Co-funded by the European Union

german cooperation
DEUTSCHE ZUSAMMENARBEIT

Norwegian Embassy
Islamabad

Jewellery CAD-CAM

Trainer & Learner Guide

National Vocational Certificate Level 3-5

Version 1 - March 2020

NAVTTC

Implemented by
giz Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

Published by
National Vocational and Technical Training Commission
Government of Pakistan

Headquarter
Plot 38, Kirthar Road, Sector H-9/4, Islamabad, Pakistan
www.navttc.org

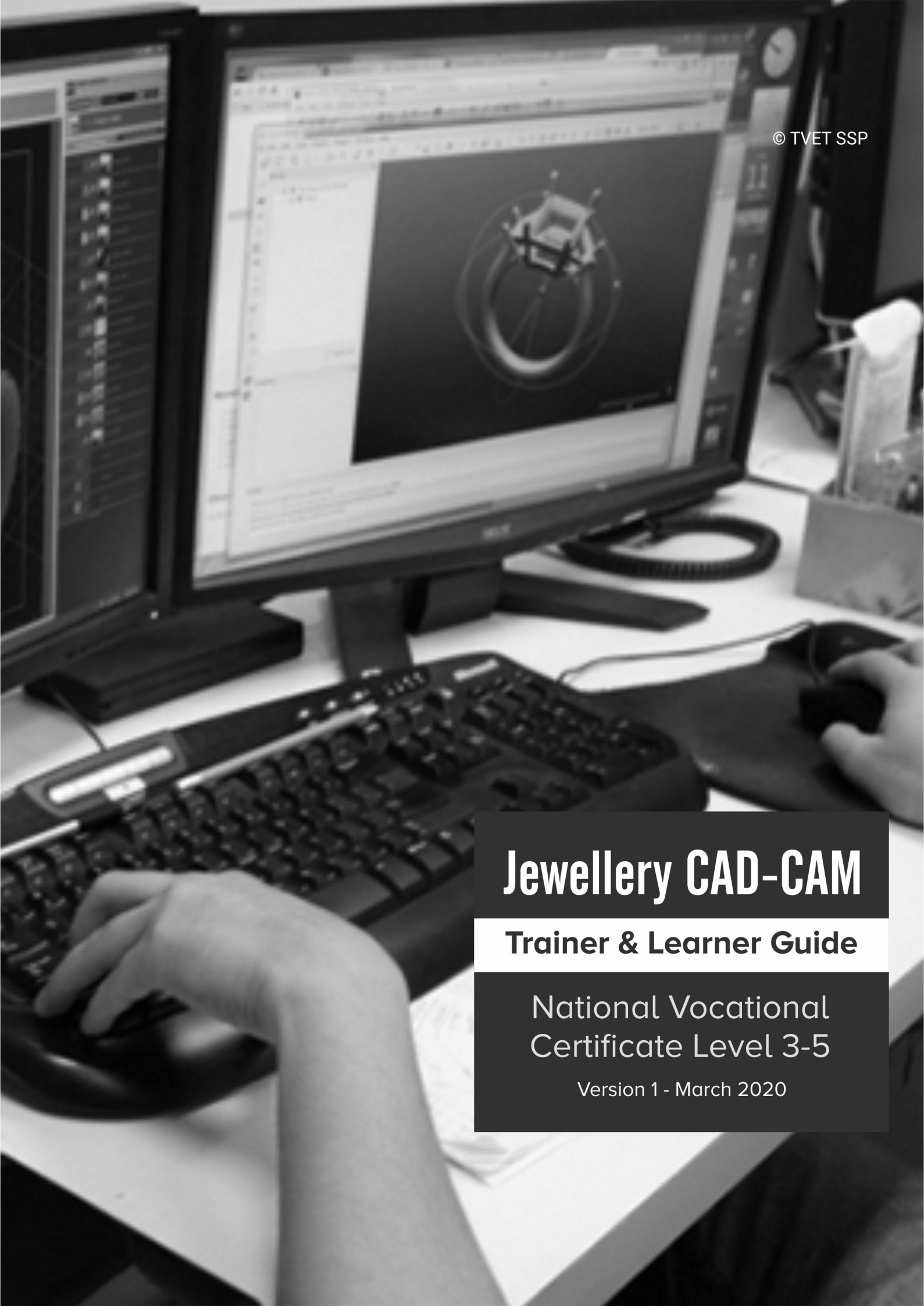
Responsible
Director General Skills Standard and Curricula, National Vocational and Technical Training Commission
National Deputy Head, TVET Sector Support Programme, Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

Layout & design
SAP Communications

Photo Credits
TVET Sector Support Programme

This document has been produced with the technical assistance of the TVET Sector Support Programme, which is funded by the European Union, the Federal Republic of Germany and the Royal Norwegian Embassy and has been commissioned by the German Federal Ministry for Economic Cooperation and Development (BMZ). The Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH in close collaboration with the National Vocational and Technical Training Commission (NAVTTC) as well as provincial Technical Education and Vocational Training Authorities (TEVTAs), Punjab Vocational Training Council (PVTC), Qualification Awarding Bodies (QABs)s and private sector organizations.

Document Version
March, 2020
Islamabad, Pakistan



Jewellery CAD-CAM

Trainer & Learner Guide

National Vocational Certificate Level 3-5

Version 1 - March 2020

Introduction

The learner guide for Gems and Jewellery sector of "Jewellery CAD/CAM" will provide an insight to the development of the Gem and Jewellery industry on modern means of technological advancements. It will provide an opportunity to the learner in better understanding of the use of Jewellery CAD/CAM software in providing state of the art solutions to the customers. A special care is observed in designing the learner guide to bring an easy solution in understanding with examples and practical exercises for your first time users and also it will bring a lot learning opportunities for the mid-career workers in the sector. Programme is to engage young people with a programme of development that will provide them with the knowledge, skills and understanding in working as a well professionally groomed worker or even starting own venture as an entrepreneur. The programme has been developed to address specific issues, such as the national, regional and local cultures, the manpower availability within the country, and meeting and the exceeding needs and expectations of their customers. The main elements of your Teaching and Learning Material are:

- **Introduction:**
  - This includes a brief description of your guide and guidelines for you to use it effectively.
- **Modules:**
  - The modules form the sections in your Teaching and Learning Material.
- **Learning Units:**
  - Learning Units are the main sections within each module
- **Learning outcomes**:
  - Learning outcomes of each learning units are taken from the curriculum document
- **Learning Elements:**
  - This is the main content of your Teaching and Learning Material with detail of the knowledge and skills (practical activities, projects, assignments, practices etc.) you will require achieving learning outcomes stated in the curriculum.
  - This section will include examples, photographs and illustrations relating to each learning outcome
- **Summary of modules**:
  - This contains the summary of the modules that make up your Teaching and Learning Material
- **Frequently asked questions**:
  - These have been added to provide further explanation and clarity on some of the difficult concepts and areas. This further helps you in preparing for your assessment.
- **Multiple choice questions for self-test**:

- These are provided as an exercise at the end of your Teaching and Learning Material to help you in preparing for your assessment.

BASIC CONCEPT OF JEWELLERY

Jewellery: is a decorative ornament to worn on body which may be an abstract or depict a design theme having proportion, rhythm, function and wearable features.

Material or Medium used for Jewellery:

Precious Metals: like Silver, Gold, Platinum, Palladium etc.

Semi-Precious Metals: like Brass, Copper, Bronze, Lead, Zinc etc

Gem stones: are also used in jewellery, for instance: Diamond, Ruby, Emerald, Sapphire, Aquamarine, Tourmaline, Opal, Pearl, Agate, Amethyst, Mozanite, Zirconia, Coral etc.

ERAS OF JEWELLERY DEVELOPMENT

History of Jewellery

Jewellery has been worn by the earliest civilizations. Even those ancient bodies found frozen or entombed, all are found with various types of jewellery - amulets, bracelets, earrings, etc.

Jewellery has been used as symbols of emotions represented by specific stones or jewellery designs. If you decide to collect vintage and antique jewellery, you probably enjoy other types of antiques, as well.

Jewelry Eras	Period
Georgian:	1714 -1836
Victorian:	1837 - 1900
Edwardian:	1901 - 1910
Art Nouveau:	1880 - 1914
Arts & Crafts:	1890 - 1914
Art Deco:	1920 - 1939
Retro:	1935 - 1950

Georgian Jewellery of the 1700 and 1800's

The era is named after England's Kings, George I, II, & III. This was a time when the aristocratic and wealthy classes wore an abundance of jewels - men, as well as women. Jeweled buttons on coats and knee breeches, pocket watches, chains, fobs and jeweled shoe buckles were worn by both sexes.

EARLY VICTORIAN or ROMANTIC ERA 1837-1860

The Victorian era covers such a long period of time that many styles are covered in the one name, "Victorian". Transitions were not usually abrupt and a piece can show several influences at once. The Art Nouveau era, for example, overlaps the time period for Victorian jewellery but has a unique and very recognizable style. (These styles are discussed individually.)

The Victorian Era gets it's name from England's Queen Victoria, who ascended the throne in 1837 at the age of 18. The queen was an influence on fashion and jewellery styles and this was particularly true during the early years of her reig.

One transition style that covers both the end of the Georgian and beginning of the Victorian eras are Ferronieres. These were chains or ribbons studded with a center jewel intended to be worn on the forehead.

Brooches were extremely popular and were worn in a variety of ways; on the shoulder, of course, but also at the neck, waist, in the hair, and on ribbons as necklaces and bracelets. In addition to silver, gold, and base metals, jewellery was created from Pique, Tortoiseshell, Mother-of-Pearl, and "Lava" (carved mud to form cameos. Religious symbols were mainstays of jewellery design in both the Georgian and Victorian eras. Queen Victoria's engagement ring from Prince Albert was in the form of a serpent.

Victorian jewellery designers loved natural themes and flowers as did earlier generations. Early Victorian designs are generally small and delicate unlike the larger, heavier, and more ornate pieces made later.

EDWARDIAN ERA

Lasting about a decade, the Edwardian era (named after England's King Edward VII) was a mix of styles and tastes. Though the era was a short one, jewellery pieces can easily be found. New technology allowing faster manufacture of items reduced costs and made jewellery available to more people than ever before. Fine jewellery of the Edwardian era used a lot of Diamonds, white Gold, and Platinum. Although Platinum had been available earlier, it had been very difficult to work with so the new technology made it more practical for jewellery. Designs were made with delicacy to blend with the current tastes for fabrics of lace and silk.

Necklaces of all kinds were very popular and can be found by the collector. The Sautoir is a very long necklace made of beads that fall below the waist; these often have tassels on the ends. This type of necklace would be popular through the Art Deco period.

A Lavaliere necklace is one that has a pendant suspended from a thin chain. These are the most common types of necklaces found from this era.

Brooches with sporting motifs of fox heads, horseshoes, golf clubs, and riding crops can be found from this time period. Bracelets were worn both singly and in multiples. The "knife

edge" technique, previously mentioned, was used to make lightweight pieces, often set with stones.

ART NOUVEAU ERA

Coinciding with the Victorian era, it's a style intended as a statement against the industrialization of jewellery making. Designs are curvy, fluid; often of nude female figures, heads, insects, crescents, and common plants. Jewellery of this era was considered very "avant garde" for the time and it took a bold person who dared to wear it.

Look for designs that incorporate

Butterflies ,Wasps , Dragonflies ,Bees ,Swans ,Owls ,Bats ,Peacocks ,Dragons ,Poppies Sunflowers ,Dandelions , Mums ,Fantasy Creatures

The art of Japan was a new and exciting influence on Art Nouveau with the "opening" of Japan to the West in 1853. Up until this time, it had virtually been a closed society and society was fascinated by examples of designs and goods from this mysterious and exotic country. Scenes of nature, done in this style with its simplicity and understatement, made a major impact on European arts and designs. The beautiful jewel-toned enamels, widely used in Japan for centuries, were now duplicated in Art Nouveau and Arts & Crafts designs.

ARTS & CRAFTS ERA

The Arts and Crafts movement was a transitional period between the Art Nouveau and Art Deco eras. You can often see elements of both styles in a single piece of jewellery. Arts & Crafts was more than just a design style; it was a political and philosophical movement. Devotees of this art form interested themselves in social reform and individual rights. The style was a revolt against new technology they felt was destroying craftsmanship. It was their view that the imperfections and inconsistencies of hand-made pieces increased the beauty of a piece.

In Arts and Crafts jewellery, cabochon cuts were preferred over faceted stones and Silver was the preferred metal over gold. As with Art Nouveau jewellery, "humble" materials, like brass and copper, were valued and used to create jewellery. Enamel continued its popularity in this era, but in simpler, less flowing lines than Art nouveau examples.

ART DECO ERA

The "Roaring Twenties" also called "The Jazz Age", was a time of rapid change. U. S. women finally got the right to vote with passage of the 19th amendment.

Fashion reflected the fact that women were more independent than ever before. Dresses were short and straight in new, thin fabrics with dropped waists.

Deco jewellery is often bold and angular - forming geometrical shapes. Wildly colorful pieces were common, but in addition to these, were ones made using just two colors, perhaps black and white. Women again wore multiples of everything; rings, bracelets, necklaces, but in ways that were different from the past. In addition to precious stones, jewellery was made of paste, coral, crystal, and onyx. Sometimes the precious and non-precious stones were used side-by-side to create looks uniquely "Art Deco".

Long strands of beads and pendants were worn hanging to the waist. Ropes of pearls or beads could be knotted at the neck and reach to the thigh or worn with the length in back - calling attention to a plunging dress back.

Men accessorized with cufflinks, tie bars and tiepins. While the styles were usually simpler in ornamentation than a similar woman's object, they showed the same artistic style and beauty.

Costume jewellery in the 1920's and 30's was available in all kinds of material - paste, faux gems, horn, bone, and celluloid, and all were mass-produced.

Bakelite was a staple for Art Deco costume pieces. It?s an early form of plastic that can be molded and carved. All sorts of jewellery can be found; some pseudo-serious, some very whimsical - like necklaces of fruit or cartoon-like brooches.

Module 1: PREPARE DRAWING OF BASIC JEWELLERY ARTICLE MANUALLY

Introduction:

This module is an essential milestone in designing and drafting fundamentals of jewellery article manually. It will cover the basic elements and principles of design that how trainee will transfer ideas in to practical jewellery article. Furthermore it emphasizes the designing of jewellery article conceptually following manufacturing techniques to produce jewellery article with precision and accuracy. It covers the introduction and historical eras of jewellery evolution.

The trainee will be able to sketch necessary views of jewellery article on scale. This technical drawing will act as prerequisite for the jewellery craftsman to manufacture jewellery article physically keeping its wear ability and aesthetics.

The course learning units are arranged in such a way to integrate concepts and ideas related to each topic through tools and application-oriented projects. This makes the learning simple and systematic and enables one to gain more insight knowledge on the various tools covered.

LEARNING UNIT 1: PERFORM BASIC SKETCHING

Objectives:

In this learning unit you will learn how to “sketch” a drawing or a design often done as a preliminary study, which acts as an essential tool for a designer to conceptualize and communicate. The jewellery article will be sketched by free-hand through techniques of assorted lines, correct angles, variation of lines and shapes.

LEARNING OUTCOMES

The student will be able to:

1. Analyze jewellery article on measurements
2. Draw outline sketch of basic jewellery article with free hand
3. Draw jewellery design elements.

BASIC CONCEPTS:

Design:

Design is the process of selecting and organizing elements or components in order to fulfill a specific purpose. This purpose may be functional or aesthetic, or (frequently) both.

Basic elements of design:

The elements are components or parts which can be isolated and defined in any visual design or work of art. They are the structure of the work, and can carry a wide variety of messages. These elements are:

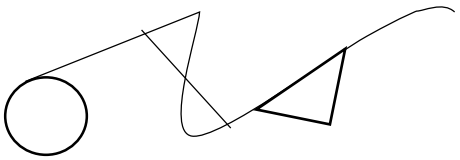
- Point
- Line
- Form, shape and space
- Movement
- Color
- Pattern
- Texture

POINT

A point indicates position. It has no length or breadth. It is the beginning and end of a line, and is where two lines meet or intersect. Even if there is only one point, one mark on a blank page there is something built into the brain that wills meaning for it, and seeks some kind of relationship or order. If there are two points, immediately the eye will make a connection and "see" a line. If there are three points, it is unavoidable to interpret them as a triangle; the mind supplies the connections. This compulsion to connect parts is described as grouping.

LINE

The most basic element of art, can take many different forms; it can be circular, zigzag, straight, curved or spiral for instance. Zigzag and circular lines represent motion/ movement and can be used to create dynamic shapes,

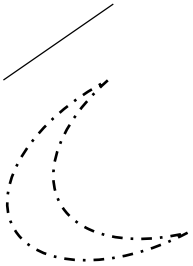


Types of Line

There are three types of line, the real line, the implied line and the psychic line.

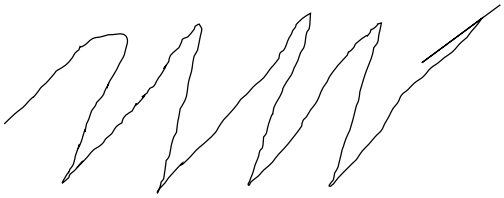
The real line: is a line we can physically see and touch, for example the lines that appear above and below the sub-headings.

The implied line: When a series of points are positioned in a certain way, the eye tends to connect them together, this is the implied line. For example when

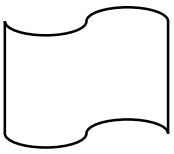


we look at a series of dashes or dots we 'see' a line, this line however is not actually there, it is implied.

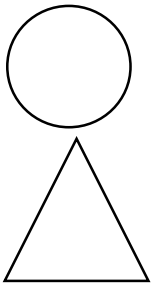
The psychic line: is where you create a mental connection between various visual elements. For example there is no line between this section of the page and the navigation bar however you mentally 'see' a line separating the two sections.



FORM, SHAPE AND SPACE



- Form and shape are areas or masses which define objects in space. Form and shape imply space; indeed they cannot exist without space.
- Shapes can be created in a number of ways, through the use of lines or color to define the edge and therefore enclose a space. These shapes can then be used within compositions.



- The arrangement of these forms or shapes can affect the whole composition as it is more visually pleasing to look at something that is balanced.

MOVEMENT

Movement is also a key element of art and design and can be achieved in three main ways. These are blurred outlines, repeated figures and multiple elements.

Blurred outlines show the movement an object has been through. Therefore we can picture in our mind the object moving, for example the image below uses this feature to provoke a feeling of movement between the marbles.

COLOR

Color is one of the most powerful of elements. It has tremendous expressive qualities. Understanding the uses of color is crucial to effective composition in design and the fine arts. Color is an important part of art and design and has many properties, these are Hue (or Chroma), Value, Brightness, Saturation and Lightness

PATTERN

Pattern is an underlying structure that organizes surfaces or structures in a consistent, regular manner. Pattern can be described as a repeating unit of shape or form, but it can also be thought of as the "skeleton" that organizes the parts of a composition.

TEXTURE

Texture is the quality of an object which we sense through touch. It exists as a literal surface we can feel, but also as a surface we can see, and imagine the sensation might have if we felt it. Texture can also be portrayed in an image, suggested to the eye which can refer to our memories of surfaces we have touched. So a texture can be imaginary.

Bristly, rough, and hard -- this is what we usually think of as texture, but texture can also be smooth, cold and hard too. Smooth, soft, and/or warm and Wet or dry are also textures; in fact, any tactile sensation we can imagine is a texture.

WHAT IS 2D & 3D?

There are various ways to categorize form and shape. Form and shape can be thought of as either two dimensional or three dimensional. Two dimensional forms have width and height. It can also create the illusion of three dimension objects. Three dimensional shapes have depth as well as width and height.

ORGANIC AND GEOMETRIC FORMS

Form and shape can also be described as either organic or geometric.

Organic forms such as these snow-covered boulders typically are irregular in outline, and often asymmetrical. Organic forms are most often thought of as naturally occurring.

Geometric forms are those which correspond to named regular shapes, such as squares, rectangles, circles, cubes, spheres, cones, and other regular forms.

PRINCIPLES OF DESIGN

The Principles are concepts used to organize or arrange the structural elements of design. Again, the way in which these principles are applied affects the expressive content, or the message of the work. These are as follows :

- Balance
- Proportion
- Rhythm
- Emphasis
- Unity
- Harmony
- Functionality

Balance:

Balance is the concept of visual equilibrium, and relates to our physical sense of balance. It is a reconciliation of opposing forces in a composition that results in visual stability. Most

successful compositions achieve balance in one of two ways: symmetrically or asymmetrically

Proportion:

Proportion involves the relationship of size between objects. Proportion is also relative sizes of surface areas of different colors in a room. The proportion of color areas such as on a wall of a living room may be chosen to be visually pleasing. Proportion also depends on functionality of object. For example, for the best proportion between a room and furniture, the sizes of furniture depends on the size of the room

Rhythm:

The recurrence of elements within a piece: colors, lines, shapes, values, etc. Any element that occurs is generally echoed, often with some variation to keep interest. Rhythm is a repeating pattern like four identical candles space evenly apart on a book shelf.

Emphasis:

Emphasis is also referred to as point of focus, or interruption. It marks the locations in a composition which most strongly draw the viewers' attention. Usually there is a primary, or main, point of emphasis, with perhaps secondary emphases in other parts of the composition. The emphasis is usually an interruption in the fundamental pattern or movement of the viewer's eye through the composition, or a break in the rhythm.

Unity:

Unity refers to a sense that everything in the artwork belongs there, and makes a whole piece. It is achieved by the use of balance, repetition and/or design harmony. Unity can be achieved through the effective and consistent use of any of the elements, but pattern-- that is, underlying structure-- is the most fundamental element for a strong sense of unity. Consistency of form and color are also powerful tools that can pull a composition together.

Harmony:

Harmony is achieved through the sensitive balance of variety and unity. Color harmony may be achieved using complementary or analogous colors. Harmony in design is similarity of components or objects looking like these belong together. Harmony is when some or many of the components (usually three or four objects depending on size of project or room) such as a furniture, drapes in a room share a common trait or two. Harmony is achieved through the sensitive balance of variety and unity.

Functionality:

A design must have good functionality. Great functionality and best possible materials for the function usually also increases visual appeal, and prestige. Functionality is a great gauge at

seeing how effective the design is communicating the message or purpose to the customers or consumers in face-to-face situations.

IDENTIFY AND USE OF SKETCHING MATERIAL

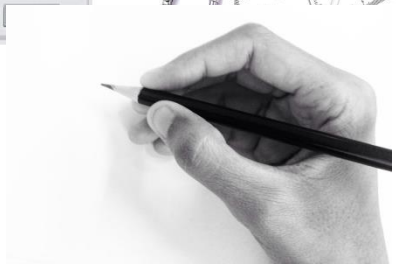
It is important to identify and understand the tools and instruments for basic hand sketching.

These are as under :

- Geometry box (Set square 30,45,60,90 degree)
- Pencil HB /Clutch Pencil (0.5,0.3mm)
- Drawing sheet(A4,A3,A2)
- Drawing boards A2 size
- Paper cutter
- Masking Tape

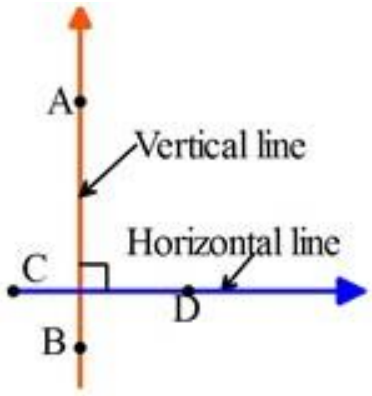
Method of holding pencils

There are different ways to hold pencil for writing and sketching but the correct method to hold the pencil for sketching task by eliminating fatigue and stress on thumb and figure is shown in figure.

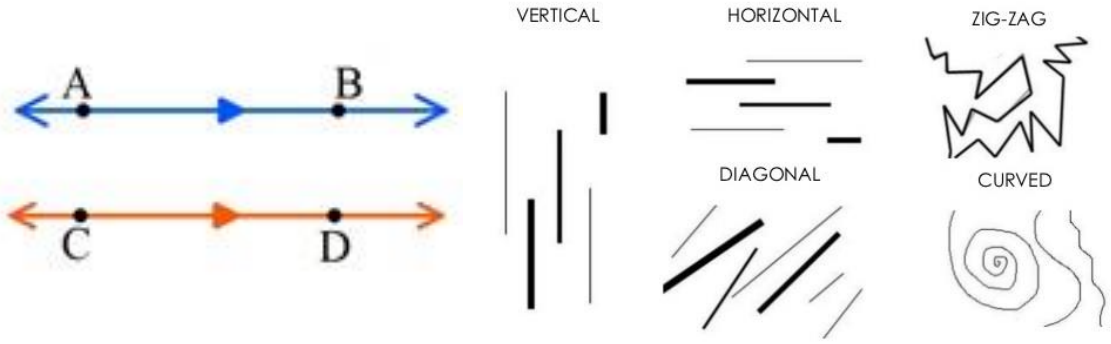


Various types & Methods of lines (vertical & horizontal)

Lines are defined based on their orientation/direction and the angles if any, formed between them. Generally there are four types of lines depending on angle horizontal line, vertical line, perpendicular, and parallel lines.



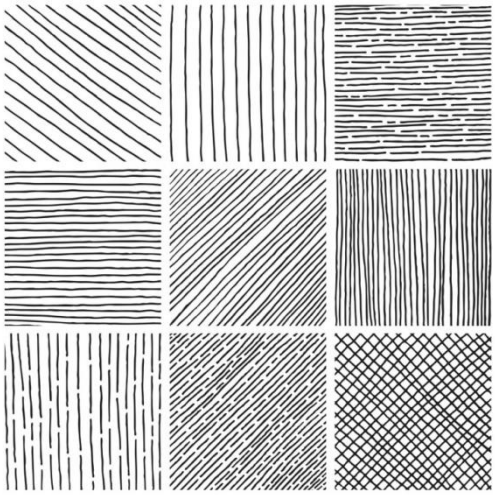
- A line that runs from left to right in a straight line is called a horizontal line.
- A line that runs from top to bottom in a straight line is a vertical line
- When two straight lines intersect (i.e. cross) each other at right angles (= 90°), then these two lines are said to be perpendicular to each other. Here AB and CD are the two perpendicular lines, and they are represented as $AB \perp CD$
- When two lines never meet each other, no matter how much you extend them, then these two lines are said to be parallel to each other.
- Lines AB and CD are parallel lines, and are always the same distance apart from each other. Parallel lines are represented by the two large arrows on the lines



PRACTICAL No. 1: DRAW AND PRACTICE VARIOUS TYPES OF LINES

Various types of hatching lines on angles

- These are the combination of horizontal, vertical or both and diagonal lines used to create texture, value, section and the illusion of form.
- Hatching technique work well with a variety of different drawing mediums including pen and ink, graphite, colour pencils etc.



PRACTICAL No. 2: DRAW AND PRACTICE VARIOUS TYPES OF HATCHING LINE PATTERNS

Line is considered to be basic element of art. In terms of art, line is considered to be a moving dot. It has an endless number of uses in the creation of art. Line can control a viewer's eye. It can describe edges. It can indicate form as well as movement. It can also indicate value and a light source in drawing. When line is used for value or shading, we most typically see it used in the form of hatching or cross hatching. Although these are arguably the most common forms of using line for adding value, there is an endless number of ways that it can be used.

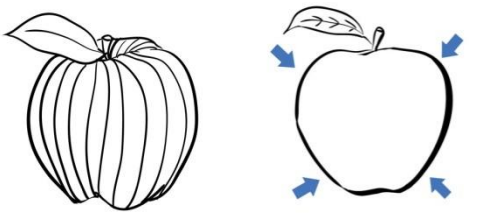
Draw lines in below mention designs.

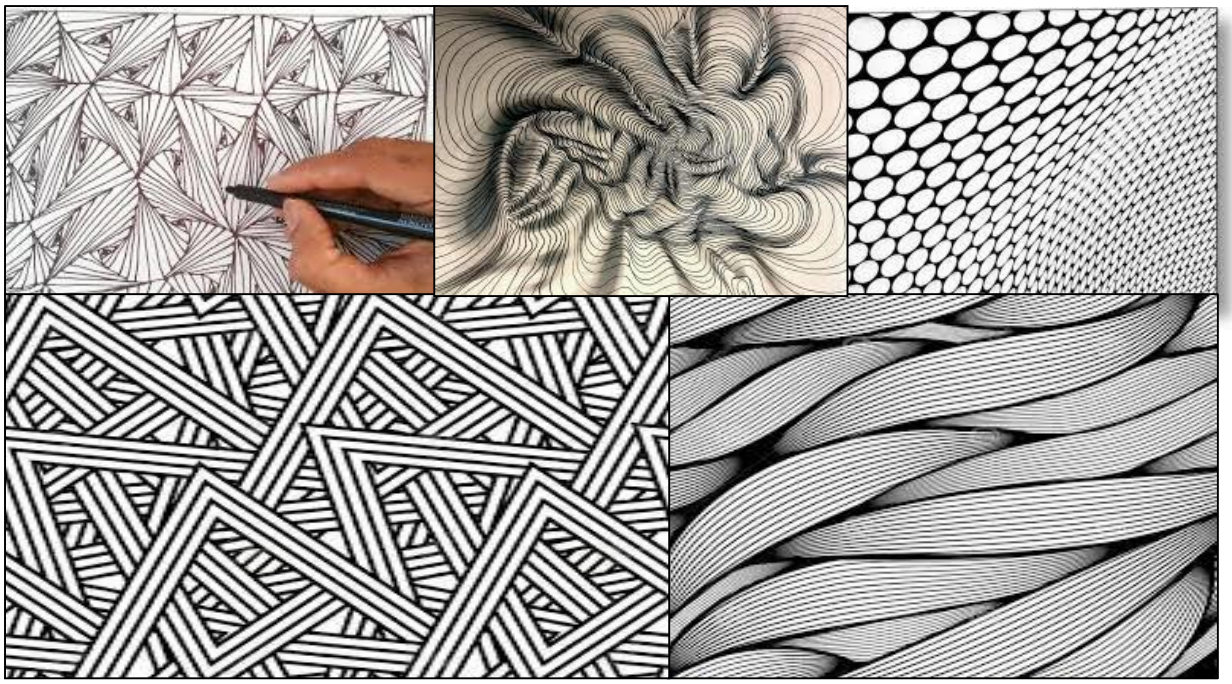
- Long, short or anything in between
- Thick, thin
- Smooth or rough
- Continuous, implied, dotted, dashed
- Change direction
- Change in degree of curve (curved Lines)
- Any of the above combined

A simple way of thinking of a line is to imagine a point that moves...

The most common use of line is showing where an object ends. This type of line is called a contour line. Contour lines are most commonly called outlines. Line can also create the illusion of form in a drawing. Line quality is the thickness or thinness of a line. By varying the line quality an artist can show form in a drawing with just the use of line.

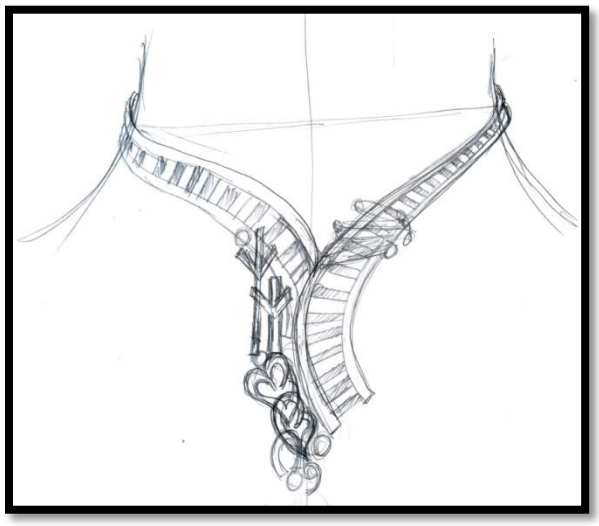
Line can also indicate shadow and form through the use of cross contour lines. Cross contour lines follow the contours of the object, much like running your finger around the form of an object.

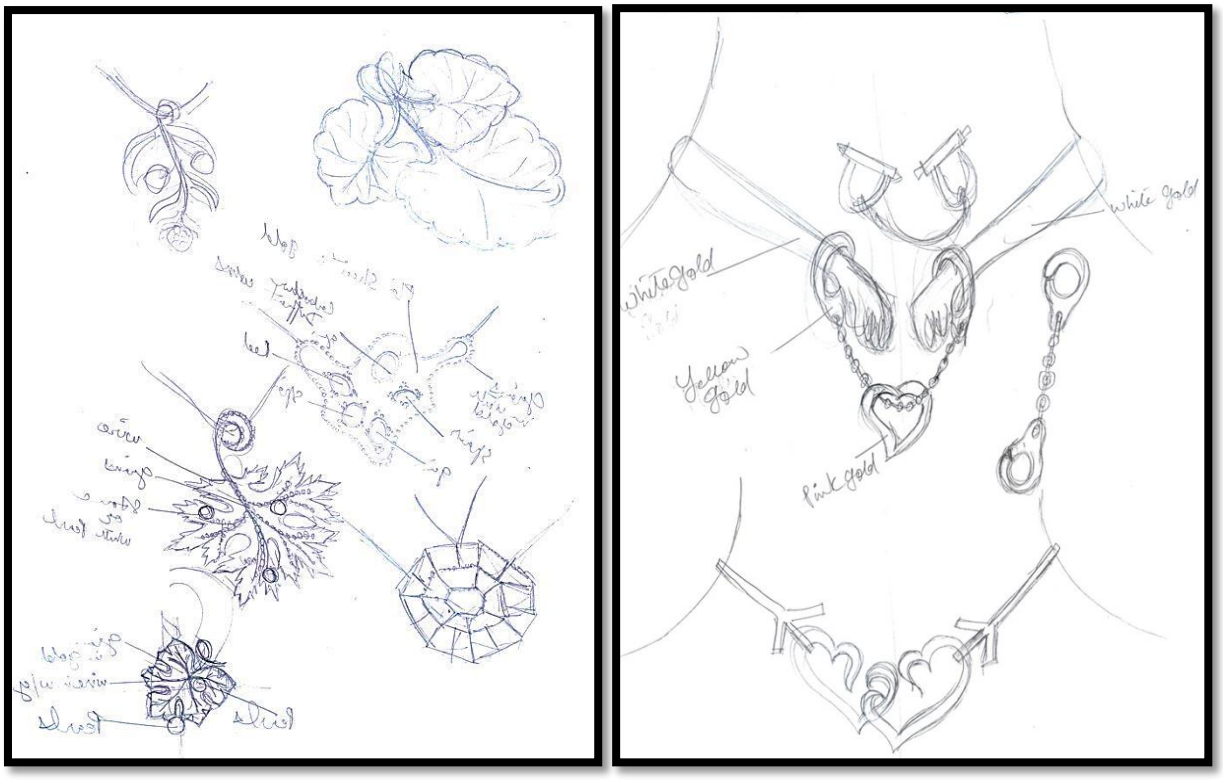




PRACTICAL No. 3: DRAW AND PRACTICE THE PATTERNS WITH VARIATION OF LINES

Practice on free hand sketching of different objects as per designs of the article or in the pictures.





PRACTICE No. 4: SKETCH ANY TWO OBJECTS AROUND YOU

Perform free hand sketching of any two object such as; cup, chair, leaf or any jewellery article around you while following the below mentioned nine sketching techniques.

Sketching and drawing techniques

- Hatching and cross hatching. Hatching is one of the most basic drawing techniques.
- Tonal sketching. Unlike hatching and cross hatching, the tonal approach has no visible lines.
- Keep your paper smudge free with another sheet of paper
- Blending.
- Accent lines.
- Use your eraser to define form.

Nine (9) Sketching Techniques:

When you're beginning to learn in drawing, picking up a pencil is generally the first thing you do. But, that's where many of us stop; we learn how to doodle, but don't go beyond the basics. If you're unfamiliar with drawing with a pencil—beyond stick figures or scribbles, there

are sketch techniques that you need to know. We will go over nine of them that will get you well on your way to more advanced drawings.

Choosing the right materials

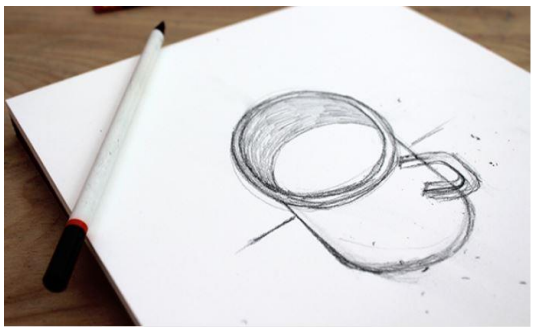
1. **Before you start, learn about graphite.**

Graphite comes in a variety of scales. Did you ever notice that your standard pencil says HB? That's not arbitrary. It refers to the density of the lead. A pencil that says "H" is going to be harder and will therefore make lighter, crisper lines. Alternatively, a "B" indicates that the graphite is soft, and it's perfect for drawing deep, rich darks. So, HB is right in the middle. For sketching, it's important to have a range of pencils.

2. **Paper is important.**

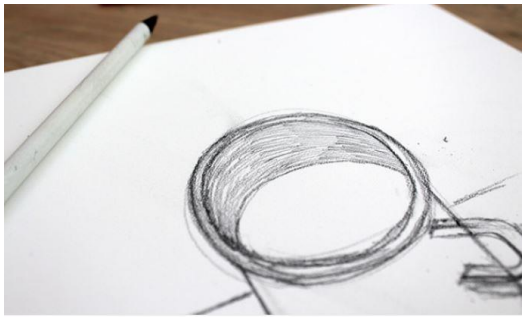
Like graphite, your paper choices are seemingly endless. It can vary in tone (looking "warm" or "cool") and texture, with a smooth finish or "toothiness." When trying to select sketching paper, look for something that is optimized for graphite.

3. **Composition and form**



To make something less daunting, start with simple shapes. Pick a coffee mug to try out sketch techniques. It's relatively easy to draw because it can be easily broken down into basic shapes. Try the same thing, pick something and study it for a couple of minutes. Ask yourself: What are the defining shapes? Where do they overlap? With the coffee mug, a circle makes up the lip of the cup, and an oval makes up the body. Overlap the lines/ areas in which the shapes meet.

4. **When drawing, check your angles with simple trick.**



While drawing the handle of coffee mug, notice that it was foreshortened, meaning that part of it is facing closer to me and looks distorted. To get the angle of the handle correct, use this trick: Hold your pencil and line it up to the angle that you're trying to replicate. Then, bring your pencil directly to the paper, without moving it. That will ensure you have the right (pun intended) angle!

5. Sketching approaches

Hatching and cross hatching

Hatching is one of the most basic drawing techniques. To create volume and shading, draw lines that follow the curve of a line. These lines do not touch. Cross hatching is layered hatching, where the lines intersect. The distance between the lines and intersections will determine how dark an area is.

Tonal sketching

Unlike hatching and cross hatching, the tonal approach has no visible lines. To do this, sweep your pencil back and forth across the page in a fluid motion. With this technique, pressure and graphite scale is important. The harder you press, the darker the tone will appear.

6. Blending

Build on the tonal technique with blending. Simply use your finger or blending stick to create a smooth, even surface. (Wash your hands afterward!)

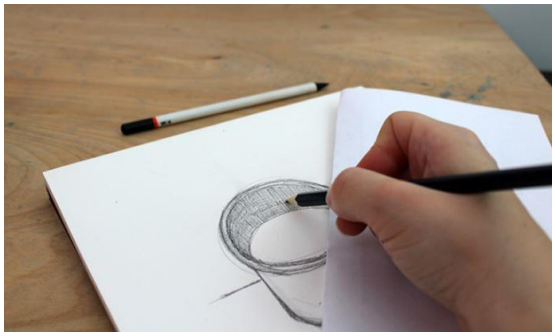
7. Accent lines

Accent lines don't necessarily build form, but they add style to your drawing. Wood grain, for instance, is a great example of decorative accent lines you can incorporate.

8. Use your eraser to define form

Highlights are a great way to define and build form. Bright, crisp shapes will make something look extra shiny, but this can get muddled the way more you draw. Once you're done drawing, use a clean eraser to bring the white of the paper bag. Use this technique sparingly, however—you don't want your drawing to look fake!

9. **Keep your paper smudge free with another sheet of paper**



It seems counter intuitive, but this really works. To avoid smudging your artwork as you draw, place of piece of paper on top of your drawing. Rest your hand on it while you sketch

LEARNING UNIT 2: DRAW TECHNICAL DRAWINGS OF JEWELLERY ARTICLES

Objectives:

In this learning unit you will learn the construction of technical drawing of various jewellery articles by developing fundamental shapes and forms. The trainee will be able to understand the use of Jewellery measuring instruments by following international measuring systems for gems and jewellery. The creation of perspective, isometric, orthographic and three (3) dimensional views will help to have better understanding of manufacturing and wearabilty of rings, pendants, earrings etc.

LEARNING OUTCOMES:

The trainee will be able to:

- Analyze jewellery article on measurements
- Draw three views of the jewellery article
- Draw cross sections.
- Mark dimensions on the drawing
- Add design elements to three views.
- Draw drawing panel.

BASIC CONCEPTS:

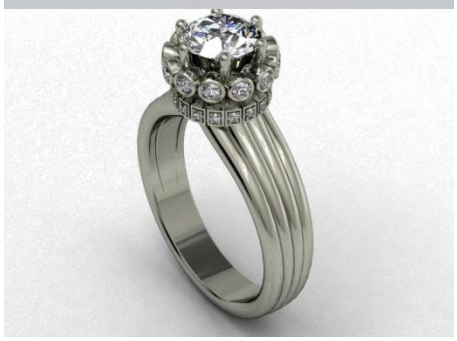
Difference between Jewellery Motif & Article

Jewellery Motif:

It is defined as a recurrent of image, idea or symbol that develops or explains the theme.

Jewellery Article:

It is defined as a combination of motives in repetitive order with or without moving links that shows functional, esthetic and wearable features.



PRACTICAL No. 1: DRAW ANY TWO JEWELLERY ARTICLES ON SCALE

International Measuring Systems

Before starting drawing any figure in Matrix we must be aware of international measuring systems and units used in the Jewellery CAD software.

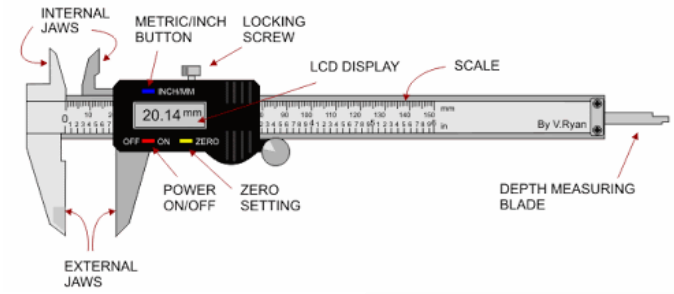
EASURE SYSTEM	DISTANCE (Length)	WEIGHT
American System (S.I)	Kilometer, Meter, Centimeter, Millimeter	Kilogram, Gram, Milligram , carat
British System (B.S)	Miles, Yard , Foot, Inch	Pounds , Ounce

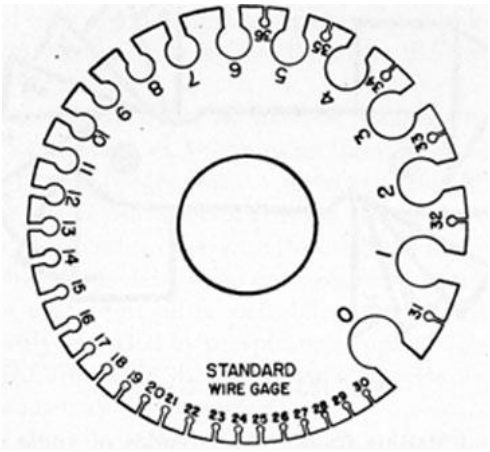
Few conversion factors are: 1 inch = 25.4 mm, 10 mm = 1cm, 1gm = 5 Carat

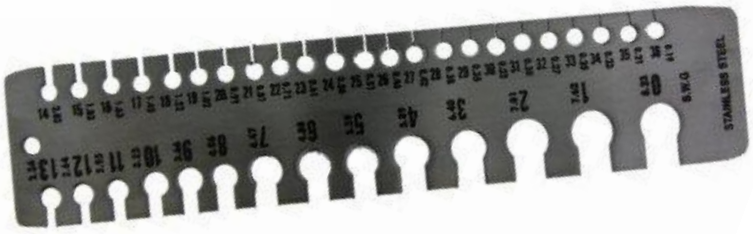
Jewellery Measuring Instruments and Gauges

The measuring instruments are as under**:**

- Steel Rule
- Wire Gauge
- Vernier Caliper

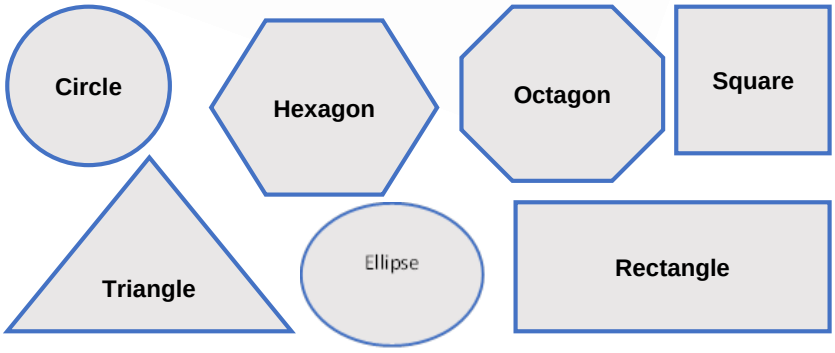




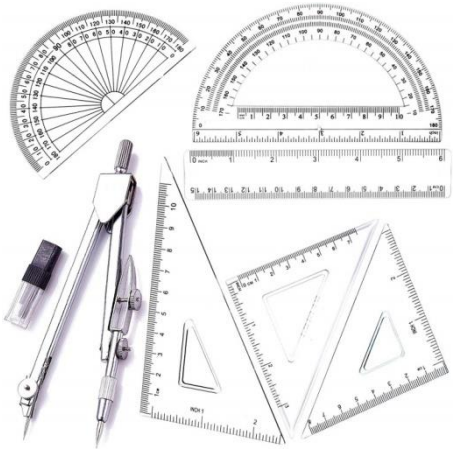


Geometrical shapes

The geometrical shapes can be drawn manually by using geometry box at accurate angles. The 2D geometrical shapes are also called as 2-D Primitives shapes. Few basic 2d shapes namely as rectangle, circle, ellipse, triangle, Square and other polygons, pentagon and hexagon.



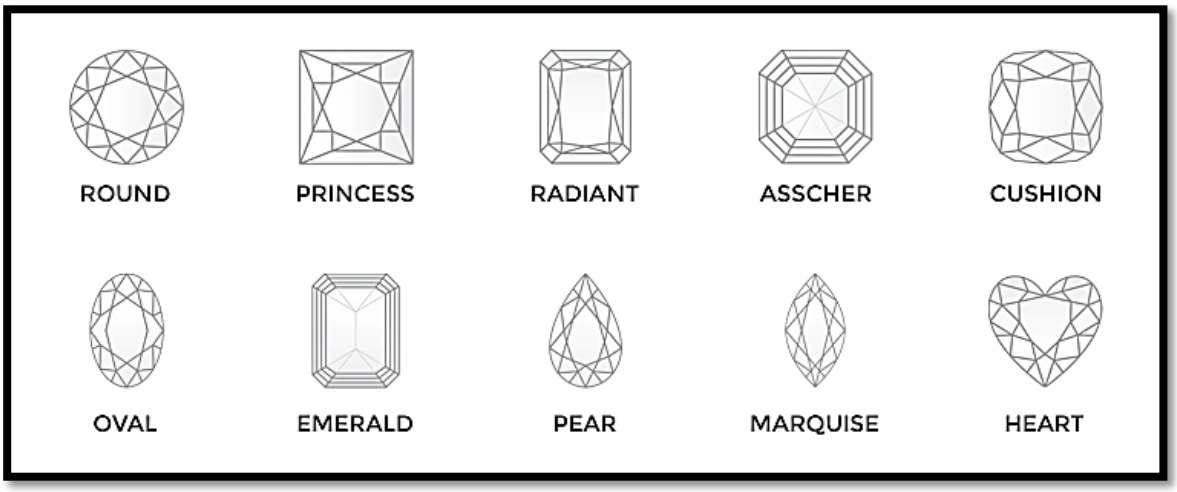
Use of geometry tool set



The following instruments are used to draw accurate geometrical figures .These include ruler, dividers, protractor, set squares, compass, T-square etc.

Gemstone shapes and cuts

Gemstones may come in a variety of shapes, such as round, pear, square, octagon, oval, heart, and triangular, among many others. Each of these shapes may be fashioned into many different cuts, depending on the jeweler's choice of exposing the gemstone's many facets. There shapes are as under:



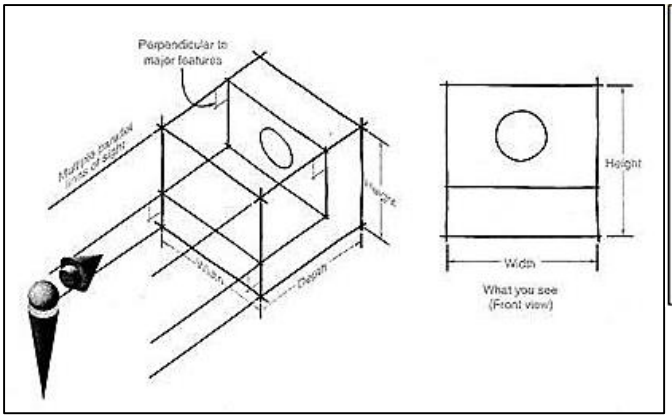
Wear-ability parameters of jewellery designs

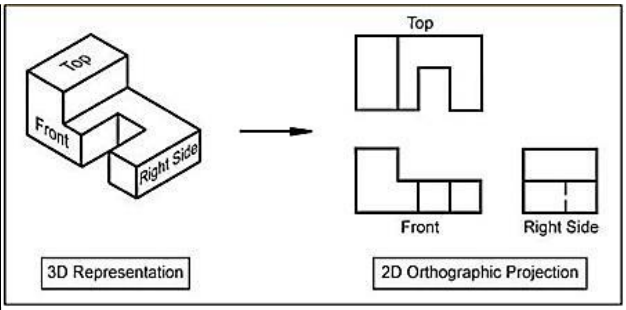
Wear-ability is an essential and core aspect of jewellery article which depends upon the following parameters.

- Design balance and proportion
- Attractive aesthetic look
- Free of pointed and sharp edges
- Fine finishing
- Adequate Weight
- Adequate size

Orthographic (3D) projections of jewellery elements

The type of drawing in which parallel projection is used for the preparation of the drawing of an object. These lines are perpendicular to the plane. In this drawing, it is assumed that the object is at infinity. The shape of an object is seen in actual size in such drawing. A plane is an imaginary surface on which pictures are prepared imaginably. Then it is transferred to the paper. This plane is faced toward the object whose view is to be prepared.





Generally, three views of an object are prepared. These are Top View, Front View, and Side View.

1. **Front View:**

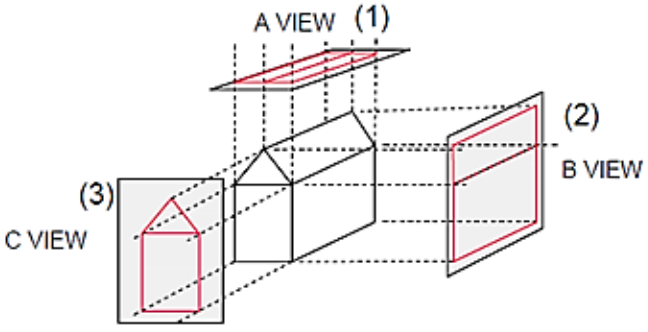
This view is prepared by placing the object in front. The length and height of an object are shown in this view.

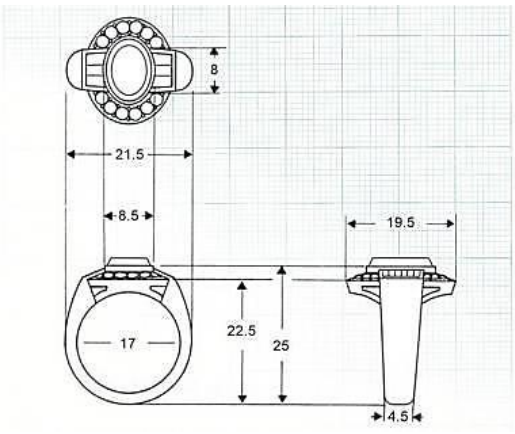
2. **Top View:**

This view is prepared by looking to the object from the upper side. The length and breadth of the object are shown in it.

3. **Side View:**

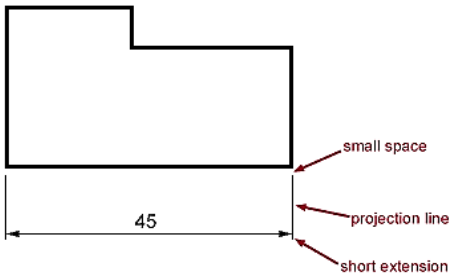
This view is prepared by looking to the object from the right side or left side. The breadth and height of the object are shown in it.





Dimensioning

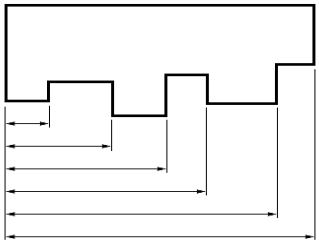
It is defined as the process of measurement of an object either linearly, aligned, diametrically or radially.



Types of Dimensioning

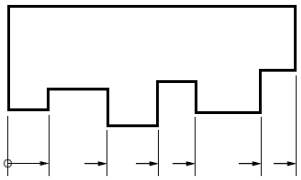
1. Parallel Dimensioning

Parallel dimensioning consists of several dimensions originating from one projection line.



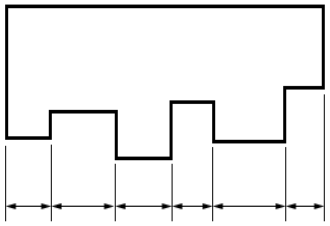
2. Superimposed Running Dimensions

Superimposed running dimensioning simplifies parallel dimensions in order to reduce the space used on a drawing. The common origin for the dimension lines is indicated by a small circle at the intersection of the first dimension and the projection line.



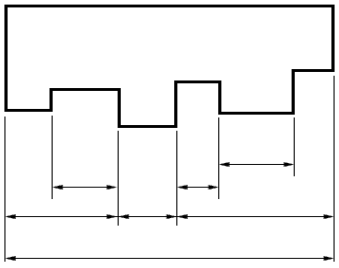
3. Chain Dimensioning

Chain dimensioning simplifies parallel dimensions in order to reduce the space used on a drawing.



4. Combined Dimensions

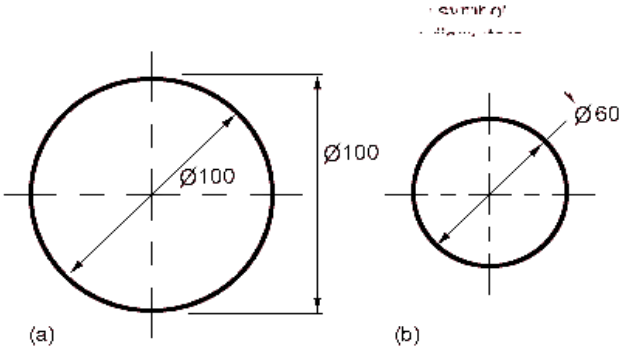
A combined dimension uses both chain and parallel dimensioning.



Dimensioning of circles

(a) Shows two common methods of dimensioning a circle. One method dimensions the circle between two lines projected from two diametrically opposite points. The second method dimensions the circle internally.

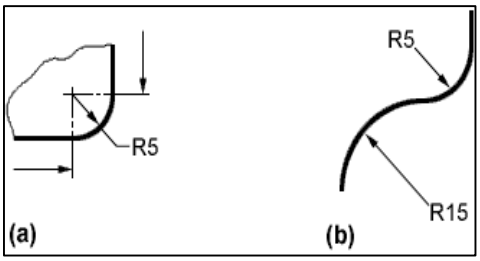
(b) is used when the circle is too small for the dimension to be easily read if it was placed inside the circle.



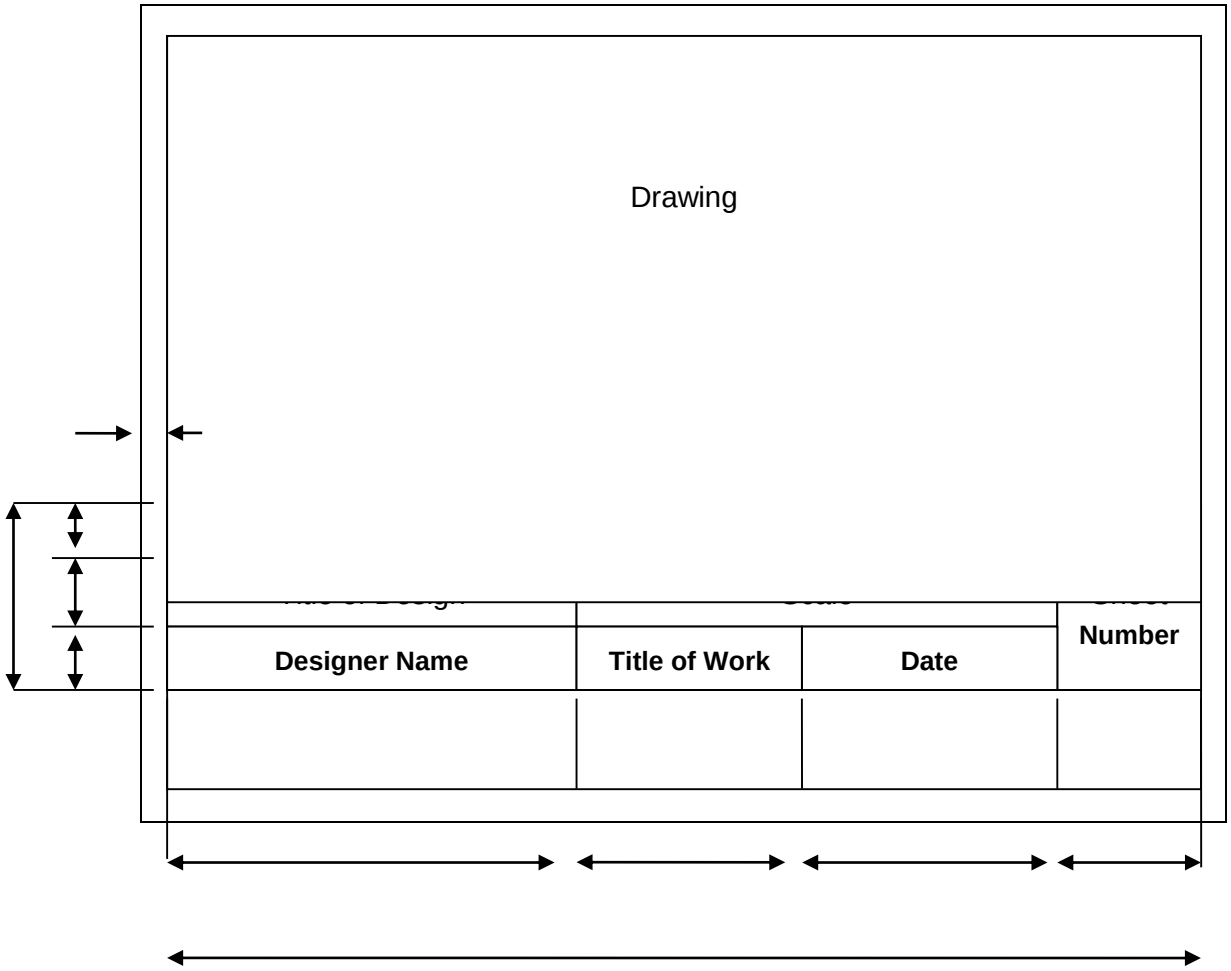
Dimensioning Radii

All radial dimensions are preceded by the capital **R**.

- (a) Shows a radius dimensioned with the centre of the radius located on the drawing.
- (b) Shows how to dimension radii which do not need their centres locating.



Page setup



ANGLE OF PROJECTIONS & PERSPECTIVE VIEWS (1-POINT & 2-POINT)

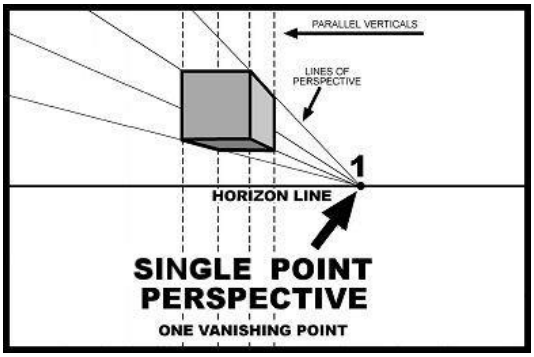
Perspective definition

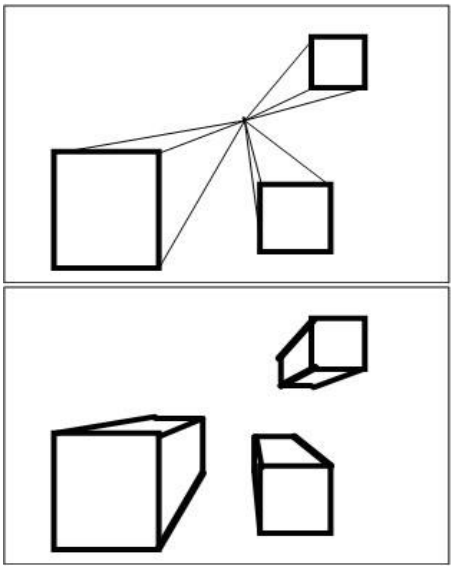
- The art of picturing objects or a scene in such a way, e.g., by converging lines (linear perspective), as to show them as they appear to the eye with reference to relative distance or depth
- the appearance of objects or scenes as determined by their relative distance and positions

- the effect of relative distance and position

One-point perspective

In one-point perspective, all lines converge to a single point on the horizon.



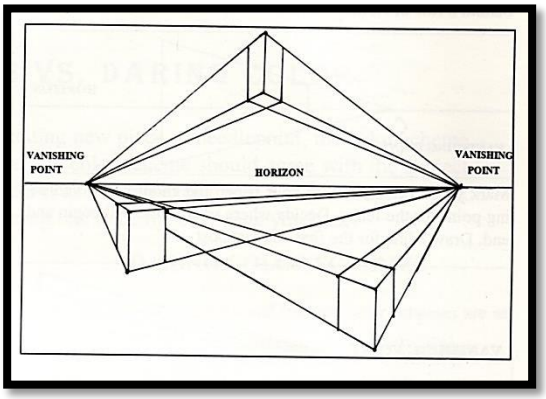


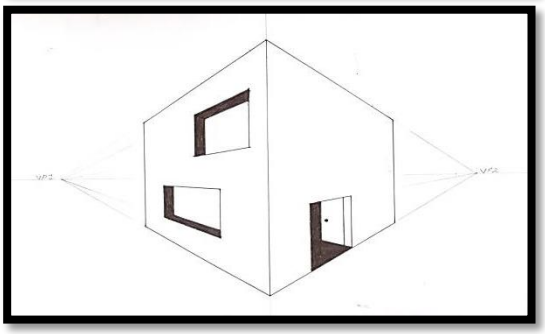
Two-point perspective

The type of perspective in which parallel lines along the width and depth of an object are represented as meeting at two separate points on the horizon that are 90 degrees apart as measured from the common intersection of the lines of projection

Two-point perspective addresses the drawing issues we face rendering our subject from the side, where horizontal lines converge to two points on the horizon

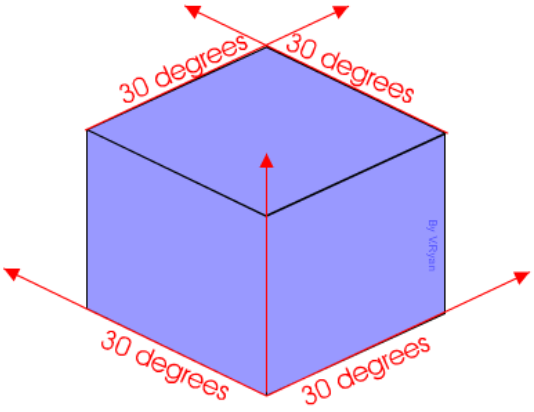
Ref :https://www.handprint.com/HP/WCL/perspect3.html https://en.wikipedia.org/wiki/Perspective_(graphical)#One-point_perspective

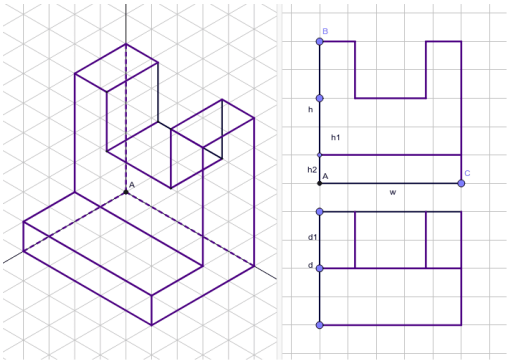


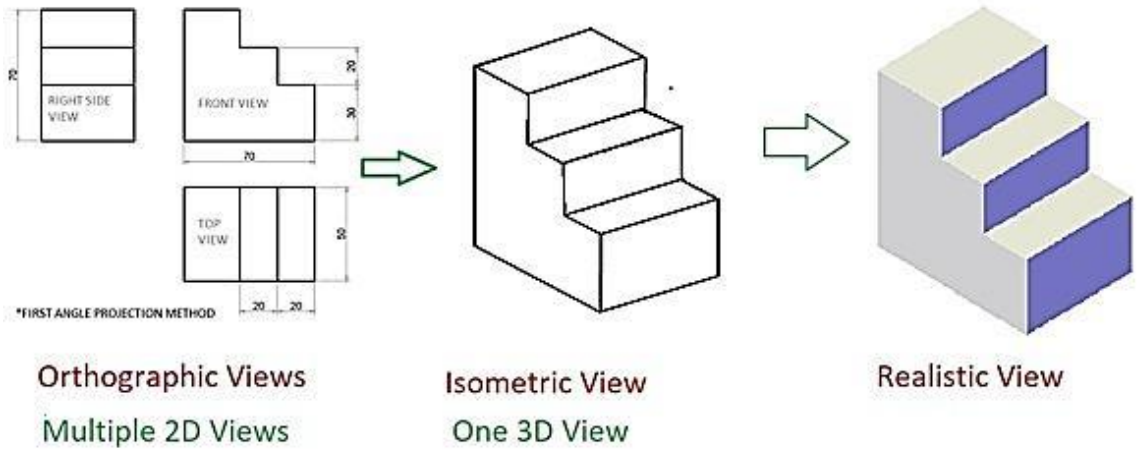


Isometric View and Projection

Isometric projection is a two-dimensional representation for viewing a three-dimensional object with the three primary lines equally tilted away from the viewer. The angles to draw the isometric projections are 30 and 60 degree.







Frequently Asked Questions

Test Yourself (Multiple Choice Questions)

Introduction

The learner guide for Gems and Jewellery sector of "Jewellery CAD/CAM" will provide an insight to the development of the Gem and Jewellery industry on modern means of technological advancements. It will provide an opportunity to the learner in better understanding of the use of Jewellery CAD/CAM software in providing state of the art solutions to the customers. A special care is observed in designing the learner guide to bring an easy solution in understanding with examples and practical exercises for your first time users and also it will bring a lot learning opportunities for the mid-career workers in the sector. Programme is to engage young people with a programme of development that will provide them with the knowledge, skills and understanding in working as a well professionally groomed worker or even starting own venture as an entrepreneur. The programme has been developed to address specific issues, such as the national, regional and local cultures, the manpower availability within the country, and meeting and the exceeding needs and expectations of their customers. The main elements of your Teaching and Learning Material are:

- **Introduction:**
  - This includes a brief description of your guide and guidelines for you to use it effectively.
- **Modules:**
  - The modules form the sections in your Teaching and Learning Material.
- **Learning Units:**
  - Learning Units are the main sections within each module
- **Learning outcomes**:
  - Learning outcomes of each learning units are taken from the curriculum document
- **Learning Elements:**
  - This is the main content of your Teaching and Learning Material with detail of the knowledge and skills (practical activities, projects, assignments, practices etc.) you will require achieving learning outcomes stated in the curriculum.
  - This section will include examples, photographs and illustrations relating to each learning outcome
- **Summary of modules**:
  - This contains the summary of the modules that make up your Teaching and Learning Material
- **Frequently asked questions**:
  - These have been added to provide further explanation and clarity on some of the difficult concepts and areas. This further helps you in preparing for your assessment.
- **Multiple choice questions for self-test**:

- These are provided as an exercise at the end of your Teaching and Learning Material to help you in preparing for your assessment.

MODULE: 2 CREATE COMPUTER AIDED DRAWING OF BASIC LEVEL JEWELLERY

OBJECTIVE:

The purpose of this module is to enable the trainee in understanding the importance and role of CAD/CAM in jewellery field. Furthermore it describes the use of setup interface of jewellery CAD software, creating 2D drawings, designing of simple jewellery article along with its presentation.

MODULE SUMMARY

This module is an essential milestone in designing and understanding of the fundamentals of jewellery article on computer aided software at basic level. It will cover the basic elements and principles of design that how trainee will transfer ideas in to practical jewellery article on CAD software. Furthermore it emphasizes the designing of jewellery article conceptually following manufacturing techniques to produce jewellery article with precision and accuracy. It covers the Setup interface of Jewellery CAD software, creating 2D and 3D drawings and to perform Basic level Rendering.

The course learning units are arranged in such a way to integrate concepts and ideas related to each topic through tools and application-oriented projects. This makes the learning simple and systematic and enables one to gain more insight knowledge on the various tools covered.

LEARNING UNIT 1: SETUP INTERFACE OF JEWELLERY CAD SOFTWARE

LEARNING OUTCOMES

You will be able to:

- Analyze jewellery article on measurements (Rings, Earing, Bangles and Pendants).
- Set up canvas in CAD Jewellery software.
- Scan and import image of manual 2D drawing if required

MATERIALS REQUIRED

- Computer Machine as per software compatible

- Operating system (Windows Pack)
- Jewellery Design Software (Rhinoceros 3D & Matrix)
- Steel Ruler
- Ring Sizer
- Vernier Caliper

LEARNING UNIT 2: CREATE 2D DRAWINGS

LEARNING OUTCOMES

You will be able to:

- Draw three views of the jewellery article
- Mark dimensions on the drawing
- Add design elements to three views.
- Draw cross sections

MATERIALS REQUIRED

- Computer Machine as per software compatible
- Operating system (Windows Pack)
- Jewellery Design Software (Rhinoceros 3D & Matrix)
- Digital Vernier Callipers
- Steel Rule
- Wire Gauge
- Ring Sizer
- Bangle Sizer

LEARNING UNIT 3: CREATE 3D DRAWINGS

LEARNING OUTCOMES

You will be able to:

- Generate 3D surface using profiles, cross sections etc.
- Place simple design components (Gemstone, metal inserts etc.) on jewellery article if required.
- Assign material to 3D model and calculate weight of jewellery article and its components

MATERIALS REQUIRED

- Machine as per software compatible
- Operating system (Windows Pack)
- Jewellery Design Software (Rhinoceros 3D & Matrix)
- Digital Vernier Callipers
- Steel Rule
- Wire Gauge
- Ring Sizer
- Bangle Sizer

LEARNING UNIT 4: PERFORM BASIC LEVEL RENDERING

LEARNING OUTCOMES

You will be able to:

- Prepare 3D model for presentation.

- Apply pre-set parameters as per environment
- Render 3D model

MATERIALS REQUIRED

- Machine as per software compatible
- Operating system (Windows Pack)
- Jewellery Design Software (Rhinoceros 3D & Matrix)
- Paper Printer (Colour)
- Steel Rule
- Paper cutter
- Ring Filer

BASIC CONCEPTS

CAD/CAM has become a necessary tool in designing and manufacturing of jewellery. It emphasizes the creation of conceptual jewellery both qualitatively and quantitatively. Candidates will learn to translate concepts into creative patterns by using CAD software. It will develop creative and technical skills to enhance designing and manufacturing capabilities.

COMPUTER AIDED JEWELLERY DESIGNING (CAD)

CAD is defined as effective and efficient use of computers to assist the design process. Computer-aided designing involves the use of computer systems to assist in the creation, modification, analysis, or optimization of a design.

COMPUTER AIDED JEWELLERY MANUFACTURING (CAM)

Computer Aided Jewellery Manufacturing (CAM) is the manufacturing process of jewellery article based on the modern techniques on computer. It involves the integration of CAD engineering data and the computerized equipment which manufactures the jewellery products. Computer aided manufacturing is “the use of computers for managing manufacturing processes.”

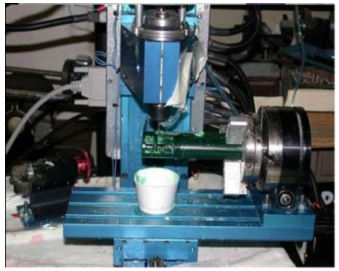
CAD / CAM (computer-aided design and computer-aided manufacturing) is a term that refers to computer systems that are used to both design and manufacture of jewellery products. CAM system takes a CAD design made in a 3D environment. CAD design is then manipulated according to defined parameters and resulting information is fed to CAM Machine. CAM Machine then starts working on stack. These machines are controlled by computer with minimal operator’s interaction to enhance and facilitate greater control over quality. It also allows machine to monitor the maintenance of its parts

TYPES OF CAM MACHINES

There are mainly two (2) types of CAM machines.

1. CNC Machine (Computer Numerically Controlled)
2. RP Machine (Rapid Prototype)

ROLE OF CAD /CAM IN JEWELLERY



The jewellery industry uses computer-aided design (CAD) and computer aided modeling (CAM) technology for designing, drafting and tracing of a jewellery motive. CAD/CAM software systems are capable to present 3D solid and surface models. These software can also frequently allow rotations in three dimensions, allowing viewing of a designed object from any desired angle, even from the inside looking out. CAD/CAM is used in the model design of complex creations of jewellery as well as in simple patterns.

CAD/CAM has become an especially important technology within the scope of computer-aided technologies, with benefits such as lower product development costs and a greatly shortened design cycle. CAD/CAM enables designers to layout and develops work on screen, print it and save it for future editing, saving time on their drawings

SIGNIFICANCE OF CAD/CAM IN JEWELLERY

CAD/CAM software is much more efficient in modeling for Jewellery products

- The output for RP is much accurate and precise
- Experienced users of CAD software can spend 3-5 times less time in manual designing and drafting of jewellery article.
- Users can model a design with less time if they are familiar with basic CAD.
- These software have additional useful time efficient functions for jewellery designing and making
- These software have extensive built in library for jewellery modeling
- In terms of price & production performance, CAD software will be more justified to use

STRENGTH OF CAD

CAD Software can deliver powerful, easy, artistic tools, including the ability to create a 3D model directly from a digital image. Scan in a photo, and Software will create an organic, sculpted piece using the highlights and shadows as guidelines for height.

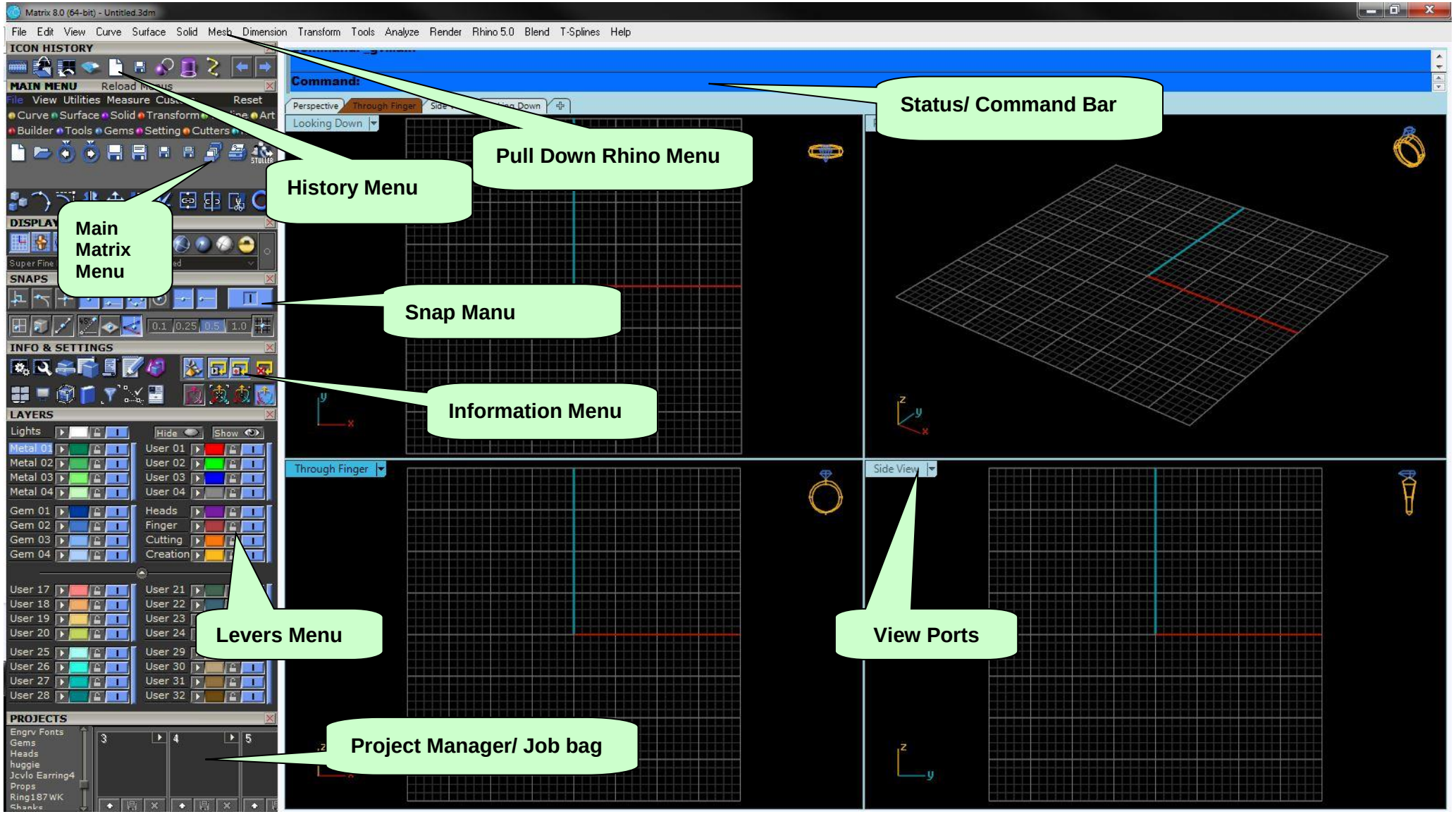
Drafting using computers became a reality when graphics were added (CAD used to mean computer aided drafting). From Picture to Sculpture look into the picture.

REQUIREMENT OF COMPUTER MACHINE FOR JEWELLERY CAD SOFTWARE:

The following Specification of Computer Machine required as per jewellery CAD software Matrix 8.0 and Rhinoceros 5.0

Specifications	**Minimum Requirement**	**Specifications**	**Minimum Requirement**
Processor Speed	Minimum Core i5	Operating system	MS-Windows 7 (Recommended Windows 10)
RAM	Minimum 8 GB	Software (Jewellery Dedicated)	Rhinoceros 5.0
Hard Disk	Minimum 500 GB		Matrix 8.0
VGA Card	NVIDIA 1GB		

GRAPHICAL INTERFACE OF JEWELLERY DESIGN SOFTWARE (GEMVISION MATRIX)



MENU 'S DESCRIPTION

Main Pull Down Rhino Menu

History Menu

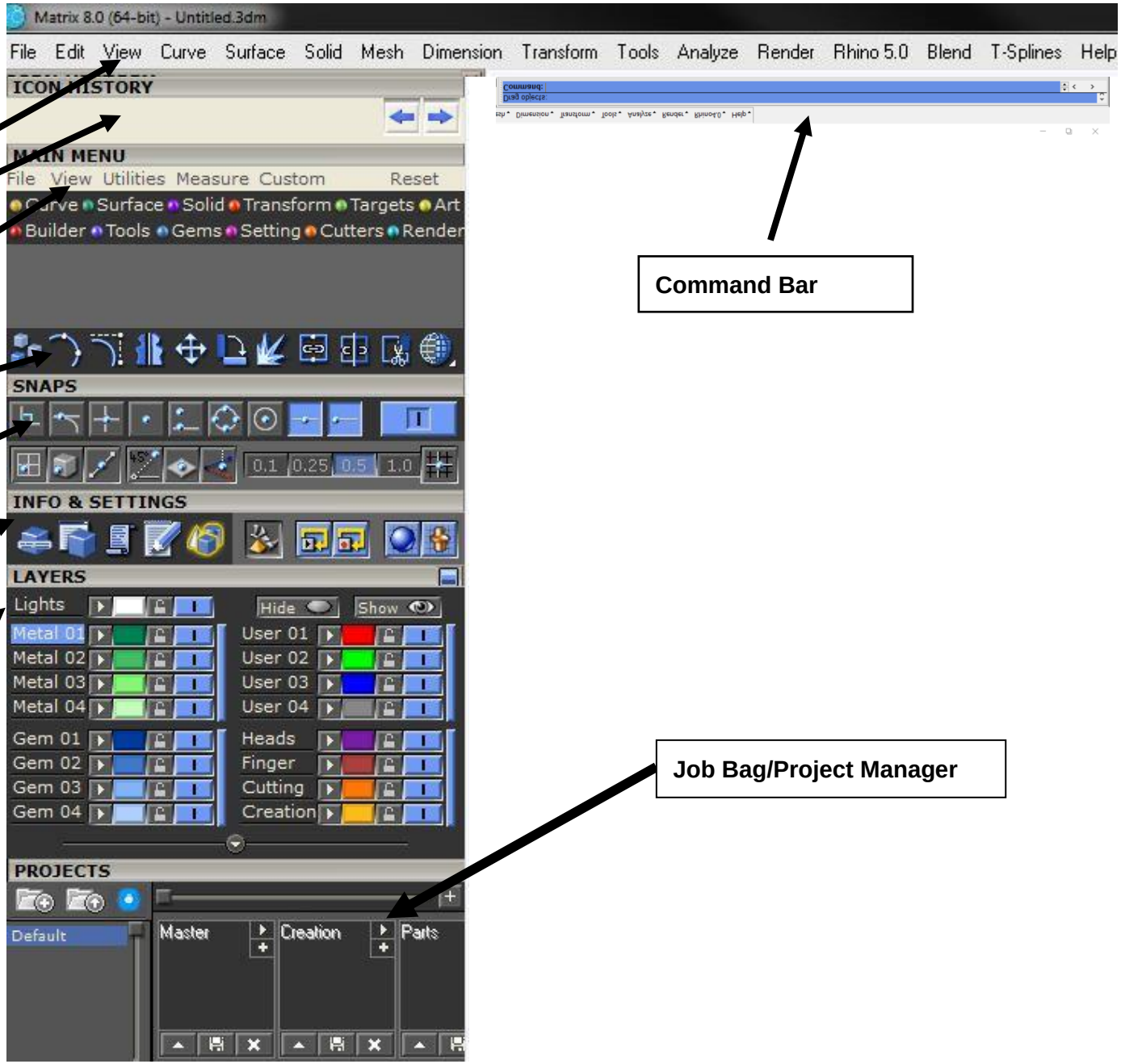
Matrix Main Menu

Top 11 Tools Menu

Osnap Menu

Information Menu

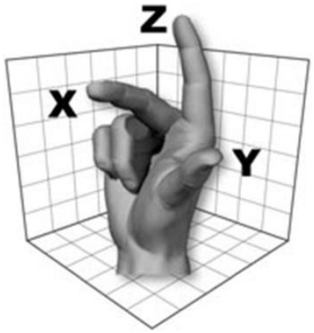
Layer Menu



Command Bar

Job Bag/Project Manager

COORDINATE REFERENCE AXIS:

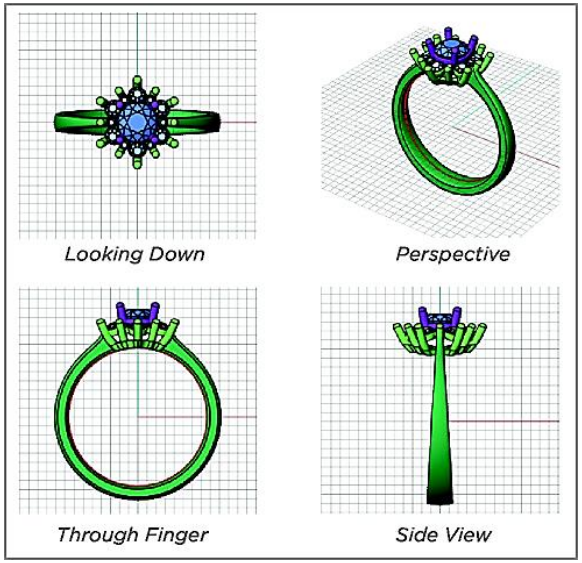


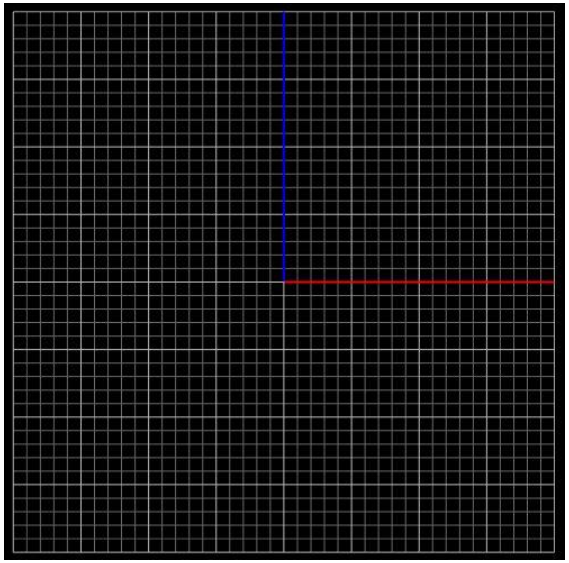
X, Y and Z are reference axis used to specify and construct the required object on Grid.

These X, Y and Z axis are at 90 degree to each other.

GRID

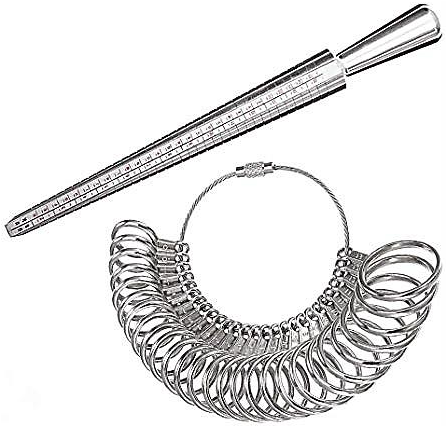
- Grid or graph is comprised of equal horizontal and vertical lines to construct any object on actual scale.
- The smallest box is of 1-mm and large box is of 05 –mm.
- The 40x40mm grid is broken into 1 x 1 mm squares indicated by the light grid lines and 5 X 5 mm squares indicated by the LIGHTER grid lines.





ANALYZE JEWELLERY ARTICLE ON MEASUREMENTS

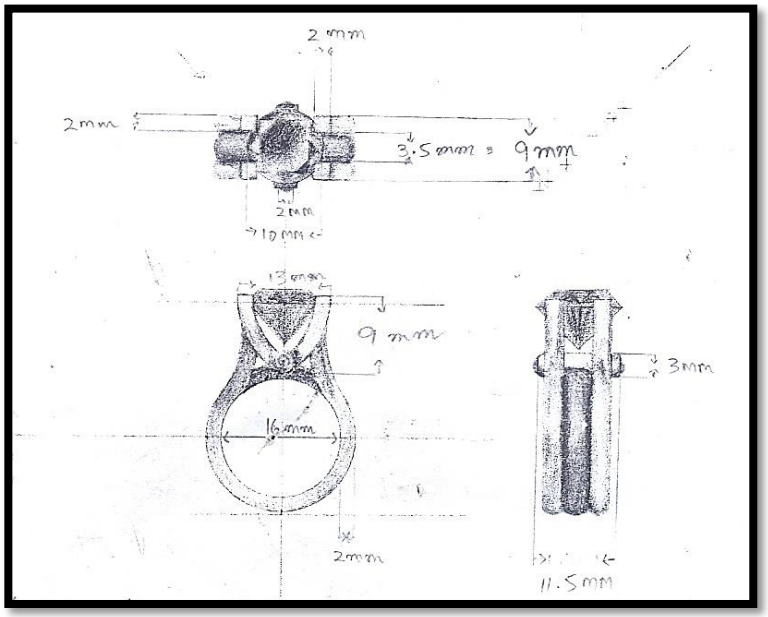
- First of all we have to analyze the jewellery article from all views
- Then we have to note its critical dimensions/ gauges by using the following tools.

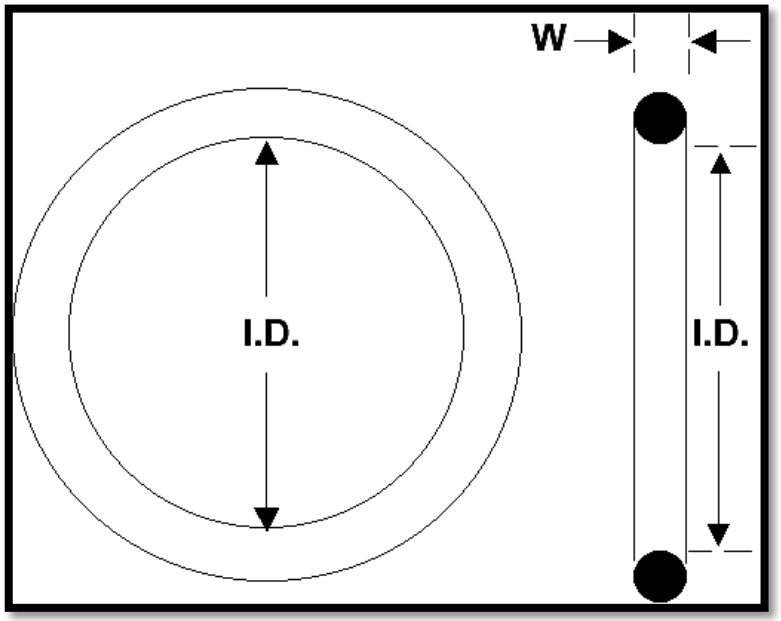


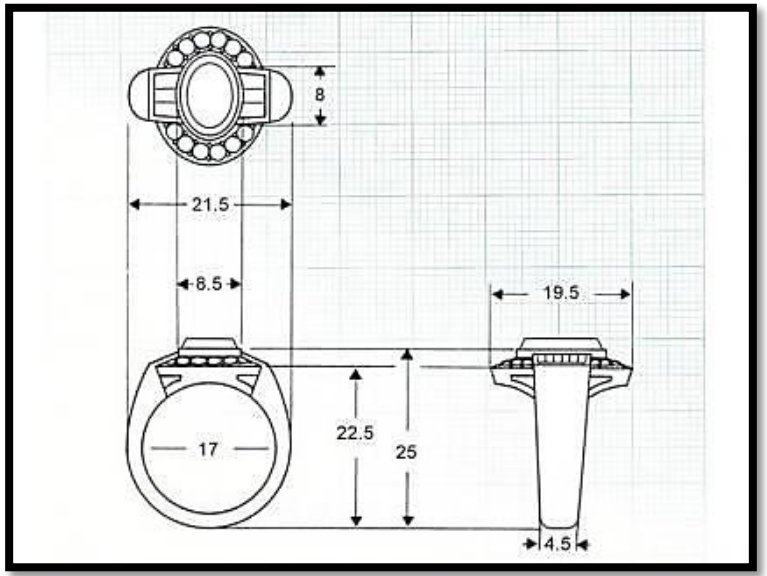
Measuring Tools

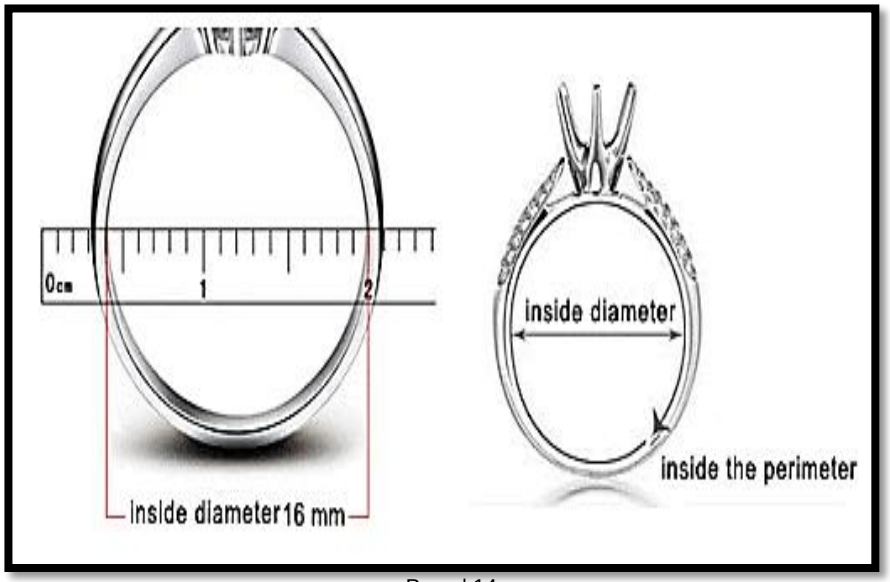
- Steel Ruler
- Ring Sizer
- Vernier Caliper

CRITICAL DIMENSIONS

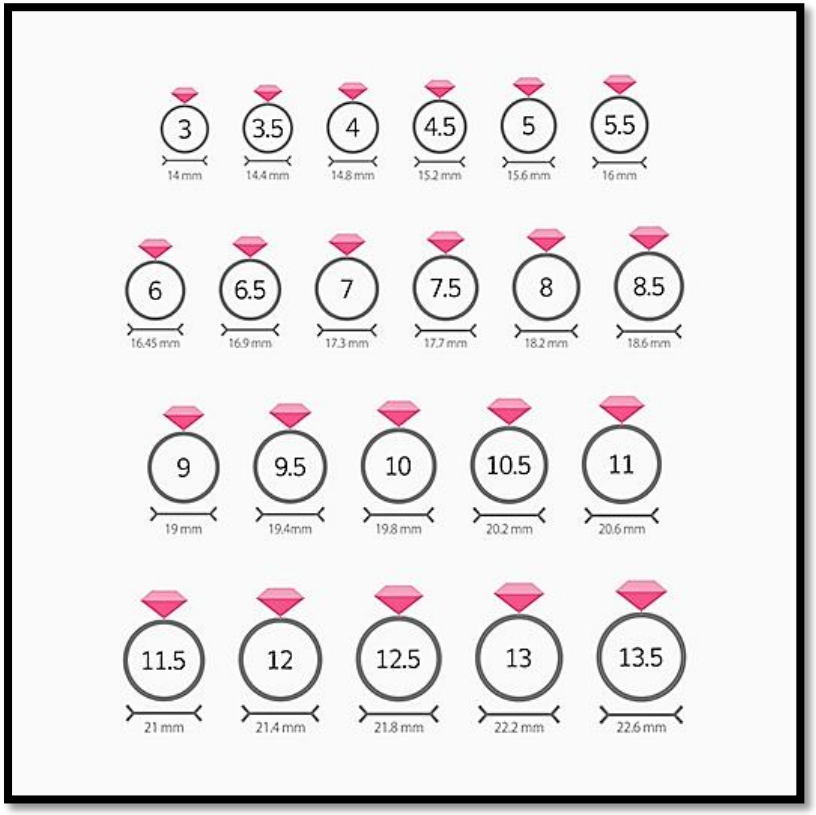








RING SIZER


3
14 mm
3.5
14.4 mm
4
14.8 mm
4.5
15.2 mm
5
15.6 mm
5.5
16 mm
6
16.45 mm
6.5
16.9 mm
7
17.3 mm
7.5
17.7 mm
8
18.2 mm
8.5
18.6 mm
9
19 mm
9.5
19.4 mm
10
19.8 mm
10.5
20.2 mm
11
20.6 mm
11.5
21 mm
12
21.4 mm
12.5
21.8 mm
13
22.2 mm
13.5
22.6 mm


1# (6mm Thick)
6mm
38mm
41mm
47mm
14mm
50mm
84g
89g
103g
109g
2# (9mm Thick)
9mm
38mm
41mm
44mm
14mm
47mm

INTERNATIONAL RING SIZE CHART

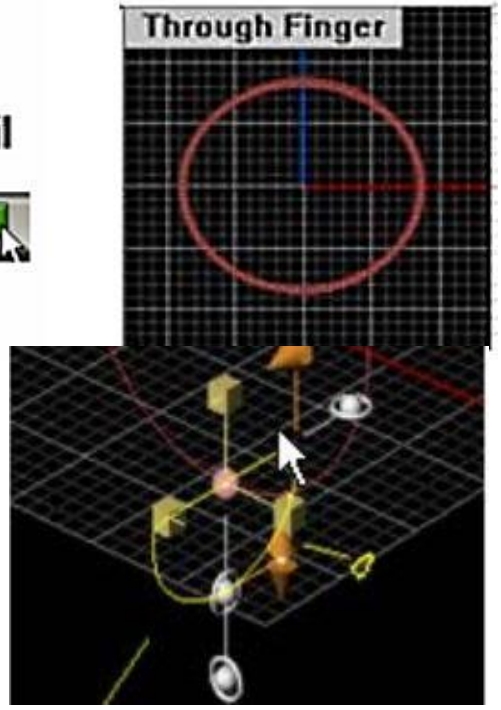
US Ring Size	Metric Ring Size	Diameter (mm)	Circum. (mm)	Material Thickness											
				10 ga. 2.6 mm	2.4 mm	2.2 mm	12 ga. 2.1 mm	2.0 mm	1.8 mm	14 ga. 1.6 mm	1.4 mm	16 ga. 1.3 mm	1.2 mm	18 ga. 1.0 mm	20 ga. 0.8 mm
1	39.0	12.4	39.0	47.1	46.5	45.9	45.6	45.2	44.6	44.0	43.4	43.0	42.7	42.1	41.5
1 1/2	40.2	12.8	40.2	48.4	47.8	47.1	46.8	46.5	45.9	45.2	44.6	44.3	44.0	43.4	42.7
2	41.5	13.2	41.5	49.6	49.0	48.4	48.1	47.8	47.1	46.5	45.9	45.6	45.2	44.6	44.0
2 1/2	42.7	13.6	42.7	50.9	50.3	49.6	49.3	49.0	48.4	47.8	47.1	46.8	46.5	45.9	45.2
3	44.0	14.0	44.0	52.2	51.5	50.9	50.6	50.3	49.6	49.0	48.4	48.1	47.8	47.1	46.5
3 1/2	45.2	14.4	45.2	53.4	52.8	52.2	51.8	51.5	50.9	50.3	49.6	49.3	49.0	48.4	47.8
4	46.5	14.8	46.5	54.7	54.0	53.4	53.1	52.8	52.2	51.5	50.9	50.6	50.3	49.6	49.0
4 1/2	47.8	15.2	47.8	55.9	55.3	54.7	54.3	54.0	53.4	52.8	52.2	51.8	51.5	50.9	50.3
5	49.0	15.6	49.0	57.2	56.5	55.9	55.6	55.3	54.7	54.0	53.4	53.1	52.8	52.2	51.5
5 1/2	50.3	16.0	50.3	58.4	57.8	57.2	56.9	56.5	55.9	55.3	54.7	54.3	54.0	53.4	52.8
6	51.5	16.4	51.5	59.7	59.1	58.4	58.1	57.8	57.2	56.5	55.9	55.6	55.3	54.7	54.0
6 1/2	52.8	16.8	52.8	60.9	60.3	59.7	59.4	59.1	58.4	57.8	57.2	56.9	56.5	55.9	55.3
7	54.0	17.2	54.0	62.2	61.6	60.9	60.6	60.3	59.7	59.1	58.4	58.1	57.8	57.2	56.5
7 1/2	55.3	17.6	55.3	63.5	62.8	62.2	61.9	61.6	60.9	60.3	59.7	59.4	59.1	58.4	57.8
8	56.6	18.0	56.5	64.7	64.1	63.5	63.1	62.8	62.2	61.6	60.9	60.6	60.3	59.7	59.1
8 1/2	57.8	18.4	57.8	66.0	65.3	64.7	64.4	64.1	63.5	62.8	62.2	61.9	61.6	60.9	60.3
9	59.1	18.8	59.1	67.2	66.6	66.0	65.7	65.3	64.7	64.1	63.5	63.1	62.8	62.2	61.6
9 1/2	60.3	19.2	60.3	68.5	67.9	67.2	66.9	66.6	66.0	65.3	64.7	64.4	64.1	63.5	62.8
10	61.6	19.6	61.6	69.7	69.1	68.5	68.2	67.9	67.2	66.6	66.0	65.7	65.3	64.7	64.1
10 1/2	62.8	20.0	62.8	71.0	70.4	69.7	69.4	69.1	68.5	67.9	67.2	66.9	66.6	66.0	65.3
11	64.1	20.4	64.1	72.3	71.6	71.0	70.7	70.4	69.7	69.1	68.5	68.2	67.9	67.2	66.6
11 1/2	65.3	20.8	65.3	73.5	72.9	72.3	71.9	71.6	71.0	70.4	69.7	69.4	69.1	68.5	67.9
12	66.6	21.2	66.6	74.8	74.1	73.5	73.2	72.9	72.3	71.6	71.0	70.7	70.4	69.7	69.1
12 1/2	67.9	21.6	67.9	76.0	75.4	74.8	74.5	74.1	73.5	72.9	72.3	71.9	71.6	71.0	70.4
13	69.1	22.0	69.1	77.3	76.7	76.0	75.7	75.4	74.8	74.1	73.5	73.2	72.9	72.3	71.6
13 1/2	71.3	22.7	71.3	79.5	78.9	78.2	77.9	77.6	77.0	76.3	75.7	75.4	75.1	74.5	73.8
14	72.6	23.1	72.6	80.7	80.1	79.5	79.2	78.9	78.2	77.6	77.0	76.7	76.3	75.7	75.1

SET UP OF COMMANDS FOR BASIC JEWELLERY ARTICLE

TO MAKE A SIMPLE BAND: The following command/ tools are used to create a simple band.

LEARNING UNIT 2: CREATE 2D DRAWING

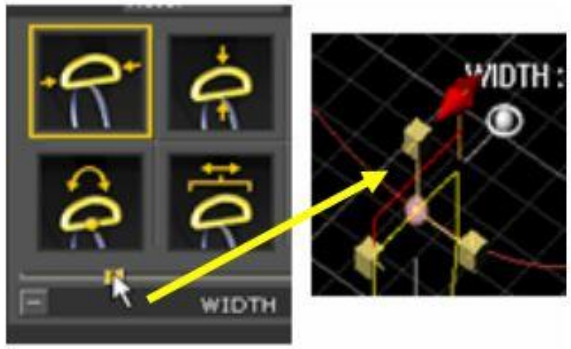
- Take a Ring rail (circle).
- Click on to Tools Menu
- Click Rail Ring
- Assign finger size in mm :…… then click function



- Click Profile Placer
- Load Ring Rail in vacant curve window
- This will show a profile placer along circumference of the ring rail.

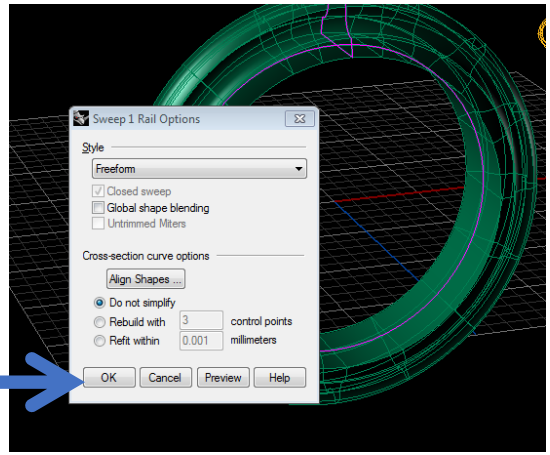
Adjust the following parameters

- Width = 3 mm
- Height = 2.5 mm

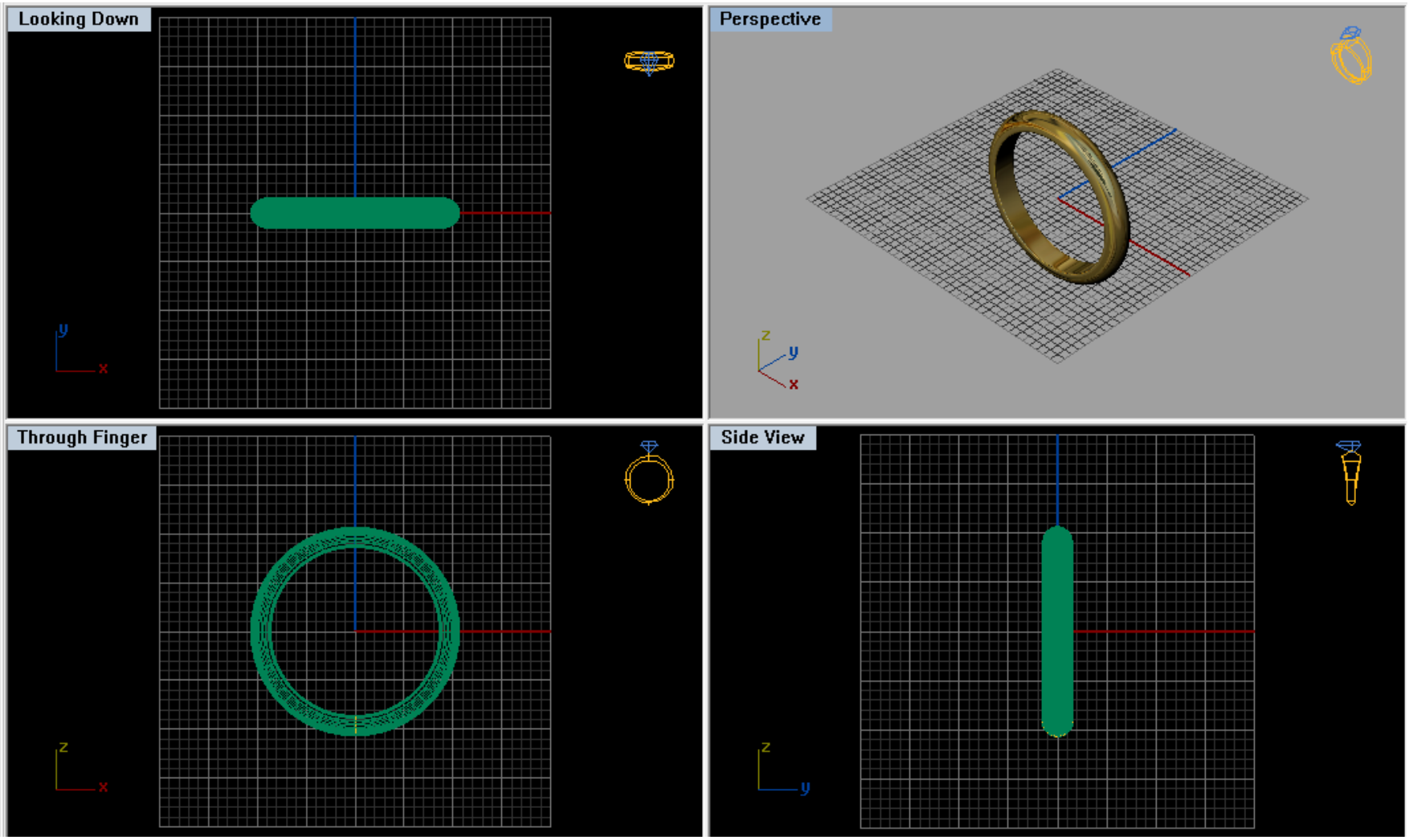


LEARNING UNIT 3: CREATE 3D DRAWING

- Go to surface Menu
- Click “Sweep 1” it will ask:
- Select Ring Rail : click on Ring rail in Front view
- Select cross section : click Profile placer
- Then press Enter
- Then press OK.



Then apply quick display and shade mode



PRACTICAL 01: Create an Open Shank Band or Ring by using Simple Sweep: (Reference: Gemvision Matrix Manual)

Create a basic ring with a ring rail, profiles and sweep function.

Learn to use the Ring Rail and Profile Placer tools to draw a simple ring at the desired ring size. Practice adjusting the profiles (also known as cross-section curves) that make up this ring to create a tapered shank. Then, use Sweep 1 with History to complete the shank.

 **Ring Rail**

 **Profile Placer**

 **Sweep 1 History**

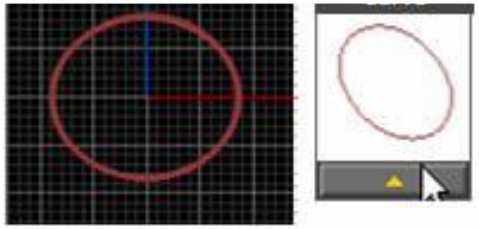
 **Cap Planar**

PRACTICAL 02: CREATE 2D DRAWINGS

1. BEGIN WITH RING RAIL

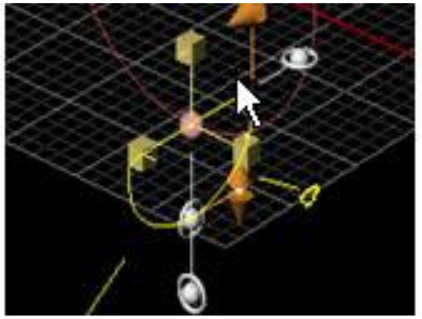
Click on the Tools fly-out menu and select the Ring Rail tool. Select a Size 7 ring rail from the drop down menu and click on the green arrow button to place it in the viewports

2. ADD TO PROFILE PLACER



Open the Profile Placer builder, also found in the Tools fly-out menu, and select the rail curve that was already placed in the viewports, clicking on it once so that it is highlighted in pink. Click on the in arrow beneath the Curve preview window in the Profile Placer builder and the curve will appear in the box. Now it is ready for a profile!

3. PROFILES AND VCH

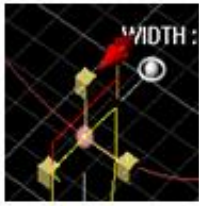


You'll notice a default DOME profile has already appeared in the view port on the Ring Rail. Included with the profile are a variety of controls that will scale, move and rotate the profiles. These are called Viewport Control Handles (VCH).

4. PROFILE PLACER MENU

A series of graphics and an Interactive Control slider bar (IC controls) are also available under the Profile Placer menu for editing capabilities. When you click on the builder menu graphic representing the dimension you wish to change (Width, shown above), the slider control will change to that dimension, allowing you to adjust it.

5. Editing & Adding Profiles

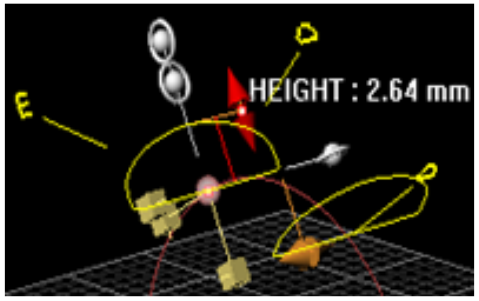


To adjust the IC controls, "click and drag" the slider control by left-clicking on the white cube and, holding down the left mouse button. Move the mouse left or right to drag the slider to the position needed. Release the left mouse button to set the slider. As you do this, the corresponding VCH on the screen will turn red and identify the handle.

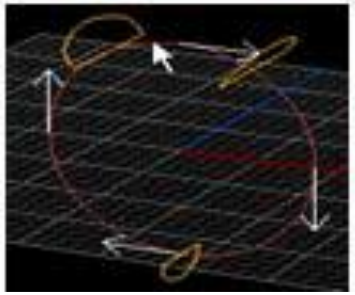
After editing and positioning the first profile, you may add more profiles by clicking on the Add button. You must then click on the Position on Curve graphic (or VCH) to re-position the additional profile higher on the Ring Rail.

6. Mirroring Profiles

With the additional profile added to the Ring Rail, click on the Add Mirror button in the Profile Placer menu and an identical profile will appear on the opposite side of the rail. You can again utilize either the IC controls or the VCH to make adjustments to the height, width and location of the top profiles. Once you have them in place, you must hit the ENTER key to set the profiles. The VCH on the screen will disappear. Now you are ready to sweep the rail!

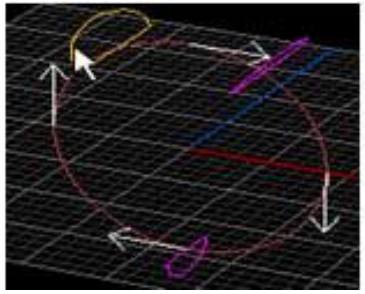


LU3: (PRACTICAL 1) CREATE 3D DRAWINGS



1. Sweeping the Ring (a)

Click on the Sweep 1 with History icon in the Surface flyout menu and instructions will appear in the Command Line to Select Rail. Click on the Ring Rail in the viewports and directional arrows will appear on the rail

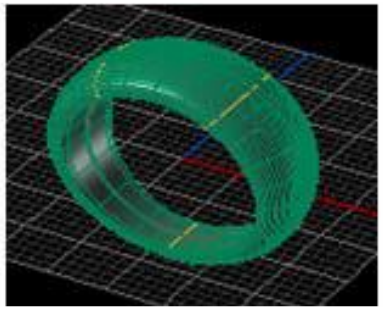


2. Sweeping the Ring (b)

The Command Line will instruct you to Select Profile. You must select each profile following the direction of the arrows (in this example, in a clockwise direction). When you have selected all three profiles, hit ENTER.

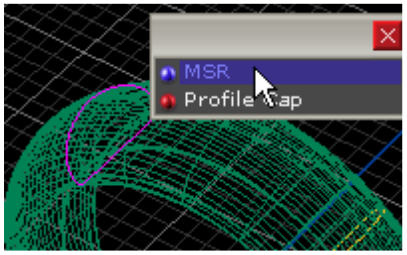
3. Shade your model

You now have a swept surface. Right click on the Shade button and you will see a solid model in all four view ports. Right click again to turn shade off.



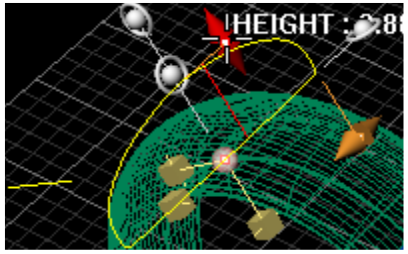
4. History and F6 Key

History allows the user to make changes to many different elements of a model and receive immediate feedback on the results of those updates. To change the profile, click on the profile curve, press F6 and a list box will appear. Select the MSR option (Move, Scale and Rotate).

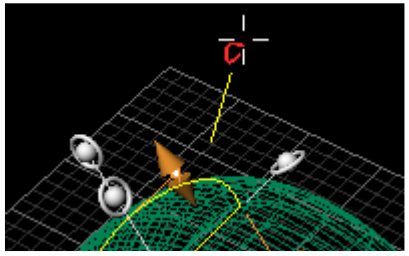


5. Changing the model

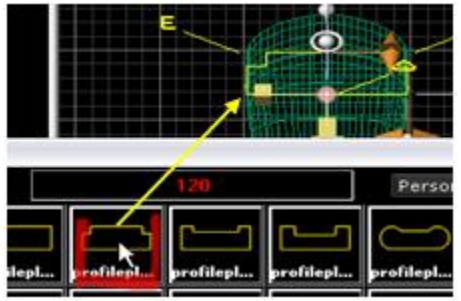
When MSR is selected, the VCH reappear, allowing you the ability to resize, move or change the profile shape. Make the profile taller and wider using the VCH or the IC controls in the menu. When you are finished updating the profiles, press ENTER and the ring will automatically update (or re-sweep).

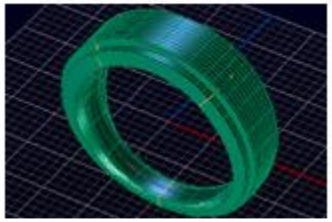


To change the shape of the profile, click again on the profile curve and press F6. Select MSR from the list box. When the VCH reappear, click on the yellow shaped icon near the handles. It will turn red when selected. This will open the Profile Browser – a library of profile shapes to choose from. Select a new shape by clicking on an image with your left mouse button.



The new profile shape will appear in the viewport. You may again resize or position your new profile shape, or simply press ENTER to accept the changes and the ring will update to a new model.





6. Selecting a model

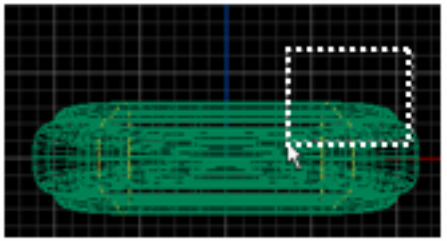
In order to save your model, you must first select it. There are two methods to select objects on the screen. The first is called Region Selecting. **To region select**, click and drag the mouse from the upper left-hand corner of a model down to the lower right-hand corner of the model to draw a selection box around it.

Region Selecting – Solid line

When using this technique, you MUST SURROUND the ENTIRE MODEL with the selection box!!

**This selection method is denoted by a solid line.

Note: The model will change to a bright pink color when selected.



Crossing – Dotted line

The second method is called **Crossing**. To select a model with this method, simply click and drag the mouse from the upper right-hand corner of the model down toward the lower left-hand corner. When using this technique, ANYTHING YOU CROSS with the selection box will be highlighted during the selection!! In other words, the item need not be surrounded by the box: it needs to just be touched or "crossed" by the box in order to be selected.

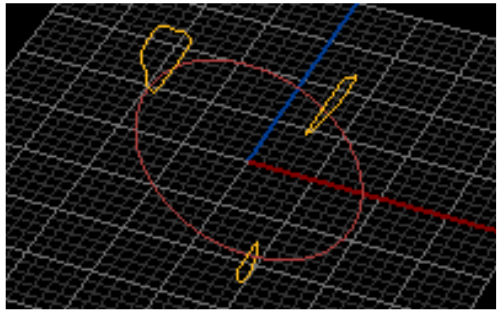
**This selection method is denoted by a dotted line.

7. Saving Models

Save this model by using the Project Manager. To begin, select the model using one of the methods described. With the model selected, click on the white “IN” arrow beneath an open Job Bag.

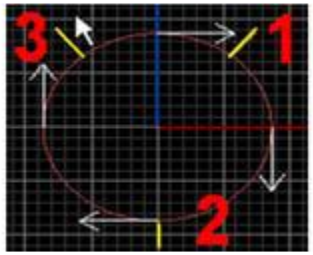
Do NOT put an object into a job bag that is already full (has a preview in it), or else you will overwrite the contents of that job bag, and you will not be able to get them back. Only put an object into an empty job bag, unless you are POSITIVE you don’t need the contents of the job bag you are going to overwrite!!

8. Deleting the Mesh



Now click on just the green wire frame surface of the model, highlighting it, and press Delete on your keyboard. This will leave just the rail (peach colored) and profiles (yellow) that you placed there earlier.

9. Open Sweep

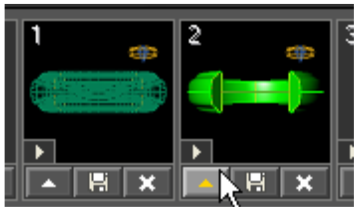


We’re now going to do what is known as an open sweep. Click on the Sweep 1 with History button found in the Surface fly-out menu. Now, click on the ring rail to select it. Then, working in the sequence shown above, click on each profile, working your way from the upper right, down and around to the upper left, of the ring. Select each one, then refer to the Command Line above the view ports. An option is listed there titled “Closed = Yes.” Click on that option and it will change to “Closed = No.”  Press ENTER.

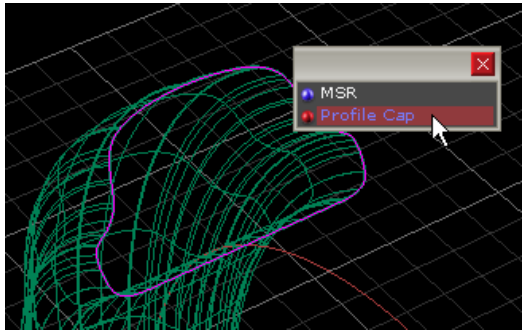
Before Cap Planar: **After Cap Planar:**

The result is an  open shank. When the open sweep appears, select the surface and click on Cap Planar found in the Solids menu to create a solid ring.

Select this item and Job Bag it as well.

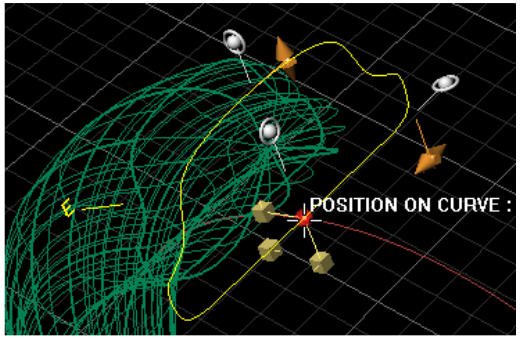


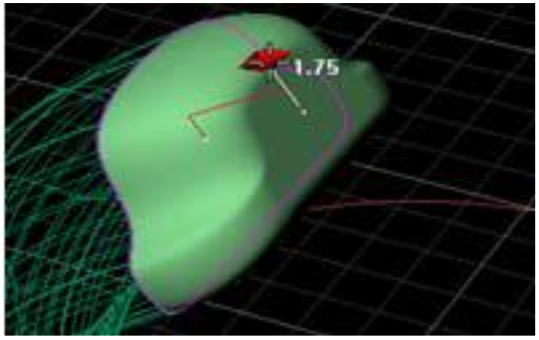
10. Profile Cap



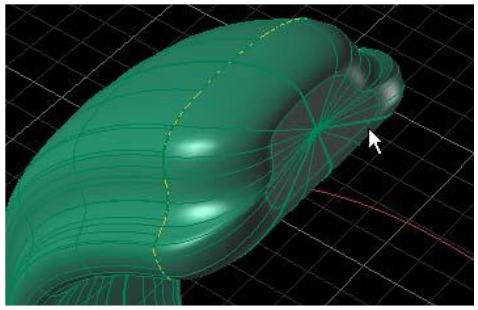
Another option to cap the ends of your open shank is Profile Cap. Instead of using Cap Planar, simply click one of the open profiles at the top of the shank and press F6. The list box will appear, offering a choice between MSR and Profile Cap. Choose Profile Cap.

An end cap will appear with a white, cone shaped control handle. Click and hold the handle with your left mouse button and pull away from the end of the shank. A round, blended cap will appear at the end of the shank! Pull it to the length you desire, but be sure to make a note of the length you assigned and follow the same steps for the other end of the shank. Press Enter to set it. Be sure to Job Bag your model.

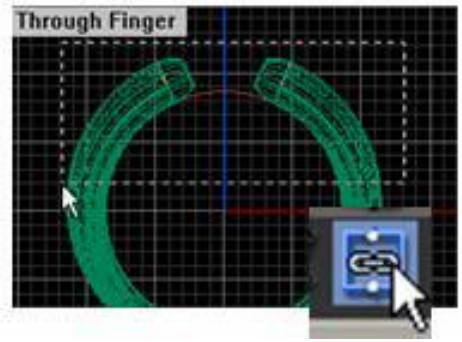




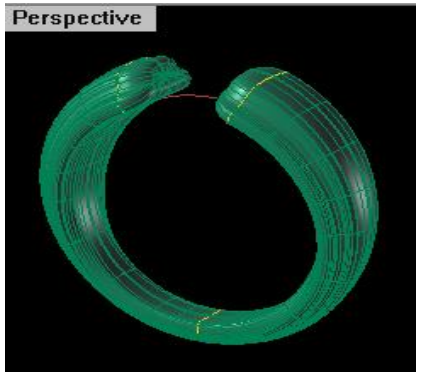
If you decide to make any changes to the details of your shank, such as the shape, size or location of your top profiles, you can do so without affecting the end caps. Since History is present, your end caps will recalculate and blend according to the changes you make.

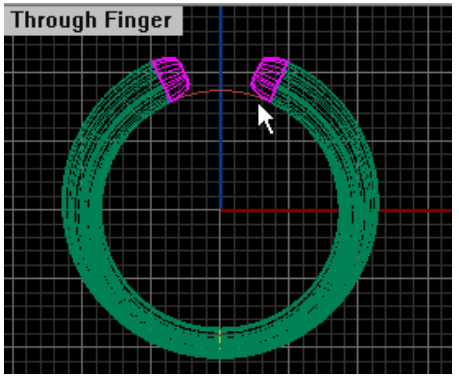


With two end caps on your shank, you now have three open surfaces: the shank and both end caps.



In order for these to become one, solid shank, you will need to select everything and click on the Join tool.





FOLLOW GEMVISION BASIC MANUAL FOR CURVE MENU EXERCISE

PRACTICAL 3: Tracing Technique of Bitmaps Image File

LU1: Create 1D Drawings

Import images into Matrix and trace the objects for a variety of design uses.

Learn to place a background bitmap in the viewports and trace it with Curve tools, creating a closed curve. Use the Edit Points or Control Points commands to fine-tune the shape once you are done.


Place Background


Interp Curve


Edit Points

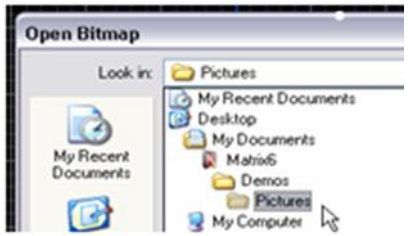

Control Points


Hide Background


Show Background


Remove Background

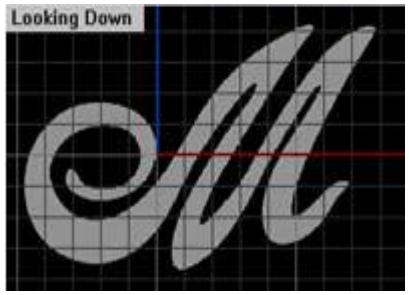
1 Find the File



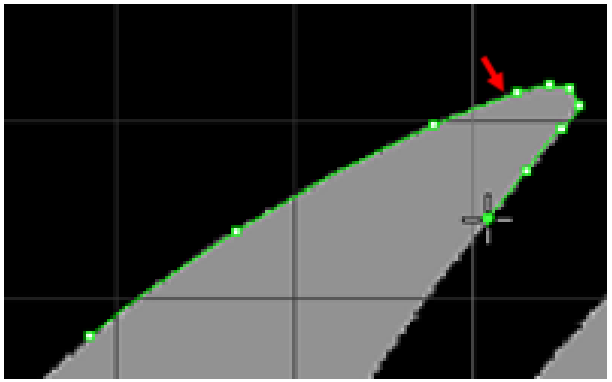
It is very easy to bring a bitmap image into Matrix. First, start with a fresh viewport by clicking on File and New. Go to the View fly-out menu. Click on the Place Background Bitmap icon. The bitmap file is located in My Documents > Matrix6 > Demos > Curves folder. Select the files called "The M" and click to open.

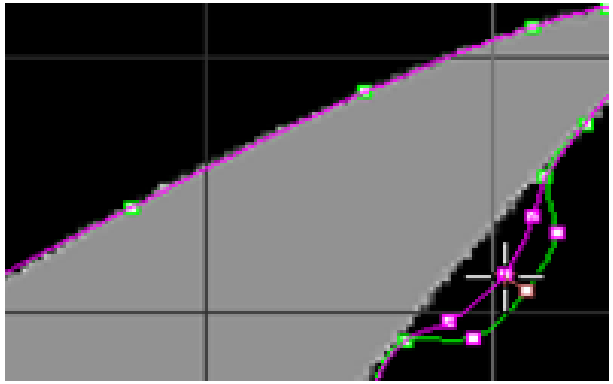
2 Bring the Image Out

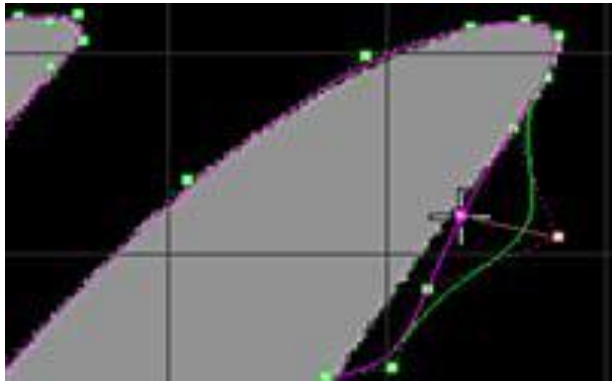
You will now be prompted to create a rectangle in the Looking Down viewport that will tell Matrix where you want the Background Bitmap to be placed. The Command line at the top of your screen should now say "First Corner". In the Looking Down viewport, click your left mouse button wherever you'd like to position the first corner of your bitmap.



Then it will say "Second corner or length:" in the Command Line. Pull the cursor in a diagonal direction (Opposite corner) until you arrive at the desired size. Click the mouse one more time to position your bitmap. The M will appear in the viewport







Tracing the Image

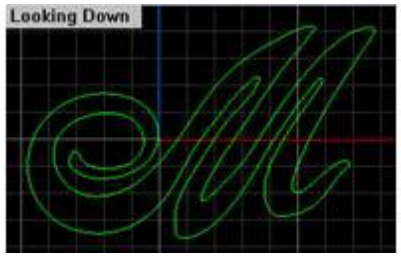
Now, using the Interp Curve tool, trace the “M”. It is a good idea to turn your Grid Snaps OFF at this point so that you can follow the curve of the “M” faithfully. Each time you click, you create an edit point. Space these points closer together to create tight curves and leave more space between each for gradual curves. Trace com- pletely until you reach the start point.

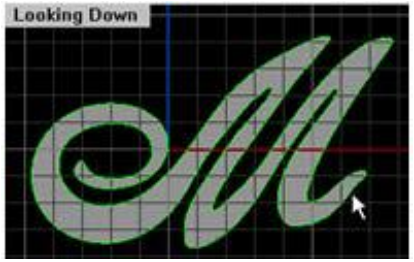
Edit Points

When your tracing is completed, remember that you can edit an Interp Curve using Edit Points or Control Points. Edit Points allows you to move each edit point independently. You can highlight several points if you wish to move them as a group.

Control Points

Control Points allows you to control the steepness of the curve. When you’re done adjusting your curve with these commands, you have to tell Matrix to stop the command. This is done by hitting the Escape key twice.





Hide Click on **Hide Background Bitmap** in the View fly-out menu to check your work. This temporarily removes the bitmap – revealing only your curve. **And Show** If you **Hide** your Bitmap, it is similar to “turning out the lights”. You must remember to click on Show **Background** to turn the lights (or image) back ON. If you try to **Place** another **Background Bitmap** in your viewports and **Hide Background** is still active, it will never appear on the screen!

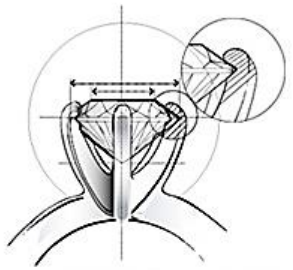
Remove Background

Be sure to **Job Bag** your work! Only AFTER you have done so should you click on **Remove Background**. This will permanently remove the bitmap from the screen. Even Undo will not bring it back, so be certain you are finished

TYPES GEM SETTING

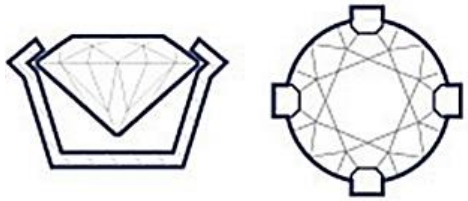
The most common types of gem settings are as under

- Prong/ Claw
- Bezel



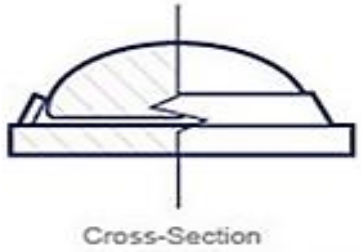
1-PRONG/ CLAW SETTING

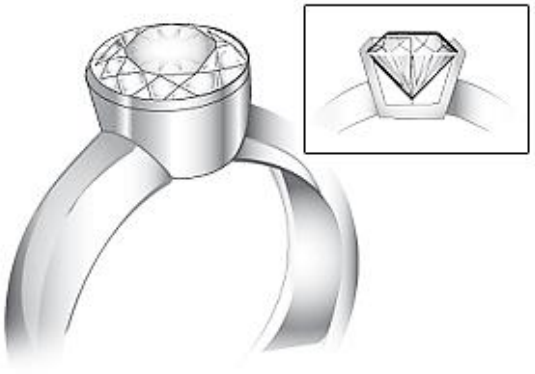
It is defined as a combination of three(3) or four (4) prongs that hold the stone in place. This type of setting exposes the maximum amount of light to the sides and bottom.



2. BEZEL SETTING

In this type of setting a vertical strip of metal is formed to encircle the stone, and then soldered to a metal base. The stone is secured by pushing and bending the bezel towards the stone using a burnishing tool.

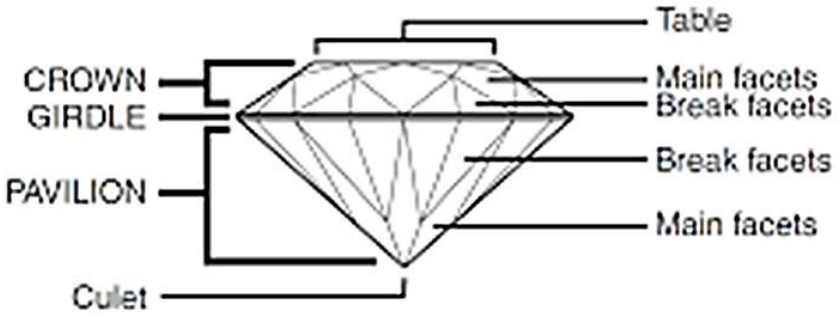




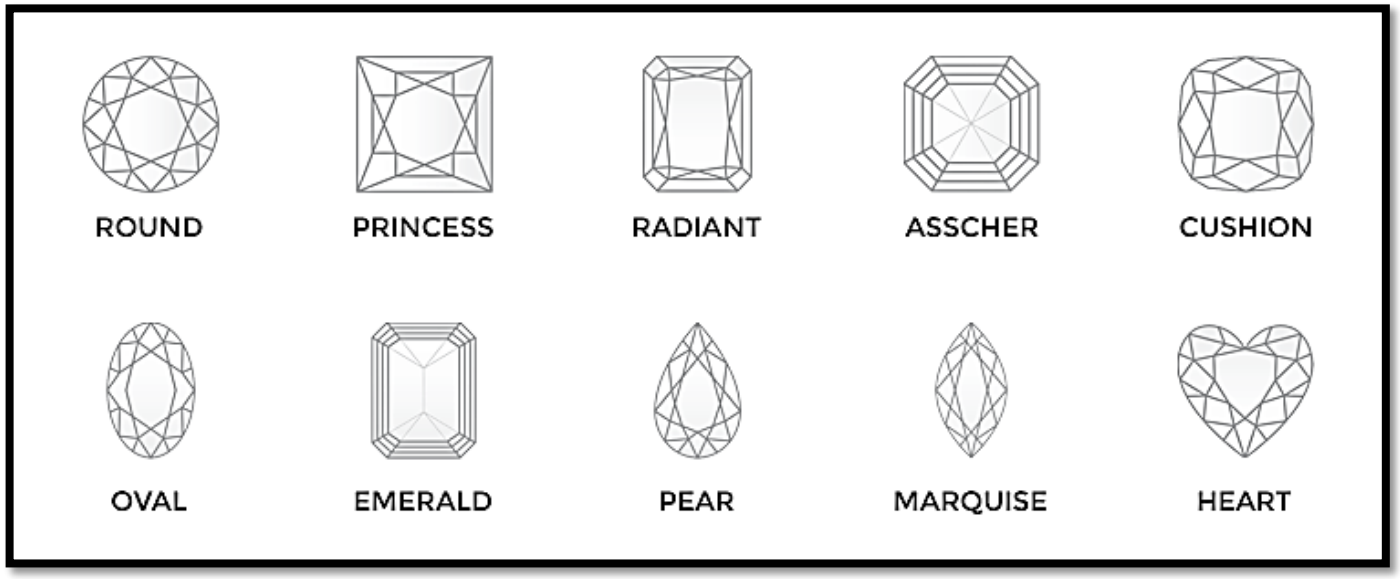
DEFINITION OF GEM (JEWEL)

A Jewel is referred as precious stone; a Gem

GEMS ANATOMY



GEMS SHAPES WITH RESPECT TO CUT



PRACTICAL: 3 Copy, Move, Rotate and Mirror

Create a three-stone head design using the techniques listed below.

Practice using the Copy, Rotate, and Mirror commands to create a three-stone head design. Mid- and End- O-Snaps assist in this tutorial, as well.

Icon Key:

 **Copy**

 **Move**

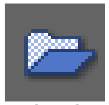
 **EndO-Snaps**

 **Mid O-Snaps**

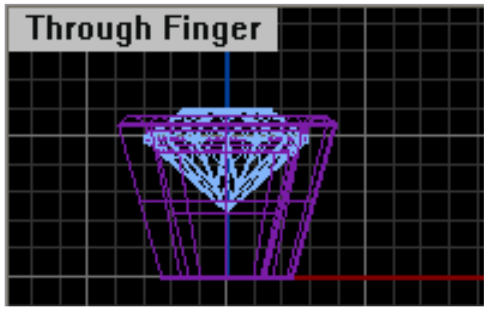
 **Rotate**

 **Mirror**

---

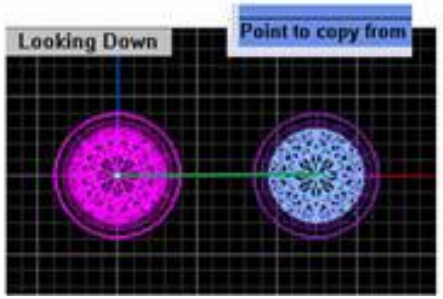
1. **Open File** 

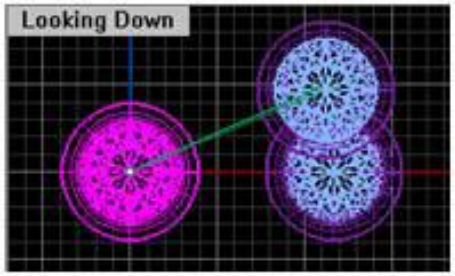
Click on the **Open** icon in the **File** fly out menu. In the **Matrix** folder found in “My Documents”, click on the **Models** folder and open up the **Copy, Move, Rotate**, Mirror tutorial to see it in the viewports. We will begin by copying this bezel so that we can start arranging our design..



2. **Duplicate Bezel**

Go to the Duplicate command and click on it. The Command line says “Select objects to copy:” Highlight the bezel and the gem in the Through Finger viewport and press Enter. The prompt now reads: “Point to copy from:” Matrix needs a reference and at this point it is at the center of the grid. That location has been mapped to a pacific

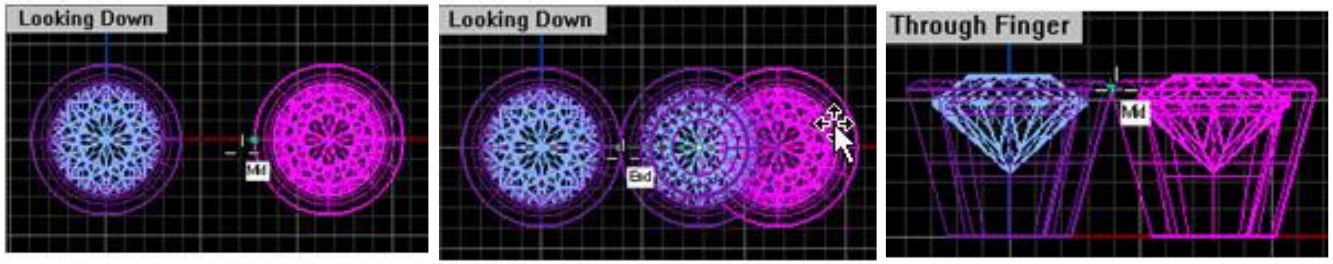




shortcut key which is F4. This is called “The Center of the Universe.” From the Looking Down view, press F4. A second bezel will appear in the viewport. To place the second bezel straight out from the first; simply move the mouse the right. To keep it on the same plane, you must also hold down the shift key to engage Ortho. Click once on your left mouse button to set the second bezel in place.

---

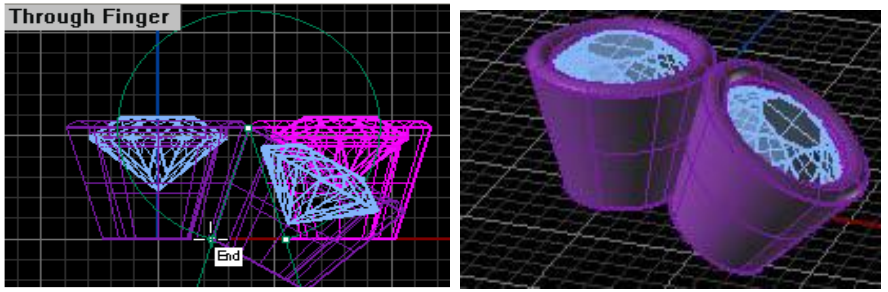
3. Move Bezel and Gem



Highlight the second bezel and the gem in the **Through Finger** viewport and press Enter. The prompt now reads: “Point to copy from:” We want to snap to the Mid **O-Snap** on the left side of the selected bezel. When the Mid-point appears, click your left mouse button once. You are now holding the gem and bezel from that point to be repositioned. The prompt now reads: “Point to move to:” With the mouse, drag the bezel and gem toward the other bezel. You will need to snap to **the End O-Snap** of the center bezel. When the End point appears, click the left mouse button and the two bezels will be precisely connected at those points.

---

4. Rotate Bezel and Gem

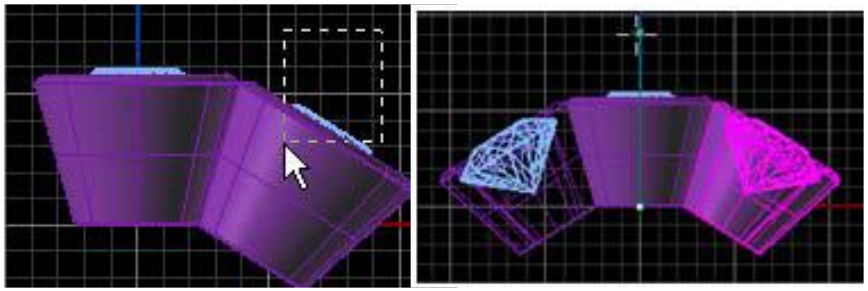


Go to Rotate. When the Command line prompts you to “Select objects to rotate:” highlight the bezel on the right. Press Enter. The prompt is now looking for the “Center of rotation:” We want to rotate this so that the two bezels are flush on the sides. Snap to the top left of the bezel on the right. When the Command line prompts you for the “Angle or first reference point:” snap to the bottom left of the same bezel, which is **the Mid O-Snap** Now the prompt reads “Second u reference

point:" You'll notice as you move your mouse across the screen that it will spin the bezel until you click your mouse button again. Snap to the bottom left of the bezel on the left to finish the **Rotate** command.

---

5. Mirror



Now we want to copy this bezel over to the other side. Go to **Mirror**, select the rotated bezel and press Enter when the **Command** line prompts En you to "Select object to mirror:" When prompted for the "Start of mirror plane:" select F4 in the Through **Finger** viewport. Holding the Shift key down, move your mouse up over top of the bezel and click once to indicate the "End of mirror plane:" This is what it should look like.

Be sure to Job Bag this.

Render of completed head assembly

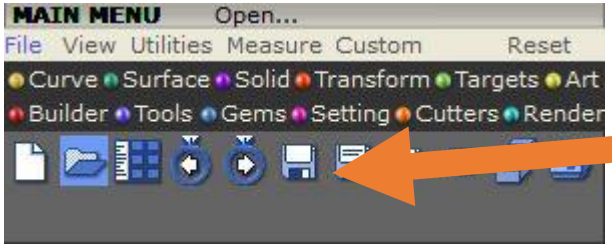
SAVING OF CAD MODEL IN A FILE:

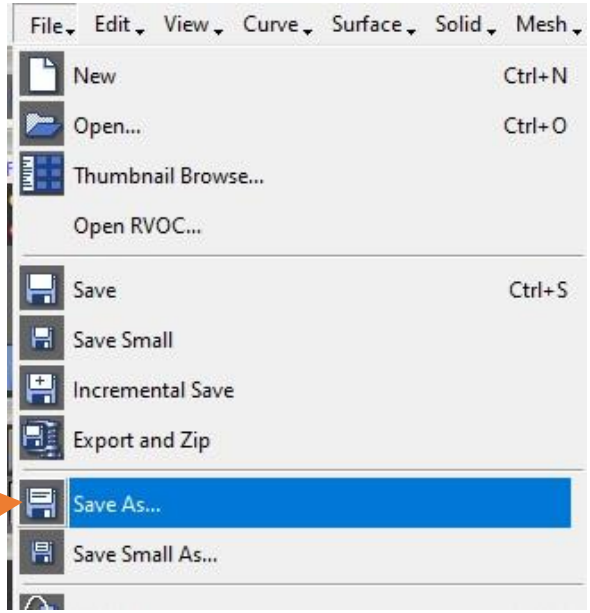
There are two methods of saving a CAD file

Method 1:

First go “file Menu” Click on “Save as” The file extension of CAD file is *.3DM. Its abbreviation is as follows

3D	3 Dimension
M	Model





- The window will open ask for the file saving path in a particular folder”
- Select the folder of your own choice
- Then give a specific name to file as “Model1”
- Then Click to “OK”

Method 2:

- The second method is to save the model in Project Manager /Job Bag.
- This can be done by selecting the model first and then upload in the menu as shown below.
- Project Manager /Job Bag is generally used for incremental saving

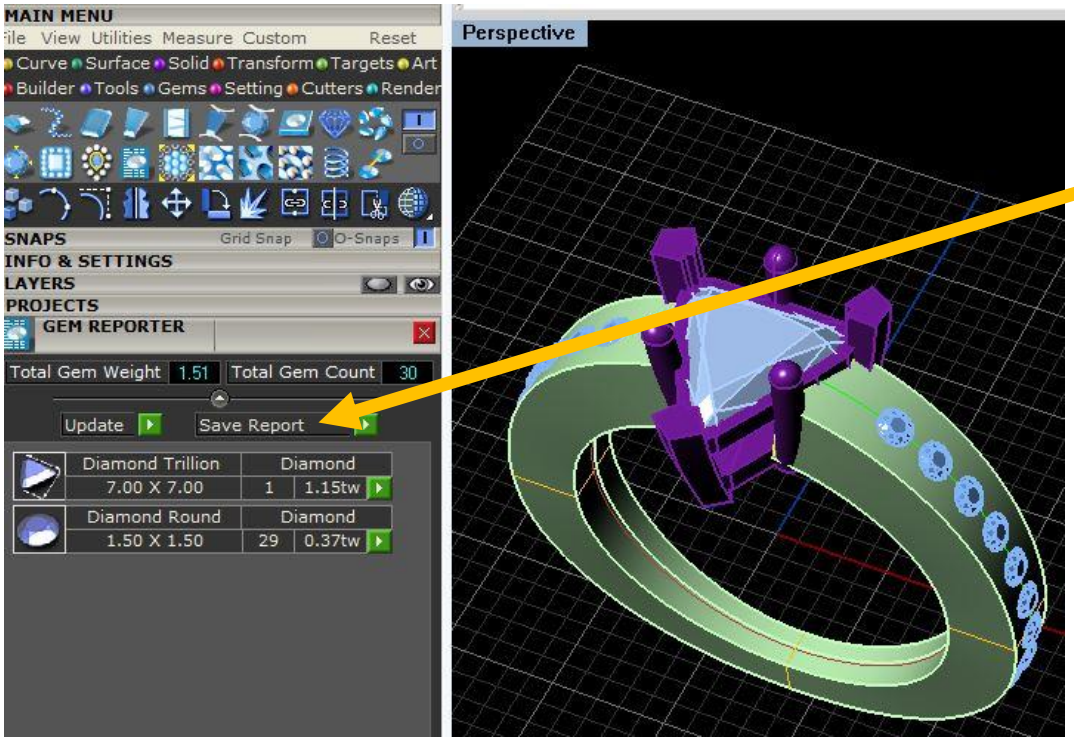
CALCULATION OF METAL WEIGHT AND NUMBER OF GEMS

- The Matrix software has a strong command to check n verify the weight of solid jewellery piece in all Karatage of gold , silver etc, along with the calculation of weight and number of gems used in respective jewellery piece.
- These commands lie in Tools Menu.
- Calculating weight of Solid Jewellery piece

Command: Metal Weight

CALCULATING GEM NUMBERS AND WEIGHT IN TERMS OF CARAT:

The command lies in Gem Menu named as **"Gem Reporter"**

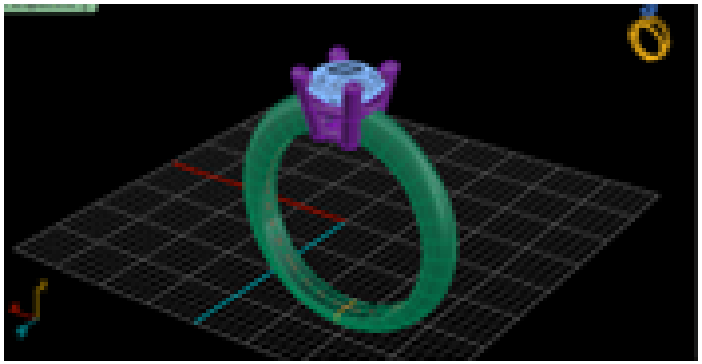


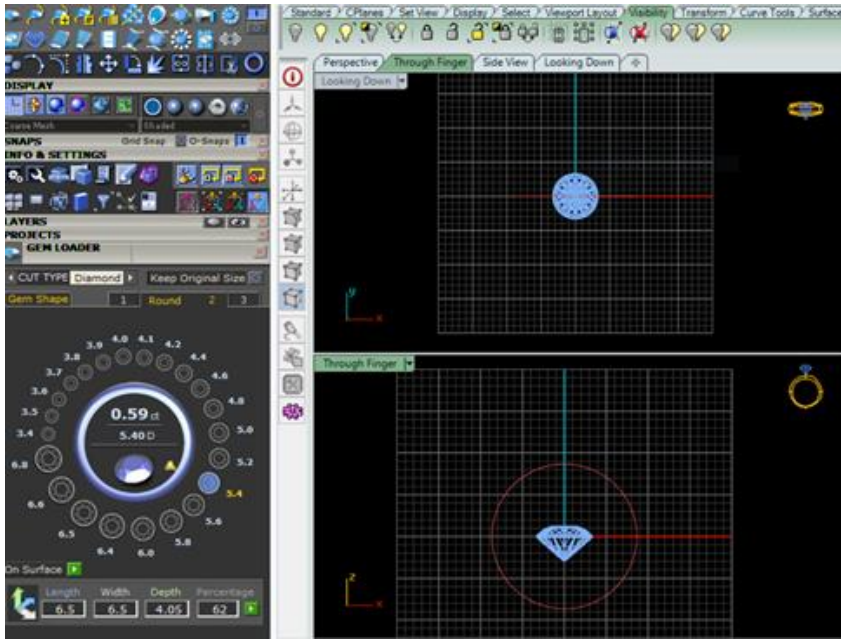
PRACTICAL: 4 TO DESIGN A PRONG SETTING RING

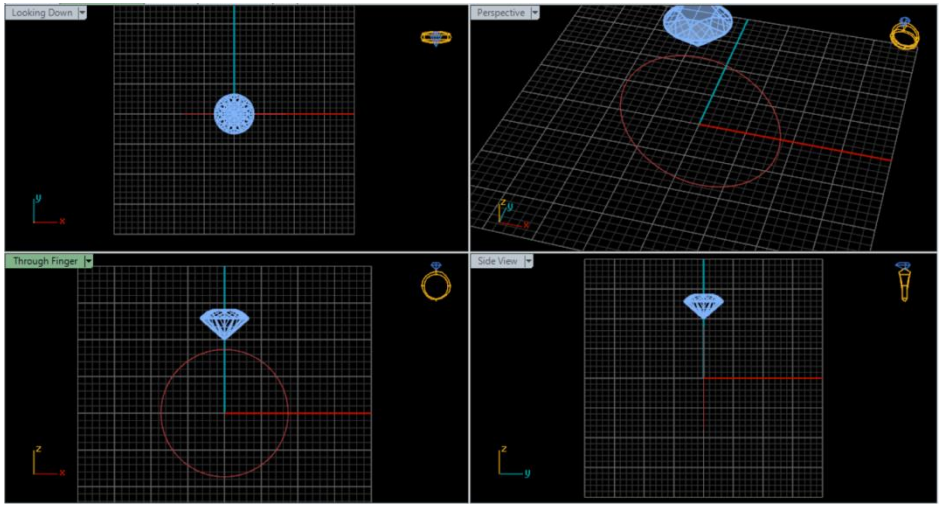
LU1: Setup interface of Jewelry CAD software

- Go to Tools Menu……Load Ring Rail = 17 mm (your finger size)
- Go to Gem Menu ……Click Gem Loader
- Drag gem on the top of Ring rail by pressing Shift+ Mouse.

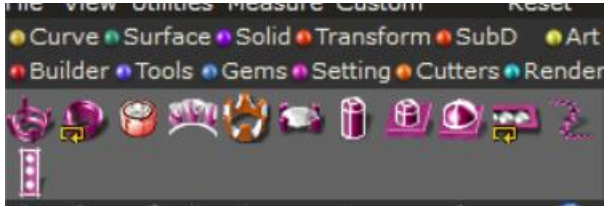
Note: the distance between Culet & Ring rail = 1mm



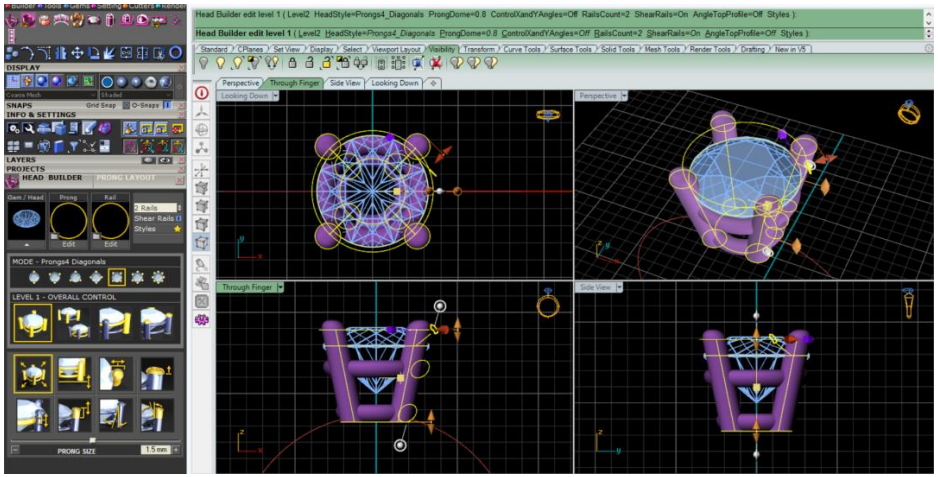




LU2: Create 2D Drawings



- Go to Setting Menu …..Click Head Builder
- Select gem and load in Gem Shadow window
- Select the respective combination of prongs :
- 2-prongs or 3 prongs or 4 –prongs , 6- prongs , 8- prongs



Adjust the prong parameters

a- Prong Size : 0.8 to 2.0 mm
b- Head Drop : Restrict to Ring rail top
c- Prong Nudge : Don't change
d- Prong Dome : 1mm (or as per your design requirement)
e- Rail Drop : Adjust near to gem girdle.
f- Height above Girdle: 1.0 mm to 2.0 mm
g- Head Angle : (as per your design requirement)

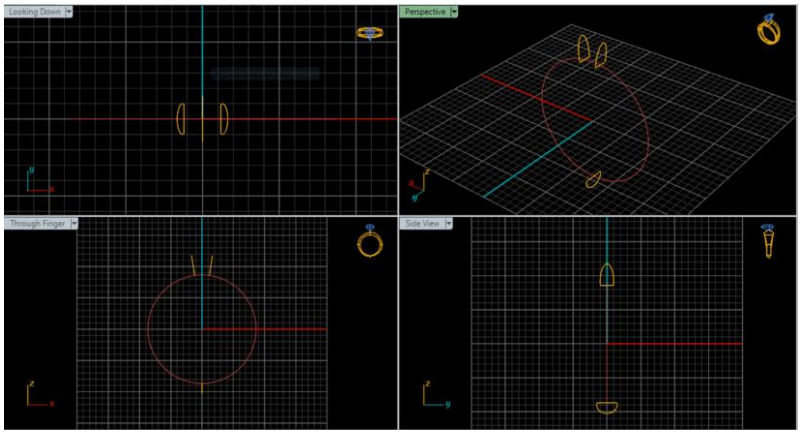
V-shape = 10º Straight = 0º Λ-shape = -10º

h- Top Angle : (as per your design requirement)

Go to Tool Menu …Click Profile Placer

- Select Ring Rail and load in "Curve Shadow Window"

Note: Profile Placer will be shown at the bottom of Ring Rail



- Click on "Profile Placer Window", it will show built-in library of Profile Placers.
- Select the shape of Profile Placer as per your design requirement.

Adjust Height & Width of Profile Placer

a- Width = 2.5 mm to 4.0 mm (as per gem size)
b- Height = 2.5 mm to 4.0 mm (as per girdle seat)

c- Position on Curve= adjust near the prong & lower seat so that it may penetrate inside prong on either side.

- Click “Add Mirror” to get duplicate Profile placer on opposite side.

Note: Click Right button of Mouse at any View Port window to come out of this command.

- Go to Surface Menu …..Click Sweep1

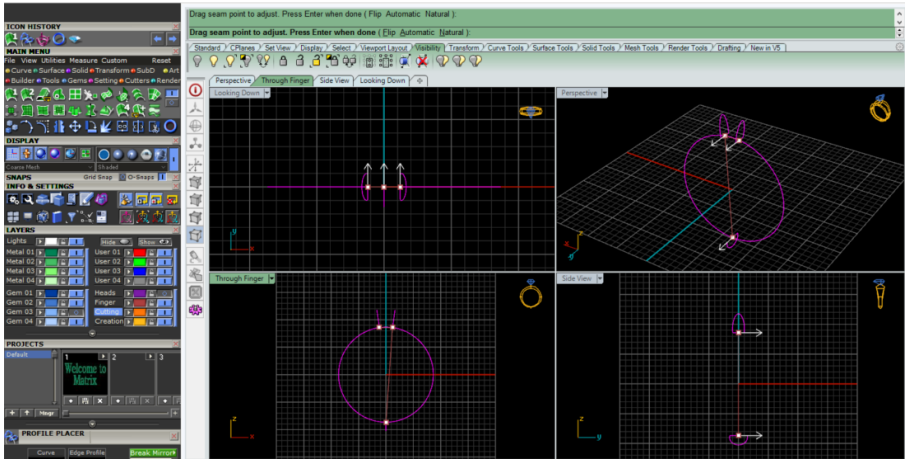
It will ask:

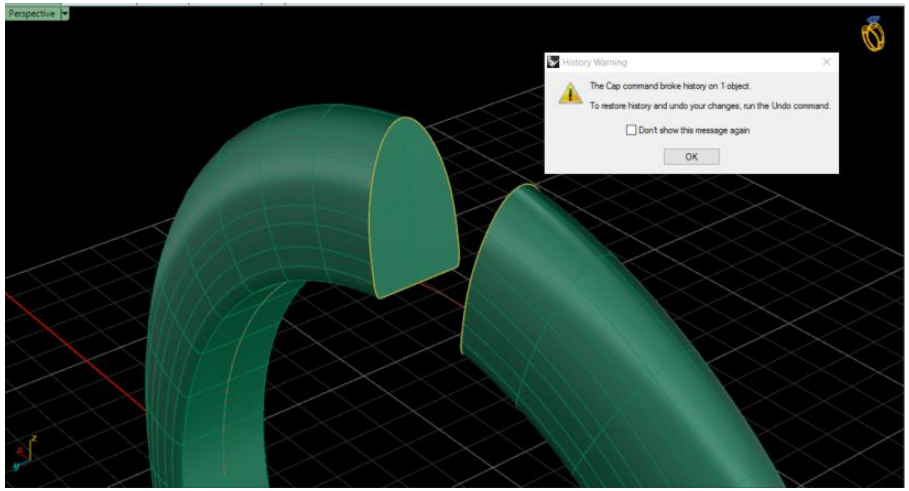
a- Select Rail: Click on Ring Rail

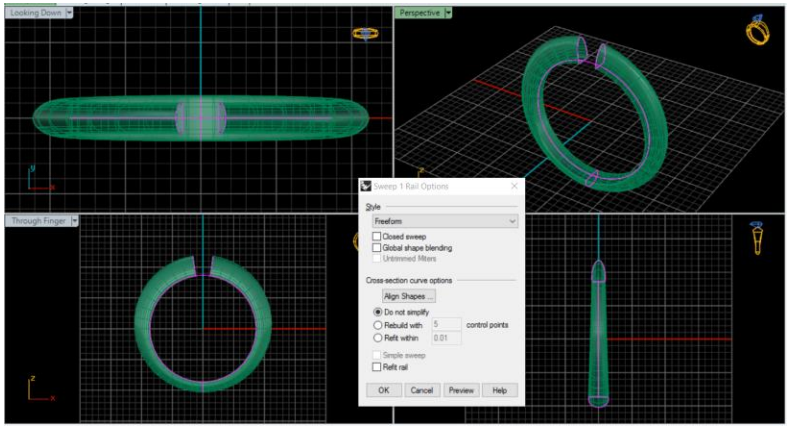
- Select Cross Section: Click one by one on Profile Placers
- click Enter key two times.

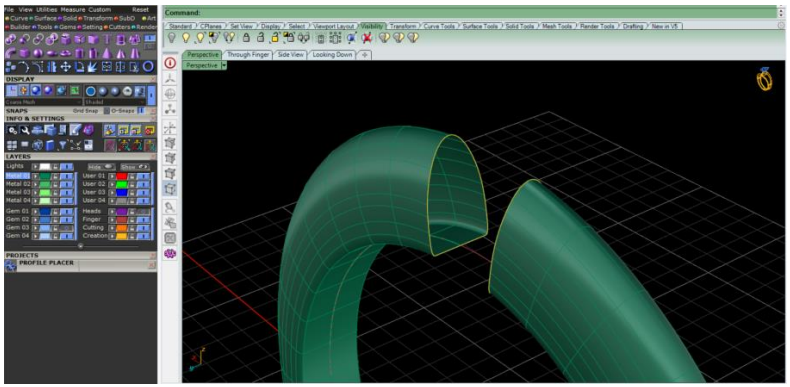
Note: Uncheck the “Close Sweep”

- Click “OK” in opened window.
- Go to Solid Menu …..Click “Cap Planar”
- Select the Shank Surface and then click to fill the material.
- Go to Tool Menu …..Click “Object Checker”

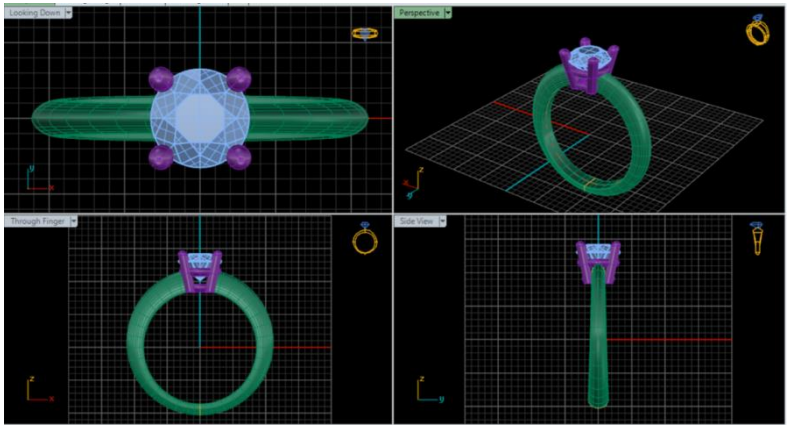




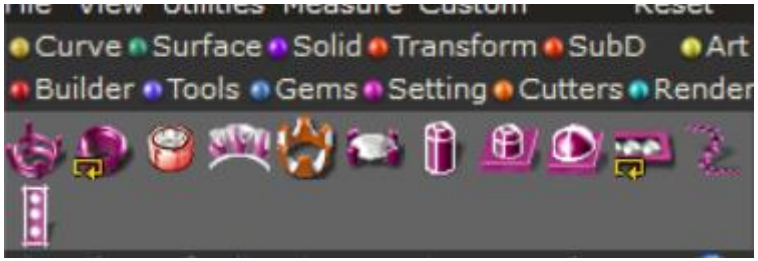




- At the end Select your complete Ring = Shank+ Gem+ Prongs and load in Object Check window to verify that the ring is solid.



PRACTICAL: 4 TO DESIGN A BEZEL SETTING RING



LU1: Setup interface of Jewellery CAD software

- Go to Tools Menu
- Load Ring Rail

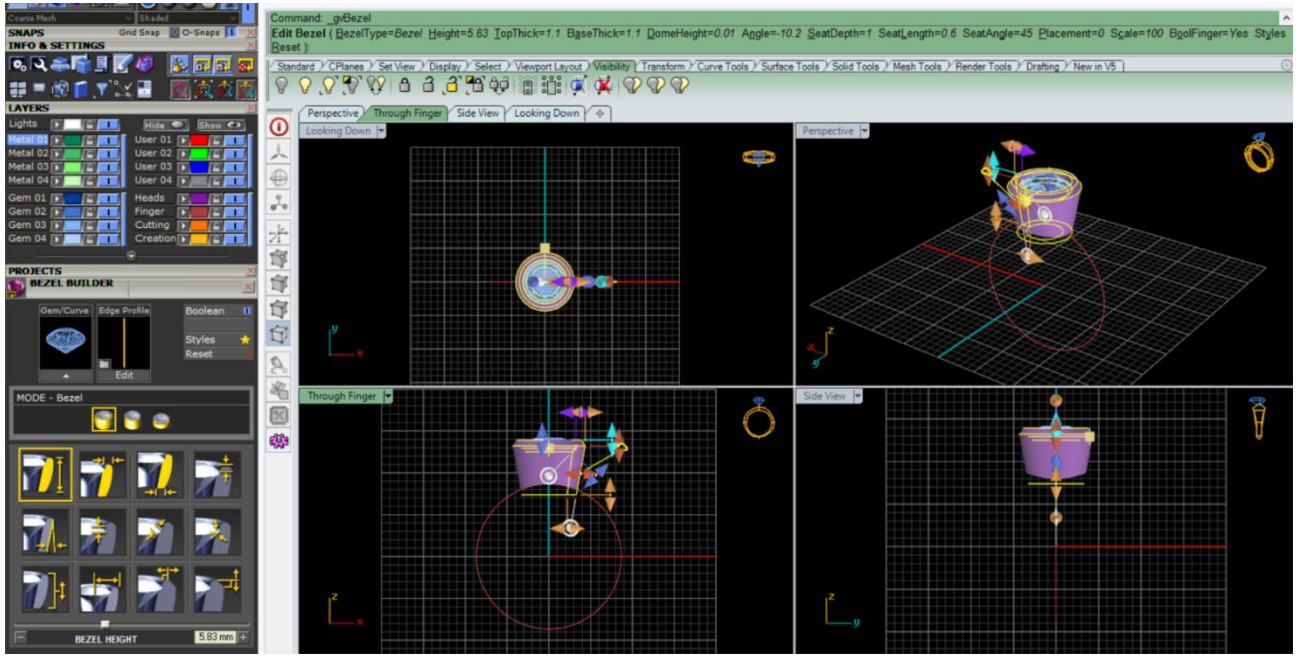
Type your finger size..mm D:_____

- Go to Gem Menu ……Click Gem Loader
- Drag gem on the top of Ring rail by pressing Shift+ Mouse.

Note: the distance between Culet & Ring rail = 1mm

LU2: Create 2D Drawings

- Go to Setting Menu …..Click Bezel Builder
- Select gem and load in Gem Shadow window



Adjust the Bezel parameters.

i- Bezel Height : Don't Change
j- Top Thickness : 0.8 ~1.5 mm
k- Base Thickness : 0.8 ~1.5 mm

Both values should be same

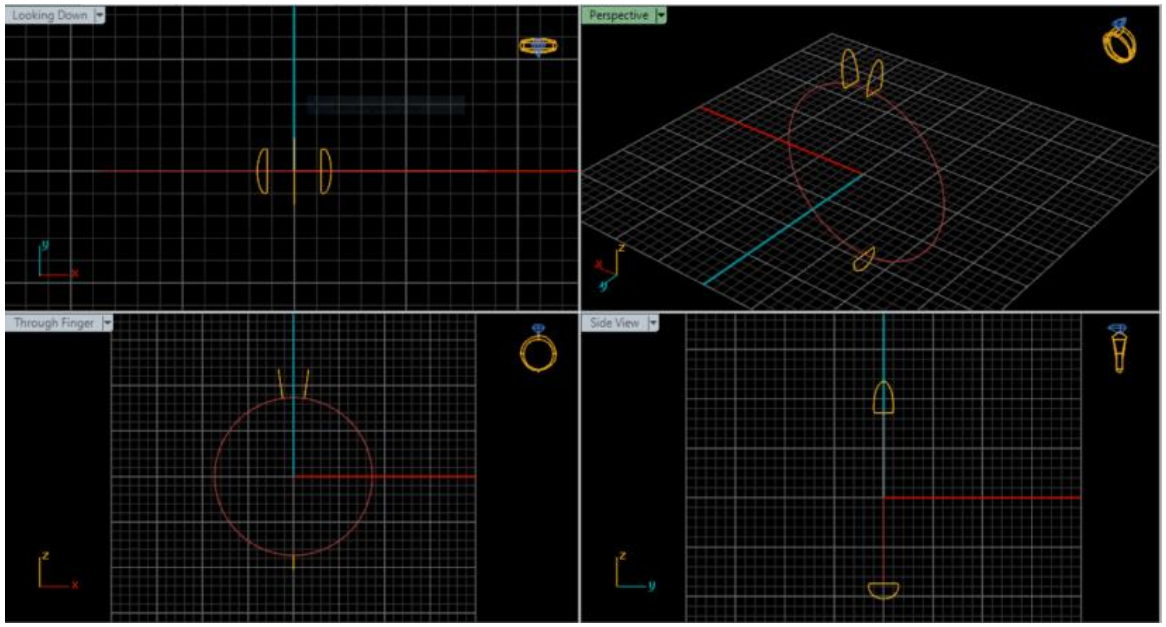
l- Dome Height: as per your design requirement.

Bezel Angle: (as per your design requirement)

v-shape = 10º Straight = 0º Λ-shape = -10º

m- Seat Depth : (Don't change)
n- Seat length: (Don't change)
o- Seat Angle : (Don't change)
p- Bezel Placement: Change to make prominent the Gem Table.
q- Bezel Scale: (Don't change)
r- Bezel Chamfer X: (Don't change)
s- Bezel Chamfer Z: (Don't change)

- Go to Tool Menu …Click Profile Placer



- Select Ring Rail and load in “Curve Shadow Window”
- *Note : Profile Placer will be shown at the bottom of Ring Rail*
- Click on “Profile Placer Window” , it will show built-in library of Profile Placers.
- Select the shape of Profile Placer as per your design requirement.
- Adjust Height & Width of Profile Placer

d- Width = 2.5 mm to 4.0 mm (as per gem size)

e- Height = 2.5 mm to 4.0 mm (as per girdle seat)

f- Position on Curve= adjust inside bezel so that it may penetrate inside bezel on either side.

- Click “Add Mirror” to get duplicate Profile placer on opposite side.

Note: Click Right button of Mouse at any View Port window to come out of this command.

LU3: Create 3D Drawings

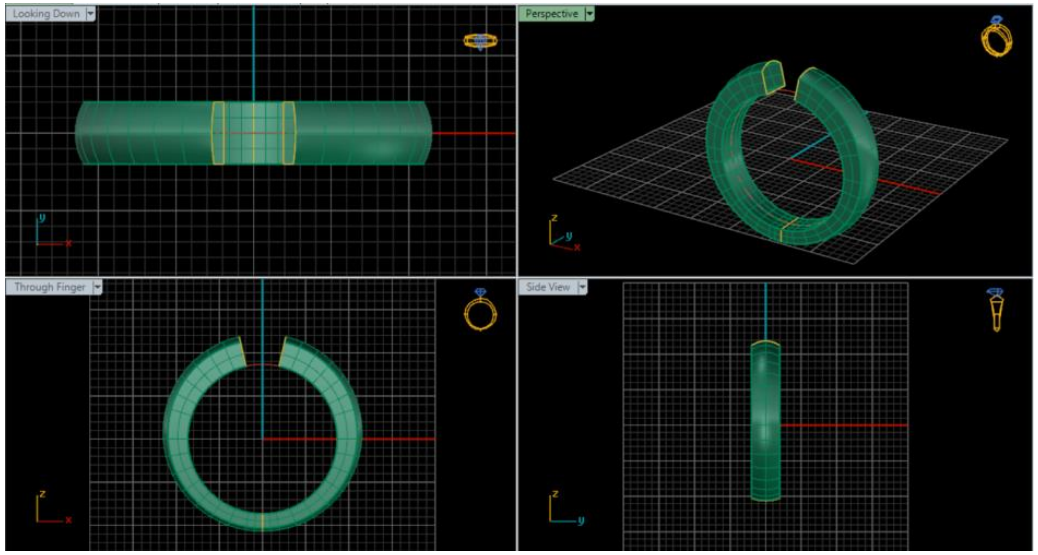
- Go to Surface Menu …..Click Sweep1
- it will ask :

  b- Select Rail : Click on Ring Rail

  c- Select Cross Section: Click one by one on Profile Placers
- Press Enter key two times.

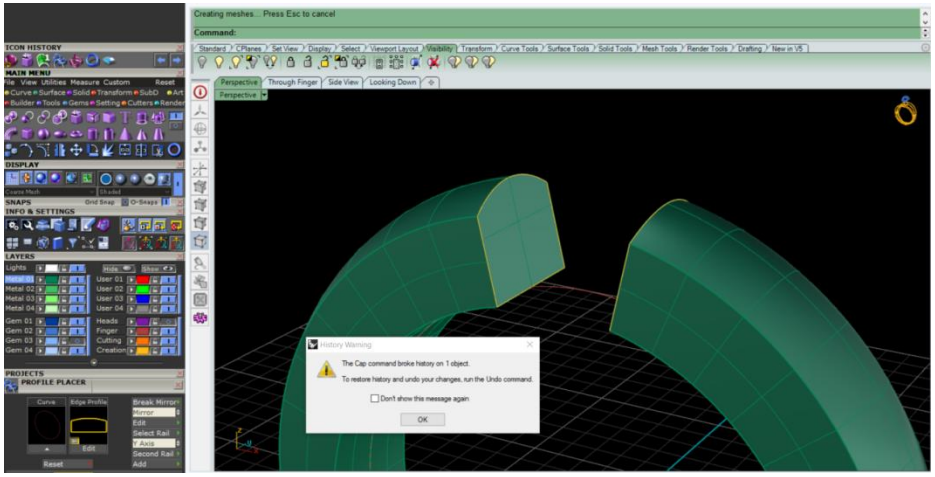
Note: Uncheck the “Close Sweep”

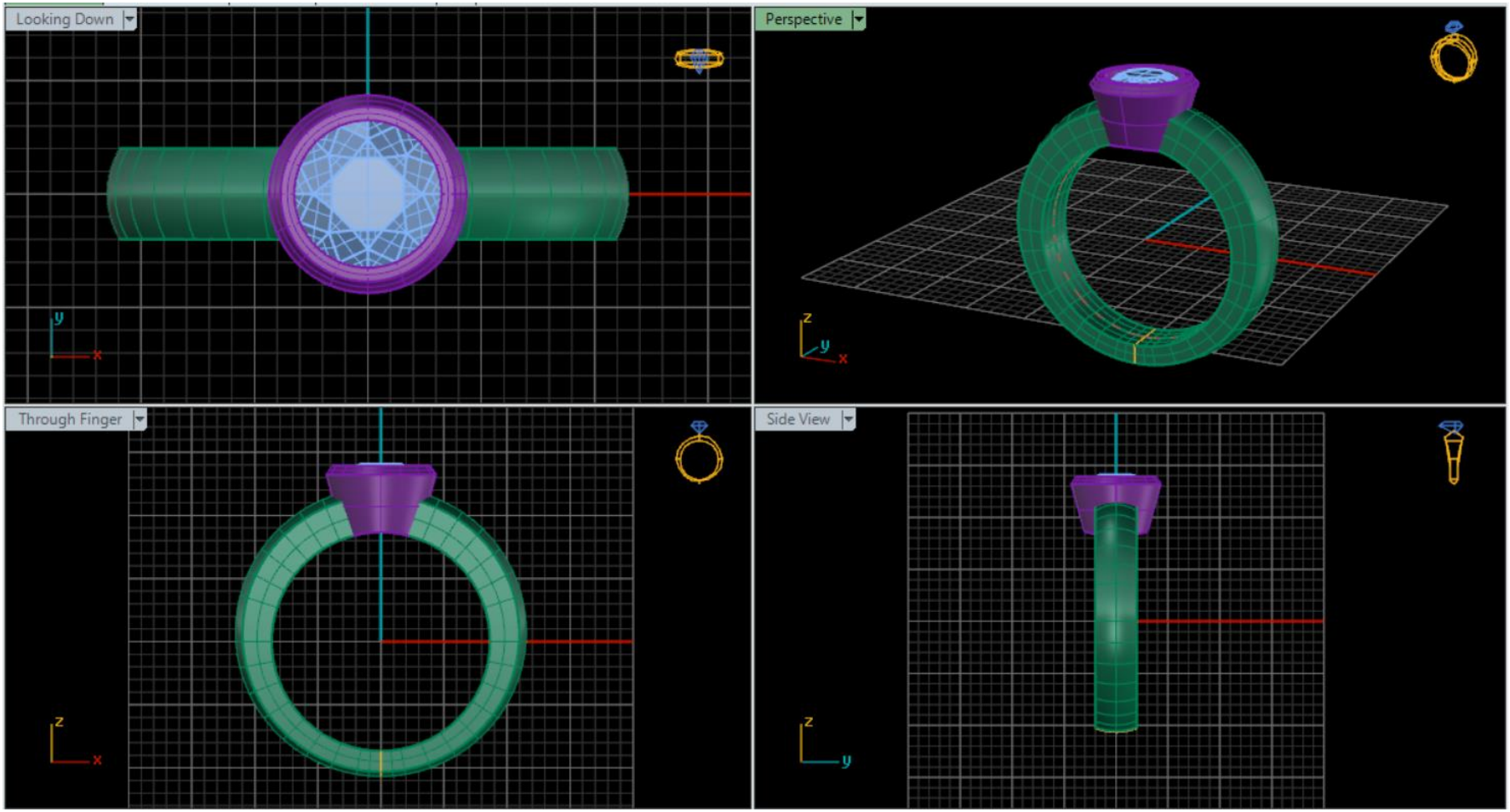
- Click “OK” in opened window.



- Go to Solid Menu …..Click “Cap Planar”
- Select the Shank Surface and then click to fill the material.

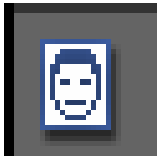
- Go to Tool Menu …..Click “Object Checker”
- Select your complete Ring = Shank+ Gem+ Bezels and load in Object Check window to verify that the ring is solid.




Looking Down
Perspective
Through Finger
Side View

PRACTICAL: 5 TO REPLICATE A HEART SHAPE PENDANT FROM THE IMAGE BY USING TRACING TECHNIQUE

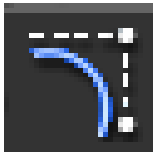
LU1: Set up of Commands for Basic Jewellery Article



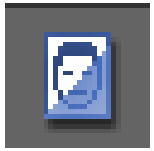
Place Background

Interp Curve

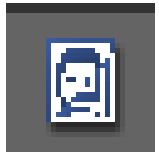
Edit Points



Control Points



Hide Background

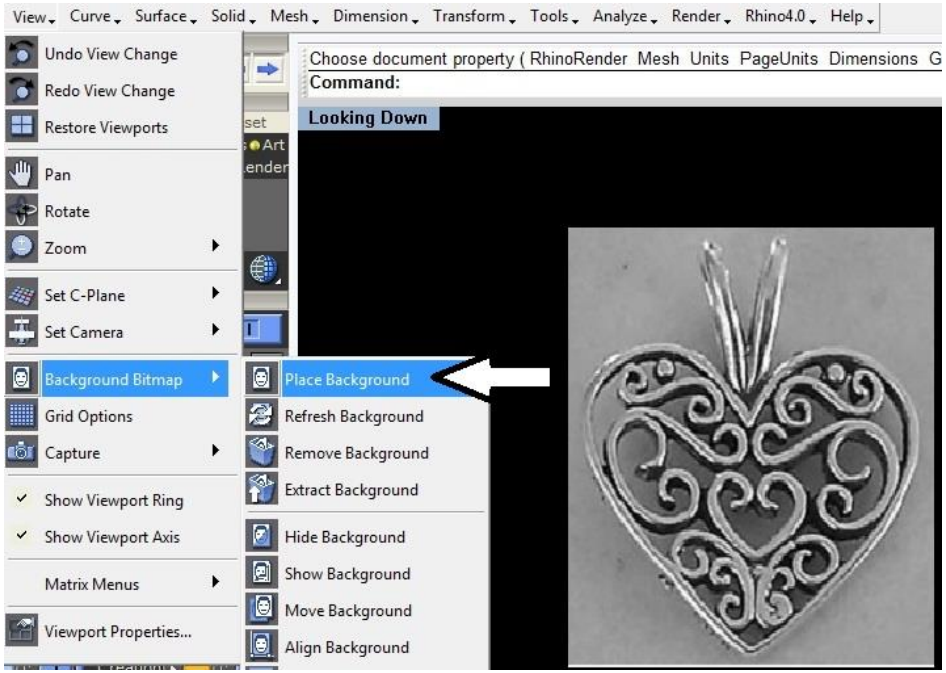


Show Background

Remove Background

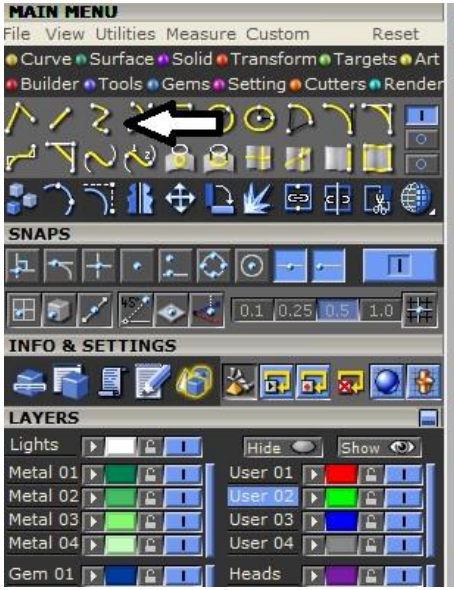
LU2: Create 2D Drawings

1.Insert .jpg picture in Looking Down View by clicking View Menu, Background Bitmap-Place



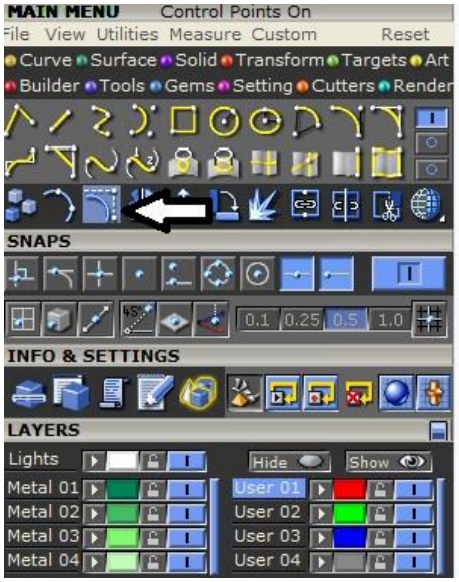
2. sing free form pen tool “interpt curve” from Curve Menu ,

start tracing the outline of either side(left or right) of pandent.

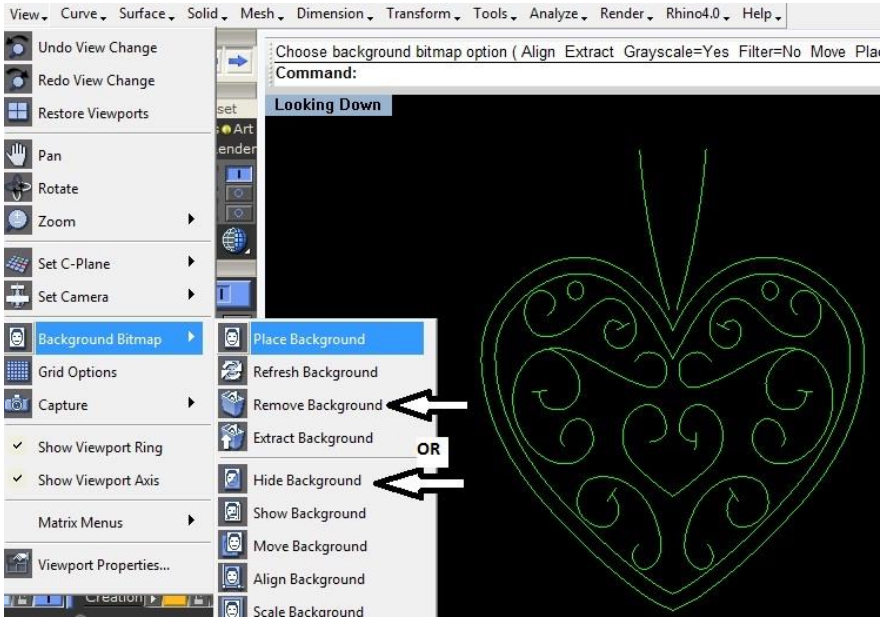


3.Refine the outline by activatingcommand “Edit Points,

And or Control points” or press F10 key.



4.After perfect tracing and refining the picture outline , “Remove” or “Hide” the picture.

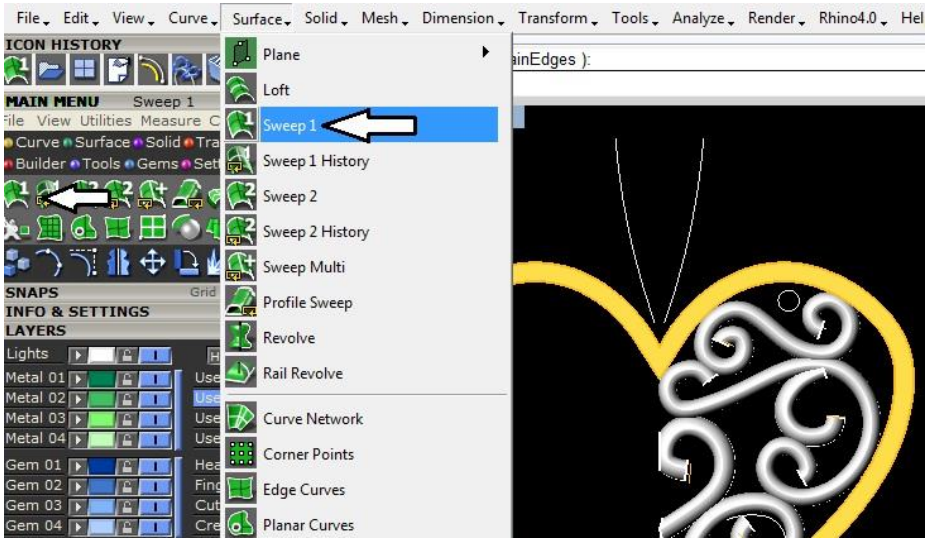


5.Click “Tools Menu” and apply profile placer on each line work.
Profile Placer’s,
Width= 1.0 mm
Height= 1.0 mm

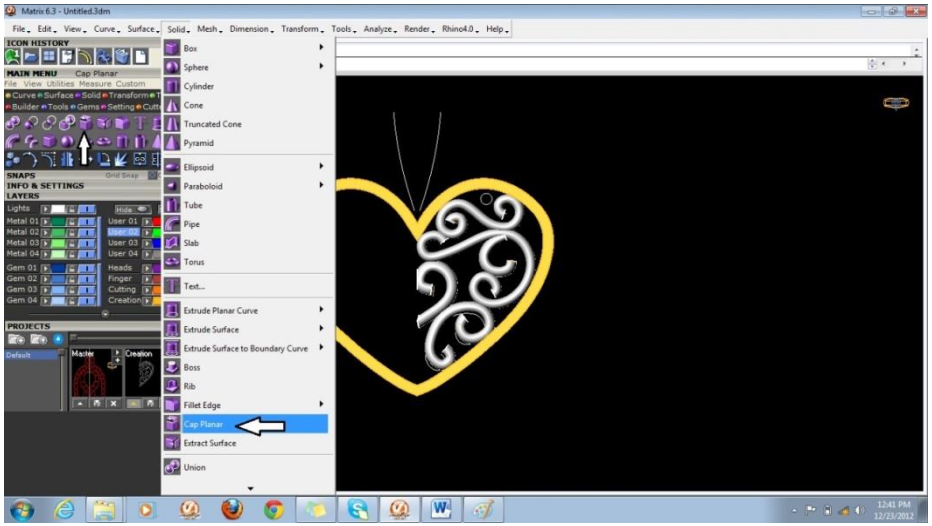
Adjust “Roll on” to change dome of profile placer on the top.

LU3: Create 3D Drawings

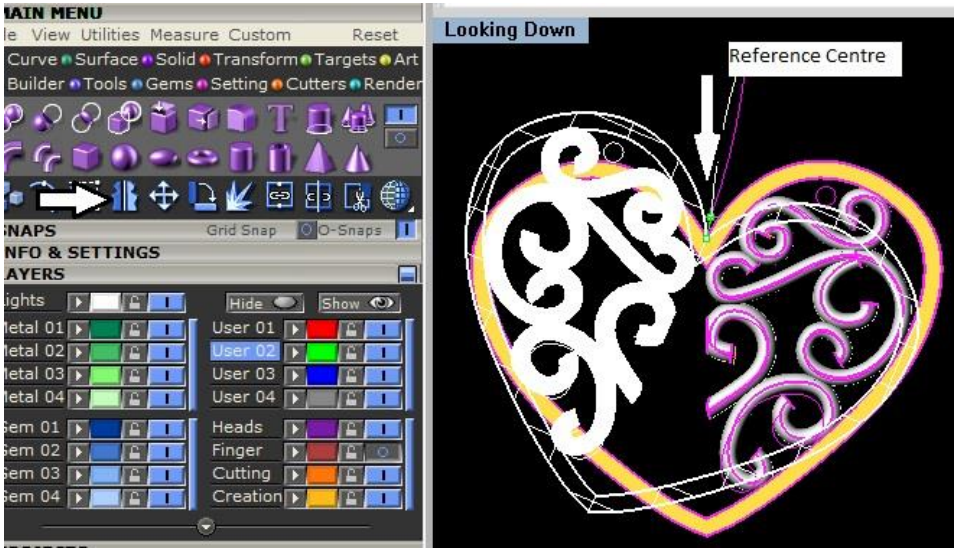
6.Apply “sweep-1” one by one from Surface Menu. Select Rail and Cross section for each link as asked, then press “Enter” and “OK”



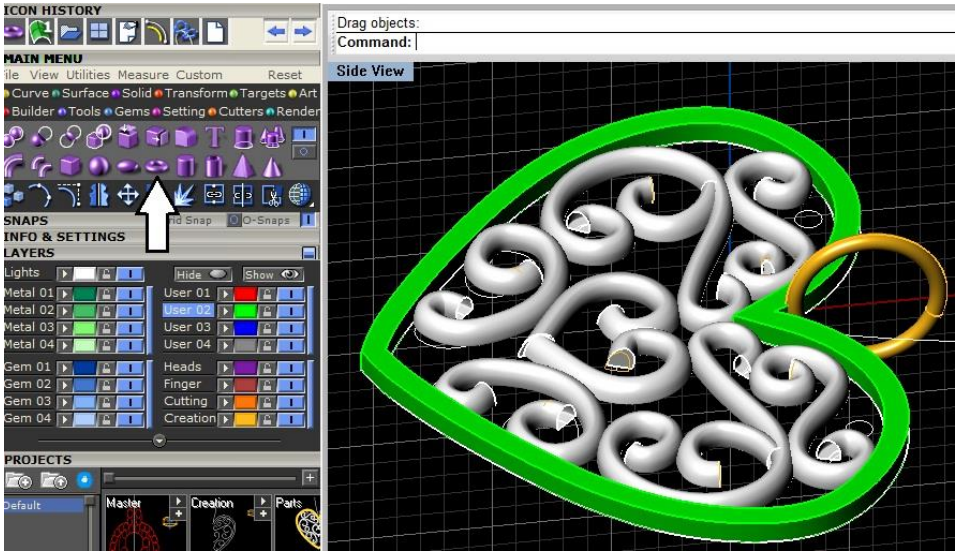
7.Apply “Cap Planner “ in solid Menu to fill the hollow sweep1-surfaces .



8.Use “Mirror” command to get the duplicate solid surfaces on left side by defining reference centre.



9.Contruct a “Torus /Dough Nut” from “Solid Menu”in Side View.



10.At the end use “Object Checker” command in Tools menu to verifiy that whole pandent is solid.

11.Finally apply “Boolean Union” to unit or solder all links.

Optional

12.Apply gem with bezel at the desired location.

LU4: PERFORM BASIC LEVEL RENDERING

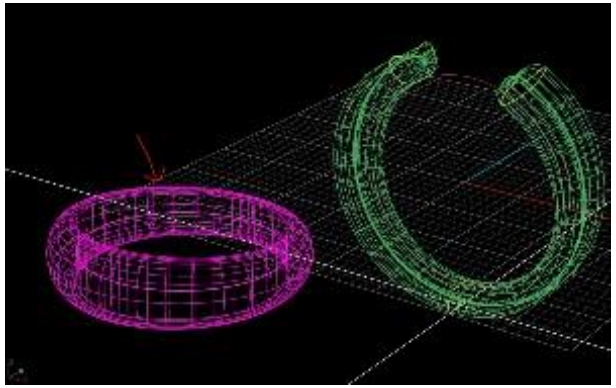
RENDERING PHENOMENON:

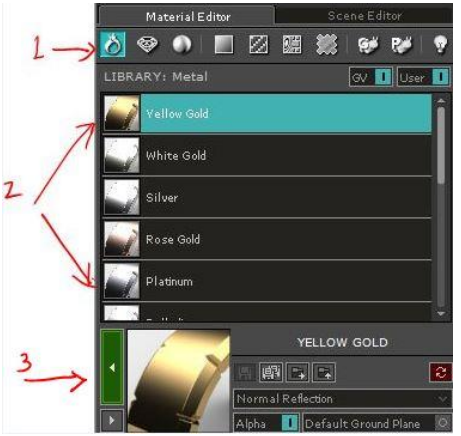
The effect of light upon a jewellery article to highlight its material color and shading, brilliance, so that we can get the feel of photo realistic effects

RENDERING STEPS:

Requirements:

- Position your 3D object in tilt position in Perspective View Port.
- Enlarge your Perspective View Port.
- Remove any Duplicate gems, curves, surfaces, solids
- Your object should be complete solid by checking in "Object Checker"
- Load Master files without Boolean Union.





Command Steps:

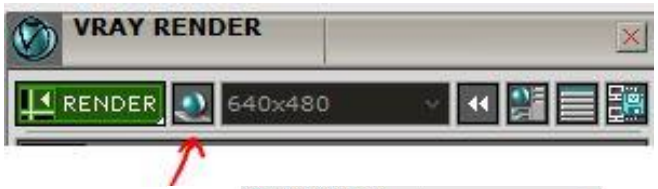
- Go to Render Menu.
- Click on "V-Ray Style"
- Click on " Add ground Plane"

TIP: Zoom in or out smoothly by holding the control button, then click and hold the right mouse key.

Click on the Rendering menu and then choose the VRay Styles tool. By doing so, the VRay Render Builder will appear on the right side of the screen. This menu is arranged with a neatly ordered outline of materials for you to apply to your model.

Ground Plane

Before you begin to apply materials to your piece, it is very important that you first assign the Ground Plane to Your viewport. This identifies the area your model rests on – that is, where it sits in space. Click on the Ground Plane button and it will appear in the viewport.



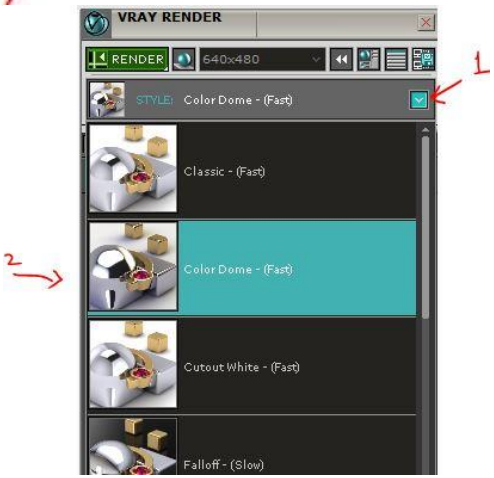
Click on "**Ground Planes**" and load respective back ground of our own choice.

a-Tiles

b-Wood

c-Architecture

d-Fabric----------Linen and -Silk



Material Editor

The next step is to choose the surfaces you want for your ring and render environment.

We will begin first with Metals. Select Metal Material icon to expand different metals. Select the model in the viewport you want to apply yellow gold material to, it will turn pink when selected. Select yellow gold material in material editor Hit Green Play button to Apply yellow gold Material to selected object.

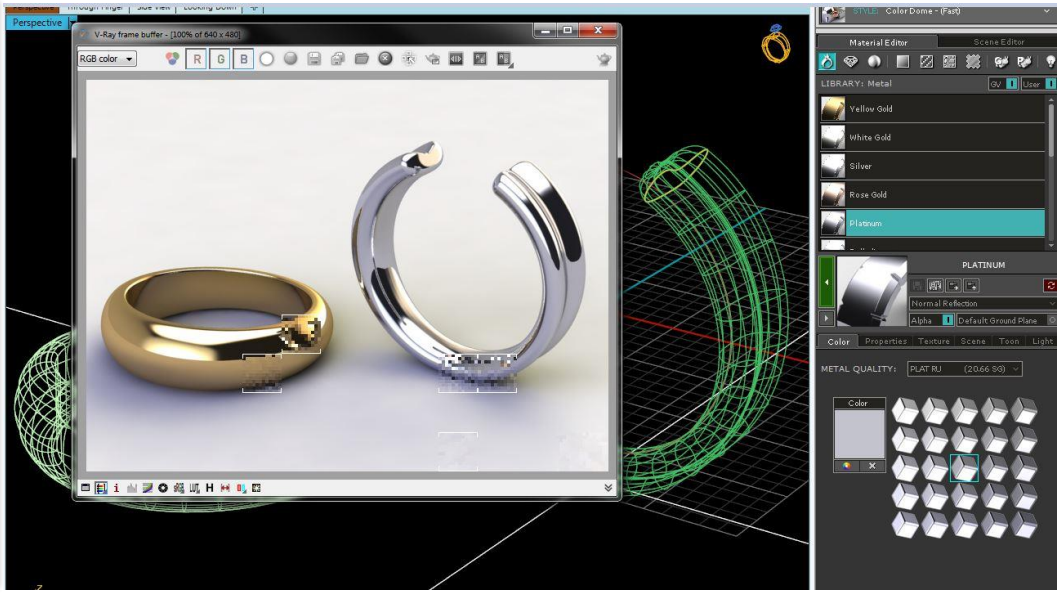
Select the model in the viewport you want to apply Platinum material to, Select Platinum material in material editor Hit Green Play button to apply platinum material to selected object

Setting Environment

1. Click drop down icon to expand different environment styles
2. Select desired environment to apply.

Setting Resolution

- Click drop down icon to expand different resolution options and set desired resolution
- Hit Render button to start rendering.
- After completion of rendering ……save your rendered image as a picture file (.jpg, .bmp, .gif, tiff, png)….preferably as ".jpg" at required directory with name.



Frequently Asked Questions

Test Yourself (Multiple Choice Questions)

LU1: Setup interface of Jewellery CAD software

LU2: Create 2D Drawings

LU3: Create 3D Drawings

Introduction

The learner guide for Gems and Jewellery sector of "Jewellery CAD/CAM" will provide an insight to the development of the Gem and Jewellery industry on modern means of technological advancements. It will provide an opportunity to the learner in better understanding of the use of Jewellery CAD/CAM software in providing state of the art solutions to the customers. A special care is observed in designing the learner guide to bring an easy solution in understanding with examples and practical exercises for your first time users and also it will bring a lot learning opportunities for the mid-career workers in the sector. Programme is to engage young people with a programme of development that will provide them with the knowledge, skills and understanding in working as a well professionally groomed worker or even starting own venture as an entrepreneur. The programme has been developed to address specific issues, such as the national, regional and local cultures, the manpower availability within the country, and meeting and the exceeding needs and expectations of their customers. The main elements of your Teaching and Learning Material are:

- **Introduction:**
  - This includes a brief description of your guide and guidelines for you to use it effectively.
- **Modules:**
  - The modules form the sections in your Teaching and Learning Material.
- **Learning Units:**
  - Learning Units are the main sections within each module
- **Learning outcomes**:
  - Learning outcomes of each learning units are taken from the curriculum document
- **Learning Elements:**
  - This is the main content of your Teaching and Learning Material with detail of the knowledge and skills (practical activities, projects, assignments, practices etc.) you will require achieving learning outcomes stated in the curriculum.
  - This section will include examples, photographs and illustrations relating to each learning outcome
- **Summary of modules**:
  - This contains the summary of the modules that make up your Teaching and Learning Material
- **Frequently asked questions**:
  - These have been added to provide further explanation and clarity on some of the difficult concepts and areas. This further helps you in preparing for your assessment.

- **Multiple choice questions for self-test**:
  - These are provided as an exercise at the end of your Teaching and Learning Material to help you in preparing for your assessment.

MODULE 3: CREATE COMPUTER AIDED DRAWING OF INTERMEDIATE LEVEL JEWELLERY

OBJECTIVE:

The purpose of this module is to enable the trainee in designing computer aided 3D model of jewellery article at intermediate level of difficulty while using jewellery CAD software and performing rendering

MODULE SUMMARY

This module is an essential milestone in designing and understanding of the fundamentals of jewellery article on computer aided software at intermediate level of difficulty. It will cover the basic elements and principles of design that how trainee will transfer ideas in to practical jewellery article on CAD software. Furthermore it emphasizes the designing of jewellery article conceptually following manufacturing techniques to produce jewellery article with precision and accuracy. It covers the setup interface of Jewellery CAD software, creating 2D and 3D drawings and to perform intermediate level Rendering.

The course learning units are arranged in such a way to integrate concepts and ideas related to each topic through tools and application-oriented projects. This makes the learning simple and systematic and enables one to gain more insight knowledge on the various tools covered.

LEARNING UNIT 1: SETUP INTERFACE OF JEWELLERY CAD SOFTWARE

LEARNING OUTCOMES

The trainee will be able to:

- Analyze jewellery article on measurements (Rings, Earing, Bangles and Pendants).
- Set up commands in CAD Jewellery software.

For setting up the software interface of the Jewellery CAD software, first of all analyze the jewellery article from all views then we have to note its critical dimensions/ gauges by using the appropriate tools.

LEARNING UNIT 2: CREATE 2D DRAWING

LEARNING OUTCOMES

The student will be able to:

- Scan and import image of manual 2D drawing if required.
- Create 2D drawing

LEARNING UNIT 3: CREATE 3D DRAWING

LEARNING OUTCOMES

The student will be able to:

- Generate 3D surface using cross sections etc.
- Place intermediate level design components (Gemstone, metal inserts etc.) on jewellery article.
- Assign material to 3D model and calculate weight of jewellery article and its components.
- Create specs sheet of designed jewellery article

LEARNING UNIT 4: PERFORM INTERMEDIATE LEVEL RENDERING

LEARNING OUTCOMES

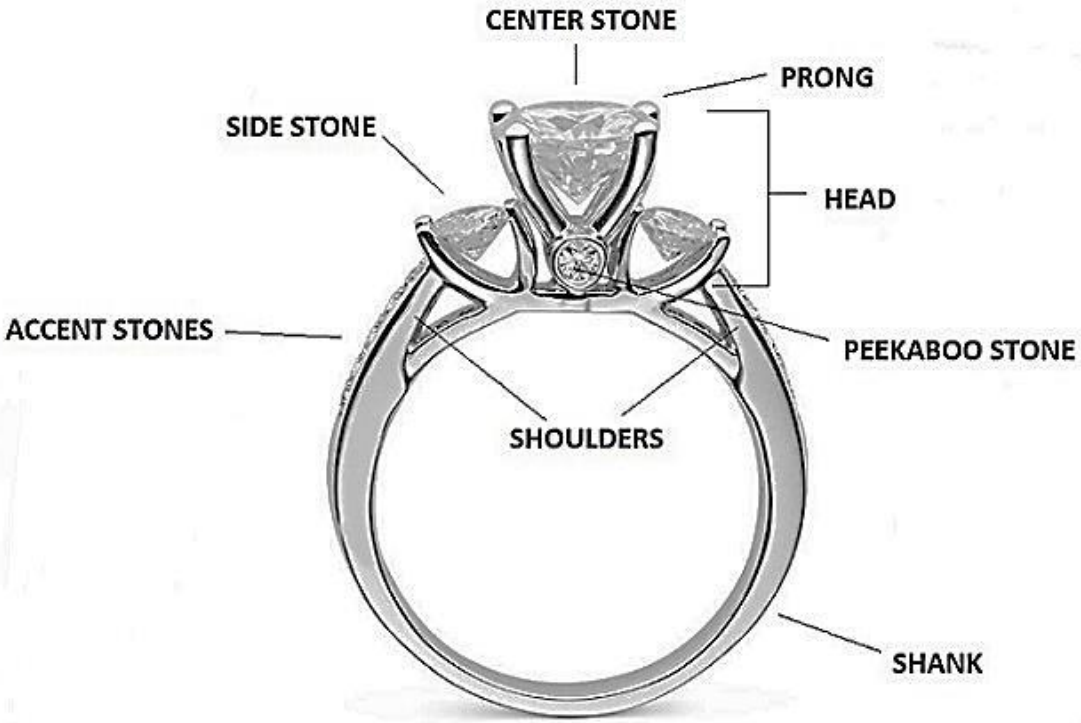
Trainee will be able to:

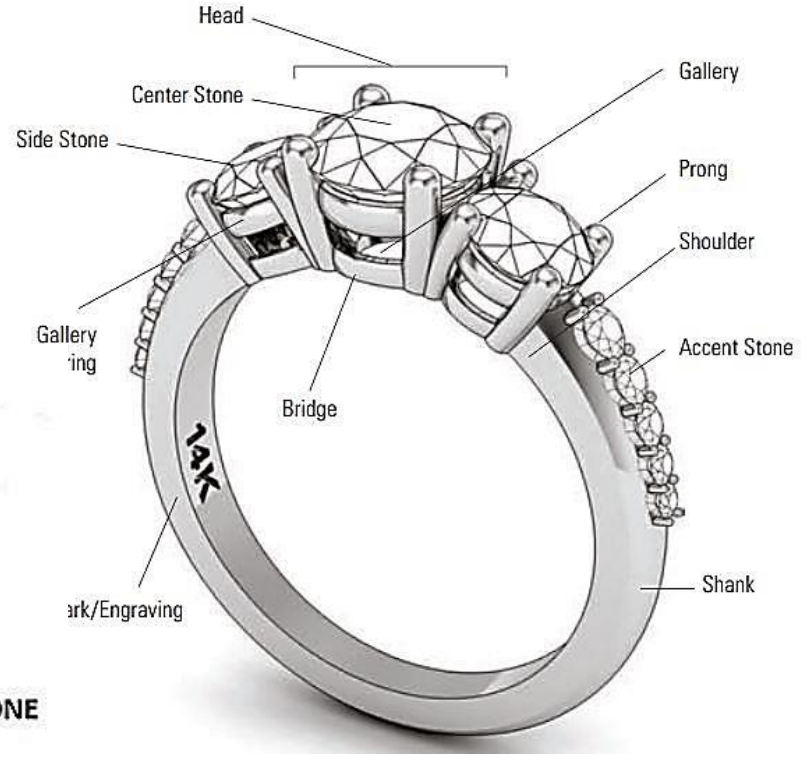
- Prepare 3D model for presentation.
- Apply customized parameters.
- Create animation of 3D Jewellery Article for presentation

TOOLS AND MATERIALS REQUIRED FOR LU 1, 2 3 AND 4

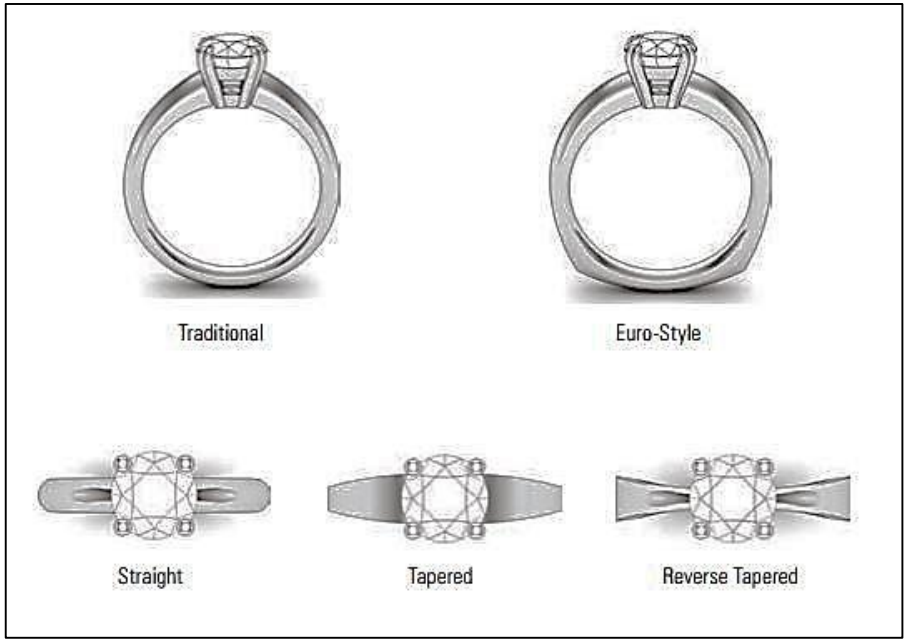
- Computer System compatible with CAD software
- Operating system (Microsoft Windows)
- Jewellery Design Software (Rhinoceros 3D & Matrix)
- Paper Printer (Colour)
- Steel Rule
- Paper cutter
- Ring Sizer
- Vernier Caliper

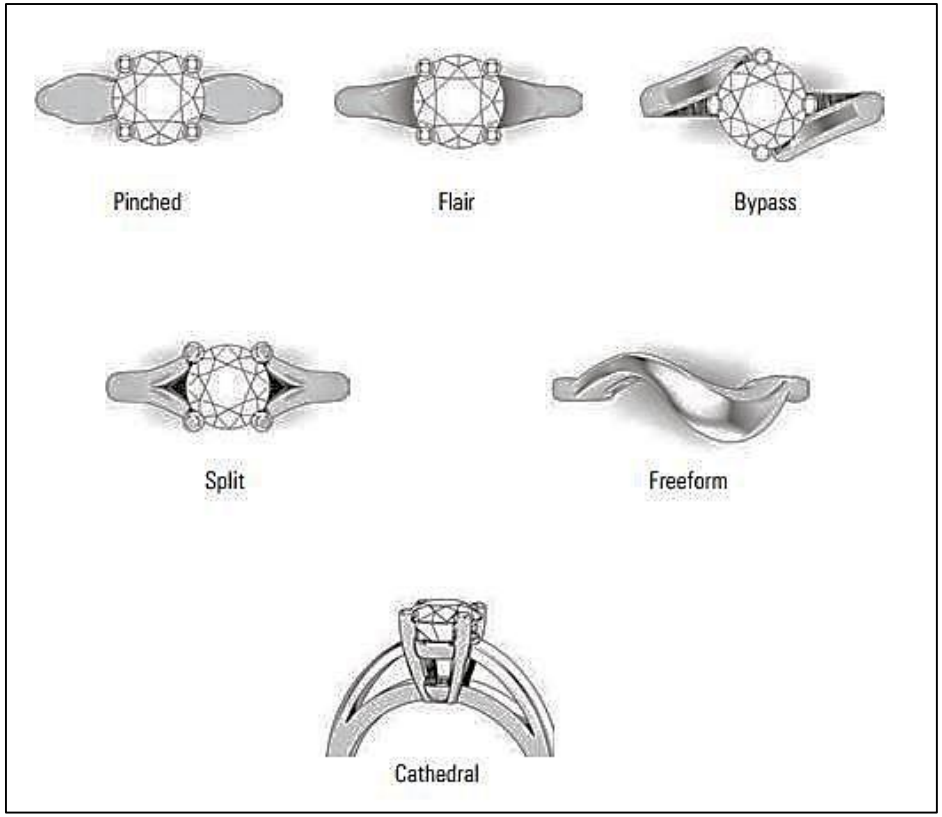
ANATOMY OF RING





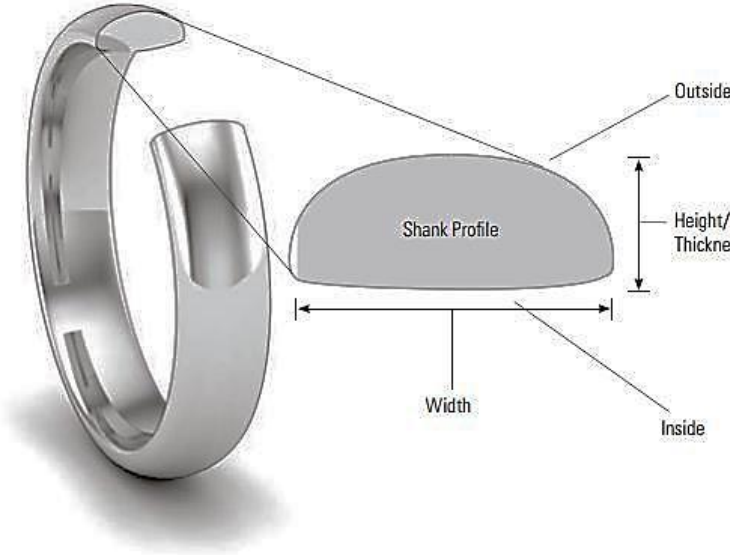
SHAPES OF SHANK

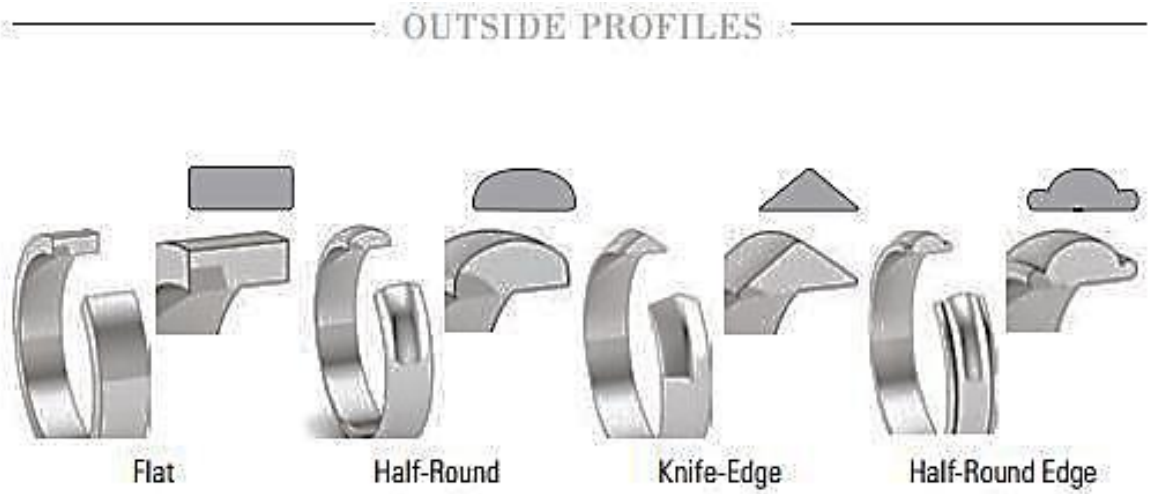


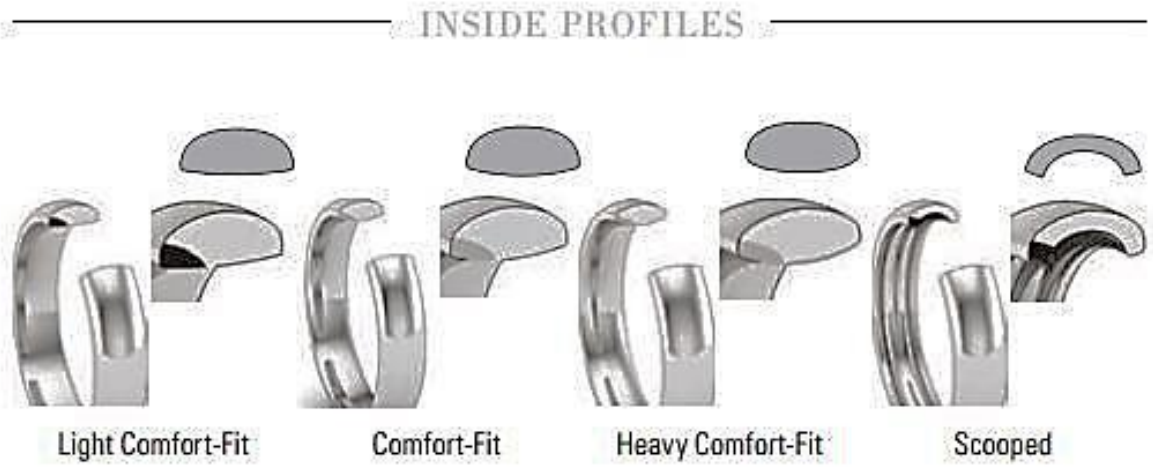


SHAPES OF SHANK

SHAPES OF PROFILE PLACER







RING STYLES

Engagement

Solitaire

Bridal Set
(Engagement Ring and Wedding Band)

Fashion

Halo

3-Stone

Promise

Semi-Mount

Award/Signet

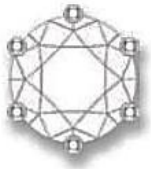
Wedding Band

Anniversary Band

Eternity Band

PRONG TYPES AND STYLES

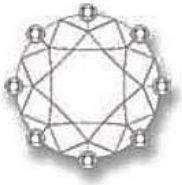
Four (Standard)



Six

Two (Vertical)

Four (Diagonal)



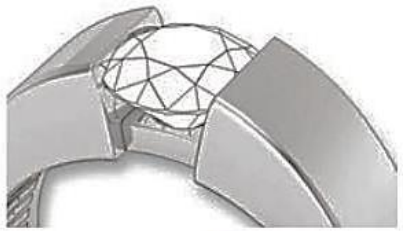
Eight

Two (Horizontal)

Bright-Cut

Bridge Accent

Illusion

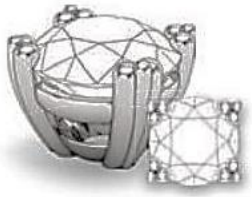


Channel

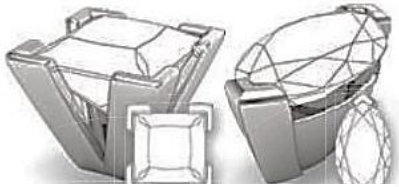
Trellis

Single

Double



Triple



Basket

Peg Head

Decorative

Bezel

Half-Bezel

Bar/Channel

DIFFERENCE BETWEEN KARAT AND CARAT

KARAT

- It is defined as the percentage of purity in gold.
- Jewellery is not manufactured in pure gold because it is easily distortable and deform.
- Gold is mixed with different metals to increase its mechanical properties for manufacturing jewellery article

Pure Gold = 24 K 1K =11.664 gm

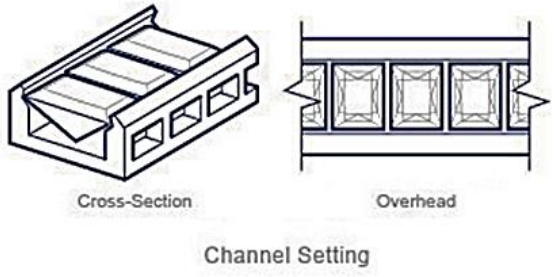
CARAT

- It is defined as a unit to measure the weight of a gem stone

1 Gm = 5 Carat 1 Carat = 100 Cent

CHANNEL SETTING

- The stones are aligned in a channel, sitting girdle-to-girdle.
- Step-cut stones can rest on a track giving a "keystone" effect.
- Matching stones that are cut to a uniform size for use in channel settings are called "calibré-cut," as in "eternity rings."



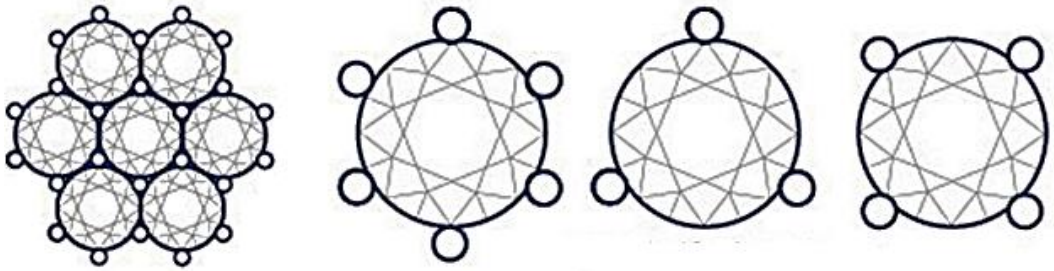
PAVÉ SETTING

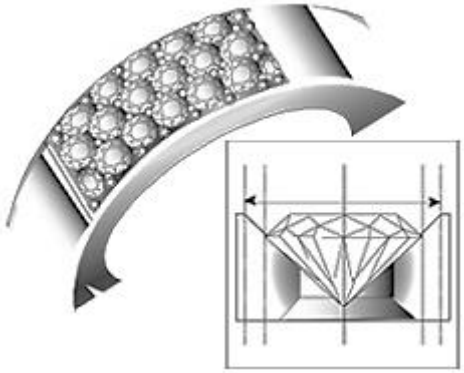
- It is a tight grouping of identically sized stones laid across a flat or convex surface, from the French word for "paved."
- The stones are held in place using three to six raised prong per stone

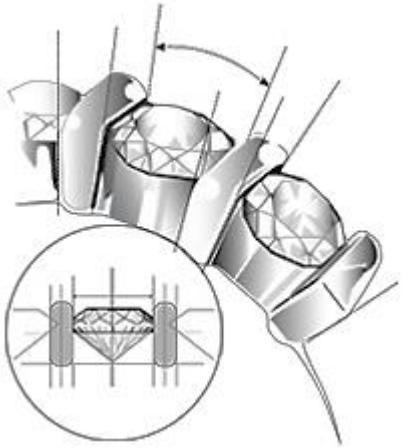
BAR SETTING

A variation of the channel setting is the bar channel setting.

- The metal plates in the channel rise to the top level of the stone and can be seen between the stones.







PRACTICAL 1: DESIGN A FILIGREE PENDANTBY DEVELOPING BEZEL AND PRONGS MANUALLY

LU1: Setup interface of Jewellery CAD software

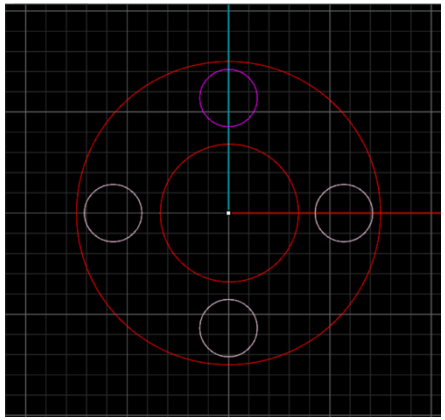
Commands Detail

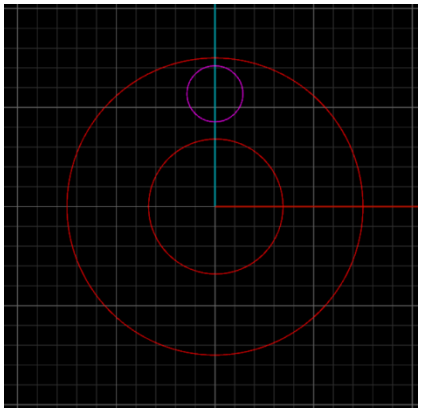
Circle, Interp Curve, Offset Curve, Ellipse, Helix, Extrude Surface Straight, Chamfer, Gem Loader, Array Polar, Mirror, Trim, Delete, Join, Fillet, Layer Menu, Solid Box

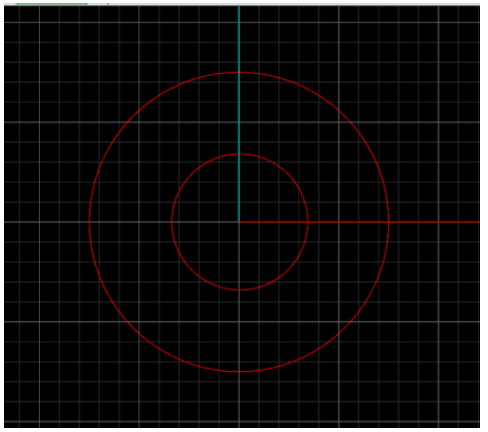
LU2: Create 2D Drawing

- Draw a circle of diameter = 20mm using “circle command” in Curve Menu
- Draw two more circles one is inner of dia 10 mm ,
  and other is off center of dia = 3mm

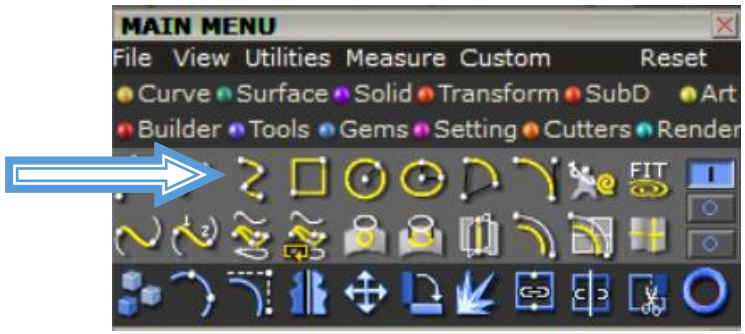
Then using “Array Polar” command from Transform Menu

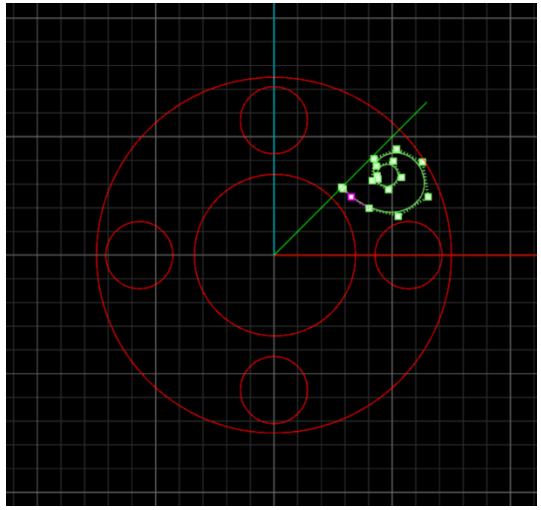




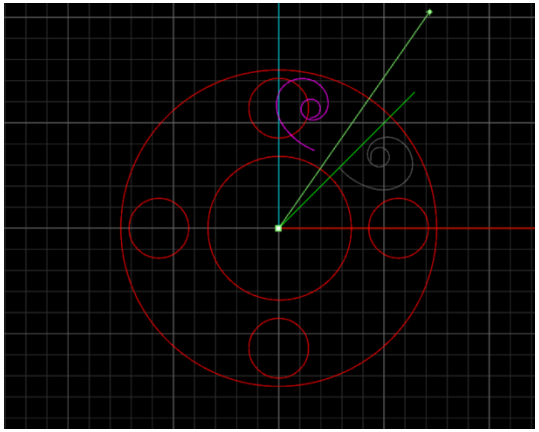


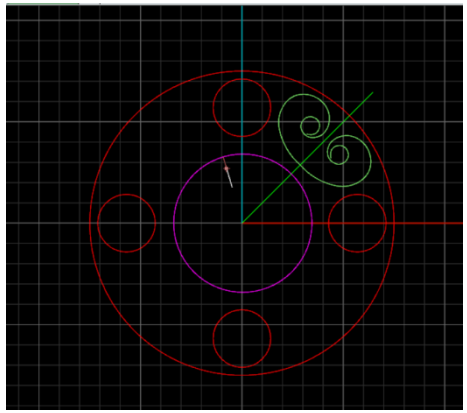
- Draw a spiral shape using “Interp Curve”



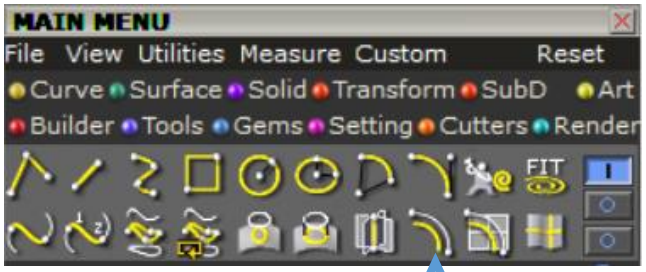


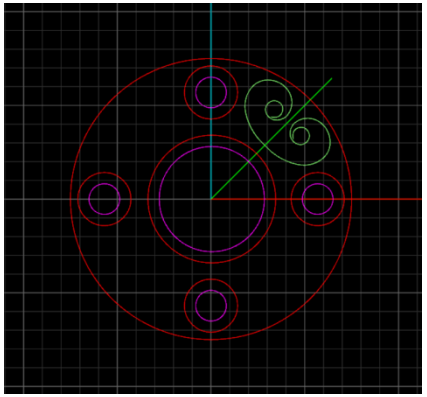
- Mirror the spiral shape by using Mirror command from “Top11Tools Menu”





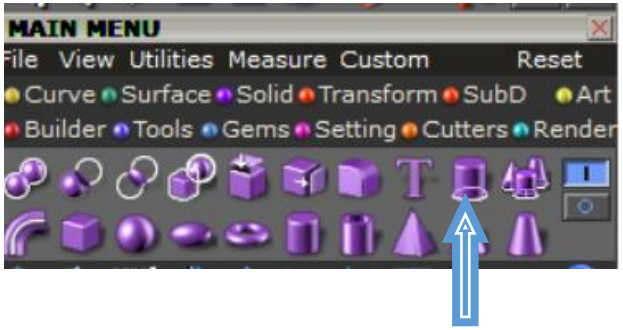
- Draw another offset circle of inner circle with offset distance = 0.5 mm

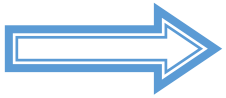


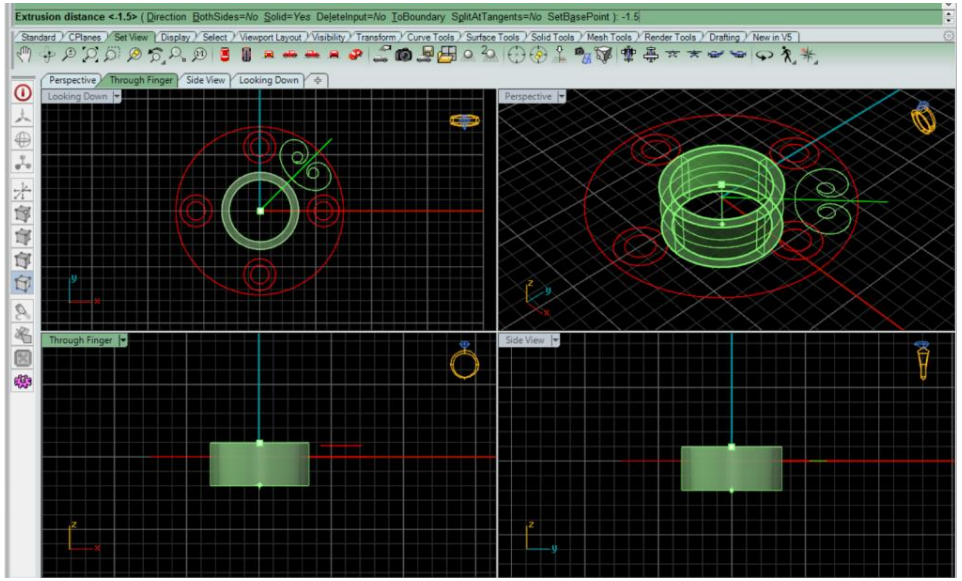


LU3: Create 3D Drawing

- Convert inner circular curves in solid surface by applying “Extrude Curves Straight” from Solid Menu.

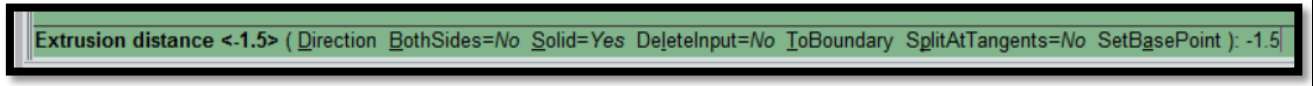


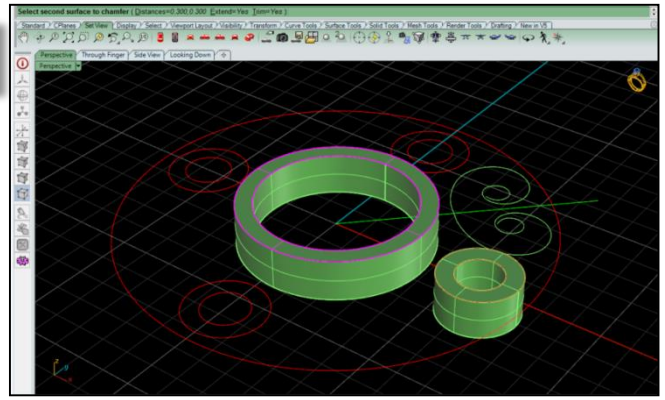




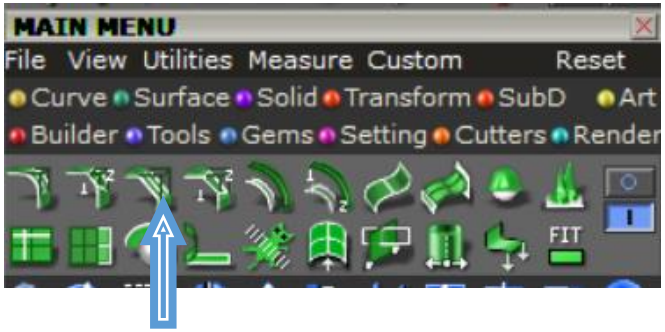
- The extruded height is 3mm,
- This will create the inner bezel

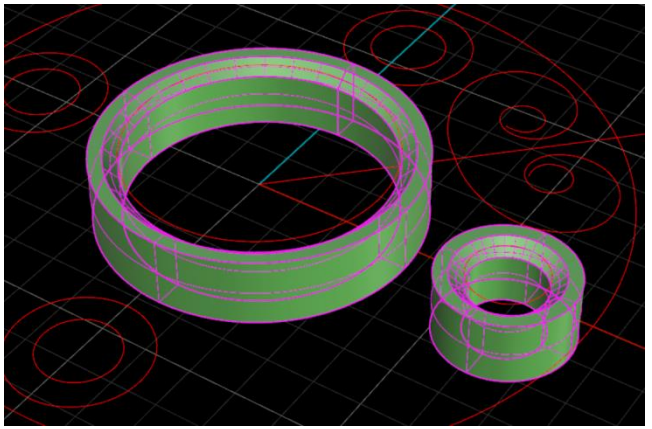
- Convert outer circle to small bezel of height 1.5 mm following the same above procedure Draw another



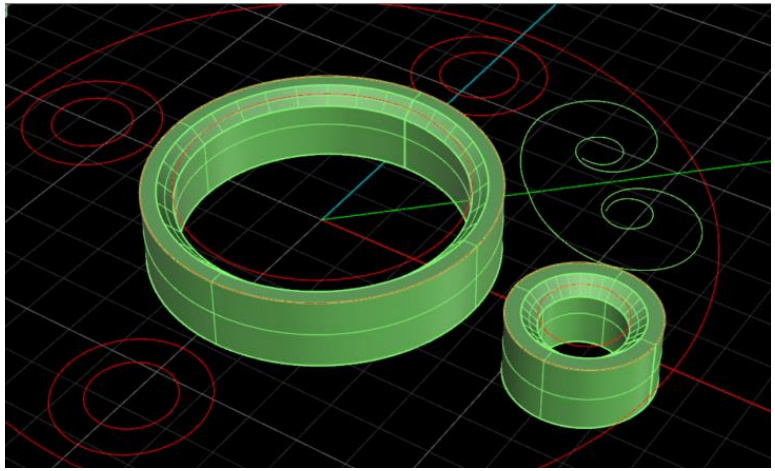


- Apply Chamfer command to the edge of both bezels from Surface Menu

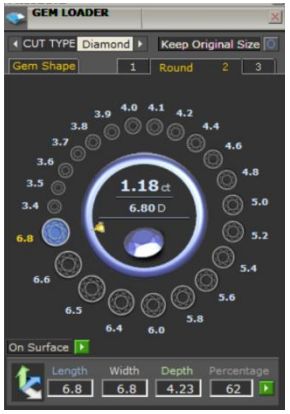


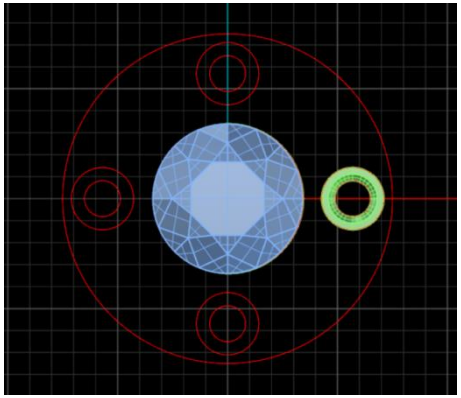


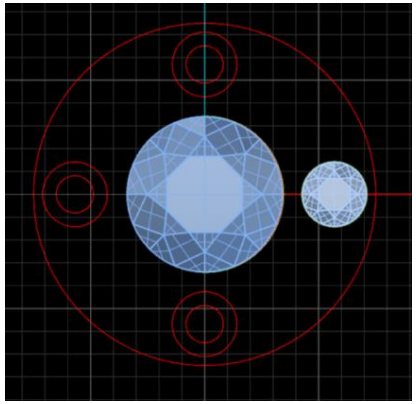
- Apply Join command if the surfaces are open.



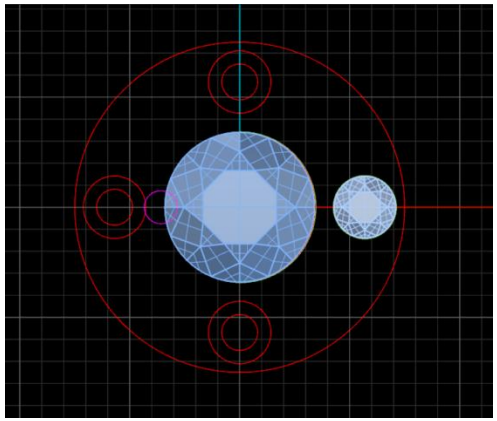
- Then go to “Gem Loader “ and load big Round Gem of size(Girdle Dia) = 6.8 mm and small gem of 2.8 mm

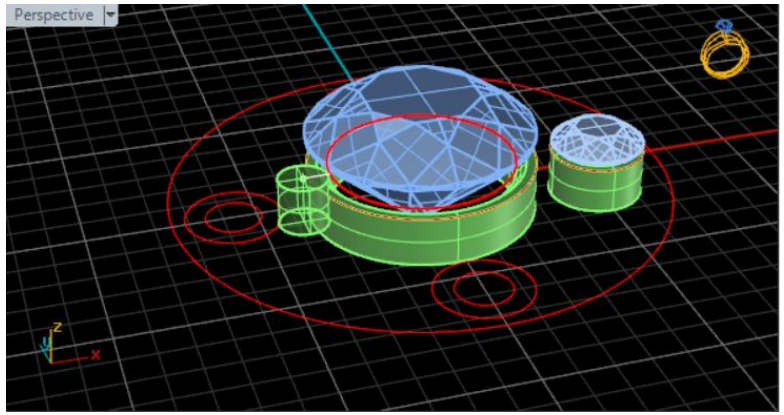




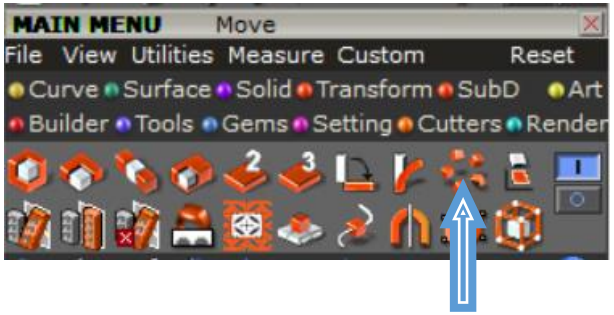


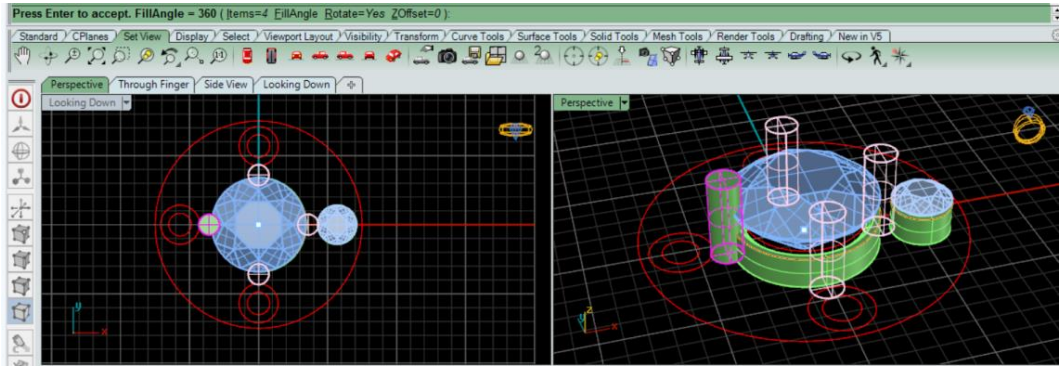
- Draw a small circle of dia = 0.5 ~ 1.0 mm between inner and outer gems to make a central prong.

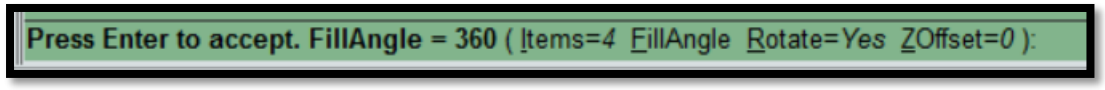




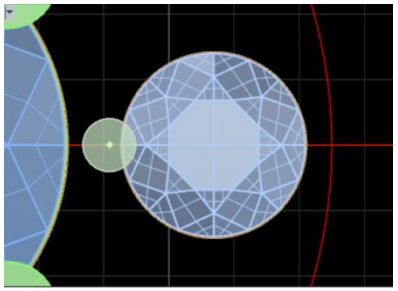
- Extrude the inner prong to height of 2~3 mm by using “Extrude curve Straight command”
- Apply “Array polar” command to outer bezel and prong to make a set of “4” by giving center reference to F4 and step angle of 360 degree.

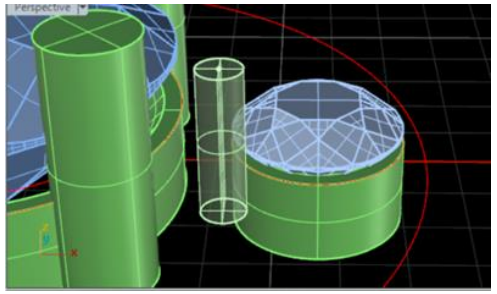




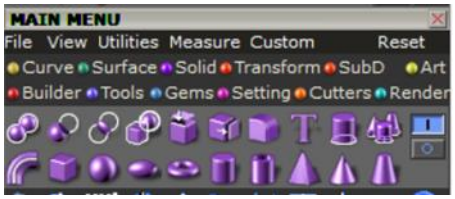


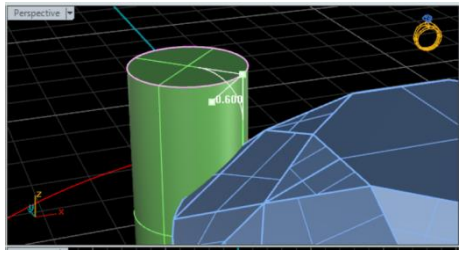
- Construct micro prongs for outer small bezel of dia = 0.8 ~ 0.5 mm by following the same above procedure.

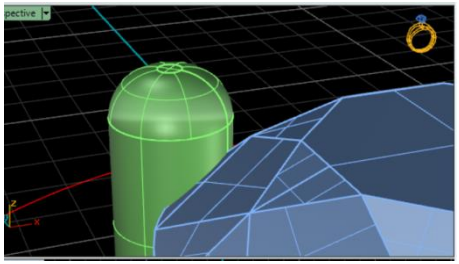




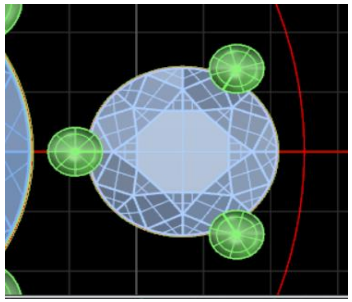
- Round off all edges of prongs to radius of 0.6 mm by applying command “Fillet Edge “ from Solid Menu

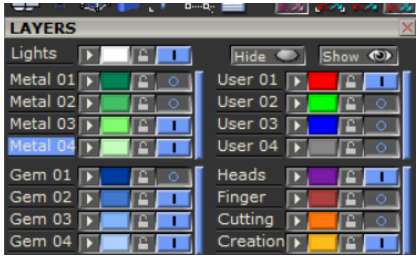


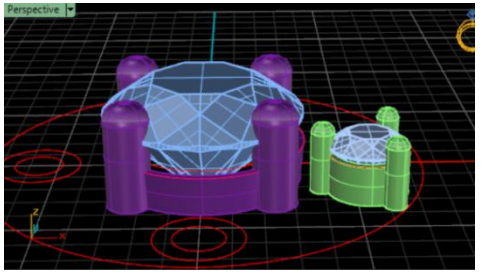




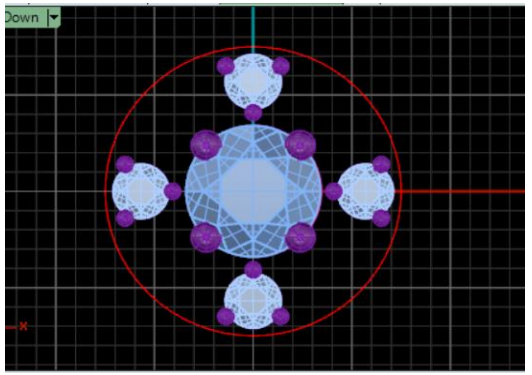
- Create three(3) prongs for small bezel by applying “Array polar” command
- Use layer menu to declare small and big prongs head to green and purple color respectively.



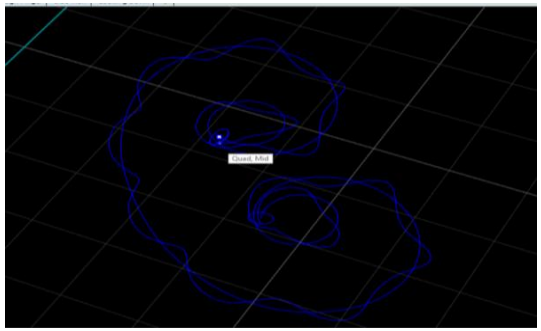




- Apply array polar command to replicate 4 small bezels

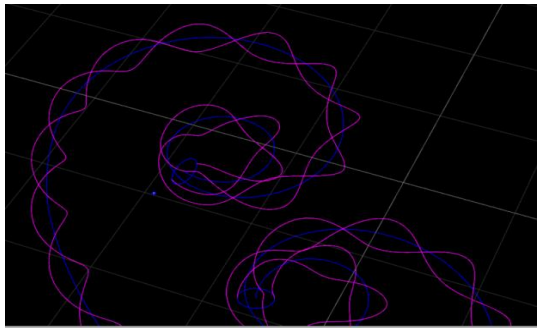


- Use the “Helix” command develops helix around the curve with the parameters as shown below.

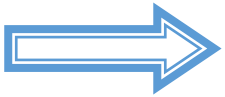


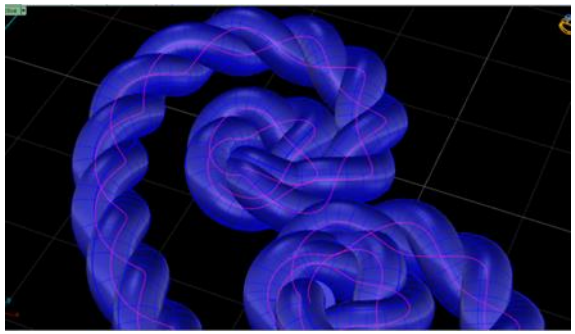
Radius and start point <0.150> (Diameter Mode=*Turns* Turns=*15* Pitch=*1.47751* ReverseTwist=*No* NumPointsPerTurn=*5*):

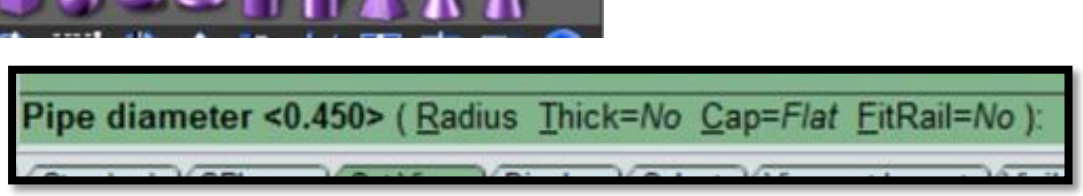
- Create another helix in reverse direction by using the above same command



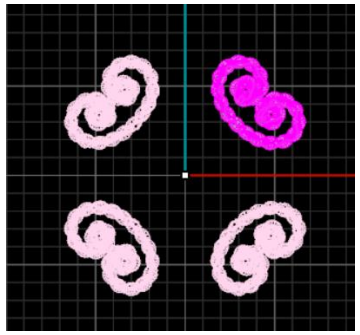
- Apply “pipe command “from solid menu having dia = 0.45 mm on both helix curves to develop Filigree.

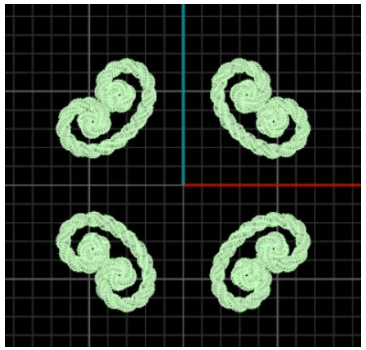




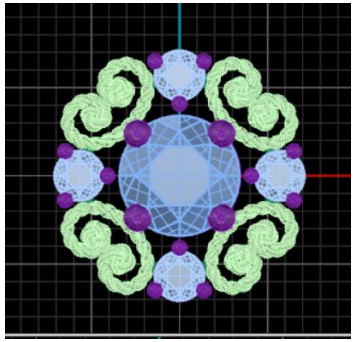


- Create four filigree patterns through “Array Polar”.

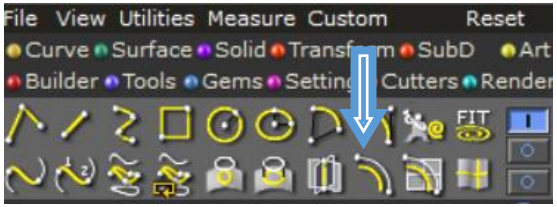


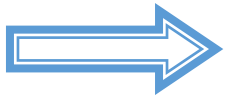


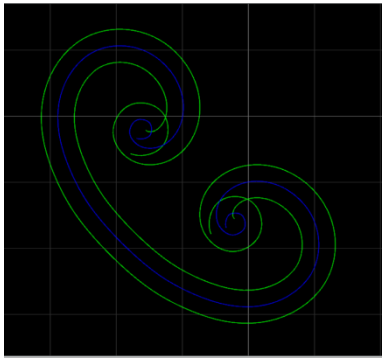
- Click Purple Layer on for the hidden bezels

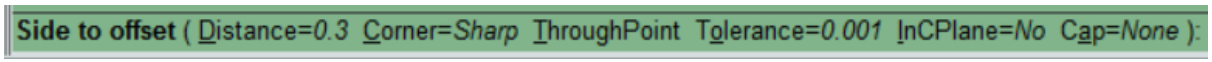


- Create the base curve as a foundation around the filigree by using “Curve Off Set” at 0.3 mm.

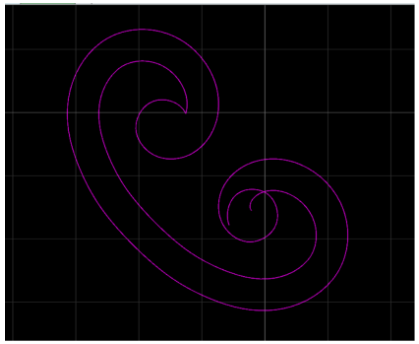


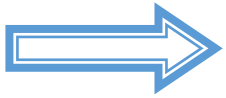


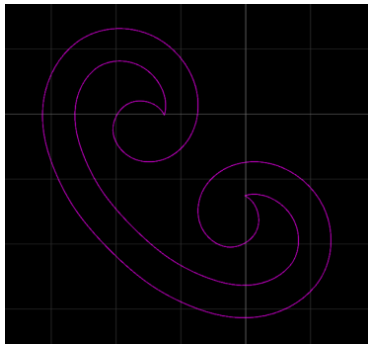




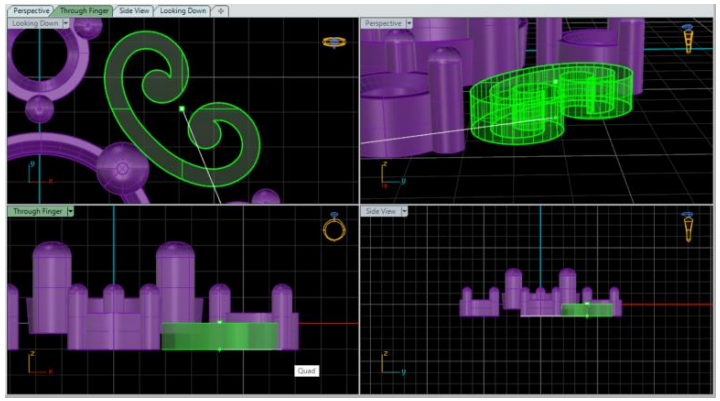
- Trim and delete the unnecessary curves by using Trim and Delete commands and then apply “Join” to open curves for making one closed curve.

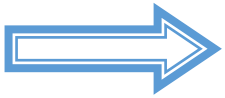


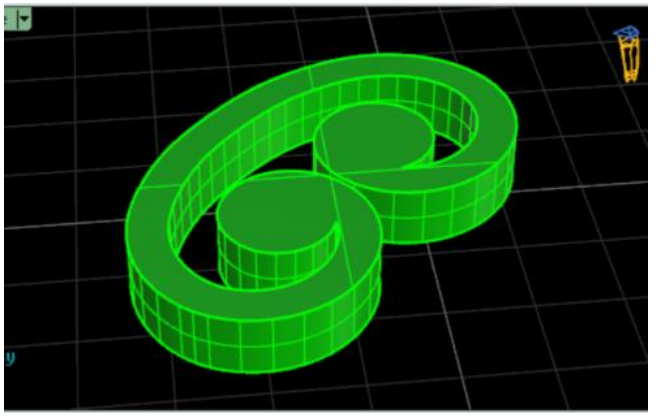




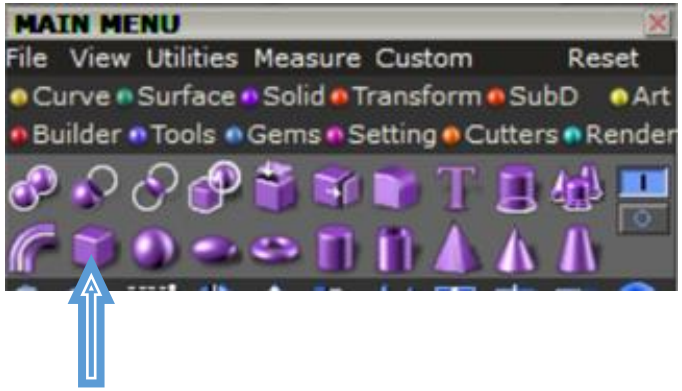
- Extrude the above curves to 1.0 mm by using “Extrude Curves Straight”

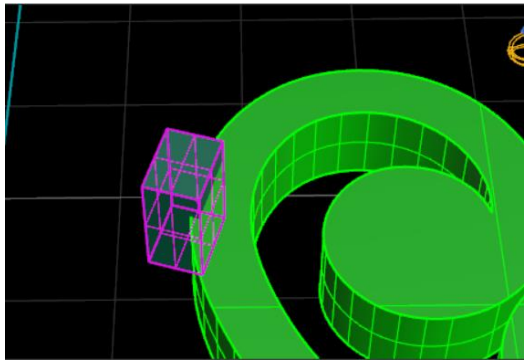




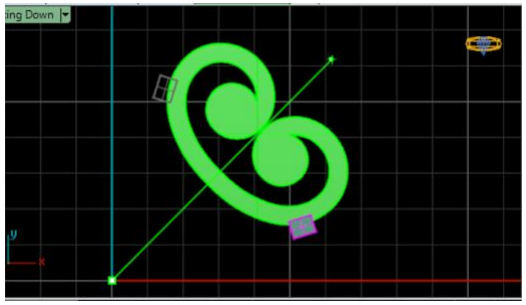


- Create an intermediate block of dimension 0.6 x0.45x1.0 mm by using “Box” in Solid Menu

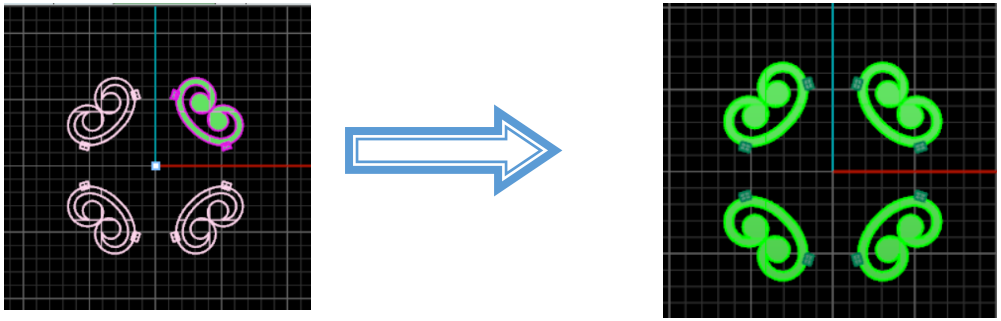




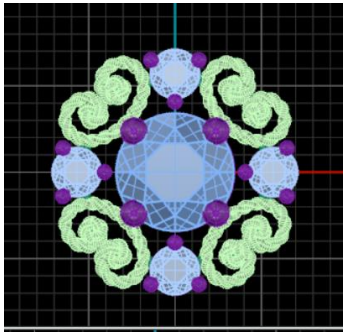
- Mirror the solid block by using a reference of 45 degree from Grid Tool Bar.

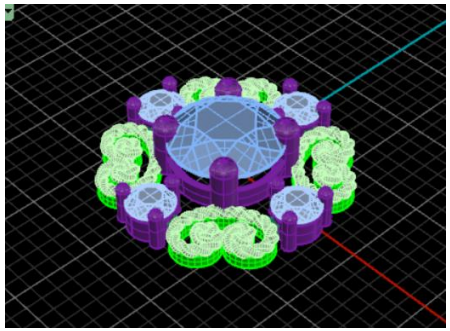


- Create the duplicate copies of block by applying “Array Polar” command



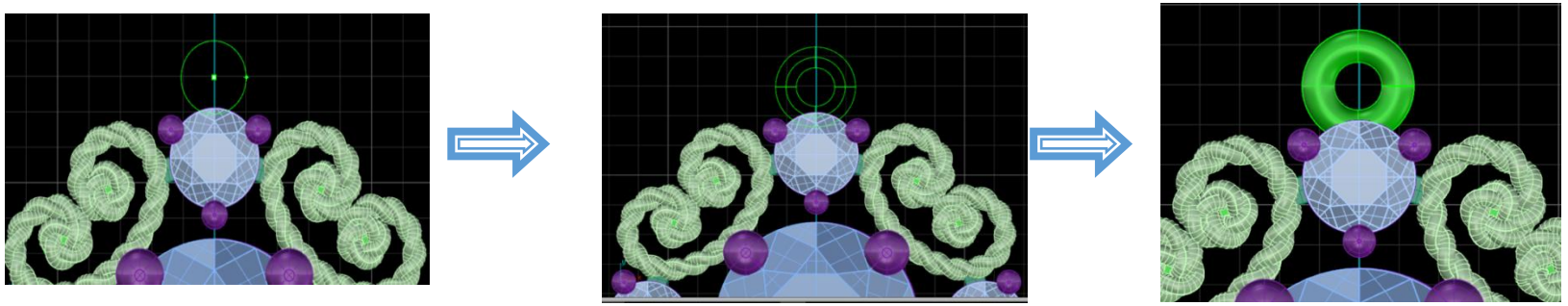
Click the essential layers on from Layer Menu



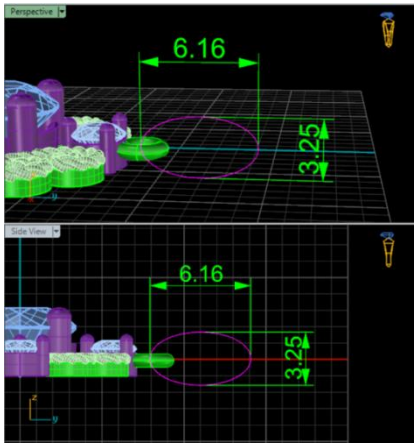


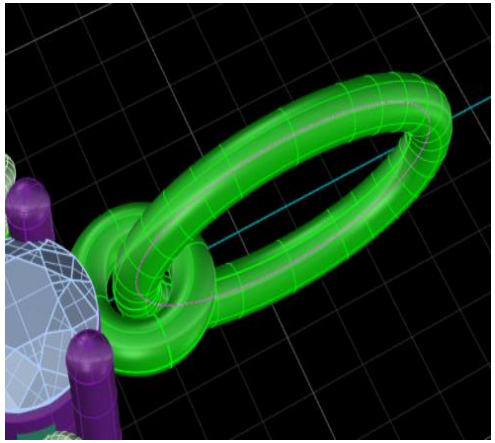
- Create a “Circle “of dia 2.0 mm at the top of pendant for hanging hook. Apply Pipe of dia=0.5 mm.

- This hook can also be created through Solid Torus

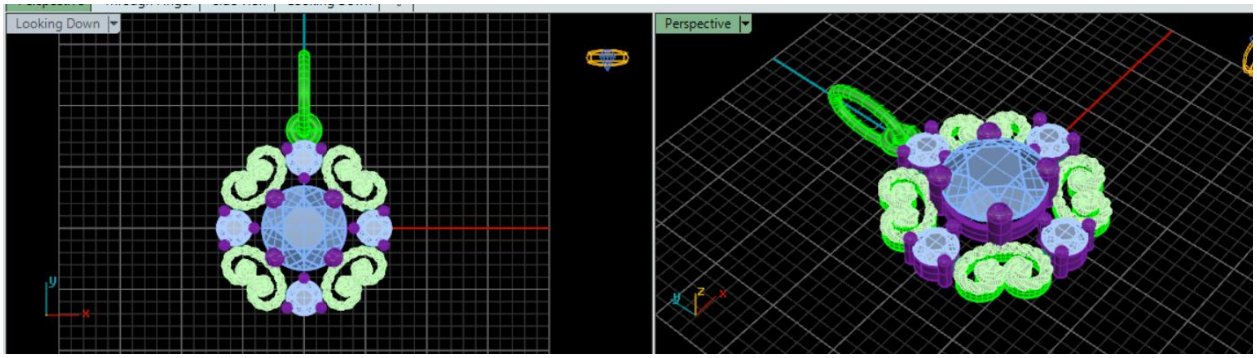


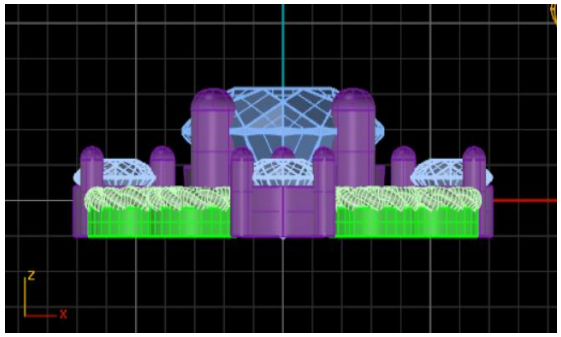
- At the end draw an Ellipse of dimensions as shown.
- Solidify it by using “Pipe” command again.





- Finally the pendant will be checked in Object Checker to ensure its Solidification.
- Weight of metal and gems can be calculated using the specific commands.
- Finally Filigree Pendant and then Render it.





RENDER IMAGES

CONVERTING CAD FILES TO CAM FILE

Matrix software has a strong algorithm to convert CAD model into machine language to produce physical wax pattern either by CNC machining or Rapid Prototyping.

BASIC REQUIREMENTS:

- Object should be a perfect 3D solid model
- Hide all Curves , 2D- surfaces , Duplicate object &

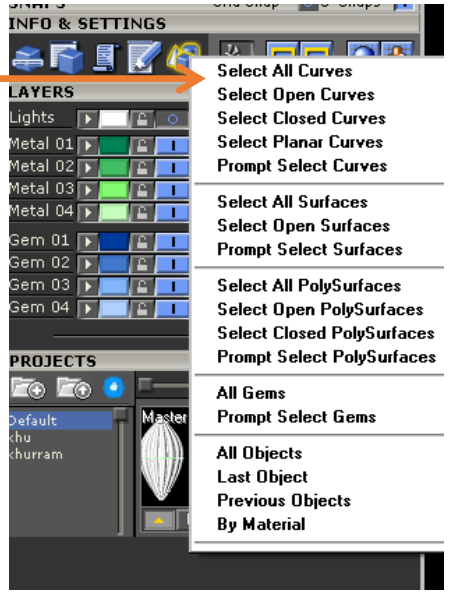
Gems by using “Super Select” command.

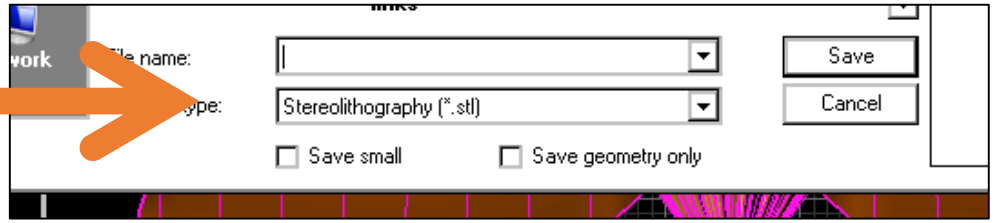
STEPS:

1. Go to “**File Menu”**
2. Select your 3D –model (so that it becomes pink).
3. Click “**Export selected**”
4. Target window will be opened to save your model in required directory

And give a unique name to file.

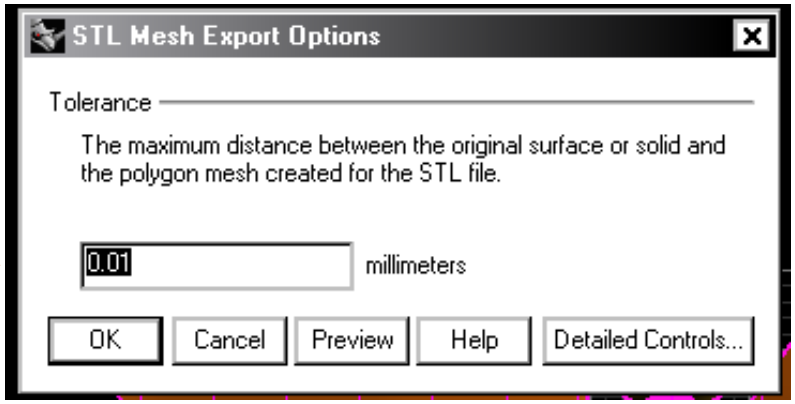
5. Select file type “ **. stl** ”
6. Mark tick on “**save small”**
7. **Then click “Save”**





This will open a window showing

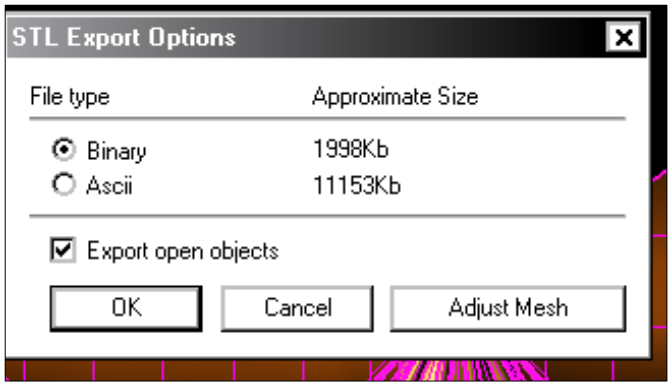
8. Set **Tolerance** to **0.01mm.**



9. It will convert into **STL Mesh** format by showing window.
10. Save the file in " **Binary" file type and**

Then press "OK".

11. It will process your 3D Model into STL CAM file**.**



Frequently Asked Questions

Test Yourself (Multiple Choice Questions)

Introduction

The learner guide for Gems and Jewellery sector in "Jewellery CAD/CAM" will provide an insight to the development of the Gem and Jewellery industry on modern means of technological advancements. It will provide an opportunity to the learner in better understanding of the use of Jewellery CAD/CAM software in providing state of the art solutions to the customers. A special care is observed in designing the learner guide to bring an easy solution in understanding with examples and practical exercises for your first time users and also it will bring a lot learning opportunities for the mid-career workers in the sector. Programme is to engage young people with a programme of development that will provide them with the knowledge, skills and understanding in working as a well professionally groomed worker or even starting own venture as an entrepreneur. The programme has been developed to address specific issues, such as the national, regional and local cultures, the manpower availability within the country, and meeting and the exceeding needs and expectations of their customers. The main elements of your Teaching and Learning Material are:

- **Introduction:**
  - This includes a brief description of your guide and guidelines for you to use it effectively.
- **Modules:**
  - The modules form the sections in your Teaching and Learning Material.
- **Learning Units:**
  - Learning Units are the main sections within each module
- **Learning outcomes**:
  - Learning outcomes of each learning units are taken from the curriculum document
- **Learning Elements:**
  - This is the main content of your Teaching and Learning Material with detail of the knowledge and skills (practical activities, projects, assignments, practices etc.) you will require achieving learning outcomes stated in the curriculum.
  - This section will include examples, photographs and illustrations relating to each learning outcome
- **Summary of modules**:
  - This contains the summary of the modules that make up your Teaching and Learning Material
- **Frequently asked questions**:
  - These have been added to provide further explanation and clarity on some of the difficult concepts and areas. This further helps you in preparing for your assessment.
- **Multiple choice questions for self-test**:

- These are provided as an exercise at the end of your Teaching and Learning Material to help you in preparing for your assessment.

MODULE 4: CREATE COMPUTER AIDED DRAWING OF ADVANCE LEVEL JEWELLERY

OBJECTIVE:

The purpose of this module is to enable the trainee in designing computer aided 3D model of semi complex jewellery article using CAD software and performing advance rendering.

MODULE SUMMARY

This module is an essential milestone in designing and understanding of the fundamentals of jewellery article on computer aided software at advance level of difficulty. It will cover the basic elements and principles of design that how trainee will transfer ideas in to practical jewellery article on CAD software. Furthermore it emphasizes the designing of jewellery article conceptually following manufacturing techniques to produce jewellery article with precision and accuracy. It covers the setup interface of Jewellery CAD software, creating 2D and 3D drawings and to perform advance level Rendering.

The course learning units are arranged in such a way to integrate concepts and ideas related to each topic through tools and application-oriented projects. This makes the learning simple and systematic and enables one to gain more insight knowledge on the various tools covered.

LEARNING UNIT 1: SETUP INTERFACE OF JEWELLERY CAD SOFTWARE

LEARNING OUTCOMES

The trainee will be able to:

- Analyze jewellery article on measurements (Rings, Earing, Bangles, and Pendants etc.)
- Set up canvas in CAD Jewellery software.

For setting up the software interface of the Jewellery CAD software, first of all analyze the jewellery article from all views then we have to note its critical dimensions/ gauges by using the appropriate tools.

LEARNING UNIT 2: CREATE 2D DRAWING

LEARNING OUTCOMES

The student will be able to:

- Scan and import image of manual 2D drawing if required.
- Create 2D Drawing

LEARNING UNIT 2: CREATE 2D DRAWING

LEARNING OUTCOMES

The student will be able to:

- Generate 3D surfaces using rails, cross sections etc.
- Place advance level design components on jewellery article
- Assemble different parts (links, hinges and findings etc.) of jewellery article.
- Assign material to 3D model and calculate weight of jewellery article and its components.
- Create specs sheet of designed jewellery article.

LEARNING UNIT 4: PERFORM ADVANCE LEVEL RENDERING

LEARNING OUTCOMES

Trainee will be able to:

- Prepare 3D model for presentation.
- Apply customized parameters Create customized background image (s) / logo (s).
- Create customized color of metal according to Cartage.
- Create customized color of gems and pearls.
- Assign color of enameling film (if required).
- Execute advance level rendering of 3D Jewellery Article.
- Create advance level (object and camera) animation of 3D Jewellery Article for presentation

TOOLS AND MATERIALS REQUIRED FOR LU 1, 2 3 AND 4

- Computer System compatible with CAD software
- Operating system (Microsoft Windows)
- Jewellery Design Software (Rhinoceros 3D & Matrix)
- Paper Printer (Color)
- Steel Rule
- Paper cutter
- Ring Sizer
- Vernier Caliper

LEARNING UNIT 5: GENERATE CAM FILE

LEARNING OUTCOMES

Trainee will be able to:

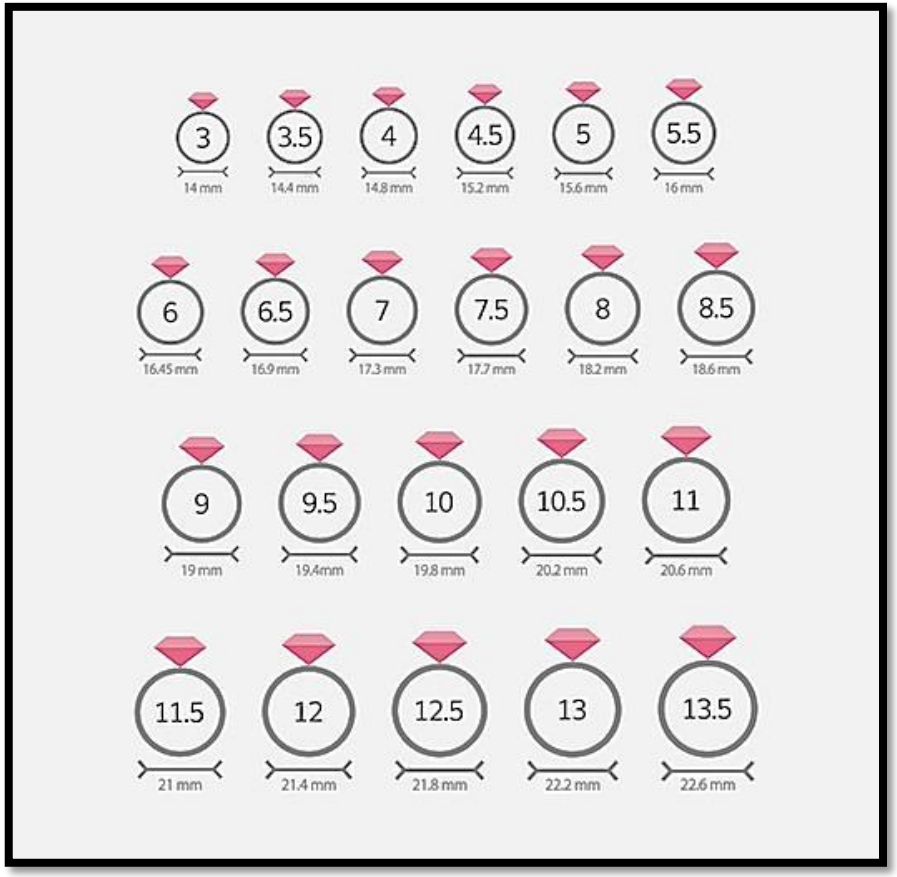
- Ensure 3D solid model is water tight and excludes gems, naked edges, duplicate and open surfaces.
- Export CAD file of 3D jewellery model according to CAM file format.

TOOLS AND MATERIALS REQUIRED

- Machine as per software compatible
- Operating system (MS Windows)
- Jewellery Design Software (Rhinoceros 3D & Matrix)

SOME BASIC CONCEPTS AND UNDERSTANDING

RING SIZE



INTERNATIONAL

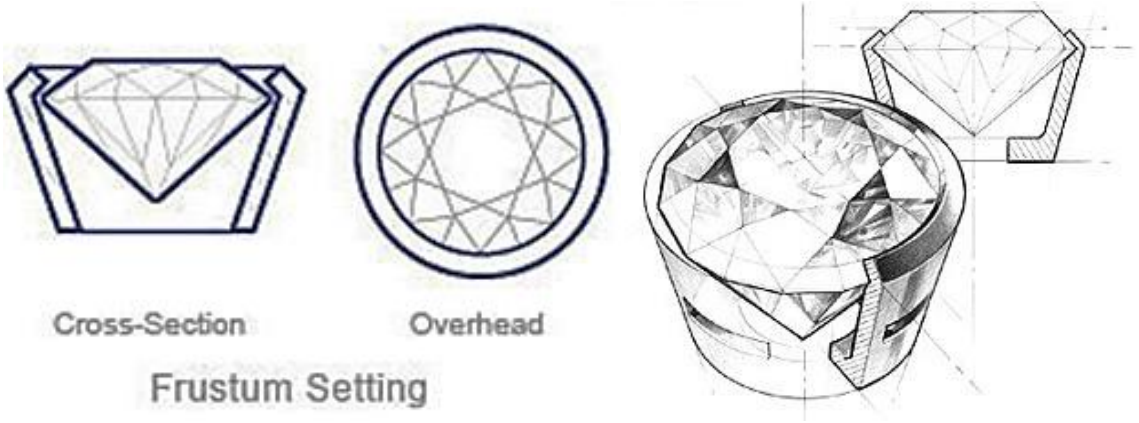
RING SIZE CHART

Measurements		Ring Conversion Table					
Inches	mm	US	Japanese	French	Swiss	German	British
1 3/4	44.5	3	4	44	4	14.0	F
1 25/32	45.2	3.5	6	45	5.5	14.5	G
1 13/16	46.0	4	7	47	7	15.0	H
1 7/8	47.6	4.5	8	48	9	15.5	I
1 15/16	49.2	5	9	50	10	15.8	J
2	50.8	5.5	10	52	12	16.0	K
2 1/16	52.4	6	12	53	13	16.5	L
2 3/32	53.2	6.5	13	54	14	17.0	M
2 1/8	54.0	7	14	55	15	17.3	N
2 3/16	55.6	7.5	15	56	16.5	17.8	O
2 1/4	57.2	8	16	57	18	18.0	P
2 5/32	57.82	8.5	17	58	19	18.5	Q
2 5/16	58.7	9	18	59	20	19.0	R
2 3/8	60.3	9.5	19	60	21.5	19.5	S
2 7/16	61.9	10	20	61	22	20.3	T
2 1/2	63.5	10.5	22	62	23.5	20.8	U
2 9/16	65.1	11	23	63	25	21.0	W
2 19/32	65.9	11.5	24	64	26	21.3	X
2 5/8	66.7	12	25	66	27.5	21.8	Y

ADVANCE GEM SETTINGS

FRUSTUM SETTING

- A Frustum, or "Hollow Cone" setting is a conical or tapered setting constructed from sheet metal.
- The stone's pavilion rests against the inside of the cone and the outer edge of the cone's lip is bet over the girdle to secure the stone.



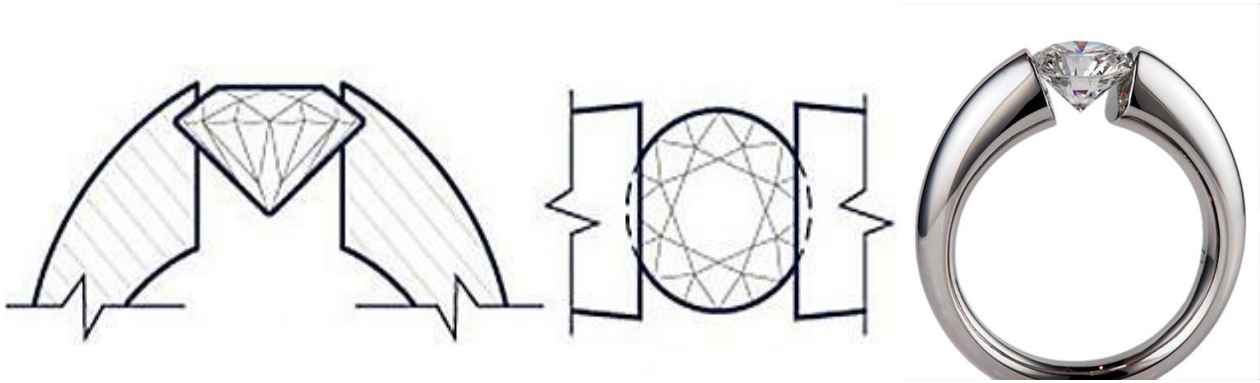
ILLUSION SETTING

- An illusion setting is designed to make a stone look larger than it really is.
- It consists of a white gold or platinum disc with a hole in the center into which a small stone is fitted.
- The stone is traditionally bead-set or grain-set and the chiseled beading creates carved facets on the disc, which enhance the stone and confuse the eye.

INVISIBLE SETTING

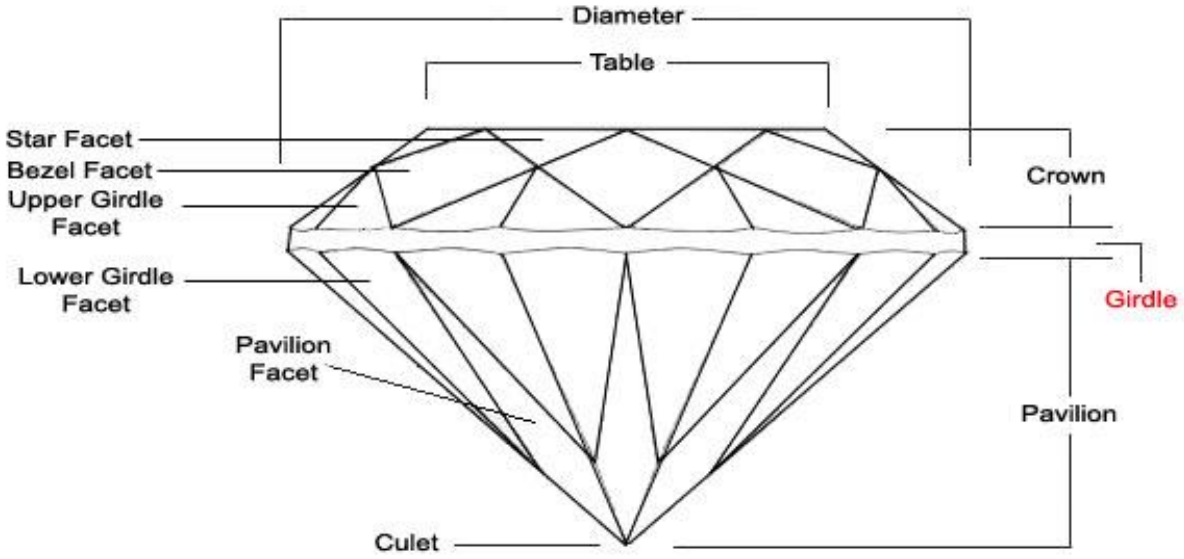
- The invisible setting technique was developed in France more than two centuries ago.
- Invisible setting is popular because of its clean minimal look.
- Grooves in each stone's girdle slip into a metal framework below the surface, but the metal cannot be seen, so the stones will sit side-by-side, creating a solid surface of gems.
- The invisible setting technique is used to create the illusion of larger diamonds in engagement and wedding rings.

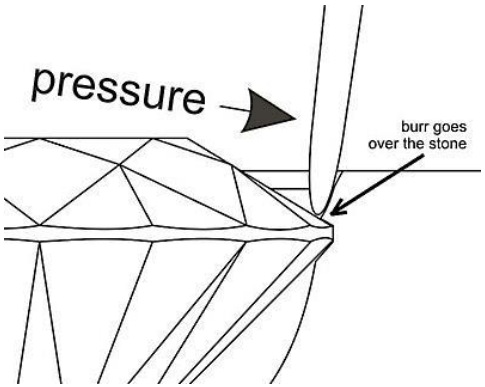
TENSION SETTING

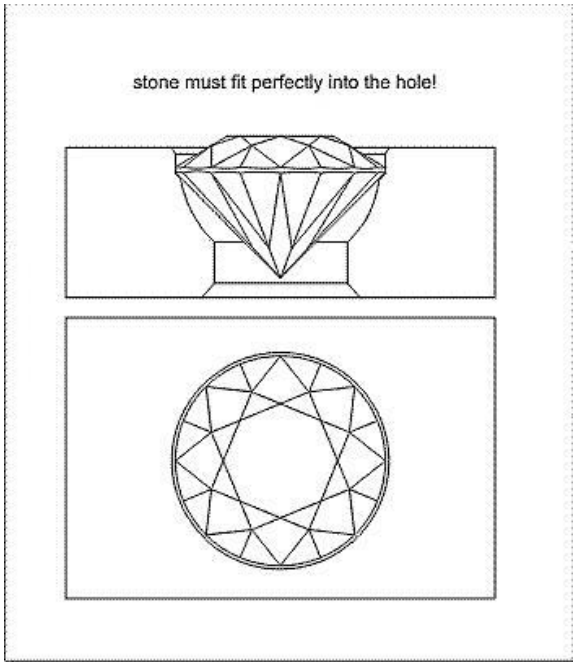


- It uses the metal's natural tendency to "spring" back to its original position to hold the stone in place.
- The metal is spread apart, and the girdle of the stone is seated into small grooves in the inside surface of the metal.

ANATOMY OF GEMS

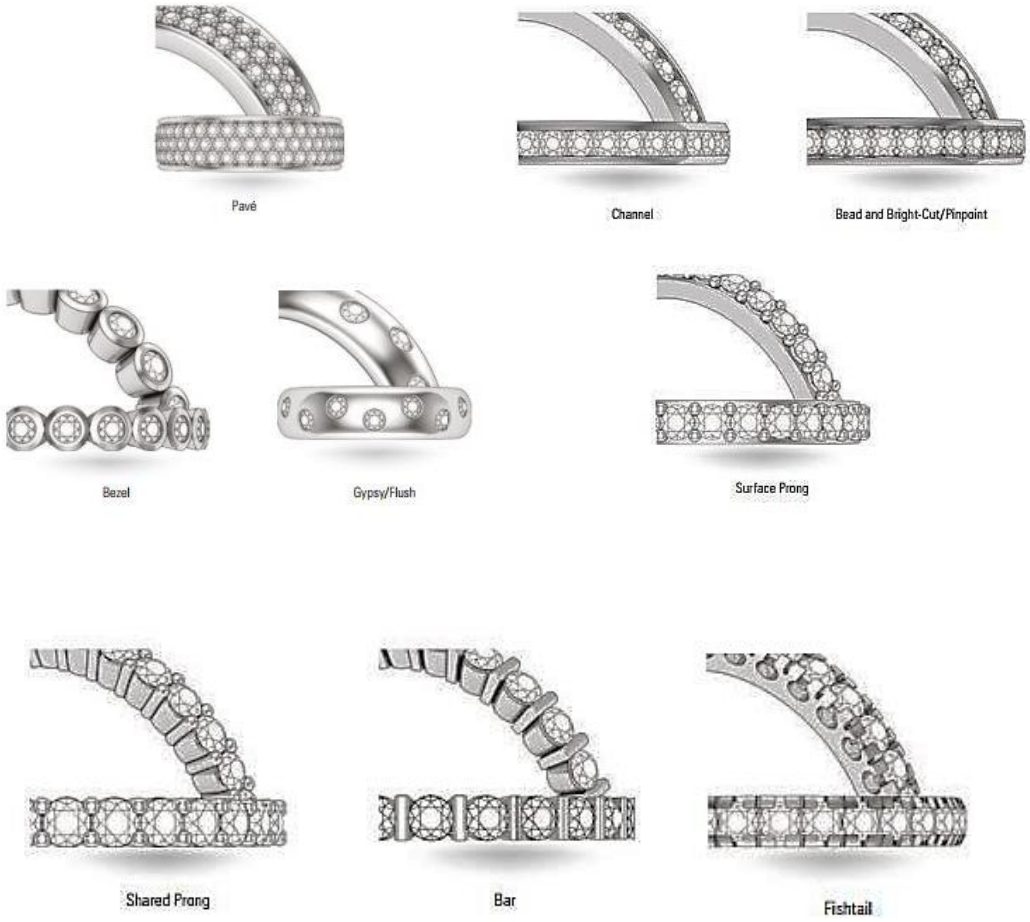


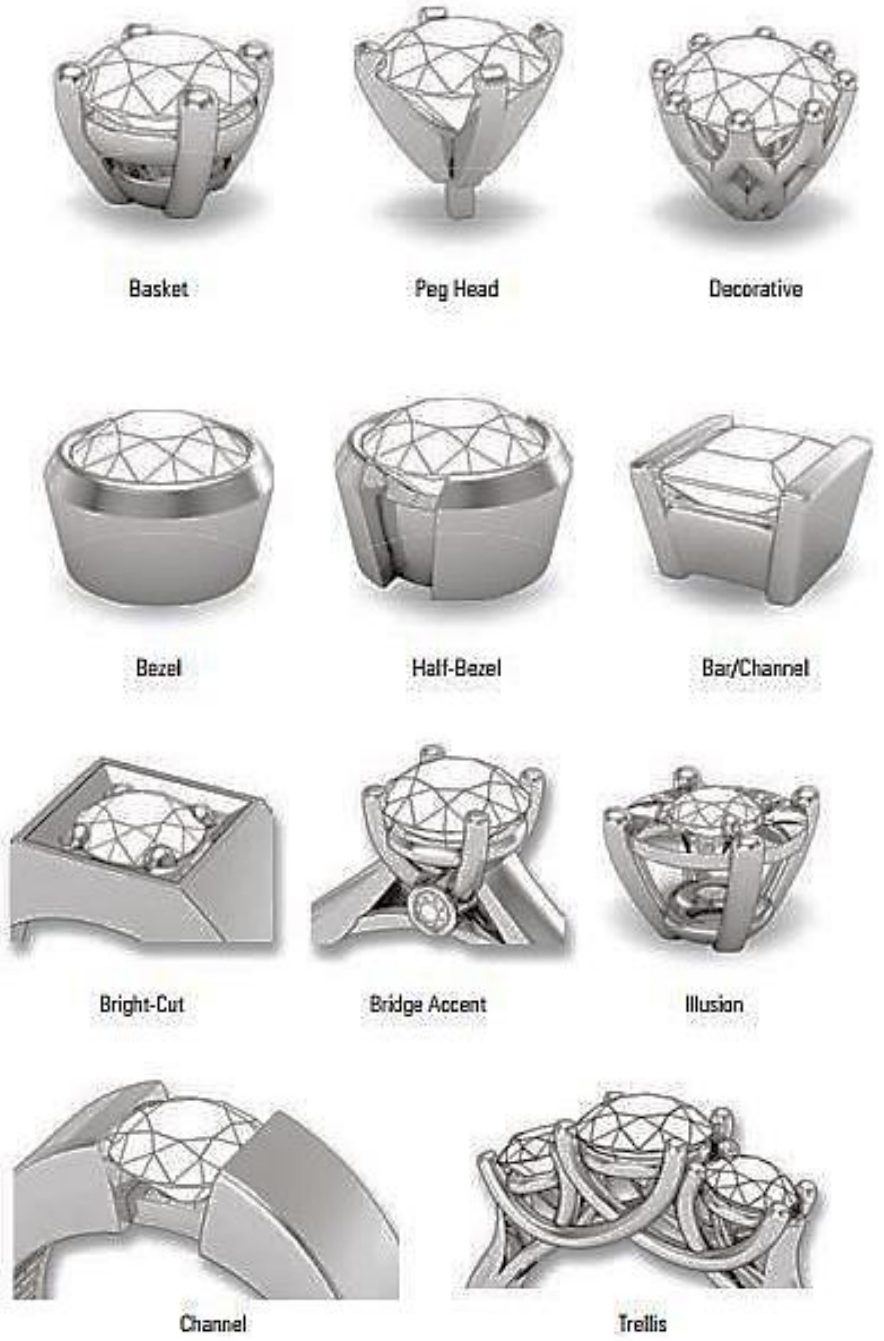




SUMMARY OF STONE SETTINGS

(REF: STULLER BASIC JEWELRY MANUAL)





CABOCHON

- The shape cabochon (KAB-oh-shon) refers to a piece of gemstone (or other material) which has been shaped and polished, instead of faceted.
- Such stones have a domed front surface and a flat back

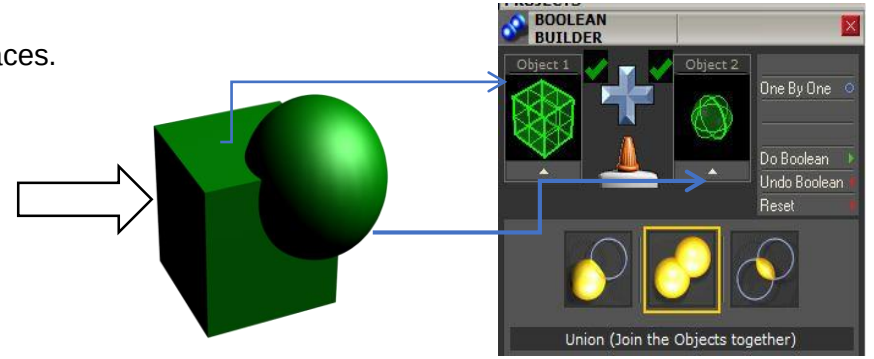
(Ref :https://www.firemountaingems.com/resources/jewelry-making-articles/c77j)

BOOLEAN OPERATIONS: Boolean Operations are used

- To join or weld or solder two or more solids that are in contact
- To subtract or drill holes or to make cavity in solids
- To intersect or extract the common part between the solids

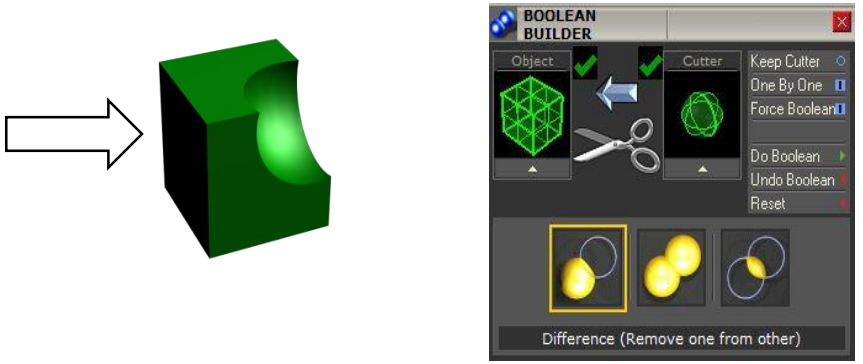
Note: These operations are only applicable to 3D solids not on curves and 2D surfaces.

Types of Boolean Operations:



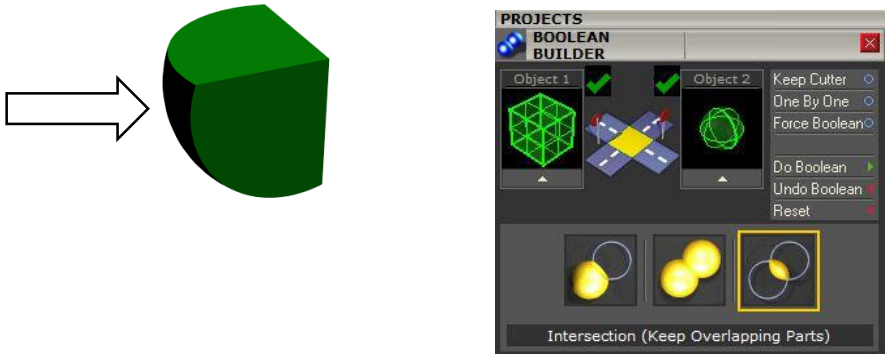
1. **<u>Boolean Union</u>**

Combines/ weld / solder two or more solids that are in contact



2. **<u>Boolean Difference</u>**

Subtracts or drill holes or make cavity in solids

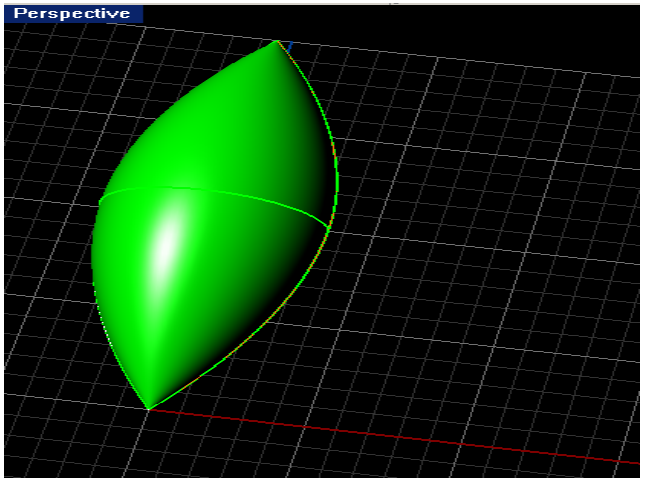


3. **<u>Boolean Intersection</u>**

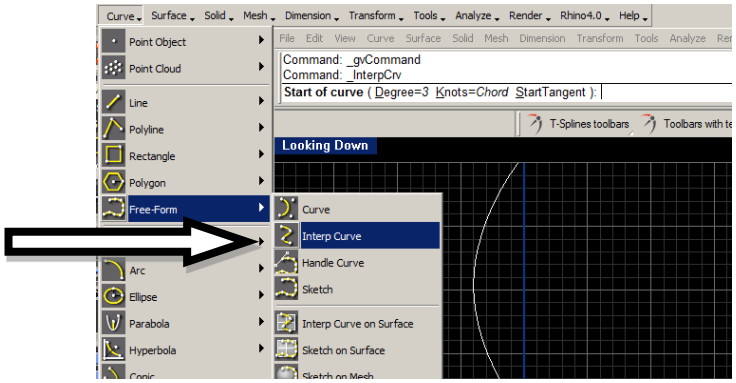
Extracts the common part between two solids

PRACTICAL: 1 DESIGN A FLOWER BY CREATING A SYMMETRICAL DOME SURFACE

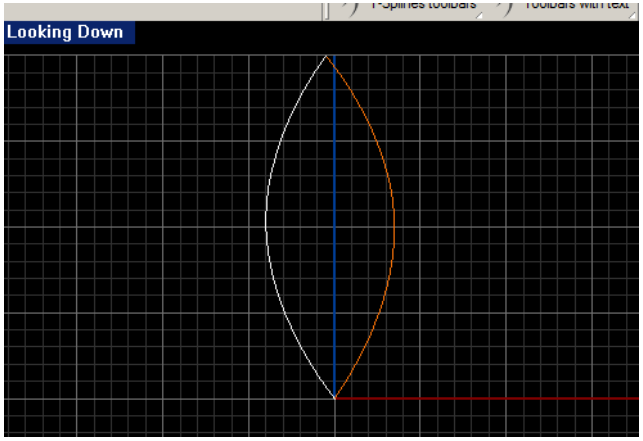
LU1: SETUP INTERFACE OF JEWELRY CAD SOFTWARE



- Construct a symmetrical line work in Looking Down window using freeform command “Interpt Curve” and declare it as Rail-1



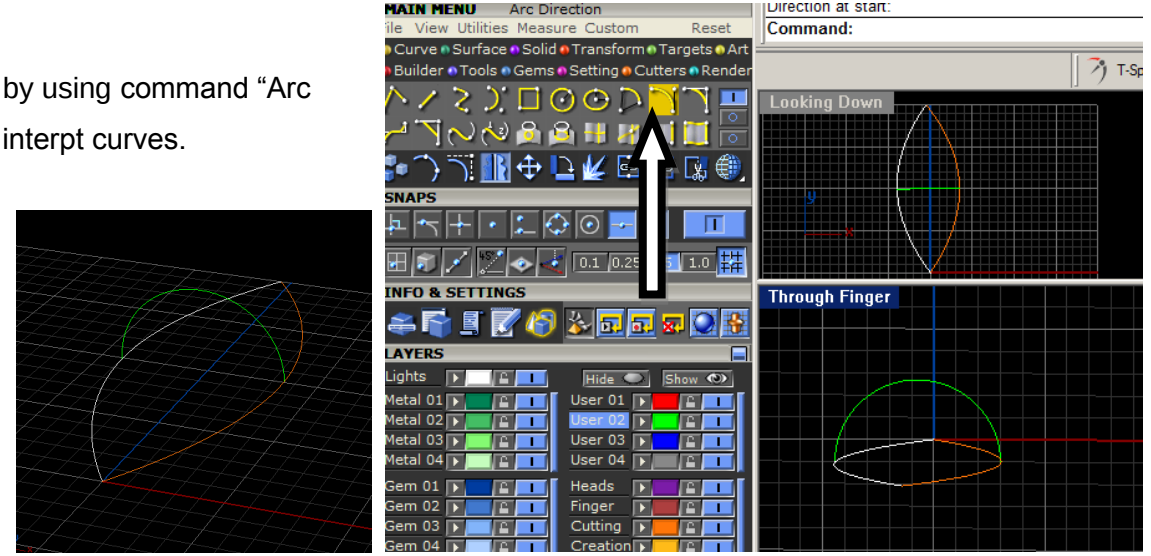
- Make a similar copy of above interpt curve either by using command “Mirror” or “Duplicate and declare it as Rail-2



Note: Don’t try to join the end points of above two curves.

LU2: CREATE 2D DRAWING

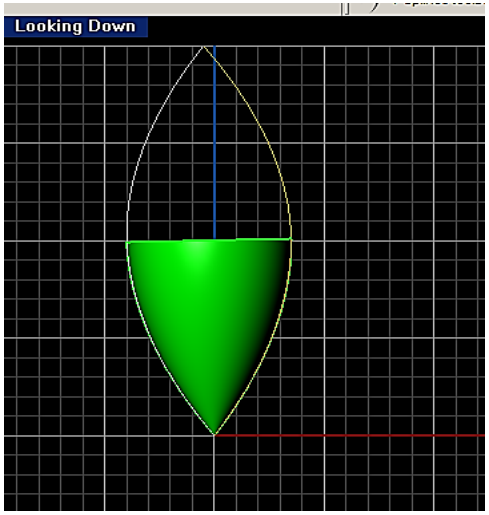
- Go to Through Finger Window, and draw a dome arc by using command “Arc Direction”, so that it may touch the mid points of both interpt curves.

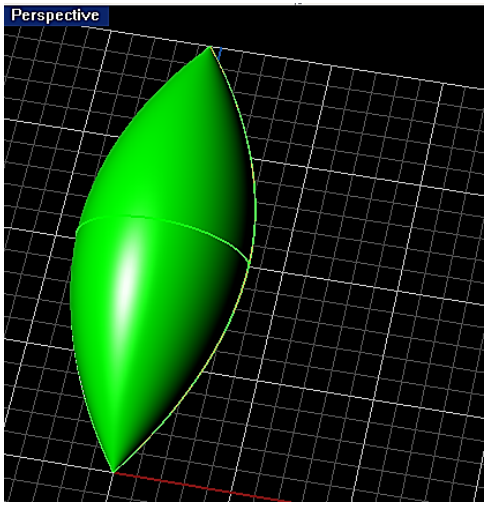


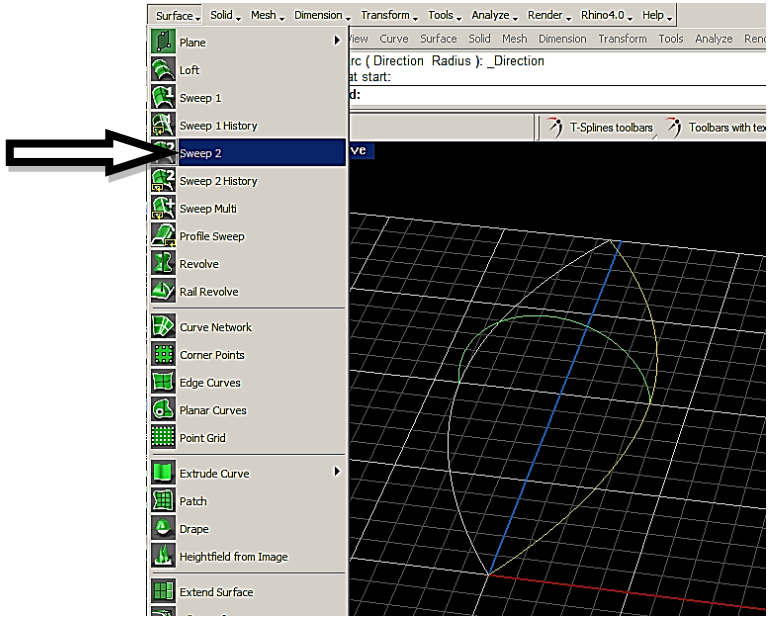
- The required arc will at 90º to both interpt curves.

- Click Surface Menu and apply command “Sweep-2” by selecting

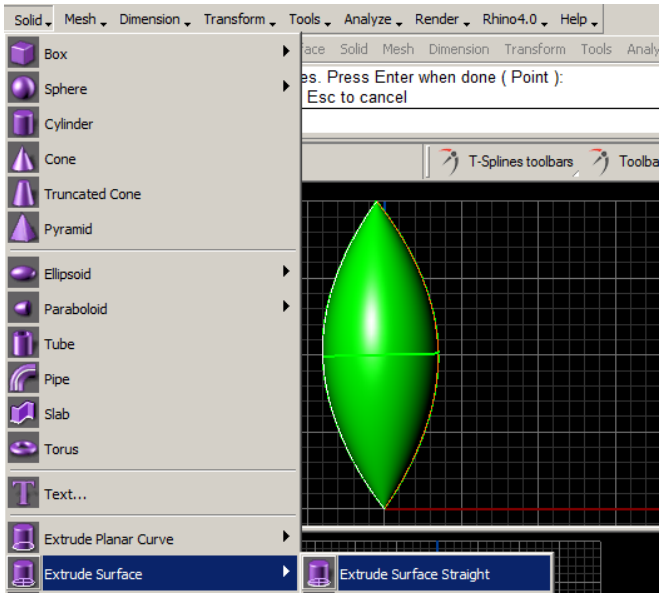
1st interpt curve as as Rail-1 and then select 2nd interpt curve as Rail-2







- Then select Arc Direction as a “cross section”.
- This will show a Sweep-2 window.
- At the end click “OK” to get hair line 2D Dome surface.
- Repeat the same command “Sweep-2” to complete the remaining dome surface.

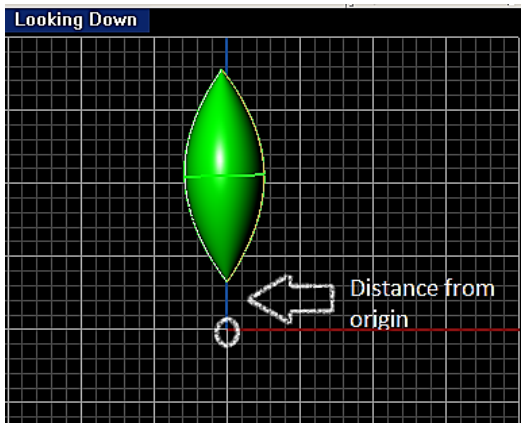


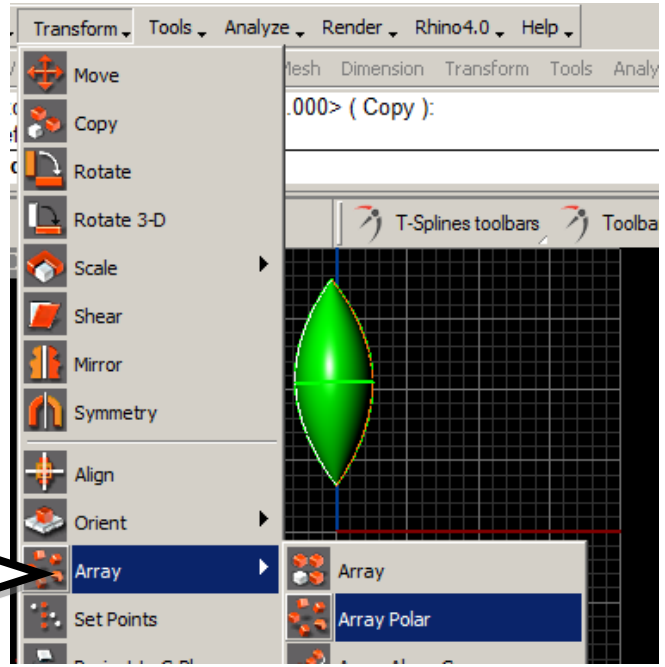
LU2: CREATE 3D DRAWINGS

- To convert 2D Dome surface to 3D surface, go to Solid Menu.

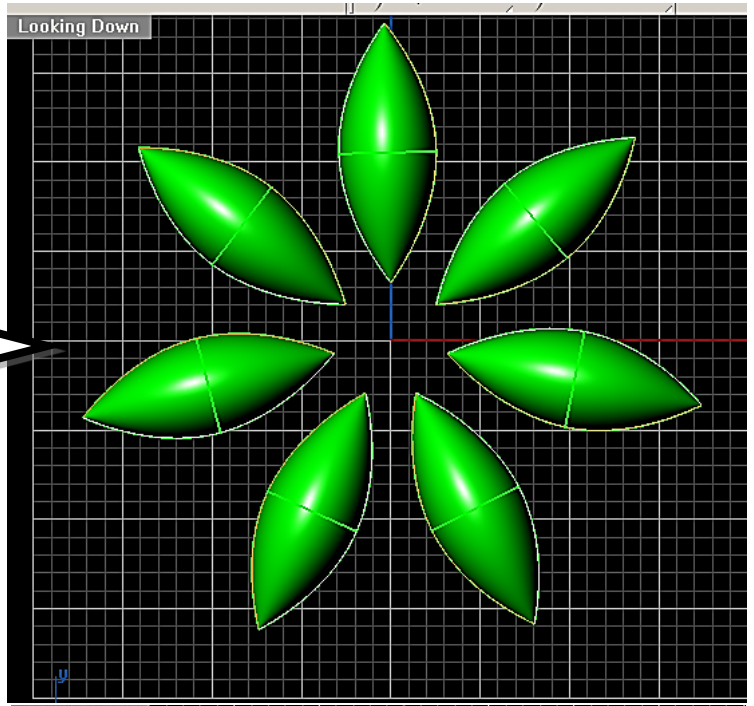
- Click “Extrude surface straight” and type required thickness e.g 1.0, 1.5, 2.0, 2.5 etc…

  Place a dome surface petal at a distant of 4~5 mm apart from grid origin.

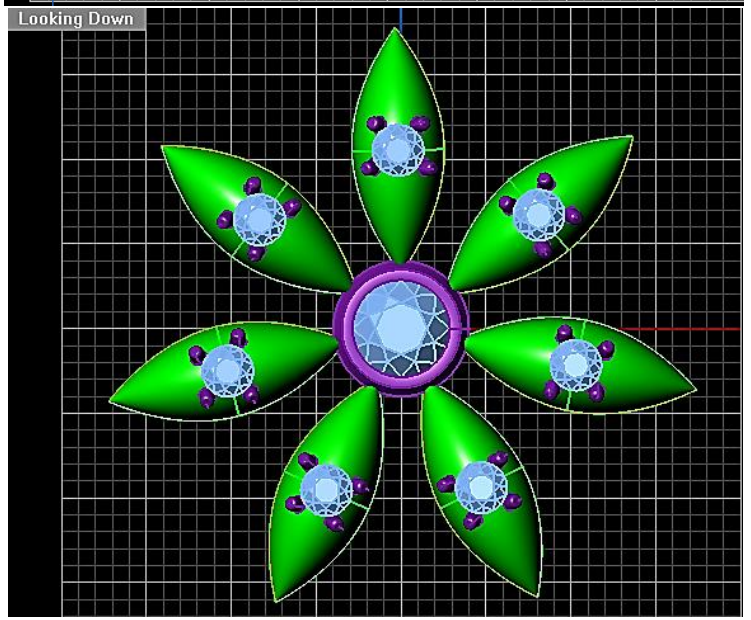




- Go to Transform Menu and Click Array and then “Array Polar”
- This command will be executed as follows:
- Select object to array: click the 3D dome motive & Press “Enter”.
- Center of Polar Array: Press “F4”
- Number of items: type 5,6,7..(no. of copies to be filled within 360 deg
- Angle to fill or first reference point: type 360
- Then press “Enter”



- This will show a repetitive pattern of dome motive in a circular form.
- To make this dome motive more beautiful , put gems on each petal using command “ Gem on Surface” and place prongs by using command “Prong on Surface” one by one.



PRACTICAL 2: DESIGN AN OVAL CABOCHON RING

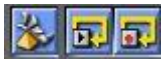
Create Oval profiles and sweep function.

Learn to use the **CurveNetwork** and **MatrixArt** tools to draw an engraved oval ring. Practice 2D drawing with interpCrv, blendCrv, JoinHistory, Create UV Curves, and Project Curves,

 Ring Rail  Profile Placer  Sweep 1 History  Cap Planar

LU1: Setup interface of Jewelry CAD software

To start this practical make sure that

1. all snaps are switched off except end O-Snap and mid O-Snap in Snaps menu
2. all display modes are swithed off in display menu
3. All three History buttons  are active in Info And Settings menu.

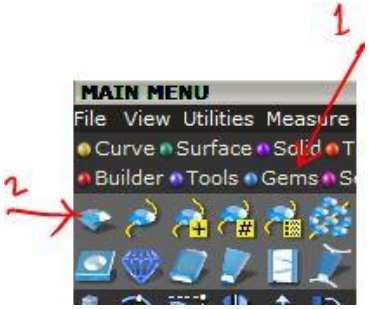
LU2 and LU3: Create 2D Drawings and Generate 3D Surfaces

1. **Begin with Ring Rail**

Click on the **Tools** fly-out menu and select the **Ring Rail** tool. Select a **Size 7** ring rail from the drop down menu and click on the green arrow  button to place it in the viewports

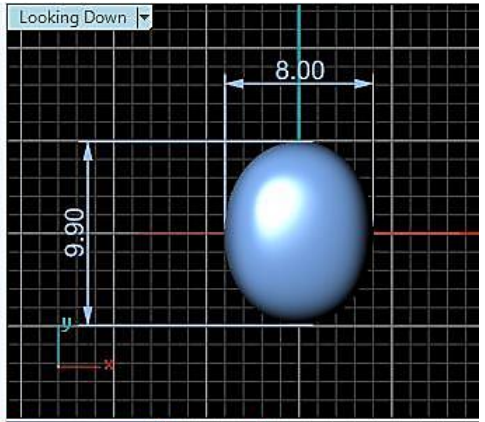
2. Add Oval Cabochon

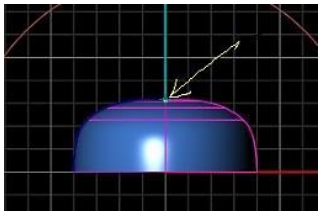
1. Open Gem Loader in Main Menu,



2. Choose Gem cut type, Cabochon shape in this case the from the fly out button at the right of cut type

3. Choose required size or in this case put the values 9.9 in Length, 8.0 in width, and 3.15 in depth column and hit the green play button at the bottom right. Oval Cabochon will appear in the center of the viewport.

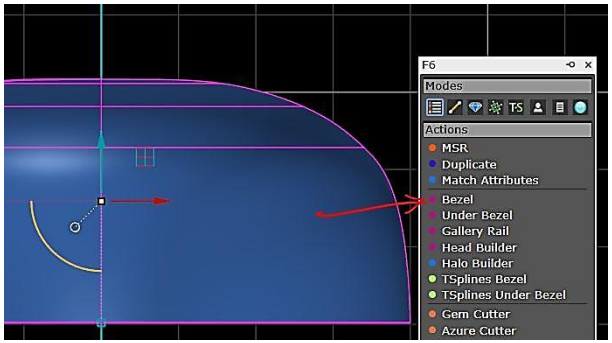




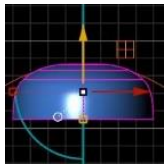
3. Place the Cabochon at required position

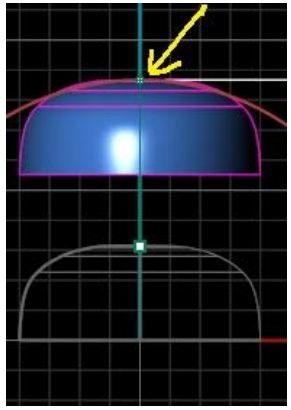
1. Select Cabochon and run move command in “Top 11 tools bar”
2. Snap the top endpoint of the cabochon to define ‘point to move from’, Left click on it to drag the Cabochon,

3. Switch the quad Snap **On** while the **move** command is active and place the cabochon to the top quad position of the ring rail

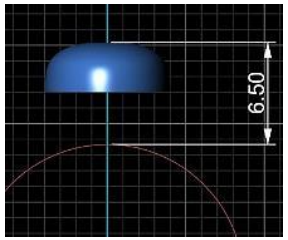


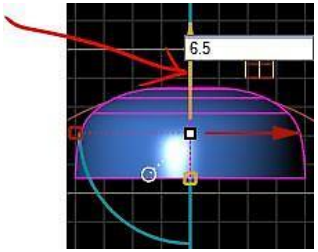
4. Switch On the **Gumball** from the 'info and settings' toolbar while the cabochon is still selected, Translation handles of Gumball will appear on the cabochon





5. **Click** the Yellow (Z axis) handle once, a small dialogue will open, put the required value in the dialogue, 6.5 in this case to move the cabochon up, Hit enter and the cabochon will move 6.5mm up from the top quad of the ring rail.



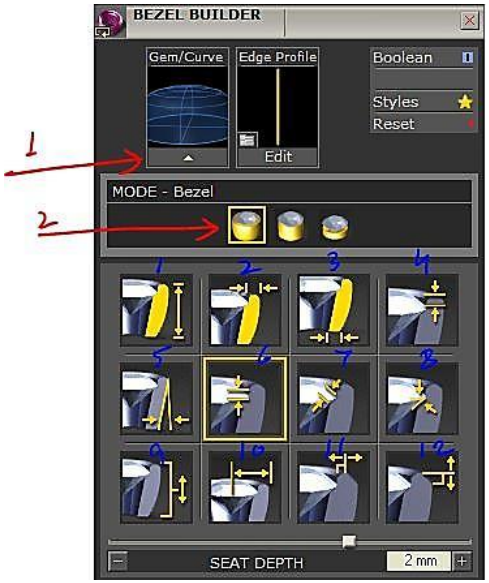


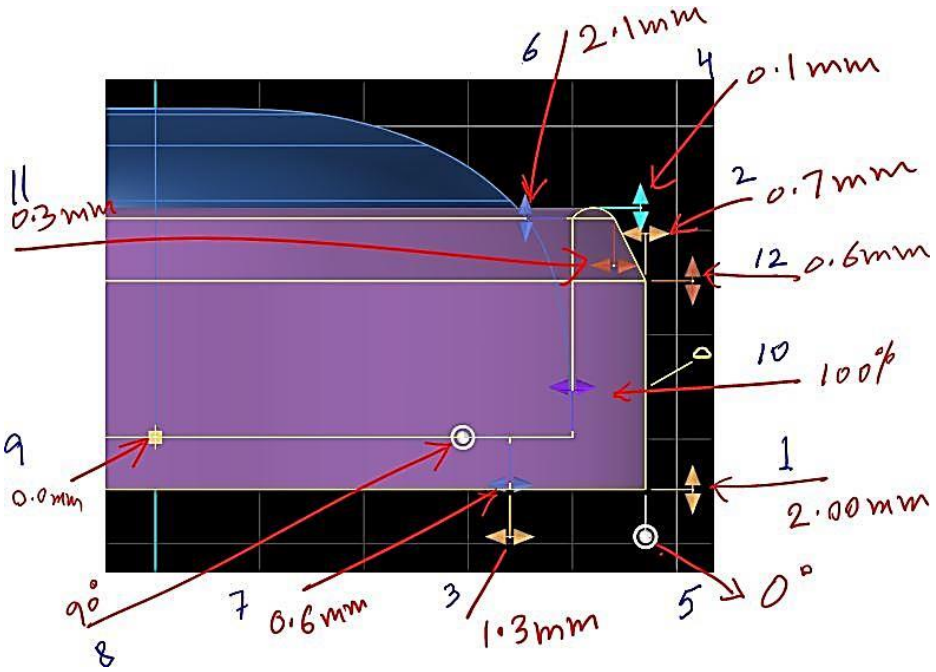
4. Setting Bezel to the Cabochon

- Select Cabochon, hit F6 key or press mouse wheel to open F6 menu
- Choose Bezel option in The F6 menu to open bezel builder in the Main menu
- Make sure that cabochon is visible in gem/curve window and bezel mode-1 is selected
- Select each of the 12 options and insert values in the bottom 

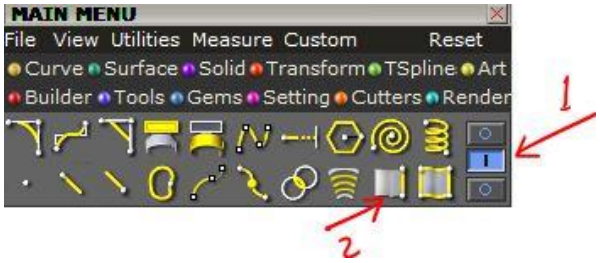
right dialogue according to the following chart, left click in the blank area of the viewport and press enter.

1. bezel height=2.0mm
2. top thickness=0.70mm
3. base thickness=1.30mm
4. dome height=0.10mm
5. bezel angle=0 degree
6. seat depth=2.10mm
7. seat length=0.60mm
8. seat angle=90 degree
9. bezel placement=0.0mm
10. bezel scale=100%
11. bezel chamfer X=0.3mm
12. bezel chamfer Z=0.6mm





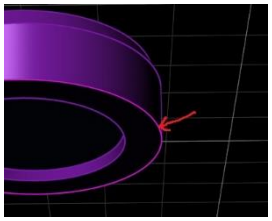
5. Creating Curves for 'Curve Network'

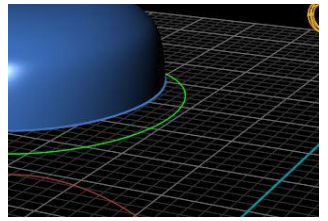


1. Left Click on the green **User 02** layer name in **layers menu** to make it active,

2. Go to curve menu, switch On to second scroll button  and run dupEdge command Second last at the bottom

3. Select the bottom edge of the bezel to get the edge curve on user 2 green layer

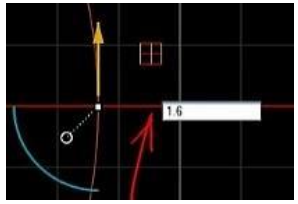




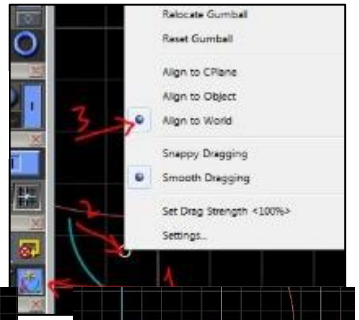
4. Switch off the head layer 

to make the green curve visible

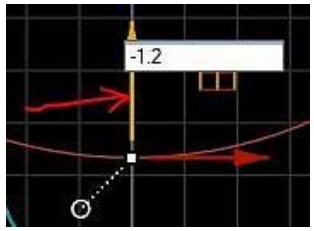
5. Draw a point at the 3 O-clock and a point at 6 O-clock position Quads of the ring rail to be used as modeling aids.



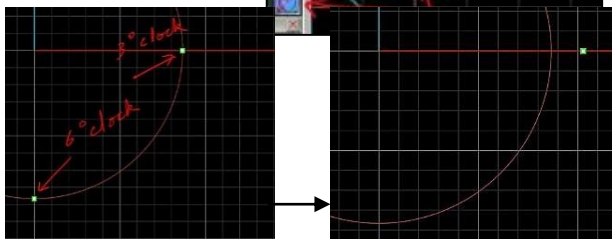
Make sure that gumball is active and set to world mode



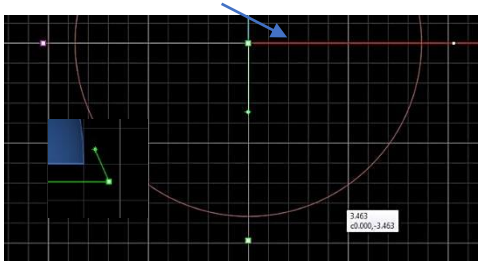
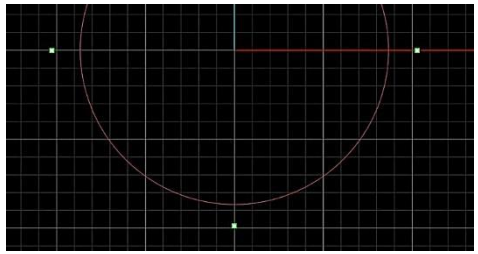
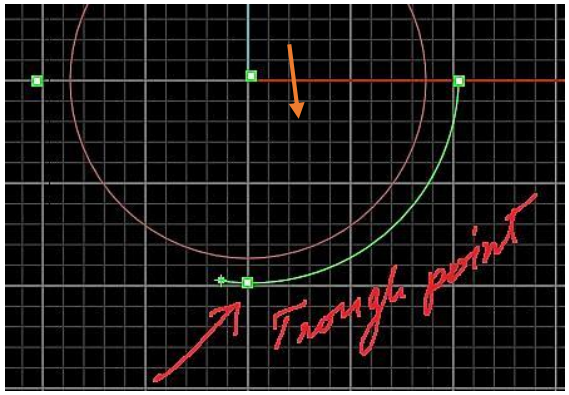
Select the right point at 3 o-clock in through finger viewport Click the red handle once to open dialogue and put the value 1.6mm to move right side and hit enter

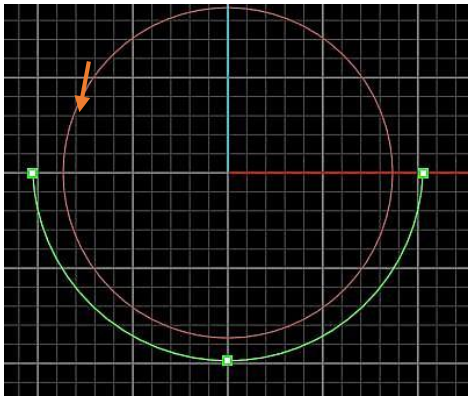


Select the bottom point at 6 o-clock and Click once to the yellow handle to open an input dialogue, Put the value -1.2 in the dialogue to move down the point vertically, and hit enter.



6. Select right point, Right click the **mirror** button  to select f4 as mirror plane, hold shift key  to make **Ortho** active and left click upside or downside to complete the mirror command

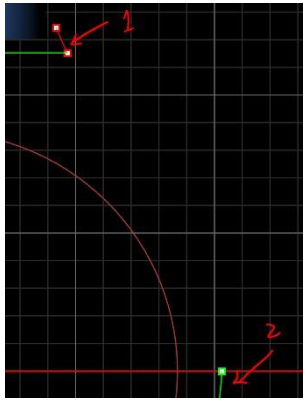





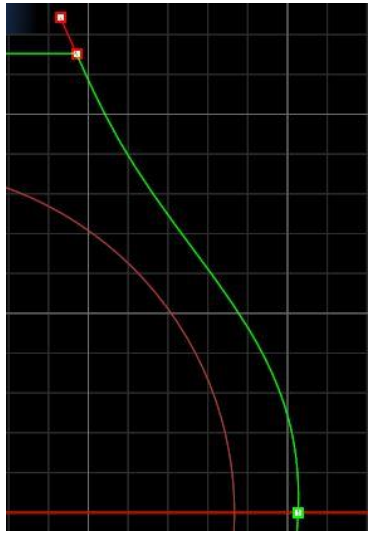
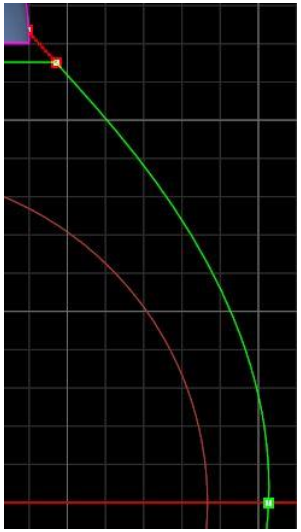


7. Switch on the point OSnap 

   Run arc Direction  command in 

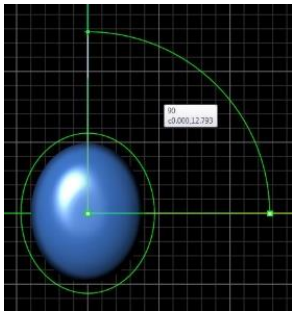
curve menu; snap the right point as start point, choose ‘through Point’ option in command bar and snap the point at 6 o-clock, now snap the left point to complete the arc direction command



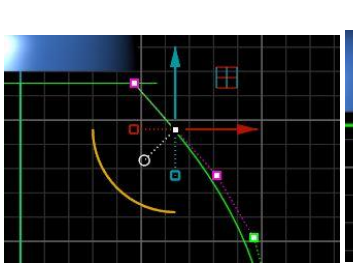
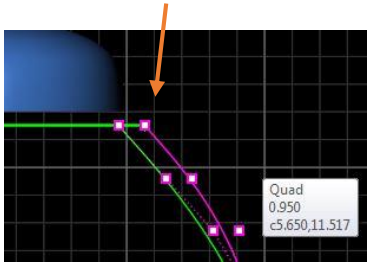



8. Start **Line** tool  in curve menu ,
9. snap to the right quad point of oval extracted Curve and place at top left position to create a reference line for modeling aid
10. select the line and put in the red layer  ,
11. Switch on the control point of the selected red line

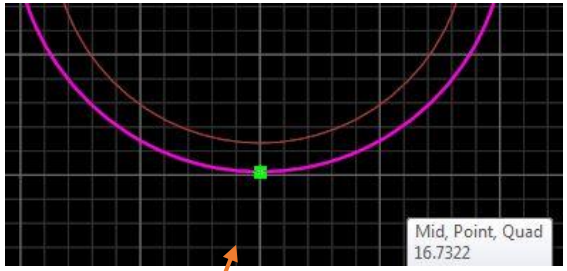
12. Run blend tool in curve menu 
13. Select the bottom of line as first curve And the right corner of the arc as the second curve to get the blended curve 
14. Pick and adjust the top point of the red line to adjust the blended curve



15. Select the blended curve and mirror to the left side using the f4 as mirror plane
16. Select all three curves (arc, blended curve and the mirrored curve and hit join  button to make one curve.

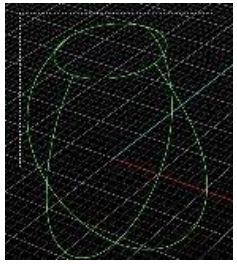
17. Select the joined curve, right click on the Split  button to split with a point
18. Snap to the point at 6 o-clock and hit enter or right click in the blank area of the viewport to complete the command.
19. Select all three helping points and red line and hit delete button on keyboard to get rid of this crap now.



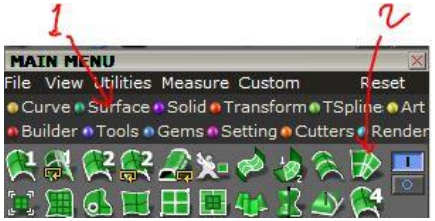
20. Select right split curve and switch to the top(looking down) view port, and right click the rotate button  to rotate with copy **yes** option, press f4 to define rotation center, hold shift key, left click on the right side to define first reference point and draw a 90 degree arc and left click to define second reference point, it will place the same new curve in side viewport,

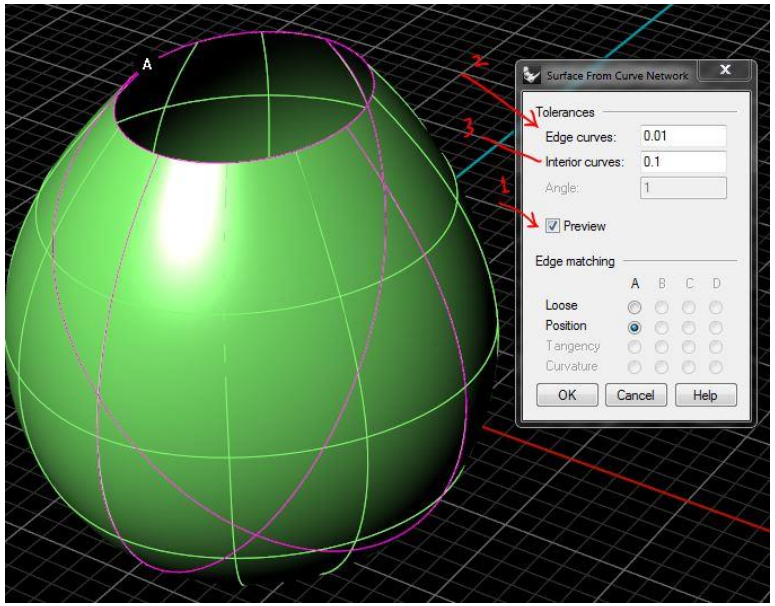
21. select the curve and **switch on** the control points  , select top three control points, run move  command, pick the top point to define point to move from, Snap the right quad of the oval curve and left click to place The control points

Hit escape key of the keyboard to switch off the control points, Select the adjusted curve in side view, and mirror to the left side. Switch off the gem 02 layer to hide the cabochon, Now we have four open curves touching each other at a point in the bottom and a closed oval curve at the top.



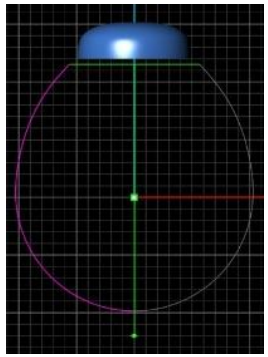
Using these four open curves and a closed curve we are ready to run the **curve network** command.

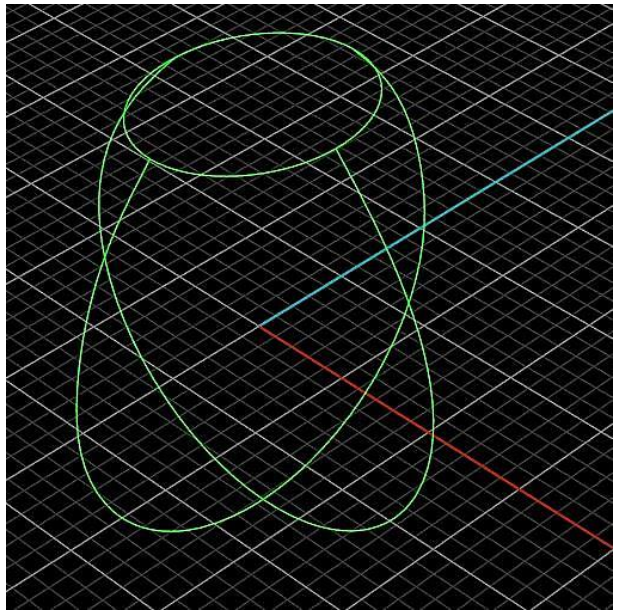




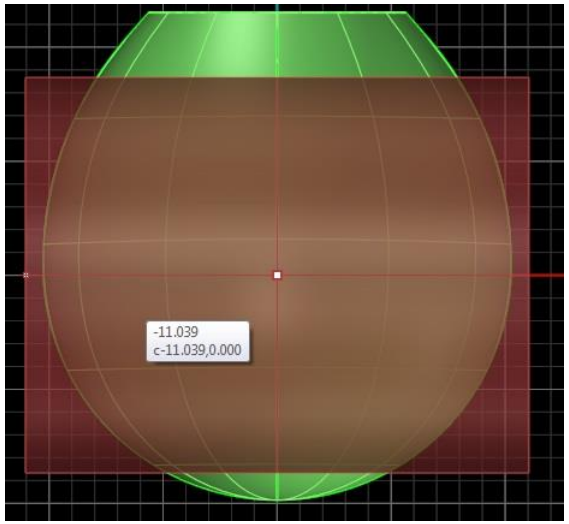
6. Generating Surface Using Curve Network

1. Select all 5 curves and run the ***Curve Nekwork*** Command by going first in Surface Menu, and choosing the Curve Network from the Surface Menu





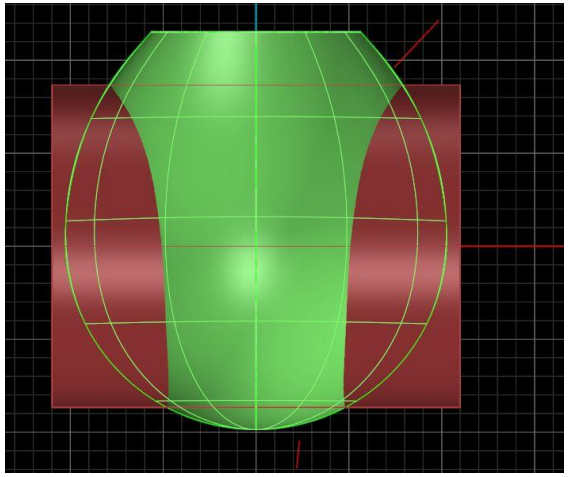
2. A dialogue will open Put the value “0.01” in ***Edge curves*** dialogue and “0.1” in the ***Interior Curves*** option, Check mark to preview the surface and if you are satisfied with the result, then hit Enter to complete the command.



7. Adjusting the shape of the ring in side Viewport

1. Switch to the Side Viewport 

and double click on it to expand.
2. Select XRay mode in Display menu

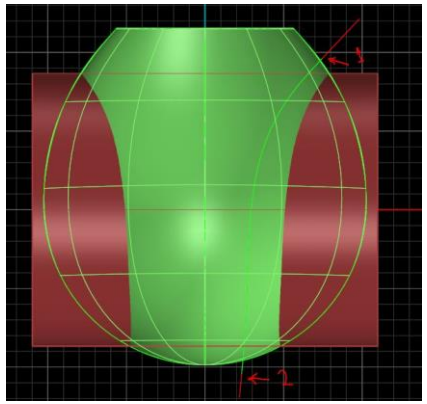


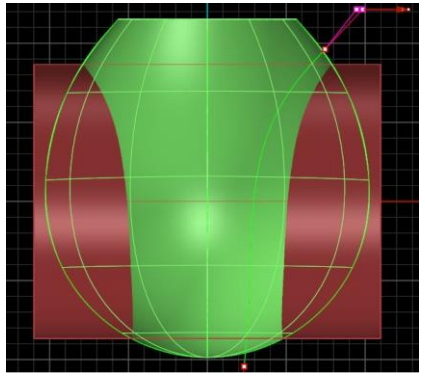
3. Left Click on the finger layer color swatch to make it active layer, and right click to select the Ring Rail on it.
4. Run the ‘Surface Extrude all’  command from the second row of Surface menu
5. Choose Straight option in the command bar while extrude command active and complete extrude, in side viewport.

6. Select User01 red layer 

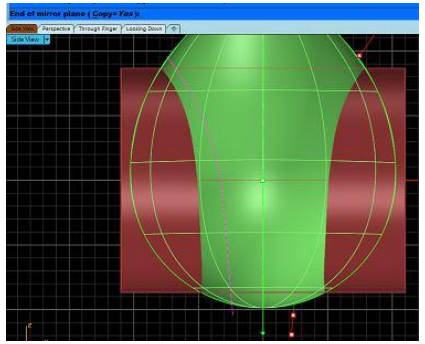
to make it active.
7. Select line tool  in curve menu and Draw a reference line at top right side and a reference line at the bottom right side in side viewport. Select User 02(Green) Layer 

to make it active
8. Run ***Blend***  command in curve menu,
9. You will see in command bar (***Select first curve to blend –select near end***) option, pick the near end of first line where you want to start blend, You will now see the option in Command bar (***Select second curve to blend – select near end***) now pick the near end of the second line where you want to complete the blend. And you will get a blend curve on ***User 02 layer***

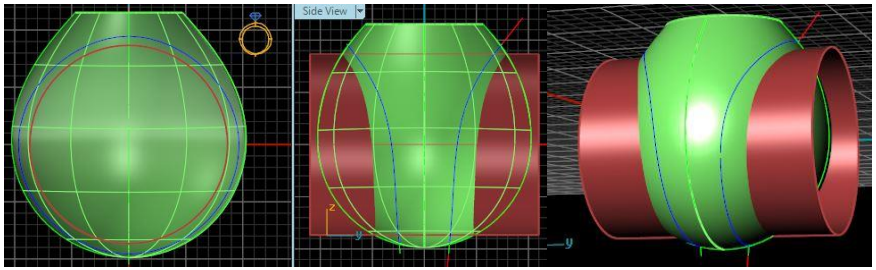




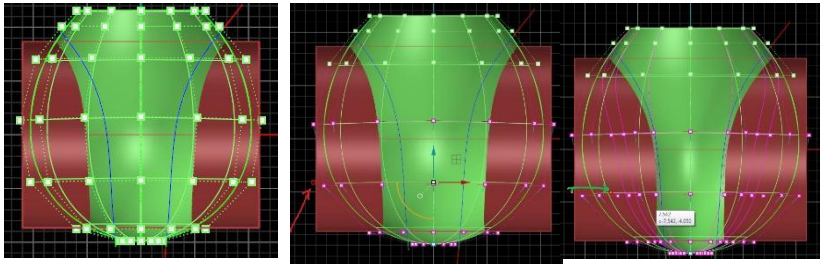
10. If you want to adjust the blend result using rhino history left click on the control points  Button to switch On the control points for both reference lines on ***User 01 layer*** and move control points to adjust the result curve on user 02 layer.



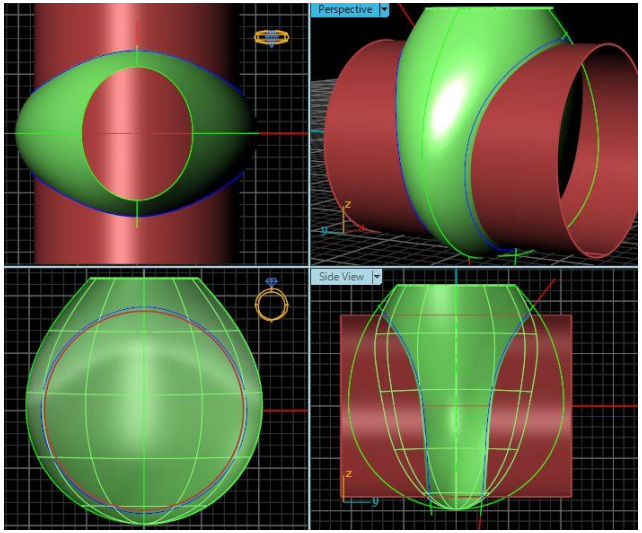
11. Now mirror the newly created curve by selecting the ‘start of mirror plane’ **F4** and ‘End of mirror plane’ at the bottom holding shift key, Left click on the User 03 (blue) Layer name  to make it active layer,



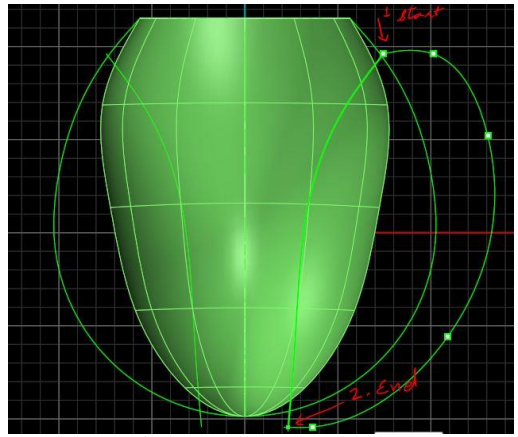
12. Run **Project**  command from the second row of curve menu, and read the command bar carefully, select both newly created curves on user 02 layers to project and press enter, Now select the surface created by curve network to project the curves onto, and press enter to complete the command. You will get two curves to define the width of the ring.



13. Select the ***curve network*** surface and switch **On** its control points by pressing the Control Points  command in top 11 tools,
14. Region select the control points you want to adjust and 1D scale the control points using the gumball handle until you manage to get the required shape.
15. Hit Escape key to exit the control points command and you will get this result



8. Creating Side Cutters for the Shank

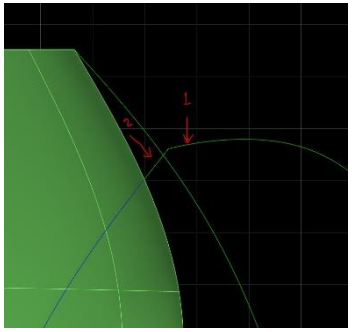


1. Switch off the User01, User03, and the finger layer
2. and left click at the User02 layer name to make it active 

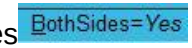
3. Draw a curve using **interp curve** snaping the one end of blended curve as **Start** and

   The other end to complete the curve
4. Left click on "**Cutting** layer name to make it active 

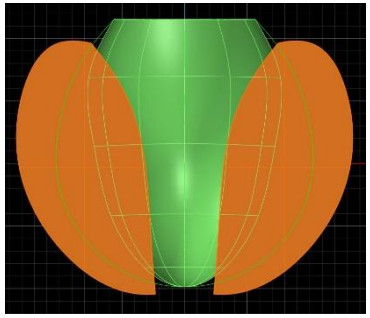
5. Run Join History" command  Select both curves and hit enter to get a new joined curve on Cutting (orrange) Layer.



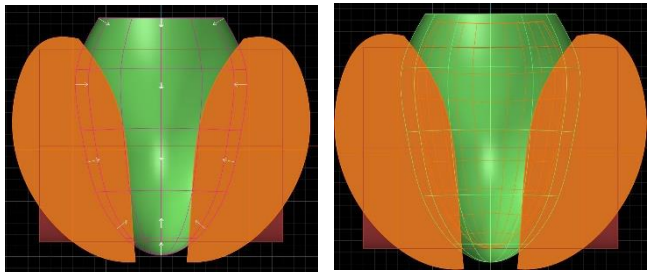
6. Select the orange curve and Run **ExtrudeCrv**  Command in Solid menu,Put extrusion distance15,

   make sure that the Bothside=yes 

is set in command bar and hit enter, Select the extruded poly surface and right click on the mirror button to set the F4 as mirror plane and left click upside holding shift key to complete the mirror command, You will get two poly surfaces on (orange) Cutting layer.

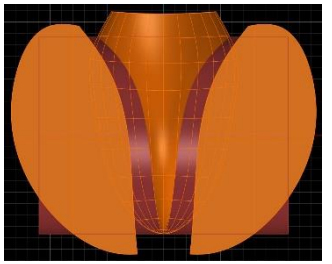


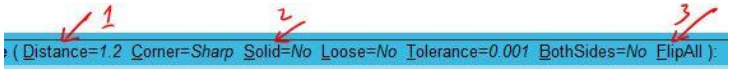
9. Creating Inside Cutter for the Shank



1. In Surface menu select second scroll button  And Run Off set Srf  command
2. Select the light green Surface on **Metal03** layer to offset while Cutting layer is selected and hit enter, Now read the command bar carefully and
   a. Set the distance to 1.2, and make sure the solid is set to NO,
   b. Left click on the FlipAll to invert the offset direction to inside and hit enter. You will get an offset surface on cutting layer. **Switch Off** 

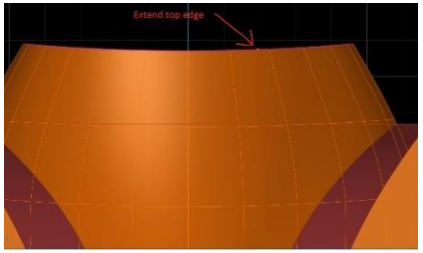
the Metal03 layer to make the offset surface visible.

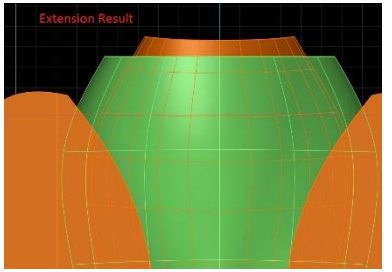




Now we need to extend the top edge of this surface to make sure that it is higher than the original surface to get an intersection.

3. Run the extend surface  command in the second scroll window of the Surface menu, Pick the top edge of the offset surface to extend and set the Extrusion factor value to ‘2’ and hit enter. You will get the top edge of the surface extended 2mm.

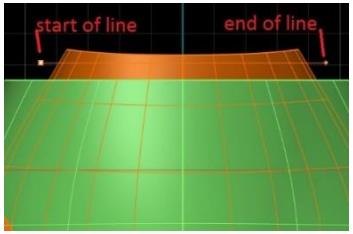


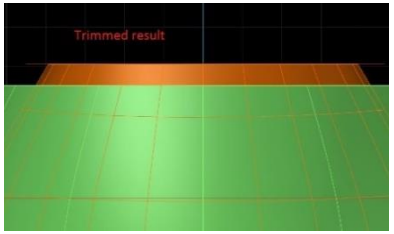


4. Switch back **On** 

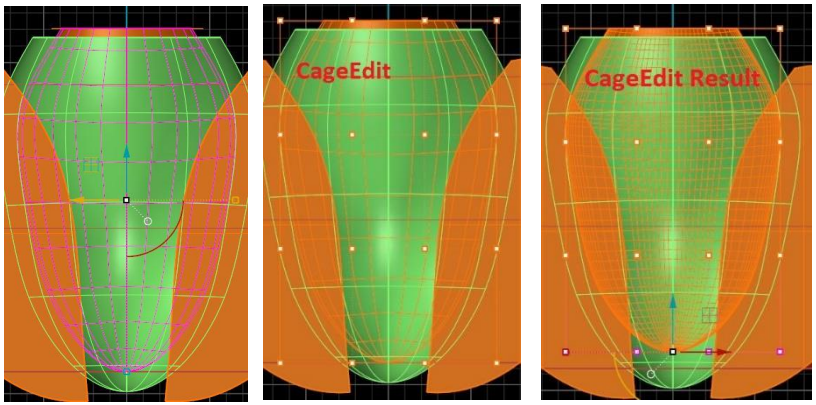
the **Metal03** layer to get the preview of surfaces on both layers.

5. Run Line  tool in curve menu, Left click on the left side to define ‘start of line’ and left click on the right side holding Shift key to define the ‘end of line’ and Complete the line as a cutter that fully intersects the top edge of the orange offset surface,





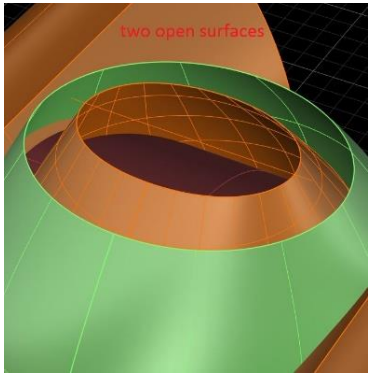
6. Run the trim command and select the line as a cutter and left click on the top edge of the offset surface to trim out and make the edge planar,



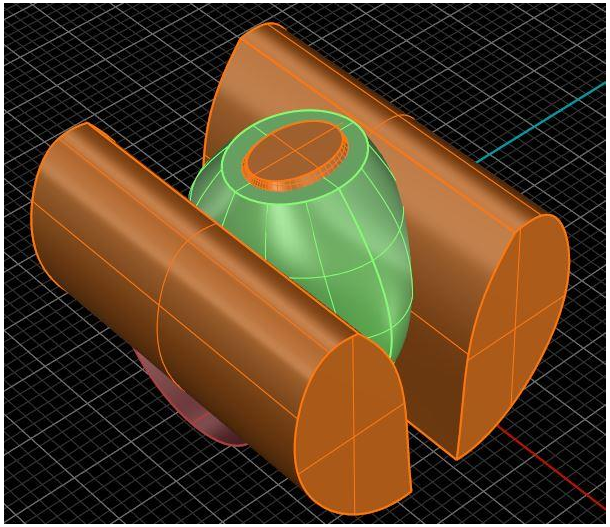
7. Select the extended orange surface and run **Cage Edit** command In Transform menu, Read the command bar options carefully and
   a. Select 'bounding box' as control object and hit enter
   b. Make sure that coordinate system is set to 'world' and hit enter
   c. Make sure the **cage points** are set **4x4x4** for xyz and degree is also set to **3** for xyz then hit enter,
   d. Make sure the '**region to edit'** is set to '**global**' and hit enter to complete the command. A cage will appear to edit the trimmed offset surface.

8. Select the lowest edit points drawing a full window, and move up about 1mm using Gumball. Hit escape to exit the edit points, select the cage and hit 'delete' to get rid of the cage

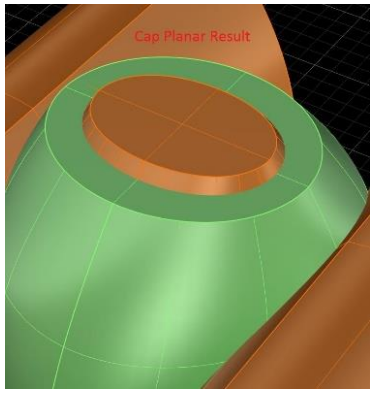
9. Switch to the perspective viewport and keep it expanded to get a good preview of both surfaces,



10. Select both 'the **Curve Network** surface' on Metal03 layer and '**offset** surface' on cutting layer,



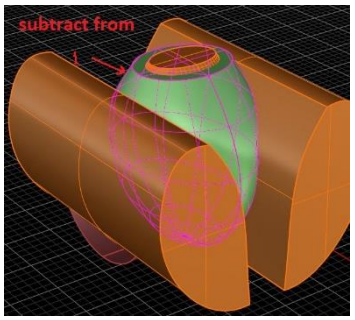
11. Run Cap Planar  command in Solid menu to cap both surfaces and make them Closed poly surfaces. Now we have three poly surfaces on **Cutting Layer** as cutters, and one poly surface on **Metal03** layer and we are all set to do Boolean operation

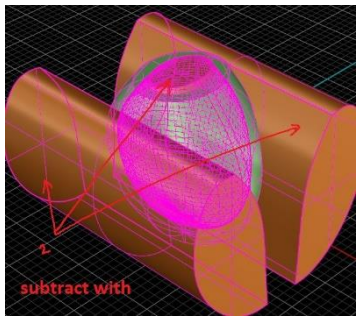


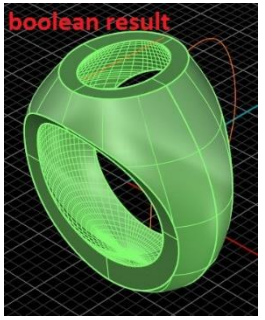
10. Boolean Operation to the shank

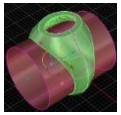
1. Run Boolean Difference  command from the Solid menu,
   a. Select the poly surface on **Metal03** layer to subtract from and hit enter,
   b. Select three Ploy surfaces on **Cutting** Layer to subtract with, keep the Option 'delete input=yes' 

In command bar and hit Enter to complete the Boolean operation.









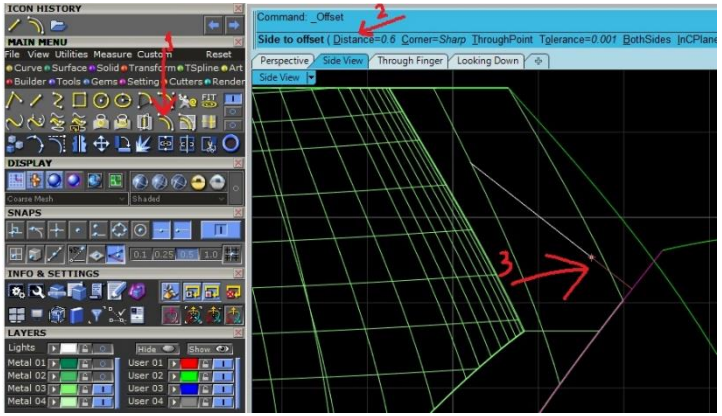
2. Switch On the **finger** layer 

Select the cylinder on it and hit 'delete' to get rid of it.

3. Switch to the through finger viewport and expand it 

   Switch off the display menu to get wireframe mode 

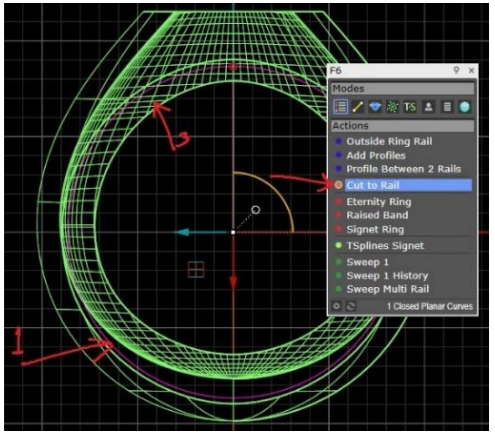
4. Select the ring-rail on **finger** layer and hit F6,



5. In F6 menu
   a. select the option ‘cut to rail’
   b. Select the green object on **metal03** from the inside of the rail to cut and hit enter to get the final plane shank.
6. Switch on the display mode and set to shade mode for all viewports to get the preview of the shank
7. Right click on the **cutting** Cutting **,**

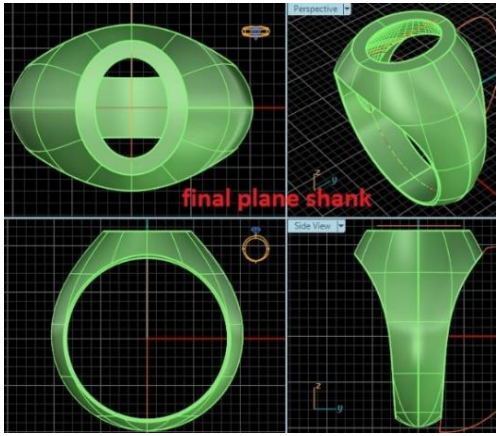
   User01 User 01, and **User03** User 03 color swatches to select the curves on these layers, and

   Hit delete key to delete these curves.

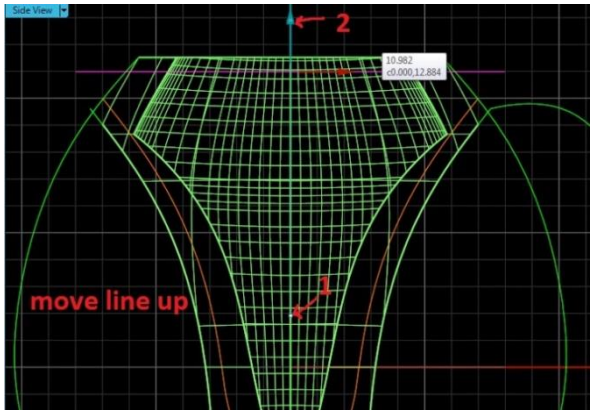


11. Preparing curves and surfaces for FlowAlongSurface

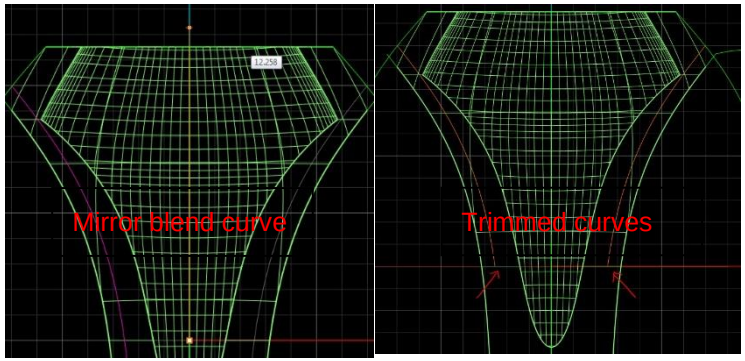
1. Switch to the side viewport and expand it Perspective Side View Through Finger Looking Down Side View
2. Switch On the User02 layer to preview the curves on it User 02
3. Left click on the **Cutting** Cutting layer name to make it active
4. Select the blend curve on user02 layer and run Offset command in curve menu, set the distance value to 0.6, hit enter and left click in the required direction to complete the command. You will get an offset curve on **cutting** layer. Make sure that this curve fully intersects the shank.



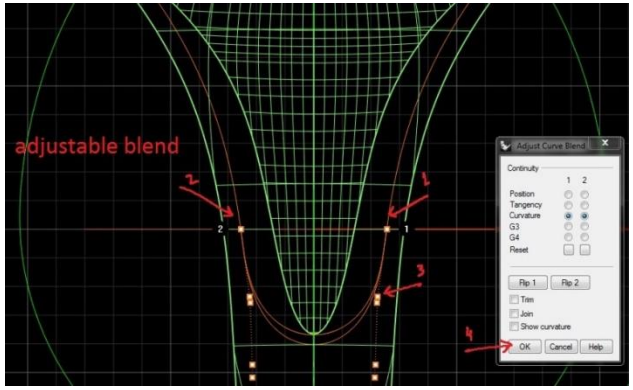
5. Select the new offset curve and right click on mirror command to set F4 as mirror plane and left click on upside holding shift key to complete the command.



6. Run Line command in curve menu, choose both Sides Start of line (BothSides Option and hit F4 to set the middle of line, Hold shift key and left click about 8mm right side from the center to complete the line command, you'll get a 16mm line on cutting layer
7. Use the line as a cutter and trim both curves from the bottom
8. Run Adjustable blend in curve menu and select both lower ends of trimmed curves to blend, a dialogue with adjustable handles will appear, hold shift key and pick one side handle to adjust symmetrical with opposite handle, press OK button in the dialogue when required shape is achieved to complete the blend command. Select these three curves and hit join button to make those a single curve.

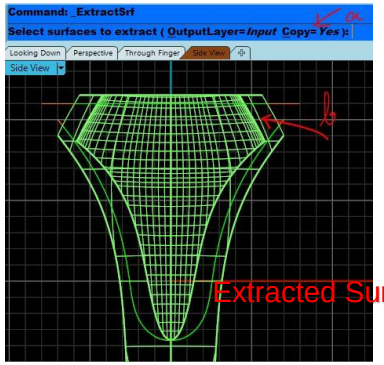


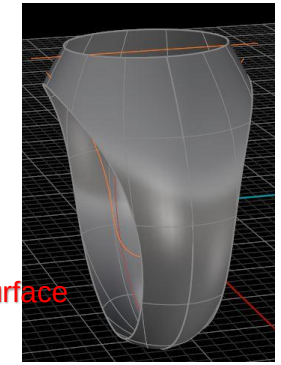
9. Select the16mm line which is used as a cutter, Move it up using gumball and place about 0.6mm below the top of the shank. Now we have a line and a curve on cutting layer Visible in side viewport.



10. Left click on User02 Layer name to make it active 

11. Run **Extract Srf**  command in solid menu,
    a. Select copy=yes option in command bar and
    b. Select outer surface of the shank to extract and press enter.

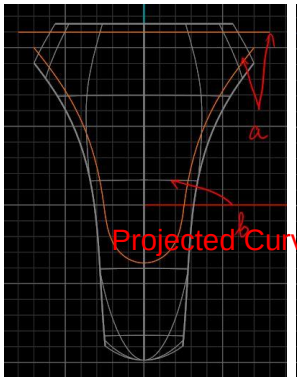


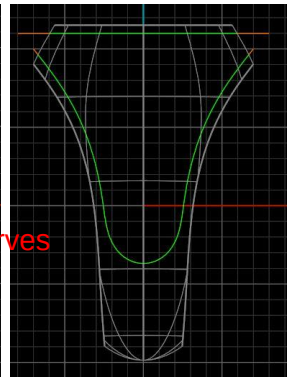


You will get a duplicate outer surface of the shank selected

c. Put the duplicate surface on user04 layer by pressing input icon 

of the layer and switch off the Metal03 layer 





12. Run Project command in curve menu, and
    a. Select both orange curves in cutting layer to project and press enter
    b. Select the grey surface on user04 layer to project to and press enter

    You will get projected curves on (bright green) **user02 layer**

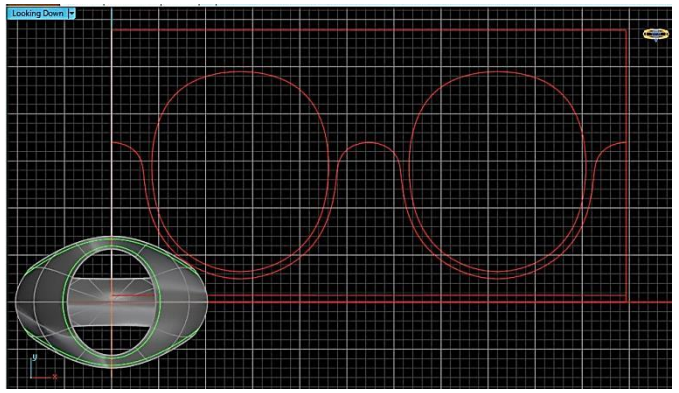
13. Left click to the **User01** 

Layer name to make it active
14. Switch to the Looking Down 

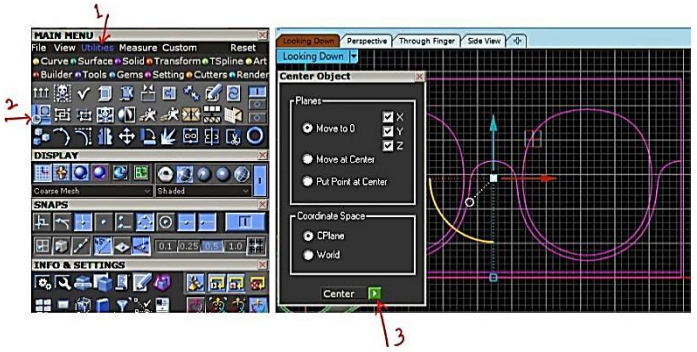
Viewport and expand it
15. Run **Create UVCrv**  command and read command bar carefully
    a. Select extracted surface on user04 

layer to create UV curves
    b. Right click on User02 

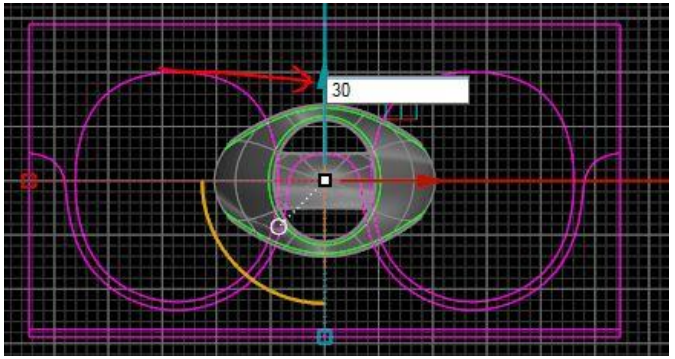
layer to select projected curves on surface to create UV curves and press enter
    You will get planar UV curves for the surface and projected curve



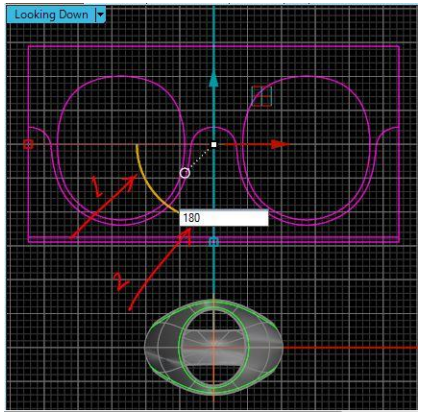
16. Right click on user01 layer color swatch  to select curves and run Center Object  command in Utility menu; a dialogue will open with move to 0 and xyz checked, click on the green  button to center the curves to 0.

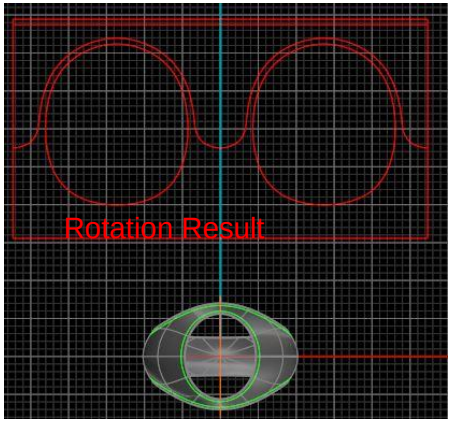


17. While the curves yet selected left click the blue Y axis handle  of gumball once to open a small input dialogue and type 30 in the dialogue and hit enter. The curves will move up 30mm in y direction



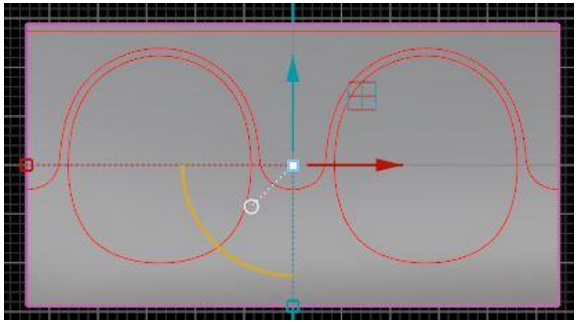
18. While the curves yet selected now left click the Yellow rotation handles  of gumball once to open input dialogue and type 180 in the Dialogue and hit enter to rotate curves 180 degree. Hit escape to clear the selection.



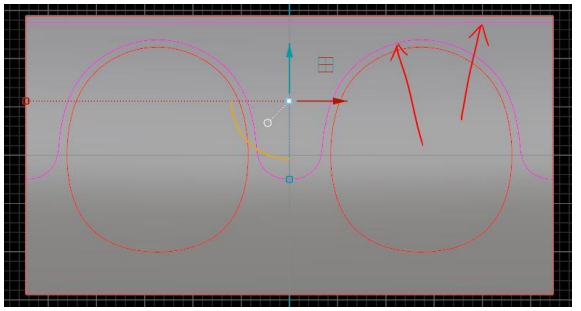


19. Left click on User04 layer name to make it active 

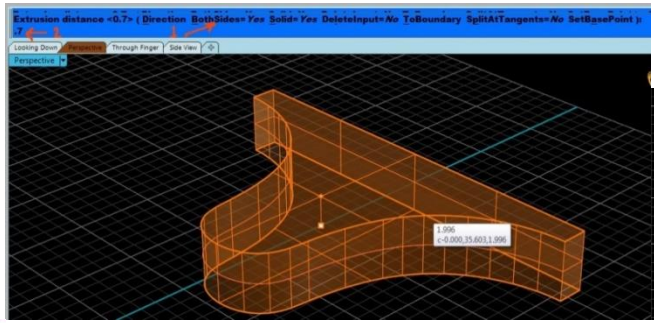
20. Select the outer rectangular curve and press  Planar curves button in Surface menu you will get a planar surface on User04 layer, our curves and Surfaces are ready to run Flow along Surface command, Now it's time to create objects to flow
21. Left click on User03 layer name to make it active 

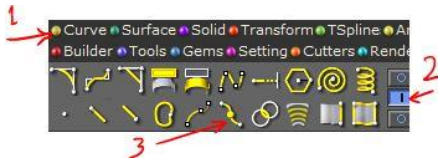


22. Select two curves marked and put these curves To **User03**  layer, and **switch Off**  the **User01**  **, User02**  and **User 04**  layers to view the curves you need to work on.



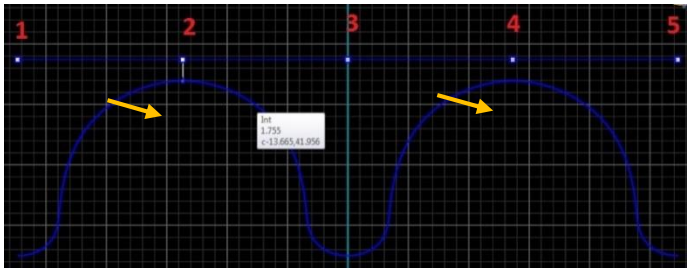
23. Select the straight blue line and run **Divide** Command in second scroll window of curve Menu, In command bar type 4 to set ‘number of segments’ and press enter.





Once the cursor is locked to elevator mode you can only move the cursor to the locked direction

In Snap Menu **switch on** the point and intersect OSnaps



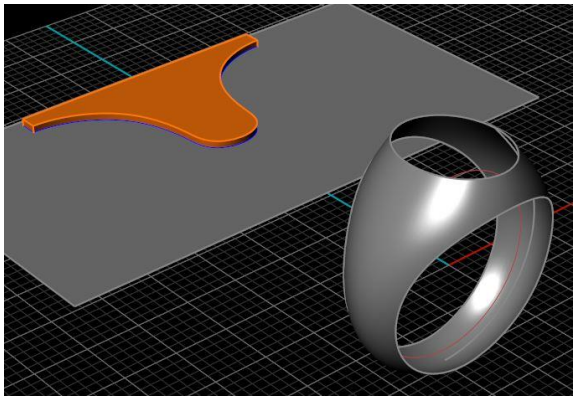
24. Run Line command and snap the second left point as start of line and Move cursor down while holding shift key and press TAB key to lock cursor in elevator mode Snap to the intersection point of the second curve as an end of line and left click to complete the line.
25. Repeat the line command for the fourth point.

26. In Info and Settings Menu press **Super Select** button, a dialogue will appear, choose ‘select points’ from the list to select all points and hit delete key to get rid of those points.
27. Right click on the blue color swatch 

of User03 layer to select curves on this layer and left click on trim button in main menu, click on unwanted curves to trim, hit enter and while curves selected hit join to get a closed Blue curve.

28. Left click on User01 

layer name to switch it On and make active,
And draw a scroll pattern according to your wish using interp  Curve command in curve menu,
Take some time to draw the Pattern and make sure that it is closed and planar (**Only closed** and **planar** curves drawn in any of first 16 layers in looking down viewport will be accepted in **Matrix Art** builder)



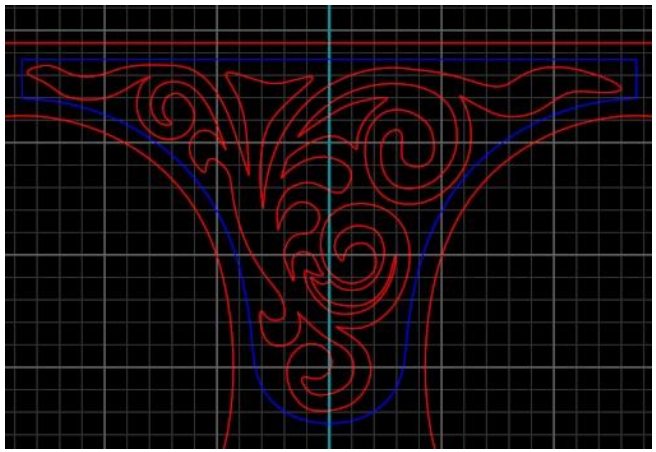
29. Switch Off  the User01 Layer 

30. Switch to 

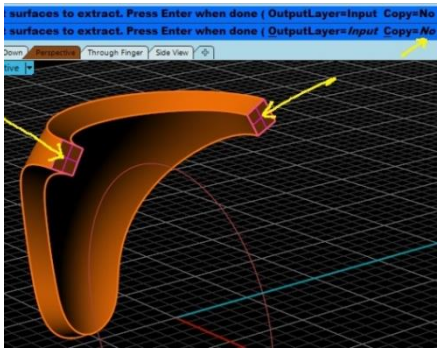
viewport and expand it, select Plastic  Mode in Display menu
31. Right click on the Cutting 

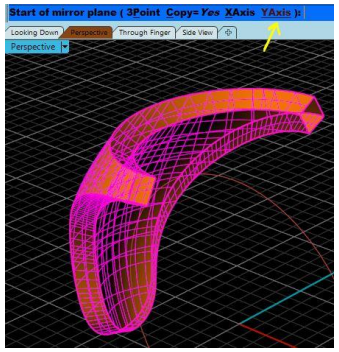
layer name (to make it active and select curves on it) and hit delete to get rid of these curves.
32. Select the blue closed curve in viewport and Run **ExtrudeCrv**  command in Solid menu, in command Bar type 0.7 to set extrusion distance, Make sure that Bothsides=yes 

is set in command bar and press enter to complete extrude command.



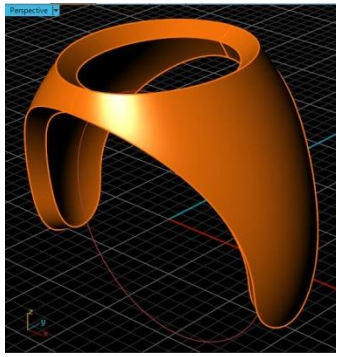
12. FlowAlongSurface Operation





1. Switch On the User04 layer to show the surfaces on it Make sure all history buttons in **Info and settings** are switched On

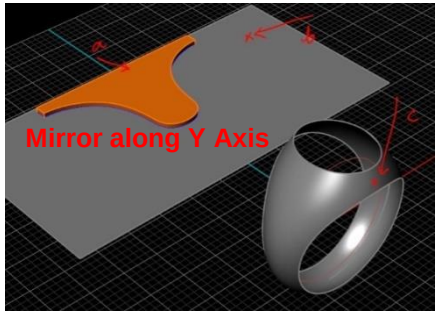
2. Run **Flow Along Srf** command in second scroll window of transform Menu and read the command bar carefully and

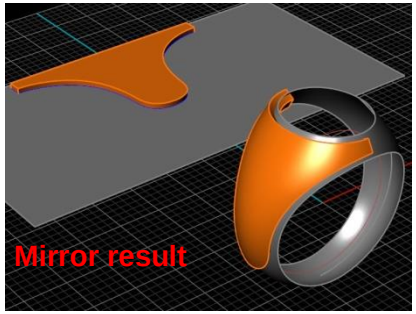


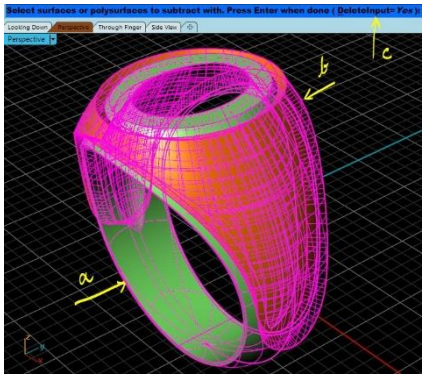
   a. Select the orange poly surface on Cutting layer to flow along a surface and press enter
   b. Left click on the near right corner of the planar surface on user04 layer to select as base surface
   c. Now left click (Copy=Yes Rigid=No Plane): on the near matching corner of the shank to select as target surface to complete the command. Make sure that Copy=yes and Rigid=no in command bar. You will get a poly surface on the left side of the Shank to be used as a cutter.

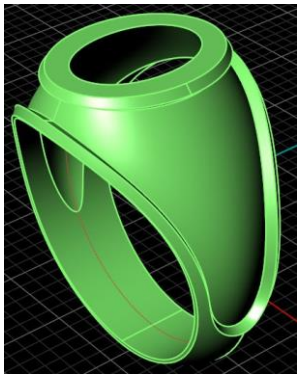
13. Creating inset in the shank for Artwork

1. Switch Off the **User04** layer
2. Run Extract Srf in Solid Menu Make sure ‘copy=no’ in command bar Select both end caps of the cutters To extract and press enter
3. Now hit delete key to delete these caps





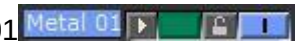




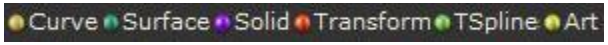
4. Select the open poly surface and Run mirror command, in Command bar choose YAxis to complete the mirror along y axis
5. Select both polysurfaces and press join button to get a closed polysurface as a cutter.
6. Switch on the Metal03 

layer to show the shank.
7. Run Difference command in Solid Menu
   a. Select the Shank on Metal03 to subtract from and press enter.
   b. Select Orange cutter to subtract with
   c. Make sure that the Delete Input=yes is set in command bar and press enter to complete the command.
8. Right click on the Cutting layer color swatch to select the remaining object on it and hit delete to get rid of this object.

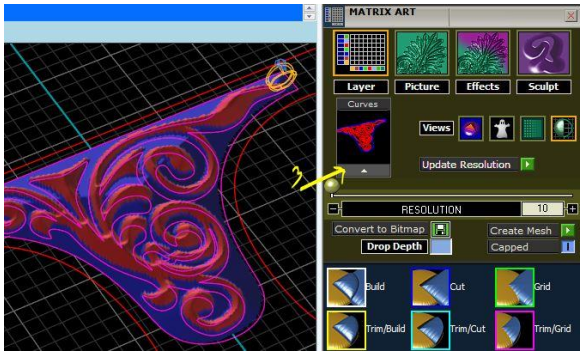
14. Creatiing Mesh in Art Menu

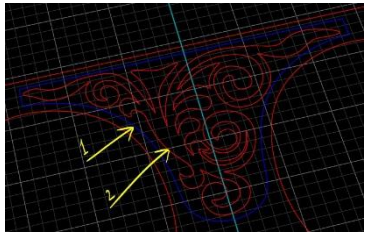
1. Left click on the Metal01 

Layer name to make it active
2. Left click on the Art button in Main Menu, Matrix Art Builder will open at the right side of the viewport

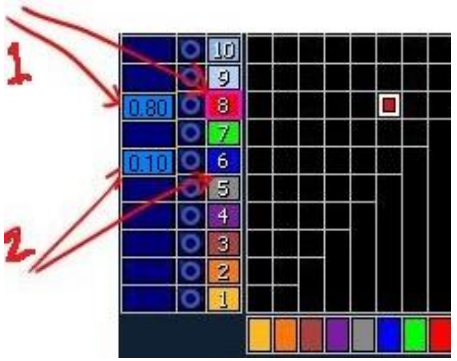


3. Switch On the User01 Layer to show curves on it
4. Select the blue curve on user03 layer and Red Scroll curve on user01 layer and put in the input window of the Art menu

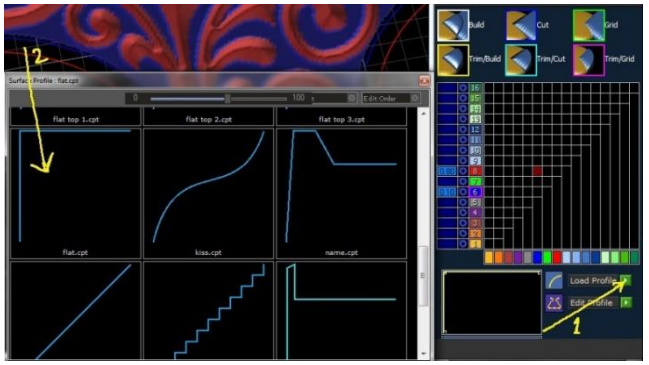




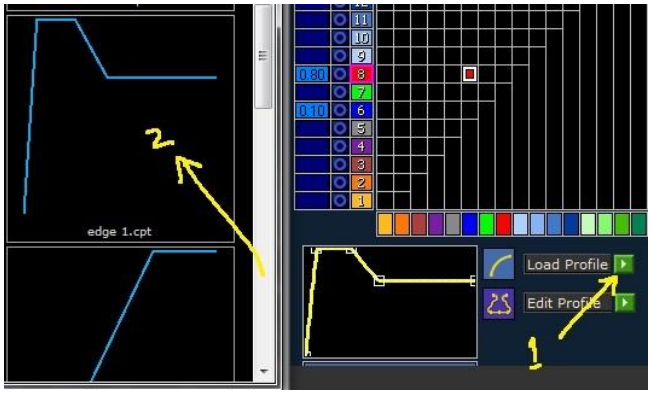
5. In the layer graph left click on the red color swatch to make the red layer  active and put the value 0.8 in left dialogue, now left click on the Blue layer  color swatch and put the value 0.1 in left dialogue.
6. Right click and hold on any blank area of the Builder and drag up to access the lower menu of the builder



7. Click the  play button to open profiles browser and choose ‘flat’ profile from the browser to set on blue layer.



8. Left click the red  layer color to make active again and repeat the Process and choose ‘edge1’ profile for this layer and adjust the Profile in preview window if you like to. (You may see the dynamic result of mesh preview in the viewport)



You will get the mesh preview of both layers in viewport

9. Now notice in the Layer's graph
   a. there is a red box that sets the relation of the red layer with the blue layer
   b. The red box has a white outline which represents the 'build mode' relation between two layers
10. Left click this red box to turn its relation to blue 'cut mode', Left click again to set the outline to green 'grid mode',

    Grid Mode means that the red layer has no impact of blue layer on itself, and it builds from grid if no layer is added below the blue layer. Layer mode is all set for both layers; we may switch to picture mode now.

11. In Matrix Art now switch to the Picture mode 

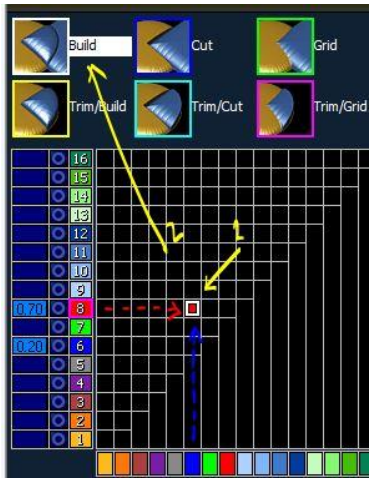
12. Go to the current layer option and choose blue 6 layer 

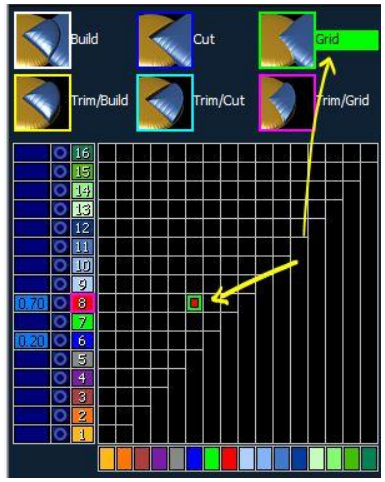
from the Dropdown list 

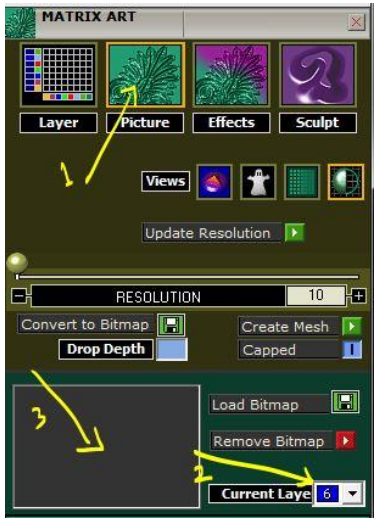
13. Left click to the blank window to open a browser and
14. Browse the given path to select a bump Map

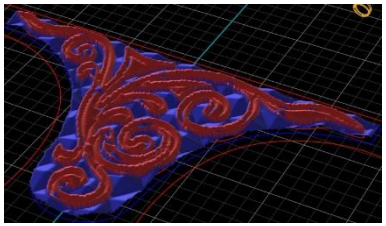
    C:\Users\Public\Documents\Matrix8Common\VRay\Library\Bump Maps

    And choose the Knurl1 map  to add it to Layer 6



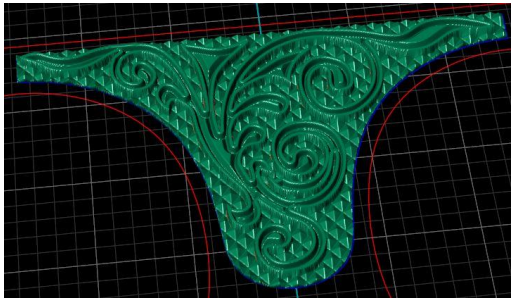


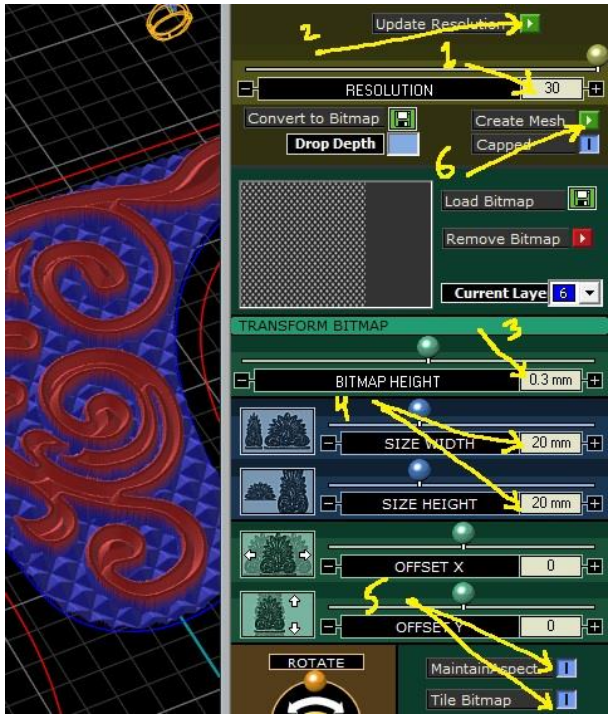




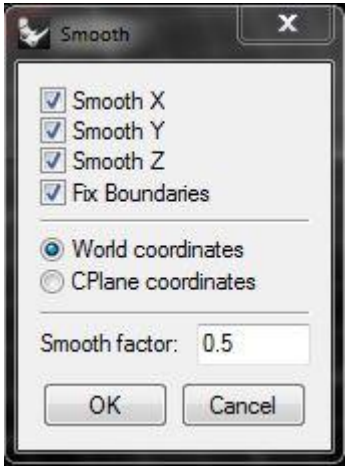
You will get this preview after adding Knurl1 map on layer6

15. Look at the Picture mode carefully and complete the following process
    1. Set the Resolution to 30 and
    2. Press play button to update Resolution
    3. Set the bitmap Height to 0.3mm
    4. Set the Size of width and Height to 20mm
    5. Switch **On** the 'Tile Bitmap' and 'Maintain Aspect' options.
    6. When you are satisfied with all settings Press the Play button to **Create Mesh,** You will Get a Mesh created on **Metal01** layer
    7. Close the Matrix Art builder from top right corner button

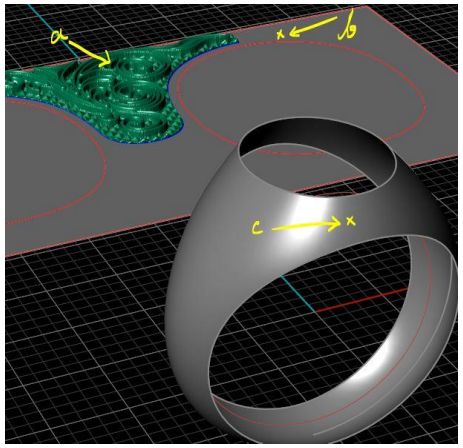


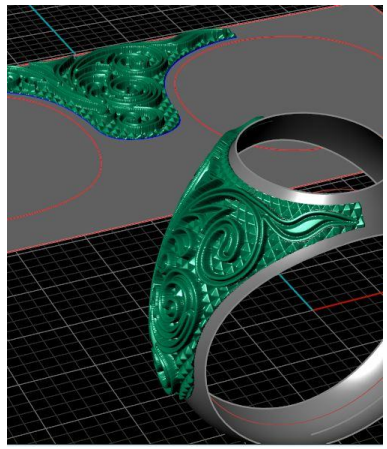


16. Select the Mesh on User01 Layer and type "smooth" command in command bar A dialogue will open, press OK button to reduce crispness of the mesh and repeat Smooth command two three times if require

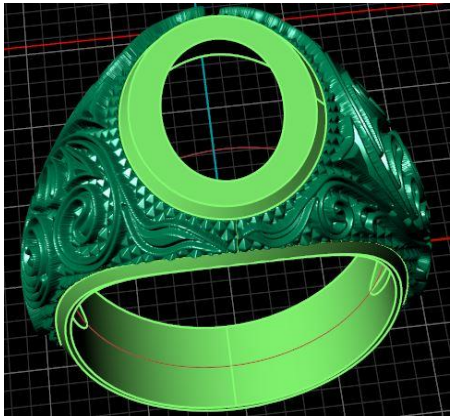


15. FlowAlongSurface Operation to flow Mesh





1. Switch On  the User04  layer to show the surfaces on it and switch Of the **Metal03**  Layer to hide the shank
2. Run **FlowAlongSrf**  command in second scroll window of transform Menu and read the command bar carefully and
   a. Select the green mesh on Metal01  layer to flow along a surface and press enter
   b. Left click on the near right corner of the planar surface on user04 layer to select as base surface
   c. Now left click on the near matching corner of the shank to select as target surface to complete the command. Make sure that Copy=yes and Rigid=no in command bar 
3. Switch On  the Metal03  Layer again To show the shank, and switch Off the User04 Layer  to hide the Base and target surfaces
4. Select the Mesh on Shank and Run Rotate  command, choose copy=yes  In command bar and hit F4 to select 0 as center of rotation, Type 180 in command bar and hit enter to set rotation angle and hit enter again to complete the rotation with copy process.

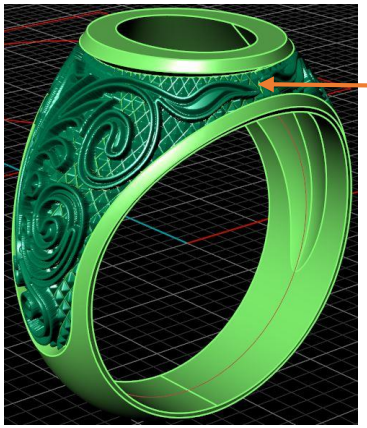


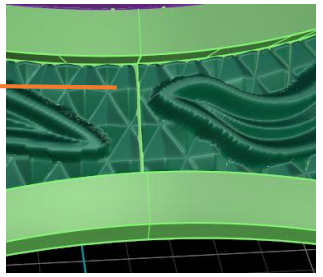
5. elect the Mesh on Base surface and left click once on the yellow Z handle of gumball to open input dialogue and type -0.8 value and hit enter to move the mesh 0.8mm down

Both meshes on the shank will be adjusted following the Rhino History

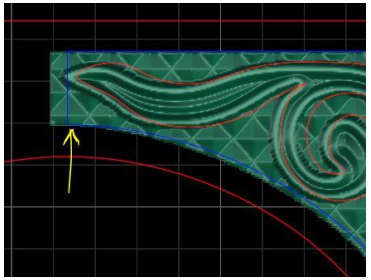
6. Switch to the Looking Down 

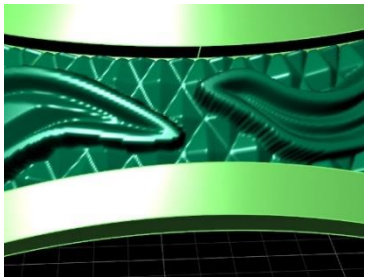
Viewport and expand it.
7. Select the Mesh and scale Up 1D using x axis scale Handle and see the result to the meshes on the shank

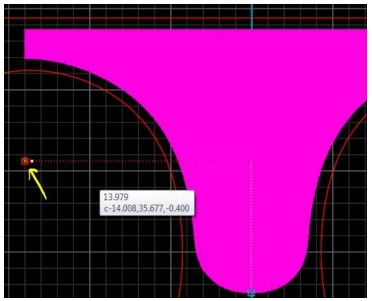




Notice the minor gap where both meshes meet, we need to fix it

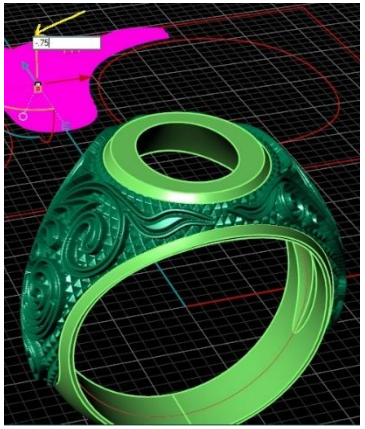






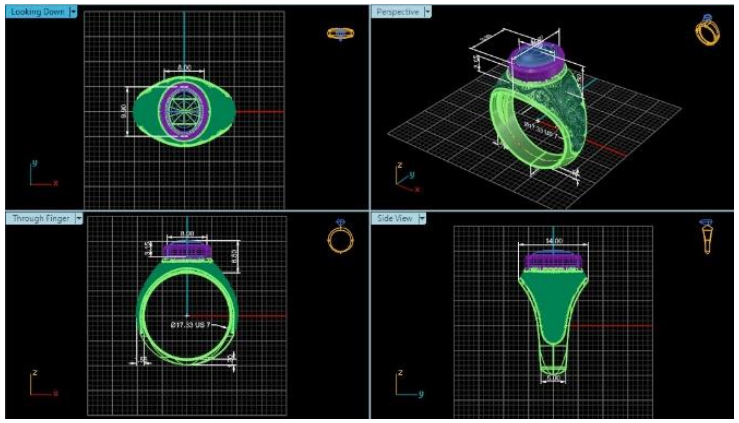
Rotate with copy result

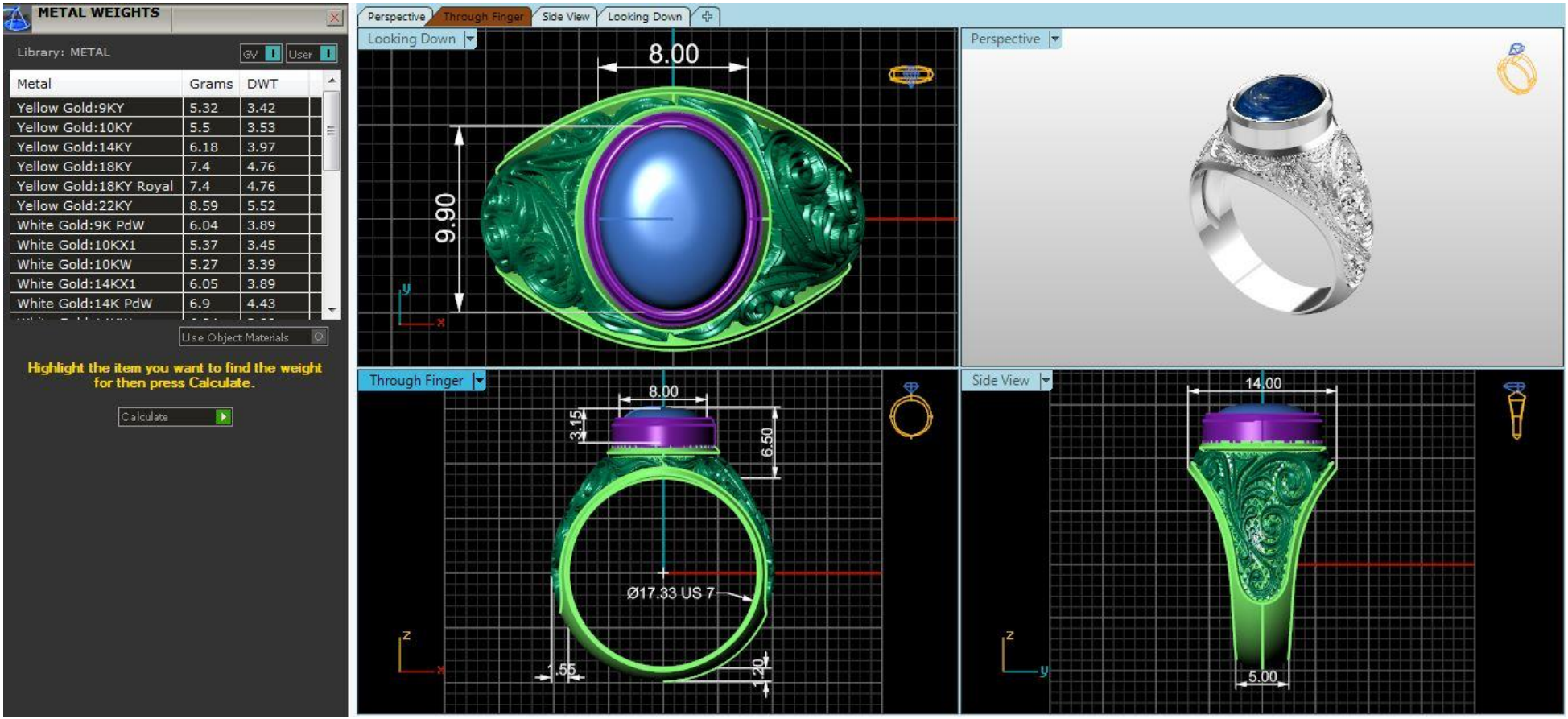
Adjustment result on the shank



Notice that the mesh is high at the shank; we need to lower its position

8. Switch Off the User01 and User03 Layers
9. Select the Mesh on base surface and put it in User 02 User02 Layer and switch off the layer
10. Switch On the Heads and Gem02 layers to show the Cabochon and bezel
11. Left click the View tab in Main Menu and press Restore Viewport button; you will switch to 4 viewport mode.
12. Left click the Measure Tab in Main Menu and use Horizontal, Vertical and diameter tools to draw Technical details on **Lights** layer Lights
13. Right click on Metal01,Metal03 and Heads Layers color swatches to select the ring and press Metal Weights button in Tools Menu, A dialogue will open at the bottom of main menu, press the green play button to calculate the weight.
14. Select all objects in 'looking down' and press Zoom Selected button in view Menu or press F3 key to maximum zoom the objects
15. Repeat the process for all viewports and right click on Plastic mode button in display menu to apply this mode on all viewports
16. In Main Menu click 'File' and "Save Small As" button and give it a name production version,
17. Repeat the same save command to save the file as presentation version to prepare it for presentation

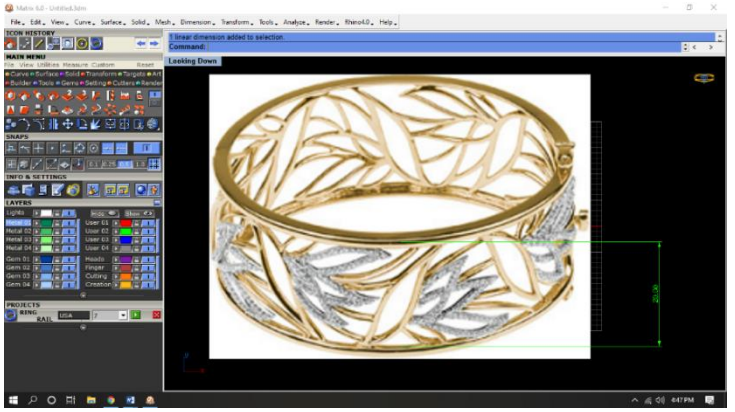



METAL WEIGHTS
Library: METAL
GV
User
Metal
Grams
DWT
Yellow Gold:9KY 5.32 3.42
Yellow Gold:10KY 5.5 3.53
Yellow Gold:14KY 6.18 3.97
Yellow Gold:18KY 7.4 4.76
Yellow Gold:18KY Royal 7.4 4.76
Yellow Gold:22KY 8.59 5.52
White Gold:9K PdW 6.04 3.89
White Gold:10KX1 5.37 3.45
White Gold:10KW 5.27 3.39
White Gold:14KX1 6.05 3.89
White Gold:14K PdW 6.9 4.43
Use Object Materials
Highlight the item you want to find the weight for then press Calculate.
Calculate
Perspective
Through Finger
Side View
Looking Down
Looking Down
8.00
9.90
Perspective
Through Finger
8.00
3.15
6.50
Ø17.33 US 7
1.55
1.20
Side View
14.00
5.00

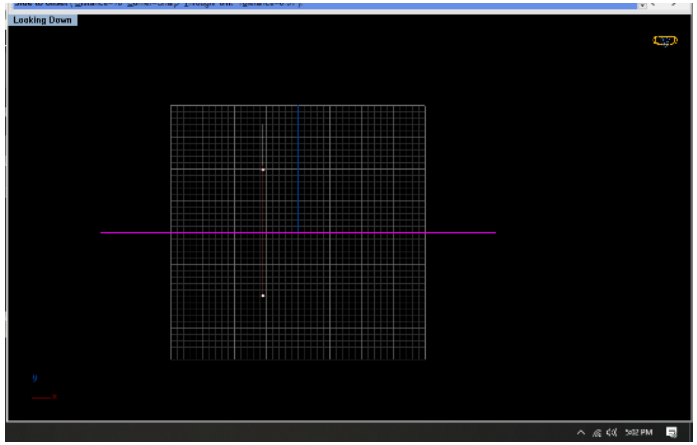
PRACTICAL 3: DESIGN A BANGLE

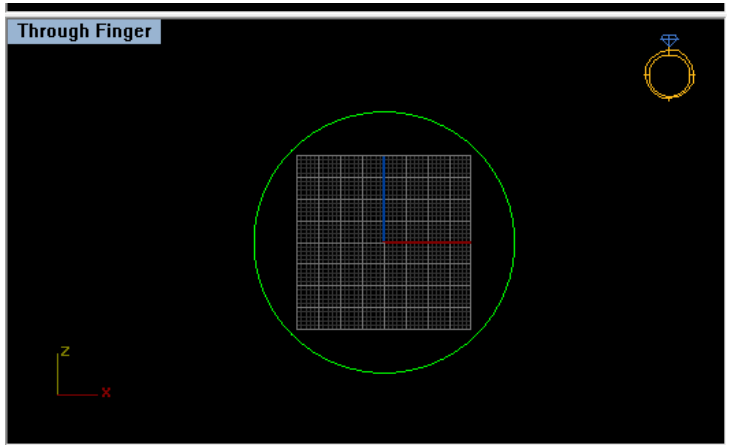
LU1: SET UP OF COMMANDS FOR ADVANCE JEWELRY ARTICLE

- Import picture by using command “Back Ground Bitmap” located in View Menu”



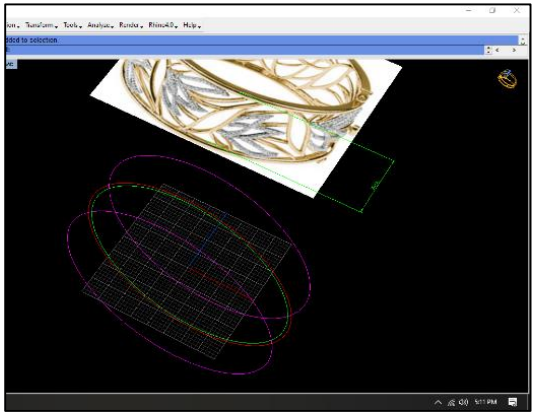
- Draw a ring rail or circle of diameter 60mm by taking reference center F4

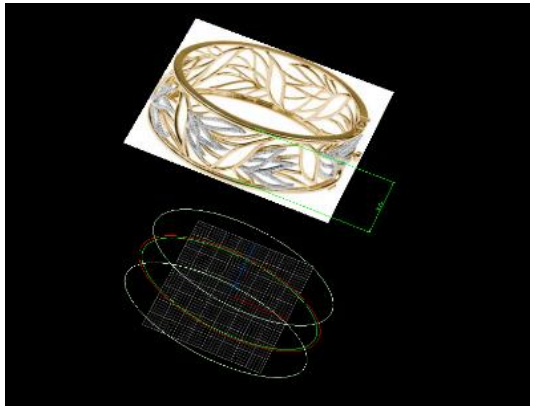




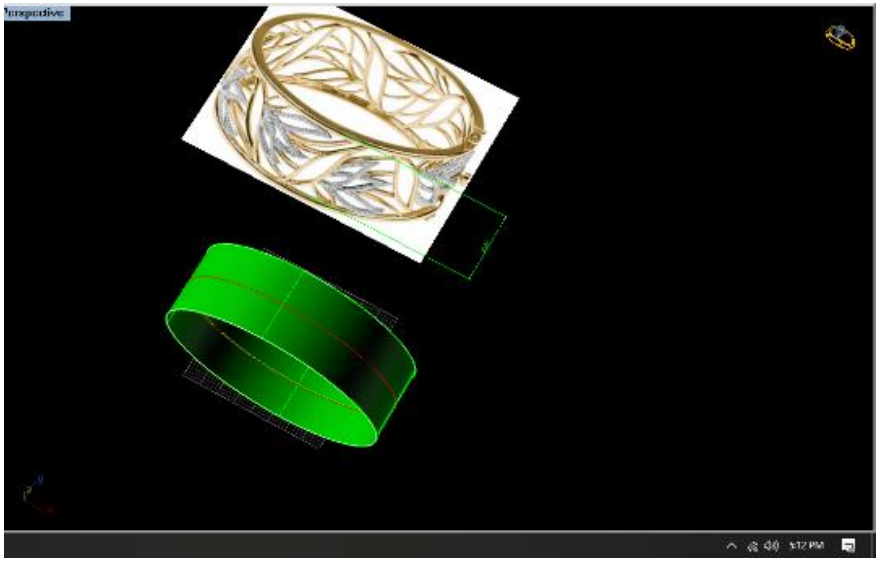
- From Looking down View, Use “offset curve” command for offsetting Ring Rail /Circle to 10mm to both sides.

Offset the Ring Rail to inner side of 1.0 mm, Perspective View shows the proper placement of Curves

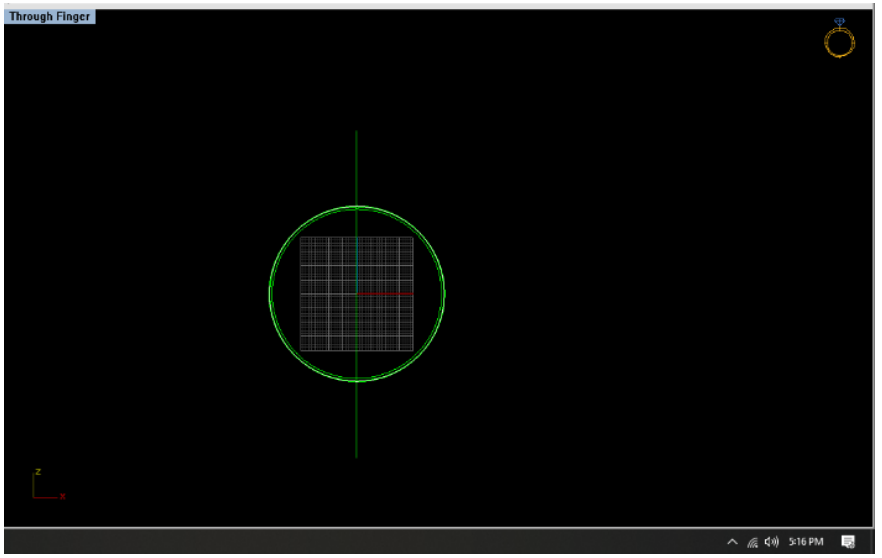




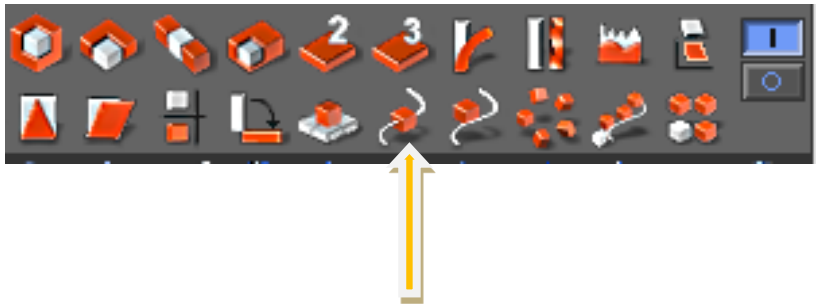
- Select both outside curves and use “Loft” from Surface Menu.
- Loft creates Open poly surface.

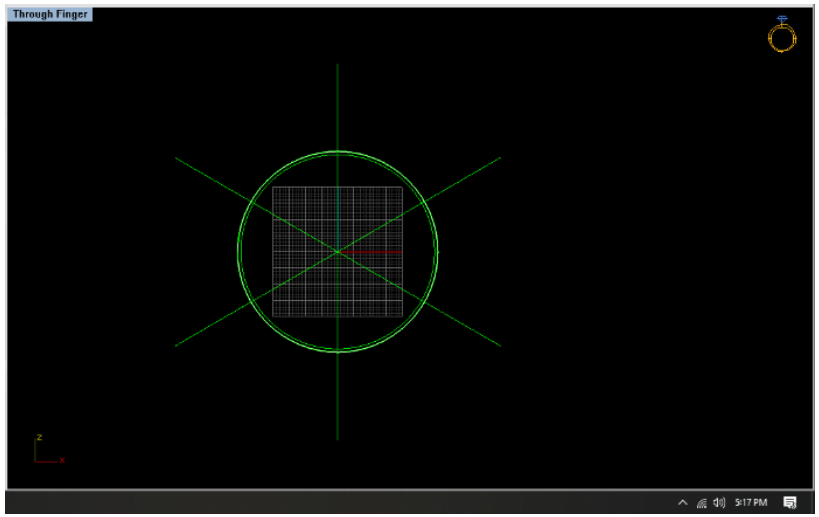


- Create straight line from curve menu by selecting F4 key as reference.

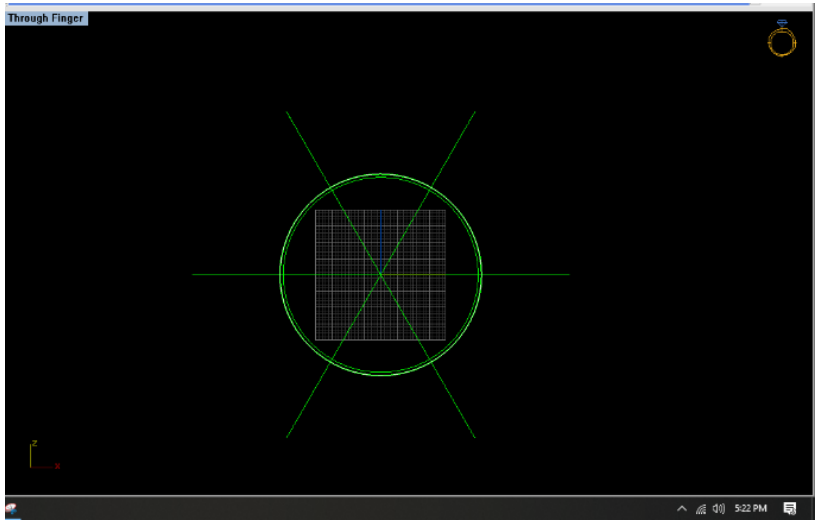


- **Create 6 copies of line by using “Array Polar”**

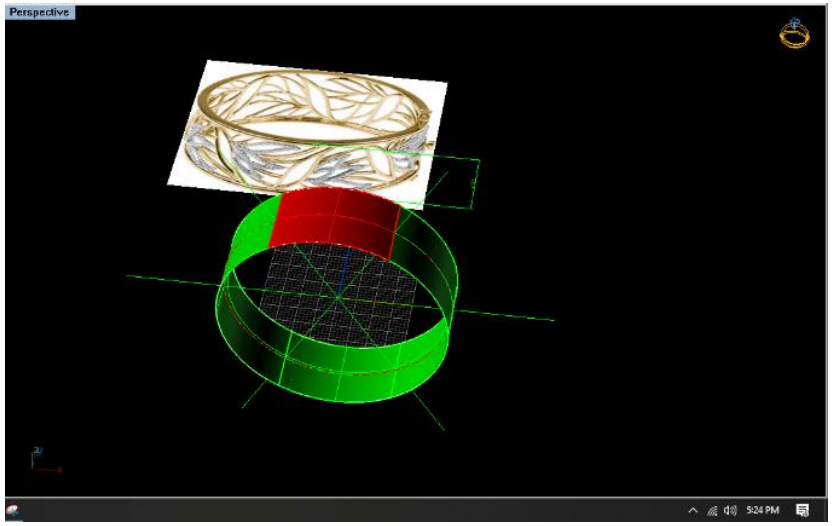




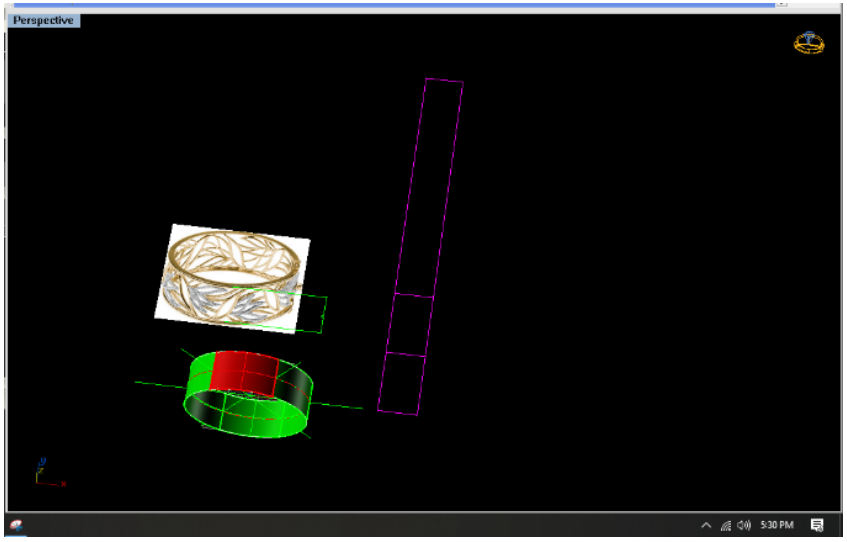
- **Rotate all six Curves to divide the bangle in equal part.**



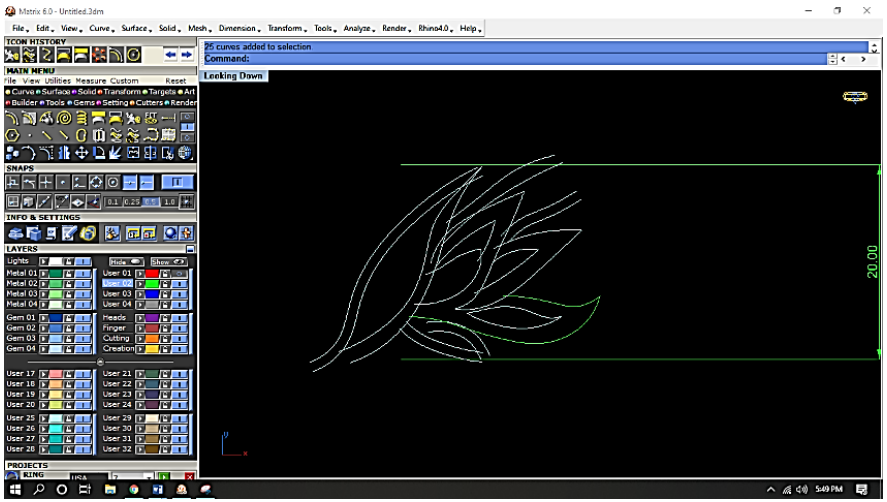
- **Split the poly surface in 6 equal parts** 
- **Declare the top center splited polysurface in Red layer.**

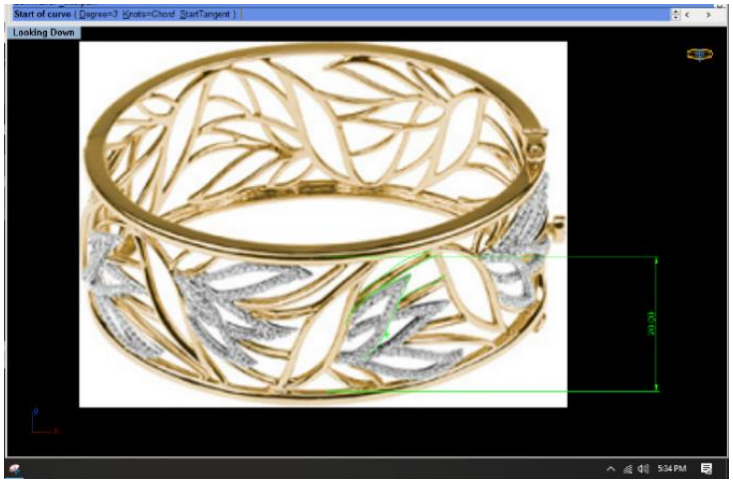


- **Apply Command “CREATE UV CURVE” from Curve Menu**



- **Trace curves on the picture by using “Interp Curve” command**

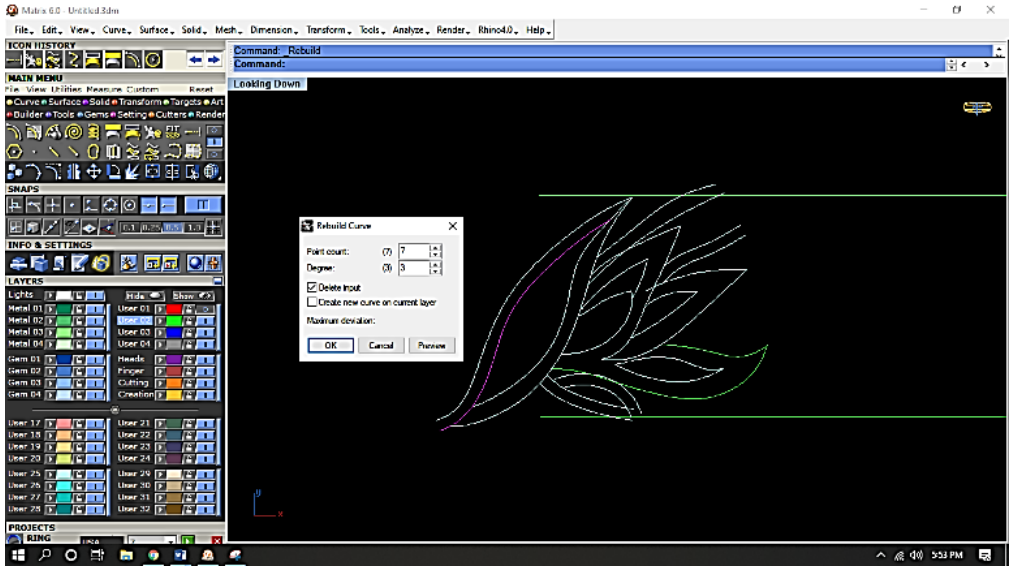




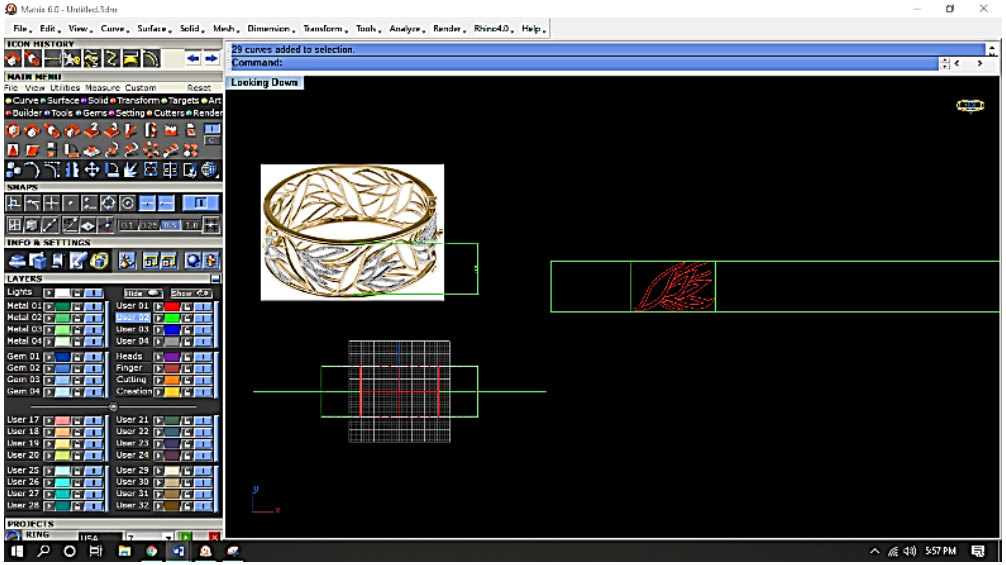
- **Trim, Rebuild, Control points,to Align the curves .**

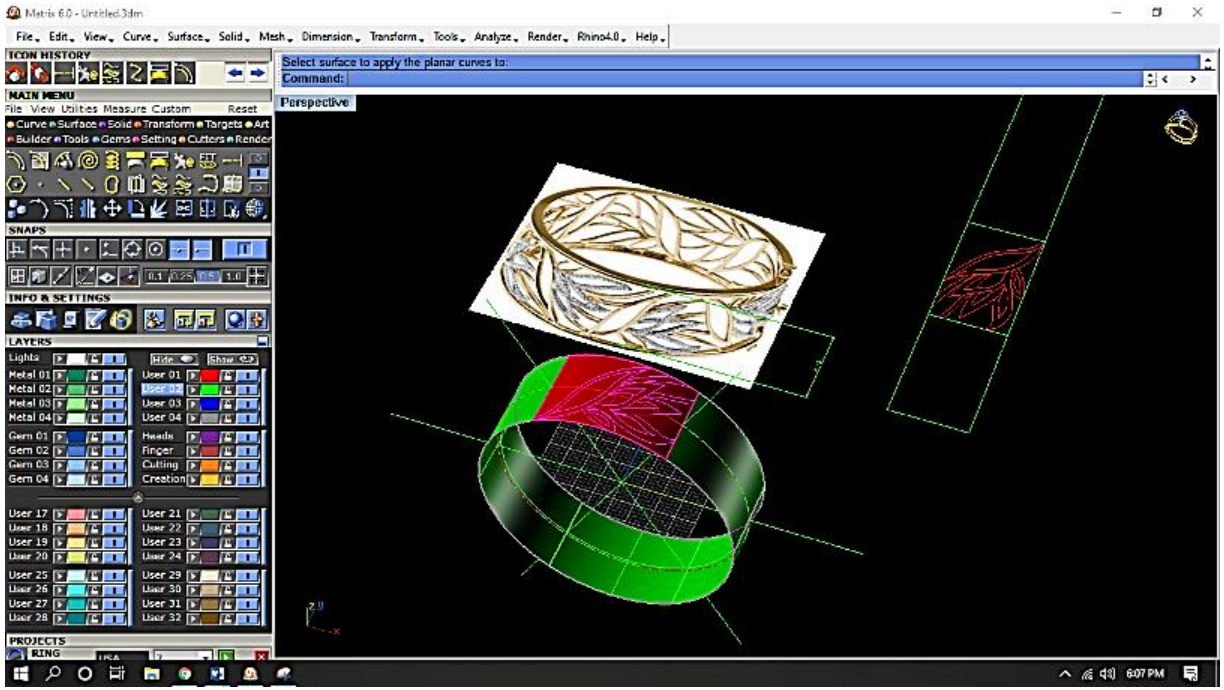
- **Rebuild All Curves**

- **Place and adjust all curves in the UV curves.**

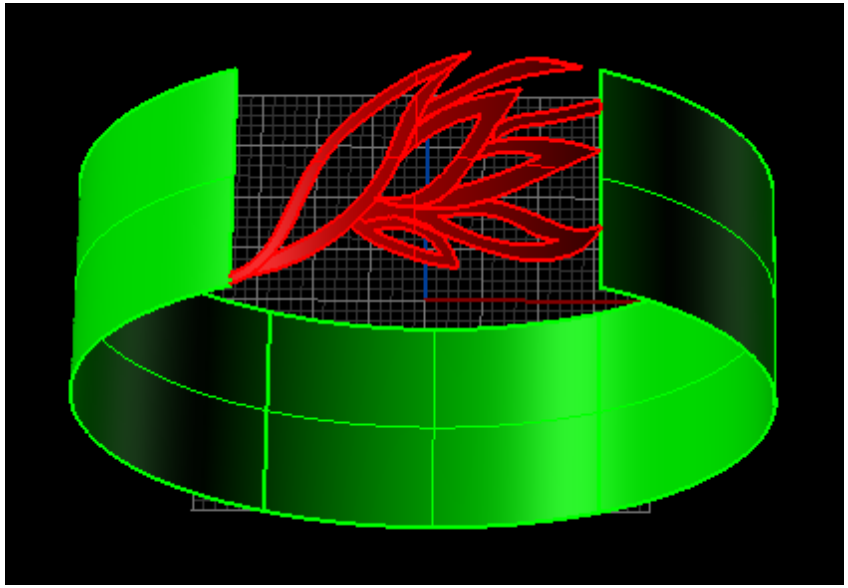


- **Apply UV curve from curve menu and change the Layer color.**

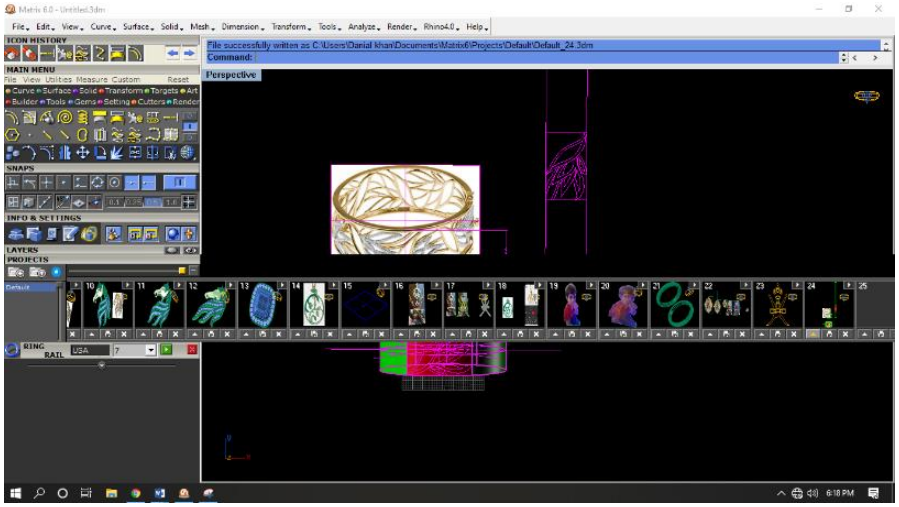




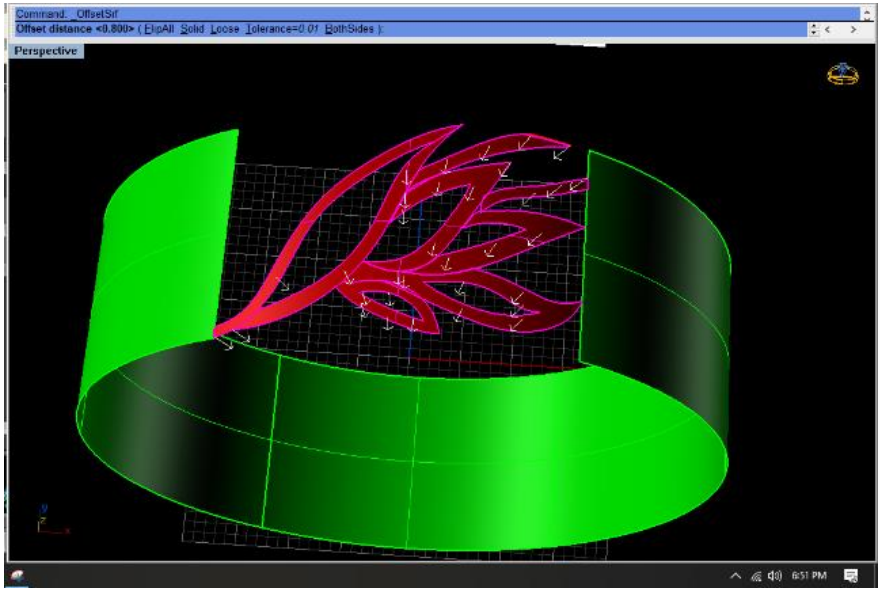
- **Split**  **and remove extra surface**



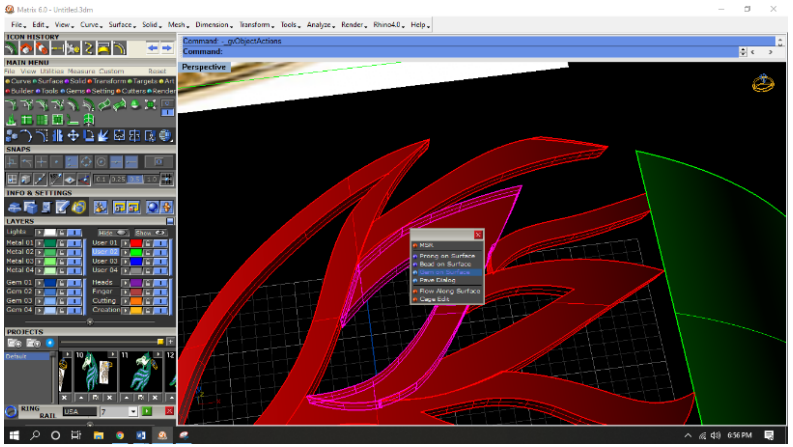
- **Remove or save extra surface after splitting in job bag.**

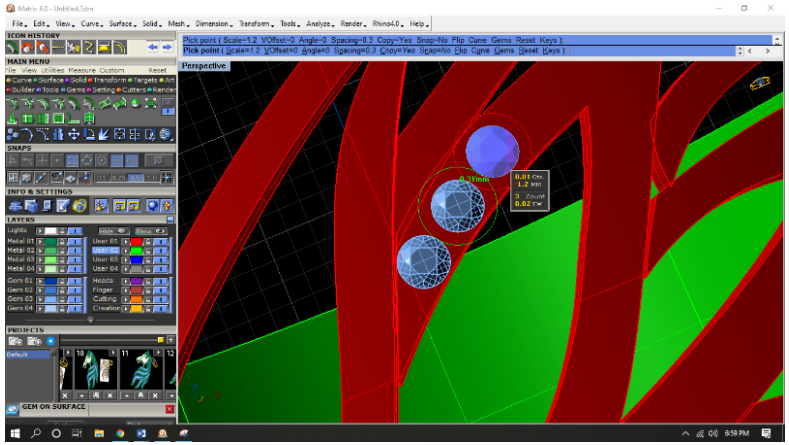


- **Select All Red Surfaces and perform Offset Surface (press solid) from Surface Menu.**

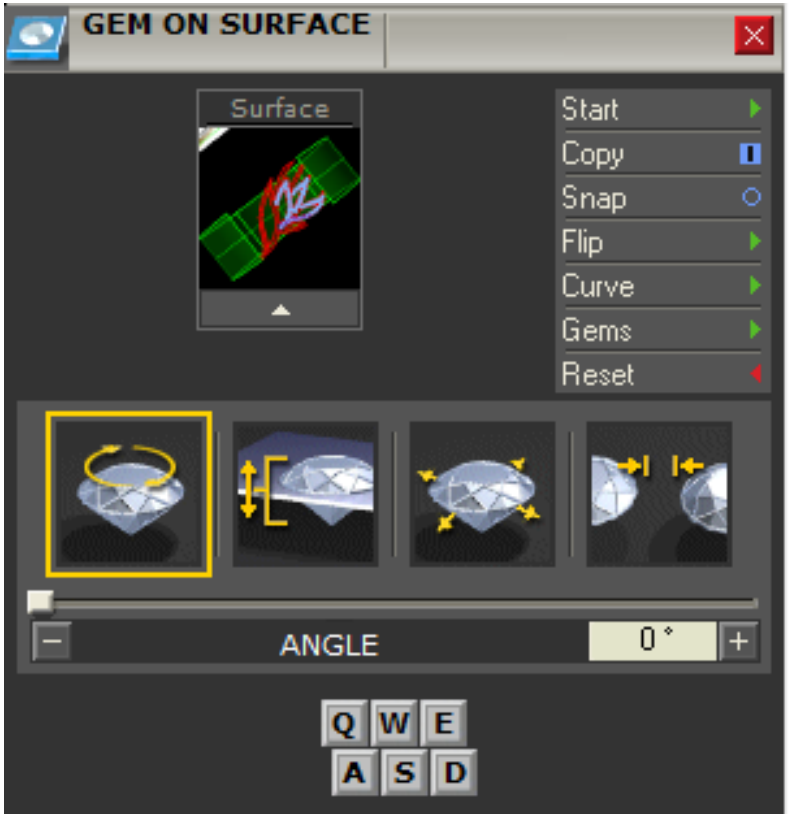


- **Place Gems by selecting Surface and then press F6 or select “Gems on surface” Command**

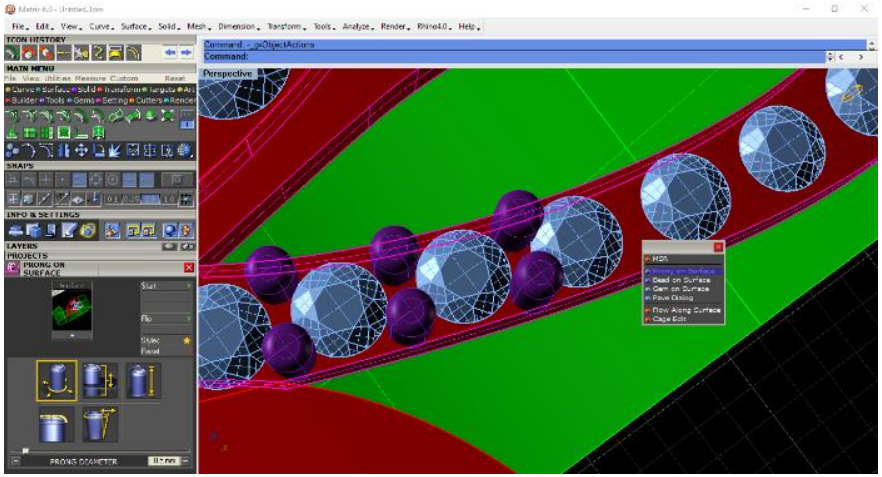


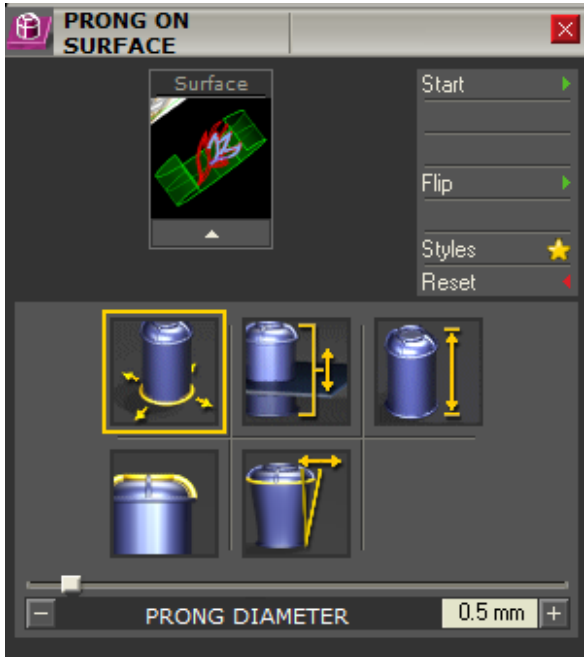


- **Select the size of gems as Dia =1.2 mm and spacing of 0.3 to 0.5 mm between 2 gems.**

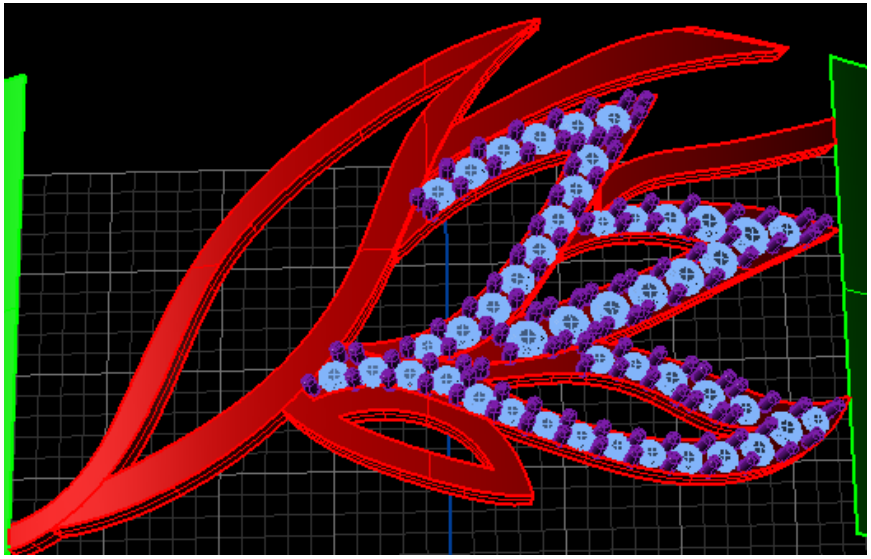


- **then Apply Prongs by selecting surface and press F6 or selecting command “Prongs on surface”**

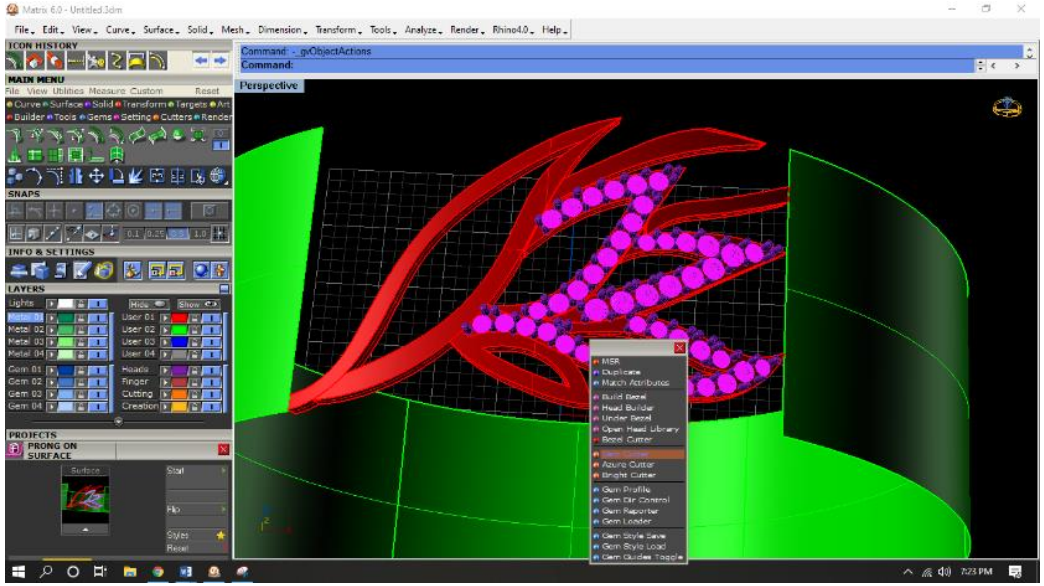




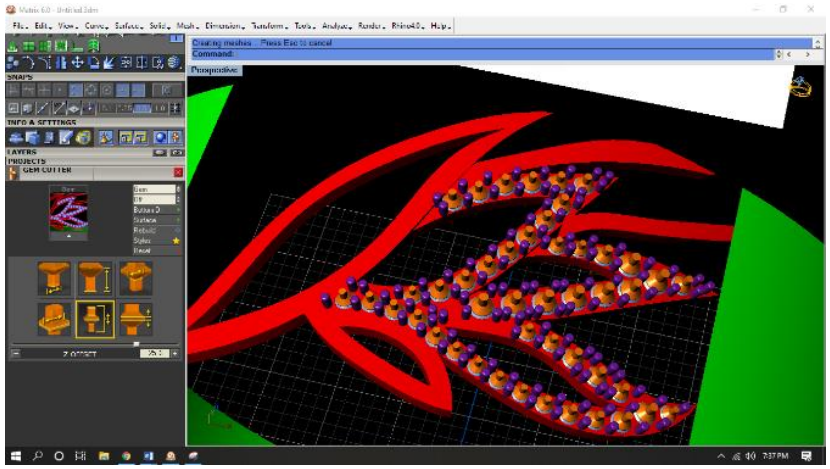
- **Set the prongs height and thickness to 0.5 mm**



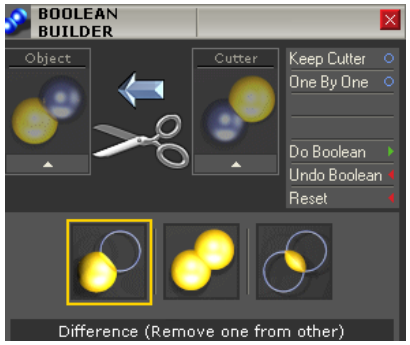
- **Select all Stones by clicking the light blue layer and press F6 to apply command “Gem Cutter”**

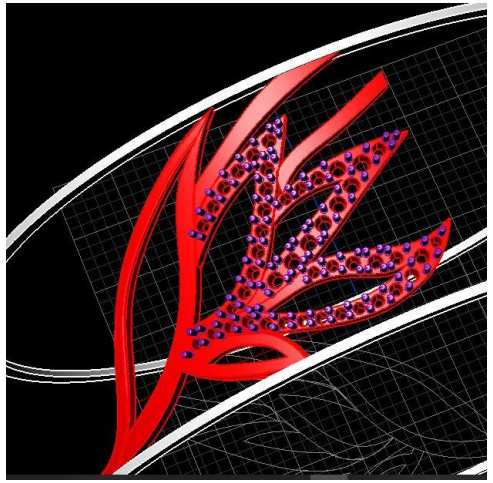


- **This will show the cutters on the top of All gems.**

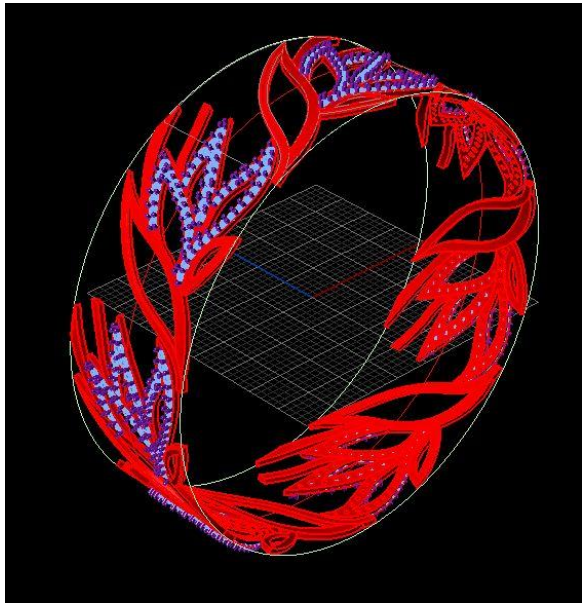


- **Then go to Solid Menu and perform “Boolean Difference” to make gem holes.**



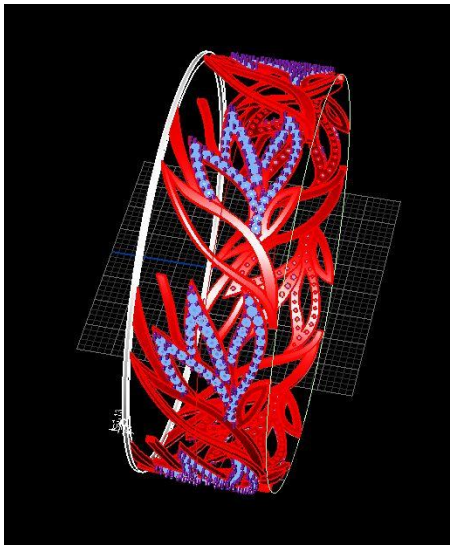


- **Then Apply “Array polar” to get seven (7) times repition of the pattern.**

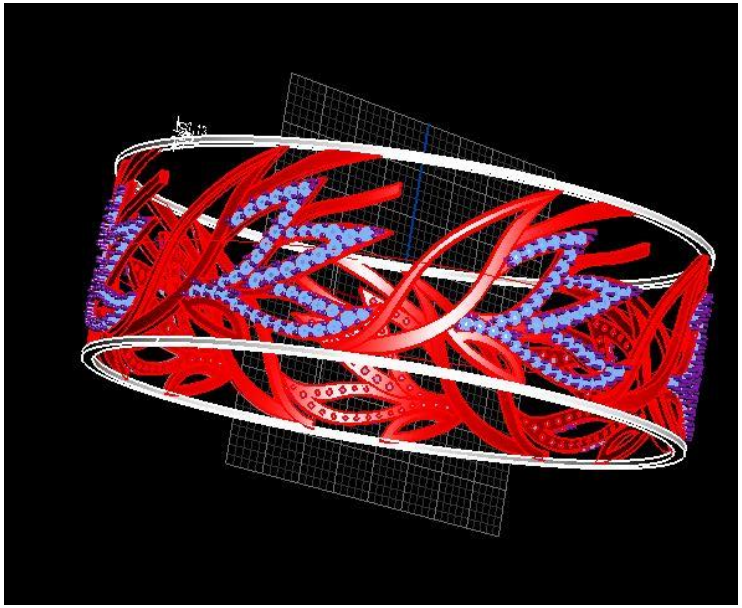


- **Unhide the side circular Ring rails and draw square profile placer/cross section as shown below.**

- **Apply “Sweep1”using side ring rail and square profile placer/cross section.**



Replicate the outer solid polysurface by using “Mirror” command.



- **The final bangle can be got by “Boolean Union” and rendering.**

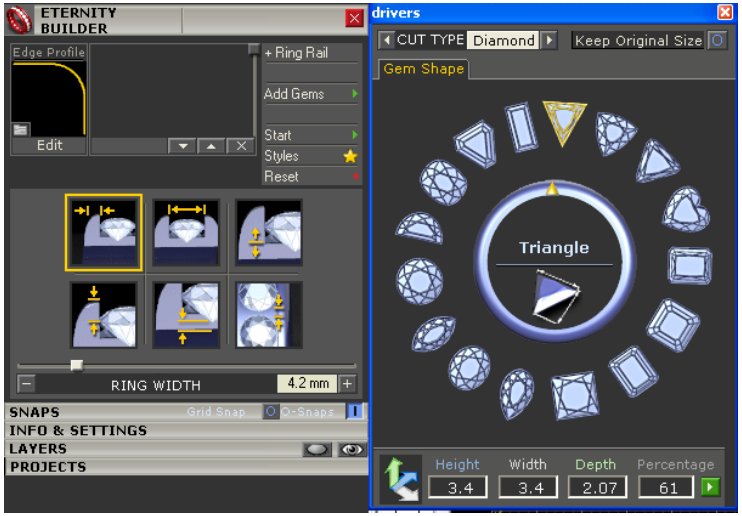
PRACTICAL: DESIGN A CHANNEL SETTING BAND (ETERNITY BAND)

LU1: Set up of Commands for Advance Jewelry Article

Builder Menu, Eternity Builder, Channel Cutter, Cutter Profile, Boolean Difference

LU2: CREATE 2D DRAWING

- Go to Builder Menu
- Click Eternity Ring Builder
- Click Ring Rail and type your finger size. mm D:_17 mm
- Click Add Gems by Selecting calibrated and symmetrical round gems of size 3`4 mm



LU3: CREATE 3D DRAWING

- Click “Start” button, this will show channel set band on the screen.

- **Adjust the following parameters.**

  a- Ring Width : as per your design requirement

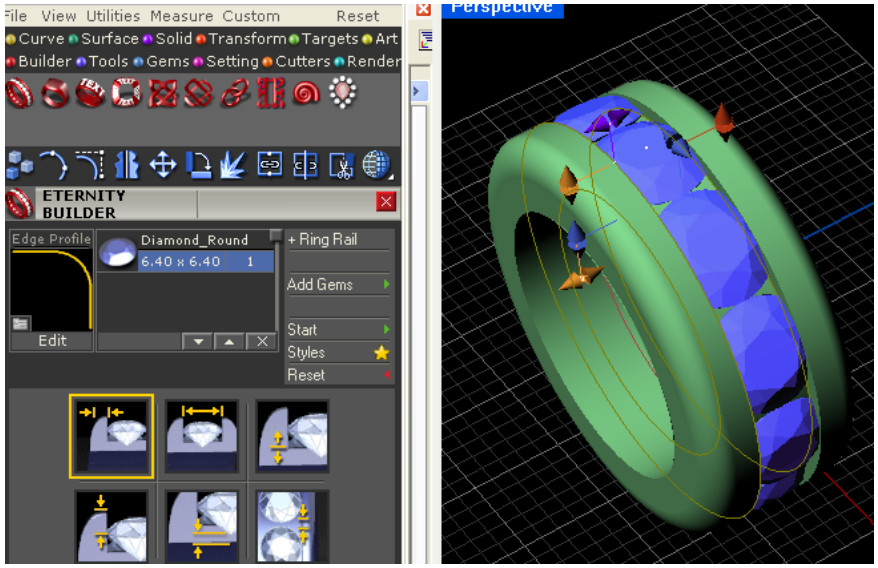
  b- Channel width : as per your design requirement

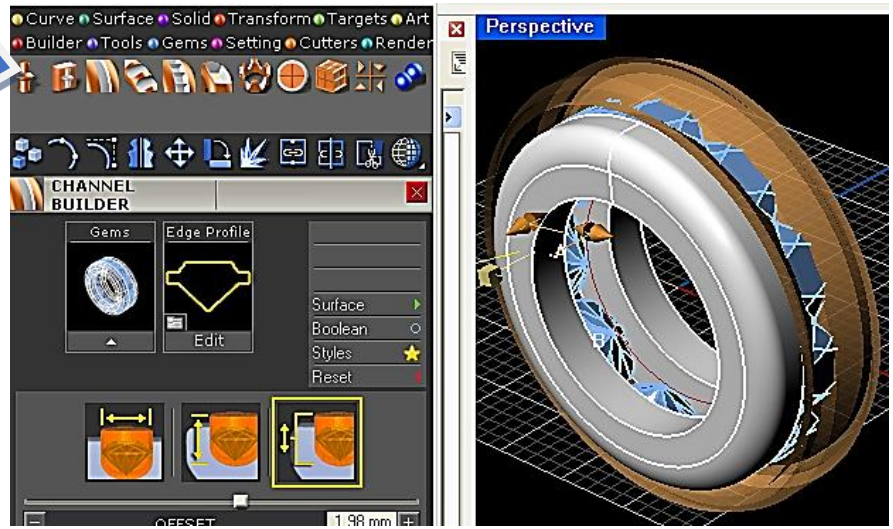
  c- Channel Depth : to extreme right i.e. 6.0 mm and more (for see through)

  d- Extra Height : as per your design requirement

  e- Cullet to Finger : Don’t Change

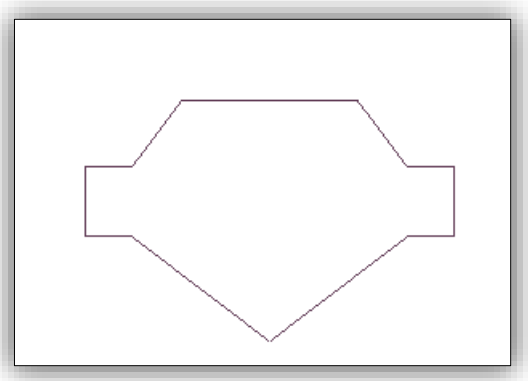
  f- Gem spacing : as per your design requirement





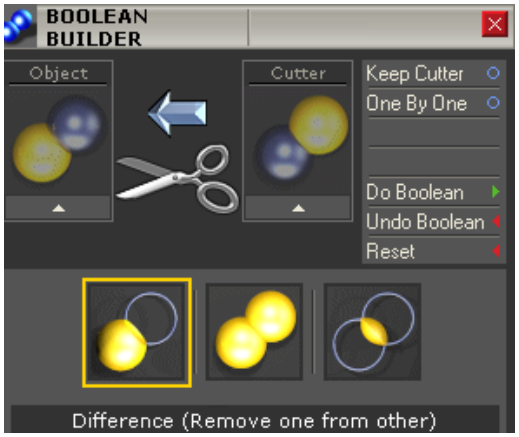
- At end, click right button of mouse to come out of command.
- In order to make, channel groove inside the band walls.
- Go to Cutter Menu and Click “Channel Builder”

- **Make an edge profile cutter of shape to make accurate grooves inside the wall of band.**



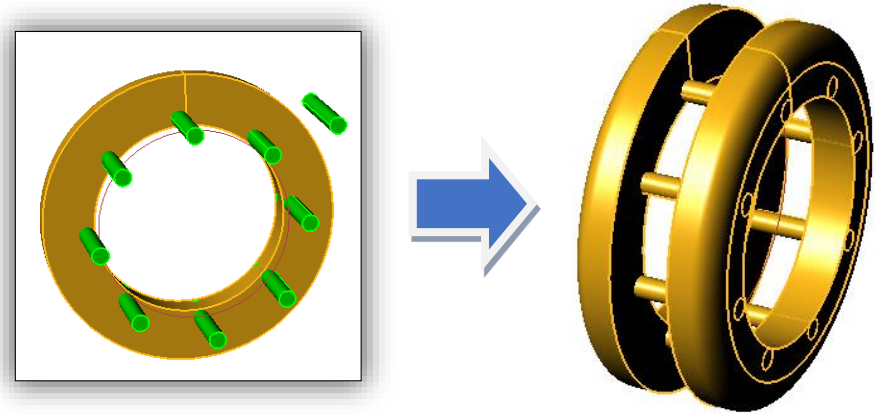
- **Adjust the following parameters as per your desire.**
  a-width, b – height , c- offset

- **At the end apply ,Boolean Difference**



- **In order to solder both shanks , make a support cylinder of dia = 0.8 mm near the culet of gem and apply Array Polar with no. of copies =6 or 8 ...**

- **Then apply Boolean Union to solder both wall of band.**
- **At the end show all gems**

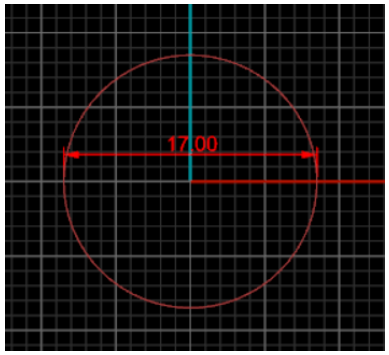


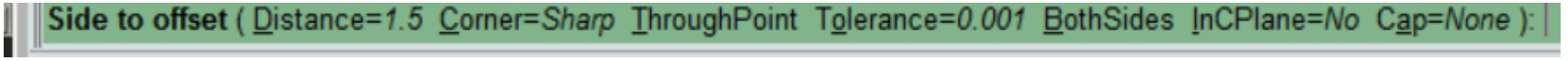
PRACTICAL: DESIGN A UNIQUE BAND WITH CLUSTER SETTING

LU1: Set up of Commands for Advance Jewelry Article

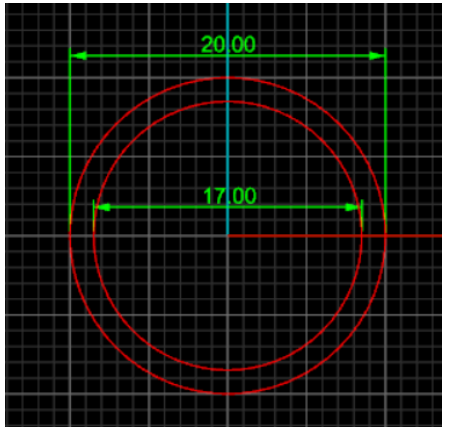
Cutter Profile, Boolean Difference
LU2: CREATE 2D DRAWING

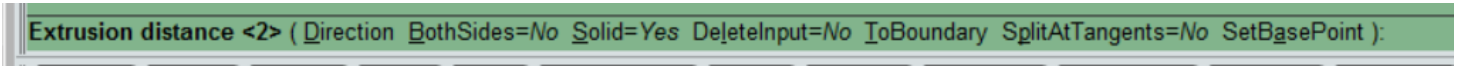
- Draw ring rain of Dia = 17 mm



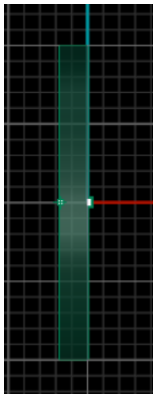


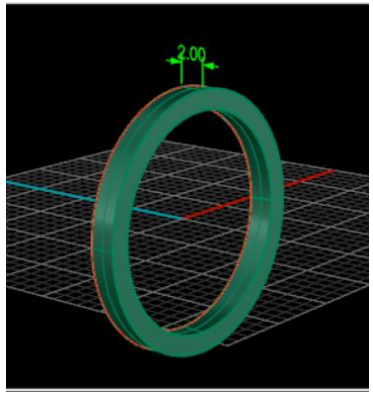
- Offset Ring rail to 1.5 mm



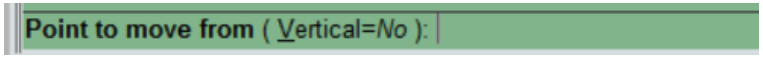


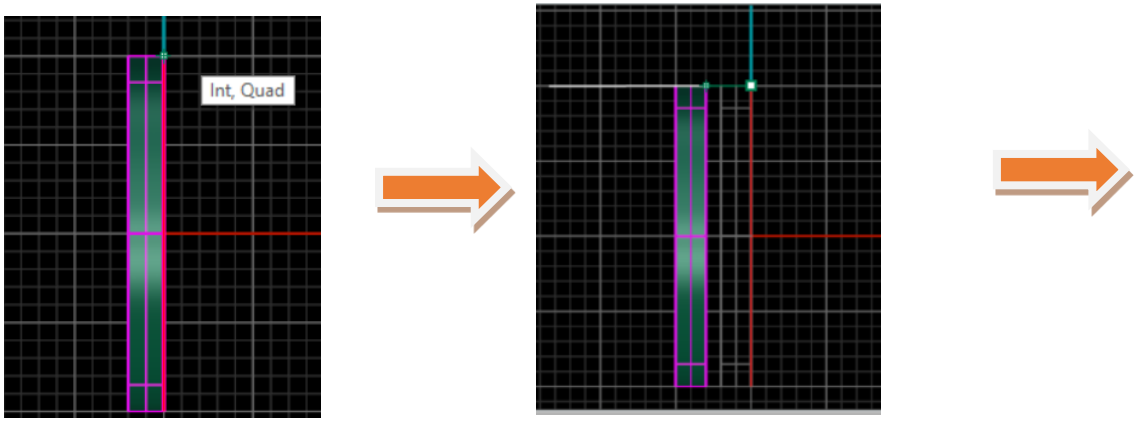
- Extrude both curves in Front view to thickness of 2.0 mm

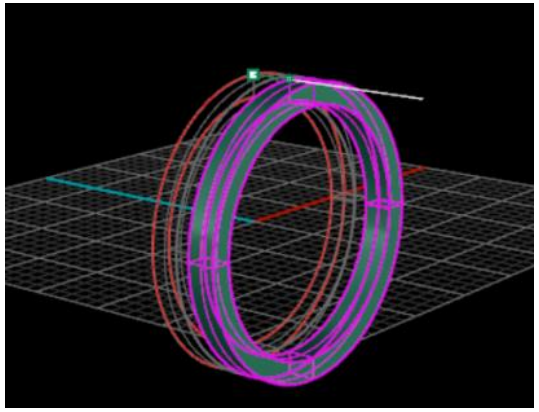




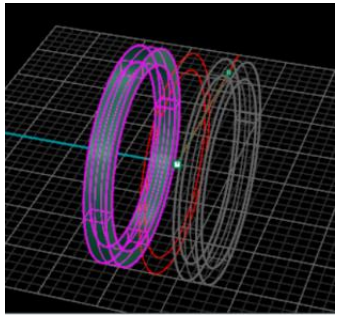
- Using “Move” command or Gumball displace the extruded band to 3.0 mm either on left or right side in Side View.

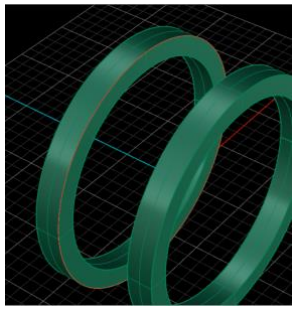




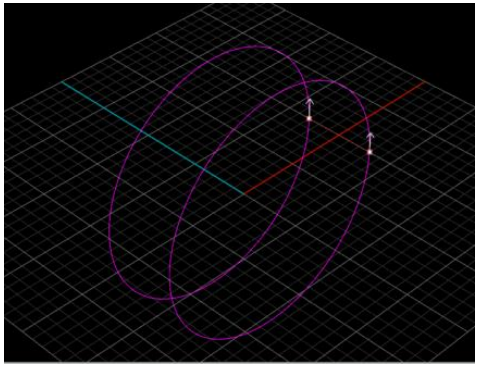


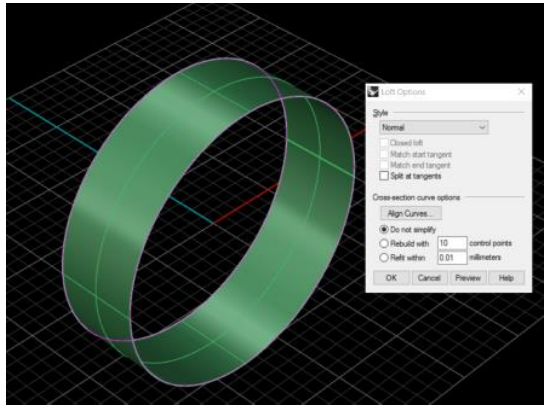
- Apply Mirror Command



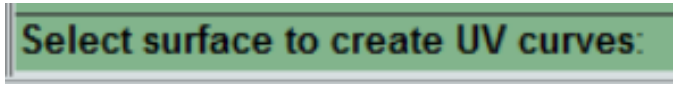


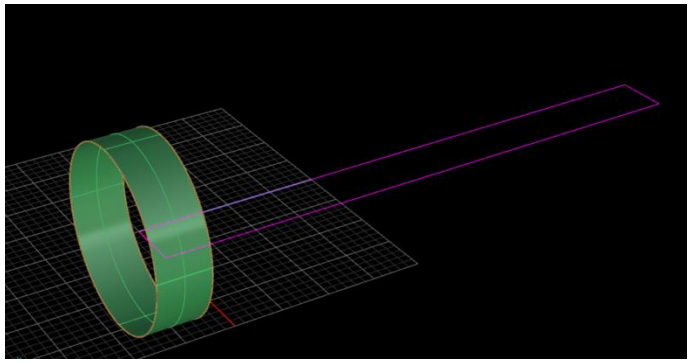
- Hide both outer bands to show duplicate rings rails.
- Using “Loft” or “Sweep 2”Commands from surface menu draw inner polysurface.





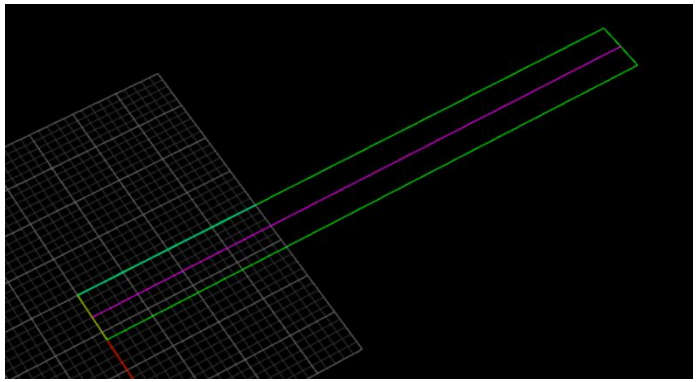
- Apply command “Create UV “ from Curve menu to open the seam surface of round polysurface on grid plane.

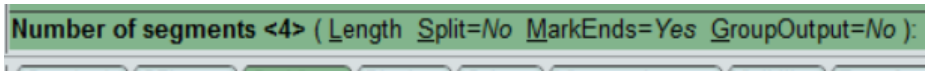




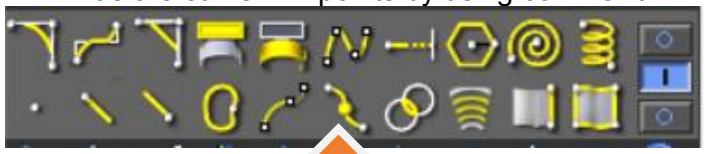
- Explode the UV curves box

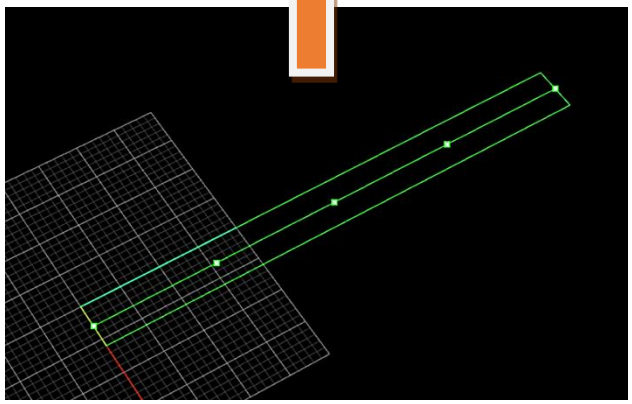
- Create a mean line of UV curves box by applying command “Mean Curve” of Offset to half of UV curves box



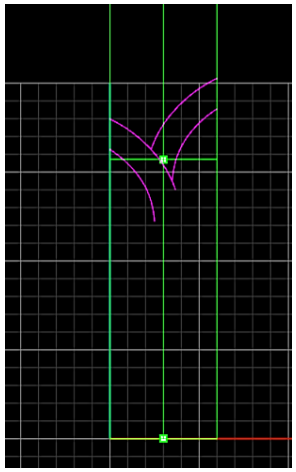


- Divide the curve in 4 points by using command “Divide Curve “

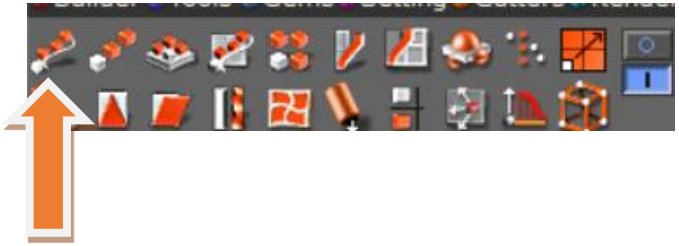


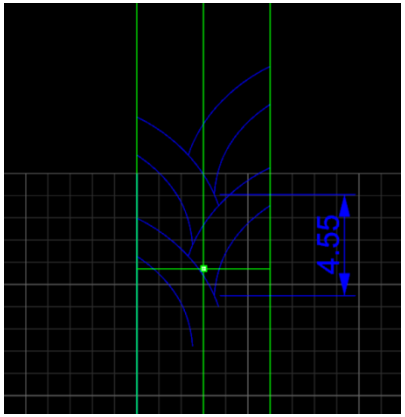


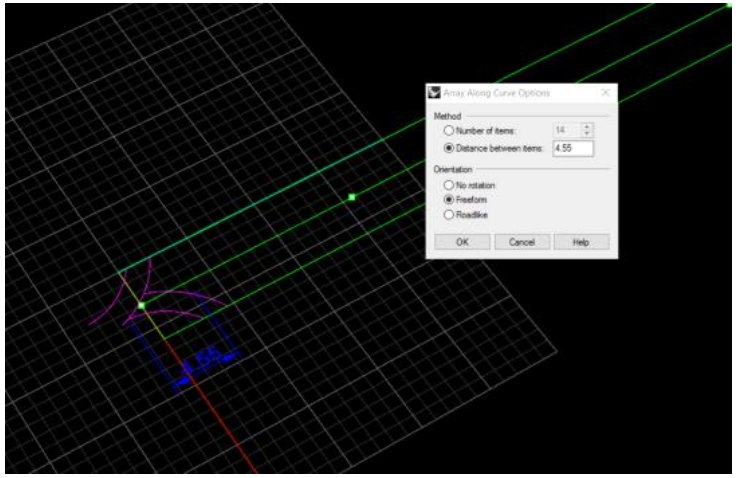
- Draw the arc pattern by using “Interp Curve “as shown bellow

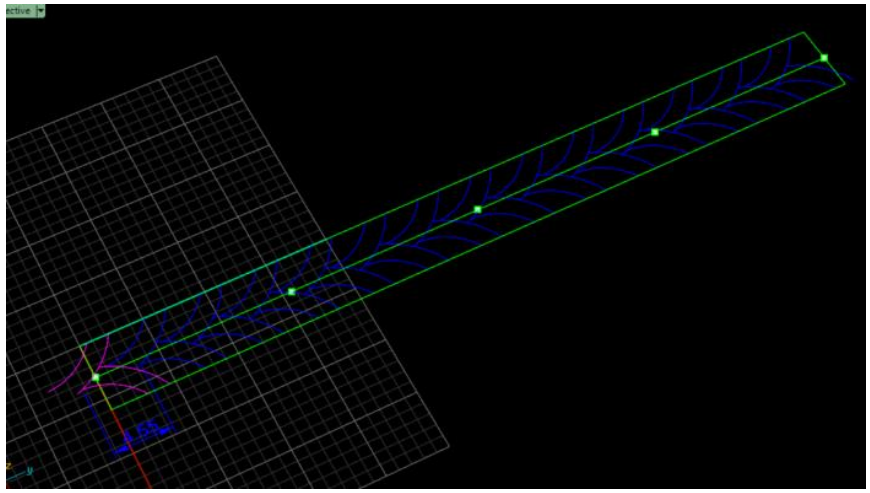


- Apply command “Array along Curve “ to repeat the patterns by giving center distance of 4.55 mm



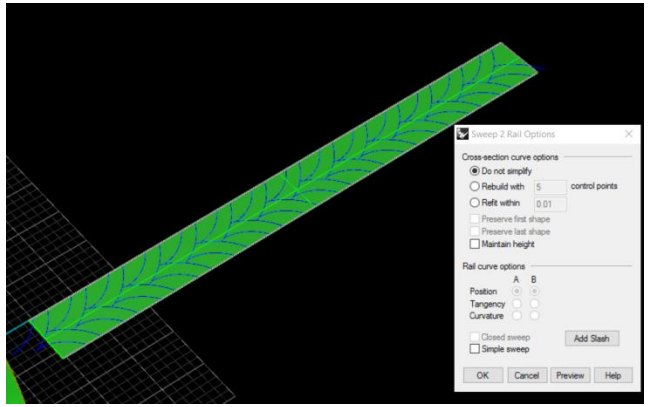




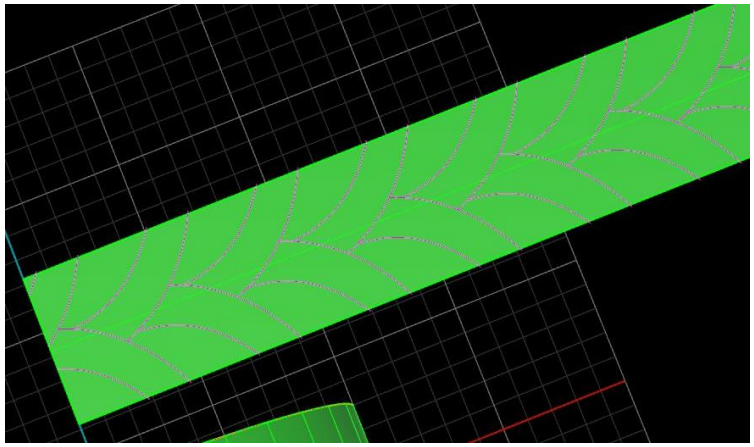


LU3:CREAT 3D DRAWING

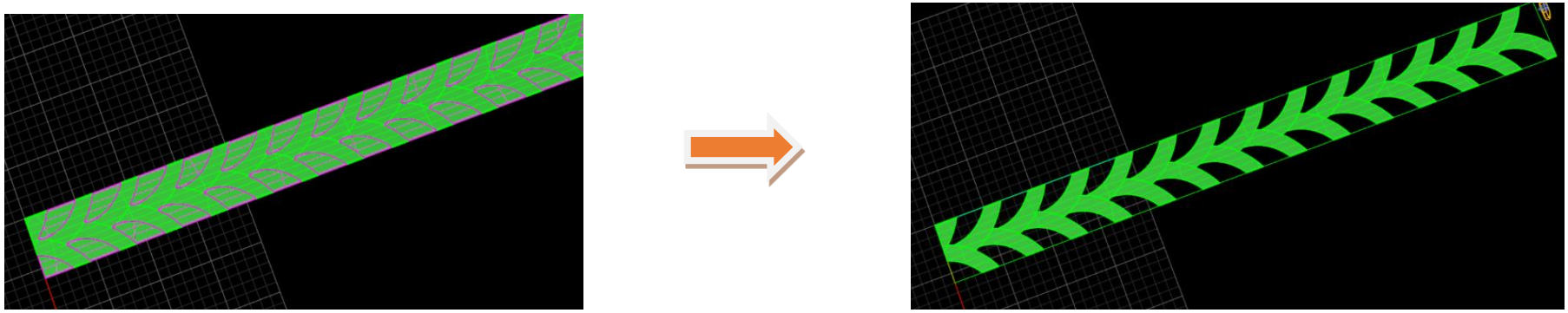
- Hide the Centre line and apply “Sweep2” command to create 2D surface with UV curves box.



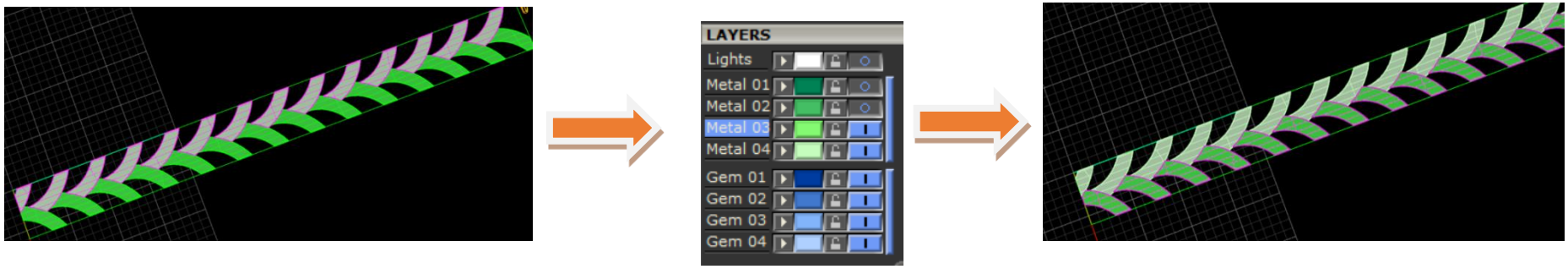
- Apply Split command to pattern curves and delete the unnecessary marginal 2D surfaces



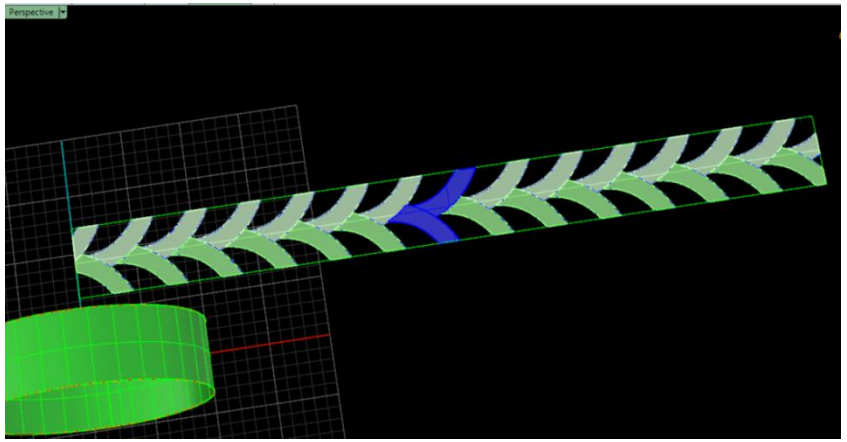
- Highlight the unwanted splited surfaces and delete these.



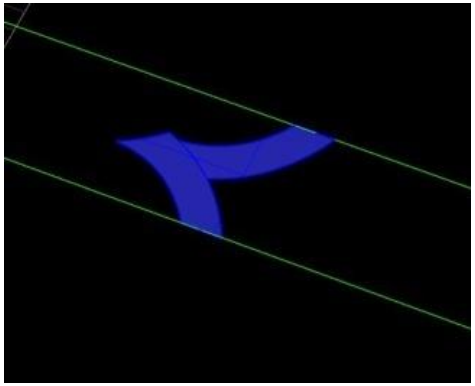
- Select 1 side of pattern and change its Layer color.

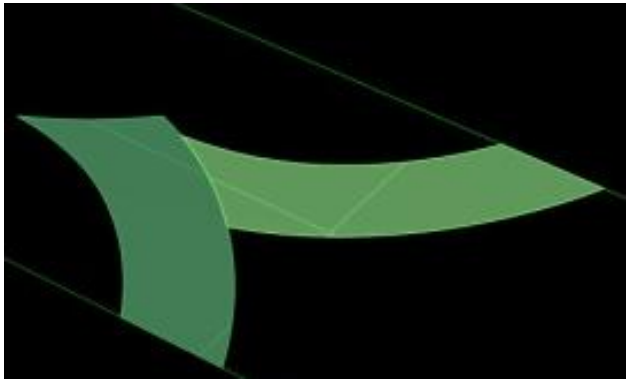


- Change the Layer color of 1 pattern to blue and hide the remaining in green Layer.



- Re-change the color from blue to green

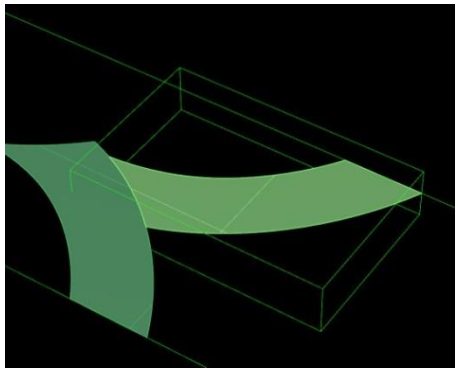


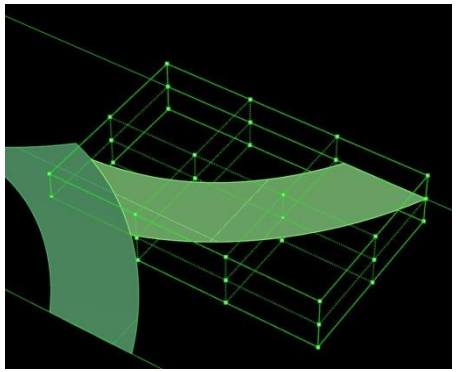


- Then apply “Cage Edit “Command from transform menu to uplift one side of pattern

```
Select control object ( BoundingBox  Line  Rectangle  Box  Deformation=Accurate  PreserveStructure=No ):
Coordinate system <CPlane> ( CPlane  World  3Point ):
Cage points ( XPointCount=4  YPointCount=3  ZPointCount=3  XDegree=3  YDegree=2  ZDegree=2 ):
```

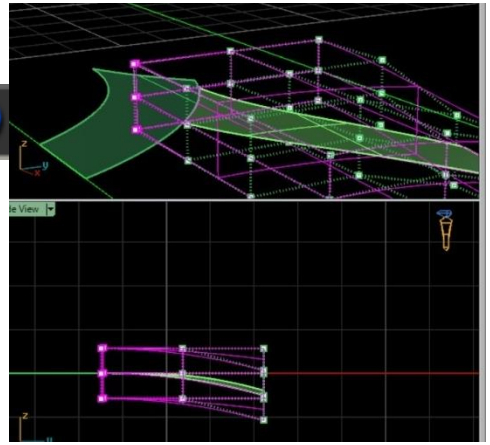
- This shows the bounding box and control

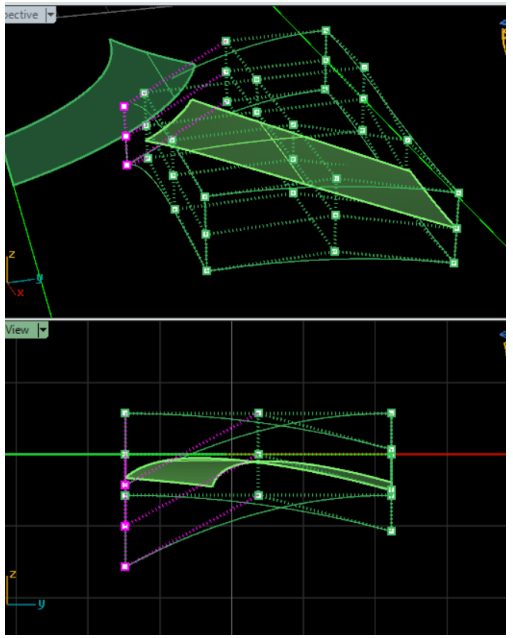




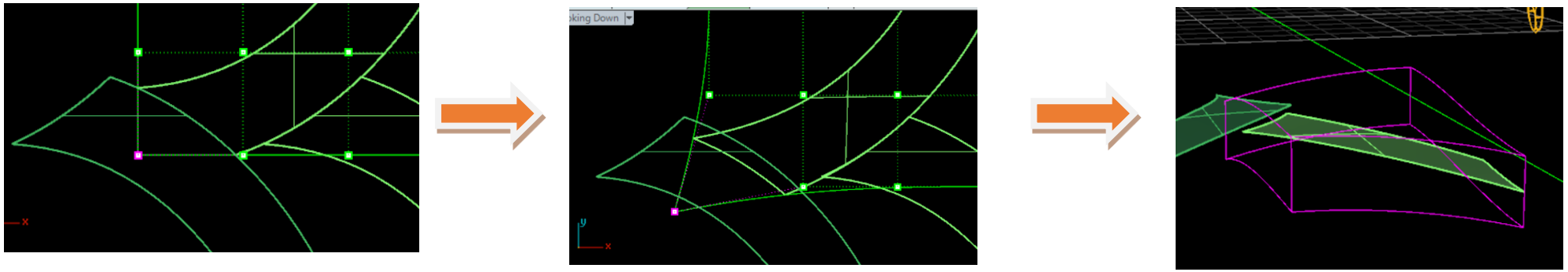
- Up-lift the motif to height of 0.5 mm by selecting control points in the bonding box.

Select control point and move 0.5 mm down

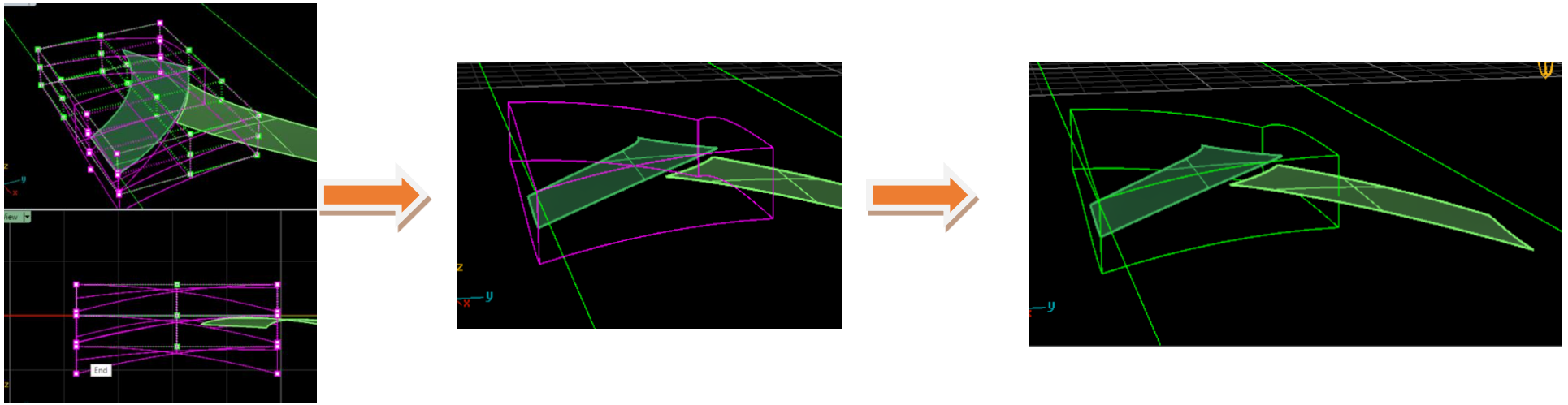




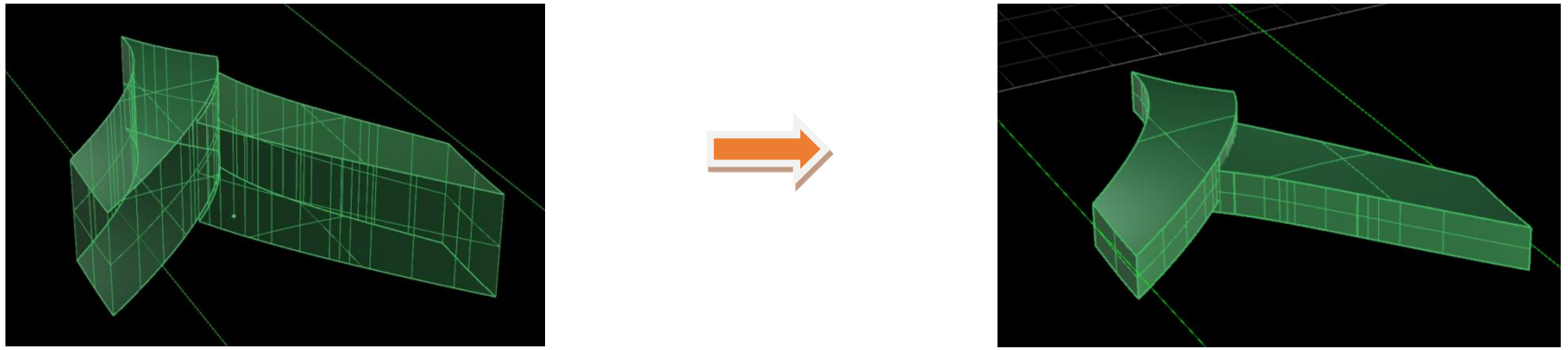
- Displace /move the horizontal control points of motif inward to 0.5 mm in Looking Down View Port.



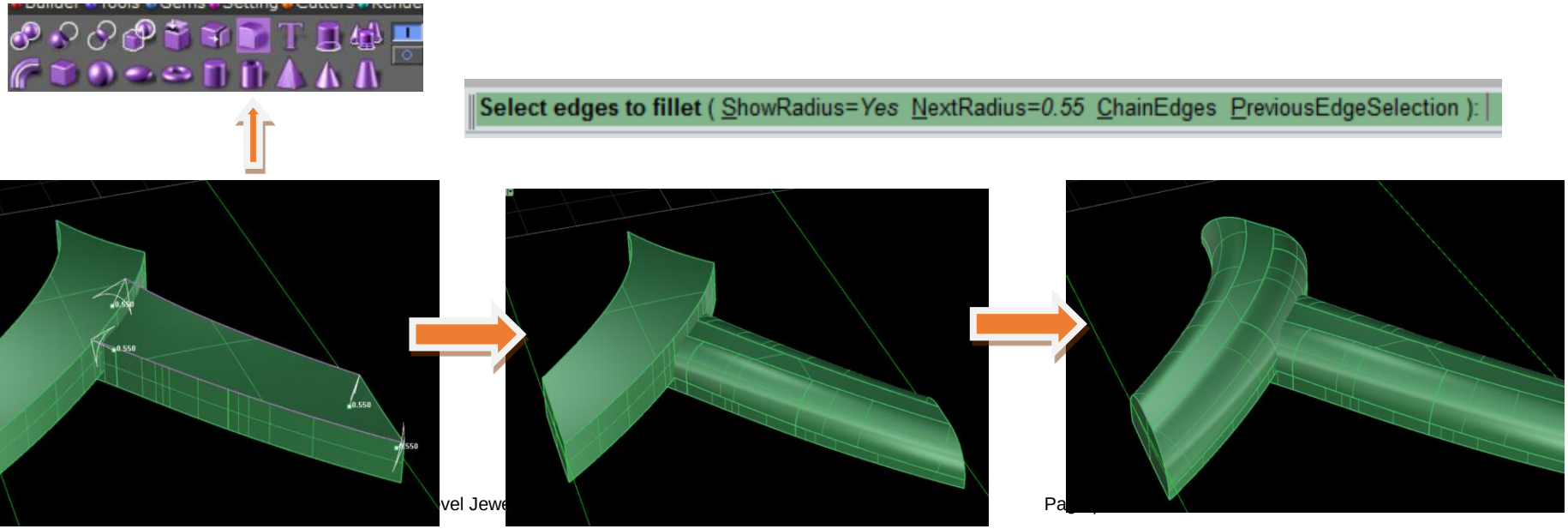
- Repeat the same command of instruction and uplift the adjacent motif pattern.



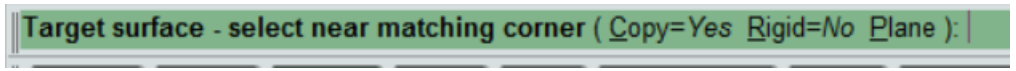
- Give thickness of 1.0 mm to pattern by applying command" Extrude Surface Straight"

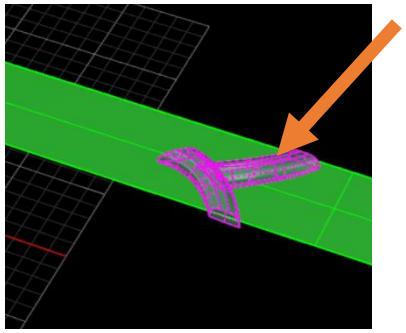


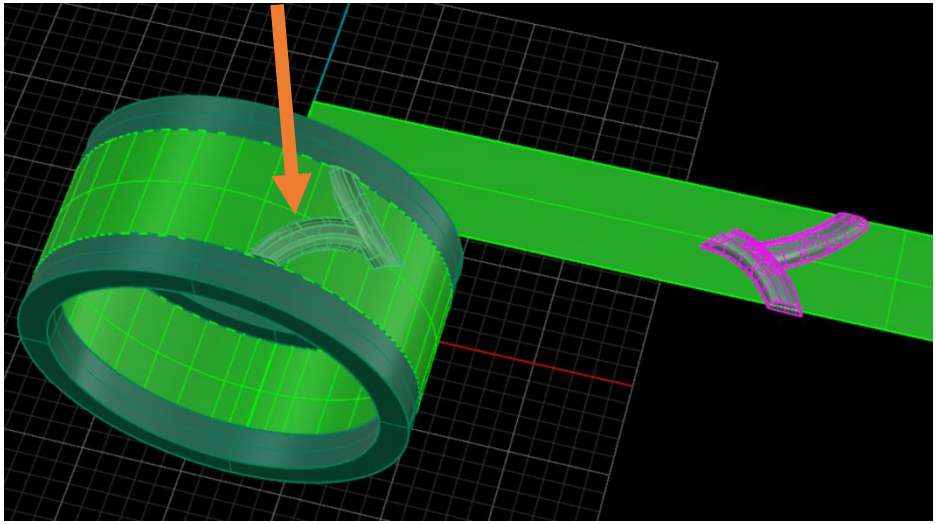
- Apply "Fillet" of 0.Radius = 0.55 to 0.6 mm command from Solid Menu to round off the edges.

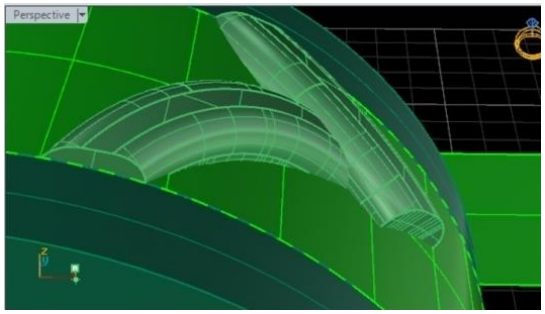


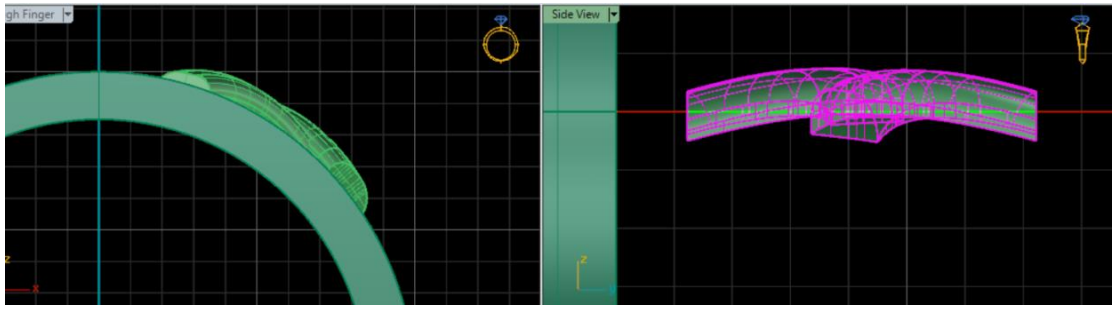
- Using command “Flow along Surface” from Transform menu , transfer the pattern on the band inner 2D surface.



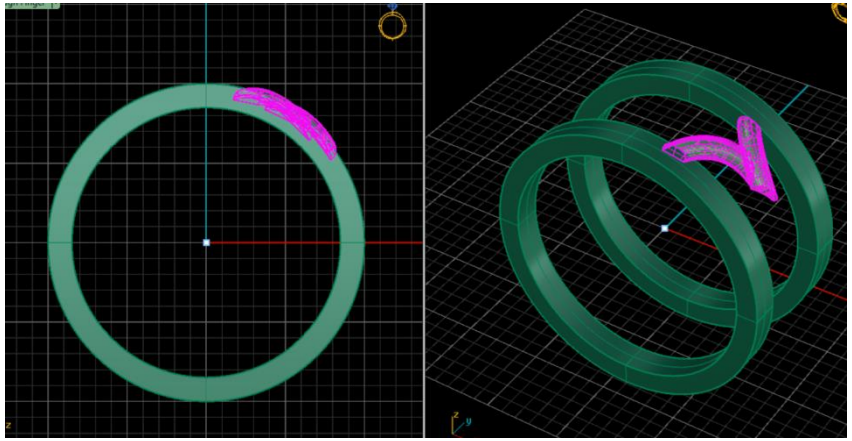


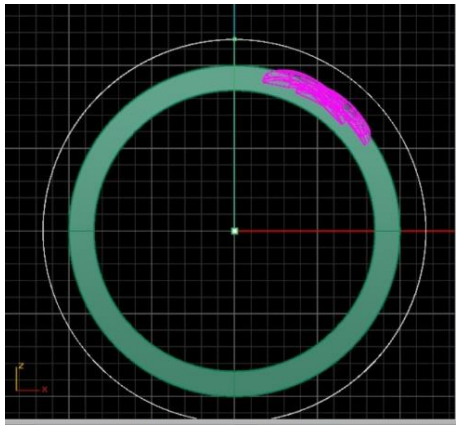


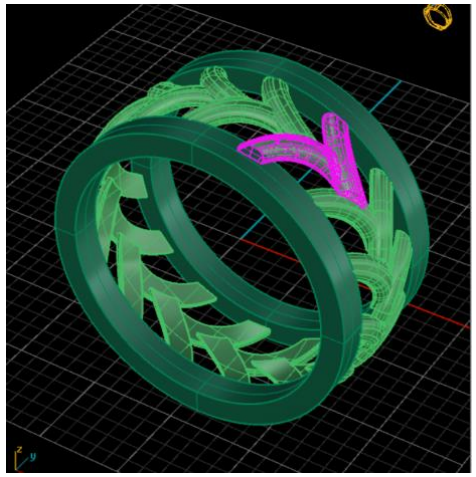


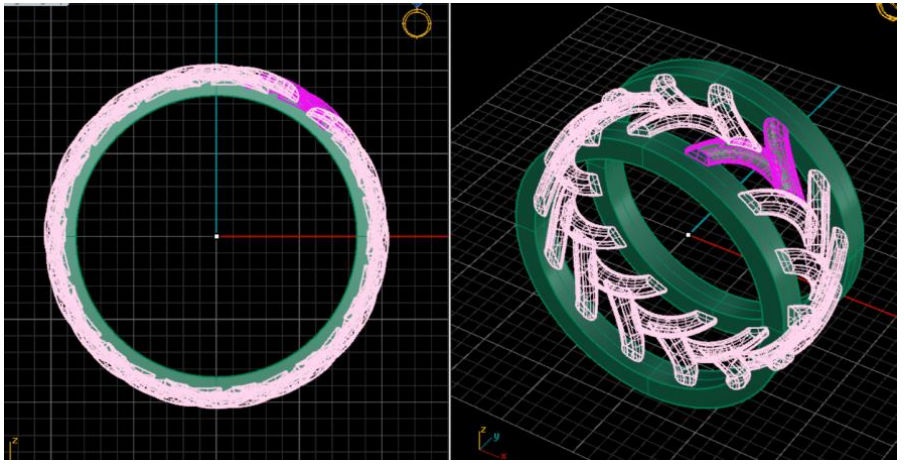


- Array Polar the pattern to copies of 14.

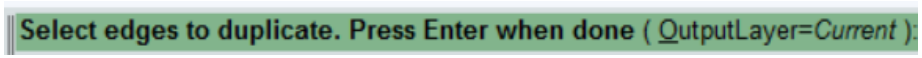


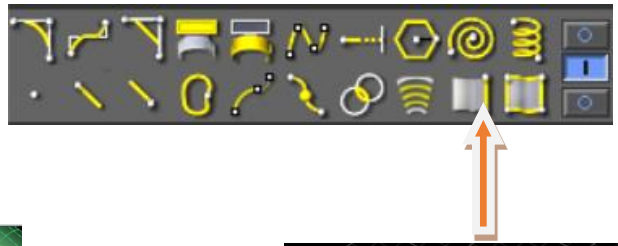




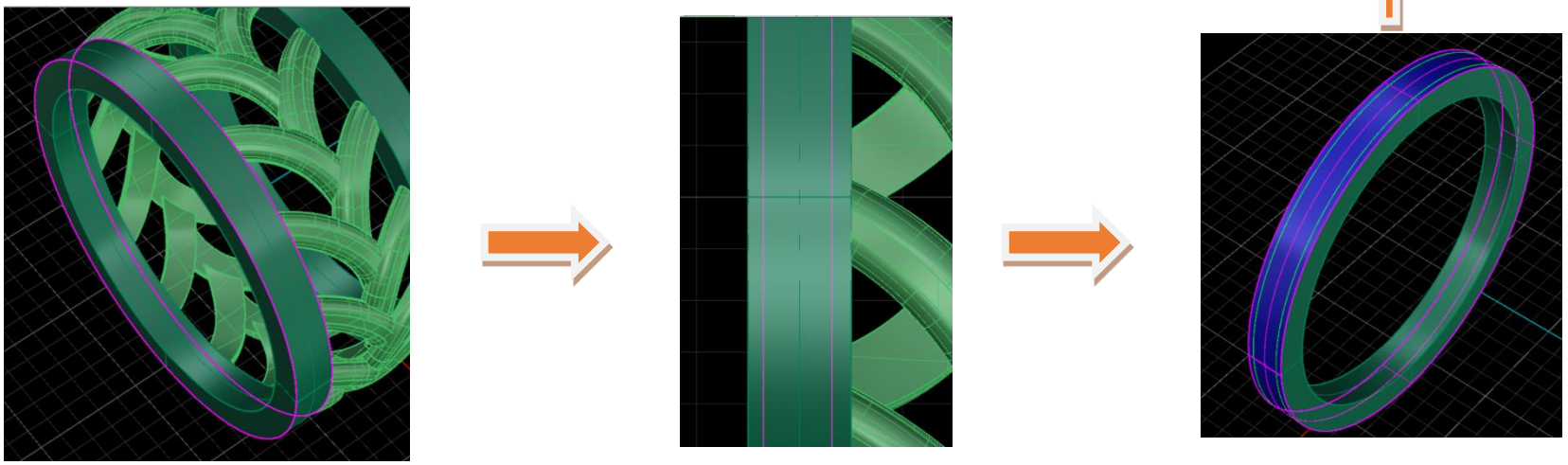


- Apply command “Duplicate Edge to extract outer circular curves.

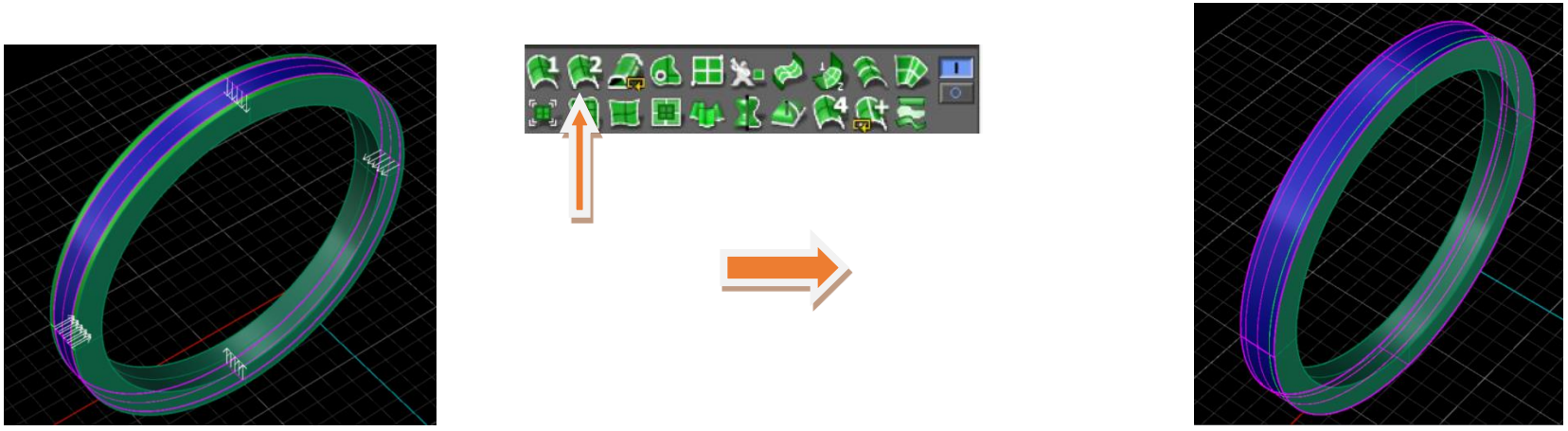




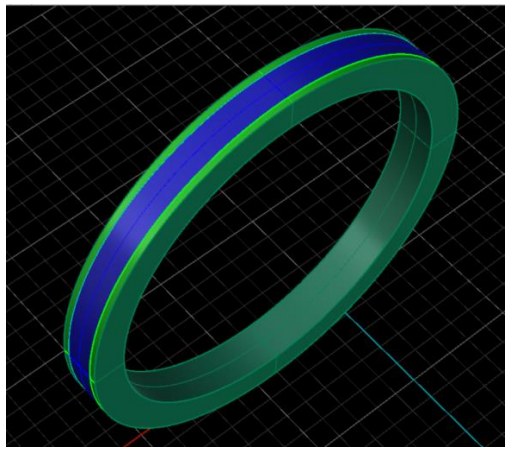
- Make inset of duplicate border to 0.5 mm.

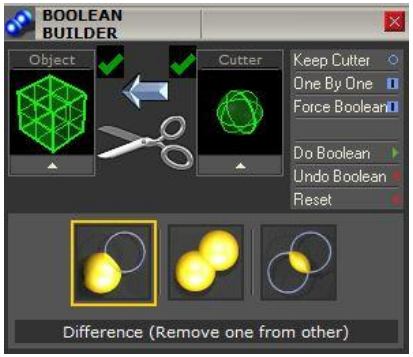


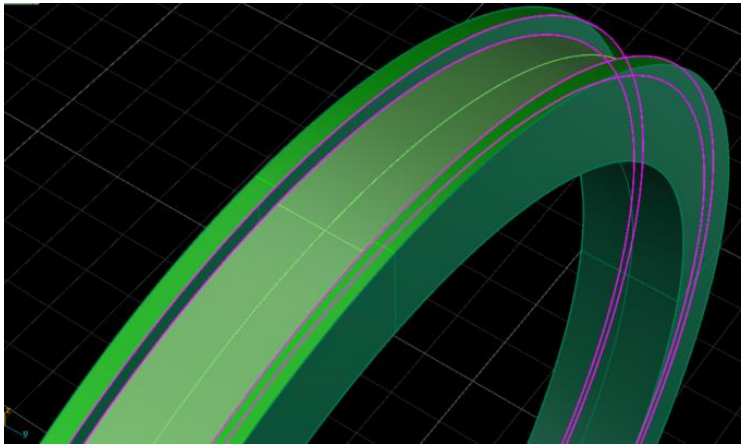
- Apply Sweep1 to make surfaces through duplicate curves and then offset the surface to 0.3 m



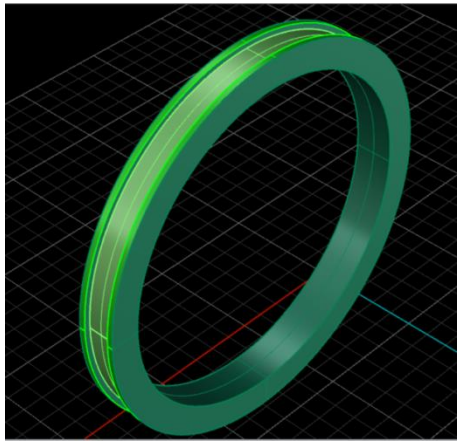
- Apply Boolean Difference to get surface in-set groove.

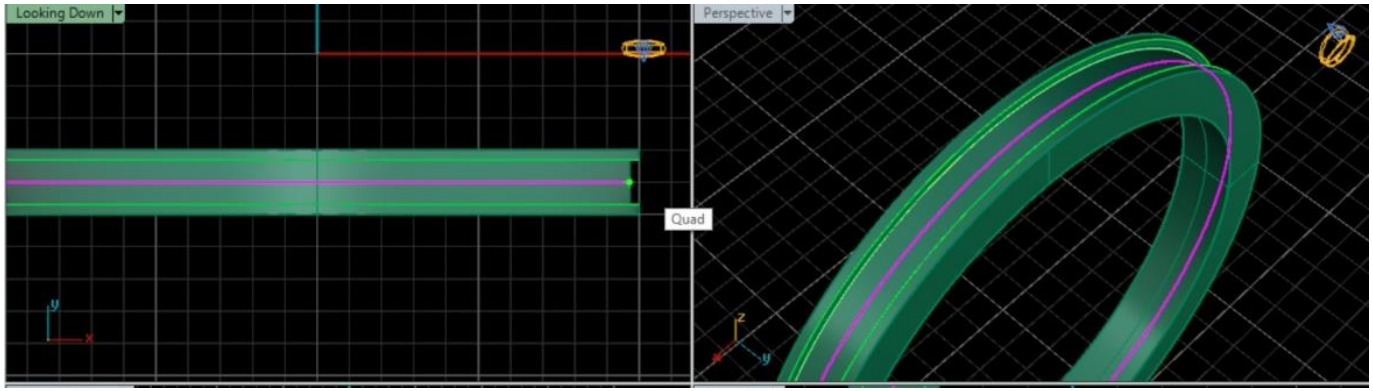




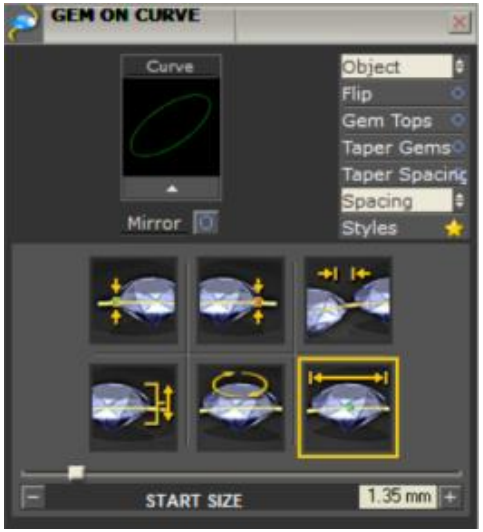


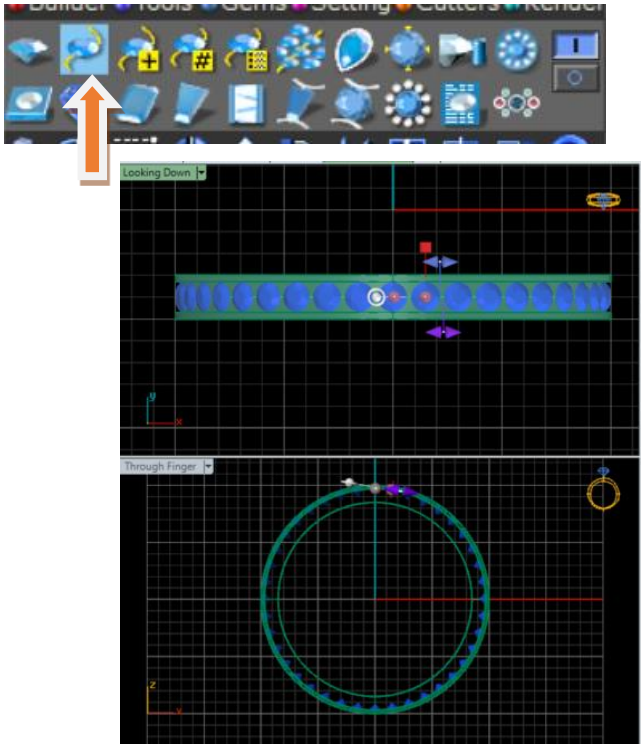
- Create top center line by using command “Extract ISO-Curve”



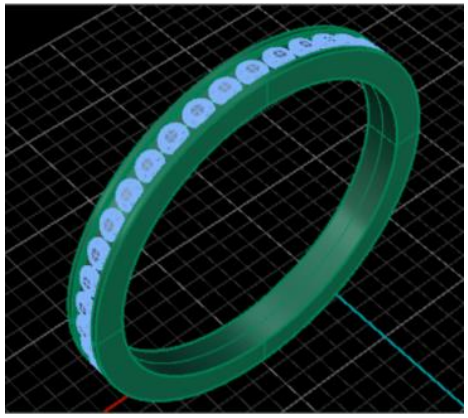


- Go Gem Menu and load command “Gem on Curve” by selecting ISO-Curve.

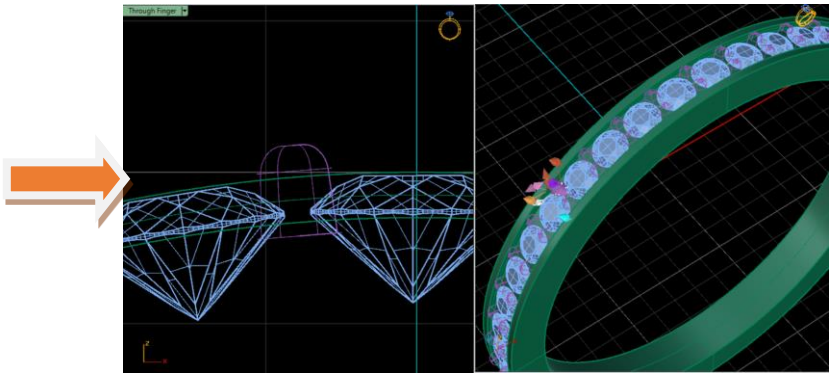


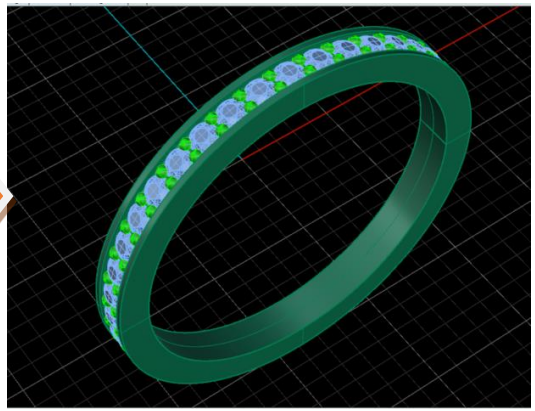


- Adjust the following gems parameters:
- Gem Size = 1.35 mm
- Staring & Ending Position = 0 ~ 100 %
- Gem Space = 0.3 ~ 0.5 mm



- The apply Prongs through Builder/Prong Adders by selecting all gems through Blue layer.

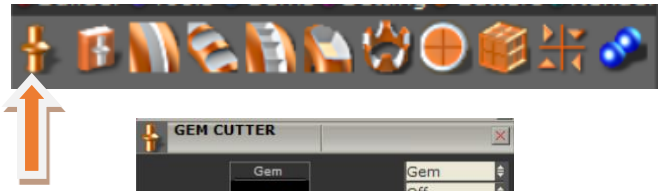


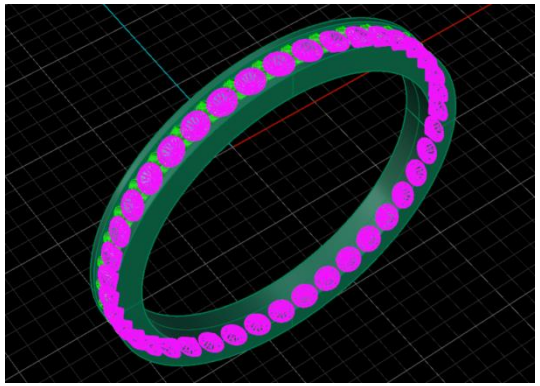


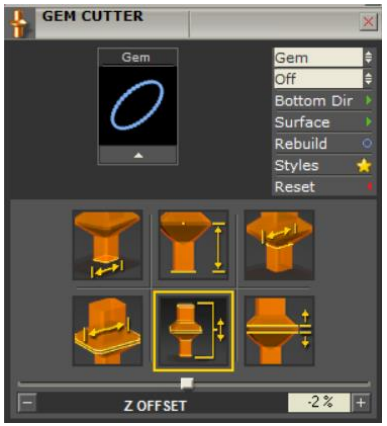
- Select and adjust two(2) Sharing Prongs parameters as follows:
- Prongs Dia = 0.5 ~ 0.6 mm
- Prongs Height = 0.5 ~0.8 mm
- Surface Depth = 0.3 ~0.5 mm
- Prongs Nudge = 40 %
- Fillet = 68%
- Taper = 12.9 %

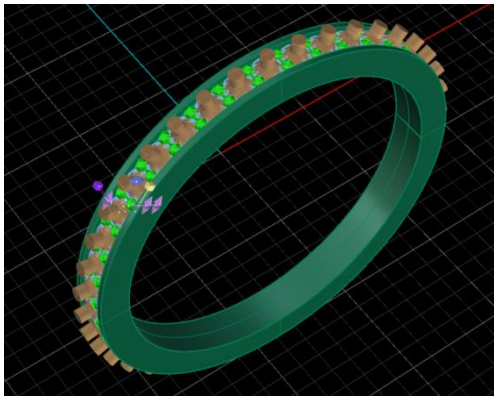
Pick point (LargeDiameter=*0.6* SmallDiameter=*0.58* Drop=*0.1* HeightLarge=*0.3* HeightSmall=*0.8* Fillet=*68* Nudge=*40* Taper=*12.9* Rotate=*0* MiddleProngLayout=*TwoShared* EndProngLayout=*Two* Styles Reset):

- Apply “Gem Cutter “ to all round gems



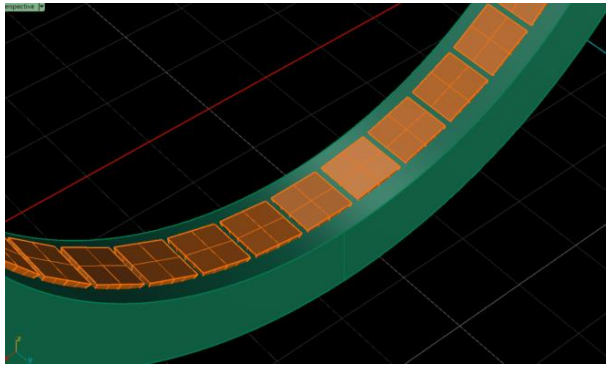


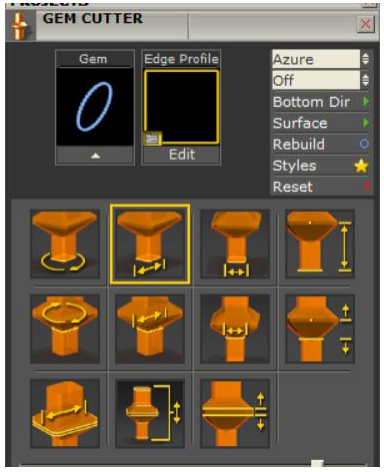


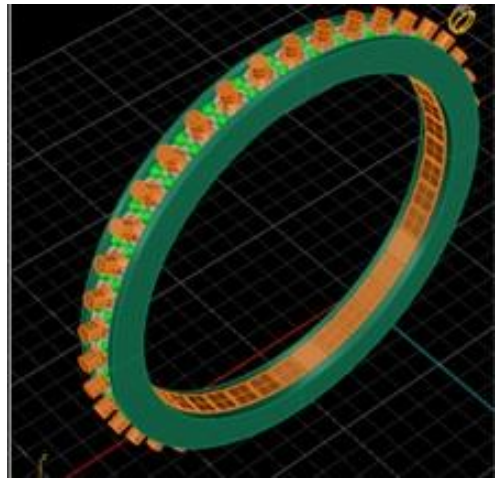


- Adjust the Cutter parameter as follows:

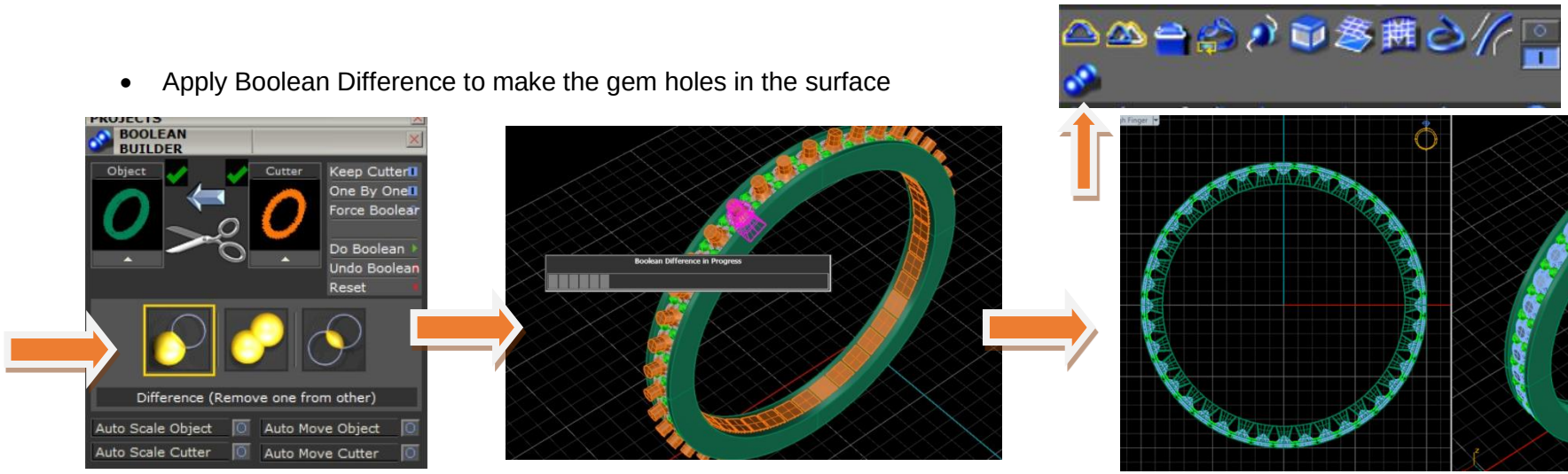
- Cutter Profile =Square
- Lower Depth = -500 %
- Note that other setting will remain the same



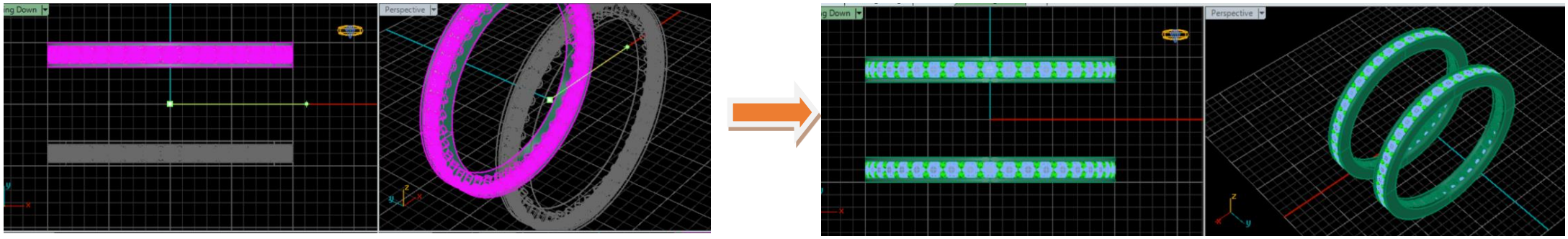




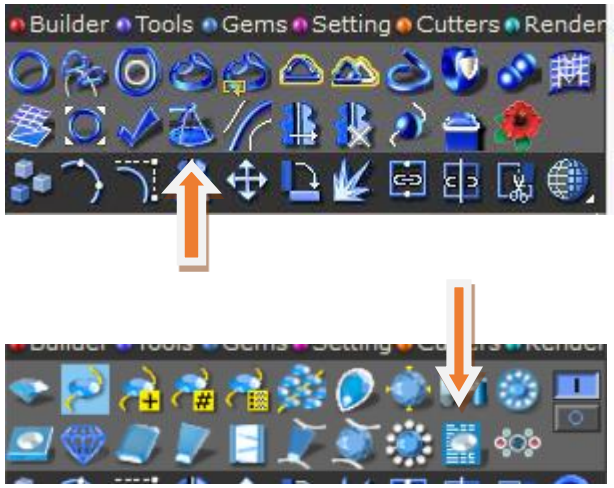
- Apply Boolean Difference to make the gem holes in the surface

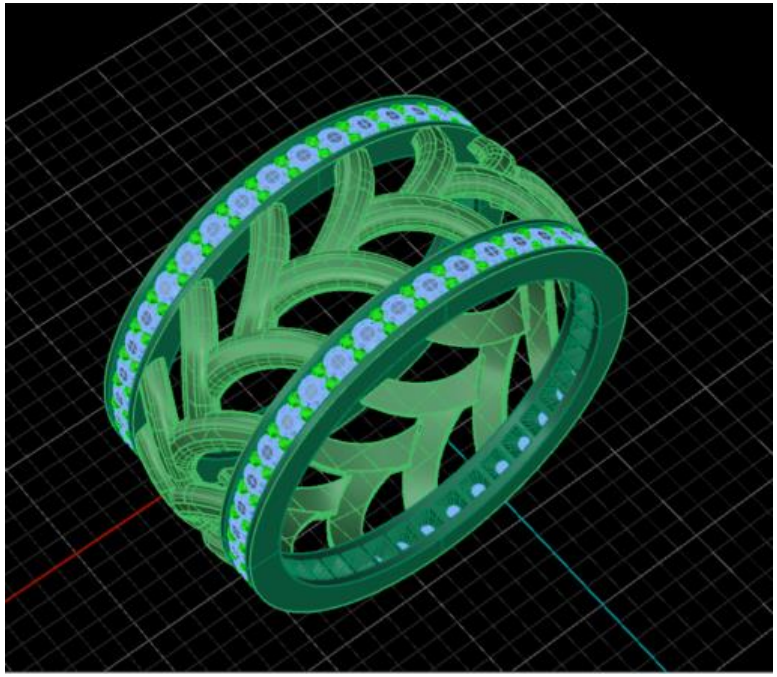


- At the end Apply “Mirror” to replicate the surface with gems on other side.



- Finally unite all the solid polysurfaces by applying “Boolean Union”
- Re-check the band in solid form through “Object Checker”
- Find the whole Weight of metal through “Metal Weight “
- Also find the Carat weight and quantity of gems by applying command “Gem Reporter”





CONVERTING CAD FILES TO CAM FILE

Matrix software has a strong algorithm to convert CAD model into machine language to produce physical wax pattern either by CNC machining or Rapid Prototyping.

BASIC REQUIREMENTS:

- Object should be a perfect 3D solid model
- Hide all Curves , 2D- surfaces , Duplicate object &

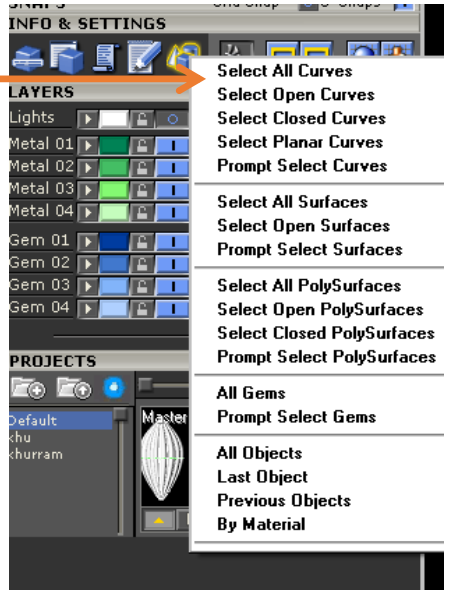
Gems by using “Super Select” command.

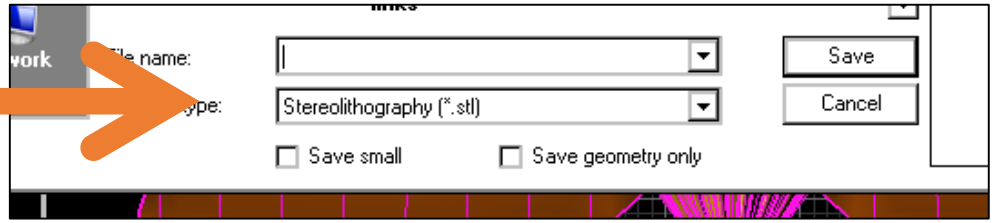
STEPS:

1. Go to “**File Menu”**
2. Select your 3D –model (so that it becomes pink).
3. Click “**Export selected**”
4. Target window will be opened to save your model in required directory

And give a unique name to file.

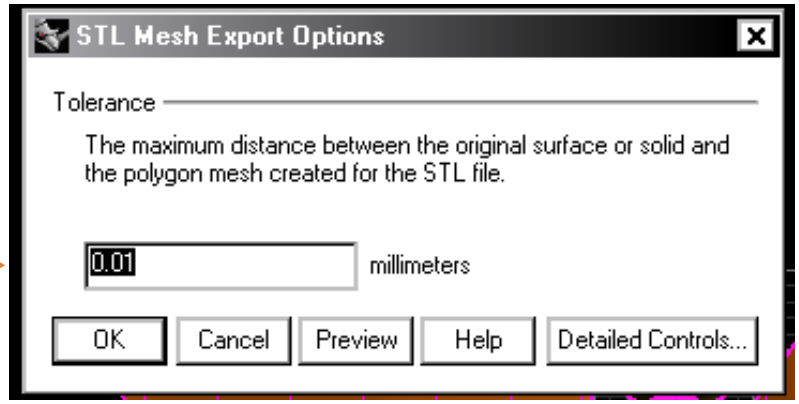
5. Select file type “ **. stl** ”
6. Mark tick on “**save small”**
7. **Then click “Save”**





This will open a window showing

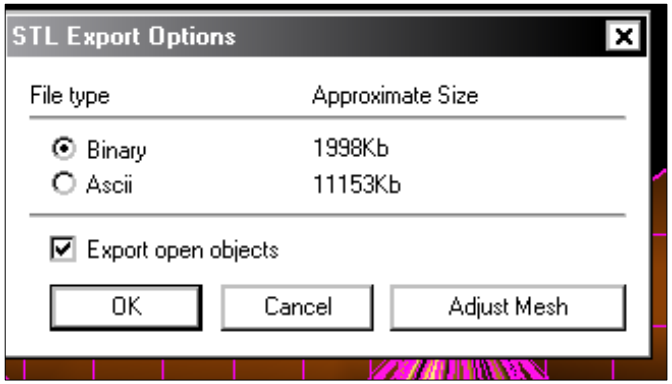
8. Set **Tolerance** to **0.01mm.**



9. It will convert into **STL Mesh** format by showing window.
10. Save the file in " **Binary" file type and**

Then press "OK".

11. It will process your 3D Model into STL CAM file**.**



Frequently Asked Questions

Test Yourself (Multiple Choice Questions)

Introduction

The learner guide for Gems and Jewellery sector in “Jewellery CAD/CAM” will provide an insight to the development of the Gem and Jewellery industry on modern means of technological advancements. It will provide an opportunity to the learner in better understanding of the use of Jewellery CAD/CAM software in providing state of the art solutions to the customers. A special care is observed in designing the learner guide to bring an easy solution in understanding with examples and practical exercises for your first time users and also it will bring a lot learning opportunities for the mid-career workers in the sector. Programme is to engage young people with a programme of development that will provide them with the knowledge, skills and understanding in working as a well professionally groomed worker or even starting own venture as an entrepreneur. The programme has been developed to address specific issues, such as the national, regional and local cultures, the manpower availability within the country, and meeting and the exceeding needs and expectations of their customers. The main elements of your Teaching and Learning Material are:

- **Introduction:**
  - This includes a brief description of your guide and guidelines for you to use it effectively.
- **Modules:**
  - The modules form the sections in your Teaching and Learning Material.
- **Learning Units:**
  - Learning Units are the main sections within each module
- **Learning outcomes**:
  - Learning outcomes of each learning units are taken from the curriculum document
- **Learning Elements:**
  - This is the main content of your Teaching and Learning Material with detail of the knowledge and skills (practical activities, projects, assignments, practices etc.) you will require achieving learning outcomes stated in the curriculum.
  - This section will include examples, photographs and illustrations relating to each learning outcome
- **Summary of modules**:
  - This contains the summary of the modules that make up your Teaching and Learning Material
- **Frequently asked questions**:
  - These have been added to provide further explanation and clarity on some of the difficult concepts and areas. This further helps you in preparing for your assessment.

- **Multiple choice questions for self-test**:
  - These are provided as an exercise at the end of your Teaching and Learning Material to help you in preparing for your assessment.

Module 5: **PRODUCE PROTOTYPE OF JEWELLERY ARTICLE USING 3D PRINTER**

OBJECTIVE:

The objective undermine this module is to enable a trainee in skills and knowledge required to identify personal hazards at work place, prepare CAM file for 3d printing (rapid prototyping) and printing 3D jewellery model on CAM machine.

MODULE SUMMARY

This module is an essential milestone in designing and understanding of the fundamentals of computer aided jewellery manufacturing (CAM) file for 3D printing (rapid prototyping) of the jewellery article. It will cover the basic elements and principles of jewellery manufacturing that how trainee will transfer ideas in to practical jewellery article on CAM software. Furthermore it emphasizes the designing of jewellery article conceptually following manufacturing techniques to produce jewellery article with precision and accuracy. It covers to identify personal hazards at work place, preparing CAM file for 3D printing (Rapid prototyping) and setting up the interface of Jewellery CAM software.

The course learning units are arranged in such a way to integrate concepts and ideas related to each topic through tools and application-oriented projects. This makes the learning simple and systematic and enables one to gain more insight knowledge on the various tools covered.

INTRODUCTION TO COMPUTER AIDED MANUFACTURING (CAM)

Computer aided manufacturing is “the use of computers for managing manufacturing processes of Jewellery article developed during the Computer Aided Designing (CAD).”

CAM system takes a CAD design made in a 3D environment. CAD design is then manipulated according to defined parameters and resulting information is fed to CAM Machine. CAM Machine then starts working on stack. These machines are controlled by computer with minimal operator’s interaction to enhance and facilitate greater control over quality. It also allows machine to monitor the maintenance of its parts

TYPES OF CAM MACHINES

There are mainly two (2) types of CAM machines.

1- CNC Machine (Computer Numerically Controlled)
2- RP Machine (Rapid Prototype)

LEARNING UNIT 1: IDENTIFY PERSONAL HAZARDS AT WORK PLACE

OBJECTIVE:

The trainee must be aware of risk s and hazards and implement the protective measures by adopting risk control measures at work place. He must segregate hazardous or non-hazardous wastes as per approved procedure.

LEARNING OUTCOMES

You will be able to:

- Identify hazards and risks at work place
- Identify risk control measures.
- Segregate hazardous or non-hazardous wastes as per approved procedure.
- Use personal protective equipment according to risk at workplace.

MATERIALS REQUIRED

Personal protective equipment

SETTING UP A WORK PLACE FOR RAPID PROTOTYPING

The following instruments are used for 3D printing of Jewelry Article

Instruments and safety Material

- Personal protective equipment
- 3D Printer (Jewellery Specific) with accessories
- Ultrasonic Cleaner
- UV-Curing Unit
- Weighing Scale Machine (0-50 gm)
- Air Blower (with regulator and nozzle)
- Nose Plier and Tweezers
- Operating system (MS Windows)
- Digital Vernier Calipers
- Steel Rule
- Goggles
- Fine Grit Sandpaper
- Personal protective equipment

Gloves

Ultra sonic Cleaner

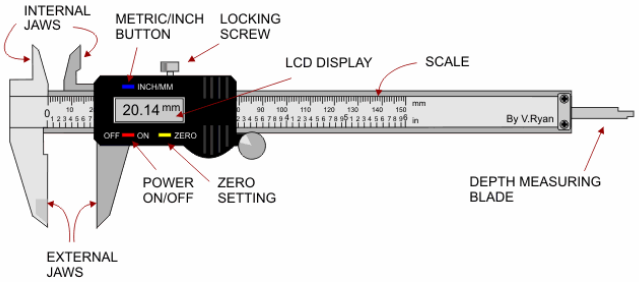
Air Blower

Ultra violet Curing Unit

Weighing Machine

Face Mask and Goggles

Pliers, Tweezers, Screwdriver, Air Gauge, scraper



***Ve*rnier Caliper**

Loupe

Magnifying Glass

Surgical Blade

SAFETY & PRECAUTIONS

- Wear Face Mask when rinsing & cleaning the Prototype platform by Isopropyl Alcohol after 3D Printing.
- Exhaust Fan must be installed in the Room.
- Proper Lighting used in the Room
- Make sure Resin Container and Isopropyl Alcohol Container lid must be closed properly. Due to Alcoholic Fumes developed in the room which may cause Irritation suffocation for eyes and mouth
- After print make sure resin must be transferred to the resin bottle from the Printer Vat (Base Plate)
- Be careful to cut supports with surgical blade.
- Do not make eyes contact directly to Ultra Violet Curing Unit.
- Electrical supplies must be properly installed and insulated.

Practical: Identify the safety signs

No smoking Area

Electrical Supply

Authorized Personal only

Fire safety

LEARNING UNIT 2: PREPARE CAM FILE FOR 3D PRINTING (RAPID PROTOTYPING)

LEARNING OUTCOMES

You will be able to:

- Import CAD file into printable format in CAM software
- Fix surface errors of CAD file using commands & tools of CAM software.
- Perform support generation of 3D Jewellery model
- Determine estimated Production Time, Weight & Shrinkage of 3D jewellery model in CAM material.

MATERIALS REQUIRED

- 3D Printer (Jewellery Specific) with accessories
- Ultrasonic Cleaner
- UV-Curing Unit
- Weighing Scale Machine (0-50 gm)
- Air Blower (with regulator and nozzle
- Operating system
- Digital Vernier Calliper

CAM AND SUPPORT GENERATIONS SOFTWARE(S) FOR JOB PREPARATION

1. Magics
2. Mesh Lab/ mesh mixer
3. Slicer Etc.

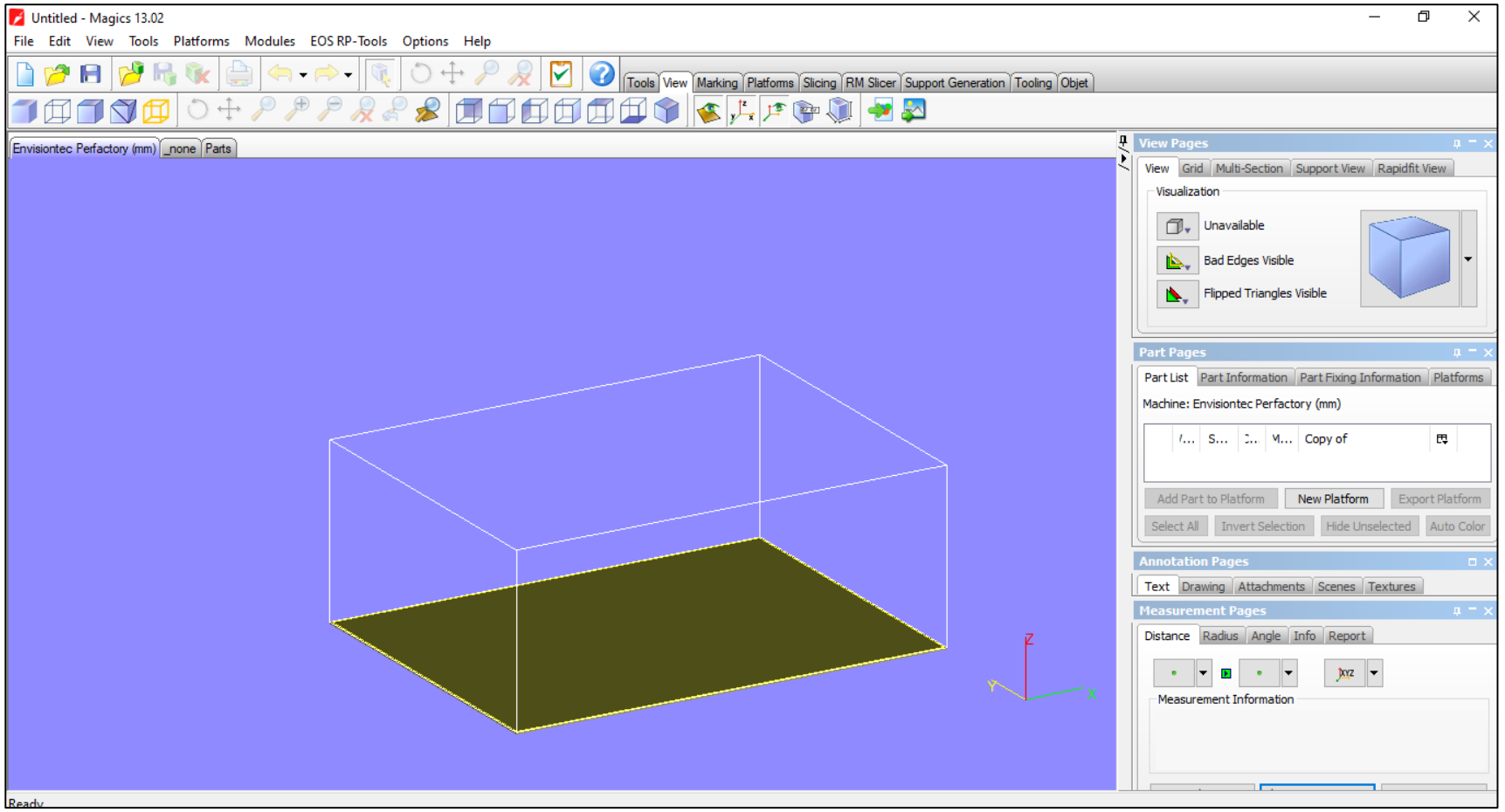
CAM FILE FORMATS

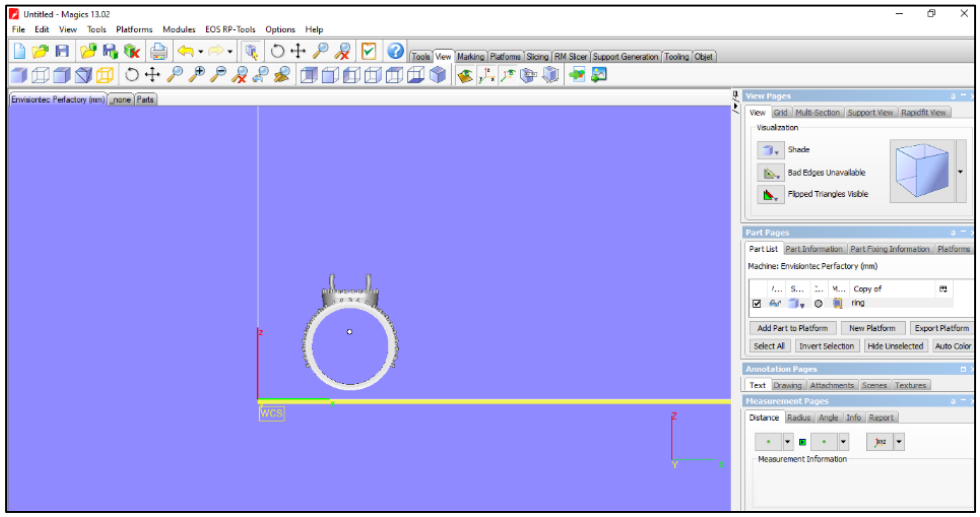
Following are the formats for CAM file. **STL. OBJ. PLY .3DS etc.**

STEREO LITHOGRAPHY .STL

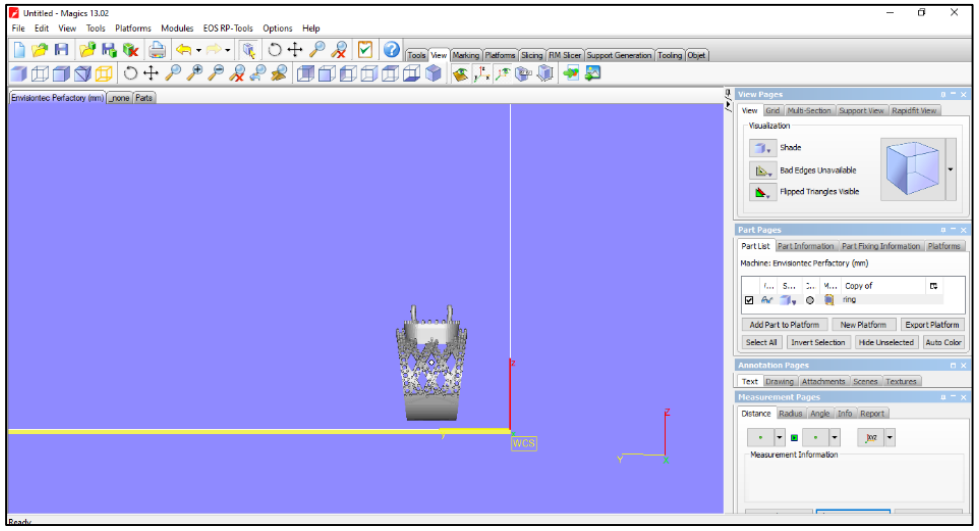
The most common and universal file formats for 3D printing is **STL**. **STL** stands for “Stereo Lithography” it is a 3D rendering that contains only a single color.

DIFFERENT VIEWS OF THE SOFTWARE

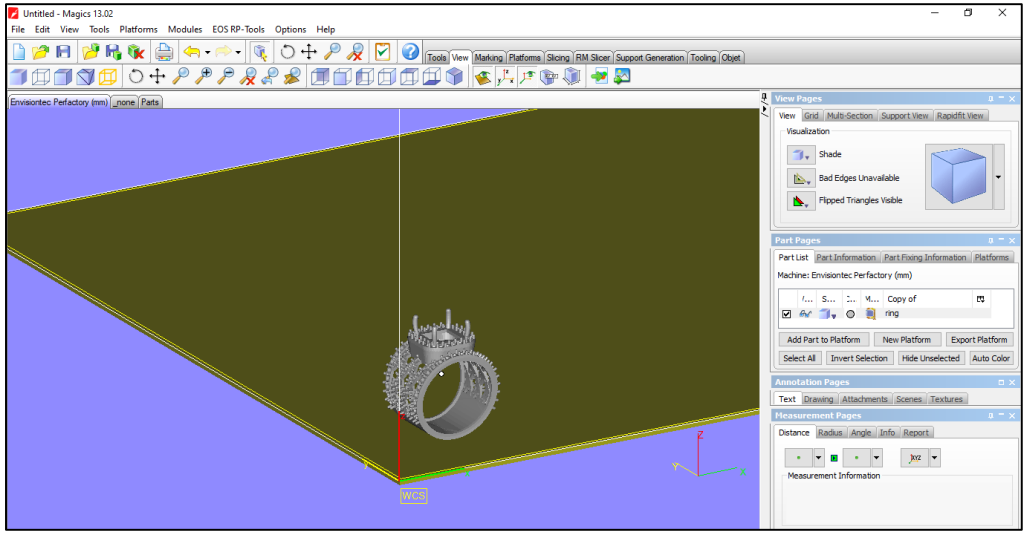




Front View

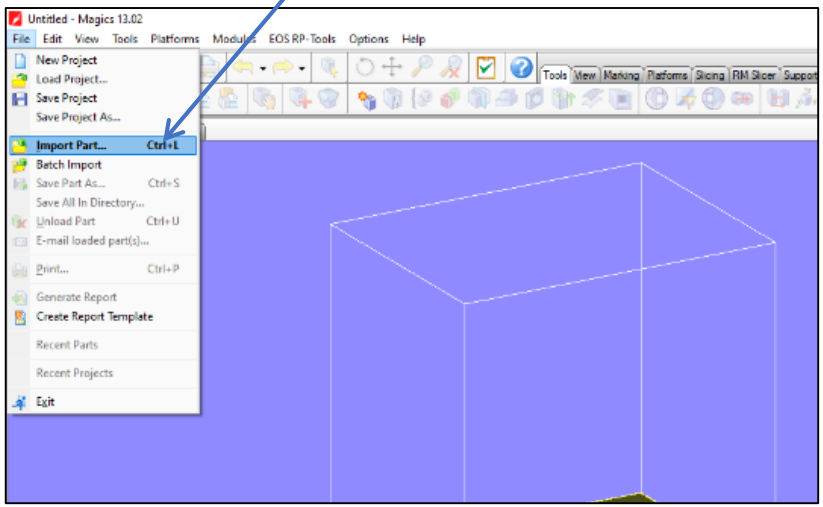


Side View

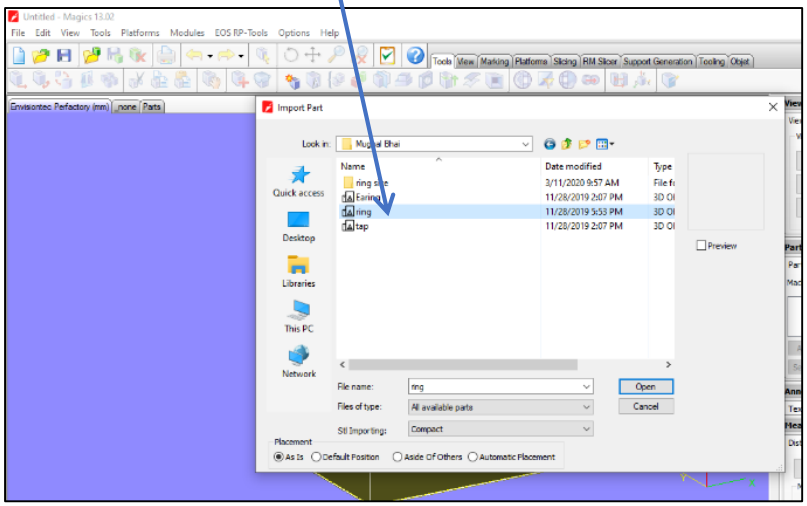


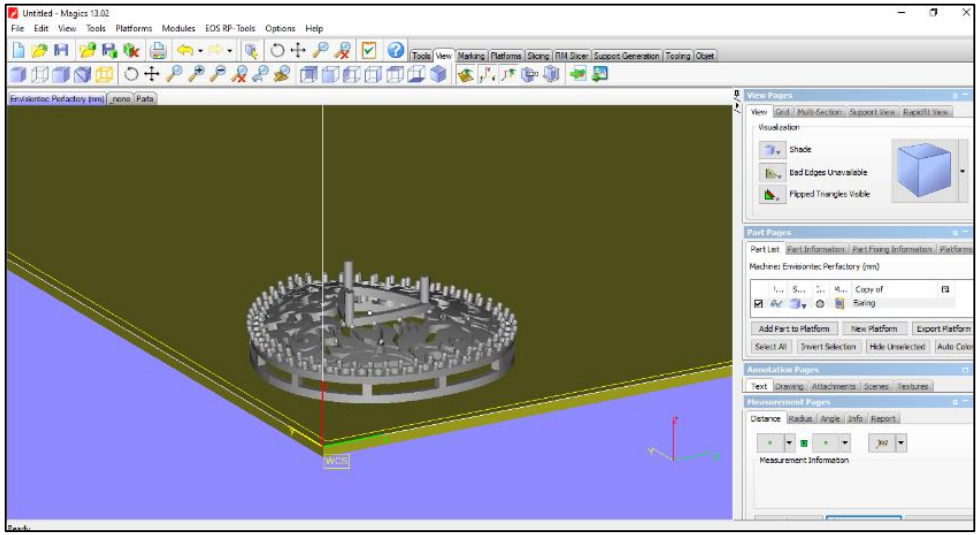
Perspective View

IMPORT OF *.STL FILE INTO MAGICS

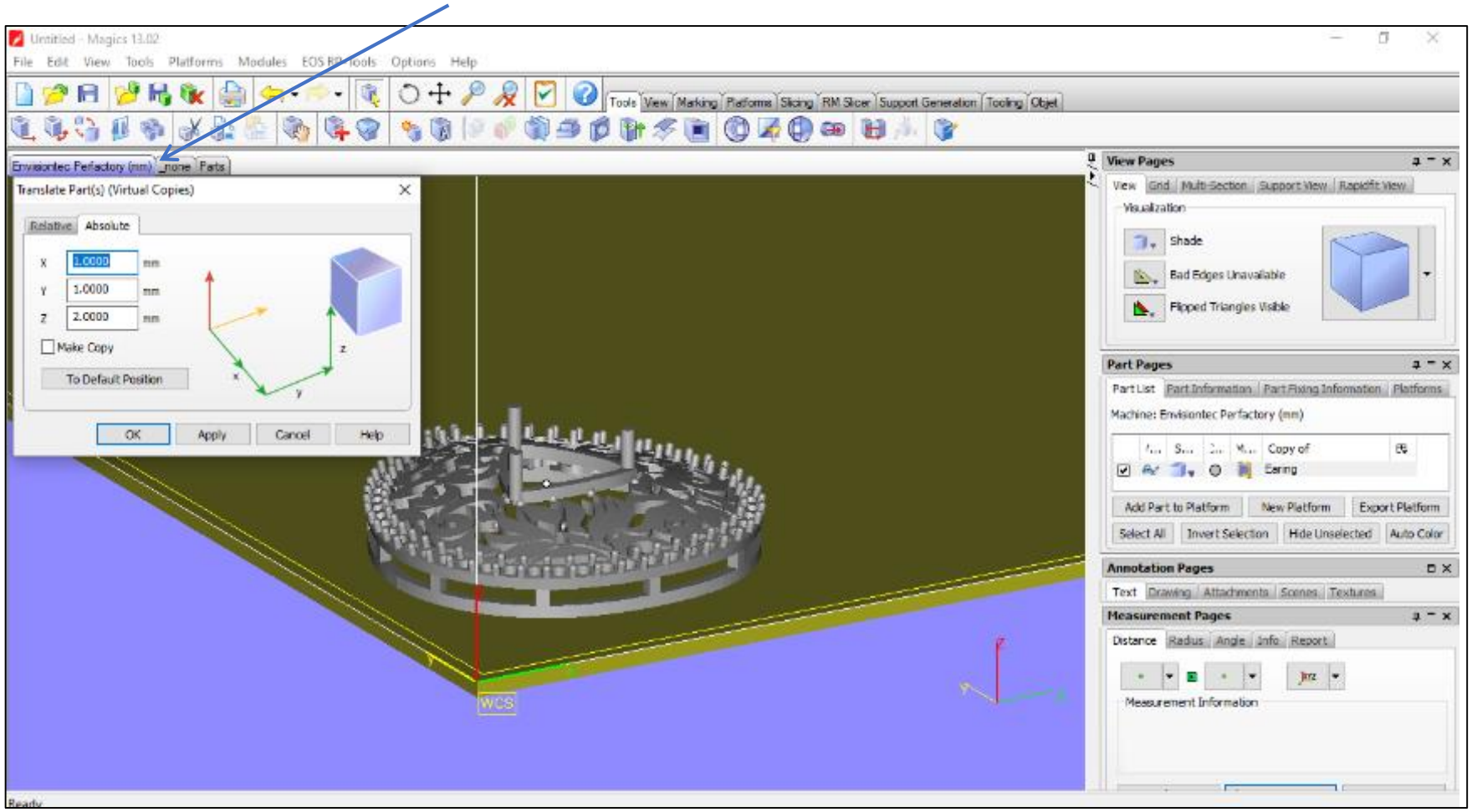


IMPORT *.STL FILE FROM BROWSER

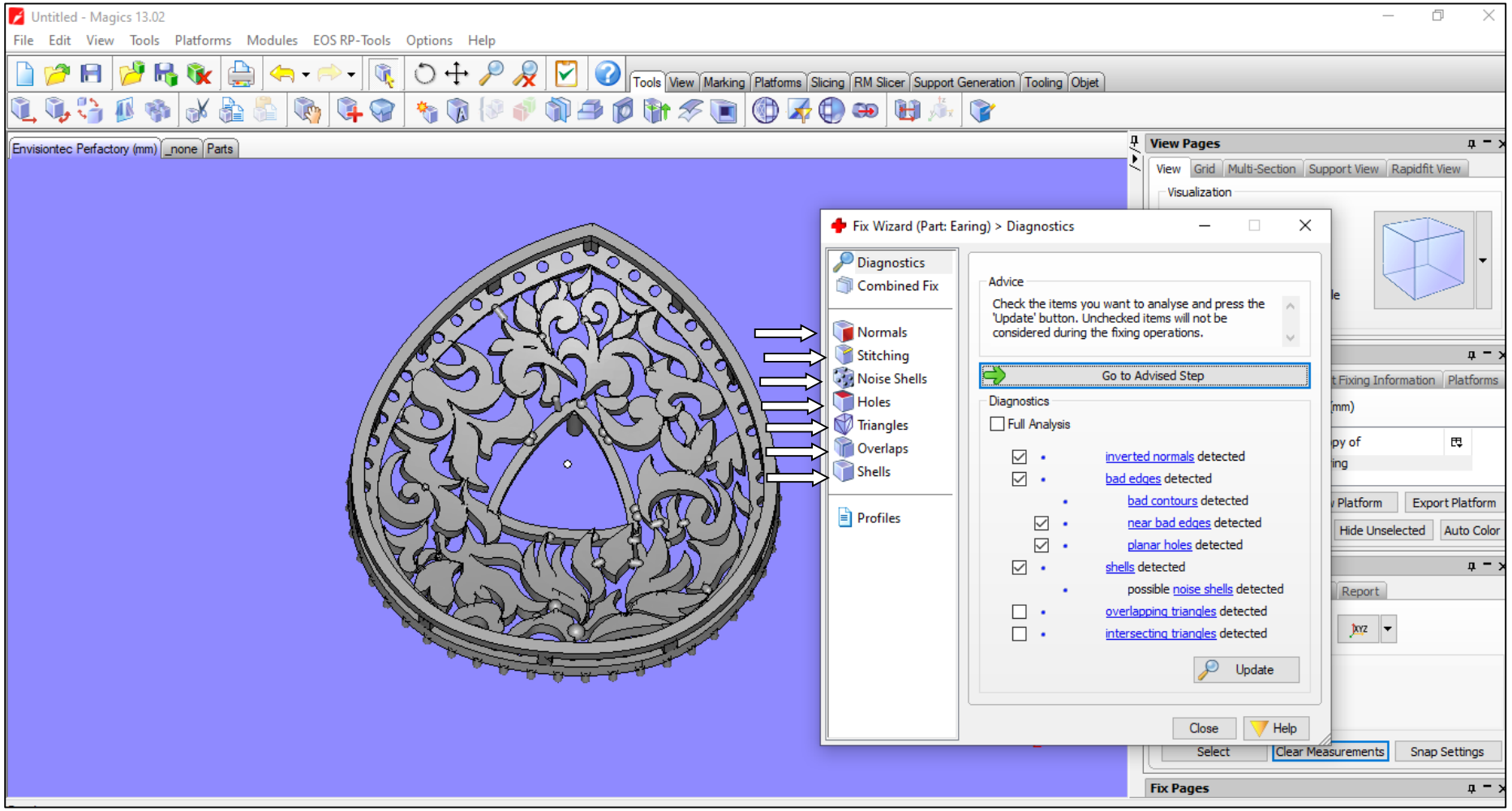




Go to Tools menu and translate the part for proper placement on platform

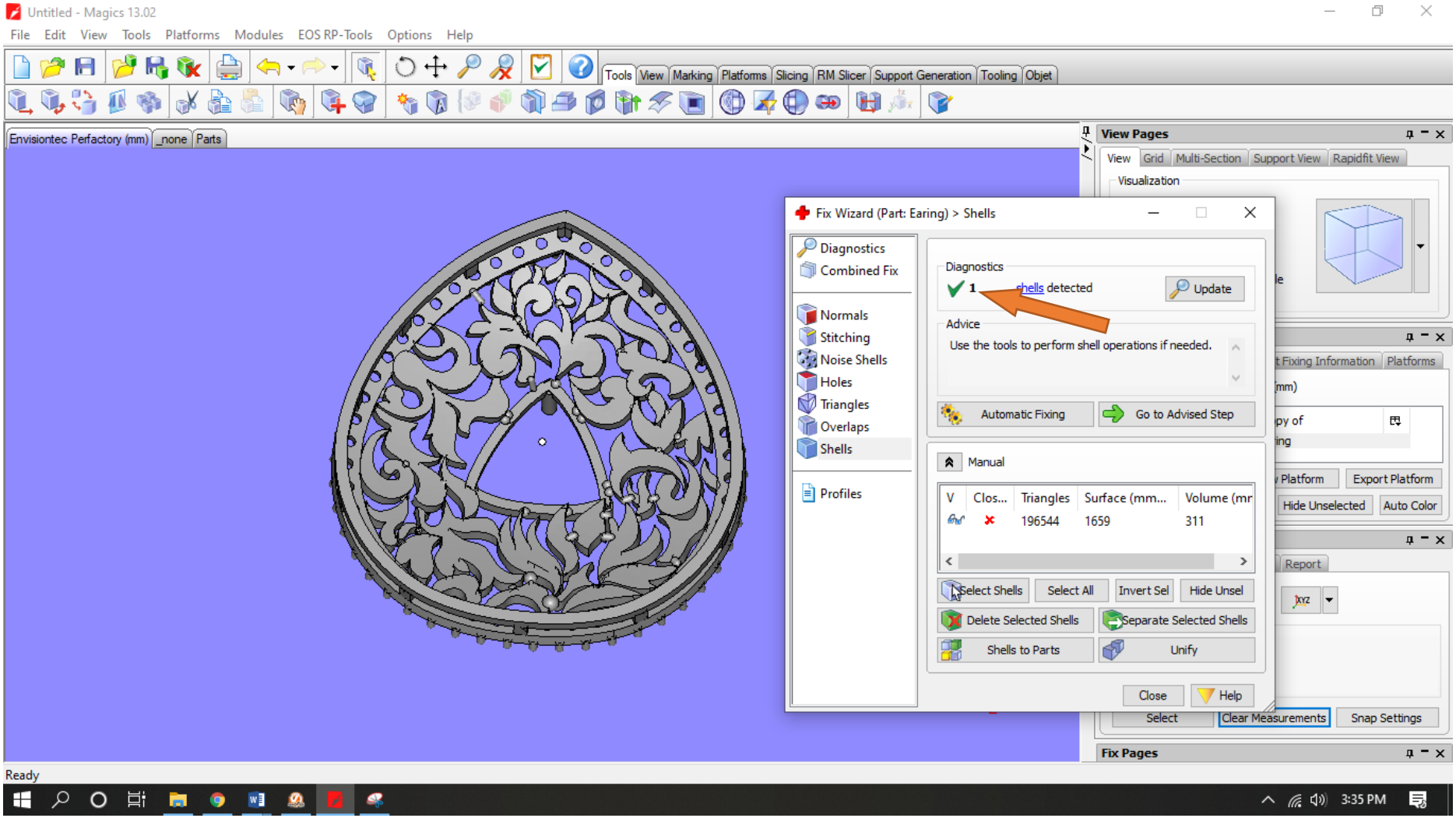


Click Setup Fix Wizard Icon and analyze the errors in 3D models

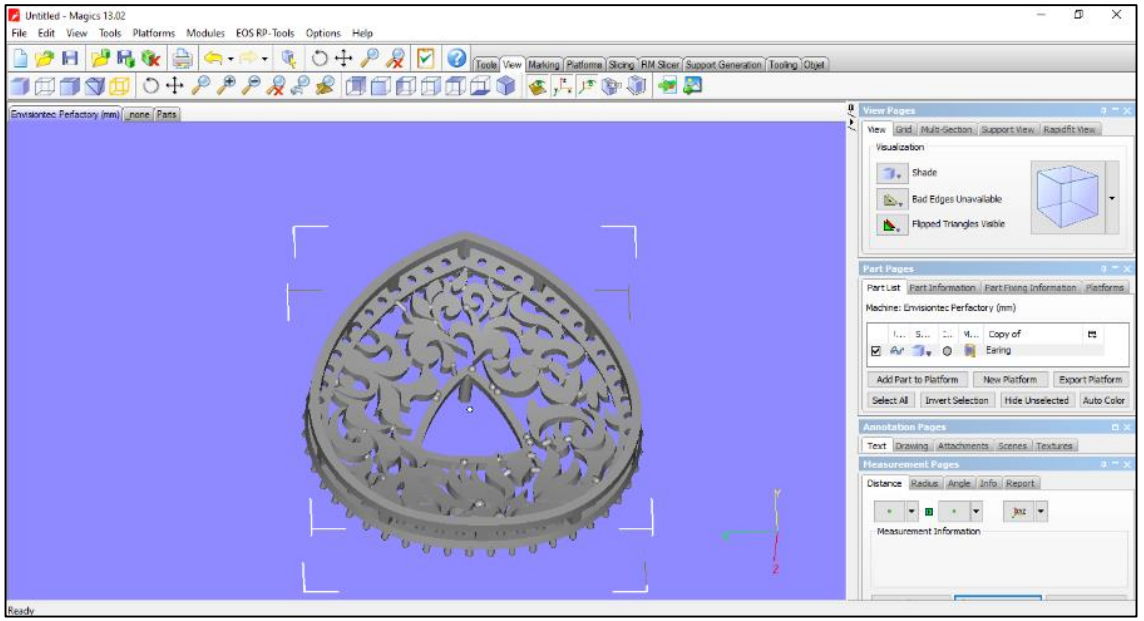


Follow mentioned steps According to the 3D model

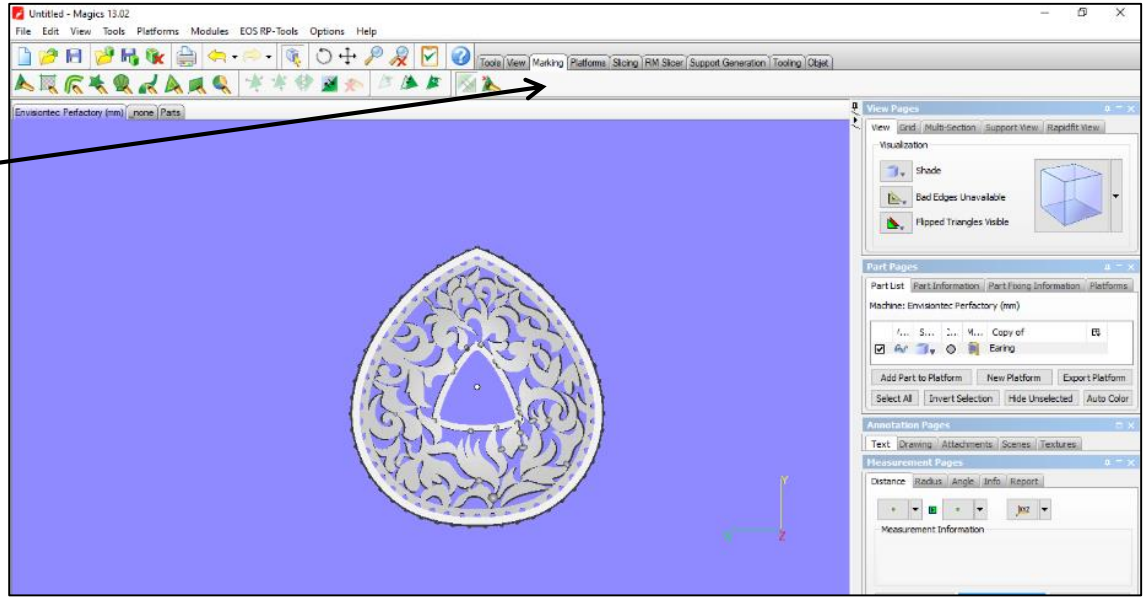
Unify the 3D model into One (1) Shell.



Place supports from the bottom view

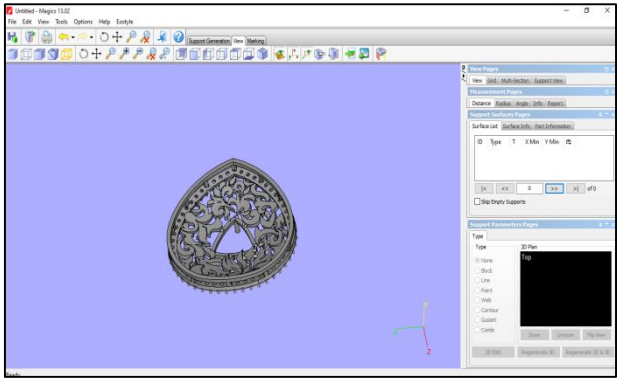


Go to Support Generation Module Menu



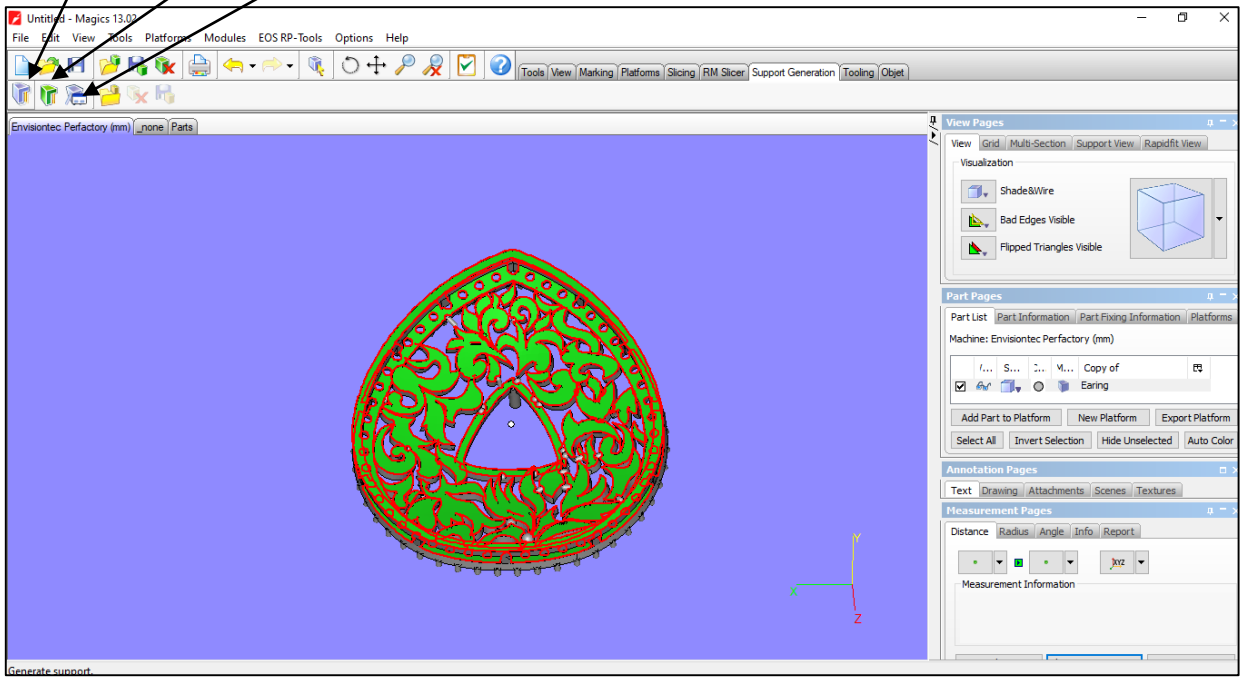
Options of Support Generation Module

For Manual Support



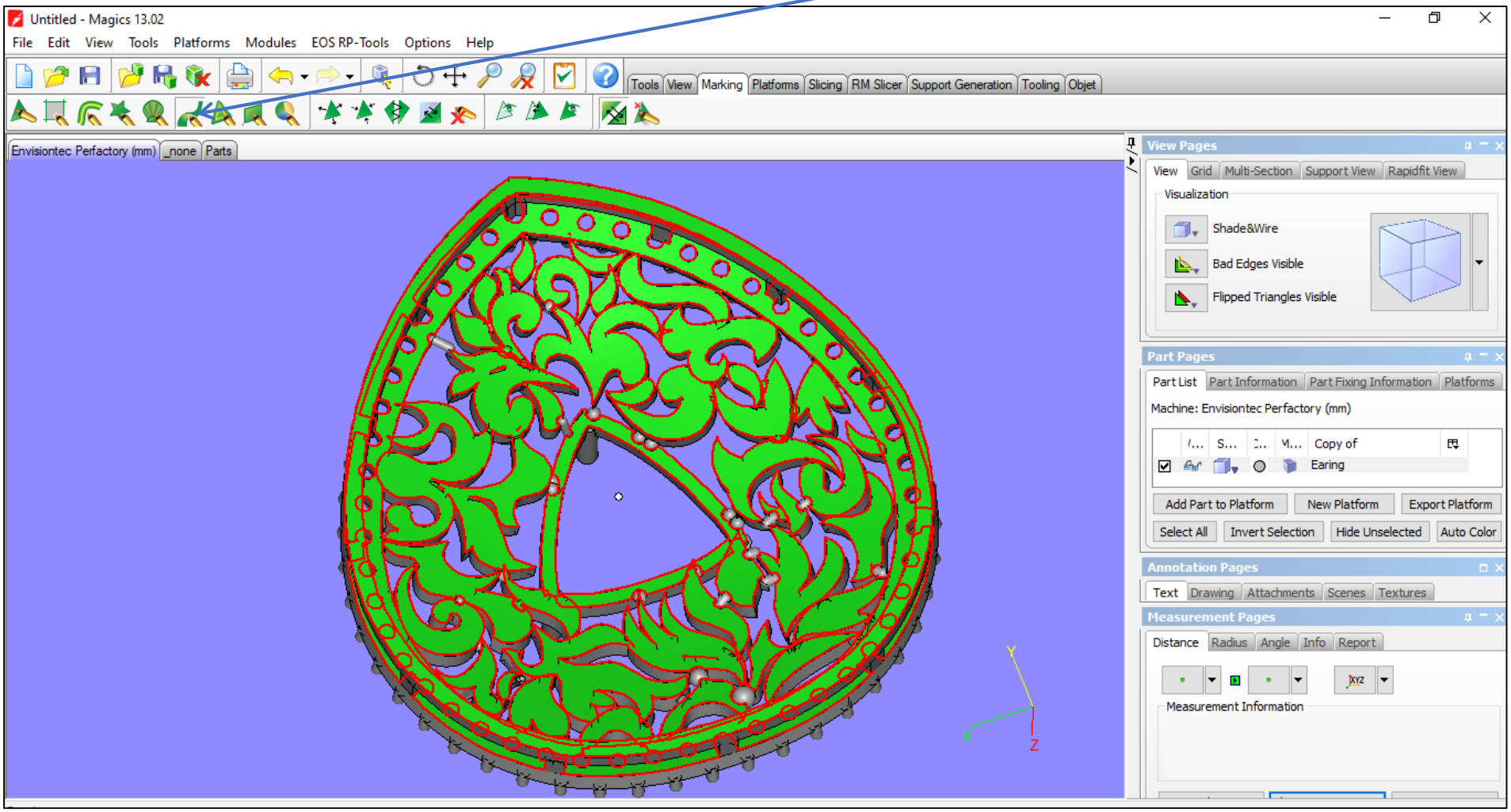
Generate Support **Auto Support**

Manual Support

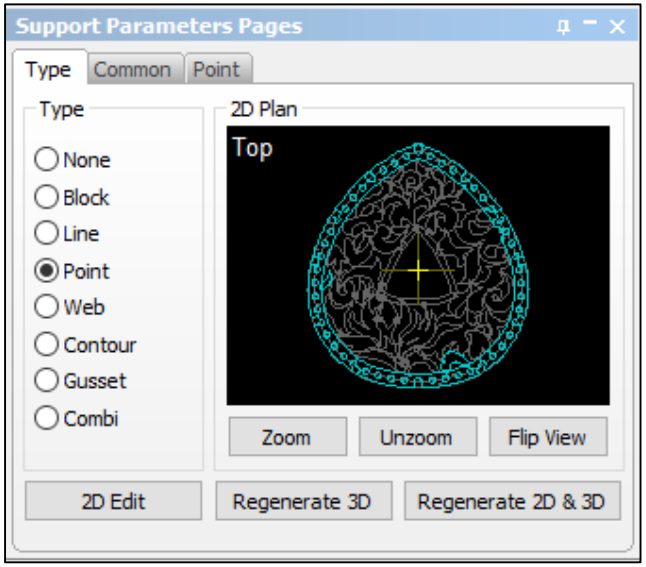


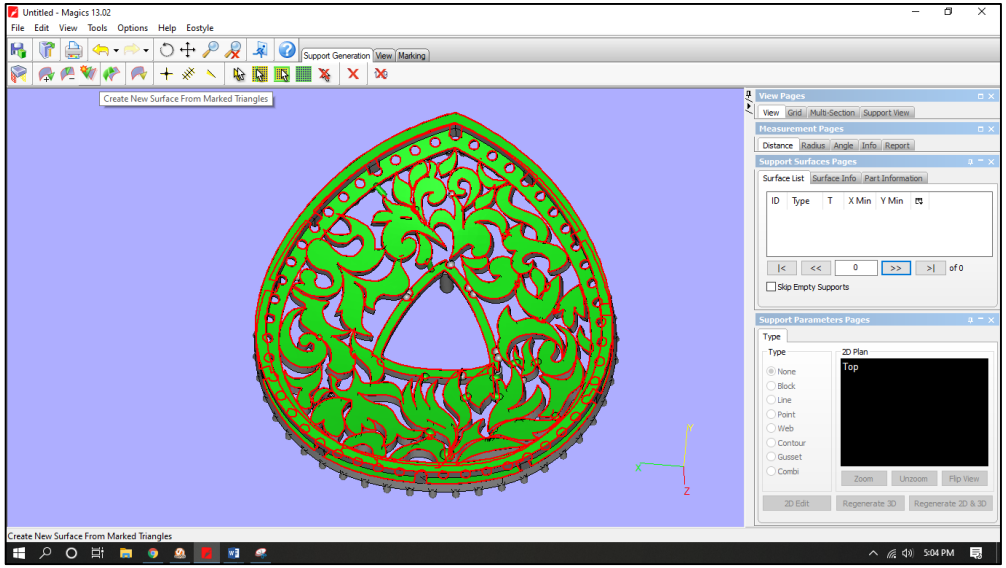
Mark the lower Surface where supports to be place by using Marking Module.

Create New Surface from Marked Triangles

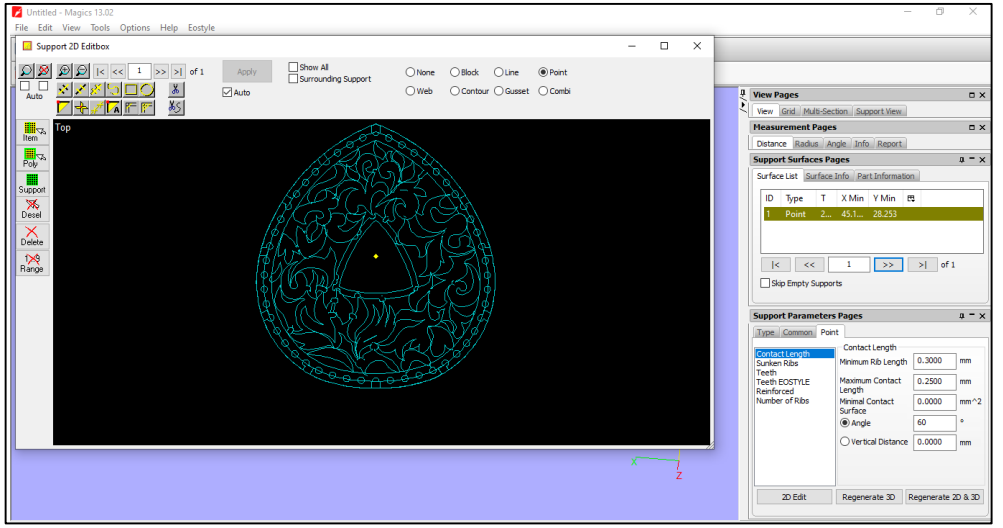


Setup and select parameter of Supports According to the Model structure

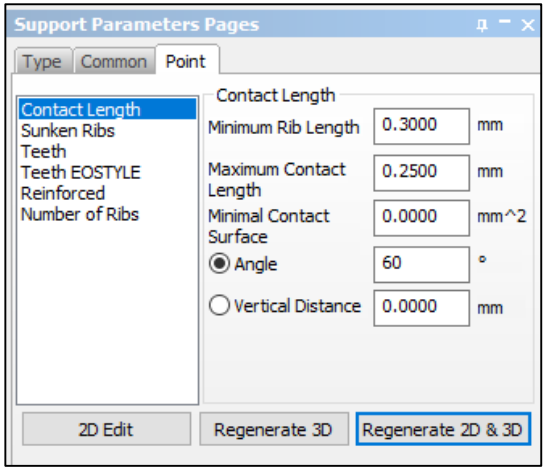




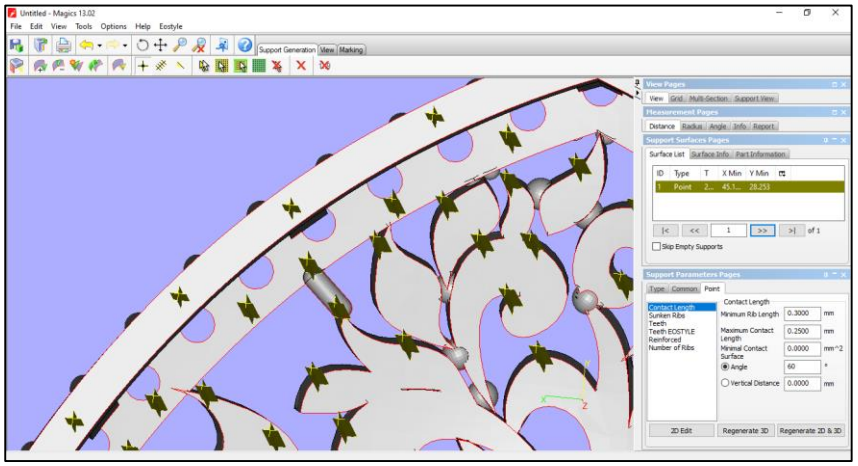
Remove the center support in Edit menu Box



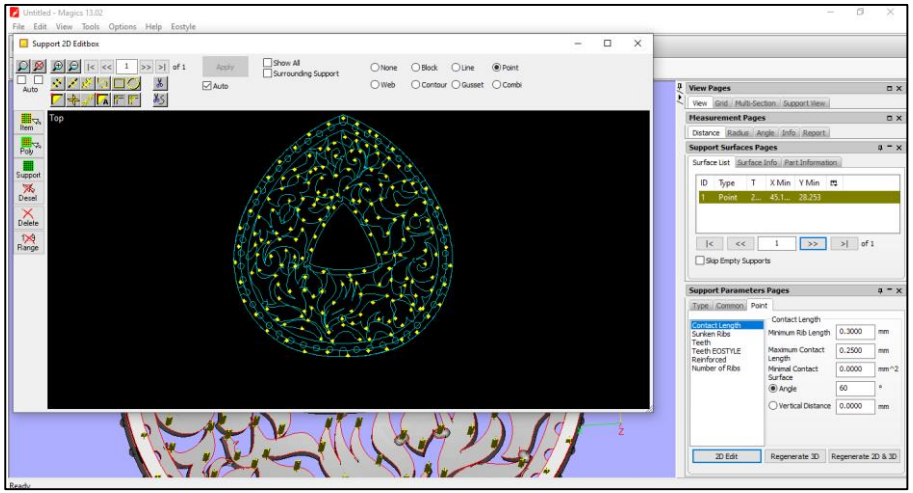
Regenerate 2D & 3D support parameter.



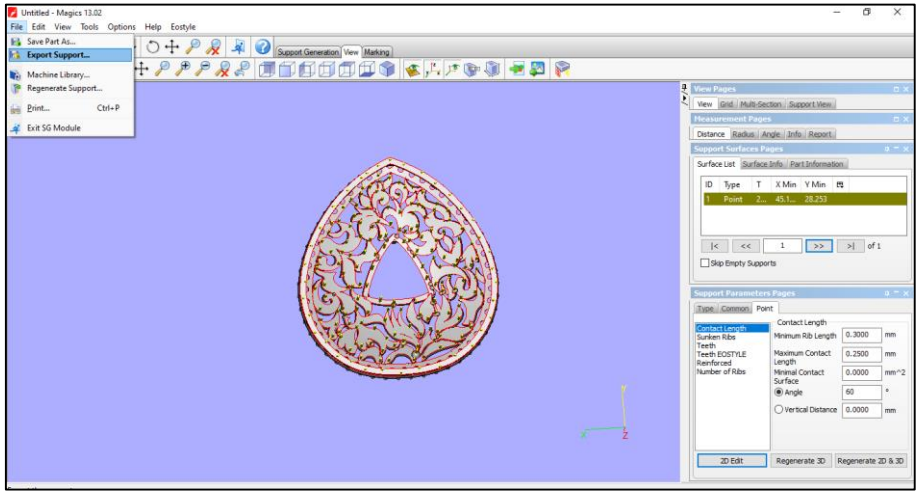
Place support



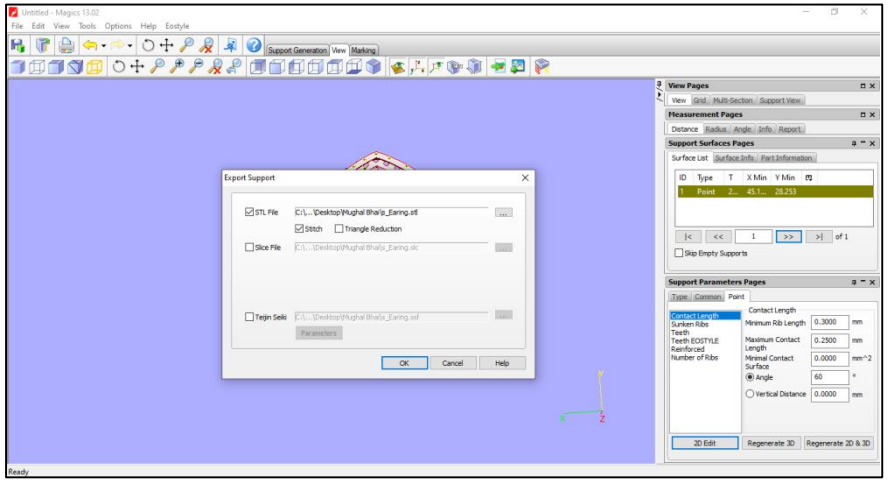
Support Edit Menu

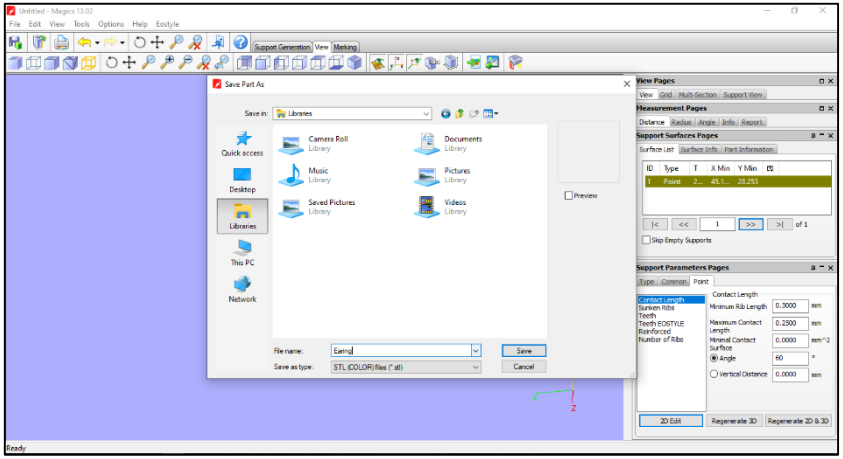


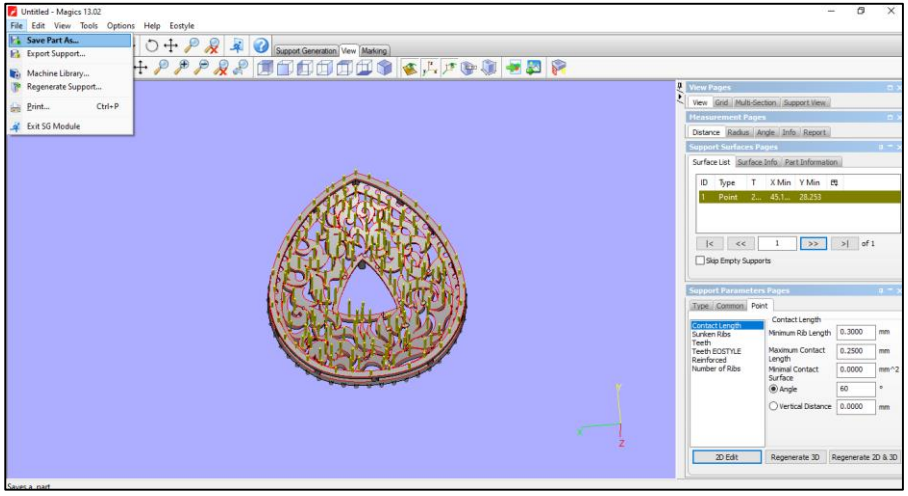
Export Support



Save & Export File in .Stl Format







LEARNING UNIT 3: PRINT 3D JEWELLERY MODEL ON CAM MACHINE

LEARNING OUTCOMES

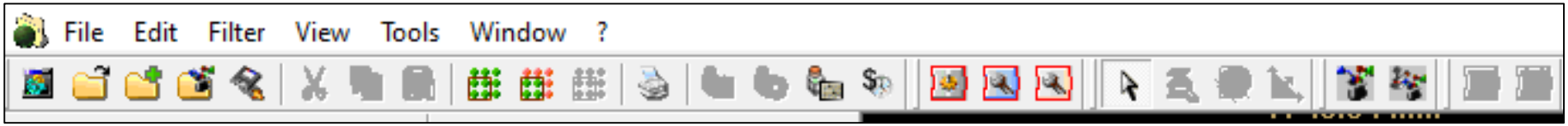
You will be able to:

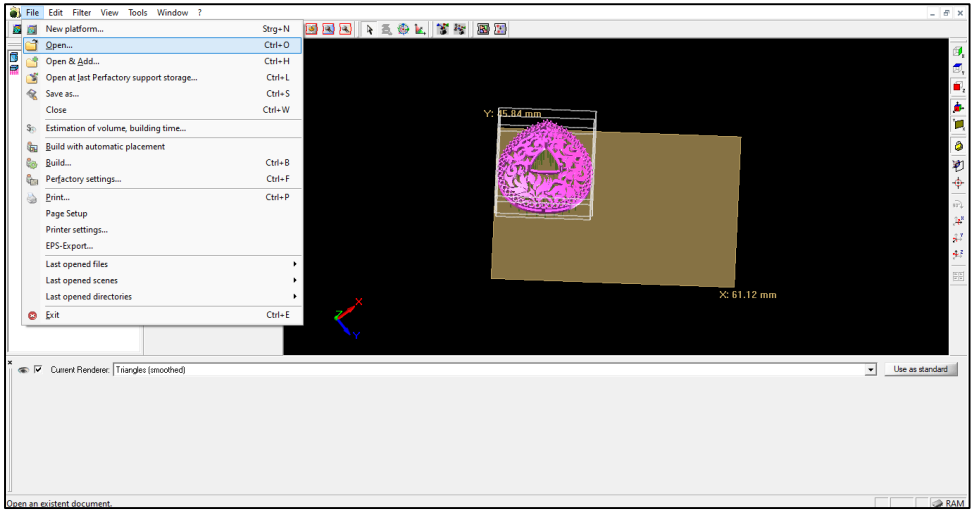
- Set parameters of CAM machine
- Load printable liquid (Resin) considering minimum & maximum level.
- Align and arrangement of multiple 3D jewellery models on machine platform
- Build the job on CAM machine.

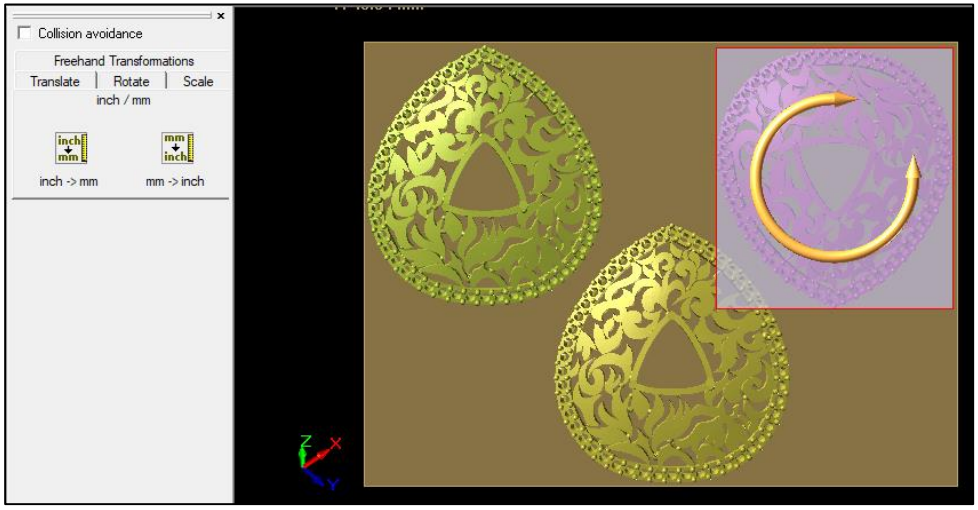
MATERIALS REQUIRED

- 3D Printer (Jewellery Specific) with accessories
- Ultrasonic Cleaner
- UV-Curing Unit
- Weighing Scale Machine (0-50 gm)
- Air Blower
- Digital Vernier Callipers

Import 3D model and setup a job for 3D print using command Menu (Rotate,move,scale,transform copy / duplicate)
link is also available **https://www.youtube.com/watch?v=tLOpofT1gH8**

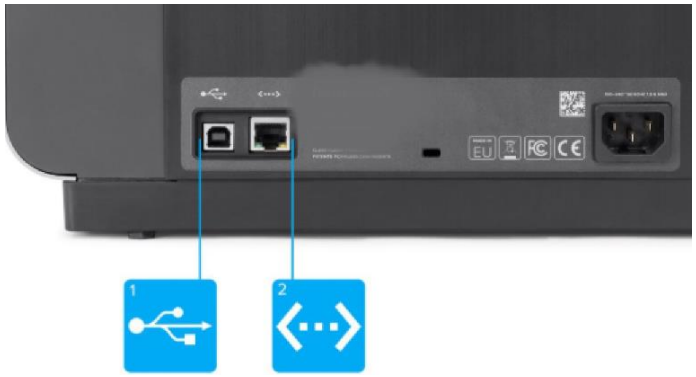






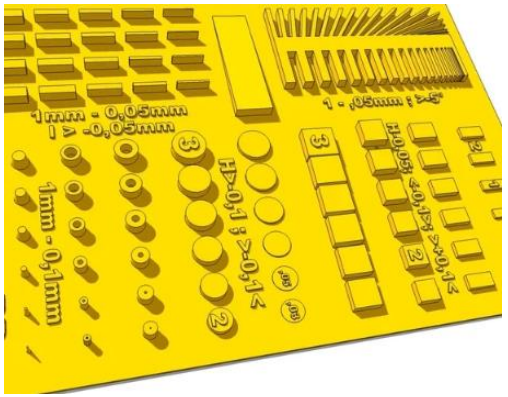
Complete the Placement of 3D models in the Machine Platform

The Assign file (s) is sent to 3d Printer via USB LAN OR WIFI connectivity.

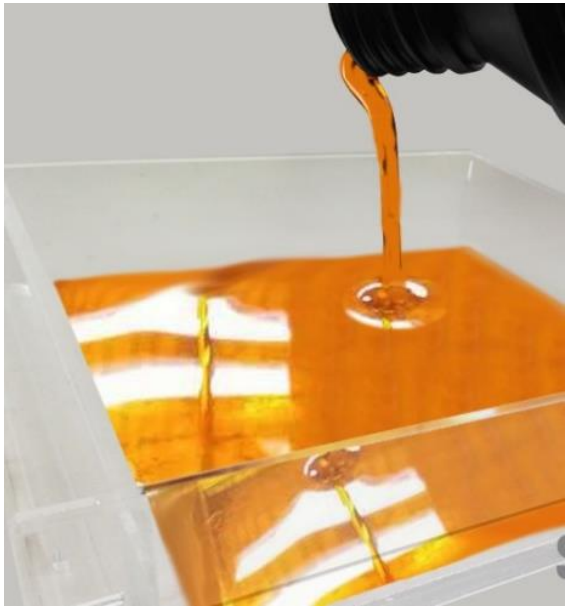


Printer Calibration Method

(Depends on the Printer used in Assign Work place)



Maintain the level of Resin

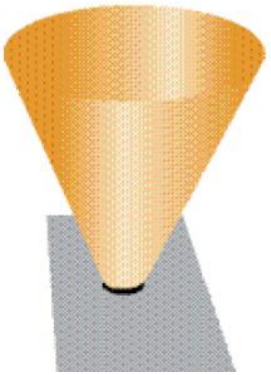


LIST OF PRINTER CONSUMABLES ARE AS UNDER

- UV Resin.
- VAT (Base Plate)or Resin Container
- UV Lamp, LED, or LCD (Depends which Light source used in the 3D printer)

UV Resin

Resin container

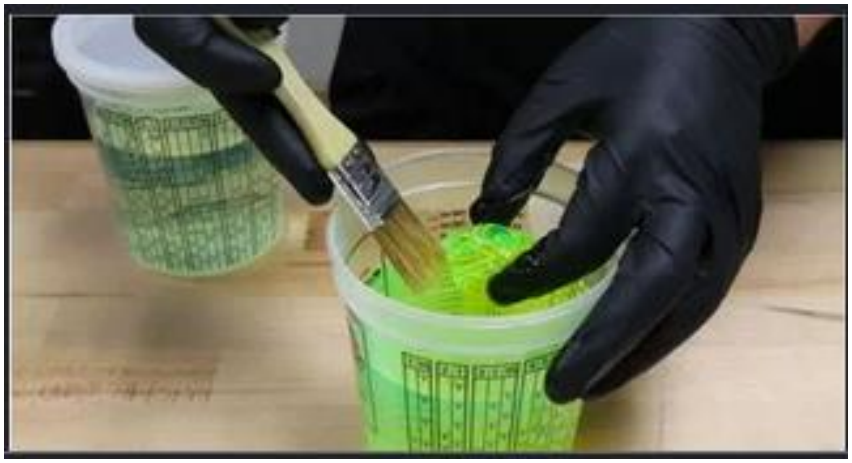


Light source (DLP, LED, LCD)

Completion of print job

Prepare washing Kit with Iso-propyl Alcohol

Removal of 3D model from build Plate



Rinsing and cleaning for 3d Printed parts in Isopropyl Alcohol

Removal of Supports

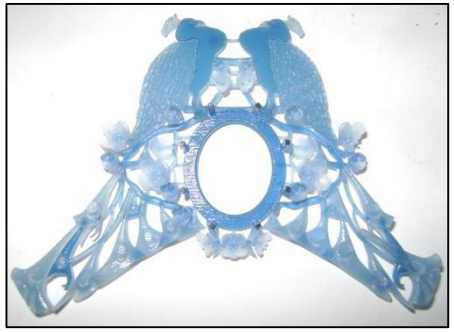
Ultra violet post Curing

Ready 3D printed Parts



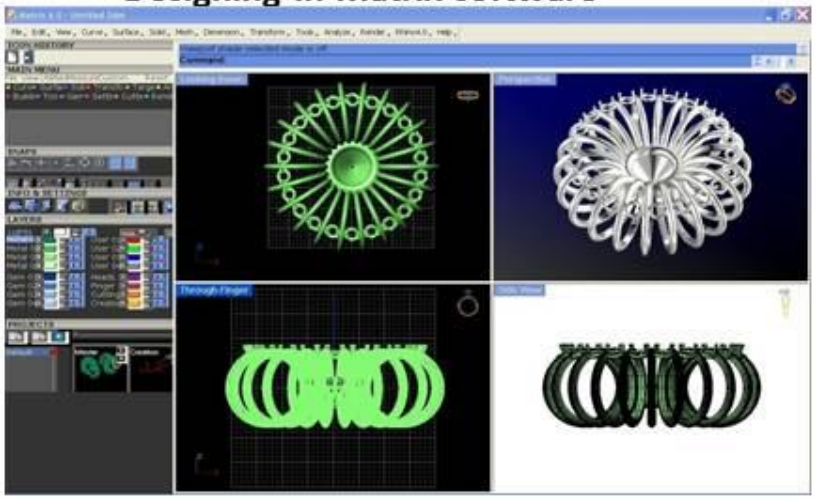




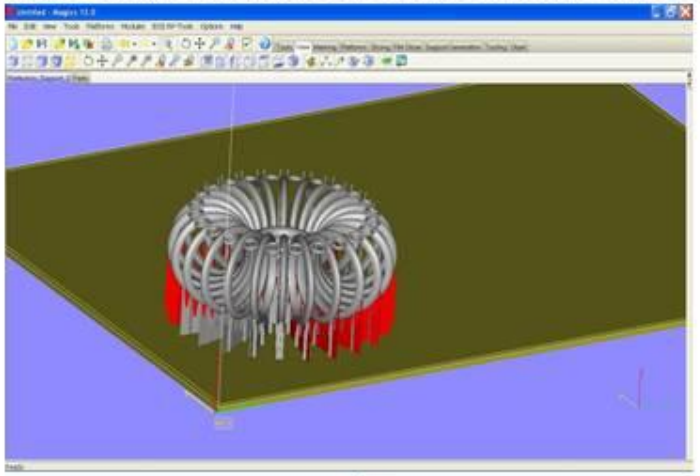



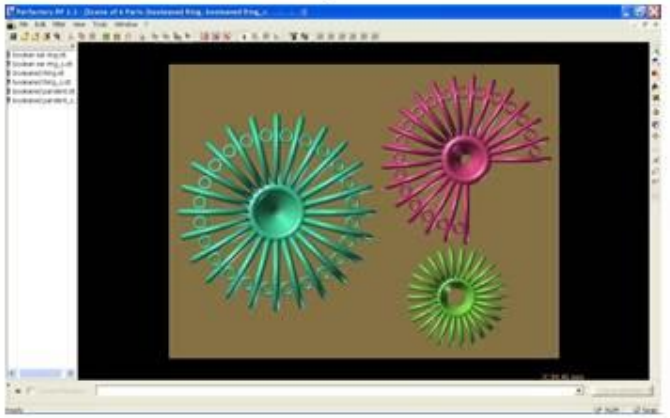

CAD/CAM WORK FLOW

Designing in Matrix software



Supports generation in Intermediate software





Placement in Perfactory software

Production in RP Machine

RP Models produced

Frequently Asked Questions

Test Yourself (Multiple Choice Questions)

National Vocational and Technical Training Commission (NAVTTC)

Plot 38, Kirthar Road, Sector H-9/4, Islamabad, Pakistan
+92 51 9044 322
+92 51 9044 322
info@navttc.org
www.navttc.org