



Design out the box

Computer Aided Design: Aircraft Lamp

Lesson Objectives...

Computer Aided Engineering: Step by Step Guide to Lamp Construction

- To understand the basic tools used in SketchUp.
- To understand the advantages of using CAD
- To be able to successfully use CAD independently to complete a range of tutorials in 2D and 3D
- To develop advanced skills and problem solving skills when using Sketch Up
- To use correct dimensions when using sketch up to draw models that can be 3D printed or manufactured using CAM machines in school (i.e. Laser Cutter, 3D Router).

Skills to be used in this project...

Basic Skills	New and Higher Skills
Zoom tool	Rotate tool
Orbit tool	Move tool
Pan tool	Offset tool
Line tool	Arc tool
Rectangle tool	Follow Me tool
Circle tool	Paint Bucket tool
Eraser tool	Dimensions tool
Push/Pull tool	Making Components

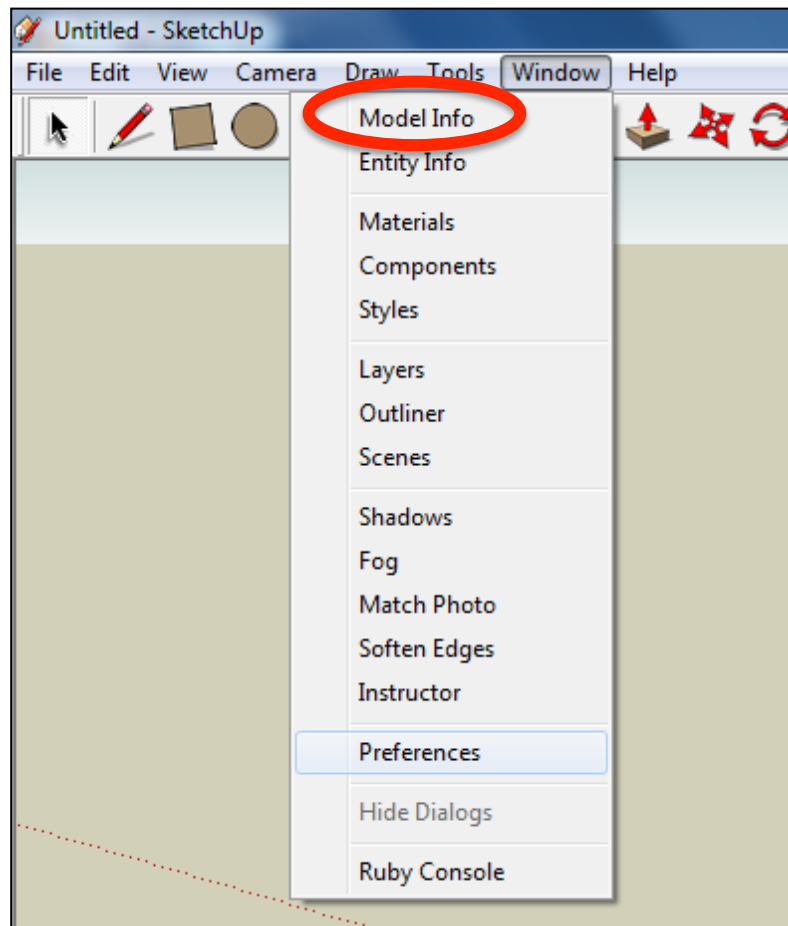
Basic skills are those required to do very basic drawings and are detailed as part of this presentation.

New and higher skills may be new to the novice and are the focus for learning in this presentation.

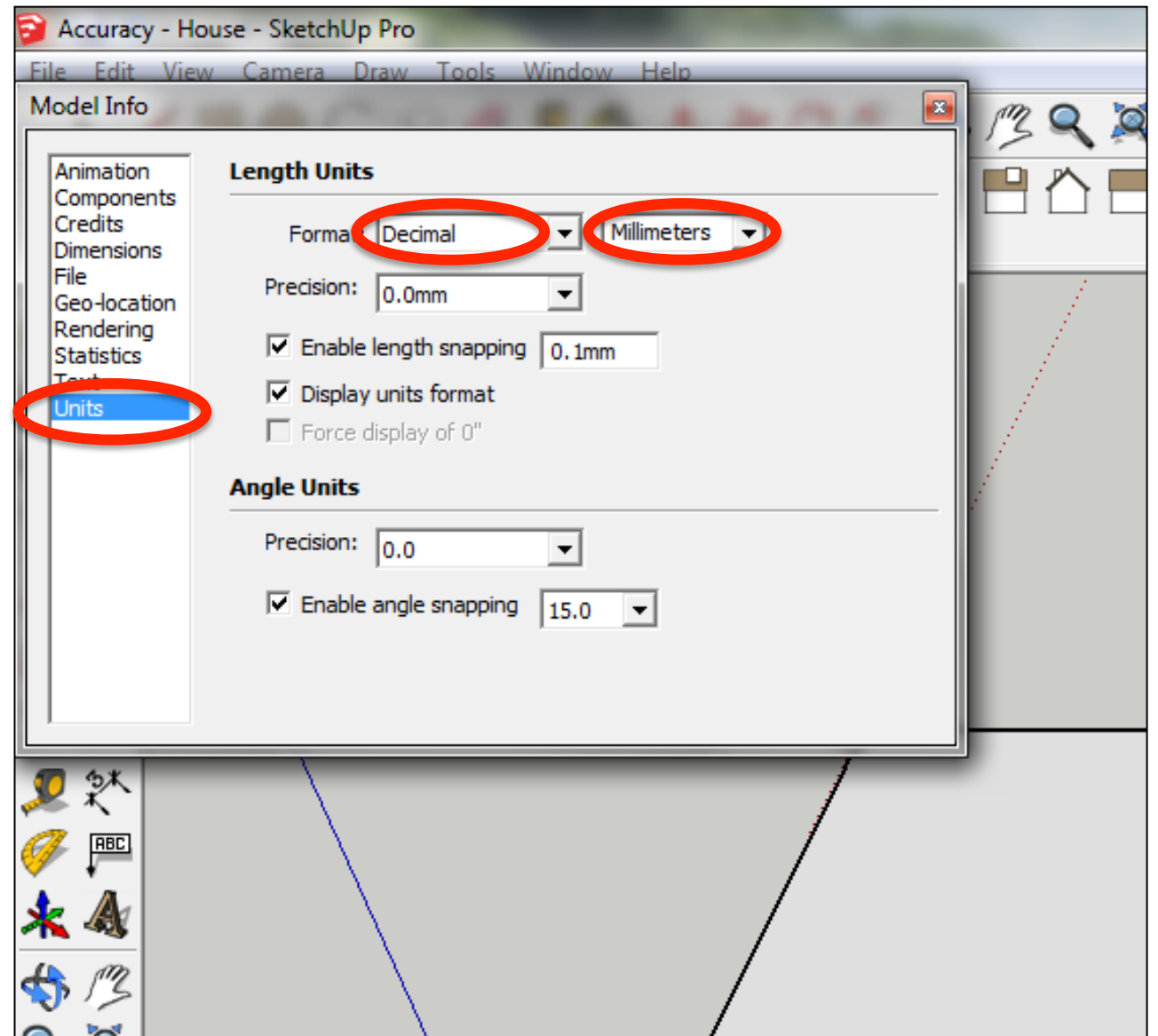
Lesson Outcomes...

By the end of this tutorial you will be able to...

- Use the push pull and move tool
- Learn about centre lines
- Create, Move and Rotate components
- Use the offset tool to make objects and add detail
- Shape and form your design
- Draw your design to the correct size to enable it to be manufactured.



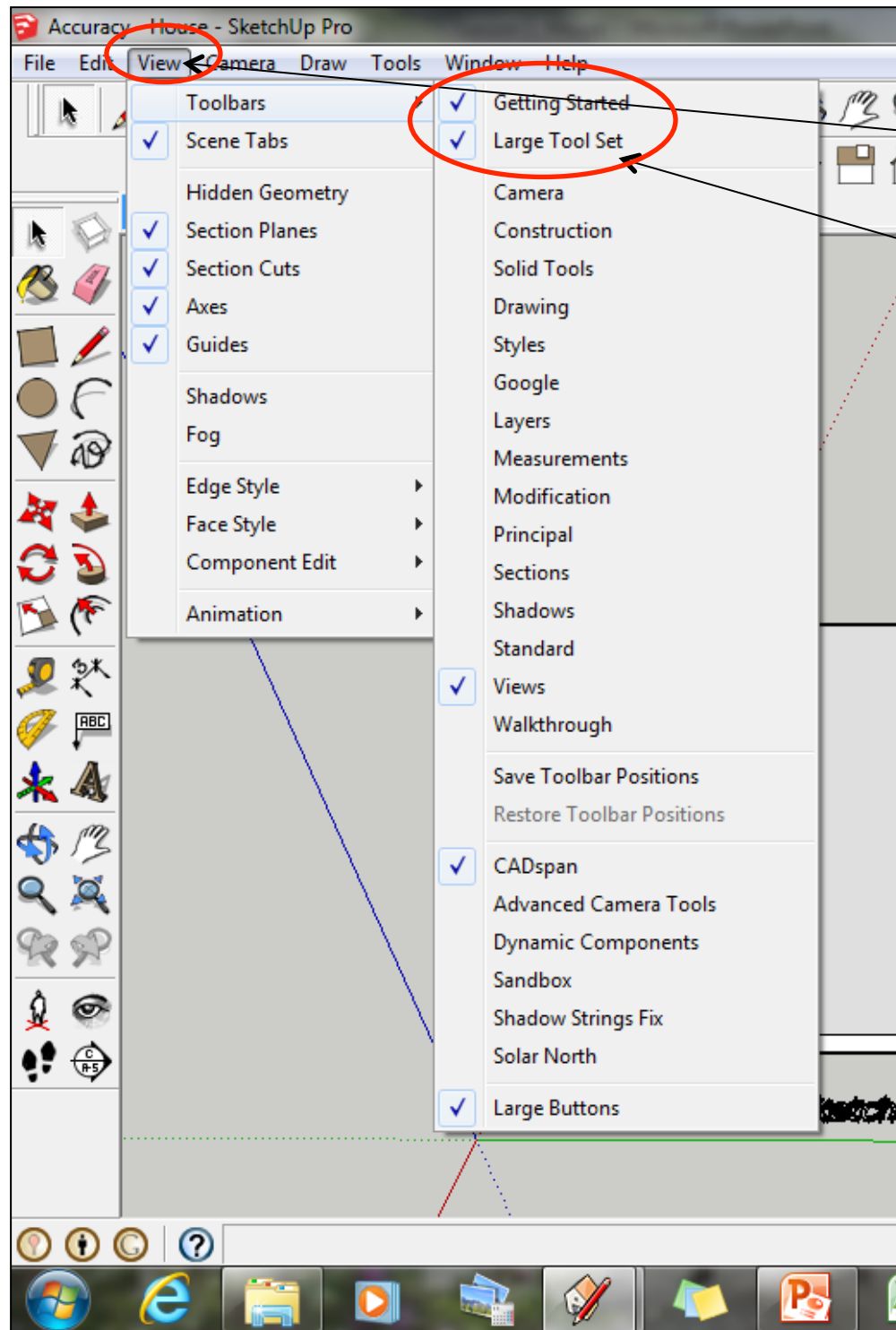
1. Open the sketch up drawing. Once you have opened SketchUp, go to **Window** and select **Model Info**



2. Select **Units** and choose **Decimal Millimetres**. We are using this template because we are doing a product design.

Note: It is often necessary to start a new file to use the new template. Go to **File** then **New**.

3. Now select the **View** then **toolbars** and ensure **Getting Started** and **Large Tool Set** are ticked



3a Select **View**

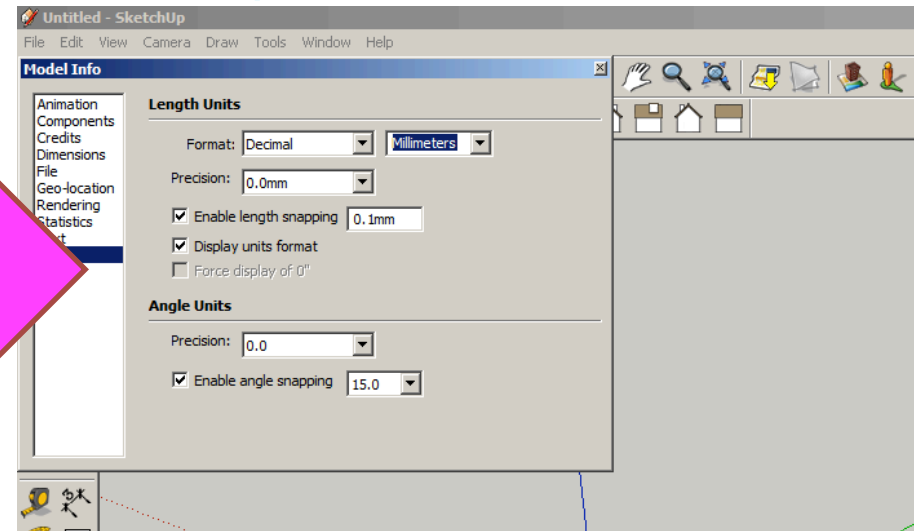
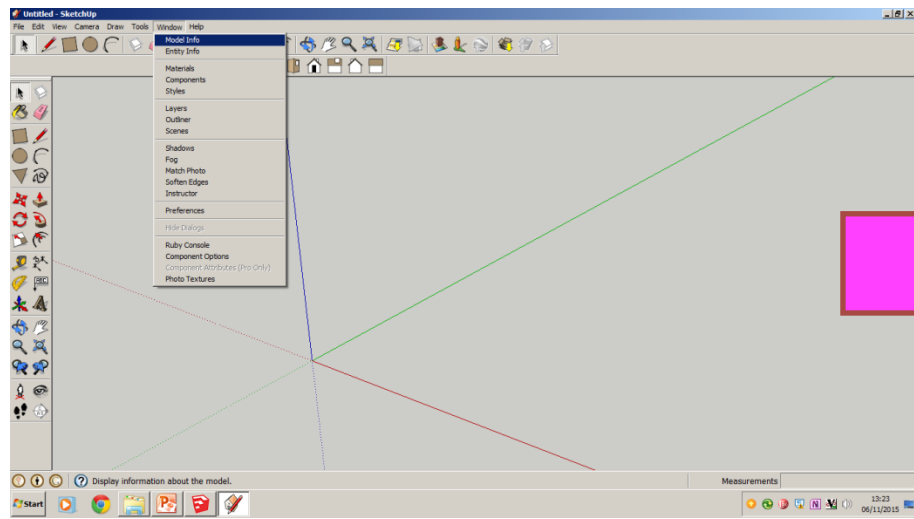
3b Tick Getting Started

3c Tick Large Tool Set

Note: this will place a tool bar across the top (**getting started**) and the side (**Large Tool Set**)

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Start by setting up *window/ model info*.

Select Units and change to *decimal - millimetres*

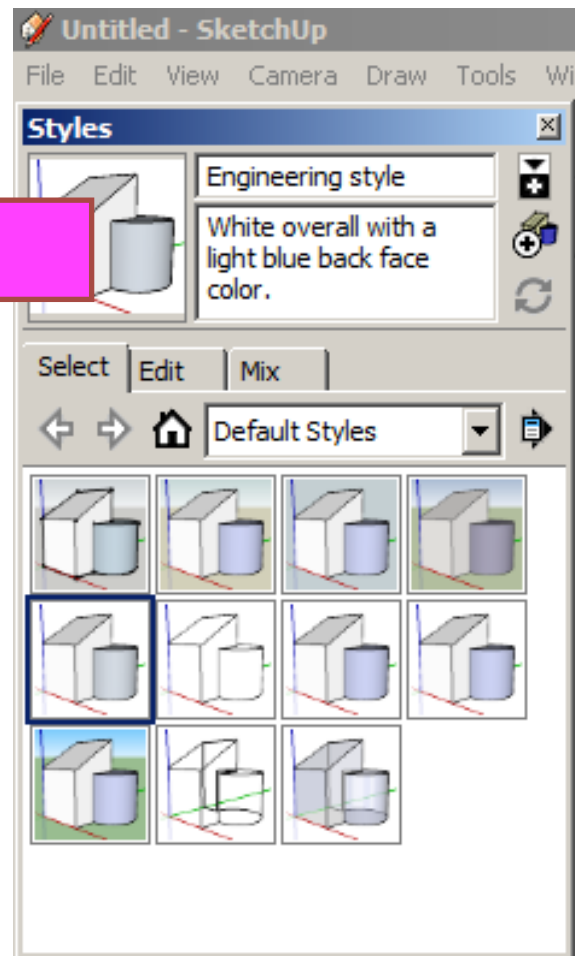
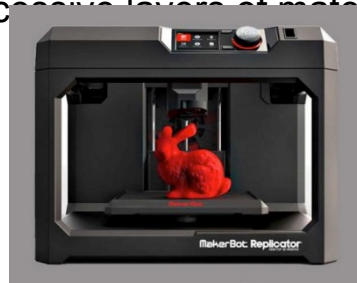
Select engineering Style allows me to use the following equipment in school

- CNC router
- CNC laser cutter
- CNC 3D Printer

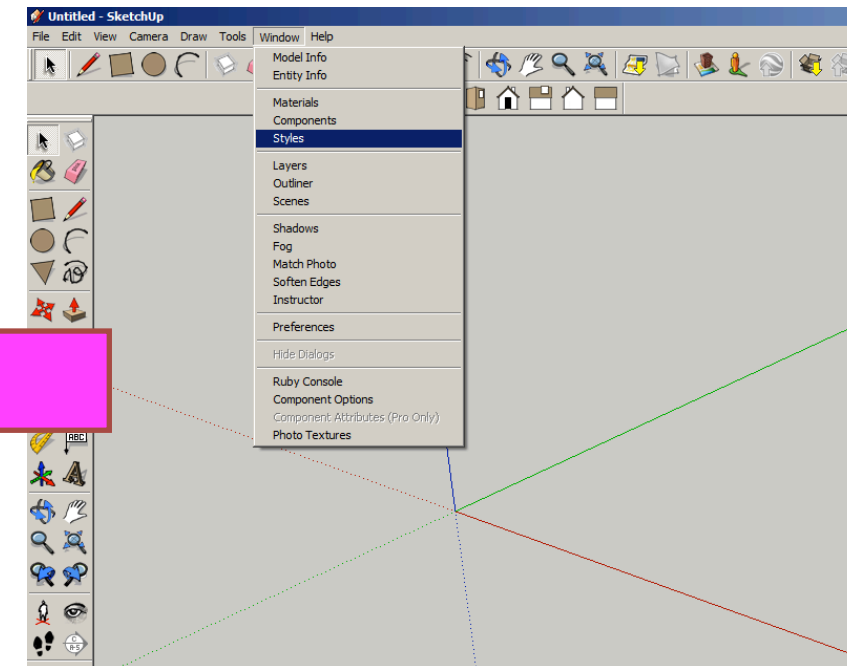
CNC means computer numerically controlled and converts CAD drawings to co-ordinates and codes to be cut out by a machine.

3D printers

3D printers print 3D models, using a process called additive manufacturing or AM. This process uses computer control to lay successive layers of material to build a 3D



Select *engineering* Style



Select *Window-Styles*

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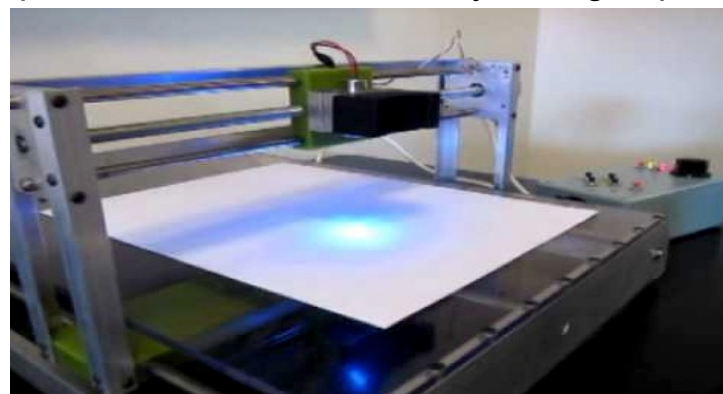
CNC Router

A **CNC router** is a computer controlled cutting machine related to the hand held **router** used for cutting various hard materials, such as wood, composites, aluminium, steel, plastics, and foams. **CNC** stands for computer numerical control.



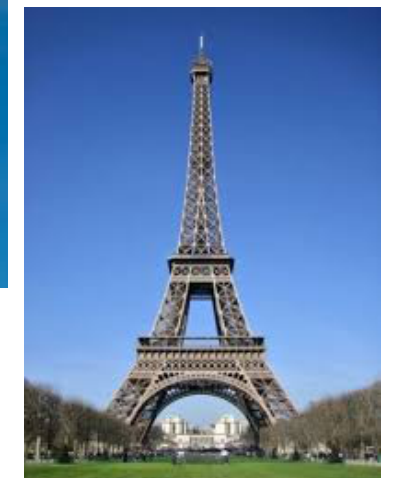
CNC Laser cutter

Laser cutting is a technology that uses a **laser** to **cut** materials, and is typically used for industrial manufacturing applications, but is also starting to be used by schools, small businesses, and hobbyists. **Laser cutting** works by directing the output of a high-power **laser** most commonly through optics



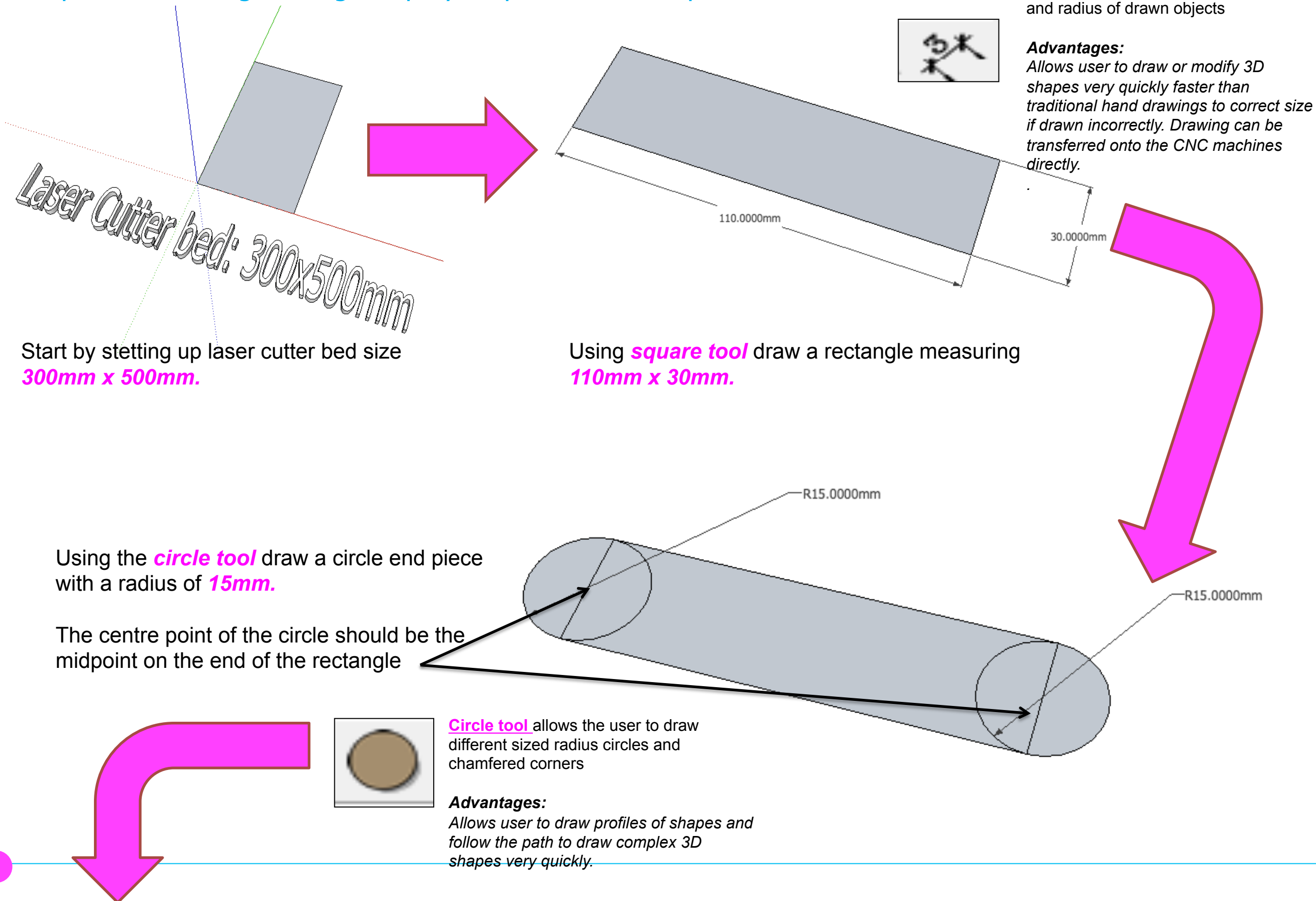
Products which are designed for self-assembly are popular for many reasons and help to keep costs as low as possible. An international furniture warehouse chain is constantly on the look-out for fresh ideas for their lighting sections. They are particularly interested in cutting edge designs which allow the customer to assemble the products in a variety of ways.

Design and make a lamp based around a famous buildings, structures or a retro theme . The product will need to be manufactured in full-scale and will need assembly instructions which do not rely upon text. The use of commercial knock-down fittings and/or standard components might be a key feature of the product. Accuracy will be a vital requirement and manufacturing aids such as drilling jigs or the use of CAM should be regarded as essential.



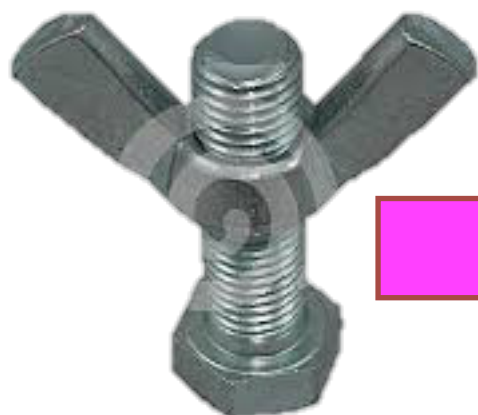
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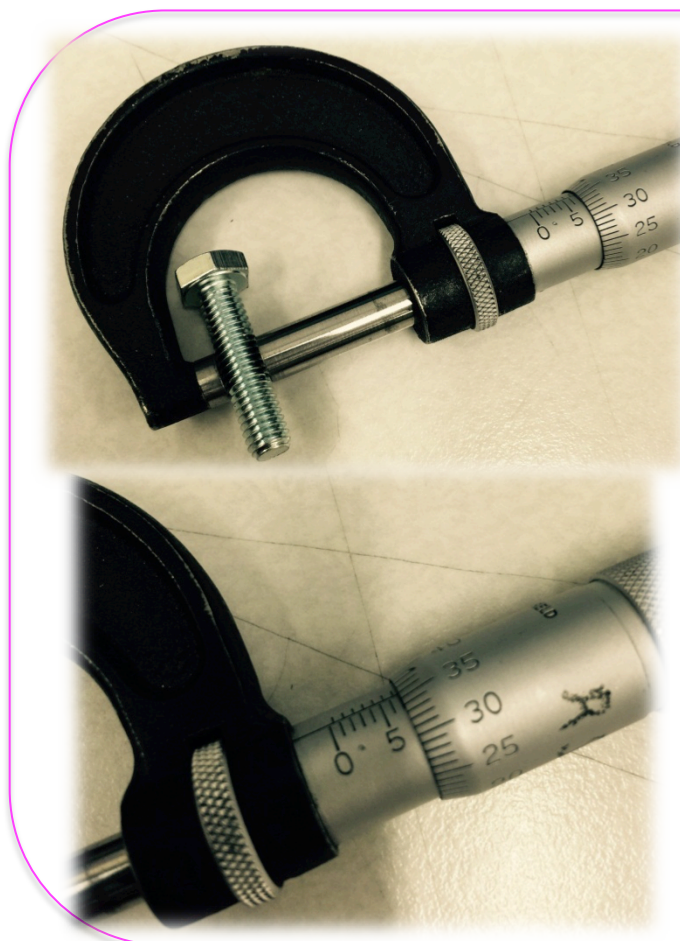


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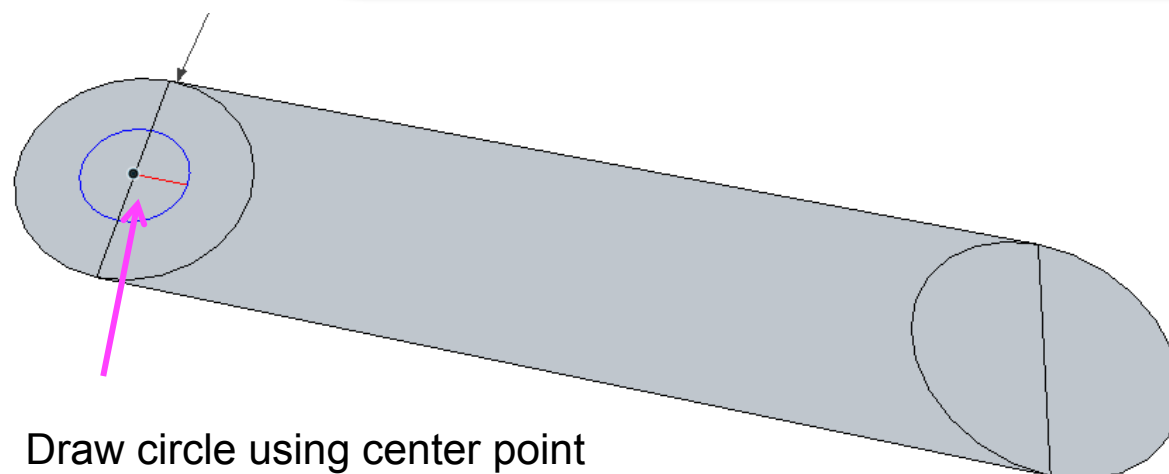
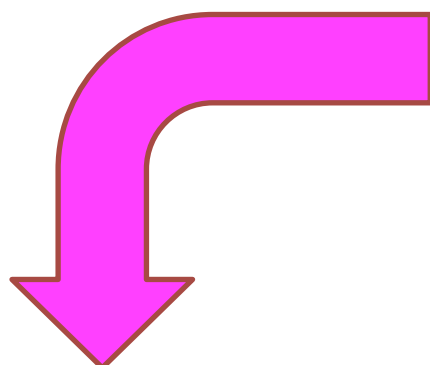
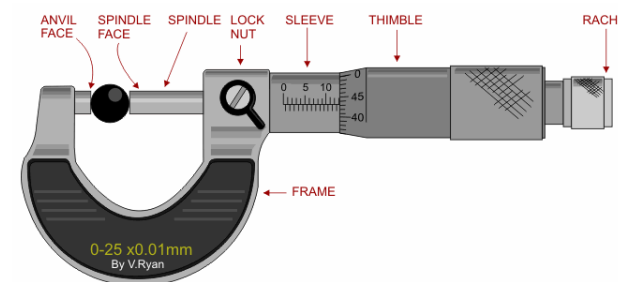
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To allow the lamp to move I am going to use a wing nut and bolt for the arms to rotate around. I will need to measure the bolt to get the radius to allow it to go through the lamp arms



The micrometer is a precision measuring instrument, used by engineers. Each revolution of the ratchet moves the spindle face 0.5mm towards the anvil face. The object to be measured is placed between the anvil face and the spindle face. The ratchet is turned clockwise until the object is 'trapped' between these two surfaces and the ratchet makes a 'clicking' noise. This means that the ratchet cannot be tightened any more and the meas



Draw circle using center point shown. Type in radius 3.675

We can figure out the radius by dividing the diameter in half. The radius is one-half the measure of the diameter.

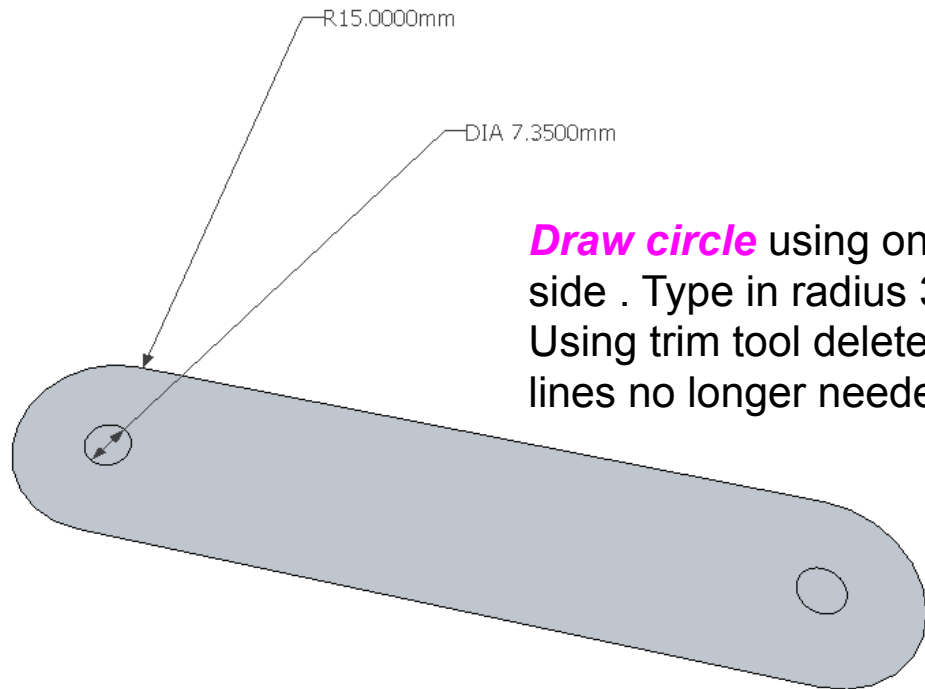
$$7.35/2 = 3.675\text{mm}$$

The radius of the circle is 3.675mm.

Radius 3.675

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Draw circle using on opposite side . Type in radius 3.675. Using trim tool delete all the lines no longer needed.



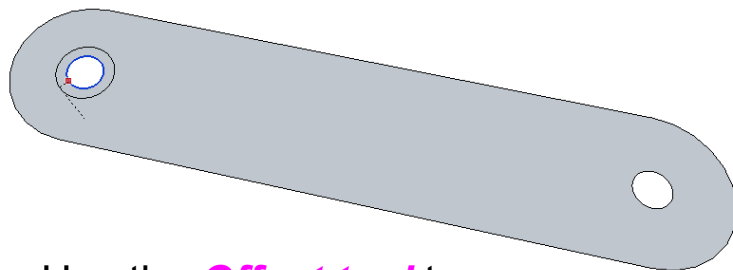
Trim tool allows the user to remove overlapping elements.

Advantages:
Allows user to erase overlapping lines and edges to draw complex 3D shapes very quickly.

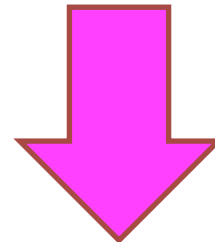


Offset tool You can use the **contour** tool to draw parallel lines or lines within lines.

Advantages:
Allows user to draw duplicate lines and position them within shapes quickly to draw complex 3D shapes very quickly.

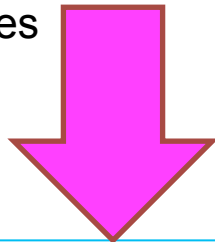


Use the **Offset tool** to add a clearance of 0.25mm on both circles



At the moment the radius on the arm of my lamp is an **interference** fit.

I want the arm of the lamp to rotate to change the shape so I am going to need to add **clearance** to enable the arm to rotate.



Clearance / Tolerance

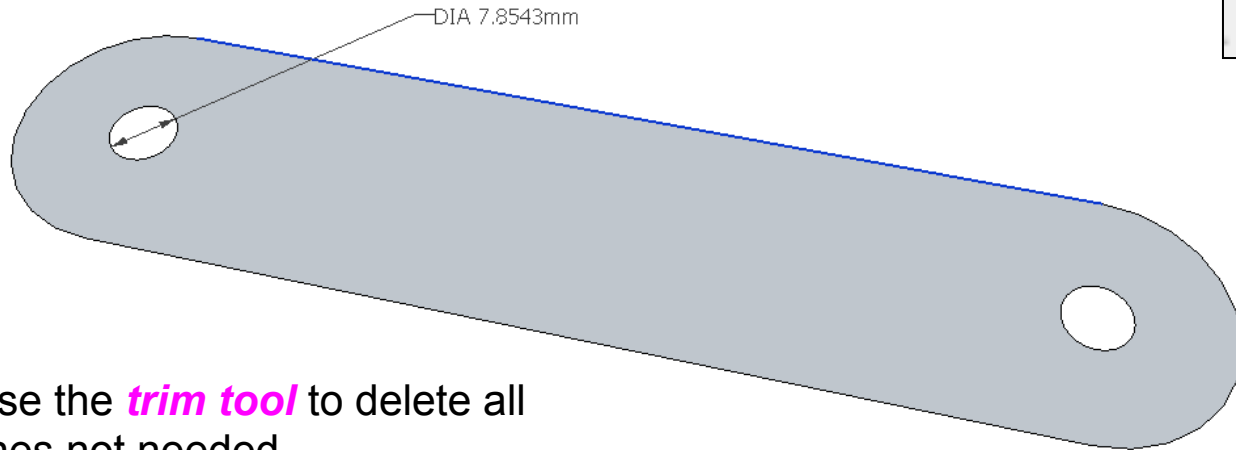
Manufactured parts are very frequently required to mate with one another. They may also be designed to slide freely against one another or they may be designed to bind together to form a single unit. The most common fit found in the machine shop is that of a shaft in a hole.

There are three general categories of fits:

- 1) **Clearance** fits for when it may be desirable for the shaft to rotate or slide freely within the hole.
- 2) **Transition** fits for when it is desirable that the shaft to be held precisely, yet not so tightly that it cannot be disassembled, this is usually referred to as a Location or Transition fit.
- 3) **Interference** fits, for when it is desirable for the shaft to be securely held within the hole and it is acceptable that some force be necessary for assembly

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Use the **trim tool** to delete all lines not needed.

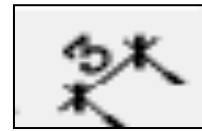
Use the **dimensions tool** to check the radius has increase to provide **clearance**



Move Tool used to move entire shapes or pull lines on a drawing.

Advantages:
Allows user to draw or modify shapes very quickly and can be used to construct unusual 3D shapes quickly

Highlight the arm, click on the move tool and press **Ctrl** to copy. Move so that the arms are in a row joining each circle together

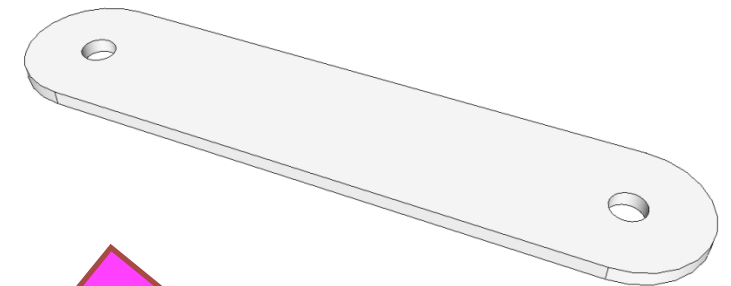
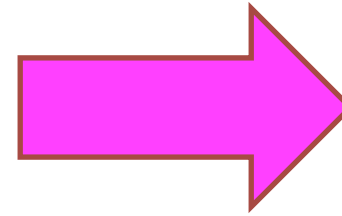


Dimensions tool

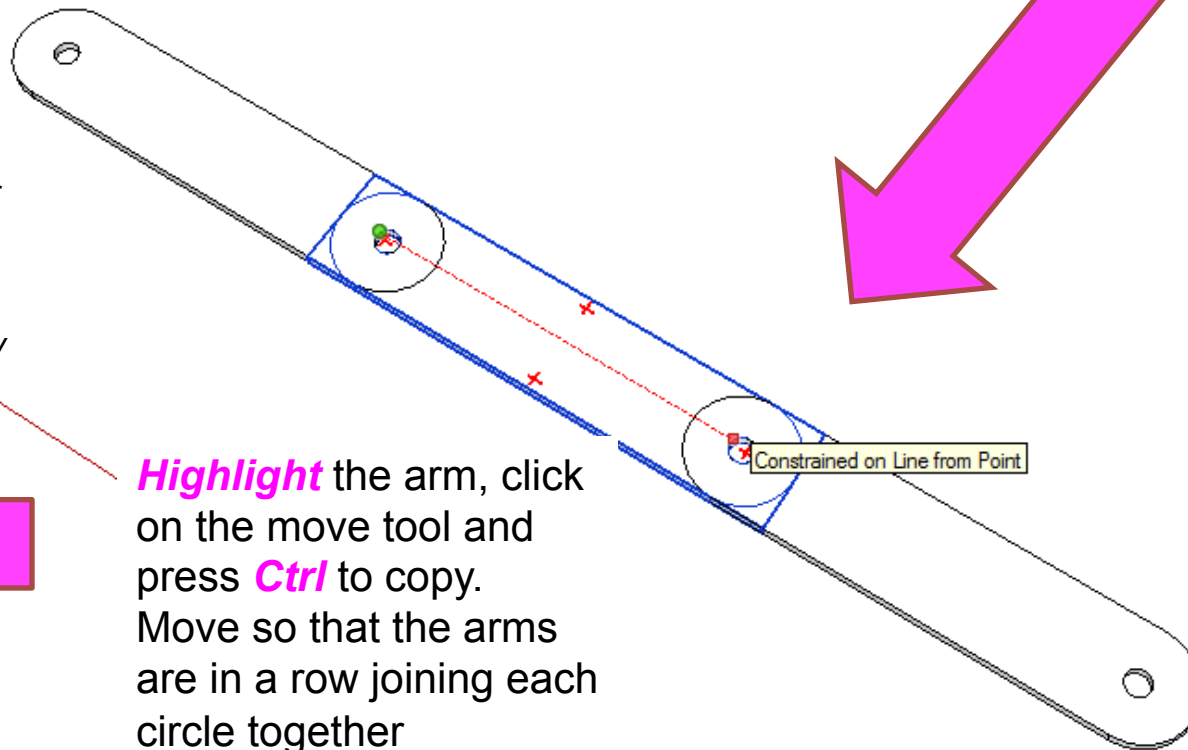
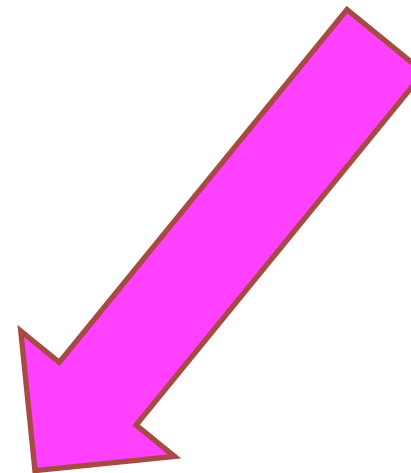
used to show sizes and radius of drawn objects

Advantages:

Allows user to draw or modify 3D shapes very quickly faster than traditional hand drawings to correct size if drawn incorrectly. Drawing can be transferred onto the CNC machines directly



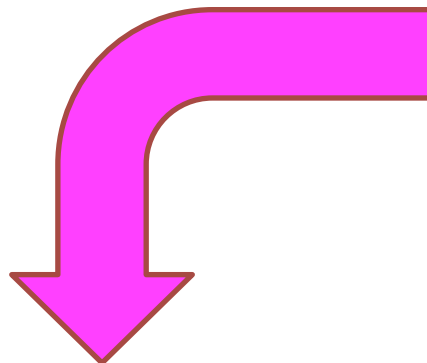
Use the **PUSH PULL** tool to give the arm thickness of 3mm for acrylic.



Push/pull tool used to turn solid objects into 3D objects instantaneously. Typing a size allows a user to extrude or pull an object to a certain size or height

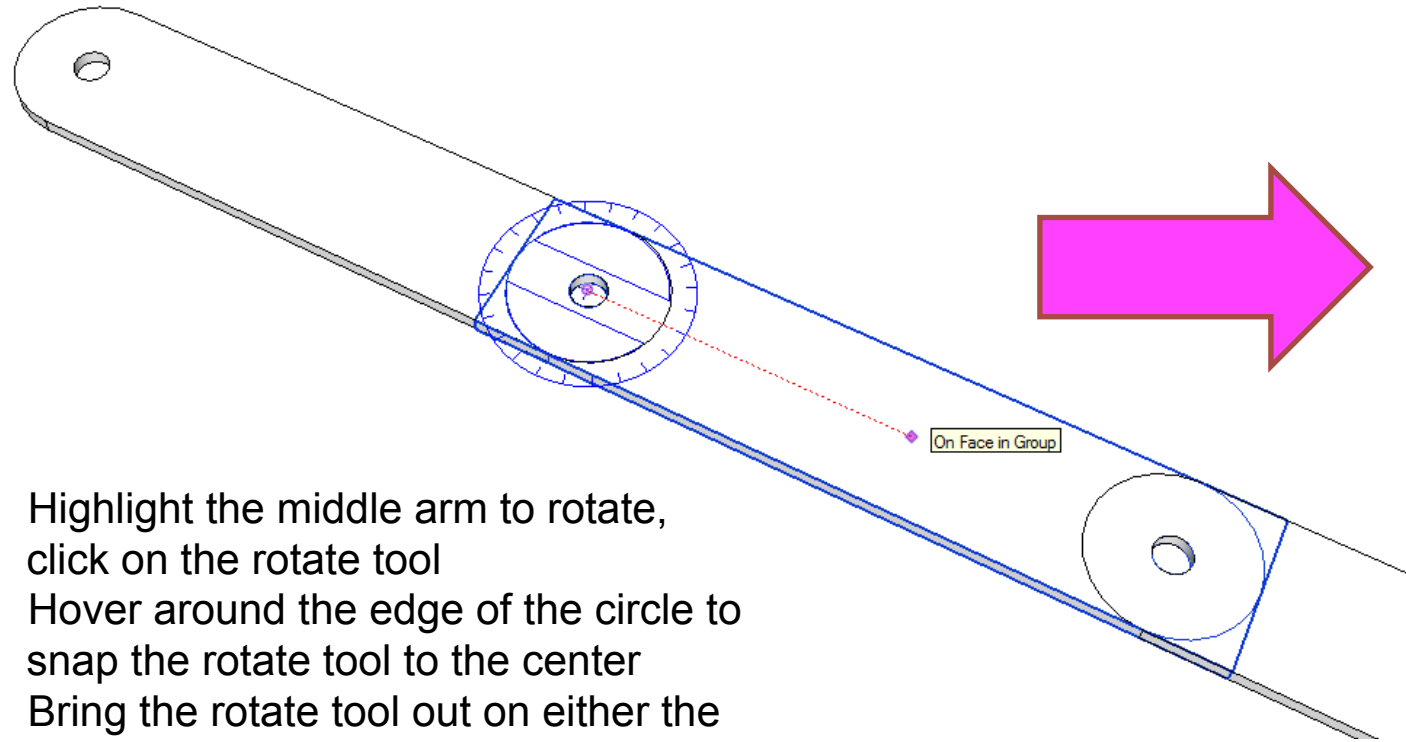
Advantages:

Allows user to draw or modify 3D shapes very quickly faster than traditional hand drawings. You can click on a face (plane) and adjust. Can be used to extrude shapes on 3D objects already drawn.



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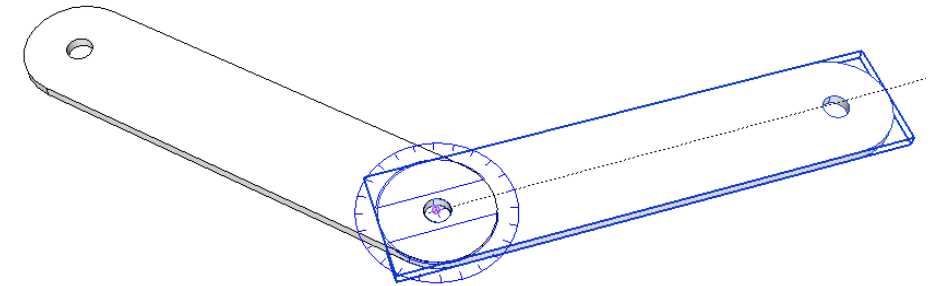
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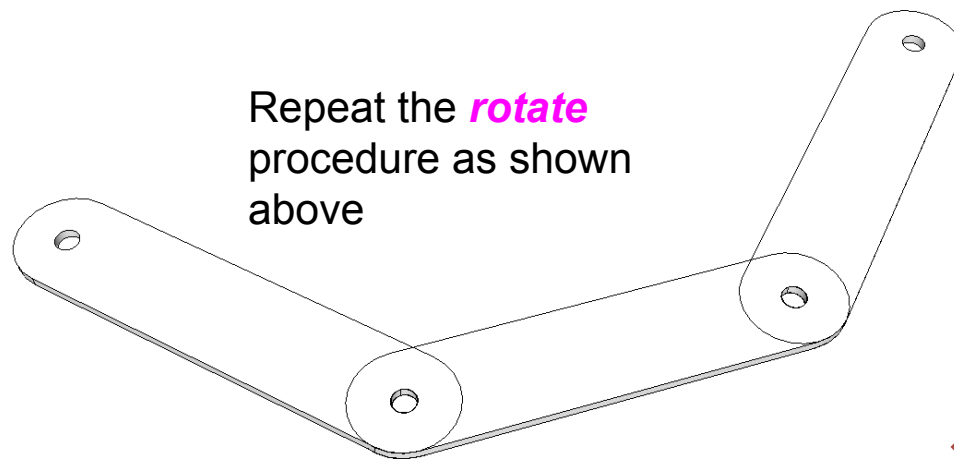
- Highlight the middle arm to rotate, click on the rotate tool
- Hover around the edge of the circle to snap the rotate tool to the center
- Bring the rotate tool out on either the green or red axis

Rotate Tool used to move rotate parts of a shape or entire shapes on x, y and Z coordinates.

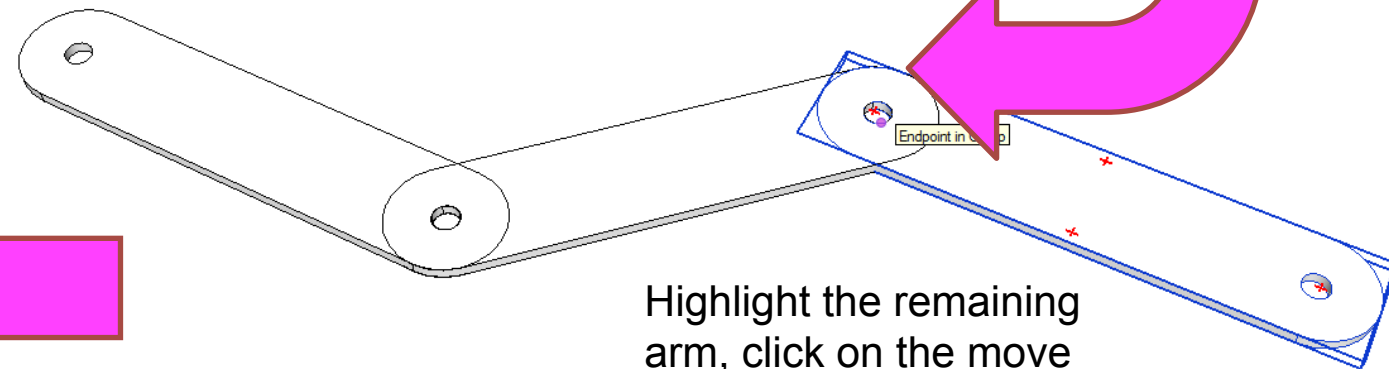
Advantages:
Allows user to draw or modify shapes very quickly and can be used to construct unusual 3D shapes quickly



- Rotate the arm
- **Type in 45 and press enter**



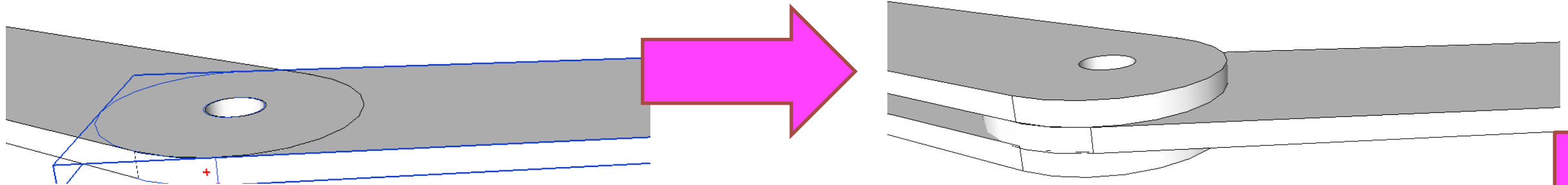
Repeat the **rotate** procedure as shown above



Highlight the remaining arm, click on the move tool. Move so that the arms are in a row joining the circles shown together

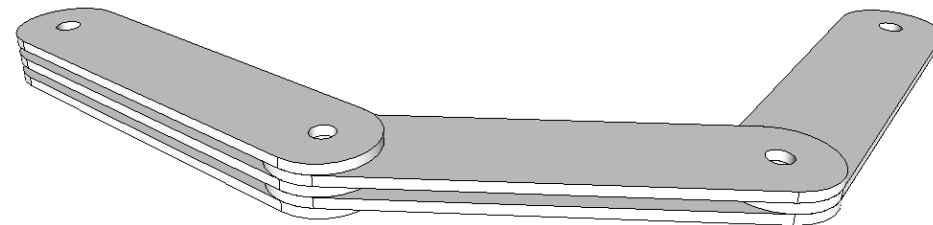
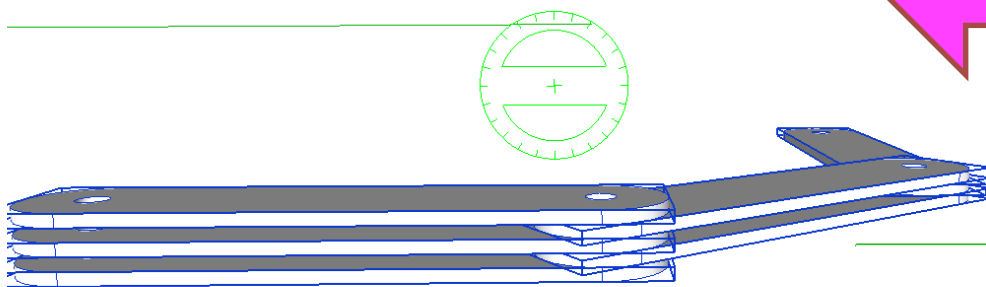
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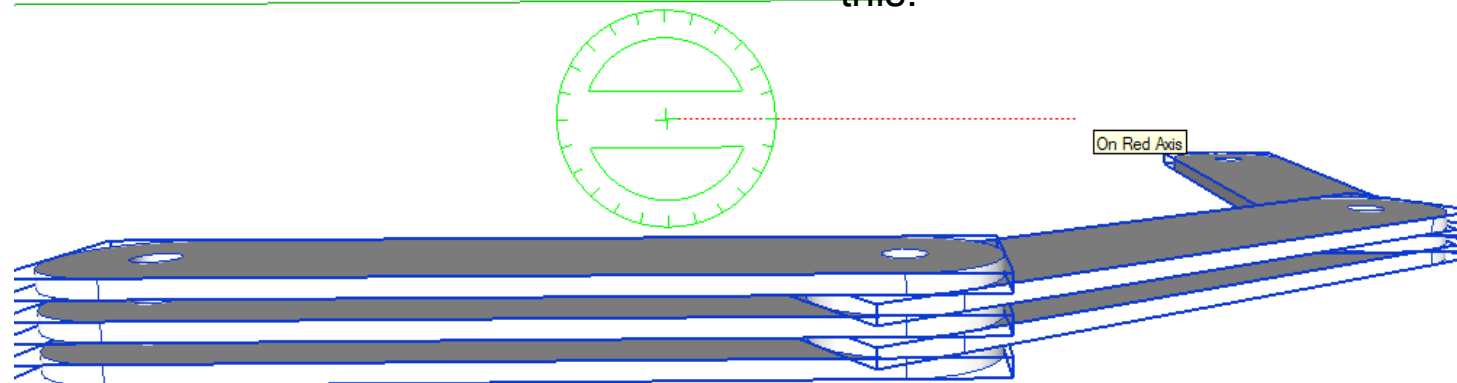
Highlight the middle arm, click on the move tool. Click on an edge and move the arm up so it sits on the bottom arm as shown above. *Hint you can type in the height you want to move it 3mm – 4mm. Make sure you are moving directly vertical on the blue axis*

Highlight the bottom arm this time, click on the move tool. Click on an edge and move the arm up so it sits on top of the arm shown. *Make sure you are moving directly vertical on the blue axis*



Repeat the process until your lamp looks like this.

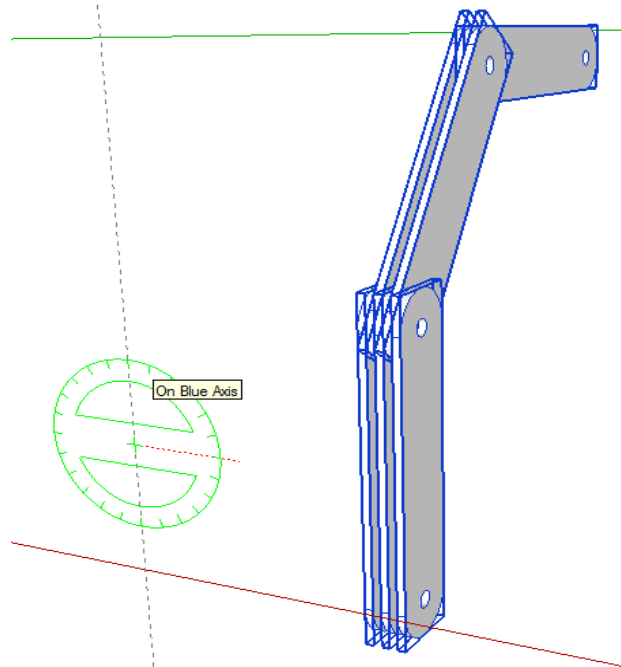
Highlight the entire lamp. Click on the rotate tool. When it is either **green** or **red** click to set it.



Pull the line out on either the **green** or **red** axis. Click on the rotate tool. Type in 90 to rotate the lamp 90 degrees.

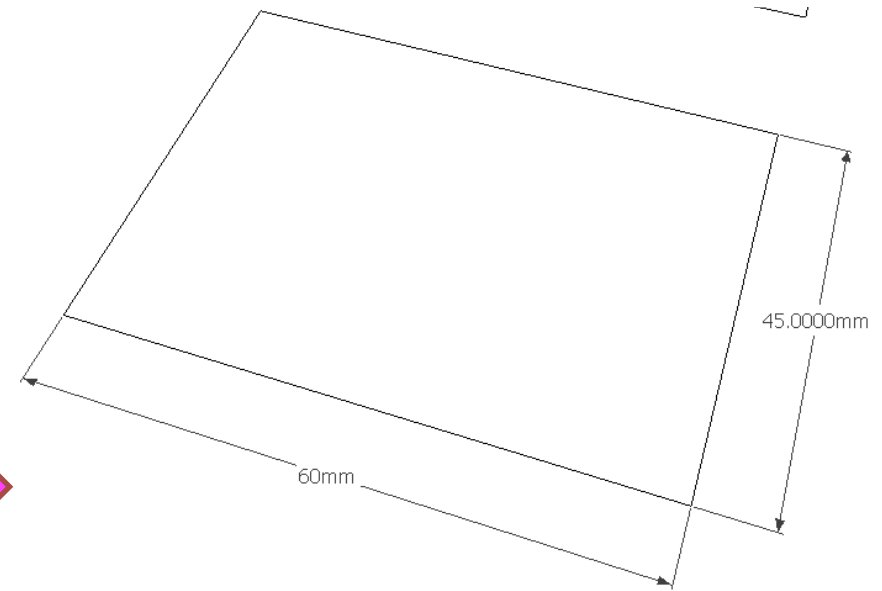
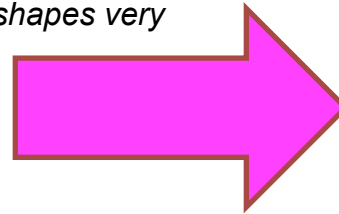
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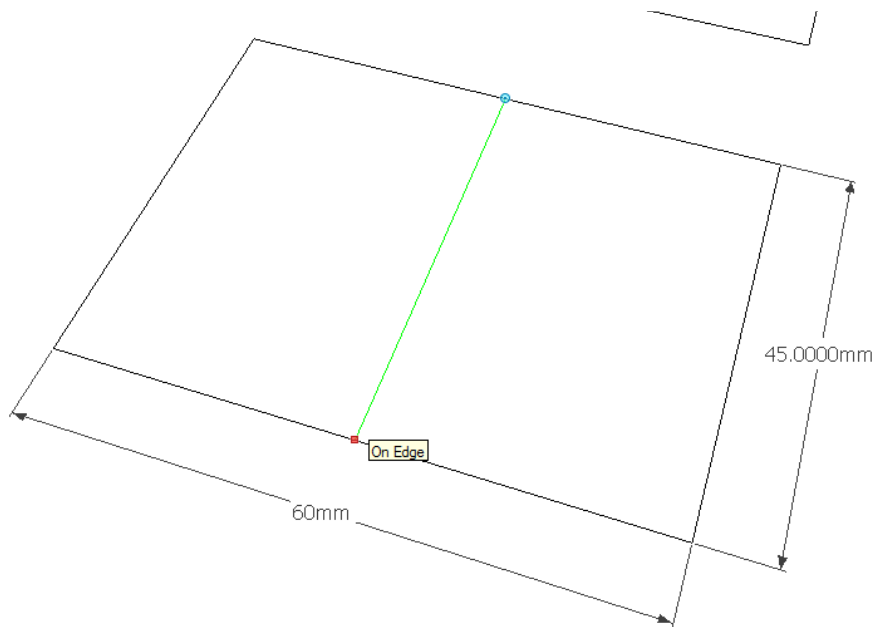
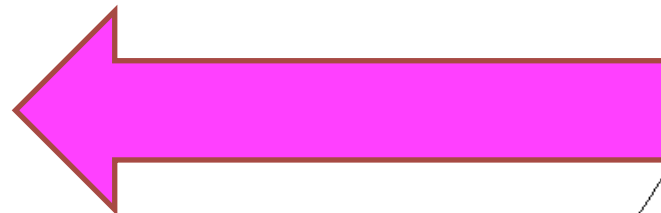
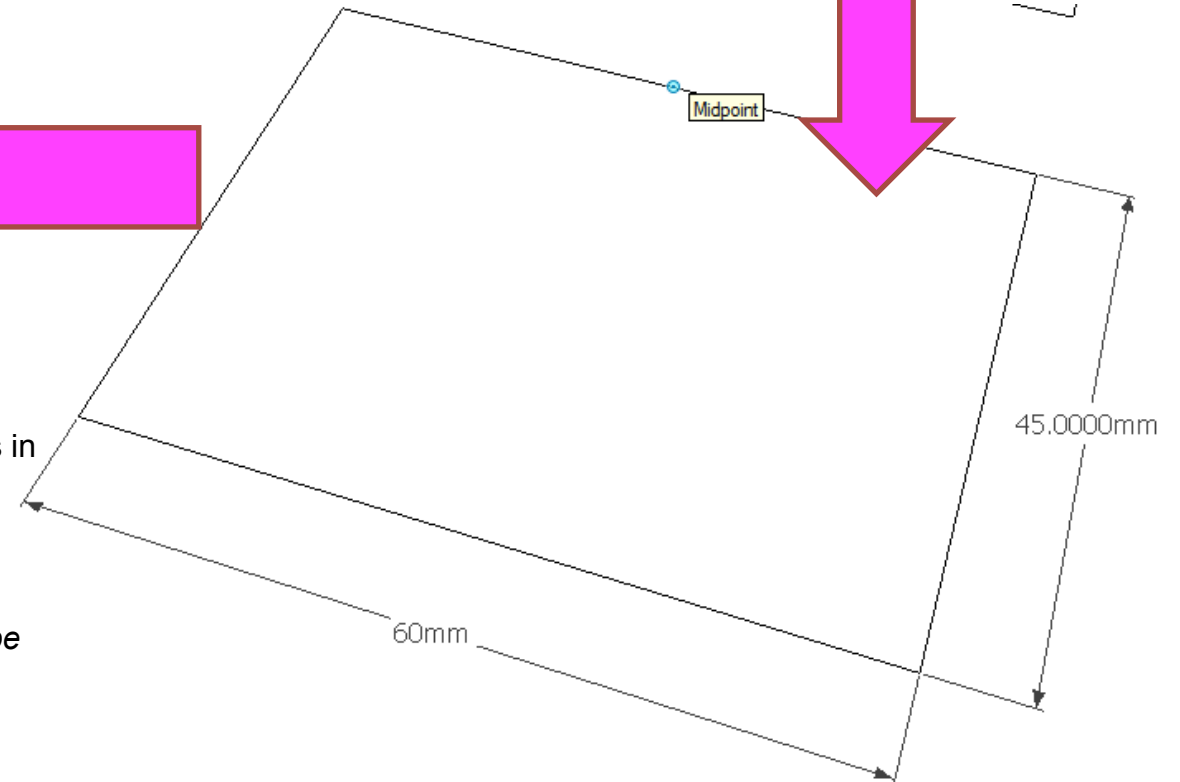
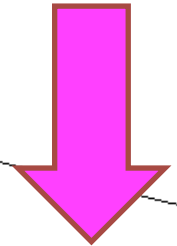


Rotate tool You can use the **rotate** tool to rotate an object along the x,y or Z axis.

Advantages:
Allows user to rotate and position shapes quickly to draw complex 3D shapes very quickly.



Use the **rectangle tool** to draw a rectangle that measures **60mm x 45mm**



Pencil tool used to draw lines in X, Y and Z direction.

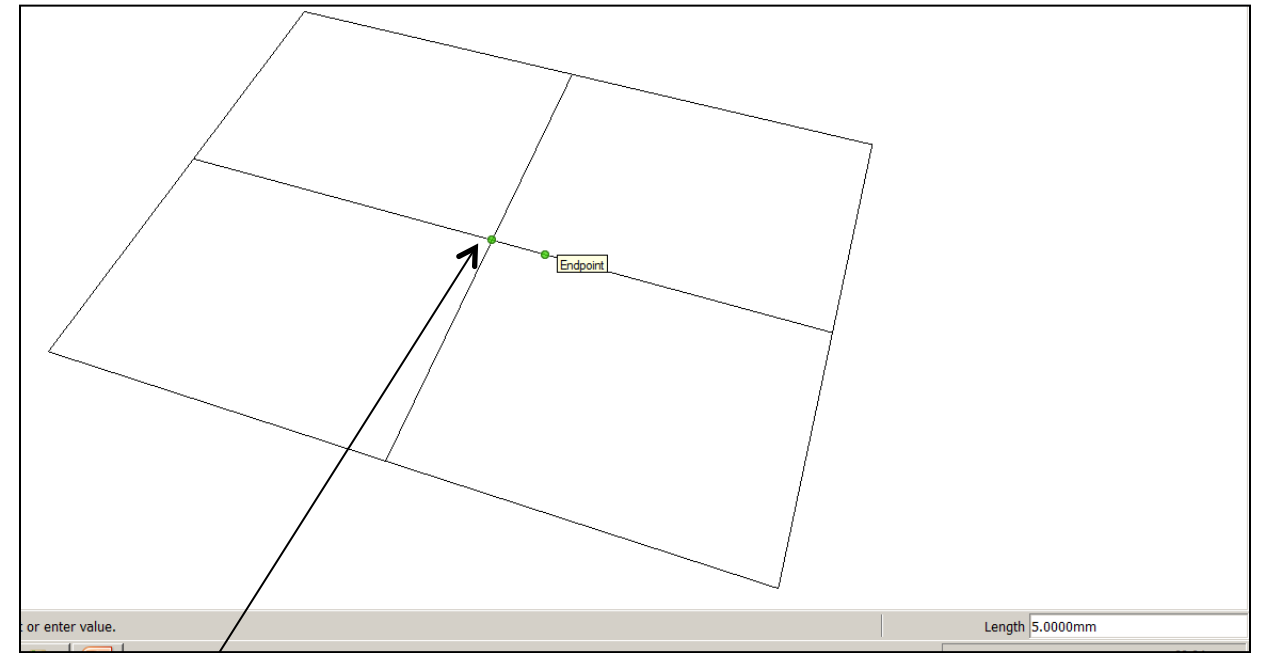
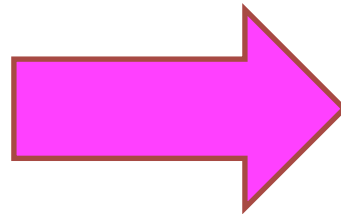
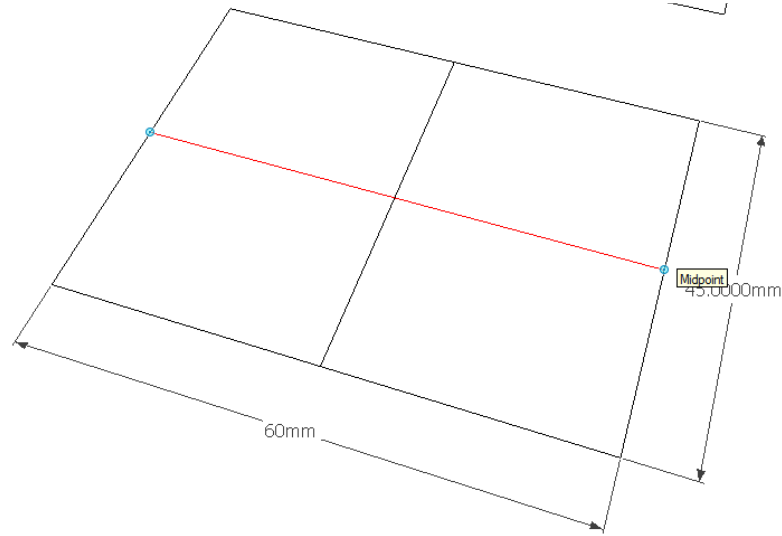
Advantages:
Allows user to draw or modify shapes very quickly and can be used to construct 3D objects faster than traditional hand drawings

Draw a line across the **green** or **red** axis to the opposite midpoint

Use the **pencil tool**, run it along one of the edges until it snaps to midpoint.

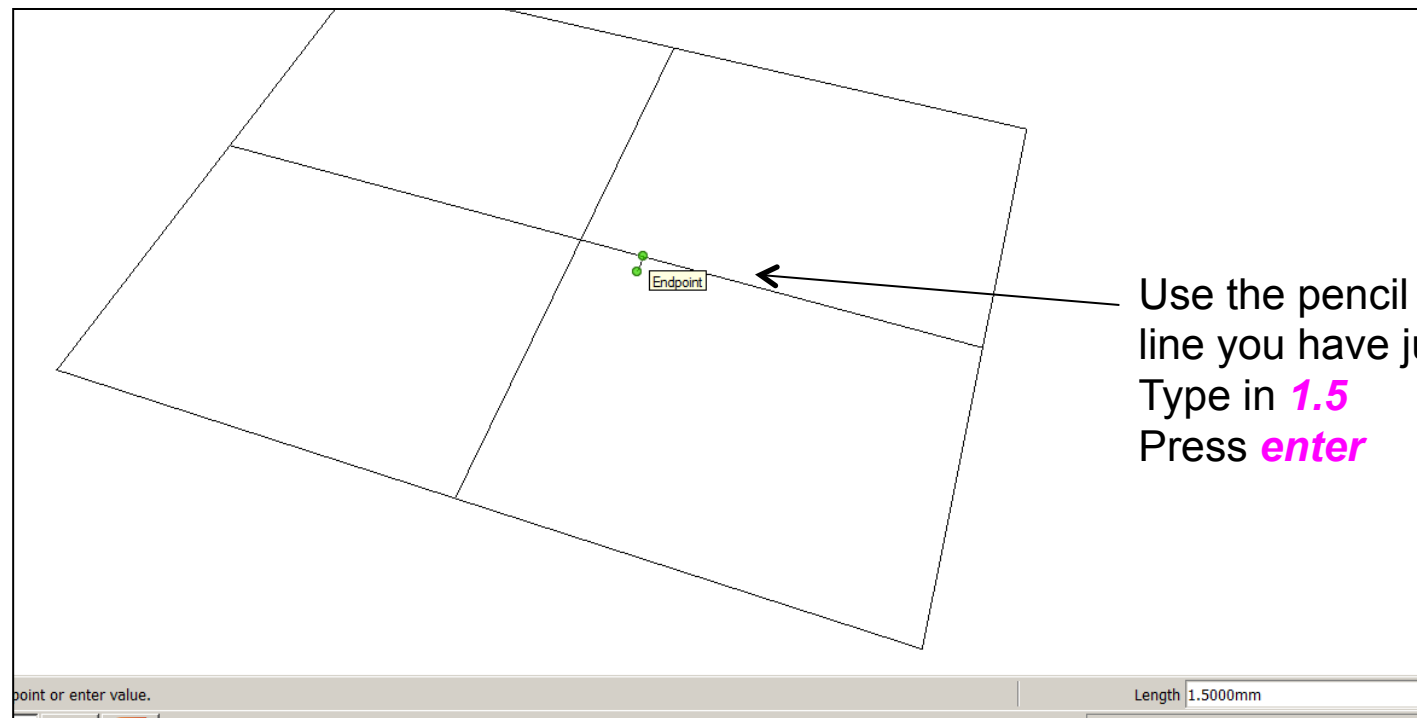
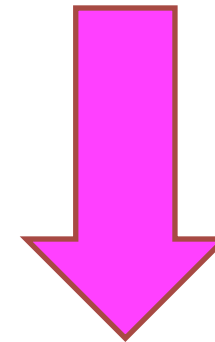
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Repeat the process on the other edge

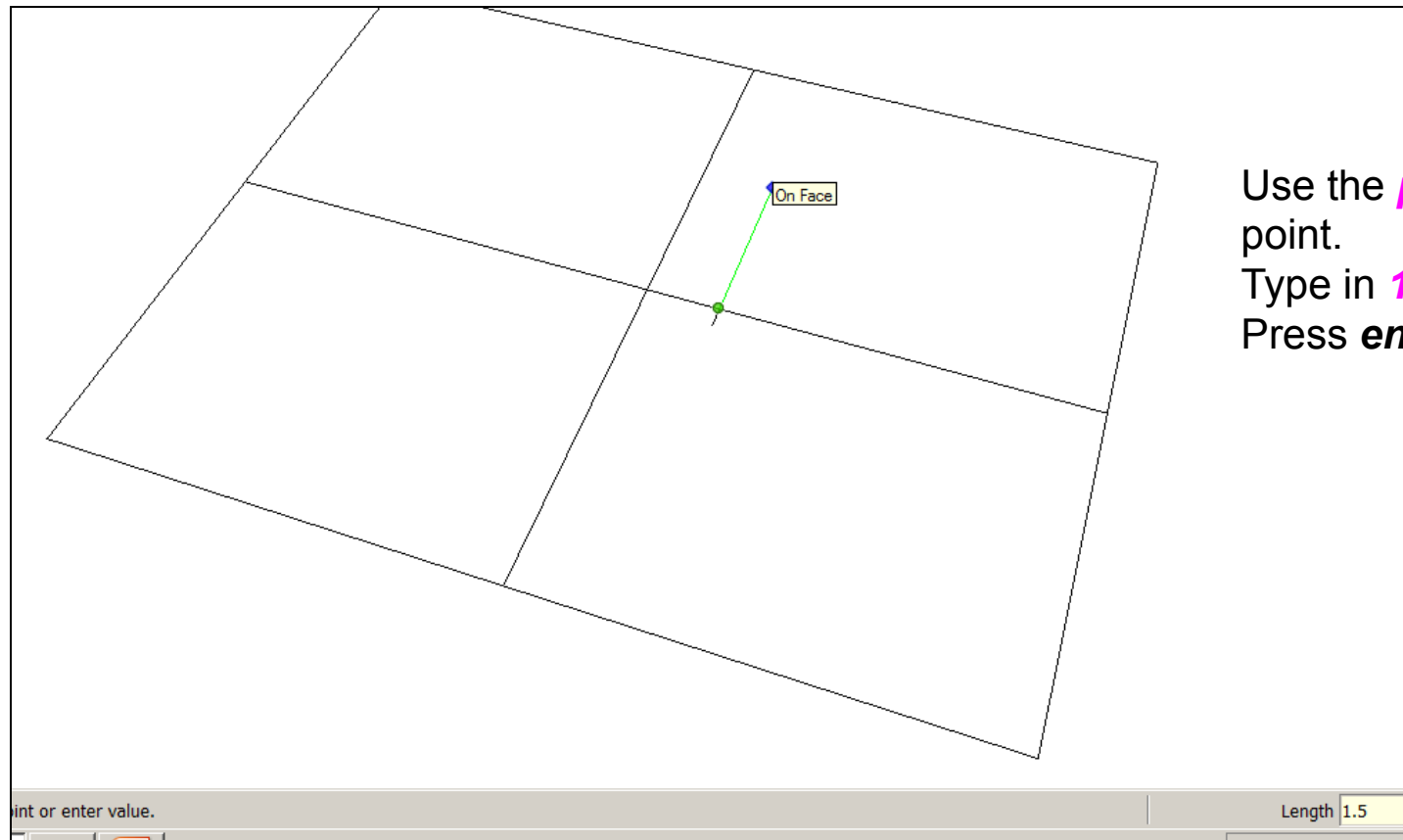
Use the **pencil tool**. Draw a line out from the center.
Type in **5**
Press **enter**



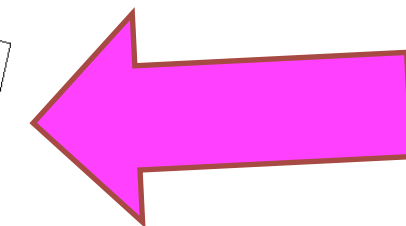
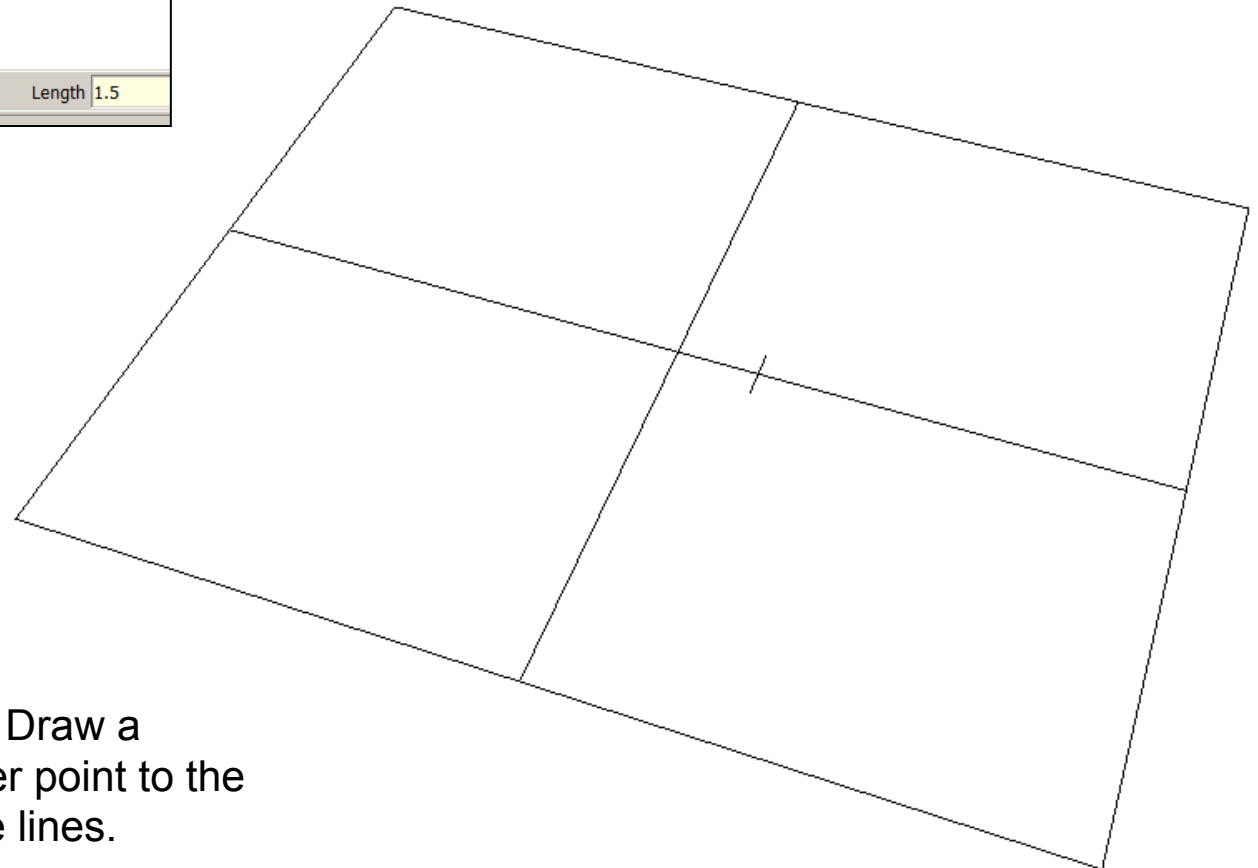
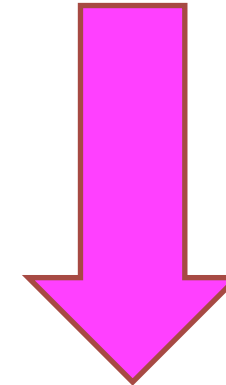
Use the pencil tool. Draw a line down from the endpoint of the last line you have just drawn.
Type in **1.5**
Press **enter**

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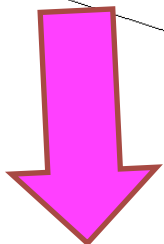
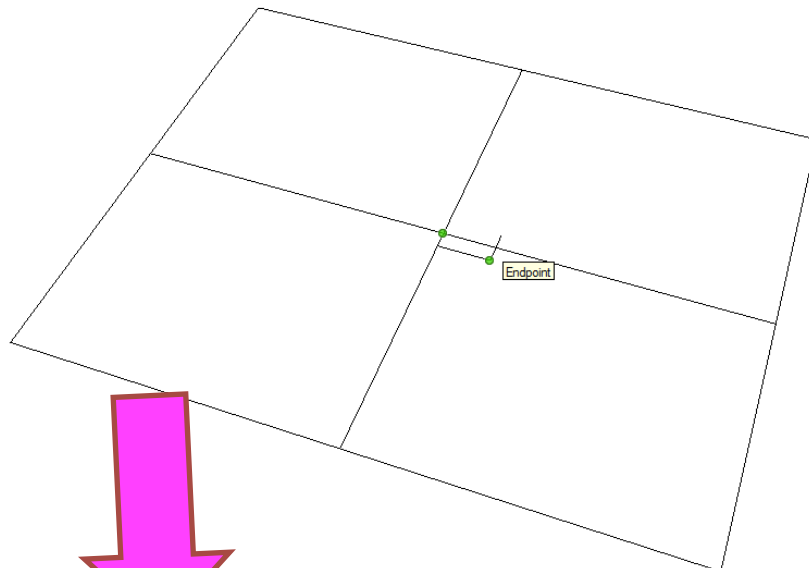
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Use the **pencil tool**. Draw a line up this time from the center point.
Type in **1.5**
Press **enter**

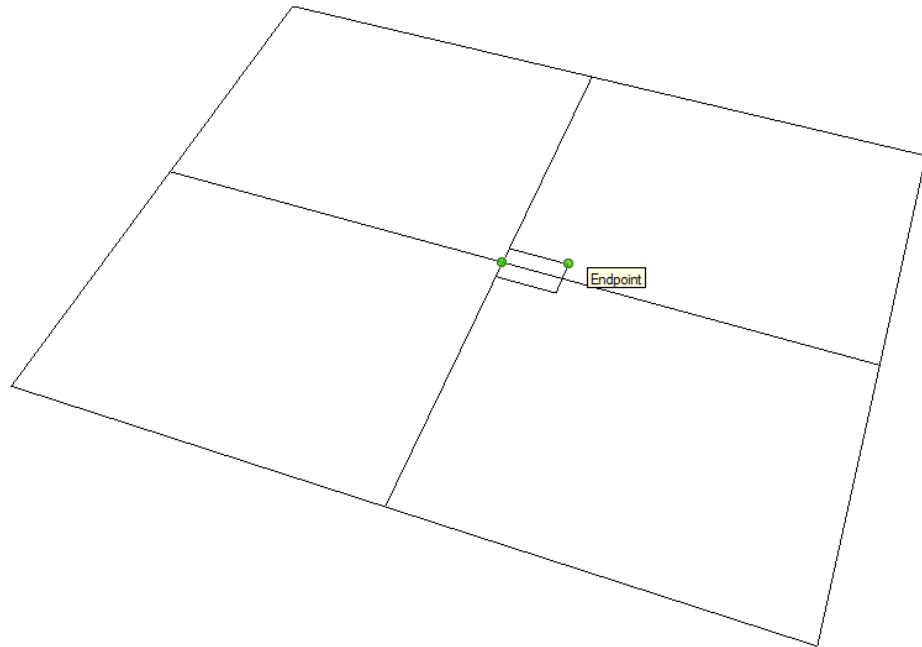


Use the **square tool**. Draw a square from the center point to the endpoint of one of the lines.

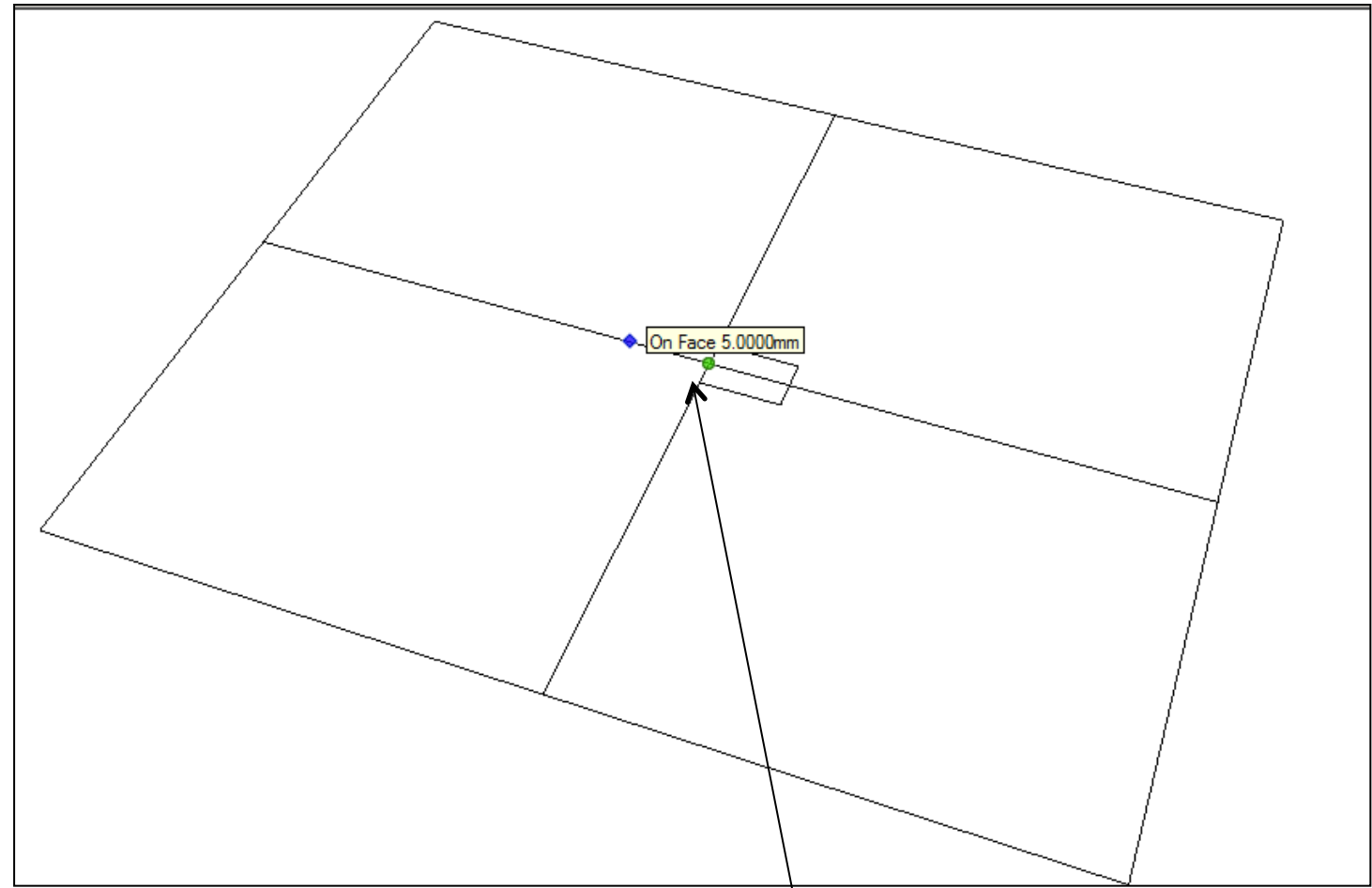


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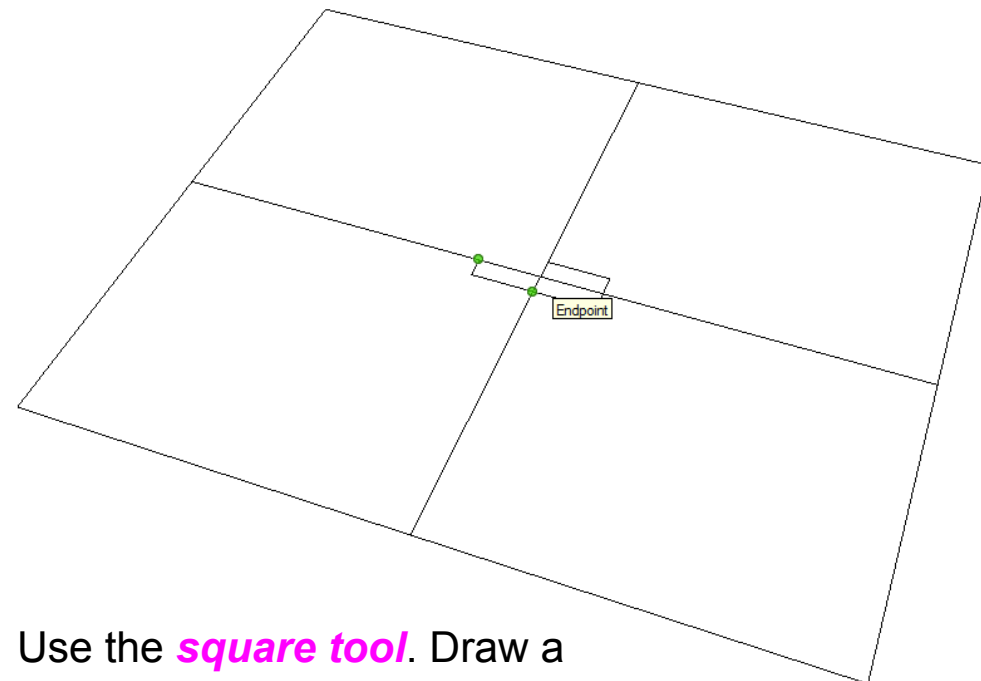
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Use the **square tool**. Draw a square from the center point to the endpoint of other line



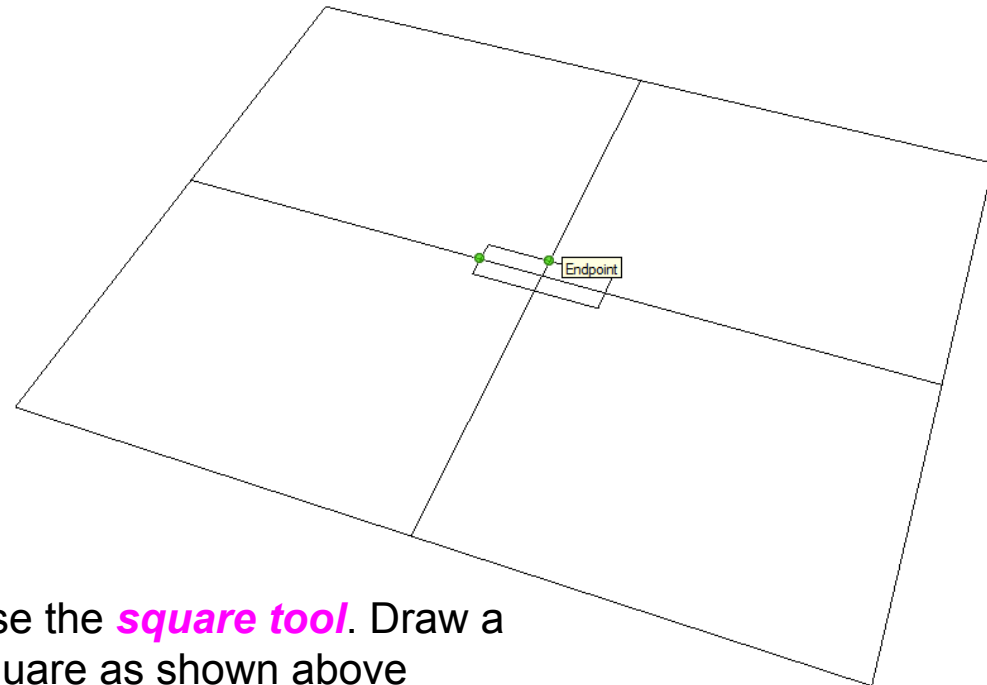
Use the **pencil tool**. Draw a line out from the center on the left hand side.
Type in **5**
Press **enter**



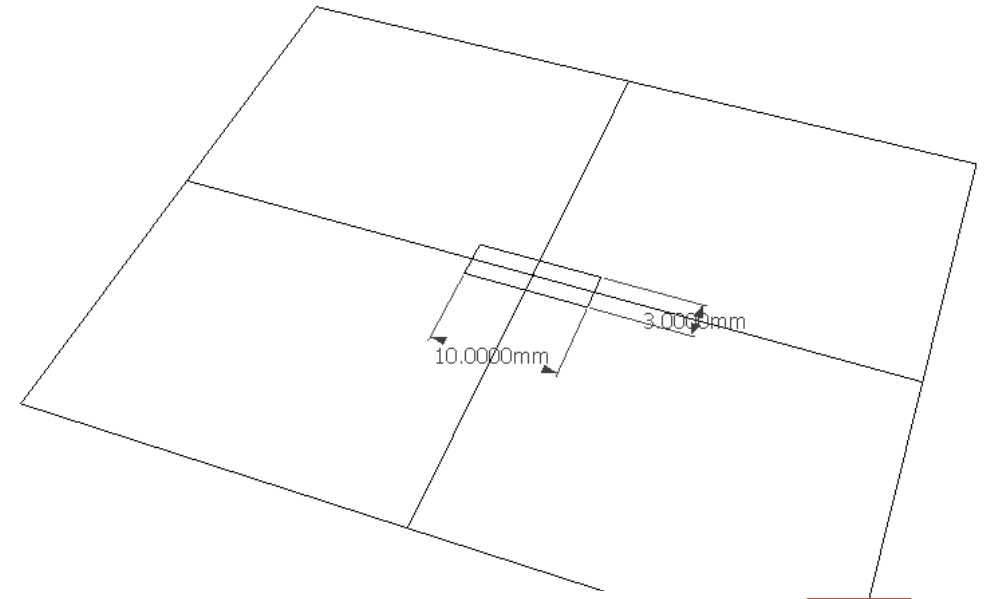
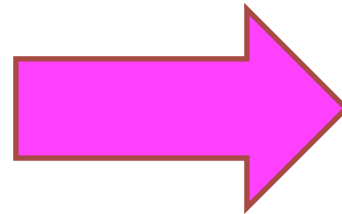
Use the **square tool**. Draw a square as shown above

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Use the **square tool**. Draw a square as shown above

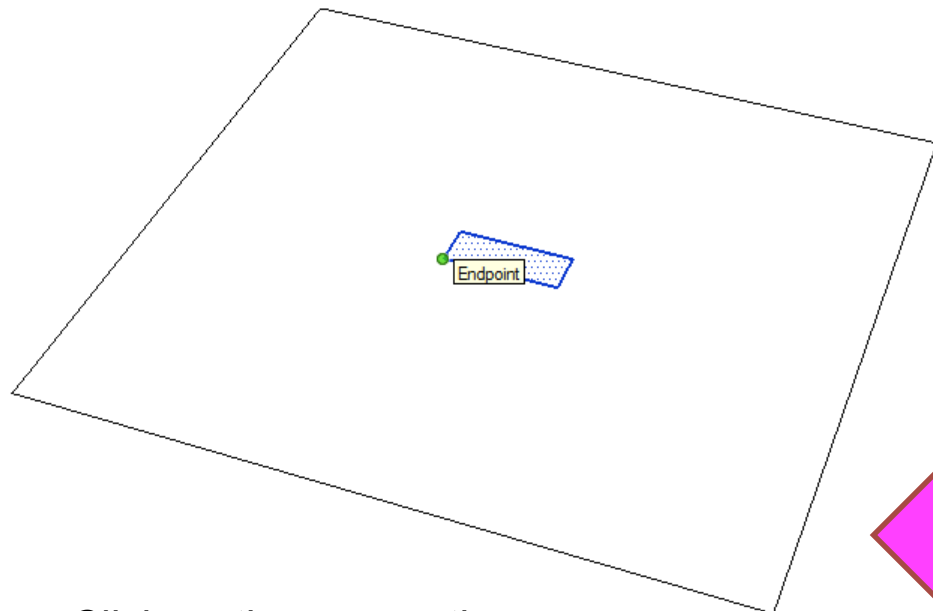


You should now have a center square that measures 10mm x 3mm

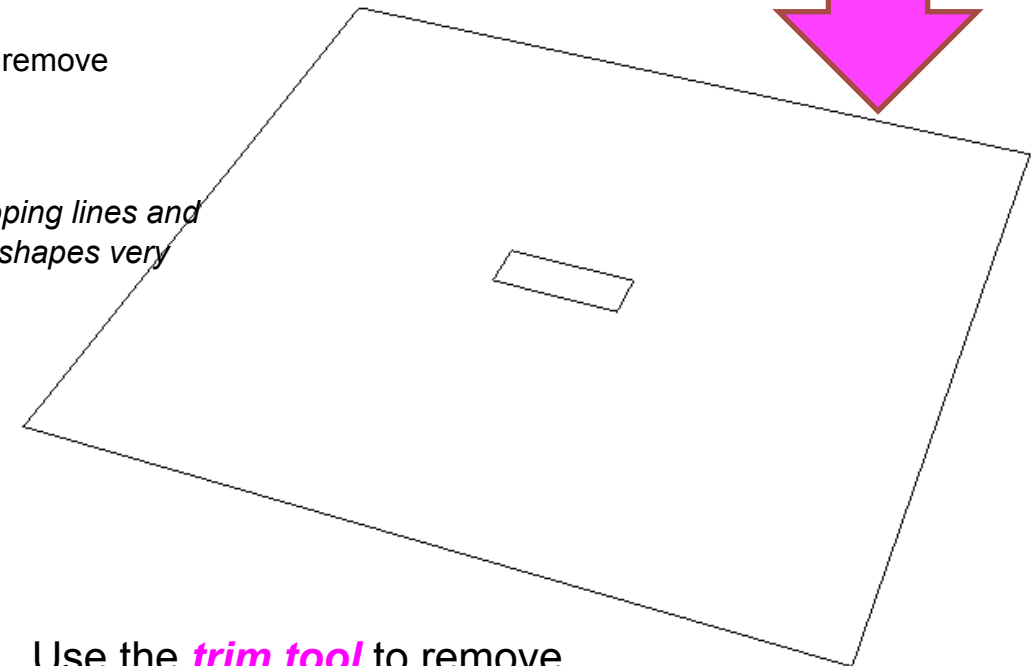
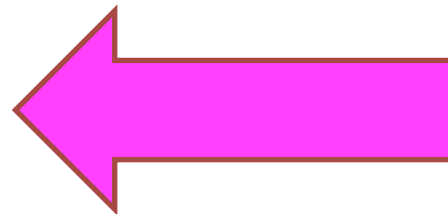


Trim tool allows the user to remove overlapping elements.

Advantages:
Allows user to erase overlapping lines and edges to draw complex 3D shapes very quickly.



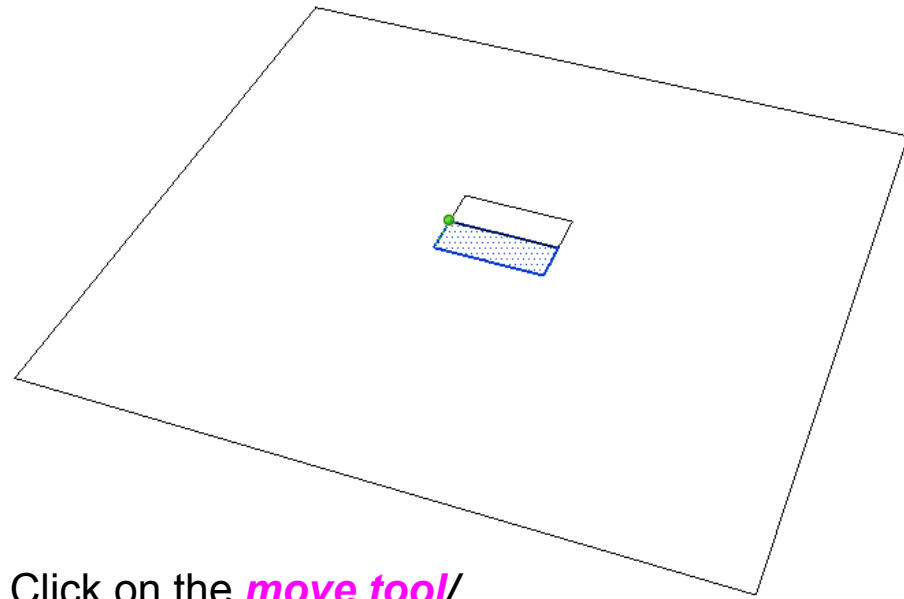
Click on the square three times to highlight it.



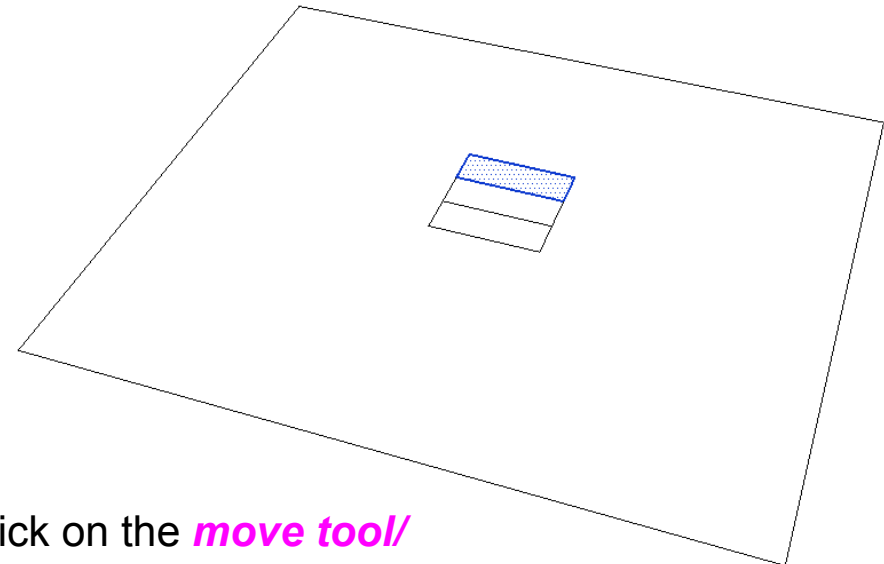
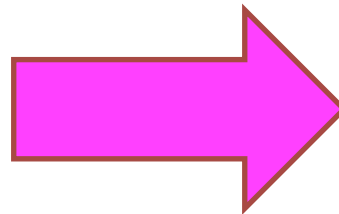
Use the **trim tool** to remove the guidelines no longer needed.

Computer Aided Design: Aircraft Lamp

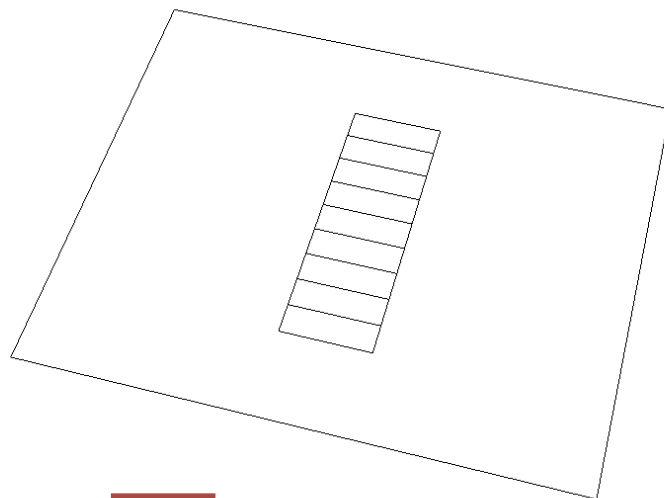
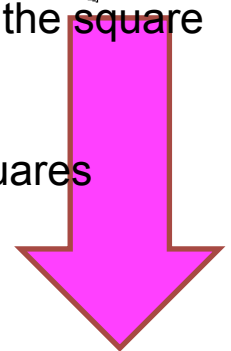
Computer Aided Engineering: Step by Step Guide to Lamp Construction



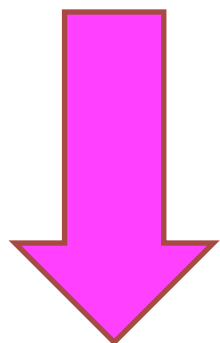
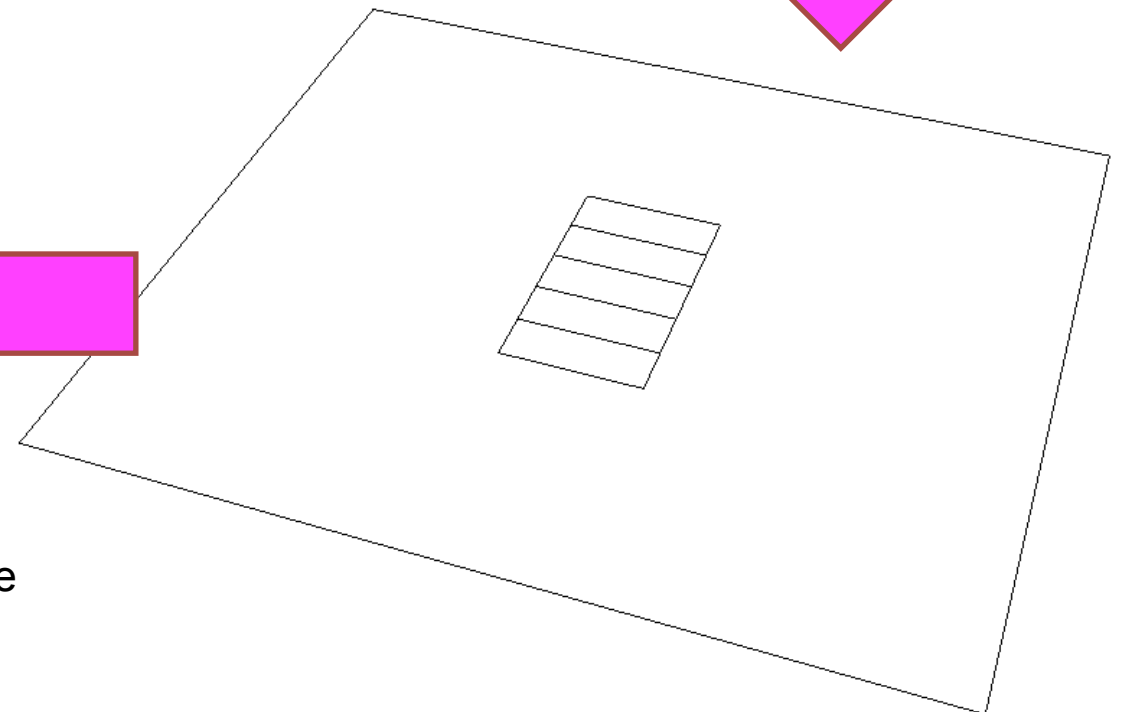
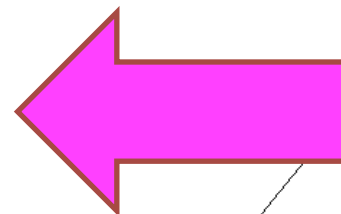
Click on the *move tool*/
Click on the bottom left hand corner of the square
Press Ctrl
Move on top of the last square.



Click on the *move tool*/
Click on the bottom left hand corner of the square
Press Ctrl
Move on top of the last square.
Repeat process until you have four squares
Above the middle square

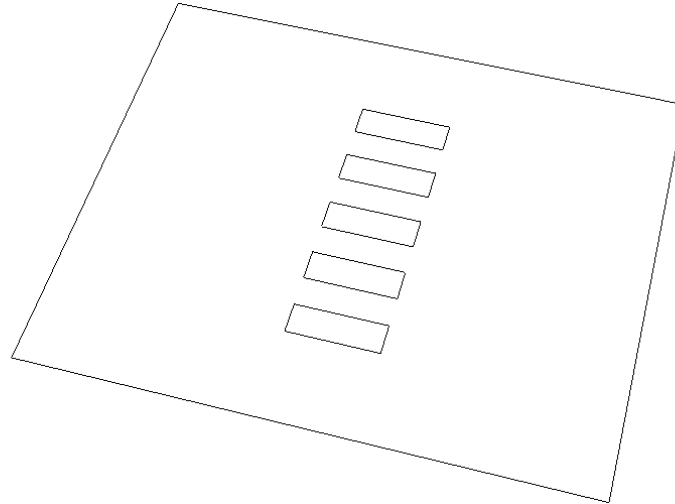


Click on the *move tool*/
Click on the bottom left hand corner of the square
Press Ctrl
Move below the center square
Repeat process until you have four squares
Above the middle square



Computer Aided Design: Aircraft Lamp

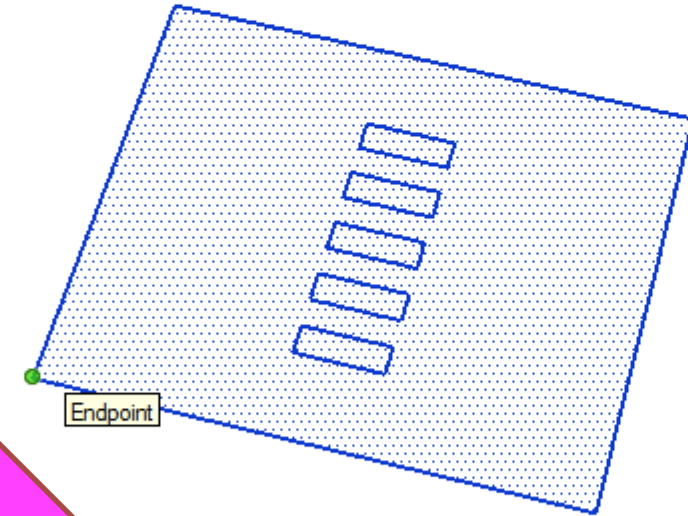
Computer Aided Engineering: Step by Step Guide to Lamp Construction



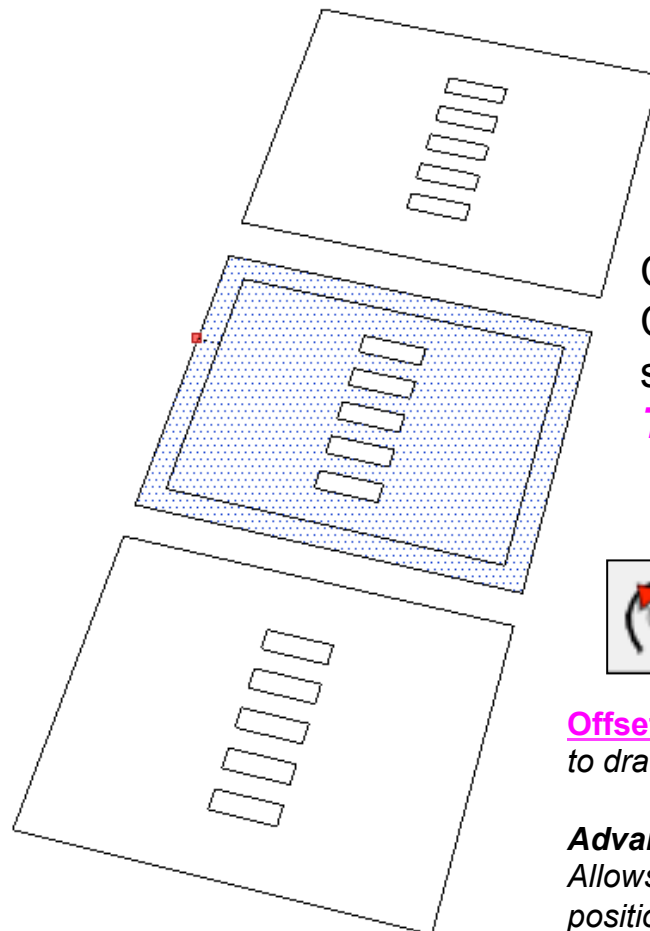
Trim tool allows the user to remove overlapping elements.

Advantages:
Allows user to erase overlapping lines and edges to draw complex 3D shapes very quickly.

Use the **trim tool** to remove the alternative squares either side of the center square.



Click on the square **three times** to highlight as shown.



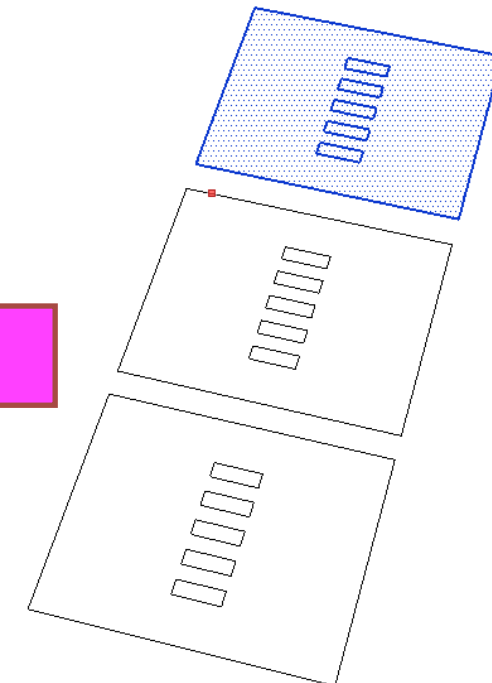
Click on the **offset tool**/
Click on the outside edge of the middle square

Type in 2 and press **enter**



Offset tool You can use the **contour tool** to draw parallel lines or lines within lines.

Advantages:
Allows user to draw duplicate lines and position them within shapes quickly to draw complex 3D shapes very quickly.

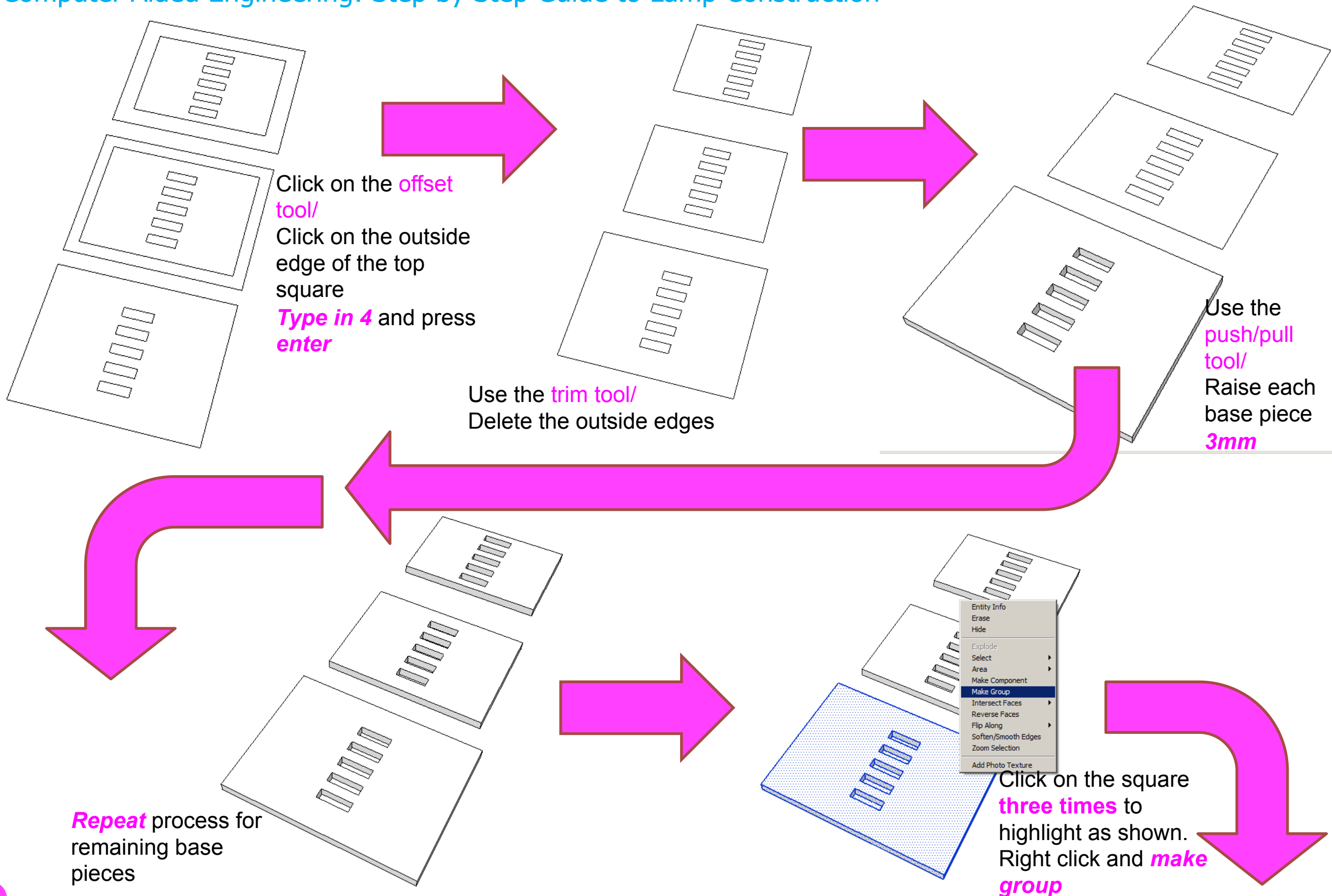


Click on the **move tool**/
Click on the bottom left hand corner of the square
Press Ctrl

Move below the square above the original
Repeat process until you have three square base pieces

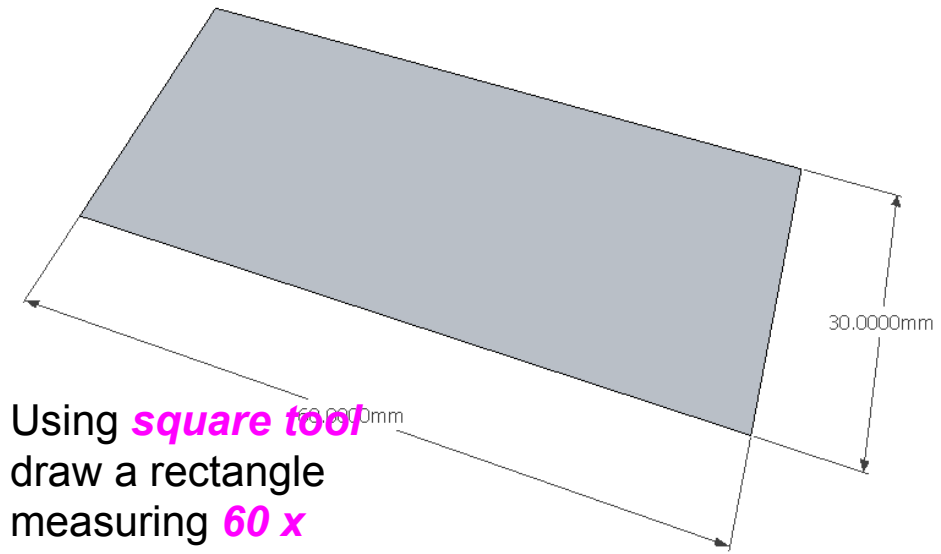
Computer Aided Design: Aircraft Lamp

Computer Aided Engineering: Step by Step Guide to Lamp Construction

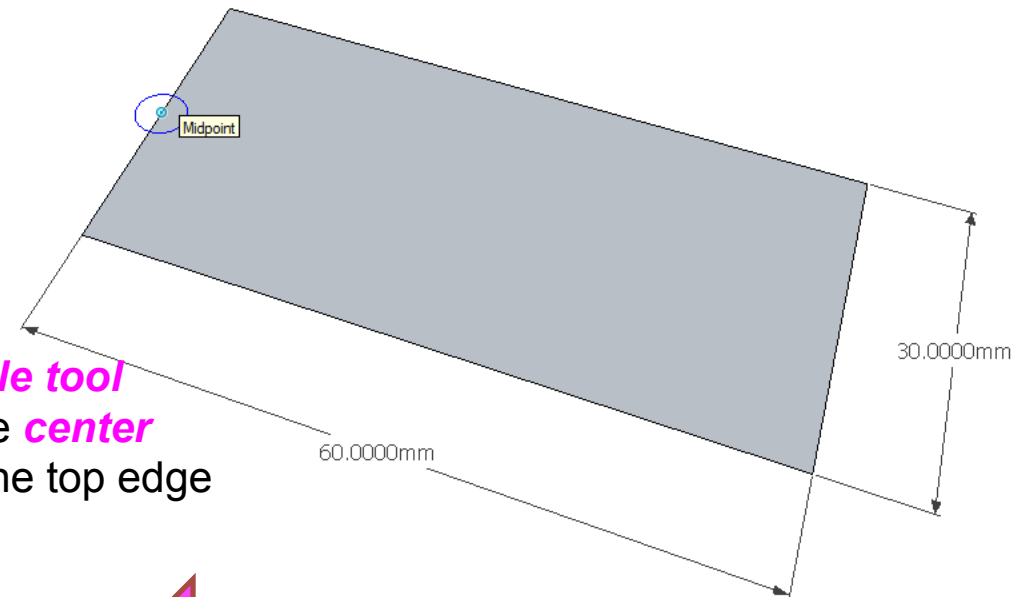
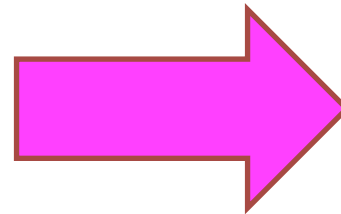


Computer Aided Engineering: Learning Aim A: Task 3

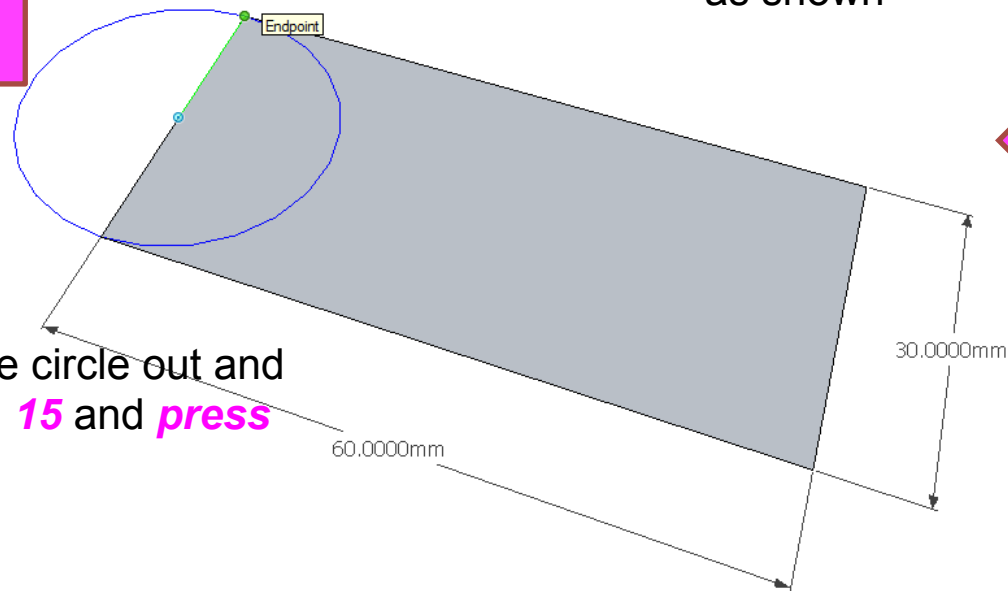
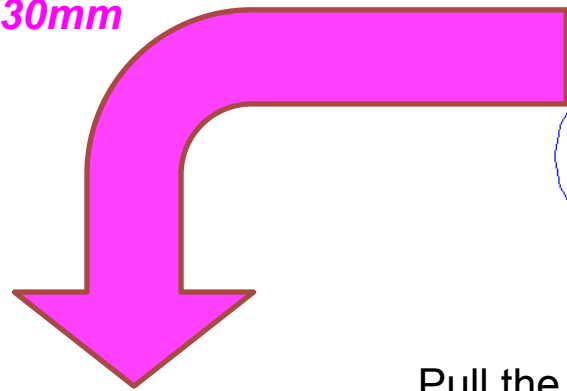
Computer Aided Engineering: 14. Step by Step Guide to Lamp Construction



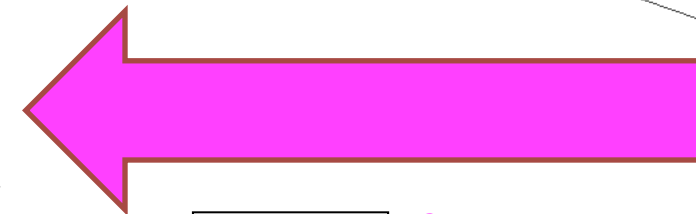
Using **square tool** draw a rectangle measuring **60 x 30mm**



Using **circle tool** snap to the **center point** on the top edge as shown

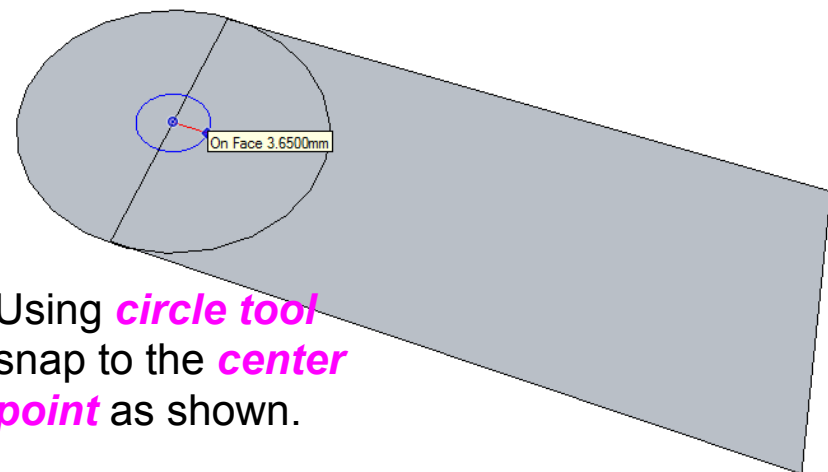


Pull the circle out and type in **15** and **press enter**



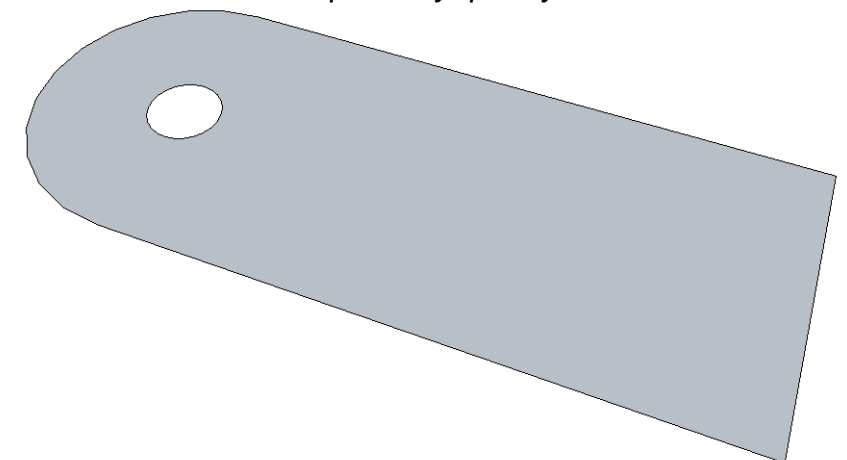
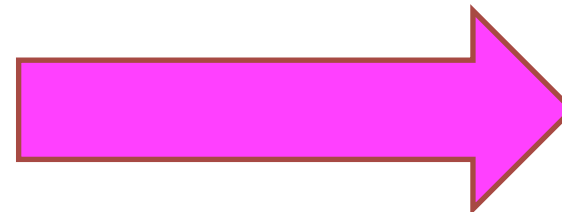
Circle tool allows the user to draw different sized radius circles and chamfered corners

Advantages:
Allows user to draw profiles of shapes and follow the path to draw complex 3D shapes very quickly.



Using **circle tool** snap to the **center point** as shown.

Type in radius **3.675**.



Using **trim tool** delete all the lines no longer needed.

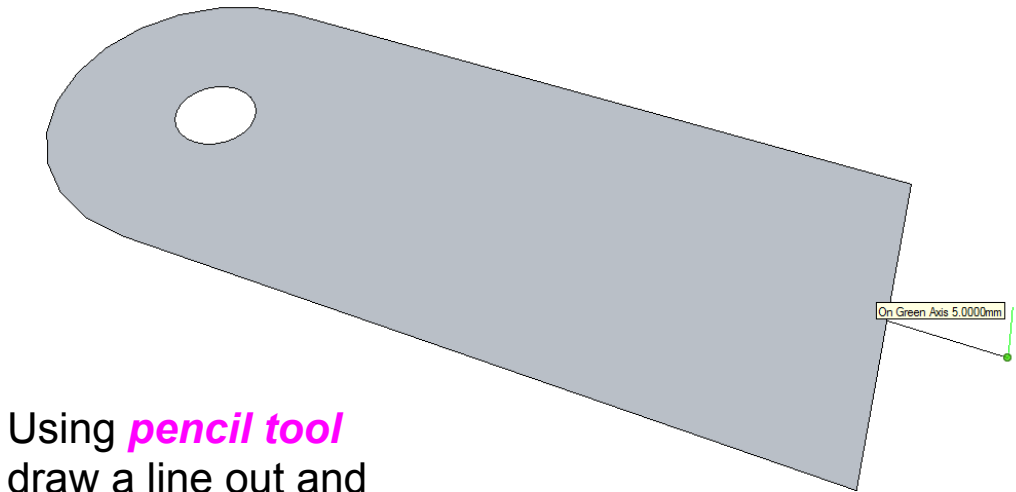
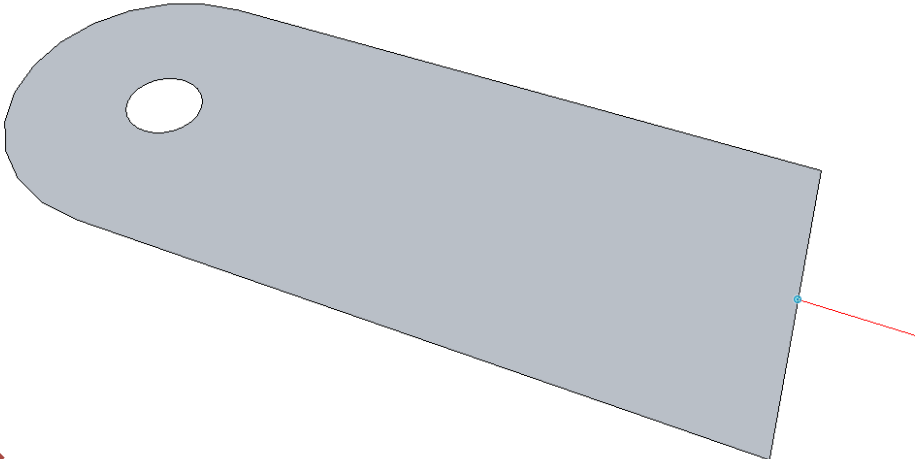
Computer Aided Engineering: Learning Aim A: Task 3

Computer Aided Engineering: 14. Step by Step Guide to Lamp Construction

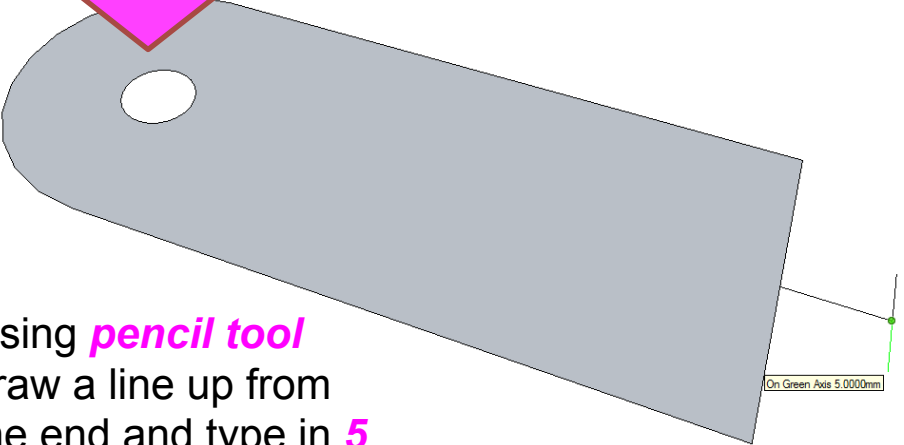
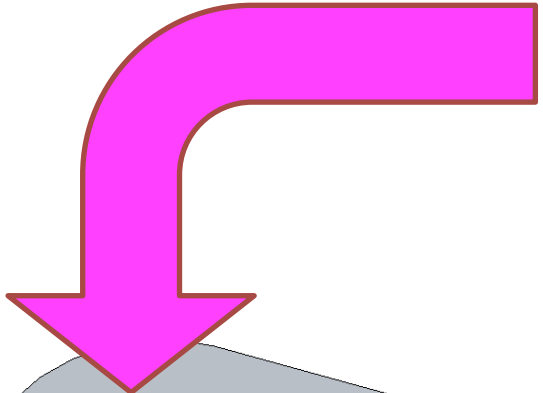
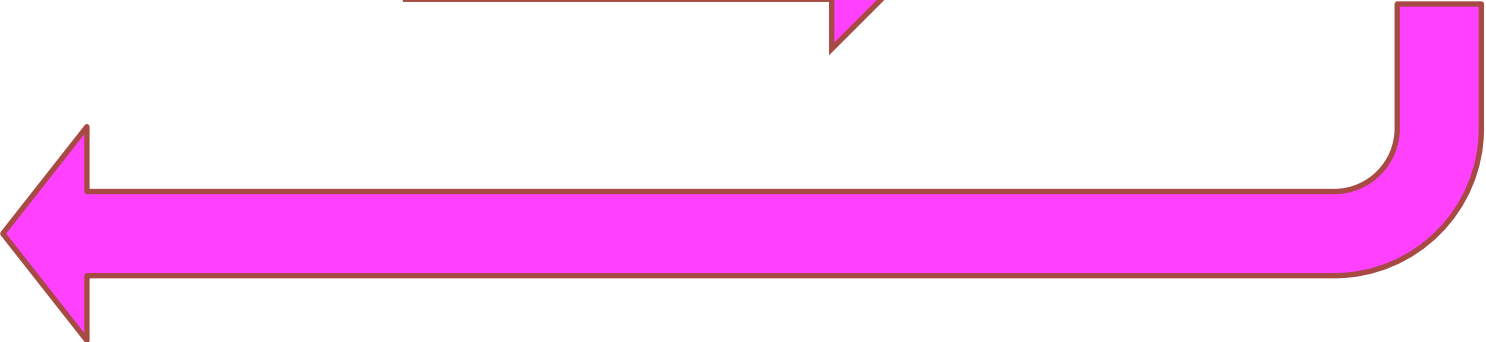


Pencil tool used to draw lines in X, Y and Z direction.

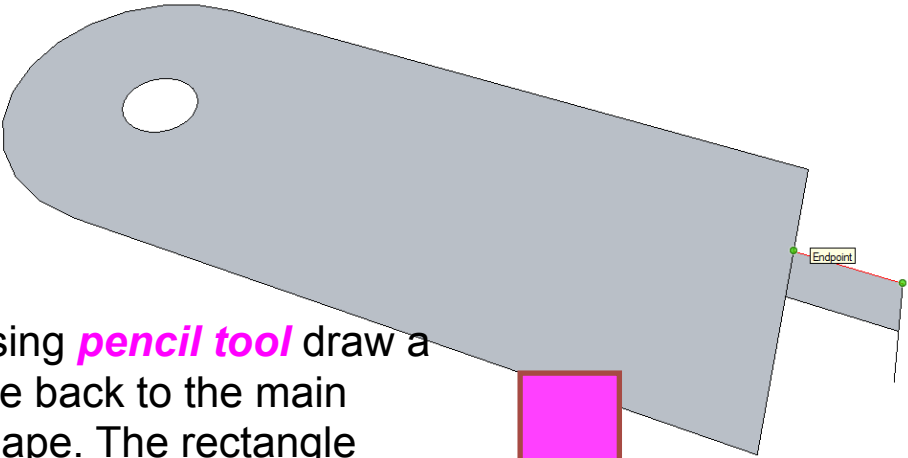
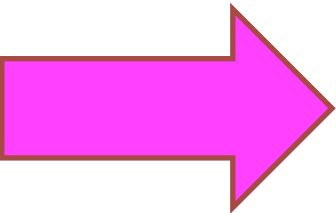
Advantages:
Allows user to draw or modify shapes very quickly and can be used to construct 3D objects faster than traditional hand drawings



Using **pencil tool** draw a line out and type in **9**

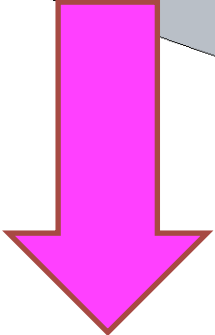


Using **pencil tool** draw a line up from the end and type in **5**



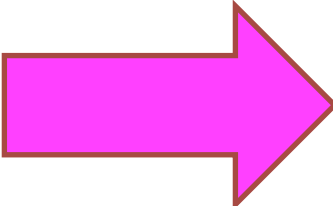
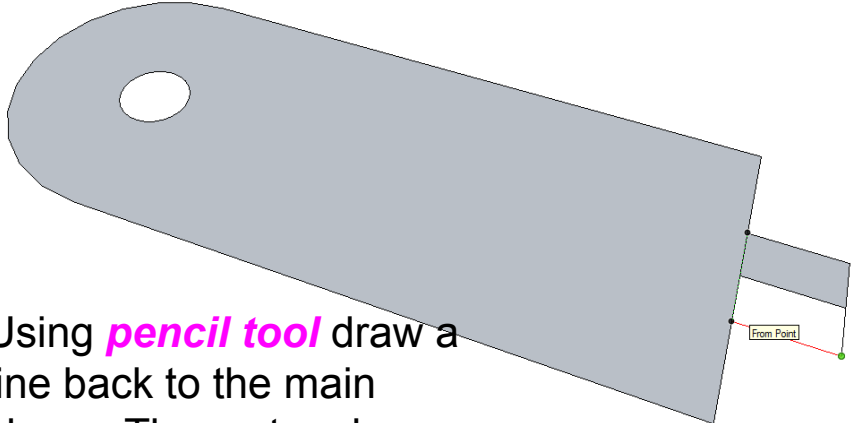
Using **pencil tool** draw a line back to the main shape. The rectangle should fill in grey

Using **pencil tool** draw a line from the center point down **and type in 5**

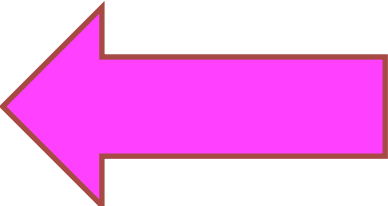
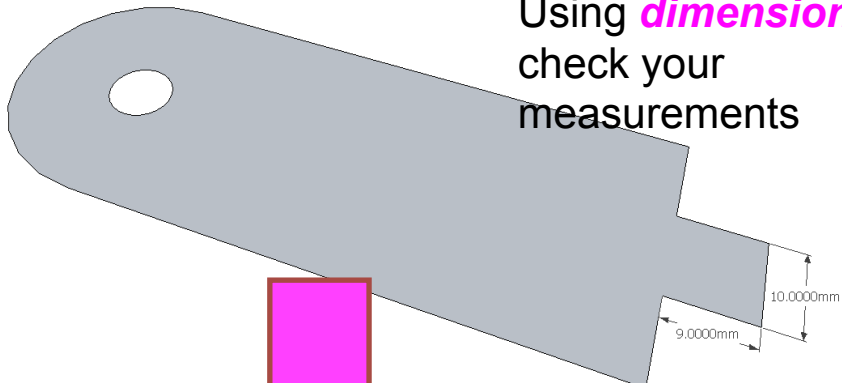
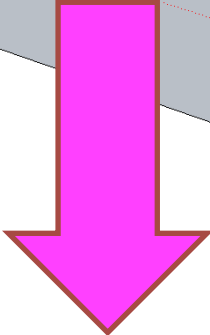
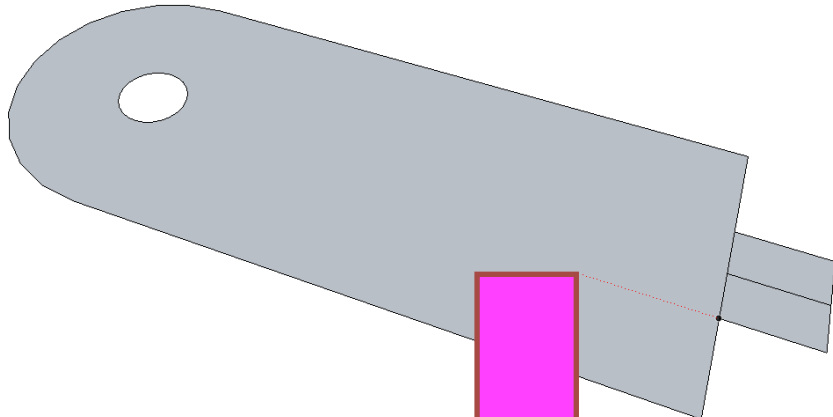


Computer Aided Engineering: Learning Aim A: Task 3

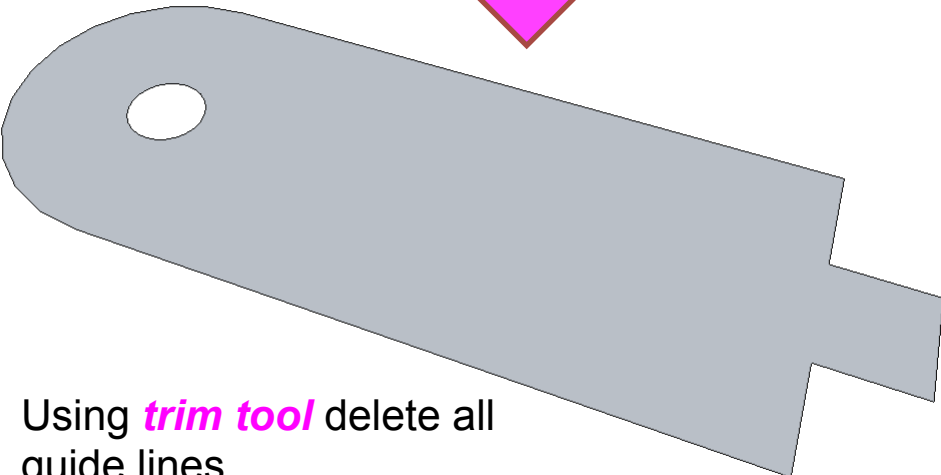
Computer Aided Engineering: 14. Step by Step Guide to Lamp Construction



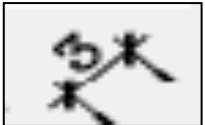
Using **pencil tool** draw a line back to the main shape. The rectangle should fill in grey



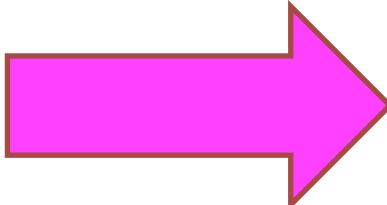
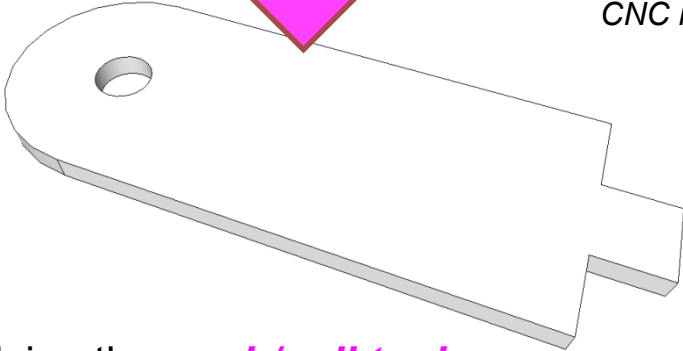
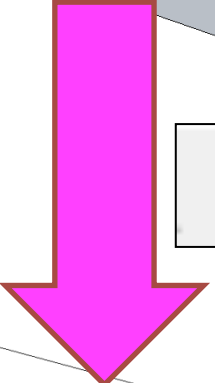
Using **dimensions tool** check your measurements



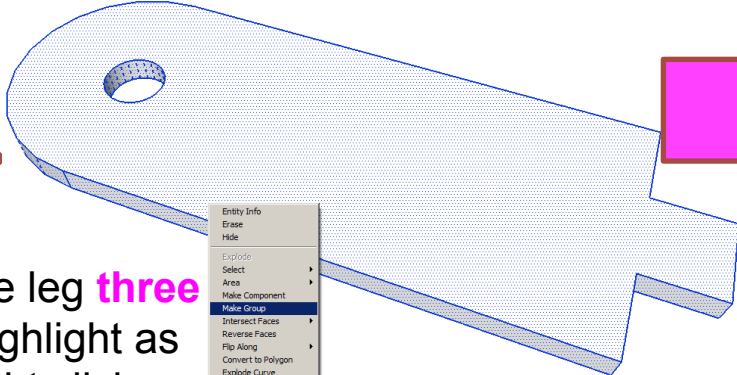
Using **trim tool** delete all guide lines



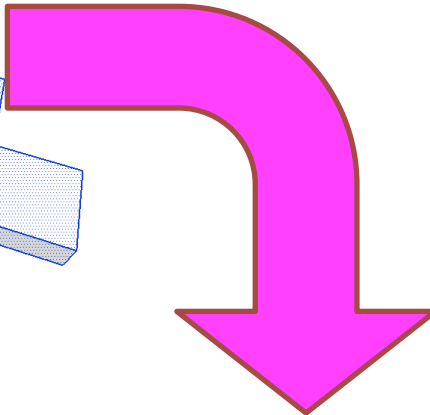
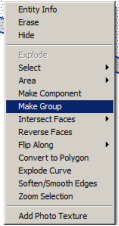
Dimensions tool used to show sizes and radius of drawn objects
Advantages:
Allows user to draw or modify 3D shapes very quickly faster than traditional hand drawings to correct size if drawn incorrectly. Drawing can be transferred onto the CNC machines directly



Using the **push/pull tool** pull the object up by **3**

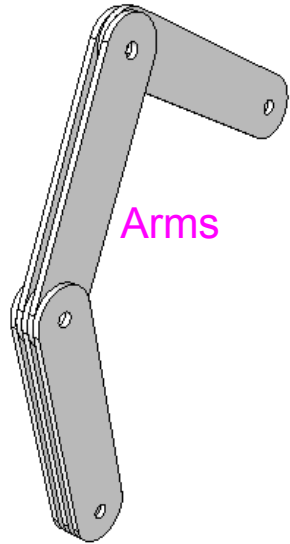


Click on the leg **three times** to highlight as shown. Right click and **make group**



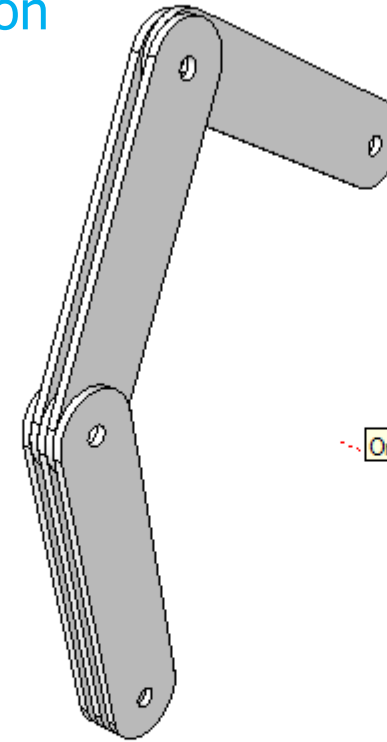
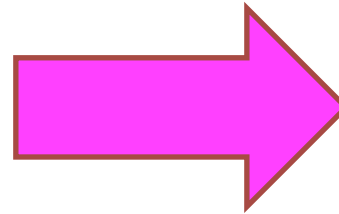
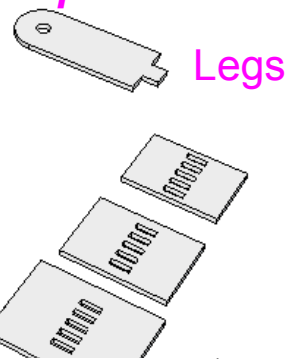
Computer Aided Design: Aircraft Lamp

Computer Aided Engineering: Step by Step Guide to Lamp Construction

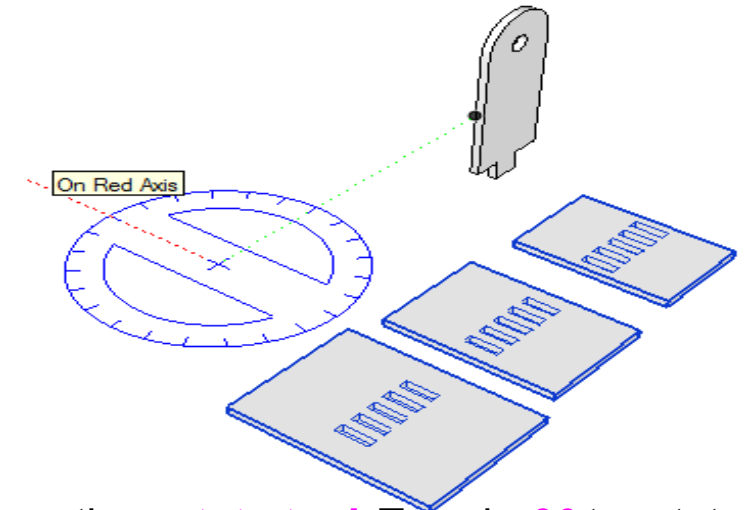
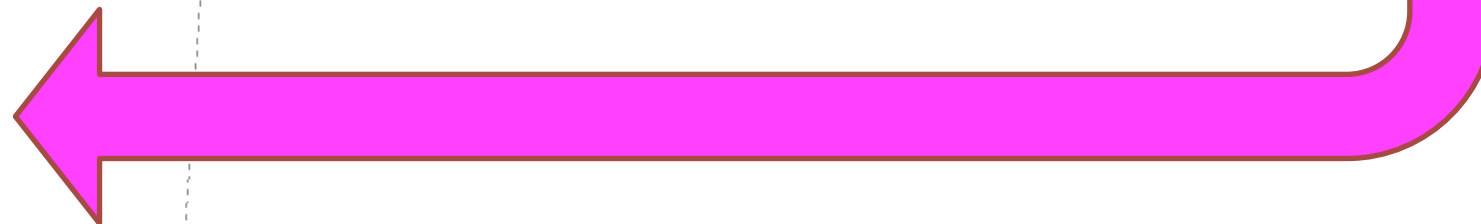
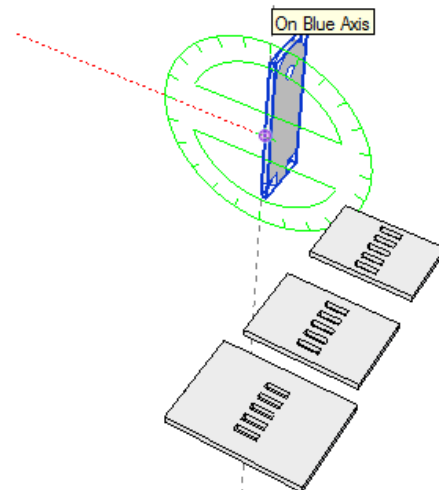
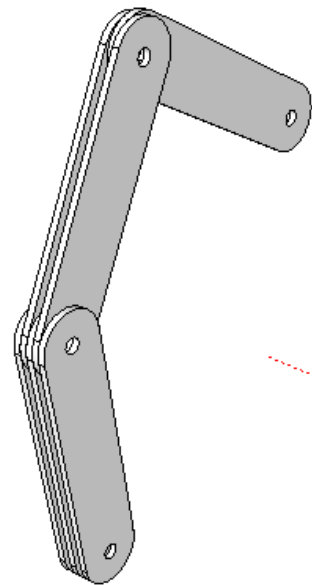
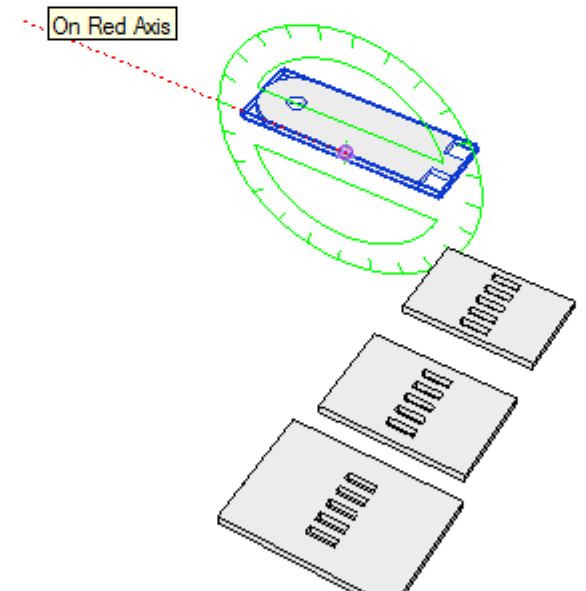


You should have now drawn your lamp legs and your base pieces. Time to arrange and assemble your lamp.

Each individual part should be grouped.

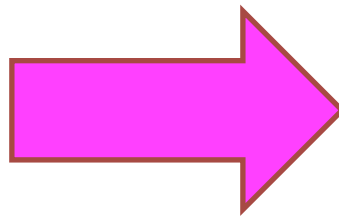


Highlight the leg. Click on the **rotate tool**. When it is either **green** or **red** click to set it.



Pull the line out on either the **green** or **red** axis. Click on the **rotate tool**. Type in **90** to rotate the lamp **90 degrees**.

Click on the **rotate tool**. Type in **90** to rotate the base **90 degrees if needed so the slots line up with the leg**.

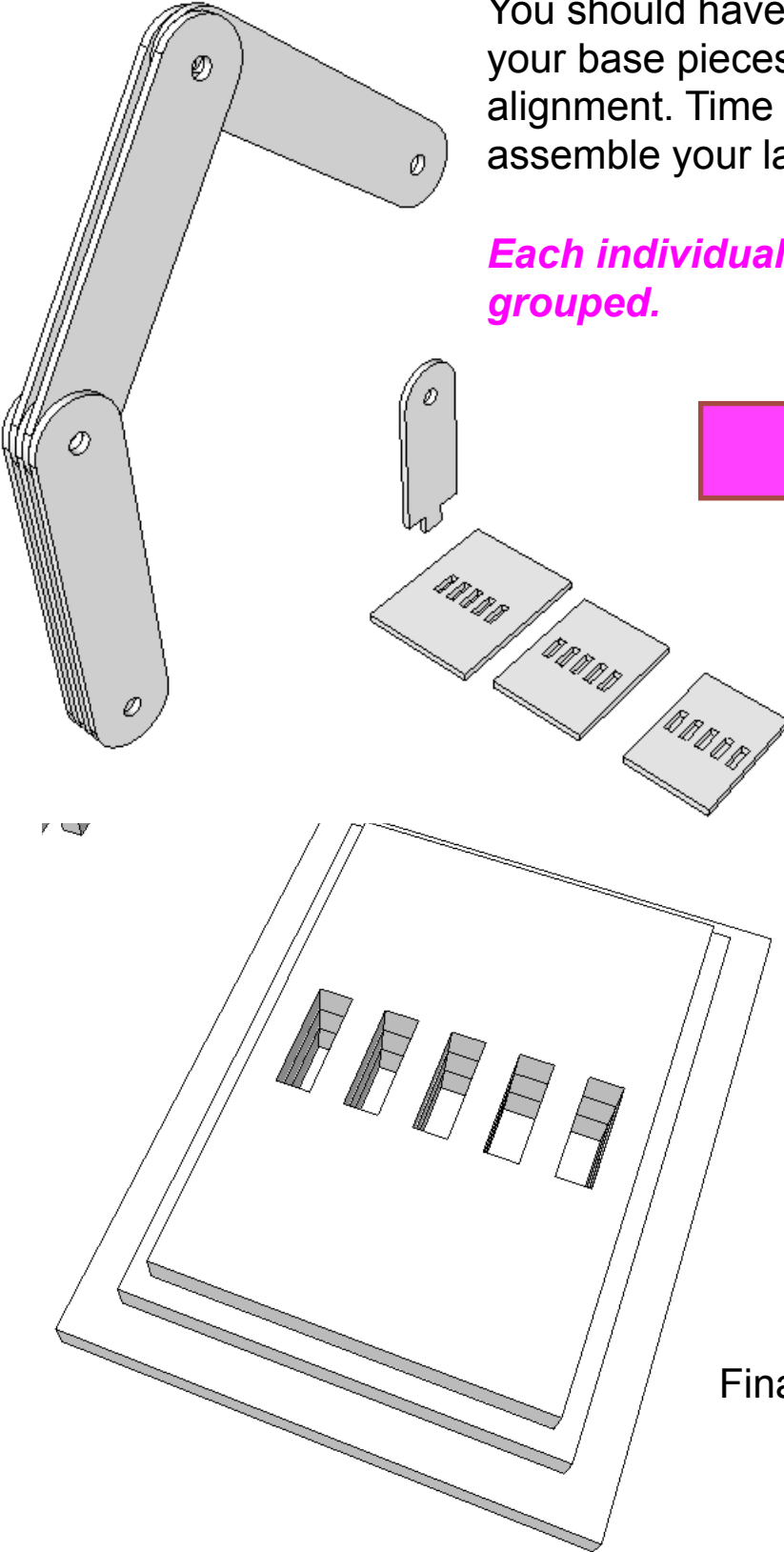


Computer Aided Design: Aircraft Lamp

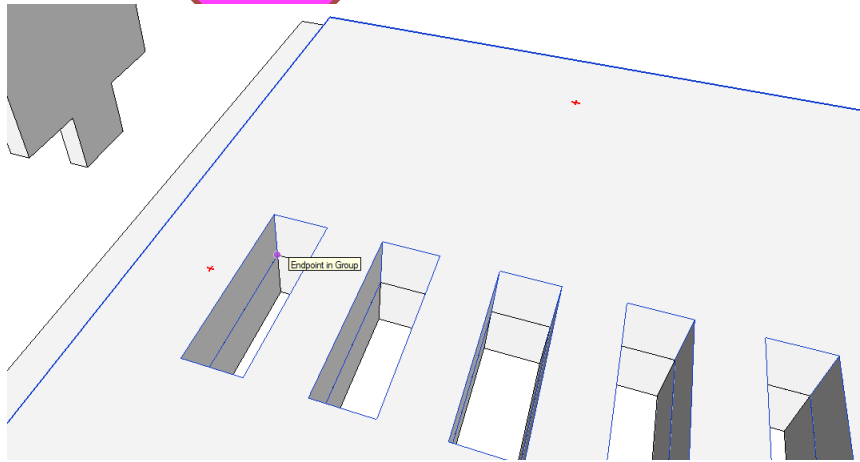
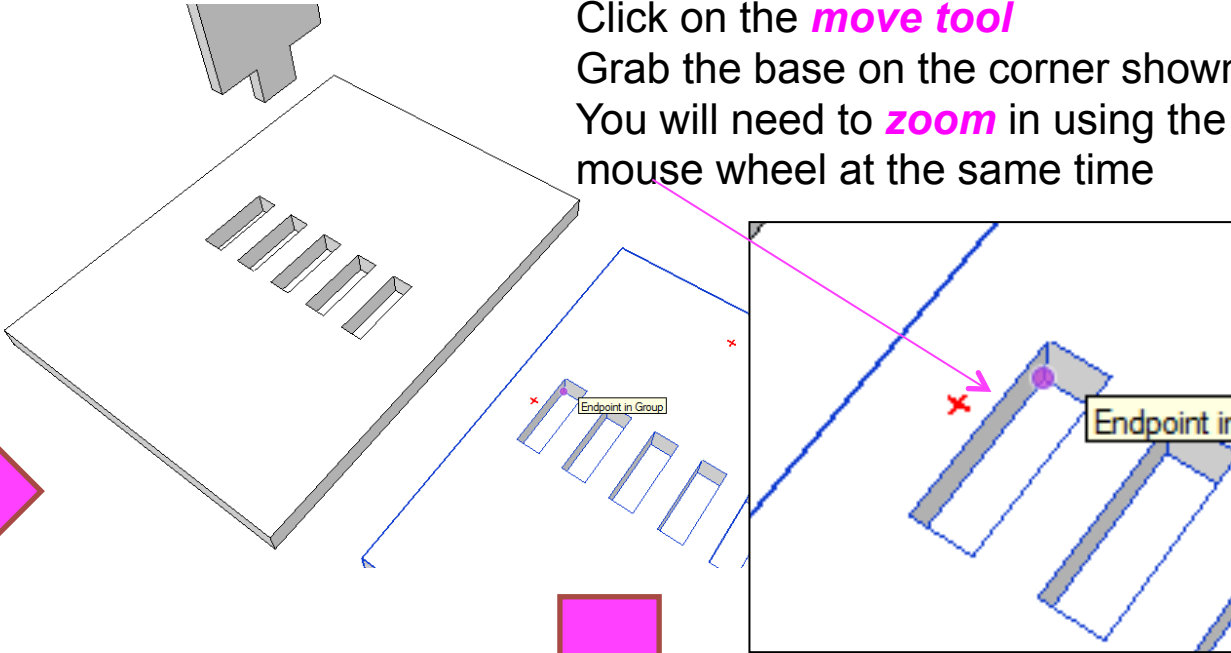
Computer Aided Engineering: Step by Step Guide to Lamp Construction

You should have your lamp legs and your base pieces in the correct alignment. Time to arrange and assemble your lamp.

Each individual part should be grouped.



Select the middle base piece
Click on the *move tool*
Grab the base on the corner shown
You will need to *zoom* in using the mouse wheel at the same time



Align the middle base piece with bottom piece
Using the *move tool sit on top*

Repeat the process with the top base piece

Final stepped base piece

Computer Aided Design: Aircraft Lamp

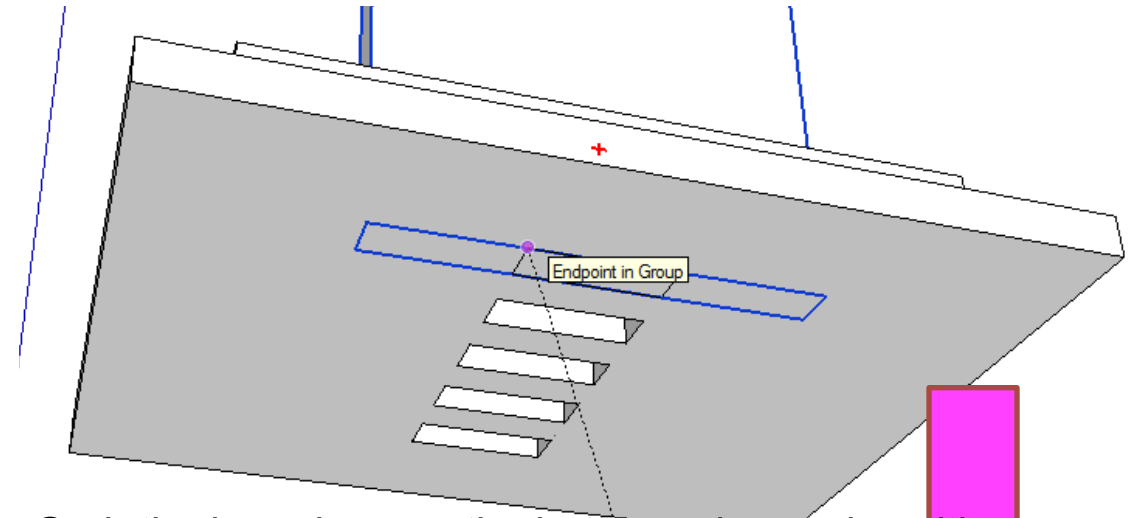
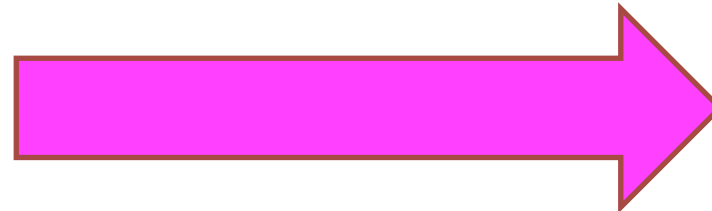
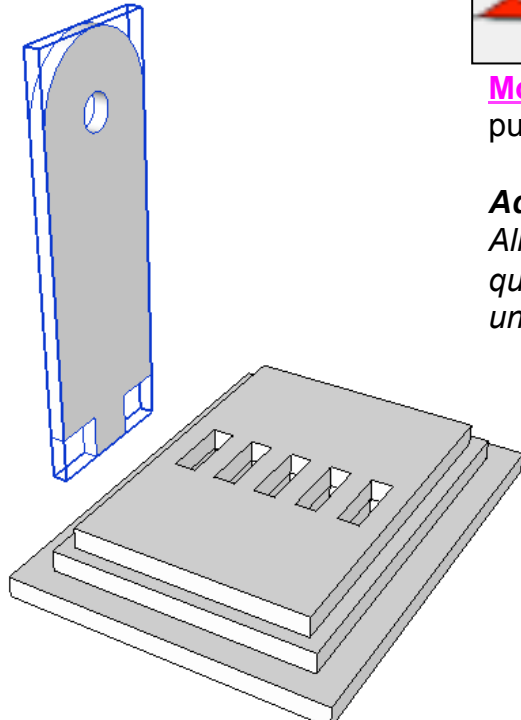
Computer Aided Engineering: Step by Step Guide to Lamp Construction



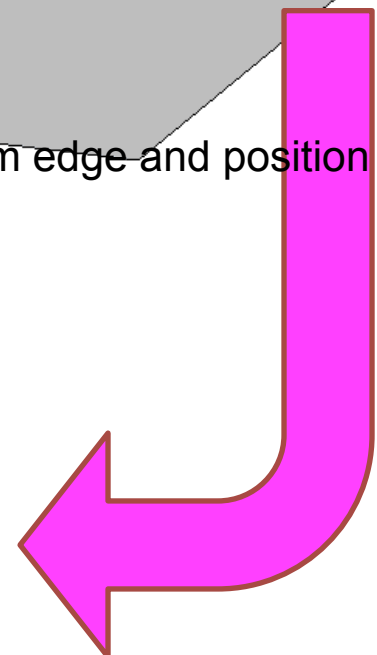
Move Tool used to move entire shapes or pull lines on a drawing.

Advantages:

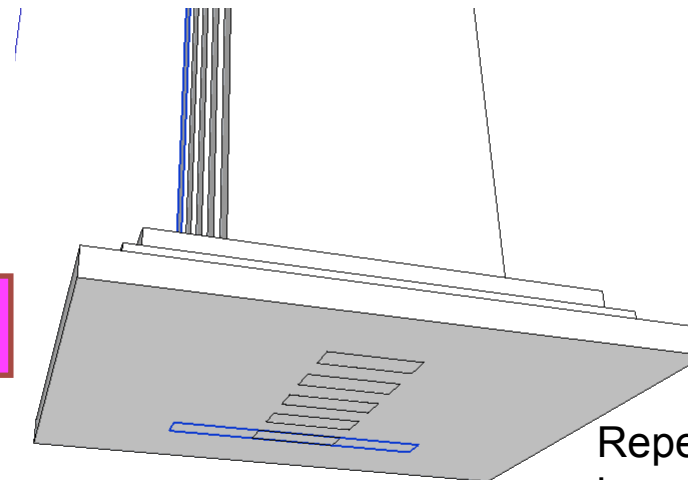
Allows user to draw or modify shapes very quickly and can be used to construct unusual 3D shapes quickly



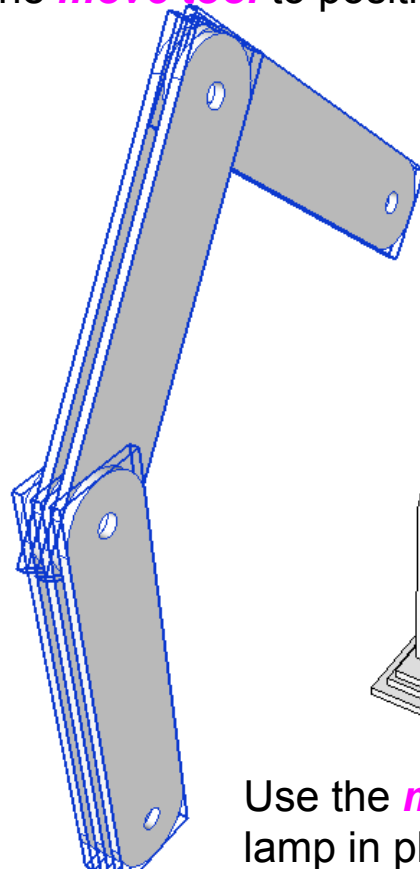
Grab the base legs on the bottom edge and position underneath the base as shown



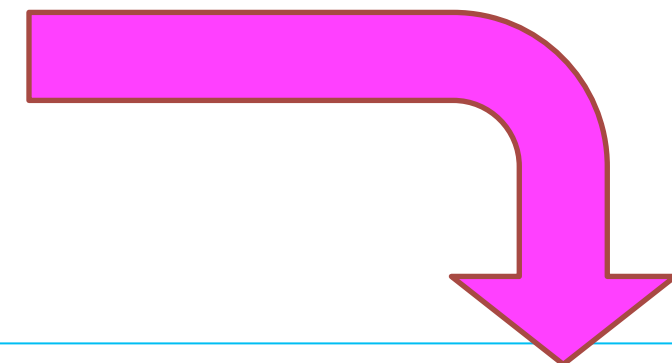
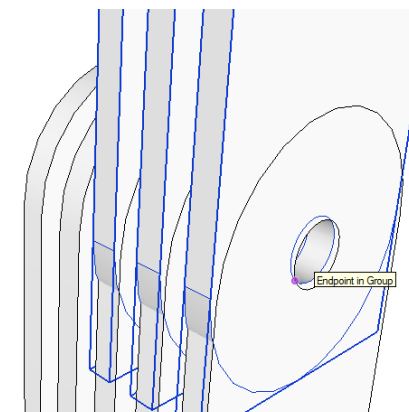
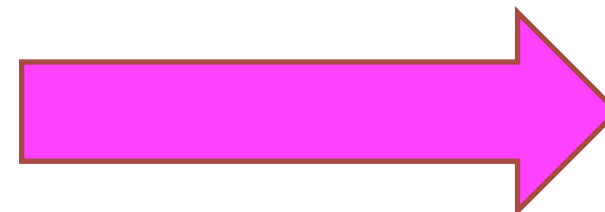
Use the **move tool** to position the base legs in place



Repeat this for the other five base legs as shown.

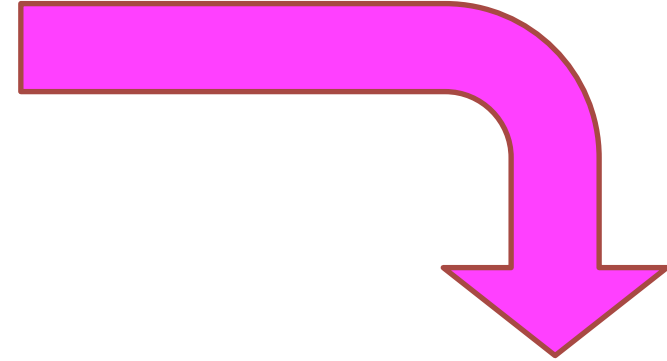
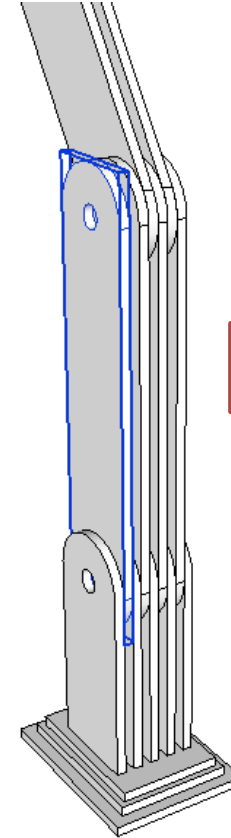
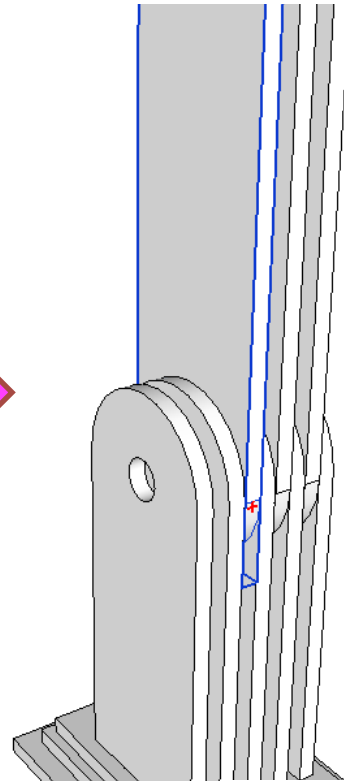
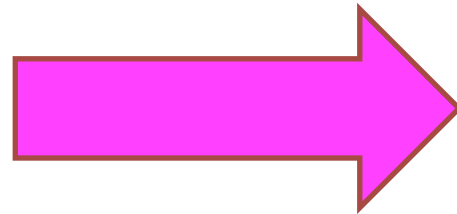
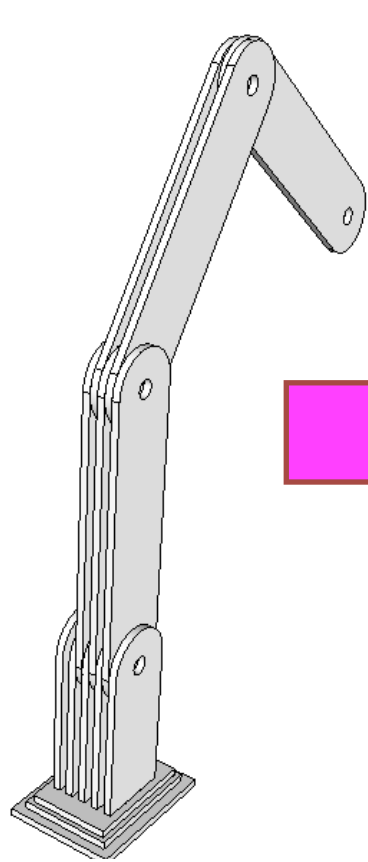


Use the **move tool** to position the lamp in place as shown.

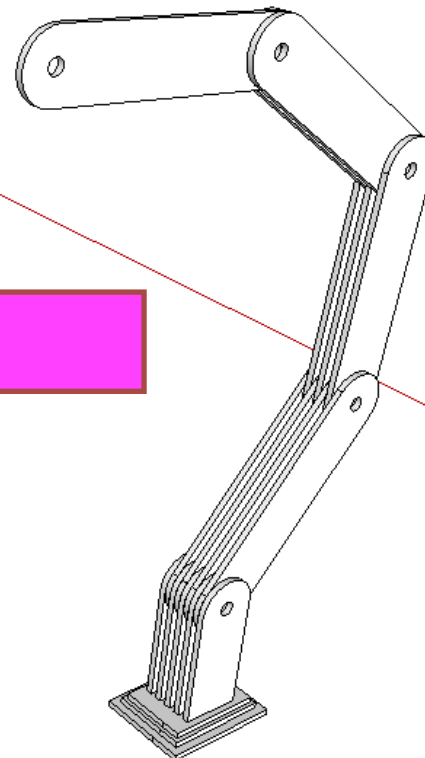
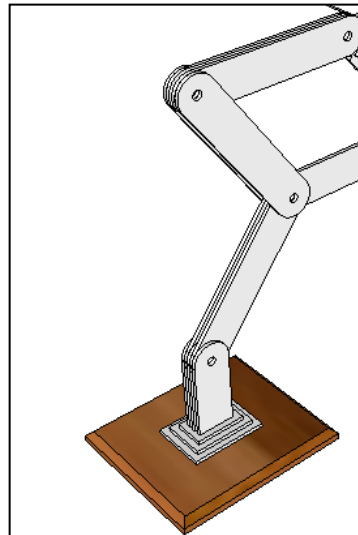


Computer Aided Design: Aircraft Lamp

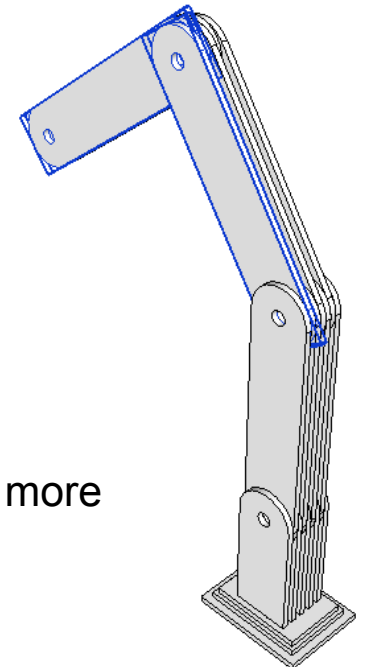
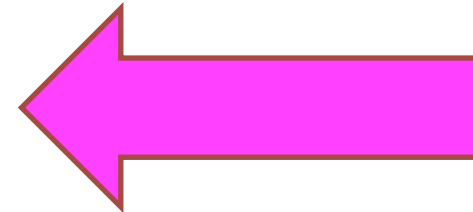
Computer Aided Engineering: Step by Step Guide to Lamp Construction



Use the copy and paste tool and the **move tool** to position the more lamp legs in place



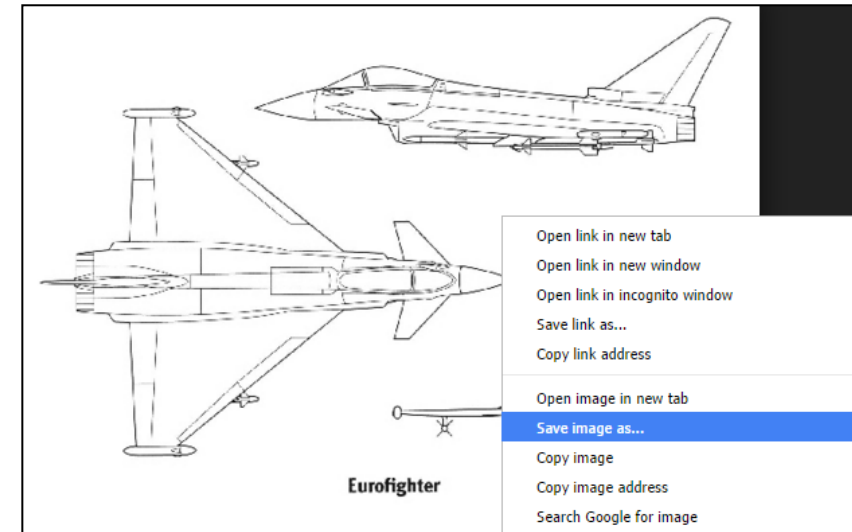
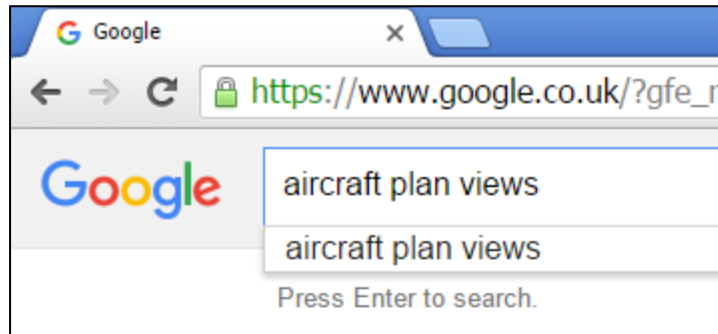
Add more height etc. by adding more legs



Computer Aided Engineering: Learning Aim A: Task 3

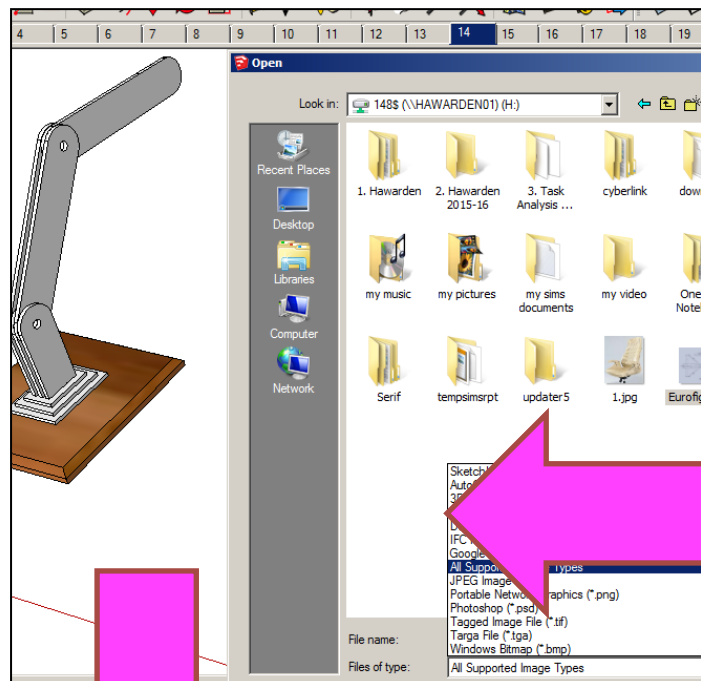
Computer Aided Engineering: 14. Step by Step Guide to Lamp Construction

We now need to add the design to the lamp legs

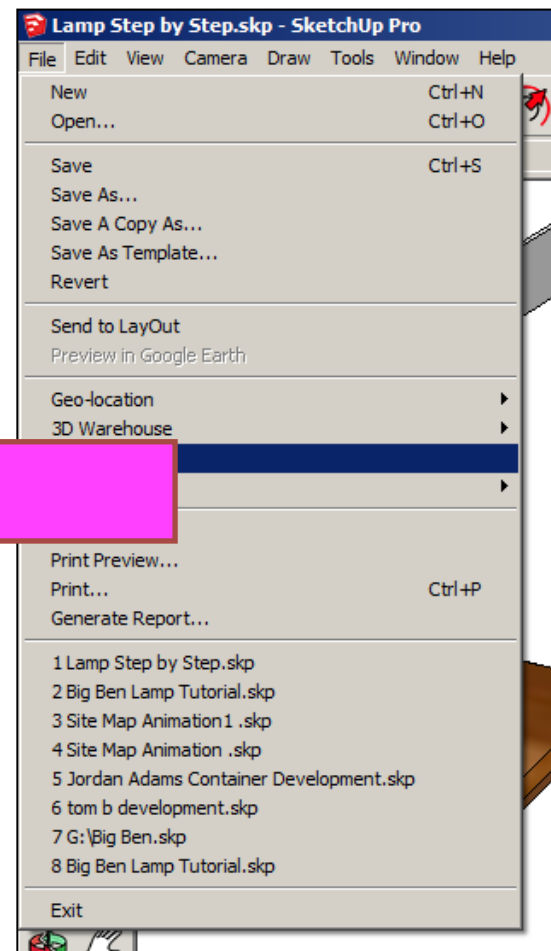


Search Google for *aircraft plan* drawings or 2D drawings

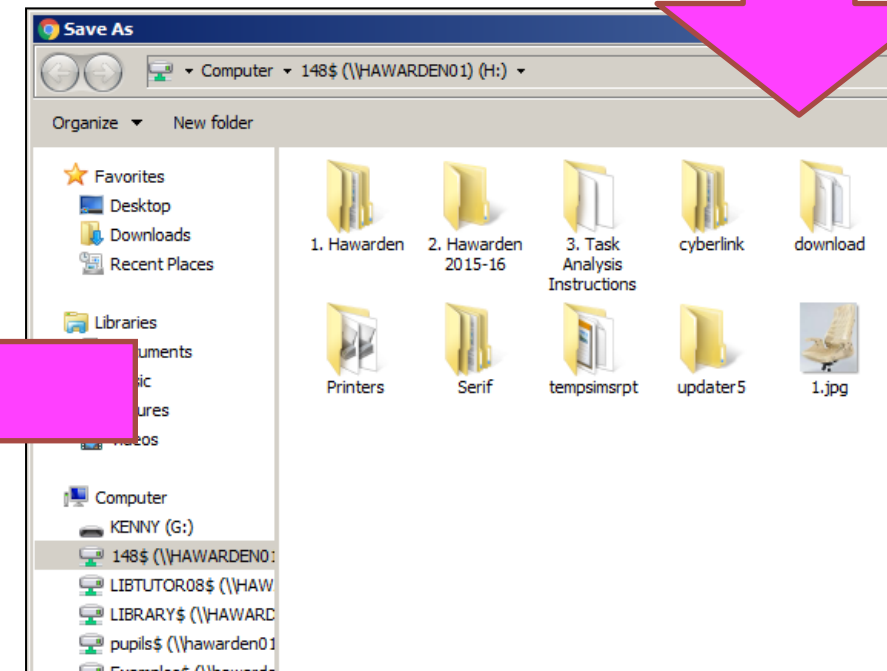
Save image as *JPEG or Bitmap* drawings



Change the file type to all *supported images*



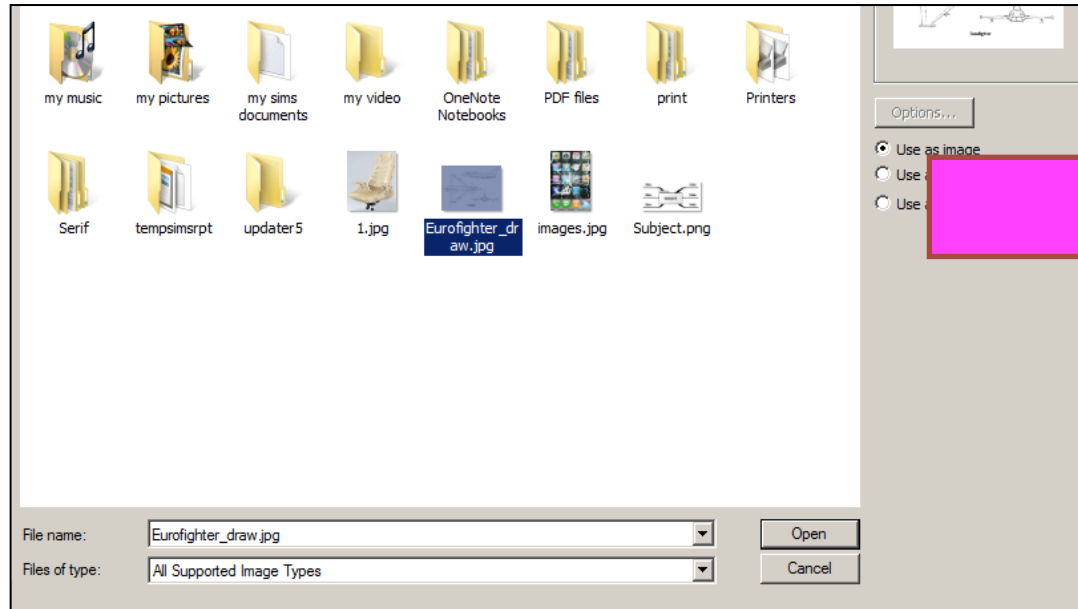
In Sketchup click on *file import*



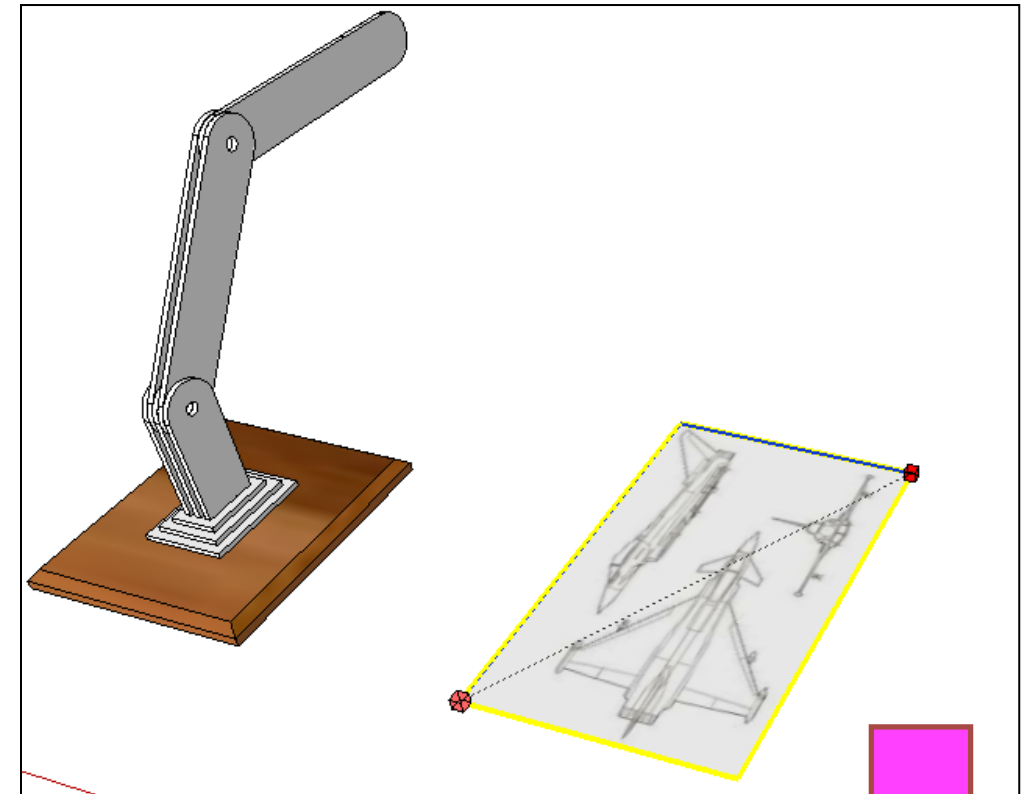
Make a not of where the file is saved in your area

Computer Aided Engineering: Learning Aim A: Task 3

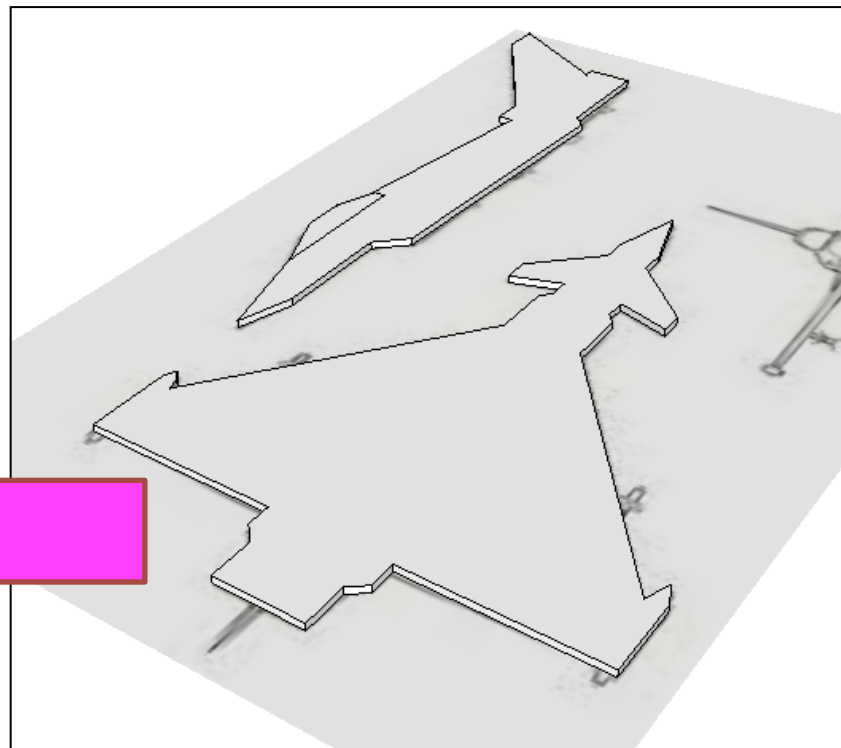
Computer Aided Engineering: 14. Step by Step Guide to Lamp Construction



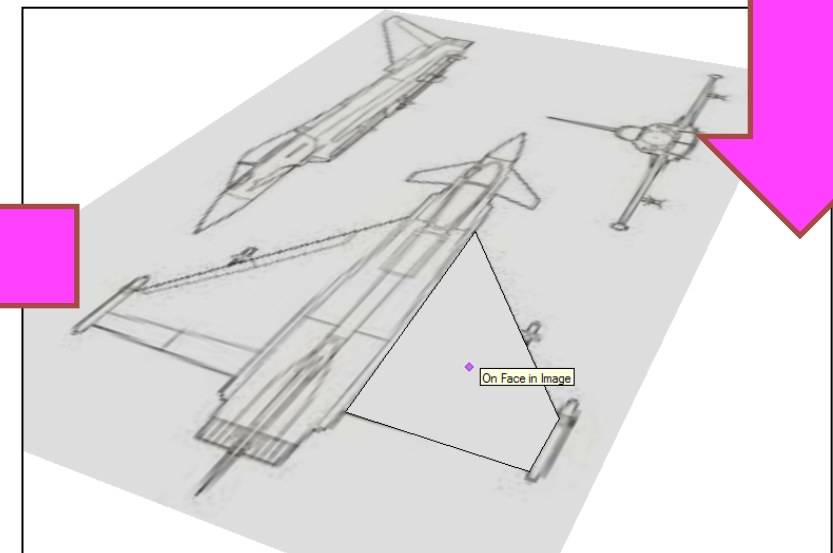
Search for where you saved your file and click *import*



Using the move tool and scale tool, size your image next to your lamp



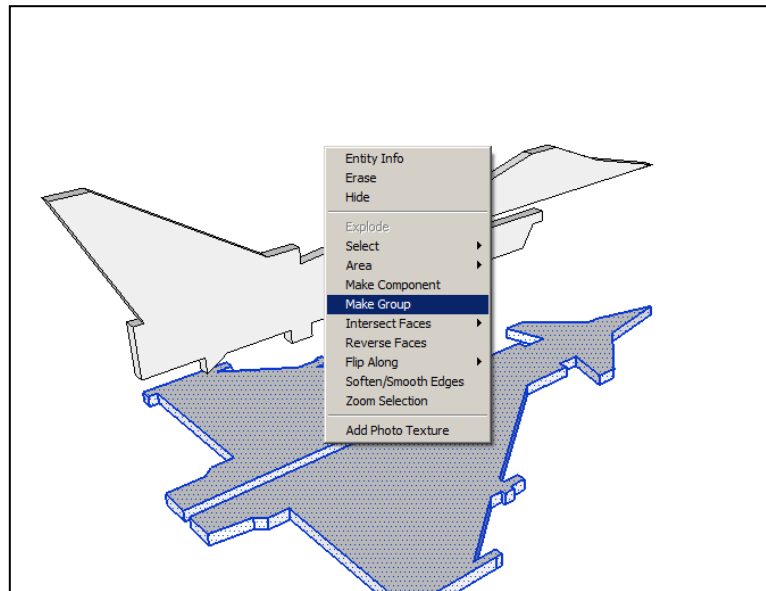
Using the *push pull tool* give the aircraft 4mm thickness



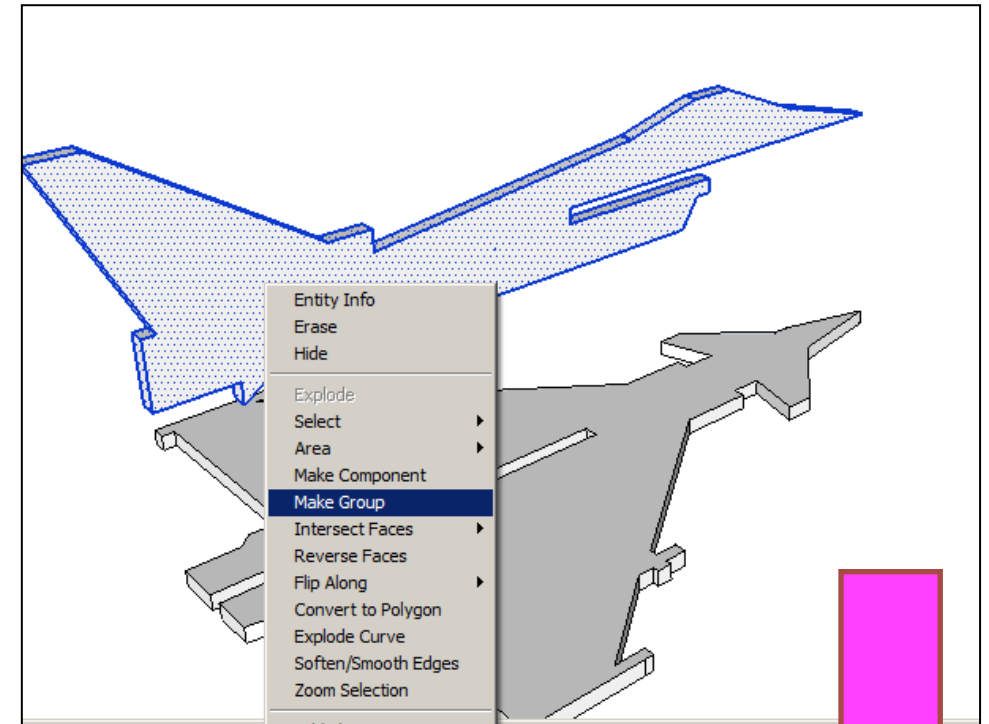
Using the *pencil tool* and the *arc tool* trace the top and side view of the aircraft

Computer Aided Engineering: Learning Aim A: Task 3

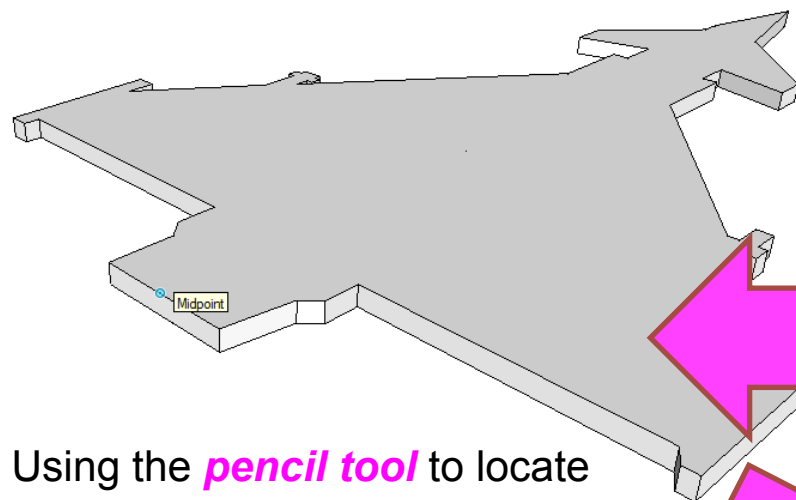
Computer Aided Engineering: 14. Step by Step Guide to Lamp Construction



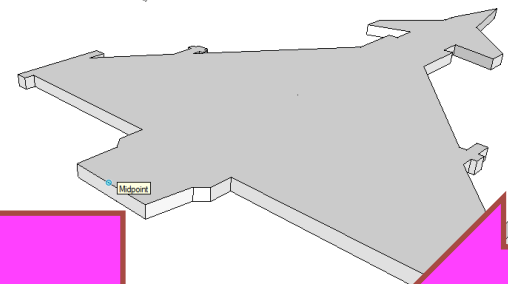
Highlight the base, right click and make group.



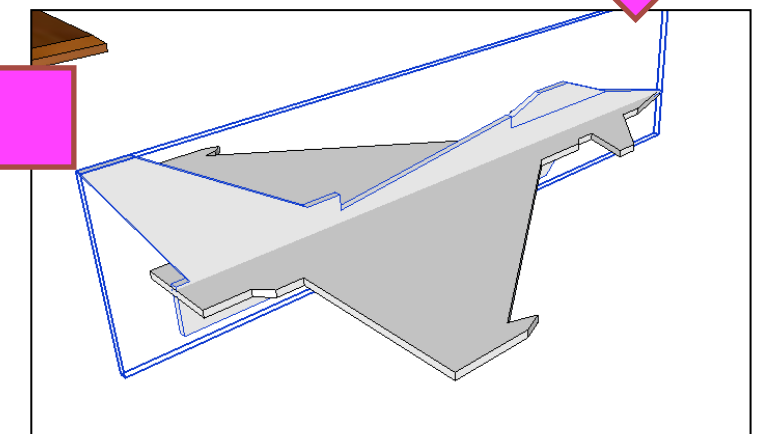
Highlight the side, right click and make group.



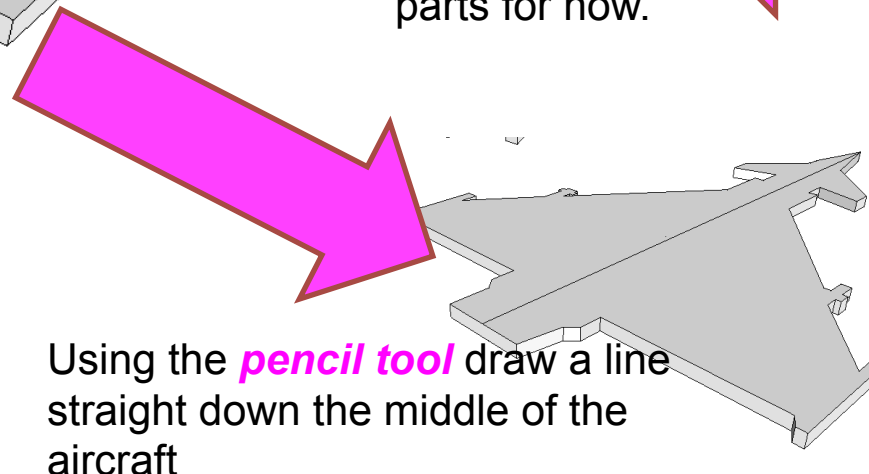
Using the *pencil tool* to locate the center point at the end of the aircraft



Separate the two parts for now.



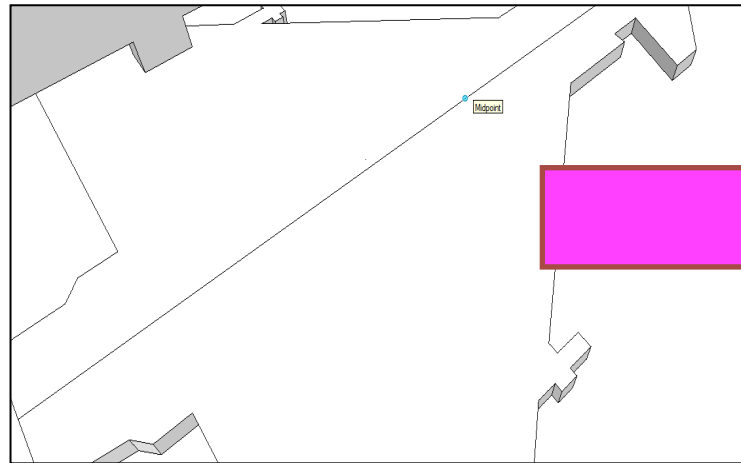
Using the *rotate tool* and rotate the side piece 90 degrees through the green or red axis



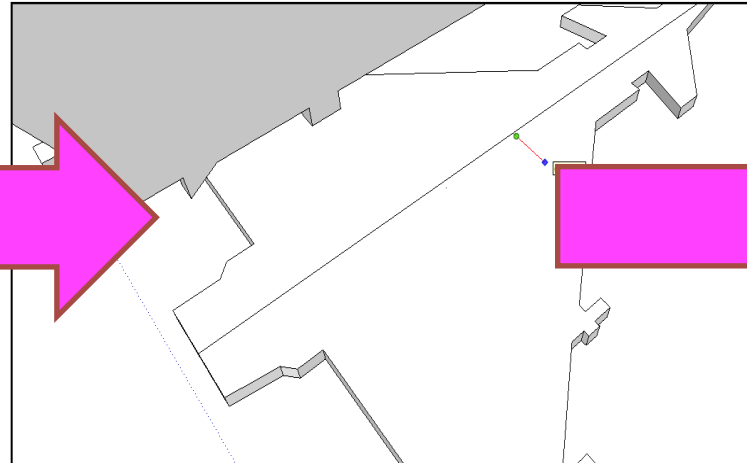
Using the *pencil tool* draw a line straight down the middle of the aircraft

Computer Aided Engineering: Learning Aim A: Task 3

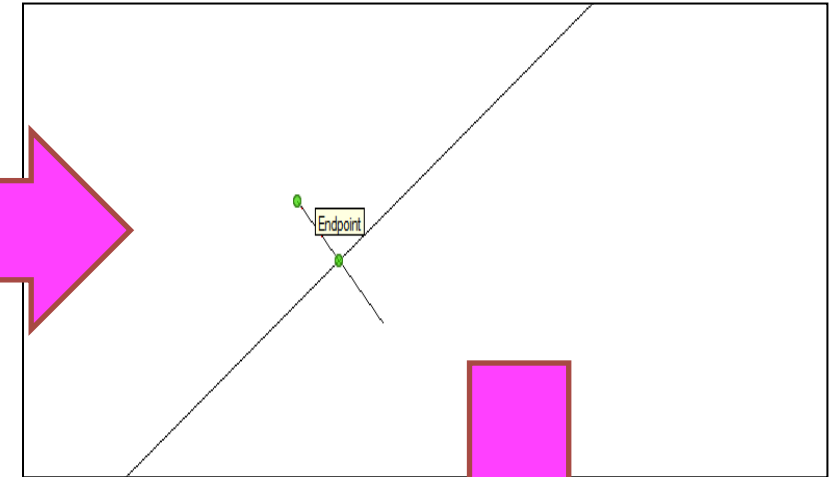
Computer Aided Engineering: 14. Step by Step Guide to Lamp Construction



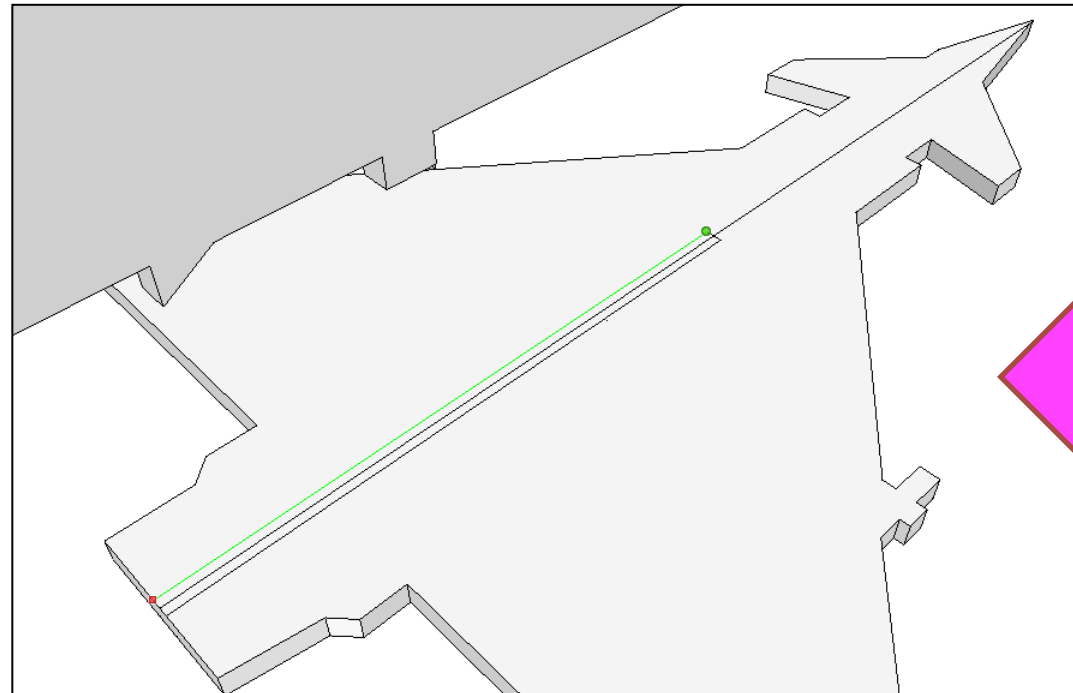
Using the *pencil tool* to locate the center point on the line you have just drawn.



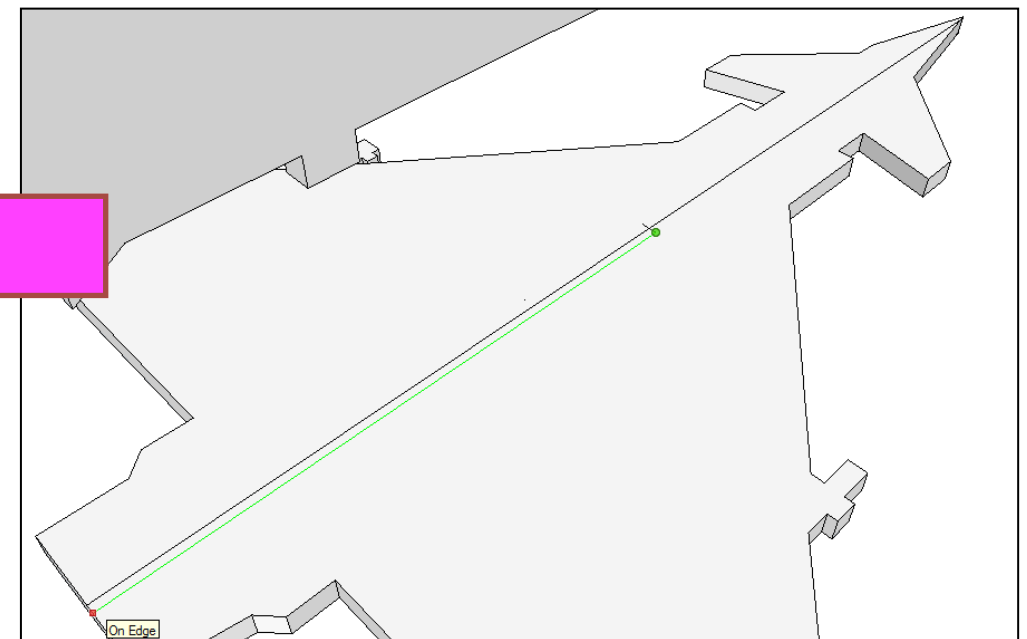
Using the *pencil tool* draw a line out on the red axis and type in 2 and press enter



Repeat the process on the other side of the center line



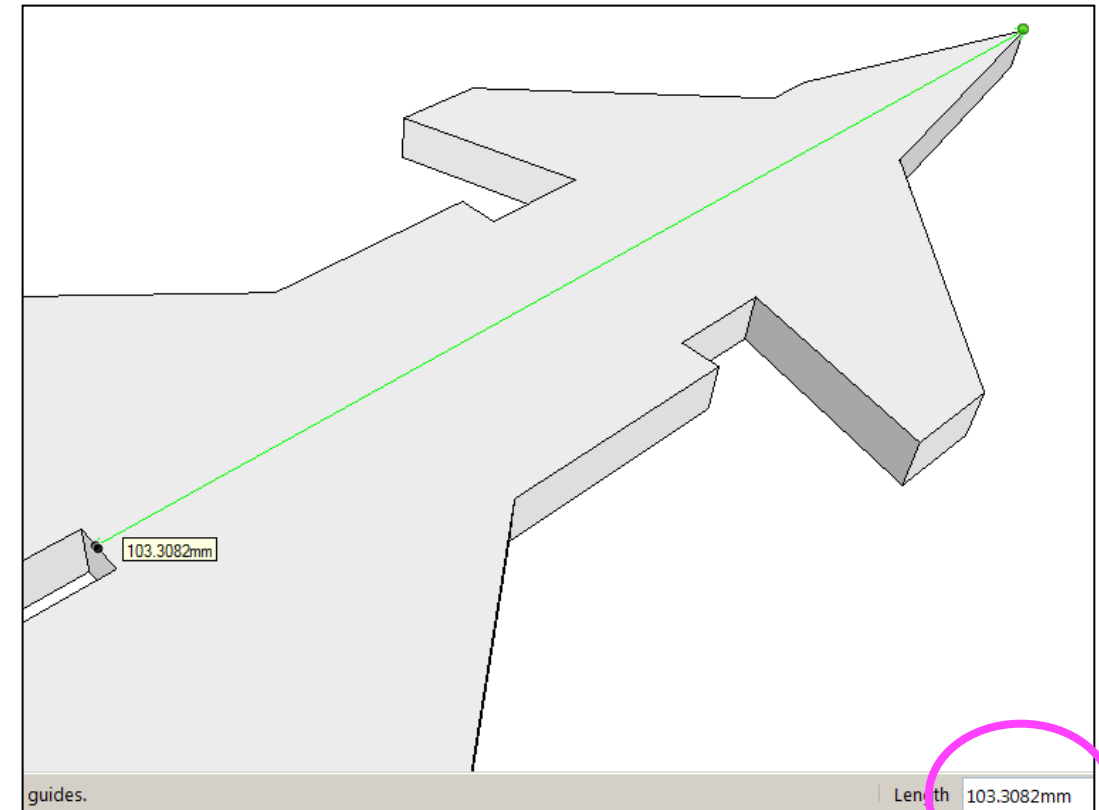
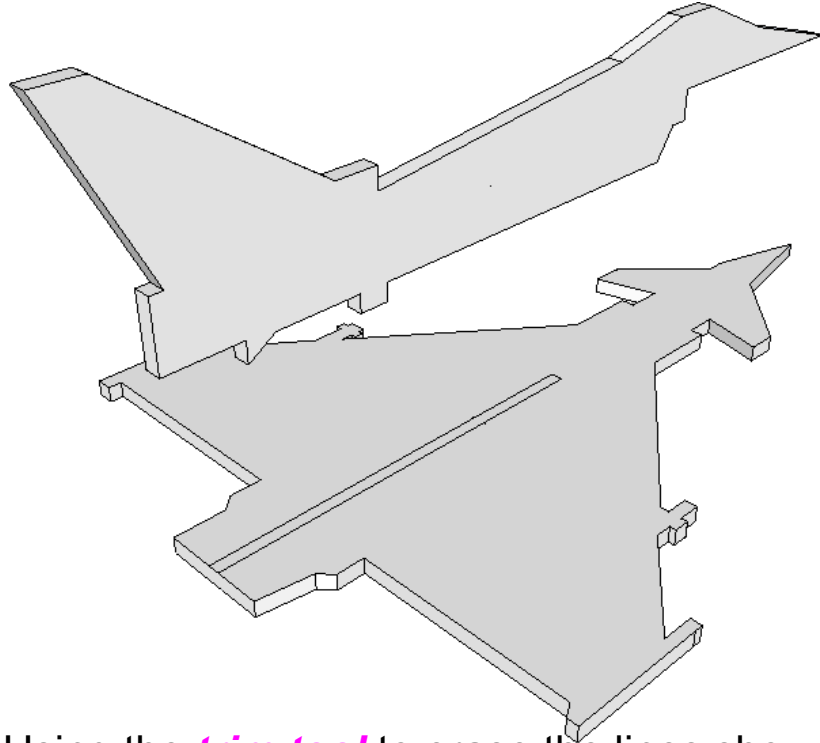
Repeat the process on the other side of the center line



Using the *pencil tool* draw a line from the end of the last mark you made on the green axis to the end of the aircraft

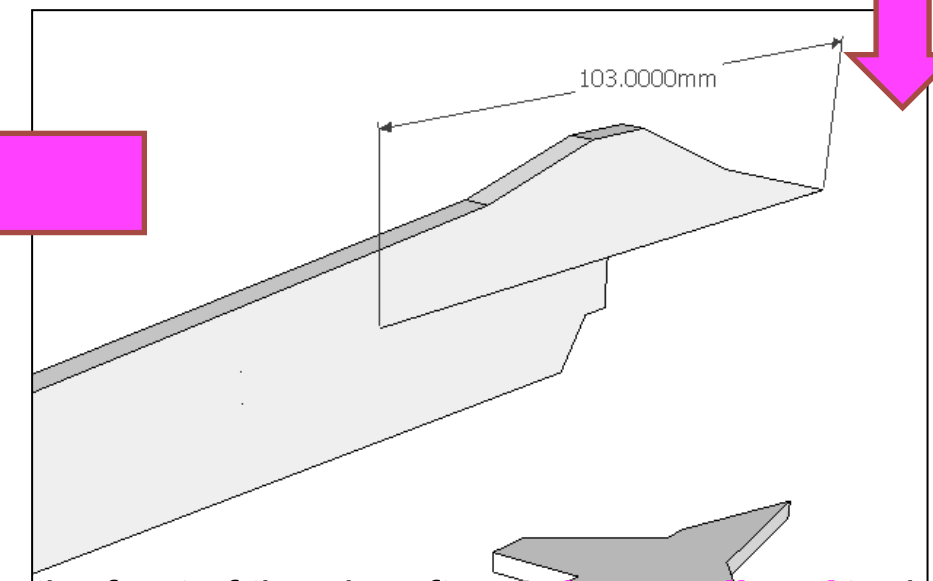
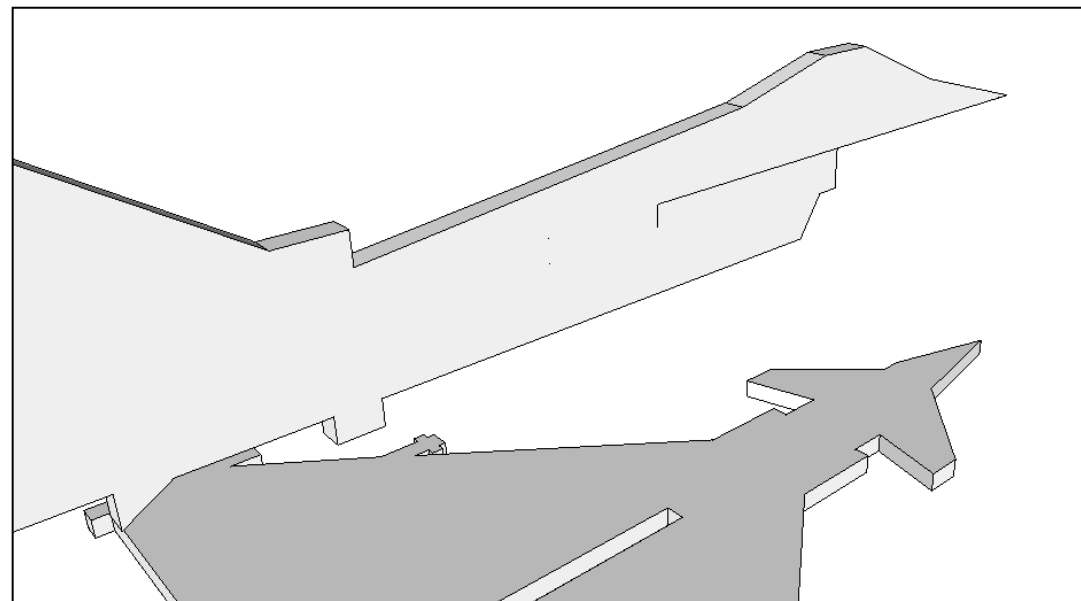
Computer Aided Engineering: Learning Aim A: Task 3

Computer Aided Engineering: 14. Step by Step Guide to Lamp Construction



Using the **trim tool** to erase the lines shown and use the push pull tool to add the slot shown

Using the **tape measure tool** to measure from the center of the slot to the front of the aircraft. Note the size circled

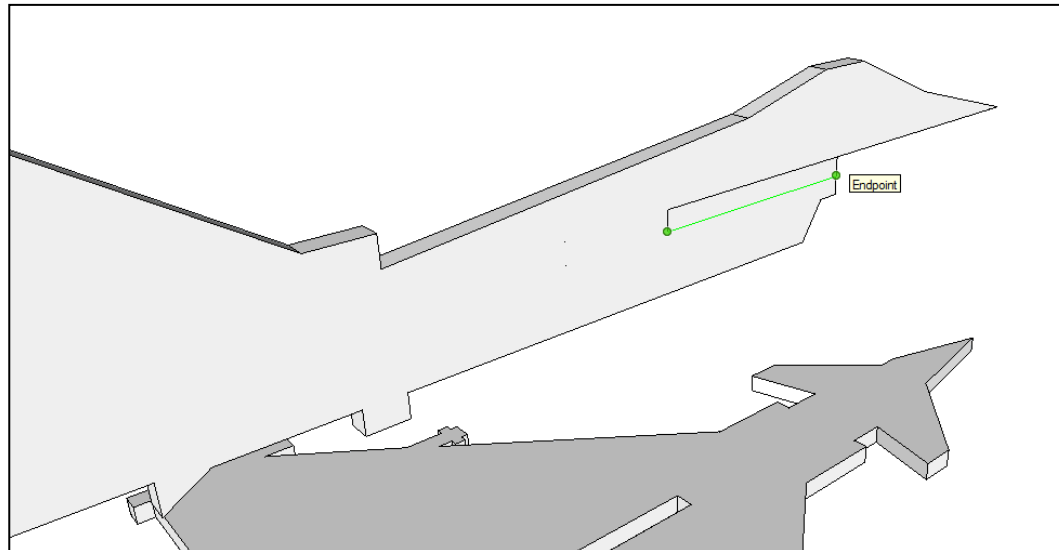


Using the **pencil tool** to draw a line down. Type in 4 and press enter

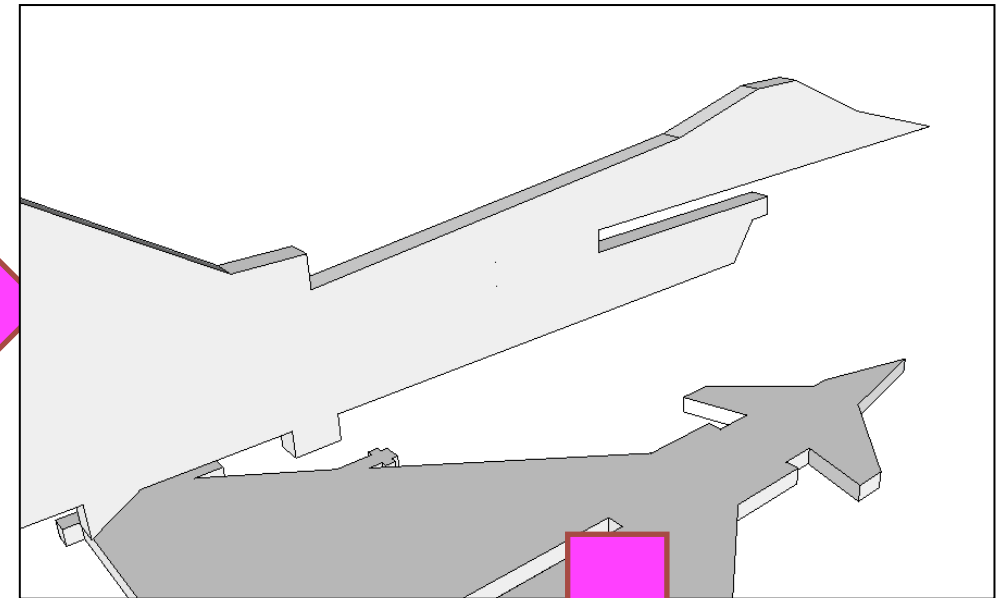
From the front of the aircraft use **the pencil tool** to draw a line back on the green axis and type in the length identified above.

Computer Aided Engineering: Learning Aim A: Task 3

Computer Aided Engineering: 14. Step by Step Guide to Lamp Construction



Using the *pencil tool* to complete the slot as shown



Using the *push/pull tool* to remove the material as shown

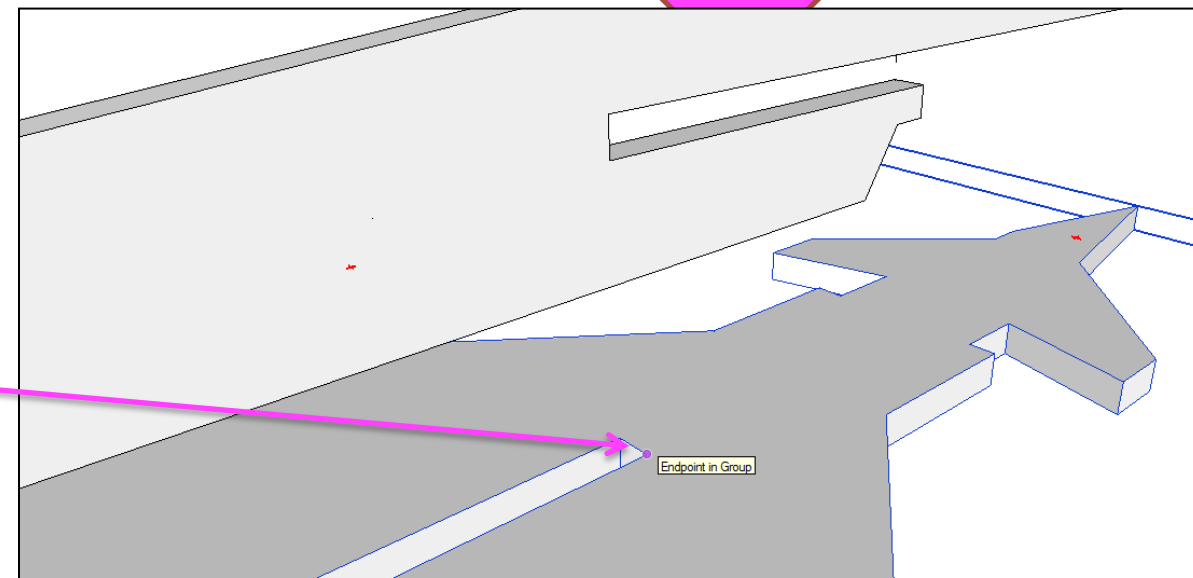


Move Tool used to move entire shapes or pull lines on a drawing.

Advantages:

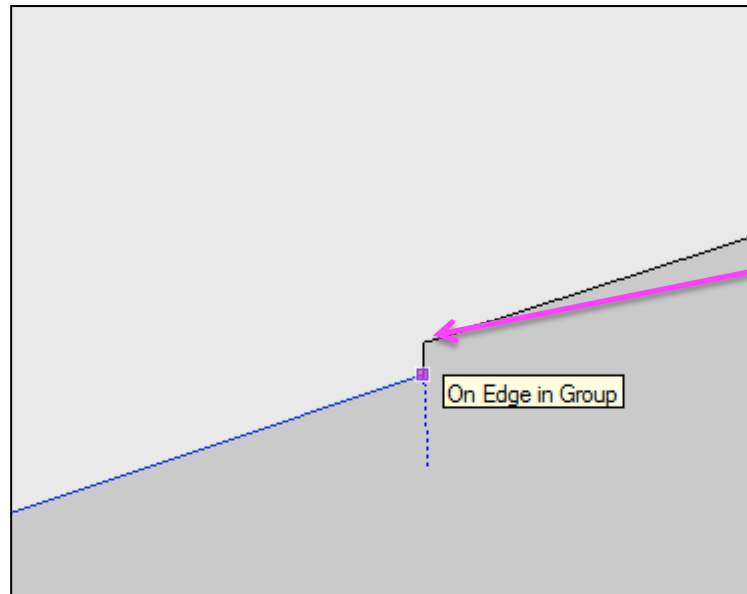
Allows user to draw or modify shapes very quickly and can be used to construct unusual 3D shapes quickly

Using the *move tool* to grab the aircraft base in the corner of the slot identified

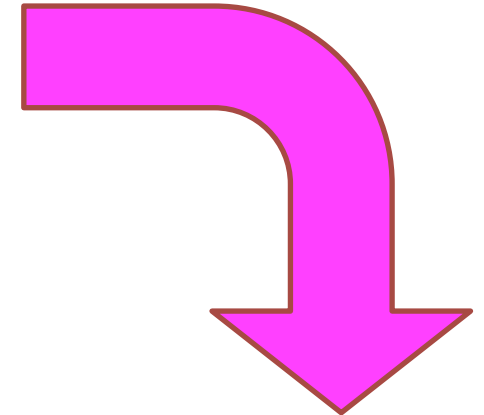


Computer Aided Engineering: Learning Aim A: Task 3

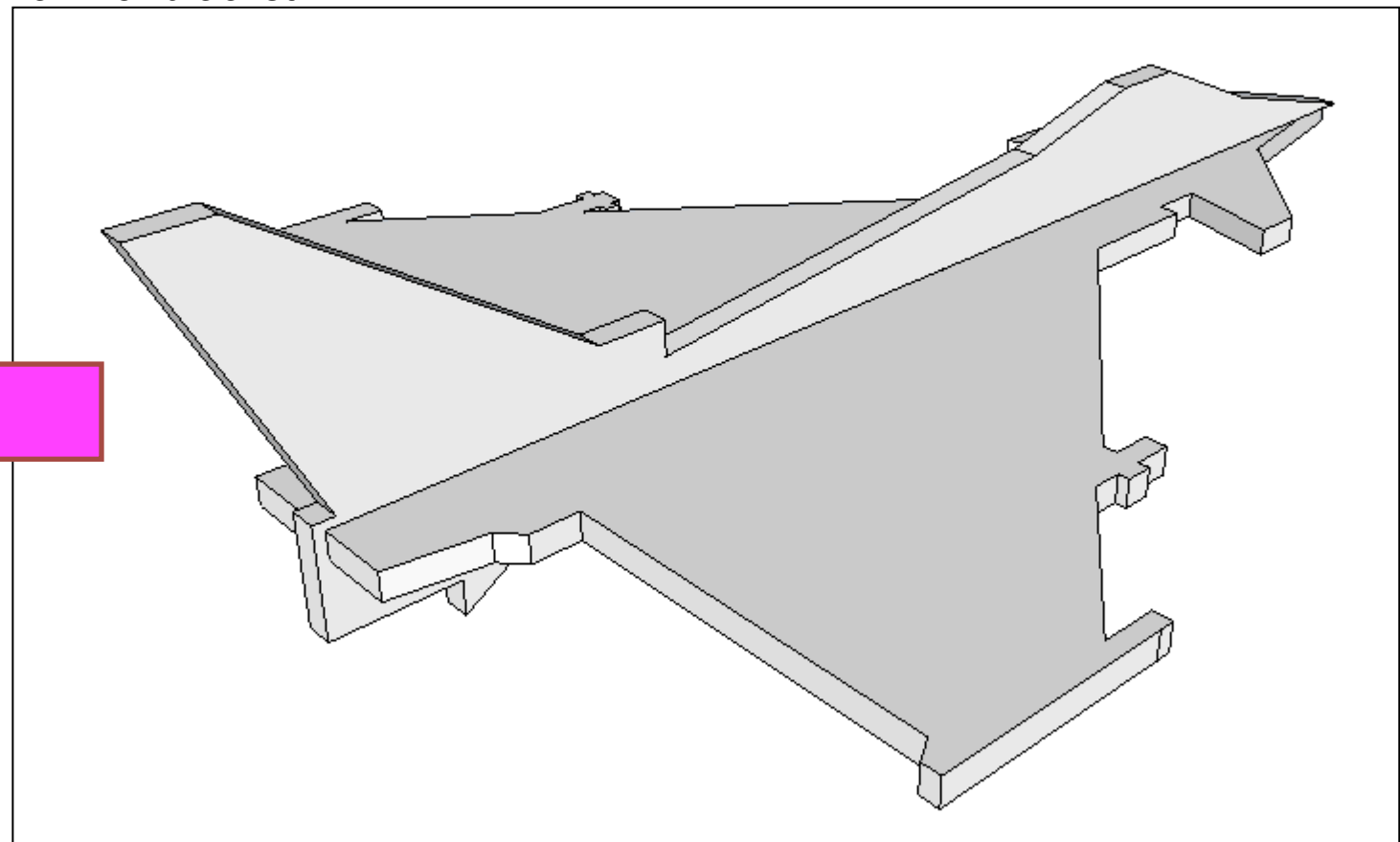
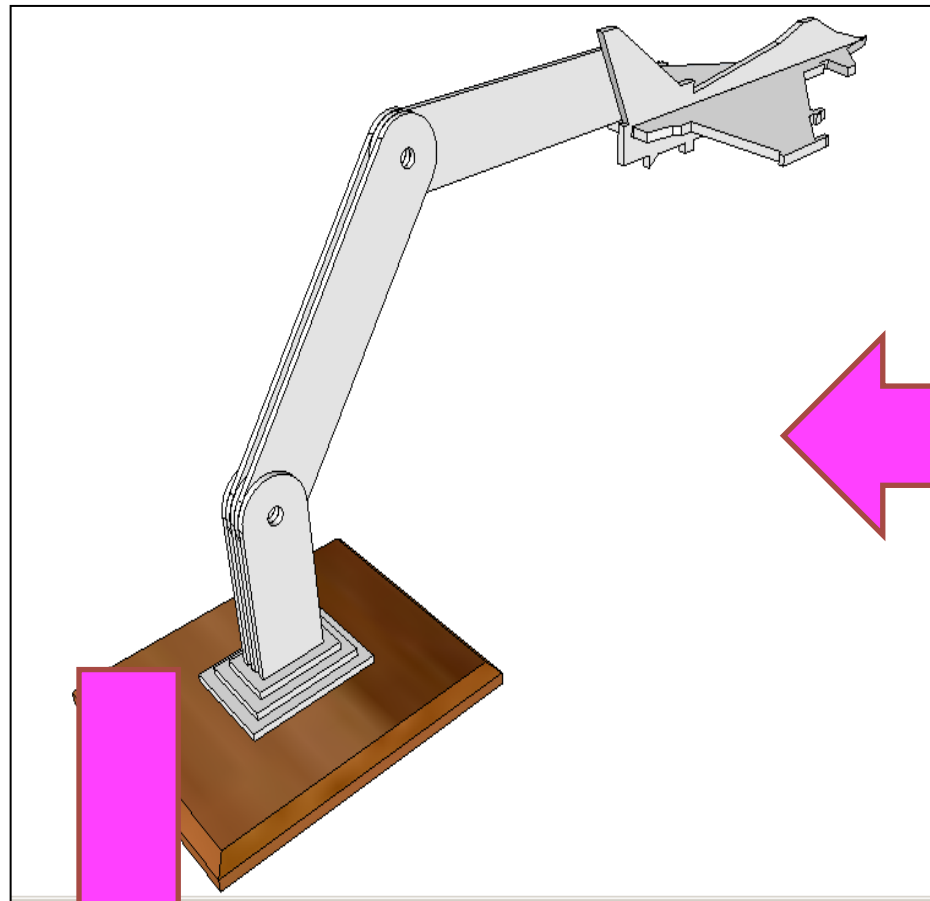
Computer Aided Engineering: 14. Step by Step Guide to Lamp Construction



Using the *move tool* to move the aircraft base in the corner of the slot to the corresponding corner on the side piece.

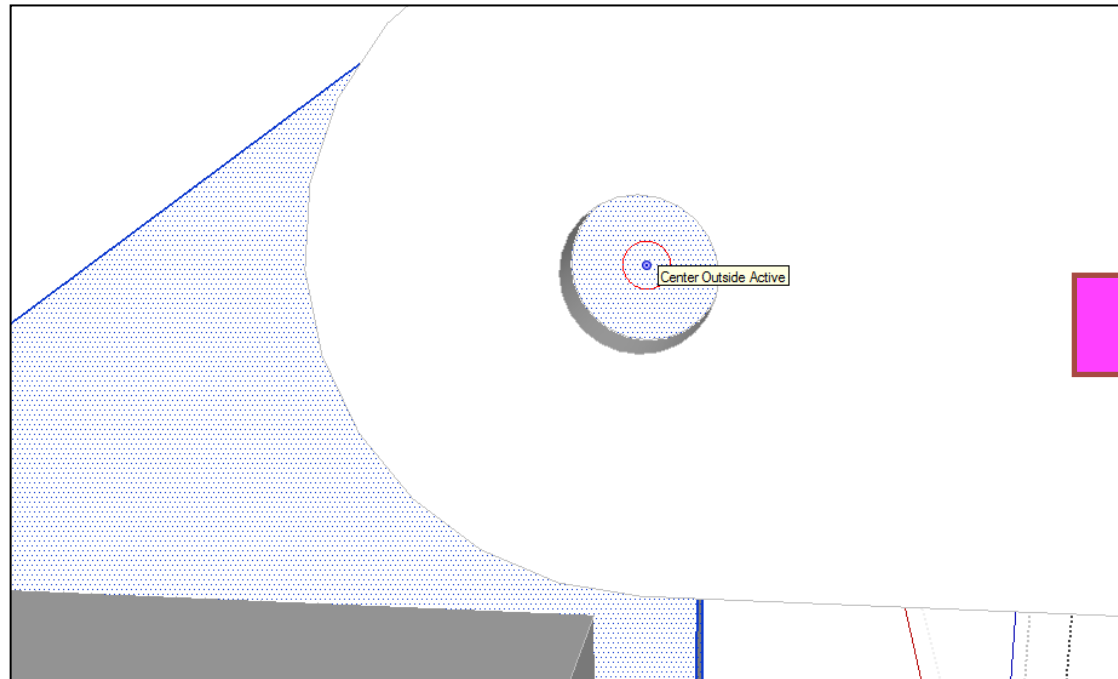


Using the *aircraft should slot together as shown below*. Move onto the top arm of your lamp so the tail of the aircraft sits next to the arm or bracket.

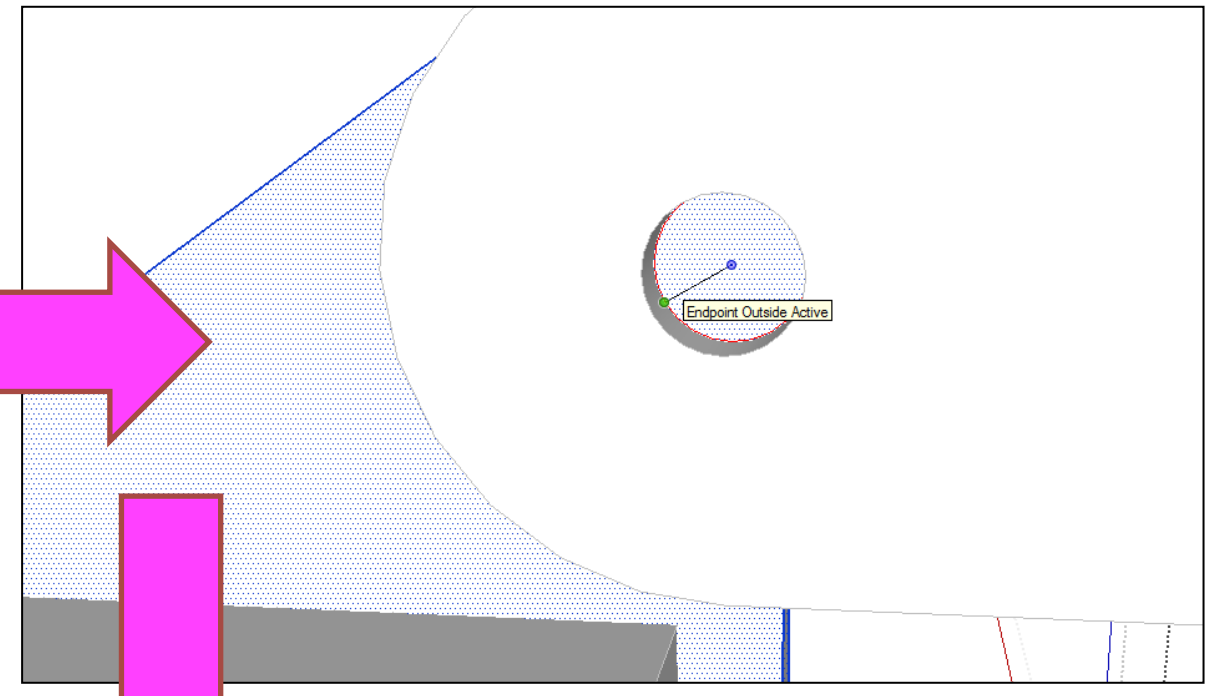
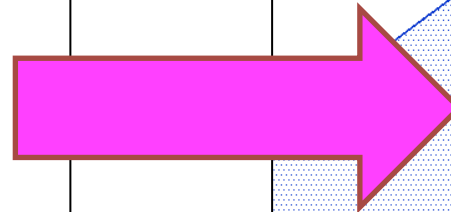


Computer Aided Engineering: Learning Aim A: Task 3

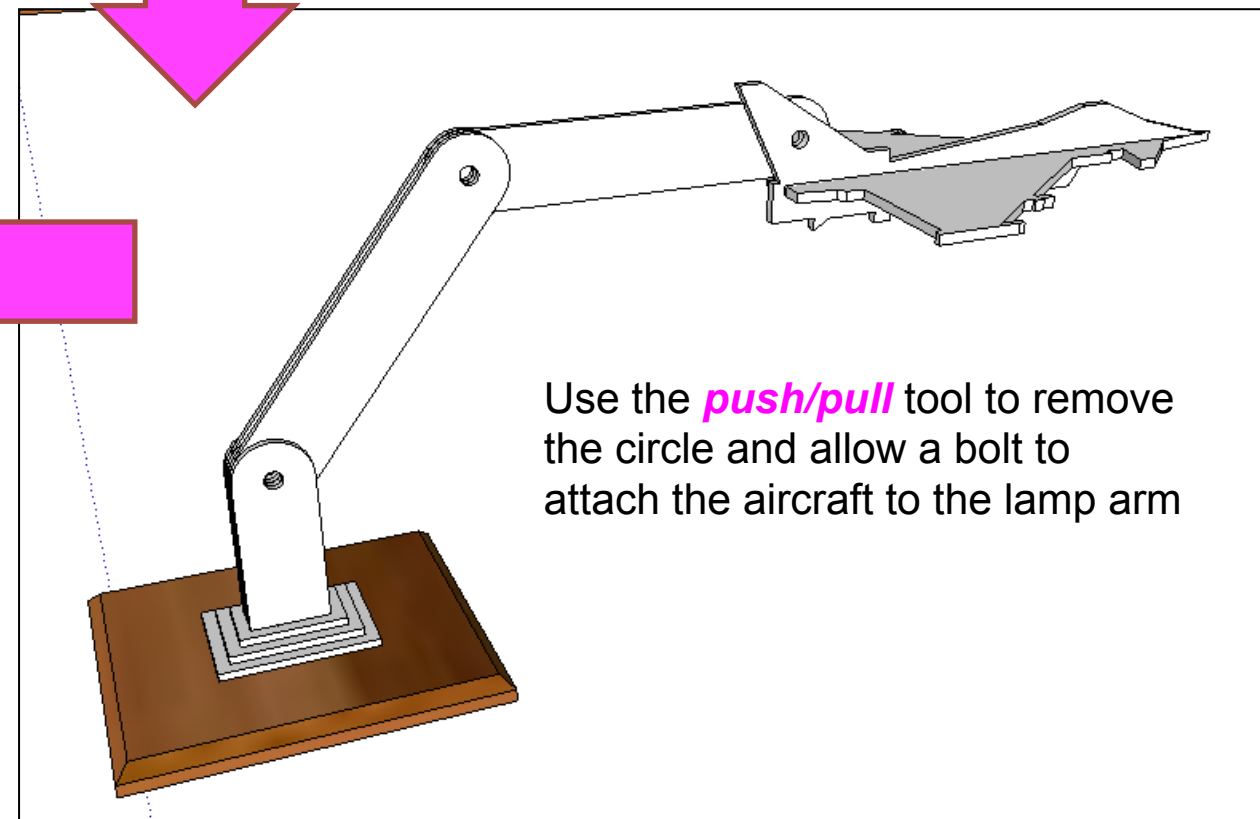
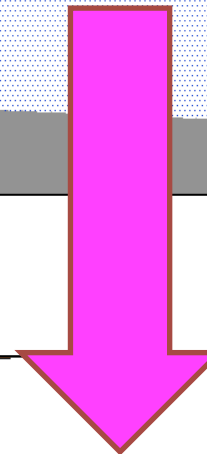
Computer Aided Engineering: 14. Step by Step Guide to Lamp Construction



Position so that you are looking through the circle cut out of the arm. **Double click** the aircraft tail. Use the **circle tool**, run it around the inside circle of the lamp arm and it should snap to the center on the aircraft.



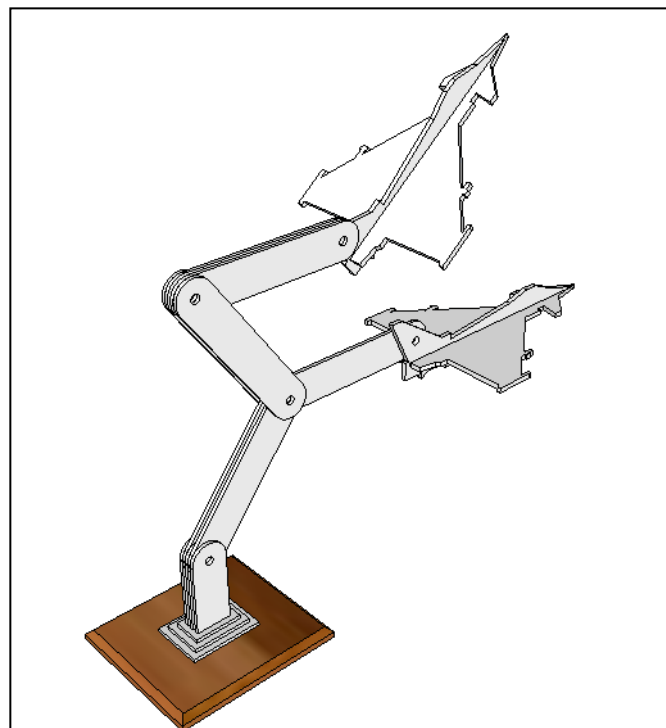
Increase the circle size so it matches the lamp arm. It will snap into place



Use the **push/pull** tool to remove the circle and allow a bolt to attach the aircraft to the lamp arm

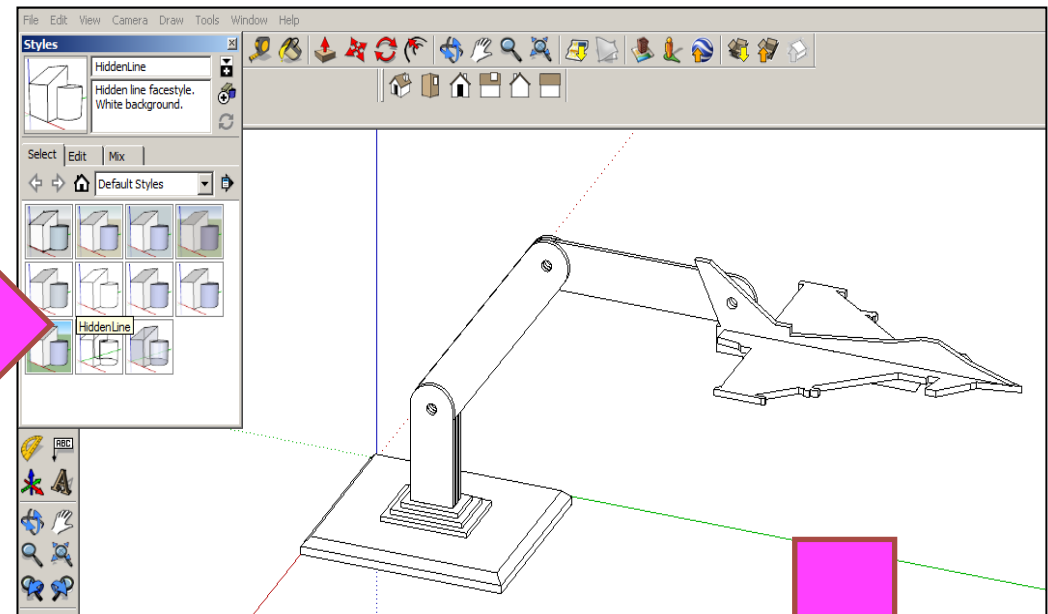
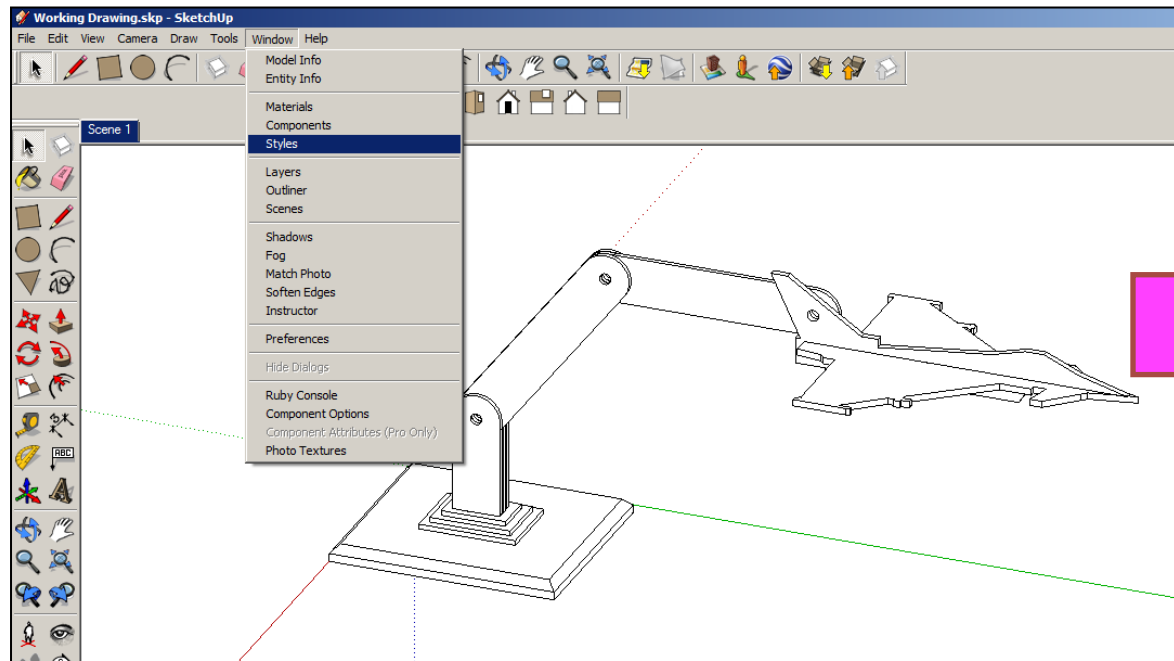


Add more arms and aircraft to the lamp design



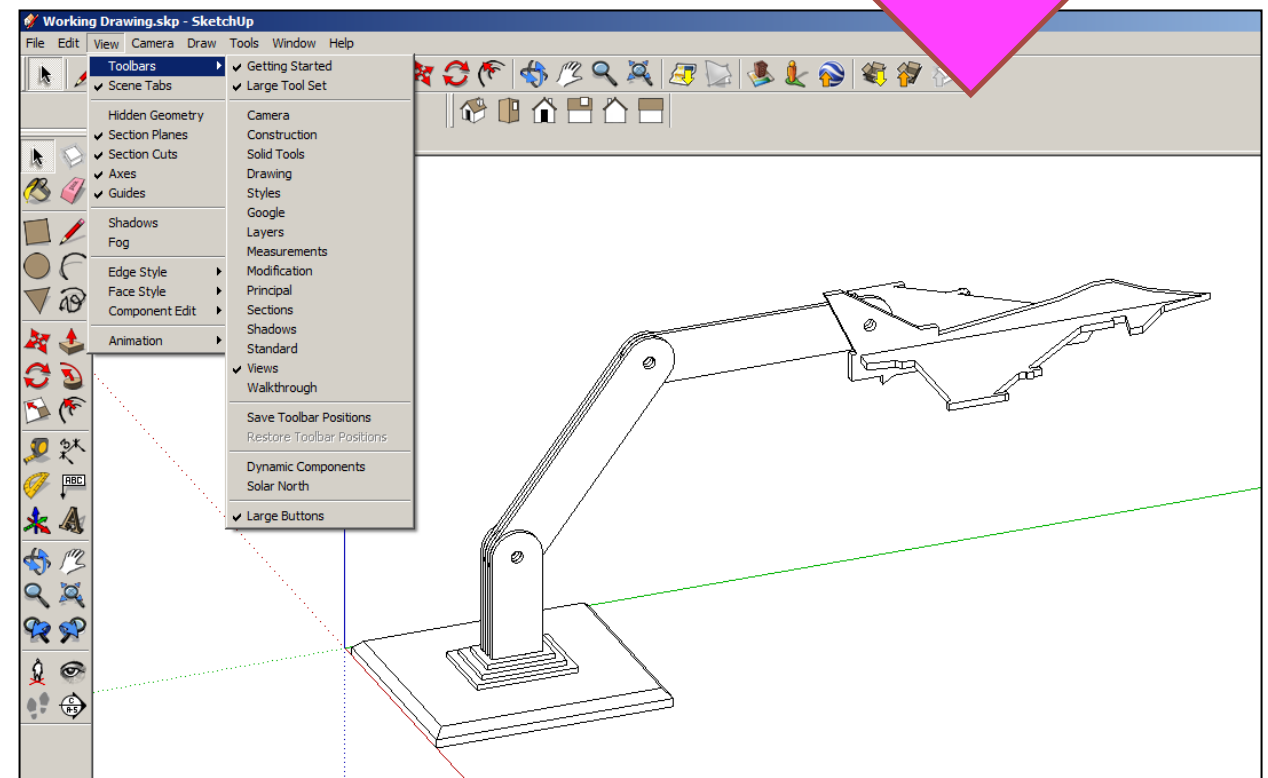
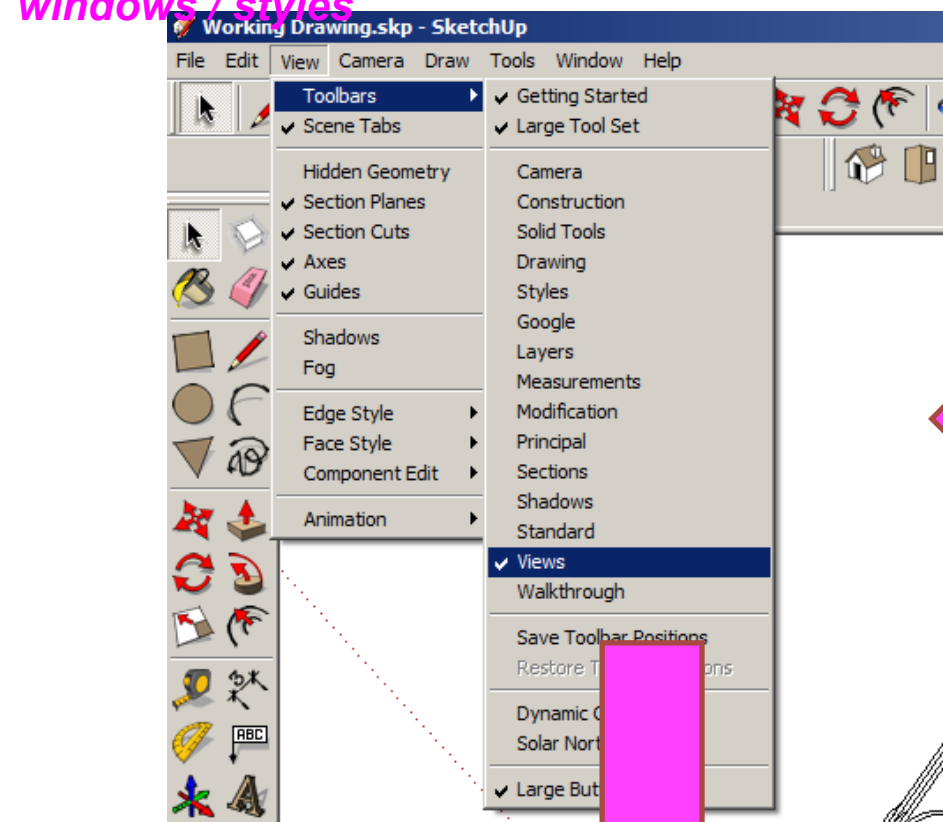
Computer Aided Design: Aircraft Lamp Working Drawing

Computer Aided Engineering: 1. Working Drawing Instructions (Setting up Correct Format)



Click on **Windows / Default / hidden line**

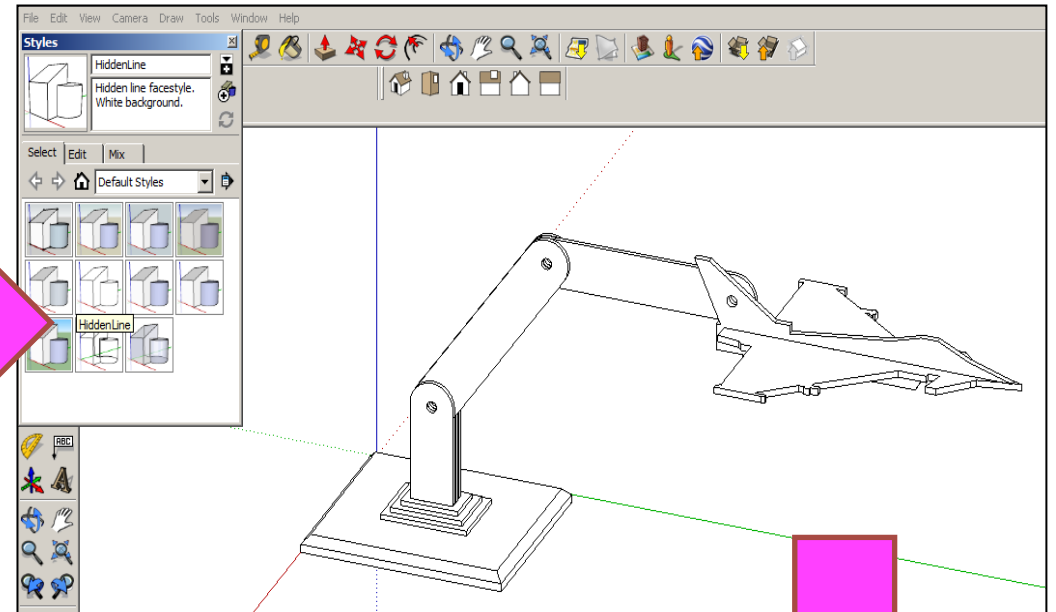
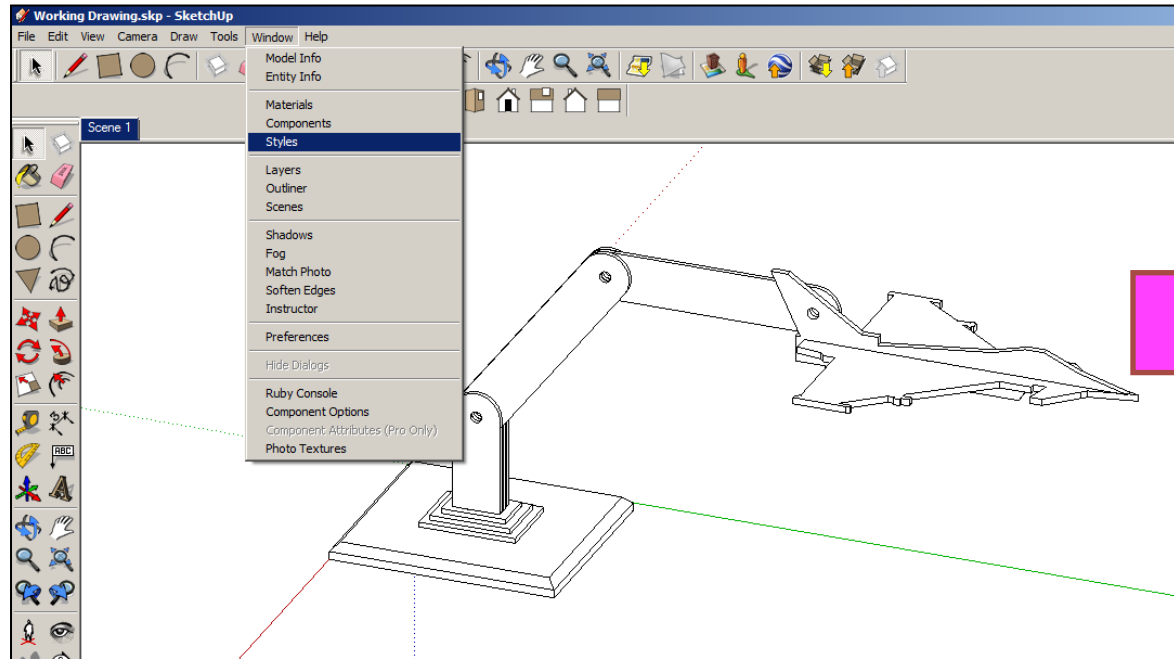
Now its time to convert your drawing into a working drawing (NB this **must be exact** to achieve a level 2. **Click windows / styles**



Click on **Toolbars / Views**

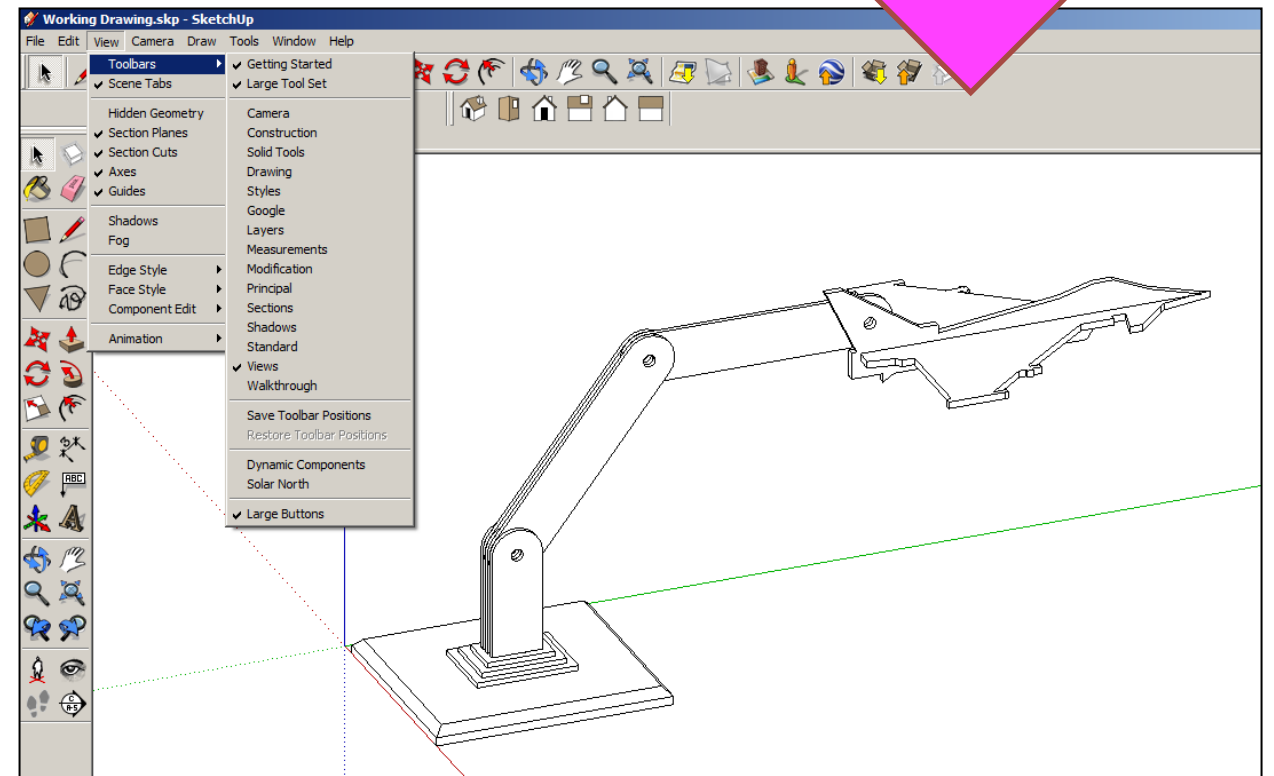
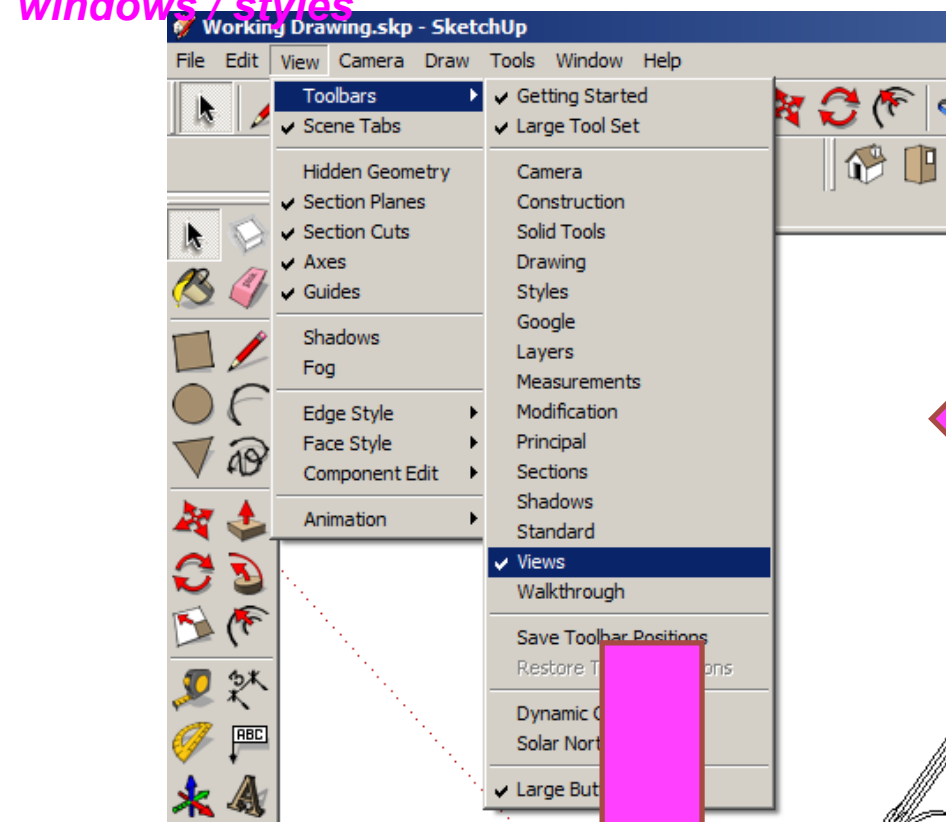
Computer Aided Design: Aircraft Lamp Working Drawing

Computer Aided Engineering: 1. Working Drawing Instructions (Setting up Correct Format)



Click on **Windows / Default / hidden line**

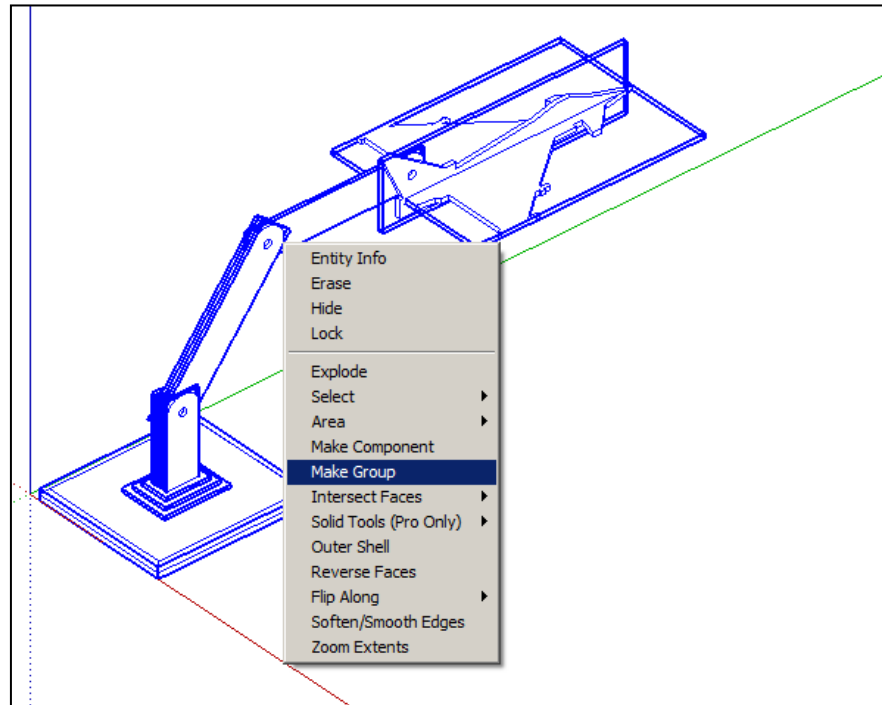
Now its time to convert your drawing into a working drawing (NB this **must be exact** to achieve a level 2. **Click windows / styles**



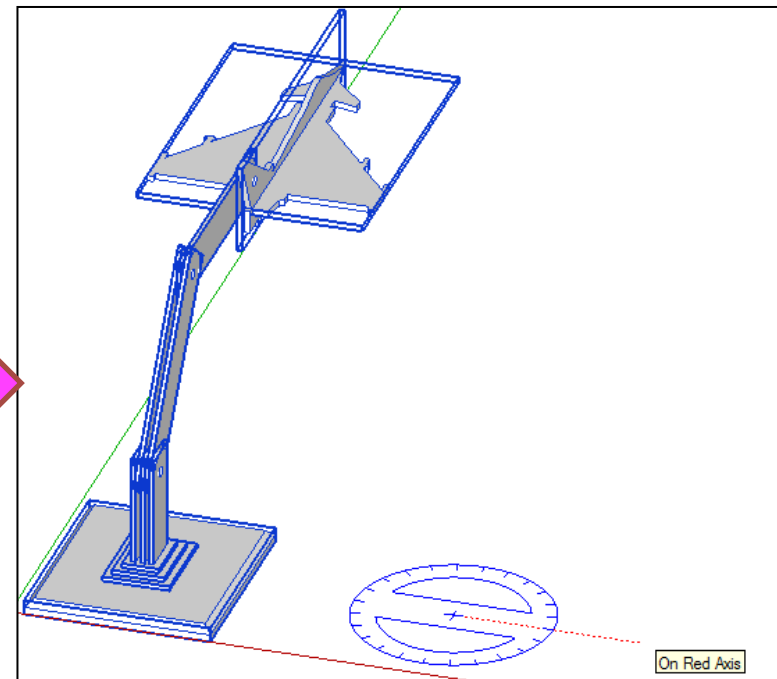
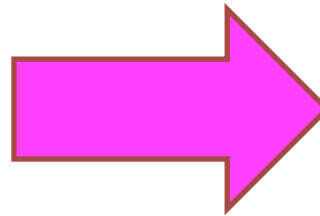
Click on **Toolbars / Views**

Computer Aided Design: Aircraft Lamp Working Drawing

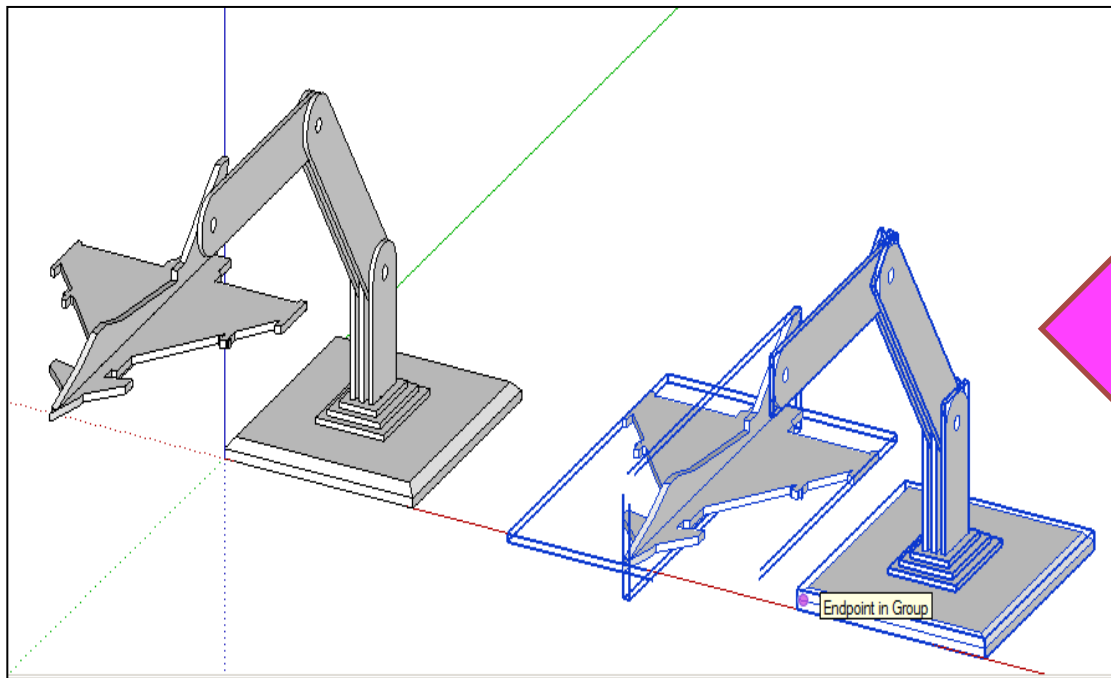
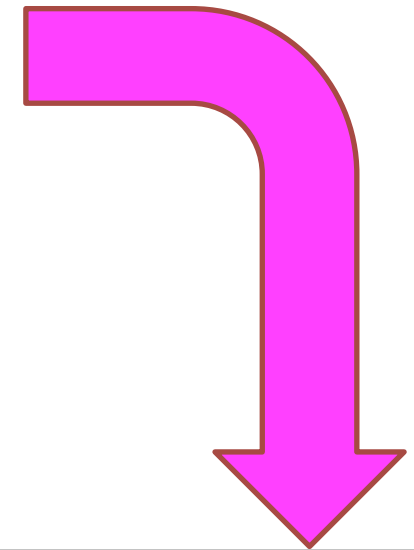
Computer Aided Engineering: 1. Working Drawing Instructions (Setting up Correct Format)



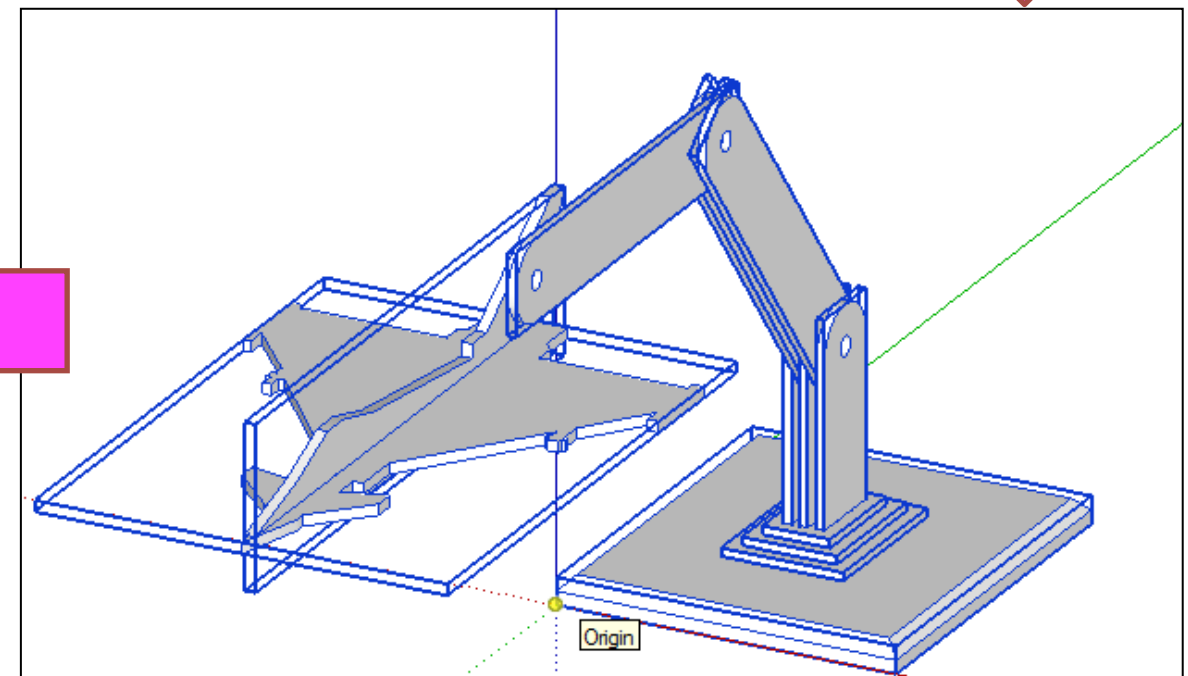
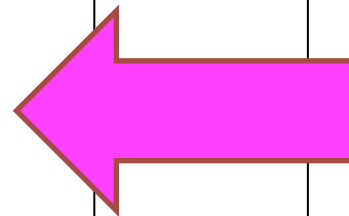
Highlight the entire lamp and right click **make group**



Click on the rotate tool and turn the lamp **around as shown below**



Copy and move a second lamp along the **red axis**

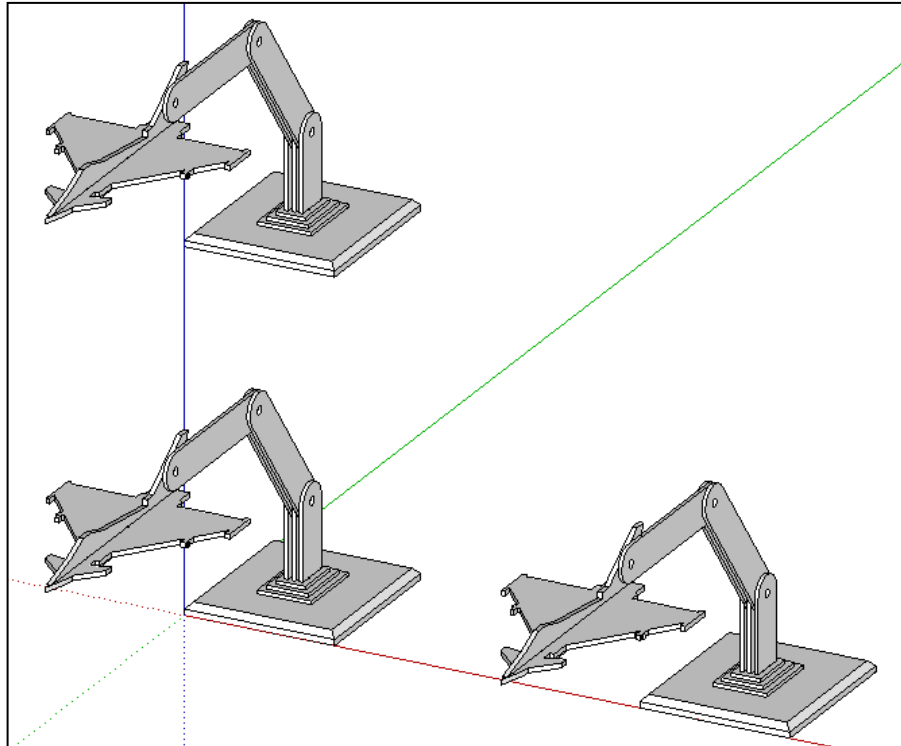


Click on the **move tool** and move the lamp so the corner is on the origin

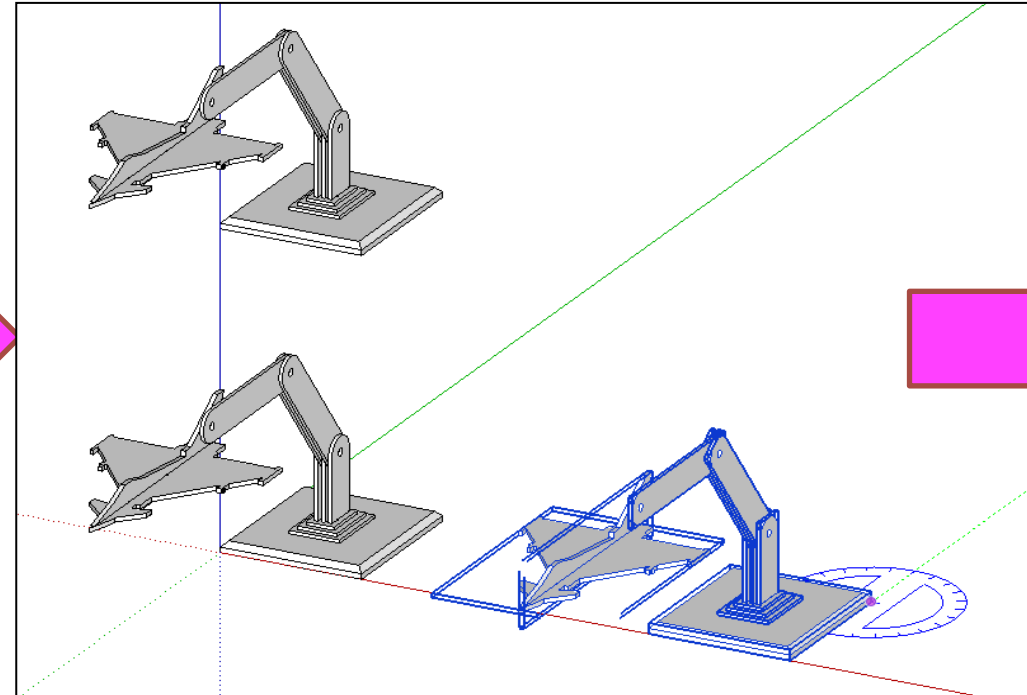
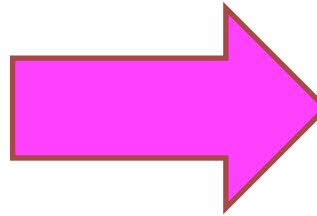


Computer Aided Design: Aircraft Lamp Working Drawing

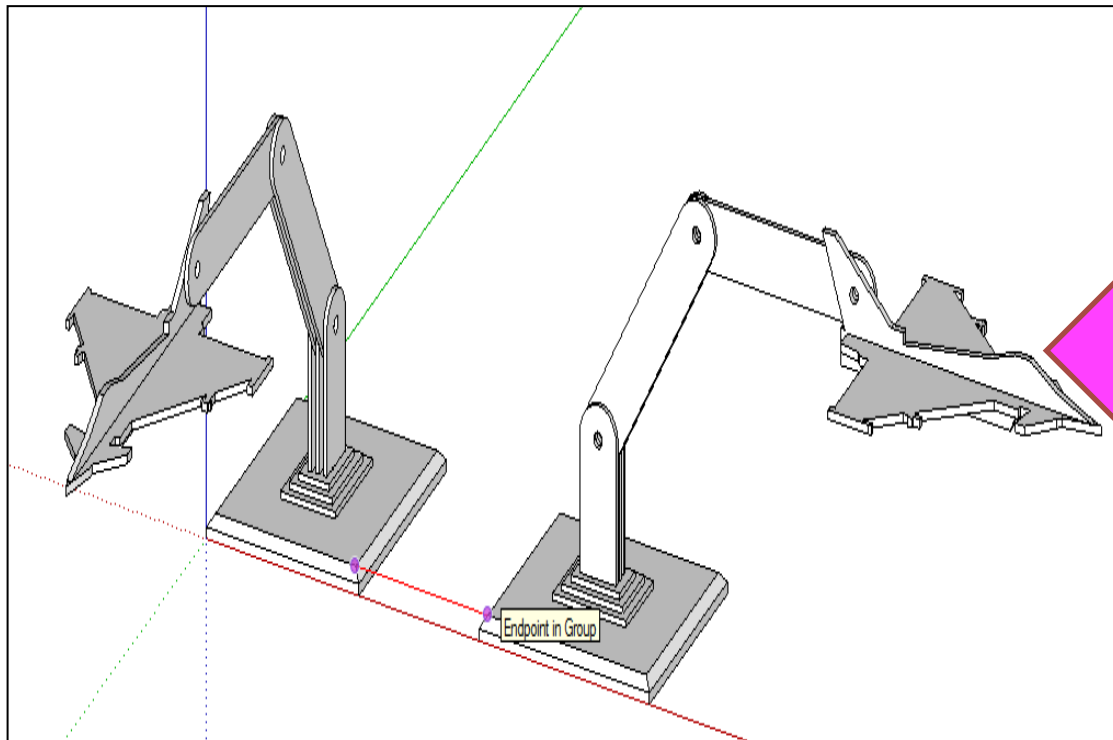
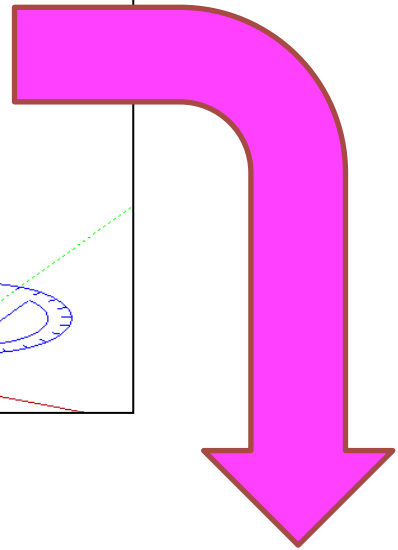
Computer Aided Engineering: 2. Working Drawing (Setting up Correct Format)



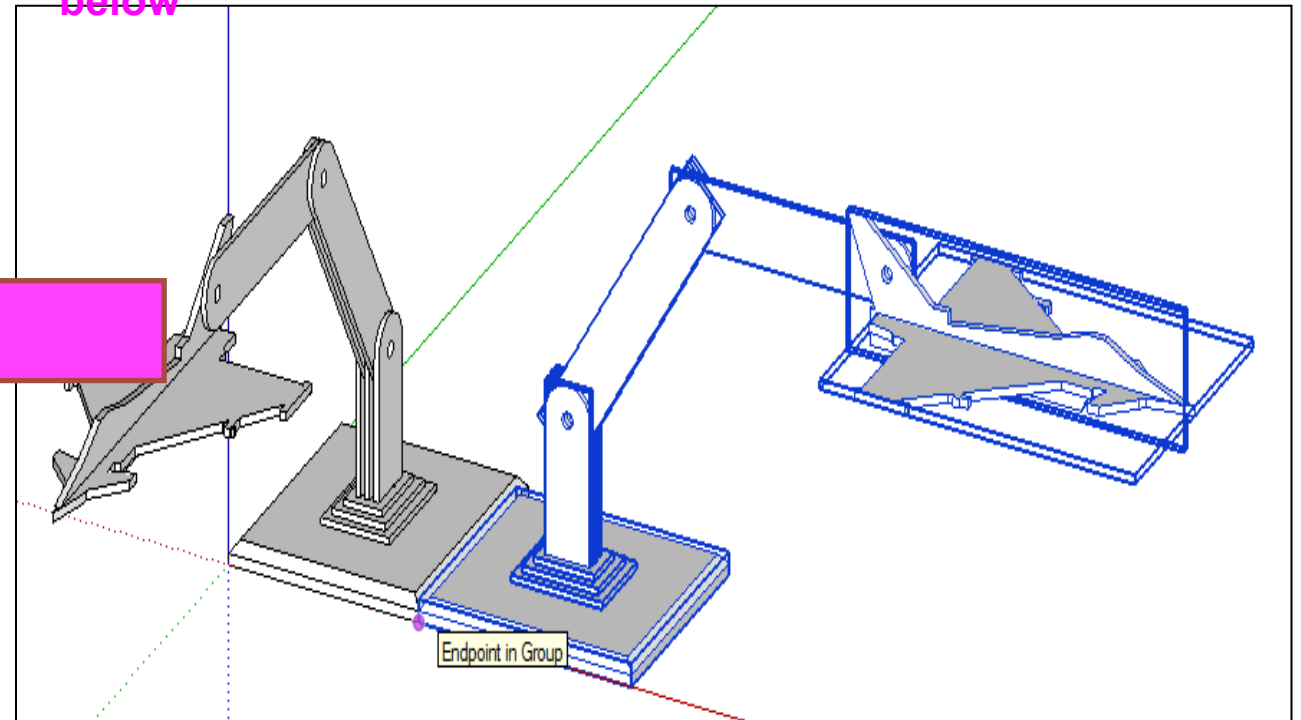
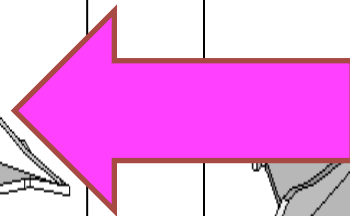
Copy and move a second lamp along the **blue axis**



Click on the rotate tool and turn the lamp **around 90 degrees as shown below**



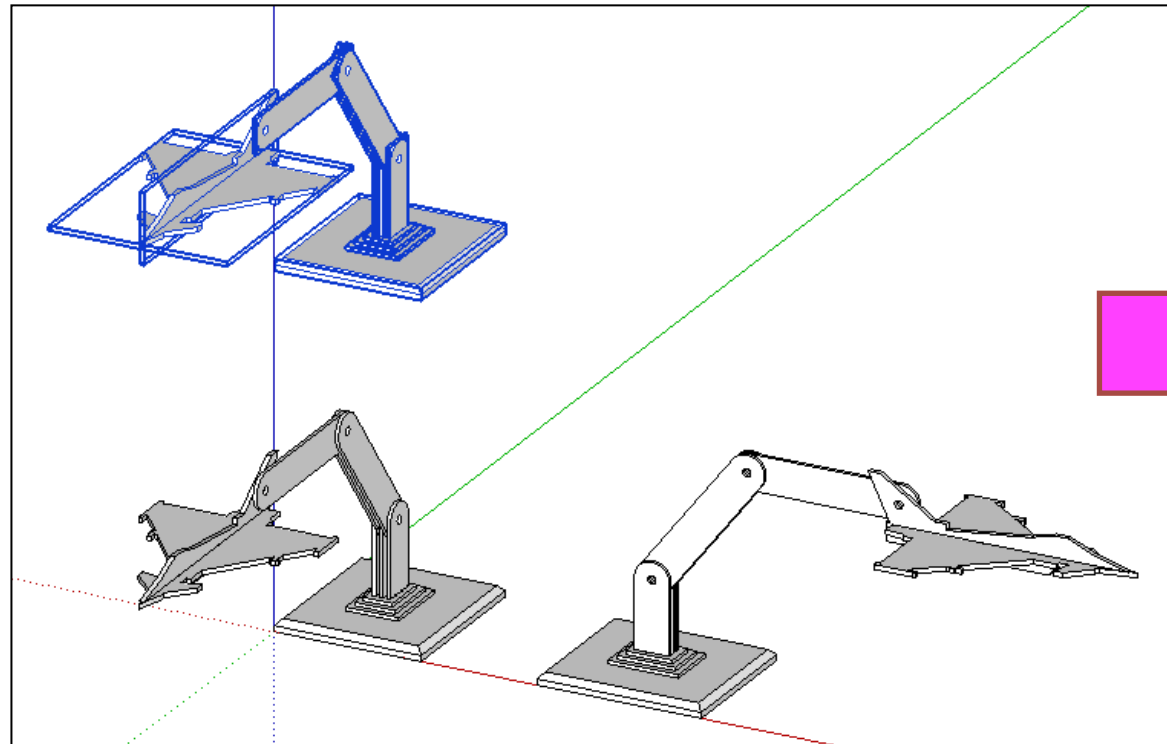
Click on the **move tool** along the red axis. You should be able to draw a line that turns red from corner to corner to indicate it lines up exactly



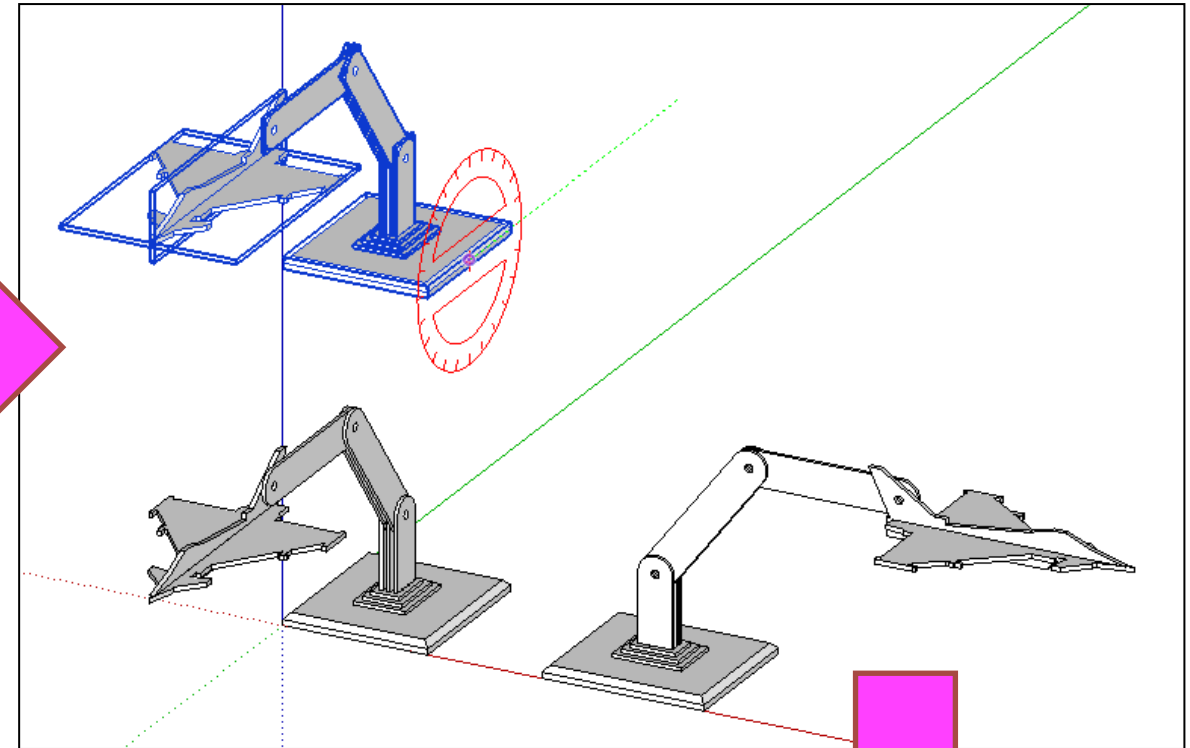
Click on the **move tool** and move the lamp so the corners of the base meet

Computer Aided Design: Aircraft Lamp Working Drawing

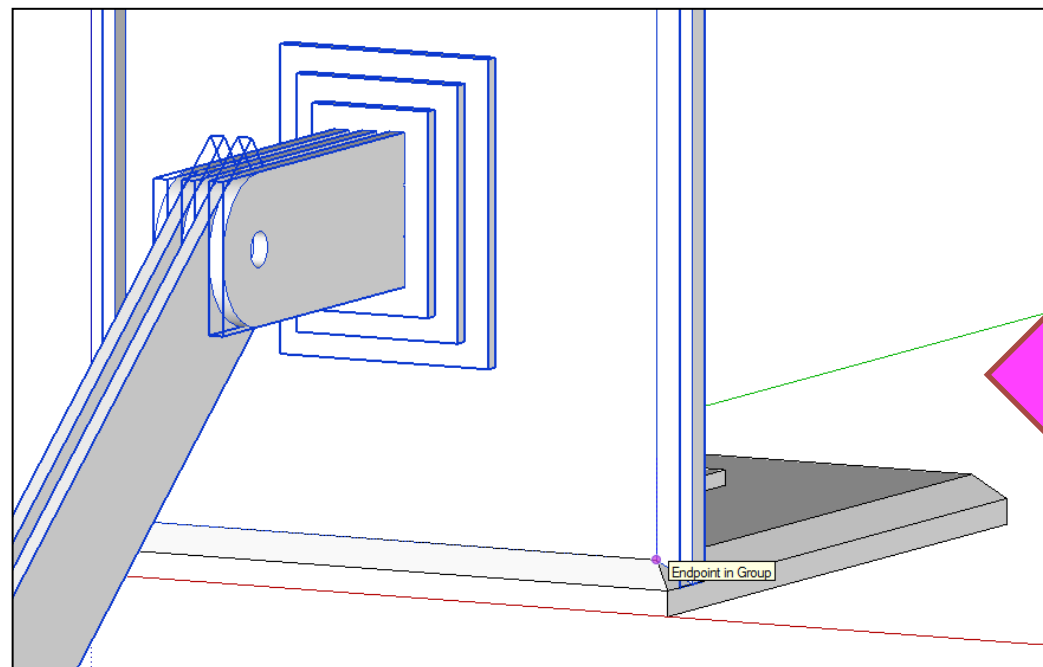
Computer Aided Engineering: 2. Working Drawing (Setting up Correct Format)



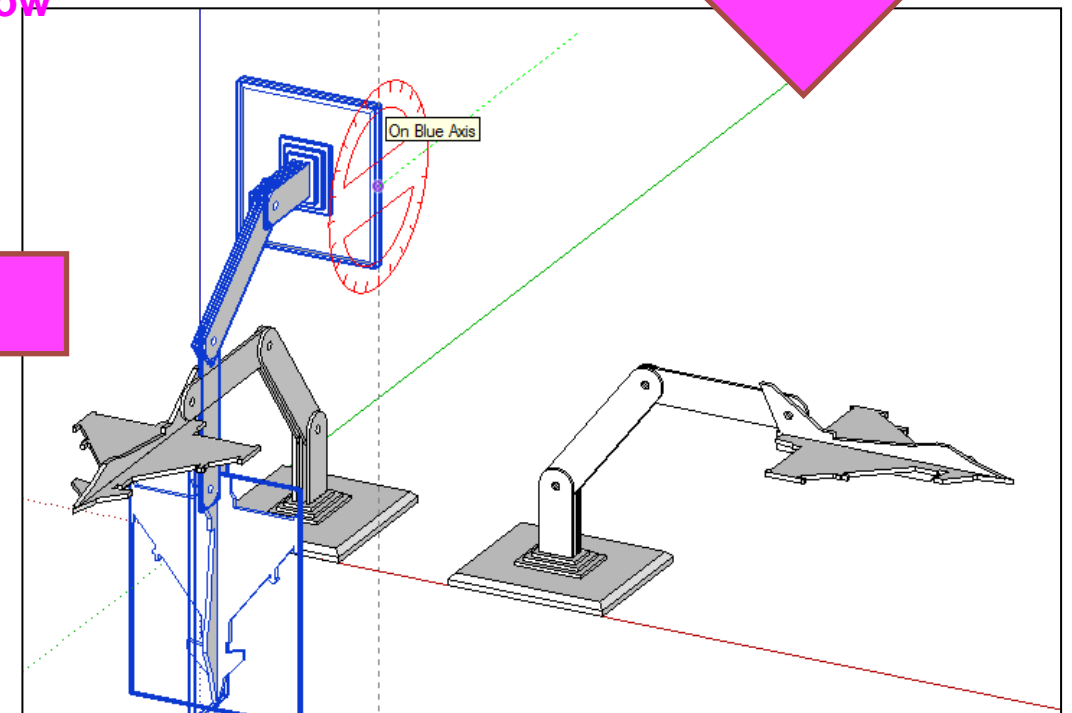
Click on the top lamp



Click on the rotate tool and turn the lamp **around 90 degrees as shown below**

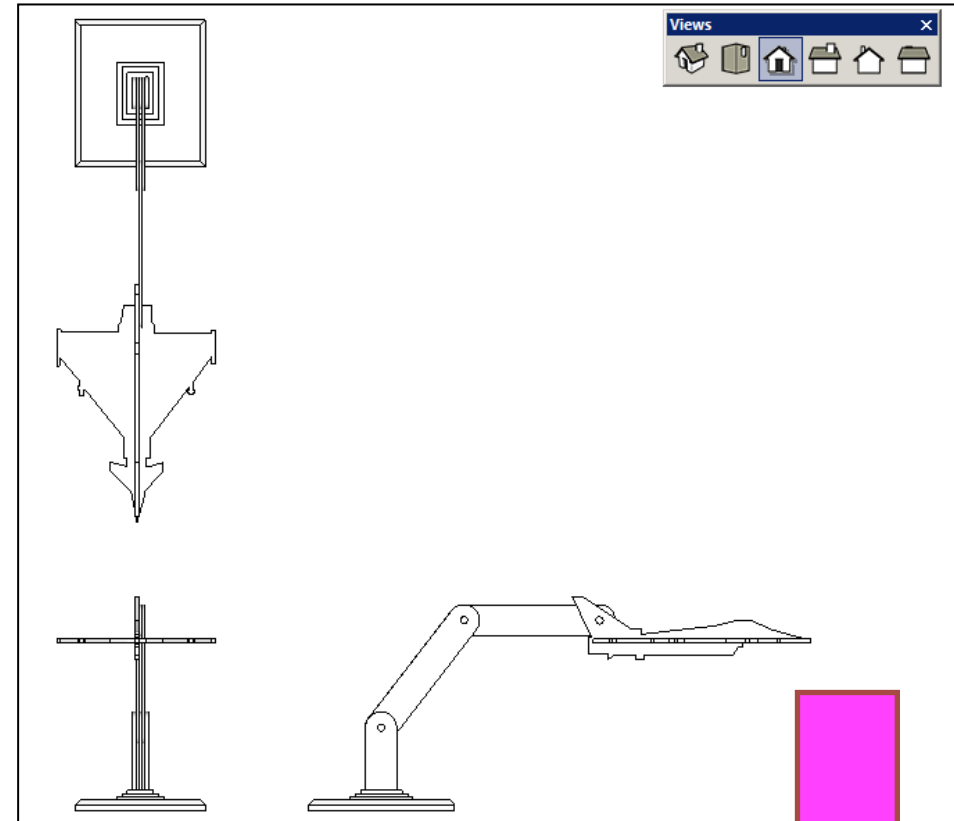
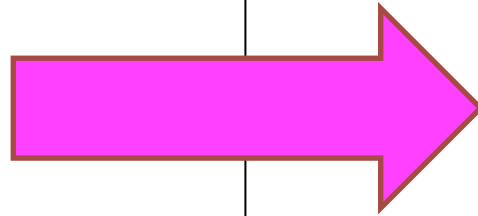
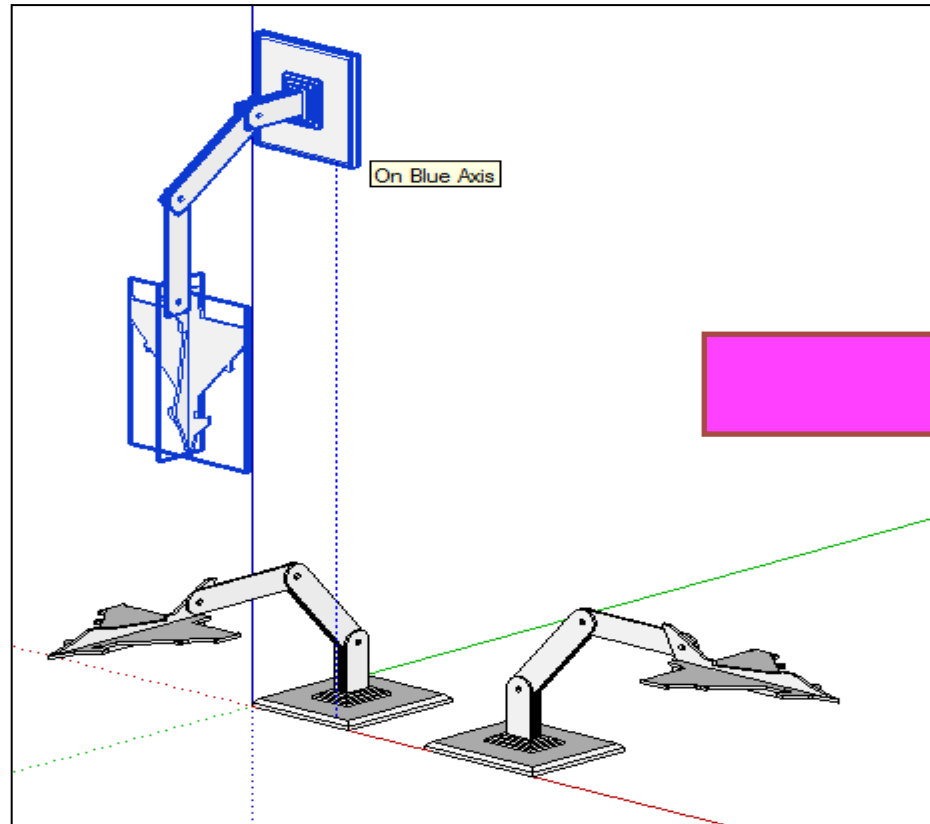


Click on the **move tool** and move the lamp so the corners of the base meet

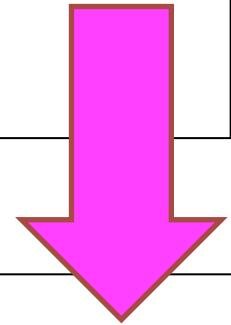


Computer Aided Design: Aircraft Lamp Working Drawing

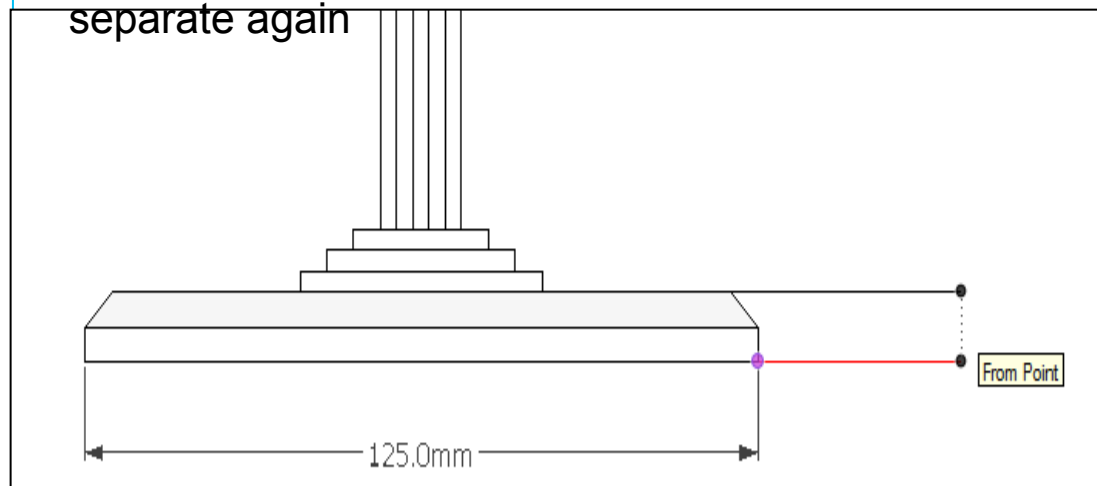
Computer Aided Engineering: 2. Working Drawing (Adding Dimensions)



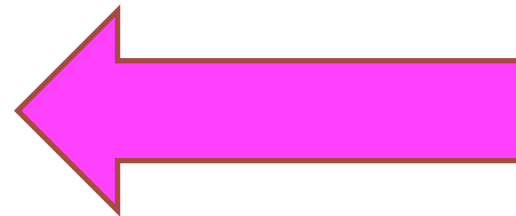
Click on the **front view** using the **view toolbar**



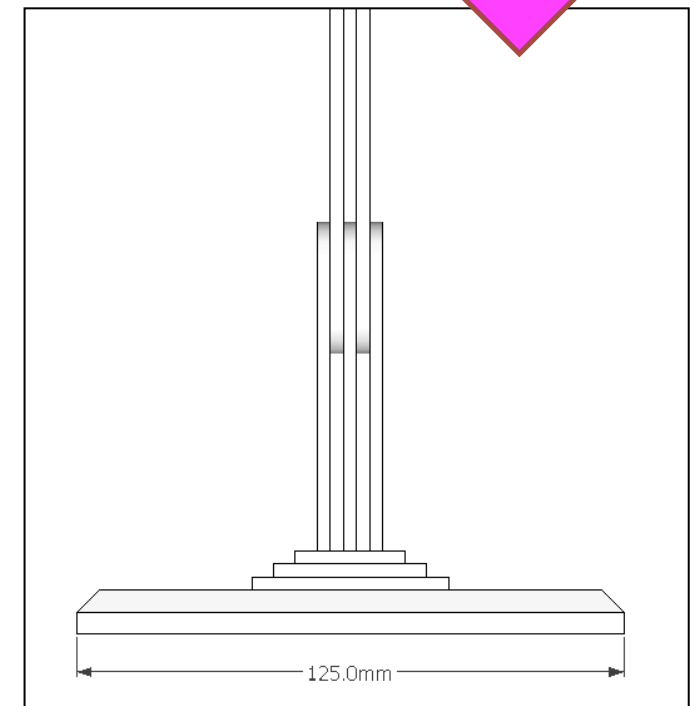
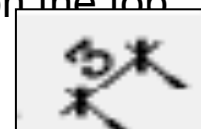
Click on the **move tool** and move the lamp so the corners of the base meet and then separate again



Certain points are difficult to add sizes using the pencil tool to line up edges as shown above.

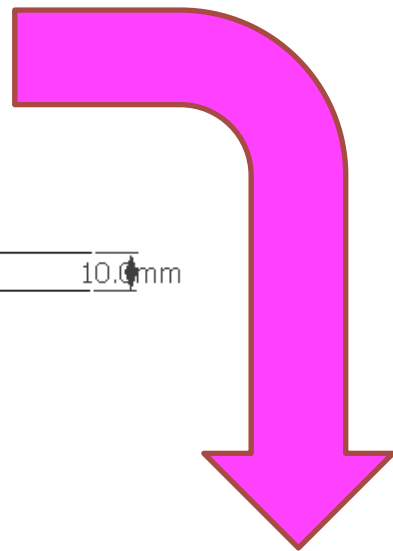
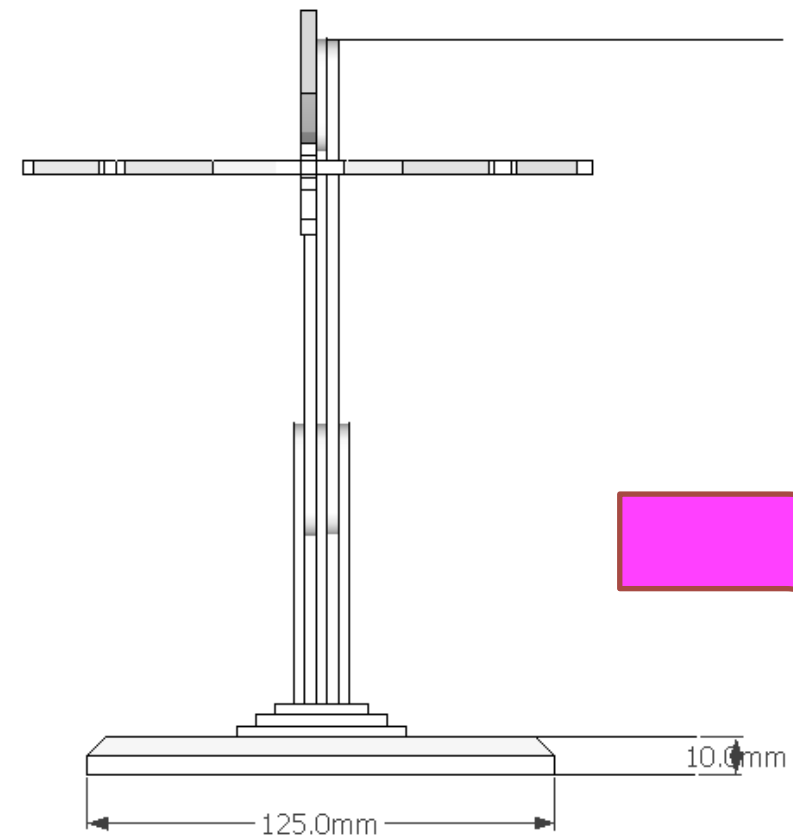
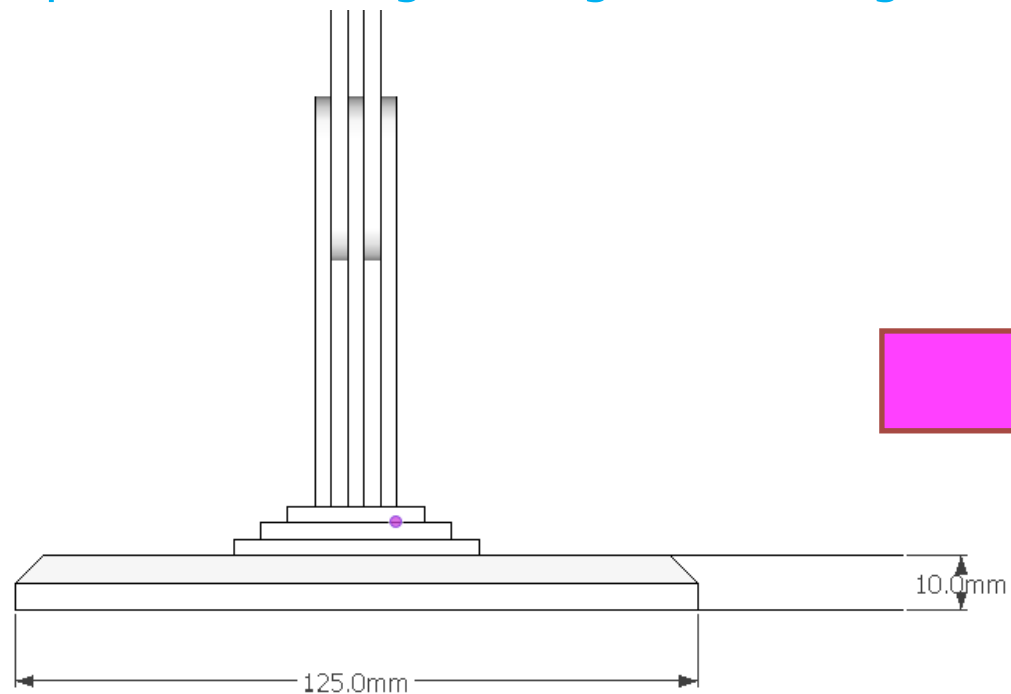


Click on the **dimensions tool bar** and add sizes. All sizes should be below and to the right. Never on the left hand side or on the top

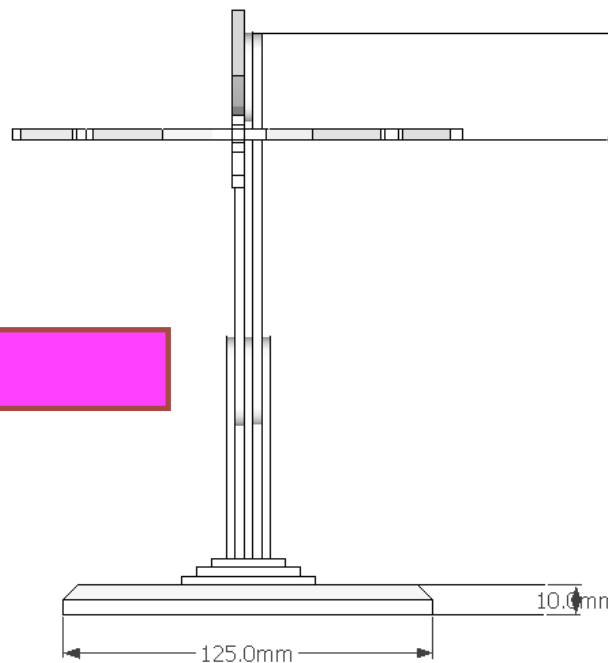
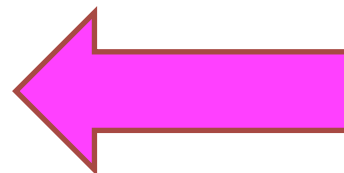
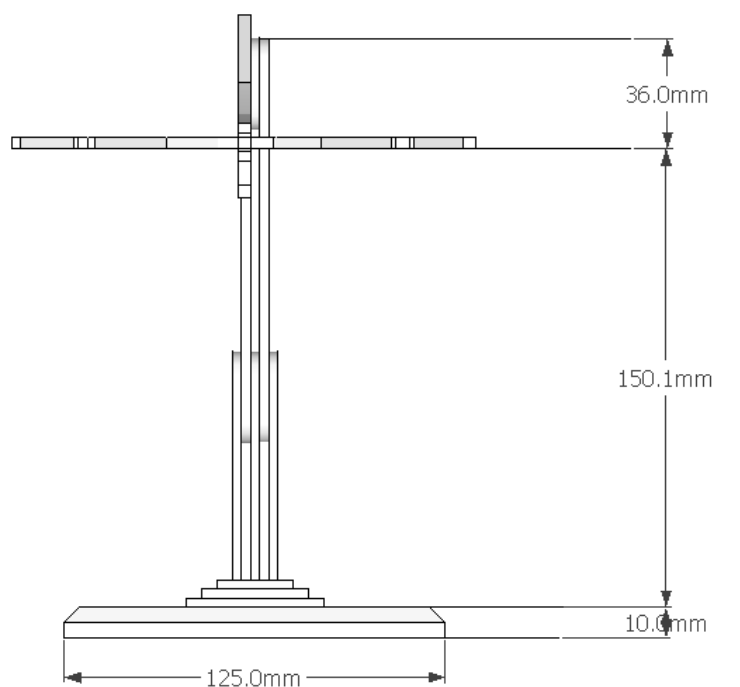


Computer Aided Design: Aircraft Lamp Working Drawing

Computer Aided Engineering: 2. Working Drawing (Setting up Correct Format)

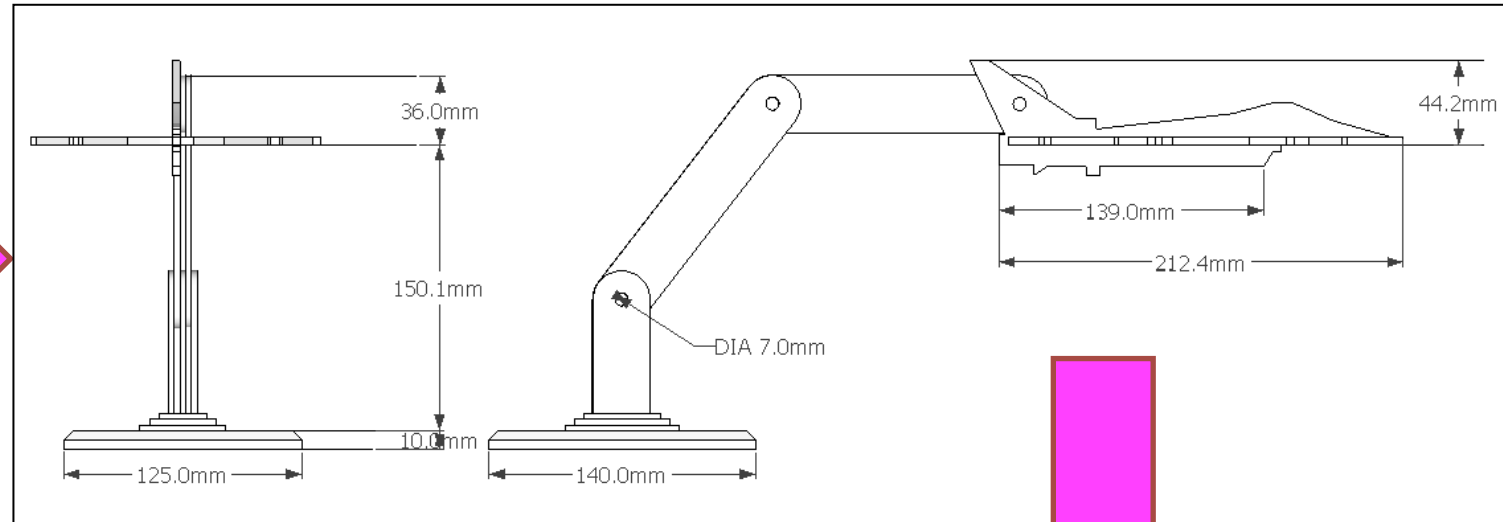
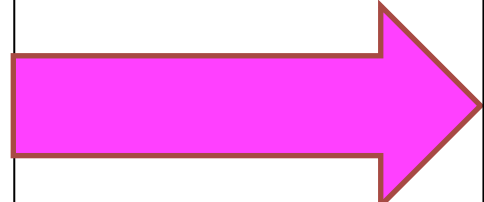
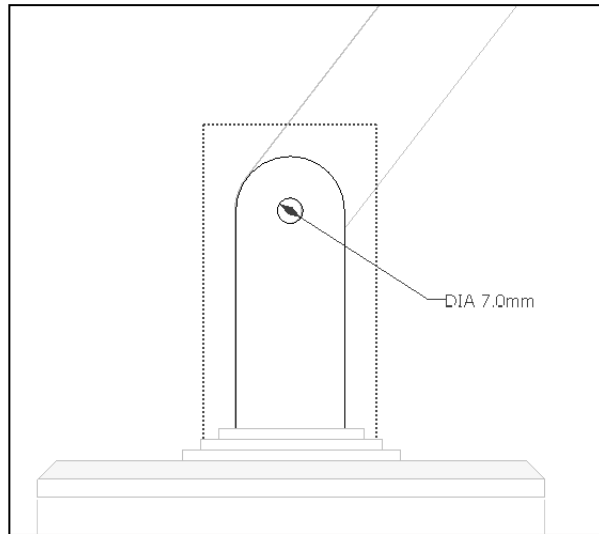


Add sizes to show height, width and any other important sizes. You will compare these to the lamp later on



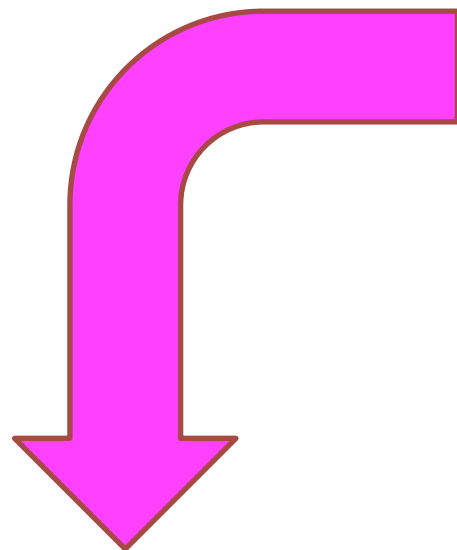
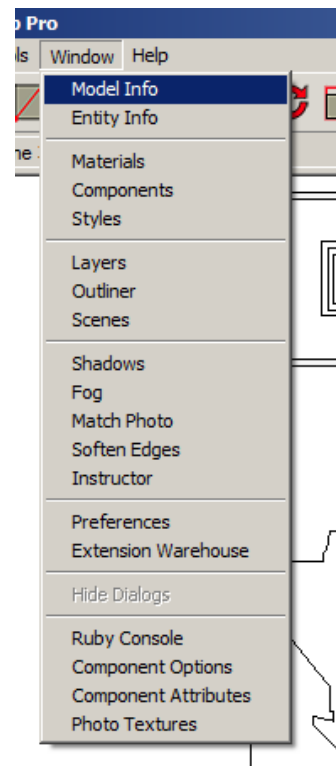
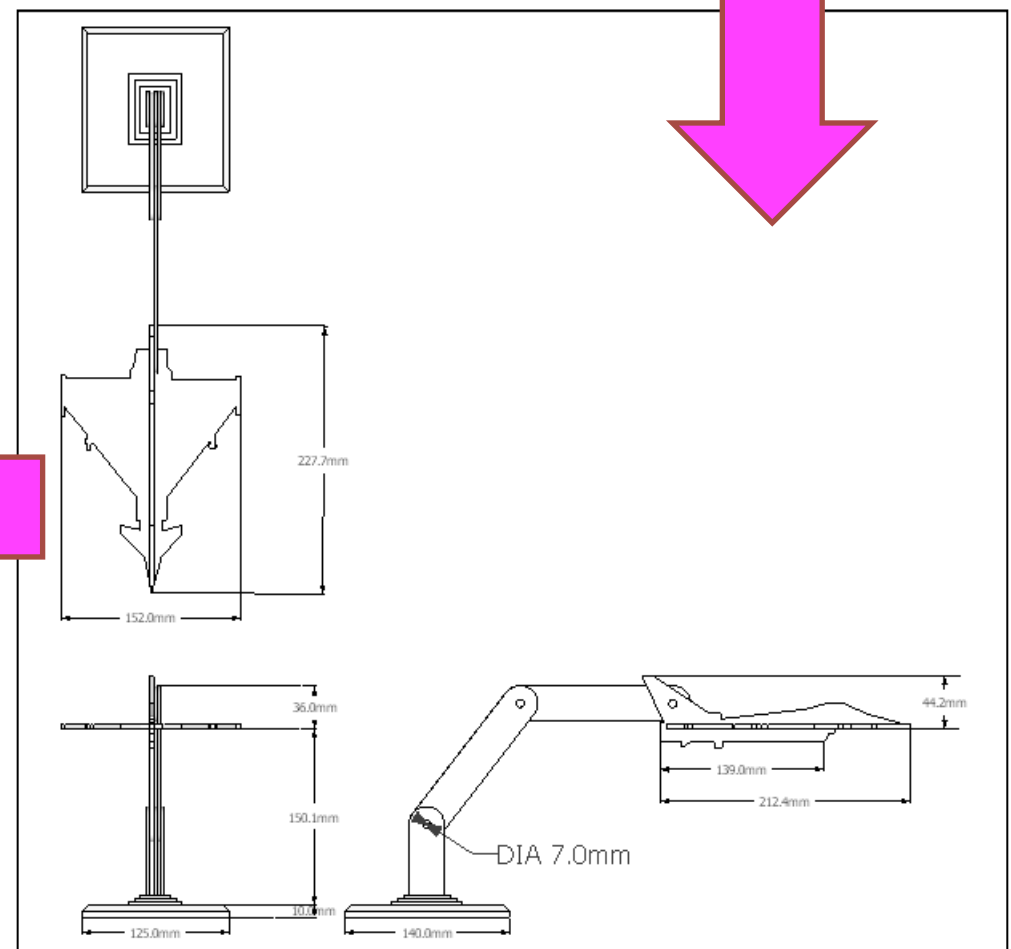
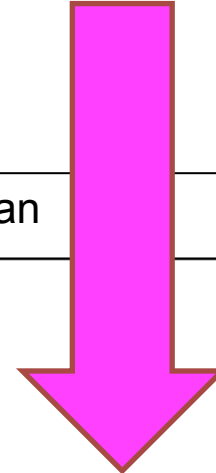
Computer Aided Design: Aircraft Lamp Working Drawing

Computer Aided Engineering: 2. Working Drawing (Setting up Correct Format)



If the object is grouped you may need to double click to add some sizes and radius

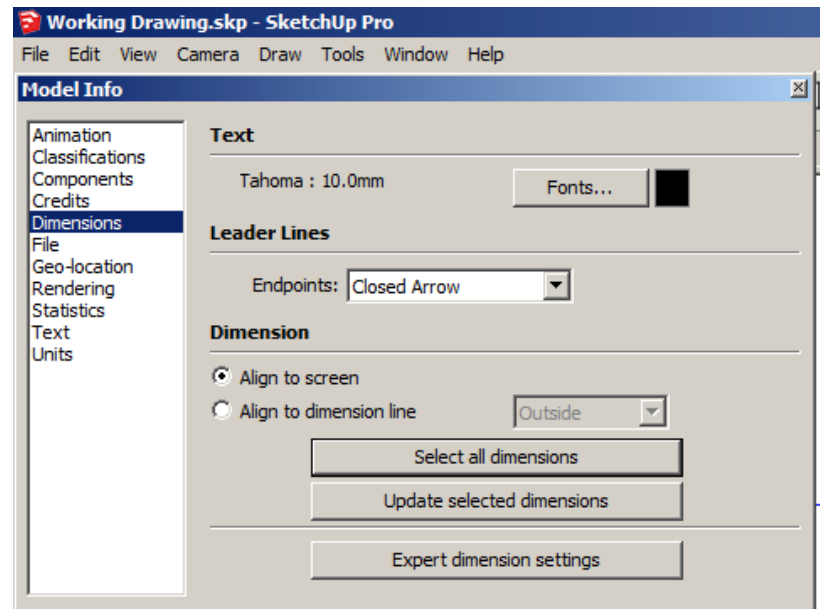
Add sizes to the three drawings Front, Side and Plan



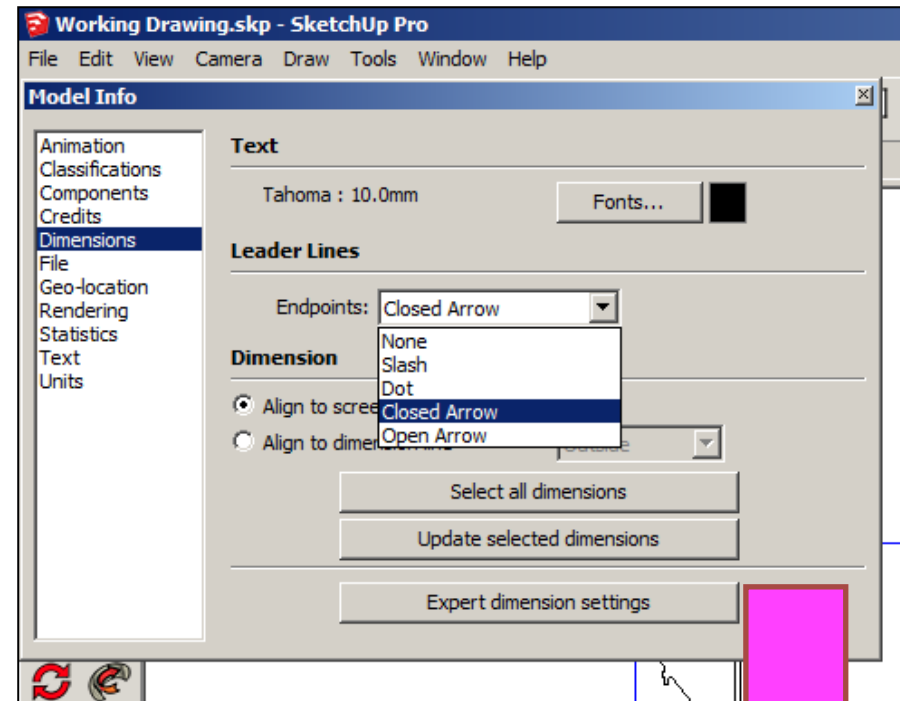
Click on *Window / Model Info*

Computer Aided Design: Aircraft Lamp Working Drawing

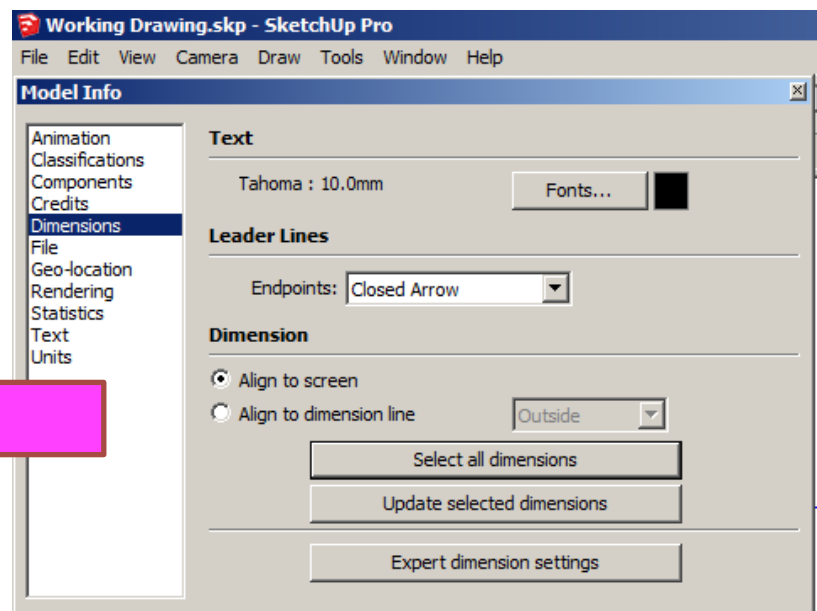
Computer Aided Engineering: 2. Working Drawing (Setting up Correct Format)



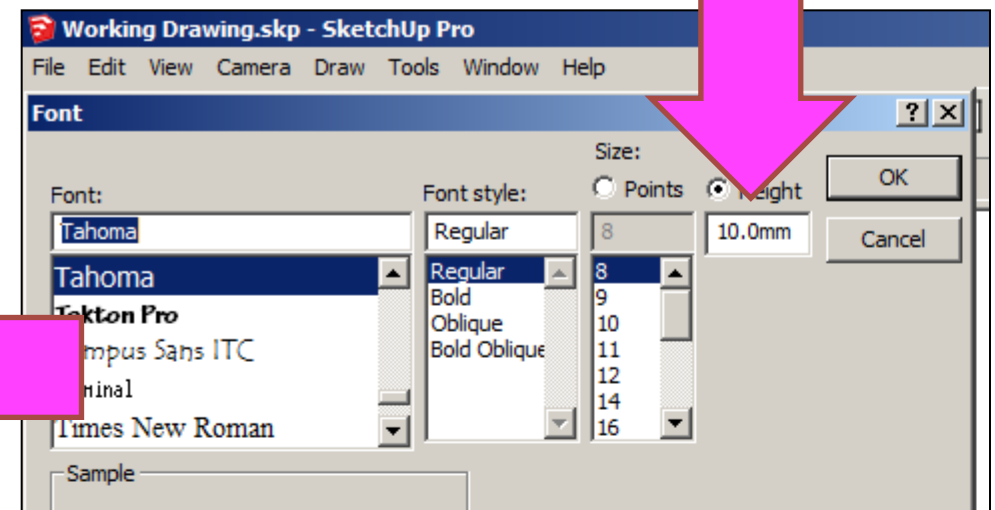
Click on **Dimension** and select all dimensions



Click on **Endpoints** and select closed arrow from the drop down menu



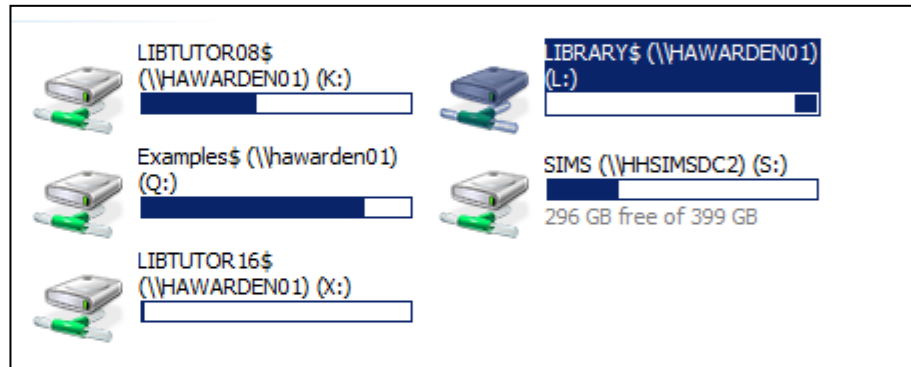
Click on **Update all dimensions**. The dimensions should change on the screen. When your happy close window down.



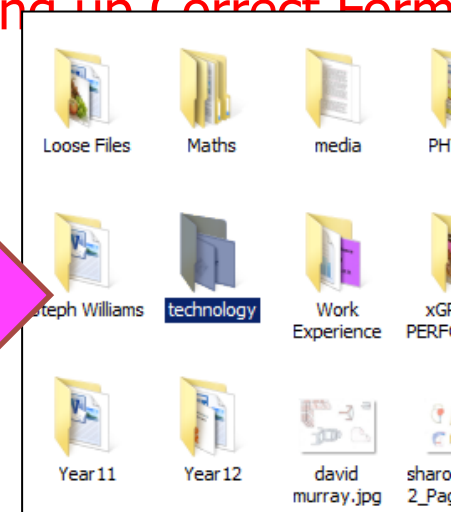
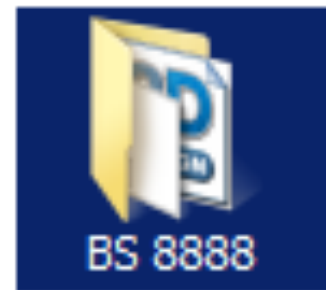
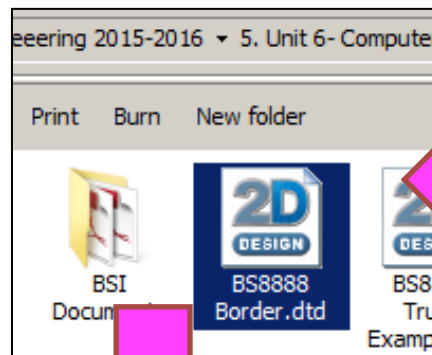
Click on **Fonts** and select a suitable size to be able to read the sizes on your drawing. You may have to repeat the above steps until your happy.

Computer Aided Design: Aircraft Lamp Working Drawing

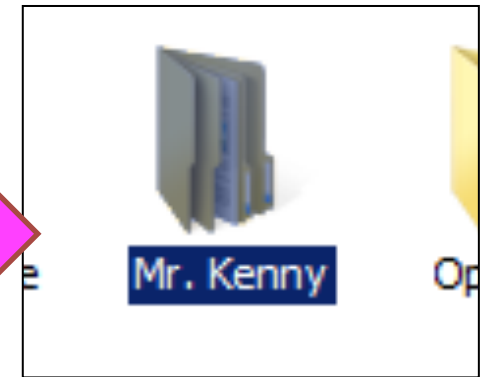
Computer Aided Engineering: 2. Working Drawing (Setting up Correct Format)



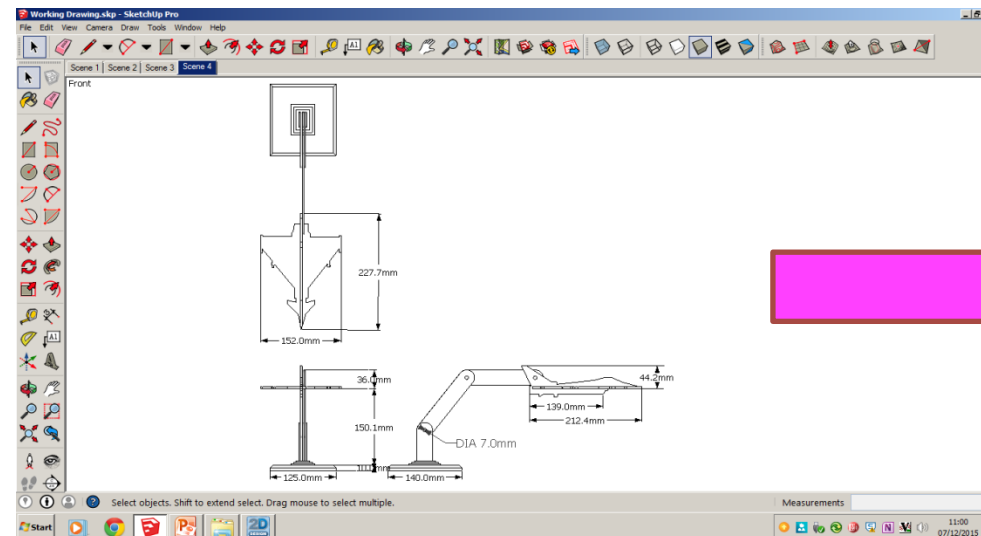
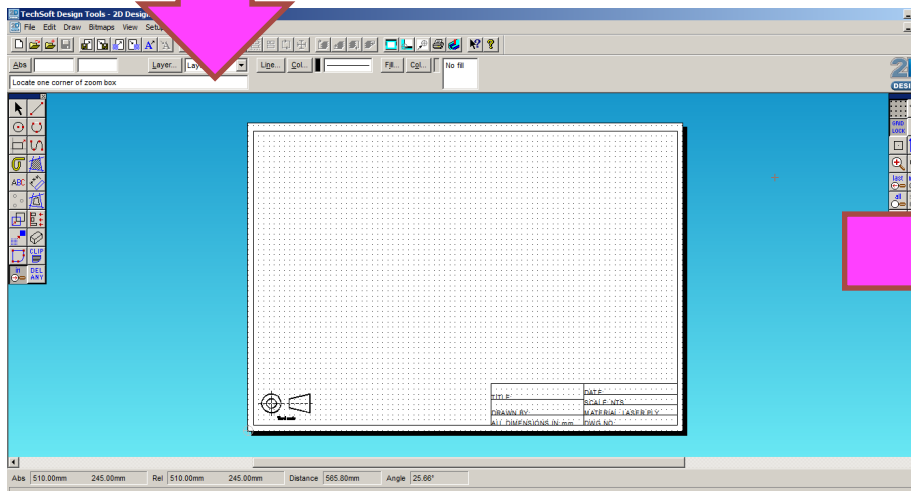
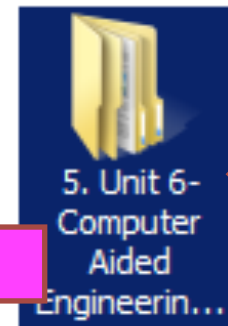
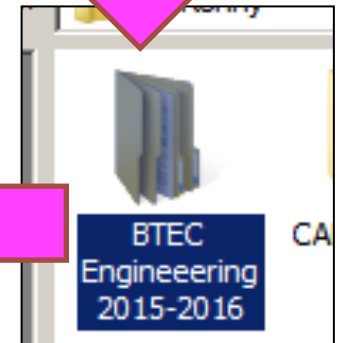
Click on *Library*.



Click on *Technology*.



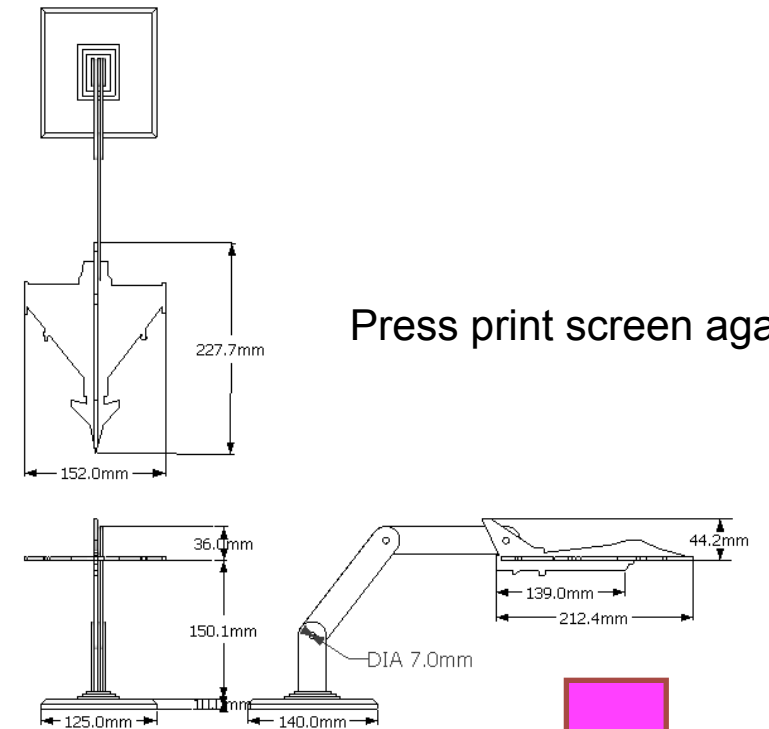
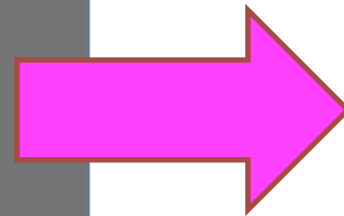
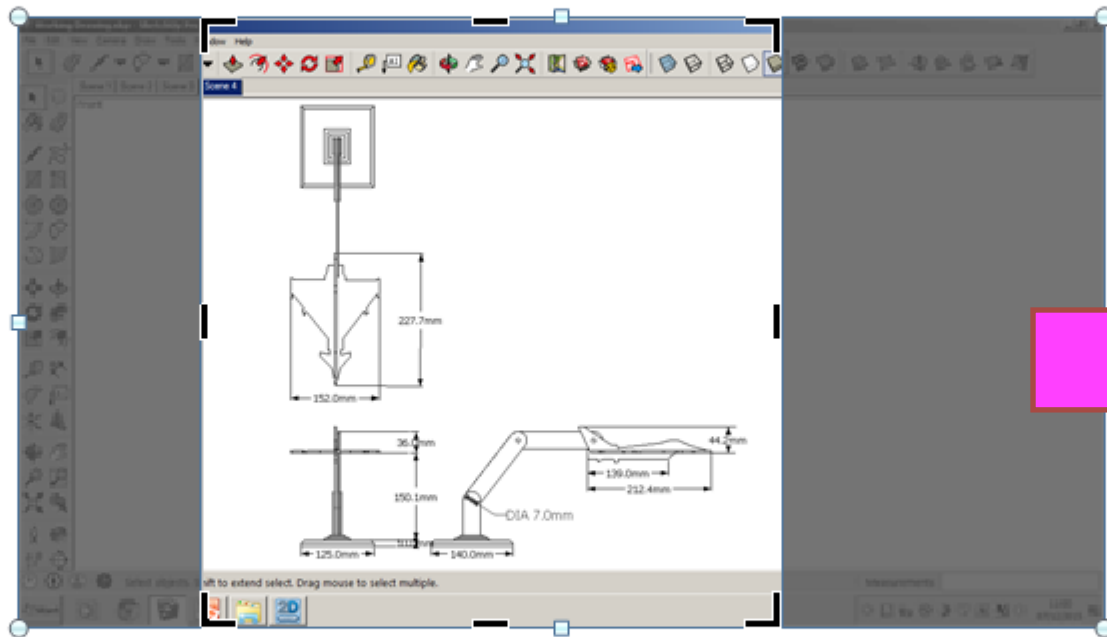
Click on *Mr Kenny*.



Go back to your working drawing. *Click on camera / Parallel projection and then press print screen*

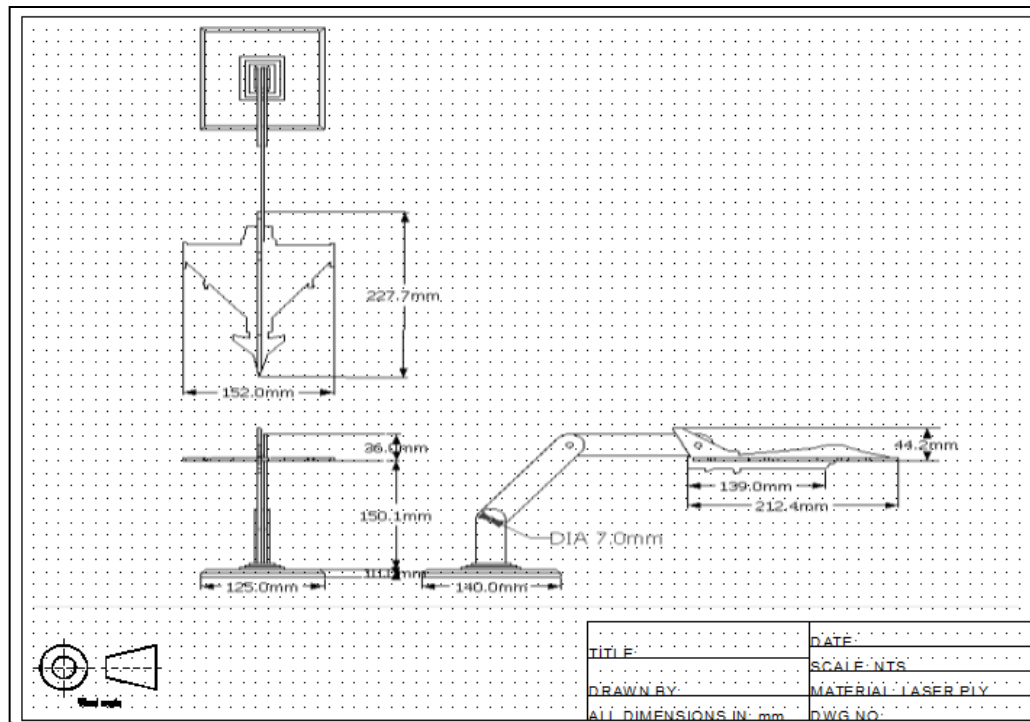
Computer Aided Design: Aircraft Lamp Working Drawing

Computer Aided Engineering: 2. Working Drawing (Importing DXF into 2D Design)

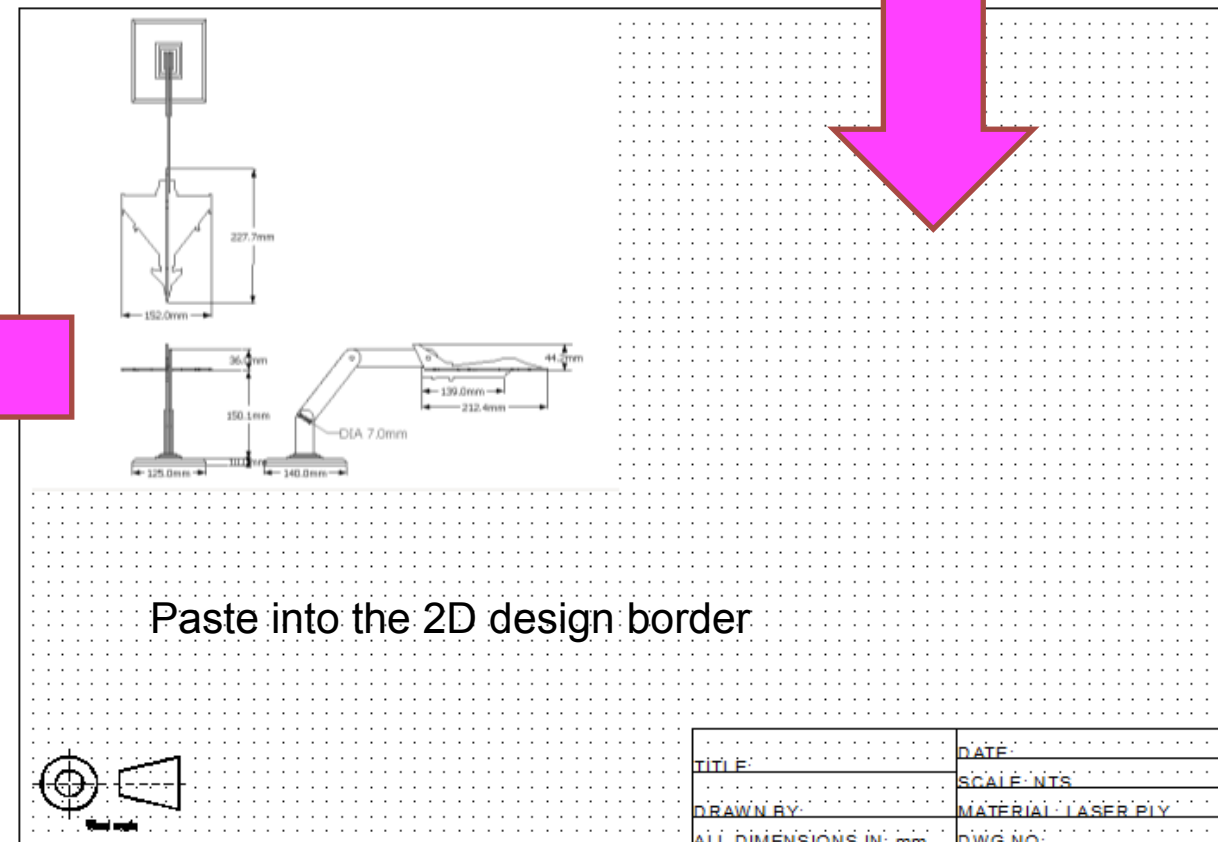
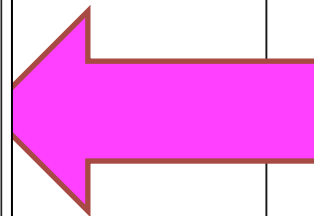


Press print screen again.

Paste into Power point first and then crop.



Resize appropriately



Paste into the 2D design border

Computer Aided Design: Aircraft Lamp Working Drawing

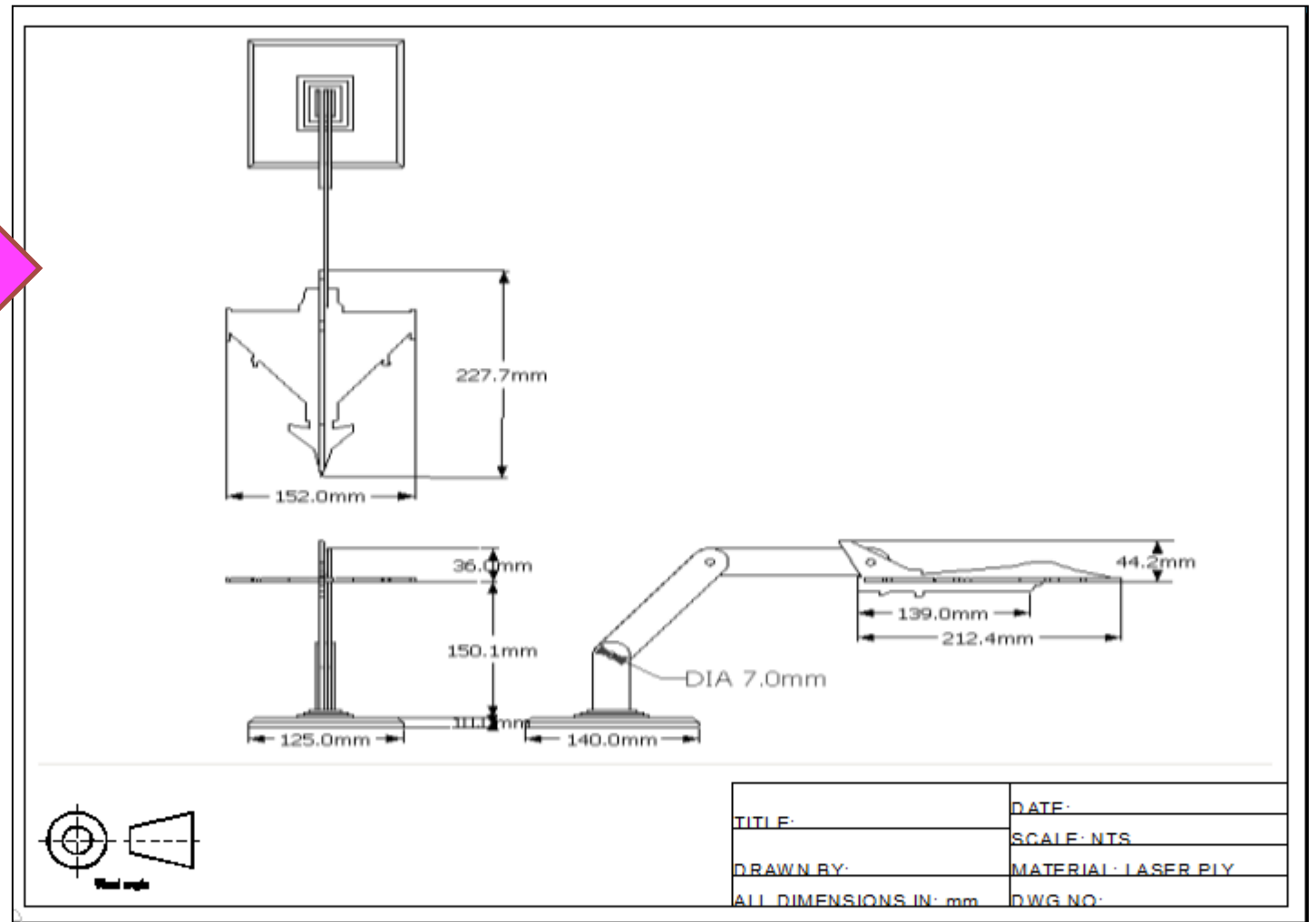
Computer Aided Engineering: 2. Working Drawing (Importing DXF into 2D Design)



Click the dots **OFF**



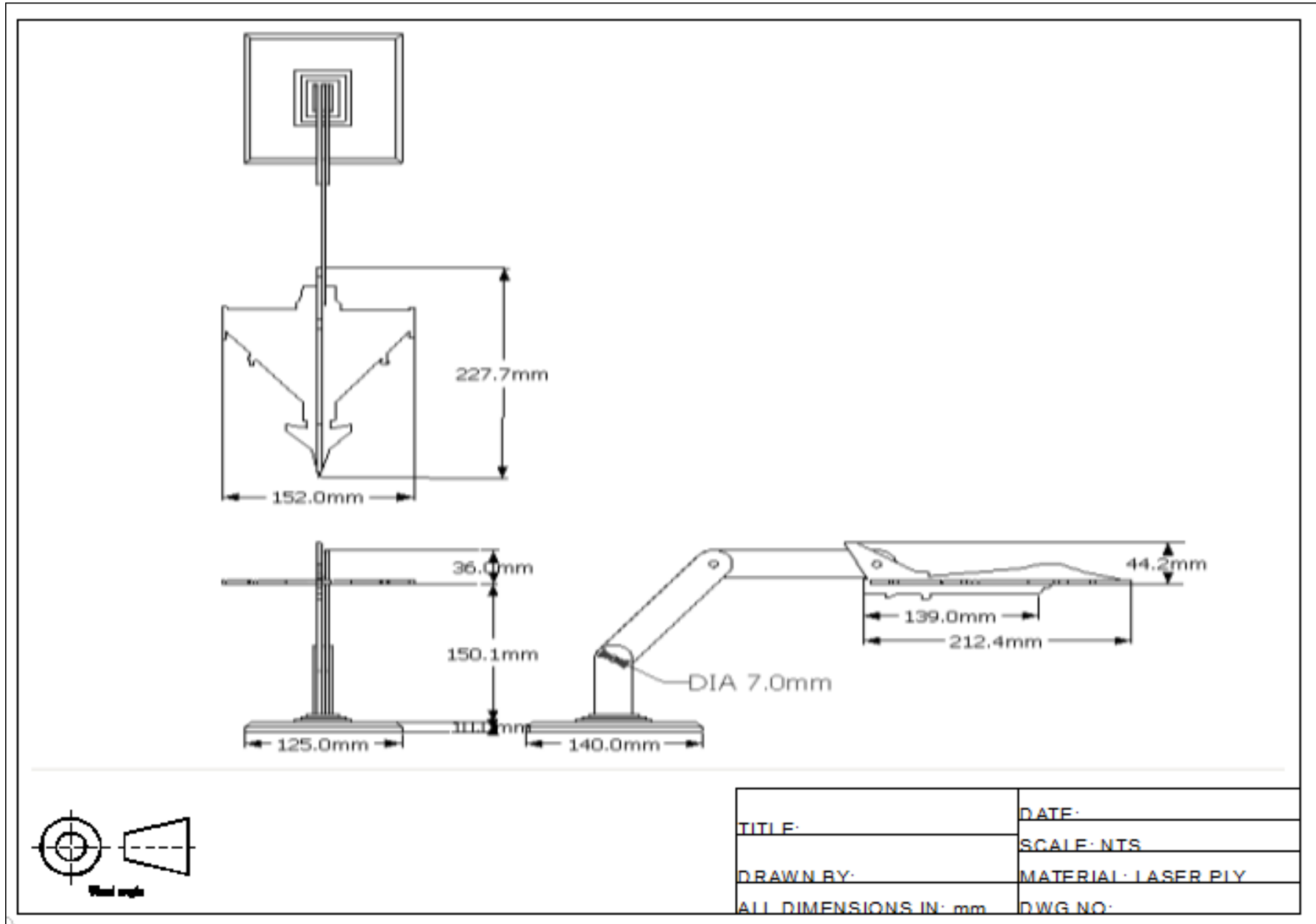
Complete the border at the bottom of the page
Title
Drawn by
Date



Print screen and paste into your folder. Drawing on the next page represents a correct Engineered Lamp drawing. If yours **does not look like this you cannot achieve a level 2**

Computer Aided Design: Aircraft Lamp Working Drawing

Computer Aided Engineering: 2. Working Drawing (Importing DXF into 2D Design)



Extension

- Design a wooden lamp based around a culture.....

