Preface

Thermal mass plays an important role in building energy conservation and in control of internal thermal comfort. It has been observed that it can be also greatly assisted by the incorporation of building components with latent heat storage capabilities. Phase change materials (PCMs) are one of the thermal control means used today in building envelopes and in internal construction components. PCMs in buildings can be utilized for many different purposes including reduction of space conditioning energy consumption, thermal peak load shaving and shifting, local temperature control in building envelope components, or improvement of overall system durability. The scope of this book is to summarize and explain the most important basics of PCM applications in building structures. Despite wide interest in PCM-enhanced building technologies by researchers from industry and academia, engineers, architects, building developers, energy policy makers, code officials, and home owners, there is still a shortage of publications supporting design and analysis in this field. In addition, the industry lacks sufficient technical data and performance information for performance comparisons and development of new technologies. At the same time, industry and government code bodies call for adequate performance testing and rating standards.

Note that there are a large number of engineering and research publications focus on PCMs as a major topic. However, even though PCM-enhanced building materials represent today the major market share for the PCM industry, there is still very little engineering literature dedicated to this subject. Most recent publications treat PCM-enhanced building components more from the material perspective (i.e., PCM types, PCM packaging and encapsulation, PCM manufacturing processes, and experimental analysis of PCMs from the chemical and thermal engineering points of view), rather than focusing on the building component scale. As a result, analysis of the PCM-enhanced building components is most often based on the very basic material scale (only the PCM's performance is examined), or a relatively inaccurate whole building scale analysis is performed without taking into consideration that PCM-enhanced envelopes are distinct building systems with their own properties and performance characteristics.

This work is almost exclusively focused on PCM applications as parts of building envelopes and internal building fabric components. A variety of PCM building products and applications are presented here, followed by subsequent thermal and energy performance data. This publication also presents state-of-the-art testing methods to enable thermal performance analysis of building envelope systems containing PCMs. In addition, numerical methods for dynamic thermal analysis of PCM-enhanced building envelopes and whole buildings containing PCM building envelope components are presented here.

This work was motivated by my desire to further the evolution and widespread application of PCM-based building technologies. Since my goal was to reach a wide audience, I organized this book so that it could be easily understood by advanced undergraduate mechanical engineering students and first-year graduate students of architecture and different engineering disciplines with sufficient thermal/energy analysis and material engineering backgrounds. However, this publication also offers an inclusive collection of references leading to more detailed technology descriptions, performance data, and advanced analytical methods, which may be helpful in research work. In my opinion, this publication is mainly intended for:

- Architects, building designers, home owners, and architectural students, who I trust, will benefit from learning about the history of PCM applications in building envelopes and will be able to study most common material configurations, and PCM locations within a building.
- Building materials and systems developers, engineers, and researchers will find in this book an overview of different types of PCMs, their physical characteristics, commonly used PCM carriers, and a selection of commercially available building products containing PCMs. This group of potential readers may also benefit from the patent list associated with PCM-enhanced building products.
- Researchers, engineers, and code officials will learn from information presented here about performance characteristics of the PCM-based building technologies and descriptions of experimental methods used worldwide for testing of PCMs and PCM-enhanced building products.
- Students, engineers, researchers, product developers, designers, home owners, and finally, energy policy government officials should find the field performance data generated during various whole-system and whole-building field experiments worldwide very helpful.
- Lastly, students, engineers, researchers, and energy modelers should find useful the chapter dedicated to numerical performance analysis of the PCM-enhanced building envelopes and whole buildings utilizing these technologies.

Please bear in mind that publications of this type inevitably reflect the opinions and prejudices of their authors. Hence, some readers may inevitably disagree with my opinions, book structure, and of course the choice of presented material.

In my opinion, such disagreements usually represent healthy reflections coming from the diversity of technology under discussion and are essential for its evolution. Nevertheless, I hope that all future readers will find something of interest here.

Boston Jan Kośny

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Kosny, J.
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