World Definition Language

WED/WDL reference manual

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Latest news, hints and demos are available from our web page http://www.conitec.com and from the online **ACKNEX User's Magazine** at http://www.conitec.com/aum/aum_e.htm.

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Introduction

Congratulations! You have purchased the conitec 3D GameStudio. This toolkit now allows you to create 3-D demos, role playing, action, adventure or racing games *without programming knowledge* and to publish them subsequently without having to pay royalties if you should wish to do so.

In order to construct a game you have to create a script file (**WDL**) which will contain the 'source-code' for the game world with specifications concerning textures, regions, things, and actors. The level topograpy is contained in a second file (**WMP**) with the coordinates (vertices) of all objects. All files contain plain ASCII text, so you may edit them with any ASCII editor like WORDPAD or EDIT. The WMP file, however, is normally created with the topography editor **WED**.

WED contains the **ACKNEX** 3-D raycasting engine for running and testing the game. When your level is finished, you may compile it and all additional graphics or sound files into one compressed and encrypted world resource file(.**WRS**). This resource file, together with a **runtime module** which you can either pourchase or create yourself, will be distributed as your finished game.

There are currently three versions of ACKNEX, the lite, commercial and professional version. They differ in the features supported, and , of course, in price. In the last chapter of this manual you'll find the features and royalty conditions listed.

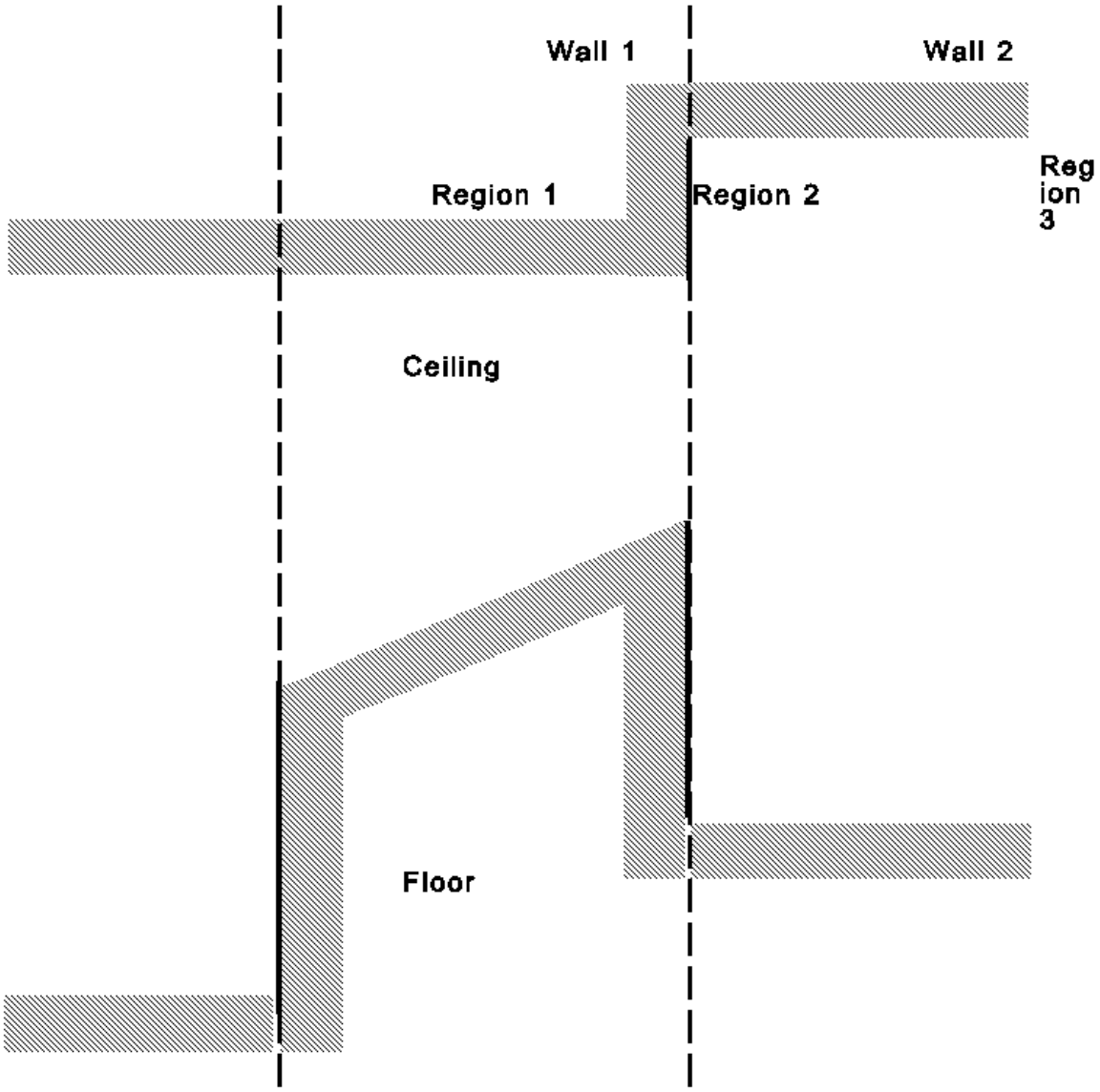
This handbook is supposed to serve as a reference. In order to familiarize yourself with the many features WDL offers we would suggest to thoroughly use the tutorial also included.

The virtual world which you can create with 3D GameStudio is composed of the following elements:

A **level** can be compared to a two-dimensional 'map'. The graphics and other components of a level will be in the RAM or the virtual memory respectively in their entirety. After loading a level the world will be pre-computed and rendered. Every change of levels will therefore results in a disk access.

The level is split into **regions**. A region is defined by the walls surrounding it, and by its floor and ceiling. You can consider it as a solid column of infinite height, with a 'gap' between the floor and the ceiling. It may have the shape of a complex polygon. Each region may contain any number of further regions. The heights and slopes of floor and ceiling of a given region are freely definable; this way you can build staircases, gorges etc. (one step of a staircase equalling one region!). One source of light may be defined per region. You can stack regions vertically in order to insert more 'gaps' into the column, to construct bridges, suspended objects, vehicles or multi-floor buildings. Floors and ceilings have textures and ambient light values, or may be given a backdrop (sky) texture. The same region may appear several times within a level.

The regions are bordered by vertical **walls** of any height, length and angle. Thus on each side of a wall there has to be a region. Walls are represented by lines connecting two **vertices** on the two-dimensional map. They can be at any angle to each other. Their visible heights - the parts of a wall you see - are determined by the *difference* of floor and ceiling heights of the regions of both sides. If both regions have the same height of floor and ceiling, the wall is hidden within the floor and ceiling, and thus invisible.



The figure shows you a side view like a vertical cut through three adjacent regions of different heights. The middle region represents a slant `wall`. Wall textures are only visible along the continous lines. Steps, windows or portals result from different heights of floors or ceilings.

Floors and ceilings may be inclined by the positions of the Z-coordinates of their vertices (represented by wall 2 in above figure). If the ceiling of a region is given a sky texture, the open sky will be seen over this region.

In the level you can place objects (**things**) or living beings (**actors**) at any position whatsoever. The texture of such an object may change with the perspective, thus the object - although only two-dimensional - may appear to be spatial. Actors are independently moving, 'intelligent' objects. The behaviour and properties of an actor may be defined by appropriate use of the WDL language. With the WED you can give actors a **"way**" which they will follow in the level. Each actor is a state machine with determined **actions**, triggered by **events**.

Textures are bitmaps of any desired size, which can cover walls, floors, ceilings or objects. Textures may be animated. They can have a sound and they can change during gameplay, e.g. by being hit. Through the 'attach' feature you can cover a wall with as many ‘layers’ of textures as you desire, eg in order to display inscriptions or bullet holes. Textures are shaded in real time, depending upon the ambient light, their own reflectivity and their distance to the player. 256 colors

are available, including a transparent color for holes or windows.

In the following chapters the commands and functions of the editor and the World Definition Language WDL are described as a reference listing. If you want to start at once with the developing a game level, first read the **tutorial** at the end of this book. There you will find a step by step explanation of how to build a minimal level.

To **install** simply copy all files from the PROGRAM disk into a directory of your choice, which should then be included in the DOS path via AUTOEXEC.BAT. This allows you to call the programm WED in the DOS mode from any directory. If you should find a READ.ME file on the floppy disk, kindly read it. It contains new information that we were not yet able to include in this manual.

World Editor

The world editor WED.EXE (WEDS.EXE in the lite, WEDC.EXE in the commercial version) is the integrated environment to create and edit the world topography. WED scans the WDL and - if any exists - the WMP file; it creates a new WMP file and complies it into a runable World Resource upon request.

In detail WED enables you to

- create, delete or move vertices,
- connect two or more vertices with line, which then may be assigned a wall definition from the WDL file,
- assign region definitions from the WDL to both sides of a wall,
- place things and actors,
- create or edit a way,
- compile the world resource (professional version only),
- create the runtime module (commercial/professional version),
- start and test the game with the integrated **ACKNEX** engine.

Start the world editor with the following DOS command:

WED *[WED options] name[.WDL] [name.WMP] [ACKNEX options]*

If you omit the WMP name, WED loads the WMP file which is declared in the WDL script. Should this file not exist, it will be created.

You can give the following WED command line options (the ACKNEX options are discussed in the next chapter):

-S SVGA resolution 800x600

-I SVGA resolution 1024x768

-VESA Use VESA BIOS for the graphic display (slower!). Start with this option if your video card has a strange chipset and the SVGA display seems distorted (e.g. Matrox Mystique). Hint: If your video card is not supplied with a VESA BIOS, use a shareware VESA driver like UNIVBE.

-VGA Start with this option if you don't have a SVGA card or if you want to work in a DOS box under Windows 95. Floor and wall textures, however, cannot be displayed in this mode.

-RUN Run the game directly without switching to WED.

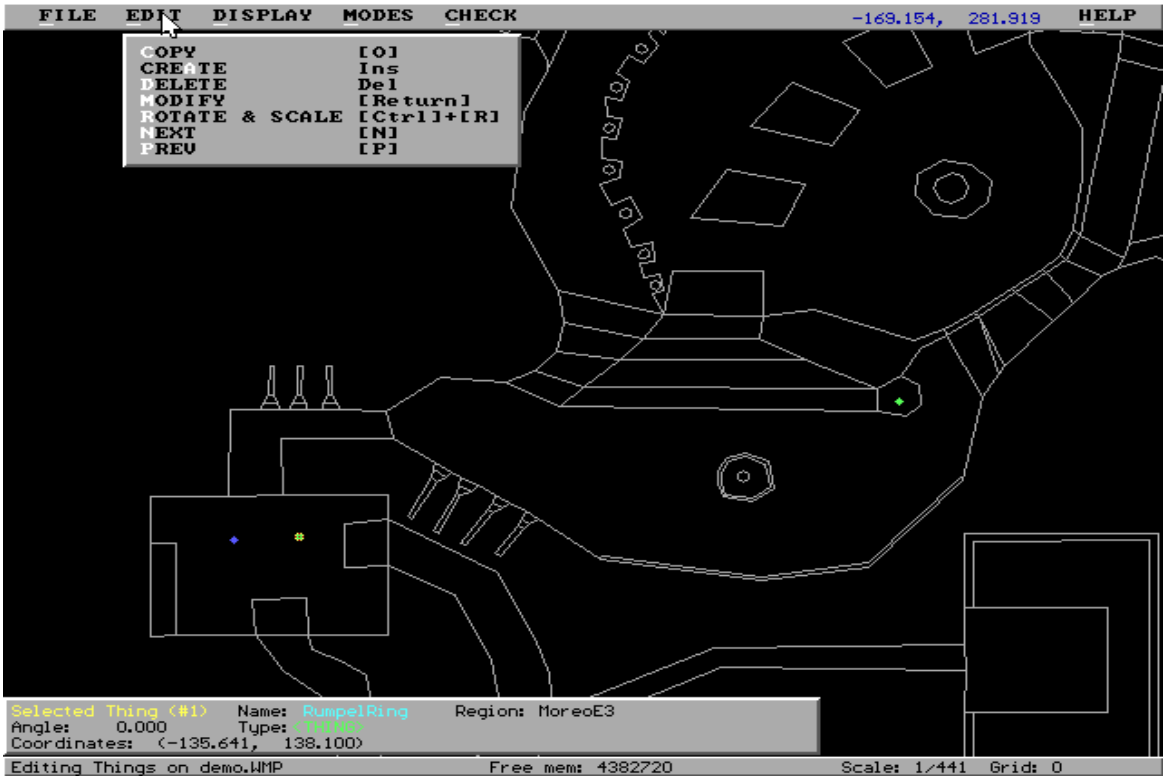
Batch options (professional version only):

WED -C *name[.WDL] [name[.WDL]...]*

Compiles all level files *name*.WDL given to the resource *name*.WRS.

WED -X *name[.WDL] directory*

Copies only those files you need to run *name*.WDL into the given *directory*.



After start-up WED shows the WMP file as 'map' representing walls as white lines, things as green crosses, actors as red crosses, giving a blue cross for the starting point of the player. The scale is adjusted to allow the complete map to fit on the screen.

You can work WED like a CAD program: Objects are *selected* with a touch of the mouse. In order to *mark* it, click with the left mouse button. The info panel on the lower screen gives you information about the current mode and the parameters of the object selected or marked most recently.

WED menu functions:

FILE	**[Alt-F]**	**File submenue**
OPEN WMP	[F3], [Ctrl-O]	Loads a new WMP file with definitions based on the actual WDL file. If no such file exists, it will be created.
SAVE WMP	[F2],	Saves the actual WMP file with backup

	[Ctrl-S]	(.BAK) file creation.
SAVE AS	Shift-[F2]	Saves the actual WMP file under a new name.
PUBLISHED IT WDL	[F4]	Ruft einen definierbaren Texteditor auf und editiert die WDL-Datei.Automatically generates a Runtime module (VRUN.EXE) for the current level (commercial version only). The game may then be sold together with the runtime module free of royalties.
COMPILE	[F9]	Runs the integrated world compiler and creates a world resource file (.WRS) out of all files belonging to the level (professional version only).
PRINT	[Ctrl-P], [F5]	Druckt die Landkarte auf HP Laserjet.
EXIT	[Alt-F4], [Ctrl-Q], [F10]	Exits WED.
MODE	**[Alt-M]**	**Mode submenu**
VERTICES	[V]	Activates vertex mode.
WALLS	[W]	Activates wall mode.
REGIONS	[R]	Activates region mode.
THINGS	[T]	Activates thing/actor mode.
WAYS	[Y]	Activates way mode.
WALK-THROUGH	[Shift-^] [Shift-~]	Starts the game, or switches between game and editor while the game is running. This allows you to test your topography. If the player position is changed within WED, the new position will instanteously be taken over into the game. Changes of walls, things, and actors will also simultaneously appear in the game.

EDIT	**[Alt-E]**	**Edit submenu**
UNDO	[BkSp], [Ctrl-Z]	Cancels successively the last operations.
UNDO ALL	[Ctrl-U]	Cancels all changes after the last saving.
COPY	[Ctrl-V]	Copies the selected object complete with all characteristics, offsets etc. by 1 snap to the lower right.
CREATE	[Ins], Left Click	Creates a new object, dependent on the actual mode.
DELETE	[Del]	Deletes the selected object.
MODIFY	[Return], Right Click	Changes the attributes (name etc.) of the selected object or object(s) marked.
IMPORT	[Ctrl-I]	Adds vertices and objects from an external .WMP file to the map. The WMP file may be selceted from the current directory using a file scroll box. All names of the new objects must be defined in the actual .WDL file!
EXPORT	[Ctrl-E]	Saves all marked objects including all belonging vertices to a new .WMP file in the actual directory.
ROTATE & SCALE	[Ctrl-T]	Rotates and scales the selected or marked object(s) by a given angle and percentage value.
NEXT	[Tab]	Selects next object.
PREV	[Shift-Tab]	Selects previous object.
WALL	**[Alt-W]**	**Wall submenu (wall mode only)**
SPLIT	[S]	Splits the selected wall and inserts a new vertex in the middle.

JOIN	[J]	Connects several adjacent walls marked and erases the joint vertices. The properties of the first of the old walls are assigned to the new wall.
FLIP	[F]	Alters the orientation of the selected or marked walls by exchanging the start and end vertex as well as the left and right region. It mirrors the wall texture and is necessary for functions which treating the left and right sides of a given marked wall differently.
RESET	[Z]	Resets the horizontal and vertical alignments (X and Y offset) of all marked walls to zero.
ALIGN HOR	[A]	Adjusts the textures of the right sides of several connected walls horizontally so that their edges are seamless. This is done by changing the X offsets. You must select a connected chain of walls. If necessary, change the orientation of single walls with FLIP. Starting with the first wall of the chain, all X offsets of the adjacent walls are adjusted so as to start any texture at the end of the preceding texture.
ALIGN CEILING	[C]	Adjusts the textures of several marked walls vertically to the ceiling by changing the Y offsets. After this operation the upper borders of the textures match exactly with the ceiling of the right hand region of the first marked wall.
ALIGN FLOOR	[L]	Adjusts the textures of one or more several marked walls vertically to the floor by changing the Y offsets. After this operation the upper borders of the textures lie exactly at floor level of the right hand region of the first marked wall.
LENGTH	[Ctrl-L]	Assigns a defined length to a selected wall by moving the second vertex of this wall. When calling this function only one wall can be selected. A numeric window allows you to define the length of the wall in steps.
RECTANGLE	[Ctrl-R]	Creates a quadrilateral of four walls at cursor position. A numeric window allows you to define the desired length in steps.

POLYGON	[Ctrl-Y]	Creates an n-sided polygon of n walls at cursor position. You can specify the number and length of the sides in a numeric window.
DISPLAY	**[Alt-D]**	**Display submenu**
GRID	[G]	Switches the blue grid on and off. If the grid is enabled you can place vertices, things and actors only at the grid points.
GRID+	[+], [Num+]	Doubles the scale of the grid.
GRID-	[-], [Num-]	Halves the scale of the grid.
ZOOM+	[Num*]	Increases the scale of the map (also with keys [0]..[9]).
ZOOM-	[Num/]	Reduces the scale of map.
SCROLL	[Scroll Lock]	Switches the autoscroll feature on or off. In autoscroll off mode the visible section of the map can only be moved with the cursor keys.
CHECK	**[Alt-C]**	**Check submenu**
KEYWORDS	[Ctrl-K]	Checks the actual WMP names against the definitions in the WDL file.
STATISTICS	[Ctrl-H]	Shows the number of objects of the current level.
SCAN REGIONS	[O]	Checks all regions and switches to region mode. Necessary, if new regions were created e.g. by splitting a region with a wall.
CHECK	[Ctrl-W]	Checks the consistency of the assignement of regions to walls. All

WALLS		suspicious Walls that are wrongly assigned are automatically marked.
DUPLICATES	[Ctrl-D]	Marks all regions, walls, things, actors, or regions which have the same name as the selected object.
HELP	**[Alt-H]**	**Help submenue**
ABOUT		Shows the version number.

If the mouse pointer is positioned above an object, it will automatically be selected with a yellow frame. Clicking the left mousebutton marks the selected object with a green frame. You can draw a frame to mark several objects, or click on them with pressed **[Shift]** key. You can drag and drop the selected or marked object(s) with pressed left button.

In all modes you can zoom the section of the map containing the mouse pointer by the keys [1]..[9] in fixed steps. With the **[TAB]** key you jump the selection mark from one object to the next.

1. Vertex mode

You can select this mode with the **[V]** key or by menu. You may place, move or erase vertices and connect them with lines which then will become walls. As a result of restricted mathematical accuracy the distance between a vertex and an independent wall must be at least 0.25 steps. If the respective wall should also be visible from farther off, the distance must increased correspondingly. When tilting regions by use of the vertex Z coordinates be careful not to 'bend' floor and ceiling areas, and to hold the angle of inclination below around 75°. Tilted areas will not be shown very pecisely, therefore diffuse textures are more desirable in this case.

In vertex mode the following mouse and keyboard functions are active:

Left click on background places a vertex. The vertex is shown as green cross.

Left click on vertex marks the Vertex. If **[Shift]** or **[Ctrl]** is pressed simultaneously with the click, all previously marked vertices remain marked - otherwise they will be unmarked. A marked vertex is identified by a green frame.

Left pull on background creates a frame for marking several vertices.

Left pull on vertex marks and shifts the vertex. If **[Shift]** or **[Ctrl]** is pressed, all other marked Vertices are moved; otherwise they will be unmarked.

Right click on vertex allows editing of the Z coordinate (height) of a vertex, in order to create tilted regions.

[Del] erases all marked vertices.

[Ins] connects all marked vertices with wall lines in the sequence they were marked in and switches into the wall mode. If there are already defined regions to the left or right of the the new walls, they will automatically be assigned to the walls.

[Shift]-[Ins] connects all marked vertices - if there are more than two - with wall lines in the sequence they were marked in, forming a closed polygon of wall lines. as above.

2. Wall mode

This mode is switched on using the **[W]** key or by menu. It allows you to place, erase, shift, rotate or scale groups of lines. Every wall MUST have been given a name and a left and right region. The right side of each wall is marked with a small perpendicular 'nose'. Regions must be enclosed by walls on all sides. Regions touching without being seperated by walls will cause visible errors in the picture!

Left click on wall marks the wall. If you press **[Shift]** or **[Ctrl]** simultaneously, all marked walls stay marked; otherwise they will be unmarked. A green frame appears around the marked wall.

Left pull on background creates a frame for marking walls.

Left pull on wall marks and shifts the wall together with its vertices. Simultaneously pressing the **[Shift]** or **[Ctrl]** shifts all additionally marked walls; otherwise they are unmarked.

Right click on wall causes a scrollbox to appear. It allows you to assign this wall a wall name from the WDL file.

[Del] erases all marked walls including their vertices.

3. Region mode

In this mode you can assign your previously defined regions to areas surrounded by walls, and alter the floor or ceiling heights. If you have created new regions by placing walls, switch into region mode with **[O]** (**SCAN REGIONS**), otherwise **[R]** is sufficient.

Left click on region marks the region. When simultaneously pressing either **[Shift]** or **[Ctrl]** all regions marked afterwards will remain marked; else they will be unmarked. A green frame appears around the marked regions.

Left pull on background creates a frame for marking several regions.

Left pull on region marks and shifts the region together with its walls and vertices. When simultaneously pressing either **[Shift]** or **[Ctrl]** all regions marked afterwards will also be shifted; else they will be unmarked.

Right click on region causes a scrollbox to appear. It allows you to assign the region (or all marked regions) a new region-keyword from the WDL file. You can either change the region heights or using the default heights from the region definition.

[Del] erases all marked regions including their walls and vertices.

4. Thing and actor mode

Here you can place Things and Actors, assign starting angles and mark positions - for example the starting position of the player.

Left click on background creates an object (Thing or Actor). The object appears as a circle with a green cross.

Left click on object marks the object. When simultaneously pressing either [Shift] or [Ctrl] all objects marked afterwards will remain marked; else they will be unmarked. Around the marked object a green frame will appear.

Left pull on background creates a frame for marking several objects.

Left pull on object marks and shifts the object. When simultaneously pressing either **[Shift]** or **[Ctrl]** all objects marked afterwards will remain marked; else they will be unmarked.

Right click on object causes a scrollbox to appear. It allows you to assign the object marked the player starting position or a thing/actor keyword.

[Ins] creates an object (same as left click).

[Del] erases all marked objects.

5. Way mode

This mode is activated with the **[Y]**-key or through the menu. You may define a closed path of any number of waypoints for an actor. The path is displayed on screen as a light-blue dotted line connecting the waypoints. The following mouse and keyboard functions are active in this mode:

Left click on background creates a new waypoint at the cursor position in the actual way. This waypoint appears as blue cross and will automatically be inserted between the two closest waypoints connected with each other or be connected to the last marked waypoint.

Left click on waypoint marks the waypoint. When simultaneously pressing either **[Shift]** or **[Ctrl]** all waypoints marked afterwards will remain marked; else they will be unmarked. A blue frame will appear around the waypoint marked.

Left pull on background creates a frame for marking several waypoints.

Left pull on waypoint marks and shifts a waypoint. When simultaneously pressing either [Shift] or [Ctrl] all waypointsmarked afterwards will remain marked; else they will be unmarked.

Right click on Waypoint assigns a way name. A pop-up list of all defined way keywords appears, from which you can choose one.

[Ins] creates a new way and sets the first waypoint at the actual cursor position.

[Del] erases all marked waypoints from the way. The remaining waypoints will stay connected.

6. WMP file format

The WMP file generated from WED contains plain ASCII text which can be edited with any text editor (but we suggest better not to try it!). It includes a list of all coordinates and objects in declared sequence in the following format:

VERTEX *x y z*;

Wall vertex definition. *x*, *y* and *z* are fixed point numbers and correspond to the X and Y coordinate and the height of the Vertex in steps.

REGION *name f c*;

Region definition; *name* is the keyword for the region from the WDL file, *f* is the floor and *c* the ceiling height.

WALL *name v1 v2 rr rl sx sy*;

Wall position. *name* is the keyword for the assigned wall from the WDL file. *v1* and *v2* are the consecutive numbers of the vertices of both corner points. *rr* and *rl* are the consecutive numbers of the left and right regions (relative to the view from *v1* to *v2*). *sx* and *sy* are the horizontal and vertical texture offsets in pixels, which may be changed by the ALIGN function.

THING *name x y a r*;

Thing position. *name* is the keyword from the WDL thing definition, *x* and *y* the coordinates of the thing, *a* the angle of the thing in units from 0...360 and *r* the region the thing inhabits.

ACTOR *name x y a r*;

Actor position. *name* is the keyword from the WDL actor definition, *x* and *y* the coordinates of the actor's starting position in steps, *a* the angle of the actor in units from 0...360 and *r* the region the actor inhabits.

PLAYER_START *x y a r*;

Starting position, angle and region of the player.

WAY *name x1 y1 x2 y2... xn yn*;

Way definition. *name* is the assigned keyword of the way, followed by the pairs of coordinates for the waypoints.

The ACKNEX 3D engine

This is the core of the software - the 3D rendering engine which runs the game. You can start it by running WED with option **-RUN** or by selecting **WALKTHROUGH** or pressing **[F11]** from the WED window.

Apart from the file name the following WED command line options are available:

-WMP *name* Uses the topography from the file *name.WMP* , even if a different file was defined with MAPFILE.

-Dir *name* Employs the directory defined for the game score, even if a different directory was defined in the WDL.

-D *name* Defines the tolen *name* for evaluation in the WDL file by **IFDEF** (see below).

-NODE *n* Number of the network node (0...1)with multi-player games (professional version only)

-COM*n* Number of the serial interface (1...4) used for communication with multi-player games. The interface may not be reserved for the mouse and must have a free interrupt available. COM1 and COM3 are assigned to INT4, COM2 and COM4 are assigned to INT3.

-WDL *name* Forces *name.WDL*, even if the given resource file contains another WDL.

-WMP *name* Uses the topography from the given file *name.WMP*, even if another file is defined via the MAPFILE assignment.

-DIR *name* Uses the given directory *name* for game saving, even if another directory is assigned via the SAVEDIR assignment.

-NODE *n* Nummer des Netzwerkknoten (0..9) für Multiplayerspiele.

-COM *n* Nummer der seriellen Schnittstelle (1..4) für die Kommunikation bei Multiplayerspielen. Die Schnittstelle darf nicht von der Maus belegt sein und muß über einen freien Interrupt verfügen. COM1 und COM3 wird INT4, COM2 und COM4 INT3 zugeordnet.

-NODE n Number of Network Nodes (0..9) for multiplayer games.

-COM n Com port number (1..4) used for communications during multiplayer games. This port may not be controlled by a mouse driver, and must have a free interrupt. Com ports 1 and 3 share interrupt #4, and Com ports 2 and 4 share interrupt #3. To avoid undue Tech Support advise, make sure that any device which shares the same Interrupt (as your chosen multiplayer Com port) is turned off, disabled, or inactive.

-OS Run without sound.

-OM Run without music.

-OCD Without detection of audio CDs.

-OT Test run without sound, music and timer.

-PO Play polyphonic sound via soundblaster.

-SB Play monophonic sound via soundblaster.

-AD Use Adlib/OPL2 for music.

-RO Use MPU401, if available, for wavetable music.

-NJ Disable the joystick; useful for avoiding joystick port problems under a multitasking operating system like Win95.

-NM Disable the mouse.

-C Syntax check mode; checks only the syntax of the WDL and WMP files.

-E Numer of error messages. Usually up to 6 error messages will be returned after which the pressing of any button is required.

-W1 Extended syntax check with warnings for potential errors in the WDL file.

-W2 Like **-W1**, but also shows unused objects and superfluous definitions.

-GOD God mode: The player can now pass massive walls and objects within the level (be carefully - may crash!).

-NC No **CLIP_DIST** check (see below).

-? Prints the version number and an option list.

With the game running you can toggle special debugging modes by pressing certain key combinations. These modes are disabled within the **VRUN** runtime module.

[Ctrl]-[Alt]-[G] Toggles God mode.

[Ctrl]-[Alt]-[C] Toggles **CLIP_DIST** check.

[Ctrl]-[Alt]-[S] Toggles single step mode. The game 'freezes' and can be continued frame by frame by pressing the **[S]** key.

[Ctrl]-[Alt]-[End] Quits the game.

[F11] Switches back to WED.

If not redefined by WDL, the following keys are active within the game:

[F2] Saves the game into the file "TEST_0.SAV".

[F3] Loads the last saved game.

[F5] Toggles motion blur.

[F6] Takes screenshots into the file "SHOT_n.PCX".

[F10] Quits the game.

[F12] Toggles music and sound.

[**TAB**] Toggles the automap.

[0] Activates a default player movement which allows the player to fly and move vertically (disabled within runtime module).

World Definition Language

7. Introduction

The elements and objects of your virtual world - walls, regions, actors and so on - are described in a WDL script (WDL = World Definition Language). If the game consists of several levels, a seperate WDL script can be written for each level.

There are different types of definitions, e.g. for regions, walls, actors, things, textures, bitmaps and sounds. Objects of a higher order like walls may contain lower order elements like textures which themselves may contain bitmaps or sounds. You can describe the **properties** of an object by predefined parameters. You may assign **actions** to objects, triggered through **events** that act upon the object. These actions themselves may change the properties of a given object.

Space and time units of the virtual world are the *step* and the *tick*. One step is equivalent to a screen diameter (around 40 cm). One tick is equivalent to the time between two frame cycles on a 486 PC - this means around 1/16 second. Angles are stated in radians (0 to 6.28) and counted counter-clockwise, while 0 is equivalent to the positive direction of the X axis coordinate.

The following special characters are valid within WDL:

...; Semicolon terminates assignment

...,... Commata separate parameters

{...} Parameter lists are between winged brackets

"..." Text is between quotation marks

<...> File names (without path) are between pointed brackets

#... Comment until end of line

//... Comment until end of line

/*...*/ Comment block

8. Keywords

All elements of the world and their properties are addressed by **keywords**. In WDL keywords have a similar role as variables in a programming language. Some keywords are predefined. The keywords for files, objects, textures and so on may be defined by the user.

Keywords are generally defined and assigned a value by a line in the WDL script which looks like this:

TYPE ***Keyword value;***

or

TYPE ***Keyword { ... more keywords ... }***

Keyword is any name consisting of up to 30 letters. Names must not begin with numbers nor contain any special characters except the underscore _. Nor are you allowed to allot the same keyword to different objects. TYPE stands for the keyword type, *value* is for the assigned content, possibly a number or more keywords, respectively a complete list of keywords between winged brackets {...}. The keyword definition may stretch over some lines and is closed with a semicolon. These are the types for user-defined keywords (in alphabetical order):

ACTION for a real time action - a listing of instructions that may be triggered during game through an event, and may change the properties of walls, things, actors or regions,

ACTOR for an animated object, a state machine with certain behaviour primitives and action and reaction capabilities,

BMAP for a bitmap (graphics file) in formats .PCX, .LBM or .BBM or a rectangular section of such a bitmap,

FLIC for an animation file in .FLI or .FLC format (professional version only),

FONT for a bitmap which is interpreted as a character set to represent

numbers or text,

MODEL for a textured 3D model file in format .MDL,

MUSIC for a song file in format .CMF or .MID,

MSPRITE for the mouse pointer overlay,

OVERLAY for a screen overlay in order to show cockpits, weapons or tools over the rendered scene in the 3-D window,

OVLY for a bitmap assigned to an overlay,

PANEL for a display panel with bar graph or numeric displays,

REGION for a region in the map bordered by walls,

SKILL for a numeric property,

SOUND for a sound file in VOC or WAV format,

STRING for raw text, e.g. for descriptions, menus or dialogues,

SYNONYM for a blank 'template' to fill in,

TEXT for formatted text,

TEXTURE for an animated texture, which may be assigned to floors, ceilings, walls, things or actors,

THING for a tool, a weapon or other inanimate object,

WALL for a wall separating regions,

WAY for the way an actor covers within a level.

The *value* to be assigned to the defined keyword dependens on the type of the keyword. The following values may be assigned:

Number Assigns a number to the keyword. Numbers are integers of up to five digits (e.g. 12345) or fixed point numbers of up to three digits following the decimal (e.g. -12345.678).

Number,... Number

Assigns a list of several numbers, separated by comma, to a keyword.

Keyword Assigns another previously defined keyword to a keyword.

Keyword, ... Keyword

Assigns a list of several previously defined keywords to a keyword.

"*Text*" Assigns a text string to a keyword. Line feeds are written in C notation as "\n".

<*Filename*> Assigns the content of a file to a keyword. The kind of file is apparent from the extension. Valid extensions are <.LBM>, <.BBM>, <.PCX> for bitmaps or palettes, <.FLI>, <.FLC> for animations, <.MDL> for 3D model files, <.MID> for songs, <.IBK> for instruments, <.WAV>, <.VOC> for sound effects, <.TXT> for ASCII text. All files in pointed brackets will be bound compiled into a world resource by the compiler.

{...} Assigns a complex description consisting of a listing of parameter assignments to the keyword. This description can have any number of lines and is closed by brackets.

Subsequently the predefined keywords are written in CAPITALS; user defined keywords, parameters or numbers are written in *italics*. Keywords whose values may be changed during gameplay through actions are marked by an arrow (➢) Keywords whose values automatically change after each frame and can be evaluated by actions and may not be predefined are indicated by a rectangle (■).

9. Files

Keywords may be assigned to files to define bitmaps, animations, sounds or songs. Files that belong to the game and have to be compiled must be stated without path in pointed brackets <...>. The following file keywords exist:

BMAP*Keyword,<Filename>;*

BMAP*Keyword,<Filename>,x,y,dx,dy;*

Assigns a bitmap - a graphics file - to the keyword, in the format .PCX, .LBM or .BBM. The second form assigns a rectangular section from a bitmap to the keyword. The coordinates *x,y* mark the upper left corner of the section, *dx,dy* give the height and width in pixels. Omitting the coordinates causes the entire bitmap to be assigned to the keyword.

OVLY *Keyword,<Filename>;*

OVLY *Keyword,<Filename>,x,y,dx,dy;*

Like BMAP; except that it assigns an overlay to the keyword. Overlays are for showing cockpits, weapons, mouse pointers or similar objects over the rendered scene. They consume two or three times as much RAM as a bitmap, but they can be drawn much faster. The number of horizontal pixels of the overlay bitmap must be divisible by 4.

FONT *Keyword,<Filename>,width,height;*

FONT *Keyword,<Filename>,width,height ,x,y,dx,dy;*

Assigns a set of characters to a keyword. *width, height* gives the size of the single characters in pixels. All characters must have the same size. The bitmap can either contain 11 characters - numbers 0..9 and space - for numeric displays, or the 128 or 256 characters respectively of the PC or ASCII set of characters for displays and texts. The sequence of alphanumeric characters in the bitmap must correspond to the PC (ASCII) character set. In the bitmap, the characters may appear in several lines. The number of characters and their arrangement is automatically determined from the character size and the size of the bitmap. The bitmap size must exactly be either 11 times, 128 times, or 256 times the given character size.

MODEL ***Keyword,<Filename>;***

Assigns a 3D polygonal model in MDL format. You can use a freeware or shareware MDL tool, e.g. QuakeMe or Meddle, to create the MDL files, and import DXF meshes. For creating palettes for the skin, use PCX2PAL to create a raw 768-byte palette.lmp for QuakeMe (simply copy it into the main directory), or Paintshop Pro to create a JASC .pal file for Meddle.

The MDL file must obey the following restrictions: Not more than 1024 faces, the lesser the better; one skin only, which must be adapted to the level palette; only triangles as polygons;certain 'critical' polygons (especially long narrow ones) may have to be split into smaller ones if they are displayed in wrong order.

SOUND ***Keyword,<Filename>;***

Assigns a sound file in WAV format to the keyword.

MUSIC ***Keyword,<Filename>;***

Assigns a song file in MID format to the keyword. The internal predefined instruments correspond to the general midi standard.

FLIC ***Keyword,<Filename>;***

Assigns an animation file in FLI or FLC format to the keyword.

10. Predefined Keywords

The following keywords, which must be given at the beginning of the WDL script, are used to define the basic modes for graphics and sounds:

VIDEO ***Keyword*;**

Sets the screen resolution. The keywords for the following resolutions were predefined:

320x200 VGA resolution 320x200 pixels.

X320x240 VGA resolution 320x240 pixels (mode X).

X320x400 VGA resolution 320x400 pixels (mode X).

S640x480 SVGA resolution 640x480 pixels (not supported by lite version).

A low resolution of 320x200 is meant for fast action games, the SVGA resolution for adventures. In this case a SVGA card with VESA driver is required.

NEXUS ***Number*;**

Sets the size of the nexus, which refers to the internal data structure for picture rendering. The nexus size depends on the number of objects, walls and regions that will be visible consecutively. The bigger the nexus, the more complex rooms may be shown, but the more memory is needed. The given value for the nexus is 14. Too small a nexus is indicated by a error message.

CLIP_DIST ***Number*;**

Default value for the region **CLIP_DIST** (usually 1000 steps). Only walls and objects that are entirely within the distance from the player position given in **CLIP_DIST** will be rendered. In individual regions you may define individual **CLIP_DIST**s that differ from the given value, which can accelerate the rendering of the picture in complex levels by up to 30%. Walls outside **CLIP_DIST** will be rendered monochromatically using the palette colour 1. A **CLIP_DIST** that is too small may cause image errors. This may sometimes be a desireable effect, e.g. with regions where everything beyond a certain distance is supposed to dissolve into darkness or fog.

LIGHT_ANGLE ***number*;**

This parameter allows you to define the direction a infinitely distant source of light is in within the range of 0..2 π. All walls with an **ALBEDO** type texture (see below) will reflect the light from the direction given according to their orientation. The value of 0 here corresponds to east (sunrise), the value of 3.145 corresponds to west (sunset).

IBANK ***<Filename>*;**

DRUMBANK*<Filename>*;

Loads the instrument bank, to be used for midi songs. *Filename* is an ADLIB instrument file in the .IBK-format. Percussions are put out through midi-channel 10. If no **DRUMBANK** is specified, only 5 standard-drums will available; if no **IBANK** is specified, internal general midi compatible instruments will be used by the program.

MIDI_PITCH ***Number*;**

Number of octaves by which the pitchbend parameter changes the pitch on midi songs; values from 1..12, default is 2.

INCLUDE ***<Filename>;***

Reads additional WDL definitions from the separate WDL file <*Filename*> and then continues scanning the original WDL file. This way definitions common to all levels can

be summarized in separate WDL files, which will be read using the INCLUDE keywords from the main WDL for every level. In the main WDL file any number of INCLUDE-keywords are allowed.

BIND ***<Filename>;***

The given file will included in the game by the compiler, e.g. for changing levels. You may give any number of BIND files.

MAPFILE ***<Filename>;***

Defines the corresponding WMP topographic file. This keyword must be included in the main WDL and cannot be read by way of INCLUDE.

SAVEDIR ***"Dirname";***

Names the directory for saving games. If this directory does not exist, it will be created when first saving the game. Note that backslashes ("\") have to be given in C-notation, i.e. as double backslaches (e.g. "C:\\gstudio\\mygame"). The directory name given here may be replaced by the command line option **-DIR** with the VRUN.EXE during run time.

PATH ***"Dirname";***

All additional files - bitmaps, sounds or midi - will be first searched for in the actual directory and then in the path given here (again state backslashes as "\\"!). You can specify up to 16 **PATH** keywords, which will be searched in the given sequence.

DEFINE *NewName*[*,OldName*]*;*

This keyword, like the **-d** command line option (see above), allows you to rename keywords and parameters in the WDL file, and to include or exclude WDL lines depeding on conditions (nothing new for C-programmers, see below).

STARTTEXT *"Text"/String*;

Ein Text, der entweder direkt oder als voher definiertes String-Schlüsselwort angegeben werden kann, wird vor Spielstart und vor den Scannen der WDL-Datei auf dem DOS-Bildschirm ausgegeben. Renaming does not affect the function of the respective values, but it does make rather large WDL actions a lot more ‘readable’, once the object skills or numbers are given meaningful names.

Example:

```
DEFINE MyNumber,-3456;

DEFINE HitEffect,SKILL3;

ACTION kill {

SET RESULT,MY.HitEffect;

SET MyActor.HitEffect,MyNumber;
```

}

Characters like "{} ,;()<>" cannot be redefined, and **DEFINE**s may not be nested.

IFDEF *Name*;

IFNDEF *Name*;

IFELSE;

ENDIF;

These keywords are to skip WDL lines dependent on previous **DEFINE**s or command line option -d. All WDL lines between **IFDEF** and **ENDIF** are skipped if the **IFDEF** parameter was not **DEFINE**d before. All lines between **IFNDEF** and **ENDIF** are skipped if the **IFNDEF** parameter was **DEFINE**d before. The keyword **IFELSE** reverses the line skipping or non-skipping.

Example:

```
DEFINE hires; // alternatively start WRUN -d hires

IFDEF hires;

VIDEO S640x480; // SVGA high resolution

IFELSE;

VIDEO X320x400; // VGA mid resolution

ENDIF;
```

11. Palettes

Since the pixels of 256-color bitmaps contain no final colors, but only color numbers, you need a *palette* for your game to define which visible colors are represented by the numbers. The palette thus contains a graphics file whose colors are taken as a reference. Normally all textures in your level should share the same palette; otherwise, they'll look psychedelic.

Palettes are responsible not only for the color representation, but also for **shading** - the darkening or 'fogging' of textures depending on the surrounding light and the distance from the player. To perform shading the colors in the palette have to be sorted in groups - *shading ranges* - of declining brightness (or inclining 'foggyness'). Textures in great distance or utter darkness will be given the the second colour of the palette.

The first three colors have a special meaning: The first one (color #0) corresponds to transparency, the second one (color #1) to darkness or foggyness, i.e. the color for wide distances, the third one (color #2) is the color of the lightsources in the level.

You can use only one palette at a given moment; but you can switch or fade between palettes at any time. The last defined palette in the WDL file will be used at game start. With the following definition a palette of 256 colors may be created from any graphics

file in the format .PCX, .BBM, or .LBM:

PALETTE ***Keyword* { ... }**

Assigns a definition of the palette to the keyword. The definition may contain - in the sequence given - the following keyword assignments between winged brackets:

PALFILE ***<Filename>;***

Determines the graphics file (PCX,LBM, or BBM) whose colors are used for the basic palette.

RANGE ***s,l;***

Shading range in the basic palette. A shading range is a group of the same colors with continually declining levels of brightness. *Sart* gives the number of the intial color (1..254), *Length* the number of colors in the range (up to 255). The initial color of the range must be the brightest, the last one the darkest color, which nearly ought to equal the **INFINITY** color #1.

Up to 24 shading ranges may be defined per palette. If there are no ranges defined, shading will be switched off, which results in slightly faster rendering. Colors outside all ranges are not shaded, so they can be used to represent sources of light.

ANIFILE <Filename>;

Determinates the graphics file, which colours will be used for the animationpalette. On palette animation, some colors of the basic-palette are exchanged for colors from the animationpalette.

ANICOLOR c,s,l,d;

Color animation. c is the number of colour in the basic-palette which will be animated. s is the number of the starting-colour of the animationpalette (0..255), l is the number of colors in the animation-area (0..255). d is the time-gap in ticks between any change of colors. You can define up to 32 colours for animation but none of them are allowed to be in an area of shading.

FLAGS ***Keyword1,Keyword2...;***

Here a list of keywords (flags) determining the properties of the palette may be given. The following flags may be set:

HARD

Using this keyword causes a ‘hard’ shading to be performed. The trasitional area between bright and dark is smaller, colors will not be converted but merely shifted. However, this causes darkened textures to be displayed with greater contrast. Details of textures thus are better perceived.

AUTORANGE

This flag causes automatic shading of all colors on the palette that are included in any of the **RANGE**s given above, even if they are not sorted. The colours will be shaded according to their similarity to the **INFINITY** colour - the second color of the palette. This allows you to attain shading or 'fogging' effects even with entirely unsorted palettes. Nevertheless does a manual sorting of the colors result in a more differentiated colours **RANGE** in general and especially a more controllable shading.

BLUR

Setting this flag initiates the motion blur effect 'softer'. During movements the 3D image will be shown slightly out of focus, which moderates the 'pixeling' of textures rich in contrast. It also allows you to represent textures as semi-transparent (**DIAPHANOUS**). Disadvantage: start-up of the game and changing palettes takes about 2 seconds longer per **BLUR** palette. If all level's palettes are similar, setting the flag **BLUR** for the main palette only will suffice.

Example:

```
PALETTE my_pal {
PALFILE <raw.pcx>;          // unsorted palette, 2nd color = black
RANGE   16,224;   // shade all colors from #16 up to #240
FLAGS   BLUR,AUTORANGE;          // don't bother about ranges
}
```

12. Textures

Textures set the appearance of the world. There are textures for walls, floors, ceilings, backgrounds (sky textures), things, actors, panels and overlays which are all defined as follows:

TEXTURE *Keyword* { ... }

This assigns the keyword a texture definition. A texture definition may contain - in the given sequence - the following keyword assignments between winged brackets:

SIDES *Number*;

Number of sides of the texture. Each side is the equivalent of one or - for animated textures - several bitmaps. Depending on the object the texture was assigned to, the significance of the sides changes. Usually, bitmaps assigned to sides change depending on the angle from which the respective object is perceived. Hereby things and actors are given a spacial appearance. Texture for things and actors may have an unlimited number of sides, which are counted clockwise, the first side being equivalent to the frontal view.

Wall textures usually have only one side. Two-sided wall textures change the bitmap depending on the perspective the wall is perceived from: starting from the first vertex of the wall up to the middle the first side, from the middle to the end vertex the second side

is visible. This way spatial elements of textures are shown more clearly. If the wall has four sides, the first two are assigned to its right side or front, the last two to its left side or back.

More than four sides are sometimes useful with multi-storied regions (see below): the first four sides are assigned to the uppermost region, the **BELOW** region has the next four sides and so on.

Sky textures may have any number of sides; they will be distributed evenly among the 360° panorama. For example does a **SKY** texture consisting of ten pages assume an area of 36° for each bitmap. Therefore the horizontal scale of sky textures is derived from the size of the bitmaps and the number of sides. There is no vertical scaling of sky textures.

CYCLES ***Number*;**

Number of phases (frames) of texture animation; dafault=1.

FRAME ***Number*;**

Number of the start frame of an animated **MODEL** texture, between 1 and the max number of frames within the MDL file (default=1).

BMAPS ***Bitmap1, Bitmap2...*;**

List of keywords, which were assigned the bitmap files of the texture. All bitmaps of wall, floor, or ceiling textures must have the same size, the bitmaps of actor's or thing's textures may differ in size .The number of bitmaps is unlimited, but must be equal to the product of (SIDES * CYCLES). In the **BMAPS** list the cycles of the front side ar to be listed first, then those of all other sides counterclockwise around the object. Instead of the keyword of the bitmap the keyword **NULL** may also be used, but only with textures for things, actors or transparent walls. The respective cycle or side of the texture will then not be displayed, as if the object were invisible. In the case of walls at least one bitmap of the texture must be non-**NULL**.

The maximum width or height of a bitmap is 1024 pixels. Apart from that, a bitmap of a thing or actor texture can have any size. Bitmaps in the LBM format must have an even-numbered width. Wall textures can have any size horizontally; the vertical number of pixels must be a power of two, e.g. 64, 128 or 256 pixels. Floor and ceiling textures must be quadratic, only sizes of 64x64, 128x128 or 256x256 pixels are allowed.

Backdrop bitmaps (**SKY**) may have any horizontal size; the vertical size depends on the maximum visible background section (depending on the vertical angle **PLAYER_TILT**, see below). Usually the sky bitmap's lower edge touches the horizon. You can shift sky textures vertically and horizontally through the object's **OFFSET_X** and **OFFSET_Y** parameters and additional through the predefined skills **SKY_OFFS_X** and **SKY_OFFS_Y** (see below). Vertically the sky texture is neither zoomed nor repeated. If the texture's border exceeds the top or bottom pixel line of the sky bitmap, the rest of the sky is automatically filled with this pixel line; so the first and last line of the sky bitmap should be monochrome.

FLIC ***Flic*;**

Texture FLIC animation, alternative to **BMAPS** (professional version only). *Flic* is a previously defined keyword denoting a FLI/FLC file. The size of the texture results from the size of this animation. The same rules concerning size that were given for **BMAPS** apply here. The Flic palette must correspond to the level-palette. As long as **ONESHOT** is not set, the animation is repeated in a loop.

TITLE *String*;

With the parameter **TITLE** a texture can be given a string, who is displayed with the texture FONT (see below). The string may be given as keyword or directly (TITLE "It's a title!";). The **TITLE** has the same restrictions as a bitmap would have for the same texture; e.g. the font height for a one-line title on a wall texture must have be power of two. If a texture has a **TITLE**, it must not be animated, and must have no **BMAPS**.

```
TEXTURE title_tex {

FONT my_font;

TITLE "That's a title!";

}
```

MODEL *Model*;

3D animated model, alternative to **BMAPS**. *Model* is a previously defined keyword denoting a **MDL** model file. A model texture can only be assigned to things or actors. The size of the texture results from the positions of the model vertices (in pixels); the skin bitmap palette must correspond to the level palette. The same rules concerning size that were given for **BMAPS** apply here. Only one **DELAY** value is allowed. As long as **ONESHOT** is not set, the model animation is repeated in a loop. If you want to use only a part of the MDL frames for the animation, use the **FRAME** and **CYCLES** parameters. Example:

```
TEXTURE hero3d_tex {

MODEL hero_mdl;

DELAY 2;

SOUND hero_snd;

}
```

DELAY ***Number, Number....;***

List of phase durations in ticks for every cycle of animation. The number of **DELAY** values must be equal to the value of **CYCLES**. If this list is not stated, animation is working with one tick per phase. The higher the **DELAY** value, the more does the animation speed remain constant on different frame rates.

MIRROR ***Flag, Flag....;***

List of mirror flags (0 or 1) for every texture side. If the mirror flag is set at 1, all bitmaps of the concerned side are shown side-inverted. The number of flags must be equal to the number of **SIDES**. If this list is not given, all bitmaps are shown un-inverted.

OFFSET_X ***Number, Number...;***

OFFSET_Y ***Number, Number...;***

Each bitmap of an animated thing or actor texture may be given an individual shift in horizontal and vertical direction by these parameters in pixel units. The number of **OFFSET_X/Y** parameters must be equal to the number of **BMAPS**. Example:

```
TEXTURE animthing_tex {

SCALE_XY 10,10;

BMAPS thing_map,thing_map,thing_map,thing_map;

DELAY 6,6,6,6;

OFFSET_X 5,10,20,40;

OFFSET_Y 5,10,20,40;

}
```

RANDOM ***Number;***

Maximum value for a random factor of delay (0..1, default 0), which is added to every phase of a texture animation.

- **SCALE_X** ***x;***

- **SCALE_Y** ***y;***

Scaling of the textures in horizontal and vertical direction in pixels per step. With floor and ceiling textures the value *x* indicates the scaling in the direction of X, *y* indicates the scaling in the direction of Y within the system of coordinates. The smaller the value given, the larger the texture will be displayed; the larger the value, the higher the pixel resolution in the object's proximity. Should this keyword be ommitted, the textures will be scaled by 16 pixels per step in each direction. The keyword does not apply to **SKY** textures.

- **AMBIENT** ***Number;***

Brightness of the texture (-1 .. 1, 32 levels, default 0). At 0 the wall texture is only illuminated by the player's lightsource and the ambient light of the region; at 1 the texture itself shines brightly. Negative ambients reduce the power of reflexion of a texture; this could be used to simulate areas covered by shadows.

- **ALBEDO** *Number;*

The reflexion factor of a texture (0...1, default 0) respective to light coming from

LIGHT_ANGLE or a separate source of light (cf. **GENIUS**). Buildings, columns, or ledges appear more spatial when given a texture **ALBEDO** (ca. 0.3).

RADIANCE *Number;*

Through this parameter (0..1, default 0) the maximum brightness of a texture can be determined. With high ambients, textures with a **RADIANCE**>0 get colored with the 'brightness' color of the palette (#2).

➢**SOUND** ***Sound;***

Keyword which has been assigned a sound file (.VOC or .WAV). On floor textures this sound is played rhythmically while moving, on ceiling textures it will be heard - if SLOOP is set - continuously in the whole region.

➢**SVOL** ***Number*;**

Maximum volume of the sound (0..1). If no value is given here, the sound will be played at volume 0.5.

➢**SDIST** ***Number*;**

Critical horizontal range in steps within which the sound is audible (default 100). The closer one gets to the object to which the texture has been assigned, the louder it gets. With stereo soundcards you can locate the direction of the object from differing volumes on the right or left channel. Close to the texture the sound is played at the maximum volume determined by **SVOL**.

➢**SVDIST** ***Number*;**

Critical vertical range in steps within which the sound is audible (default 0, i.e. inactive). Only effective with values >0 and with things or actors. If the player is located above or below the object's height plus **SVDIST**, the sound is inaudible.

SCYCLES ***Flag, Flag....*;**

List of sound trigger flags (0 or 1) for every phase of animation. If the sound flag is set at 1, the texture sound is played on the appropriate cycle. The number of flags must be equal to the number of **CYCLES**. If this list is not given, the sound initiates with the first cycle.

➢**ATTACH** ***texture*;**

To attach an additional texture to a wall, thing or actor texture in order to show paintings, inscriptions, bullet holes, or shadows. The new texture is transparent. Another texture may be attached to the new texture in the same way.

In the case of walls any number of textures may be overlayed on the same wall - a whole row of bullet holes, for example. But please note that the chain must have an end! A

texture which is - directly or indirectly - **ATTACH**ed to itself will cause an engine crash. In the case of things or actors only one single **ATTACH** texture is allowed, and the **ATTACH** parameter of the actor himself, not of his texture, must be used.

ATTACH textures may be displayed **DIAPHANOUS** (see below) or semi-tranparent (**GHOST**). They may be animated, if the original texture also is animated. The number of **CYCLES** of the original and the **ATTACH** textures must correspond. The original texture's **DELAY** and**RANDOM** values apply to the animation. If only the **ATTACH** textures are meant to be animated, the original texture may be assigned a 'dummy-animation' of identical bitmaps.

- **POS_X** *number*;
- **POS_Y** *number*;

The **ATTACH** texture appears at the pixel positions given by these keywords relative to the upper left corner of the original texture. If both **POS_X** and **POS_Y** are 0 (default), they will both appear exactly in the upper left.

Advice: In order to position an **ATTACH** texture exactly in the middle of a wall independently from the height and scaling of the wall, the position should be calculated as follows (rule-of-thumb):

POS_X = **OFFSET_X** + **SIZE_X**/2 - **WA**/2

POS_Y = **HW** - **OFFSET_Y** - **HA**/2 - (**CEIL_HGT+FLOOR_HGT)***SCALE_Y**/2

POS_X, **POS_Y**: Position of **ATTACH** texture in pixels,

WA, **HA**: Width and height of **ATTACH** texture in pixels,

OFFSET_X, **OFFSET_Y**: Offsets of wall in pixels,

HW: Height of wall texture in pixels,

SCALE_Y: Scaling factor of wall texture,

SIZE_X: Length of wall in pixels,

CEIL_HGT, **FLOOR_HGT**: Height of ceiling and floor.

PORTCULLIS or **FENCE** walls allow for a much simpler way to calculate. Given a wall **POSITION** of 0 the vertical zero of an **ATTACH** texture refers to the lower edge of the wall, i.e. the attach texture needs to be shifted upwards by a negative **POS_Y** to become visible. If **POSITION**=1, the vertical zero of the **ATTACH** texture refers to the upper edge of the wall.

The following parameter determine the response to touch or clicking on with the mouse of objects that were given the respective texture. The skill **TOUCH_RANGE** allows you to specify the maximum distance within which the object will still react to the mouse in steps. Objects with the flag **IMMATERIAL** set are 'invisible' to the mouse. **ATTACH** textures may also respond to the mouse, but only the last (uppermost) texture is relevant

here.

➢**TOUCH** ***string*;**

The given text string is displayed as soon as the mouse pointer touches the wall, thing or actor the texture is assigned to and the predefined skill **TOUCH_MODE** (see below) is above or equal to 1. You can give the maximum object distance with the predefined skill **TOUCH_DIST** (default 100).

FONT ***font*;**

Character set for the **TOUCH** or **TITLE** string.

➢**IF_TOUCH** ***action*;**

The given action is triggered by touching the texture with the mouse pointer.

➢**IF_RELEASE** ***action*;**

The given action is triggered by leaving the object's texture with the mouse pointer.

➢**IF_KLICK** ***action*;**

When touching an object with the mouse pointer, by left klicking on the object this action is triggered instead of the 'common' **IF_KLICK** action.

FLAGS ***Keyword1,Keyword2...;***

Here a list of keywords (flags) may be given, which determine the properties of a texture. The following flags can be set:

ONESHOT

If this flag is set, the texture is not permanently animated. It normally shows the first phase of animation. By setting of the flag PLAY to the assigned object (wall, thing, actor or region - v.) the texture can be animated for one cycle and it will stop at the last phase.

GHOST

If this flag is set, the texture is shown semi-transparent on things, actors or transparent walls.

DIAPHANOUS

Like **GHOST**, except that the textures will be represented diaphanous and not dithered. Yet, this flag only works with a **BLUR** palette and increases computing time for the respective textures by ca. 30%.

BEHIND

The **ATTACH** texture appears behind the original texture (e.g. with things oder actors).

SHADOW

The **ATTACH** texture appears at the actor's floor height.

Using a dark **DIAPHANOUS** texture this way actor shadows can be generated. Example:

```
TEXTURE shadow_tex {

BMAPS shadow_map; // flat black spot (2nd color)

FLAGS DIAPHANOUS,BEHIND,SHADOW;

}

ACTOR guy {

TEXTURE guy_tex;

ATTACH shadow_tex;

}
```

LIGHTMAP

This **ATTACH** texture flag maps light and shadows spots onto a wall texture. The **LIGHTMAP** bitmap must contain only the colors #0..#15 and #241..#255 (otherwise: engine crash!!). Color #0 does nothing, colors #1..#15 darken the wall texture, colors #255..#241 brighten it (#241=brightest). The darkest color corresponds to the level palette color #1, the brightest color to the palette color #2, which should be a white or yellow. Example:

```
BMAP torchlight_map,<torchlight.pcx>;

TEXTURE torchlight_tex {

BMAPS torchlight_map;

FLAGS LIGHTMAP;

POS_X 40;

POS_Y 10;

}

WALL stone_wall {

TEXTURE stone_tex;

ATTACH torchlight_tex;

}
```

SKY

If this flag is set, there ensues no perspective, but a parallax projection of the texture. It will therefore be shown as 'background' (for mountains, sky, horizon etc.). **SKY** textures

will not be zoomed, so that they will appear always at an infinite distance. You can assign **SKY** textures to walls, floors, and ceilings.

SYNC If this flag is stated, the movement of the textureanimation is synchronized with the concerned object. The texturephases are changing depending on the speed of the object, while the phasetime (DELAY) determines the quantity of steps per phase. By the animation, single phases may be skipped depending on speed of the object!

WIRE

MODEL textures only: Displays the **MODEL** as a non-textured wireframe with **MAPCOLOR**.

CLUSTER

MODEL textures only: Displays only the vertices of the MODEL polygons.

NO_CLIP

This flag forces thing's and actor's textures not to be cut off on the floor or ceiling of a region.

CLIP

This flag forces thing's and actor's textures to be cut off on the floor or ceiling of a region.

SLOOP

If this flag is set, texture sounds will be played continuously in a loop, independently of the animation phase. Volume and direction are continually adapted. As this does take up qute some computing time especially with wall textures and all sound channels will be continually busy within the texture's earshot this flag should be used economically.

CONDENSED

Setting this flag compresses the mouse text string (**TOUCH**) horizontally by 1 pixel. Especially italics often look better that way.

NARROW

Like **CONDENSED**, only the textstring will be compressed further.

SAVE

This flag must be set in the texture definition, if the parameter of the texture are to be changed by an action during the game. The texture will then be saved with the score (**SAVE** command).

WDL example: Definition of a multi-sided sky texture for a landscape with two towers in the east:

```
BMAP    hills       <huegel.lbbm>;
BMAP    tower       <turm.lbm>;
TEXTURE             tower_landscape   {
SIDES   10;         // bitmap spreads over 36° viewing sector
BMAPS   tower, hills, tower, hills, hills, hills, hills, hills, hills, hills, hills;
FLAGS   SKY;
};
```

2nd. **Example**: Definition of a multi-sided animated texture. It will show a swimming fish:

```
BMAP PIRAN_0_1 <fish1.bbm>;         // Fish animated in 4 Phases,
BMAP PIRAN_0_2 <fish2.bbm>;         // and drawn in 5 views,
BMAP PIRAN_0_3 <fish3.bbm>;         // here from the front
BMAP PIRAN_0_4 <fish4.bbm>;
BMAP PIRAN_45_1         <fishvr1.bbm>;      // from right front (45°)
BMAP PIRAN_45_2         <fishvr2.bbm>;
BMAP PIRAN_45_3         <fishvr3.bbm>;
BMAP PIRAN_45_4         <fishvr4.bbm>;
BMAP PIRAN_90_1         <fishr1.bbm>;       // from right (90°)
BMAP PIRAN_90_2         <fishr2.bbm>;
BMAP PIRAN_90_3         <fishr3.bbm>;
BMAP PIRAN_90_4         <fishr4.bbm>;
BMAP PIRAN_135_1        <fishhr1.bbm>;      // from right back...
BMAP PIRAN_135_2        <fishhr2.bbm>;
BMAP PIRAN_135_3        <fishhr3.bbm>;
BMAP PIRAN_135_4        <fishhr4.bbm>;
BMAP PIRAN_180_1        <fishh1.bbm>;       // from the back.
BMAP PIRAN_180_2        <fishh2.bbm>;
BMAP PIRAN_180_3        <fishh3.bbm>;
BMAP PIRAN_180_4        <fishh4.bbm>;
SOUND   PIRAN_SND       <shwssh.voc>;
```

```
TEXTURE         PIRAN_TEX       {
SCALE_X         20;             // Scale 20 pixels per step
SCALE_Y         20;
SIDES           8;                      // Object has 8 sides
CYCLES 4;                       // and 4 phases
BMAPS   PIRAN_0_1,PIRAN_0_2,PIRAN_0_3,PIRAN_0_4,
PIRAN_45_1,PIRAN_45_2,PIRAN_45_3,PIRAN_45_4,
PIRAN_90_1,PIRAN_90_2,PIRAN_90_3,PIRAN_90_4,
PIRAN_135_1,PIRAN_135_2,PIRAN_135_3,PIRAN_135_4,
PIRAN_180_1,PIRAN_180_2,PIRAN_180_3,PIRAN_180_4,
// these are mirrored
PIRAN_135_1,PIRAN_135_2,PIRAN_135_3,PIRAN_135_4,
PIRAN_90_1,PIRAN_90_2,PIRAN_90_3,PIRAN_90_4,
PIRAN_45_1,PIRAN_45_2,PIRAN_45_3,PIRAN_45_4;
MIRROR 0,0,0,0,0,1,1,1;     // show last 3 sides mirrored
DELAY           3,3,2,2;                // Cycle lengths in ticks
SCYCLES         1,0,0,0;                // Sound starts at first cycle
RANDOM          0.2;                            // additional random delay
SOUND           PIRAN_SND;
SDIST           30;     // Sound only audible whithin 30 steps
};
```

Hints for Designing Textures

You have several way available to produce bitmaps, depending on the athmosphere you wish to create in the game. You may use paint software, render them using 3D software or scan them from models. Even with the last two options you will most certainly have to work on the bitmaps manually and adapt them to your level palette.

All bitmaps for things, actors, and walls - with the exception of sky, panel, and overlay bitmaps - are zoomed. As that means that single rows of pixels are suppressed depending on distance, adjacent single pixels should not display great contrasts in color and brightness (on scanned bitmaps this is automatically the case). Dithering, lattice structures, thin lines and so on cause flickering and moiré effects and should be avoided. If sharp lines and rich contrasting edges are required they should blend in smoothly with the background on one side at least.

Wall and floor textures should normally fit together on all sides. Exceptions are such textures that cover a wall or floor completely and without repetition. The vertical size of a sky texture should allow for ist upper and lower borders never to become visible in the field of vision. Otherwise the upper border should be of a single color, as it will be repeated on leaving the field of vision. Thing and actor bitmaps should be cut out with at least one pixel 'air' on all sides.

For the size of bitmaps some rules should be noted (see above). As textures may be scaled, their bitmap sizes do not determine their sizes in the game. Generally a texture bitmap should only be larger to show more texture details, not a larger image. Things and actors the player comes close to should have large bitmaps, floor and ceiling textures smaller ones correspondingly. As a general rule textures which are far away from the player should be scaled by a **SCALE_X/Y** less then 10; textures which may come close should be scaled by 20 or higher.

If the length of a wall or the scale or light value of a texture is changed by an action during gameplay, with all objects concerned (walls, things, or actors) the texture has to be re-set through a **SET** instruction (see chapter 'Actions').

When generating **LBM** or **BBM** bitmaps with the paint software Deluxe Paint please note that the width of the bitmap needs to be even-numbered. On saving of LBM bitmaps with Deluxe Paint II please note that the button 'old' at the menu SAVE AS must be deactivated. Allmost all converter programs (GWS, Paintshop Pro) save the LBM bitmaps with the 'old' format, which cannot be read from ACKNEX. Please use **PCX** instead.

Hints concering Sounds

The **WAV** sounds employed must be saved in 8 bit mono format (ACKNEX itself will take care of the stereo effect). The **WAV** files should not contain any special events like *loop-points, regions* or *play lists*. For normal sounds usually a sampling rate of 11 kHz should suffice. High-frequncy sounds (hissing, rushing or splashing) may be sampled at 22 kHz.

13. Walls

Vertical walls run along the connecting lines between two vertices. They separate the regions of the map. Their properties are defined in the wall definition:

WALL *Keyword* { .... }

The wall keyword defined in such a fashion may later be assigned to a connecting line with the WED. A wall definition may contain - in the given sequence - the following keyword assignments:

➢**TEXTURE**	*Texture*;	Texture for the wall, up to 4 sides. On two-sided textures the bitmap changes depending on which vertex of the wall is closer

		to the viewer. Four-sided textures always differentiate between the right and left side of a wall.
➢**ATTACH**	*Texture;*	Superimposed texture for the wall; only one side. The number of cycles (**CYCLES**) must either correspond to the wall texture's or equal 1.
➢**OFFSET_X** ➢**OFFSET_Y**	*Number*;	Shifts the wall texture **OFFSET_X** pixels to the left and/or **OFFSET_Y** pixels down. **OFFSET_X** must not be negative. If one of these keywords is used, the wall texture may not be shifted using the ALIGN function in WED. For sky textures **OFFSET_Y** is the distance of the horizon from the lower border of the bitmap.
➢**CYCLE**	*n*;	The current animation phase of the texture.
➢**POSITION**	*Number*;	The use of this keyword is dependent on the flags (see below).
MAP_COLOR	*n*;	Mode (0...1, default 1) for drawing of the wall on the automap. If 0 no map will be drawn; if 1 the wall will be drawn antialiased in a default color (**COLOR_WALLS**, **COLOR_BORDER** - see below).
➢**DIST**	*Number*;	Border distance of the nearest vertex of the wall to the player, default=0. By crossing this border distance an **IF_NEAR** or **IF_FAR** action (see below) may be triggered. If the **DIST** is set to 0 (default), an **IF_NEAR**

		action can be triggered simply by touching or passing through the wall. If the **DIST** is >0, but less then half the length of the wall, an **IF_NEAR** action will not be triggered near the center of the wall, as only the distance to the nearest vertex is relevant!
➢**SKILL1...** ➢**SKILL8**	*Number*;	Eight 'universal parameters', which initially have no influence on the properties of the wall. They can be changed and evaluated by an action.
■**DISTANCE**	*Number*;	Approximate (± 20%) distance of the player to the nearest vertex of the wall; only valid for walls within the player's **CLIP_DIST**. May be evaluated by an action.
■**LENGTH**	*Number*;	The length of the wall in steps.
■**SIZE_X**	*Number;*	Length of the wall in pixels, depending on the scaling of the texture.
➢**X1,** ➢**Y1,** ➢**Z1**	*Number*;	Position of vertex1 of the wall. These parameters can be changed by an action, in order to shift or rotate walls or regions. Be aware that walls may not cross. If the lenght of the wall changes, a **SHAKE** command (see below) must be executed.
➢**X2,** ➢**Y2,** ➢**Z2**	*Number*;	Position of vertex2 of the wall.
The following keywords allow you to assign actions, which will be triggered by certain events associated with the wall:		
➢**IF_NEAR**	*Action*;	This action is triggered as soon

		as the player crosses the border distance (**DIST**) of the nearest vertex. If no border distance is defined, the action will be triggered by every touching or passing through of the wall.
➢**IF_FAR**	*Action*;	This action is triggered as soon as the player distancs himself from the wall beyond the border distance (**DIST**).
➢**IF_HIT**	*Action*;	This action is triggered if the player hits the wall with the **SHOOT**-instruction or if the wall is hit by an exploding object.
➢**EACH_CYCLE**	*Action*;	This action is triggered after every animation cycle of the wall texture, or after the end of an **ONESHOT** animation.
➢**EACH_TICK**	*Action*;	This action is triggered after every frame rendering cycle (i.e. approx. every 1/16 second).
The following keyword allows you to set a whole list of further keywords (Flags) determining the properties of the wall. During actions flags take on either the value of 1 (=set) or 0 (=not set).		
FLAGS	*Flag1, Flag2... ;*	The following flags may be given (set) in this listing or evaluated or changed by actions:
➢**INVISIBLE**	If this flag is set, the wall is invisible, but impenetrable. The same region must be on both sides of an invisible wall.	
➢**PASSABLE**	If this flag is set, the wall is passable (permeable) to the player and actors.	
➢**IMMATERIAL**	After setting this flag, the wall will no longer be influenced by **SHOOT** instructions or mouse clicks.	

➢**IMPASSABLE**	If this flag is set, the wall bcomes impenetrable over it enitre length and width, even if it is not visible. If the **PASSABLE** flag is set simultaneously, the wall remains passable for the player, but not for actors.
■**VISIBLE**	This flag is set automatically, as long as the wall is seen by the player. It can be evaluated in actions.
➢**SEEN**	This flag is set automatically, as soon as the player has once seen the wall, and then stays set. It will be evaluated by the automap function.
➢**BERKELEY**	If this flag is set, the wall exists only as long as it is viewed or the player is within its border distance. This flag saves rendering time in levels with many animated wall textures.
➢**TRANSPARENT**	If this flag is set, the color 0 of a wall texture is transparent, e.g. for fences or lattices. Please note that the same region must be on both sides of a transparent wall.
➢**PLAY**	If this flag is set, the wall texture will be animated for one cycle; it will then stop on the last phase. On the texture concerned the flag **ONESHOT** has to be set. At the end of the animation, the flag **PLAY** is set automatically back to 0, and an **EACH_CYCLE** action will be triggered if necessary.
CURTAIN	If this flag is set, the wall reaches from the floor up to the ceiling, independent of the region heights.
➢**PORTCULLIS**	This flag 'fastens' the wall texture to the upper or lower edge of the wall; useful for walls that move vertically, e.g. elevators or roll-down doors. If this flag is set, the wall texture is automatically adjusted to the lower border (at **POSITION**=0) or the

	upper border (at **POSITION**=1) of the wall, so that it can be moved with the wall.
FENCE	By setting this flag you can 'cut off' transparent walls at the upper edge of their texture. The wall parameter **POSITION** gives the depth (in steps) of the lower wall edge within the floor, a negative **POSITION** lets the wall 'float' above the ground. By changing **POSITION** you can raise or lower the wall like a lattice. With **FENCE** walls the flag **PORTCULLIS** is set automatically.
➢**SENSITIVE**	After setting this flag the corresponding wall will trigger ist **IF_NEAR** action already when being seen by the player.
➢**FRAGILE**	If this flag is set, the **IF_HIT** action of the wall may be triggered by an **EXPLODE** instruction (see below).
FAR	If this flag is set, the wall will also be visible outside **CLIP_DIST** (see **CLIPPING** skill); useful for distant **SKY** walls, as it allows you to cut down computing time by lowering **CLIP_DIST**. Walls with **FAR** set may not border **BELOW** regions.
SAVE	If this flag is set, all properties of the wall are saved through the **SAVE** instruction.
➢**FLAG1...** ➢**FLAG8**	Eight 'universal flags', which have no influence on the properties of the wall at first. They may be changed or evaluated by actions.

For reasons of mathematical inaccuracy with the representation of textures, walls should have a maximum length of 200 steps and height of 1000 steps. Longer walls have to be split into appropriate sections.

14. Regions

Regions are closed areas of the map, bordered by walls, that may be stacked vertically at will. Their properties are defined in the region definition:

REGION *Keyword* { .... }

The region defined with this keyword may be assigned to the right or left side of walls using the WED. A region definition may contain - in the sequence given - the following keyword assignments:

➢**FLOOR_TEX**	*Texture*;	Assigns a texture to the floor of a region. The texture sound plays on moving in the region, rhythmically accompanying either the **WALK** or **WAVE** cycles (see below), depending whether the texture's **SLOOP** flag was set or not. Volume or pitch may be changed using predefined skills (**PSOUND_VOL**, see below).
➢**CEIL_TEX**	*Texture*;	Assigns a texture to the ceiling of a region. The sound of the ceiling texture plays when entering the region; if the **SLOOP**-flag is set, the sound is continued independent of the movements of the player.
➢**FLOOR_HGT** ➢**CEIL_HGT**	*Number*;	Height of the floor or ceiling of the region in steps; slanted regions add the height (**Z**) of the vertices to this value. The difference of height btween floor and ceiling should not exceed 1000 steps.
➢**FLOOR_OFFS_X** ➢**FLOOR_OFFS_Y** ➢**CEIL_OFFS_X** ➢**CEIL_OFFS_Y**	*Number*;	Shifting of the textures of floor or ceiling in direction of the X- or Y-coordinate in pixels, relative to the coordinates of the playing-field.
➢**FLOOR_ANGLE** ➢**CEIL_ANGL**	*Number;*	Texture angels of the floor and ceiling textures; range 0..2π, default 0. This angle corresponds to one revolution of the texture

E		around the center **GENIUS** (see below). Revolved floor or ceiling textures do of course take up more computing time and are only possible with regions that are nor slanted.
BELOW	*Region*;	Assigns a predefined lower region in order to display balconies, bridges, multistoried buildings or hovering objects or to define underwater regions. The lower region may be assigned another **BELOW** region, too, and so on. In the level all regions 'connected' by **BELOW** assignements are shown stacked one over the other.
➢**GENIUS**	*Object;*	Assigns either a Thing or an Actor to serve as a source of light for the walls of the region, alternatively to **LIGHT_ANGLE** (cf. **ALBEDO**), and as the rotational center fo the **ROTATE** commands at the same time. The object may be **INVISIBLE**, but needs to have a texture **AMBIENT** >0 in order to serve as a source of light instead of the global **LIGHT_ANGLE**. It may also be situated ourside the region and be assigned to more than one region simultaneously.
➢**AMBIENT**	*Number*;	Basic brightness of the region (range 0 .. 1, 16 degrees, default 0). The values of **AMBIENT** and of textuöre and region together with the player source of light (**PLAYER_LIGHT**) and the distance from the player form the texture’s brightness.

CLIP_DIST	*Number*;	All walls at a distance larger than given (in *steps*) from the player position are not rendered. If this value is not given, the region will use the default **CLIP_DIST** (see above). Regions with interiors that are never visible - e.g. if the floor and ceiling touch - should be given a **CLIP_DIST** of 0.
➢**SKILL1...** ➢**SKILL8**	*Number*;	Eight 'universal parameters', which intially do not have any influence on the properties of the region. They can be evaluated or changed by actions.
➢**IF_ENTER**	*Action*;	This action is triggered as soon as the player enters the region. Still, the player must remain in the region for at least one frame, which is especially important to keep in mind with small regions and fast moving players.
➢**IF_LEAVE**	*Action*;	This action is triggered as soon as the player leaves the region.
➢**IF_DIVE**	*Action*;	This action is triggered as soon as the eye level of the player (**PLAYER_Z**) reaches or falls below floor level.
➢**IF_ARISE**	*Action*;	This action is triggered as soon as the player's eye level reaches or rises above ceiling level.
➢**EACH_CYCLE**	*Action*;	This action is triggered at the end of every texture animation cycle or at the end of an **ONESHOT** animation of the floor or ceiling texture.
➢**EACH_TICK**	*Action*;	This action is triggered after every frame cycle.
FLAGS	*Flag1,*	Here a list of keywords (flags) can be set, which determine the

	Flag2... ;	properties of the region. The following keywords are possible:
FLOOR_ASCEND **CEIL_ASCEND** **FLOOR_** **DESCEND** **CEIL_DESCEND**	If one of these flags are set, the corner points of the floor and/or ceiling are lifted upwards (**ASCEND**) or downwards (**DESCEND**) by the Z-values of their vertices. Floors and ceilings can be tilted this way (see note below).	
■**VISIBLE**	This flag is set automatically as long as a floor, ceiling or wall of the region is visible. May be evaluated by actions.	
➢**SEEN**	This flag is set automatically as soon as the region is once seen by the player.	
SAVE	If this flag is set, all properties of the region will be saved on game saving.	
SAVE_ALL	If this flag is set, all walls and things within this region are saved by **SAVE** instructions. This makes sense if the region is moved during gameplay e.g. by **ROTATE**.	
■**HERE**	This flag is set automatically as long as the player is within this region.	
➢**BASE**	This flag assures that the player's floor height (**PLAYER_HGT**) does not change when entering the region. Useful with narrow holes or slits in the ground the player is not supposed to 'fall' into.	
STICKY	If this flag is set, the player will be moved together with the region's floor by **SHIFT** or **ROTATE** instructions.	
➢**PLAY**	If this flag is set, the floor and ceiling textures will be animated for one cycle; they will then stop on the last phase. The texture itself must have the flag	

	ONESHOT set. At the end of the animation the flag **PLAY** is set back automatically to 0 and an **EACH_CYCLE** action is triggered if necessary.
➢**FLAG1...** ➢**FLAG8**	Eight 'universal flags', which intially have no influence on the properties of the region. They can be changed or evaluated by actions.

Please note the following restrictions for **BELOW** regions:

- A region's floor height must be higher than it's **BELOW** region's ceiling height.
- While the player walks through a multi-storied region, the region synonym **HERE** (see below) corresponds to his current **BELOW** region.
- Things and actors without **GROUND** flag are placed on the uppermost region at game start. Things and actors with **GROUND** flag are placed onto the lowest region whose ceiling is above the object's feet.
- Walls of **BELOW** regions may not have the **FAR, PORTCULLIS** or **FENCE** flag set.

Underwater-Regions:

- If the **CEIL_HGT** of a **BELOW** region corresponds exactly to the **FLOOR_HGT** of the region above, the **BELOW** region may serve as an 'underwater' region. The predefined skill **PLAYER_DEPTH** (see below) does, with such **BELOW** regions, contain the difference between the floor heights and thus the 'depth' of the water; with other regions it is 0. **PLAYER_DEPTH** may for example be used to reduce **PLAYER_SIZE** while wading using an action. If the upper region does contain an **IF_DIVE**-and the lower an **IF_ARISE** action, floor and ceiling become permeable to the player.

Example:

```
REGION under_water { // to be defined BEFORE water region
                        FLOOR_HGT       -5;
                        CEIL_HGT        1;
                FLOOR_TEX       mud_tex;
CEIL_TEX        underwater_tex;
        IF_ARISE        water_arise;
}
REGION water {
FLOOR_HGT       1;              // same as under_water's CEIL_HGT!
```

```
FLOOR_TEX       water_tex;
CEIL_HGT        20;
CEIL_TEX        sky_tex;
BELOW           under_water;
IF_DIVE  water_dive;
}

                        ACTION water_dive       { FADE_PAL blue_pal,0.5; }
                        ACTION water_arise      { FADE_PAL blue_pal,0;   }
```

Please note the following restrictions for slanted regions (**LIFTED**, **FLOOR_LIFTED**, **CEIL_LIFTED**):

- Textures are projected vertically onto slanted floors or ceilings, so that they will align seamlessly despite being slanted. The angel should not be chosen too high because of the distorted projection; additionally only textures low in contrast should be used. As the representation of slanted areas does use up computing time they should preferably be used with moderation.
- With large floor or ceiling bitmaps (256x256 Pixel) the **SCALE_X/Y**-factor of the texture should not exceed the value 32, otherwise the texture may show a 'swimming' effect in the distance. Smaller bitmaps may be scaled with a higher factor.
- When assigning heights (Z values) to vertices the floor and ceiling textures of the region must not be 'bent'.
- Several identical regions with a different incline are not allowed to border the same **BELOW** region. In this case for each region a different region would have to be defined.
- Walls separating slopes may be rendered invisible using the flags **INVISIBLE** and **PASSABLE**.
- The floor of a slope must not penetrate the ceiling (keep 0.01 steps security distance).
- The **AMBIENT** of a slanted region should be chosen as to make sure that the luminosity of floor and ceiling resulting from the texture **AMBIENT** and **PLAYER_LIGHT** does never exceed 1, and never aqcuire a negative value.

1. Things, Actors, Ways

   Things are one-dimensional items with only one vertex (as opposed to walls). Their properties are defined in the thing definition:

   THING *Keyword* { .... }

   An actor differs from a thing only in its more complex action and reaction behaviour.

ACTOR *Keyword* { .... }

Defining the actor this way allows you to place him at any place on the map via WED . Additionally, you can assign him a **way**, i.e. a list of **waypoints**. Such a way definition simply consists of the keyword **WAY** followed by the way name which then can be assigned to a waypoint list in WED.

WAY *Keyword*;

The actor who has been assigned this way, "wanders" in a cycle from one waypoint to the next. No collision detection is carried out, except when the actor flag **CAREFULLY** is set (see below).

A thing or actor definition contains the following assignments in given sequence:

➢**TEXTURE**	*Texture;*	The texture keyword. On multi-sided textures the side changes depending on the angle from which the actor or thing is seen.
➢**ATTACH**	*Texture;*	**ATTACH** texture for the object. The number of **CYCLES** and **SIDES** must either correspond to the object's texture's or equal 1. Things and Actors may only be assigned an **ATTACH** texture; the texture parameter **ATTACH** itself will be ignored.
➢**CYCLE**	*Number;*	Current animation cycle of the texture.

➢**OVERLAY**	*Overlay;*	Assigns an overlay keyword (see below) to the thing or actor which can then be accessed by actions, eg. for picking up the object with the mouse or representation within an inventory.
		Example:
		SET MY.INVISIBLE,1; // disappear
		SET MSPRITE,MY.OVERLAY; // appear
		These lines within an action, triggered by a texture **IF_CLICK**, will allow you

		to ‘pick up’ an object with the mouse pointer.
➢**TARGET**	*Keyword*;	Assigns a new destination or basic behaviour to the actor. Combining or event-triggered changing of these **TARGET**s may cause the Actor to show complex behaviour. The following target keywords may be assigned:
NULL	The actor does not move (default).	
MOVE	The actor moves straight on in the direction of his **ANGLE**. His parameter **SPEED** (see below) allows you to define his horizontal speed. **VSPEED** defines the tangens of the vertical angle for the actor movement, e.g. with **VSPEED=1** the actor climbs upwards at an angle of 45°. If his **CAREFULLY** flag is set, his **IF_ARRIVED** action (see below) is triggered each time he crosses a region border.	
BULLET	Like **MOVE**; but on hitting an obstacle the **IF_HIT** action of the actor is triggered. The flag **CAREFULLY** (see below) needs to be set to detect collisions.	
STICK	The actor tries to keep his current distance from and angle to the player with maximum-**SPEED**. By changing the parameters **REL_ANGLE** and **REL_DIST** his position relative to the player can be changed. If **CAREFULLY** is set, the skills **IMPACT_VX, IMPACT_VY,** and **IMPACT_VROT** (see below) are changed when the actor collides with walls, similar to player collisions. **STICK** actors may be used to give the player a three-dimensional ‘structure’, so that he may enter narrow corridors only sideways for example.	
FOLLOW	The actor moves towards the player with	

	SPEED and - if **VSPEED** is >0 - tries to adjust his height to that of the player. The maximum vertical speed for height adjustment is determined by positive value of **VSPEED**. If **VSPEED** is negative, the actor will move upwards with **SPEED** at most, and downwards with **VSPEED**. If the **CAREFULLY** flag is set, the **IF_ARRIVED** action is triggered each time a region border is crossed.
REPEL	Like **FOLLOW**; but the actor moves away from the player, and his height does not change.
VERTEX **NODE1** **...** **NODE8**	The Actor moves towards the position corresponding to his target coordinates **TARGET_X** and **TARGET_Y** (see below). Upon arrival at this position the action **IF_ARRIVED** will be triggered.
NODE1 **NODE2**	The actor will be remote-controlled by the player pluggerd in via the number given in **NODE** (professional version only). Until communication with the node has been established the actor will remain invisible. If the number (1 or 2) *n* does correspond to the current node (command line option -**NODE**), the player will 'inherit' the position and perspective of this actor on game start.
Way	Stating a **WAY** keyword assigns this way to the actor. The actor immediately moves towards the first way point with **SPEED**. The keyword **WAYPOINT** is set to 1. **VSPEED** is ignored. On arrival at each waypoint the **IF_ARRIVED** action is triggered.
Wall, Thing,	Giving a keyword or synonym for a wall, a thing, or another actor assigns the first vertex or the position of the object as target to the actor, which he trys to reach

Actor	horizontally and vertically with **SPEED** and **VSPEED**. If more than one object with the same keyword exists, the one with the lowest WED index number is chosen. When reaching the target the **IF_ARRIVED** action is triggered.	
➢**WAYPOINT**	*Number*;	Assigns the actor a waypoint on the way as destination. The actor moves directly towards this waypoint. During gameplay the number of the next directed waypoint can be evaluated with this keyword.
➢**TARGET_X** ➢**TARGET_Y**	*number;*	If an actor has **WAY, FOLLOW** or an object as **TARGET**, these parameter contain the coordinates of his current target. With **TARGET VERTEX** the target coordinates may be given here.
➢**REL_ANGLE** ➢**REL_DIST**	*number*;	Angle and distance of the actor with **TARGET STICK** to the player; can be changed e.g. to move the actor around the player.
➢**HEIGHT**	*Number*;	Height of the 'feet' of the thing or actor, either absolute (with **GROUND** flag set, see below) or relative to the floor level of its region. The perspective of objects with relative height sometimes seems more 'realistic' if they are shifted a little bit into the floor e.g. by **HEIGHT = -0.25**.
➢**ANGLE**	*Number*;	Object angle in radians (0..6.28). It is added to the angle given by WED and may be changed by an action.
➢**SPEED**	*Number*;	Horizontal speed of the actor in steps per tick, default= 0.
➢**VSPEED**	*Number*;	Vertical speed of the actor, dependent on its **TARGET** either

		as slope (tangens of the vertical angle) or as speed in steps per tick, default= 0.
ASPEED	*Number;*	Through this parameter (default = 0 = disabled) his maximum rotation speed can be given in radians per tick. Especially multi-sided or **MODEL** actors behave more naturally on their WAYs with a rotation speed of around 0.2.
MAP_COLOR	*n*;	Color number (0..255, default 1) that represents the thing or actor on the map. If assigned 0 the object is not drawn, if 1 the object is drawn using a default color (skills **COLOR_ACTORS**, **COLOR_THINGS** - see below).
➢**DIST**	*Number*;	Border distance from the object's center to the player, default=0. On crossing this border distance, an **IF_NEAR** or **IF_FAR** action may be triggered. If **DIST**=0, an **IF_NEAR** action can be triggered only by touching the object. Hint: If the **DIST** is >0, but less then half the size of the object plus the width of the player, the player would have to penentrate the object to trigger an **IF_NEAR** action!
➢**SKILL1...** ➢**SKILL8**	*Number*;	Eight 'universal properties', which intially have no influence on the behaviour of the object.They can, however, be evaluated or changed by actions.
The following parameters are calculated by the program and can be evaluated by actions:		
■**DISTANCE**		

		Approximate distance (+/- 20%) of the player from the center of the object; only valid for objects within the player's **CLIP_DIST**.
■**SIZE_X** ■**SIZE_Y**		Horizontal and vertical size of the object in steps; results from pixel size and scale of the texture.
■**FLOOR_HGT**■**RESULT**		Resulting value from SHOOT or EXPLODE instructions in range of value from 0..1; must manually be set back to 0 after evaluation.Height of the floor at the position of the thing or actor in steps.
➢**X,** ➢**Y**	*Number*;	Vertex position of the thing or actor. By changing this parameters actors may be 'beamed' to a new position during the game. He must also given his new region manually, and if his height above the floor is changed as a consequence, a **SHAKE** (see below) needs to be carried out.
➢**REGION**	*Region*;	Region of thing or actor, may have to be re- assigned manually when changing positions. The region of things may not be changed as the collision detection would no longer work afterwards!
With the following keywords you can indicate actions which will be triggered through certain events associated with the the thing or actor. The actions will only be carried out if the object is within **CLIP_DIST** or has the flag **LIBER** (see below) set.		

➢**IF_NEAR**	*Action*;	This action will be triggered as soon as the player approaches the border distance of the thing or actor (**DIST**). If no border distance is defined, the action will be triggerd at every contact.
➢**IF_FAR**	*Action*;	This action is triggered as soon as the player has moved away from the object beyond the border distance (**DIST**).
➢**IF_ARRIVED**	*Action*;	This action is triggered as soon as the actor with the **CAREFULLY** flag set crosses a region border or arrives at its target or at the next waypoint.
➢**IF_HIT**	*Action*;	This action is triggered if the object is hit with a **SHOOT** or **EXPLODE** instruction or if it collides with an obstacle (see **BULLET**, **FRAGILE**).
➢**EACH_CYCLE**	*Action*;	This action will be triggered after every animation cycle of the object's texture or at the end of a **ONESHOT** animation.
➢**EACH_TICK**	*Action*;	This action is triggered after every frame cycle (i.e. ever 1/16 sec approximately).
With the following keyword a list of more keywords (flags) may be 'set', which determine the properties of the object. When evaluated in actionsflags either have the values 1 (set) or 0 (clear).		
FLAGS	*Flag1, Flag2... ;*	The following flags may be assigned (set) in this listing or evaluated or changed in actions:
➢**INVISIBLE**	If this flag is set, the thing or actor is invisible and passable, as if it was not there. The actor concerned is not moving, his actions aren't running and events are not	

	triggered. On things or actors that are defined by WDL but not placed in the level, the **INVISIBLE**-flag is automatically set.
➢**PASSABLE**	If this flag is set, the object is passable to the player.
■**VISIBLE**	This flag is automatically set as long as a thing or actor is visible. It may be evaluated in actions.
➢**BERKELEY**	If this flag is set, the object is inactive (**INVISIBLE**) as long as it is not seen and the player is outside its **DIST**. It can be used to stop actor movement if he is out of sight. This flag also saves rendering time in levels with many animated things and actors.
➢**LIBER**	If this flag is set, the object moves and executes actions even if it is outside the player's **CLIP_DIST**. Which of course takes up computing time...This flag is useful with objects sporting behaviour that is supposed to be independent from the player's movments, e.g. with guards patrolling, **EACH_TICK** time bombs or projectiles.
➢**GROUND**	If this flag is set, the **HEIGHT** of a thing or actor is not referred to the height of the region but to the Z coordinate. A thing or actor with **GROUND** set is vertically clipped ('cut off') at the heights of the floor and ceiling of its region, slopes not bing taken into account. This way objects may e.g. submerge into and rise from water. Things and actors without **GROUND** will always be displayed in full, even if parts of them penetrate into the floor or the ceiling. Still, walls and region's borders cause the penetrating parts to be clipped. If they are in a multi-storied region at game start they will be placed in the uppermost region. Please note that if this flag is

	changed by an action, the **HEIGHT** will be automatically converted!
CANDELABER	Only effective if **GROUND** is not set: the object will not be suited to the floor, but to the ceiling of its region. Useful for representing pendant objects like stalactites or candelabra.
➢**SEEN**	This flag is automatically set as soon as the object is seen by a player. It is for example evaluated by the automap function.
➢**MOVED**	This flag is set automatically if the actor has moved in the latest image cycle. It may be evaluated in actions and may then have to be reset manually.
➢**PLAY**	If this flag is set, the texture will be animated for one cycle and then stop on the last phase. On the texture concerned, the flag **ONESHOT** has to be set. At the end of the animation the flag **PLAY** is automatically set back to 0, and an **EACH_CYCLE** action may be triggered.
➢**IMMATERIAL FLAT**	This flag causes the object not to show the player the frontside everytime. But it will conduct like a transparent wall in direction of the thing-angle (ANGLE); this is meant for flat or longish object (spears, missiles...).After setting this flag the respective thing or actor will no longer be affected by **SHOOT** instructions or mouse clicks.
➢**SENSITIVE**	After setting this flag an **IF_HIT** action will be triggered with actors after they have collided with an obstacle, and the **IF_NEAR** actions will be triggered already when the actor is spotted by the player.
➢**FRAGILE**	If this flag is set, the **IF_HIT** action of a thing or actor may be triggered by an **EXPLODE** instruction.
➢**CAREFULL**	If this flag is set, the actor performes

Y	collision detection on his way, and avoids walls, things and other actors. Also he detects a change of region, adjusting his height to the height of the region, if his flag **GROUND** is not set. This takes up computing time, however.
SAVE	If this flag is set, all properties of the thing are saved at game saving. The **SAVE** flag is automatically set for actors.
➢**FLAG1...** ➢**FLAG8**	Eight 'universal flags', which initially have no influence on the properties of the object. They may be changed or evaluated by actions.

Hint: Since the bitmap-changing through **SIDES** on non-moving things or actors may look unnatural, only moving and animated actors should be multi-sided.

Actors that are invisible and farther away from the player than their **DIST** usually perform a **TARGET** movement (see skill **SKIP_FRAMES**) every 6th frame only. If this is not desired for a certain actor, the **DIST** parameter of the respective actor needs to be increased accordingly.

2. Actions

Actions can give the objects of the game world the pseudo-intelligent behaviour of state machines. There are 'global' actions, triggered at certain moments or by hitting a key, and actions corresponding to objects that will be triggered by object **events** like **IF_NEAR** or **IF_FAR**. An action consists of a list of instructions which will be executed one after another. **ACKNEX** is a multitasking engine; thus any number of actions execute simultaneously as in real life. The instructions represent a kind of a simple programming language, which allows you to influence the playing of the game in numerous ways.

ACTION *Keyword* { .... }

Assigns an action to the *keyword*. The following instructions can be given within an action:

SET [*Object1.*]*Keyword1, Number*/[*Object2.*]*Keyword2;*

The most common instruction of them all: **SET** assigns any keyword, object parameter or skill (skills are numeric properties, see below) a new value or another keyword. This way actions may change or disable themselves (by assigning the keyword **NULL**) even during the game. For *object1/2* the keyword or synonym (see below) of the region, the wall, actor or thing will be given, whose parameters are to be changed. The object must either be placed in the level or at least have its definition placed in the WDL file before the action.

Please note that if there is more than one object with this keyword placed within the level, the instruction only changes the first object placed via WED (cf . **SET_ALL**). If no *object* keyword is given, the instruction relates to a skill. For *keyword1* a **FLAG** keyword can also be assigned, which will be set by 1 or cleared by 0.

Examples:

```
SET tank.CEIL_TEX, water_tex; // Changes ceiling texture

SET bumper.FLAG3, 1;          // Sets FLAG3 of thing bumper

SET adist, MY.DISTANCE;       // Assigns a value to a skill

SET energy, 300;                    // dito

SET EACH_TICK.5, NULL;        // Deletes an EACH_TICK action
```

SET_ALL [*Object1.*]*Keyword1, Zahl*/[*Object2.*]*Keyword2;*

Like **SET**, except that **SET_ALL** affects all objects or regions with the keyword or synonym given via WDL, and not only the first. Positions (**X**,**Y**,**Z**, **X1**,**Y1**,**Z1**, **X2**,**Y2**,**Z2**) of objects may however not be changed with **SET_ALL**.

ADD [*Object1.*]*Keyword1, Number*/[*Object2.*]*Keyword2;*

Increases the value of a keyword - see **SET** - by the amount *number* or the given skill respectively. If the number is negative, the concerning value is decreased by the amount.

ADDT [*Object1.*]*Keyword1, Number*/[*Object2.*]*Keyword2;*

Like **ADD**, but the addition is time controlled, i.e. the second value is first multiplied with the predefined skill **TIME_CORR** and then added. Useful, when properties are to be altered independently of the current frame rate at a fixed speed, e.g. the height of elevators.

SIN [*Object1.*]*Keyword1, Number*/[*Object2.*]*Keyword2;*

Like **ADD**, but assigns the first parameter the sine of the second parameter.

ASIN [*Object1.*]*Keyword1, Number*/[*Object2.*]*Keyword2;*

Like **ADD**, but assigns the first parameter the arc sine of the second parameter.

SQRT [*Object1.*]*Keyword1, Number*/[*Object2.*]*Keyword2;*

Like **ADD**, but assigns the first parameter the square root of the second parameter.

AND [*Object1.*]*Keyword1, Number*/[*Object2.*]*Keyword2;*

Like **ADD**, but assigns the first parameter the results of a logical AND operation of the first and the second parameter.

ACCEL [*Object1.*]*Keyword1, Number*/[*Object2.*]*Keyword2;*

Like **ADD**, but adding works in a special way similar to an acceleration. The first keyword is equivalent to a speed which is accelerated or decelerated by the value of the second keyword. Inertia and friction factors may be regulated with the predefined skills **INERTIA** (default 1) and **FRICTION** (default 0.5).

RANDOMIZE **[*Object1.*]*Keyword1, Number*/[*Object2.*]*Keyword2;***

Assigns the first parameter a random value between 0 and the second parameter.

RULE ***x = a * (b + c) / d - e;***

Assigns the result of an arithmetic expression to the given skill or parameter. The arithmetic expression may contain numbers, further skills, object parameters, brackets and the four basic arithmetic operators. If a border value (**MIN** or **MAX**) of the resulting skill is traversed, the skill is set to its relevant border value. Because of the limited calculation accuracy (fixed point arithmetic with 3 places after decimal) no factors below 0.01 should be used.

IF_ABOVE ***[Object.]Keyword, Number*/[*Object2.*]*Keyword2;***

Performs the subsequent instruction only if the value assigned to the first keyword - see **SET** - exceeds the number or value of the second keyword. Otherwise the following instruction will be skipped.

IF_BELOW ***[Object.]Keyword, Number*/[*Object2.*]*Keyword2;***

Performs the subsequent instruction only if the value assigned to the keyword - see **SET** - is lower than *number*; see **IF_ABOVE**.

IF_EQUAL ***[Object.]Keyword, Number*/[*Object2.*]*Keyword2;***

Performs the subsequent instruction only if the value assigned to the keyword equals *number*; see **IF_ABOVE**.

Hint: With **IF_EQUAL** only such flags or integer skills may be compared which have not been altered by rules! Skills or parameters that were time corrected (**ADDT**) or changed by ‘uneven’ values at some time or other, are hardly ever exactly equal, which would cause the comparison to fail most of the times. When comparing such ‘uneven’ values you should always use **IF_ABOVE** or **IF_BELOW**.

IF_MIN ***Skill;***

Performs the subsequent instruction only if the skill has reached its minimum border value.

IF_MAX ***Skill;***

Performs the subsequent instruction only if the skill has reached its maximum border value.

ELSE;

Führt die nachfolgende Anweisung nur aus, wenn die auf die letzte IF_..-Anweisung folgende Anweisung übersprungen wurde.

SKIP ***Number;***

Relative jump: omits the given number of instructions in the action and proceeds with performing the remaining instructions. If *number* is negative, instructions are skipped backwards.

GOTO ***Label;***

Jumps to a target label in the action and proceeds from there with the subsequent instructions. *Label* may be any keyword followed by a colon as target mark anywhere between two instructions in the action.

Example:

```
IF_ABOVE      energy, 50;              // If energy just above 50...
              GOTO        enough;      // skip the 2 following lines
PLAY_SOUND    alert, 0.3; // otherwise give acustic warning
FADE_PAL      red_pal,0.5;             // and optic warning
enough:                                // it goes on at this point
```

BRANCH ***Action;***

Aborts the current action at this point and instead executes the given new action.

CALL ***Action;***

Performs the given action immediately and then - either after the end of the **CALL**ed action or during a **WAIT** instruction (see below) in the new action - goes on with the next instruction of the current action.

END;

Ends this action.

WAIT ***Number / Skill;***

Causes the action to stop for the given number of frame cycles. Instead of a fixed number, a skill can also be given, e.g. **TIME_FAC**. During the **WAIT** time period all other actions keep running. If the action with the **WAIT** instruction was **CALL**ed from another action, this other action will also go on and perform its next instructions during the **WAIT** time.

EACH_TICK actions may not contain **WAIT** instructions, neither do actions directly (**CALL, BRANCH**) or indirectly (**IF_HIT**) triggered by **EACH_TICK** actions.

WAITT ***Number / Skill;***

Like **WAIT**, but the action is halted for a given number of ticks. This instruction is able to wait for a fixed period of time.

PLAY_SOUND ***Sound, Volume, [Balance];***

Starts a sound with the given volume. *Sound* is an previously defined keyword for a sound file, *volume* a number between 0 and 1, or a skill. With stereo soundcards you can shift the sound between the left and right channel by the optional parameter *Balance* (-1..+1). If *Balance* is not specified, both channels will be given the same volume.

Alternatively to a value for *Balance* the keyword of an object (wall, thing, actor) may be given. The sound will then emanate from the direction of the object within **SDIST** of its texture.

Example:

```
SOUND    crrahh,<crow.wav>;

TEXTURE          bird_tex    { BMAPS bird_map; SDIST 200; }

ACTOR    bird    { TEXTURE bird_tex; WAY bird_way; }

ACTION   bird_cry { PLAY_SOUND crrahh,0.5,bird; }
```

PLAY_SOUNDFILE ***<filename>, Volume, [Balance];***

Like **PLAY_SOUND**, but the sound is played directly from CD-ROM or hard disk without using up memory. Using an object instead of the *Balance* parameter is not possible here.

STOP_SOUND;

Aborts all sounds running.

PLAY_SONG ***Music, Volume;***

Starts a new background song, which is repeated until another **PLAY_SONG** instruction. *Music* is a previously defined keyword for a midi file, *Volume* may be any value between 0 and 1. By playing a song with *Volume* 0 the music is switched off.

PLAY_SONG_ONCE ***Music, Volume;***

Like **PLAY_SONG**, but plays the song only once.

PLAY_CD *Start, End;*

Plays the audio tracks of a CD. DOS 6.0 or higher and MSCDEX 2.2 or higher are required. The skills or numbers *Start* and *End* respectively indicate the first and the last track to be played (min 1, max. 20). If *End* is larger than the number of tracks on the CD, the CD will be played to its end. If *Start* is 0, the CD currently playing will be stopped; if *End* is 0, the CD will resume at the place it was stopped. If both are 0, nothing will happen.

After each execution of **PLAY_CD** the predefined skill **CD_TRACK** will assume the number of the track currently being played or 0, if the CD is not playing. Inbetween **CD_TRACK** won't change; to display the current track continously, a **PLAY_CD 0,0;** instruction has to be performed repeatedly, e.g. each second.

PLAY_FLIC ***Flic;***

Starts a full-screen animation (professional version only). *Flic* is a keyword for a 320x200 FLI or FLC file with its own palette, defined beforehand via **FLIC**. During flic play the building of the screen and movements will stop, the palette of the animation file will be activated. The 16 'global' **EACH_TICK** actions (see below) keep running, and may be used to start sound effects or songs precisely at each desired frame number by comparing the predefined skill **FLIC_FRAME**.

PLAY_FLICFILE ***<Filename>;***

Like **PLAY_FLIC**; but reads the flic directly from the file. The memory claimed by the animation will be deallocated after playing. This instruction requires disk access. It is to b preferred if long animations are to be played without having to keep them in memory permanently.

STOP_FLIC;

Stops playing the current flic.

BEEP;

Plays a short sequence of notes on the PC speaker. Useful during level development, as it allows you to quickly find out that certain action was triggered.

INPORT *Skill, adr;*

The given *Skill* is set to the content of port *#adr* (professional version only). Through this instruction I/O ports can directly be accessed e.g. to control external devices or to implement new input devices.

Example:

```
SKILL input {}

SKILL my_port { VAL 372; }

INPORT input,my_port; // set input to the content of port #372
```

OUTPORT *Number/Skill, adr;*

The given number or *Skill* is sent to the port *#adr* (professional version only). Only values between 0 and 255 are possible.

FADE_PAL ***Palette, Number / Skill;***

Sets or changes the actual palette by fading. *Palette* is the keyword for a new palette definition, which is to be faded to from the current palette. The number or the skill gives the fade factor (value range from 0..1); by gradually increasing the factor soft fading is achieved. A fade factor of 1 or above makes the given palette the new current palette.

If the palettes differ not only in the shades of their colours, but also in the range of colours, a factor of or above 2 allows you to compute a new shading table. However this will take aprox. 0.3 sec. if the flag **AUTORANGE** is set. With a factor of or above 3 a new **BLUR** table will also be computed if necessary (approx. 2 sec.).

Example:

```
PALETTE black_pal { PALFILE <BLACK.PCX>; }      // all colors just black

PALETTE level_pal { PALFILE <MYPAL.PCX>; }      // define it AFTER black_pal!!
```

```
SKILL      fade {}

ACTION fade_out {    // fades the picture softly to black

SET                        fade,0;

loop:

ADD                        fade,0.1;

FADE_PAL          black_pal,fade;

WAIT                       1;

IF_BELOW          fade,1;

GOTO              loop;

}                                                    // now everything is dark!
```

SETMIDI *Channel*, *status*;

GETMIDI *Channel*, *status*;

Set or get the device type for a midi channel. *Channel* must be in the range 0..15. For *status* the following midi devices are available: 0 = FM mode (default), 1 = digital mode (DDK option only) and 2 = external mode (Midi output via Wave port resp. Midi port of the sound card).

MIDI_COM *Statusb*, *data1*, *data2*;

Send data directly to a Midi channel. The skill statusb is composed of the sum of (Midi command*16) plus channel number (0..15).

Example:

```
SKILL stbef { VAL 11; } // command

SKILL statusb { VAL 0; } // status byte

SKILL channel { VAL 0; } // channel

SKILL data1 { VAL 123; } // 1. data byte

SKILL data2 { VAL 0; } // 2. data byte

ACTION PlayNoteTest {

SET stbef,9; // command

SET data2,100; // volume

loop:

RULE statusb = 16*stbef+channel;

MIDI_COM statusb,data1,Data2;

RULE data1=data1+5;

WAIT 1;

IF_BELOW data1,200;
```

GOTO loop;

}

Please note that you may not send too fast to an external midi channel, because the midi port (only 31 kBit/sec) is not buffered.

INKEY *String*;

Copies the keyboard input into the string with the name or synonym given. The local keyboard layout will be activated automatically. The instruction then waits for the termination of the input via **[Return]** and only then proceeds with the action, similar to **WAIT**. However, no **SAVE/LOAD** instructions are executed during an **INKEY** input. **[Esc]**, **[Up]**, **[Down]**, **[PgUp]**, or **[PgDn]** allows you to abort the input at any time. The previous content of the string will be restored. The text of the input can be edited using **[BackSpace]**, **[Del]**, **[Cursor right]** and**[Cursor left]**. The keyboard layout corresponds to the respective country-specific layout.

If the string appears in a **TEXT** displayed on screen (see below), the input as well as the cursor (flashing character 127 from the corresponding **FONT**) are visible. If the end of the string is reached (results from the length of the intial string of the **STRING** definition), no further keyboard input apart from **[Return]** and **[Esc]**will be accepted. After the termination of the input the skill **RESULT** will be at -1 if the input was aborted with **[Esc]**, 72 with **[Up]**, 73 with **[PgUp]**, 80 with **[Down]** or 81 with **[PgDn]**, else it will be 0.

SET_STRING *String1, String2*;

Copies the content of the 2nd string into the 1st.

FIND *Text, String*;

Sets the **OFFSET_Y** and **INDEX** parameters of the given *Text* to its **STRING** whose first characters match the content of the given *String*.

FREEZE *Bmap, Number/Skill;*

Copies the current 3D image into an existing bitmap, reduced and without panels and overlays. *Bmap* is a keyword that was assigned the bitmap. *Number/Skill* specifies the factor of reduction (1..16). The size of the image depends on the current **MOTION_BLUR**, so better set it temporarily to 0 before **FREEZ**ing. The bitmap may then be displayed as a **PICTURE** in a panel, for example. The modified bitmap is saved with the instruction **SAVE_INFO**; this may only be done one frame cycle after the **FREEZE** instruction at the earliest (insert a **WAIT** instruction!).

SCREENSHOT *Name, Number/Skill*;

Grabs the content of the screen and saves it as PCX file with the given *Name* (max. 5 characters) plus a 3-digit number (*Skill*) and extension "PCX". The size of the picture depends on the current **MOTION_BLUR**, so better set it to zero 1 tick before taking the **SCREENSHOT**.

LOCATE [*Object*];

Through this instruction the lost region of the player, of a thing or an actor is found and re-assigned. This works even if by 'beaming' or moving an actor without **CAREFULLY** flag his original region got lost. **LOCATE** with an object parameter restores the region of the thing or actor concerned, **LOCATE** without parameter restores the actual player region (**HERE** synonym).

DROP ***Object*;**

The given thing or actor is placed in the line of sight of the player (**PLAYER_ANGLE**) at the distance of its **DIST** parameter. If the mouse pointer is active, the object is placed in the direction of the pointer instead (**MOUSE_ANGLE**). If this is not desired, the **MOUSE_ANGLE** has to be set to the **PLAYER_ANGLE** before the instruction. For collision detection to work, the new position of the object must lie in the same region as that of the player; so it's recommended to **DROP** it at a **DIST** of 0.

PLACE *Object*;

If vertex positions of the given wall, thing or actor are changed by its parameters X, Y resp. X1, Y1, Z1, X2, Y2, or Z2, this instruction must be performed. This way walls can be shifted or rotated. Take note that floors and ceilings must not be 'bent`, each wall and thing has to remain in its region and no walls must be crossing!

SHOOT **[*Object*];**

A most important instruction for action games. If the optional parameter *object* is omitted, an **IF_HIT** action is triggered with the nearest object - wall, thing or actor - in the player's line of sight. By the predefined skill **SHOOT_FAC** the 'gun-power', by **SHOOT_RANGE** the maximum range, by **SHOOT_X** and **SHOOT_Y** the deviation from the center of the 3D window is set (range of value from -1..+1). After the **SHOOT** instruction the skill **HIT_DIST** is given the distance of the object hit and the skill **RESULT** contains the power of the hit: **RESULT = SHOOT_FAC * (1-HIT_DIST / SHOOT_RANGE)**. The skills **HIT_X** and **HIT_Y** give the pixel coordinates of the texture pixel hit, relative to the upper left corner of the texture, so that an **ATTACH** bullet hole texture can be set there. If no object is hit, both skills are set to 0.

Only objects with no **IMMATERIAL** flag set will be 'hit' by this instruction. The transparent parts of a thing or actor texture will not be hit by a **SHOOT** instruction. **SHOOT** may be used for shots but also for activating nearby switches or to open doors.

If the keyword or synonym of a thing or actor is given for *object*, this instruction may establish whether the player is visible from the object. In this case the skills **HIT_DIST** and **RESULT** are set according to the distance of player and object; otherwise **HIT_DIST** and **RESULT** are set to 0. After the instruction the predefined skill **SHOOT_ANGLE** gives the angle from the object to the player, which may then be given to a projectile or the actor itself (**SET actor.ANGLE, SHOOT_ANGLE**;).

The skill **SHOOT_SECTOR** (default = 2π) may be used to adjust the range of angle the actor uses when carrying out the **SHOOT** instructions. The **ANGLE** of the the actor is at the centre of this range. If the player is outside this sector, **SHOOT** will merely return a **HIT_DIST** and **RESULT** of 0. This way you may get a monster to see the player only from the front while 'sneaking' on it from behind.

EXPLODE ***Object*;**

Triggers the **IF_HIT** actions on all walls, things or actors which had set **FRAGILE** flags and whose nearest edge is within the distance **SHOOT_RANGE** from the position of the actor with name or synonym *Object*. The **RESULT** skill is set depending on power of the hit - similar to **SHOOT** - to a value between 0 and 1.

After the instruction the skills **HIT_DIST** and **RESULT** are set as with **SHOOT**, should the player himself be hit. The skill **HIT_MINDIST** contains either the distance to the nearest object hit or 0 if no object with **IF_HIT**-action was within the critical distance.

If the **IF_HIT** action of the object hit itself contains an **EXPLODE** instruction, a wait (**WAIT**1;) should be inserted before the action, in order to avoid that two adjoining objects block each other's **EXPLODE** engines.

PUSH *Number/Skill*;

Triggers the **IF_HIT** action with the closest visible object (wall, thing, or actor) within the distance specified by *number* or *skill*. Can be used to open doors or start elevators. The skills **HIT_DIST** (either 0 or distance) and **RESULT** are set like with **SHOOT**.

SHAKE *Object*,

Tells the object (wall, thing, actor) that its position was changed. A **SHAKE** instruction is required after each direct setting of coordinates if the floor height of the object of the length of a wall was changed as a consequence.

Example:

```
ADDT        MY.X1,0.5;

ADDT        MY.Y1,0.5;

SHAKE   MY;
```

LIFT ***Region, Number/Skill;***

Increases the z values of all vertices, things and actors belonging to the region *region* by the given amount or skill. You can use this instruction to accomodate the vertical position of things or actors to lifts moving up or down.

Please keep in mind that the flag **SAVE** must be set with the walls and objects of the corresponding regions, if the change of height is to be saved when saving the score. The same is true for the following regon-changing instructions:

TILT ***Region, Number/Skill;***

Multiplies the z values of all vertices, things and actors inside the region by the given amount or skill. You can use this instruction to change the slope of a region during gameplay.

SHIFT ***Region, dx, dy;***

Shifts all vertices, things and actors belonging to the region *region* in the direction of *x* or *y* on the system of coordinates by the amount or skill given. This instruction for example allows you to let vehicles or rafts move. Still, no wall of the region may neither touch nor cross any other wall of the region while moving!

ROTATE *Region, Number/Skill;*

Rotates all walls and objects of a region by the angel given. The centre of rotation is the region parameter **GENIUS**. The **GENIUS** may also be situated outside the region and be assigned to more than one region at the same time, causing them to rotate around a common centre. No wall of the region may neither touch nor cross any other wall of the region while rotating!

Example:

```
ACTOR wheel_center { TEXTURE any_tex; FLAGS INVISIBLE;}

REGION wheel {

FLOOR_HGT       2;

CEIL_HGT        20;

FLOOR_TEX       wood_tex;

CEIL_TEXstone_tex;

GENIUS          wheel_center;

EACH_TICK       wheel_rotate;

FLAGS           SAVE;                   // to keep any changes
```

```
}

ACTION wheel_rotate {

ROTATE   wheel,0.05;              // 0.05 Rad = ca. 3 Degrees

ADD                    wheel.FLOOR_ANGLE,0.05;      // to rotate the texture also

}
```

SAVE ***"Name", Number/Skill*;**

Saves the game under a specifiable name plus a number in the game directory (see **SAVEDIR**). The name of the saved file is composed of the first five letters of the string "*Name*" plus a three-place number that represents the value of *skill* plus the extension .SAV.

LOAD ***"Name", Number/Skill*;**

Loads, decompresses and decodes the score, which was saved under the name *Name* plus a number of three digits maximum that represents the value of *skill.*

SAVE_INFO ***"Name", Number/Skill*;**

Like **SAVE**; but saves only the **LOCAL** and **GLOBAL** skills, all bitmaps changed by **FREEZE** and all strings changed by **INKEY** in the game file.

LOAD_INFO ***"Name", Number/Skill*;**

Like **LOAD**; but loads only those values saved with **SAVE_INFO**.

SAVE_DEMO "*Name*", *Number/Skill*;

Records the movement of the players to a demo file in the game directory. The name of the saved file is composed of the first five letters of the string "*Name*" plus a three-place number that represents the value of *skill* plus the extension .SAV.

PLAY_DEMO "*Name*", *Number/Skill*;

Replays the demo file. Pressing of any key stops the replaying.

STOP_DEMO;

Stops recording or replaying of the demo file.

MAP ***<Filename>*;**

Level change; loads a new level topography from the file *<filename[.WMP]>* and sets the player and all actors to the their new starting positions.

LEVEL ***<Filename>*[,*"Resourcename"*];**

Complete level change (professional version only); loads a new world definition from the script *<filename*[.WDL]>, loads the topography given in **MAPFILE** and performs the new **IF_START** action. When the WDL file is contained in a new WRS-resource, it may also be specified. Please make sure not to include the resource name in brackets, as it would then be compiled into the level resource! All regions, objects and skills - except the **GLOBAL** skills, see below - are replaced by the elements of the new level.

EXIT ***["Text"/String]*;**

Ends the game and returns to DOS. The optional text, which can be given either directly or as a previously defined string keyword, is issued on the DOS screen after the end of the game.

Besides the actions triggered by object events, the following keywords may be used to specifiy standard actions:

➢**EACH_TICK** ***Action,Action...*;**

This list of up to 16 actions is performed after every frame cycle, i.e. approx. every 1/16 second. The actions are executed consecutively in the order given. With the instruction **SET EACH_TICK.*n,Action*** (*n* = 1..16) actions on whichever position on the list may be changed; **SET EACH_TICK.n,NULL** deletes the action concerned from the listing. **EACH_TICK** actions may not contain **WAIT** instructions nor may they execute **CALL** or **BRANCH** instructions referring to actions containing **WAIT**s.

The event **EACH_TICK** is especially suited to actions 'fluently' changing general parameter in the game. It would certainly be sensible to assign certain positions on the list specific actions with a fixed meaning that may then be changed or removed precisely. **EACH_TICK.16** could be used for the movement of the player, **EACH_TICK.15** for turning lights up and down etc.

Example: The following actions let the floor of a region move up and down like an elevator upon entering it:

```
REGION lift {
....
IF_ENTERlift_start;
}
ACTION lift_start {
PLAY_SOUND      lift_rumpel, 0.3;               // elevator noises
SET                     EACH_TICK.5, lift_up;           // set action to move up
IF_ABOVE        lift.FLOOR_HGT, 10; // already at upper floor?
SET             EACH_TICK.5, lift_down;         // then move down
}
ACTION lift_up {
ADDT                    lift.FLOOR_HGT, 0.2;// lift floor
IF_ABOVE        lift.FLOOR_HGT,10;              // arrived?
SET             EACH_TICK.5,NULL;               // then stop action
}
ACTION lift_down {
ADDT                    lift.FLOOR_HGT, -0.2;           // lower floor
IF_BELOW        lift.FLOOR_HGT, 0;              // arrived?
SET             EACH_TICK.5,NULL;               // then stop
}
```

➢**EACH_SEC** ***Action,Action...;***

This list of up to 16 actions is performed every second. The actions are execuöted consecutively in the order given. With the instruction **SET EACH_SEC.n,*Action*** (n = 1..16) actions on whichever position on the list may be changed; **SET EACH_SEC.n,NULL** deletes the action concerned from the listing.

➢**IF_HIT** ***Action;***

The action is performed, if the player was hit by a SHOOT-instruction.

IF_START ***Action;***

The action specified, which may contain change of palette, title animation, songs or other, is performed at the start of the game.

➢**IF_LOAD**

The action spedified will be executed after loading of a score that was previously saved. It may be used to reset the panels or skills (**MOVE_MODE** etc.) used for saving to normal.

➢**IF_LEFT** ***Action;***

The given action is performed when the left mouse button or the joystick button 1 was pressed.

➢**IF_MIDDLE** ***Action;***

The given action is performed when the middle mouse button or the joystick button 3 was pressed.

➢**IF_RIGHT** ***Action;***

The given action is performed when the right mouse button or joystick button 2 was pressed.

➢**IF_KLICK** ***Action;***

The given action is performed when clicking left with the mouse pointer somewhere within the 3-D window, without hitting any object or panel.

➢**IF_MSTOP** *Action;*

This action is triggered when the mouse pointer is active and the mouse was held stationary for ½ second. The skill **MOUSE_CALM** may be used to specify a maximum distance in mouse-pixels that is still considered to represent immobility (default 3). By evaluating the skill **MOUSE_MOVING** you may also find out, whether the mouse is held stationary (0) or is moving(1).

➢**IF_ANYKEY** ***Action;***

The action specified is performed when any key is pressed.

➢**IF_F1...** ***Action;***

The action specified is performed when the [F1] key is pressed. The following keys may be assigned actions by the same way: **IF_F2...IF_F12, IF_ESC, IF_TAB, IF_CTRL, IF_ALT, IF_SPACE, IF_BKSP, IF_CUU, IF_CUD, IF_CUR, IF_CUL, IF_PGUP, IF_PGDN, IF_HOME, IF_END, IF_INS, IF_DEL, IF_PAUSE, IF_CAR** (Full stop), **IF_CAL** (Comma), **IF_ENTER, IF_0...IF_9, IF_A...IF_Z**. Key actions may be redefined with **SET** instructions (e.g. **SET IF_F1, *action;***) during gameplay.

3. Synonyms

Frequently one action is supposed to change multiple objects of regions. In order to avoid writing an action for each of these objects you may use a **Synonym** instead of the keyword indicating the object or region. Some synonyms are predefined(**MY, HERE, THERE**); any number of furhter synonyms may be defined by the user:

SYNONYM *Keyword* { ... }

Such a synonym definition may contain the following keywords - in the sequence given:

TYPE *Keyword*; Refers to the type of synonym. *Keyword* may either stand for **OVERLAY, TEXTURE, WALL, THING, ACTOR, REGION, PANEL, TEXT, STRING,** or **ACTION**.

DEFAULT *Keyword*; Optional: object the synonym stands for at gamestart.

You can use synonyms like normal keywords:

```
SYNONYM lift_region { TYPE REGION; }

REGION lift_1 {

...

}

ACTION lift_start {

lift_loop:

ADDT            lift_region.FLOOR_HGT,0.2;

IF_ABOVE        lift_region.FLOOR_HGT,10;   // desired height reached?

END;                                                                    // then stop

WAIT            1;

GOTO            lift_loop;

}

ACTION lift1_start {

SET             lift_region,lift_1;                     // assign region

CALL            lift_start;

}
```

Synonyms can be assigned each other:

```
SYNONYM         lift_syn1           { TYPE REGION; }

SYNONYM         lift_syn2           { TYPE REGION; }

SYNONYM         lift_floor   { TYPE TEXTURE; }
```

```
ACTION lift1_to_lift2 {
SET             lift_syn1, lift_1;
SET             lift_syn2, lift_syn1;
SET             lift_floor, lift_syn2.FLOOR_TEX;
}
```

Action synonyms can be started by **CALL** or **BRANCH** instructions.

The following synonyms are predefined:

➢ **HERE**	This synonym stands for the region the player is in; important for the collision detection and height adjustment. If the player changes its region by direct displacement of the player position (skills **PLAYER_X**, **PLAYER_Y**) **HERE** may have to be manually reassigned.
THERE	Synonym either for the region that has triggered the current action (by **IF_ENTER**, **EACH_TICK**, etc), or the region of the object (**MY**) which has triggered the action.
MY	Synonym for the object that has triggered the current action (by **IF_NEAR**, **IF_FAR**, **EACH_TICK** etc.). This allows to directly adress singular objects without knowing their index (e.g. with **SET MY.TEXTURE, crash_tex;**). If the current action is not triggered by an object event, this synonym is undefined.
HIT	Synonym for the object last hit with the **SHOOT** instruction by the player, or objects clicked with the mouse, or the object hit by the lates **EXPLODE** instruction which is closest to the center of the explosion.

4. Skills & role playing games

'Role Playing Games' is a traditional expression for games in which players and actors have individual properties (skills) like in real life. The nature and the effects of these properties can be defined freely. Skills are like variables in a programming language. There is a number of predefined skills which may for example determine the movemental behaviour of the player. Additionally any number of skills can be defined - state of health, combat prowess, magic ability, blood pressure, level of alcohol in blood and so on... all this is left to the author’s imagination.

The skills are defined as follows:

SKILL *Keyword* { ... }

Such a skill definition may contain - in the given order - the following keywords:

TYPE *Keyword*; This is related to the type of skill. *Keyword* stands for **LOCAL** or **GLOBAL** or **PLAYER** (default). There are only differences concerning the behaviour of the skills during saving and loading: **GLOBAL** skills are saved with the instructions **SAVE** and **SAVE_INFO**,. **LOCAL** skills only with **SAVE_INFO**, **PLAYER** skills only with **SAVE**.

- **VAL*Number*;** Fixed point number, starting value of a skill. If no value is given, the skill value is set to 0.

- **MIN*Number*;** Fixed point number, lower margin of the skill. The skill value never drops below this margin.

- **MAX *Number*;** Fixed point number, upper margin of the skill. The skill value never exceeds this margin.

GLOBAL skills are especially suited to all values that are supposed to be kept for each level of the game, like prowess, score, or severity. After starting the game or changing levels (instruction **LEVEL**) they may be reloaded from the last game score saved using a **LOAD_INFO** instruction.

LOCAL skills always keep the last value when loading a game score. They are suited for user-settings like volume or screen resolution that are not supposed to change when loading an old score.

Once the skills are defined, their values may be changed, like with any other keyword, by actions with **SET**-, **RULE**- or other instructions.

Example: At beginning of game a countdown is to start, which terminates the game after 60 seconds. The remaining time is to be shown in a panel.

```
SKILL counter { VAL 60; MIN 0;}

ACTION countdown {

RULE                counter = counter - 1;

IF_MIN    counter;

                    EXIT;     // Game ends on counter == 0

}

EACH_SEC countdown;

FONT countdown_font <led.bbm>,16,32;

PANEL grau {
```

```
PAN_MAP          graupanel;

DIGITS           60,4,2,countdown_font,1,countdown;

}
```

Another example: The player has a quality called HEALTH. This health should normally decrease continuously. If the player is hit by an evil actor, the HEALTH quality suddenly drops by a fixed amount, and then returns slowly to the previous value later. All this may be defined as follows:

```
SKILL health       { DEFAULT 100; MIN 0; MAX 1000; }

SKILL recover      { MIN 0;}

SKILL rec_factor   { DEFAULT 0.5; }

ACTION permanent {

RULE health = health + rec_factor * recover - 0.005;

RULE recover = recover - 1;  // Decrease value down to 0

}

ACTION ouch {

RULE health = health - 25;    // Hit - Health drops

RULE recover = 10;                    // For 10 seconds time to recover

}

EACH_SEC permanent;
```

Please note that the values are choosen to allow the player a recovery time of exactly 10 seconds after each hit - if I have calculated right...

Besides the user defined skills, the following predefined skills are available, which may be evaluated in actions and - if marked with the triangle ➢ - may also be changed:

➢**SCREEN_WIDTH** ➢**SCREEN_HGT**	The width and height of the 3-D window in pixels. The default and maximum values are the result of the screen resolution set via the **VIDEO**. You can change the window size during gameplay; please note that the width must be divisible by 16, the height by 2. By redefining these skills the maximum window size can be set at game start to save memory. These maximum

	values may then never be exceeded during gameplay.
➢**SCREEN_X** ➢**SCREEN_Y**	Horizontal and vertical distance of the 3-D window from the upper left corner of the screen in pixels; default = 0. The maximum distance results from the screen resolution set by **VIDEO** minus **SCREEN_WIDTH** and **SCREEN_HGT** respectively. The horizontal distance must be divisible by 4.
➢**ASPECT**	Height-to-width ratio of the rendered scene within the 3-D window, range of value from 0.1..10. The default value of 1 sets a ratio of 1:1.
➢**SKY_OFFS_X** ➢**SKY_OFFS_Y**	Horizontal and vertical shifting of all sky textures in pixels. **SKY_OFFS_X** must never be negative. By periodically increasing **SKY_OFFS_X** in an action you may achieve a 'wandering cloud' effect.
➢**MOTION_BLUR**	Parameter for the motion blur effect (0..1). The motion blur effect automatically reduces the screen resolution during player movement; causing the movement to appear smoother on slower machines. The default value is 0 (no motion blur effect).
➢**BLUR_MODE**	By setting this skill (default 0) to 1 the motion blur is permanently activated, even it the player doesn't move. By setting **BLUR_MODE** to 0.5 the blurring is activated if either the player or the mouse moves.
➢**RENDER_MODE**	Rendering activity within the 3-D window. The following values are possible: 2:

	Complete rendering; necessary after changing the screen size or after direct displacement of the player position. 1: Partial rendering; necessary after direct displacement of objects or walls or the floor or ceiling level of a region. 0.5: Default setting. The image is rendered according to the movements of the player. 0: Rendering is suppressed (to show titles, credtis, or full-screen menus). If **RENDER_MODE** is returned to 0.5 automatically after each frame cycle.
➢**MOVE_MODE**	Movement of players and actors, default=1. With this skill, actions and movement in the level may be 'frozen'. The following gradation is possible: 1: Default. 0.5: The movements of actors and object **EACH_TICK** actions are stopped. 0: Also the movement of the player and all object and region events

	won't be carried out any more. -0.5: All actions, except the keyboard events, are stopped.
➢**CLIPPING**	Controls the suppression of objects outside the **CLIP_DIST**. The following gradation is possible: 0: Default; walls are not visible if one of their vertices is outside the **CLIP_DIST**. 0.5: Walls are not visible if both of their vertices are outside the **CLIP_DIST**, and their flag **FAR** is not set. If you have a large outside area, use flag **FAR** for the surrounding **SKY** walls. 1: Walls are not visible if either both vertices are outside the **CLIP_DIST**, or a wall of their region is not visible. Walls with flag **FAR** are visible in each case. Use this with caution - it only works with your level split into small regions.

➢**THING_DIST** ➢**ACTOR_ DIST**	Ratio of the thing's resp. actor's, and wall's **CLIP_DIST**. **THING_DIST** must be between 0 and 1 (default), while **ACTOR_DIST** must be equal or below **THING_DIST**.
➢**MAP_OF FSX** ➢**MAP_OF FSY**➢**MAP _OFFSX** ➢**MAP_OF FSY**	Horizontal and vertical deviation of the map-centre from the middle of the 3-D-window in pixels.Horizontal and vertical deviation of the centre of the map from the centre of the 3D window in pixels; default 0.
■**MAP_MAXX** ■**MAP_MI NX** ■**MAP_MA XY** ■**MAP_MI NY**	Maximum and minimum X and Y coordinates of all the level's objects; is automatically calculated at game start.
➢**MAP_EDGE_X1** ➢**MAP_ED GE_X2** ➢**MAP_ED GE_Y1** ➢**MAP_ED GE_Y2**	Left and right limits of the map display on screen, given as distance in pixels from the upper left edge of the screen. Defaults correspond to the current size of the screen.
➢**MAP_SCALE**	Scale of the automap relative to the size of the 3-D window; default=0.9. On a value of 1 the automap fits exactly in the window.

➢**MAP_MODE**	Map display mode; range of values from 0..1, default 0. On values > 0 the map of all regions and objects previously explored and seen is shown in the 3-D-window. On values of >= 1 all objects - including objects not yet seen - are shown.
➢**MAP_LAYER**	Number of the overlay layer (see **LAYERS**), the map appears upon. Range of value from 0..16, default 0. All overlays on higher layers are drawn over the map.
➢**MAP_ROT**	If this skill is set to 1, the map will rotate along with the player angle around the player symbol, similar to a radar display. However, only objects within **CLIP_DIST** will be shown.
➢**COLOR_PLAYER**	Color number for the player symbol on the automap (default=7).
➢**COLOR_ACTORS**	Default color number for actor symbols on the automap (default = 3).
➢**COLOR_THINGS**	Default color number for thing symbols on the automap (default = 13).
➢**COLOR_WALLS**	Default color for walls on the automap (Default = 244). If the color lies within a shading range, the walls are drawn with 'antialiasing'.
➢**COLOR_BORDER**	Default color for border walls on the automap (Default = 244). If the color lies within a shading range, the borders are drawn with 'antialiasing'.
➢**TEXT_LAYER**	Number of the overlay layer (see **LAYERS**), above which all text appears. Range of value from 0..16, default 0. All overlays on higher

	layers are drawn above the text.
➢**PANEL_LAYER**	Number of the overlay layer (see **LAYERS**), above which all panels appear. Range of value from 0..16, default 0. All overlays on higher layers are drawn above the panels.
➢**MOUSE_MODE**	Mouse representation. At a setting of 0 (default) the mouse pointer is not shown on the screen; if set at 1 the pointer (**MSPRITE**, see below) appears. If set at 2 mouse movements don't change the **FORCE_**... skills anymore, allowing the mouse to be moved independently from the player.
➢**TOUCH_MODE**	If set to 1 (default) the texture strings (**TOUCH**) of touched objects are shown at the mouse pointer position.
■**MOUSE_-MOVING**	Mouse is moving (1) or has been immobile for 1/4 second.
➢**MOUSE_CALM**	Maximum distance still recognized as immobility for **MOUSE_MOVING** (default 3)
➢**MOUSE_TIME**	Time in ticks that is used to measure the distance **MOUSE_CALM** in order to determine **MOUSE_MOVING**; default 4.
■**MICKEY_X** ■**MICKEY_Y**	Movement of the mouse in dots since the last frame; can be used to set the skills **MOUSE_X** and **MOUSE_Y**.
➢**MOUSE_X** ➢**MOUSE_Y**	Horizontal and vertical position of the mouse pointer in pixels, relative to the upper left screen corner. If the mouse pointer is switched on through **MOUSE_MODE**, it may be moved over the screen by changing

	these skills.
	
	Example:
	
	ADD MOUSE_X,MICKEY_X;
	
	ADD MOUSE_Y,MICKEY_Y;
	
	The **MIN** and **MAX** values should be adjusted in such a way as to assure that the mouse pointer cannot move beyond the edge of the screen.

■**MOUSE_ANGLE**	Directional angle of the mouse pointer in the level, e.g. for throwing away an object at the mouse pointer (**DROP**); is automatically calculated from **MOUSE_X** and the **PLAYER_ANGLE**. May be changed directly to adjust the **DROP** angle.
➢**TOUCH_DIST**	Maximum distance of an object to trigger the texture mouse events **TOUCH, IF_TOUCH, IF_RELEASE, IF_KLICK**. Default = 100 steps.
■**TOUCH_STATE**	This skill (default 0) takes on the value of 1 when the mouse pointer is on an object with **TOUCH** text, 2 if an **IF_CLICK** action was assigned to the object texture, and 3 if both are the case.
■**JOYSTICK_X** ■**JOYSTICK_Y**	Movements of the joystick axes in the range -255...+255.

➢**SOUND_VOL**	Volume for sound effects, range from 0..1; is to be multiplied by the individual volume of each sound.
➢**MUSIC_VOL**	Volume for music, range from 0..1; is to be multiplied by the individual volume of each song. If this value is set to 0, the music is switched off.
■**CHANNEL**	Number of the sound channel (0..7), the last sound was assigned to for example by a **PLAY_SOUND** instruction. If the sound is not played for one reason or other (e.g. if all channels are busy with **SLOOP** sounds), **CHANNEL** acquire a value of -1
■**CHANNEL_0..** ■**CHANNEL_7**	These skills allow you to continuously query for the state of the 8 sound channels: 0 = No sound, channel free 1 = Normal sound is playing 2 = **SLOOP** sound playing.
➢**AMBIENT**	Global light intensity (range -1..+1, default 0) that is added to all texture and region **AMBIENT**s.
➢**PLAYER_LIGHT**	Power of a source of light the player carries with him (0..1, 16 grades, default 1).
➢**LIGHT_DIST**	Distance the between player and the beginning of a shading area (default 10 steps). Objects closer than **LIGHT_DIST** will no longer be affected by **PLAYER_LIGHT**.
■**DARK_DIST**	Distance of the area of darkness from the player, is automatically

	recalculated on every change of **PLAYER_LIGHT**.
➢**PLAYER_WIDTH**	Minimal distance of the player from walls and objects; used for the collision detection. Default and minimum value 1.2 steps.
➢**PLAYER_SIZE**	Distance between the 'feet' and the 'eyes' of the player in steps (default = 3 steps). Essential for calculating the eye level as well as for collision detection.
➢**PLAYER_CLIMB**	Maximum heigth difference in steps, which the player can overcome when changing regions - e.g. when ascending a staircase. Used for the collision detection. Default =1.5 steps.
➢**WALK_PERIOD**	The quantity of steps for a period of rhythmical up/down or back/forth movements dependant on the course being followed, to represent walk or swim motions. Default = 4 steps. Simultaneously the floor texture sound is repeated as the sound of the player's footsteps.
➢**WALK_TIME**	Time constant for the **WALK** motion. Default = 4 Ticks.
➢**WAVE_PERIOD**	Number of ticks for a period of rhythmical time-dependant player movements. Default = 16.
■**WALK**	Current steering of the rhythmical player walk motion (-1.0 .. +1.0).
■**WAVE**	Current steering of the rhythmical wave motion (-1.0 ... +1.0).
➢**PSOUND_VOL**	Relative volume of the player's sound (sound of the floor texture) with a range of 0..2 (default = 1). The volume with which the sound is

	played results from the product of (**PSOUND_VOL * texture.SVOL**).
➢**PSOUND_TONE**	Pitch of the player's sound (sound of the floor texture) with a range of 0..4 (default = 1).
➢**PLAYER_VX** ➢**PLAYER_VY**	Speed of the player in X and Y direction of the net of coordinates in steps per tick. By changing this skill, the player can be moved horizontally; is automatically adapted in case of collisions with walls or objects.
➢**PLAYER_VZ**	Speed of the player in Z-direction (vertical).
➢**PLAYER_VROT**	Speed of rotation of the player's line of sight (**PLAYER_ANGLE**) in radians per tick. By changing this skill, the player's head can be turned around his vertical axis.
➢**PLAYER_TILT**	Tangent of the player's vertical line of sight (turning around the transverse axis). By changing this skill the view of the player is lifted or lowered.
➢**PLAYER_ARC**	Range of the player's eye's focal length in radians (0.2..2.0). May be changed during the game for 'zoom'- or 'stoned'-effects. The default value 1.0 represents approximately the field of vision of the human eye (ca. 60°).
	Coefficient for friction on the **ACCEL** instruction; range from 0 to

➢**FRICTION**	1, default 0.5.
➢**INERTIA**	Coefficient for inertia (mass) on the **ACCEL** instruction; any value over >0, default 1.
➢**SHOOT_RANGE**	Maximum distance of an object for the **SHOOT** instruction; default 500 Steps.
➢**SHOOT_-SECTOR**	Range of values for the angle for the **SHOOT** instruction from object to player; default = 2π. Needs to be set to the desired value before each **SHOOT** instruction. If the player is outside this sector (relative to the actor's line of sight), **SHOOT** will always return a **HIT_DIST** and a **RESULT** = 0.
➢**SHOOT_FAC**	'Hit-power' factor for the **RESULT** calculation on the **SHOOT** and **EXPLODE** instructions; range 0..1, default 1.
➢**SHOOT_X** ➢**SHOOT_Y**	Horizontal and vertical deviation of the **SHOOT** direction from the center of the 3-D window or from the center of the object within a range of value of 0..1.
■**HIT_DIST**	Distance to the last object hit by **SHOOT** or **EXPLODE** instructions in steps. If no object was hit, this skill is set to 0.
■**HIT_MINDIST**	Distance of the object hit stringes by an explosion from the center of **EXPLODE**.
■**RESULT**	This skill represents the 'power' of

	an event, the impact of a hit or the result of an action, generally in a range of 0..1.
■**SHOOT_ANGLE**	Angle of the shooting actor relative to the player; is set by a **SHOOT** instruction and can be used to set the initial angle of a bullet.
■**HIT_X** ■**HIT_Y**	Coordinates of the texture pixel hit by a **SHOOT** instruction, relative to the upper left corner of the texture. These skills are also valid during texture mouse actions (**IF_CLICK, IF_TOUCH**). For walls **HIT_X** returns the horizontal pixel coordinate of the **SHOOT** hit or the mouse click, including the texture offset (**OFFSET_X**).
➢**SKIP_FRAMES**	Actors which aren't visible and are outside their **DIST** from the player normally move only each 6th frame (covering a greater distance), to save rendering time. This skill (default 5) allows you to redefine the number of skipped frames.
➢**ACTOR_CLIMB**	With this skill (default 1) you can define the maximum height of steps which actors can climb on stairs during their **TARGET** movements (like **PLAYER_CLIMB**, see below).
➢**ACTOR_WIDTH** ➢**THING_WIDTH**	These skills (default = 1) allow you to define a factor the texture width of all actors or things is to be multiplied with for the purposes of collision detection.
■**ACTOR_-IMPACT_VX** ■**ACTOR_-**	Rebound of an actor from an obstacle in direction x and y, or by colliding with the floor or ceiling of its region. Theses skills contain valid values only with the actor's **CAREFULLY** flag set, only within

IMPACT_VY **■ACTOR_-** **IMPACT_VZ**	their **EACH_TICK** action and only immedeately after an actor movement (**MOVED** flag set).
■ACTOR_- **FLOOR_HGT** **■ACTOR_-** **CEIL_HGT**	Height of floor and ceiling at the position of the actor. These skills contain valid values only for actors with **TARGET** movement and **CAREFULLY** flag, only within their **EACH_TICK** action and only immedeately after an actor movement (**MOVED** flag set).
➢PLAYER_X **➢PLAYER_Y**	Position of the player on the X- and Y-axis of the coordinate system. Please note: By directly changing the player position no collision detection will occur, and you have to assign the new player region manually!
➢PLAYER_Z	Absolute height of the player's eye level in steps, relative to the leve's zero height (cf. **PLAYER_HGT**). By directly changing the player position no collision detection will occur!
➢PLAYER_ANGLE	Horizontal line of sight of the player in radians (0..6.28). The angle 0 represents the direction of the positive X axis of the coordinate system (east).
■PLAYER_SIN **■PLAYER_COS**	Sine and cosine of the horizontal viewing direction. These values are needed for those rules calculating the components **PLAYER_VX** and **PLAYER_VY** from the player's speed.

■**PLAYER_SPEED**	Component of speed in direction of the player' line of sight; is calculated from **PLAYER_VX**, **PLAYER_VY** and **PLAYER_ANGLE**. When moving exclusively sidewards this skill is 0; if the player is moving backwards, **PLAYER_SPEED** is negative.
■**ACCELERATION**	Acceleration in direction of the player's line of sight; is calculated from changes in **PLAYER_SPEED**. If the player is moving backward, **ACCELERATION** becomes negative.
■**PLAYER_HGT**	Relative heigth of player`s feet above or below the region's floor level; important for correcting the vertical motion. Value is yielded from (**PLAYER_Z - PLAYER_SIZE - FLOOR_HGT**).
■**FLOOR_HGT** ■**CEIL_HGT**	Real floor and ceiling height in steps at player position; is automatically calculated from the region floor or ceiling heights, the Z values of the edge vertices and the slope of the region.
➢**IMPACT_VX** ➢**IMPACT_VY**	Collision vector; change of speed by collision with walls or objects in X and Y direction. This values are automatically increased on every collision and have to be manually set back to 0 after evaluation. They may be used to generate an intensified 'bouncing-off' (pinball effect).
■**PLAYER_-DEPTH**	Depth of an underwater **BELOW**region below the player, its height of ceiling corresponding to the height of the floor of the player region.
➢**PLAYER_LAST**	

_X, ➢**PLAYER_LAST_Y**	These skills contain the last player position during the previous frame cycle and are used for the internal calculation of the skills **STEP, WALK** etc. If the player is supposed to meet without any **WALK** changes - eg when moving along with a vehicle - these values may be changed via an action.
➢**IMPACT_VX** ➢**IMPACT_VY**	Collision vector; change of speed as consequence of the player or a **STICK** actor colliding with a wall in X or Y direction. These values are increased automatically at each collision and have to be reset to 0 manually when evaluated. May be used to generate an increased rebound (pinball machine effect).
➢**IMPACT_VZ**	Collision vector, change of speed in vertical direction as a result of collisions with floor or ceiling.
➢**IMPACT_VROT**	If an actor with target **STICK** bounces against an obstacle, this skill will return its resulting change of angle relative to the player. **IMPACT_VROT** may be used to give the player a spin by rebounding.
■**BOUNCE_VX** ■**BOUNCE_VY**	These skills contain a reflection vector if the player collides with a wall. If they are added to the player's speed, the player is given a realistic 'bouncing' behaviour like a pinball.
■**SLOPE_AHEAD** ■**SLOPE_SIDE**	Ascent of the region floor in direction of the player’s line of sight and perpendicular to it (rising per step). May be used for example for movement actions of the player, to raise his sight or let the player slide down a slope.

■**SLOPE_X** ■**SLOPE_Y**	Ascent of the region floor in direction of the X and Y axis.
■**MOVE_ANGLE** ■**DELTA_ANGLE**	The skill **MOVE_ANGLE** contains the real movement direction of the player, the skill **DELTA_ANGLE** the angular difference between **MOVE_ANGLE** and **PLAYER_ANGLE**.
■**NODE**	Number of the current node with multi-plyer games; is yielded from the command line (professional version only).
➢**REMOTE_0** ➢**REMOTE_1**	Skills to transmit information and events to a linked up PC with multi-player games (professional version only).
■**RANDOM**	This skill delivers a random number between 0.0 and 1.0, which changes after every frame cycle.
■**TIME_CORR**	Time correction factor. On a frame rate of 16 frames/sec. this skill has a value of 1; on higher frame rates the value drops, on lower ones it is proportionally increased. This is used to adapt speeds in the game to different frame rates.
■**TIME_FAC**	Time correction factor, inversed value of **TIME_CORR**. The faster

	the frame rate is the higher this skill becomes.
➢**TICKS**	The value of this skill increases every 1/16 second by 1.
➢**SECS**	The value of this skill increases every second by 1.
➢**STEPS**	The value of this skill increases by the number of steps the player covers on his way.
■**FLIC_FRAME**	Gives the frame number of the currently playing flic. Can be used to start speech, sound effects or music within a global **EACH_TICK** action at the desired frame number, by instructions like this: IF_EQUAL FLIC_FRAME, **50**; PLAY_SOUND bang,0.7;
■**CD_TRACK**	Number of the audio CD track currently playing; is updated with the instruction **PLAY_CD**.
■**MOUSE_LEFT,** ■**MOUSE_MIDDLE,** ■**MOUSE_RIGHT,** ■**JOY_4**	Condition of the mouse or joystick button concerned; 0=not pressed, 1=pressed. The three mouse buttons correspond to the first, third and second joystick button.
■**KEY_ANY**	These skill takes on the value of 1 if any key is pressed, otherwise it is 0.
■**KEY_F1...KEY_F12,** ■**KEY_ESC,** ■**KEY_TAB,** ■**KEY_SHIFT,** ■**KEY_CT**	Condition of the key concerned; 0= not pressed, 1= pressed.

RL, **■KEY_ALT,** **■KEY_SPACE,** **■KEY_BKSP,** **■KEY_CUU,** **■KEY_CUD,** **■KEY_CUR,** **■KEY_CUL,** **■KEY_PGUP,** **■KEY_PGDN,** **■KEY_HOME,** **■KEY_END,** **■KEY_INS,** **■KEY_DEL,** **■KEY_PAUSE,** **■KEY_CAR,** **■KEY_CAL,** **■KEY_PLUS,** **■KEY_MINUS,** **■KEY_ENTER,** **■KEY_0...KEY_9,** **■KEY_A...KEY_Z**	

■**FORCE_AHEAD**	Analog value entered by mouse, joystick or keybord (Cursor up / dn keys) for forward or backward movement of the player; range of value from ca. -1 .. +1. The range of value for the movement skills may be influenced by the keywords **KEY_SENSE**, **JOY_SENSE**, **MOUSE_SENSE**, **SHIFT_SENSE** (s.b.).
■**FORCE_STRAFE**	Value for left and right movement, entered by the [,] and [.] keys or by pressing **[Alt]** and moving the mouse or joystick sidewards.
■**FORCE_ROT**	Value for the horizontal rotation of the line of sight, entered by the cursor right/left keys or by moving the mouse or joystick sidewards.
■**FORCE_TILT**	Value for lifting and lowering the line of sight, entered by pressing **[Pg up]** or **[Pg dn]**.
■**FORCE_UP**	Value for vertical movements (e.g. jumping or ducking), entered by pressing the **[Home]** or **[End]** key.
➢**KEY_SENSE**	Sensitivity of the player movements by operating the cursor key, **[,]**, **[.]**, **[PgUp]**, **[PgDn]**, **[Home]** and **[End]**. The skill gives the value for the corresponding **FORCE** skill on operating the button (default = 0.7).
➢**SHIFT_SENSE**	Factor for raising the keyboard values for movement by pressing the **[Shift]**-key (default = 2).
➢**MOUSE_SENSE**	Sensitivity of movement by mouse. The value of 1 represents middle sensitivity (default=1).
➢**JOY_SENSE**	Sensitivity of movement by joystick. The value of 1 represents a middle

	sensitivity (default=1).
The following skills are for the purpose of testing only. They are available in the editor WED.EXE, but not in the runtime module VRUN.EXE:	
■**ERROR**	Error code for the current image; may be displayed in a panel. The following error codes are possible: 0 = no error, 1 = **CLIP_DIST** too small, 3 = **NEXUS** too small (too many walls visible), 5 = missing Bitmap, 6 = missing region texture, 7 = faulty sound, 8 = incorrect use of synonyms, 9 = missing region. The last error code is held until a new error occurs. The occurance of an error in the view is also signalled by a clicking noise from the PC speaker.
➢**DEBUG_MODE**	If this skill is set to 1, the program stops after every frame cycle until the **[S]**-key is pressed (Single Step Mode). May also be activated by **[Ctrl][Alt][S]** or by the command line option **-SST**.

■**MAX_DIST**	Distance of the farthest visible vertex within **CLIP_DIST**; can be used to optimize the region **CLIP_DIST**s.
■**ACTIONS**	Number of currently active actions.
■**ACTIVE_NEXUS**	Utilization of the nexus.
■**ACTIVE_TARGETS**	Number of actors with **TARGET**.
■**ACTIVE_OBJTICKS**	Number of objects with running **EACH_TICK** actions.

5. Changing levels, saving the game and the multiplayer mode

   Changing levels with the instruction **LEVEL** corresponds to restarting the game. All skills and parameters are reloaded from the WDL file, except the **LOCAL** and **GLOBAL** skills. For that, in both the new level and the old one exactly the same **LOCAL** and **GLOBAL** skills need to be defined in the same order; the 'normal' skills may differ. **GLOBAL** skills allow you to buffer parameters and ‘transport’ them to the new level, e.g. combat prowess and equipment of the player.

   When changing the topography with the instruction **MAP**, the **LOCAL**, **GLOBAL** and PLAYER skills are kept, with exception of the player position. All walls, things, regions and actors are loaded from the new WMP file.

   With the instructions **SAVE** and **LOAD** game scores may be saved and reloaded. The following parameters of the game will be saved:

   - The name of the actual .WDL- and .WMP file,
   - all **PLAYER** and **GLOBAL** skills (**LOCAL** skills are not saved),
   - all synonyms,
   - the state of the lists **EACH_TICK, EACH_SEC, LAYERS, PANELS, MESSAGES**,
   - all key actions (**IF_F1** etc.),
   - the actual state of all currently running actions,
   - the positions and all other parameters of any **PANEL**, **TEXT**, or **OVERLAY**,
   - the positions, skills and other parameters of all actors,
   - the flags of all regions, walls and things,

- the positions, skills and all other parameters of any region, any wall and any thing, for which the flag **SAVE** is set.

The game-parameters that may be saved too, result from the listings of keywords, which themselves may have any length:

SAVE_KEYS Keyword11.Keyword12, Keyword21.Keyword22, ...;

The stating of keywords ensues as on the SET-instruction. Any number of SAVE_KEYS-instructions may stand in the WDL. Synonyms like MY, THERE or HERE may not be not used. In the listing may be given e.g. the condition of doors or the FLOOR_HGT and CEIL_HGT of elevators.Please note that all **EACH_TICK** actions running at the time of saving are started anew after reloading the game. If another level is running at the time of loading, the levels will be changed automatically. The loading itself is - like on **LEVEL** and **MAP** - not carried out directly in the action with the **LOAD** instruction, but rather at the end of the action.

With the instructions **SAVE_INFO** and **LOAD_INFO**, which will work exclusively on **GLOBAL** skills, general parameters of a game, e.g. sound volume or screen resolution can be saved independently of game score saving.

A similar KEY-listing exists for the transmission of parameter-changes on multiplayergames:

REMOTE_KEYS Keyword11.Keyword12, Keyword21.Keyword22, ...;

After a cange of parameters has occured this listing will be checked after every picture build-up. The changed parameters are transmitted by network, modem, or serial port to the adapted nodes. To save math-time, this listing should be short. Also bitmaps changed with **FREEZE** are saved with this command. In the tutorial actions for level changing and game saving are discussed in more detail.

To let two player play the game as opponents (*Deathmatch* mode) two PCs may be linked via a nullmodem cable - e.g. a serial laplink-, Norton Commander-, or Interlink transmission cable. The same level must run on both computers. In order to establish the link the number of the serial port for communication must be given via command line option (option **-COM***n*) as well as the ‘network number’ (-**NODE0** or -**NODE1**) when starting the program. The **NODE** given on start up may be queried in actions with the skill **NODE**.

In the level the ‘opposing’ player is represented by an actor with the **TARGET NODE0** or **NODE1**. Such a actor will perform the movements of the player on the PC linked up to the corresponding network number **NODE0** or **NODE1**. The PCs linked up in the simple serial multiplayer mode do not transmit the position of actors nor the changes to objects and regions. Nevertheless simple actions (moving lifts or doors) may be transmitted to the other PC by evaluating **REMOTE** skills.

6. User interface: Panels, Texts and Overlays

At game start the 3-D window fills the entire screen; at first no menu is visible. The user interface, however, can be freely defined with the help of overlays and panels. Graphic elements within the 3-D window, like cockpits, tools or weapons, are best defined as **overlays**. Overlays are drawn faster than panels, but they have no buttons or displays and need three times the memory space. Up to 16 overlays may be shown one over the other.

OVERLAY *Keyword* { ... }

This assigns an overlay definition to the keyword. It may contain - in given order - the following keyword assignments:

- **POS_X** ***x*;**
- **POS_Y** ***y*;**

Distance of the upper left corner of the overlay from the upper left corner of the 3-D window or - if flag **ABSPOS** (see below) is set - from the upper left corner of the screen in pixels. By changing these values the overlay may be shifted across the screen during gameplay.

CYCLES *Zahl*;

Quantity of phases on animated overlays (1..64, default = 1). If this keyword is not stated, the overlay is not animated

SIDES *Zahl*;

Quantity of 'Sides' of the overlay (1..64, default = 1). Every side is appropriate to one or - on animated overlays - more overlay-bitmaps. The side-bitmaps are changing depending on the value of SIDE (s.b.

OVLYS ***Ovly*;**

Listing of at maximum 64 keywords, to which the single overlay-bitmaps have been assigned to by OVLY-keyword. The single overlay-bitmaps may have a different size. The quantity of bitmaps must be the equivalent of the product (SIDES*CYCLES).

DELAY *Zahl1, Zahl2...*;

Listing of duration of phases in ticks (1..31) for every phase of animation. The quantity of numbers corresponds to the value of cycles. If this listing is not stated, animation is working by one tick per phase.

- SIDE *Zahl*;

Represented SIDE of the overlay; value of 0..1. The SIDE visible on screen is given by the product (SIDE*SIDES).

OFFSET_X *x1, x2...*;

OFFSET_Y *y1, y2...*;

Listing of horizontal and vertical differences of position (offsets) for the single overlay-bitmaps in pixels. The quantity of positions have to be appropriate to the quantity of OVLYS. Every overlay-bitmap is shifted by its respective x- and y-offsets with regard to POS_X and POS_Y. If the offset-listings are not stated, no shifting occurs.

The keyword for the actual overlay a bitmaps needs to be assigned to with the keyword **OVLY**.

- **SIZE_X** *x*;
- **SIZE_Y** *y*;

Size of the overly bitmap in pixels; may be evaluated in actions

FLAGS *Keyword1,Keyword2...;*

Here a list of keywords (flags) determining the properties of the overlays may be given. The following flags may be set:

ABSPOS

If this flag is set, the overlay position (**POS_X**, **POS_Y**) does not refer to the upper left corner of the 3-D window, but rather to the upper left corner of the screen.

- **VISIBLE**

By setting this flag through an action, the overlay will appear directly on the **MAP_LAYER** (see above). This allows you to display as many overlays as you want next to each other on the screen, e.g. for the purpose of giving an ‘inventory’.

A standard application for an overlay is the mouse pointer:

- **MSPRITE** ***Overlay*;**

This overlay appears as mouse pointer on the screen. The mouse pointer is moved with the predefined skills **MOUSE_X** and **MOUSE_Y**. The overlay parameters **POS_X** and **POS_Y** define the 'Hot Spot' pixel of the mouse pointer where clicking and touching will be performed.

Panels are used to represent operating features, displays, and images. Panels should be outside the 3-D window, otherwise their background has to be redrawn on every frame cycle, which which costs computing time (s. Flag **REFRESH**).

PANEL ***Keyword* { ... }**

This defines a display panel with the name *keyword*. A panel definition may contain - in given sequence - the following assignments:

PAN_MAP ***Bmap*;**

Bitmap keyword for the panel background. The size of this bitmap determines the size of the panel. With every change of the panel position (**POS_X**, **POS_Y**) the background bitmap

will be redrawn.

TARGET_MAP *Bmap*;

Bitmap-keyword for a possible target-bitmap of the panel. This bitmap must have the size to include all the panel-elements, otherwise the program will crash. If there is no target-bitmap assigned, the panel will be represented directly on the screen.

- **POS_X** ***x*;**
- **POS_Y** ***y*;**

Distance of the upper left border of the panel from the upper left border of the screen. If these values are changed during gameplay by a **SET** instruction, the complete panel is drawn anew.

FLAGS ***Keyword1,Keyword2...;***

Here a list of keywords (flags) determining the properties of the panels may be given. The following flags may be set:

TRANSPARENT

If this flag is set, the panel background as well as the bitmaps of the **PICTURE** and **WINDOW** display features (see below) will be rendered transparent, i.e. the colour 0 will be suppressed.

REFRESH

If this flag is set, panels and displays are redrawn at every frame cycle. This is required e.g. for displaying a panel above th 3D window or having a test roll across the panel without overwriting the background. Without **REFRESH** a display element is only redrawn if the corresponding skill is changed. Especially on larger panels constant redrwaing costs considerable rendering time which reduces the frame rate; therefore in some cases it's better to use an **OVERLAY** for the panel background.

RELPOS

If this flag is set, the panel position (**POS_X**, **POS_Y**) is not given relative to the upper left corner of the screen, but rather to the upper left corner of the 3-D window. Panels with flag **RELPOS** set are clipped off at the edges of the 3-D window.

Within the following display element definitions the given ***x,y*** positions refer to the distance of the upper left corner of the respective element to the upper left edge of the panel:

BUTTON ***x,y,BmapOn,BmapOff,ActionOn,ActionOff*;**

Button on the panel. The size of the given button corresponds to the size of the bitmap with the keyword given by *BmapOn*. Normally the bitmap *BmapOff* appears on the panel; at

clicking left on it the bitmap changes to *BmapOn*, and the action *ActionOn* is triggered. Release of the mouse button changes the bitmap again to *BmapOff* and triggers *ActionOff*. If the button is supposed to be invisible when inactive, use the keyword **NULL** instead *BmapOff*.

VSLIDER ***x,y,len,Bmap,Skill;***

HSLIDER ***x,y,len,Bmap,Skill;***

Vertical or horizontal slider for entering skills. The value *len* corresponds to the height or width of the slider range in pixels. The bitmap *Bmap* is used for the slider button, which can be pulled with the left mouse button. The skill borders (**MIN**, **MAX**) determine the value range of the slider: At start position the skill is given the value **MIN**, at end position **MAX**.

VBAR ***x,y,len,Bmap,fac,Skill;***

HBAR ***x,y,len,Bmap,fac,Skill;***

Vertical or horizontal bar graph display for the graphical representation of a skill in the panel. The bitmap is shifted vertically depending on the skill value. *len* is the vertical or horizontal size of the display in pixels. *fac* is a fixed point number, which when multiplied by the skill value results in the vertical shifting in pixels. The bitmap shown must have a minimum of (*len* + *fac**(skill value maximum)) pixels in height resp. width.

DIGITS ***x,y,len,Font,fac,Skill;***

Numeric display. Font is a character set either consisting of 11 characters (numbers 0..9 and space) or of 128 characters in ASCII order. The integer part of a skill is shown with *len* digits in the panel. The skill value is first multiplied by the factor *fac*. Please note the limited accuracy of skill arithmetics; a skill with value 0.1, which is multiplied by 1000 may be shown in the panel as '99'!

Leading zeros are suppressed. If the font does not contain a ‘minus’ character, negative values are not shown. Instead of showing numbers you can show pictures or symbols with a one-digit display.

PICTURE ***x,y,Texture,Skill;***

Animated picture. The given texture may contain up to 32 **SIDES**, which may be animated by **CYCLES** and change depending on the integer value of the given skill. The bitmaps of the texture will be showns unscaled.

WINDOW *x,y,dx,dy,Bmap,Skillx,Skilly*;

Displays a cutout ‘window’ from a bitmap. The values *dx* and *dy* determine the size of the cutout in pixels. The source bitmap *bmap* must not be smaller than *dx* and *dy*. Both *Skillx* and *Skilly* give the position of the cutout window on the bitmap in pixels, relative to the upper left corner. The window may only be placed inside the bitmap’s borders.

MASK ***Overlay;***

This overlay is drawn over the panel after every change of a display.

MSPRITE ***Overlay*****;**

Overlay for an alternative mouse pointer within the panel. If this keyword is not given, the mouse pointer keeps its normal look.

➢**IF_KLICK** ***Action;***

Instead of the 'global' **IF_KLICK** action, this given action is performed by left clicking with the mouse pointer anywhere within the panel background.

Texts are used for menus, for messages or for the dialogue with actors. They are constructed like bitmaps and textures: The 'raw' text is defined by the keyword **STRING**, the formatted text by the keyword **TEXT**.

STRING ***Keyword,"Text";***

Definition of a character sequence with the name *Keyword* and the content *Text*. This text is between quotation marks. Line feeds within the text are represented as '\n', or given as a line feed in the WDL file, quotation marks as '\"'.

TEXT ***Keyword*** **{ ... }**

This defines a formatted text with the name *Keyword*. A text definition may contain - in given order - the following keywords:

➢**POS_X** ***x*****;**

➢**POS_Y** ***y*****;**

Distance of the upper left edge of the text from the upper left edge of the screen. The position may be outside the screen, but then only the visible part of the text is represented. The position of the text may be changed during the game. In this way longer texts may be scrolled horizontally or vertically over the screen.

➢**SIZE_Y** *n*;

Height of the displayed text in pixels (default and moximum = height of screen). The text is only displayed within the vertical range of **POS_Y** and **POS_Y+SIZE_Y**. Characters situated outside this range are suppressed.

➢**OFFSET_Y** *n*;

Number of the first pixel line of the text, which will be displayed on **POS_Y** position. This parameter allows you to scroll the text vertically pixel by pixel.

STRINGS *n*;

Maximum number of strings this **TEXT** may contain. The strings will be represented in succession without space in between.

FONT ***Font;***

The character set for text; must contain either 128 or 256 characters in ASCII order.

■**SCALE_X**

■**SCALE_Y**

Size of a single character of the **FONT** in pixels; may be evaluated in actions.

➢**STRING** *Keyword1,Keyword2...***;**

The actual text, containing of one or more strings (define maximum number in **STRINGS** beforehand!). *Keyword* is the keyword for a previously defined text string. It may be changed in actions during gameplay. If a string keyword **NULL** is assigned, no text is represented.

➢**INDEX** *n*;

Number of the string to be changed with the **STRING** keyword by an action; range 1..**STRINGS**, default 1.

FLAGS ***Keyword1,Keyword2...;***

Here a list of keyword (flags) determining the properties of the text may be given. The following flags may be set:

CENTER_X

CENTER_Y

Setting this flag causes the text to centred by **POS_X** horizontall and by **POS_Y** vertically. If the respective flag is not set, the text will be returned justified left or up resp.

CONDENSED

Setting this flag causes the text to be condensed horizontally by 1 pixel per character. Especially **FONTS** in italics look better that way.

NARROW

Similar to **CONDENSED**, but text is compressed further.

➢**VISIBLE**

Only by setting this flag the text will appear on the screen.

Panels and overlays must be contained in display lists in order to be displayed on the screen (only exception is the flag **VISIBLE** for overlays). For this purpose the following display lists are available:

PANELS ***Panel,Panel....;***

LAYERS ***Overlay,Overlay....;***

Each list may contain up to 16 elements, which are enumerated from 1 to 16 and may be changed individually during gameplay by **SET** instructions (e.g. **SET LAYERS.3, sword_ovl;**). Elements with a higher number cover those with smaller numbers on the screen. **LAYERS** are generally represented above **PANELS**. Assigning the keyword **NULL** erases the element concerned from the list.

Problems & Hints

Windows 95

ACKNEX was designed for DOS; it does run under Windows 95, but we cannnot guarantee that for all possible configurations. Due to the multitasking **ACKNEX** runs distinctly slower (up to 25%) under Windows 95 than under plain DOS. Additionally there can be problems with the joystick port, which you see as a spontaneous shaking of the player. In this case start with joystick disabled (option **-NJ**).

Some rather large levels with many bitmaps may exceed the virtual memory automatically reserved for the DOS window. In this case **ACKNEX** will abort start up, returning the message *'Out of Memory'*. If you sufficient memory available on the harddisk, you may increase the virtual memory to the required value with the DOS setting (click right on DOS icon, ➢ *Properties* ➢ *Memory* ➢*memory for DPMI*

Some sound cards don't play midi songs within a DOS screen if there was any song played before under windows. This is an error of the 95 release of Windows 95 and has nothing to do with **ACKNEX**.

You can change between WED and other Windows 95 applications with **[Alt]-[Return]** if WED was started with the option **-VGA**.

Restrictions

Once again a summary of the software restrictions, which should be observed on level design:

Total number of objects (walls, things, actors) per level	10000
Actors per level	500
Regions per level	1000
Walls and things per region	200
Steps per wall (Length)	200
Steps per wall (Heigth)	500

On the lite and commercial version the total number of walls plus things/actors per level is limited to 1500.

Frame rate

The frame rate which is responsible for the 'smoothness' of the motions can fluctuate by up to

200% depending on level design and player position. The frame rate is influenced not only by the processor performance, size and resolution of the 3-D window, but also by the following factors:

Number of objects (Walls, Things, Actors) in the level: around 25%

Number of objects within **CLIP_DIST**: up to around 30%

(This is the reason why **CLIP_DIST**'s should be small!)

Simultaneously running actions and ways: up to around 50%

Number of visible walls and objects: up to around 200%

Relation of floors,ceilings, things to walls in the picture: around 40%

Relation of inclined to straight floor areas: up to around 100%

Also the movement action of the player has a strong influence on the subjective perception of speed in the game. For a good frame rate on 486-PC's we recommend an implementation of no more than 2000 walls and objects per level of which no more than 50 should be simultaneously visible. No more than 20 actors with way and **CAREFULLY** flag should move around simultaneously. It should be avoided to let actors run over tilted floors. A large level with widely scattered rooms is better for the performance than a small, narrow level with rooms laid close together.

Royalties, Features & Updates

In the following table you'll find listed all features differing for the three GameStudio version:

Feature / Version	Lite	Commercial	Professional
Max. objects per level (walls+things+actors)	1500	1500	10000
2-Player mode	no	yes	yes
SVGA	no	yes	yes
FLIC player	no	no	yes
Polygon models	no	no	yes
CD audio	no	no	yes
OUTPORT/INPORT	no	no	yes

LEVEL instruction	no	no	yes
Resource compiler	no	no	yes
Runtime module	no	yes	yes

Normally, you may distribute games or demos created with 3D GameStudio **royalty free**. Exceptions are games used commercially at public places, in arcade machines, at events, fairs, TV shows and so on; or 'big' games which use professional version features. For these products usually a single **royalty** payment is due to Conitec, which is dependent on the size and distribution of your game and listed in the following table. Alternative royalty agreements are possible.

End user price	below $30	$30 and above
Non-commercial demo	royalty free	royalty free
Shareware game (self distributed)	$1500	$2000
Advertising game	$2500	$2500
Commercial game * (national distribution)	$4000	$7500
Commercial game * (international distribution)	$8000	$15000

* Game which is sold by a distributor, or sold in shops

Games which don't use professional version features are generally royalty free. Thus you may launch these games on the market at your will. The only thing you will still need is a runtime module **WRUN.EXE** adapted to your game, as of course you are not allowed to sell the **WED** as part of the game. If you own the commercial or professional version you can produce this runtime module with the **PUBLISH** feature. Otherwise you'll have to send, email or upload your game to our mailbox so we can produce the module and send it to you (normally within one working day). The adaption fee is **$49.-**.

Depending on the version, you've got some graphic files together with 3D GameStudio. The graphics distributed on the **DEMO** disk are not royalty free; you may use them for exercising, but not for distribution. If you've got the action game on the **SKAPH** disk, you may use these graphics royalty free - but only for your games produced with 3D GameStudio.

You can **upgrade** from one version to another by paying a reduced price. We'll normally release

two major **updates** a year with the spring and summer release. Look at the list of upgrade fees, prices and new features at our web page to decide wether it's worth the money.

If you need some **special features** for your game which are not yet supported by the engine, just ask us. We'll develop **ACKNEX** game engines especially adapted for your purpose. You'll find the latest news about 3D GameStudio on our web page.