

# Chapter

# 6

## Developments

### 6.1: Overview

A lot of material has been covered up to this point, including:

- Techniques of orthographic projection used to create multi-view drawings.
- Common drafting standards and conventional practices.
- Distinguishing between lines that are true length and those that are foreshortened.
- Creating auxiliary views and sections.

All of these topics play a vital role in the process of making construction patterns and templates for your projects. At this point, you might be asking yourself: “What’s left to discuss?”

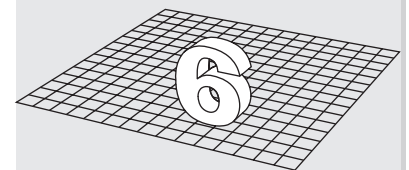
The answer is: “Some of the most useful and powerful 2D methods of all!” So, yes, there is still a ways to go. In fact, this is a rather long chapter. But, with that said, you may find the effort to read through it well worthwhile since the topics presented here and in the last chapter of this book could prove very valuable once you begin to design and build your own projects.

As you will see, many shapes and objects can be created by cutting parts out of sheets of material or “sheet stock” and then assembling them. The question then becomes: “How can you derive the patterns needed to make these parts?”

Take, for example, a simple cylinder. If it is small enough, you might be able to use an existing off-the-shelf component such a pipe or a piece of tubing. But, what if you need a very large cylinder or one that has an odd diameter? In that event, you may need to make it yourself from scratch. So, how exactly can you do something like this?

Using the advanced techniques for making construction patterns demonstrated in this chapter, you can develop the surface of a cylinder to create a flat “template” for building it from scratch. The patterns needed to do this are known as developments. You might think of this process as *unfolding* an object as illustrated in **Figure 6.1.1**.

**NOTE:** Underlined terms appear in the Glossary.



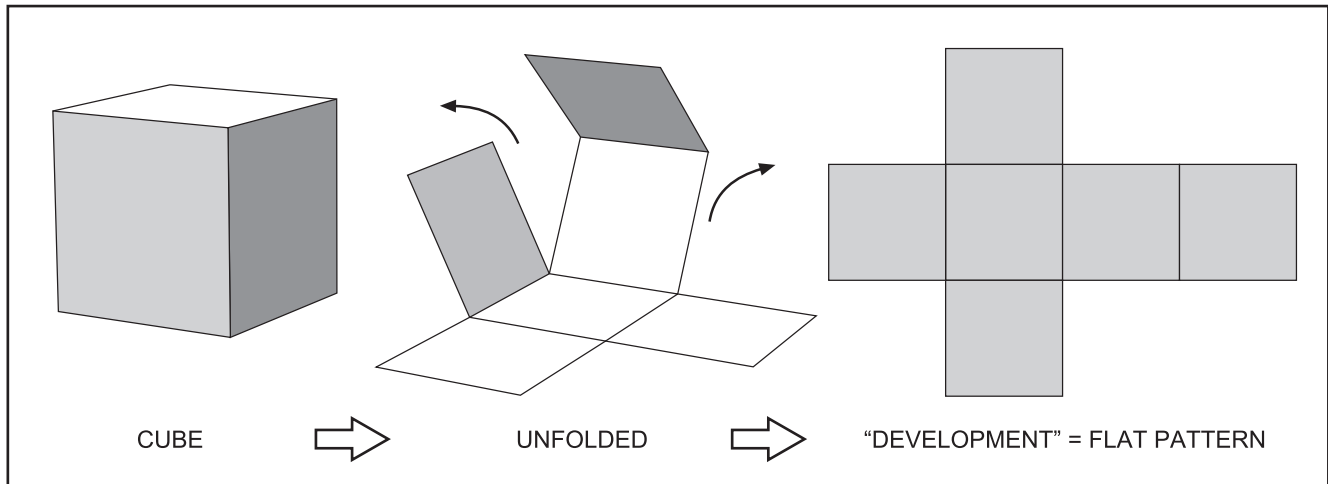


Figure 6.1.1. Some objects can be *developed* or “unfolded” to create flat patterns.

Other objects such as a cylinder can be *unrolled* in a similar fashion. In fact, a surprising number of seemingly complex shapes can be created in this manner! The individual pieces that make up these shapes become the “building blocks” needed to make a model of the subject. As a result, knowing how to *develop* or break down a shape into its flat components is a very valuable skill for any modeler to learn.

Unfortunately, the art of developing surfaces can seem challenging at times. Figuring out patterns for what appear to be simple geometric shapes can sometimes become a daunting task. As a result, you may find yourself using many or all the techniques covered so far in this book as you unfold or unroll structures to create flat patterns that can be used for constructing your projects.

### 11.2: Geometric Solids

Models are often constructed from three-dimensional variants of basic two-dimensional shapes such as squares, rectangles, circles, and multigons. When a geometric figure takes on a three-dimensional form, the resulting shape is known as a geometric solid. Many such solids are illustrated in **Figure 6.2.1**. Since you might need to use many of these shapes when creating patterns for your projects, it is a good idea to become familiar with them.

Geometric solids fall into several broad categories:

- Cubes
- Cylinders
- Prisms
- Cones
- Pyramids
- Spheres
- Polyhedrons

### *Cubes*

Nearly everyone is familiar with the cube. This shape is built from a series of squares. In some cases, however, the squares are not arranged at right angles to one another, thus causing the object to “lean” in one direction. When this occurs, the resulting shape is known as an oblique parallelepiped.

Cubes and boxes are discussed in **Section 6.4**.

### *Cylinders*

A cylinder is a solid shape that has the cross section of a circle. Cylinders are quite useful in modeling. A right cylinder stands upright while an oblique cylinder “leans” at an angle in one direction. Developing a right cylinder is very easy while an oblique cylinder is more challenging to develop. Some cylinders may be cut or *truncated* and this complicates the development process even more.

Cylinders are covered in detail starting in **Section 6.5**.

### *Prisms*

Closely related to the cube is the prism. You may think of a prism as being triangular in cross section, but a prism can be actually constructed from just about any regular geometric shape. A right prism stands upright with edges that form 90-degree angles to one another. On the other hand, an oblique prism “leans” at an angle in one direction. A prism “sliced” or cut on one end is said to be truncated.

Prisms are discussed in **Section 6.7**.

### *Cones*

Cones are very useful shapes in modeling. Developing cones can be rather tricky, but the techniques come in quite handy in a variety of circumstances. As a result, all modelers should become familiar with and know how to develop patterns for cones.

A cone that stands upright is known as a right cone. A cone that “leans” in any direction is an oblique cone. If a cone does not extend all the way to a point, it is a truncated cone.

Cones are covered in detail starting in **Section 6.8**.

### *Pyramids*

A pyramid rises to a point from a base with four or more sides. Pyramids are very familiar shapes thanks to the famous landmarks on the Gizeh Plateau in Egypt. But, did you know that a pyramid is not required to have a square base? As it turns out, pyramids can also be formed from a pentagon, a hexagon,

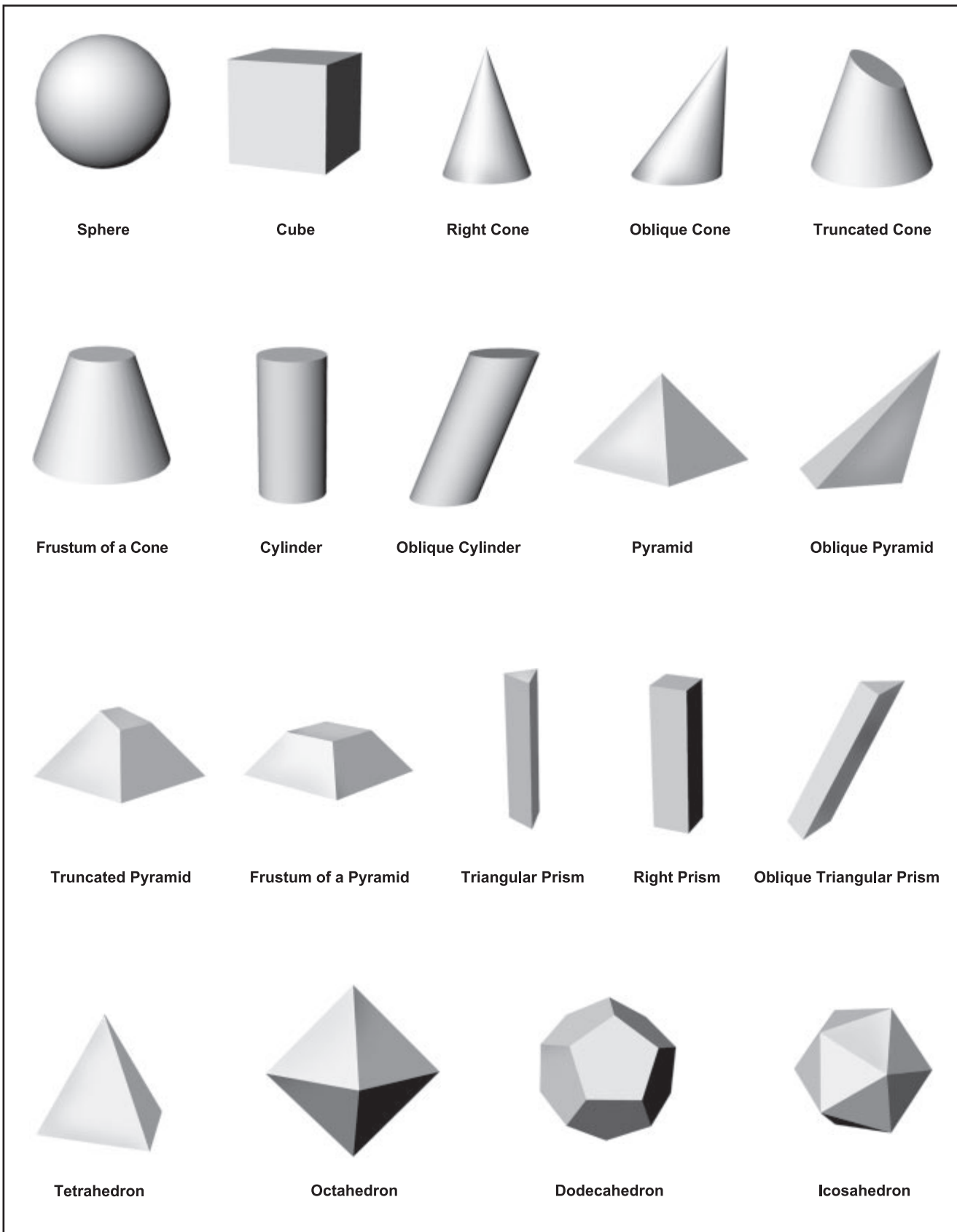


Figure 6.2.1. Many different structures can be made from three-dimensional shapes known as *geometric solids*.

or other multi-sided geometric shape! In addition, pyramids can be *truncated*. When this occurs, the development process becomes more complicated.

Pyramids are discussed in **Section 6.9**.

### *Spheres*

A sphere is, of course, a three-dimensional form of a circle. Cutting a sphere in half yields a hemisphere. There are also other shapes formed from parts of a sphere and some of these may not be familiar. These shapes, illustrated in **Figure 6.2.2**, include:

- Segment
- Spherical Cap
- Lune (also known as a gore)

While it is not possible to develop or “unfold” a sphere due to the compound curves involved, it is possible to *approximate* the surface of a sphere using flat patterns. This involves creating patterns called *gores*. These patterns, when assembled, will form a close approximation to the surface of a sphere. This process is commonly used to create globes from flat paper patterns.

See **Section 6.10** for more information on developing a sphere.

### *Polyhedrons*

A polyhedron is formed by combining multiple copies of simple geometric shapes into a three dimensional figure. Each shape becomes a side or “facet” of the overall form. In fact, polyhedrons (or “polyhedra”) with a large number of sides can resemble a faceted “ball.” Keep in mind, all the shapes that make up the sides do not have to be identical – they can also be combined with other shapes!

**Section 6.11** includes tips on developing patterns for a polyhedron.

## **6.3: Forming Three Dimensional Shapes**

The study of three-dimensional forms is the foundation of 3D modeling. Understanding how to make these shapes becomes much easier when you are familiar with some basic 3D modeling concepts. In addition, many of the steps needed for “unfolding” geometric solids become much simpler if you have access to 3D tools. Because of this, certain 3D modeling concepts will be introduced here in this chapter. This will also serve as bridge to **Volume 2** of this series which discusses how to make patterns for building 3D models.

The most basic technique for creating a three dimensional shape is known as extruding. With this process, a simple two-dimensional outline becomes a three-dimensional object by adding “height” to the shape. To keep things