

Preface

Our planet has been bathed in daylight from the sun for over 4 billion years. The role of daylight in buildings has profoundly changed over the time frame of the last century. In the early twentieth century, electric light began to displace what had been the dominant source of lumens in a building interior for all of human existence—the sun and sky. Due to rapid improvements in electric lighting technology, e.g., fluorescent lamps, and the ubiquity of the electric grid with low cost power, electric lighting became the dominant luminous source in buildings by mid-century. The oil crisis of the 1970s followed by a new focus on the environmental impacts of carbon emissions and sustainability challenges at the end of the twentieth century refocused new attention on effective daylighted building designs. But by the first two decades of the twenty-first century, new advances in electric lighting and smart controls have once again reopened the discussion and debate on the appropriate role of daylight in buildings.

This book captures the result of multiyear efforts by the authors to address those issues by postulating and exploring a dual pathway whereby effective daylight design continues to serve as a powerful energy management strategy while enhancing its value to occupants for visual performance, view, comfort, and health. This leads to exploring the technical potential of the building facade as a mechanism for utilizing environmental services provided by natural systems to address building energy and carbon reduction goals, while enhancing occupant experience and well-being. Daylight is a renewable source of high efficacy light, which makes the daylighting of buildings an attractive energy design strategy compared to standard practices of electrical lighting design. And there is a growing body of scientific knowledge linking access to sufficient daylight and window views with improved health and well-being. While the daylighting of buildings is not a new topic, one of the central barriers to effective daylighting is that daylighting *performance* is often narrowly defined by different stakeholders, leading to a fragmented approach to performance assessment in the design and operational life-cycle of buildings. Despite decades of discussion and design, there remain relatively few successful examples of projects where performance outcomes consistently meet

design intent, particularly from the perspective of building occupants and measured reductions in energy use.

Daylight cannot be easily separated from electric lighting in its impact on people and buildings. It is unique as a light source in terms of its intrinsic variability (intensity, directionality and color) over time and weather, and the differences one can experience spatially within a building. Furthermore, at a time when the efficacy and control of electric lighting is improving, after decades without major change, the continued importance of daylight design has been questioned. This book explores the case for advanced building-facade daylighting design practices informed both by important energy, power, and carbon emissions constraints as well as by human-centric factors such as health, comfort, and performance. The state-of-the-art approaches are discussed in the context of simulation-based design workflows, innovative technologies, and real project case studies, all targeting low and Zero Net Energy (ZNE) solutions. The book seeks to redefine effective daylighting by challenging the contemporary approach to glazing and facade system design. Contemporary design is often driven by the goal of architectural “transparency,” pursued through the near-universal application of a sealed and static, highly glazed building skin to projects across the globe. While “transparent” facades have become one of the most iconic symbols for buildings promoted as “sustainable,” “green,” or “high-performance,” these designs often fail to achieve claimed energy savings and can be visually and thermally uncomfortable. The book argues that we must replace this simplified approach to design and engineering with alternate approaches that more effectively incorporate local site and climate, carbon reduction goals, and the needs of building occupants as critical drivers of building performance, design solutions, and technological innovation.

While the book is informed by a broad spectrum of work by researchers and designers over the last 50 years, it focuses on the recent evolution of technology, systems and software solutions that are changing how buildings are designed and operated today, and explores how that might evolve in the future. In comparing “what is” to “what is needed” the book suggests the need to shift design practices from:

- The application of universal design guidance to climate, people and program specific design goals.
- Static, unresponsive systems to dynamic, adaptive systems.
- Homogeneous generic indoor work environments to granular, personalized environments.
- Fragmented collections of building components towards integrated (and interconnected) daylighting/perimeter-zone systems.
- Rule-of-thumb design guidance to evidence-based design solutions.
- Compliance-based prescriptive workflows to performance-based design workflows.

Broader principles and trends are illustrated with examples from the authors' studies and from the design community at large. Readers benefit from a comprehensive approach that addresses the world of design and engineering through a focus on building occupants. The book is intended for architects, lighting designers, facade engineers, manufacturers, building owners/operators, and advanced students, all of whom are essential partners in the drive to capture the full benefits that effective daylight design offers for people, for buildings and for the environment.

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