Dr.Babasaheb Ambedkar Open University

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BCADES-304

3D ILLUSION-1

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3D ILLUSION-1

Dr. Babasaheb Ambedkar Open University

Editor

Dr. Himanshu Patel
Assistant Professor, School of Computer Science,
Dr. Babasaheb Ambedkar Open University, Ahmedabad

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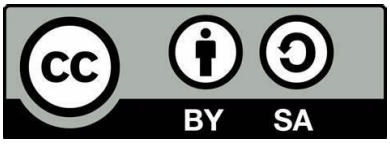

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3D ILLUSION-1

Block – 1: 3D Modelling

Unit-1 Introduction to 3D space

Introduction

Welcome to Blender, the free and Open Source 3D animation suite. Blender can be used to create 3D visualizations such as still images, video, and real-time interactive video games. Blender is well suited to individuals and small studios that benefit from its unified pipeline and responsive development process. It is a cross-platform and runs on Linux, macOS, and MS-Windows systems with less memory and disk footprint. Its interface uses OpenGL to provide a consistent experience across all supported hardware and platforms.

Key Features

- Blender is a fully integrated 3D content creation suite, offering a broad range of essential tools, including Modelling, Rendering, Animation, Video Editing, VFX, Compositing, Texturing, Rigging, many types of Simulations, and Game Creation.
- Cross platform, with an OpenGL GUI that is uniform on all major platforms (and customizable with Python scripts).
- High-quality 3D architecture enabling fast and efficient creation work-flow.
- Excellent community support from forums and IRC.
- Small executable size, optionally portable.

Title-**Img 1. 1***A rendered image being post-processed.*

Source- blender.org Link-

https://docs.blender.org/manual/en/dev/getting_started/about/introduction.html

Despite everything Blender can do, it remains a tool. Talented artists do not create masterpieces

by pressing buttons or manipulating brushes, however, by learning and practicing subjects such as **human anatomy, composition, lighting, animation principles.**

3D Content Creation Software such as Blender has the added technical complexity and jargon associated with the underlying technologies. Terms like UV maps, Materials, Shaders, Meshes, and "Sub surf" are the mediums of the digital artist, and understanding them, even broadly, will help you to use Blender to its best. As this is a 3D based software, the navigation and the working pattern are very different unlike any other 2D based software. In this Unit, you will learn about the Interface of the software.

Outcomes

Upon completion of this unit you will be able to:

- Interface and customize elements as the Info Editor (Top), a large 3D View, TimeLine(Bottom), Outliner (Top right), properties Editor (Bottom right) etc.
- Experience the Navigation within the 3D space using different Transformation tools and the creation of basic meshes (objects) in Blender
- Use Transformation tools in Blender
- Manage Navigation in Space
- Create Basic Primitives
- Work on the Interface
- Create Shortcuts and
- Identify Buttons and Controls

Terminology

Header	:	Header contains various menus and controls based on the current mode.
Menu	:	Menu offers tools to navigate in 3D space.
Mode	:	3D view has several modes used for editing different kinds of data.
Viewport shading	:	Allows you to change the way objects are displayed in the viewport.
Transform Manipulator:	:	These handy selectors allow you to rotate or move objects by grabbing (clicking with your mouse) their controls and moving your mouse in the axis.
Snap	:	Controls the snapping tools that help with transforming and modelling objects.
Tool Shelf	:	Tool shelf is a context-sensitive region containing tools depending on

the current mode.

Properties Region	:	Properties Region contains properties of the active object and selected objects.
Grid Floor	:	The grey squares forming a floor mark the zero height of the world.
Orbit	:	Rotate the view around the point of interest.
Roll	:	Rotate the viewport camera around its local Z axis in 15° discrete steps.

Introduction to 3D view

3D View is used to interact with 3D scene for a variety of purposes, such as modeling, animation, texture painting, etc.

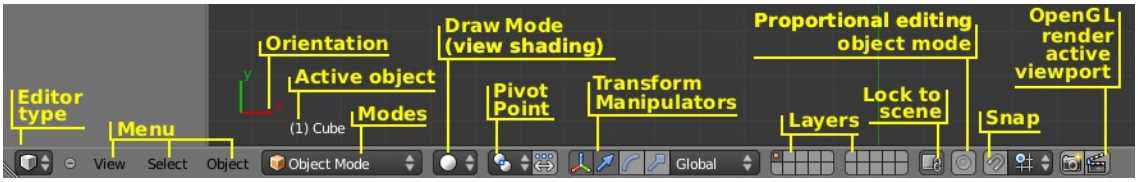
Main Region

One region, which is always visible, is known as the Main Region and is the most prominent part of the editor.

Each editor has a specific purpose, so the main region and the availability of additional regions are different between editors.

Header

The header contains various menus and controls based on the current mode.



Title-Img 1. 2. 3D View header Attribution

Attribution- Source- blender.org

Link-https://docs.blender.org/manual/en/dev/editors/3dview/introduction.html

Menus

View This menu offers tools to navigate in 3D space.

Select Contains tools for selecting objects.

Add Gives a list of different objects types that can be added to a scene.

Object This menu appears when in Object Mode. It contains tools to edit objects. In edit mode, it will change to the appropriate menu with editing tools.

Controls Modes The 3D view has several modes used for editing different kinds of data:

Object Mode The default mode, available for all object types, as it is dedicated to *object data-block editing*

Edit Mode A mode available for all renderable object types, as it is dedicated to their *"shape" Object*

Pose Mode An armature only mode, dedicated to *armature posing*.

Sculpt Mode A mesh-only mode, that enables Blender's mesh *3D-sculpting tool*.

Particle Edit A mesh-only mode, dedicated to *particle systems*, useful with editable systems (hair).

Arranging the Screen

Blender uses a novel screen-splitting approach to arrange areas. The idea is that you split up the big application window into many number of smaller (but still rectangular) non-overlapping areas. That way, each area is always fully visible, and it is very easy to work in one area and hop over to work in another.

Changing the Size

You can resize areas by dragging their borders with LMB. Simply move your mouse cursor over the border between two areas, until it changes to a double-headed arrow, and then click and drag.

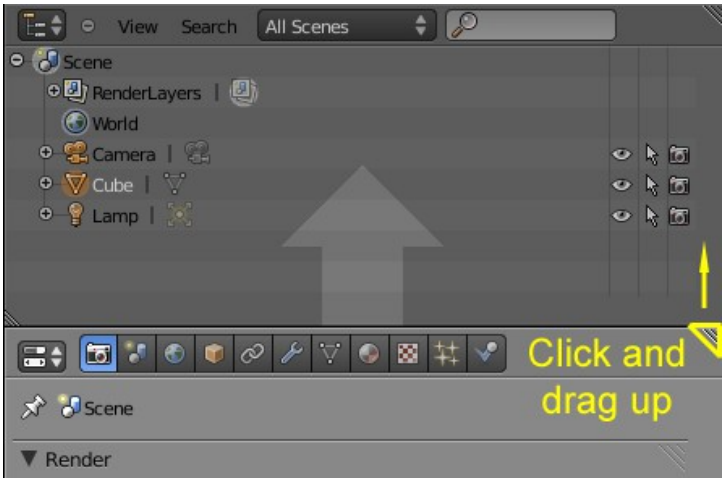
- Splitting and Joining
- Area Split Widget

Title-Img 1. 3. Changing the size **Attribution-**

Source- blender.org

*Link-**https://docs.blender.org/manual/en/dev/interface/window_system/areas.html***

In the upper right and lower left corners of an area are the area split widgets, and they look like a little ridged thumb grip. It bothsplits and combines areas. When you hover over it, your cursor will change to a cross (+). (Refer Img 1.3) LMB and drag it inward split the area. You define the direction of that border by either dragging horizontally or vertically. In order to join two areas LMB click and drag the area splitter outward. They must be the same dimension (width or height) in the direction you wish to join. This is so that the combined area space results in a rectangle.



Title-Img 1. 3 Properties Editor is being merged "over" the Outliner. **Attribution-**
Source- blender.org

Link- ***https://docs.blender.org/manual/en/dev/interface/window_system/areas.html***

The area that was closed gets a dark overlaid with an arrow. Now you can select the area to be closed by moving the mouse over it. **Release the** LMB **to complete the join. If you press** Esc **or** RMB **before releasing the mouse, the operation will be aborted.**

Area Options

RMB on the border opens the Area Options. Split Area Shows an indicator line that lets you select the area and position where to split. Tab switches between vertical/horizontal. Join Areas Shows the join direction overlay. Confirm or cancel works as described above.

Toggle Maximize Area

- **Menu: View** ‣ Toggle Maximize Area
- **Hotkey:** Ctrl-Up, Shift-Spacebar

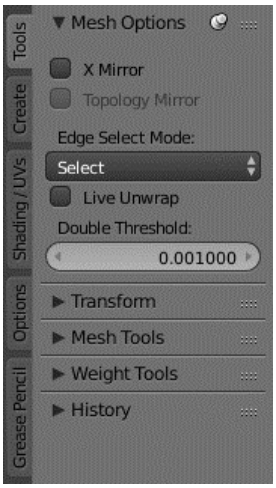
The maximized area fills the whole application window. It contains the Info Editor and the select area. You can maximize an area with the View ‣ Toggle Maximize Area menu entry. To return to normal size use again menu entry, or RMB on the editor's header and select Maximize Area and Tiled Area to return. In the Info Editor header, the Back to Previous button on the right of the menus also returns to tiled areas. A quicker way to achieve this is to use the

shortcuts: Shift-Spacebar, Ctrl-Down or Ctrl-Up to toggle between maximized and normal areas.

Tabs & Panels

Tabs

Tabs are overlapping sections in the user-interface. The Tabs header can be vertical (Tool Shelf) or horizontal (Properties Editor, User Preferences). Vertical tabs can be switched with the Wheel within the tab header and Ctrl-Wheel changes tabs from anywhere in the region.



Title-Img 1. 4Tools tab (selected), Create, etc

Source- blender.org

Link- https://docs.blender.org/manual/en/dev/interface/window_system/tabs_panels.html

Title-Img 1. 5 Horizontal tab header Attribution- Source- blender.org

Link- https://docs.blender.org/manual/en/dev/interface/window_system/tabs_panels.html

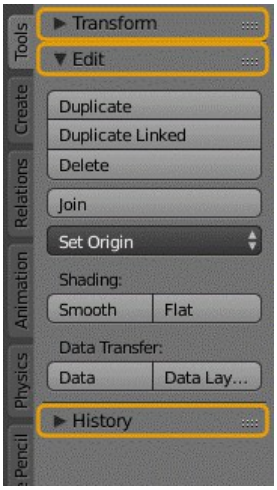
Panels

The smallest organizational Unit in the user interface is a Panel. Panels can be collapsed to hide its contents. They are used in the Properties Editor, but also for example in the Tool Shelf

and the Properties region. In the image on the right there are three panels:

1. Transform
2. Edit
3. History

The Edit panel is expanded and the other two panels are collapsed.



Title-Img 1. 6 Tool Shelf panels. Orange: Panel Headers Attribution-
Source- blender.org
Link- https://docs.blender.org/manual/en/dev/interface/window_system/tabs_panels.html

Collapsing and expanding

A triangle on the left of the title shows the **expanded (▼)** and **collapsed (►)** state of the panel.

- A click with the LMB on the panel header expands or collapses it.
- Pressing A expand/collapses the panel under the mouse pointer.
- A **Ctrl-LMB** click on the header of a specific panel will collapse all other panels and make this the only expanded one.
- Dragging with **LMB** over the headers will expand or collapse many at once.

Panel Position

You can change the position of a panel within its region by clicking and dragging it with the LMB on the grip widget (::::) in the upper right corner.

Pinned Panel Often it is desirable to view panels from different tabs at the same time. This has been solved by making panels pinnable. A pinned panel remains visible regardless of which tab has been selected. You can pin a panel by Shift clicking its header, or by RMB clicking on the header and choosing Pin in the context menu. In the image shown to the right, is an example of the Mesh Options pinned in the tools tab.

Zoom

The zoom factor of a whole region with panels can be changed by Ctrl-MMB clicking and moving the mouse anywhere within that region or use the Numpad Plus and Numpad Minus to zoom in and out the contents. Pressing Home (Show All) will reset the zooming at the screen/panel focused by the mouse pointer.

Alignment

The alignment of the panels in the Properties Editor can be changed between vertical and horizontal. To do this, click with RMB somewhere within the main region of the Properties Editor and choose either Horizontal or Vertical from the appearing menu. Keep in mind though that the panels are optimized for vertical alignment.

Viewport Shading

It allows you to change the way objects are displayed in the Viewport.

Header: Viewport Shading

Title-Img 1. 7The Viewport Shading menu Attribution- Source- blender.org

Link- https://docs.blender.org/manual/en/dev/editors/3dview/properties/shading.html

Bounding Box

Only shows rectangular boxes that outline an object's size and shape.

Wireframe

Objects appear as a mesh of lines representing the edges of faces and surfaces.

Solid

The default drawing mode using solid coloured surfaces and simple lighting.

Textured

Shows meshes with an image applied using the mesh's active UV Map. For Cycles materials, the image is the last one selected in the Node Editor. For other render engine's, the UV Map's applied face texture will be shown.

Material

A fast approximation of the applied material.

Rendered

An accurate representation using the selected Render Engine and lit with the visible scene lights.

Keyboard Shortcut

- Shortcuts Switches between Wireframe and Solid draw modes. Z
- Switches between the current and Rendered draw modes. Shift-Z
- Switches between Solid and Textured draw modes. Alt-Z

Except for Rendered, these shading modes are not dependent on light sources in the scene. Instead they use a simple default lighting adjusted by the Solid OpenGL Lights controls on the System tab of the User Preferences editor.

The viewport shading controls the appearance of all objects in a scene, but this can be overridden for individual objects using the Display panel in their Object Properties.

3D Space Navigation

Navigating in 3D space is done with the use of both mouse movement and keyboard shortcuts. To be able to work in the three-dimensional space that Blender uses, you must be able to change your viewpoint as well as the viewing direction of the scene. While describing 3D View editor, most of

the other editors have similar functions. For example, it is possible to translate and zoom in the UV/Image editor.

Orbit

- **Mode**: All modes
- **Menu**: View ▸ Navigation ▸ Orbit
- **Hotkey**: MMB, Numpad2, Numpad4, Numpad6, Numpad8, Ctrl-Alt-Wheel

Rotate the view around the point of interest. Click and drag MMB on the viewport's area. If you start in the middle of the area and move up and down or left and right, the view is rotated around the middle of the area.

To change the viewing angle in discrete steps, use Numpad8 and Numpad2 (which correspond to vertical MMB dragging, from any viewpoint), or use Numpad4 and Numpad6 (or Ctrl-Alt-Wheel) to rotate the scene around the global Z axis from your current point of view. Finally, Numpad9 switches to the opposite side of the view.

Alternatively, if the Emulate 3 button mouse option is select in the User Preferences you can press and hold Alt while dragging LMB in the viewport's area.

Roll

- Mode: All modes
- Menu: View ▸ Navigation ▸ Roll
- Hotkey: Shift-Numpad4, Shift-Numpad6, Ctrl-Shift-Wheel
  Rotate the viewport camera around its local Z axis in 15° discrete steps.

Panning

- Mode: All modes
- Menu: View ▸ Navigation ▸ Pan
- Hotkey: Shift-MMB, Ctrl-Numpad2, Ctrl-Numpad4, Ctrl-Numpad6, Ctrl-Numpad8

Move the view up, down, left and right. To pan the view, hold down Shift and drag MMB in the 3D View. For discrete steps, use the hotkeys Ctrl-Numpad8, Ctrl-Numpad2, Ctrl-Numpad4

and Ctrl-Numpad6 as with orbiting (note: you can replace Ctrl by Shift). For those without a middle mouse button, you can hold Shift-Alt while dragging with LMB.

Zooming

- Mode: All modes
- Menu: View ▸ Navigation ▸ Zoom
- Hotkey: Ctrl-MMB, Wheel, Numpad Plus, Numpad Minus

Move the camera forwards and backwards. You can zoom in and out by holding down Ctrl and dragging MMB. The hotkeys are Numpad Plus and Numpad Minus. The View ▸ Navigation sub-menu holds these functions too as well. Refer to the 3D View's View menu image above for more information. If you have a wheel mouse, you can zoom by rotating the Wheel.

Zoom Border

- Mode: All modes
- Menu: View ▸ Zoom Border
- Hotkey: Shift-B

The Zoom Border tool allows you to specify a rectangular region and zoom in so that the region fills the 3D View. You can access this through the View menu, or the shortcut Shift-B, then LMB click and drag a rectangle to zoom into. Alternatively you can zoom out using the MMB.

Dolly Zoom

- Mode: All modes
- Hotkey: Ctrl-Shift-MMB

In most cases its sufficient to zoom the view to get a closer look at something, however, you may notice that at a certain point you cannot zoom any closer. This is because, Blender stores a view-point that's used for orbiting and zooming. It works well in many cases, however sometimes you want to move the view-point to a different place. This is what Dolly supports, allowing you to transport the view from one place to another. You can dolly back and forth by holding down Ctrl-Shift and dragging MMB.

Transform Manipulators

These handy selectors allow you to rotate or move objects by grabbing (clicking with your mouse) their controls and moving your mouse in the axis.

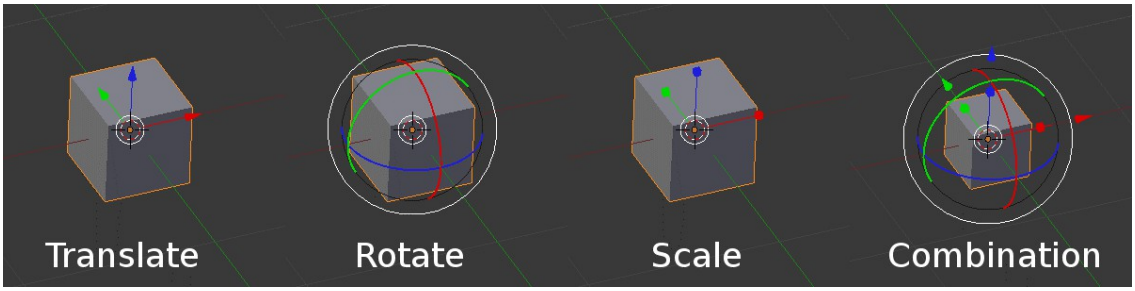
Title-Img 1. 8 Transform Manipulators **Attribution-**

Source- blender.org

Link-https://docs.blender.org/manual/en/dev/editors/3dview/object/editing/transform/control/manipulators.html

- Mode: Object and Edit Modes
- Menu:
- Hotkey: Ctrl-Spacebar

The Transformation manipulator widgets allow mouse controlled translation, rotation and scaling in the 3D View. There is a separate manipulator for each operation. Each manipulator can be used separately or in combination with the others.



Title-**Img 1. 9 The different Manipulators** Attribution-

Source- **blender.org**

Link-

https://docs.blender.org/manual/en/dev/editors/3dview/object/editing/transform/control/manipulators.html

Header Controls

Manipulators can be accessed through the header of the 3D View.

Axis : Enable/disable the manipulators Ctrl-Spacebar.

Manipulators: Toggles each of the manipulators. Clicking with Shift-LMB on multiple manipulator icons will combine the manipulators.

Arrow: Translation.

Arc: Rotation.

Box: Scale.

Basic Transformations

Grab/Move

- **Mode**: Object Mode, Edit Mode, and Pose Mode
- **Panel:** Tool Shelf ▸ Tools ▸ Transform ▸ Translate
- **Menu:** Object type ▸ Transform ▸ Grab/Move
- **Hotkey:** G

In Object Mode, the grab/move option lets you translate (move) objects. Translation means changing location of objects. It also lets you translate any elements that make up the object

within the 3D space of the active 3D View. Pressing G activates “Grab/Move” transformation mode. The selected object or element then moves freely according to the mouse pointer’s location and camera.

You can also move an object by clicking and holding RMB on the object to move it. To confirm the action, press LMB.

Rotate

- Mode: Object and Edit Modes
- Panel: Tool Shelf ‣ Tools ‣ Transform ‣ Rotate
- Menu: Object/Mesh/Curve/Surface ‣ Transform ‣ Rotate
- Hotkey: R

Rotation is also known as a spin, twist, orbit, pivot, revolve, or roll and involves changing the orientation of elements (vertices, edge, face, Object etc.) around one or more axes or the Pivot Point

Scale

- Mode: Object and Edit Modes
- Panel: Tool Shelf ‣ Tools ‣ Transform ‣ Scale
- Menu: Object/Mesh/Curve/Surface ‣ Transform ‣ Scale
- Hotkey: S

Scaling means changing proportions of objects. Pressing S will enter the Scale transformation mode where the selected element is scaled inward or outward according to the mouse pointer’s location. The element’s scale will increase as the mouse pointer is moved away from the Pivot Point and decrease as the pointer is moved towards it. If the mouse pointer crosses from the original side of the Pivot Point to the opposite side, the scale will continue in the negative

direction and flip the element.

Title-Img 1. 10 Basic scale usage

Source- blender.org

Link- https://docs.blender.org/manual/en/dev/editors/3dview/object/editing/transform/basics.html

From left to right, the panels show: the original Object, a scaled down Object, a scaled-up Object and a scale-flipped Object.

Transform Orientations

- Mode: Object and Edit Modes
- Panel: Properties region ‣ Transform Orientations
- Hotkey: Alt-Spacebar

Orientations affect the behaviour of Transformations: Location, Rotation, and Scale. You will see an effect on 3D Manipulator (the widget in the centre of the selection), as well as on transformation constraints (like axis locking). This means that, when you press G-X, it will constrain to the global X-axis, but if you press G-X-X it will constrain to your Transform Orientations X-axis.

Title-Img 1. 11Transform Orientations selector **Attribution-**

Source- blender.org

Link- https://docs.blender.org/manual/en/dev/editors/3dview/object/editing/transform/control/orientations.html
The Orientations options can be set through the Orientation selector in 3D View header, with Alt-Spacebar, or in the Transform Orientations panel in the Properties region.

Orientations Global

The manipulator matches the global axis. When using the Global orientation, the orientation's XYZ matches world's XYZ axis. When this mode is selected, the local coordinates of the object are subjected to the Global coordinates. This is good to place objects in the scene. To constrain an axis, press G and the desired axis. To constrain to a local axis, press the desired axis two times. The difference between Global and Local, is more noticeable when you have an object in which the origin is not located at the exact center of the object, and does not match the Global coordinates.

Local

The manipulator matches the object axis.

Notice that, here, the Manipulator is at a slight tilt (it is most visible on the object's Y-axis, the green arrow). This is due to our 15° rotation of the object. This demonstrates the difference between local coordinates and global coordinates. If we had rotated the object 90° along its X-axis, we would see that the object's "Up" is the world's "Forward" – or the object's Z-axis would now be the world's Y-axis. This orientation influences many parts of the interface, so it is important to understand the distinction.

Normal

The Z-axis of the manipulator will match the normal vector of the selection.

In Object Mode, this is equivalent to Local Orientation, in Edit Mode, it becomes more interesting.

As you see, the light blue lines indicate the faces' normals, and the darker blue lines indicate the vertex normals (these were turned on in the N Properties region under Mesh Display ▸ Normals ▸ Face and Vertex). Selecting any given face will cause our Manipulator's Z-axis to align with that normal. The same goes for Vertex Select Mode. Edge Select is different – A selected Edge has the Z-axis aligned with it (so you will have to look at the Manipulator widget to determine the direction of X and Y). If you select several elements, it will orient towards the average of those normals.

A notable example of how this is useful is in Vertex Select Mode: Pick a vertex and then do G, Z, Z to tug it away from the mesh and shove it into the mesh. To make this even more useful, select a nearby vertex and press Shift-R to repeat the same movement – except along that second vertex's normal instead.

Gimbal

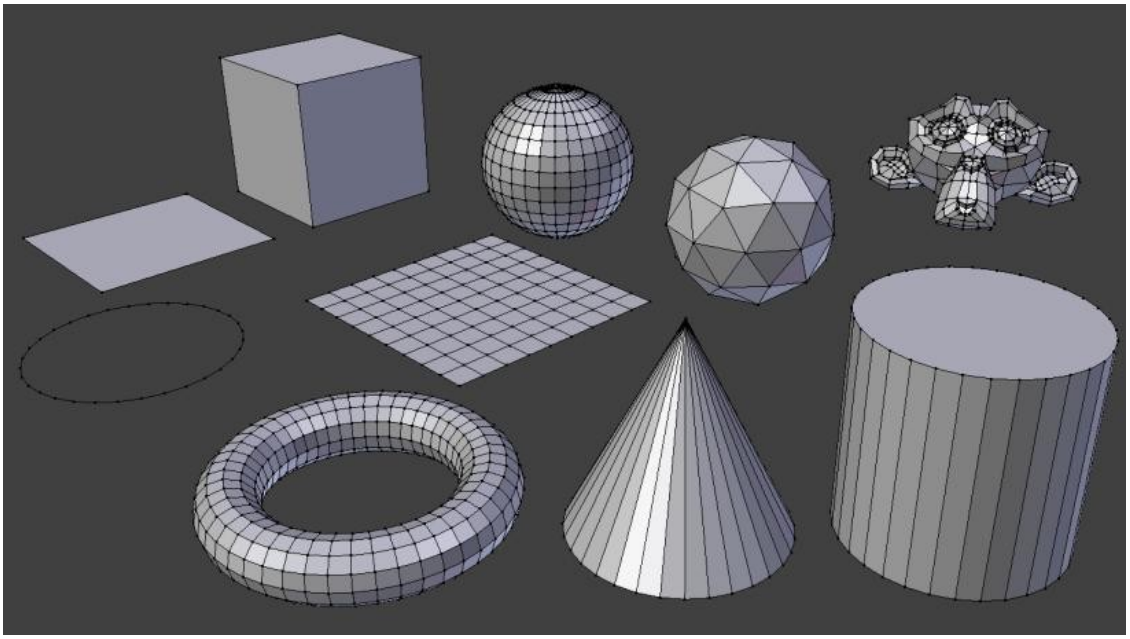
Uses a Gimbal behaviour that can be changed depending on the current Rotation Mode.

Creating Basic Primitives

- Mode: Object Mode and Edit Mode
- Panel: Tool Shelf ▸ Create ▸ Add Primitive/Mesh
- Menu: Add ▸ Mesh
- Hotkey: Shift-A

A common object type used in a 3D scene is a Mesh. Blender comes with several "primitive" mesh shapes that you can start modelling from. You can also add primitives in Edit Mode at the 3D cursor. If the created object can be removed by hitting delete key.

Undo Hotkey: Ctrl-Z
Redo Hotkey: Ctrl-Shift-Z



Title-Img 1. 12 Blender's standard primitives **Attribution-**

Source- blender.org

Link- https://docs.blender.org/manual/en/dev/modeling/meshes/primitives.html

Unit summary

In this Unit, you have learnt what is 3D Interface and how to

- Work effectively and navigate in 3D space within Blender to manage the work flow
- Customize the user interface to limit the tools and option required for the user in Blender.
- Use Hot keys
- Identify buttons and controls
- Interact with 3D scene using 3D View for a variety of purposes, such as modeling, animation, texture painting, etc.
- Use the Info Editor at the top, a large 3D View, TimeLine at the bottom, Outliner at the top right, properties Editor at the bottom right etc.

After learning this Unit, you can download the Open Source Software available on the internet for free of cost to practice the possibilities of creating 3D Interface.

Assignment

- Create a Dining Table with a table lamp using the basic primitives.

Assessment

- Explain 3D Navigation in Blender
- Define Primitives.
- Write a brief note on Transform Manipulator.
- Describe the types of Viewport Shading.
- Write a brief note on Track Panel.
- How are the splitting and arranging widgets used?

Fill in the Blanks

1. _____allows you to change the way objects are displayed in the viewport.
2. _____tool is used to rotate the view around the point of interest.
3. Pressing _____expand/collapses the panel under the mouse pointer.
4. In _____mode, objects appear as a mesh of lines representing the edges of faces and surfaces.
5. The_____short cut can be used to grab and move object.

Resources

While studying this Unit, you can browse the internet links for online tutorials and several books and training DVDs available in theBlender Storeand on theBlender Cloud.

- wiki.blender.org
- archive.org
- www.blender.org
- docs.blender.org

Unit-2 Introduction to Modeling

Introduction

In this Unit, you will learn about the important Tools, which support the work flow in Modelling and the many ways of Selecting an Object, Duplicating, Mirroring, etc. Common use of Mirroring is to model Half an Object, duplicate it and then use the mirror transform to create a reversed version to complete the model. You will also learn how to organize 3D scenes by using Layers, as it often becomes exponentially more confusing as they grow more complex. Sometimes the artist also needs precise control over how individual Objects are lit, and does not want lights for one Object to affect nearby Objects.

Outcomes

Upon completion of this unit you will be able to:

- Draw with Selection Tools
- Select, duplicate and mirror an Object
- Create Multiple Objects with Mirror and Duplicate
- Edit Pivot Point
- Use Snap Tool
- Organize 3D Scenes using Layers

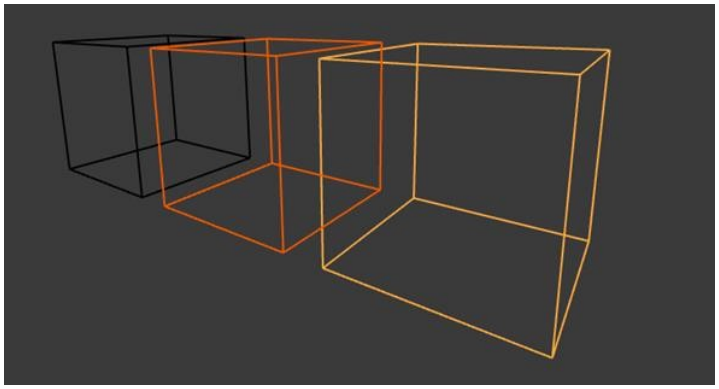
Terminology

Active Object	In Object Mode, the last (de)selected item is called the "Active Object"
Point selection	Selecting the Object in the viewport with a RMB.
Border select	With Border Select, you can draw a rectangle while holding down LMB.
Lasso select	Lasso select is used to draw a dotted line around the pivot point of the Objects, in Object Mode.
Circle select	Circle Select is used to move with dotted circle through Objects with LMB.
Mirror	Mirroring an Object or Mesh selection will create a reversed version of the selection.
Duplicate	This will create a visually-identical copy of the selected Object(s).
Edge Ring	In Edge select mode, holding Ctrl-Alt while selecting an edge selects a sequence of edges that are not connected.

Selection to grid		Snaps the currently selected Object(s) to the nearest grid point.
Cursor to Selected		Moves the cursor to the centre of the selected Object(s).
Layers		Objects can be placed into one or more "layers" using Object layers.
Cursor to center		Moves the cursor to the center of the grid.

Work Flow of Modeling

Object Selection Selections and the Active Object Blender distinguishes between **two different states of selection**:



Title- Img 2. 1 Unselected Object in black, selected Object in orange, and active Object in yellow.

Source-Blender.org

Link-https://docs.blender.org/manual/en/dev/editors/3dview/object/select ing/introduction.html

- In **Object Mode,** the last (de)selected item is called the "**Active Object**" and is outlined in **yellow** (the others are orange). There is exactly one active Object at any time (even when nothing is selected).
- Many actions in Blender use the active Object as a reference (for example linking operations). If you already have a selection and need to make a different Object the active one, simply re-select it with **Shift-RMB.**
- All other selected Objects are just selected. You can select any number of Objects.

Point Selection

- The simplest form of Object selection consists of using **RMB** on it.
- To add to the selection, use **Shift-RMB** on more Objects.
- If the Objects are **overlapping** in the view, you can use **Alt-RMB** to cycle through possible choices.
- If you want to add to a selection this way, then the shortcut becomes **Shift-Alt-MB.**
- **To activate** an Object that is already selected, click **Shift- RMB** on it.
- To deselect an active Object, click **Shift-RMB** one time and hence, two clicks if the Object is not active. Note that this only works if there are no other Objects under the mouse. Otherwise it just adds those to the selection. There appears to be no workaround for this bug.

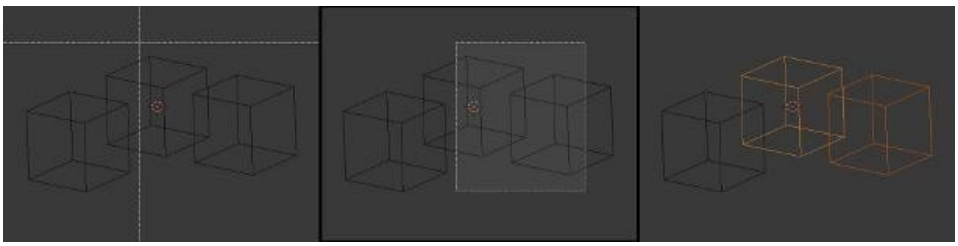
Border Selection

- **Mode**: Object Mode and Edit Mode
- **Menu**: Select ▸ Border Select
- **Hotkey**: B

With Border Select you draw a rectangle while holding down **LMB**. Any Object that lies even partially within this rectangle becomes selected.

- For deselecting Objects, use **MMB** or Border Select again with holding **Shift.**
- To cancel the selection use **RMB.**

Example



Title-Img 2. 2 Border selecting in three steps

Source-Blender.org

Link-*http://blender-manual- i18n.readthedocs.io/ja/latest/modeling/objects/selecting.html*

Border Select has been activated in the first image and is indicated by showing a **dottedcross-haircursor**. In the second image, the selection region is being chosen by drawing a **rectangle** with the **LMB**. The rectangle is only covering two cubes. Finally, in the third image, the selection is completed by releasing **LMB.**

Notice in the third image, the bright color of left-most selected cube. This means it is the "**Active Object**", the last selected Object prior to using the **Border Select** tool.

Lasso Select

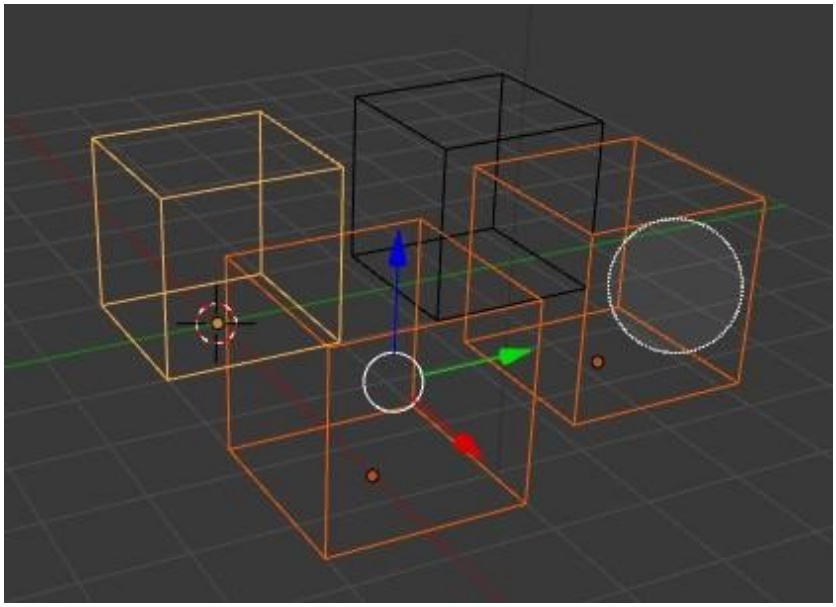
- **Mode**: Object Mode and Edit Mode
- **Menu**: no entry in the menu
- **Hotkey**: Ctrl-LMB

Lasso select is used by **drawing a dotted line** around the pivot point of the Objects, in Object Mode.

Circle Select

- **Mode:** Object Mode and Edit Mode
- **Menu:** Select ▸ Circle Select
- **Hotkey:** C

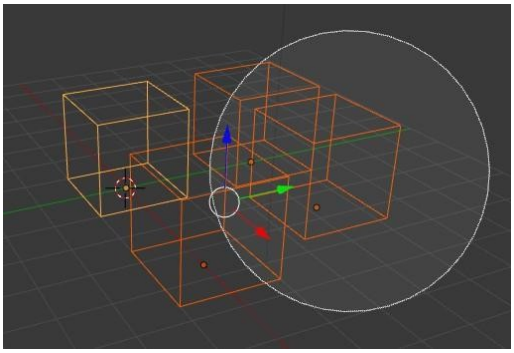
Circle Select is used by moving with **dotted circle** through Objects with **LMB**. You can select any Object by touching of circle area. It is possible to dynamically change the diameter of circle by scrolling **MMB** as seen in Img 2.3 and Img 2.4. Deselection is under the same principle - **MMB**. To cancel the selection use **RMB** or key Esc.



Title- Img 2. 3 Circle selection

Source-Blender.org

Link-*https://wiki.blender.org/index.php/Doc%3A2.6/Manual/Modeling/Objects/Selecting*



Title-Img 2. 4 with huge circle

Source-Blender.org

Link-*https://wiki.blender.org/index.php/Doc%3A2.6/Manual/Modeling/Objects/Selecting*

Menu Selection

The selection methods described above are the **most common**. There are also many more options accessible through the Select menu of the 3D View.

Select Grouped

- **Mode**: Object Mode

- **Menu**: Select ▸ Grouped
- **Hotkey**: Shift-G

There are **two ways** to organize the Objects in relation to one another.

1. Parenting
2. Simple grouping

Select Grouped uses the Active Object as a base to select all others.

Title-Img 2. **5** Select Grouped menu

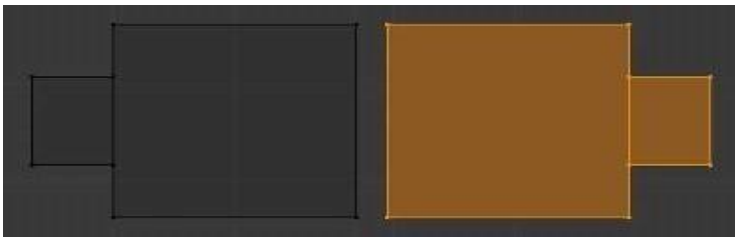
Source-wiki.Blender.org

Link-*https://wiki.blender.org/index.php/File:25-Manual-Object-Selection-Grouped.png*

Mirror Object

- **Mode:** Object and Edit Modes
- **Menu:** Object/Mesh▸ Mirror
- **Hotkey:** Ctrl-M

Mirroring an Object or **Mesh selection** will create a reversed version of the selection. The position of the mirrored version of the selection is determined by the **Pivot Point**. A common use of mirroring is to **model halfan Object**, duplicate it and then use the **mirrortransform** to create a reversed version to complete the model.



Title- Img 2. 6 Mirroring a Selection

Source-Blender.org

Link- *https://docs.blender.org/manual/en/dev/editors/3dview/object/editing/transform/mirr or.html*

Duplicate Object

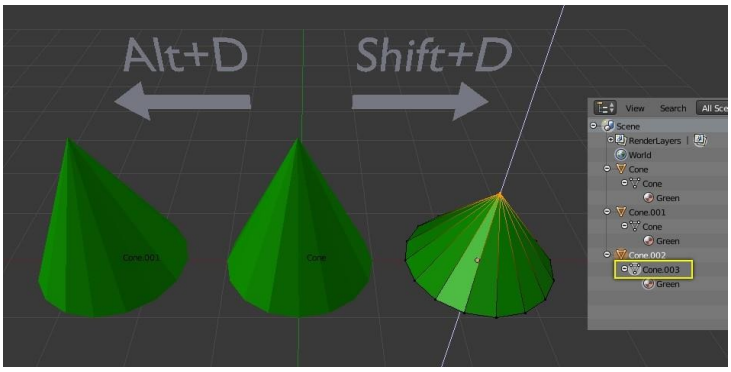
This will create a **visually-identical copy** of the selected Object(s). The copy is created at the same position as the original Object and you are automatically placed in **Grab mode**.

This copy is a new Object, which shares some data-blocks with the original Object (by default, all the Materials, Textures, and F-Curves), but which has copied others, like the mesh, for example. Therefore, this form ofduplicationissometimescalled"**shallowlink**", becausenotall data- blocks are shared; some of them are "**hard copied**"!

- **Mode**: Edit and Object Modes
- **Menu**: Object ‣ Duplicate
- **Hotkey**: Shift-D

This will create a visually-identical copy of the selected Object(s). The copy is created at the same position as the original Object and you are automatically placed in **Grab mode**. See the example below (Img 2.7).

Examples



Title-Img 2. **7** The MeshCone.006 of Object Cone.002 is being edited.

Source-Blender.org

Link- *https://docs.blender.org/manual/en/dev/editors/3dview/object/editing/duplica tion.html*

The mesh's unique data-block ID name is highlighted in the Outliner.

The cone in the middle has been

(1) link duplicated to the left and

(2) duplicated to the right.

The **duplicated right cone** is being edited; the original cone in the middle remains unchanged. The **Mesh data** has been **copied not linked**.

Likewise, if the right cone is edited in Object mode, the original cone remains unchanged. The new Objects transform properties or data-block is a **copy, not linked**.

When the right cone was duplicated, it inherited the material of the middle cone. The material properties were **linked, not copied**.

Snapping

- **Mode**: Object and Edit Mode
- **Hotkey**: Shift-S

Transform Snapping

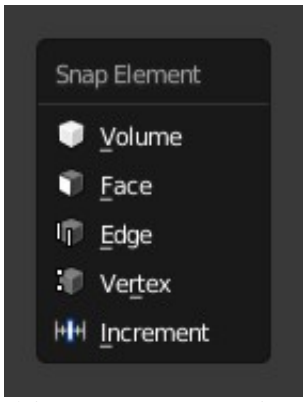
Title-Img 2. 8 Magnet icon in the 3D View header (red when enabled)

Source-Blender.org

Link- *https://docs.blender.org/manual/en/dev/editors/3dview/object/editing/transform/cont rol/snap.html*

The ability to snap Objects and Mesh element to various types of scene elements during a transformation is available by toggling the magnet icon (which will turn red) in the 3D View's header buttons**.**

Snap Element



Title-Img 2. 9 Snap Element menu

Source-Blender.org

Link- *https://docs.blender.org/manual/en/dev/editors/3dview/object/editing/transform/cont rol/snap.html*

Volume

Snaps to regions within the volume of the first Object found below the mouse cursor. Unlike the other options, this one controls the depth (i.e. Z-coordinates in current view space) of the transformed element. By toggling the button that appears to the right of the snap target menu (Refer Img 2.10), target Objects will be considered as whole, when determining the volume center.

Face

Snap to the surfaces of faces in Mesh Objects. It is useful for retopologizing the surface of the geometry.

Edge

Snap to edges of Mesh Objects.

Vertex

Snap to vertices of Mesh Objects.

Increment

Snap to grid points. When in Orthographic view, the snapping incrementchangesdepending on zoom level.

Icon	Details
	Align rotation with the snapping target.
	Project individual elements on the surface of other objects.
	Snaps elements to its own mesh.
	Consider Objects as whole when finding volume center.
	Snap to grid, instead of snapping in increments relative to the current location.

Title-Img 2. 10 Various Snap Option

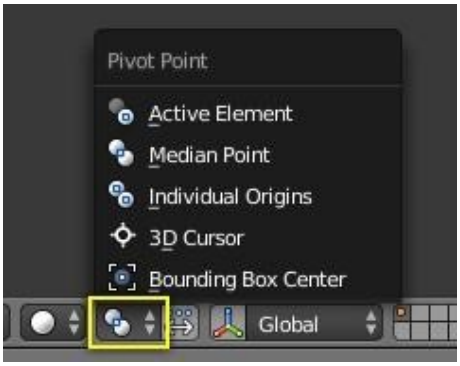
Source-Blender.org

Link- *https://docs.blender.org/manual/en/dev/editors/3dview/object/editing/transform/cont rol/snap.html*

Pivot Points

Origin of the 3D model, which is therefore not the physical center of gravity of the Object, but rather the **pivot point** that will identify the location coordinates of the Object in 3D space, and in toward which operations (such as rotation and scaling of the entire Object) will be carried out, in Object Mode.

- **Mode**: Object Mode and Edit Mode
- **Menu**: Drop list in the header of the 3D View

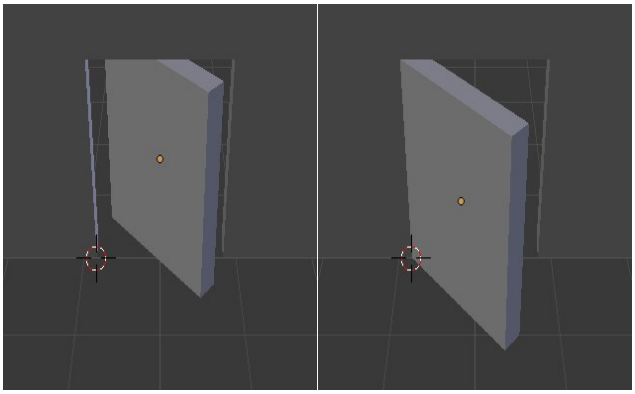


Title-Img 2. 11 Pivot Point modes

3D Cursor

- **Mode:** Object Mode and Edit Mode
- **Menu:** Select from the icon in the 3D View header.
- **Hotkey: .**

The 3D cursor is the most **intuitive of the pivot points**. With the 3D cursor selected as the active pivot point (from either the Editors Header or via.), simply position the 3D cursor and then do the required transformation. All **rotation and scaling** transformations will now be done relative to the location of the 3D cursor. The image below shows the difference when rotating an Object **around the median** point (left) and **around the 3D cursor** (right).



Title- Img 2. 12 Rotation around the 3D cursor compared to the median point.

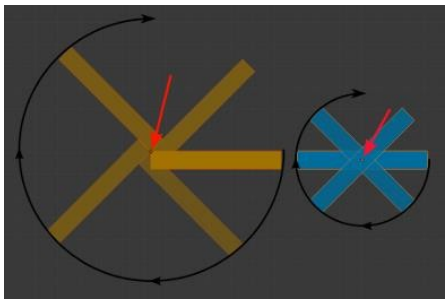
Attribution- Source-Blender.org

Link*https://docs.blender.org/manual/en/dev/editors/3dview/object/editing/transform/control/pivot_point/3d_cursor.html*

Individual Origins

- **Mode**: Object Mode and Edit Mode
- **Menu**: Select from the pivot-icon icon in the 3D View header.
- **Hotkey**: Ctrl-.

In Object Mode



Title-Img 2. 13 Rotation around individual origins.

Source-Blender.org

Link-

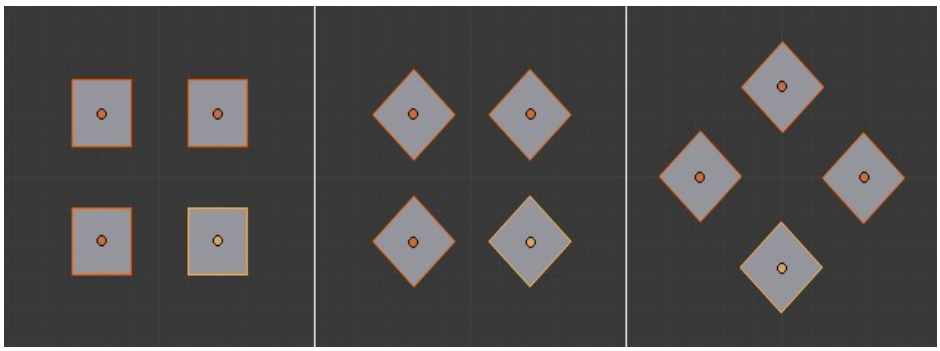
https://docs.blender.org/manual/en/dev/editors/3dview/object/editing/transform/control/pivot_point/individual_origins.html?highlight=rotation%20around%20individual%20 origins

The **OriginofanObject**isshown in the 3D Viewbya **smallorangecircle**. This is highlighted in the image to the right by **the red arrow**. The origin tells Blender the relative position of that Object in 3D space. What you see in the 3D View (vertices, edges etc.) is what makes up the Object.

While the Origin is equivalent to the center of the Object, it does not have to be located in the center of the Mesh. This means that an Object can have its center located on one end of the Mesh or even completely outside the mesh. For example, the orange rectangle in the image has its Origin located on the far left of the mesh.

Now let us examine: Rotation around the individual origins:

- The **blue rectangle** has its Origin located in the center of the mesh, while the orange rectangle has its Origin located on the left-hand side.
- When the **Pivot Point** is set to Individual Origins, the center of each Object (indicated by the red arrow) remains in place while the Object rotates around it in the path shown by the black arrow.

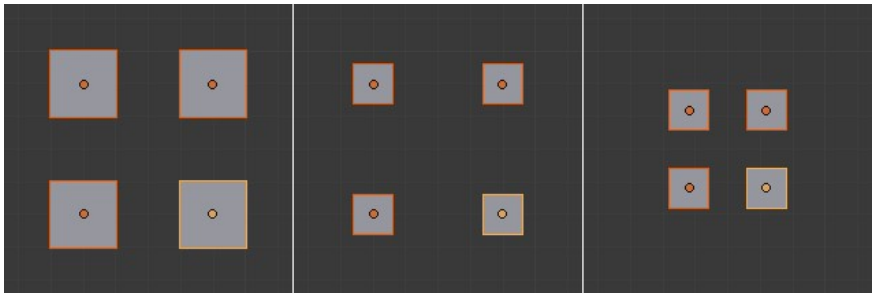


Title-Img 2. 14 Rotation around individual origins (middle) compared to the median point (right)

Source-Blender.org

Link-

https://docs.blender.org/manual/en/dev/editors/3dview/object/editing/transform/control/pivot_point/individual_origins.html



Title-Img 2. 15 Scaling around individual origins (middle) compared to the median point (right).

Source-Blender.org

Link- *https://docs.blender.org/manual/en/dev/editors/3dview/object/editing/transform/control/pivot_point/individual_origins.html*

Working with Layers

3D scenes often become exponentially more confusing as they grow more complex. Sometimes the artist also needs precise control over how individual Objects are lit, and does not want lights for one Object to affect nearby Objects. For this and other reasons below, Objects can be placed into one or more "**layers"**. Using Object layers, you can:

Selectively display Objects from certain layers in your 3D View, by selecting those layers in the 3D View header. This allows you to speed up interface redrawing, reduce virtual-world clutter, and help improve your workflow.

Mode: Object Mode

- **Panel:** Object ▸ Relations
- **Menu:** Object ▸ Move to Layer...
- **Hotkey:** M

Viewing layers

Blender provides **twenty layers** whose visibility can be toggled with the small unlabelled buttons in the header (Refer Img 2.16, 3D View layer buttons). To select a single layer, click the appropriate button with **LMB**; to select more than one, use **Shift-LMB** - doing this on an already active layer will deselect it.

Title-Img 2. 16 3D View layer buttons.

Source-Blender.org

Link- https://docs.blender.org/manual/en/dev/editors/3dview/object/properties/rela tions/layers.html

To select layers via the keyboard,

- **Step 1:** press **1 to 0** (on the main area of the keyboard) for layers 1 through 10 (the top row of buttons), and
- **Step 2: Alt-1** to **Alt-0** for layers 11 through 20 (the bottom row). Use Shift for multiple (de)selection works for these shortcuts too.

You can select or deselect all Scene Layer buttons at once by pressing **\.**

Locking to thescene

By default, the lock button directly to the right of the layer buttons is enabled. This means that changes to the viewed layers affect all other 3D Views locked to the scene

Multiple Layers

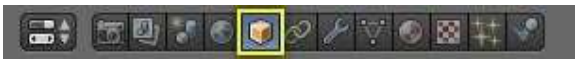
An Object can exist on **multiple layers**. For example, a lamp that only lights Objects on a shared layer could "be" on layers **1, 2, and 3.** An Object on layers **3 and 4** would be lit, whereas an Object on **layers 4 and 5** would not. There are many places where layer-specific effects come into play, especially lights and particles.

Moving Objects between layers

Title-Img 2. 17 Layer selection. Source-Blender.org

Link- *https://docs.blender.org/manual/en/dev/editors/3dview/object/properties/relations/la yers.html*

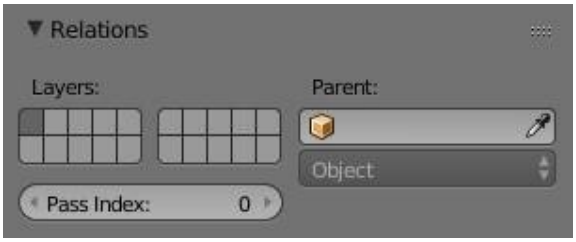
To move selected Objects to a different layer, press **M** and then select the layer you want from the pop-up menu. Objects can also be on **more than one layer** at a time. To have an Object on multiple layers, hold **Shift** while clicking.



Title-Img 2. 18 Selection in the Object tab Source-Blender.org

Link- *https://docs.blender.org/manual/en/dev/editors/3dview/object/properties/relations/la yers.html*

Another way to view or change a selected Object layer is via the Relations panel, in the Object tab.



Title-Img 2. 19 Layers in Object tab, Relations panel. Source-Blender.org

Link- *https://docs.blender.org/manual/en/dev/editors/3dview/object/properties/relations/la yers.html*

You will then see the layer buttons in the Relations panel – as before – the Object can be displayed on more than one layer by clicking **Shift- LMB**.

Objects in Blender

The geometry of a scene is constructed from one or more Objects. These Objects can range from lamps to light your scene, **basic 2D and 3D shapes** to fill it with models, armatures to animate those models, to cameras to take pictures or video of it all.

Object Types

Mesh

Meshes are Objects composed of Polygonal Faces, Edges and/or Vertices, and can be edited extensively with Blender's Mesh editing tools.

Curve

Curves are mathematically defined Objects which can be manipulated with control handles or control points (instead of vertices), to manage their length and curvature.

Surface

Surfaces are patches that are also manipulated with control points. These are useful for simple rounded forms and organic landscapes.

Metaball

Meta Objects (or Metaballs) are Objects formed by a mathematical function (with no control points or vertices) defining the 3D volume in which the Object exists. Metal Objects have a liquid-like quality, where when two or more Metaballs are brought together, they merge by smoothly rounding out the connection, appearing as one unified Object.

Text

Text Objects create a two-dimensional representation of a string of characters.

Armature

Armatures are used for rigging 3D models in order to make them poseable and animateable.

Lattice

Lattices are non-renderable wireframes, commonly used for taking additional control over other Objects with help of the Lattice Modifier.

Empty

Empties are null Objects that are simple visual transform nodes thatdonotrender.Theyareuseful

forcontrollingtheposition or movement of other Objects.

Speaker

Speaker brings to scene source of sound.

Camera

This is the virtual camera that is used to determine what appears in the render.

Lamp

These are used to place light sources in the scene.

Force Field

Force Fields are used in physical simulations. They give simulations external forces, creating movement, and are represented in the 3D View editor as small control Objects.

Group Instance

Let's you select from a list of existing Object groups. Once selected, an Empty Object will be created, with an instance of the selected group (group duplication active).

Objects

The geometry of a scene is constructed from one or more Objects. These Objects can range from lamps to light your scene, basic 2D and 3D shapes to fill it with models, armatures to animate those models, to cameras to take pictures or video of it all.

Unit Summary

In this Unit, you have learnt how to

- Work with 3D modelling using various options
- Channelize your work flow that helps you to bring down the complexities of the software.
- Create basic Objects, selection, duplication and mirroring Objects
- Load the Objects to layers to ensure an organised way of handling complex scenes.
- Create Object with the knowledge of the pivot
- Manipulate the pivot using various options to develop more complicated duplication of Objects.
- Arrange the Object precisely using one of the most important features of the software "snap" which gives us more flexibility.

After learning this Unit, you can download the Open Source Software available on the internet for free of cost to practice the possibilities of creating 3D Objects

Assignment

- Create "**House model**" with proper interiors using the basic primitives looking at the given image.

No need to add colors to the model. (you can do it after learning the texturing unit)The total length of the video should be **2-5 minutes.**

Assessment

1. Explain the various Selection Modes in Blender.
2. Describe the Method of Duplication and Mirror.
3. Describe the Uses of Layers.
4. Why do we need Snap Tool, explain?
5. Write a brief note on the Object Types in Blender.
6. Explain any three types of Snap Options.

Fill in the Blanks

1. In Object Mode, the last (de)selected item is called the_____.
2. The simplest form of Object Selection consists of using ____on it.
3. The____icon is used to Snap Objects and Mesh element to several types of scene elements.
4. _____will identify the location coordinates of the Object in 3D space.
5. Circle Select is used by moving with dotted circle through Objects with _____.

Resources

While studying this Unit, you can browse the internet links for tutorials and several books and

training DVDs available in the Blender Store and on the Blender Cloud.

- wiki.blender.org
- archive.org
- www.blender.org
- docs.blender.org

Unit-3 Inorganic Modeling

Introduction

Curves and Surfaces are very important for Modeling.

Curves and Surfaces are types of **Blender Objects**. They are expressed by mathematical functions rather than a series of points. Using the specific features of both **Bezier** and **NURBs curves,** you will create a model in 3D, and explore how they are computed behind the scenes than how they appear from a modeler's perspective.

Bezier curves are generally more intuitive because they start and end at the control points that you set, but **NURBs curves** are more efficient for the computer to calculate when there are many twists and turns in a curve.

Curves are **2D objects**, and Surfaces are their **3D extension**. Note however, that in Blender, you only have **NURBS Surfaces, no Bezier**. Even though curves and Surfaces share the same object type, they are not the same thing; For example, you cannot have in the same object both curves and Surfaces.

In this Unit, you will learn the **usage of Curves and Surfaces** for modeling.

Outcomes

Upon completion of this unit you will be able to:

- Create and work with Curves.
- Edit the Curves using different Modes.
- Working Surface modeling.
- Create Objects using Curves and
- Prepare Curve Deformation and Curve Extrusion

Terminology

Bezier Curve: Adds an open 2D Bezier curve with two control points.

Bezier Circle: Adds a closed, circle-shaped 2D **Bezier curve** (made of four control points).

NURBS Curve: It adds an open 2D **NURBS curve**, with four controls.

NURBS Circle: It adds a closed, circle-shaped 2D NURBS curve (made of eight control

points).

Path: It adds a NURBS open 3D curve made of five aligned control points, with Endpoint knots and the Curve Path setting enabled.

NURBS: Non-Uniform Rational B-Splines.

Extrude: Will extrude the curve along both the positive and negative local Z axes.

Bevel Depth: Changes the size of the bevel.

Subdividing: Curve subdivision simply subdivides all selected segments by adding one or more control points between the selected segments.

Duplication: This command duplicates the selected control points, along with the curve segments implicitly selected (if any).

Separating Curves: Curve objects that are made of multiple distinct, curves can be separated into their own objects by selecting the desired segments.

Fill: Fill determines the way a Curve is displayed when it is bevelled.

Introduction to Curves and Surfaces Curves

Bézier Curves

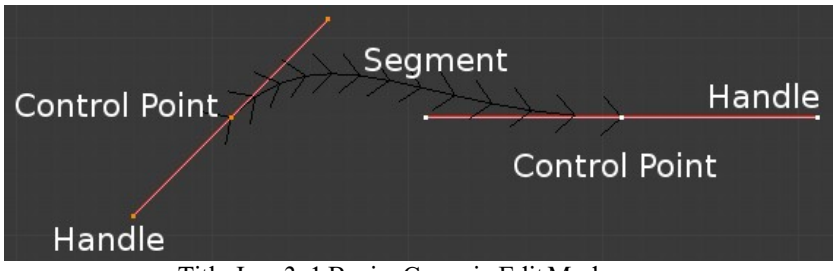
The main elements used in editing Bezier Curves are the **Control Points and Handles**.

Control Points

A Segment (the actual Curve) is found between **two Control Points**.

In the image below (Img 3.1), the Control Points can be found in the **middleofthepinkline** while the Handles comprise the **extensions** from the Control Point.

By default, the arrows on the Segment represent the **direction** and **relative speed** and direction of movement Objects will have when moving along the curve. This can be altered by defining a custom **F- Curve**.



Title-Img 3. 1 Bezier Curve in Edit Mode.

Source-Blender.org

Link-*http://blender-manual- i18n.readthedocs.io/ja/latest/modeling/curves/introduction.html?highlight=Bezier%20Curve%20in%20Edit%20Mode.*

Editing Bézier Curves

A Bézier curve can be edited by moving the locations of the Control Points and Handles:

- **Step 1:** Add a Curve by Shift-A to bring up the Add menu, followed by

  Curve ▸ Beziers.

- **Step 2:**Press Tab to enter Edit Mode.
- **Step 3:** Select one of the Control Points and move it around. Use LMB to confirm the new location of the Control Point, or use RMB to cancel.
- **Step 4:** Now select one of the Handles and move it around. Notice how this change the curvature of the curve.

To add more Control Points:

- **Step 1:** Select at least two adjacent Control Points.
- **Step 2:** Press **W**and select Subdivide.

Optionally, you can press **F6** immediately after the subdivision to modify the number of subdivisions

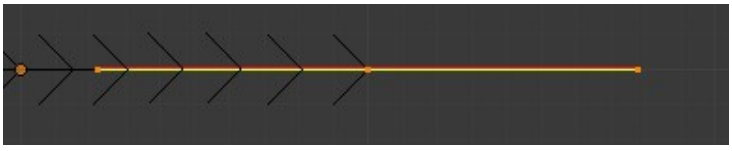
Handles

There are **Four Bézier Curve Handle types**. They can be accessed by pressing **V** and selecting from the list that appears, or by pressing the appropriate **hotkey** combination. Handles can be rotated, moved, scaled and shrunk/fattened like any vertex in a Mesh.

Bézier Curve Handle Types

1. Automatic V-A

This handle has a completely automatic length and direction which is set by Blender to ensure the **smoothest result**. These handles convert to **Aligned handles** when moved.



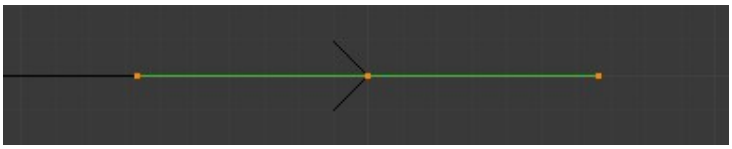
Title-Img 3. 2 Bezier handle type.

Source-

Link-*http://blender-manual- i18n.readthedocs.io/ja/latest/modeling/curves/introduction.html?highlight=Bezier%20Curve%20in%20Edit%20Mode.*

2. Vector V-V

Both parts of a handle always point to the previous handle or the next handle which allows you to create curves or sections thereof made of straight lines or with sharp corners. Vector handles convert to **free handles** when moved.



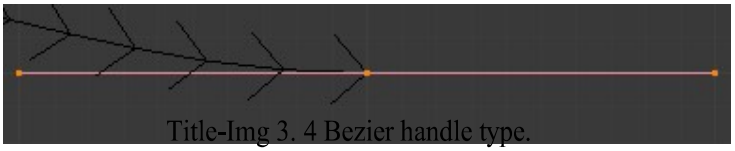
Title-Img 3. 3 Bezier handle type.

Source-Blender.org

Link-*http://blender-manual- i18n.readthedocs.io/ja/latest/modeling/curves/introduction.html?highlight=Bezier%20Curve%20in%20Edit%20Mode*.

3. Aligned V-L

These handles always lie in a **straight line**, and give a continuous curve without sharp angles.



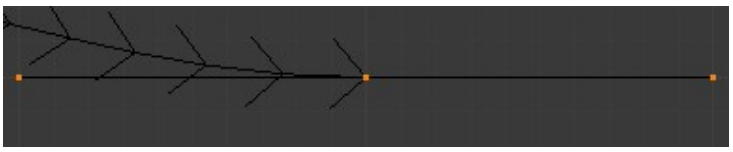
Title-Img 3. 4 Bezier handle type.

Source-Blender.org

Link-*http://blender-manual- i18n.readthedocs.io/ja/latest/modeling/curves/introduction.html?highlight=Bezier%20Curve%20in%20Edit%20Mode.*

4. Free V-F

The handles are **independent** of each other.



Title-Img 3. 5 Bezier handle type.

Source-Blender.org

Link-*http://blender-manual- i18n.readthedocs.io/ja/latest/modeling/curves/introduction.html?highlight=Bezier%20Curve%20in%20Edit%20Mode.*

Additionally, the **V-T shortcut** can be used to toggle between Free and Aligned handle types.

NURBS Curves

One of the major differences between Bézier Objects and NURBS Objects is that Bézier Curves are approximations.

For example, a Bézier circle **approximates a circle**, whereas a NURBS circle is an **exact circle**.In practice, many of the Bézier curve operations discussed above apply to NURBS curves in the same manner. The following text will concentrate only on those aspects that are unique to NURBS curves.

Editing NURBS Curve

A NURBS Curve is edited by moving the location of the Control Points:

- **Step 1:** Place a Curve by **Shift-A** to bring up the Add menu, followed by Curve ▸ NURBS curve.
- **Step 2:**Press Tab to enter Edit Mode.
- **Step 3:** Select one of the Control Points and move it around. Use LMB to confirm the new location of the Control Point, or use RMB to cancel.

To add additional Control Points

- **Step 1:** select both the Control Points
- **Step 2:** press **W**and
- **Step 3:** select Subdivide.
- **Step 4:** Press **F6** immediately after to determine how many subdivisions to make.

Transform Tools

Deforming Tool

- **Mode**: Edit Mode
- **Menu**: Curve ▸ Transform

The **Shear, Warp and Push/Pull transform tools** are described in the Transformations sections. The two other tools, **Tilt and Shrink/Fatten Radius** are related to **Curve Extrusion**.

Smoothing Tool

- **Mode**: Edit Mode
- **Hotkey**: W ▸ smooth

Curve smoothing is available through the specials menu. For Bézier curves, this smoothing operation **reduces the distance** between the selected control point/s and their neighbors, while keeping the neighbors anchored. **Does not affect** control point tangents.

Mirror Tool

- **Mode**: Edit Mode
- **Menu**: Curve ▸ Mirror
- **Hotkey**: Ctrl-M

The Mirror tool is also available, behaving exactly as with **Mesh vertices**. **Set Bézier**

Handle Type

- **Mode**: Edit Mode
- **Panel**: Curve Tools ▸ Handles
- **Menu**: Curve ▸ Control Points ▸ Set Handle Type
- **Hotkey**: V

Handle types are a **property of Bézier curves** that can be used to alter features of the curve. For example, switching to Vector handles can be used to create curves with **sharp corners**. Read the Bézier curves page for more details.

Extending Curves

- **Mode**: Edit Mode
- **Menu**: Curve ▸ Extrude
- **Hotkey**: Ctrl-LMB, E

Once a curve is created you can add **new segments** (in fact, new control points defining new segments), either by extruding, or placing new handles with **Ctrl-LMB**. Each new segment is added to one end of the curve. The Bézier curve can only be extend at the endpoints. **Ctrl-LMB** on inner control points will make unconnected duplicates.

Subdivision

- **Mode**: Edit Mode
- **Panel**: Curve Tools
- **Menu**: Surface tools ▸ Modeling ▸ Subdivide
- **Hotkey**: W

Curve subdivision simply subdivides all selected segments by adding one or more control points between the selected segments. To control the number of cuts, **press W** to make a single subdivision. Then **press F6** to bring up the Number of Cuts menu.

Duplication

- **Mode**: Edit Mode
- **Menu**: Curve ▸ Duplicate
- **Hotkey**: Shift-D

This command **duplicates** the selected control points, along with the curve segments implicitly selected (if any). The copy is selected and placed in **Grab mode**, so you can move it to another place.

Joining Curve Segments

- **Mode**: Edit Mode
- **Menu**: Curve ▸ Make Segment
- **Hotkey**: F

Two open curves can be **combined into one** by creating a segment between the two curves. To join two separated curves, select one end control point from each curve then **press F**. The two curves are joined by a segment to become a **single curve**.

Separating Curves

- **Mode**: Edit Mode
- **Menu**: Curve ▸ Separate
- **Hotkey**: P

Curve objects that are made of multiple distinct curves can be **separated** into their own objects by selecting the desired segments and **pressing P**. Note, if there is only one curve in a Curve object, pressing P will create a new Curve object with **no control points**.

Deleting Elements

- **Mode**: Edit Mode
- **Menu**: Curve ▸ Delete...

- **Hotkey**: X, Delete
- **Selected: This** will delete the selected control points, without breaking the curve (i.e. the adjacent points will be directly linked, joined, once the intermediary ones are deleted).

- **Segment:** This option is somewhat the opposite to the preceding one, as it will cut the curve, without removing any control points, by erasing one selected segment.

Opening and Closing a Curve

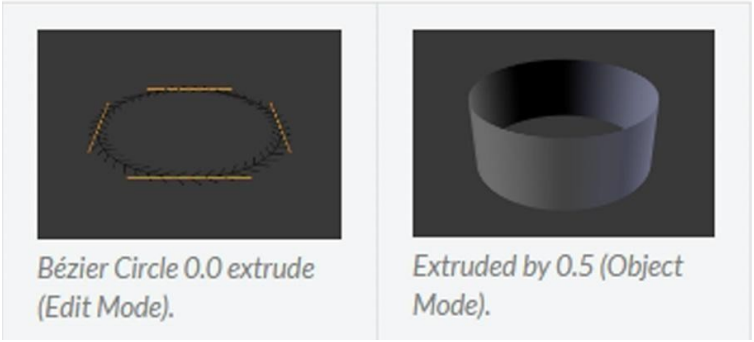
- **Mode**: Edit Mode
- **Menu**: Curve ▸ Toggle Cyclic
- **Hotkey**: Alt-C

This toggles between an open curve and closed curve **(Cyclic)**. Only curves with at least one selected control point will be **closed/open**. The shape of the closing segment is based on the **start and end** handles for Bézier curves, and as usual on adjacent control points for **NURBS**. The only time a handle is adjusted after closing is if the handle is an **Auto one**. Open and Closed curves is the same Bézier curve open and closed.

Curve Extrution

- **Mode**: Object or Edit Mode
- **Panel**: Curve and Surface
- **Extrude**

Turns a **one-dimensional curve into a two-dimensional curve** by giving it height. Note that this is not related to **Extrude** used in Mesh edit-mode. With a scale of one, an Extrusion of 0.5 will extrude the **curve 0.5 BU** in both directions, perpendicular to the curves normals.



Title-Img 3. 6 Curve Extrution

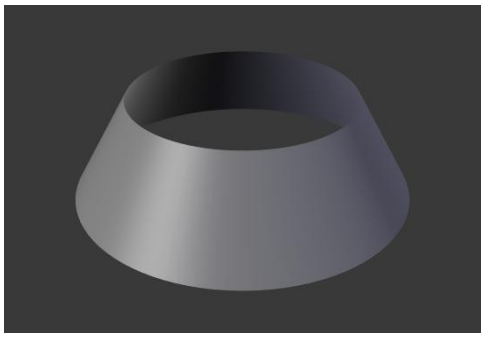
Attribution- Source-Blender.org

Link-*https://easyblend.org/html/modeling/curves/editing/extrude.html*

Tilt This setting controls how the normals **(visualization: arrows)** twist around each control point – so it is only relevant with 3D curves! You set it using the Tilt transform tool in the **T tool shelf**, the **N ▸ transform ▸ Mean tilt**, or **Curve ▸ Transform ▸ Tilt**.

You can also reset it to its default value (i.e. perpendicular to the original curve plane) with **Alt-T**, **Curve ▸ Control Points ▸ Clear Tilt.**

With **NURBS**, the tilt is always smoothly **interpolated**. However, with **Bézier**, you can choose the interpolation algorithm between Linear, Ease, B-Spline, and Cardinal, in the Properties Editor ▸ Object Data ▸ Active Spline ▸ Tilt



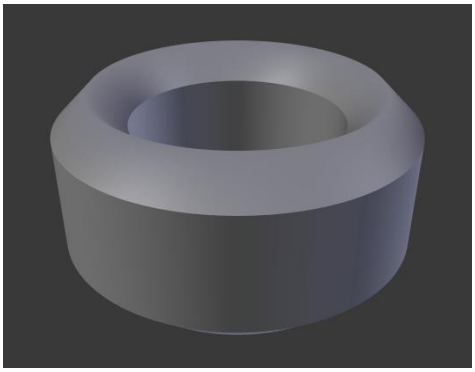
Title-Img 3. 2 30-degree Mean Tilt of all control points.

Source-Blender.org

Link-*https://easyblend.org/html/modeling/curves/editing/extrude.html*

Bevel Depth

This will add a bevel to the Extrusion. Refer Img 3.8 for its effects... Note that the bevel makes the Extrusion wider and higher. If **set to 0.0**, there is no bevel.



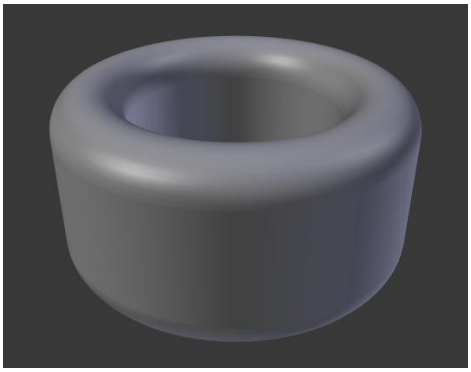
Title-Img 3. 3*Bevel depth of 0.25, fill set to full, zero Mean Tilt.*

Source-Blender.org

Link-*https://easyblend.org/html/modeling/curves/editing/extrude.html*

Bevel Resolution

It controls the resolution of the bevel created by a Bevel Depth **higher than zero**. Ifset theto0 (thedefault), thebevelisasimple“flat”Surface. Higher values will smooth, round off the bevel, similar to the resolution settings of the curve itself.



Title-Img 3. 4 *Bevel resolution set to 10.*

Source-Blender.org

Link-*https://easyblend.org/html/modeling/curves/editing/extrude.html*

Offset

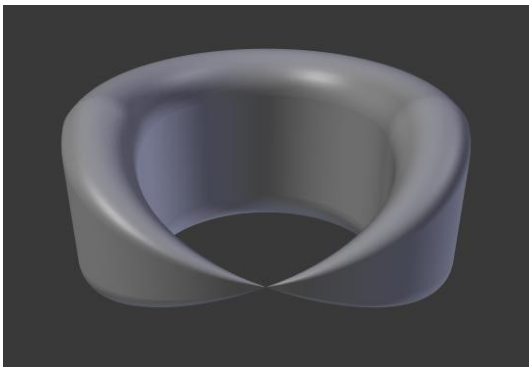
Offset Moves the Extrusion parallel to the curve normal. Almost like scaling

-1 Offset, 0.5 Extrusion, 0.25 Bevel Depth, 10 Bevelresolutions

Radius

The Radius allows you to **directly control** the width of the Extrusion along the “spinal” curve. The Radius of the points is set using the Shrink/Fatten Radius transform tool **Alt-S**, the **Curve ► Transform ►**

Shrink/Fatten Radius, or the **N ► transform ► Radius**.



Title-Img 3. 5 One control point radius set to zero

Source-Blender.org

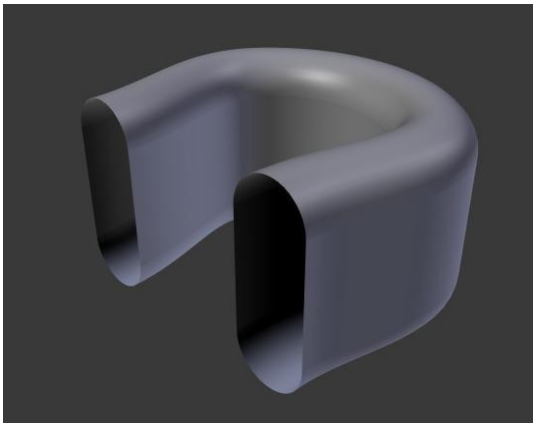
Link-*https://easyblend.org/html/modeling/curves/editing/extrude.html*

Three Sub-Classes ofCurve:

We have **three sub-classes** of results, depending on whether the curve is **open** or **closed** or **3D.**

Open 2D Curve

The Extrusion will create a **"wall" or "ribbon"** following the curve shape. If using a Bevel Depth, the wall becomes a sort of slide or gutter. If your normals are facing the wrong way you can switch their direction as shown here.



Title-Img 3. 6 Open 2D Curve with Alt-C, fill set to none, zero offset, 0.5 Extrusion, 0.25 Bevel Depth, 10 Bevel resolution.

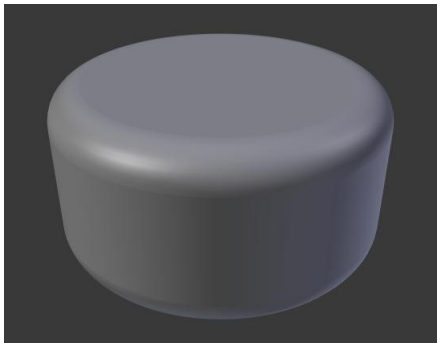
Source-Blender.org

Link-*https://docs.blender.org/manual/en/dev/modeling/curves/properties/geometry.html*

Closed 2D Curve

This is probably the most useful situation, as it will quickly create a volume, with (by default) two flat and parallel Surfaces filling the two sides of the extruded "wall". You can remove one or both faces by choosing the fill mode: **both, front, back, or none.**

The optional bevel depth will always create a **90 degree** bevels here.



Title-Img 3. 7 *Closed 2D Curve, 0.5 extrude, 0.25 Bevel Depth, 10 Bevel resolution, Fill: Both.*

Source-Blender.org

Link-*https://docs.blender.org/manual/en/dev/modeling/curves/properties/geometry.html*

Advanced Extrution

These Extrusions use **one or two** additional curve objects, to create very complex organic shapes.

To enable this type of Extrusion, you must type a **valid curve object** name in the Bevel Object field of the curve you are going to use as the "spinal column" of your Extrusion. The **"bevel" curve** will control the cross section of the extruded object. Whether the Bevel Object curve is **2Dor 3D** hasnoimportance, butifitisclosed, itwillcreatea"tube-like" Extrusion; otherwise you will get a sort of gutter or slide object...

The object is extruded along the entire length of all internal curves. By default, the width of the **Extrusionisconstant**, but you have two ways to control it,

1. Radius property of control points
2. Taper Object.

Taper Curve

Taper Curve is evaluated along the **local X axis**, using the **local Y axis** for width control. Note also that:

It must be an **open curve**.

The taper is applied independently to all curves of the extruded object.

Only the first curve in a Taper Object is evaluated, even if you have several separated segments.

The scaling starts at the first control-point on the left and moves along the curve to the last control-point on the right.

Negative scaling, (negative local Y on the Taper Curve) is possible as well. However, rendering artifacts may appear.

It might need to increase the curve resolution to see more detail of the taper.

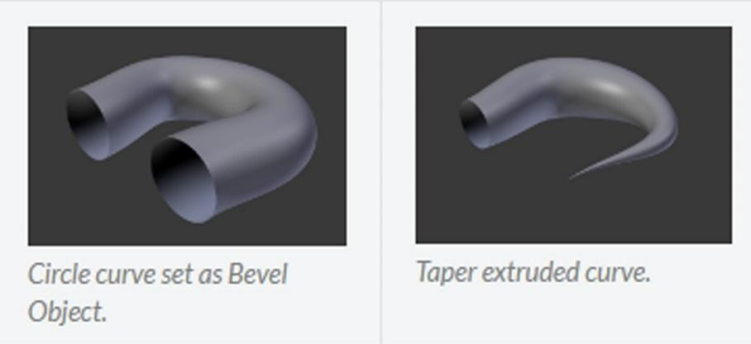
With **closed curves**, the Taper Curve in Taper Object acts along the whole curve (perimeter of the object), not just the length of the object, and varies the Extrusion depth. In these cases, you want the relative height of the Taper Object Taper Curve at both ends to be the same, so that the **cyclic point** (the place where the endpoint of the curve connects to the beginning) is a smooth transition.

Let us taper a simple curve circle extruded object using a Taper Curve.

- **Step 1:** Add a curve,
- **Step 2:** Then exit Edit Mode.
- **Step 3:** Add another one (a closed one, like a circle);
- **Step 4:** Call it "Bevel Curve",
- **Step 5:** Enter its name in the Bevel Object field of the first curve (Curve and Surface tab). We now have a pipe.
- **Step 6:** Add a third curve while in Object Mode and
- **Step 7:** Call it "Taper Curve".
- **Step 8:** Adjust the left control-point by raising it up about 5 units.
- **Step 9:** Now return to the Object tab,
- **Step 10:** Edit the first curve's Taper Object field in the Curve and Surface panel to reference the new Taper Curve which we called "Taper Curve".

When you hit enter the Taper Curve is applied immediately, with the results shown in Img 3.13 Circle curve set as Bevel Object.

Title-Img 3. 8Taper curve

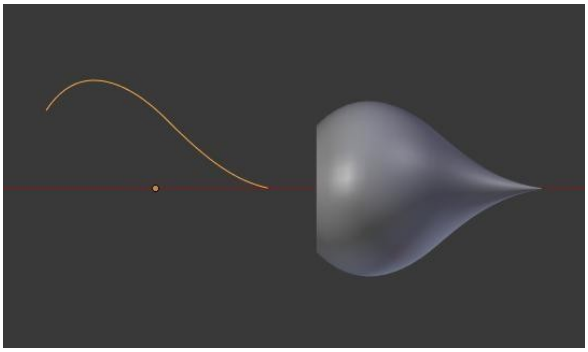


Source-Blender.org

Link-*https://docs.blender.org/manual/en/dev/modeling/curves/properties/geometry.html*

You can see the Taper Curve being applied to the extruded object. Notice how the pipe's volume shrinks to nothing as the Taper Curve goes from left to right. If the Taper Curve went below the local Y axis the pipe's inside would become the outside, which would lead to **rendering artifacts**. Of course, as an artist, that may be what you are looking for!

Taper Examples

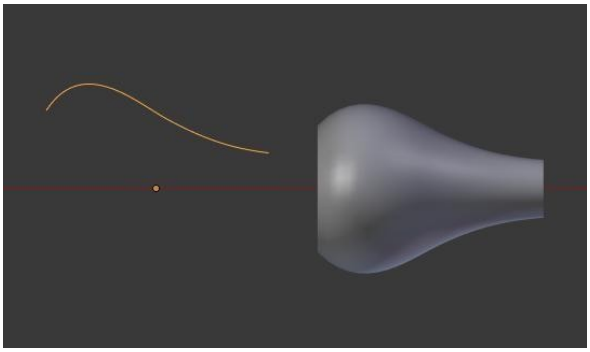


Title-Img 3. 9*Taper example 1.*

Source-Blender.org

Link- *https://docs.blender.org/manual/en/dev/modeling/curves/properties/geometry.html*

In Taper example 1 (Img 3.14), You can clearly see the effect the left Taper Curve has on the right curve object. Here the left Taper Curve is closer to the object center and that results in a smaller curve object to the right.

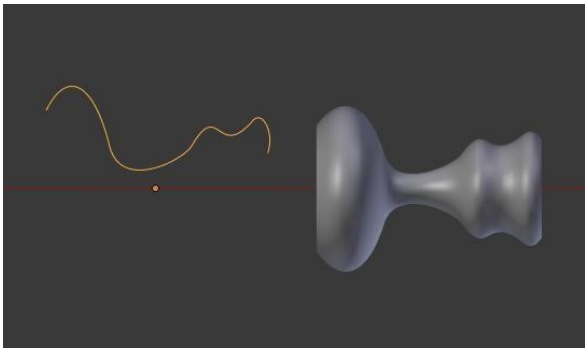


Title-Img 3. 10*Taper example 2.*

Source-Blender.org

Link- ***https://docs.blender.org/manual/en/dev/modeling/curves/properties/geometry.html***

In Taper example 2 (Img 3.15), A control point in the Taper Curve to the left is moved away from the center and that gives a wider result to the curve object on the right.

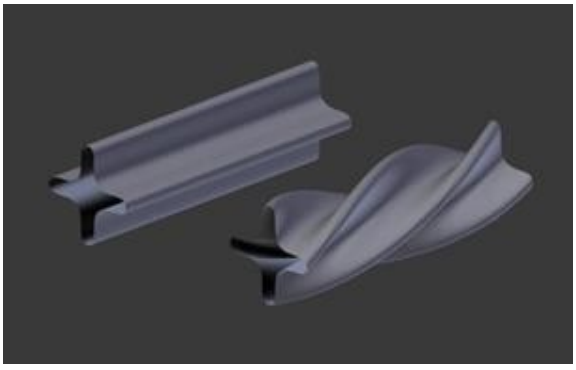


Title-Img 3. 11 *Taper example 3.*

Source-Blender.org Link-

https://docs.blender.org/manual/en/dev/modeling/curves/properties/geometry.html

In Taper example 3 (Img 3.16), We see the use of a more irregular Taper Curve applied to a curve circle.



Title-Img 3. 12 Bevel Extrusion with Tilt example.

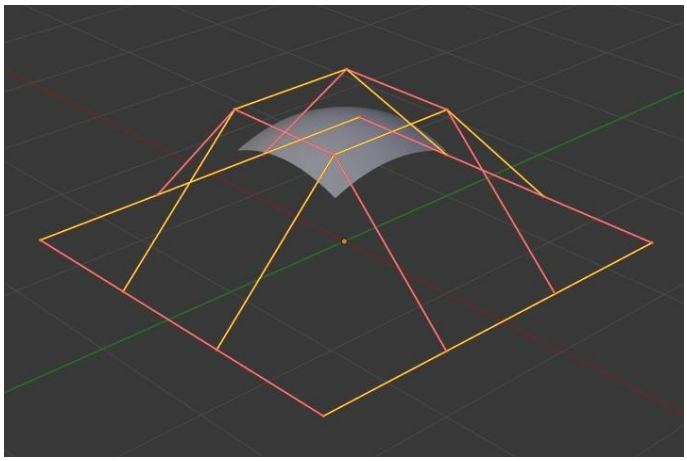
Source-Blender.org

Link-*https://docs.blender.org/manual/en/dev/modeling/curves/properties/geometry.html*

Surfaces

Surface Editing

Curves are 2D objects, and **Surfaces are their 3D** extension. Note however, that in Blender, you only have **NURBS Surfaces, no Bezier** (you have the Bezier knot type, though; see below), nor polygonal (but for these, you have Meshes!). Even though curves and Surfaces share the same object type (with texts also...), they are not the same thing; for example, you cannot have in the same object both curves and Surfaces.



Title-Img 3. 13Nurbs Surface in edit mode

Source-Blender.org

Link-*https://docs.blender.org/manual/en/dev/modeling/surfaces/introduction.html*

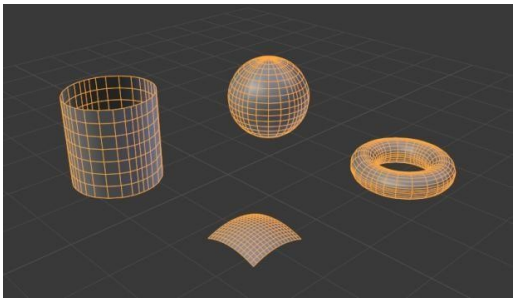
Nurbs Surface in Edit Mode

You may ask yourself "The Surface appears to be 3D, why is it only 2D?" In order to be 3D, the object needs to have "**Volume**", and a Surface, even when it is closed, does not have volume; it is infinitely **thin**. If it had a volume the Surface would have a **thickness** (its third dimension). Hence, it is only a 2D object, and has only two interpolation dimensions or axes or coordinates (if you know a bit of math, think of non-euclidean geometry – well, Surfaces are just non-euclidean 2D planes...).

Primitives

To get started in creating Surfaces, there are **four preset NURBS Surfaces**, found in the Add › Surface as

1. NURBS Surface
2. NURBS Tube
3. NURBS Sphere
4. NURBS Torus

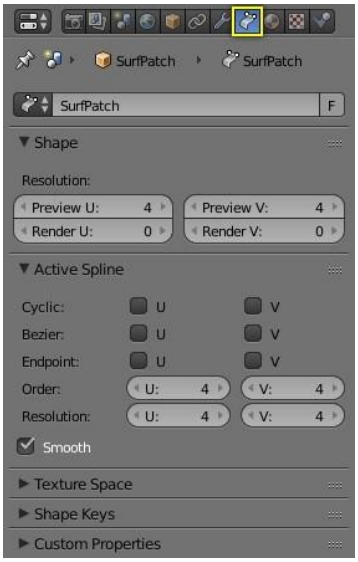


Title-Img 3. 14 *NURBSSurface primitives*.

Source-Blender.org

Link- *https://docs.blender.org/manual/en/dev/modeling/surfaces/primitives.html#comm on-options*

Properties



Title-Img 3. 15 *Surface Properties.*

Source-Blender.org

Link*-https://docs.blender.org/manual/en/dev/modeling/surfaces/properties.html*

Shape

Title-Img 3. 16 *Shape panel.*

Source-Blender.org

Link-*https://docs.blender.org/manual/en/dev/modeling/surfaces/properties.html*

You can adjust the resolution separately for both preview and render, to not slow things down in the viewport, but still get **good render results**.

Preview

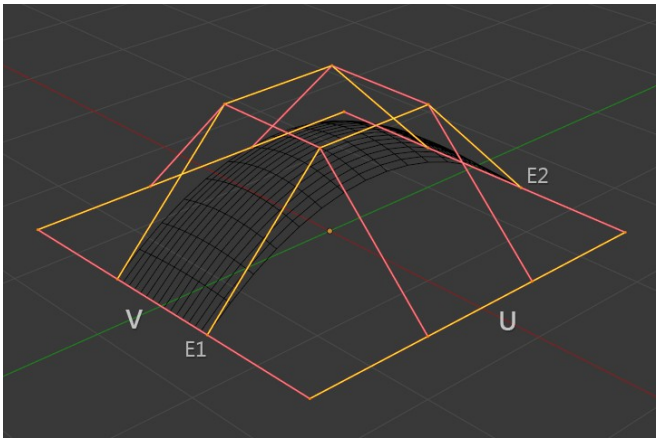
U, V

Render

U, V

Bezier Endpoint

Just like with NURBS curves, **NURBS Surfaceshavetwoknotvectors**, one for each **U and V axis**. Here again, they can be one of Cyclic, Endpoint, or Bezier, with the same properties as for curves. And as with curves, only Open Surfaces (in the relevant direction) are affected by this setting.



Title-Img 3. 17*Endpoint U.*

Source-Blender.org

Link-*https://docs.blender.org/manual/en/dev/modeling/surfaces/properties.html*

In Img 3.22 Endpoint U, the **Uinterpolation** axis islabeled as “U” andthe **V interpolation** axis is labeled as “V”. The U’s interpolation axis has been set to **Endpoint** and as such the Surface now extends to the outeredges from **E1 to E2** along the U interpolation axis.

Adding or Extruding

- **Mode**: Edit Mode
- **Menu**: Surface ▸ Extrude
- **Hotkey**: E, Ctrl-LMB

Unlike Meshes or curves, you cannot generally directly add new control points to a Surface (with **Ctrl-LMB** clicks), as you can only extend a Surface by adding a **whole U- or V-row** at once. The only exception is when working on a NURBS Surface curve, i.e. a Surface with only one control point on each U- or V-row. In this special case, all works exactly as with curves.

Most of the time, **only Extrusion** is available. As usual, once the tool is activated the Extrusion happens immediately and you are placed into Grab mode, ready to drag the new extruded Surface to its destination.

There are two things very important to understand:

Surfaces are 2D objects. So, you cannot extrude anything inside a Surface (e.g. “inner” row); it wouldnotmakeanysense!

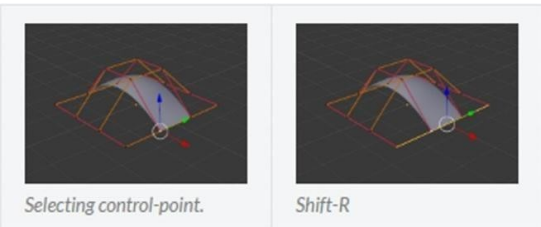
The control “grid” must remain “squarish”, which means that youcanonlyextrudeawholerow,not partsofrowshereand there.

To summarize, the Extrude tool will only work, when **only one whole border row** is selected, otherwise nothing happens.

Examples

Selecting control-point to show a typical Extrusion along the side of a Surface.

In Img 3.23, Selecting **control-point** and **Shift-R**, a border row of control points was highlighted by selecting a single control point, and then using the handy row select tool **Shift-R** to select the rest of the control points.



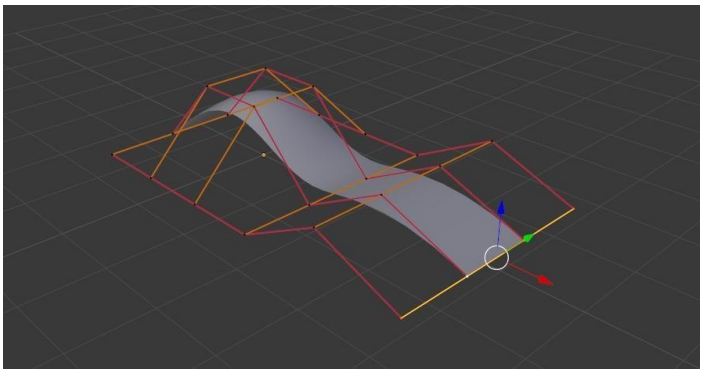
Selecting control-point. Shift-R

Title-Img 3. 18 *Selecting control point*

Source-Blender.org

Link-*https://docs.blender.org/manual/en/dev/modeling/surfaces/editing.html*

The edge is then extruded using E as shown in *Img 3.24* Extruding. Notice how the Mesh has bunched up next to the highlighted edge. That is because the new extruded Surface section is bunched up there as well.



Title-Img 3. 19 *Extruding*

Source-Blender.org

Link-*https://docs.blender.org/manual/en/dev/modeling/surfaces/editing.html*

By moving the new section away from the area, the Surface begins to "**un-bunch**".

You can continue this process of extruding or adding new Surface sections until you have reached the final shape for your model.

Deleting Elements

- **Mode**: Edit Mode
- **Menu**: Curve ‣ Delete...
- **Hotkey**: X, Delete

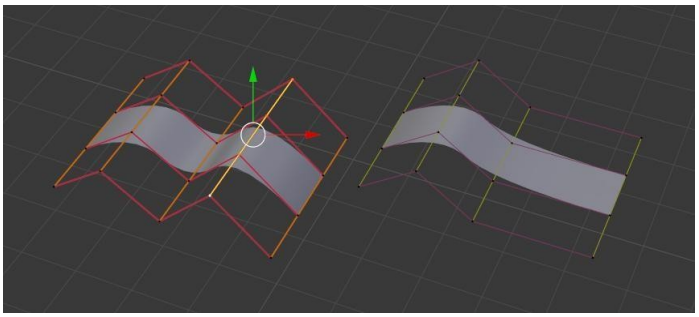
The Erase pop-up menu of Surfaces offers an option:

- **Selected**

This will delete the selected rows, without breaking the Surface (i.e. the adjacent rows will be directly linked, joined, once the intermediary ones are deleted). The selection must abide by the following rules:

Whole rows, and only whole rows must be selected. Only rows along the same axis must be selected (i.e. you cannot delete **both U- and V-rows** at the same time).

Example



Title-Img 3. 20 *Before and After*

Source- Blender.org

Link-*https://docs.blender.org/manual/en/dev/modeling/surfaces/editing.html*

In Img 3. 21 Before and after (left) a row of control points has been selected by initially selecting the one control point and using **Shift-R** to select the remaining control points. Then, using the **Delete Menu X,** the selected row of control points is erased, resulting in Img 3. 22 Before and after (right).

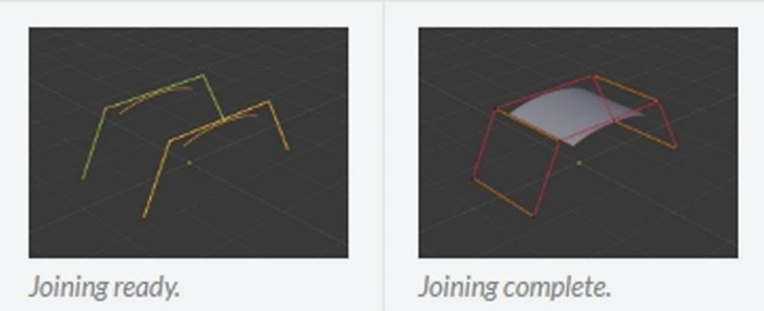
Joining or Merging Surfaces

- **Mode**: Edit Mode
- **Menu**: Surface ▸ Make Segment
- **Hotkey**: F

This command is equivalent to creating edges or Faces for Meshes (hence its shortcut), and so it only works in **Edit Mode**. The selection must contain only border rows of the same resolution (with the same number of control points), else Blender will try to do its best to guess what to merge with, or the merge will fail (either silently, or stating that Resolution does not match if rows with different number of points are selected, or that there are too few selections to merge if you only selected points in one Surface).

Examples

Title-Img 3. 23 *Before and After*



Source-Blender.org

Link-*https://docs.blender.org/manual/en/dev/modeling/surfaces/editing.html*

Unit summary

In this Unit, you have learnt what is 3D Interface and how to

- Create Objects and work with Curves and Surfaces in Blender
- Edit the Curves and Surfaces using different Modes in Blender
- Work with Surface modelling
- Work with Nurbs modelling
- Work effectively with 2D shapes
- Prepare Curve Deformation and Curve Extrusion

After learning this Unit, you can download the Open Source Software available on the internet for free of cost to practice the possibilities of creating 3D Interface.

Assignment

- Create a **Flower Vase**, a **Wine Glass** and a **Cup** using Nurbs curves

Assessment

- Explain Nurbs Modelling.
- Write a brief note on the Editing methods in Curve.
- Explain Bezier handle types.
- Describe the properties of 2D and 3D shapes. Write a brief note on Extending curves Explain the types of Curve Extrusion

Fill in the Blanks

1. _____are the most commonly used curves for designing letters or logos.
2. _____turns a one-dimensional curve into a two-dimensional curve by giving it height.
3. _____moves the Extrusion parallel to the curve normal.
4. _____allows you to directly control the width of the Extrusion along the "spinal" curve.
5. _____handle has a completely automatic length and direction which is set by Blender to ensure the smoothest result.

Resources

While studying this Unit, you can browse the internet links for online tutorials and several books and training DVDs available in the Blender Store and on the Blender Cloud.

- wiki.blender.org
- archive.org
- www.blender.org
- docs.blender.org

Unit 4 Organic Modeling

Introduction

In this Unit, you will learn the **creation of a 3D scene** and the usage of three key components to create the **real-time geometry Modelling** in Blender.

You will also learn to use the specific features of your chosen 3D software, each one of these **Primitives** can be manipulated to produce an Object. You will create **a model in 3D**, and explore the various modelling methods used in the production.

There are **three basic methods** that will be used to create a 3D model, and you will understand **how to create a model** using each technique.

Outcomes

Upon completion of this unit you will be able to:

- Create Object with 3D Primitives
- Edit the Object with different Modes
- Mesh Modelling
- Create Polygon Objects
- Analyse the Mesh

Terminology

Structure: With Meshes, everything is built from three basic structures: Vertices, Edges and Faces.

Vertices: A vertex is primarily a single point or position in 3D space.

Edges: An edge always connects two vertices by a straight line.

Faces: Faces are used to build the actual surface of the Object.

Loops: Edge and Face Loops are sets of faces or edges that form continuous "loops".

Edge Lops: Loops (1 and 2) in Img 4. 1 Edge and Face Loops are edge Loops.

Face Lops: These are a logical extension of Edge Loops in that they consist of the faces between two Edge Loops.

Edge Ring: In Edge select mode, holding Ctrl-Alt while selecting an edge selects a sequence of edges that are not connected.

Subdividing: Technique for adding more geometry to a Mesh. It creates new vertices on subdivided edges, new edges between subdivisions and new faces based on new edges.

Tessellation: The tiling of a plane using one or more geometric shapes usually resulting in Micro polygons.

Coplanar: Refers to any set of elements that are all aligned to the same 2D plane in 3D space.

Modeling Modes

3D View has **three principal modes** that allow for the creation, editing and manipulation of the Mesh models. Each of the three modes has a **variety of tools**. Some tools may be found in one or more of the modes.

Modes used forModeling

Creation of a **Mesh Primitive** typically starts by adding a **Mesh Object** in Object Mode. Limited types of editing such as size, location, and orientation can be accomplished in Object Mode. Object Mode also provides the means to **Join and Group Multiple Mesh** Primitives.

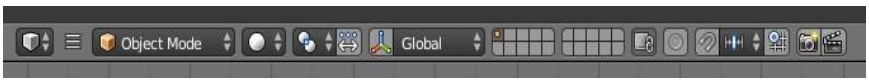
- Object Mode
- Edit Mode
- Sculpt Mode

More detailed editing of the Mesh model shape is done in **Edit Mode, and Sculpt Mode**. The nature of these three modes determines the tools that are available within the various panels of 3D View. Switching between modes while Modelling is common. Some tools may be available in more than one mode while others may be unique to a particular mode.

You can work with **Geometric Objects** in two modes.

Object Mode

Object Mode Operations in Object Mode affect the **whole Object**. Object Mode has the following header in 3D View:



Title-Img 4. 1 Object Mode Header.

Source-Blender.org

Link-https://docs.blender.org/manual/en/dev/modeling/meshes/introduction.html

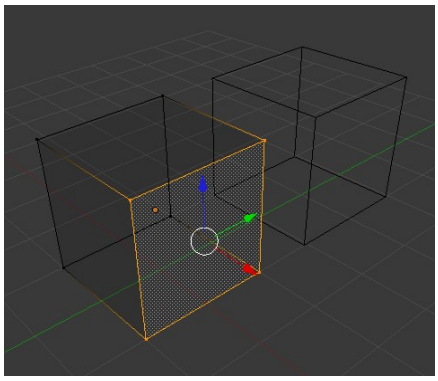
Edit Mode

Operations in Edit Mode affect only the **geometry of an Object**, but not global properties such as location or rotation. Edit Mode has the following header in 3D View:

Title-Img 4. 2 Edit Mode Header.

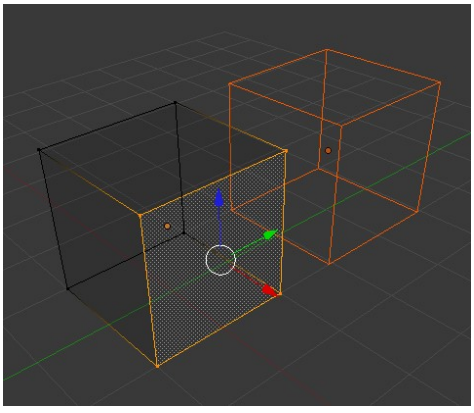
Source-Blender.org
Link-https://docs.blender.org/manual/en/dev/modeling/meshes/introduction.html

Visualization



Title-Img 4. 3 One cube selected

Source-Blender.org
Link-https://docs.blender.org/manual/en/dev/modeling/meshes/introduction.html



Title-Img 4. 4 Two cube selected before entering edit mode

Source-Blender.org

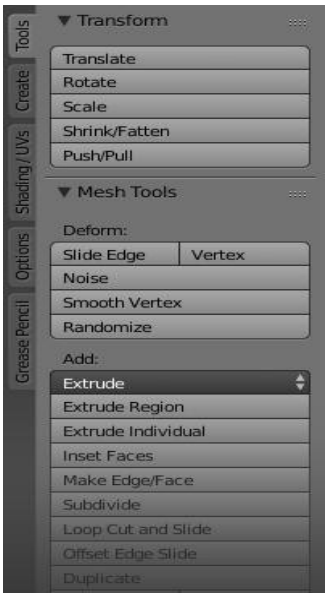
Link-https://docs.blender.org/manual/en/dev/modeling/meshes/introduction.html

By default, **Blender** highlights selected geometry in **orange in both Object Mode and Edit Mode.**

- In **Object Mode** with Wireframe shading enabled **Z**, Objects are displayed in black when unselected and in orange when selected. If more than one Object is selected, all selected Objects except the active Object, typically the Object last selected, are displayed in a **darker orange color**. Similarly, in Edit Mode, unselected geometry is drawn in black while selected faces, edges, or vertices are drawn in orange. The active face is highlighted in **white**.
- In **Edit Mode**, only **one Mesh** can be edited at the time. However, several Objects can be joined into a single Mesh (**Ctrl-J** in Object Mode) and then separated again (**P** in Edit Mode). If multiple Objects are selected before entering Edit Mode, all the selected Objects remain highlighted in **orange** indicating that they are part of the active selection set.

If two vertices joined by an edge are selected in **Vertex selection mode**, the edge between them is highlighted too. Similarly, if enough vertices or edges are selected to define a face, that face is also highlighted.

Tool Shelf



Title-Img 4. 5 The Tool Shelf panel in edit mode.

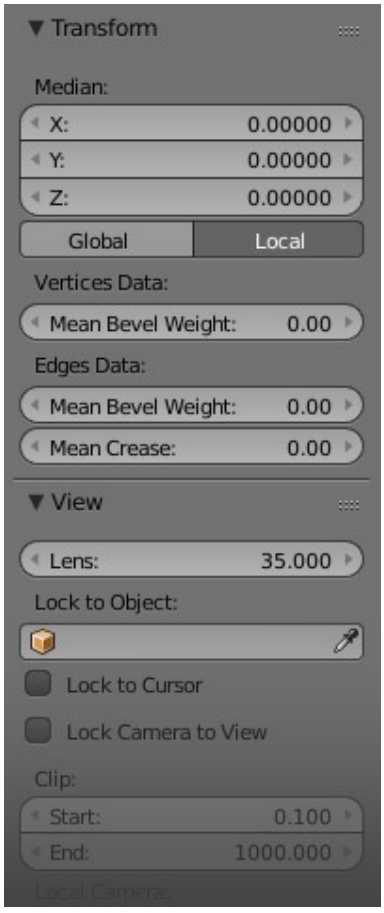
Attribution- Source-Blender.org

*Link-*https://docs.blender.org/manual/en/dev/modeling/meshes/introduction.html

Open/Close the Mesh Tools panel using **T**. When entering Edit Mode, several Mesh tools become available.

Most of these tools are also available as shortcuts (displayed in the **Tooltips** for each tool) and/or in the Specials Menu **W**, the Edge menu **Ctrl-E**, and Face menu **Ctrl-F**. The properties of each tool are displayed in the operator panel at the bottom of the **ToolShelf**.

Properties Region



Title-Img 4. 6 The Properties Region in edit mode.

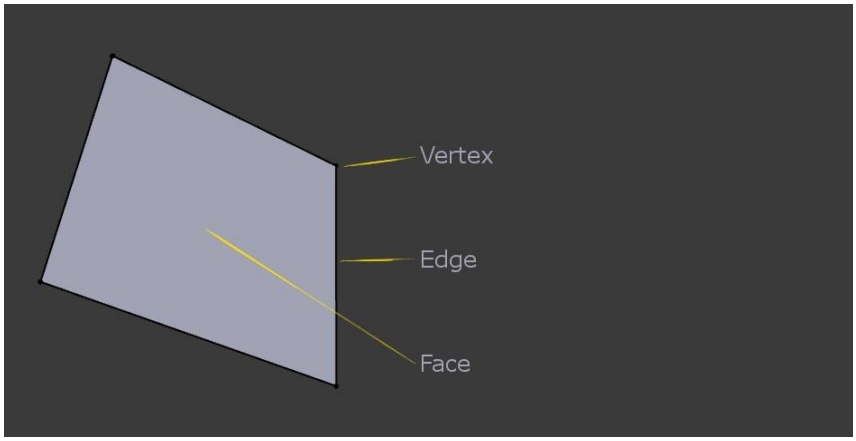
Source-Blender.org

*Link-*https://docs.blender.org/manual/en/dev/modeling/meshes/introduction.html

Open/close the Properties Region using N.

In the Properties Region, panels directly related to Mesh editing are the Transform panel, where numeric values can be entered, and the Mesh Display panel, where for example normals and numeric values for distances, angles, and areas can be turned on.

With Meshes, everythingisbuiltfrom **threebasic**structures: **Vertices, Edges and Faces.**



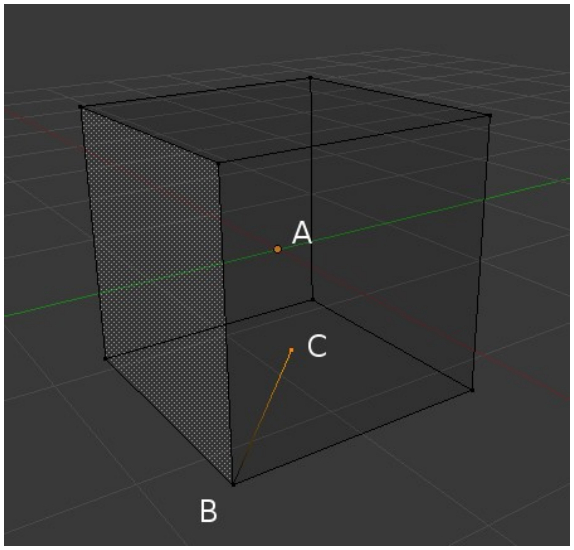
Title-Img 4. 7 Example of Mesh structure.

Source-Blender.org

*Link-*https://docs.blender.org/manual/en/dev/modeling/meshes/structure.html

Vertices

A vertex is primarily a **single point or position**in 3D space. It is usually invisible in rendering and in Object Mode. Do not mistake the center point of an Object for a vertex. It looks similar, but it is **bigger** and you cannot select it. Refer Vertex example (Img 4.8). Shows the center point labelled as “A”; “B” and “C” are vertices.



Title-Img 4. 8 Vertex example

Source-Blender.org

*Link-*https://docs.blender.org/manual/en/dev/modeling/meshes/structure.html

A simple way to create a new vertex is to click **Ctrl-LMB** in Edit Mode. Of course, as a computer screen is two-dimensional, Blender cannot determine **all three vertex** coordinates

from a single mouse click, so the new vertex is placed at the depth of 3D cursor. Using the method described above (Img 4.8), any vertices selected previously are automatically connected to the new ones by an edge. In the image above, the vertex labelled "C" is a new vertex added to the cube with a new edge added between "B" and "C".

Edges

An Edge always **connects two vertices** by a straight line. The edges are the "**wires**" you see when you look at a Mesh in wireframe view. They are usually invisible on the rendered image. They are used to construct faces. Create an edge by selecting two vertices and pressing **F**.

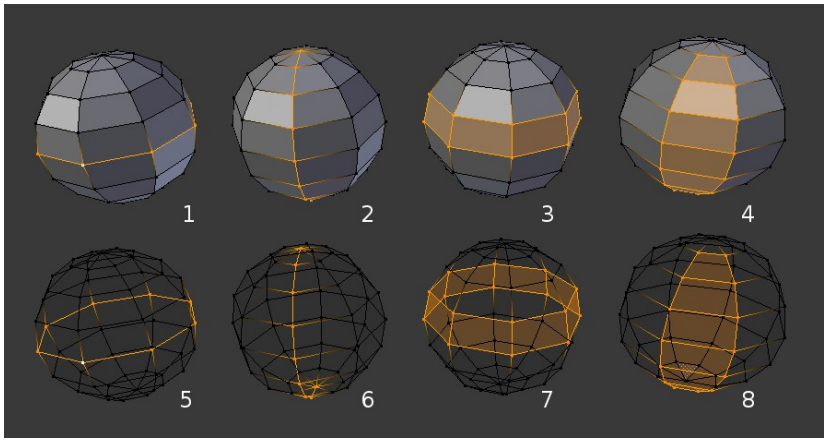
Face

A Face is defined as the area between either **three (triangles)**, **four (quadrangles**) or more (ngons) vertices, with an edge on every side. These are often abbreviated to **tris, quads & ngons.**

Triangles are always **flat** and therefore **easy to calculate**. On the other hand, quadrangles "**deform well**" and are therefore preferred for **subdivision Modelling**.

While you could build a cube with triangular faces, it would just look more confusing in Edit Mode.

Loops



Title-Img 4. 9 Edge and Face Loops

Source-Blender.org

Link- https://docs.blender.org/manual/en/dev/modeling/meshes/structure.html#fig-_mesh-topo-loop

Edge and Face Loops are sets of faces or edges that form continuous "loops" as shown in Img 4. 9.

Edge and Face Loops:

- Top row (1 - 4) shows a **solid view**,
- Bottom row (5 - 8) a **wireframe view** of the same loops.

In the image above (Img 4. 9), loops that do not end in poles are **cyclic(1 and 3)**. They start and end at the **same vertex** and divide the model into two partitions. Loops can be a quick and powerful tool to work with specific, continuous regions of a Mesh and are a prerequisite for **Organic Character Animation**.

Edge Loops

Loops (1 and 2) in Img 4. 9**Edge** and **Face Loops** are edge Loops. They connect vertices so that each one on the loop has exactly two neighbours that are not on the loop and placed on both sides of the loop (except the start and end vertex in case of poles).

Edge Loops are an important concept especially in **organic (subsurface) Modelling** and **character animation**. When used correctly, they allow you to build models with relatively few vertices that look very natural when used as subdivision surfaces and deform very well in animation.

Face Loops

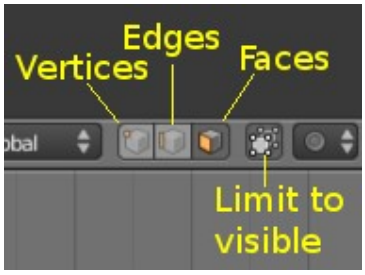
These are a **logical extension of Edge Loops** in that they consist of the faces between two Edge Loops, as shown in loops (3 and 4) in Img 4. 9 Edge and Face Loops. Note that for non-circular loops (4) the faces containing the poles are not included in a Face Loop. (Refer Img 4. 9)

Selection Mode

Select Mode Header Widgets

- **Mode**: Edit Mode
- **Menu**: 3D View Header ‣ Select Mode
- **Hotkey**: Ctrl-Tab

In Edit Mode, there are **three different selection modes**. You can enter the different modes by selecting one of the three buttons in the header.



Title-Img 4. 6 Edit Mode selection buttons

Source-Blender.org

Link- https://docs.blender.org/manual/en/dev/modeling/meshes/selecting/introduction.html

Vertices

In this mode, vertices **are drawn** as points.

- Selected **vertices** are drawn in **orange**,
- Unselected **vertices** in **black**
- **Active** or last selected vertex in **white**

Edges

In this mode, the vertices **are not drawn**. Instead,

- Selected **edges** are drawn in orange,
- Unselected **edges** black,
- **Active** or last selected edge in white.

Faces

In this mode, the faces **are drawn** with a selection point **in the middle** which is used for selecting a face.

- Selected **faces** and their selection point are drawn in orange,
- Unselected **faces** are drawn in black,
- **Active**or last selected face is highlighted in white.

Almost all tools are available in all three Mesh selection modes. So, you can **Rotate, Scale, Extrude, etc**. in all modes. Of course, rotating and scaling a single vertex will not do anything

useful (without setting the pivot point to another location), so some tools are applicable in some modes.

Selection Loops

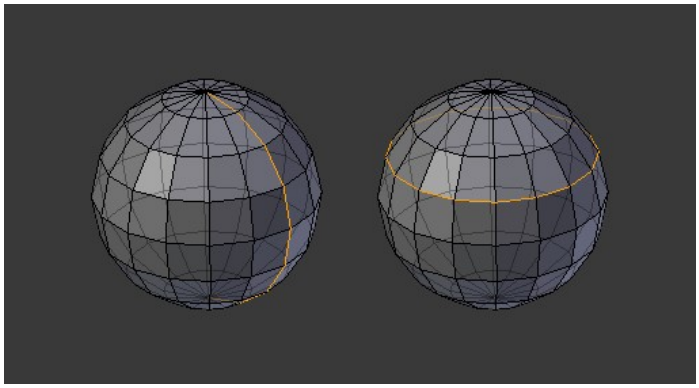
You can easily select loops of components:

Edge Loops and Vertex Loops

- **Mode**: Edit Mode –> Vertex or Edge select mode
- **Menu**: Select ▸ Edge Loop or Mesh ▸ Edges ▸ Edge Loop
- **Hotkey**: **Alt-RMB** or **Ctrl-E**▸ Edge Loop

Holding **Alt** while selecting an edge selects a loop of edges that are connected in a line end to end, passing through the edge under the mouse pointer. Holding **Alt-Shift** while clicking adds to the current selection.

Edge loops can also be selected based on an existing edge selection, using either **Select ▸ Edge Loop,** or the Edge Loop Select option of the Edge Specials Menu **Ctrl-E.**



Title-Img 4. 7 Longitudinal and latitudinal edge loops

Source-Blender.org

Link- https://docs.blender.org/manual/en/dev/modeling/meshes/selecting/advanced.html

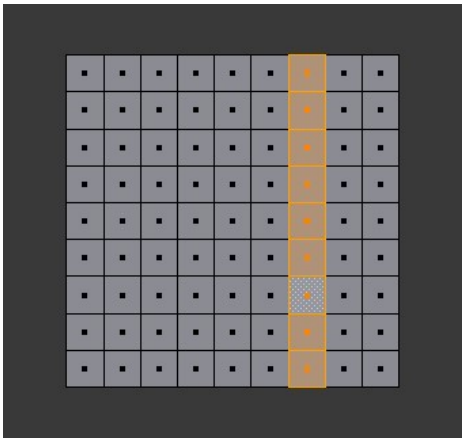
Face Loops

- **Mode:** Edit Mode –> Face or Vertex select modes
- **Hotkey: Alt-RMB**

In **face select mode**, holding **Alt** while selecting an edge selects a loop of faces that are

connected in a line end to end, along their opposite edges.

In **vertexselectmode**, the same can be accomplished by using **Ctrl-Alt**to select an edge, which selects the face loop implicitly**.**

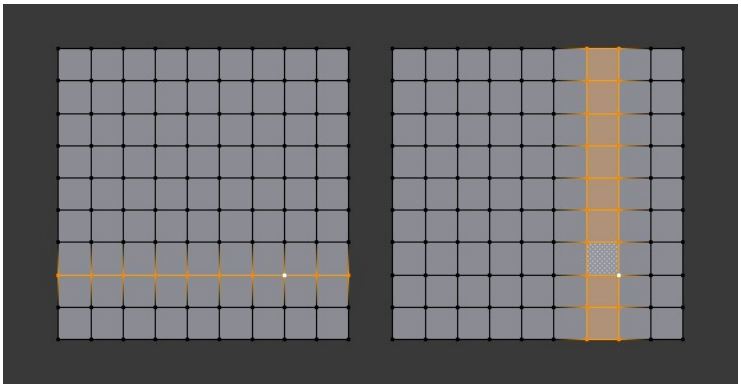


Title-Img 4. 8 Face loop selection

Source-Blender.org

Link- https://docs.blender.org/manual/en/dev/modeling/meshes/selecting/advanced.html

This face loop was selected by clicking with **Alt-RMB** on an edge, in face select mode. The loop extends perpendicular from the edge that was selected.



Title-Img 4. 9Alt versus Ctrl-Alt in vertex select mode

Source-Blender.org

Link- https://docs.blender.org/manual/en/dev/modeling/meshes/selecting/advanced.html

A face loop can also be selected in Vertex select mode. Technically **Ctrl- Alt-RMB** will select an Edge Ring, however, in Vertex select mode, selecting an Edge Ring implicitly selects a Face Loop since selecting opposite edges of a face implicitly selects the entire face.

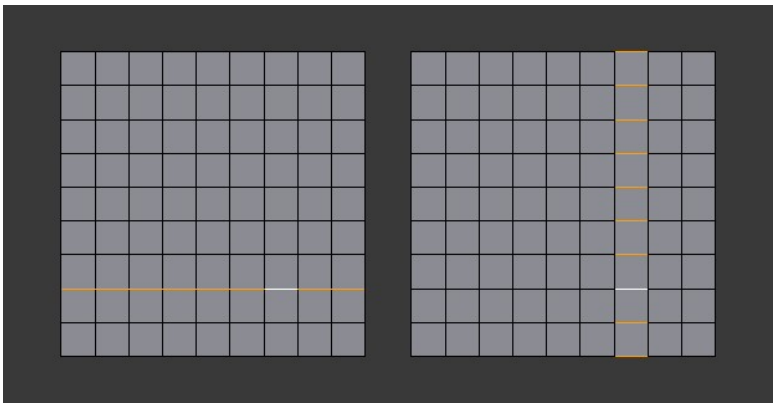
Edge Ring

- **Mode:** Edit Mode –> Edge select mode

- **Menu:** Select ▸ Edge Ring or Mesh ▸ Edges ▸ Edge Ring
- **Hotkey: Ctrl-Alt-RMB** or **Ctrl-E** ▸Select ▸ Edge Ring

In Edge select mode, holding **Ctrl-Alt** while selecting an edge selects a sequence of edges that are not connected, but on opposite sides to each other continuing along a face loop.

As with edge loops, you can also select **edge rings** based on current selection, using either **Select ▸ Edge Ring**, or the Edge Ring Select option of the Edge Specials Menu **Ctrl-E.**



Title-Img 4. 10 A selected edge loop, and a selected edge ring

Source-Blender.org

Link- https://docs.blender.org/manual/en/dev/modeling/meshes/selecting/advanced.html

In Img 4.14, A selected edge loop, and a selected edge ring. The same edgewasclickedon, but twodifferent"groupsofedges" wereselected, based on the different commands. One is **based on edges** during computation and the other is **based on faces**.

Duplicating / Mesh EditingTools

This section covers **Mesh editing tools** that add additional geometry by duplicating existing geometry in some way.

Duplicate Geometry

Extrusion

Spin

Screw

Duplicate Geometry Tool

- **Mode:** Edit Mode
- **Menu:** Mesh ▸ Duplicate
- **Hotkey: Shift-D**

This tool simply **duplicates the selected** elements, without creating any links with the rest of the Mesh (unlike extrude, for example), and places the duplicate at the location of the original. Once the duplication is done, only the new duplicated elements are selected, and you are automatically placed in **grab/move mode**, so you can translate your copy elsewhere.

Extrude Tool

Extrude Region

- **Mode**: Edit Mode
- **Panel**: Mesh Tools ▸ Extrude
- **Menu: Mesh▸** Extrude Region
- **Hotkey**: **E** or **Alt-E**

One tool of paramount importance for working with Meshes is the **Extrude tool**. It allows you to create parallelepipeds from rectangles and cylinders from circles, as well as easily create such things as **tree limbs**. **ExtrudeisoneofthemostfrequentlyusedModellingtoolsinBlender**

The selection is extruded along the common normal of selected faces. In every other case the extrusion can be **limited to a single axis** by specifying an axis (e.g. X to limit to the X axis or Shift-X to the YZ plane. When extruding along the face normal, limiting movement to the **global Z axis** requires pressing **Z twice,** once to disable the face **normal Z axis** limit, and once to enable the global Z axis limit.

Selected face **During extrude** **Set to Z axis**

Title-Img 4. 15 Extrude face

Source-Blender.org

Link- https://docs.blender.org/manual/en/dev/modeling/meshes/editing/duplicating/extrude.html

Ext Mode: Edit Mode

- **Panel:** Mesh Tools ▸ Extrude Individual
- **Menu:** Mesh ▸ Extrude Individual
- **Hotkey:** Alt-E

Extrude Individual allows you to **extrude a selection** of multiple faces as individuals, instead of as a region. The faces are extruded along their own normals, rather than their average. This has several consequences: first, "**internal**" edges (i.e. edges between two selected faces) are **no longer deleted** (the original facesare).

Title-Img 4. 11 Selection of multiple faces, extruded using extrude region and Extruded using Extrude Individual

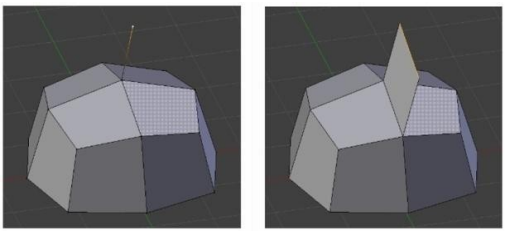
Source-Blender.org

Link- https://docs.blender.org/manual/en/dev/modeling/meshes/editing/duplicating/extrude.html

Extrude Edges and Vertices Only

- **Mode**: Edit Mode, Vertex and Edge
- **Hotkey: Alt-E**

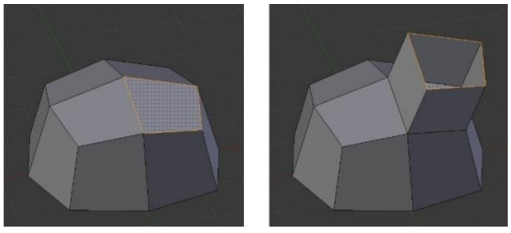
If vertices are selected while doing an extrude, but they do not form an edge or face, they will extrude as expected, forming a non-manifold edge. Similarly, if edges are selected that do not form a face, they will extrude to form a face.



Title-Img 4. 12 Single vertex extruded. Single edge extruded

Source-Blender.org

Link- https://docs.blender.org/manual/en/dev/modeling/meshes/editing/duplicating/extrude.html



Title-Img 4. 13Single edge extruded. Edge only extrude

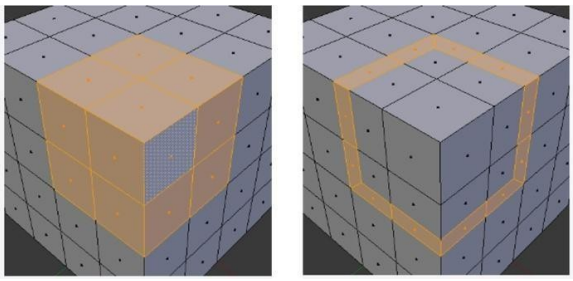
Source-Blender.org

Link- https://docs.blender.org/manual/en/dev/modeling/meshes/editing/duplicating/extrude.html

Inset Tool

- **Mode**: Edit Mode
- **Menu**: Mesh ▸ Faces ▸ Inset
- **Hotkey: I**

This tool takes the **currently selected** faces and creates an inset of them, with adjustable thickness and depth. The tool is modal, such that when you activate it, you may adjust the thickness with your mouse position. You may also adjust the depth of the inset during the modal operation by **holding Ctrl.**



Selection to inset **Selection with inset**

Title-Img 4. 14Single vertex extruded. Single edge extruded

Source-Blender.org

Link- https://docs.blender.org/manual/en/dev/modeling/meshes/editing/duplicating/inset.html

Spin Tool

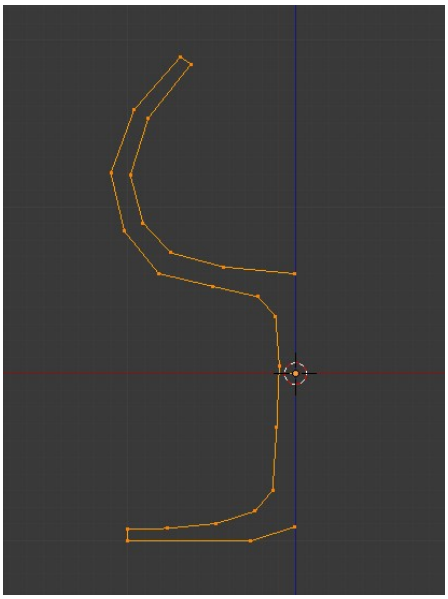
- **Mode:** Edit Mode
- **Panel:** Mesh Tools

Use the Spin tool to create the sort of Objects that you would produce on a lathe (this tool is often called a "**lathe**"-tool or a "**sweep**"-tool in the literature, for this reason). In fact, it does a sort of circular extrusion of your selected elements, center on 3D cursor, and around the axis perpendicular to the working view...

The point of view will determine around which axis the extrusion spins.

The position of 3D cursor will be the center of the rotation. (Refer Img. 4.20)

Example



Title-Img 4. 15Glass profile

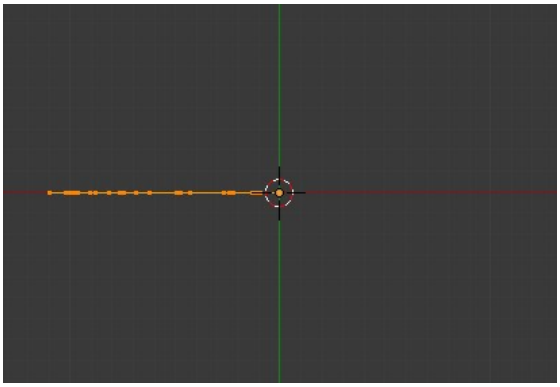
Source-Blender.org

Link-https://docs.blender.org/manual/en/dev/modeling/meshes/editing/duplicating/spin.html?highlight=glass%20profile

First, create a Mesh representing the profile of your Object. If you are Modelling a hollow Object, it is a good idea to thicken the outline. Img.4.20 Glass profile Shows the profile for a **wine glass** we will model as a demonstration.

Go to the **Edit Mode** and select all the vertices of the Profile with A.

We will be rotating the Object around the cursor in the top view, so switch to the top view with **Numpad7.**



Title-Img 4. 16 Glass profile, top view in Edit Mode, just before spinning.

Source-Blender.org

Link-

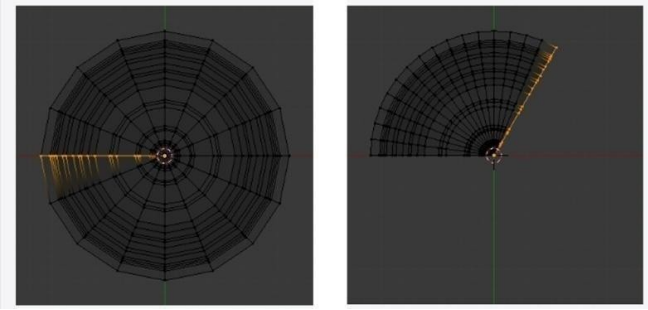
https://docs.blender.org/manual/en/dev/modeling/meshes/editing/duplicating/spin.html?highlight=glass%20profile

Place the cursor along the center of the profile by selecting one of the vertices along the center, and snapping 3D cursor to that location with

Mesh ► Cursor ► Selection. (Img 4. 171 Glass profile, top view in Edit Mode, just before spinning.) Shows the wine glass profile from **topview**, with the cursor correctly positioned.

Click the **Spin button**. If you have **more than one 3D View** open, the cursor will change to an arrow **withaquestionmark** and you will have to click in the area containing the top view before continuing. If you have **only one 3D View open**, the spin will happen immediately. Img 4. 18 Spun profile Shows the **result of a successful spin**.

Angle

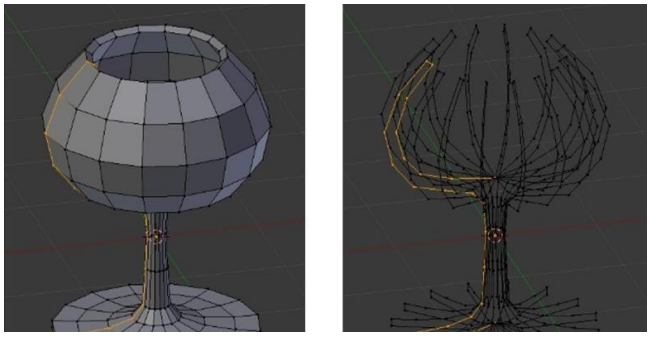


Title-Img 4. 19 Spun Profile with an angle of 360 and 120.

Source-Blender.org

Link-

https://docs.blender.org/manual/en/dev/modeling/meshes/editing/duplicating/spin.html?highlight=glass%20profile



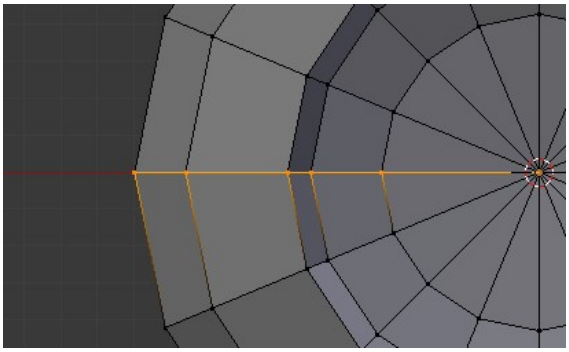
Result of spin operation **Resultof Duplienabled**

Title-Img 4. 20 Result of spin and Dupli

Source-Blender.org

*Link-*https://docs.blender.org/manual/en/dev/modeling/meshes/editing/duplicating/spin.html?highlight=glass%20profile

Merge Duplicates



Title-Img 4. 21Duplicate Vertices

Source-Blender.org

Link-

https://docs.blender.org/manual/en/dev/modeling/meshes/editing/duplicating/spin.html?highlight=glass%20profile

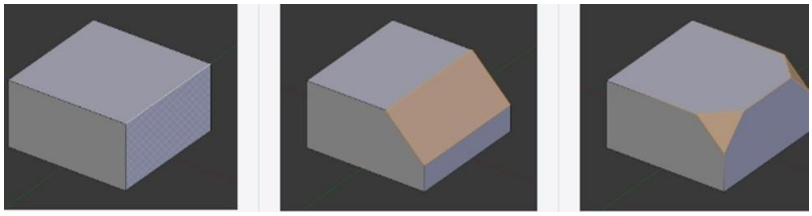
The spin operation leaves duplicate vertices along the profile. You can select all vertices at the seam with **Box select B** shown in Img 4. 24 Duplicate vertices. Seam vertex selection and perform a **Remove Doubles operation**.

Bevel Tool

- **Mode**: Edit Mode
- **Menu**: Mesh ▸Edges ▸Bevel or **Ctrl-E**▸Bevel
- **Usage**

The **Bevel tool** works only on selected edges. It will recognize any edges included in a vertex or face selection as well, and perform the bevel the same as if those edges were explicitly selected. In "**vertex only**" mode, the Bevel toolworksonselectedverticesinsteadofedges. The Bevel tool smooths the **edges and/or "corners**" (vertices) by replacing them with faces making smooth profiles with a specified number of segments (see the options below Img 4. 25 for details about the bevel algorithm).

Use **Ctrl-B** or a method listed above to run the tool. Move the mouse to interactively specify the bevel offset, and scroll the Wheel to increase or decrease the number of segments. (See Img 4. 25)



Edge before beveling **Edge Bevel** **Vertex bevel**

Title-Img 4. 22Bevel

Source-Blender.org

Link- https://docs.blender.org/manual/en/dev/modeling/meshes/editing/subdividing/bevel.html

Merge Vertices

This tool allows you to **merge all selected** vertices to a unique one, deleting all others. You can choose the location of the surviving vertex in the menu this tool pops up before executing**.**

Unit summary

- Create Object with 3D Mesh / Primitives
- Edit the Object with different Modes
- Work with Mesh Modelling
- Create Polygon Objects
- Analyse the Mesh

After learning this Unit, you can download the Open Image Source Software available on the internet for free of cost to practice the possibilities of creating 3D Objects.

Assignment

Createa **flowervase**, a **wineglass**and **acup**using **Nurbs**curves.

Assessment

1. Explain the Modelling Modes in Blender
2. Write a brief note on the Structure of a Mesh
3. Explain the Loops used in Polygon Modelling

4. Describe the types of selection modes in Mesh modelling
5. Write a brief note on Edge/Face tool
6. How is Mirror Editing tool used?

Fill in the Blanks

1. ___is available in either Edit Mode or Object Mode.

2. Selected vertices are drawn in___color, unselected vertices in__color.

3. Pressing_____Key when selecting a higher selection mode, all elements touching the current selection will be added.

4. A___is primarily a single point or position in 3D space.

5. Operations in_____effect only the geometry of an Object.

Resources

While studying this Unit, you can browse the internet links for online tutorials and several books and training DVDs available in the Blender Store and on the Blender Cloud.

- wiki.blender.org
- archive.org
- www.blender.org
- docs.blender.org

BCADES-304

3D ILLUSION-1

Block – 2: 3D Shading

Unit-1 Introduction to Materials and Shaders in Blender

Introduction

Materials in Blender define how an object appears visually, simulating real-world surfaces such as metal, fabric, or glass. These properties can include color, transparency, reflectivity, and texture. Materials can vary across an object's surface or between different faces of an object. In this Unit, you will learn about **Materials and Shader in Blender**.

Outcomes

Upon completion of this unit you will be able to:

- Apply Materials and Shaders to your 3D Scenes
- Demonstrate the utility of Material Panel and its Slots
- Use Multiple Materials
- Practice Material Operations like Naming and Linking

Terminology

BSDF:	Bidirectional Scattering Distribution Function is defined as how light is reflected and refracted at a surface.
Reflection:	BSDF Reflects an incoming ray on the same side of the surface.
Transmission:	BSDF Transmits an incoming ray through the surface, leaving on the other side.
Refraction:	BSDF refraction is a type of Transmission, transmitting an incoming ray and changing its direction as it exists on the other side of the surface.

How Blender Simulates Light

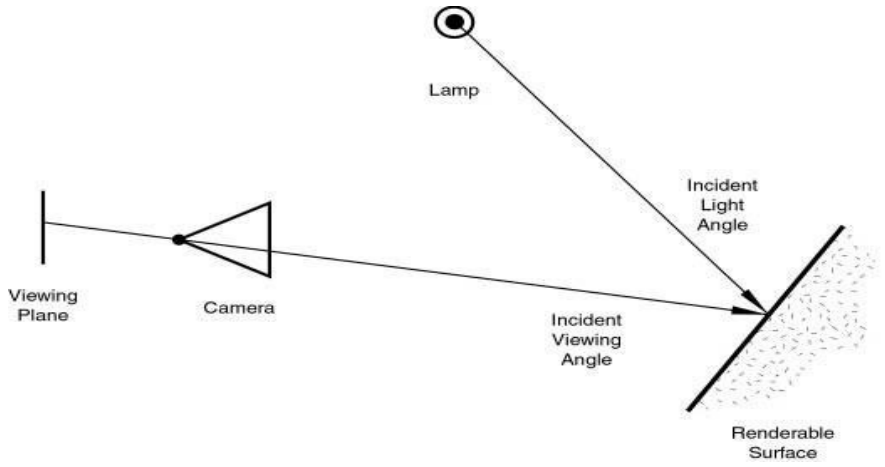
Blender's rendering engine simulates light by tracing rays from the camera into the scene. When a ray hits a surface, Blender calculates how light interacts at that point to determine the final color.

The **Rendered Image** you create with Blender is a projection of the scene onto an imaginary surface called the **Viewing Plane**. The viewing plane is analogous to the film in a traditional camera, or the rods and cones in the human eye, except that it receives ***simulated light, not real light.***

To render an image of a scene, you must first determine what light from the scene is arriving at each point on the viewing plane? The best way to answer this question is to **follow a straight line** (the simulated light ray) backwards through that point on the viewing plane and the focal

point (the location of the camera) until it hits a renderable surface in the scene, at which point you can determine what light would strike that point. (Refer image 1.1)

The surface properties and **Incident Light Angle** tell us how much of that light would be reflected along the **IncidentViewing Angle** (Rendering engine Basic Principle).



Title- Img 1. 1 Rendering Engine Basic Principle

Two basic types of phenomena would take place at any point on a surface when a light ray strikes it:

1. Diffusion
2. Specular Reflection

Diffusion and Specular reflection are distinguished from each other mainly by the relationship between the **Incident Light Angle** and the **Reflected Light Angle**.

The **shading (or coloring)** of the object during render will then consider the base color (as modified by the diffusion and specular reflection phenomenon) and the light intensity.

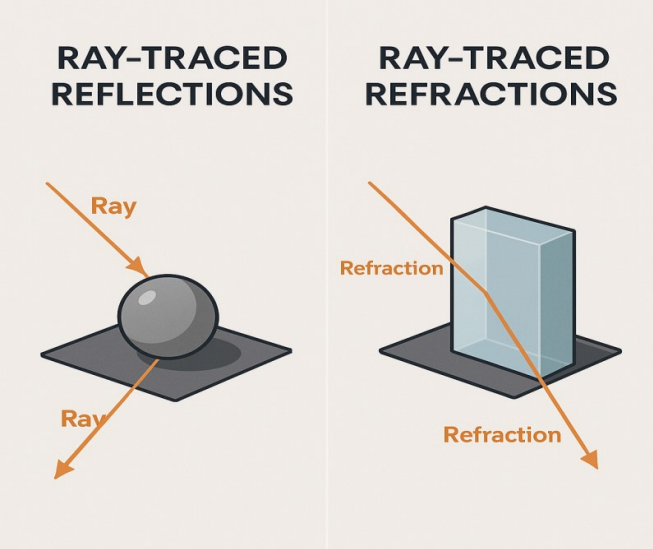
Using the **Internal Ray Tracer,** other (more advanced) phenomena could occur.

In **Ray-Traced Reflections,** the point of a surface struck by a light ray will return the color of its ***surrounding environment***, according to the rate of reflection of the material (mixing the base color and the surrounding environment) and the viewing angle.

On the other hand, in **Ray-Traced Refractions**, the point of a surface struck by a light ray will return the color of its ***background environment,*** according to the rate of transparency (mixing the base color and the background environment along with its optional filtering value) of the material and the optional index of refraction of the material, which will distort the viewing angle. Of course, shading of the object hit by a light ray will be about mixing all these phenomena at the same time during the rendering.

Advanced Rendering Techniques

Ray-Traced Reflections simulate how surfaces reflect their surroundings. Ray-Traced Refractions simulate how transparent materials distort light passing through.



Material Settings

While rendering, the appearance of the object depends upon many inter-related settings:

- World (Ambient color, Radiosity, Ambient Occlusion)
- Lights
- Material settings (including ambient, emission, and every other setting on every panel in that tab)
- Texture(s) and how they are mixed
- Material Nodes
- Camera
- Viewing Angle
- Obstructions and transparent occlusions
- Shadows from other opaque/transparent objects
- Render settings
- Object dimensions (SS settings are relevant to dimensions)
- Object shape (refractions, Fresnel effects)

As stated above, the material settings usually determine the **surface properties of the object.** There are several ways in which materials can be set up in Blender. Generally, these are not compatible.

You must choose which method you are going to use for each particular object in your scene:

Step 1: you can set the Properties in the various Material Panels.

Step 2: you can use Nodes; a Graphical Nodes Editor is available.

Step 3: you can directly set the colour of object surfaces using various special effects.

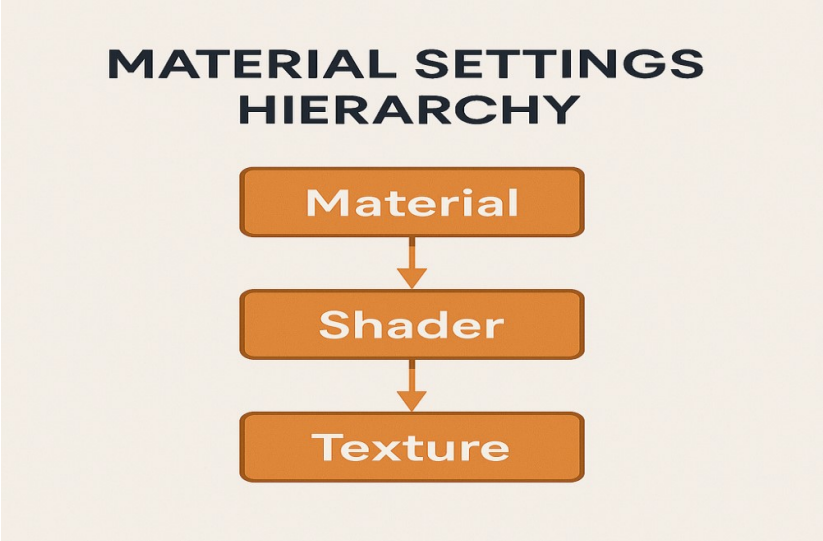
Strictly, these are not the materials at all, however they are included here because they will affect the appearance of your objects. These include

- Vertex Painting,
- Wire Rendering,
- Volume Rendering, and
- Halo Rendering

The exact effect of Material settings can be affected by the number of system settings.

1. First and foremost is the **Render Engine** used: **Cycles and the Blender Render Engine (aka Blender Internal or BI)** require quite different illumination levels to achieve similar results, and even then, the appearance of objects would be quite different.
2. Also, the material properties settings can be affected by the **Texture Method** used **(Single Texture, Multitexture or GLSL)**.

So, it is always recommended to select the appropriate system settings before starting the design of materials.



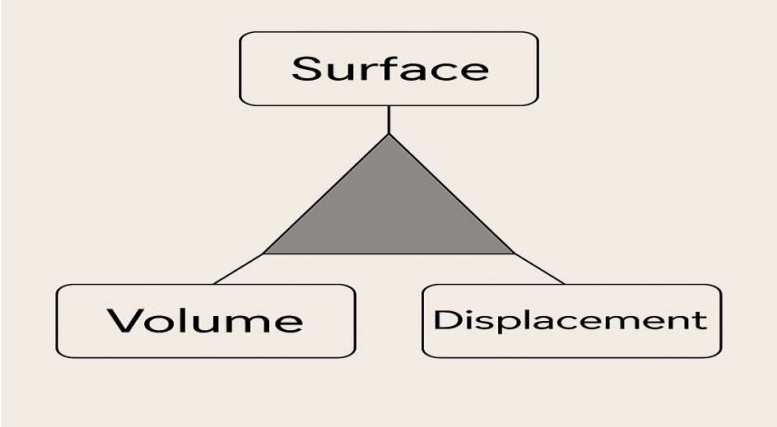
Introduction to Shaders

Materials define the appearance of meshes, curves and other objects. They consist of **Three Shaders,** which define the appearance of the

1. Surface of the mesh,
2. Volume inside the mesh, and
3. Displacement of the surface of the mesh.

Title- Img 1. 2 Materials with shaders

Shaders control how light interacts with an object's surface, interior, and geometry. They include surface, volume, and displacement shaders.



Unit-2 Working with Materials in Blender

Surface Shader

The Surface Shader defines the light interaction at the surface of the mesh. One or more BSDFs specify if incoming light is reflected back, refracted into the mesh, or absorbed.

Emission defines how light is emitted from the surface, allowing any surface to become a light source.

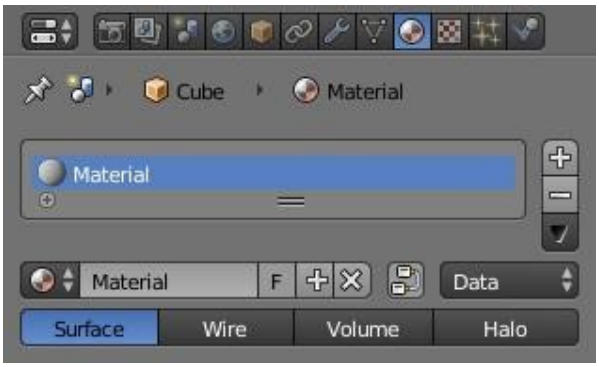
Material Panel

Materials can be linked to Objects and Object's data in the

Materials Tab ▸ Materials Panel

Here, you can manage how materials are linked to objects, meshes, etc. and activate a material for editing in the rest of the panels. (Refer 1.3)

Title-Img 1.3 Material panel



Source- Blender.org

Link- https://docs.blender.org/manual/en/dev/render/blender_render/materials/ma terial_panel.html

- **Material slots - Active Material**

  Theobject's material slots are displayed in a List View. (Refer 1.4)

- **Specials**

- Copy and paste the selected material slot.

- **Multiple materials**

- Meshes can handle having more than one material. Materials can be mapped on a per-face basis, as detailed on the Multiple Materials. In edit mode, the

following tools appear:

- **Assign**
- Assign the material in the selected material slot to selected vertices.
- **Select**
- Select vertices assigned to the selected material slot.
- **Deselect**

  Deselect vertices assigned to the selected material slot.

Materials Slots

The object's material slots are displayed in a List View.

List View

Title-Img 1. 4 List view

Source- Blender.org

Link- https://docs.blender.org/manual/en/dev/interface/controls/templates/list_pre sets.html#ui-list-view

This control is useful to manage lists of items. They can be found in example in the object data properties.

Select

To select an item, **LMB** on it.

- **Rename**

  By double clicking on an item, you can edit its name via a text field. This can also be achieved by pressing **Ctrl-LMB** over it.
- **Resize**

  The list view can be resized to show more or fewer items. Hover the mouse over the handle **(==)** then click and drag the handle to expand or shrink the list.
- **Filter**

  Click the *Show filtering options* button **(+)** to toggle filter option buttons.

Search Type part of a list item's name in the *filter text field* to filter items by their name.

Filter Include When the magnifying glass icon has a + sign then only items that match the text will be displayed.

Filter Exclude When the magnifying glass icon has a - sign then only items that do not match text will be displayed.

- **Sort**

  Sort list items.

  Alphabetical This button switches between alphabetical and non-alphabetical ordering.

  Inverse Sort objects in ascending or descending order. This also applies to alphabetical sorting, if selected.

On the right of the list view are additional buttons:

- **Add +**

  Adds a new item.

- **Remove -**

  To remove the selected item.

- **Specials**

  The down arrow on dark background opens a pop-up menu with operators' context-sensitive to the item type. i.e. copy paste, or operations on all items.

- **Move Up**

  The button showing an up arrow moves the selected item up one position.

- **Move Down**

  The down arrow moves the item down.

Presets

Title-Img 1. 5 Presets without and with specials

Attribution- Source- Blender.org

Link- https://docs.blender.org/manual/en/dev/interface/controls/templates/list_presets.html#ui-list-view

- **Selector**

A list of available presets. A selection will override the included properties.

- **Add +**

New presets can be added based on the preset included properties, which will be saved for later

re-use. A pop-up opens, where you can set a name after which you can select it from the list and in some cases additional settings.

- **Remove -**

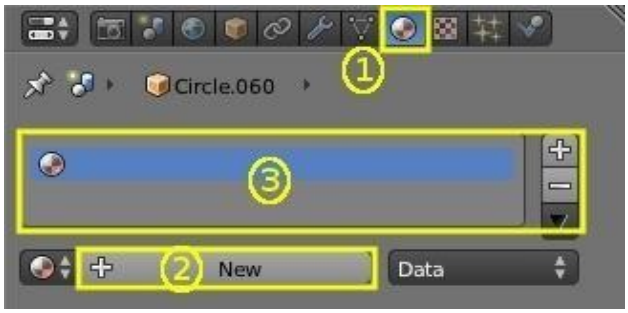
Deletes the selected preset.

- **Specials**

The down arrow on dark background opens a pop-up menu with operators' context-sensitive to the preset type. i.e. copy paste.

Multiple Materials

Normally, different colors or patterns on an object are achieved by adding textures to your materials. However, in some applications you can obtain multiple colors on an object by assigning different materials to the individual faces of the object.

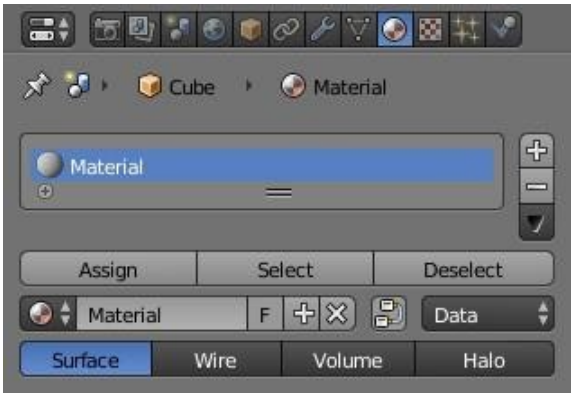


Title-Img 1. 4Add new material

Attribution- Source- Blender.org

Link- https://docs.blender.org/manual/en/dev/render/blender_render/materials/assigning_a_material.html

To apply several materials to different faces of the same object, you use the Material Slots **options (3)** in the Materials Header Panel. (Refer 1.6)



Title-Img 1. 5 Material menu in edit mode

Attribution- Source- Blender.org

Link- https://docs.blender.org/manual/en/dev/render/blender_render/materials/assigning_a_material.html

The workflow for applying a Second Material to some faces of an object covered by a Base Material is as follows:

Step 1:

In Object Mode, apply the Base Material to the whole object (as shown in Assigning a material)

Step 2:

Create/select the Second Material (the whole object will change to this new material).

Step 3:

In the Active Material box (2), re-select the base material.

Step 4:

Go to Edit Mode and Face Select (a new box appears above the Active Material box with Assign/Select/Deselect).

Step 5:

Select the face/faces to be coloured with the second material.

Step 6:

In the Object Material Slots box (3), click the Plus to create a new slot, and while this is still active, click on the second material in the Available Materials list.

Step 7:

Click the Assign button, and the second material will appear on the selected object faces.

You can also make this new material a copy of an existing material by adding the data-block:

- Select the object,
- get the material,
- (R Click) and Copy data to clipboard.

When you have renamed the material,

- click**"Link: Data"** to link to the existing material.
- Proceed to assign faces as required.

Note: If you change the material on the original object, the new object color changes too. Meshes can handle having **more than one material.** Materials can be mapped on a per-face basis, as detailed on the Multiple Materials. In **Edit Mode,** the following tools appear:

- **Assign**

Assign the material in the selected material slot to selected vertices.

- **Select**

  Select vertices assigned to the selected material slot.

- **Deselect**

  Deselect vertices assigned to the selected material slot.

Material Naming and Linking

- **Material**

  The **Material Data-Block Menu** for the selected material slot.

- **Nodes**

  Toogle that designates this material to be a material node setup, and not from the Material /Ramps / Shaders settings.

- **Data-block Links**

  It specifies whether the material is to be linked to the Object or to the Object Data. The **Link selector** has two choices: **1. Data** and **2. Object**. These two menu choices determine whether the material is linked to the object or to the data, (i.e. a mesh or curve).

- The **Data Menu Item** determines that this material will be linked to the mesh's data-block which is then linked to the object's data-block.

- The **Object Menu Item** determines that the material will be linked to the object's data-block directly.

This will have consequences, of course. For example, different objects may share the same mesh data-block. Since this data-block defines the shape of the object, any change in "Edit Mode" will be reflected on all those objects. Moreover, anything linked to that mesh data-block will be shared by every object that shares that mesh. So, if the material is linked to the mesh, every object will share it.

On the other hand, if the material is linked directly to the object data-block, the objects can have different materials and still share the same mesh.

Brief explanation: If connected to the object, you can have several instances of the same Object Data using different materials.

Unit 3 Introduction to Shader

Introduction

Materials can have a **Wide Array of Properties**. It is the combination of things that define the way how the **Material looks,** and how **objects will appear** when rendered. These properties are set using the various panels in the Material tab.

Remember that the appearance of your Materials is affected by the way that they are **rendered** (surface, wire, volume or halo), and by the **rendering engine** (Blender, Cycles, or Game) used. Most properties for images rendered using **Cycles** can only be controlled using the **Node system.**

Outcomes

In this Unit, you will learn about **how to design Materials and Shaders.**

Upon completion of this unit you will be able to:

- Design suitable Materials and Shaders to your 3D Scenes
- Utilize Materials effectively to shade the 3D Objects
- Create Color Ramps, Specular, Transparency, Reflection and Refraction
- Use Material properties and
- Practice Material Operations on 3D Scenes.

Terminology

Preview:	A Preview of the current Material mapped on to one of the basic objects.
Diffuse Shaders:	The basic color of the Material, together with different models for dispersion.
Specular Shaders:	The reflected highlights: color, strength and different models for dispersion.
Color ramps:	How to vary the base color over a surface in both Diffuse and Specular Shaders.
Shading:	Properties of various characteristics of the shading model for the Material.

Transparency:	Sets options for objects in which light can pass through.
Mirror:	(Only Blender Render): Reflective properties of the Material.
Subsurface scattering:	(Only Blender Render): Simulates semi- translucent objects in which light enters, bounces around, then exits in a different place.
Strand:	(Only Blender Render): For use when surfaces are covered with hair, fur, etc.
Options:	Various options for shading and colouring the object.
Shadow:	Controls how objects using this Material cast and receive shadows.
Game settings:	(Only Blender Render): Controls settings for real-time rendering of Game Engine objects.

Diffuse Shaders

A **Diffuse Shader** is determined by the **General Color of a Material** when light shines on it. Most Shaders that are designed to mimic reality give a smooth falloff from bright to dark from the point of the strongest illumination to the shadowed areas, however **Blender** also has **other Shaders** for various special effects.

Common Options

All Diffuse Shaders have the following options:

Color

Select the base *Diffusecolor* of the Material.

Intensity

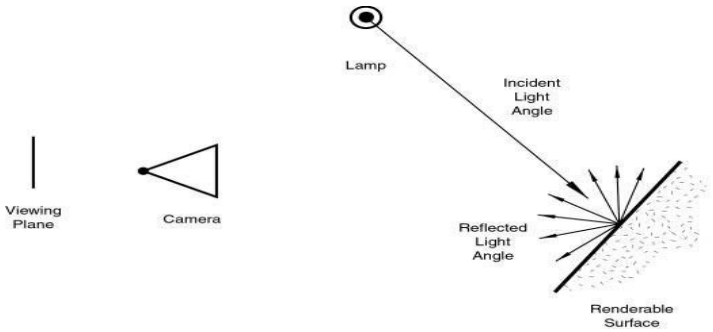
The Shader's brightness, or more accurately, the amount of incident light energy that is Diffusely reflected towards the camera.

Ramp

Allows you to set the range of colors for the *Material*, and define how the range will vary over a surface.

Technical Details

Light striking a surface and then re-irradiated via a Diffusion phenomenon will be scattered, i.e., re-irradiated in all directions isotopically. This means that the camera will see the **same amount of light** from that surface point no matter what **the *incident viewing angle* is.** This quality makes Diffuse light ***viewpoint independent***. Of course, the amount of light that strikes the surface depends on the incident light angle. If most of the light striking a surface is reflected Diffusely, the surface will have a ***matte appearance*** (Light re-irradiated in the diffusion phenomenon).

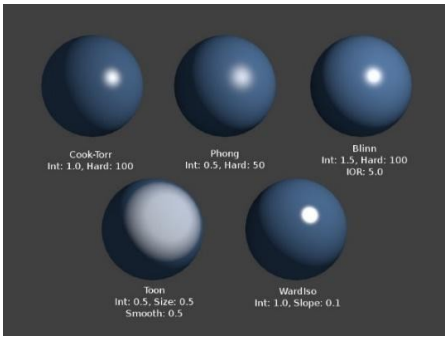


Title- Img 2. 1 Light re-irradiated in the diffusion phenomenon.

Source- blender.org

Link *https://docs.blender.org/manual/en/dev/render/blender_render/materials/properties/diffuse_shaders.html*

Types of Diffuse Shaders



Lambert Shader

Title- Img 2.2 Lambert Shader.

Source- blender.org

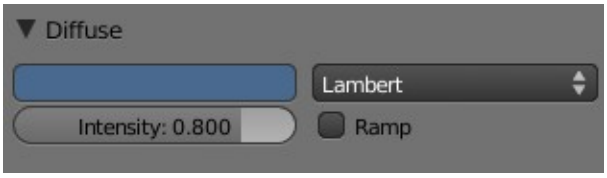
Link-*https://docs.blender.org/manual/en/dev/render/blender_render/materials/properties/diffuse_shaders.html*

This is **Blender's default Diffuse Shader**, and is a good general all- around workhorse for

Materials showing low levels of Specular reflection.

Johann Heinrich Lambert (1728-1777) was a Swiss mathematician, physicist and astronomer who published the works on the reflection of light, most notably the **Beer-Lambert Law,** which formulates the law of light absorption.

This Shader has only the default option, determining **how much of available light is reflected**. **Default is 0.8** to allow other objects to be brighter.



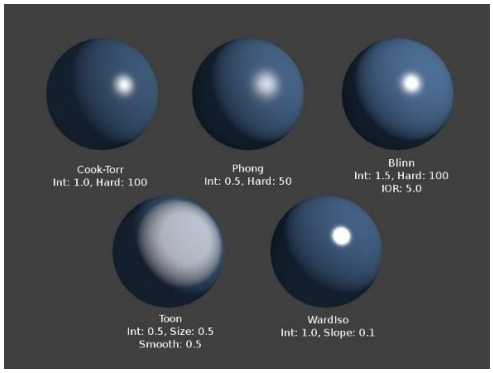
Title- Img 2.3 The Lambert Diffuse Shader settings.

Source-blender.org

*Link-**https://docs.blender.org/manual/en/dev/render/blender_render/materials/p roperties/diffuse_shaders.html***

Oren-Nayar Shader

Title- Img 2.4 Oren-Nayar Shader.



Source-blender.org *Link-*

https://docs.blender.org/manual/en/dev/render/blender_render/materials/p roperties/diffuse_shaders.html

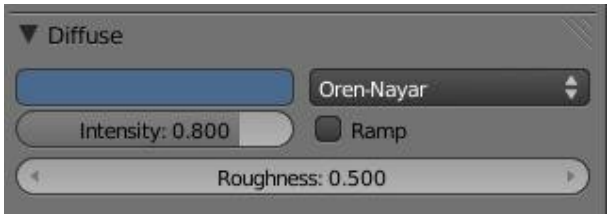
Oren-Nayar has taken a somewhat more **'physical'** approach to the diffusion phenomena as it considers the **amount of microscopic roughness of the surface**.

Michael Oren and **Shree K. NayarTheir** reflectance model developed in the **early 1990s**, is a generalization of Lambert's law now widely used in Computer Graphics.

Options

Roughness

The roughness of the surface, and hence, the amount of Diffuse scattering.

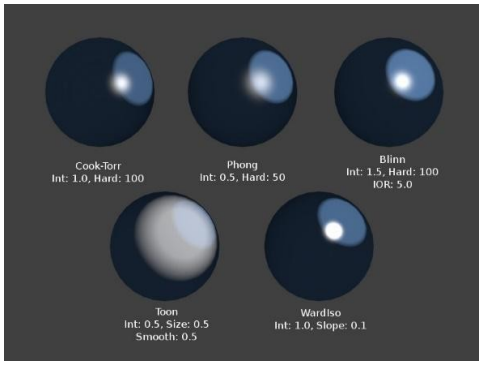


Title-Img 2.5 The Oren-Nayar Diffuse Shader settings.

Source-blender.org

*Link-**https://docs.blender.org/manual/en/dev/render/blender_render/materials/p roperties/diffuse_shaders.html***

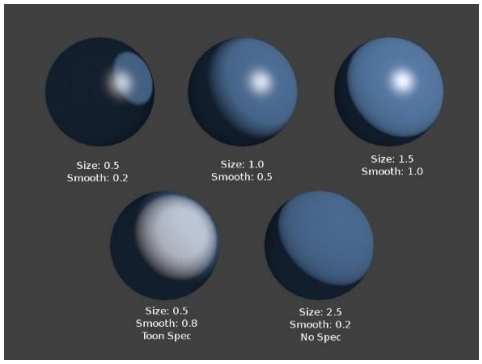
Toon Shader



Title- Img2.6 Toon Shader, Different Spec.

Source-blender.org

Link-https://docs.blender.org/manual/en/dev/render/blender_render/materials/properties/diffuse_shaders.html



Title-Img 2.7 Toon Shader Variations.

Source-blender.org

Link-https://docs.blender.org/manual/en/dev/render/blender_render/materials/properties/diffuse_shaders.html

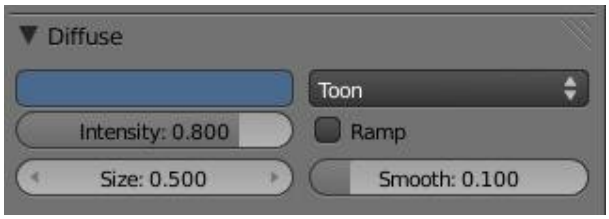
Toon Shader is a very **'un-physical'** Shader that is not meant to fake reality, however to produce cartoon cell styled rendering, with clear boundaries between light and shadow and uniformly lit/shadowed regions.

Options Size

The size of the lit area.

Smooth

The softness of the boundary is between lit and shadowed areas.

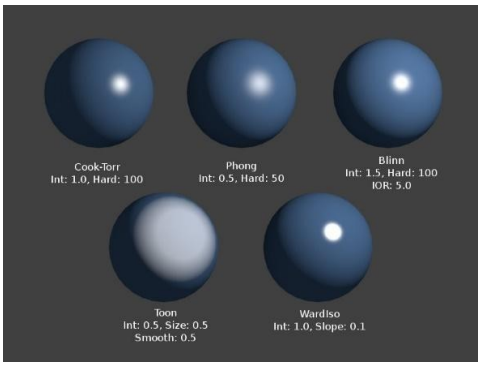


Title-Img 2.8 Toon Diffuse Shader settings.

Source-blender.org

Link-https://docs.blender.org/manual/en/dev/render/blender_render/materials/properties/diffuse_shaders.html

MinnaertShader



Title- Img 2.9 Minnaert Shader.

Source-blender.org

Link-https://docs.blender.org/manual/en/dev/render/blender_render/materials/properties/diffuse_shaders.html

Minnaert Shader works by **darkening** parts of the standard Lambert Shader.

So, if ***Dark* is 1**, you get **exactly the Lambertian** result.

Higher darkness values will darken the center of an object (where it points towards the viewer).
Lower darkness values will lighten the edges of the object, making it look somewhat velvet.

Marcel Minnaert (1893-1970) was a Belgian astronomer interested in the effects of the atmosphere on light and images who in **1954** published a book entitled "***The Nature of Light and Color in the Open Air***".

Options

Dark

Thedarknessof the 'lit' areas(higher) orthedarkness of the edges pointing away from the light source (lower).

Title-Img2.10 Minnaert Diffuse Shader settings.

Fresnel Shader

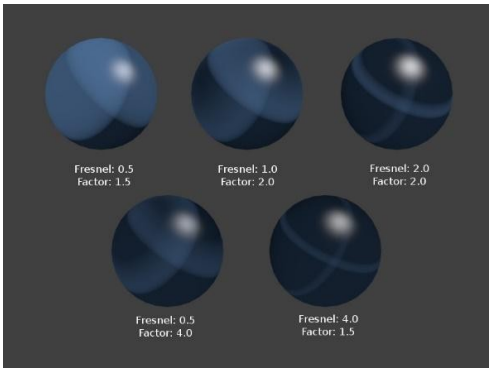
Source-blender.org

Link-https://docs.blender.org/manual/en/dev/render/blender_render/materials/p roperties/diffuse_shaders.html

Reference

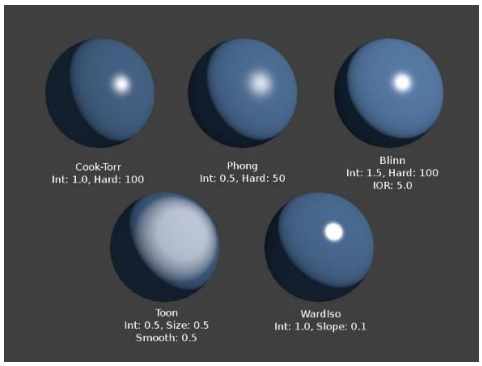
Mode: All Modes

Panel: Shading/Material Shaders



Title- Img 2. 11 Various settings for the Fresnel Shader, Cook-Torr Specular Shader kept at Intensity 0.5, Hardness: 50.

Source-blender.org
Link-[*https://docs.blender.org/manual/en/dev/render/blender_render/materials/properties/diffuse_shaders.html*](https://docs.blender.org/manual/en/dev/render/blender_render/materials/properties/diffuse_shaders.html)



Title-Img2.12 Fresnel Shader, Different Spec.

Source-blender.org *Link-*
https://docs.blender.org/manual/en/dev/render/blender_render/materials/p roperties/diffuse_shaders.html

With a **Fresnel Shader,** the amount of Diffuse reflected light depends on the incidence angle, i.e. from the direction of the light source.

Areas pointing directly towards the light source appear darker; Areas perpendicular to the incoming light become brighter.

Augustin-Jean Fresnel (1788-1827) was a French physicist who contributed significantly to the establishment of the theory of **wave optics.**

Options

Title- Img 2.13 The Fresnel Diffuse Shader settings.

Source-blender.org *Link-*

https://docs.blender.org/manual/en/dev/render/blender_render/materials/p roperties/diffuse_shaders.html

Fresnel

Power of the Fresnel effect, 5.0 is max.

Factor: Blending factor of the Fresnel factor to blend in, 5.0

Emit:

Amount of light to emit

Ambient

Amount of global ambient color the Material receives

Translucency

Amount of Diffuse shading on the back side

Shadeless

Make this Material insensitive to light or shadow

Specular Shaders

Tangent Shading

Use the Material's tangent vector instead of the normal for shading – for anisotropic shading effects (e.g. soft hair and brushed metal).

Specular Shaders create the bright highlights that one would see on a **glossy surface**, mimicking the **reflection of light sources**. Unlike Diffuse shading, Specular reflection is *viewpoint dependent*. According to **Snell's Law**, light striking a Specular surface will be reflected at an angle which mirrors the incident lightangle(withregardtothesurface'snormal), whichmakesthe viewing angle very important.

Common Options

Each Specular Shader shares the following common options:

Specular Color

The color of the Specular highlight

Intensity

The intensity, or brightness of the Specular highlight. This has a range of [0-1].

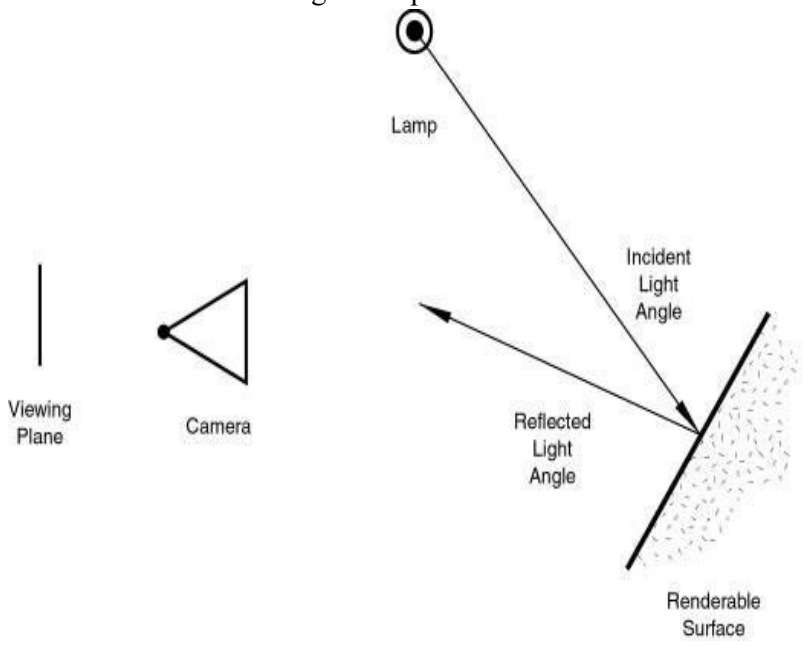
Ramp

Allows you to set a range of Specularcolors for *Material*, and define how the range will vary over a surface.

As a result, a Material has at least **two different colors**, a Diffuse, and a Specular one. The Specular color is normally set to **pure white** (the same "pure white" as the reflected light source), however, it can be set to **different values for various effects** (e.g. metals tend to have colored highlights).

Technical Details

Title- Img 2.14 Specular Reflection.



Source-blender.org

Link-

https://docs.blender.org/manual/en/dev/render/blender_render/materials/properties/specular_shaders.html?highlight=specular%20reflection

In reality, the quality of Diffuse and Specular reflection is generated during the **same process of light scattering**, however are not the same. Diffusion is actually subsurface scattering at a very small scale.

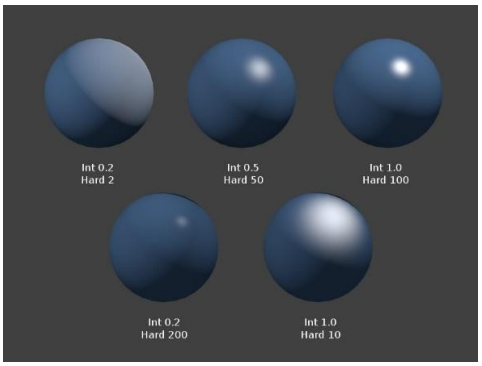
Imagine that a surface is made up of extremely microscopic semi- transparent, reflective facets. The **sharpness of Specular** reflection is determined by the **distribution of the angle** of these microfacets on the surface of an object. The deeper and jagged these facets are, the

more the light spreads when it hits the surface. When these facets are flatter against the "**macro surface**", the surface will have a tighter reflection, closer to a mirror. This is a condensed explanation of the generally accepted microfacet theory of reflectance, which is the basis of all modern **BRDFs** (Bi-directional Reflectance Distribution Functions), or shading models.

Because these microfacets are **transparent**, some light that hits them travels into the surface and Diffuses. The light that makes it back out is roughly Lambertian most of the time, meaning that it **spreads evenly** in all directions. It is also attenuated by the pigmentation in the surface, hence creating what you perceive as Diffuse, and **the color of an object**.

Note that at glancing angles, the reflectivity of a surface will always go to 1. *(Refer*Img 2.14*)*

Cook-Torrance Shader



Title-Img 2.15 Cook-Torrance Shader(Lambert 0.8).

Source-blender.org

Link-

https://docs.blender.org/manual/en/dev/render/blender_render/materials/properties/specular_shaders.html?highlight=specular%20reflection

Cook-Torrance is a **basic Specular**Shader that is **most useful for creating shiny plastic surfaces**. It is a slightly optimized version of **Phong.**

Robert L. Cook (LucasFilm) and **Kenneth E. Torrance (Cornell University)** In their **1982** paper A Reflectance Model for Computer Graphics (PDF), they described "**a new reflectance model for rendering computer synthesized images**" and applied it to the simulation of metal

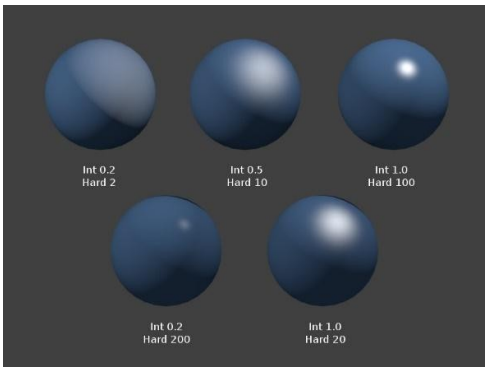
and plastic.

Option

Hardness

Size of the Specular highlight

PhongShader



Title-Img 2.16 Phong Shader (Lambert 0.8).

Source-blender.org

Link

https://docs.blender.org/manual/en/dev/render/blender_render/materials/properties/specular_shaders.html?highlight=specular%20reflection

Phong is a basic Shader that is very **similar to CookTorr**, however, it is better for **skin and organic surfaces.**

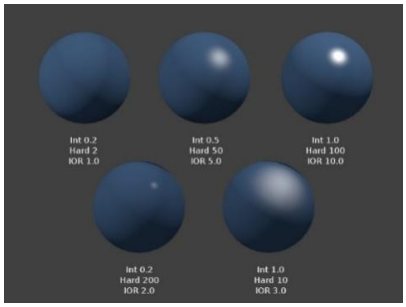
Bui TuongPhong (1942-1975) was a Vietnamese-born Computer Graphics pioneer that developed the first algorithm for simulating Specular phenomenon. His model included components not only for Specular lighting, but **also Diffuse and ambient lighting.**

Option

Hardness

Size of the Specular highlight.

BlinnShader



Title-Img 2. 17 Blinn Shader (Oren-Nayar Int 0.8, Rough 0.5).

Source-blender.org

Link

https://docs.blender.org/manual/en/dev/render/blender_render/materials/properties/specular_shaders.html?highlight=specular%20reflection

Blinn is a more **'physical' Specular Shader**, often used with the **Oren-Nayar Diffuse Shader**. It can be **more controllable** because it adds a fourth option, **an index of refraction**, to the above mentioned three.

James F. Blinn worked at NASA's Jet Propulsion Laboratory and became widely known for his work on **Carl Sagan's TV** documentary ***Cosmos***. The model he described in his **1977** paper Models of Light Reflection for **Computer Synthesized Pictures** (PDF) included changes in Specular intensity with light direction and more accurately positioned highlights on a surface.

Options

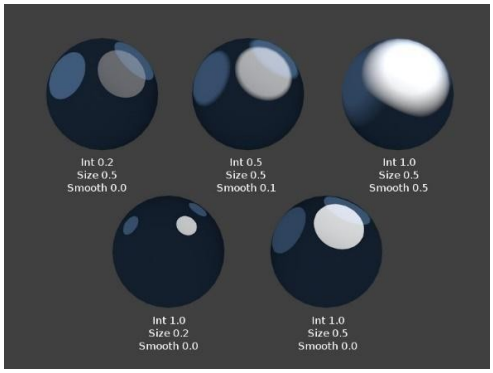
Hardness

Size of the Specular highlight. The BlinnShader is capable of much tighter Specular highlights than **Phong**or**CookTorr.**

IOR

'Index of Refraction'. This parameter is not actually used to compute refraction of light rays through the Material (a ray tracer is needed for that), however to correctly compute Specular reflection intensity and extension via Snell's Law.

Toon Shader



Title-Img 2. 18 Toon Specular Shader (Toon Diffuse, Int 0.8, Size & Smooth match).

Source-blender.org

Link-

https://docs.blender.org/manual/en/dev/render/blender_render/materials/properties/specular_shaders.html?highlight=specular%20reflection

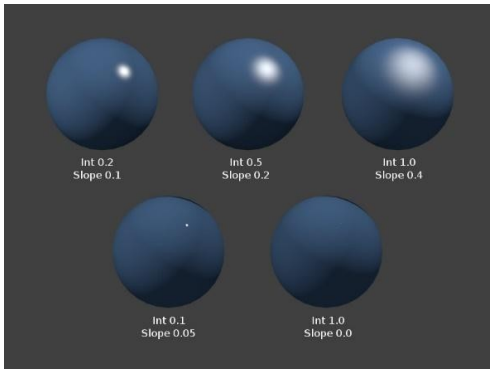
Toon Specular Shader matches the Toon Diffuse Shader. It is designed to produce the ***sharp, uniform highlights of cartoon cells.***

Options

Size: Size of the Specular highlight.

Smooth: Softness of the highlight's edge.

Ward Isotropic Shader



Title- Img2.19 Ward isotropic Shader.

Source-blender.org

Link-

https://docs.blender.org/manual/en/dev/render/blender_render/materials/properties/specular_shaders.html?highlight=specular%20reflection

Ward Isotropic is a **flexible Specular Shader** that can be useful for metal or plastic**.**

Gregory J. Ward developed a relatively simple model that obeyed the most basic laws of physics. In his 1992 paper, "Measuring and modeling anisotropic reaction", Ward introduced a **Bidirectional Reflectance Distribution Function (BRDF)** since then widely used in Computer Graphics because the few parameters it uses are simple to control. His model could represent **both isotropicsurfaces** (independent of light direction) and **anisotropic surfaces** (direction dependent). In Blender, the Ward Specular Shader is still called "**Ward Isotropic**" however is actually anisotropic.

Option

Slope

Standard deviation for surface slope. Previously known as the **root-mean-square or rms value**, this parameter in effect controls the size of the Specular highlight, though using a different method to that of the other Specular Shaders. It is capable of extremely sharp highlights.

Color Ramps Shading

In many real-life situations, like skin or metals, the **color of Diffuse and Specular** reflections can differ slightly, based on the amount of energy a surface receives or on the light angle of incidence. The ***Ramp Shader*** options in Blender allow you to

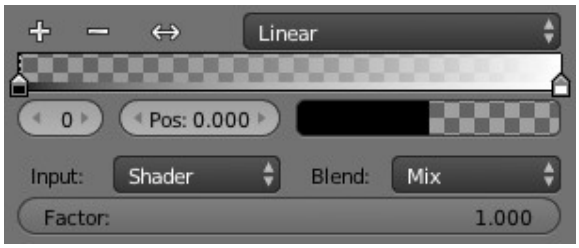
- set a **range of colors for a *Material*,**
- define how the **range will vary** over a surface,
- how it **blends** with the 'actual color' (typically from a Material or as output of a texture).

Ramps allow you to precisely control the **color gradient across a Material**, rather than just a simple blend from a brightened color to a darkened color, from the most strongly lit area to the darkest lit area. As well as several options for controlling the gradient from lit to shadowed, ramps also provide 'normal' input, to define a gradient from surfaces facing the camera to surfaces facing away from the camera. This is often used for Materials of **metallic car paint that change color based on viewing angle.**

Since texture calculations in Blender happen before shading, the *Ramp Shader* can completely replace texture or Material color. However, using the mixing **options and Alpha values**, it is possible to create an **additional layer of shading** in Blender Materials.

Options

Title- Img 2.20 Ramps Panel.



Source-blender.org *Link-*

https://docs.blender.org/manual/en/dev/render/blender_render/materials/p roperties/ramps.html

For the first part of the color ramp option, see Color Ramp Widget.*(Refer* Img 2.20*)*

Input

The input menu contains the following options for defining the gradient:

Shader

The value as delivered by the Material's Shader (*Lambert*, *Cook Torrance*) defines the color. Here the **amount of light** does not matter for color, only the **direction** of the light.

Energy

As *Shader*, now also lamp **energy, color, and distance** are considered. This makes the Material change color when more light shines on it.

Normal

The surface normal, relative to the camera, is used for the Ramp Shader. This is possible with a texture as well, however added for convenience.

Result

While all three previous options work per lamp, this option only works **after shading calculations**. This allows full control over the entire shading, including 'Toon' style results. Using alpha values here is most useful for tweaking a finishing touch to a Material.

Blend

A list of the various Color Blend Modes are available for blending the ramp Shader with the color from Input.

Factor

This slider denotes the overall factor of the ramp Shader with the color from Input.

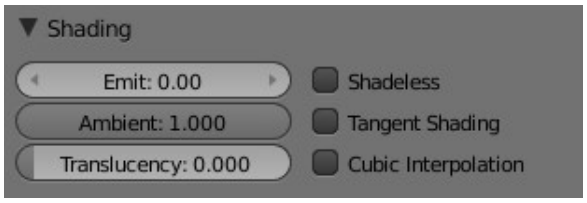
Shading Panel

While all three previous options work per lamp, this option only works **after shading calculations**. This allows full control over the entire shading, including 'Toon' style results.

Using alpha values here is most useful for tweaking a finishing touch to a Material.

A list of the various Color Blend Modes are available for blending the ramp Shader with the color from Input.

This slider denotes the overall factor of the ramp Shader with the color from Input. In the separate *Shading* panel **SIX MORE OPTIONS** are available:



Title- Img 2.21 Shading menu, default settings.

Source-blender.org

Link-https://docs.blender.org/manual/en/dev/render/blender_render/materials/p roperties/ramps.html

Emit

Amount of light to emit.

Ambient

Amount of global ambient color the Material receives. Each Material has an Ambient slider that lets you choose **how much ambient light** that object receives. Set to **1.0 by default**.

Ambient Color

*You should set this slider depending on the amount of ambientlightyouthinktheobject will receive.Something **deep in the cave** will not get any ambient light, whereas something **close to the entrance will get more**. Notethat you cananimatethis effect, to change it as the object comesoutoftheshadowsandintothelight.*

Translucency

Amount of light from the back side that shows through.

Shadeless

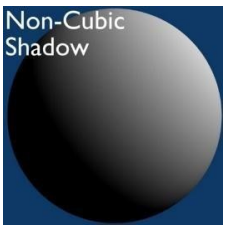
Disables the calculation of any shading. This makes the Material insensitive to light or shadow, resulting in a solid, uniform color for the whole object.

Tangent Shading

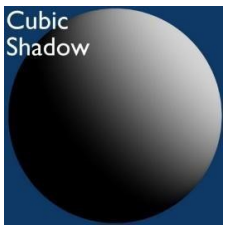
Use the Material's **tangent vector** instead of the normal for shading, i.e. for anisotropic shading effects (like soft hair and brushed metal).

Cubic Interpolation

Use cubic interpolation for Diffuse values, for smoother transitions between light areas and shadowed areas. Enhances the perceived contrast.



Without Cubic enabled.



With Cubic enabled

Cubic enabled.

Title- Img 2. 22 Shading menu, default settings.

Source-blender.org

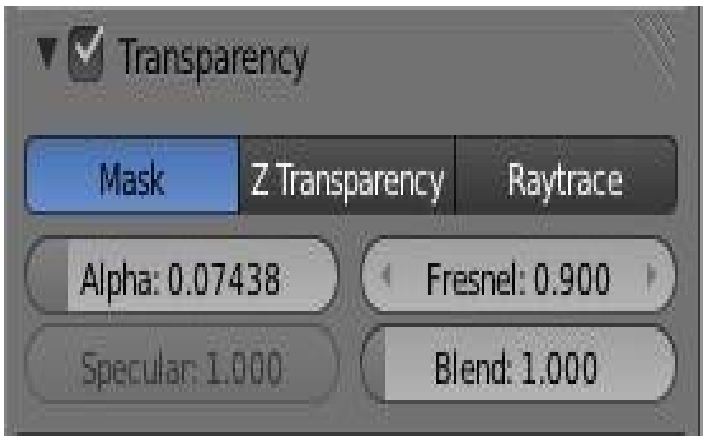
*Link-**http://blender-manual.readthedocs.io/en/master/render/blender_render/materials/properti_es/shading.html***

Unit 4 Advanced Shader Techniques

Transparency Panel

Materials in Blender can be set **to be transparent**, so that light can pass through any objects using the Material. Transparency is controlled using **an "alpha" channel**, where each pixel has an additional value, **range 0-1**, in addition to its RGB color values.

- If **alpha=0**, then the pixel is **transparent**, and the RGB values forthe surfacecontributenothingtothepixel'sappearance;
- If **alpha=1**, the surface is **fully opaque**, and the color of the surface determines the final color of the pixel.



Title-Img 2.23 Transparency Panel.

Source-blender.org *Link*-

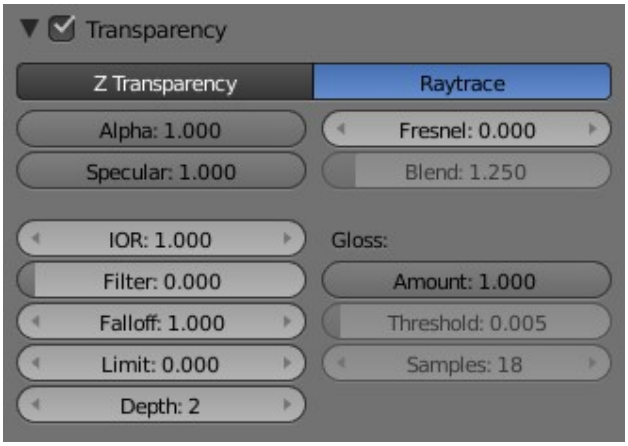
https://docs.blender.org/manual/en/dev/render/blender_render/materials/p roperties/transparency.html

In Blender, there are **three ways** in which the transparency of a Material can be set:

1. **Mask,**
2. **Z-Buffer**
3. **Ray-trace**

Each of these is explained in more detail below. The Material Preview option with a sphere object gives a good demonstration of the capabilities of these three options.

Options



Title- Img 2. 24 The Transparency Panel.

Source-blender.org

Link-https://docs.blender.org/manual/en/dev/render/blender_render/materials/p roperties/transparency.html

IOR

In addition to the common options given above, the following property controls are available: Index of Refraction. Sets how much a ray traveling through the Material will be refracted, hence producing a distorted image of its background.

Filter

Amount of filtering for transparent ray trace. The higher this value, the more the base color of the Material will show. The Material will still be transparent; however, it will start to take on the color of the Material. **Disabled (0.0) by default**.

Falloff

How fast light is absorbed as it passes through the Material. Gives '**depth**' and '**thicknesses to glass**.

Limit

Materials **thicker than** this are not transparent. This is used to control the threshold after which the filter color starts to come into play.

Depth

Sets the **maximum number** of transparent surfaces a single ray can travel through. There is no typical value. Transparent objects outside the Depth range will be rendered **pitch black** if viewed through the transparent object that the Depth is set for. In other words, if you notice black areas on the surface of a transparent object, the solution is probably to **increase its Depth value** (this is a common issue with ray tracing transparent objects). You may also need to turn on transparent shadows on the background object.

Gloss

Settings for the glossiness of the Material.

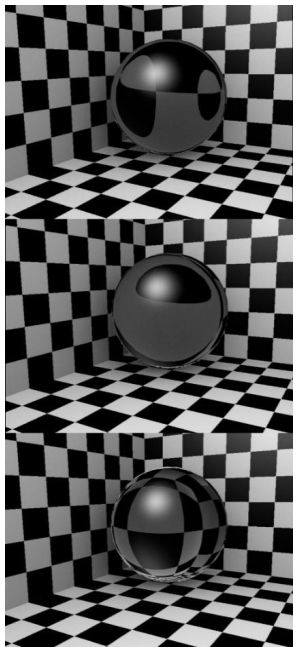
Amount

The **clarity** of the refraction. Set this to something **lower than zero** to get **a blurry** refraction.

Threshold

Threshold for **adaptive sampling**. If a sample contributes less than this amount (as a percentage), sampling is stopped.

Index of Refraction (IOR)



Title- Img 2. 25 Influence of IOR of an Object on the distortion of the background: spheres of Water, Glass and Diamond (top to bottom).

Source-blender.org

Link-

https://docs.blender.org/manual/en/dev/render/blender_render/materials/properties/transparency.html

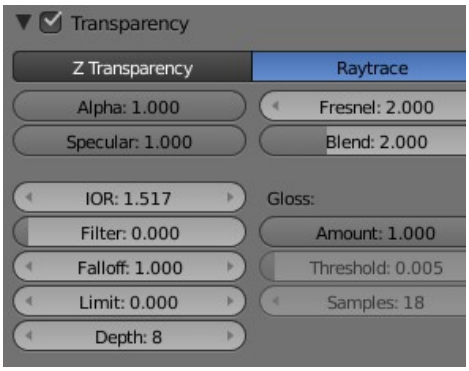
There are different values for typical Materials:

- **Air:** 1.000 (no refraction),
- **Alcohol:** 1.329,
- **Glass:** 1.517,
- **Plastic:** 1.460,
- **Water:** 1.333 and
- **Diamond:** 2.417

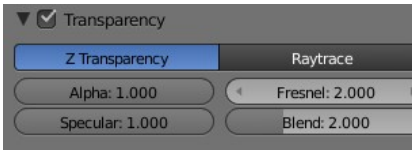
Fresnel

With ray-traced transparency.

With alpha buffered transparency.



Settings for Fresnel using ray- traced.



Settings for Fresnel using Z transparency.

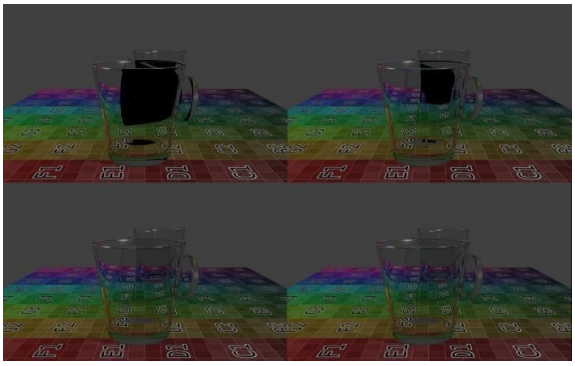
Title- Img 2. 26 Fresnel Effect

Source-blender.org

Link-

https://docs.blender.org/manual/en/dev/render/blender_render/materials/properties/transparency.html

Depth



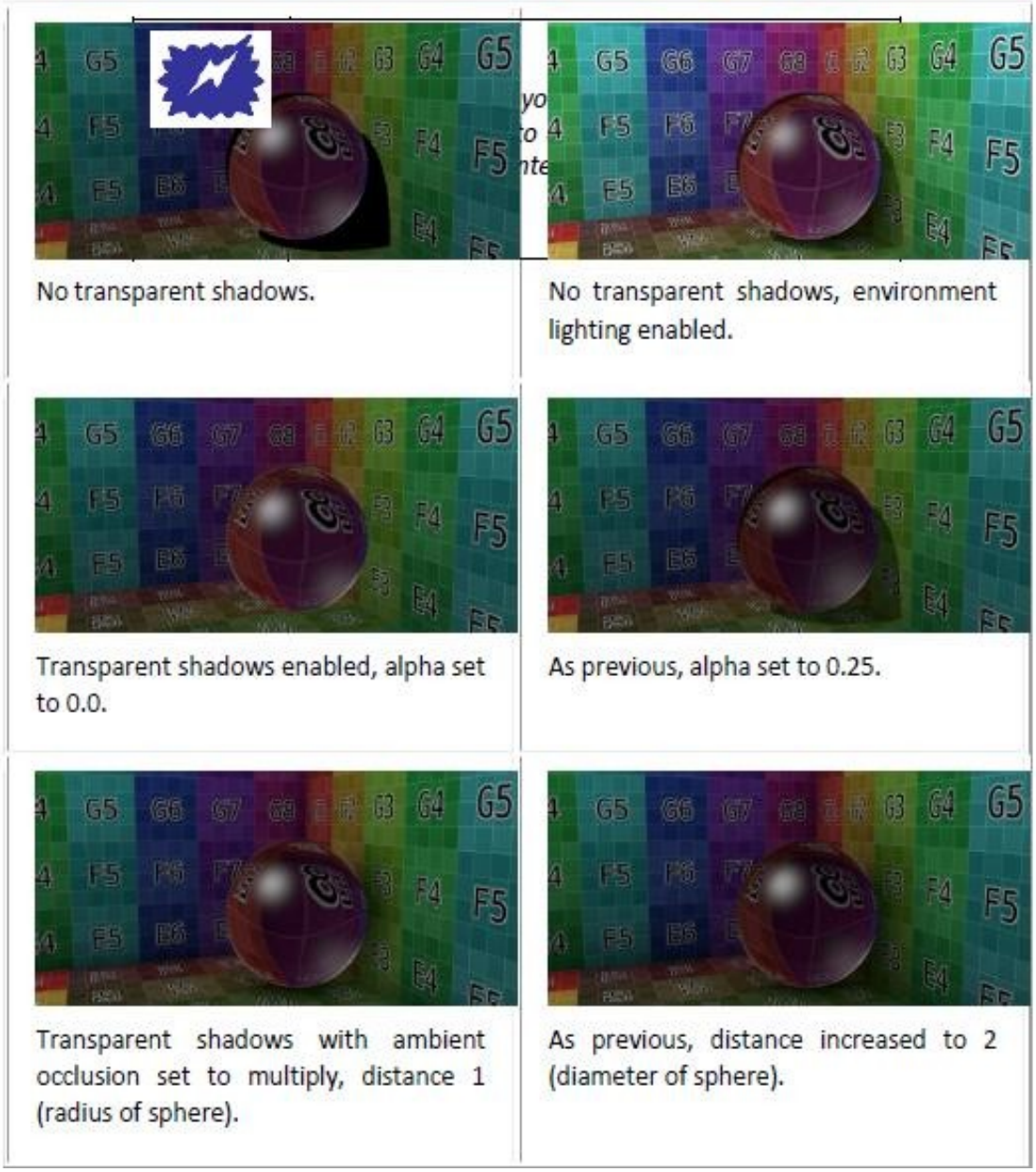
Title- Img 2. 27 Depth

Source-blender.org *Link-*

https://docs.blender.org/manual/en/dev/render/blender_render/materials/p roperties/transparency.html

Increasing *Depth* also considerably **increases render time**. Each time a light ray passes through a surface, the **ray-tracing algorithm** is called recursively. In the example above, each side of each glass has an **exterior and an interior surface**. Light rays thus have to pass through four surfaces for each glass.

However not only that, at every point on a surface, some of the light can **be reflected**, or **mirrored off** the surface in various directions. This results in multiple rays needing to be calculated for each point (often referred to as a tree of rays). In each of the rendered images above there are **640×400=256 000 pixels**. By increasing *Depth*, at least one tree of rays is added to each pixel.



Title- Img 2. 28 Transparent Shadows

Source-blender.org

Link-https://docs.blender.org/manual/en/dev/render/blender_render/materials/p roperties/transparency.html

Transparent shadows

By default, the shadows of transparent objects are rendered **solid black**, as if the object was not transparent at all. However, in reality, the **more transparent** an object is, the **lighter its shadow** will be.

In Blender, transparent shadows are set on the Materials that receive the shadows from the transparent object. This is enabled and disabled with the ***Receive Transparent*** **button**, in the

Material

- Shadow panel. The shadow's brightness is dependent on the ***Alpha*** **value** of the shadow casting Material.

Alternatives to transparent ray-traced shadows can be found in the ***World*** **tab**, namely the ***Ambient Occlusion***, ***Environment Lighting***, **and** ***Gather*** **panels**. Alternatively, a texture can be used to control the *Intensity* value of the shadow-receiving Material.

Mirror Reflection

Mirror reflections are computed in the Blender Render and Cycles render engines using **ray tracing**. (NB: Reflections are not available in the **Game Engine**.) Ray tracing can be used to make a Material reflect its **surroundings, like a mirror**.

The principle of ray-traced reflections is very simple: a ray is fired from the camera and travels through the scene until it encounters an object.

- If the first object hit by the ray **is not reflective**, then the ray takes **the color** of the object.
- If the object is **reflective**, then the ray bounces from its current location and travels up to another object, and so on, until a non-reflective object is finally met and gives the whole chain of rays its color.

Eventually, the first reflective object **inherits the colors** of its environment, proportional to its ***Reflectivity*** **value**. Obviously, if there are only reflective objects in the scene, then the render could last forever. Hence a mechanism for limiting the travel of a single ray is set through the ***Depth*** **value**: this parameter sets the maximum number of bounces allowed for a single ray.

Options

Title- Img 2. 28 The Mirror Panel.

Source-blender.org *Link-*

https://docs.blender.org/manual/en/dev/render/blender_render/materials/properties/mirror.html?highlight=mirror%20panel

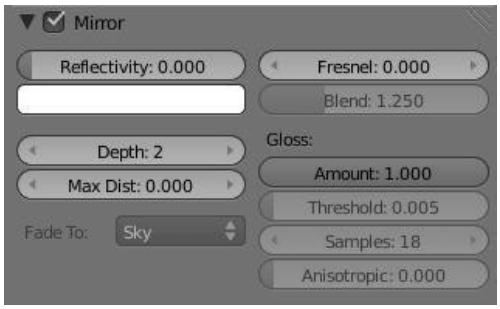
Enable ray-traced reflections

Enable or disable ray-traced reflections

Reflectivity

Sets the amount of reflectiveness of the object. Use a value of 1.0 if you need a perfect mirror, or set it to 0.0 if you do not want any reflection.

Mirror Color



Title- Img 2. 29 Picking a mirror color.

Source-blender.org *Link-*

https://docs.blender.org/manual/en/dev/render/blender_render/materials/properties/mirror.html?highlight=mirror%20panel

Color of mirrored reflection by default, an almost perfectly reflective Material like chrome, or a mirror object, will **reflect the exact colors** of its surrounding. However, some other equally reflective Materials tint the reflections with their own color. This is the case for **well-polished copper and gold,** for example. In order to replicate this within Blender, you have to set the Mirror Color accordingly. To set a mirror color, simply click the color button in the mirror panel and select a color.

Options Fresnel

Sets the power of the Fresnel effect. The Fresnel effect controls how reflective the Material is, depending on the angle between the surface normal and the viewing direction. Typically, the **larger the angle**, the **more reflective** a Material becomes (this generally occurs on the outline of objects).

Blend

A controlling factor **to adjust** how the blending happens between the reflective and non-

reflective areas.

Depth

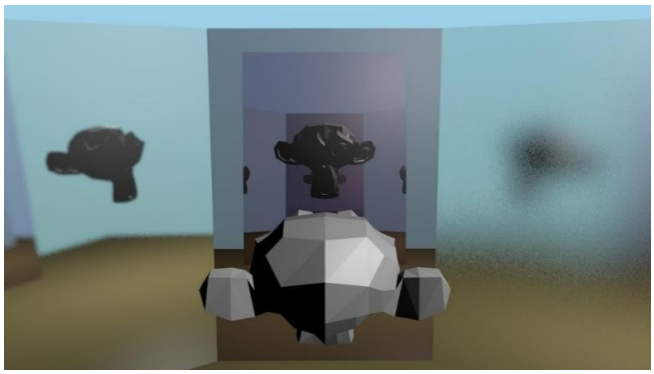
Maximum allowed number of light inter-reflections. If your scene contains many reflective objects and/or if the camera zooms in on such a reflective object, you will need to increase this value if you want to see surrounding reflections in the reflection of the reflected object. In this case, a **Depth of 4 or 5** is typically a good value.

Max Distance

Maximum distance of reflected rays away from camera **(Z-Depth)** in Blender Units. Reflections further than this range fade out to reduce compute time.

Fade to

The color that rays with no intersection within the ***Max Distance*** **take**. *Material* color can be best for indoor scenes, *Sky* color (World settings) for outdoorscenes.



Title- Img 2.30 Suzanne in the Fun House

Source-blender.org *Link-*

https://docs.blender.org/manual/en/dev/render/blender_render/materials/properties/mirror.html?highlight=mirror%20panel

Gloss

In paint, a **high-gloss finish** is very smooth and shiny. A flat, or low gloss, finish disperses the light and gives a very blurry reflection. Also, uneven or waxed-however-grainy surfaces (such as car paint) are not perfect and therefore slightly need a Gloss **greater than 1.0**

In the example to the right, the left mirror has a **Gloss of 0.98**, the middle is **Gloss = 1.0**, and the right one has **Gloss of 0.90**. Use this setting to make a realistic reflection, all the way up to a completely foggy mirror. You can also use this value to mimic depth of field in mirrors.

Amount

The shininess of the reflection. **Values < 1.0** give Diffuse, blurry reflections and activate the settings below.

Threshold

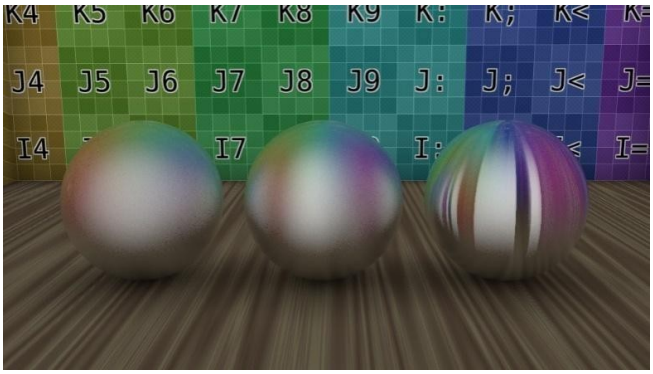
Threshold for **adaptive sampling**. If a sampling contributes less than this amount (as percentage), sampling is stopped. Raising the threshold will make the adaptive sampler skip

more often, however, the reflections could become noisier.

Samples

Number of cone samples averaged for blurry reflection. More samples will give a **smoother result**, however will also **increase render time**.

Anisotropic



Title- Img 2. 31 Anisotropic tangent reflecting spheres with anisotropic set to 0.0, 0.75, 1.0. (.blend)

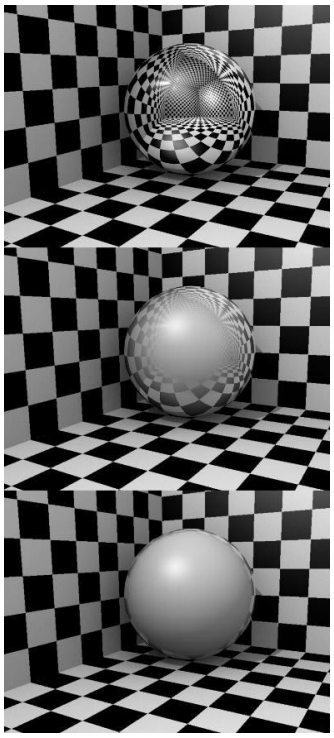
Source-blender.org

Link-***https://docs.blender.org/manual/en/dev/render/blender_render/materials/p roperties/mirror.html***

The shape of the reflection, from 0.0 (circular) to 1.0 (fully stretched along the tangent). If the ***Tangent Shading*** **is on**, Blender automatically renders **blurry reflections** as anisotropic reflections. When Tangent is switched on, the *Anisotropic* slider controls the strength of this anisotropic reflection, with a range of 1.0 (default) being fully anisotropic and 0.0 being fully circular, as is when tangent shading on the Material is switched off.

Anisotropic ray-traced reflection uses the same tangent vectors as for tangent shading, so you can modify the angle and layout the same way, with the auto-generated tangents, or based on the mesh's UV co-ordinates.

Examples Fresnel



Title- Img 2. 32 Demonstration of Fresnel effect with values equal to (from top to bottom) 0.0, 2.5 and 5.0.

Source-blender.org *Link-*

https://docs.blender.org/manual/en/dev/render/blender_render/materials/p roperties/mirror.html

Let us undertake a small experiment in order to understand what **Fresnel is really about**. After a rainy day, go out and stand over a puddle of water. You can see the ground through the puddle. If you kneel just in front of the puddle, your face close to the ground, and look again at a distant point on the puddle of water, the liquid surface part which is closer to you lets you see the ground, however if you move your gaze towards the other end of the puddle, then the ground is gradually masked until all you see is the reflection of the sky. This is the **Fresnel effect:** having a surface sharing reflective and non-reflective properties according to the viewing angle and the surface normal.

In *Demonstration of Fresnel effect with values equal to (from top to bottom)* ***0.0, 2.5 and 5.0***, this behavior is demonstrated for a perfectly reflective Material (Mirror Reflectivity 1.0).

- Fresnel 0.0 stands for a perfect mirror Material,
- Fresnel 5. 0 could stand for a glossy Material.

It is barely noticeable however in the lower picture, the Material is perfectly reflective around the edges.

The **smoothness** of the Fresnel limit can be further controlled using the ***Blend*** **slider**.

Subsurface Scattering (SSS)

Many organic and inorganic Materials are **not totally opaque** right at the surface, so light does not just bounce off the top surface. Instead, some light also penetrates the skin surface deeply, and scatters around inside, taking on the color of the insides and emerging back out at a different location. **Human/animal skin, the skin of grapes, tomatoes, fruits, wax, gels (like honey, or Jello)** and so on all have Subsurface Scattering (SSS), and photo-realism really cannot be achieved without it.

It is important to understand that **Subsurface Scattering and Diffuse are one and the same.** The difference is in how far light can Diffuse beneath the surface before it is absorbed or transmitted back out.

How it works

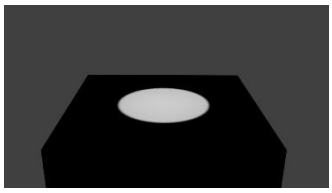
Actually, calculating the light path **beneath the surface** of an object is not practical. However, it has been shown that it is not necessary to do this, and that one can use a different approach.

Blender calculates SSS in two steps:

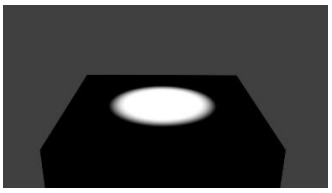
Step 1: At first, the **irradiance, or brightness** of the surface is calculated, from the front side of the object as well as from its back side. This is pretty much the same as in a **normal render**. Ambient Occlusion, Radiosity, the type of Diffuse Shader, the light color, etc. are considered.

Step 2: In the second step, the final image is rendered, however now the **SSS Shader replaces the Diffuse Shader**. Instead of the lamps, the calculated lightmap is used. The brightness of a surface point is the calculated "**Average**" of the brightness of its surrounding points. Depending on your settings the whole surface may be considered, and it is a bit more complicated than simply calculating the average, however do not bother too much with the math behind it.

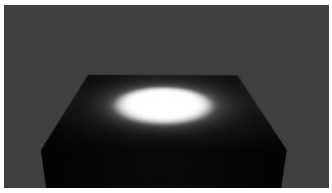
Instead, let us see what **SSS** does to a **distinct light point**.



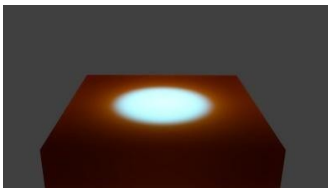
No SSS.



Small SSS radius.



SSS radius enlarged.



SSS with very large red radius value.

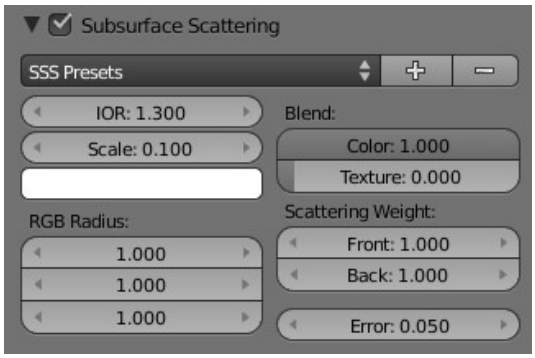
Title- Img 2.33 SSS.

Source-blender.org *Link-*

https://docs.blender.org/manual/en/dev/render/blender_render/materials/properties/subsurface_scattering.html

If you **turn on SSS**, the light is distributed over a **larger area**. The size of this area depends on the **radius values**. Instead of distributing all colors with the same amount, you may choose different radius values for each of the RGB colors. If you use a very large radius value for a color, its light is evenly distributed over the whole object.

Enabling Subsurface Scattering



Title- Img 2. 34 The SSS Panel. SSS is already enabled.

Source-blender.org *Link-*
https://docs.blender.org/manual/en/dev/render/blender_render/materials/p roperties/subsurface_scattering.html

Step 1: Enable SSS by clicking on the *Subsurface Scattering* button.

Step 2: Accessible at the top are various presets. When you select a preset, the *Radius* values, the *RGB Radius* and the IOR are set for you. The remaining options are not set (because they are mostly dependent on the size of your object).

*SubsurfaceScattering*does **not need ray tracing**. However, since it is dependent on the incident light and shadows, you need proper shadow calculation (which may need ray tracing).

Developing your own SSS Material

The Traditional Approach

A more common however less intuitive approach is to use "layering". This is a simplified version of the layering approach. See the external links for more information:

Step 1:

Set the SSS color on a value of your choice, normally the predominant color of the object. If you want to use different radii for the colors, do not make it too dark.

Step 2:

Set the scale factor. If you want to see much translucency you need small objects or large scale values.

Step 3:

Set the radius values.

Step 4:

Adjust the brightness with the *Front*and *Back*values.

A more intuitive approach

Step 1

Set the Scattering color to 0.5

Step 2

Set the Front weight to 2.0

Step 3

Set the scale factor based on the size of your object relative to the scene. If you want to see much translucency you need small objects or large scale values.

Step 4

Set the radius values appropriately.

Examples

Skin

				
Scale: 1.	Scale: 2.	Scale: 3.	Scale: 4.	Scale: 5.

Title-Img 2.35 Increasing SSS scale (blend-file)

Source-blender.org *Link-*

https://docs.blender.org/manual/en/dev/render/blender_render/materials/p roperties/subsurface_scattering.html

Strands

The **Strand** section of the Material tab is specific to the **rendering of Hair particles**. There are two different strand methods available:

Polygon strands

This is the **default (old) method**. The strands are rendered as **flat polygons**. The number of polygons depend on the ***Steps*** settings in the ***Particles system*** tab.

Strand Primitive

You activate Strand Primitive with the button ***Strand render*** **in the** ***Render*** **panel** of the particle system. The hair curves are not stored as polygons; only the key points are stored, which are then converted to polygons on the fly. A second difference is the **way transparency works**. Rather than rendering using the existing system, all strand segments in a part are sorted front to back and rendered in that order.

Polygon strands

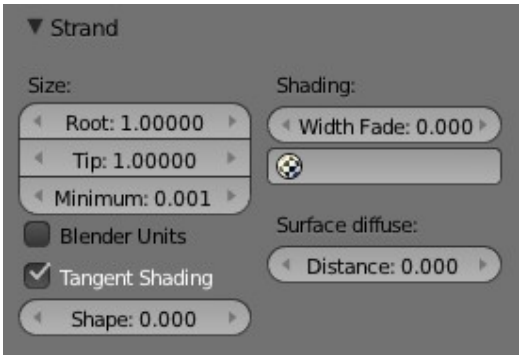
- Work well with greater width, so you can use them as an **alternative to billboards** because the strands may have an **animated shape**.
- Can be textured with a **UV-Texture** along the strands.
- Are seen by **ray tracing**.

Strand Primitives

Are more memory efficient and faster, to make rendering of large amounts of **fur and grass** possible. For good performance, the **render steps button should be lowered** (e.g.2 should be good enough fur), since the result will be a smoothed curve anyway. You need 1 to 2 render steps less than steps in the 3D View. Also, using more render parts helps to **reduce memory usage.**

- Have a distance of **vision reduction** (in the *Render* panel under *Child Simplification*) for children from faces.
- May be faded out towards the tip without an additional texture.
- Are not ray traced. So, they are not visible through ray- transparent Materials or in a ray mirror (you can use ***Environment Mapping*** for that).
- Have **shape problems** if they are rendered with a **greater width**.
- Cannot carry a **UV-Texture** along the strand.

Strands Shading



Title- Img 2.36 Strands Panel.

Root Tip

Source-blender.org *Link-*

https://docs.blender.org/manual/en/dev/render/blender_render/materials/p roperties/subsurface_scattering.html

Strands are rendered with the Material of the **underlying face/vertex**, including shading with a UV-Texture. Since you can assign more than one Material to each face, each particle system may have its own Material and the Material of the underlying face can be different from the Material of the strands.

Additionally, strands can be shaded along the strand (**from root to tip**) with a **mono-dimensional texture**; only **polygon strands can carry a two-dimensional UV-Texture**.

Options:

The options for strand shading are in the *Strands* section of the *Material*tab. *(Refer* Img 2.37*)*

Width of the hair at the root. Width of 42the hair at the tip.

Minimum

This is the minimum thickness (in pixels) of the strands. Strands below that size are not rendered smaller, however are faded to alpha (well, the fading works only for strand primitives). This gives a **much better rendering** result for **thin hair**.

Blender Units

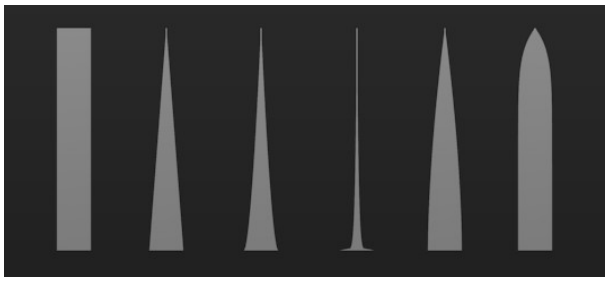
Normally strands are **quite thin**; the thickness is given in screen pixels. If you use **Blender Units (BU)** you may set the **root value up to 2 BU**, and the **tip value up to 1 BU.** You have to consider the overall object size, because the smallest possible size is 0.001 BU. So if you use 1 BU for 1 meter the smallest possible size would be **1 mm (too thick for thin hair).**

Use Tangent Shading

Calculates the light as if the strands were **very thin and round**. This makes the hair appear **brighter and shinier**. Disabling the "**Tangent Shading**" option will still render nicely, however resembles more solid strands, as though made of metal or wood.

Shape Slider

This slider allows you **to control the interpolation**. Default (**0.0**) is a linear interpolation between ***Root* and *Tip***. A negative value will make the strand narrower (spiky), a positive value will make it fatter.



Title- Img 2. 37 Various Shape settings. From left to right, 0 (root and tip are equal in the first), 0, -0.4, -0.9, 0.4, 0.9.

Source-blender.org *Link*-

https://docs.blender.org/manual/en/dev/render/blender_render/materials/p roperties/strands.html

Width Fade

To fade out along the width of the strand. This works only for **Strand Primitives**. 0.0 is no fading at all, 1.0 linear fading out.

UV Layer

You can texture **polygon strands with a UV-Texture**. Fill in the name of the UV-Set (not the texture) here. You also must load the texture in the **Texture tab** and **Material tab** (Mapping: UV) you may use every Influence setting you like – especially the alpha value;

Refer Img 2.38 **->**From left to right, 0 (root and tip are equal in the first), 0, -0.4, -0.9, 0.4, 0.9.).

Surface Diffuse

Computes the strand normal, taking the normal at the surface into account. This eases the **coloring and lighting of hair** a lot, especially for **Strand Primitives**. Essentially hair reacts similar to ordinary surfaces and do not show exaggerated strong and large Specular highlights.

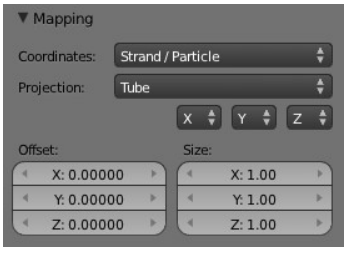
Distance

The distance in Blender Units over which to blend in the normal at the surface (if you want to use *Surface Diffuse* only for **Grass/Fur** at greater distances).

Texturing along the Strand

Strands can be textured along the strand, i.e. from root to tip. To do that you must select ***Strand/Particle*** in the ***Coordinates*** **select menu** in the *Mapping* panel of the *Material* tab.

Pretty much the most important setting is shown in **Image 2.39 ->**Fading a strand to alpha. How to fade the tip of a strand to alpha to make nice, fuzzy-looking hair. Normally you would use a **linear blend** texture for this.



Fading a strand to alpha.

The render result.

Title- Img 2. 38Texturing along the strand

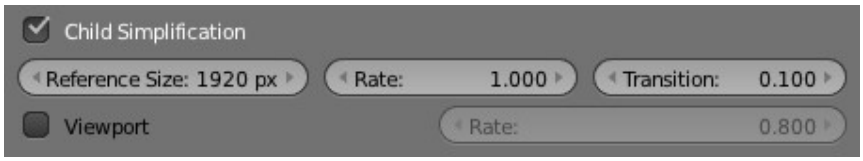
Source-blender.org Link-

https://docs.blender.org/manual/en/dev/render/blender_render/materials/p roperties/strands.html

You may of course set any attribute you like, **especially color**. Be careful with Specularity; hairs tend to get too shiny.

Strand Render Simplification

If you use **Strand Primitives** (*Strand render* button) and haveactivated ***Interpolated Children***, the *Child Simplification* option appears. The strand render has options to remove child strands as theobject's facesbecomesmaller.

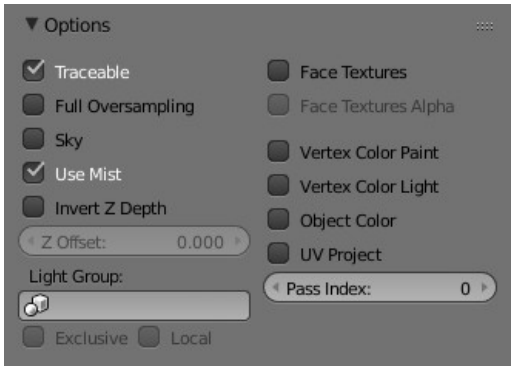


Title- Img 2. 39 Strand render child simplification.

Source-blender.org Link-

https://docs.blender.org/manual/en/dev/render/blender_render/materials/p roperties/strands.html

Material Options Panel



Title- Img 2. 40 Material Options panel

Source-blender.org Link-

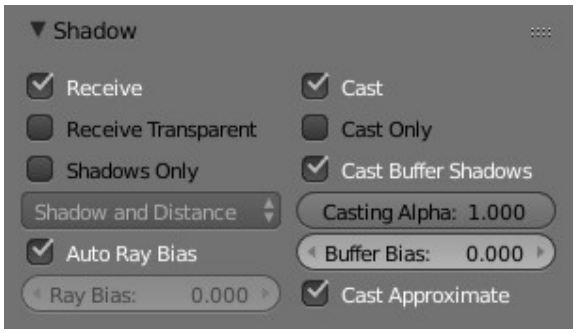
https://docs.blender.org/manual/en/dev/render/blender_render/materials/p roperties/options.html

Shadows Panel

This panel provides a series of control options concerning how **objects using this Material** will appear in the rendered image. All controls are set default to **"Off"** unless otherwise stated.

The Shadows that appear in a scene are affected by a combination of the **layout** of objects, **the shape** of the objects, the **Materials** of the objects, and the **lighting**. In Blender, the **Display Mode** (Single Texture, Multitexture, or GLSL) also affects the appearance of shadows.

Title- Img 2. 41 Shadow Panel.

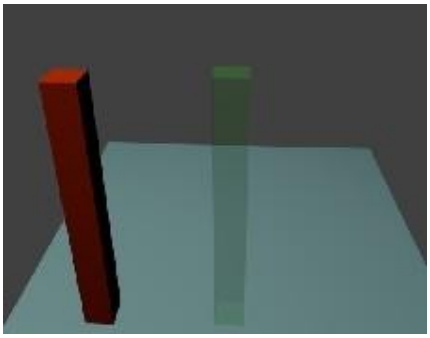


Source-blender.org

Link-

https://docs.blender.org/manual/en/dev/render/blender_render/materials/properties/shadows.html?highlight=shadows%20panel

The Shadow panel in the *Materials Properties editor* ***(Refer*** Img 2.42***)*** controls the effects that the Material can have on the shadows that appear in the scene. The various properties are described in the sections below.



Title- Img 2. 42 Scene with all shadow properties off.

Source-blender.org Link-

https://docs.blender.org/manual/en/dev/render/blender_render/materials/properties/shadows.html?highlight=shadows%20panel

Options

The following properties can be set for each individual Material with which objects in the **scene are shaded**. The effects are illustrated with rendered images for a simple scene (**Refer** Img 2.43) consisting of two "posts", one with red (totally non-transparent) Material one with green (partially transparent) Material **set up on a light blue plane to receive the shadows.** The illustrations were all taken in **Blender Render engine**, with Multitexture mode.

Shadow Receiving Object Material

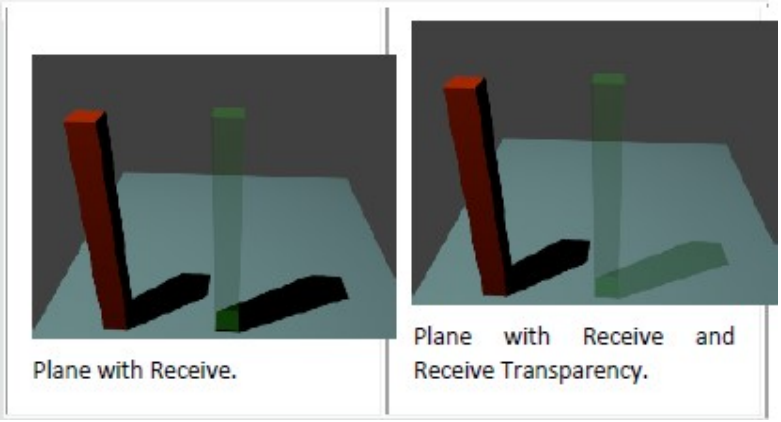
The following options affect the Material that receives shadows:

Receive

Allows this Material to receive **full-intensity shadows** (Refer Img 2.44 Plane with Receive.).

Receive Transparent

Allows this Material to receive shadows whose intensity is modified by the transparency and color of the shadow-casting object (Refer Img 2.44 Plane with Receive and Receive Transparency.).



Title- Img 2. 43Shadow receiving object material

Source-blender.org Link-

https://docs.blender.org/manual/en/dev/render/blender_render/materials/properties/shadows.html?highlight=shadows%20panel

Shadow Casting Object Material

The following options affect the Material that casts shadows:

Cast Only

Causes objects with the Material to only cast a shadow, and not appear in renders. *(Refer* Img 2.45 - *Posts with Cast Only.).*

Casting Alpha

Sets the Alpha of shadow casting. Used for **irregular and deep** shadow buffering.

Shadows Only

Renders shadows as Materials alpha value, making Materials transparent, except for areas where it receives shadows from other objects, and it retains its own transparency *(Refer* Img

2.45 - *Posts with Shadows Only)*. Note the faint image of the partly- transparent post.

Shadow Only Type

Set the type of shadows used when Shadows only is enabled.

- Shadow and Distance
- Shadow Only
- Shadows and Shading

Title- Img 2. 44 Shadow & cast

Source-blender.org Link-

https://docs.blender.org/manual/en/dev/render/blender_render/materials/properties/shadows.html?highlight=shadows%20pane

Buffered Shadow Options

In addition to the shadow options described above, there are further Material properties which control buffered shadow features. See Section On-Spot Buffered Shadows for further discussion of these techniques.

Unit summary

In this Unit, we have learnt what is the Material and how to

- Use Shaders, Colors
- Preview those Shaders with Specular and Ramps in your Material editor
- Edit the Properties of the Shaders
- Work on Transparency settings to create Reflection and Refractions using Index tables to create Mirrors and Glasses
- Work on Subsurface Scattering which helps the objects to create scattering of lights and shadows within the objects.

After learning of this Unit, you can download the Open Source Software available on the internet for free of cost to practice the possibilities of creating Materials.

Assignment

Create a Simple Living Room with few objects like Chairs, Tables, Flower Vases, Metal Objects, Papers/Files/Books, Glasses etc., and assign Shaders to the scene. Use Index of Refraction table https://en.wikipedia.org/wiki/List_of_refractive_indices

*Use these key words **"living room"**, **"3d Shaders"** on* https://www.google.com *to collect the reference images to build your shading scenes.*

Assessment

- Define Diffuse Shader
- Differentiate between Lambert Shader and Toon Shader
- Write notes about Specular Shaders with Illustrations
- Explain the Process of making a Glass Shader
- List the IOR values of any 5 common Materials based on Liquids, Transparent Materials, Opaque Materials, Gemstones and Metals
- Write notes about Subsurface Scattering and its usage in the real-time situations
- Describe the use of Strands Shader
- Define Shadows in 3D Mode

Resources

While studying this course, you can browse the internet links for video tutorials and to download the relevant texture maps to assign on the objects that you have created and use the same for your assignments.

- wiki.blender.org
- archive.org
- www.blender.org
- docs.blender.org

Unit 5 Shading Organic Models

Introduction

Our eyes have been trained to believe that **an image is real** if it shows **Artifacts** that result from the **Mechanical Process** of photography.

Three examples of these **Artifacts** are

1. **Motion Blur**
2. **Depth of Field**
3. **Lens Flares**

We will learn about Motion Blur and Depth of Field in the next Unit 04**.**

We will learn about **Lens Flares** in this Unit, which can be produced with special **Materials and Shader**. A simulated lens flare tells the viewer that **the image was created with a camera**, which makes the viewer think that it is **authentic**.

Many things can happen to the light as it passes through the volume, which will influence the final color that arrives at the camera. This represents physical interactions that happen in the real world. Most of these are dependent on the **density of the volume**, which can either be a **constant density** throughout, or **varied, controlled** by a texture.

It is by controlling the density that one can get the **typical 'Volumetric' Effects** such as **clouds or thick smoke or fire** using **Volume Rendering**.

Outcomes

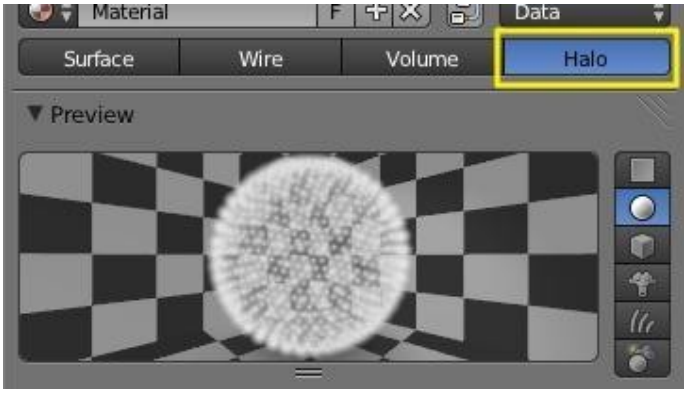
Upon completion of this unit you will be able to:

- Create **Special Effects** for your 3D Scenes using the Materials and Shaders;
- Identify the different type of Material effects available in Blender to create **Authentic Photo Effects**;
- Create **Volume Renders** for light that passes through Materials;
- Create **Fire and Fog Effects**
- Design various styles of rendering using Special Materials and Shaders

Terminology

Alpha:	This is the Transparency information of the Shader.
Diffuse Color:	The color of the Halo itself.
Size:	Sets the dimension of the Halo.
Seed:	If non-zero, it will randomize the ring dimension and line location. To use, give any (integer) number to start the random-number generator.
Hardness:	Sets the hardness of the Halo. Like specular hardness
Vertex Normal:	Use the vertex normal to specify the dimension of the Halo.

Halo Rendering



Title- Img3.1 Activating Halo rendering.

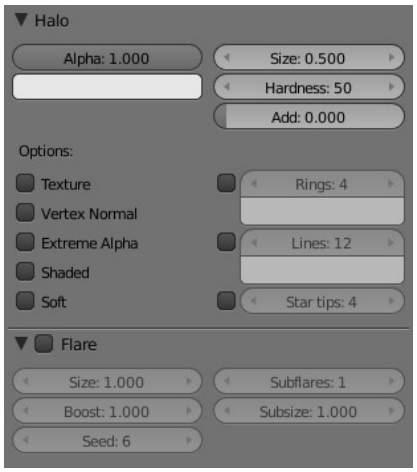
Source-blender.org Link-
https://docs.blender.org/manual/en/dev/render/blender_render/materials/special_effects/halo.html?highlight=activating%20halo%20rendering

Halo Material renders each object's points as glowing dots or some little clouds of light. Although they are not really lights, because they do not cast light into the scene like a lamp. These are called Halos because you can see them, however, they do not have any substance.

Halos are rendered with **Vertex Shaders** and not with **Face Shaders**.

This Material is useful for simulating special effects, like **Particle effects** or **Lens Flares.**

Options



Title- Img 3. 2 Halo panels.

Source-blender.org

Link-

https://docs.blender.org/manual/en/dev/render/blender_render/materials/special_effects/halo.html?highlight=activating%20halo%20rendering

To enable *Halos*, **Step 1:** Press the ***Halo* button** in the ***Material* menu**'s top panel. As you would see in the 3D View, the **Mesh faces** are no longer rendered. Instead just the **Vertex** is rendered, since that is where each Halo will originate. Halos can be **hard to find** in a crowded scene, so name it well for easy location in the outliner. In the roperties Editors, we normally find the ***Diffuse*, *Specular*,** and ***Shading* panels**. Now, we see Panels relative to the *Halo* characteristics:

Halo Panel

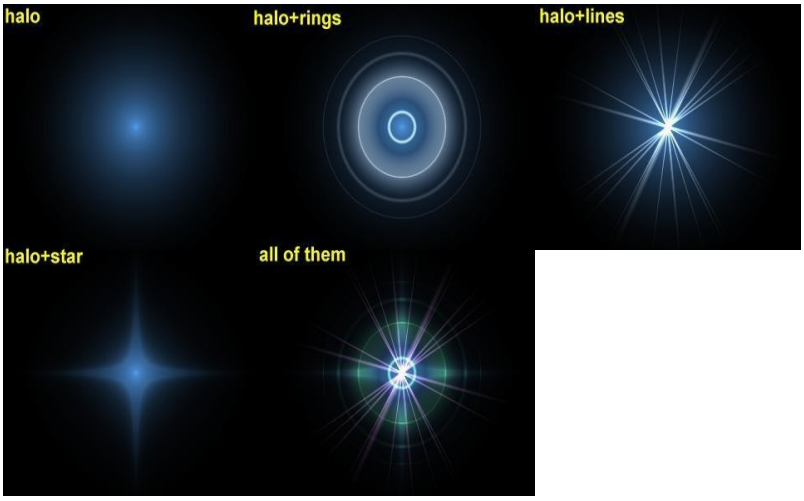
Alpha	The transparency.
Diffuse Color	The color of the Halo itself.
Seed	If non-zero, it randomizes the ring dimension and line location. To use, give any (integer) number to start the random-number generator.
Size	Sets the dimension of the Halo
Hardness	Sets the hardness of the Halo. Like specular hardness
Add	Determine how much the Halo colors are 'added to', rather than mixed with, the colors of the objects behind and together with other Halos. **By increasing Add**, the Halo will appear to **light up objects** that move behind it or through the Halo field. (Refer Img 3.3)

Title- Img 3. 3 Effect of Add. Source-blender.org

Link-
https://docs.blender.org/manual/en/dev/render/blender_render/materials/special_effects/halo.html?highlight=activating%20halo%20rendering

Texture	Gives Halo a texture. By default, textures are applied to objects with Object coordinates and reflects on the Halos by affecting their color based on the color of the vertex originating the Halo. Enable this feature to have the texture **take effect *within* the Halo**, and hence to have it with varying colors or transparencies; this will map the whole texture to ***every* Halo**. This technique proves very useful when you want to create a **realistic rain effect** using particle systems, or similar.
Vertex Normal	Use the vertex normal to specify the dimension of the Halo.
Extreme Alpha	Boosts alpha.
Shaded	Let Halo receive light and shadows from external objects. **When shaded** is enabled, the Halo will be affected **by local light**; a lamp will make it brighter and affect its diffuse color and intensity.
Soft	Softens the edges of the Halos at intersections with other geometry. In addition, several other special effects are available. To enable some of these effects, set the number of points/rings, or set the color of each effect individually:

You **cannot use color ramps**. Lines, Rings and an assortment of special effects are available with the relevant toggle buttons, which include Flare, Rings, Lines, Star, Texture, Extreme Alpha, and Shaded. *Halo Variations* shows the result of applying a Halo Material to a single vertex mesh.



Title- Img 3. 4 Halo Variations

Source-blender.org

Link-

https://docs.blender.org/manual/en/dev/render/blender_render/materials/special_effects/halo.html?highlight=activating%20halo%20rendering

Flare Panel	Enabling Flare Renders the Halo as a lens flare.
Size	Sets the factor by which the flare is larger than the Halo.
Boost	Give the flare extra strength.
Seed	Specifies an offset in the flare seed table.
Subflares	Sets the number of subflares.
Subsize	Sets the dimensions of the subflares, dots, and circles.

Lens Flares

Our eyes have been trained to believe that **an image is real** if it shows **Artifacts** that result from the **Mechanical Process** of photography.

Three examples of these **Artifacts** are

1. **Motion Blur**
2. **Depth of Field**
3. **Lens Flares**

We will learn about Motion Blur and Depth of Field in the next Unit 04.

Now, we learn about **Lens Flares** in this Unit, which can be produced with special **Materials and Shader**. A simulated lens flare tells the viewer that **the image was created with a camera**, which makes the viewer think that it is **authentic**.

We create **Lens Flares** in Blender from a mesh object using first **the *Halo* button** and then the ***Flare* options** in the ***Shaders* Panel** of the Material settings. Try turning on ***Rings* and *Lines***, however, keep the colors for these settings fairly subtle. Play with the *Flares:* number and *Fl. seed:* settings until you arrive at something that is pleasing to the eye. You might need to play with *Boost:* for a stronger effect.

Note that this tool does not simulate the physics of photons traveling through a glass lens; it's just **an eye candy**.

Blender's Lens Flarelooksniceinmotion, anddisappearswhen another object occludes the **flare mesh**.

Title- Img 3. 4Lens Flare. Source-blender.org

Link-
https://docs.blender.org/manual/en/dev/render/blender_render/materials/special_effects/halo.html?highlight=activating%20halo%20rendering

Halo Texturing

By default, textures are applied to objects with **Object coordinates** and reflects on the Halos by affecting their color, as a whole, on the basis of the color of the vertex originating the Halo. To have the texture take effect *within* the Halo, and hence to have it with varying colors or transparencies press **the *Texture* button**; this will map the whole texture to ***every* Halo**. This technique proves very useful when you want to create a **realistic rain** effect using particle systems, or similar.

Another Option is **Shaded**. When shaded is enabled, the Halo will be affect by local light; a lamp will make it brighter and affect its diffuse color and intensity.

Examples

Dot-Matrix Display

Let us use a Halo Material to create a dot-matrix display:

Step 1: To begin, add a grid with the dimensions **32×16**. Then add a camera and adjust your scene so that you have a nice view of the billboard.

Step 2: Use a 2D image program to create some red text on a black background, using a simple and bold font, you can just save the picture on your hard drive as Dot-matrix image texture and show an image 512 pixels wide by 64 pixels high, with some black space at both sides.

Title- Img 3. 5Dot matrix image texture. Source-blender.org

Link-
https://docs.blender.org/manual/en/dev/render/blender_render/materials/special_effects/halo.html?highlight=activating%20halo%20rendering

Step 3: Add a Material for the billboard, and set it to the type *Halo*. Set the ***Halo Size* to 0.06** and when you render the scene you should see a grid of white spots.

Step 4: Add a Texture, then change to the Texture Buttons and make it an image texture. When you load your picture, and render again you should see some **red tinted dots** in the grid. *(Refer* Img 3.6*)*

Step 5: Return to the Material Buttons and adjust the ***size X***

parameter to about 0.5 then render again; the text should now be centered on the Billboard.

Step 6: To remove the white dots, adjust the Material color to a **dark red** and render. You should now have **only red dots**; however, the billboard is still too dark. To fix this enter ***Edit Mode*** for the board and copy all vertices using the **Shift-D** shortcut (take care not to move them!). Then adjust the brightness with the *Add* value in the Halo panel. *(Refer* Img 3.7*)*

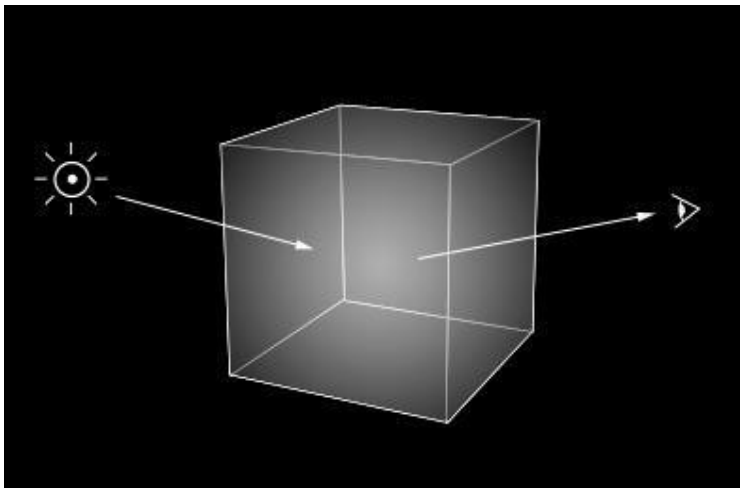
Title- Img 3. 6Dot Matrix display

Source-blender.org Link-

https://docs.blender.org/manual/en/dev/render/blender_render/materials/special_effects/halo.html?highlight=activating%20halo%20rendering

You can now animate the texture to move over the billboard, using the ***Offset X* value** in the *Texture* tab of the Mapping panel. (You could use a higher resolution for the grid, however, if you do you must adjust the size of the Halos by shrinking them, or they will overlap. *(Refer* Img 3.7 *Dot Matrix display).*

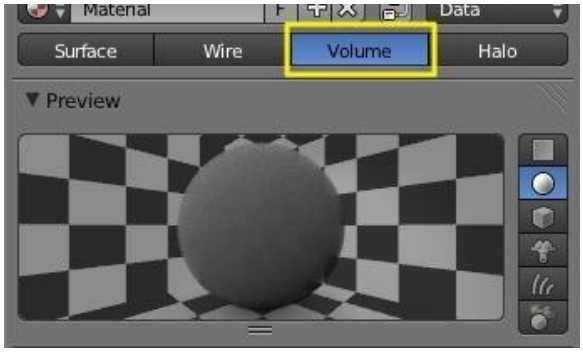
Volume Rendering



Title- Img 3. 7Activation volume rendering.

Source-blender.org Link-

https://docs.blender.org/manual/en/dev/render/blender_render/materials/special_effects/volume.html?highlight=activation%20volume%20rendering



Title- Img 3. 8Volume rendering.

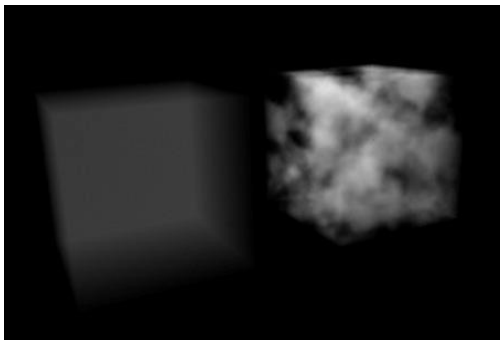
Source-blender.org Link-

https://docs.blender.org/manual/en/dev/render/blender_render/materials/special_effects/volume.html?highlight=activation%20volume%20rendering

Volume Rendering is a method for rendering light as it passes through participating media, within a 3D region. The implementation in Blender a **physically based model**, which represents the various interactions of light in a volume relatively realistically.

Rendering a volume is different than **Solid Render**. For volume light enters a 3D region of space (defined as the volume) that may be filled with small particles, such as **smoke, mist or clouds.** The light bounces around off the various molecules, being scattered or absorbed, until some light passes through the volume and reaches the camera. For that volume to be visible, the renderer must figure out how much Material the light has passed through and how it has acted and reacted within that volume, the volume object needs to contain a 3D region of space, **for example** a manifold closed mesh, such as a cube, not just a flat surface like a plane. To get an image, the renderer must step through that region, andseehowmuch'stuff'is there(density)toseehowlight is absorbed or scattered or whatever. This can be a **time-consuming process** since it must check a lot of points in space and evaluate the density at each.

Options



Title- Img 3. 9 Constant density vs textured density. Source-blender.org

Link-
https://docs.blender.org/manual/en/dev/render/blender_render/materials/special_effects/volume.html?highlight=activation%20volume%20rendering

Many things can happen to the light as it passes through the volume, which will influence the **final color** that arrives at the camera. These represent physical interactions that happen in the real world, and most of these are **dependent on the density** of the volume, which can either be a constant density throughout, or varied, controlled by a texture. It is by controlling the density that one can get the typical **'volumetric' effects** such as **clouds or thick smoke.**

Density

The base density of the Material. Other densities from textures are added on top.

Density Scale

A global multiplier to increase or decrease the apparent density. This can be useful for getting consistent results across different scene scales.

Shading

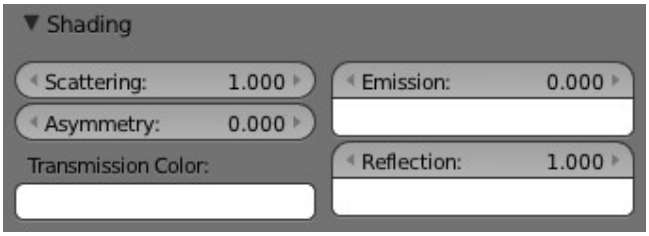
Title- Img 3. 10 Spot lamp scattering in a constant volume.

Source-blender.org

Link-
https://docs.blender.org/manual/en/dev/render/blender_render/materials/special_effects/volume.html?highlight=activation%20volume%20rendering

When light enters a volume from an external source, it does not just **pass straight** through. Light gets scattered off tiny particles in the volume, and some proportion of that light reaches the camera. This property makes it possible to **see light beams** as they travel though a volume and are scattered towards the eye.

Options



Title- Img 3. 11 Shading options.

Source-blender.org

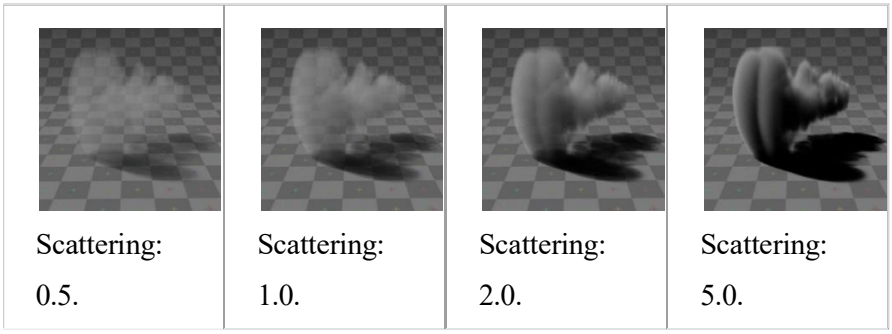
Link-

https://docs.blender.org/manual/en/dev/render/blender_render/materials/special_effects/volume.html?highlight=activation%20volume%20rendering

Scattering

The amount of light that is scattered out of the volume. The **more light** that is scattered out of the volume, the **less it will penetrate** through the rest of the volume. Raising this parameter can have the effect of making the volume seem denser, as the light is scattered out quickly at the '**surface' of the volume**, leaving the areas internal to the volume darker, as the light does not reach it.

Note in the examples below, the **less light** that is scattered out of the volume, **the more easily it penetrates** throughout the volume and to the shadow.

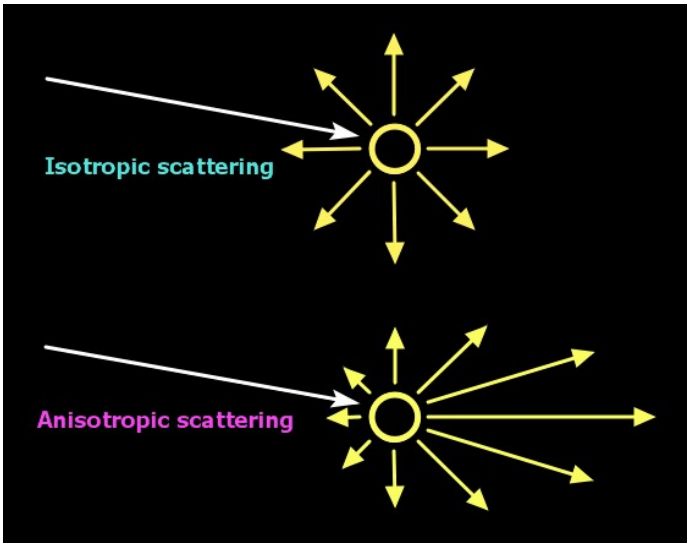


Scattering: 0.5.	Scattering: 1.0.	Scattering: 2.0.	Scattering: 5.0.

Title- Img 3. 12 Scattering Source-blender.org

Link-

https://docs.blender.org/manual/en/dev/render/blender_render/materials/special_effects/volume.html?highlight=activation%20volume%20rendering



Title- Img 3. 13 Isotropic and Anisotropic scattering.

Source-blender.org Link-
https://docs.blender.org/manual/en/dev/render/blender_render/materials/special_effects/volume.html?highlight=activation%20volume%20rendering

Types of Scattering

- The default method for scattering light in a volume is for the light to be deflected **evenly in all directions**, also known as **Isotropic scattering**.
- In real life, different types of media can scatter light in **different angular directions**, known as **Anisotropic scattering.**
- **Back-scattering** means that light is scattered more towards the incoming light direction.
- **Forward-scattering** means it is scattered along the same direction as the light is traveling.

Asymmetry

Asymmetry controls the range **between** back-scattering **(-1.0)** and forward-scattering **(1.0).** The default **value of 0.0** gives Isotropic scattering (even in all directions).

Transmission

Transmission is a general term for light that is transmitted throughout a volume.

This transmitted light can be the result of various interactions, for example:

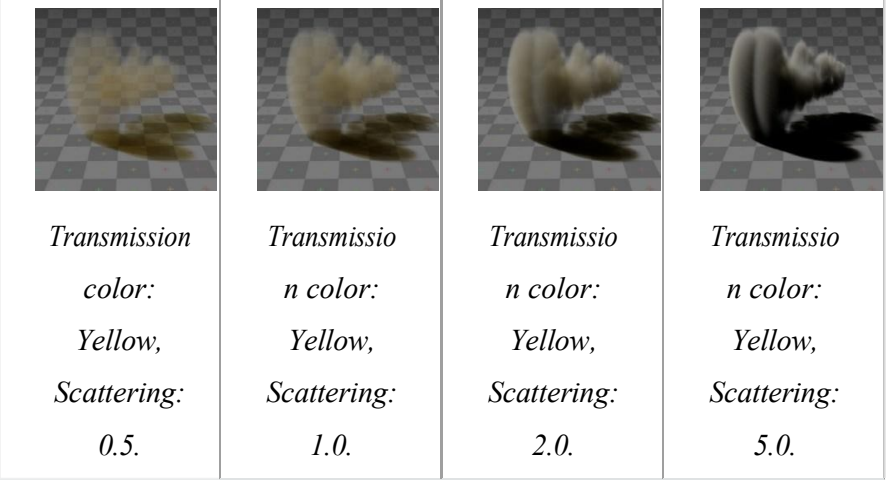
- the left-over result of incoming light after it has reflected/scattered out of the volume
- the left-over result of light after being absorbed by the volume (and converted to heat)

Here, the transmission color is used to set the result color that light becomes after it is transmitted through the volume.

Transmission Color

The resultant color of light that is transmitted through the volume.

Note in the examples below, as **more light** is scattered out of the volume, there is **less available to be transmitted** through.



Title- Img 3. 14 Transmission of color. Source-blender.org

Link-
https://docs.blender.org/manual/en/dev/render/blender_render/materials/special_effects/volume.html?highlight=activation%20volume%20rendering

- ***Emission***

  Some volumes can emit light where there was none before, via chemical or thermal processes, such as fire. This light is generated from the volume itself and is independent of light coming from external sources.

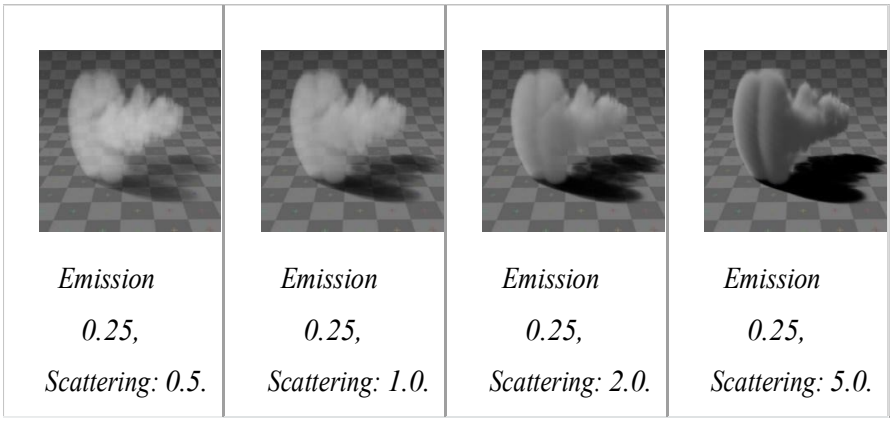
  Currently, this emitted light does not affect other volumes or surfaces (like surface Material type, 'Emit' option).

- ***Emission Color***

The color of light that is emitted by the volume.

Emission

An intensity multiplier for the emitted color, for scaling up and down.



Title- Img 3. 15 Emission

Source-blender.org Link-
https://docs.blender.org/manual/en/dev/render/blender_render/materials/special_effects/volume.html?highlight=activation%20volume%20rendering

Reflection

The ***Reflection*** parameters can be used **to tint or scale the light** that is scattered out of the volume. This **affects only the light** that has come from lamps and been scattered out, it does **not affect the color** of transmitted or emitted light and is.

These settings are not physically correct, because they **do not conserve energy**. This means the light scattering out does not affect the remaining light, that is transmitted throughout the rest of the volume.

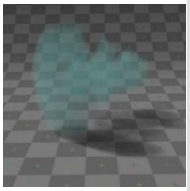
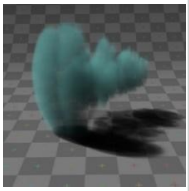
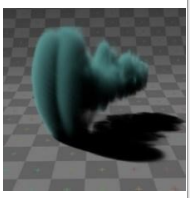
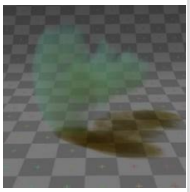
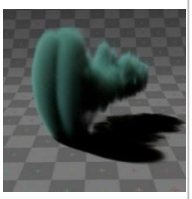
For example, if the orange components of the light are scattered out of the volume towards the camera, only the inverse of that (blue) will remain to continue penetrating through the volume,causing the volume to take on a multi-colored appearance, which can be difficult to use. To make it a bit easier to **plainly set the color of the volume**, you can use the **reflection parameters** to quickly set an overall tint.

- **Reflection Color**

  The color of light that is scattered out of the volume.

- **Reflection**

An intensity multiplier for the reflection, for scaling up and down.

 *Reflection: Green, Scattering: 0.5.*	 *Reflection: Green, Scattering: 1.0.*	 *Reflection: Green, Scattering: 2.0.*	 *Reflection: Green, Scattering: 5.0.*
 *Reflection: Green, Transmissio n: Yellow,*	 *Reflection: Green, Transmissio n: Yellow,*	 *Reflection: Green, Transmissio n: Yellow,*	 *Reflection: Green, Transmissio n: Yellow,*
Scattering: 0.5.	*Scattering: 1.0.*	*Scattering: 2.0.*	*Scattering: 5.0.*

Title- Img 3. 16 Reflection

Source-blender.org Link-

https://docs.blender.org/manual/en/dev/render/blender_render/materials/special_effects/volume.html?highlight=activation%20volume%20rendering

Lighting

Title- Img 3.17 Lighting options. Source-blender.org

Lighting Mode

Shadeless	Shadeless is the simplest, useful for thin, wispy mist or steam.
Shadowed	Shadowed is similar, however, with shadows of external objects.
Shaded	Shaded uses a volumetric single-scattering method, for self-shading the volume as light penetrates through.
Multiple Scattering	Allows multiple scatter calculations.
Shaded + Multiple Scattering	Combines Shaded and Multiple Scattering functionality.

Shaded Options

External Shadows	Receive shadows from sources outside the volume (temporary).
Light Cache	Pre-calculate the shading information into a voxel grid, speeds up shading at slightly less accuracy.
Resolution	Resolution of the voxel grid, low resolutions are faster, high resolutions use more memory.

Multiple Scattering Options

Diffusion	Diffusion factor, the strength of the blurring effect.
Spread	Proportional distance over which the light is diffused.
Intensity	Multiplier for multiple scattered light energy.
Transparency	The transparency settings are the same as Solid Render except you have less settings. For volume rendering you only have: • Mask • Z Transparency • Raytrace

Link-
https://docs.blender.org/manual/en/dev/render/blender_render/materials/special_effects/volume.html?highlight=activation%20volume%20rendering

Several **shading modes** are available, providing a range of options between fast to render and physically accurate.

Integration

Title- Img 3. 18 Integration options. Source-blender.org

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https://docs.blender.org/manual/en/dev/render/blender_render/materials/special_effects/volume.html?highlight=activation%20volume%20rendering

Step Calculation Method	Method of calculating the step through the volume.
Randomized	Randomized method of calculating the step.
Constant	Constant method of calculating the step.
Step Size	Distance between subsequent volume depth samples. Step Sizes determine how noisy the volume is. Higher values result in lower render times and higher noise.
Depth Cutoff	Stop ray marching early if transmission drops below this luminance threshold. Higher values will give a speedup in dense volumes at the expense of accuracy.

Options

Title- Img 3. 19Material volume options.

Source-blender.org Link-

https://docs.blender.org/manual/en/dev/render/blender_render/materials/special_effects/volume.html?highlight=activation%20volume%20rendering

- **Traceable**

Allow this Material to **calculate ray tracing**.

- **Full Oversample**

  Force this Material to render **full shading/textures** for all anti-aliasing samples.

- **Use Mist**

  Use mist with this Material (in world settings).

- **Light Group**

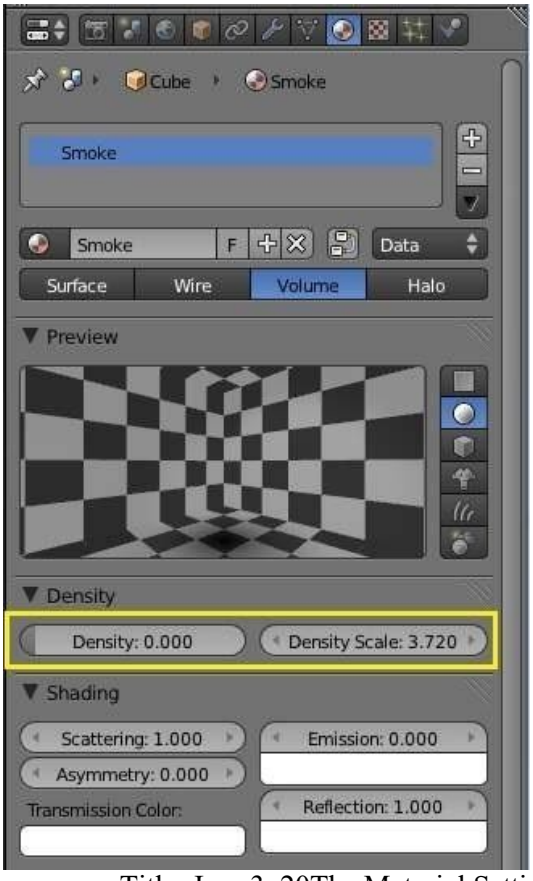
  Limit lighting of this Material to lamps in this group.

- **Exclusive**

  Material uses this group exclusively. Lamps are excluded from other scene lighting.

Smoke and Fire

Create the Material The Material must be a **Volumetric Material** with a **Density of 0**, and a **high-Density** Scale.



Title- Img 3. 20The Material Settings.

Source-blender.org Link-

https://docs.blender.org/manual/en/dev/render/blender_render/materials/special_effects/volume.html?highlight=activation%20volume%20rendering

Smoke requires a **complex Material** to render correctly.

Step 1: Select the big cube

Step 2: Go to the Material tab.

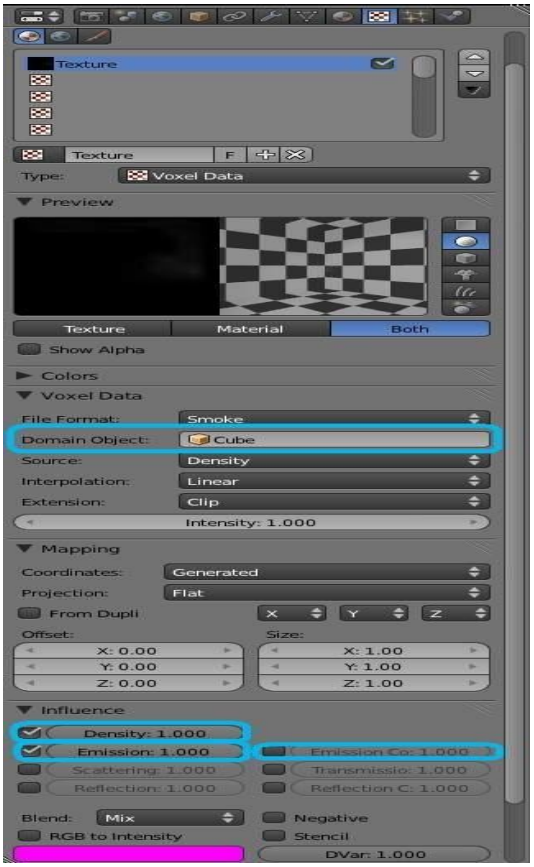
Step 3: Change the Material to 'Volume' S

Step 4: Set the density to 0. If you set the density to values bigger than 0 the domain cube will be filled with the volume Material.

The other settings willaffectthesmoke, though. We'llcoverthose later.

Add the Texture

In addition, Smoke requires its **own texture**, you can use a **Volumetric Texture** known as **Voxel Data**. You must remember to set the domain object and change the influence.



Title- Img 3. 21The texture settings.Source-blender.org

Link-

https://docs.blender.org/manual/en/dev/render/blender_render/materials/special_effects/volume.html?highlight=activation%20volume%20rendering

Step 1: Go to the *Texture tab*

Step 2: Change the *Type* to *VoxelData.*

Step 3: Under the *Voxel Data-Settings*, set the *Domain Object* to our *domaincube* (it should be listed just as 'Cube' since we are using Blender's default cube.

Step 4: Under *Influence* check '*Density*' and leave it *at1.000* (Emission should be automatically checked, too).

Now you should be able to render single frame. You can choose to color your smoke as well, by turning ***Emission Color*** **back on**.

Title- Img 3. 22Finished Result.

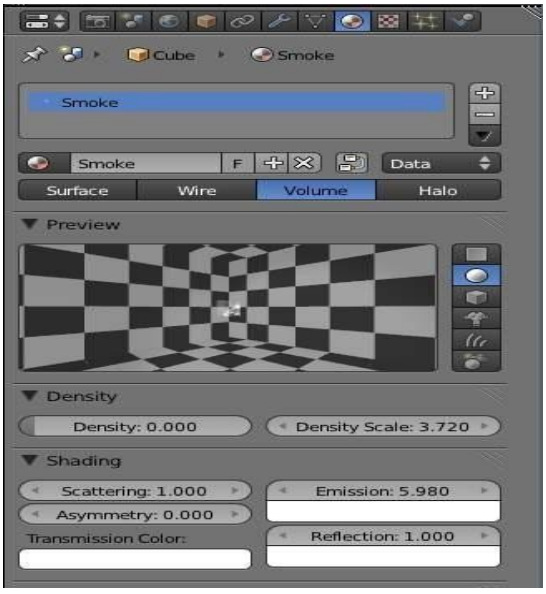
Source-blender.org

Link-

https://docs.blender.org/manual/en/dev/render/blender_render/materials/special_effects/volume.html?highlight=activation%20volume%20rendering

Smoke Simulator with fire texture

You can also **turn your smoke into fire** with another texture!



Title- Img 3. 23 The Fire Material.

Source-blender.org Link-

https://docs.blender.org/manual/en/dev/render/blender_render/materials/special_effects/volume.html?highlight=activation%20volume%20rendering

To make fire,

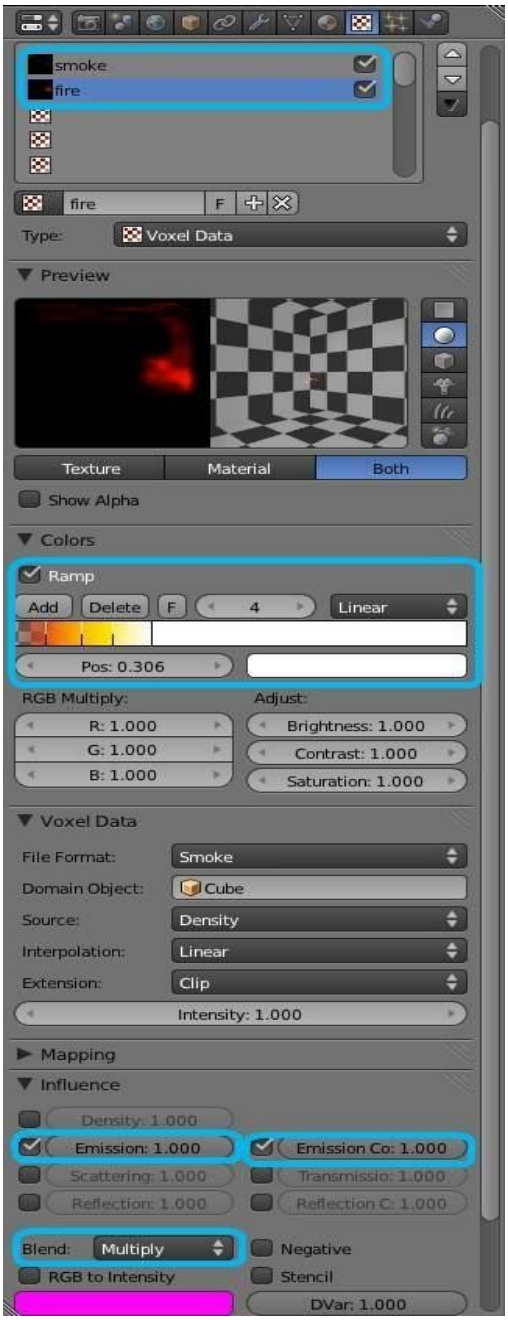
Step 1: Turn up the **Emission Value** in the **Materials panel**

Step 2: Add another texture (Keep the old texture or the smoke will not show)

Step 3: Give it a fiery color ramp, which colors are based on the alpha

Step 4: Change the influence on Emission and Emission color

Step 5: Change the blend to Multiply

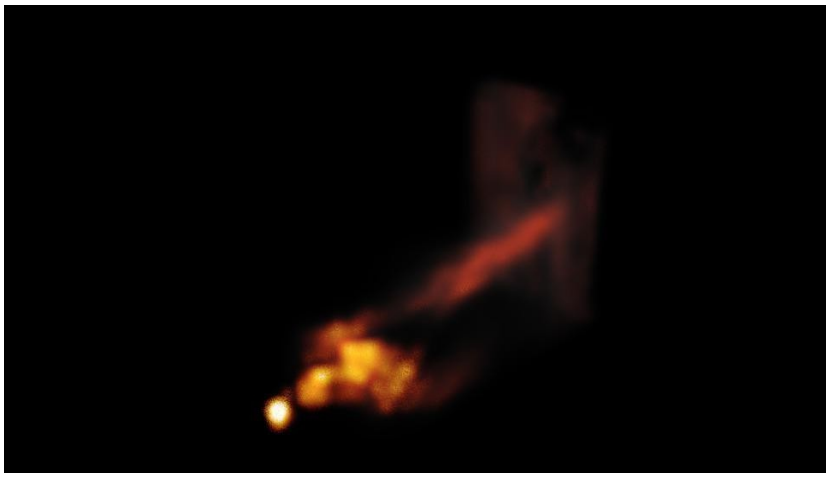


Title- Img 3. 24 The fire texture settings.

Source-blender.org

Link-

https://docs.blender.org/manual/en/dev/render/blender_render/materials/special_effects/volume.html?highlight=activation%20volume%20rendering



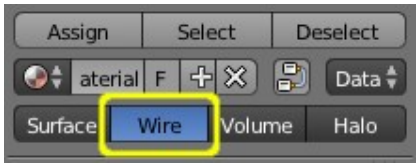
Title- Img 3. 25 The fire render.

Source blender.org

Link-

https://docs.blender.org/manual/en/dev/render/blender_render/materials/special_effects/volume.html?highlight=activation%20volume%20rendering

Wire Render



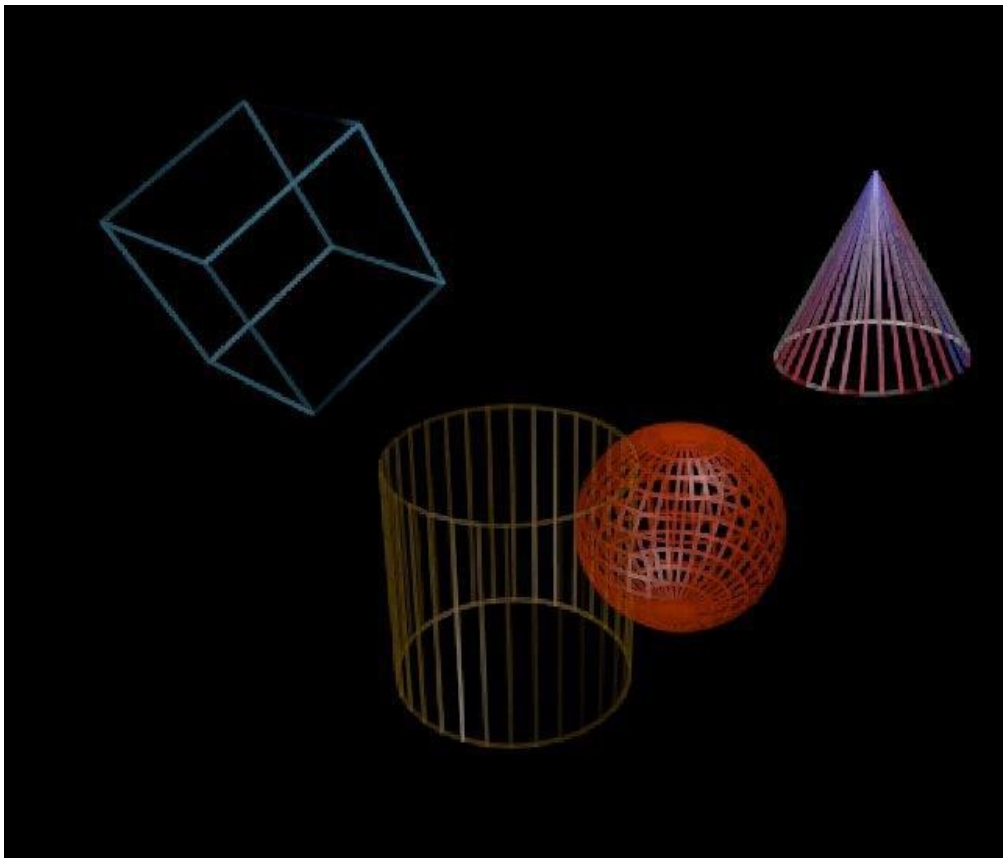
Title-Img 3. 26Wire Render.

Attribution- Source-blender.org

Link-

https://docs.blender.org/manual/en/dev/render/blender_render/materials/special_effects/wire.html?highlight=wire%20render

The Wire Render option in the Materials section provides a way of showing a rendered mage of the edges in an object. Each edge is rendered as a single-pixel image of the edges which make up the mesh. The colors, alpha and other relevant properties of the lines are selected with the same control panels as provided by the Surface rendered image.



Title-Img 3. 27 Wire Render.

Source-blender.org **Link-**
https://docs.blender.org/manual/en/dev/render/blender_render/materials/special_effects/wire.html?highlight=wire%20render

Unit summary

In this Unit, you have learnt how to

- Use **Special Effects Materials**
- Create **Add-on effects** to your 3D Objects like create Glow, Halo, Streaks Lens flare and blurs
- Create **Photorealistic effects** to your 3D Scene, also known as **Post render effects** in many other applications.
- Use **Integrating effects** such as Halo texturing, Volume rendering by using lights
- Create fire, smoke and transparency in your 3D Project
- Create Special render style using Wire Render

After learning of this Unit, you can download the Open Source Software available on the internet for free of cost to practice the possibilities of creating Materials.

Assignment

Create a **Simple Study Room** with few objects like Chair and Study Tables in the corner of the room along with a Table Lamp, few books, pencils, pens beside and assign Normal Shaders and Special Shaders to the scene.

Use these key words **"Study room"**, **"3D Volume light effects"** on https://www.google.com to collect the reference images to build your shading scene.

Assessment

- Write down the steps to create Stars in Halo Effects
- Explain the process of making a Lens Flare
- Describe Halo Textures with examples
- Write the use of Volume Rendering
- Explain Light Scattering in Volume Render
- Explain the process of creating Fire and Smoke using Volume Render
- State how to use Wire Render
- Define Reflection and Refraction in Scattering of Volume Materials.

Resources

While studying this course, you can browse the internet links for video tutorials and to download the relevant texture maps to assign on the objects that you have created and use the same for your assignments.

Links to Download Open Projects

The iconic Blender Institute Open Movies. Featuring all the production files, assets, artwork, and never-seen-before content.

https://cloud.blender.org/open-projects

- wiki.blender.org
- archive.org
- www.blender.org
- docs.blender.org

BCADES-304

3D ILLUSION-1

Block – III: 3D Animation & Rigging (Practical)

Unit 1 Introduction to Texture-1

Introduction

In Computer Graphics Imaginary (CGI), **Texture Mapping** is a method to add detail to surfaces by projecting images and patterns onto those surfaces.

The projected images and patterns can be set to affect **not only color**, however, **also specularity**, **reflection**, **transparency**, and even **fake 3-dimensional depth**. Most often, the images and patterns are projected during render time, however, Texture Mapping is also used to **sculpt, paint** and **deform** objects.

In this Unit, you will learn more about **Textures and Mapping**.

Outcomes

Upon completion of this unit you will be able to:

- Create appropriate Textures for 3D Objects
- List the different type of mapping techniques
- Design various blending modes to mix textures with Shaders
- Create more natural effect using Bump, Normal and Displacement mapping techniques
- Organize the maps for various texture types and Procedural mapping for complex 3D scenes

Terminology

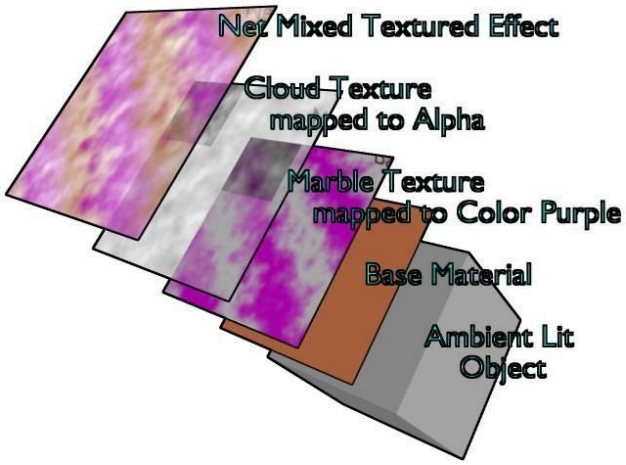
CGI:	Computer Graphics Imaginary
Environment maps:	It take a render of the 3D scene and apply it to a texture, to use for faking reflections.
Hue:	Specifies how the hue rotation of the image. 360° are mapped to (0 to 1). The hue shift of 0 (-180°) and 1 (+180°) have the same result.
Saturation:	A saturation of 0 removes hues from the image, resulting in a grayscale image. A shift greater 1.0 increases saturation.
Value:	Value is the overall brightness of the image. De/Increasing values shift an image darker/lighter.

Factor:	Controls the amount of influence the node exerts on the output image.
Image:	Standard image input.

Properties: The transformations are relative shifts. In the Shader and texture context the following properties are available as input sockets.

Material Textures

The Material settings that you have seen so far produce **smooth, uniform objects**, however, such objects are not particularly true to reality, where uniformity tends to be uncommon and out of place. In order to deal with this unrealistic uniformity, **Blender** allows the user to **apply "textures"** which can modify the reflectivity, specularity, roughness and other surface qualities of a Material.



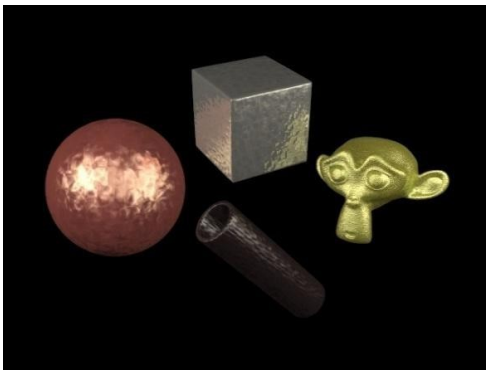
Title-Img 4. 1 Textures Layer on base Material.

Source-blender.org **Link-**
https://docs.blender.org/manual/en/dev/render/blender_render/textures/introduction.html?highlight=textures%20layer%20base%20material

Textures are like additional layers on **top of the base Material**. Textures affect one or more aspects of the **Object's Net Coloring**. The net color you see is a sort of layering of effects, as shown in the example image (Refer Img 4. 1). The layers are:

- **Your Object**, lit with ambient light based on your world settings.
- **Your Base Material**, which colors the whole surface in a uniform color that reacts to light, giving different shades of the diffuse, specular, and mirror colors based on the way light passes through and into the surface of the object.

- **A Primary Texture Layer** that overlays a purple marble coloring.
- **A Second Cloud Texture** that makes the surface transparent in a misty/foggy sort of way by affecting the Alpha value.
- These two textures are mixed with the base Material to provide the net effect: a cube of purplish-brown fog. (**Net Mixed Textured Effect**)



Title-Img 4. 2 Some Metal Textures.

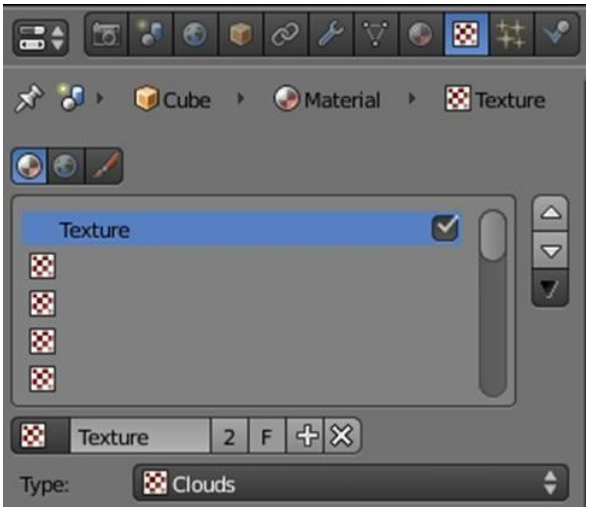
Source-blender.org **Link-**
https://docs.blender.org/manual/en/dev/render/blender_render/textures/introduction.html?highlight=textures%20layer%20base%20material

This notion of using **more than one texture**, to achieve a combined effect, is one of the **"hidden secrets"** of creating realistic-looking objects. If you carefully "look at the light" while examining any real-life object, you will observe that the final appearance of that object is best described as the combination, in different ways and in different amounts, of several distinct underlying visual characteristics. These characteristics might be more (or less) **strongly apparent** at different angles, under different lighting conditions, and so forth. **Blender allows you to achieve** this in many ways.

You can use "**a stack of texture layers**" as described in this Unit, or you can also use arbitrarily-complex networks of "**texture nodes**" as discussed here.

Texture Panel

In the **Properties Editor**, choose the **Texture Tab**: this will show the **Texture Panel**.



Title-Img 4. 3 Texture Panel.

Source-blender.org **Link-**

https://docs.blender.org/manual/en/dev/render/blender_render/textures/introduction.html?highlight=textures%20layer%20base%20material

Texture Context The radio button selects the texture data type, that is, the kind of texture that is being edited.

World

World Background.

Material/Lamp

Material type is described in the following section. Lamps Textures in the lightning section. **Brush**

Brush textures are applied in Painting & Sculpting.

Textures Stack Active Texture

The Texture slots are displayed in a List Views & Presets. The order in the stack defines how textures are overlayed in the rendered image. The checkbox enables/disables the selected texture.

Texture Data-Block Texture

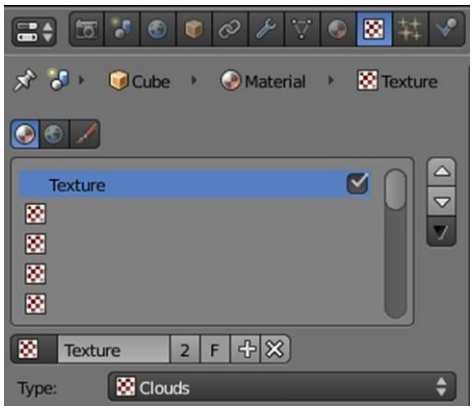
The Texture Data-Block Menu for the selected texture slot.

Texture Type

Choose the type of texture that is used for the current texture data-block.These types are described in detail in this Unit.

Assigning a Texture

This page just shows how to add a texture to a slot. The Texture Panel is explained on the previous page.



Title-Img 4. 4 Texture Panel.

Source-blender.org

Link-http://blender-manual-i18n.readthedocs.io/ja/latest/render/blender_render/textures/assigning_a_tex___ture.html

Creating a new Texture Data-Block in a new Texture Slot Step 1:

Select an *empty slot*

Step 2: click on the *Newbutton*. This will do two things:

- It will create a **new texture data-block**.
- Also, it will add **a new slot** in the textures stack.

Creating a new Texture Data-Block in a non-empty slot Step 1:

Select a non-empty slot

Step 2: Click on the *Plus* button. This will do two things:

- It will create a new texture data-block, with a new name, by making a copy of the texture data-block assigned to the selected slot.
- It will assign this new data-block to the selected slot.

Sharing a Texture Data-Block in a non-empty slot

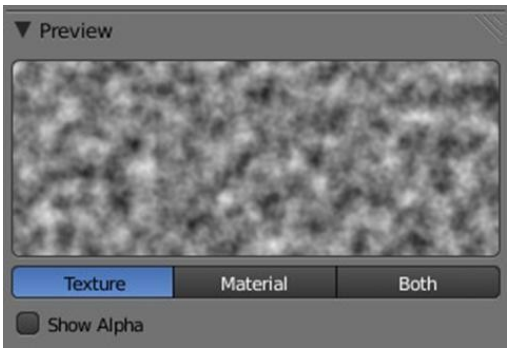
Step 1: Select a non-empty slot

Step 2: Click on the *Browse* button. This will open a menu showing all the available Texture data-blocks in this file.

Step 3: Choose a texture data-block in the menu to assign it to the selected slot.

This will share the chosen texture with more than one object, hence the *Number of users* shown in the texture data-block will **increase by one**.

Texture Properties



Title-Img 4. 5 Texture Preview Panel.

Source-blender.org

Link-http://blender-manual- i18n.readthedocs.io/ja/latest/render/blender_render/textures/options.html?highlight=Texture%20Preview%20Panel

The **Texture Preview Panel** provides a **quick pre-visualization** of how the texture looks on its own, without mapping.

Preview

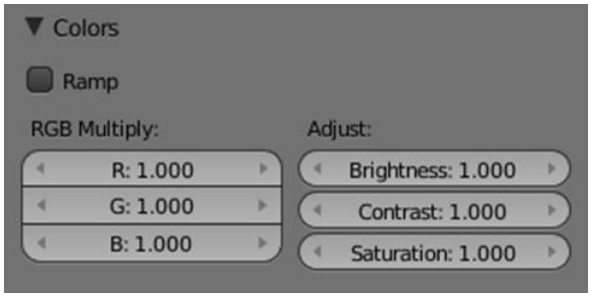
Choose to display only the flat texture, only the Material Preview, or both side-by-side.

Texture, Material/World, Both Show Alpha

Show alpha in preview:

- If Alpha: Use is **checked** in the **Image Sampling Panel**, the image's alpha channel is displayed.
- If Alpha: Use is **unchecked,** an alpha channel based on averaged RGB values is displayed like it would be used by the Alpha slider in the Influence Panel.

Colors



Title-Img 4. 6 Colors Panel.

Source-blender.org

Link-http://blender-manual- i18n.readthedocs.io/ja/latest/render/blender_render/textures/options.html?highlight=Texture%20Preview%20Panel

The ***Ramp* button** activates a color ramp which allows you to remap the colors of a texture to new ones.

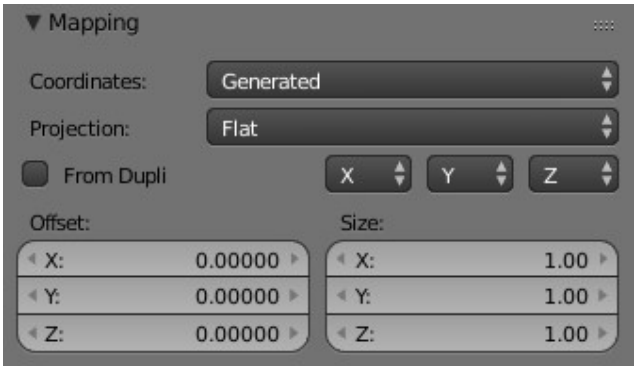
The **color of a texture** can be modified with the ***Brightness, Contrast, and Saturation buttons.*** All textures with RGB-Values, including *Images* and *Environment Maps*, may be modified with the RGB sliders.

R, G, B	Tint the color of a texture by brightening each Red, Green and Blue channel.
Brightness	Change the overall brightness/intensity of the texture.
Contrast	Change the contrast of the texture.
Saturation	Change the saturation of the texture.

Mapping

Textures need mapping coordinates, to determine how they are applied to the object. The mapping specifies how the texture will ultimately wrap itself to the object.

For example, a 2D image texture could be configured to wrap itself around a cylindrical shaped object.



Title-Img 4. 7 Mapping Panel.

Source-blender.org **Link-**

https://docs.blender.org/manual/en/dev/render/blender_render/textures/properties/mapping.html

Coordinates

Mapping works by using a set of coordinates to **guide the mapping process**. These coordinates can come from anywhere, usually the object to which the texture is being applied to.

Global	The scene's global 3D coordinates. This is also **useful for animations**; if you move the object, the texture moves across it. It can be useful for letting objects appear or disappear at a certain position in space.
Object	Uses an object as source for coordinates. Often used with an *Empty*, this is **an easy way to place a small image** at a given point on the object. This object can also be animated, to move a texture around or through a surface.
Object	Select the name of an object.
Generated	The original unreformed coordinates of the object. This is the **default option** for mapping textures.
UV	UV mapping is a very precise way of mapping a **2D texture to a 3D surface**. Each vertex of a mesh has its own UV co-ordinates which can be unwrapped and laid flat like a skin. You can almost think of UV coordinates as a mapping that works on a 2D plane with its own local coordinate system to the plane on which it is operating on. This mapping is especially useful when using 2D images as textures, as seen in UV Mapping. You can use multiple textures with one set of UV coordinates.
Layer	UV layer to use for mapping.
Strand/Particle	Uses normalized 1D strand texture coordinate or particle age (X) and trail position (Y). Use **when texture is applied to hair strands or particles.**
Window	The rendered image window coordinates. This is well suited to blending two objects.
Normal	Uses the direction of the surface's normal vector as coordinates. This is very useful when creating certain special effects that depend on viewing angle.
Reflection	Uses the direction of the reflection vector as coordinates. This is useful for adding reflection maps. You will need this input when Environment Mapping.
Stress	Uses the difference of edge length compared to original coordinates of the mesh. This is useful, for example, when a mesh is deformed by modifiers.
Tangent	Uses the optional tangent vector as texture coordinates.
Flat	

Flat mapping	gives the best results on **single planar faces**. It does produce interesting effects on the sphere, however, compared to a sphere-mapped sphere the result looks flat. On faces that are not in the mapping plane the last pixel of **3D Animation 121** the texture is extended, which produces stripes on the cube and cylinder.
Cube	**Cube Cube mapping** often gives the most **useful results** when the objects are not too curvy and organic (notice the seams on the sphere).
Tube	**Tube mapping** maps the texture around an object like a label on a bottle. The texture is therefore more stretched on the cylinder. This mapping is of course very good for making the label on a bottle or assigning stickers to rounded objects. However, this is not a cylindrical mapping so the ends of the cylinder are undefined.
Sphere	**Sphere mapping** is the best type for mapping a sphere, and it is perfect for making planets and similar objects. It is often very useful for creating organic objects. It also produces interesting effects on a cylinder.

Inheriting coordinates from the parent object

From Dupli

Duplis instance from vertices, faces, or particles, inherit texture coordinates from their parent.

Coordinate Offset, Scaling and Transformation

Offset

The texture co-ordinates can be translated by an offset. Enlarging of the Offset moves the texture towards the top left.

Size

These buttons allow you to change the mapping of axes between the texture's own coordinate system, and the mapping system you choose (Generated, UV, and etcetera.) More precisely, to each axis of the texture corresponds one of four choices that allow you to select to which axis in the mapping system it maps! This implies several points:

- For **2D textures** (such as images), only the first two rows are relevant, as they have no Z data.
- You can **rotate a 2D picture** a quarter turn by setting the first row (i.e. X texture axis) to Y, and the second row (Y texture axis) to X.
- When you map **no texture axis** (i.e. the three "void" buttonsareset), you willgetasoliduniform texture, as you use zero dimension (i.e. a dot, or pixel) of it (and then Blender extends or repeats

this point's color along all axes.)

- When you only **map one texture axis** (i.e. two "void" buttons are enabled) you will get a "striped" texture, as you only use one dimension (i.e. a line of pixel) of it, (and then Blender stretches this line along the two other axes).

- The same goes, for **3D textures** (i.e. procedural ones), when one axis is mapped to nothing, Blender extends the plan ("slice") along therelevant third axis.

Texture Blending Modes

Blending Modes are different methods of controlling how the texture influences Material properties. While a blending mode defines, the specific operation performed, blending factor controls the amount, the **overall "strength"** of this operation. For textures, such blending factor is set via sliders in the **Influence Panel**.
Blend Blending operation to perform.

RGB to Intensity

With this option enabled, an RGB texture (affects color) is used as an intensity texture (affects a value).

Blend Color

If the texture is mapped to Color, what color is blended in according to the intensity of the texture?

Negative

The effect of the Texture is negated. Normally white means on, black means off, Negative reverses that.

Stencil

The active texture is used as a mask for all following textures. This is useful for semitransparent textures and "Dirt Maps". Black sets the pixel to "untexturable". The Stencil mode works similar to a layer mask in a 2D program. The effect of a stencil texture cannot be overridden, only extended. You need an intensity map as input.

Destination Value

The value (not for RGB) with which the Intensity texture blends with the current value. Two

examples:

- The **Emit value** is normally 0. With a texture mapped to Emit you will get maximal effect, because **DVar is 1 by default**. If you set DVar to 0 no texture will have any effect.

- If you want transparent Material, and use a texture mapped to **Alpha**, nothing happens with the default settings, because the Alpha value in the Material Panel is 1. So you have to set **DVar to 0** to get transparent Material (and of course Z Transparency also). This is a common problem for beginners. Or do it the other way round: set **Alpha to 0** and **leave Dvar on 1**. Of course, the texture is used inverted then.

Unit-2 Introduction to Mapping-1

Types of Maps

There are **two types** of Maps.

1. Bump Maps
2. Normal Maps

Bump Maps and Normal Maps both serve the **same purpose**: they simulate the impression of a detailed 3D surface, by modifying the shading as if the surface had **lots of small angles**, rather than being completely flat. Because it is just **modifying the shading** of each pixel, this will not cast any shadows and will not obstruct other objects. If the camera angle is too flat to the surface, you will notice that the surface is not really shaped.

Both Bump Maps and Normal Maps work by **modifying the normal angle** (the direction pointing perpendicular from a face), which influences how a pixel is shaded. Although the terms Bump Map and Normal Map are often used synonymously, there are certain differences.

Bump maps

These are textures that store an intensity, the relative height of pixels from the viewpoint of the camera. The pixels seem to be moved by the required distance in the direction of the face normal. (The"bump" consists **only of a displacement**, which takes place along the existing, and unchanged, normal-vector of the face.) You may either use grayscale pictures or the intensity values of a RGB-Texture (including images).

Normal maps

These are images that store a direction, the direction of normal directly in the **RGB values of an image**. They are much more accurate, as rather than only simulating the pixel being away from the face along a line, they can simulate that pixel being moved at any direction, in an arbitrary way. The **drawbacks** to normal maps are that unlike bump maps, which can easily be **painted by hand**, normal maps usually must be generated in some way, often from higher resolution geometry than the geometry you are applying the map to.

Normal maps in Blender store a normal as follows:

- **Red** maps from (0 - 255) to X (-1.0 - 1.0)
- **Green** maps from (0 - 255) to Y (-1.0 - 1.0)
- **Blue** maps from (0 - 255) to Z (0.0 - 1.0)

Since normal all points towards a viewer, negative Z-values are not stored (they would be invisible

anyway). In Blender, we store a full blue range, although some other implementations also map **blue colors** (128 - 255) to (0.0 - 1.0). The latter convention is used in "**Doom 3**" for example.

Workflow

The steps involved in making and using Bump and Normal Maps are:

Step 1: Model a highly detailed ("hi-poly") model.

Step 2: Bake the Bump and/or Normal maps.

Step 3: Make a low-poly, less detailed model.

Step 4: Map the map to the low-poly model using a common coordinate system.

Consult the **Modeling** section for how to model a highly detailed model using the Mesh tools. How much detail you put in is totally up to you. The more ridges and details (knobs, creases, protrusions) you put in, the more detailed your map will be. **(Step 1)**

Baking a map, simply put, is to take the detail of a high polygon mesh, and apply it to a similar object. The similar object is identical to the high-poly mesh except with less vertices. Use the Render Bake feature in Blender to accomplish this. **(Step 2)**

Modeling a low-poly using Blender's Mesh editing tools. In general, the same or similar faces should exist that reflect the model. For example, a highly detailed ear may have 1000 faces in the high-poly model. In the low-poly model, this may be replaced with a single plane, oriented in the same direction as the detailed earmesh.(Tip: Blender's multi-resolution mesh modeling feature can be used to good effect here.) **(Step 3)**

Mapping is the process of applying a texture to the low-poly mesh. Consult the Textures Mapping section for more information on applying a texture to a mesh's Material. Special considerations for Bump and Normal Maps is: **(Step 4)**

- When using a **Bump map,** map the texture to Normal and enable No RGB.
- When using a **Normal map**, map the texture to Normal.

The coordinate systems of the two objects must match. For example, if you bake using a UV map of the high-poly model, you must UV map the low poly model and line up its UV coordinates to match the outline of the high-poly image.

Displacement Maps

Displacement mapping allows a texture input to manipulate **the position of vertices** on rendered geometry. Unlike Normal or Bump mapping, where the shading is distorted to give an illusion of a bump (discussed on the previous page), Displacement Maps create **real bumps, creases, ridges, etc in the actual**

mesh. Thus, the mesh deformations can cast shadows, occlude other objects, and do everything that changes in real geometry can do, however,, on the other hand, requires **a lot more vertices** to work.

Options

In the Influence Panel, the strength of the displacement is controlled by the
Displace and Normal sliders:

- If a texture provides only **normal information** (e.g. Stucci), vertices move according to the texture's normal data. The normal displacement is controlled by the **Normal slider**.
- If a texture provides only **intensity information** (e.g. Magic, derived from color), vertices move along the directions of their normal (a vertex has no normal itself, it is the resulting vector of the adjacent faces). White pixels move outward in the direction of the normal, black pixels move in the opposite direction. The amount of displacement is controlled with the **Displace slider**.

The two modes are not exclusive. Many texture types provide both information (Clouds, Wood, Marble, and Image). The amount of each type can be mixed using the respective sliders. **Intensity displacement** gives a smoother, more continuous surface, since the vertices are displaced only outward. **Normal displacement** gives a more aggregated surface, since the vertices are displaced in multiple directions.

The depth of the displacement is scaled with an **object's scale**, however, not with the relative size of the data. This means if you **double the size** of an object in object mode, the **depth** of the displacement is also doubled, so the relative displacement appears the same. If you scale inside **Edit Mode**, the displacement depth is not changed, and thus the relative depth appears smaller.

Subdivision Surface Meshes

Rendered face size is controlled with render subdivision level. Displacement really likes smooth normal.

Manually (Edit Mode) subdivided meshes

Control render faces with number of subdivides. (This can be combined with the above methods). Displaces exactly the same Simple Subdivision Surface, however, the overhead of drawing extra faces can slow down editing.

Meta Objects

Control render faces with render wire size. Small wire == more faces.

The following are available, however, currently do not work well. It is recommended that you

convert these to meshes before rendering.

Open NURBS Surfaces

Control render faces with U/V Surface Resolution. Higher numbers give more faces. (Note normal errors).

Closed NURBS Surfaces

Control with Surface Resolution controls. (Note the normal errors, and how implicit seam shows).

Curves and Text

Control with Surface Resolution controls. Higher gives more render faces. (Note that the large flat surfaces have few render faces to displace).

Texture Types

The term ***Image Texture*** simply means that a graphic image, which is a **pixel grid** composed of R, G, B, and sometimes Alpha values. It is used as the input source to the texture. As with other types of textures, this information can be used in a number of ways, not only as a simple "decal".

Video textures are some kind of Image textures and based on **movie file** or sequence of successive numbered separate images. They are added in the same way that image textures are.

When the Texture Type *Image or Movie* is selected, **three new Panels** present themselves allowing to control most aspects of how image textures are applied:

1. *Image*,
2. *Image Sampling*, and
3. *Image Mapping*.

UV Textures vs. Procedural Textures

A **Material Texture**, that has a Map Input of UV, and is an image texture that is mapped to Color, is equivalent to a UV Texture. It provides much **more flexibility**, because it can be sized and offset, and the degree to which it affects the color of your object can be controlled in the Map To Panel. In addition, you can have **different images** for each texture channel; one for color, one for alpha, one for normals, one for specularity, one for reflectivity, *etc.*

Procedural textures, like Clouds, are incredibly simple and useful for adding ***realism and details to an image***.

UV Texture **Procedural Texture**

Image maps to precise coordinates on the **selected faces of the mesh.**	Pattern is generated dynamically, and is mapped to the **entire mesh** (or portion covered by that Material).
Image maps once to a range of mesh faces **specifically selected.**	Maps once to all the faces to which that Material is assigned; either the **whole mesh** or a portion.
Image is mapped **once** to faces.	Size XYZ in the Map Input allows tiling the texture **many times** across faces. Number of times depends on size of mesh.
Affect the **color and The alpha** of the object.	Can also affect normal (bumpiness), reflectivity, emit, displacement, and a dozen other aspects of the mesh's appearance; can even **warp or stencil** subsequent textures.
Can have **many** for a mesh.	Can be layered, **up to 10** textures can be applied, layering on one another. Many mix methods for mixing multiple channels together.
Any Image type (still, video, rendered). Generated test grid available.	Many different types: clouds, wood grain, marble, noise, and even magic.
Provides the UV layout for **animated textures**.	**Noise** is the only animated procedural texture.
Takes very **limited** graphics memory	Uses **no or little** memory; instead uses CPU compute power.

So, in a sense, a single UV texture for a mesh is simpler, however, more limited than using multiple textures (mapped to UV coordinates), because they do one specific thing very well: adding image details to a range of faces of a mesh. They work together if the procedural texture maps to the UV coordinates specified in your layout.

As discussed earlier, you can map **multiple UV textures to different images** using the UV Coordinate mapping system in the Map Input Panel.

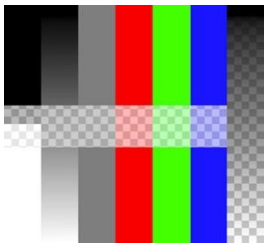
Options

Image

In the *Image* Panel, we tell Blender which source file to use.

Image Sampling

In the *Image Sampling* Panel, we can control how the information is retrieved from the image.

	
Background image.	Foreground image.

Title-Img 4. 8 Image Sampling

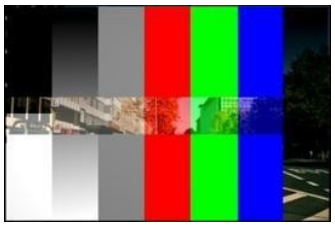
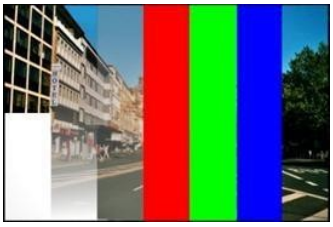
Source-blender.org **Link-**

https://docs.blender.org/manual/en/dev/render/blender_render/textures/type s/image/options.html

The two images presented here are used to demonstrate the different image options.

- ***Background image*** is an ordinary JPG-file,
- ***Foreground image*** is a PNG-file with various alpha and grayscale values.

The vertical bar on the right side of the foreground image is an **Alpha blend**, the horizontal bar has **50% alpha**.

 Foreground image with Use alpha. The alpha values of the pixels are evaluated.	 Foreground image with Calculate alpha.

Title-Img 4. 9 Image Sampling

Source-blender.org **Link-**

https://docs.blender.org/manual/en/dev/render/blender_render/textures/type s/image/options.html

Alpha

Options related to transparency.

Use

Works with PNG and TGA files since they can save transparency information (Foreground Image with Use Alpha). Where the alpha value in the image is less than 1.0, the object will be partially transparent and stuff behind it will show.

Calculate

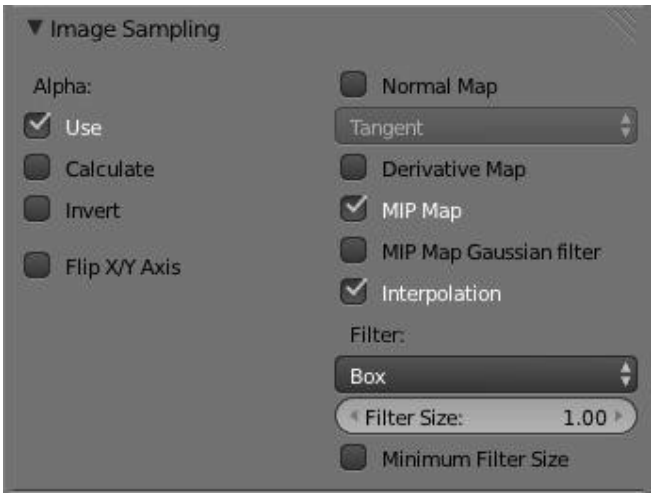
Calculate an alpha based on the RGB values of the Image. **Black (0, 0, 0)** is transparent, **white (1, 1, 1**) opaque. Enable this option if the image texture is a mask. Note that mask images can use shades of gray that translate to semi- transparency, like ghosts, flames, and smoke/fog.

Invert

Reverses the alpha value. Use this option if the mask image has white where you want it transparent and vice-versa.

Flip X/Y Axis

Rotates the image **90 degrees**counterclockwise when rendered.



Title-Img 4. 10 Image Sampling Panel

Source-blender.org **Link-**

https://docs.blender.org/manual/en/dev/render/blender_render/textures/type s/image/options.html

Normal Map

This tells Blender that the image is to be used to create the illusion of a bumpy surface, with each of the three RGB channels controlling how to fake a shadow from a surface irregularity. Needs specially prepared input pictures.

Derivative Map

Use red and green as derivative values.

MIP Map

MIP Maps are pre-calculated, smaller, filtered Textures for a certain size. A series of pictures is generated, each half the size of the former one. This optimizes the **filtering process**. By default, this option is enabled and speeds up rendering (especially useful in the Game Engine). When this option is OFF, you generally get a **sharper image**, however, this can significantly increase calculation time if the filter dimension (see below) becomes large. Without MIP Maps, you may get varying pictures from slightly different camera angles, when the Textures become very small. This would be noticeable in an animation.

MIP Map Gaussian filter

Used in conjunction with MIP Map, it enables the MIP Map to be made smaller based on color similarities. In the Game Engine, you want your textures, especially your MIP Map textures, to be as small as possible to increase rendering speed and frame rate.

Interpolation

This option interpolates the pixels of an image. This becomes visible when you enlarge the picture.

By default, this option is on. Turn this option off to keep the individual pixels visible and if they are correctly anti-aliased. This last feature is useful for regular patterns, such as lines and tiles; they remain 'sharp' even when enlarged considerably. When you enlarge this **10×10 pixel** Image the difference with and without Interpolation is clearly visible. Turn this image off if you are using digital photos to preserve crispness.

Enlarged Image texture without and with Interpolation	
	

Title-Img 4. 11Enlarged Image texture without and with *Interpolation*

Source-blender.org **Link-**

https://docs.blender.org/manual/en/dev/render/blender_render/textures/type s/image/options.html

Filter

The filter size used in rendering, and also by the options ***MipMap*** and ***Interpolation***. If you notice gray lines or outlines around the textured object, particularly where the image is transparent, turn this value down from **1.0 to 0.1** or so.

Texture Filter Type

Texture filter to use for **image sampling**. Just like a ***pixel***represents a *pic*ture *el*ement, a ***texel***represents a *tex*ture *el*ement. When a texture (2D texture space) is mapped onto a 3D model (3D model space), different algorithms can be used to compute a value for each pixel based on samplings from several texels.

Box

A fast and simple nearest-neighbor interpolation known as Monte Carlo integration

EWA (Elliptical Weighted Average)

One of the most efficient direct convolution algorithms developed by **Paul Heckbert** and **Ned Greene in the 1980s**. For each Texel, EWA samples, weights, and accumulates texels within an elliptical footprint and then divides the result by the sum of the weights.

Eccentricity

Maximum Eccentricity. Higher values give less blur at distant/oblique angles, however, is slower

FELINE (Fast Elliptical Lines)

Uses several isotropic probes at several points along a line in texture space to produce an anisotropic filter to reduce aliasing artifacts without considerably increasing rendering time.

Probes

Number of probes to use. An integer between **1 and 256**. Further reading: **McCormack, J; Farkas, KI; Perry, R; Jouppi, NP (1999)** Simple and Table Feline: Fast Elliptical Lines for Anisotropic Texture Mapping, WRL

Area

Area filter to use for image sampling.

Eccentricity

Maximum Eccentricity. Higher values give less blur at distant/oblique angles, however, is slower.

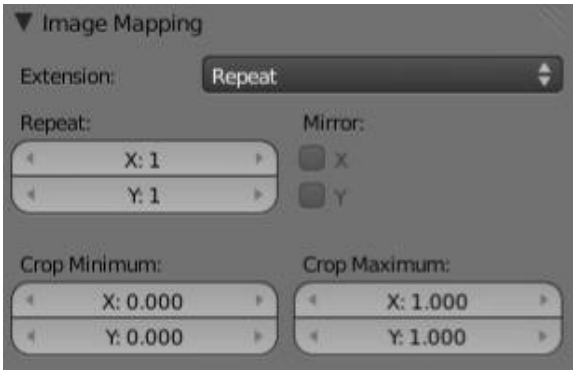
Filter Size

The filter size used by MIP Map and Interpolation.

Minimum Filter Size

Use Filter Size as a minimal filter value in pixels.

Image Mapping



Title-Img 4. 12Image Mapping Panel

Source-blender.org **Link-**

https://docs.blender.org/manual/en/dev/render/blender_render/textures/type s/image/options.html

Extend

In the *Image Mapping*Panel, we can control how the image is **mapped or projected** onto the 3D model

Extension

Outside the image the colors of the edges are extended.

Clip

Clip to image size and set exterior pixels as transparent. Outside the image, an alpha value of 0.0 is returned. This allows you to 'paste' a small logo on a large object.

Clip Cube

Clips to cubic-shaped area around the images and sets exterior pixels as transparent. The same as Clip, however, nowthe**'Z' coordinate** is calculated as well. An alpha **value of 0.0** is returned outside a cube-shaped area around the image.

Repeat

The image is repeated horizontally and vertically.

Mirror

Mirror on X/Y axes. This buttons allow you to map the texture as a mirror, or automatic flip of the image, in the corresponding X and/or Y direction.

Checker

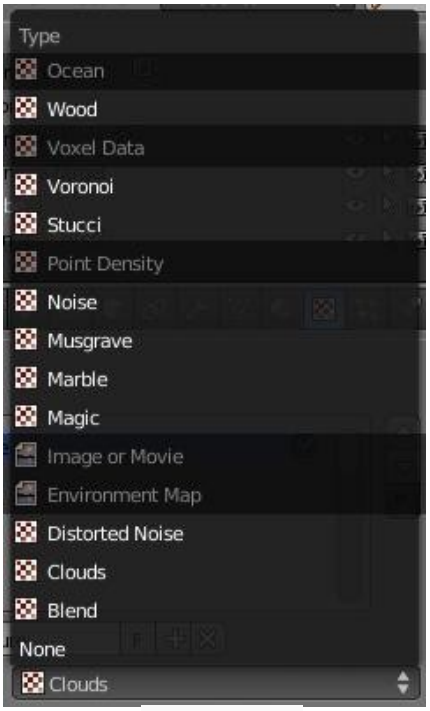
Checkerboards quickly made. You can use the option size on the Mapping Panel as well to create the desired number of checkers **Even / Odd** *Set even/odd tiles*

Distance

Governs the distance between the checkers in parts of the texture size.

Crop Minimum / Crop Maximum

The offset and the size of the texture in relation to the texture space. Pixels outside this space are ignored. Use these to crop, or choose a portion of a larger image to use as the texture.Procedural Textures



Title-Img 4. 13Texture type list

Source-blender.org **Link-**

https://docs.blender.org/manual/en/dev/render/blender_render/textures/type s/procedural/introduction.html

The Texture Type list in the Texture Panel of the Texture buttons. (Non-procedural textures darkened out)

Procedural textures are textures that are defined mathematically. They are generally relatively simple to use, because they do not need to be mapped in a special way. This does not mean that procedural textures cannot become very complex.

These types of textures are **'real' 3D**. By that, we mean that they fit together perfectly at the edges and continue to look like what they are meant to look like even when they are cut; as if a block of wood had really been cut in two. **Procedural textures** are not filtered or anti-aliased. This is hardly ever a problem: the user can **easily keep** the specified frequencies within acceptable limits.

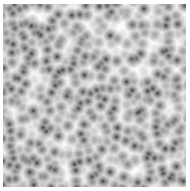
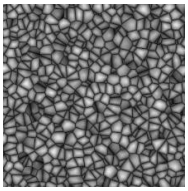
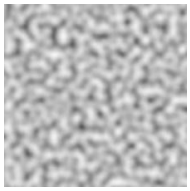
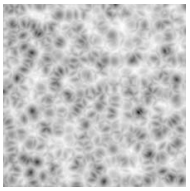
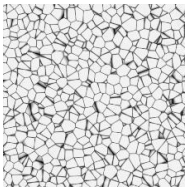
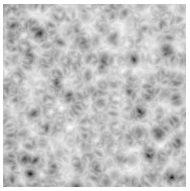
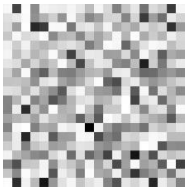
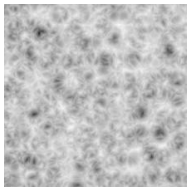
Common options

Noise Basis

Each noise-based Blender texture (with the exception of Voronoi and simple noise) has a Noise Basis setting that allows the user **to select which algorithm is used** to generate the texture. This list includes the original Blender noise algorithm. The Noise Basis settings makes the procedural

textures **extremely flexible** (especially **Musgrave**).

The Noise Basis governs the structural appearance of the texture:

 Blender Original .	 Voronoi F1.	 Voronoi F2-F1.
 Original Perlin.	 Voronoi F2.	 Voronoi Crackle .
 Improved Perlin.	 Voronoi F3.	 Cell Noise.
 Voronoi F4.		

Title-Img 4. 14Noise basis

Source-blender.org **Link-**

https://docs.blender.org/manual/en/dev/render/blender_render/textures/type s/procedural/introduction.html

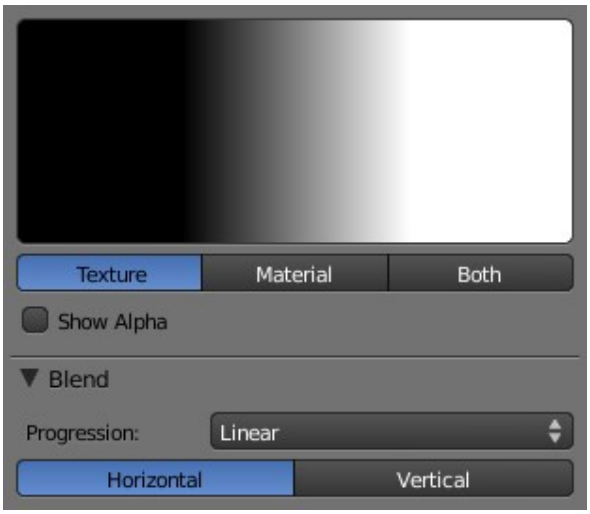
There are two more possible settings for Noise Basis, which are relatively similar to Blender **Original: Improved Perlin**and **Original Perlin**.

Nabla

Almost all procedural textures in Blender use derivatives for **calculating normal** for

Texture Mapping (with an exception Blend and Magic). This is important for Normal and Displacement Maps. The strength of the effect is controlled with the Nabla Number button.

Blend



Title-Img 4. 8 Blend Texture Panels.

Source-blender.org **Link-**
https://docs.blender.org/manual/en/dev/render/blender_render/textures/types/procedural/blend.html?highlight=blend%20texture%20panels

Often used for

This is one of the **most frequently used procedural textures**. You can use blend textures to blend other textures together (with Stencil), or to create nice effects (especially with the Mapping: Normal trick).

Note

Remember that if you use a ramp to create a custom blending, you may have to use
No RGB, if the Mapping value needs an intensity input.

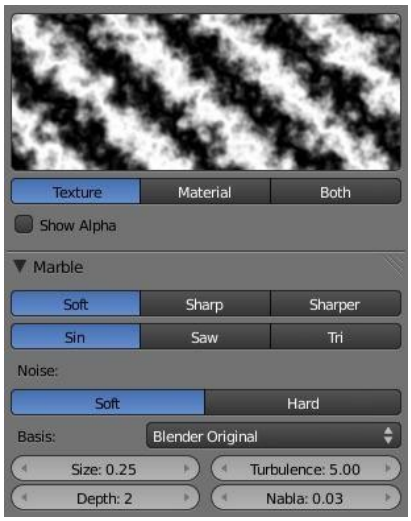
Result(s)Intensity.

The Blend texture generates a smoothly interpolated progression.

Options

Progression	Profile of blend.
Easing	A flowing, non-linear progression.
Spherical	A progression with the shape of a three-dimensional ball.
Quadratic Sphere	A quadratic progression with the shape of a three-dimensional ball.

Radial	A radial progression: Horizontal / Vertical. The direction of the progression is flipped a quarter turn.



Title-Img 4. 9 Marble Texture Panels.

Marble

Source-blender.org **Link-**

https://docs.blender.org/manual/en/dev/render/blender_render/textures/types/procedural/marble.html?highlight=marble%20texture%20panels

- **Often used for**
  Marble, Fire, Noise with a structure.
- **Result(s)**

Intensity value only. *Bands are generated based on the sine, saw, or triangular formula and noise turbulence.*
Bands are generated based on the sine, saw, or triangular formula and noise turbulence.

Options

Marble

Type

Three settings for soft to more clearly defined Marble.

Soft, Sharp, Sharper

Noise basis

Shape of wave to produce bands.

Sine, Saw, Triangle

Noise Type

The noise function works with two methods.

Soft, Hard

Size

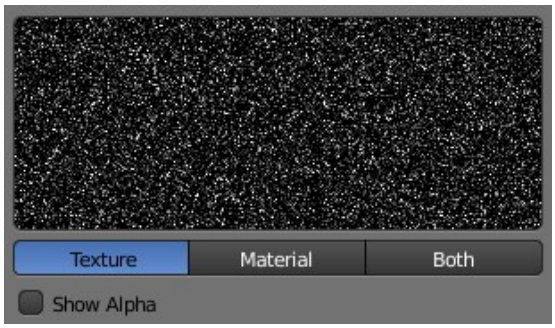
The dimensions of the noise table

Depth

The depth of the Marble calculation. A higher value results in greater calculation time, however, also in finer details.

Turbulence

The turbulence of the sine bands.



Title-Img 4. 10 Noise Texture Panel.

Noise

Source-blender.org **Link-**

https://docs.blender.org/manual/en/dev/render/blender_render/textures/type s/procedural/noise.html

Although this looks great, it is **not Perlin Noise**! This is a true, randomly generated Noise. This gives a different result every time, for every frame, for every pixel.

Options

*There are **no options** for this noise.*

- *Often used for*

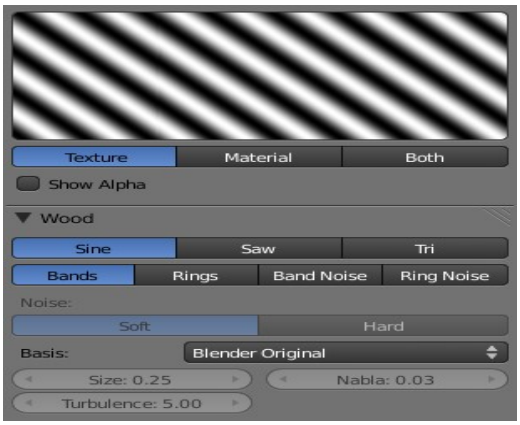
White noise in an animation. This is not well suited if you do not want an

animation. For Material displacement or bump, use clouds instead.

- *Result(s)*

  Intensity.

Wood



Title-Img 4. 11 Wood Texture Panels.

Source-blender.org **Link-**
https://docs.blender.org/manual/en/dev/render/blender_render/textures/types/procedural/wood.html?highlight=wood%20texture%20panels

- **Often used for**

  Woods and ring-shaped patterns.

- **Result(s)**

  Intensity only.

Options

Noise Basis	Shape of wave to produce bands Sine, Saw, Triangle
Wood Type	Set the bands to either straight or ring-shaped, with or without turbulence. Bands, Rings, Band Noise, Ring Noise
Noise Type	There are two methods available for the Noise function Soft, Hard
Size	Dimension of the Noise table
Turbulence	Turbulence of the Band Noise and Ring Noise types

Environment Maps

Environment maps take a **render of the 3D scene** and apply it to a texture, to use for **faking reflections.** If you want to achieve a very realistic result, raytraced reflections are a good solution. Environment Maps are another way **to create reflective surfaces**, however, they are not so simple to set up.

So why should one use Environment Maps?

- The main reason is probably that they can be much **faster than raytracing** reflections. In certain situation, they need to be calculated only once, and may be reused like any ordinary texture. You may **even modify** the precalculated Environment Map in an image editor.

- Environment maps can also be **blurred** and render **even faster**, because the resolution can then be lowered. Blurring a reflection with the raytracer always adds to the render time, sometimes quite a lot.

- **Halos** (a visualization type for particles) are not visible to raytraced reflections, so you need to setup environment maps to reflect them.

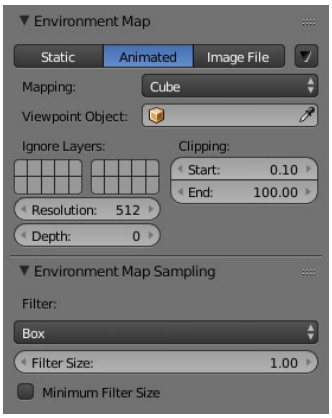
- **Keypoint strands** (another visualization type for particles) are also not visible to raytraced reflections, so you need to setup environment maps to reflect them.

Just as we render the light that reaches the viewing plane using the camera to define a viewpoint, we can render the light that reaches the surface of an object (and hence, the light that might ultimately be reflected to the camera). Blender's environment mapping **renders a cubic image map** of the scene in the six cardinal directions from any point. When the six tiles of the image are mapped onto an object using the Reflection input coordinates, they create the visual complexity that the eye expects to see from shiny reflections.

Options Important

For correct results, the mapping of an environment map texture must be set to Reflection (reflection co-ordinates) in the **Map Input Panel** of the **Material tab.**

Blender allows **three types of environment maps**, as you can see in Img 4.19 Reflecting plane Environment Map settings.:



Title-Img 4. 12 Reflecting plane Environment Map settings.

Source-blender.org **Link-**

https://docs.blender.org/manual/en/dev/render/blender_render/textures/types/environment.html?highlight=reflecting%20plane%20environment%20map%2 0settings

Static

The map is only calculated once during an animation or after loading a file.

Animated

The map is calculated each time a rendering takes place. This means moving Objects are displayed correctly in mirroring surfaces.

Image File

When saved as an image file, environment maps can be loaded from disk. This option allows the fastest rendering with environment maps, and also gives the ability to modify or use the environment map in an external application.

When using **planar reflections**, if the camera is the only moving object and you have a reflecting plane, the Empty must move too and you must use Animated environment map. If the reflecting object is small and the Empty is in its center, the environment map can be **Static**, even if the object itself rotates since the Empty does not move. If, on the other hand, the Object translates the Empty should follow it and the environment map be of Animated type.

Specials

Clear Environment Map

Clears the currently rendered environment map from memory. This is useful to refresh a Static environment maps and you have changed things in your scene since the last time the environment map was rendered. Animated environment maps do this automatically on every render.

Save Environment Map

Saves the currently stored static environment map to disk as an image file. This can be loaded

again with Load.

Clear All Environment Map

Does the same as Free Data, however, with all environment maps in the scene. This is a useful shortcut when using recursive environment maps (when the Depth is greater than 0).

Viewpoint Object

Environment maps are created from the perspective of a specified object. Thelocationofthisobject willdeterminehow'correct' the reflection looks, though different locations are needed for different reflecting surfaces. Usually, **an Empty is used** as this object:

- For **planar reflections**, the object should be in a location mirrored from the camera, on the other side of the plane of reflection (see Examples). This is the most accurate usage of Environment maps.
- For **spherical reflections**, the object should be in the center of the sphere. Generally, if the reflecting sphere's object center point is in the center of its vertices, you can just use the name of the actual sphere object as the Viewpoint Object
- For **irregular reflections**, there is no hard and fast rule, you will probably need to experiment and hope that the inaccuracy does not matter.

Ignore Layers

The layers are **to exclude** from the environment map creation. Since environment maps work by rendering the scene from the location of the Viewpoint Object, you will need to exclude the actual reflecting surface from the environment map, otherwise it will occlude other objects that should be reflected on the surface itself.

Eg. If you are rendering an environment map from the center of a sphere, all the environment map will show by default is the **inside of the sphere**. You will need to move the sphere to a separate layer, then exclude that layer from the environment map render, so that the environment map will show (and hence reflect) all the objects outside the sphere.

Resolution

The resolution of the cubic environment map render. Higher resolutions will give a sharper texture (reflection), however, will be slower to render.

Depth

The number of recursive environment map renders. If there are multiple reflecting objects using environment maps in the scene, some may appear solid, as they will not render each other's reflections. In order to show reflections within reflections, the environment maps need to be made

multiple times, recursively, so that the effects of one environment map can be seen in another environment map. See Examples.

Clipping Start/End

The clipping boundaries of the virtual camera when rendering the environment map. Sets the minimum and maximum distance from the camera that will be visible in the map.

Minimum Filter Size

Use Filter Size as a minimal filter value in pixels.

Examples

In this example, an empty is used as the **Viewpoint Object** of the reflecting plane's environment map. It is located in the specular position of the camera with respect to the reflecting surface. (This is possible, strictly speaking, only for planar reflecting surfaces.)

Environment Map Sampling

Filter Box

Box Filter

EWA

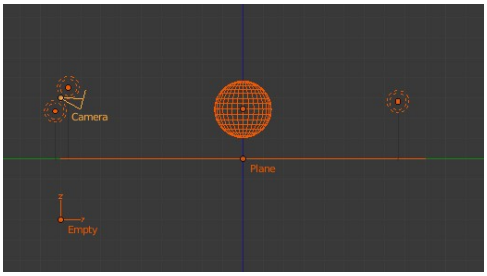
Elliptical Weighted Average. One of the most efficient direct convolution algorithms developed by **Paul Heckbert and Ned Greene in the 1980s.** For each Texel, EWA samples, weights, and accumulates texels within an elliptical footprint and then divides the result by the sum of the weights.

Eccentricity

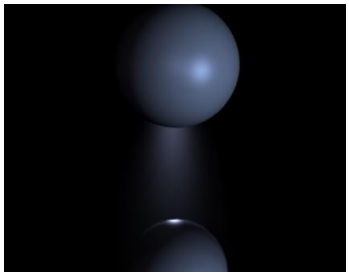
Maximum eccentricity (highergives less blur at distant/oblique angles, however, is also slower)

FELINE

FELINE (Fast Elliptical Lines), uses several isotropic probes at several points along a line in texture space to produce an anisotropic filter to reduce aliasing artifacts without considerably increasing rendering time.



Planar reflection example.



Sphere on a reflecting surface.

Title-Img 4. 13 Reflecting plane Environment Map settings.

Source-blender.org **Link-**

https://docs.blender.org/manual/en/dev/render/blender_render/textures/type s/environment.html

Probes

Maximum number of samples (higher gives less blur at distant/oblique angles, however, is also slower)

Area Eccentricity

Maximum eccentricity (higher gives less blur at distant/oblique angles, however, is also slower)

Filter Size

The amount of blurring applied to the texture. Higher values will blur the environment map to fake blurry reflections.

Minimum Filter Size

Use Filter Size as a minimal filter value in pixels.

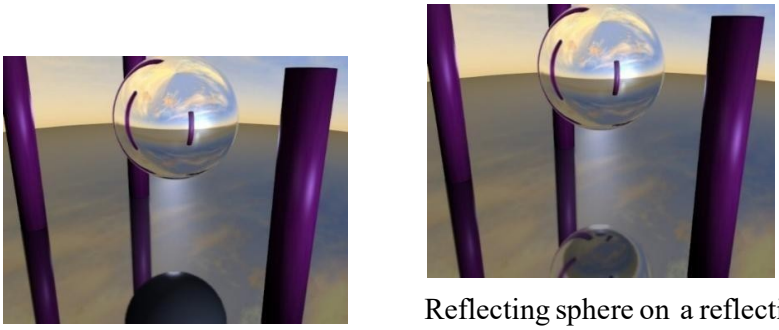
Examples

In this example, an empty is used as the **Viewpoint Object** of the reflecting plane's environment map. It is located in the specular position of the camera with respect to the reflecting surface. (This is possible, strictly speaking, only for planar reflecting surfaces.)

Ideally, the location of the empty **would mirror** the location of the camera across the plane of the polygon onto which it is being mapped.

The following images show the **effect of the Depth**. The first render has depth **set to 0**. This means the environment map on the plane has rendered before the environment map of the sphere, so the

sphere's reflection is not shown. By raising the Depth, the environment map is rendered recursively, in order to get reflections of reflections.



Reflecting sphere on a reflecting surface.

Reflecting sphere on a reflecting surface with multiple reflections.

Title-Img 4. 14 Reflecting sphere

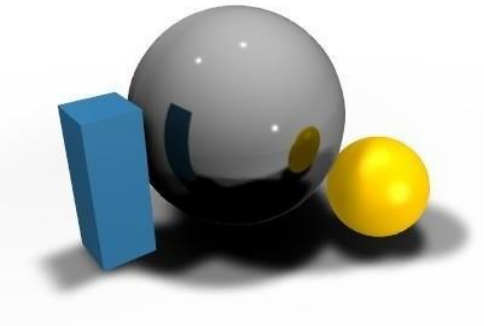
Source-blender.org **Link-**

https://docs.blender.org/manual/en/dev/render/blender_render/textures/type s/environment.html

Limitations

Because environment maps are calculated from the **exact location of the Viewpoint Object's object center**, and not from actual reflecting surface, they can often be inaccurate, especially with spheres. In the following image, the rectangular prism and the smaller spheres are touching the sides of the large reflecting sphere; however, because the environment map is calculated from the center of the sphere, the surrounding objects look **artificially far away**.

Title-Img 4. 15 Inaccurate spherical reflection, the colored objects are artificially offset.



Source-blender.org **Link-**

https://docs.blender.org/manual/en/dev/render/blender_render/textures/type s/environment.html

Introduction to Nodes

In addition to creating Materials as just described using all the settings on all the Materials Panels, Blender allows you to create a Material by routing basic Materials through a **set of nodes.** Each node performs some operation on the Material, changing how it will appear when applied to the mesh, and passes it on to the next node. In this way, **very complex Material** appearances can be achieved.

You should already be familiar with general Material concepts and how to create Materials/textures using the Material menu. You should also have a general understanding of the texture coordinate systems available in Blender (e.g. Generated, UV, etc.). Also, many aspects of a node will be skipped here because in later sections you will see the function expanded upon. Each section builds off the previous.

To start, the node system does not make the Material menu obsolete. Many features and Material settings are still only accessible through the **Material Panel** (e.g. Ray Mirror). However, with the advent of nodes, more complex and fantastic Materials can be created since we now have **greater control**.

Just in case you are not (yet) familiar with the concepts: when you create a system of nodes, you are describing a **data-processing pipeline of sorts**, where data "flows from" nodes which describe various *sources,* "**flows through**" nodes which represent various processing and filtering stages, and finally "**flows into**" nodes which represent outputs or destinations. You can connect the nodes to one another in many different ways, and you can adjust "knobs," or parameters, that control the behavior of each node. This gives you a tremendous amount of creative control. And, it will **very quickly become intuitive**.

Having said all that, let us begin with a **normal Material**.

Here we have the standard Material added to a cube mesh. We could, as we have in the past, add color and other settings to this Material and it would certainly look nice. however, let us say we are just not getting what we are looking for? What if we want to control the creation more tightly or add more complexity? Here is where nodes come in.

Making this **node map** is accomplished by working in a **Node Editor**. This section covers:

- Enabling Material Nodes.
- The Node Editor, its basic controls, and working with nodes.
- The specific types of nodes available for Materials.

Accessing the Node Editor

First, let's enter the node editor and make sure that the node editor has the Material node button (the sphere icon) pressed, not the composite or texture node buttons.

Enabling Node Materials

Let us take the base Material and hit the Nodes button next to the Material name in the Material Panel or the node editor. You will see a change in the Material Panel.

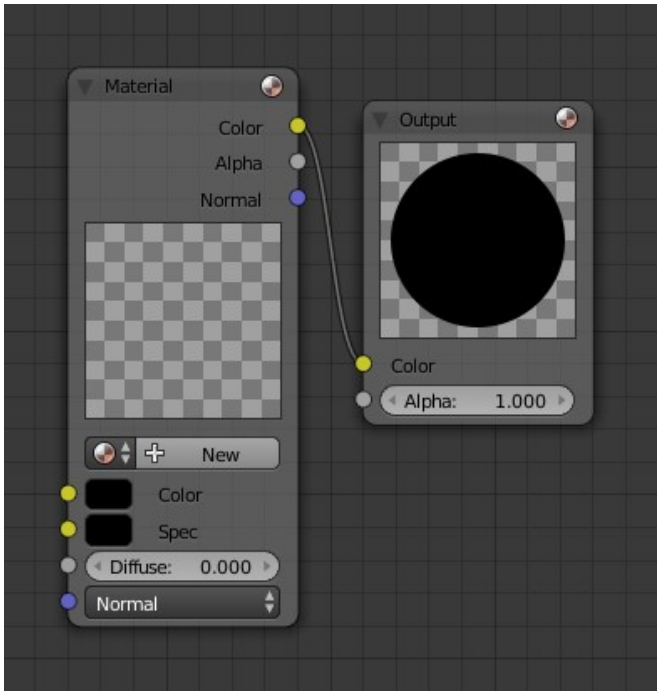
Title-Img 4. 16Use Material nodes button.

Source-blender.org **Link-**

https://docs.blender.org/manual/en/dev/render/blender_render/materials/no des/introduction.html

What you have just done is told Blender to make the Material you were on to become the node tree. Most of the Panels we normally find in the Material menu are now gone.

If you switch to the ***Compositing*** **screen with Ctrl-Left,** if you are on the default screen, you will find a *Node Editor* on the top half of the screen. When you enabled Material nodes, a Material node and an output node were automatically added to the node editor.

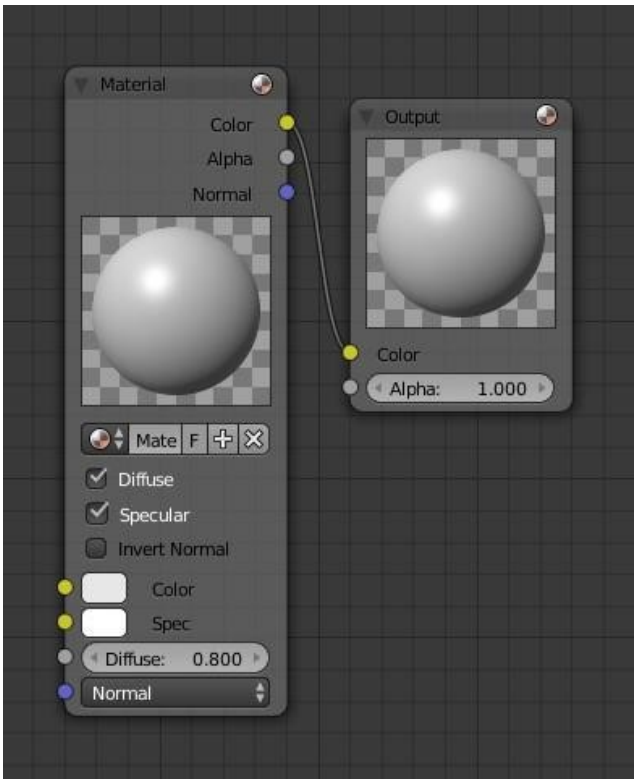


Title-Img 4. 17Default nodes.

Source-blender.org **Link-**

https://docs.blender.org/manual/en/dev/render/blender_render/materials/no des/introduction.html

You can also split the 3D View in the default screen in two and change one into a *Node Editor*. It is important to note that you can add a new Material (which you can edit and change like any other Material in the Material Panel), add an already created Material or append a Material from another blend-file, and also use the Material that you used to create the node tree.



Title-Img 4. 18A first Material added to the node setup.

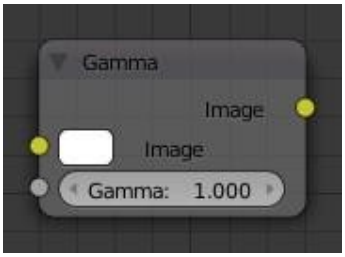
Source-blender.org **Link-**

https://docs.blender.org/manual/en/dev/render/blender_render/materials/no des/introduction.html

Here, we added a new Material in the *Node editor* "**Material.001**", and as we did, we can access the properties of this Material in the Material's menu.

Node Types

Gamma Node



Title-Img 4. 19A first Material added to the node setup.

Source-blender.org **Link-**

https://docs.blender.org/manual/en/dev/render/cycles/nodes/types/color/gamma.html?highlight=gamma%20node

Gamma Node.

Use this node to apply a gamma correction.

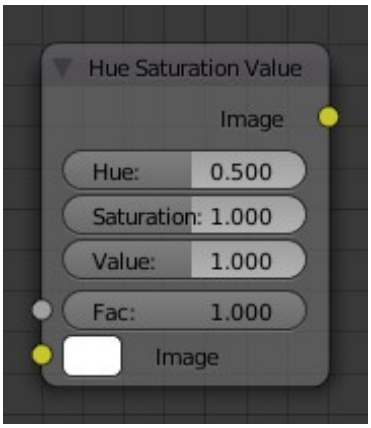
Inputs

Image	Standard image input.
Gamma	An exponential brightness factor.
Properties	This node has no properties.

Outputs

Image	Standard image input.

Examples

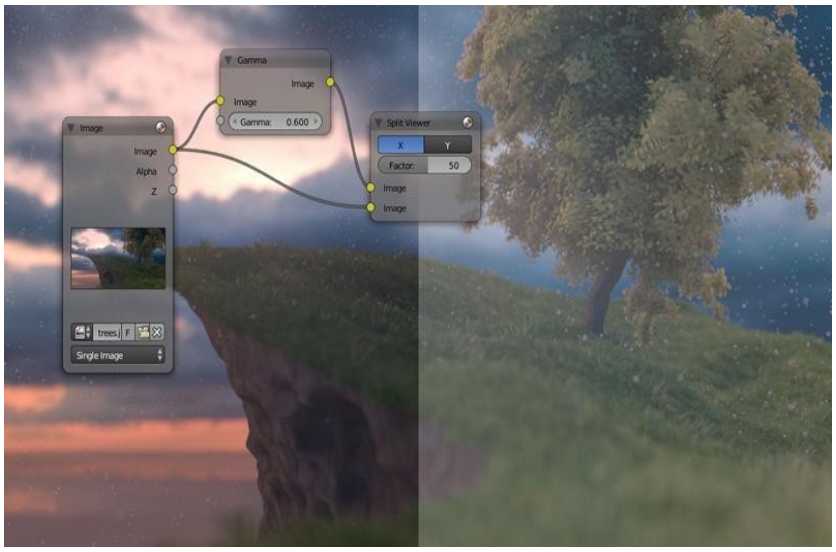


Title-Img 4. 20 Example of Gamma node.

Source-blender.org **Link-**

https://docs.blender.org/manual/en/dev/render/cycles/nodes/types/color/ga mma.html?highlight=gamma%20node

Hue Saturation Value Node



Title-Img 4. 21Hue Saturation Node.

Source-blender.org **Link-**
https://docs.blender.org/manual/en/dev/render/blender_render/materials/nodes/types/color/hue_saturation.html?highlight=saturation%20node

This node applies a color transformation in the **HSV color space**. Called "Hue Saturation Value" in Shader and texture context.

Inputs

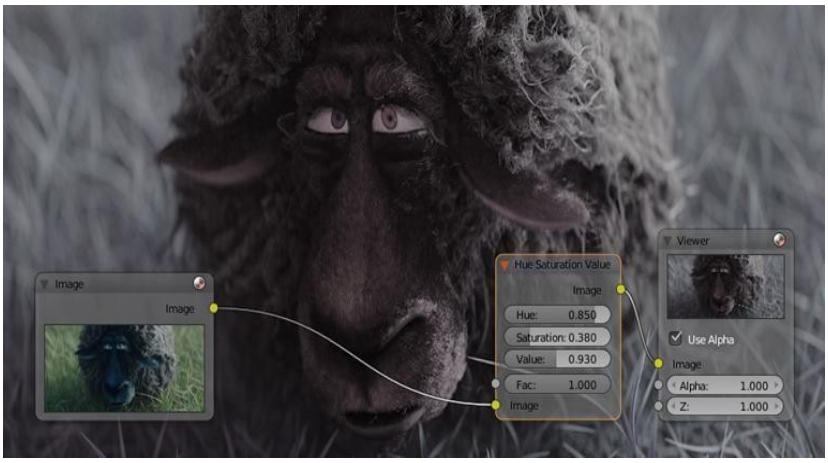
Factor	Controls the amount of influence the node exerts on the output image.
Image	Standard image input.
Properties	The transformations are relative shifts. In the Shader and texture context the following properties are available as input sockets.
Hue	Specifies how the hue rotation of the image. 360° are mapped to (0 to 1). The hue shift of 0 (-180°) and 1 (+180°) have the same result.
Saturation	A saturation of 0 removes hues from the image, resulting in a grayscale image. A shift greater 1.0 increases saturation.
Value	Value is the overall brightness of the image. De/Increasing values shift an image darker/lighter.

Outputs

Image	Standard image output.

Hue/Saturation Tips	Some things to keep in mind that might help you use this node better:
Hues are vice versa	A blue image, with a Hue setting at either end of the spectrum (0 or 1), is output as yellow (recall that white, minus blue, equals yellow). A yellow image, with a Hue setting at 0 or 1, is blue.
Hue and Saturation work together.	So, a Hue of 0.5 keeps the blues the same shade of blue, however, Saturation can deepen or lighten the intensity of that color.
Gray & White are neutral hues	A gray image, where the RGB values are equal, has no hue. Therefore, this node can only affect it with *Value*. This applies to all shades of gray, from black to white; wherever the values are equal.
Changing the effect over time	The Hue and Saturation values can be animated with a *Time Node* or by animating the property.

HSV Example



Title-Img 4. 22 A basic example.

Source-blender.org
Link-
https://docs.blender.org/manual/en/dev/render/blender_render/materials/nodes/types/color/hue_saturation.html?highlight=saturation%20node

Invert Node

Title-Img 4. 23Invert Node.

Source-blender.org **Link-**
https://docs.blender.org/manual/en/dev/compositing/types/color/invert.html? highlight=invert%20node

This node **inverts the colors** in the input image, producing a negative**.**

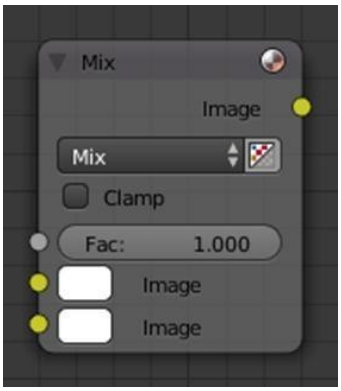
Inputs

Factor	Controls the amount of influence the node exerts on the output image.
Color	Standard image input.
Properties	In the compositing context, this node has the following properties.
RGB	De/activation of the color channel inversion.
Alpha	De/activation of the alpha channel inversion.

Outputs

Color	Standard image output.

Mix Node



Title-Img 4. 24Mix Node

Source-blender.org
Link-
https://docs.blender.org/manual/en/dev/render/blender_render/materials/nodes/types/color/mix_rgb.html?highlight=mix%20node

This node **mixes images** by working on the individual and correspondingpixelsofthetwoinput images.Called"**MixRGB**"in the Shader and texture context.

Inputs

Factor	Controls the amount of influence the node exerts on the output image.
Image	The background image. The image size and resolution sets the dimensions of the output image.
Image	The foreground image.

Properties

Mix	The Blend types could be selected in the select menu. Add, Subtract, Multiply, Screen, Divide, Difference, Darken, Lighten,

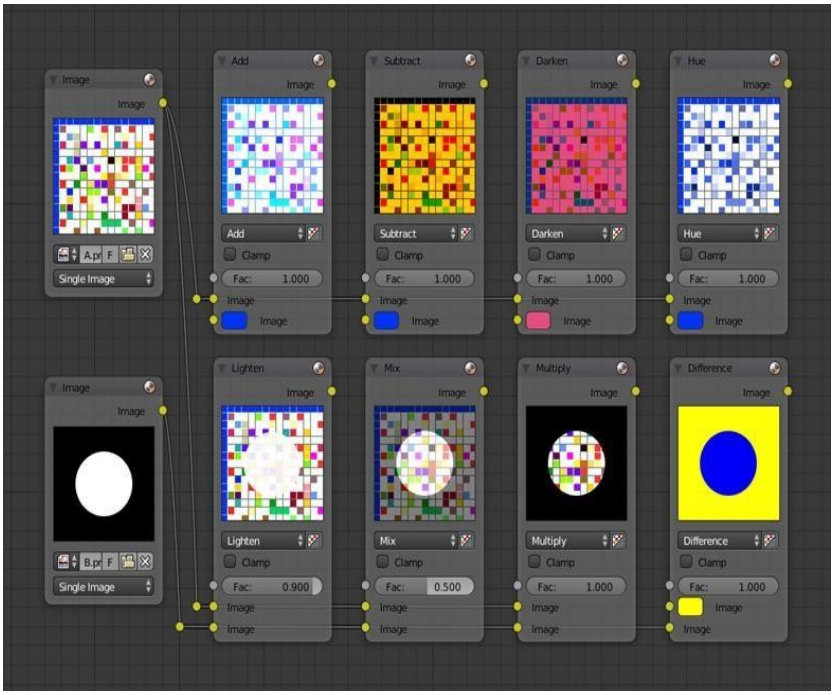
	Overlay, Dodge, Burn, Hue, Saturation, Value, Color, Soft Light, Linear Light
Use Alpha	If activated, by clicking on the *Color and Alpha* icon, the Alpha channel of the second image is used for mixing. When deactivated, the default, the icon background is a light gray. The alpha channel of the base image is always used.
Clamp	Limit the highest color value to not exceed 1.

Output

Image	Standard image output.

Examples

Below are samples of common mix modes and uses, mixing a color or checker with a mask.



Title-Img 4. 25 Some explanation of the mixing methods above might help you use the Mix node effectively.

Source-blender.org

Link-

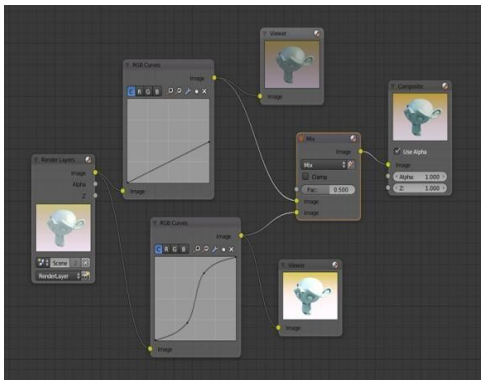
https://docs.blender.org/manual/en/dev/render/blender_render/materials/nodes/types/color/mix_rgb.html?highlight=mix%20node

Add	Adding blue to blue keeps it blue, however, adding blue to red makes purple. White already has a full amount of blue, so it stays white. Use this to shift a

	color of an image. Adding a blue tinge makes the image feel colder.
Subtract	Taking Blue away from white leaves Red and Green, which combined make Yellow. Taking Blue away from Purple Leaves Red. Use this to desaturate an image. Taking away yellow makes an image bluer and more depressing.
Multiply	Black (0.00) times anything leaves black. Anything times White (1.00) is itself. Use this to mask out garbage, or to colorize a black-and-white image.
Hue	Shows you how much of a color is in an image, ignoring all colors except what is selected: makes a monochrome picture (style '**Black & Hue'**).
Mix	Combines the two images, averaging the two.
Lighten	Like bleach makes your whites whiter. Use with a mask to lighten up a little.
Difference	Kinda cute in that it takes out a color. The color needed to turn Yellow into White is Blue. Use this to compare two very similar images to see what had been done to one to make it the other; sorta like a change log for images.
Darken	With the colors set here, is like looking at the world through rose-colored glasses.

Contrast Enhancement

Here is a **small map** showing the effects of two other common uses for the **RGB Curve**: *Darken* and *Contrast Enhancement*. You can see the effect each curve has independently, and the combined effect when they are *mixed* equally.



Title-Img 4. 26 Example node setup showing "Darken", "Enhance Contrast" and "Mix" nodes for composition.

Source-blender.org **Link-**

https://docs.blender.org/manual/en/dev/render/blender_render/materials/nodes/types/color/mix_rgb.html?highlight=mix%20node

As you can hopefully see, our original magic monkey was overexposed by too much light. To cure an overexposure, you must **both darken the image and enhance the contrast**.

In the top **RGB curve, *Darken***, only the right side of the curve was lowered; thus, any **X input** along the bottom results in a geometrically less **Y output.** The *Enhance Contrast* RGB (S shaped)

curve scales the output such that middle values of X change dramatically; namely, the middle brightness scale is expanded, and thus, whiter whites and blacker blacks are output. To make this curve, simply click on the curve and a new control point is added. Drag the point around to bend the curve as you wish. The Mix node combines these two effects equally, and Suzanne feels much better.

Watermark images

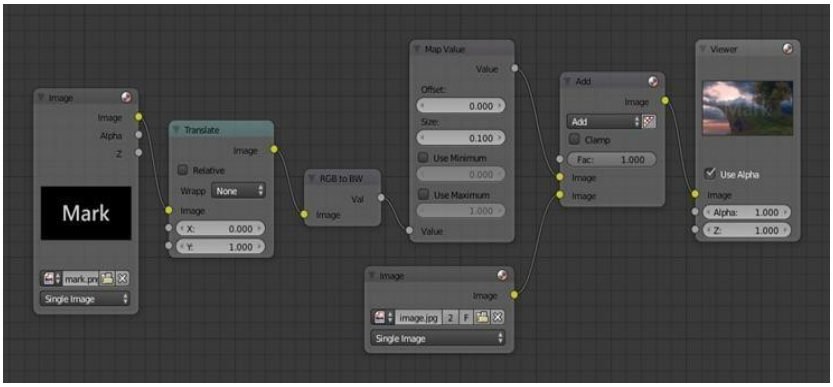
In the olden days, a pattern was pressed into the **paper mesh as it dried,** creating a mark that identified who made the paper and where it came from. The mark was barely perceptible except in just the right light. Probably the first form of subliminal advertising. Nowadays, people **watermark their images** to identify them as personal intellectual property, for subliminal advertising of the author or hosting service, or simply to track their image's proliferation throughout the web.

Blender provides a complete **set of tools** for you to both encode your watermark and to tell if an image has your watermark.

Encoding Your Watermark in an Image

First, construct your own personal watermark. You can use your name, a word, or a shape or image not easily replicated. While neutral gray works best using the encoding method suggested, you are free to use other colors or patterns. It can be a single pixel or a whole gradient; it is up to you. In the example below, we are encoding the watermark in a specific location in the image using the *Translate* node; this helps later because we only have to look at **a specific location for the mark**. We then use the **RGB to BW node** to convert the image to numbers that the Map Value node can use to make the image subliminal. In this case, it reduces the mark to one-tenth of its original intensity. The Add **node** adds the corresponding pixels, make the ones containing the mark ever-so-slightly brighter.

Title-Img 4. 27Embedding your mark in an Image using a Mark and Specific Position.



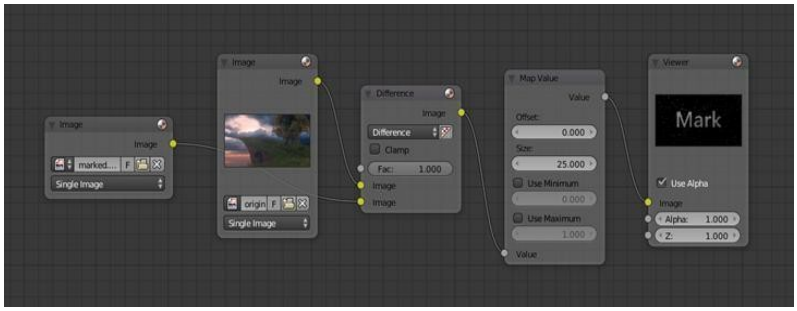
Source-blender.org **Link-**

https://docs.blender.org/manual/en/dev/render/blender_render/materials/nodes/types/color/mix_rgb.html?highlight=mix%20node

Of course, if you *want* people to notice your mark, **do not scale it so much**, or make it a **contrasting color**. There are also many other ways, using other mix settings and fancier rigs. Feel free to experiment!

Decoding an Image for your Watermark

When you see an image that you think might be yours, use the node map below **to compare it to your stock image** (pre-watermarked original). In this map, the **Mix node** is set to Difference, and the Map Value node amplifies any difference. The result is routed to a viewer, and you can see how the original mark stands out, clear as a bell:

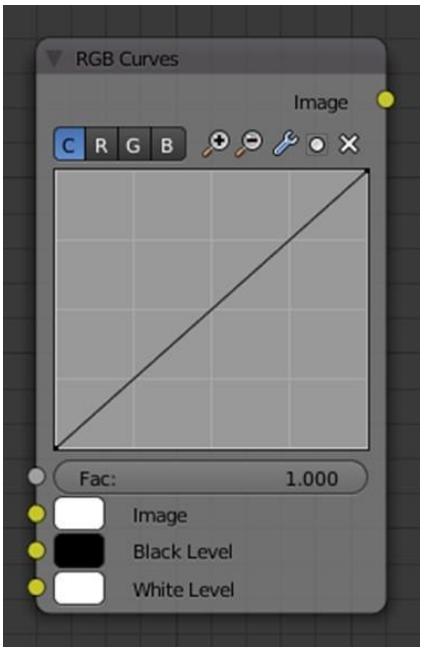


Title-Img 4. 28 Checking an image for your watermark.

Source-blender.org **Link-** https://docs.blender.org/manual/en/dev/render/blender_render/materials/nodes/types/color/mix_rgb.html?highlight=mix%20node

Various image compression algorithms lose some of the original; the difference shows as noise. Experiment with different compression settings and marks to see which works best for you by having the **encoding map** in one scene, and the **decoding map** in another. Use them while changing Blender's image format settings, reloading the watermarked image after saving, to get an acceptable result. In the example above, the mark was clearly visible all the way up to **JPEG compression of 50%.**

RGB Curves Node



Title-Img 4. 29RGB Curves Node**.**

Source-blender.org **Link-**

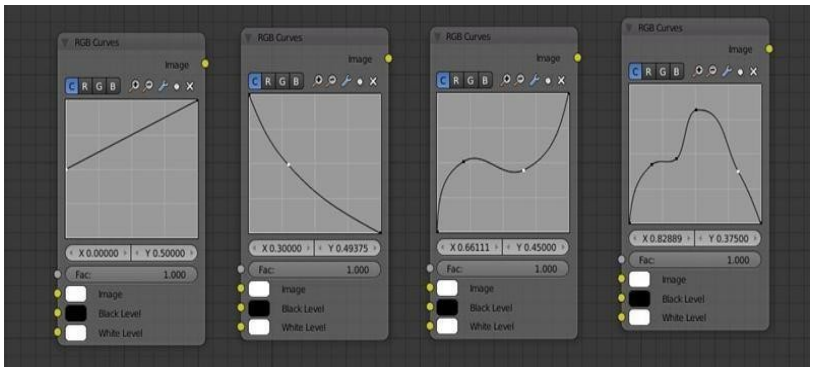
https://docs.blender.org/manual/en/dev/compositing/types/color/rgb_curves. html?highlight=rgb%20curves%20node

This node allows **color corrections** for each color channel and levels adjustments in the compositing context.

Inputs	
Factor	Controls the amount of influence the node exerts on the output image.
Image	Standard image input.
Black Level	Defines the input color that is (linear) mapped to black.
White Level	Defines the input color that is (linear) mapped to white.
Properties	
Channel	Clicking on one of the channels displays the curve for each. C (Combined RGB), R (Red), G (Green), B (Blue), L (Luminance)
Curve	A Bézier curve that varies the input levels (x-axis) to produce an output level (y-axis).
Outputs	
Image	Standard image output.

Examples

Here are some common curves you can use to achieve desired effects:



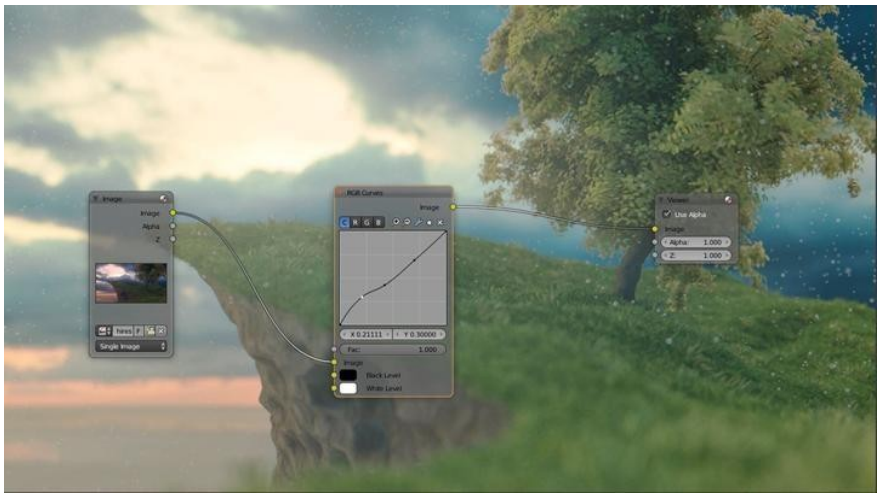
Title-Img 4. 30 From left to right: 1. Lighten 2. Negative 3. Decrease Contrast 4. Posterize.

Attribution- Source-blender.org

Link-

https://docs.blender.org/manual/en/dev/compositing/types/color/rgb_curves.html?highlight=rgb%20curves%20node

Color correction using Curves



Title-Img 4. 31Color correction with curves.

Source-blender.org **Link-**

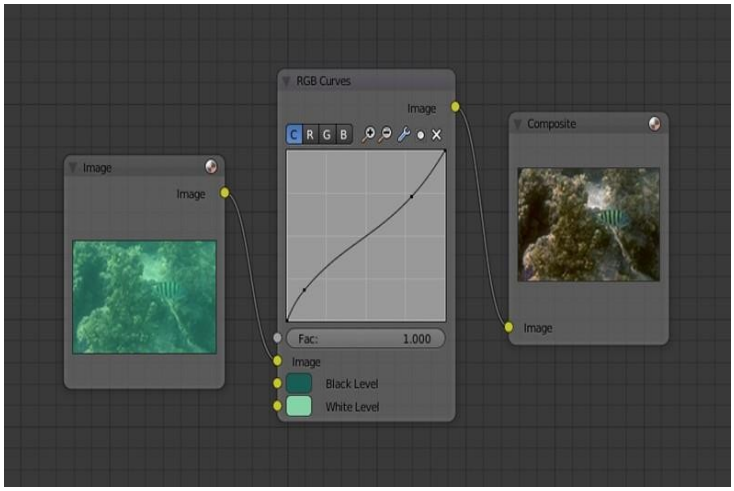
https://docs.blender.org/manual/en/dev/compositing/types/color/rgb_curves. html?highlight=rgb%20curves%20node

In this example, the image has way **too much red** in it, so we run it through an **RGB node** and reduce the **Red channel by about half**.

We added a **middle dot,** so we could make the line into a sideways exponential curve. This kind of curve evens out the amount of a color in an image as it reaches saturation. Also, read on for

examples of the **Darken and Contrast Enhancement** curves.

Color correction using Black/White Levels



Title-Img 4. 32Color correction with Black/White Levels.

Source-blender.org

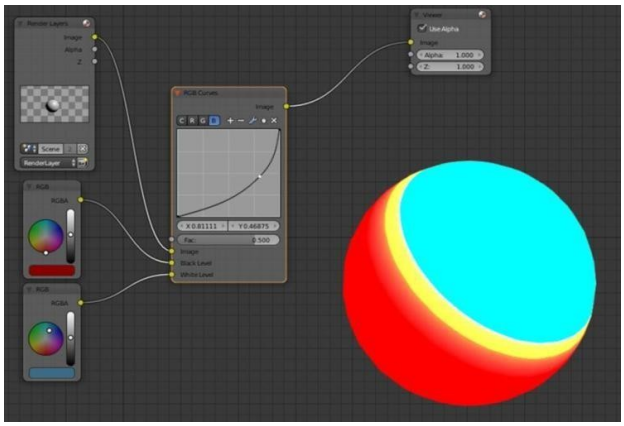
Link-https://docs.blender.org/manual/en/dev/compositing/types/color/rgb_curves.html?highlight=rgb%20curves%20node

Manually adjusting the RGB curves for color correction can be **difficult**. Another option for color correction is to use the **Black and White Levels** instead, which really might be their main purpose.

In this example, the **White Level** is set to the color of a **bright spot of the sand** in the background, and the **Black Level** to the color in the center of the **fish's eye**. To do this efficiently it is best to bring up the **UV/Image editor** showing the original input image. You can thenusethelevels' color picker to easily choose the appropriate colors from the input image, zooming into pixel level if necessary. The result can be **fine-tuned with the RGB curves** like in the previous example.

The curve for C is used to compensate for the increased contrast that is a side-effect of setting Black and White Levels.

Effects



Title-Img 4. 33Changing colors.

Source-blender.org **Link-**

https://docs.blender.org/manual/en/dev/compositing/types/color/rgb_curves. html?highlight=rgb%20curves%20node

Curves and Black/White Levels can also be used to completely change the colors of an image.

Note that e.g. setting **Black Level to red** and **White Level to blue** does not simply substitute black with red and white with blue as the example image might suggest. Levels do **color scaling,** not substitution, however, depending on the settings they can result in the described color substitution.

(What really happens when setting **Black Level to pure red** and **White Level to pure blue** is that the **red channel gets inverted**, **green gets reduced to zero** and blue remains unchanged.)

Because of this, the results of setting arbitrary Black/White Levels or RGB curves is hard to predict, however, can be fun to play with.

Unit summary

In this Unit, we have learnt what is Texture and how to

- map those textures onto your 3D Objects
- use texture Panels and assign textures with various mapping types
- create complex shading texture using blending techniques both with colors and maps making it more procedural and along with environmental mapping with reflection and refractions.

After learning of this Unit, you can download the Open Source Software available on the internet for free of cost to practice the possibilities of creating Materials and Texturing.

Assignment

- *Texture **the 3D Scene** appropriately with good high-resolution maps available online, make it morepersonalizedthewayyou would **decorate your room**.*
- *Use thesekeywords **"bedroom designs"**, **"bedroom furniture"** on*www.google.com *tocollectthe referenceimagetobuild your shadingscene.*

Assessment

- Explain the process of assigning a Texture to 3D Object
- Write a note on Mapping and Warping
- List and Explain the projection types in Texture map
- Differentiate Bump and Normal Maps
- Write a note on Displacement Map
- List any five types of Procedural Textures.
- Name the different types of Node in Blender
- Decode an image for your Watermark

Resources

While studying this course, you can browse the following
internet links for video tutorials and to download the relevant texture maps to assign on the objects that you have created and use the same for your assignments.

Links to Download Open Projects

The iconic Blender Institute Open Movies. Featuring all the production files, assets, artwork, and never-seen-before content.

https://cloud.blender.org/open-projects

- wiki.blender.org
- archive.org
- www.blender.org
- docs.blender.org

Unit-3 Introduction to Rigging

Introduction

Rigging is a process done prior to the Animation. Rigging is a process of taking a static mesh, creating an internal digital skeleton, creating a relationship between the mesh and the skeleton (known as skinning, enveloping or binding) and adding a set of controls that the animator can use to push and pull the character around as if he/she is a puppeteer.

Most commonly, characters are Rigged before they are animated because if a character model doesn't have a Rig, they can't be deformed and moved around. Process of Rigging also involves Rigging character or creatures and Objects like car, plane, or a robot.

In this Unit, you will learn about the process of Rigging and how it is important in designing 3D animation.

Outcomes

Upon completion of this unit you will be able to

- Explain the Usage of Constraints
- Plan for Adding or Removing Constraints
- Describe the Functions of Header
- Explain the term Header, Target, Space, Influence
- Create IK Constraint
- Create Spline IK Constraint

Terminology

Constraints	:	Constraints are a fantastic way to add sophistication and complexity to a Rig
Header		A Header sits at the top of every Constraint.
Target	:	The Target field lets you link the Constraint to a Target Object of your choosing
Space	:	The frame of reference is called the “space” of the Constraint
World space		Transformation, Rotation and Scale are oriented to the world axes
Local Space	:	Transformation, Rotation and Scale are oriented to the parent Object axe

Influence	:	The influence slider determines how much the Constraint will affect the constrained Object
IK Solver Constraint	:	The Inverse Kinematics Constraint implements the inverse kinematics armature posing technique
Spline IK Constraint	:	The Spline IK Constraint aligns a chain of Bones along a curve
Stretch to Constraint	:	The Stretch To Constraint causes its owner to rotate and scale its Y axis towards its Target.
Action Constraint	:	It allows you to control an Action using the transformations of another Object.
Child of Constraint	:	Child of Constraint is the Constraint version of the standard parent/children relationship

Working with Constraints

Constraints control the behavior of one Object with data from another. It can make the eyes of a tennis player track a tennis ball bouncing across the court. It allows the wheels on a bus to all rotate together. It helps a dinosaur's legs bend at the knee automatically. It makes it easy for a hand to grip the hilt of a sword and the sword to swing with the hand.

Constraints, in Blender, work with Object and Bone.

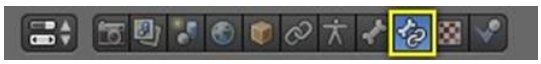
Object Constraint

Title-Img 1. 1 Object Constraints

Source-blender.org

Link :https://docs.blender.org/manual/en/dev/rigging/constraints/introduction.html

Bone Constraint

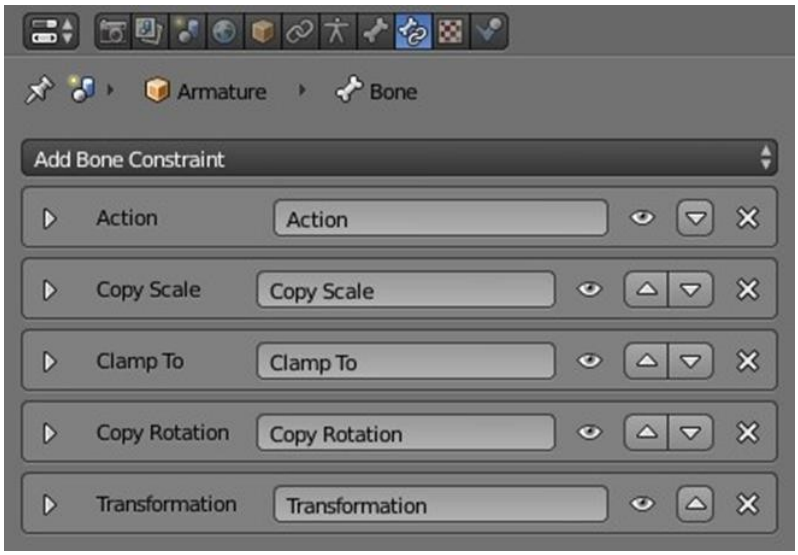


Title-Img 1. 2 Bone Constraints

Source-blender.org

Link https://docs.blender.org/manual/en/dev/rigging/constraints/introduction.html

Constraints work in combination with each other to form a **Constraint Stack**.



Title-Img 1. 3 Constraint Stack

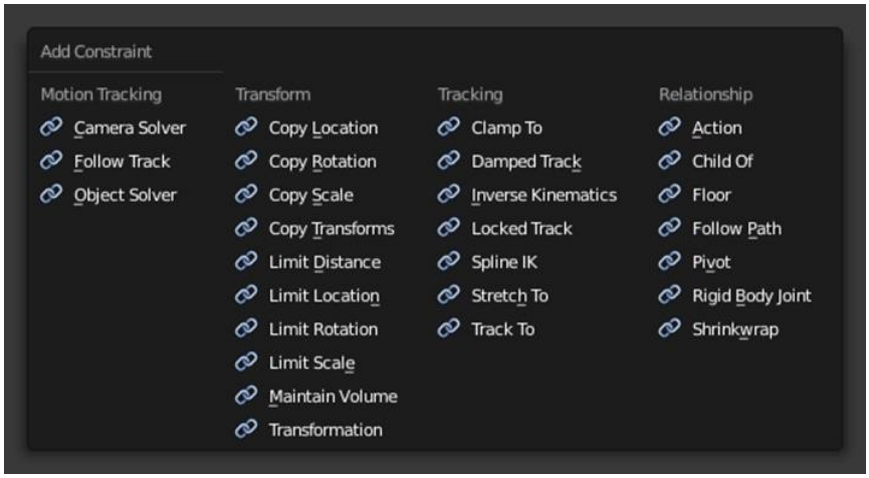
Source-blender.org

Link : https://docs.blender.org/manual/en/dev/rigging/constraints/introduction.html

The **Constraint Stack** is evaluated from top to bottom.

Constraints are a fantastic way to add sophistication and complexity to a Rig. However, be careful not to rush in too quickly, piling up Constraint upon Constraint until you lose all sense of how they interact with each other.

Adding/Removing a Constraint



Title-Img 1. 4 Adding/Removing Constraint

Source-blender.org

Link:https://docs.blender.org/manual/en/dev/rigging/constraints/interface/adding_removing.html

To add a Constraint in the Constraints Panel:

- Step 1: Click on the “Add Constraint” menu. (Refer Img 1.4)

To add a Constraint in 3D View:

- Step 2: Select the Object you would like to constrain.
- Step 3: Press Ctrl-Shift-C and choose a Constraint from the pop-up menu.

If the chosen Constraint needs a Target, Blender will add **an empty automatically** as the Target and position it **at the center** of the constrained Object.

To add a Constraint in 3D View and simultaneously give it a Target:

- Step 1: Select the Target first and then shift-select the Object you would like to constrain.
- Step 2: Press Ctrl-Shift-C and choose a Constraint from the pop-up menu.

To remove a Constraint:

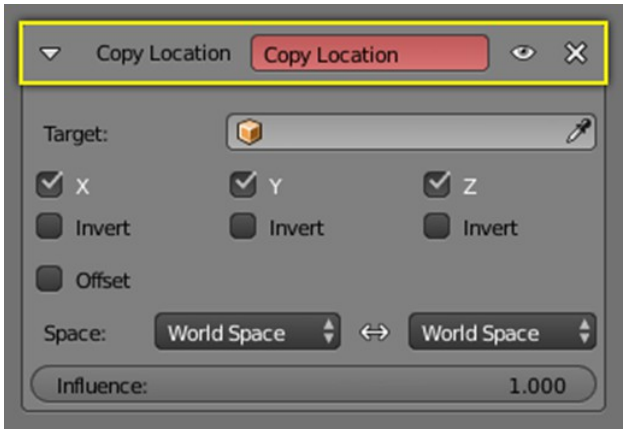
- Step 1: Click on the "X" button in the header.

To remove all Constraints from all selected Object(s):

- Step 2: Click Object ‣ Constraints ‣ Clear Object Constraints in 3D View Header.
- Step 3: Or Pose ‣ Constraints ‣ Clear Pose Constraints (for Bone Constraints).
- Step 4: Or, press Ctrl-Alt-C.

Header

Every Constraint has a header. The interface elements of the header are explained below using a Copy Location Constraint as an example. (Refer Img 1.5)



Title-Img 1. 2 A Header sits at the top of every Constraint.

Source-blender.org

Link : https://docs.blender.org/manual/en/dev/rigging/constraints/interface/header.

Expansion Arrow (pointing down or Right)

Show or Hide the settings of the Constraint. Tidy up the Constraint stack by hiding Constraints that do not currently need attention. Constraints will continue to affect the scene even when hidden.

- **“Copy Location” (first occurrence)**

  The type of Constraint is determined when a new Constraint is created to help in the process of Rigging.

- **“Copy Location” (second occurrence)**

  Give the Constraint a meaningful name in this field, something that describes its intent. Meaningful names help to understand what each Constraint is supposedto do.

The **red background** is a warning that the Constraint is not yet functional. The background will turn **grey** when the Constraint is functioning. When this Copy Location Constraint has a valid Target in the “**Target Field**” it will turn **grey** and begin to function.

- **Eyeball (open or closed)**

  Enable or Disable (Mute/Unmute) the Constraint. Disabling a Constraint will stop its effect on the scene.

Disabling a Constraint is useful for turning off a Constraint without losing all its settings. Disabling means you can enable the Constraint later with the settings intact. Disabling is like setting the influence slider to 0.0.

- **Up/Down Arrows**

  Move a Constraint up or down in the Constraint stack. Since the stack is evaluated from top to bottom, moving a Constraint in the stack can significantly affect the final outcome of the stack.

  If there is **only one Constraint** in the stack, the arrows will not be drawn. If the Constraint is at the **top** of the stack, only the **down arrow** will be drawn. If the Constraint is at the **bottom** of the stack, only the **up arrow** will be drawn.

  Delete the Constraint from the stack. The settings will be lost. The Constraint will no longer affect the final outcome of the stack.

Target

The Target field lets you **link the Constraint** to a Target Object of your choosing. This link provides data to the Constraint so that it can begin to function. For example, the **Copy Location Constraint** needs location data to function. Fill in the Target field, and the Copy Location Constraint will begin to use location data from the Target Object.

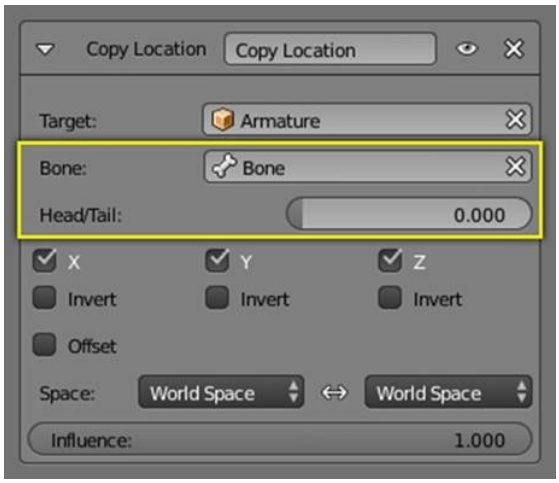
The **Target field** must be filled in for the Constraint to function. (Refer Img 1.6)

By default, the Target will use the **Object Center** as the **Target point**.

- If the Target field links to a **Mesh or Lattice Object**, a **Vertex Group field** will appear. Enter

the name of a vertex group and the Constraint will Target the median point of this vertex group instead of the Object center.

- If the Target field links to **an Armature**, a **Bone field**will appear along with a Head or Tail slider. Enter the name of a Bone and the Constraint will Target the Bone instead of the entire armature Object center. Slide the slider and the Constraint will Target the head, the tail or somewhere in-between.



Title-Img 1. 3 Target Field.

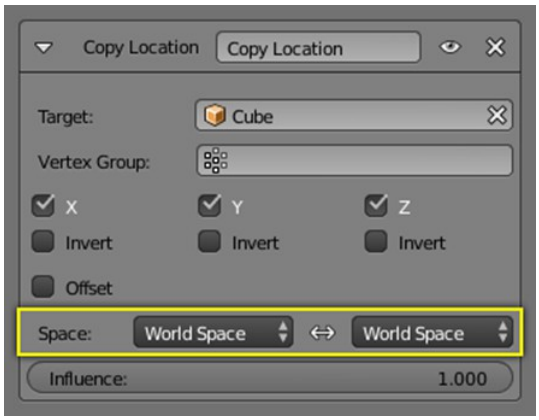
Source-blender.org

Link-https://docs.blender.org/manual/en/dev/rigging/constraints/inter face/common.html

Space

Constraints need a **frame of reference** in order to function. This frame of reference is called the "**space**" of the Constraint. Choosing **one space vs. another** will change this frame of reference and substantially alter the behaviour of a Constraint. (Refer Img 1.7)

To understand how changing the space will change the behaviour of the Constraint, consider experimenting with two empties. Makesure they display **as arrows** so that you can see the **local axes for each empty**. Make sure to size one empty a little larger than the other so that they are both always visible even if directly on top of each other. Then add a Constraint to one empty that Targets the other and experiment thoroughly by moving, rotating and scaling the Target in many different ways.



Title-Img 1. 4. Space

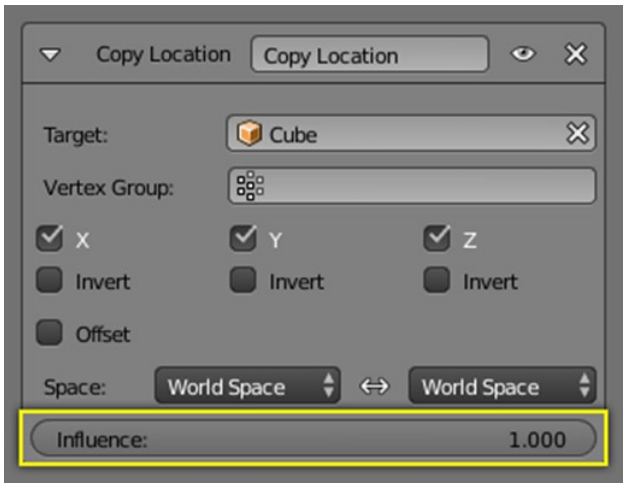
Source-blender.org

Link:https://docs.blender.org/manual/en/dev/rigging/constraints/interface/c ommon.html

*This Constraint is set to use **World Space** as the frame of referencefor both its **Target Space** and its **Owner Space**.*

Influence

The influence slider determines **how much the Constraint** willaffect the constrained Object.



Title-Img 1. 5 Influence

Source-blender.org

Linkhttps://docs.blender.org/manual/en/dev/rigging/constraints/interface/c ommon.html

- An influence of **0.0** will have **no effect**.
- An influence of **1.0** will have the **full effect**.
- Values **between (0.0 and 1.0)**, will have a **partial effect**, however, be careful. These partial effectscan be difficult to control, especially as the Constraint stack grows in complexity.

The influence value is animatable, allowing Constraints to be **turned off**, or partially on as

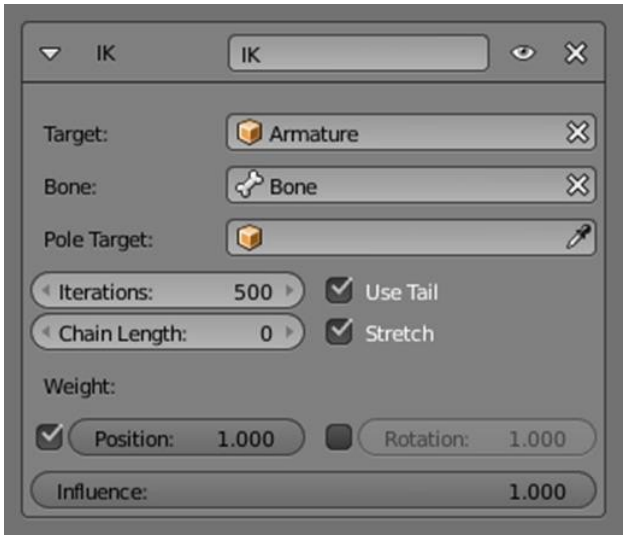
needed. (Refer Img 1.8)

IK Solver Constraint

The **Inverse Kinematics Constraint** implements the inverse kinematics armature posing technique. Hence, it is only available **for Bones**. (Refer Img 1.9)

- To quickly create an IK Constraint with a Target, select a Bone in pose mode, and press **Shift-I**.

Options



Title-Img 1. 6Inverse Kinematics panel.

Source-blender.org

Link-https://docs.blender.org/manual/en/dev/rigging/constraints/tracking/ik_solver.html

- **Target**

  Must be an armature.

- **Bone**

  A Bone in the armature.

- **Pole Target**

  Object for pole rotation.

- **Iterations**

  Maximum number of solving iterations.

- **Chain Length**

  How many Bones are included in the IK effect? Set to 0 toinclude all Bones.

- **Use Tail**

Include Bone's tail as last element in chain.

- **Stretch**
  Enable IK stretching.
- **Weight**
- **Position**
  - For Tree-IK: Weight of position control for thisTarget.
- **Rotation**
  - Chain follow rotation of Target.
- **Target**
  Disable for Target-less IK.
- **Rotation**
  Chain follows rotation of Target.

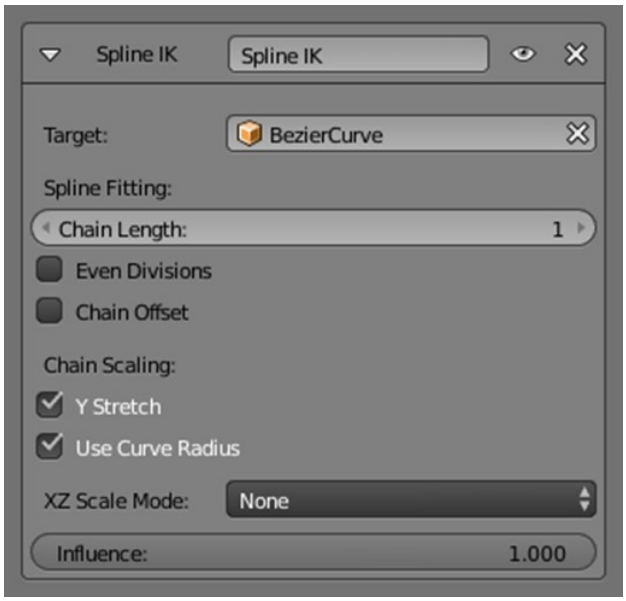
Spline IK Constraint

The Spline IK Constraint aligns a **chain of Bones** along a curve. By leveraging the ease and flexibility of achieving aesthetically pleasing shapes offered by curves and the predictability and well- integrated control offered by Bones, **Spline IK** is an invaluable tool in the **Riggers' toolbox**. It is particularly well suited for Rigging flexible body parts such as **tails, tentacles, and spines, as well as inorganic items such as ropes.** (Refer Img 1.10)

To set up Spline IK, it is necessary to have a **chain of connected Bones** and a curve to constrain these Bones to:

- **Step 1:** With the **last Bone in the chain** selected, add a Spline IK Constraint from the Bone Constraints tab in the Properties Editor.
- **Step 2:** Set the '**Chain Length**' setting to the number of Bones in the chain (starting from and including the selected Bone) that should be influenced by the curve.
- **Step 3**: Finally, set **Target** to the curve that should control the curve.

Options



Title-Img 1. 7. Spline IK panel.

Source-blender.org

Link :https://docs.blender.org/manual/en/dev/rigging/constraints/tracking/s pline_ik.html

- **Target**

  The type of the Target curve.

- **Spline Fitting**
  - **Chain Length**

  How many Bones are included in the chain.

- **Even Division**

  Ignore the relative length of the Bones when fitting to thecurve.

- **Chain Offset**

Offset the entire chain relative to the root joint.

- **Chain Scaling**
  - **Y stretch**

  Stretch the Y axis of the Bones to fit the curve.

- **XZ Scale Mode**
  - **None**

  Do not scale the X and X axes.
  - **Bone Original**

  Use the original scaling of the Bones.
  - **Volume Preservation**

Scale of the X and Z axes is the inverse of the Yscale.

- **Use Curve Radius**

  Average radius of the endpoints is used to tweak the X andZ scaling of the Bones, on top of the X and Z scale mode.

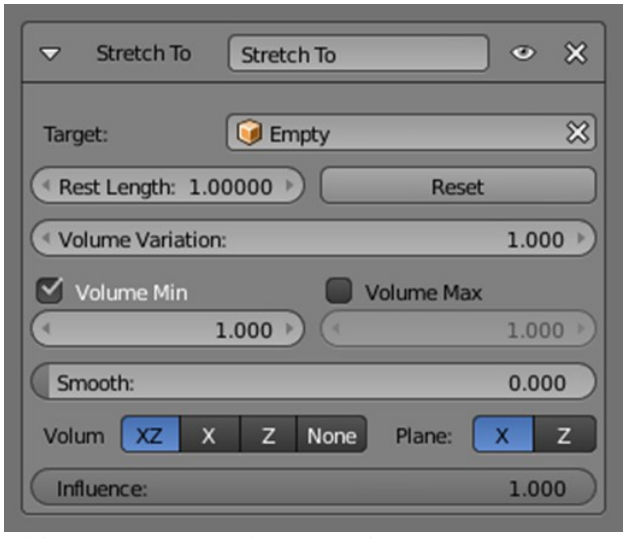
Stretch to Constraint

The Stretch To Constraint causes its **owner to rotate** and **scale itsY axis** towards its Target. So, it has the same tracking behavior as the **Track To Constraint**. However, it assumes that the Y axis willbe the tracking and stretching axis, and does not give you the option of using a different one.

It also optionally has some **raw volumetric features**, so the owner can **squash down** as the Target moves **closer**, or **thin out** as the Target moves **farther** away. Note that it is not the real volume of the owner which is thus preserved, however, rather the virtual one defined by its scale values. Hence, this feature works evenwith **non-volumetric Objects**, like empties, 2D meshes or surfaces,and curves.

With Bones, the "**volumetric**" variation scales them along their own local axes (remember that the local Y axis of a Bone is aligned with it, from root to tip). (Refer Img 1.11)

Options



Title-Img 1. 8 Stretch To panel.

Source-blender.org

Link: https://docs.blender.org/manual/en/dev/rigging/constraints/track ing/stretch_to.html

- **Target (Mesh Object Type)**

This Constraint uses one Target, and is not functional (redstate) when it has none.

- **Vertex Group**

When Target is a mesh, a new field is display where avertex group can be selected.

- **Target (Armature Object Type)**

This Constraint uses one Target, and is not functional (redstate) when it has none.

- **Bone**

When Target is an armature, a new field for a Bone isdisplayed.

- **Head/Tail**

When using a Bone Target, you can choose where alongthis Bone the Target point lies.

- **Rest Length**

This number button sets the rest distance between theowner and its Target, i.e. the distance at which there is no deformation (stretching) of the owner.

- **Reset**

When clicked, this small button will recalculate the Rest Length value, so that it corresponds to the actual distance between the owner and its Target (i.e. the distance before this Constraint is applied).

- **Volume**

These buttons control which of the X and/or Z axes should be affected (scaled up/down) to preserve the virtual volume while stretching along the Y axis. If you enable the none button, the volumetric features are disabled.

- **Plane**

These buttons are equivalent to the Up ones of the TrackTo Constraint: they control which of the X or Z axes should be maintained (as much as possible) aligned with the global Z axis, while tracking the Target with the Y axis.

Relationship

Action Constraint

The Action Constraint is **powerful**. It allows you to **control anAction** using the transformations of another Object.

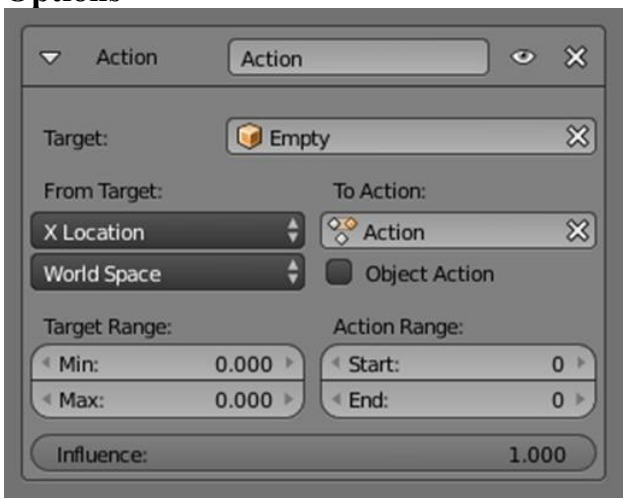
The underlying idea of the Action Constraint is very similar to the one behind the Drivers, except that the former uses a whole action (i.e. a bunch a F-Curves of the same type), while the latter controls a **single F-curve** of their "owner"

Note that even if the Constraint accepts the **Mesh action** type, only the Object, Pose and Constraint types are really working, as Constraints can only affect Objects' or Bones' transform properties, and **not meshes' shapes**. Also, note that only the **Object transformation (location,**

rotation, scale) is affected by the action, if the action contains keyframes for other properties they are ignored, as Constraints do not influence those.

As an example, let us assume you have defined an **Object action** (it can be assigned to any Object, or even no Object at all), and have mapped it on your owner through an **Action Constraint**, so that moving the Target in the (0.0 to 2.0) range along its X-Axis maps the action content on the owner in the (0 to 100) frame range. This will mean that when the Target's X property is **0.0** the owner will be as if in **frame 0** of the linked action; with the Target's X property at **1.0** the owner will be as if in **frame 50** of thelinked action, etc. (Refer Img 1.12)

Options



Title-Img 1. 9 Action panel.

Source-blender.org

Linkhttps://docs.blender.org/manual/en/dev/rigging/constraints/relationship/action.html

- **Target**

This Constraint uses one Target, and is not functional (redstate) when it has none.

- **Bone**

When Target is an armature Object, use this field to selectthe Target Bone.

- **Transform Channel**

This selector controls which transform property (location, rotation or scale along/around one of its axes) from the Target to use as "action driver".

- **Target Space**

This Constraint allows you to choose in which space toevaluate its Target's transform properties.

- **To Action**

Select the name of the action you want to use.

- **Object Action**

Bones only, when enabled, this option will make the constrained Bone use the "Object" part of the

linked action, instead of the “same-named pose” part. This allowsyou to apply the action of an Object to a Bone.

- **Target Range Min/Max**

The lower and upper bounds of the driving transform property value.

- **Action Range Start/End**

The starting and ending frames of the action to be mapped.

Child of Constraint

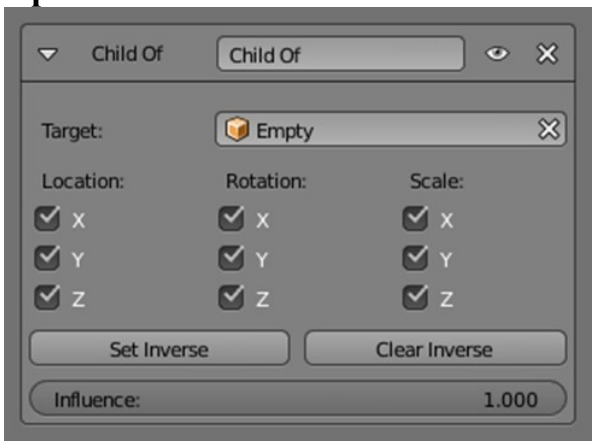
Child of Constraint is the **Constraint version of the standard** parent/children relationship between Objects (the one establishedthrough the **Ctrl-P** shortcut, in **3D Views**).

Parenting with a Constraint has **several advantages** and enhancements, compared to the traditional method: (Refer Img 1.13)

You can have several **different parents** for the sameObject (weighting their respective influence with the Influence slider).

As with any Constraint, you can key (i.e. animate)its Influence setting. This allows the Object which has a Child of Constraint upon it to change over time which Target Object will be considered theparent, and therefore have influence over the Child of Constraint Object.

Options



Title-Img 1. 10 Child Of panel

Source-blender.org

Link- https://docs.blender.org/manual/en/dev/rigging/constraints/relationship/child_of.html

- **Target**

The Target Object that this Object will act as a child of. ThisConstraint uses one Target, and is not functional (red state)when it has none. If Target is an armature or a mesh, a newname field appears where a name of a Bone or a Vertex Group can be selected.

- **Location X, Y, Z**

Each of these buttons will make the parent affect or not affect the location along the corresponding

axis.

- **Rotation X, Y, Z**

Each of these buttons will make the parent affect or not affect the rotation around the corresponding axis.

- **Scale X, Y, Z**

Each of these buttons will make the parent affect or not affect the scale along the corresponding axis.

- **Set Inverse**

By default, when you parent your owner to your Target,the Target becomes the origin of the owner's space. This means that the location, rotation and scale of the owner are offset by the same properties of the Target. In other words, the owner is transformed when you parent it to your Target. This might not be desired! So, if you want to restore your owner to its before-parenting state, click on the Set Inverse button.

- **Clear Inverse**

This button reverses (cancels) the effects of the above one,restoring the owner/child to its default state regarding its Target/parent.

Technical Note

If you use this Constraint with all channels on, it will use a **straight matrix multiplication** for the parent relationship, not decomposing the parent matrix into **loc /rot/size**. This ensures any transformation correctly gets applied, also for combinations of**rotated** and **non-uniform** scaled parents.

Unit summary

In this Unit, you have learnt what is Rigging and how to

- Use the Constraints
- Do Adding or Removing Constraints
- Describe the Functions of Header
- Explain the term Header, Target, Space, Influence
- Edit the Properties of the Header panel, working on Parentand Child relationship
- Create IK Constraint
- Create Spline IK Constraint

After learning this Unit, you can download the Open Source Software available on the internet for free of cost to practice the possibilities of creating Rig.

Assignment

- Create a basic Mechanical Rig referring to the YouTube video link

Assessment

- Define Constraints.
- State the Differentiate between Local space and World space.
- Write notes on Adding and Deleting Constraints withexamples.
- Describe the Process of making a Parent Constraint.
- Write a brief note on the uses of Header.
- Explain Parent and Child Constraint.
- Write down the process of Creating Spline IK.
- Define Stretch Constraint

Fill in the Blanks

1. _____ is a good first Constraint to explore in thebeginning.
2. _____sits at the top of every Constraint.
3. _____Enables or Disables (Mute/Unmute) theConstraint.
4. _____allows you to control an Action using thetransformations of another Object.
5. The_____slider determines how much theConstraint will affect the constrained Object.

Resources

While studying this Unit, you can browse the internet links for online video tutorials and several books and training DVDs available in the Blender Store and on the Blender Cloud.

- wiki.blender.org
- archive.org
- www.blender.org
- docs.blender.org

Unit-4 Introduction to Working with Armature

Introduction

An **Armature in Blender** is similar to the **Armature of a real skeleton**. Just like a real skeleton, an Armature can consist of**many Bones**. These Bones can be moved around and anythingthat they are attached to or associated with will move and deform in a similar way. An "**Armature**" is a type of **Object used for rigging**. Armature Object borrows many ideas from real life skeletons.

As Armatures are designed to be posed, either for a **static oranimated** scene, they have a specific state, called "**rest position**". This is the Armature's default "**shape**", the default position/rotation/scale of its Bones, as set in **Edit mode**.

In Edit mode, you will always see your Armature in **rest position**, whereas in Object and Pose mode, you usually get the current "**pose**" of the Armature (unless you enable the Rest Position button of the Armature panel).

This unit will describe how you can **work with Armatures in Blender**.

Outcomes

Upon completion of this unit you will be able to:

- Explain the Usage of Bones
- List the types of Armature structure
- Manage to Edit an Armature
- Arrange Linking Objects to Bone
- Set up Mesh and Armature using Skinning
- Create Poses for the Rigged Character

Terminology

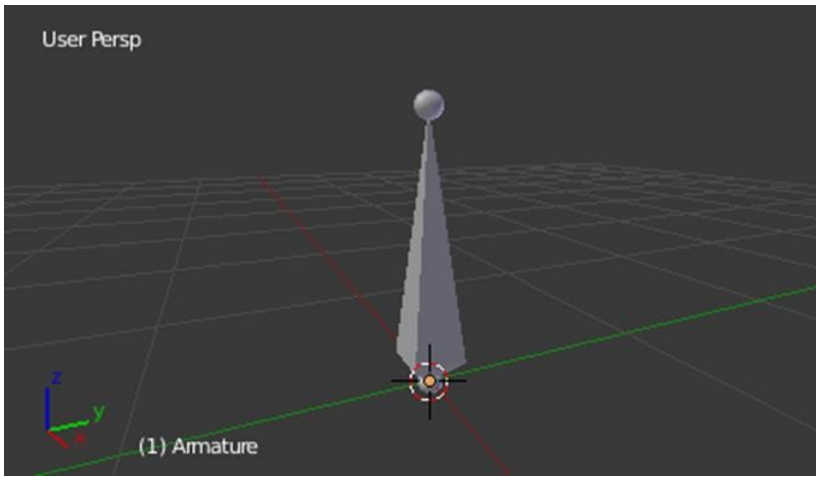
Armatures	:	Armature is the Object type used for rigging and it borrows many ideas from real life skeletons
Roll	:	Activating Axes checkbox on the will show localaxes for each Bone's tip.
Bones Influence	:	Basically, a Bone controls geometry when vertices "follow" the Bone
Armature Layers	:	Each Armature has 32 "Armature layers" which allow you to organize your Armature by "regrouping" sets of Bones into layers.
Octahedral Bone	:	This is the default visualization, well suited formost of editing tasks.
Stick Bone	:	This is the simplest and most non-intrusivevisualization.
B-Bone Bone	:	This visualization shows the curves of "smooth" multi-segmented Bones; see the Bendy Bones for details.
Envelope Bone	:	This visualization materializes the Bone deformation influence.
Pose Library	:	The Pose Library panel is used to save, apply,and manage different

		Armature poses.
Ghost	:	In traditional cartoon creation animators use tracing paper, to see several frames preceding the one they are working.
Shadow	:	Controls how objects using this Material castand receive shadows.
Structure	:	Armatures mimic real skeletons. They are made from Bones, which are (by default) rigid elements.
Chains of Bones	:	Bone can be the parent of several children, andhence be part of several chains at the same time.

Working with Armature

First, let us try to add the **default Armature** in Blender.

- **Step 1:** Open a default scene.
- **Step 2:** Delete all Objects in the scene.
- **Step 3:** Make sure the cursor is in the world originwith Shift-C.
- **Step 4:** Press Numpad1 to see the world in Frontview.
- **Step 5:** Add a Single Bone (Add ‣ Armature ‣ SingleBone).
- **Step 6:** Press Numpad Delete to see the Armatureat maximum zoom.



Title-Img 2. 1 The default Armature.

Source- blender.org

Link- https://docs.blender.org/manual/en/dev/rigging/armatures/intro duction.html

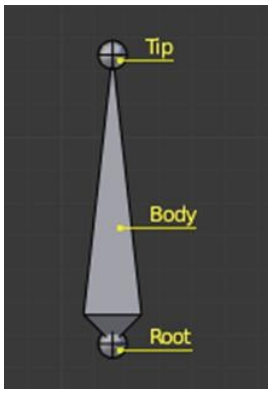
Armature Object

As you can see, an Armature is like any other Object type inBlender:

- It has a **center, a position, a rotation and a scale factor**.

- It has an **Object Data data-block** that can be edited in **Edit Mode.**
- It can be linked to other scenes, and the same Armature data can be **reused** on multiple Objects.
- All animation you do in Object Mode is only working on thewhole Object, not the **Armature's Bones** (use the **PoseMode** to do this).
- As Armatures are designed to be posed, either for a **static or animated scene**, they have a specific state, called "**rest position**". This is the Armature's default "**shape**", the default position/rotation/scale of its Bones, as set in Edit Mode.
- In **Edit Mode**, you will always see your **Armature in rest position**, whereas in **Object Mode and Pose Mode**, you usually get the current "**pose" of the Armature** (unless you enable the Rest Position button of the Armature panel).

Bones Structure



Title-Img 2. 2 The elements of a Bone.

Source- blender.org

Link- https://docs.blender.org/manual/en/dev/rigging/armatures/bones/stru cture.html

They have three elements:

1. "Start joint" named **Root** or Head,
2. "**Body**" itself,
3. "End joint" named **Tip** or Tail.

With the default Armature in edit-mode, you can select the root and the tip, and move them as you do with mesh vertices. Both root and tip (the "**joints**") define the Bone by their respective position.

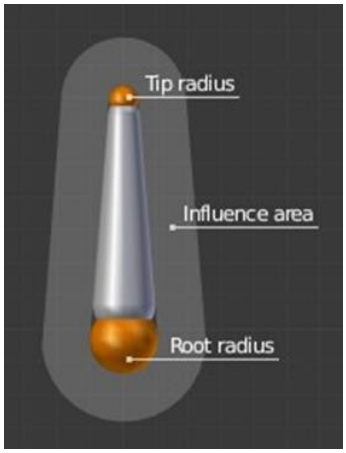
They also have a radius property, only useful for the envelope deformation method.

Roll

Activating Axes checkbox on the Armature tab ‣ Display panel, will show local axes for each Bone's tip. The Y axis is always aligned along the Bone, oriented from root to tip. So, this is the

"**roll**" axis of the Bones.

Bones Influence



Title-Img 2. 3 A Bone in Envelope visualization, in Edit Mode.

Source-blender.org

Link- https://docs.blender.org/manual/en/dev/rigging/armatures/bones/stru cture.html

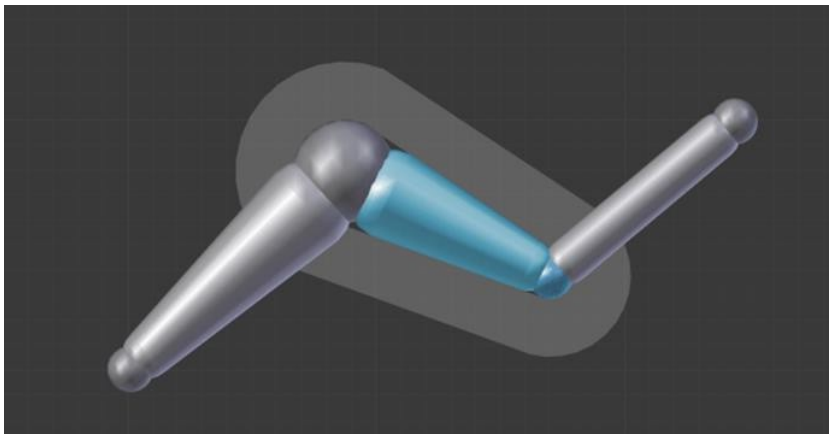
Basically, a Bone **controls geometry** when vertices "follow" the Bone. This is like how the muscles and skin of your finger follow your **finger-Bone when you move a finger**.

To do this, you must define the strength of influences a Bone has on a certain vertex.

The simplest way is to have each Bone affecting those parts of the geometry that are within a given range from it. This is called the **Envelope Technique**, because each Bone can control only the geometry "enveloped" by its own influence area.

If a Bone is visualized as **Envelope**, in **Edit Mode** and in **Pose Mode** you can see the area of influence, which depends on:

- The Distance Property and
- The Root's Radius and the Tip's Radius.



Title-Img 2. 4 Our Armature in Envelope visualization, in Pose Mode.

Source- blender.org

Linkhttps://docs.blender.org/manual/en/dev/rigging/armatures/bones/st ructure.html

Selection of Bones

You can select and edit **Bones of Armatures** in Edit Mode and in Pose Mode. Here, we will see how to select Bones in Edit Mode. Selecting Bones in **Pose Mode** is similar to selecting in **Edit Mode** with a few specific differences that will be detailed in the posing part.

Similar to vertices/edges selection in meshes, there are **two ways** to select whole Bones in Edit Mode:

- Directly, by selecting the Bone's body.
- Selecting both of its joints (roots and tip).

This is an important point to understand, because **selecting Bones'joints** only might lead to non-obvious behavior, with respect to which Bone you actually select.

Selecting Bone Joints

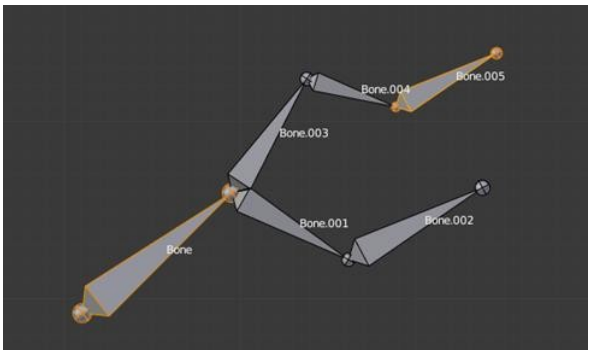
To select Bones' joints, you have the standard selectionmethods.

- **Inverse selection**

As stated above, you must remember that these selection tools are **for Bones' joints** only, not the **Bones' bodies.**

For example, the **Inverse selection** option **Ctrl-I** inverts the selection **of Bones' joints**, not of **Bones.**

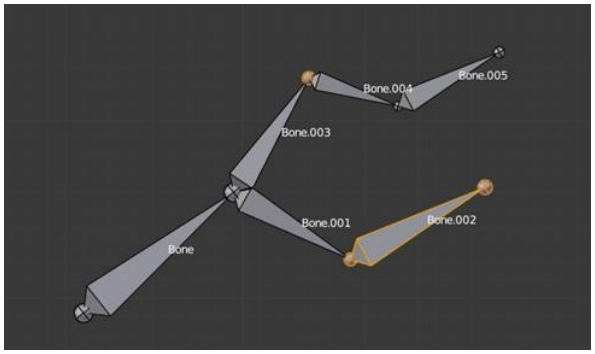
Remember that **a Bone** is selected only if both its joints areselected. So, when the selection status of **Bones' joints** is inverted, a new set of Bones is selected.



Title-Img 2. 5 Two Bones selected.

Source- blender.org

Link- https://docs.blender.org/manual/en/dev/rigging/armatures/bones/se lecting.html



Title-Img 2. 6 The result of the inverse selection Ctrl-I the Bones

joints selection has been inverted, and not the Bones selection.

Source- blender.org

Linkhttps://docs.blender.org/manual/en/dev/rigging/armatures/bones/se lecting.html

Selecting connected Bone Joints

Another Example: when you select the **root of a Bone**connected to its parent, you also **implicitly select the tip** ofits parent (and vice versa).

Selecting Bones

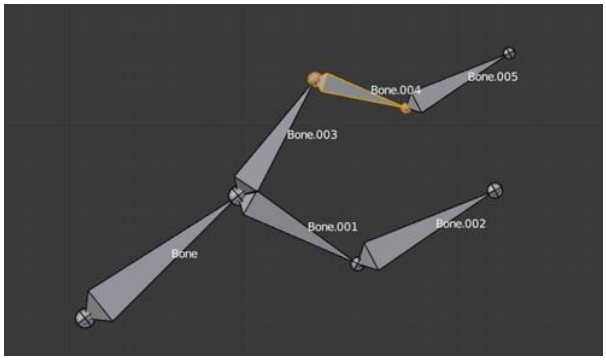
By **RMB** clicking on a **Bone's body**, you will select it (and hence you will implicitly select its root and tip).

Using **Shift-RMB**, you can add to/remove from the selection.

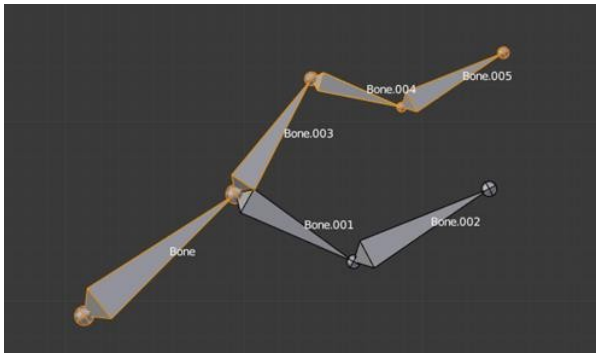
You also have some **Advanced Selection** options, based on their relations.

You can select at once all the Bones in the chain which the active (last selected) Bone belongs to by using the linked **selection tool, L.**

Linked Bones selection



Title-Img 2. 7 A single selected Bone.
Source- blender.org
Link:https://docs.blender.org/manual/en/dev/rigging/armatures/bones/sele cting.html



Title-Img 2. 8 Its whole chain selected with L.

Source- blender.org

Link- https://docs.blender.org/manual/en/dev/rigging/armatures/bone s/selecting.html

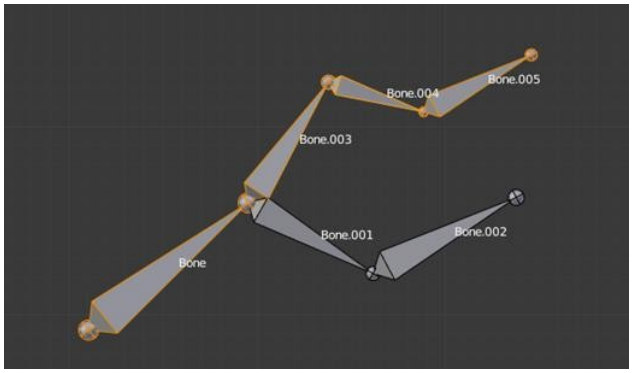
- Mirror Shift-Ctrl-M
- Flip the selection from one side to another.
- Pick Shortest Path Ctrl-RMB
- Selects the path from the active Bone to the Boneunder the mouse
- Deselecting connected Bones

There is a subtlety regarding connected Bones.

When you have several connected Bones selected, if you **deselect one Bone**, its tip will be deselected, however, **not its root**, if it is also the tip of another selected Bone.

To understand this, look at Img 2.9 Bone deselection in a selected chain.

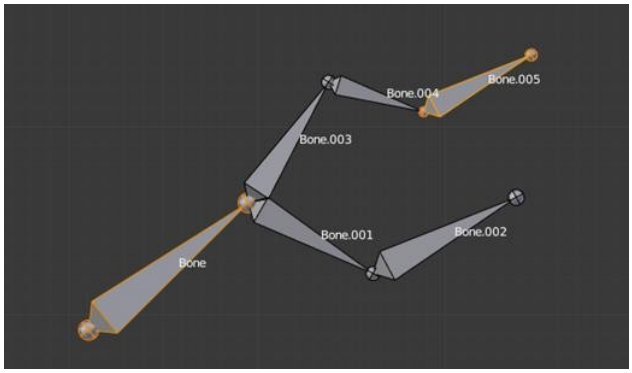
Bone deselection in a selected chain.



Title-Img 2. 9 A selected chain.

Source- blender.org

Link- https://docs.blender.org/manual/en/dev/rigging/armatures/bones/sele cting.html



Title-Img 2. 10 Two selected Bones.

Source- blender.org

Link- https://docs.blender.org/manual/en/dev/rigging/armatures/bones/sele cting.html

- After Shift-RMB -clicking "**Bone.003**":
- "Bone.003" 's tip (which is same as "**Bone.004**" 's root) is deselected.
- "Bone" is "Bone.003" 's parent. Therefore "Bone.003" 's root is same as the tip of "Bone". Since "Bone" is still selected, its tip is selected. Thus, the root of "Bone.003" remains selected.
- Mouse Clicks
- Reference
- Mode: Edit Mode
- Hotkey: Ctrl-LMB

If at least one Bone is selected, Ctrl-LMB -clicking adds a **new Bone**.

About the new Bone's tip:

After you Ctrl-LMB -clicked it becomes the **Active Element** in the Armature,

It appears to be right where you clicked, however, (As in mesh editing) it will be on the plane parallel to the viewand passing through the 3D cursor.

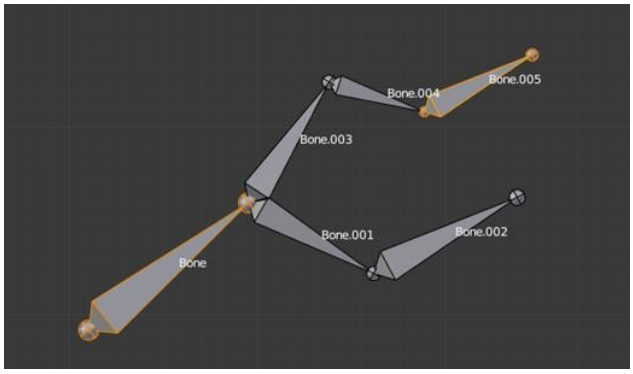
The position of the Root and the parenting of the newBone depends on the **Active Element.**

Active Element

If the Active Element is a Bone

The new Bone's Root is placed on the **Active Bone's tip**

The new Bone is parented and connected to the **Active Bone** (check the Outliner in Img 2.11 Ctrl-clicking when the Active Element is a Bone.).



Title-Img 2. 11 Ctrl-clicking when the Active Element is a Bone.

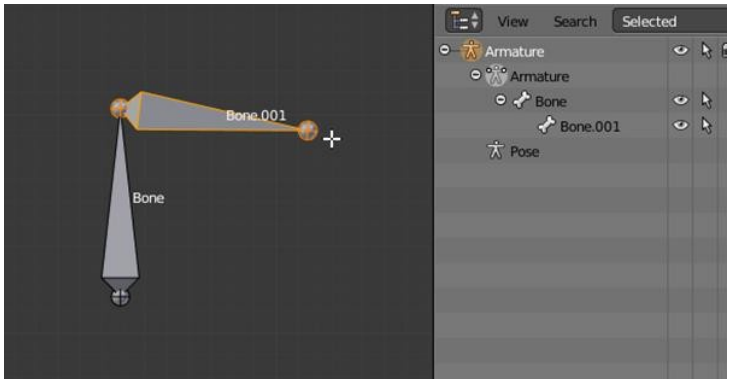
Source- blender.org

Linkhttps://docs.blender.org/manual/en/dev/rigging/armatures/bones/editi ng/bones.html

If the Active Element is a Tip

The new Bone's root is placed on the **Active Tip**

The new Bone is parented and connected to the Bone owning the **Active Tip** (check the Outliner in Img 2.12 Ctrl- clicking when the Active Element is a tip.).



Title-Img 2. 12 Ctrl-clicking when the Active Element is a tip.

Source- blender.org

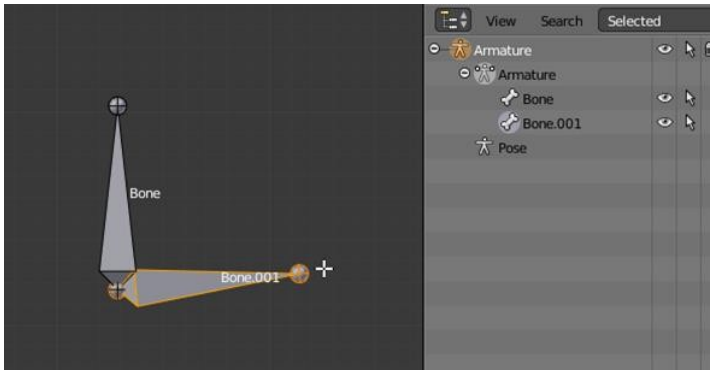
Link- https://docs.blender.org/manual/en/dev/rigging/armatures/bones/editi ng/bones.html

If the Active Element is a Disconnected Root:

The new Bone's root is placed on the **Active Root**

The new Bone is not parented to the Bone owning the Active Root (check the Outliner in Img 2.13 Ctrl-clicking when the Active Element is a disconnected root.).

And hence the new Bone will not be connected to **any Bone**



Title-Img 2. 13 Ctrl-clicking when the Active Element is a disconnected root.

Source-blender.org

Link-https://docs.blender.org/manual/en/dev/rigging/armatures/bone s/editing/bones.html

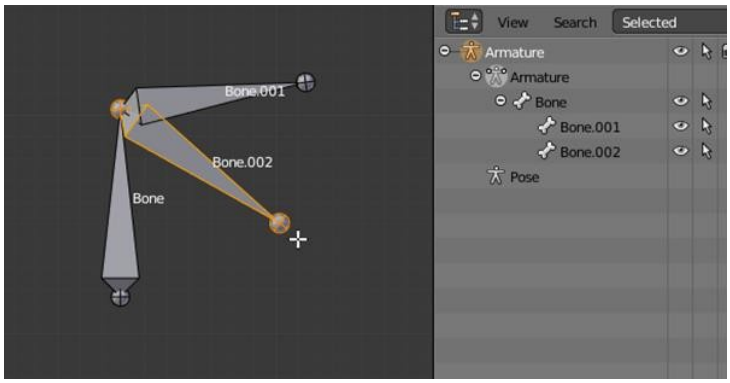
If the Active Element is a Connected Root:

The new Bone's root is placed on the **Active Root**

The new Bone is parented and connected to the parent of the Bone owning the Active Root (check the Outliner in Img 2.14 Ctrl-clicking when the Active Element is a connected root.).

This should be obvious because if the Active Element is a **connected root** then the Active Element is also the tip of the parent Bone, so it is the same as the second case.

As the tip of the new Bone becomes the Active Element, you can repeat these Ctrl-RMB several times, to consecutively add several Bones to the end of the same chain.



Title-Img 2. 14 Ctrl-clicking when the Active Element is a connected root.

Source-blender.org

Link-https://docs.blender.org/manual/en/dev/rigging/armatures/bones/editi ng/bones.html

Delete Selected Bone(s)

X

Hotkey:

This tool **deletes selected Bones,** selected joints are ignored.

If you delete a Bone in a chain, its child(ren) will be automatically **re-parented to its own** parent, however, not connected, to avoid deforming the whole Armature.

Merge Bones

Hotkey: Alt-M

You can **merge together** several selected Bones, as long as they form a chain. Each sub-chain formed by the selected Bones will give one Bone, whose root will be the root ofthe root Bone, and whose tip will be the tip of the tip Bone.

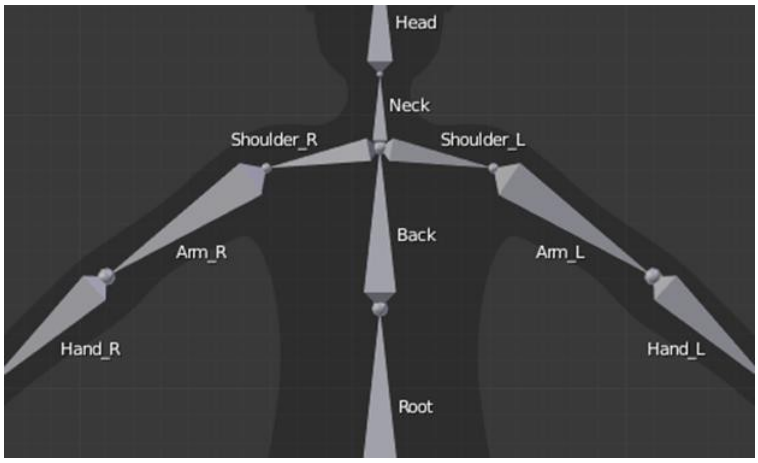
Subdivide Bones

You can **subdivide** Bones, to get two or more Bones where there was just one Bone. The tool will subdivide all selected Bones, preserving the existing relationships: the Bones created from a subdivision always form a connected chain of Bones.

Naming Conventions

Naming conventions in Blender are not only useful for you in finding the right Bone, however, also to tell Blenderwhen any two of them are counterparts.

In case your Armature can be **mirrored in half** (i.e. it is bilaterally symmetrical), it is worthwhile to stick to a **left/right** naming convention. This will enable you to use some tools that will probably save your time and effort(like the **X-Axis Mirror editing tool** we saw above...).



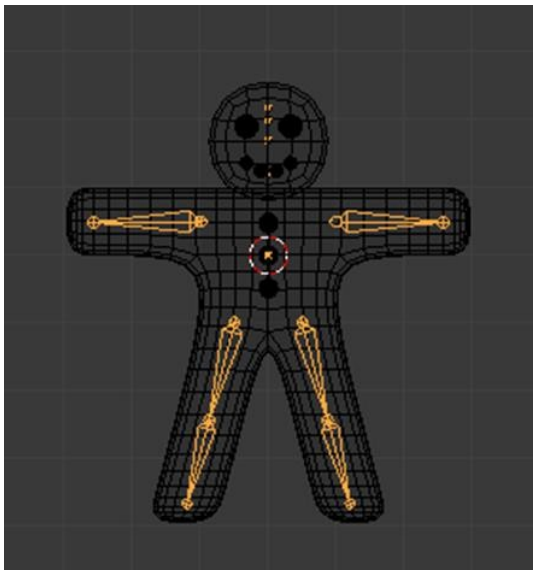
Title-Img 2. 15 An example of left/right Bone naming in a simple rig.

Source-blender.org

Link-https://docs.blender.org/manual/en/dev/rigging/armatures/bones/editi ng/naming.html

Structure

Armatures **mimic real skeletons**. They are made out of Bones, which are (by default) rigid elements. However, you have more possibilities than with real skeletons: In addition to the "natural" rotation of Bones, you can also **translate and even scale** them! And your Bones do not have to be connected to each other; they can be completely free if you want. However, the most natural and useful setups imply that some Bones are related to others, forming so-called "**chains of Bones**".



Title-Img 2. 16 Example of a very basic Armature.

Source-

Link- http://blender-manual- i18n.readthedocs.io/ja/latest/rigging/armatures/structure.html

Chains of Bones

The Bones inside an Armature can be completely **independent** from each other (i.e. the modification of one Bone does not affect the others). However, this is not oftena useful set up: To create a leg, all Bones "after" the thigh Bone should move "with" it in a well-coordinated manner. This is exactly what happens in Armatures by parenting a Bone to the next one in the limb, you create a "**chains of Bones**". These chains can be **ramified**. For example, *five fingers attached to a single "hand" Bone*.

Skinning

In Blender, you have **two main skinning types**:

1. You can **Parent/Constrain Objects to Bones** - then, when you transform the Bones in Pose Mode, their "children" Objects are also transformed, exactly as with a standard parent/children relationship... The "children" are never deformed when using this method.
2. You can Using the **Armature Modifier on entire Mesh**, and then, some parts of this Object to some Bonesinside this Armature. This is the more complex and powerful method, and the only way to really deform the geometry of the Object, i.e. to modify its vertices/control points relative positions.

Armature Deform Parent

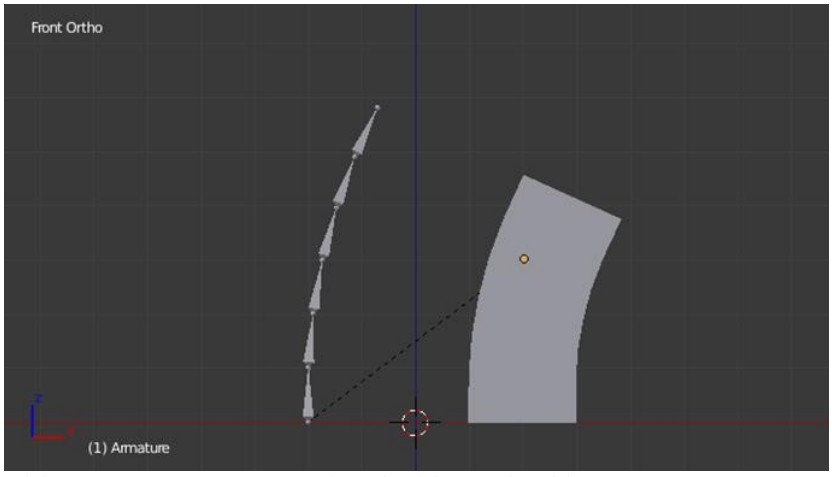
Hotkey: Ctrl-P

Armature Deform Parenting is a way of **creating and setting up** an **Armature Modifier.**

To use Armature Deform Parenting, you must

- **Step 1:** First select all the child Objects that will beinfluenced by the Armature
- **Step 2:** Lastly, select the **Armature Object** itself.
- **Step 3:** Once all the child Objects and the Armatureare selected press Ctrl-P
- **Step 4:** Select Armature Deform in the **Set ParentTo** pop-up menu.

The Armature will be the parent Object of all the other child Objects and each child Object will have an **Armature Modifier** with the **Armature associated** (Object field).



Title-Img 2. 17 Bone associated with Mesh Object.

Source-

Link- https://docs.blender.org/manual/en/dev/rigging/armatures/skinning/pa renting.html

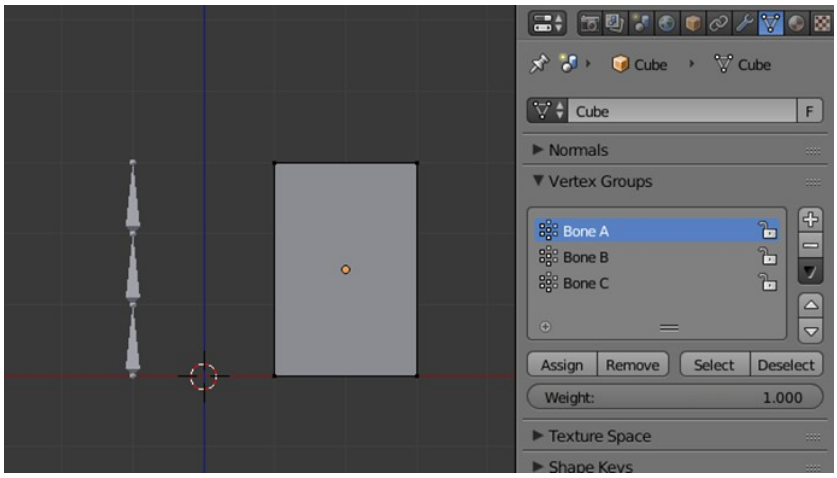
With Empty Groups

When parenting, it will create **empty vertex** groups on the child Objects (if they do not already exist) for and named after each deforming Bone in the Armature. The newly created vertex groups will be empty this means they will **not have any weights assigned**. Vertex groups will only be created for Bones which are setup as deforming **(Properties Editor ▸ Bone ▸ Deform Panel).** You can then manually select the vertices and assign them to a particular vertex group that you are choosing to have Bones in the **Armature influence**.

Choose this option if you have already created (and weighted) allthe vertex groups the mesh requires.

Example

For example, if you have an **Armature** which consists of three Bones named "**Bone A**", "**Bone B**" and "**Bone C**" and cube mesh called "**Cube**". If you parent the cube to the Armature the cube will get three new vertex groups created on it called "Bone A", "Bone B" and "Bone C". Notice that each vertex group is empty.



Title-Img 2. 18 Cube in Edit Mode using Armature Deform with empty groups.
Source
Link- https://docs.blender.org/manual/en/dev/rigging/armatures/skinning/pa renting.html

With Automatic Weights

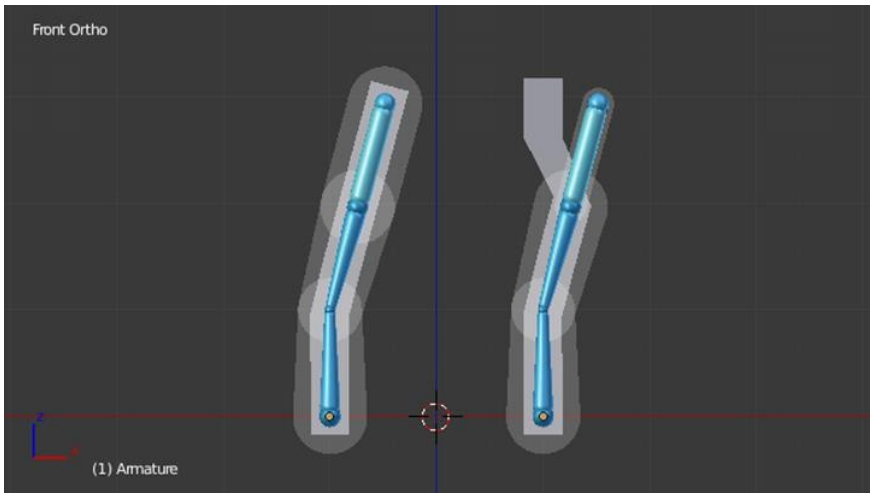
With Automatic Weights, parenting works similar to **With Empty Groups**, however, it will not leave the vertex groups empty. It calculates how much influence a particular Bone would have on vertices based on the distance from those vertices to a particular Bone ("**Bone heat**" algorithm). This influence will be assigned **as weights** in the vertex groups.

This method of parenting is certainly easier setup; however, it can often lead to Armatures which do not deform child Objects in ways you would want. **Overlaps** can occur when it comes to determining which Bones should influence certain vertices when calculating influences for **more complex Armatures** and child Objects. Symptoms of this confusion are that when transforming the **Armature in Pose Mode** parts of the child Objects do not deform as you expect; If Blender does not give you the results you require you will have to manually alter the weights of vertices in relation to the vertex groups they belong to and have influence in.

With Envelope Weights

With Envelope Weights, parenting works in a similar way like **Automatic Weights**. The difference is that the influences are calculated based on the **Bone Envelopes settings**. It will assign to each vertex groups the vertices that are inside its Bone's influence volume, weighted depending on their distance to this Bone.

This means newly included/excluded vertices or new envelope settings will not be taken into account. You will have to apply **Armature Deform** with **Envelope Weights parenting** again.



Title-Img 2. 19 Two sets of Armatures each with three Bones.

Source-

Link-https://docs.blender.org/manual/en/dev/rigging/armatures/skinning/parenting.html

Unit summary

In this Unit, you have learnt

- To Create and edit different types of Bones and apply it todifferent mesh
- Types of Armature structure
- To Edit an Armature
- To Arrange Linking Objects to Bone

- To Set up Mesh and Armature using Skinning
- To Create Poses for the Rigged Character
- To Skin the mesh to the Bones
- To Add and remove influence for a Bone
- After learning this Unit, you can download the Open Source Software available on the internet for free of cost topractice the possibilities of creating 3D Objects.

Assignment

Create a **Basic Primitive Human Rig** referring to the Youtube video link

Assessment

- Explain Armature in Blender
- Describe the Deforming Bones
- Write a brief note on Bone influence
- Explain five different Processes of Editing Bones
- Write a brief note on Bone structure
- Explain the process of skinning with examples

Fill in the Blanks

1. _____are directly involved in altering the positions of vertices associated with their Bones.
2. _____can be seen when the Bone is in edit mode.
3. Using_____command on the keyboard, you can add to/remove from the selection.
4. If at least one Bone is selected, clicking_____adds a new Bone.
5. In 3D View, clicking_____will add a new Bone to your Armature.

Resources

While studying this Unit, you can browse the internet links for online video tutorials and several books and training DVDs available in the Blender Store and on the Blender Cloud.

- wiki.blender.org
- archive.org
- www.blender.org
- docs.blender.org

યુનિવર્સિટી ગીત

સ્વાધ્યાયઃ પરમં તપઃ
સ્વાધ્યાયઃ પરમં તપઃ
સ્વાધ્યાયઃ પરમં તપઃ

શિક્ષણ, સંસ્કૃતિ, સદ્‌ભાવ, દિવ્યબોધનું ધામ
ડૉ. બાબાસાહેબ આંબેડકર ઓપન યુનિવર્સિટી નામ;
સૌને સૌની પાંખ મળે, ને સૌને સૌનું આભ,
દશે દિશામાં સ્મિત વહે હો દશે દિશે શુભ-લાભ.

અભણ રહી અજ્ઞાનના શાને, અંધકારને પીવો ?
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સુખની ટપાલ પહોંચે સૌને પોતાને સરનામે;
સમાજ કેરે દરિયે હાંકી શિક્ષણ કેરું વહાણ,
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ભવ્ય રાષ્ટ્ર નિર્માણ...
દિવ્ય રાષ્ટ્ર નિર્માણ...
ભવ્ય રાષ્ટ્ર નિર્માણ

DR. BABASAHEB AMBEDKAR OPEN UNIVERSITY
(Established by Government of Gujarat)
'Jyotirmay' Parisar,
Sarkhej-Gandhinagar Highway, Chharodi, Ahmedabad-382 481
Website : www.baou.edu.in

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