

ARCHITECTURAL DETAILING

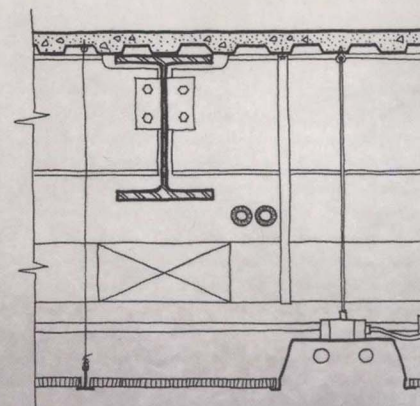
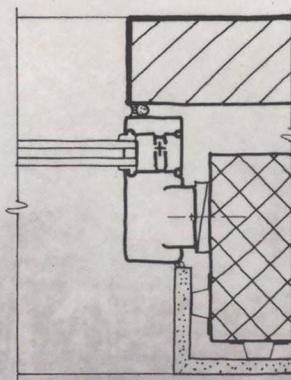
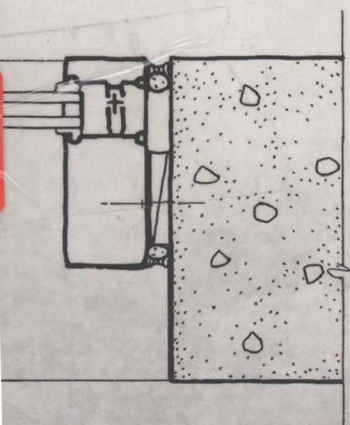
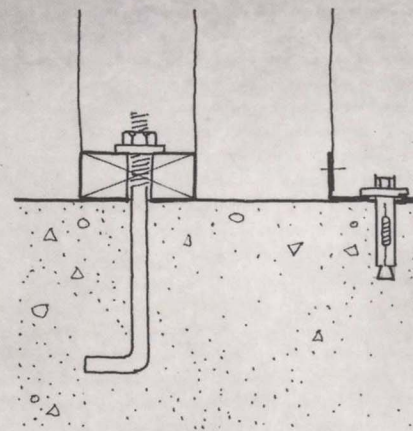
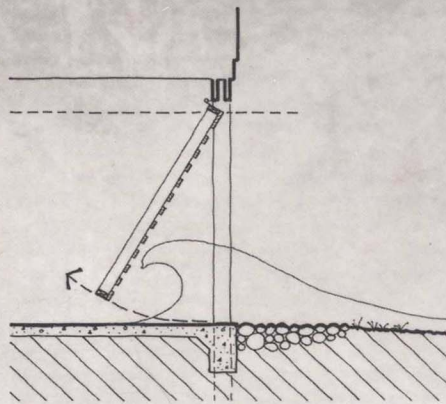
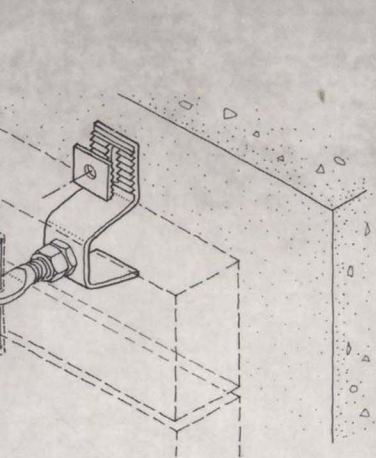
FUNCTION

CONSTRUCTIBILITY

AESTHETICS

EDWARD ALLEN · PATRICK RAND

THIRD EDITION



WILEY

Architectural Detailing

Function • Constructibility • Aesthetics

Third Edition

Edward Allen and Patrick Rand

WILEY

Cover Design: Wiley

Cover Images: drawings courtesy of author; abstract background © jessicahyde/iStockphoto

This book is printed on acid-free paper. ∞

Copyright © 2016 by John Wiley & Sons, Inc. All rights reserved.

Published by John Wiley & Sons, Inc., Hoboken, New Jersey.

Published simultaneously in Canada.

No part of this publication may be reproduced, stored in a retrieval system, or transmitted in any form or by any means, electronic, mechanical, photocopying, recording, scanning, or otherwise, except as permitted under Section 107 or 108 of the 1976 United States Copyright Act, without either the prior written permission of the Publisher, or authorization through payment of the appropriate per-copy fee to the Copyright Clearance Center, 222 Rosewood Drive, Danvers, MA 01923, (978) 750-8400, fax (978) 646-8600, or on the web at www.copyright.com. Requests to the Publisher for permission should be addressed to the Permissions Department, John Wiley & Sons, Inc., 111 River Street, Hoboken, NJ 07030, (201) 748-6011, fax (201) 748-6008, or online at www.wiley.com/go/permissions.

Limit of Liability/Disclaimer of Warranty: While the publisher and author have used their best efforts in preparing this book, they make no representations or warranties with the respect to the accuracy or completeness of the contents of this book and specifically disclaim any implied warranties of merchantability or fitness for a particular purpose. No warranty may be created or extended by sales representatives or written sales materials. The advice and strategies contained herein may not be suitable for your situation. You should consult with a professional where appropriate. Neither the publisher nor the author shall be liable for damages arising herefrom.

For general information about our other products and services, please contact our Customer Care Department within the United States at (800) 762-2974, outside the United States at (317) 572-3993 or fax (317) 572-4002.

Wiley publishes in a variety of print and electronic formats and by print-on-demand. Some material included with standard print versions of this book may not be included in e-books or in print-on-demand. If this book refers to media such as a CD or DVD that is not included in the version you purchased, you may download this material at <http://booksupport.wiley.com>. For more information about Wiley products, visit www.wiley.com.

Library of Congress Cataloging-in-Publication Data:

ISBN 978-1-118-88199-6 (cloth); ISBN 9781118882603 (ebk); ISBN 9781118882504 (ebk)

Printed in the United States of America

10 9 8 7 6 5 4 3 2

ACKNOWLEDGMENTS

Edward Allen thanks his longtime colleague Joseph Iano, who collaborated on the first edition of this book. His comments and ideas have strengthened the book in many important ways. Edward is very grateful for the wisdom, experience, and fresh point of view of Patrick Rand, who joined him again as coauthor with this third edition. He has long regarded Pat as one of the finest teachers of architectural technology in the world today.

At John Wiley & Sons, Inc., Paul Drougas, senior editor, guided all phases of the preparation and publication of the previous edition of this book with wisdom, patience, and good humor. Margaret Cummins, executive editor, provided valuable guidance and judgment in this new edition. Karin Kincheloe applied her limitless talent and resourcefulness to the design of the original edition. Many thanks to Doug Salvemini, who was the production editor for this book.

Lu Wendel Lyndon, Maynard Hale Lyndon, and Mary M. Allen were informal advisors throughout the writing and illustrating of the book. To all these friends and coworkers, the author extends sincere thanks. He also expresses his profound gratitude to his many students in detailing classes at the Massachusetts Institute of Technology and Yale University, who helped sharpen the focus of this book.

EDWARD ALLEN
South Natick, MA

Patrick Rand thanks Edward Allen, generous mentor to a generation of architectural educators, for this opportunity to collaborate again. Ed shows us all how to make the most important aspects of our craft vivid and accessible, empowering countless young designers to make architecture that is functional, constructible, and aesthetically pleasing.

Pat is also grateful to his many students, whose ambitious designs and probing questions helped him grow. Students in his graduate detailing seminars probed the breadth and depth of the principles in this book as they used them to analyze existing buildings and to design their own new projects. Work by these students provoked revisions of nearly all of the patterns in this edition, and the creation of several new patterns. He also thanks Christine Nalepa for her patience, support, and candid critiques of word and image.

Both authors acknowledge the perspective of landscape architect and educator Tom R. Ryan, who collaborated with them on a related book, *Detailing for Landscape Architects* (John Wiley & Sons, 2011). A number of the drawings in this book are based on illustrations in Allen and Iano, *Fundamentals of Building Construction: Materials and Methods*, 6th ed. (John Wiley & Sons, 2014). They have been adapted for this volume with the permission of the publisher, John Wiley & Sons, Inc.

PATRICK RAND
Raleigh, NC

INTRODUCTION

The transition from architectural idea to built reality is composed of countless decisions that are made amid a landscape of ever-changing circumstances. Architects design and draw for each building a set of details that show how it will be put together. Architects have primary responsibility for the detailing in buildings, a fact that architectural curricula often underappreciate. Detailing should be at least as prominent in architecture curricula as structures and mechanical systems: two areas in which consulting engineers often have primary responsibility. This book is intended to help students and young professionals become proficient with architectural detailing.

How does the architect know if these details will achieve the desired result? Will the building that they represent go together easily and economically? Will it shed water? Will it be easy to heat and cool? Will the details look good with one another and with the overall form and space of the building? Will the building grow old gracefully, and will it last for the requisite period of time? There are many more questions of similar importance.

The experienced architect does not leave the answers to chance. Each detail, no matter how special or unprecedented, is designed in conformance with universal, timeless patterns that, given competent execution on the construction site, virtually guarantee satisfactory building performance. These detail patterns are the subject of this book.

Detail patterns are elemental principles that are present in all successful building details. They represent an accumulation of centuries of wisdom about what works in building construction and what does not. Many of the patterns are firmly grounded in scientific fact. Others are based just as solidly on common sense and the realities of human performance. The experienced architect employs all these patterns automatically, as if by instinct, when designing details.

Good detailing is an opportunity to advance the concepts and aesthetic themes of the basic design. The detail patterns can be used to edit the schematic design, celebrating its strengths and eliminating features that are not contributing to the central ideas.

The patterns clarify the issues relevant to a particular detail but avoid stating what the solution should be. They are meant to provoke the designer to discover many possible solutions and to provide a clear process through which each can be assessed.

Details are rarely designed from scratch, as a pure response to a situation, as if it had never existed before. More often, we build upon precedents. The architect uses the detail patterns as a reliable means of analyzing and understanding existing details. They are helpful in reviewing one's own work, in checking the work of other detailers in the office, in judging the quality of manufactured

building components, and in diagnosing problems in existing buildings. The absence of attention to a particular detail pattern, or the presence of a feature that contradicts a pattern, usually indicates a problem or a potential problem that should be corrected.

The detail patterns are straightforward and easy to learn. There are slightly more than 100 of them. Each is irreducibly simple.

The first portion of this book introduces each of the patterns in turn, explains it, and illustrates several instances of its use. Each pattern is given a simple descriptive name and a graphical icon to assist in the memorization of it.

The patterns are arranged in three main groups: Function, Constructibility, and Aesthetics, corresponding to the three major concerns of the detailer. The order of presentation of these groups is not intended to imply their hierarchy or their sequence in the design process. Under each of these groupings, the patterns are further categorized by similarity of intent. The first category of patterns under Function, for example, is Controlling Water Leakage, comprising 13 detail patterns that offer a complete strategy for accomplishing this important task.

The second portion of the book demonstrates the use of the detail patterns during the process of designing the details of three different hypothetical buildings: one in wood, one in architectural concrete, and one in brick veneer over a reinforced concrete frame.

The book closes with an annotated listing of publications recommended for the detailer's own reference shelf and a list of websites of particular interest. Exercises for self-study or classroom use are also provided.

The almost 500 original sketches and drawings by the authors are intended to be illustrative of the building elements and natural phenomena being addressed. They are not working drawings. Almost all are freehand sketches, because this remains the primary means that designers use to begin creating details. Some information has been intentionally deleted or added to make the drawings effective instructional tools. For instance, anchors securing a masonry veneer to the backup are drawn in these sections, whereas they might be identified only in specifications or in a large-scale detail in a set of working drawings produced in an office. By including them in the sketches, readers will engage the visual reality in more complete terms.

It is assumed that the reader has a general background in the materials and methods of building construction and is familiar with the conventions of architectural drawing. In the detail drawings throughout the book, outdoors is always to the left or top of the drawing.

CONTENTS

Introduction xiii

PART I – DETAIL PATTERNS 1

SECTION 1 FUNCTION 3

CHAPTER 1 Controlling Water 5



Wash 7



Overlap 12



Overhang and Drip 15



Drain and Weep 19



Unobstructed Drainage 21



Ventilated Cold Roof 22



Foundation Drainage 24



Moisture Break 25



Capillary Break 26



Labyrinth 28



*Rainscreen Assembly and Pressure
Equalization* 29



Upstand 34



Sealant Joints and Gaskets 36

CHAPTER 2 Controlling Air 45



Air Barrier System 46



Weatherstripped Crack 48



Thermal Insulation 52



Thermal Break 54



Multiple Glazing 59



White and Bright Surfaces 60



Reflective Glazing 61



Reflective Surface and Airspace 62



Outside-Insulated Thermal Mass 64

CHAPTER 4 Controlling Water Vapor

67



Warm Interior Surfaces 68



Warm-Side Vapor Retarder 70



Vapor Ventilation 75



Condensate Drainage 78

CHAPTER 5 Controlling Sound

79



Airtight, Heavy, Limp Partition 80



Cushioned Floor 83



Quiet Attachments 85



Sound-Absorbing Surfaces 86

CHAPTER 6 Accommodating Movement

89



Seasoning and Curing 91



Vertical-Grain Lumber 94



Equalizing Cross Grain 96



Relieved Back 98



Foundation below Frost Line 99



Structure/Enclosure Joint 100



Abutment Joint 102



Expansion Joint 103



Control Joint 106



Sliding Joint 109



Building Separation Joint 111

*Small Structures* 114*Distributing Loads* 118*Connecting Dissimilar Materials* 116

CHAPTER 8 Providing Passages for Mechanical and Electrical Services

121

*Vertical Chase* 122*Horizontal Plenum* 125

CHAPTER 9 Health and Safety

129

*Safe Footing* 130*Fire-Safe Materials* 137*Fall Protection* 132*Fire-Resistant Assemblies* 138*Safe Edges* 134*Barrier-Free Design* 140*Safe Glazing* 135*Universal Design* 141*Nontoxic Materials* 136

CHAPTER 10 Providing for the Aging of the Building

145

*Life Cycle* 146*Dry Wood* 156*Expected Life* 148*Protected and Similar Metals* 158*Surfaces That Age Gracefully* 150*Less Absorbent Materials* 161*Repairable Surfaces* 152*Robust Assemblies* 163*Cleanable Surfaces* 153*Building Armor* 164*Maintenance Access* 154*Extreme Event Protection* 166

CHAPTER 11 **Ease of Assembly**

171

*Uncut Units* 172*Minimum Number of Parts* 174*Parts That Are Easy to Handle* 175*Repetitious Assembly* 178*Simulated Assemblies* 180*Observable Assemblies* 182*Accessible Connections* 183*Detailing for Disassembly* 185*Installation Clearance* 187*Nonconflicting Systems* 188CHAPTER 12 **Forgiving Details**

191

*Dimensional Tolerance* 192*Sliding Fit* 197*Adjustable Fit* 201*Reveal* 204*Butt Joint* 206*Clean Edge* 209*Progressive Finish* 211*Forgiving Surface* 213CHAPTER 13 **Efficient Use of Construction Resources**

215

*Factory and Site* 216*Repetitious Fabrication* 218*Rehearsing the Construction Sequence* 220*Off-the-Shelf Parts* 223*Local Skills and Resources* 224*Aligning Forms with Forces* 226*Refining the Detail* 228*All-Weather Construction* 229*Pride of Craftsmanship* 231*Accepted Standards* 232

CHAPTER 14 **Aesthetics**

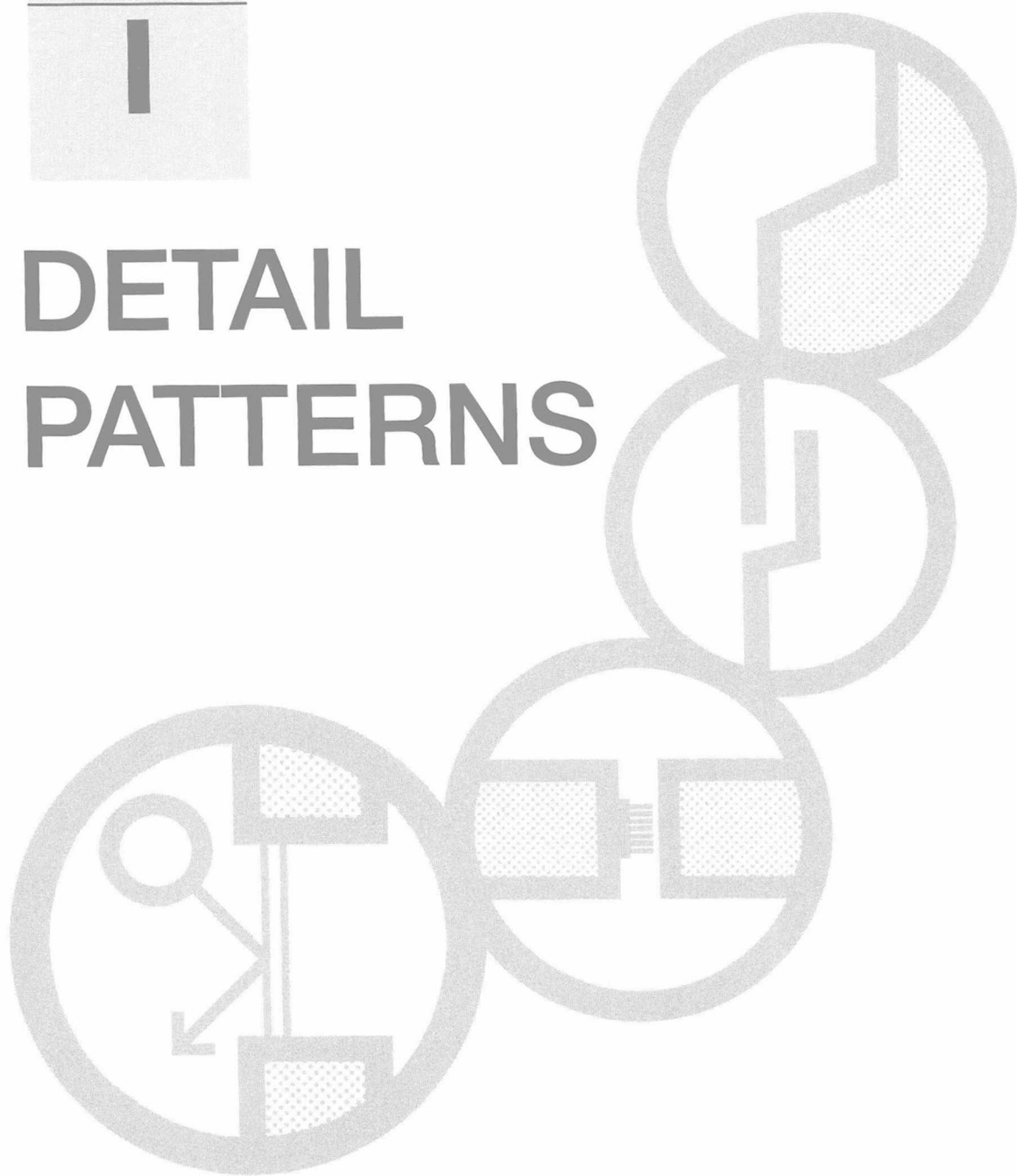
235

*Contributive Details* 235*Timeless Features* 238*Geometry and Proportion* 239*Hierarchy of Refinement* 241*Intensification and Ornamentation* 243*Sensory Richness* 245*Formal Transitions* 246*Didactic Assemblies* 249*Composing the Detail* 250**PART II – DETAIL DEVELOPMENT****251****SECTION 1 APPLYING THE DETAIL PATTERNS****253**CHAPTER 15 **Detailing a Building in Wood Light Framing****255**CHAPTER 16 **Detailing a Building in Architectural Concrete****289**CHAPTER 17 **Detailing a Brick Facing on a Concrete Frame****311****SECTION 2 GETTING STARTED****345****APPENDIX A: The Detailer's Reference Shelf****349****APPENDIX B: Formulating Exercises for Self-Study, Studio, or Classroom Use****355****INDEX****357**

PART

I

DETAIL PATTERNS



SECTION

1

FUNCTION

For a building to function well, its details must function well. When designing details for a building, the detailer has countless choices to make and no prescribed path toward the best solution. This portion of the book guides the detailer along this path by describing factors that affect the functional performance of details.

In architecture, function certainly includes the technical performance of the details that contribute to making a building safe and secure for its occupants. But function also includes features that affect the *qualities* of the forms, surfaces, and spaces that compose the building. A space that is firm and dry but that has an aggravating echo or glaring light does not function as well as it could.

The detailer is challenged to address the function needs of the building when it is new, but also long into the future and sometimes beyond the lifetime of those who designed or constructed it. Buildings constantly change in response to natural forces, such as the daily cycles of temperature and light, as well as in response to seasonal changes. A basic grasp of physics and of biological and chemical processes is part of the detailing process. Other functions concern the people who engage with the building every day, altering it internally and externally through countless actions.

The detail patterns that relate to function address the breadth of these topics. They are organized into thematic groups to focus the detailer's attention on each topic individually. Each pattern builds awareness of the issue and includes directions toward possible solutions. The patterns describe the natural processes involved, as well as the codes, standards, and conventional practices that are relevant to discovering appropriate detailing solutions.

INTRODUCTION

Water must be controlled in order to prevent **leakage**, which is the penetration of water through a building assembly. For water to penetrate through a building assembly, three conditions must all occur at the same time:

1. There must be an opening through the assembly.
2. There must be water present at the opening.
3. There must be a force to move the water through the opening.

If any one of these three conditions is not met, water will not penetrate the assembly. In designing any exterior detail, therefore, we can pursue one or more of three strategies:

1. We can try to eliminate openings in building assemblies.
2. We can try to keep water away from openings in building assemblies.
3. We can try to neutralize forces that move water through openings in building assemblies.

Complete success in any one of these three strategies will result in the complete elimination of water leaks, but sometimes in detailing we pursue two of these strategies or even all three of them at the same time. This approach gives added security in case one of the strategies fails as a result of poor workmanship or building deterioration. Let us consider each of these strategies briefly and list the detail patterns that relate to each. All of the patterns listed will be further explained later in this chapter.

1. Eliminating openings in building assemblies

Every building is full of openings. A shingled roof has an opening under each shingle. A wall has cracks around windows and doors, and around joints between the units of material from which the wall is made. Additional cracks and holes may form as the building ages and deteriorates. We can attempt to eliminate all these openings by using preformed gaskets and sealants. As the sole strategy, this is unreliable, however. Gaskets may not seal securely if they are the wrong size or resiliency, or if the surfaces they touch are rough or unclean. Sealants may fail to adhere properly if the materials to which they are applied are not scrupulously clean and properly primed, or if the installer does not compress the sealant fully into the seam. Both sealants and gaskets can deteriorate from weathering and from the flexing and stretching they may undergo as the building ages. A building skin that relies on sealants and gaskets alone for watertightness will leak sooner or later. Furthermore, even a small defect in a sealant or gasket that is exposed to

the weather can leak very large amounts of water, just as a small hole in a bathtub can create a very large puddle.

Sealants and preformed gaskets are extremely useful, however, as components of an overall strategy for making a building skin watertight. Therefore, it is important to know how to detail sealant joints and gasket joints correctly and how to incorporate them into more complex schemes for controlling water penetration. The detail pattern that relates to eliminating openings in building assemblies is:

Sealant Joints and Gaskets (p. 36)

2. Keeping water away from openings in building assemblies

There are a number of effective ways to keep water away from openings. Often it is useful to keep most water away from an opening simply to reduce the volume of water that must be dealt with at the opening itself. In many cases we can easily and securely keep all water away from an opening.

The detail patterns that relate to keeping water away from openings in building assemblies are the following:

Wash (p. 7)

Overlap (p. 12)

Overhang and Drip (p. 15)

Drain and Weep (p. 19)

Ventilated Cold Roof (p. 22)

Foundation Drainage (p. 24)

3. Neutralizing forces that move water through openings in building assemblies

There are five forces that can move water through an opening in a wall or a roof: (1) gravity, (2) surface tension, (3) capillary action, (4) momentum, and (5) air pressure differentials. In most cases, it is surprisingly easy to detail a building assembly so that all five of these forces are neutralized, and the most secure strategies for keeping water out of a building are based on this approach.

We have already encountered the detail patterns for neutralizing two of these forces, because these same patterns are useful in keeping water away from openings in buildings. The force of gravity is neutralized by the following:

Wash (p. 7)

Overlap (p. 12)

Surface tension, a force that causes water to cling to the underside of a surface where it can run into an opening, is neutralized by:

Overhang and Drip (p. 15)

The patterns for neutralizing the other three forces are the following:

Moisture Break (p. 25)

Capillary Break (p. 26)

Labyrinth (p. 28)

Rainscreen Assembly and Pressure

Equalization (p. 29)

Upstand (p. 34)

The capillary break neutralizes capillary action. The labyrinth neutralizes momentum, and the rainscreen assembly and the upstand neutralize air pressure differentials. By combining these seven patterns in each exterior joint of a building, we can make a building entirely waterproof.

When conceived as a well-coordinated group, these features combine to form the water control layer of the building envelope. The designer should be able to draw an uninterrupted line in plan and section representing the water control layer. A building with a continuous water control layer is entirely waterproof.

A WASH is a slope given to a horizontal surface to drain water away from vulnerable areas of a building. In general, every external horizontal surface of a building should have a wash. More permeable materials should have a steeper slope to shed water more quickly.

1. A window or door sill, whether made of stone, concrete, wood, or metal, always has a wash to keep water from accumulating next to the door or sash. A minimum slope for this type of wash is about 1 in. per foot (1:10 or 1:12). A steeper slope drains water faster and is more secure, because the more quickly water is removed from a surface, the less time it has to leak through. It is also more difficult for wind to drive water up a steeper slope.

2. The wash on this concrete chimney cap keeps water away from the vulnerable crack between the clay flue tile and the concrete. The slope should be at least 1:12. The outer edge of the cap should have a thickness of at least 3 in. (75 mm) to discourage cracking of the concrete, not the feather edge that is commonly used (see *Clean Edge*, Chapter 12). The cricket on the upslope side of the chimney consists of two washes that divert water around the shaft of the chimney. ▷

