



Technical bulletin

Paderborn, 21/07/2015

Contact: tech.support@malighting.com

Tutorial Creation of fixtures for grandMA 3D

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1. Introduction

grandMA 3D is created for the visualization of three dimensional stage layouts to be utilized in conjunction with the grandMA light control desk. It comes with a library of common types of light fixtures e.g. par cans, moving mirror, moving heads and LED fixtures.

With the huge amount of different fixtures it is not possible to cover all models. grandMA 3D offers the opportunity to import 3D model created via a 3D CAD program. Most of the 3D CAD programs offer the export into the .3ds format. So this file format was chosen to import models into grandMA 3D.

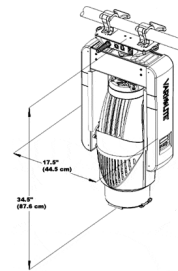
Note: This tutorial requires the knowledge of handling a 3D construction program.

2. Workflow

The construction of the new fixture has to be done with an external 3D CAD tool like Cinema 4D, Blender etc. In this example we use Cinema 4D but any tool that can export the 3ds format can be used.

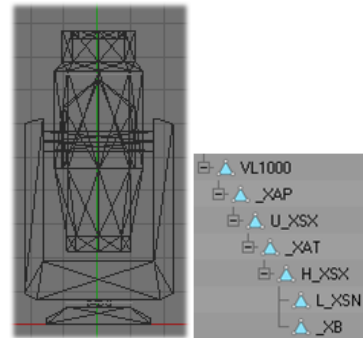
For the construction we need a drawing with the dimensions of the fixture.

In this example we use a Vari-Lite VL1000.



Create a 3D model with a 3D CAD program.
Respect the restrictions for the 3D objects and names.

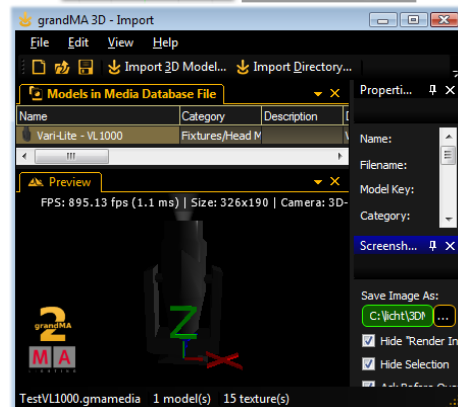
Export the CAD file into .3ds format.



Import the model into grandMA 3D.

The import tool generates a unique model key to identify it later and saves all properties of the model into an .xml description file.

After saving the model in the media database it is ready to use it within grandMA 3D.

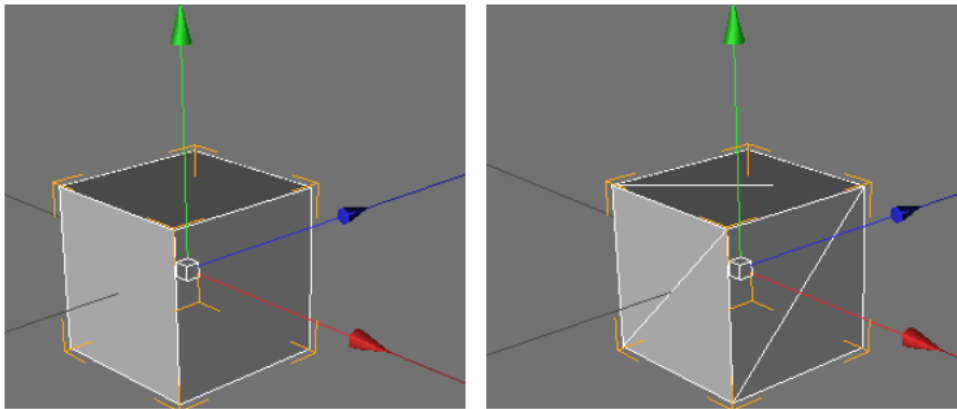


2.1 3D Design of a Fixture

This example describes the construction of a Head Mover fixture on the example of a Vari-Lite VL-1000.

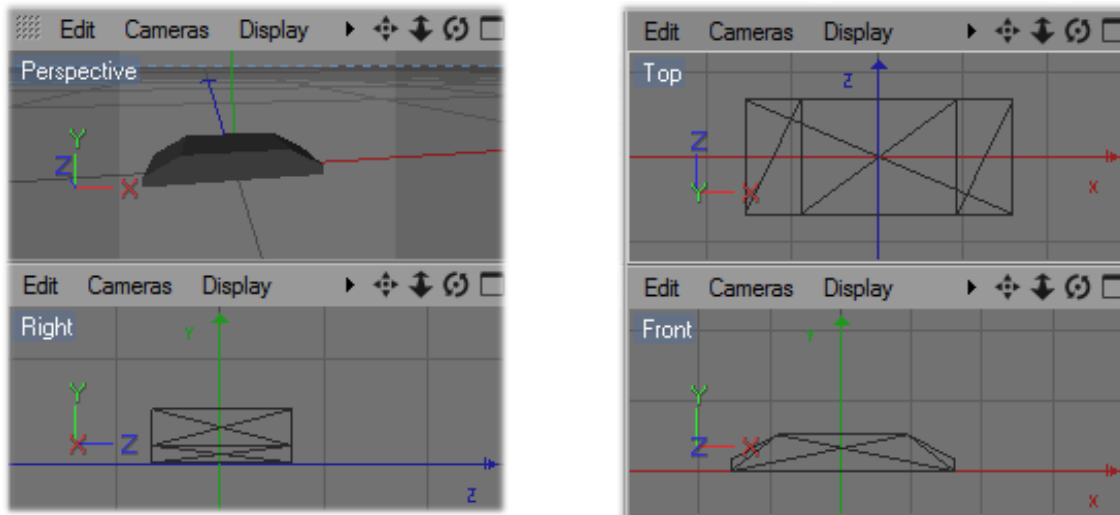
Note: Each time when a new object is created it must be triangulated, otherwise this object will be ignored by grandMA3D Import Tool. You can triangulate an object in Cinema 4D via Functions → Make Editable and then Functions → Triangulate.

Example: cube before and after triangulation:



- Create the foot of the housing.

Note the different orientation of the axes! Cinema 4D uses 'Z' for the depth. grandMA 3D uses 'Y' for the depth.



- Dimensions

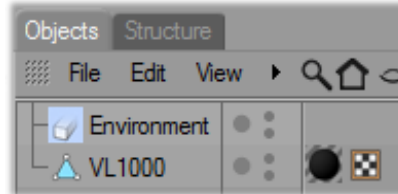
the size of the model can be rescaled within the import tool of grandMA 3D. So you can use other scaling factors while creating the model. In this case a scaling of 100 is used (1m = 1cm). The .xml description file then contains the line:

```
<Scale>0.01</Scale>
```

Coordinates		
Position	Size	Rotation
X 0 m	X 31.603 m	H 0 °
Y 0.119 m	Y 5.146 m	P 0 °
Z 6.76 m	Z 13.478 m	B 0 °
Object		Size
Apply		

- The foot housing [VL1000]

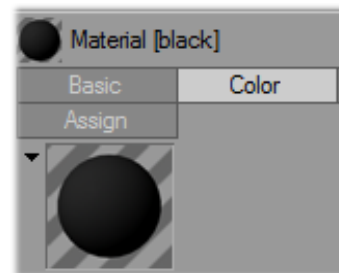
is the root of the object tree and is named with the model name 'VL1000'. It consists of a low number of polygons combined to a flattened box. To reduce the number of polygons you can use the point collapse plugin in Cinema 4D.



- Colors and textures

are defined via the material. Add the UVW tag for texture mapping and a material by dragging the material to the object.

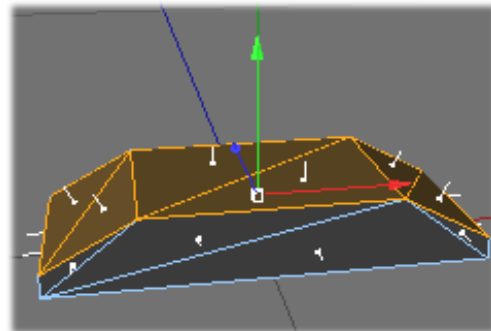
Note grandMA 3D can use the assigned texture. Therefore the texture file (max. 8 characters) must be placed in the same folder like the .3ds file.



- Normals

mark the visibility of the areas. In Cinema 4D they are marked with white lines.

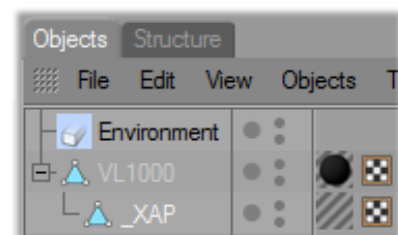
Hint: To make both sides visible, duplicate the object and reverse the normals of the duplicate.



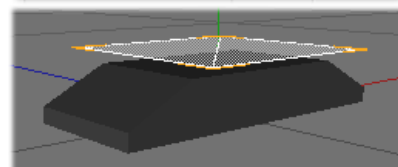
- Anchor for Pan Axis [_XAP]

To provide the pan movement in grandMA 3D the object name starts with an '_X'.

This marks a parameter block. All child objects will follow the pan movement. The following Sub parameters 'AP' mark the axes 'A' and define the pan movement 'P'. So the name for the pan anchor is '_XAP'.



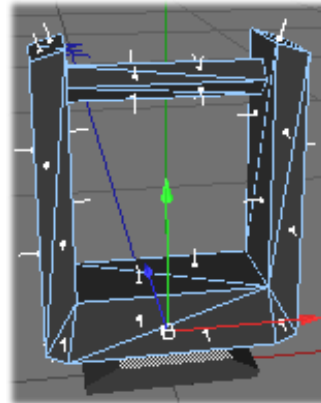
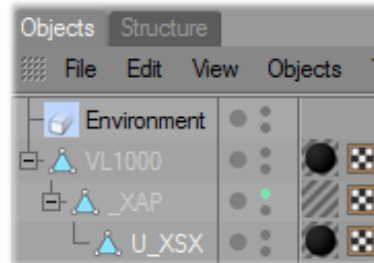
The material is transparent so it is not visible.



- Clamp for Pan Axis [U_XSX]

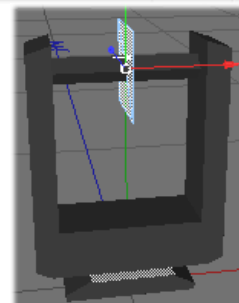
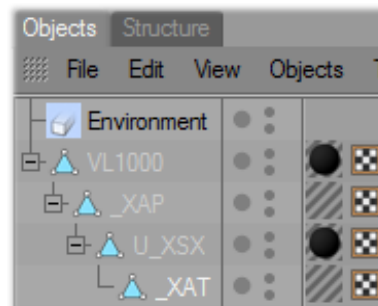
The Clamp is a child object of the anchor of the pan axis.

It has the same UVW tag and material as the foot.



- Anchor for Tilt Axis [_XAT]

To provide the tilt movement the object is named '_XAT'. All child objects will follow the tilt movement. The material is transparent so it is not visible.



- Lamp head [H_XSX]

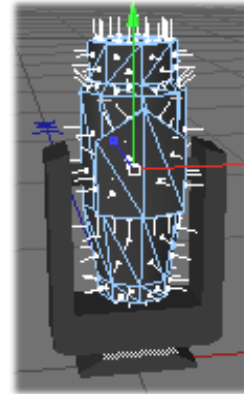
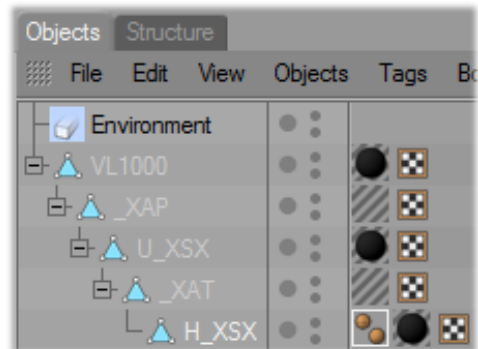
The lamp head is a child object of the anchor of the tilt axis.

The name is 'H_XSX' that means (H-will be ignored)

'_X' - Parameter

'SX' - Sunshade type excludes the own beam.

It has the same UVW tag and material as the foot housing.



- Lens [L_XSN]

The lens is a child object of the lamp head.

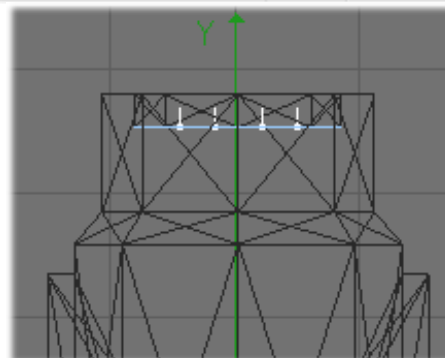
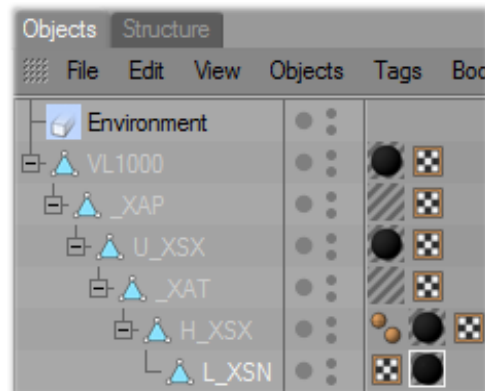
The name is 'L_XSN' that means:

(L-will be ignored)

'_X' - Parameter

'SN' - Sunshade type is None. Neither the beam is affected nor gobos are projected on the object.

It has the same UVW tag and material as the foot housing.



- Origin of the Beam [_XB]

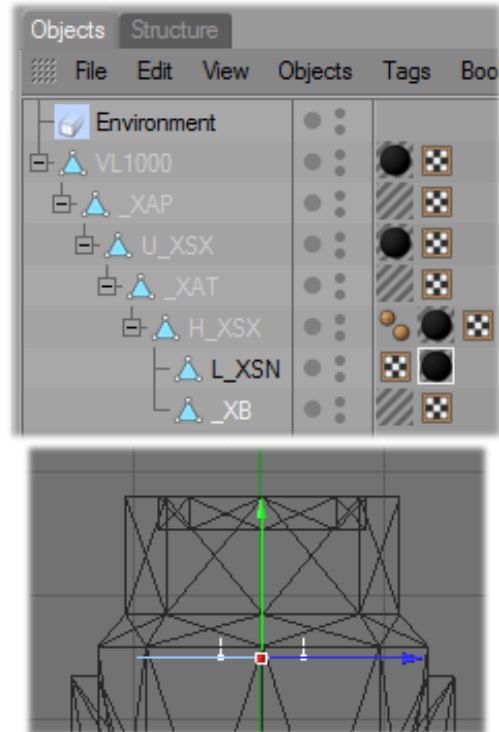
The origin of the beam is a child object of the lamp head.

The name is '_XB' that means:

'_X' - Parameter

'B' - Origin of the Beam cone

The material is transparent so it is not visible.



After creation of the model you can export it into 3D Studio format (.3ds).



2.2 Import 3D Model into grandMA 3D

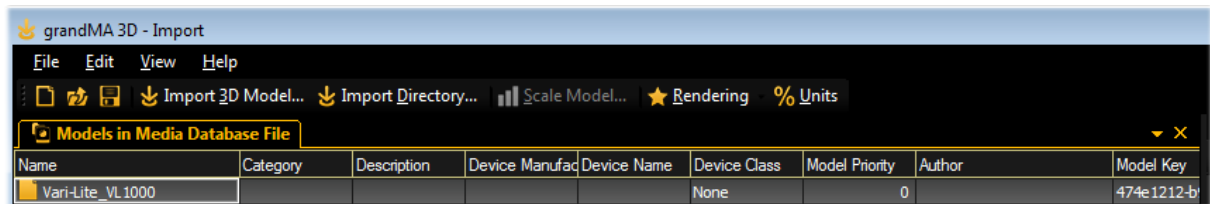
- Open grandMA 3D

In the Media Database you can find e.g. all 3D objects ordered in a tree structure.

Here you find all fixture of the type 'Head Mover'



- Open the import tool via the menu entry 'File – Import – Import 3D Model'.
Select 'Import 3D Model' and choose your created 3D file 'Vari-Lite_VL1000.3ds'



When import is done an .xml description file is generated and stored in the folder parallel to the .3ds file like 'Vari-Lite_VL1000.import.xml'. This file is created once with a new unique model key when import is initiated. If the file already exists, the importer uses the data from this file to fill out the following fields:

- Fill out the property fields of your model. Important fields are:


Category – to place the model inside the object tree

Device Manufacturer and Name – to find the right model for variant spellings

Device Class – to assign the right parameters

Model Priority - Priority for selecting this model. High numbers are more probable

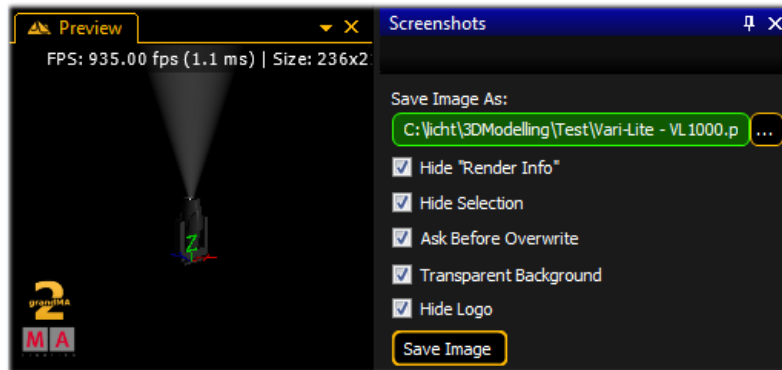
See: 3.4 Assigning of Models to Fixture Types



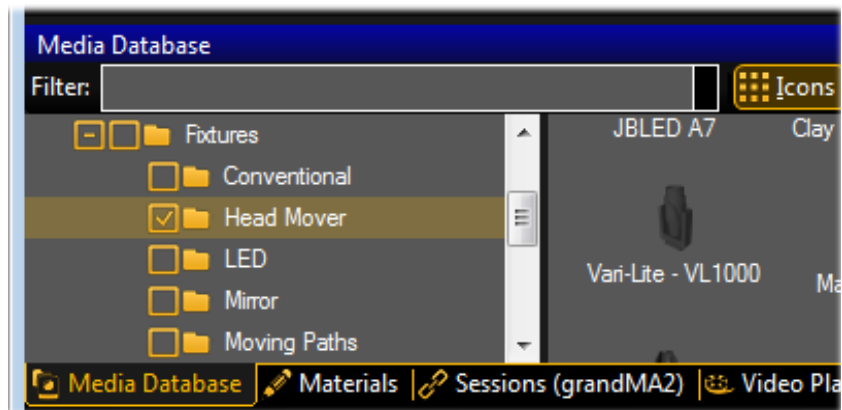
The screenshot shows a 'Properties - Vari-Lite - VL1000' dialog box with the following fields and values:

- Name: Vari-Lite - VL 1000
- Filename: C:\ProgramData\MA Lighting
- Model Key: ccf3aa2f-8855-4ebf-8233-0a7f2
- Category: Fixtures/Head Mover
- Device Manufacturer: Vari?Lite
- Device Name: VL 1000*
- Device Class: Headmover (dropdown menu)
- Model Priority: 0 (spin box)
- Author: MA Lighting
- Description: (empty text field)
- Size [m]: 0,45 | 0,31 | 0,88 (spin boxes)
- Vertices: 412 (spin box)

- Generate a significant preview image of the fixture position in the preview window.
Then save the Image as... (Browse to the folder of the .3ds file) parallel to your model. The name should be the same like the model e.g. 'Vari-Lite-VL1000.png'



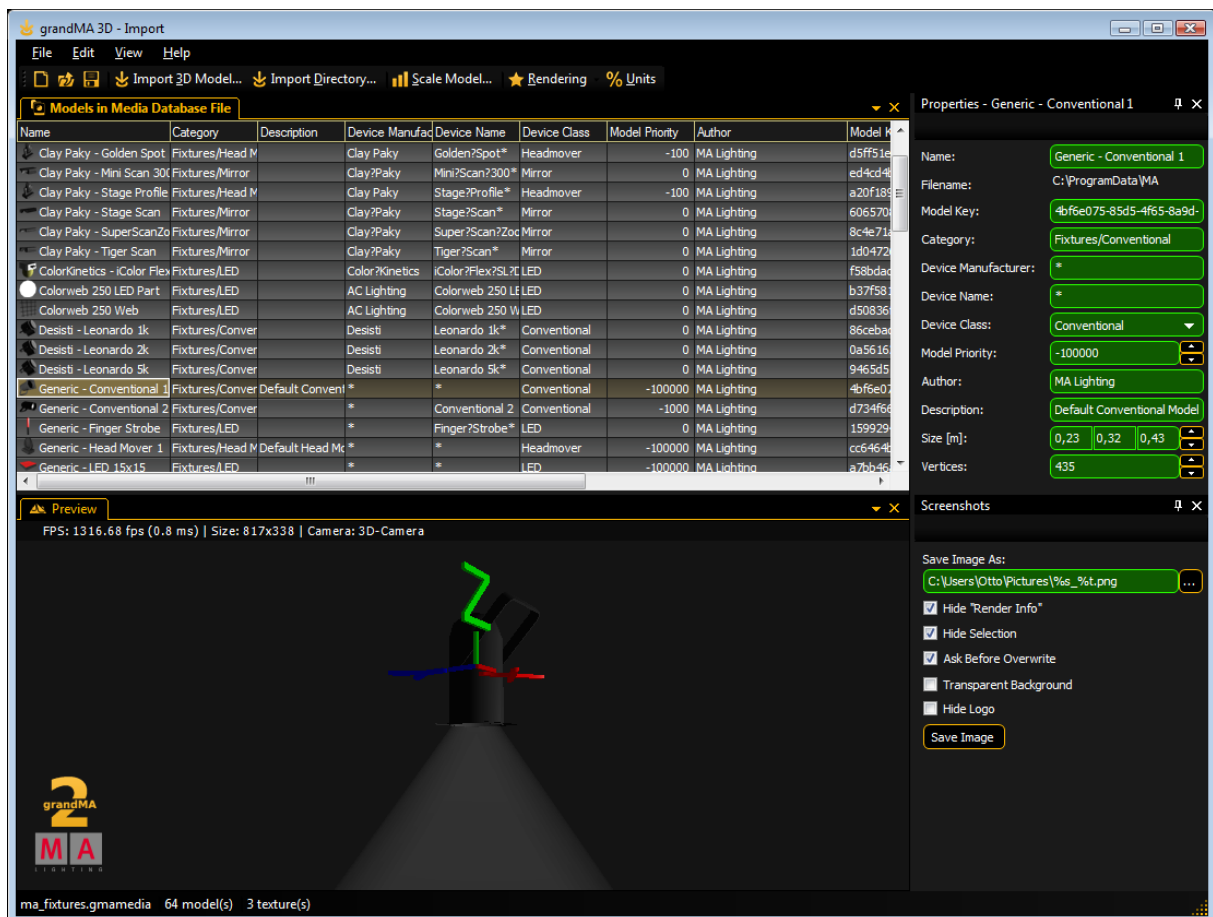
- Save the result as grandMA Media file via 'save' e.g. 'test.gmamedia'
Now the Fixture is available in the media database in the category Fixtures/Head Mover and the image appears as thumbnail.



3. 3D Modeling

3D objects are created with external tools like 'Cinema 4D, Blender etc.'. After creation the model is imported in .3ds format via the grandMA 3D import function. The import tool can be found via the menu entry: 'File – Import – Import 3D Model...'. Single files as well as complete directories can be imported.

Objects inside a 3D model can be stuffed with parameters. These parameters have influence of the behavior of the object within grandMA 3D. The parameter is defined via the name of the object. The parameters are graduated in a tree order. A parameter block begins with '_X'. After that the sub-parameter follow without separators e.g. 'Test_XAP' identifies the object as an axes for the pan movement.



The imported model can be viewed in the 'Model Test Area' window that can be operated similar to the 3D 'Stage View'. Properties like 'Name'; 'Category' etc. can be edited. After that the model can be stored in the media database and is ready to be used in grandMA 3D.



3.1 3D Models Principles

The import tool offers no functionality to edit the 3D-Model afterwards. So the imported 3D model must contain all information.

To avoid the determination on a specific modeling tool we choose the '3DS' file format that can be exported by most applications.

All parameters can be referred to by the names of the simple objects.

Important restrictions for 3D objects:

- Names of objects max. 8 characters (incl. parameter)
- No special characters allowed
- Names must be unique, each object must have a unique name.
Note that some modeling applications shorten names while exporting to 3ds.
The name must stay unique after exporting
- All objects must consist of triangles
(e.g. Cinema 4D 'Functions – Make Editable' & 'Functions – Triangulate')
- Only one material can be assigned to an object
- Only one texture can be assigned to a material

These limitations must be abided even in future when other file formats are allowed.

Furthermore 3D objects should consist of as few triangles as possible. Curves can be pictured realistically with little triangles if the normals simulate this (Cinema 4D: 'Phong Tag').

Note: The max. angle for curves is set to 89.5° in Cinema 4D (in 3ds)

3.2 Parameters

Parameters can be added to the names of objects to set further properties of the object.

Example: The object name ,Test_XAP' is a pan-axis.

A parameter block must start with '_X' followed by the (sub) parameters without separators as shown in the following table:



Parameter	Sub-Parameter	Description
V	-	Available for user The Object can be manipulated by the user. Per default the top object in the tree structure can always be manipulated by the user, sub objects not.
N	-	Not available for the user. Object cannot be manipulated by the user. (Can only be used for sub objects.)
D	-	Delete Object will not be imported.
A		Axis (also see: 0 3.2.1 Axes) Object will be transformed to a movement axis. The parameter is only valid in association with one of the following sub parameters. The sub parameter specifies the type of axis.
	P	Pan axis
	T	Tilt axis
	R	Roll
	X	Shift (X axis)
	Y	Shift (Y axis)
	Z	Shift (Z axis)
	U	Scale (X axis)
	V	Scale (Y axis)
	W	Scale (Z axis)
	J	Rotation (round X axis)
	K	Rotation (round Y axis)
	L	Rotation (round Z axis)
	1	Axis of 1. barndoor
	2	Axis of 2. barndoor
	3	Axis of 3. barndoor
	4	Axis of 4. barndoor
	G	Continuous rotation round (X axis)
	H	Continuous rotation round (Y axis)
	I	Continuous rotation round (Z axis)
	C	Clamp Rotation axis of the clamp
S		Sunshade type Specifies how the object casts a shadow or how gobos are shown on the object.
	N	None Has no influence on the object. Neither the beam is affected nor gobos are projected on the object. For example the object is a lens of a fixture. The lens does not block the beam, and no gobos are projected on the lens. The lens is fixed in the case so it doesn't cast a shadow if it is hit by an external beam.
	R	Regular The object casts a shadow and gobos are projected on the object. Default setting if nothing else is parameterized.

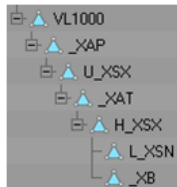


X	<p>Exclude own beam</p> <p>Compared to other fixtures the object behaves like option ,R' and compared to the own source of light like option 'N'.</p> <p>This parameter should be set for example for the body of moving heads and the clamp, meaning the parts that are never lighted by the own beam. This simplifies the rendering and avoids the casting of a shadow by the own beam.</p>
G	<p>Ghost (Currently not implemented)</p> <p>The object casts a shadow and gobos are projected on the object. The object itself is not visible, only if it is hit by a beam.</p> <p>For example an LED panel consisting of several LEDs with one body. The LEDs can be excluded from the shadow via parameter 'N'. The body for the LEDs has the parameter 'G' for the common shadow. Note that color mixing will only work correctly if the diffuse color of the ghost object and of the covered objects is the same.</p>
B	<p>Beam cone</p> <p>Marks the origin of the beam cone. (See:0 3.2.4. Beam of Light)</p>
LD	<p>Beam cone frustum</p>
LC	<p>LD marks the beam output of the cone frustum. LC marks the frustum where the beam is cut. (See:0 3.2.4. Beam of Light)</p>
I	<p>Diffuse Inking *</p> <p>Extension parameter for other materials. The color specifies the ratio of the diffuse color to the fixture color. White means: the diffuse color gets brighter by 100% of the fixture color.</p>
E	<p>Emissive Color *</p> <p>Extension parameter for other materials. Specifies the color/texture of the object's self shine.</p>
J	<p>Emissive Inking *</p> <p>Extension parameter for other materials. The color specifies the ratio of the emissive color to the fixture color. White means that the emissive color gets 100% brighter with the fixture color.</p>
C	<p>Children</p> <p>Sub controls, to be placed in grandMA 3D below the object of a model. Other sub objects in grandMA 3D will be inserted below this item. Used for moving paths to create sub objects below an axis.</p>
MD	<p>Modify Model / Double Faces</p> <p>This can be used to make both sides of a plane visible without doubling the faces inside the 3d modeling application. Also it can be used to import a bad model with incorrect normals. (But this will let to performance penalties because there will be created unnecessary faces/vertices. Anymore it can result in visible edges at rounded surfaces if the direction of the normals flips inside.)</p> <p>Example: Plane_XMD – This plane is visible from both sides</p>

*This parameter can be used only for materials. The material with the parameter extends the other material. For example 'Lens_XJ' describes the emissive inking color for the material (without parameter) with the same name 'Lens'. The extended material must not be assigned to an object. This detour is necessary because the modeling software does support this functionality.

3.2.1 Axes

Objects can be configured with movement axes. The position of the axis is marked with an auxiliary object. Objects ordered below the auxiliary object in the tree structure can be moved in the appropriate manner:



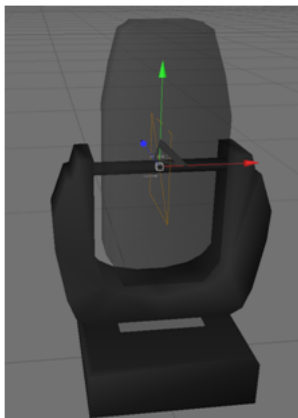
The image shows an object tree of a moving head fixture. The object 'VL1000' is the root of the fixture. '_XAP' is the pan axis of the model. All objects below are rotated around this axis.

3.2.2 Rotation Axes

Rotation axes are marked with a square (consisting of two triangles). The name of this object must contain the appropriate parameter for the desired axis (e.g. _XAT) see Parameter. Furthermore all normals of this object should point in the same direction.

When importing the object it is converted into an axis. It is aligned along the direction of the normals (vertical on the square) positioned in the center of the square.

In case of movement the right-hand rule is applicable: Thumb shows into direction of normals, objects will rotate into the direction of the fingers (with positive values).



The image shows the tilt axis of a moving head fixture. The normals of the square show to the left direction.

The lens will move away from the viewer if the tilt axis is driven with values bigger than 0°.

3.2.3 Linear Axes

Linear axes are marked in the same manner as rotation axes. The normal of the square shows the direction of movement.

3.2.4. Beam of Light (cone)

Cone for conventional spots or washes:



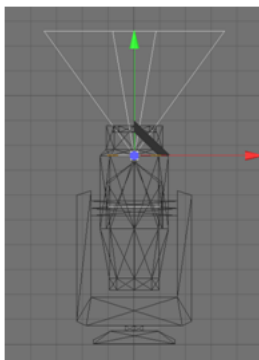
_XB

Similar to the rotation axes the position of the beam (cone) is marked with a square. The center of the square marks the origin of the cone (e.g. _XB). The normals mark the direction.

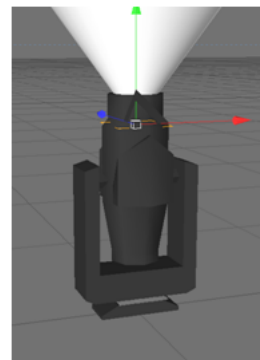
The position inside the fixture body can be determined with an auxiliary cone that is placed temporarily into the body.

The radius (r) of the cone can be calculated with the following formula:
 $r = \tan([\text{max. open radius} / 2]) * [\text{height of the cone}]$

Normally the cone uses the complete lens hole of the fixture. The square is placed at the top of the cone:



Placement of the cone 2D



Placement of the cone 3D

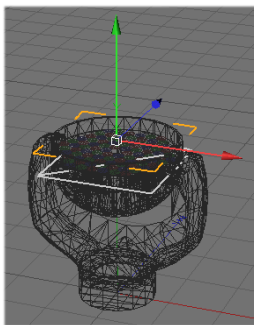
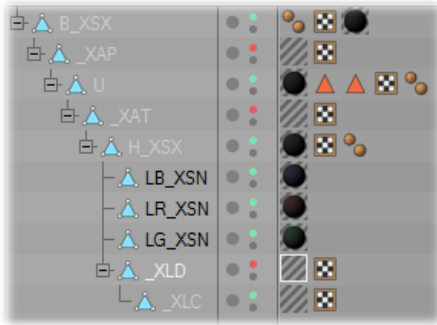
Cone frustum for LED spots or washes:



_XLD

_XLC

At LED spots with flat housings the light beam is a cone frustum. This needs 2 parameters (squares) for the beam, LD and LC:
 - LD marks the diameter of the beam output.
 - LC marks the clipping plane of the beam where the beam is cut.
 The direction of the beam is marked via the normals.



Placement of the cone frustum in 2D

The upper square shows the _XLD square
 and the lower square shows the _XLC square where the beam is cut.



3.3 Automated Import

Meta data of a 3D model can be left appropriately for the import. Later editing with the import tool is not required.

The placeholder [file] stands for the filename (without extension) that has to be imported. For example if the file 'test.3ds' has to be imported, '[file]' stands for 'test':

File	Description
_global.import.xml	Global import setting valid for the complete directory. Structure like [file].import.xml.
[file].import.xml	XML file with meta data for the model. If this file does not exist, it will be created automatically to store the model key.
[file].import.png	Preview image of the model. Size is 32x32 pixel (32 Bit RGBA). Will be created if not exists. Note: The if you use "%oo.png" instead of the filename the .png file is generated with the right name.
[file].png	If no preview image exists the import tool tries to create it. It searches in the given order on the side. The image should be exempted via alpha channel. Borders are cut automatically when the thumbnails are created.
[file].tif	
[file].bmp	
[file].jpg	

Example for an '*.import.xml' file:

```
<?xml version="1.0"?>
<GrandMA3DImportSettings xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xmlns:xsd="http://www.w3.org/2001/XMLSchema"
xmlns="http://schemas.malighting.de/GrandMA3D/GrandMA3DImportSettings/1.0">
  <Name>Generic - Head Mover</Name>
  <Category>Fixtures/Head Mover</Category>
  <ModelKey>cc6464b5-c992-4b9e-8a96-31691d9cdd90</ModelKey>
  <DeviceManufacturer>*</DeviceManufacturer>
  <DeviceName>*</DeviceName>
  <DeviceClass>Headmover</DeviceClass>
  <ModelPriority>-100000</ModelPriority>
  <ModelManufacturer>MA Lighting</ModelManufacturer>
  <Description>Default Head Mover Model</Description>
  <Scale>0.01</Scale>
  <Move>MoveBottomToZ0</Move>
  <AmbientFlare>0.02</AmbientFlare>
  <DoubleAllFaces>>false</ DoubleAllFaces >
</GrandMA3DImportSettings>
```

This file is created once when import is initiated. If the file already exists, the importer uses the data from this file to fill out the fields like

```
<Category>Fixtures/Head Mover</Category>
```

So these entries must not be done twice if the model is corrected and imported again.

Field	Description
Name	Name of the model '/filename' will be replaced with the filename of the import file (without extension)
Category	Category in the 'Media Database' Sub categories can be separated with a '/'. e.g. 'Fixtures/Head Mover'
ModelKey	[see: 3.4 Assigning of Models to Fixture Types]
DeviceManufacturer	[see: 3.4 Assigning of Models to Fixture Types]
DeviceName	[see: 3.4 Assigning of Models to Fixture Types]
DeviceClass	[see: 3.4 Assigning of Models to Fixture Types] Possible values: None, Mirror, Headmover, Conventional, LED, MovingPath
ModelPriority	[see: 3.4 Assigning of Models to Fixture Types]
ModelManufacturer	Designer of the model.
Description	Short description.
Scale	Object will be scaled by this factor.
Move	Moves the object after the import. None: No movement MoveBottomToZ0: Model is placed on XY plane Z = 0 MoveCenterToZ0: Center of the object is placed to Z = 0
AmbientFlare	Clarification grade of the fixture environment.
DoubleAllFaces	Can be set to true if the normals are not set correctly. true – sets both sides of all planes to visible false – (default setting) only the sides with the normals are visible Note: This will let to performance penalties because there will be created unnecessary faces/vertices.

Not used (necessary) fields can be omitted.



3.4 Assigning of Models to Fixture Types

Field	Description
ModelKey	Unique key of the model. This key is created with the first importing of the model and saved in the XML file (*.ImportSettings.xml). The key identifies exactly the model. If the model is imported again the same key will be used from the XML file.
DeviceManufacturer	Manufacturer of the fixture that is represented by the model.
DeviceName	Name of the fixture that is represented by the model.
DeviceClass	Type of the model if it represents a fixture. E.g. 'Headmover'
ModelPriority	Priority for selecting this model. High numbers are more probable. The standard value '0' should only be used if the meaning is clear, see description below.

At best the fixture type of a device is left in the data base. If the very same type is found by grandMA 3D (ModelKey == Model.ModelKey) it will be used without any validation. In this case a fixture type always will be assigned to the same model.

If no model key is found the application searches for a more suitable model, like same 'DeviceManufacturer', 'DeviceName' etc..

Note:

The fields 'DeviceManufacturer' and 'DeviceName' can be placeholders to find the right model for variant spellings. For example: 'Vari*Lite' is often spelled as 'Vari-Lite', or a 'VL1000 AS' should use the same model as 'VL1000 AI'. In this case both fields should contain a 'Vari?Lite' and 'VL1000*'.

Possible placeholders:

*	0-n any characters
+	1-n any characters
?	0-1 any characters
#	1 arbitrary character

Often there are several variants of fixture types in a model range. So the attachment of a '*' is recommended – for example: 'VL1000*'. The spelling is not case sensitive.

If a special 3D object shall be used for a model even though a model with the notation exists the 'ModelPriority' can be increased (in steps of 100). For example a 'VL1000AS' with the priority of 100 would be preferred instead of 'VL1000*' with a standard priority of 0.

grandMA 3D is delivered with standard models for every 'DeviceClass' type. The standard model has the following setting: DeviceManufacturer = '*', DeviceName = '*' and ModelPriority = -100000. These models have a low priority and are used only if no other model with higher priority is found.



3.5 Checklist for 3D Modeling

- ✓ Sunshade type settings for all objects are correct?
For example shadow calculations for the own source of light of the fixture body, clamp and head are excluded?
- ✓ Names of objects don't exceed 8 characters (.3ds files)?
- ✓ Names of object are unique?
- ✓ Objects exclusively are composed of triangles?
- ✓ No information has been lost while exporting? To check this, open the exported file with the modeling tool.

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