



GRIHA

A GRIHA COUNCIL
PUBLICATION

GRIHA for INTERIOR SPACES

Version 1.0

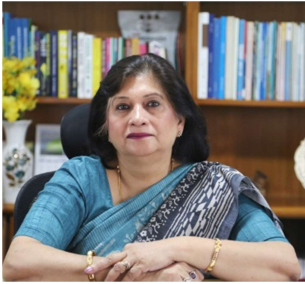
USER MANUAL

GRIHA InS V1.0



MESSAGE

DIRECTOR GENERAL, TERI



In the dynamic realm of sustainable development, the building industry significantly contributes to global emissions from economic activities, necessitating the evolution of energy and sustainability rating systems towards achieving net-zero emissions.

India's burgeoning population and economic growth have led to increased emissions driven by a demand for luxurious living more often resulting in increased carbon footprint. The global challenge of rising carbon footprints has prompted the establishment of rating systems. The GRIHA council in India is playing a pivotal role since 2007 in this sector. Recognizing the potential environmental impact of extensive material consumption in the growing building stock worldwide, a crucial shift to a 'Clean Energy Transition' is imperative to disrupt the conventional trend of economic development.

In this critical juncture, building rating systems become decisive, offering an effective and transparent evaluation mechanism for sustainable practices in the industry. In this context it becomes even more important to have an interior rating system. "GRIHA for Interiors," developed by The Energy and Resources Institute (TERI) in collaboration with the GRIHA Council, exemplifies this commitment. This manual aligns with national goals while contributing to the global imperative of reducing carbon emissions in the built environment.

TERI, a stalwart in environmental responsibility, has been at the forefront of sustainable practices. With a rich legacy in the built environment, TERI's pioneering work includes the development of the first TERI GRIHA Manual in 2010. "GRIHA for Interiors" is a testament to TERI's dedication to advancing green building practices, embodying the institute's 50 years of research aimed at sustainable growth. GRIHA, as India's Green Building Rating System since 2007, exemplifies a holistic approach to sustainable construction, setting benchmarks for resource efficiency, waste reduction and environmental impact across the entire life cycle of buildings continuously since its inception.

As we embark on this journey with "GRIHA for Interiors," let us celebrate not only the manual but also the decades-long commitment of TERI to sustainability. This commitment has shaped the trajectory of the built environment, laying the groundwork for a more resilient and harmonious future.

Dr. Vibha Dhawan

FOREWORD

VICE PRESIDENT AND CEO, GRIHA COUNCIL



The global construction and building sectors jointly contribute approximately 40% to the overall carbon footprint, primarily due to processes such as lighting, cooling, and heating of building. The impact of carbon emissions from interior construction and renovation projects has not received much attention due to its overall minimal impact on carbon emissions. Studies indicate that each interior renovation of a building increases carbon emissions, accumulating significantly over the building's lifespan.

So far, GRIHA variants have focused on all segments of new and existing construction sector with its underlined principle "What gets measured, gets managed". Aligning with its mission and facilitating the specific group of stakeholders specializing in the building interiors, we, at GRIHA Council are pleased to introduce the "GRIHA for Interior Spaces" rating. As a comprehensive assessment and rating tool, GRIHA for Interior Spaces Rating has been developed to assist in the design and rating of building interiors. It evaluates the environmental performance of building interiors for low-impact materials, increased energy and water efficiencies, improved occupant comfort and enhanced social well-being.

GRIHA for Interior Spaces Rating endorses eco-friendly materials, energy-efficient designs, and innovative sustainability measures, thereby, significantly contributing to India's broader vision towards green nation building.

With the introduction of economically viable advanced technologies and sustainable practices, the rating would keep evolving. This would drive the building interiors segment towards attaining higher levels of sustainability with improved health and livability.

I acknowledge the efforts of all colleagues associated with the development of this rating and look forward to their continued support for its enhancement.

A handwritten signature in blue ink, appearing to read 'Sanjay Seth', with a long horizontal stroke extending to the right.

Sanjay Seth

ACKNOWLEDGEMENTS



The GRIHA for Interior Spaces (InS) rating is an outcome of the development team and various experts in the buildings industry. The GRIHA Council would like to express our sincere gratitude to all the experts who spared valuable time and guided us throughout the process.

We would like to thank all stakeholders, ranging from facility managers, green building consultants, academia and building practitioners for their constant support and encouragement during the development process.

The GRIHA InS rating would not have been conceivable without extremely valuable technical advisory team and technical guidance of Mr. Sanjay Seth, Vice President and CEO, GRIHA Council.

We would like to express our gratitude to Dr Vibha Dhawan, Director General, TERI for providing her leadership, without which development of this rating would have not been possible.



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ABBREVIATIONS

.dwg	Cad drawing
A	Area
AHU	Air Handling unit
AQI	Air Quality Index
BEE	Bureau of Energy Efficiency
BQ	Bill of Quantities
CAGR	Compound Annual Growth Rate
CCTV	Closed Circuit Television
CFM	Cubic Feet per Minute
CO	Carbon Monoxide
CO₂	Carbon di oxide
COP	Coefficient of Performance
CPCB	Central Pollution Control Board
CRI	Color Rendering Index
DfD	Design for Disassembly
DG	Diesel Generator
DGP	Daylight Glare Probability
ECBC	Energy Conservation Building Code
EML	Equivalent Melanopic Lux
EN	European standard
EPD	Environmental Product Declaration
EPI	Energy Performance Index
GRIHA	Green Rating for Integrated Habitat Assessment
GW	Gigawatt
GWh	Gigawatt-hour
GWP	Global Warming Potential
HFC	Hydro fluorocarbon
HVAC	Heating, Ventilation, and Air Conditioning
HVAC & R	Heating, Ventilation, Air Conditioning & Refrigeration
IMAC	India Model for Adaptive Comfort
IS	Indian Standards
ISEER	Indian Seasonal Energy Efficient Ratio
ISHRAE	Indian Society of Heating, Refrigerating and Air Conditioning Engineers
IT	Information Technology
kWh	Kilowatt-hour
LCA	Life Cycle Assessment
LPD	Lighting Power Density
MEP	Mechanical, electrical and plumbing engineering
NBC	National Building Code
NRC	Noise Reduction Coefficient
PPE	Personal Protective Equipment
PPM	Parts Per Million
PU	Polyurethane



RCC	Reinforced Concrete
RE	Renewable Energy
REC	Renewable Energy Certificate
RH	Relative Humidity
RT	Reverberation Time
Sq.m	Square Meter
STC	Sound Transmission Class
T	Temperature
TVOC	Total Volatile Organic Compound
TWA	Time-Weighted Average
UDI	Useful Daylight Illuminance
UGR	Unified Glare Ratio
UPS	Uninterruptible Power Supply
V	Volume
VOC	Volatile Organic Compound
VOC	Volatile Organic Compounds
VRF	Variable Refrigerant Flow

GLOSSARY

3D Printing in Construction

3D printing in construction refers to the use of additive manufacturing techniques to create building components or entire structures. It involves layer-by-layer deposition of materials, such as concrete or specialized construction-grade polymers, to build structures. 3D printing in construction can offer greater design flexibility and reduce material waste while potentially lowering construction costs and time.

Carbon Emissions

Carbon dioxide emissions are those stemming from the burning of fossil fuels. They include carbon dioxide produced during consumption of solid, liquid, and gas fuels and gas flaring.

Coefficient of Performance (COP) cooling

The ratio of the rate of heat removal to the rate of energy input, in consistent units, for a complete refrigerating system or some specific portion of that system under designated operating conditions.

Coefficient of Performance (COP) – heating

The ratio of the rate of heat delivered to the rate of energy input, in consistent units, for a complete heat pump system, including the compressor and, if applicable, auxiliary heat, under designated operating conditions

Color Rendering Index (CRI)

Color Rendering Index (CRI) is a measurement of how natural colors render under an artificial white light source when compared with sunlight.

Connected load

The sum of the rated wattage of all equipment, appliances and devices to be installed in the building or part of building or building complexes, in terms of kilowatt (kW) that will be allocated to all applicants for electric power consumption in respect of the proposed building or building complexes on their completion.

Contract demand

The maximum demand in kilo Volt Ampere (kVA) agreed to be supplied by the electricity provider or utility in the agreement executed between the user and the utility or electricity provider.

Day lighting

Day lighting is the controlled admission of natural light, direct sunlight, and diffused-skylight into a building to reduce the need for electric lighting and to save energy. By providing a direct link to the dynamic and perpetually evolving patterns of outdoor illumination, day lighting helps create a visually stimulating and productive environment for building occupants, while reducing as much as one-third of total building energy costs.

Design for Disassembly (DFD)

DFD is an approach that focuses on creating buildings and structures with components and materials that can be easily taken apart or disassembled when needed. The primary goal is to facilitate the deconstruction of the building while minimizing damage to its components, enabling their reuse or recycling. It promotes sustainability by extending the lifecycle of building materials and reducing the environmental impact associated with construction and demolition processes through circularity in the built environment.

Energy Performance Index (EPI)

EPI of a building means its annual energy consumption in kilowatt-hours per square meter of the area of the building which shall be calculated in the existing or proposed building.



Fenestration

Products classified as either vertical fenestration or skylights and sloped glazing, installed in such a manner as to preserve the weather resistant barrier of the wall or roof in which they are installed. Fenestration includes products with glass or other transparent or translucent materials.

Glare

It is defined as the condition of vision in which there is discomfort or a reduction in the ability to see significant objects due to an unsuitable distribution or range of luminances

Green and safe housekeeping chemical products

These products are eco-friendly and non-toxic cleaning solutions designed to maintain cleanliness and hygiene while minimizing environmental impact and health risks. These products are formulated with biodegradable ingredients, low VOCs, and no harmful chemicals, promoting a sustainable and healthy living environment.

Illuminance

Illuminance is the measure of the amount of light received on the surface. It is typically expressed in lux (lm/m²)

Indian Seasonal Energy Efficiency Ratio (ISEER)

It is the ratio of total seasonal cooling load in watt to total seasonal energy consumption in watts under design operating conditions.

Light pipes

The light pipe daylighting system consists of a light collector, a light pipe, and a luminaire to capture sunlight from the top roof and transport it to the entire building. To avoid glare and overheating, the amount of light entering the room is carefully adjusted

Light Shelf

Light shelf is a passive architectural element that serves the dual purpose of providing shade and reflecting light. The main component of the light shelf is a horizontal element that is positioned either on the exterior or interior side of window façade, or both.

Light well

It is a shaft / small courtyard designed to admit light to the interior rooms of a building

Lighting Power Density (LPD)

Maximum lighting power per unit area of a space as per its function or building as per its classification.

Low Impact Biomaterials

These are sustainable and environmentally friendly materials derived from renewable biological sources, such as plants or microorganisms. They have a reduced environmental footprint and offer potential benefits in various applications due to their biodegradability and minimal harm to ecosystems.

Low Impact Materials

These are materials that have a minimal environmental footprint, meaning they are sustainable, renewable, or have low toxicity and energy requirements, making them more environmentally friendly choices for various applications.

Luminance

Luminance is the measure of the amount of light reflected or emitted from a surface. It is typically expressed in cd/m².

Noise Reduction Coefficient

It is an average rating of how much sound an acoustic product can absorb.

Non-Redeye Flight

A flight on which a passenger cannot expect to get much sleep on account of the time of departure or arrival.

Passive Design

“Passive design” is an approach to building design that uses the building architecture to minimize energy consumption and improve thermal comfort. The building form and thermal performance of building elements (including architectural, structural, envelope and passive mechanical) are carefully considered and optimized for interaction with the local microclimate. The ultimate vision of passive design is to fully eliminate requirements for active mechanical systems (and associated fossil fuel-based energy consumption) and to maintain occupant comfort.

Prefabrication in Construction

Prefabrication is a construction method that involves manufacturing building components or modules in a factory or off-site location and then assembling them on the construction site. This approach increases efficiency, reduces construction time, and minimizes waste, resulting in cost savings and improved quality in building projects.

Renewable Energy Certificate

Renewable Energy Certificate (REC) mechanism is a market-based instrument to promote renewable energy and facilitate compliance of renewable purchase obligations (RPO). It is aimed at addressing the mismatch between availability of RE resources in state and the requirement of the obligated entities to meet the renewable purchase obligation (RPO).

Reverberation Time

Reverberation time (RT) is the time required for the sound in a room to decay over a specific dynamic range, usually taken to be 60dB, when a source is suddenly interrupted

Solar Reflectance Index

The Solar Reflectance Index (SRI) is a measure of the solar reflectance and emissivity of materials that can be used as an indicator of how hot they are likely to become when solar radiation is incident on their surface. The lower the SRI, the hotter a material is likely to become in the sunshine.

Sound transmission class

Sound transmission class (STC) is a rating of sound isolation of a building wall assembly. The higher the STC rating, the better sound isolation the wall assembly is to achieve.

Thermal Comfort

Thermal comfort is the condition of mind that expresses satisfaction with the thermal environment and is assessed by subjective evaluation (ANSI/ASHRAE Standard 55)

Time-Weighted Average

A time-weighted average is equal to the sum of the portion of each time period (as a decimal, such as 0.25 hour) multiplied by the levels of the substance or agent during the time period divided by the hours in the workday (usually 8 hours).

Unified Glare Ratio

It is an objective measure of glare. It predicts the glare caused by an electric lighting system along a psychometric scale of discomfort.

Useful Daylight Illuminance

Useful Daylight Illuminance is defined as the annual occurrence of illuminances across the work plane where all the illuminances are within the range 100-3000 lux.

U-value

The U-Value of a system is defined as the heat flow rate per unit area, divided by the temperature difference between the surroundings on each side of the system.

Visible Light Transmittance

The percentage of visible light that passes through a window or other glazing unit is called the Visible Light Transmittance (VLT).

Visual Comfort

Visual comfort criteria measure the ability of an individual to carry out tasks comfortably in terms of their photo-sensory perception of their environment. They are dependent on many factors including: light intensity, direction of light source, reflection of surfaces, contrast of surfaces, the nature of the task being undertaken and the photo-sensory response of the eye.

Volatile Organic Compound

Volatile organic compounds (VOC) mean any compound of carbon, excluding carbon monoxide, carbon dioxide, carbonic acid, metallic carbides or carbonates, and ammonium carbonate, which participates in atmospheric photochemical reactions. These are organic chemical compounds whose composition makes it possible for them to evaporate under normal indoor atmospheric conditions of temperature and pressure.

INTRODUCTION

In today's rapidly changing world, the way we design, construct, and inhabit interior spaces holds immense significance. With escalating concerns about climate change, dwindling resources, and the well-being of occupants, it is imperative that we re-evaluate our approach to interior design. The GRIHA for Interior Spaces (InS) emerges as a ground breaking framework, addressing the pressing need for sustainable, eco-conscious, and socially responsible interior spaces. At its core, **GRIHA InS** is a comprehensive solution, integrating diverse aspects of interior design to create spaces that are not just aesthetically pleasing but also environmentally sustainable and conducive to human flourishing. By emphasizing energy and water efficiency, **GRIHA InS** advocates for the optimal use of energy through efficient appliances and renewable sources, alongside responsible water conservation practices. A fundamental pillar of **GRIHA InS** lies in the selection and utilization of materials. Encouraging the procurement of sustainable, contaminant-free building materials and promoting design optimization, the system ensures that the environmental impact of materials is minimized. This includes a meticulous evaluation of material and product's life cycle, emphasizing durability and longevity.

Equally crucial is **GRIHA InS** focus on occupant health and comfort. Prioritizing thermal, visual, and acoustic comfort, the system creates spaces where individuals can thrive. Indoor air quality often overlooked but essential to well-being, is a key consideration, ensuring that occupants breathe clean, unpolluted air. In tandem with these objectives, **GRIHA InS** champions responsible waste management practices. By promoting the segregation and reduction of waste, the system reduces the environmental burden associated with solid waste generation, contributing to a cleaner, healthier environment. **GRIHA InS** goes beyond the physical aspects of design, delving into the social fabric of interior spaces. It advocates for inclusive, engaging environments that foster a sense of community and overall well-being among occupants. Furthermore, the system underscores the importance of sustainable housekeeping and maintenance, embedding green initiatives and efficient procedures into the daily operations of interior spaces. Crucially, **GRIHA InS** serves as a catalyst for innovation. By nurturing a culture of creativity and ingenuity, the system encourages the development and adoption of pioneering solutions. Through this, **GRIHA InS** not only addresses current challenges but also prepares the groundwork for future advancements in sustainable interior design.

In essence, the GRIHA for Interior Spaces redefines our approach to interior spaces. It signifies a paradigm shift—a commitment to creating spaces that are in harmony with the nature, promoting occupant well-being, and upholds the principles of environmental stewardship. By embracing the principles outlined in **GRIHA InS**, designers, architects, and stakeholders contribute significantly to a sustainable future, shaping interior spaces that resonate with the ethos of our culture & traditions.



ELIGIBILITY

Carpet area

All projects with a minimum carpet area of 25 sq.m are eligible for certification under GRIHA Interiors.

The following areas are excluded, which shall not be considered for registration fees calculation:

- Parking area (Stilt/Basement)
- Non-habitable basement spaces
- Service rooms: These are spaces that are dedicated to building services, such as electrical room, server room, meter room, etc., with no occupancy.

Building typology

GRIHA- Interiors has options to fit every project, for buildings under renovation with and without occupancy, existing building with occupancy.

- Owner occupied buildings ¹
- Tenant occupied buildings

Table 1 Eligible Building Typologies

HEALTHCARE FACILITY	HOSPITALITY	INSTITUTIONAL	OFFICE	RESIDENTIAL	RETAIL	TRANSIT TERMINAL
Hospitals	Hotels	Universities	IT buildings/ data centers	Multi- dwelling unit	Shopping complexes	Airports
Clinics	Guest houses	Schools	Co- working spaces	Hostels	Banquets/ Wedding halls	Heliports
Medical colleges	Service apartments	Colleges	Owner- occupied offices	Co- living spaces	Restaurants	Bus stands
Dispensaries	Community/ Visitors center	Institutes	Industries	Bungalows	Food courts	Railway stations
Hospice center	Resorts	Sports complexes	Court	Villas	Cafeterias	Metro stations
	Day care center	Place of worship		Mansions	Gallery/ Museum	Multi- modal transit hub
	Old- age care center			Military barracks	Sports and leisure facilities	
					Auditorium/ Theatre	
					Mixed use development buildings	

Building operation schedule

With the wide range of typologies being considered in the rating system, the operation schedule of a registered project is categorized into two categories that are, daily and weekly².

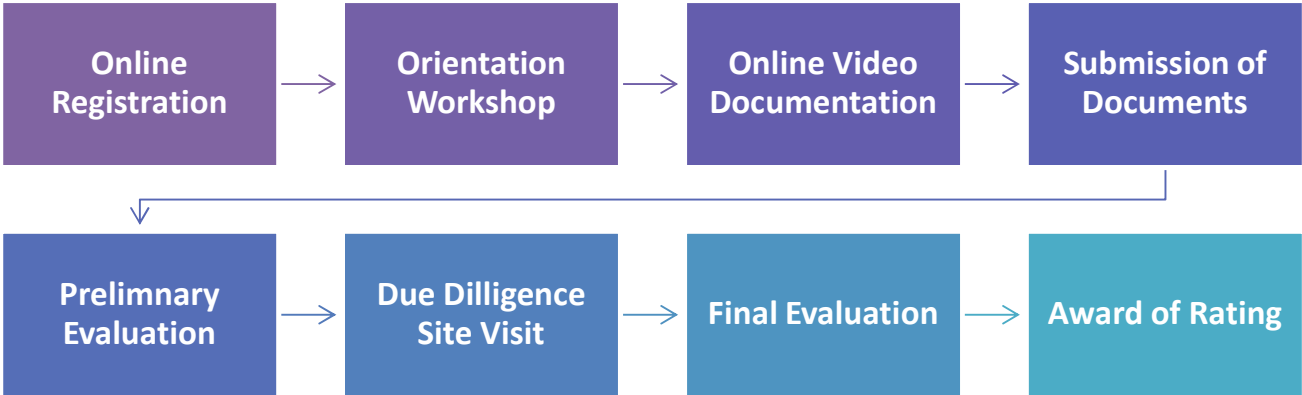
Table 2 Building operation schedule

S.NO	FREQUENCY IN OPERATION	OPERATIONAL DURATION
1.	Daily	8 hours
		24 hours
2.	Weekly	5 days
		7 days

In case of a project with multiple buildings (registered outside the complex virtual boundary), it is mandatory for each building to meet the minimum mandatory requirements of various Criteria of GRIHA. The overall points may be achieved based on averages as may be defined in different appraisals.

RATING PROCESS

1. **Feasibility check** – As a first step, the owner/ maintenance team / project team is responsible for checking the facilities & housekeeping. They are required to check if their project is eligible for a GRIHA for Interior Spaces rating with the help of the online feasibility check calculator available on the GRIHA website. The project must meet the mandatory clauses in order to be eligible for the GRIHA for Interior Spaces rating. Based on the information provided by the project proponent, the calculator gives anticipated level of rating. The rating level achieved in the feasibility check is just an indication, and rating shall be awarded once the project gets registered and submitted documents are evaluated and verified by GRIHA Council.
2. **Online Registration** – The project proponent needs to initiate the registration process by filling the expression of interest (EOI) form available on the GRIHA website. The registration is complete after the payment is successfully completed by the project proponent. Once the project is registered, the project proponent will be provided with a username and password for documentation on the online panel.
3. **Orientation workshop** –The registration is followed by an orientation workshop conducted by GRIHA Council. The intent of this workshop is to provide detailed information of interior spaces rating covering all criteria and to address specific queries of project proponent on the certification process.
4. **Online Video Documentation**- As the project is registered; the project proponent will upload a video documentation on the online panel with the username and password provided during registration.
5. **Submission of documents** – Post the orientation workshop, the project proponent must submit the documents for all criteria on the online panel by using the username and password provided during registration.
6. **Preliminary evaluation** – After online submission of documents, the preliminary evaluation is carried out by a team of professionals from GRIHA Council as well as external evaluators who are experts in the respective field. The documentation must be complete in all aspects for all attempted criteria. Any attempted criteria with incomplete documentation shall not be evaluated. Online calculators provided for specific criteria need to be filled in and submitted. The GRIHA Council professionals shall first review compliance of all criteria and establish compliance with mandatory criteria; followed by estimation of the total number of achievable points. A preliminary evaluation report shall be submitted within 25 working days after document submission.
7. **Due diligence site visit** – A due diligence site visit shall be conducted by GRIHA Council to verify the submitted documentation with onsite implementation. The visit will be done once the project is complete and all equipment's are installed. The due diligence report shall be uploaded on the panel within 15 working days from the site visit.
8. **Final Document Submission**– GRIHA Council evaluates submitted documentation in response to preliminary evaluation and due diligence report. On the basis of this evaluation, GRIHA Council shall prepare a final score card within 25 working days after the project team furnishes requisite information sought during preliminary evaluation and due diligence site visit. Final rating will be awarded based on the final evaluation.



CRITERIA AND THEIR WEIGHTAGE

GRIHA for Interior Spaces is a performance-oriented system where points are awarded for meeting the intent (appraisals) of the criteria. Each criterion has certain number of points assigned.

Compliances, as specified in the relevant criterion, have to be submitted in the prescribed format. While the intent of some of the criteria is self-validating in nature, there are others which need to be validated on-site through performance monitoring. The points related to these criteria (specified under the relevant sections) are awarded after verification through monitoring, validation, and documents/photographs to demonstrate compliance.

GRIHA for Interior Spaces is divided into six environmental sections, which are further classified into 19 criteria, covering all the requisite parameters required to be addressed while making a 'Sustainable green Interiors. An additional section on 'innovation' is a part of the rating system that rewards the project team for walking an extra mile to achieve environmental and social sustainability. Each criterion under these sections is explained in detail in the subsequent volume.

Different levels of certification (one star to five stars) are awarded based on the number of points earned. The minimum points required for certification is 25.

Table 3 Rating thresholds under GRIHA for Interior Spaces

Rating Threshold	GRIHA for Interior Spaces
25-40	★
41-55	★★
56-70	★★★
71-85	★★★★
86 and more	★★★★★

Table 4 List of criteria under GRIHA for Interior Spaces

Sections	Criterion Number	Criterion Name	Maximum Points	Section Weightage
Section 1. Energy & Water Efficiency	1	Energy optimization using efficient appliances	4	16
	2	Lighting Power Density (LPD) Optimization	3	
	3	Renewable Energy Utilization	4	
	4	Water conservation	5	
	5	Water quality	0	
Section 2A. Low Impact Materials	6	Procurement of materials	7	17
	7	Use of contaminant free building materials	6	
	8	Design optimization	4	
Section 2B. Life Cycle Assessment	9	Material & product life cycle assessment	13	13
Section 3. Occupant Health & Comfort	10	Thermal comfort	2	28
	11	Visual comfort	16	
	12	Acoustic comfort	5	
	13	Indoor air quality	5	
Section 4. Solid Waste Management	14	Segregation and reduction of waste	4	6
Section 5. Social & Well-Being	15	Social	5	10
	16	Wellbeing	5	
Section 6. Housekeeping & Maintenance	17	Green housekeeping	4	10
	18	Operation and maintenance	6	
Section 7. Innovation	19	Innovation	4	4