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The Development of a Simplified Lighting Assessment Tool for Health and Well-being Based on the SOOK Building Standard

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Abstract

The process of designing lighting to promote health and well-being typically requires the knowledge of specialists who are responsible for designing and carrying out initial assessments. These assessments require the use of mathematics, measurements, and careful consideration of the completed designs or construction. Insufficient implementation due to a lack of understanding may result in the need for further improvements. This study aims to identify the key factors for assessing lighting that promote good health and well-being in built environments. Additionally, the goal is to develop a simplified tool for evaluating lighting in terms of its impact on occupants' health and well-being, using Thailand's SOOK Building Standard as a basis. The tool aims to require no extensive understanding of health-specific illumination standards. Nevertheless, it can still assess whether the lighting conditions in a certain region or design affect the health of the individuals in the building, according to health guidelines. We determine the key assessment factors by analyzing the specific requirements and criteria described for each measure in the research methodology process. We employed the relevant lighting measures for the calculations and used a climate-based computational simulation to calculate the average daylight illumination for the topic of daylighting. We employed the minimum thresholds for each requirement in the lighting measurement metrics to analyze a data range that satisfies the specified criteria, allowing us to verify additional measurement input data and identify any correspondences within the defined data range. The results illustrate the key assessment factors for the required inputs, which include both lighting and physical area measurements on-site. This research concentrates on addressing the implementation challenge, leading to the development of a prototype assessment tool that evaluates these measurement inputs and displays the overall score for each attribute of light and health, as per the SOOK Building Standard. The assessment tool's development findings will encourage wider adoption of lighting design techniques in built environments. This will establish an environment that actively promotes and enhances human health and well-being.

Keywords

SOOK Building Standard; Assessment tool; Lighting, Health; Well-being

1. Introduction

Lighting plays a crucial role in the built environment, influencing not only the aesthetic appeal and functionality of spaces but also the health and well-being of their occupants. In recent years, numerous studies have highlighted the impact of lighting on various aspects of human health, including circadian rhythm regulation, mood, cognitive function, and overall well-being (Blume et al., 2019; Boyce, 2021; Brown et al., 2022). The increasing demand for controllable building environments that prioritize building occupants necessitates the application of a design strategy that has proven to produce well-being outcomes for end users. Currently, building measurements that establish standards for controlling the indoor environment and improving human life quality via the built environment are known as the WELL Building Standard. The United States International Well Building Institute (International WELL Building Institute [IWBI], 2014) developed this standard based on scientific research and empirical evidence. In Thailand, more than 10 architectural projects have been certified under the WELL Building Standard, which focuses on promoting health and well-being through building design, particularly in lighting and overall occupant health. These projects reflect Thailand's growing commitment to integrating health-focused design principles in architecture, aligning with the global trend towards creating spaces that support the physical and mental well-being of their occupants. These projects also led to the development of health and well-being building criteria in Thailand, as represented by the Thai Green Building Institute (TGBI) and known as the SOOK Building Standard. Regarding lighting attributes, the SOOK Building Standard and the WELL criteria have the same approach to evaluating the quality of lighting on health-related aspects for building occupants. The only difference is that the SOOK standard adjusted the minimum specific requirements to suit the circumstances in Thailand. Contrary to the Ministerial Regulation Prescribing Type or Size of Building and Standard, Criteria and Procedure in Designing Building for Energy Conservation B.E. 2563 (2020) (Ministerial Regulation Prescribing Standard, Criteria, and Energy Management Procedures in Designated Factories and Buildings B.E. 2563, 2020), the Ministry of Energy's notification on criteria and calculation methods for building design of various systems, Overall Energy Consumption of Buildings and Use of Renewable Energy of Various Building Systems B.E. 2552 (Ministry of Energy, 2009), and the ministerial regulation no. 39 (Ministerial Regulation No. 39 (B.E. 2537) issued by virtue of the Building Control Act B.E. 2522, 1994), the lighting criteria used in Thailand prioritize environmental friendliness, energy efficiency, and the amount of light in a given area. The Thai Green Building Institute already has certified the SOOK Building Standard, making it the sole criterion for assessing the health of building occupants in Thailand.

While the lighting and health criteria adopted in the SOOK Building Standard are widely recognized and acknowledged globally, the implementation and assessment currently are limited to expertise in the field of lighting and research institutions that are familiar with metrics including Equivalent Melanopic Lux (EML), spatial daylight anatomy (sDA), and annual sunlight exposure (ASE). The integration of such knowledge into practical assessment tools remains fragmented and inconsistent. Hence, it is imperative to provide a simple accessible assessment tool that can simplify the implementation of the SOOK standard's recommendations, offering wider adoption and practical application. This research seeks to bridge this gap by determining and establishing the key factors required for developing an effective prototype lighting assessment tool that aims to enhance health and well-being in built environments, under the guidance of the SOOK Building Standard (Figure 1). The Sook standard was used as the model since it is considered the first and only criterion for evaluating the health of building occupants in Thailand and already has been certified by the Thai Green Building Institute.

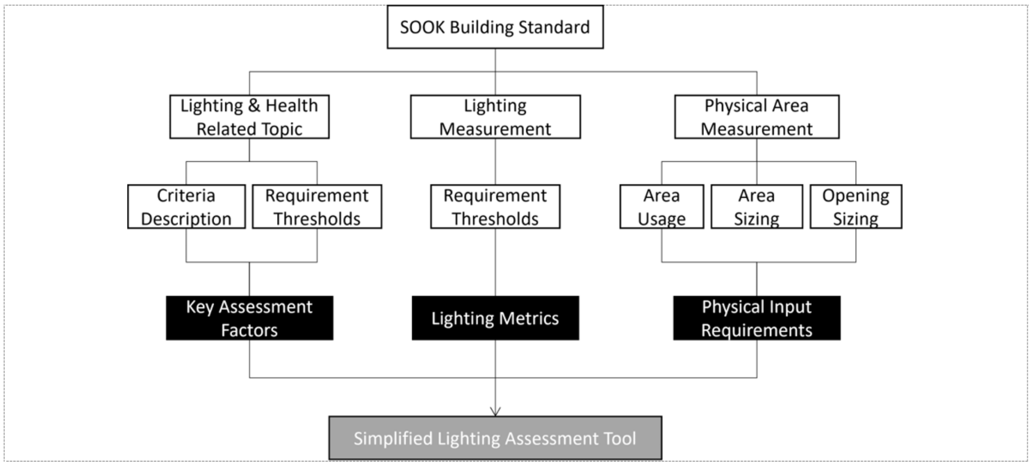

Figure 1. A framework diagram for identifying the key factors that are necessary for assessing the required input data.

To achieve our objective, a comprehensive literature review and empirical evaluations were employed. The literature review provided a foundation through a summary of current understanding and identifying gaps in existing assessment methodologies by investigating the lighting requirements to promote well-being, following the guidelines outlined in the SOOK Building Standard. The standard was examined to identify the attributes that influence the minimum required criterion. The diagram in Figure 1 outlines the sequence of steps for carrying out this research, starting with the analysis of the SOOK Building Standard and progressing to the development and use of an assessment tool. Ultimately, this research aims to contribute to the field of building science by providing a robust, simplified, and scientifically grounded lighting assessment tool. Such a tool not only will enhance the implementation of the SOOK Building Standard but also will promote environments that support the health and well-being of their occupants.

2. Overview of SOOK Building Standard

The Sook Builing Standardwas developed and published by the Thai Green Building Institute (TGBI) which currently is in the process of preparing a manual and training for future enforcement. The (Thai Green Building Institute [TGBI], 2023) divides the SOOK Building Standard into 5 distinct categories, each contributing to a total score of 110 points. The architectural design category (AD) includes lighting for health, which consists of 5 attributes. These attributes contribute a cumulative total of 7 points out of 42 points, accounting for 6% of the overall score. Within the realm of interior design and material utilization (IM) category, one mandatory attribute and two additional attributes collectively reflect a score of 4 points, equivalent to 4% of the overall score. The scores for all lighting attributes contribute 10% to the overall score, as shown in Figure 2. Table 1 also outlines the requirements for each attribute and their corresponding scores.

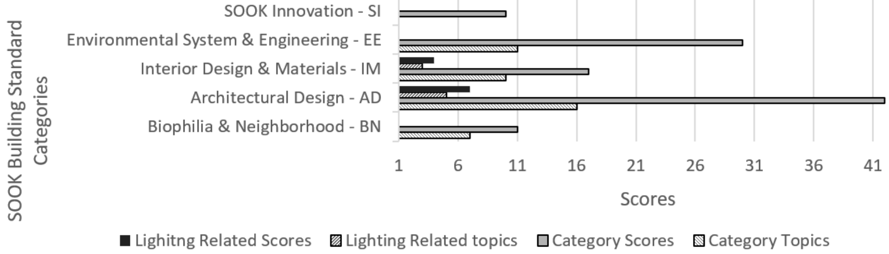

Figure 2. The subjects of lighting in SOOK Building Standards categories and corresponding score weight.

Table 1. Guidelines for Lighting-related attributes from catagories AD and IM in SOOK Building Standards

Attributes	Requirements description	Points
AD 8 Visual Lighting	1. Visible Light Transmittance (VLT) > 40% 2. Visible Light Reflectance Indoors (VLR) < 15% 3. Daylight Factor (DF) > 2% (70% of regularly occupied space.)	1
AD 9 Daylight	$SDA_{300,50\%}$ at least 55% of regularly occupied space *(1 point)* $SDA_{300,50\%}$ at least 75% of regularly occupied space *(2 points)*	2
AD 10 Glare Control	1. Glare control system must be installed according to below *(1 point)*: - Windows must be equipped with sunshades which can be adjusted by building occupants or set automatically to adjust according to the intensity of daylight - Luminaires must have a device to reduce glare with a shielding angle (α) <10° - Anti-glare/ Honeycomb must be installed - Luminaires installed at task area <5 m to meet UGR of 19 - Luminaires installed at task area ≥ 5 m to meet UGR of 22 2. Annual sunlight exposure of $ASE_{1000,250}$ is achieved for no more than 10% of regularly occupied space, exclude the foyer. *(1 points)*	2
AD11 Right to Light	At least 75% of regularly occupied space is within 7.5 m of glazing or atrium.	1
AD12 Shading & Dimming	1. Shading devices that can be adjusted by building occupants or set automatically to adjust according to the intensity of daylight 2. At the sides with WWR > 40% must be equipped with exterior sunshades 3. Luminaires must be equipped with an occupied area sensor which is set to 20% dimmed or turned off when the space is unoccupied	1
IMp2 Basic Color Quality	Luminaires in regularly occupied space meet Color Rendering Index CRI≥ 80	P
IM 2 Color Quality	Luminaires in regularly occupied space meet Color Rendering Index CR≥ 90 Luminaires in regularly occupied space meet Color Rendering Index CRI ≥ 80 with R9 ≥ 50	2
IM 10 Circadian Lighting	1. Between 9 a.m. – 1 p.m., at least 150 Equivalent Melanopic Lux (EML) at 0.45 m from task level [1.2 m] of all workstation areas *(1 point)* 2. Between 9 a.m. – 1 p.m., at least 120 EML at 0.45 m from task level [1.2 m] from artificial light only of all workstation area and SDA300,50% at least 75% of regularly occupied space *(2 points)*	2

Source: Compiled from the SOOK Building Standard V.1 (TGBI, 2023)
Note: P = Prerequisite

From Table 1, the main goal from lighting subjects can be categorized into two parts: ensuring sufficient daylight during the day, as specified in the Architectural Design (AD) category and providing quality artificial lighting, which is addressed in the Interior Design & Materials (IM) category.

2.1 Lighting-Related Attributes in Architectural Design Category (AD)

2.1.1 The AD8 assessment evaluates the amount of daylight penetration into the building via windows and openings. When assessing building glass, it is important to consider the visual light transmittance (VLT) value, expressed as a percentage (%), with higher values indicating greater light transmission. The VLT must be a minimum of 40%. Additionally, the indoor visible light reflectance value (VLR) must not exceed 15%. This value denotes the reflectance of a surface, with higher values indicating greater light reflection as opposed to transmission, hence influencing internal heat within a building. Both values normally should be provided by glass manufacturers in their specification sheet or website. The amount of daylight that penetrates a building's interior is evaluated using the daylight factor (DF), which requires a minimum threshold of 2% for 70% of the regularly occupied space. The daylight factor is calculated using equation 1, as per the CIE standard (International Commission on Illumination, 1994):

$$DF = \frac{E_{int}}{E_{ext}} \times 100\% \tag{1}$$

where: *DF* is the daylight factor (expressed as a percentage)

E_{int} is the illuminance inside the room due to daylight (in Lux)

E_{ext} is the outdoor illuminance on a horizontal plane (in Lux)

The daylight factor (DF) is commonly determined by dividing the indoor illuminance at a specific spot by the outside illuminance under an overcast sky. A key limitation of the daylight factor method is that the building's orientation has no impact on the daylight factor. Additionally, the method is not well implemented in places where an overcast sky is not dominant (Reinhart & Herkel, 1999), such as intropical regions like Thailand where the sky is luminous and dominated by clear and partly cloudy conditions of 80% during the daytime (Mettanant et al., 2017). Alternatively, the daylight factor can be calculated by modern building simulation programs using weather data, including hourly measurements of global horizontal irradiance (GHI) and diffuse horizontal irradiance (DHI). Rhinoceros software (Robert McNeel & Associates, 2023) is one of the most popular architectural design programs which allows background running of several building performance simulation plugins such as Ladybug and Honeybee for building energy and daylighting analysis (Roudsari & Pak, 2013). Ladybug uses EnergyPlus Weather (EPW) files (Lawrie & Crawley, 2022) to perform climate analysis. These files contain detailed weather data for specific locations. This enables the calculation of an estimated outdoor illuminance level based on the precise location, in order to validate it against the measured illuminance in the buit environment. Hence, it is crucial to integrate both g horizontal irradiance (GHI) and diffuse horizontal irradiance (DHI) data in order to precisely compute Sky Ratio (SR) (McDermott & Gordon-Smith, 1951) and the daylight factor (DF) in tropical regions. To estimate Eext , the formula below can be used:

$$E_{ext} = E_{GHI} \times (1 - SR) \tag{2}$$

where: *SR* is the sky diffuseness ratio, calculated as $SR = \frac{E_{DHI}}{E_{GHI}}$

EGHI is global horizontal irradiance (in Lux),

EDHI is diffuse horizontal irradiance (in Lux).

21.2 AD9 is evaluated using spatial daylight anatomy (sDA) values, which consider areas that can take advantage of sufficient natural light. The criteria used to evaluate the condition, $sDA_{300,50\%}$ = 55, are such that 55% of the regularly used area should receive natural light with an illuminance of at least 300 Lux, not less than 50% of the working time throughout the year. Similarly, the condition, $sDA_{300,50\%}$ = 75, requires that 75% of the regularly used area should receive natural illuminance of at least 300 Lux, not less than 50% of the working time throughout the year. The design receives 1 point and 2 points, respectively, if it meets these specified requirements. Calculation methods from LEED V2009 (U.S. Green Building Council [USGBC], 2009) in equation 3 are used to analyze the appropriate natural light coverage following the Spatial Daylight Anatomy Index ($sDA_{300, 50\%}$):

$$0.15<VLT \times WFR<0.18 \quad (3)$$

where: *VLT* is visible light transmittance,

WFR is Window-to-Floor Area Ratio (determined by calculating the ratio of the opening area to the usable area)

21.3 In AD10, we evaluated the effectiveness of shielding against intense light from both daylighting and artificial sources. We organized the content into categories that focus on using shading devices to harness daylight and implementing anti-glare mechanisms for lighting fixtures. The evaluation includes the Annual Sunlight Exposure Index ($ASE_{1000,250}$), which considers areas that receive excessive natural light or daylight with an illuminance of over 1,000 Lux for no more than 250 hours per year. This evaluation applies to areas that make up no more than 10% of the regularly used space.

2.1.4 AD11 can be evaluated if a minimum of 75% of the regularly occupied space is located within 7.5 m from the glass or atrium.

2.1.5 AD12 focuses on minimizing the negative impact of external glare on the building. It is recommended to install shading devices that can be manually adjusted by occupants or automatically adjusted based on the intensity of daylight. Moreover, exterior sunshades should be installed, particularly on building facades that have a window-to-wall ratio (WWR) exceeding 40%.

2.2 Lighting-Related Attributes in Interior Design & Materials Category (IM)

2.2.1 IMp2 is mandatory for the optimal utilization of light bulbs with a Color Rendering Index (CRI) of 80 or higher to provide electric illumination for the entire usable area of the building.
IM 2 is determined for frequently utilized areas by employing electric light bulbs with a Color Rendering Index (CRI) of no less than 80 and an R9 value of 50, or CRI of no less than 90, which can accurately reproduce the colors of objects. The values mentioned in the bulb or luminaire descriptions can be found on the package or the manufacturer's website.

2.2.2 IM 10 is determined based on the Equivalent Melanopic Lux (EML), which is a unit of measurement used to quantify the amount of light from light sources that will activate the melanopsin receptors in the human eye. The response to light is mediated by melanopsin, a photopigment found in the retina. Measurements are done at the eye level of building users, either the height of 0.45 m above the work surface or 1.20 m above the floor level. Considering physiological systems, building occupants should receive adequate daylighting and artificial lighting throughout the entire workspace. To receive 1 point, both daylight and artificial lighting must produce at least 150 Equivalent Melanopic Lux (EML). The electrical system for lighting must maintain 150 EML or higher between 9:00 a.m. and 1:00 p.m. daily. Workspaces with 75% coverage receive 2 points. To calculate the Equivalent Melanopic Lux (EML), multiply the luminaire's Melanopic Ratio (MR) obtained from the Spectral Power Distribution (SPD) of a light source with the photopic Lux measured at the eye level of the building occupant using equation 4, per (IWBI, 2014):

$$EML=E_v \times MR \quad (4)$$

where *MR* is a value calculated based on the Spectral Power Distribution (SPD) of the LED and Luminous packages which can be obtained from standard luminaire manufacturers.

Ev is the vertical luminance value (Lux).

3. Methodology

To enhance the accessibility and simplify the health lighting assessment criteria of the SOOK Building Standard, it is important to carefully analyze the specific criterion description for indentifying physical area requirement inputs, as well as the concepts and metrics used for determining the minimum thresholds of each lighting measure. These factors are important for determining the attributes utilized in the key assesment. Relevant lighting metrics used for the calculation of each measure were utilized and subtituted with the minimum threshold value for each measure. This approach aims to establish a set of data that aligns with the required standards. It is used to evaluate and compare the inputted information from the measurement to determine if it falls within the criteria and to assign a corresponding score based on the criteria.

When evaluating the quality and quantity of light, it is important to consider the area's dimensions and the opening's physical features. Figure 3 establishes a direct connection between the precise criteria and the measurable data of the evaluated region, along with the specific threshold requirements for illumination conditions. The SOOK Building Standard consists of eight attributes (discussed in the previous section) and it utilizes three ways for evaluating inputted data: observation, data-based evaluation, and computational or simulation. By observing physical conditions inside a room, such as the placement of sunshades, the amount of time spent within 7.5 m of windows, and the use of anti-glare devices on artificial lights in the order given (AD10, AD11, and AD12), many conditions and uncertainties can be clarified. One can conduct data-based evaluation by organizing sets of data that align with the specified parameters for measurement, such as the standard glass specifications provided by the manufacturer for each type, color, and thickness. This is particularly relevant for evaluating visible light reflectance (VLR) and visible light transmittance (VLT) in the attribute AD8. Similarly, attributes IMp2 and IM2 can supply sets of CRI data based on each type of light source from conventional lighting suppliers. Equation 4 for the IM10 attribute uses these data to calculate the necessary market research (MR) needed for EML computation. The computation results should not be lower than 150 EML, calculated by multiplying the MR associated with the light source by the measured on-site illuminance. Computational climate simulations were conducted using Rhino3D and Grasshopper programs, utilizing Ladybug plug-ins to analyze the latest meteorological data obtained from hourly records in the ISD (US NOAA's Integrated Surface Database) for the year 2021 (Lawrie & Crawley, 2022). The process of hourly analysis of meteorological data for each month between 6:00 a.m. and 6:00 p.m., illustrated in Figure 4, enables the computation of an average hourly global horizontal irradiance (GHI) and diffuse horizontal irradiance (DHI). Subsequently, the results were substituted into equation 2 to determine the average outdoor illuminance on a horizontal plane (E_{ext}) enabling furthur analysis using the daylight factor method.

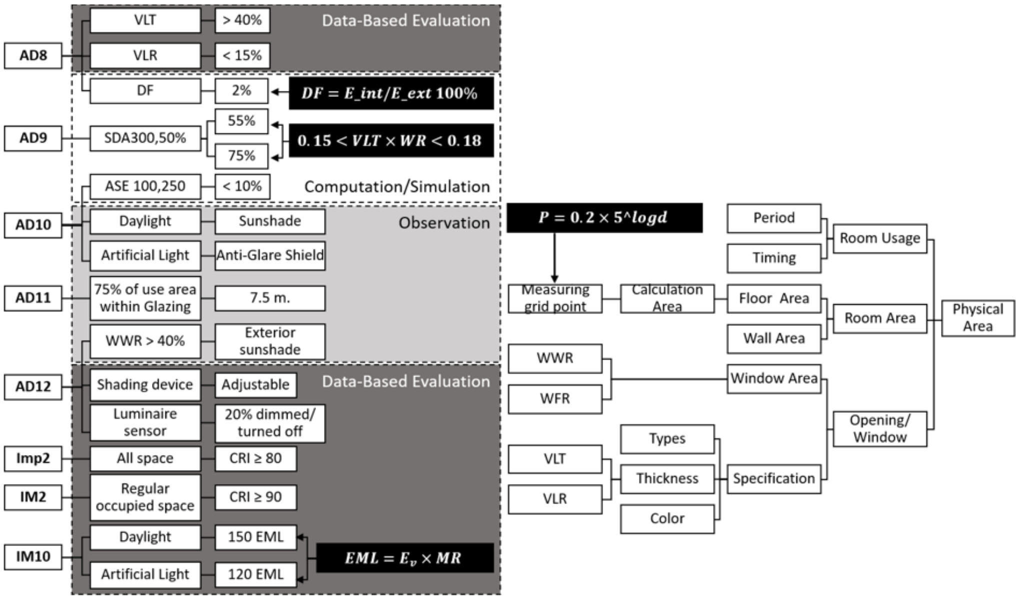

Figure 3. The analysis of the criterion descriptions of the SOOK Building Standard to determine the association between lighting-related evaluation attributes and physical area data measurements.

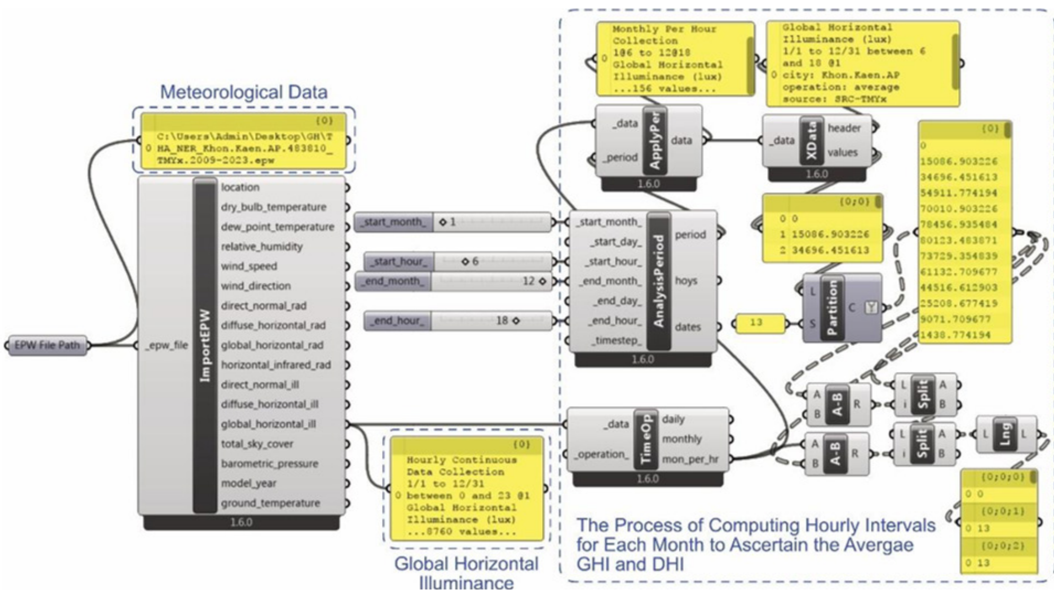

Figure 4. The analysis of meteorological data in the EPW file format using the Grasshopper method to determine each month's average hourly global horizontal illuminance.

We then use these findings to replace the values in equation (1), establishing the DF value at 2%. We rearrange the equation to determine the minimum indoor illuminance value for further evaluation using the measured illuminance input, as illustrated in the following equation:

$$E_{int} = \frac{(E_{GHI} \times (1 - SR)) \times 2}{100} \quad (5)$$

Using a portable lux meter or a mobile application for light meter, one can quantify the brightness on-site while following the designated measuring location. We divided the calculation's surface into a rectangular grid, maintaining a length to width ratio for each grid cell of between 0.5 m and 2 m (Deutsches Institut für Normung e.V. [DIN], 2011: European Committee for Standardization [CEN], 2018), while excluding a 0.5 m strip along each external wall. We conducted measurements at the precise center of the measurement fields. We determined the calculation grid point for estimating the average brightness by computing the maximum distance between calculation points within the grid using the formula in equation (6). Each point location can employ a Lux meter to quantify the luminous intensity for both daylighting and artificial lighting. Therefore, we calculated the average illuminance from the on-site measurements to evaluate the performance in AD8, AD9, and IM10.

$$P = 0.2 \times 5^{logd} \tag{6}$$

Where P is the maximum distance between the calculation points (0.2 m – 5 m),

d is the longer dimension for the surface (distance factor, m),

$logd$ is the logarithm of the distance factor.

0.2×5 are coefficients utilized to effectively adjust the logarithmic function for a particular application.

4. Results

From the analysis of each attribute, we can categorize the key assessment factors into six metrics based on the inputs required for each attribute: room usage, room area, windows, daylight, artificial lighting, and shading devices. Figure 5 presents the necessary input data for the assessment, which need to be analyzed using the data-based approach from the process outlined in the previous section. We transferred these data into an Excel table format to enable parallel entry of relevant formulas, associated equations, and data derived from the collection. We created a preliminary version of the assessment tool, as depicted in Figure 6, that enables the entry of measured illuminance levels, physical area dimensions, opening area dimensions, types of shading and anti-glare devices, pertinent glass materials, and fundamental lighting fixtures. We specifically designed this tool to evaluate the impact of both natural and artificial light on overall health and well-being by associating pertinent equations with the tables to analyze the outcomes of measuring input data using the data supplied in this research. The tool operates in accordance with the precise specifications outlined in the SOOK Building Standard. Figure 7 exhibits the results page of the prototype evaluation tool. This page displays the scores obtained for each of the six metrics linked to the input data, as well as the overall score out of 11 points. It also provides detailed information on incomplete sub-elements, allowing the designer or the occupant to rectify them further.

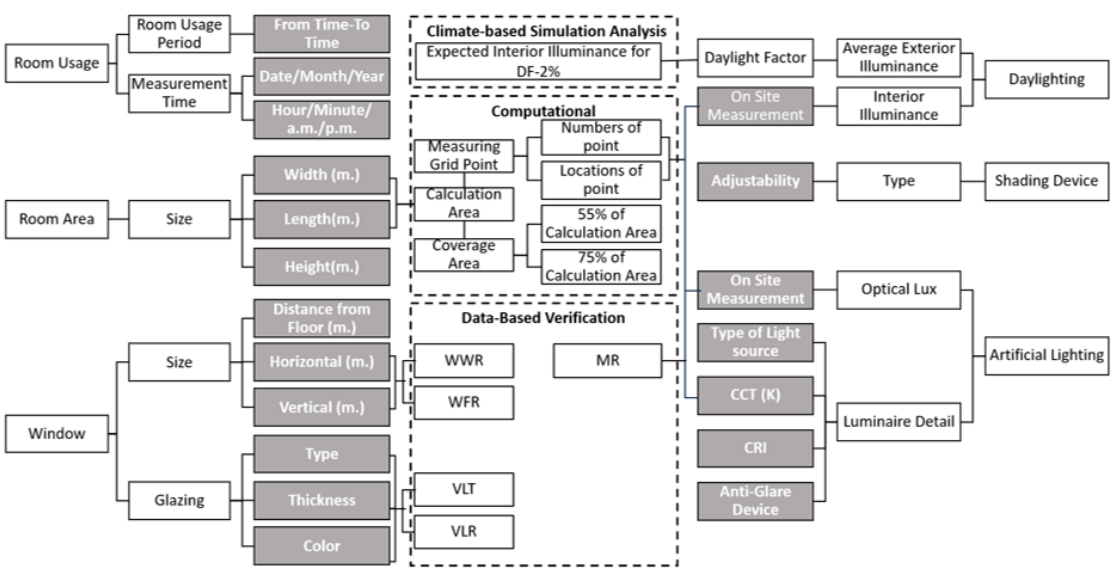

Figure 5. The key assessment factors and inputs from the 6 groups for the assessment tool development.

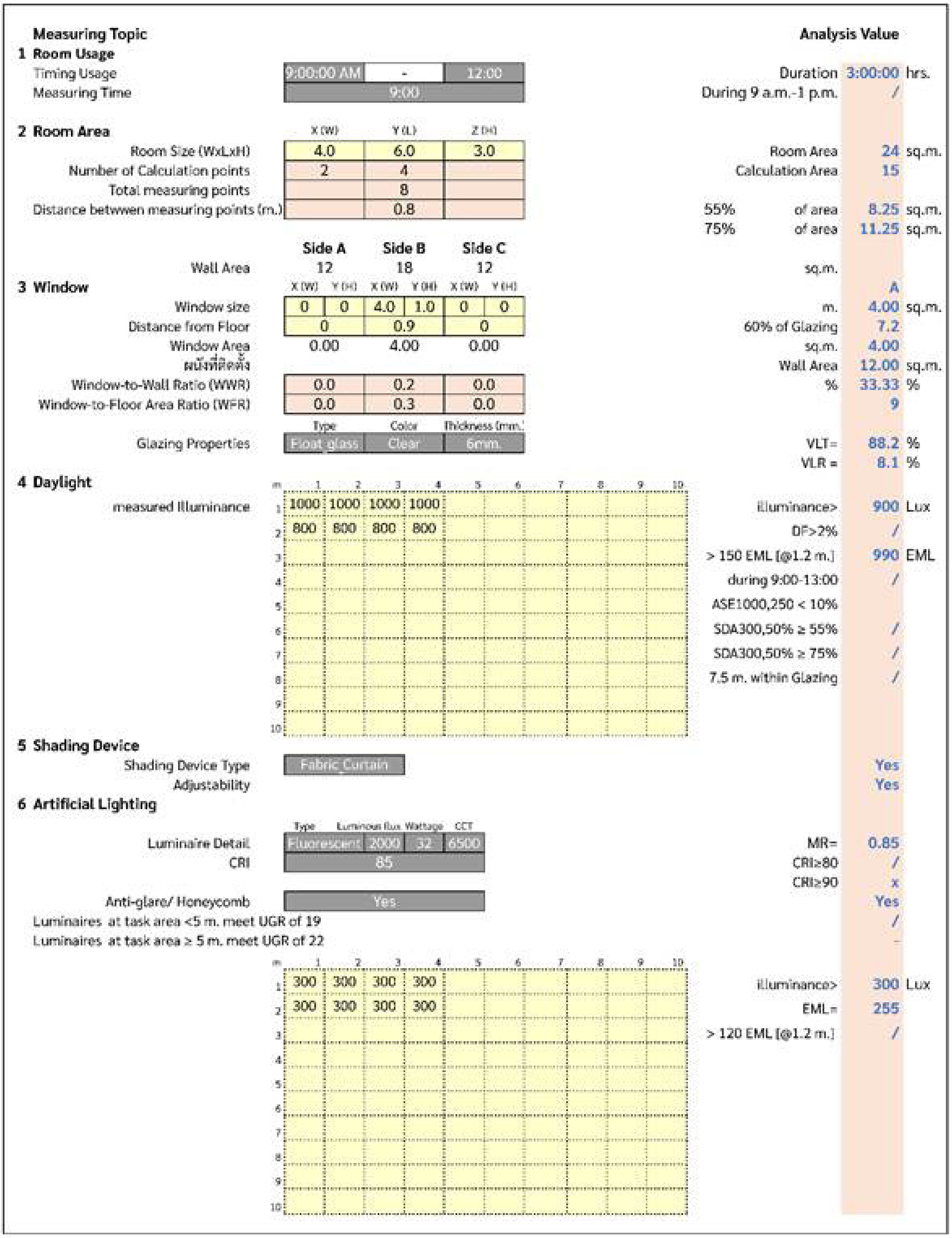

Figure 6. A prototype of a formula for evaluating lighting based on data input.

Attribute	Points	Requirements description	Scores	
AD 8 Visual Lighting	1	1. Visible Light Transmittance (VLT) > 40%	/	1
		2. Visible Light Reflectance Indoors (VLR) < 15%	/	
		3. Daylight Factor (DF) > 2%	/	
AD 9 Daylight	2	SDA300,50% at least 55% of regularly occupied space. *(1 point)*	/	2
		SDA300,50% at least 75% of regularly occupied space. *(2 points)*	/	
AD 10 Glare Control	2	1. Glare control system must be installed according to below *(1 point)*: - Windows must be equipped with sunshades. which can be adjusted by building occupants. Or set to adjust according to the intensity of daylight automatically. - Luminaires must have a device to reduce glare with a shielding angle (α) <10° - Anti-glare/ Honeycomb must be installed. - Luminaires installed at task area <5 m. meet UGR of 19 Luminaires installed at task area ≥ 5 m. meet UGR of 22	/	1
		2. Annual sunlight exposure of ASE1000,250 is achieved for no more than 10% of regularly occupied space. *(2 points)*	x	
AD11 Right to light	1	At least 75% of regularly occupied space is within 7.5 m. of glazing or atrium.	/	1
AD12 Shading & Dimming	1	1. Shading devices that can be adjusted by building occupants. Or set to adjust according to the intensity of daylight automatically.	/	0
		2. At the side with WWR > 40% must equipped with exterior sunshades.	N/A	
		3. Luminaires must be equipped with an occupied area sensor which is set to 20% dimmed or turned off when the space is unoccupied.	N/A	
Imp2		Luminaires in regularly occupied space meet Color Rendering Index CRI≥ 80.	/	P
IM 2 Color Quality	2	Luminaires in regularly occupied space meet Color Rendering Index CR≥ 90.	x	0
		Luminaires in regularly occupied space meet Color Rendering Index CRI ≥ 80 with R9 ≥ 50.	x	
IM 10 Circadian Lighting	2	1. Between 9 a.m. – 1 p.m., at least 150 Equivalent Melanopic Lux (EML) at 0.45m. from task level [1.2 m.] of all workstation areas. *(1 point)*	/	2
		2. Between 9 a.m. – 1 p.m., at least 120 EML at 0.45 m. from task level [1.2 m.] from artificial light only of all workstation area and SDA300,50% at least 75% of regularly occupied space. *(2 points)*	/	
Total	11			7

Figure 7. The result page of the prototype of the lighting assessment tool.

5. Discussion

The findings revealed several critical elements that contribute to a successful prototype of an assessment tool. This involves assisting in establishing the criteria for acquiring data for assessment and analysis, which are light intensity, color temperature, circadian rhythm alignment, and visual comfort. The results are in line with existing literature, reinforcing the importance of tailored lighting solutions that address both visual and non-visual effects. This is similar to the WELL Building Standard. Moreover, the alignment with Boyce (2021) and Brown et al., (2022) work on circadian lighting further validates the health benefits of such systems. The results of this study have important implications for the development of the lighting assessment tool. The tool may conduct a preliminary assessment of the impact of lighting on occupants' well-being by integrating and structuring information and data, establishing connections between data and calculation formulae, and generating precise data for assessing outcomes. Furthur development of the assessment tool could be done as a mobile application to facilitate analytical and decision-making speed. This feature will empower architects, designers, and facility managers to construct spaces that foster physical and mental wellness while also complying with the rigorous SOOK Building Standard. While the study provides useful insights, it is based on a small sample size, specific types of illumination sources, and daytime illuminance datasets. Subsequent investigations should broaden the dataset and use a more diverse range of light sources to improve the applicability of the results.

6. Conclusion

In conclusion, this study underscores the critical role of lighting in promoting health and well-being and provides a simplified tool for assessing lighting quality based on the SOOK Building Standard. The development of an effective lighting assessment tool has the potential to improve indoor environments by encouraging the wider adoption of lighting design techniques in built environments. This will establish an environment that actively promotes and enhances human health and well-being. Continued research and innovation in this area will be essential to fully realize the benefits of advanced lighting solutions for the built environment.

Ethical Considerations and Acknowledgements.

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Author Contributions

Conceptualization, N.H.; methodology, N.H.; software, N.H.; validation, N.H.; investigation, N.H.; formal analysis, N.H.; resources, N.H.; Writing (original draft, review, and editing), N.H.; visualization, N.H.; supervision, Y.C. Both authors agreed to the published version of the manuscript and declared no conflict of interest.

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