In the middle of the nineteenth century, experimentation with rolling of iron beams finally culminated in construction of the Cooper Union Building in New York City, the first building to utilize hot-rolled steel beams. In 1889, Rand McNally Building in Chicago became the first skyscraper with all-steel framing.[2]

Prefabricated metal buildings first appeared at about the same time. As early as the mid-nineteenth century, "portable iron houses" were marketed by Peter Naylor, a New York metal-roofing contractor, to satisfy housing needs of the 1848 California Gold Rush fortune seekers; at least several hundred of those structures were sold. A typical iron house measured 15 by 20 ft and, according to the advertisements, could be put together in less than a day by a single man. Naylor's ads claimed that his structures were cheaper than wood houses, fireproof, and more comfortable than tents.[1] Eventually, of course, California's timber industry got established and Naylor's invention lost its market.

In the first two decades of the twentieth century, prefabricated metal components were mostly used for garages. Founded in 1901, Butler Manufacturing Company developed its first prefabricated building in 1909 to provide garage space for the ubiquitous Model T. That curved-top building used wood framing covered with corrugated metal sheets. To improve fire resistance of its buildings, the company eventually switched to all-metal structures framed with corrugated curved steel sheets. The arch-like design, inspired by cylindrical grain bins, influenced many other prefabricated metal buildings.[3]

In 1917, the Austin Company of Cleveland, Ohio, began marketing 10 standard designs of a factory building that could be chosen from a catalog. The framing for these early metal buildings consisted of steel columns and roof trusses which had been designed and detailed beforehand. The Austin buildings were true forebears of what later became known as pre-engineered construction, a new concept that allowed for material shipment several weeks earlier, because no design time needed to be spent after the sale. Austin sold its buildings through a newly established network of district sales offices.[4]

In the early 1920s, Liberty Steel Products Company of Chicago offered a prefabricated factory building that could be quickly erected. The LIBCO ad pictured the building and boasted: "10 men put up that building in 20 hours. Just ordinary help, and the only tools needed were monkey wrenches.…"[1]

By that time, steel was an established competitor of other building materials. The first edition of Standard Specification for the Design, Fabrication and Erection of Structural Steel for Buildings was published by the newly formed American Institute of Steel Construction in 1923.

Several metal-building companies were formed in the 1920s and 1930s to satisfy the needs of the oil industry by making buildings for equipment storage; some of these companies also produced farm buildings. For example, Star Building Systems was formed in 1927 to meet the needs of oil drillers in the Oklahoma oil boom. Those early metal buildings were rather small—8 by 10 ft or 12 by 14 ft in plan—and were framed with trusses spanning between trussed columns. The wall panels, typically 8 by 12 ft in size and spanning vertically, were made of corrugated galvanized sheet sections bounded by riveted steel angles.

1.1.3 The War Years and After

During World War II, larger versions of those metal buildings were used as aircraft hangars. Their columns were made of laced angles, perhaps of 6 by 4 by $^3/_8$ in in section, and roof structure consisted of bowstring trusses. Military manuals were typically used for design criteria. These buildings, unlike their predecessors, relied on intermediate girts for siding support.

The best-known prefabricated building during World War II was the Quonset hut, which became a household word. Quonset huts were mass-produced by the hundreds of thousands to meet a need for inexpensive and standardized shelter (Fig. 1.1). Requiring no special skills, these structures were assembled with only hand tools, and—with no greater effort—could be readily dismantled, moved, and reerected elsewhere. The main producer of Quonset huts was Stran-Steel Corp., a pioneering metal-building company that developed many "firsts" later.

Quonset huts followed GIs wherever they went and attested to the fabled benefits American mass production could bestow. Still, these utterly utilitarian, simple, and uninspiring structures were widely perceived as being cheap and ugly. This impression still lingers in the minds of many, even though quite a few Quonset huts have survived for over half a century.

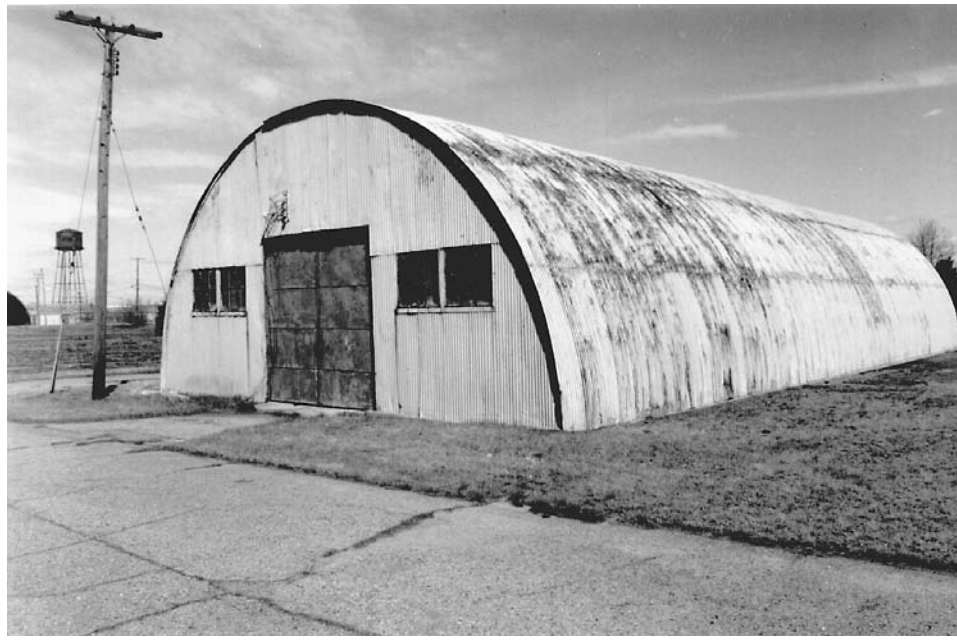

FIGURE 1.1 Quonset hut, Quonset Point, R.I. (*Photo: David Nacci.*)

The negative connotation of the term *prefabricated building* was reinforced after the war ended and the next generation of metal buildings came into being. Like the Quonset hut, this new generation filled a specific need: the postwar economic boom required more factory space to satisfy the pent-up demand for consumer products. The vast sheet-metal industry, well-organized and efficient, had just lost its biggest customer—the military. Could the earlier sheet-metal prefabricated buildings and the Quonset hut, as well as the legendary Liberty Ship quickly mass-produced at Kaiser's California shipyard, provide a lesson for a speedy making of factory buildings? The answer was clearly: "Yes!"

In the new breed of sheet-metal-clad buildings, the emphasis was, once again, on rapid construction and low cost, rather than aesthetics. It was, after all, the contents of these early metal structures that was important, not the building design. Using standardized sheet-metal siding and roofing, supported by gabled steel trusses and columns—a 4:12 roof pitch was common—the required building volumes could be created relatively quickly. In this corrugated, galvanized environment, windows, insulation, and extensive mechanical systems were perceived as unnecessary frills. The sheer number of these prefabricated buildings, cloned in the least imaginative mass-production spirit, was overwhelming.

Eventually, the economic boom subsided, but the buildings remained. Their plain appearance was never an asset. As time passed and these buildings frayed, they conveyed an image of being worn out and out of place. Eventually, prefabricated buildings were frowned upon by almost everyone. The impression of cheapness and poor quality that characterized the Quonset hut was powerfully reinforced by the "boom factories." This one-two punch knocked respectability out of "prefabricated buildings" and may have forever saddled the term with negative connotations.

The metal building industry understood the problem. It was looking for another name.

1.1.4 Pre-Engineered Buildings

The scientific-sounding term *pre-engineered buildings* came into being in the 1960s. The buildings were "pre-engineered" because, like their ancestors, they relied upon standard engineering designs for a limited number of off-the-shelf configurations.