CHAPTER 4

Objective abstraction: axonometric

This chapter introduces readers to the technique of axonometric construction and the work of architect and academic El Lissitzky. If you have ever doodled a cube, then you have most likely drawn an axonometric. They are drawings commonly found in our daily lives, including construction assembly directions and 3-D building maps.

Axonometric drawing is an objective three-dimensional representation that combines plan and elevation in one abstract drawing. It is objective in the sense that it is not a view that can ever be perceived in real space. The axon is measured along three axes in three directions and its ease of construction is possible due to the fact that parallel elements remain parallel in the representation. This differs greatly from the construction of a perspective drawing, where receding lines converge in space.

The three-dimensional axonometric can be derived from a two-dimensional plan or elevation. The construction retains true scale measurements throughout the drawing. The axonometric allows you to see and understand relationships along multiple surfaces simultaneously. It can be used to study form and space and relationships between vertical and horizontal elements. Design iterations that study spatial strategies can be easily constructed and recorded using the axonometric. Using the axon, you can study both positive and negative space—both the form and the space that is the result of that form.

There is a variety of axonometric types including isometric, diametric, trimetric, and oblique projections.

The use of the axonometric drawing can be tied directly to those in art and architecture interested by its abstract quality and its implication of infinity. Architects who embrace the axonometric include Theo van Doesburg, James Stirling, Steven Holl, and Peter Eisenman.
Introduction to axonometric

There are a number of different types of axonometric drawings, including the axonometric projection made up of isometric, diametric, trimetric, and the oblique projection, which is further subdivided into the elevation oblique and plan oblique.

The most straightforward axonometric to construct is the plan oblique (which is often referred to as axonometric). Its construction is derived directly from the plan and can be measured and scaled at any point in the drawing. The plan oblique is derived from a rotated plan. The plan can be rotated along any angle, though 30, 60, and 45 degree angles are often used. Each angle provides a slightly different emphasis on the object and thus should be selected with care. A 30/60 rotation emphasizes the left side, the 60/30 emphasizes the right side, while the 45/45 provides equal emphasis on both sides. Be aware of the plan orientation so that emphasis on particular elements can be made before constructing the drawing.

One way to enhance the reading of depth in an axonometric is to distinguish between spatial edges using line weight adjustments. A continuous spatial edge can be drawn where the edge of the object meets open space beyond. This profile line weight is darker than the elevation line.

The basic construction of the axonometric box can be thought of as an extrusion from the plan. The extruded form provides a framework for you to draw within. From the plan, true measurements along the vertical axis can be made. All lines parallel in the plan can be established with parallel lines in axonometric. Elevation and section information can be transferred onto the axonometric through measuring. Any circle that is drawn in plan remains a circle while circles in the vertical plane become ellipses.

Constructing a plan oblique

1. Rotate your plan to an angle that highlights components of the design. Begin construction by extruding the corners of the box, using a 4H lead. Measure heights using the same scale as the plan.

2. Continue using construction lines, but start to add detail like doors and windows. Take vertical measurements to determine the height of the window off the ground.

3. Find elements that are not parallel to the plan, such as the roof, using heights taken from the corresponding elevations. Plot the height of the low and high points of the roof and connect them with a straight line.

4. Darken in those components of the construction lines that are visible as elevation lines in HB lead. You can leave the lightly drawn construction lines on the drawing.
Quick digital modeling

Three-dimensional modeling programs like Sketch-up and Form-Z have become commonplace in architecture studios and offices. They provide quick and easy ways to model simple spaces and can provide base drawings for hand-drawn overlays. The software allows you the opportunity to rotate and look at a model from any viewpoint. Sketch-up is good for transforming 2D work into 3D study models. It is easy to extrude objects and cast simple shadows. Its rendering capabilities are limited and therefore it is better used as a base for hand-drawn overlays. Form-Z provides more sophisticated rendering and lighting opportunities.

Axon variations

The isometric is a type of axonometric that provides a lower angle view than a plan oblique. Equal emphasis is given to the three major planes. The isometric does not allow for construction to be extruded directly from the existing plan, but requires the reconstruction of the plan with its front corner being drawn at 120 degrees instead of 90 degrees. The isometric is typically drawn with vertical information true to scale. The measurements are transferred along the receding 30 degree lines.

The diametric, another axonometric projection, has two axes that are equally foreshortened, while the third appears longer or shorter than the others.

Variations on any of the axonometric types include the Choisy axon, exploded axon, cutaway axon, transparent-view axon, and sequence axon. The Choisy axonometric (also known as the worm’s-eye view), emphasizes a view from below; typically of a ceiling of a building and its adjacent spaces. The exploded axon pulls apart the object into smaller elements, while maintaining a sense of the whole. The location of the exploded elements is typically maintained relative to the original mass with dashed lines.

Peter Eisenman

Peter Eisenman (American b. 1932) was a member of the New York Five, a group of influential architects practicing in the 1970s. He later became known as one of the first Deconstructionist architects. Deconstructionism explores the relationship of literary theory to contemporary architecture, especially the literary works of Jacques Derrida. Peter Eisenman’s early works were explored in axonometric drawings. This method of representation reinforced the narrative of his design intentions. Without vanishing points, as in a perspective, axonometric drawings imply infinite space. This tradition was pioneered by early 20th-century artists such as El Lissitzky, Theo van Doesburg, and other artists and writers.

Cutaway axon

The cutaway axon allows for views into interior spaces that may not be visible from an exterior constructed axonometric. Parts of the wall and the entire ceiling are removed to reveal the interior spaces.

Transparent axon

The transparent axon depicts overlapping spaces as see-through to allow the interior to be revealed. It is similar to the cutaway axonometric, but shows the removed part as a transparent element. The darkest line, a profile line, indicates the edge between the object and open space.
Providing opportunities for the multiplicity of spaces to be comprehended is an important design tool in architecture. Understanding the types of strategies that can be used to impact the multitude of spaces is key.

Axonometrics provide a drawing tool to help develop and understand well-defined, clear, three-dimensional spaces in architectural design. Because axonometric drawing is three-dimensional, it can depict plan and section information simultaneously. It allows each to inform the other in one drawing.

When using axonometric drawing as a design tool, architects usually think in terms of volume. Using the axonometric drawing, you can begin to see and represent space as a physical thing.

Axons provide a representational tool to depict space three-dimensionally. Once you understand how to define one space, you can overlap multiple spaces to explore the variety of spatial zones established in a project. The transparent axonometric allows you to see how spaces relate and interact with one another. The reciprocal relationship between container and space is made apparent with this drawing type. The number of different ways to define a space depends on the clarity of the elements that form the space.

**Spatial overlap**
A series of spatial models for a small library and reading room. Excavation (top): the volume of the sunken reading room is underground to minimize distractions and control light into the space. Reflective space (center): public spaces and book storage were contained in a volume on the second floor, distinct and discrete from the reading room and other portions of the library. Circulation elements (bottom): elements such as stair towers are housed in this last volume which completes the upper courtyard, as well as providing access in its stair tower on the ground level.

**Spatial diagrams**
Similar to the axonometric diagrams, these perspectival digital spatial diagrams depict the apparent and implied spaces that are formed after two new elements are inserted into an existing context.
Exploration of properties and processes

Each of these small-scale designs is an exploration of material properties and fabrication processes. They are translations of flat materials into three-dimensional forms that hold space. Added fasteners, such as glue or screws, are limited, forcing the nature of the material itself to make any connections and satisfy the function of the piece. Each design is created not in an additive process, but through a sculpting of space with a two-dimensional material. The design process simultaneously involves drawing, experiments with the material itself to discover its limitations and advantages, and full-scale models to test and further the drawn forms. Process drawings are presented alongside the final product as a way to demonstrate the entire process of thinking and making, from idea, to form, to product.

**Designer:** Martha Foss

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**Candle holder**

This wall-mounted candle holder is laser cut from one 9 x 4 in (23 x 10 cm) sheet of stainless steel, minimizing waste and exploiting the nature of the production process. The two planar pieces, one extracted from the other, can be packaged and sold flat. These two pieces are then separated and locked back together in a new way, creating the three-dimensional candle holder.

**Pencil/letter holder**

This pencil-and-letter holder is made from bent and laminated maple. The wood is curved, looping back on itself to create a space-containing piece. The first series of curves produces voids to hold letters, and one final gesture creates a place for a pencil.

**Coat hook**

This coat hook is cut and bent from one flat sheet of aluminum. The thin material gains strength when it is bent and held in the three-dimensional position. The manipulation of the material creates the functional form and increases the material’s resistance to force. The only fastener added is the screw to anchor it to the wall.
Introduction to analysis

We see diagrams in our everyday life: subway maps, assembly directions, musical notes, graphs, and so on. In architecture, diagrams are the result of an analytic process of abstracting a building or object into its component parts. A single analysis can be represented by a single diagram or series of diagrams. Analyses can be constructed using both drawings and models.

Analysis is a reductive process; a simplification of one idea in isolation. It is a depiction of a design intention.

Analytical models and diagrams may depict the following:

- formal qualities
- conceptual ideas
- ordering principles
- circulation
- public vs. private
- structure

**Analytical representation**
Analysis can help you understand the basic ordering elements of a project. These need not be shown in plan but are often depicted in such abstract forms including plan, section, elevation, and axonometric drawings, or models. The abstraction aids in the reductive process. Diagrams in particular can be used to show arrangements of component parts to the whole.

**Context analysis**
This diagram identifies distant views of a high rise design within the context of the city. The diagram juxtaposes elevation views with color coded view corridors in plan.

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Read this!
Clark, Roger H. and Pause, Michael
*Precedents in Architecture: Analytic Diagrams, Formative Ideas, and Partis*

Key concepts for building analysis
- Parti
- Massing
- Structure
- Circulation
- Axis
- Symmetry
- Scale and proportion
- Balance
- Regulating lines
- Light quality
- Rhythm and repetition
- View
- Part to whole
- Geometry
- Hierarchy
- Enclosure
- Space/void relationship

For a full glossary see pages 140–141.
Key concepts for urban analysis

- Figure–ground relationships
- Street patterns
- Street section—horizontal vs. vertical
- Scale—hierarchy of form or space
- Land use
- Typologies
- Neighborhood relationships—changing street grid, formal street variation, building type change
- Perspectival relationships—views
- Edge conditions, surfaces, and materials
- Natural vs. manmade
- History
- Type vs. program
- Open space
- Public green space vs. building
- Access—pedestrian, vehicular, other?
- Adjacencies
- Circulation—vehicular vs. pedestrian
- Pedestrian usage
- Movement
- Water elements
- Climate—sun angles/sun shadows

For a full glossary see pages 140–141.

There is a difference between data collection and analysis. Stating what is already in existence and plotting it in a drawing or model is data collection—the identification of existing information. Analysis implies an interpretation of the data. That interpretation calls on the viewer to think about what they are seeing and provide something more than what is purely an existing condition. Analyses are generally depicted graphically in a diagram.

Analysis can provide the basis for many design decisions. Site analysis provides a deeper understanding of existing conditions, context, and environment. Analysis can be utilized at the beginning of the design process to study the site, the program, formal opportunities, and to represent a conceptual idea. In the middle phases of the design process, analysis can be used to clarify and strengthen ideas. Toward the end of the design process, analysis can be used to explain the conceptual basis for the design, especially during presentations.

The presentation of a project to academics or architects can be made with diagrams, allowing the idea to be understood quickly, while letting the discovery of the details happen through questions or observations. In complex projects, it is often easier to explain the overall project through diagrams than by showing every facet of a project at once.

The “parti” of the project is considered the main idea of the project and can be represented in a diagram. There may be a number of supporting ideas, but typically there is one single main idea that organizes the project.

Privacy analysis
These analysis plans show the hierarchy of public and private spaces within a school building. Different colors are used to represent areas of access and overlap.

Diagramming designs
Richard Meier’s designs can be clearly diagrammed based on geometry, public/private, structure, and enclosure, among others.

Richard Meier

Richard Meier (American b. 1934) was a member of the New York Five (along with Peter Eisenman, see page 75). He has designed a large number of buildings in North America and Europe, ranging in scale from private residences to the development of civic buildings encompassing several city blocks. Despite his obvious visual homage to the early Modern works of Le Corbusier, Meier’s projects are also rich with the classical ideals of proportioning and ordering devices.
Introduction to El Lissitzky

Compositions possess an order: implicit or explicit. This order can be derived from geometry.

El Lissitzky, well known as an experimental Russian artist, contributed to the Suprematist art movement during the early part of the 20th century with his abstract, non-representational art. His works, known as "Prouns" (Project for the Affirmation of the New), were geometrical abstractions, both two- and three-dimensional. He was interested in creating the world through art rather than describing it.

Born in 1890 in Pochinok, Russia, Lissitzky later became one of the most influential yet controversial experimental artists of the early 20th century. His list of professions included architect, painter, designer, lecturer, theorist, photographer, and head of the graphic arts, printing, and architecture workshops at the People’s Art School in Vitebsk.

Russian artist Kazimir Malevich was a major influence on Lissitzky’s work. At the time, Malevich developed a two-dimensional system of abstract art composed with straight lines and colored forms dispersed over a white neutral canvas. This mode of dynamically arranged forms of squares and rectangles, floating freely on the page, was referred to as Suprematism. Suprematist artists challenged the conventional representations of the world. They thought art should be an interpretation, not a description (much like the description of observation sketching in Unit 9).

Lissitzky became a Suprematist disciple, embracing the geometric abstraction depicted across an infinite backdrop. The works did not respond to the traditional role of gravity in a painting. Lissitzky created tensions by contrasting shape, scale, and texture of elements throughout the canvas from simultaneous multiple points of view. He used the axonometric as a graphic tool to demonstrate his interest in nonhierarchic, infinite space.

In addition to being a prolific painter, Lissitzky was a visionary architect creating skyscrapers and temporary structures, including his speaker’s podium known as the Lenin Tribune. The lectern’s diagonal form reinforced the dynamic and gestural qualities of a speaker using it.

Two-dimensional geometric form
El Lissitzky’s constructions explored nontraditional spatial relationships through the arrangement of two- and three-dimensional geometric forms.

Chapter 4: Objective abstraction: axonometric
UNIT 22: Introduction to El Lissitzky

Analyze a Proun

Grounded in the traditions of the Bauhaus movement of the early 20th century, this assignment combines analysis and development of space to create a new three-dimensional object generated from an El Lissitzky Proun. Your task is to imagine what exists beyond the Proun’s canvas. Think about the painting as if you could see beyond the canvas, from a skewed view from the side, perpendicular to the plane of the painting or from behind. It is open to multiple interpretations. What can you infer from what is there?

Brief
Find a Lissitzky Proun and translate it into 3D. You will analyze, model, and draw your transformation of the Proun. Lissitzky’s work is abstract; therefore, you will need to experiment with the transformation into 3D form in an abstract manner with a focus on the development of space. Analyze the painting and then translate that analysis into a new 3D object. You are conceptualizing a 3D space from a 2D representation and then translating it back into a 2D drawing set. You should build a series of 3D models of the Proun exploring the relationships between the planes, volumes, shapes, and interstitial space. Analyze the Proun by looking at geometry, scale, proportion, transparency, hierarchy, depth, and color. This list is not exhaustive; if you think of others, use them. These analysis drawings should be sketched on a continuous piece of trace. You should scale your Proun image so that it fits as large as possible on an 8½ x 11 in (216 x 279 mm) sheet of paper. It is important to remember that the shapes you make have spatial consequences that should be considered with equal emphasis. Making the positive space is just as important as making the negative space. Part of the assignment has to do with your own expression and editing of the Proun into three dimensions. You are working at full scale. Thus the model is not a representation of a form but a creation of the real thing, much in the spirit of Lissitzky himself. The model is supposed to be an interpretation of the Proun and not literally recreate the implied 3D characteristics of the painting.

In developing the new 3D form, you should be recording a narrative (your own thesis) that supports your thinking. Consider what diagrams from the analysis phase you use to generate the 3D form and what interested you about them. Then reconsider what interests you after you create a series of study models.

This exercise explores the iterative process of design. It is a developmental process, like writing, that requires multiple edits and adjustments in support of a thesis, narrative, or concept.

Assignment rules
In creating the transformation of the Lissitzky Proun, the new form must fit inside a 6 in (152 mm) volume. In addition, each of the six sides of the cube must be touched by some part of the new form. This rule requires you to think well beyond the limitations of the flat canvas.

Final requirements
Compose an orthographic set of drawings and an axonometric drawing.

Pencil on vellum for final drawings:
• plans
• sections
• axonometric

Process

1 Find a Proun to analyze. Place trace over it and start to isolate and analyze elements of the image.

2 Make numerous analyses, from which you will select three to develop into three-dimensional models.

3 Create a physical model of each analysis using chipboard; the model should fit inside of a 3-in (76-mm) cube (half the size of the final model). It is often helpful to study ideas at a smaller scale, especially when testing out new concepts before a direction of inquiry is settled upon. Finally, create a new model from your analysis models; this model should be at full scale—the 6-in (152-mm) cube.