NANYANG TECHNOLOGICAL UNIVERSITY

First Year Common Engineering Course

FE1072 Laboratory Experiment 1B

Laboratory Manual
For
Experiment M7

Sketching in 2-Point Perspective – Shades and Shadows

Laboratory : Design Office 2 (MAE)

Location : N2-B1c-14 (MAE)

Session 2006/2007

NANYANG TECHNOLOGICAL UNIVERSITY
SCHOOL OF MECHANICAL AND AEROSPACE ENGINEERING

DESIGN OFFICE 2

M7 SKETCHING IN 2-POINT PERSPECTIVE – SHADES AND SHADOWS

1. INTRODUCTION

We often want to learn about things around us, be aware of them and their influence on us. This is especially important when we wish to design. To design we need to have a perspective or an image of what we have in mind that we are designing. We must be able to continually get information from our environment to help us create and improve our design. The ability to draw can help us notice and see things better and thus help us to ***think*** better. Through drawing, we can enhance our understanding of how things are put together, how they function, and how they relate to each other.

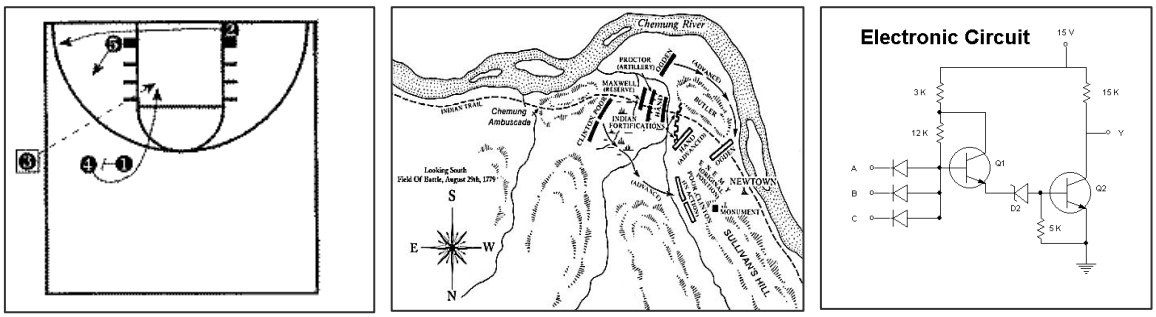
The ability to draw is inherent in us. As a young child, you probably started to first make marks on the wall or a paper as a way to communicate or express yourself way before you first learn to write. For most of us this ability has not been actively developed. This session, will give you an introduction to some of the schemes that will help you to better express yourself visually on a sheet of paper, and be able to use it to help you communicate, both with yourself and with others.

2. OBJECTIVE

To understand the basic principles of perspective projection used in drawing and be able to use two point perspective drawing to design and illustrate objects including shades and shadows.

3. THEORY

Fast sketching of a schematic or a diagram is an excellent way to visually explain the relationships of things, systems and process. These can be basketball tactics, battle plans, organization flow charts, concepts for urban planning, electronic circuit diagrams or mechanical assembly sketches (See Figure 1). Such flat two-dimensional drawings serve their purposes very well and help enhance the thought processes for which they are used. They are excellent communication tools too.

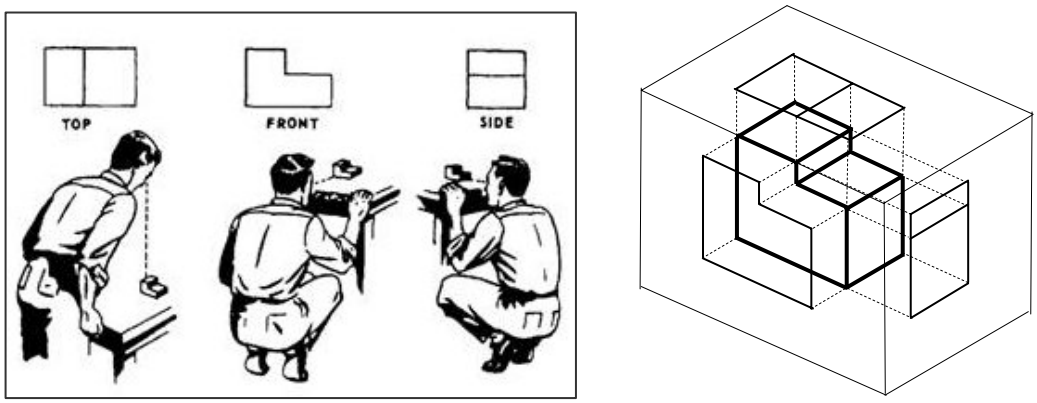


(a) (b) (c)

Figure 1: Sketches of (a) basketball tactics, (b) battle plans and (c) electronic circuit.

However, we live in a 3-dimensional world and most of what we need to do or plan to do will be in such a world. As such representing 3-dimensions on a flat piece of paper will be an important skill for engineers enabling them to communicate their ideas to themselves as well as others. This is especially useful when one needs to design and show these design to non-engineers who may not have good visualization skills.

There are several well established and commonly used 3-dimensional drawing systems used to produce realistic representation of an object or design. The most commonly used system in engineering for progression from flat to 3-dimensional is called **orthographic projection** (see Figure 2). Only when we view an object head-on (one side at a time) do we get the true physical information about an object. What we see will be its true dimensions, shape and proportions.



(a) The projection view (b) The transparent view box

Figure 2: Orthographic projection

In understanding what orthographic projection is, just imagine an object (like that shown in Figure 2) that is suspended in the middle of a transparent box, you can then observe the object from six sides, namely, top, front, right side, left side, and bottom. The transparent box can then be unfolded and the drawing can be placed on a flat piece of paper as shown in Figure 3. If the object is to be made, it is common that the drawing of the object will consist of at least a front, top and one of the side views.

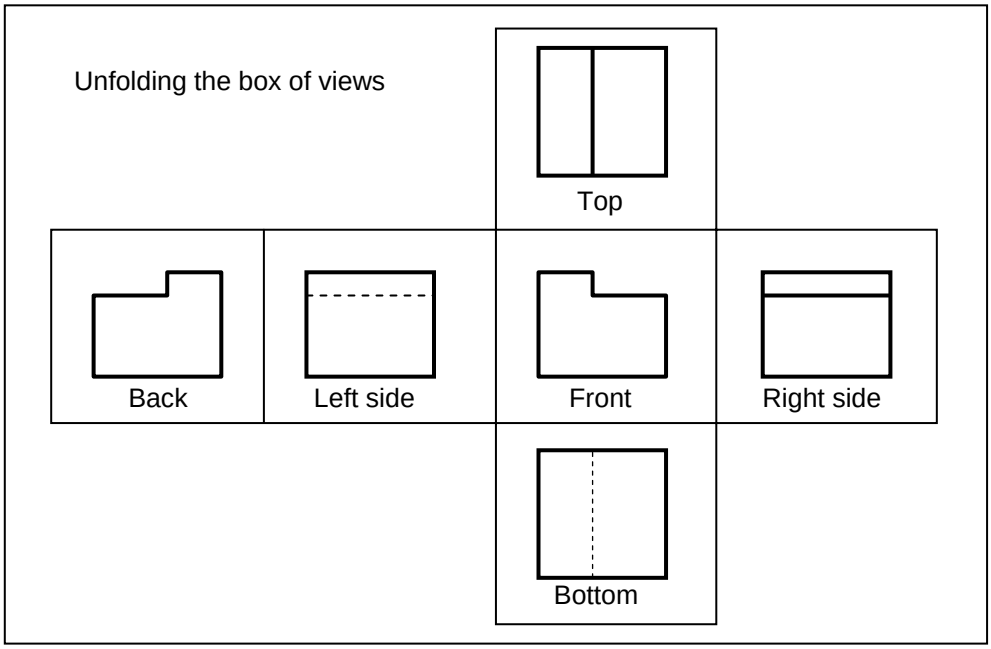


Figure 3: Unfolding the box of view into an orthographic projection drawing.

Another drawing system that is able to present 3-dimensional information on a flat surface is that by perspective. **Linear perspective** is a technique used for portraying depth with a high degree of realism and has been used in Western Art for many centuries. This was a mathematical system developed by Renaissance artists that show depth logically and consistently, by tricking the eye into seeing depth on a flat surface. It gave artists a powerful tool to create realistic art.

The artists, together with their mathematician counterparts, experimented with perspective drawing long ago. An example is shown in Figure 4, from a 1525 woodcut by Albrecht Dürer, "Unterweisung der Messung". In the illustration, the screw eye on the wall is the desired position of the viewer's eye, the lute on the table is the object, the taut string is the ray of light and the picture plane is mounted on the swivel.

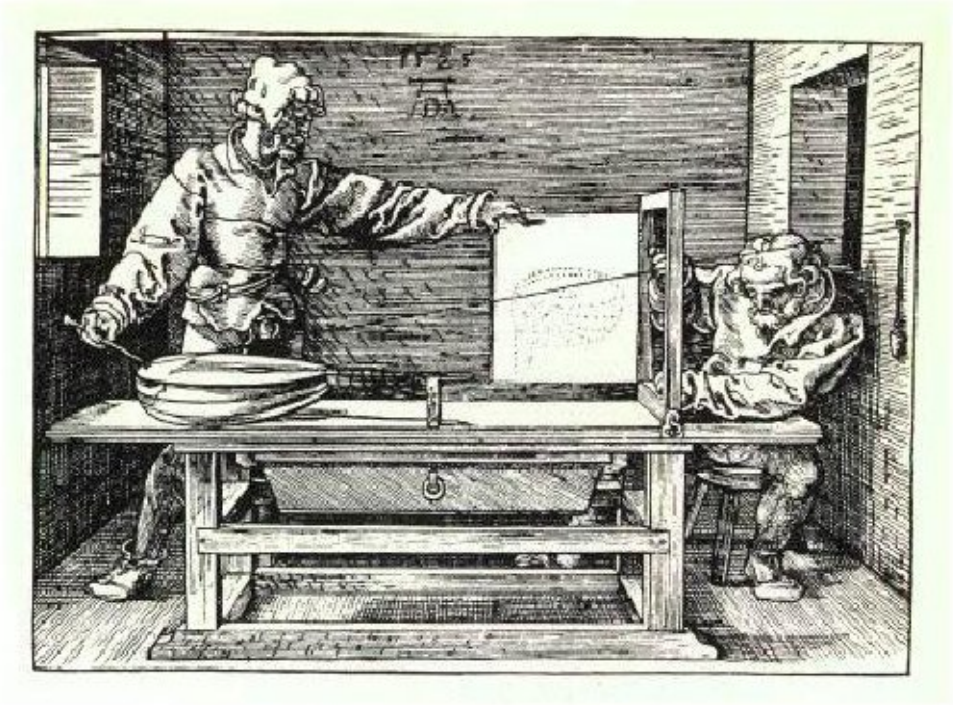


Figure 4: "Unterweisung der Messung" by Albrecht Dürer, 1525.

Linear perspective is based on the way the human eyes sees the world and how they realize space. This is why perspective drawing is such a power tool in presenting 3-D information on a 2-D flat surface. The space cues were learnt throughout our growing years and we have become accustomed to them without explicitly realizing it. Here are some of them:

- Objects that are closer appear larger – relative size
- Objects that are further appear smaller – atmospheric perspective
- Objects in front are closer – overlap
- Objects nearer are clearer in focus – focus
- The eyes tend to move upwards as they focus on distant objects - horizon

To create this illusion of space on a flat surface, we can establish a vanishing point on the horizon line. Some of the concepts of space cues are used here. As an object is pushed further and further away into the distance, it would appear smaller and smaller till it become a point, far away at the horizon. This is known as the **vanishing point**

(VP). In perspective, this is also the point to which parallel lines would appear to converge to. Objects drawn in this way will create an impression of depth.

In this exercise, you will learn to draw in **two-point perspective**. This is as opposed to one-point perspective in which the objects draw on the flat surface appear to vanish to one common point on the horizon, i.e. one vanishing point on the drawing. Figure 5 shows a sketch of three rectangular prisms drawn in one point perspective.

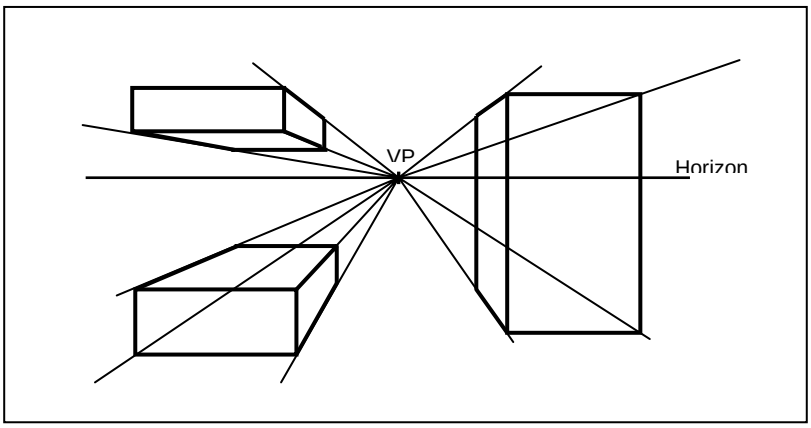


Figure 5: One point perspective.

Two-point perspective drawing system is much more useful than the simpler one-point perspective system. Objects drawn in two-point perspective have a more natural appearance. In two-point perspective, there are **two vanishing points**. The sides of the object drawn vanish to one of these two vanishing points on either side of the horizon. The horizon is the eye level. The vertical lines remain vertical. Objects drawn with two-point perspective are shown at an angle rather than face-on (as in one-point perspective). Figure 6 shows an example of two cubes drawn in 2-point perspective.

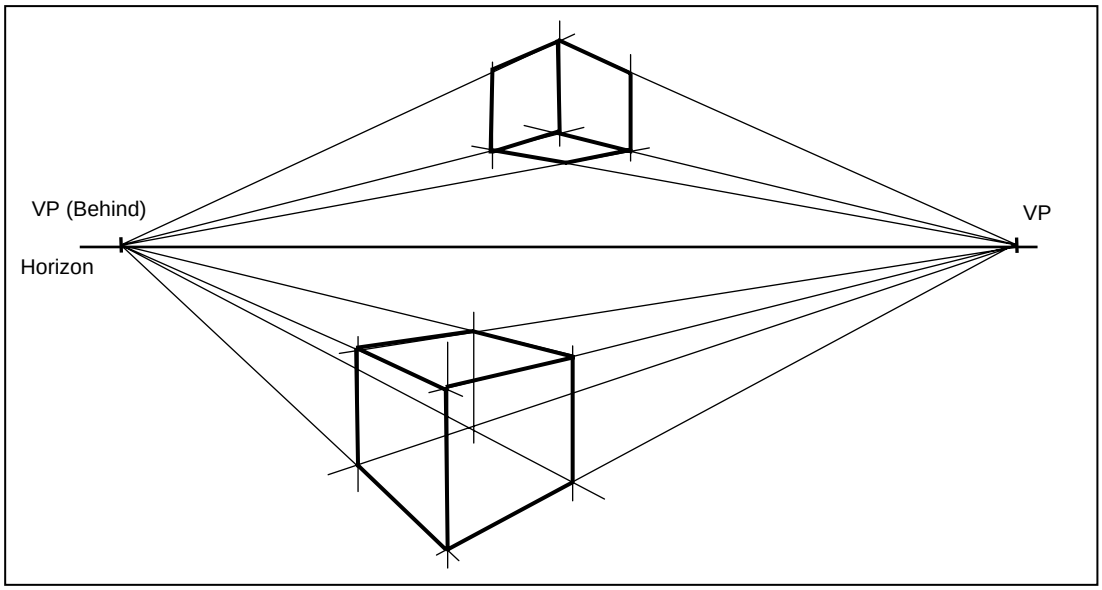


Figure 6: Two point perspective.

Some characteristics of two-point perspective are:

- There are two basic kinds of lines in two-point perspective drawing:
  - Vertical lines

- Converging lines

- The horizon line is always horizontal.
- The vanishing points are always behind the objects you are drawing.
- Vertical lines are always vertical.
- Lines that are parallel will converge to the vanishing point.
- When you draw single object, the ideal layout is a horizontal division of $^1/_3$ to $^2/_3$ and an angle of at least 110° for the converging lines nearest to the observer (see Figure 7).
- When drawing multiple objects, you can place a circle over the prime area and keep your drawings inside it. Objects drawn outside this circle would appear distorted. The closer it is to the vanishing point, the greater the distortion (see Figure 7).

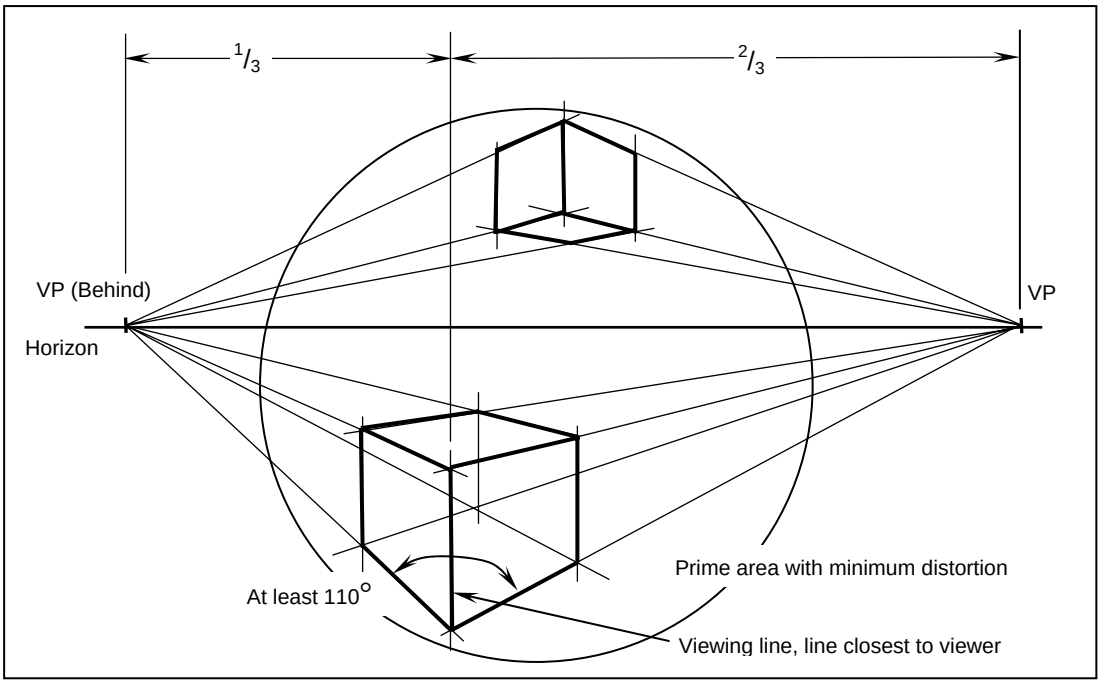


Figure 7: Characteristics of 2-point perspective drawing.

An example of a sketch of a kitchen layout in a two point perspective is shown in Figure 8. The essence of making a good drawing in two point perspective is to draw the objects such that they appear visually correct. This can be enhanced by the following guidelines:

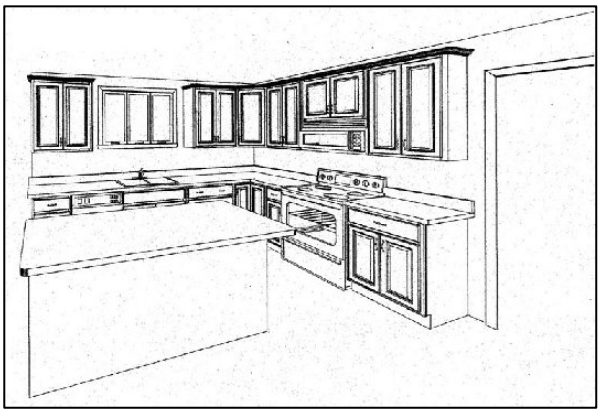


Figure 8: An example of a 2-point perspective sketch.

- Ensure that the two vanishing points are not too close to one another.
- Learn to recognize a square in perspective.
- Learn to select the correct station points. Station points are the position at which we view the object we draw. We can look down, look directly, or look up at it. It is important to select the right station point that gives the most information about the object.

- Learn to judge a cube properly in perspective as it will provide you with the basic building block to build the object in correct perspective.
- Develop the ability to judge proportion (e.g. relationship between the height and breadth) to make the object appear visually convincing.

4. HOW TO DRAW IN 2-POINT IN PERSPECTIVE

In two point perspective drawing, lines that are not vertical should converge onto one of the two vanishing points (VP). Thus the first thing to establish in two point perspective is the horizon and the two vanishing points (see Figure 9-1), one on the left (LVP) and one on the right (RVP). Remember not to place the two vanishing points too close to one another. The example shown here is to draw a simple book shelf with drawer and the instructions to make this drawing are given in Figure 9.

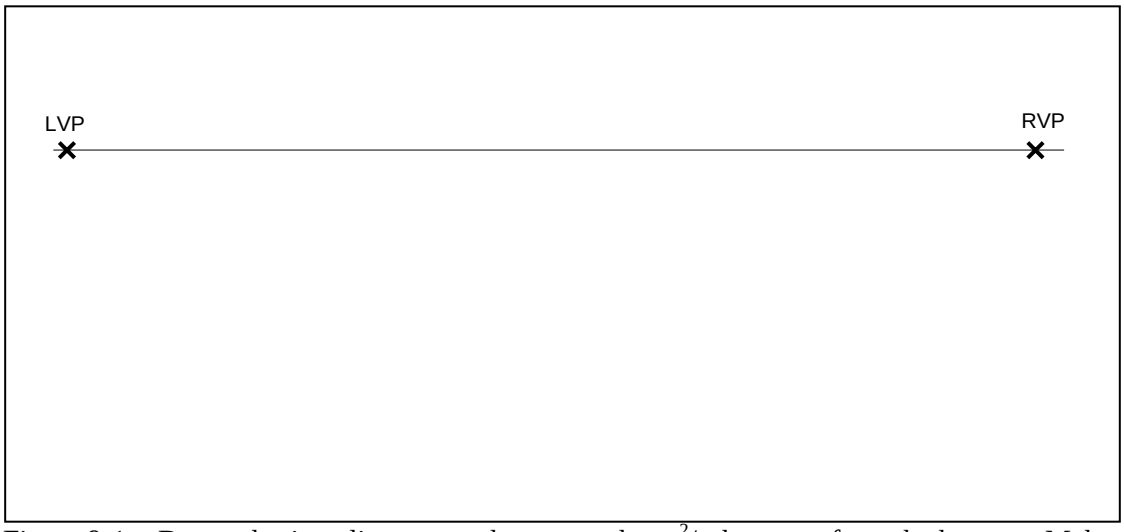


Figure 9-1: Draw a horizon line across the paper, about $^2/_3$ the paper from the bottom. Make sure that the line is horizontal. Then make two vanishing points, one on each end of the horizon (the left and right vanishing points, LVP and RVP).

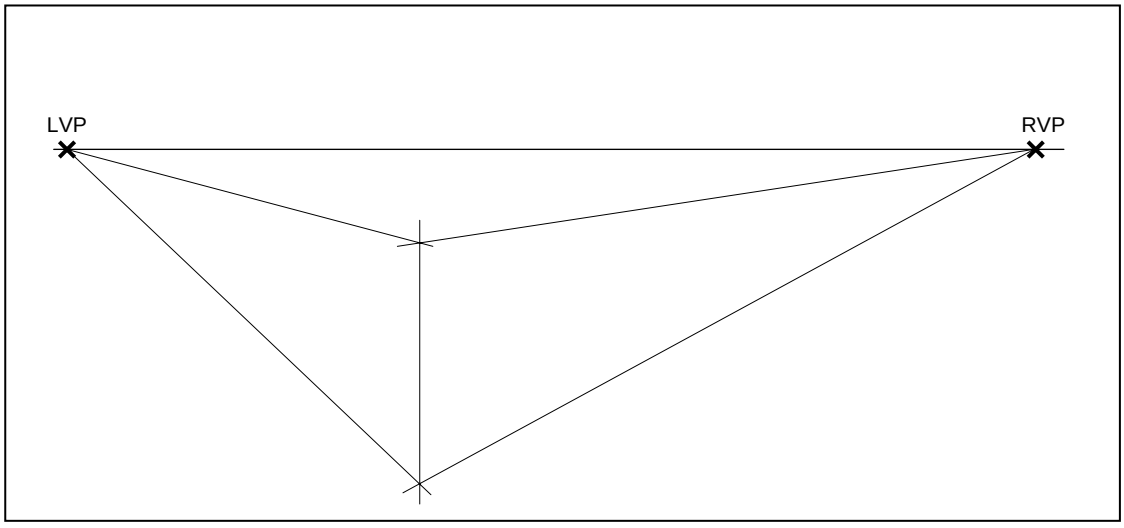


Figure 9-2: Pick the station point such that the viewing line closest to the viewer is at the ideal division (horizontal division of $^1/_3$ to $^2/_3$) and draw the vertical line that will be the edge closest to you. Pick and draw in the top and bottom spots of the shelf (this is done approximately to the proportion of the shelf). Join each of the end points to the repective vanishing point. This will form the top and bottom edges of the shelf.

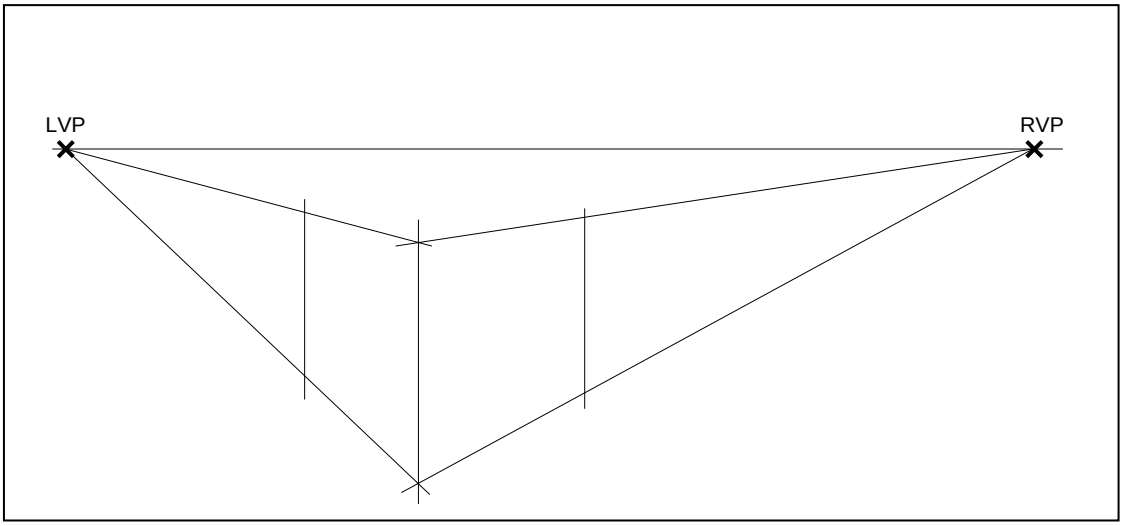


Figure 9-3: Putting in the depth and width of shelf is a little tricky. You have to convince your eyes that you have selected the right proportion. This will improve with more practice. Draw in the two vertical lines that define the width (on the right) and the depth (on the left) of the shelf.

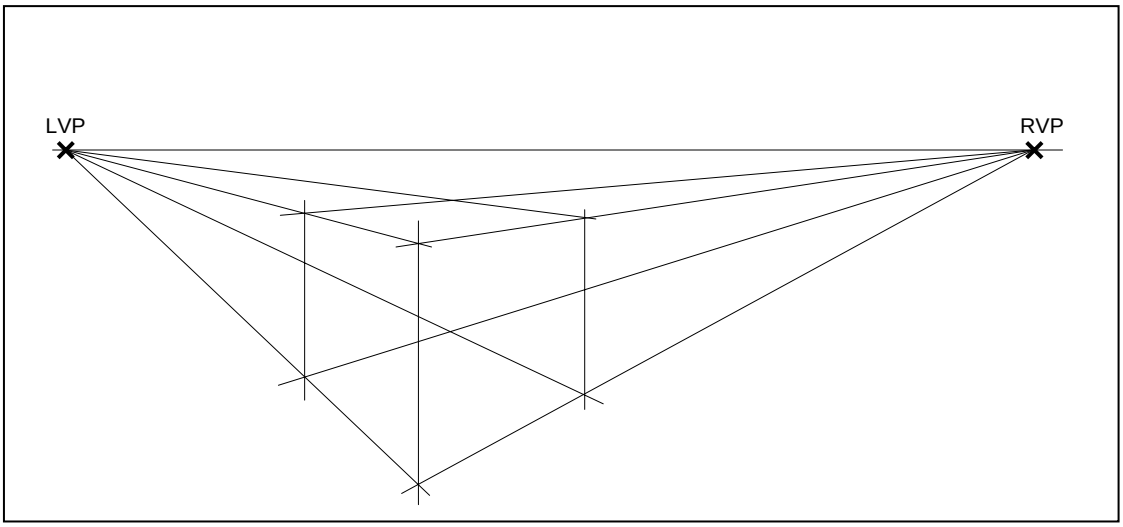


Figure 9-4: From the intersections of the two vertical lines with the converging at the front, lines are projected to the opposite vanishing points to form the outline of the shelf. It should appear like a box. This is darkened in the next figure.

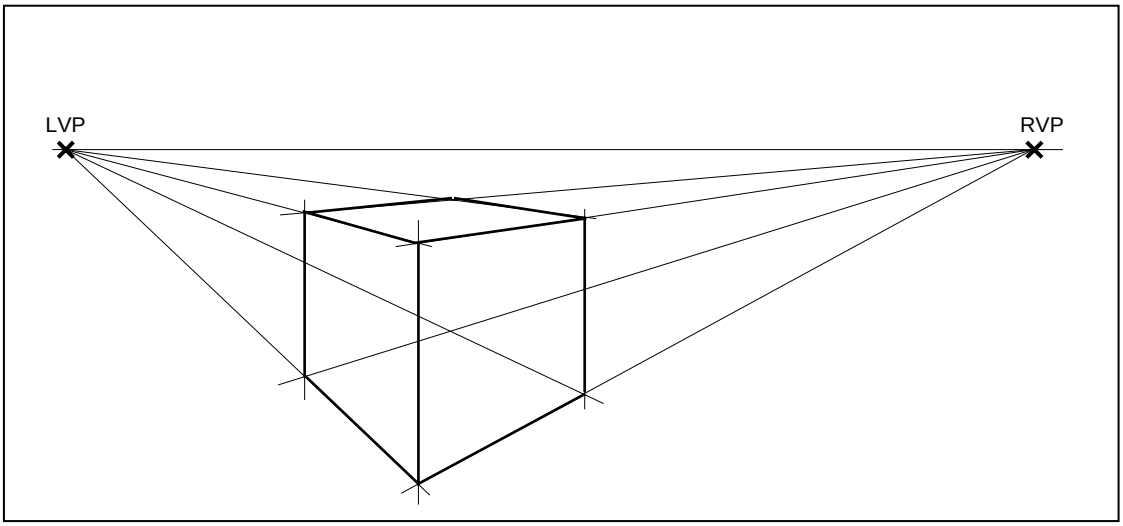


Figure 9-5: The outline of the shelf is darkened to show where the focus of the drawing will be.

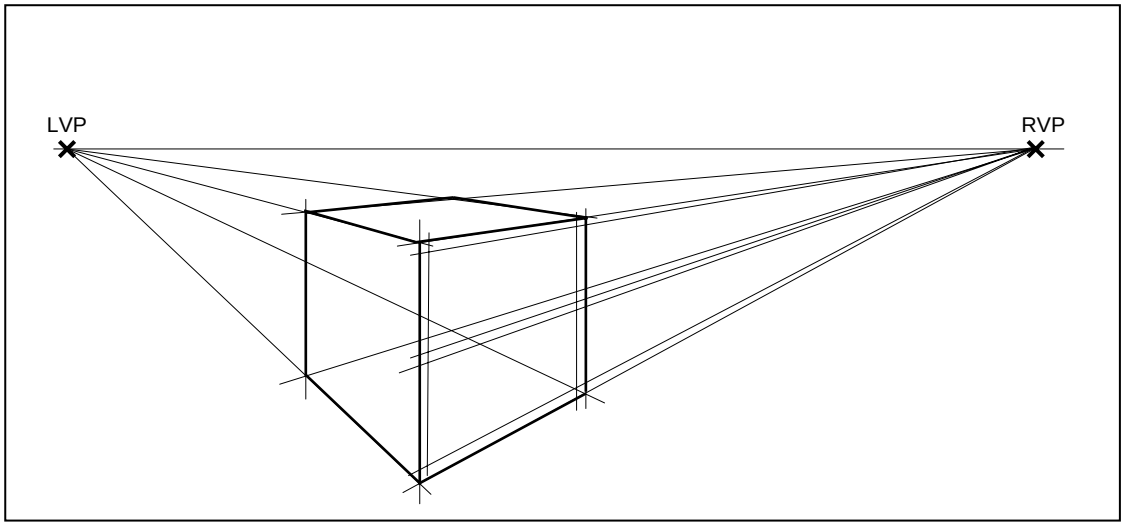


Figure 9-6: The next step is to draw in the thickness of the shelf. Again this is done by proportion and judged by the eye. Here two vertical lines are drawn for the vertical thicknesses and four converging lines to the RVP shows the side thickness.

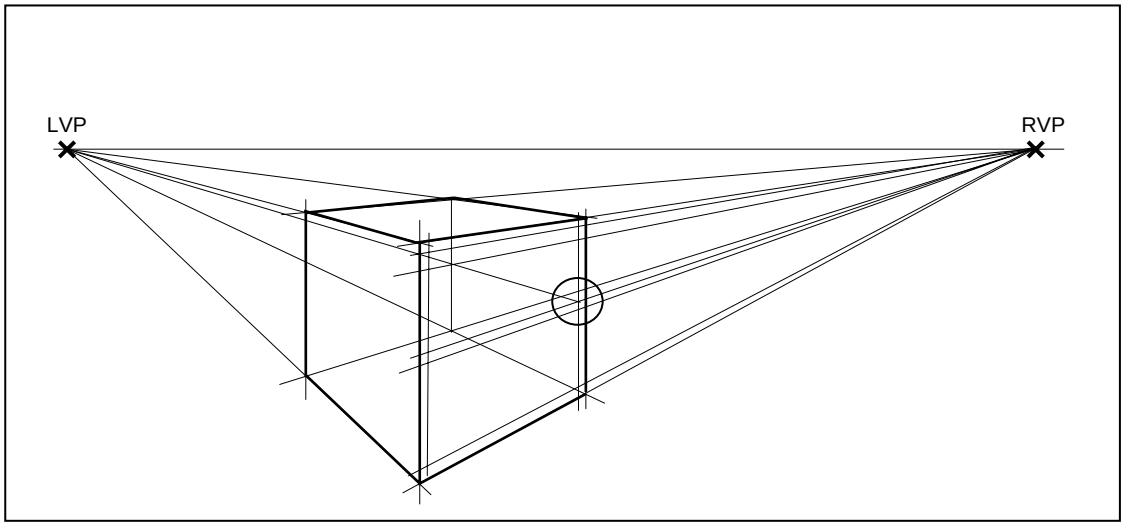


Figure 9-7: In drawing the top open shelf, the right front side of the shelf is located (circled). A line is projected to the LVP. The back corner of the open shelf is located by joining the top back corner and bottom back corner. From the intersection point, a line is projected to the RVP to show the back edge of the open shelf.

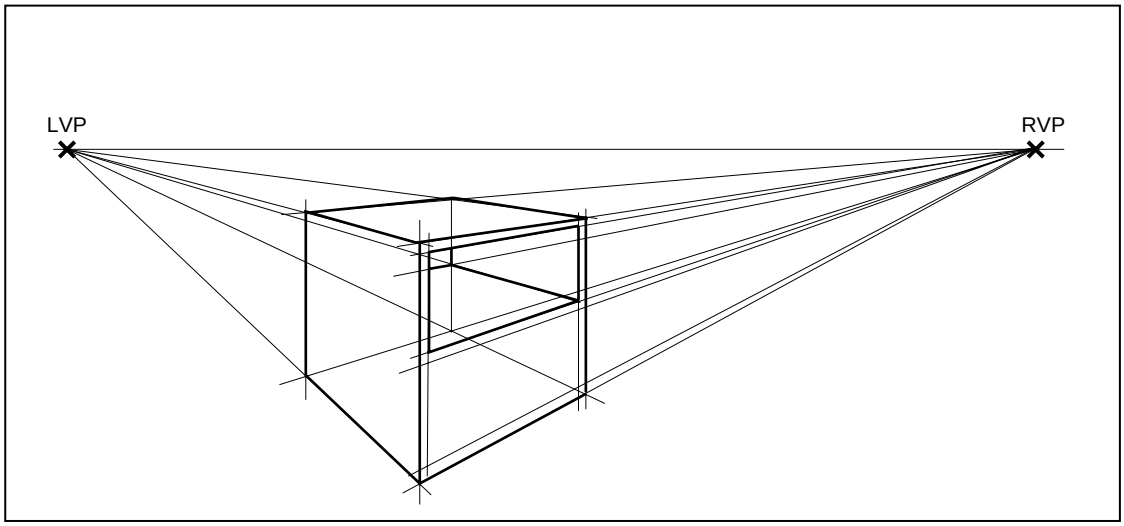


Figure 9-8: The open shelf is darkened to show the inside of the shelf.

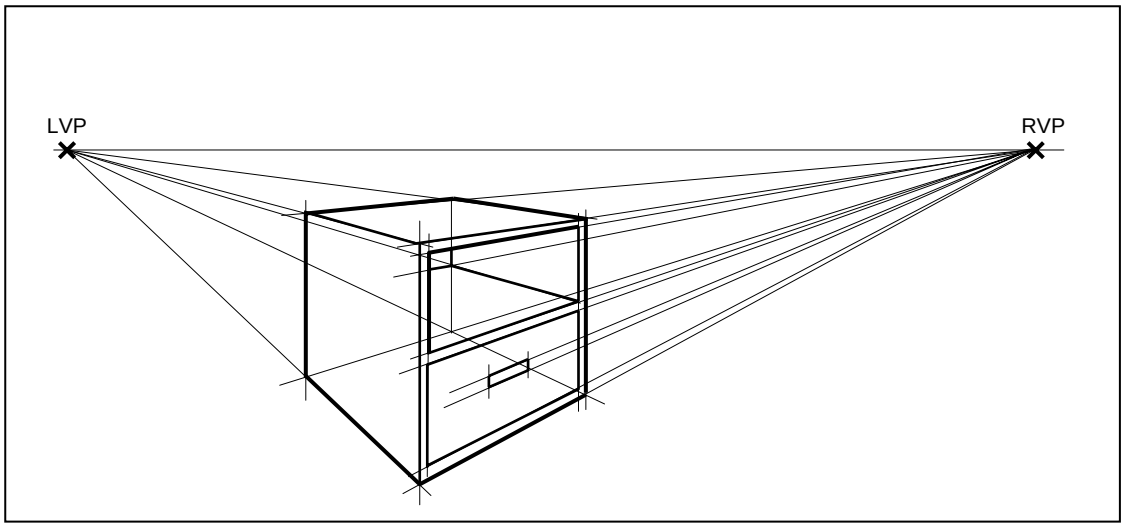


Figure 9-9: The bottom drawer of the shelf is drawn in and darkened. Additional details canbe added as desired to make the drawing more realistic.

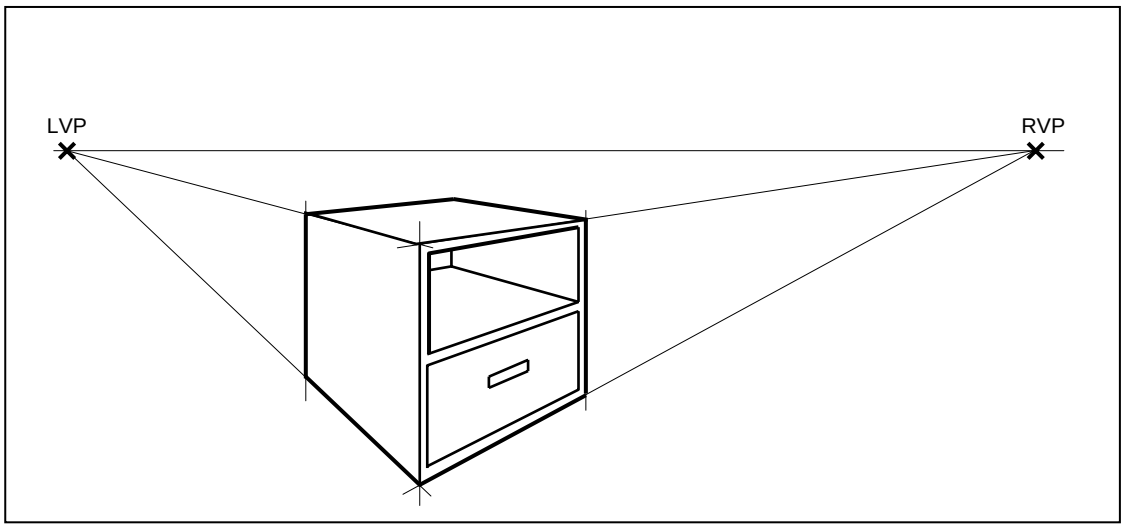


Figure 9-10: The figure shows the open shelf with drawer with most of the construction lines removed.

From the descriptions above, it is easy to notice that two main characteristics of perspective drawing are distinctive: foreshortening and convergence. Foreshortening happens when a rod is held up in front of a viewer's eyes and is turned till it is along the viewer's line of sight; the apparent length of the rod will progressively diminish. Convergence occurs when the viewer is moved further and further away from it, the objects appear to converge to a point. Both of them occur naturally in the way our eyes see. This is why perspective drawings appear visually realistic and easy to understand.

5. HOW TO ADD SPATIAL QUALITY TO PERSPECTIVE DRAWINGS

The instructions presented thus far are mainly for drawing prismatic objects that have straight edges. Circles and curves are dealt with in M6 Sketching in 2-Point Perspective – Circles. There are some more simple drawing and shading techinqiues, especially the use of shades and shadows, that can enhance the illusion of depth, volume and interests in perspective drawing.

One of the rules to remember is that lines in the foreground should be stronger (thicker) and more contrasting. Lines that are further away should fade or are lighter. Different line weights will help make your drawing more three dimensional. To enhance the 3-dimensional feel of the object draw, we can use bolder outline to show the shape of the object through space (See Figure 10)

The use of shading and shadows can give more clues to the realization of space on a flat surface. For shading, pencils, charcoal, pastels and even markers can be used. But before we can start shading or adding shadows to the drawing, we must determine where the light is coming from. Typically, we draw using pencils or pens (or markers) on a white sheet of paper. As such, the background is usually white, i.e. the medium is already lighted. Thus it is easier to assume that the light source is from the back of the paper, and if the object we are drawing is viewed from above, then the light is from the top corner of the paper. This is illustrated in Figure 10

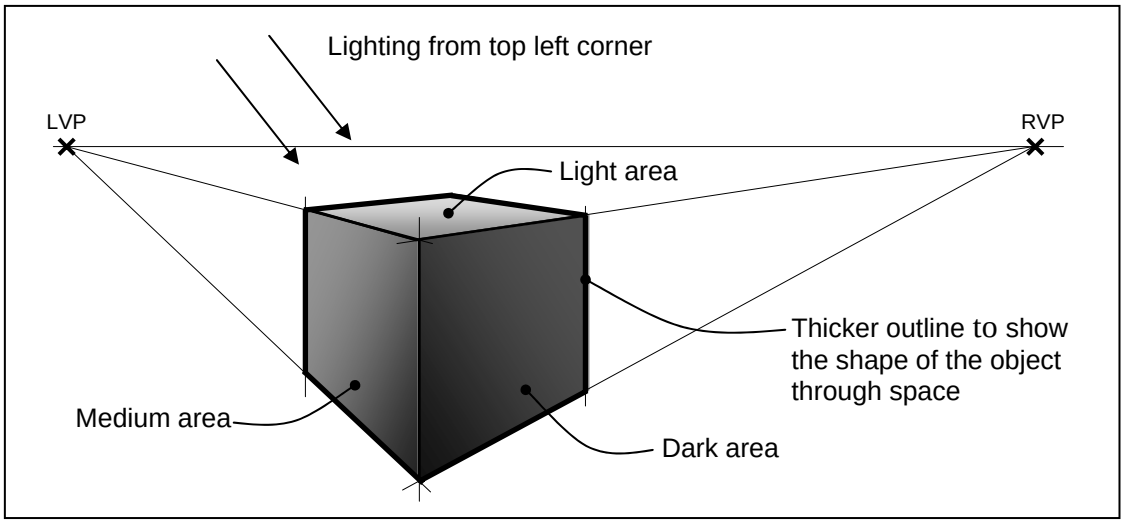


Figure 10: Shading a cube showing no shadows, with light source from the top left corner.

The surface furthest away from the light source will therefore be the darkest, and the surface illuminated by the light source will be lightest. The surface in between will have a medium shade. These are the often use light shades in perspective drawing: light, medium and dark. In fact, the area that is nearest to the viewer will have the highest contrast (in the area of the viewing line). The shade can be achieved by tones shading with pencils or using density of lines (or hatchings).

A cylinder can be similarly shaded, except that as the surface of the cylinder is curved, the shading is gradual rather than an abrupt change and there are highlights indicating reflection from the environment. This is shown in Figure 11.

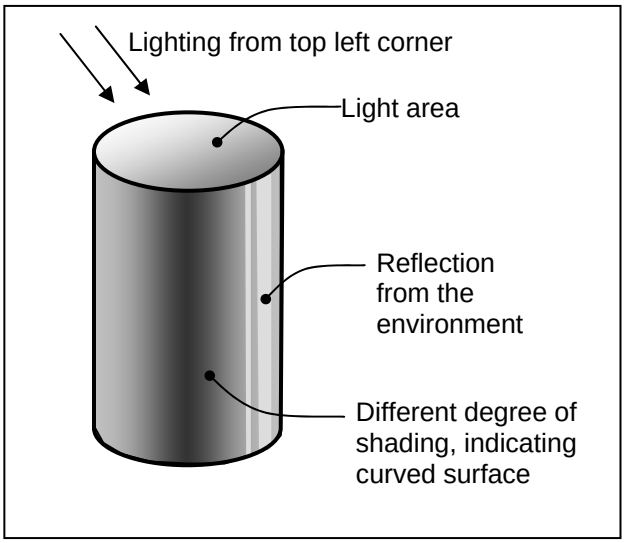


Figure 11: Shading a vertical cylinder with light source from the top left corner.

Usually, if there is sufficient light to see an object, there will be sufficient light to cast shadows. When drawing shadows, remember the key physically property of light–it travels in straight lines. Here are some points to take note when drawing shadows:

- The height, position and type of light source will determine the angle, position and length of the shadow cast.
- The shadows will show the direction of the light source.
- The shadow can be determined from either parallel rays (the sun, see Figure 12) or diverging rays (from artificial light, e.g. lamp, see Figure 13).

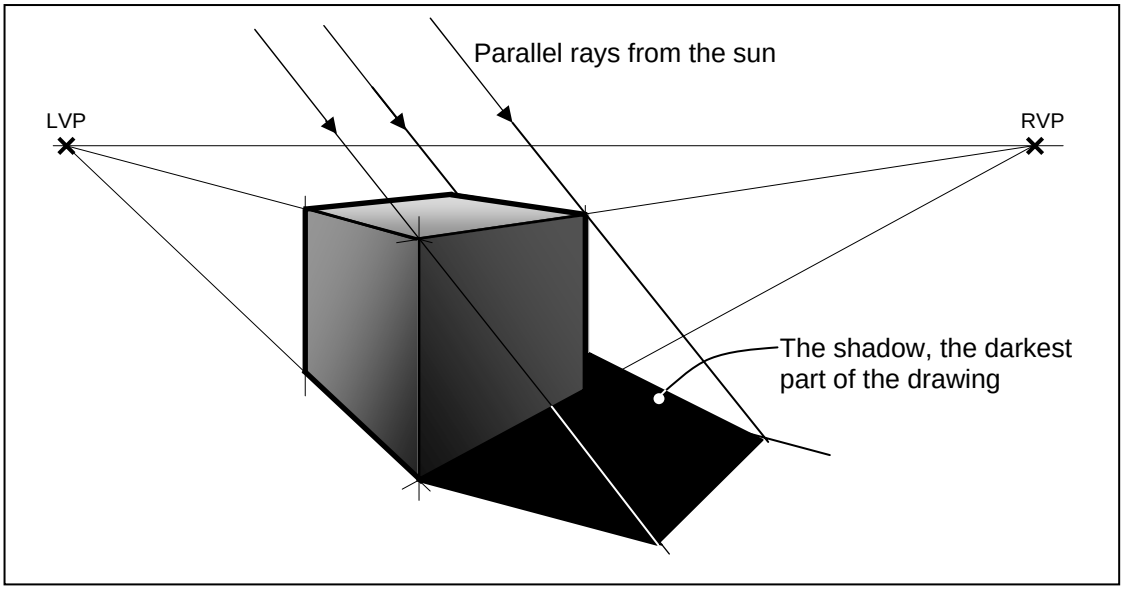


Figure 12: Cast shadow on a cube with parallel rays (from the sun).

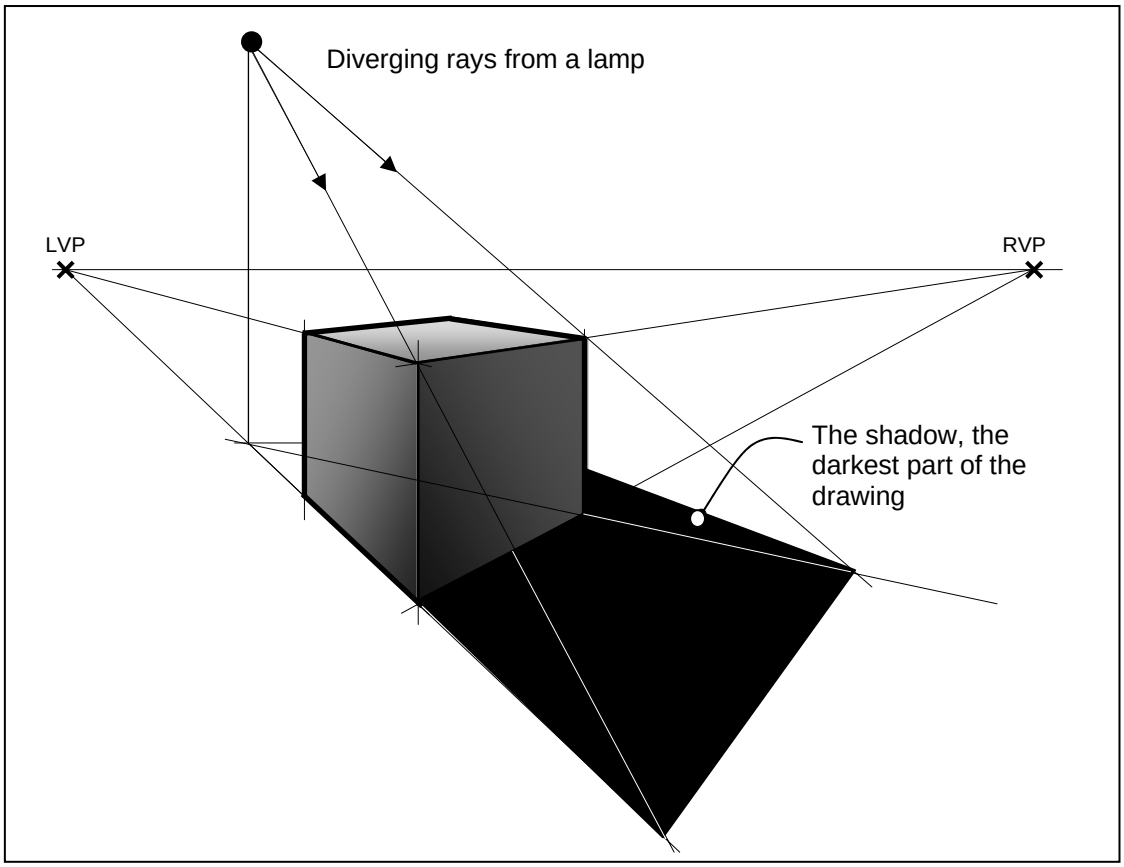


Figure 13: Cast shadow on a cube with diverging rays (from an artificial light).

- The cast shadow is the darkest part of the drawing as it is the area that will receive the least amount of light.

Shadings and shadows that appear visually correct can be achieved through practice and experimentation. The techniques used can be individually developed and you can invent your own 'style' to attain the best results.

6. MATERIALS

The drawing materials needed for the exercise include the following:
A3 size sketch pad paper.
HB, 2B, and 4B pencils
Ruler and eraser

7. DRAWING EXERCISE

Figure 14 shows a sketch of a proposed design of a dollar note counter and verifier. The proposed design has a LCD screen on top, the crisp dollars are put in on the right hand side and fed into the device. The counted and verified notes are ejected out in the front collector box. You are required to complete the design of the device and draw the complete design in two-point perspective. Shade and draw in the shadow to best illustrate your design. Use the guidelines mentioned in the above. You may choose to use an artificial light or sun light to illuminate your design. Make all assumptions necessary to complete your design.

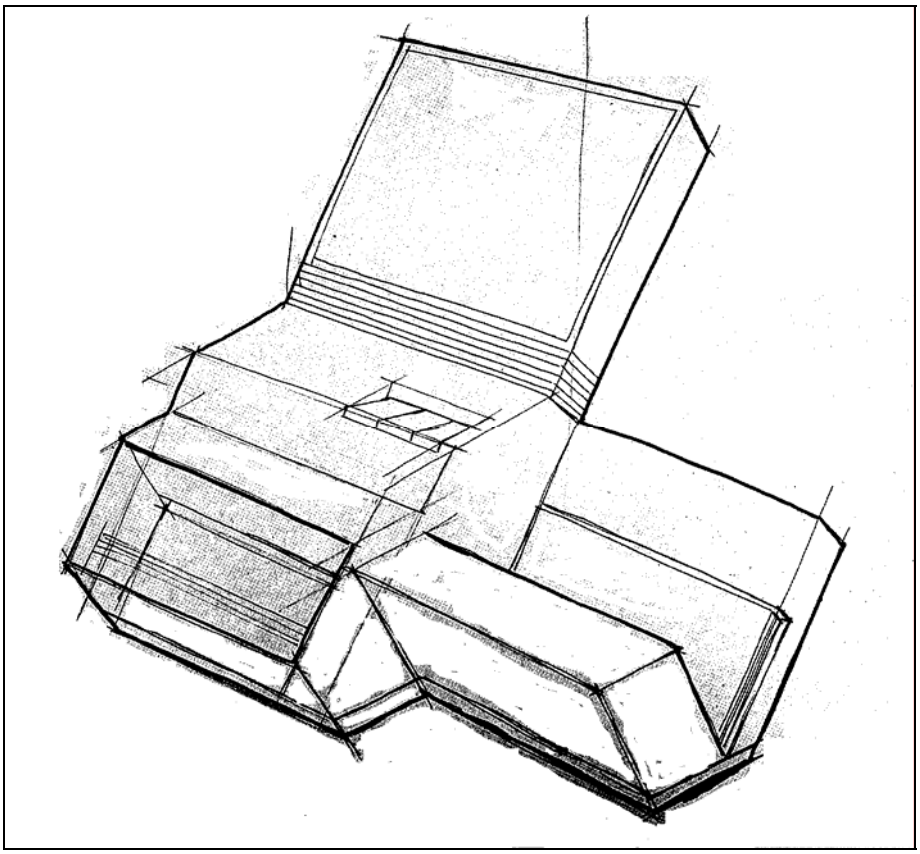


Figure 14: A sketch of an incomplete design of a dollar note counter and verifier.