

CHAPTER

4

Wood Structures

This chapter treats the use of wood from trees as a basic material for building structures. While an understanding of the nature of the basic material is important, it is equally important to be aware of the products developed from the basic material and of the various structural systems that can be developed with the products.

4.1 GENERAL CONCERNS FOR WOOD

Wood from trees has a long history of usage for structural purposes, most notably in regions where large stands of trees exist (see Figure 4.1). At the time of the early colonization of the United States, vast areas of the country were covered with forests. It was, indeed, a major problem for early settlers of the eastern, southeastern, and midwestern areas. Travel was difficult because of the dense growth and, up to the middle of the nineteenth century, was mostly accomplished by using the many navigable rivers. As in many countries today, land for cultivation of crops or grazing of animals was claimed by burning off or otherwise destroying forest lands.

While much of that early dense forest was lost—most notably vast stands of hardwood trees—a considerable amount of timber was used for construction. Thus a heritage of wood construction was developed and an extensive industry was established. This industry extends to today, with wood remaining as a major source for building construction uses.

We no longer build extensively with construction that directly utilizes the source. Log cabins, roughly hacked boards, and pole construction with peeled logs do not account for the majority of buildings. Today, wood as a building material is treated as an industrialized product, receiving considerable processing on the way to the construction site. Still, a major use—and one treated extensively in this book—is that of the lightly processed pieces of wood that are cut directly from the

logs, smoothed up a bit, and used as quickly as possible in their solid-sawn form. This product is what we generally refer to as *lumber*, and the lumberyard is still a major business in almost every large community in the United States. Wood is indeed the all-American building material and will be found somewhere on just about every building site.

This section deals with some of the basic issues concerning the use of wood, with concentration on the direct usage for structural lumber.

Sources of Wood

The particular type of tree from which wood comes is called the *species*. Although there are thousand of species of trees, most structural wood used in the United States comes from a few dozen species that are selected for commercial processing.

The two groups of trees used for building purposes are the *softwoods* and *hardwoods*. Most softwood trees like pine and spruce are coniferous, or cone bearing, whereas hardwood trees have broad leaves exemplified by oak and maple. Softwoods are indeed mostly softer than hardwoods, although there are other properties that define the types.

The two species of trees used most extensively for structural wood in the United States are Douglas fir and southern pine. However, several other species are also used, depending partly on regional availability. Although the terms *timber* and *lumber* are often used interchangeably, current industry usage tends to reserve timber for structural wood members of large cross-sectional area.

Tree Growth

The trees used for lumber in the United States are exogenous; that is, they increase in size by growth of new wood on the outer surface under the bark. The cross section of a tree trunk reveals the layers of new wood that are formed annually. These layers, called *annual rings*, are typically composed of