

Participant Handbook

Sector
Gem and Jewellery

Sub-Sector
**Cast and Diamonds Set
Jewellery**
Occupation
**Designing and Product
Development**

Reference ID: **G&J/Q2303, Version 3.0**
NSQF Level 4



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Jewellery Designer - CAD

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Shri Narendra Modi
The Prime Minister of India

“ Skilling is building a better India.
If we have to move India towards
development then Skill Development
should be our mission. ”



**COMPLIANCE TO
QUALIFICATION PACK – NATIONAL OCCUPATIONAL
STANDARDS**

is hereby issued by the

GEM AND JEWELLERY SKILL COUNCIL OF INDIA
for

SKILLING CONTENT : PARTICIPANT HANDBOOK

Complying to National Occupational Standards of

Job Role/ Qualification Pack: **'Jewellery Designer - CAD'** QP No. **'G&J/Q2303 / NSQF Level 4 Version - 3'**

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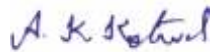
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Sincerely,



Adil Kotwal
Chairman, GJSCI

About this book

This Participant Handbook is designed to enable training for the Jewellery Designer-CAD Qualification Pack. Each National Occupational (NOS) is covered across Unit/s.

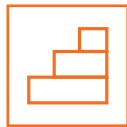
Key Learning Objectives for the specific NOS mark the beginning of the Unit/s for that NOS. The symbols used in this book are described below.

- This book is a detailed description on Jewellery Designer- CAD at basic level.
- This book covers the right information from the beginning of the introduction of CAD software to basic working on different CAD softwares to making finished CAD based Jewellery products.
- This book will help the individual to grow their potential in terms of thinking, observing and creating a piece on the CAD software.
- This book contains tips and worksheet at the end of every unit, this will help in Gain knowledge oning the unit deeply.

Symbols Used



Key Learning
Outcomes



Steps



Tips



Notes



Unit
Objectives



Exercise

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It is recommended that all the trainings include the appropriate Employability Skills Module.

Content for the same is available here:
<https://www.skillindiadigital.gov.in/content/list>





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Transforming the skill landscape



1. Introduction

Unit 1.1 - Gem & Jewellery Sector in India

Unit 1.2 - Objectives of the Course

Unit 1.3 - About Jewellery



Key Learning Outcomes

At the end of this module, you will be able to:

1. Discuss the Gem and Jewellery sector in India, and its sub-sectors.
2. Gain knowledge about jewellery and its need of designing.
3. Define your Roles and responsibilities as jewellery CAD designer.
4. Identify tools and equipment required while CAD designing.
5. Demonstrate skills required for the job (behavioural, professional, technical and communication).
6. Maintain a safe, hygienic and secure working environment.

Unit 1.1: Gem and Jewellery Sector in India

Unit Objectives

At the end of this unit, you will be able to:

1. Gain knowledge on the significance of the gem and jewellery sector in India.

1.1.1 Significance of Gem and Jewellery Sector in India

The Gems and Jewellery Sector plays a major role within the Indian economy, impacting approximately 6-7 % of the country's gross domestic product (GDP) Being one of the quickest growing sectors, it's particularly export directed and labour intensive.

Based on its potential for growth and worth addition, the Government of India has declared the Gems and Jewellery sector as focus industry for export promotion. The Government has recently undertaken various measures to boost investments and to upgrade technology and skills to market 'Brand India' within the international market.

India's Gems and Jewellery sector has been conducive in an exceedingly huge way to the country's foreign exchange earnings (FEEs). The Government of India has viewed this industry as a robust area for export promotion.

- With a market size of just about INR 4,54,100 crores, the industry encompasses a massive share of the gross domestic product at approximately 5.9 %, apart from large-scale employment generation and foreign exchange earnings.
- Market research reveals that jewellery accounts for over a fourth of discretionary expenditure by consumers in India. This combined with rising earning levels in India may be a major growth driver.
- India has a calculable 229 crore women in the age group of 20 to 49. The number of working women in skilled sectors who are considered the amongst the key consumers for jewellery is rising rapidly.
- With over 300 crore individuals falling within the 25-29 age bracket in the period 2011-21, an estimated 150 crore weddings are expected to take place during this period.
- In Tier-3 zones, where landowners and moneylenders are the primary resource of monetary credit, jewellers have emerged as an alternate, providing investment choices through gold jewellery.

1.1.1 Significance of Gem and Jewellery Sector in India

Gem and Jewellery industry classification

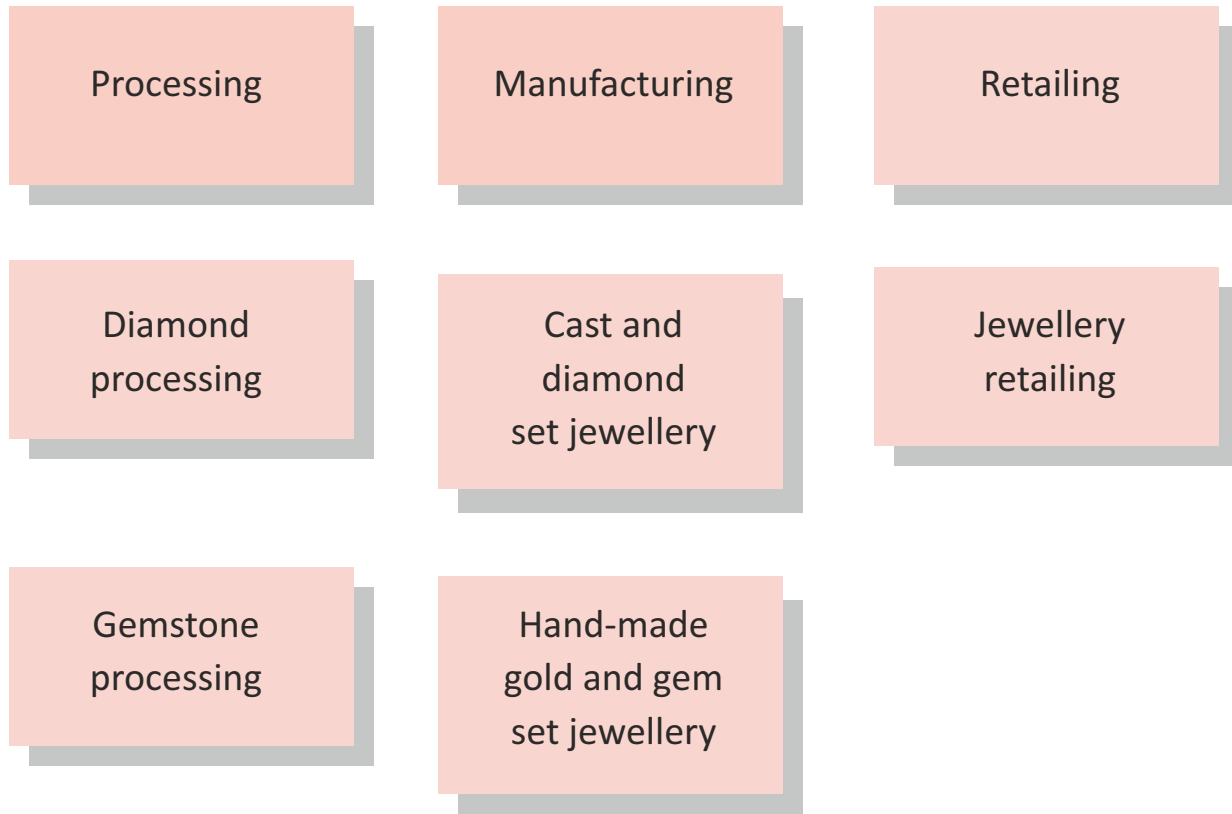


Fig 1.1.1.1

Based on economic activities from NIC-2008, key sub-sectors of sector are: processing (diamond and gemstone), manufacturing (cast and diamond set, and handmade and gem set) and retailing.

1.1.1 Significance of Gem and Jewellery Sector in India

- With a market size of approximately INR 4,54,100 crores, the gem and jewellery segment has a sizeable share of the gross domestic product (GDP) at approximately 5.9%, apart from large-scale employment generation and foreign exchange earnings.
- The highly labour-intensive nature of the sector with large number of employees in the unorganised space, has led to job creation, employing more than 0.464 million people in the country in 2013. This is more than the population of Kolkata, the seventh most populated city in India with a population of 4.5 crore; this indicates the high employment generation capacity of this sector.
- Indian markets for diamond processing — Surat, Ahmedabad; for gemstone processing — Bhavnagar and Jaipur; and for handmade gold jewellery — Kolkata, Thrissur and Coimbatore — are among other areas that are known world over for their products.
- Every region of the country has a different unique style of jewellery. Some examples of these traditional jewellery forms include Bikaneri, Dhokra, Minakari and Filigree.
- India is a source for manufacturing all varieties of products; and its presence in the global gems and jewellery sector is of much importance.

1.1.1 Significance of Gem and Jewellery Sector in India

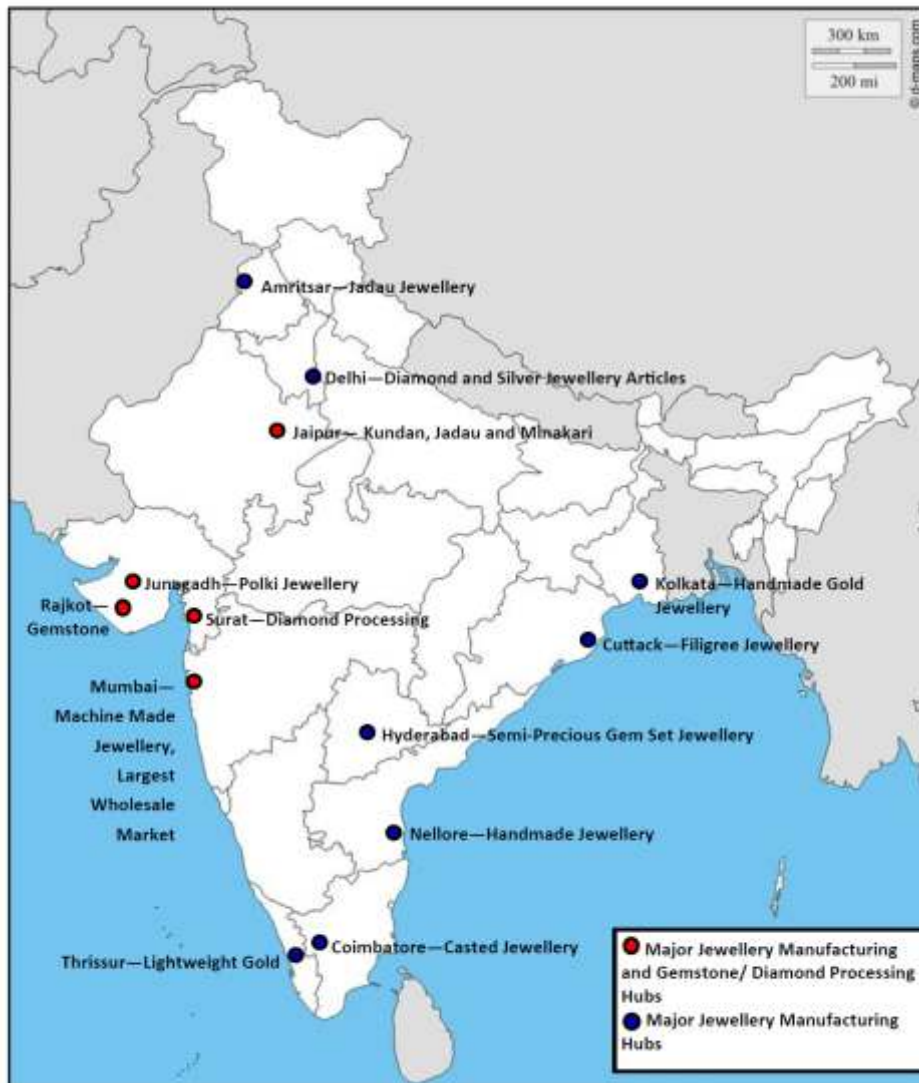


Fig 1.1.1.2 Geographical Markets: Employment Zones in India

- Over two-thirds of the sector workforce in India are working in the processing and manufacturing areas of the value chain.
- These workers are employed in certain zones, as indicated in the map above.
- The retailing manpower extends across India ranging from major metro cities in urban areas to the smallest towns in rural areas.

1.1.1 Significance of Gem and Jewellery Sector in India

Processing and Manufacturing Markets:

- Employment is concentrated in the states of Rajasthan, Gujarat, Maharashtra, West Bengal and the Southern states of Kerala and Tamil Nadu.
- Amritsar and Jaipur are well-known for Kundan and Jadau jewellery with Minakari work, while Delhi – NCR is known for silver jewellery. Further, Jaipur is also one of the biggest coloured gemstone cutting and polishing centre in the world.
- Surat is the world's biggest diamond processing centre and processes about 85 percent of the rough diamond imports of India. Surat has a large group of workforce and is also home to the world's leading diamond institute, the Indian Diamond Institute (IDI).
- Besides being the largest trading centre and wholesale market in India, Mumbai, is also a significant centre for cast and diamond set jewellery.
- SEEPZ in Mumbai alone accounts for almost a quarter of the jewellery exports to USA, the world's largest jewellery consuming country.
- Thrissur is a hub for lightweight plain gold jewellery, a style traditional to Kerala, while Coimbatore is known for electroformed jewellery.
- Kolkata is renowned for handmade gold jewellery.
- Its importance also comes from the fact that a large number of skilled artisans in India hail from this region. However, off lately there has been a decline in the number of skilled artisans mainly due to a decrease in inherited talents.

1.1.1 Significance of Gem and Jewellery Sector in India

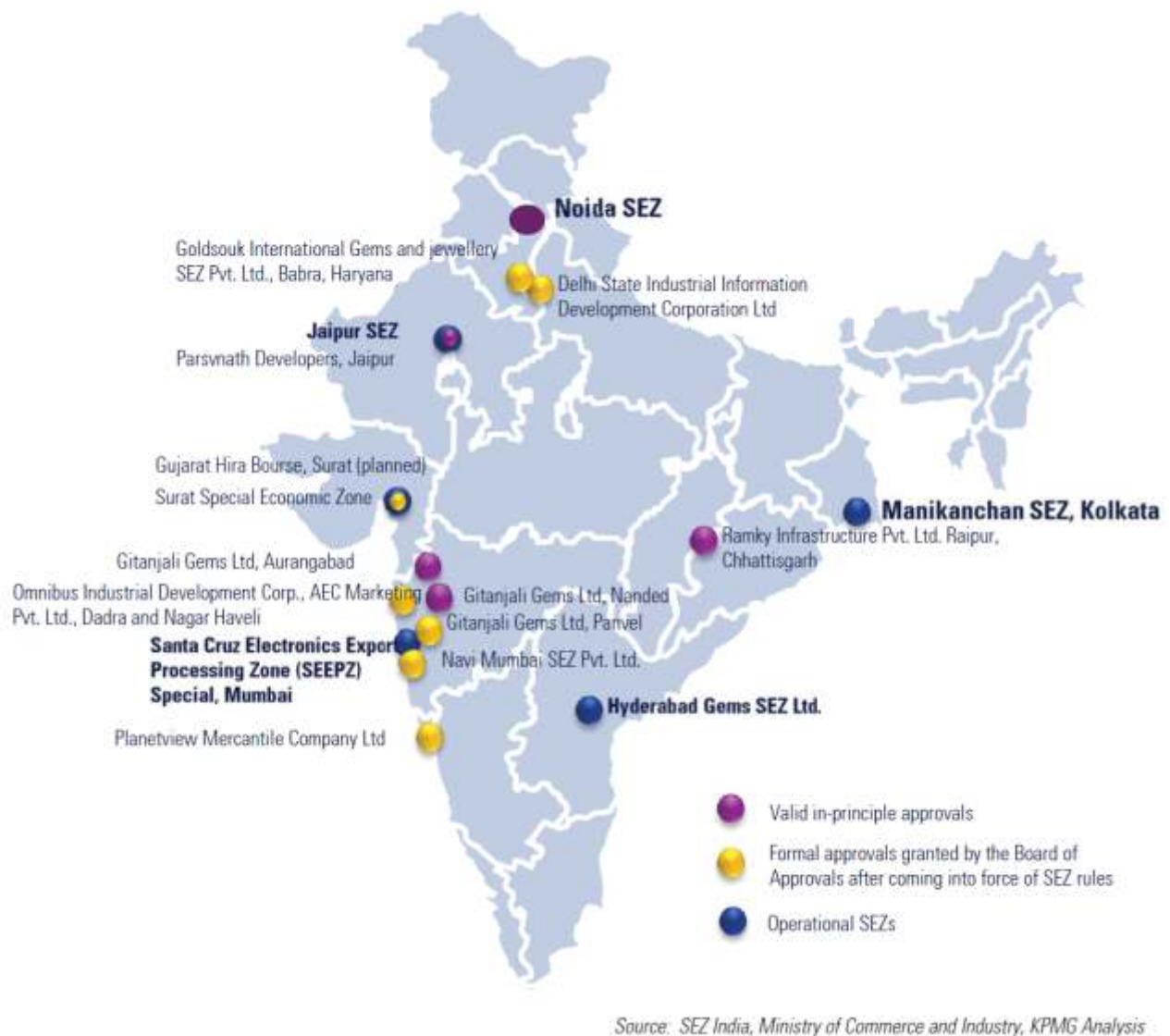


Fig 1.1.1.3 Geographical Markets

- India has multiple operational SEZs focused in the sector and many others expected to operationalise in the coming years.
- Currently, there are about 22 G&J SEZ's approved under the SEZ Act, 2005, throughout India.
- Out of these, 5 are operational, 4 have valid-in principle approvals and 12 are at the formal approval stage.
- The focus of investment is currently concentrated in Maharashtra, followed by Gujarat and Rajasthan.
- These areas will require skilled manpower and in line with current employment areas indicating that these areas will continue to be employment destinations for manpower supply.

1.1.1 Significance of Gem and Jewellery Sector in India

- Incremental human resource requirement (2013-17, 2017-22) and skill gaps.
- Workforce of 4.64 crore in 2013 is expected to increase to 8.23 crore by 2022.

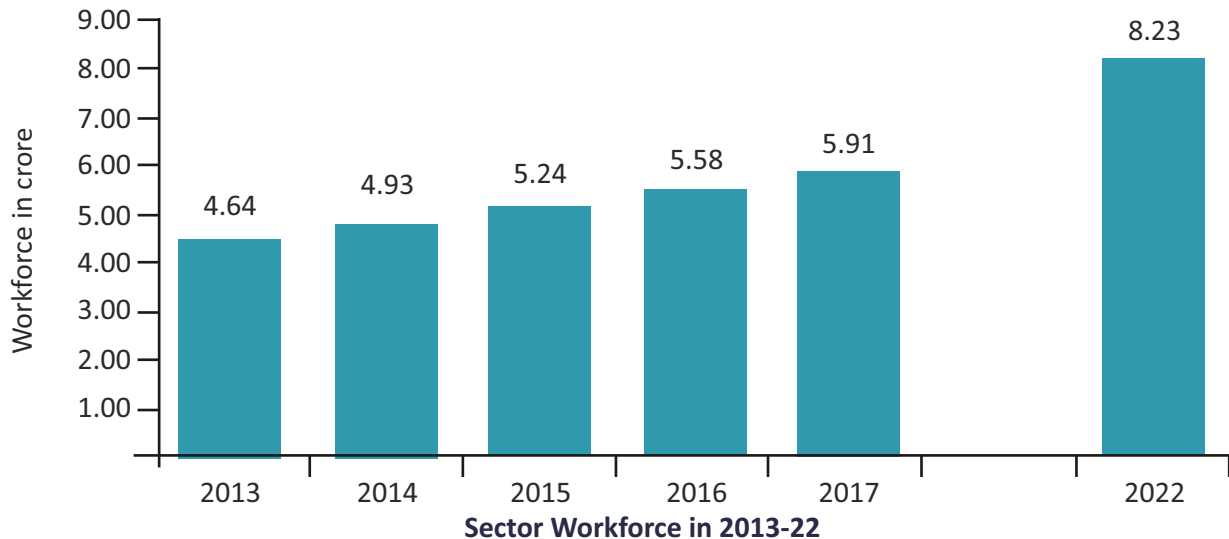


Fig 1.1.1.4 Workforce in the sector

- The sector is planning to hire approximately 8.23 crore employees by 2022.
- This suggests a further increase of ~3.59 crore jobs in the stated nine-year period.
- The period 2013 – 2018 saw slow progression in employment vis-à-vis 2017 – 2022 due to the effects of the worldwide recessions of 2008 – 2009.
- The industry will recuperate and will require more work-force in the later period viz 2017 – 2022.

All facts and figures are based on research conducted by KPMG

Scan the QR Code to watch the related video or click on link



Click Here

Gem & Jewellery industry Orientation

Unit 1.2: Objectives of the Course

Unit Objectives

At the end of this unit, you will be able to:

1. Gain the fundamental skills required to render and present your jewellery designs in an attractive manner and in the appropriate format using the 3D CAD software.
2. Communicate your design ideas.
3. Explain your design information to clients, product development department, merchandiser, marketing development department or craftsmen.

1.2.1 Employment Opportunities for CAD Designers

The purpose of this course is to train the students with skills to design and to render Jewellery in a 3D CAD software. This will help them in communicating their design ideas and information to the clients, product development departments, merchandiser, and marketing personnel. There is a lot of demand for CAD designer. The increasing Gem and Jewellery sector in India has created many jobs in the jewellery industry.

Employment opportunities for CAD designers with skills are:-

- 1 Junior/Executive CAD designer in jewellery firm
- 2 Freelancer (Independently)
- 3 CAD Design internee at the jewellery firm
- 4 CAD operator at the jewellery firm

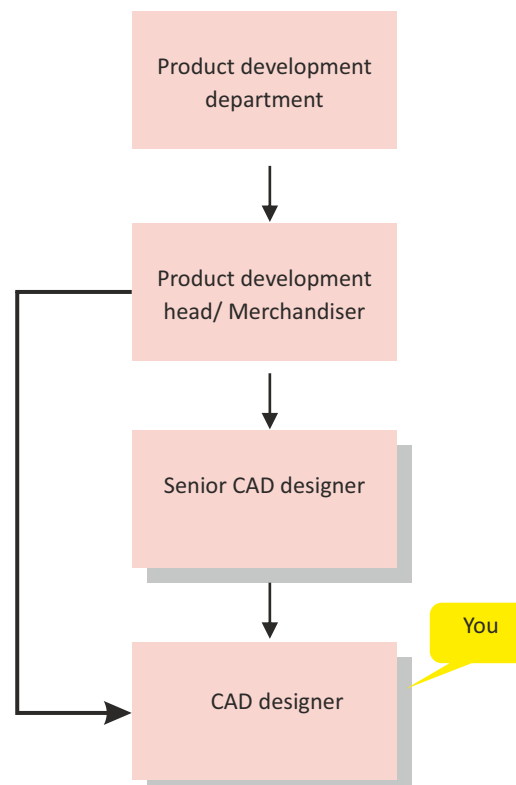


Fig 1.2.1.1 Cad Designer employment opportunity

Unit 1.3: About Jewellery

Unit Objectives

At the end of this unit, you will be able to:

1. Recognize jewellery as a form of adornment.
2. Know on the necessity of jewellery designing.

1.3.1 What is Jewellery?

Jewellery → (Latin word)Jocale → (Meaning)Playing

The word jewellery is used to describe any piece of precious material (gemstones, Noble metal etc) used for adornment. Jewellery can be worn on the body or clothes. In most cultures, jewellery often indicates status, through its material properties, its patterns, or for substantive symbols. Jewellery has been created to adorn nearly every part of the body.

Jewellery is a universal type of ornamentation. Jewellery made from stones, bones and shells dates to prehistoric times. It is likely that from early eras it was worn for safety from the dangers of life or as a symbol of prestige or rank.

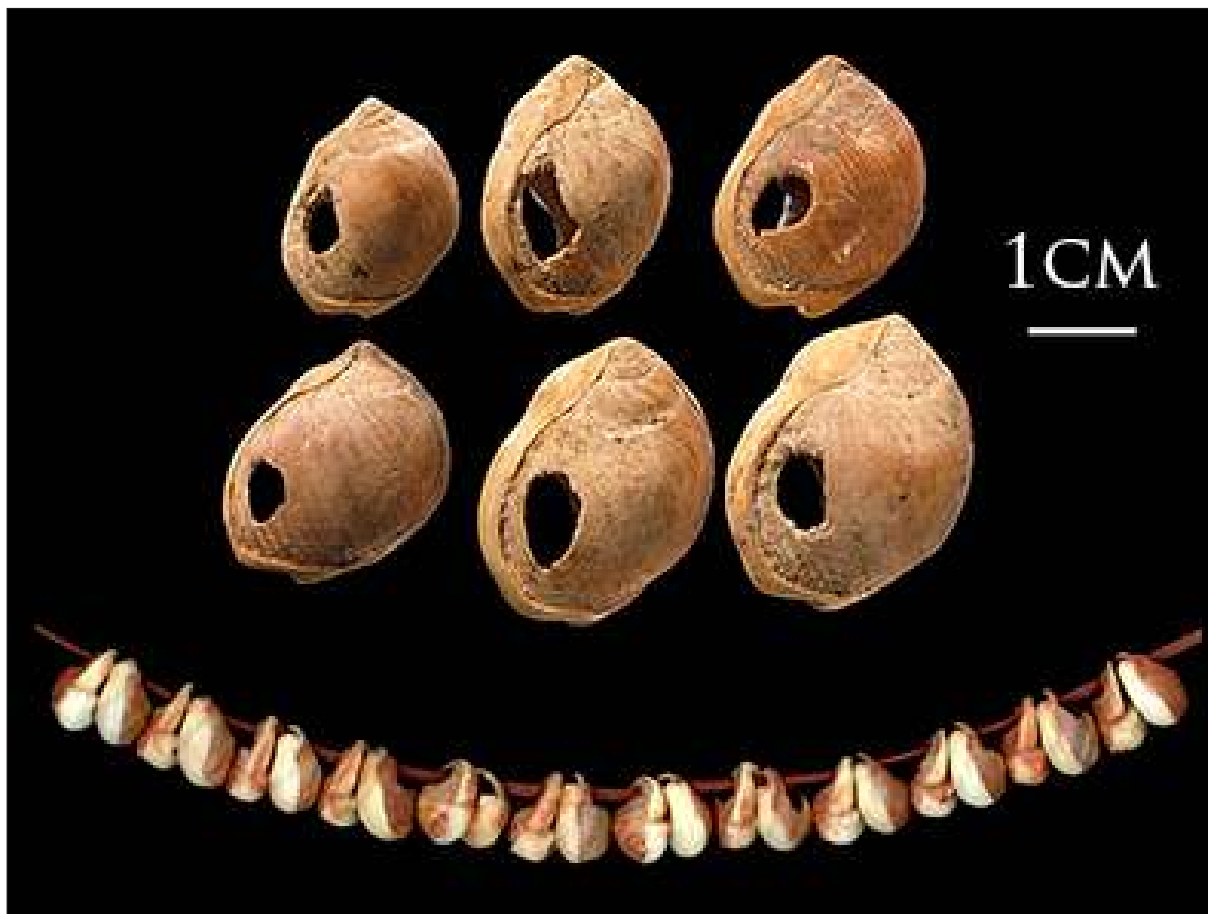


Fig. 1.3.1.1 Prehistoric archeological shell beads used to create a modern concept of a shell necklace.

1.3.2 Need for Jewellery Design

Why Design is important:

1. Leads to stimulation of the brain - Good design is a lot like clear thinking made visual.

- **Edward Tufte**

A design is considered to be strong and powerful in a way our mind sees and captures the visuals. More than a real image, a design stimulates the mind. The impact a design has to the brain is more than any other image. Thus a design is important.

2. Identification - The greatest art form in the world is the transition of a natural rough crystal into a perfect polished diamond. - **Laurence Graff**



Fig. 1.3.2.1

3. Adds distinction - In order to be irreplaceable one must always be different. - **Coco Chanel**



Fig. 1.3.2.2

1.3.2 Need for Jewellery Design

4. Portrays functional aspects- Design is not just what it looks like and feels like. Design is how it works like. - **Steve**



Fig. 1.3.2.3

5. Display aesthetic appeal- Everything is Designed. Few things are Designed Well. - **Brian Reed**



Fig. 1.3.2.4

Design in reference to jewellery can be interpreted as an intellectual or intuitive concept in which materials are used and arranged in relationships of shapes, forms and surface treatments to create an integrated object.

Design development involves the designer's ability to visualize the finished work in its ultimate stage -adorning the wearer. By determining the sequence of tasks in advance, possible errors can be anticipated and hence avoided.

Scan the QR Code to watch the related video or click on link



Click Here
Diversity in Indian Jewellery



Click Here
Categories of Indian Jewellery

Tips



About CAD Designer:

1. A CAD Designer is responsible for creating beautiful, comfortable, wearable, unique 3D designs by making a masterpiece in CAD.
2. They work according to the concepts and inspiration of customers thus making jewellery worth it's purchase.

Notes





2. Create Jewellery Design using CAD Part - I

- Unit 2.1 - Introduction of CAD Software
- Unit 2.2 - Introduction of Rhinoceros
- Unit 2.3 - Explain Rhino Window
- Unit 2.4 - Standard Toolbar
- Unit 2.5 - Modeling Aids
- Unit 2.6 - Working with Curve Tools
- Unit 2.7 - Editing Geometry
- Unit 2.8 - Solid Creation
- Unit 2.9 - Working with Surface Commands
- Unit 2.10 - Curve Tool
- Exercises



Key Learning Outcomes

At the end of this module, you will be able to:

1. Prepare 3D CAD drawings.
2. Have knowledge of how to Prepare different types of 3D jewellery designs.
3. Provide the details and dimensions for jewellery piece to be manufactured.
4. Provide detailed information related to the product made or gemstones used or material of the metal used or manufacturing specification.
5. Work on production parameters i.e. Getting a model ready for 3d printing for example-adding supports, checking for bad surfaces and adding shrinkage.
6. Explain clear views of the design (Top View, Front view, Side view, Perspective View).
7. Prepare well balanced designs based on input from marketing, product development and production department.
8. Apprehend on to use CAD work station, software and hardware.
9. Basic skills of computer and digital camera.
10. Apprehend how to manage the data properly.

Unit 2.1: Introduction to CAD Software

Unit Objectives

At the end of this unit, you will be able to:

1. Basic understanding of CAD/CAM terminology.
2. List of various CAD software used to model jewellery.
3. Identifying with the Rhino7 interface.
4. Creation of all essentials like lines, curves, solids and surfaces with the help of modeling aids.
5. Usage of all editing commands required to modify curves, surfaces and solids.

2.1.1 Introduction to CAD Software

CAD

CAD stands for Computer-aided design. Using various computer software's two-dimensional drawings and manufacture ready three-dimensional models can be created. These 3D models can be directly 3D printed or manufactured using traditional machines and tools. It is used in various industry Automotive, Architecture, Dental, Interior design, Medical, jewelry, etc. by engineers, geologists, architects and designers, etc.

CAD has replaced the pencil, manual drafting and has empowered the designer with better representation of design ideas, easy modification of designs. Use of CAD software's increases productivity, saves time, improves accuracy, reduces errors, etc. There are many different types of polygonal, solid, surface, parametric modeling CAD software's available in the market. Software selection should be done by evaluating CAD solutions meets the needs of product development, the production facility potential of particular organisation.

CAM

CAM stands for Computer-aided manufacturing also known as computer-aided machining. CAM uses of software and computer-controlled machinery to automate a manufacturing process. CAD for product designing and CAM for making the product. CAD models are exported to CAM for machining. There are different kinds of CAM machines are available in the market like, milling machine, CNC machine, etc., used in different sectors. In jewellery 3D printing machines are used for CAM.

In other words, the CAD/CAM software not only gives you the possibility of creating a jewellery design, but it can also aid you in the physical creation using various 3D Printers, CNCs and other equipment.

Fig. 2.1.1.1

2.1.1 Introduction to CAD Software

Every CAD designer must note that CAD modeling is definitely not automatic and always man is the 'Brain' behind every CAD process. A wrong choice can cause big problems in the use of the system. To sum up, CAD/CAM system is able to carry out the development, control and preparation of the model or of the tools required for model manufacturing such as molds, templates or setting of machine tools.

How are 3D Resources Used in Jewellery »

There are many 3D programmes in the market today that can be adapted to design jewellery, but some of these programmes, like Rhino, have more sophisticated resources which make the task much easier. The commonly used programme in this segment is the Rhinoceros 3D. Rhino possesses many specific plug-ins for the modeling of products. For jewellery, the specific plug-in is called Rhino Gold.

LIST OF VARIOUS CAD SOFTWARE USED IN JEWELRY:

- Rhinoceros 3D: Rhinoceros a 3D modeling software is primarily a surface modeling tool, but has many related features. Many Rhino designers use only a small portion of what Rhino has to offer, while others need and use a lot more and even use plug-ins to extend the functionality; it depends on what the individual user is trying to accomplish with the application.
- Matrixgold : This is the newest, most powerful CAD software and it brings a wealth of fresh features and benefits. If you're an ambitious designer who wants total creative exploration to build jewelry from a blank slate, Matrix gold has the features you need.
- Solidworks: This software is used to develop mechatronics systems from the beginning to end. At the initial stage the software is used for planning, visual ideation, modeling and prototyping. This software is being acquired in Jewellery Designing.
- JewelCAD: This is a free-form surface based modeling software to create complex and unique jewelry designs. With JewelCAD program, designers have the ability to create powerful free-from modeling with advanced tools to achieve artistic and stylish designs.
- Blender: This is a free and open source 3D computer graphics software toolset used for creating animated films, art and 3D models. Blender is being adapted in jewelry designing and modeling.
- Zbrush :This is a digital sculpting tool that combines 3D/2.5D modeling, texturing and painting. It uses pigo technology which stores lighting, color,material,orientation and depth information for points making up all objects on the screen. Also being adapted in jewelry designing.
- Corel Draw (2D): This is a vector graphics editor software,primarily used to design 2D objects like brochures, news letters, business cards and jewelry drawings.
- Illustrator (2D):Adobe illustrator is also an vector graphics editor software ,adapted in creating 2D jewelry presentations.

2.1.2 Comparison of various CAD Software

Software	Organic	Parametric	Jewelry Specific	Interface	Customization	Price
Rhinoceros	★★★	★★	★★★	★★★★★	★★★	★★★
Matrixgold	★★★★★	★★	★★★★★	★★★★★	★★★★★	★★
Solidworks	★	★★★	★	★★★	★★★	★
JewelCAD	★	★	★★★	★★	★	★★★
Blender	★★★★★	★	★	★	★	★★★★★
Zbrush	★★★★★	★	★★★★★	★★★★★	★★★★★	★★★

Fig. 2.1.2.1 Comparison of various CAD software

Exercise 1

1) What is the full form of CAD?

2) What is the full form of CAM

3) List the different software being used for jewelry designing

4) Which software out of the above do you think is best for jewelry modeling?

Unit 2.2: Introduction to Rhinoceros

Unit Objectives

At the end of this unit, you will be able to:

1. Know how Rhino software works.

2.2.1 Introduction - RHINO 7

Rhino could be a playground for your imagination and a work space where your concepts become masterpieces. The fundamental geometric objects in Rhino are points, curves, surfaces, polysurfaces, extrusion objects and polygon mesh objects. Rhino relies on the NURBS (Non uniform rational B-splines) technology that gives the flexibility and accuracy required for most inventive, difficult, and complicated designs. NURBS models can be used in any process from illustration and animation to manufacturing. Very experienced users will also find new and useful tools they were previously unaware of in the new Rhino version 7. According to jewelry a limited portion is acquired in teaching jewelry designing and modeling.

Once the design is approved, send it directly to 3D printing or CAM to produce the physical model for casting. Other than creating rings, pendants, bracelets, bangles and brooches, Rhino has the ability to make any ornament design which is in demand.

RHINO 7 is the most significant upgrade till now. You can create organic shapes with our new SubD tools. Run Rhino and Grasshopper as a Revit Add-On with Rhino.Inside.Revit. Use the robust QuadRemesh algorithm to create a beautiful quad mesh from NURBS geometry or meshes. With this release a complete new modeling workflow and steadfast features are unlocked.

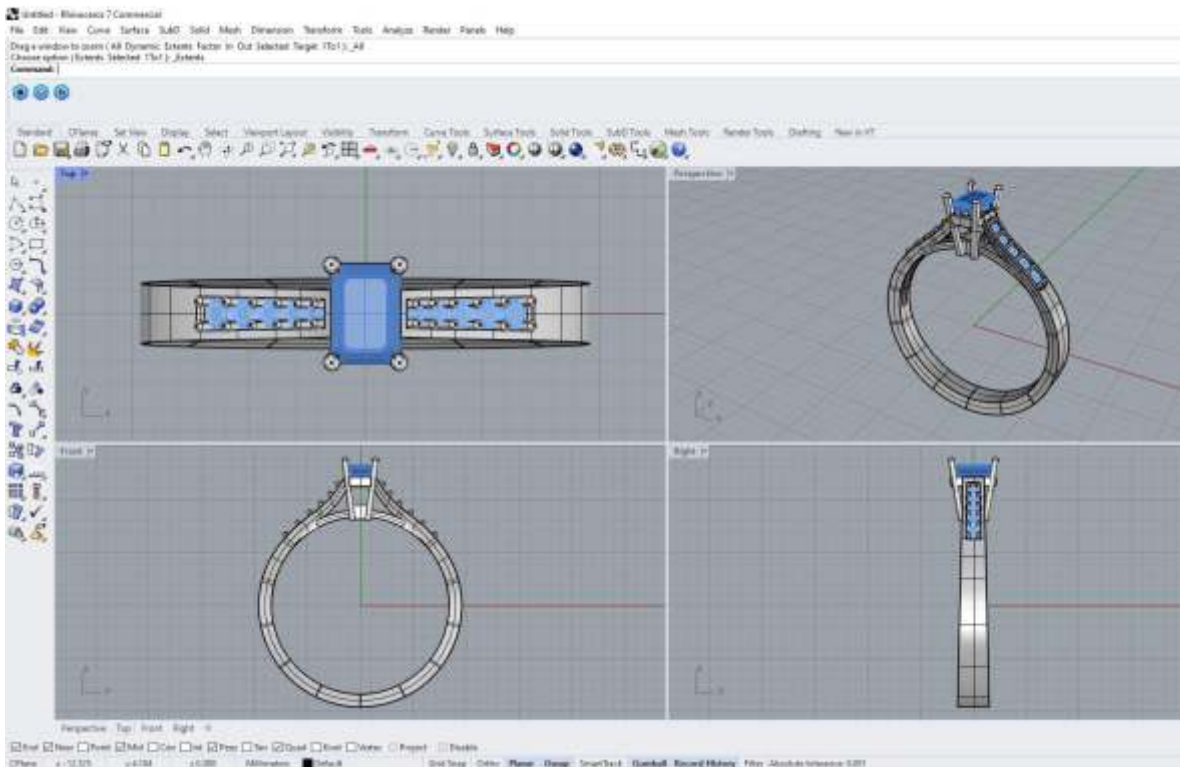


Fig. 2.2.1.1 View Port

2.2.2 Introduction - RHINO 7



Fig. 2.2.2.1 Standard Toolbar

Rhino can create, edit, analyze, document, render, animate and translate NURBS curves, surfaces and solids, sub-division geometry (SubD), point clouds and polygon meshes. There are no limits on complexity, degree or size beyond those of your hardware.

Special features include:

- Uninhibited free-form 3D modeling tools like those found only in products costing 20 to 50 times more. Model any shape you can imagine.
- Accuracy needed to design, prototype, engineer, analyze and manufacture anything from an airplane to jewelry.
- Compatibility with all your other design, drafting, CAM, engineering analysis, rendering, animation and illustration software.
- Read and repair meshes and extremely challenging IGES files.
- Accessible. So easy to learn and use that you can focus on design and visualization without being distracted by the software.
- Fast even on an ordinary laptop computer. No special hardware needed.
- Development platform for hundreds of specialty 3D products.

2.2.3 CAD processflow

A simplistic projection of the whole design and manufacture process is shown below in diagram 1.



Fig. 2.2.3.1 Projection of the whole design and manufacture process

2.2.3 CAD processflow

Steps To Create Jewelry :-

1. Conceptualization of design in 2D/Sketching
2. Conversion of image to digital curves. Repairing the curve data in CAD.
3. Modeling surface with curve data and doing the necessary repairing.
4. Surface quality analysis.
5. Solid modeling of surfaces.
6. Preparing the model for 3D printing(stl or stereolithography file).
7. Casting
8. Assembling jewelry pieces
9. Stone Setting
10. Polishing and Finishing

Diagram 2 however explains in detail some in between steps which are followed to achieve desired results.

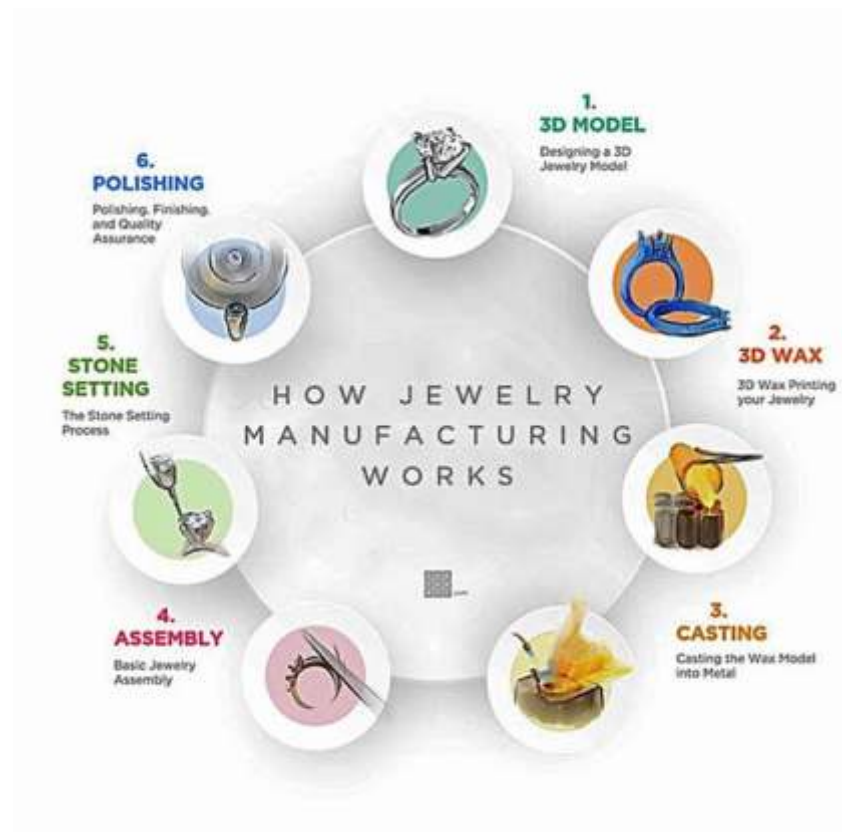


Fig. 2.2.3.2 How Jewellery manufacturing works

2.2.3 CAD processflow

Diagram 3 explains in detail how different companies choose to prototype the 3D model eventually casting it into various metals.



Fig. 2.2.3.3 Standard Jewellery manufacturing workflows

Here are a few examples of 3D printed models (above) Please refer to Formlabs site for above pics of 3D printed models.

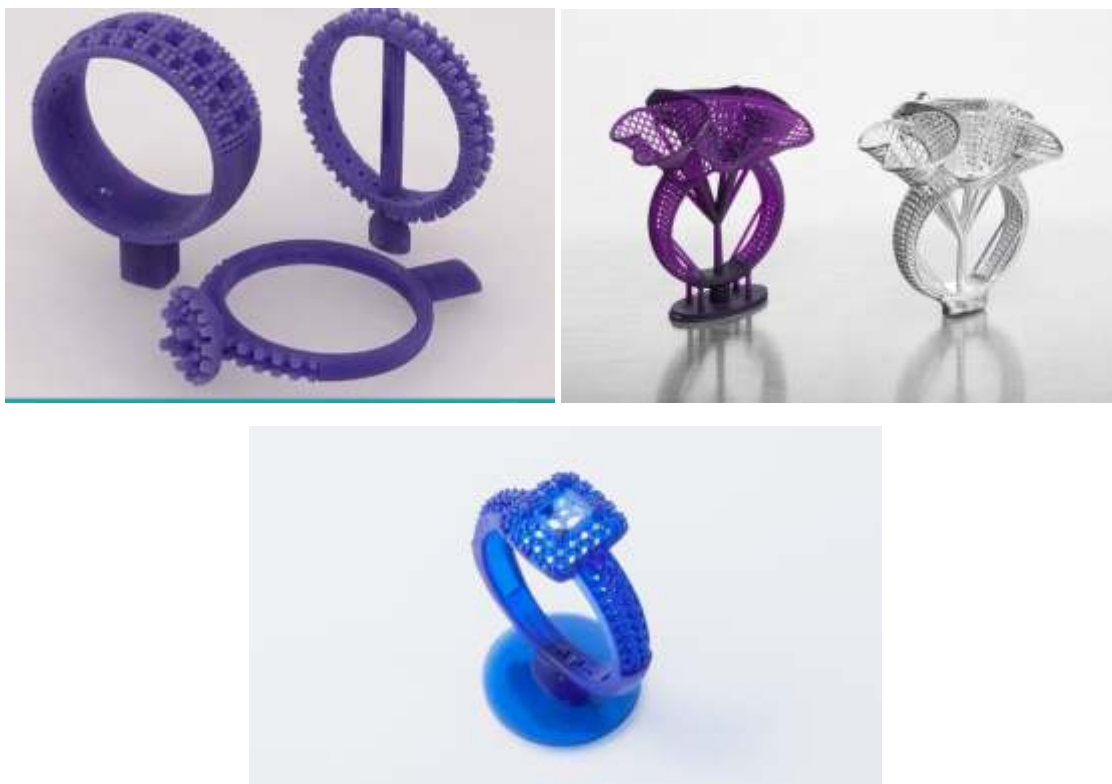


Fig. 2.2.3.4 3D printed models

Tips



1. Rhinoceros is a user friendly software as it works on nurbs modeling.
2. The usage of Rhino software is not limited to the jewellery industry but is also widely used in other industries.

Notes



Exercise 1

1) What is the full form of NURBS?

2) What is NURBS technology?

3) Please explain the CAD process flow in precise points?

4) Name a few plugins used with the new Rhino 7?

Unit 2.3 Explain Rhino Interface

Unit Objectives

At the end of this unit, you will be able to:

1. Learn Rhino interface.
2. Apprehend on the various Rhino menu elements.

2.3.1 Explain Rhino Interface

Before learning individual tools, we will get acquainted with the Rhino interface. The following points will explain the interface elements used in the Rhino software: the Rhino window, viewports, menus, toolbars, and dialog boxes.

While working with Rhino, you can access the commands by using the menus, toolbars and the keyboard. In this unit, we will learn about the menus.

To open Rhino:

Double-click the Rhino icon on the computer or laptop screen. The interface is divided into sections discussed below.

Screen Area	Description
1)Window Title	Displays the current model's name and file size
2)Menu	Access commands, options, and help. Command history window lists prompts, commands entered, and information displayed by the command. Displays 500 lines of the most recently used commands. Press F2 to activate this window.
3)Command window	Displays the previous commands. Text from this area can be copied and pasted into the command line prompt.
4)Command Prompt	Use the command line to type commands ,click command options,type coordinates,type distances or shortcuts.
5)Toolbar group	A collection of tabbed toolbars for the users convenience.
6)Toolbar/Sidebars	Access shortcuts to commands and options. Updates when selecting tabbed toolbar. You can float a toolbar anywhere on the screen or dock it at the edge of the graphics area.
7)Viewports/Graphics Area	Rhino graphics area includes the viewports. Displays the working environment including object display, viewport title ,background, construction plane and world axis icon.
8)Viewport title and menu	The viewport title appears in the upper left corner of each viewport and offers a shortcut for viewport actions.
9)Viewport tabs	You can also display the viewport titles in tabs. The highlighted tab designates the active viewport.

10)Osnap control	Contains persistent object snap toggles.
11)Status bar	Displays the coordinates, current location, delta of the cursor and the Status Bar panes.
12)Panels	Many Rhino controls are contained in tabbed panels. The panels are docked to the right side of the Rhino screen by default but they can be floated anywhere.

Rhino Window

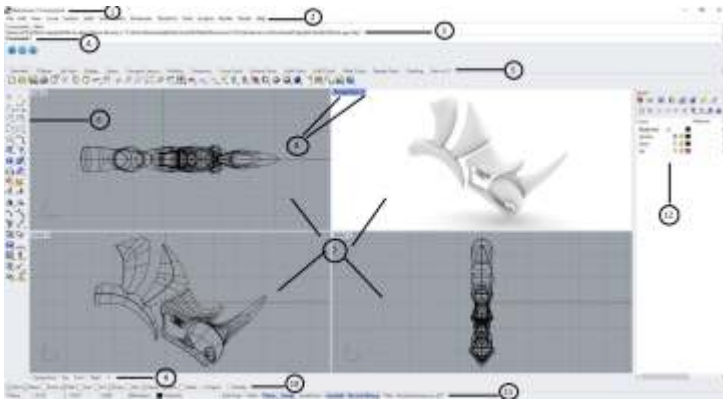


Fig. 2.3.1.1 Rhino Window

Menu

Rhino commands can be located in the menus and toolbars sections. Shortcut buttons to commands is provided in the Rhino toolbars. A toolbar can be floated anywhere on the screen or can be docked at the edge or corner of the graphics area. On starting the Rhino, the Standard toolbar group is docked above the graphics area while the Main toolbar is docked as the sidebar on the left side of the screen.

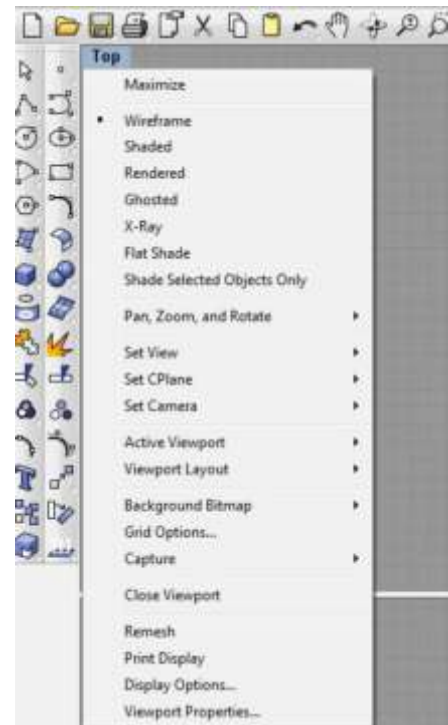


Fig. 2.3.1.2 Menu

Scan the QR Code to watch the related video or click on link



Click Here
Rhino Viewports
and Navigation (By Vimeo)



Click Here
Overview of the Rhino 7 for
Windows User Interface (By Vimeo)

Tooltip

Tooltips gives the information related to the function of each button. When you move the pointer over a button without clicking it, a small yellow coloured tag containing the name of the command will appear. In Rhino, a number of buttons can execute more than one command i.e. dual function. The tooltips can help in identifying the buttons which have dual functions.

For example: If you want to start a Polyline, click the Left Mouse Button (LMB). If you want to start the Line Segments command, click the Right Mouse Button (RMB).

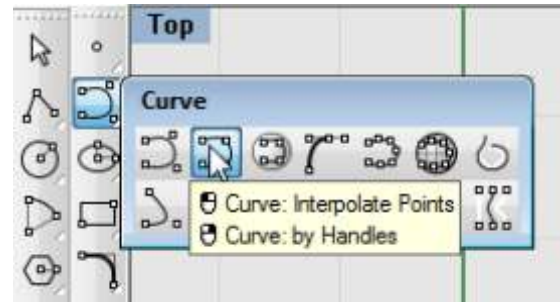


Fig. 2.3.1.3 Tool Tips

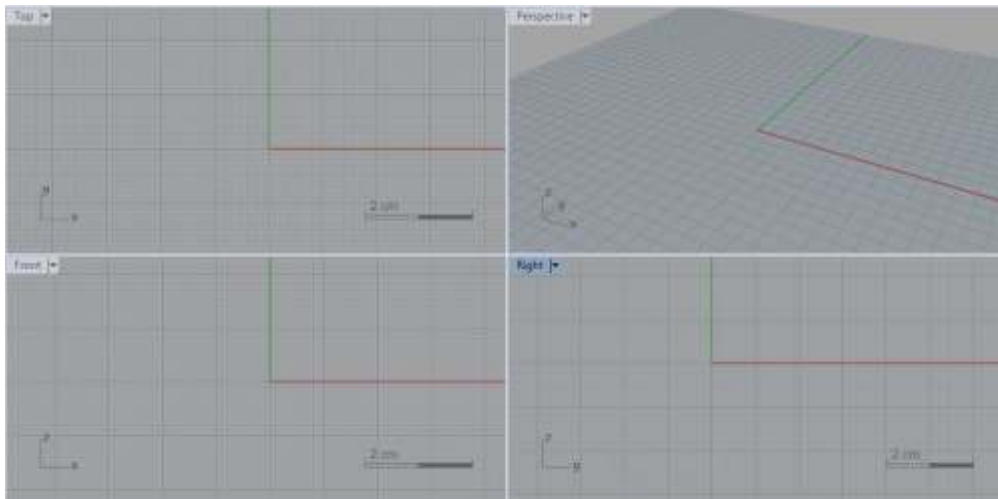


Fig. 2.3.1.4 Graphics Area

Graphics Area

The viewports are included in the Rhino graphics area. The viewports and their position can be customized as per your preference. The viewport position is adjustable.

View ports

Windows located in the graphics area that display the views of the model are called Viewports. Drag the viewport borders or title in order to move or resize them. New viewports can be created, new and old viewports can be renamed and predefined viewport configurations can be used by the designer.

Each viewport has its own construction plane and grid that the cursor usually moves on and a projection mode. Double-click a viewport title.

Viewport tabs

You can display the viewport titles in tabs if you prefer. The highlighted tab designates the active viewport. Tabs make it easy to switch between viewports when using maximized or floating viewports. The tabs are located below the graphics area.

Command Area

The command area displays commands and command prompts. The command line can be docked at the top or the bottom of the screen or it can float anywhere. The command window shows two lines by default.

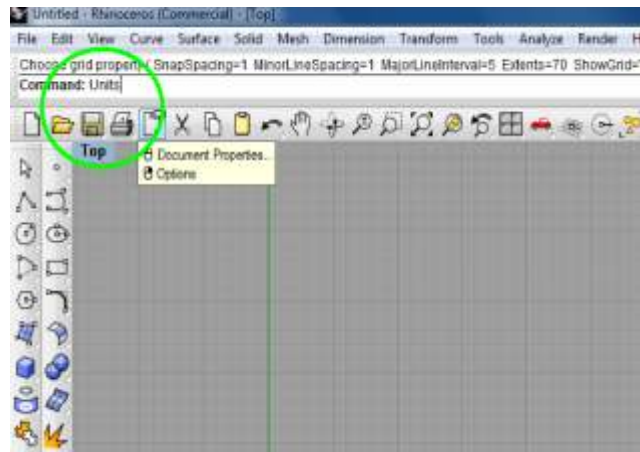


Fig. 2.3.1.5 Command Area

Press F2 to open a command window. The text in the Command History window can be selected and copied to the Windows clipboard.



Fig. 2.3.1.6 Mouse

Mouse

When using the Rhino viewport, the left mouse button will select objects and pick locations. The right mouse button can be used for multiple functions which include panning and zooming, popping up a context-sensitive menu as well as imitating the Enter key function. The left mouse button can be used for selecting objects in the model, commands or options on the menus and buttons in the toolbars. The right mouse button can be used to complete a command, to move between stages of commands and to repeat the previous command. The right mouse button can also be used to initiate commands from a few toolbar buttons. Drag the right mouse button to rotate and pan in viewports. Hold down the Ctrl key or use the mouse wheel and drag with the right mouse button to zoom in and out within a viewport. To activate this feature, you need to press and hold the right mouse button down.

Entering Commands

Use the command line to type commands, pick command options, type coordinates, type distances, angles, or radii, type shortcuts, and view command prompts.

To enter information typed at the command line, press Enter, Spacebar, or right mouse button over a viewport. Note: Enter and Spacebar perform the same function.



Fig. 2.3.1.7 Commands

Shortcuts and Aliases

Shortcuts are customizable key combinations. You can program the function keys and Ctrl key combinations to perform Rhino commands.

Command aliases run Individual Rhino commands or scripts. You can type command aliases just like normal Rhino commands or use them to create abbreviations for often used commands or command scripts.

Clickable options

To use command options, click the option on the command line or type the underlined letter of the option and press Enter. (The interior capitalization is meaningless.)

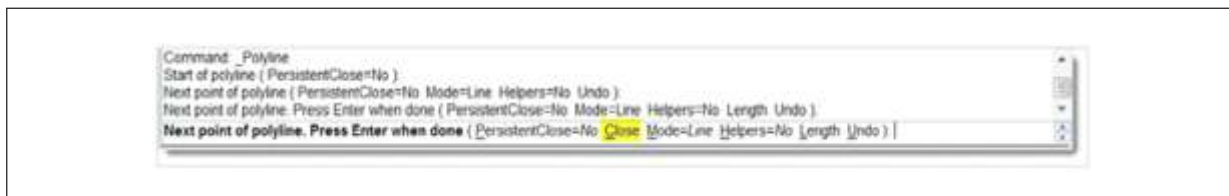


Fig. 2.3.1.8 Commands

Repeating commands

To repeat the last command, right-click in a viewport, press Enter, or press the spacebar. To repeat previous commands, right-click in the command line window and select from a list.

Cancelling commands

To cancel a command, press Esc or enter a new command from a button or a menu.

View the Command Line History

The command history window lists the last 500 command lines from the current Rhino session. Press F2 to view the command history.



Fig. 2.3.1.10 History

View ports

View ports are windows in the Rhino graphics area that show you a view of your model. To move and resize view ports, drag the viewport title or borders. You can create new view ports, rename view ports, and use predefined viewport configurations. To activate a viewport click anywhere in the viewport and the title highlights. In a command sequence, you simply have to move your cursor into a viewport to activate.

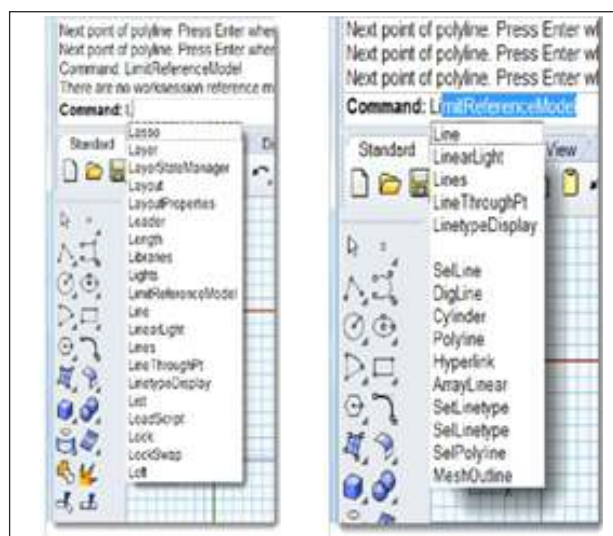


Fig. 2.3.1.9 Commands

View Recent Commands

Right-click the command line to view recently used commands. To repeat the command, select it from the popup menu.

The number of commands listed is set in Rhino Options. The default limit is twenty commands. When you use your twenty-first command the first one drops off the list.

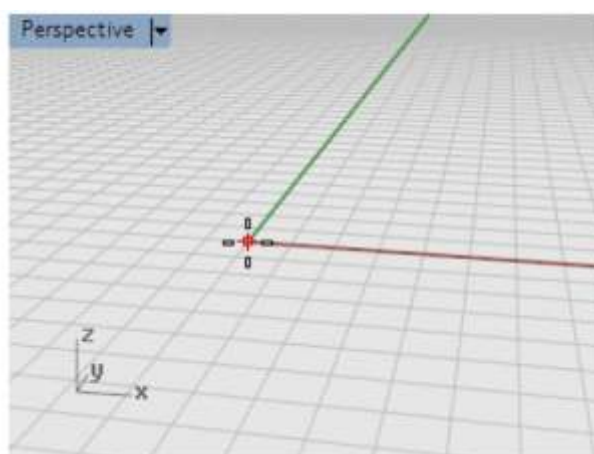


Fig. 2.3.1.11 Construction plane

Autocomplete command name

Type the first few letters of a command name to activate the autocomplete command list. When enough letters of the command are typed so that it is unique, the command name completes on the command line. Press Enter to activate the command once the full command name appears. As you type command names, the autocomplete command list appears. As you type more letters, the list is narrowed down to the possible commands. Left click on the command in the list to start it.

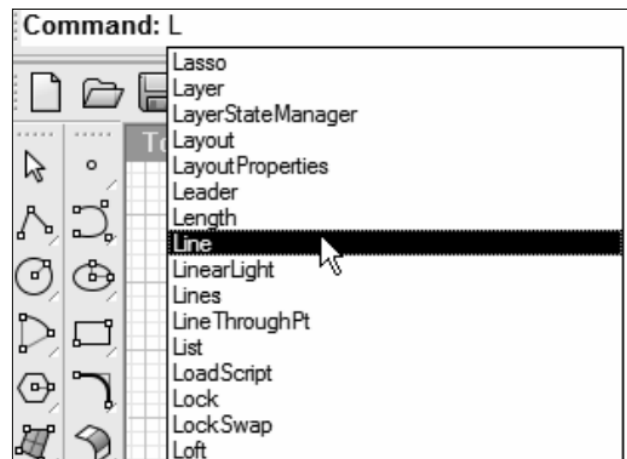


Fig. 2.3.1.12 Commands

Construction planes

The construction plane is the guide used for modeling Rhino objects. Points you pick are always on the construction plane unless you use coordinate input, elevator mode, or object snaps.

Each construction plane has its own axes, a grid, and an orientation relative to the world coordinate system.

The grid is a plane of perpendicular lines lying on the construction plane. On default grids, every fifth line is slightly thicker.

The red line represents the construction plane x-axis. The green line represents the construction plane y-axis. The red and green lines meet at the construction plane origin.

The icon in the left hand corner always shows world coordinates, which are different from the construction plane axes.

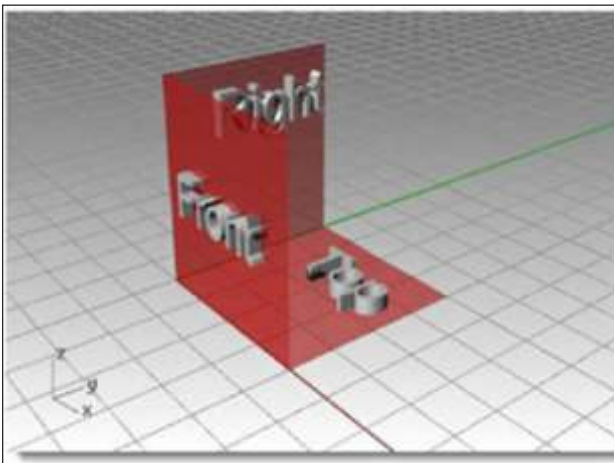


Fig. 2.3.1.13 History

Default construction planes are provided with the default viewports.

- The Top construction plane (x- and y-axes) align with the world x- and y-axes.
- The Right construction plane (x- and y-axes) align with the world y- and z-axes.
- The Front construction plane (x- and y-axes) align with the world x- and z-axes.
- The Perspective viewport uses the Top construction plane.

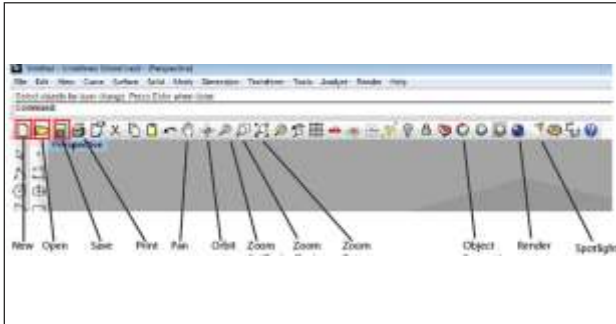


Fig. 2.3.1.14 Shortcuts

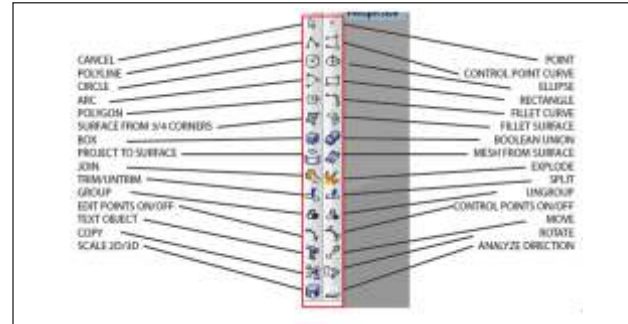


Fig. 2.3.1.15 Generic commands

Exercise 1

1) What is the use of Window Title?

2) What is the use of Command prompt?

3) What all functions do the Panels have ?

4) List the functions of the mouse 's left and right click in the interface.

5) What is the use of Tooltips and where are they located?

6) How can you view and access all the recent commands used?

Unit 2.4: Standard Toolbar

Unit Objectives

At the end of this unit, you will be able to:

1. Understand the use of the standard toolbar.

2.4.1 Standard Toolbar

File Menu

Command	Description
New	Creates a new Rhino model based on a template.
Open	Opens an existing Rhino or other supported format file. Default Rhino opens a 3D Model file. When Rhino opens a non-3D model, the title bar reflects the name of the model that was opened. When the model is saved for the first time, this model name is entered as the file name.
Save	Save your work periodically during a session to keep it from being accidentally deleted. Saves your model and keeps it open.
Save small	Save your model without render or analysis meshes and preview image to minimize file size.
Incremental save Save as	Save sequentially numbered versions of your model. Saves your model to a specified file name, location, and format. Save as a template.
Save as Template	Save as Template
Revert	Discards changes and reverts to the previously saved document.

It is good practice to save your model in stages under different names, using the Save As command. This lets you go back to an earlier version of your model for modifications if necessary.

Import

Merges all objects from file into the current model. Rhino imports objects to the model on their original layers and creates the layers if they do not already exist. If the imported file type does not contain layer information, such as when you Save a file using the Geometry only option, the objects are placed on the current layer.

Export

Saves selected objects to a new Rhino (or other supported format Like STL File) file.



Options:

Save small : Though clearing the render meshes makes the file smaller, it will shade and render more slowly the next time you open the file.

Save geometry only : Saves geometry objects only. No layers, materials, properties, notes, or units settings are saved. This is similar to exporting the objects. A new file is made, but it does not become your active Rhino model.

Undo and Redo

If you make a mistake or do not like the results of a command, use Undo. If you decide you want those undone results back, use Redo command. Redo restores the last thing undone.

Rhino Button	Mouse	Button	CommandDescription
	Left-click or ctrl+Z	Undo	Cancels the effects of the last command.
	Right-click or ctrlr+Y	Redo	Restores the effects of undo.

The number of undos kept in memory can be set in Rhino Options on the General page.

Cut

Deletes objects from the model and places them in the Windows Clipboard. All selected objects are removed from your model and placed on the Windows Clipboard. Object properties and location are stored with the object. When you Paste objects into Rhino, they are placed on the same layer they came from in the original model. If the layer does not exist, it is created when the object is pasted.

Copy

Copies selected objects to the Windows Clipboard. The object's Properties and location are stored with the object. If the objects are grouped, a new group is created from the copied objects. The objects are not added to the group from which they were copied. When you Paste objects into Rhino, they are placed on the same layer they originally had. If the layer does not exist, it is created when the object is pasted.

Paste

Inserts objects from the Windows Clipboard. If there are Rhino objects on the Windows Clipboard, they are pasted into your model. Object properties and location are restored with the object. When you paste objects into Rhino, they are placed on the same layer they came from in the original model. If the layer does not exist, it is created when the object is pasted.

Zoom command

Moves the viewport camera point toward and away from the target point.

Window (default)

Draws a window to define the view

- Hold down the left mouse button and drag a rectangle in a viewport to define the view.

All

Zooms all viewports.

Options

Extents	:	Zooms all viewports to show all objects.
Selected	:	Zooms all viewports to show all selected objects.
1to1	:	Zooms all viewports so that the views are full scale.

Dynamic

Zooms the view as you drag the mouse.

Hold down the left mouse button and drag the mouse up and down to zoom in and out.

Extents

Zooms the view to show all objects.

Factor

Zooms the view in or out the specified amount. Values greater than 1 zoom in; values between 0 and 1 zoom out.

In

Zooms the view in.

Out

Zooms the view out.

Selected

Zooms the view to show all selected objects.

Target

Zooms the view by specifying a target and window.

Pick a location for the view center.

A rectangular window forms to define the zoom with the target as the view center.

When you rotate a view after Zoom Target, the scene will rotate about the target. This is particularly useful in perspective views.

1To1

Zooms the active viewport so that the view is full scale.

The command must be calibrated for this command to work properly.

In perspective views, only objects on the target plane will be displayed full scale; in parallel views objects on any plane perpendicular to the camera axis are displayed full scale.

The model must have units set.

Shortcut	Zoom Action
Mouse wheel	Zoom In and Out
Ctrl + Right-mouse drag	Zoom Dynamic
Z	Zoom
Page Up	Zoom In
Page Down	Zoom Out
Ctrl + W	Zoom Window
Shift + Ctrl + E	Zoom Extents
Alt + Ctrl + E	Zoom Extents All Viewports

Rotate View

Rotates the view camera around the target. Mouse navigation in perspective views.
Drag with the right mouse button. Constrain to horizontal or vertical.

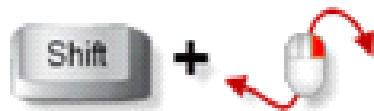


Fig. 2.4.1.1 Rotate

Exercise 1

- 1) Which command merges all objects from a file into the current model?

- 2) What is the function of a mouse wheel?

- 3) What are the shortcuts for the following:

- Undo
- Redo
- Cut
- Copy
- Paste

Unit 2.5: Modeling Aids

Unit Objectives

At the end of this unit, you will be able to:

1. Use the modeling aids.

2.5.1 Modeling Aids

Modeling aids are modes that you can toggle on or off by pressing shortcut keys, a function key, typing a single letter command, or clicking a button.

Click the Grid Snap, Ortho, Planar, Gum ball, SmartTrack or Record History panes on the status bar to toggle these modeling aids on and off.

Grid Snap

This modeling aid constrains the marker to snap on grid intersections. You can also toggle Grid Snap on and off by pressing F9 or typing the letter S and pressing Enter. Pressing F7 hides or shows a reference grid in the current viewport of the graphics screen at the construction plane.

Ortho

This modeling aid constrains the marker movement to the points at a specified angle from the last point created. The default angle is 90 degrees. You can also toggle Ortho on and off by pressing F8 or pressing and holding the Shift key down.

Osnap

Object snaps constrain the marker to an exact location on an object such as the end of a line or the center of a circle.

SmartTrack

This modeling aid uses temporary reference lines and points that are drawn in the Rhino viewport using implicit relationships among various 3-D points, other geometry in space, and the coordinate axes' directions.

Planar

This is a modeling aid similar to Ortho. This helps you model planar objects by constraining the input to be on a plane parallel to the construction plane that passes through the last point that you picked. You can also toggle Planar on and off by typing the letter P and pressing Enter.

Gum ball

Displays a display widget, on a selected object, facilitating move, scale, and rotate transformations around the gumball origin.

Record History

Records history and updates history-aware objects. With History recording and Update turned on, a lofted surface, for example, can be changed by editing the input curves. In general, it is best to leave the Record option set to No and use the Record History status bar pane to selectively record history. Recording history uses computer resources and makes saved files larger.

Filter

This modeling aid restricts any selection mode to specified object types. Objects types that can be restricted are: Annotations, Blocks, Control points, Curves, Lights, Meshes, Point clouds, Points, Polysurfaces, Surfaces, Hatches, and others.

Object Snaps

Object Snaps are tools for specifying points on existing objects. Object snaps are often referred to as osnaps. In Rhino, reliable modeling and easy editing depends on objects actually meeting at specified points. To open the Osnap toolbar Click the Osnap pane in the status bar. This toolbar controls persistent object snaps. The display of the Osnap toolbar is controlled with the Osnap pane in the Status bar. Click on it to toggle the display on and off. When an object snap is active, moving the cursor near an eligible point on an object causes the marker to jump to that point and a tooltip to appear.

Command	Description
End	End snaps to the end of a curve, surface edge corner or polyline segment end.
Near	Near snaps to the nearest point on an existing curve or surface edge.
Point	Point snaps to a control point or point object.
Mid	Midpoint snaps to the midpoint of a curve or surface edge.
Cen	Center snaps to the center point of a curve. This works best with circles and arcs.
Int	Intersection snaps to the intersection of two curves.
Perp	Perpendicular To snaps to the point on a curve that makes a perpendicular to the last selected point. It doesn't work on the first point that a command prompts you to pick.
Tan	Tangent To snaps to the point on a curve that makes a tangent to the last selected point. It doesn't work on the first point that a command prompts you to pick.
Quad	Quad snaps to the quadrant point. The quadrant point is the maximum or minimum direction on a curve in the x or y construction plane direction.
Knot	Knot snaps to knot points on curves or surface edges.
Project	Projects the snap point to the construction plane.
Vertex	Mesh vertex is the location where the edges of the mesh faces meet.
Disable	Temporarily turns off persistent object snaps, retaining settings.

Display Mode

Manages the appearance of the viewport display modes. Lists the display modes saved in the model. The built-in display modes are:

Wireframe

Sets the viewport display to unshaded wireframe

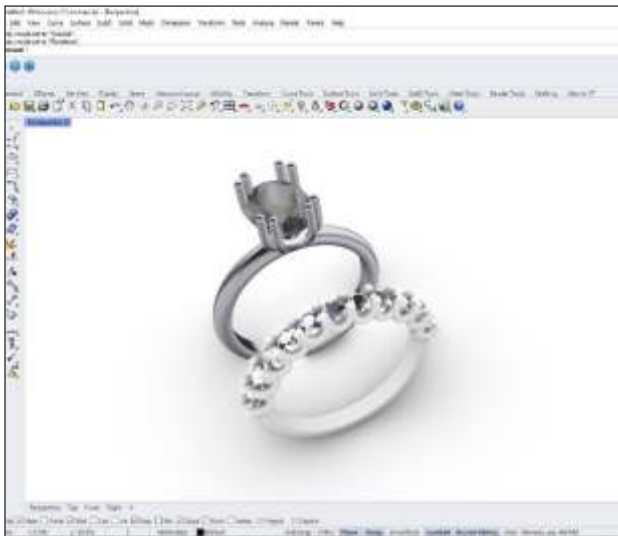


Fig.2.5.1.2 Rendered mode

Rendered

Shades the viewport with a simulation of the rendered view.

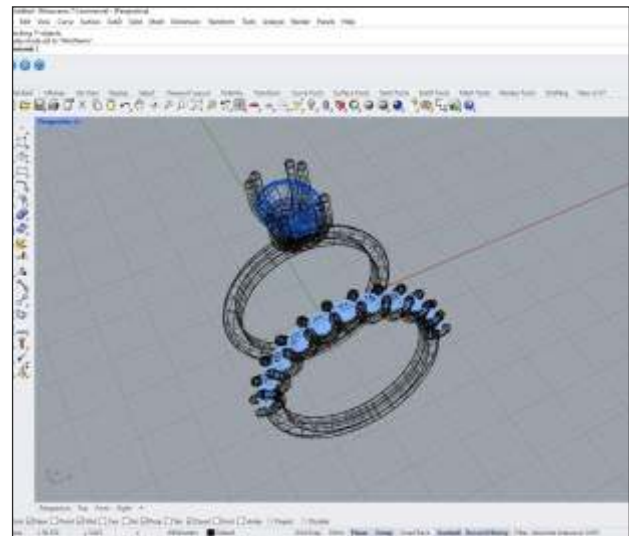


Fig.2.5.1.1 Wireframe mode

Shaded

Sets the viewport to opaque shaded mode. Shaded mode uses a mesh to shade surfaces using the layer colours.

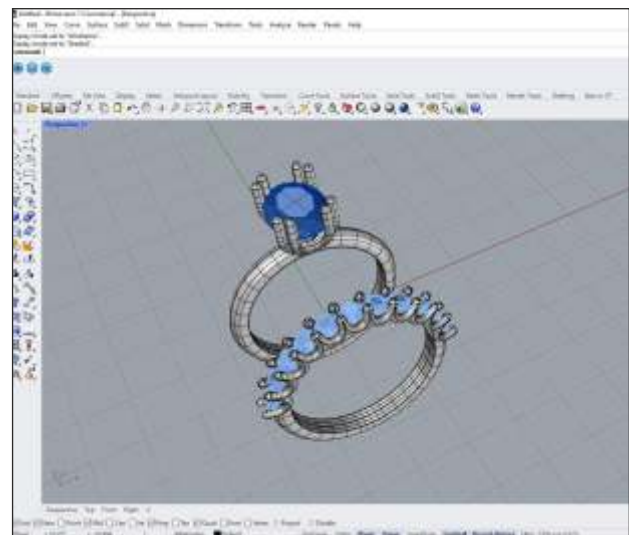


Fig.2.5.1.3 Shaded mode

Ghosted

Sets viewport display so surfaces are translucent.

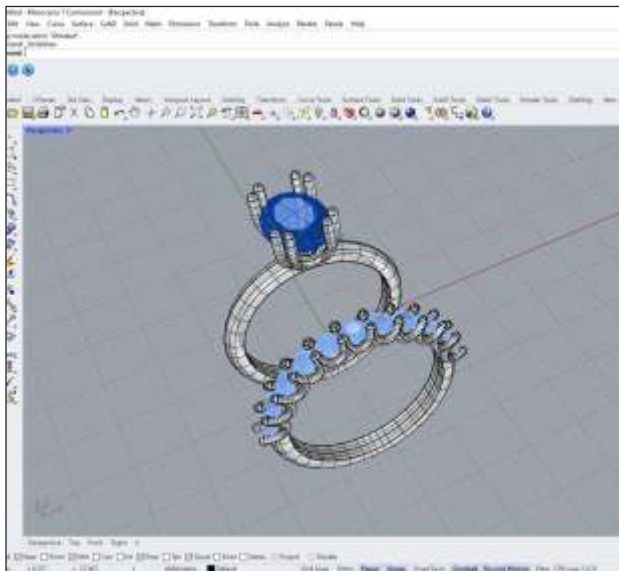


Fig. 2.5.1.4 Ghosted mode

X-Ray

Shades with isoparametric curves not obscured by objects in front.

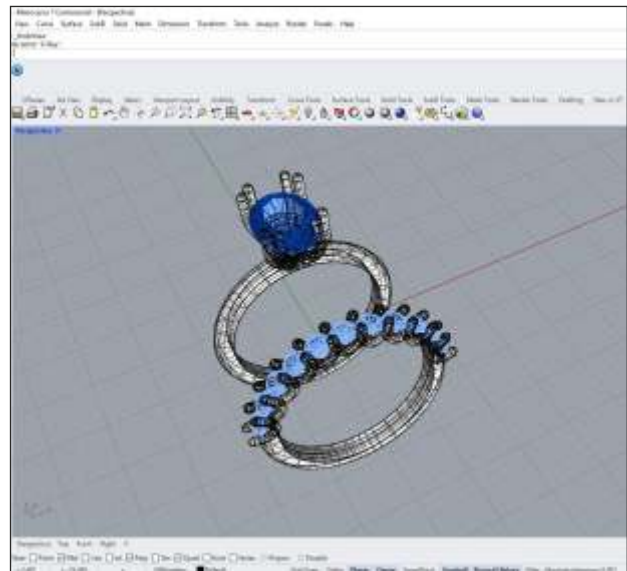


Fig. 2.5.1.5 X-Ray mode

Technical

Uses real-time silhouettes and intersections, creases, borders, blended shaded and rendered display. Objects behind other objects are occluded.

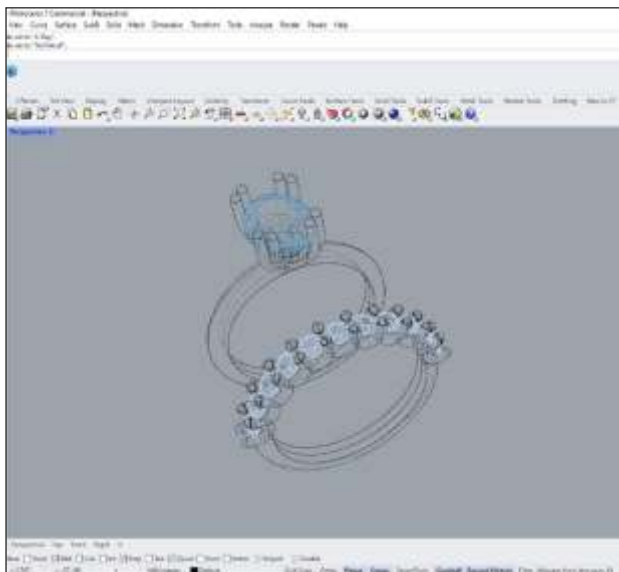


Fig. 2.5.1.6 Technical mode

Artistic

Uses an image background and soft lines to create a pencil drawing effect.

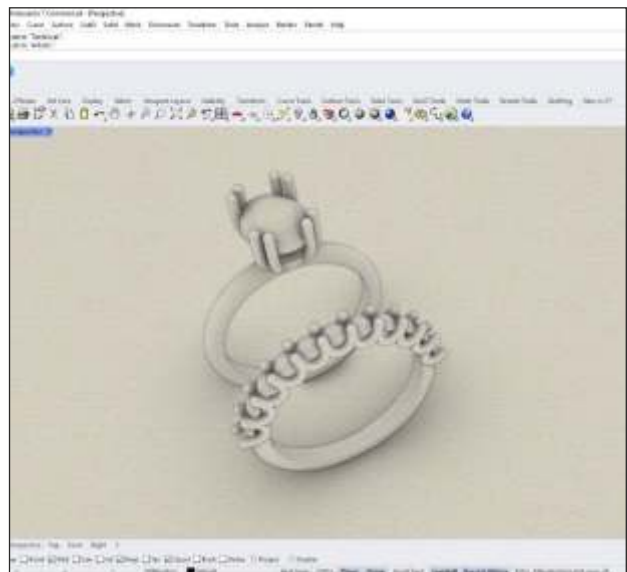


Fig. 2.5.1.7 Artistic mode

Pen

Uses white with black lines to simulate a pen drawing.

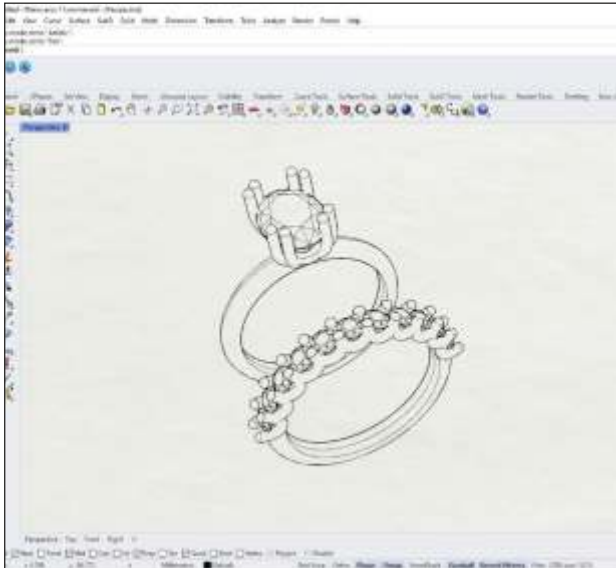


Fig. 2.5.1.8 Pen mode

Arctic

This shaded display mode sets the viewport to opaque shaded mode.

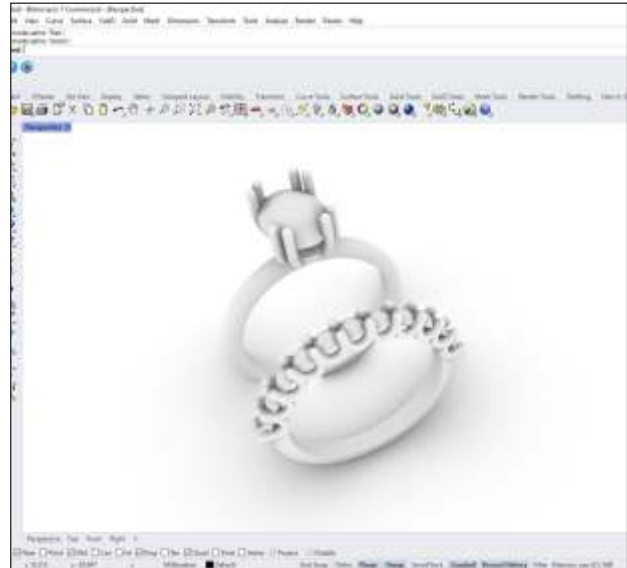


Fig. 2.5.1.9 Arctic mode

Raytraced

This display mode sets the viewport to a render mode with Cycles, a real time raytracer. The image will continue to progressively improve indefinitely.

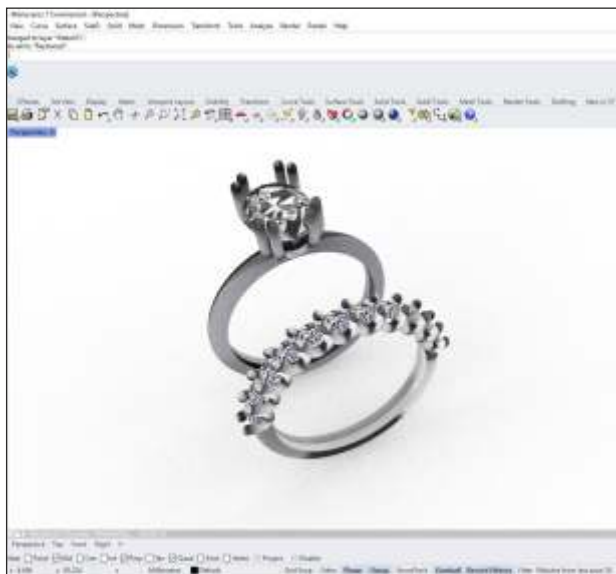


Fig. 2.5.1.10 Raytraced mode

2.5.2 3D and 2D Representation of objects in rhino

A 3D model is a mathematical representation of something three dimensional. A 3D model helps to construct any shape imaginable while retaining production capability and brings visions come together with relative ease. Below is the representation of various 3D objects in Rhino 7.

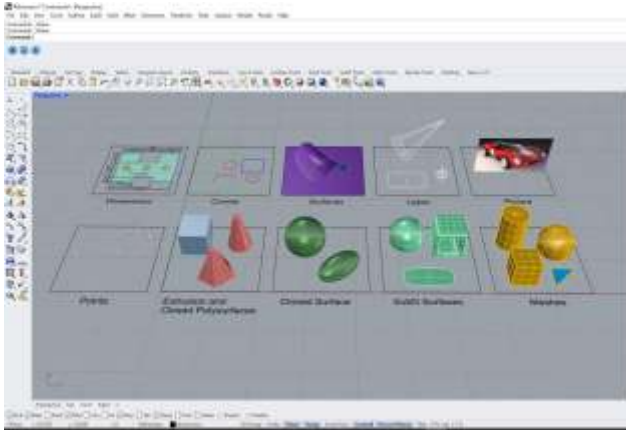


Fig. 2.5.2.1 How you see different kinds of objects example- points, curves surfaces, polysurfaces etc. in 3D view/perspective view

A 2D model or representation is a geometric model of an object as a two dimensional figure. Even though all geometric models are 3 dimensional, a 2D model is often adequate for certain flat objects, such as paper cut outs and machine parts made out of sheet metal.

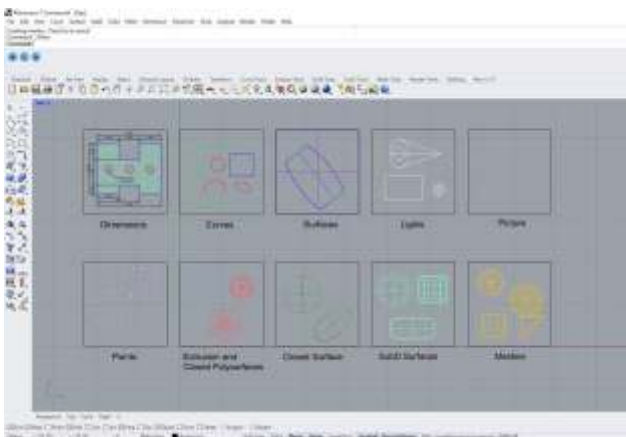


Fig. 2.2.3.1 The same kind of objects in 2d or top/front/right view

Scan the QR Code to watch the related video or click on link



Click Here
Object Types | Rhino for Windows
(By Vimeo)

Exercise 1

1) Open Camera model and try all shading options. (Go to Help- LearnRhino-Tutorials and Samples)

2) What is the difference between Object snaps and Modeling aids?

3) What is the function of Ortho?

4) The grid snap restricts the cursor to _____ on the grid area.

5) Define 2d and 3d models in your own words.

Unit 2.6: Working with Curve Tools

Unit Objectives

At the end of this unit, you will be able to:

1. Work with the curve technology and know its uses.

2.6.1 Curve Technology

In Rhino terminology, the word curve includes lines, polylines (a series of straight-line segments joined end to end), arcs, ellipses, circles or free form curves that are generally smooth. Polycurves are made up of 2 or more curve joined end to end. Curves are used as input for creating and editing surfaces. For example, you can trim an object with a curve, but they may be useful in themselves as well, as in making a 2D drawing of a 3D model or as construction geometry. You can derive and extract curves from surfaces. For example, all surfaces have edges and it is possible to extract an edge curve. You can also extract isocurves (all surfaces are represented by either some outline curves plus some interior curves called Isocurves)

Line

A line segment appears between the two points. The segments meet at a common point, but are not joined.

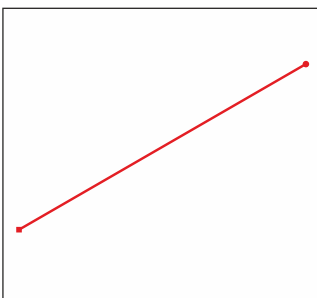


Fig. 2.6.1.1 Line

PolyLine

This makes an open polyline. A polyline is made of line segments that are joined together. It is one object.

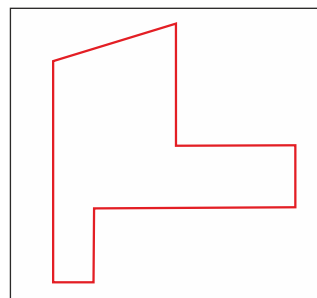


Fig. 2.6.1.2 Polyline

Line: From Midpoint

Draws a line on both sides of the start point, creating the line twice as long as you indicate.

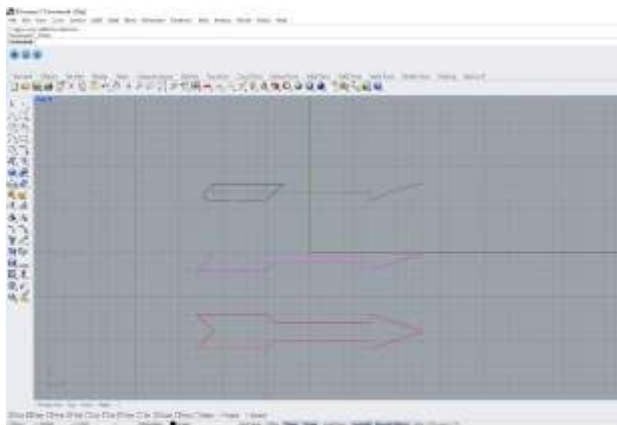
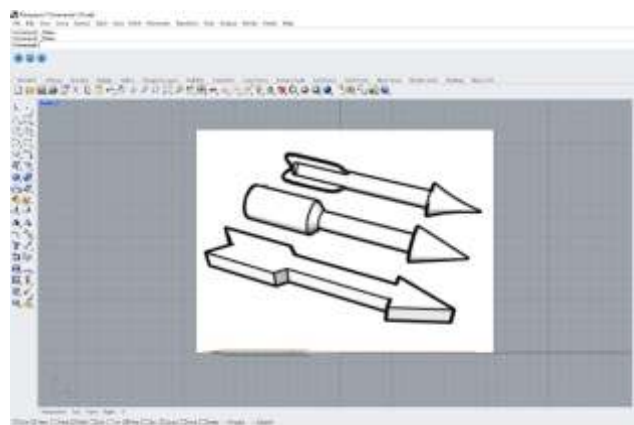


Fig. 2.6.1.3 line and polyline



Interpolate Curve/Curve

The InterpCrv and Curve commands draw free-form curves. The InterpCrv command draws a curve through the points you pick. The Curve command uses control points to create a curve.

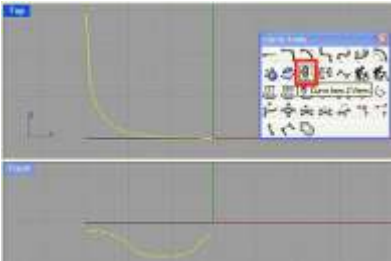


Fig. 2.6.1.4 Interpolate curve/curve

Control Point

Control points are coefficients of NURBS basis functions. Sometimes also called control vertex or node. Control points are used as "grips" on objects such as curves, surfaces, lights, hatch boundaries, and dimensions and can not be separated from their objects.

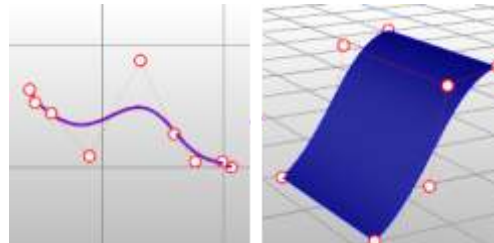


Fig. 2.6.1.5 Control point

Circles

You can create circles using a center point and radius, center point and a diameter, two points on the diameter, three points on the circumference, and tangent points to two coplanar curves and a radius.

Command	Description
Circle	Draw a circle using the center and radius.
Circle 3 Point	Draw a circle through three points on its circumference
Circle Diameter	Draw a circle using two diameter points.
Circle Tangent,	Draw a circle tangent to two curves with a given radius. Tangent, Radius
Circle Tangent to 3 Curves	Draw a circle tangent to three curves.
Circle AroundCurve	Draw a circle perpendicular to a curve at the chosen point.
Deformable	Draws an approximation of a circle with a defined number of control points.
Vertical	Draw a circle perpendicular to the construction plane.

Example :

Arcs

You can create arcs using various points on the arc and construction geometry.

You can continue an existing curve with an arc to an existing curve, to a point or by an angle.

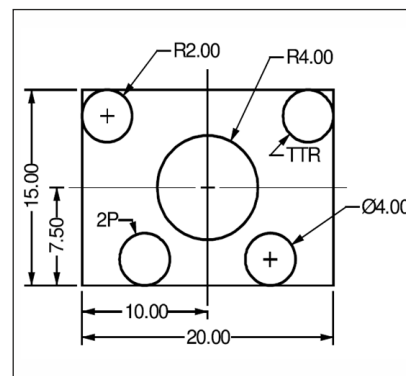


Fig. 2.6.1.6 Arcs

Command	Description
Arc	Draw an arc from the center, start, and angle.
Arc :Start, End, Point on Arc	Draw an arc from three points.
Arc: Start, End, Direction	Draw an arc from start point, end point, and the direction from the start point. The direction can be entered after the start point is entered or after the end point is entered.
Arc: Tangent, Tangent, Radius	Creates an arc from tangents and radius.
Arc: Start End Radius	Creates an arc from start point, end point, and radius.
Convert Output arcs	Converts a curve to arc segments that are joined together.

Example::

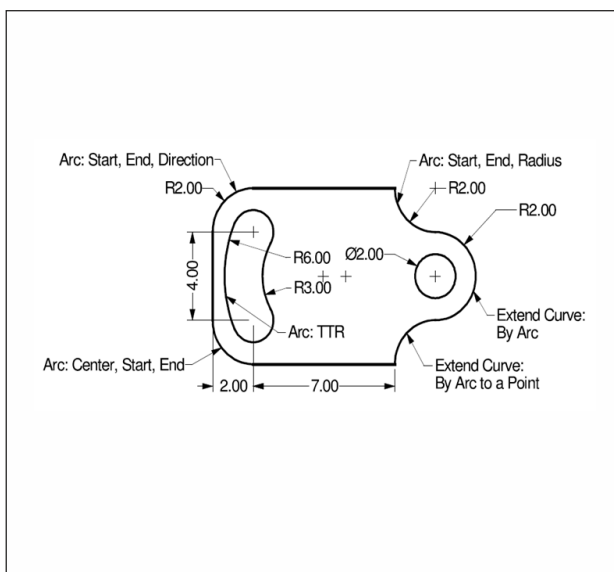


Fig. 2.6.1.7 Arcs

Ellipses

You can draw ellipses from the center or by the ends. You can draw polygons from a center point or an edge. You can draw a rectangle from diagonal corners or by choosing three points.

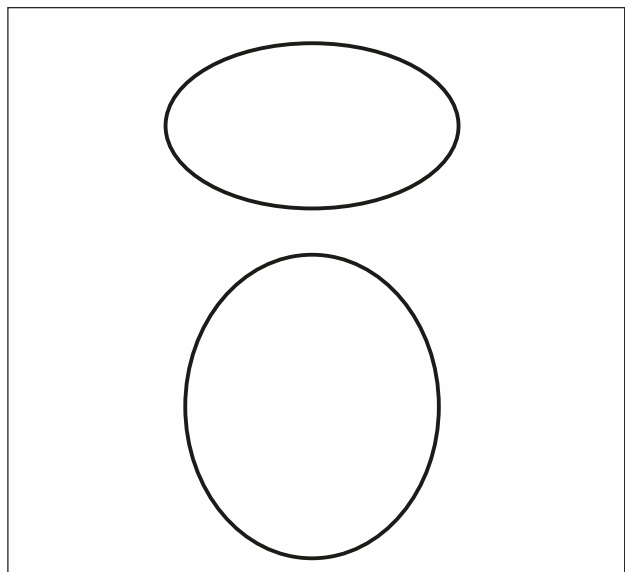


Fig. 2.6.1.8 Ellipses

Command	Description
Ellipse	Draw an ellipse by specifying the center point and axis ends.
Ellipse Diameter	Draw an ellipse by specifying the axis ends.
Ellipse From Focal	Draw the ellipse from the focus points.
Ellipse Around Curve	Draw an ellipse whose axes are perpendicular to a curve.

Polygons

Rectangles and other closed polylines are types of polygons, or closed figures with three or more sides. The Rhino Polygon command provides a quick way of drawing regular polygons (all sides and angles are equal).

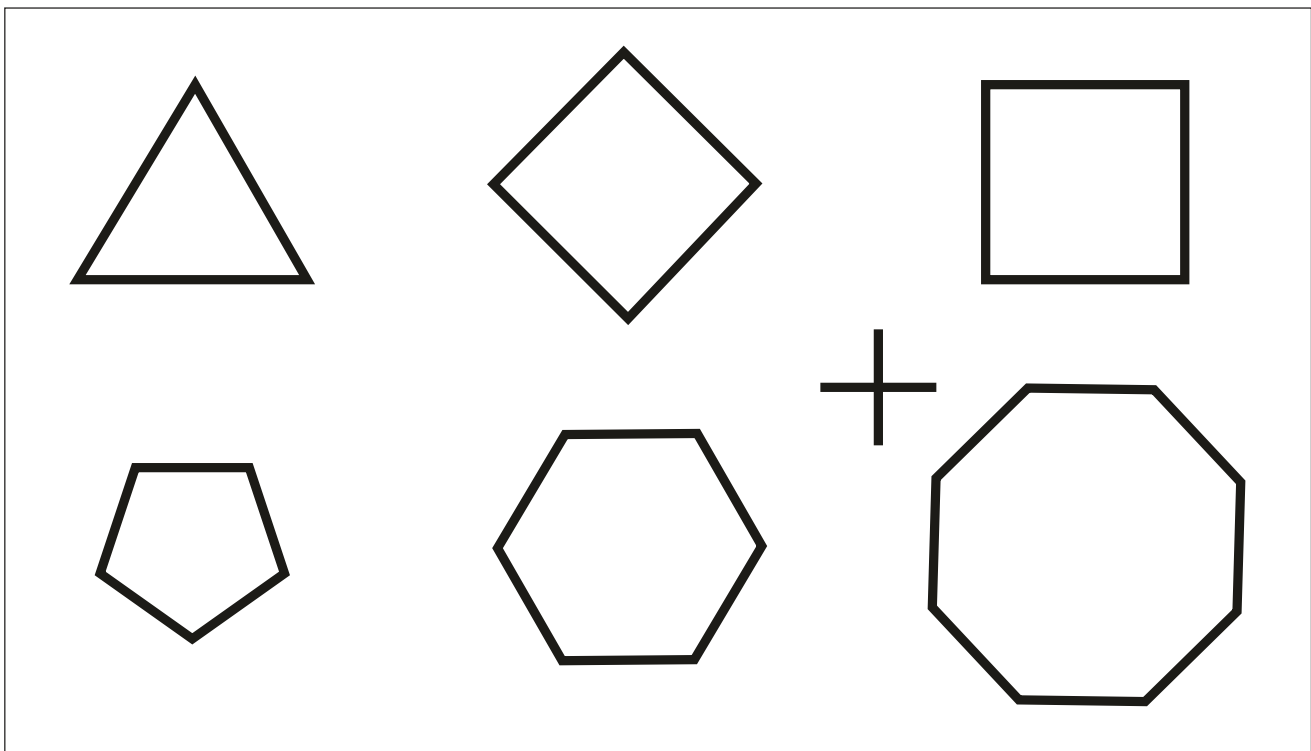


Fig. 2.6.1.9 Polygon

Command	Description
Polygon	Creates a polygon from its center and radius.
Polygon Edge	Draw a polygon by specifying the ends of one edge.
Polygon Star	Draw a polygonal star.
Polygon options	
Num Sides	Specify the number of sides for the polygon.
Circumscribed	Draw a polygon that is circumscribed about a radius. The default is to draw a polygon that is inscribed in a specified radius.

Rectangles

In Euclidean plane geometry, a rectangle is any quadrilateral with four right angles. The Rectangle command is used to draw a rectangle whose sides are vertical and horizontal. The position and size of the rectangle are defined by picking two diagonal corners.

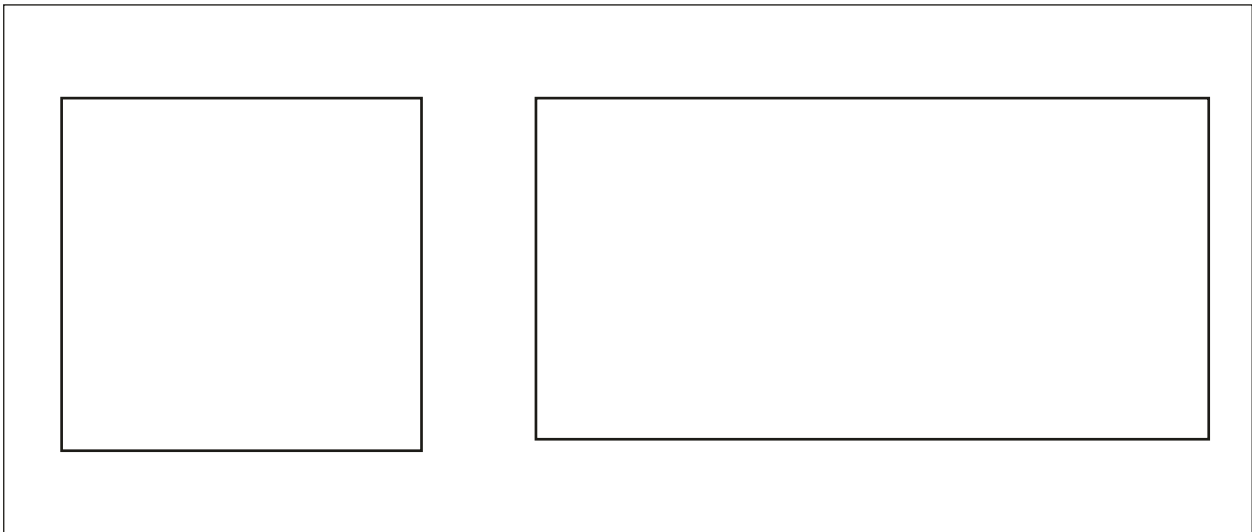


Fig. 2.6.1.10 Rectangles

Command	Description
Rectangle	Draw a rectangle using opposite corners.
Rectangle Center	Draw a rectangle from center and a corner.
Rectangle 3Point	Draw a rectangle through three points.
Rectangle Vertical	Draw a rectangle that is perpendicular to the construction plane.
Rectangle Rounded	Create a rectangle with rounded corners (arc or conic).

Example : Polygon, Ellipse & Rectangle

Line: Surface Normal

The Normal option draws the line normal to a location on a surface.

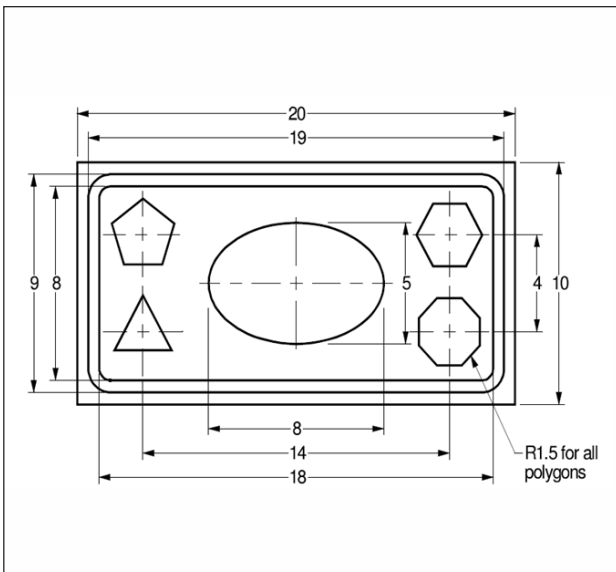


Fig. 2.6.1.11 Polygons

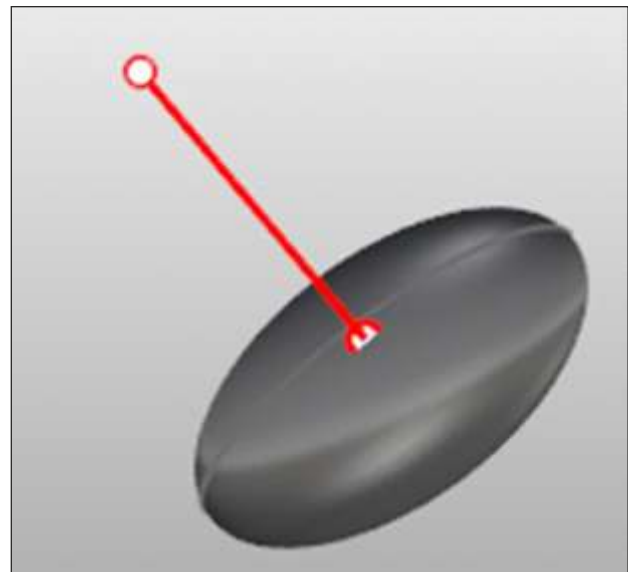


Fig. 2.6.1.12 Line

Helix and Spiral

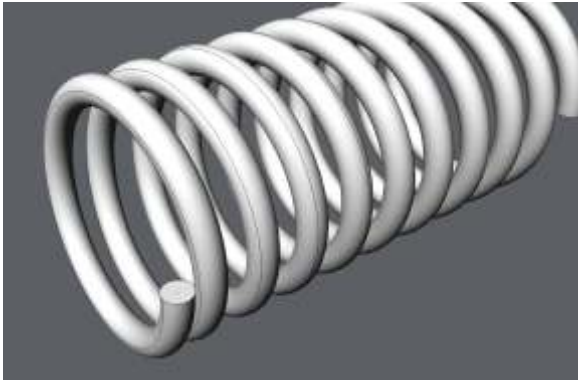


Fig. 2.6.1.13 Helix

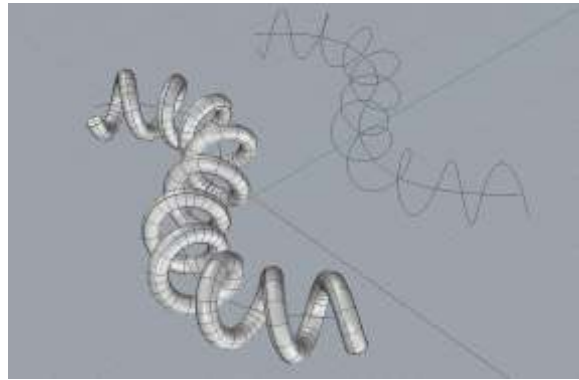


Fig. 2.6.1.14 Spiral

Command	Description
Helix	Draw a helix. User can specify a radius, the number of turns, the length and direction of the axis.
Spiral	Draw a spiral. User can specify two radius, the number of turns, the length and direction of the axis.

Background bitmap

Background bitmaps are always aligned with the x-axis of the construction plane. If you want your bitmap rotated with respect to the construction plane, you must open it in a bitmap editing program and rotate it there, or you can create a rotated construction plane and place the bitmap on it.

Only one image can be placed in a viewport at a time; placing a second deletes the first. Background bitmaps are a construction aid, not a part of the scene that will be rendered.

Align

Aligns the background bitmap to selected points. Note: Background bitmaps are always aligned with the x axis of the construction plane. If you want your bitmap rotated with respect to the construction plan, you must open it in a bitmap editing program and rotate it there, or you can create a rotated construction plane and place the bitmap on it.

Grayscale

- **Click Yes** - The background bitmap displays in shades of gray.
- **No** - The background bitmap displays the original color of image.

Extract

- Click extract from bitmap options, this will save the bitmap to an external file.

Filter

- Click yes, the image will be filtered to estimate pixel values to try to create a smoother image.

Move

(Moves the background image)

- Pick a base point.
- Pick a point to move to.

Place

- (Places a background image in the current viewport)

Note: Placing a new background bitmap replaces the current bitmap.

Refresh

- Clicking refresh will update the stored bitmap if the file has changed.

Remove

- Clicking remove will remove the background image from the current viewport.

Scale

- Scales the background image in the current viewport.

Visible

- Click visible option Yes. If No, the background bitmap is hidden

Picture Frames

Picture Frames can be used to make a more flexible and powerful version of Rhinos Background Bitmap. Images are attached as texture maps to planes in 3d space and displayed in rendered mode, thus showing the texture map, rather than placed in the background of the viewport independent of geometry. Some advantages to using Picture Frames.

- An unlimited number of images can be placed in the scene. These can be viewed in any and all viewports.
- Images can be scaled and rotated as needed, unlike Background Bitmap which align only with the C plane X and Y.
- Images can be dimmed and/or made more or less transparent A possible disadvantage is that there is no guarantee that the image will always be behind everything in space-Picture Frames are just objects in 3d space.

Layers

Rhino layers work like CAD layering systems. By creating objects on different layers, you can edit and view related portions of a model separately or as a composite. You can create as many layers as you like. You can display all layers simultaneously or turn any of them off. You can lock layers so they are displayed but cannot be selected. Each layer has a color. You can assign a name to each layer (for example, Base, Body, Top) to organize the model or you can use preset layer names (Default, Layer 01, Layer 02, Layer 03).

The Layers panel manages layers. Use it to set up layers for your model. The Layers panel can be floating or docked with the other tabbed panels like Properties, Command Help, Lights, Notes, and more.

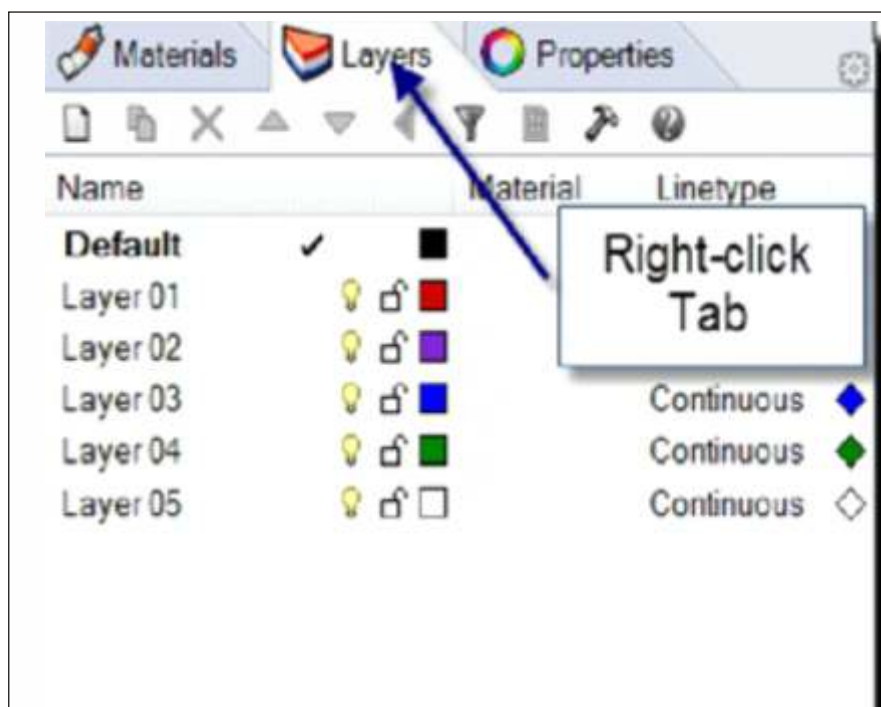


Fig. 2.6.1.15 Layers

Dimension Types

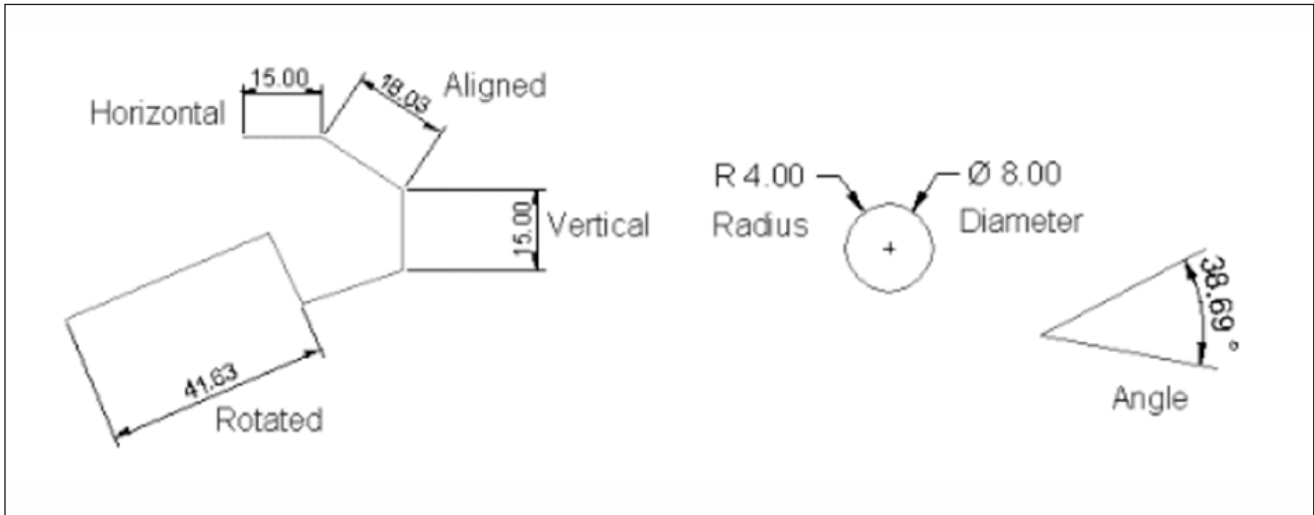


Fig. 2.6.1.16 Dimension Types

	Command	Description
	Dim	Creates a horizontal or a vertical dimension.
	Dim Aligned	Creates an aligned dimension.
	Dim Rotated	Creates a rotated dimension.
	Dim Angle	Creates an angular dimension.
	Dim Radius	Creates a diameter dimension.
	Dim Diameter	Creates a diameter dimension.
	Text	Creates 2-D annotation text.
	Leader	Draw an arrow leader.
	Properties	Edit dimensions and text.
	Dim Recenter Text original	Returns text that has been moved away from its default position to its original location.
	Make 2D	Creates curves from the selected objects as silhouettes relative to the active construction plane. The silhouette curves are projected flat and then placed on the world x, y plane

Dimension Leader

The Leader command draws an annotation leader with arrowhead and attached text.

Steps

1. Pick the head of the leader. This is the arrow end.
2. Pick the next points of the leader.
3. Press Enter to end the command. Note: Dimension Document Properties control the text height and arrow size.
4. In the Leader text dialog box, type text for the leader.

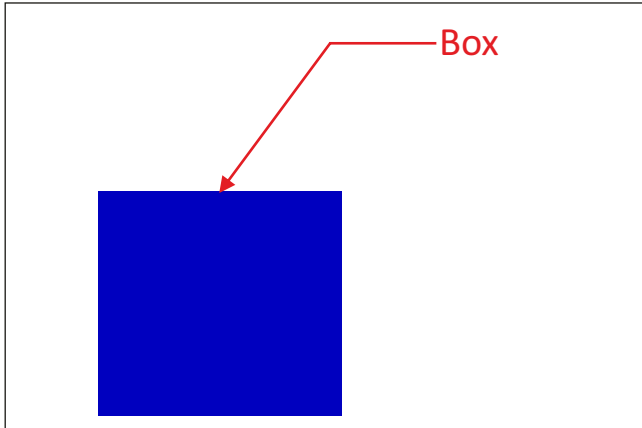


Fig 2.6.1.17 Dimension Leader

Exercise 1

- 1) State the difference between Line, Polyline and Interpolate Curve.

- 2) Name the command to measure Angle between two lines

- 3) State True and False-

- a) Background bitmap once placed cannot be edited.
- b) Picture frames can be sized using Gumball.

- 4) What is the function of Dimension leader?

Unit 2.7: Editing Geometry

Unit Objectives

At the end of this unit, you will be able to:

1. Apprehend the use of editing geometry.

2.7.1 Editing Geometry

Once you create objects, you can move and edit them to produce complex and detailed variations in your designs. These commands in Editing Geometry are very helpful and save time as it gives you the freedom to experiment with the object designed.

Group/Ungroup

Grouping objects allows all members of the group to be selected as one. You can then apply commands to the entire group.

Left-click or Ctrl+G	-	Group - Makes a group from selected objects.
Left-click or Ctrl+Shift+ G	-	Ungroup- Removes grouping

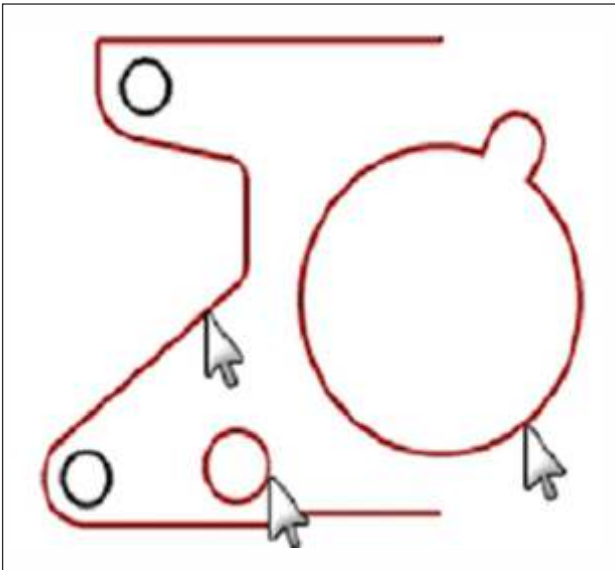


Fig. 2.7.1.1

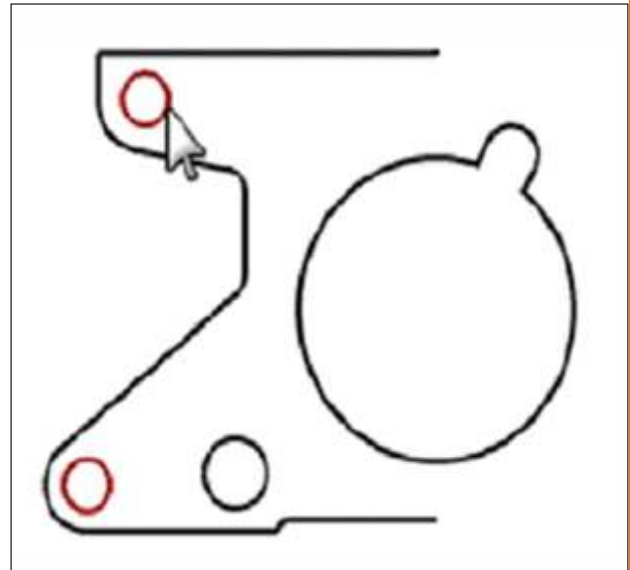


Fig. 2.7.1.2

Lock/Unlock

Lock : Sets the state of selected objects so they can be seen and snapped to, but cannot be selected for editing. The object becomes shaded gray.

Unlock : The Unlock command redisplay all locked objects

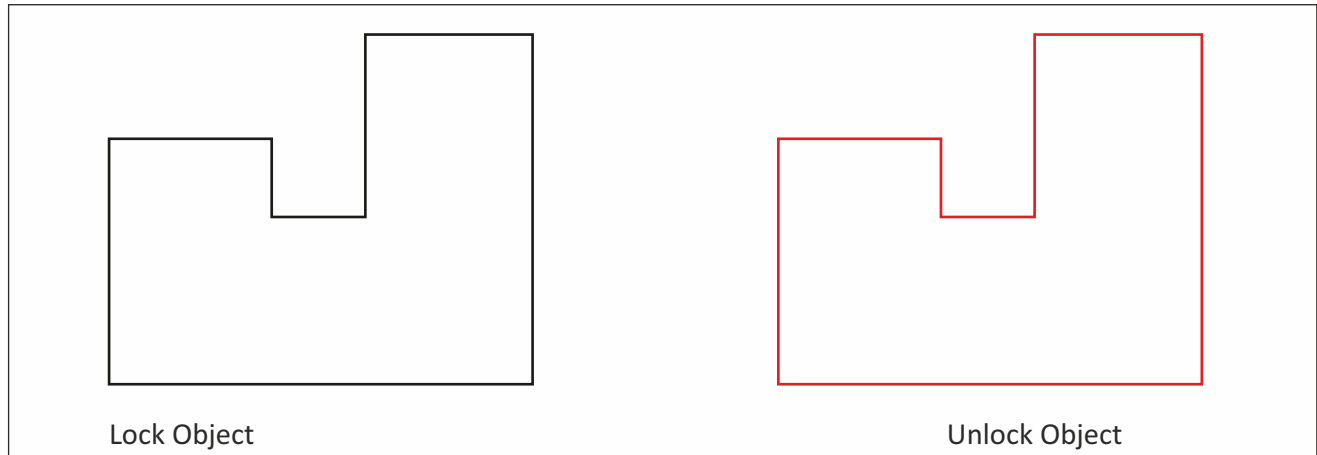


Fig. 2.7.1.3

Hide

The Hide command conceals selected objects from view.

Shortcut : Ctrl + H

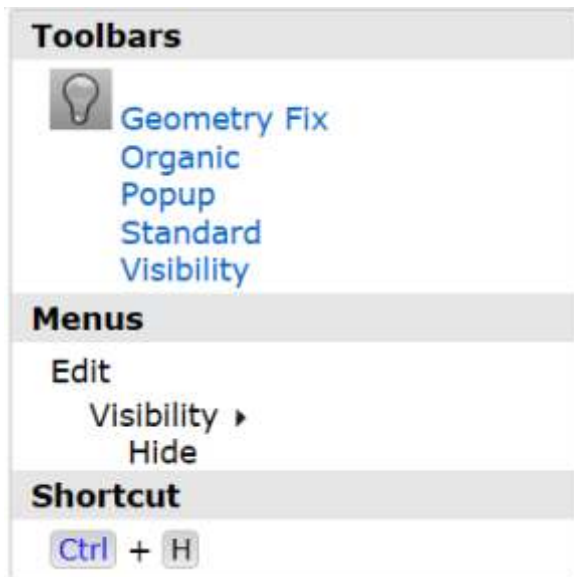


Fig. 2.7.1.4

Show

The Show command re-displays all hidden objects.

Shortcut : Ctrl+ Alt+ H



Fig. 2.7.1.5

Move

Use Move to move objects without changing orientation or size.

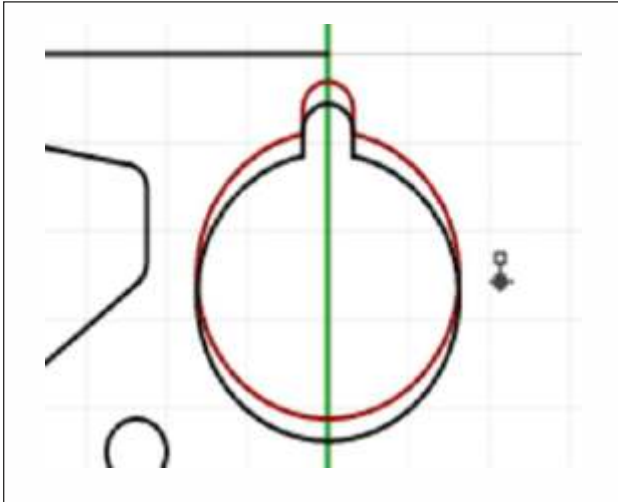


Fig. 2.7.1.6 Move

Rotate

Use Rotate to move objects in a circular motion around a base point. For precise rotation, enter a number of degrees to rotate. Positive numbers rotate counter clockwise; negative numbers rotate clockwise.

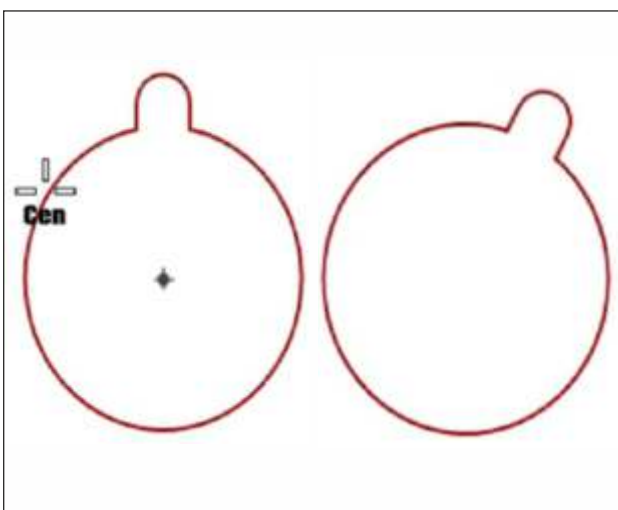


Fig. 2.7.1.8 Rotate

Copy

Copy duplicates selected objects and places them in a new location. The command can repeat to create more than one copy in the same command sequence.

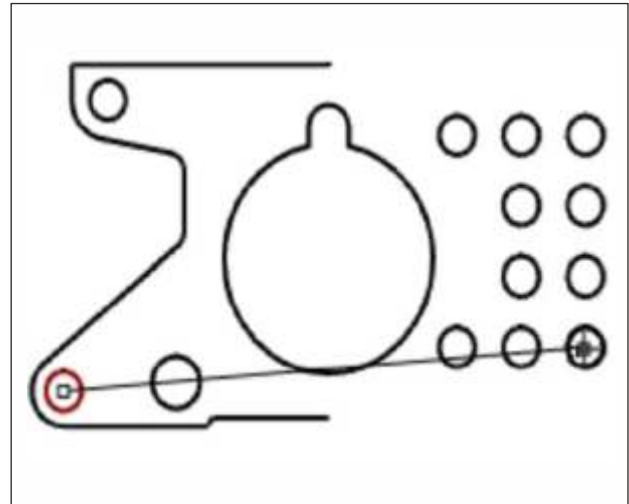


Fig. 2.7.1.7 Copy

Scale

Scale changes the size of existing objects without changing their shape. This command scales three-dimensional objects equally along all three axes. There are also 2-dimensional, one-dimensional, and non-uniform scale commands.

Scale : Changes the size of selected objects uniformly in the x-, y-, and z-directions.

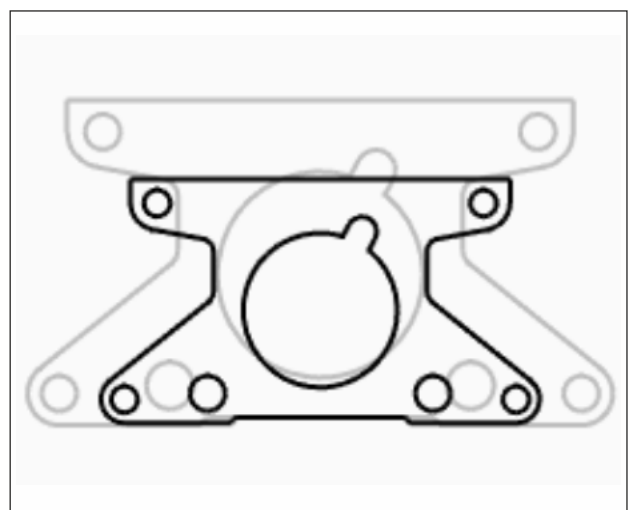


Fig. 2.7.1.9 Scale

Scale 2D : Changes the size of selected objects uniformly in two directions. The objects are expanded or contracted uniformly in the two directions of the axes of the active viewport construction plane where you specify the scale factor.



Fig. 2.7.1.10

Scale 1D

Changes the size of selected objects in one direction. The objects expand or contract in the single direction specified, without expanding the objects in the other directions.

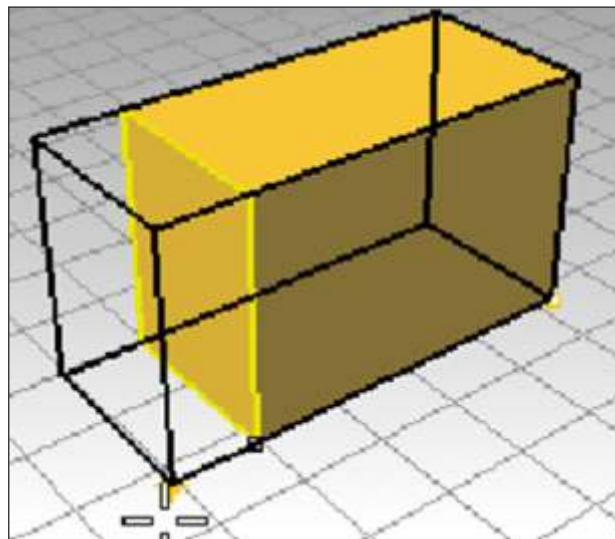


Fig. 2.7.1.11

Mirror

Mirror creates a copy of the objects flipped over a specified axis on the construction plane.

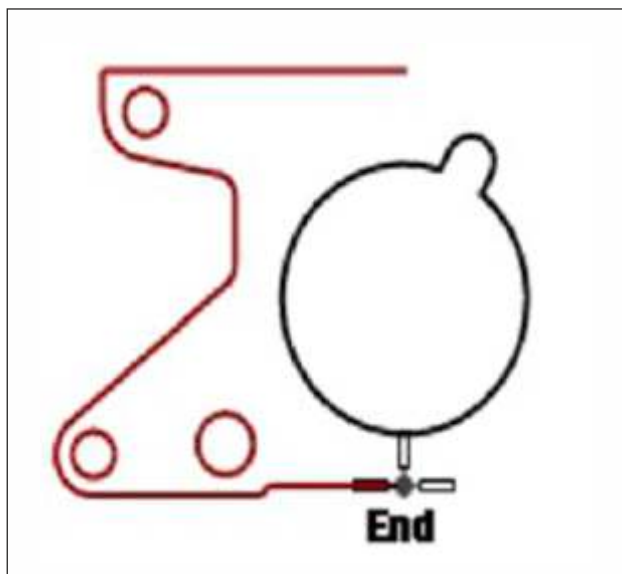


Fig. 2.7.1.12

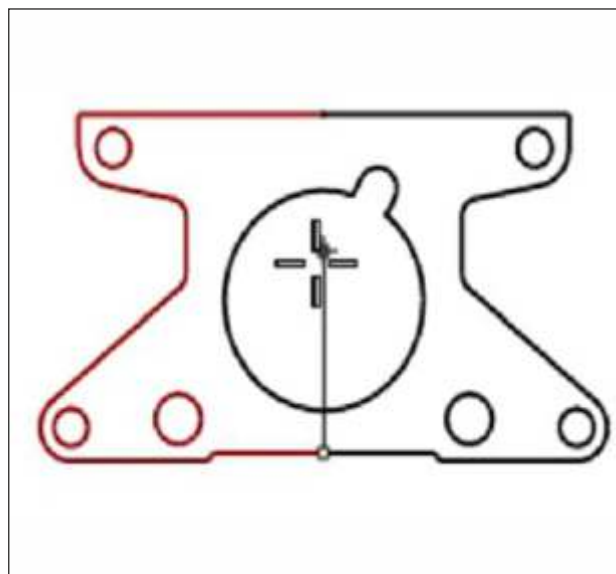


Fig. 2.7.1.13

Rotate 3D

Rotates objects around a specified axis in 3-D space.

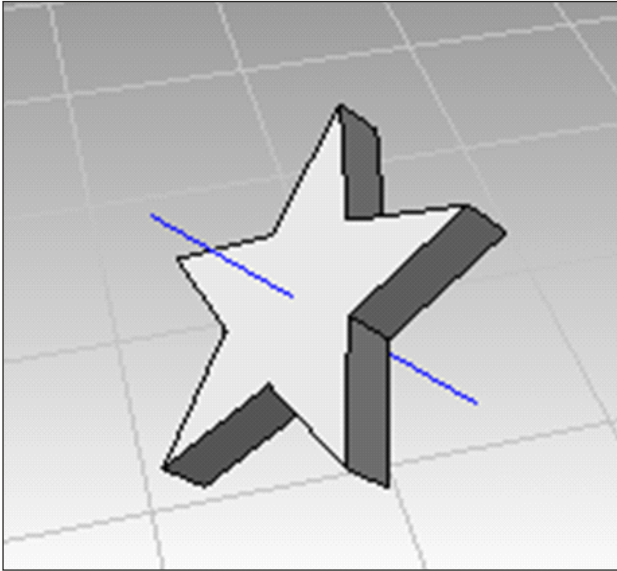


Fig. 2.7.1.14

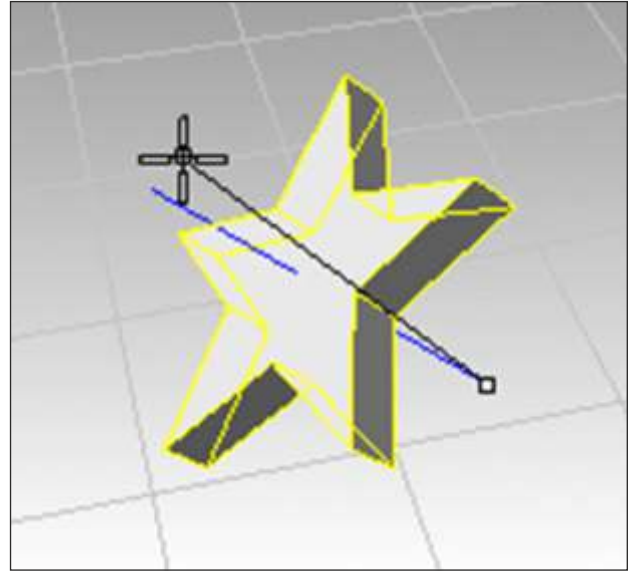


Fig. 2.7.1.15

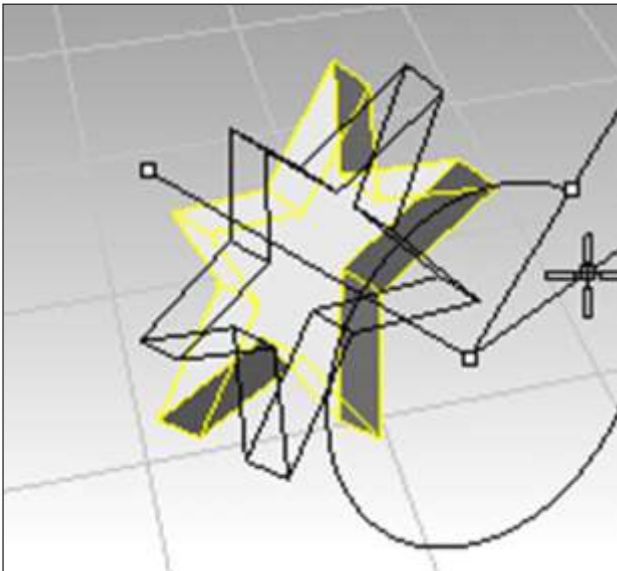


Fig. 2.7.1.16

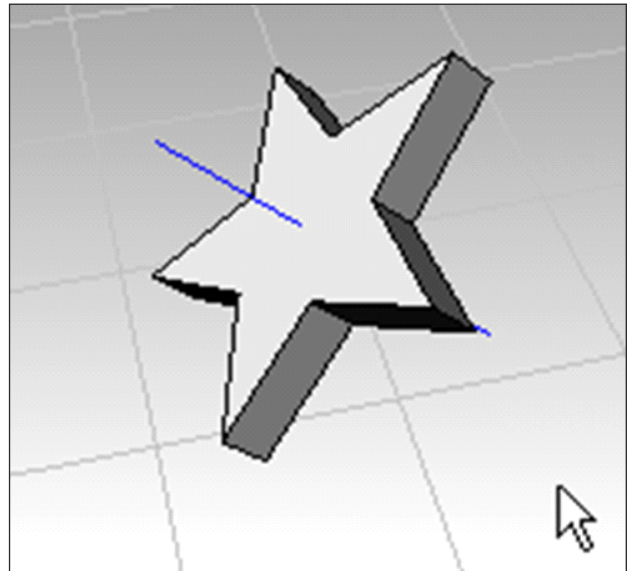


Fig. 2.7.1.17

Symmetry

Mirrors curves and surfaces, makes the mirrored half tangent to the original, and then when the original object is edited, the mirrored half updates to match the original.

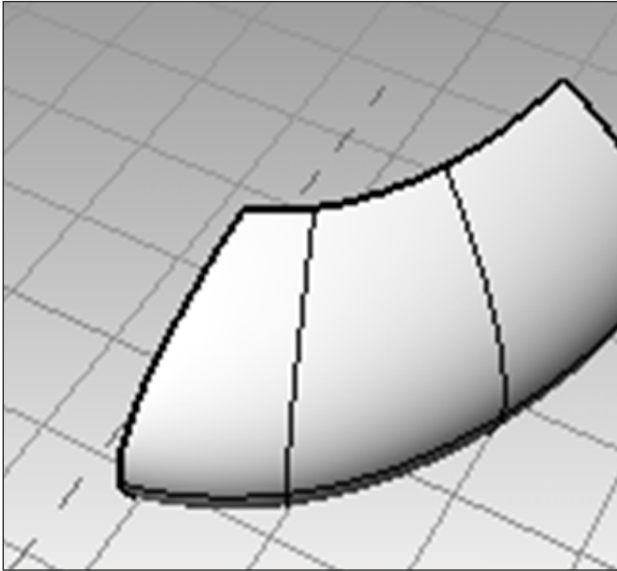


Fig. 2.7.1.18

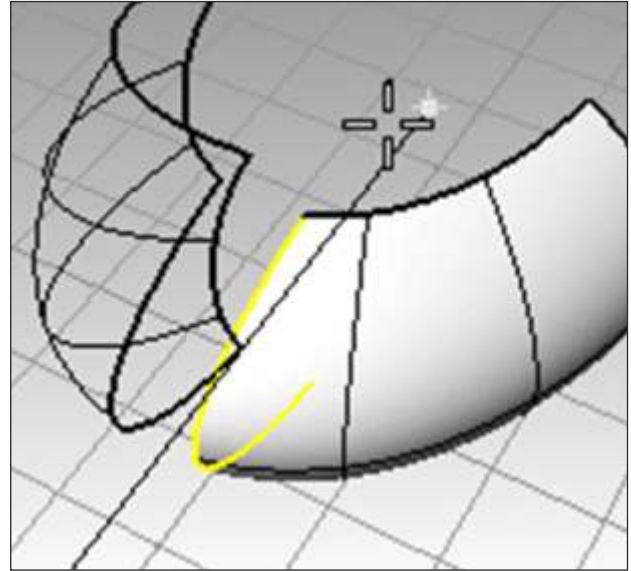


Fig. 2.7.1.19

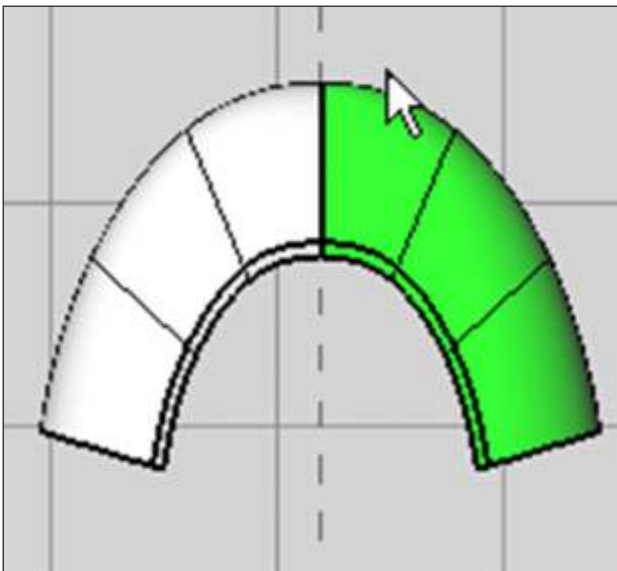


Fig. 2.7.1.20

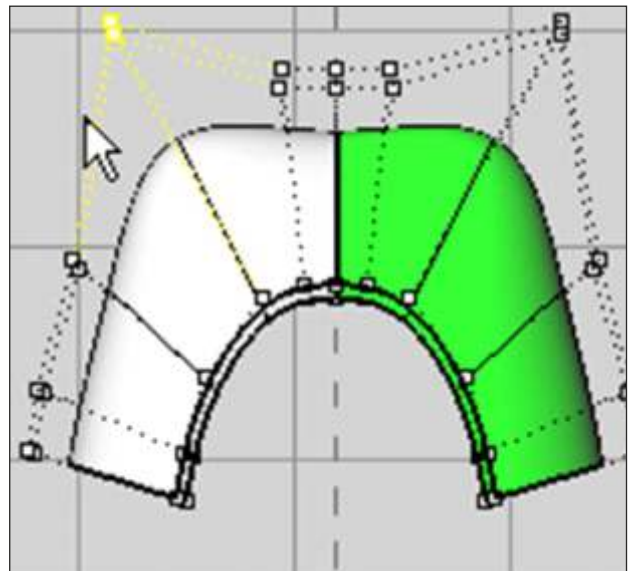


Fig. 2.7.1.21

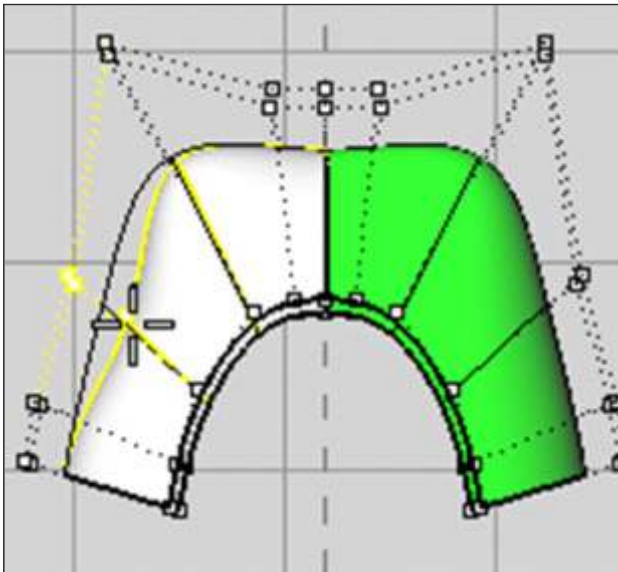


Fig. 2.7.1.22

Editing with the gumball

Gumball displays a widget on a selected object which is used to facilitate the direct editing. The gumball provides move, scale, and rotate transformations around the gumball origin.

Click the Gumball pane in the status bar.



Fig. 2.7.1.23

Gumball actions:

- Drag gumball arrows to Move the object.
- Drag scale handles (squares) to Scale the object in one direction.
- Drag arcs to rotate the object.
- Tap the Alt key after starting to drag to toggle copy mode.
- Click a control handle to enter a numeric value.
- Hold the Shift key during Scale to force 3-D scale.

Gumball Controls

- 1 Axis plane indicator
- 2 Free move origin
- 3 Menu ball Move arrows,
- 4 Move X,
- 5 Move Y
- 6 Move Z

Rotation arcs

- 7 Rotate X
- 8 Rotate Y
- 9 Rotate z

Scale handles

- 10 Scale X
- 11 Scale Y
- 12 Scale z

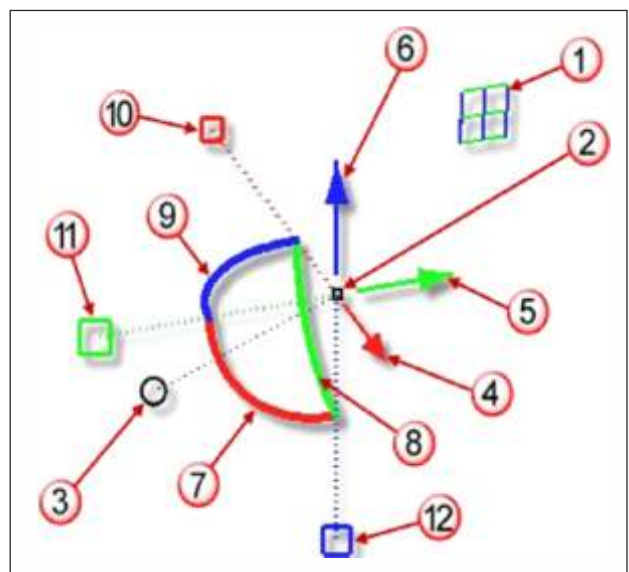


Fig. 2.7.1.24

Extend

Extend lengthens an object to make it end precisely at its intersection with another object or you can lengthen an object when there is no intersection.

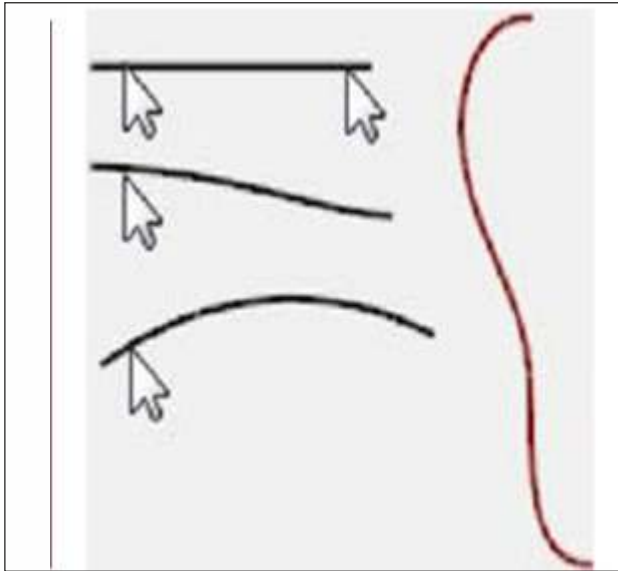


Fig. 2.7.1.25

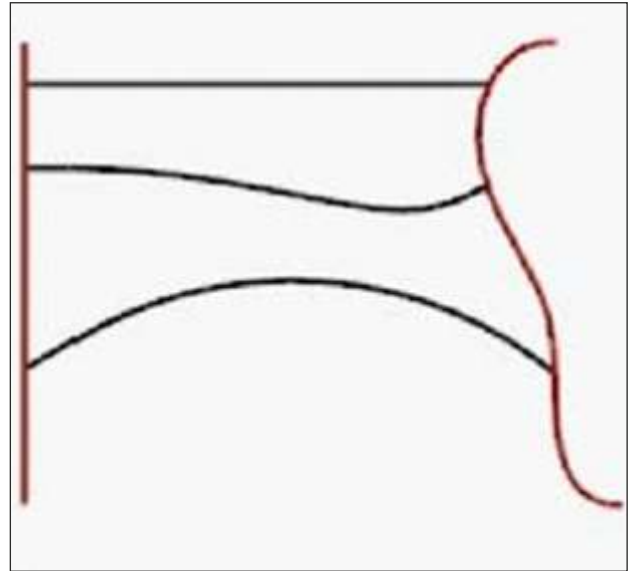


Fig. 2.7.1.26

Fillet

Fillet connects two lines, arcs, circles, or curves extending or trimming them to touch or to join with a circular arc. Rules to follow when filleting curves:

- The curves must be coplanar.
- The created fillet is determined by picking on the curve portion to keep.
- The radius cannot be so large that it runs past the end of the curve.

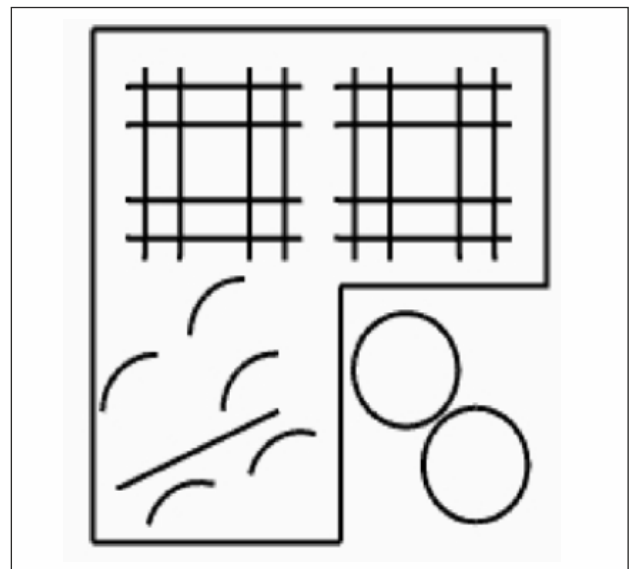


Fig. 2.7.1.27

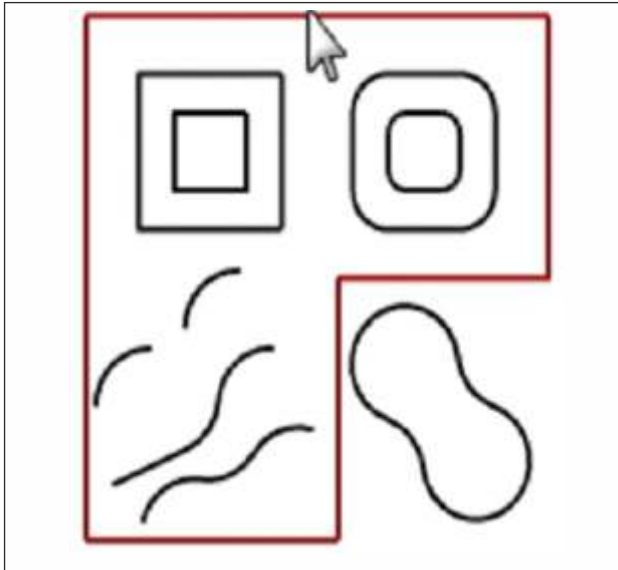


Fig. 2.7.1.28

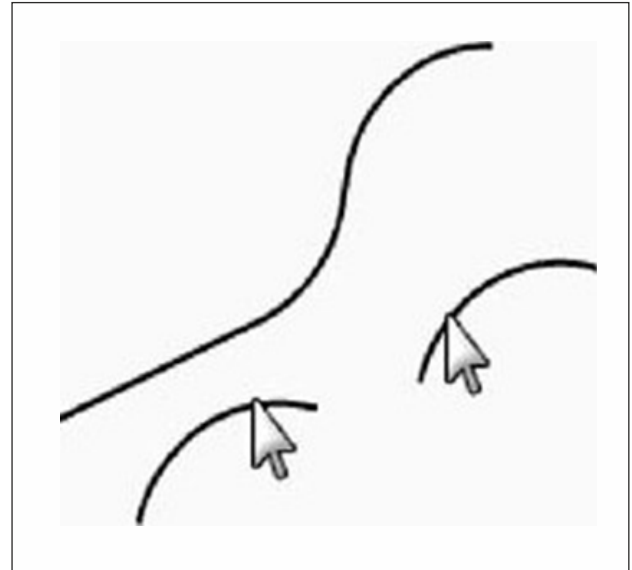


Fig. 2.7.1.29

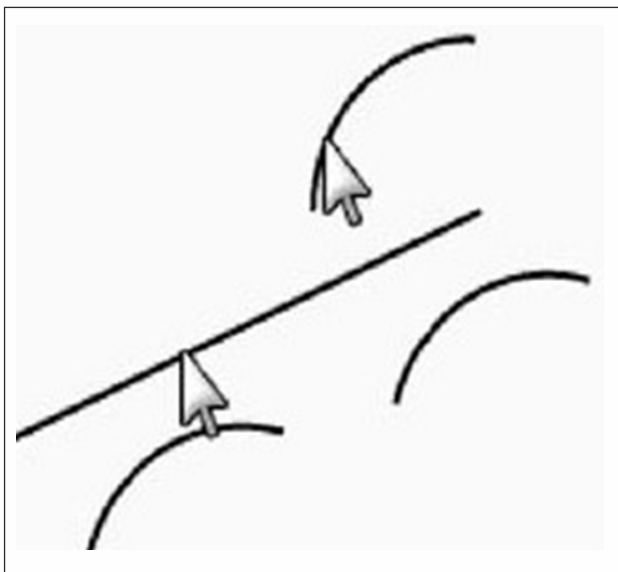


Fig. 2.7.1.30

Blend

Blending is another method to connect lines, arcs, or curves. There are three blend commands that work on curves, BlendCrv (default), Blend (Quick Blend) and Arc Blend.

BlendCrv allows you to adjust the continuity with the input curves and has adjustable endpoints.

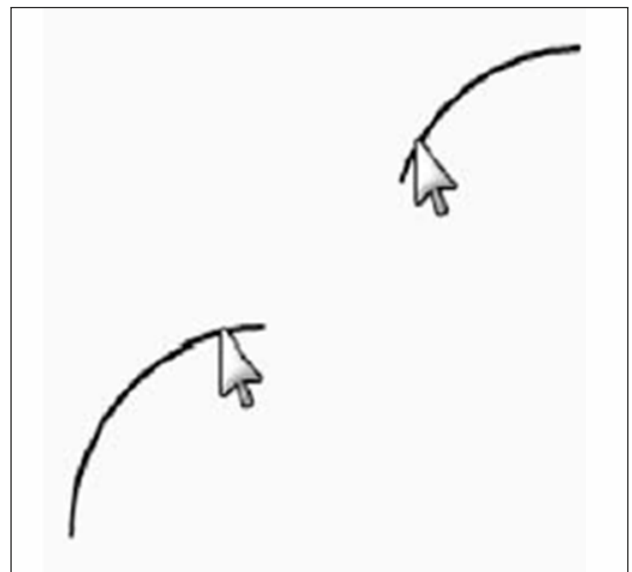


Fig. 2.7.1.31

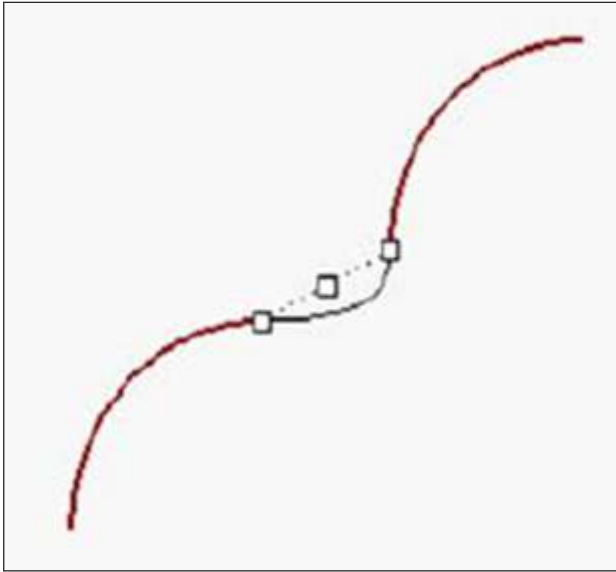


Fig. 2.7.1.32

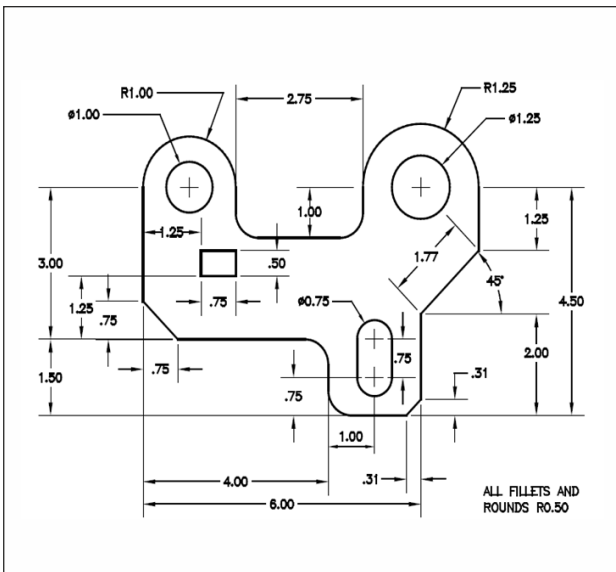
Example:

Fig. 2.7.1.34

Offset

Offset creates an object parallel or concentric to another object. Use Offset to create specialized copies, such as parallel lines, concentric circles, and concentric arcs, through specified points or at pre-set distances.

Chamfer

Chamfer connects two curves by extending or trimming them to intersect or to join with a beveled line. Chamfer works on convergent or intersecting curves.

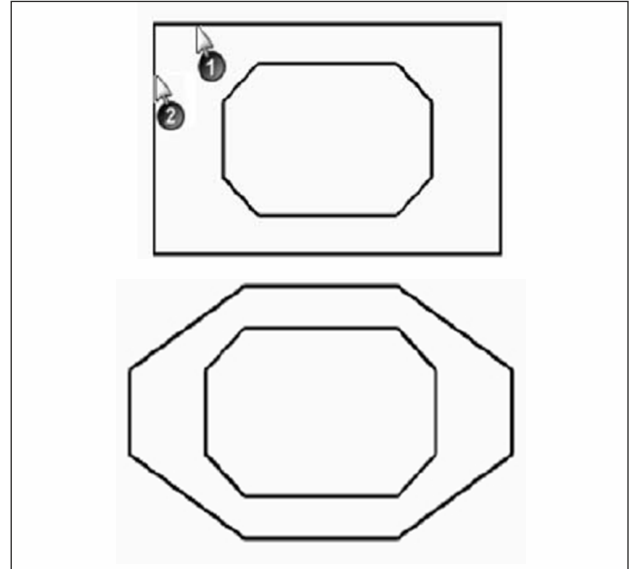


Fig. 2.7.1.33

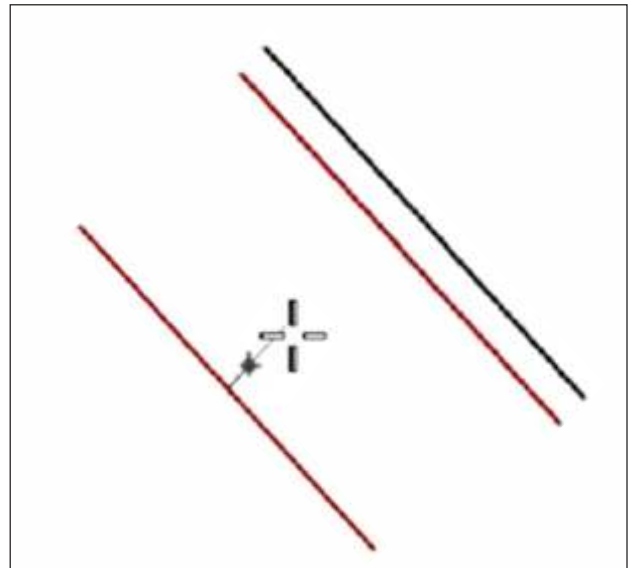


Fig. 2.7.1.35

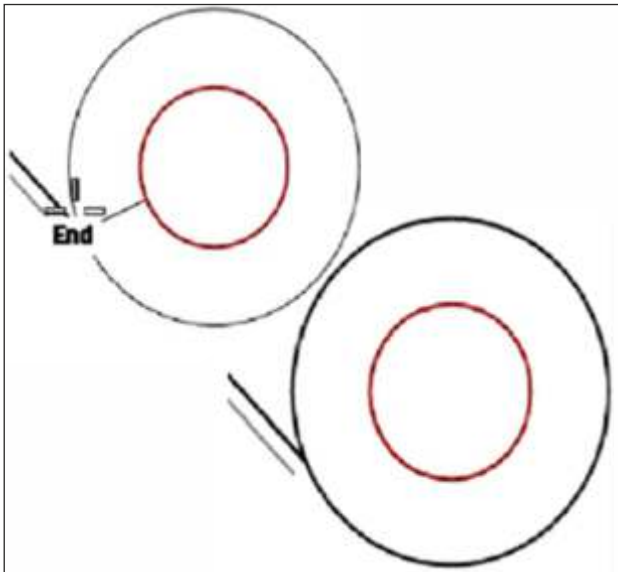


Fig. 2.7.1.36

Join

Join unites curves that meet at a common end, making a single curve. Join can unite curves that do not touch, if you select them after the command has started. As you select non-touching curves, a dialog box asks if you want to fill the gap.

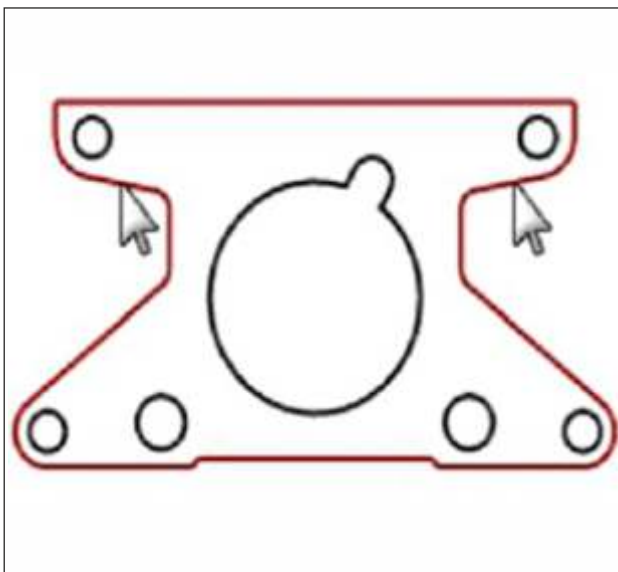


Fig. 2.7.1.38

Rebuild

Reconstructs selected curves or surfaces to a specified degree and control point number.

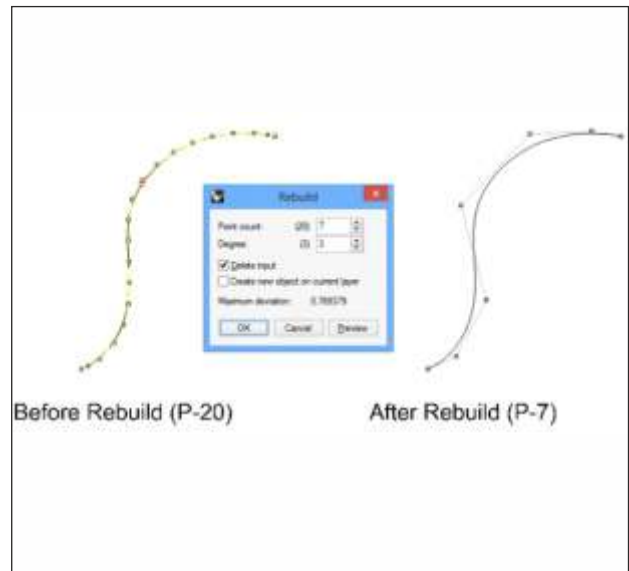


Fig. 2.7.1.37

Explode

Breaks objects down into components.

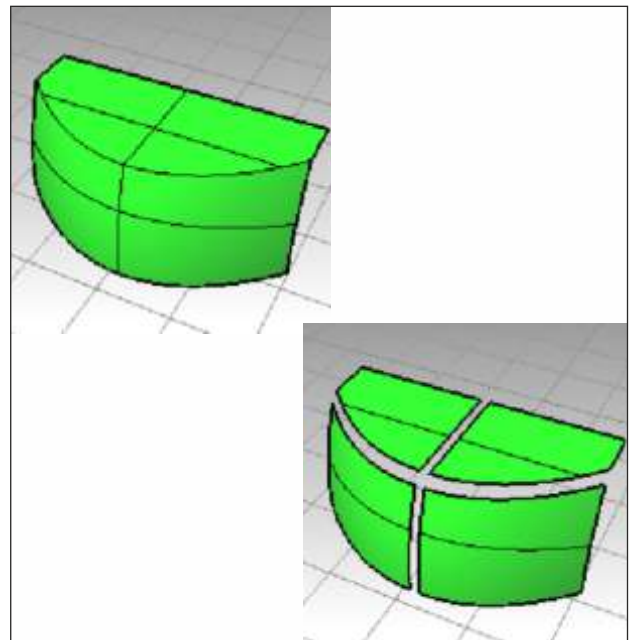


Fig. 2.7.1.39

Trim

Trim cuts and deletes portions of an object to make it end precisely at its intersection with another object.

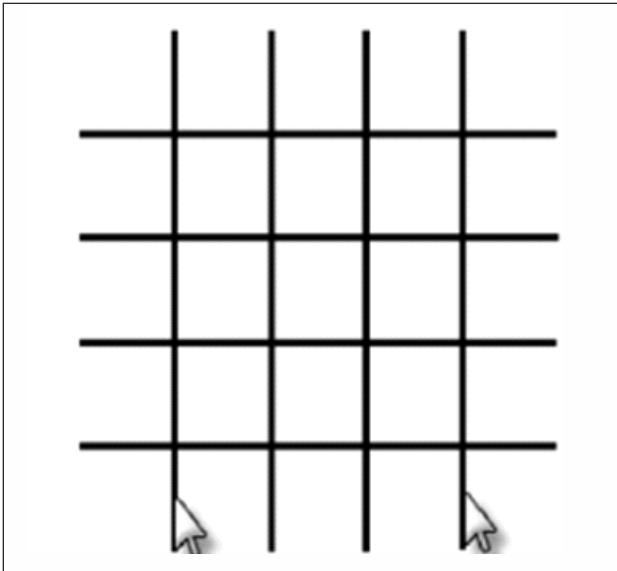


Fig. 2.7.1.40

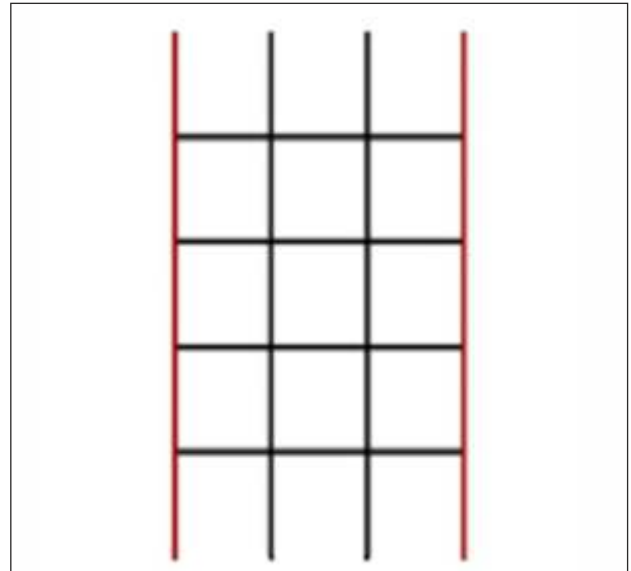


Fig. 2.7.1.41

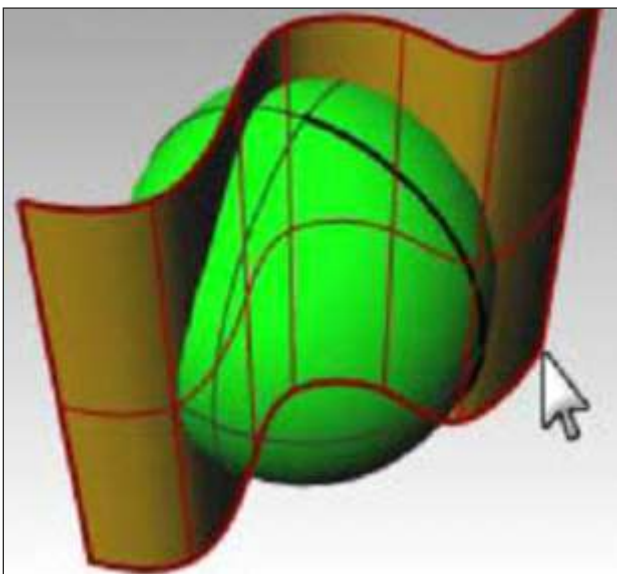


Fig. 2.7.1.42

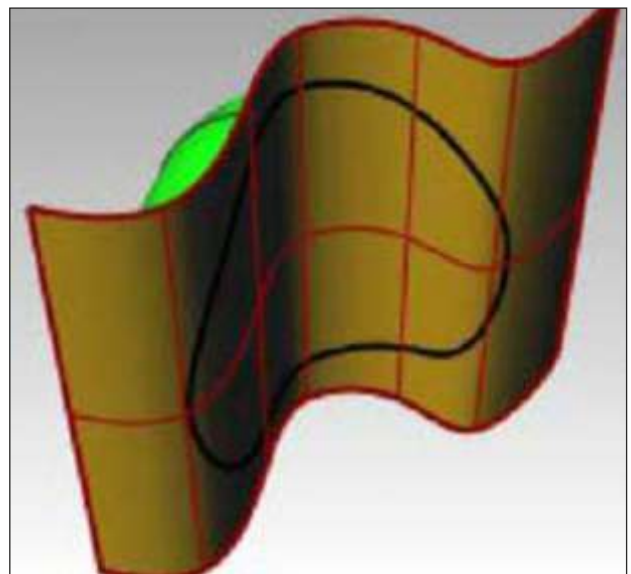


Fig. 2.7.1.43

Split

Split divides objects into parts using other objects as cutters. The Split command breaks the object where it intersects the cutting object but does not delete anything.

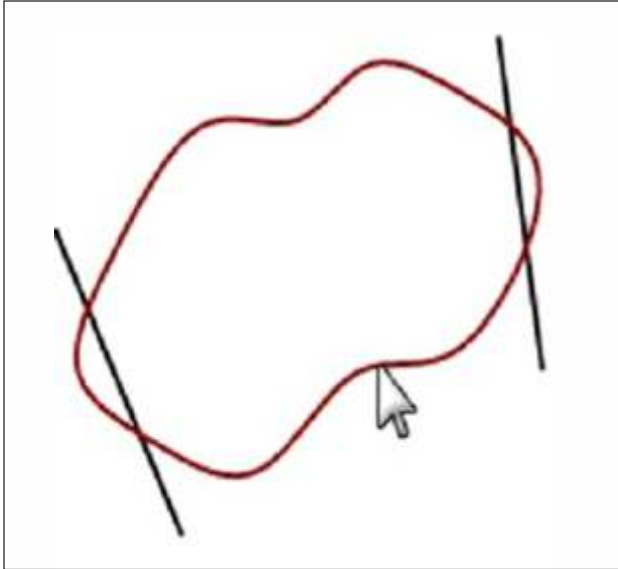


Fig. 2.7.1.44

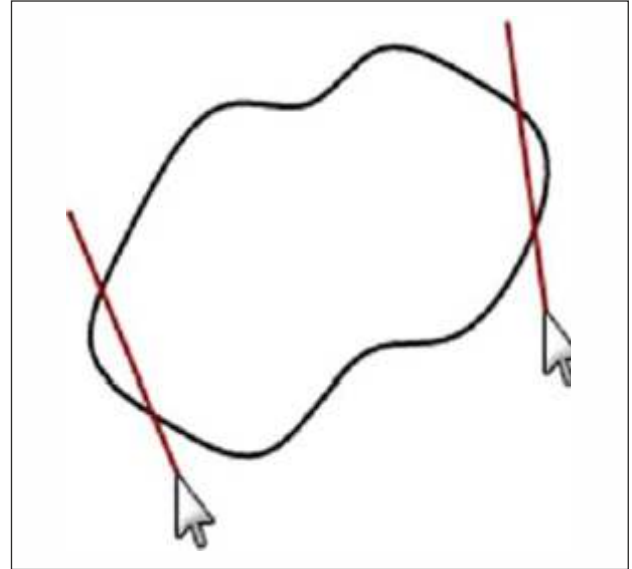


Fig. 2.7.1.45

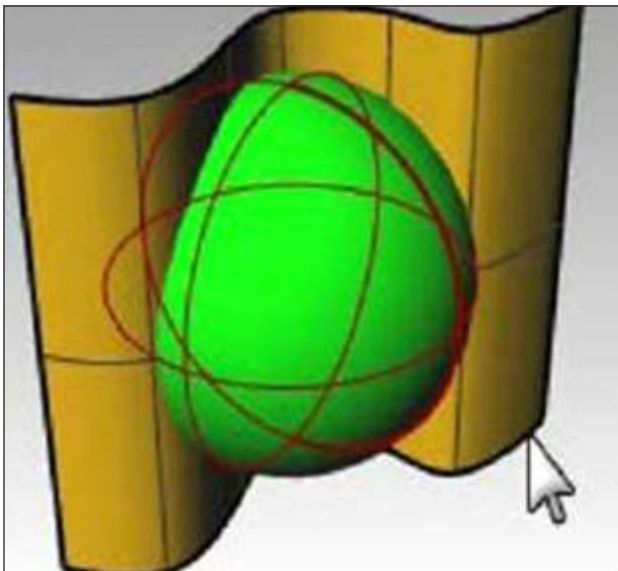


Fig. 2.7.1.46

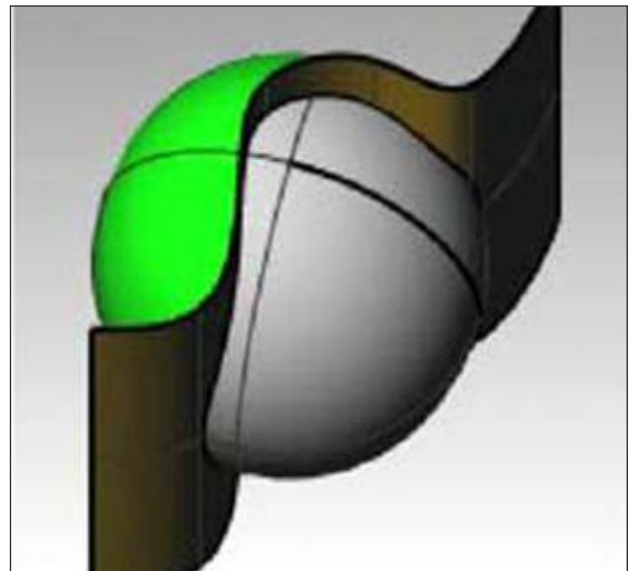


Fig. 2.7.1.47

Shrink Trimmed - Surface

The Shrink Trimmed Srf command contracts the underlying untrimmed surface close to trimming boundaries.

- **Select trimmed surfaces.**

Trimmed surfaces are represented by an untrimmed surface with trimming boundaries. When textures are applied to surfaces, the textures map to the underlying untrimmed surface. Sometimes the underlying untrimmed surface is much larger than the trimmed surface, resulting in only a small portion of the texture showing up in the rendering.

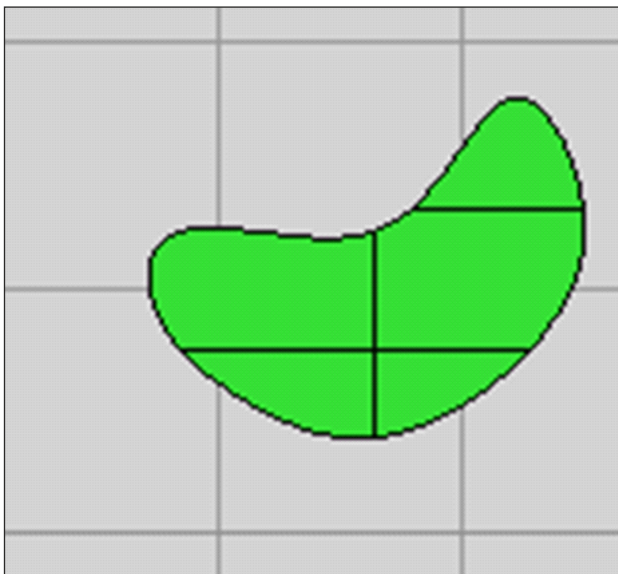


Fig. 2.7.1.48

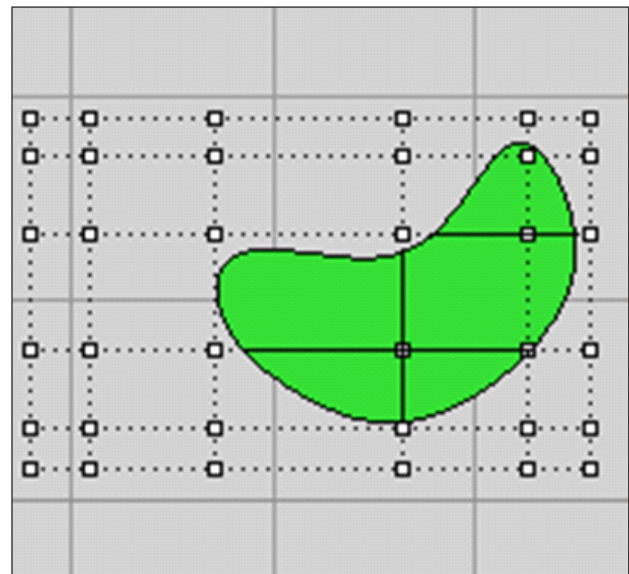


Fig. 2.7.1.49

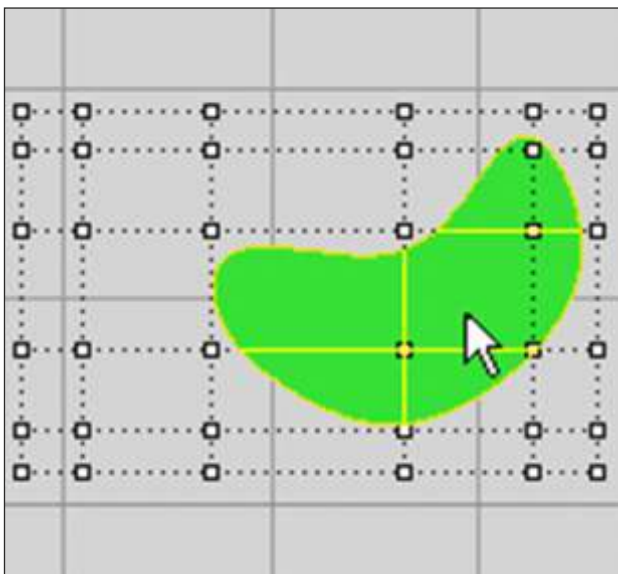


Fig. 2.7.1.50

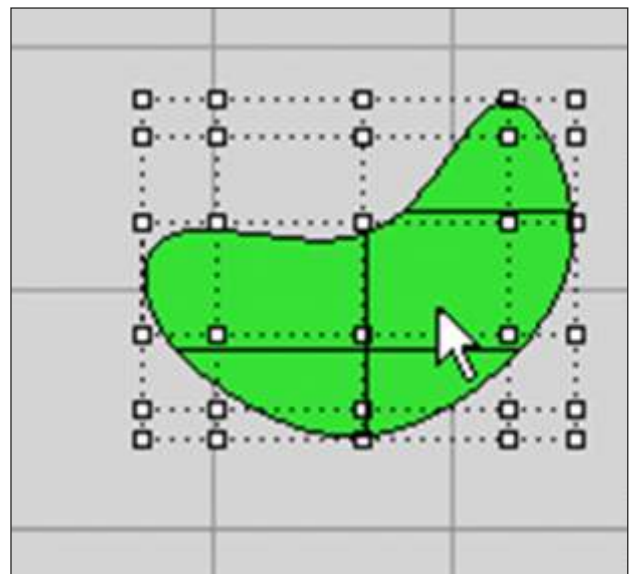


Fig. 2.7.1.51

Select**Select curve**

Select all curves.

Select > select curves

Sel curves > select curves.

Select Point

Select all point objects.

Select > select points

Select by layer

Select all objects on layer. Use the pick button in the dialog box to select an object on the layer.

Select > Select by layer.

Select duplicate object

Select objects that are geometrically identical with another object and visible, regardless of other objects property.

Select > Select duplicate object.

Exercise 1

- 1) Which commands out of these can make copies also-
 - a) Mirror
 - b) Hide
 - c) Rotate
 - d) Scale
 - e) Show
 - f) Symmetry

- 2) This command reconstructs curves or surfaces to a specified degree and control point number.

- 3) State True or false-
 - a) Join unites 2 or more curves. Curves need not be placed end to end.
 - b) For trimming or splitting curves or surface all selected objects have to be intersecting.

Scan the QR Code to watch the related video or click on link



Click Here

RHINO / Editing Curves (By IIT DC)

Unit 2.8: Solid Creation

Unit Objectives


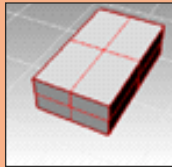


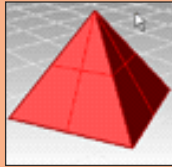
At the end of this unit, you will be able to:

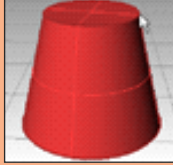


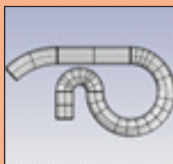
1. Gain knowledge on the use of geometry objects.

2.8.1 Solid Toolbar

- In Rhino solids are closed surfaces or polysurfaces that enclose a volume.
- Some of the solid primitives are closed single surfaces carefully edge matched others are polysurfaces.
- Rhino's polysurface objects are deformable by using the deformation commands under the Transform menu.
- You can also extract surfaces and deform the surfaces with control point editing .

Create 3D Solid Tool

Command	Description	Image
Sphere	Draws a solid sphere.	
Box	Draws a Solid Box	
Ellipsoide	Draws a Ellipsoide Box	
Cone	Draws a Cone	
Pyramid	Draws a Pyramid	

Command	Description	Image
Truncated Cone	Draws a cone whose apex is truncated by a plane.	
Cylinder	Draw a Cylinder.	
Tube	Draws a closed cylinder with a concentric cylindrical hole.	
Torus	Draws a torus (donut shape).	
Pipe	Creates a surface with a circular profile around curves.	

Exercise 1

1) Name a few primitive solid objects in Rhino

2) Draw a sphere with radius 10 mm

3) How many faces does a box have?

4) How many faces does an Ellipsoid have?

Unit 2.9: Working with Surface Commands

Unit Objectives

At the end of this unit, you will be able to:

1. Use the surface command.

2.9.1 Surface Command

A Rhino surface is similar to a piece of stretchy fabric. It can take on many different shapes. Surfaces are bound by curves called edges. To visualize the surface shape Rhino displays a grid of isocurves on the surface.

Surface Point

Creates a surface by picking three or four points in space for corners.

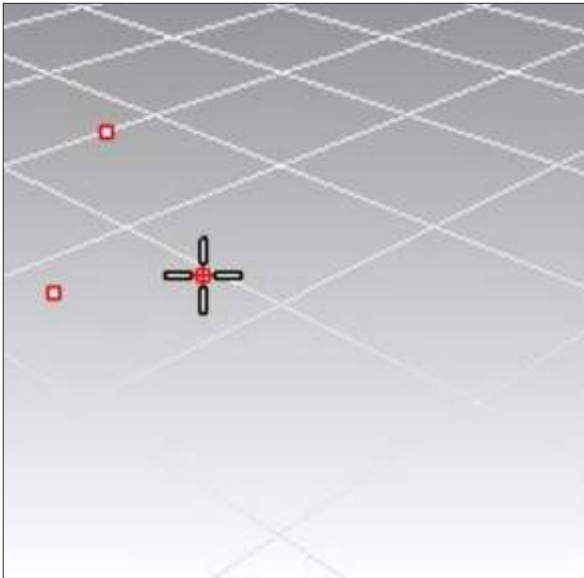


Fig. 2.9.1.1

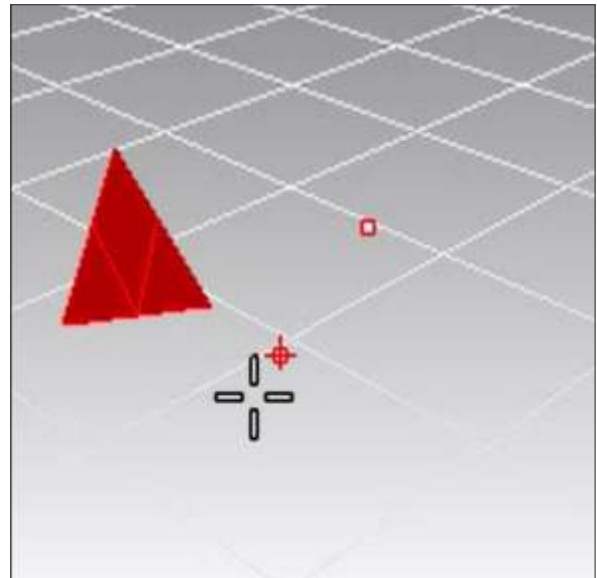


Fig. 2.9.1.2

Edge Surface

Creates a surface by selecting two; three; or four existing curves whose ends meet exactly.

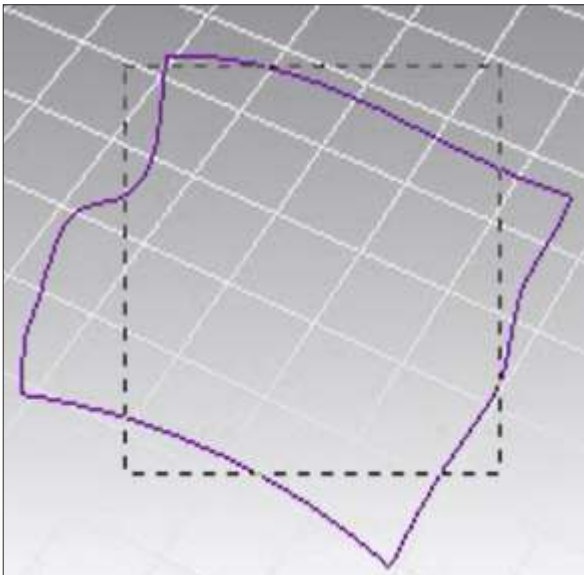


Fig. 2.9.1.3

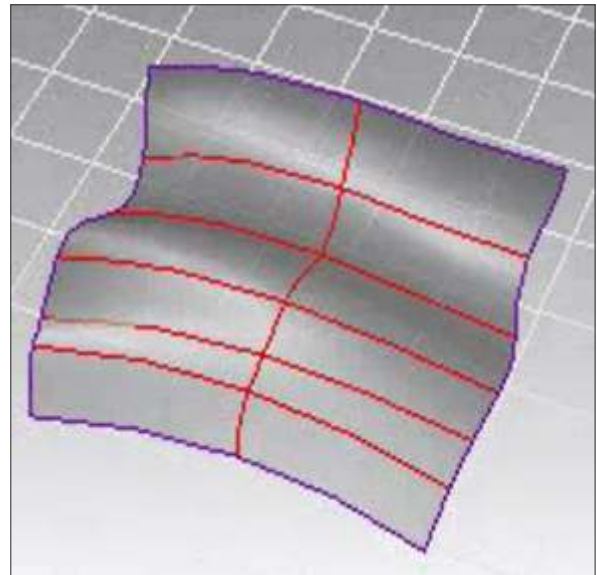


Fig. 2.9.1.4

Planar Surface

Creates a surface from planar curves that enclose an area.

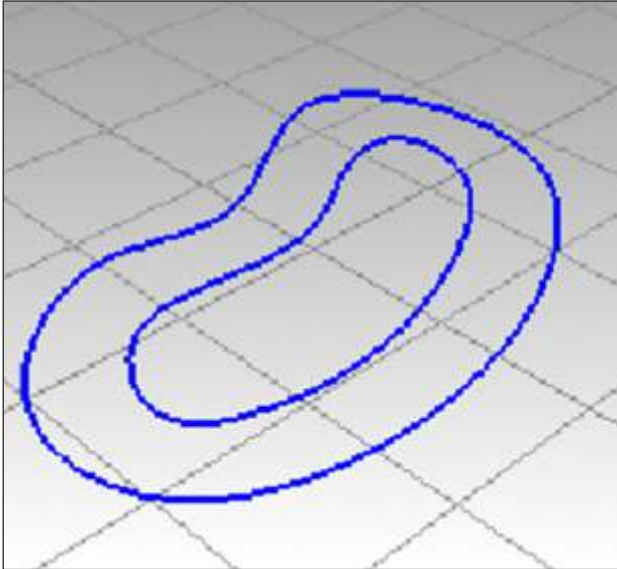


Fig. 2.9.1.5

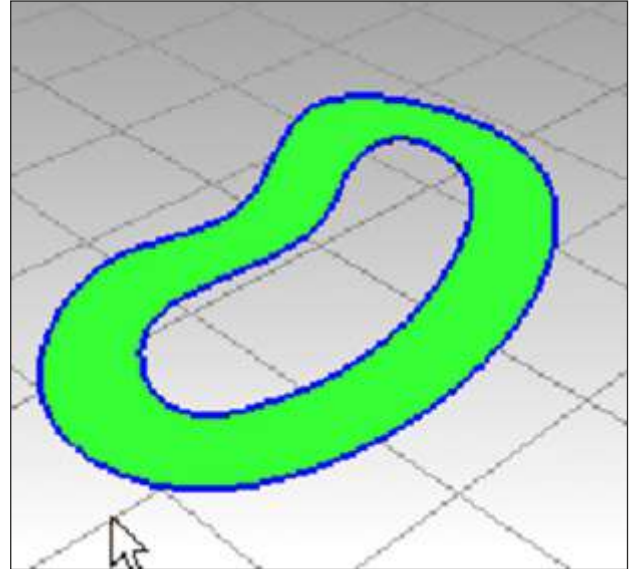


Fig. 2.9.1.6

Plane

Creates a rectangular planar surface parallel to the construction plane from two diagonal points.

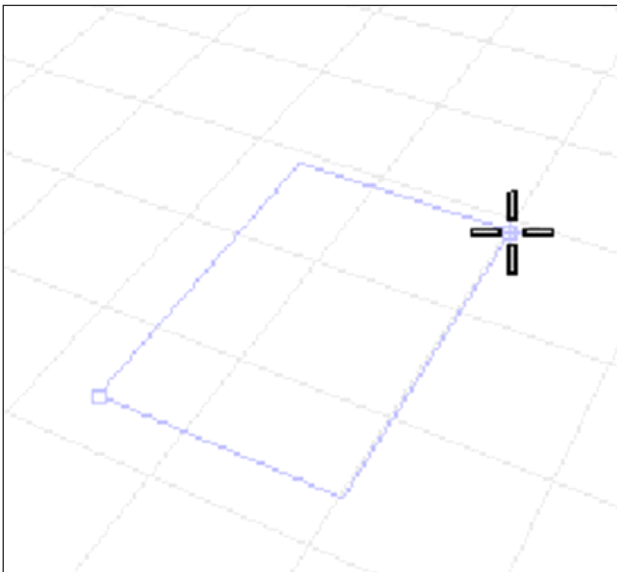


Fig. 2.9.1.7

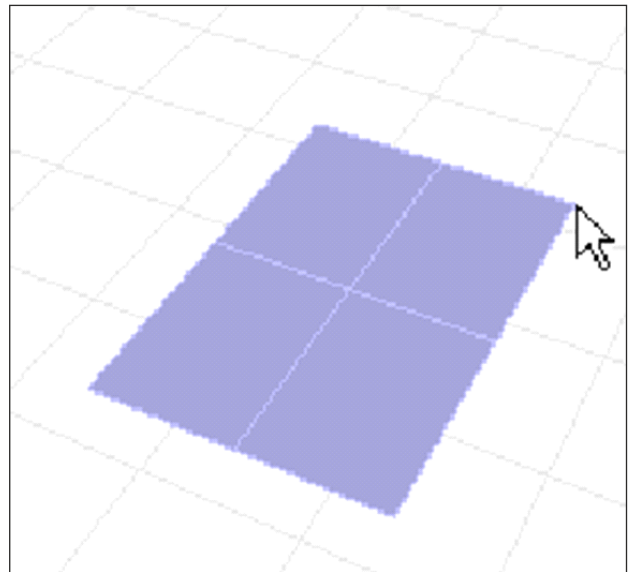


Fig. 2.9.1.8

Extrude

Extrudes a curve perpendicular to the construction plane with option to taper the surface with a draft angle.

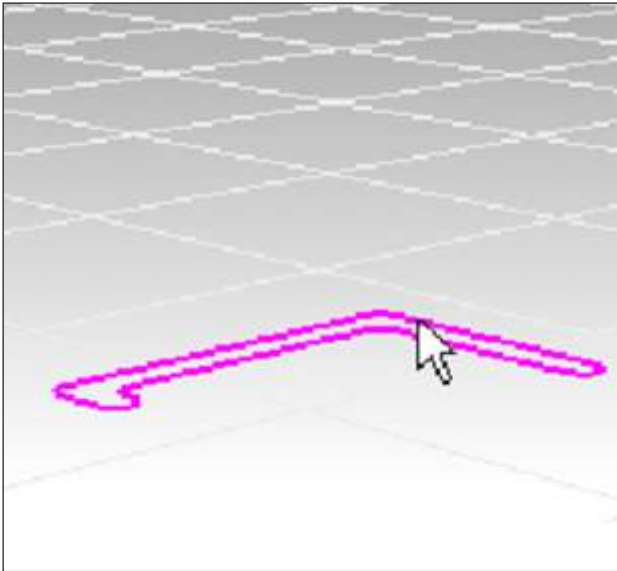


Fig. 2.9.1.9

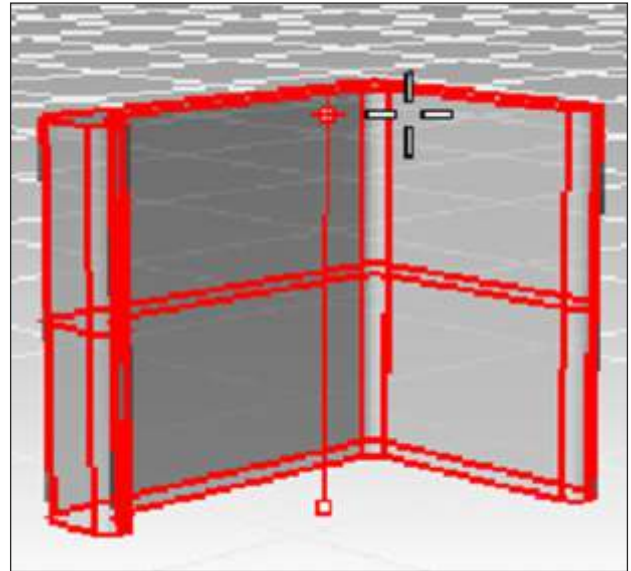


Fig. 2.9.1.10

Extrude along Curve :

Extrudes a curve following along a second curve.

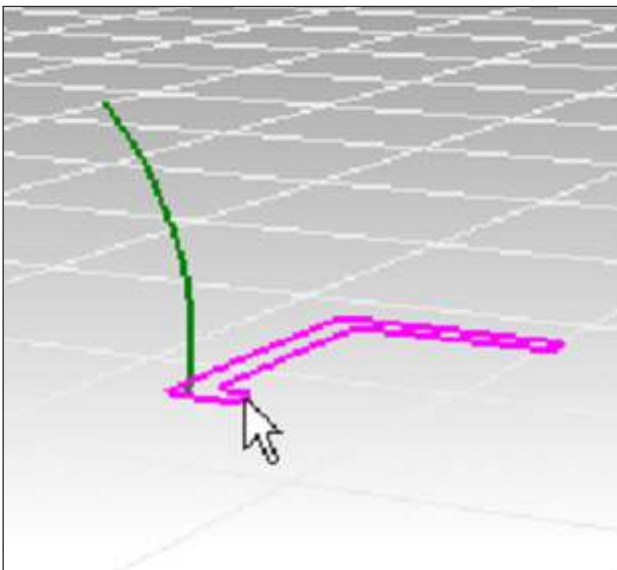


Fig. 2.9.1.11

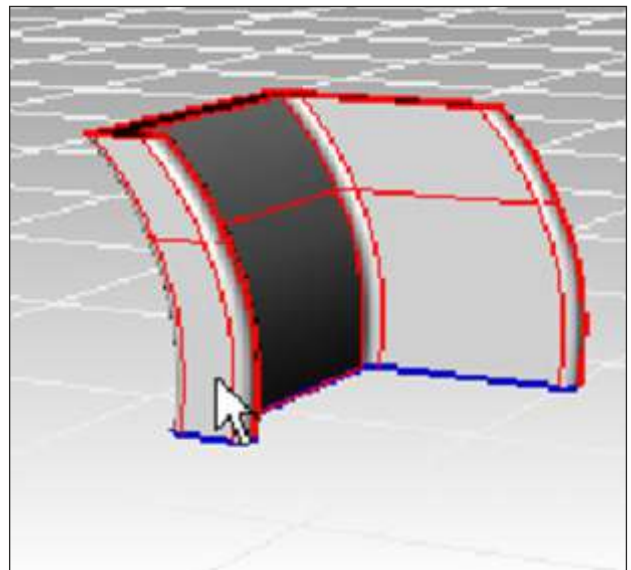


Fig. 2.9.1.12

Extrude to Point :

Extrudes a curve to a point.

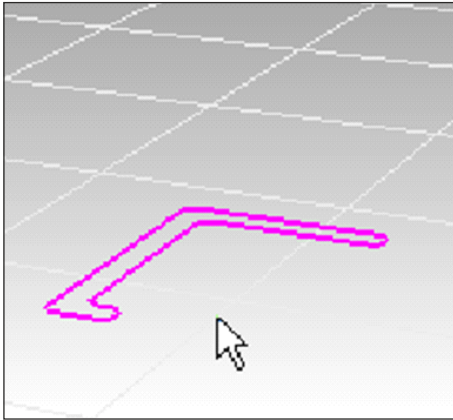


Fig. 2.9.1.13

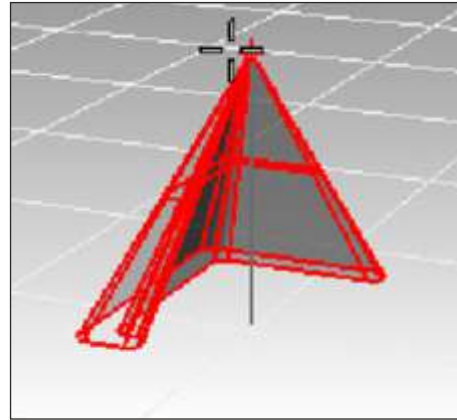


Fig. 2.9.1.14

Extrude Tapered :

Creates a surface by tracing the path of a curve in a straight line tapering in or out at a specified draft angle.

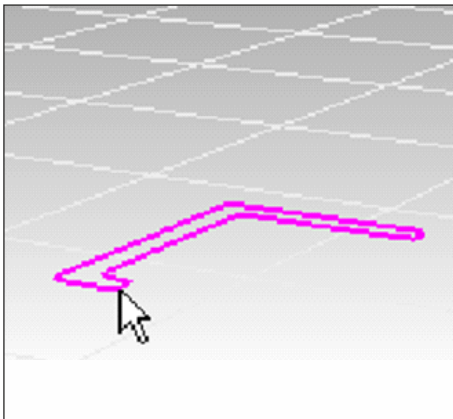


Fig. 2.9.1.15

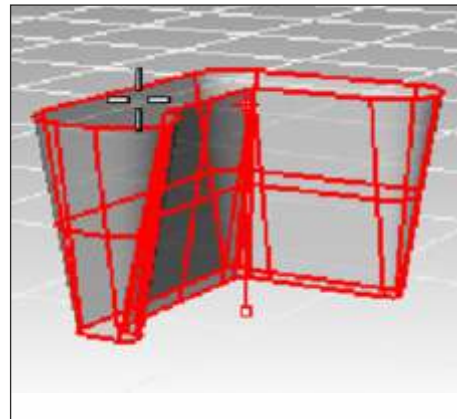


Fig. 2.9.1.16

Scan the QR Code to watch the related video or click on link



Click Here
Extrude and Tapered Ring

SWEEP 1 RAIL

Fits a surface through a series of profile curves that define the surface shape and one curve that defines a surface edge. Convert curve to 3D surface with one rail and one cross section using “sweep 1” command.

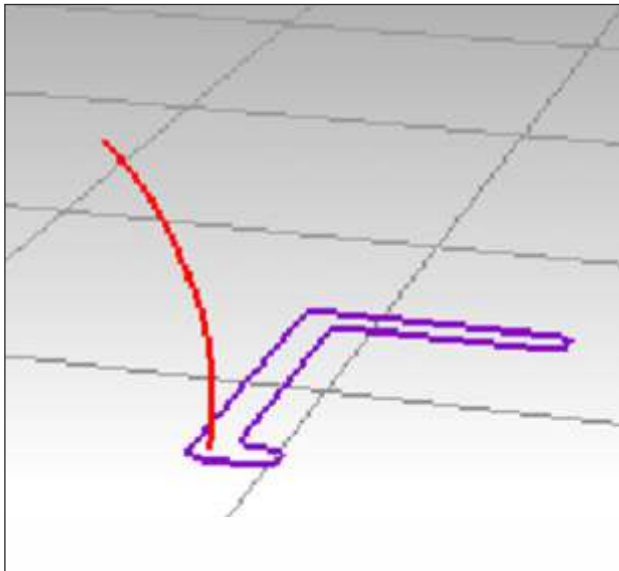


Fig. 2.9.1.17

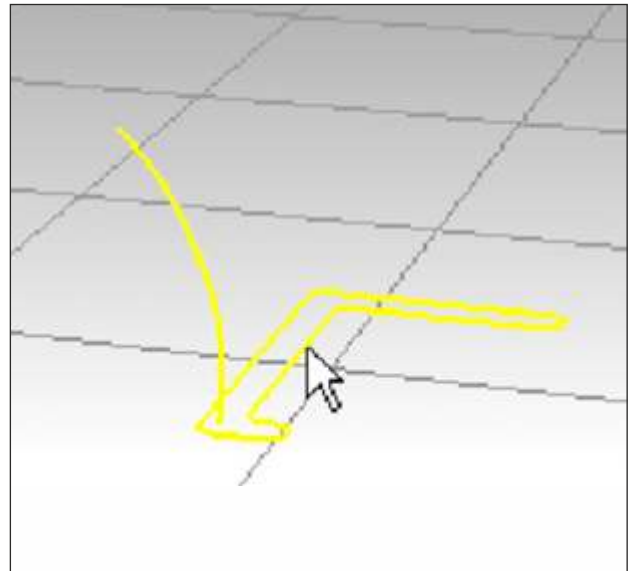


Fig. 2.9.1.18

SWEEP 2 RAIL

Fits a surface through a series of profile curves that define the surface shape and two curves that define the surface edges.

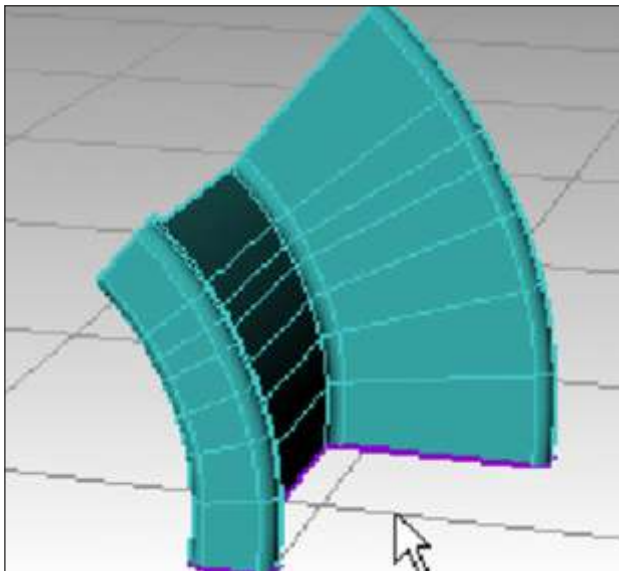


Fig. 2.9.1.19

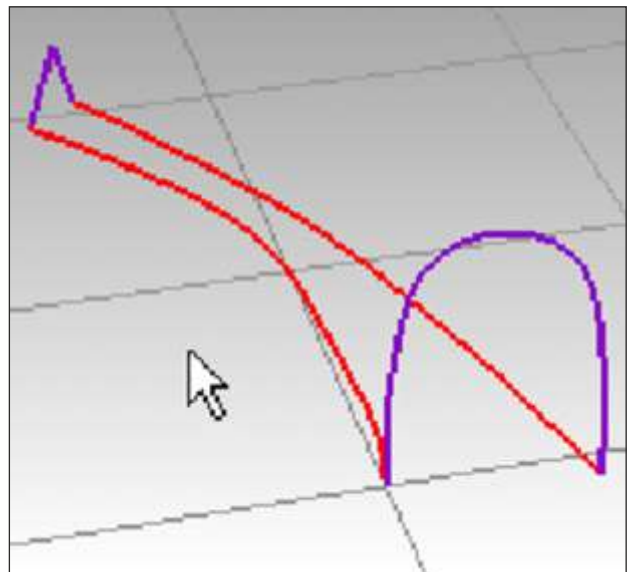


Fig. 2.9.1.20

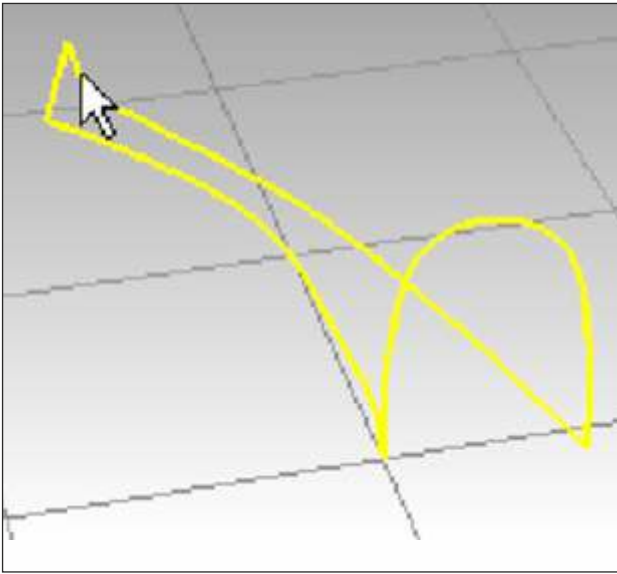


Fig. 2.9.1.21

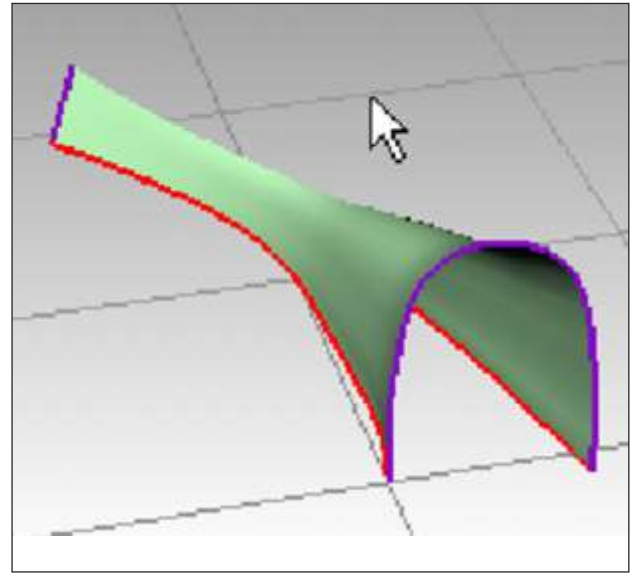


Fig. 2.9.1.22

Revolve

Creates a surface by revolving a profile curve that defines the surface shape around an axis.

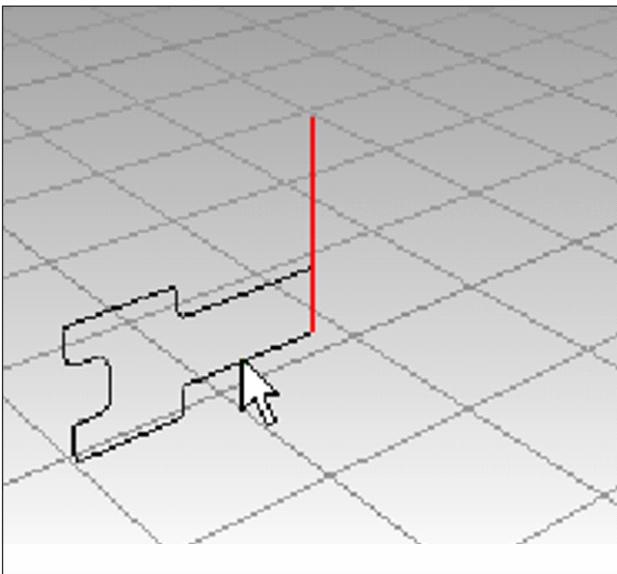


Fig. 2.9.1.23

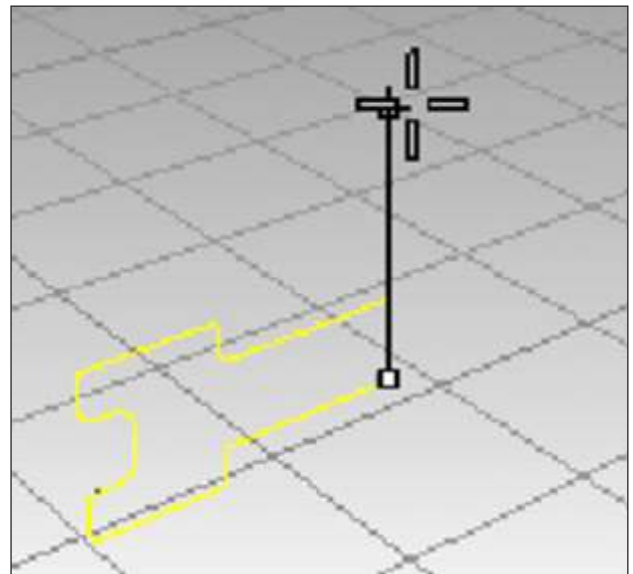


Fig. 2.9.1.24

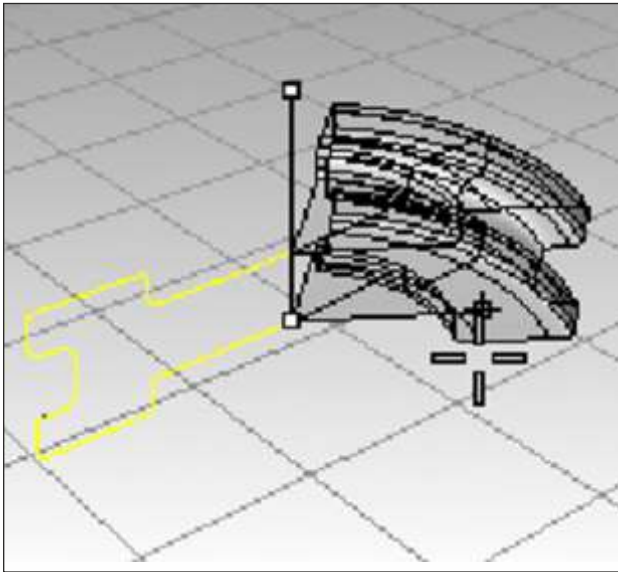


Fig. 2.9.1.25

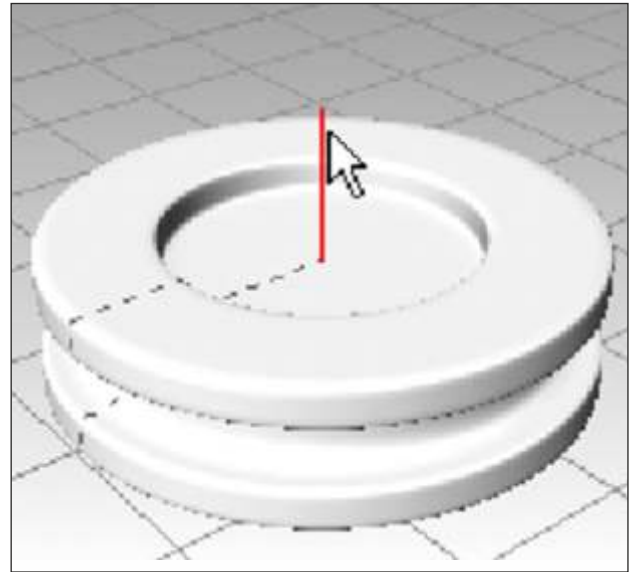


Fig. 2.9.1.26

Rail Revolve

Creates a surface by revolving a profile curve that defines the surface shape around a rail curve that defines the surface edge.

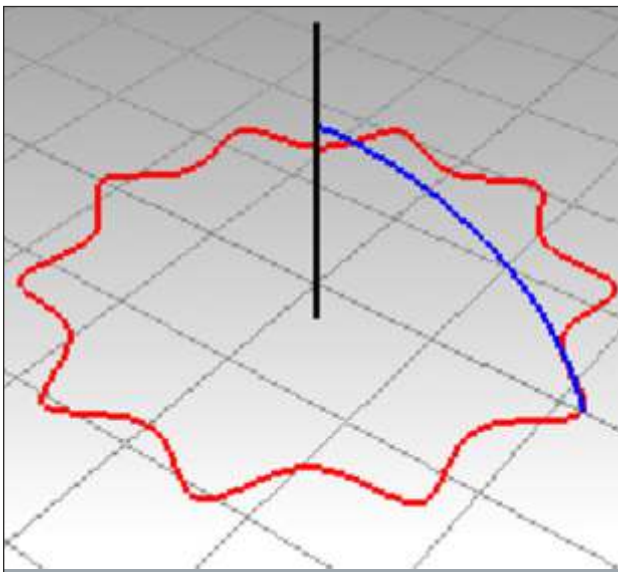


Fig. 2.9.1.27

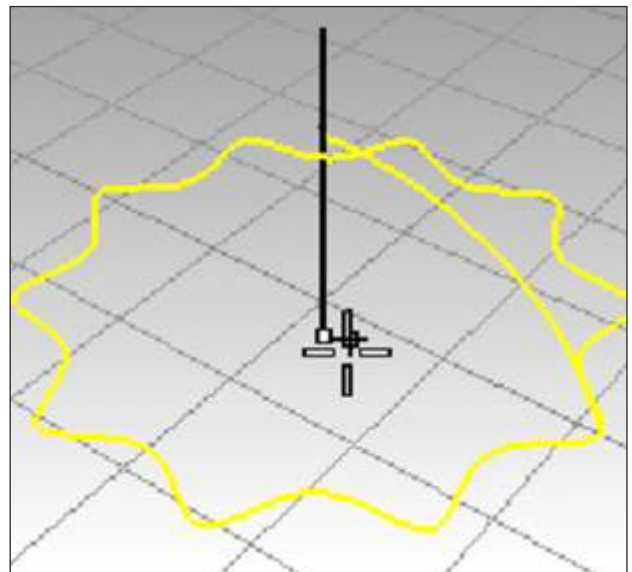


Fig. 2.9.1.28

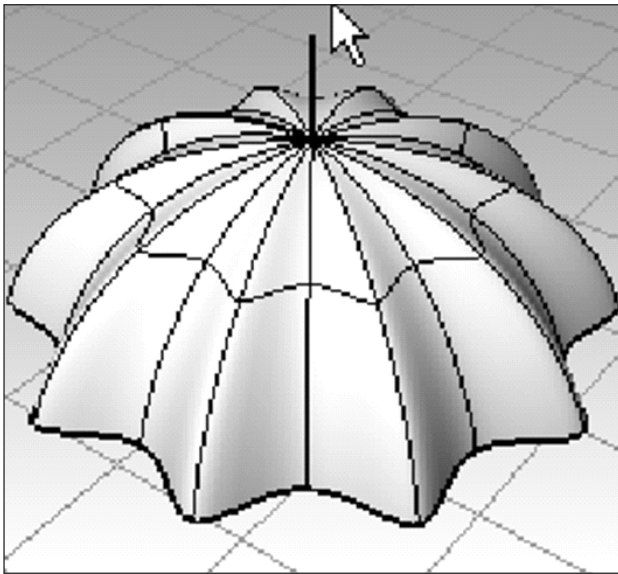


Fig. 2.9.1.29

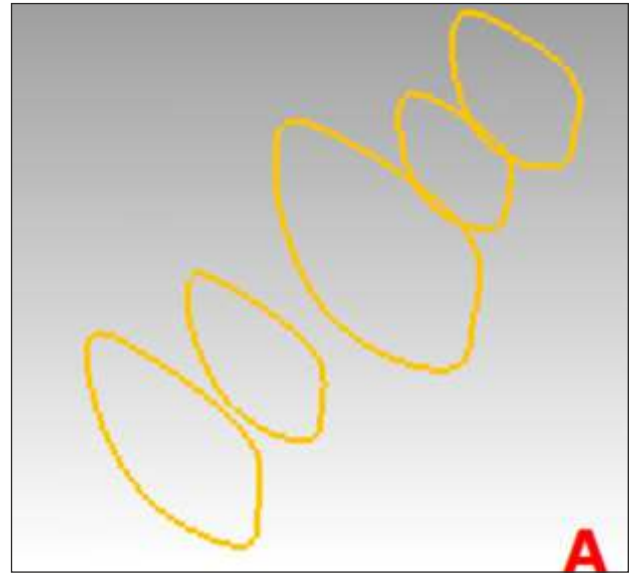


Fig. 2.9.1.30

Loft

Creates a surface from shape curves; the normal; loose; and tight options make a surface with no creases as it passes over the shape curves. The Straight Sections option creates a surface with creases at each shape curve and straight sections between the shapes curves.

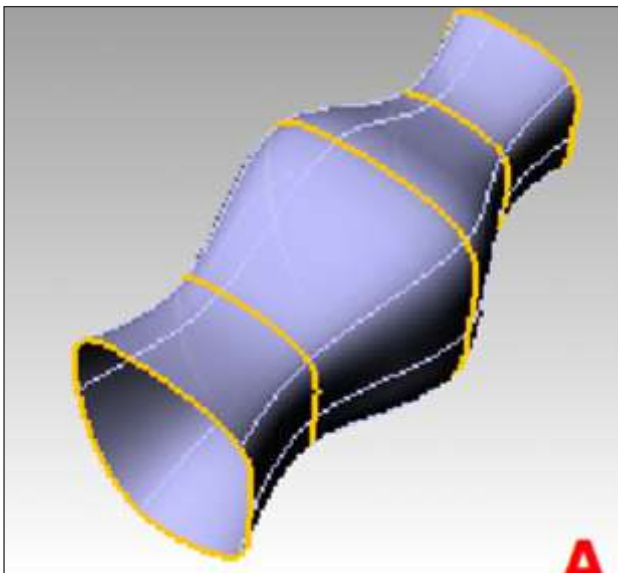


Fig. 2.9.1.31

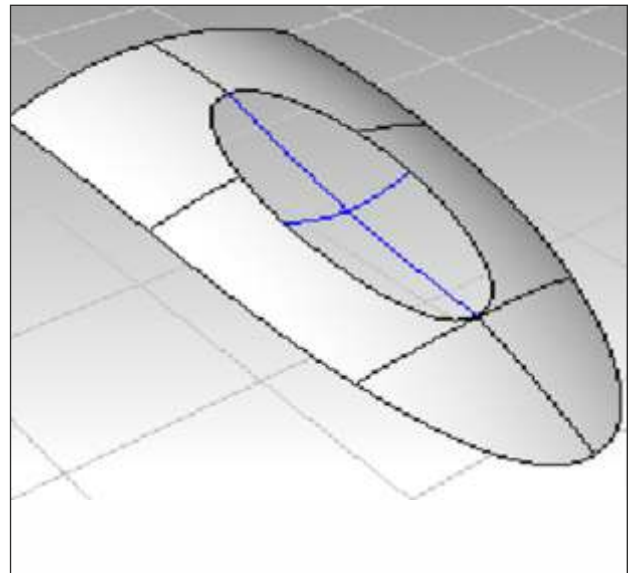


Fig. 2.9.1.32

Patch

Creates a surface that approximates a set of curves and/or point objects.

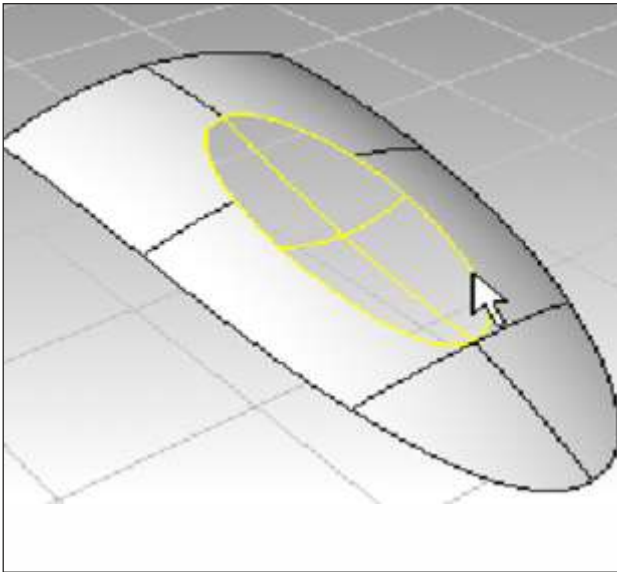


Fig. 2.9.1.33

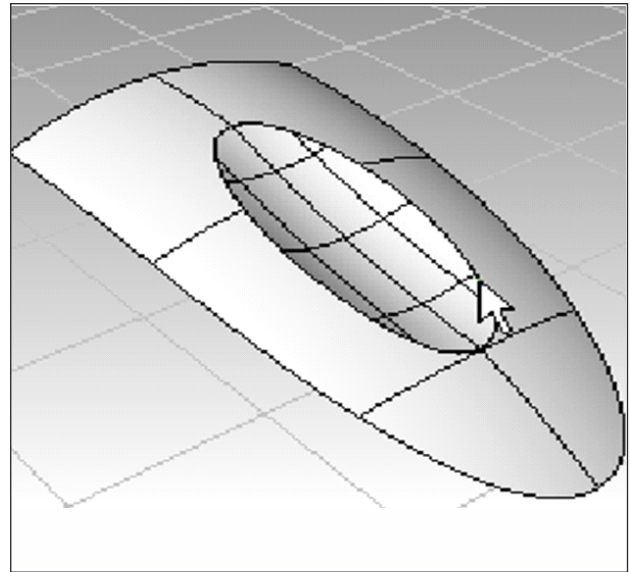


Fig. 2.9.1.34

Networksrf

Creates a surface from a network of crossing curves.

All curves in one direction have to cross all curves in the other direction and cannot cross each other.

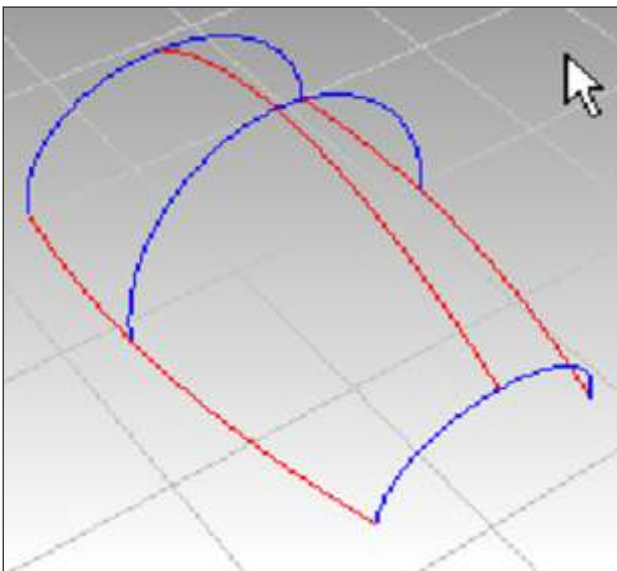


Fig. 2.9.1.35

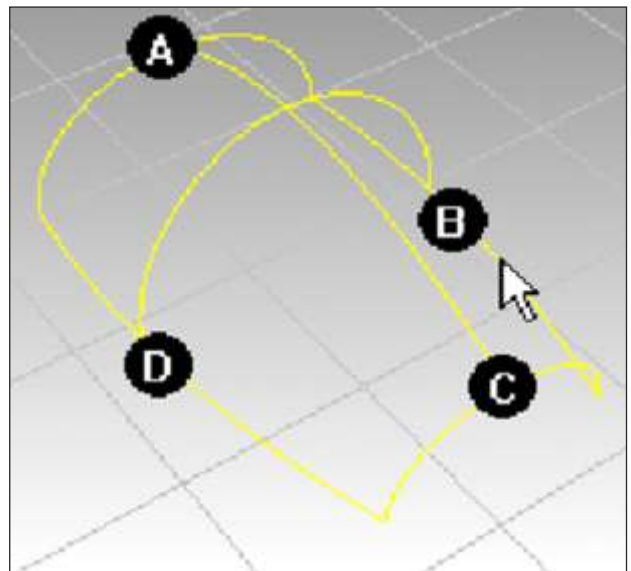


Fig. 2.9.1.36

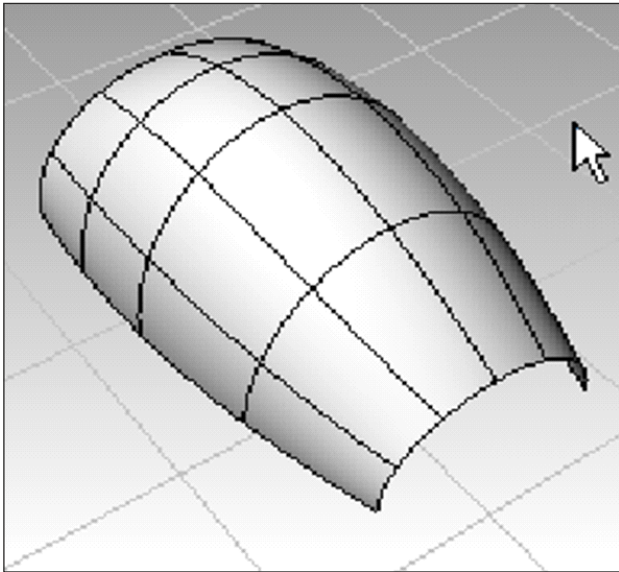


Fig. 2.9.1.37

Fillet Surface

Creates a fillet or round between two surfaces.

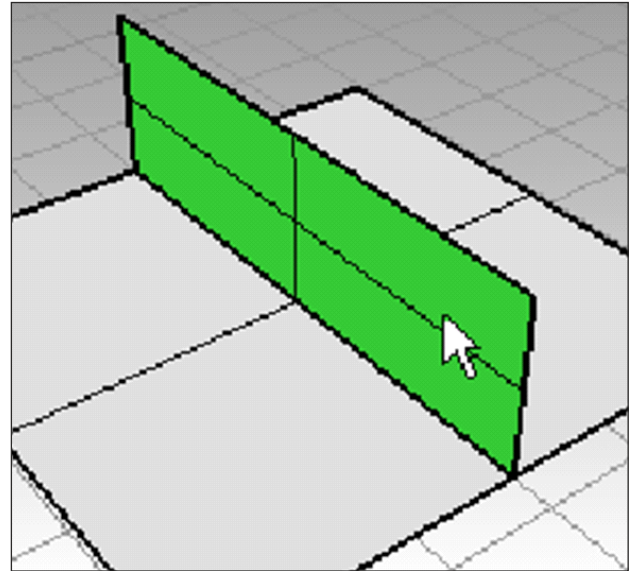


Fig. 2.9.1.38

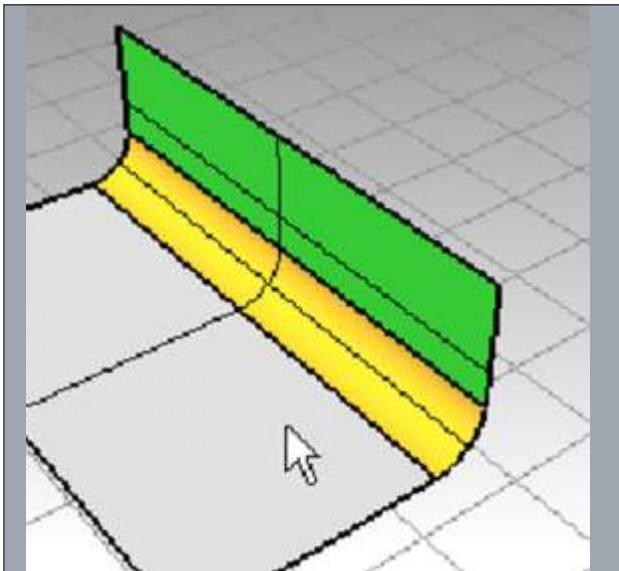


Fig. 2.9.1.39

Blend Surface

Creates a blend surface between two surfaces.

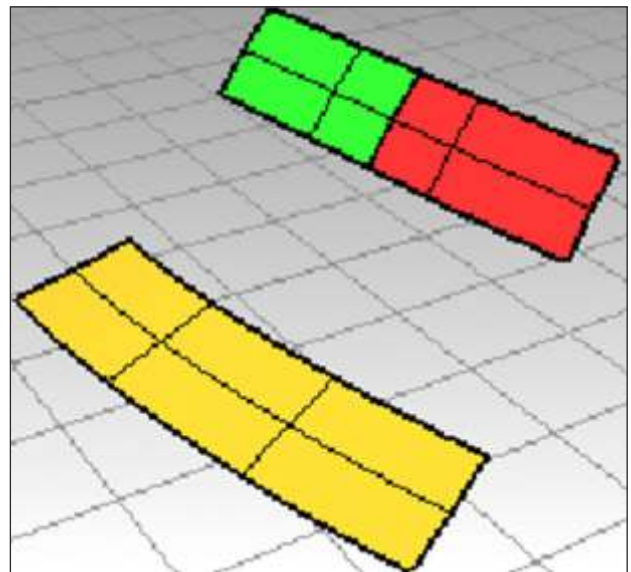


Fig. 2.9.1.40

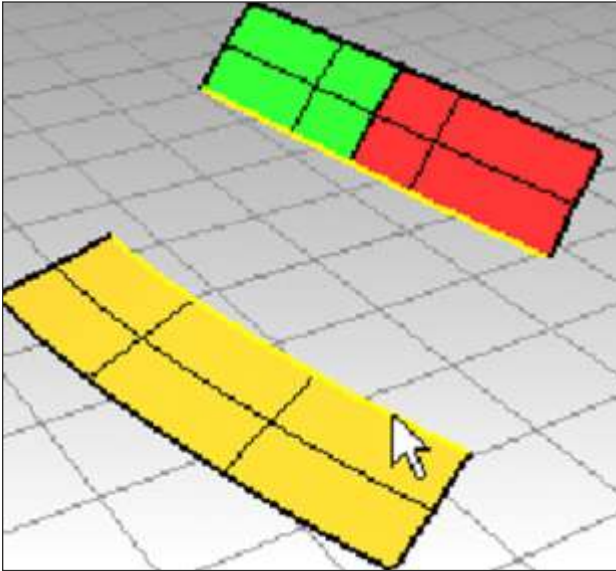


Fig. 2.9.1.41

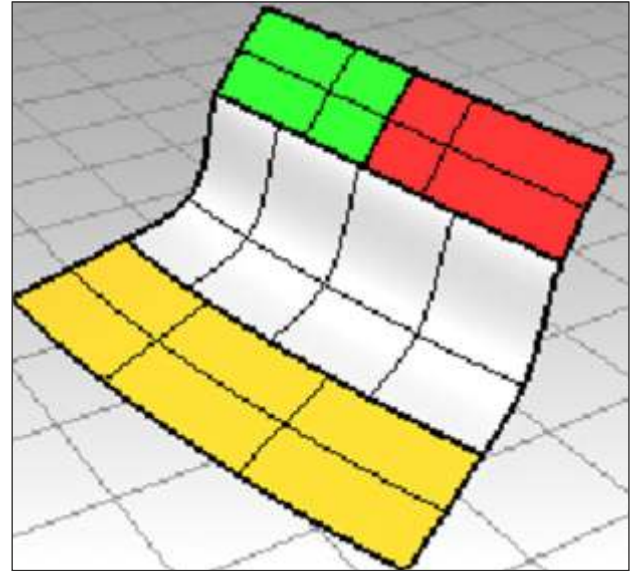


Fig. 2.9.1.42

Offset Surface :

Copies a surface or polysurface so that locations on the copied surface are the same specified distance from the original surface.

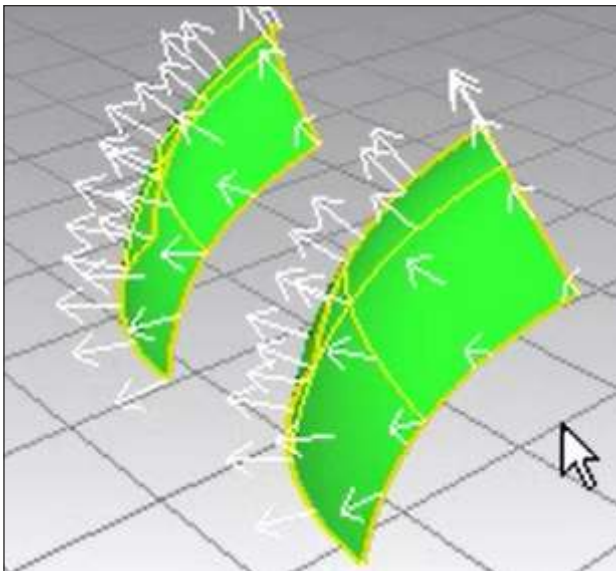


Fig. 2.9.1.43

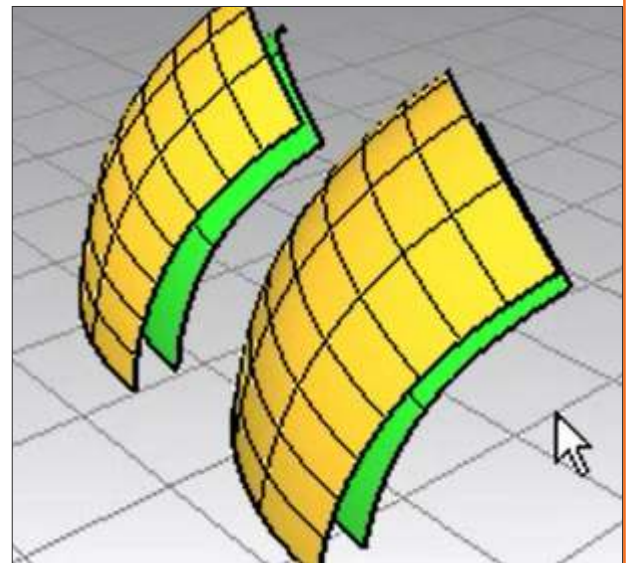
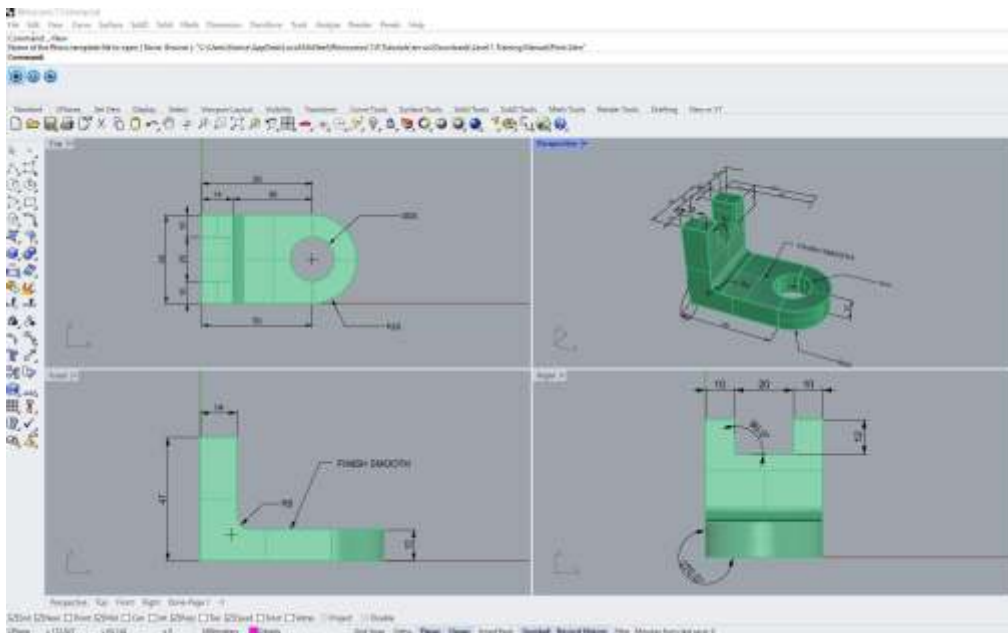


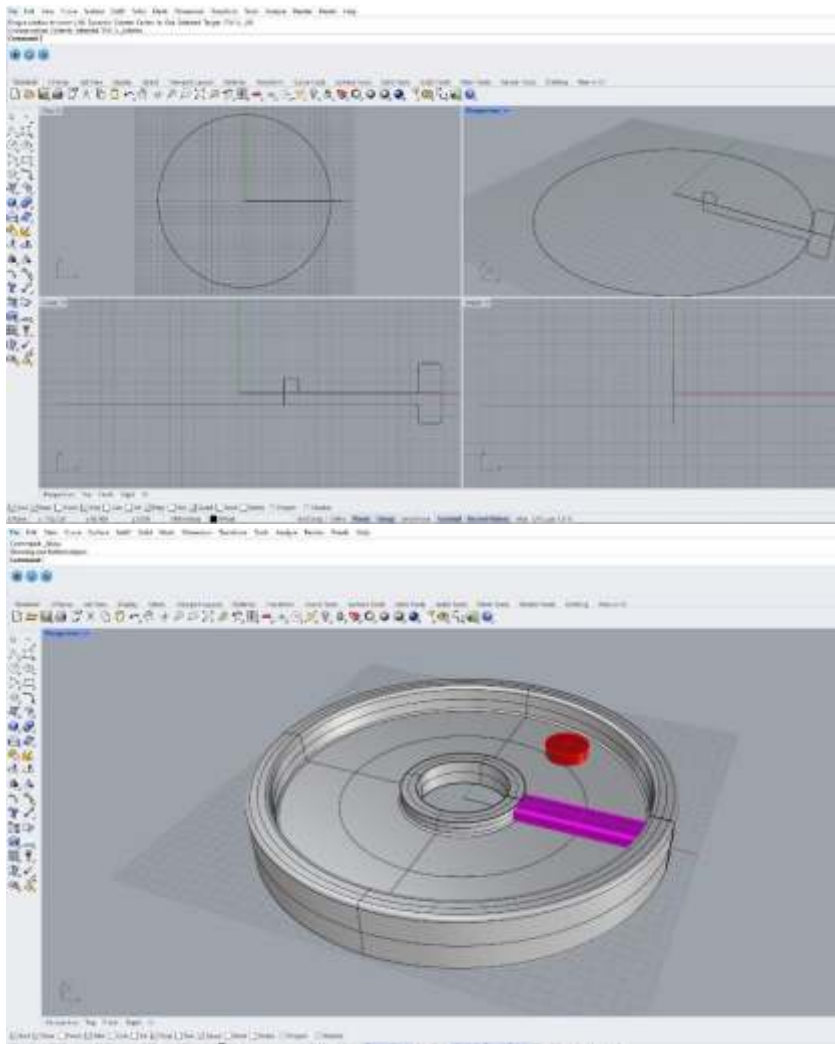
Fig. 2.9.1.44

Exercise 1

CONSTRUCT AND EXTRUDE



Use revolve command to construct as shown below



Exercise 2

1) What are isocurves?

2) State True or False- To extrude a curve into a closed polysurface the input curve needs to be closed and planar.

3) What is the main difference between Sweep 1 and Sweep 2 Rail?

4) State True or False-

a) Revolve uses only a profile curve to give a surface shape around an axis

b) Rail revolve uses multiple profile curves and two shape defining curves to develop a surface

Scan the QR Code to watch the related video or click on link



Click Here
Overlapping Ring

Unit 2.10: Curve Tool

Unit Objectives

At the end of this unit, you will be able to:

1. Apprehend on the use of curve tools.

2.10.1 Curve Tools

Duplicate Edge

Creates a curve that duplicates a surface edge.

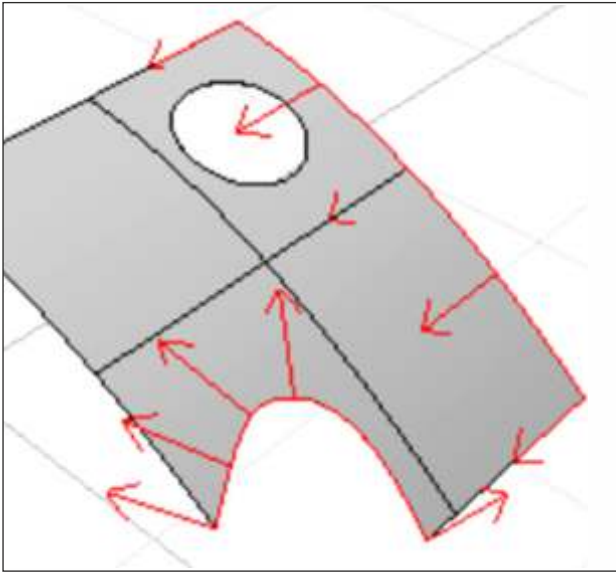


Fig. 2.10.1.1

Naked Edges

A surface or polysurface edge that is not connected to another edge. Solid objects have no naked edges.

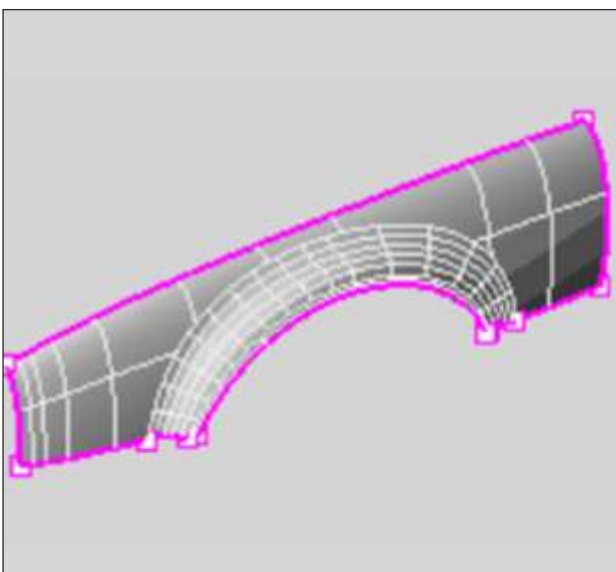


Fig. 2.10.1.3

Create Border/Duplicate Border

Creates a curve or polyline that duplicates a surface, polysurface, hatch, or mesh border.

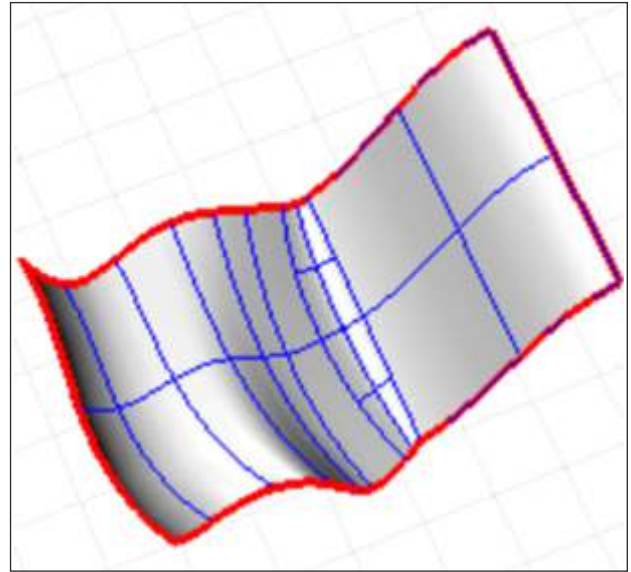


Fig. 2.10.1.2

Section

Creates a planar curve or points resulting from the intersection of a defined cutting plane through objects.

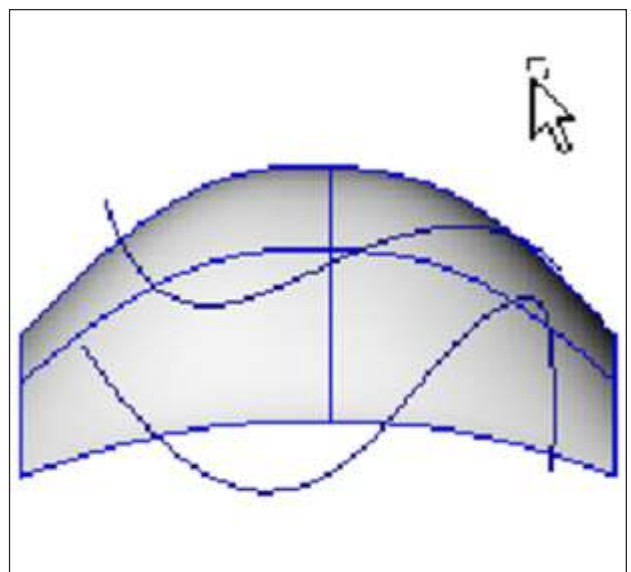


Fig. 2.10.1.4

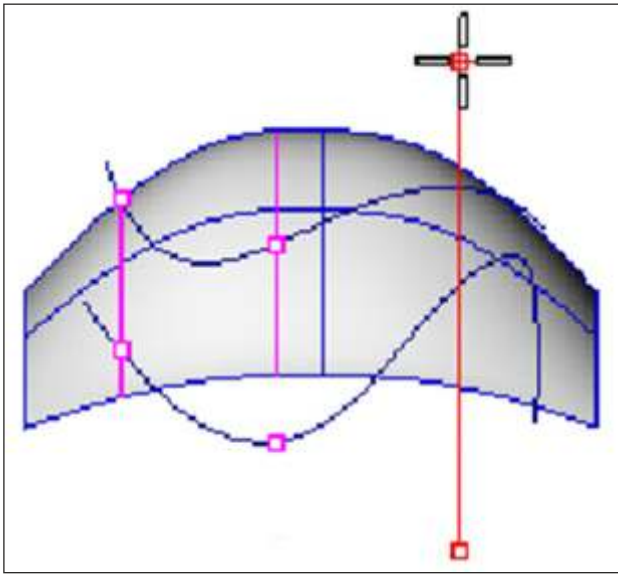


Fig. 2.10.1.5

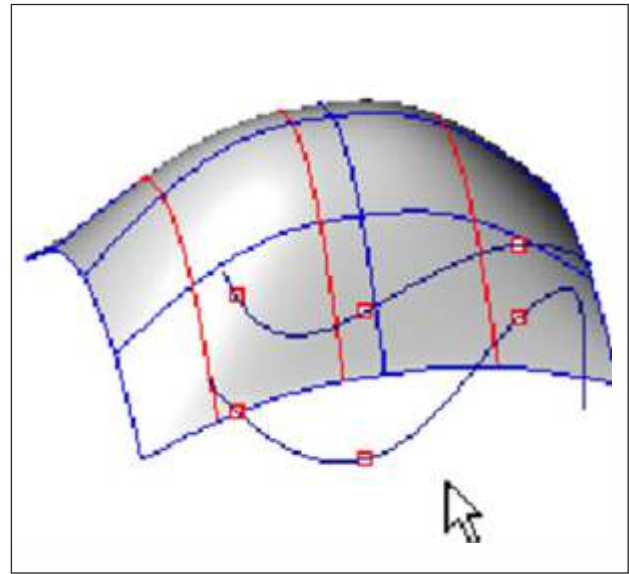


Fig. 2.10.1.6

Contour

Creates a spaced series of planar curves and points resulting from the intersection of a defined cutting planes through curves, surfaces, polysurfaces, or meshes.

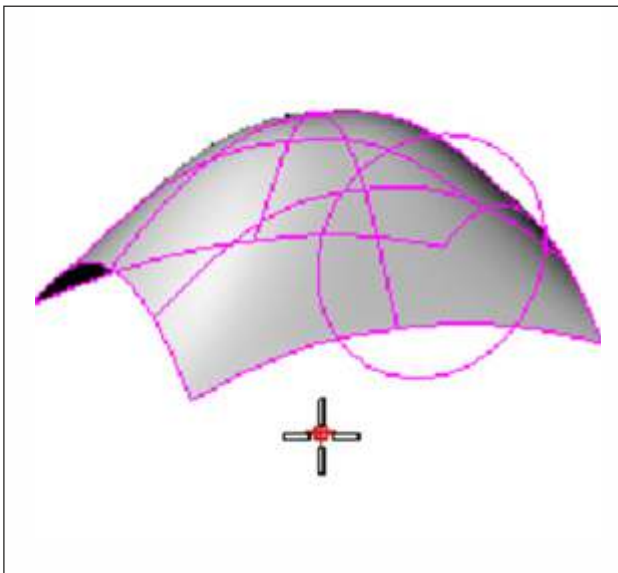


Fig. 2.10.1.7

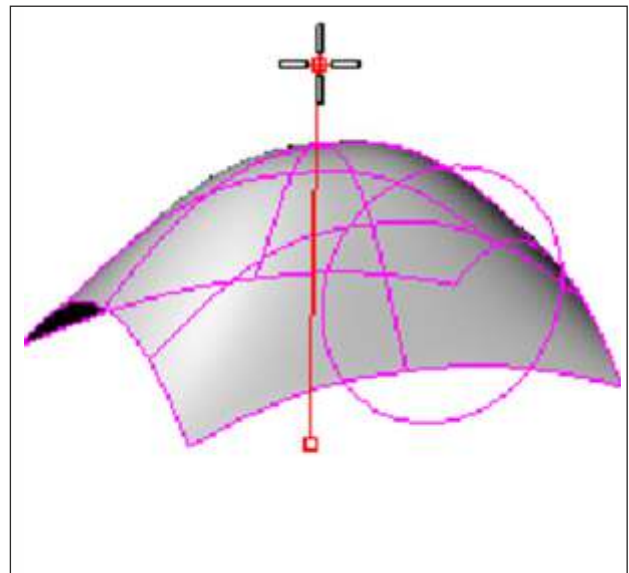


Fig. 2.10.1.8

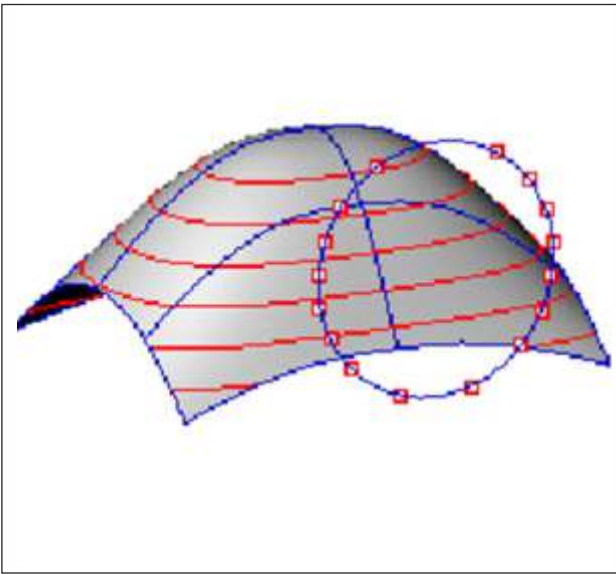


Fig. 2.10.1.9

Project

Creates curves or points on a surface that are the intersections of the surface and curves or points projected toward the construction plane.

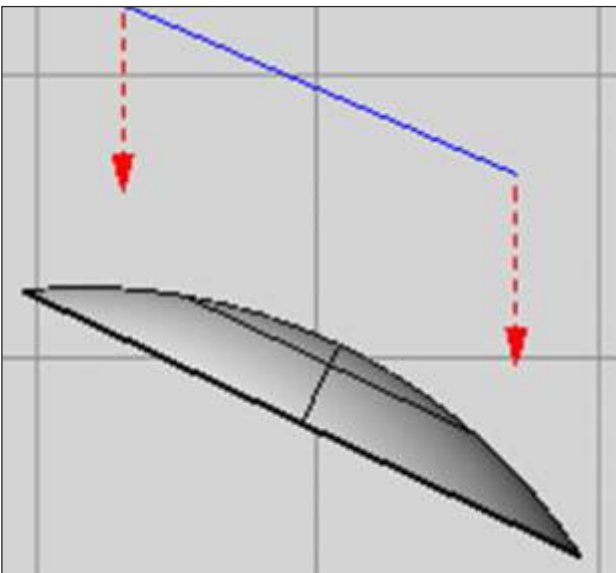


Fig. 2.10.1.11

Mean curve

The Mean Curve command creates curves between two open or closed input curves.



Fig. 2.10.1.10

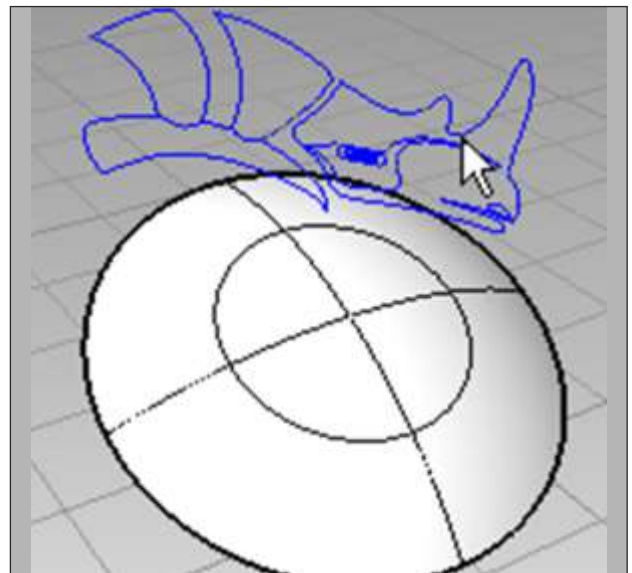


Fig. 2.10.1.12

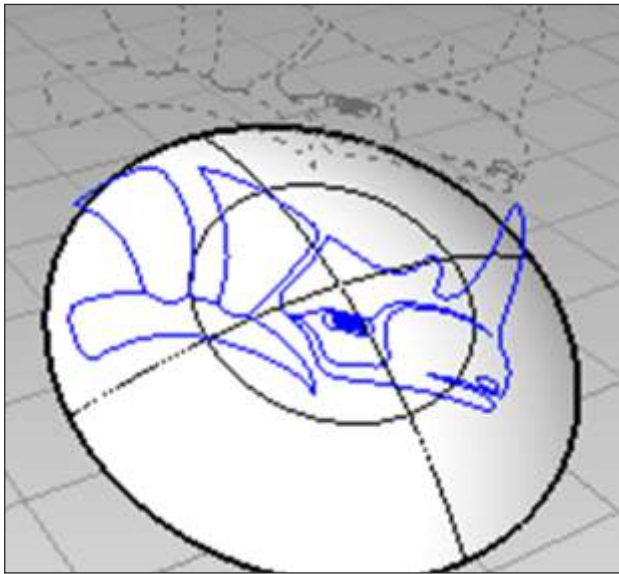


Fig. 2.10.1.13

Pull

Creates curves and points on a surface that are the intersections of curve or points pulled toward a surface in the surface normal direction

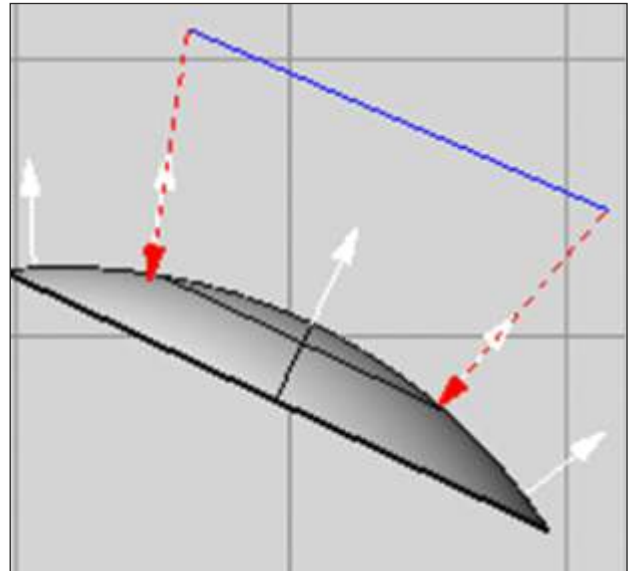


Fig. 2.10.1.14

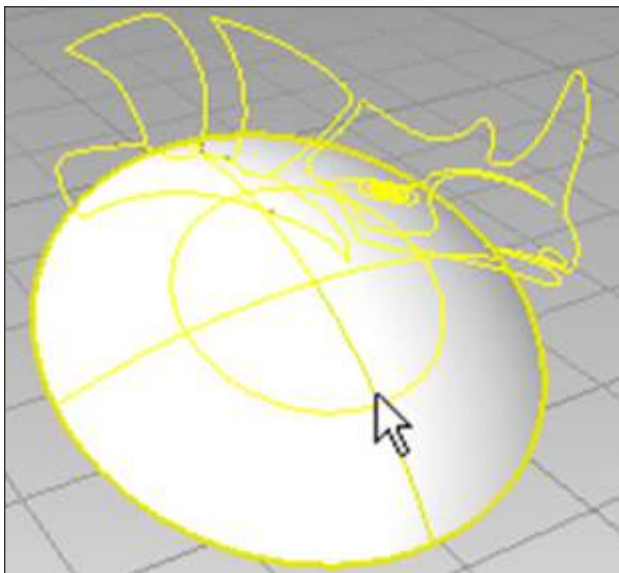


Fig. 2.10.1.15

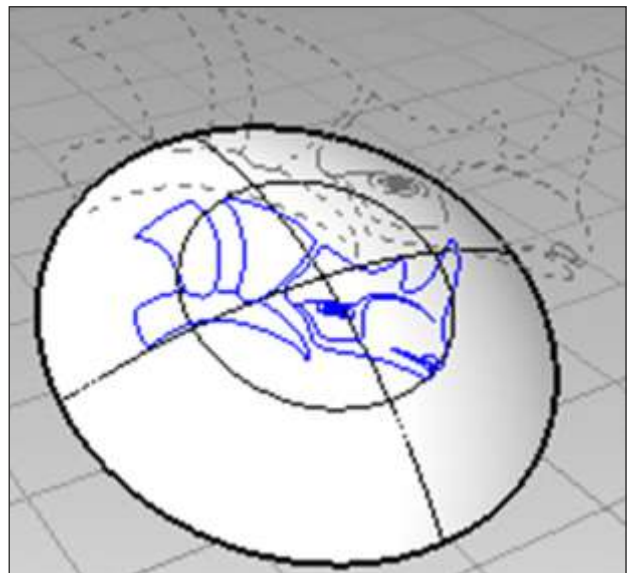


Fig. 2.10.1.16

Curve from 2 Views

Creates a curve from selected curves that are planar in different views. Use to create a curve when you know its profile in two directions. The example demonstrates creating a curve that follows the edge of a boat hull from 2-D curves in the top and front views. The AlignProfiles command is useful for lining up curves in two views prior to creating a curve from two views.

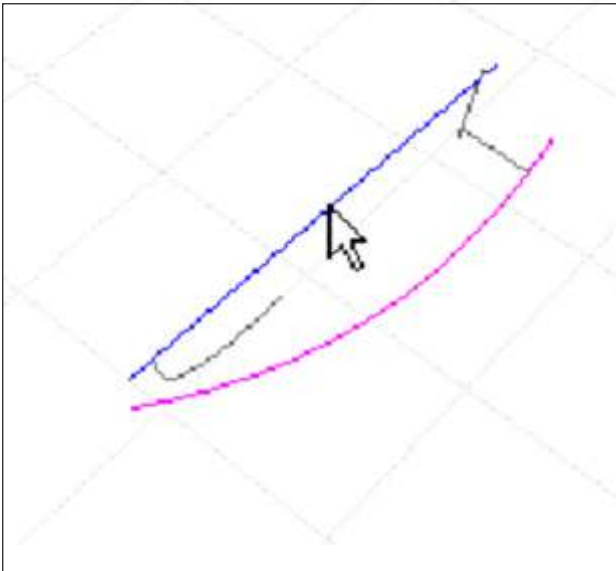


Fig. 2.10.1.17

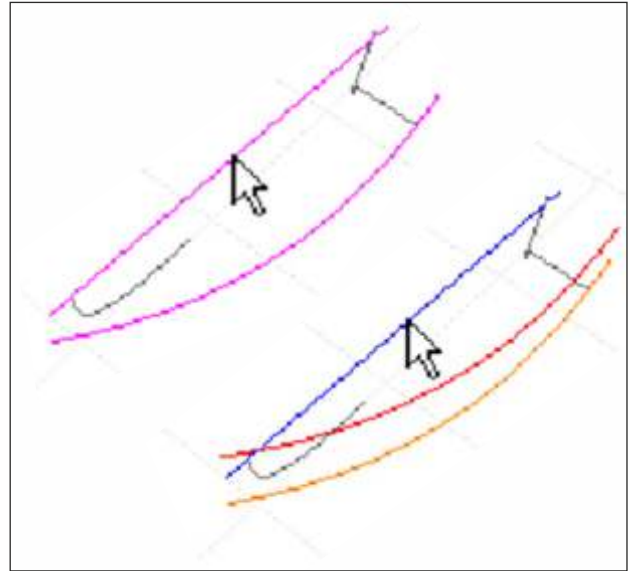


Fig. 2.10.1.18

Extract Surface

The Extract Surface command separates or copies a polysurface face.

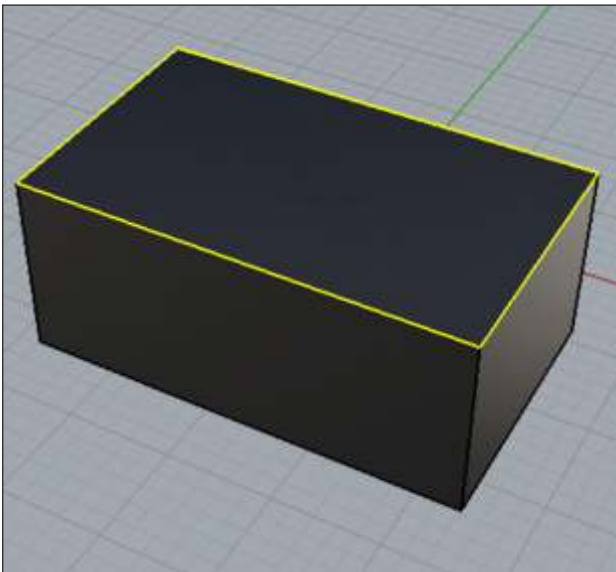


Fig. 2.10.1.19

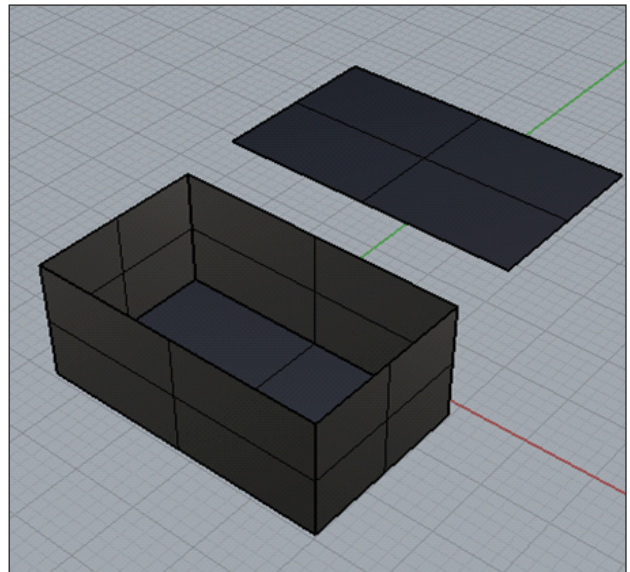


Fig. 2.10.1.20

Create UV Curve

Creates curves that duplicate the untrimmed boundary and trim curves of a surface as planar curves onto the world x-y plane.

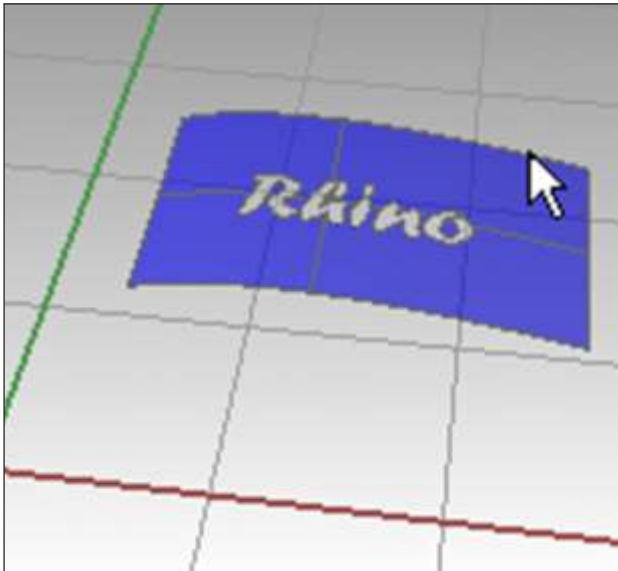


Fig. 2.10.1.21

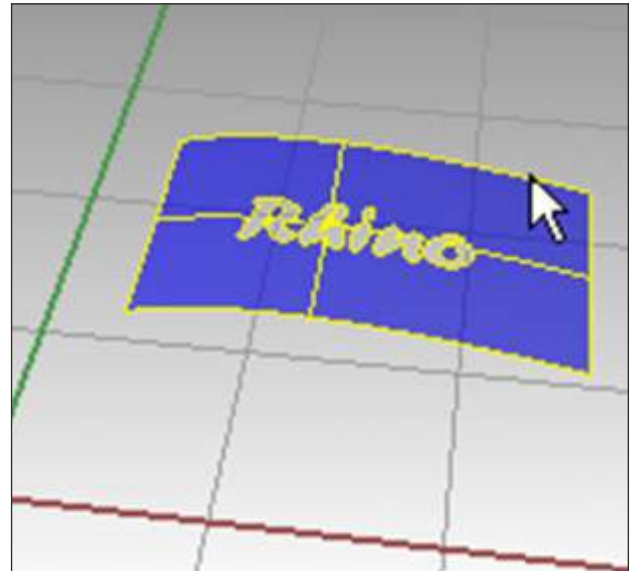


Fig. 2.10.1.22

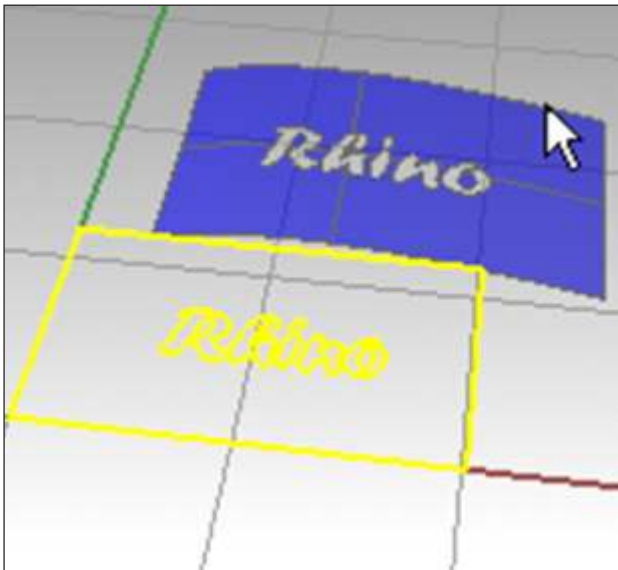


Fig. 2.10.1.23

Apply UV Curve

Wraps a curve onto a surface.

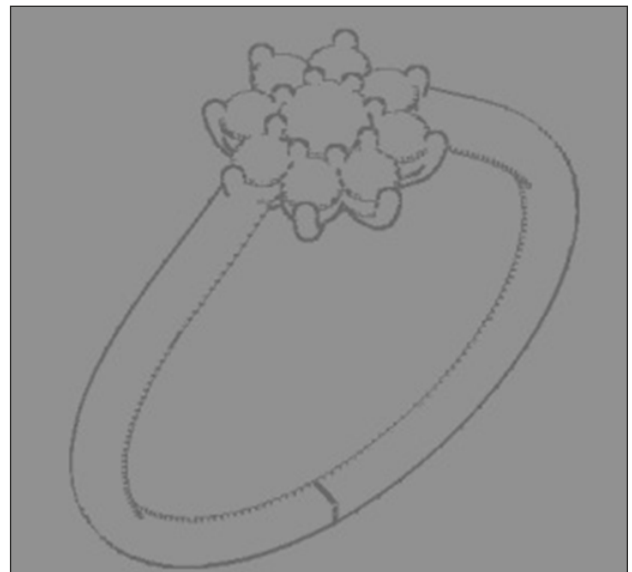


Fig. 2.10.1.24

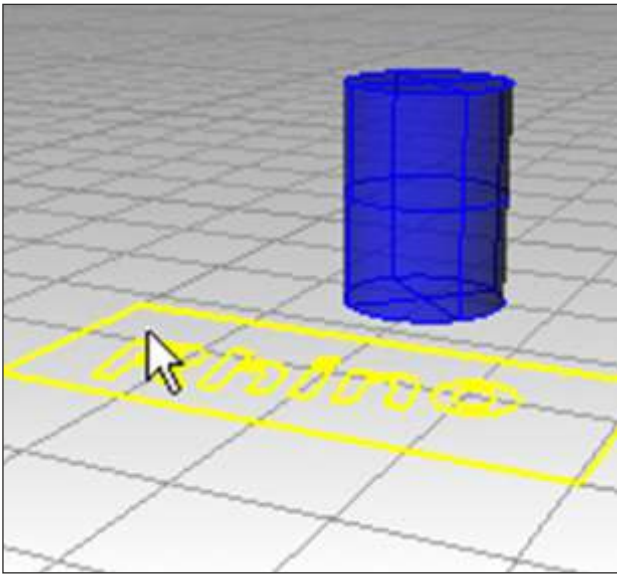


Fig. 2.10.1.25

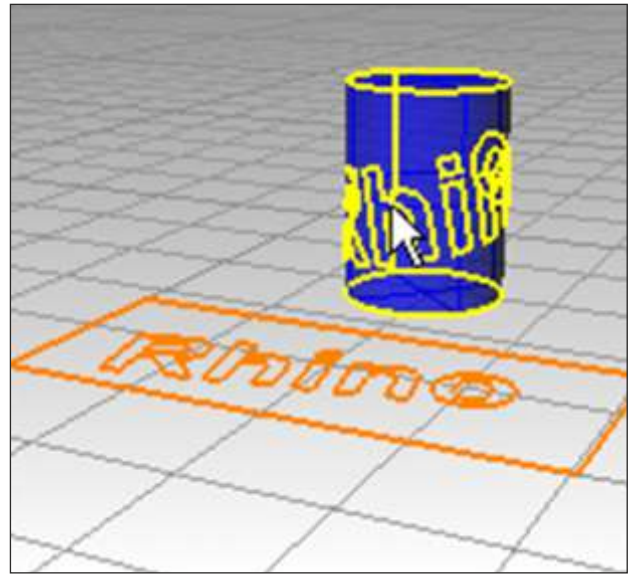


Fig. 2.10.1.26

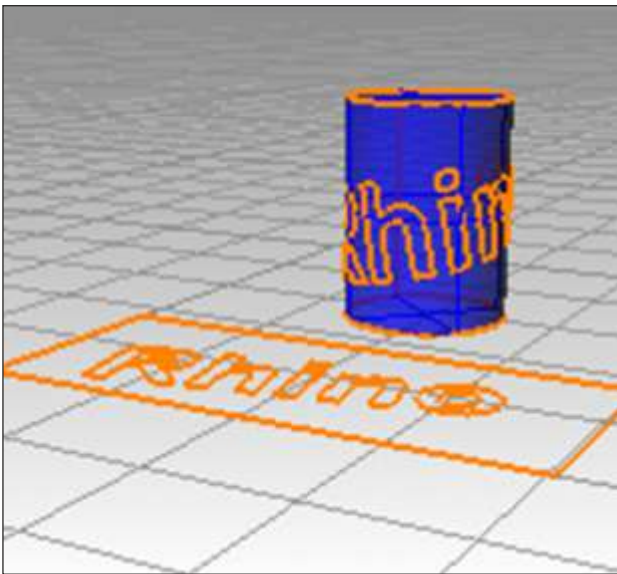


Fig. 2.10.1.27

Exercise 1

1. How does CAD Software help in Jewellery designing?
2. Which technology does Rhino rely on and how does the technology help in jewellery designing?
3. Once you have made a model design of your ornament, how will you view it?
4. What the different ways you can view your designed object through different modes?
5. What are the advantages of using picture frames?

Exercise 2

Draw a model of an ornament and use the standard tool bar commands.
File Menu commands-Open, Save, Save Small, Save as template, Import, Export, Save geometry only, Undo & Redo, Cut, Copy, Paste, Zoom

Exercise 3

1. How will you group or ungroup objects?
2. What does locking/ unlocking objects mean?
3. What are the shortcut keys used to Hide and Show objects?
4. How does Symmetry work with objects?
5. Use the blend, chamfer, offset and rebuild in an object you would draw.

Exercise 4

1. What result does Duplicate Edge give- Curve or Surface?
2. What commands out of these are used to place a curve on another curve or surface- Project, Pull, Mean Curve, Curve from 2 views, Extract Surface, Create And Apply Uv Curves

Exercise 5

Mark the statements as right or wrong

1. Rhino Software relies on NURBS Technology that makes its designs very complicated.
2. The Rhino Software has the ability to make any ornament design that's in demand.
3. Rhino Software is limited to jewellery industry.
4. Construction Plane is the guide used for modelling Rhino objects.
5. Objects Snaps are tools for specifying points on existing objects.
6. Wireframe is a frame made of wire.
7. The Interpolate Curve commands draws a curve commands draws a curve through the points one picks.
8. The Rhino Polygon, Command is a slow way of drawing regular polygons.
9. Picture Frames are more powerful version of Rhino background bitmap
10. Left click or Control + Shift + G leads to grouping of selected objects.

Exercise 6

1. Create your model using the tools Rhino Software provides. You can start with sketching, drawing, making a physical model, scan data or any idea and using Rhino tools to make the model ready and also record the design for animation, rendering, analysis, drafting and manufacturing.
2. While making your design model, practise the commands Cut, Copy, Paste, Zoom, Undo and Redo
3. Which modelling aid constrains the marker to an exact location on an object.
4. Which modelling aid constraints the marker movement to points at a specified angle from the last point created.
5. Name the modelling aid that uses temporary reference lines and points that are drawn in the Rhino Viewport.

Scan the QR Code to watch the related video or click on link



[Click Here](#)
Split Ring



[Click Here](#)
Wire Ring



3. Create Jewellery Design using CAD Part - II

- Unit 3.1 - Solid Tool
- Unit 3.2 - Transform Toolbar
- Unit 3.3 - Orient Tool
- Unit 3.4 - Solid Editing Tool
- Unit 3.5 - Analyse Tool
- Unit 3.6 - Gemstones
- Unit 3.7 - Jewellery Setting Exercises



Unit 3.1: Solid Tool

Unit Objectives

At the end of this unit, you will be able to:

1. Understand the use of solid tools.

3.1.1 Solid Tools

Boolean Union

Trims the shared areas of selected polysurfaces or surfaces and creates a single polysurface from the unshared areas.

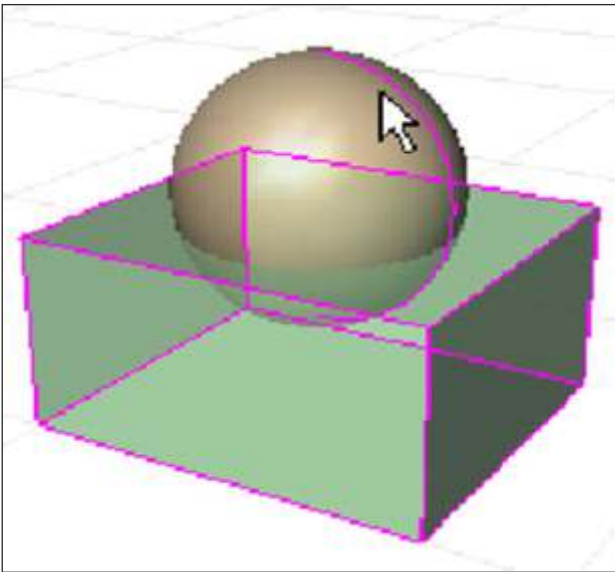


Fig. 3.1.1.1

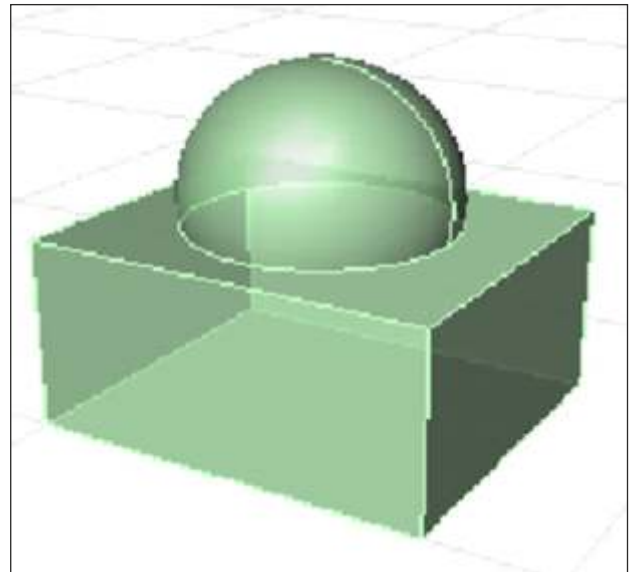


Fig. 3.1.1.2

Boolean Difference

Trims the shared areas of selected polysurfaces or surfaces with another set of polysurfaces or surfaces.

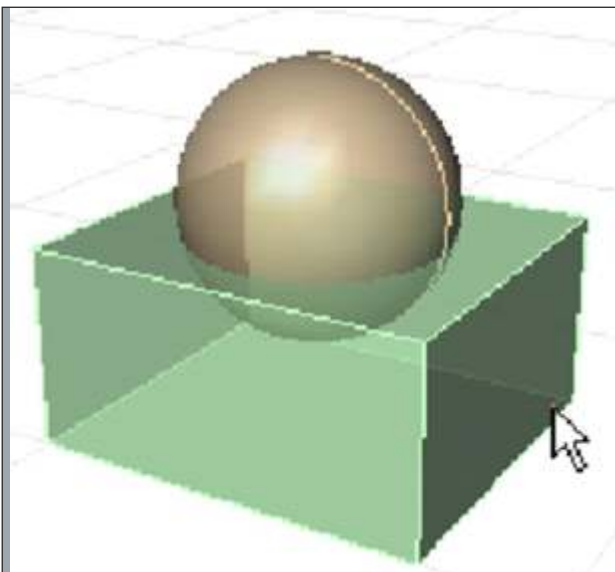


Fig. 3.1.1.3

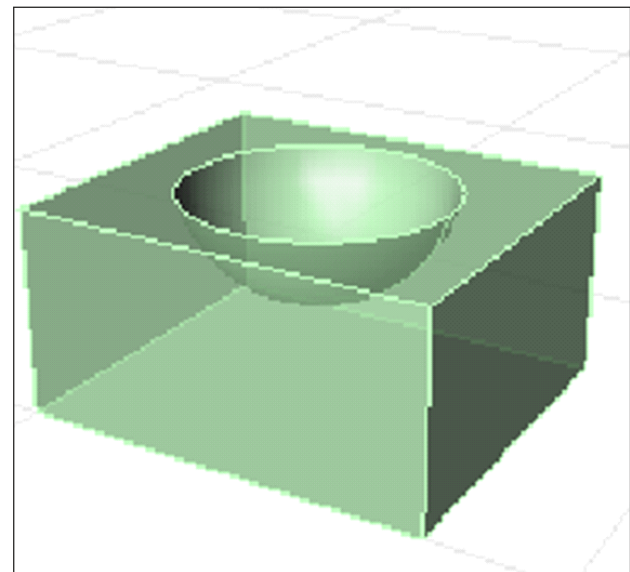


Fig. 3.1.1.4

Boolean Intersection

Trims the unshared areas of selected polysurfaces or surfaces.

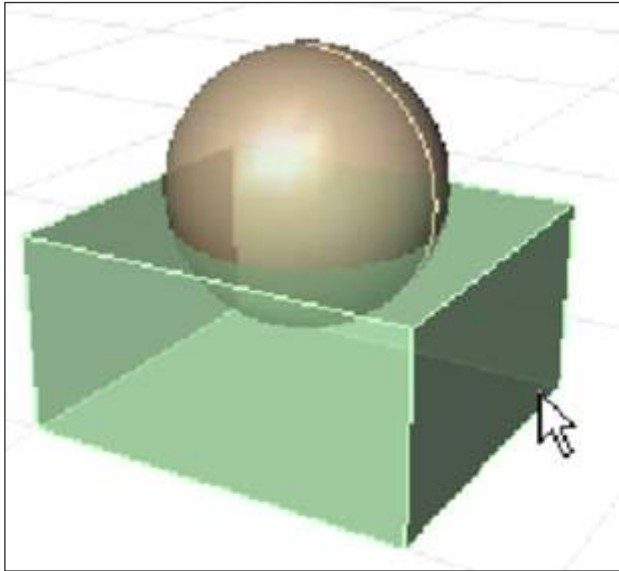


Fig. 3.1.1.5

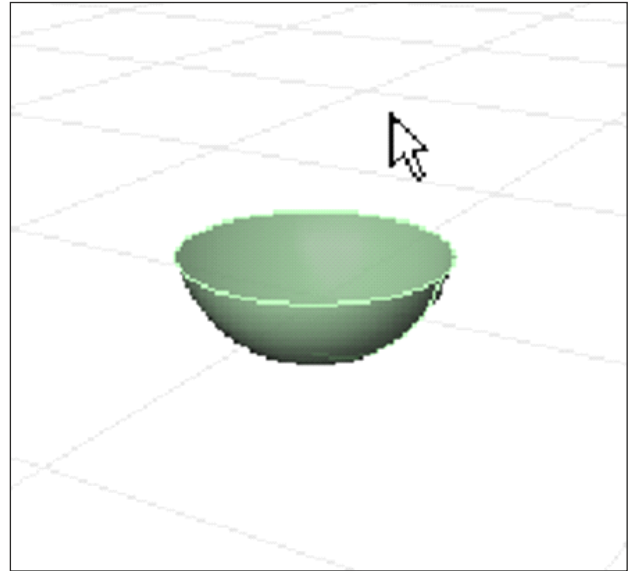


Fig. 3.1.1.6

Cap Planner

Fills openings in surfaces or polysurfaces with a planar surface joined to the hole edge. The openings must have edge loops that are closed and planar.

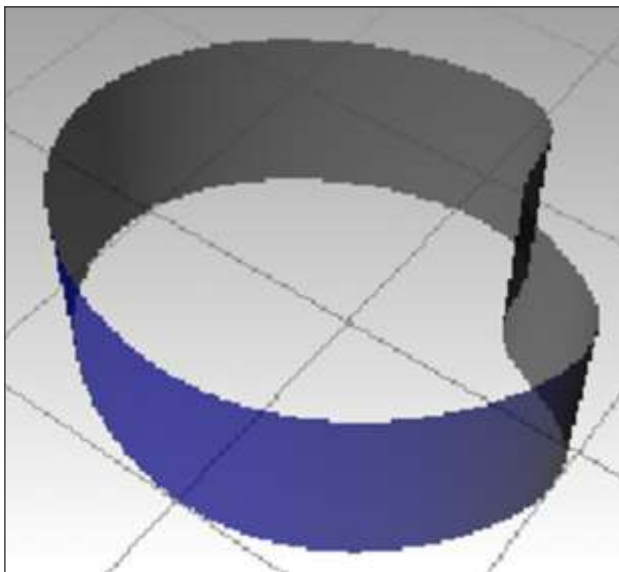


Fig. 3.1.1.7

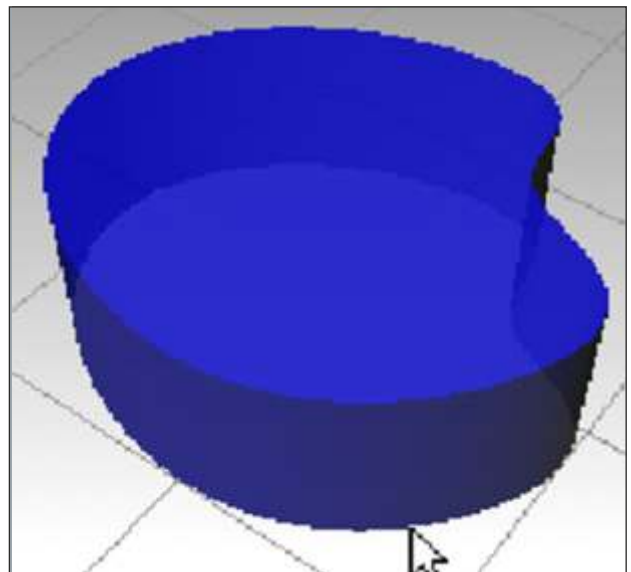


Fig. 3.1.1.8

Extract Surface

The surfaces are separated from the polysurfaces. The remainder of each polysurface will stay joined. The extracted surface is also removed from any groups to which the original surface may belong.

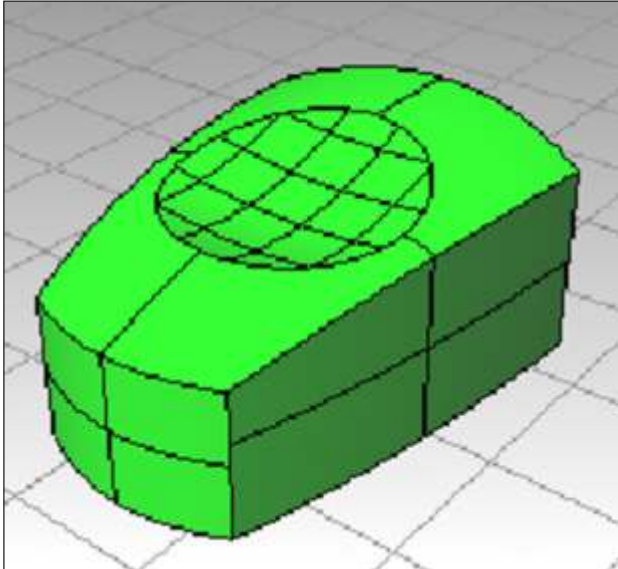


Fig. 3.1.1.9

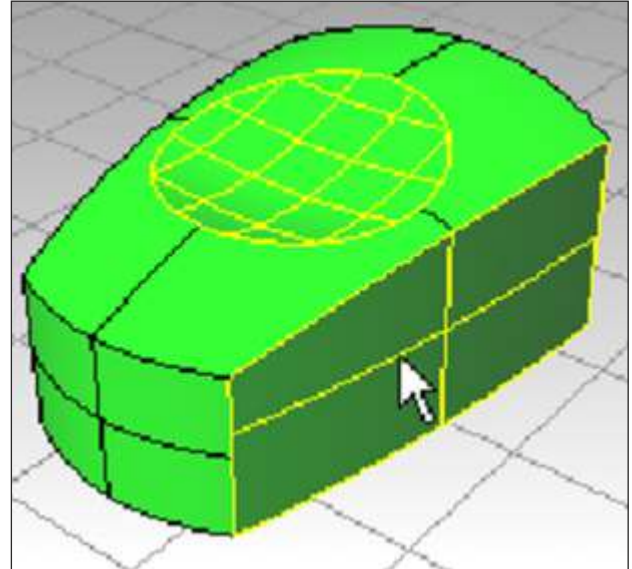


Fig. 3.1.1.10

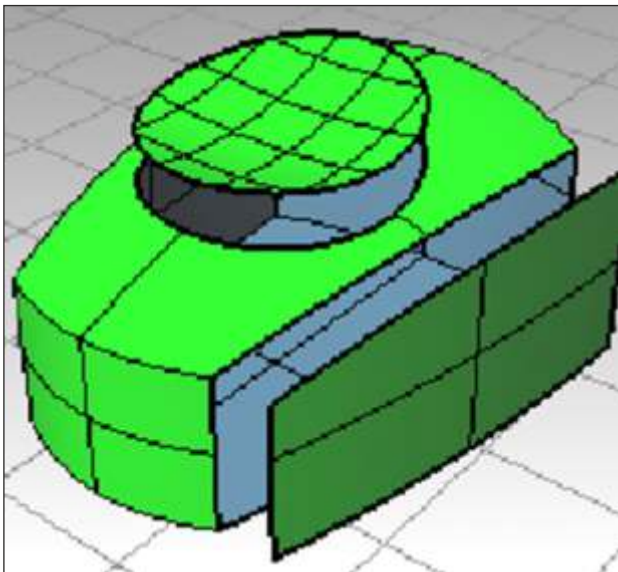


Fig. 3.1.1.11

Fillet Edge

Creates a tangent surface between polysurface edges with varying radius values then trims and joins the original faces to the fillet surfaces.

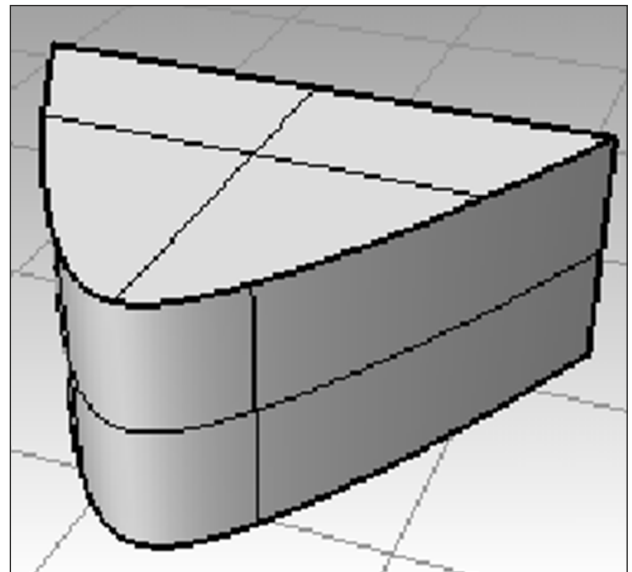


Fig. 3.1.1.12

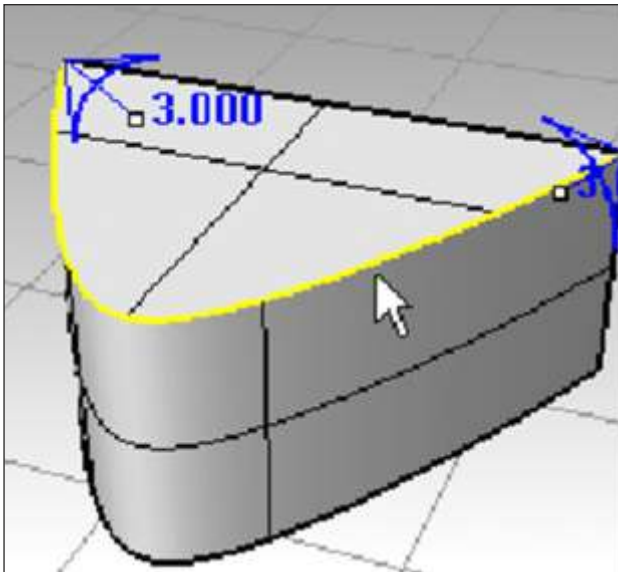


Fig. 3.1.1.13

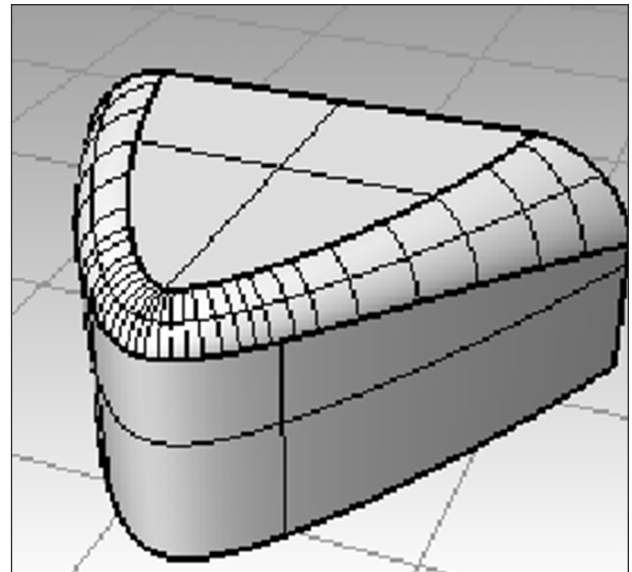


Fig. 3.1.1.14

Chamfered Edge

Creates a ruled surface between selected polysurface edges with varying chamfer distances, trims and joins the chamfer surfaces to the surface.

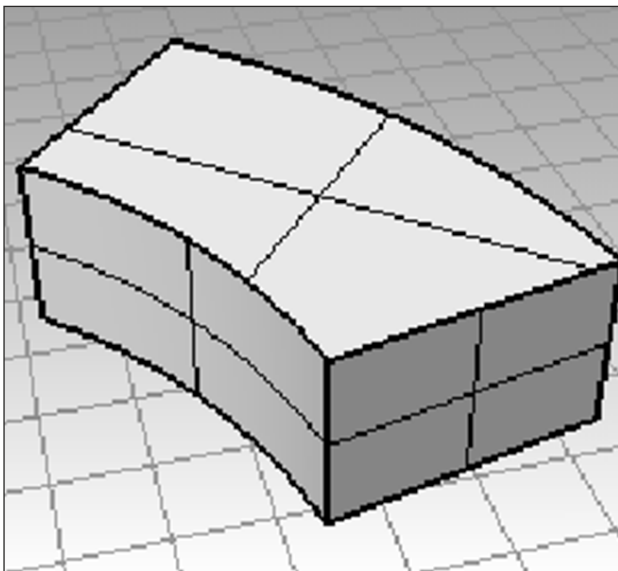


Fig. 3.1.1.15

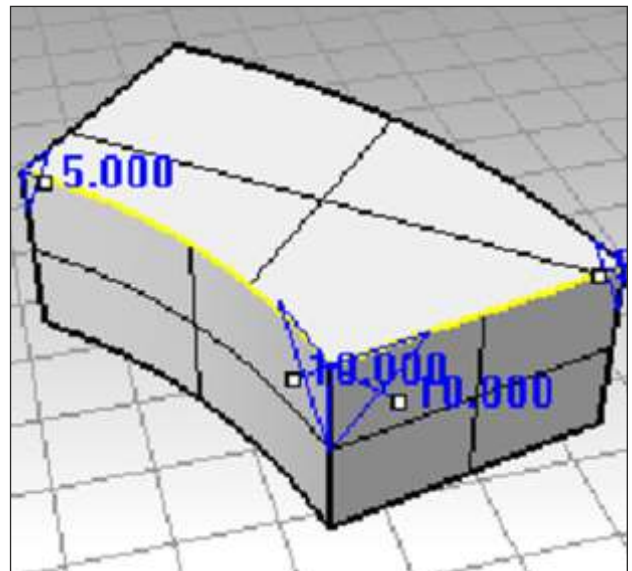


Fig. 3.1.1.16

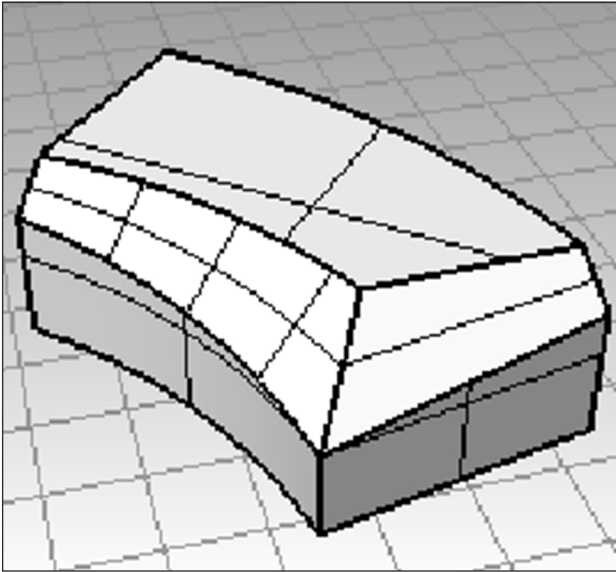
Make Hole

Fig. 3.1.1.17

The Make Hole command projects selected closed curves to a surface or polysurface to define hole shapes.

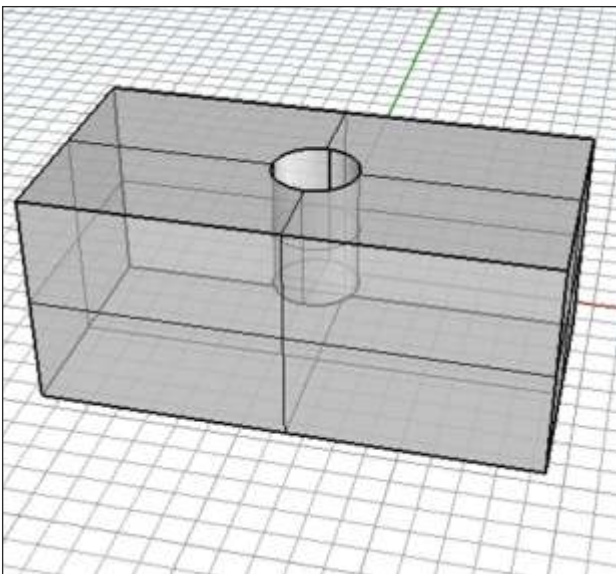


Fig. 3.1.1.19

Move Hole

The Move Hole command moves a hole cut in a planar surface.

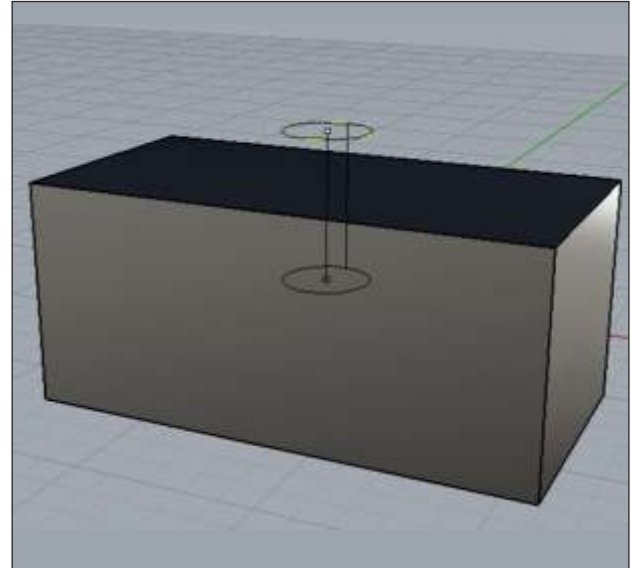
Move Edge/Move Hole/Make Hole/Delete Hole**Make Hole**

Fig. 3.1.1.18

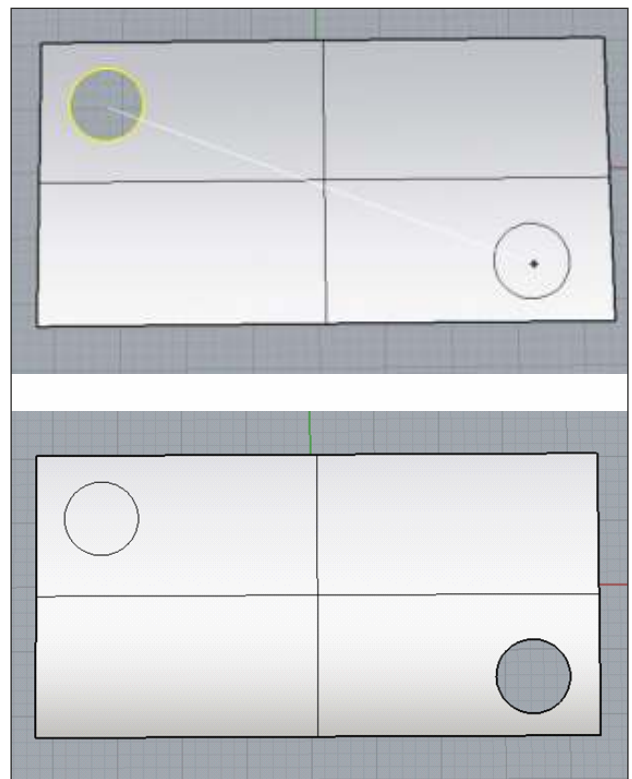


Fig. 3.1.1.20

Delete Hole

The Delete Hole command deletes a hole from a polysurface and remakes the surface.



Fig. 3.1.1.21

Move Edge

The Move Edge command moves a polysurface edge.

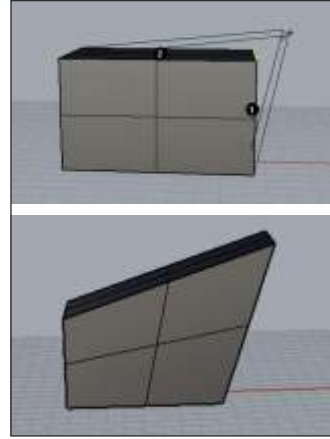
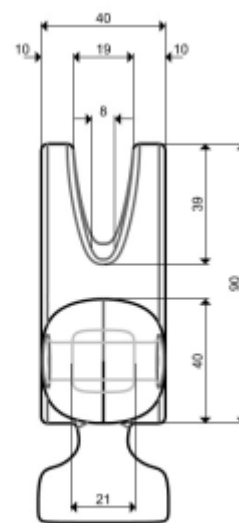
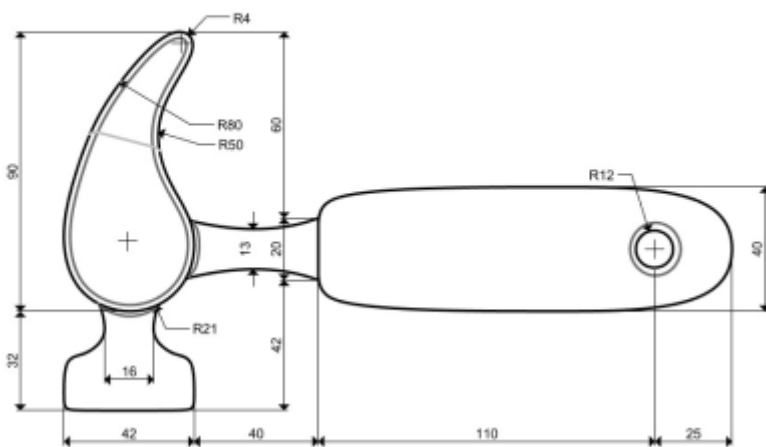


Fig. 3.1.1.22

Exercise 1

Hammer



Follow the measurements and guidelines provided to make the toy hammer
Use commands circle, arc, revolve, sweep 1, sweep 2, boolean difference, trim and more to complete the model

Unit 3.2: Transform Toolbar

Unit Objectives

At the end of this unit, you will be able to:

1. Apprehend on the use of array tools.

3.2.1 Array Tools

Array Object

Use the Array commands to make multiple copies of selected objects. Array Rectangular makes rows and columns of objects. Array Polar copies objects in a circle around a center point.

Rectangular

Copies objects spaced in columns, rows, and levels in the x-, y-, and z-directions.

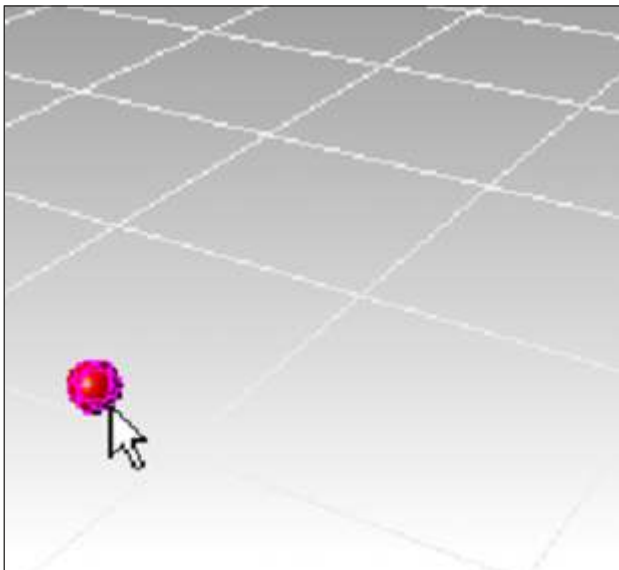


Fig. 3.2.1.1

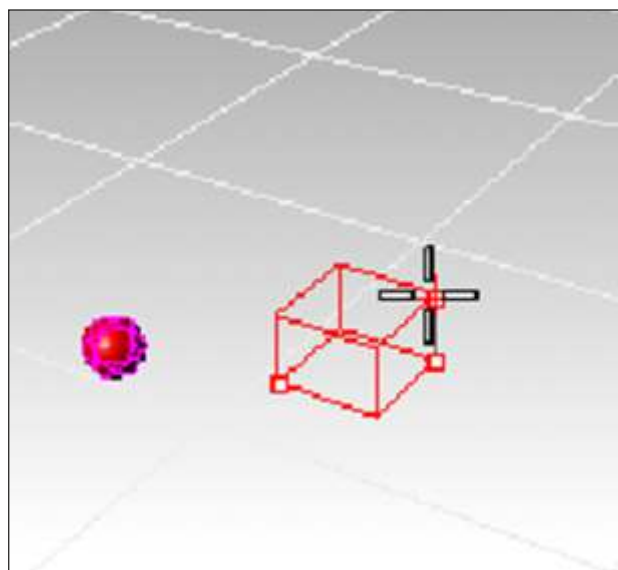


Fig. 3.2.1.2

Polar

Copies objects around a central location.

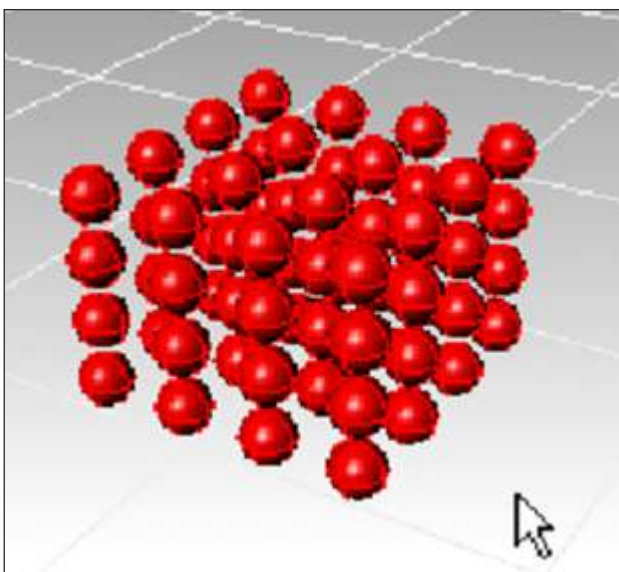


Fig. 3.2.1.3

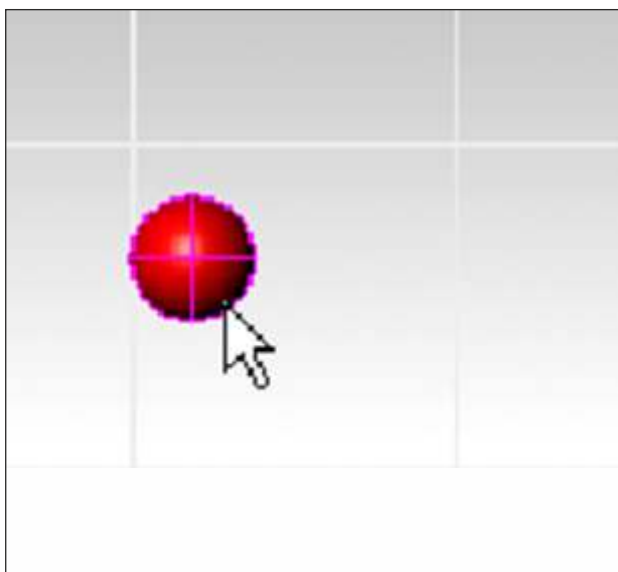


Fig. 3.2.1.4

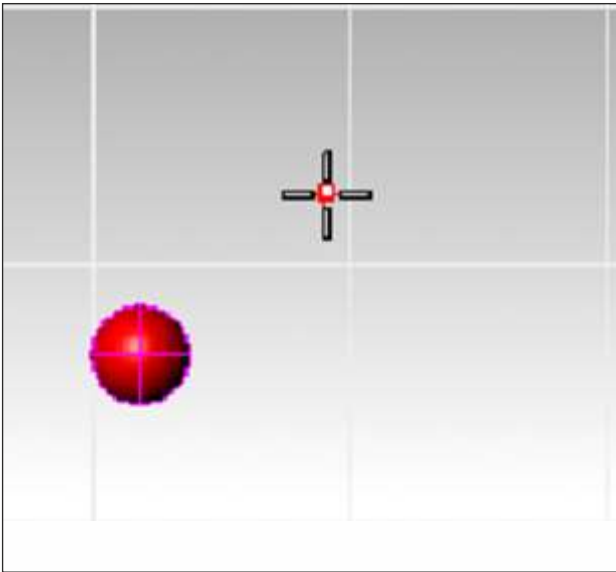


Fig. 3.2.1.5

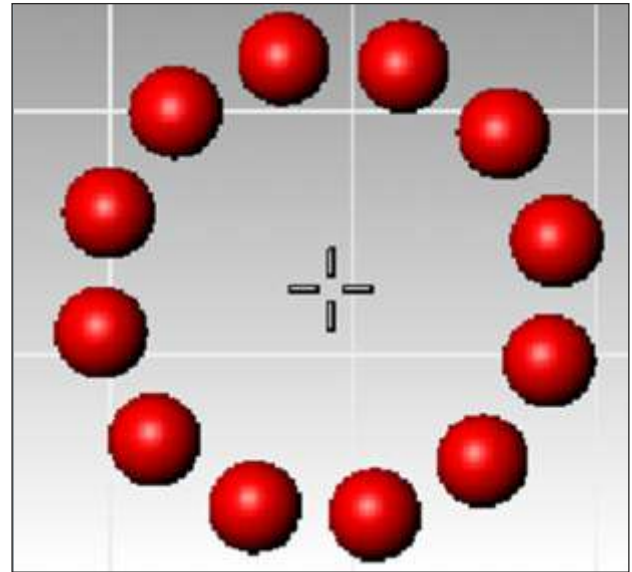


Fig. 3.2.1.6

Along Curve

Copies objects spaced along a curve.

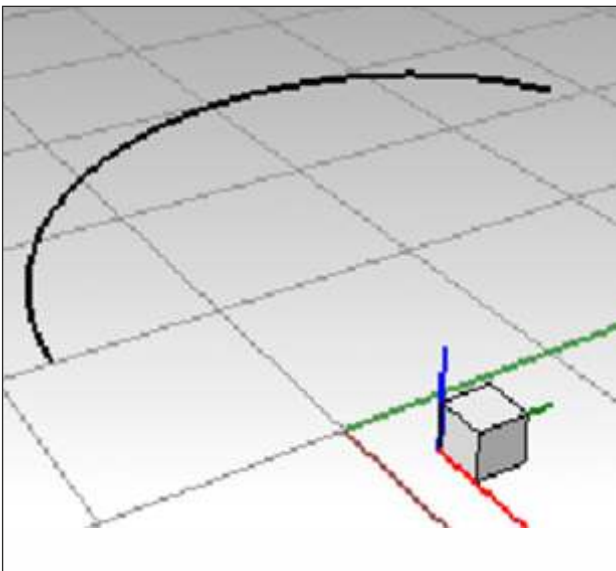


Fig. 3.2.1.7

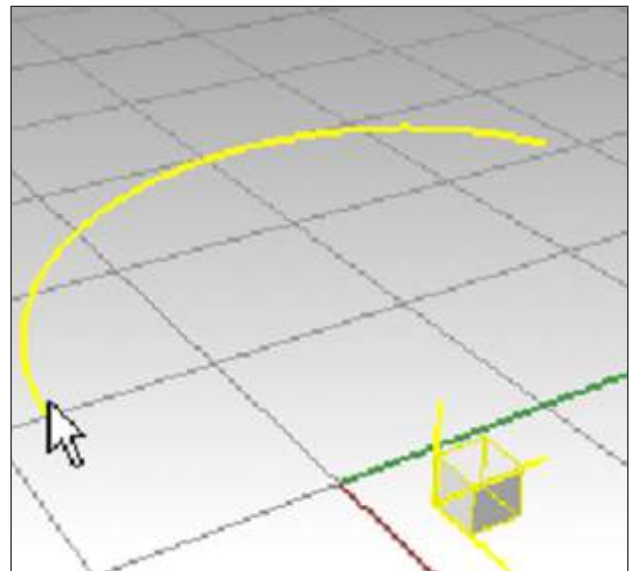


Fig. 3.2.1.8

Along Surface

Copies objects in rows and columns on a surface. The surface normal direction determines the orientation of the objects.

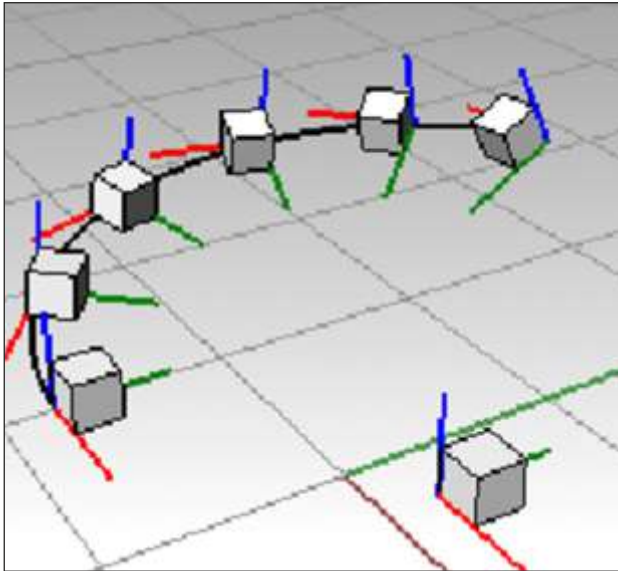


Fig. 3.2.1.9

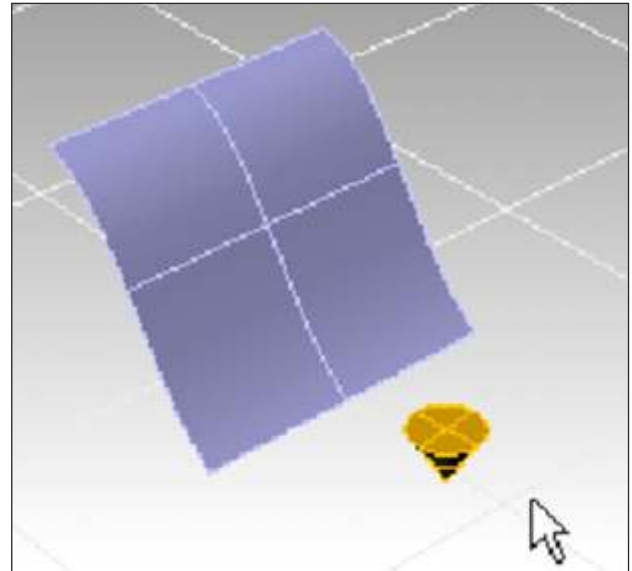


Fig. 3.2.1.10

Along Curve on Surface

Copies objects spaced and rotated along a curve on a surface. The surface normal determines the orientation of the arrayed objects.

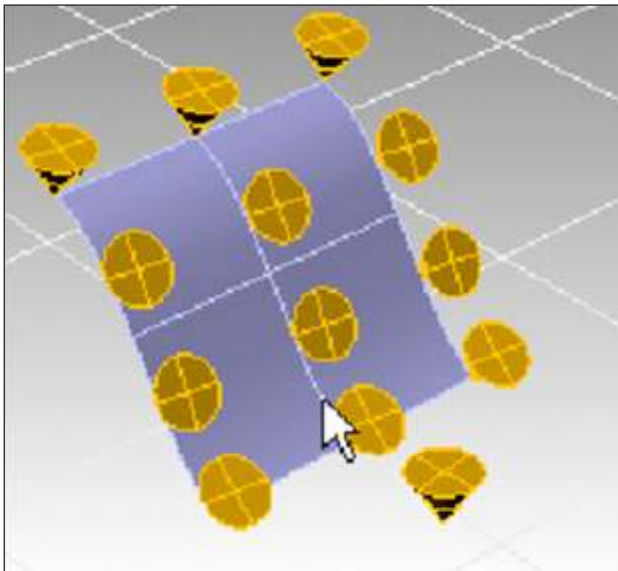


Fig. 3.2.1.11

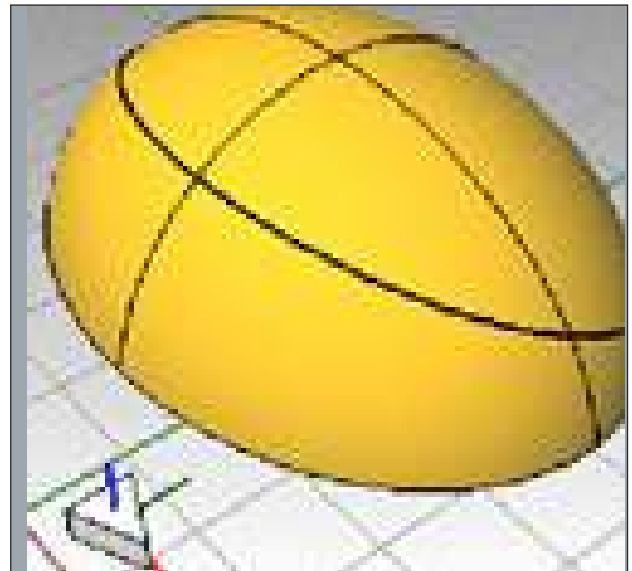


Fig. 3.2.1.12

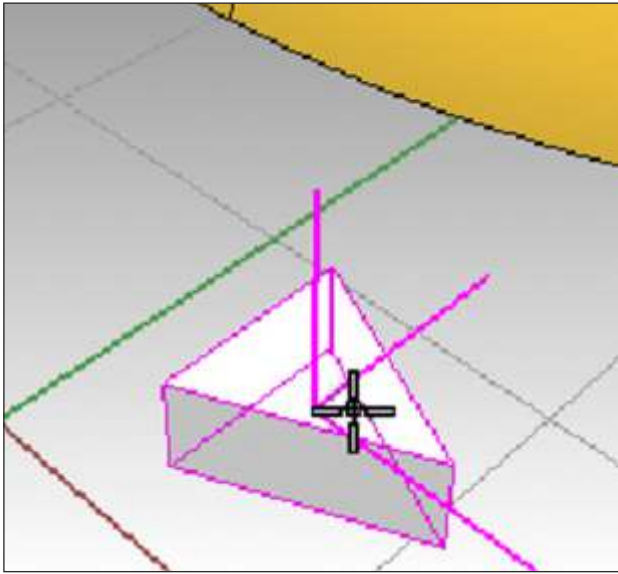


Fig. 3.2.1.13

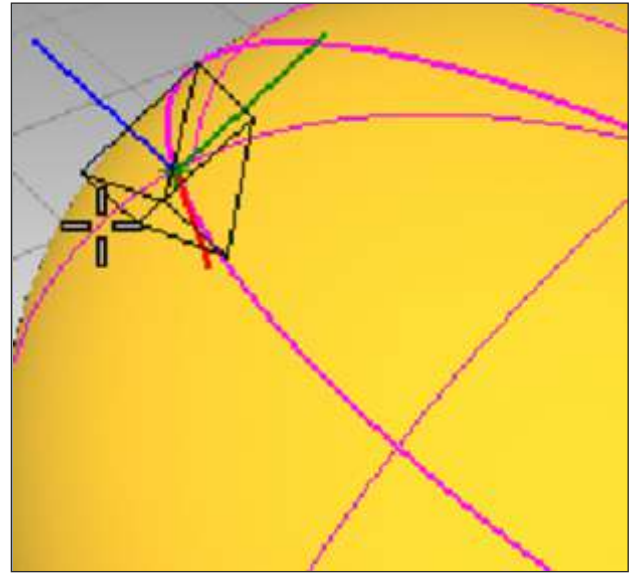


Fig. 3.2.1.14

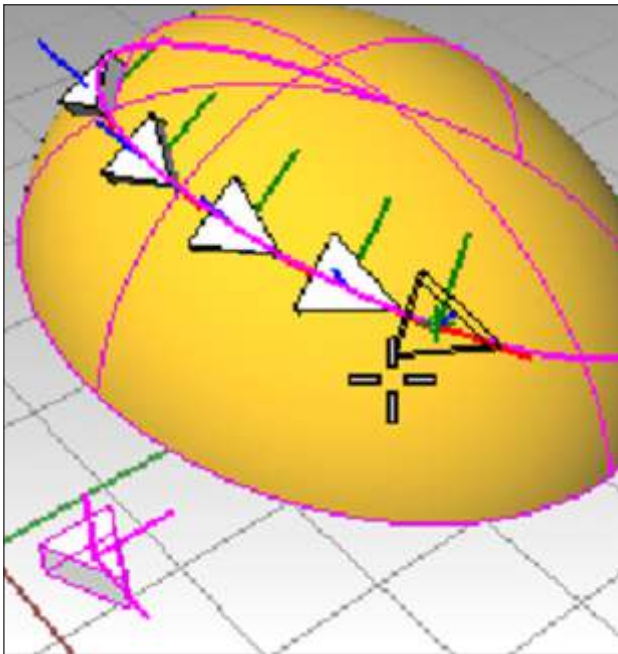


Fig. 3.2.1.15

Unit 3.3: Orient Tool

Unit Objectives

At the end of this unit, you will be able to:

1. Gain knowledge on the use of orient tools.

3.3.1 Orient Tool

The orient commands moves or copies, rotates, scales objects using two reference and two target points.

On Curve

Moves or copies, rotates, and scales objects using two reference and two target points.

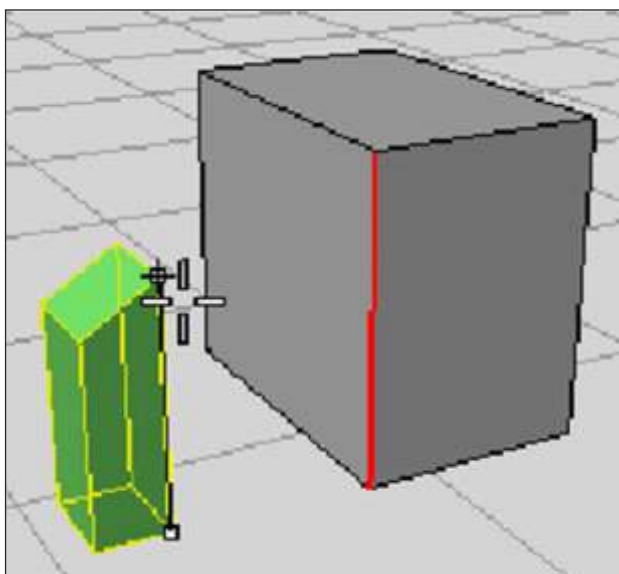


Fig. 3.3.1.1

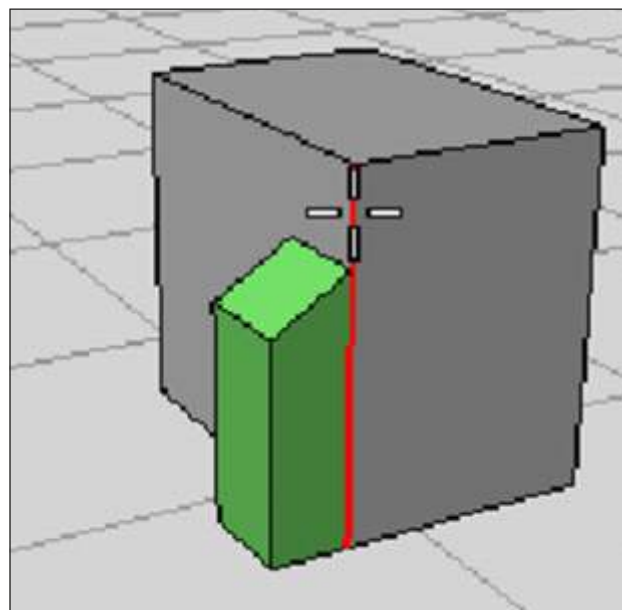


Fig. 3.3.1.2

Perpendicular to Curve

Orients the object perpendicular to the curve. The perpendicular plane is determined by the current construction plane when the base point is picked.

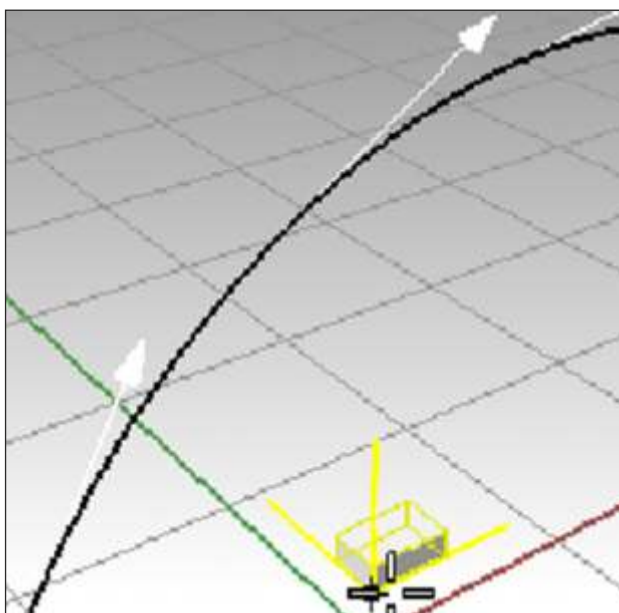


Fig. 3.3.1.3

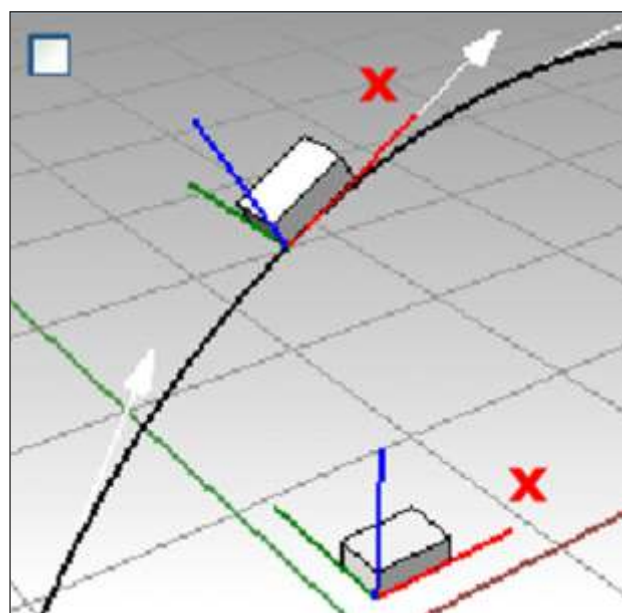


Fig. 3.3.1.4

ON Surface

Moves or copies and rotates objects on a surface using the surface's normal direction for orientation.

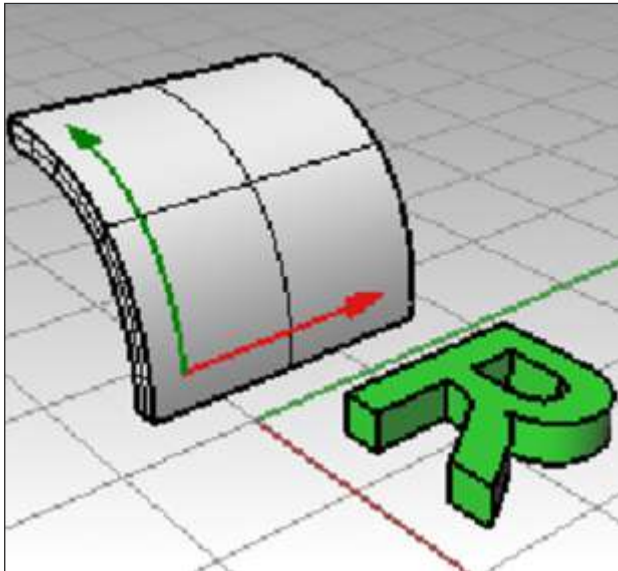


Fig. 3.3.1.5

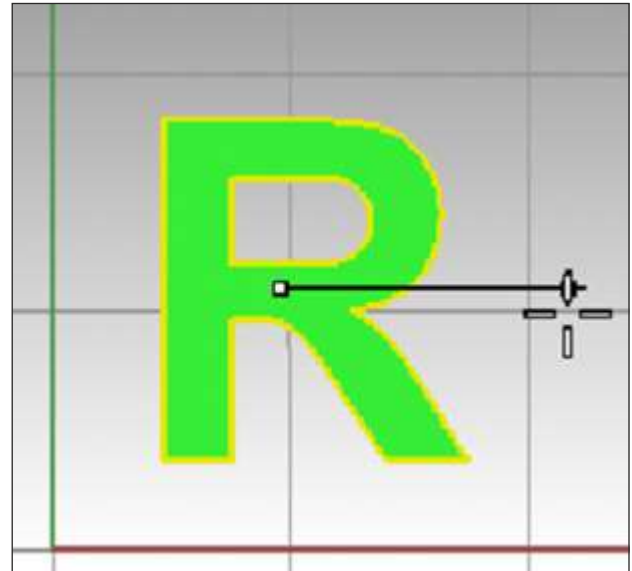


Fig. 3.3.1.6

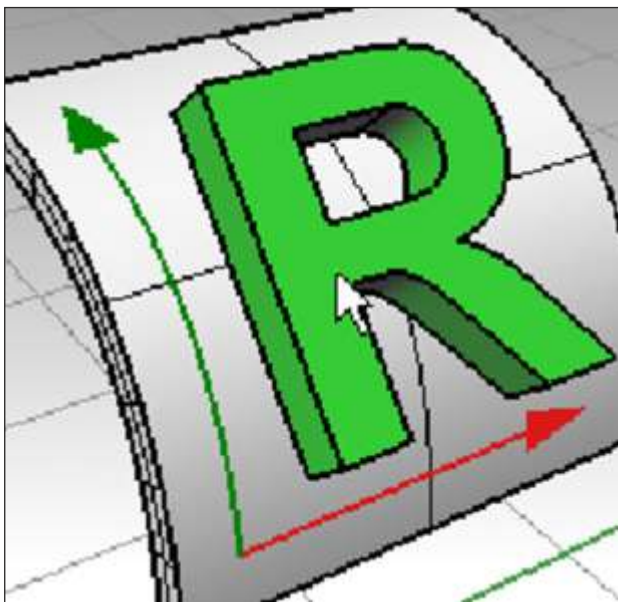


Fig. 3.3.1.7

Unit 3.4: Solid Editing Tool

Unit Objectives

At the end of this unit, you will be able to:

1. Apprehend on the use of solid editing tools.

3.4.1 Solid Editing Tool

Twist

Deforms objects by rotating them around an axis.

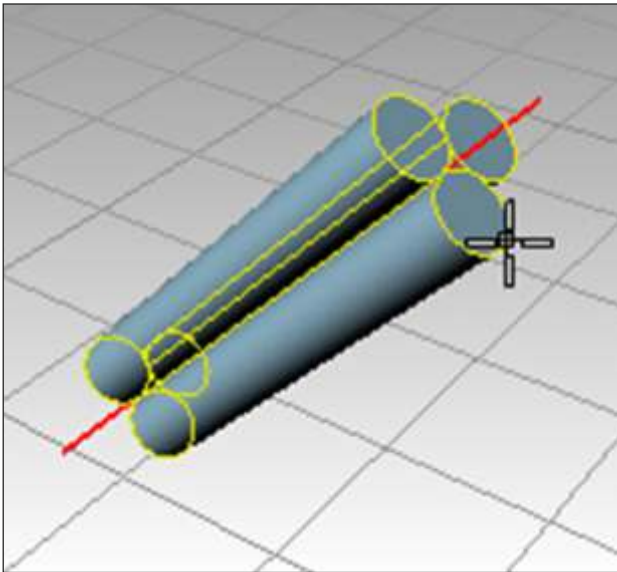


Fig. 3.4.1.1

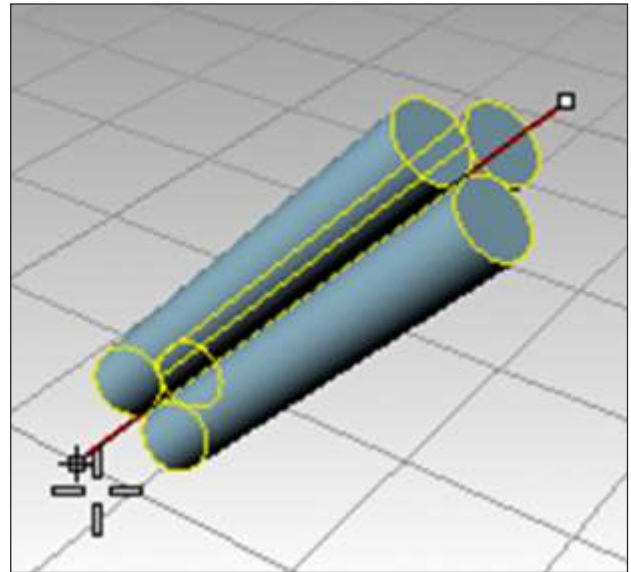


Fig. 3.4.1.2

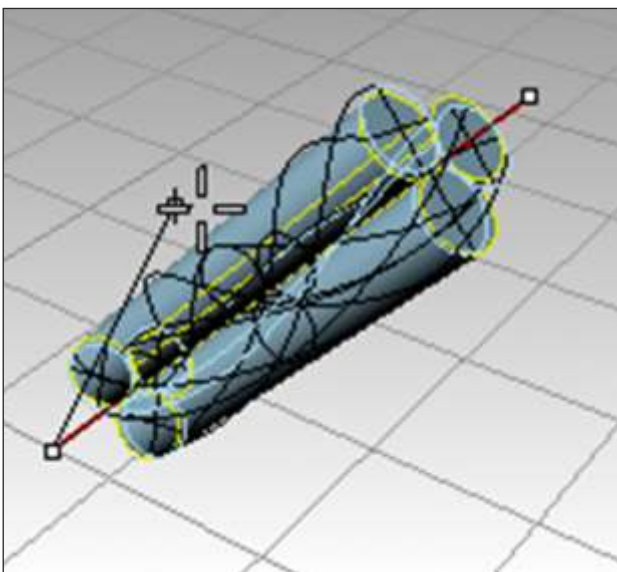


Fig. 3.4.1.3

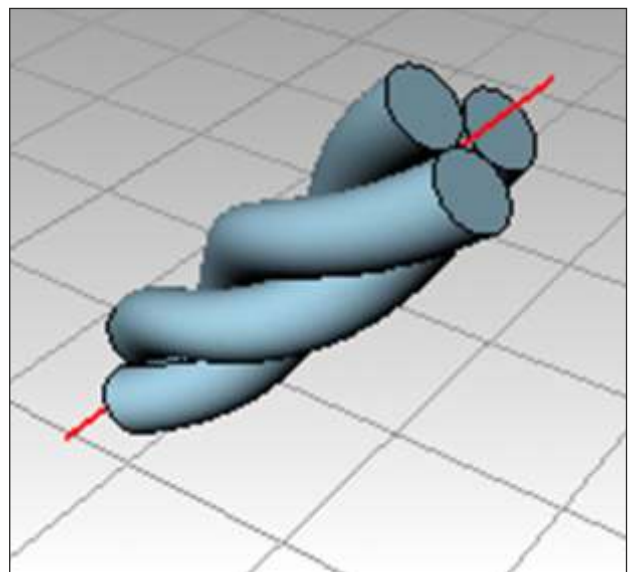


Fig. 3.4.1.4

Bend

Deforms objects by bending along a spine arc.

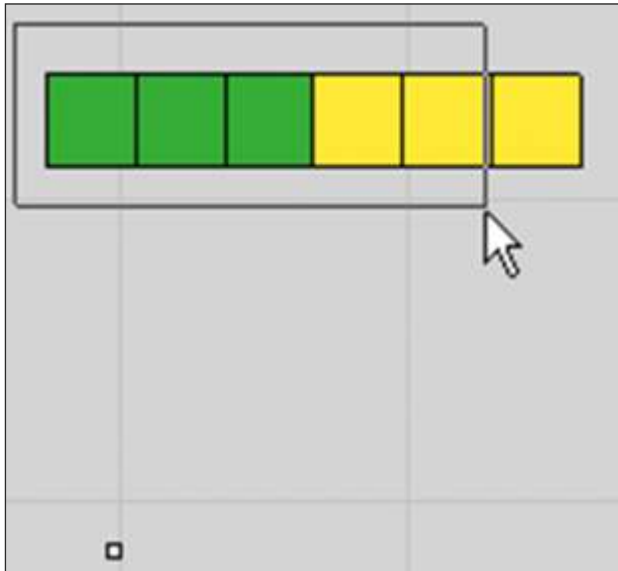


Fig. 3.4.1.5

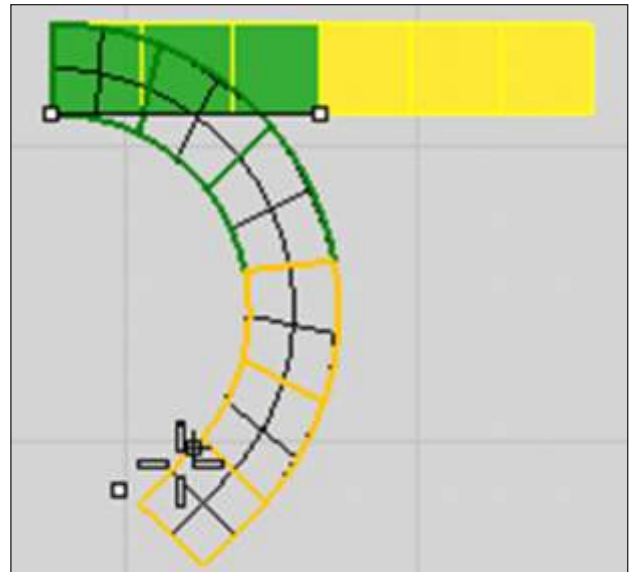


Fig. 3.4.1.6

Flow Along Curve

Re-aligns an object or group of objects from a base curve to a target curve. Use the Flow command to map a flat, straight shape to a curved shape, since it can be easier to draw things when they are lined up than to draw a complex shape around a curve.

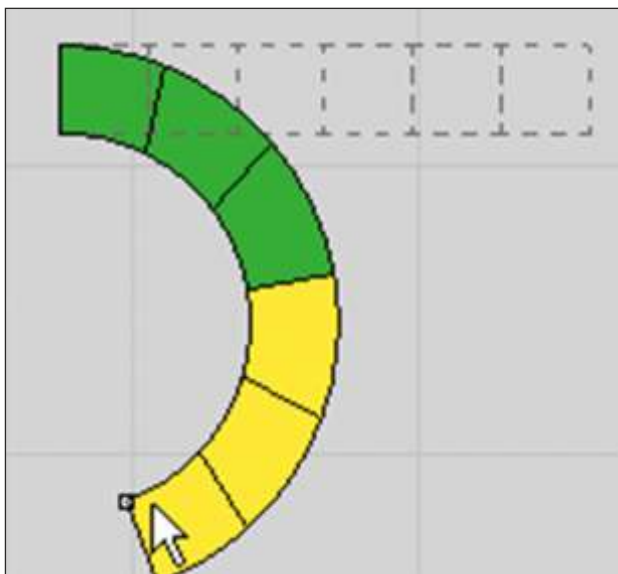


Fig. 3.4.1.7

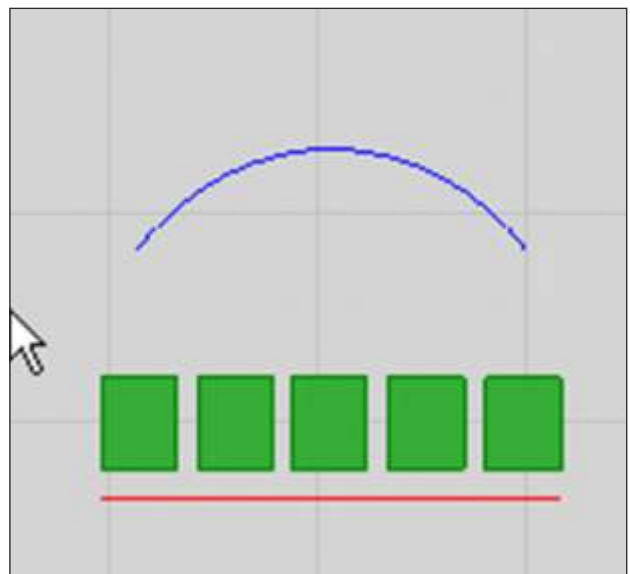


Fig. 3.4.1.8

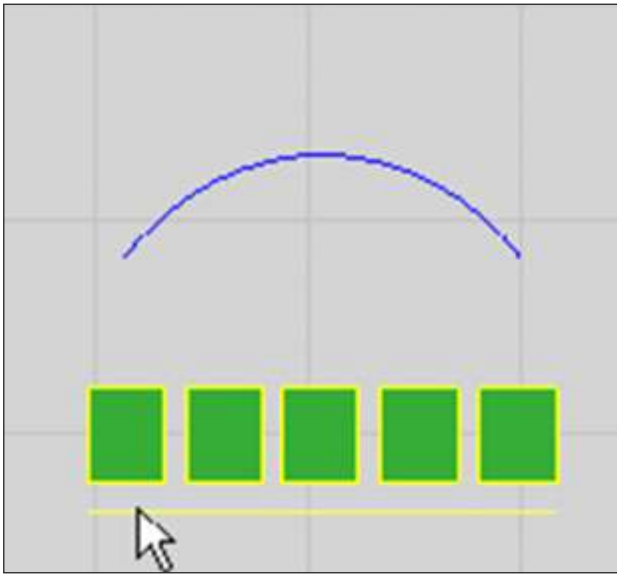


Fig. 3.4.1.9

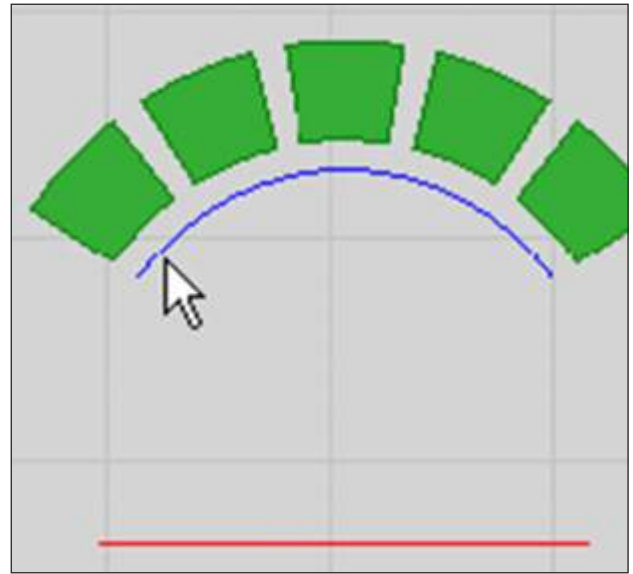


Fig. 3.4.1.10

Flow Along Surface

Morphs objects from a source surface to a target surface.

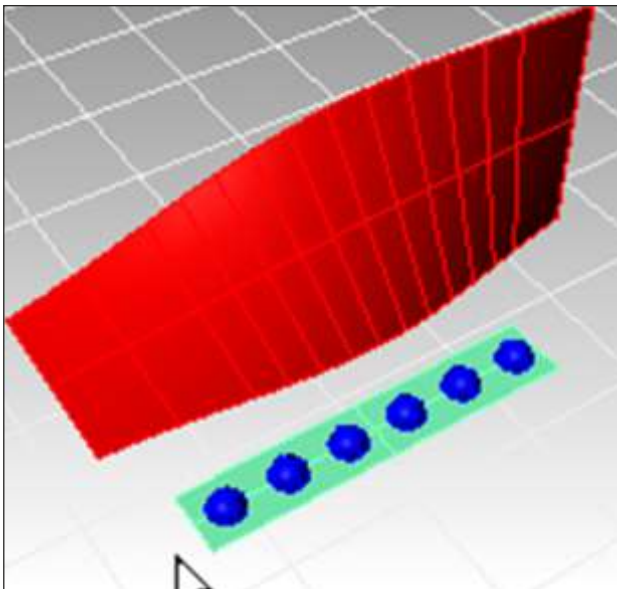


Fig. 3.4.1.11

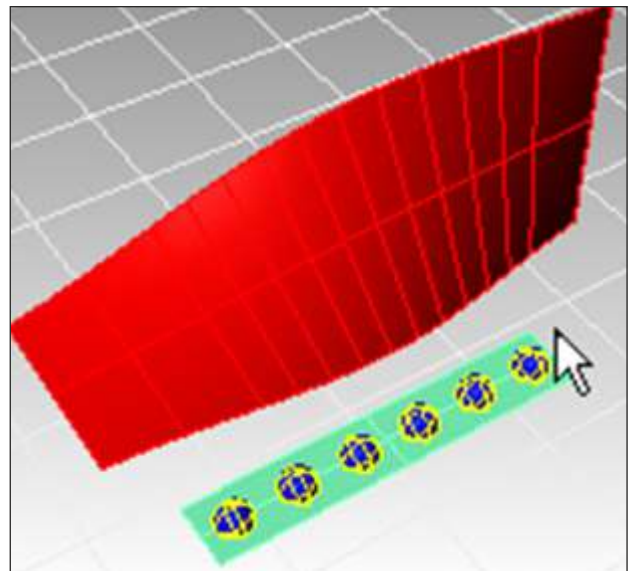


Fig. 3.4.1.12

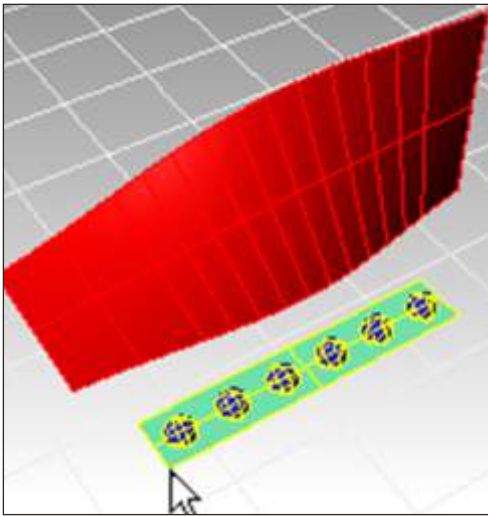


Fig. 3.4.1.13

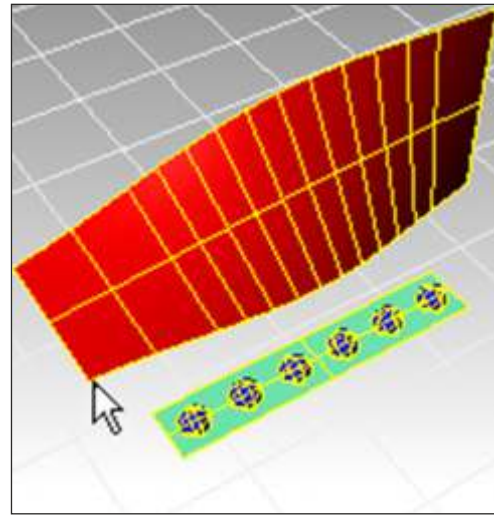


Fig. 3.4.1.14

Cage Edit

Deforms objects smoothly using 1D, 2D, and 3D cages.

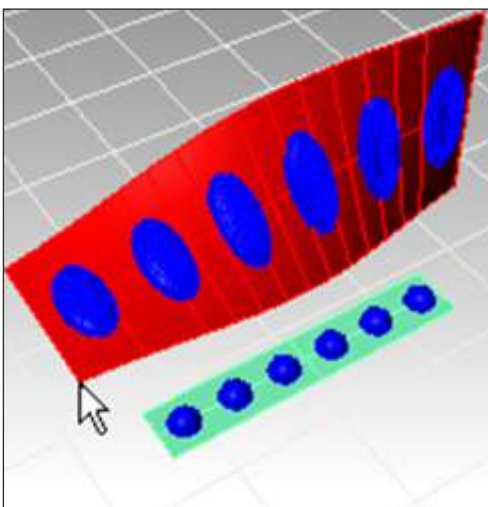


Fig. 3.4.1.15

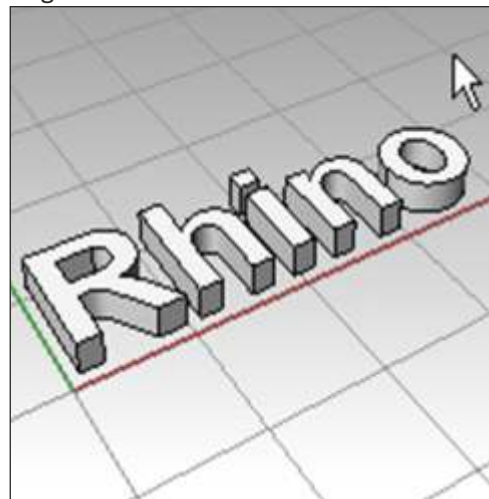


Fig. 3.4.1.16

Scan the QR Code to watch the related video or click on link



Click Here
Earring Flower & Pearl



Click Here
Articulated Bracelet

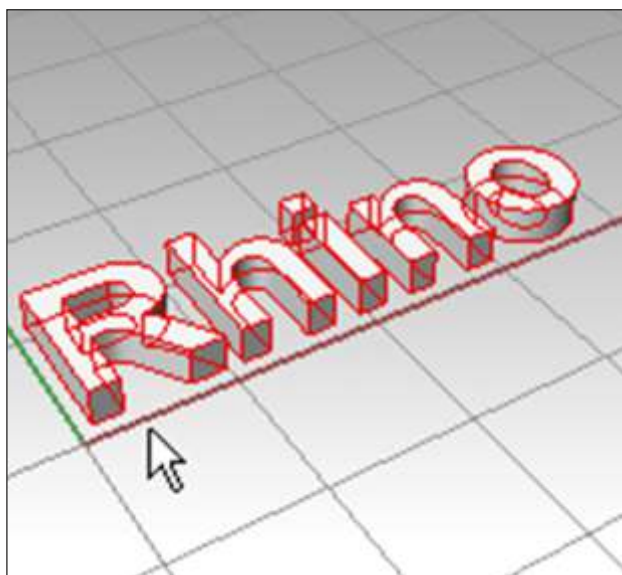


Fig. 3.4.1.17

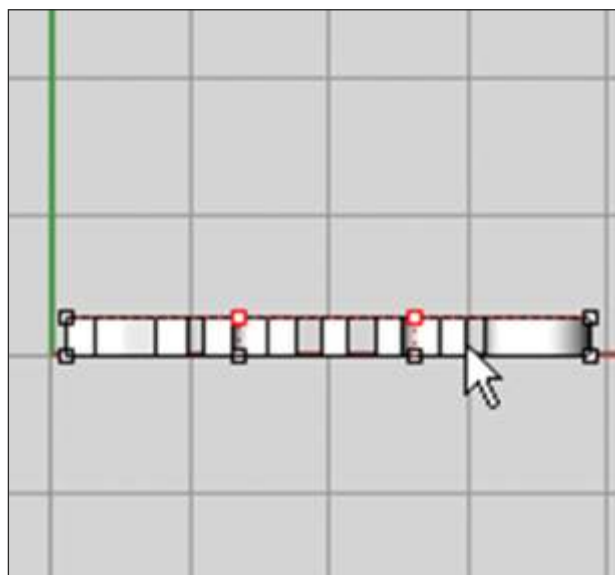


Fig. 3.4.1.18

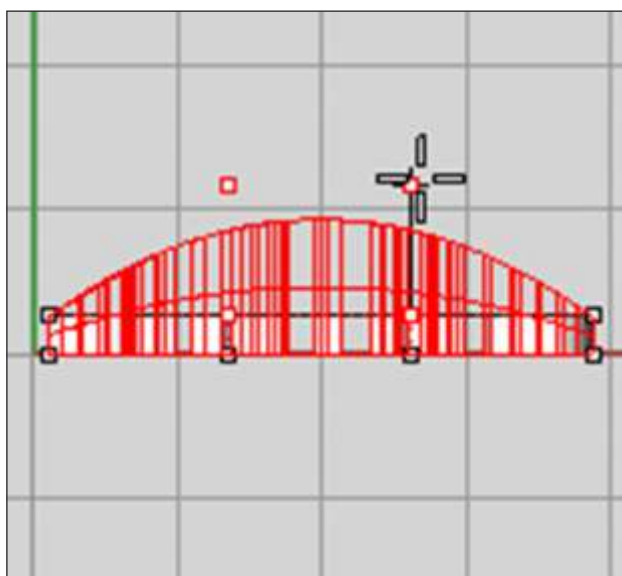


Fig. 3.4.1.19

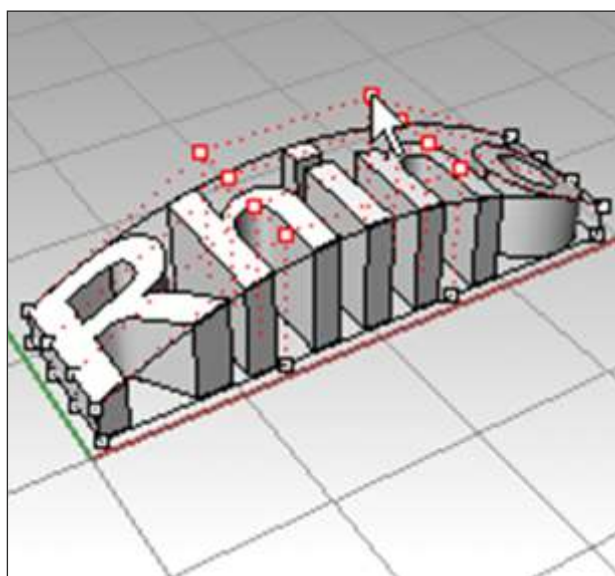


Fig. 3.4.1.20

Bounding Box

The Bounding Box command creates a rectilinear box object (polyline or polysurface) that encloses selected objects.

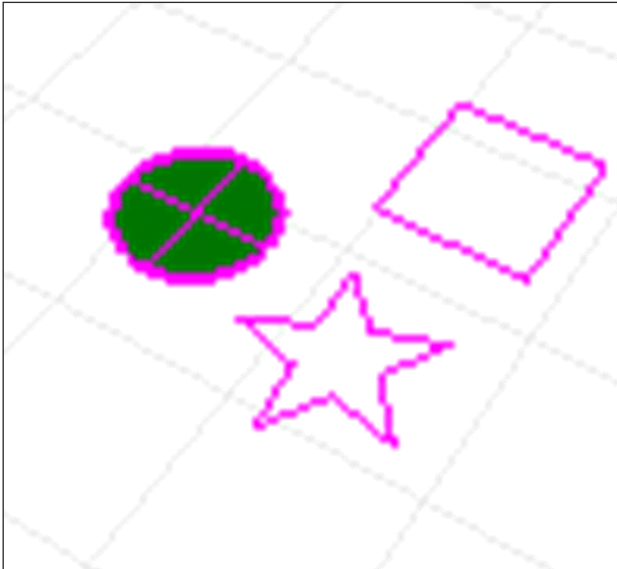


Fig. 3.4.1.21

- **Select the objects.** If the objects are contained in a plane parallel to a coordinate system plane, the bounding box is a rectangular polyline.

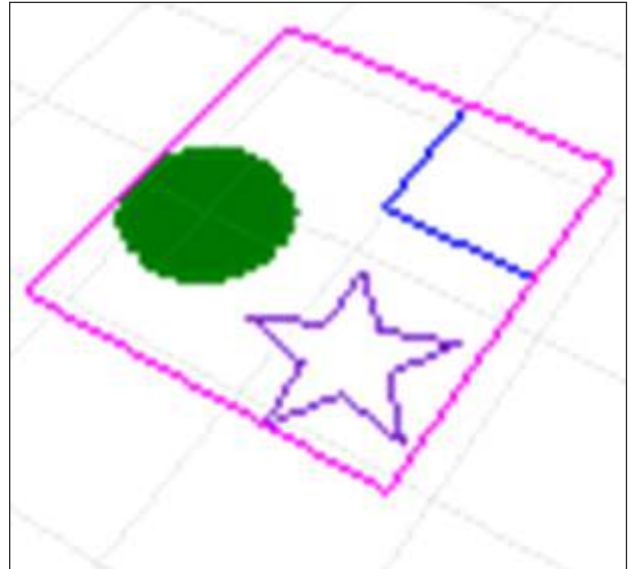


Fig. 3.4.1.22

- Otherwise, a polysurface box is created.

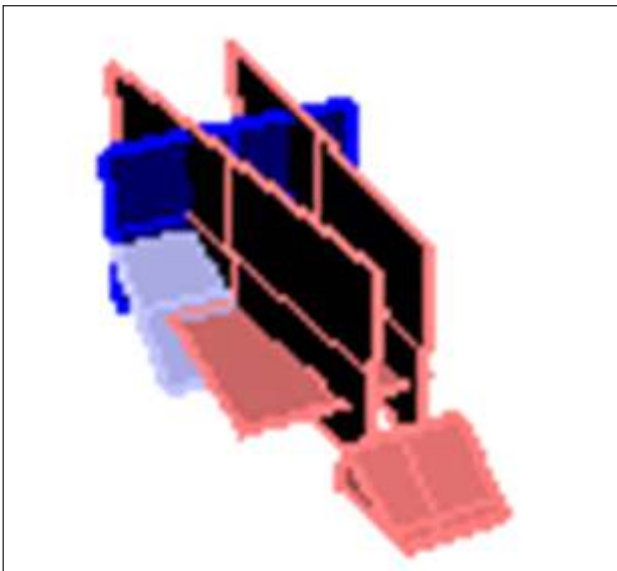


Fig. 3.4.1.23

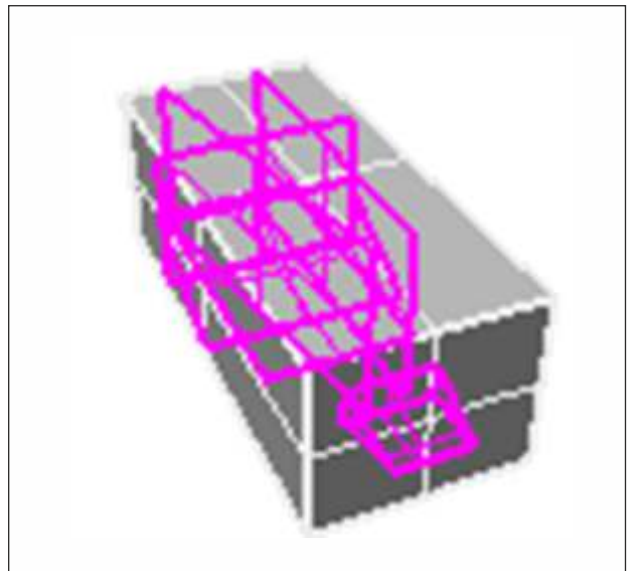


Fig. 3.4.1.24

The extreme corners of the bounding box object are reported at the command line in the chosen coordinate system.

Stretch

The Stretch command scales selected areas of an object in one direction.

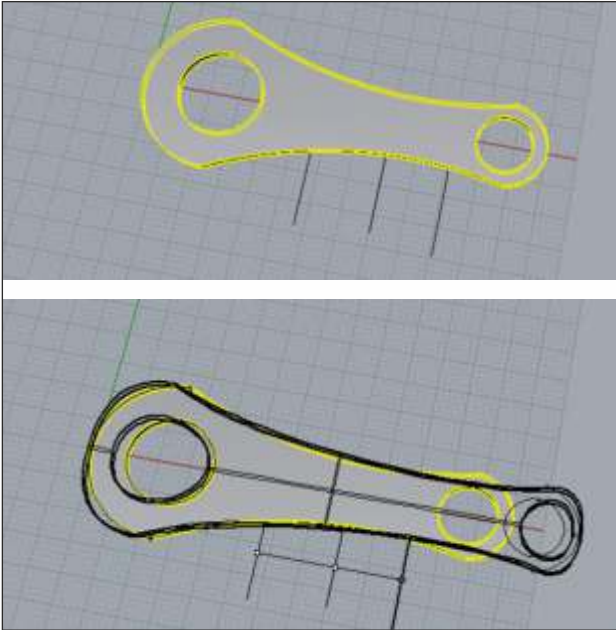


Fig. 3.4.1.25

Ribbon

Create a surface by offsetting a curve and creating a ruled surface in the area between the two curves.

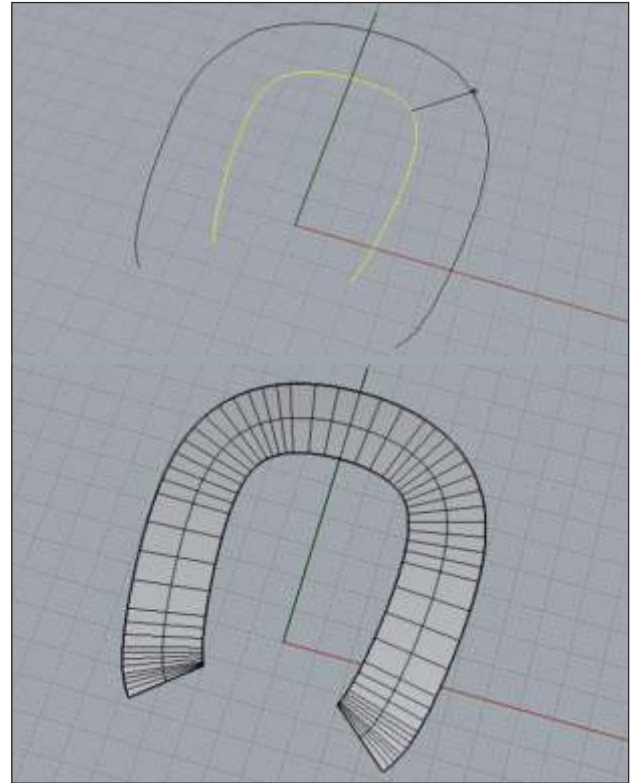


Fig. 3.4.1.26

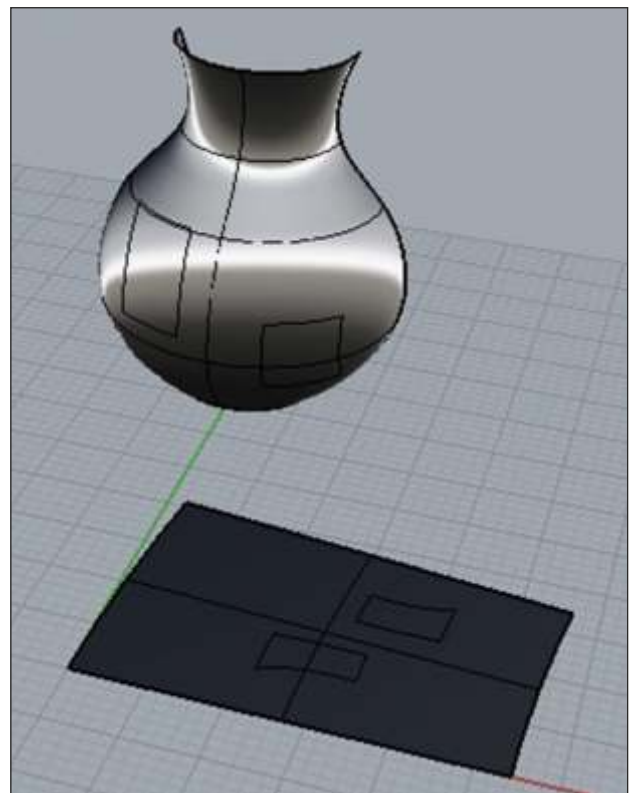


Fig. 3.4.1.27

Unit 3.5: Analyse Tool

Unit Objectives

At the end of this unit, you will be able to:

1. Apprehend on the use of analyse tools.

3.5.1 Analyse Tool

To calculate volume of any product

- Select metal and hide all of rest.
- Go to Analyse Menu then Mass property then Volume
- Volume will come in cubic millimetre.
- Now apply formula to calculate the weight of the product.

$$\text{Weight of Any Metal (gm.)} = \frac{\text{Specific gravity of Metal} \times \text{Volume of Product}}{1000}$$

Scan the QR Code to watch the related video or click on link



Click Here
Introduction to Precious metal

3.5.2 Metal Weight

Specific Gravity of Metal			
Metal	Specific Gravity	Metal	Specific Gravity
Aluminum	2.7	Iridium	22.5
Antimony	6.62	Iron (Pure)	7.87
Beryllium	1.82	Lead	11.34
Bismuth	9.8	Magnesium	1.74
Cadmium	8.65	Manganese	7.43
Carbon	2.22	Molybdenum	10.2
Chromium	7.19	Nickel	8.9
Cobalt	8.9	Osmium	22.5
Copper	8.96	Palladium	12
Gold	19.32	Phosphorus	1.82
18K Green	15.9	Platinum	21.45
18K Yellow	15.58	15% Iridium Plat.	21.59
18K White	14.64	10% Iridium Plat.	21.54
18K Red	15.18	5% Iridium Plat.	21.5
14K Green	14.2	Rhodium	12.44
14K Yellow	13.07	Ruthenium	12.2
14K White	12.61	Silicon	2.33
14K Red	13.26	Silver	10.49
10K Green	11.03	Sterling Silver	10.36
10K Yellow	11.57	Coin Silver	10.31
10K White	11.07	Tin	7.3
10K Red	11.59	Zinc	7.13

3.5.2 Metal Weight

For Example :

Volume	= 245.36 Cubic mm
18 k Yellow Gold Specific Gravity	= 15.58
925 Silver Specific Gravity	= 10.36
Weight of Any Metal (gm.) =	$\frac{\text{Specific gravity of Metal} \times \text{Volume of Product}}{1000}$

$$18 \text{ K Gold Weight} = 245.36 \times 15.58 / 1000 = 3.822 \text{ gm}$$

$$925 \text{ Silver Weight} = 245.36 \times 10.36 / 1000 = 2.541 \text{ gm}$$

Analyses- Length, Distance

Length: The Length command reports the length of curves or edges.

Steps : Select curves or edges.

The accumulated length of the curves or edges displays on the command line.

Distance: Measures and reports the radius of a curve at a specified point.

Steps : Pick the first point.

Pick the second point.

The distance between the points displays in the command history window, with angles and distances in the axis directions in world and construction plane coordinates.

Select Bad Objects

- Select all objects that do not pass Check .
- Note: Delete or rebuild the object.

Join Naked Edges

The Join Edge command joins two naked edges that are out of tolerance.

- Select two naked surface or polysurface edges that are coincident or close together.
- If the edges overlap (run somewhat parallel) along at least part of their length (an interval), but are not coincident, the Edge Joining dialog box reports, "Joining these edges requires a join tolerance of <distance>. Do you want to join these edges?". The surfaces will extend to join along the intervals.

3.5.3 New In Rhino 7

Commands and Enhancements useful in jewellery making:

Generic Commands

- BatchRenderNamedViews- Renders all the named views in the model and saves the renderings as image files to a folder.
- LockViewport- Toggles the locking state of the current viewport (Viewport title- locked).
- Layouts- Opens the Layouts panel that manages the layouts in the model.
- RibbonOffset- Offsets a closed curve and then creates a ruled or Sweep 2 surface between the input and offset curves.
- MergeSrf- Combines curves connected end to end into a single curve.
- Array polar- New UseLastAxis option and ZOffset Supports negative values.
- Cap- Rejects self-intersection inputs and shows a warning.
- Gumball- New Align To View option, allows extruding multiple faces in the same polysurface and allows snapping a scale handle to Gumball origin to flatten the object.
- Mirror- New ZAxis option
- Move- New Normal option
- Offset- New Corner=None and Trim= Yes/No options.
- OrientOnCrv- New Flip option.
- History- Moving parent and child together keeps connection between them and parent and child objects will stay connected if they are cut/copy-pasted together.
- Join- Maintains degree and control points of the input curves.
- Keyboard- Arrow keys are able to select through items in named panels.
- Layer- Allows deleting layers with keyboard delete key.
- Plu-ins- It is possible to install 3rd party v6 plug-ins for v7 without v6 being installed.

3.5.3 New In Rhino 7

Commands and Enhancements useful in jewellery making:

Model Creation Tools

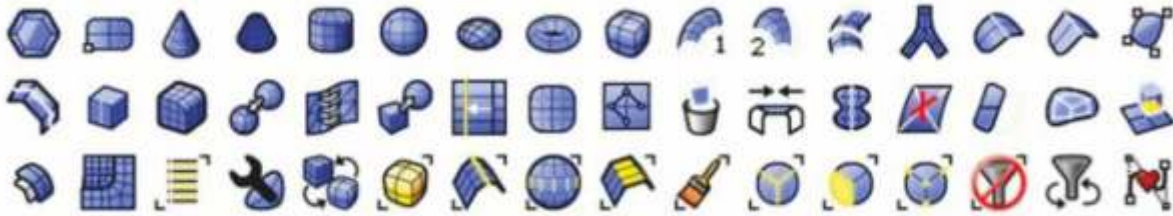


Fig. 3.5.3.1 Model Creation tools

- SubD- (New Plug-in) for designers who need to explore organic shapes quickly. SubD is a new geometry type that can create editable, highly accurate shapes. Unlike other geometry types, SubD combines free-form accuracy while still allowing quick editing.
- Revolve- Ends of the revolving axis can be attached to objects using object snaps when History is recorded.
- DupBorder- Added history support.
- FilletSrf- Now has a G2 option.
- MatchSrf- History locking allows editing control points of matched surfaces.
- BlendSrf- New refine checkbox avoids creating a simpler blend surface also new automatic straighten button and angle threshold.
- Grasshopper- (New Plug-in) The Grasshopper command opens the plug-in window. It is a graphical algorithm editor tightly integrated with Rhino's 3D modeling tools.

New features in Grasshopper:-

- a) Turn your Grasshopper definitions into Rhino commands.
- b) Clash Detection: Quickly search a large number of objects to find points of intersection between pairs of clashing objects.
- c) Component Placeholders: Placeholder component for missing plug-ins.
- d) New components for Hatch, Rhino. Inside. Revit and more.

3.5.3 New In Rhino 7

Editing



Fig. 3.5.3.2 Editing tools

- Named Selections- For anyone who has a need to repeatedly select objects and sub-objects, Named selections is a productivity enhancement which makes recalling selections easier.
- Curve Surface Intersection- Improves results for Trims, Splits and Booleans. This can be 4x faster in some cases.
- BlendEdge- Changed the spacing of control points in BlendEdge based on customer feedback.
- Boolean Operations- Have been improved to union, subtract or intersect coplanar surfaces.

Interface



Fig. 3.5.3.3 Interface tools

- User Interface- Coordinate read out, floating/dockable command area, pop-up recently used commands, clickable command options, auto complete command line, customizable pop-up commands, pop-up layer manager, synchronize views, camera based view manipulation, perspective match image, configurable middle mouse button, customizable icons and user workspace, customizable pop-up toolbar, transparent toolbars, context-sensitive right click menu, multiple monitor support, Alt key copy and OpenGL hardware support with antialiasing.
- Construction Aids- Unlimited Undo and Redo, Undo and Redo multiple, exact numeric input, units including feet, inches and fractions, x,y,z point filters, object snaps with identifying tag, grid snaps, ortho, planar, named construction planes, next and previous construction planes, orient construction plane on curve, layers, layer filtering, groups, back ground images, object hide/show, show selected objects, select by layer, select front most, color, object type, last object and previous selection set, swap hidden objects, objects lock/unlock, unlock selected objects, control and edit points on/off and points off for selected objects.

3.5.3 New In Rhino 7

Display



Fig. 3.5.3.4 Display

Features include extremely fast 3D graphics, unlimited viewports, shaded, working views, perspective working views, named views, floating views, full screen display, draw order support, two point perspective, clipping planes and one to one scale to view models at full size.

- Rendered display mode captures more lighting in a real time working mode.
- Viewports and Rhino render now use the same rendering settings.
- Transparent color support on layers and objects.
- Per face color support for polysurfaces and SubD.

Rendering and Presentation



Fig. 3.5.3.5 Object Rendering

Features include

Rhino Render, a raytrace render with textures, bumps, highlights, transparency, spotlights with hotspot, angle and direction control, point lights, directional lights, rectangular lights, linear lights, shadows and customizable resolution. Real time render preview, real time render preview selected objects, turntable, export to many common file formats used by renderers, rendering plug in support, setting saved in file.

- Rhino uses the new Cycles engine with new textures and materials added.
- Modern progressive rendering technology including advanced usage of both the CPU and GPU hardware.
- Denoisers- Produce beautiful renderings in a fraction of time using Denoisers in Rhino. These post effect filters use artificial intelligence techniques to remove the grainy noise from your draft renderings, dramatically reducing the time to reach a high quality image.
- Physically Based Rendering (PBR) materials- PBR materials are the best choice for renderings and presentations for professionals who want realistic looking materials. PBR materials are supported natively in Rhino's rendering engines and viewports.

3.5.3 New In Rhino 7

Compatibility

.3dm .3ds .sat .ai .amf **.dwg** .dxf .cd .iges
.sat **.dgn** .m **.pdf** .ply **.sldprt** .x .pts **.svg** .dae
.skp **.stl** **.step** .stp **.obj** .rib .xgl .x_t .zpr **.fbx**

Fig. 3.5.3.8 Compatibility

Rhino is compatible with hundreds of different CAD, CAM, CAE, rendering and animation products. The open NURBS library allows hundreds of other applications to read and write Rhino's native 3DM files.

In Rhino V7 improved fidelity for existing formats and support for SubD is now possible. In addition you can now Copy/Paste between Rhino and Illustrator, Inkscape and Affinity Designer(Windows only).

Unit 3.6: Gemstones

Unit Objectives

At the end of this unit, you will be able to:

1. Apprehend gemstones.
2. Gain knowledge on the type of gemstones.
3. Shade (faceted and cabochon) gemstones.

3.6.1 Introduction to Gemstones

A gemstone or gem is a piece of crystal (mineral), which in cut and polished form, is used to make jewellery or other adornments. Beauty of a gemstone is defined by its : Cut, Colour, Clarity, Carat .

The traditional classification begins with the distinction between precious and semi-precious gemstones.

Precious Gemstone



Cat's Eye



Diamond



Hessonite Garnet



Yellow Sapphire



Pearl



Sapphire



Emerald



Coral



Ruby

Fig. 3.6.1.1

3.6.1 Introduction to Gemstones

Cabochon gemstone (Cabs)

A cabochon is a stone that is cut with a highly polished rounded or convex top with no faceting, with a flat or slightly domed base. A cabochon may be cut in any shape.

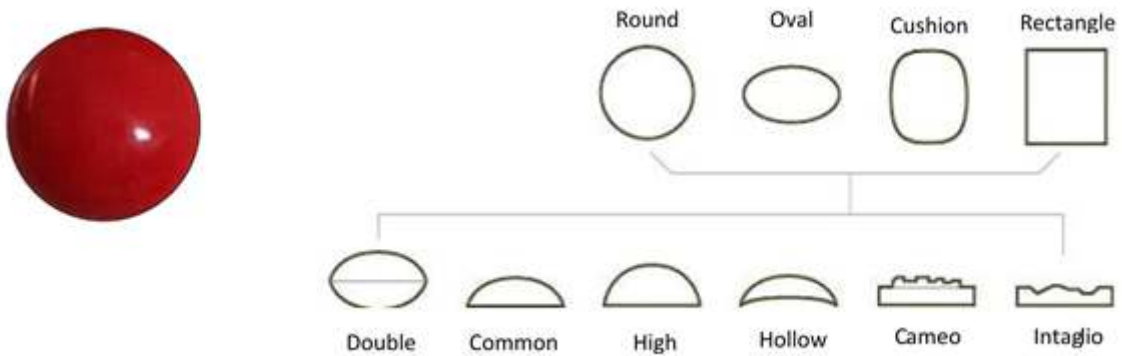


Fig. 3.6.1.2

Faceted gemstone

Faceting is the style of cutting gemstone with several geometrical patterns on its surface. Each of these flat surfaces is called a facet. The gem is faceted by a faceter on a faceting machine. The purpose of faceting is to bring out the brilliance of a gem. That is where the light entering the stone is reflected off the bottom facets and returned to the viewer.

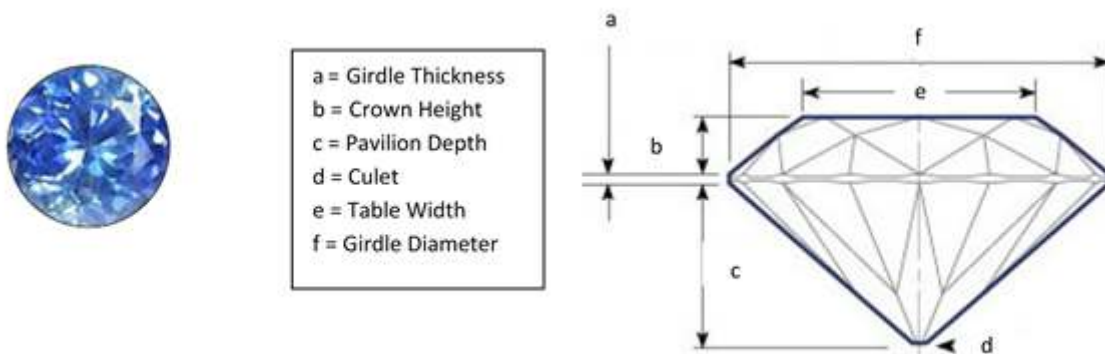


Fig. 3.6.1.3

3.6.2 Type of Gemstones

TRANSPARENT, TRANSLUCENT AND OPAQUE GEMSTONES

A Gemstone can also be transparent, translucent or opaque. These properties depend on the amount of light being absorbed and the chemical structure of the rock.

The amount of light able to pass through a mineral determines its transparency. Light is able to pass through transparent minerals.

Translucent minerals partially let light pass through.

Opaque minerals do not let any light through.

Flaws, inclusions, and impurities degrade the transparency of a mineral.



Transparent



Translucent



Opaque

Fig. 3.6.2.1

3.6.3 Basic Stone

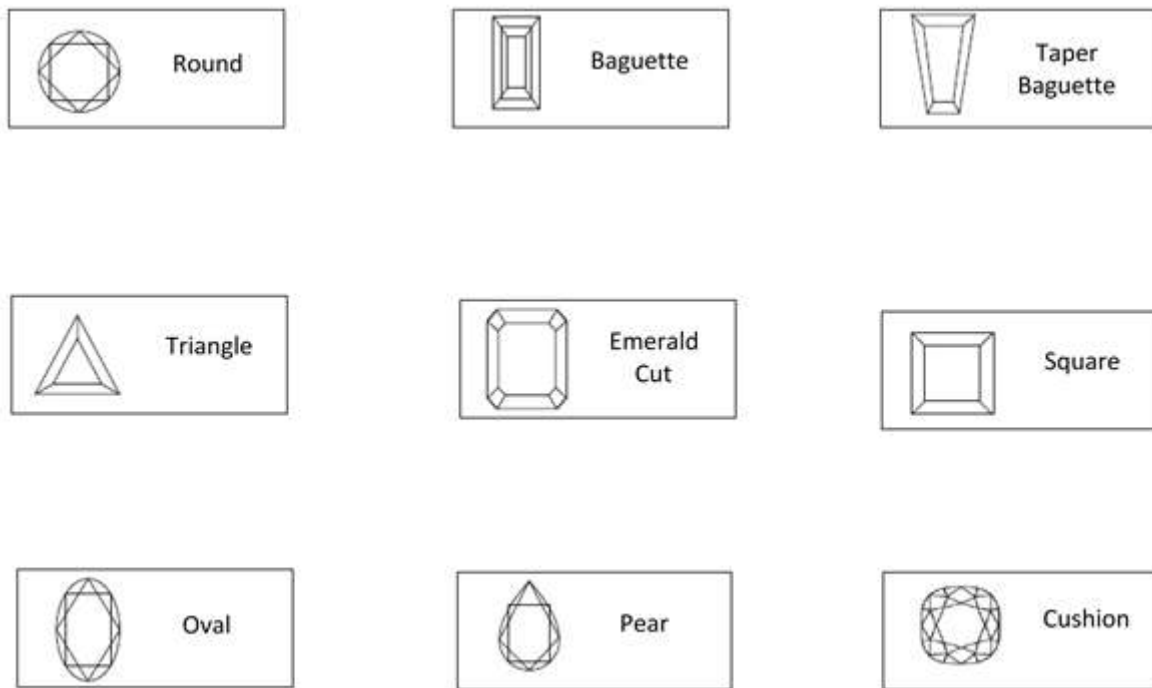


Fig. 3.6.3.1

Scan the QR Code to watch the related video or click on link



[Click Here](#)
Types of Gemstone Settings

Unit 3.7: Jewellery Setting

Unit Objectives

At the end of this unit, you will be able to:

1. Cognize on the importance of settings and its importance in jewellery.
2. Know the different types of settings.

3.7.1 Basic Jewellery Settings

Stone setting is the art of securing precious or semi-precious gemstones into jewellery. The term setting refers to different ways in which a gemstone is mounted in a piece of jewellery. The concept of stone setting is the idea of stone seating in its fixed place and is held securely without any danger of loss.

Setting can be classified under the basic concept of closed, open and group setting and in each of these variations and modifications are possible.

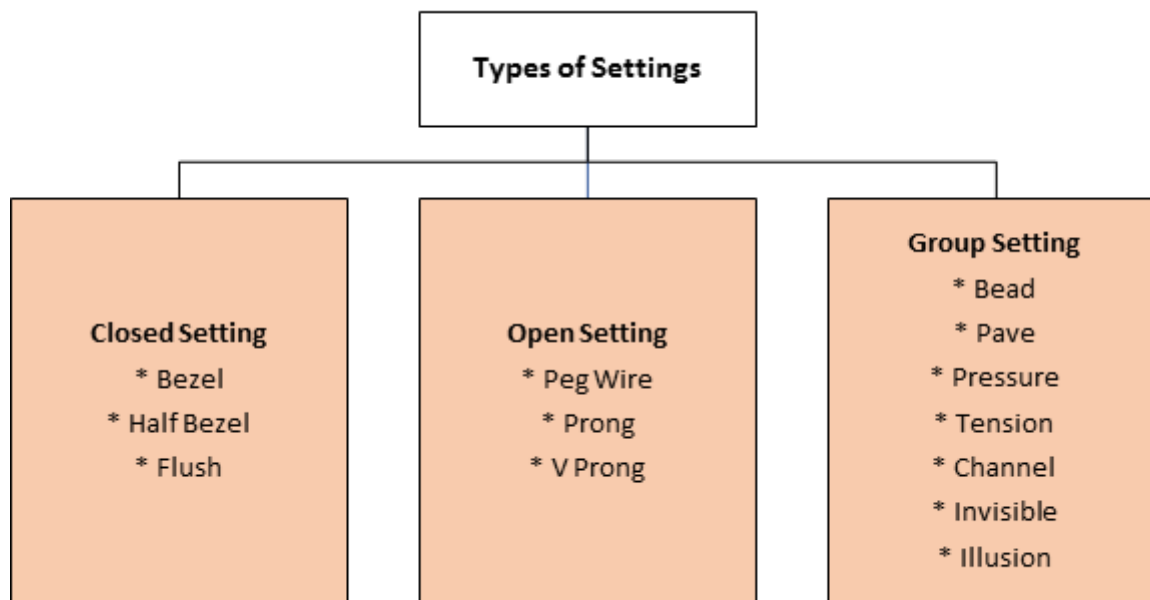


Table 3.7.1.1

- **Closed Setting:**
These settings are considered more secure as the stone is normally open to light from the top i.e. above the girdle area and held in place by precious metal covering the girdle all around.
- **Open Setting:**
A faceted gemstone shows its full lustre and brilliance in Prong/ Claw/ Tiffany/ Illusion settings also known as Open Settings. The light enters the gemstone below the girdle edge through the pavilion facet.
- **Group Setting:**
Any setting type showing several stones set together.

3.7.2 Prong Setting

Prong setting is used to secure gemstones to a piece of Jewellery with the help of metal projections called prongs.

A prong setting from top and front view:

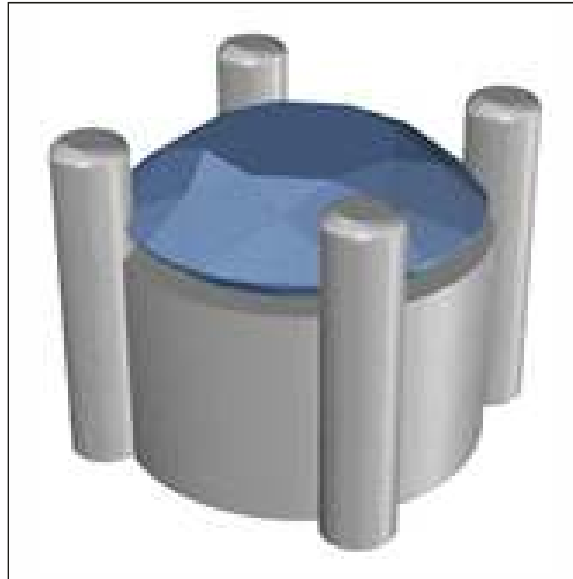


Fig. 3.7.2.1 Prong Setting

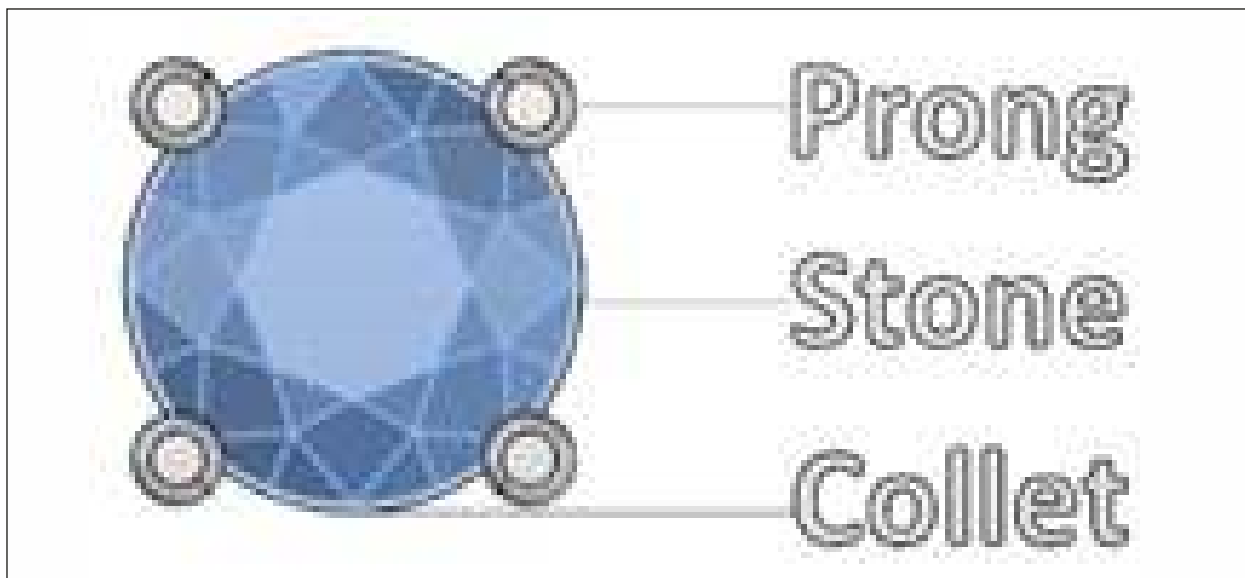


Fig. 3.7.2.2 Top View

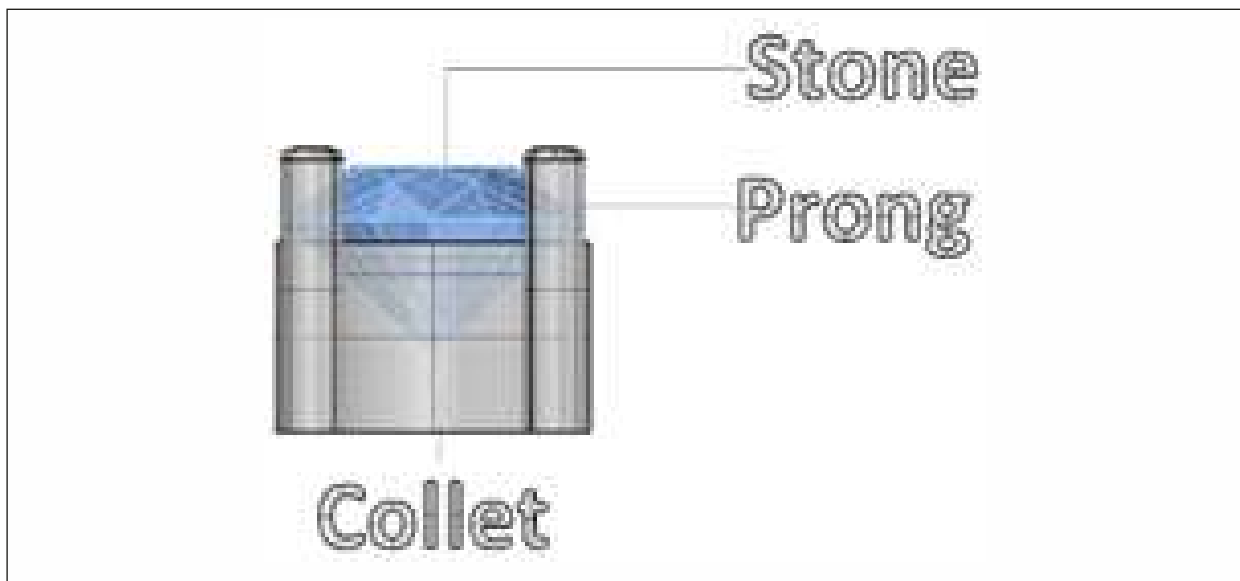


Fig. 3.7.2.3 Front View

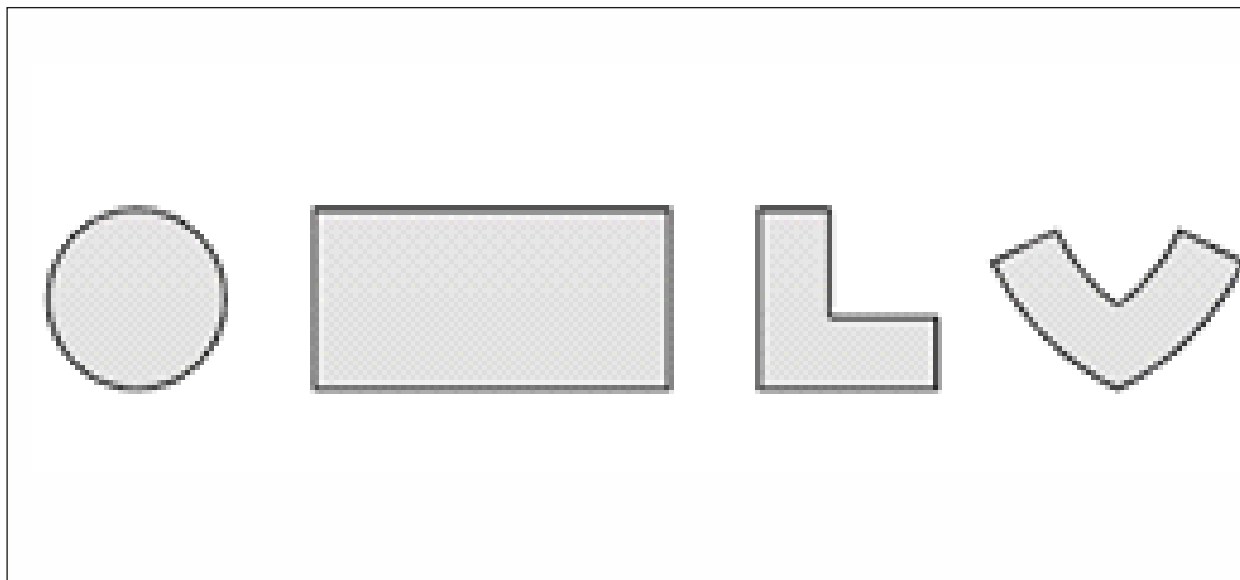


Fig. 3.7.2.4 Different Type of Prong Shapes

There are many other fancy shapes of prongs which are also used in fashion Jewellery like heart shape, star shape etc.

3.7.3 Bezel Setting

The gemstone or diamond which is completely surrounded by a metal band or metal strip to securely hold the stone is known as bezel setting.

If we see a bezel setting from top and front view:

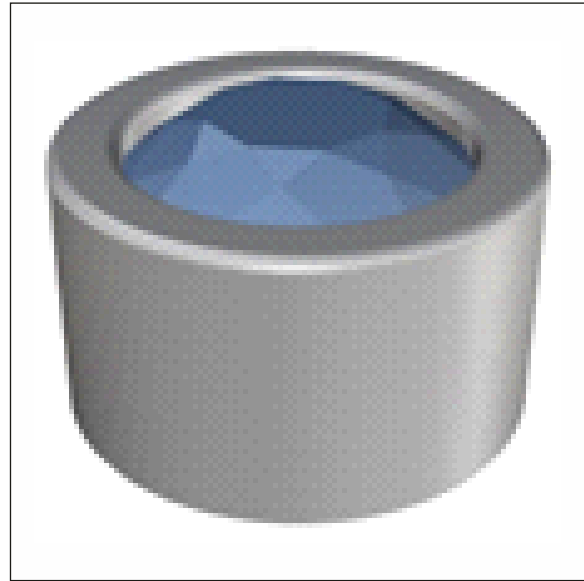


Fig. 3.7.3.1 Bezel Setting

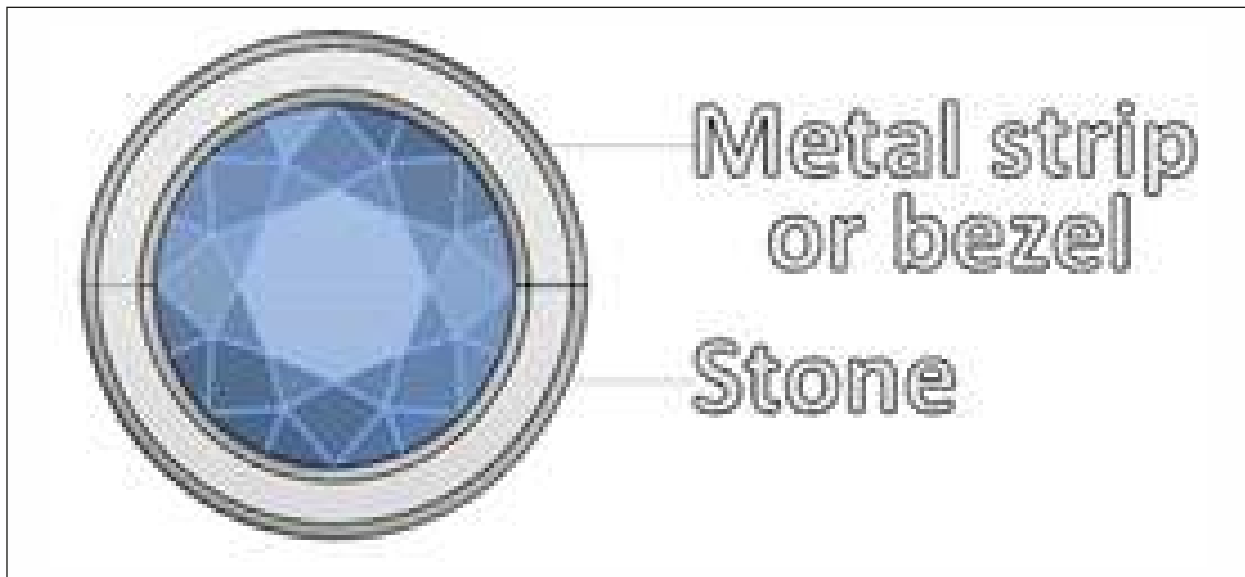


Fig. 3.7.3.2 Top View

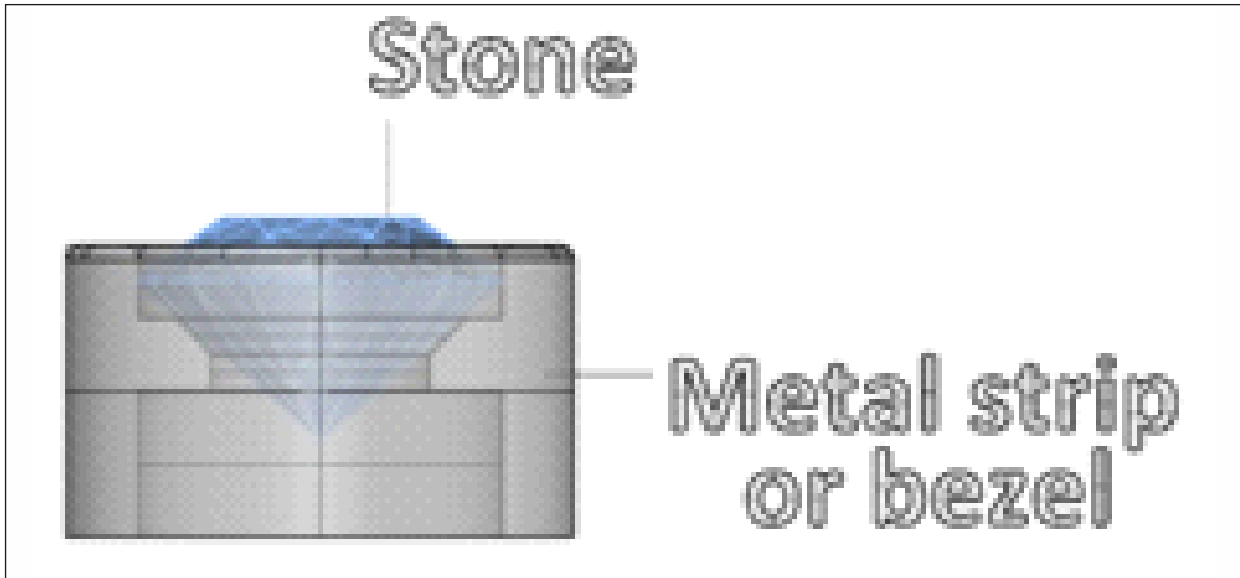


Fig. 3.7.3.3 Front view

Front View

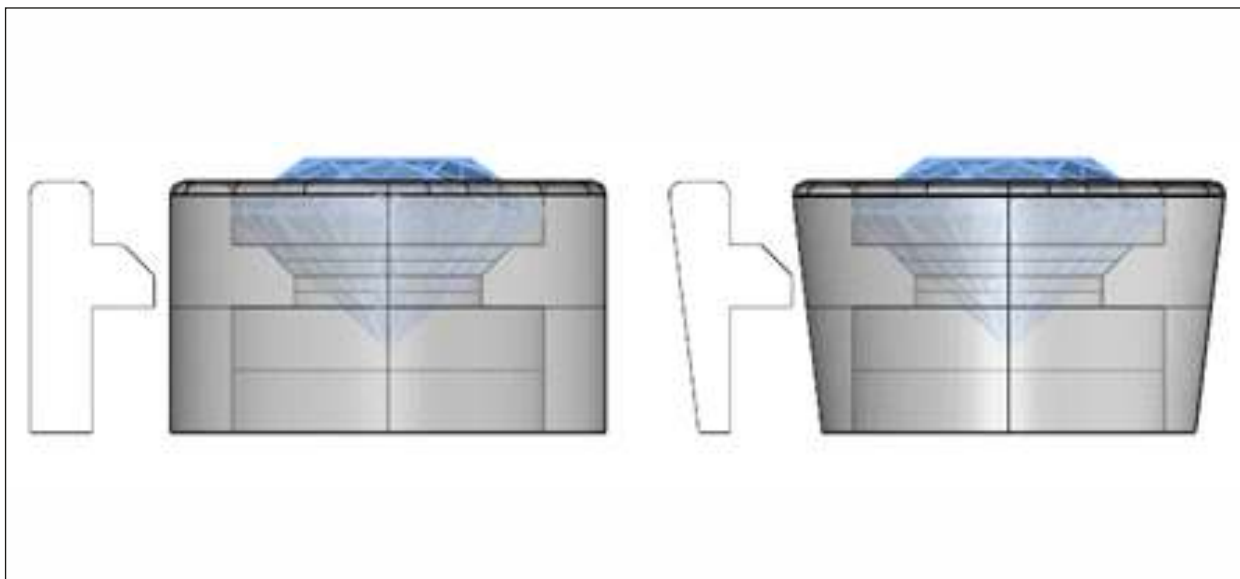


Fig. 3.7.3.4

There are many other fancy sections of bezel which are also used in fashion Jewellery.

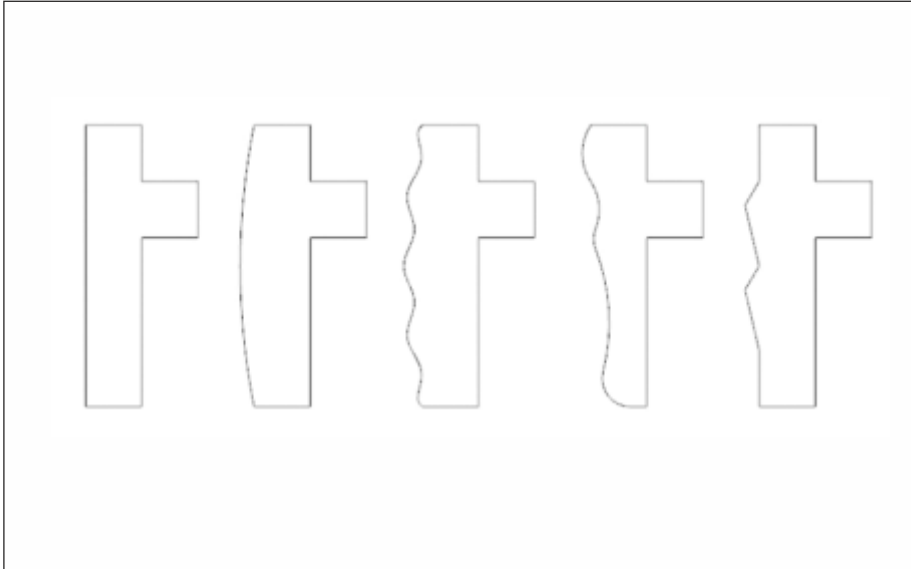


Fig. 3.7.3.5

3.7.4 Pave Setting

Lots of gemstones are closely set on a metal sheet with little beads of the setting metal. These are either pulled from the existing metal in the setting, or they are soldered on. The beads virtually disappear into the background, and the result is what looks like a continuous surface of diamonds or other gems.

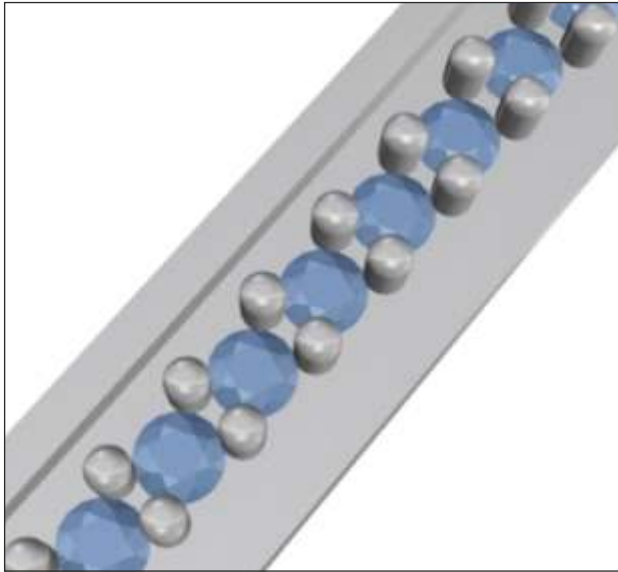


Fig. 3.7.4.1 Pave Setting

Pave setting from top and front view:

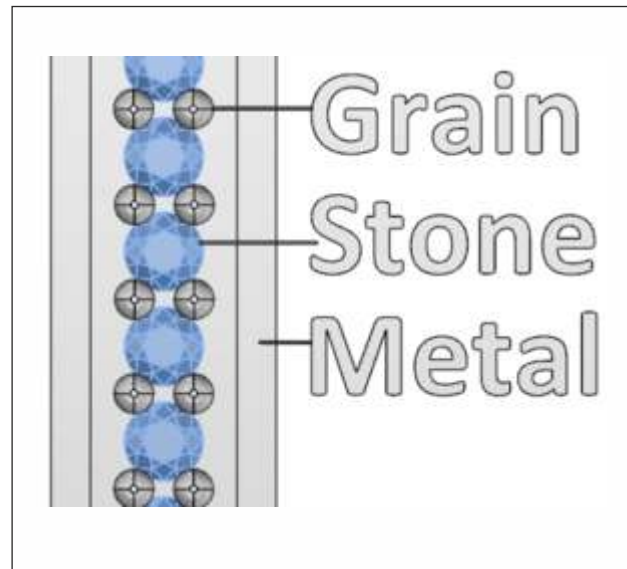


Fig. 3.7.4.2 Top View

Pave setting can be further classified into different types:

- 1 Single Row Pave setting or bead Setting

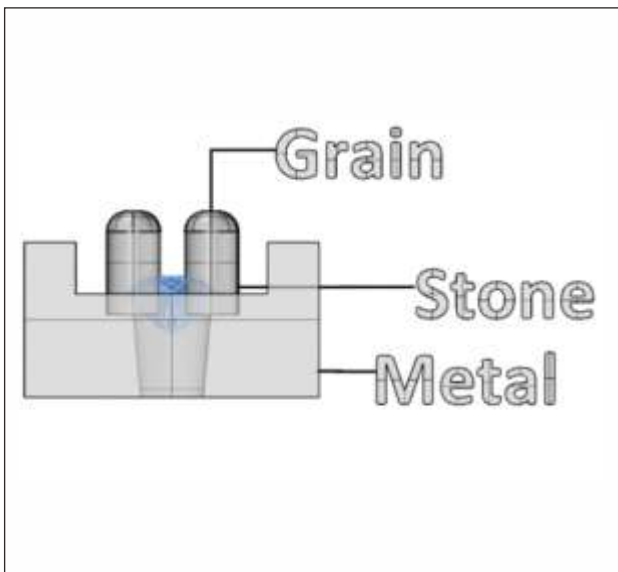


Fig. 3.7.4.3 Front View

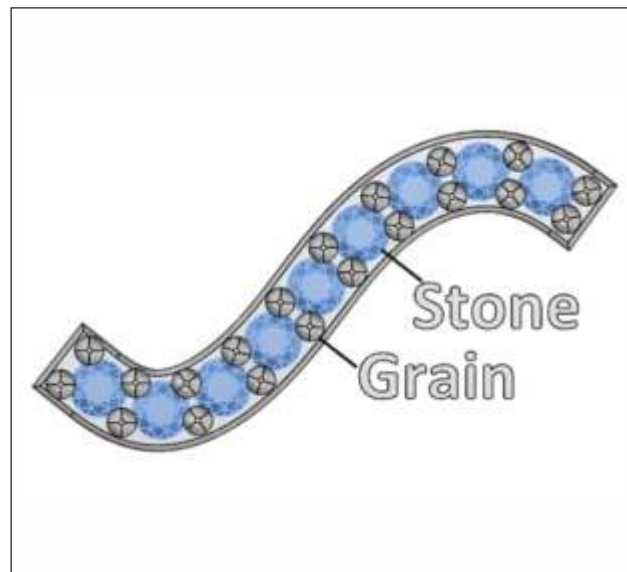


Fig. 3.7.4.4

2 Group setting or grain setting

There are two ways of doing pave setting:

1 With sharing grains

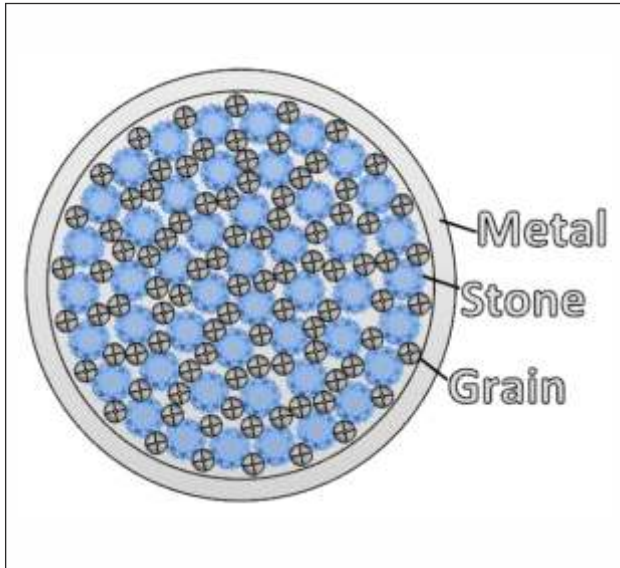


Fig. 3.7.4.5

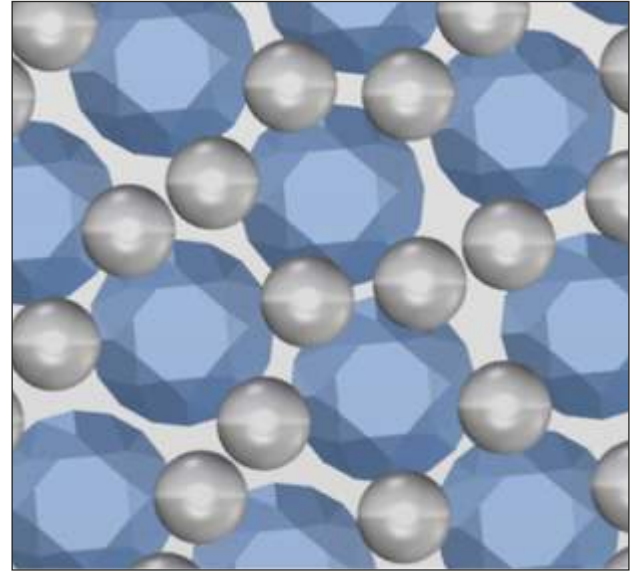


Fig. 3.7.4.6

2 With individual grains

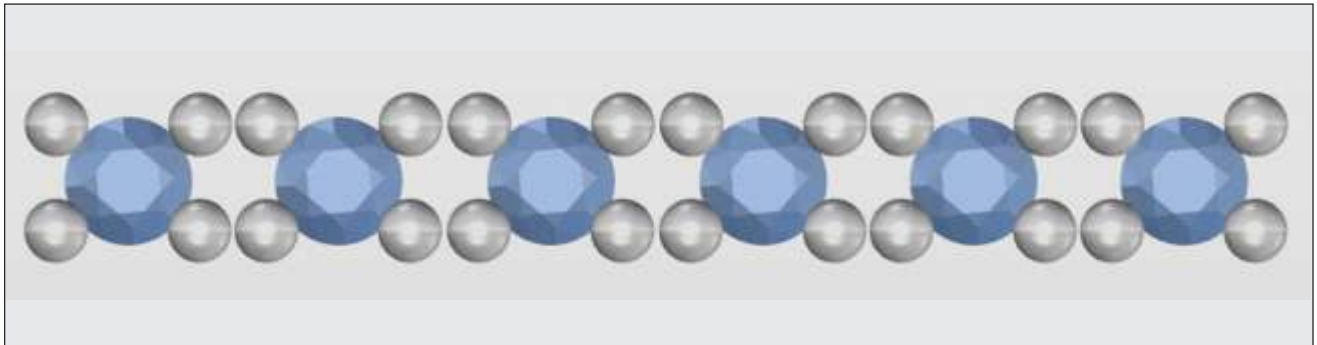


Fig. 3.7.4.7

Exercise 1

Extrude Object

Tools:- Circle, Extrude Planar Curve (Straight/Taper)

Step by Step :-

- 1 On viewport front, make a circle on point "0" using the "Circle: Center, Diameter" tool. Select the tool, type "0" and press "Enter" to confirm. Now create a circle of size 17.19mm. In the command prompt, click on "diameter" and type "17.19" and press "Enter" to create a circle.

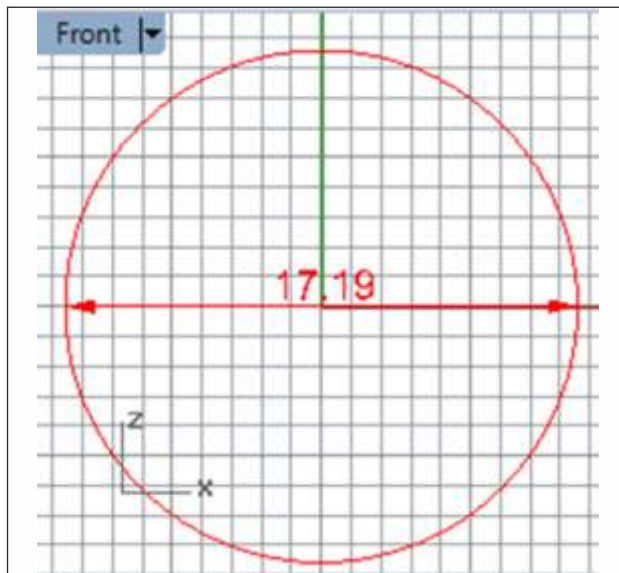


Fig. 1

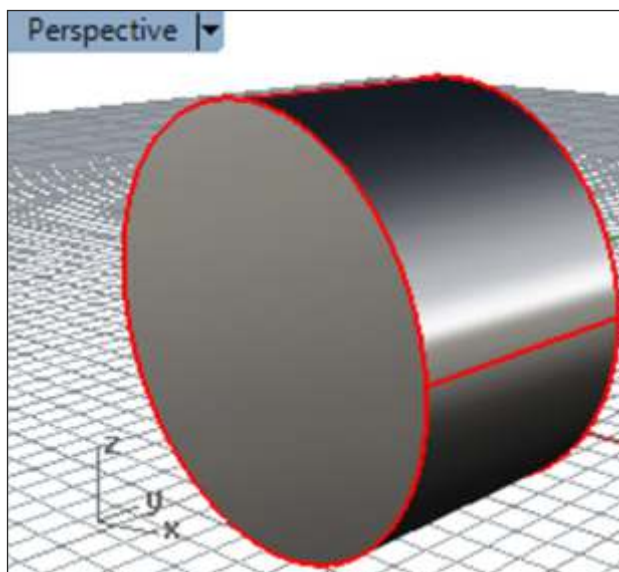


Fig. 3 Shaded View

- 2 On "Viewport Right" using the "Extrude Planar Curve" command extrude the planar curve either straight or taper. Apply the command "Extrude Planar curve straight", select the curve to extrude and then press "Enter". Now click on "Solid"; give the extrusion distance (suppose) 10mm then press "Enter".

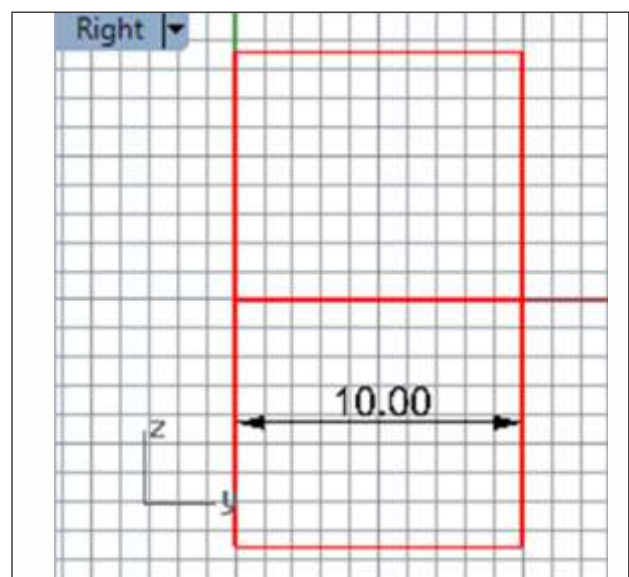


Fig. 2

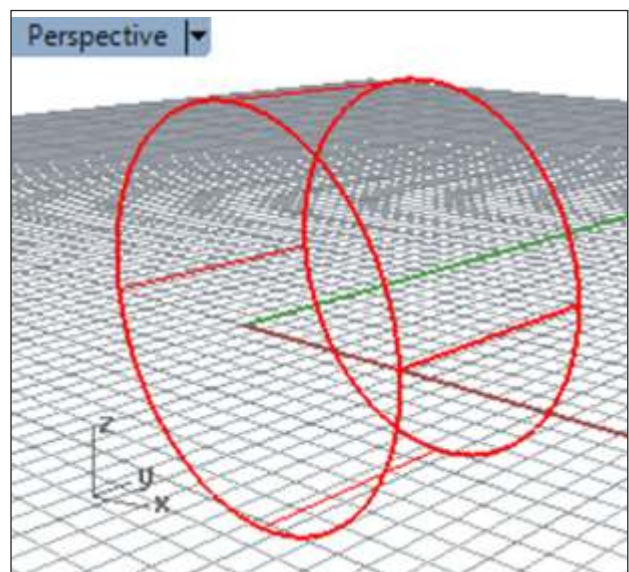


Fig. 4 Wireframe View

- 3 Similarly if you want to extrude the curve both side then in step 2 select the command “Extrude planar curve straight”. Select the curve to extrude and then press “Enter”. Now click on “Solid”, click on “Both side” give the extrusion distance (suppose) 10mm then press “Enter”. Now the total distance will be 20mm.

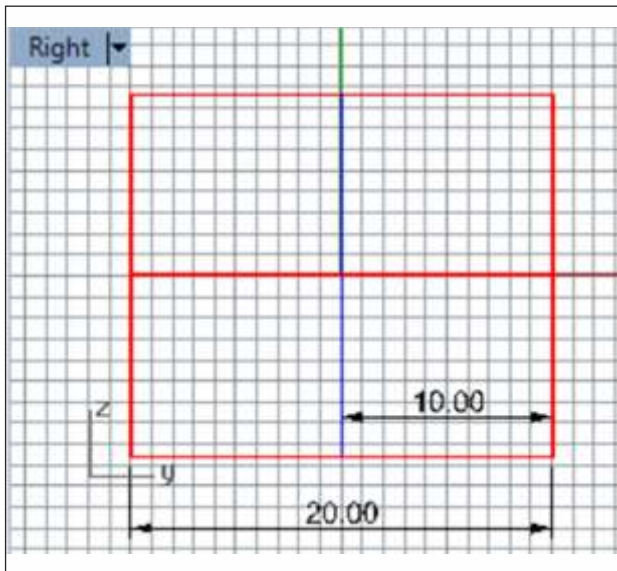


Fig. 5

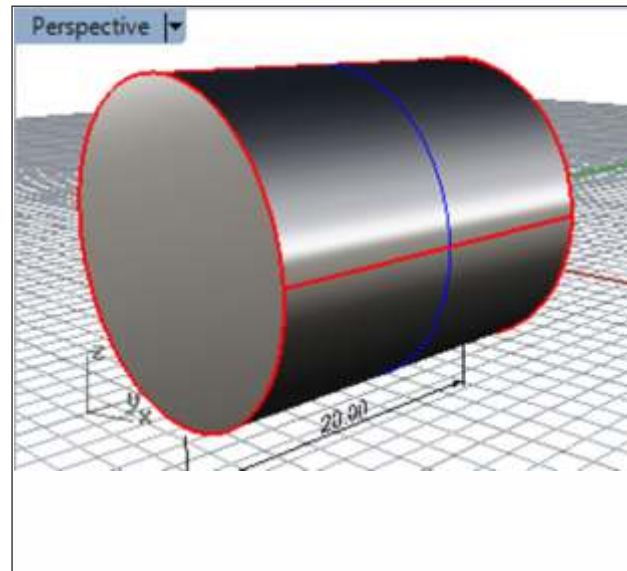


Fig. 6

- 4 Similarly if you want to extrude the curve Taper; then in step 2 select the command “Extrude planar curve Tapered”. Select the curve to extrude and then press “Enter”. Now click on “Solid”, click on “Flip Angle” to adjust the taper side, give the extrusion distance (suppose) 10mm then press “Enter”.

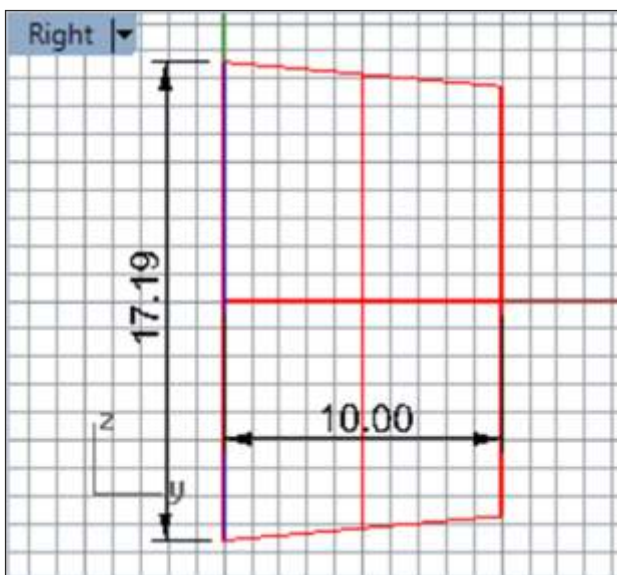


Fig. 7

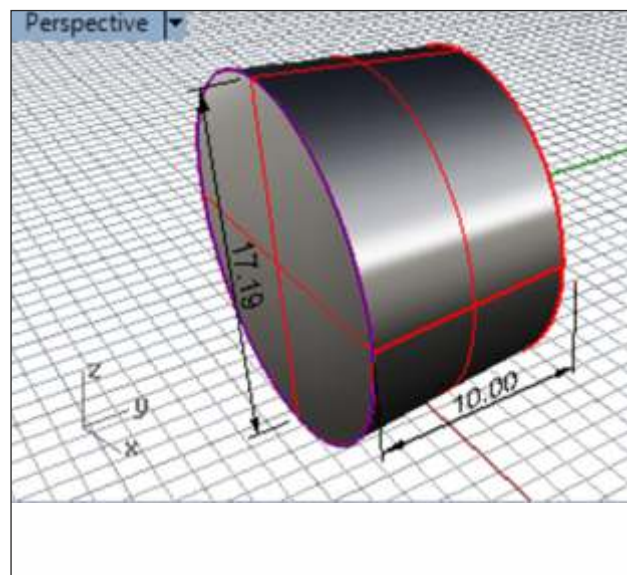


Fig. 8

Sweep 1 Rail

Tools:- Circle, Polyline, Sweep 1 Rail

Step by Step :-

On viewport front, make a circle on point "0" using the "Circle: Center, Diameter" tool. Select the tool, type "0" and press "Enter" to confirm. Now to create a circle of size 17.19mm. In the command prompt, click on "diameter" and type "17.19" and press "Enter" to create a circle. On viewport right, draw with the "Polyline" tool the profile of figure 1 using your measurements. Being the drawing on the superior quadrant of the ring. Certify yourself that "Ortho" and "Quad" are enabled. On "Viewport Right" click on the upper quadrant of the circle, type in "2mm", press "Enter", take the cursor to the side and click. Do the same with the other measurements until you close the drawing.

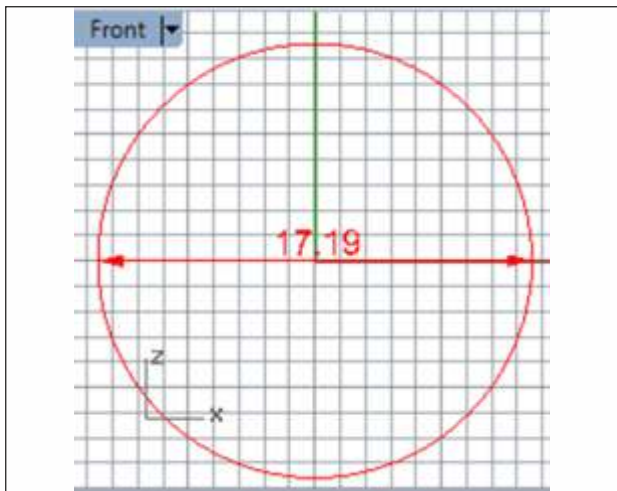


Fig. 9

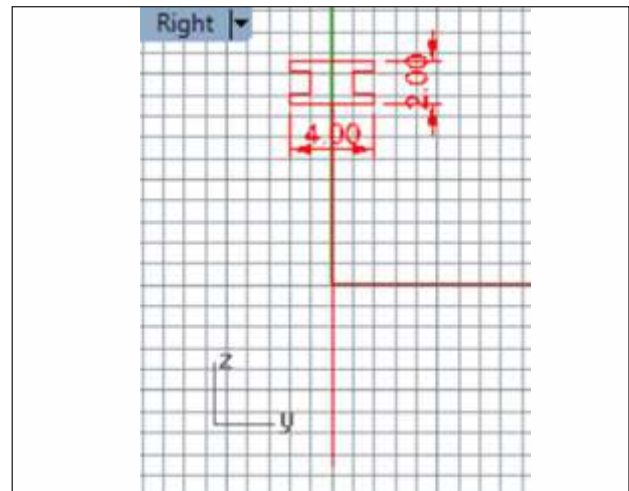


Fig. 10

On viewport perspective, use the "Sweep 1 Rail" tool so that the drawn profile can be made around the ring's rim. Select the tool, click on the path (1), in the rim's case, click on the profile (2) and press "Enter". On the window that appears, click "OK".

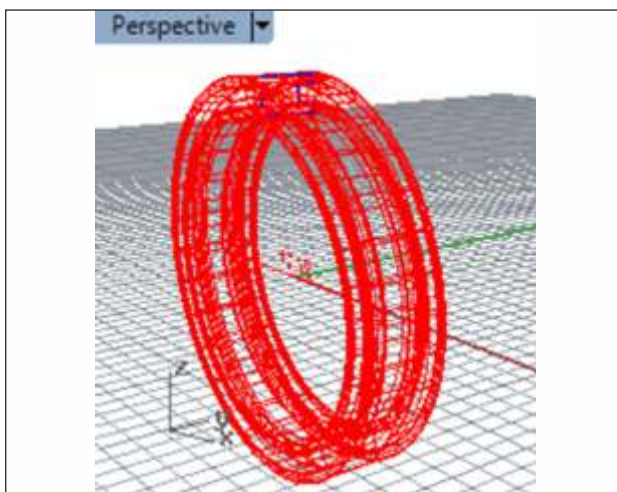


Fig. 11 Wireframe View

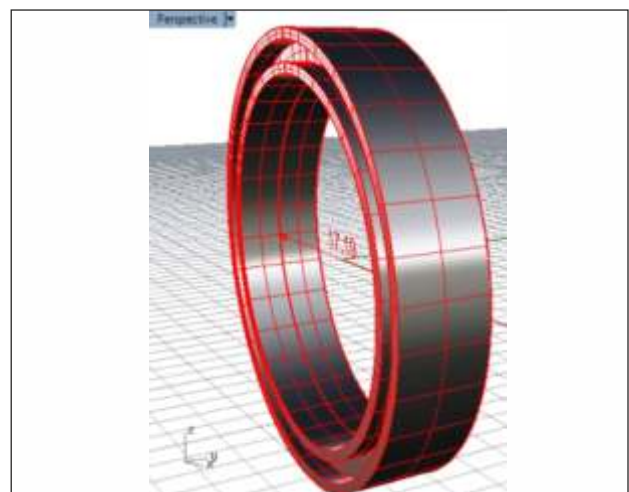


Fig. 12 Shaded View

Sweep 1 Rail

Use the “Fillet Edge” tool with the “0.5mm” radius measurement to round the ring’s internal edges.

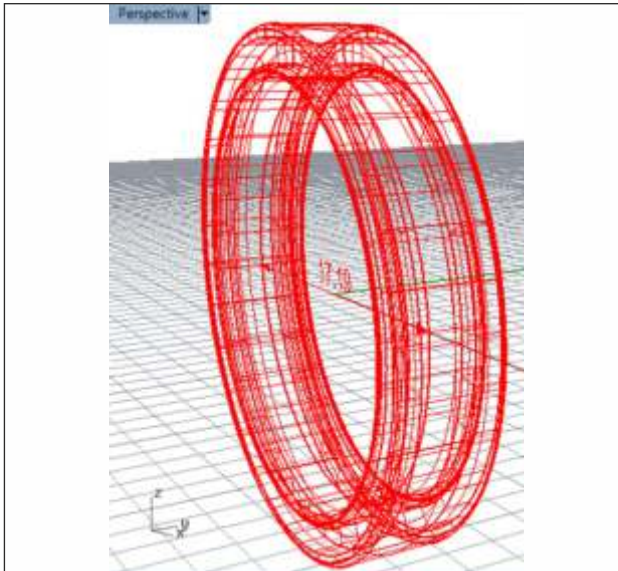


Fig. 13 Wireframe View

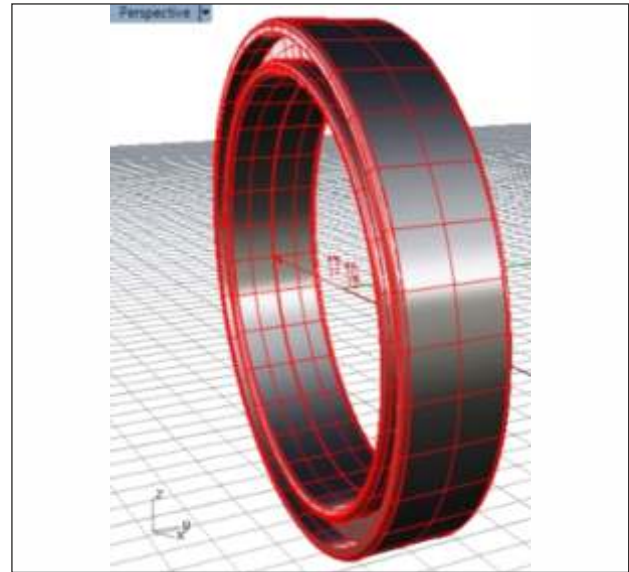


Fig. 14 Shaded View

Similarly we can apply multiple section in step 2. But on applying sweep 1 rail in Step 3 seam points appear, adjust them in the identical same direction and press “Enter”; a box gets opened click on close sweep then press OK follow further steps likewise.

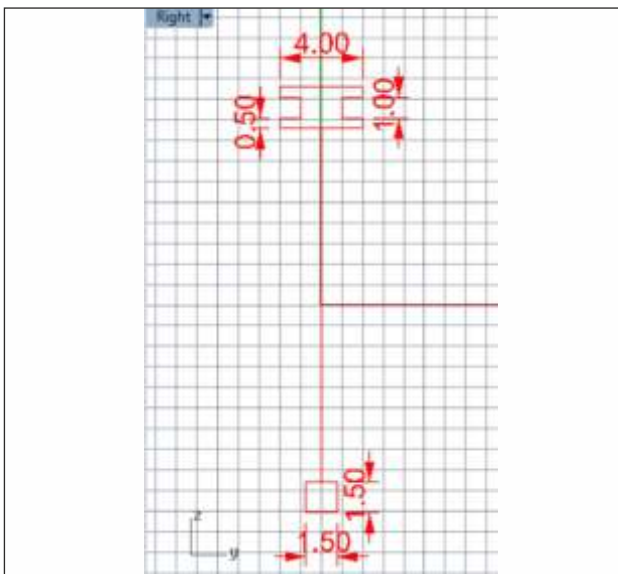


Fig. 15

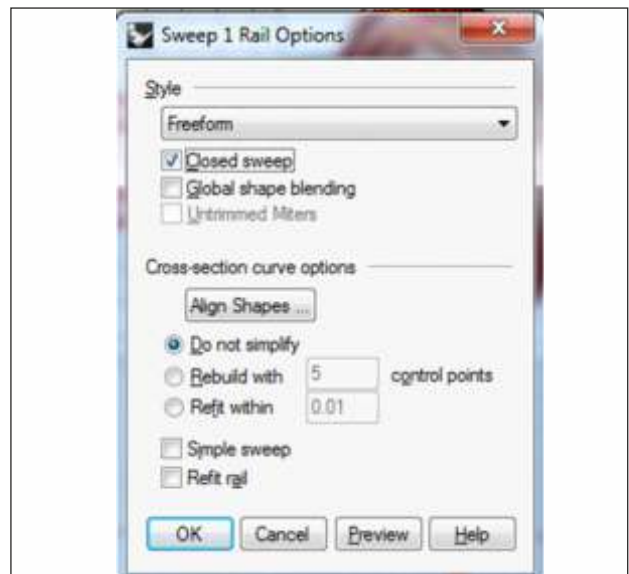


Fig. 16

Sweep 1 Rail

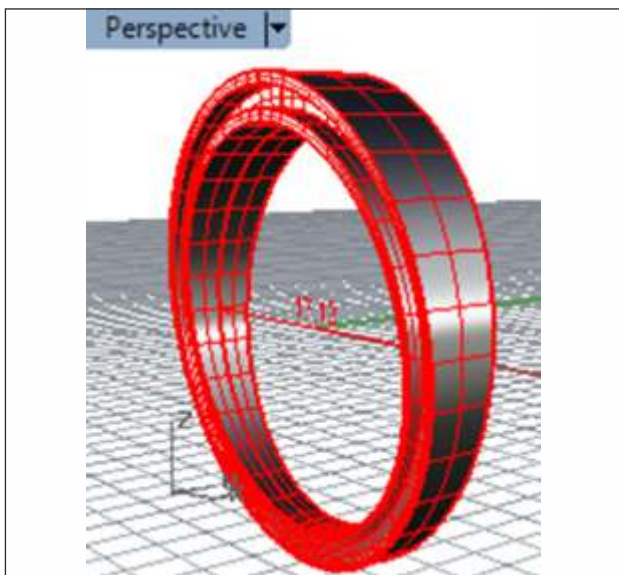


Fig. 17

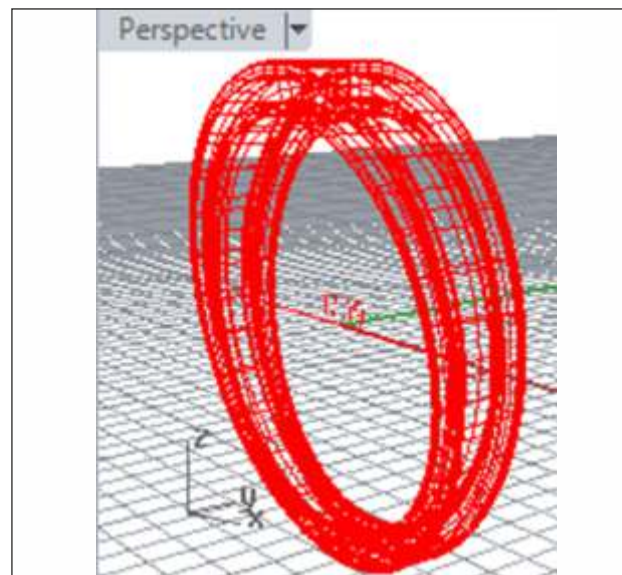


Fig. 18

Sweep 2 Rail

Tools:- Circle, Offset Curve, Arc (Start, End, Point on arc), Polyline, Sweep 2 Rail, Mirror, Join

Step by Step :-

- 1 On viewport front, make a circle on point "0" using the "Circle: Center, Diameter" tool. Select the tool, type "0" and press "Enter" to confirm. Now to create a circle of size 17.35mm (US 7). In the command prompt, click on "diameter" and type "17.35" and press "Enter" to create a circle.

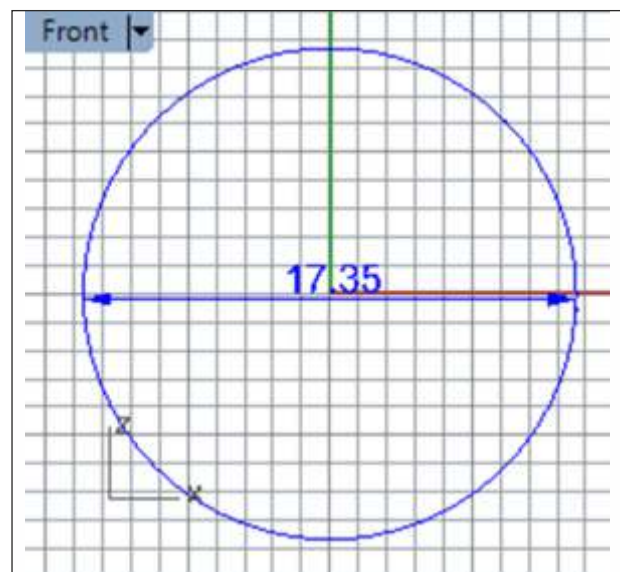


Fig. 19

Sweep 2 Rail

- Now on "Viewport Front"; using command "Offset Curve", offset the circle three times. For this apply the command and Select the curve (circle 17.35mm) to offset. Click on distance and give offset distance 1.5mm, 2.25mm, 3mm consecutively to the circle (17.35mm).

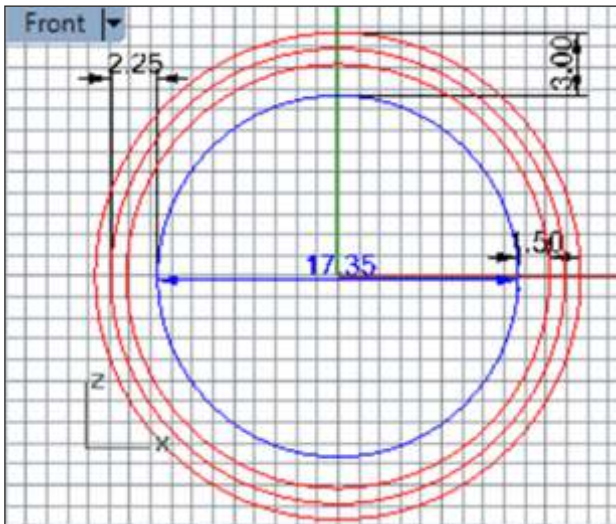


Fig. 20

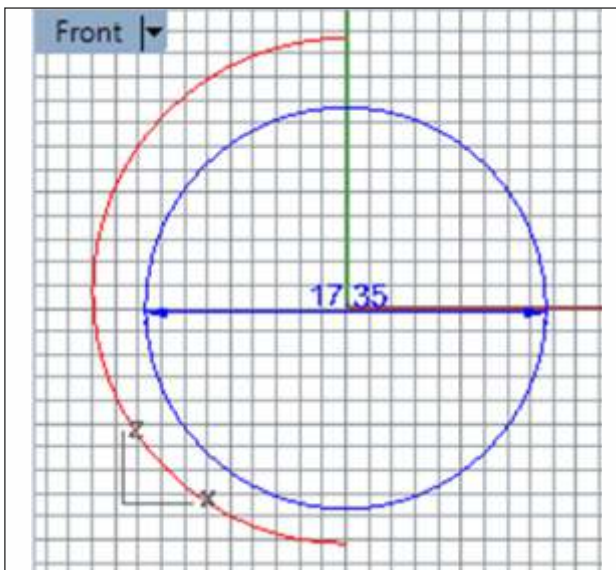


Fig. 22

- Now on "Viewport Front"; select all the circles which we offset previously (1.5mm, 2.25mm, 3mm) and delete.

Now on "Viewport Front"; using the command "Mirror", mirror the arc which we made. Select the

- Now on "Viewport Front"; using command "Arc (Start, End, Point on arc)", make an arc. For this take the arc start it from the lower quad of the 1.5mm offset circle and end point on the upper quad of the 3mm offset circle then touch the arc point on either right or left quad of 2.25mm offset circle.

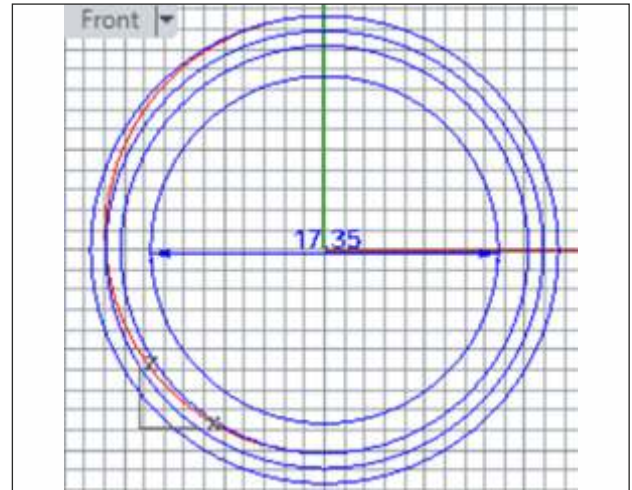


Fig. 21

command, select the arc to mirror, start the mirror plane from any of the end point of the arc and end of the mirror plane will be the another end point of the arc. Now using the "Join" command select both the arc and apply join.

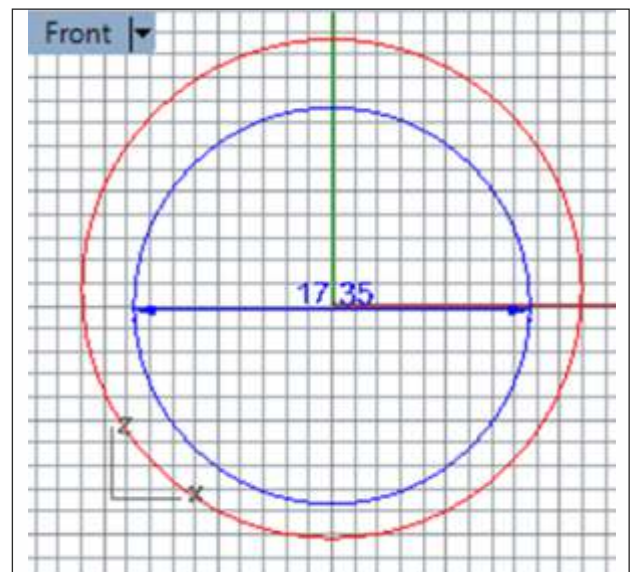


Fig. 23

Sweep 2 Rail

5 “On Viewport Right”, draw with the “Polyline” tool the profile of figure 1 using your measurements. Being the drawing on the superior quadrant of the ring (17.35mm). Certify yourself that “Ortho” and “Quad” are enabled. On “Viewport Right” click on the upper quadrant of the circle(17.35mm) , give dimensions like “3mm” and press “Enter”, take the cursor to upper side and click. Do the same with the other measurements until you close the drawing and make your upper section.

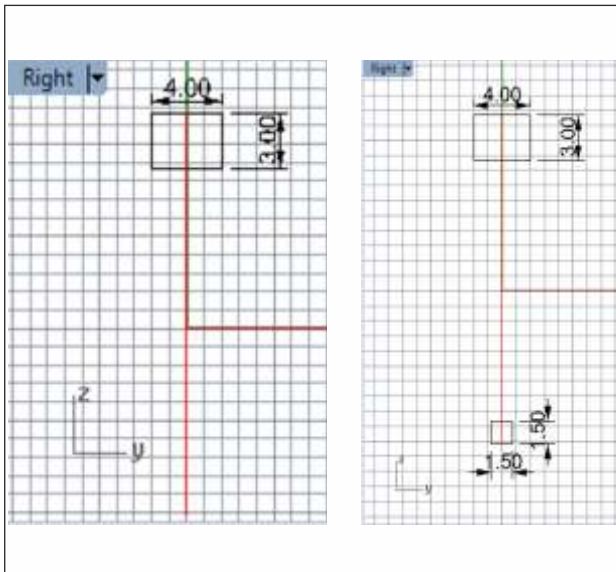


Fig. 24

Similarly we can apply multiple sections likewise:

6 On “ Viewport Perspective”, use the “Sweep 2 Rail” tool so that the drawn profile can be made around the ring’s rim. Select the tool, click on the path (1) in the rim’s case, click on the path (2) in the rim’s case click on the cross sections we made and press “Enter”. Now on applying sweep 2 rail seam points appear, adjust them in the identical same direction and press “Enter”; a box gets opened click on Close Sweep then press OK On the window that appears.

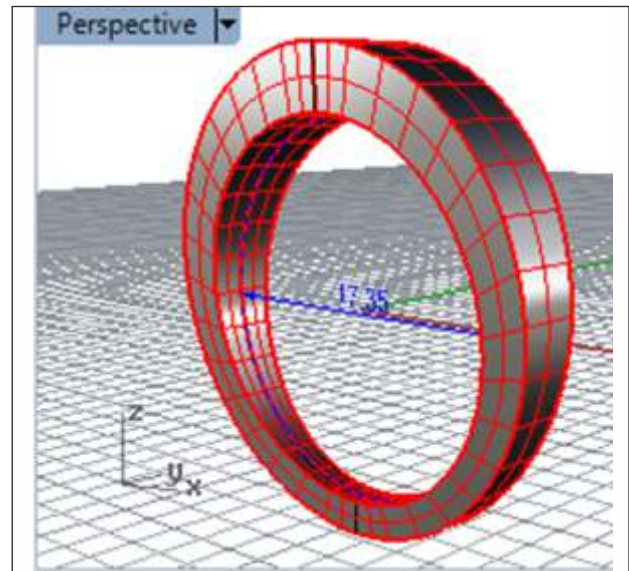


Fig. 25 Shaded View

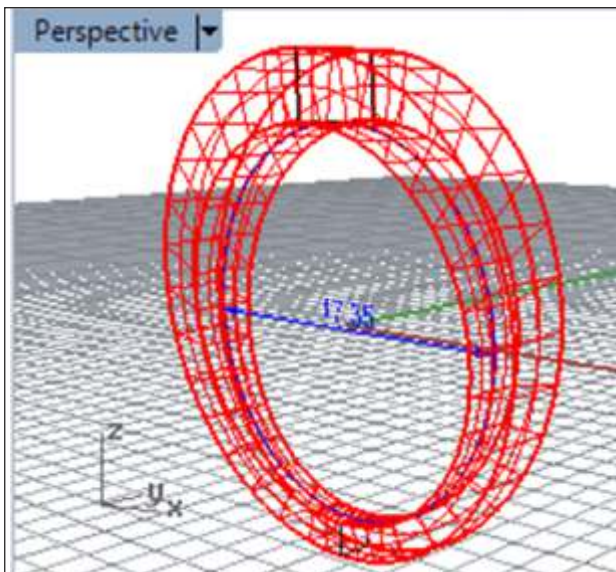


Fig. 26 Wireframe View

Sweep 2 Rail

- 7 Now in “Sweep 2 Rail”, we can design the path or rail also. “For this after step 5” make circles using the “Circle: Center, Diameter” tool on the outside rail according to required design like:-

Now trim the design using the “Trim” tool select the cutting object and press “enter” then select the object to trim then join the curves using “Join” command like:-

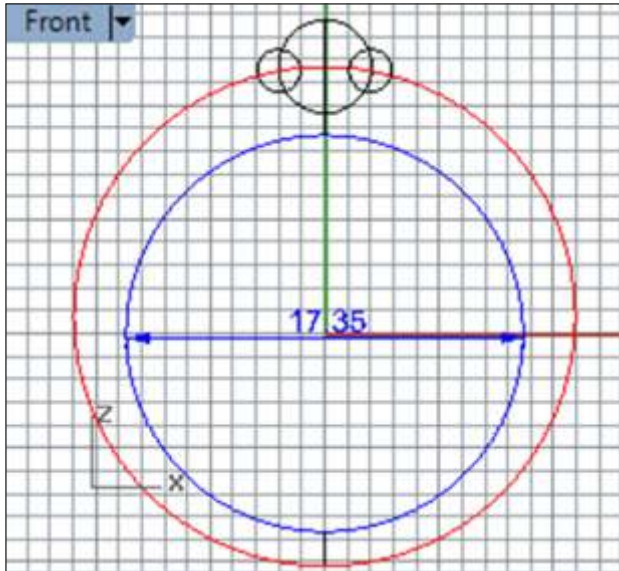


Fig. 27

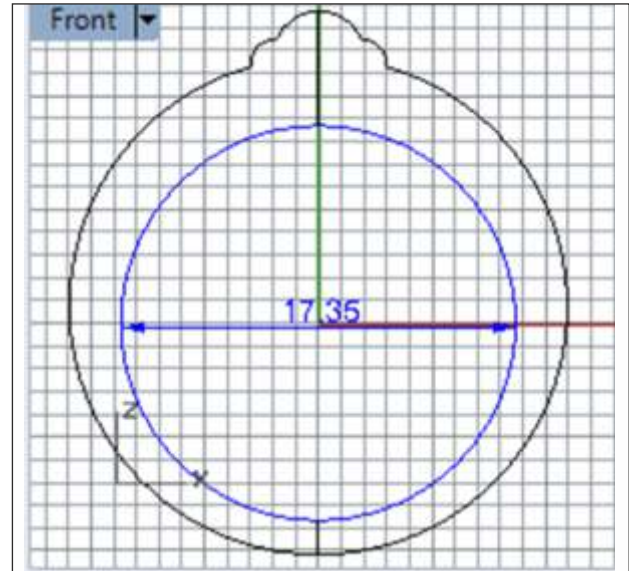


Fig. 28

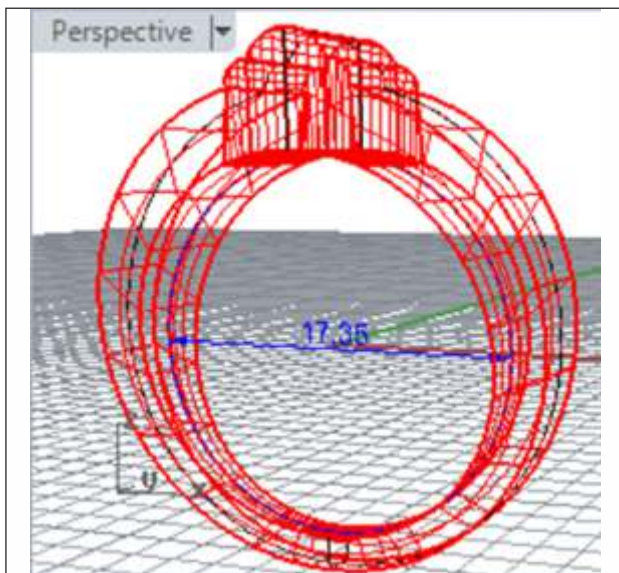


Fig. 29 Wireframe View

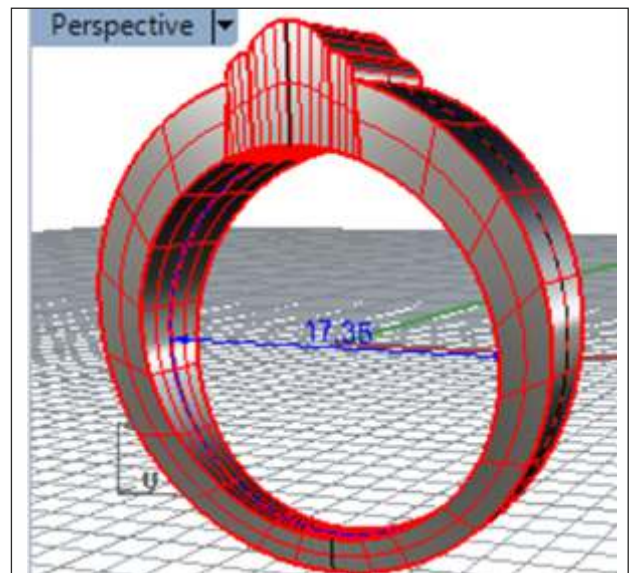


Fig. 30 Shaded View

Revolve

Tools:- Curve interpolate, Offset, Revolve, Shade.

This wine glass will be modeled using simple method, where you draw glass as you wish, define execute the action, make it in 360* to make it round.

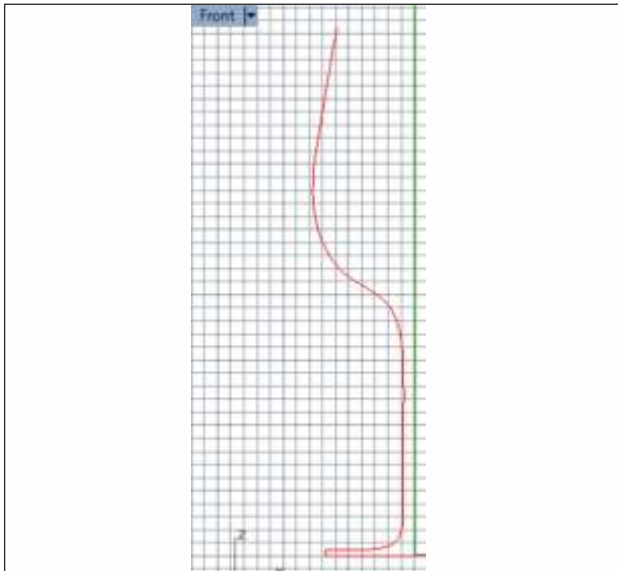


Fig. 31

- Now we will give the thickness to the glass, “Tool bar Curves Tool, Offset” select the curve to offset.

In the command prompt, click on the “Distance” and type the distance, lets take the a distane of “.5” and press enter to offset it, close both curves by line

Step by Step :-

- On “Viewport Front” make a curve half side from the point “0” using the “Tool bar Curve: Curve Interpolet” tool. Select the tool, type “0” and press “Enter” to confirm. Now start making the curve in the shape of the wine glass.

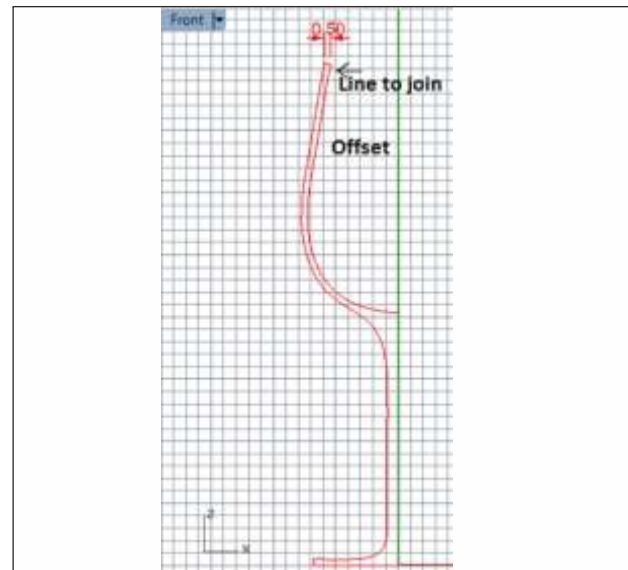


Fig. 32

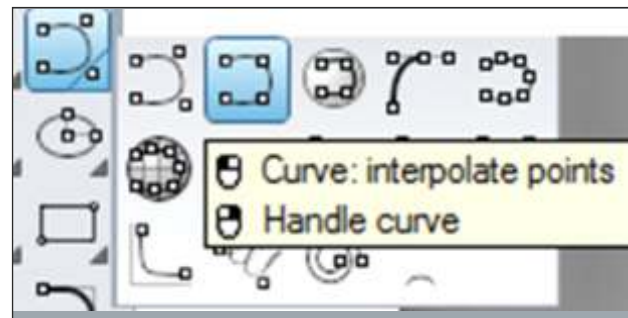


Fig. 33

```
Command: _Offset
Select curve to offset ( Distance=0.5 Corner=Sharp ThroughPoint Tolerance=0.001 BothSides InCPlane=No Cap=None ): |
```

Fig. 34

Revolve

- 3 Now we will apply command “Surface, Revolve” see the command line Select the curve to revolve, press enter then it will ask for start of revolve axis “0” enter it, the starting point drag it straight upside to the end of axis and leave it. And now in command prompt it will ask the start angle 0*and revolution angle 360* to make it complete round.

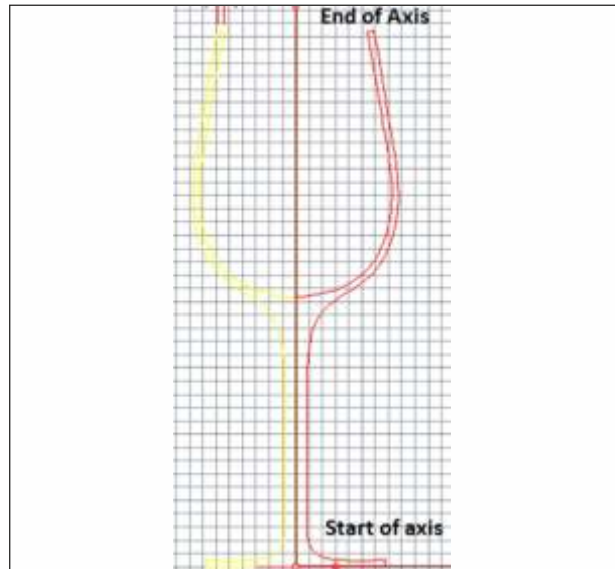


Fig. 35

```
End of revolve axis (Press Enter to use CPlane z-axis direction):
Start angle <360> ( DeleteInput=No Deformable=No FullCircle AskForStartAngle=Yes SplitAtTangents=No ): |
Start angle <360> ( DeleteInput=No Deformable=No FullCircle AskForStartAngle=Yes SplitAtTangents=No ):
Revolution angle <360> ( DeleteInput=No Deformable=No FullCircle SplitAtTangents=No ): |
```

Fig. 36

Top View

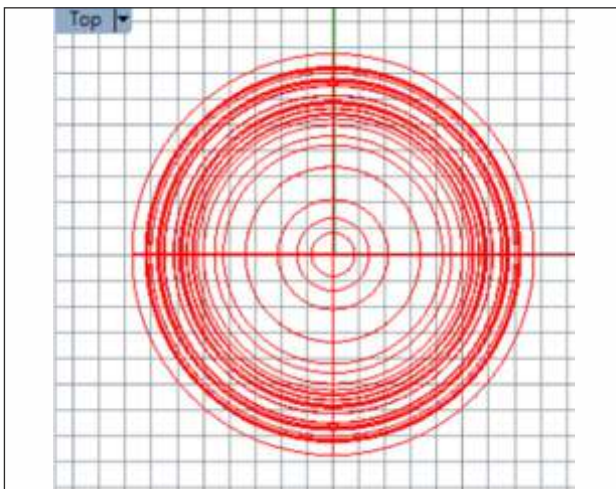


Fig. 37

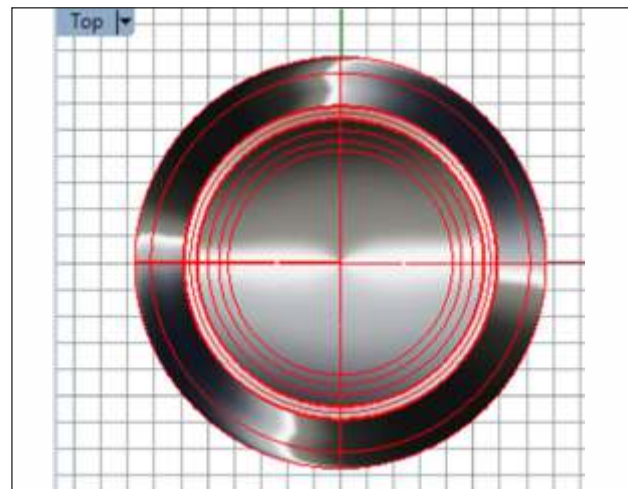


Fig. 38

Revolve

4 Now we will use “Standard Tool, Shade Viewport” bar to give colour to the object wine glass.



Fig. 39

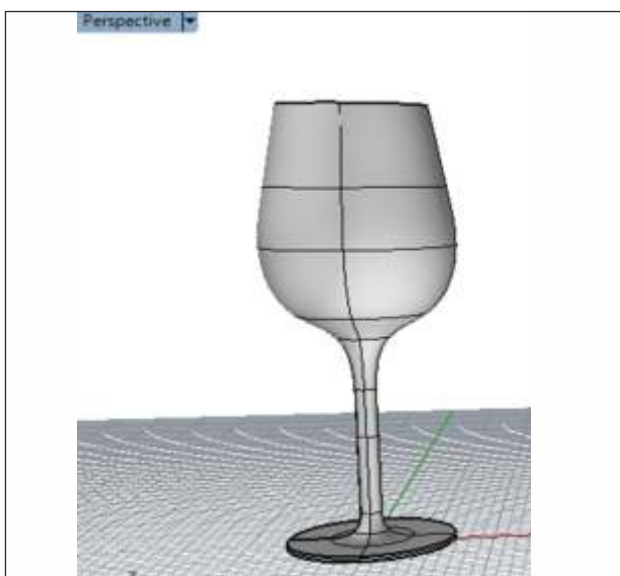


Fig. 40



Fig. 41

Scan the QR Code to watch the related video or click on link



[Click Here](#)
Enamel Ring



[Click Here](#)
Channel Ring



[Click Here](#)
Hoops



[Click Here](#)
Leaf Shape Pendant



[Click Here](#)
Cluster ring



[Click Here](#)
Ring Channel on Bezel

Exercise 3

Create Ring Using Flow Along Curve

Tools:- Circle, Polyline, Length, Move, Mirror, CrvSeam, Solid Extrude, Flow Along Curve.

Step by Step:-

- 1 On "Viewport Front", make a circle on point "0" using the "Circle: Center, Radius" tool. Select the tool, type "0" and press "Enter" to confirm. In the command prompt, click on "Diameter" and type in 17.19mm.

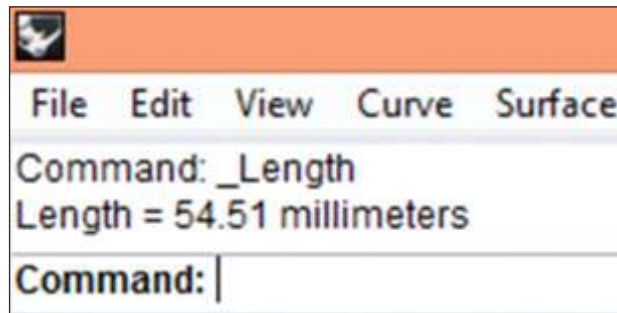


Fig. 1

- 2 On "Viewport Top", Analyze the length of Such Round Circle using Command "Analyze > Length" and Make straight Polyline of such length value 54.51mm.

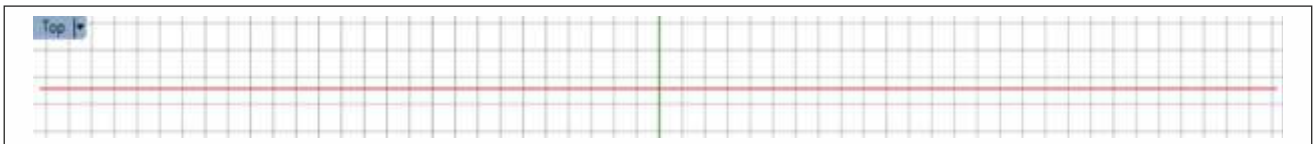


Fig. 2

- 3 On "Viewport Top" Make a design within the Straight Line area.

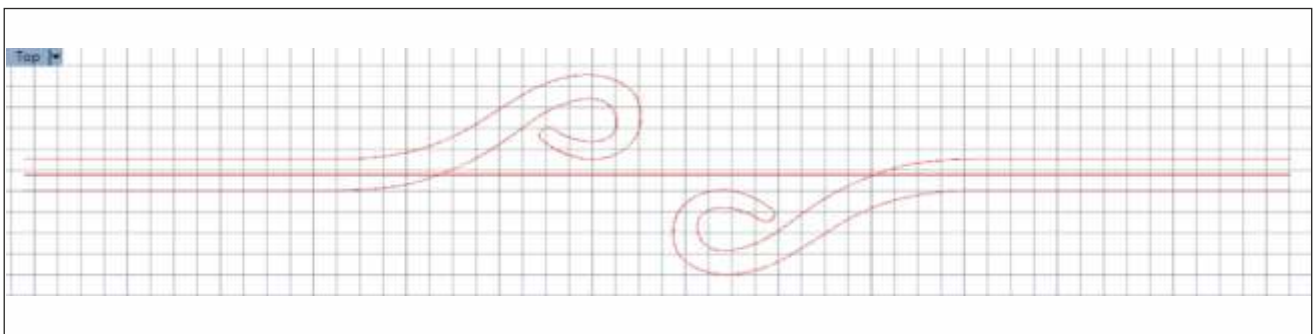


Fig. 3

Create Ring Using Flow Along Curve

- On "Viewport Front", Get the "CrvSeam" down using command "CrvSeam". Click on CrvSeam command and then Select the Circle Curve and press "Enter" for Confirmation then Select the CrvSeam Point and get it down.

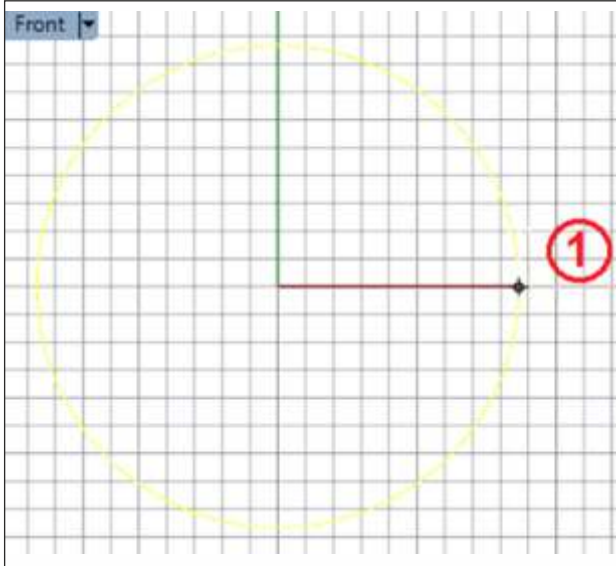


Fig. 4

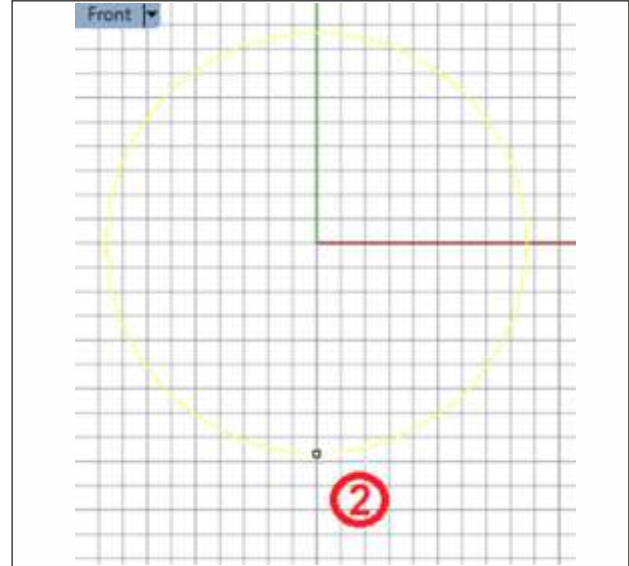


Fig. 5

- On "Viewport Front", Extrude both Design curve using command "Solid > Extrude Planer Curve > Straight". Click on Command, Select Curves and Press Enter for confirmation then press value of solid and then press Enter. (Between command, Solid = Yes, Bothside = No)
- On "Viewport Top" Flow such Design using Flow along Curves Command (Transform > Flow along Curve). Process is Click on Flow along Curve, select design, Press enter for confirmation then Select Base curve then Select the Target Curve (Circle Curve).

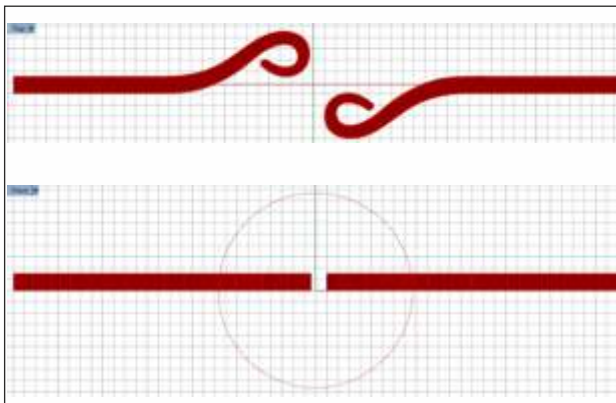


Fig. 6

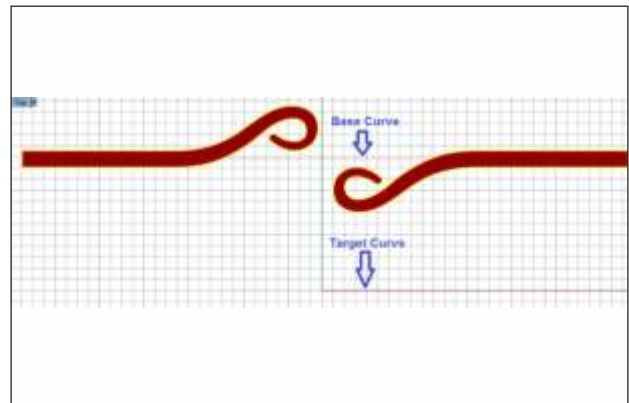


Fig. 7

Exercise 4

Use the Create and UV Apply Curve and Flow Along Curve

- 1 On the front viewport, make a circle of 2.75 diameter using circle diameter tool. Then create a section for bezel setting and then using revolve command make a solid circle.



Fig. 1

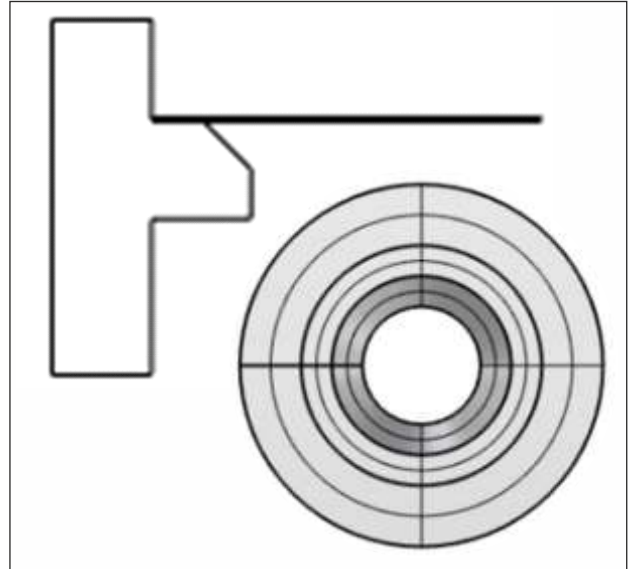


Fig. 2

- 2 On the front viewport, make the curves for the ear using interpolate curves and arc (start,end, direction at start) and adjust it with control points and make closed curves by joining them.
- 3 Now, using line tool, make lines slight tapered downwards and make it a closed curve. Like this make three parts.
- 4 Now, extrude the curves using extrude planar curve at distance of 2mm.
- 5 Now, in front viewport, create the curves and then extrude the other curves at different levels. Extrude the curves at 1mm, 1.5mm and 2mm

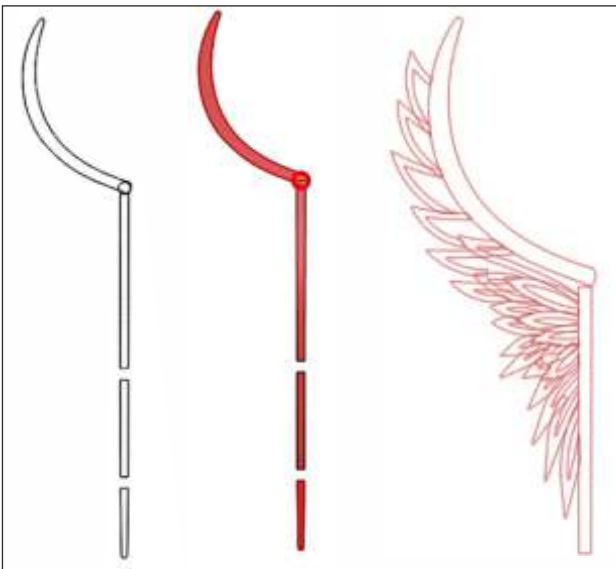


Fig. 3



Fig. 4



Use the Create and UV Apply Curve and Flow Along Curve

Distance (can be seen in the picture, the black portions are the extruded one) This will show the levels in the design.

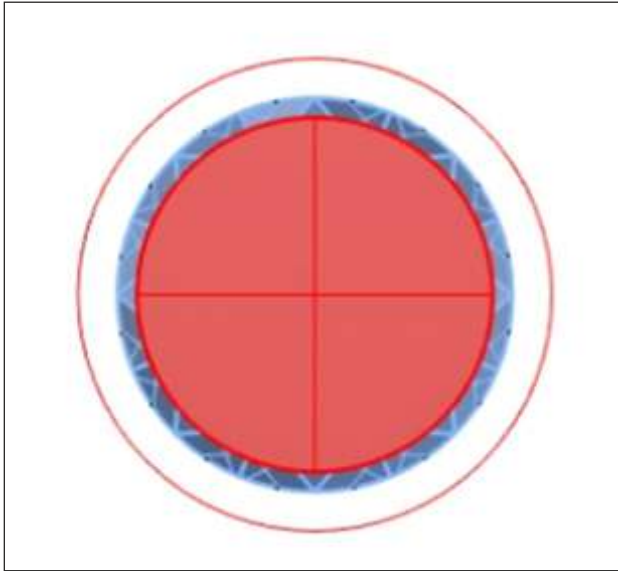


Fig. 5

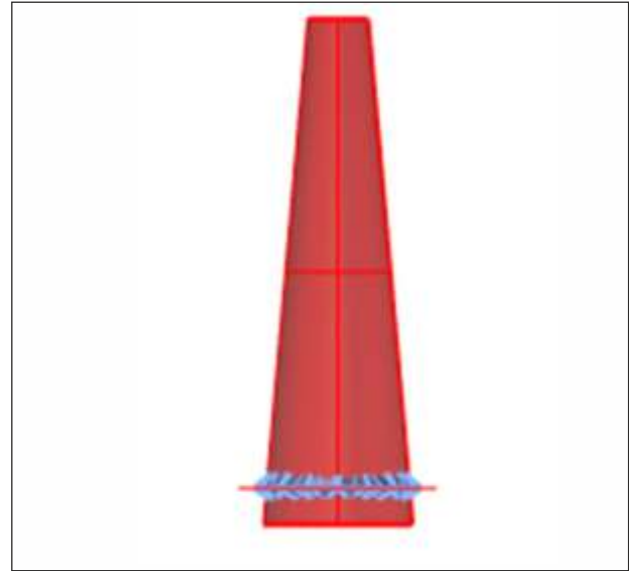


Fig. 6

- 6 Now, select all (ctrl+A) and hide. Create a circle of 2mm using circle center diameter tool. Offset it using offset curve command at a distance of .2mm outside (reference line) and .1mm inside (for cutter).
- 7 Now, import the stone and select the stone from top viewport, go to transform, select orient, click on remap to c plane, and then click on front viewport. Then using scale 3D command, scale the stone by scale factor .2mm (varies according to the stone size).
- 8 Now, extrude the .1mm circle by extrude planar curve, taper command. In the top viewport move the extrusion down it should be more than the table portion.
- 9 Now, define them in different layers and group the objects together.
- 10 Similarly, repeat the process (6 to 9) creates stones of size 2.5mm, 2.25mm, 1.8mm, 1.5mm, 1.4mm, 1.2mm, 1.1mm, 1mm. After that set the stones accordingly.
- 11 Now, in the front viewport, create a circle of .8mm at 0 point and extrude it straight by using extrude planar curve at distance of 1mm then fillet the edges using fillet edge command and move the prong .8mm forward. Similarly, create the prongs of the following sizes according to the stone and set the prongs according to the stone size. The prong should be .2mm inside metal and .8mm outside.



Use the Create and UV Apply Curve and Flow Along Curve



Stone size	Prong size
2.5mm	.9mm
2.25mm	.9mm
2mm	.8mm
1.8mm	.8mm
1.5mm	.7mm
1.4mm	.65mm
1.2mm	.5mm
1.1mm	.5mm
1mm	.45mm

12 Now, select all and ungroup it until everything gets ungrouped. Then do the Boolean difference of the base surface and the cutters.

13 For connectivity, in the front view port, create a circle of .8mm and offset it by .3mm. Then apply pipe command, select the outer curve (offset .3mm) and give the radius .3mm and press enter. Then copy the pipe and paste it on itself, the rotate it in top viewport. At the end move it down and place where connectivity is needed.



Fig. 7



Fig. 8



Skill India
कौशल भारत-कुशल भारत



सत्यमेव जयते
GOVERNMENT OF INDIA
MINISTRY OF SKILL DEVELOPMENT
& ENTREPRENEURSHIP



N · S · D · C
National
Skill Development
Corporation

Transforming the skill landscape



Gem & Jewellery Skill Council of India

4. Maintain Health and Safety at Workplace

Unit 4.1 - Potential Sources of Accidents

Unit 4.2 - Safety Signs and Appropriate Requirements to be Safe

Unit 4.3 - Ergonomics or Bad Posture of Body

Unit 4.4 - Fire Safety Rules

Unit 4.5 - How to Deal with Emergency Situations



G&J/N9902

Key Learning Outcomes

At the end of this module, you will be able to:

1. Inspect safety procedures.
2. Inspect potential hazards.
3. Analyze what to do in an emergency situation.
4. Analyze how to use the fire extinguisher by identifying the appropriate fire.
5. Analyze how complying with company safety rules and regulations can be safe for you.

Unit 4.1: Potential Sources of Accidents

Unit Objective

At the end of this unit, you will be able to:

1. Analyze the potential sources of accidents in a workplace.

4.1.1 Potential Sources of Accidents

Accidents are unpleasant events that happen unexpectedly, causing damage, injury or sometimes even death. Working people spend most of the time in work, thus accidents at work can happen unexpectedly.

Accidents or hazards mean an incident involving loss of life inside or outside the workplace, suffering injuries internally and/or externally, or release of toxic chemical or explosion or fire, or spilling of hazardous chemical resulting in 'on-site' or 'off-site' emergencies or damage to equipment leading to stoppage of process or adverse effects to the environment.

- Accidents or hazards usually occur due to: Faulty equipment
- Improper working conditions
- Faulty inspection or repairing equipment or tool without the proper instructions
- Irregular maintenance of equipment and tools
- Repairing of faulty equipment by someone who is not qualified to repair
- Lack of concentration or bringing personal tensions to work
- Unsafe practices such as plugging wires directly into sockets without a plug
- Not reading voltage instructions for imported equipment
- Improper or insufficient safety training
- Smoking in non-smoking zones
- Storage of chemicals near heat emitting machines
- Improper storage of chemicals
- Improper work clothing or lack of protective gears
- Exposed wire or wires bitten by rats or other animals
- Wires with bad insulation
- Improper electric connections
- Using wrong tools and equipment in wrong place or plugging into wrong socket
- Using too many wires in one spike guard or electric socket
- Bad housekeeping which includes wet floors, sweeping not done, papers thrown on floor, dustbins not covered or emptied
- Tools and equipment not stored properly after work
- Not unplugging tools and equipment after work or during breaks
- Leaving main switch ON of tools and equipment after work
- Non reporting of hazards to supervisor or ignoring potential dangers

4.1.1 Potential Sources of Accidents

The below figure clearly shows an exposed wire that can be hazardous to anyone who accidentally touches or comes in contact with it.



Fig 4.1.1.1 Exposed Wire

4.1.1 Potential Sources of Accidents

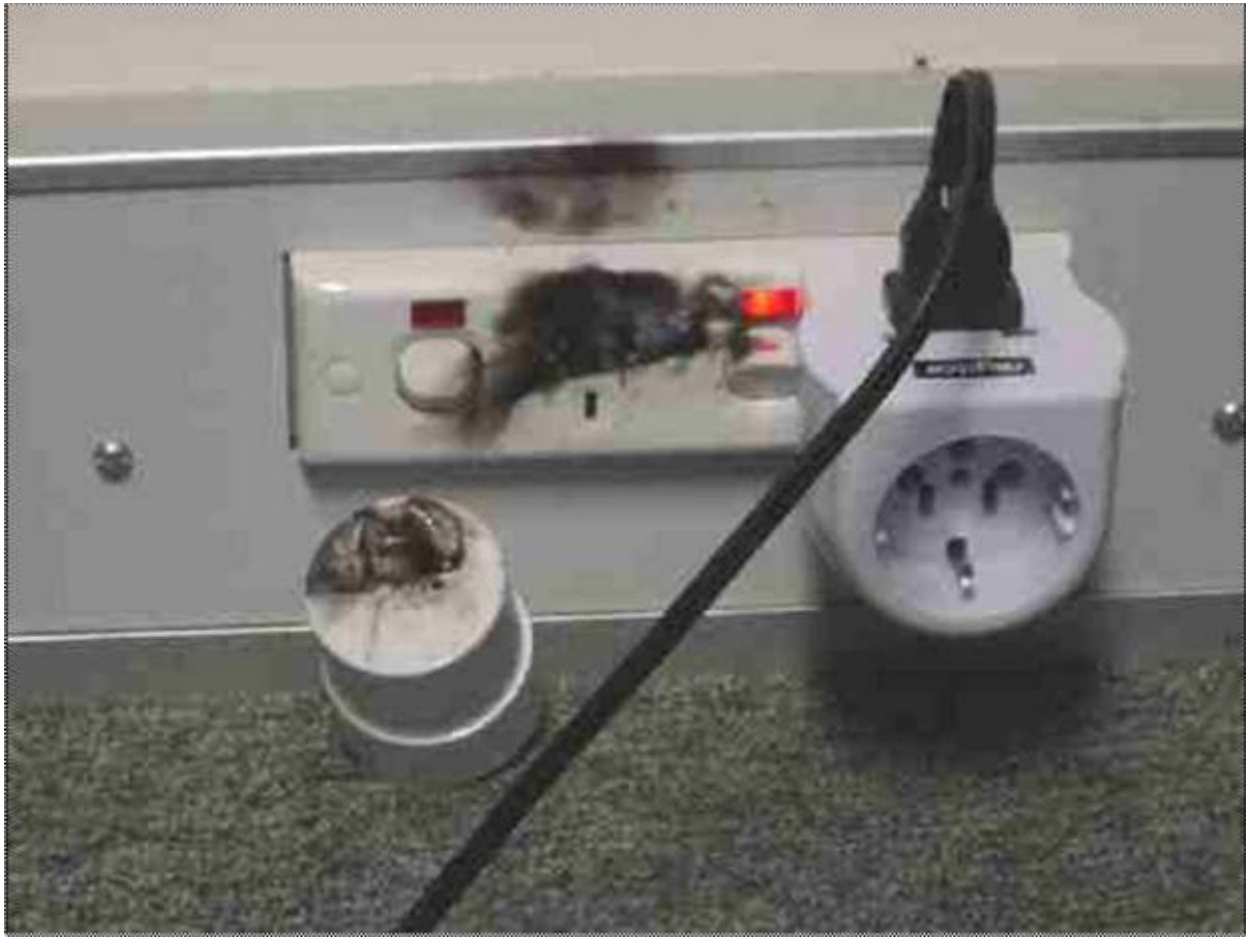


Fig 4.1.1.2 Burned Socket – Not advised to use the working plug

4.1.1 Potential Sources of Accidents

In the picture it is clear that the floor is wet with equipment lying on it. This can lead to serious accident and the workers should be very careful.



Fig 4.1.1.3 Liquid spilled on carpet floor with tools and equipment around

4.1.1 Potential Sources of Accidents



Fig 4.1.1.1 Causes of Accidents

Unit 4.2: Safety Signs and Appropriate Requirements to be Safe

Unit Objective

At the end of this unit, you will be able to:

1. Analyze the safety signs and appropriate requirements to be safe and to make the workplace safe for yourself and others.

4.2.1 Safety Signs

Safety Signs are some very important tips that you see around when you need some help in any situation where safety is required. You are just required to keep your mind alert during work and to look for any safety sign for your use. These are signs that cannot be avoided and are especially useful when nobody else is around to help.



Fig 4.2.1.1 Safety Sign - 1

4.2.1 Safety Signs



Fig 4.2.1.2 Safety Sign - 2

4.2.1 Safety Signs



Fig 4.2.1.3 Safety Sign - 3



Fig 4.2.1.4 Safety Sign - 4

4.2.1 Safety Signs



Fig 4.2.1.5 Safety Sign - 5



Fig 4.2.1.6 Safety Sign - 6

4.2.1 Safety Signs

In the figure you can see various signs explaining physical hazards and health hazards that you need to check around yourself. These are majorly warning signs that alert you beforehand.

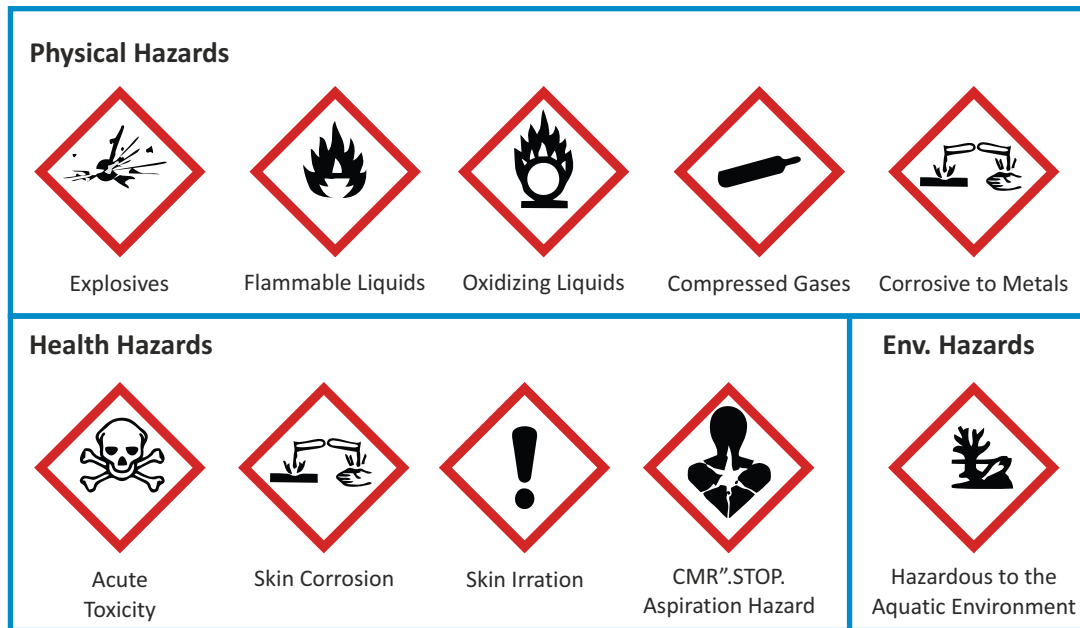


Fig 4.2.1.7 Safety Sign – 7

4.2.2 Safety First

DOUBLE HEARING PROTECTION 	EYE & EAR PROTECTION 	DUST MASK 	RESPIRATOR 
EAR PROTECTION 	SAFETY GOGGLES 	HARDHAT 	GLOVES 
EAR PLUGS 	SAFETY GLASSES 	APRON 	PROTECTIVE SUIT 
FACE SHIELD 	HAIR NET 	SAFETY SHOES 	BOOTS 

Fig 4.2.2.1 Safety gears to be worn while working with tools and equipment



Fig. 4.2.2.2 Refer to voltage mentioned on equipment and machines before plugging in socket to avoid short circuit

4.2.2 Safety First



Fig 4.2.2.3 Housekeeping rules for every employee

4.2.2 Safety First

Just say no to electrical hazards.

Before you turn it on, make sure that you say no the following:

- Are outlets, motors, or circuits overloaded?
- Are the electric wires passing near water or heat sources?
- Are cords twisted or tangled?
- Do I see sparks or smoke?
- Are my hands wet?
- Am I wearing any metal jewellery?

Unit 4.3: Ergonomics or Bad Posture of Body

Unit Objective

At the end of this unit, you will be able to:

1. Develop the right body posture required while carrying out any kind of work.
2. Analyze how to relax your body more and put less strain on your body.

4.3.1 Ergonomics or Bad Posture of Body

IN SOME CASES TOOLS CAN BE CHANGED TO
KEEP THE ARMS LOW AND ELBOWS IN
BAD DESIGN



SOLDERING IRON WITH BENT HANDLE ALLOWS
ELBOW TO BE LOWERED AND WRIST STRAIGHTENED
GOOD DESIGN



Fig 4.3.1.1 Straining elbows can strain the shoulder leading to body pain

4.3.1 Ergonomics or Bad Posture of Body

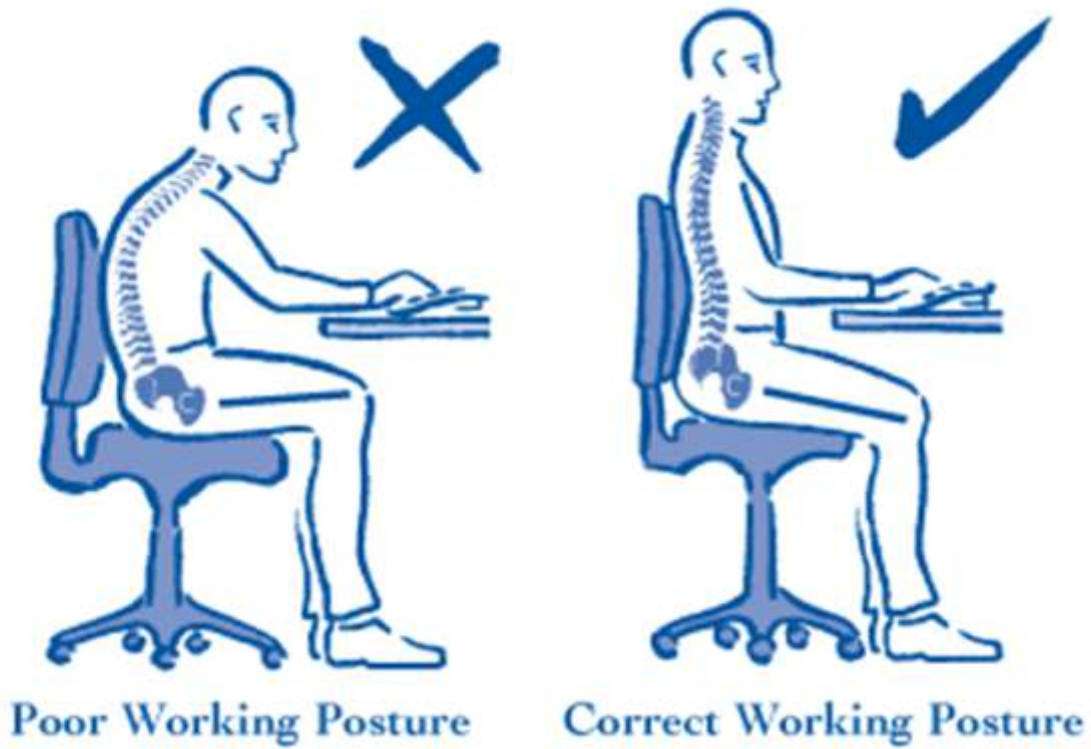


Fig 4.3.1.2 Wrong and right way to sit



Fig 4.3.1.3 Right way to work on computer

4.3.1 Ergonomics or Bad Posture of Body



Fig 4.3.1.4 Problems to avoid

Unit 4.4: Fire Safety Rules

Unit Objectives

At the end of this unit, you will be able to:

1. Inspect the fire safety rules.
2. Develop the skills on how to use a fire extinguisher.

4.4.1 Fire Safety Rules



CLASSES OF FIRES	TYPES OF FIRES	PICTURE SYMBOL
A	Wood, paper, cloth, trash & other ordinary materials.	
B	Gasoline, oil, paint and other flammable liquids.	
C	May be used on fires involving live electrical equipment without danger to the operator.	
D	Combustible metals and combustible metal alloys.	
K	Cooking media (Vegetable or Animal Oils and Fats)	

Fig 4.4.1.1 Know the different types of fire with classification codes and symbols

4.4.1 Fire Safety Rules



Fig 4.4.1.2 Know your fire extinguisher code



Fig 4.4.1.3 Know the refill date on the fire extinguisher

4.4.1 Fire Safety Rules

UNDERSTAND BASIC FIRE FIGHTING CONCEPTS

RACE

upon discovery of fire or smoke

- R** **Rescue:** Remove persons in immediate from danger
- A** **Alarm:** Alert others and Emergency Services
- C** **Contain:** Contain fire and smoke (close doors)
- E** **Extinguish:** Extinguish &/or Evacuate

Fig 4.4.1.4 Basic fire fighting steps



Fig 4.4.1.5 Do not use elevator or lift when there is a fire

4.4.2 Using the Fire Extinguisher



Fig 4.4.2.1 Steps to use the fire extinguisher – use the right extinguisher for the fire

Unit 4.5: How to Deal with Emergency Situations

Unit Objective

At the end of this unit, you will be able to:

1. Analyze an emergency situation and how to deal with it.

4.5.1 Emergency Situations



Fig 4.5.1.1 Emergency situations

4.5.2 Dealing with Emergency Situations

Evaluate Situation

- Check the surroundings.
- Evaluate the situation.
- Are there things that may place you in danger or harm?
- Are you or the victim endangered by fire, harmful smoke or gasses, an unstable construction, live electrical wires or alternative dangerous scenario?
- Don't rush into a situation wherever you may find yourself as a victim?
- If approaching the victim will endanger your life, seek professional help immediately; they have higher levels of training and know how to handle these situations.
- First aid becomes useless if you can't safely perform it without hurting yourself.



Fig 4.5.2.1 Evaluate situation

4.5.2 Dealing with Emergency Situations

Call for Help

- Call for help.
- Call the appropriate authorities or emergency services immediately if you feel someone is seriously injured.
- If you are the only person on the scene, try to check if the person is breathing before calling for help.
- Do not leave the victim alone for an extensive amount of time.

Take Care of the Person

- Take care of the person.
- A person who has just gone through a serious trauma requires to be taken care of including providing emotional support and physical treatment such as first aid.
- Always remember to remain calm and try to be reassure the person about help arriving.

Check for Response

- Determine responsiveness.
- If a person is unconscious, try to wake them by gently tickling their bare hands and feet or by speaking to them.
- If they do not respond to activity, sound, touch or other stimulation, check if they are breathing.

4.5.2 Dealing with Emergency Situations

Conducting CPR OR First Aid

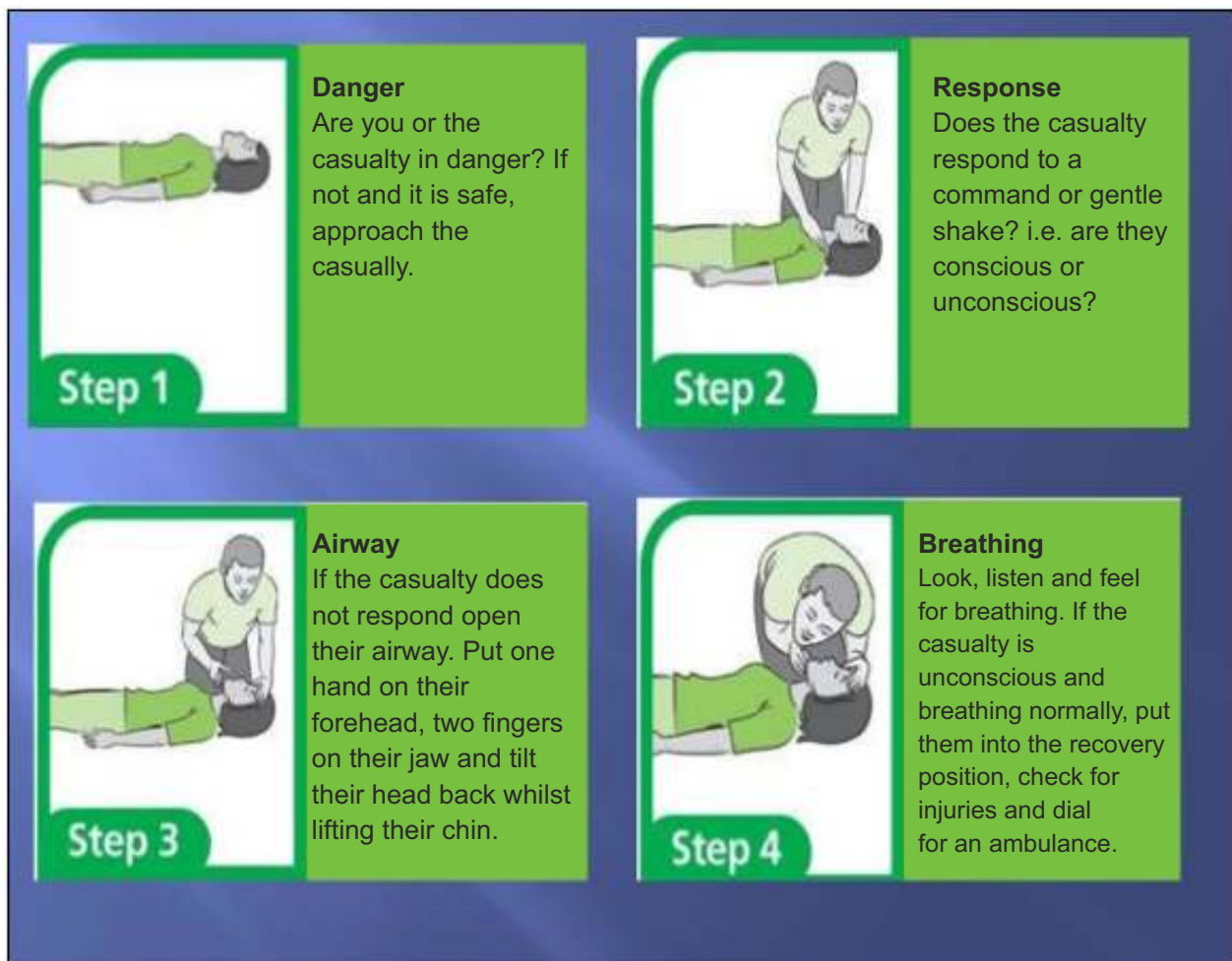


Fig 4.5.2.1 Conducting CPR or first aid

EMERGENCY NUMBERS IN INDIA

- 100 for Police
- 102 for Ambulance
- 101 for Fire
- 108 for Disaster management
- 181 for Women's helpline

4.5.3 Solving the Issue



Fig. 4.5.3.1 Incident Priorities



Tips



1. Always participate in emergency drills organized by your company, you may never know when the knowledge will come in use.
2. Ask your company for a live demonstration of first aid administration.
3. Check with your company the contents of the first aid box and where it is kept.
4. Always report an incident to your supervisor or others, rather than hiding it.
5. Always care for others in an emergency situation.

Exercise

1. Write the full form of RACE.
2. Identify the meaning of the safety signs.

Safety Sign	Meaning of Safety Sign
	
	
	

3. Identify the following emergency numbers.
 - a. 100: _____
 - b. 101: _____
 - c. 102: _____
4. Accidents or hazards usually occur due to-
 - a) Faulty equipment
 - b) Smoking in non-smoking zones
 - c) Improper electric connections
 - d) All of these
5. If you find that someone is stuck in an emergency situation, how will you deal with it? Write in short.



5. Conservation of Energy and Materials

Unit 5.1 : Energy Conservation

Unit 5.2: Conservation of Materials



Key Learning Outcomes



At the end of this module, the trainee will be able to,

- Telling about the importance of energy conservation.
- Explain the different types of energy.
- Following various methods of energy saving practices.
- Explain the importance of material conservation.
- Explain the commonly used materials in industrial establishments.
- Following various methods of material conservation practices.

Unit 5.1 : Energy Conservation

Unit Objective

At the end of this unit, the trainee will be able to,

- Telling about the importance of energy conservation.
- Explain the different types of energy.
- Following various methods of energy saving practices.

5.1.1 Definition of Energy

In fact, energy is a property of objects, which can be transferred to other objects or transformed into various forms. The ability of any object and human being to do work is called energy. Water falling from a height has energy because it can turn a wheel, which can generate electricity.

It is difficult to give a simple definition of energy. Energy is not a thing. We cannot see it, it occupies no space, and it casts no shadow. Energy exists in many forms, including electromagnetic radiation (such as light), gravitational potential energy, kinetic energy, thermal energy, nuclear energy, and chemical bonds.

5.1.2 Importance Of Energy Conservation

Energy is an important means of meeting all the important needs of human life. Energy is the reason for movement in life, whether it is for our walking or for the operation of machines, energy is needed in every field of life. There are limited reserves of energy. That's why we have to go towards energy conservation so that our future generations do not face energy crisis. Energy conservation becomes a major issue in today's time considering the rapidly increasing population and consumption of energy.

Because energy is a precious gift given to us by nature, to be honest, life has no meaning without it. We are constantly making new inventions and making full use of energy and filling our future life with comforts. Yes – No it is not a wrong thing but when this energy is misused in useless things then it is completely wrong thing because by doing this we are harming ourselves and nature as well.

5.1.3 Different Types of Energy

Generally energy is of two types

- Renewable Energy/Non-conventional
- Non-Renewable/Conventional Energy



5.1.3.1 Renewable Energy & Non Renewable Energy

Renewable energy is pollution-free and never-ending energy, they can be used anytime, for example, solar energy, wind energy, tidal energy, etc. come in renewable energy.

Under non-renewable energy, those energies come which cannot be obtained again once they are exhausted, it may take millions of years to be formed, for example, coal, petroleum etc.

- **Conventional Sources of Energy:**

- Coal
- Petroleum/Mineral Oil
- wood
- Natural gas, etc.

Coal (coal):

This is the largest source of energy production in India, coal meets about 67% of the country's commercial energy demand, India has coal reserves in many states such as Jharkhand, Odisha, Chhattisgarh, Tamil Nadu And so on.

Biomass or dry organic matter:

Under this comes dry branches of trees, wood, dung, and oil obtained from living beings etc. It is also an important medium of energy, which fulfills about 14 percent of the world's energy. In developing countries, its amount is up to 43 percent, so there is continuous deforestation, the day is not far when we will destroy the environment completely. Will give and myself too.

Oil:

Petroleum and oil products contain more energy than coal. Many organic and inorganic substances are obtained from crude oil. Oil reserves are mostly found in porous rocks and 40% of the world's energy is obtained from oil energy. And out of that 55% only from Central Asian countries.

Natural gas:

Natural gas is also found mainly near oil deposits, it also contains some amount of carbon dioxide and other flammable gases ethane and propane.

Nuclear energy:

^{235}U is used for its production, energy is obtained from the disintegration of Uranium 235. It is disintegrated in a nuclear reactor.

Hydroelectric energy:

This energy is cheap and frequently used energy, the earth receives energy from the sun every year. It is absorbed by energy which becomes vapor then we get this energy again through rain.

- **Non-Conventional Sources:**

Solar energy

Solar energy is used for human welfare in direct and indirect form, direct solar energy is radiation energy while indirect solar energy is the energy that comes from the elements, in which solar energy radiation is first contained.

Solar energy is used directly in the form of heat energy and this energy is converted into electricity. Photovoltaic batteries directly convert solar energy into electricity.

When solar energy is used indirectly among many types of energy sources, biomass energy is the most prominent. Biomass is used here for all those substances which are made by the process of photosynthesis.



5.1.3.2 Solar Energy

Wind energy

The fan is rotated by using wind (air) and electricity is generated but there is also a problem in this, energy through wind cannot be obtained in every area, for this only islands, coastal, and mountainous areas are better.



5.1.3.3 Wind Energy

Tidal energy

Electricity is produced through high tides and low tides that rise in the ocean.

Geothermal energy

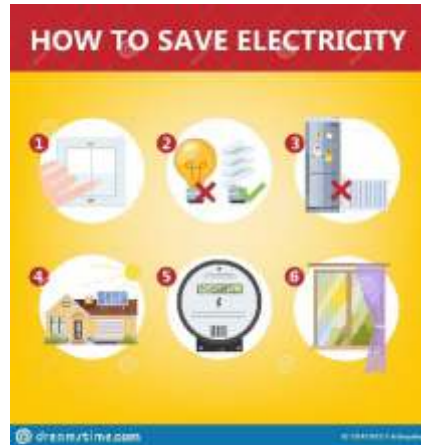
Electricity is generated by rotating the turbine from the springs and surface water flowing in the form of hot water.

Ocean wave energy

Electrical energy is also produced by running turbines in sea waves generated by wind.

5.1.4 Different ways of energy / Power saving practices

Most of the light is received from the sun, which is generally 1 lakh lux / Sq.meter, while office work generally requires 200 to 250 lux labeled light. Therefore, to make maximum use of the sunlight, keep the curtains of the windows open.



5.1.4.1 How to save electricity

General measure:

- The walls of the rooms should be painted with white/light colors and the ceilings should be painted with white paint, due to which the temperature inside the room decreases as compared to the outside.
- All electrical appliances used for cooling and heating should have a thermostat switch. A thermostat is such a device that controls the power supply by sensing the current temperature.
- Domestic wiring should not have joint or loose connection.
- All electrical equipment should be earthed.
- Solar energy should be used as far as possible.
- Use of fancy/decorative lights should be minimized. Neon/LED lamps should be used in night lamps.
- Use star rated appliances. BEE Using electrical appliances of higher star rating approved by the IAEA results in less energy consumption as well as carbon emissions. According to its power consumption "Star" rating is given like one / single star appliance consumes the most power and on the other hand five / five-star appliance consumes the least power.
- Unnecessarily more electricity is spent on switching off the equipment from the remote instead of turning it off directly from the switch. Therefore, as far as possible, the equipment should be switched off.



5.1.4.2 BEE star rating label



5.1.4.3 Turn off light

Arrangement / measures of lighting electrical equipment:

- Using LEDs instead of ordinary lamps saves up to 75 percent of electrical energy while providing the same amount of light.
- Use a task light (table lamp) to provide proper illumination at the work place.
- Light gets reduced by up to 50 percent when dust accumulates on the lights. So keep them clean.
- Automatic systems save a lot of electrical energy, such as infrared sensors, motion sensors, automatic timers, street lights and dimmers, etc. can be used to switch on / off like automatic switches.
- Keep the switches of electrical equipment closed when not required. It is the best way of saving electrical energy.

Coolers and fans:

- Five star rated fans should be used to save energy.
- Electronic regulator should be used in coolers and fans.
- Keep fans and coolers switched off when not required.
- Before the start of the season, overhauling of coolers and fans should be done, this increases their capacity.
- Automatic timer switch should be used to turn on/off the pump in coolers. This saves electrical energy as well as water.

Room air conditioner:

- An air conditioner of appropriate capacity should be installed according to the size of the room.
- AC Energy is saved by installing false ceiling in the room.
- AC room should be air sealed.
- Five star rated air conditioners should be used to save energy.
- Goods made of heat absorbent materials should not be kept in AC room.
- Turn off the AC half an hour before leaving the room.
- The air filter and air conditioner coil should be cleaned from time to time.
- The thermostat should be set at a minimum of 25 degrees centigrade, which provides comfortable coolness at low cost. About 03 percent electricity is saved for every 01 degree centigrade higher temperature set.
- Painting of white ceramic paint on the outer surface of the roof reduces the temperature of the room by 6 to 8 degrees. Due to which the load on AC will reduce and electricity will be saved.
- As far as possible do not install AC on the south and west walls, because these walls get more sun rays due to which the AC gets damaged and the load on AC will be more.



*5.1.4.4 Soft Starter -
For Industrial Motors*

Electric motor :

- Energy efficient motor should be used.
- If the motor load is less than 50%, then it should be replaced with an energy efficient motor of lower capacity.
- Soft starter should be used in the motor.
- If the motor burns out, instead of rewinding the motor, the motor should be replaced with an energy efficient motor. On rewinding, there is a loss of 5 percent to 10 percent energy efficiency.
- Use of flat belt in place of V-belt reduces frictional loss, thereby saving energy.
- The motor should operate at optimum voltage, not at excess voltage.
- Motor should not be run without load.
- Variable frequency drives (VFDs) should be used for variable torque loads like blowers, pumps etc.



*5.1.4.5 Variable Frequency
Drives - For Industrial
Blowers & Pumps*

Unit 5.2: Conservation of Materials

Unit Objective

At the end of this unit, the trainee will be able to,

- Explain the importance of material conservation.
- Explain the commonly used materials in industrial establishments.
- Following various methods of material protection practices.

5.2.1 Conservation of materials and resources

Different types of materials and resources are used in industrial establishments for different purposes or applications. The following types of materials are commonly used extensively in industry

- Water / Steam
- compressed air
- paper
- Oils and Lubricants
- Petrol/Diesel
- Industrial gases
- Chemicals
- Plastic Bags
- Wax
- Polishing Compound

It is important to use such materials/resources or minimum to reduce the effect of some of the bad consequences mentioned below, such as,

- Environmental pollution
- Depletion of valuable/non-renewable resources for future generations
- Monetary Expenditure
- Ozone depletion
- Health hazards to employees working in hazardous processes

5.2.2 Different Methods of Material Conservation

What can you do to conserve water?

1. Check that there is no water leakage in your house.
2. Use only as much water as you need.
3. Keep the water taps closed after use.
4. Keep the tap closed while brushing and open it only when necessary.
5. Don't waste too much water for bathing.
6. Use such a washing machine which does not consume much water.
7. Do not leave taps open while washing food items and clothes.
8. Never pour water down the drain, but use it for other uses like watering plants or garden or cleaning. Etc.
9. The water used for washing vegetables and fruits is used to water the pots of flowers and ornamental plants.
10. Do not throw away the remaining water in the water bottle, but use it to irrigate the plants.
11. Do not leave the water tank open.
12. Don't throw garbage in ponds, rivers or sea.



5.2.2.1 How to save water

Some water conservation measures in industrial establishments:

1. Reuse non-potable water for other purposes.
2. Re-install existing appliances and fixtures
3. Replace old appliances with energy-efficient alternatives.
4. Removal of water from cleaning processes when dry alternatives are possible.
5. Reduce the amount of water required for non-essential operational activities.
6. Install water saving taps at common points of consumption.

Suggestions to reduce the use of paper in office work:

1. Post in-house reminders near copy machines or on individual desktops.
2. Track the individual print footprint in your office.
3. Hold paperless meetings
4. Encourage the use of email extensively
5. Set the default on the computer for double sided printing, font size of 10, and lower margin setting for MS Word related documents.
6. Reuse the paper used on one side for photocopying purpose.

Some tips to save fuel for private vehicles:

- Do not press the accelerator or brake suddenly, it consumes more fuel.
- Avoid running the air conditioner if it is not needed.
- Do not drive in reverse gear excessively, it consumes unnecessary fuel. While parking the car in the parking lot, park it in reverse, so that when you want to go, you can get out of the car directly.
- Keep the air pressure in the wheels correct. Follow the specifications given by the vehicle manufacturer.
- Avoid carrying unnecessary items in the vehicle. Keep only essential items in the trunk.
- Avoid keeping luggage on the roof of the vehicle, it consumes more fuel.
- Get the vehicle serviced on time, getting the service done at the right time gives more mileage, because fuel is spent more due to dirty air filter, old spark plug and less fluid.
- Use public transportation.
- Plan well before you set out on a trip. Try to leave in the morning itself, the crowd is less. Car pooling can also be used.
- Before buying a new car, do know its mileage, don't buy a car just because of its looks.

Some tips for saving fuel in industrial establishments:

1. Take proper care of machines on time.
2. Follow the operating standards given by the machine manufacturer.
3. Take proper care of your generator. Maintaining your generator can significantly reduce fuel consumption.
4. Remove carbon deposits.
5. Minimize the use of generators.
6. Don't overload or underload.
7. Maintain proper coolant temperature.

Plastic bags, wax, polishing compound:

- Select the correct option by adopting the principle of Re-do, Re-use, Recycle














6. Annexure







Annexures 1 - QR codes - Video Link








Annexure: Chapter wise QR codes

Chapter No.	Unit No.	Topic Name	Page No.	Url	QR code (s)
1. Introduction	Unit 1.1: Gem and Jewellery Sector in India	1.1.1 Significance of Gem and Jewellery Sector in India	9	https://www.youtube.com/watch?v=nKY1AbPz668&t=1s	 Gem & Jewellery industry Orientation
1. Introduction	Unit 1.3: About Jewellery	1.3.2 Need for Jewellery Design	13	https://drive.google.com/file/d/1Reg-5FCnxLzJkTj9NFecrL8EYnNNv6nA/view?usp=sharing	 Diversity in Indian Jewellery
1. Introduction	Unit 1.3: About Jewellery	1.3.2 Need for Jewellery Design	13	https://drive.google.com/file/d/1szE3LWEmzgSt1xGopymE3shRhDCwpLqf/view?usp=sharing	 Categories of Indian Jewellery
2. Create Jewellery Design using CAD Part - I	Unit 2.3 Explain Rhino Interface	2.3.1 Explain Rhino Interface	28	https://vimeo.com/176390754	 Rhino Viewports and Navigation (By Vimeo)
2. Create Jewellery Design using CAD Part - I	Unit 2.3 Explain Rhino Interface	2.3.1 Explain Rhino Interface	28	https://vimeo.com/58212839	 Overview of the Rhino 7 for Windows User Interface (By Vimeo)

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2. Create Jewellery Design using CAD Part - I	Unit 2.5: Modeling Aids	2.5.2 3D and 2D Representation of objects in rhino	44	https://vimeo.com/606610665	 <p>Object Types Rhino for Windows (By Vimeo)</p>
2. Create Jewellery Design using CAD Part - I	Unit 2.7: Editing Geometry	2.7.1 Editing Geometry	71	https://www.youtube.com/watch?v=JYVxSsdtlqI	 <p>RHINO / Editing Curves (By IIT DC)</p>
2. Create Jewellery Design using CAD Part - I	Unit 2.9: Working with Surface Commands	2.9.1 Surface Command	77	https://drive.google.com/file/d/1FTS4-OIKaQ370C9Z9MLpLGzBsA27A2xq/view?usp=share_link	 <p>Extrude and Tapered Ring</p>
2. Create Jewellery Design using CAD Part - I	Unit 2.9: Working with Surface Commands	2.9.1 Surface Command	86	https://drive.google.com/file/d/1D-5UIFVPJwYNfUMmoMZSwCrW_npplr9b/view?usp=share_link	 <p>Overlapping Ring</p>
2. Create Jewellery Design using CAD Part - I	Unit 2.10: Curve Tool	2.10.1 Curve Tools	96	https://drive.google.com/file/d/1SMAucp4OTxQIYPoh_wl0E4_3M7YR8wX/view?usp=share_link	 <p>Split Ring</p>
2. Create Jewellery Design using CAD Part - I	Unit 2.10: Curve Tool	2.10.1 Curve Tools	96	https://drive.google.com/file/d/1ebWPs8SXRuiPuSvJZ22vNhyFIZ5OWNv4/view?usp=share_link	 <p>Wire Ring</p>

Chapter No.	Unit No.	Topic Name	Page No.	Url	QR code (s)
3. Create Jewellery Design using CAD Part - II	Unit 3.4: Solid Editing Tool	3.4.1 Solid Editing Tool	113	https://drive.google.com/file/d/1JqBLZOZ0AYLJtRjoLdrRNn0OEETMXr3n/view?usp=share_link	 Earring Flower & Pearl
3. Create Jewellery Design using CAD Part - II	Unit 3.4: Solid Editing Tool	3.4.1 Solid Editing Tool	113	https://drive.google.com/file/d/1kpXRtxm9UuVsJqlBhkw5tkoRO3PHqqw9/view?usp=share_link	 Articulated Bracelet
3. Create Jewellery Design using CAD Part - II	Unit 3.5: Analyse Tool	3.5.1 Analyse Tool	117	https://drive.google.com/file/d/1eWzT-AO66CBSbpcdkpl6cIY8qXMseP25/view?usp=sharing	 Introduction to Precious metal
3. Create Jewellery Design using CAD Part - II	Unit 3.6: Gemstones	3.6.3 Basic Stone	129	https://drive.google.com/file/d/1_2XPTcEapET9ICY4n0IJ_BaRTmWX1c3q/view?usp=sharing	 Types of Gemstone Settings
3. Create Jewellery Design using CAD Part - II	Unit 3.7: Jewellery Setting	3.7.4 Pave Setting	149	https://drive.google.com/file/d/1D13RHM0jgbYOYNAfgJeZkGfnyYdQBs08/view?usp=share_link	 Enamel Ring
3. Create Jewellery Design using CAD Part - II	Unit 3.7: Jewellery Setting	3.7.4 Pave Setting	149	https://drive.google.com/file/d/1ojPcqccVsPjEiKvpRMDjzjDXVbsWuCC8/view?usp=share_link	 Channel Ring

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3. Create Jewellery Design using CAD Part - II	Unit 3.7: Jewellery Setting	3.7.4 Pave Setting	149	https://drive.google.com/file/d/1meFZc35QHQRy58qbMZQ2fBnnsQTxO-_e/view?usp=share_link	 Hoops
3. Create Jewellery Design using CAD Part - II	Unit 3.7: Jewellery Setting	3.7.4 Pave Setting	149	https://drive.google.com/file/d/1YSUoHpkpUI2qGt6hhqCld2ZiGxYffZO/view?usp=share_link	 Leaf Shape Pendant
3. Create Jewellery Design using CAD Part - II	Unit 3.7: Jewellery Setting	3.7.4 Pave Setting	149	https://drive.google.com/file/d/1zJaCCXeGgeldHcmu93OiRMCrs8COWj_X/view?usp=share_link	 Cluster ring
3. Create Jewellery Design using CAD Part - II	Unit 3.7: Jewellery Setting	3.7.4 Pave Setting	149	https://drive.google.com/file/d/1zvM4RwVNfX96H1HtWktYjyQ7whE6_Td6/view?usp=share_link	 Ring Channel on Bezel
Employability Skills				https://www.skillindia.digital.gov.in/content/list	 Employability Skills



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