A DEVICE FOR DEMONSTRATING ORTHOGRAPHIC PROJECTION

Author
Ralph Insinger
The University of Michigan, School of Art
2000 Bonisteel Boulevard
Ann Arbor, Michigan 48109

Keywords Visualization, Mechanical Drawing, Design Process

Category Technology
Type Class Assignment
Level Sophomore
Duration 3-4 Weeks

Abstract

A transparent cube has been fabricated, into which objects can be placed and then traced onto the cube's sides. Built with edges, which either hinge or separate, the cube can be unfolded into a plane. By projecting the object's form to each grid on the cube's sides, all dimensional coordinates of the object can be related and measured in any view.

Objectives

A course in visualization is offered to engage the student in mechanical drawing as a means of thinking visually and communicating ideas graphically. In contrast to teaching how to design, it builds the skills, which support the design process through the various stages of development. Beginning with basic drafting conventions, the work proceeds to perceiving and describing points, lines, planes, and solids in space. Describing such features in space requires identifying spatial coordinates (X = length, Y=depth, and Z = height) which can be given specific dimensions. Orthographic projection is a drafting system for that purpose, using parallel and perpendicular lines to illustrate multi-views of an object with given coordinates, which are then assigned actual dimensions. Since orthographic projection is the only graphic system for drawing objects with true form and dimensions which can be tied to precise coordinates in space, it is imperative that the student be informed about the origin of the views and their respective spatial placement.

When viewing an object, an imaginary transparent box can be visualized around it. Each side of the transparent box is actually like a picture plane upon which images of the object can be projected. Dimensions of the object can be transposed to the "picture planes" and measured there with the help of a 1" grid applied to the sides of the box. The entire object can be described from all views (Horizontal, Frontal and Profile), and when the sides of the box are swung around, one sees the direct relationship of the three-dimensional object's form to its two-dimensional image.

Criteria

In our three-dimensional world we conventionally describe objects by their length, depth and height. Designers, architects, draftspersons, etc., who use graphic methods to express ideas, are challenged to create two-dimensional images that represent three-dimensional objects. They must visualize objects during ideation and document those ideas, quite frequently using orthographic projections to accomplish this. Designs that will ultimately be realized require exact descriptions by the creator to aid other individuals who will participate in producing them.

Students aspiring to any of the disciplines noted above must acquire the skills to describe their work visually. Difficult as it is to relate three-dimensional vision with a two-dimensional medium, it is enormously more difficult for the student novice to understand the abstract process one goes through to get accurate results. For that reason it is compelling in the teaching process to develop a device that illustrates the procedure of converting a three-dimensional object orthographically to specific drawings, and establishing actual dimensions.In its simplest application, with perfectly level or plumb objects, the device can provide considerable assistance in understanding positions of coordinates from front to back. However, its greatest use is evident when considering auxiliary views or oblique positions, which appear foreshortened. The ability to see the reorientation to the picture plane is vital to defining the actual coordinates of sloped lines and planes. Students have such ability with this device.

Process

A transparent plexiglass cube measuring 12" on each edge must be assembled. The primary faces are Horizontal (top), Frontal (front) and Profile (right side). The secondary faces are the rear, bottom and left side. A 1" x 1" grid is scored or drawn with permanent marker on the Horizontal, Frontal and Profile faces of the plexiglass. The cube edges between the Frontal-Horizontal and the Frontal-Profile must be fitted with hinges to permit swinging those sides about, to form a plane surface made up of the three faces. The other edges can be fitted with hinges or clips, providing that they are capable of easy separation.

Thus equipped with movable sides, the interior of the box is accessible, allowing.one to place a variety of objects within. The extremities of the objects can be sighted perpendicularly on the grid and outlined there, on each of the three planes. When all three are done, the box can be unfolded into a “flat” on which the interrelationship of all the views becomes apparent.

Project Length

The segment of time in class devoted to orthographic projection is about five weeks. Before the application of this device, it required half of the five weeks to achieve understanding of space coordinates, and gain the ability to do the class work. After introducing the cube device, the students can comprehend the principles within the first week of study with orthographic projection.

Resources

Architectural Graphics and Communication, 2nd Edition, by Robert Duncan
Graphics for Architecture by Kevin Forseth with David Vaughan
Leaming to Look. 2nd Edition, by Joshua Taylor
Technical Descriptive Geometry by B. Leighton Welhnan

Credits

The inspiration for the transparent cube device came after seeing textbook drawings, which use rotation between drawing views to achieve common dimensional indications in all the drawings. Also to be credited are books on orthographic drawing, which refer to the surfaces on which object elevations are drawn as "transparent" picture planes with imaginary projectors which intersect those planes.

Documentation

Schematic Drawing
A Device for Demonstrating Orthographic Projection