Fundamentals of Building Operation, Maintenance, and Management

Angela Lewis Bradley Brooks

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A Course Book for
Self-Directed or Group Learning



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Angela Lewis, PE, LEED AP, is a professional engineer with a diverse background. She has worked as an engineer, researcher, and technical editor. As an engineer, Angela has worked on both green and conventional HVAC design projects, energy audits and controls master plans. Her research interests include proactive energy and maintenance management, facility management technologies, high-performance green building processes, and building operator training. As a technical editor, Angela has edited the IFMA Foundation Sustainability How-To Guide Series. She has authored multiple academic and trade journal publications and has spoken at numerous industry and academic conferences. As an active ASHRAE member, Angela is a member of GPC32, TC7.3, and TC7.1.

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Table of Contents

Preface ix

Acknowledgments xi

Chapter 1: Introduction 1

Importance of Building Operation, Maintenance, and Management. . 1

Types of Maintenance Techniques and Their Application 4

Computerized Maintenance Management Systems (CMMS). 5

Owning and Operating Costs 6

Heating, Ventilating, and Air-Conditioning Controls 7

Contractor Start-Up and Handover Procedures 7

Commissioning and Testing 8

Risk Assessment Procedures 9

Greening Your Facility 10

Health and Safety. 10

Chapter 2: Maintenance Techniques and Their Application 15

Introduction. 15

Maintenance Strategy and Control 16

Transitioning from Reactive to Proactive Maintenance 26

Maintenance Contracts 26

Establishing a Minimum Standard for Inspection and Maintenance of Equipment 28

Operating and Maintenance Documentation 31

Maintenance Technician Training 34

Chapter 3: Computerized Maintenance Management Systems (CMMSs) 41

Introduction. 41

Benefits of Implementing a CMMS 42

CMMS Modules 44

CMMS Selection Process 56

How to Implement a CMMS 59

Going-Live Phase 63

Keys to Successful Use of a CMMS 64

Using a CMMS to Generate Key Performance Indicators and to Track Performance 64

Cost of Implementing a CMMS 65

Field Devices 67

Training 68

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Chapter 4: Owning and Operating Costs 75
Introduction 75
First Costs of Building Ownership 76
New Building Construction Project Delivery Methods 76
Estimating Costs 78
Service Life 83
Depreciation 83
Recurring Costs 84
Maintenance Costs 84
Utility Costs 88
Regulatory Costs 90
Utility Billing Analysis 91
Economic Analysis 92
Chapter 5: Heating, Ventilating, and Air-Conditioning Controls . . . 105
Introduction 105
Control Components 106
Specifying Control Systems and Writing Control Sequences 116
Effective Use of Control Technology 119
Using the Control System for Energy Management 123
Impact of Controls on Operating Costs 129
Emerging Control Technologies and Strategies 129
Chapter 6: Contractor Start-Up and Handover Procedures 137
Introduction 137
Pre-Start-Up Procedures 138
Equipment and System Start-Up 141
Equipment and System Testing 144
Operator Training 147
Substantial Completion and Occupancy Permit 151
Handover Procedures 152
Record Drawings 152
Operating and Maintenance Documents 153
Warranty 155
Postwarranty Operation 155
Chapter 7: Commissioning and Testing 161
Introduction 161
Definitions 162
Commissioning Benefits 162
Commissioning Process 163
Functional Acceptance Testing 170
Testing, Adjusting, and Balancing (TAB) 172
Existing Building Commissioning 177

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Chapter 8: Risk Assessment and Emergency Preparedness 187
Introduction. 187
Defining Risk 187
Emergency Response Plans 188
Activating an Emergency Response Plan 192
Types of Risk and What to Do During an Emergency 193
What to Do After an Emergency 203
Chapter 9: Greening Your Facility 209
Defining Green Buildings 209
Developing a Plan to Green an Existing Facility 212
Areas of Green and Strategies to Green a Facility 215
Green Building Rating and Certification Systems 220
Benchmarking Tools 224
Selecting Energy Efficient Equipment and Building Products 226
Green Building Case Studies 227
Green Professional Credentials 229
Chapter 10: Health and Safety 237
Introduction. 237
Health and Safety Regulations 238
Health and Safety Policies 241
Organizational Health and Safety Programs 241
Safe Work Practices 244
Building Operating Regulations 258
Skill Development Exercises

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Preface

Operation and maintenance make up the largest portion of the economic and environmental life cycle of a building and have become primary considerations of building owners and operators. New directives and regulations governing energy use, sustainability, carbon emissions, indoor air quality, and systems performance have required an evolution in the knowledge and skills necessary to operate and maintain buildings. Although this course focuses on fundamentals, it presents sufficient detail to be useful to both recent students and experienced professionals

Heating, ventilating, and air-conditioning (HVAC) systems and equipment are the primary focus of this course, as they account for a majority of operation and maintenance efforts. However, plumbing, electrical, and life safety systems, as well as other building systems are also presented. Charts, tables, and graphics provide easy and orderly reference to information and illustrate key ideas. Chapters describe concepts, define terminology, and discuss typical practices and procedures, project examples, and case studies.

Each chapter addresses a unique topic of interest to building professionals. Chapter 1 provides an overview of building operation, maintenance, and management. Chapter 2 discusses maintenance and management techniques and their application. Chapter 3 focuses on use and application of computerized maintenance management systems (CMMS). Chapter 4 outlines several economic factors related to building operation and provides equations and examples to illustrate concepts described. HVAC controls, contractor start-up and hand-over procedures, and commissioning and testing are discussed in Chapters 5, 6, and 7, respectively. Chapters 8, 9, and 10 present risk assessment procedures, greening facilities, and health and safety.

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Introduction

Study Objectives

After completing this chapter, you should be able to

- ❑ list topics important to understanding the fundamentals of building operations, maintenance, and management;
- ❑ understand some terminology that will be used within future chapters; and
- ❑ understand the importance of building operations, maintenance, and management.

Instructions

Read the material in Chapter 1. At the end of the chapter, complete the skill development exercises without referring to the text.

Importance of Building Operation, Maintenance, and Management

The study of building operation, maintenance, and management is an important and timely topic. Never has a greater emphasis been placed on these activities. In the latter half of the 20th century, creation of built environments on the roles of architect, engineer, and builder. Architects designed and developed the physical structures and in the process determined the aesthetics of a building, engineers designed systems to support building functions, and contractors built the physical structures and were responsible for installation of equipment and systems.

It is building engineers and operators, however, who adjust, tune and optimize building systems to perform according to the owners' and occupants' requirements. For too long, design and construction have been the focus, and operation and maintenance of buildings have been neglected.

Management of building operation is a science, and today's building managers not only must be well versed in operation and maintenance of equipment and systems, they must have a fundamental knowledge of cost control, technology, contracting, risk assessment, and how to ensure a healthy and safe work environment. *Energy usage*, *sustainability*, and *high-performing buildings* are terms related to operation now common in discussion of buildings. Economic

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