


ebookbig.com

or scan the QR code to access the digital study portal.

# ACKNOWLEDGMENTS

This book has its own story, and many individuals have helped shape it into what it is today. The idea for *Studio Companion* was hatched by the two authors, sitting on a rock outcropping on a sunny afternoon in Fairmont Park, Philadelphia. Both of us will always look back on that day with gratitude, along with a bit of nostalgia and amazement.

Along the way, a handful of editors, publishers, and designers have played special parts in creating and sustaining this book. Most recently, Margaret Cummins, executive editor, has stepped in and smoothly shepherded this sixth edition through its production phases. Amanda Miller, publisher, has over many years been a source of unwavering support. A few of the many others who have made past contributions and deserve mention include Donna Conte, senior production editor for many editions; Judith R. Joseph and Claire Thompson, editors during the publication of this book's first edition; and Karin Kincheloe, designer for the first edition. Paul Drougas, former editor, will always be appreciated for his many years of ever-patient support and encouragement.

Over this book's many iterations, a long list of educators and professionals have graciously donated their time and expertise to helping make this a more useful and authoritative reference. Most recently, Tom Marseille of WSP/Parsons Brinckerhoff deserves a special thanks for his comments and suggestions. Others who have contributed similarly in the past include (in no particular order) Carl Bovill of the University of Maryland, Stephen Vamosi of the University of Cincinnati, Robert Heryford and Peter S. Watt of R. G. Vanderweil Associates, Marvin Mass of Cosentini Associates, Richard J. Farley of the University of Pennsylvania, Daniel Schodek of Harvard University, Joel Loveland of the University of Washington, Elliot Dudnick of the University of Illinois at Chicago, Dan Faoro of Lawrence Technological University, Ralph Hammann of the University of Arizona, James Edwin Mitchell of Drexel University, Kevin Nute of the University of Oregon, Mahesh Senagala of the University of Texas at San Antonio, Sandy Stannard of California Polytechnic State University San Luis Obispo, Bruce E. Moore of Drury University, Diane Armpriest of the University of Idaho, David Glasser of Temple University, Roger N. Goldstein of Goody Clancy Associates, Jack Kremers of Kent State University, Sandra Davis Lakeman of California Polytechnic University, Alan Levy of the University of Pennsylvania, John Reynolds of the University of Oregon, Donald Prowler of the University of Pennsylvania, Marc Shiler of the University of Southern California, Harvey Bryan, Mark Dooling, Jerry Hicks, Douglas Mahone, Peter Stone, Ginger Feretto, Allen Iano, David Lipe, and Lesley Bain.

Thank you all.

# HOW TO USE THIS BOOK

This book is your desktop technical advisor for the earliest stages of building design. It reduces complex engineering and building code information to simple formal and spatial approximations that are readily incorporated into design explorations. If you are not familiar with this book, below is a recommended pathway for completing the preliminary design of your building. For more detailed guidance on how to use the information in this book, see the full example beginning on page 479.

Alternatively, information in this book may be accessed in any sequence that fits your particular needs or approach to designing buildings. To jump to any major topic, use the quick index that appears on the inside cover. From within any particular section, you may also follow the many cross references to related information in other parts. In the end, we hope this becomes your personalized handbook, an essential reference for your way of creating buildings.

**Step 1: Determine your building code and Occupancy.** Starting on page 5, determine what model building code to use for your project and what Occupancy Classifications apply to the planned activities within your building. These pieces of information are your key to unlocking information throughout other sections of this book.

**Step 2: Find what types of construction are permitted for your project.** Based on the information determined in Step 1, consult the height and area tables that begin on page 391 to determine what code-defined Construction Types are permitted for a building of your size and use.

**Step 3: Complete a preliminary structural design.** Review possible structural systems for your project, beginning on page 24, and consider approaches to the overall configuration of such systems, beginning on page 39. Once you have settled on a system for further study, you can complete a preliminary structural layout and assign approximate sizes to the system's major elements, using the information beginning on page 55.

**Step 4: Consider using daylighting.** Use the information beginning on page 142 to study the potential benefits and formal implications of using daylight illumination in your project.

**Step 5: Plan for mechanical and electrical systems.** Use the information beginning on page 168 for large buildings, or that on page 240 for small buildings, to consider heating and cooling systems that meet the needs of your project. Or, if you are particularly interested in passive heating and cooling systems, start on page 223. Once a viable system has been selected, use the information in the following sections to allocate spaces

within your building for its HVAC, electrical, plumbing, and other systems.

**Step 6: Determine building code requirements for egress and accessibility.** Use the information that begins on page 269 to lay out the necessary components of your building's exiting system. If needed, incorporate provisions for accessibility as well.

**Step 7: Add accommodations for parking.** If provision for parking is a requirement of your project, use the information beginning on page 337 to evaluate both surface and structured parking options.

# CONTENTS


- COVER
- THE ARCHITECT'S STUDIO COMPANION
- COPYRIGHT
- ACKNOWLEDGMENTS
- HOW TO USE THIS BOOK
- SECTION 1 DESIGNING WITH BUILDING CODES
  - 1 DESIGNING WITH BUILDING CODES
    - BUILDING CODES AND ZONING ORDINANCES
    - OCCUPANCIES: INTERNATIONAL BUILDING CODE
    - OCCUPANCIES: NATIONAL BUILDING CODE OF CANADA
- SECTION 2 DESIGNING THE STRUCTURE
  - 1 SELECTING THE STRUCTURAL SYSTEM
    - BUILDING CODE CRITERIA FOR THE SELECTION OF STRUCTURAL SYSTEMS
    - DESIGN CRITERIA FOR THE SELECTION OF STRUCTURAL SYSTEMS
    - DESIGN CRITERIA: SUMMARY CHART
    - PRACTICAL SPAN RANGES FOR STRUCTURAL SYSTEMS
    - LIVE LOAD RANGES FOR BUILDING OCCUPANCIES
    - LIVE LOAD RANGES FOR STRUCTURAL SYSTEMS
    - SOME TYPICAL CHOICES OF STRUCTURAL SYSTEMS FOR DIFFERENT BUILDING TYPES
  - 2 CONFIGURING THE STRUCTURAL SYSTEM
    - LATERAL STABILITY AND STRUCTURAL SYSTEMS
    - WALL AND SLAB SYSTEMS
    - COLUMN AND BEAM SYSTEMS
    - TALL BUILDING STRUCTURES
    - TALL BUILDING STRUCTURES
  - 3 SIZING THE STRUCTURAL SYSTEM
    - WOOD STRUCTURAL SYSTEMS
    - WOOD STUD WALLS
    - WOOD FLOOR JOISTS
    - WOOD ROOF RAFTERS
    - WOOD FLOOR AND ROOF TRUSSES—LIGHT
    - WOOD COLUMNS
    - WOOD DECKING

WOOD BEAMS
GLUE-LAMINATED WOOD BEAMS
CROSS-LAMINATED TIMBER
WOOD TRUSSES—HEAVY
GLUE-LAMINATED WOOD ARCHES
MASONRY STRUCTURAL SYSTEMS
BRICK MASONRY COLUMNS
BRICK MASONRY WALLS
BRICK MASONRY LINTELS
BRICK MASONRY ARCHES
CONCRETE MASONRY COLUMNS
CONCRETE MASONRY WALLS
CONCRETE MASONRY LINTELS
STEEL STRUCTURAL SYSTEMS
LIGHTWEIGHT STEEL WALL STUDS
LIGHTWEIGHT STEEL FLOOR JOISTS
STRUCTURAL STEEL COLUMNS
STRUCTURAL HOLLOW STEEL COLUMNS
STEEL FLOOR AND ROOF DECKING
STRUCTURAL STEEL BEAMS AND GIRDERS
OPEN-WEB STEEL JOISTS
SINGLE-STORY RIGID STEEL FRAMES
STRUCTURAL STEEL TRUSSES
SITECAST CONCRETE STRUCTURAL SYSTEMS
SITECAST CONCRETE COLUMNS
SITECAST CONCRETE WALLS
SITECAST CONCRETE BEAMS AND GIRDERS
SITECAST CONCRETE ONE-WAY SOLID SLAB
SITECAST CONCRETE ONE-WAY JOISTS
SITECAST CONCRETE TWO-WAY FLAT PLATE
SITECAST CONCRETE TWO-WAY FLAT SLAB
SITECAST CONCRETE WAFFLE SLAB
PRECAST CONCRETE STRUCTURAL SYSTEMS
PRECAST CONCRETE COLUMNS
PRECAST CONCRETE WALL PANELS
PRECAST CONCRETE BEAMS AND GIRDERS
PRECAST CONCRETE SLABS
PRECAST CONCRETE SINGLE AND DOUBLE TEES

SECTION 3 DESIGNING WITH DAYLIGHT
1 Design Criteria for Daylighting Systems
DESIGN WITH DAYLIGHT
SKY COVER
THE PATH OF THE SUN
SKY DOME OBSTRUCTION
BUILDING SITING AND SHAPE
BUILDING SITING AND SHAPE
BUILDING INTERIOR CONFIGURATION
DAYLIGHTING AND ENERGY CONSERVATION
2 CONFIGURING AND SIZING DAYLIGHTING SYSTEMS
RECOMMENDED ILLUMINANCE LEVELS
SIDELIGHTING
SIDELIGHTING
SIDELIGHTING
TOPLIGHTING
TOPLIGHTING
SECTION 4 DESIGNING SPACES FOR MECHANICAL AND ELECTRICAL SERVICES
1 SELECTING HEATING AND COOLING SYSTEMS FOR LARGE BUILDINGS
HEATING AND COOLING SYSTEMS FOR LARGE BUILDINGS
COMMON CHOICES OF HEATING AND COOLING SYSTEMS FOR LARGE BUILDINGS
DESIGN CRITERIA FOR THE SELECTION OF HEATING AND COOLING SYSTEMS FOR LARGE BUILDINGS
HEATING AND COOLING SYSTEMS FOR LARGE BUILDINGS: DESIGN CRITERIA SUMMARY
CENTRAL ALL-AIR SYSTEMS: VARIABLE AIR VOLUME (VAV)
CENTRAL ALL-AIR SYSTEMS: CONSTANT AIR VOLUME (CAV)
CENTRAL AIR AND WATER SYSTEMS: ACTIVE CHILLED BEAMS
CENTRAL ALL-WATER SYSTEMS: FAN-COIL TERMINALS
CENTRAL ALL-WATER SYSTEMS: CLOSED-LOOP HEAT PUMPS
CENTRAL ALL-WATER SYSTEMS: HYDRONIC CONVECTORS
CENTRAL ALL-WATER SYSTEMS: HYDRONIC RADIANT HEATING AND COOLING
LOCAL SYSTEMS: PACKAGED TERMINAL UNITS AND THROUGH-THE-WALL UNITS
2 CONFIGURING AND SIZING MECHANICAL AND ELECTRICAL SERVICES FOR LARGE BUILDINGS

MAJOR EQUIPMENT SPACES FOR LARGE BUILDINGS
VERTICAL DISTRIBUTION OF SERVICES FOR LARGE BUILDINGS
HORIZONTAL DISTRIBUTION OF SERVICES FOR LARGE BUILDINGS
SIZING SPACES FOR MAJOR HEATING AND COOLING EQUIPMENT
SIZING SPACES FOR AIR HANDLING
3 PASSIVE HEATING AND COOLING SYSTEMS
PASSIVE HEATING AND COOLING DESIGN
SELECTING PASSIVE HEATING AND COOLING SYSTEMS
PASSIVE SOLAR HEATING
NATURAL VENTILATION COOLING
THERMAL MASS COOLING
EVAPORATIVE COOLING
4 MECHANICAL AND ELECTRICAL SYSTEMS FOR SMALL BUILDINGS
DESIGNING SPACES FOR MECHANICAL AND ELECTRICAL SERVICES FOR SMALL BUILDINGS
DESIGN CRITERIA FOR THE SELECTION OF HEATING AND COOLING SYSTEMS FOR SMALL BUILDINGS
HEATING AND COOLING SYSTEMS FOR SMALL BUILDINGS: SUMMARY CHART
GENERAL CONSIDERATIONS: SMALL BUILDINGS
FORCED AIR HEATING AND COOLING
HYDRONIC (FORCED HOT WATER) HEATING
ACTIVE SOLAR HEATING
PACKAGED EVAPORATIVE COOLER
SMALL PACKAGED HEATING AND COOLING UNITS
ELECTRIC BASEBOARD CONVECTORS
ELECTRIC FAN-FORCED UNIT HEATERS
ELECTRIC RADIANT HEATING
WALL FURNACE AND DIRECT-VENT SPACE HEATERS
HEATING STOVES
PLUMBING SYSTEMS FOR SMALL BUILDINGS
ELECTRICAL AND COMMUNICATIONS WIRING FOR SMALL BUILDINGS
SECTION 5 DESIGNING FOR EGRESS AND ACCESSIBILITY
1 CONFIGURING THE EGRESS SYSTEM AND PROVIDING ACCESSIBLE ROUTES
COMPONENTS OF THE EGRESS SYSTEM

THE EXIT ACCESS
THE EXIT
THE EXIT DISCHARGE
ACCESSIBLE BUILDINGS AND ROUTES
ACCESSIBLE BUILDINGS AND ROUTES
EGRESS FROM AUDITORIUMS, CONCERT HALLS, AND THEATERS
WHEELCHAIR REQUIREMENTS FOR ASSEMBLY SEATING
OTHER EGRESS REQUIREMENTS
2 SIZING THE EGRESS SYSTEM
HOW TO SIZE THE EGRESS SYSTEM
INTERNATIONAL BUILDING CODE
NATIONAL BUILDING CODE OF CANADA
3 STAIRWAY AND RAMP DESIGN
STAIRWAY AND RAMP PROPORTIONS
EXIT STAIRWAY DESIGN TABLES
SECTION 6 DESIGNING FOR PARKING
1 DESIGN CRITERIA FOR PARKING FACILITIES
PARKING FACILITY TYPES
PARKING CAPACITY AND LEVEL OF SERVICE
ACCESSIBLE PARKING
2 CONFIGURING PARKING FACILITIES
PARKING CIRCULATION BASICS
SURFACE PARKING DESIGN
STRUCTURED PARKING DESIGN
STRUCTURAL SYSTEMS FOR STRUCTURED PARKING
3 SIZING PARKING FACILITIES
GENERAL SIZING CRITERIA
SIZING SURFACE PARKING
SIZING SINGLE-THREADED HELIX PARKING STRUCTURES
SIZING DOUBLE-THREADED HELIX PARKING STRUCTURES
SIZING SPLIT-LEVEL PARKING STRUCTURES
SIZING MULTI-BAY PARKING STRUCTURES
SECTION 7 DESIGNING WITH HEIGHT AND AREA LIMITATIONS
1 HEIGHT AND AREA LIMITATIONS
HEIGHT AND AREA LIMITATIONS
MIXED-OCCUPANCY BUILDINGS
MEZZANINES, FLOOR OPENINGS, AND ATRIUMS

FIRE PROTECTION
CONSTRUCTION TYPES
2 HEIGHT AND AREA TABLES
INTERNATIONAL BUILDING CODE
NATIONAL BUILDING CODE OF CANADA
APPENDIX A EXAMPLE USE OF THIS BOOK
APPENDIX B UNITS OF CONVERSION
BIBLIOGRAPHY
INDEX
EULA