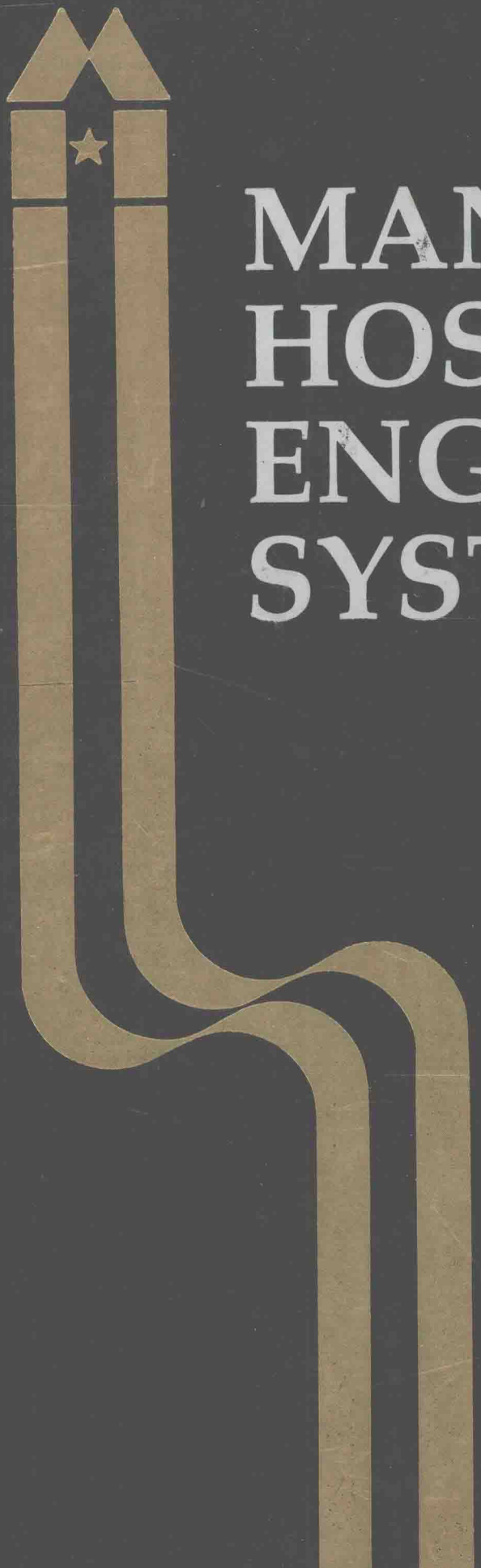

MANAGING HOSPITALITY ENGINEERING SYSTEMS

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David M. Stipanuk

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the EDUCATIONAL INSTITUTE
OF THE AMERICAN HOTEL & MOTEL ASSOCIATION

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Preface

This text has been prepared with the needs of three separate audiences in mind: students enrolled in hospitality management programs, hospitality facility managers interested in furthering their understanding of property operation and maintenance, and engineering/maintenance managers. The content and organization of the text have been carefully chosen to benefit each of these three groups significantly.

For the student enrolled in a hospitality management program and the instructor in such a program, the text affords flexibility in the amount and depth of exposure on any individual topic. This flexibility allows the text to be used for courses in both two- and four-year programs, where the amount of time available for the treatment of property operation and maintenance in lodging facilities varies considerably from program to program.

For the program which has less than a full semester to devote to the study of the engineering department and building systems, Chapters 1, 2, and 3 provide a concise treatment of these topics. Chapter 1 introduces the reader to some of the basic costs associated with the physical plant, starting with the building design and construction and including property operation and maintenance, energy, and renovation. Also included is a summary of the major duties and responsibilities of the engineering department in modern lodging establishments. In Chapter 2, the management function of the engineering department is discussed and developed in detail. Chapter 3 provides an overview of the major building engineering systems, their design, and their operational characteristics.

Chapters 4 through 9 discuss the major building systems traditionally covered in a course in building engineering systems: water and wastewater systems, electrical systems, heating systems, food service refrigeration systems, air conditioning systems, and integrated HVAC systems. Chapters 10 through 13 supplement these major systems with discussions of HVAC equipment, lighting systems, fire protection systems, and energy management. For full-semester programs, Chapters 1 through 13 should prove to be an ambitious yet realizable goal.

The hospitality manager reading this book with the goal of better understanding the engineering department will greatly benefit from Chapters 1 and 2, where the costs and responsibilities of the engineering department are developed and discussed in relation to the other departments in a facility and to a property's overall goals. The material should provide the manager with a number of suggestions for improving the operation of the department at his or her facility. Managers who wish to improve their understanding of building systems will benefit from the material in Chapter 3, which contains a great deal of basic information concerning building systems in non-technical terms. The hospitality manager with a further interest in a specific type of building system should find the appropriate chapter to be very readable, with a heavy emphasis on descriptive detail. When used with the Index, the book will be a very useful reference volume for any hospitality manager.

The building engineering manager reading this text may be in for a few surprises. The duties of the department, managerial responsibilities, and personnel characteristics discussed in Chapters 1 and 2 are more extensive and varied than some managers realize. Most engineers will want to skip Chapter 3 and use the detailed information on building systems contained in the remainder of the text. In these remaining chapters, the engineering manager will find the basic system description and variations on system design helpful in training new staff or in broadening the knowledge of existing personnel. With most chapters containing Applications sections which develop certain aspects of the chapter material in some depth, engineering managers should find each chapter helpful in improving their understanding and manage-

ment of building systems. Engineering managers will also appreciate the text's two appendixes. Appendix A contains a refresher course in basic engineering principles, something which is often helpful as a reference. Appendix B discusses the relationship of temperature and humidity to human comfort, a topic of great importance in an industry dedicated to guest satisfaction. The Index provides a ready reference.

The text cites a number of references. Any reader desiring additional material on the topics contained in the text should refer to these books, magazines, and other publications. Regularly reviewing the various periodical publications is an excellent way of keeping abreast of the latest developments.

The authors represent the most recent standard-bearers in a long tradition of Cornell University School of Hotel Administration educators dealing with the physical plant. Beginning with Frank Randolph and continuing with our colleagues Richard H. Penner and Richard A. Compton, the School has long emphasized in its curriculum the importance of the physical plant. We have certainly been influenced by this tradition and acknowledge its contribution to the development of this text.

Dean John J. Clark of the School, formerly a member of the Properties Management faculty, will find woven into the fabric of the book several insights and approaches derived from his extensive course notes. His support in the allocation of time and resources to aid the development of this text has been a major contribution.

The Executive Engineers Committee of the American Hotel & Motel Association has provided a forum for discussing fertile ideas, many of which are incorporated here. Its encouragement and assistance is certainly appreciated. In addition, several of its members served as our review committee, contributing significantly to the style and order of the text and providing many worthwhile comments during its formative stages. Our thanks go to review committee members Robert E. Aulbach, Robach Inc.; Paul R. Broten, CEOE, Conrad Hilton College, University of Houston; Charles C. Cocotas, CEOE, Lehr Associates; and Raymond B. Hambel, CEOE, Hilton Hotels Corporation.

We have used numerous resources in the development of this text and are indebted to many authors. We have carefully attempted to credit all those whose work made a unique contribution to the text. Still, we know that we have been influenced by and owe much to the writings and comments of many unnamed others who have guided our thoughts through their articles in trade journals, books, and magazines.

Given the months which have been devoted to the preparation of this text, we must acknowledge the support we have received from our wives and children. They have endured hearing about "the book" for all too long. Their quiet understanding of the process of becoming an author is greatly appreciated.

Much of the art in the text has been prepared by Susan MacKay. Her professionalism has certainly contributed to the overall quality of the text and is much appreciated. Arianne Steinbeck was also involved in the production of some of the illustrations, providing excellent assistance in our efforts to meet the production deadlines for the text. In addition, our editor at the Educational Institute, Tim Eaton, significantly aided us in clarifying our wording and in developing a professional text. He has been very helpful and we hope we have not caused him to age too prematurely.

Finally, we must extend thanks to all the students who have attended our seminars and classes over the past years in maintenance, energy management, building systems, safety, and security. These students, both in the School and from the industry, have greatly contributed to our insights into the needs which exist in the hospitality field for an understanding of physical plant management.

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Contents

1

Introduction to the Physical Plant and Building Operations

The Physical Plant

The term *physical plant* refers to the grounds, building structure, building systems, interior finishes (that is, paint, carpeting, wallpaper, and so forth), and furniture, fixtures, and equipment (FF&E) of a lodging facility. Many of these components of the physical plant are highly visible, such as the grounds, the exterior building structure, and the FF&E. Other portions of the physical plant, such as the structural steel in the building, the plumbing, and large amounts of the heating, ventilating, and air conditioning (HVAC) system, are seldom seen by the guests or most of the employees. The elements of the physical plant constitute a significant portion of the construction cost of a facility and consume a significant fraction of the maintenance and energy cost incurred over the building's lifetime.

The care and operation of the physical plant of modern lodging facilities is largely the responsibility of the engineering or maintenance department (the two terms are used interchangeably in this text). To understand the scope of this department's duties and responsibilities relative to the physical plant, a brief overview of the physical plant of modern lodging facilities and how these facilities have changed over time is helpful.

Yesterday and Today

The vast diversity of the modern lodging industry results in great variety in the complexity of the physical plant. As lodging facilities have grown in physical size, they have also grown in the complexity of their design, systems, and services. The physical plants of simple roadside motels in the 1930s and 1940s required little more skill to maintain and operate than that needed by a homeowner. In contrast, the "mega-hotels" of the late 1980s require several degreed engineers and individuals with specialized skills for their operation.

A list of some of the systems found in most modern lodging establishments would include:

- HVAC (heating, ventilation, and air conditioning)
- Water (hot and cold)
- Sewer (storm and sanitary)
- Lighting
- Telephone
- Refrigeration
- Cable television
- Fire protection

- Vertical transportation (elevators and escalators)

While not all establishments have every system, the list is impressive and growing. As recently as 20 years ago, it was rare for a property to have a cable television system and a health club and to *own* its telephone system. Today, such arrangements are almost standard. Systems and services which are relatively rare today but which are growing in popularity, such as personal computers in the guestroom, may become standard by the early 1990s. Each new system or service will bring with it new demands on facilities designers and on the engineering and maintenance function.

To operate the systems found in most properties, the properties need to purchase or produce certain basic services. At most United States properties, basic services such as water, sewer, fuel, electricity, communications, refuse removal, and so forth are purchased from a reliable local vendor. In many locations in the world, this is not the case. Properties in such locations may need to supply their own electricity, dispose of their own wastes, and operate other systems taken for granted in more developed countries. In many ways, lodging establishments in less developed countries find themselves in situations which are similar to those of United States hotels earlier in this century.

Many services and features of today's lodging properties were either non-existent in properties of the not-so-distant past or were provided by very different systems or equipment. During the early part of this century, hotels in urban areas burned coal to supply their heating needs, operated steam turbines and engines to produce electricity, provided space cooling only to a few dining areas, and used ammonia as the refrigerant in refrigeration systems.[1] The early 1900s saw Ellsworth Statler pioneer several then-new concepts in his Buffalo, New York, hotel, including installing individual bathrooms in hotel rooms, piping chilled drinking water to the guestrooms, carpeting the hallways to reduce noise, and more. In 1926, Statler stunned his board of directors by announcing he was going to put a radio in every room of his Boston hotel at a cost of $50,000.[2] The first complete guestroom air conditioning system was not installed until 1934 at the Detroit Statler.[3]

Engineering and Marketing

Technological innovations in the industry have often served as marketing elements for lodging facilities. When Statler installed individual bathrooms, he marketed his product with the slogan "A room and a bath for a buck and a half." In the early days of the motel business, properties clearly advertised that they offered television and were air conditioned. In communities where fire had taken a high toll, such as Chicago and San Francisco, properties prominently advertised their fire-proof construction and announced the presence of onsite water storage to combat fires. Lodging properties have been notable for their early adoption of new technologies in the constant quest for better guest service and an edge in the marketplace.

Spatial and Operating Characteristics: Some Managerial Aspects of Engineering

When the responsibilities of the engineering department are discussed, it is often easy to focus merely on the detail of the required activity, that is, to maintain and repair. But if we focus too narrowly on the detail, we may forget to see and appreciate the purpose of this department and its crucial role in the overall functioning of a lodging operation. A lodging property may benefit substantially if its management establishes broad goals for the engineering department. Identifying and clearly communicating such goals may help motivate personnel, define duties and responsibilities, and clarify interdepartmental relationships.

The following is a sample set of general operational goals for the engineering department which results in a functional way of viewing the department's responsibilities (and which is the basis for much of this text):

- Protect the investment in the physical plant.
- Control maintenance costs.
- Contribute as appropriate or necessary to overall guest satisfaction.
- Contribute to the efficient operation of other departments.

- Minimize the energy costs of the facility.
- Minimize potential safety problems.

The engineering department is organized to provide services to the guests and the remainder of the departments within a lodging facility. In order to provide the services, the staff of the department must accomplish functions that fall into two distinct categories: technical functions and managerial functions. The technical functions (for example, repairing the chiller) relate to the physical building and its landscaping, systems, interior finishes, furniture, and equipment, while the managerial functions (for example, planning the budget) relate to the operation of the department as a unit within the managerial structure of the property and, when applicable, the overall corporate structure of the operating company.

The success of the department in accomplishing the technical functions is totally dependent on the performance of the department in the managerial functions, which are similar to those functions necessary for the operation of any department. Engineering managers (whether the director of engineering in a very large first-class property or the head maintenance person in a small budget property) must have the ability to perform the typical management functions of planning, organizing, directing, controlling, staffing, setting goals, motivating their staff, communicating with their staff and with the rest of the property, and developing their staff. All of this is accomplished through a departmental structure that is appropriate to the size of the property.

For the department to be effective, engineering managers must also interact with the other managers in the property throughout the annual business cycle so that the technical functions completed by the department are compatible with the business objectives of the managers of the property. For example, the director of engineering must determine through the budgeting process that the level of maintenance and the cost associated with this level are sufficient to portray the appropriate image to the guests. Additionally, the head of the department in a chain property must interact with the central engineering group of the operating company in order to receive or provide information (for example, energy consumption reports, staffing reports) that is helpful for the coordinated operation of the specific property within the lodging chain.

Clearly, then, the managerial aspects of engineering are of vital importance. Managers must understand a variety of factors that influence engineering concerns. Just as important, they must understand that an approach to a problem that works at one property may not work at another property, even if the properties seem to be similar in many ways. In the next few pages, we will discuss a wide variety of general information and statistics concerning spatial and operating characteristics of lodging facilities that may provide important insights into the differences involved in managing different properties.

Types and Sizes of Facilities

Lodging facilities can be classified in numerous ways. Classification can be based, for example, on the market a property serves, the property's location, the rates it charges, and the facilities it provides. Thus, we could have a transient (market) facility at an airport (location) which is an economy (rate) property that provides lodging only (facilities). The variations in types of lodging facilities and the resulting variations in space and operating needs of these facilities could easily fill a book in itself (and has done so several times). One recent book, *Hotel Planning and Design* by Walter A. Rutes and Richard H. Penner, serves as the basis for the following discussion.[4] In their book, Rutes and Penner discuss various types of lodging facilities in detail, describing their characteristics, origins, and market growth. It is not possible in the limited space available here to summarize all the various types of lodging establishments. For a detailed discussion of the nature, variations, and requirements of lodging facilities, we suggest the reader refer to Rutes and Penner's book or a similar volume. We must assume that the reader is familiar with the industry.

Rutes and Penner discuss the facilities program as it relates to various classifications of lodging facilities. Exhibit 1.1 illustrates the space planning needs of various functional areas within the property for the major lodging property types considered in their book. Note how much the total area of a guestroom and total building area per guestroom varies from one facility type to another. Maintenance needs and

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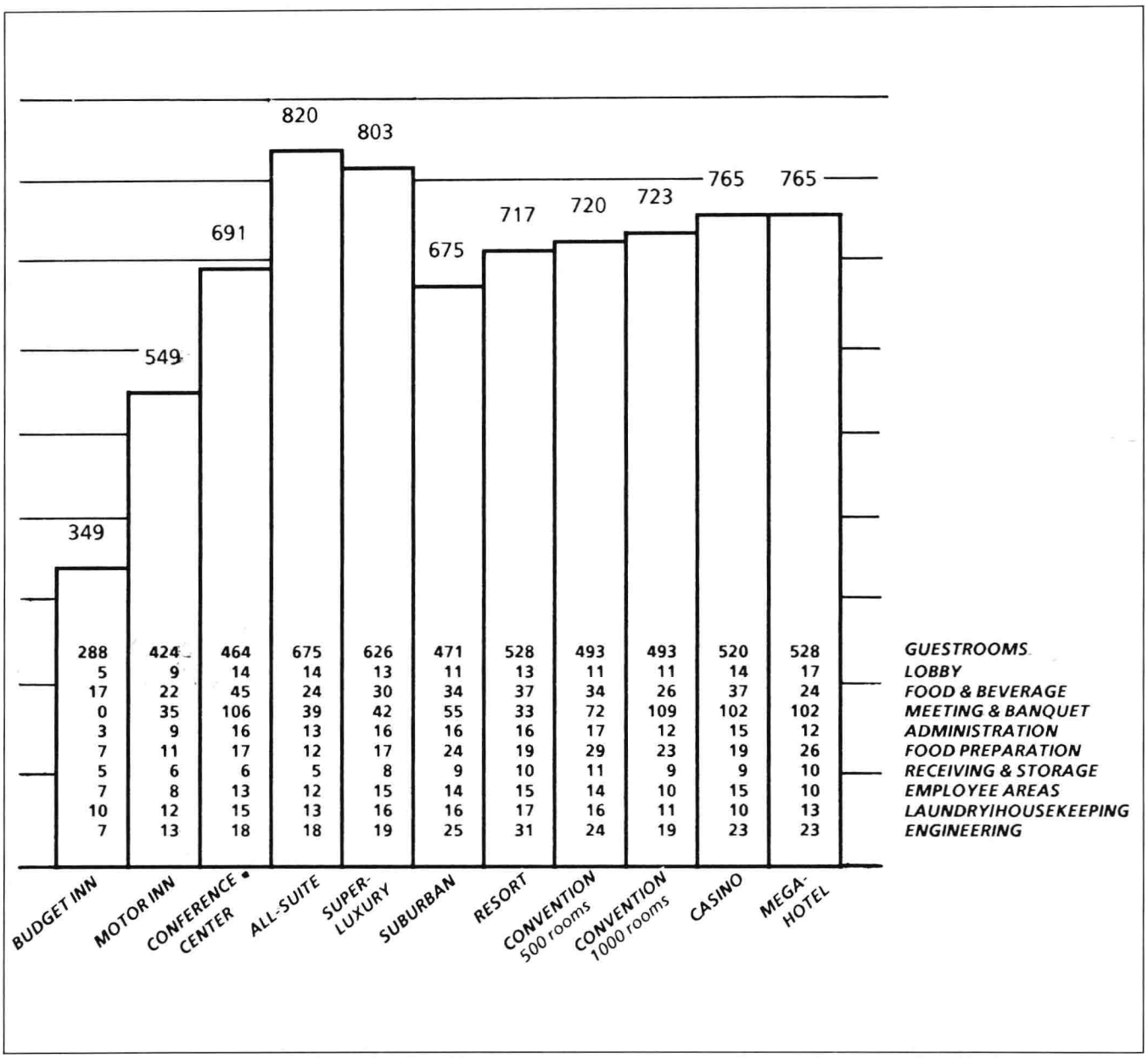
Exhibit 1.1 Space Requirements by Property Type: Area per Room

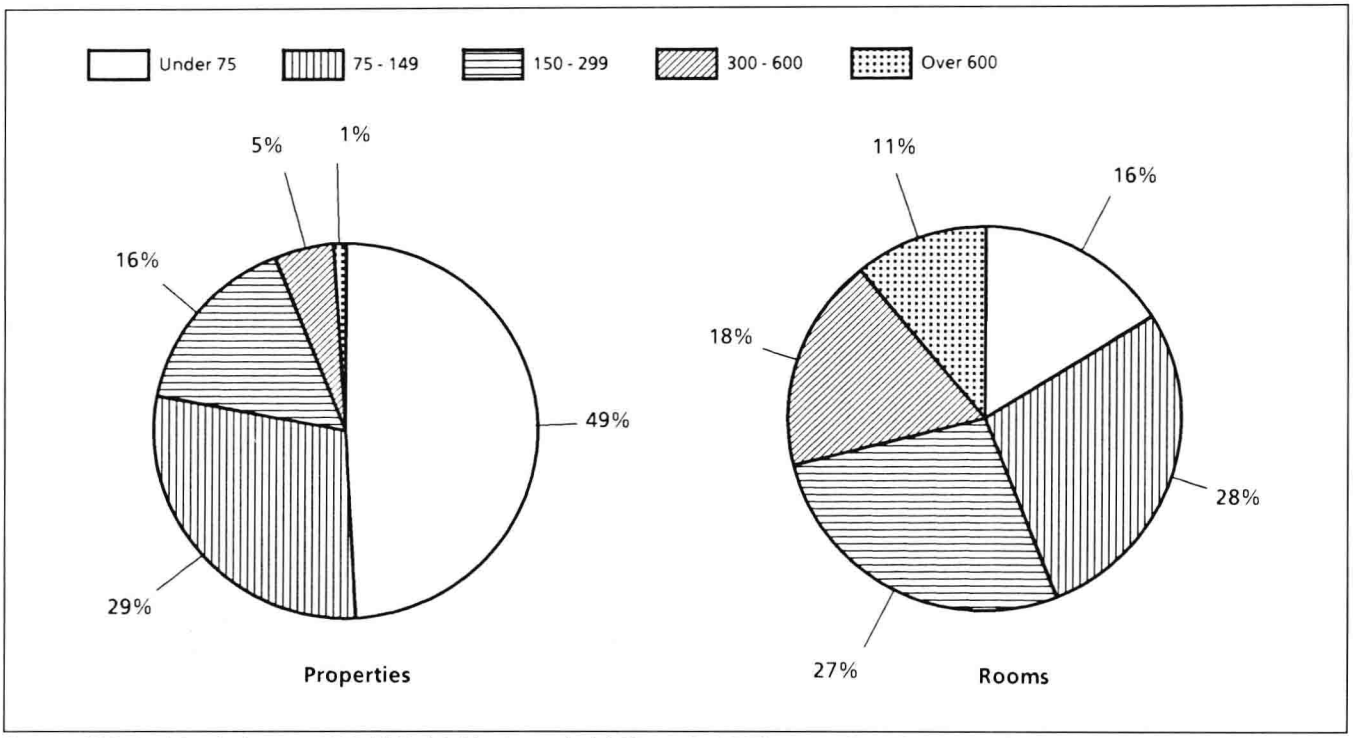


Source: Walter A. Rutes and Richard H. Penner, *Hotel Planning and Design* (New York: Whitney Library of Design, 1985), p. 158. Used by permission.

energy usage will be highly dependent on the size, facilities, and finishes of the property.

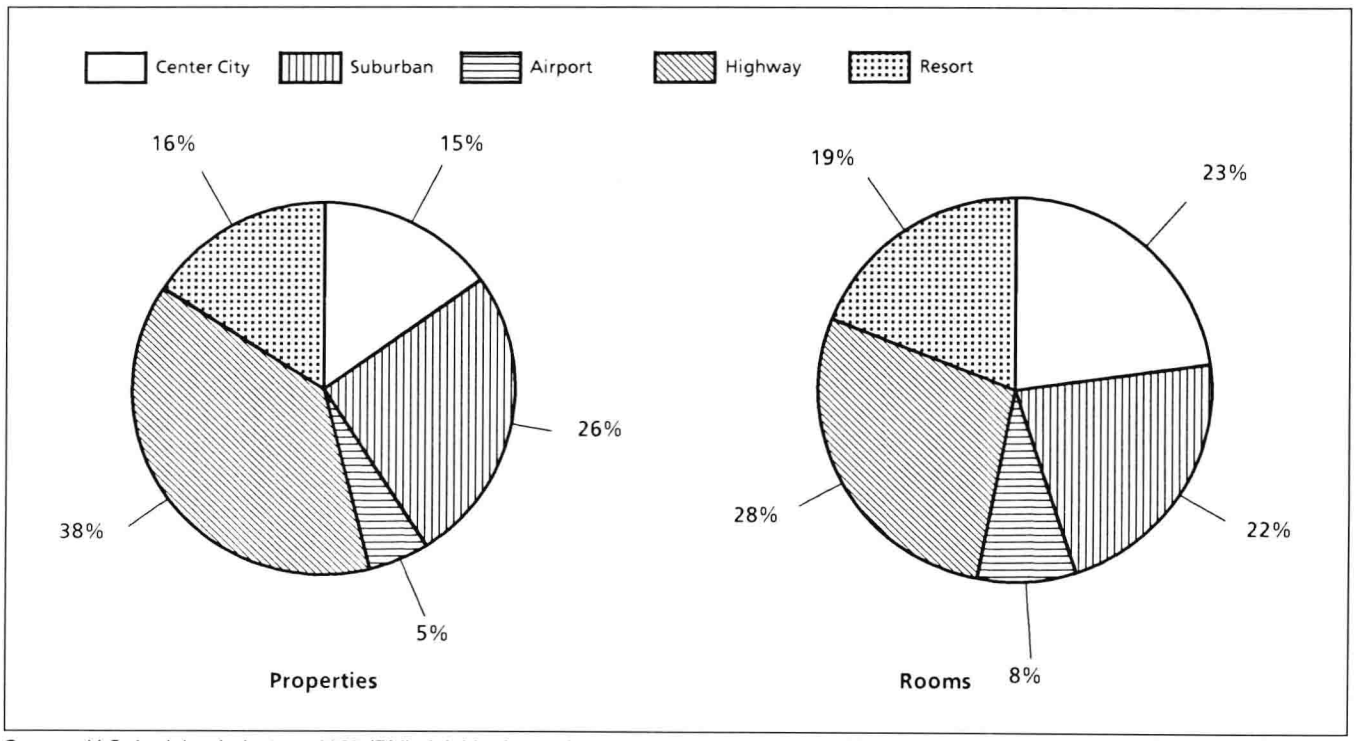
Exhibit 1.2 illustrates the distribution of lodging facilities by size of facility in terms of both the number of properties and the number of rooms. Exhibit 1.3 illustrates the distribution of these facilities in terms of location. Approximately 95% of the lodging establishments have under 300 rooms and approximately 71% of the total rooms are found in establishments under 300 rooms in total size. In 1985, the lodging industry (defined by Laventhol & Horwath—a national accounting firm—as all properties open all year and having more than 25 rooms) comprised approximately 54,000 establishments and 2.2 million rooms.

Exhibit 1.2 U.S. Lodging Industry: Distribution of Properties and Rooms by Size



Source: *U.S. Lodging Industry—1985* (Philadelphia: Laventhol & Horwath, 1985), p. 91. Used by permission.

Exhibit 1.3 U.S. Lodging Industry: Distribution of Properties and Rooms by Location



Source: *U.S. Lodging Industry—1985* (Philadelphia: Laventhol & Horwath, 1985), p. 91. Used by permission.

Costs of Construction

The costs of lodging facility construction vary significantly with the size and type of facility, its location, and the finishes used within the building. Of particular interest in this text is the cost of lodging properties' various components.

Rutes and Penner provide a discussion of the capital cost associated with a large (500-room) hotel. A copy of their data is shown in Exhibit 1.4. This data reveals a characteristic which is very common in the detailing of such costs: The components of the general construction cost—which represents over 50% of the total cost—are listed with little detail, while other cost components are provided in much more detail. It is this construction cost, the grounds, the parking facilities, and the FF&E installed within the building which constitute the major focus of the property maintenance effort over the building's life. We should also note, with regard to Exhibit 1.4, that the cost of many of a project's components are in some way directly related to the general construction costs; therefore, reductions in the general construction cost reduce other costs as well.

The distribution of the construction cost among its various components will vary from building to building depending on design, site, and facilities included. Exhibit 1.5 provides a component breakdown of the general construction cost for a small property and a convention property. Because of the greater complexity of systems and the greater difficulty in the design and construction of HVAC and electrical systems in larger buildings, these costs often represent a somewhat higher percentage of total construction costs in larger buildings.

As seen in Exhibit 1.5, the building HVAC, plumbing, and electrical equipment constitute approximately 30% of the building construction cost. When combined with the building conveying system and certain elements of fixed equipment, the percentage figure rises to 35–40%. It is this 35–40% of the building construction cost which is the primary focus of this text in terms of systems descriptions and operational concerns. In addition, these elements of the building are the primary consumers of energy at the facility. Basic elements of energy management at lodging facilities are also covered in this text.

Costs of Property Operation and Maintenance and Energy

The major operating costs associated with the engineering department are found in the *Property Operation and Maintenance* (or *POM*) and the *Energy* accounts of the uniform systems of accounts for lodging properties. The POM account is concerned with the expenses of the engineering/maintenance activity in the building. This account includes labor costs, materials and supplies used in building maintenance and repair, and building-related contract services. It does not include capital improvements. The Energy account includes not only fossil fuel purchases (such as oil and natural gas), but also electricity, purchased steam and chilled water, and potable water and sewer costs.

Laventhol & Horwath data for 1985 indicates the properties in their study expended about 10–12% of the total sales dollar on POM and Energy (each averaging about 5–7% of total sales). Exhibit 1.6 reveals variations in POM and Energy costs per room per year as they relate to the number of rooms at a property. In 1985, the resulting combined expenditures had a median value of about $2,000 per available room per year in properties in the size range of 150 to 299 rooms.[5] For properties with more than 600 rooms, the median figure rose to $3,400 per room per year.

While the absolute dollar expenditure on energy per room increases significantly as the size of the property increases, the percentage that these expenditures represent of total sales in properties with more than 300 rooms decreases as the property size increases. The reasons for the increase in expenditures relate to the generally greater overall building area per guestroom associated with the larger properties and the greater likelihood that energy-using facilities (such as in-house laundry, heated swimming pools, and multiple restaurant operations) will be associated with these properties. These features have a tendency to increase energy usage per guestroom. Offsetting these increases, however, is a greater overall revenue per guestroom which more than offsets the increased cost of energy.

The POM variations in Exhibit 1.6 do not fit as readily explainable a pattern as the energy cost variations do. POM costs per room increase with increasing property size, but the percent-

Exhibit 1.4 Capital Cost Outline for a Typical 500-Room Hotel

ITEM	PREDESIGN ESTIMATE BASIS		AMOUNT(S)
Land	Purchase		**2,000,000**
General construction			**23,000,000**
Sitework		$1,000,000	
Utilities	Allowance	200,000	
Surface parking roads	600 cars × 1,000	600,000	
Structured parking	None		
Landscaping	Allowance	200,000	
Basic building	500 bays × 600 sq.ft. (55.7 sq. m) = 300,000 sq.ft. (27,850 sq.m)		
	300,000 sq. ft. × 70	21,000,000	
Interior finishes	500 bays × 2,000	1,000,000	
Furniture, fixtures, and equipment	500 days × 14,000		**7,000,000**
Furniture and fixtures	55% × 7,000,000	3,850,000	
Kitchen, laundry, back-of-house equipment	25% × 7,000,000	1,750,000	
Inventories (linen, china, glassware, utensils, uniforms, supplies, printing)	15% × 7,000,000	1,050,000	
Purchasing fee	5% × 7,000,000	350,000	
Special systems			**550,000**
Telephone	500 bays × 900	450,000	
Computer (leased)	Allowance for conduit	50,000	
Special audiovisual equipment	Allowance	50,000	
Technical expenses			**2,450,000**
Architect-engineers (total)	3.5% × 22,000,000	770,000	
Architect (balance)	54% × 770,000	415,800	
Structural	12% × 770,000	92,400	
Mechanical, electrical, elevators, and civil engineering	28% × 770,000	215,600	
Audiovisual, acoustical, life safety, and landscape	6% × 770,000	46,200	
Interior designer (including lighting, signage graphics)	6.5% × 4,800,000*	312,000	
Menu graphics consultant	Allowance	20,000	
Food service equipment consultant	3.5% × 800,000	28,000	
Laundry equipment consultant	.2% × 400,000	8,000	
Site survey	Allowance	5,000	
Environmental consultant	Allowance	20,000	
Geotechnical consultant	Allowance	5,000	
Soils testing	Allowance	7,000	
Construction manager	2% × 25,000,000	500,000	
Hotel operators technical services	500 bays × 300	150,000	
Project field administration	1.5 years × 120,000	180,000	
Mock-up of typical guestroom	Allowance	25,000	
Lender's inspecting architect	Allowance	45,000	
Reimbursables	Allowance	150,000	
Construction testing	Allowance	150,000	
Permits	.2% × 25,000,000	50,000	
Feasibility study	Allowance	25,000	
Legal, financial, administrative			**750,000**
Financing fees	Debt: 70% × 40,000,000 = 28,000,000		
Loan commitment fees	1% × 28,000,000	280,000	
Brokerages	.5% × 28,000,000	140,000	
Owner's legal fees	Allowance	45,000	
Lender's legal fees	Allowance	55,000	
Developer's fee	None		
Appraisal	Allowance	10,000	
Investment tax credit study	Allowance	15,000	
Real estate taxes	Allowance	50,000	
Title insurance	Allowance	60,000	
Builders risk insurance	Allowance	45,000	
Liability insurance	Allowance	40,000	
Liquor license	Allowance	10,000	

* Cost of furniture, fixtures, accessories, and interior finishes designed and detailed by the interior designer.

(continued)

Exhibit 1.4 (continued)

Preopening expense	500 bays × 2,000	**1,000,000**
Working capital	500 bays × 500	**250,000**
Employee housing	None	
Interest during construction	Debt: 70% × 38,400,000 13% × 18 months × 55% (average cash flow balance)	**2,900,000**
Contingency	5% × 30,000,000	**1,500,000**
Total		**41,400,000**
Total cost per bay	**$41,400,000/480 keys**	**86,250**

Source: Rutes and Penner, *Hotel Planning and Design* (New York: Whitney Library of Design, 1985). Used by permission.

Exhibit 1.5 Average Lodging Property Construction Costs—Percentage Distribution

BUILDING SYSTEM	SMALL HOTEL/MOTEL	CONVENTION HOTEL
Foundations	5.5	4.0
Floors On Grade	0.5	1.0
Superstructure	21.9	28.0
Roofing	1.5	1.0
Exterior Walls	8.1	10.0
Partitions	9.1	13.0
Wall Finishes	5.4	3.0
Floor Finishes	4.5	1.0
Ceiling Finishes	3.7	1.0
Conveying Systems	6.0	6.0
Specialties	2.0	1.0
Fixed Equipment	1.8	0.0*
HVAC	9.4	16.0
Plumbing	11.2	5.0
Electrical	9.4	10.0

Note: The small hotel/motel category includes properties from 50,000 to 80,000 square feet. The convention hotel category includes properties from 700,000 to 900,000 square feet.

*Cost data for convention hotels was not reported.

Source: *Dodge Construction Costs—1985* (Princeton, N.J.: McGraw-Hill Information Systems, 1986). Used by permission.

Exhibit 1.6 1985 POM and Energy Cost Variations with Property Size (cost per available room)

	Under 150 Rooms	150-229	300-600	Over 600
ENERGY COSTS				
Per Room	$897	$1118	$1278	$1504
Ratio to Total Sales	5.9%	6.1%	4.9%	4.4%
POM COSTS				
Payroll Cost	$374	$417	$758	$966
Other	$425	$468	$740	$874
TOTAL	$789	$907	$1600	$1908
Ratio to Total Sales	5.0%	5.1%	5.7%	5.5%

Note: Since median values are reported for each item, the totals given above will generally not equal the sum of the median values for the component parts.

Source: *U.S. Lodging Industry—1986* (Philadelphia: Laventhol & Horwath, 1986). Used by permission.

age that these costs represent of total sales is relatively constant. As you view the POM data, keep in mind the variations in square footage per room (total property area divided by number of guestrooms) and the facilities and systems associated with these different size properties. As the number of rooms in the property grows, the amount of money necessary to maintain the property obviously increases. This increase in cost occurs in both the Payroll Cost and the Other categories, with the increase the greatest in the Payroll Cost category. While a portion of the payroll increase is due to an increased number of staff per room, a large percentage of the increase is due to an increased cost of labor for the larger properties. This increased cost may be due to the need to hire more skilled individuals for the more complex needs of the larger property and/or to the greater likelihood that the larger properties would be in urban areas with higher labor costs. Another factor which may contribute to increased labor requirements would be an increase in the amount of work which is done by in-house personnel instead of outside contractors.

Another Laventhol & Horwath study revealed the 1984 mean energy costs per occupied room per day for the study participants to be $1.10 for fuel, $3.63 for electricity, and 53 cents

Exhibit 1.7 Percentage Distribution of POM Expenditures (1984 mean for all establishments)

Payroll and related expenses	45.9%
Building	5.3
Electrical and mechanical equipment	11.7
Furniture	2.5
Grounds and landscaping	10.2
Operating supplies	5.0
Painting and decorating	2.5
Removal of waste matter	4.9
All other expenses	12.0
TOTAL	100.0%

Exhibit 1.8 Expenditures on Energy and POM—1985 for Various Types of Lodging Properties

	Resort Hotels	Motels with Restaurants	Motels without Restaurants
Energy Cost	$1616	$1102	$569
Energy as Percentage of Revenue	4.8	6.3	5.3
POM Cost	$1902	$787	$637
POM as Percentage of Revenue	5.6	5.1	6.0

All dollar figures are per available room per year.

Source: *Trends in the Hotel Industry*, USA Edition (Houston, Texas: Pannell Kerr Forster, 1986). Used by permission.

for water.[6] Clearly, electricity represents by far the greatest portion of the energy costs.

Exhibit 1.7 contains information concerning how the POM dollar is spent. Payroll represents slightly under 50% of the POM costs, with electrical and mechanical equipment and grounds and landscaping consuming significant percentages as well.

Comparisons of POM and Energy expenditures by type of property are possible using data compiled by Pannell Kerr Forster (PKF).[7] Exhibit 1.8 contains PKF data on resort hotels, motels with restaurants, and motels without restaurants. These types of properties exhibit very different total expenditures. The percentages these expenditures represent of total revenues

Exhibit 1.9 1984 POM and Energy Cost Variations with Property Age (dollars per available room)

	Built Pre-1960	1960-1969	1970-1979	Post 1980
Energy Costs				
Per Room	$1094	$990	$1032	$1074
% of Total Sales	5.1	6.5	5.4	7.0
POM Costs				
Payroll	$590	$328	$460	$492
Other	507	522	570	512
TOTAL	$1388	$877	$979	$876
% of Total Sales	6.2	5.4	4.8	4.2

Note: Since median values are reported for each item, the totals given above will generally not equal the sum of the median values for the component parts.

Source: *U.S. Lodging Industry* (Philadelphia: Laventhol & Horwath, 1985). Used by permission.

differ as well. Resorts have the highest dollar expenditure per available room of these three categories of properties, but with only one exception expend a smaller percentage of revenue in these areas. Motels with restaurants have greater costs per room than those without restaurants, but the POM costs are a smaller percentage of revenue.

Exhibit 1.9 shows the variation in POM and Energy costs as a function of property age. The variation with property age in energy expenditures (dollars per room) is rather slight. The age grouping with the lowest per room expenditure (1960–69) has the highest percentage of total sales expended on energy. This seeming anomaly is due to a reduced total sales per room for this age category of property relative to the others in the survey. The POM expenditure exhibits a significant variation with the age of the property. Those properties built before 1960 spend the most money and the highest percentage of sales on POM. Newer properties expend decreasing percentages of sales on POM, but not necessarily decreasing dollar amounts. The primary portion of the POM expenditures which vary depending on age is the Payroll component. The Other category of POM includes several contractual elements which are likely to vary little with the age of the property. Among these

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