operations mode

GLOB_SCALE	drawing scale (view dependent, do not use in parameter script)
according to the current window	
GLOB_DRAWING_BGD_PEN	pen of the drawing background color (view dependent, do not use in parameter script)
the best matching (printable) pen from the current palette to the background color of the current window	
GLOB_NORTH_DIR	project North direction (project dependent, do not use in parameter script)
relative to the default project coordinate system according to the settings made in the Project Location dialog	
GLOB_PROJECT_LONGITUDE	project longitude (project dependent, do not use in parameter script)
GLOB_PROJECT_LATITUDE	project latitude (project dependent, do not use in parameter script)
GLOB_PROJECT_ALTITUDE	project altitude (project dependent, do not use in parameter script)
the geographical coordinates of the project origin according to the settings specified in the Project Location dialog	
GLOB_PROJECT_DATE	project date (project dependent, do not use in parameter script)
array of the following six values: 1 - year, 2 - month, 3 - day, 4 - hour, 5 - minute, 6 - second. This variable contains the project's current date and is only set in the EcoDesigner STAR® add-on (in other cases all values are set to 0). The value of this variable is modified by the add-on when running the solar analysis routines to allow certain GDL objects (for example deciduous trees) to be represented differently at different times of the year.	
GLOB_WORLD_ORIGO_OFFSET_X	(project dependent, do not use in parameter script)
GLOB_WORLD_ORIGO_OFFSET_Y	(project dependent, do not use in parameter script)
Position of the project origin relative to the world origin. See Illustrating the usage of the GLOB_WORLD_ORIGO_... globals.	
GLOB_MODPAR_NAME	name of the last modified parameter
in the settings dialog or library part editor, including parameters modified through editable hotspots.	
GLOB_UI_BUTTON_ID	id of the button pushed on the UI page
or 0, if the last action was not the push of a button with id.	
GLOB_CUTPLANES_INFO	(project dependent, do not use in parameter script)
array of 4 length values: 1 - cutplane height, 2 - cutplane top level, 3 - cutplane bottom level, 4 - absolute display limit, in the library part's local coordinate system. See details in ARCHICAD Set Floor Plan Cutplane dialog.	
GLOB_STRUCTURE_DISPLAY	structure display detail (project dependent, do not use in parameter script)
informs about the partial structure display option settings (integer): 0 - entire structure, 1 - core only, 2 - without finishes	

GLOB_ISSUE_SCHEME list of custom data defined in the Issue Scheme

Available in all context. 2-row string array, containing the names of fields defined in the Issue Scheme (first row), with the corresponding GUIDs (second row). The first five columns are fixed: Revision ID, Issue ID, Issue Name, Issue Date, Issued by.

For example:

Revision ID	***Issue ID***	***Issue Name***	***Issue Date***	***Issued By***	***Recipient***	***Status***	...
{RevIdGUID}	*{IssueIdGUID}*	*{IssueNameGUID}*	*{IssueDateGUID}*	*{IssuedByGUID}*	*{Custom1GUID}*	*{Custom2GUID}*	

LAYOUT_REVISION_HISTORY list of the current Layout's Revision History

Available in Layout context only. String array, containing 1 row per Revision, in the same structure as GLOB_ISSUE_SCHEME. The first five columns are fixed: Revision ID, Issue ID, Issue Name, Issue Date, Issued by.

For example:

01	*1*	*First Issue*	*2013-06-30*	*user1*	*Everyone*	*SD*	...
02	*3*	*General Update*	*2013-07-31*	*user2*	*Mechanical*	*DD*	
03	*5*	*Structural Update*	*2013-08-31*	*user1*	*Structural*	*DD*	
...							

GLOB_CHANGE_SCHEME list of custom data defined in the Change Scheme

Available in all context. 2-row string array, containing the names of fields defined in the Change Scheme (first row), with the corresponding GUIDs (second row). The first five columns are fixed: Revision ID, Change ID, Change Name, Last Modified Date, Last Modified by.

For example:

Revision ID	***Change ID***	***Change Description***	***Last Modified***	***Last Modified By***	***Created by***	***Approved by***	...
{RevIdGUID}	*{ChIdGUID}*	*{ChDescGUID}*	*{ModiTimeGUID}*	*{ModiByGUID}*	*{Custom1GUID}*	*{Custom2GUID}*	

LAYOUT_CHANGE_HISTORY list of all the Changes appearing in the current Layout's Revision History

Available in Layout context only. String array, containing 1 row per Change, in the same structure as GLOB_CHANGE_SCHEME. The first five columns are fixed: Revision ID, Change ID, Change Name, Last Modified Date, Last Modified by.

For example:

2	*Ch-13*	*Kitchen*	*2013-07-13*	*user1*	*Architect 1*	*Lead Architect 1*	...
2	*Ch-15*	*Ventillation*	*2013-07-16*	*user2*	*Architect 2*	*Lead Architect 1*	
3	*Ch-18*	*Structural Col.*	*2013-08-03*	*user2*	*Architect 1*	*Lead Architect 2*	
3	*Ch-19*	*Truss Sections*	*2013-08-12*	*user1*	*Architect 3*	*Lead Architect 2*	
B	*Ch-23*	*Door Numbering*	*2013-10-01*	*user3*	*Architect 2*	*Lead Architect 1*	
...							

LAYOUT_CURRENTREVISION_OPEN Work in Progress state of the current Layout (project dependent, do not use in parameter script)

Available in Layout context only. 0 - current Layout has no open Revision, 1 - current Layout has an open Revision (it is a Work in Progress Layout)

Story information

GLOB_HSTORY_ELEV elevation of the home story (project dependent, do not use in parameter script)

home story is the one the object is placed on

GLOB_HSTORY_HEIGHT height of the home story (project dependent, do not use in parameter script)

home story is the one the object is placed on

GLOB_CSTORY_ELEV elevation of the current story (project dependent, do not use in parameter script)

current story is the one currently shown in the Floor Plan window

GLOB_CSTORY_HEIGHT height of the current story (project dependent, do not use in parameter script)

current story is the one currently shown in the Floor Plan window

GLOB_CH_STORY_DIST relative position of the current story to the home story (project dependent, do not use in parameter script)

current story is the one currently shown in the Floor Plan window

Fly-through information

GLOB_FRAME_NR	current frame number in animation (view dependent, do not use in parameter script)
valid only for animation, -1 for still images	
GLOB_FIRST_FRAME	first frame index in fly-through (view dependent, do not use in parameter script)
valid only for animation, 0 for still images	
GLOB_LAST_FRAME	last frame index in fly-through (view dependent, do not use in parameter script)
valid only for animation, 0 for still images	
GLOB_EYEPOS_X	current camera position (x) (view dependent, do not use in parameter script)
valid only in perspective projection for both animation and still images	
GLOB_EYEPOS_Y	current camera position (y) (view dependent, do not use in parameter script)
valid only in perspective projection for both animation and still images	
GLOB_EYEPOS_Z	current camera position (z) (view dependent, do not use in parameter script)
valid only in perspective projection for both animation and still images	
GLOB_TARGPOS_X	current target position (x) (view dependent, do not use in parameter script)
valid only in perspective projection for both animation and still images	
GLOB_TARGPOS_Y	current target position (y) (view dependent, do not use in parameter script)
valid only in perspective projection for both animation and still images	
GLOB_TARGPOS_Z	current target position (z) (view dependent, do not use in parameter script)
valid only in perspective projection for both animation and still images	
GLOB_SUN_AZIMUTH	sun azimuth (project dependent, do not use in parameter script)
according to the settings in the Sun... dialog box	
GLOB_SUN_ALTITUDE	sun altitude (project dependent, do not use in parameter script)
according to the settings in the Sun... dialog box	

General element parameters

GLOB_LAYER	layer of the element	*name of the layer the element is assigned to*
GLOB_ID	user ID of the element	*ID as set in the settings dialog box*
GLOB_INTGUID	internal GUID of the element	*the internal GUID generated by the program (cannot be controlled by the user)*
GLOB_ELEVATION	base elevation of the element	• *door/window objects: sill height, according to current settings* • *slab: the elevation of the chosen reference plane of the slab, according to settings* • *other elements/objects: the base elevation, according to settings*
GLOB_ELEM_TYPE	element type, for labels and property objects contains the type of the parent element	*0 - none (individual label), 1-object, 2-lamp, 3-window, 4-door, 5-wall, 6-column, 7-slab, 8-roof, 9-fill, 10-mesh, 11-zone, 12 - beam, 13 - curtain wall, 14 - curtain wall frame, 15 - curtain wall panel, 16 - curtain wall junction, 17 - curtain wall accessory, 18 - shell, 19 - skylight, 20 - morph*

Object, Lamp, Door, Window, Wall End, Skylight parameters

SYMB_LINETYPE	line type of the library part	*applied as the default line type of the 2D symbol*
SYMB_FILL	fill type of the library part	*applied on cut surfaces of library parts in section/elevation windows*
SYMB_FILL_PEN	pen of the fill of the library part	*applied on cut surfaces of library parts in section/elevation windows*
SYMB_FBGD_PEN	pen of the background of the fill of the library part	*applied on cut surfaces of library parts in section/elevation windows*
SYMB_SECT_PEN	pen of the library part in section	*applied on contours of cut surfaces of library parts in section/elevation windows*

SYMB_VIEW_PEN	default pen of the library part
applied on all edges in 3D window and on edges on view in section/elevation windows	
SYMB_MAT	default material of the library part
SYMB_POS_X	position of the library part (x)
relative to the project origin (excluding door, window and wall end: relative to the startpoint of the including wall)	
SYMB_POS_Y	position of the library part (y)
relative to the project origin (excluding door, window and wall end: relative to the startpoint of the including wall) Note: see the section called "Doors and Windows" for orientation of Y and Z axes	
SYMB_POS_Z	position of the library part (z)
relative to the project origin (excluding door, window and wall end: relative to the startpoint of the including wall) Note: see the section called "Doors and Windows" for orientation of Y and Z axes	
SYMB_ROTANGLE	rotation angle of the library part
numeric rotation from within the settings dialog is performed around the current anchor point	
SYMB_MIRRORED	library part mirrored
0-no, 1-yes (mirroring is performed around the current anchor point.) Always 0 for wall ends, except when the origin of the local coordinate system is in a non-rectangular vertex of a trapezoidal wall's polygon.	

Object, Lamp, Door, Window, Wall End, Skylight, Curtain Wall Accessory parameters - available for listing and labels only

SYMB_A_SIZE	nominal length/width of library part
length of object/lamp, width of window/door (fixed parameter), width of accessory	
SYMB_B_SIZE	nominal width/height of library parts
width of object/lamp, height of window/door (fixed parameter), height of accessory	

Object, Lamp, Curtain Wall Accessory parameters - available for listing and labels only

SYMB_Z_SIZE	nominal height/length of the library part
length of accessory or if a user parameter is named in zzyzx format then it will be used for nominal height, otherwise 0	

Window, Door and Wall End parameters

WIDO_REVEAL_ON	window/door built-in reveal is on
0-reveal is off, 1-reveal is on	
WIDO_SILL	sill depth of the window/door - sometimes referred to as reveal depth
for curved walls: in radial direction at nominal sized opening corner	
WIDO_SILL_HEIGHT	window/door nominal sill height
WIDO_RSIDE_SILL_HEIGHT	window/door sill height on the reveal side
WIDO_OPRSIDE_SILL_HEIGHT	window/door sill height on the side opposite to the reveal side
WIDO_RIGHT_JAMB	window/door built-in jamb on the right side
WIDO_LEFT_JAMB	window/door built-in jamb on the left side
WIDO_THRES_DEPTH	window/door built-in sill/threshold depth
WIDO_HEAD_DEPTH	window/door built-in head depth
WIDO_HEAD_HEIGHT	window/door nominal head height
WIDO_RSIDE_HEAD_HEIGHT	window/door head height on the reveal side
WIDO_OPRSIDE_HEAD_HEIGHT	window/door head height on the side opposite to the reveal side
WIDO_REVEAL_SIDE	reveal side is opposite to the opening side
1-yes, 0-no - when placing an element, the default value is 0 for windows, 1 for doors	
WIDO_FRAME_THICKNESS	frame thickness of window/door
when flipping doors/windows, they will be mirrored then relocated automatically by this value	
WIDO_POSITION	offset of the door/window
angle or distance between the axis of the opening or wall end and the normal vector at the wall's starting point	
WIDO_ORIENTATION	window/door opening orientation
left/right - it will work fine only if the door/window was created according to local standards	
WIDO_MARKER_TXT	window/door marker text
WIDO_SUBFL_THICKNESS	subfloor thickness (for sill height correction)

WIDO_PREFIX	window/door sill height prefix
WIDO_CUSTOM_MARKER	window/door custom marker switch
1-parameters can be used in the 2D script while the automatic dimension is not present	
WIDO_ORIG_DIST	distance of the local origin from the center of curvature of the wall
distance of the local origin from the centerpoint of the curved wall, 0 for straight walls. Negative for wall ends at the ending point of the curved wall.	
WIDO_PWALL_INSET	parapet wall inset

Window, Door parameters - available for listing and labels only

WIDO_RSIDE_WIDTH	window/door opening width on the reveal side
WIDO_OPRSIDE_WIDTH	window/door opening width on the side opposite to the reveal side
WIDO_RSIDE_HEIGHT	window/door opening height on the reveal side
WIDO_OPRSIDE_HEIGHT	window/door opening height on the side opposite to the reveal side
WIDO_RSIDE_SURF	window/door opening surface area on the reveal side
WIDO_OPRSIDE_SURF	window/door opening surface area on the side opposite to the reveal side
WIDO_N_RSIDE_WIDTH	nominal window/door opening width on the reveal side
WIDO_N_OPRSIDE_WIDTH	nominal window/door opening width on the side opposite to the reveal side
WIDO_N_RSIDE_HEIGHT	nominal window/door opening height on the reveal side
WIDO_N_OPRSIDE_HEIGHT	nominal window/door opening height on the side opposite to the reveal side
WIDO_N_RSIDE_SURF	nominal window/door opening surface on the reveal side
WIDO_N_OPRSIDE_SURF	nominal window/door opening surface on the side opposite to the reveal side
WIDO_VOLUME	window/door opening volume
WIDO_GROSS_SURFACE	window/door opening nominal surface area
WIDO_GROSS_VOLUME	window/door opening nominal volume

Lamp parameters - available for listing and labels only

LIGHT_ON *0-light is off, 1-light is on*	light is on
LIGHT_RED	red component of the light color
LIGHT_GREEN	green component of the light color
LIGHT_BLUE	blue component of the light color
LIGHT_INTENSITY	light intensity

Label parameters

LABEL_POSITION *array[3][2] containing the coordinates of the 3 points defining the label position*	position of the label
LABEL_ASSOC_ELEM_ORIENTATION • *straight elements: the direction of the reference line* • *curved elements: the direction of the chord of the arc* • *point-like elements: the rotation angle of the element*	orientation of the associated element
LABEL_CUSTOM_ARROW *1 if the Use symbol arrow checkbox is checked, 0 otherwise*	use symbol arrow option on/off
LABEL_ARROW_LINETYPE	line type of the line of the arrow
LABEL_ARROW_PEN	pen of the arrow
LABEL_ARROWHEAD_PEN	pen of the arrowhead
LABEL_FONT_NAME	font name
LABEL_TEXT_SIZE	text size
LABEL_TEXT_PEN	pen of the text
LABEL_TEXT_BG_PEN *0 if opaque is off, the background pen otherwise*	text box background pen

LABEL_FONT_STYLE	font style
0-normal, 1-bold, 2-italic, 4- underline	
LABEL_FONT_STYLE2	font style in the settings dialog box
*0 - normal, otherwise j1 + 2*j2 + 4*j3 + 32*j6 + 64*j7 + 128*j8, j1 - bold, j2 - italic, j3 - underline, j6 - superscript, j7 - subscript, j8 - strikethrough*	
LABEL_FRAME_ON	label frame on/off
1 if the label frame is checked, 0 otherwise	
LABEL_FRAME_OFFSET	frame offset
LABEL_ANCHOR_POS	label anchor position
0 - middle, 1 - top, 2 - bottom	
LABEL_ROTANGLE	rotation angle
LABEL_ALWAYS_READABLE	label text is always readable
1 if Always Readable is checked, 0 otherwise	
LABEL_TEXT_WRAP	wrap label text
1 if Wrap Text is checked, 0 otherwise	
LABEL_TEXT_ALIGN	text alignment
1 - left aligned, 2 - center aligned, 3 - right aligned, 4 - full justified	
LABEL_TEXT_LEADING	line spacing factor
LABEL_TEXT_WIDTH_FACT	width factor
LABEL_TEXT_CHARSPACE_FACT	spacing factor

Wall parameters - available for Doors/Windows, listing and labels

WALL_ID	user ID of the wall
WALL_INTGUID	internal GUID of the wall
the internal GUID generated by the program (cannot be controlled by the user)	
WALL_RESOL	3D resolution of a curved wall
effective in 3D only	

WALL_THICKNESS	thickness of the wall
in case of inclined walls: the wall thickness at the opening axis (local z axis)	
WALL_START_THICKNESS	Start thickness of the wall
WALL_END_THICKNESS	End thickness of the wall
WALL_INCL	inclination of the wall surfaces
the angle between the two inclined wall surfaces - 0 for common straight walls	
WALL_HEIGHT	height of the wall
WALL_MAT_A	surface attribute index of the wall on the side opposite to the opening side
WALL_MAT_B	surface attribute index of the wall on the opening side
this can vary from opening to opening placed in the same wall	
WALL_MAT_EDGE	surface attribute index of the edges of the wall
WALL_LINETYPE	line type of the wall
applied on the contours only in the floor plan window	
WALL_FILL	fill type of the wall
fill index, first skin of a composite structure	
WALL_FILL_PEN	pen of the wall fill
WALL_COMPS_NAME	name of the composite or complex structure of the wall
the name of the profile attribute for complex wall, the name of the composite attribute for composite walls, empty string otherwise.	
WALL_BMAT_NAME	name of the building material of the wall
building material name of the wall, empty string for composite or complex walls.	
WALL_SKINS_NUMBER	number of composite or complex wall skins
range of 1to 127, 0 if single fill applied	

WALL_SKINS_PARAMS parameters of the composite or complex wall skins

array with 17 columns with arbitrary number of rows:

- *[1] fill*
- *[2] thickness*
- *[3] (old contour pen)*
- *[4] pen of fill*
- *[5] pen of fill background*
- *[6] core status*
- *[7] upper line pen*
- *[8] upper line type*
- *[9] lower line pen*
- *[10] lower line type*
- *[11] end face pen*
- *[12] fill orientation*
- *[13] skin type*
- *[14] end face line type*
- *[15] finish skin status*
- *[16] oriented fill status*
- *[17] trapezoid/double slanted status.*

core status: 0 - not part, 1 - part, 3 - last core skin; fill orientation: 0 - global, 1 - local; skin type: 0 - cut, 1 - below cutplane, 2 - above cutplane (all skin types are 0 for simple walls); trapezoid status: 0 - is not, 1 - is. For D/W in complex walls on the floor plan this variable contains the data of all cut skins, for wall ends on the floor plan the data of all skins. finish skin status: 0 - not finish skin, 1 - finish skin, oriented fill status: 0 - global or local fill orientation as set in the "fill orientation" column, 1 - fill orientation and size match with the wall skin direction and thickness

For D/W and wall ends in the 3D window contains the data of the skins actually cut by the D/W or wall end.

WALL_SKINS_BMAT_NAMES building material names of the composite or complex wall skins

array with 1 column: building material name of the skin and with arbitrary number of rows.

For D/W and wall ends in the 3D window contains the data of the skins actually cut by the D/W or wall end.

WALL_SECT_PEN pen of the contours of the wall cut surfaces

applied on contours of cut surfaces both in floor plan and section/elevation windows

WALL_VIEW_PEN pen of the contours of the wall on view

applied on all edges in 3D window and on outline edges (edges on view below cutting plane) in floor plan and section/elevation window

WALL_FBGD_PEN pen of the background of the fill of the wall

WALL_DIRECTION	direction of the wall
straight walls: the direction of the reference line, curved walls: the direction of the chord of the arc	
WALL_POSITION	absolute coordinates of the wall
array with 3 columns: x, y, z, which means the position of the wall's starting point relative to the project origin	
WALL_TEXTURE_WRAP	texture wrapping data of the wall to be used in VERT and COOR{2}, or COOR{3} commands. The wall texture coordinates are transformed to match the local coordinate system of the wall-connected object (no additional transformations needed).
array with 14 rows: • *[1]: wrapping_method* • *[2]: wrap_flags* • *[3]-[4]-[5]: origin_X, origin_Y, origin_Z (nodes of vert 1)* • *[6]-[7]-[8]: endOfX_X, endOfX_Y, endOfX_Z (nodes of vert 2)* • *[9]-[10]-[11]: endOfY_X, endOfY_Y, endOfY_Z (nodes of vert 3)* • *[12]-[13]-[14]: endOfZ_X, endOfZ_Y, endOfZ_Z (nodes of vert 4)*	

Wall parameters - available for listing and labels only

WALL_LENGTH_A	length of the wall on the reference line side
WALL_LENGTH_B	length of the wall on the side opposite to the reference line
WALL_LENGTH_A_CON	conditional wall length on the reference line side
WALL_LENGTH_B_CON	conditional wall length on the side opposite to the reference line
WALL_CENTER_LENGTH	length of the wall at the center
WALL_AREA	area of the wall
WALL_PERIMETER	perimeter of the wall
WALL_SURFACE_A	surface area of the wall on the reference line side
WALL_SURFACE_B	surface area of the wall on the side opposite to the reference line
WALL_SURFACE_A_CON	conditional wall surface area on the reference line side
WALL_SURFACE_B_CON	conditional wall surface area on the side opposite to the reference line
WALL_GROSS_SURFACE_A	gross surface area of the wall on the reference line side

WALL_GROSS_SURFACE_B	gross surface area of the wall on the side opposite to the reference line
WALL_EDGE_SURF	surface area of the edge of the wall
WALL_VOLUME	volume of the wall
WALL_VOLUME_CON	conditional volume of the wall
WALL_GROSS_VOLUME	gross volume of the wall
WALL_VOLUME_A	wall skin volume on the reference line side
WALL_VOLUME_A_CON	conditional wall skin volume on the reference line side
WALL_VOLUME_B	wall skin volume on the side opposite to the reference line
WALL_VOLUME_B_CON	conditional wall skin volume on the side opposite to the reference line
WALL_DOORS_NR	number of doors in the wall
WALL_WINDS_NR	number of windows in the wall
WALL_HOLES_NR	number of empty openings
WALL_DOORS_SURF	surface area of doors in the wall
WALL_WINDS_SURF	surface area of windows in the wall
WALL_HOLES_SURF	surface area of empty openings in the wall
WALL_HOLES_SURF_A	analytic surface area of openings on the reference line side
WALL_HOLES_SURF_B	analytic surface area of openings on the opposite side
WALL_HOLES_VOLUME	analytic volume of openings in the wall
WALL_WINDS_WID	combined width of the windows in the wall
WALL_DOORS_WID	combined width of the doors in the wall
WALL_COLUMNS_NR	number of columns in the wall
WALL_CROSSSECTION_TYPE *0 - complex profiled, 1 - rectangular, 2 - slanted, 3 - double slanted*	cross-section type of the wall
WALL_MIN_HEIGHT	minimum height of the wall
WALL_MAX_HEIGHT	maximum height of the wall

WALL_SKIN_MIN_HEIGHT_A	minimum height of the wall skin on the reference line side
WALL_SKIN_MAX_HEIGHT_A	maximum height of the wall skin on the reference line side
WALL_SKIN_MIN_HEIGHT_B	minimum height of the wall skin on the reference line side
WALL_SKIN_MAX_HEIGHT_B	maximum height of the wall skin on the side opposite to the reference line
WALL_SKIN_THICKNESS_A	wall skin thickness on the reference line side
WALL_SKIN_THICKNESS_B	wall skin thickness on the side opposite to the reference line
WALL_INSU_THICKNESS	wall insulation skin thickness
WALL_AIR_THICKNESS	wall air skin thickness

Column parameters - available for listing and labels only

COLU_CORE	core/veneer properties
serves compatibility: it is only effective in the properties script of .CPS (Column.Properties) files	
COLU_HEIGHT	height of the column
COLU_MIN_HEIGHT	Minimum height of the column
COLU_MAX_HEIGHT	Maximum height of the column
COLU_VENEER_WIDTH	thickness of the column veneer
COLU_CORE_X	Width of the core
COLU_CORE_Y	Depth of the core
COLU_DIM1	1st dimension of the column
COLU_DIM2	2nd dimension of the column
COLU_MAT	surface attribute index of the column
Wall wrapping will replace column surface with the surfaces of the connecting walls	
COLU_LINETYPE	line type of the column
applied on the contours only in the floor plan window	
COLU_CORE_FILL	fill of the column core

COLU_CORE_BMAT_NAME	building material name of the column core
COLU_VENEER_FILL	fill of the column veneer
COLU_VENEER_BMAT_NAME	building material name of the column veneer
COLU_SECT_PEN	pen of the contours of the column cut surfaces
applied on contours of cut surfaces in both floor plan and section/elevation windows	
COLU_VIEW_PEN	pen of the column on view
applied on all edges in 3D window and on outline edges (edges on view below cutting plane) in floor plan and section/elevation windows	
COLU_CORE_FILL_PEN	pen of the fill of the column core
COLU_CORE_FBGD_PEN	pen of the background of the fill of the column core
COLU_VENEER_FILL_PEN	pen of the fill of the column veneer
COLU_VENEER_FBGD_PEN	pen of the background of the fill of the column veneer
COLU_PERIMETER	Perimeter of the column
COLU_AREA	Area of the column
COLU_VOLUME	Volume of the column
COLU_GROSS_VOLUME	Gross volume of the column
COLU_CORE_SURF	surface area of the column core
COLU_CORE_GROSS_SURF	Gross surface area of the column
COLU_CORE_VOL	volume of the column core
COLU_CORE_GROSS_VOL	Gross volume of the core
COLU_VENEER_SURF	surface area of the column veneer
COLU_VENEER_GROSS_SURF	Gross surface area of the veneer
COLU_VENEER_VOL	volume of the column veneer
COLU_VENEER_GROSS_VOL	Gross volume of the veneer
COLU_CORE_TOP_SURF	Surface area of the core top
COLU_CORE_BOT_SURF	Surface area of the core bottom

COLU_VENEER_TOP_SURF	Surface area of the veneer top
COLU_VENEER_BOT_SURF	Surface area of the veneer bottom
COLU_CORE_GROSS_TOPBOT_SURF	Gross surface area of the core top and bottom
COLU_VENEER_GROSS_TOPBOT_SURF	Gross surface area of the veneer top and bottom
COLU_CROSSSECTION_TYPE *0 - complex profiled, 1 - rectangular, 4 - round*	cross-section type of the column
COLU_PROFILE_NAME	name of the profile of the column, if complex

Beam parameters - available for listing and labels only

BEAM_THICKNESS	thickness of the beam
BEAM_HEIGHT	height of the beam
BEAM_REFLINE_OFFSET	offset of the reference line relative to the axes of the beam
BEAM_PRIORITY	3D intersection priority index number
BEAM_MAT_RIGHT	surface attribute index of the beam on the right side of the reference line
BEAM_MAT_LEFT	surface attribute index of the beam on the left side of the reference line
BEAM_MAT_TOP	surface attribute index of the beam on the top
BEAM_MAT_BOTTOM	surface attribute index of the beam at the bottom
BEAM_MAT_END	surface attribute index of the beam at both ends
BEAM_OUTLINE_LINETYPE	line type of the beam outline
BEAM_AXES_LINETYPE	line type of the beam axes
BEAM_FILL	fill type of the beam
BEAM_BMAT_NAME	building material name of the beam
BEAM_FILL_PEN	pen of the beam fill
BEAM_SECT_PEN	pen of the contours of the beam cut surfaces
BEAM_FBGD_PEN	pen of the background of the fill of the beam

BEAM_DIRECTION	the direction of the beam reference line
BEAM_POSITION	absolute coordinates of the beam axis starting point
BEAM_LENGTH_RIGHT	length of the beam on the right side of the reference line
BEAM_LENGTH_LEFT	length of the beam on the left side of the reference line
BEAM_RIGHT_SURF	surface area of the beam on the right side of the reference line
BEAM_LEFT_SURF	surface area of the beam on the left side of the reference line
BEAM_TOP_SURF	surface area of the top of the beam
BEAM_BOTTOM_SURF	surface area of the bottom of the beam
BEAM_END_SURF	surface area of both ends of the beam
BEAM_VOLUME	volume of the beam
BEAM_VOLUME_CON	conditional volume of the beam
BEAM_HOLES_NR	number of holes in the beam
BEAM_HOLES_SURF	total surface area of holes in the beam
BEAM_HOLE_EDGE_SURF	total surface area of hole edges in the beam
BEAM_HOLES_VOLUME	total volume of holes in the beam
BEAM_CROSSSECTION_TYPE *0 - complex profiled, 1 - rectangular*	cross-section type of the beam
BEAM_PROFILE_NAME	name of the profile of the beam, if complex

Slab parameters - available for listing and labels only

SLAB_THICKNESS	thickness of the slab
SLAB_ELEVATION_TOP	top elevation of the slab
SLAB_ELEVATION_BOTTOM	bottom elevation of the slab
SLAB_MAT_TOP	surface attribute index of the top surface of the slab
SLAB_MAT_EDGE	surface attribute index of the edges of the slab

SLAB_MAT_BOTT	surface attribute index of the bottom surface of the slab
SLAB_LINETYPE	line type of the slab
SLAB_FILL *fill index - its value is negative in case of a composite structure*	fill of the slab
SLAB_FILL_PEN	pen of the fill of the slab
SLAB_FBGD_PEN	pen of the background of the fill of the slab
SLAB_COMPS_NAME	name of the composite structure of the slab
SLAB_BMAT_NAME	building material name of the slab, empty string for composite slabs
SLAB_SKINS_NUMBER *range of 1 to 8, 0 if single fill applied*	number of composite slab skins
SLAB_SKINS_PARAMS *array with 16 columns with arbitrary number of rows:* • *[1] fill* • *[2] thickness* • *[3] (old contour pen)* • *[4] pen of fill* • *[5] pen of fill background* • *[6] core status* • *[7] upper line pen* • *[8] upper line type* • *[9] lower line pen* • *[10] lower line type* • *[11] end face pen* • *[12] fill orientation* • *[13] skin type* • *[14] end face line type* • *[15] finish skin status* • *[16] oriented fill status* *core status: 0 - not part, 1 - part, 3 - last skin of core, fill orientation: 0 - global, 1 - local; skin type: in the current ARCHICAD always 0 - cut, it can be used as in walls later; finish skin status: 0 not finish skin, 1: finish skin*	parameters of the composite slab skins

SLAB_SKINS_BMAT_NAMES	building material names of the composite slab skins
array with 1 column: building material name of the skin and with arbitrary number of rows.	
SLAB_SECT_PEN	pen of the contours of the slab in section
applied on contours of cut surfaces in both floor plan and section/elevation windows	
SLAB_VIEW_PEN	pen of the slab
applied on all edges in 3D window and on visible edges in section/elevation windows	
SLAB_TOP_SURF	top surface area of the slab
not reduced by the surface area of holes	
SLAB_GROSS_TOP_SURF	gross surface area of the slab top without hole
reduced by the surface area of holes	
SLAB_TOP_SURF_CON	conditional top surface area of the slab
reduced by the surface area of holes, which are bigger than the given value	
SLAB_BOT_SURF	bottom surface area of the slab without hole
not reduced by the surface area of holes	
SLAB_GROSS_BOT_SURF	gross surface area of the slab bottom
reduced by the surface area of holes	
SLAB_BOT_SURF_CON	conditional bottom surface area of the slab
reduced by the surface area of holes, which are bigger than the given value	
SLAB_EDGE_SURF	surface area of the edges of the slab
not reduced by the surface area of holes	
SLAB_GROSS_EDGE_SURF	gross surface area of the slab edges without hole
reduced by the surface area of holes	
SLAB_PERIMETER	perimeter of the slab
SLAB_VOLUME	volume of the slab
not reduced by the volume of holes	

SLAB_GROSS_VOLUME *reduced by the volume of holes*	gross volume of the slab without hole
SLAB_VOLUME_CON *reduced by the volume of holes, which are bigger than the given value*	conditional volume of the slab
SLAB_SEGMENTS_NR	number of segments of the slab
SLAB_HOLES_NR	number of holes in the slab
SLAB_HOLES_AREA	area of holes in the slab
SLAB_HOLES_PRM	perimeter of holes in the slab
SLAB_GROSS_TOP_SURF_WITH_HOLES	gross surface area of the slab top
SLAB_GROSS_BOT_SURF_WITH_HOLES	gross surface area of the slab bottom
SLAB_GROSS_EDGE_SURF_WITH_HOLES	gross surface area of the slab edges
SLAB_GROSS_VOLUME_WITH_HOLES	gross volume of the slab

Roof parameters - available for skylights, listing and labels

ROOF_THICKNESS	thickness of the roof
ROOF_ANGLE	slope of the roof
ROOF_MAT_TOP	surface attribute index of the top surface of the roof
ROOF_MAT_EDGE	surface attribute index of the edges of the roof
ROOF_MAT_BOTT	surface attribute index of the bottom surface of the roof
ROOF_LINETYPE *applied on the contours only in the floor plan window*	line type of the roof
ROOF_FILL *fill index - its value is negative in case of a composite structure*	fill of the roof
ROOF_FILL_PEN	pen of the fill of the roof
ROOF_FBGD_PEN	pen of the background of the fill of the roof

ROOF_COMPS_NAME	name of the composite structure of the roof
ROOF_BMAT_NAME	building material name of the roof, empty string for composite roofs
ROOF_SKINS_NUMBER	number of composite roof skins
range of 1 to 8, 0 if single fill applied	
ROOF_SKINS_PARAMS	parameters of the composite roof skin
array with 16 columnswith arbitrary number of rows: • *[1] fill* • *[2] thickness* • *[3] (old contour pen)* • *[4] pen of fill* • *[5] pen of fill background* • *[6] core status* • *[7] upper line pen* • *[8] upper line type* • *[9] lower line pen* • *[10] lower line type* • *[11] end face pen* • *[12] fill orientation* • *[13] skin type* • *[14] end face line type* • *[15] finish skin status* • *[16] oriented fill status* *core status: 0 - not part, 1 - part, 3 - last skin of core, fill orientation: 0 - global, 1 - local; skin type: in the current ARCHICAD always 0 - cut, it can be used as in walls later; finish skin status: 0 not finish skin, 1: finish skin*	
ROOF_SKINS_BMAT_NAMES	building material names of the composite roof skin
array with 1 column: building material name of the skin and with arbitrary number of rows.	
ROOF_SECT_PEN	pen of the contours of the roof cut surfaces
applied on contours of cut surfaces both in floor plan and section/elevation windows	
ROOF_VIEW_PEN	pen of the roof on view
applied on all edges in 3D window and on outline edges (edges on view below cutting plane) in floor plan and section/elevation windows	

Roof parameters - available for listing and labels only

ROOF_BOTTOM_SURF	bottom surface area of the roof
not reduced by the surface area of the holes, which are bigger than the given value	
ROOF_GROSS_BOTTOM_SURF	gross surface area of the roof bottom
reduced by the surface area of the holes	
ROOF_BOTTOM_SURF_CON	conditional bottom surface area of the roof
reduced by the surface area of the holes, which are bigger than the given value	
ROOF_TOP_SURF	top surface area of the roof
not reduced by the surface area of the holes, which are bigger than the given value	
ROOF_GROSS_TOP_SURF	gross surface area of the roof top
reduced by the surface area of the holes	
ROOF_TOP_SURF_CON	conditional surface area of the roof
reduced by the surface area of the holes, which are bigger than the given value	
ROOF_EDGE_SURF	surface area of the edge of the roof
not reduced by the surface area of the holes	
ROOF_GROSS_EDGE_SURF	gross surface area of the roof edges
reduced by the surface area of the holes	
ROOF_CONTOUR_AREA	area covered by the roof
ROOF_PERIMETER	perimeter of the roof
ROOF_VOLUME	volume of the roof
not reduced by the volume of holes	
ROOF_GROSS_VOLUME	gross volume of the roof
reduced by the volume of holes	
ROOF_VOLUME_CON	conditional volume of the roof
reduced by the volume of holes, which are bigger than the given value	

ROOF_SEGMENTS_NR	number of segments of the roof
ROOF_HOLES_NR	number of holes in the roof
ROOF_HOLES_AREA	area of holes in the roof
ROOF_HOLES_PRM	perimeter of holes in the roof
ROOF_INSU_THICKNESS	roof insulation skin thickness
ROOF_RIDGE	roof ridges length
ROOF_VALLEY	roof valleys length
ROOF_GABLE	roof gables length
ROOF_HIP	roof hips length
ROOF_EAVES	roof eaves length
ROOF_PEAK	roof peaks length
ROOF_SIDE_WALL	roof side wall connection length
ROOF_END_WALL	roof end wall connection length
ROOF_TRANSITION_DOME	roof dome connection length
ROOF_TRANSITION_HOLLOW	roof hollow connection length

Fill parameters - available for listing and labels only

FILL_LINETYPE	line type of the fill
FILL_FILL	fill type of the fill
FILL_BMAT_NAME	building material name of the fill
FILL_FILL_PEN	pen of the fill pattern of the fill
FILL_PEN	pen of the fill
FILL_FBGD_PEN	pen of the background of the fill
FILL_SURF	area of the fill
FILL_PERIMETER	perimeter of the fill

FILL_SEGMENT_NR	number of segments of the fill
FILL_HOLES_NR	number of holes in the fill
FILL_HOLES_PRM	perimeter of holes in the fill
FILL_HOLES_AREA	area of holes in the fill
FILL_FILL_CATEGORY *0 - Draft, 1 - Cut, 2 - Cover*	fill category of the fill

Mesh parameters - available for listing and labels only

MESH_TYPE *1- closed body, 2 - top & edge, 3 - top surface only*	type of the mesh
MESH_BASE_OFFSET	offset of the bottom surface to the base level
MESH_USEREDGE_PEN	pen of the user defined ridges of the mesh
MESH_TRIEDGE_PEN	pen of the triangulated edges of the mesh
MESH_SECT_PEN *applied on contours of cut surfaces of walls both in floor plan and section/elevation windows*	pen of the contours of the mesh in section
MESH_VIEW_PEN *applied on all edges in 3D window and on edges on view in section/elevation windows*	pen of the contours on view
MESH_MAT_TOP	surface attribute index of the top surface of the mesh
MESH_MAT_EDGE	surface attribute index of the edges of the mesh
MESH_MAT_BOTT	surface attribute index of the bottom surface of the mesh
MESH_LINETYPE *applied on the contours only in the floor plan window*	line type of the mesh
MESH_FILL	fill type of the mesh
MESH_BMAT_NAME	building material name of the mesh
MESH_FILL_PEN	pen of the fill of the mesh

MESH_FBGD_PEN	pen of the background of the fill of the mesh
MESH_BOTTOM_SURF	bottom surface area of the mesh
MESH_TOP_SURF	top surface area of the mesh
MESH_EDGE_SURF	surface area of the edge of the mesh
MESH_PERIMETER	perimeter of the mesh
MESH_VOLUME	volume of the mesh
MESH_SEGMENTS_NR	number of segments of the mesh
MESH_HOLES_NR	number of holes in the mesh
MESH_HOLES_AREA	area of holes in the mesh
MESH_HOLES_PRM	perimeter of holes in the mesh

Curtain Wall parameters - available for listing and labels only

CWALL_ID	user ID of the curtain wall
CWALL_FRAMES_LENGTH	length of frames in the curtain wall
CWALL_CONTOUR_FRAMES_LENGTH	length of frames on contour in the curtain wall
CWALL_MAINAXIS_FRAMES_LENGTH	length of frames on primary gridlines in the curtain wall
CWALL_SECAXIS_FRAMES_LENGTH	length of frames on secondary gridlines in the curtain wall
CWALL_CUSTOM_FRAMES_LENGTH	length of other frames in the curtain wall
CWALL_PANELS_SURF	surface area of panels in the curtain wall
CWALL_PANELS_SURF_N	surface area of north panels in the curtain wall
CWALL_PANELS_SURF_S	surface area of south panels in the curtain wall
CWALL_PANELS_SURF_E	surface area of east panels in the curtain wall
CWALL_PANELS_SURF_W	surface area of west panels in the curtain wall
CWALL_PANELS_SURF_NE	surface area of northeast panels in the curtain wall
CWALL_PANELS_SURF_NW	surface area of northwest panels in the curtain wall

CWALL_PANELS_SURF_SE	surface area of southeast panels in the curtain wall
CWALL_PANELS_SURF_SW	surface area of southwest panels in the curtain wall
CWALL_SURF	surface area of the curtain wall
CWALL_SURF_BOUNDARY	surface area of the curtain wall bordered by boundary frames
CWALL_LENGTH	length of the curtain wall
CWALL_HEIGHT	height of the curtain wall
CWALL_SLANT_ANGLE	slant angle of the curtain wall
CWALL_THICKNESS	thickness of the curtain wall
CWALL_PANELS_NR	number of panels in the curtain wall
CWALL_PATTERN_ANGLE	pattern angle of the curtain wall

Curtain Wall Frame parameters - available for listing and labels only

CWFRAME_TYPE *'Invisible', 'Generic', 'Butt-glazed' or the name of the GDL object*	type of the frame
CWFRAME_CLASS *0 - mullion, 1 - transom, 2 - boundary, 3 - custom*	class of the frame
CWFRAME_POSITION *0 - primary gridline, 1 - secondary gridline, 2 - boundary, 3 - other*	location of the frame
CWFRAME_DIRECTION *degree between 0 and 90*	slant angle of the frame
CWFRAME_WIDTH	width of the frame
CWFRAME_DEPTH	depth of the frame
CWFRAME_LENGTH	length of the frame
CWFRAME_MAT	surface attribute index of the frame

Curtain Wall Panel parameters - available for listing and labels only

CWPANEL_TYPE *"Generic" or the name of the GDL object*	type of the panel
CWPANEL_CLASS *0 - main, 1 - distinct, 2 - custom*	class of the panel
CWPANEL_VERTICAL_DIRECTION *degree between -90 and 90*	slant angle of exterior surface of the panel
CWPANEL_HORIZONTAL_DIRECTION *degree between -180 and 180*	angle of exterior surface of the panel from Project North
CWPANEL_WIDTH	width of the panel
CWPANEL_NOMINAL_WIDTH	nominal width of the panel
CWPANEL_HEIGHT	height of the panel
CWPANEL_NOMINAL_HEIGHT	nominal height of the panel
CWPANEL_THICKNESS	thickness of the panel
CWPANEL_SURF	surface area of the panel
CWPANEL_GROSS_SURF	gross surface area of the panel
CWPANEL_NOMINAL_SURF	nominal surface area of the panel
CWPANEL_PERIMETER	perimeter of the panel
CWPANEL_MAT_OUTER	surface attribute index for the exterior surface of the panel
CWPANEL_MAT_INNER	surface attribute index for the interior surface of the panel
CWPANEL_MAT_CUT	surface attribute index for the edge of the panel
CWPANEL_FUNCTION *0 - fixed, 1 - door, 2 - window*	function of the panel
CWPANEL_ORIENTATION *left/right*	opening orientation of door/window panel

Curtain Wall Junction parameters - available for listing and labels only

CWJUNC_TYPE *name of the GDL object*	type of the junction

Curtain Wall Accessory parameters - available for listing and labels only

CWACC_TYPE *name of the GDL object*	type of the accessory

Migration parameters - available for migration scripts only

FROM_GUID	Main GUID of the library part which was placed originally
TO_GUID	Main GUID of the library part to which the migration is performed

Skylight parameters - available for listing and labels only

SKYL_MARKER_TXT	skylight marker text
SKYL_OPENING_SURF	skylight opening surface
SKYL_OPENING_VOLUME	volume of the opening cut by the skylight
SKYL_OPENING_HEIGHT	skylight opening height
SKYL_OPENING_WIDTH	skylight opening width
SKYL_HEADER_HEIGHT	skylight header height
SKYL_SILL_HEIGHT	skylight sill height

Common Parameters for Shells and Roofs - available for listing and labels only

SHELLBASE_THICKNESS *equal to ROOF_THICKNESS for roofs*	thickness of the shell/roof/slab
SHELLBASE_MAT_REFERENCE *equal to ROOF_MAT_BOTT for roofs*	material of the bottom surface of the shell/roof

SHELLBASE_MAT_EDGE	material of the edges of the shell/roof
equal to ROOF_MAT_EDGE for roofs	
SHELLBASE_MAT_OPPOSITE	material of the top surface of the shell/roof
equal to ROOF_MAT_TOP for roofs	
SHELLBASE_LINETYPE	line type of the shell/roof
applied on the contours only in the floor plan window, equal to ROOF_LINETYPE for roofs	
SHELLBASE_FILL	fill of the shell/roof
fill index - its value is negative in case of a composite structure, equal to ROOF_FILL for roofs	
SHELLBASE_FILL_PEN	pen of the fill of the roof shell/roof
equal to ROOF_FILL_PEN for roofs	
SHELLBASE_FBGD_PEN	pen of the background of the fill of the shell/roof
equal to ROOF_FBGD_PEN for roofs	
SHELLBASE_COMPS_NAME	name of the composite structure of the shell/roof
equal to ROOF_COMPS_NAME for roofs	
SHELLBASE_BMAT_NAME	building material name of the shell/roof
equal to ROOF_BMAT_NAME for roofs	
SHELLBASE_SKINS_NUMBER	number of composite roof skins shell/roof
range of 1 to 8, 0 if single fill applied, equal to ROOF_SKINS_NR for roofs	

SHELLBASE_SKINS_PARAMS parameters of the composite roof skin shell/roof

array with 16 columnswith arbitrary number of rows:

- *[1] fill*
- *[2] thickness*
- *[3] (old contour pen)*
- *[4] pen of fill*
- *[5] pen of fill background*
- *[6] core status*
- *[7] upper line pen*
- *[8] upper line type*
- *[9] lower line pen*
- *[10] lower line type*
- *[11] end face pen*
- *[12] fill orientation*
- *[13] skin type*
- *[14] end face line type*
- *[15] finish skin status*
- *[16] oriented fill status*

core status: 0 - not part, 1 - part, 3 - last skin of core, fill orientation: 0 - global, 1 - local; skin type: in the current ARCHICAD always 0 - cut, it can be used as in walls later; finish skin status: 0 not finish skin, 1: finish skin

equal to ROOF_SKINS_PARAMS for roofs

SHELLBASE_SKINS_BMAT_NAMES building material names of the composite roof skin shell/roof

array with 1 column: building material name of the skin and with arbitrary number of rows.

equal to ROOF_SKINS_BMAT_NAMES for roofs

SHELLBASE_SECT_PEN pen of the contours of the roof cut surfaces shell/roof

applied on contours of cut surfaces both in floor plan and section/elevation windows, equal to ROOF_SECT_PEN for roofs

SHELLBASE_VIEW_PEN pen of the roof on view shell/roof

applied on all edges in 3D window and on outline edges (edges on view below cutting plane) in floor plan and section/elevation windows, equal to ROOF_VIEW_PEN for roofs

SHELLBASE_REFERENCE_SURF reference side surface of the shell/roof

not reduced by the surface of holes, equal to ROOF_BOTTOM_SURF for roofs

SHELLBASE_COND_REFERENCE_SURF	conditional reference side surface of the shell/roof
equal to ROOF_BOTTOM_SURF_CON for roofs	
SHELLBASE_GROSS_REFERENCE_SURF	gross surface of the shell/roof reference side
reduced by the surface of the holes, equal to ROOF_GROSS_BOTTOM_SURF for roofs	
SHELLBASE_OPPOSITE_SURF	surface of the opposite side to the reference side of the shell/roof
not reduced by the surface of holes, equal to ROOF_TOP_SURF for roofs	
SHELLBASE_COND_OPPOSITE_SURF	conditional surface of the opposite side to the reference side of the shell/roof
reduced by the surface of the holes, which are bigger than the given value; equal to ROOF_TOP_SURF_CON for roofs	
SHELLBASE_GROSS_OPPOSITE_SURF	gross surface of the opposite side to the reference side of the shell/roof
reduced by the surface of the holes, equal to ROOF_GROSS_TOP_SURF for roofs	
SHELLBASE_EDGE_SURF	surface of the edge of the shell/roof
not reduced by the surface of holes, equal to ROOF_EDGE_SURF for roofs	
SHELLBASE_GROSS_EDGE_SURF	gross surface of the shell/roof edges
reduced by the surface of holes, equal to ROOF_GROSS_EDGE_SURF for roofs	
SHELLBASE_PERIMETER	perimeter of the shell/roof
equal to ROOF_PERIMETER for roofs	
SHELLBASE_VOLUME	volume of the shell/roof
not reduced by the volume of holes, equal to ROOF_VOLUME for roofs	
SHELLBASE_COND_VOLUME	conditional volume of the roof shell/roof
reduced by the volume of holes, which are bigger than the given value; equal to ROOF_VOLUME_CON for roofs	
SHELLBASE_GROSS_VOLUME	gross volume of the roof shell/roof
reduced by the volume of holes, equal to ROOF_GROSS_VOLUME for roofs	
SHELLBASE_HOLES_NR	number of holes in the shell/roof
equal to ROOF_HOLES_NR for roofs	

SHELLBASE_HOLES_SURF *equal to ROOF_HOLES_AREA for roofs*	surface of holes in the shell/roof
SHELLBASE_HOLES_PRM *equal to ROOF_HOLES_PRM for roofs*	perimeter of holes in the shell
SHELLBASE_OPENINGS_NR	number of openings in the shell
SHELLBASE_OPENINGS_SURF	surface of openings in the shell
SHELLBASE_INSU_THICKNESS *equal to ROOF_INSU_THICKNESS for roofs*	shell/roof insulation skin thickness
SHELLBASE_RIDGE *equal to ROOF_RIDGE for roofs*	shell/roof ridges length
SHELLBASE_VALLEY *equal to ROOF_VALLEY for roofs*	shell/roof valleys length
SHELLBASE_GABLE *equal to ROOF_GABLE for roofs*	shell/roof gables length
SHELLBASE_HIP *equal to ROOF_HIP for roofs*	shell/roof hips length
SHELLBASE_EAVES *equal to ROOF_EAVES for roofs*	shell/roof eaves length
SHELLBASE_PEAK *equal to ROOF_PEAK for roofs*	shell/roof peaks length
SHELLBASE_SIDE_WALL *equal to ROOF_SIDE_WALL for roofs*	shell/roof side wall connection length
SHELLBASE_END_WALL *equal to ROOF_END_WALL for roofs*	shell/roof end wall connection length

SHELLBASE_TRANSITION_DOME *equal to ROOF_TRANSITION_DOME for roofs*	shell/roof dome connection length
SHELLBASE_TRANSITION_HOLLOW *equal to ROOF_TRANSITION_HOLLOW for roofs*	shell/roof hollow connection length

Parameters for Morphs - available for listing and labels only

MORPH_LINETYPE	Line type of the morph on view
MORPH_FILL	Fill of the morph cut surfaces
MORPH_BMAT_NAME	Building material name of the morph cut surfaces
MORPH_FILL_PEN	Pen of the morph cut surfaces
MORPH_FBGD_PEN	Pen of the background of the fill of the morph cut surfaces
MORPH_SECT_LINETYPE	Line type of the contours of the morph cut surfaces
MORPH_SECT_PEN	Pen of the contours of the moprh cut surfaces
MORPH_VIEW_PEN	Pen of the contours of the morph on view
MORPH_SOLID	Morph body solid (on/off)
MORPH_MAT_DEFAULT	Morph default material
MORPH_CASTS_SHADOW	Cast shadow (on/off)
MORPH_RECEIVES_SHADOW	Receive shadow (on/off)
MORPH_SURFACE	Gross surface of the morph
MORPH_VOLUME	Volume of the morph
MORPH_FLOOR_PERIMETER	perimeter of the morph on the floor plan

Free users' globals

GLOB_USER_1
GLOB_USER_2
GLOB_USER_3

GLOB_USER_4	
GLOB_USER_5	
GLOB_USER_6	
GLOB_USER_7	
GLOB_USER_8	
GLOB_USER_9	
GLOB_USER_10	free variables 1 to 10 are initialized to number by default
GLOB_USER_11	
GLOB_USER_12	
GLOB_USER_13	
GLOB_USER_14	
GLOB_USER_15	
GLOB_USER_16	
GLOB_USER_17	
GLOB_USER_18	
GLOB_USER_19	
GLOB_USER_20	free variables 11 to 20 are initialized to string by default

Example usage of global variables

Example: Illustrating the usage of the GLOB_WORLD_ORIGO_... globals

```
ADD2 -GLOB_WORLD_ORIGO_OFFSET_X-SYMB_POS_X, -GLOB_WORLD_ORIGO_OFFSET_X-SYMB_POS_Y
LINE2 -0.1, 0.0, 0.1, 0.0
LINE2 0.0, -0.1, 0.0, 0.1
HOTSPOT2 0.0, 0.0, 1
TEXT2 0, 0, "( 0.00 ; 0.00 )"
TEXT2 0, 0.5, "World Origin"
DEL TOP
if ABS(GLOB_WORLD_ORIGO_OFFSET_X) > 0.01 OR\
         ABS(GLOB_WORLD_ORIGO_OFFSET_Y) > 0.01 THEN
    ADD2 - SYMB_POS_X, - SYMB_POS_Y
    LINE2 -0.1, 0.0, 0.1, 0.0
    LINE2 0.0, -0.1, 0.0, 0.1
    HOTSPOT2 0.0, 0.0, 2
    TEXT2 0, 0, "(" +
            STR (GLOB_WORLD_ORIGO_OFFSET_X, 9, 4) + "; " +
            STR (GLOB_WORLD_ORIGO_OFFSET_Y, 9, 4) + " )"
    TEXT2 0, 0.5, "Virtual Origin"
    DEL TOP
ENDIF
if ABS(GLOB_WORLD_ORIGO_OFFSET_X + SYMB_POS_X) > 0.01 OR\
         ABS(GLOB_WORLD_ORIGO_OFFSET_Y + SYMB_POS_Y) > 0.01 THEN
    LINE2 -0.1, 0.0, 0.1, 0.0
    LINE2 0.0, -0.1, 0.0, 0.1
    HOTSPOT2 0.0, 0.0, 3
    TEXT2 0, 0, "(" +
            STR (GLOB_WORLD_ORIGO_OFFSET_X + SYMB_POS_X, 9, 4) + "; " +
            STR (GLOB_WORLD_ORIGO_OFFSET_Y + SYMB_POS_Y, 9, 4) + " )"
    TEXT2 0, 0.5, "Object Placement"
ENDIF
```

Deprecated Global Variables

These globals are still working in ARCHICAD's environment for compatibility reasons, but we recommend avoiding them during new object creation.

GLOB_CONTEXT	context of appearance (view dependent, do not use in parameter script)

1 - library part editor, 2 - floor plan, 3 - 3D view, 4 - section/elevation, 5 - settings dialog, 6 - list, 7 - detail drawing, 8 - layout, 22 - editing feedback mode from the floor plan, 23 - editing feedback mode from a 3D view, 24 - editing feedback mode from a section/elevation, 28 - editing feedback mode from a layout, 43 - generating as an operator from a 3D view, 44 - generating as an operator from a section/elevation, 46 - generating as an operator from a list. See the section called "GDL execution contexts" for more details.

Old Global Variables

Old global variable names can be used; however, the use of the new names is recommended. Each old global corresponds to a new variable with a long name.

A_	GLOB_SCALE
B_	GLOB_HSTORY_ELEV
C_	WALL_THICKNESS
D_	WALL_HEIGHT
E_	WALL_SECT_PEN
F_	WALL_FILL_PEN
G_	WALL_MAT_A
H_	WALL_MAT_B
I_	WALL_MAT_EDGE
J_	GLOB_ELEVATION
K_	WIDO_SILL
L_	SYMB_VIEW_PEN
M_	SYMB_MAT
N_	GLOB_FRAME_NR
O_	GLOB_FIRST_FRAME
P_	GLOB_LAST_FRAME
Q_	GLOB_HSTORY_HEIGHT
R_	WIDO_ORIG_DIST
S_	GLOB_USER_1
T_	GLOB_USER_2
U_	GLOB_USER_3
V_	GLOB_USER_4
W_	GLOB_USER_5
X_	GLOB_USER_6
Y_	GLOB_USER_7
Z_	GLOB_USER_8

A~	WALL_FILL
B~	WIDO_RIGHT_JAMB
C~	WIDO_THRES_DEPTH
D~	WIDO_HEAD_DEPTH
E~	WIDO_REVEAL_SIDE
F~	WIDO_FRAME_THICKNESS
G~	GLOB_USER_9
H~	WIDO_POSITION
I~	GLOB_USER_10
J~	WALL_RESOL
K~	GLOB_EYEPOS_X
L~	GLOB_EYEPOS_Y
M~	GLOB_EYEPOS_Z
N~	GLOB_TARGPOS_X
O~	GLOB_TARGPOS_Y
P~	GLOB_TARGPOS_Z
Q~	GLOB_CSTORY_ELEV
R~	GLOB_CSTORY_HEIGHT
S~	GLOB_CH_STORY_DIST
T~	GLOB_SCRIPT_TYPE
U~	GLOB_NORTH_DIR
V~	SYMB_MIRRORED
W~	SYMB_ROTANGLE
X~	SYMB_POS_X
Y~	SYMB_POS_Y
Z~	SYMB_POS_Z

FIX NAMED OPTIONAL PARAMETERS

Parameters set by ARCHICAD

The new method of ARCHICAD for providing information is the method of fixed named optional parameters. If a given library part has a parameter matching a fix named optional parameter in name and in type, ARCHICAD sets its value according to its function.

Parameters for D/W attributes (available for Door, Window, Label, Listing)

Floor plan display

ac_hole_cut_linetype	linetype
pen of cut lines [floor plan and section]	
ac_hole_overhead_pen	pen
pen of the above view edges (overhead) [floor plan only]	
ac_hole_overhead_linetype	linetype
line type of the above view edges (overhead) [floor plan only]	
ac_hole_uncut_pen	pen
pen of the below view edges (uncut) [floor plan only]	
ac_hole_uncut_linetype	linetype
line type of the below view edges (uncut) [floor plan only]	
ac_hole_display_option	integer
floor plan display option: 1 - Projected, 2 - Projected with Overhead, 3 - Symbolic, 5 - Overhead All	

Direction

ac_hole_direction_type	integer
opening plane direction: 1 - Associated to Wall, 2 - Vertical	
ac_wido_rotation	angle
door/window rotation angle relative to the horizontal cut plane	
ac_openingside	string
door/window orientation parameter for listing (L - left, R - right, Custom) according to orientation definition settings (Automatic, Custom). ARCHICAD will disregard any settings of Compatibility Options/Orientation Displaying if this parameter is present.	

Polygonal wall data

ac_walltype	integer
tells whether the window is in a polygonal wall or not. 1 - non polygonal, 2 - polygonal.	
ac_wallContourPolygon[][3]	length
The polygon of the wall in 2D points plus an extra angle value for arc sections. [set only if **ac_walltype** *equals 2]*	
ac_windowInWallContour[4]	integer
Indices of the four vertices of the **ac_wallContourPolygon** *polygon that part of the wall contour polygon as window corner points. [set only if* **ac_walltype** *equals 2]*	

Hole position

ac_hole_position_angle	angle
In case of curved walls it gives the angle between the axis of the opening and the normal vector at the wall's starting point.	

Anchor data

ac_vertAnchorPos	integer
vertical anchor of D/W: 1 - Sill, 2 - Header	
ac_revealAnchorPos	integer
reveal anchor of D/W: 1 - Face, 2 - Core	
ac_revealToWallCore	length
reveal depth measured from the reveal side of the wall core.	

Parameters for WALL attributes (available for Door, Window, Label, Listing)

Floor plan display

ac_wall_overhead_pen	pen
pen of the above view edges of the wall (overhead) [floor plan only]	
ac_wall_overhead_linetype	linetype
line type of the above view edges of the wall (overhead) [floor plan only]	

ac_wall_uncut_linetype	linetype
line type of the below view edges of the wall (uncut) [floor plan only]	
ac_wall_display_option	integer
floor plan display option of the wall: 1 - Projected, 2 - Projected with Overhead, 3 - Symbolic, 4 - OutLines Only, 5 - Overhead All	
ac_wall_show_projection_to	integer
vertical view depth limitation of the wall: 1 - To Floor Plan Range, 2 - To Absolute Display Limit, 3 - Entire Element	

Geometric data

ac_wall_elevation	length
elevation of the wall bottom, relative to home story of the wall	
ac_wall_crosssection_type	integer
wall cross section type: 1 - Simple, 2 - Complex, 3 - Slanted, 4 - Trapezoid	
ac_wall_profile_name	string
*profile name if the wall is complex with profile attribute, "Custom_Profile_i" if complex with custom profile (**i** being the id of the placed wall) or "n/a" if the wall is simple, slanted or trapezoid*	
ac_wall_slant_angle1	angle
first slant angle of the wall relative to the horizontal (90 degrees if the wall is vertical)	
ac_wall_slant_angle2	angle
second slant angle of the wall relative to the horizontal (90 degrees if the wall is vertical)	
ac_wall_direction_type	integer
wall direction type; the construction method of the wall, which means the adjustment of the wall body and the reference line: 0 - Right, 1 - Left, 2 - Center (Right), 3 - Center (Left). Center values mean that the wall is set to 'Center' in the user interface, but the side notation shows how the wall acts internally.	

Parameters for COLUMN attributes (available for Label, Listing)

Floor plan display

ac_colu_overhead_pen	pen
pen of the above view edges of the column (overhead) [floor plan only]	
ac_colu_overhead_linetype	linetype
line type of the above view edges of the column (overhead) [floor plan only]	
ac_colu_uncut_linetype	linetype
line type of the below view edges of the column (uncut) [floor plan only]	
ac_colu_display_option	integer
floor plan display option of the column: 1 - Projected, 2 - Projected with Overhead, 3 - Symbolic, 4 - OutLines Only, 5 - Overhead All	
ac_colu_show_projection_to	integer
vertical view depth limitation of the column: 1 - To Floor Plan Range, 2 - To Absolute Display Limit, 3 - Entire Element	

Geometric data

ac_colu_crosssection_type	integer
column cross section type: 1 - Rectangular, 2 - Round, 3 - Complex	
ac_colu_profile_name	string
*profile name if the column is complex with profile attribute, "Custom_Profile_i" if complex with custom profile (**i** being the id of the placed column) or "n/a" if the column is rectangular or round*	
ac_colu_inclination	angle
inclination angle of the column relative to the horizontal line	
ac_colu_twist_angle	angle
twist angle of the cross section	

Parameters for BEAM attributes (available for Label, Listing)

Floor plan display

ac_beam_overhead_pen	pen
pen of the above view edges of the beam(overhead) [floor plan only]	
ac_beam_overhead_linetype	linetype
line type of the above view edges of the beam (overhead) [floor plan only]	
ac_beam_uncut_pen	pen
pen of the below view edges of the beam (uncut) [floor plan only]	
ac_beam_uncut_linetype	linetype
line type of the below view edges of the beam (uncut) [floor plan only]	
ac_beam_display_option	integer
floor plan display option of the beam: 1 - Projected, 2 - Projected with Overhead, 3 - Symbolic, 4 - OutLines Only, 5 - Overhead All	
ac_beam_show_projection_to	integer
vertical view depth limitation of the beam: 1 - To Floor Plan Range, 2 - To Absolute Display Limit, 3 - Entire Element	

Geometric data

ac_beam_crosssection_type	integer
beam cross section type: 1 - Rectangular, 2 - Complex	
ac_beam_profile_name	string
*profile name if complex with profile attribute, "Custom_Profile_i" if complex with custom profile (**i** being the id of the placed beam) or "n/a" if the beam is rectangular*	
ac_beam_inclination	angle
inclination angle of the beam relative to the horizontal line	
ac_beam_twist_angle	angle
twist angle of the cross section (0.0 for non-complex beams)	

Parameters for ROOF attributes (available for Label, Listing)

Floor plan display

ac_roof_overhead_pen	pen
pen of the above view edges of the roof (overhead) [floor plan only]	
ac_roof_overhead_linetype	linetype
line type of the above view edges of the roof (overhead) [floor plan only]	
ac_roof_display_option	integer
floor plan display option of the roof: 1 - Projected, 2 - Projected with Overhead, 3 - Symbolic, 4 - OutLines Only, 5 - Overhead All	
ac_roof_show_projection_to	integer
vertical view depth limitation of the roof: 1 - To Floor Plan Range, 2 - To Absolute Display Limit, 3 - Entire Element	

Door/Window Marker attributes

ac_wido_id	string
ID of the opening	
ac_wido_a_size	length
opening width	
ac_wido_b_size	length
opening height	
ac_wido_z_size	length
opening depth/thickness	
ac_glob_elevation	length
elevation of the base line of the opening	
ac_wido_subfl_thickness	length
height of the subfloor wall part	

ac_wido_reveal_side	boolean
legacy opening reveal side value, use ac_wido_reveal_side_2 instead	
ac_wido_reveal_side_2	boolean
*reveal side, the value of the **WIDO_REVEAL_SIDE** global variable set for the opening*	
ac_wido_mirrored	boolean
mirrored state of the opening	
ac_wall_thickness	length
thickness of the wall at the origin of the opening	
ac_wido_oversize_l	length
left opening oversize	
ac_wido_oversize_r	length
right opening oversize	
ac_wido_oversize_t	length
top opening oversize	
ac_wido_oversize_b	length
bottom opening oversize	
ac_wido_orientation	string
marker position: "L" - Left, "R" - right, or any custom value set in the Details window of the library part editor according to the current mirrored state	
ac_wido_type	integer
1 - Door, 2 - Window	
ac_symb_rotangle	angle
opening rotation in the wall	
ac_sill_to_curr_story	length
sill height of the opening measured from the start of the story linked to the window sill	

ac_sill_to_anchor_level	length
sill height of the opening measured from the level of the anchor point; the anchor point may be the bottom of the wall or the selected story, accordingly	

Detail/Worksheet Marker attributes

ac_showboundary	boolean
Marker boundary polygon state. 0 - boundary off, 1 - boundary on.	

Curtain wall accessory attributes

ac_frameWidthLeft	length
Reference frame contour width 1 (usually a/2)	
ac_frameWidthRight	length
Reference frame contour width 2 (usually a/2)	
ac_frameWidthFront	length
Reference frame contour length 1 (usually b/2)	
ac_frameWidthBack	length
Reference frame contour length 2 (usually b/2)	
ac_accessoryFlipped	boolean
Accessory flipped state. 0 - not flipped, 1 - flipped	
ac_globalZDir	length, array
Vector of local z direction in the global coordinate system	
ac_validCellAngle1	boolean
Defines if there is cell 1 or not	
ac_validCellAngle2	boolean
Defines if there is cell 2 or not	
ac_cellAngle1	angle
The accessory's frame can be connected to maximum 2 cells. These cells are cell1 and cell2. Cell1 is the cell with the smaller angle from local Y direction, considering the positive direction of local X. Parameter ac_cellAngle1 is the angle between cell1 and local Y direction.	

ac_cellAngle2	angle
The accessory's frame can be connected to maximum 2 cells. These cells are cell1 and cell2. Cell2 is the cell with the greater angle from local Y direction, considering the positive direction of local X. Parameter ac_cellAngle2 is the angle between cell2 and local Y direction.	

Drawing Title attributes

ac_drawingName	string
Name of the drawing.	
ac_drawingNumber	string
ID of the drawing.	
ac_sourceFileName	string
Name of the drawing source file (if the drawing comes from an external file).	
ac_sourceFilePath	string
Path of the drawing source file (if the drawing comes from an external file).	
ac_drawingScale	string
Drawing scale set for the drawing.	
ac_magnification	real number
Magnification percentage set for the drawing.	
ac_originalDrawingScale	string
Drawing scale of the originating view.	
ac_enableBackReference	boolean
Back referencing is enabled for the drawing.	
ac_backReferenceGUIDList	string array
List of referred layout GUIDs. They can be used in autotext outputs.	
ac_showDrawingReferences	boolean
Show back references.	

General running context

ac_programVersion	integer

This parameter contains the version of ARCHICAD executing the library part's scripts.

Room parameters (available for Zone Stamps)

Name	Type	Default	Description
ROOM_NAME	String	""	Zone name
ROOM_NUMBER	String	""	Zone number
ROOM_LSIZE	Real	0.0	Font size
ROOM_AREA	Real	0.0	Area of gross/net polygon
ROOM_PERIM	Length	0.0	Perimeter of gross/net polygon
ROOM_HOLES_PRM	Length	0.0	Perimeter of net polygon holes
ROOM_WALLS_PRM	Length	0.0	Perimeter of net polygon (with holes) but only where bordered by wall
ROOM_CORNERS	Integer	0	Corners of net polygon (with holes)
ROOM_CONCAVES	Integer	0	Concave corners of net polygon (with holes)
ROOM_WALLS_SURF	Real	0.0	Bordering walls' surfaces (bordering parts)
ROOM_DOORS_WID	Real	0.0	Doors' lengths at border
ROOM_DOORS_SURF	Real	0.0	Doors' surfaces at border
ROOM_WINDS_WID	Length	0.0	Windows' lengths at border
ROOM_WINDS_SURF	Real	0.0	Windows' surfaces at border
ROOM_BASELEV	Length	0.0	Zone level
ROOM_FL_THICK	Length	0.0	Zone subfloor thickness
ROOM_HEIGHT	Length	0.0	Zone height
ROOM_NET_AREA	Real	0.0	Area of net polygon (with holes)
ROOM_NET_PERIMETER	Length	0.0	Perimeter of net polygon (with holes)
ROOM_WALL_EXTR_AREA	Real	0.0	Reducing area by walls inside zone (not zone boundary type!)

Name	Type	Default	Description
ROOM_COLUMN_EXTR_AREA	Real	0.0	Reducing area by columns inside zone (not zone boundary type!)
ROOM_FILL_EXTR_AREA	Real	0.0	Reducing area by hatches inside zone (considering percentage!)
ROOM_LOW_EXTR_AREA	Real	0.0	Reducing area by low parts (trimmed) (considering preferences!)
ROOM_TOTAL_EXTR_AREA	Real	0.0	Sum of previous values (total extraction)
ROOM_REDUCED_AREA	Real	0.0	ROOM_NET_AREA - ROOM_TOTAL_EXTR_AREA
ROOM_AREA_FACTOR	Real	0.0	1 - Reduced_by_in_dialog / 100
ROOM_CALC_AREA	Real	0.0	ROOM_REDUCED_AREA * ROOM_AREA_FACTOR
ROOM_VOLUME	Real	0.0	Calculated from trimmed room upon net polygon
ROOM_BOUNDARY_SURF	Real	0.0	Surface of boundary side pages
ROOM_TOP_SURFACE	Real	0.0	Surface of zone top
ROOM_BOT_SURFACE	Real	0.0	Surface of zone bottom
ROOM_ROOF_TOP_SURF	Real	0.0	Surface of zone top where trimmed by a Roof
ROOM_ROOF_BOT_SURF	Real	0.0	Surface of zone bottom where trimmed by a Roof
ROOM_SLAB_TOP_SURF	Real	0.0	Surface of zone top where trimmed by a Slab
ROOM_SLAB_BOT_SURF	Real	0.0	Surface of zone bottom where trimmed by a Slab
ROOM_BEAM_TOP_SURF	Real	0.0	Surface of zone top where trimmed by a Beam
ROOM_BEAM_BOT_SURF	Real	0.0	Surface of zone bottom where trimmed by a Beam
ROOM_WALL_IN_TOP_SURF	Real	0.0	Sum of top surfaces of wall insets (or recess or niche)
ROOM_WALL_IN_BACK_SURF	Real	0.0	Sum of back surfaces of wall insets (facing to window)
ROOM_WALL_IN_SIDE_SURF	Real	0.0	Sum of side surfaces of wall insets
AC_TextFont_1	String	0.0	Zone main text font
ROOM_POLY_STATUS	Integer	0	0:manual, 1:Auto, 2:Auto-refline

Parameters read by ARCHICAD

ARCHICAD can get values from library parts through parameters with predefined name and function. The list of such parameters follows below.

Objects on Floor Plan

Floor plan cutting of planar elements (i.e. skylight object, roof accessory objects)

ac_special_2d_symbol boolean

This parameter enables a 2D cutting mechanism in ARCHICAD floor plan. If the parameter is set to 1, ARCHICAD cuts the 2D model (generated by the 2D script of the libpart) according to the parameter values in: ac_symb_display_option, ac_symb_show_projection_to and ac_plane_definition. This 2D-based cut works like the display of simple roofs with the same settings. Naturally, this method gives correct output for plane-like elements only - like skylights and roof accessories. The plane of the flat object - and the plane of the cut - is defined by the parameter ac_plane_definition. In case of Skylight and Roof Accessory elements - if ac_special_2d_symbol is 1 -, the above parameters are set by the add-on automatically. In case of other elements, they should be filled in by the library developer.

ac_plane_definition length

Plane definition: ([1],[2],[3]): a point on the plane, ([4],[5],[6]): normal vector of the plane.

ac_symb_display_option integer

1 - Projected, 2 - Projected with Overhead, 3 - Symbolic, 4 - OutLines Only, 5 - Overhead All

ac_symb_show_projection_to integer

1 - To Floor Plan Range, 2 - To Absolute Display Limit, 3 - Entire Element

ac_bottomlevel length

This parameter indicates the lowest point of the object. When Show on Stories is set to All Relevant Stories, if this lowest point (calculated from the object's home story settings) is contained in a story's vertical extension, the object is displayed on the story. Top level has to be above the bottom level.

ac_bottomlevel *starts from the object origin of the object.*

ac_toplevel length

When Show on Stories is set to All Relevant Stories this parameter tells the top of the object. The object will be visible on a story if the story's height is between the bottomlevel and the toplevel. Top level has to be above the bottom level.

ac_toplevel *starts from the object origin of the object.*

Door/Window objects

ac_wido_sill	length
This parameter provides full access to the sill depth of the opening object. The parameter can get a value list, it can be locked and hidden and its value can be set via the parameter script. Its current value will be assigned to the WIDO_SILL global variable for compatibility with older scripts.	
ac_wido_hide_options	integer
Via this bitfield parameter you can disable options from the window/door settings dialog. **ac_wido_hide_options = j1 + 2*j2**. *If j1 is set, the sill depth inputs on the default ARCHICAD settings dialog is hidden. If j2 is set, the reveal settings in the settings dialog are disabled.*	
ac_wido_flip_once	boolean
Flips the window or door once after the execution of the migration script if the parameter is present and its value is **true**.	
ac_wido_flip_disable	integer
This parameter can disable the "Flip" button on the user interface. The default value affects only the placing of the object. *-1: Flip is enabled.* *0: Flip is disabled. The default is not flipped.* *1: Flip is disabled. The default is flipped.*	
ac_wido_mirror_once	boolean
Mirrors the window or door once after the execution of the migration script if the parameter is present and its value is **true**.	
ac_hole_hotspot_control	integer
Controls whether openings have automatic hotspots. 0 - No automatic hotspots, 1 - Only in 2D, 2 - Only in 3D, 3 - Everywhere	

Curtain wall panel attributes

ac_originIsFrameCenter	boolean
If the parameter is present and its value is **true**, *the panel origin is in the center point of the starting (left) frame. Otherwise, the origin is in the starting point of the left clamp.*	
ac_aSizeIsWithClamp	boolean
If the parameter is present and its value is **true**, *ARCHICAD sets the* ***A*** *size as the distance between the frames plus the clamps' size. Otherwise, the* ***A*** *size is measured between the frames.*	

Custom Component Template

ac_custom_component_type_name string

This parameter contains the name of the Custom Component Template which is displayed on the "Save Component As..." menu. It can differ from the object name.

Zone Stamp parameters

ac_disable_controls integer

This parameter can control the visibility of the Font Size input area of the Zone Stamp settings dialog: 0 or the object doesn't have the parameter - show Font Size, 1 - hide Font Size (therefore allowing extra space for the parameter list)

Label paremeters

ac_bDisableLabelFrameDisplay boolean

Compatibility: introduced in ARCHICAD 20.

Hides the built-in rectangular frame drawing around the Label Symbol in case of the built-in Pointer and Frame is set, enabling the user to script custom shaped frame.

ac_bCustomPointerConnection boolean

Compatibility: introduced in ARCHICAD 20.

Controls the automatic Pointer Connections of the Label Symbol in case of the built-in Pointer is set. If this parameter is set to ON, 6 hotspots can be defined in the 2D script for the custom pointer connection in accordance with the built-in types. These hotspots should have fix ID-s from 1 to 6. The ID's indicate the following connection positions:

If the Pointer is on the left side of the Label Symbol:

- *1: left top connection*
- *3: left middle connection*
- *5: left bottom connection*
- *6: right bottom connection*

If the Pointer is on the right side of the Label Symbol:

- *2: right top connection*
- *4: right middle connection*
- *6: right bottom connection*
- *5: left bottom connection*

Parameters for add-ons

Add-ons can get values from library parts through parameters with predefined name and function. The list of such parameters related to ARCHICAD package add-ons follows below.

Parameters of Skylight add-on

Hole edge cut manipulation

ac_edge_lower_type	integer
Cut type of the lower edge: 0 - Vertical, 1 - Perpendicular, 2 - Horizontal, 3 - Custom	
ac_edge_lower_angle	angle
Angle of the cut of the lower edge, if ac_edge_lower_type is 3. The value range is [1-179] degrees, 90 is the perpendicular case.	
ac_edge_upper_type	integer
Cut type of the upper edge: 0 - Vertical, 1 - Perpendicular, 2 - Horizontal, 3 - Custom	
ac_edge_upper_angle	angle
Angle of the cut of the upper edge, if ac_edge_upper_type is 3. The value range is [1-179] degrees, 90 is the perpendicular case.	

Parameters of Corner Window add-on

Basic parameters of Corner Window objects

ac_cw_function	boolean
Window place mode, controlled by the add-on. 0 - Window, 1 - Corner window	
ac_corner_window	boolean
Corner window mode selector, controlled by the object. 0 - Disable corner window mode, 1 - Enable corner window mode	
ac_corner_angle	angle
Angle between the connected walls.	
ac_diff_con_wall_thk	boolean
Always true (1). It is a historical feature showing whether the connected wall has a different thickness from the containing wall.	
ac_con_wall_thk	length
Thickness of the connected wall.	
ac_cw_debug	boolean
For internal usage only. Aspect of GDL programmers have no interest.	

Wall skins data parameters of Corner Window objects (available from ARCHICAD 12)

ac_con_wall_skins_number	integer
Number of skins in the connected wall. In case of solid walls it is zero.	
ac_con_wall_skins_params	length
Parameters of the connected composite wall skins. Same as the WALL_SKINS_PARAMS GDL global parameter of the owner wall.	
ac_con_wall_direction_type	integer
Connected wall flipped state; the flipped state of the wall, which means the adjustment of the wall body and the reference line: 0 - not flipped, 1 - flipped. (old meaning: 0 - Right, 1 - Left, 2 - Center (Right), 3 - Center (Left).)	

Parameters of IFC add-on

Common basic parameters of Door and Window objects

ifc_LiningDepth	length
Thickness of the door/window frame.	
ifc_LiningThickness	length
Width of the door/window frame.	
ifc_TransomThickness	length
Width of the transom.	

IFC2x_ConstEnum integer / string

This parameter defines the basic types of construction of doors/windows.

ifc_ConstEnum (integer) parameter value	***IFC2x_ConstEnum (string) parameter value***	***IfcDoorStyleConstructionEnum category*** ***IfcWindowStyleConstructionEnum category***
0	*Not Defined*	*NOTDEFINED*
1	*Aluminum*	*ALUMINIUM*
2	*High Grade Steel*	*HIGH_GRADE_STEEL*
3	*Steel*	*STEEL*
4	*Wood*	*WOOD*
5	*Aluminum Wood*	*ALUMINIUM_WOOD*
6	*Aluminum Plastic*	*ALUMINIUM_PLASTIC*
7	*Plastic*	*PLASTIC*
8	*User Defined*	*USERDEFINED*

Basic parameters of Door objects

ifc_optype - Doors integer / string

Door Opening Type, controlled by the IFC_optype_door.gsm macro.

ifc_optype (integer) parameter value	***ifc_optypestr (string) parameter value***	***IfcDoorStyleOperationEnum category***
0	*Not Defined*	*NOTDEFINED*
1	*Single Door Single Swing*	*SINGLE_SWING_LEFT* *SINGLE_SWING_RIGHT*
2	*Double Door Single Swing*	*DOUBLE_DOOR_SINGLE_SWING*
3	*Single Door Double Swing*	*DOUBLE_SWING_LEFT* *DOUBLE_SWING_RIGHT*
4	*Double Door Double Swing*	*DOUBLE_DOOR_DOUBLE_SWING*
5	*Double Door Single Swing Opposite*	*DOUBLE_DOOR_SINGLE_SWING_OPPOSITE_LEFT* *DOUBLE_DOOR_SINGLE_SWING_OPPOSITE_RIGHT*
6	*Single Door Sliding*	*SLIDING_TO_LEFT* *SLIDING_TO_RIGHT*
7	*Double Door Sliding*	*DOUBLE_DOOR_SLIDING*
8	*Single Door Folding*	*FOLDING_TO_LEFT* *FOLDING_TO_RIGHT*
9	*Double Door Folding*	*DOUBLE_DOOR_FOLDING*
10	*Revolving*	*REVOLVING*
11	*Rolling Up*	*ROLLINGUP*
12	*Other*	*USERDEFINED*

ifc_LiningOffset length

Offset of the door frame.

ifc_CasingDepth *Thickness of the door casing.*	length
ifc_CasingThickness *Width of the door casing.*	length
ifc_ThresholdDepth *Depth of the door threshold.*	length
ifc_ThresholdThickness *Thickness of the door threshold.*	length
ifc_ThresholdOffset *Offset of the door threshold.*	length
ifc_TransomOffset *Offset of the transom.*	length

ifc_DoorPanel	length - array

ifc_DoorPanel[x][1] - thickness of the door sash.
ifc_DoorPanel[x][2] - width of the door sash.

ifc_DoorPanel[x][3] parameter value	***IfcDoorPanelOperationEnum category***
0	*NOTDEFINED*
1	*SWINGING*
2	*DOUBLE_ACTING*
3	*SLIDING*
4	*FOLDING*
5	*REVOLVING*
6	*ROLLINGUP*
7	*USERDEFINED*

ifc_DoorPanel[x][4] parameter value	***IfcDoorPanelPositionEnum category***
0	*NOTDEFINED*
1	*LEFT*
2	*MIDDLE*
3	*RIGHT*

Basic parameters of Window objects

ifc_optype - Windows	integer / string

Window Opening Type, controlled by the IFC_optype_door.gsm macro.

ifc_optype (integer) parameter value	***ifc_optypestr (string) parameter values***	***IfcWindowStyleOperationEnum category***
0	*Not Defined*	*NOTDEFINED*
1	*Single*	*SINGLE_PANEL*
2	*Double Vertical*	*DOUBLE_PANEL_VERTICAL*
3	*Double Horizontal*	*DOUBLE_PANEL_HORIZONTAL*
4	*Triple Vertical*	*TRIPLE_PANEL_VERTICAL*
5	*Triple Horizontal*	*TRIPLE_PANEL_HORIZONTAL*
6	*Triple Bottom*	*TRIPLE_PANEL_BOTTOM*
7	*Triple Top*	*TRIPLE_PANEL_TOP*
8	*Triple Left*	*TRIPLE_PANEL_LEFT* *TRIPLE_PANEL_RIGHT*
9	*Triple Right*	*TRIPLE_PANEL_RIGHT* *TRIPLE_PANEL_RIGHT*
10	*Other*	*USERDEFINED*

ifc_MullionThickness	ifc_MullionThickness - length

Width of the mullion.

ifc_FirstMullionOffset	ifc_FirstMullionOffset - length

Offset of the mullion centerline.

ifc_SecondMullionOffset	ifc_SecondMullionOffset - length

Offset of the mullion centerline of the second mullion.

ifc_FirstTransomOffset	ifc_FirstTransomOffset - length

Offset of the transom centerline.

ifc_SecondTransomOffset *Offset of the transom centerline for the second mullion.*	ifc_SecondTransomOffset - length

ifc_WindowPanel	length - array

ifc_WindowPanel[x][1] - thickness of the window sash.
ifc_WindowPanel[x][2] - width of the window sash.

ifc_WindowPanel[x][3] parameter value	***IfcWindowPanelOperationEnum category***
0	*NOTDEFINED*
1	*SIDEHUNGRIGHTHAND*
2	*SIDEHUNGLEFTHAND*
3	*TILTANDTURNRIGHTHAND*
4	*TILTANDTURNLEFTHAND*
5	*TOPHUNG*
6	*BOTTOMHUNG*
7	*PIVOTHORIZONTAL*
8	*PIVOTVERTICAL*
9	*SLIDINGHORIZONTAL*
10	*SLIDINGVERTICAL*
11	*REMOVABLECASEMENT*
12	*FIXEDCASEMENT*
13	*OTHEROPERATION*

ifc_WindowPanel[x][4] parameter value	***IfcWindowPanelPositionEnum category***
0	*NOTDEFINED*
1	*LEFT*
2	*MIDDLE*
3	*RIGHT*
4	*BOTTOM*
5	*TOP*

Basic parameters of Transport Elements

ifc_optype - Transport Elements	integer

Type choice for Transport Element.

ifc_optype (integer) parameter value	***IfcTransportElementTypeEnum category***
0	*NOTDEFINED*
1	*ELEVATOR*
2	*ESCALATOR*
3	*MOVINGWALKWAY*
4	*USERDEFINED*

Basic parameters of Lift objects

ifc_CapacityByWeight	realnum

Capacity of the transport element measured by weight.

ifc_CapacityByNumber	integer

Capacity of the transportation element measured in number of persons.

Basic parameters of Stair objects

ifc_StairType integer

The basic configuration of the stair type in terms of the number of stair flights and the number of landings, controlled by the StairMaker add-on for the built-in stairs.

0	*Not Defined*
1	*StraightRunStair*
2	*TwoStraightRunStair*
3	*QuarterWindingStair*
4	*QuarterTurnStair*
5	*HalfWindingStair*
6	*HalfTurnStair*
7	*TwoQuarterWindingStair*
8	*TwoQuarterTurnStair*
9	*ThreeQuarterWindingStair*
10	*ThreeQuarterTurnStair*
11	*SpiralStair*
12	*DoubleReturnStair*
13	*CurvedRunStair*
14	*TwoCurvedRunStair*
15	*OtherOperation*

ifc_NumberOfRiser integer

Total number of risers in the stair.

ifc_NumberOfTreads integer

Total number of treads in the stair.

ifc_RiserHeight integer

Vertical distance from tread to tread. The riser height is supposed to be equal for all steps of a stair or stair flight.

ifc_TreadLength integer

Horizontal distance from the front of the tread to the front of the next tread. The tread length is supposed to be equal for all steps of the stair or stair flight at the walking line.

Basic parameters of MEP elements

ifc_subtype integer

1	*IfcAirTerminalBoxType*	*21*	*IfcHeatExchangerType*	*41*	*IfcElectricFlowStorageDeviceType*
2	*IfcAirTerminalType*	*22*	*IfcHumidifierType*	*42*	*IfcElectricGeneratorType*
3	*IfcAirToAirHeatRecoveryType*	*23*	*IfcPipeFittingType*	*43*	*IfcElectricHeaterType*
4	*IfcBoilerType*	*24*	*IfcPipeSegmentType*	*44*	*IfcElectricMotorType*
5	*IfcChillerType*	*25*	*IfcPumpType*	*45*	*IfcElectricTimeControlType*
6	*IfcCoilType*	*26*	*IfcSpaceHeaterType*	*46*	*this value is skipped*
7	*IfcCompressorType*	*27*	*IfcTankType*	*47*	*IfcJunctionBoxType*
8	*IfcCondenserType*	*28*	*IfcTubeBundleType*	*48*	*IfcLampType*
9	*IfcCooledBeamType*	*29*	*IfcUnitaryEquipmentType*	*49*	*IfcLightFixtureType*
10	*IfcCoolingTowerType*	*30*	*IfcValveType*	*50*	*IfcMotorConnectionType*
11	*IfcDamperType*	*31*	*IfcVibrationIsolatorType*	*51*	*IfcOutletType*
12	*IfcDuctFittingType*	*32*	*IfcFireSuppressionTerminalType*	*52*	*IfcProtectiveDeviceType*
13	*IfcDuctSegmentType*	*33*	*IfcSanitaryTerminalType*	*53*	*IfcSwitchingDeviceType*
14	*IfcDuctSilencerType*	*34*	*IfcStackTerminalType*	*54*	*IfcTransformerType*
15	*IfcEvaporativeCoolerType*	*35*	*IfcWasteTerminalType*	*55*	*IfcActuatorType*
16	*IfcEvaporatorType*	*36*	*IfcCableCarrierFittingType*	*56*	*IfcAlarmType*
17	*IfcFanType*	*37*	*IfcCableCarrierSegmentType*	*57*	*IfcControllerType*
18	*IfcFilterType*	*38*	*IfcCableSegmentType*	*58*	*IfcFlowInstrumentType*
19	*IfcFlowMeterType*	*39*	*IfcElectricApplianceType*	*59*	*IfcSensorType*
20	*IfcGasTerminalType*	*40*	*this value is skipped*		

REQUEST Options

REQUEST `(question_name, name | index, variable1 [, variable2, ...])`

The first parameter represents the question string while the second represents the object of the question (if it exists) and can be of either string or numeric type. The other parameters are variable names in which the return values (the answers) are stored. The function's return value is the number of the answer (in the case of a badly formulated question or a nonexistent name, the value will be 0).

Request Parameter Script Compatibility

The use of most requests in parameter scripts (or master scripts run as parameter script) can result in unstable returned values, therefore should be avoided.

Compatibility up to ARCHICAD 19: The use of most requests in parameter scripts (or master scripts run as parameter script) could result in unreliable returned values.

Compatibility starting from ARCHICAD 20: the following applies in parameter script cases:

- *the request expression will always have 0 as success return value*
- *the requested values will contain a type-matching default only (empty string or 0)*

Using restricted requests in the parameter script will also generate GDL warnings starting from ARCHICAD 19.

To check the parameter script compatibility, refer to the tables below.:

Legend:

✅	works without restriction
⚠️	works (with additional warning)
⛔	does not work: expression returns 0, while containing dummy type-matching defaults in returned variables (empty string or 0) - with additional warning

Compatibility in Parameter Script	ARCHICAD 18	ARCHICAD 19	ARCHICAD 20
ANCESTRY_INFO	✅	⚠	⛔
ANGULAR_DIMENSION	✅	⚠	⛔
ANGULAR_LENGTH_DIMENSION	✅	⚠	⛔
AREA_DIMENSION	✅	✅	✅
ASSOCEL_PROPERTIES	✅	⚠	⛔
ASSOCLP_NAME	✅	⚠	⛔
ASSOCLP_PARVALUE	✅	✅	✅
ASSOCLP_PARVALUE_WITH_DESCRIPTION	✅	✅	✅
AUTOTEXT_LIST	-	-	⛔

Compatibility in Parameter Script	ARCHICAD 18	ARCHICAD 19	ARCHICAD 20
BUILDING_MATERIAL_INFO	✅	⚠	⛔

Compatibility in Parameter Script	ARCHICAD 18	ARCHICAD 19	ARCHICAD 20
CALC_ANGLE_UNIT	✅	⚠️	⛔
CALC_AREA_UNIT	✅	⚠️	⛔
CALC_LENGTH_UNIT	✅	✅	✅
CALC_VOLUME_UNIT	✅	✅	✅
CLASS_OF_FILL	✅	✅	✅
CLEAN_INTERSECTIONS	✅	⚠️	⛔
COMPONENT_PROJECTED_AREA	✅	⚠️	⛔
COMPONENT_VOLUME	✅	⚠️	⛔
CONFIGURATION_NUMBER	-	-	⛔
CONSTR_FILLS_DISPLAY	✅	⚠️	⛔
CUSTOM_AUTO_LABEL	✅	⚠️	⛔

Compatibility in Parameter Script	ARCHICAD 18	ARCHICAD 19	ARCHICAD 20
DOOR_SHOW_DIM	✅	⚠️	⛔

Compatibility in Parameter Script	ARCHICAD 18	ARCHICAD 19	ARCHICAD 20
ELEVATION_DIMENSION	✅	⚠️	⛔

Compatibility in Parameter Script	ARCHICAD 18	ARCHICAD 19	ARCHICAD 20
FLOOR_PLAN_OPTION	✓	⚠	⛔
FONTNAMES_LIST	✓	✓	✓
FULL_ID_OF_PARENT	-	⚠	⛔

Compatibility in Parameter Script	ARCHICAD 18	ARCHICAD 19	ARCHICAD 20
HEIGHT_OF_STYLE	✓	✓	✓
HOME_STORY	✓	✓	✓
HOME_STORY_OF_OPENING	✓	✓	✓
HOMEDB_INFO	✓	✓	✓

Compatibility in Parameter Script	ARCHICAD 18	ARCHICAD 19	ARCHICAD 20
ID_OF_MAIN	✓	⚠	⛔
INTERNAL_ID	✓	✓	✓

Compatibility in Parameter Script	ARCHICAD 18	ARCHICAD 19	ARCHICAD 20
LAYOUT_LENGTH_UNIT	✓	⚠	⚠
LAYOUT_TEXT_SIZE_UNIT	✓	✓	✓
LEVEL_DIMENSION	✓	⚠	⛔
LINEAR_DIMENSION	✓	✓	✓

Compatibility in Parameter Script	ARCHICAD 18	ARCHICAD 19	ARCHICAD 20
MATCHING_PROPERTIES	✓	⚠	⛔
MATERIAL_INFO	✓	⚠	⛔
MODEL_LENGTH_UNIT	✓	⚠	⚠
MODEL_TEXT_SIZE_UNIT	✓	⚠	⛔

Compatibility in Parameter Script	ARCHICAD 18	ARCHICAD 19	ARCHICAD 20
NAME_OF_FILL	✓	⚠	⛔
NAME_OF_LINE_TYPE	✓	⚠	⛔
NAME_OF_LISTED	✓	⚠	⛔
NAME_OF_MACRO	✓	✓	✓
NAME_OF_MAIN	✓	✓	✓
NAME_OF_MATERIAL	✓	⚠	⛔
NAME_OF_PLAN	✓	⚠	⛔
NAME_OF_PROGRAM	✓	⚠	⛔
NAME_OF_STYLE	✓	⚠	⛔

Compatibility in Parameter Script	ARCHICAD 18	ARCHICAD 19	ARCHICAD 20
PEN_OF_RGB	✓	⚠	⛔
PROGRAM_INFO	✓	✓	✓
PROPERTIES_OF_PARENT	-	-	⛔
PROPERTY_NAME	-	-	⛔
PROPERTY_VALUE_OF_PARENT	-	-	⛔

Compatibility in Parameter Script	ARCHICAD 18	ARCHICAD 19	ARCHICAD 20
RADIAL_DIMENSION	✓	⚠	⛔
REFERENCE_LEVEL_DATA	✓	✓	✓
RGB_OF_MATERIAL	✓	⚠	⛔
RGB_OF_PEN	✓	⚠	⛔

Compatibility in Parameter Script	ARCHICAD 18	ARCHICAD 19	ARCHICAD 20
SILL_HEIGHT_DIMENSION	✓	✓	✓
STORY	✓	⚠	⛔
STORY_INFO	✓	✓	✓
STYLE_INFO	✓	⚠	⚠
SUM_WITH_ROUNDING	-	-	✓

Compatibility in Parameter Script	ARCHICAD 18	ARCHICAD 19	ARCHICAD 20
TEXTBLOCK_INFO	✓	⚠	⛔

Compatibility in Parameter Script	ARCHICAD 18	ARCHICAD 19	ARCHICAD 20
VIEW_ROTANGLE	✓	✓	✓
WINDOW_DOOR_DIMENSION	✓	✓	✓
WINDOW_DOOR_SHOW_DIM	✓	⚠	⛔
WINDOW_DOOR_ZONE_RELEV	✓	⚠	⚠
WINDOW_DOOR_ZONE_RELEV_OF_OWNER	✓	⚠	⚠
WINDOW_SHOW_DIM	✓	⚠	⛔
WORKING_ANGLE_UNIT	✓	⚠	⚠
WORKING_LENGTH_UNIT	✓	✓	✓

Compatibility in Parameter Script	ARCHICAD 18	ARCHICAD 19	ARCHICAD 20
ZONE_CATEGORY	✓	✓	✓
ZONE_COLUS_AREA	✓	⚠	⛔
ZONE_RELATIONS	✓	✓	✓
ZONE_RELATIONS_OF_OWNER	✓	⚠	⚠

Details of Requests

```
REQUEST ("Name_of_program", "", program_name)
```

Returns in the given variable the name of the program, e.g., "ARCHICAD". *Expression returns 0 and contains dummy return values (emtpy string or 0) if used in parameter script, causing additional warning.*

Example 1: Printing the name of the program

```
n=REQUEST ("Name_of_program", "", program_name)
PRINT program_name
```

REQUEST (**"Name_of_macro"**, "", my_name)
REQUEST (**"Name_of_main"**, "", main_name)

After executing these function calls, the my_name variable will contain the name of the macro, while main_name will contain the name of the main macro (if it doesn't exist, empty string).

REQUEST (**"ID_of_main"**, "", id_string)

For library parts placed on the floor plan, returns the identifier set in the tool's settings dialog box in the id_string variable (otherwise empty string). Not working on annotation elements (e.g. Label, D/W Marker, Zone Stamp). *Expression returns 0 and contains dummy return values (emtpy string or 0) if used in parameter script, causing additional warning.*

REQUEST (**"Full_ID_of_parent"**, "", id_string)

For annotation elements linked or hotlinked on the floor plan, returns all identifiers (Master ID) of the linked modules and the parent library parts' identifier set in the tool's settings dialog box in the id_string variable (otherwise empty string). *Expression returns 0 and contains dummy return values (emtpy string or 0) if used in parameter script, causing additional warning.*

REQUEST (**"Name_of_plan"**, "", name)

Returns in the given variable the name of the current project. *Expression returns 0 and contains dummy return values (emtpy string or 0) if used in parameter script, causing additional warning.*

REQUEST (**"Story"**, "", index, story_name)

Returns in the index and story_name variables the index and the name of the current story. *Expression returns 0 and contains dummy return values (emtpy string or 0) if used in parameter script, causing additional warning.*

REQUEST (**"Home_story"**, "", index, story_name)

Returns in the index and story_name variables the index and the name of the home story.

REQUEST (**"Home_story_of_opening"**, "", index, story_name)

Returns the index and the name of the home story of the opening in the index and story_name variables. The home story is the first story, where the opening is visible. Can be used in scripts of doors, windows, wallends, corner windows and skylights, and in the script of their labels and markers. Causes warning if used in parameter script.

```
REQUEST ("Story_info", expr, nStories,
         index1, name1, elev1, height1 [,
         index2, name2, ...])
```

Returns the story information in the given variables: number of stories and story index, name, elevation, height to next successively. If expr is a numerical expression, it means a story index: only the number of stories and the information on the specified story is returned. If expr is a string expression, it means that information on all stories is requested. The return value of the function is the number of successfully retrieved values.

Example 2:

```
DIM t[]
n = REQUEST ("STORY_INFO", "", nr, t)
FOR i = 1 TO nr
    nr = STR ("%.0m", t [4 * (i - 1) + 1])
    name = t [4 * (i - 1) + 2]
    elevation = STR ("%m", t [4 * (i - 1) + 3])
    height = STR ("%m", t [4 * (i - 1) + 4])
    TEXT2 0, -i, nr + "," + name + "," + elevation + "," + height
NEXT i
```

With the following requests, you can learn the dimension formats set in the Options/Preferences/Dimensions and Calculation Units dialog boxes. These requests return a format string that can be used as the first parameter in the STR () function.

REQUEST (**"Linear_dimension"**, "", format_string)
REQUEST (**"Angular_dimension"**, "", format_string)

Expression returns 0 and contains dummy return values (emtpy string or 0) if used in parameter script, causing additional warning.

REQUEST (**"Angular_length_dimension"**, "", format_string)

Expression returns 0 and contains dummy return values (emtpy string or 0) if used in parameter script, causing additional warning.

REQUEST (**"Radial_dimension"**, "", format_string)

Causes warning if used in parameter script.

REQUEST (**"Level_dimension"**, "", format_string)

Causes warning if used in parameter script.

REQUEST (**"Elevation_dimension"**, "", format_string)

Expression returns 0 and contains dummy return values (emtpy string or 0) if used in parameter script, causing additional warning.

REQUEST (**"Window_door_dimension"**, "", format_string)
REQUEST (**"Sill_height_dimension"**, "", format_string)
REQUEST (**"Area_dimension"**, "", format_string)
REQUEST (**"Calc_length_unit"**, "", format_string)
REQUEST (**"Calc_area_unit"**, "", format_string)

Expression returns 0 and contains dummy return values (emtpy string or 0) if used in parameter script, causing additional warning.

REQUEST ("**Calc_volume_unit**", "", format_string)
REQUEST ("**Calc_angle_unit**", "", format_string)

Expression returns 0 and contains dummy return values (emtpy string or 0) if used in parameter script, causing additional warning.

Example 3:

```
format = "" num = 60.55
REQUEST ("Angular_dimension", "",format)!"%.2dd"
TEXT2 0, 0, STR (format, num)!60.55
```

REQUEST ("**Clean_intersections**", "", state)

Returns the state of the Clean Wall & Beam Intersections feature (1 when turned on, 0 when off) *Expression returns 0 and contains dummy return values (emtpy string or 0) if used in parameter script, causing additional warning.*

REQUEST ("**Zone_category**", "", name, code)

For zones, returns the name and the code string of the current zone category.

```
REQUEST ("Zone_relations", "",
         category_name, code, name, number
         [, category_name2, code2, name2, number2])
```

Returns in the given variables the zone category name and code and the name and number of the zone where the library part containing this request is located. For doors and windows, there can be a maximum of two zones. The return value of the request is the number of successfully retrieved values (0 if the library part is not inside any zone).

```
REQUEST ("Zone_relations_of_owner", "",
         category_name, code, name, number
         [, category_name2, code2, name2, number2])
```

Returns in the given variables the category name & code and the zone name & number of the zone where the owner of the object is located. So, it is meaningful, if the library part has owner (door-window labels and door-window markers, etc.). In case of a door label, its owner is the door. For doors and windows, there can be a maximum of two related zones. The return value of the request is the number of successfully retrieved values (0 if the object has no owner, or its owner is not inside any zone). Causes warning if used in parameter script.

REQUEST ("**Zone_colus_area**", "", area)

Returns in the area variable the total area of the columns placed in the current zone. Effective only for Zone Stamps. Available only for compatibility reasons. It is recommended to use quantities set in Zone Stamp fix parameters. *Expression returns 0 and contains dummy return values (emtpy string or 0) if used in parameter script, causing additional warning.*

REQUEST ("**Custom_auto_label**", "", name)

Returns in the name variable the name of the custom auto label of the library part or an empty string if it does not exist. *Expression returns 0 and contains dummy return values (emtpy string or 0) if used in parameter script, causing additional warning.*

REQUEST (**"Rgb_of_material"**, name, r, g, b)
REQUEST (**"Rgb_of_pen"**, penindex, r, g, b)
REQUEST (**"Pen_of_RGB"**, "r g b", penindex)

Like the REQ() function (but in just one call), returns in the specified variables the value of the r, g, b components of the material and pen, or the index of the pen corresponding to the given RGB values. *All 3 expressions return 0 containing dummy return values (emtpy string or 0) if used in parameter script, causing additional warning.*

REQUEST (**"Height_of_style"**, name, height [, descent, leading])

Returns in the given variables the total height of the style measured in millimeters (height in meters is height / 1000 * GLOB_SCALE); the descent (the distance in millimeters from the text base line to the descent line) and the leading (the distance in millimeters from the descent line to the ascent line).

REQUEST (**"Style_info"**, name, fontname [, size, anchor, face_or_slant])

Returns information in the given variables on the previously defined style (*see style parameters at the DEFINE STYLE command*). Can be useful in macros to collect information on the style defined in a main script. Causes warning if used in parameter script.

REQUEST (**"Name_of_material"**, index, name)

Returns in the variable the material name identified by index. *Expression returns 0 and contains dummy return values (emtpy string or 0) if used in parameter script, causing additional warning.*

REQUEST (**"Name_of_fill"**, index, name)

Returns in the name variable the fill name identified by index. *Expression returns 0 and contains dummy return values (emtpy string or 0) if used in parameter script, causing additional warning.*

REQUEST (**"Name_of_line_type"**, index, name)

Returns in the given variable the line name identified by index. *Expression returns 0 and contains dummy return values (emtpy string or 0) if used in parameter script, causing additional warning.*

REQUEST (**"Name_of_style"**, index, name)

Returns in the given variable the name of the style identified by index. *Expression returns 0 and contains dummy return values (emtpy string or 0) if used in parameter script, causing additional warning.*

If index < 0, it refers to a material, fill, line type or style defined in the GDL script or the MASTER_GDL file. A call of a request with index = 0 returns in the variable the name of the default material or line type. (Empty string for fill and style.)

The return value of the request is the number of successfully retrieved values (1 if no error occurred, 0 for error when the index is not valid).

REQUEST (**"WINDOW_DOOR_SHOW_DIM"**, "", show)

Before 9.0 returns 1 in the show variable if Options/Display Options/Doors & Windows is set to "Show with Dimensions", 0 otherwise. Since 9.0 display options were split to separate Door and Window display options, so for compatibility reasons ARCHICAD checks if the request is used in a Window (or marker of a Window) or a Door (or marker of a Door) and automatically returns the corresponding display option. In other cases (symbol, lamp, label) the Window option is returned. Can be used to hide/show custom dimensions according to the current Display Options. *Expression returns 0 and contains dummy return values (emtpy string or 0) if used in parameter script, causing additional warning.*

Since 9.0 the "window_show_dim", and the "door_show_dim" separate requests are available.

`REQUEST ("window_show_dim", "", show)`

Returns 1 in the show variable if in the Model View Options/Window options the "with Markers" is checked, 0 otherwise. *Expression returns 0 and contains dummy return values (emtpy string or 0) if used in parameter script, causing additional warning.*

`REQUEST ("door_show_dim", "", show)`

Returns 1 in the show variable if in the Model View Options/Door options the "with Markers" is checked, 0 otherwise. *Expression returns 0 and contains dummy return values (emtpy string or 0) if used in parameter script, causing additional warning.*

`REQUEST ("name_of_listed", "", name)`

Returns in the name variable the name of the library part associated with the property type library part containing this request. For elements (Walls, Slabs, etc.), the name is an empty string. Causes warning if used in parameter script.

`REQUEST ("window_door_zone_relev", "", out_direction)`

Effective only for Doors and Windows. Use it as complement to the "zone_relations" request. Returns 1 in the out_direction variable if the Door/Window opening direction is in that of the first room identified by the "zone_relations" request, 2 if the opening direction is towards the second room. It also returns 2 if there is only one room and the opening direction is to the outside. Causes warning if used in parameter script.

`REQUEST ("window_door_zone_relev_of_owner", "", out_direction)`

Effective only if the library part's parent is a door or a window (markers, labels). Use it as a complement to the "zone_relations_of_owner" request. Returns 1 in the out_direction variable if the parent's opening direction is in that of the first zone identified by the zone relations type requests, 2 if the opening direction is towards the second zone. It also returns 2 if there is only one zone and the opening direction is to the outside. Causes warning if used in parameter script.

`REQUEST ("matching_properties", type, name1, name2, ...)`

If type = 1, returns in the given variables individually associated property library part names, otherwise property library part names associated by criteria. If used in an associative label, the function returns the properties of the element the label is associated with. *Expression returns 0 and contains dummy return values (emtpy string or 0) if used in parameter script, causing additional warning.*

```
REQUEST ("Working_length_unit", "", format_string)
REQUEST ("Working_angle_unit", "", format_string)
```

With these requests, the user can get the working unit formats as set in the Options > Project Preferences > Working Units dialog box. They return a format string that can be used as the first parameter in the STR () function. The requests both work when interpreting the user interface script, but "Working_angle_unit" causes warning if used in parameter script.

REQUEST ("**Model_length_unit**", "", format_string)
REQUEST ("**Layout_length_unit**", "", format_string)

With these requests, the user can get the layout and the model unit formats as set in the Options > Project Preferences > Working Units dialog box. They return a format string that can be used as the first parameter in the STR () function. *Both expressions return 0 containing dummy return values (emtpy string or 0) if used in parameter script, causing additional warning. Both work in User Interface Script only.*

REQUEST ("**Model_text_size_unit**", "", format_string)
REQUEST ("**Layout_text_size_unit**", "", format_string)

With these requests, the user can get the layout and the model text size formats. They return a format string that can be used as the first parameter in the STR () function. The requests cause warning if used in parameter script.

REQUEST ("**Properties_Of_Parent**", "", parentProperties)

Returns the properties of the parent object. All properties are returned in one array with the following form: ID, type, group, name. Can be used only in labels. *Expression returns 0 and contains dummy return values (emtpy string or 0) if used in parameter script, causing additional warning.*

```
Core property:  [id,    "",     "",             PropertyName]
AC property:    [guid,  "",     "GroupName",    PropertyName]
IFC property:   [id,    "IFC",  "GroupName",    PropertyName]
```

Compatibility: introduced in ARCHICAD 20.

Example 4:

```
DIM parentProperties[]
n = REQUEST ("Properties_Of_Parent", "", parentProperties)
! parentProperties =   [Id1, TypeName1, GroupName1, PropertyName1,
                         Id2, TypeName2, GroupName2, PropertyName2,
                         ...
                         Idn, TypeNamen, GroupNamen, PropertyNamen]
```

REQUEST ("**Property_Value_Of_Parent**", "id", type, dim1, dim2, propertyValues)

Returns value array of the selected property. Can be used only in labels. *Expression returns 0 and contains dummy return values (emtpy string or 0) if used in parameter script, causing additional warning.*

Compatibility: introduced in ARCHICAD 20.

id: the ID of the selected property (string).

type: the type of the selected property value.

`1:` boolean
`2:` integer
`3:` real number
`4:` string

`dim1, dim2:` the dimensions of the **propertyValues** array.
`dim1 = 0, dim2 = 0:` simple, scalar value.
`dim1 > 0, dim2 > 0:` list of values.

Example 5:

```
DIM propertyValues[]
n = REQUEST ("Property_Value_Of_Parent", "ExampleId", type, dim1, dim2, propertyValues)
```

`REQUEST ("Property_Name",` `"id", typeName, groupName, propertyName)`

Returns the **type, group and name** of the selected property. Can be used only in labels. *Expression returns 0 and contains dummy return values (emtpy string or 0) if used in parameter script, causing additional warning.*

Compatibility: introduced in ARCHICAD 20.

`id:` the ID of the selected property (string).

`typeName:` the Type of the selected property (string).
`"IFC":` for IFC properties
`"":` other properties

`groupName:` the Group of the selected property (string).

empty string ("") for Core properties.

`propertyName:` the Name of the selected property (string).

`REQUEST ("AUTOTEXT_LIST",` `"", autoTextListArray)`

Returns one AUTOTEXT array of the autotexts used in the project with the following triplets ["ID", "Category", "Name"]. *Expression returns 0 and contains dummy return values (emtpy string or 0) if used in parameter script, causing additional warning. Can be used only in UI script.* The ID is stored in the parameter via the **UI_CUSTOM_POPUP...** commands.

Contains all autotexts from Project Info and Autotext Dialog (Text tool - Insert Autotext).

Compatibility: introduced in ARCHICAD 20.

Example 6:

```
DIM autoTextListArray[]
n = REQUEST ("AUTOTEXT_LIST", "", autoTextListArray)
! autoTextListArray =   [ID1, CategoryName1, TextName1,
                          ID2, CategoryName2, TextName2,
                          ...
                          IDn, CategoryNamen, TextNamen]
```

`REQUEST{3}` `(`**`"Sum_with_rounding"`**`, req_name, addends_array, result)`

Returns the sum of the numbers in **addends_array**, with rounding according to the "Calculate Totals by" project preference. This preference can be found in Project Preferences / Calculation Units and Rules.

Possible project preference settings:

- "Displayed values": the request will first round the addends according to **req_name**, and then sum them.
- "Exact values": the request will simply sum the addends.

Causes warning if used in parameter script.

Compatibility: introduced in ARCHICAD 20.

Return values:

- 0, if **req_name** is invalid.
- 1, if the call succeeded.

`req_name:` the name of the formatting request specifying how the addends have to be rounded if "Calculate Totals by" is set to "Displayed values".

For example if **req_name = "Area_dimension"**, and the Project Preferences / Dimensions / Area Calculations is set to "square centimeter" with 3 decimals, rounding to 0.025, then the addends will be rounded to the multiples of 0.025 cm², that is to 0.0000025 m².

Valid request names:

Linear_dimension, Angular_dimension, Radial_dimension, Level_dimension, Elevation_dimension, Window_door_dimension, Sill_height_dimension, Area_dimension, Calc_length_unit, Calc_area_unit, Calc_volume_unit, Calc_angle_unit.

`addends_array:` the array of numbers to be added. Whether they have to be treated as m, m², m³ or degrees is determined by **req_name**.

`result:` a number, on return it will be set to the sum of the addends according to the "Calculate Totals by" preference. Note that **result** is in the same unit as the addends. It is not converted to the target unit specified by **req_name**.

`REQUEST` `(`**`"ASSOCLP_PARVALUE"`**`, expr, name_or_index, type, flags, dim1, dim2, p_values)`

REQUEST ("ASSOCLP_PARVALUE_WITH_DESCRIPTION", expr, name_or_index, type,
    flags, dim1, dim2, p_values_and_descriptions)

Returns information in the given variables on the library part parameter with which the library part containing this request is associated. Can be used in property objects, labels and marker objects.

The function return value is the number of successfully retrieved values, 0 if the specified parameter does not exist or an error occurred.

expr: the request's object, associated library p art parameter name or index expression.

name_or_index: returns the index or the name of the parameter, depending on the previous expression type (returns index if a parameter name, name if the index is specified).

type: parameter type, possible values:

1: boolean
2: integer
3: real number
4: string
5: length
6: angle
7: line
8: material
9: fill
10: pen color
11: light switch
12: rgb color
13: light intensity
14: separator
15: title

flags:

flags = j_1 + 2*j_2 + 64*j_7 + 128*j_8, where each j can be 0 or 1.

j_1: child/indented in parameter list
j_2: with bold text in parameter list
j_7: disabled (locked in all contexts)
j_8: hidden in the parameter list

dim1, dim2: dim1 is the number of rows, dim2 the number of columns.

`dim1 = 0, dim2 = 0:` simple, scalar value
`dim1 > 0, dim2 = 0:` one dimensional array
`dim1 > 0, dim2 > 0:` two dimensional array
`If dim2 > 0, then dim1 > 0.`

`p_values:` for ASSOCLP_PARVALUE returns the parameter value or array of values. The array elements are returned successively, row by row as a one dimensional array, independently of the dimensions of the variable specified to store it. If the variable is not a dynamic array, there are as many elements stored as there is room for (for a simple variable only one, the first element). If values is a two dimensional dynamic array, all elements are stored in the first row.

`p_values_and_descriptions:` for ASSOCLP_PARVALUE_WITH_DESCRIPTION returns the parameter value followed by the parameter description string (as specified at the VALUES command command) or an array of these pairs. For string type parameters the description string is always empty. The array element - array element description string pairs are returned successively, row by row as a one dimensional array, independently of the dimensions of the variable specified to store it. If the variable is not a dynamic array, there are as many elements stored as there is room for (for a simple variable only one, the first element). If values is a two dimensional dynamic array, all elements are stored in the first row.

`REQUEST ("ASSOCLP_NAME", "",` `name)`

Returns in the given variable the name of the library part associated with the label or marker object. For elements (Walls, Slabs, etc.) the name is an empty string. *Expression returns 0 and contains dummy return values (emtpy string or 0) if used in parameter script, causing additional warning.*

`REQUEST ("ASSOCEL_PROPERTIES",` `parameter_string, nr_data, data)`

Returns, in the given variables, own property data or the element properties which the library part containing this request is associated to (in labels and associative marker objects). The function return value is the number of successfully retrieved values, 0 if no property data was found or an error occurred. The function does not work in property objects during the listing process. *Expression returns 0 and contains dummy return values (emtpy string or 0) if used in parameter script, causing additional warning.*

`parameter_string:` a combination of keywords separated by commas representing the requested fields of the property data records. Records will be ordered accordingly. Possible values:

```
"ISCOMP"
"DBSETNAME"
"KEYCODE"
"KEYNAME"
"CODE"
"NAME"
"FULLNAME"
"QUANTITY"
```

```
"TOTQUANTITY"
"UNITCODE"
"UNITNAME"
"UNITFORMATSTR"
"PROPOBJNAME"
```

`nr_data:` returns the number of the data items.

`data:` returns the property data, records containing and being ordered by the fields specified in the parameter string. Values are returned as a one dimensional array which contains the requested record fields successively, independently of the dimensions of the variable specified to store it. If the variable is not a dynamic array, there are as many elements stored as there is room for (in case of a simple variable only one, the first element). If values is a two dimensional dynamic array, all elements are stored in the first row.

Example 7:

```
DIM DATA []
n = REQUEST ("ASSOCEL_PROPERTIES", "iscomp, code, name", nr, data)
IF nr = 0 THEN
    TEXT2 0, 0, "No properties"
ELSE
    j = 0
    FOR i = 1 TO nr
        IF i MOD 3 = 0 THEN
            TEXT2 0, -j, DATA [i] ! name
            j = j + 1
        ENDIF
    NEXT i
ENDIF
```

```
REQUEST ("REFERENCE_LEVEL_DATA", "", name1, elev1, name2, elev2,
         name3, elev3, name4, elev4)
```

Returns in the given variables the names and elevations of the reference levels as set in the Options/Project Preferences/Reference Levels dialog. The function return value is the number of successfully retrieved values, 0 if an error occurred.

```
REQUEST ("ANCESTRY_INFO", expr, name [, guid,
         parent_name1, parent_guid1,
         ...
         parent_namen, parent_guidn)
```

Ancestry information on a library part. *Expression returns 0 and contains dummy return values (emtpy string or 0) if used in parameter script, causing additional warning.*

If expr = 0, returns in the given variables the name and the globally unique identifier of the library part containing this request function. Optionally the function returns the names and globally unique identifiers of the parents of the library part (parent_namei, parent_guidi). If the parent templates are not loaded their names will be empty strings.

If expr = 1, returns information on the library part replaced by the template containing this function. In this case if the template is not actually replacing, no values are returned.

The return value of the request is the number of successfully retrieved values.

Example 8:

```
DIM strings[]
n = REQUEST ("ANCESTRY_INFO", 1, name, guid, strings)
IF n > 2 THEN
    ! data of replaced library part
    TEXT2 0, -1, "replacing: " + name + ' ' + guid
    ! parents
    l = -2
    FOR i = 1 TO n - 2 STEP 2
        TEXT2 0, l, strings [i]
        l = l - 1
    NEXT i
ENDIF
```

REQUEST ("TEXTBLOCK_INFO", textblock_name, width, height)

Returns in the given variables the sizes in x and y direction of a text block previously defined via the TEXTBLOCK command. The sizes are in mm or in m in model space depending on the fixed_height parameter value of TEXTBLOCK (millimeters if 1, meters in model space if 0). If width was 0, the request returns the calculated width and height, if width was specified in the text block definition, returns the calculated height corresponding to that width. *Expression returns 0 and contains dummy return values (emtpy string or 0) if used in parameter script, causing additional warning.*

REQUEST{2} ("Material_info", name_or_index, param_name, value_or_values)

Returns information in the given variable(s) on a parameter (or extra parameter, see the section called “Additional Data”) of the specified material. RGB information is returned in three separate variables, texture information is returned in the following variables: file_name, width, height, mask, rotation_angle corresponding to the texture definition. All other parameter information is returned in single variables. *Expression returns 0 and contains dummy return values (emtpy string or 0) if used in parameter script, causing additional warning.* Possible material parameter names corresponding to parameters of the material definition:

param_name:

"gs_mat_surface_rgb": surface R, G, B [0.0..1.0]

"gs_mat_ambient": ambient coefficient [0.0..1.0]
"gs_mat_diffuse": diffuse coefficient [0.0..1.0]
"gs_mat_specular": specular coefficient [0.0..1.0]
"gs_mat_transparent": transparent coefficient [0.0..1.0]
"gs_mat_shining": shininess [0.0..100.0]
"gs_mat_transp_att": transparency attenuation [0.0..4.0]
"gs_mat_specular_rgb": specular color R, G, B [0.0..1.0]
"gs_mat_emission_rgb": emission color R, G, B [0.0..1.0]
"gs_mat_emission_att": emission attenuation [0.0..65.5]
"gs_mat_fill_ind": fill index
"gs_mat_fillcolor_ind": fill color index
"gs_mat_texture": texture index

Example 9:

```
REQUEST{2} ("Material_info", "Brick-Face", "gs_mat_ambient", a)
REQUEST{2} ("Material_info", 1, "gs_mat_surface_rgb", r, g, b)
REQUEST{2} ("Material_info", "Brick-Face", "gs_mat_texture",
            file_name, w, h, mask, alpha)
REQUEST{2} ("Material_info", "My-Material", "my_extra_parameter", e)
```

REQUEST{2} ("**Building_Material_info**", name, param_name, value_or_values)

Returns information in the given variable(s) on a parameter of the specified building material. *Expression returns 0 and contains dummy return values (emtpy string or 0) if used in parameter script, causing additional warning.* Possible building material parameter names corresponding to parameters of the building material definition:

param_name:

"gs_bmat_id": building material id
"gs_bmat_surface": building material surface index
"gs_bmat_description": building material description
"gs_bmat_manufacturer": building material manufacturer
"gs_bmat_collisiondetection": building material participates in collision detection (0 or 1)
"gs_bmat_intersectionpriority": building material intersection priority
"gs_bmat_cutFill_properties": building material cut fill properties (cut fill index number, cut fill foreground pen index number, cut fill background pen index number)

`"gs_bmat_physical_properties":` building material physical properties (thermal conductivity, density, heat capacity, embodied energy, embodied carbon)

Example 10:

```
REQUEST{2} ("Building_Material_info", "Brick", "gs_bmat_id", id)
REQUEST{2} ("Building_Material_info", "Brick", "gs_bmat_surface", index)
REQUEST{2} ("Building_Material_info", "Brick", "gs_bmat_physical_properties",
             thermalConductivity, density, heatCapacity, embodiedEnergy, embodiedCarbon)
```

REQUEST (**"FONTNAMES_LIST"**, "", fontnames)

Returns in the given variables the fontnames available on the current computer (with character codes included). This list (or any part of this list) can be used in a VALUES command to set up a fontname popup. The function return value is the number of successfully retrieved values, 0 if an error occurred.

Example 11:

```
dim fontnames[]
REQUEST ("FONTNAMES_LIST", "", fontnames)
VALUES "f" fontnames, CUSTOM
```

This form of the VALUES command assembles a fontnames pop-up for the simple string-typed parameter "f". The "fontnames" variable contains the possible fontnames (with character codes included) which can be set manually or using the REQUEST ("FONTNAMES_LIST", ...) command. The CUSTOM keyword is necessary for the correct handling of missing fonts on other platforms/computers: if it is specified, a fontname set on another platform/computer missing in the current environment will be preserved in the parameter settings as a custom value (otherwise, due to the implementation of the VALUES command, a missing string popup value in the parameter settings will be replaced with the first current string value). It is recommended to include this function in the ARCHICAD_Library_Master file.

REQUEST (**"HomeDB_info"**, "", homeDBIntId, homeDBUserId, homeDBName, homeContext)

Returns in the given variables the internal ID (integer), the user ID and name (strings) of the home database (where the library part containing this request was placed).

- if placed on the floor plan: the story internal ID, index as a string and name, homeContext = 1,
- if placed on a section: the section internal ID, reference ID and name, homeContext = 2,
- if placed on a detail: the detail internal ID, reference ID and name, homeContext = 3,
- if placed on a master layout: the layout internal ID, empty string and name, homeContext = 4,
- if placed on a layout: the layout internal ID, number and name, homeContext = 5.

For labels the returned data refers to the labeled element. The collected data can be used to uniquely identify elements in different ARCHICAD databases of a plan file. Causes warning if used in parameter script.

REQUEST (**"floor_plan_option"**, **""**, storyViewpointType)
Returns the story viewpoint type which is set in the Model View Options. 0 stands for "Floor Plan", 1 stands for "Ceiling Plan". *Expression returns 0 and contains dummy return values (emtpy string or 0) if used in parameter script, causing additional warning.*
REQUEST (**"class_of_fill"**, index, class)
Returns class of the fill identified by index in the class variable. Causes warning if used in parameter script.

class: Possible values:
- 1: vector fill
- 2: symbol fill
- 3: translucent fill
- 4: linear gradient fill
- 5: radial gradient fill
- 6: image fill

REQUEST (**"view_rotangle"**, **""**, angleViewRotation)
Returns the rotation angle of the current view. *Expression returns 0 and contains dummy return values (emtpy string or 0) if used in parameter script, causing additional warning.*
REQUEST (**"program_info"**, **""**, name[, version[, keySerialNumber[, isCommercial]]])
Returns information on the currently running program. *Expression returns 0 and contains dummy return values (emtpy string or 0) if used in parameter script, causing additional warning.*

name: name of the program

version: version number of the program

keySerialNumber: serial number of the keyplug

isCommercial: returns true if there is running a full (commercial) version of the program
REQUEST (**"Configuration_number"**, **""**, stConfigurationNumber)
Returns the configuration number (as string expression) assigned to the current ARCHICAD license in case of soft license or hardware key. Returns empty string in case of Edu, Trial or Demo licenses. Each configuration number is unique and does not change.

Expression returns 0 and contains dummy return values (emtpy string or 0) if used in parameter script, causing additional warning.

Compatibility: introduced in ARCHICAD 20.
REQUEST (extension_name, parameter_string, variable1, variable2, ...)
If the question isn't one of those listed above, the REQUEST() function will attempt to use it as an extension-specific name. If this extension is loaded, it will be used to get as many variable names as are specified. The parameter string is interpreted by the extension.
REQUEST (**"COMPONENT_PROJECTED_AREA"**, idxSkin, projectedArea)

Returns the projected area of the indexed skin. Available in property script only (other scripts return 0). *Expression returns 0 and contains dummy return values (emtpy string or 0) if used in parameter script, causing additional warning.*

`idxSkin:` Possible values:

- `0:` for basic elements
- `1- :` index of the skin in composites
- `1- :` index of the component in profiles

Example 12:

```
n = request ("COMPONENT_PROJECTED_AREA", 0, a)
COMPONENT "Projected Area", a, "m2"
```

Used in property script, first request the area of the skin, then create a component using the returned value.

`REQUEST` `(`**`"COMPONENT_VOLUME"`**`, idxSkin, skinVolume)`

Returns the volume of the indexed skin/component. Available in property script only (other scripts return 0). *Expression returns 0 and contains dummy return values (emtpy string or 0) if used in parameter script, causing additional warning.*

`idxSkin:` Possible values:

- `0:` for basic elements
- `1- :` index of the skin in composites
- `1- :` index of the component in profiles

Example 13:

```
n = request ("COMPONENT_VOLUME", 0, v)
COMPONENT "Volume", v, "m3"
```

Used in property script, first request the volume of the skin, then create a component using the returned value.

Deprecated Requests

`REQUEST` `(`**`"Constr_Fills_display"`**`, "", optionVal)`

Expression returns 0 and contains dummy return values (emtpy string or 0) if used in parameter script, causing additional warning.

Compatibility up till ARCHICAD 19: returns in the given variable the value of the Cut Fills Display option as set in the Document/ Set Model View/ Model View Options. (previous Construction Fills).

Compatibility starting from ARCHICAD 20: the returned value is always 6 by default (Cut fill patterns: as in Settings).

`optionVal:` cut fill display code.

`1:` Show cut fill contours only (previous Empty)
`2:` Show cut fill contours only with separator lines (previous No Fills)
`4:` Cut fill patterns: Solid (previous Solid)
`6:` Cut fill patterns: as in Settings (previous Vectorial Hatching)

`REQUEST ("internal_ID", "", id)`

Always returns 1. Use GLOB_INTGUID global variable instead.

APPLICATION QUERY OPTIONS

`n = APPLICATION_QUERY (extension_name, parameter_string, variable1, variable2, ...)`

Below is a list of request functions ARCHICAD can provide with the help of the APPLICATION_QUERY command. These request options are given in the **extension_name** and the **parameter_string** parameter of the command. Note, that the query options and return values of an APPLICATION_QUERY may vary according to the execution context.

The use of the following application query types in parameter script is not supported. These queries cause GDL warnings starting from ARCHICAD 19, and will return either 0 or empty string starting from the next versions. The restriction applies to:

- "document_feature"

Document feature

This command can return features of the active document/view. Currently there is only one feature it can return - the view direction of the document. These type of queries are restricted from the parameter script and cause GDL warnings.

View direction

`n = APPLICATION_QUERY ("document_feature", "view_direction", type)`

This command returns the viewing direction of the current document type in which the object is being visualized. This command has no additional parameters.

`type:` Returned type values:

`"vertical_only":` for floor plan
`"horizontal_only":` for section and elevation generated from 3D (not when the object is placed into a S/E)
`"free":` for 3D and 3D document
`"none"`

```
"unset"
```

MEP System

This command returns MEP system types and information about MEP systems. It has more functions which can be addressed via the **parameter_string** parameter:

Get MEP Systems

```
DIM d[2][]
n = APPLICATION_QUERY ("MEPSYSTEM", "GetMEPSystems(domain)", d)
```

`domain:` MEP classification index (DuctWork – 1, PipeWork – 2) (GDL defines the MEP classifications based on connector class)

`d:` Array of values:

- `[2*k-1]:` MEP system index
- `[2*k]:` MEP system name

`n:` Number of MEP systems multiplied by 2.

Get Domain

```
n = APPLICATION_QUERY ("MEPSYSTEM", "GetDomain(idx)", d)
```

`idx:` MEP system index

`d:` domains (integer)

- `1:` DuctWork
- `2:` PipeWork
- `3:` Duct- and PipeWork
- `4:` Cabling
- `5:` DuctWork and Cabling
- `6:` PipeWork and Cabling
- `7:` DuctWork, PipeWork and Cabling

`n:` 1 if successful, 0 otherwise

Get Contour Pen

```
n = APPLICATION_QUERY ("MEPSYSTEM", "GetContourPen(idx)", pen)
```

`idx:` MEP system index

pen: contour pen index (integer)

n: 1 if successful, 0 otherwise

Get Fill Pen

```
n = APPLICATION_QUERY ("MEPSYSTEM", "GetFillPen(idx)", pen)
```

idx: MEP system index

pen: fill pen index (integer)

n: 1 if successful, 0 otherwise

Get Background Pen

```
n = APPLICATION_QUERY ("MEPSYSTEM", "GetBgPen(idx)", pen)
```

idx: MEP system index

pen: background pen index (integer)

n: 1 if successful, 0 otherwise

Get Fill Type

```
n = APPLICATION_QUERY ("MEPSYSTEM", "GetFillType(idx)", filltype)
```

idx: MEP system index

filltype: fill type index (integer)

n: 1 if successful, 0 otherwise

Get Center Line Type

```
n = APPLICATION_QUERY ("MEPSYSTEM", "GetCenterLineType(idx)", line)
```

idx: MEP system index

line: center line type index (integer)

n: 1 if successful, 0 otherwise

Get Center Line Pen

```
n = APPLICATION_QUERY ("MEPSYSTEM", "GetCenterLinePen(idx)", pen)
```

`idx:` MEP system index

`pen:` center line pen index (integer)

`n:` 1 if successful, 0 otherwise

Get System Material

```
n = APPLICATION_QUERY ("MEPSYSTEM", "GetSystemMaterial(idx)", material)
```

`idx:` MEP system index

`material:` system material index (integer)

`n:` 1 if successful, 0 otherwise

Get Insulation Material

```
n = APPLICATION_QUERY ("MEPSYSTEM", "GetInsulationMaterial(idx)", material)
```

`idx:` MEP system index

`material:` insulation material index (integer)

`n:` 1 if successful, 0 otherwise

MEP Modeler

This command returns whether MEP modeler is active. It has one function which can be addressed via the **parameter_string** parameter:

Is Available

```
n = APPLICATION_QUERY ("MEPMODELER", "IsAvailable()", isavailable)
```

`isavailable:` MEP Modeler is present (integer)

`n:` 1 if successful, 0 otherwise

MEP Connection Type

This command returns the connection types and the styles of connection types. It has two functions which can be addressed via the **parameter_string** parameter:

Get Connection Types

```
DIM d[2][]
```

`n =` **`APPLICATION_QUERY`** `("`**`MEPCONNECTIONTYPE`**`", "GetConnectionTypes(connectorClass)", d)`

`connectorClass:` connector class (Duct – 1, Pipe – 2, Cable carrier – 3)

`d:` Array of values:
  `[2*k-1]:` connection type GUID
  `[2*k]:` connection type name

`n:` Number of connection types multiplied by 2.

Get Connection Type Style

```
DIM d[]
n = APPLICATION_QUERY ("MEPCONNECTIONTYPE", "GetConnectionTypeStyle(connectorClass)", d)
```

`connectorClass:` connector class (Duct – 1, Pipe – 2, Cable carrier – 3)

`d:` Array of values:
  `[]:` connection type styles

`n:` Number of connection types.

MEP Flexible Segment

This command returns the geometry of flexible segments. It has four functions which can be addressed via the **parameter_string** parameter:

Start Sectioning

`n =` **`APPLICATION_QUERY`** `("`**`MEPFLEXIBLESEGMENT`**`", "StartSectioning()", r)`

Indicates that sectioning has begun.

`r:` not used

`n:` 1 if successful, 0 otherwise

Add Control Point

`n =` **`APPLICATION_QUERY`** `("`**`MEPFLEXIBLESEGMENT`**`", "AddControlPoint(x; y; z)", r)`

Provides a control point to the add-on.

`AddControlPoint:`
  `x:` X coordinate of the control point
  `y:` Y coordinate of the control point
  `z:` Z coordinate of the control point

r: not used

n: 1 if successful, 0 otherwise

Add Direction and Width Vector

```
n = APPLICATION_QUERY ("MEPFLEXIBLESEGMENT",
                  "AddDirectionAndWidthVector(i; dx; dy; dz; wx; wy; wz)", r)
```

Provides the direction and side vectors of the ends of spline to add-on. It is called twice.

AddDirectionAndWidthVector:

- `i:` id of port (1: 0. port, 2: 1. port etc.)
- `dx:` X component of direction vector of the port
- `dy:` Y component of direction vector of the port
- `dz:` Z component of direction vector of the port
- `wx:` X component of side vector of the port
- `wy:` Y component of side vector of the port
- `wz:` Z component of side vector of the port

r: not used

n: 1 if successful, 0 otherwise

End Sectioning

```
DIM d[]
n = APPLICATION_QUERY ("MEPFLEXIBLESEGMENT", "EndSectioning(res)", d)
```

Getting of the result of sectioning.

res: resolution of sectioning

d: Array of values:

- `[9*k-8]:` X position of k segment
- `[9*k-7]:` Y position of k segment
- `[9*k-6]:` Z position of k segment
- `[9*k-5]:` X component of tangent vector of k segment
- `[9*k-4]:` Y component of tangent vector of k segment
- `[9*k-3]:` Z component of tangent vector of k segment
- `[9*k-2]:` X component of normal vector k segment

`[9*k-1]:` Y component of normal vector k segment
`[9*k]:` Z component of normal vector k segment

n: Number of segments

MEP Bend

This command returns the geometry of flexible segment. It has four functions which can be addressed via the **parameter_string** parameter:

Start Sectioning

```
n = APPLICATION_QUERY ("MEPBEND", "GetBendTypeNames()", d)
```

d: Bend Type Names (examples of INT version)

```
"Radius"
"Square Throat"
"Mitered"
"45° Throat with 45° Heel"
"45° Throat with 90° Heel"
"45° Throat with Radius Heel"
"Radius Throat with 90° Heel"
"Pleated"
"Stamped"
"Segmented"
"Segmented Standing Seam"
```

n: 1 if successful, 0 otherwise

Parameter Script

This command can return various conditions of the parameter script. Currently there is only one feature it can return - the distinction of the first run.

First Occasion in Progress

```
n = APPLICATION_QUERY ("parameter_script", "firstoccasion_in_progress", isFirstRun)
```

This command returns whether the current run is the first run or a consequence of a previous execution of the parameter script which changed some parameters. This command has no additional parameters.

The distinction may be important when a part of the parameter script executes a triggered event - e.g. it handles the pushing of a function button.

`isFirstRun`: The returned value shows whether the current run is the first run

Tags and Categories

These commands return the folder names, parameter names and parameter values of "Tags and Categories" tabpage. The order of parameters is the same as on the tabpage. There are two possible **extension_names** in these commands:

- **"OwnCustomParameters"** returns parameters of the object
- **"ParentCustomParameters"** returns parameters of the object's parent

Get Parameter Folder Names

```
DIM folderNamesArray[] ! [idString 1],[shortNameString 1],[longNameString 1],
                       ! ...
                       ! [idString n],[shortNameString n],[longNameString n]
n = APPLICATION_QUERY (extension_name, "GetParameterFolderNames()", folderNamesArray)
```

Returns the folder names of Tags and Categories parameters.

`folderNamesArray`: String array which contains the foldernames of Tags and Categories

`n+1`: Number of folders including the root folder

Get Parameter Names

```
DIM parNamesArray[] ! [idString 1],[shortNameString 1],[longNameString 1],
                    ! ...
                    ! [idString n],[shortNameString n],[longNameString n]
n = APPLICATION_QUERY (extension_name,
                "GetParameterNames(folderNamesArray[i][1])", parNamesArray)
```

Returns the names of Tags and Categories parameters.

The first column of the array returned at the section called “Get Parameter Folder Names”.

`parNamesArray`: String array which contains the names of Tags and Categories parameters

`n`: Number of parameters

Get Parameters

```
n = APPLICATION_QUERY (extension_name, "GetParameter(parNamesArray[i][2])", parValue)
```

Returns the values of Tags and Categories parameters.

The second column of the array returned at the section called "Get Parameter Names".

`parValue:` String which contains the value of Tags and Categories parameters

`n:` 1 if successful, 0 otherwise

Library manager

This command can return various features of the library manager.

Ies files

```
n = APPLICATION_QUERY ("LIBRARY_MANAGER", "IES_FILES", ies_files_list)
```

This command returns the list of file names with .ies extensions loaded with the active libraries.

User image files

```
n = APPLICATION_QUERY ("LIBRARY_MANAGER", "USER_IMAGE_FILES", image_files_list)
```

This command returns the list of user-provided image file names loaded with the active libraries (image files which are not in the dedicated folders with names containing [TImg]*, [BImg]*, [UImg]*, or [HImg]*)

GDL Style Guide

Introduction

This document contains the GDL coding standard of GRAPHISOFT, which mainly sets the formal requirements for writing source code. It also describes a few rules and recommendations for the content. You have to obey these rules in order to produce manageable scripts; by default every declarative or imperative sentence is a rule, except where 'recommendation' (or avoidable, optional, etc.) is explicitly stated.

This document was created to establish a common format of GDL scripting. The GDL language is insensitive to the character case and most of the whitespace characters. As a result, lots of coding practices and standards exist. This gets intolerable, when such practices meet in the same project or organization. The following sections describe the GRAPHISOFT company standard, which remains purely a recommendation for non-GRAPHISOFT related developers. The supposed format will not be included in the GDL language's constraints ever.

Naming Conventions

General rules

Because of the subtype hierarchy, the child library parts automatically inherit all parameters of the parent. (Read more about subtypes and parameter in the ARCHICAD User Guide). Parameters are identified by their name, so inherited and original parameters can have the same name. It is the responsibility of the library author to avoid conflicts by using descriptive parameter names prefixed with abbreviated library part names. For handler parameters and user-defined parameters, GRAPHISOFT has introduced a parameter naming convention in its libraries.

Note

Handlers add extra functionality to library parts (e.g. doors and windows cut holes in walls). Parameter names with the prefix ac_ are reserved for special parameters associated with ARCHICAD handlers (e.g. ac_corner_window). Check the standard ARCHICAD Library subtype templates for the complete list.

Standard GRAPHISOFT parameter names are marked with the gs_ prefix (e.g. gs_frame_pen). Please check the ARCHICAD library parts for reference. Use these parameters in your GDL scripts to ensure full compatibility with GRAPHISOFT libraries.

FM_ is reserved for ArchiFM (e.g. FM_Type).

Variable names

Variable and parameter names should be related with the function of the parameter.

mixedCase: starts with a lowercase letter; every new word should start with an uppercase letter. E.g.: `size`, `bRotAngle180`, `upperLeftCorner`

Don't use one or two letter variable names - no one will know what you meant.

You should use a prefix in generally used variable names to denote general categories. This can spare time when someone needs to find out the type of a variable or parameter. Don't forget to replace the prefix if you change the meaning of a variable.

Table 11. Variable name prefixes

Prefix	Meaning	Example
i	General integer value / integer index	`iRiser`
n	Integer value - amount of something	`nRiser`
b	Boolean value	`bHandrail`
st	String type value	`stPanelTypes`
x	X coordinate of a point	`xRailPos`
y	Y coordinate of a point	`yRailPos`
pen	Pen color	`penContour`
lt	Linetype	`ltContour`
fill	Fill type	`fillMainBody`
mat	Material type	`matCover`

Using underscores (_) is recommended for distinguishing variables and parameters in the same script: use single underscore (_) prefix for a variable in a script, and double (__) for a variable declared and used only inside a subroutine section. Do not use underscores in the beginning of parameter names, or to separate words in a name. Historical names coming from subtypes are exceptions.

Example

```
_iDoorTypes = iDoorTypes
! "_iDoorTypes" variable gets the value of "iDoorTypes" parameter
gosub "exampleScript"
end

"exampleScript":
    __iDoorTypes = _iDoorTypes * 3
    ! "__iDoorTypes" subroutine variable gets the value of 3 times "_iDoorTypes" variable
return
```

Capitalization

- Commands should be written consistently lowercase or uppercase according to your taste. **GRAPHISOFT recommends lowercase.**
- GDL global variables should always be written uppercase for easier script reading.

- The following keywords should be lowercase: `call, goto, gosub, parameters`.

Expressions

- Space should be used in front of and behind the following binary operators:
  - arithmetical: *****, **/**, **%** (mod), **+**, **-**, **^** (**)
  - logical: **&** (and), **|** (or), **@** (excluding or), **=**, **<>** (#), **<**, **<=**, **>**, **>=**
  - assignment: **=**

  E.g.:

```
a = (b + c % d) * e
```

- No spaces are allowed in front of and behind the following unary operators:
  - subscripting: `array[25]` Note: avoid space inside brackets (`array[ 5]`) to make "find" function easier
  - logical not: `not(x)`
  - unary minus, unary plus: `-x, +x`
- Function calls should have a space in front of the opening parenthesis of the parameter list, and behind every comma separating the parameters:

```
abs (signedLength)
minimum = min (a, 25 * b, c)
```

- When testing equality with constants (e.g. `i = 5`) the constant should be the second operand.
- When assigning values to Boolean variables the logical expression should be parenthesized:

```
bBoolValue = (i > j)
```

- Do not use the Boolean result of logical negation of integer values or variables. E.g. instead of `if not(iIntVal) then` please use `if iIntVal = 0 then`. (Of course, Boolean variables and expressions can be negated, e.g. `if not(bBoolVal) then`).
- Do not compare Boolean variables and expressions to true or false; use the value of Boolean or its negated value:

```
bBoolVal = 1
if bBoolVal then          ! instead of: if bBoolVal = 1
    ...
endif
if not(bBoolVal) then     ! instead of: if bBoolVal = 0
    ...
endif
```

- Complex expressions (e.g. where `and` and `or` are both present) should be parenthesized to clarify precedence.
- Put parentheses around rarely used operator combinations.
- Logical expressions consisting of many parts should be placed on multiple lines, and you should also align the sub-expressions or the logical operators:

```
  bResult = (bValue1        & bValue3        & not(bValueWithLongerName))  | \
            (not(bValue1)   & not(bValue3)   & bValueWithLongerName)       | \
            (not(bValue12)  & bValue3        & not(bValueWithLongerName))  | \
            (bValue2        & not(bValue3)   & bValueWithLongerName)
```

Control flow statements

if - else - endif

Avoid using the one line form of conditional expressions.

To improve code readability, it is essential to express the hierarchy of nested statements. The following example shows the recommended tabulation of code blocks.

```
if condition1 then
    statement1
    ...
    statementn
else
    statementn+1
    ...
    statementn+m
endif

if condition2 then
    if condition3 then
        ...
    else
        ...
    endif
    if condition4 then
        ...
    endif
else
    ...
endif
```

for - next, do - while, while - endwhile, repeat - until

To improve code readability, it is essential to express the hierarchy of nested statements. The following example shows the recommended tabulation of code blocks.

```
for i = initialValue to endValue
    statement1
    ...
    statementn
next i

do
    ...
    for i = initialValue to endValue
        statement1
        ...
        statementn
    next i
    ...
    bCondition = ...
    ...
while bCondition
```

Subroutines

Pieces of code that are needed more than once should be turned into subroutines. This makes later corrections less risky, and the code more structured. The label of the subroutine should correspond with its function. Do not use numbers as names, it makes the code unreadable. Variables used and declared only inside a subroutine should start with double underscore.

Style (italic texts should be replaced implicitly):

```
! ==============================================================================
!   Short description of the functionality
! ------------------------------------------------------------------------------
! Input Parameters:
!   par1:    short description (type)
!   par2:    short description (type)
!   ...
! Output:
!   par1:    short description
!   ...
! Remark:
!   Remarks for the caller
!   Description of key points of the implementation
! ==============================================================================

subroutine_title:
    ! body
return
```

You should write the body of the subroutine indented by one tabulator field to the right.

You should leave two empty lines behind the closing '`return`' of the subroutine.

You should write one statement per line.

Subroutines shouldn't be longer than 1-2 screens (about 80 lines) if possible.

Check all incoming parameters for validity and/or declare the restriction in comment

The `call` and `parameters` keywords are lowercase.

Writing comments

The language of the comments should be English; avoid bad words.

You should use the following style for comments:

Script header

It is only a recommendation

```
! <contact person initials>
! ==============================================================================
!   One sentence description of the purpose of the script
! ------------------------------------------------------------------------------
! Input Parameters:
!   par1:    description of the parameter (integer)
!   par2:    description of the parameter (1 / -1)
!   par3:    description of the parameter (0 / 1)
!   ...
! Output: [if a macro returns values]
!   [1]:    description of the value (type)
!   [2]:    description of the value (type)
!   [ ... NSP]: original stack elements
! Remark:
!   Longer description.
!   Note for the caller
! ==============================================================================
```

Any code can come only after this.

Section divide

```
! ==============================================================================
! Section name
! ==============================================================================
```

The length of the full comment line is 80 characters.

For the subroutines you should always explain the meaning of non-trivial parameters and the return value. E.g. for indices always indicate the range (starts from 0 or 1, any special values, etc.).

Example in the section called "Subroutines"

You should always indicate with the TODO keyword if you leave something unfinished, it's easy to search for later:

```
n = 5 ! TODO: set initials; it will be computed from the length
```

You can also put optional section descriptions in between the lines of the source code, beginning at the current tab depth. You can also add short explanations to the end of the source line by adding a tab at the end; or, if there are more of those, you can align them with tabs.

You should always add comments:

- For unusual solutions
- If it would help others understand the code more quickly.
- If something is forbidden or not recommended for others.

Optional (others will be thankful) if it helps in any way.

Do not let the comments break the rhythm of the code, or the merits of the code.

When commenting a coherent code block, you may use the following format:

```
! == code block name ===[
statement1
...
statementn
! ]=== code block name ===
```

This facilitates the isolation of the block by the look plus some editors support the search for the matching bracket by a shortcut (e.g.: `ctrl + ]` in Microsoft Visual Studio)

Comment the end of 'if' statements if there are many code lines between `if` and `endif` as follows:

```
if condition1 then
    ...
    if condition2 then
        ...
        ! many statements
        ...
    endif   ! if condition2

endif   ! if condition1
```

Some script types (Forward and Backward Migration Scripts especially) have a recommended form of separators and structures. For examples, see the ARCHICAD library or the section called “Basic Technical Standards”.

Script structure

Set your editor to use 4 character wide tabs. Spaces should never be used to tabulate lines. Instead, use spaces to adjust expressions to each other inline.

The maximum length of the lines is 120 characters. Statements shouldn't even get close to this number. In case they do, you get a warning.

All file name references are case sensitive in scripts, the extensions accordingly.

Values used multiple times should be calculated directly before the block of usage if it can be well localized or at the beginning of the script otherwise. There is no compromise. Calculate complex values only once to spare calculation time by storing them in variables (but do not waste variables unnecessary) or in the transformation stack (add, rot, etc.).

The object scripts are linear which makes them clearer. Subroutines should only break it when a calculation or model generation segment is needed more than once, or for script readability. Avoiding coding the same thing twice is an important principle in all programming languages. Redundancy makes later changes a lot more difficult.

Try not to use huge choice branches, instead prepare the data for a calculation or generation command in smaller choice-blocks, where you can avoid redundancy easier.

Bad Solution

```
if bOnHomeStory then
    line_type ltContour
    fill gs_fill_type
    poly2_b 5, 3, gs_fill_pen, gs_back_pen,
        left,   0,      1,
        left,   -depth, 1,
        right,  -depth, 1,
        right,  0,      0,
        left,   0,     -1
endif
if (bOnUpperStory or bOnAboveUpper) and bDrawContBB then
    line_type ltBelow
    fill fillTypeBelow
    poly2_b 5, 3, fillPenBelow, fillBackBelow,
        left,   0,      1,
        left,   -depth, 1,
        right,  -depth, 1,
        right,  0,      0,
        left,   0,     -1
endif
```

The definition of geometry is duplicated! It could be even worse if the distance between the identical commands were bigger.

Good Solution

```
if bOnHomeStory then
    bPolygon = 1
    line_type ltContour
    fill gs_fill_type
    fillPen = gs_fill_pen
    fillBGPen = gs_back_pen
endif
if (bOnUpperStory or bOnAboveUpper) and bDrawContBB then
    bPolygon = 1
    line_type ltBelow
    fill fillTypeBelow
    fillPen = fillPenBelow
    fillBGPen = fillBackBelow
endif
if bPolygon then
    poly2_b 5, 3, fillPen, fillBGPen,
        left,   0,      1,
        left,   -depth, 1,
        right,  -depth, 1,
        right,  0,      0,
        left,   0,     -1
endif
```

Prepare your scripts for localization.

Use `"asdf"` for non-localized strings (e.g. macro calls) and `` `asdf` `` for localized strings (e.g. string constants, parameter values).

BASIC TECHNICAL STANDARDS

Introduction

The release of new ARCHICAD® national versions, the growing GRAPHISOFT product line and the BIMcomponents® portal have dramatically increased the demand for GDL objects and object libraries. As a result, many independent or third party GDL programmers have started developing libraries or objects for GRAPHISOFT.

Basic guidelines are necessary to keep these objects compatible and to achieve the standard of quality people expect from GRAPHISOFT products. The purpose of this document is to provide guidance to GDL developers in creating objects, with useful tips and tricks, examples, descriptions of previously undocumented and new ARCHICAD features.

Library part format

File extension

Most GDL Library Objects are saved with the *.gsm extension and they are distinguished by their subtype in ARCHICAD. There is a special extension, *.gdl (GDL Script Files) for the MASTER_GDL/MASTEREND_GDL files. ARCHICAD handles any GDL Script File starting with the string "MASTER_GDL..." or "MASTEREND_GDL..." in their file name in a special way. These files can be used to load attribute definitions, define line types, and materials etc. (more information in **The GDL Script Analysis on page 10**).

Identification

The identifier

$$\overbrace{\underbrace{\texttt{\{2B0688E1-BE95-4F94-AC6A-DD76D21592D3\}}}_{\text{Main ID}}\ \texttt{-}\ \underbrace{\texttt{\{7728A37F-ABD0-43D6-A07D-B4866CB23905\}}}_{\text{Revision ID}}}^{\text{Library Part ID}}$$

The ID consists of two parts, each 36 hexadecimal characters long. The first 36 characters represent the **Main ID** and the last 36 characters represent the **Revision ID**.

- The Main ID is created when the library part is saved for the first time. It is also modified if the library part is resaved using the "Save as" command.
- The Revision ID is also created when the library part is saved for the first time but it is modified if the library part is resaved using the "Save" command. Using the LP_XMLConverter tool a compilation will change the Revision ID and leave the Main ID untouched, of course.

This means that Main ID identifies a library part in its function and the Revision ID helps in distinguishing the revisions of the object. Let's see this in practice.

Library Part Identification

When placing an object in ARCHICAD, the program stores the reference by the ID and considers the name only for objects without an ID (library parts saved before ARCHICAD 8 and .gdl files). In case of Library Parts coming from versions earlier than ARCHICAD 8, there was no such thing as a GUID. So when such a Library Part is encountered in the file, ARCHICAD will fill out its ID with zeros.

When loading a library, ARCHICAD uses the following hierarchical criteria for matching loaded library parts to objects already placed in the project:

- In case the stored ID is valid:
  - ARCHICAD tries to get an exact match of both parts of the ID
  - Failing that, ARCHICAD tries to match the first part of the ID, which is the Main ID.
  - In case it doesn't find one matching, it starts to check other elements' Migration Table values to find a substitute.
  - Finally, when loading files saved before ARCHICAD 12, ARCHICAD tries to match by library part name.
- In case the stored ID is zero, the identification procedure tries to match by name only.

The same process is executed when looking for macros in a placed element as every library part contains a lookup table for its called macros' GUIDs. Naturally, when saving an object containing macro calls, this table is collected using a name-based search in the currently loaded library.

How to know what the exact GUID of a Library Object is

For this you have to get to know the Subtype Hierarchy dialog window. In this dialog you can see the subtype hierarchy of the currently loaded library in a tree view. The main attributes - name, version, ID, file location, flags indicating if the object is template or placeable - of the selected library part are displayed in the bottom of the window.

This dialog appears in 3 contexts:

- Open Object by Subtype... (in File menu)
- Select Subtype... (in the Library Part Editor window)
- Place All Objects (in the Special menu)

Naturally, you can read the ID in the XML format of the library part (location: xpointer (/Symbol/@UNID)). To get this, use the LP_XMLConverter tool.

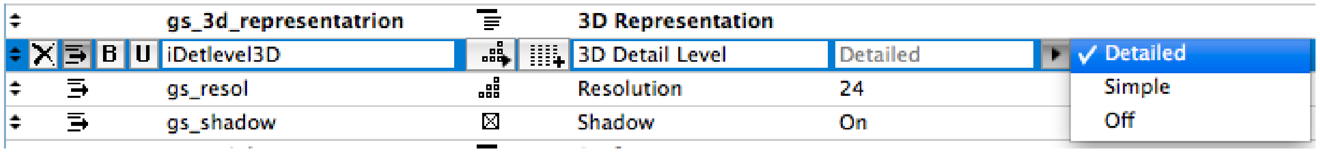
Compatibility issues

The most important principle is that the Main ID represents a constant functionality to the users of the library. This means that if you publish a new library part using a Main ID that is already in use by an old library part, when loading an old project with the new library, the old placed elements will be replaced by the new object. This contradicts the users' expectations, such as there will be no change in the object's parameters and their functions. If you want to change the name or the function of old parameters, generate a new Main ID and use migration scripts to avoid ambiguity and unexpected data loss. Make sure that this new Main ID is unique - not identical with any other ID in the library.

Note, that renaming an object won't make it incompatible with its past self for ARCHICAD as long as their MainIDs remain identical. Similarly, giving the name of an existing library part to a new one (with a new ID) will not make them compatible.

This issue effects the localization of libraries, too. If you have string type controlling parameters, the relevant values will differ between national versions. For example: if you are unaware of the problem, loading a German plan file with the Danish sibling library will change the generated elements since some control parameters have meaningless values. There are two solutions. The easy way is to declare that the German and Danish libraries have nothing to do with each other and to change the Main IDs in localization consequently. The second - and more user friendly - solution is to create an integer type control parameter acting as string (see VALUES). These integer parameters are determinant, the visible string descriptions are just an input method for them (therefore localizations can be different, but the true meaning will stay the same). When writing a script, the integer parameter values should be used.

The following example code features a detail level integer parameter acting as a string type:



Variable	Name	Value
gs_3d_representatrion	3D Representation	
iDetlevel3D	3D Detail Level	Detailed
gs_resol	Resolution	24
gs_shadow	Shadow	On

```
! Master script:
dim stDetlevel3DDesc [3]
stDetlevel3DDesc[1]=`Detailed`
stDetlevel3DDesc[2]=`Simple`
stDetlevel3DDesc[3]=`Off`

! iDetlevel3D constants
DETLEVEL3D_DETAILED = 1
DETLEVEL3D_SIMPLE   = 2
DETLEVEL3D_OFF      = 3

! Parameter script:
values{2} "iDetlevel3D"  DETLEVEL3D_DETAILED, stDetlevel3DDesc[1],
                         DETLEVEL3D_SIMPLE,   stDetlevel3DDesc[2],
                         DETLEVEL3D_OFF,      stDetlevel3DDesc[3]
```

Migrating Elements

It is possible to maintain a link between the old and the new, updated version (with new Main ID) of a library part by using migration scripts (the section called “Forward Migration script”, the section called “Backward Migration script”) and the section called “Migration table”.

In these scripts you can define which library part substitutes which (by connecting the old and new Main ID-s), and how to update the new object's parameter values based on the old one (or vice versa). You can set rules for the migration to happen only under certain parametric conditions. If the subject of the migration meets these, the upgrade or downgrade is possible, otherwise it will not be an option.

Generally, it is possible for the subject of the migration to have one or more successors (or ancestors in backward migration) depending on parameter settings. The case is a little different when migrating Zone Stamps, though. One type of Zone Stamp can be linked to many Zone Categories. But each category can use only one kind of Zone Stamp. When migrating a Zone Stamp, the Category stays the same. If the route of migration diverges ("Zone Old" is upgraded to "Zone New 1", or to "Zone New 2", depending on different parameter settings), it is possible to get a Category with two different Stamps linked. While this is a valid result regarding the migration process, it is an inconsistent situation for ARCHICAD. Make sure you only migrate Zone Stamps in a direct way, to avoid this.

General scripting issues

Numeric types - Precision

Before ARCHICAD 9 all numeric values were stored internally as floating point values which resulted in imprecise vaules. This meant that integer values were - a little - imprecisely stored. From ARCHICAD 9 integers - and hence GDL parameter types that are best described with integers - are correctly stored internally as integers.

`Parameter types internally stored as an Integer:`

```
 Integer,
 Boolean,
 Material,
 Line type,
 Fillpattern,
 Pencolor,
 Intensity (Light)
```

`Parameter types internally stored as a Floating-point number:`

```
 Length,
 Angle,
 Real,
 RGB Color component (Light)
```

GDL variables still don't require type definition, the type is determined during the interpretation from the value to be loaded into the variable. The output of numeric operators now have a type. You should consult the GDL Manual for this information.

The programmer can safely compare integer types with the equality operator. In fact, from ARCHICAD 9 warnings are now issued, if a programmer tries to directly compare floating point values with integer values using the equality operator. For equality-comparisons of floating-point numbers use a small epsilon value meaning the precision of the comparison. For equality-comparisons of a floating-point number and an integer use the `round_int` function.

Below some sample methods of testing for equivalence between different numeric types are described:

```
iDummy = 1 * 2
if iDummy = 2 then
    ! valid comparison, it is true, these statements will be executed
    ...
endif


dDummy = 1.5 + 0.5
if dDummy = 2 then
    ! you never know if it is true, don't trust such comparisons
    ...
endif


dDummy = 1.1 * 2
if dDummy = 2.2 then
    ! you never know if it is true, don't trust such comparisons
    ...
endif


! EPS = 0.0001 -> in the master script
dDummy = 1.1 * 2
if abs (dDummy - 2.2) < EPS then
    ! valid comparison, it is true, these statements will be executed
    ...
endif


dDummy = 1.5 * 2
if round_int (dDummy) = 3 then
    ! valid comparison, it is true, these statements will be executed
    ...
endif
```

Trigonometry functions

While GDL scripting, you may need various trigonometry functions. The following functions are directly available from GDL: `cos, sin, tan, acs, asn, atn.`

All other functions can be easily derived as follows.

```
Secant Sec(X) = 1 / cos(X)
Cosecant Cosec(X) = 1 / sin(X)
Cotangent Cotan(X) = 1 / tan(X)
Inv. Sine Arcsin(X) = atn(X / Sqr(-X * X + 1))
Inv. Cosine Arccos(X) = atn(-X / sqr(-X * X + 1)) + 2 * atn(1)
Inv. Secant Arcsec(X) = atn(X / sqr(X * X - 1)) + sgn((X) -1) * 2*atn(1)
Inv. Cosecant Arccosec(X) = atn(X / sqr(X*X - 1)) + (sgn(X) - 1) * 2*atn(1)
Inv. Cotangent Arccotan(X) = atn(X) + 2 * atn(1)
Hyp. Sine HSin(X) = (exp(X) - exp(-X)) / 2
Hyp. Cosine HCos(X) = (exp(X) + exp(-X)) / 2
Hyp. Tangent HTan(X) = (exp(X) - exp(-X)) / (exp(X) + exp(-X))
Hyp. Secant HSec(X) = 2 / (exp(X) + exp(-X))
Hyp. Cosecant HCosec(X) = 2 / (exp(X) - exp(-X))
Hyp. Cotangent HCotan(X) = (exp(X) + exp(-X)) / (exp(X) - exp(-X))
Inv. Hyp. Sine HArcsin(X) = log(X + sqr(X * X + 1))
Inv. Hyp. Cosine HArccos(X) = log(X + sqr(X * X - 1))
Inv. Hyp. Tangent HArctan(X) = log((1 + X) / (1 - X)) / 2
Inv. Hyp. Secant HArcsec(X) = log((sqr(-X * X + 1) + 1) / X)
Inv. Hyp. Cosecant HArccosec(X) = log((sgn(X) * sqr(X * X + 1) +1) / X)
Inv. Hyp. Cotangent HArccotan(X) = log((X + 1) / (X - 1)) / 2
```

Note:

```
Logarithm to base N LogN(X) = log(X) / log(N)
```

GDL warnings

Like any other programming language, GDL has a syntax and logic to be followed. If there is a mistake in syntax, the programmer gets an error message. If there is something confusing, or some unexpected thing happens when running the script, a GDL warning is sent out.

You can choose WHERE you want to send these messages in Options/Work Environment/Model Rebuild Options:

- **Interrupt with error messages**: a dialog pops up at every problem
- **Write Report**: the message is written in the Report window

You can choose WHAT you want to send out as message: this setting is available in the Library Developer menu, called **"Check Library Part Scripts for Warnings"**. When enabled, not only errors, but warnings get reported as well according to the WHERE settings.

You can also choose WHEN you want to see warning messages. This can be set in the Library Developer menu as well, called **"Always Send GDL Messages"**. Turning this feature on, every time GDL is executed, the warnings and errors get force-reported anyway. Leaving it off, the warning report contexts stay as usual.

Note, that using some combinations of the above switches can result in difficulties: for example, having the **"Always Send GDL Messages"** and the **"Interrupt with error messages"** enabled together may prevent the execution of something as "simple" as moving an editable hotspot, popping up dialogs all the time.

Pressing **"Check script"** in the library part editor, if there is a problem with your script using the current parameter settings, you will always get a warning or error message popup window. Using the `PRINT` command, or the GDL debugger may help a lot locating mistakes hard to find otherwise.

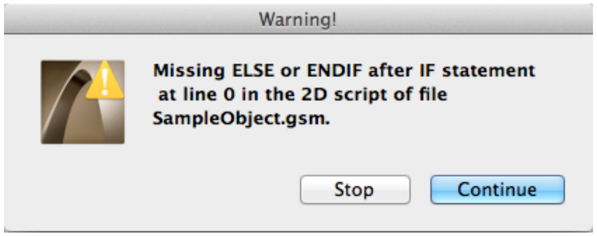
Note that the line numbers in the GDL warnings refer to the script which contains the problem.

Parsing errors must be handled with extra care. These denote the first line in which the parsing gets impossible but the actual problems may be some lines before.

Example

The interpreter detects the missing statement first at the `endif` and stops there; though the problem is obviously around line 4 where an `endif` is really missing.

```
if condition1 then
    if condition2 then
        ! do something

    ! do something - BUT WE MISSED AN 'endif'
else
    ! a potentially long code block
endif
```


Warning!

Missing ELSE or ENDIF after IF statement at line 0 in the 2D script of file SampleObject.gsm.

Here are some examples of the latest warning messages developed, with some explanation:

Warning message	**Possible explanation**
Simple parameter redeclared as an array	specifying a simple parameter in an object and using it as an array in the called macro
Undefined parentId "id" used in UI_PAGE definition	missing parent ID in tabpage hierarchy
View/Project dependent global "globalName" used in parameter script	see the section called “Global Variables”
Request "requestName" used in parameter script	see the section called “REQUEST Options”
Application query "applicationQueryName" used in parameter script	see the section called “Application Query Options”
Possibly unwanted parameter type change	a parameter receives a value not supported by its original type

Hotspot and Hotline IDs

Purpose of hotspot/hotline/hotarc identification

In ARCHICAD the hotspot/hotline/hotarc identification is introduced to support associative dimensioning in section. Via this feature a dimensioning item can refer to any of a GDL object's hotspots/hotlines. It will become an important issue when the number of hotspots/ hotlines changes between the object's different parameterization states.

Problem of old-school hotspots/hotlines

If the programmer doesn't specify hotspot/hotline/hotarc IDs - or if he sets them to 0 - ARCHICAD will assign continuously increasing ordinal numbers. This solution is correct for static objects but causes dimensioning problems when some hotspots/hotlines appear or hide between parameter set-ups. Namely, the IDs will be rearranged so they will change, and the associative dimensioning items - in section - will go astray.

Correct hotspot/hotline/hotarc scripting

For all these reasons you should assign fix IDs to the hotspots/hotlines in your objects. This can be done by reserving wide intervals for the hotspots/hotlines of individually controllable features.

Let's take a stair for example. The bounding hotspots/hotlines may use the [1-100] interval, the handrails may use the [200-299] interval and the risers the [1000-) one. This guarantees that the dimensioning of the handrails won't be corrupted if the number of risers changes or even if the bottom connection gets more complex (using more hotspots/hotlines).

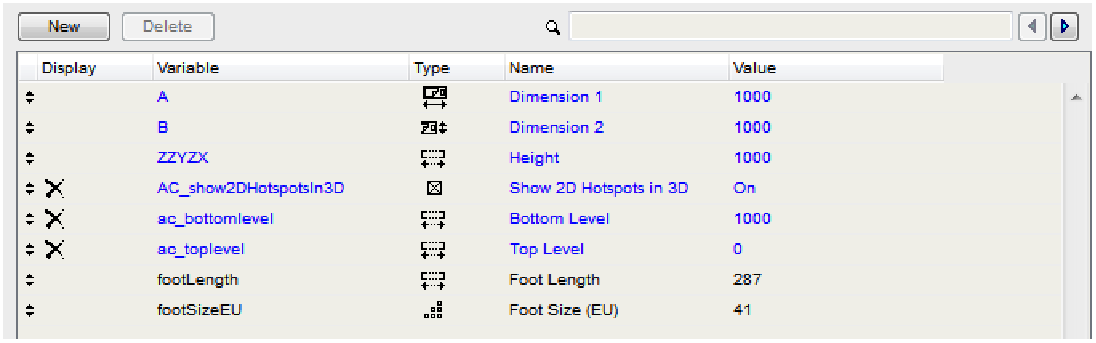
Editable hotspots

Since ARCHICAD 8 release you can use editable hotspots in your library parts. The feature is described in *Graphical Editing Using Hotspots* except for one possibility.

In some cases you may want to display a different parameter from the edited one. See the example code below:

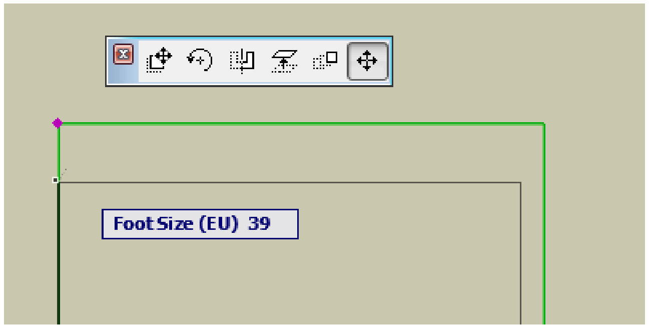
Editable hotspot example - Shoe / Shoe-rack

We want to have the size of a shoe in meters and in shoe sizes, too. For that we create two parameters and connect them in the parameter script. Naturally, the type of the explaining parameter can be different (e.g. text). We emphasize that the edited parameter is `footLength` all the way, `footSizeEU` - the displayed parameter - must be updated via the parameter script.



Display	Variable	Type	Name	Value
	A		Dimension 1	1000
	B		Dimension 2	1000
	ZZYZX		Height	1000
✕	AC_show2DHotspotsIn3D	☒	Show 2D Hotspots in 3D	On
✕	ac_bottomlevel		Bottom Level	1000
✕	ac_toplevel		Top Level	0
	footLength		Foot Length	287
	footSizeEU		Foot Size (EU)	41

2D editing



Parameter script

```
DIM lengthValues[10]
DIM sizeValues[10]
for i = 1 to 10
    sizeValues[i] = i + 35
    lengthValues[i] = (i + 35) * 0.007
next i


values "footLength" lengthValues
values "footSizeEU" sizeValues

if GLOB_MODPAR_NAME = "footLength" then
    parameters footSizeEU = round_int (footLength / 0.007)
else
    if GLOB_MODPAR_NAME = "footSizeEU" or GLOB_MODPAR_NAME = "" then
        parameters footLength = footSizeEU * 0.007
    endif
endif
```

2D script

```
rect2 0, 0, footLength * 0.4, footLength   ! or a more realistic shoe model

hotspot2 0, 0,          1, footLength, 1 + 256, footSizeEU
hotspot2 0, footLength, 2, footLength, 2, footSizeEU
hotspot2 0, -0.1,       3, footLength, 3
```

GDL execution contexts

ARCHICAD lets the GDL object know about the context it is being displayed or used in. The next global variables are used for this purpose:

- GLOB_VIEW_TYPE to determine the active view
- GLOB_PREVIEW_MODE to determine the active preview
- GLOB_FEEDBACK_MODE for editing context indication
- GLOB_SEO_TOOL_MODE for solid element operations context indication

For the possible values refer the the section called “General environment information” and the following list:

GLOB_VIEW_TYPE = 2 - 2D, floor plan

The model is displayed in the standard 2D floor plan. In a 3D script this means that the model is projected to 2D via the `project2D` command. This is the main use of an object - this 2D model must be always correct and efficient.

If **GLOB_FEEDBACK_MODE = 1** then the model is displayed via feedback lines on the 2D floor plan during the hotspot editing of the object. This model is drawn many times in a single second throughout the user interaction. This implies that the model should represent the essential parts of the object only. Note, that texts (generated by `text2` command) are not refreshed in feedback mode - since it would slow down the output.

GLOB_VIEW_TYPE = 3 - 3D view

The 3D model is displayed in the standard 3D model window or it is the source of photorealistic rendering. This view should omit internal details of the object, since these cannot be seen anyway. This is the second most important use of an object - the 3D model must be always correct and efficient. This target type demands correct outside look.

If **GLOB_FEEDBACK_MODE = 1** then the 3D model is displayed via feedback lines in the 3D model window during the hotspot editing of the object. This model is drawn many times in a single second throughout the user interaction. This implies that the model should represent the essential and visible parts of the object only.

GLOB_VIEW_TYPE = 4 - section or **GLOB_VIEW_TYPE = 5 - elevation**

The 3D model is displayed in a section/elevation window. For these views, the object should generate internal details which are unnecessary for every other view type.

If **GLOB_FEEDBACK_MODE = 1** then the 3D model is displayed via feedback lines in a section/elevation window during the hotspot editing of the object. This model is drawn many times in a single second throughout the user interaction. This implies that the model should represent the essential and visible parts of the object only.

GLOB_VIEW_TYPE = 6 - 3D document

The 3D model is displayed in an axonometric window as a drawing. This is used for documentation, dimensioning in 3D.

GLOB_VIEW_TYPE = 7 - detail drawing

The model is used in a detailed drawing window. The model can be more detailed than in other views consequently. The 2D and 3D models are not distinguished - that information can be derived from the script type.

GLOB_VIEW_TYPE = 8 - layout

The model is used in a layout window, with its print display. The model should show its printing look. The 2D and 3D models are not distinguished - that information can be derived from the script type.

If **GLOB_FEEDBACK_MODE = 1** then the model is displayed via feedback lines in a layout window during the hotspot editing of the object. This model is drawn many times in a single second throughout the user interaction. This implies that the model should represent the essential and visible parts of the object only.

GLOB_VIEW_TYPE = 9 - calculation and/or **GLOB_PREVIEW_MODE = 2 - listing**

The 3D model is used for surface and volume calculation by the listing engine. This context is the proper place to do some model alterations for listing. E.g. you can generate extra bodies to raise the surface to be painted and the amount of required paint. Use the combination of the 2 globals for the desired result in calculation and listing model generation.

GLOB_PREVIEW_MODE = 1 - settings dialog

The model is displayed in the Object Settings Dialog's preview box. The 2D and 3D models are not distinguished - that information can be derived from the script type. The object should provide a fast, rough preview of the model considering the limited size of the preview.

GLOB_SEO_TOOL_MODE = 1 generating as an operator for Solid Element Operations

The generated 3D model is used as a parameter for solid (CSG) operations. This can be useful, when the object's space demand is larger than the object itself. E.g. when you subtract a stair from a slab, you'd expect that the stair cuts a hole for the walking people, too. To achieve this, in this context the stair should generate a model containing that walking space.

Communicating values with ARCHICAD

There are two directions of parameter value flow between ARCHICAD and the library part. The first direction means that the ARCHICAD informs the library part about an attribute of its context (e.g. the drawing scale of the project or the thickness of the wall a window is placed into). The second direction is when the library part asserts something about itself which instructs ARCHICAD to change that something in the direct context of the object (e.g. the depth a wall end cuts in the wall).

Information flow from ARCHICAD

There are 3 channels of information coming from ARCHICAD: global variables, parameters with predefined names and directly called values.

Global variables

Global variables are filled by ARCHICAD according to the current project settings and to the placement context of the object. Note, that not all globals are filled in every context and view.

For the complete list of global variables and their relevant restrictions in certain scripts, consult the section called “Global Variables”.

Fix named optional parameters

The newer method of ARCHICAD for providing information is the method of fixed named optional parameters. If a given library part has a parameter with a name and type matching any optional parameter, ARCHICAD sets its value according to its function.

Refer the section called “Parameters set by ARCHICAD” in the section called “Fix named optional parameters” to learn the ARCHICAD defined library part parameters.

Requests and Application Queries

For rarely used, special information, library parts use Request calls or Application Queries in their scripts. Unlike global variables, these only give a return value when the containing actual scripts runs. Note, that most requests and queries should be avoided in a parameter script, or a master script run as a parameter script. If used in those scripts, the validity of the returned value or the function can not be guaranteed.

Refer the section called “REQUEST Options” and the section called “Application Query Options” to learn more about options, parameter script compatibility and syntax.

Information coming from the library part

ARCHICAD needs certain informations to use the library parts correctly. These informations depend on the function and the context, and are stored in the built-in ARCHICAD subtypes as parameters with predefined name and function. In addition to built-in ARCHICAD subtypes some functions might need fixed named optional parameters.

Consult the fix parameters of built-in subtypes and the section called “Parameters read by ARCHICAD” in the section called “Fix named optional parameters” to get a view of the possibilities.

Model View Options, Library Global

The display of library parts in the plan may depend on the current view.

Internal Model View Options

The view's internal settings are available via GDL global variables (e.g. GLOB_SCALE, GLOB_STRUCTURE_DISPLAY) and request options (e.g. "window_show_dim", "door_show_dim", "floor_plan_option", "view_rotangle").

Library Global View Options

From ARCHICAD 13 on, you can define view options from your library. These options are stored into each view and they are returned accordingly.

The following properties/parameters/options should be stored in view dependent library globals:

- showing/hiding opening lines
- showing/hiding minimal spaces
- pen and other view attributes which shouldn't be changed individually for the sake of uniformity (e.g. minimal spaces)
- showing/hiding specific accessory elements (e.g. knobs, handles)
- setting 2D symbol types for object groups

Things which should NOT be stored in view dependent library globals: general values for the whole project, general values for the whole country, values which may be required to be set individually for objects.

To insert a tab page into the MVO dialog, you have to make a library part which is derived from the *Library Global Settings* (GUID: {709CC5CC-6817-4C56-A74B-BED99DDB5FFA}) subtype. This object must contain the desired global options as parameters and it must have a user interface definition for the tab page. The width of the UI should be set to 600 pixels to match the existing panels. The height of the UI is freely definable. It may have a parameter script for connecting parameters or user interface elements.

The `LIBRARYGLOBAL` command can be used in your placeable elements to query values of your own library global settings object depending on the current view settings.

Script type specific issues

Master script

When writing the master script you should keep in mind that it will be evaluated before the run of each script by ARCHICAD. This implies the following things:

- Placing parameter definitions and calculations used by multiple scripts in the master script is a good idea: it reduces file size and makes elements easily modifiable.
- Be sure to put only common calculations here to avoid an unnecessary increase of the evaluation time of the libpart (remember that master script is evaluated before each and every script).

- Avoid using the parameter buffer in the master script for effectiveness reasons.
- Do not put `end` commands in the master script; otherwise, ARCHICAD will not run the rest of the scripts.

2D script

Execution context

The 2D script is executed when a 2D model is generated:

- 2D plan
- 2D editing feedback
- 2D preview in the Object Settings dialog window
- Layout drawing
- Layout drawing feedback

Mind that most of the architectural design is done in 2D, so usually this model is the most important. This implies requirements of exact look, fast generation time and proper function when editing via hotspots.

General recommendation

Try to avoid using fragments and the binary 2D format in order to make objects modifiable.

2D script is much more customizable than the 2D symbol, prefer this solution. In a binary 2D symbol, the curved fills aren't stretched correctly, you don't have to face this problem in 2D scripting, either.

Defining line and fill properties

From ARCHICAD 9 on you have the possibility to choose from several main categories of lines and fills from GDL. Lines and polygon segments can be defined as contour, inner or general; fills can be defined cut, cover or drafting. These categories are described in the ARCHICAD user documentation, let's see how we use them in GDL objects.

Setting the correct properties for lines and fills will enable you to eliminate the display-option dependence from your scripts. Formerly, you had to add a condition for drawing of some inner lines according to the set display option. Now you should define an inner line for that purpose and ARCHICAD will display it or not as implied by the display options.

Let's see the extract of the 2D script of a window to summarize the definition cases:

```
! ===== Sill =====

line_property 0    ! general lines

! the sill is seen from above -> cover fill
poly2_b{2} 4, 1 + 2 * (gs_fillSillCover > 0) + 4 + 64, ...
...

! ===== Wall segment / Cavity Closure =====

line_property 1    ! inner lines
line2 ...
...

line_property 2    ! wall contours
line2 ...
...

! wall segment is seen cut -> cut fill
poly2_b{2} 4, 2 + 4 + 8 + 16 + 32, ...

! ===== Window Frame =====

line_property 0    ! general lines

! side window frame is seen cut -> cut fill
poly2_b{2} 4, 1 + 2 * (gs_fillFrames > 0) + 4 + 32, ...
...
```

3D script

Execution context

The 3D script is executed each time a 3D model is generated:

- 3D window (wire, hidden line, solid model)
- 2D plan when `project2` is used to project the 3D model to 2D

- 2D section - mind the details
- 3D editing feedback - optimize for speed
- Operator for solid operations in 3D - ask the designer for the desired functionality
- Surface and volume calculation for Listing
- 3D preview in the Object Settings dialog window
- Layout drawing when `project2` is used to project the 3D model to 2D
- Layout drawing feedback

General recommendation

Try to avoid using binary format in order to make objects modifiable.

Use status codes to control the visibility of the objects in hidden line views. Make the contour lines of curved surfaces visible. Hide unnecessary lines when it is possible.

Define editable hotspots instead of fix ones whenever possible.

Don't use `del top` command to make later modifications easier.

Always restore the global coordinate system at the end of the 3D script and follow it with an `end` command to make further modifications on the object easier.

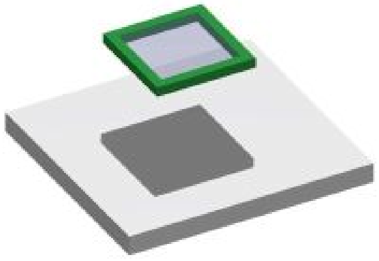
Modeling transparent bodies

Use the `body -1` command between solid and transparent parts of an object to make correct shadow casting with Internal Rendering Engine (e.g., window sash with grilles).

Table 12. Examples for transparent bodies

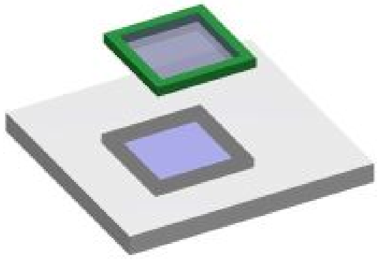
Incorrect

```
prism_ 10, 0.1,
    0,   0,   15,
    1,   0,   15,
    1,   1,   15,
    0,   1,   15,
    0,   0,   -1,
    0.1, 0.1, 15,
    0.9, 0.1, 15,
    0.9, 0.9, 15,
    0.1, 0.9, 15,
    0.1, 0.1, -1



material "blueglass"

prism_ 5, 0.1,
    0.1, 0.1, 15,
    0.9, 0.1, 15,
    0.9, 0.9, 15,
    0.1, 0.9, 15,
    0.1, 0.1, -1
```



Correct

```
prism_ 10, 0.1,
    0,   0,   15,
    1,   0,   15,
    1,   1,   15,
    0,   1,   15,
    0,   0,   -1,
    0.1, 0.1, 15,
    0.9, 0.1, 15,
    0.9, 0.9, 15,
    0.1, 0.9, 15,
    0.1, 0.1, -1

body -1

material "blueglass"

prism_ 5, 0.1,
    0.1, 0.1, 15,
    0.9, 0.1, 15,
    0.9, 0.9, 15,
    0.1, 0.9, 15,
    0.1, 0.1, -1
```



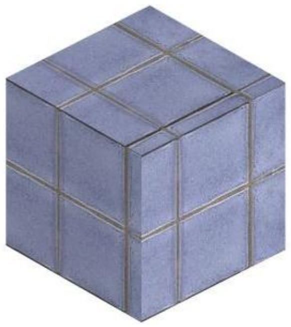
Texture mapping

Always check if texture mapping is applied correctly on your objects. If the default ARCHICAD texture mapping process doesn't produce a good result, use the `coor` command to set the correct method. See the case below for example.

Table 13. Example code for random and for correctly aligned tiling

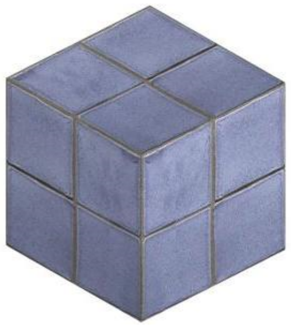
Random texture

```
define texture "owntile" "T.jpg",
        1, 1, 128+256, 0

define material "tilemat" 21,
        0.7, 0.7, 1,
        0.15, 0.95, 0, 0.0,
        0, 0,
        ind (fill, ""), 1,
        ind (texture, "owntile")

material tilemat

block 1, 1, 1
```



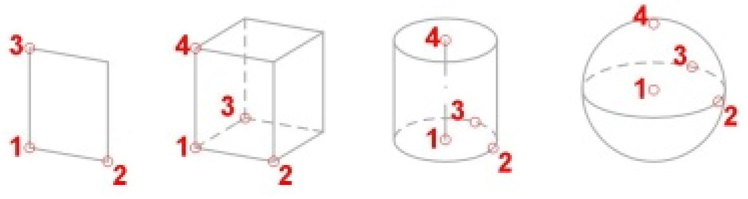
Aligned texture

```
define texture "owntile" "T.jpg",
        1, 1, 128+256, 0

define material "tilemat" 21,
        0.7, 0.7, 1,
        0.15, 0.95, 0, 0.0,
        0, 0,
        ind (fill, ""), 1,
        ind (texture, "owntile")

material tilemat

block 1, 1, 1

base
vert 0, 0, 0
vert 1, 0, 0
vert 0, 1, 0
vert 0, 0, 1

coor 2 + 256, -1, -2, -3, -4
```



In general, separate bodies which require different texture coordinate systems with a `body -1` command.

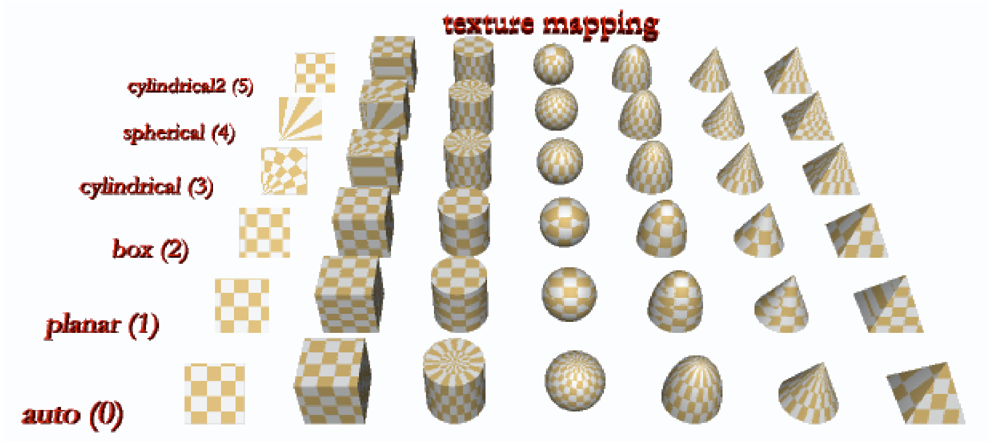
When using different texture mapping modes, you should take care of correct axis definitions with the `vert` or `teve` commands. The node order is shown below.



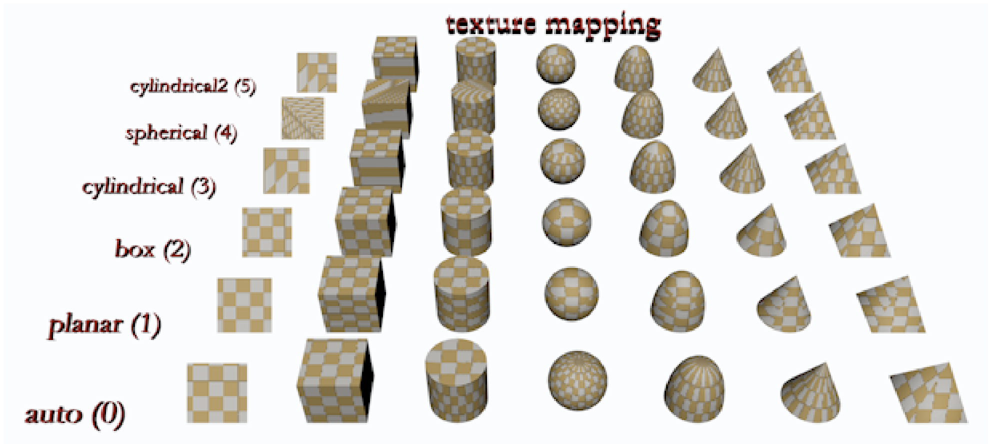
You can distort the textures by setting different distances between the nodes defined by the `vert` or `teve` commands.

Take care that working with different rendering engines can produce slightly different results, see the examples.

Internal engine:



C4D engine:



Correct texture mapping on complicated surfaces or distorted textures can be modeled with `coor` and `teve` commands. In this way you can make surface models only. In ARCHICAD, there is no direct texture specification. You can define a texture as a part of a material definition. This texture is used in Rendering Engines and in OpenGL – but in OpenGL we have only limited implementation of our full texture mapping, and no texture (fill) mapping in our Internal 3D Engine at all.

So with TEVE command you can map a planar texture point (u,v) to a spatial geometric point (x, y, z):

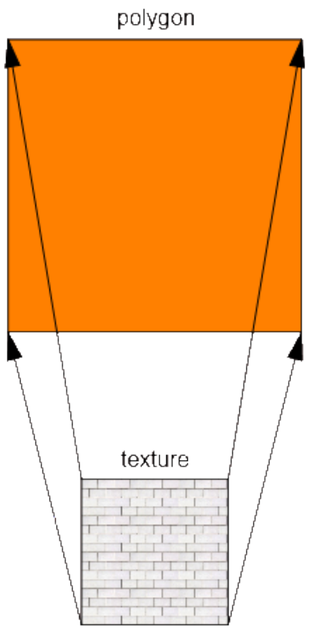
- **(x, y, z)** is measured in meters in the local coordinate system, as usual
- **(u, v)** is measured in units in the infinite texture space. One unit is as long as the texture extent in that direction.

You can give a negative or more than one value for either u or v.

See the example 1:

Table 14. Teve example 1: mapping with no distortion

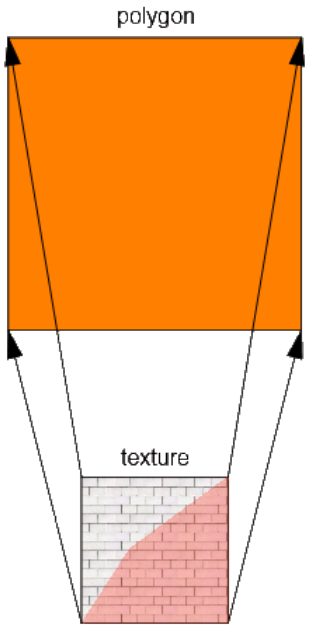
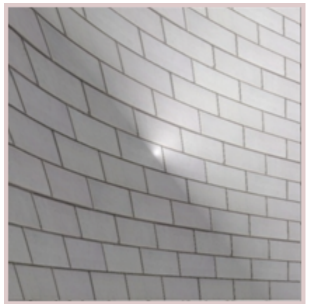
Program	Logic	Result

```
base

teve  0, 0, 1,    0, 0
teve  2, 0, 1,    1, 0
teve  0, 2, 1,    0, 1
teve  2, 2, 1,    1, 1
teve  0, 0, 1,    1, 1

edge  1, 2, -1, -1, 0
edge  2, 4, -1, -1, 0
edge  4, 3, -1, -1, 0
edge  3, 1, -1, -1, 0

set material 92

pgon 4, 0, 0, 1, 2, 3, 4
coor 1024, 1, 2, 3, -5

body -1
```
		

If you make a non-regular mapping, the Rendering engine will fit the shape in texture space to the shape in model space:

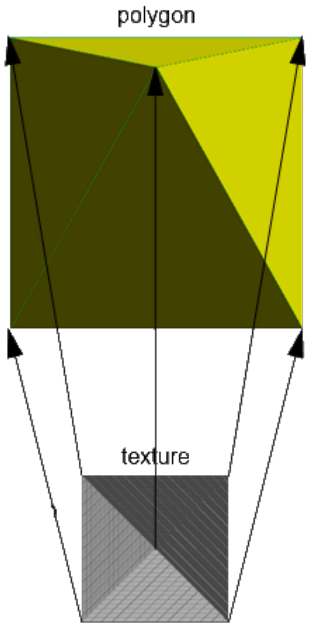
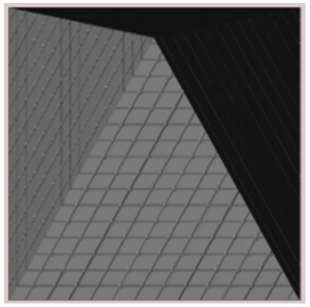
Table 15. Teve example 1: mapping with distortion

Program	Logic	Result

`base`
 	
`teve  0, 0, 1,    0,    0`
`teve  2, 0, 1,    1,    0`
`teve  0, 2, 1,    0.3,  0.5`
`teve  2, 2, 1,    1,    1`
`teve  0, 0, 1,    1,    1`
 	
`edge  1, 2, -1, -1, 0`
`edge  2, 4, -1, -1, 0`
`edge  4, 3, -1, -1, 0`
`edge  3, 1, -1, -1, 0`
 	
`set material 92`
 	
`pgon 4, 0, 0, 1, 2, 3, 4`
`coor 1024, 1, 2, 3, -5`
 	
`body -1`
		

The same is true for real 3D bodies, as you can see in this example:

Table 16. Teve example 1: mapping with distortion on a pyramid

Program	Logic	Result
see below		

```
base

teve  0, 0, 1,    0,    0 ! 1
teve  2, 0, 1,    2,    0 ! 2
teve  2, 2, 1,    2,    2 ! 3
teve  2, 2, 1,    0,    2 ! 4
teve  1, 1, 3,    1,    1 ! 5

edge  1, 2, -1, -1, 0
edge  2, 4, -1, -1, 0
edge  4, 3, -1, -1, 0
edge  3, 1, -1, -1, 0

set material 92

pgon 3, 0, 0, 1, 6, -5
coor 1024, -6, -7, -8, -9

body -1
```

Please note, that you can assign only one texture vertex for a model vertex. It is not possible to assign the texture vertices on a per polygon basis. It is sometimes an advantage and sometimes a disadvantage.

Picture elements

It may be a good idea to replace complicated parts of a model with a single picture. This method can be well used for trees and bushes.

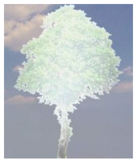
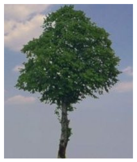
Using an external image referred by its file name, don't omit the file extension.

When you place a picture in a 3D model using the `picture` command, a polygon will be created using the picture as a face. The material of the polygon affects the result of the rendering. With this in mind you should use a matte surface - the color may be chosen depending on the picture.

```
define material "pictmat" 2,
        1, 1, 1             ! RGB

material "pictmat"

picture "filename.extension", a, b, mask
```

The first picture shows a picture on a shiny surface - the undesired side-effect can be observed. In the second picture you can see a texture on a precisely set material - the wanted result.

Table 17. Transparent images

Shiny surface	Matte surface
	

For transparent images - like the tree above - you should consider a more precise definition of the base material. See the following example.

```
define material "pictmat" 0,
        1, 1, 1,             ! RGB
        0.5, 0.8, 0, 0,
        0, 0,
        0, 0, 0,
        0, 0, 0,
        0

material "pictmat"

picture "filename", a, b, mask
```

Group operations

Group operations bring the power of solid operations into GDL. On the other hand they present a risk factor when misused.

An important point is that you mustn't place a group inside another one. In such situations you should define a new group like in the source snippet below:

```
subtractionResult = subgroup ("sub_operand_1", "sub_operand_2")
```

Parameter script

Execution context

The parameter script is run in the following cases:

- Opening the Object Settings dialog window
- Changing a parameter's value in the Object Settings dialog window
- Changing a parameter's value using editable hotspots (even while generating the feedback)
- Stretching the object using conventional hotspots
- loading step-by-step migration libraries (starting from AC18)

The parameter script MAY be run on:

- Dragging the object, in case the object refers to `SYMB_POS_X/SYMB_POS_Y`
- *Update Zones* runs the parameter script of the affected zones if necessary

The parameter script is NOT run on:

- Rebuild
- Changing scale
- Changing story

Editing multiple selection may result unintended parameter values.

Note that the parameter script may be run multiple times on a single user interaction. The reason for this is that the parameter script can change the value of parameters and this requires the parameter script to be run again, and so on. Therefore it makes no sense to increase a parameter value by one in the parameter script since you may not be able to predict the cardinality of executions.

The run of the parameter script is linear, and not necessarily multiple. You can force the parameter script to start only once by checking the **Run the parameter script only once** option in the object's Compatibility Options panel, if you are sure you don't need it to run many times. This can make objects react faster, saving time and computing resources.

General recommendation

When you control parameters in the parameter script, try to follow the order of additional parameters.

You can define relations between parameters using the GLOB_MODPAR_NAME value (containing the name of the last modified parameter). For example you can make a circle object for which both the radius and the diameter can be set (maybe one of them via the parameter list and the other via editable hotspots). Don't use this possibility to define the valid range of parameters - use values command instead.

Define the valid value range for all parameters using the values command.

When resetting the value of a parameter in a certain condition in the Parameter Script using the parameters command, a similar statement must be put into the Master Script. This keeps the object's display correct in cases when the parameter script is not run by the system. E.g.:

```
! parameter script
if bCondition then
    yy = 1
    parameters yy = yy
endif

! master script
if bCondition then yy = 1
```

Font type names

If you want to have a string parameter - named stFont in the sample - for setting the font type for a text, use the following value list definition to get a platform independent sound solution.

```
DIM fontNames[]
request ("FONTNAMES_LIST", "", fontNames)
values "stFont" fontNames, CUSTOM
```

If you do this in the ARCHICAD_Library_Master.gsm object, every loaded library part with the same "stFont" parameter will automatically receive the same value list.

CUSTOM value is needed to deal with missing or unexpected font types.

Setting limits for array parameters

Array parameters should be used for homogeneous data; i.e. all array elements should have a similar meaning.

Example code snippet for limiting all components of array parameter gridXPosition to the range [1, 5] and how to use it on the UI:

```
! parameter script
values "gridXPosition" range [1, 5]

! UI script
for i = 1 to nGridLines      ! nGridLines: number of lines in the array parameter
    ui_infield{3}   gridXPosition[i], xPos, yPos, infieldWidth, infieldHeight

    yPos = yPos + diffY
next i
```

User Interface script

Execution context

The User Interface script is displayed in only one context: the user interface tab page in the Object Settings dialog window.

The script is run on the initialization of the dialog window and after each user interaction and parameter change.

General recommendation

If you want the Custom Settings page to appear in the topmost UI selector as default instead of the parameter list, push the **Set as Default** button (or add the "STBit_UIDefault" bit to the "StatBits" section of the XML). Otherwise the parameter list will be the starting tab. For Hierarchical pages, push the **Hierarchical Pages** button in the GDL Editor/UI window (or add the "STBit_UIUseHierarchicalPages" bit to the "StatBits" section of the XML).

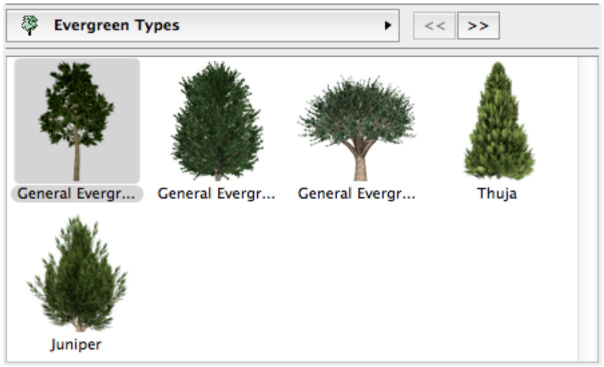
When styling texts, note that extra small letters cannot get any style but plain. In addition, *Outline* and *Shadow* styles have no effect on Windows platform.

Note that ARCHICAD tries to match the fonts used in dialogs with the operating systems. When scripting graphical user interfaces on Windows, leave more space around texts otherwise Mac users will see truncated texts.

Thumbnail control pictures

If you use the `ui_infield` command to define a thumbnail view field for value lists, be aware of the following. There should be equal sized thumbnails for all parameter values (including empty value). Thumbnails have to be the same size at which they will be displayed otherwise ARCHICAD will distort them. We advise you to use ARCHICAD's figure tool for assembling the thumbnails into one picture file.

Table 18. Infield with picture

Input picture	Output picture
	 Evergreen Types << >> General Evergr... General Evergr... General Evergr... Thuja Juniper

A user interface picture used by only one object should be integrated in the library part file itself. This can be done using the LP_XMLConverter tool.

When using an external image referred to by its file name, don't omit the file extension. This way, you will avoid errors stemming from pictures and objects having the same name.

Keep all pictures used by interface scripts in the Macros folder, or embedded in the object itself. Using external images: add the `file_dependence` command to make sure they are saved in archive format with the object.

Tab page handling

Starting from ARCHICAD 18, a new hierarchical paging option is available for tabpage selection. This is accessed via the UI_PAGE command, by adding some extra parameters, and setting the **Hierarchical Pages** parameter in the object itself. Doing so, a separate popup tabpage control will appear above the custom UI field. The order and hierarchy of the available pages can be defined by the ID of the pages. Root ID is always `-1`. The possibility to set up an "oldschool" tabpage selector within the UI page still remains available.

Let's see an example script:

```
! Master Script

! TabIDs
TABID_ROOT      = -1
TABID_PAGE_1    = 50
TABID_PAGE_2    = 60

dim uiUsedPageIDs[][2]
dim uiUsedPageNames[][2]


idxPage = 1

uiUsedPageNames[idxPage][1] = "PageName_1"
uiUsedPageNames[idxPage][2] = "pageIconName_1.png"

uiUsedPageIDs[idxPage][1]   = TABID_PAGE_1
uiUsedPageIDs[idxPage][2]   = TABID_ROOT    ! Parent Page ID

idxPage = idxPage + 1

uiUsedPageNames[idxPage][1] = "PageName_2"
uiUsedPageNames[idxPage][2] = "pageIconName_2.png"

uiUsedPageIDs[idxPage][1]   = TABID_PAGE_2
uiUsedPageIDs[idxPage][2]   = TABID_PAGE_1  ! Parent Page ID



file_dependence "pageIconName_1.png"
file_dependence "pageIconName_2.png"
file_dependence "pageIconName_3.png"
```

```
! Parameter Script

dim pageValues[]
for i = 1 to vardim1(uiUsedPageIDs)
    pageValues[i]= uiUsedPageIDs[i][1]
next i

values "gs_ui_current_page" pageValues


! UI Script

ui_dialog "Custom Settings Title"
ui_current_page gs_ui_current_page

for i = 1 to vardim1(uiUsedPageIDs)
    if uiUsedPageIDs[i][1] = TABID_PAGE_1 then
        ui_page uiUsedPageIDs[i][1],    uiUsedPageIDs[i][2],
                uiUsedPageNames[i][1],  uiUsedPageNames[i][2]
        if gs_ui_current_page = TABID_PAGE_1 then
            gosub "pageSubroutinTitle_1"
        endif
    endif

    if uiUsedPageIDs[i][1] = TABID_PAGE_2 then
        ui_page uiUsedPageIDs[i][1],    uiUsedPageIDs[i][2],
                uiUsedPageNames[i][1],  uiUsedPageNames[i][2]
        if gs_ui_current_page = TABID_PAGE_2 then
            gosub "pageSubroutinTitle_2"
        endif
    endif
next i
```

```
! ==============================================================================
! Call User Interface Macro's TabPages
! ==============================================================================

call "ui_customMacro" parameters all    uiUsedPageIDs   = uiUsedPageIDs,
                                        uiUsedPageNames = uiUsedPageNames

! ==============================================================================
end ! end ! end ! end ! end ! end ! end ! end ! end ! end ! end ! end ! end ! en
! ==============================================================================


! ==============================================================================
! UI Page Subroutines
! ==============================================================================

"pageSubroutinTitle_1":
    ! UI Page 1 description
return


"pageSubroutinTitle_2":
    ! UI Page 2 description
return
```

Thumbnail controls with dynamic items

From ARCHICAD 10 on, a new dynamic method is available for linking control items and value list items. Using this method you can localize the logic of the availability of parameter values to the parameter script - the control will adopt the set of available values. This dynamic linking is available for `ui_infield{3}` and `ui_infield{4}`. The old-style static linking is still working for static functions (using `ui_infield` and `ui_infield{2}`).

The two components of the dynamic method are:

1. Define the user interface control with an option for every possible value.

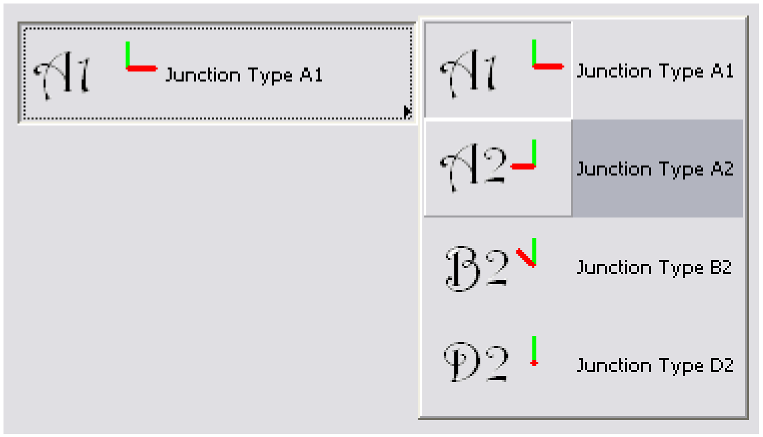
The example shows a popup menu control (method = 2) which uses an index image containing 2 rows and 4 columns. The sample control supports 8 possible values.

```
ui_infield{3} iJunctionType, xColumn1-10, 44, 200, 50,
    2, 3, 8, 2,
    70, 45, 70, 45,
    1, `Junction Type A1`, 2,
    2, `Junction Type B1`, 4,
    3, `Junction Type C1`, 1,
    4, `Junction Type D1`, 3,
    5, `Junction Type A2`, 5,
    6, `Junction Type B2`, 7,
    7, `Junction Type C2`, 6,
    8, `Junction Type D2`, 8
```

2. Set the list of available values for the parameter under the given circumstances.

```
if iLeftNeighbour = 1 then
    values "iJunctionType" 1, 3, 4, 6
else
    if iRightNeighbour = 1 then
        values "iJunctionType" 2, 5, 7, 8
    else
        values "iJunctionType" 1, 5, 7
    endif
endif
```

The resulting control is shown in the image below. (iLeftNeighbour = 0, iRightNeighbour = 1)



Transparent UI pictures

In ARCHICAD 10 a new method has been introduced that can handle alpha-layer based transparent pictures. The following controls handle pictures with alpha layers correctly:

- ui_pict
- ui_infield{3}, method = 1 (thumbnail view control)
- ui_infield{3}, method = 2 (popup with icons and texts)
- ui_infield{3}, method = 3 (popup with icons only)
- ui_infield{3}, method = 4 (icon radio push button)
- ui_infield{4}, method = 1 (thumbnail view control)
- ui_infield{4}, method = 2 (popup with icons and texts)
- ui_infield{4}, method = 3 (popup with icons only)
- ui_infield{4}, method = 4 (icon radio push button)

Font sizes on the UI

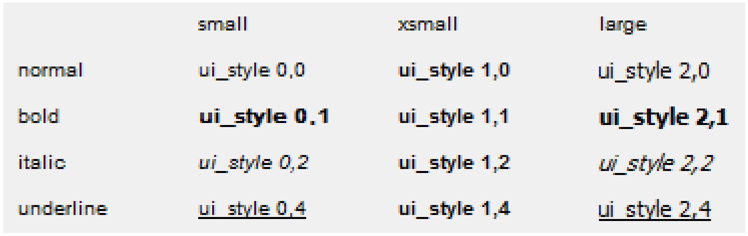
If you use static texts (possibly in combination with the `ui_style` command), be aware of the following.

Because of the differences of the targeted operating systems, font sizes are not the same on Windows and on Mac. As a side effect, the *extra small* font size is a bit larger than the *small* one on Windows. As a general rule, always test user interfaces on both platforms to check overlapping and clipping.

Furthermore, special styles like Bold, Italic and Underline are not allowed in combination with *extra small* size. Outline and Shadow are old Macintosh styles, which are no longer used.

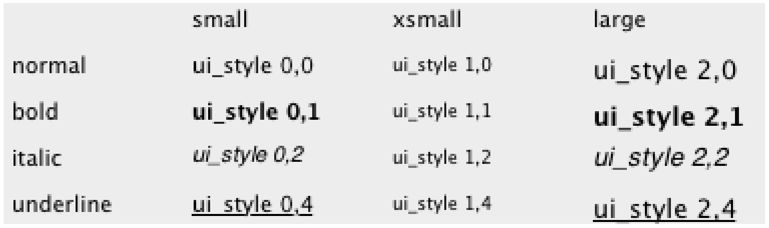
The two pictures show the look of static texts with different sizes and styles.

On Windows:



	small	xsmall	large
normal	ui_style 0,0	ui_style 1,0	ui_style 2,0
bold	**ui_style 0,1**	ui_style 1,1	**ui_style 2,1**
italic	*ui_style 0,2*	ui_style 1,2	*ui_style 2,2*
underline	ui_style 0,4	ui_style 1,4	ui_style 2,4

On Mac:



	small	xsmall	large
normal	ui_style 0,0	ui_style 1,0	ui_style 2,0
bold	**ui_style 0,1**	ui_style 1,1	**ui_style 2,1**
italic	*ui_style 0,2*	ui_style 1,2	*ui_style 2,2*
underline	ui_style 0,4	ui_style 1,4	ui_style 2,4

Forward Migration script

Execution context

The FWM script is executed when a project saved in an earlier version of ARCHICAD is opened in a later version (starting with ARCHICAD 15) with the updated library. This new library can be loaded manually or by using the Consolidate option in the Library Manager. If a placed instance of an object has a new, changed Main ID and a valid Forward Migration Script in the new library, it can be automatically substituted by ARCHICAD. If the execution of the script is successful, the old element gets replaced by the new one.

This script enables the object to set the new parameters based on the old ones, without feature loss or a major change in appearance.

General recommendation

The first line of the script fills the FROM_GUID global variable (this contains the main ID of the original object to be migrated) into the "actualGuid" variable. You may want to use the following structure to ensure maintainability.

The rest of the script is divided into subroutine calls, one for every change of GUID. Every block must have a corresponding line in the Migration Table of the object and a block in the Backward Migration script. The latest change of Main ID always has to be the last call of this script. In every block you set the ID to start from (_startID), and the one to end up with (_endID), define the migration logic in a subroutine (for details and GDL commands, see the GDL Reference Guide), and at the end of the block you always set the new "_endID" (or set an empty ID, which means that the upgrade process will stop at the previous block's version of the object) into the "actualGuid" variable. Example:

```
actualGUID = FROM_GUID

! ==============================================================================
! Subroutines
! ==============================================================================

    _startID    = "AAAA-AAAA-...AAA"
    _endID      = "BBBB-BBBB-...BBB"
gosub "migrationstepname_FWM"

! ==============================================================================
! Set Migration GUID
! ==============================================================================

setmigrationguid actualGUID

! ==============================================================================
end ! end ! end ! end ! end ! end ! end ! end ! end ! end ! end ! end ! end ! en
! ==============================================================================

! ==============================================================================
! migrationstepname
! ==============================================================================
"migrationstepname_FWM":
    if actualGuid = _startID then
        newParameter = oldParameter
        parameters newParameter = newParameter
        actualGuid = _endID
    endif
return
```

Backward Migration script

Execution context

The BWM script is executed when a project is saved to the previous version of ARCHICAD. If the current version of the library part has a different Main ID than its equivalent in the previous version, the migration script of the object is evaluated. As a result, the libpart will be either downgraded if possible (sometimes with some minor compromise, if it does not affect the item's main functions), or will be lost completely (in this case, it will appear as a "missing" dot sign in the earlier version project). The latter happens when a new function set introduced in the current version represents a major change compared to the previous version.

A successful backward migration process should convert the object's parameters in a way that avoids major feature loss or changes in appearance.

General recommendation

The first line of the script sets the continuity control variable to valid. You may want to use the following structure to ensure maintainability.

The rest of the script is divided into subroutines: one change of Main ID is one subroutine. Every subroutine must have a corresponding line in the Migration Table of the object and a corresponding subroutine in the Forward Migration script. The **latest step back** in changing Main ID always has to be the **first subroutine** of this script.

At the start of each subroutine the target GUID is checked. If not empty, the script runs in called order. Backward migration only works for one version back, so the targetGUID only needs to be set once (except when you make a fork in the migration to separate previous-version objects).

The end of the subroutine is about setting the destination (old) ID into the "targetGuid" variable. If you set an empty ID to the variable, the downgrade process is canceled there. If the "targetGuid" matches the TO_GUID global variable (containing the main ID of the target element in the conversion), the first part of the migration process is complete.

Adding a title or a short description of the migration step for every subroutine is highly recommended. You should use the same title for the Forward Migration script pair of the subroutine.

After you have reached the desired stage of the object's devolution, you have to set the placed object's ID by using the `setmigrationguid`

In case the migration returns an empty ID, the element is going to be missing from the project opened in the previous version.

```
targetGUID = TO_GUID

! ==============================================================================
! Subroutines
! ==============================================================================

gosub "migrationstepname_BWM"

! ==============================================================================
! Set Migration GUID
! ==============================================================================

setmigrationguid targetGUID

! ==============================================================================
end ! end ! end ! end ! end ! end ! end ! end ! end ! end ! end ! end ! end ! en
! ==============================================================================


! ==============================================================================
! migrationstepname
! ==============================================================================
"migrationstepname _BWM":
    if targetGUID # "" then
        bMigrationSuccess = 1
        if bMigrationSuccess = 1 then
            oldParameter = newParameter
            parameters oldParameter = oldParameter
        else
            targetGuid = ""
        endif
    endif
return
```

Migration table

Every time you change an object's Main ID, you need to fill in the old ID into the Migration Table of the element. Each line contains a previous ID and an ARCHICAD version number (or 0, if you change more than once between two versions). During forward migration, the program scans this list of ID-s, preselecting the elements available for the migration process. During backward migration, scanning this list the program chooses only those with a version equivalent to the previous ARCHICAD version. Every line of this table must have at least one corresponding subroutine in the Forward Migration script and the Backward Migration script.

Writing macros

Try to collect frequently used functionalities into macros. Calling a macro object from many objects can reduce library size and increase soundness by reducing redundancy.

However avoid creating macros with small functional addition to the previous abstraction level. For example don't create a block_1x1x1 macro for the generation of a 1m x 1m x 1m block. This increases the number of macro calls needlessly and it may worsen transparency.

Don't ever use .gdl as macros, use macro objects instead.

When you call a macro, always use the `call` keyword and put the name of the macro between quotation marks (e.g., `call "m_rail_wired"`). Do not create macro calls where the macro name is a parameter to avoid missing macros from archive files. ARCHICAD saves the default macro only into the archive file. (Workaround: call all parameter values as a macro after the end statement.)

Be careful at using the parameter buffer. Save the content of it at be beginning of the script if you want to use it. Be sure that only the defined (return) values are in the buffer by the end of the script.

Macro return parameters

From ARCHICAD 10 on macros can return parameters to the caller object. At the caller's side, returned values can be collected using the `returned_parameters` keyword followed by a variable list. The returned values will be stored in these variables in the order they are returned in the called macro. The number and the type of the variables specified in the caller and those returned in the macro must not match. If there are more variables specified in the caller, they will be set to 0 integer. Type compatibility is not checked: the type of the variables specified in the caller will be set to the type of the returned values. If one of the variables in the caller is a dynamic array, all next values will be stored in it.

In the macro object the `end` and the `exit` commands define the values that have to be return to the caller object. See the example below.

Advanced parameters all

From ARCHICAD 10 on after `parameters all` keyword you can specify extra parameters to pass it to the macro. They will override the values coming from the caller or parameters of the called macro left to be default. The macro can return parameters in this case also.

Faster macro call

Speed of parameter value transferring between the caller object and the macro was improved in ARCHICAD 10. Find out tips about utilization of macro call's speed enhancements in the section called “Speed Issues”.

Macro call example

Script in the caller object.

```
call "myMacro" parameters all extraParam = 1
call "myMacro" parameters returned_parameters realWidth
call "myMacro" parameters all extraParam = 1 returned_parameters realWidth
call "myMacro" parameters all returned_parameters realWidth
```

Script in the macro.

```
realWidth = 2
end realWidth
```

Background Conversion Issues

Starting from ARCHICAD 19, all calculations necessary for opening 3D related views or viewpoints will be run as backgound processes.

Supported viewpoints:

- 3D Window
- Section
- Elevation
- Interior elevation (except when "Add bounded area" or "Detect and Fit to Zones" are enabled)
- 3D Document

If the backgound process is successful, the requested view takes only a few seconds to open. **However, there may be some non thread-safe library parts or objects placed in the planfile, which can disable background calculations:**

- Zones
- Objects including text engine operations (except set style and define style commands)
- Objects using the following requests: "CUSTOM_AUTO_LABEL", "ZONE_COLUS_AREA", "MATCHING_PROPERTIES", "ASSOCEL_PROPERTIES", "STYLE_INFO", "TEXTBLOCK_INFO", "FONTNAMES_LIST"
- Objects using variable named macros, or non-thread safe macros. Project2 command or symbol fill definition are counted as non-thread safe macro calls.

The relationship between GDL add-ons and background processing depends on the add-on itself.

Deterministic add-ons (not affecting background processing):

- Polygon Operations
- Property Add-on
- If used in read-only mode, and with files loaded in the active library: Text or Data I/O Add-ons, XML Add-on

Non-deterministic add-ons (disabling background processing):

- DateTime Add-on
- FileManager Add-on
- If not used in read-only mode, or not with files loaded in the active library: Text or Data I/O Add-ons, XML Add-on

The object scripts are examined statically, so the background conversion is disabled even if the obstacle function itself is not executed with the current settings of the library part.

To check the loaded library parts' compatibility with background processing, use the "Check if Library Parts are Thread Safe" command of the Library Developer menu.

Speed Issues

Try to avoid using the `project2` command as it slows down plan regeneration.

Reduce the number of surfaces in your model to the minimum in order to make 3D regeneration faster. Use `RESOL`, `TOLER` and `RADIUS` commands to control segmentation of curved surfaces.

Note that closed bodies regenerate faster in 3D than open ones (e.g., a cylinder is faster than an open tube).

When scripting the master script consider that the master script is run before each script type, so don't put script-type specific calculations here. This is the place for common calculations needed by multiple scripts.

When scripting doors and windows avoid making unnecessary cuts (`wallhole` and `wallniche`).

Use integer values and operations whenever reasonable, these are much faster than floating point operations.

Try to minimize the usage of string operations.

In case of calling macros use the same parameter order after the `call` command as it is in the parameter list of the macro. `call "myMacro" parameters all` is faster when the parameter orders of the macro and the caller object are similar. Try to avoid transferring string type parameters in macro calls. Use numeric types where possible.

Windows-Macintosh compatibility

Though GDL objects and libraries are considered by GRAPHISOFT as platform independent, the following difficulties occur when objects are manually moved from Windows to a Macintosh:

- Windows fonts will be replaced by the default Macintosh font in objects and list templates and vice-versa.

- Text type listing files (listset.txt, listkey.txt, list templates, etc.) could lose line breaks, therefore listing won't work (non-utf-8 coded texts, usually)

Changing platform with binary libraries

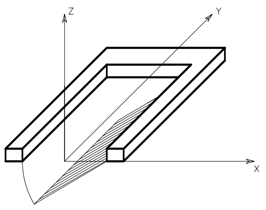
To avoid the above problems, save a .pla archive file of your library on the first platform, then extract it on the second. This way the non-utf-8 files will be converted correctly as well.

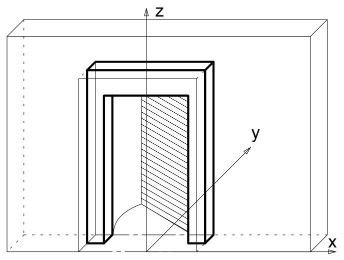
Doors and Windows

This section discusses the various special options related to the creation of Door/Window library elements.

General Guidelines

Once a door/window is inserted into a wall, the default position of these library parts' coordinate system is rotated so that the x-y plane is vertical and the z axis points horizontally into the wall. The origin is placed on the bottom center of the wall opening, on the exterior side of the wall. This way, doors/windows can be easily modeled by elements in the x-y plane. See the illustrations below.





Because of the special behavior of these library parts, the 2D symbol is generated from a special built-in projection otherwise not accessible by users (an upside-down side view from a 90 degree direction). The symbol and the 3D shape are fitted to the Door/Window origin by the lower (y) center (x) of the bounding box, but no adjustment is made along the z axis to enable users to design doors/windows extending beyond the wall in either z direction.

Considering these rules, here are some hints that will help you construct doors/windows that will work properly:

- When constructing the door/window in the floor plan window, visualize it as if you are looking at it from the inside of the wall it will be inserted into.
- Think of the project zero level as the external surface of the wall.
- Elements that should be inside the wall, like the window frame, should be above the zero level.
- Door panels opening to the outside should be below the zero level.

Positioning

A door is correctly defined if its insertion works as follows: clicking to the right of the insertion point means that the door leaf will open to the same side on the right. A window is correctly defined if, upon insertion, the side that is clicked corresponds to the outer side.

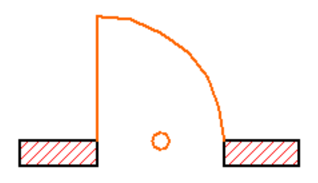
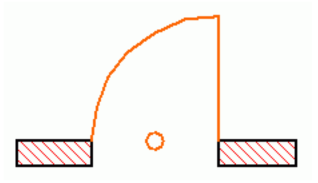
An opening position can take one of 8 forms. These are represented by three global variables in GDL:

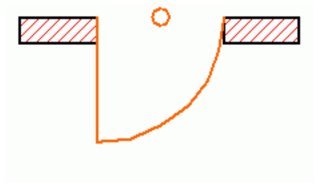
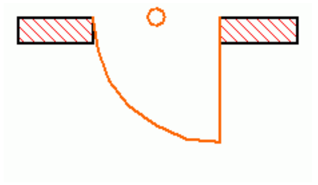
- mirroring to the Y-Z plane in 3D or to the Y axis in 2D (`SYMB_MIRRORED`)
- mirroring by the longitudinal axis of the wall (rotation by 180 degrees: `SYMB_ROTANGLE`)
- flipping (`WIDO_REVEAL_SIDE`)

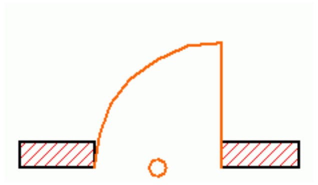
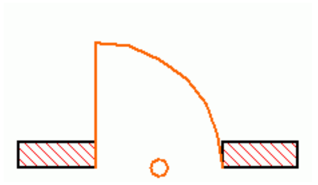
Usually each part of the window should react in a different way to these conditions. The specification must be clear on deciding how the parts of the object should, or should not act. E.g. a door leaf moves with these transformations, but the cavity closure does not. To keep the library part consistent, several transformations should be used for these combinations. When changing the reveal side (flipping), the library part is mirrored and dragged back by the value of the nominal frame thickness.

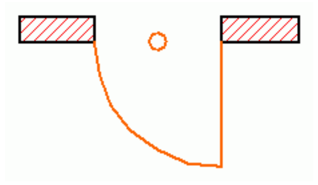
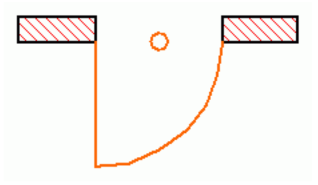
Illustration of the 8 states with a simplified door - the little circle flags the origin.

Global variables 1.	**Example drawing 1.**	**Global variables 2.**	**Example drawing 2.**

`WIDO_REVEAL_SIDE = 0`
`SYMB_MIRRORED = 0`
`SYMB_ROTANGLE = 0`
		`WIDO_REVEAL_SIDE = 0`
		`SYMB_MIRRORED = 1`
		`SYMB_ROTANGLE = 0`
			

`WIDO_REVEAL_SIDE = 1`
`SYMB_MIRRORED = 0`
`SYMB_ROTANGLE = 180`
		`WIDO_REVEAL_SIDE = 1`
		`SYMB_MIRRORED = 1`
		`SYMB_ROTANGLE = 180`
			

`WIDO_REVEAL_SIDE = 1`
`SYMB_MIRRORED = 0`
`SYMB_ROTANGLE = 0`
		`WIDO_REVEAL_SIDE = 1`
		`SYMB_MIRRORED = 1`
		`SYMB_ROTANGLE = 0`
			

`WIDO_REVEAL_SIDE = 0`
`SYMB_MIRRORED = 0`
`SYMB_ROTANGLE = 180`
		`WIDO_REVEAL_SIDE = 0`
		`SYMB_MIRRORED = 1`
		`SYMB_ROTANGLE = 180`
			

Sample code undoing the automatic transformations done by ARCHICAD:

```
! 2D script
bRotated = round_int (SYMB_ROTANGLE) = 180
if bRotated then
 rot2 180
endif
if SYMB_MIRRORED then
 mul2 -1, 1
endif
if WIDO_REVEAL_SIDE exor bRotated then
 add2 0, WALL_THICKNESS
endif

! 3D script
bRotated = round_int (SYMB_ROTANGLE) = 180
if bRotated then
 roty 180
endif
if SYMB_MIRRORED then
 mulx -1
endif
if WIDO_REVEAL_SIDE exor bRotated then
 addz -WALL_THICKNESS
endif
```

Note that though flipping and mirroring is possible for all doors and windows, it is incorrect in manufacturer libraries where a library part models a real window - which, of course, cannot be turned inside out. In this case the script should undo the mirroring done by ARCHICAD.

Creation of Door/Window Library Parts

When creating Door/Window type library parts, several possibilities exist, presenting different problems:

- Creation of rectangular doors/windows in straight walls
- 3D related challenges
    - Creation of non-rectangular doors/windows in straight walls
    - Creation of rectangular doors/windows in straight walls
    - Creation of non-rectangular doors/windows in curved walls
- 2D related challenges
    - Cutting custom wall opening

- WALLHOLE2
- Extending the wall polygon
- WALLBLOCK2
- WALLLINE2
- WALLARC2

Rectangular Doors/Windows in Straight Walls

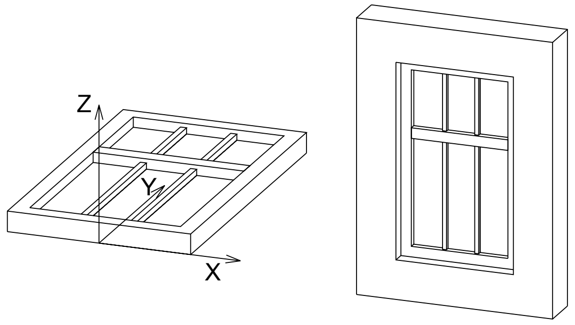
This is the easiest and most straightforward way of creating doors and windows. The use of simple GDL commands such as PRISM_ or RECT is recommended.

If you want to match the surface materials of door/window elements to those of the wall, the bottom surface of the elements should match the outside, and the top surface the inside of the wall. You can achieve this from your scripts using the WALL_MAT_A, WALL_MAT_B and WALL_MAT_EDGE global variables representing the materials of the wall into which the door/window is placed. In the 2D script, the WALL_SECT_PEN, WALL_FILL_PEN and WALL_FILL global variables can be useful, as these give you the pen numbers of the wall contour and fill plus the index number of the fill of the wall on the floor plan into which the door/window is placed. With composite walls, you have to use the corresponding global variables.

See Miscellaneous for details.

The object libraries come with a large set of door/window macros. These GDL scripts contain common building elements which are used by many doors/windows in the library. There are macros for generating commonly-used frames, panels and many other types of door/window parts. Open some door/window library parts to see what kind of macros they call and what type of parts those macros generate.

Example:



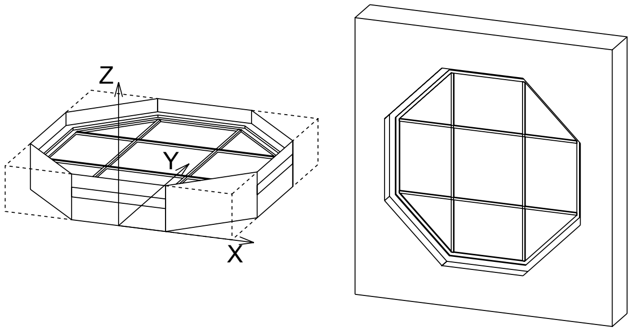
```
a=0.9: b=1.5: c=0.1: d=0.08
e=0.08: f=0.9: g=0.03: h=3
PRISM_ 10, c,
        -a/2, 0, 15, a/2, 0, 15,
        a/2, b, 15, -a/2, b, 15,
        -a/2, 0, -1,
        -a/2+d, d, 15, a/2-d, d, 15,
        a/2-d, b-d, 15, -a/2+d, b-d, 15,
        -a/2+d, d, -1
ADD -a/2+d, f, 0
BRICK a-2*d, e, c
ADD -g/2, -f+d, c/2
GOSUB 1
ADDZ -g
GOSUB 1
DEL 2
MATERIAL "Glass"
ADD 0, -f+d, c/2
RECT a-2*d, f-d
ADDY f-d+e
RECT a-2*d, b-f-e-d
END

1:
    FOR i=1 TO h-1
        ADDX (a-2*d)/3
        BLOCK g, f-d, g
        ADDY f+e-d
        BLOCK g, b-f-d-e, g
        DEL 1
    NEXT i
    DEL h-1
    RETURN
```

3D Related Challenges

Non-Rectangular Doors/Windows in Straight Walls

When working with doors/windows, it is important to know that placing a door/window always cuts a rectangular hole into the wall. The size of this hole is determined by the A and B parameters of the door/window library part. However, when the door/window is not rectangular in elevation, it does not entirely fill the cut rectangular hole. The solution to this is to use the WALLHOLE or WALLNICHE command to define a polygon shape to be cut into the wall where the door/window is placed. There are two solutions for this:

- The 3D script has to contain parts that generate those parts of the wall that fill the hole between the door/window body and the edges of the rectangular wall cut. In this case, special attention must be paid to the visibility of the edges of these fillings.



- With the WALLHOLE or WALLNICHE command, you can define a polygon shape to be cut into the wall where the door/window is placed.

WALLHOLE

```
WALLHOLE n, status,
        x1, y1, mask1,
        ...
        xn, yn, maskn
        [, x, y, z]
```

n: the number of polygon nodes.

status:

1: use the attributes of the body for the generated polygons and edges,

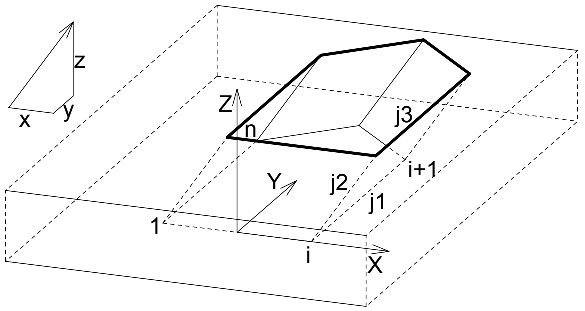
2: generated cut polygons will be treated as normal polygons.

xi, yi: cross-section polygon coordinates.

`maski:` similar to the CUTPOLYA command:

`maski = j`$_1$` + 2*j`$_2$` + 4*j`$_3$` + 64*j`$_7$, where each j can be 0 or 1.

`x, y, z:` optional direction vector (default is door/window Z axis).

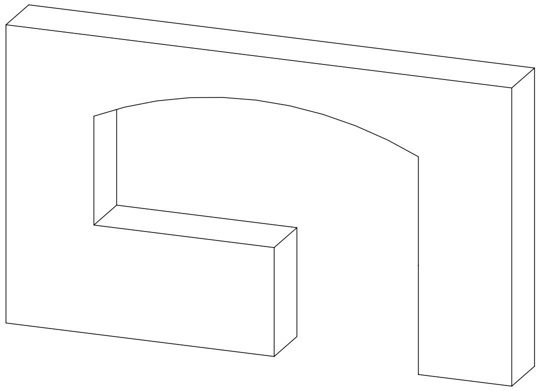


This command can be used in doors'/windows' 3D script to cut custom hole(s) in the wall they are placed into. During the 3D generation of the current wall, the 3D script of all its doors/windows is interpreted without model generation to collect the WALLHOLE commands. If they exist, the current wall will be cut using an infinite tube with the polygonal cross-section and direction defined in the script. There can be any number of WALLHOLEs for any door/window, so it is possible to cut more holes for the same door/window, even intersecting ones. If at least one WALLHOLE command is interpreted in a door/window 3D script, no rectangular opening will be generated for that door/window.

Note: The 3D reveal will not be generated automatically for custom holes, you have to generate it from the script. The hole customized this way will only be visible in 3D, because WALLHOLE commands do not have any effect in 2D. A 2D representation can be scripted if needed (used with framing in plan off).

The use of convex polygonal cross-sections is recommended; using concave polygons may result in strange shadings/renderings or cut errors. Convex polygons can be combined to obtain concave ones. Mirroring transformations affect the cutting direction in an unexpected way - to get a more straightforward result, use the WALLNICHE command.

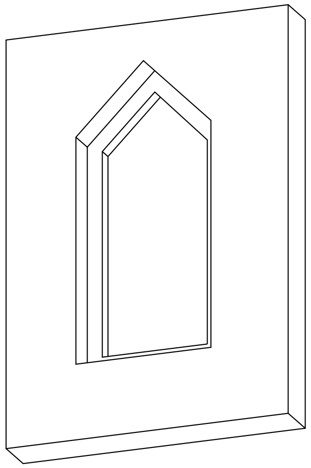
Example 1:



```
RESOL 72
l1 = 2.7: l2=1.2
h1=2.1: h2=0.3: h3=0.9
r = ((l1/2)^2+h2^2)/(2*h2)
a = ATN((l1/2)/(r-h2))
WALLHOLE 5, 1,
        -l1/2, h3,    15,
        l1/2,  h3,    15,
        l1/2,  h1-h2, 13,
        0,     h1-r,  915,
        0, 2*a, 4015
WALLHOLE 4, 1,
        l1/2-l2, 0,  15,
        l1/2,    0,  15,
        l1/2,    h3, 15,
        l1/2-l2, h3, 15
```

Example 2:

```
WALLHOLE 5, 1,
        -0.45, 0, 15,
        0.45, 0, 15,
        0.45, 1.5, 15,
        0, 1.95, 15,
        -0.45, 1.5, 15
PRISM_ 12, 0.1,
        -0.45, 0, 15,
        0.45, 0, 15,
        0.45, 1.5, 15,
        0, 1.95, 15,
        -0.45, 1.5, 15,
        -0.45, 0, -1,
        -0.35, 0.1, 15,
        0.35, 0.1, 15,
        0.35, 1.45, 15,
        0, 1.80, 15,
        -0.35, 1.44, 15,
        -0.35, 0.1, -1
```



WALLNICHE

```
WALLNICHE n, method, status,
        rx, ry, rz, d,
        x1, y1, mask1, [mat1,]
        ...
        xn, yn, maskn[, matn]
```

Similar to the CUTFORM command.

`method`: Controls the form of the cutting body:

`1:` prism shaped,

`2:` pyramidal,

`3:` wedge-shaped cutting body. The direction of the wedge's top edge is parallel to the Y axis and its position is in rx, ry, rz (ry is ignored).

`status`: Controls the extent of the cutting body and the treatment of the generated cut polygons and new edges.

`status` $= j_1 + 2*j_2 + 8*j_4 + 16*j_5 + 32*j_6 + 64*j_7 + 128*j_8 + 256*j_9$, where each j can be 0 or 1.

`j`$_1$: use the attributes of the body for the generated polygons and edges,
`j`$_2$: generated cut polygons will be treated as normal polygons,
`j`$_4$: define the limit of the cut (with j4),
`j`$_5$: define the limit of the cut (with j5),
`j`$_6$: generate a boolean intersection with the cutting body rather than a boolean difference. (can only be used with the CUTFORM command),
`j`$_7$: edges generated by the bottom of the cutting body will be invisible,
`j`$_8$: edges generated by the top of the cutting body will be invisible.
`j`$_9$: cutting shape has custom side materials (mati).

`j4 = 0 and j5 = 0:` finite cut,

`j4 = 0 and j5 = 1:` semi-infinite cut,

`j4 = 1 and j5 = 1:` infinite cut,

`rx,ry,rz:` defines the direction of cutting if the cutting form is prism-shaped, or the top of the pyramid if the method of cutting is pyramidal.

`d:` defines the distance along rx,ry,rz to the end of the cut. If the cut is infinite, this parameter has no effect. If the cut is finite, then the start of the cutting body will be at the local coordinate system and the body will end at a distance of d along the direction defined by rx,ry,rz.

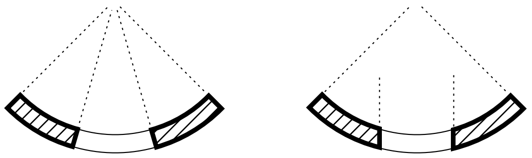
If the cut is semi-infinite, then the start of the cutting body will be at a distance of d along the direction defined by rx,ry,rz and the direction of the semi-infinite cut will be in the opposite direction defined by rx,ry,rz.

`mati:` side material of the cutting shape (when status j9 = 1)

`mask:` Defines the visibility of the edges of the cutting body.
`j1:` the polygon will create a visible edge upon entry into the body being cut,
`j2:` the lengthwise edge of the cutting form will be visible,
`j3:` the polygon will create a visible edge upon exiting the body being cut,
`j4:` the bottom edge of the cutting form will be visible,
`j5:` the top edge of the cutting form will be visible,
`j7:` controls the viewpoint dependent visibility of the lengthwise edge.

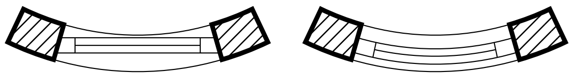
Rectangular Doors/Windows in Curved Walls

When placing doors/windows into curved walls, the sides of the hole cut into the wall can vary according to the picture below.



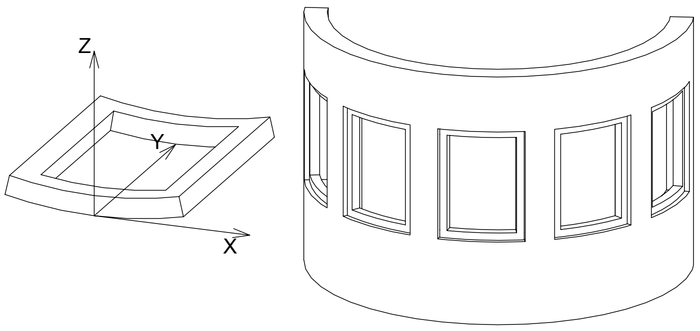
The hole in the wall on the left is created when the program automatically cuts the hole for the door/window. In this case the sides will be of radial direction. On the right, the hole is cut using the WALLHOLE command in the 3D Script of the door/window object. The object itself needs to be written by taking these factors into consideration.

Another thing to consider is whether the door/window placed into the curved wall is a straight or a curved one.



In the case of a straight door/window, as on the left above, the thickness and width of the object and the thickness of the wall are closely related, since above a certain dimension the object would fall outside of the wall. When using true curved doors/windows, this problem doesn't occur.

Example: Window with a frame following the curve of the wall

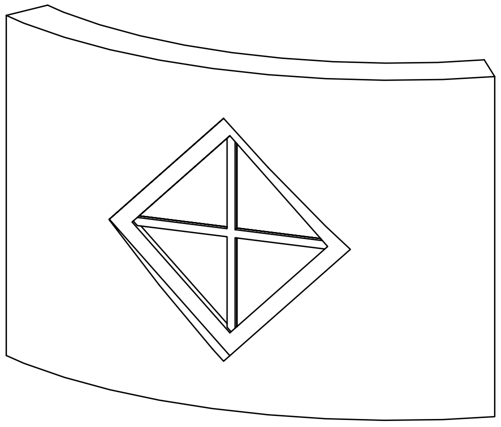


```
RESOL 72
ROTX -90 : MULY -1
C= 0.12 : Z=360*A/(2*WIDO_ORIG_DIST*PI)
Y= 360*C/(2*WIDO_ORIG_DIST*PI) : A1= 270+Z/2 : A2=270-Z/2
GOSUB "curved_horizontal_frame"
ADDZ B
MULZ -1
GOSUB "curved_horizontal_frame"
DEL 2
ADDZ C
GOSUB "vertical_frame"
MULX -1
GOSUB "vertical_frame"
END
"curved_horizontal_frame":
    PRISM_ 9, C,
            cos(A2)*R_, SIN(A2)*R_+R_, 11,
            cos(A2+Y)*R_, sin(A2+Y)*R_+R_, 13,
            0, R_, 900,
            0, Z-2*Y, 4009,
            cos(A1)*R_, sin(A1)*R_+R_, 11,
            cos(A1)*(R_-0.1), sin(A1)*(R_-0.1)+R_, 11,
            cos(A1-Y)*(R_-0.1), sin(A1-Y)*(R_-0.1)+R_, 13,
            0, -(Z-2*Y), 4009,
            cos(A2)*(R_-0.1), sin(A2)*(R_-0.1)+R_, 11
    RETURN
"vertical_frame":
    PRISM_ 4, B-2*C,
            cos(A2)*R_,         sin(A2)*R_+R_, 10,
            cos(A2+Y)*R_,       sin(A2+Y)*R_+R_, 15,
            cos(A2+Y)*(R_-0.1), sin(A2+Y)*(R_-0.1)+R_, 10,
            cos(A2)*(R_-0.1),   sin(A2)*(R_-0.1)+R_, 10
    RETURN
```

Non-Rectangular Doors/Windows in Curved Walls

The general guidelines given for rectangular doors/windows in curved walls applies here, too.

Example:



```
wFrame=0.1: wDivider=0.025
Z=A/2-SQR(2)*wFrame: Y=A/2-SQR(2)*wFrame-wDivider
ADDY A/2
WALLHOLE 4, 1,
        0,    -A/2, 15,
        A/2,  0,    15,
        0,    A/2,  15,
        -A/2, 0,    15
PRISM_ 10, 0.1,
        0,    -A/2, 15,
        A/2,  0,    15,
        0,    A/2,  15,
        -A/2, 0,    15,
        0,    -A/2, -1,
        0,    -Z,   15,
        Z,    0,    15,
        0,    Z,    15,
        -Z,   0,    15,
        0, -  Z,    -1
ADDZ 0.02
GOSUB "cross_divider"
ADDZ 0.03
GOSUB "cross_divider"
ADDY -Z
SET MATERIAL "Glass-Blue"
ROTZ 45
RECT SQR(2)*Z, SQR(2)*Z
END
```

```
"cross_divider":
    PRISM_ 16, 0.03,
            0, -Z, 15,
            wDivider, -Y, 15,
            wDivider, -wDivider, 15,
            Y, -wDivider, 15,
            Z, 0, 15,
            Z, wDivider, 15,
            wDivider, wDivider, 15,
            wDivider, Y, 15,
            0, Z, 15,
            -wDivider, Y, 15,
            -wDivider, wDivider, 15,
            -Y, wDivider, 15,
            -Z, 0, 15,
            -Y, -wDivider, 15,
            -wDivider, -wDivider, 15,
            -wDivider, -Y, 15
    RETURN
```

2D Related Challenges

Cutting custom wall opening

Placing a door/window cuts a rectangular hole into the wall by default. The size of this hole in 2D is determined by the A parameters of the door/window library part. Implementing custom reveals or cavity closures requires cutting custom shaped holes in the wall or extending it a bit in the floor plan view.

A correct solution for this issue can be achieved by using the WALLHOLE2, WALLBLOCK2, WALLLINE2 and WALLARC2 commands.

WALLHOLE2

```
WALLHOLE2 n, fill_control, fill_pen, fill_background_pen,
        fillOrigoX, fillOrigoY, fillAngle,
        x1, y1, s1,
        ...
        xn, yn, sn
```

Wall opening definition for the plan view coupled with a cover polygon. Only the cut part of the wall is affected, view wall polygons stay intact. The cover polygon has no contour.

This command can be used in the 2D script of door/window objects only.

The parameterization of the command is mainly the same as the one of the POLY2_B{2} command.

`fill_control:`

`fill_control = 2*`j_2` + 8*`j_4` + 16*`j_5` + 32*`j_6` + 64*`j_7, where each j can be 0 or 1.

j_2: draw cover fill on the polygon,

j_4: local fill orientation,

j_5: local fill should align with the wall direction (fill origin is at the wall origin and directions are matching),

j_6: fill is cut fill (default is drafting fill),

j_7: fill is cover fill (only if j6 = 0, default is drafting fill).

WALLHOLE2{2}

```
WALLHOLE2{2} n, frame_fill, fillcategory, distortion_flags,
        fill_pen, fill_background_pen,
        fillOrigoX, fillOrigoY,
        mxx, mxy, myx, myy,
        innerRadius,
        x1, y1, s1,
        ...
        xn, yn, sn
```

Advanced version of WALLHOLE2, where fill distortion can be controlled in an enhanced way.

It is equivalent to the POLY2_B{5} command in the geometric definition.

`distortion_flags:`

`distortion_flags = `j_1` + 2*`j_2` + 4*`j_3` + 8*`j_4` + 16*`j_5` + 32*`j_6` + 64*`j_7` + 128*`j_8, where each j can be 0 or 1.

The valid value for distortion_flags is between 0 and 255. Don't use value out of this range.

j_1-j_7: similar to the POLY2_B{5} command,

j_8: local fill should align with the wall direction (fill origin is at the wall origin and directions are matching), meaningful only when j4 is set. Distortion matrix (mij parameters) are omitted.

Extending the wall polygon

WALLBLOCK2

```
WALLBLOCK2 n, fill_control, fill_pen, fill_background_pen,
        fillOrigoX, fillOrigoY, fillAngle,
        x1, y1, s1,
        ...
        xn, yn, sn
```

WALLBLOCK2{2}

```
WALLBLOCK2{2} n, frame_fill, fillcategory, distortion_flags,
        fill_pen, fill_background_pen,
        fillOrigoX, fillOrigoY,
        mxx, mxy, myx, myy,
        innerRadius,
        x1, y1, s1,
        ...
        xn, yn, sn
```

Wall polygon (extension) definition for the plan view. Both the cut and view wall polygons are cut by the defined polygon. Wall openings defined via WALLHOLE2 in another window/door object cut the polygon generated by this command, while wallholes coming from the same object don't.

This command can be used in the 2D script of door/window objects only.

The parameterization of the command is exactly the same as the ones of WALLHOLE2.

WALLLINE2

```
WALLLINE2 x1, y1, x2, y2
```

Wall line (extension) definition between two points for the plan view. Wall openings defined via WALLHOLE2 in another window/door object cut the line generated by this command, while wallholes coming from the same object don't.

This command can be used in the 2D script of door/window objects only.

The parameterization of the command is exactly the same as the one of the LINE2 command.

WALLARC2

```
WALLARC2 x, y, r, alpha, beta
```

An arc with its centerpoint at (x, y) from the angle alpha to beta, with a radius of r, which is drawn by the containing wall. Wall openings defined via WALLHOLE2 in another window/door object cut the arc generated by this command, while wallholes coming from the same object don't.

This command can be used in the 2D script of door/window objects only.

The parameterization of the command is exactly the same as the one of the ARC2 command.

GDL Created from the Floor Plan

Saving the floor plan as a GDL script or library part will result GDL elements. You can use these GDL scripts as templates for your custom library parts.

Keywords

Common Keywords

```
FILE_DEPENDENCE
MOD
AND
OR
EXOR
FOR
TO
STEP
NEXT
DO (at DO - WHILE, at WHILE - ENDWHILE)
WHILE (at DO - WHILE, at WHILE - ENDWHILE)
ENDWHILE
REPEAT
UNTIL
IF (at IF - GOTO, at IF - THEN - ELSE - ENDIF)
THEN (at IF - GOTO, at IF - THEN - ELSE - ENDIF)
GOTO (at IF - GOTO, at GOTO)
GOSUB (at IF - GOTO, at GOSUB)
ELSE
ENDIF
RETURN
```

```
END
EXIT
BREAKPOINT

FILLTYPES_MASK (at DEFINE FILL, at DEFINE FILLA, at DEFINE SYMBOL_FILL, at DEFINE
SOLID_FILL, at DEFINE EMPTY_FILL, at DEFINE LINEAR_GRADIENT_FILL, at DEFINE
RADIAL_GRADIENT_FILL, at DEFINE TRANSLUCENT_FILL, at DEFINE IMAGE_FILL, at VALUES)
DIM
PUT
GET
USE
NSP
CALL
RETURNED_PARAMETERS
DEFAULT
PRINT

VARDIM1
VARDIM2
PARVALUE_DESCRIPTION
ABS
CEIL
INT
FRA
ROUND_INT
SGN
SQR
ACS
ASN
ATN
COS
SIN
TAN
```

```
PI
EXP
LGT
LOG
NOT
MIN
MAX
RND
BITTEST
BITSET
REQ
REQUEST
IND
APPLICATION_QUERY
LIBRARYGLOBAL
STR
STR{2}
SPLIT
STW
STRLEN
STRSTR
STRSUB
STRTOUPPER
STRTOLOWER
OPEN
INPUT
VARTYPE
OUTPUT
CLOSE
INITADDONSCOPE
PREPAREFUNCTION
CALLFUNCTION
CLOSEADDONSCOPE
```

Reserved Keywords

The keywords listed below are reserved; they exist for compatibility reasons or are not publicized.

```
BAS
BOX
CONT
FILTER
GDLBIN
HIP_ROOFS
LIN_
LINE_
MIGRATIONWARNING
NOD
NODE
ORIGO
PARS
PAUSE
PLOTMAKER
PLOTTER
RECT_
REF
SFLINE
TET
TETRA
TRI
WALL_
VOCA
UI_OK
UI_CANCEL
```

3D Use Only

```
ADDX
ADDY
ADDZ
ADD
MULX
MULY
```

```
MULZ
MUL
ROTX
ROTY
ROTZ
ROT
XFORM

BLOCK
BRICK
CYLIND
SPHERE
ELLIPS
CONE
PRISM
PRISM_
CPRISM_
CPRISM_{2}
CPRISM_{3}
CPRISM_{4}
BPRISM_
FPRISM_
HPRISM_
SPRISM_
SPRISM_{2}
SPRISM_{3}
SPRISM_{4}
SLAB
SLAB_
CSLAB_
CWALL_
BWALL_
XWALL_
```

```
XWALL_{2}
XWALL_{3}
BEAM
CROOF_
CROOF_{2}
CROOF_{3}
CROOF_{4}
MESH
ARMC
ARME
ELBOW
EXTRUDE
PYRAMID
REVOLVE
REVOLVE{2}
REVOLVE{3}
REVOLVE{4}
REVOLVE{5}
RULED
RULED{2}
SWEEP
TUBE
TUBEA
COONS
MASS
MASS{2}
POLYROOF
POLYROOF{2}
POLYROOF{3}
POLYROOF{4}
EXTRUDEDSHELL
EXTRUDEDSHELL{2}
EXTRUDEDSHELL{3}
```

```
REVOLVEDSHELL
REVOLVEDSHELL{2}
REVOLVEDSHELL{3}
REVOLVEDSHELLANGULAR
REVOLVEDSHELLANGULAR{2}
REVOLVEDSHELLANGULAR{3}
RULEDSHELL
RULEDSHELL{2}
RULEDSHELL{3}
TEXT
BODY
BASE
NURBSCURVE2D
NURBSCURVE3D
NURBSSURFACE
NURBSVERT
NURBSEDGE
NURBSTRIM
NURBSTRIMSINGULAR
NURBSFACE
NURBSLUMP
NURBSBODY
POINTCLOUD
CUTPLANE
CUTEND (at CUTPLANE, at CUTPLANE{2}, at CUTPLANE{3}, at CUTPOLY, at CUTPOLYA, at CUTSHAPE)
CUTPLANE{2}
CUTPLANE{3}
CUTPOLY
CUTPOLYA
CUTSHAPE
CUTFORM
CUTFORM{2}
GROUP
```

```
ENDGROUP
ADDGROUP
ADDGROUP{2}
ADDGROUP{3}
SUBGROUP
SUBGROUP{2}
SUBGROUP{3}
ISECTGROUP
ISECTGROUP{2}
ISECTGROUP{3}
ISECTLINES
PLACEGROUP
KILLGROUP
SWEEPGROUP
SWEEPGROUP{2}
SWEEPGROUP{3}
SWEEPGROUP{4}
CREATEGROUPWITHMATERIAL
BINARY
WALLNICHE

HOTSPOT
HOTLINE
HOTARC
LIN_
RECT
POLY
POLY_
PLANE
PLANE_
CIRCLE
ARC
LIGHT
```

```
PICTURE
RICHTEXT
VERT (at VERT, at VERT{2})
TEVE
VECT
EDGE
PGON
PGON{2}
PGON{3}
PIPG
COOR
COOR{2}
COOR{3}
MODEL
WIRE
SURFACE
SOLID
MATERIAL
SECT_FILL
SECT_ATTRS
SHADOW
ON
OFF
AUTO
DEFINE MATERIAL (at DEFINE MATERIAL, at DEFINE MATERIAL BASED_ON)
BASED_ON
DEFINE TEXTURE
WALLHOLE
```

2D Use Only

```
ADD2
MUL2
```

```
ROT2

LINE2
RECT2
POLY2
POLY2_
POLY2_A
POLY2_B
POLY2_B{2}
POLY2_B{3}
POLY2_B{4}
POLY2_B{5}
ARC2
CIRCLE2
SPLINE2
SPLINE2A
TEXT2
RICHTEXT2
FRAGMENT2
PROJECT2
PROJECT2{2}
PROJECT2{3}
PROJECT2{4}
DRAWING2
DRAWING3
DRAWING3{2}
DRAWING3{3}
WALLHOLE2
WALLHOLE2{2}
WALLBLOCK2
WALLBLOCK2{2}
WALLLINE2
```

```
WALLARC2

HOTSPOT2
HOTLINE2
HOTARC2
PICTURE2
PICTURE2{2}
LINE_PROPERTY
DRAWINDEX
FILL
LINE_TYPE
DEFINE FILL
DEFINE FILLA
DEFINE SYMBOL_FILL
DEFINE SOLID_FILL
DEFINE EMPTY_FILL
DEFINE LINEAR_GRADIENT_FILL
DEFINE RADIAL_GRADIENT_FILL
DEFINE TRANSLUCENT_FILL
DEFINE IMAGE_FILL
DEFINE LINE_TYPE
DEFINE SYMBOL_LINE
```

2D and 3D Use

```
DEL (at DEL, at DEL TOP)
TOP
NTR
ADDITIONAL_DATA (at LIGHT, at DEFINE MATERIAL BASED_ON)
LET
RADIUS
RESOL
TOLER
PEN
```

```
SET (at [SET] STYLE, at [SET] MATERIAL, at [SET] FILL, at [SET] LINE_TYPE)
STYLE
DEFINE STYLE
DEFINE STYLE{2}
PARAGRAPH
ENDPARAGRAPH
TEXTBLOCK
TEXTBLOCK_
```

Non-Geometric Scripts

Properties Script

```
DATABASE_SET
DESCRIPTOR
REF DESCRIPTOR
COMPONENT
REF COMPONENT
BINARYPROP
SURFACE3D
VOLUME3D
POSITION
WALLS
COLUMNS
BEAMS
DOORS
WINDOWS
OBJECTS
CEILS
PITCHED_ROOFS
LIGHTS
HATCHES
ROOMS
```

```
MESHES
DRAWING
```

Parameter Script

```
VALUES
CUSTOM (at VALUES, at UI_INFIELD{4})
RANGE
VALUES{2}
PARAMETERS (at PARAMETERS, at CALL)
LOCK
ALL (at LOCK, at HIDEPARAMETER, at CALL)
HIDEPARAMETER
```

Interface Script

```
UI_DIALOG
UI_PAGE
UI_CURRENT_PAGE
UI_BUTTON (at UI_BUTTON, at UI_TOOLTIP)
UI_PREV
UI_NEXT
UI_FUNCTION
UI_LINK
UI_PICT_BUTTON (at UI_PICT_BUTTON, at UI_TOOLTIP)
UI_SEPARATOR
UI_GROUPBOX
UI_PICT (at UI_PICT, at UI_TOOLTIP)
UI_STYLE
UI_OUTFIELD (at UI_OUTFIELD, at UI_TOOLTIP)
UI_INFIELD (at UI_INFIELD, at UI_TOOLTIP)
UI_INFIELD{2} (at UI_INFIELD{2}, at UI_TOOLTIP)
UI_INFIELD{3} (at UI_INFIELD{3}, at UI_TOOLTIP)
UI_INFIELD{4} (at UI_INFIELD{4}, at UI_TOOLTIP)
UI_CUSTOM_POPUP_INFIELD (at UI_CUSTOM_POPUP_INFIELD, at UI_TOOLTIP)
```

```
    UI_CUSTOM_POPUP_INFIELD{2} (at UI_CUSTOM_POPUP_INFIELD{2}, at UI_TOOLTIP)
    UI_RADIOBUTTON (at UI_RADIOBUTTON, at UI_TOOLTIP)
    UI_RADIOBUTTON{2}
    UI_LISTFIELD (at UI_LISTFIELD, at UI_TOOLTIP)
    UI_LISTITEM (at UI_LISTITEM, at UI_TOOLTIP)
    UI_LISTITEM{2} (at UI_LISTITEM{2}, at UI_TOOLTIP)
    UI_CUSTOM_POPUP_LISTITEM (at UI_CUSTOM_POPUP_LISTITEM, at UI_TOOLTIP)
    UI_CUSTOM_POPUP_LISTITEM{2} (at UI_CUSTOM_POPUP_LISTITEM{2}, at UI_TOOLTIP)
    UI_TOOLTIP
    UI_COLORPICKER
    UI_COLORPICKER{2}
    UI_SLIDER
    UI_SLIDER{2}
```

Forward and Backward Migration Scripts

```
    SETMIGRATIONGUID
    STORED_PAR_VALUE
    DELETED_PAR_VALUE
    NEWPARAMETER
```

GDL Data I/O Add-On

The GDL Data In/Out Add-On allows you to access a simple kind of database by using GDL commands. Otherwise this Add-On is similar to the GDL Text In/Out Add-On.

Description of Database

The database is a text file in which the records are stored in separate lines. The database can be queried and modified based on a single key. The key and the other items are separated by a character (specified in the OPEN command).

The length of the lines does not need to be the same and even the number of columns in the records may be different.

If a database is open for writing then there should be enough space beside the database file for duplicating the whole file.

Opening and closing a database may be time consuming, so consecutive closing and opening of a database should be avoided.

Large databases (with more than some hundred thousand records) should be ordered by the key values.

A database can be opened, queried, modified and closed by this Add-On using the OPEN, INPUT, OUTPUT and CLOSE GDL commands.

Opening a Database

`channel = OPEN (filter, filename, paramstring)`

Opens the database. If the database file is to be opened for modification and the file does not exist, it creates a new file. If the database file is to be opened for reading and the file does not exist, an error message is displayed.

Its return value is a positive integer that will identify the specific database. This value will be the database's future reference number.

If the database is opened before open command, it will generate a channel number only.

`filter:` the internal name of the Add-On, in this case "DATA"

`filename:` the name of the database file to be opened

`paramstring:` add-on specific parameter, contains separator characters and file opening mode parameters

The paramstring may contain the following:

`SEPARATOR:` after the keyword between single quotation marks ('') you can define a character that you want to use in your text file (both in case of writing and reading) for the separation of data fields. A special case is the tabulator character ('\t').

`MODE:` after the keyword the mode of opening has to follow. There are three modes of opening:

- RO (read only)
- WA (read, append/modify)
- WO (overwrite) Empties the database if exists.

`DIALOG:` the 'filename' parameter is working as a file-identifier, otherwise it is a full-path-name. The file-identifier is a simple string, which will be matched to an existing file by the Add-On during a standard 'Open/Save as' dialog. This matching is stored by the Add-On and it won't ask again except when the file is not available any more. If the open mode is read only, the Add-On will put up an Open dialog to select an existing document. Otherwise the Add-On put up an alert-dialog to select between the 'Create' and 'Browse' options:

- Create: create a new data-file (Save as Dialog).
- Browse: search an existing data-file (Open dialog)

`LIBRARY:` If the LIBRARY keyword is present in the parameter string, the data file has to be in the loaded library. Opening data file from the loaded library for reading is possible from all scripts, but writing is only enabled in the parameter, user interface and property scripts.

Always put a comma (,) between the components of paramstring.

If you use keywords that don't exist, if the separator characters given are wrong or if there is nothing in the parameter string, the extension will use the default settings: `"SEPARATOR = '\t', MODE = RO"`

Example:

```
ch1 = OPEN ("DATA", "file1",
        "SEPARATOR=';', MODE = RO, DIALOG")
ch2 = OPEN ("DATA", "file2", "")
ch3 = OPEN ("DATA", "newfile",
        "SEPARATOR = '\t', MODE = WA")
```

Reading Values from Database

```
INPUT (channel, recordID, fieldID, var1 [, var2, ...])
```

Queries the database based on the key value.

If it finds the record, it reads items from the record starting from the given column and puts the read values into the parameters in sequence.

In the parameter list there has to be at least one value. The values can be of numeric or string type independently of the parameter type defined for them. The return value is the number of successfully read values.

If there are more parameters than values, the parameters without corresponding values will be set to zero. In case of empty columns (i.e. if there is nothing between the separator characters) the parameters will be set to zero.

If it finds no record it returns (-1).

`channel:` channel value, used to identify the connection.

`recordID:` key value (numeric or string).

`fieldID:` the column number in the given record (the smallest number, 1 refers to the item after the key value).

`vari:` variables to receive the read record items.

Example:

```
! input of three values from the first column of the first row
nr = INPUT (ch1, "key1", 1, v1, v2, v3)

PRINT nr, v1, v2, v3
```

Writing Values into Database

```
OUTPUT channel, recordID, fieldID, expr1 [, expr2, ...]
```

In case of record creation or modification, it sets the record belonging to the given key value. The record will contain the given values in the same sequence as they appear in the command. The values can be of numeric or string type. There has to be at least one expression.

In case of deletion the record belonging to the given key value is removed from the database. The expression values are ignored, however at least one should be specified.

Modifying data files loaded with the library is only enabled in the parameter, user interface and property scripts.

`recordID:` key value (numeric or string)

`fieldID:` flag: specify 0 (or <= 0) to delete a record, specify 1 (or > 0) to create or modify a record

`expri:` new item values of the found or new record in case of deletion these values are ignored

Example:

```
string = "Date: 19.01.1996"
a = 1.5
OUTPUT ch2, "keyA", 1, "New record"
OUTPUT ch2, "keyA", 1, "Modified record"
OUTPUT ch2, "keyA", 0, 0 ! deletes the record
OUTPUT ch2, "keyB", 1, a, string
```

Closing Database

```
CLOSE channel
```

`channel:` channel value

Closes the database identified by the channel value.

GDL DATETIME ADD-ON

The DateTime extension allows you to set various formats for the current date and time set on your computer.

The Add-On works the same way the GDL file operations. You have to open a channel, read the information and close the channel.

This Add-On is also available by using the REQUEST GDL command, in which case the sequence of commands OPEN, INPUT and CLOSE is called internally. This is the simplest way to obtain the date/time information, with just a single GDL command line:

```
REQUEST ("DateTime", format, datetimestring)
```

The second parameter of the Request function is the same as that described in the OPEN function paramstring parameter.

Opening Channel

```
channel = OPEN (filter, filename, paramstring)
```

Its return value is a positive integer that will identify the opened channel. This value will become the channel's future reference number. The paramstring can contain specifiers and other characters.

`filter:` the internal name of the Add-On, in this case "DateTime"

`filename:` unused (there is no need to open any file to get the system date and time)

`paramstring:` add-on specific parameter, contains the desired output format of the date and time
The specifiers are replaced with date and time values as follows:

%y	year without century, as a decimal number (00-99)
%Y	year with century, as a decimal number
%b	abbreviated month name
%B	full month name
%m	month, as a decimal number (01-12)
%d	day of the month as a decimal number (01-31)
%H	hour (24-hour clock), as a decimal number (00-23)
%I	hour (12-hour clock), as a decimal number (01-12)
%M	minute, as a decimal number (00-59)
%S	second, as a decimal number (00-59)
%P	AM/PM designation for a 12-hour clock
%c	date and time in the form: 01:35:56 PM Wednesday, March 27, 1996
%x	date in the form Wednesday, March 27, 1996
%X	time in the form 01:35:56 PM
%a	abbreviated weekday name
%A	full weekday name
%w	weekday, as a decimal number (0 (Sunday)-6 (Saturday))
%j	day of the year, as a decimal number (001-366)
%U	week number of the year (with Sunday as the first day of the first week), as a decimal number
%W	week number of the year (with Monday as the first day of the first week), as a decimal number (00-53)
%Z	GDL ignores this specifier. According to the standard, it prints the time zone if it can be determined
%%	the % character

Example:

```
dstr = ""
ch = OPEN ("DateTime", "", "%w/%m/%d/%Y, %H:%M%P")
n = INPUT (ch, "", "", dstr)
CLOSE (ch)
PRINT dstr !it prints 3/03/27/1996, 14:36 PM
```

Reading Information

```
n = INPUT (channel, "", "", datetimestr)
```

It reads a string type value which represents the date and/or time in the format given at the OPEN sequence. The second and third parameters are unused (they can be empty strings or 0-s as well)

The return value is the number of successfully read values, in this case 1.

`channel:` channel value, used to identify the connection.

`datetimestr:` string type value

Closing Channel

```
CLOSE channel
```

Closes the channel identified by the channel value.

GDL File Manager I/O Add-On

The GDL File Manager In-Out Add-On allows you to scan a folder for the contained files/subfolders from a GDL script.

Specify the folder you would like to scan by using the OPEN command.

Get the first/next file/folder name in the specified folder by using the INPUT command.

Finish folder scanning by using the CLOSE command.

Specifying Folder

```
channel = OPEN (filter, filename, paramstring)
```

`channel:` folder id

`filter:` the internal name of the Add-On, in this case "FileMan"

`filename:` the name of folder to be scanned (OS dependent path) - folder id string (in DIALOG mode - see later)

`paramstring:` Add-on specific parameter. The parameters in paramString must be separated by commas (,).

`1. parameter: FILES/FOLDERS:` What would you like to search for?
`2. parameter (optional): DIALOG:` Indicates that the folder is given by a file id string instead of a file path. When this is the case, at the first time (and each time when the corresponding file path seems to be invalid) the user will be faced a dialog box to set the id string - file path correspondence, which will be stored.

Example: Opening the root directory of the C drive (on a PC) for file-scanning

```
folder = OPEN ("FileMan", "c:\", "FOLDERS")
```

Getting File/Folder Name

```
n = INPUT (channel, recordID, fieldID, var1 [, var2, ...])
```

`channel:` folder id (returned by the OPEN command)

`recordID:` 0 (reserved for further development)

`fieldID:` 0 (reserved for future development)

`var1, ...:` variable(s) to receive the file/folder name(s)

`n:` the number of successfully filled variables

Example: Fetching the next file name from the specified folder

```
n = INPUT (folder, 0, 0, fileName)
```

If it succeeds, `n` will be 1. If there are no more files/subfolders the variable `n` will be set to zero.

Finishing Folder Scanning

```
CLOSE (channel)
```

Closes the folder identified by the channel value.

Example: Listing a single folder

```
topFolder = open ("FileMan", "MyFavouriteFolder", "files, dialog")
y = 0
n = input (topFolder, 0, 0, fileName)
while n = 1 do
    text2 0, y, fileName
    y = y - 0.6
    n = input (topFolder, 0, 0, fileName)
endwhile
close (topFolder)
```

This code segment (as the 2D script section of an object, for example) lists the files in the folder specified by the MyFavouriteFolder identifier. At first usage, the user will have to assign an existing folder to this identifier. Later, MyFavouriteFolder id will represent that folder.

GDL TEXT I/O ADD-ON

The GDL Text In/Out Add-On allows you to open external text files for reading/writing and to manipulate them by putting/getting values from/to GDL scripts.

This Add-On interprets the strings on the parameter list of the OPEN, INPUT, OUTPUT commands from the GDL script.

The created files are placed in a subfolder of the application data folder if it is given by a relative path. The folder can contain subfolders where the extension will look for existing files. It can read and write TEXT type files.

Opening File

```
channel = OPEN (filter, filename, paramstring)
```

Opens the file. If the file into which you want to write doesn't exist, it creates the file. If a file to be read doesn't exist, an error message is displayed.

Its return value is a positive integer that will identify the specific file. This value will be the file's future reference number.

`filter:` the internal name of the Add-On, in this case "TEXT"

`filename:` the name of the file to be opened

`paramstring:` add-on specific parameter, contains separator characters and file opening mode parameters

The paramstring may contain the following:

`SEPARATOR:` after the keyword between apostrophes (') you can assign a character to use in the text file (for both writing and reading) to separate columns. Special cases are the tabulator ('\t') and the new row ('\n') characters.

`MODE:` the mode of opening has to follow this keyword. There are only three modes of opening:

- RO (read only)
- WA (write only, append at the end of the file)
- WO (write only, overwrite) the data previously stored in the file will be lost!

A file cannot be open for reading and writing at the same time.

`DIALOG:` If this keyword is present, a dialog box will appear in which you can enter a file name.

`FULLPATH:` If this keyword is present, the file name will be interpreted as a full path name.

`LIBRARY:` If this keyword is present, the data file must be in the loaded library. Opening data file from the loaded library for reading is possible from all scripts, but writing is only enabled in the parameter, user interface and property scripts.

Always put a comma (,) between the keywords.

`NEWLINE:` definition of new line character(s). Possible values:

- CR (Carriage return, 0x0D)
- LF (Line feed, 0x0A)
- CRLF (Carriage return + Line feed, 0x0D0x0A)

For Windows-like line ends use "NEWLINE = CRLF"

If you use keywords that don't exist, if the separator characters given are wrong or if there is nothing in the parameter string, the extension will use the default settings: `"SEPARATOR = '\t', MODE = RO, NEWLINE = LF"`

Example:

```
ch1 = OPEN ("TEXT", "file1", "SEPARATOR = ';', MODE = RO")
ch2 = OPEN ("TEXT", "file2", "")
ch3 = OPEN ("TEXT", "file3", "SEPARATOR = '\n', MODE = WO")
```

Reading Values

`INPUT (channel, recordID, fieldID, var1 [, var2, ...])`

It reads as many values from the given starting position of the file identified by the channel value as many parameters are given. In the parameter list there has to be at least one value. The function puts the read values into the parameters in sequence. The values can be of numeric or string type independently of the parameter type defined for them.

The return value is the number of successfully read values, in case of end of file (-1).

Both the row and the column numbers have to be positive integers, otherwise you will get an error message.

If the row or column numbers are incorrect, the input will not be carried out. (n = 0)

If the row and the column can be identified, as many values shall be input from the given starting position as many parameters are given, or if there are more parameters than values, the parameters without corresponding values will be set to zero.

In case of empty columns (i.e. if there is nothing between the separator characters) the parameters will be set to zero.

`channel:` channel value, used to identify the connection.

`recordID:` the row number (numeric or string)

`fieldID:` the column number in the given row

`var1``, ...:` variables to receive the read record items

Example:

```
nr = INPUT (ch1, 1, 1, v1, v2, v3) ! input of three values
! from the firstcolumn of the first row
PRINT nr, v1, v2, v3
```

Writing Values

```
OUTPUT channel, recordID, fieldID, expr1 [, expr2, ...]
```

Outputs as many values into the file identified by the channel value from the given position as many expressions are defined. There has to be at least one expression. The types of the output values are the same as those of the expressions.

In case of a text extension, the OUTPUT will either (depending on the mode of opening) overwrite the file or add to the end of the file the given expressions to consecutive positions using between them the separator characters defined when opening the file. In this case, the given position is not interpreted.

Modifying data files loaded with the library is only enabled in the parameter, user interface and property scripts.

`channel:` channel value

`recordID:` The recordID is used to direct the new rows in the output

If the recordID is positive, the output values will be followed by a new row, otherwise the last value will be followed by a separator character.

`fieldID:` no role, its value is not used

`expr1:` values to output

Example:

```
string = "Date: 19.01.1996"
a = 1.5
OUTPUT ch2, 1, 0, string ! string followed by a new row
OUTPUT ch2, 0, 0, a, a + 1, a + 2! separator character after a + 2 ! without new row
```

Closing File

```
CLOSE channel
```

Closes the text file identified by the channel value.

`channel:` channel value

Example:

A GDL object that will simply copy the contents of the "f1" file both into the "f2" and the "f3" files, but will write all the values tabulated in "f1" into a separate row in both "f2" and "f3".

```
ch1 = open ("TEXT", "f1", "mode = ro")
ch2 = open ("TEXT", "f2", "separator = '\n', mode = wo")
ch3 = open ("TEXT", "f3", "separator = '\n', mode = wo")
i = 1

1:
    n = input (ch1, i, 1, var1, var2, var3, var4)
    if n <> -1 then
        output ch2, 1, 0, var1, var2, var3, var4
        output ch3, 1, 0, var1, var2, var3, var4
        i = i + 1
        goto 1
    else
        goto "close all"
    endif

"close all":
    close ch1
    close ch2
    close ch3
    end
```

PROPERTY GDL ADD-ON

The purpose of this add-on is to make an ARCHICAD property database accessible from GDL scripts. You can open database tables and query their contents, just like you would do it with SQL. You can query single records and multiple records (lists). Note that you cannot modify the database, and you cannot append records to it.

For the detailed description of the property database please refer to the "ARCHICAD Calculation Guide" in the Help menu.

Open property database

`OPEN ("PROP", "database set name", "[database files]")`

Return value: channel number

Opens a communication channel to the given database files. The content of the database files are read into memory for faster access. As long as it is open modifications to the property database will not be accessible from this add-on. This is usually not a problem though.

`database set name:` an arbitrary name that will identify a set of database files in subsequent OPEN calls.

`database files:` a list of text files that are part of the property database. This parameter is optional, if you have previously assigned `database set name` to the files you would like to read. The order of the files is fixed: `key file`, `component file`, `descriptor file`, `unit file`. You don't need to give full paths, because ARCHICAD will look up these files for you in the active libraries. If you use long filenames or names with spaces, put them between quotes (' or ").

Example 1:

```
channel = OPEN ("PROP", "sample",
        "'AC 8_KEY.txt', 'AC 8_COMP.txt', 'AC 8_DESC.txt', 'AC 8_UNIT.txt'")
```

Opens a database that consists of the files above (those are the files of the ARCHICAD Property database), and names it "sample". Note that inside the third parameter you must use a different quotation character (you can use " and ').

Example 2:

```
channel = OPEN ("PROP", "sample", "")
```

This command can be issued after explicitly opening the database files (like in example 1), but before closing it. This lets you use the explicit command at one place in the Master_GDL script, and use the shorter version later.

Close property database

```
CLOSE (channel_number)
```

Return value: none

Closes the previously opened communication channel.

Input to property database

```
INPUT (channel_number, "query type", "field list", variable1 [, ...])
```

`channel_number:` a valid communication channel number given by a previous OPEN command.

`query type:` specifies the query you would like to execute. The add-on understands the following keywords:

- Single-record queries:
  - KEY, <keycode> - query the record from the key database where <keycode> is the value of the keycode attribute. Valid fields: KEYCODE, KEYNAME
  - UNIT, <unitcode> - query the record from the unit database where <unitcode> is the value of the unit code attribute. Valid fields: UNITCODE, UNITNAME, UNITFORMATSTR
  - COMP, <keycode>, <code> - query the record from the unit database where <keycode> is the key code attribute value, and <code> is the component code attribute value. Valid fields: KEYCODE, KEYNAME, CODE, NAME, QUANTITY, QUANTITYSTR, UNITCODE, UNITNAME, UNITFORMATSTR

  - DESC, <keycode>, <code> - query the record from the unit database where <keycode> is the key code attribute value, and <code> is the descriptor code attribute value. Valid fields: KEYCODE, KEYNAME, CODE, NAME, NUMOFLINES, FULLNAME
- Listing queries:
  - KEYLIST - list all records in the key database. Valid fields: KEYCODE, KEYNAME
  - UNITLIST - list all records in the unit database. Valid fields: UNITCODE, UNITNAME, UNITFORMATSTR
  - COMPLIST[, <keycode>] - list all records in the component database, or if <keycode> is given, then only those records are listed whose keycode equals <keycode>. Valid fields: KEYCODE, KEYNAME, CODE, NAME, QUANTITY, QUANTITYSTR, UNITCODE, UNITNAME, UNITFORMATSTR
  - DESCLIST[, keycode] - list all records in the descriptor database, or if <keycode> is given, then only those records are listed whose keycode equals <keycode>. Valid fields: KEYCODE, KEYNAME, CODE, NAME, NUMOFLINES, FULLNAME
  - COMPDESCLIST[, <keycode>] - list all records in the component and the descriptor database, or if <keycode> is given, then only those records are listed whose keycode equals <keycode>. Valid fields: ISCOMP, KEYCODE, KEYNAME, CODE, NAME, QUANTITY, QUANTITYSTR, UNITCODE, UNITNAME, UNITFORMATSTR, NUMOFLINES, FULLNAME

    Use this query with care! If either field is not valid in a database (e.g. FULLNAME in the component database) it will be simply left out from the resulting list (you should be aware of that)

`field list:` lists the database attributes whose values you would like to see in the output. If the output is a list, it will be sorted in the order of the fields listed here.

The following fields can be used:

- KEYCODE - key code attribute. Type: string. Usable in queries: KEY, COMP, DESC, KEYLIST, COMPLIST, DESCLIST, COMPDESCLIST
- KEYNAME - key name attribute. Type: string. Usable in queries: KEY, COMP, DESC, KEYLIST, COMPLIST, DESCLIST, COMPDESCLIST.
- UNITCODE - unit code attribute. Type: string. Usable in queries: UNIT, COMP, UNITLIST, COMPLIST, COMPDESCLIST
- UNITNAME - unit name attribute. Type: string. Usable in queries: UNIT, COMP, UNITLIST, COMPLIST, COMPDESCLIST
- UNITFORMATSTR - GDL format string of the unit. Type: string. Usable in queries: UNIT, COMP, UNITLIST, COMPLIST, COMPDESCLIST.
- CODE - component or descriptor code attribute (depends on the query). Type: string. Usable in queries: COMP, DESC, COMPLIST, DESCLIST, COMPDESCLIST.
- NAME - name of component or the first line of a descriptor record. Type: string. Usable in queries: COMP, DESC, COMPLIST, DESCLIST, COMPDESCLIST.
- QUANTITY - quantity of a component as a number (for calculations). Type: number. Usable in queries: COMP, COMPLIST, COMPDESCLIST.

- QUANTITYSTR - quantity of a component in string format. Type: string. Usable in queries: COMP, COMPLIST, COMPDESCLIST.
- NUMOFLINES - number of lines in a descriptor record. Type: number. Usable in queries: DESC, DESCLIST.
- FULLNAME - the whole descriptor record. Type: string(s). Usable in queries: DESC, DESCLIST.
- ISCOMP - tells you whether the next record is a component or a descriptor. Type: number (1 if component, 0 if descriptor). Usable in queries: COMPDESCLIST

`variables:` will hold the result of the query upon completion. You can list several variables if you know exactly how many you need (e.g. with single queries) or you can specify a dynamic array. The records are listed sequentially.

Example 1:
```
INPUT (channel, "KEY, 001", "KEYNAME", keyname)
```
This is a simple query: the name of the key with "001" code is put into the keyname variable.

Example 2:
```
INPUT (channel, "DESC, 004, 10", "NUMOFLINES, FULLNAME", desc_txt)
```
The descriptor record with keycode "004" and code "10" is processed, the number of lines of the description text and the text itself is put into the desc_txt array. The result is:

desc_txt[1] = <numoflines> (number)

desc_txt[2] = <first row of description> (string)

...

desc_txt[<numoflines+1>] = <last row of description>

Example 3:
```
INPUT (channel, "COMPLIST", "NAME, KEYNAME, QUANTITY", comp_list)
```
Create a component list, sort it by the name field, then by the keyname and finally by the quantity field and put it into the comp_list array. The result is:

complist[1] = <name1> (string)

complist[2] = <keyname1> (string)

complist[3] = <quantity1> (number)

complist[4] = <name2> (string)

... etc.

Example 4:

```
INPUT (channel, "COMPDESCLIST, 005", "ISCOMP, KEYNAME, NAME, QUANTITY", x_list)
```

Creates a common component and descriptor list, which means that records from both tables are listed where <keycode> is "005". The output is:

x_list[1] = 0 (number, 0 –> it is a descriptor)

x_list[2] = <name1> (string –> descriptors do not have <keyname> field, so it is left out)

x_list[3] = 0 (number, descriptors do not have quantity field)

...

x_list[(n*2)-1] = 1 (number –> there were n-1 descriptors listed, now the components come)

x_list[n*2] = <keyname_n> (string) ... etc.

Output to property database

This command is not implemented in this add-on, since property databases are read-only.

GDL XML Extension

This extension allows reading, writing and editing XML files. It implements a subset of the Document Object Model (DOM) interface. XML is a text file that uses tags to structure data into a hierarchical system, similar to HTML. An XML document can be modeled by a hierarchical tree structure whose nodes contain the data of the document. The following node types are known by the extension:

- *Element:* what is between a start-tag and an end-tag in the document, or for an empty-element it can be an empty-element tag. Elements have a name, may have attributes, and usually but not necessarily have content. It means that element type nodes can have child nodes. Attributes are held in an attribute list where each attribute has a different name and a text value.
- *Text:* a character sequence. It cannot have child nodes.
- *Comment:* text between the comment delimiters: <!-- the comment itself --> . In the text of the comment each '-' character must be followed by a character different from '-'. It also means that the following is illegal: <!-- comment ---> . Comment type nodes cannot have child nodes.
- *CDATASection:* text between the CDATA section delimiters: <![CDATA[the text itself]]> . In a CDATA section characters that have special meaning in an XML document need not (and must not) be escaped. The only markup recognized is the closing "]]>". CData section nodes cannot have child nodes.
- *Entity-reference:* reference to a predefined entity. Such a node can have a read-only subtree and this subtree gives the value of the referenced entity. During the parsing of the document it can be chosen that entity references are translated into text nodes.

On the top level it is obligatory to have exactly one element type node (the root), and there can be several comment type nodes, as well. The document type node of the DOM interface is not available through the extension's interface.

	name	value
Element	name of the tag	"" (empty string)
Text	"#text"	the text content of the node
Comment	"#comment"	the text content of the node
CDATASection	"#cdata-section"	the text content of the node
Entity-reference	name of the referenced entity	"" (empty string)

For each node in the tree there is a name and a value string associated whose meanings depend on the type of the node:

Element:	ELEM
Text:	TXT
Comment:	CMT
CDATA section:	CDATA
Entity reference:	EREF

The success or error code of an OPEN, INPUT or OUTPUT command can be retrieved by the GetLastError instruction of the INPUT command.

Opening an XML Document

```
channel = OPEN (filter, filename, parameter_string)
```

`filter:` file extension. This should be 'XML'.

`filename:` name and path of the file to open (or create), or an identifier name if the file is opened through a dialog box and the file's location is given by the user.

`parameter_string:` a sequence of character flags that determine the open-mode:

`'r':` open in read-only mode. In general only the INPUT command can be used.
`'e':` entity references are not translated into text nodes in the tree. Without this flag there are no entity-references in the document structure.
`'v':` validity check is performed during reading in and writing out. If a DTD exists in the document, the document's structure must agree with it. Without this flag a well-structured but invalid document can be read in and written out without error message.
`'n':` create a new file. If the file exists, the open will fail. (After the OPEN the CreateDocument instruction must be the first to execute.)

`'w':` overwrite file with empty document if it exists. If it doesn't exist, a new file will be created. (After the OPEN the CreateDocument instruction must be the first to execute.)
`'d':` the file is obtained from the user in a dialog box. In later runs it will be associated with the identifier given in the filename parameter of the OPEN command. (If the identifier is already associated to a file, the dialog box will not be opened to the user.)
`'f':` the filename parameter contains a full path.
`'l':` the file is in the loaded library parts. Opening data file from the loaded library for reading is possible from all scripts, but writing is only enabled in the parameter, user interface and property scripts.

`channel:` used to identify the connection in subsequent I/O commands.

If you want to open an existing XML file for modification, then none of the 'r', 'n' and 'w' flags must be set in the parameter string. Only one of the 'd', 'f' and 'l' flags should be set. If none of these flags is set then filename is considered to be a path relative to the user's documents folder.

Reading an XML Document

DOM is an object-oriented model that cannot be adapted to a BASIC-like language like GDL directly. To represent the nodes in the hierarchy tree we define position descriptors. When we want to walk through the nodes of the tree, first we have to request a new position descriptor from the extension. Originally a new descriptor points to the root element. The descriptor is in fact a 32 bit identification number whose value has no interest for the GDL script. The position it refers to can be changed as we move from one node in the tree to another.

```
INPUT (ch, recordID, fieldID, var1, var2, ...)
```

`ch:` channel returned by the OPEN command.

`recordID:` instruction name plus parameters.

`fieldID:` usually a position descriptor.

`var1, var2, ...:` optional list of variables receiving returned data.

INPUT instructions:

- **GetLastError:** retrieve the result of the last operation
  recordID: "GetLastError"
  fieldID: ignored
  return values:
  var1: error code / ok
  var2: the explanation text of error / ok
- **NewPositionDesc:** request for a new position descriptor
  recordID: "NewPositionDesc"

fieldID: ignored

return value: var1: the new position descriptor (initially refers to the root)

- **CopyPositionDesc:** request for a new position descriptor whose starting node is taken from another descriptor.

  recordID: "CopyPositionDesc"

  fieldID: an existing position descriptor

  return value: var1: the new position descriptor (initially refers to where the descriptor given in fieldID refers to)
- **ReturnPositionDesc:** when a position descriptor is no longer needed.

  recordID: "ReturnPositionDesc"

  fieldID: the position descriptor

  var1: ignored

  Call this instruction when a position descriptor received from the NewPositionDesc or CopyPositionDesc instructions is no longer used.
- **MoveToNode:** change the position of a descriptor. (and retrieve the data of the new node)

  This instruction can be used for navigating in the tree hierarchy.

  recordID: "MoveToNode searchmode nodename nodetype nodenumber">

  fieldID: position descriptor

  searchmode (or movemode): the nodename parameter must contain a path that determines an element or entity reference node in the xml document.

  To specify an exact path, the Path movemode should be used. After this movemode only the required path should be present.

  The path is relative to the node given in fieldID. The delimiter is the ':' character (which is otherwise an accepted character in an element's name so this doesn't work for all cases). The '..' string in the path means a step to the parent node. The starting node can be different from an element or entity reference node, in which case the path must begin with '..' to step back. If there are several element nodes on the same level with the same name then the first one is chosen.

  For the following move-modes the rest of the parameters must not be present:

  ToParent: moves to the parent of the node given in fieldID.

  ToNextSibling: moves to the next node on the same level.

  ToPrevSibling: moves to the previous node on the same level.

  ToFirstChild: moves to the first descendant of the fieldID node.

  ToLastChild: moves to the last descendant of the fieldID node.

  The following are the search-modes for which the rest of the parameters may occur, but they have default values if not present:

FromNextSibling: searching starts from the next node on the same level and it moves forward.

FromPrevSibling: searching starts from the node before fieldID and it moves backward on the same level.

FromFirstChild: searching starts from the first descendant of the fieldID node and moves forward.

FromLastChild: searching starts from the last descendant of the fieldID node and moves backward.

nodename: the searching considers those nodes only whose name or value matches nodename. The * and ? characters in nodename are considered as wildcard characters. For element and entity reference type nodes the name is compared, while for text, comment and CDATA section nodes the value is compared. Default value: *

nodetype: the searching considers those nodes only whose type is allowed by nodetype. The * means all types are allowed. Otherwise the type keywords can be combined with the + character to form the nodetype (it must be one word without spaces, like TXT+CDATA.) The default value is *

nodenumber: if there are several matching nodes, this gives the number of the searched node in the sequence of matching nodes. (Starts from 1) Default value: 1

return values:

var1: name of the node

var2: value of the node

var3: type keyword of the node

Example:

We want to move backwards on the same level to the 2nd node that is an element or an entity reference and whose name starts with K:

```
INPUT (ch, "MoveToNode FromPrevSibling K* ELEM+EREF 2", posDesc, name, val, type)
```

- **GetNodeData:** retrieve the data of a given node.

  recordID: "GetNodeData"

  fieldID: the position descriptor

  return values:

  var1: name of the node

  var2: value of the node

  var3: type keyword of the node
- **NumberofChildNodes:** gives the number of child nodes of a given node

  recordID: "NumberofChildNodes nodetype nodename"

The following optional parameters can narrow the set of child nodes considered:

nodetype: allowed node types as defined in the MoveToNode instruction

nodename: allowed node names or values as defined in the MoveToNode instruction

fieldID: position descriptor

return values:

var1: number of child nodes

- **NumberofAttributes:** returns the number of attributes of an element node.

  recordID: "NumberofAttributes attrname"

  attrname: if present, it can narrow the set of attributes considered as only those attributes will be counted whose names (and not the values) match attrname. In attrname the * and ? characters are considered wildcard characters.

  fieldID: position descriptor (must refer to an element node)

  return values:

  var1: number of attributes
- **GetAttribute:** return the data of an attribute of an element node

  recordID: "GetAttribute attrname attrnumber"

  fieldID: position descriptor (must refer to an element node)

  optional parameters:

  attrname: give the name of the attribute. The * and ? are considered wildcard characters. Default value: *

  attrnumber: If several attribute matches attrname, attrnumber chooses the attribute in the sequence of matching attributes. (Counting starts from 1.) Default value: 1

  return values:

  var1: value of the attribute

  var2: name of the attribute
- **Validate:** check the validity of the document.

  The validity is not checked during a document modification instruction. It is checked during writing back the file to disk if the 'v' flag was set in the open-mode string. A validity check can be forced any time by the Validate instruction, however it can consume considerable amount of time and memory so it is not advisable to do so after every modification.

  recordID: "Validate"

  fieldID: ignored

var1: ignored

Modifying an XML Document

`OUTPUT (ch, recordID, fieldID, var1, var2, ...)`

`ch:` channel returned by the OPEN command.

`recordID:` instruction name plus parameters.

`fieldID:` usually a position descriptor.

`var1, var2, ...:` additional input data.

OUTPUT instructions:

Most of the OUTPUT instructions are invalid for files opened in read-only mode.

- **CreateDocument:**

  recordID: "CreateDocument"

  fieldID: ignored

  var1: name of the document. This will be the tagname of the root element, as well.

  CreateDocument is allowed only if the file was opened in new-file or overwrite mode. In these modes this instruction must be the first to be executed in order to create the XML document.
- **NewElement:** insert a new element type node in the document

  recordID: "NewElement insertpos"

  fieldID: a position descriptor relative to which the new node is inserted

  var1: name of the new element (element tag-name)

  insertpos can be:

  AsNextSibling: new element is inserted after the position given in fieldID

  AsPrevSibling: new element is inserted before the position given in fieldID

  AsFirstChild: new element is inserted as the first child of the node given in fieldID (which must be an element node)

  AsLastChild: new element is inserted as the last child of the node given in fieldID (which must be an element node)
- **NewText:** insert a new text node in the document

  recordID: "NewText insertpos"

  fieldID: position descriptor

  var1: text to be inserted

See also the NewElement.

- **NewComment:** insert a new comment node in the document

  recordID: "NewComment insertpos"

  fieldID: position descriptor

  var1: text of the comment to be inserted

  See also the NewElement.

- **NewCDATASection:** insert a new CDATA section node in the document

  recordID: "NewCDATASection insertpos"

  fieldID: position descriptor

  var1: text of the CDATA section to be inserted

  See also the NewElement.

- **Copy:** make a copy of a subtree of the document under some node

  recordID: "Copy insertpos"

  fieldID: position descriptor relative to which the subtree is inserted

  var1: position descriptor giving the node of the subtree to be copied

  insertpos: same as in the NewElement

  The copied subtree remains unchanged. Position descriptors pointing to some node in the copied subtree will point to the same node after the copy.

- **Move:** replace some subtree in the document to some other location

  recordID: "Move insertpos"

  fieldID: position descriptor relative to which the subtree is inserted

  var1: position descriptor giving the node of the subtree to be moved

  insertpos: same as in the NewElement

  The original subtree is deleted. Position descriptors pointing to some node in the moved subtree will point to the same node in the new position of the subtree.

- **Delete:** delete a node and its subtree from the document

  recordID: "Delete"

  fieldID: position descriptor giving the node to delete

  var1: ignored

All position descriptors pointing to some node in the deleted subtree become invalid.

- **SetNodeValue:** change the value of a node

  recordID: "SetNodeValue"

  fieldID: position descriptor, it must refer to either a text, a comment or a CDATA section type node

  var1: new text value of the node
- **SetAttribute:** change an attribute of an element node or create a new one

  recordID: "SetAttribute"

  fieldID: position descriptor, it must refer to an element type node

  var1: name of the attribute

  var2: text value of the attribute

  If the element already has an attribute with this name then its value is changed, otherwise a new attribute is added to the element's list of attributes.
- **RemoveAttribute:** removes an attribute of an element node

  recordID: "RemoveAttribute"

  fieldID: position descriptor, it must refer to an element type node

  var1: name of the attribute to remove
- **Flush:** write the current document back to file

  recordID: "Flush"

  fieldID: ignored

  var1: ignored

  If the file was opened in validate mode, then only a valid document is saved.
- **ChangeFileName:** associate another file with the current document

  recordID: "ChangeFileName"

  fieldID: new file path

  var1: gives how fieldID should be interpreted. If var1 is an empty string, fieldID contains a path relative to the user's documents folder. 'd' means the file's location is obtained from the user from a file dialog box (see open-mode flags in the section called “Opening an XML Document”). 'l' means the file is taken from the loaded libraries. 'f' means fieldID contains a full path.

  This instruction can be called even if the file was opened in read-only mode. In this case after the execution the document loses the read-only attribute, so it can be modified and saved to the new file location.

Table 19. Error codes and messages

0	"Ok"
-1	"Add-on Initialization Failed"
-2	"Not Enough Memory"
-3	"Wrong Parameter String"
-4	"File Dialog Error"
-5	"File Does Not Exist"
-6	"XML Parse Error"
-7	"File Operation Error"
-8	"File Already Exists"
-9	"This channel is not open"
-10	"Syntax Error"
-11	"Open Error"
-12	"Invalid Position Descriptor"
-13	"Invalid Node Type for this Operation"
-14	"No Such Node Found"
-15	"Internal Error"
-16	"Parameter Error"
-17	"No Such Attribute Found"
-18	"Invalid XML Document"
-19	"Unhandled Exception"

-20	"Read-Only Document"
-21	"CreateDocument Not Allowed"
-22	"Document Creation Failed"
-23	"Setting NodeValue Failed"
-24	"Move Not Allowed"
-25	"Delete Not Allowed"
-26	"SetAttribute Not Allowed"
-27	"Format File Error"
-28	"Insertion (or Copy) Not Allowed"
-29	"Node Creation Failed"
-30	"Bad String"
-31	"Invalid Name"

POLYGON OPERATIONS EXTENSION

This add-on calculates result polygons based on the input polygons and the operation that is carried out on them.

Input polygons are identified by a name when passed to the add-on and are stored in a previously defined container. Result polygons are automatically named by the add-on and are stored in a second, target container. Input and result polygons are thus stored in different containers.

Multiple polygons, possibly with an even greater number of contours, can be created by a single operation. These will be administered as individual polygons in the target container. As a result, these polygons can be accessed in subsequent polygon operations. The principle is the same as with the Solid Geometry Commands (see in the section called “Solid Geometry Commands”). Input polygons must be contiguous.

A polygon is defined by several contours, each of which is an uninterrupted sequence of connected vertices. The first contour is the outer boundary. The subsequent contours must all be inside the first, they may not overlap, and they create cutouts of the first polygon.

Opening a channel

```
ch = INITADDONSCOPE ("PolyOperations ", "", "")
```

Opens a channel. The return value is the ID of the opened channel.

Polygon container management

```
PREPAREFUNCTION ch, "CreateContainer", "myContainer", ""
```

Creates a new polygon container.

```
PREPAREFUNCTION ch, "DeleteContainer", "myContainer", ""
```

Delete an existing polygon container.

```
PREPAREFUNCTION ch, "EmptyContainer", "myContainer", ""
```

Emptying an existing polygon container.

```
PREPAREFUNCTION ch, "SetSourceContainer", "mySourceContainer", ""
```

Set container as source container.

```
PREPAREFUNCTION ch, "SetDestinationContainer", "myDestinationContainer", ""
```

Set container as destination container.

Polygon management

```
PREPAREFUNCTION ch, "Store", "poly1", nVertices, nContours,
    vertArray, contourArray [, defaultInhEdgeInfo, inhEdgeInfosArray]
```

Stores the polygon "poly1" with the given parameters in the actual source container.

poly1: name of the stored polygon

nVertices: number of vertices

nContours: number of contours

vertArray: Array containing exactly nVertices items that describes all contours of the polygon. Two dimension array of (x, y, angle) records where x, y, and angle is real value. The angle parameter is the view-angle (deflection) in case of arched edges. This is a signed value, reflecting the orientation. Zero value means straight edge.

contourArray: An array which contains the index of the last vertex of the i-th contour. It must have exactly nContours items.

defaultInhEdgeInfo: One piece of inherited edge information. To the brand new edges (not created with split) in operations performed later this information will be attached. With the aid of this you can easily trace the newly created edges after complex operations. (Optional)

inhEdgeInfosArray: Array containing information attached to edges. It must of contain exactly nVertices integer type items. If an edge splits into more than one new edge in an operation, this information will be inherited without change to all new edges created. You can use it for example to store the side angles of a roof. (Optional)

Remarks:

- Polygons can have holes and curved edges though these curved edges can be only circle-arcs.

- This polygon can link to additional data for every edge.
- The first vertex must be always repeated in the last for all contours. So in this representation, a triangle have four vertices, where the first and the last vertex is identical.
- The first contour is the main contour, and it must contain the others.

```
PREPAREFUNCTION ch, "Dispose", "poly1", "myContainer"
```

Deletes the polygon "poly1" from the container "myContainer".

Polygon operation settings

```
PREPAREFUNCTION ch, "HalfPlaneParams", "", ca, cb, cc
```

Set the half plane in 2D to be used in the "PolyCut" operation.

Defining inequality for the half plane: ca * x + cb * y > cc.

ca: Coefficient of x

cb: Coefficient of y

cc: Constant

```
PREPAREFUNCTION ch, "OffsetParams", "", itemIdx, offsetValue
```

Set the offset parameters used in "OffsetEdge" and "ResizeContour" operation.

itemIdx: Index of the edge to be translated (for "OffsetEdge" operation). Index of the resizable contour (for "ResizeContour" operation).

offsetValue: Distance of the translation. Negative and positive offset values make the edge move inside and outside, respectively. If the offset is big, the neighboring vertices can be cut out.

Polygon operations

In the following polygon operations the "poly1" and "poly2" source polygons are located in the source polygon container. The resulting polygons are stored in the destination polygon container with an unique name started with "resPolygonID", where "ID" is a number.

```
dim resPolyIDArray[]
nPgon = CALLFUNCTION (ch, "poly1 OP poly2", "", resPolyIDArray)
```

Executes the "OP" operation with "poly1" and "poly2" polygons and puts the new values into the given parameters. The return value is the number of the generated polygons

OP: can be:

`+:` Polygon addition
`-:` Polygon subtraction
`/:` Polygon intersection

`resPolyIDArray:` Array of resulting polygon identifiers.

Copying a polygon from the source container to the destination container

```
dim resPolyIDArray[]
nPgon = CALLFUNCTION (ch, "CopyPolygon", "poly1", resPolyIDArray)
```

Regularizing a polygon - Making it geometrically valid.

```
dim resPolyIDArray[]
nPgon = CALLFUNCTION (ch, "Regularize", "poly1", resPolyIDArray)
```

A polygon is valid if

- Its first boundary contains all the others
- Is oriented correctly (the main contour is a positively oriented curve, the rest is oriented negatively)
- Has no self-intersections
- Its area is not zero
- Has no zero length edges

Intersecting the polygon with a halfplane.

The halfplane must be set with an "HalfPlaneParams" command. The result will be regularized.

```
dim resPolyIDArray[]
nPgon = CALLFUNCTION (ch, "PolyCut", "poly1", resPolyIDArray)
```

Translating an edge of a polygon perpendicularly to its direction.

The edge index and translation offset must be set with an "OffsetParams" command. The result will be regularized.

```
dim resPolyIDArray[]
nPgon = CALLFUNCTION (ch, "OffsetEdge", "poly1", resPolyIDArray)
```

Enlarges or shrinks a contour of a polygon.

The contour index and translation offset must be set with an "OffsetParams" command. The result will be regularized.

```
dim resPolyIDArray[]
nPgon = CALLFUNCTION (ch, "ResizeContour", "poly1", resPolyIDArray)
```

Get resulting polygons

Getting all polygon names from the actual source container.

```
dim resPolyIDArray[]
nPgon = CALLFUNCTION (ch, "GetSourcePolygons", "", resPolyIDArray
```

Getting all polygon names from the actual destination container.

```
dim resPolyIDArray[]
nPgon = CALLFUNCTION (ch, "GetDestinationPolygons", "", resPolyIDArray)
```

Getting the resulting polygon vertices after any polygon operation call.

The polygon with name "polygonID" located in the destination polygon container.

```
dim resVertices[]
nVertices = CALLFUNCTION (ch, "GetVertices", polygonID, resVertices)
```

Getting the resulting polygon contour end indices after any polygon operation call.

The polygon with name "polygonID" located in the destination polygon container.

```
dim contArr[]
nContours = CALLFUNCTION (ch, "GetContourEnds", polygonID, contArr)
```

Getting the resulting polygon contour information after any polygon operation call.

```
dim inhEdgeInfosArr[]
nEdgeInfos = CALLFUNCTION (ch, "GetInhEdgeInfos", polygonID, inhEdgeInfosArr)
```

The polygon with name "polygonID" located in the destination polygon container.

Closing channel

```
CLOSEADDONSCOPE (ch)
```

Closes channel "ch". Deletes all of the stored polygons.

AUTOTEXT GUIDE

It's not part of GDL itself. ARCHICAD will substitute all references to autotext fields in whatever GDL output it finds them. For example, if you write `<PROJECTSTATUS>` in the parameter string of a text2 command, ARCHICAD will nicely replace it with the actual value. All this is invisible to GDL – consequently the size and other attributes of the text are not measurable.

Project info keywords

```
PROJECTNAME
PROJECTNUMBER
PROJECTSTATUS
DATEOFISSUE
SITEFULLADDRESS

SITEADDRESS1
SITEADDRESS2
```

```
SITEADDRESS3
SITECITY
SITESTATE

SITEPOSTCODE
SITECOUNTRY
KEYWORDS
NOTES
ARCHITECTNAME

ARCHITECTPOSITION
CADTECHNICIAN
ARCHITECTCOMPANY
ARCHITECTFULLADDRESS
ARCHITECTADDRESS1

ARCHITECTADDRESS2
ARCHITECTADDRESS3
ARCHITECTCITY
ARCHITECTSTATE
ARCHITECTPOSTCODE

ARCHITECTCOUNTRY
ARCHITECTEMAIL
ARCHITECTPHONE
ARCHITECTFAX
ARCHITECTWEB

CLIENTNAME
CLIENTCOMPANY
CLIENTFULLADDRESS
CLIENTADDRESS1
CLIENTADDRESS2

CLIENTADDRESS3
CLIENTCITY
CLIENTSTATE
CLIENTPOSTCODE
CLIENTCOUNTRY
```

```
CLIENTEMAIL
CLIENTPHONE
CLIENTFAX
```

General

```
SHORTDATE
LONGDATE
TIME
FILENAME
FILEPATH
LASTSAVEDAT
LASTSAVEDBY
```

Layout autotexts

```
LAYOUTNAME
LAYOUTID
SUBSETNAME
SUBSETID
LAYOUTNUMBER
NUMOFLAYOUTS
```

Drawing autotexts

```
DRAWINGNAME
DRAWINGID
DRAWINGSCALE
ORIGINALSCALE
MAGNIFICATION
RENOVATIONFILTER
```

Reference type autotexts

```
LAYOUTNAME_R
LAYOUTID_R
SUBSETNAME_R
SUBSETID_R
DRAWINGNAME_R
DRAWINGID_R
DRAWINGSCALE_R
ORIGINALSCALE_R
MAGNIFICATION_R
FILENAME_R
FILEPATH_R
LAYOUTNUMBER_R
RENOVATIONFILTER_R
```

Marker type autotexts

```
MARKERSHEETNUMBER_R
MARKERDRAWINGNUMBER_R
MARKERSHEETNUMBER90_R
MARKERDRAWINGNUMBER90_R
MARKERSHEETNUMBER110_R
MARKERDRAWINGNUMBER110_R
BACKREFSHEETNUMBER_R
```

Change related autotexts

```
CHANGEID
CHANGEDESCRIPTION
REVISIONID
ISSUEID
ISSUEDESCRIPTION
ISSUEDATE
```

```
ISSUEDBY
```

Layout revision related autotexts

```
CURRENTREVISIONID
CURRENTISSUEID
CURRENTISSUEDESCRIPTION
CURRENTISSUEDATE
CURRENTISSUEDBY
```

NEW GDL FEATURES IN ARCHICAD 20

This section informs you about new GDL features in ARCHICAD 20. You can find the definition of the new and modified commands by following the links.

Introducing NURBS

NURBS geometry compatible GDL commands

From ARCHICAD 20 GDL has the possibility to create and store exact NURBS geometries.

See the section called "NURBS Primitive Elements" for the new commands.

New versions of existing commands in relations with NURBS

- `COOR{3}` The coordinate system of the projection body is included in the COOR{3} command itself, no need to define additional vertexes in the current BODY. Compatible with NURBS bodies (no non-NURBS primitives are needed to set up the texture coordinate system).
- `PROJECT2{4}` adds the possibility to define multiple cutting planes parallel to the X-Y plane, and to control the attributes of the cut and projected parts of the slices, including the line type, pens and fills, within one command.

General new features

New Global Variables

See the section called "Global Variables" for details:

- WALL_TEXTURE_WRAP: this array contains all data for correct texture alignment of wall-connected objects (wall ends, doors, windows).

Property related new features

New Request options (see the section called “REQUEST Options” for details):

- REQUEST "Properties_Of_Parent": Returns the properties of the parent object. All properties are returned in one array with the following form: ID, type, group, name. Can be used only in labels. Causes warning if used in parameter script.
- REQUEST "Property_Value_Of_Parent": Returns value array of the selected property. Can be used only in labels. Causes warning if used in parameter script.
- REQUEST "Property_Name": Returns the type, group and name of the selected property. Can be used only in labels. Causes warning if used in parameter script.

Commands for property visualization:

- `UI_CUSTOM_POPUP_INFIELD`
- `UI_CUSTOM_POPUP_LISTITEM`

Additional new REQUEST Options

- REQUEST{3} "Sum_with_rounding": Returns the sum of the numbers in addends_array, with rounding according to the “Calculate Totals by” project preference. This preference can be found in Project Preferences / Calculation Units and Rules.
- REQUEST "AUTOTEXT_LIST": Returns one AUTOTEXT array of the autotexts used in the project with the following triplets [“ID”, “Category”, Name”]. Causes warning if used in parameter script. Can be used only in UI script.
- REQUEST "Configuration_number": Returns the configuration number of the current ARCHICAD license. Causes warning if used in parameter script.

Additional new Fix Named Optional Parameters

The following parameters can be used to customize label frame and pointer connection:

- ac_bDisableLabelFrameDisplay: enable/disable built-in rectangular frame display in connection with Pointer
- ac_bCustomPointerConnection: set up custom connection points on a label head using special hotspots

Enhanced commands

- `UI_RADIOBUTTON{2}`: option for string expressions
- `UI_INFIELD`: new picture method 9
- `STR{2}`: new format flag *7

Deprecated functions and commands

- COOR: the old versions will work, but COOR{3} is the new standard
- REQUEST "Constr_Fills_display": the returned value will always be 6 by default (Cut fill patterns: as in Settings).

Recommended updates of existing library parts

Restrictions of Global Variables and Requests used in Parameter Script

To ensure the stored parameter value consistency of a library part, and the validity of returned values in all views, contexts, and TeamWork environment, the use of some Global Variables, Requests and Application Queries is not supported in the following environments, starting from ARCHICAD 20:

- parameter script
- master script used as parameter script
- Master.gdl, Master.gsm, and Library Master objects

The occurence of such items in parameter script will cause GDL warnings, while the requests expressions will return zero (containing 0 or empty string values as retuned parameters) and the global variables will contain a type matching default value only. To use returned values of restricted requests as parameter value, use the `UI_CUSTOM_POPUP_INFIELD` or the `UI_CUSTOM_POPUP_LISTITEM` commands in the User Interface Script.

For more detailed information, please consult:

- the section called “Global Variables” for a list of not supported globals
- the section called “REQUEST Options” for a list of not supported requests
- the section called “Application Query Options” for a list of not supported application queries

INDEX

SYNTAX LISTING OF GDL COMMANDS

A

```
ABS (x)

ACS (x)

ADD dx, dy, dz

ADD2 x, y

ADDGROUP (g_expr1, g_expr2)

ADDGROUP{2} (g_expr1, g_expr2, edgeColor, materialId, materialColor [, operationStatus])

ADDGROUP{3} (g_expr1, g_expr2, edgeColor, materialId, materialColor [, operationStatus])

LIGHT red, green, blue, shadow,
        radius, alpha, beta, angle_falloff,
        distance1, distance2,
        distance_falloff [[,] ADDITIONAL_DATA name1 = value1,
        name2 = value2, ...]

DEFINE MATERIAL name [,] BASED_ON orig_name [,] PARAMETERS name1 = expr1 [, ...]
        [[,] ADDITIONAL_DATA name1 = expr1 [, ...]]

ADDX dx

ADDY dy

ADDZ dz

LOCK ALL ["name1" [, "name2", ..., "namen"]]

HIDEPARAMETER ALL ["name1" [, "name2", ..., "namen"]]
```

```
CALL macro_name_string [,]
    PARAMETERS [ALL][name1=value1, ..., namen=valuen][[,]
    RETURNED_PARAMETERS r1, r2, ...]
```

```
APPLICATION_QUERY (extension_name, parameter_string, variable1, variable2, ...)
```

```
ARC r, alpha, beta
```

```
ARC2 x, y, r, alpha, beta
```

```
ARMC r1, r2, l, h, d, alpha
```

```
ARME l, r1, r2, h, d
```

```
ASN (x)
```

```
ATN (x)
```

B

```
BASE
```

```
DEFINE MATERIAL name [,] BASED_ON orig_name [,] PARAMETERS name1 = expr1 [, ...]
        [[,] ADDITIONAL_DATA name1 = expr1 [, ...]]
```

```
BEAM left_material, right_material, vertical_material,
        top_material, bottom_material,
        height,
        x1, x2, x3, x4,
        y1, y2, y3, y4, t,
        mask1, mask2, mask3, mask4
```

```
BINARY mode [, section, elementID]
```

```
BINARYPROP
```

```
BITSET (x, b [, expr])
```

```
BITTEST (x, b)
```

```
BLOCK a, b, c
```

```
BODY status

BPRISM_ top_material, bottom_material, side_material,
        n, h, radius,
        x1, y1, s1,
        ...
        xn, yn, sn

BREAKPOINT expression

BRICK a, b, c

BWALL_ left_material, right_material, side_material,
        height, x1, x2, x3, x4, t, radius,
        mask1, mask2, mask3, mask4,
        n,
        x_start1, y_low1, x_end1, y_high1, frame_shown1,
        ...
        x_startn, y_lown, x_endn, y_highn, frame_shownn,
        m,
        a1, b1, c1, d1,
        ...
        am, bm, cm, dm
```

C

```
CALL macro_name_string [,]
    PARAMETERS [ALL][name1=value1, ..., namen=valuen][[,]
    RETURNED_PARAMETERS r1, r2, ...]

 CALL macro_name_string [,]PARAMETERS
    value1 or DEFAULT [, ..., valuen or DEFAULT]


CALL macro_name_string [, parameter_list]

CALLFUNCTION (channel, function_name, parameter, variable1 [, variable2, ...])
```

```
CEIL (x)

CIRCLE r

CIRCLE2 x, y, r

CLOSE channel

CLOSEADDONSCOPE channel

COMPONENT name, quantity, unit [, proportional_with, code, keycode, unitcode]

CONE h, r1, r2, alpha1, alpha2

COONS n, m, mask,
        x11, y11, z11, ..., x1n, y1n, z1n,
        x21, y21, z21, ..., x2n, y2n, z2n,
        x31, y31, z31, ..., x3m, y3m, z3m,
        x41, y41, z41, ..., x4m, y4m, z4m

COOR wrap, vert1, vert2, vert3, vert4

COOR{2} wrap_method, wrap_flags, vert1, vert2, vert3, vert4

COOR{3} wrapping_method, wrap_flags,
        origin_X, origin_Y, origin_Z,
        endOfX_X, endOfX_Y, endOfX_Z,
        endOfY_X, endOfY_Y, endOfY_Z,
        endOfZ_X, endOfZ_Y, endOfZ_Z

COS (x)

CPRISM_ top_material, bottom_material, side_material,
        n, h,
        x1, y1, s1, ..., xn, yn, sn

CPRISM_{2} top_material, bottom_material, side_material,
        n, h,
        x1, y1, alpha1, s1, mat1,
        ...
        xn, yn, alphan, sn, matn
CPRISM_{3} top_material, bottom_material, side_material, mask,
          n, h,
          x1, y1, alpha1, s1, mat1,
          ...
          xn, yn, alphan, sn, matn
CPRISM_{4} top_material, bottom_material, side_material, mask,
          n, h,
          x1, y1, alpha1, s1, mat1,
          ...
          xn, yn, alphan, sn, matn
CREATEGROUPWITHMATERIAL (g_expr, repl_directive, pen, material)
CROOF_ top_material, bottom_material, side_material,
        n, xb, yb, xe, ye, height, angle, thickness,
        x1, y1, alpha1, s1,
        ...
        xn, yn, alphan, sn
CROOF_{2} top_material, bottom_material, side_material,
        n, xb, yb, xe, ye, height, angle, thickness,
        x1, y1, alpha1, s1, mat1,
        ...
        xn, yn, alphan, sn, matn
CROOF_{3} top_material, bottom_material, side_material, mask,
          n, xb, yb, xe, ye, height, angle, thickness,
          x1, y1, alpha1, s1, mat1,
          ...
          xn, yn, alphan, sn, matn
CROOF_{4} top_material, bottom_material, side_material, mask,
          n, xb, yb, xe, ye, height, angle, thickness,
          x1, y1, alpha1, s1, mat1,
             ...
             xn, yn, alphan, sn, matn

CSLAB_ top_material, bottom_material, side_material,
        n, h,
        x1, y1, z1, s1, ..., xn, yn, zn, sn

CUTPLANE [x [, y [, z [, side [, status]]]]]
[statement1 ... statementn]
CUTEND

CUTPLANE{2} angle [, status]
[statement1 ... statementn]
CUTEND

CUTPLANE{3} [x [, y [, z [, side [, status]]]]]
[statement1 ... statementn]
CUTEND

CUTPOLY n,
        x1, y1, ..., xn, yn
        [, x, y, z]
[statement1
statement2
...
statementn]
CUTEND

CUTPOLYA n, status, d,
        x1, y1, mask1, ..., xn, yn, maskn [,
        x, y, z]
[statement1
statement2
...
statementn]
CUTEND
```

```
CUTSHAPE d [, status]
[statement1 statement2 ... statementn]
CUTEND

CUTFORM n, method, status,
        rx, ry, rz, d,
        x1, y1, mask1 [, mat1],
        ...
        xn, yn, maskn [, matn]

CUTFORM{2} n, method, status,
        rx, ry, rz, d,
        x1, y1, mask1 [, mat1],
        ...
        xn, yn, maskn [, matn]

CUTPLANE [x [, y [, z [, side [, status]]]]]
[statement1 ... statementn]
CUTEND

CUTPLANE{2} angle [, status]
[statement1 ... statementn]
CUTEND

CUTPLANE{3} [x [, y [, z [, side [, status]]]]]
[statement1 ... statementn]
CUTEND

CUTPOLY n,
        x1, y1, ..., xn, yn
        [, x, y, z]
[statement1
statement2
...
statementn]
CUTEND
```

```
CUTPOLYA n, status, d,
        x1, y1, mask1, ..., xn, yn, maskn [,
        x, y, z]
[statement1
statement2
...
statementn]
CUTEND
```

```
CUTSHAPE d [, status]
[statement1 statement2 ... statementn]
CUTEND
```

```
CWALL_ left_material, right_material, side_material,
        height, x1, x2, x3, x4, t,
        mask1, mask2, mask3, mask4,
        n,
        x_start1, y_low1, x_end1, y_high1, frame_shown1,
        ...
        x_startn, y_lown, x_endn, y_highn, frame_shownn,
        m,
        a1, b1, c1, d1,
        ...
        am, bm, cm, dm
```

```
CYLIND h, r
```

D

```
DATABASE_SET set_name [, descriptor_name, component_name, unit_name, key_name,
        criteria_name, list_set_name]
```

```
 CALL macro_name_string [,]PARAMETERS
    value1 or DEFAULT [, ..., valuen or DEFAULT]
 CALL macro_name_string [,]PARAMETERS
    value1 or DEFAULT [, ..., valuen or DEFAULT]

DEFINE EMPTY_FILL name [[,] FILLTYPES_MASK fill_types]

DEFINE FILL name [[,] FILLTYPES_MASK fill_types,]
        pattern1, pattern2, pattern3, pattern4,
        pattern5, pattern6, pattern7, pattern8,
        spacing, angle, n,
        frequency1, direction1, offset_x1, offset_y1, m1,
        length11, ..., length1m,
        ...
        frequencyn, directionn, offset_xn,
        lengthn1, ..., lengthnm

DEFINE FILLA name [,] [FILLTYPES_MASK fill_types,]
        pattern1, pattern2, pattern3, pattern4,
        pattern5, pattern6, pattern7, pattern8,
        spacing_x, spacing_y, angle, n,
        frequency1, directional_offset1, direction1,
        offset_x1, offset_y1, m1,
        length11, ..., length1m,
        ...
        frequencyn, directional_offsetn, directionn,
        offset_xn, offset_yn, mn,
        lengthn1, ..., lengthnm

DEFINE IMAGE_FILL name image_name [[,] FILLTYPES_MASK fill_types]
        part1, part2, part3, part4, part5, part6, part7, part8,
        image_vert_size, image_hor_size, image_mask, image_rotangle

DEFINE LINEAR_GRADIENT_FILL name [[,] FILLTYPES_MASK fill_types]

DEFINE LINE_TYPE name spacing, n,
        length1, ..., lengthn
```

```
DEFINE MATERIAL name type,
        surface_red, surface_green, surface_blue
        [, ambient_ce, diffuse_ce, specular_ce, transparent_ce,
         shining, transparency_attenuation
         [, specular_red, specular_green, specular_blue,
          emission_red, emission_green, emission_blue, emission_att]]
        [, fill_index [, fillcolor_index, texture_index]]
```

```
DEFINE MATERIAL name [,] BASED_ON orig_name [,] PARAMETERS name1 = expr1 [, ...]
        [[,] ADDITIONAL_DATA name1 = expr1 [, ...]]
```

```
DEFINE RADIAL_GRADIENT_FILL name [[,] FILLTYPES_MASK fill_types]
```

```
DEFINE SOLID_FILL name [[,] FILLTYPES_MASK fill_types]
```

```
DEFINE STYLE name font_family, size, anchor, face_code
```

```
DEFINE STYLE{2} name font_family, size, face_code
```

```
DEFINE SYMBOL_FILL name [,][FILLTYPES_MASK fill_types,]
        pat1, pat2, pat3, pat4, pat5, pat6, pat7, pat8,
        spacingx1, spacingy1, spacingx2, spacingy2,
        angle, scaling1, scaling2, macro_name [,] PARAMETERS [name1
        = value1, ..., namen = valuen]
```

```
DEFINE SYMBOL_LINE name dash, gap, macro_name PARAMETERS [name1 = value1,
        ...
        namen = valuen]
```

```
DEFINE TEXTURE name expression, x, y, mask, angle
```

```
DEFINE TRANSLUCENT_FILL name [[,] FILLTYPES_MASK fill_types]
        pat1, pat2, pat3, pat4, pat5, pat6, pat7, pat8,
        percentage
```

```
DEL n [, begin_with]
```

```
DEL TOP
```

```
DELETED_PAR_VALUE ("oldparname", outputvalue)
```

```
DESCRIPTOR name [, code, keycode]

DIM var1[dim_1], var2[dim_1][dim_2], var3[ ],
        var4[ ][ ], var5[dim_1][ ],
        var5[ ][dim_2]

DO [statment1
    statement2
    ...
    statementn]
WHILE condition

WHILE condition DO
    [statement1
    statement2
    ...
    statementn]
ENDWHILE

DRAWINDEX number

DRAWING

DRAWING2 [expression]

DRAWING3 projection_code, angle, method

DRAWING3{2} projection_code, angle, method [, backgroundColor,
        fillOrigoX, fillOrigoY, filldirection]

DRAWING3{3} projection_code, angle, method, parts [, backgroundColor,
        fillOrigoX, fillOrigoY, filldirection][[,]
        PARAMETERS name1=value1, ..., namen=valuen]
```

E

```
EDGE vert1, vert2, pgon1, pgon2, status

ELBOW r1, alpha, r2
```

```
ELLIPS h, r

IF condition THEN statement [ELSE statement]

IF condition THEN
    [statement1
    statement2
    ...
    statementn]
[ELSE
    statementn+1
    statementn+2
    ...
    statementn+m]
ENDIF

END [v1, v2, ..., vn]

GROUP "name"
    [statement1 ... statementn]
ENDGROUP

IF condition THEN
    [statement1
    statement2
    ...
    statementn]
[ELSE
    statementn+1
    statementn+2
    ...
    statementn+m]
ENDIF

PARAGRAPH name alignment, firstline_indent,
        left_indent, right_indent, line_spacing [,
        tab_position1, ...]
    [PEN index]
    [[SET] STYLE style1]
    [[SET] MATERIAL index]
    'string1'
    'string2'
    ...
    'string n'
    [PEN index]
    [[SET] STYLE style2]
    [[SET] MATERIAL index]
    'string1'
    'string2'
    ...
    'string n'
    ...
ENDPARAGRAPH
```

```
WHILE condition DO
    [statement1
    statement2
    ...
    statementn]
ENDWHILE
```

```
EXIT [v1, v2, ..., vn]
```

```
EXP (x)
```

```
EXTRUDE n, dx, dy, dz, mask,
        x1, y1, s1,
        ...
        xn, yn, sn
```

```
EXTRUDEDSHELL topMat, bottomMat, sideMat_1, sideMat_2, sideMat_3, sideMat_4,
        defaultMat,
        n, offset, thickness, flipped, trimmingBody,
        x_tb, y_tb, x_te, y_te, topz, tangle,
        x_bb, y_bb, x_be, y_be, bottomz, bangle,
        preThickenTran_11, preThickenTran_12, preThickenTran_13, preThickenTran_14,
        preThickenTran_21, preThickenTran_22, preThickenTran_23, preThickenTran_24,
        preThicakenTran_31, preThickenTran_32, preThickenTran_33, preThickenTran_34,
        x_1, y_1, s_1,
        ...
        x_n, y_n, s_n
EXTRUDEDSHELL{2} topMat, bottomMat, sideMat_1, sideMat_2, sideMat_3, sideMat_4,
        defaultMat,
        n, status, offset, thickness, flipped, trimmingBody,
        x_tb, y_tb, x_te, y_te, topz, tangle,
        x_bb, y_bb, x_be, y_be, bottomz, bangle,
        preThickenTran_11, preThickenTran_12, preThickenTran_13, preThickenTran_14,
        preThickenTran_21, preThickenTran_22, preThickenTran_23, preThickenTran_24,
        preThicakenTran_31, preThickenTran_32, preThickenTran_33, preThickenTran_34,
        x_1, y_1, s_1,
        ...
        x_n, y_n, s_n
EXTRUDEDSHELL{3} topMat, bottomMat, sideMat_1, sideMat_2, sideMat_3, sideMat_4,
        defaultMat,
        n, status, offset, thickness, flipped, trimmingBody,
        x_tb, y_tb, x_te, y_te, topz, tangle,
        x_bb, y_bb, x_be, y_be, bottomz, bangle,
        preThickenTran_11, preThickenTran_12, preThickenTran_13, preThickenTran_14,
        preThickenTran_21, preThickenTran_22, preThickenTran_23, preThickenTran_24,
        preThicakenTran_31, preThickenTran_32, preThickenTran_33, preThickenTran_34,
        x_1, y_1, s_1,
        ...
        x_n, y_n, s_n
```

F

```
FILE_DEPENDENCE "name1" [, "name2", ...]
```

```
[SET] FILL name_string
```

```
[SET] FILL index
```

```
DEFINE FILL name [[,] FILLTYPES_MASK fill_types,]
        pattern1, pattern2, pattern3, pattern4,
        pattern5, pattern6, pattern7, pattern8,
        spacing, angle, n,
        frequency1, direction1, offset_x1, offset_y1, m1,
        length11, ..., length1m,
        ...
        frequencyn, directionn, offset_xn,
        lengthn1, ..., lengthnm
```

```
DEFINE FILLA name [,] [FILLTYPES_MASK fill_types,]
        pattern1, pattern2, pattern3, pattern4,
        pattern5, pattern6, pattern7, pattern8,
        spacing_x, spacing_y, angle, n,
        frequency1, directional_offset1, direction1,
        offset_x1, offset_y1, m1,
        length11, ..., length1m,
        ...
        frequencyn, directional_offsetn, directionn,
        offset_xn, offset_yn, mn,
        lengthn1, ..., lengthnm
```

```
DEFINE SYMBOL_FILL name [,][FILLTYPES_MASK fill_types,]
        pat1, pat2, pat3, pat4, pat5, pat6, pat7, pat8,
        spacingx1, spacingy1, spacingx2, spacingy2,
        angle, scaling1, scaling2, macro_name [,] PARAMETERS [name1
        = value1, ..., namen = valuen]
```

```
DEFINE SOLID_FILL name [[,] FILLTYPES_MASK fill_types]
```

```
DEFINE EMPTY_FILL name [[,] FILLTYPES_MASK fill_types]
```

```
DEFINE LINEAR_GRADIENT_FILL name [[,] FILLTYPES_MASK fill_types]
```

```
DEFINE RADIAL_GRADIENT_FILL name [[,] FILLTYPES_MASK fill_types]
```

```
DEFINE TRANSLUCENT_FILL name [[,] FILLTYPES_MASK fill_types]
        pat1, pat2, pat3, pat4, pat5, pat6, pat7, pat8,
        percentage
```

```
DEFINE IMAGE_FILL name image_name [[,] FILLTYPES_MASK fill_types]
        part1, part2, part3, part4, part5, part6, part7, part8,
        image_vert_size, image_hor_size, image_mask, image_rotangle
```

```
VALUES "fill_parameter_name" [[,] FILLTYPES_MASK fill_types,] value_definition1
   [, value_definition2, ...]
```

```
FOR variable_name = initial_value TO end_value [ STEP step_value ] NEXT variable_name
```

```
FPRISM_ top_material, bottom_material, side_material, hill_material,
        n, thickness, angle, hill_height,
        x1, y1, s1,
        ...
        xn, yn, sn
```

```
FRA (x)
```

```
FRAGMENT2 fragment_index, use_current_attributes_flag
```

```
FRAGMENT2 ALL, use_current_attributes_flag
```

G

```
GET (n)
```

```
IF condition THEN label
IF condition GOTO label
IF condition GOSUB label
```

```
GOSUB label
```

```
IF condition THEN label
IF condition GOTO label
IF condition GOSUB label
```

```
GOTO label
```

```
GROUP "name"
    [statement1 ... statementn]
ENDGROUP
```

H

```
HIDEPARAMETER "name1" [, "name2", ..., "namen"]
```

```
HIDEPARAMETER ALL ["name1" [, "name2", ..., "namen"]]
```

```
HOTARC r, alpha, beta, unID
```

```
HOTARC2 x, y, r, startangle, endangle, unID
```

```
HOTLINE x1, y1, z1, x2, y2, z2, unID
```

```
HOTLINE2 x1, y1, x2, y2, unID
```

```
HOTSPOT x, y, z [, unID [, paramReference [, flags [, displayParam [, customDescription]]]]]
```

```
HOTSPOT2 x, y [, unID [, paramReference [, flags [, displayParam [,
 "customDescription"]]]]]
```

```
HPRISM_ top_mat, bottom_mat, side_mat,
        hill_mat,
        n, thickness, angle, hill_height, status,
        x1, y1, s1,
        ...
        xn, yn, sn
```

I

```
IF condition THEN label
IF condition GOTO label
IF condition GOSUB label
```

```
IF condition THEN label
IF condition GOTO label
IF condition GOSUB label
```

```
IF condition THEN label
IF condition GOTO label
IF condition GOSUB label
```

```
IF condition THEN statement [ELSE statement]
```

```
IF condition THEN
    [statement1
    statement2
    ...
    statementn]
[ELSE
    statementn+1
    statementn+2
    ...
    statementn+m]
ENDIF
```

```
IND (MATERIAL, name_string)
```

```
IND (FILL, name_string)
```

```
IND (LINE_TYPE, name_string)
```

```
IND (STYLE, name_string)
```

```
IND (TEXTURE, name_string)
```

```
INITADDONSCOPE (extension, parameter_string1, parameter_string2)
```

INPUT (channel, recordID, fieldID, variable1 [, variable2, ...])

INT (x)

ISECTGROUP (g_expr1, g_expr2)

ISECTGROUP{2} (g_expr1, g_expr2, edgeColor, materialId, materialColor [, operationStatus])

ISECTGROUP{3} (g_expr1, g_expr2, edgeColor, materialId, materialColor [, operationStatus])

ISECTLINES (g_expr1, g_expr2)

K

KILLGROUP g_expr

L

[LET] varnam = n

LGT (x)

LIBRARYGLOBAL (object_name, parameter, value)

```
LIGHT red, green, blue, shadow,
        radius, alpha, beta, angle_falloff,
        distance1, distance2,
        distance_falloff [[,] ADDITIONAL_DATA name1 = value1,
        name2 = value2, ...]
```

LINE2 x1, y1, x2, y2

LINE_PROPERTY expr

[SET] LINE_TYPE name_string

[SET] LINE_TYPE index

LIN_ x1, y1, z1, x2, y2, z2

LOCK "name1" [, "name2", ..., "namen"]

```
LOCK ALL ["name1" [, "name2", ..., "namen"]]
```

```
LOG (x)
```

M

```
MASS top_material, bottom_material, side_material,
        n, m, mask, h,
        x1, y1, z1, s1,
        ...
        xn, yn, zn, sn,
        xn+1, yn+1, zn+1, sn+1,
        ...
        xn+m, yn+m, zn+m, sn+m
```

```
MASS{2} top_material, bottom_material, side_material,
          n, m, mask, h,
          x1, y1, z1, s1,
          ...
          xn, yn, zn, sn,
          xn+1, yn+1, zn+1, sn+1,
          ...
          xn+m, yn+m, zn+m, sn+m
```

```
[SET] MATERIAL name_string
```

```
[SET] MATERIAL index
```

```
MAX (x1, x2, ..., xn)
```

```
MESH a, b, m, n, mask,
        z11, z12, ..., z1m,
        z21, z22, ..., z2m,
        ...
        zn1, zn2, ..., znm
```

```
MIN (x1, x2, ..., xn)
```

```
MODEL WIRE

MODEL SURFACE

MODEL SOLID

MUL mx, my, mz

MUL2 x, y

MULX mx

MULY my

MULZ mz
```

N

```
NEWPARAMETER "name", "type" [, dim1 [, dim2]]

FOR variable_name = initial_value TO end_value [ STEP step_value ] NEXT variable_name

NOT (x)

NSP

NTR ()

NURBSBODY shadowStatus, smoothnessMin, smoothnessMax

NURBSCURVE2D degree, nControlPoints,
        knot_1, knot_2, ..., knot_m,
        cPoint_1_x, cPoint_1_y, weight_1,
        cPoint_2_x, cPoint_2_y, weight_2,
        ...,
        cPoint_n_x, cPoint_n_y, weight_n

NURBSCURVE3D degree, nControlPoints,
        knot_1, knot_2, ..., knot_m,
        cPoint_1_x, cPoint_1_y, cPoint_1_z, weight_1,
        cPoint_2_x, cPoint_2_y, cPoint_2_z, weight_2,
        ...,
        cPoint_n_x, cPoint_n_y, cPoint_n_z, weight_n
```

```
NURBSEDGE vert1, vert2, curve, curveDomainBeg, curveDomainEnd, status, tolerance
```

```
NURBSFACE n, surface, tolerance,
        trim1, trim2, ..., trimn
```

```
NURBSLUMP n, face1, face2, ..., facen
```

```
NURBSSURFACE degree_u, degree_v, nu, nv,
       knot_u_1, knot_u_2, ..., knot_u_mu,
       knot_v_1, knot_v_2, ..., knot_v_mv,
       cPoint_1_1_x, cPoint_1_1_y, cPoint_1_1_z, weight_1_1,
       cPoint_1_2_x, cPoint_1_2_y, cPoint_1_2_z, weight_1_2,
       ...,
       cPoint_1_nv_x, cPoint_1_nv_y, cPoint_1_nv_z, weight_1_nv,
       cPoint_2_1_x, cPoint_2_1_y, cPoint_2_1_z, weight_2_1,
       ...,
       cPoint_nu_nv_x, cPoint_nu_nv_y, cPoint_nu_nv_z, weight_nu_nv
```

```
NURBSTRIM edge, curve, curveDomainBeg, curveDomainEnd, tolerance
```

```
NURBSTRIMSINGULAR vertex, curve, curveDomainBeg, curveDomainEnd, tolerance
```

```
NURBSVERT x, y, z, hard, tolerance
```

O

```
OPEN (filter, filename, parameter_string)
```

```
OUTPUT channel, recordID, fieldID, expression1 [, expression2, ...]
```

P

```
PARAGRAPH name alignment, firstline_indent,
        left_indent, right_indent, line_spacing [,
        tab_position1, ...]
```

```
    [PEN index]
    [[SET] STYLE style1]
    [[SET] MATERIAL index]
    'string1'
    'string2'
    ...
    'string n'
    [PEN index]
    [[SET] STYLE style2]
    [[SET] MATERIAL index]
    'string1'
    'string2'
    ...
    'string n'
    ...
ENDPARAGRAPH

PARAMETERS name1 = expression1 [,
        name2 = expression2, ...,
        namen = expressionn]

CALL macro_name_string [,]
    PARAMETERS [ALL][name1=value1, ..., namen=valuen][[,]
    RETURNED_PARAMETERS r1, r2, ...]

 CALL macro_name_string [,]PARAMETERS
    value1 or DEFAULT [, ..., valuen or DEFAULT]

 PARVALUE_DESCRIPTION (parname [, ind1 [, ind2]])

PEN n

PGON n, vect, status, edge1, edge2, ..., edgen

PGON{2} n, vect, status, wrap, edge_or_wrap1, ..., edge_or_wrapn
```

```
PGON{3} n, vect, status, wrap_method, wrap_flags, edge_or_wrap1, ..., edge_or_wrapn

PI

PICTURE expression, a, b, mask

PICTURE2 expression, a, b, mask

PICTURE2{2} expression, a, b, mask

PIPG expression, a, b, mask, n, vect, status,
     edge1, edge2, ..., edgen

PLACEGROUP g_expr

PLANE n, x1, y1, z1, ..., xn, yn, zn

PLANE_ n, x1, y1, z1, s1, ..., xn, yn, zn, sn

POINTCLOUD "data_file_name"

POLY n, x1, y1, ..., xn, yn

POLY2 n, frame_fill, x1, y1, ..., xn, yn

POLY2_ n, frame_fill, x1, y1, s1, ..., xn, yn, sn

POLY2_A n, frame_fill, fill_pen,
        x1, y1, s1, ..., xn, yn, sn

POLY2_B n, frame_fill,
        fill_pen, fill_background_pen,
        x1, y1, s1, ..., xn, yn, sn

POLY2_B{2} n, frame_fill,
        fill_pen, fill_background_pen,
        fillOrigoX, fillOrigoY, fillAngle,
        x1, y1, s1, ..., xn, yn, sn

POLY2_B{3} n, frame_fill,
        fill_pen, fill_background_pen,
        fillOrigoX, fillOrigoY,
        mxx, mxy, myx, myy, x1, y1, s1, ..., xn, yn, sn
POLY2_B{4} n, frame_fill,
        fill_pen, fill_background_pen,
        fillOrigoX, fillOrigoY,
        mxx, mxy, myx, myy,
        gradientInnerRadius,
        x1, y1, s1, ..., xn, yn, sn
POLY2_B{5} n, frame_fill, fillcategory, distortion_flags,
        fill_pen, fill_background_pen,
        fillOrigoX, fillOrigoY,
        mxx, mxy, myx, myy,
        gradientInnerRadius,
        x1, y1, s1, ..., xn, yn, sn
POLYROOF defaultMat, k, m, n,
        offset, thickness, applyContourInsidePivot,
        z_1, ..., z_k,
        pivotX_1, pivotY_1, pivotMask_1,
        roofAngle_11, gableOverhang_11, topMat_11, bottomMat_11,
        ...
        roofAngle_1k, gableOverhang_1k, topMat_1k, bottomMat_1k,
        ...
        pivotX_m, pivotY_m, pivotMask_m,
        roofAngle_m1, gableOverhang_m1, topMat_m1, bottomMat_m1,
        ...
        roofAngle_mk, gableOverhang_mk, topMat_mk, bottomMat_mk,
        contourX_1, contourY_1, contourMask_1, edgeTrim_1, edgeAngle_1, edgeMat_1,
        ...
        contourX_n, contourY_n, contourMask_n, edgeTrim_n, edgeAngle_n, edgeMat_n
POLYROOF{2} defaultMat, k, m, n,
        offset, thickness, totalThickness, applyContourInsidePivot,
        z_1, ..., z_k,
        pivotX_1, pivotY_1, pivotMask_1,
        roofAngle_11, gableOverhang_11, topMat_11, bottomMat_11,
        ...
        roofAngle_1k, gableOverhang_1k, topMat_1k, bottomMat_1k,
        ...
        pivotX_m, pivotY_m, pivotMask_m,
        roofAngle_m1, gableOverhang_m1, topMat_m1, bottomMat_m1,
        ...
        roofAngle_mk, gableOverhang_mk, topMat_mk, bottomMat_mk,
        contourX_1, contourY_1, contourMask_1, edgeTrim_1, edgeAngle_1, edgeMat_1,
        ...
        contourX_n, contourY_n, contourMask_n, edgeTrim_n, edgeAngle_n, edgeMat_n
POLYROOF{3} defaultMat, mask, k, m, n,
         offset, thickness, totalThickness, applyContourInsidePivot,
         z_1, ..., z_k,
         pivotX_1, pivotY_1, pivotMask_1,
         roofAngle_11, gableOverhang_11, topMat_11, bottomMat_11,
         ...
         roofAngle_1k, gableOverhang_1k, topMat_1k, bottomMat_1k,
         ...
         pivotX_m, pivotY_m, pivotMask_m,
         roofAngle_m1, gableOverhang_m1, topMat_m1, bottomMat_m1,
         ...
         roofAngle_mk, gableOverhang_mk, topMat_mk, bottomMat_mk,
         contourX_1, contourY_1, contourMask_1, edgeTrim_1, edgeAngle_1, edgeMat_1,
         ...
         contourX_n, contourY_n, contourMask_n, edgeTrim_n, edgeAngle_n, edgeMat_n
POLYROOF{4} defaultMat, mask, k, m, n,
         offset, thickness, totalThickness, applyContourInsidePivot,
         z_1, ..., z_k,
         pivotX_1, pivotY_1, pivotMask_1,
         roofAngle_11, gableOverhang_11, topMat_11, bottomMat_11,
         ...
         roofAngle_1k, gableOverhang_1k, topMat_1k, bottomMat_1k,
         ...
         pivotX_m, pivotY_m, pivotMask_m,
         roofAngle_m1, gableOverhang_m1, topMat_m1, bottomMat_m1,
         ...
         roofAngle_mk, gableOverhang_mk, topMat_mk, bottomMat_mk,
         contourX_1, contourY_1, contourMask_1, edgeTrim_1, edgeAngle_1, edgeMat_1,
         ...
         contourX_n, contourY_n, contourMask_n, edgeTrim_n, edgeAngle_n, edgeMat_n
```

```
POLY_ n, x1, y1, s1, ..., xn, yn, sn
```

```
POSITION position_keyword
```

```
PREPAREFUNCTION channel, function_name, expression1 [, expression2, ...]
```

```
PRINT expression [, expression, ...]
```

```
PRISM n, h, x1, y1, ..., xn, yn
```

```
PRISM_ n, h, x1, y1, s1, ..., xn, yn, sn
```

```
PROJECT2 projection_code, angle, method
```

```
PROJECT2{2} projection_code, angle, method [, backgroundColor,
        fillOrigoX, fillOrigoY, filldirection]
```

```
PROJECT2{3} projection_code, angle, method, parts [, backgroundColor,
        fillOrigoX, fillOrigoY, filldirection][[,]
        PARAMETERS name1=value1, ..., namen=valuen]
```

```
PROJECT2{4} projection_code, angle,
       useTransparency, statusParts,
       numCutplanes,
       cutplaneHeight1, ..., cutplaneHeightn,

       method1, parts1,
        cutFillIndex1,
        cutFillFgPen1, cutFillBgPen1,
        cutFillOrigoX1, cutFillOrigoY1, cutFillDirection1,
        cutLinePen1, cutLineType1,
        projectedFillIndex1,
        projectedFillFgPen1, projectedFillBgPen1,
        projectedFillOrigoX1, projectedFillOrigoY1,
        projectedFillDirection1,
        projectedLinePen1, projectedLineType1,
        ...
        method(numCutplanes+1)), parts(numCutplanes+1),
        cutFillIndex(numCutplanes+1),
        cutFillFgPen(numCutplanes+1), cutFillBgPen(numCutplanes+1),
        cutFillOrigoX(numCutplanes+1), cutFillOrigoY(numCutplanes+1),
        cutFillDirection(numCutplanes+1),
        cutLinePen(numCutplanes+1), cutLineType(numCutplanes+1),
        projectedFillIndex(numCutplanes+1),
        projectedFillFgPen(numCutplanes+1), projectedFillBgPen(numCutplanes+1),
        projectedFillOrigoX(numCutplanes+1), projectedFillOrigoY(numCutplanes+1),
        projectedFillDirection(numCutplanes+1),
        projectedLinePen(numCutplanes+1), projectedLineType(numCutplanes+1)
```

`PUT expression [, expression, ...]`

`PYRAMID n, h, mask, x1, y1, s1, ..., xn, yn, sn`

R

`RADIUS radius_min, radius_max`

`RECT a, b`

`RECT2 x1, y1, x2, y2`

`REF COMPONENT code [, keycode [, numeric_expression]]`

```
REF DESCRIPTOR code [, keycode]
```

```
REPEAT [statement1
    statement2
    ...
    statementn]
UNTIL condition
```

```
REQ (parameter_string)
```

```
REQUEST (question_name, name | index, variable1 [, variable2, ...])
```

```
RESOL n
```

```
RETURN
```

```
CALL macro_name_string [,]
    PARAMETERS [ALL][name1=value1, ..., namen=valuen][[,]
    RETURNED_PARAMETERS r1, r2, ...]
```

```
REVOLVE n, alpha, mask, x1, y1, s1, ..., xn, yn, sn
```

```
REVOLVEDSHELL topMat, bottomMat, sideMat_1, sideMat_2, sideMat_3, sideMat_4,
        defaultMat,
        n, offset, thickness, flipped, trimmingBody, alphaOffset, alpha,
        preThickenTran_11, preThickenTran_12, preThickenTran_13, preThickenTran_14,
        preThickenTran_21, preThickenTran_22, preThickenTran_23, preThickenTran_24,
        preThickenTran_31, preThickenTran_32, preThickenTran_33, preThickenTran_34,
        x_1, y_1, s_1,
        ...
        x_n, y_n, s_n
```

```
REVOLVEDSHELLANGULAR topMat, bottomMat,
        sideMat_1, sideMat_2, sideMat_3, sideMat_4, defaultMat,
        n, offset, thickness, flipped, trimmingBody, alphaOffset, alpha,
        segmentationType, nOfSegments,
        preThickenTran_11, preThickenTran_12, preThickenTran_13,
        preThickenTran_14,
        preThickenTran_21, preThickenTran_22, preThickenTran_23,
        preThickenTran_24,
        preThickenTran_31, preThickenTran_32, preThickenTran_33,
        preThickenTran_34,
        x_1, y_1, s_1,
        ...
        x_n, y_n, s_n
REVOLVEDSHELLANGULAR{2} topMat, bottomMat,
        sideMat_1, sideMat_2, sideMat_3, sideMat_4, defaultMat,
        n, status, offset, thickness, flipped, trimmingBody, alphaOffset, alpha,
        segmentationType, nOfSegments,
        preThickenTran_11, preThickenTran_12, preThickenTran_13,
        preThickenTran_14,
        preThickenTran_21, preThickenTran_22, preThickenTran_23,
        preThickenTran_24,
        preThickenTran_31, preThickenTran_32, preThickenTran_33,
        preThickenTran_34,
        x_1, y_1, s_1,
        ...
        x_n, y_n, s_n
REVOLVEDSHELLANGULAR{3} topMat, bottomMat,
        sideMat_1, sideMat_2, sideMat_3, sideMat_4, defaultMat,
        n, status, offset, thickness, flipped, trimmingBody, alphaOffset, alpha,
        segmentationType, nOfSegments,
        preThickenTran_11, preThickenTran_12, preThickenTran_13,
        preThickenTran_14,
        preThickenTran_21, preThickenTran_22, preThickenTran_23,
        preThickenTran_24,
        preThickenTran_31, preThickenTran_32, preThickenTran_33,
        preThickenTran_34,
        x_1, y_1, s_1,
        ...
        x_n, y_n, s_n
REVOLVEDSHELL{2} topMat, bottomMat, sideMat_1, sideMat_2, sideMat_3, sideMat_4,
        defaultMat,
        n, status, offset, thickness, flipped, trimmingBody, alphaOffset, alpha,
        preThickenTran_11, preThickenTran_12, preThickenTran_13, preThickenTran_14,
        preThickenTran_21, preThickenTran_22, preThickenTran_23, preThickenTran_24,
        preThickenTran_31, preThickenTran_32, preThickenTran_33, preThickenTran_34,
        x_1, y_1, s_1,
        ...
        x_n, y_n, s_n
REVOLVEDSHELL{3} topMat, bottomMat, sideMat_1, sideMat_2, sideMat_3, sideMat_4,
        defaultMat,
        n, status, offset, thickness, flipped, trimmingBody, alphaOffset, alpha,
        preThickenTran_11, preThickenTran_12, preThickenTran_13, preThickenTran_14,
        preThickenTran_21, preThickenTran_22, preThickenTran_23, preThickenTran_24,
        preThickenTran_31, preThickenTran_32, preThickenTran_33, preThickenTran_34,
        x_1, y_1, s_1,
        ...
        x_n, y_n, s_n
REVOLVE{2} n, alphaOffset, alpha, mask, sideMat,
        x1, y1, s1, mat1, ..., xn, yn, sn, matn
REVOLVE{3} n, alphaOffset, alpha, betaOffset, beta, mask, sideMat,
        x1, y1, s1, mat1, ..., xn, yn, sn, matn
REVOLVE{4} n, alphaOffset, alpha, betaOffset, beta, mask, sideMat,
        x1, y1, s1, mat1, ..., xn, yn, sn, matn
REVOLVE{5}n, alphaOffset, alpha, betaOffset, beta, mask, sideMat,
        x1, y1, s1, mat1, ..., xn, yn, sn, matn
RICHTEXT x, y,
        height, 0, textblock_name
```

```
RICHTEXT2 x, y, textblock_name

RND (x)

ROT x, y, z, alpha

ROT2 alpha

ROTX alphax

ROTY alphay

ROTZ alphaz

ROUND_INT (x)

RULED n, mask,
        u1, v1, s1, ..., un, vn, sn,
        x1, y1, z1, ..., xn, yn, zn

RULEDSHELL topMat, bottomMat,
        sideMat_1, sideMat_2, sideMat_3, sideMat_4, defaultMat,
        n, m, g,
        offset, thickness, flipped, trimmingBody,
        preThickenTran_11, preThickenTran_12, preThickenTran_13, preThickenTran_14,
        preThickenTran_21, preThickenTran_22, preThickenTran_23, preThickenTran_24,
        preThickenTran_31, preThickenTran_32, preThickenTran_33, preThickenTran_34,
        firstpolyX_1, firstpolyY_1, firstpolyS_1,
        ...
        firstpolyX_n, firstpolyY_n, firstpolyS_n,
        secondpolyX_1, secondpolyY_1, secondpolyS_1,
        ...
        secondpolyX_m, secondpolyY_m, secondpolyS_m,
        profile2Tran_11, profile2Tran_12, profile2Tran_13, profile2Tran_14
        profile2Tran_21, profile2Tran_22, profile2Tran_23, profile2Tran_24
        profile2Tran_31, profile2Tran_32, profile2Tran_33, profile2Tran 34
        generatrixFirstIndex_1, generatrixSecondIndex_1,
        ...
        generatrixFirstIndex_g, generatrixSecondIndex_g

RULEDSHELL{2} topMat, bottomMat,
        sideMat_1, sideMat_2, sideMat_3, sideMat_4, defaultMat,
        n, m, g, status,
        offset, thickness, flipped, trimmingBody,
        preThickenTran_11, preThickenTran_12, preThickenTran_13, preThickenTran_14,
        preThickenTran_21, preThickenTran_22, preThickenTran_23, preThickenTran_24,
        preThickenTran_31, preThickenTran_32, preThickenTran_33, preThickenTran_34,
        firstpolyX_1, firstpolyY_1, firstpolyS_1,
        ...
        firstpolyX_n, firstpolyY_n, firstpolyS_n,
        secondpolyX_1, secondpolyY_1, secondpolyS_1,
        ...
        secondpolyX_m, secondpolyY_m, secondpolyS_m,
        profile2Tran_11, profile2Tran_12, profile2Tran_13, profile2Tran_14
        profile2Tran_21, profile2Tran_22, profile2Tran_23, profile2Tran_24
        profile2Tran_31, profile2Tran_32, profile2Tran_33, profile2Tran 34
        generatrixFirstIndex_1, generatrixSecondIndex_1,
        ...
        generatrixFirstIndex_g, generatrixSecondIndex_g

RULEDSHELL{3} topMat, bottomMat,
        sideMat_1, sideMat_2, sideMat_3, sideMat_4, defaultMat,
        n, m, g, status,
        offset, thickness, flipped, trimmingBody,
        preThickenTran_11, preThickenTran_12, preThickenTran_13, preThickenTran_14,
        preThickenTran_21, preThickenTran_22, preThickenTran_23, preThickenTran_24,
        preThickenTran_31, preThickenTran_32, preThickenTran_33, preThickenTran_34,
        firstpolyX_1, firstpolyY_1, firstpolyS_1,
        ...
        firstpolyX_n, firstpolyY_n, firstpolyS_n,
        secondpolyX_1, secondpolyY_1, secondpolyS_1,
        ...
        secondpolyX_m, secondpolyY_m, secondpolyS_m,
        profile2Tran_11, profile2Tran_12, profile2Tran_13, profile2Tran_14
        profile2Tran_21, profile2Tran_22, profile2Tran_23, profile2Tran_24
        profile2Tran_31, profile2Tran_32, profile2Tran_33, profile2Tran 34
        generatrixFirstIndex_1, generatrixSecondIndex_1,
        ...
        generatrixFirstIndex_g, generatrixSecondIndex_g
```

```
RULED{2} n, mask,
        u1, v1, s1, ..., un, vn, sn,
        x1, y1, z1, ..., xn, yn, zn
```

S

```
SECT_ATTRS fill, fill_background_pen,
        fill_pen, contour_pen [, line_type]
```

```
SECT_FILL fill, fill_background_pen,
        fill_pen, contour_pen
```

```
[SET] STYLE name_string
```

```
[SET] STYLE index
```

```
[SET] MATERIAL name_string
```

```
[SET] MATERIAL index
```

```
[SET] FILL name_string
```

```
[SET] FILL index
```

```
[SET] LINE_TYPE name_string
```

```
[SET] LINE_TYPE index
```

```
SETMIGRATIONGUID guid
```

```
SGN (x)
```

```
SHADOW casting [, catching]
```

```
SIN (x)

SLAB n, h, x1, y1, z1, ..., xn, yn, zn

SLAB_ n, h, x1, y1, z1, s1, ..., xn, yn, zn, sn

MODEL SOLID

SPHERE r

SPLINE2 n, status, x1, y1,
        angle1, ..., xn, yn, anglen

SPLINE2A n, status, x1, y1, angle1, length_previous1, length_next1,
        ...
        xn, yn, anglen, length_previousn,
        length_nextn

SPLIT (string, format, variable1 [, variable2, ..., variablen])

SPRISM_ top_material, bottom_material, side_material,
        n, xb, yb, xe, ye, h, angle,
        x1, y1, s1,
        ...
        xn, yn, sn

SPRISM_{2} top_material, bottom_material, side_material,
        n,
        xtb, ytb, xte, yte, topz, tangle,
        xbb, ybb, xbe, ybe, bottomz, bangle,
        x1, y1, s1, mat1,
        ...
        xn, yn, sn, matn

SPRISM_{3} top_material, bottom_material, side_material, mask,
        n,
        xtb, ytb, xte, yte, topz, tangle,
        xbb, ybb, xbe, ybe, bottomz, bangle,
        x1, y1, s1, mat1,
        ...
        xn, yn, sn, matn
SPRISM_{4} top_material, bottom_material, side_material, mask,
        n,
        xtb, ytb, xte, yte, topz, tangle,
        xbb, ybb, xbe, ybe, bottomz, bangle,
        x1, y1, s1, mat1,
        ...
        xn, yn, sn, matn
SQR (x)
FOR variable_name = initial_value TO end_value [ STEP step_value ] NEXT variable_name
STORED_PAR_VALUE ("oldparname", outputvalue)
STR (numeric_expression, length, fractions)
STR (format_string, numeric_expression)
STRLEN (string_expression)
STRSTR (string_expression1, string_expression2[, case_insensitivity])
STRSUB (string_expression, start_position, characters_number)
STRTOLOWER (string_expression)
STRTOUPPER (string_expression)
STR{2} (format_string, numeric_expression [, extra_accuracy_string])
STW (string_expression)
[SET] STYLE name_string
[SET] STYLE index
SUBGROUP (g_expr1, g_expr2)
```

```
SUBGROUP{2} (g_expr1, g_expr2, edgeColor, materialId, materialColor [, operationStatus])
```

```
SUBGROUP{3} (g_expr1, g_expr2, edgeColor, materialId, materialColor [, operationStatus])
```

```
MODEL SURFACE
```

```
SURFACE3D ()
```

```
SWEEP n, m, alpha, scale, mask,
        u1, v1, s1, ..., un, vn, sn,
        x1, y1, z1, ..., xm, ym, zm
```

```
SWEEPGROUP (g_expr, x, y, z)
```

```
SWEEPGROUP{2} (g_expr, x, y, z)
```

```
SWEEPGROUP{3} (g_expr, x, y, z, edgeColor, materialId, materialColor, method)
```

```
SWEEPGROUP{4} (g_expr, x, y, z, edgeColor, materialId, materialColor, method, status)
```

T

```
TAN (x)
```

```
TEVE x, y, z, u, v
```

```
TEXT d, 0, expression
```

```
TEXT2 x, y, expression
```

```
TEXTBLOCK name width, anchor, angle, width_factor, charspace_factor, fixed_height,
        'string_expr1' [, 'string_expr2', ...]
```

```
TEXTBLOCK_ name width, anchor, angle, width_factor, charspace_factor, fixed_height, n,
        'expr_1' [, 'expr_2', ..., 'expr_n']
```

```
IF condition THEN label
IF condition GOTO label
IF condition GOSUB label
```

```
IF condition THEN statement [ELSE statement]
IF condition THEN
    [statement1
    statement2
    ...
    statementn]
[ELSE
    statementn+1
    statementn+2
    ...
    statementn+m]
ENDIF
```

```
FOR variable_name = initial_value TO end_value [ STEP step_value ] NEXT variable_name
```

```
TOLER d
```

```
DEL TOP
```

```
TUBE n, m, mask,
        u1, w1, s1,
        ...
        un, wn, sn,
        x1, y1, z1, angle1,
        ...
        xm, ym, zm, anglem
```

```
TUBEA n, m, mask,
        u1, w1, s1,
        ...
        un, wn, sn,
        x1, y1, z1,
        ...
        xm, ym, zm
```

U

```
UI_BUTTON type, text, x, y [, width, height, id [, url]]

UI_BUTTON type, text, x, y, width, height [, id [, url]] [ UI_TOOLTIP tooltiptext ]

UI_COLORPICKER "redParamName", "greenParamName", "blueParamName", x0, y0 [, width [,
 height]]

UI_COLORPICKER{2} redParamName, greenParamName, blueParamName, x0, y0 [, width [, height]]

UI_CURRENT_PAGE index

UI_CUSTOM_POPUP_INFIELD "name", x, y, width, height,
        storeHiddenId, treeDepth,
        groupingMethod, selectedValDescription,
        value1, value2, valuesArray1, .... valuen, valuesArrayn


UI_CUSTOM_POPUP_INFIELD "name", x, y, width, height , extra parameters ...
        [ UI_TOOLTIP tooltiptext ]

UI_CUSTOM_POPUP_INFIELD{2} name, x, y, width, height,
        storeHiddenId, treeDepth,
        groupingMethod, selectedValDescription,
        value1, value2, valuesArray1, .... valuen, valuesArrayn


UI_CUSTOM_POPUP_INFIELD{2} name, x, y, width, height , extra parameters ...
        [ UI_TOOLTIP tooltiptext ]

     UI_CUSTOM_POPUP_LISTITEM itemID, fieldID, "name", childFlag, image, paramDesc,
     storeHiddenId, treeDepth,
     groupingMethod, selectedValDescription,
     value1, value2, valuesArray1, .... valuen, valuesArrayn


UI_CUSTOM_POPUP_LISTITEM itemID, fieldID, "name", childFlag , image , paramDesc,
        extra parameters ...
        [ UI_TOOLTIP tooltiptext ]
     UI_CUSTOM_POPUP_LISTITEM{2} itemID, fieldID, name, childFlag, image, paramDesc,
     storeHiddenId, treeDepth,
     groupingMethod, selectedValDescription,
     value1, value2, valuesArray1, .... valuen, valuesArrayn

UI_CUSTOM_POPUP_LISTITEM{2} itemID, fieldID, name, childFlag , image , paramDesc,
        extra parameters ...
        [ UI_TOOLTIP tooltiptext ]
UI_DIALOG title [, size_x, size_y]
UI_GROUPBOX text, x, y, width, height
UI_INFIELD "name", x, y, width, height [,
        method, picture_name,
        images_number,
        rows_number, cell_x, cell_y,
        image_x, image_y,
        expression_image1, text1,
        ...
        expression_imagen, textn]
UI_INFIELD "name", x, y, width, height [, extra parameters ... ]
        [ UI_TOOLTIP tooltiptext ]
UI_INFIELD{2} name, x, y, width, height [,
        method, picture_name,
        images_number,
        rows_number, cell_x, cell_y,
        image_x, image_y,
        expression_image1, text1,
        ...
        expression_imagen, textn]
```

```
UI_INFIELD{2} name, x, y, width, height [, extra parameters ... ]
        [ UI_TOOLTIP tooltiptext ]
UI_INFIELD{3} name, x, y, width, height [,
        method, picture_name,
        images_number,
        rows_number, cell_x, cell_y,
        image_x, image_y,
        expression_image1, text1, value_definition1,
        ...
        [picIdxArray, textArray, valuesArray,
        ...]
        expression_imagen, textn, value_definitionn]
UI_INFIELD{3} name, x, y, width, height [, extra parameters ... ]
        [ UI_TOOLTIP tooltiptext ]
UI_INFIELD{4} "name", x, y, width, height [,
        method, picture_name,
        images_number,
        rows_number, cell_x, cell_y,
        image_x, image_y,
        expression_image1, text1, value_definition1,
        ...
        [picIdxArray, textArray, valuesArray,
        ...]
        expression_imagen, textn, value_definitionn]
UI_INFIELD{4} "name", x, y, width, height [, extra parameters ... ]
        [ UI_TOOLTIP tooltiptext ]
UI_LISTFIELD fieldID, x, y, width, height [, iconFlag [, description_header [,
 value_header]]]
UI_LISTFIELD fieldID, x, y, width, height [, iconFlag [, description_header [,
 value_header]]]
```

```
        [ UI_TOOLTIP tooltiptext ]
UI_LISTITEM itemID, fieldID, "name" [, childFlag [, image [, paramDesc]]]
UI_LISTITEM itemID, fieldID, "name" [, childFlag [, image [, paramDesc]]]
        [ UI_TOOLTIP tooltiptext ]
UI_LISTITEM{2} itemID, fieldID, name [, childFlag [, image [, paramDesc]]]
UI_LISTITEM{2} itemID, fieldID, name [, childFlag [, image [, paramDesc]]]
        [ UI_TOOLTIP tooltiptext ]
UI_OUTFIELD expression, x, y [, width, height [, flags]]
UI_OUTFIELD expression, x, y, width, height [, flags] [ UI_TOOLTIP tooltiptext ]
UI_PAGE page_number [, parent_id, page_title [, image]]
UI_PICT picture_reference, x, y [, width, height [, mask]]
UI_PICT expression, x, y [, width, height [, mask]] [ UI_TOOLTIP tooltiptext ]
UI_PICT_BUTTON type, text, picture_reference,
        x, y, width, height [, id [, url]]
UI_PICT_BUTTON type, text, picture_reference,
        x, y, width, height [, id [, url]] [ UI_TOOLTIP tooltiptext ]
UI_RADIOBUTTON name, value, text, x, y, width, height
UI_RADIOBUTTON name, value, text, x, y, width, height [ UI_TOOLTIP tooltiptext ]
UI_RADIOBUTTON{2} "name", value, text, x, y, width, height
UI_SEPARATOR x1, y1, x2, y2
UI_SLIDER "name", x0, y0, width, height [, nSegments [, sliderStyle]]
UI_SLIDER{2} name, x0, y0, width, height [, nSegments [, sliderStyle]]
UI_STYLE fontsize, face_code
UI_BUTTON type, text, x, y, width, height [, id [, url]] [ UI_TOOLTIP tooltiptext ]
```

```
UI_PICT_BUTTON type, text, picture_reference,
        x, y, width, height [, id [, url]] [ UI_TOOLTIP tooltiptext ]
UI_INFIELD "name", x, y, width, height [, extra parameters ... ]
        [ UI_TOOLTIP tooltiptext ]
UI_INFIELD{2} name, x, y, width, height [, extra parameters ... ]
        [ UI_TOOLTIP tooltiptext ]
UI_INFIELD{3} name, x, y, width, height [, extra parameters ... ]
        [ UI_TOOLTIP tooltiptext ]
UI_INFIELD{4} "name", x, y, width, height [, extra parameters ... ]
        [ UI_TOOLTIP tooltiptext ]
UI_CUSTOM_POPUP_INFIELD "name", x, y, width, height , extra parameters ...
        [ UI_TOOLTIP tooltiptext ]
UI_CUSTOM_POPUP_INFIELD{2} name, x, y, width, height , extra parameters ...
        [ UI_TOOLTIP tooltiptext ]
UI_RADIOBUTTON name, value, text, x, y, width, height [ UI_TOOLTIP tooltiptext ]
UI_OUTFIELD expression, x, y, width, height [, flags] [ UI_TOOLTIP tooltiptext ]
UI_PICT expression, x, y [, width, height [, mask]] [ UI_TOOLTIP tooltiptext ]
UI_LISTFIELD  fieldID,  x,  y,  width,  height  [,  iconFlag  [,  description_header  [,
 value_header]]]
        [ UI_TOOLTIP tooltiptext ]
UI_LISTITEM itemID, fieldID, "name" [, childFlag [, image [, paramDesc]]]
        [ UI_TOOLTIP tooltiptext ]
UI_LISTITEM{2} itemID, fieldID, name [, childFlag [, image [, paramDesc]]]
        [ UI_TOOLTIP tooltiptext ]
UI_CUSTOM_POPUP_LISTITEM itemID, fieldID, "name", childFlag , image , paramDesc,
        extra parameters ...
        [ UI_TOOLTIP tooltiptext ]
```

```
UI_CUSTOM_POPUP_LISTITEM{2} itemID, fieldID, name, childFlag , image , paramDesc,
        extra parameters ...
        [ UI_TOOLTIP tooltiptext ]
```

```
REPEAT [statement1
    statement2
    ...
    statementn]
UNTIL condition
```

```
USE (n)
```

V

```
VALUES "parameter_name" [,]value_definition1 [, value_definition2, ...]
```

```
VALUES "fill_parameter_name" [[,] FILLTYPES_MASK fill_types,] value_definition1
   [, value_definition2, ...]
```

```
VALUES{2} "parameter_name" [,]num_expression1, description1,
   [, num_expression2, description2, ...]
```

```
VALUES{2} "parameter_name" [,]num_values_array1, descriptions_array1
   [, num_values_array2, descriptions_array2, ...]
```

```
VARDIM1 (expr)
```

```
VARDIM2 (expr)
```

```
VARTYPE (expression)
```

```
VECT x, y, z
```

```
VERT x, y, z
```

```
VERT x, y, z, hard
```

```
VOLUME3D ()
```

W

```
WALLARC2 x, y, r, alpha, beta

WALLBLOCK2 n, fill_control, fill_pen, fill_background_pen,
        fillOrigoX, fillOrigoY, fillAngle,
        x1, y1, s1,
        ...
        xn, yn, sn

WALLBLOCK2{2} n, frame_fill, fillcategory, distortion_flags,
        fill_pen, fill_background_pen,
        fillOrigoX, fillOrigoY,
        mxx, mxy, myx, myy,
        innerRadius,
        x1, y1, s1,
        ...
        xn, yn, sn

WALLHOLE n, status,
        x1, y1, mask1,
        ...
        xn, yn, maskn
        [, x, y, z]

WALLHOLE2 n, fill_control, fill_pen, fill_background_pen,
        fillOrigoX, fillOrigoY, fillAngle,
        x1, y1, s1,
        ...
        xn, yn, sn

WALLHOLE2{2} n, frame_fill, fillcategory, distortion_flags,
        fill_pen, fill_background_pen,
        fillOrigoX, fillOrigoY,
        mxx, mxy, myx, myy,
        innerRadius,
        x1, y1, s1,
        ...
        xn, yn, sn
```

```
WALLLINE2 x1, y1, x2, y2
```

```
WALLNICHE n, method, status,
        rx, ry, rz, d,
        x1, y1, mask1, [mat1,]
        ...
        xn, yn, maskn[, matn]
```

```
DO [statment1
    statement2
    ...
    statementn]
WHILE condition
```

```
WHILE condition DO
    [statement1
    statement2
    ...
    statementn]
ENDWHILE
```

```
MODEL WIRE
```

X

```
XFORM a11, a12, a13, a14,
      a21, a22, a23, a24,
      a31, a32, a33, a34
```

```
XWALL_ left_material, right_material, vertical_material, horizontal_material,
        height, x1, x2, x3, x4,
        y1, y2, y3, y4,
        t, radius,
        log_height, log_offset,
        mask1, mask2, mask3, mask4,
        n,
        x_start1, y_low1, x_end1, y_high1,
        frame_shown1,
        ...
        x_startn, y_lown, x_endn, y_highn,
        frame_shownn,
        m,
        a1, b1, c1, d1,
        ...
        am, bm, cm, dm,
        status
XWALL_{2} left_material, right_material, vertical_material, horizontal_material,
          height, x1, x2, x3, x4,
          y1, y2, y3, y4,
          t, radius,
          log_height, log_offset,
          mask1, mask2, mask3, mask4,
          n,
          x_start1, y_low1, x_end1, y_high1,
          sill_depth1, frame_shown1,
          ...
          x_startn, y_lown, x_endn, y_highn,
          sill_depthn, frame_shownn,
          m,
          a1, b1, c1, d1,
          ...
          am, bm, cm, dm,
          status
XWALL_{3} left_material, right_material, vertical_material, horizontal_material,
        height, x1, x2, x3, x4,
        y1, y2, y3, y4,
        t, radius,
        log_height, log_offset,
        mask1, mask2, mask3, mask4,
        n,
        x_start1, y_low1, x_end1, y_high1,
        sill_depth1, frame_shown1,
        ...
        x_startn, y_lown, x_endn, y_highn,
        sill_depthn, frame_shownn,
        m,
        a1, b1, c1, d1,
        ...
        am, bm, cm, dm,
        status
```