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HUMAN VISUAL AND NON-VISUAL RESPONSE TO THE BUILT ENVIRONMENT IEA SHC TASK 70 BOOK

Summary

The article presents a new book with the provisional title "Human visual and non-visual response to the built environment". The book is written and edited by researchers affiliated with IEA SHC Task 70 Low carbon, high comfort, and integrated solutions. The book is due for publication on 1 July 2026 and will be printed in the coming months. The book's content is literary based on 34 recently published scientific articles, mainly authored by Task 70 participants. Each article is shortened to approximately six pages, which helps to communicate the new scientific discoveries in a short, simple and convincing way. The illustrations are carefully selected and adapted to the research topic and the layout of the book.

Keywords: built environment, visual environment, visual stress, glare, non-visual effects of light, integrative lighting, window view

Field of application for the findings: daylighting, lighting design, façade design, architecture, and interior architecture

Addressed audience: The book is intended primarily for practitioners working in or related to the construction sector. The most relevant professions are lighting design, façade design, architecture, and interior architecture. The book will also be useful for developers and investors, for manufacturers in the lighting and facade industry, and for various other user groups like "Administrative professional cooperatives".

1. Background

Despite major research advances, our understanding of human responses to the visual environment remains grounded in frameworks developed decades ago. The discovery of the intrinsically photosensitive retinal ganglion cells (ipRGC) in the human retina in 2002 by David Berson marks an era in which the human response to light is about to be completely rewritten. It turns out that humans' responses to light extend well beyond the visual aspects of vision. In particular, short-wave radiation plays a far more significant role in regulating physiological and behavioral processes than previously assumed. The emerging evidence also points to broader spectral ranges, particularly in near ultraviolet and near infrared ranges, that influence us in ways that we are only beginning to understand. The importance of non-visual and beyond-visual effects surprises us with its scope and importance. Moreover, even within research purely dealing with visual responses, the view out of the window and the complex relation between the perception of glare and the quality of the window view are about to be much better understood. The focus has shifted from indoor lighting conditions to a broader perspective of including the environment outside the window and its contribution to the visual experience. These developments raise important questions: what can we learn from these emerging developments in research, and what are the practical implications? To answer this question, we summarize the newest research results in a book form.

2. Methods

The book takes the pulse of research that has been developed in recent years across countries and continents. Most authors are members of the IEA SHC Task 70 Subtask B - Visual and non-visual User Requirements. In addition, the expertise from all other subtasks is included, namely A – Low carbon lighting and passive solar, C – Digitized lighting solutions, and D – lab and field study performance tracking.

The content of the book is literary based on thirty-four recently published scientific articles or doctoral thesis. Each article is shortened to about six pages, which helps to convey the new scientific discoveries in a short, simple, and convincing way. Illustrations are carefully chosen and adjusted to the research topic and to the book's layout.

3. Results

The book begins with a general introduction that describes the background and origins and introduces the main parts of the book. The book is divided into six parts. The first three parts present the bulk of the research conducted within the framework of subtask B. Each part has an introductory chapter in which the main concepts and notions are explained in a simple way and the current state of knowledge is briefly outlined.

Part 1 Visual Stress in the Build Environment.

It starts with the introductory chapter, entitled Environmental Risk Factors in the Visual Environment. It presents basic knowledge about different types of visual stress from excessively intense electric lighting, solar glare, unevenness of illumination to contrast patterns. The article-chapters, see Table 1, guide the reader through scientific advances that aim to better understand the human visual system's response to the visual environment and the risk factors of uncomfortable environment. Solar glare, solar shading and view preservation are the dominating topics here. Additionally, Eyestrain and the Temporal Light Modulation Activation are discussed. Moreover, Daylight Glare Metric and a Mathematical Model for the Assessment of the Impact of Illuminance on Visual Acuity are included here as well.

Table 1. Article-chapters in Part 1.

1.	Control Strategies for Active Shading in Daylighting Management: A Review with a Focus on View Preservation
2.	Characterisation of View Relative to Solar-Control System
3.	Personalized Environmental Control Systems in the Visual Domain: A Systematic Review of Lighting and Daylighting Applications
4.	Daylight-Related Visual Comfort Evaluation of Perforated Solar Screen Facades: Office Case Study
5.	The Daylight Glare Metric (DGM) as a modified DGP for improved evaluation of small glare sources
6.	The effect of artificial lighting on both biophilic and human-centric design
7.	Lighting Standards Revisited: Introduction of a Mathematical Model for the Assessment of the Impact of Illuminance on Visual Acuity
8.	Evaluation of a gaze-driven photometry for discomfort glare assessments
9.	Quantification of tree crown shading properties, investigated through radiative budget simulations
10.	Is Eyestrain Associated with Muscuskeletal Strain and Visual Symptoms
11.	Temporal Light Modulation Activation in Visual Cortex – A 7T fMRI Study on Healthy Subjects

Part 2. Window View

The introduction to Part 2, entitled "The essence and importance of the window view", gives a short historical perspective of the view out as important quality factor in architecture. The present understanding of window view quality and importance is discussed and described. Articles included in Part 2, see Table 2, present the current knowledge about view preferences, view attributes and view assessment methods. The impact of individual long-term experience with the view is discussed as well as dynamics of window view. The window view is also conferred on the urban scale, including the implications for Real Estate. This part ends with the GIS-based evaluation of urban density and visual access.

Table 2. Article-chapters in Part 2.

1.	View preferences and the relation with glare. Cases in Brazilian context case studies in tropical climate
2.	Methods of window view quality assessment
3.	Window view – assessment by the view owner and the others
4.	Window view attributes and preferences
5.	Seasonal dynamics of window views and resident satisfaction: insight from a longitudinal in-situ study
6.	Reviewing the Value of Window Views and Daylight: Implications for Real Estate

7.	Dynamic view assessments through integrated image-based and self-reported methods - Why are Window views never static?
8.	View quality and window design from urban-level and building-level perspectives
9.	GIS-Based evaluation of urban density effects on daylight availability and visual access

Part 3. Non-visual effects of light.

Part 3 starts with the introduction: ”What we know about non-visual aspects of light exposure”, which presents the overall status of knowledge in the field and explain notions and concepts connected with this topic. Article-chapters present diverse topics, where the most important is integrative lighting, e.i. lighting combining both visual and non-visual effects and producing physiological and/or psychological benefits upon humans. It presents findings about integrative lighting in classrooms and offices, discusses control systems and office workers' performance and satisfaction with the luminous environment. In addition, it presents measurements and assessment methods of non-visual aspects. It disseminates the research about wearable devices, discusses evaluation protocols, and presents human centered daylight performance developed using machine learning. Article-chapters are shown in Table 3.

Table 3. Article-chapters in Part 3

1.	Daylight-linked control systems and integrative lighting
2.	Short-term non-visual effects of light: Workers' performance and satisfaction
3.	Human centred Daylight Performance: A Multicriteria Approach Using Machine Learning
4.	Visual well-being of neurodivergent people: the case of Autism Spectrum Condition (ASC)
5.	Integrative lighting in existing small-to-medium offices: a performance analysis
6.	Integrative lighting in existing middle-school classrooms: a performance analysis
7.	Daylighting supports energy efficient integrative lighting
8.	Evaluation Protocols for non-visual effects of lighting in complex indoor environments: The case of Intensive Care Units
9.	An Occupant-Centred Approach to Evaluating Lighting Impact on Well-being
10.	A Replicable Open-Source Wearable System for Human-Centric Light Research: Integrated Hardware and Software for Spectral Acquisition and Multi-Metric Assessment of Visual and Non-Visual Effects

In the fourth part, “One case – few issues”, the reader will find a detailed description and analysis of a case study building. Here, the visual and non-visual metrics and measurements discussed in the first three parts are applied in the analysis. The aim is to illustrate how recently developed knowledge can be applied into holistic design and assessment of the luminous environment in a real building and to show how to integrate the “new requirements” and research findings in the design of new buildings.

The fifth part, Lighting simulation tools, is devoted to the characterization and classification of lighting simulation tools from the point of view of visual and non-visual effects of the luminous environment. This part provides practitioners with guidance on which tools are most appropriate to transfer research findings into everyday practice and hereby will support the integration into design practice.

A sixth part, LCA impacts, puts things into the context of low carbon: i.e. components, impact, costs, and carbon footprint of higher illuminance levels, etc.

The book ends with three appendices that provide practitioners with powerful and simple tools for assessing the visual environment and maintaining a comfortable visual environment.

4. Conclusion

The book is intended primarily for practitioners working in or related to the construction sector. The most relevant professions are lighting design, façade design, architecture, and interior architecture. The book will also be useful for developers and investors, for manufacturers in the lighting and facade industry, and for various other user groups like “Administrative professional cooperatives”. The book presents the essence of newly developed knowledge in an easy-to-understand way, which should be useful in everyday practice, in long life learning and in academic teaching.