PART I
Introduction

Double-layer aluminum space frame under construction. This is one of the two structures pictured in Figure 2.3. (Courtesy of Conservatek Industries, Inc.)

1 What's in This Book?

Our book is about the use of aluminum as a material of construction for structural components.

Our major themes are:

- The suitability of aluminum as a structural material,
- How to design aluminum structural components in accordance with the Aluminum Association's *Specification for Aluminum Structures,*
- How to apply the design methods to actual structures.

We begin by introducing you to aluminum, and we hope that by the end of Part I you are sufficiently well acquainted to be ready to get serious about the relationship. In Part II we explain the design requirements of the 2000 edition of the *Specification for Aluminum Structures* (hereafter called the Aluminum *Specification*), published by the Aluminum Association in its *Aluminum Design Manual* (4). Those of you who can't wait to plug and chug may want to jump right ahead to Part III, and refer back to Part II only when you want to know "Where did that come from?"

We assume that you have already had ample exposure to methods of load determination and structural analysis, so we do not replow that ground. We do, however, include in Part II a discussion on local buckling since this is a limit state (i.e., failure mode to you old-timers) that you may have been sheltered from if your design experience has been primarily with hot-rolled steel.

As we discussed in the Preface, we have keyed the discussion of design requirements to the Aluminum *Specification.* In Part II we compare these design provisions to the more familiar requirements for steel buildings published by the American Institute of Steel Construction (AISC) in the *Specification for Structural Steel Buildings* (hereafter called the Steel *Specification*) (38, 39). The Aluminum *Specification* is primarily intended for building structures; thus, we focus on these applications.

Throughout the book we give attention to those features of aluminum that differentiate it from other structural materials, particularly steel. Perhaps the most significant feature that distinguishes aluminum from steel is its *extrudability.* Extruding is the process of forming a product by pushing it through an opening called a *die*. The cross section of the resulting product is determined by the shape of the die. You may simply prepare a drawing of the

cross section that you desire for a certain application, then have the mill make a die for producing that shape. This is not the case for steel.

We know from personal experience that while custom extrusions enable designers to exercise a great deal of creativity, the process of sizing a unique shape can be very tedious. When designing with steel, engineers often restrict their choices to those shapes listed in tables of *compact sections,* where the section properties and dimensions are all provided, and the *slenderness* of the cross-sectional *elements* have already been checked to confirm that they are not governed by *local buckling.* While this approach may be safe, it is not very creative. When we create our own shape, however, we assume responsibility for determining its section properties and checking the slenderness of the cross-sectional elements. Furthermore, we may find that our new section is not compact, and we must then determine the local buckling stress limits. As mentioned previously, Part II includes a comprehensive explanation of the behavior of these slender (light gauge) shapes, which is also pertinent to the design of cold-formed steel structures. Although your task does become more complicated when you venture beyond using off-the-shelf shapes, we will guide you through it.

Your first reaction may be that the chore of performing these additional calculations poses too large a cost to pay for obtaining your creative license. We have made it easier, however, by presenting in Part III a straightforward method of performing the design checks required by the Aluminum *Specification.* We also provide some simple tables to make the process easier. Thus, if you pay attention, you can achieve maximum design freedom with minimal computational burden.

We presented the design checks required for individual structural components in Part III, and in Part IV we illustrate the application of these design requirements to actual structures. These include an example of cold-formed construction to demonstrate design with slender shapes, and we demonstrate the checks for beams, columns, and combined stresses in the design of a triangulated dome frame.

We present the design requirements and examples in the Allowable Stress Design (ASD) format because it is still the method in widest use. In Part V, however, we remove the shroud of mystery from Load and Resistance Factor Design (LRFD), so that when you do encounter it, you need not fear it.

Finally, we have compiled useful data in the Appendices, including a cross-reference in Appendix H of the provisions of the Aluminum *Specification* indexed to where they are discussed in this book. There is also a glossary of technical terms.