

chiller plant diagram

chiller plant diagram is a fundamental tool in understanding the design and operation of chiller systems used in large-scale cooling applications. A chiller plant diagram visually represents the components and flow of refrigerant, chilled water, and condenser water within the system, providing clarity on how the chiller plant functions as a whole. This article explores the key elements of a chiller plant diagram, its significance in HVAC design, and the various types of chiller systems. Additionally, it discusses common configurations, operational principles, and maintenance considerations. By examining the chiller plant diagram in detail, engineers, facility managers, and technicians can optimize performance, improve energy efficiency, and troubleshoot issues more effectively. The article also includes practical insights into interpreting diagrams and integrating them into building management systems.

- Understanding the Components of a Chiller Plant Diagram
- Types of Chiller Systems Illustrated in Diagrams
- Function and Flow in a Typical Chiller Plant Diagram
- Importance of Chiller Plant Diagrams in HVAC Design and Maintenance
- Common Configurations and Variations in Chiller Plant Diagrams

Understanding the Components of a Chiller Plant Diagram

A chiller plant diagram typically includes a range of mechanical and electrical components that work together to provide cooling. Each element is represented by standardized symbols and lines that indicate flow paths and connections.

Main Components

The primary components featured in a chiller plant diagram include the chiller unit itself, cooling towers, pumps, heat exchangers, and control devices. The chiller unit contains the compressor, evaporator, condenser, and expansion valve which form the refrigeration cycle.

Supporting Equipment and Instrumentation

Additional equipment such as chilled water pumps, condenser water pumps, expansion tanks, and air separators are also depicted. Instrumentation like temperature sensors,

pressure gauges, and flow meters are essential for monitoring system performance and are often indicated in detailed diagrams.

- Chiller unit (compressor, evaporator, condenser, expansion valve)
- Cooling towers for heat rejection
- Chilled water and condenser water pumps
- Heat exchangers and expansion tanks
- Control valves and instrumentation

Types of Chiller Systems Illustrated in Diagrams

Chiller plant diagrams vary based on the type of refrigeration system used. Understanding these variations helps in selecting and designing appropriate systems for specific applications.

Water-Cooled Chiller Systems

Water-cooled chillers use water from cooling towers to remove heat from the refrigerant in the condenser. The diagram shows the flow of chilled water through the building and condenser water between the chiller and cooling tower.

Air-Cooled Chiller Systems

Air-cooled chillers reject heat directly to the air via fans and heat exchangers. The chiller plant diagram for air-cooled systems is generally simpler as it omits cooling towers and condenser water pumps.

Hybrid and Variable-Speed Systems

Some chiller plants use hybrid configurations or variable-speed drives to enhance energy efficiency. Diagrams for these systems include additional control elements and variable frequency drives (VFDs) to illustrate modulation of flow and capacity.

Function and Flow in a Typical Chiller Plant

Diagram

The chiller plant diagram illustrates the process flow of chilled water and refrigerant through the system, highlighting energy transfer and temperature control.

Chilled Water Circuit

The chilled water circuit circulates cooled water from the chiller evaporator to air handling units or fan coil units within a building. The diagram shows pumps moving water through chilled water piping, delivering cooling to the conditioned spaces.

Condenser Water Circuit

In water-cooled systems, the condenser water circuit carries heat away from the chiller to the cooling tower. The water absorbs heat from the refrigerant condenser and then releases it to the atmosphere via the cooling tower.

Refrigeration Cycle Representation

The refrigeration cycle components—compressor, condenser, expansion valve, and evaporator—are depicted to show refrigerant flow and phase changes. This helps in understanding how heat is absorbed and rejected within the system.

1. Compressor compresses refrigerant vapor
2. Condenser rejects heat to condenser water or air
3. Expansion valve reduces refrigerant pressure
4. Evaporator absorbs heat from chilled water

Importance of Chiller Plant Diagrams in HVAC Design and Maintenance

Chiller plant diagrams serve as critical tools throughout the lifecycle of HVAC systems, from design and installation to operation and maintenance.

Design and Engineering Applications

Engineers use chiller plant diagrams to plan system layouts, select components, and ensure proper hydraulic and mechanical integration. Accurate diagrams facilitate efficient

space utilization, energy optimization, and compliance with codes.

Operation and Troubleshooting

Facility managers and technicians rely on diagrams to monitor system performance, identify faults, and perform routine maintenance. Clear visualization of flow paths and component relationships aids in diagnosing issues and minimizing downtime.

Energy Efficiency and Optimization

Well-documented chiller plant diagrams enable analysis of energy consumption patterns and implementation of control strategies. Variable flow systems, optimized pump schedules, and chiller sequencing are better managed with precise diagram references.

Common Configurations and Variations in Chiller Plant Diagrams

Chiller plant diagrams come in various configurations depending on the scale, capacity, and specific application requirements. Familiarity with these variations supports effective design and operational decisions.

Single Chiller vs. Multiple Chiller Plants

Single chiller systems are simpler and typically used in smaller buildings, while multiple chiller plants incorporate several chillers working in parallel to provide redundancy and capacity modulation.

Primary-Secondary Pumping Systems

Many chiller plants use a primary-secondary pumping arrangement to decouple the chiller loop from the building loop, improving hydraulic control and system stability. Diagrams show separate pumps and piping circuits for these loops.

Decentralized vs. Centralized Plants

Decentralized chiller plants serve individual zones or buildings with localized equipment, whereas centralized plants provide chilled water from a central location to multiple buildings. The diagrams reflect these system architectures accordingly.

- Single vs. multiple chiller arrangements

- Primary-secondary pumping configurations
- Centralized and decentralized plant layouts
- Integration of thermal storage or free cooling options

Frequently Asked Questions

What is a chiller plant diagram?

A chiller plant diagram is a schematic representation of the components and flow of a chiller system, showing how chilled water is produced and distributed to air conditioning or industrial processes.

Why is a chiller plant diagram important in HVAC systems?

A chiller plant diagram helps engineers and technicians understand the layout, operation, and interconnection of equipment like chillers, pumps, cooling towers, and control valves, facilitating maintenance, troubleshooting, and optimization.

What are the main components shown in a typical chiller plant diagram?

Typical components include chillers, condenser water pumps, chilled water pumps, cooling towers, expansion tanks, valves, sensors, and piping networks.

How can a chiller plant diagram aid in energy efficiency?

By clearly illustrating the flow paths and control points, a chiller plant diagram enables better system monitoring and control strategies, helping to identify inefficiencies and optimize equipment operation to reduce energy consumption.

Where can I find standard symbols used in chiller plant diagrams?

Standard symbols for chiller plant diagrams can be found in HVAC engineering manuals, ASHRAE guidelines, and industry standards such as ANSI/ASHRAE or ISO documentation, which provide consistent graphical representations for components.

Additional Resources

1. *Chiller Plant Design and Operation Handbook*

This comprehensive guide covers the fundamentals of chiller plant design, including detailed diagrams and layout examples. It explains the principles of operation, energy efficiency considerations, and maintenance strategies. Ideal for engineers and facility managers seeking to optimize chiller plant performance.

2. *HVAC Systems and Equipment, Third Edition*

A thorough resource on HVAC equipment, this book features extensive sections on chiller plants with schematic diagrams and system integration tips. It discusses the selection, installation, and troubleshooting of chillers within larger HVAC systems. The text balances theory with practical application for industry professionals.

3. *Guide to Chilled Water Systems*

Focused specifically on chilled water systems, this book explores the components and configurations of chiller plants. It includes diagrams illustrating system flow, control strategies, and energy management techniques. The guide is valuable for engineers designing efficient chilled water loops.

4. *Energy-Efficient Chiller Plant Design*

This book emphasizes sustainable design practices for chiller plants, highlighting energy conservation and cost reduction. It provides detailed schematic diagrams and case studies showcasing innovative approaches. Readers gain insights into selecting equipment and optimizing controls for greener operations.

5. *Practical Chiller Plant Operation and Maintenance*

A hands-on manual aimed at plant operators, this title covers daily operation routines, troubleshooting, and preventive maintenance. It features visual diagrams to help understand complex system interactions and ensure reliable plant performance. The book is a practical tool for minimizing downtime and extending equipment life.

6. *Industrial Refrigeration and Chiller Systems*

This text delves into industrial-scale refrigeration and chiller plant configurations, with extensive diagrams and system schematics. It covers refrigerants, compressors, heat exchangers, and control systems in detail. Professionals involved in large facility operations will find this book particularly useful.

7. *Advanced HVAC Control Strategies for Chiller Plants*

Focusing on control technologies, this book explains how to implement advanced control algorithms in chiller plants. It includes flowcharts and system diagrams to demonstrate control loops and optimization methods. Engineers interested in automation and energy savings will benefit greatly.

8. *Fundamentals of Chiller Plant Engineering*

An introductory text, this book covers the basic principles of chiller plant engineering with clear diagrams and simplified explanations. It is designed for students and new professionals to build a solid foundation in chiller system components and operation. The content bridges theoretical concepts with practical knowledge.

9. *Chiller Plant Troubleshooting and Diagnostics*

This guide focuses on identifying and resolving common problems in chiller plants using diagnostic techniques and system diagrams. It provides step-by-step troubleshooting procedures and maintenance tips. Facility technicians and engineers will find it essential for efficient plant management.

Chiller Plant Diagram

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Chiller Plant Diagram: A Comprehensive Guide

Ebook Title: Understanding Chiller Plant Systems: A Visual and Technical Guide

Ebook Outline:

Introduction: What is a chiller plant? Types of chiller plants and their applications. Importance of understanding chiller plant diagrams.

Chapter 1: Components of a Chiller Plant: Detailed description and function of each major component (chiller, cooling towers, pumps, valves, piping, controls). Includes diagrams and illustrations.

Chapter 2: Types of Chiller Plants: Centralized vs. Decentralized systems. Water-cooled vs. air-cooled chillers. Different refrigerant types and their implications.

Chapter 3: Reading and Interpreting Chiller Plant Diagrams: Explanation of common symbols and notations used in chiller plant schematics (P&IDs). Step-by-step guide to understanding flow diagrams, piping and instrumentation diagrams (P&IDs).

Chapter 4: Troubleshooting and Maintenance: Common problems and their solutions. Preventive maintenance schedules. Safety procedures.

Chapter 5: Energy Efficiency and Optimization: Strategies for improving chiller plant efficiency. Energy saving technologies. Environmental impact considerations.

Conclusion: Recap of key concepts. Future trends in chiller plant technology.

Chiller Plant Diagram: A Comprehensive Guide

Understanding a chiller plant diagram is crucial for anyone involved in the design, operation, or maintenance of HVAC systems in large buildings. Chiller plants are complex systems responsible for providing chilled water for air conditioning, and a clear understanding of their workings, as represented in a diagram, is paramount for efficient operation and troubleshooting. This comprehensive guide will demystify chiller plant diagrams, exploring their components, types,

interpretation, and optimization.

1. Introduction: Understanding Chiller Plants and Their Diagrams

A chiller plant is a centralized refrigeration system that produces chilled water used to cool buildings or industrial processes. Unlike smaller, self-contained air conditioning units, chiller plants are large-scale systems, often found in skyscrapers, hospitals, data centers, and industrial facilities. They consist of several key components working in concert to deliver chilled water to air handling units (AHUs) throughout the building.

Several types of chiller plants exist, each with unique characteristics and applications. These include:

Centralized Chiller Plants: These systems have a single, large chiller located in a central plant room. Chilled water is then distributed via a network of pipes to various parts of the building. This is the most common type for large buildings.

Decentralized Chiller Plants: These involve multiple smaller chillers located strategically throughout a large building or campus. This approach offers redundancy and can be more energy-efficient in some situations.

Water-cooled Chillers: These chillers reject heat to a cooling tower using water as a coolant. They are generally more energy-efficient than air-cooled chillers.

Air-cooled Chillers: These reject heat directly to the atmosphere using fans and condensers. They require less infrastructure but are less efficient.

Understanding chiller plant diagrams is essential for several reasons:

Troubleshooting: Diagrams help identify the source of problems within the system.

Maintenance: Regular maintenance requires an understanding of the system's layout and connections.

Efficiency Optimization: Diagrams facilitate the identification of areas for energy savings.

System Expansion or Modification: Planning upgrades or modifications relies on a thorough understanding of the existing system.

2. Chapter 1: Components of a Chiller Plant

A typical chiller plant includes the following key components:

Chiller: The heart of the system, the chiller uses a refrigerant to absorb heat from the chilled water and reject it to a cooling tower or the atmosphere. Different types of chillers exist, including centrifugal, screw, and absorption chillers, each with unique operating principles.

Cooling Towers: These structures dissipate the heat absorbed by the chiller into the atmosphere through evaporation. They are crucial for maintaining the efficiency of the chiller.

Pumps: Several types of pumps circulate water through the system. These include chilled water pumps, condenser water pumps, and possibly booster pumps. The selection and sizing of pumps are critical for ensuring proper flow and pressure.

Valves: Various valves control the flow of water throughout the system, including isolation valves, control valves, and check valves. These valves are essential for maintaining system pressure and directing water flow.

Piping: The network of pipes connecting all components is crucial for delivering chilled water to AHUs and returning heated water to the chiller. Piping materials and sizing are important considerations for system performance and longevity.

Controls: A sophisticated control system monitors and regulates the chiller plant's operation, optimizing its performance and energy efficiency. This includes temperature sensors, flow meters, and programmable logic controllers (PLCs).

Expansion Tanks: These tanks accommodate variations in water volume due to temperature changes.

Detailed diagrams will show the interconnection of these components, including pipe sizes, valve types, and instrument locations.

3. Chapter 2: Types of Chiller Plants

As mentioned previously, chiller plants can be categorized in various ways:

Centralized vs. Decentralized: The choice between a centralized or decentralized system depends on the size and configuration of the building, budget, and redundancy requirements. Centralized systems are simpler to manage but can be vulnerable to single points of failure. Decentralized systems offer higher redundancy but are more complex to manage.

Water-cooled vs. Air-cooled Chillers: Water-cooled chillers are generally more energy-efficient due to the lower temperature difference between the condenser and the cooling medium. However, they require cooling towers, adding to the system's complexity and footprint. Air-cooled chillers are simpler but less efficient.

Refrigerant Type: The choice of refrigerant (e.g., R-134a, R-410A, ammonia) impacts the chiller's efficiency, environmental impact, and safety considerations. Newer refrigerants are being developed to minimize environmental impact.

4. Chapter 3: Reading and Interpreting Chiller Plant Diagrams

Chiller plant diagrams, often presented as piping and instrumentation diagrams (P&IDs), utilize standardized symbols to represent each component and its connection to the system. Understanding these symbols is critical for interpreting the diagram. These diagrams show the flow of water, refrigerant, and other fluids through the system. They illustrate the locations of valves, pumps, and other equipment. They also identify instrumentation such as pressure gauges, temperature sensors, and flow meters.

A step-by-step approach to understanding these diagrams involves:

1. **Identifying Key Components:** Locate the chiller, cooling towers, pumps, valves, and other major components on the diagram.
2. **Tracing the Flow Paths:** Follow the lines representing the flow of chilled water and condenser water. Pay attention to the direction of flow indicated by arrows.
3. **Understanding Valve Functions:** Identify the type and function of each valve, determining its role in controlling water flow.
4. **Interpreting Instrumentation:** Understand the purpose and readings of pressure gauges, temperature sensors, and flow meters.

5. Chapter 4: Troubleshooting and Maintenance

Regular maintenance and timely troubleshooting are essential for the efficient and reliable operation of a chiller plant. Common problems include:

Low Chilled Water Temperature: This could indicate problems with the chiller, cooling tower, or pumps.

High Condenser Water Temperature: This could be due to fouling in the condenser or cooling tower.

Leaks: Leaks in the piping or components can lead to significant water loss and system malfunction.

Pump Failures: Pump failures can halt the circulation of water, affecting the entire system.

Preventive maintenance schedules should include regular inspections, cleaning, and component replacements.

6. Chapter 5: Energy Efficiency and Optimization

Improving the energy efficiency of a chiller plant is crucial for reducing operational costs and environmental impact. Strategies include:

Optimized Control Strategies: Employing advanced control systems that can adapt to changing load demands.

Regular Maintenance: Proper maintenance minimizes energy losses due to fouling and component wear.

Energy-Efficient Components: Using high-efficiency chillers, pumps, and cooling towers.

Variable Frequency Drives (VFDs): Using VFDs to control the speed of pumps and fans, optimizing energy consumption based on demand.

Conclusion:

Understanding chiller plant diagrams is fundamental to efficient operation and maintenance of these critical HVAC systems. By understanding the components, various system types, and interpretation of diagrams, professionals can effectively troubleshoot issues, optimize energy efficiency, and ensure the reliable performance of chiller plants for years to come. The ongoing advancements in chiller technology, including the use of more environmentally friendly refrigerants and advanced control systems, will continue to shape the future of chiller plant design and operation.

FAQs:

1. What is the difference between a water-cooled and an air-cooled chiller? Water-cooled chillers are generally more efficient but require a cooling tower, while air-cooled chillers are simpler but less efficient.
2. How do I interpret the symbols on a chiller plant diagram? Refer to industry standards and specific diagrams' legend for symbol definitions. Common symbols represent pumps, valves, chillers, etc.
3. What are the common problems in a chiller plant? Common issues include low chilled water temperature, high condenser water temperature, leaks, and pump failures.
4. How often should I perform maintenance on my chiller plant? A regular maintenance schedule should be established based on the manufacturer's recommendations and system usage.
5. What are some energy-saving strategies for chiller plants? Implementing optimized control strategies, regular maintenance, using energy-efficient components, and employing VFDs are effective methods.
6. What are the safety precautions when working with a chiller plant? Always follow safety protocols,

including lockout/tagout procedures, and wear appropriate personal protective equipment (PPE).

7. What are the different types of chillers used in chiller plants? Centrifugal, screw, absorption, and reciprocating chillers are common types, each with varying capacities and efficiencies.

8. What is the role of a cooling tower in a chiller plant? Cooling towers dissipate the heat absorbed by the chiller into the atmosphere, maintaining the chiller's efficiency.

9. What are the environmental considerations when operating a chiller plant? Refrigerant selection, water consumption by cooling towers, and energy consumption all contribute to the environmental impact.

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2. Chiller Plant Maintenance Checklist: A comprehensive checklist for regular maintenance tasks.
3. Troubleshooting Common Chiller Plant Issues: Step-by-step guide to troubleshooting various problems.
4. Energy Efficiency in Chiller Plants: Strategies for optimizing energy consumption in chiller plant systems.
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9. Future Trends in Chiller Plant Technology: Exploring upcoming innovations in chiller plant design and operation.

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chilled water to buildings (offices, apartment houses, and factories) needing cooling for air conditioning and refrigeration. In winter, the source for the cooling can often be sea water, so it is a cheaper resource than using electricity to run compressors for cooling. The related technology of District Heating has been an established engineering practice for many years, but District Cooling is a relatively new technology now being implemented in various parts of the world, including the USA, Arab Emirates and Kuwait, and Saudi Arabia. Existing books in the area are scarce, and do not address many of the crucial issues facing nations with high overall air temperatures, many of which are developing District Cooling plans using sea water. **DISTRICT COOLING: THEORY & PRACTICE** integrates the theory behind district cooling planning with the practical engineering approaches, so it can serve the policy makers, engineers, and planners whose efforts have to be coordinated and closely managed to make such systems effective and affordable. In times of rising worldwide temperatures, District Cooling is a way to provide needed cooling with energy conservation and sustainability. This book will be the most up-to-date and comprehensive study on the subject, with Case Studies describing real projects in detail.

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discusses the expertise, skills, and techniques needed for the development of energy and renewable energy system, new materials and biomaterials, and marine technology. It focuses on finite element analysis, computational fluids dynamics, programming and mathematical methods that are used for engineering simulations, and present many state-of-the-art applications. For example, modern joining technologies can be used to fabricate new compound or composite materials, even those formed from dissimilar component materials. These composite materials are often exposed to harsh environments, must deliver specific characteristics, and are primarily used in automotive and marine technologies, i.e., ships, amphibious vehicles, docks, offshore structures, and even robots. An energy efficient methods such cogeneration, thermal energy storage and solar desalination also being highlighted as sustainable engineering in this book chapter. The committee members can be listed as follows: Patron: Dr. Hj. Zairon Mustapha (Director). Advisor: Muhammad Zubir Mohd Hanifah (Deputy Director Academic), Dr. Azhar Abdullah (Head of Innovation, Research & Commercialization). Chairman 1: Dr. Adzuien Nordin. Chairman 2: Hairi Haizri Che Amat. Secretariat 1: Dr. Woo Tze Keong. Secretariat 2: Dr. Saw Chun Lin. Secretary: Mahani Mohd Zamberi, Maslinda Rahmad. Floor Manager: Dr. Adzuien Nordin, Marzuki Mohammad Treasurer: Shahrul Nahar Omar Kamal. Webmaster: Mohamad Asyraf Othoman, Mohd Assidiq Che Ahmad, Mohd Hashim Abd. Razak. Proceeding & Editorial: Didi Asmara Salim, Khairil Ashraf Ahmad Maliki, Khirwizam Md Hkhir. Publicity: Nur Azrina Zainal Ariff, Norsheila Buyamin, Rawaida Muhammad, Noor Khairunnisa Kamaruddin. Reviewer: Zakiman Zali, Shahril Jalil. Technical Manager: Mohd Faisol Saad. Springer Publication Editorial: Dr. Saw Chun Lin, Dr. Woo Tze Keong, Didi Asmara Salim, Dr. Salvinder Singh Karam Singh. Protocol & Opening Ceremony: Mohd Rizan Abdul, Yeoh Poh See. Souvenir: Sharifah Zainhuda Syed Tajul Ariffin. Registration: Muhammad Zaki Zainal, Adi Firdaus Hat, Nor Ashimy Mohd Noor, Mohd Naim Awang. Proofread: Shamsul Banu Mohamed Siddik, Fairuz Liza Shuhaimi. Logistics: Mohd Zulhairi Zulkipli, Ahmad Fithri Hasyimie Hashim. Multimedia: Muhammad Redzuan Che Noordin, Mohd Redzuwan Danuri, Ahmad Syawal Yeop Aziz. Liason: Roseazah Ramli, Amrul Zani Mahadi. Sponsorship: Zuraini Gani, Hazril Hisham Hussin.

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expert guidance on the planning and design of “green” technologies. It focuses on management strategies for better utilization of energy in buildings and industry as well as ways of improving energy efficiency at the end use. Renowned authorities from around the globe share insights and modern points of view on a broad spectrum of topics. Summarizing proven energy efficient technologies in the building sector, the book includes examples that highlight the cost-effectiveness of some of these technologies. It introduces basic methods for designing and sizing cost-effective systems and determining whether it is economically efficient to invest in specific energy efficiency or renewable energy projects. It provides guidance for computing measures of economic performance for relatively simple investment choices and the fundamentals for dealing with complex investment decisions. The book also describes energy audit producers commonly used to improve the energy efficiency of residential and commercial buildings as well as industrial facilities. After developing the basics of HVAC control, the book explores operational needs for successfully maintained operations. It describes the essentials of control systems for heating, ventilating, and air conditioning of buildings designed for energy conserving operation. The book also defines demand-side management, covers its role in integrated resource planning, and delineates the main elements of its programs. The book demonstrates these concepts with case studies of successful demand-side management programs. These features and more provide the tools necessary to improve energy management leading to higher energy efficiencies.

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Automation, Intelligent Community and Urban Safety, Intelligentization of Heating Ventilation Air Conditioning System, Information Technology and Intelligent Transportation Systems, New Generation Intelligent Building Platform Techniques, Smart Home and Utility, and Smart Underground Space, which cover a wide range areas of smart cities and intelligent buildings. ICSCIB2018 provided an international forum for professionals, academics, and researchers to present the latest developments from interdisciplinary theoretical studies, computational algorithm developments and engineering applications in smart cities and smart buildings. This academic event featured many opportunities to network with colleagues from around the world in a wonderful environment. Its program covered invitation and presentations from scientists, researchers, and practitioners who have been working in the related areas to establish platforms for collaborative research projects in these fields. The conference invited leaders from industry and academia to exchange and share their experiences, present research results, explore collaborations and to spark new ideas, with the aim of developing new projects and exploiting new technology in these fields, and bridge theoretical studies and emerging applications in various science and engineering branches. This book addresses the recent development and achievement in the field of smart city and intelligent building. It is primarily intended for researchers and students for undergraduate and postgraduate programs in the background of multiple disciplines including computer science, information systems, information technology, automatic control and automation, electrical and electronic engineering, and telecommunications who wish to develop and share their ideas, knowledge and new findings in smart city and intelligent building.

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urgent need to manage energy use and improve thermal comfort in modern buildings while preserving their historic significance and character. This collection of ten case studies addresses the issues surrounding the improvement of energy consumption and thermal comfort in modern buildings built between 1928 and 1969 and offers valuable lessons for other structures facing similar issues. These buildings, international in scope and diverse in type, style, and size, range from the Shulman House, a small residence in Los Angeles, to the TD Bank Tower, a skyscraper complex in Toronto, and from the Calouste Gulbenkian Foundation, a cultural venue in Lisbon, to the Van Nelle Factory in Rotterdam, now an office building. Showing ingenuity and sensitivity, the case studies consider improvements to such systems as heating, cooling, lighting, ventilation, and controls. They provide examples that demonstrate best practices in conservation and show ways to reduce carbon footprints, minimize impacts to historic materials and features, and introduce renewable energy sources, in compliance with energy codes and green-building rating systems. The Conserving Modern Heritage series, launched in 2019, is written by architects, engineers, conservators, scholars, and allied professionals. The books in this series provide well-vetted case studies that address the challenges of conserving twentieth-century heritage.

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