

Topic: Design Techniques

A Mechanical Perspective System

by Arthur Dirks

The following perspective system is the product of a two-day research binge on perspective drawing systems when I just had to know how something *really* would look in space. The system below is drawn from those systems and may have parts of many or even all of one – I don't pretend it is original, I just don't remember what the original was. This is simply how I understand it, and it works.

Those working in CAD can produce a 3-dimensional wire frame from a digital ground plan if they are proficient in the software. There is likely to remain for some time a need for manual drafting that can visualize in accurate scale, particularly by those who are not routine CAD users. It is particularly valuable for those who are more accustomed to direct art methods and need a wire frame for accurate proportion.

The basic concept

What follows is to remind you how it works the next time you use it. This may make little sense at first:

There are three pieces of information you need about an object on a stage floor: for a particular point on that object, its apparent distance stage *left and right*, apparent *height*, and apparent *depth*. Apparent distance left and right is simple: sight them from an observation point through a picture plane in plan view. Depth is more difficult, because you must imagine an infinite wall like the infinite floor. Points of depth can be carried over and marked on the infinite wall in plan view, and that mark may be sighted through the picture plane from an observation point. Heights are not represented in a plan view and must be specified. In the perspective view, since all measurements are real at the picture plane, lines of height can be traced along the infinite wall toward the center vanishing point on the horizon. The appearance of the depth mark can be established along the infinite wall in the perspective view, and it's corresponding apparent or perspective height would be found in the line of height above.

These principles hold for thrust or arena staging, as well as proscenium, because a picture plane can be established anywhere between an observation point and an object. Indeed, the application need not be for theatre, although this guide assumes use for scenic design.

Preparation

- A drawing board with substantial depth of drawing space.

- An expendable ground plan in the largest practical scale. It will be marked on.
- Supporting information regarding appearance –planned height of design elements, sketches, research, theatre facility data.
- Durable tracing paper
- Very sharp pencils (consider lead holders with 4h or harder leads, and a good pointer)
- Fine felt-point pen
- Soft eraser, cleaning powder
- Scale, triangles, square, board, brush, etc.

For purposes of this guide, we are assuming a ground plan in half-inch scale (1/2"=1'-0") and an observation point of 30' from curtain line. The tracing paper is 18"x24".

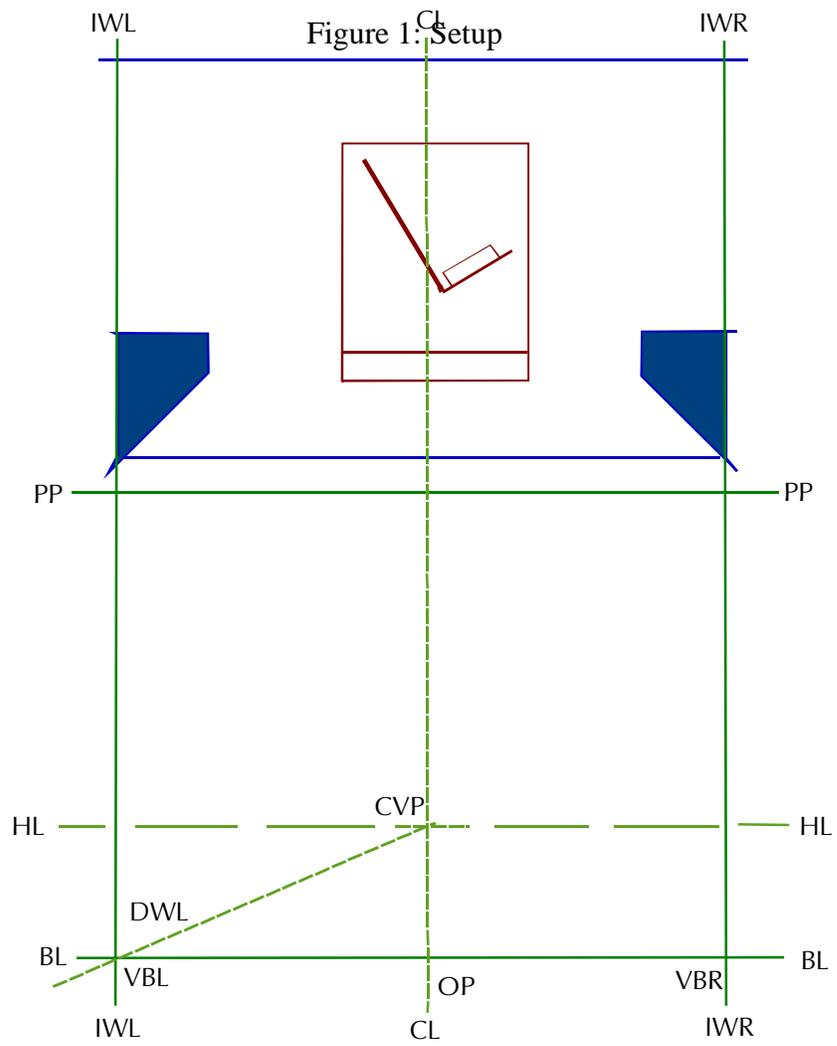
Setup

The paper may be taped out vertically or horizontally, depending on the width of the plan and the value of horizon vanishing points (I prefer horizontal). There will be two overlapping sections of the drawing, the *plan view* and the *perspective view*. The overlap may be confusing at first, but try to follow and understand when you are working with the *plan* and when with the *perspective*.

For the first few times, label the elements with the abbreviations shown.

1. Tape out the paper low on the board.
2. Establish a *centerline (CL)*. Ink it top to bottom. This will serve both the plan and the perspective.
3. Establish the *base line (BL)*. This is a horizontal line just above the line of comfort working at the bottom of the page (for me about 3" above the bottom edge). It is primarily a perspective element, and represents the bottom of the perspective view of the picture plane. Ink it all across.
4. Where it intersects the centerline, establish a point as the *observation point (OP)*. Note that this is a plan element and can be established anywhere along centerline. We set it on the base line (BL) because we don't want it to wind up in the middle of the perspective (as it is in some of the accompanying illustrations).
5. Establish the *horizon line (HL)*. It is a perspective element and is measured up from the from the base line (BL). Ink it all across. From your ideal seat, how high is your head above the stage floor? In particularly flat houses, a low angle view may be accurate but gives less three-dimensional information than a slightly raised angle. For a flat house, a 6'-0" horizon is not too distorted, while a raked house could use a higher horizon. Note that the top of six-foot-tall objects, including actors, always will be at a 6-foot horizon line, no matter where it is on the stage.

6. Establish the *center vanishing point (VPC)*. This perspective element is precisely at the intersection of the centerline (CL) and the horizon line (HL).
7. Mark the *observation distance* along the centerline up from the observation point (OP). It is plan element. For this guide the distance is 30 scale feet (15”).
8. Place the ground plan under the tracing paper so that the point just marked, the observation distance, is exactly over the centerline and plaster line (or set line) in the ground plan. Do not move tracing. Using triangles and square, be certain the centerline of the plan exactly matches and extends the centerline on the tracing. In most cases, only a little of the plan will fit under the tracing, but it should remain on the board. Tape it firmly. [The alternative in simple situations is to turn the paper vertically and draft the basic plan at the top.]
9. On the tracing paper over the plan, establish the *picture plane (PP)*. Typically, this plan element lies at the leading edge of the set, apron or other elements to be included in the perspective, and is represented by a horizontal line. Ink it all across. Note that the closer the picture plane is to the observation point (OP), the smaller the perspective view will be. It should be placed as far as practical from the observer. If plan elements do project through the picture plane (PP), their positions will be sighted back upward to the picture plane (PP), and may be marked outside the infinite wall.
10. Establish the *infinite wall left (IWL)* and *infinite wall right (IWR)*. These plan elements are vertical lines at the right and left extremes of what is to appear in the perspective view. Ink them top to bottom, and on the plan itself where it is not covered by the tracing paper. At the bottom these lines become perspective elements as the left and right edges of the perspective view of the picture plane (PP). The bottom edge of the perspective view is represented by the base line (BL).
11. In the perspective view mark the intersection of base line (BL) with infinite wall left (IWL) as *view base left (VBL)*, and with infinite wall right (IWR) as *view base right (VBR)*. These are perspective elements.
12. In the perspective view, establish the *depth wall left (DWL)* and *depth wall right (DWR)* as lines from the view base left (VBL) and view base right (VBR) on the baseline, to the center vanishing point (CVP) on the horizon line (HL). Ink these lines.



Establishing a point.

13. Select a point on the ground plan. Using a pencil, place a precise dot on the plan and mark it **A**. For purposes of this guide, select a point to the left of centerline (CL).
14. Using the square and pencil, rule it over or simply mark its depth point on the nearest infinite wall (in this case infinite wall left or IWL). Mark that point **A'** (A prime) in pencil.
15. Lay a long ruler as a sightline from the observation point (OP) to the plan point A. Mark the intersection with the picture plane (PP) as **A** in pencil.
16. Lay the ruler as a sightline from the observation point (OP) to the depth mark **A'** on the infinite wall (in this case IWL). Mark the intersection with the picture plane (PP) as **A'** in pencil. It is useful to distinguish between the two marks on the picture plane (PP), perhaps giving the depth mark more length or a tail, as well as a point label.

Distance left and right

17. Locate mark **A** on the picture plane (PP) and using a pencil, carry that point down into the perspective view. A vertical mark in the perspective space is sufficient. This is the apparent position left and right.

Point of depth

18. Locate mark **A'** on the picture plane (PP) and using a pencil, carry that point down into the perspective view. Show it as a vertical mark on the depth wall left or right (in this case DWL) and mark it as **A'**. This is the perspective view or apparent position of the **A'** mark on the infinite wall in the plan view above.
19. With the square, carry the new **A'** mark over into the space to intersect with the **A** mark indicating distance left and right. This is the apparent position of plan point **A** on the stage floor.

Point of height

20. For purposes of this guide, we specify that plan point **A** is 2'-0" above the stage floor. All measurements at the picture plane (PP) are real; that is, not in perspective. The baseline (BL) and infinite walls left and right (IWL, IWR) form edges of the perspective view of the picture plane (PP), and measurements along them are also real. To establish a ***line of height*** along the infinite wall, measure up from the view base left or right (in this case VBL) and mark the real height of the point above the floor (in this case 2'-0").
21. Rule in pencil from the height point to the center vanishing point (VPC). This is the ***line of height (LOH)***.

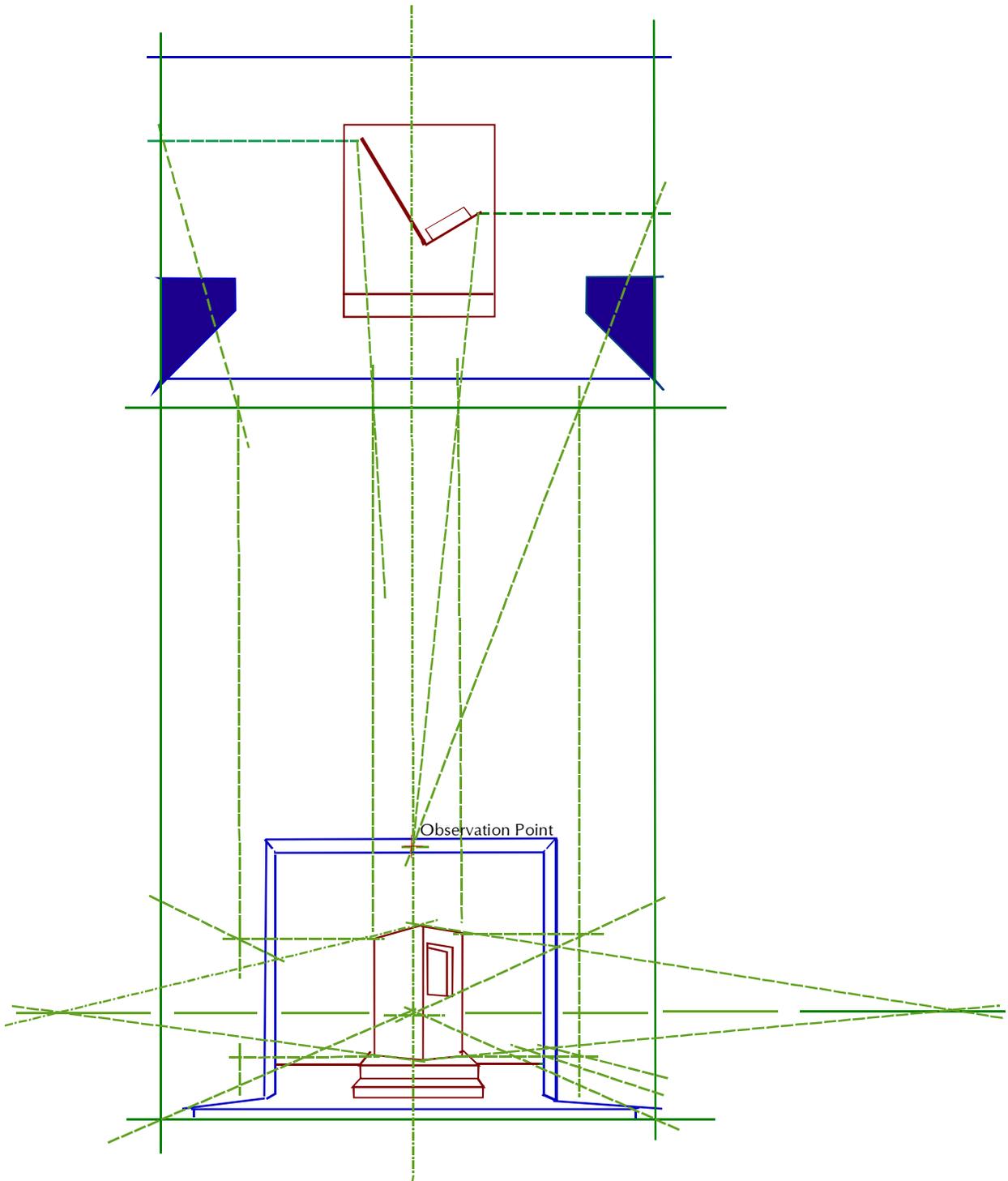
22. Find point **A'** on the depth wall (DWL), and carry it up to intersect with the line of height (LOH). Mark it as **A'2**.
23. With the square, carry the new **A'2** mark over into the space to intersect with the **A** mark indicating distance left and right. This is the apparent position of plan point **A** at 2'-0" above the stage floor.
24. Once established, the marks along the infinite wall, the picture plane, and the depth wall can be erased to avoid confusion with other points to be established (the reason for inking them).

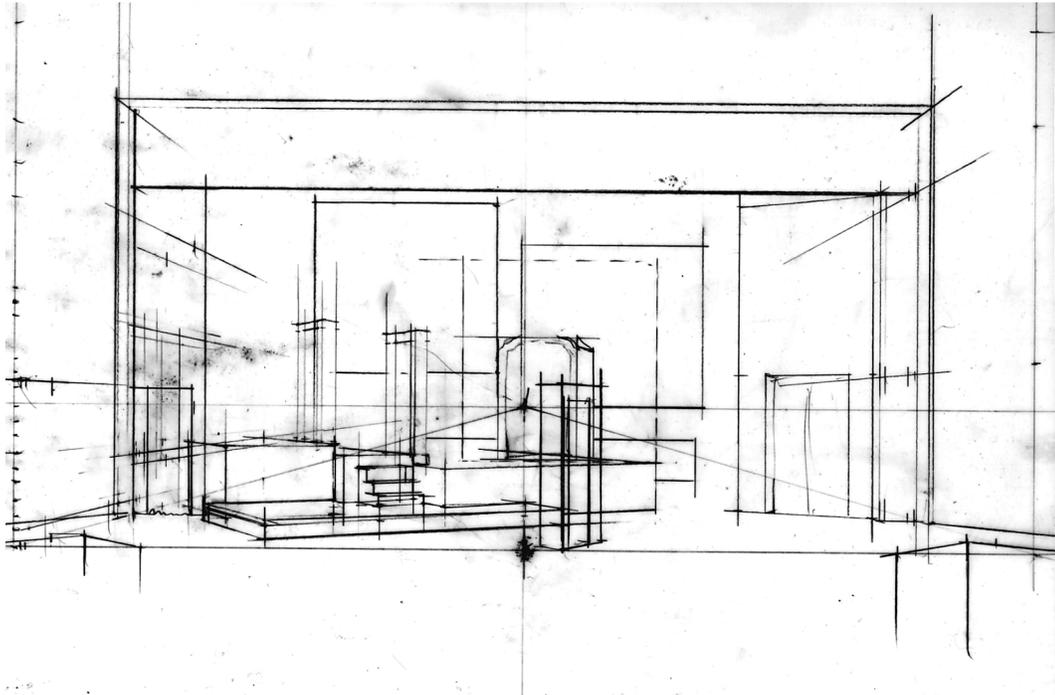
Using horizon vanishing points

- Note: All parallel lines and planes converge and vanish at the same point on the horizon. This is particularly useful when an object contains many parallel edges, such as a step unit or a wall with many horizontal window or trim lines.
- A line between any two points can be extended to intersect with the horizon. In many cases the intersection, or vanishing point, will be off the paper. Given sufficient board space, additional paper or a piece of drafting tape can be placed along an extended horizon line to permit marking the vanishing point.
- Two more points can establish a second parallel line that can be extended to confirm the vanishing point.
- All other lines parallel to the two established lines can be drawn using the vanishing point, reducing the need for some calculated points of height or depth.

Finishing

1. On the resulting wire frame, rule significant lines in ink. You will not trace these lines but use them to guide drawing. Graphite transfers to the back of the tracing paper.
2. Cover the wire frame with tracing paper and tape down. Immediately mark alignment references (CL, HL, BL).
3. Sketch and draw the design over the wire frame.





Typical wire frame