



Odisha State Open University



Commonwealth of Learning

# 3D ANIMATION

*3D Modeling*



Diploma in  
Multimedia and Animation (DMA)

DMA-04  
BLOCK-1



# 3D Animation

Block –I : 3D Modeling



ଓଡ଼ିଶା ରାଜ୍ୟ ମୁକ୍ତ ବିଶ୍ୱବିଦ୍ୟାଳୟ, ସମ୍ବଲପୁର  
ODISHA STATE OPEN UNIVERSITY, SAMBALPUR

### 3D Animation

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## Course overview

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### Welcome to Introduction to 3D Animation

In this block, you are going to study about the 3D Modelling Techniques. Basically **3D** Modelling is used for creating 3D model. By using **Blender** software one can create wonderful model. **Blender** is the free and Open Source 3D animation software. Blender can be used to **create 3D visualizations** such as still images, video, and real-time interactive video games. 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.

It is a **Cross-Platform** an OpenGL GUI and runs on **Linux, Mac OS,** 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. As this is 3D based software, the navigation and the working pattern are **very different** unlike any other 2D based software.

---

### Introduction to 3 D Space in Blender

This Course will teach you, what is **3D Interface** and how to experience the **Navigation** within the 3D space using different **Transformation Tools** to manage the work flow and the creation of basic **Meshes** (objects) in Blender; Create **Basic Primitives**, Shortcuts and Identify Buttons and Controls; Customize the user interface to limit the tools and option required for the user in Blender; Use **Hot keys**; Interact with 3D scene using **3D View** for a variety of purposes, such as modeling, animation, texture painting, etc.



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## Introduction to Modelling techniques

This unit will instruct you, what 3D Modeling is and about the important tools, which support the work flow in 3D modeling using various options. You will also learn in detail how to Create, Select, duplicate and mirroring a **Single Object**; To Create **Multiple Objects** with Mirror and Duplicate; Create Object with the knowledge of the **Pivot**; Edit Pivot Point using **Snap Tool** which gives us more flexibility; Organize 3D Scenes using **Layers**; Channelize your work flow that helps you to bring down the complexities of the software; and to Load the Objects to layers to ensure an organised way of handling **complex scenes**.

---

## Inorganic Modelling

**Curves and Surfaces** are very important for Modeling. They are the 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. 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 modelling and how to Create Objects using Curves and Surfaces in Blender; Edit them using different Modes; Work with **Surface modelling** and **Nurbs modelling**; Work effectively with 2D shapes and to Prepare **Curve Deformation** and **Curve Extrusion**.

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## Organic Modelling

This course will guide the **creation of a 3D scene** using three key components to create the **real-time Geometry Modelling** in Blender. You will also learn to use the specific features of Blender 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 with 3D Mesh / Primitives; Edit them with different Modes; Work with **Mesh Modelling**; Create **Polygon Objects** and to Analyse the Mesh.

This video will provide a brief overview of this course.

Topic	YouTube link	QR Code
Video 1 –Introduction to 3D	<a href="https://youtu.be/8d49m8PNWs0">https://youtu.be/8d49m8PNWs0</a>	
Video 2 –Introduction to Blender	<a href="https://youtu.be/RXToUHOHDxE">https://youtu.be/RXToUHOHDxE</a>	
Video 3 –Polygon Modeling	<a href="https://youtu.be/9cCgOZI6frY">https://youtu.be/9cCgOZI6frY</a>	

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## Course outcomes



### Outcomes

Upon completion of 3D Modelling you will be able to:

- Interface and customize elements as the Info Editor (Top), a large 3D View, Time Line (Bottom), Outliner (Top right), properties Editor (Bottom right etc.
- Use Transformation tools in Blender
- Create Multiple Objects with Mirror and Duplicate
- Working Surface modelling
- Create Polygon Objects



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## Timeframe



How long?

This course will be completed within “2” classes.

This course is of “1” credits.

1 Hour of study time is required for this unit.

---

## Study skills



This is a totally practical oriented course.

Hence, you should have access to personal computer or personal laptop for better understanding of this unit.

Each and every options are explained step by step in the course material.

Apart from this course material, the learner has to adopt the tendency of learning from multiple sources i.e.,

- Internet tutorials
- Video tutorials on YouTube
- Collaboration with people working in the industry etc.

Only classroom study will not make you a professional. You have to be active to grab the opportunity of learning wherever you get a chance.

---

## Need help?



Help

In case of any help needed you can browse the internet sites like youtube.com for video tutorials about the subject.

Apart from that, you can contact the writer of this course material at [praseed.nair@manipal.edu](mailto:praseed.nair@manipal.edu)



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## Assignments



### Assignments

There will be some assignments at the end of each unit.

These assignments are mostly practical based and should be submitted in CD or DVD. Theoretical assignments are to be submitted neatly written on A4 size sheet.

All assignments will be submitted to Regional centre of Odisha State Open University or as directed by Co-ordinator.

All assignment should be unit wise on separate CD/DVDs clearly mentioning course title and unit on Top. Theoretical Assignment will be neatly filed or spiral bind with cover clearly mentioning necessary information of course, student detail on top.

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## Assessments



### Assessments

There will be few assessment questions for each unit.

All practical assessment will be submitted to OSOU.

Assessment will take place once at the end of each unit.

Learner will be allowed to complete the assessment within stipulated time frame given by the university.

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## Video Resources



### Reading

This study material comes with additional online resources in the form of videos. As videos puts in human element to e-learning at the same time demonstrating the concepts visually also improves the overall learning experience.

You can download any QR code reader from Google Play to view the videos embedded in the course or type the URL on a web browser.

# Getting around this Course material

## Margin icons

While working through this Course material you will notice the frequent use of margin icons. These icons serve to “signpost” a particular piece of text, a new task or change in activity; they have been included to help you to find your way around this Course material.

A complete icon set is shown below. We suggest that you familiarize yourself with the icons and their meaning before starting your study.

			
<b>Activity</b>	<b>Assessment</b>	<b>Assignment</b>	<b>Case study</b>
			
<b>Discussion</b>	<b>Group activity</b>	<b>Help</b>	<b>Note it!</b>
			
<b>Outcomes</b>	<b>Reading</b>	<b>Reflection</b>	<b>Study skills</b>
			
<b>Summary</b>	<b>Terminology</b>	<b>Time</b>	<b>Tip</b>



# 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.** 1A rendered image being post-processed.



**Source-** blender.org

**Link-**

[https://docs.blender.org/manual/en/dev/getting\\_started/about/introduction.html](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



### 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



### Terminology

<b>Header:</b>	Header contains various menus and controls based on the current mode.
<b>Menu:</b>	Menu offers tools to navigate in 3D space.
<b>Mode:</b>	3D view has several modes used for editing different kinds of data.
<b>Viewport shading:</b>	Allows you to change the way objects are displayed in the viewport.
<b>Transform Manipulator:</b>	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.
<b>Snap:</b>	Controls the snapping tools that help with transforming and modelling objects.
<b>Tool Shelf:</b>	Tool shelf is a context-sensitive region containing tools depending on the current mode.
<b>Properties region:</b>	Properties Region contains properties of the active object and selected objects.
<b>Grid Floor:</b>	The grey squares forming a floor mark the zero height of the world.
<b>Orbit:</b>	Rotate the view around the point of interest.
<b>Roll:</b>	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

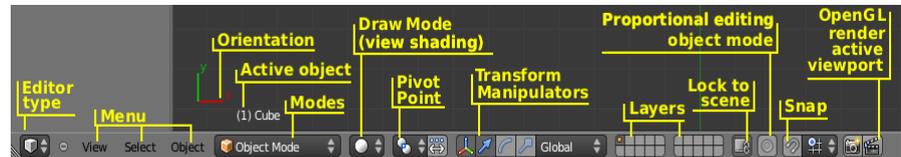
One region, which is always visible, is known as the **Main Region** and is the most prominent part of the editor.



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

**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).

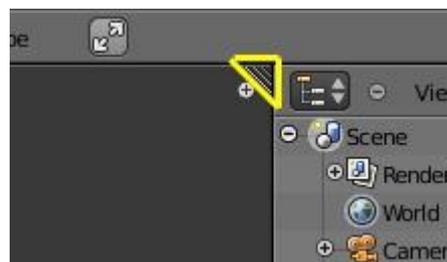
## Arranging the Screen

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

**Source-** blender.org

**Link-**

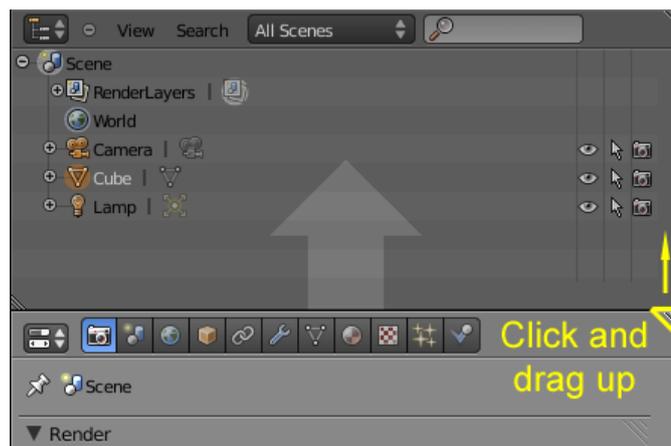
[https://docs.blender.org/manual/en/dev/interface/window\\_system/areas.html](https://docs.blender.org/manual/en/dev/interface/window_system/areas.html)



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 both splits 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.

**Source-** blender.org

**Link-**

[https://docs.blender.org/manual/en/dev/interface/window\\_system/areas.html](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.

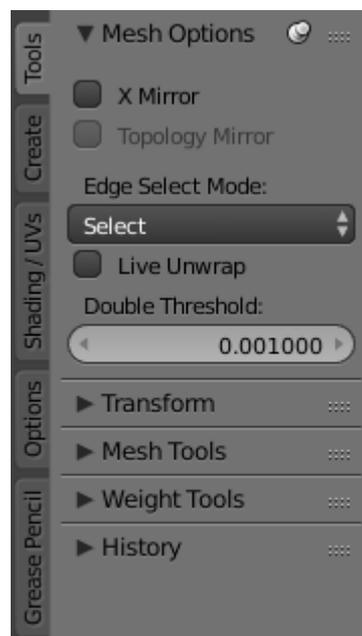
A quicker way to achieve this is to use the shortcuts: **Shift-Spacebar**, **Ctrl-Down** or **Ctrl-Up** to toggle between maximized and normal areas.

## 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](https://docs.blender.org/manual/en/dev/interface/window_system/tabs_panels.html)



**Title-Img 1. 5** Horizontal tab header

**Source-** blender.org

**Link-**

[https://docs.blender.org/manual/en/dev/interface/window\\_system/tabs\\_panels.html](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

**Source-** blender.org

**Link-**

[https://docs.blender.org/manual/en/dev/interface/window\\_system/tabs\\_panels.html](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

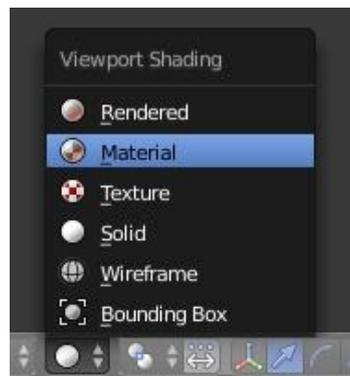


Properties Editor and choose either Horizontal or Vertical from the appearing menu. Keep in mind though that the panels are optimized for vertical alignment.

## 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

**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 Shortcuts



#### Tip

*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.

### *If You Get Lost*



**Tip**

*If you get lost in 3D space, which is common, two hotkeys will help you: Home changes the view so that you can see all objects `View ▸ View All`, while Numpad Period zooms the view to the currently selected objects when in perspective mode `View ▸ View Selected`.*

## 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** thats 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 fourth 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

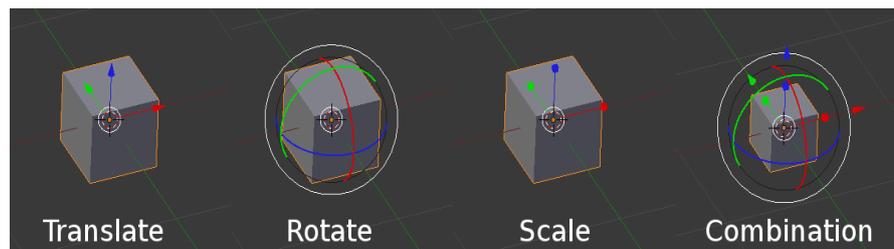
**Source-** blender.org

**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

**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

**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 centre 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 **LocalOrientation**, 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.**



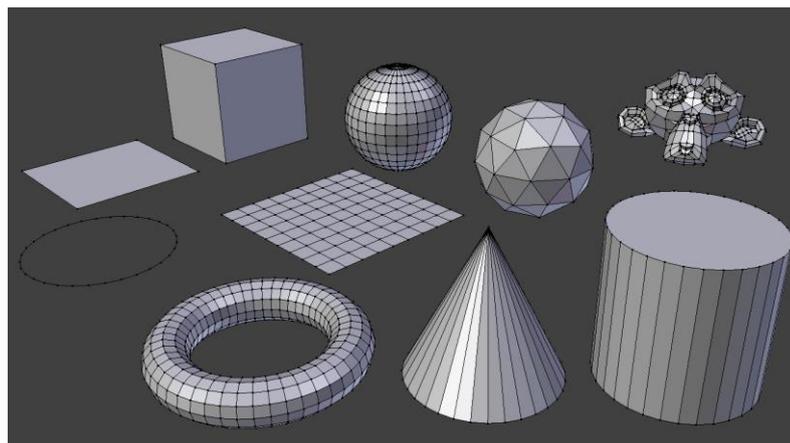
## Creating Basic Primitives

- **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**.

	<b>Undo</b>
	<b>Hotkey:</b> Ctrl-Z
	<b>Redo</b>
<b>Tip</b>	<b>Hotkey:</b> Ctrl-Shift-Z



**Title-Img 1. 12 Blender’s standard primitives**

**Source-** blender.org

**Link-**

<https://docs.blender.org/manual/en/dev/modeling/meshes/primitives.html>



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## Unit summary



### 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.

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## Assignment



### Assignment

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



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## Assessment



### 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.



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## Resources



### Study skills

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](http://wiki.blender.org)
- [archive.org](http://archive.org)
- [www.blender.org](http://www.blender.org)
- [docs.blender.org](http://docs.blender.org)



## Unit 2

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### Introduction to Modelling

#### 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:



#### Outcomes

- 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



### Terminology

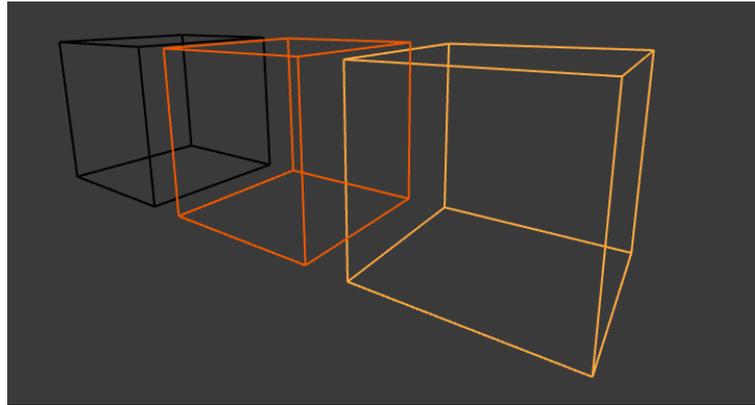
<b>Active Object:</b>	In Object Mode, the last (de)selected item is called the “Active Object”
<b>Point selection:</b>	Selecting the Object in the viewport with a RMB.
<b>Border select:</b>	With Border Select, you can draw a rectangle while holding down LMB.
<b>Lasso select:</b>	Lasso select is used to draw a dotted line around the pivot point of the Objects, in Object Mode.
<b>Circle select:</b>	Circle Select is used to move with dotted circle through Objects with LMB.
<b>Mirror:</b>	Mirroring an Object or Mesh selection will create a reversed version of the selection.
<b>Duplicate:</b>	This will create a visually-identical copy of the selected Object(s).
<b>Edge Ring:</b>	In Edge select mode, holding Ctrl-Alt while selecting an edge selects a sequence of edges that are not connected.
<b>Selection to grid:</b>	Snaps the currently selected Object(s) to the nearest grid point.
<b>Cursor to Selected:</b>	Moves the cursor to the centre of the selected Object(s).
<b>Layers:</b>	Objects can be placed into one or more “layers” using Object layers.
<b>Cursor to center:</b>	Moves the cursor to the center of the grid.

## Work Flow of Modelling

### 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/selecting/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-RMB**.



- 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.

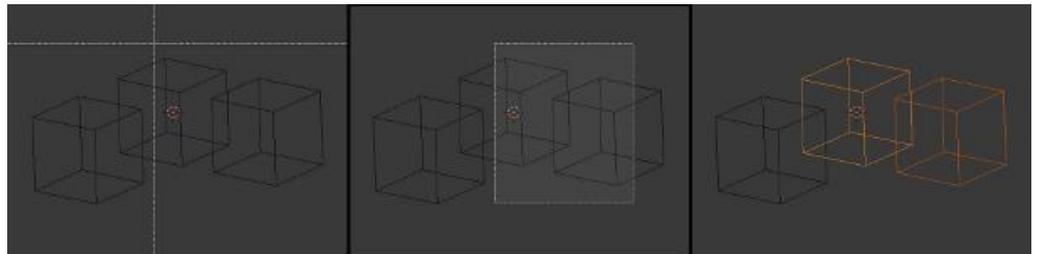
## Border Select

- **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 **dotted cross-hair cursor**. 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

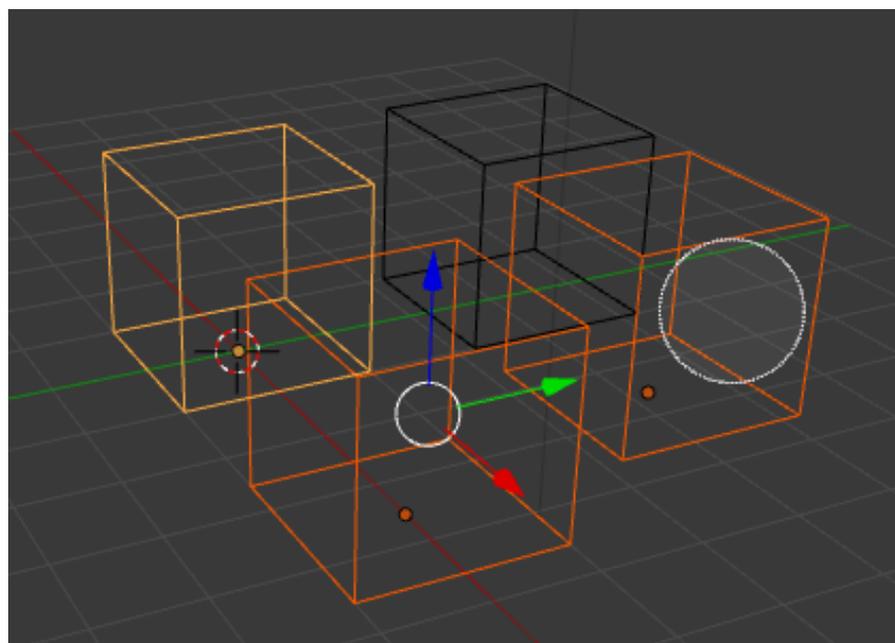
- **Mode:** Object Mode and Edit Mode
- **Menu:** no entry in the menu
- **Hotkey:** Ctrl-LMB

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.

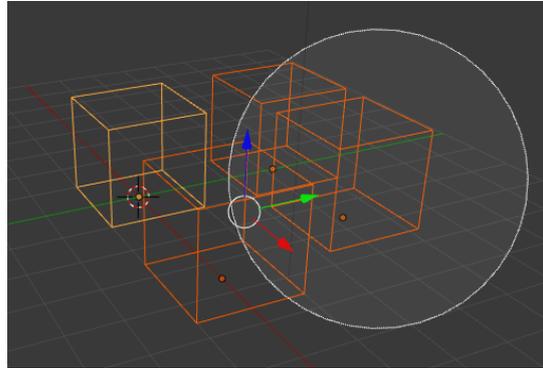


Title-Img 2. 3Circle selection

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.

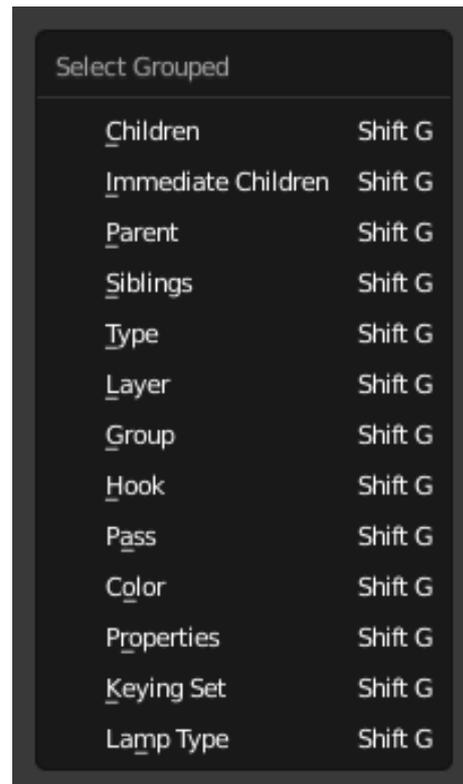
### Select Grouped

- **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 half an Object**, duplicate it and then use the **mirror transform** 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/mirror.html>

## Duplicate Object

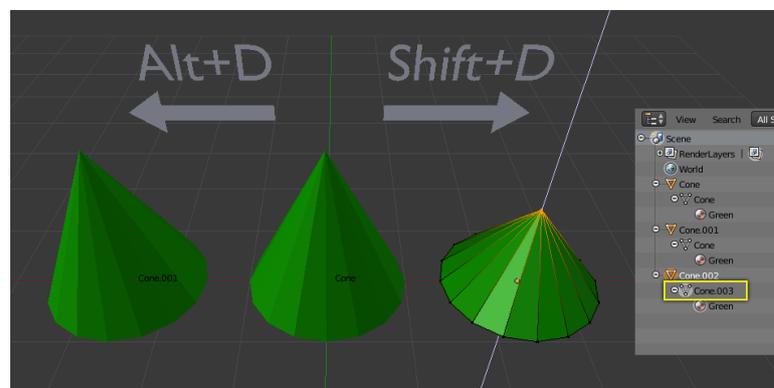
This will create a **visually-identical copy** of the selected Object(s). The copy is created at the same position as the original Object and you are automatically placed in **Grab mode**.

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 of duplication is sometimes called “**shallow link**”, because not all 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/duplication.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)

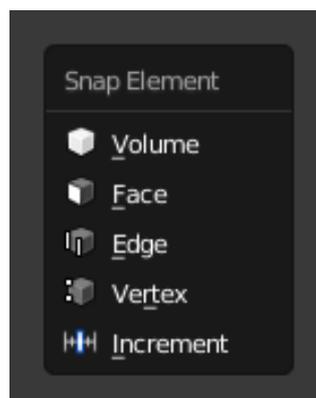
**Source-**Blender.org

**Link-**

<https://docs.blender.org/manual/en/dev/editors/3dview/object/editing/transform/control/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/control/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 increment changes depending 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. 10Various Snap option



Source-Blender.org

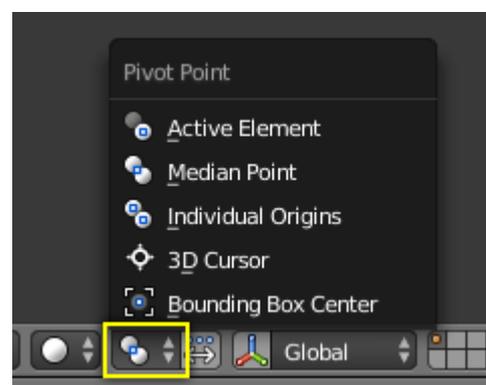
**Link-**

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

Source-Blender.org

**Link-**<http://blender-manual->

[i18n.readthedocs.io/ja/latest/editors/3dview/transform/transform\\_control/pivot\\_point/](http://i18n.readthedocs.io/ja/latest/editors/3dview/transform/transform_control/pivot_point/)

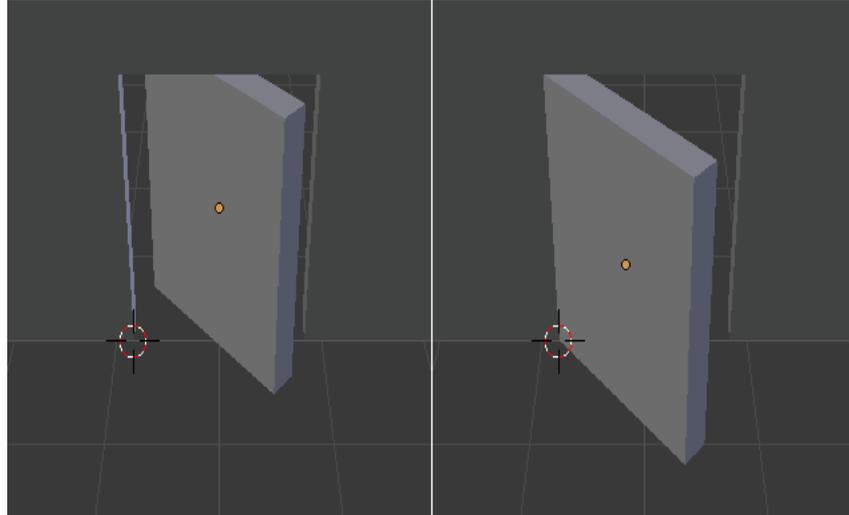
## 3D Cursor

- **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.

Source-Blender.org

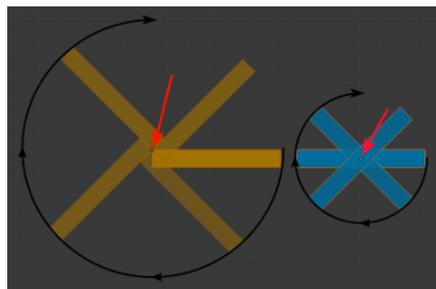
Link-

[https://docs.blender.org/manual/en/dev/editors/3dview/object/editing/transform/control/pivot\\_point/3d\\_cursor.html](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-

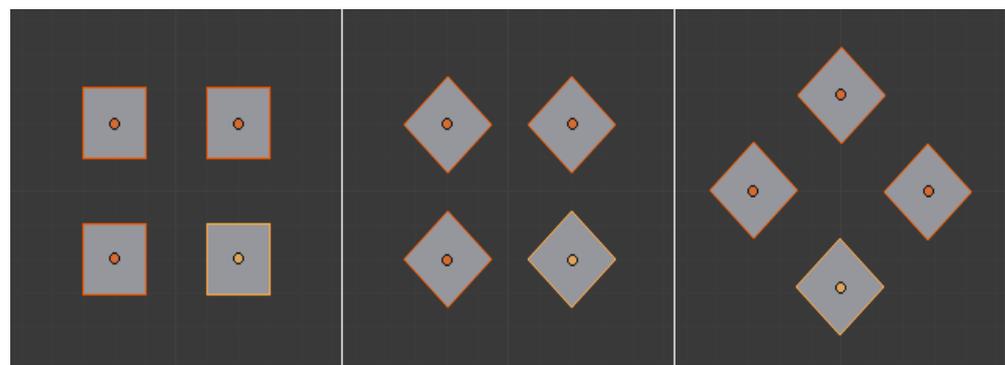
[https://docs.blender.org/manual/en/dev/editors/3dview/object/editing/transform/control/pivot\\_point/individual\\_origins.html?highlight=rotation%20around%20individual%20origins](https://docs.blender.org/manual/en/dev/editors/3dview/object/editing/transform/control/pivot_point/individual_origins.html?highlight=rotation%20around%20individual%20origins)

The **Origin of an Object** is shown in the 3D View by a **small orange circle**. 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.

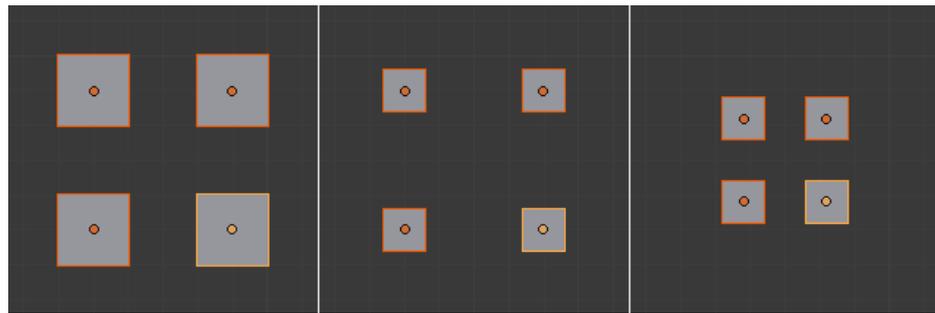


Title-Img 2. 14 Rotation around individual origins (middle) compared to the median point (right)

## Source-Blender.org

### Link-

[https://docs.blender.org/manual/en/dev/editors/3dview/object/editing/transform/control/pivot\\_point/individual\\_origins.html](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](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/relations/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 the scene

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/layers.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/layers.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/layers.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.



Tip

*New Objects can be created with  
Add menu in the 3D Views header.*



## 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 that do not render. They are useful for controlling the position 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.



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## Unit summary



### 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.

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## Assignment



### 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



### 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



### Study Skills

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](http://wiki.blender.org)
- [archive.org](http://archive.org)
- [www.blender.org](http://www.blender.org)
- [docs.blender.org](http://docs.blender.org)



## Unit 3

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### Inorganic Modelling

#### Introduction

**Curves and Surfaces** are very important for Modelling.

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 modelling.

#### Outcomes

**Upon completion of this unit you will be able to:**



#### Outcomes

- Create and work with Curves.
- Edit the Curves using different Modes.
- Working Surface modelling.
- 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 control.

**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**.

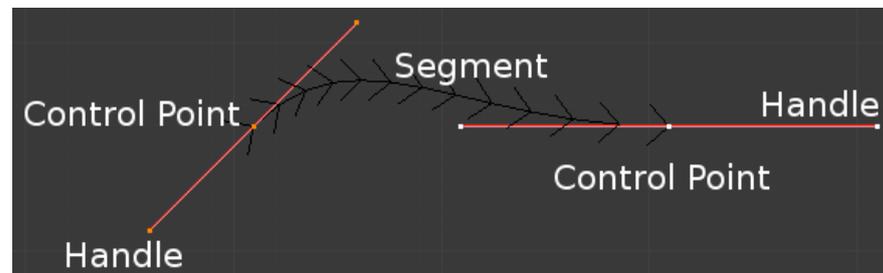
#### Control Points



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 **middle of the pink line** 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 ▶ Bezier.
- **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



**Tip**

*While in Edit Mode, you cannot directly select a Segment. To do so, select all of the Control Points that make up the Segment you want to move.*

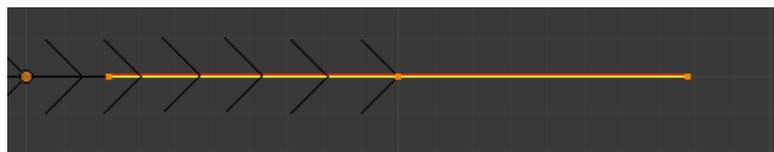
## Handles

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.



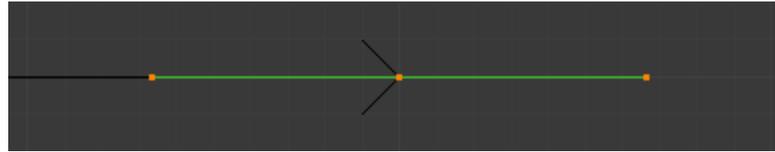
Title-Img 3. 2 Bezier handle type.

Source-

**Link-**<http://blender-manual-118n.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.



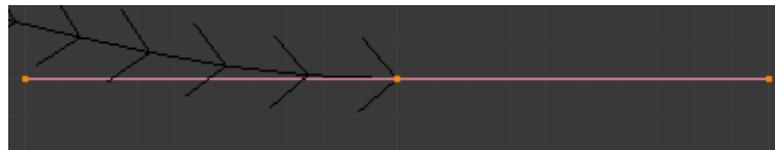
Title-Img 3. 3 Bezier handle type.

Source-Blender.org

Link-<http://blender-manual-118n.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-118n.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-118n.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 extended 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

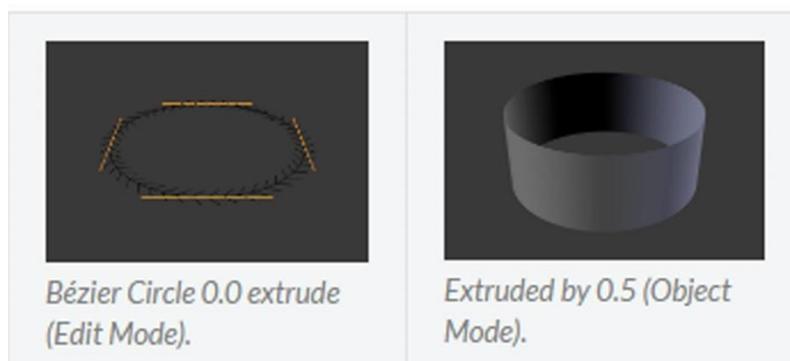
This toggles between an open curve and closed curve (**Cyclic**). Only curves with at least one selected control point will be **closed/open**. The shape of the closing segment is based on the **start and end** handles for Bézier curves, and as usual on adjacent control points for **NURBS**. The only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

- **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. 6Curve Extrusion

Source-Blender.org

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

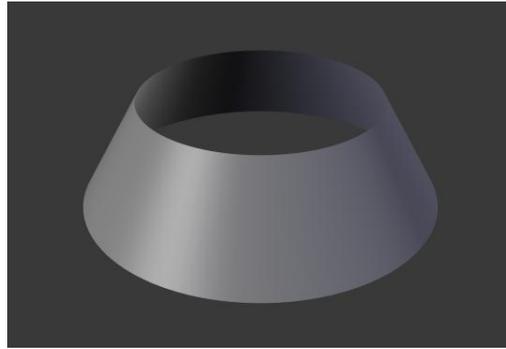
## Tilt

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



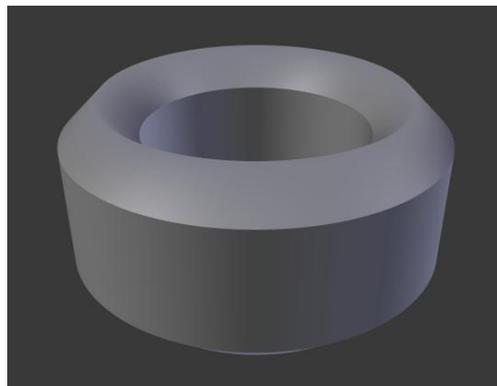
**Title-**Img 3. 2 30-degree Mean Tilt of all control points.

**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.



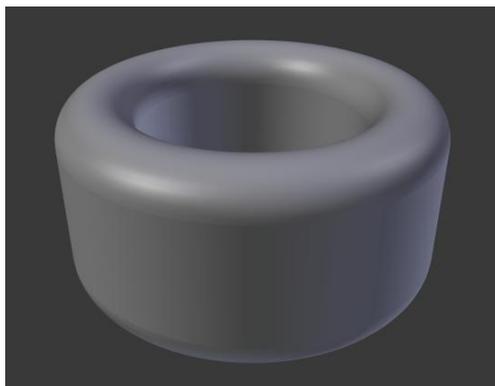
**Title-**Img 3. 3Bevel depth of 0.25, fill set to full, zero Mean Tilt.

**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**. If set the to 0 (the default), the bevel is a simple “flat” Surface. Higher values will smooth, round off the bevel, similar to the resolution settings of the curve itself.



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

Source-Blender.org

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

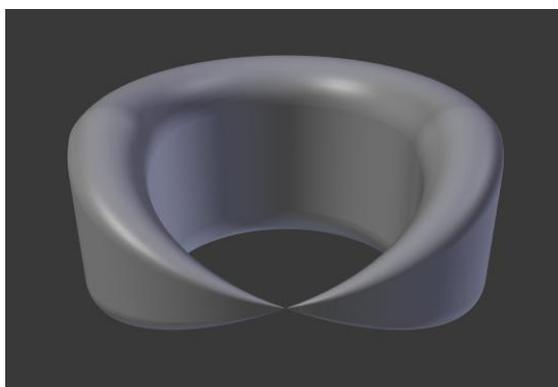
### Offset

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

*-1 Offset, 0.5 Extrusion, 0.25 Bevel Depth,  
10 Bevel resolutions*

### 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. 5One control point radius set to zero

Source-Blender.org

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



Tip

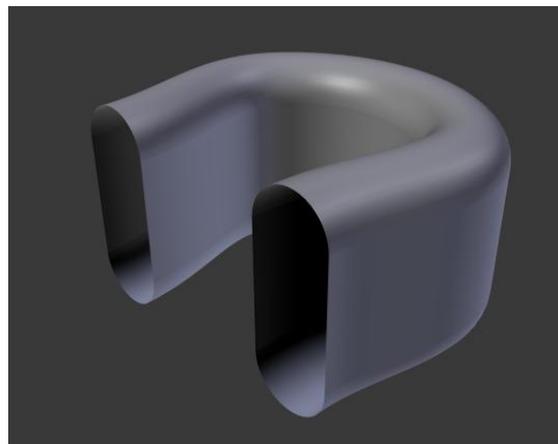
Remember, these curves can be converted into Meshes with **Alt-C** in Object Mode.

### Three Sub-Classes of Curve:

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**

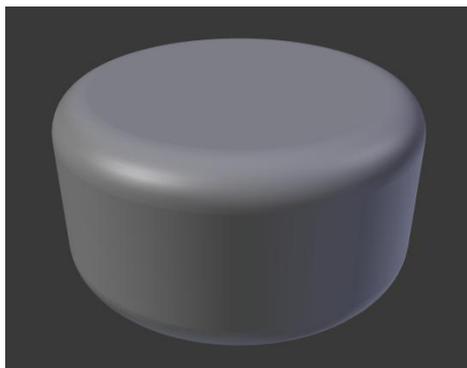
**Link-**

<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. 7Closed 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 Extrusion

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 **2D or 3D** has no importance, but if it is closed, it will create a “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 **Extrusion is constant**, 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.

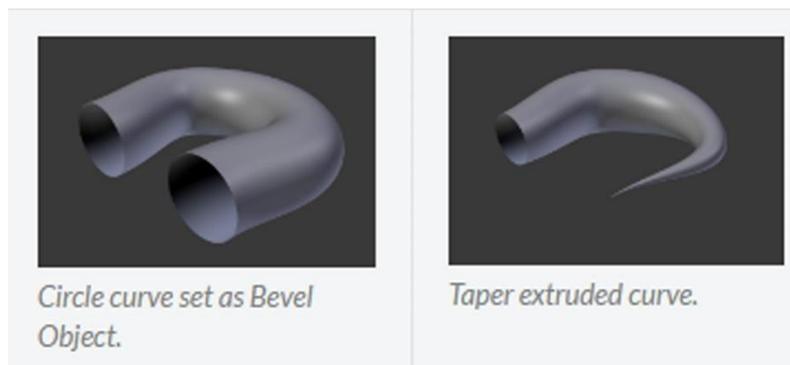
It might need to increase the curve resolution to see more detail of the taper.

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

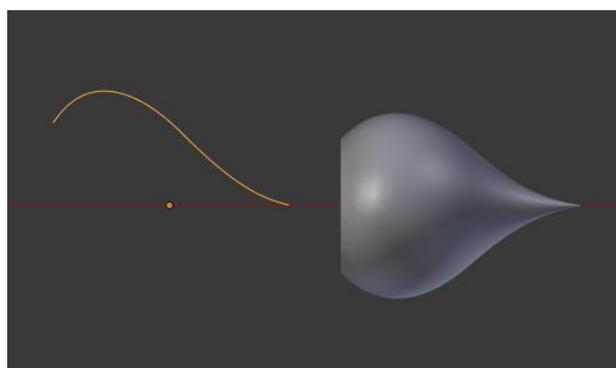
**Source-Blender.org**

**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. 9Taper example 1.

**Source-Blender.org**

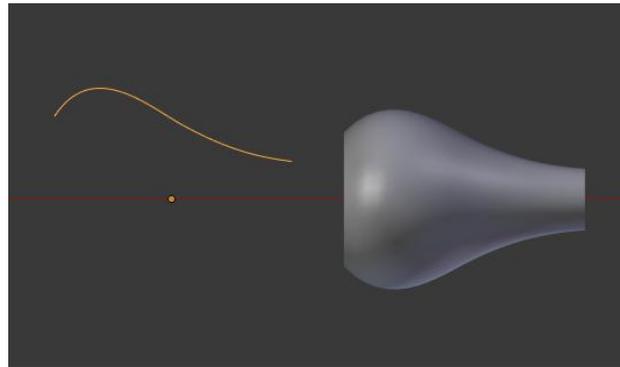
**Link-**

<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.



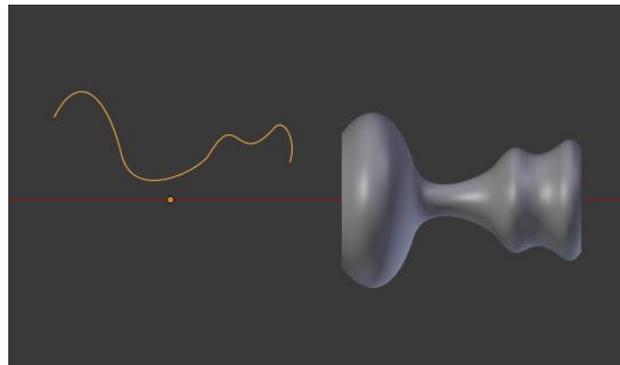
**Title-**Img 3. 10Taper example 2.

**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.



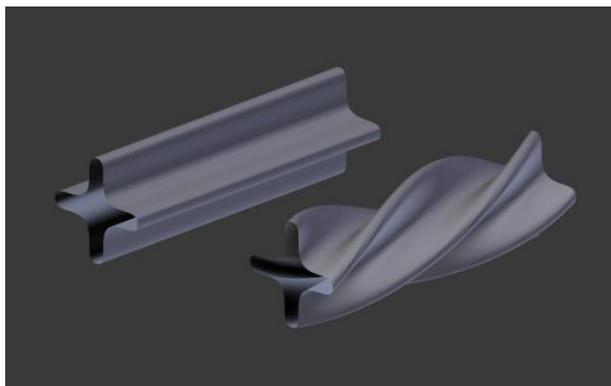
**Title-**Img 3. 11Taper example 3.

**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

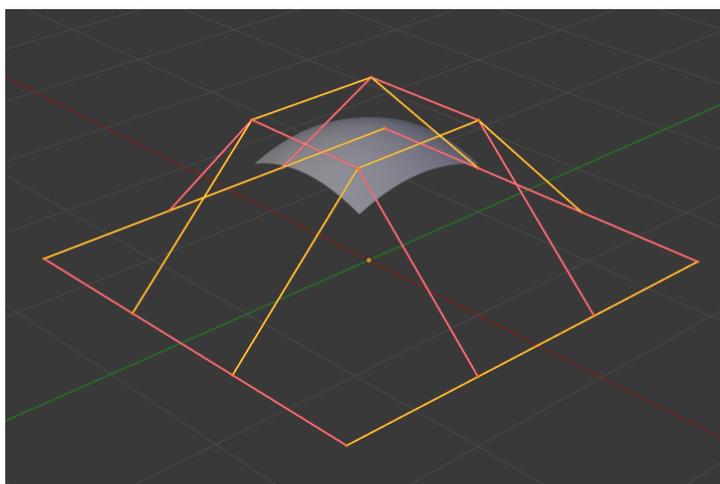
**Link-**

<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...).



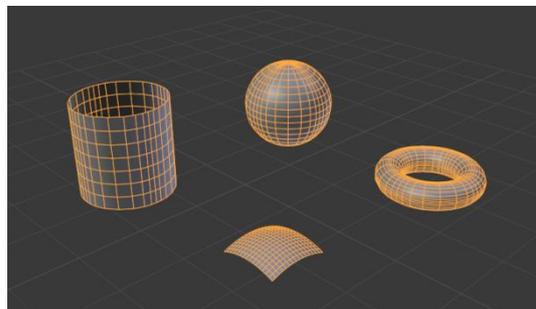
*Tip*

*To take a more “real life” example, you can roll a sheet of paper to create a cylinder; well, even if it “draws” a volume, the sheet itself will remain a nearly 2D object!*

## 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



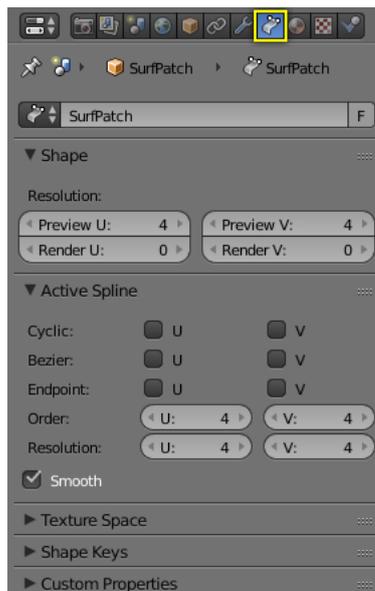
Title-Img 3. 14NURBS Surface primitives.

Source-Blender.org

Link-

<https://docs.blender.org/manual/en/dev/modeling/surfaces/primitives.html#common-options>

## Properties



**Title-**Img 3. 15Surface Properties.

**Source-**Blender.org

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

## Shape



**Title-**Img 3. 16Shape 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

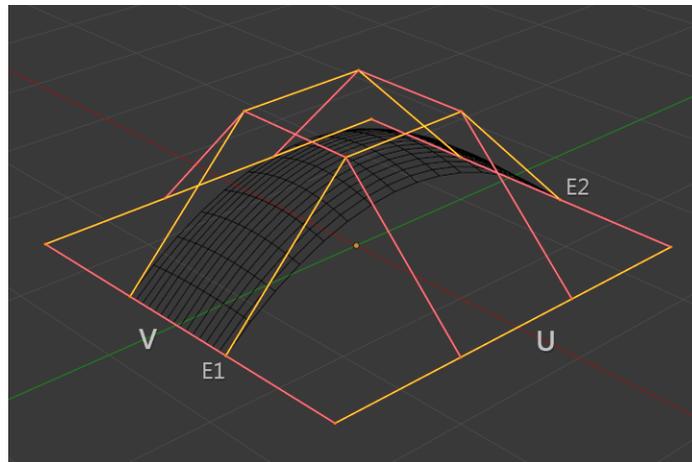
### Render

U, V



## Bezier Endpoint

Just like with NURBS curves, **NURBS Surfaces have two knot vectors**, 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. 17Endpoint U.

**Source-**Blender.org

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

In [img 3.22](#) Endpoint U, the **U interpolation** axis is labeled as “U” and the **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 outer edges 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 would not make any sense!**

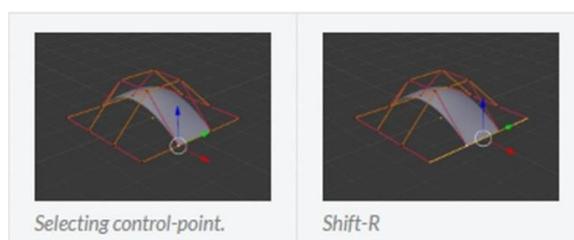
**The control "grid" must remain "squarish", which means that you can only extrude a whole row, not parts of rows here and there.**

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.

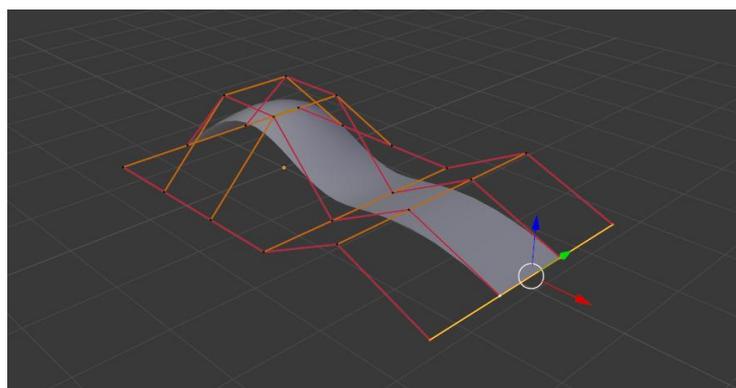


**Title-**Img 3. 18Selecting control point

**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. 19Extruding



### 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:

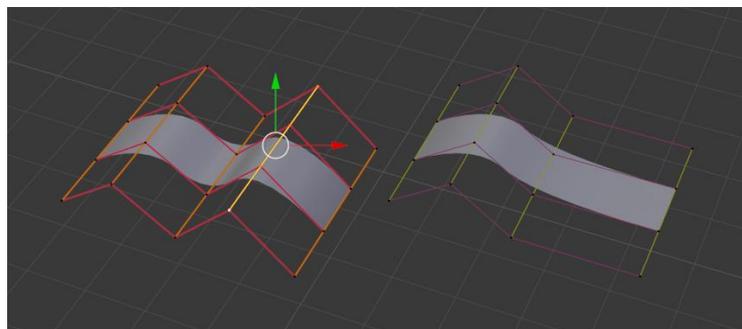
- **Selected**

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.  
20Before and  
After



**Source-**  
**Blender.or**  
**g**

**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



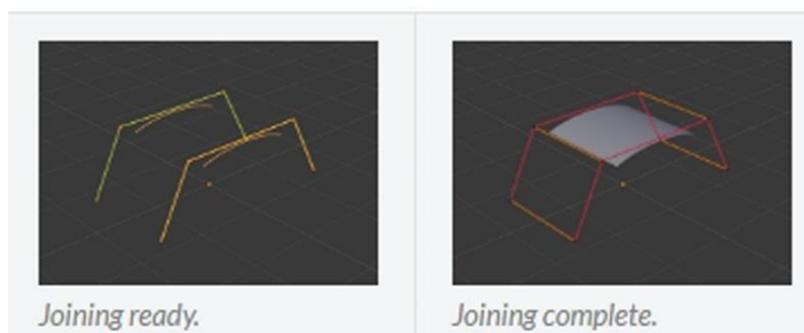
selected row of control points is erased, resulting in [Img 3. 22](#) Before and after (right).

### 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>



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## Unit summary



### 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.

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## Assignment



### 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.

1. \_\_\_\_\_ turns a one-dimensional curve into a two-dimensional curve by giving it height.
2. \_\_\_\_\_ moves the Extrusion parallel to the curve normal.
3. \_\_\_\_\_ allows you to directly control the width of the Extrusion along the “spinal” curve.
4. \_\_\_\_\_ handle has a completely automatic length and direction which is set by Blender to ensure the smoothest result.

---

## Resources



Study Skills

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](http://wiki.blender.org)
- [archive.org](http://archive.org)
- [www.blender.org](http://www.blender.org)
- [docs.blender.org](http://docs.blender.org)



## Unit 4

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### Organic Modelling

#### 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



##### 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.



<b>Edges:</b>	An edge always connects two vertices by a straight line.
<b>Faces:</b>	Faces are used to build the actual surface of the Object.
<b>Loops:</b>	Edge and Face Loops are sets of faces or edges that form continuous “loops”.
<b>Edge Lops:</b>	Loops (1 and 2) in Img 4. 1 Edge and Face Loops are edge Loops.
<b>Face Lops:</b>	These are a logical extension of Edge Loops in that they consist of the faces between two Edge Loops.
<b>Edge Ring:</b>	In Edge select mode, holding Ctrl-Alt while selecting an edge selects a sequence of edges that are not connected.
<b>Subdividing:</b>	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.
<b>Tessellation:</b>	The tiling of a plane using one or more geometric shapes usually resulting in Micro polygons.
<b>Coplanar:</b>	Refers to any set of elements that are all aligned to the same 2D plane in 3D space.

## Modelling 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 for Modelling

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



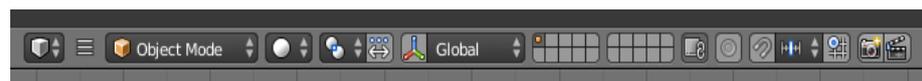
More detailed editing of the Mesh model shape is done in **Edit Mode**, and **Sculpt Mode**. The nature of these three modes determines the tools that are available within the various panels of 3D View. Switching between modes while Modelling is common. Some tools may be available in more than one mode 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. 2Object 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:

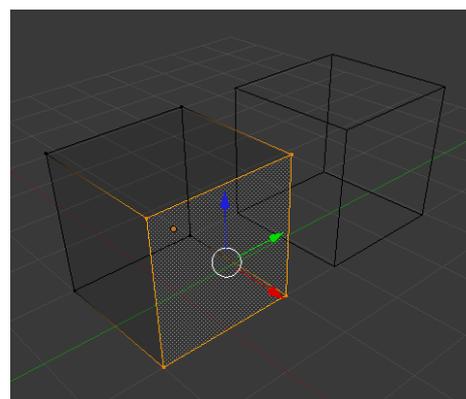


**Title-**Img 4. 2Edit Mode Header.

### Source-Blender.org

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

## Visualization

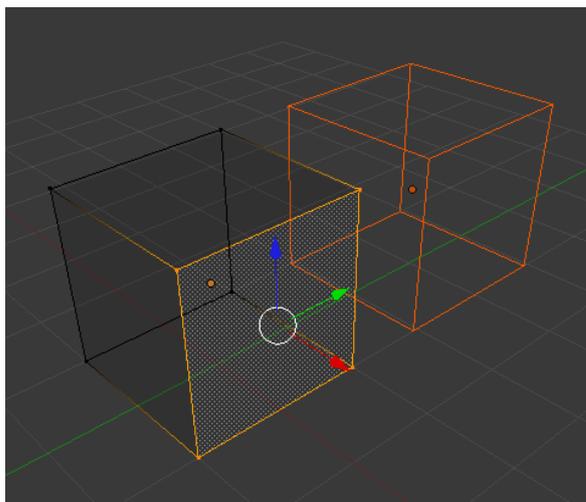


**Title-**Img 4. 3One cube selected



Source-Blender.org

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



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

Source-Blender.org

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

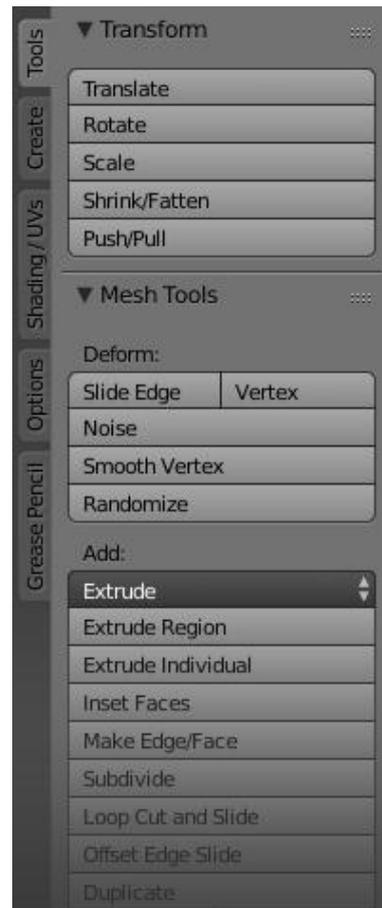
By default, **Blender** highlights selected geometry in **orange in both Object Mode and Edit Mode**.

- 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. 5The Tool Shelf panel in edit mode.

**Attribution-**

**Source-Blender.org**

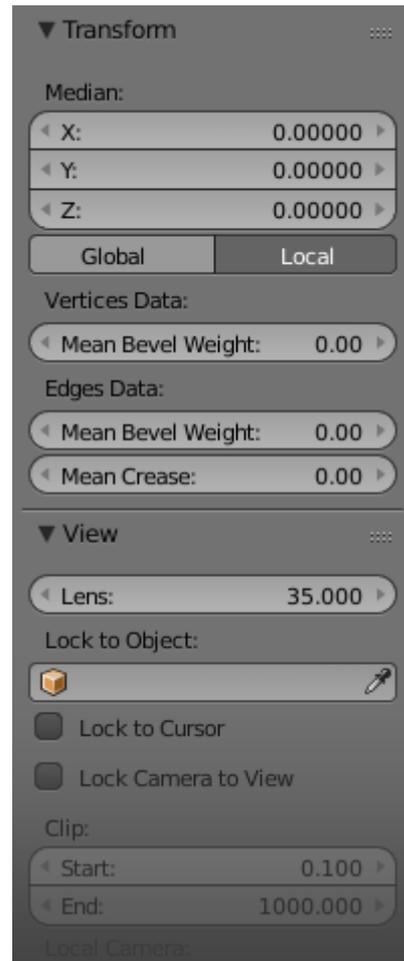
**Link-**<https://docs.blender.org/manual/en/dev/modeling/meshes/introduction.html>

**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 **Tool Shelf**.



## Properties Region



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

**Source-**Blender.org

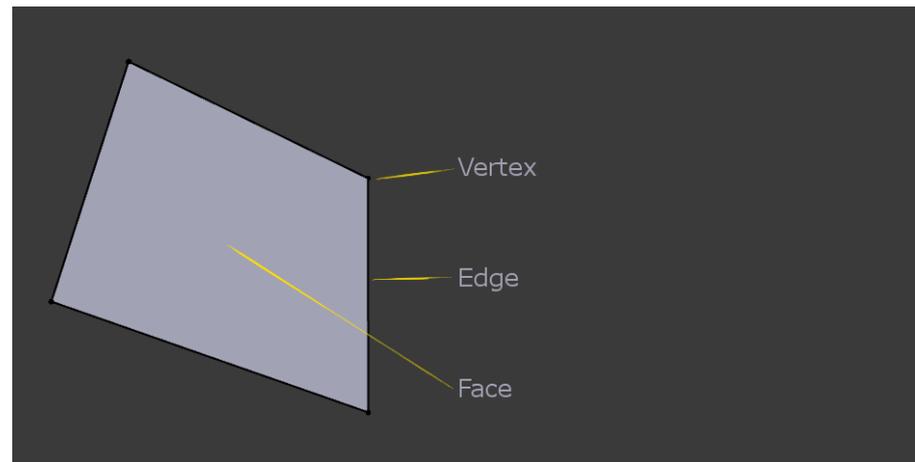
**Link-**<https://docs.blender.org/manual/en/dev/modeling/meshes/introduction.html>

**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.

## Structure

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



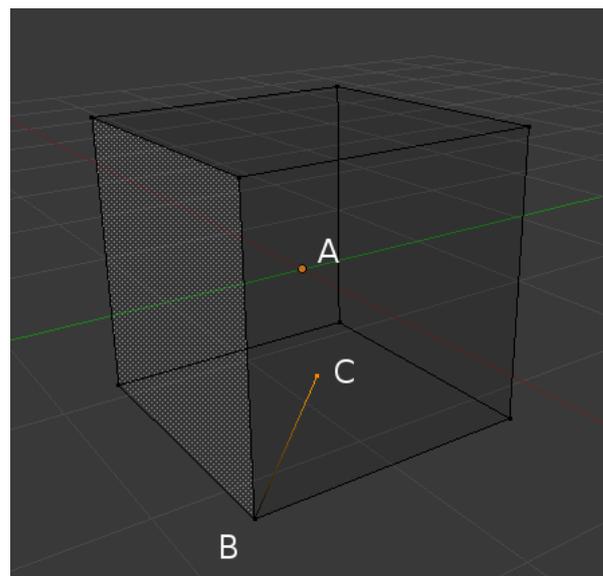
**Title-**Img 4. 3Example of Mesh structure.

**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. 4Vertex 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**.

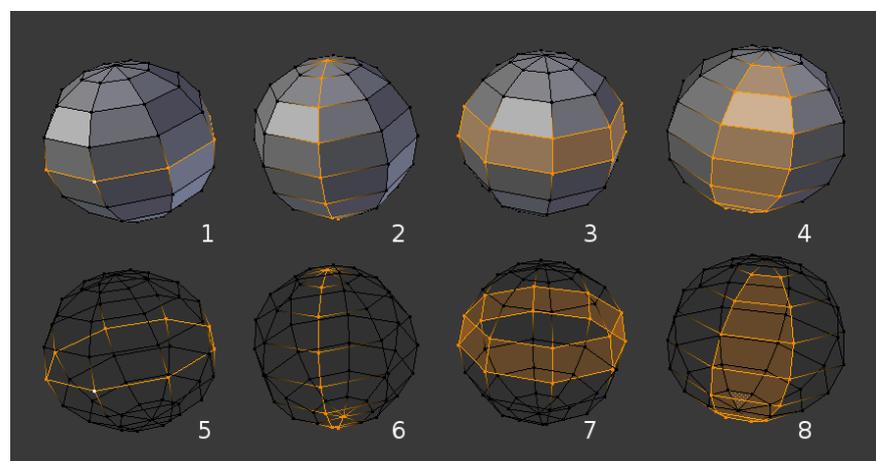
## Face

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. 5Edge 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](#))



#### Tip

*Loops (2 and 4) do not go around the whole model. Loops stop at so called **poles** because there is no unique way to continue a loop from a pole. **Poles** are vertices that are connected to either three, five, or more edges. Accordingly, vertices connected to exactly one, two or four edges are not poles.*

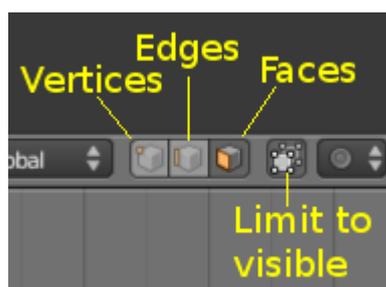


## Selection Mode

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. 6Edit 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.

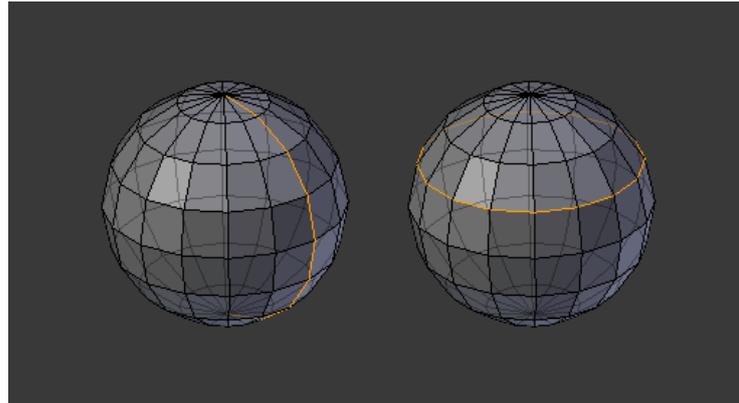
Edge loops can also be selected based on an existing edge selection, using either **Select ▸ Edge Loop**, or the Edge Loop Select option of the Edge Specials Menu **Ctrl-E**.



*Tip*

#### Vertex mode

In Vertex select mode, you can also select edge loops, by using the same hotkeys, and clicking on the edges (not on the vertices).



**Title-**Img 4. 7Longitudinal and latitudinal edge loops

**Source-**Blender.org

**Link-**

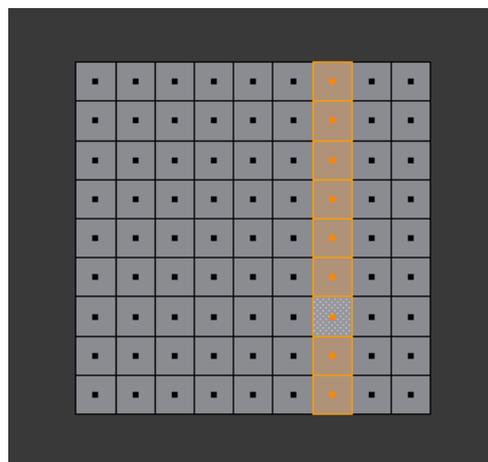
<https://docs.blender.org/manual/en/dev/modeling/meshes/selecting/advanced.html>

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



**Title-**Img 4. 8Face loop selection

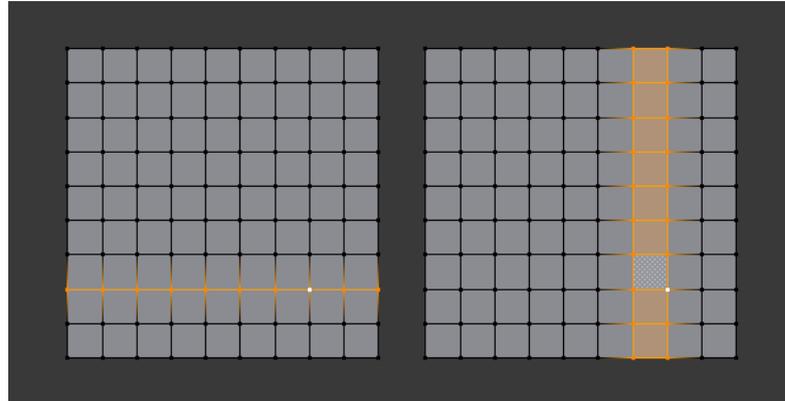
**Source-**Blender.org

**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.

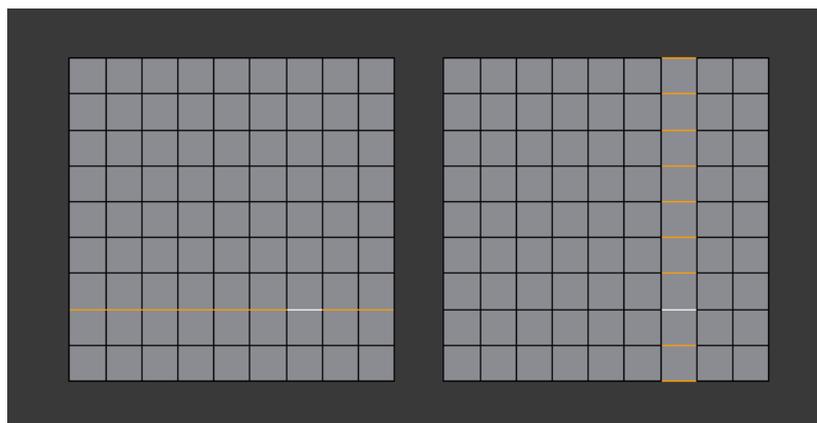
As with edge loops, you can also select **edge rings** based on current selection, using either **Select ▸ Edge Ring**, or the Edge Ring Select option of the Edge Specials Menu **Ctrl-E**.



**Tip**

#### **Vertex mode**

*In Vertex select mode, you can use the same hotkeys when clicking on the edges (not on the vertices), but this will directly select the corresponding face loop.*



**Title-**Img 4. 10A 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 edge was clicked on, but two different “groups of edges” were selected, based on the different commands. One is **based on edges** during computation and the other is **based on faces**.

## Duplicating / Mesh Editing Tools

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

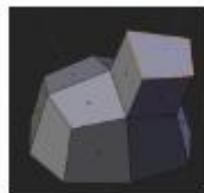
- **Mode:** Edit Mode
- **Panel:** Mesh Tools ▸ Extrude
- **Menu:** Mesh ▸ Extrude Region
- **Hotkey:** E or Alt-E

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**. **Extrude is one of the most frequently used Modelling tools in Blender**

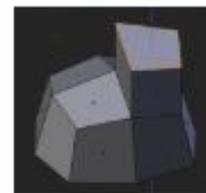
The selection is extruded along the common normal of selected faces. In every other case the extrusion can be **limited to a single axis** by specifying an axis (e.g. X to limit to the X axis or Shift-X to the YZ plane). When extruding along the face normal, limiting movement to the **global Z axis**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

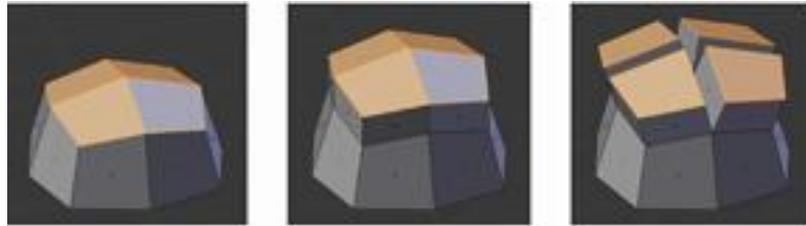
<https://docs.blender.org/manual/en/dev/modeling/meshes/editing/duplicating/extrude.html>

### 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 faces are).



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

**Source-Blender.org**

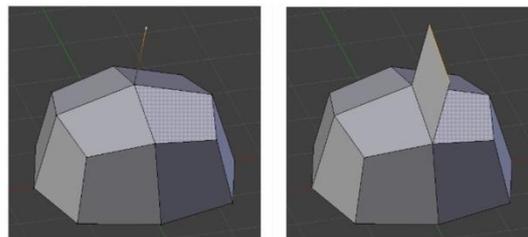
**Link-**

<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.

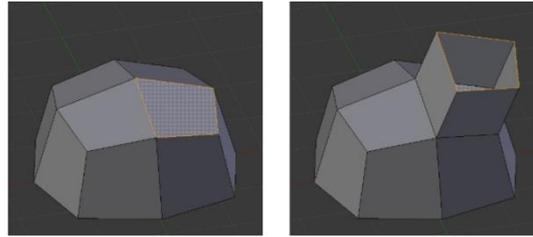


**Title-**Img 4. 12Single vertex extruded. Single edge extruded

**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**

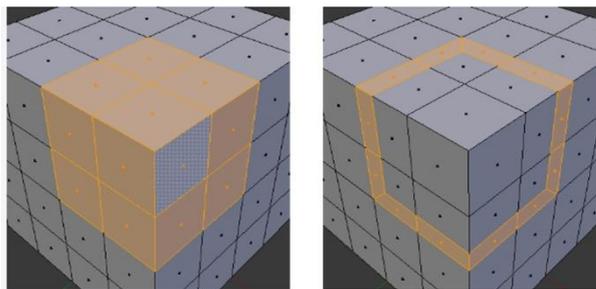
**Link-**

<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

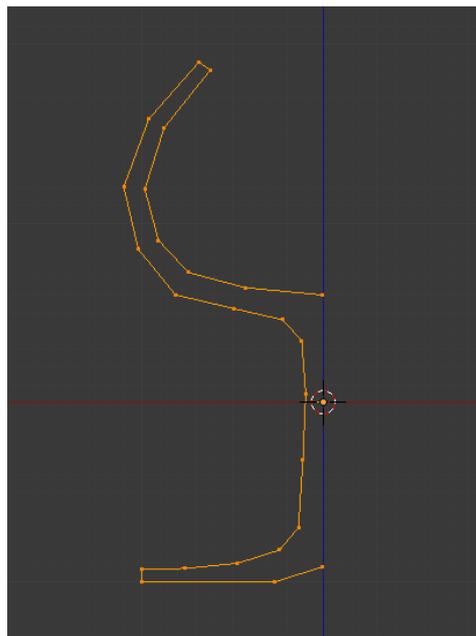
- **Panel:** Mesh Tools

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**

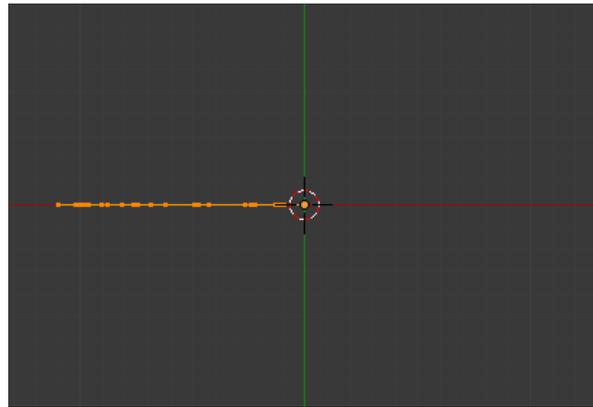
**Link-**

<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. 16Glass profile, top view in Edit Mode, just before spinning.

**Source-Blender.org**

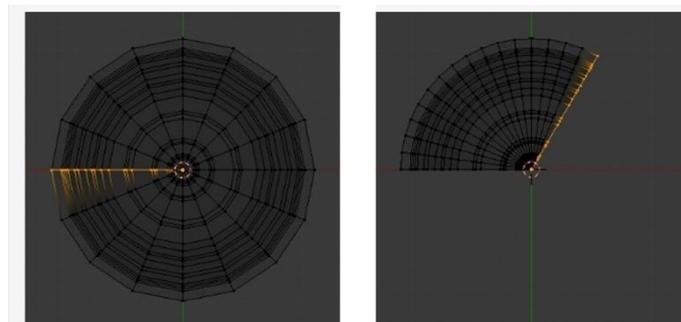
**Link-**

<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 **top view**, 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 **with a question mark** 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**

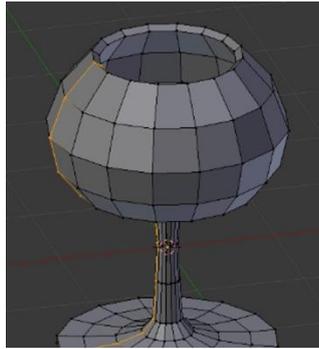


**Title-**Img 4. 19Spun Profile with an angle of 360 and 120.

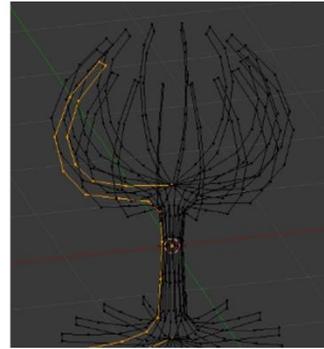
**Source-Blender.org**

**Link-**

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



Result of spin operation



Result of Dupli enabled

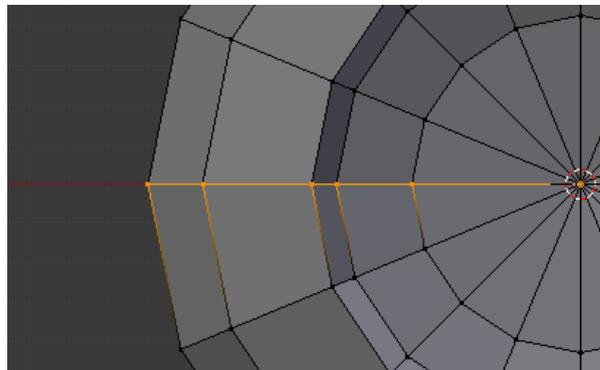
Title-Img 4. 20Result of Spin & Dupli

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

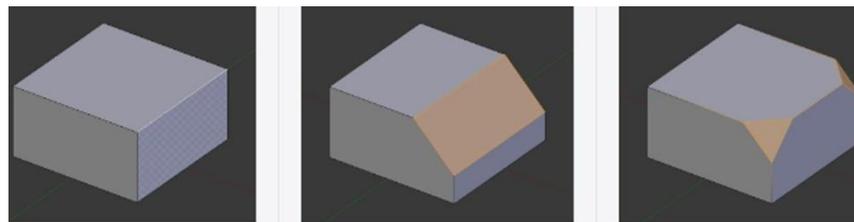
- **Mode:** Edit Mode
- **Menu:** Mesh ▸ Edges ▸ Bevel or **Ctrl-E** ▸ Bevel



- 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 tool works on selected vertices instead of edges. 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.



Study Skills

[https://en.wikibooks.org/wiki/Blender\\_3D:\\_Noob\\_to\\_Pro/Mesh\\_Modelling](https://en.wikibooks.org/wiki/Blender_3D:_Noob_to_Pro/Mesh_Modelling)



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## Unit summary



### 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



### Assignment

- Create a **flower vase**, a **wine glass** and a **cup** using **Nurbs** curves.



---

## Assessment



### 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](#).



### Study Skills

- [wiki.blender.org](http://wiki.blender.org)
- [archive.org](http://archive.org)
- [www.blender.org](http://www.blender.org)
- [docs.blender.org](http://docs.blender.org)