LANDSCAPE
ARCHITECTURAL
GRAPHIC
STANDARDS
STUDENT EDITION
LANDSCAPE ARCHITECTURAL GRAPHIC STANDARDS

STUDENT EDITION

Leonard J. Hopper, RLA, FASLA
Editor-in-Chief

Smith Maran Architects
Graphics Editor

JOHN WILEY & SONS, INC.
# CONTENTS

Preface viii
Acknowledgments ix

## Part 1

### PRACTICE OF LANDSCAPE ARCHITECTURE 1

#### GENERAL 3
- Overview of the Profession 3

#### CONSTRUCTION DOCUMENTATION 4
- Overview of Construction Documentation 4
- Project Manual 5
- Construction Drawing Layout 6
- Symbols 8
- Landscape Planning 11

#### ENVIRONMENTAL AND LEGAL 14
- Environmental Review 14
- Legal: Permits and Regulations 16

#### PROJECT ADMINISTRATION 18
- Project Management 18
- Business Administration: Records, Legal, Liability 20
- Cost Estimating 23
- Bidding 25
- Construction Observation 26
- Postoccupancy Evaluation 30

## Part 2

### STANDARDS AND GUIDELINES 33

#### HUMAN FACTORS 35
- Human Nature and Spatial Relationships 35
- Community Participation 38

#### ENVIRONMENTAL FACTORS 40
- Modifying Solar Radiation 40
- Modifying Wind 44
- Regional Climate 47
- Modifying Microclimates 50
- Modifying Air Quality 52

- Brownfields Evaluation 54
- Environmental Hazards 55
- Wetlands Evaluation 56
- Resource Inventory and Conservation 58
- Sustainable Site Design 60

#### CULTURAL FACTORS 68
- Historic Landscapes 68

#### SECURITY CONSIDERATIONS 76
- Crime Prevention through Environmental Design 76
- Site Security Planning and Landscape Design Criteria 85

#### SITE PLANNING 92
- Environmental Site Analysis 92
- The Town Planning Process 95
- Rural Village Design 97
- Elements of Urbanism 99
- Plan Types 101
- Block Types 102
- Open Space Types 103
- Building Types 106
- Spatial Definition 108
- Frontage Types 109
- Landscape Types 110
- Traditional Neighborhood Design 111
- Site Planning for Fire Protection 113
- Residential Site Planning 114
- Residential Density 115
- Single-Family Detached Housing 116
- Single-Family Attached Housing 117
- Context-Sensitive Solutions 118
- Transit-Oriented Development 120

#### CIRCULATION 127
- Vehicular Circulation 127
- Parking Standards 137
- Parking Lot Design Guidelines 138
- Parking Space Dimensions 140
- Parking Lot Design 141
- Accessible Parking 142
- Bicycle Circulation 144
- Recreational Trails and Shared-Use Paths 147

#### ACCESSIBILITY 151
- Access to the Outdoor Setting 151
Part 3

PROCESS, IMPLEMENTATION, AND APPLICATION 167

CONSTRUCTION OPERATIONS AND EARTHWORK 169
Site Construction Overview 169
Soil Mechanics 172
Embankment Stabilization 184
Site Grading and Earthwork 185
Cut and Fill Calculations 196

WATER SUPPLY AND MANAGEMENT 200
Subsurface Drainage Systems 200
Surface Drainage Systems 201
Runoff Control Systems 204
Wetland Preservation 208
Wastewater Management: Graywater Harvest and Treatment 213
Constructed Treatment Wetlands 214

STORMWATER MANAGEMENT 218
Site Design for Stormwater Management 218
Stormwater Hydrology 225
Stormwater Conveyance 228
Stormwater Quality Control 231
Rainwater Harvesting 239
Stream Restoration 244

IRRIGATION AND WATER FEATURES 249
Irrigation 249
Water Features, Fountains, and Pools 254
Fountains and Decorative Pools 257
Garden Structures 258

PAVEMENT AND STRUCTURES IN THE LANDSCAPE 259
Pavement in the Landscape 259
Unit Pavers 261
Concrete Pavement 266
Asphaltic Concrete Pavement 270
Porous Pavements 272
Stairs, Ramp, and Curbs 273
Freestanding and Retaining Walls 285
Fences and Screens 304
Gazebos and Freestanding Wood Structures 323

SITE AMENITIES 338
Lighting 338

PLANTING 348
Soils: Urban or Disturbed 348
Public Planting Design Principles 354
Residential Landscape Design Principles 355
Environmental Effects of Trees 356
Site Considerations, Plant Installation Requirements, and Details 357
Tree Planting in Urban Areas 361
Planting: Special Considerations 364
Recommended Ornamental and Shade Trees for Use in Landscape Design in the Continental United States 365
Native Species: Upper Midwest 366
Native Plants 368
Xeriscape Design 370
Construction Damage to Existing Trees On-Site: Avoidance, Protection, and Preservation 372
Plant Maintenance 376
Interior Plants 390
Turf 392
Living Green Roofs and Landscapes over Structure 399

SPECIAL CONSTRUCTION 409
Plaza Membrane Waterproofing Systems over Occupied Space 409
Therapeutic Gardens 411
Wildlife Habitat 416
Campuses 421

HAZARD CONTROL 425
Soil Erosion and Sediment Control 425

RESTORATION AND REMEDIATION 431
Ecological Community Restoration 431
Brownfields Remediation and Development 438
Sound Control and Reduction 441

PARKS AND RECREATION 443
Large City Parks 443
Small Urban Parks 446
Waterfronts 449
Outdoor Play Areas 451
Golf Course Design: Planning and Details 460
Waste Management 463
Solid Waste Collection and Recycling Spaces 463
Part 4

MATERIALS 465

SOILS 467
Soils: Agronomic 467

ASPHALT 482
Asphalt 482

CONCRETE 486
Concrete 486
Concrete Reinforcement: Reinforcing Bars and Wire 501
Environmental and Health Considerations of Concrete 503

MASONRY 506
Brick Masonry 506
Concrete Masonry Units 510

METALS 512
Metal 512

WOOD 524
Wood and Related Materials 524

RECREATIONAL SURFACES 532
Recreational Surfaces 532

NURSERY STOCK 537
Nursery Stock Standards and Practices, Shipping and Handling,
Guarantees 537

OTHER MATERIALS 542
Greenhouses 542
Geotextiles 544
Paints and Coatings 545

EVALUATING THE ENVIRONMENTAL AND
HUMAN HEALTH IMPACTS OF MATERIALS 548
Life-Cycle Phases of a Material or Product 548
Inputs and Outputs Associated with Building Materials/Products 549
Green Building Materials Defined 551
Evaluation Tools 553

Index 557
John Wiley & Sons, Inc. is pleased to present the first Landscape Architectural Graphic Standards Student Edition. This edition is intended to be a valuable resource for students who are in undergraduate and graduate programs in landscape architecture and landscape design, as well as horticulture, architecture, planning, and urban design programs.

The Student Edition is an abridged version of Landscape Architectural Graphic Standards. It focuses on the practical, how-to aspect of landscape architecture, and bridges the gap between the theory of landscape architecture and the practical skill set. The broad spectrum of topics covered in the Student Edition makes it relevant to a number of courses throughout the typical academic career. Its content also makes it an excellent choice as a required text in professional practice, design, technology, environmental studies, and planting design, among other fields of study.

The basis for the choice of topics to include in the Student Edition began with a survey of accredited landscape architectural programs, as well as many related programs in other disciplines. Course syllabi were reviewed and evaluated, to help determine the most appropriate content for the publication. The evaluation process also identified material that would qualify the Student Edition either as a primary or strong secondary resource for a wide range of required coursework.

The process of deciding which topics to include was, understandably, a difficult one, for all the material addressed in Landscape Architectural Graphic Standards is important. To accomplish this task, the decision makers had to identify, first, those topics that would be most relevant for a student and, second, those courses for which the Student Edition would likely be a required text. The task was made manageable by an excellent and thoughtful Editorial Advisory Board, composed of a carefully selected cross section of highly respected members of academia: Dr. Robert D. Brown, University of Guelph, Meg Calkins, Ball State University, Bruce K. Ferguson, University of Georgia, Frederick Steiner, PhD, University of Texas at Austin, and Daniel Winterbottom, University of Washington. All were contributors to Landscape Architectural Graphic Standards, and each brought valued expertise to a different area of the discussion, resulting in the comprehensive coverage achieved in the Student Edition.

Furthermore, the creation of the complementary Web site to the Student Edition (www.wiley.com/go/landscapearchitecturalgraphicstandards) made it possible to provide additional material, which could not be included in this abridged volume, due to size constraints. The Web site also enabled the development of supplementary material for both students and instructors, which, together with this book, constitute a comprehensive and unique learning and teaching resource.

My thanks and appreciation go out to the Editorial Advisory Board, one of the brightest and most thoughtful group of individuals with whom I have ever had the privilege of working. I also want to thank my wife, Frances Hopper, who helped handle the administrative duties, and Patrick Weisel, one of my graduate students in the Masters of Landscape Architecture Program at City College, who performed a great deal of the preparatory work that made our task easier. My thanks also to Lauren Poplawski, Kathryn Malm Bourgoine, and Amanda Miller of John Wiley & Sons, whose support, patience, and gentle guidance shepherded this book from idea to finished project.

Leonard Hopper, RLA, FASLA
Masters in Landscape Architecture Program
School of Architecture, Urban Design and Landscape Architecture
City College of New York
ACKNOWLEDGMENTS

LGS STAFF
Leonard J. Hopper, FASLA
Editor-In-Chief

James E. Holtgreven, RLA
Assistant to the Editor-In-Chief

Frances C. Hopper
Administrative Assistant to the Editor-In-Chief

Jennifer R. Hopper
Administrative Assistant to the Editor-In-Chief

Graphics Editor
Smith Maran Architects, Montclair, NJ
Ira Smith, Principal
Erik Maran, Principal
Kimberly Murray, Graphics Manager
Maria Bucci
Katherine Cobb
Daniel D’Agostino
Michelle Lee
John Pelullo
Luis Rosario

and in association with
Emina Sendich, InfoDesign

Student Edition Advisory Board
Dr. Robert D. Brown
University of Guelph, Ontario, Canada

Meg Calkins, ASLA
Ball State University, Muncie, IN

Bruce K. Ferguson, FASLA
University of Georgia, College of Environment and Design, Athens, GA

Frederick Steiner, PhD, FASLA
University of Texas at Austin, School of Architecture, Austin, TX

Daniel Winterbottom
University of Washington, Seattle, WA

Contributors
Leonardo Alvarez, ASLA, AIA
American Institute of Steel Construction
The American Society of Landscape Architects
Phillip Arnold
Randall I. Atlas, PhD, AIA, CPP

Marni Barnes, LCSW, ASLA
Michael Barnicle
Nina Basuk, PhD
Kim A. Beasley, AIA
Michael A. Bender, ASLA
Craig Benson
Henry F. Bishop, ASLA
Wendy Bloom
Ryan Bouna
Mark E. Boyer
Don Brigham, FASLA
Dr. Robert D. Brown
Jeffrey Bruce, FASLA, ASIC, LEED

Meg Calkins, RLA, ASLA
Craig Campbell, FASLA
Dennis B. Carmichael, FASLA
Mark Cederberg
Craig Churchward, ASLA
The Cintas Foundation
Andy Clarke
Georganna Collins, RLA
Concrete Reinforcing Steel Institute
Vincente Cordero, AIA
Craig Coronato
Dr. Philip J. Craul
Timothy A. Craul

Thomas D. Davies Jr., AIA
Adam Davis
Joseph DiPonzio, ASLA
Andres Duany
Kelly F. Duke

Stuart Ebach

Bruce Ferguson
Carrie Fischer
Chuck Flink, FASLA
Ann Forsythe

Timothy Gilbert, ASLA
Dr. Terry J. Gillespie
Susan Golzman, FASLA
Gary Greenman

Sarah Georgia Harrison, ASLA
Alan Harwood, AICP
Ellen Heath, AICP
Randy Hester
Todd Hill, ASLA
James E. Holtgreven, RLA
Leonard Hopper, RLA, FASLA
Thomas Hopper
MaryCarol Hunter
Acknowledgments

Nathan Imm, RLA
Industrial Fabrics Association
Industrial Perforators Association

Carol R. Johnson, FASLA
Craig Johnson
Grant R. Jones, FASLA
Stanton Jones, ASLA
Tom Jones, RLA
Eran Ben-Joseph

Greg Kamman
Niall Kirkwood
Laura L. Knott, ASLA
William B. Kuhl

Rebecca Lave
Robert T. LeBlanc
Grace S. Lee
Heather Kinkade-Levario

William T. Mahan, AIA
Doug Mann, ASLA
Clare Cooper Marcus
Marc J. Mazz, AIA, P.A.
McKey Perforating Company
Marcia McNally
Joseph P. Mensch

Isabelle Minn
Janet Lenox Moyer
Laura Musacchio

National Lands Trust
National Roofing Contractors Association
L. Robert Neville, PhD
Thomas J. Nieman, PhD, FASLA

Jeff Olson, AIA
Paralyzed Veterans of American Architecture
Charles J. Parise, FAIA, FASTM
Lawrence G. Perry, AIA
Joe Petry
Rick Phillips
Elizabeth Plater-Zyberk
Kurt T. Promsko, P.E.

D. Neil Rankins, RGA
Michelle Robinson, LEED
Paul M. Rookwood, ASLA, AICP

Ronald B. Sawhill
Janice Cervelli-Schach, FASLA
Thomas Schueler
James E. Sekela, P.E.

Iskandar Shafie

Robert W. Shuldes, P.E.
Brian Smith
Stephen W. Smith
Rob W. Sovinski, ASLA
David Spooner
Frederick Steiner, PhD, FASLA
Brodie Stephens, Esq.
James K. Stuckley, ASLA, LEED
Ray Strychalski, ASLA
Sarah Sutton
Robert D. Sykes
Stephen S. Swoke, P.E.

Brian E. Trimble
Peter Trowbridge
Aaron J. Tukey

James Urban, ASLA

R. Alfred Vick

Cladie Washburn, ASLA
Susan Weiler, ASLA
Daniel Winterbottom
Patrick Wyss, FASLA

Kamal Zaharin
Part 1

PRACTICE OF LANDSCAPE ARCHITECTURE

General
Construction Documentation
Environmental and Legal
Project Administration
OVERVIEW OF THE PROFESSION

WHAT IS LANDSCAPE ARCHITECTURE?

Landscape architecture encompasses the analysis, planning, design, management, and stewardship of the natural and built environments. Types of projects include: residential, parks and recreation, roadways, urban design, streetscapes and public spaces, transportation corridors and facilities, gardens and arboreta, security design, hospitality and resorts, institutional, academic campuses, therapeutic gardens, historic preservation and restoration, reclamation, conservation, corporate and commercial, landscape art and earth sculpture, interior landscapes, and more. Landscape architects have advanced education and professional training and are licensed in 48 states (as of June 2005).

Landscape architects plan and design traditional places such as parks, residential developments, campuses, gardens, cemeteries, commercial centers, resorts, transportation facilities, corporate and institutional centers, and waterfront developments. They also design and plan the restoration of natural places disturbed by humans, such as wetlands, stream corridors, mined areas, and forested land. Having an appreciation for how historic landscapes and cultural resources enables landscape architects to undertake preservation planning projects for national, regional, and local historic sites and areas.

Working with architects, city planners, civil engineers, and other professionals, landscape architects play an important role in environmental protection by designing and implementing projects that respect both the needs of people and of our environment. Professionals who can meet human needs by making wise use of our environmental resources are in demand today and will continue to be so in the future.

A wide range of opportunities are open to landscape architects today. They may work on a variety of projects, such as the development and preservation of open spaces, recreation areas, wildlife refuges, zoos, parks, golf courses, and transportation systems. Landscape architects also may work for many types of organizations—from real estate development firms to municipalities constructing airports or parks—and they often are involved with the development of a site from its conception. Working with architects, surveyors, and engineers, landscape architects help determine the best arrangement of roads and buildings. They also collaborate with environmental scientists, foresters, and other professionals to find the best way to conserve or restore natural resources. Once these decisions are made, landscape architects create detailed plans indicating new topography, vegetation, walkways, and other landscaping details, such as fountains and decorative features.

In planning a site, landscape architects first consider the nature and purpose of the project and the funds available. They analyze the natural elements of the site, such as the climate, soil, slope of the land, drainage, and vegetation; observe where sunlight falls on the site at different times of the day and examine the site from various angles, and assess the effect of existing buildings, roads, walkways, and utilities on the project.

After studying and analyzing the site, landscape architects prepare a preliminary design. To accommodate the needs of the client and other stakeholders in the project, as well as the conditions at the site, the design frequently evolves based on input gathered at meetings held during the design development phase. These modifications from the preliminary design lead to the approval of the final design. They also take into account any local, state, or federal regulations, such as those providing barrier-free accessibility and those protecting wetlands or historic resources.

In preparing designs, computer-aided design (CAD) has become an essential tool for most landscape architects. Many landscape architects also use video simulation to help clients envision the proposed ideas and plans. For larger-scale site planning, landscape architects also use geographic information systems (GIS) technology, a computer mapping system.

Throughout all phases of the planning and design, landscape architects consult with other professionals involved in the project. Once the design is complete, they prepare a proposal for the client. They produce detailed plans of the site, including written reports, sketches, models, photographs, land-use studies, and cost estimates, and submit them for approval by the client and by regulatory agencies. When the plans are approved, landscape architects prepare working drawings showing all existing and proposed features.

They also outline in detail the methods of construction, itemize construction details, and draw up a list of necessary materials, including the written technical specifications for the project. Finally, during the construction implementation phase of the project, the landscape architect is often called upon, by the client, to monitor the installation of his or her design.

Some landscape architects work on a variety of projects, while others specialize in a particular area, such as residential development, street and highway beautification, waterfront improvement projects, parks and playgrounds, or shopping centers. Still others work in regional planning and resource management; feasibility, environmental impact, and cost studies; or site construction. Increasingly, landscape architects are becoming involved with projects in environmental remediation, such as preservation and restoration of wetlands, as well as the restoration of degraded land, such as mines or landfills. Historic landscape preservation and restoration is another important area where landscape architects are playing an increasingly important role.

The 2004 American Society for Landscape Architects (ASLA) Business Indicators Survey reveals that landscape architecture firms are growing in size, billing rates are increasing dramatically, and the client base for the profession continues to expand, most significantly in the public sector.

ASLA commissioned the first business indicators survey in 1997 and repeated it in 1999. This latest survey is based on information gathered in 2004 from more than 1,000 private sector landscape architecture firms. Indicators include market sectors; project types; client types; billing rates; contract types; design competition participation; marketing, spending and construction cost ratios; and profit margins. Of the firms and organizations responding to the survey, 80 percent are in the private sector, 16 percent are in the public sector, and 4 percent represent academic institutions. In the 2004 survey, most respondents have been in business for 25 years on average with an average revenue of $80,275. The average salary for those with 0 to 5 years of experience is $41,803. Those with 36 to 40 years of experience earn the highest average salary, at $97,564.

Demographic comparisons by gender between the 1999 and 2004 ASLA surveys indicate there has been no change in the private sector (24 percent women, 76 percent men). However, women now make up 34 percent of public practitioners and 24 percent of professionals in academia, increases of 4 percent in both sectors since 1999.

Based on projections by the Department of Labor’s Bureau of Labor and Statistics, employment of landscape architects is expected to grow faster than the average for all occupations through the year 2012. New construction is increasingly dependent upon compliance with environmental regulations, land-use zoning, and water restrictions, spurring demand for landscape architects to help plan sites and integrate man-made structures with the natural environment in the least disruptive way. Landscape architects are also becoming increasingly involved in preserving and restoring wetlands and other environmentally sensitive sites. Due to growth and geographic shifts in population, the expertise of landscape architects will be highly sought after in the planning and development of new residential, commercial, and other types of construction. For the general public, their most important issues and concerns impacting their daily lives and routines have a close relationship to landscape architect’s area of practice and responsibility. Thus, the work of landscape architects will play an increasingly important role in shaping the world’s future by making a positive impact on health, economic, social, and environmental issues.