

# CHAPTER 5

## Steel Structures

Steel is used in some form in every type of construction. Steel nails for wood and steel reinforcement for concrete are indispensable items. This chapter deals essentially with the use of steel as a structural material in its own right. As such, steel is used in the form of industrial products of various types. A principal usage dealt with in this chapter is that of so-called *structural steel*, a term used for products produced by rolling to form a semimolten steel ingot into a linear element with some formed cross section, the product being described as a *rolled section*. Many other types of products are used for building structures and are described here as well as in other chapters.

For building structures, steel has been used for most of the very tall and very long-spanning constructions (see Figure 5.1). It is also useable at more modest scale, stretching over a wide range of building size (see Figure 5.2). A major usage is that for multistory buildings with extensive frameworks of linear beams and columns (see Figure 5.3).

### 5.1 GENERAL CONCERNS FOR STEEL

Steel is a highly variable material and is used for a wide range of products that serve many purposes for building construction. This section deals with some of the general concerns for use of the basic material and with the use of various common forms of products now produced for structural applications.

#### Types of Steel Products

Steel itself is formless, coming basically in the form of molten material or a heat-softened lump. The structural products produced derive their basic forms from the general potentialities and limitations of the industrial processes of forming

and fabricating. Standard raw stock elements—deriving from the various production processes—are the following:

*Rolled Shapes.* These are formed by squeezing the heat-softened steel repeatedly through a set of rollers that shape it into a linear element with a constant cross section. Simple forms of round rods and flat bars, strips, plates, and sheets are formed as well as more complex shapes of I, H, T, L, U, C, and Z. Special shapes, such as rails and sheet piling, can also be formed in this manner.

*Wire.* This is formed by pulling (called *drawing*) the steel through a small opening.

*Extrusion.* This is similar to drawing, although sections other than simple round ones are formed. Widely used with aluminum and plastics, this is only rarely used with steel.

*Casting.* This is done by pouring the molten steel into a form (mold). This is limited to objects of three-dimensional shape.

*Forging.* This consists of pounding the heat-softened steel into a mold until it takes the shape of the mold. This is preferred to casting because of the effects of the working on the properties of the finished material.

Stock elements produced by the basic forming processes may be reworked by various means, such as the following:

*Cutting.* Shearing, sawing, punching, or flame cutting can be used to trim and shape specific forms.

*Machining.* This may consist of drilling, planing, grinding, routing, or turning on a lathe.

*Bending.* Sheets, plates, or linear elements may be bent if made from steel with a ductile character (see the following discussion of steel properties).