

**IDT 111**  
**Interior Design**  
**Materials &**  
**Application 1**

**STUDENT HANDBOOK**

**by Hannah Pañares**



Disclaimer: This is not CTU-Pinamungajan official handbook for IDT111.  
The author created this for the student's guide on the course.

# Interior Design Materials & Application 1 - IDT111

## What is Interior Design

### Interior Design: Defined

**Interior design** is a multidisciplinary career that requires you to merge creativity and technical savvy together. Interior designers are responsible for the look, feel, function, and safety aspects of interior spaces. They must be knowledgeable in building codes, understand color theory, and be willing to cooperate with multiple teams during the building process of a home or office. In this lesson, we will learn about the duties, education, and career outlook for interior designers. We will also touch on what qualities may make a person better suited to be an interior designer than others.

### Personal Qualities and Duties

While not required, prospective interior designers should have a combination of the following qualities:

- Creative and artistic ability
- Orientation to detail
- Discipline
- Cooperation
- Problem solving ability
- Visual orientation

The work environment of an interior designer can be hectic, as they are required to collaborate with architects, mechanical engineers, builders, and industry administrators throughout the process of a project. Besides working with others, interior designers have many other daily duties.

They draft interior design plans on complex design software or by hand, for instance. Many interior designers used to do everything freehand, but that is much rarer now with the advent of computer software. Interior designers also bid on new projects and work with clients to determine the interior design goals and discuss issues that may arise in the construction phase of those desires. They evaluate interior spaces and determine how to make them best for living and working within and also establish timelines and budgets for interior design projects. Interior designers select furnishings, colors, and other interior furniture for the space. They also understand building codes for their region to determine what types of interior remodeling are not permitted.

*"interior designers are integral parts of the design process of building homes and commercial spaces. Interior designers take an empty space and turn it into a livable space that combines function and aesthetics together. "*

## Interior Design:Some History

### Elements of Interior Design

When thinking about interior design, words like creativity and flair immediately spring to mind – but many would be surprised to find there is a degree of science involved. Professional interior designers will usually follow a set of informal “rules”, based on specific interior design principles and elements. These interior design elements include space, line, forms, light, colour, texture and pattern; and keeping them balanced is the key to creating an aesthetically pleasing interior.

In addition to enhancing the appearance of a room, getting these elements to work together in harmony will also bring an increased functionality. To start, an interior designer will assess the room according to these interior design elements, and then use them to disguise or enhance the various features and flaws of the space. As a minimum, the following seven elements should always be considered in the creation of any interior.

#### Why are these elements important to interior Design?

- The elements of design are the fundamental building blocks of any composition.
- These pieces work together to form a unified composition, and when utilized successfully, create a strong, dynamic visual layout.
- The designer uses these elements as tools that control how a message is delivered to an audience.
- These principles can be applied to fine art, photography and graphic design.

### Space

*The foundation of an interior design, space is a fundamental concept to understand, ensuring you're best equipped to take advantage of what is available to you. The available 'space' usually can't be easily changed (though sometimes a designer may have the luxury of doing so), so you need to work with what you have within the physical boundaries of the room.*

In interior design we have the luxury of working within three dimensional space (length, width and height). This three dimensional space can be filled or left empty, depending upon what you need to achieve from a functionality and design perspective.

Space can be split into two categories: positive and negative space. Positive space is space containing objects, whilst negative space is the open/empty space (including any space between objects). Striking a balance between the negative and positive spaces of a room is essential to avoid overcrowding, or on the other end of the spectrum, sparseness.

This balance will be influenced by the client's needs in the specific area/room and its required functionality. For example, negative space is required for traffic paths. It is also crucial to consider the scale and size of the furniture and objects placed in a room, as this can be used to make the space appear larger or smaller given the desired outcome. A tall object such as a bookcase can give the illusion of height.

Different design styles will lend themselves to different uses of space – for example, a minimalist design will have far more negative space than your average eclectic design. However, no matter what your design brief, how you use and balance the space available to you can be the difference between hitting the mark with your design concept or missing out on your next commission.

## Line

*Horizontal, vertical and dynamic lines help to shape a room and guide the eye. Creating lines using the room's furnishings and structural design can form harmony, unity and contrast.*

Horizontal lines, created by tables and other surfaces, give a sense of stability, formality and efficiency. Interior designers highlight horizontal lines to make a room appear wider and longer, and to draw the eye to a focal point. But be careful, overemphasis of horizontal lines has the ability to make the space seem boring and uninspired.

Vertical lines, created by features such as windows and doorways, evoke feelings of freedom and strength. On a functional level, accentuating vertical lines often gives the illusion of a room being taller. Often suited to use in dining rooms, entries and offices, vertical lines must be incorporated wisely so as not to leave inhabitants feeling uneasy.

Dynamic lines refer to diagonal, zigzag or curved lines. Such lines can be found in stairs, for example, and provide energy and movement. Stimulating to the eye, dynamic lines capture our attention longer. However, too many dynamic lines in one room can be distracting, and overpower horizontal or vertical lines.

Ideally, interior designers will strike a balance with the incorporation of different lines. This is typically done by selecting one dominant feature line, in accordance with the client's brief and the desired feeling they wish to convey in the space.

## Shape

*Shape is a dimensional area which is decided by outline of an object. If two or more shapes are combined then it is called a form. Shapes have three types.*

- Natural Shapes

Natural Shapes nothing but shapes naturally occurred objects like flowers, mountains, clouds, etc. These shapes create a natural feel in the space.

- Geometric Shapes

Geometric shapes like square, rectangle, triangle, etc. contain proper area and size. They can be easily provided.

- Non-objective Shapes :

Non-objective shapes are man made artificially created by colors, random edges and lines etc.

## Form

*Form is the shape of the room, as well as any objects within the room. In other words, it relates to the physical form of anything that is three dimensional.*

Forms can usually be described as either geometric or natural. Geometric refers to hard lines and square edges, often looking man-made, while natural relates to more organic forms that seem to be created by nature. Forms can also be open – objects that can be looked into or closed – self-contained.

Another thing to take into consideration with form is the proportions and scale of the room compared to the objects being placed within it. Adding forms of similar shapes can create harmony and balance, while adding too many differing shapes can have a confusing result. A space is typically more pleasing if the dominant form is repeated in minor objects throughout the room.

## Light

*Natural or man-made light is a critical aspect of any space. Without it, all of the other elements would not be able to shine to their full potential. Light can be broken into the categories of task lighting (defined purpose), accent lighting (emphasising objects) and mood lighting (adding ambience).*

When considering lighting, it is important to address the activities that will be undertaken in the space. Both the quality and quantity should be assessed here. For example, an office will require bright lighting so that the workers can see clearly and act alert. On the other hand, living room lighting can be applied with a softer touch. Applying a dimmer has the ability to make a space much more versatile. Natural lighting should always be taken into consideration, and can be manipulated through clever placement of doors, windows and even mirrors.

Beyond its functional purpose, light has the ability to set the mood and atmosphere of a space while defining colour, line and texture. Plus, any good interior designer also knows that the lighting fixtures are a visual feature in themselves, which can add the right touch to any design.

## Color

*Color is a science all on its own, and is another extremely important element that interior designers master. It has the ability to create mood, define unity and alter the perception of how large or small a space is.*

The psychology of colour shouldn't be underestimated, and will be used to full advantage by any skilled interior designer. Colour can evoke memories and stir emotions, stimulating a physical and psychological response in our bodies. For example, greens and blues entice calmness and are suited to bedrooms, whereas red entices appetite and therefore often features in kitchens.

When considering the colour of a room, first think about what the room will be used for and the activities that will occur in that space. Secondly, consider how both natural and artificial lighting will affect your selected colour across the day and night, given that light can alter our colour perception. Finally, consider the size of the space. Interior designers will often incorporate lighter or brighter colours in smaller spaces to give the illusion of more space. Darker colours can give a powerful dimension to a larger space.

## Texture

*Texture refers to the tactile surface of an object or finish. It's an element that is often overlooked, but really does have the ability to bring a unique dimension to the room. Just like mixing colour and pattern, an interior designer mixes the textures within a space to give a subtle sense of depth. Think glossy, coarse, smooth... From furniture to accessories to fabric, texture has the ability to add interest and detail, making it visually pleasing to the eye. In essence, it gives a room feeling.*

Texture comes in two forms – visual texture and actual texture. Visual texture refers to texture that is perceived by the eye. In other words, this is the impression of texture one gets by only viewing an object. This effect is usually found in the form of patterns. Actual or tactile textures can be seen or felt and have 3D characteristics. For example, a fluffy, colourful cushion can be appreciated not only with the eye but also with touch.

Generally, if there is a sense of something missing in a room, a good interior designer will be able to distinguish that it will be due to lack of texture. Texture plays a part in every object selected for a room, and therefore is best managed with careful consideration from the ground up. The placement of each object in comparison to the texture of the object beside it will also add emphasis and contrast to the finished design.

## Pattern

*Paired with colour, pattern offers a similar use to texture in that it can add appeal to a room. A pattern is created by the use of a repetitive design and can be found in wallpaper, soft furnishings, rugs and fabrics. Patterns come in various types, such as stripes, geometric, pictorial, organic, motif and animal prints.*

When implementing a pattern, it's best to firstly consider the size and style of a room. Introducing patterns in a small room should be done sparingly, to avoid overwhelming the space. However, as discussed in the element of line, patterns that create vertical or horizontal lines can be used to give a heightened sense of space. Complex patterns made up of contrasting colours and lines can liven up a room, however they are best used in the form of a feature wall. Large scale patterns can flourish in a large space and become a distinct focal point to the room.

In regards to style, it's vital to know what category the pattern falls into to ensure that the essence of the room is maintained. For example, for traditionally styled rooms, incorporate organic, floral prints. For a contemporary touch, geometric and abstract prints should be experimented with.

Fun to use and with an element of functionality, patterns can bring a room to life. As a rule of thumb however, it's best to include a maximum of three patterns, all drawing from the same colour scheme.

## Understanding the Space

The shaping of space into rooms of specific configurations is the primary art of the interior designer. Several issues impact the proportion of rooms and their location in plan, including the intended functions of rooms, the way furniture and accessories will fill out the space, and the limitations imposed by accessibility and building codes. The best designers can juggle these myriad issues while developing an overarching concept for the character of a room. At a more sophisticated level, spaces and rooms can be knitted together in a sequence of spaces that provoke discovery and incite delight.

### Proportions of a Room

In the disciplines of art and design, proportion is concerned with one of the fundamental characteristics of shape: the aspect ratio of width to length. Significantly, the qualification of the proportion of a shape does not concern itself with dimensions. When designers speak of the proportions of a shape, they are usually discussing the relative width and length of a rectangle, but they can also address the proportion of an oval or even complex and irregular forms such as the proportions of a kidney shaped swimming pool. Most typically, proportions are considered when making design decisions about a series of related elements. For example, the designer should consider the proportion of the wall space between windows as well as the proportion of the windows themselves when designing an interior elevation. The relative proportion of the shape of the wall and the shape of the window can be construed as a more complex proportional relationship. Proportion is considered in two dimensions in drawing and painting and when composing a plan or an elevation.



## Rooms of Different Shapes

For interior design, the proportion of a space or an object is qualified by the relative length of three variables: width, length, and height. The character and use of a room is strongly influenced by the proportion of the space. A room that is relatively long, narrow, and tall is much different in character than a room that is square in plan with a low ceiling. The relative proportion of a room qualifies whether a space is primarily meant as a path or a place. Square rooms are the most geometrically stable, but are difficult to furnish and thus used for ceremonial functions when large or as threshold spaces when small. Rectangular spaces with proportions of less than 1:2 are the most common shape of place-rooms since they can accommodate a variety of furniture arrangements and can be easily aggregated along circulation armatures. Long, narrow rooms are typically circulation spaces, whether functional corridors or spaces for processional rituals and ceremonies.

## Space Planning in Interior Design

Interior designers assist in enhancing functionality and many other qualities in interior spaces. They provide building design services to create comprehensive solutions for specific intended purposes or uses called 'programmed interiors.'

Space planning is one of the services of interior design. Actually, it's the most important aspect of the profession; because space planning makes new buildings or, like in your case, existing ones, perform at their best for the special needs and requirements of clients or users.

**Space planning** is to plan a space with its allocation, divisions, arrangement, and organization to accommodate the functional, spatial, and occupancy requirements in the form of space layout and final planning. This involves creating a **space plan**, a drawing that shows the arrangement of functional elements within a space.

A space plan is developed by solving many design problems. But space planning is not like mathematics or physics; there is no single correct answer to the problems. Nonetheless, interior designers seek the best working and practical solutions in meeting the required criteria.

As no single answer is correct, there is no single step solution in space planning; it is a process of many phases. This means the planning of your new space will go through a systematic series

of actions, iterations, and decision-making between the phases of pre-design, preliminary design, and design development.

Therefore **Space planning** is a fundamental element of the **interior design** process. It starts with an in-depth **analysis** of how the space is to be used. The **designer** then draws up a plan that **defines the zones** of the space and the **activities that will take place** in those zones. The space plan will also **define the circulation patterns** that show how people will **move through the space**. The plan is finished by adding details of all the furniture, equipment and hardware placement.

### *13 Points to consider when deciding how to layout your room*

- Think about the structure of the room, what are the main focal points? These could be windows, fireplaces, doors or built in units. Are they balanced in the room? If not, think about what you can add to the space to help balance the structure of the space. Remember that the human eye is drawn to focal points, and will scan a space when entering it.
- Perception of space is based on body size. Different size spaces suit different size people: one person's claustrophobic box is another's cosy nest.
- Think about the space in terms of volume, eg: if it were a fish bowl, if you add in a sofa, chandelier, sculptures, bookshelves, table, coffee table etc, you displace some of the water. Ensure that you don't overfill the space.
- Aim to create both a prospect and a refuge in each room so you can feel enclosed, but also have a view beyond to the outside or natural world. Using **Prospect and Refuge theory** in a space can make it more comfortable for the human experience. "*We prefer a shelter (refuge) with a view (prospect), because humans have their field of vision to the front (prospect), therefore needing some sort of protection from behind (refuge).*"
- Plan your furniture with a scale drawing of your room or cut paper shapes to size and place them in the room to work out the best possible arrangement of furniture and accessories.
- Ensure that the circulation passageway through a room follows an easy and economic pathway from the door to all the other main activity areas.
- Clutter closes down space, so edit your clutter to avoid blocking both circulation and reducing the perceived size of a room.
- In large or long spaces, subdivide different activity zones to give definition to each part of the room.
- When planning decoration and lighting, work with the principles that vertical lines draw our eyes up and horizontal lines draw them across to extend or reduce the proportions of a room.
- Wallpaper with a square grid or tiling a room in squares will give the impression that it is bigger than it is – the smaller the grid, the larger the room appears.
- Borrow space from outside by ensuring an uninterrupted view of the outside world. You can also 'borrow' space from adjoining rooms by using the same flooring materials.
- When furnishing small rooms, blur the edges of the room to break up the lines between floor and walls; draw furniture a little away from the walls; buy furniture in proportion to the room; choose furniture with legs to give the illusion of more space.
- Disguise oversized sofas by breaking up their upholstered surface with a different coloured or textured runner or folded throw.

## Importance of Color in Interior Design

Color remains one of the most challenging and contentious aspects of interior design. As the painter and color theorist Josef Albers noted, “colors present themselves in continuous flux, constantly related to changing neighbors and changing conditions.”

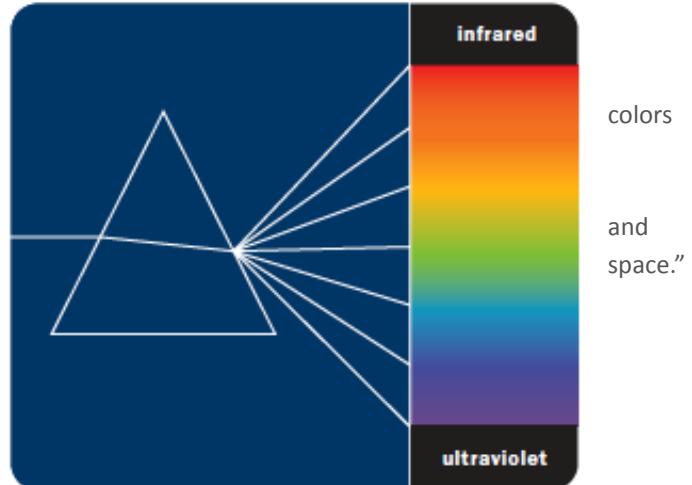
The application and mixing of color has long been an intense area of study for scientists, artists, and designers. At the same time, color can be an extremely subjective topic: Everyone has their favorite colors—colors that remind them of a place or time or that have specific emotive qualities. The role of color in interior design resists dissemination into simple rules and ideas, and yet understanding the complexities of using color in a space is fundamental to creating a successful interior. Thus, interior designers must learn the characteristics of color and how it can act as a focusing and organizing agent.

## FUNDAMENTALS OF COLOR

Color, fundamentally, is the result of the way in which an object absorbs or reflects the visible light in the color spectrum. An object that the eye perceives as red absorbs every color except red, which it reflects. White is often described as the reflection of all colors, while black is described as the absorption of all colors.

### Seeing Color

Color is a physical phenomenon, and the range of stretches far beyond what the human eye is capable of perceiving. At either end of the visible spectrum of light are the imperceptible infrared ultraviolet lights. In between is “human color. This model is best observed when light is refracted in a prism and the eye identifies the resultant color wavelengths—whose number is considered to be around 10 million—as a rainbow.



### Additive and Subtractive Color Mixing

To think about color relative to light and its effect leads to a discussion of how color mixes, either in additive or subtractive systems. Light that is emitted to create color is often referred to as additive. Combinations of red, green, and blue primary colors produce other colors; all three combined produce white. Using this color mix are monitors of all kinds, from computer screens to television sets to flat-panel display systems. Subtractive color mixing exists in two forms: combinations of cyan, magenta, and yellow and combinations of red, yellow, and blue. In these

systems, the base colors are added to each other on an opaque medium such as paper, and their mixing changes the way colors are absorbed and reflected. CMY provides the model for the printing industry, and RYB is the model for both fine art training and color theory.



#### Additive and Subtractive Color Mixing

Starting from the primary group of red, green, and blue, an additive color model occurs when colored lights overlap and mix to produce a visible spectrum. The mixing of the primaries results in the color white.

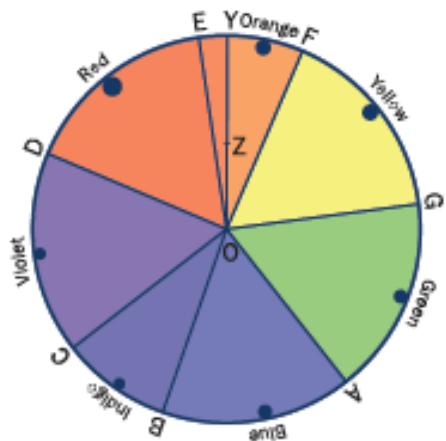
#### Subtractive CMY and RYB

In a subtractive system, colors are used to filter out the red, green, and blue from white light. In this model, color is added to paper through the mediums of ink and paint, and colors are produced through the absorption of wavelengths other than what the eye sees. The two color models of subtractive systems are defined by their use in the printing industry—which combines cyan, magenta, yellow, and black to create a visible spectrum of color—and the fine arts—where red, yellow, and blue form the basis for mixing colors.

## THEORIES OF COLOR

Many attempts have been made to establish methodologies to evaluate the advantages of certain color combinations. Very early on, color wheels or color spheres were engaged to visually communicate the associations and range of colors and their relationships to each other. In his *Opticks* of 1706, Isaac Newton split white light into seven colors—orange, yellow, green, blue, indigo, violet, and red—arranged on a disk in proportionate slices such that the spinning of the disk would result in the color white. Newton's objectification of color into a mathematically understandable system allowed for quantifiable experimentation.

The German poet Goethe along with the romantic painter Philipp Otto Runge further expanded color theory (in, respectively, *Theory of Color* of 1807 and *Color Sphere* of 1810) to include research into the subjective effects of colors: the contrast of complementary colors, the visual illusion of afterimages, and the contrasting shadows seen in colored light. They also associated color with emotion—speaking of certain colors as warm and others as cool.



### **Newton's Hue Circle**

In his attempt to develop a theory of color, Newton was the first to understand that colors did not lay on a linear chart, but rather existed in a continuum. The hue circle is represented by white at the center (O) and the hues arranged in order around the disk. Each hue is given a weight, or proportion, that balances it within the system. Newton closed his system through a mix between red and violet that did not appear in his natural primary spectrum



### **Itten's Color Wheel**

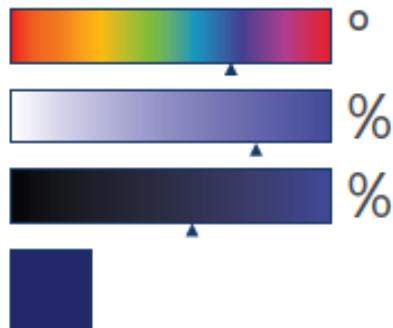
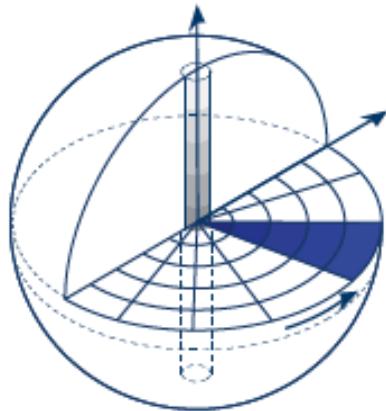
Johannes Itten developed his color wheel based on primary colors of red, yellow, and blue. From this simple starting point, two steps of mixing result in a 12-hue color circle. Itten did not believe in further expanding the wheel to 24- or 100-hue wheels, as the dilution of the naming system he established made it difficult to easily identify color distinctions.

## **Itten and Albers**

In the early twentieth century, two supportive theories of color emerged from the Basic Studies curriculum at the Weimar Bauhaus that continue to influence the way we comprehend color today. The first emerged out of the teaching of Johannes Itten, who developed the 12-hue color wheel. He identified seven rules of contrast that examined, in a scientific way, the subjective effects of color combination, proportion, and harmony. Itten's philosophical and mystical beliefs influenced his understanding of the use of color and have led some to dismiss the importance of his discoveries. His *Art of Color*, however, is still in publication. Josef Albers, who developed his *Interaction of Color* after he had begun to teach at Yale University, expanded on the instructional exercises of Itten to further emphasize the notion that color and the interaction of colors were a discipline to be learned.

## The Munsell Model

In the early 1900s, the American Albert Munsell developed a system of color analysis based around hue, value, and chroma. These elements form a three-dimensional model: Starting with a circular relationship of hues, Munsell established a decimal notational system to describe the transitional relationship as one color is identified from another.



### Munsell's Color Sphere

In Munsell's system, hue is arranged around the perimeter of a sphere, value as it moves from the top pole (light) to the bottom (dark), and chroma as it moves toward the center. Munsell also developed nomenclature that made it easy to identify any color in his system. R 5/10 would be red, value 5, chroma 10.

### Hue, Saturation, and Brightness

In most software applications, color can be chosen using the Hue, Saturation, and Brightness (HSB) model (also referred to as Hue, Saturation, and Value). Hue is measured in degrees from 0 to 360; saturation determines the vibrancy as the color moves toward white; and brightness changes the darkness of a color. Saturation and brightness are measured in percentages.

Munsell also limited the nomenclature of his color system, referring to orange as red-yellow to avoid confusion. His second term, value, describes the light or dark qualities of a color, on a scale from 1 (dark) to 10 (light). His final term, chroma, identifies a color as it moves inward from the hue band to the value pole. Other color models refer to this as saturation. To account for the variation in strength of a color (red is considered to be twice as strong in chroma as blue-green), Munsell developed what he called the color tree.

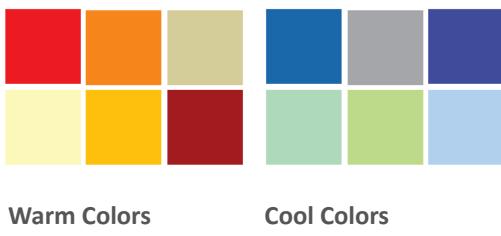
These systems serve as a starting point in understanding the complex relationships of balance, proportion, harmony, and effect that combinations of colors can produce. Each has its merits and applications for an interior design practice. Furthermore, their translation to a three-dimensional design space needs to be tested in-situ to observe the results. The following pages examine how one of these systems—that elaborated by Itten—functions as a model for developing a deeper understanding of color.

## RELATIVE COLOR

### Color Temperature

Color, inherently, has temperature. Color can be described as being warm (reds, oranges, yellows) or cold (blues, greens). Neutrals (whites, grays) also have ranges of temperatures.

Whites can shift in tone from cool to warm, and the change in temperature can enhance and tie together a color scheme. Grays, too, have temperature. In the Pantone color system, cool grays tend toward blue, while warm grays gradate toward brown.



### Color and Material

The role of color in interior design is further complicated by its association with materials. Materials have qualities of absorption, reflectance, and luminance that the abstract systems of color do not take into account. Materials might contain many layers of color, and often variations of color can occur within a single material sample. The proportional use of material within a three-dimensional space also affects how color is experienced. Through the complex interaction of color and material, an interior designer can create atmospheres of intimacy or freshness, vibrancy or muteness, and even begin to affect other senses such as sight and hearing.

Color in interior design can, moreover, be divided into two distinct categories: color as an applied surface and color as integral to a material. Paint, lacquer, specialty finishes, certain laminates, and other applications of color to the finished surface of an object are efficient and modifiable strategies for color use. There are many instances where paint and applied finishes should be avoided, however: Adolf Loos's aphorism "Do not paint concrete gray, or wood brown" holds true here. Materials with integral color—which require no finish other than a sealer—have greater depth of surface, which allows more complex, precise color relationships to be developed.

### Color Schemes

Color schemes are the result of turning color combinations into a set of rules for an interior palette. Grounded in color theory, the designer can creatively select and organize color in harmonious combinations. In the abstract—that is, when color is not tied to a material—there are six "classic" combinations of color: monochromatic, analogous, complementary, split

complementary, triadic, and tetradic. The examples below use a full-saturation color wheel, but the designer can vary both saturation and brightness.



#### Monochromatic

Uses a single color in a variety of saturations and lightnesses to unify a scheme.



#### Analogous

Uses colors directly adjacent to the chosen color. The prime color serves as the dominant color in the scheme.



#### Complementary

High-contrast scheme developed by pairing the chosen color with that directly opposite on the color wheel.



#### Split Complementary

Uses a single color in a variety of saturations and lightnesses to unify a scheme.



#### Triadic

Uses colors equally spaced around the color wheel. Produces high-contrast schemes.

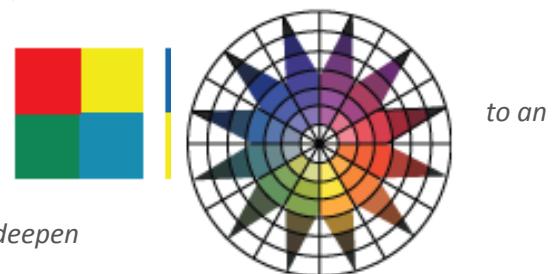


#### Tetradic

Uses two complementary color pairs. Proportions of colors must be chosen carefully to maintain balance.

## APPLYING RULES OF CONTRAST TO INTERIOR SPACE

*In the seven variations on color contrast that Itten identified, contrast considered as a range of differences between the compared effects of color interaction. The projects that follow explore the practical application of Itten's system interior project—whether at the scale of a room or a building. As with any system, continued exposure to and examination of the effects of each set of relationships will deepen understanding.*



### Contrast of Hue

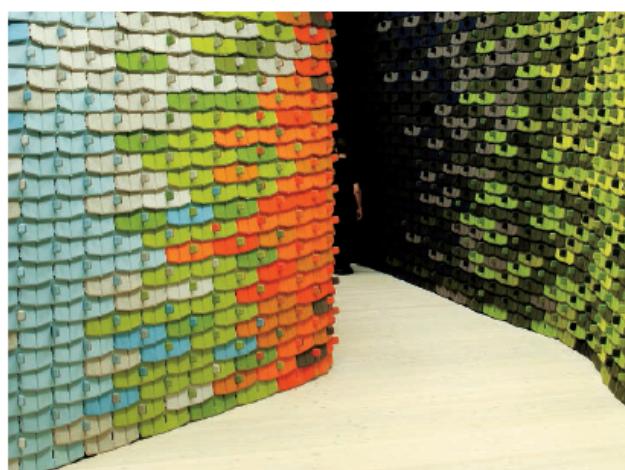
The simplest of the rules, contrast of hue, functions at the extremes of undiluted colors at the greatest luminosity. Solutions that use contrast of hue have a visual vibrancy and playful intensity. This contrast always requires three colors, and it is important to note that the effect lessens as the colors move away from Itten's three primaries.



For the interior of the SRK Legal Assistance, the Dutch firm *eijkingdelou* used contrast of hue to great effect. Colors playfully interact through the space; limeyellows, blues, and reds in the felt poppy figures lift the environment from staid office to a lively series of colored spaces.

### Light - Dark Contrast

Light-dark contrast exists in the relationship between black and white—as well as in the range of grays that exist between them. Itten saw gray as an



essentially achromatic color, shifting in relationship depending on the colors that surround it. The key to this contrast is a deeper understanding of shading and its effects.

A showroom for the textile manufacturer Kvadrat in Stockholm eschews the typical neutral background for display in favor of an innovative tile system developed by the designers Ronan and Erwan Bouroullec. The move from light to dark symbolizes a shift in function—from open showrooms to more intimate meeting spaces and offices.

### Cold-Warm Contrast

Particular colors can affect the relative comfort of a room at a specific temperature. In fact, a perceptual



change in physical temperature occurs in spaces when they are painted in cold versus warm colors. For Itten, cold-warm contrasts were highly versatile in their expressive powers.

For a lounge in the André Balazs Hotel QT, Lindy Roy uses a cold-warm contrast to distinguish the different zones of the space. The bar is surfaced in a cool blue that acts as a functional highlight against the warm, intimate spaces that surround it.

## Complementary Contrast

Complements occur when two hues are mixed and the result is a neutral gray-black. (In additive color systems, the result will be white.) Every color within a color system has its complement; finding a complementary color is a simple matter of selecting opposite colors on Itten's wheel. In complementary contrasts, colors balance each other.



For a hotel in Milan, designer Patricia Urquiola uses complementary contrast with a vibrant pallet of material and light to draw attention to specific moments within the room.

## Simultaneous Contrast

Simultaneous contrast occurs as an optical illusion: The complementary color of an applied color is not itself objectively present, but appears to be visible. Simultaneous contrast requires an adjacent neutral color or any other color that is not complementary. The longer a background is



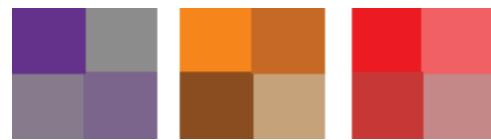
viewed, especially with more luminous colors, the greater the intensity of the simultaneous effects.



Simultaneous contrasts are difficult to capture photographically. In the Montréal Convention Centre, Saia Barbarese Topouzanov playfully uses light against painted color to suggest additional colors. As the sun changes position and color over the course of a day, new combinations appear.

## Contrast of Saturation

Color can be diluted via four methods to obtain different results: Adding white makes a color cooler; adding black reduces the overall vitality of a color and renders it more subdued and, in the absence of light, quite dark; adding gray reduces the intensity of a color and tends to neutralize it; adding the complementary color produces various effects, depending on the intensity of the colors



being mixed, their relative temperature, and their hue.

A library at the Rhode Island School of Design by Office dA uses a natural palette that lends itself to a contrast of saturation. Various shades of browns and yellows allow this intervention to fit nicely within the classical architecture it occupies. Accents of cooler colors in the existing architecture also contribute to the scheme's success.

## Contrast of Extension

Contrast of extension refers to the relative force that a color exerts in relation to the other colors in a system. Depending on the hue and value a color, careful consideration must be taken to balance the addition of another color. The result is a ratio that harmonizes the colors in play. Of all the contrast rules, this is perhaps the most subjective.



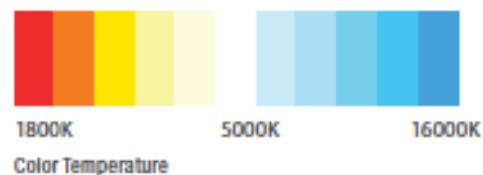
Balance is the fundamental principle behind the contrast of extension. In this maisonette apartment, Ippolito Fleitz Group uses color balance effectively—mixing strong contrasting colors, intense graphic elements, and textiles in a complex sequence that achieves a sense of equilibrium.

## COLOR TERMINOLOGY

Although it is difficult to talk about specific color through the use of nomenclature, it is important to develop a vocabulary that can objectively evaluate the specific ways a color or set of colors is being used. When discussing the effects of color, the following terms can serve as the start of a common vocabulary.

Color Space:

Refers to the final output of a color. RGB is typically used for illuminated color, while CMYK is used for absorptive colors.



Color Temperature:

Temperature of a light source, measured in Kelvins. Lower temperatures are considered warmer (adding a yellow cast to objects), while higher temperatures are considered cooler (adding a blue cast to objects).



Hue:

Gradation of color within a visible spectrum.

Pantone:

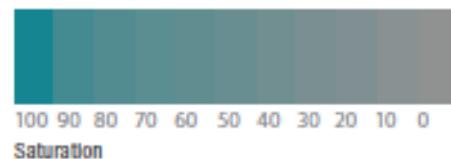
A color management system that is used to specify consistent color for prints, textiles, and paints.

Primary Colors:

Group of colors that, when mixed, can produce all other colors. Primary colors cannot be made by other colors.

Secondary Colors

Colors that result from a 50 percent mixing of any two primary colors.



Saturation

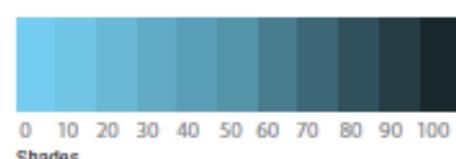
Intensity of a color, expressed as the degree to which it differs from white.

Schemes:

Method of organizing color in harmonious combinations.

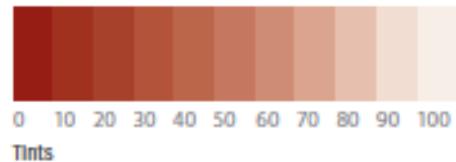
Shades:

Result of adding more black to an existing color.



Tints:

Result of adding more white to an existing color.



Tones:

Result of mixing a color with its complement. An equal mix will result in a gray.

## COLOR AND SPACE

The process by which color is chosen and utilized in a design has a profound effect on interior space. The designer's decisions can drastically change the spatial understanding of a project and also influence how it is navigated. When used with knowledge and intent, color can add perceived weight to surfaces, alter the basic proportions of a room, and variously be a calming or exciting factor. As the designer begins to explore and understand the surface effects of color, it will become the basis of a rich visual and material palette.

### Volumetric Approaches to Color

Painting all aspects of a room the same color has the effect of volumizing the space. This method of using color can be particularly effective in making small spaces appear larger or more intimate depending on the color choices. Volumetric approaches work best in situations where they can be referenced in sequence, such as an enfilade, or series of rooms connected through doors.



Elements such as furniture can emphasize the volumetric reading of a room. Here, the chairs, matched with the red walls, draw attention to the room's dimensions.

### Planar Approaches to Color

Color can be used to emphasize the planes in a given sequence of rooms or the vertical connection of spaces, as in a double-height room or loft. Painting a length of wall regardless of interruption can lead the eye through the spaces of a design and highlight elements at the end of the wall—be it a light fixture, art, or furniture piece. Planar color can also make surfaces that are perpendicular to the occupant appear closer or further away.



Painting a continuous length of a space with a single color emphasizes the planar elements within an environment.



Painting a continuous length of a space with a single color emphasizes the planar elements within an environment.

### Emphasizing Design Elements

Emphasizing the elements of a design—door and window trim, reveals at the ceiling, or the connection of materials—can draw the viewer's attention to aspects of the design. Painting elements such as reveals in the ceiling a darker color than adjacent objects can make the objects appear to float. Emphasizing the color of a door in a wall can cue the viewer to its importance. A red door in a white wall will seem more present in the room than a door within a wall of the same color.



Color can be employed to make certain aspects of a design stand out. For instance, elements such as trim, moldings, and structure take on more significance when they are colored in stark contrast with their surroundings.



Connections emphasized between spaces can use very bold, bright hues or be made to recede when matched to the color of an adjacent surface.

### Changing the Proportions of a Room

Color can change how the proportions of a room are perceived. Adding color to a certain datum, altering paint sheen, or darkening a room's upper portions are some of the strategies by which the designer might play with spatial perception. Through the careful application of color, spaces can be made to appear smaller or larger, or an eccentric volume can be proportionally controlled. Using color in geometric and abstract patterns can further enhance a space.



Adding color to lower parts of a space can provide a demarcation line for elements such as furniture and art.



Adding color to the upper regions of a space can reduce the perceived height of a room.

## TEXTURE

To work with texture, the designer must understand the effects of shadow and reflection caused by the surface configuration of materials, including fabrics, metal, stone, wood, glass, and painted plaster. Since all of these effects are concerned with how a surface catches light, the integration of texture into the design concept further requires the synthesis of material selection and lighting design.

### *Texture in Materials*

There are two basic types of textures: visual and tactile. Examples of materials with visual texture are wood and stone, their texture defined mostly by the natural graining and veining of the material. Tactile textures include hand- or machine-crafted fabrics and carpets. These textures are used most effectively when they are positioned adjacent to a contrasting texture. A rough texture next to a smooth texture, an opaque material next to a translucent material, or a matte surface next to a reflective surface are all strategies that designers should employ when thinking about finishes.

### *Texture and Color*

The interactions of color, material, and texture, in turn reacting to light, all contribute to the character of an interior environment. More specifically, color value has a direct effect on how a material translates its visual or tactile qualities. Three general families of palettes have different implications for the role of texture within the overarching design concept: the white, neutral, and dark palettes.

## PATTERN

A pattern is a repetition of elements, typically laid in a grid. Patterns give visual interest to the surfaces of a room, whether in a textile, wall covering, or flooring. Although they are commonly associated with textiles, patterns can also be found in such textural elements as a brick wall.

The repetitive elements create balance and order across surfaces, pleasing the eye, and a skilled interior designer can use patterns to establish a desired mood. Patterns can be

employed in small quantities to highlight special features in a room or can cover every surface to blend all the elements together. Although there are no set rules for applying patterns, it is important to understand the effects of patterned surfaces on an interior.

#### *Effects of Pattern*

Patterned surfaces can alter the proportional readings of a space. Large-scale repeats with complex patterns and contrasting colors can be appealing in a large room but can overwhelm a small one. Complex patterns are best left for fabrics or floor surfaces and should be carefully considered for wall coverings.

Color plays a large role in pattern. The more contrasting colors in a pattern, the more dynamic the pattern. If a pattern is made up of different tones of the same color, it may be quite subtle.

#### *Characteristics of Pattern*

The endless variations on patterns are impossible to quantify; however, most patterns share certain characteristics. Patterns are made up of repeats, which is the element repeated across the surface. At its simplest, the repeat is uniformly laid in a grid. To give variety to the pattern, it can also be rotated or mirrored along an invisible axis.

Patterns can also be categorized by the depth of the design. The repeat will be either a two dimensional figure that plays up the surface of the material or a three-dimensional figure that gives it depth. Three-dimensional patterns are most effective across a flat surface, such as a floor or wall surface; they have less impact on a billowing or draped fabric.

## LIGHT

The intangible comforts of a room, often assessed intuitively, are just as important as the visual character of a space. To make a room feel cozy on a cold winter day has as much to do with the light quality, temperature, humidity level, and lack of air movement as it does any element that can be seen. As light, whether natural or artificial, impacts almost every aspect of an interior environment, both functionally and emotionally, designers must understand how to integrate it into their concept.

## Interior Design Materials and Process

Materials are the essence of the interior designer's palette. They immediately signal the designer's vision and inform almost every decision in the process of developing an interior. Materials have a direct bearing on issues of color, light, texture, and pattern that the designer will need to address with every project. To make these decisions well, designers must learn the myriad qualities inherent in materials, from the purely functional to the aesthetic.

Needless to say, the range of materials available to interior designers is expansive. Only those materials essential to an understanding of how to treat the basic components of a room can be considered here. This book's space limitations mean that many other important materials are not covered—from the varieties of glass and metal to solid surfacing and engineered

plastics—although the resources section provides references for further research. Indeed, a designer's ability to choose the best materials for a particular interior space must be founded on an ongoing process of research. Equally important is to build a library—of both materials and literature — to keep current on the latest developments in material and product design.

## WALL TREATMENTS

Walls define the space of a room or the sequence of movement through an interior. Because they are, in many ways, the primary spatial tool of the designer, their finish is of great importance. The variety of finishes available for wall surfaces ranges from simple paints to more complicated paneling and stone veneers.

## PAINTS

Paints are used to add color, durability, and decoration to many elements in an interior, but they are especially appropriate for walls, as they offer a lot of impact for relatively little expense. All paints are composed of four main ingredients: pigment, binder, drier, and solvent. Pigment forms the color of the paint. The binder, typically a resin, surrounds the pigment and, when dry, creates the paint film. The drier speeds up the drying time of the binder. Lastly, the solvent allows the paint to flow from the brush or roller onto the surface, where it evaporates, leaving only the dried pigment and binder. Coverage—the area that a paint can conceal—is defined by the amount of solvent in the mix: the less solvent, the better. Other additives to the paint can also aid in the durability of the product.

Principles of Interior Design (*see separate readings*)

Interior Design Project Basic Elements (*see separate readings*)

Program Management in Interior Design (*see separate readings*)

Presentation Types in Interior Design (*see separate readings*)

## Interior Design Theme

Interior design comes in a range of formats and formulas, sometimes utterly distinct and other times with only the subtlest of differences. Yet each presents its own flavor, finish and experience that render a space in unique chapters of inspiration, history and creative endeavor. Therefore knowing what sets different interior design styles apart may be a lot handier than you might realize, ensuring you pick the perfect style for your space and ambitions, and helping you achieve visual perfection with a lot less hassle.

## Most Popular Interior Design Styles: What's in for 2021

### #1 Modern style



Modern living room at the Burkehill Residence by Craig Chevalier and Raven Inside Interior Design

Modern architecture and design, including interiors, is a broad umbrella term for design styles united by a common intention – a celebration of material, technology and composition through authenticity, transparency and efficiency.

Inspired by the Modernist art

movement that preceded it, the Modernist style, born at the dawn of the 20th century, reinvented our relationship with space and aesthetics to bring us closer in touch with it. A building was more than an inhabitable shell; it was now a machine for living in.

Modernist interiors are therefore often a complex overlay of functional programming, careful compositions and clearly articulated lines and geometry. The inherent materiality of a form is an integral part of the design language here, as is an emphasis on visual and functional simplicity.

### #2 Mid-century modern style



Mid-century modern living room design | Image credit: Maisons du Monde

Mid-Century modern describes a style that gained momentum in the aftermath of the Second World War. With echoes of the Bauhaus and International movement, this arm of modernist interior design is set apart by its vivid use of color, crisp lines, and interactive dialogues with nature and the outdoors.

The emphasis here is on strengthening interpersonal bonds; space was viewed as being more than just a functional container, and emerged as a canvas for the personal and social ideologies that drove humanity post WWII. Generous, open planned interiors with an emphasis on common, shared areas, broad interfaces between the home and its natural surround, and a functional and visual clarity integral to the Modernist style mark these spaces.

The color palette of Mid-century modern style usually floats in hues of orange, yellow, green and brown, although deviations are not uncommon.

### #3 Minimalist style



living room design at the HD House | Image credit: YOMAdesign

Sparked by the Minimalist arts movement of the 1960s and 70s, and inspired by [traditional Japanese design](#) and Zen philosophy, minimalist interiors express the driving concepts of modernism in an almost puritanical palette.

Stripping things down to their bare basics, minimalism offers us an aesthetic that relies on the efficiency of the design. Devoid of distractions or clutter, [minimalist interiors](#) are streamlined to maximize on bold visual impacts and the underlying use of the space.

Elements and motifs are kept to a bare minimum, with concealed storage and careful detailing playing their due part. Colors are explored in hushed tones, with an accent or two taking center stage.

The repetition and movement of lines and a generous introduction of natural light keep these interiors light and dynamic.

### #4 Scandinavian style



Scandinavian style living room | Image credit: Lundin

Like its other modernist counterparts, Scandinavian style embodies a move towards simplicity, functionality and efficiency; it also however brings an emphasis on affordability to the palette.

Stirred by democratic design ideals, [scandinavian design](#) strikes a careful balance between minimalist efficiency and warm, personal invitations.

This interior style is characterized by organic materials, bare ornamentation and clean detailing. The color palette swims in black and white, with grays and blues or the occasional pop of color bring visual respite. Silhouettes and contours in scandinavian interiors are more rounded and sinuous, which along with organic textures create a much cozier vibe in even the barest of layouts and arrangements.

## #5 Industrial style



Image from the article: [Industrial Style Kitchens by Marchi Group](#)

Industrial interiors celebrate the modernist eye for efficiency and functionality by transforming the working parts of a building into its primary aesthetic.

Beams, columns, pipes, ducts and flanges are brought to the fore to emphasize the

'machine for living', rendering these interiors in a largely masculine overtone. Unlike many other offshoots of the modern movement, industrial style interiors do not shy away from weight or roughness, embracing the worn, recycled and salvaged.

Often the style of choice in warehouse conversions and loft remodelings, industrial interiors tend to stick to warm, neutral colors such as grays and browns with iron or steel, [exposed concrete](#) and unfinished brickwork complementing them perfectly. When choosing furniture and décor, vintage industrial designs complete the look.

## #6 Contemporary style



Contemporary living room at the Hillside House by Zack de Vito

The Contemporary style, [by its very definition](#), is current and therefore is an ever evolving palette that echoes prevalent trends and tastes at any given time. As such it is tricky to characterize this style as a set of given ideas, intentions or traits; however, as a design style it diverges from the modernist aesthetic by presenting a more balanced and rounded approach to interior design.

With the Mid-century modern style being in favor at the moment, [contemporary interiors](#) currently borrow heavily from it; however these elements, colors and lines are laid out in gentler compositions that make as much room for visual indulgence as functional efficiency. Neither cold nor too formal, these are warm, [cozy spaces](#) that are a lot more fluid and instinctive in their making.

## #7 Urban style



Urban apartment by Studio AUTORI Designs

The emphasis of urban style interiors lies on elements and designs that bring the gritty vibe of the urban context indoors. Not afraid to experiment with unusual materials and features, this interior design style takes its pick of ideas to arrive at distinctive, and often bohemian, looks.

Leaning towards industrial sensibilities, the Urban style elaborates on structural features, industrial components and

exposed ducting, much like its mentor. However these elements are combined in clear open spaces, which float in light colors and clean finishes that add a touch of feminine elegance to the proceedings. In fact the urban interior usually comes with a hefty dose of artistic indulgence, often turning to the unexpected for answers.

## #8 Traditional / Classic style



Traditional style living room by Brownhouse Design

Doused in the comforts and indulgences of classic European décor, the Traditional style turns to the past to create ideas for the future. The approach here can be true to source or a slight retake on classical suggestions, bringing time-tested elements, motifs and proportions to fit a modern lifestyle.

Traditional style interiors are set apart by their silhouettes; winged back chairs, elaborate furniture pieces, claw footed tables, and other furniture and feature designs usually have their origins in 18<sup>th</sup> century English, Neoclassical, French Country or Colonial styles.

The backdrops are usually pale and simple, with rich colors, lines and profiles imbuing classical opulence into the space.

Delicately carved and lacquered dark wood furniture and architectural embellishments abound in this interior style.

### #9 Transitional style



Transitional style living room | Image credit: Pinterest

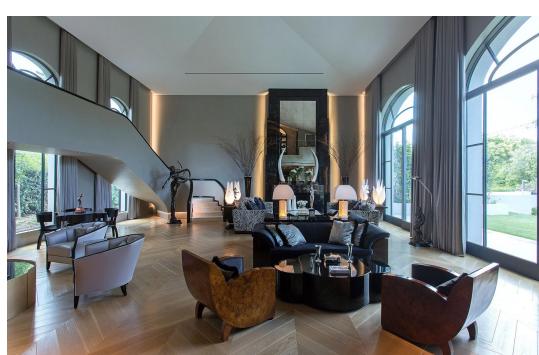
This beautiful interior design style is a delightful fusion of, and in this way, a surprising transition between two interior design trends with specific individuality – the classical traditional and the contemporary modern. These two styles might seem too far apart from each other, with the Traditional style being considered somewhat ‘old fashioned’ and ‘heavy’, while the Modern style somewhat ‘impersonal’ and ‘cold’. Yet, designers have discovered a smart way to take the best of these two ‘worlds’ and display it in a most pleasing manner.

fashioned’ and ‘heavy’, while the Modern style somewhat ‘impersonal’ and ‘cold’. Yet, designers have discovered a smart way to take the best of these two ‘worlds’ and display it in a most pleasing manner.

Transitional style features solid furniture items of a larger size and robust structure, with curved lines and focus on comfort, typical for traditional interiors. The lack of too much ornamentation, the arrangement of straight lines, and the clear restriction in number, though, celebrates the minimalist trends of the contemporary style. The result is stunning – lavish sophistication displayed with modest simplicity.

The color palette of the Transitional style is predominantly neutral and monochromatic, featured on walls, ceilings, flooring, and upholstery. Colors range from deep taupe to warm tan or vanilla, adding cozy depth and balance. This neutral background offers, however, excellent options for introducing color accents in smaller elements.

### #10 Art Deco interior design style



Art deco style living room by Moustroufis Architects

The bold and bombastic is expressed in elegant compositions through sheer balance and restraint in the Art Deco style. With its origins in the excitement and glamour of post war Europe and America, [the style](#) was born in the 1920s to offer a new aesthetic for a new time.

At its heart this style is a sensual exploration of order and symmetry, with the lines and geometry taking charge of the designs and compositions.

Angular patterns, layered designs and bold curves set off a play of form and aesthetics echoed in shiny chrome and brass fittings, glossy paint, lacquered wood, and an abundance of sprinkled glass and mirrored elements.

Art Deco interiors are also set apart by their lighting with its distinctive ambience achieved through layering of up and down lighters.

## #11 Country style



Image from the article: [We Love This Cozy Country Home in the Woods](#)

Cozy is key when designing country styled interiors, as these spaces evoke the warm embrace of a timeless cottage. As such this style can root in different traditions (English, French, Tuscan or Scandinavian to name a few) and therefore can vary significantly in its outward vocabulary. However each of these palettes is united in their love and appreciation of the organic and the rustic.

Wood, pottery, and a host of organic materials populate these spaces, carved out in a typically intimate scale and character.

Warm muted colors and patterned fabrics are popular, as are papered or stenciled walls. There is a rich variety to the Country style, with an array of elements and features coming together to create warmth, fluidity and balance.

## #12 Coastal interior design style



Coastal theme bedroom by Barclay Butera Interiors

Fresh, relaxed and excitingly versatile, just like the ocean that inspires it, the Coastal style takes organic inspiration into new dimensions. Instead of merely embellishing the interior with oceanic materials, motifs and elements, this style goes a step further and offers an aesthetic that is integrally sun kissed and [nautical in tone](#).

Natural light in abundant proportions is of course paramount, playfully bouncing off the contrast of white and blue that set these interiors apart.

Aqua, teal, turquoise and these myriad shades of blue come alive in light, organic materials that are reminiscent of summer.

There is of course also the opportunity to go completely literal with the theme, using everything from seashells, ropes, nautical icons to driftwood for maximum aesthetic impact.

### #13 Shabby chic style



Shabby-chic style bathroom by Schmidt Custom Homes

Arising in the 1980s, the Shabby chic style reinterpreted traditional British aesthetics to create soft, feminine visual statements.

Drawn out in markedly light and airy spaces, this style strikes a distinctive balance between the weathered look of an English cottage and the delicate indulgences of more

classical influences. The result is an utterly romantic vibe with a penchant for the finer things in life.

Soft cotton and French linen is drawn out in fluid designs that explore the pastels to perfection.

The time worn is celebrated as a collection of vintage elements and features that bring the space alive; even new furniture is given a distressed look to soften the overall look, feel and tone of the interiors.

### #14 Eclectic interior design style



Eclectic style by Myramar Dos

Surprising, unexpected and unafraid to break the rules, eclectic style interiors personify individuality and freedom. With no guidelines or intentions per se to box it in, this style borrows freely from others, harmonizing a gamut of ideas and inspirations to suit the space and purpose at hand.

At its core this design style comes with a lot of variation and layering, deftly using these to create an overall rhythm that animates the interior and saves it from being utterly overwhelming.

Eclectic style relies on core design sensibilities to make sense of the chaos that it dwells in, striking harmony through color, composition, balance and materiality.

Fabric and texture in particular play a prominent role in bringing variations and layers to the space and aesthetics, without compromising on its fluidity and coherence.

### #15 Vintage style



Vintage living room | Image credit: MidwestLiving

Contrary to popular opinion, vintage style isn't about recreating a flea market in your home; not everything old has vintage charm. Instead this style pays homage to the 1940s and 50s, where in the aftermath of WWII people mixed and matched, working with whatever was available, to rebuild their homes and create warm, loving spaces. It is this 'mix and match' aesthetic, largely brought

alive through the time worn and tested, that sets vintage interiors apart.

As a thumb rule the movement of lines is key here; this could play out through a contrast of patterns and motifs or through a composition of profiles and silhouettes.

Colors in vintage style interiors are therefore usually in light and neutral tones, with vivid color used only for impact. In fact the décor in a vintage interior relies on this strategy to elevate the aesthetic and bring refined elegance to it.

### #16 Asian / Zen interior design



Zen interior design style by EKE interior

Bringing the core tenets of traditional Japanese philosophy to life, Zen style interiors, just like their namesake, are about balance, harmony and consideration.

Unlike most other styles, Zen spaces are less occupied with making an impact and more concerned with introducing silence and stillness,

inside and out, into your day.

Every line, form and surface is placed with careful thought and efficiency, with no tolerance for frills or flippancy.

The material palette is predominantly organic in character, with wood and natural fibers being the materials of choice. Existing in close proximity with nature, the Zen style engages closely with the elements, weaving them into its designs and aesthetic.

Colors are soft and natural in tone, with chromatic harmony and continuity balancing surfaces and spaces.

### #17 Bohemian style



Bohemian interior design style by Ellie Lillstrom

Bohemian style is associated with free-minded and free-spirited people who express their personal unconventional philosophy of living unconstrained by any norms of the contemporary society. Their outstanding individuality shows in the interiors of their homes, too.

So unique, exuberant and vivid these interiors gave birth to a very specific design style, known as 'boho' or 'boho-chic', a style that has gained immense popularity and has been embraced by many.

La Vie Bohème allows total freedom and strong individuality in expressing personal tastes. And just as those differ extremely, boho style interiors are characterized by a unique and surprisingly stylish and cheerful 'mish-mash' of items, accessories and colors that, at first glance, have no coherence whatsoever, either in design features or color palettes.

The space is busy, both in number of items, as much as in shapes and forms. Furniture is an intriguing mix of old, even weathered items and more modern ones. Fabrics and accessories burst in flamboyant tones, prints, and patterns, creating a cheerful ambiance of the free-spirited style of life.

### #18 Tropical style



Tropical interior design in Taj Exotica Resort, Maldives

Tropical style interiors are all about the romantics of the endless beaches, the lush jungles and the vibrant colors of the exotic lands we dream of. Inspired by Nature, this interior design style features abundance of natural materials and color palettes characteristic for the Tropics in its flamboyant beauty.

Larger surfaces feature lush greens and shades of turquoise and blue, creating backgrounds for cheerful bursts of vibrant colors, such as pink, purple and orange displayed on various decorative items and interior textile. Exotic prints of tropical fruit and palm leaves dominate wall décor.

Key furniture items are of simple design and are made of wood, as this material is primary in a tropical house. Doors, [tables](#), beds, chairs, cabinets and storage items feature royal teak, cozy bamboo or rattan, delicate wicker, or majestic mahogany.

### #19 Rustic style



Rustic interior design in [a mountain cabin](#)

With its classical simplicity and warm homey feel, the Rustic style stands out among the most popular interior styles that are “evergreen”. It has that irresistible charm of a family home in the country that contemporary man longs for in the busy city. It is therefore no surprise to find the Rustic style in various buildings and interiors both, in country houses, as well as in urban apartments.

The rustic style color palettes may vary from [darker shades](#) of brown to whitewashed tones of neutral colors. Decoration features lots of hand-crafted, salvaged or repurposed items made of wood, leather, natural fibers, wicker and wrought iron.

Furniture items are of sturdy structure and classic design, looking somewhat chunky and weathered. They are mostly made of solid, usually dark-stained timber matched with upholstery of natural leather and rougher fabrics. The style's variations often include wicker and rattan furniture, too.

### #20 Hollywood Regency style



Hollywood Regency interior design style by Dkor interiors

The Hollywood Regency style is all about bringing back the glamour of the 1930s' Golden Age of the booming American movie industry. It features the lavish décor style of the homes of the major film stars of those times. Yet even if it relates to the past, it is far from being branded as 'retro'. Hollywood Regency is instead an exciting mixture of styles

and trends, exhibiting their best features in striking combinations so as to create an ambience of comfort and glamorous opulence. It's this freedom of expression that makes the style timeless.

The Hollywood Regency style interiors are spacious, open-plan and uncluttered. Furniture does not dominate the space and is rather small-scale, with simple, clean lines, within the reserved

modesty of the mid-century style. The furniture items however stand out with bright, glossy surfaces, metallic finishes in brass and gold, bold art deco patterns in high contrast, and sumptuous fabrics and textures in vibrant colors. The space glitters in sensual glamour through an abundance of luxurious shiny accessories, sparkling fine crystal, and rich textiles and carpets adorned with silky fringes and tassels.

## #21 Modern farmhouse



On this image: Modern farmhouse interior style

Modern farmhouse style is among the top favorite contemporary interior design trends in Europe, North America and other corners of the planet influenced by European culture. For, indeed, the key features of this style are based on the warm and somewhat nostalgic charm of the cozy farm houses in the idyllic countryside of

Western and Northern Europe.

What rules modern farmhouse interiors is the soothing feeling of the past, interpreted through traditional décor, practical, often repurposed, furniture items, and natural materials contributing to the charmingly vintage and rustic looks of both, the interior, as well as the exterior of the residence. Space is kept uncluttered yet cozy and functional, tones are soft and neutral, and decorations are a balanced mix-and-match display of both, vintage and contemporary fashion trends in interior décor.

So, call it classical, traditional, vintage or rustic, modern farmhouse interior design is all about ‘feeling at home’.

## Importance of Drawing

The ability to draw is essential to the design process. In the interior design profession, the meaning of “to draw” takes many forms: It can refer to hand drafting, to computational drawing, or even to photography and other methods of communication. A number of standards have been established to facilitate the transmission of visual data and ideas about a design, and it is important to understand how they function within the world of the interior designer.

## Measurement in Interior Design

Before the first line is drawn, the interior designer must grasp the language of measurement. The worldwide system of measurement collectively known as the International System of Units, or SI, is the most widely used standard for determining the length, weight, or volume of an

object and its relation to other objects. It comprises a decimal system whose base unit is the meter, which when increased or decreased by a power of 10, generates all other units of measure. Designers should be familiar with the metric system and the U.S. customary units system. Derived from a method originally developed in the United Kingdom, the latter is an irregular system that combines several unrelated base measurements—\_inches and feet (and their fractioned derivatives), for example—for linear measurement. Although all projects to be in SI units, the construction industry continues to refer to measurements in customary units (a 2" x 4" piece of wood, a 4'x 8' sheet of plywood), as do many architectural and engineering practices.

### Converting Units of Measure

Often, dimensional units are interchanged freely, and it is helpful to know how to translate between units. Designers will find a range of publications and websites with extensive conversion tables for length, area, and volume, among other measurements. Numerous online calculators also allow for swift conversions of specific dimensions. Interior designers will most frequently turn to the following formulas.

### Useful Conversion Formulas

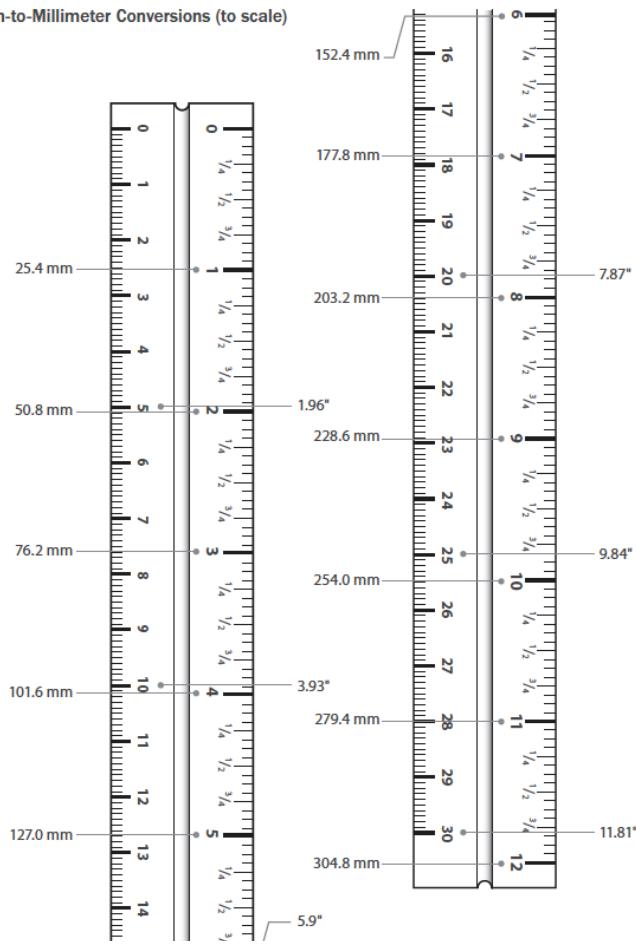
Multiply	by	to obtain	Multiply	by	to obtain
square inches	645.16	square millimeters	square millimeters	0.001 550 0	square inches
square feet	92 903.04	square millimeters	square millimeters	$1.076\ 391 \times 10^{-5}$	square feet
square feet	0.092 903 04	square millimeters	square millimeters	10.763 910	square feet
square yards	836 127.36	square millimeters	square millimeters	$1.195\ 990 \times 10^{-6}$	square yards
square yards	0.836 127 36	square millimeters	square millimeters	1.195 990	square yards

Multiply	by	to obtain	Multiply	by	to obtain
inches	25.4	millimeters	millimeters	0.039 370	inches
feet	304.8	millimeters	millimeters	0.003 281	feet
feet	0.304 8	meters	meters	3.280 8	feet
yards	914.4	millimeters	millimeters	0.001 093 6	yards
yards	0.914	meters	meters	1.093 613 3	yards

### LINEAR CONVERSIONS

Inches	Millimeters (mm)	Centimeters (cm)	Meters (m)
0.25	6.35	0.635	0.00635
0.5	12.7	1.27	0.0127
0.75	19.1	1.91	0.0191
<b>1</b>	<b>25.4</b>	<b>2.54</b>	<b>0.0254</b>
1.25	31.8	3.18	0.032
1.5	38.1	3.81	0.038
1.75	44.5	4.45	0.045
2	50.8	5.08	0.051
3	76.2	7.62	0.076
4	101.6	10.16	0.102
5	127.0	12.7	0.127
6	152.4	15.24	0.152
7	177.8	17.78	0.178
8	203.2	20.32	0.203
9	228.6	22.86	0.229
10	254.0	25.4	0.254
11	279.4	27.94	0.279
12	304.8	30.48	0.305
24	610.0	61.0	0.610
36	914.5	91.45	0.915
48	1 219.2	121.92	1.219
60	1 524.0	152.4	1.524
72	1 828.8	182.88	1.829

Inch-to-Millimeter Conversions (to scale)



## Manual Drafting Tools

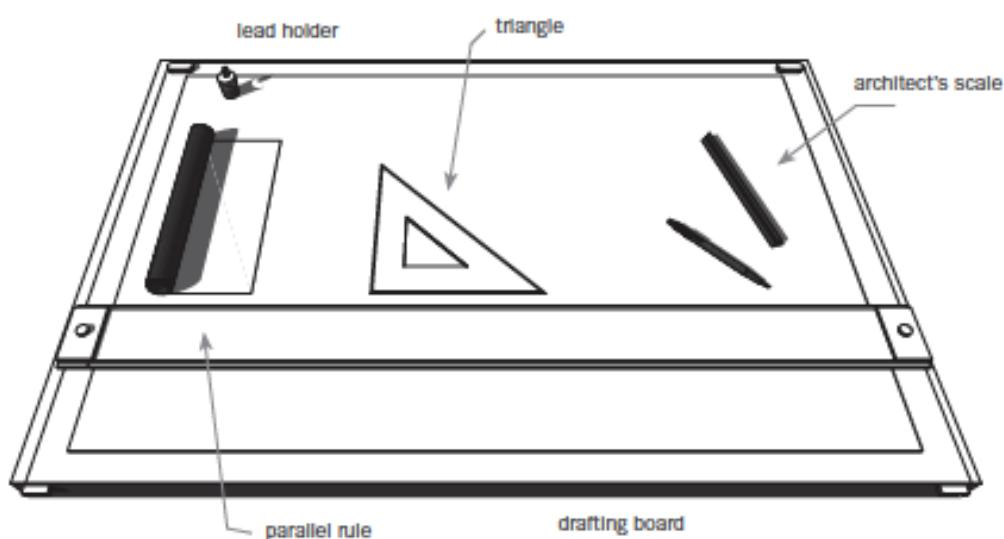
Although the computer has taken over as the primary method of drawing in most interior design practices, manual tools continue to be a part of the design process. Manual drafting is often used for developing quick ideas and details and is still employed quite frequently for final perspective drawings.

DRAWING TOOLS	
<b>Lead Holders</b>	Device that hold leads of 2 millimeters diameter; a spring-push action increases the length of lead for sharpening.
<b>Mechanical Pencils</b>	Leads, in various diameters up to 0.9 millimeter, that do not require sharpening.
<b>Other Pencils</b>	Standard wood-encased pencils; good for freehand drawing and sketching.
<b>Lead Pointers</b>	Manual sharpener whose blades give leads a specified sharpness.
<b>Graphite</b>	Leads in various hardnesses; good for drawing or sketching on tracing papers and vellum.
<b>Colored Leads</b>	Nonprint and nonphoto varieties do not show up on certain reproduction machines.
<b>Plastic Leads</b>	Leads designed for use on drawing films such as vellum and Mylar.
<b>Technical Pens</b>	Pens of specific widths designed for drafting; used exclusively on drafting films and vellums; tips can dry out and require frequent cleaning.

PARALLEL TOOLS	
<b>T-squares</b>	Plastic straightedges with a perpendicular attachment at one end to ensure that vertical lines on the page remain perpendicular to horizontal lines.
<b>Parallel Rules</b>	Plastic straightedges whose system of cables, rollers, and springs provides an edge that can move in one direction on a drawing surface.
<b>Triangles</b>	Clear plastic triangles that come in 45/90-degree and 30/60/90-degree variations.
<b>Adjustable Triangles</b>	Clear plastic triangles that can be set to any angle.
<b>Templates</b>	Wide variety of plastic sheets whose cutouts simplify drawing repetitive elements such as circles, polygons, and furniture.
<b>Flex Curves</b>	Measurable rulers that can flex to a user-defined curve or arc.
<b>French Curves</b>	Plastic guides that offer many curved radii.

Paper	Description	Sizes	Best Use
<b>Tracing Paper</b>	thin, transparent paper that comes in white or yellow	rolls in standard drafting sizes (12", 18", 24", and 36")	sketching and drafting details; overlay work; pencil, ink, and marker
<b>Vellum</b>	thicker than trace; available in various weights (16, 20, and 24 lbs); transparent and smooth finish	sheets and rolls	construction documents; hard-line detail drawings; perspective drawings; pencil, ink, and marker
<b>Drafting Film</b>	often referred to as Mylar; one- or two-sided drawing surface; of its various weights .003 and .004 are the most common	sheets (in standard drafting sizes) and rolls (36" and 42")	construction documents; plastic lead and ink; erases well and is resistant to tearing

<b>Bond</b>	opaque paper that comes in a variety of thicknesses and finishes of which hot- and cold-pressed are the most common	sheets of varying sizes	final drawings; pencil, though ink and watercolor can be used on certain papers
<b>Illustration Board</b>	finishing paper laminated to a cardboard backing; comes in single ply ( $\frac{1}{16}$ "") and double ply ( $\frac{1}{32}$ "")	sheets of varying sizes	finish presentation drawings; model making
<b>Foam Core</b>	polystyrene core faced with clay papers; comes in a variety of thicknesses	sheets up to 48" x 96"	quick model studies; dry mounting presentation boards



## Lines Weights and Types

Lines are essential to the communicative language of an interior designer. Lines convey a project's intended plan, demonstrate the sectional quality of the space, and visually cue the reader to matters of hierarchy, type, and intent. Line weights and types can be created through various media, both manually and digitally. Line types have many functions in an interior drawing. The designer determines the relative meaning for different weights; however, heavier lines are typically reserved for plans and section cuts, while lighter lines form the outlines of surfaces and furniture within a room.

0.05" (1.27)		<b>Heavy</b>
0.04" (1.02)		Used for borders of drawings, profiles of objects, and cut lines in plans and sections.
0.03" (0.76)		
0.025" (0.64)		

0.014" (0.36)



0.007" (0.18)



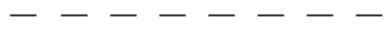
0.003" (0.08)



### Medium and Light

Used for dimensions, lines on objects that are not in the cutting plane, and objects hidden from view.

Dashed



Dashed .5x



Dash-dot-dash



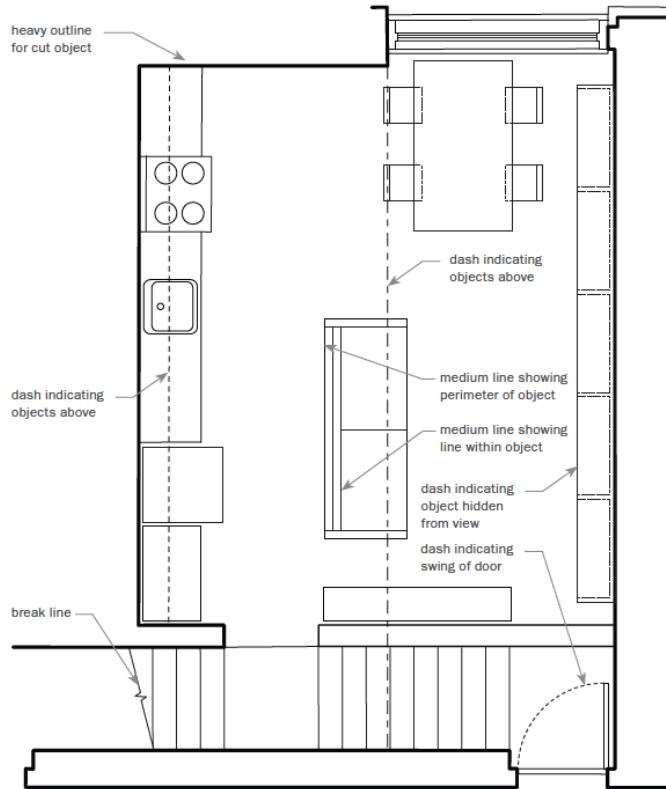
### Dashed

Used for hidden objects, either above or below the cutting plane.

Dashed lines represent many different elements, from objects that are hidden from view to objects above the cut plane (e.g., cabinets above kitchen counters), from the type of wall construction to changes in level. They can also be tied to consultant trades, showing, for example, structural grids, electrical wiring, lighting and switching, or mechanical routing.

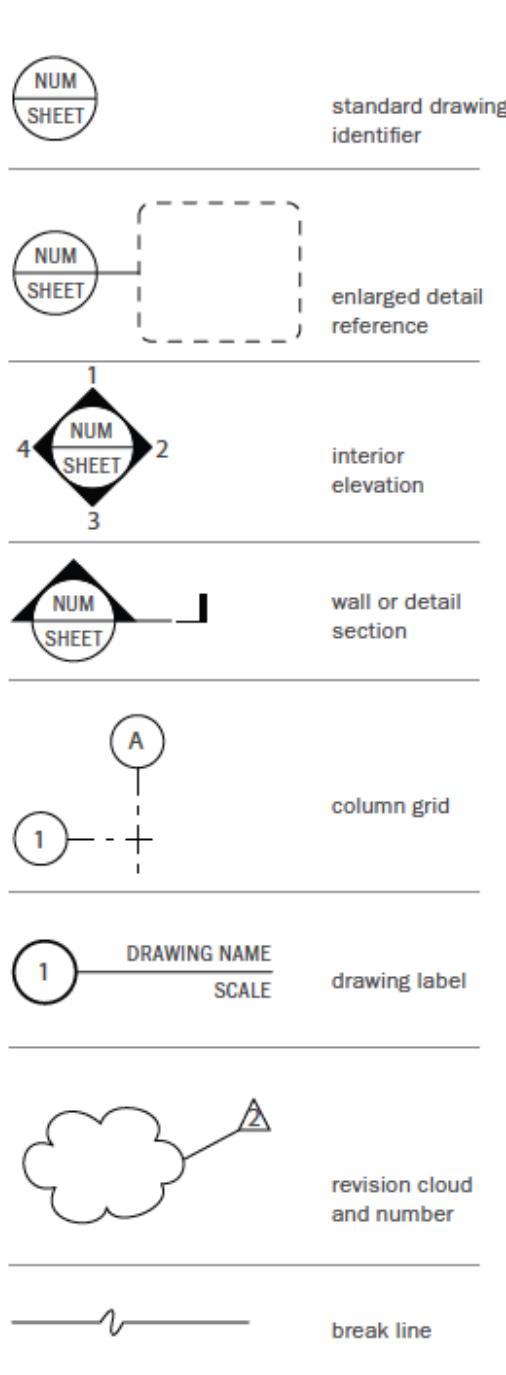
### Hierarchy

Hierarchy in a plan drawing is established through the careful use of line weights and types. Here, the walls that are cut are the most heavily rendered; furniture and built-ins are lighter; and hidden elements such as shelving and cabinetry are expressed with dashed lines.



### Drawing Symbols

Drawing symbols provide a codified language by which to specify the essential elements in drawings across a set. Below are some of the symbols typically used for an interior set.



window type

door type

wall type

centerline

room tag

wall coverings

floor coverings

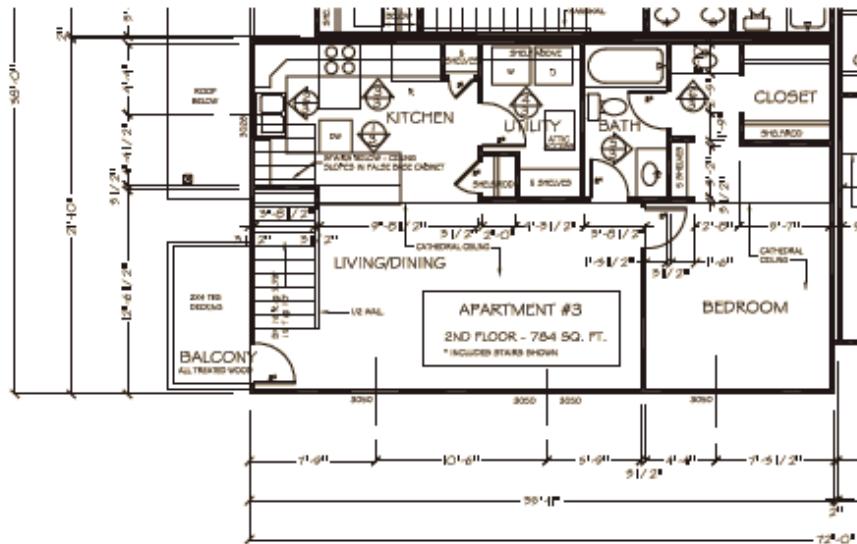
wall finishes

lighting fixture

## Types of Drawing in Interior Design

### Floor Plan

Floor plan is perhaps the most significant architectural drawing, as it contains a tremendous amount of information about the design and construction of a building or space. It also serves as the primary drawing to which many of the other specialty drawings can be keyed.



## 2ND FLOOR PLAN

1. ALL WALLS TO BE 2X4 STUDS @ 16" O.C. GYP. BOARD - UNLESS NOTED OTHERWISE  
2. FIELD VERIFY ALL CABINETRY BEFORE ORDERING/INSTALLING

SC: 1/4" = 1'-0"

A floor plan is an orthographic view of a total building or an area within a building, seen as if a horizontal cutting plane were passed through it at a height of approximately 4 feet (1219 mm) above the floor line. In some cases, it may be necessary to assume a higher cutting plane to show an item such as a high window or the space above a tall cabinet. The viewer is looking straight down into the building. In multiple-level buildings, a separate floor plan is drawn for each level.

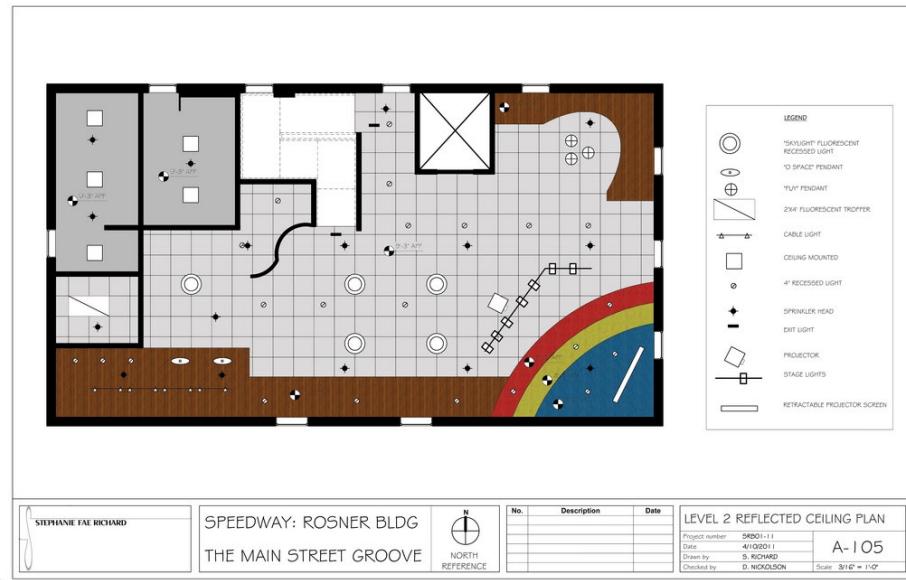
In turn, each level is aligned with the one above for bearing walls, stairways, ductwork, and other vertical elements related to both floors. Stairways are labeled "up" on one level and "down" on the level above. When viewing a floor plan of a building that includes a mezzanine or loft, the upper level is shown in plan, with the lower level also shown or simply labeled "open".

In construction drawings, floor plans are drawn to scale and detailed to show walls, doors, windows, plumbing fixtures, appliances, stairs, cabinetry, and any other built-in or free-standing interior features. Most of these items are drawn as viewed from above. Floor Plan also illustrates how a lavatory, appliances, and plumbing fixtures are drawn. Doors are drawn in the plan view in an open position showing the direction of their operation. Windows and their operation are difficult to describe in a floor-plan view. They are drawn simplistically in plan and referenced with specific symbols that relate to the type of their action and listed in a window schedule. In addition to symbols, line weights and different types of lines can be used to relay information with the floor-plan drawing.

### Reflected Ceiling Plans

The reflected ceiling plan is primarily a tool which allows the participants to look at the [proposed layout](#) from right above — a bird's eye view if you will — literally from the ceiling through a mirror that is set up about a foot under the level of the ceiling. This orients the user to the view from the top, while also giving an idea of elements such as lighting fixtures along

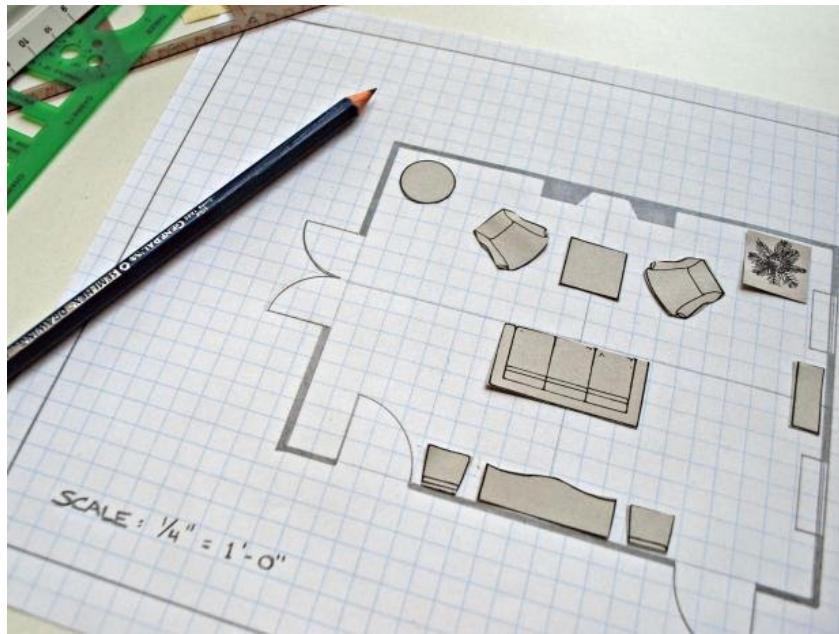
with other mechanical attributes that are relevant in a space. It also helps to create a balance between the flooring and the ceiling.



Like most architectural tools, the reflected ceiling plan is instrumental for not just the architect, interior designer or the engineer, but also other people who are an inevitable part of the construction process. Those include electricians and plumbers, among other employees who help service the construction requirements. The reflected ceiling plan is a crucial part of the documents that come with the floor plan and construction and depicts a drawing of the space as seen from the ceiling.

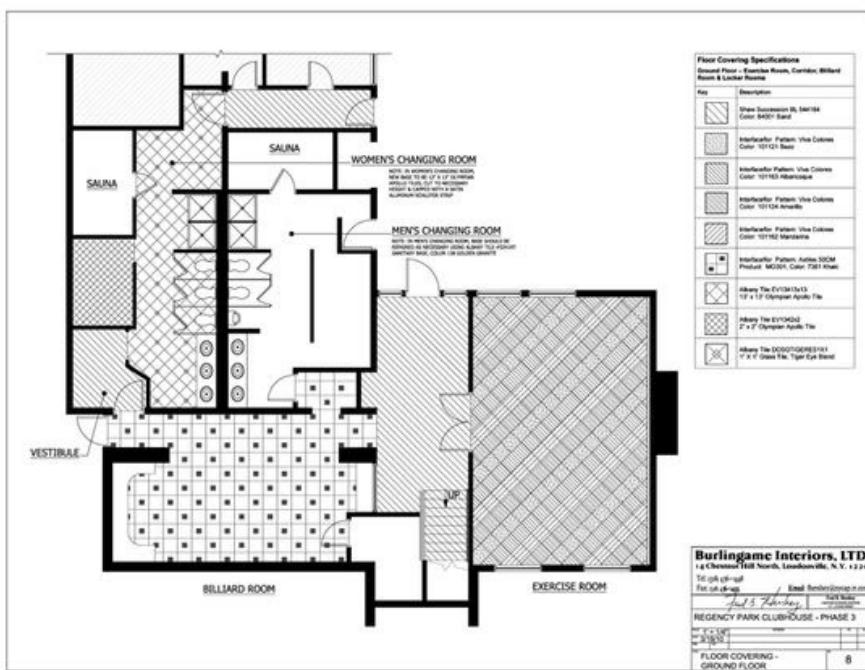
### Furniture Location Plans

Better to visualize the design on the paper, or with the help of the computer programs. It is easier to try the different furniture and color configuration in the paper or computer, than to move and replace all the furniture in the house. Effective furniture layout must address both functional and visual criteria. The functional criteria evaluate how well the layout supports the human activities that take place in the space, such as conversation, rest, or movement. The visual criteria concern the perception of the layout as a visual composition. Functional criteria for furniture layout are based on the constraints imposed by human physiology and the effects of spatial layout on human behavior. The visual criteria concern the perception of the furniture layout as a visual composition. The primary visual rules of thumb used by interior designers are visual balance, alignment, and a dominant point of emphasis.



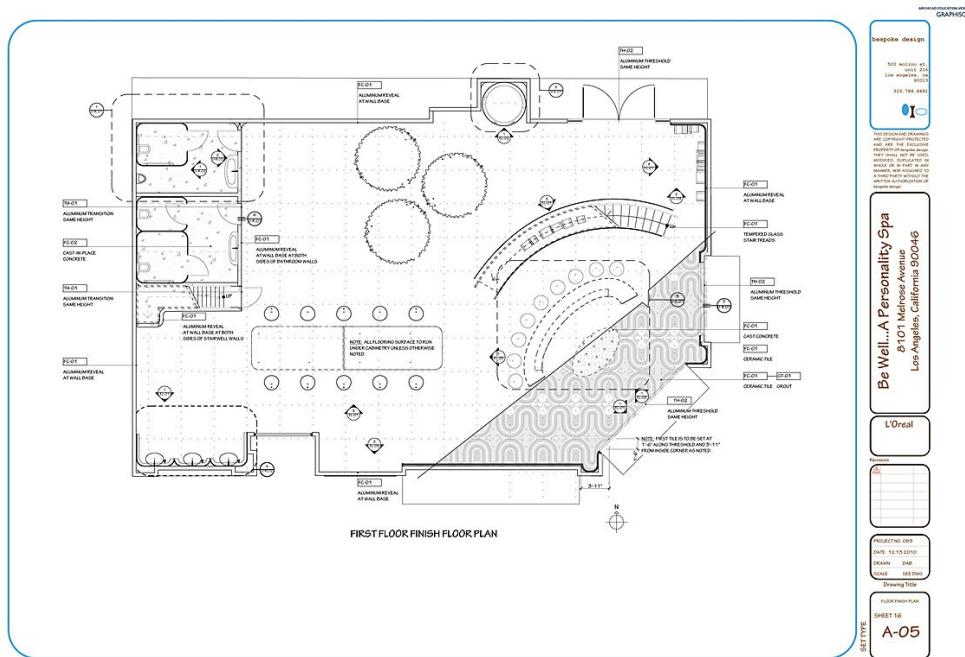
### Floor Finish and Wall

Floor finish plan shows where certain flooring is to be used, and also defines the angle of the flooring as it moves from one space to the next.



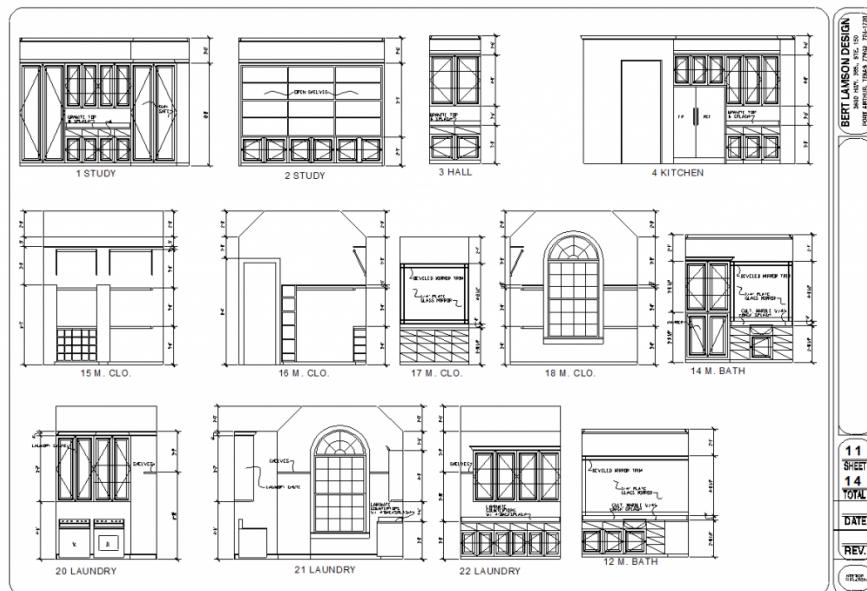
### Finish Plans

Finish Plans show what materials should be applied to the walls and floor throughout the building

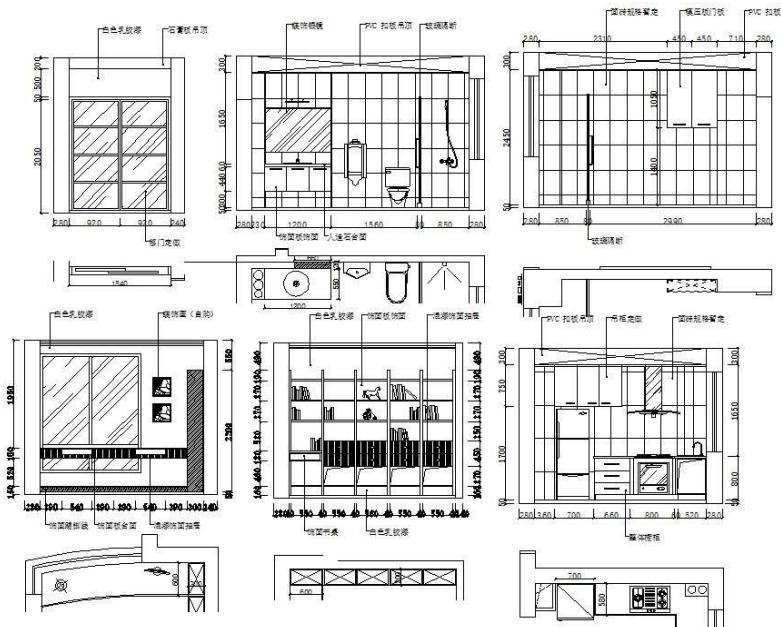


## Interior Elevations

An elevation sketch is an orthographic projection—a two-dimensional representation of a three-dimensional space. For interior design, it is a two-dimensional drawing of a wall (or series of walls) with varying degrees of detail. An interior elevation plan, or section drawing, can help give the designer a front or side view of a room, developing in complexity as details are added throughout the project, like where appliances or built-ins should be positioned.



## Details



Details indicate how the design is to be fabricated and range from wall sections to mechanical coordination details to millwork construction. They are produced at a larger scale than all other drawings in the set. Scales for details can be as small as  $1/4" = 1"$  (1:2) through to full scale. Occasionally, details are drawn at larger than full scale to transmit clearly the intent of the designer to the fabricator or contractor. In detail drawings, materials are rendered symbolically, and annotations specify the material and fabrication methods to be used.

## Sketching in Interior Design

Drawing is truly a tool for seeing. To draw an object, interior, or building, you have to look at the subject in a new way. You are forced to pause and scrutinize, as drawing requires another way of thinking, shifting into a deeper realm that encompasses elements such as shape, form, texture, rhythm, composition, and light. When you have developed your drawing skills, the finer details of a space—key features that you may not previously have noticed—will be revealed to you. Freehand drawing

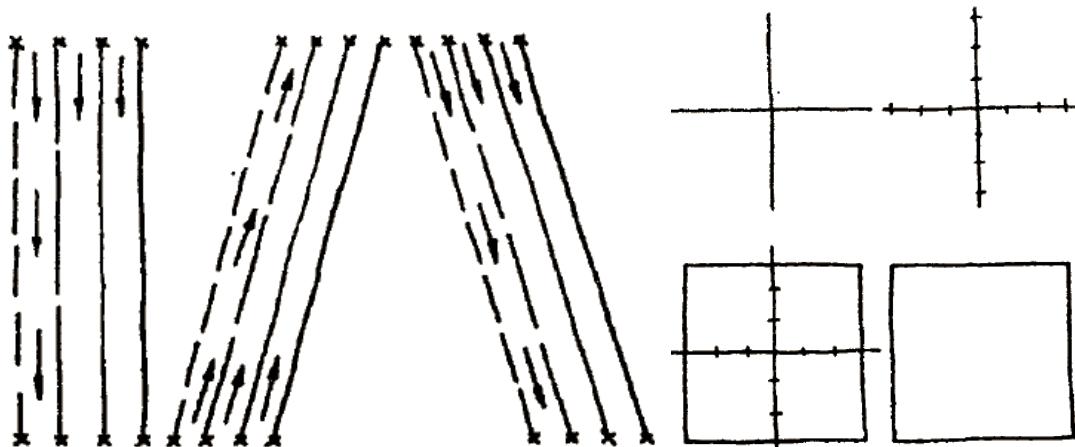
allows viewers to see in a way they never have before. The sketching process is a means of expanding your creativity and awakening your senses.

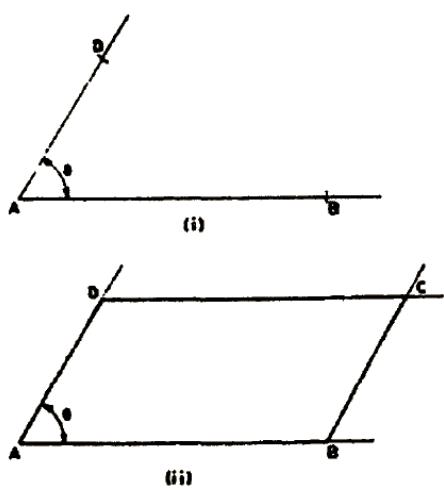
The cumulative process of sketching always begins with studying the subject, whether it be a chair, an interior, or an entire building. It is about drawing what you see, not what you think you see, or what you already know as a chair, interior, or building. Think of it as seeing the subject for the first time.



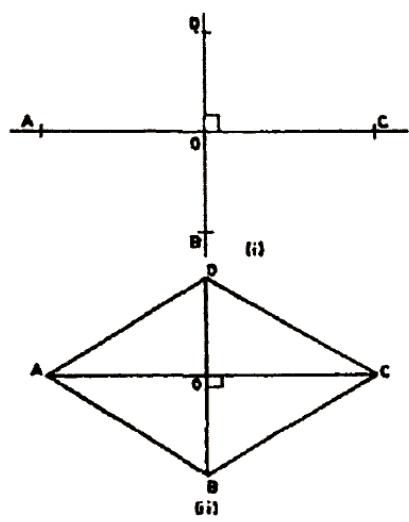
## Freehand Sketching

Freehand sketching is one of the effective methods to communicate ideas irrespective of the branch of study. The basic principles of drawing used in freehand sketching are similar to those used in drawings made with instruments. The sketches are self explanatory in making them in the sequence shown in the below image.

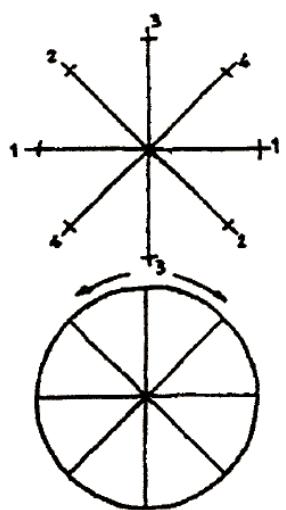




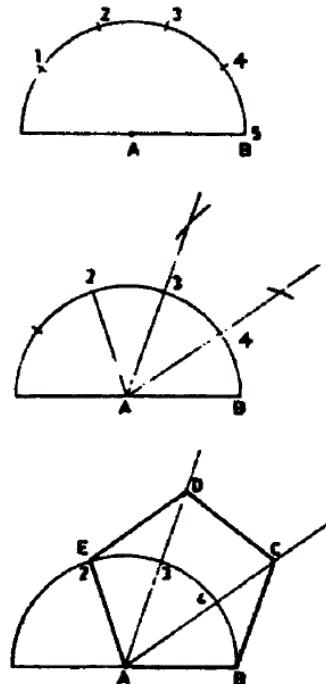
a - Sketching a Parallelogram



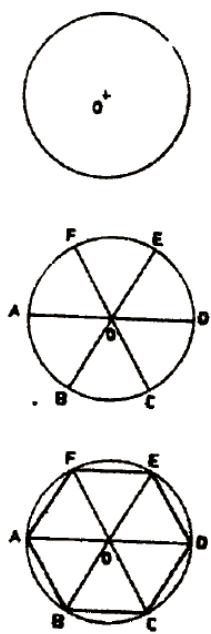
b - Sketching a Rhombus



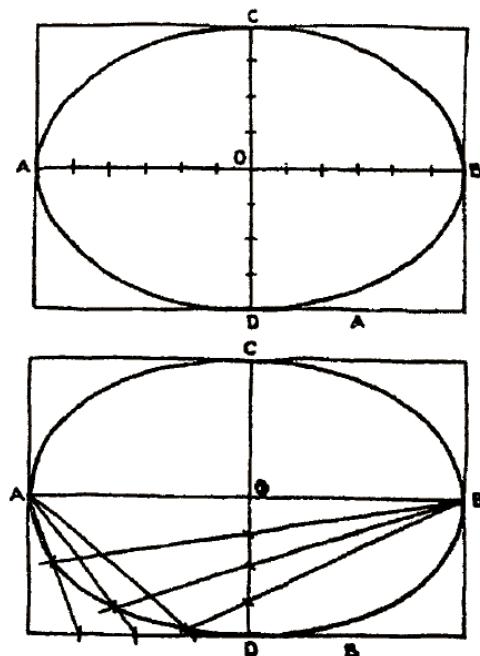
**Fig. 13.4** Sketching a Circle



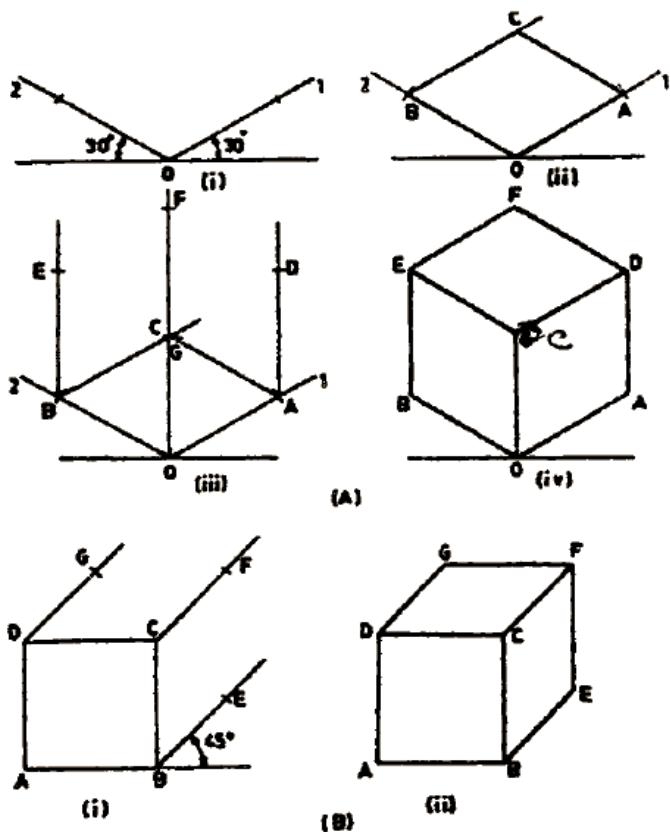
**Fig. 13.5** Sketching a Pentagon



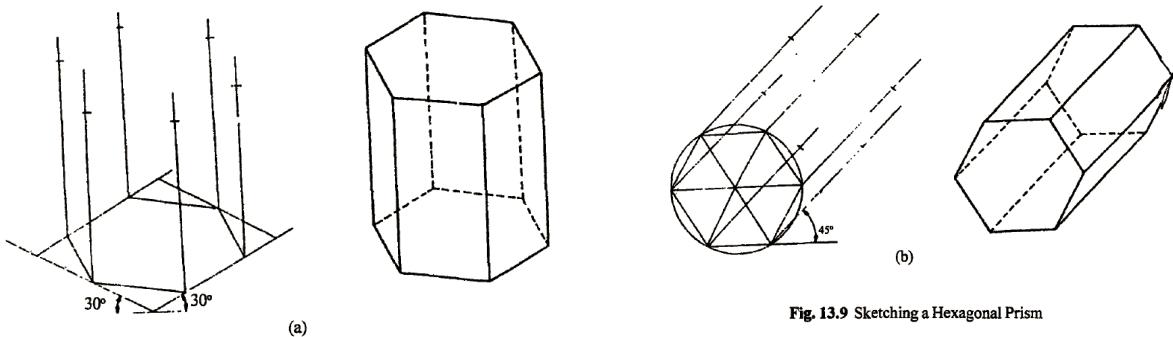
**Fig. 13.6 Sketching a Hexagon**



**Fig. 13.7 Sketching an Ellipse**



**Fig. 13.8 Sketching a Cube**



**Fig. 13.9** Sketching a Hexagonal Prism

### Geometric Construction Drawing

Engineering drawing consists of a number of geometrical constructions. Strict interpretation of geometric construction allows use of only the compass and an instrument for drawing straight lines, and with these, the geometer, following mathematical theory, accomplishes his solutions. In technical drawing, the principles of geometry are employed constantly, but instruments are not limited to the basic two as T-squares, triangles, scales, curves etc. are used to make constructions with speed and accuracy. Since there is continual application of geometric principles, the methods given in this topic should be mastered thoroughly.

(See separate Readings - Geometrical Constructions)

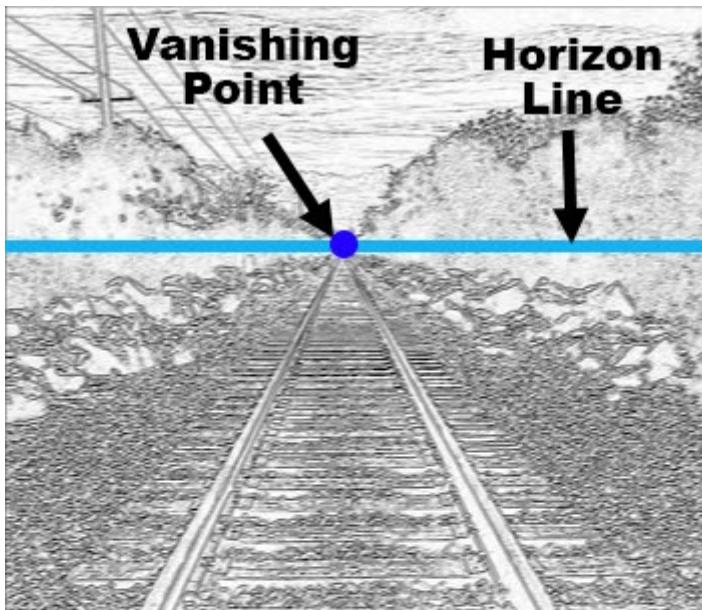
### Perspective Drawing

Artists use perspective to create convincing representations of our three-dimensional world on the two-dimensional surfaces of their drawings. When perspective is used effectively, objects in a drawing appear to recede into the distance, and they seem to exist in three-dimensional space. Perspective is one of the foundations of realism in art.

One of the most important innovations in the history of drawing was the development of linear perspective. Linear perspective is based on a series of guidelines and points that help artists create a realistic sense of depth in their drawings. There are several types of linear perspective including one point perspective, two-point perspective, and three point perspective.

### One Point Perspective Drawing

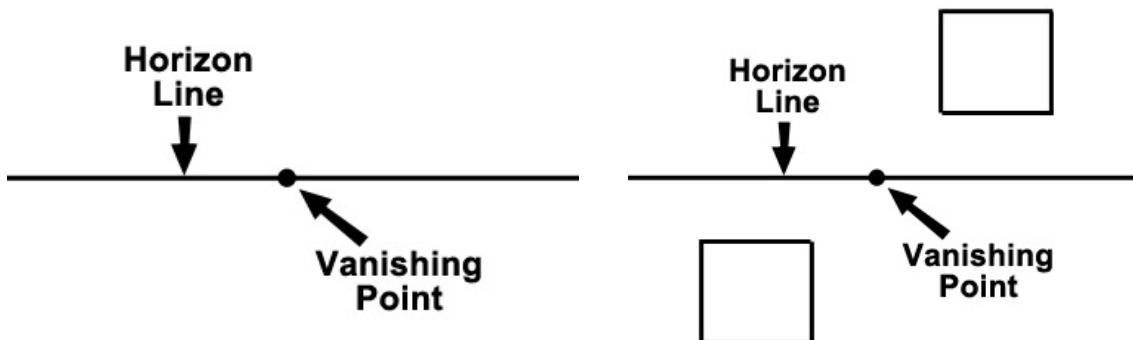
One point perspective is based on the concept that the lines and shapes in a drawing can be located in reference to a single line, called the horizon line, and a single point, called the vanishing point.



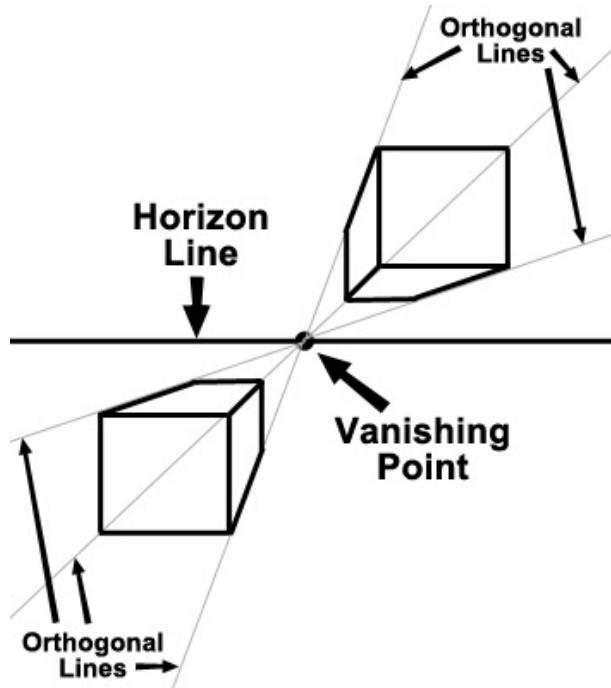
The line is called the horizon line because it often is placed where the actual horizon is located in the drawing. It is also called the eye level line because it represents the viewer's eye level in relationship to the drawing. The vanishing point is the point on the horizon line where lines in the drawing that are actually parallel in real life, such as the two rails of a railroad track, appear to merge when crossing the horizon line. Using the horizon line and vanishing point as references, artists can create convincing drawings of everything from simple cubes to complex architectural renderings.

#### *One Point Perspective in Practice*

Let's take a look at how one point perspective can be used to create a sense of depth in a drawing. Imagine you want to draw two cubes. Begin by drawing the horizon line. Place the vanishing point in the center of the horizon line.



Next, draw the sides of the cubes that face you.

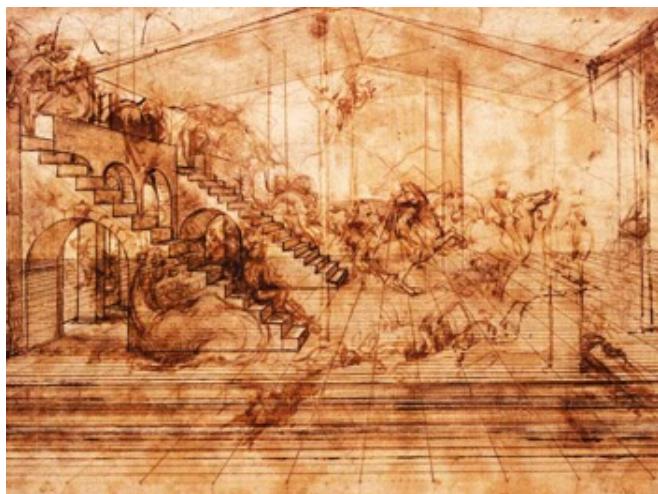


When using one point perspective, the side of an object that faces you is drawn using its undistorted, actual shape. In this case, the undistorted shape is a square. At this point, you have a simple representation of two cubes, but they're still really just two squares because your drawing has no sense of depth or perspective yet.

To give your drawing a sense of depth, draw the sides of the cubes that do not face you using lines that radiate outward from the vanishing point. These lines are called orthogonal lines.

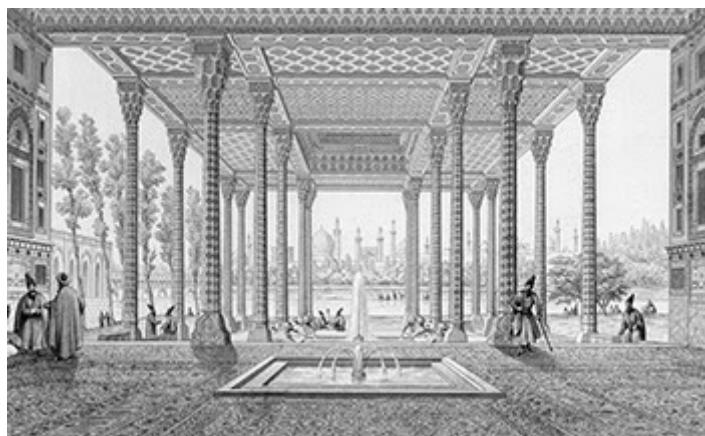
Once you have completed this step, the cubes in your drawing appear to exist in three-dimensional space, thanks to your use of one point perspective.

#### Examples of One Point Perspective



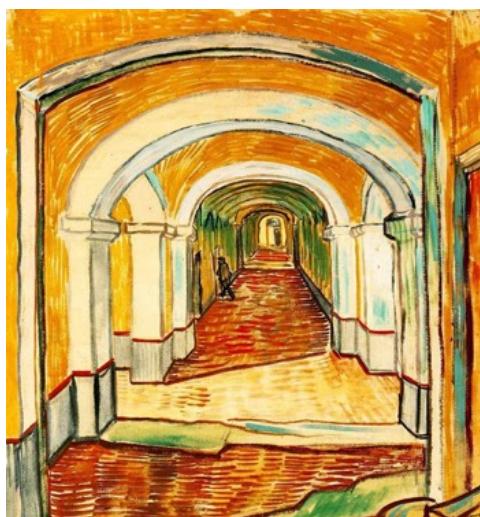
One point perspective has been used by artists for over 500 years. The one point perspective grid Leonardo Da Vinci used in this drawing is still visible. Notice how the grid's orthogonal lines converge on a single vanishing point.

The drawings of Pascal Coste demonstrate how one point perspective can be used to create complex architectural drawings.



In this drawing, Coste used a single vanishing point on a horizon line just above the fountain.

Post-Impressionist painter Vincent Van Gogh also used the technique.



In this painting, Van Gogh used one point perspective to create a strong sense of depth by placing the vanishing point at the far end of the corridor.

## Two Point Perspective

**Two-point perspective** occurs when you can see two vanishing points from your point of view. Two-point perspective drawings are often used in architectural drawings and interior designs; they can be used for drawings of both interiors and exteriors.

In two-point perspective, the view is from the corner and the sides recede toward two different vanishing points.

### *Creating a Drawing in Two-Point Perspective*

Here are the materials you will need:

- Pencil (any brand will do)

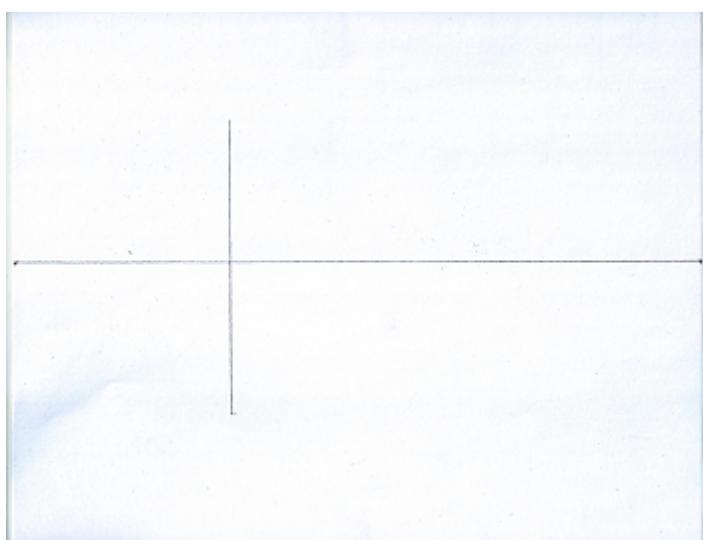
- Paper
- Ruler (at least 12 inches)
- Eraser

Using your ruler, decide where on your paper you want your vanishing points to be. Your vanishing points are the two points on your paper where you can no longer see your buildings. Use your ruler to line them up. They should be directly across from each other.

2. Place your ruler underneath your two vanishing points and connect them. This will be your horizon line, where your sky and the land come together. Don't make the line too dark, as you will be erasing it as your drawing progresses.

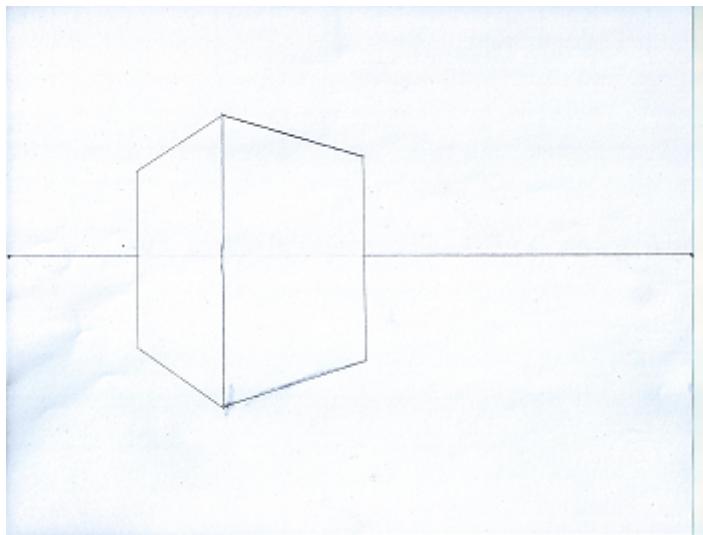


3. Place a line perpendicular to your horizon line. This will be the corner of your first building.



4. From the top of your second line, measure a length of line. This will be the top of one side of your building. Angle this line towards one vanishing point. If your line is on the left, angle your line towards the left vanishing point. If your line is on the right, angle it towards the right vanishing point. Do the same for the other three lines (top and bottom of each side of the building).

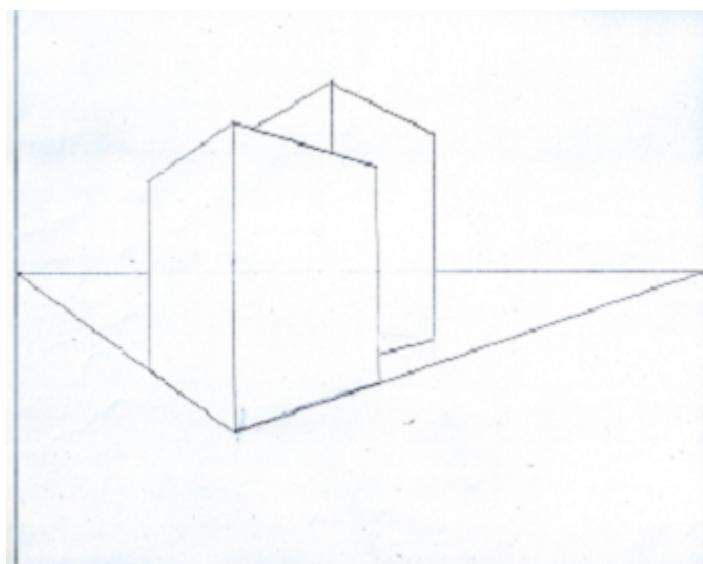
5. Join the lines together. This is your first building. Erase the horizon line inside your building.



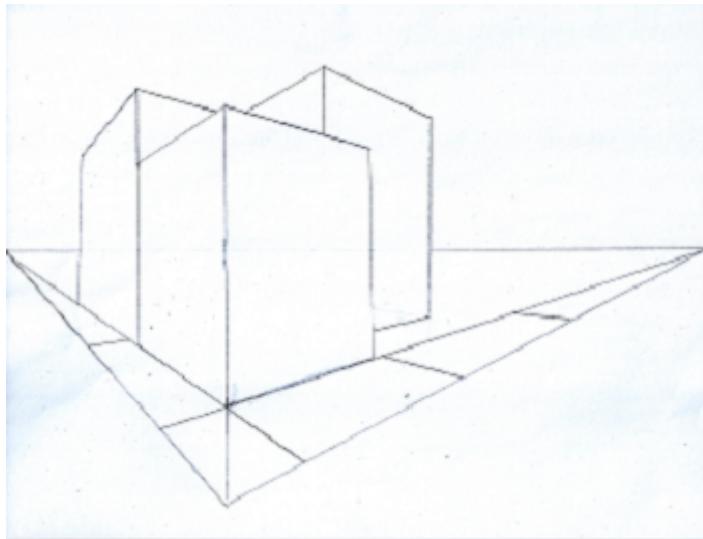
6. For your second building, draw a straight line jutting up from the top of your first building, about in the middle of one side.

7. Repeat step 4, but this time use only three lines, since this building will be slightly behind your first building and part of it won't show.

8. Take your ruler and extend the bottom lines of the first building all the way to your vanishing points. This will become part of the sidewalk.



9. Repeat steps 4, 6, and 7. You should now have three buildings.
10. Go back to your first vertical line (drawn in step 3). Extend it down as far as you would like. Now, going from the end of that line, take your ruler and line it up from the vanishing point to the end of the line. Draw a line. Repeat on the other side. This is your sidewalk.
11. Extend your lines from step 8 so they cross over each other. Then use your ruler to create more lines in your sidewalk.

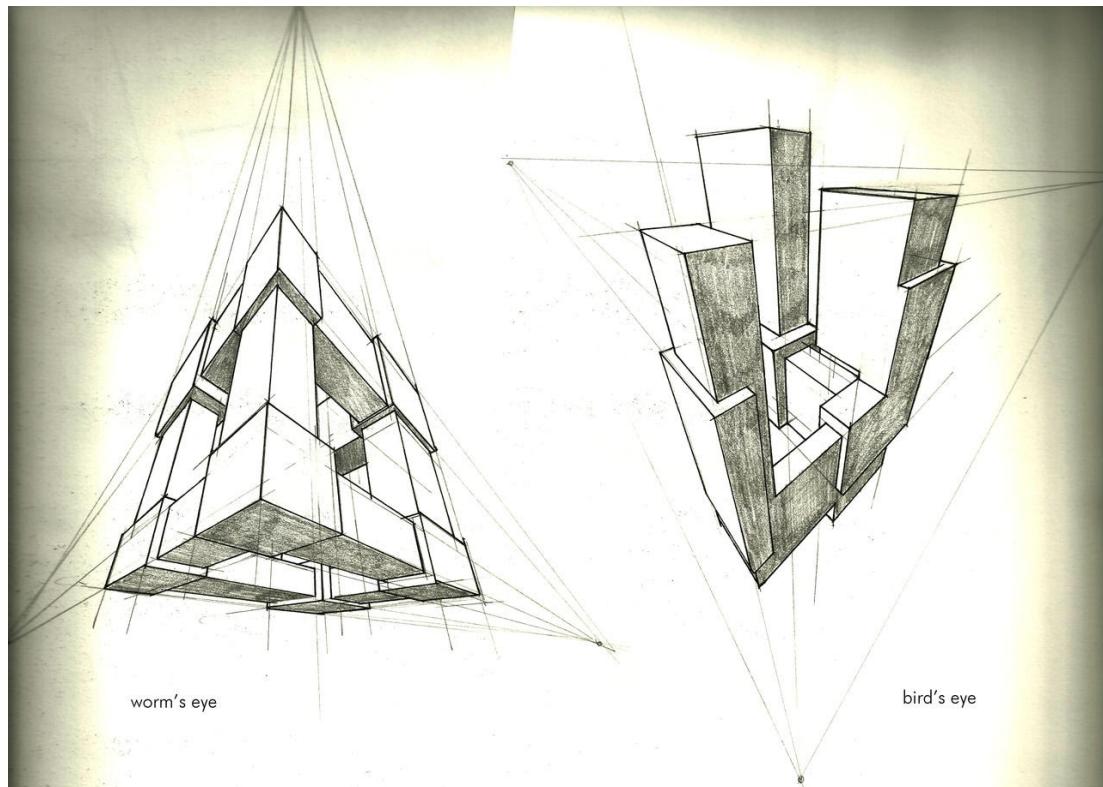


12. Add as many buildings as you want or can fit.

13. Add details.



## Three Point Perspective

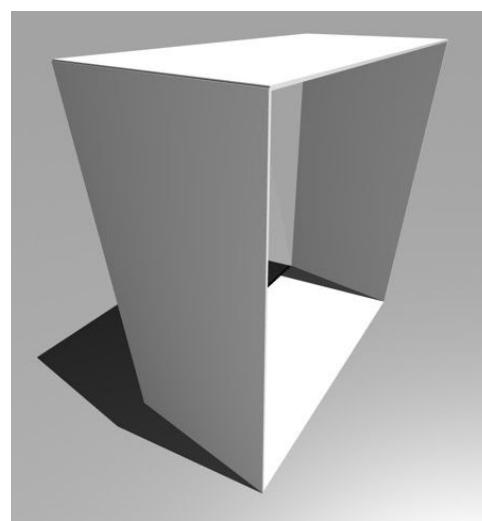


Three Point Perspective is the most complex form of perspective drawing. Three point perspective uses three sets of orthogonal lines and three vanishing points to draw an object.

Three Point Perspective is most commonly used when drawing buildings viewed from a low or high eye-level. The low eye level in our illustration creates the illusion that the box shape is towering above us and that we are looking up. It naturally suggests the scale of a tall building.

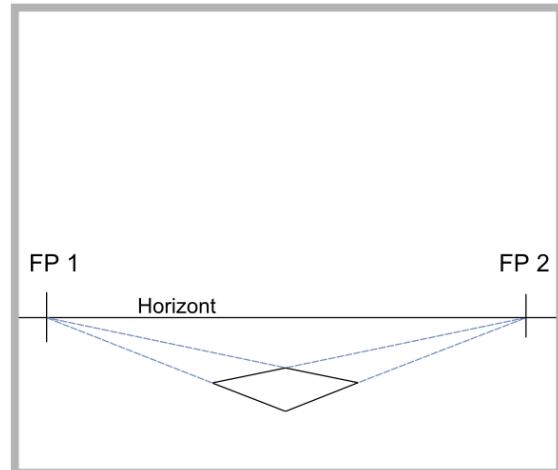
Note how the vertical transversal lines, which were parallel in one and two point perspective, now appear to recede. They form a third set of orthogonal lines, which rise from the ground plane and eventually meet at vanishing point 3, high above the picture plane.

In one and two point perspective, the picture plane is fixed at right angles to the ground plane. In three point perspective, the picture plane seems to be set at an angle as the viewer tends to tilt their head back or forward to look up or down from the eye level.



## Drawing in three-point perspective step-by-step

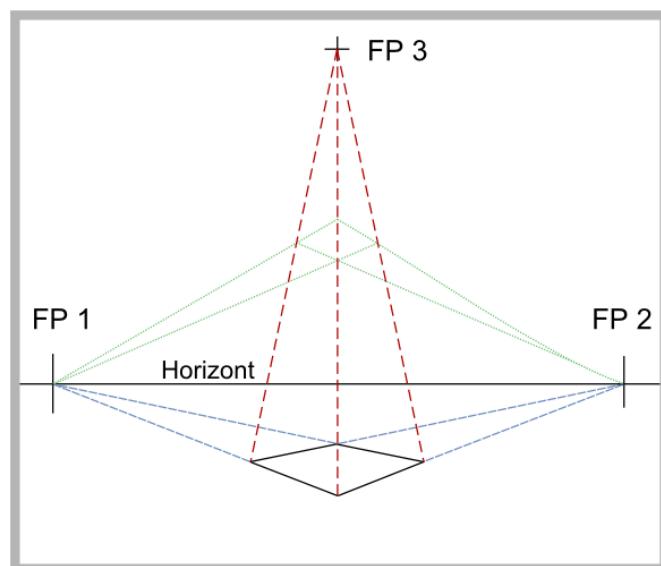
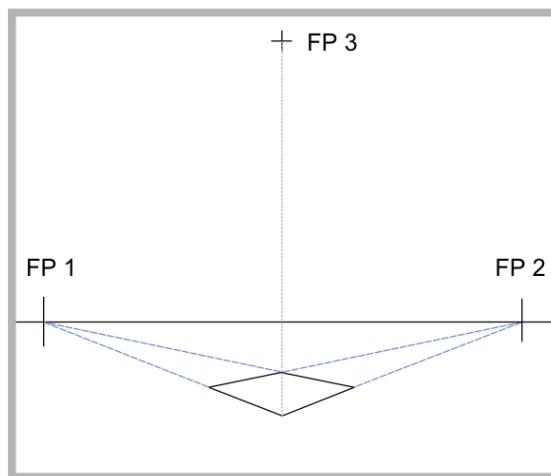
1. Start with the base of the cuboid, which is drawn in a diagonal perspective with two vanishing points.

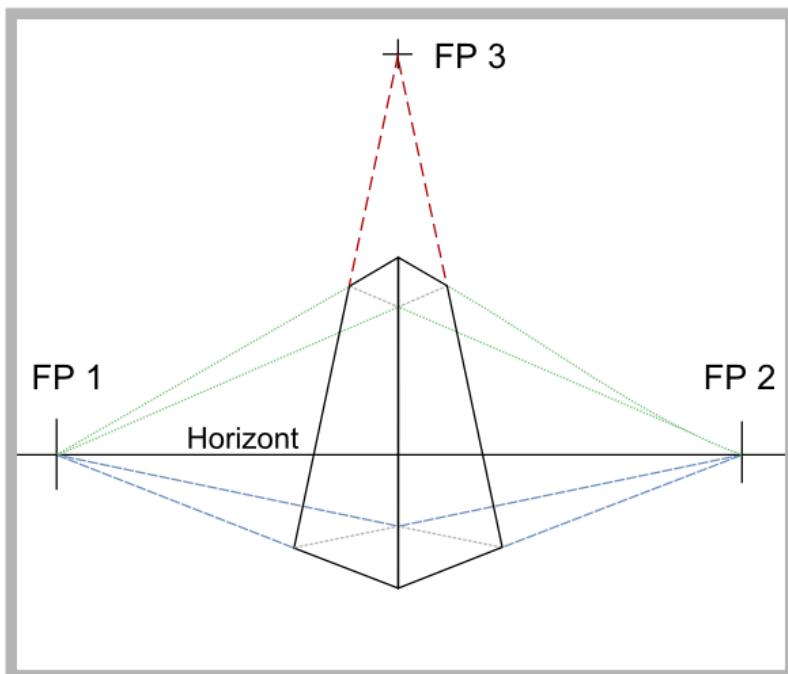


2. Draw the important third vanishing point in the middle between the two other vanishing points. The position should be - as in the sketch below - a whole bit far above the horizon.
3. Now you can draw the top of the cuboid. The height in which this surface is located can be determined freely. The corners of the surface are defined by the vanishing lines of the vanishing points FP1, FP2 and FP3.

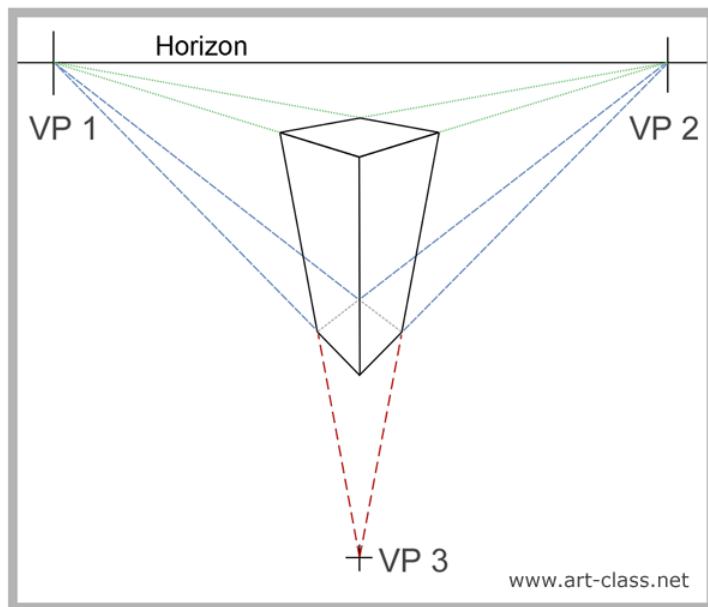
At this point the drawing of the three-point perspective is again somewhat different from other perspective illustrations, since the vanishing lines of the third vanishing point are included.

The perspective drawing is now almost finished. It is only necessary to draw the real edges of the cuboid clearly with the pencil and to erase superfluous construction lines.





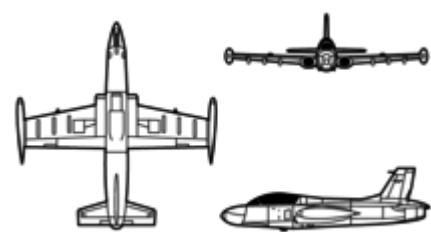
*Draw a top view in the three-point perspective*



In order to be able to draw this spatial situation, the third vanishing point travels downwards. It is thus no longer above, but under the base of the cuboid.

## Orthographic Drawing

An orthographic drawing represents a three-dimensional object using several two-dimensional views of the object. It is also known as an orthographic projection. For example, you can see in this image the front, top and side views of an aircraft.



'ORTHO' means right angle and orthographic means right angled drawing. When the projectors are perpendicular to the plane on which the projection is obtained, it is known as orthographic projection.

Orthographic drawing, which is one of the three types of parallel projections (orthographic, oblique, and axonometric), can be defined as a type of technical drawing in which 3-dimensional objects are represented in 2 dimensions by projecting planes (consisting of 2 major axes) of objects so that they are parallel with the plane of the media (paper, or computer) they are projected upon. Any type of orthographic drawing uses two-dimensional (2D) views (obtained from two different lines of sight) to represent different parts of three-dimensional objects, or planes of objects viewed from/along different axes—typically, the x, y, and z axes.

Generally, the best way to fully express all the most important visible parts of any 3D object in 2D views—either by first angle orthographic projection or third angle orthographic projection—is by using a maximum number of views, which in most cases is six—or at least four or three.

However, in practice most people or organizations use three or four views to illustrate how shapes and sizes of various parts of an object look. Generally speaking, the number of views used in an orthographic drawing or projection depends on the purpose and objective of a drawing.

### *Types of orthographic drawing*

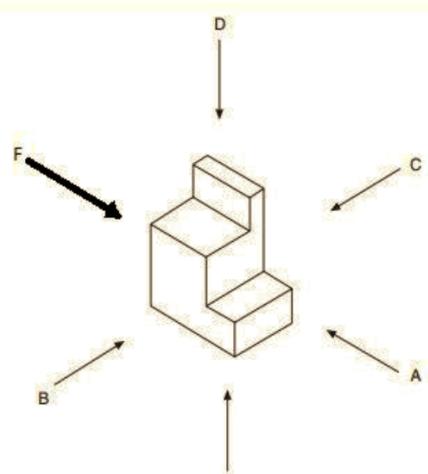
Orthographic drawing (also known as orthographic projection) consists of two types: first angle projection, and third angle projection.

#### **First angle projection**

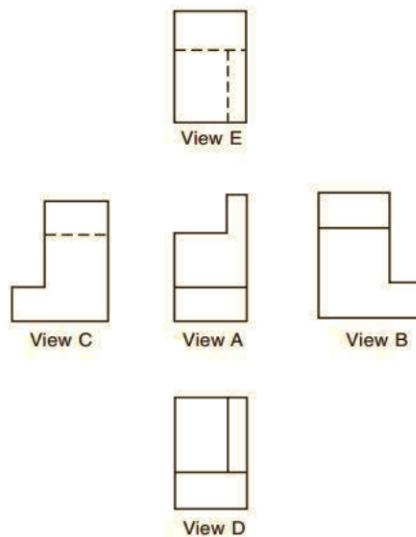
In first angle projection, which is popularly practiced in Europe, whenever six views are used to illustrate how the sides of a 3D object look from six directions, they are usually arranged in the following manner:

- The bottom view E is placed at the top of the paper.
- The front view A is placed beneath the bottom view E.
- The top view D is placed beneath front view A (i.e., at the bottom of the paper or computer screen).
- The right view C is placed on the left side of front view A.
- The left view B is placed on the right side of front view A.
- The back/rear view F (which is not shown in the below image) is usually placed at the extreme left or right—whichever position is convenient.

Six Directions for six views



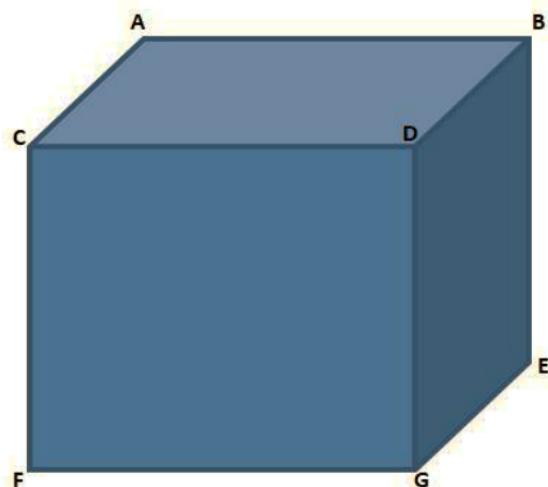
Five views of the first angle projection (A sixth view F would depend on the shape of the back/rear view of the object).



Whenever four views are used, the front view is usually placed at the top of a medium (paper, computer screen, etc.) along with the right side view which is placed at the left side of the front view, while the left side view is placed at the right side of the front view, and the top view (T) is placed alone beneath the front view.

It has to be noted that in many first angle orthographic drawing practices, three views could be sufficient enough to describe the shapes and dimensions of various sides of an object which actually exist in 3D as shown in Figure 3 below: 10

A three dimensional object with 7 visible edges

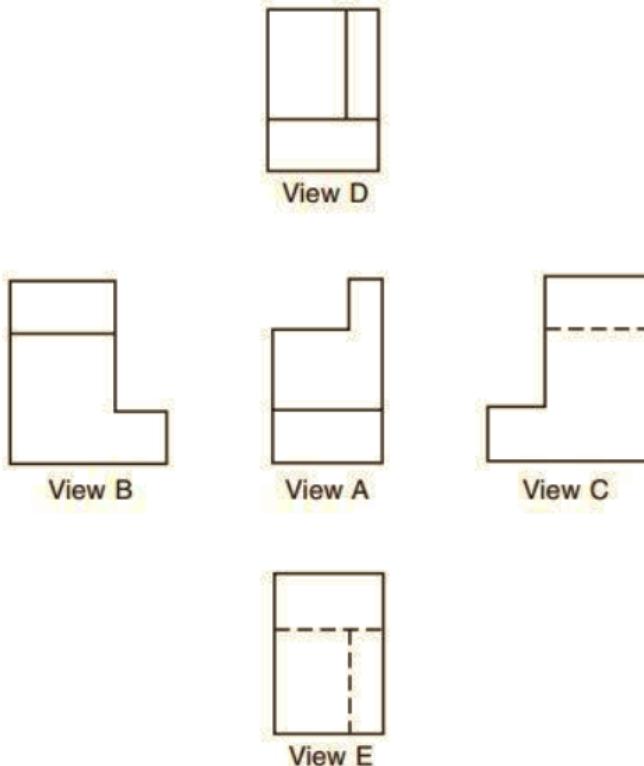


### Third Angle Projection

In third angle projection, which is mostly practiced in North America, whenever six views are used to describe the sides of a 3D object from six different directions, they are usually arranged in the following manner:

- The top view D is placed at the top of the paper
- The front view A is placed beneath the top view D.
- The bottom view E is placed beneath front view A (i.e., at the bottom of the paper).
- The right view C is placed on the right side of front view A.
- The left view B is placed on the left side of front view A.
- The back/rear view F (which is not shown in the image below) is usually placed at the extreme left or right—whichever position is convenient.

Five views of third angle projection (A sixth View F would depend on the shape of the back/rear view of the object.)



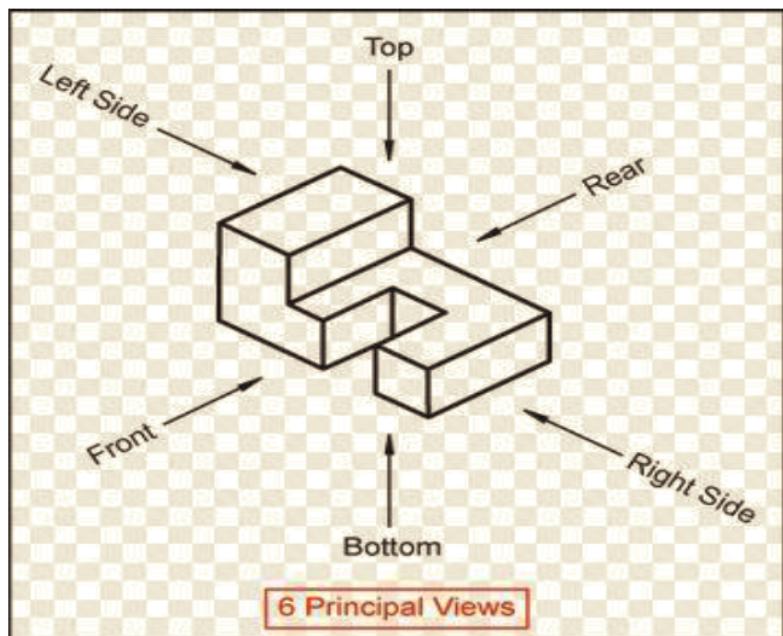
Whenever four views are used, the top view is usually placed alone at the top of a medium (paper, computer screen, etc.), while the front view is placed beneath the top view, and the right side view is placed at the right side of the front view, while the left side view is placed at the left side of the front view. (Note that third angle projection is the most popular type of orthographic drawing or projection.)

drawing/projection.

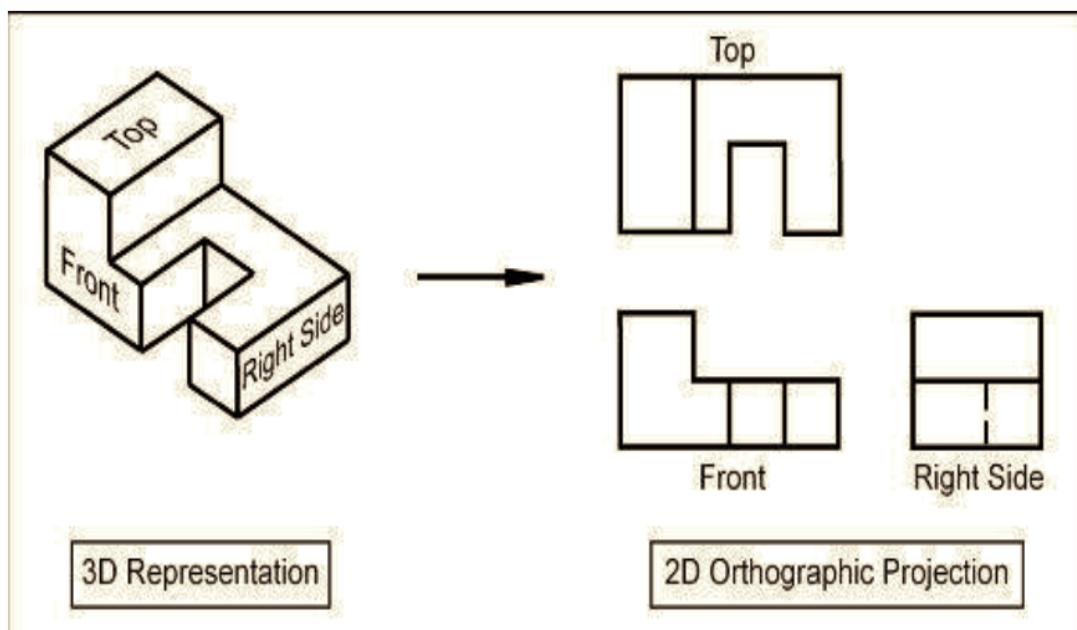
Generally, the difference between first angle projection and third angle projection depends on where each view is placed on paper according to the universally accepted requirements of the two main types of orthographic

There is no general rule per se, but the best or most recommendable way to fully express the important visible and hidden parts of any 3D object in 2D views, is by using as many views as possible: probably between three and six views.

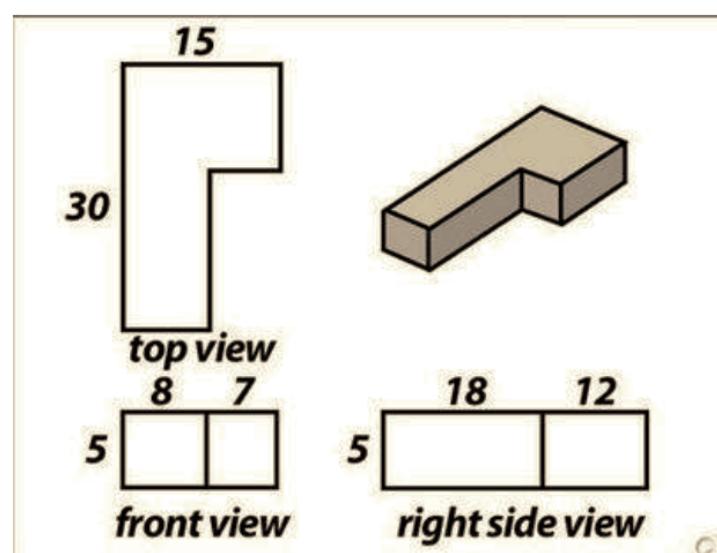
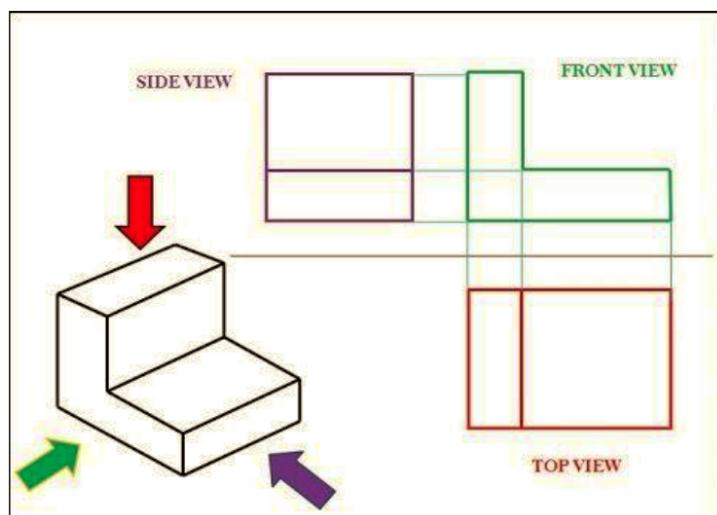
Whenever six views are used, different directions (lines of sight projected on the sides of an object) can be chosen to illustrate the top, bottom, front, rear/back, left and right views, respectively, as can be seen in figure below.



Below image is the third angle projection of the above image.



Some samples of orthographic projections of some other objects/shapes:



Always remember that in many orthographic drawing practices across the world, the number of views chosen or used, usually depends on the number of views required or needed.

### ***Orthographic Drawing Tutorial & Practice***

#### *Tools required for orthographic drawing practice*

With regular drawing practice, it is very easy to learn and perfect orthographic drawing skills. The tools usually required for practicing orthographic drawing are quite the same as the ones used in technical and engineering drawing, respectively. Generally, the tools could include:

- Drawing board.
- Drawing paper: either A<sub>0</sub>, A<sub>1</sub>, A<sub>2</sub>, A<sub>3</sub>, and A<sub>4</sub>.

- Drawing pencil.
- Eraser.
- $30^\circ$  .  $60^\circ$  and  $45^\circ$  .  $45^\circ$  set squares.
- 300 mm (30 cm) ruler.
- T-square.
- Drawing compasses

### **General Procedure**

Generally, when projecting sides or different views of 3D objects in 2D, a certain degree of concentration will be needed to ensure that shapes, sizes or dimensions are consistent and accurate. The following are important when making orthographic projections:

Estimate the area of paper that would be enough to draw all necessary and important views. In addition, determine an appropriate scale for your drawings. A scale is any ratio (examples: 1:10, 1:100, 1:1000, etc.) of the size of an object on paper, to the actual size of the same object in real life. Common scales for “enlargement of objects” include: 2:1, 5:1, 10:1, etc. On the other hand, common scales for “reduction of objects” include: 1:2, 1:5, 1:10, etc.

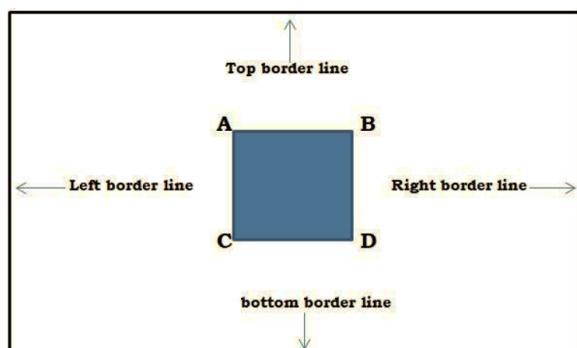
Put equal distances (which should also be considered in the total area that would be enough to accommodate all views) between views, vertically (for e.g., top, front, and bottom views), and horizontally (for e.g., left, right, and back/rear views).

When drawing any view—whether square-, rectangular-, or circular-shaped—mark the center lines of each shape and the center/centroid of each shape. Center lines are very important, not just because they are center lines, but because they serve other purposes, one of them being that they help in establishing other points and lines in drawings.

Draw the top view, and project the most visible and important lines into the front view, or vice versa.

After drawing the front view, the right and left side views can be projected and drawn. In addition, the bottom and back/rear view can also be drawn or constructed if required.

Top view of an object drawn on drawing paper



As an example, in order to draw perfectly straight vertical and horizontal lines for the two dimensional (2D) top view ABCD of a 3D object on paper as shown in the above image, the following steps should be taken:

- Points A and B should be the same distance away from the top border line on the drawing paper.
- Points C and D should be the same distance away from the bottom border line on the paper.

- Points and A and C should be the same distance away from the left border line on the paper.
- Points and B and D should be the same distance away from the right border line on the paper.

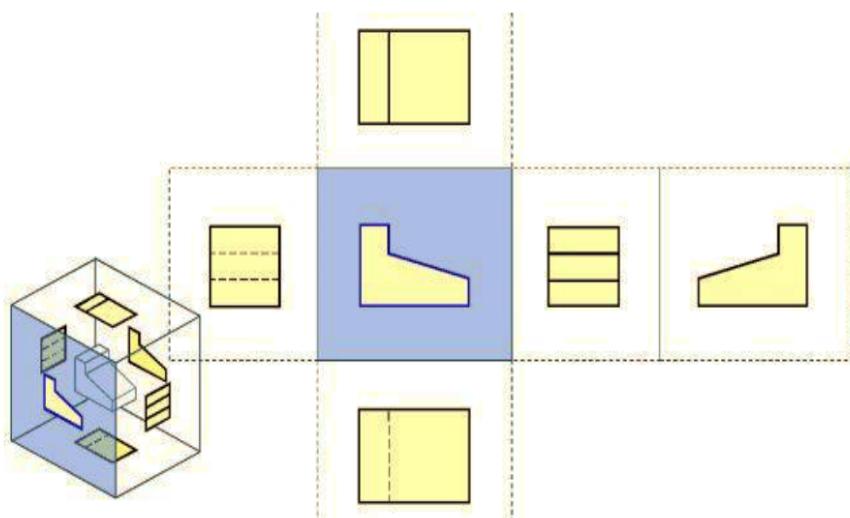
### ***Applications of orthographic drawing practice***

Orthographic drawings have many applications scattered across various fields that require planning and designing such as architecture, construction, design, engineering, environment, estate management, manufacturing, surveying, etc. Orthographic drawings are usually produced according to precision and requirements. It is possible for an orthographic drawing that has been produced in one country, to be used to manufacture an object in another country.

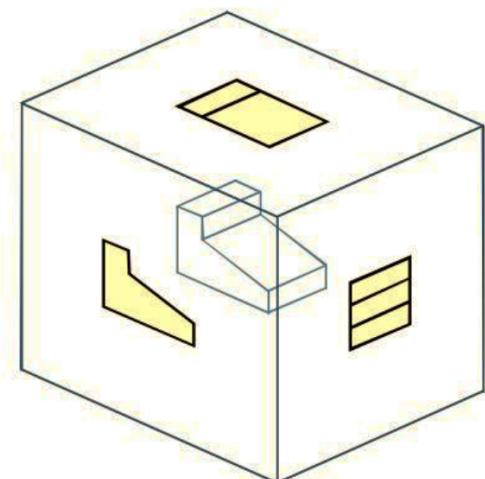
### ***Orthographic drawing shapes/objects for practice***

Like we said earlier: “practice makes perfect”. In order to strengthen your orthographic drawing skills, you may practice how to draw the views of the following objects:

*Third angle projection of an object with six views*

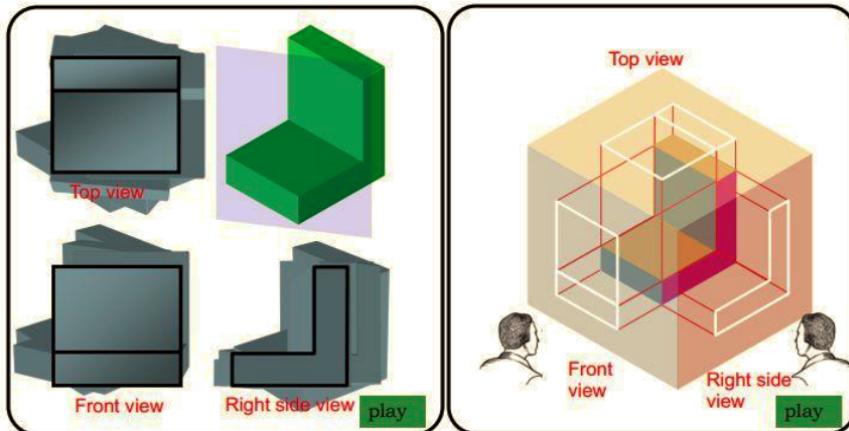


*Three commonly practiced orthographic views*

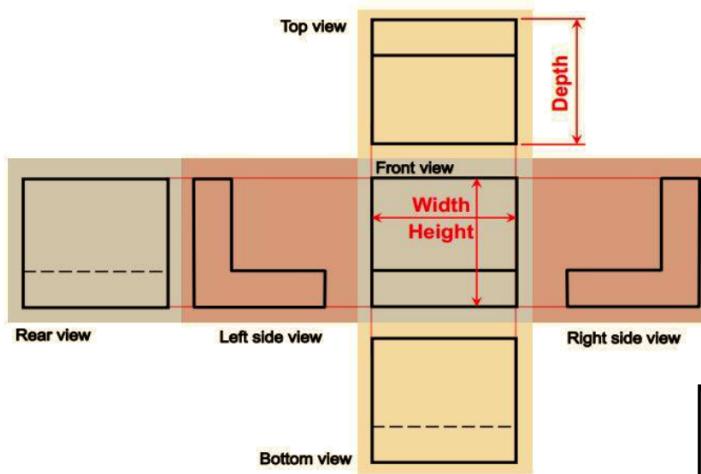


The three main 2D views, and six general 2D views of an L-shaped object can be seen in the images below.

*Three popular 2D views*



*Six views of the object*



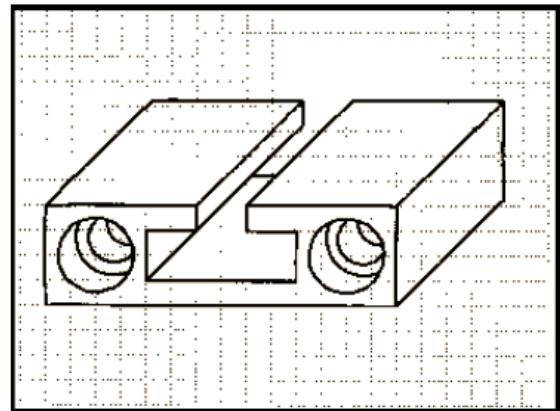
The use of colors makes it easier to understand, locate, and draw 2D views of 3D objects. With the aid of colors on objects, you can study and practice how to draw orthographic drawing.

## Oblique Drawing

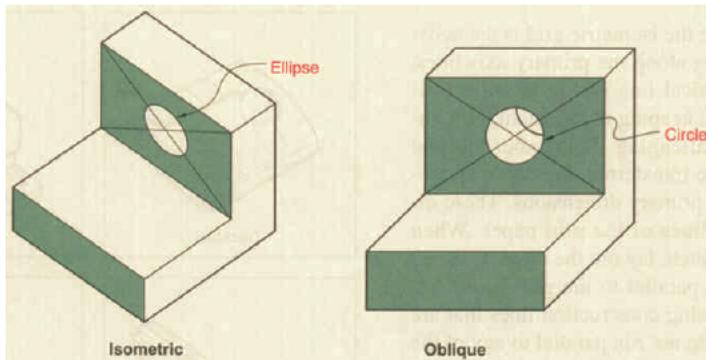
Oblique projection is a simple type of technical drawing of graphical projection used for producing two-dimensional (2D) images of three-dimensional (3D) objects.

The objects are not in perspective, so they do not correspond to any view of an object that can be obtained in practice, but the technique does yield somewhat convincing and useful images.

Oblique Projection of an object may be obtained by projecting the object with parallel projections that are oblique to the picture plane.



*An example of an Oblique Projection Drawing*



*Isometric Drawing versus an Oblique Drawing*

In oblique projection, the front face of the object appears in its true size and shape, as it is placed parallel to the picture plane. The receding lines representing the other two faces are usually drawn at  $30^\circ$ ,  $45^\circ$  or  $60^\circ$  to the horizontal,  $45^\circ$  being the most common practice.

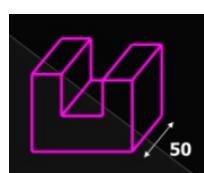
In oblique projection also, all lines that are parallel on the object appear parallel on the drawing and vertical lines on the object appear vertical

### Classification of Oblique Projection

Oblique projections are classified as cavalier, cabinet and general, depending on the scale of measurement followed along the receding lines.



**Cavalier Oblique** - an oblique drawing where in the receding side is scaled in actual size.



**Cabinet Oblique** - an oblique drawing where in the receding side is half the measurement of the actual size.



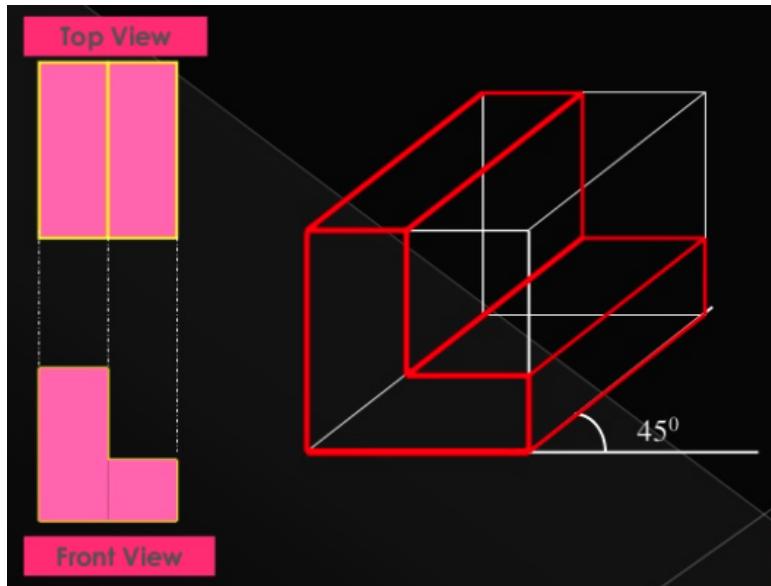
**General Oblique** - an oblique drawing where in the receding side is two-thirds of the scale of the actual size.

### Orientation of Oblique Drawing

<i>Circle Orientation</i>	<i>Arc Orientation</i>	<i>Curve Orientation</i>

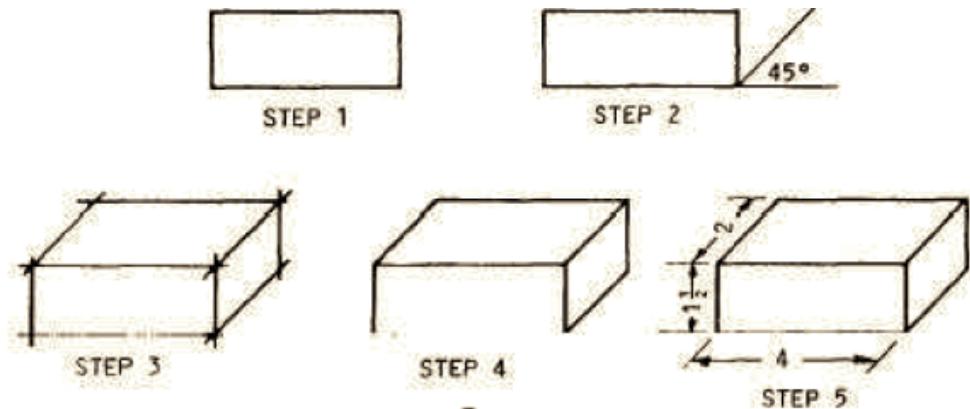
## **Methods of Drawing Oblique Projection**

*Construction of Oblique Drawing by Box method*



*Drawing an Oblique Projection*

Draw a 4" wide x 2" length x 1-1/2" height box in an Oblique Projection



Step 1: Draw the front face of the box parallel with the picture plane. This will be 4" wide and 1-1/2" high.

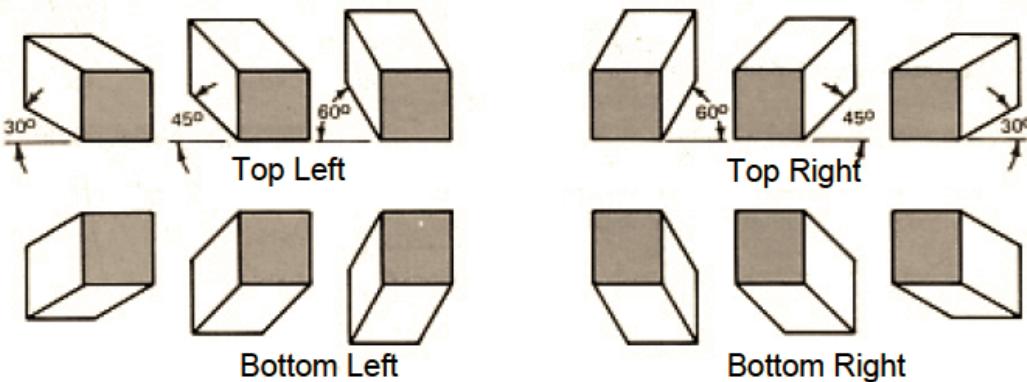
Step 2: Draw the side of the box back at a 45 degree angle. (You can draw it at 30 or 60 degrees as well). Measure along this line the depth of the box which is 2".

Step 3 and 4: Complete the remaining sides of the box and cleanup your lines.

Step 5: Your Oblique box is complete. Note the dimensions you have drawn the box at.

### *Angels of Projections in Oblique*

In oblique drawings, the three axes of projection are vertical, horizontal, and receding. The front view (vertical & horizontal axis) is parallel to the frontal plane and the other two faces are oblique (receding). The direction of projection can be top-left, top-right, bottom-left, or bottom-right. The receding axis is typically drawn at 60, 45, or 30 degrees



### *Circles, Arcs and ellipses in Oblique Drawings*

Step 1: Draw a vertical and horizontal centerline with the horizontal center line receding from the plane of projection.

Step 2: Construct a circle equal in diameter to the actual circle using as a center the intersection of the vertical and horizontal centerlines.

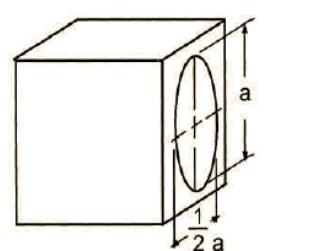
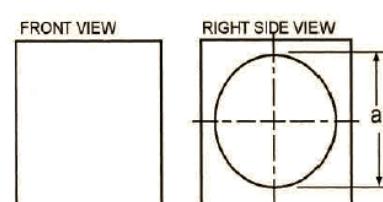
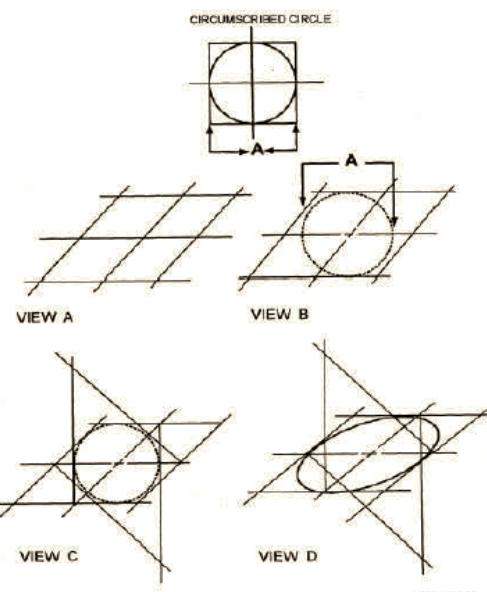
Step 3: The constructed circle will intersect each centerline at two points. From the two points on one centerline, draw two perpendiculars to the other centerline

Step 4: From the two points on the other centerline, draw two perpendiculars to the first centerline.

Step 5: From the intersection of the four perpendiculars, draw four circular arcs.

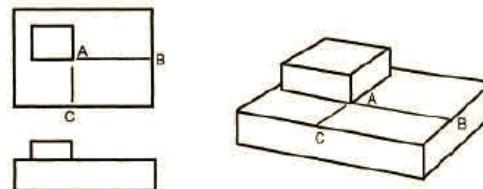
Step 6: Darken all outlines.

If you are drawing circles, arcs, or ellipses in an oblique cabinet projection, remember that the receding axis is reduced and you must reduce all measurements along the receding axis by the same scale.

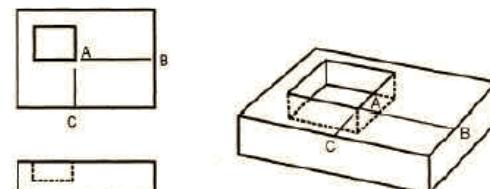


### Offset Measurements

Offset measurements are measurements or locations that are parallel to certain edges on the main surface of the object and remain parallel to the same edges after projecting to another view. When an object is drawn as a cavalier projection, all offset measurements may be drawn full scale. If the object is drawn as a cabinet projection where the receding axis is drawn in reduced scale, measurements parallel to the receding axis must be drawn to the same reduced scale



A  
B

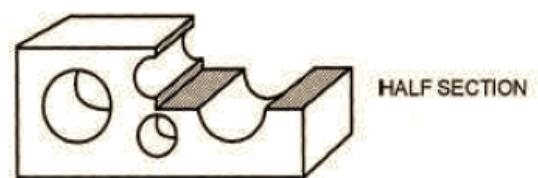
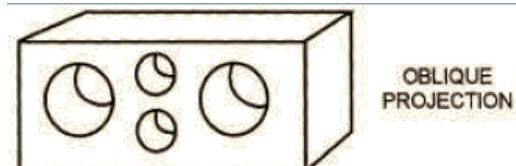


DIM2CH09T

### Sectioning Oblique Drawings

Sections in oblique projections are often used to show interior or hidden shapes. Oblique half sections where you remove only a quarter of the object is the most common section used because it shows so much more of the interior surface.

Oblique full sections where the plane of intersection passes completely through the object are seldom used.



### Choice of Position of the Object

For selecting the position of an object for drawing the oblique projection, the rules below are followed.

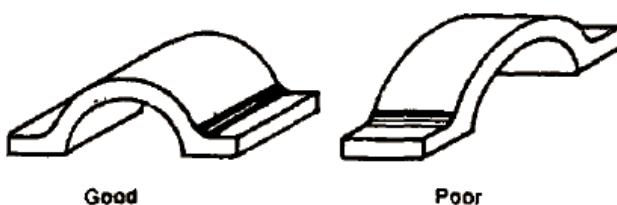
1. Place the most irregular face or the one with circular features parallel to the picture plane. This simplifies the construction and minimizes distortion.
2. Place the longest face parallel to the picture plane. This results in a more realistic and pleasing appearance of the drawing

### Isometric Drawing

An isometric drawing is a 3D representation of an object, room, building or design on a 2D surface.

One of the defining characteristics

of an isometric drawing, compared to other types of 3D representation, is that the final image is not distorted. This is due to the fact that the foreshortening of the axes is equal.



One way is to use an **isometric** view, which is derived from the Greek words iso, meaning equal, and metric, meaning measurement. When using an isometric view, you line up the drawing along three **axes** that are separated by 120-degree angles from each other. The three axes, or visible or invisible guidelines that establish directions for measurement, extend all the way to the edge of the paper or screen in both directions, forming 60-degree angles between the axes. Many of the lines in an isometric drawing will be parallel to one of the axes. Generally, every right angle on an isometric drawing will line up with at least two of the three axes.

### *A Third Dimension*

It is simple to draw a 2-dimensional object on paper because paper has two dimensions, height and width. But objects in real life have a third dimension, depth, which needs to be represented in the drawing. In isometric drawings, all three dimensions are represented on paper.

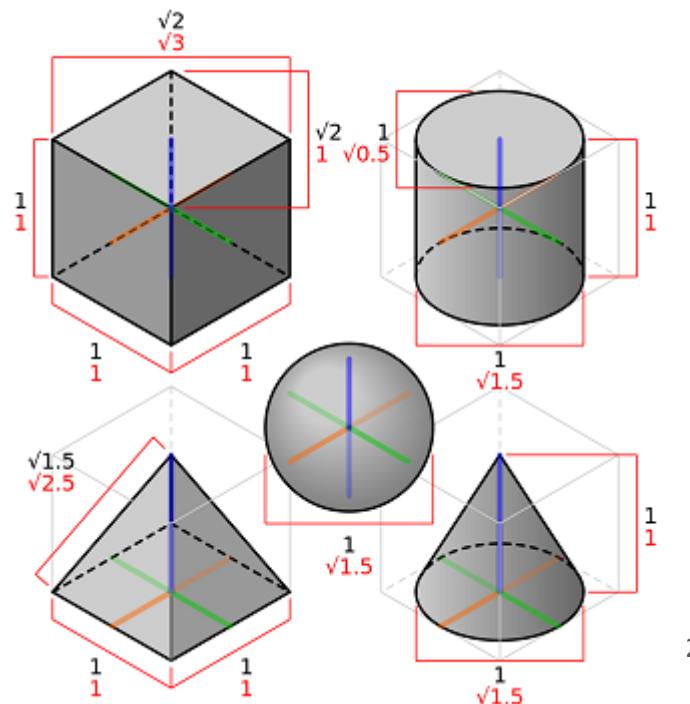
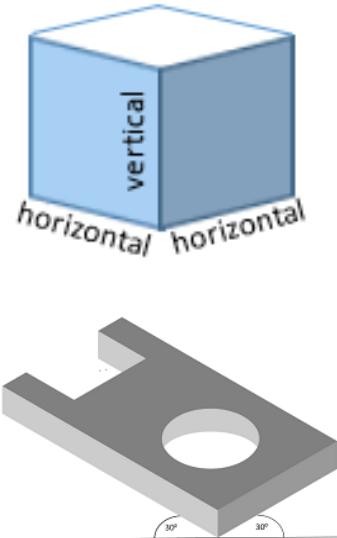
The three dimensions are represented as three axes: one vertical axis and two horizontal axes.

### *It's All about the Angles*

So what makes an isometric drawing different from other 3-dimensional drawings? The axes are drawn so that the two horizontal axes are drawn at 30 degree angles. It's as if the vertical axis is in its true position, but the horizontal axes are bent 30 degrees from their true position.

As you can imagine, it can be quite challenging to create isometric drawings of complex structures. There are software applications available that can accurately create isometric images. But if you want to draw it by hand, isometric drawing paper can be purchased or downloaded to make it much easier. It is similar to graph paper, except the horizontal lines are drawn at 30 degree angles to the vertical lines.

Right images are some examples of isometric drawings. Notice that each image shows three axes to represent each dimension of the object: the vertical axis is blue and two horizontal axes are drawn in orange and green.



## *Drawing an Object in Isometric View*

Let's look at how to draw an isometric view of a cube, such as you might find in dice or ice cubes. A cube has all right angles, so every line will be parallel to one of the three axes. As you can see in the figure below, the gold-colored lines follow the vertical axis, while the red and blue lines each follow one of the other axes:

You can use isometric paper, which has guidelines pre-drawn for you, or you can grab a protractor to help you get the angles right. To draw your cube, you can follow the numbered steps, which correspond to the axes of the cube in our figure.

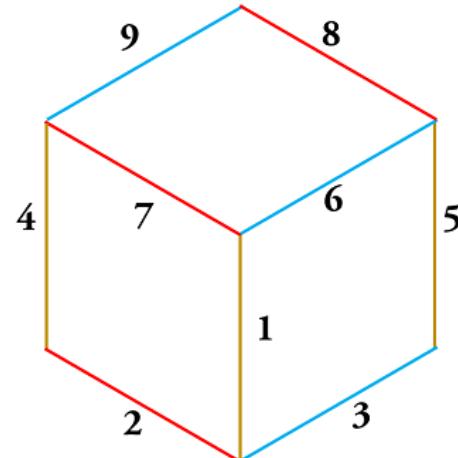
1. Draw the front vertical, two inches long, with the top of the line right in the center of the drawing.

2-3. Draw the bottom left and right edges, following the left and right axes (60 degrees to either side of the vertical).

4-5. Draw left and right verticals.

6-7. Draw the left and right top front edges, 30 degrees from horizontal.

8-9. Draw the left and right top back edges, 30 degrees from horizontal.



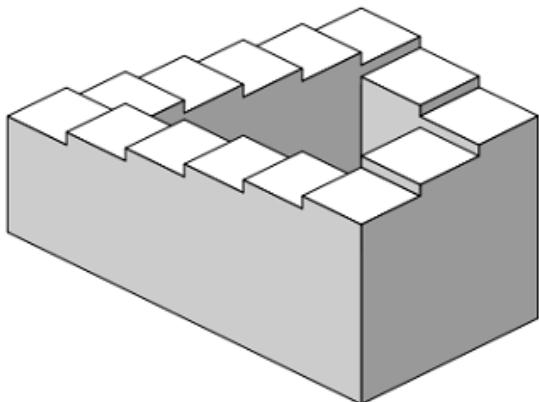
Isometric drawings can look really nice, but notice

how much the back corner of our cube seems to stick up. This is because of the difference between the isometric view and a view with more distance perspective. When you're looking at things that are far away, they look very small, and perspective drawings allow for that effect by making those lines shorter than lines in objects of the same size that are closer to you. Isometric drawings don't use that technique. They're designed to give accurate measurements, such as for machine drawings or some architectural drawings, but they have to give up some realism to do that.

Isometric drawings can only show certain sides of an object. Some machine drawings will give you views of every side of an object, but isometric drawings provide a view from only one direction. You can't see the hidden sides of the object. Let's look at some interesting isometric figures.

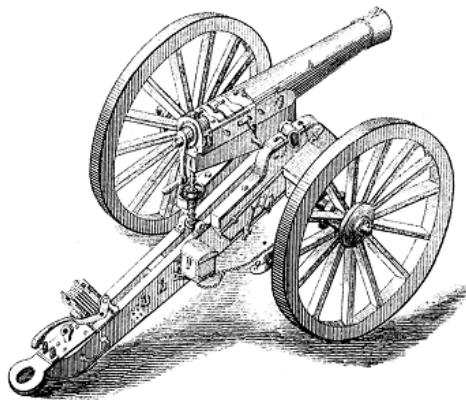
## *Other Isometric Figures*

More complex isometric figures can show us some surprising things. Since they do not obey the laws of horizon and vanishing point that our eyes and a camera display, they sometimes present illusions, visual effects that confuse the mind. For example, take a look at 'The Impossible Staircase' in the figure below:



If you imagine yourself climbing up or down the stairs, it looks like you could keep going around, forever and ever. You would never reach the end of the staircase. This is because of the way that isometric drawings can sometimes trick your eyes.

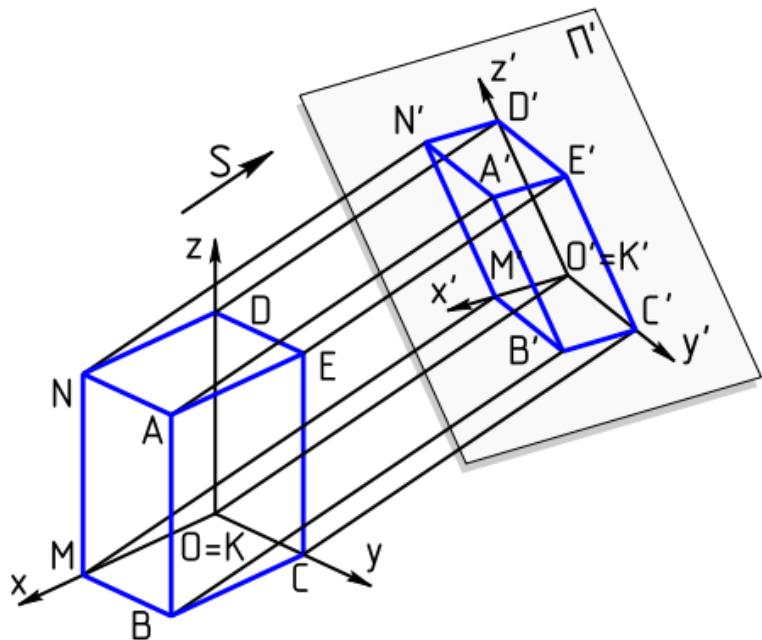
This next figure shows the 'Isometric Cannon':



You can see how some of the measurements, those not in line with one of the three axes, are shortened such as the way the circular wheels appear as ovals in the picture.

### Axonometric Drawing

Axonometric projection is a type of parallel projection used for creating a pictorial drawing of an object, where the object is rotated along one or more of its axes relative to the plane of projection.



There are three types of axonometric projection are isometric projection, dimetric projection, and trimetric projection, depending on the exact angle at which the view deviates from the orthogonal. Typically in axonometric drawing, as in other types of pictorials, one axis of space is shown as the vertical.

In isometric projection, the most commonly used form of axonometric projection in engineering drawing, the direction of viewing is such that the three axes of space appear equally foreshortened, and there is a common angle of  $120^\circ$  between them. As the distortion caused by foreshortening is uniform, the proportionality between lengths is preserved, and the axes share a common scale; this eases the ability to take measurements directly from the drawing. Another advantage is that  $120^\circ$  angles are easily constructed using only a compass and straightedge.

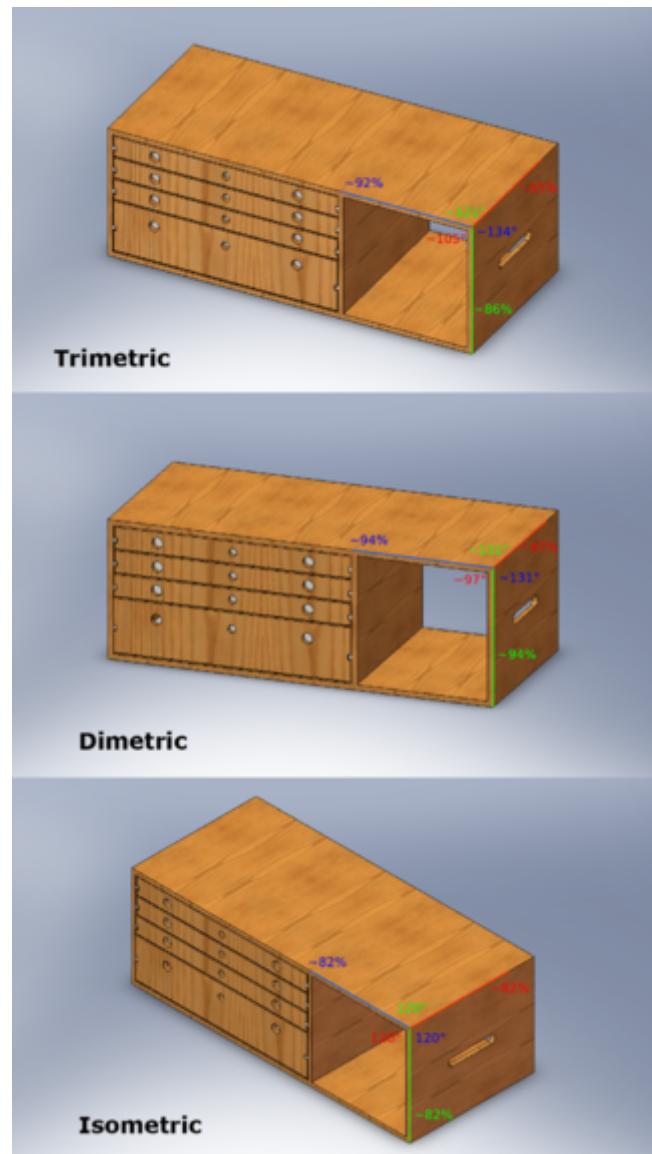
In dimetric projection, the direction of viewing is such that two of the three axes of space appear equally foreshortened, of which the attendant scale and angles of presentation are determined according to the angle of viewing; the scale of the third direction is determined separately.

Dimensional approximations are common in dimetric drawings.

In trimetric projection, the direction of viewing is such that all of the three axes of space appear unequally foreshortened. The scale along each of the three axes and the angles among them are determined separately as dictated by the angle of viewing. Dimensional approximations in trimetric drawings are common, and trimetric perspective is seldom used in technical drawings.

## Scale Drawing

All drawings can be classified as either drawings with scale or those not drawn to scale. Drawings without a scale usually are intended to present only functional information about the component or system. Prints drawn to scale allow the figures to be rendered accurately and precisely. Scale drawings also allow components and systems that are too large to be drawn full size to be drawn in a more convenient and easy to read size. The opposite is also true. A very



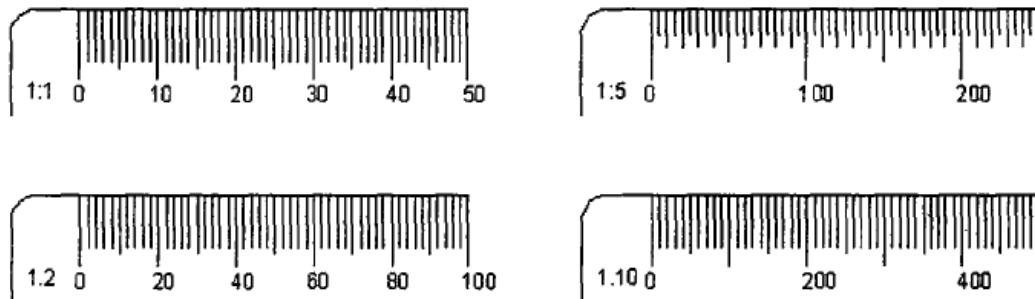
small component can be scaled up, or enlarged, so that its details can be seen when drawn on paper.

Scale drawings usually present the information used to fabricate or construct a component or system. If a drawing is drawn to scale, it can be used to obtain information such as physical dimensions, tolerances, and materials that allows the fabrication or construction of the component or system. Every dimension of a component or system does not have to be stated in writing on the drawing because the user can actually measure the distance (e.g., the length of a part) from the drawing and divide or multiply by the stated scale to obtain the correct measurements.

The scale of a drawing is usually presented as a ratio and is read as illustrated in the following examples.

- 1" = 1" Read as 1 inch (on the drawing) equals 1 inch (on the actual component or system). This can also be stated as FULL SIZE in the scale block of the drawing. The measured distance on the drawing is the actual distance or size of the component.
- 3/8" = 1' Read as 3/8 inch (on the drawing) equals 1 foot (on the actual component or system). This is called 3/8 scale. For example, if a component part measures 6/8 inch on the drawing, the actual component measures 2 feet.
- 1/2" = 1' Read as 1/2 inch (on the drawing) equals 1 foot (on the actual component or system). This is called 1/2 scale. For example, if a component part measures 1-1/2 inches on the drawing the actual component measures 3 feet.

Note: For all drawings the scale has to be mentioned without fail



### Representative Fraction

The ratio of the dimension of the object shown on the drawing to its actual size is called the Representative Fraction (RF).

$$RF = \frac{\text{Drawing size of an object}}{\text{Its actual size}} \text{ (in same units)}$$

For example, if an actual length of 3 metres of an object is represented by a line of 15mm length on the drawing

$$RF = \frac{15\text{mm}}{3\text{m}} = \frac{15\text{mm}}{(3 \times 1000)\text{mm}} = \frac{1}{200} \text{ or } 1:200$$

If the desired scale is not available in the set of scales it may be constructed and then used.

## Metric Measurements

- 10 millimetres (mm) = 1 centimetre( cm)
- 10 centimetres (cm) = 1 decimetre(dm)
- 10 decimetre (dm) = 1 metre(m)
- 10 metres (m) = 1 decametre (dam)
- 10 decametre (dam) = 1 hectometre (bm)
- 10 hectometres (bm) = 1 kilometre (km)
- 1 hectare = 10,000 m<sup>2</sup>

## Area

$$1 \text{ hectare} = 10000 \text{ m}^2$$
$$1 \text{ m}^2 = 10^4 \text{ cm}^2$$

## Volume

$$1 \text{ m}^3 = 10^6 \text{ cm}^3$$

## Type of Scales

The types of scales normally used are:

1. Plain scales - for dimensions up to single decimal
2. Diagonal Scales - for dimensions up to two decimal
3. Vernier Scales - for dimensions up to two decimal
4. Comparative Scales - for comparing two different units
5. Scale of Chords - for measuring / constructing angles

### Plain Scales

A plain scale is simply a line which is divided into a suitable number of equal parts, the first of which is further subdivided into small parts. It is used to represent either two units or a unit and its fraction such as km and bm, m and dm, cm and mm etc.

#### Example Problem of Plain Scale

On a survey map the distance between two places 1 km apart is 5 cm. Construct the scale to read 4.6 km.

$$\begin{aligned} \text{R.F} &= \frac{5 \text{ cm}}{1 \times 1000 \times 100 \text{ cm}} \\ &= \frac{1}{20000} \end{aligned}$$

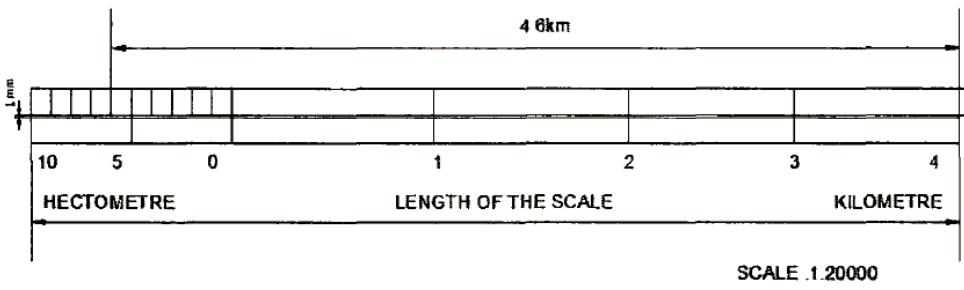
If x is the drawing size required  $x = 5 (1000)(100) \times \frac{1}{20000}$

Therefore,  $x = 25\text{cm}$

Note: If 4.6 km itself were to be taken  $x = 23 \text{ cm}$ . To get 1 km divisions this length has to be divided into 4.6 parts which is difficult. Therefore, the nearest round figure 5 km is considered.

When this length is divided into 5 equal parts each part will be 1 km.

1. Draw a line of length 25 cm.
2. Divide this into 5 equal parts. Now each part is 1 km.
3. Divide the first part into 10 equal divisions. Each division is 0.1 km.
4. Mark on the scale the required distance 4.6 km.



*Diagonal*

### Scale

Diagonal scales are used to represent either three units of measurements such as metres, decimetres, centimetres or to read to the accuracy correct to two decimals.

The principle of construction of a diagonal scale is as follows.

1. Draw a line AB and erect a perpendicular at B.
2. Mark 10 equi-distant points (1,2,3, etc) of any suitable length along this perpendicular and mark C.
3. Complete the rectangle ABCD
4. Draw the diagonal BD.
5. Draw horizontals through the division points to meet BD at 1', 2', 3' etc.

Considering the similar triangles say BCD and B44'

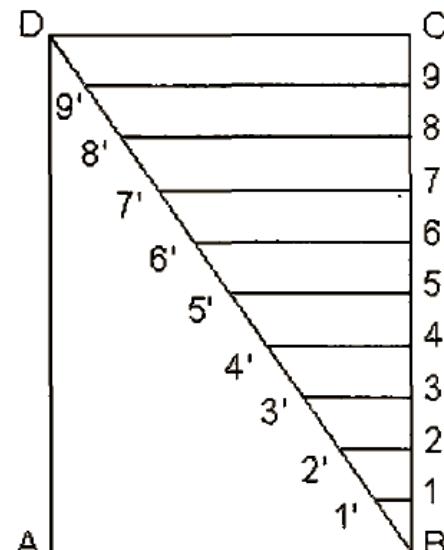
$$= \frac{B4'}{CD} = \frac{B4}{BC} ; = \frac{4}{10} \times BC \times \frac{1}{BC} = \frac{4}{10} ;$$

$$44' = 0.4 CD$$

Thus, the lines 1'-1', 2'-2', 3'-3' etc., measure 0.1CD, 0.2CD, 0.3CD etc. respectively. Thus, CD is divided into 1110 the divisions by the diagonal BD, i.e., each horizontal line is a multiple of 1/10 CD.

This principle is used in the construction of diagonal scales.

Note: BC must be divided into the same number of parts as there are units of the third dimension in one unit of the secondary division.



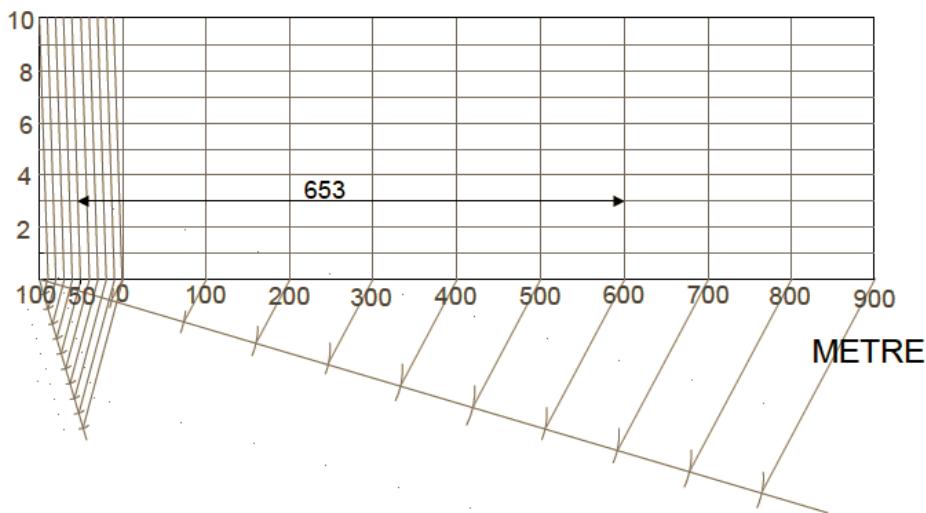
### Example Problem of Diagonal Scale

Problem: Construct a diagonal scale of R.F. = 1/6250 to read up to 1 kilometre and to read metres on it. Show a length of 653 metre on it.

$$RF = \frac{1}{6250}, \text{ Max Length} = 1 \text{ km}$$

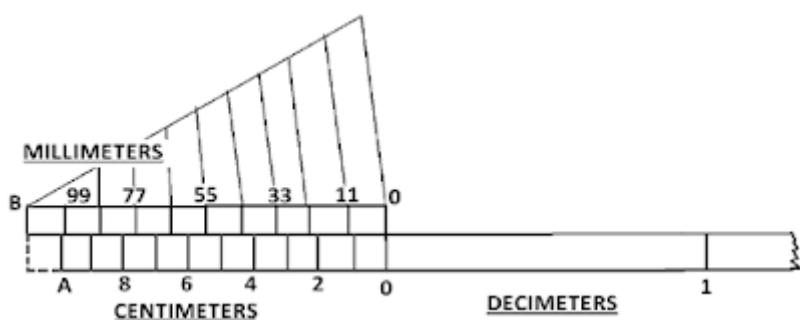
$$LOS = RF \times \text{Max Length in cm} = \frac{1}{6250} \times 1 \times 10^5 \text{ cm} = 16 \text{ cm}$$

*Hint: As the maximum length is 1km, the line should be divided into 10 equal parts, so as to represent a division of 100cm.*



### Vernier Scales

A tool used to measure fractional part of one of smallest divisions of a graduate scale. It generally consists of a little auxiliary scale which slides next to the major scale. Slightest count of the vernier = the difference between smallest division on major division and smallest division on vernier scale.



The smallest division on the main scale and vernier scale are 1 msd or 1 vsd respectively.

Generally  $(n+1)$  or  $(n-l)$  divisions on the main scale are divided into  $n$  equal parts on the vernier scale.

$$\text{Thus, } 1 \text{ vsd} = \frac{(n-1)}{n} \text{ msd or } \left(1 - \frac{1}{n}\right) \text{ msd}$$

When  $1 \text{ vsd} < 1$  it is called forward or direct vernier. The vernier divisions are numbered in the same direction as those on the main scale.

When  $1 \text{ vsd} > 1$  or  $(1 + \text{lin})$ , It is called backward or retrograde vernier. The vernier divisions are numbered in the opposite direction compared to those on the main scale.

The least count (LC) is the smallest dimension correct to which a measurement can be made with a vernier.

For forward vernier,  $LC = (1 \text{ msd} - 1 \text{ vsd})$

For backward vernier,  $LC = (1 \text{ vsd} - 1 \text{ msd})$

#### *Example Problem of Vernier Scale*

Construct a forward reading vernier scale to read distance correct to decameter on a map in which the actual distances are reduced in the ratio of  $1 : 40,000$ . The scale should be long enough to measure upto 6 km. Mark on the scale a length of 3.34 km and 0.59 km.

#### **Solution**

$$1. RF = \frac{1}{40000}; \text{ length of drawing} = \left( \frac{6 \times 1000 \times 100}{40000} \right) = 15 \text{ cm}$$

2. 15 cm is divided into 6 parts and each part is 1 km

3. This is further divided into 10 divisions and each division is equal to  $0.1 \text{ km} = 1 \text{ hectometre}$ .

$$1 \text{ msd} = 0.1 \text{ km} = 1 \text{ hectometre}$$

$$L.C \text{ expressed in terms of msd} = (1/10) \text{ msd}$$

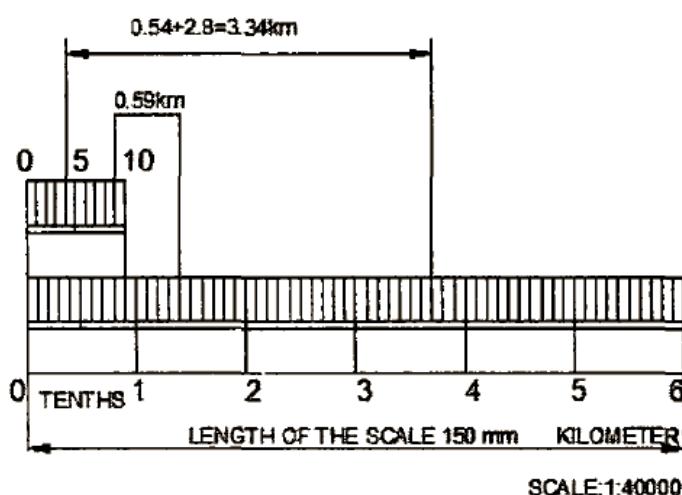
$$L.C \text{ is } 1 \text{ decametre} = 1 \text{ msd} - 1 \text{ vsd}$$

$$1 \text{ vsd} = 1 - 1110 = 9110 \text{ msd} = 0.09 \text{ km}$$

4. 9 msd are taken and divided into 10 divisions as shown. Thus  $1 \text{ vsd} = 9110 = 0.09 \text{ km}$

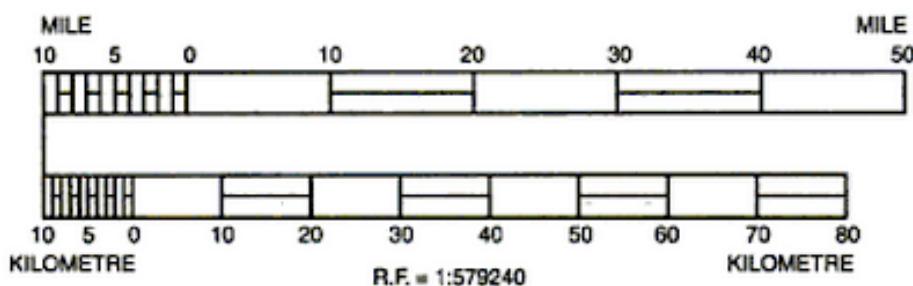
5. Mark on it by taking  $6 \text{ vsd} = 6 \times 0.9 = 0.54 \text{ km}$ ,  $28 \text{ msd} (27 + 1 \text{ on the LHS of 1}) = 2.8 \text{ km}$  and Total  $2.8 + 0.54 = 3.34 \text{ km}$ .

6. Mark on it  $5 \text{ msd} = 0.5 \text{ km}$  and add to it one vsd =  $0.09$ , total  $0.59 \text{ km}$  as marked.



### **Comparative Scale**

Comparative scales are scales by similar representative fraction but graduate to examine dissimilar units. A map or a drawing drawn by a scale reading miles and furlongs can be calculated off directly in kilometers and hectometers through a comparative scale constructed by the same representative fraction. Comparative scales can be constructed as plain scales or diagonal scales depending upon necessity.



### **Scale of Chords**

In absence of a protractor, a scale of chords can be used to calculate angle or to set necessary angle. The construction is based on lengths of chords of angles measured on the similar arc.

Draw a straight line PQ of any length and mark a point O on its centre.

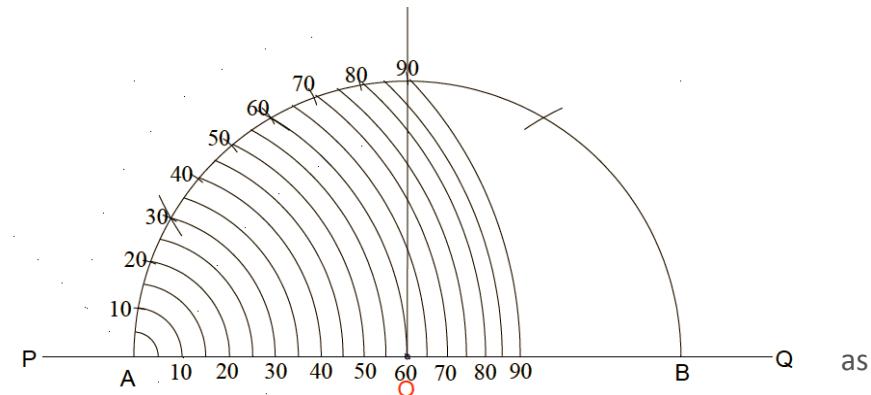
Draw a semicircle on the line PQ, with O as centre and OA as radius to intersect PQ at AB.

With A as centre and OA radius, cut an arc on the semicircle.

Similarly with B as centre and OB as radius, cut an arc on the semicircle.

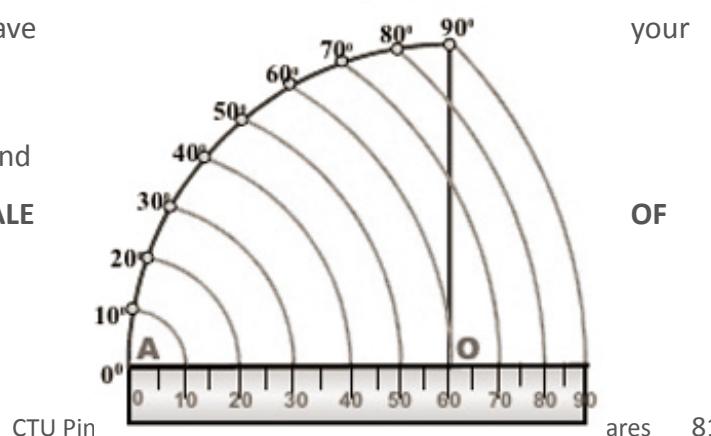
Now with these new points of intersections as centers, draw two arcs to intersect each other above O.

Join this point with O to get perpendicular at O



From the above drawing you can now have scale of Chords.

As chord lengths are used to measure and construct different angles it is called **SCALE OF CHORDS.**



### Example Problem of Scale of Chords

#### CONSTRUCTION:

**First** prepare the Scale of Cords for the problem.

**Then** construct a triangle of given sides. ( You are supposed to measure angles x, y and z)

#### To measure angle at x:

**Take** O-A distance in compass from cords scale and mark it on lower side of triangle as shown from corner x. Name O & A as shown. Then O as center, O-A radius draws arc upto upper adjacent side. Name the point B.

**Take** the A-B chord in the compass and place it on a scale of chords from Zero.

It will give value of angle at x

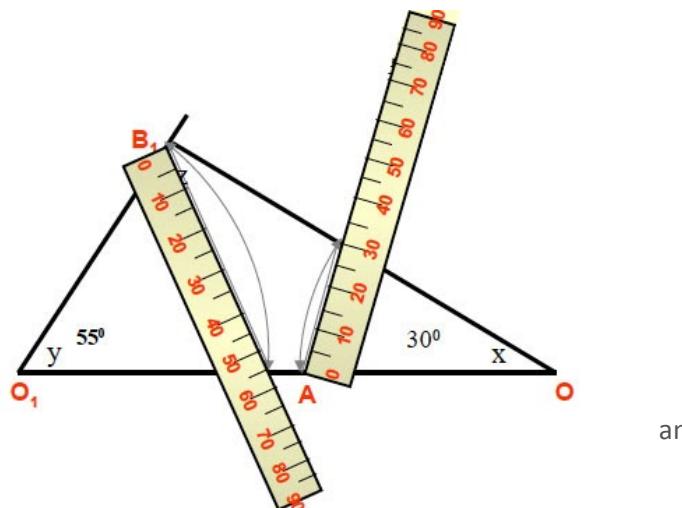
#### To measure angle at y:

**Repeat** the same process from O<sub>1</sub>. Draw arc with radius O<sub>1</sub>A<sub>1</sub>.

**Place** Cord A<sub>1</sub>B<sub>1</sub> on scale and get angle at y.

#### To measure angle at z:

**Subtract** the SUM of these two angles from 1800 to get angle at z.



## Introduction to Computer Aided Design Drawing (CADD)

CADD is an electronic tool that enables us to make quick and accurate drawings with the use of a computer. Drawings created with CADD have a number of advantages over drawings created on a drawing board. CADD drawings are neat, clean and highly presentable. Electronic drawings can be modified quite easily and can be presented in a variety of formats. There are hundreds of CADD programs available in the CADD industry today. Some are intended for general drawing work while others are focused on specific engineering applications. There are programs that enable you to do 2D drawings, 3D drawings, renderings, shadings, engineering calculations, space planning, structural design, piping layouts, plant design, project management, etc.

### Examples of CAD software

- AutoCAD, PRO/Engineer, IDEAS, UNIGRAPHICS, CATIA, Solid Works, etc.

### History of Computer Aided Design

In 1883 Charles Barbage developed the idea for computers. First CAD demonstration is given by Ivan Sutherland (1963). A year later ruM produced the first commercial CAD system. Many changes have taken place since then, with the advancement of powerful computers, it is now possible to do all the designs using CAD including two-dimensional drawings, solid modeling,

complex engineering analysis, production and manufacturing. New technologies are constantly invented which make this process quicker, more versatile and more Powerful.

### Advantages of CAD

- Detail drawings may be created more quickly and making changes is more efficient than correcting drawings drawn manually.
- It allows different views of the same object and 3D pictorial view, which gives better visualization of drawings
- Designs and symbols can be stored for easy recall and reuse.
- By using the computer, the drawing can be produced with more accuracy.
- Drawings can be more conveniently filed, retrieved and transmitted on disks and tape.
- Quick Design Analysis, also Simulation and Testing Possible.

