

# Structural Design

**Simplified Design of Building Foundations**, by James Ambrose. John Wiley & Sons. New York. 1981. 333 pages. \$36.95 hardcover.

by Paul Hanke



I used an earlier version of the *Simplified Design* series back when I studied structural mechanics in school. Since those days the author has changed, but the books continue to be an excellent resource for designers and builders.

Like others in the series, *Building Foundations* is written for readers who understand algebra, plane geometry, and trigonometry—over the heads of some, but a good middle ground between simple rules of thumb and consulting an engineer.

At the beginning, author James Ambrose describes the frequent need for alterations after the foundation is built, which reflects my own experiences. "Great accuracy and perfection are not to be expected," Ambrose says. "Overexcavation, mislocation of elements, errors in dimensions, omission of details, and so on, are common." Ambrose's book may help you work out bugs at the design stage, but the books reviewed next will help those who work in the trenches—and may need assistance the most.

The introduction to *Building Foundations* provides an overview of the basic design problems, the roles of architect, engineer, and builder, and fast-track versus normal procedures. It also discusses assumptions—that is, the so-called working-stress method of calculation, using 2,000 psi concrete where testing won't be done, and minimal reinforcing.

Chapter 2 deals with soil: its general properties; calculating its weight and moisture content; cohesive and cohesionless soils; classification systems; loads and reactions; and investigation methods. I found most interesting the diagrams and the explanation of how building and soil forces act and interact below

grade.

The next chapter, covering design of shallow bearing foundations, is the heart of the book. Ambrose focuses on continuous-wall foundations, individual column and fireplace footings, and retaining shear walls. Raft foundations, says Ambrose, are beyond the scope of the book, although these so-called floating slabs are commonly used in shallow-frost areas and low-rise commercial buildings, and should not be completely ruled out in the North.

Ambrose includes tables that show the height, width, and rebar schedules for plain and reinforced examples. In addition, there are pages of worked examples, plus review questions and problems at the end of each chapter. Other useful information includes how to equalize footing loads (and therefore settling) and the reasons behind the standard guidelines for stepped footings.

Chapter 5 concentrates on horizontal forces, including basement walls, and the design of short—less than 10 feet tall—retaining walls. Chapter 6 deals with special problems, such as slab design and hillside foundations.

Missing from the book is a consideration of pilasters, and the entire book is generally limited to concrete foundations, with the exception of grouted pier design.

I learned a lot from *Building Foundations*. It will be a useful reference, although I'm sure I'll use the tables more than the calculation methods. On the other hand, the math might enable me to rough out a design (which an engineer could then review) and save some consulting time.

The book is heavy going, but it will help you understand why foundations are—or should be—built certain ways. ■

extensive detail about good practices for wall, footing, and slab construction. It provides additional guidelines on stepped footings beyond those given by Ambrose, but, unfortunately, Ambrose's rules of thumb for length/height ratios aren't included. Proper vertical bracing—rarely seen in the real world—is illustrated, and the fabrication of plywood forms is described, along with forming single walls and stairs. The authors include watertight-mix guidelines in addition to step-by-step instructions for subgrade prep, forming, and pouring for a wide range of applications.

The authors observe that "by far the worst—and probably the most typical...way to install wire mesh is to hook it...and pull it up to about two inches from the surface [of a slab]." (How many times have you seen or done that?) Chairs or a double pour are preferred, by the way. Among the other useful hints is a troweling technique to reduce chatter—now that's getting down to fine points.

There are several pages on the pros and cons of various curing techniques (plastic sheet, wet burlap, ponding, and so on). Equally helpful is the hefty chapter devoted to the repair and patching of spalls, dusting, cracks, blisters and popouts, and the use of various epoxies. A final chapter covers finishing—colors, hardness, exposed aggregate, stamping, and nonslip surfaces.

Despite amateurish (but adequate) drawings, this is the best of the manuals reviewed here, and among the top contenders in the field.

The *ACI Guide*, which is actually a committee report, offers less in the way of either information or illustrations. The basics—mixing, placing, reinforcing, finishing, and curing—are here, but presented in outline form. You will, however, find a compressive-strength table (3,000 psi for exposed basement walls and 3,500 psi for unheated garage slabs), reinforcing tables, precautions for pouring part of a footing over bedrock, insulation guidelines, and advice on sealing joints.

The *Guide* also includes recommended tolerances: 1/2 to 3/4 inch out of plumb, and 1/2 inch out of level. (Which may explain why carpenters have to make so many adjustments after the foundation crew leaves.) The question is whether you want to part with \$21 to get this

addition to your knowledge.

In contrast, the ACI booklet on *Slabs on Grade* is a terrific compact reference. Once again, all the basics are covered—with specific emphasis on how to control cracking, and other floor-quality problems. The section on mix design includes aggregate-size specs, air-entraining recommendations, and other factors that affect durability. Various ASTM tests are covered in detail.

In the tool chapter, you'll learn what a come-along is in concrete work, why a jitterbug is "the most abused tool" for floor work, whether a wood or metal bull float is best for air-entrained concrete, and why the radius of an edger is important.

The chapter on placing and finishing slabs discusses proper subgrade preparation, why compaction by vehicle may do more harm than good, and where to place mesh in a slab (2 inches down). There's also a do/don't list to avoid segregation of aggregate, and miscellaneous tips, such as: Making a subbase one inch too low will cost you an extra cubic yard of concrete for every 18-foot-square section.

One minor bombshell is the allegation that poly vapor barriers below a slab can increase the chance of cracking, although why this might be true is never explained. (I plan to follow this up in a future issue, and I certainly wouldn't omit the vapor barrier based on this one reference.) In fact, the booklet gives a great deal of advice on how to minimize or prevent the seemingly ubiquitous shrinkage cracks that occur in slabs.

This advice includes proper jointing, which is the subject of its own chapter. Do you know the difference between *contraction* and *isolation* joints? Why an isolation joint around a column base should be diamond-shaped and intersect adjacent contraction joints at 45 degrees? Do you know how deep a sawed joint should be?

The authors adequately cover curing, but not with the thoroughness of the NAHB book, which includes cold- and hot-weather precautions. A final chapter briefly covers troubleshooting, and there are a glossary and metric-conversion chart.

My annual review of concrete books is also a plea for better quality in the trade. I hope the best of the above will find their way onto many bookshelves this year. ■

## In the Trenches

**Residential Concrete (915-3)**, by NAHB Research Foundation. National Association of Home Builders, 15th and M Sts., NW, Washington, DC 20005. 1983. 79 pages. \$12 members, \$15 nonmembers, \$2.50 handling.

**Guide to Residential Cast-in-Place Concrete Construction (ACI 332R-84)**, by ACI Committee 332. American Concrete Institute, P.O. Box 19150, Detroit, MI 48219. 1984. 37 pages. \$15.75 members, \$20.95 nonmembers, postpaid.

**Concrete Craftsman Series: Slabs on Grade**, by ACI (same address) 1982. 80 pages \$7.50 members, \$8.50 nonmembers, postpaid.

In contrast to Ambrose's rather theoretical design book, these manuals deal with the nuts and bolts of concrete construction. All three discuss the same subject from slightly different perspectives and with varying degrees of thoroughness. One is worth the price, another isn't, and the third is a real bargain.

The introduction to the NAHB's *Residential Concrete* claims that it "covers just about all the home builder needs to know about good quality concreting," which isn't much

of an exaggeration.

The booklet goes into the physics of concrete hydration more than the other two booklets do, but all three provide similar overviews of curing, mix design, admixtures, placing, and jointing of concrete. *Residential Concrete* has an excellent discussion of superplasticizers, which dramatically increase the slump and workability of stiff mixes for a short period of time. *Slabs on Grade*, on the other hand, is better on slump testing.

The NAHB book goes into

## Free or Cheap

**Consumer Information Catalog: The Consumer Information Catalog** has inexpensive—or free—booklets on everything from housing to money management to small business. A recent catalog included: *Buying Lots from Developers*, \$2.50; *Construction Guides for Exposed Wood Decks*, \$5; *Heat Recovery Ventilation for Housing*, \$2.25; and *The Repair of Historic Wooden Windows*, \$1. Write for a free copy: *Consumer Information Catalog*, P.O. Box 100, Pueblo, CO 81002.

**Window Testing:** Schlegel Corporation has just published the third in a series of free technical bulletins—*Durability: Air-Infiltration Performance Deteriorates Over Time*. The one-page bulletin describes the new ASTM procedure for durability testing for windows.

The other bulletins in the series are *Acoustics and Thermal Variance*. To receive any or all of them, contact: Schlegel Corp., Building Products Division, P.O. Box 23197, Rochester, N.Y. 14692.

**Thermographers:** A *Directory of Infrared Thermographers* is available from the Infrascopion Institute. Along with names and

addresses, the Directory includes the services offered, geographical areas serviced, and whether the thermographers are certified by the Institute. For a free copy, write or call the Infrascopion Institute, 33 Juniper Ridge, Shelburne, VT 05482, 802/985-2500.

**Asbestos:** As of January 20, all companies working with asbestos must comply with the new OSHA Asbestos Standards. To help employers, MSA (Mine Safety Appliances Company) has come out with a straightforward, 44-page booklet on OSHA compliance requirements written for contractors. For a free copy, call or write MSA at P.O. Box 426, Pittsburgh, PA 15230, 800/MSA-2222.

**Flame Spread:** The NFPA has a brochure on *Flame-Spread Performance of Wood Products*. The four-page pamphlet contains performance data, and describes building-code regulations on products used for interior finish. Write to the National Forest Products Assn., 1250 Connecticut Ave., NW, Washington, DC 20036, for a free copy.

—NEB staff