GRIHA Version 6.0

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MESSAGE

Vice President & CEO

GRIHA COUNCIL

GRIHA Council is pleased to introduce GRIHA Version 6.0, developed in keeping with the ongoing advancements in the Indian construction sector and to cater to buildings of varied functionalities and typologies. The rating continues to be aligned with national standards and guidelines such as the National Building Code 2016 and the Energy Conservation Building Code 2017, together with other relevant regulations pertaining to specific topics such as waste management, Comfort conditions etc.

We have incorporated the feedback and suggestions received from building practitioners and industry experts in the development of GRIHA Version 6.0. Throughout this process, we meticulously reviewed and modified the clauses in the rating system to incorporate valuable insights from end users and consultants. This collaborative approach has been instrumental in ensuring that the rating system is robust, comprehensive, practical, and user-friendly. By actively engaging with stakeholders from various sectors of the building and construction industry, we have addressed real-world challenges and refined our system to better meet their needs. Our goal has always been to create a tool that facilitates sustainable development while being accessible and easy to implement.

I compliment my team at GRIHA Council for their unwavering dedication in bringing “GRIHA Version 6.0” to fruition. Their hard work, commitment, and passion for sustainable development has been truly inspiring. The support and collaboration from all stakeholders in the development of this manual has been invaluable. I am grateful for their contributions and look forward to continuing this journey together as we strive to make a positive impact on our environment.

Sanjay Seth

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ABBREVATIONS

AAC	Autoclaved Aerated Concrete
AC	Air Conditioner
AHU	Air Handling Unit
ASHRAE	American Society of Heating, Refrigerating and Air Conditioning
ASTM	American Society for Testing and Materials
BEE	Bureau of Energy Efficiency
BoD	Basis of Design
BOQ	Bill of Quantities
BIS	Bureau of Indian Standards
BIPV	Building-Integrated Photovoltaics
BREEAM	Building Research Establishment Environmental Assessment Method
CAC	Ceiling Attenuation Class
CAD	Computer-Aided Design
CASBEE	Comprehensive Assessment System for Building Environment Efficiency
CDs	Compact Disc
C&D	Construction and Demolition
CFC	Chlorofluorocarbons
CFM	Cubic Feet per Minute
COP	Coefficient of Performance
CP	Certified Professional
CPCB	Central Pollution Control Board
CSEB	Compressed Stabilized Earth Block
CM	Construction Management

CO_2	Carbon Dioxide
CPHEEO	Central Public Health and Environmental Engineering Organisation
DA	Daylight Autonomy
DLDD	Desertification, Land Degradation and Drought
DG	Diesel Genset
ECBC	Energy Conservation Building Code
EO	Energy Optimization
EN	European Standard
ETP	Effluent Treatment Plant
EPD	Environmental Product Declaration
EPI	Energy Performance Index
FTL	Full Tank Level
GWP	Global Warming Potential
GDP	Gross Domestic Product
GHGs	Greenhouse Gases
GoI	Government of India
GRIHA	Green Rating for Integrated Habitat Assessment
GW	Gigawatts
HT	High Tension
HK-BEAM	Building Environment Assessment Method-Hong Kong
HVAC	Heating, Ventilation, and Air Conditioning
IAQ	Indoor Air Quality
INDC	Intended Nationally Determined Contribution
IPCC	Intergovernmental Panel on Climate Change
ICAR	Indian Council of Agricultural Research
IPLV	Integrated Part Load Value
ISO	International Organization for Standardization

ISHRAE	Indian Society of Heating Refrigerating and Air Conditioning Engineers
LCA	Life Cycle Assessment
LEED	Leadership in Energy and Environmental Design
LCC	Life Cycle Costing
LED	Light Emitting Diode
LPA	Long Period Average
LPCD	Litres per Capita per Day
LT	Low Tension
LULUCF	Land Use, Land-Use Change and Forestry
MNRE	Ministry of New and Renewable Energy
MoUD	Ministry of Urban Development
NABL	National Accreditation Board for Testing and Calibration Laboratories
NAAQS	National Ambient Air Quality Standards
NBC	National Building Code
NITI	National Institution for Transforming India
NMT	Non-motorised Transport
NRC	Noise Reduction Coefficient
OC	Occupant Comfort
ODP	Ozone Depleting Potential
OPC	Ordinary Portland Cement
OPR	Owner Project Requirement
O&M	Operation and Maintenance
OWC	Organic Waste Converter
PPC	Portland Pozzolana Cement
ppmv	Parts per Million by Volume
PMM	Performance Metering and Monitoring
PV	Photovoltaic

PRS	Pearl Rating System
PVC	Polyvinyl Chloride
RA	Recycled Aggregate
RCA	Recycled Concrete Aggregate
REC	Renewable Energy Certificate
RH	Relative Humidity
RCC	Reinforced Cement Concrete
RWA	Residents Welfare Association
SDG	Sustainable Development Goal
SHGC	Solar Heat Gain Coefficient
SOS	Save Our Soul
SP	Special Publication
SRI	Solar Reflective Index
SRR	Skylight Roof Ratio
STP	Sewage Treatment Plant
SBM	Sustainable Building Materials
SES	Socio-Economic Strategies
SSP	Sustainable Site Planning
STC	Sound Transmission Class
SWM	Solid Waste Management
TERI	The Energy and Resources Institute
TFL	Tubular Fluorescent Lamps
UNCCD	United Nations Convention to Combat Desertification
UNFCCC	United Nations Framework Convention on Climate Change
UDI	Useful Daylight Illuminance
UHIE	Urban Heat Island Effect
UN	United Nations

URDPFI	Urban and Regional Development Plans Formulation and Implementation
USAID	United States Agency for International Development
USA	United States of America
UPS	Uninterruptible Power Supply
v	Version
VLT	Visible Light Transmission
VOC	Volatile Organic Compound
VRF	Variable Refrigerant Flow
WCED	World Commission on Environment and Development
WM	Water Management
WMO	World Meteorological Organization
WTP	Water Treatment Plant
WPI	Water Performance Index
WWR	Window Wall Ratio

INTRODUCTION

GRIHA V-6.0

The GRIHA rating is in its eighteenth year since its inception. Its consistent uphill movement in the performance graph is reflective from the wide market acceptance of the concepts of sustainability and green building practices. As of November 2024, over 4700 projects are registered with GRIHA Council having a footprint of more than 1 billion Sqft, leading to have an estimated cumulative annual energy saving of 30,000 GWh and installation of 533 MWp of renewable energy system. The water savings are estimated to be 104 GL per annum. Additionally, the trees planted are around 7,37,848. The effectiveness of these implemented and proposed to be implemented strategies shall lead to 8400 Giga tons of CO_2 reduction per annum.

GRIHA Version 6.0 has been developed as an upgrade to existing GRIHA Version 2019 based on feedback received from industry partners, consultants, developers and architects. These feedbacks were received during various stakeholder meets, via GRIHA Help Centre and from the project teams working on the live project. They shared their experiences and challenges that were faced by the team while complying the project with various GRIHA norms. All the feedback were diligently reviewed, and decision was taken to include these changes as part of latest version of rating, GRIHA Version 6.0.

The new version, akin to the previous ones, was developed with the larger environmental goals of preserving the natural ecosystem by ensuring optimized utilization of resources and food security. Further, it aims to build more sustainable physical assets and infrastructure services, while enhancing the liveability and workability of the occupants.

SECTION & POINT WEIGHTAGES

GRIHA v. 6.0 is divided into ten environmental sections, which are further split into 29 criteria, covering all the requisite parameters required to be addressed while making a 'green building'. 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.

List Of Criteria

GRIHA version 6.1				
Section	**Criterion No.**	**Criterion name**	**Maximum points**	**Appraisal type**
1. Sustainable Site Planning	1	Green Infrastructure	5	Partly Mandatory
	2	Low Impact Design Strategies	5	Optional
	3	Design to Mitigate UHIE	2	Optional
2. Construction Management	4	Air and Soil Pollution Control	1	Partly Mandatory
	5	Topsoil Preservation	1	Optional
	6	Construction Management Practices	2	Optional
3. Energy Optimisation	7	Energy Optimization	12	Partly Mandatory
	8	Renewable Energy Utilization	5	Partly Mandatory
	9	Low ODP and GWP Materials	0	Mandatory
4. Occupant Comfort	10	Visual Comfort	4	Partly Mandatory
	11	Thermal & Acoustic Comfort	2	Partly Mandatory
	12	Maintaining Indoor Air Quality	7	Optional
5. Water Management	13	Water Demand Reduction	4	Optional
	14	Wastewater Treatment	2	Optional
	15	Rainwater Management	5	Optional
	16	Water Quality and Self-Sufficiency	5	Partly Mandatory
6. Solid Waste Management	17	Waste Management – Post Occupancy	4	Partly Mandatory
	18	Organic Waste Treatment	2	Optional
7. Sustainable Building Materials	19	Utilization of Alternative Materials in Building	5	Optional

	20	Alternative Materials for External Site Development	2	Optional
8. Life Cycle Assessment and Costing	21	Reduction in global warming potential through Life Cycle Assessment	5	Optional
	22	Life Cycle Cost Analysis	3	Optional
9. Socio-Economic Strategies	23	Safety and Sanitation for Construction Workers	1	Partly Mandatory
	24	Universal Accessibility	2	Optional
	25	Dedicated Facilities for Service Staff	2	Optional
	26	Positive Social Impact	2	Partly Mandatory
10. Performance Monitoring and Metering	27	Project Commissioning	4	Partly Mandatory
	28	Smart Metering and Monitoring	6	Partly Mandatory
	29	Operation and Maintenance Protocol	0	Mandatory
Total Points			**100**	
11. Innovation	30	Innovation	**5**	Optional
Grand Total			**100+5**	

CRITERION STRUCTURE

GRIHA v.2019 is a set of 29 + 1 (innovation) criteria which have been categorized into 11 sections that act as the areas of consideration while designing and constructing a green building.

Each criterion consists of the following:

Intent: This defines the specific purpose behind having a particular criterion in the rating system which would help in achieving the larger goal of sustainability and reducing GHG emissions.

Appraisals: These are the guidelines specified under each criterion that will help the project proponent create a sustainable built environment and achieve GRIHA rating by demonstrating compliance with them.

These appraisals classify into the following three categories:

1. **Mandatory**: Compliance with mandatory appraisals is a must, in the absence of which the project is rendered ineligible for rating. There are no points for mandatory appraisals.

2. **Optional**: Compliance with optional appraisals is on the discretion of the project proponent depending upon the site conditions, feasibility, and desired rating. Points have been allotted for demonstrating compliance with every optional appraisal and the same has been mentioned under the details of each criterion on provided in the manual later.
3. **Non-applicable**: In case of specific site constraints, certain appraisals become non-applicable to the project. Points allotted under these appraisals are subtracted from the denominator during the final percentile calculation. However, the project team must submit necessary documents (as mentioned in the respective detailed criteria later in the manual) to claim non-applicability.

Compliance: These are the list of documents to be provided by the project team to demonstrate compliance with the appraisals to achieve points.

SCORES AND RATING

GRIHA has a 100-point percentile-based rating system. On the submission of the required documents and upon final assessment and evaluation, the project is awarded/denied points for all the applicable appraisals. Total applicable points become the denominator while points which are not applicable (as confirmed through documentation assessment) to the project are deducted from both denominator and numerator. Points awarded represent the numerator. Points awarded under the innovation section are added only in the numerator which make them the bonus points. Based on the percentile obtained, star rating is awarded as listed in Table 7.

Table 7: *Percentile thresholds for achieving stars*

Percentile Threshold	Achievable Star Rating
25–40	★
41–55	★ ★
56–70	★ ★ ★
71–85	★ ★ ★ ★
86 and more	★ ★ ★ ★ ★

SECTION 1

Sustainable Site Planning

CRITERION 1

Green Infrastructure

INTENT

The intent of this criterion is to ensure that the site complies with the relevant master plan/local development plans and guidelines. This makes sure that the necessary compliance requirements for the building projects along with the applicable building regulatory requirements are adhered to. Additionally, it emphasizes on enhancing natural biodiversity through preservation and plantation of native vegetation. This criterion further intends to assess proximity to different nodal transport and amenities to manage last mile connectivity as well as reduce dependence on personal motorized vehicles. It also incentivizes land use optimization, which is a pressing concern in densely populated urban areas.

Maximum Points: 5

1.1 APPRAISALS

1.1.1 Ensure that the site plan is in conformity with the development plan/master plan/Urban and Regional Development Plans Formulation and Implementation (URDPFI) guidelines. This should comply with the provisions of eco-sensitive zone regulations, coastal zone regulations, heritage areas (identified in the master plan or issued separately as specific guidelines), waterbody zones (in such zones, no construction is permitted in the water-spread and buffer belt of minimum 30m around the full tank level), various hazard-prone area regulations, and others if the site falls under any such area. Furthermore, any other relevant legal approval pertaining to the project for clearance from the necessary government authority has to be compliant.

— Mandatory

1.1.2 Demonstrate that the project team implements tree preservation measures as per the alternatives mentioned below:

— Mandatory

Alternative 1: Ensure that no existing mature tree on-site is cut.

Alternative 2: Transplant existing mature trees (if applicable) within the site and ensure that they survive.

Alternative 3: Plant three trees for every one tree cut of the same native/naturalized species.

Alternative 4: Adopt any combination of the previously mentioned alternatives.

Applicability check: If there are no mature trees on-site, the project is exempt from appraisal 1.1.2

To exempt the project from Appraisal 1.1.2, project team must submit:

• Site survey plan and site photographs (date stamped) before start of construction to show that no existing trees were present on site.

1.1.3 Ensure that a minimum of one tree for every 80m^2 of site area (within GRIHA project boundary) is planted and maintained to increase vegetation on the site. The existing preserved mature trees within the site premises should be considered in the calculation.

— 1 Point

1.1.4 Ensure that per capita gross area benchmark is maintained as prescribed in Table 1.1c for optimum land utilization.

—1 Point

TABLE 1.1c: *Per capita total gross area (m^2) benchmark as per the building typology (including estimated floating population)*

Limits	Health-care Facility (per bed)	Hospitality	Institutional	Office	Residential	Retail	Transit Terminal
Minimum	100	35	4	5	12.5	3	0.6
Maximum	–	60	8	10	50	6	6

Note: Gross area includes all circulation areas, service areas, toilets, and so on, but excludes basement and parking areas within the site premises

1.1.5 Ensure that the average distance to at least five basic public amenities/services as per the building typology (defined in Appendix 1A, Table 1.1A and Table 1.2A) from the main entrance of the project is less than the GRIHA base case as per Table 1.2c.

OR

1.1.5 Provide shuttle service to nearest market/shopping complex having at least five basic public amenities/services. The shuttle service must be provided for at least 1% of total fixed occupancy.

— 2 Points

TABLE 1.2c: *Point allocation for reduction in average distance to amenities against GRIHA base case*

Reduction from Base Case (*x*) [5]	Points
10% ≤ x < 25%	1
x ≥ 25%	2

Note*: 1. An average distance of 600m to the amenities from site entrance has been considered as the GRIHA base case.*

2. Radial distances are not acceptable, walking distance must be calculated.

1.1.6. Adopt any one strategy from the list, as given below, to promote sustainable transportation within the site premises.

— 1 Point

Strategy 1: Provide at least four designated parking spaces for informal modes of transport within the site premises.

Strategy 2: Non-motorized transport/E vehicles

Part A: Provide E-vehicle parking facility for at least 5% of the total four-wheeler parking space along with charging facility for E-vehicles and adequate signage.

Part B: Additionally provide designated vehicular tracks for NMT vehicles for site areas > 50,000 m^2.

Strategy 3: Designate area equivalent to at least 5% of the total four-wheeler parking space for bicycles with parking infrastructure and adequate signage within the site premises.

1.2 COMPLIANCE

1.2.1 Submit all relevant approvals, sanctions, and clearances6 to demonstrate conformity to local development plans/master plan to demonstrate compliance with Appraisal 1.1.1.

1.2.2 Submit a site survey plan and a landscape plan (in .dwg format) with legends mentioning species and highlighting (in different colour coding/layers) the existing trees that have been transplanted, cut, and/or preserved/protected as well as new plantation to demonstrate compliance with Appraisals 1.1.2 and 1.1.3.

1.2.3 Submit letter from the local governing body permitting cutting of trees on-site to demonstrate compliance with appraisal 1.1.2.

1.2.4 Submit purchase orders highlighting full quantities of new plantation to demonstrate compliance with Appraisals 1.1.2 and 1.1.3.

1.2.5 Submit calculations on the GRIHA online portal for the number of new trees planted and the number of existing trees preserved to demonstrate compliance with Appraisal 1.1.3.

1.2.6 Submit occupancy calculations on the GRIHA online portal to demonstrate compliance with Appraisal 1.1.4.

1.2.7 Submit floor plans (in .dwg format) and area calculations indicating habitable areas considered for per capita gross area calculation to demonstrate compliance with Appraisal 1.1.4.

1.2.8 Submit DBR for fixed and floating occupancy.

1.2.9 Submit Google Map images highlighting walking distances to each basic amenity from the main entrance of the project along with date-stamped photographs of services/amenities as marked in the Google Map images to demonstrate compliance with Appraisal 1.1.5.

1.2.10 Submit calculations for average distance travelled to basic amenities on the GRIHA online portal to demonstrate compliance with Appraisal 1.1.5.

OR

Submit details about shuttle service provided in the project for commuting of occupant to the nearest shopping complex having at least 5 basic amenities as per Appendix 1A.

1.2.11 Submit calculations for percentage of sustainable modes of transport provided on-site to demonstrate compliance with Appraisal 1.1.6.

1.2.12 Submit date-stamped photographs of sustainable modes of transport provided on-site to demonstrate compliance with Appraisal 1.1.6.

1.2.13 In case of informal mode of transport, submit a site plan (in .dwg format) highlighting the location of designated parking spaces provided within the site premises to demonstrate compliance with Appraisal 1.1.6.

1.2.14 In case of NMT vehicles, submit the calculation for percentage of parking space designated for NMT on-site to demonstrate compliance with Appraisal 1.1.6.

1.2.15 Submit a site plan (in .dwg format) highlighting the location of designated parking spaces provided and charging points for E-vehicles to demonstrate compliance with Appraisal 1.1.6, Strategy 2.

1.2.16 Submit a site plan (in .dwg format) highlighting the location of designated parking spaces provided for the bicycles along with photographs of signages to demonstrate compliance with Appraisal 1.1.6, Strategy 3.

CRITERION 2

Low-Impact Design Strategies

INTENT

The intent of this criterion is to promote design strategies that enable the project to factor in ways by which natural site features (topographical/microclimatic) can be protected and/or incorporated into the project design.

Maximum Points: 5

2.1 APPRAISALS

2.1.1 Demonstrate reduction in environmental impact by adoption of various low-impact planning and design strategies as per Table 2.1c.

TABLE 2.1c: *Point allocation for low impact design strategies*

No. of Strategies Adopted	Points
2 (with at least 1 passive strategy)	1
3 (with at least 2 passive strategies)	3
5 (with at least 3 passive strategies)	5

2.2 COMPLIANCE

2.2.1 Submit analysis along with calculations/simulation reports with input and output files to demonstrate compliance with low-impact design strategies.

2.2.2 Submit drawings/schematics (in .dwg format) highlighting the integration of the low-impact design strategies into the building design/site planning.

2.2.3 Submit the narrative and date-stamped photographs of the strategies implemented.

CRITERION 3

Design to Mitigate UHIE

INTENT

The intent of this criterion is to ensure incorporation of design strategies that will aid in the reduction of UHIE.

Maximum Points: 2

3.1 APPRAISALS

3.1.1 Demonstrate the temperature reduction (in °C) from the GRIHA base case as per the alternatives mentioned below.

– 2 Points

Alternative 1

Demonstrate temperature reduction in the predicted hourly average air temperature (°C) from the GRIHA base case by performing calculations as per Table 3.1c.

TABLE 3.1c: *Reduction in predicted hourly average air temperature (°C)*

Reduction in Predicted Hourly Average Air Temperature (°C)	Points
1.5°C ≤ base case*	1
2.5°C ≤ base case*	2

Alternative 2

Demonstrate that the difference in peak air temperature has been achieved through dynamic UHIE simulation from the GRIHA base case as per Table 3.2c.

TABLE 3.2c: *Reduction in peak air temperature (°C)*

Reduction in Peak Air Temperature (°C)	Points
1°C ≤ base case*	1
2°C ≤ base case*	2

3.2 COMPLIANCE

3.2.1 Submit a site plan and site section (in .dwg format) with legends, mentioning the building heights and external surface finishes such as soft paved/covered with high solar reflectance index paints/shaded by trees/vegetated pergolas/solar panels.

3.2.2 Submit purchase orders reflecting full quantities of high albedo paints/tiles, solar panels, and so on.

3.2.3 Submit the technical specifications/brochures of high albedo paints/tiles, solar panels, and so on.

OR

Submit a valid GRIHA Product Catalogue certificate as applicable for the products.

3.2.4 Submit the narrative and date-stamped photographs of the strategies implemented.

3.2.5 Submit calculations using the GRIHA UHIE calculator to demonstrate compliance with Alternative 1.

3.2.6 Submit calculations and supporting drawings (in .dwg format) for sky view factor, average surface albedo, average height to building ratio, wall area, hard paved area and green area to demonstrate compliance with Alternative 1.

3.2.7 Submit a simulation report (along with input and output files) to demonstrate compliance with Alternative 2.

SECTION 2

Construction Management

CRITERION 4

Air and Soil Pollution Control

INTENT

The intent of this criterion is to minimize air and soil pollution due to construction activities.

Maximum Point: 1

4.1 APPRAISALS

4.1.1 Adopt at least six measures to minimize air and soil pollution during construction, with the first three strategies being mandatory.

– Mandatory

- **Provide 3m high continuous barricading along the site boundary/virtual boundary.**
- **Provide wheel washing facility/gravel bed at all vehicular entrances and exits of the site.**
- **Ensure DG sets have an exhaust with stack height of at least 2m from the top of the generator with a cowl.**
- Ensure DGs are in compliance with CPCB norms.
- Implement a spill prevention plan for storage of diesel, admixtures, curing compounds, bitumen, and other hazardous materials.
- Ensure that fine aggregate, excavated earth, and other construction materials with a tendency to get airborne are covered or are sprinkled regularly with non-potable water.
- Ensure sprinkling of water on unpaved pathways on the site with non-potable water.
- Limit the speed of vehicular movement on-site to 10km/h.
- Ensure that vehicles carrying waste materials out of the site are covered.

4.1.2 Ensure that the soil erosion channels are constructed, and they are connected to a sedimentation tank in order to reduce movement of soil outside the site throughout the construction phase of the project.

– 1 Point

4.2 COMPLIANCE

4.2.1 Submit tender document (relevant section only) mentioning the measures to be taken by the contractor during the construction phase to prevent air and soil pollution. It must also include the construction of soil erosion channels and sedimentation tanks for demonstrating compliance with Appraisals 4.1.1 and 4.1.2.

4.2.2 Submit a site management plan (in .dwg format) highlighting the location of strategies implemented on-site to minimize air and soil pollution during construction and soil erosion channels connected to a sedimentation tank demonstrating compliance with Appraisals 4.1.1 and 4.1.2.

4.2.3 Submit date-stamped photographs describing various strategies adopted to minimize air and soil pollution and soil erosion channels and sedimentation tank during construction phase for demonstrating compliance with Appraisals 4.1.1 and 4.1.2.

4.2.4 Submit test reports of smoke released from the exhaust of all the DG sets on-site (minimum three reports to be shared over the entire period of construction) indicating that emission parameters are within permissible limits, as prescribed by the CPCB, demonstrating compliance with Appraisal 4.1.1 (refer to Appendix 2A: Emission limits as prescribed by CPCB, 2016).

4.2.5 Submit copies of challans if treated water (in sewage treatment plant) is being used on-site to demonstrate compliance with Appraisal 4.1.1.

4.2.6 Submit a section of sedimentation tank (in .dwg format) indicating that minimum depth of tank should be 1m to manage storm-water run-off for demonstrating compliance with Appraisal 4.1.2.

Note: *Compliance with Appraisals 4.1.1 and 4.1.2 would be verified during site visit I and II. Please refer, Rating Process, step III for more details.*

CRITERION 5

Topsoil Preservation

INTENT

The intent of this criterion is to ensure the preservation of available fertile soil on-site and avoid its degradation during the process of construction.

Maximum Point: 1

5.1 APPRAISALS

5.1.1 Ensure that topsoil from the excavated area is preserved, stabilized within the site, and its fertility is maintained throughout the construction period. Additionally, ensure that 100% of the landscaping soil demand(both ground and roof) is met through the use of preserved soil.

–1 Point

Applicability check: If the topsoil present on-site before construction is not fertile, the project is exempt from Appraisal 5.1.1.

To exempt the project from Appraisal 5.1.1, kindly submit topsoil fertility test report conducted by an Indian Council of Agricultural Research (ICAR)-accredited laboratory indicating that the topsoil is not fertile and cannot be made fertile.

5.2 COMPLIANCE

5.2.1 Submit calculations indicating the total quantity of topsoil preserved and used in landscape activity post construction.

5.2.2 Submit a site plan (in .dwg format) highlighting the areas of excavation and preservation of topsoil.

5.2.3 Upload date-stamped photographs with description of the measures implemented.

5.2.4 Submit supporting document such as challans/gate pass etc. for removing soil from project boundary (in case soil is transferred from project).

Note: *Compliance with Appraisal 5.1.1 would be verified during site visit I and II. Please refer, Rating Process, step III for more details.*

CRITERION 6

Construction Management Practices

INTENT

The intent of this criterion is to ensure adoption of good management practices on-site during the construction phase.

Maximum Points: 2

6.1 APPRAISALS

6.1.1 Adopt construction management practices (e.g., stacking and storage of construction materials at different stages of construction) and ensure safe disposal of waste generated during construction.

– 1 Point

6.1.2 Adopt at least two strategies from the list, as given below, to minimize water consumption during construction, with the first strategy being mandatory.

–1 Point

- **Use gunny bags, ponding technique, or curing compound.**

Mandatory only if 6.1.2 is attempted

- Meter and monitor the consumption of water during construction.
- Use water-reducing admixtures in concrete mix.
- Use treated wastewater and/or captured stormwater.

Note: *This is not a mandatory appraisal. In the event a project fails to demonstrate compliance with this appraisal, their rating won't be denied. However, if a project intends to comply with this appraisal, then the first strategy becomes mandatory for them in order to achieve 1 point.*

6.2 COMPLIANCE

6.2.1 Submit a site management plan (in .dwg format) highlighting the location of storage areas for various construction materials, such as steel, building blocks, or stone, and for waste generated, such as empty cement bags, packaging waste, or construction/demolition debris, to demonstrate compliance with Appraisal 6.1.1.

6.2.2 Submit copies of log sheets for the total quantity of waste generated, reused, and/or sold to recyclers on-site, demonstrating compliance with Appraisal 6.1.1 (refer to Appendix 2C: Template for total amount of waste generated on-site,).

6.2.3 Submit copies of challans for all the waste materials sold to recyclers demonstrating compliance with Appraisal 6.1.1.

6.2.4 Upload date-stamped photographs with description of construction management practices adopted on-site and measures to minimize water consumption during construction to demonstrate compliance with Appraisals 6.1.1 and 6.1.2.

6.2.5 Submit a purchase order reflecting full quantities of curing compound used during the construction phase to demonstrate compliance with Appraisal 6.1.2.

6.2.6 Submit a technical specification sheet/brochure of curing compound used during the construction phase.

OR

Submit a valid GRIHA Product Catalogue certificate as applicable for the product to demonstrate compliance with Appraisal 6.1.2.

6.2.7 Submit a narrative describing various strategies adopted to reduce water consumption to demonstrate compliance with Appraisal 6.1.2.

6.2.8 Install a water meter on all sources of water such as tube well, municipal supply, and others to monitor the consumption of water and submit date-stamped photographs demonstrating compliance with Appraisal 6.1.2.

6.2.9 Submit copies of logbooks for the total quantity of water consumed, demonstrating compliance with Appraisal 6.1.2 (refer to Appendix 2D: Template for source of water used in construction activity,)

6.2.10 Submit a design mix report and a batch mix report indicating the use of admixtures to demonstrate compliance with Appraisal 6.1.2.

6.2.11 Submit a purchase order reflecting full quantities of admixtures used during the construction phase to demonstrate compliance with Appraisal 6.1.2.

6.2.12 Submit a technical specification sheet/brochure of admixture used during the construction phase.

OR

Submit a valid GRIHA Product Catalogue certificate as applicable for the product to demonstrate compliance with Appraisal 6.1.2.

Note: *Compliance with Appraisals 6.1.1 and 6.1.2 would be verified site visit I and II. Please refer, Rating Process, step III for more details.*

SECTION 3

Energy Optimization

CRITERION 7

Energy Optimization

INTENT

The intent of this criterion is to ensure that the projects are made energy efficient by enhancing the envelope performance while also reducing energy consumption through installation of efficient equipment and lighting fixtures.

Maximum Points: 12

7.1 APPRAISALS

7.1.1 Ensure that the project demonstrates compliance with the mandatory requirements of ECBC 2017 for non-residential buildings and ENS for residential buildings.

– Mandatory

7.1.2 Ensure that the heat gain through the building envelope (air- conditioned and hybrid buildings) is below the GRIHA threshold for peak heat gain as per table 7.1c.

– 2 Points

Applicability check: If the building is non-air conditioned, the project is exempt from Appraisal 7.1.2.

To exempt the project from appraisal 7.1.2, submit the DBR of the project.

Alternative 1:

TABLE 7.1c: *Threshold for peak heat gain (W/m2) for different building typologies*

Operating Hours	**Daytime Occupancy**		**24–hours Occupancy**					
	5 days a week		**7 days a week**					
Climate Zone	**Institutional**	**Office**	**Health care Facility**	**Hospitality**	**Office**	**Residential**	**Retail**	**Transit Terminal**
Composite	40	30	35	35	45	45	30	30
Hot and dry	40	40	35	35	45	45	30	30
Warm and humid	35	25	35	30	45	45	25	25
Moderate	30	25	35	25	35	35	25	30
Cold	30	30	40	40	30	30	25	60

Note: For buildings/projects with more than 80% built-up area (both FSI and non-FSI) falling under residential use shall be considered as a residential project. Peak heat gain of each building in the project will be assessed on its respective typology.

Additionally, residential typology of projects can demonstrate compliance as per RETV method defined in Eco-Niwas Samhita 2018 for the building envelope (except roof) for four climate zones, namely, Composite, Hot-Dry, Warm-Humid, and Temperate, and shall comply with the maximum RETV of 12 W/m^2.

Alternative 2:

TABLE 7.1c: *Threshold for peak heat gain (W/m^2) for different building typologies*

Climate Zone	Composite	Hot and Dry	Warm and Humid	Temperate/ Moderate	Cold
Peak heat gain (W/m^2)	30	30	25	25	25

Note: *Alternative 2 under appraisal 7.1.2 shall be applicable only to projects opting for Alternative 1 Option B under 10.1.1.*

7.1.3 Demonstrate that 100% of exterior lighting fixtures[7] (lamp + ballast) meet the luminous efficacy of 80lm/W.

– 1 Point

7.1.4 Ensure that the project demonstrates reduction from the GRIHA benchmark for EPI as per Table 7.2c. Additional reduction in EPI will be awarded points as mentioned Table 7.3c.

- Mandatory + 8 points

TABLE 7.2c: *GRIHA benchmark for EPI (kWh/m2/year) for different building typologies*[8]

Operating Hours	Daytime Occupancy		24–hours Occupancy					
	5 days a week		7 days a week					
Climate Zone	Institutional	Office	Health care Facility	Hospitality	Office	Residential	Retail	Transit Terminal
Composite	90	90	250	275	225	70	225	300
Hot and dry	90	90	250	275	225	70	225	300
Warm and humid	90	90	275	275	225	70	225	300
Moderate	75	75	250	250	210	50	210	300
Cold	90	120	275	300	275	100	225	275

Alternative 1

TABLE 7.3c: *Additional reduction from GRIHA benchmark for EPI*

Reduction from GRIHA Benchmark for EPI (x)	Points
5%	**Mandatory**
10<X≤20%	1
20%<X≤30%	2
30%<X≤40%	4
40%<X≤50%	6
X >50%	8

Alternative 2

TABLE 7.3c: *Additional reduction from GRIHA benchmark for EPI*

Reduction from GRIHA Benchmark for EPI (x)	Points
10%	**Mandatory**
10 < X ≤ 25 %	1
25 < X ≤ 40 %	2
40 < X ≤55 %	4
55 < X ≤75 %	6
X > 75%	8

Note: *Alternative 2 under appraisal 7.1.4 shall be applicable only to projects opting for Alternative 1 Option B under 10.1.1*

7.1.5 Ensure that the equipment installed within the project (whichever applicable as per Table 7.4c) is either BEE star labelled or of equivalent performance.

- Mandatory + 1 Point

7 Special purpose lighting occasionally used as floodlights, stage lights, pool lights/underwater lights, etc., are exempted from the calculations as mentioned in Appraisal 7.1.3. However, the façade lighting is not exempted.

8 For buildings/projects with more than 80% built-up area (both FSI and non-FSI) falling under residential use shall be considered as a residential project. In case the occupied hours of a project is more than 6 days and 14 hours per day, then 24x7 occupied office benchmark EPI will be considered or else if the occupied hours are less than 6 day and 14 hours per day, then day time occupied office benchmark EPI will be considered.

TABLE 7.4c: *List of BEE star-labelled equipment*

Equipment	Star Labelled	3 Stars and Above
Unitary/ Room air conditioners	Mandatory	1 Point
Washing machine		
Ceiling Fans		
Geysers		
Fridge		
TV		

7.2 COMPLIANCE

7.2.1 Submit a narrative with descriptions of various systems and their components to demonstrate compliance with Appraisal 7.1.1.

7.2.2 Submit technical specification sheets/brochures of various systems and their components to demonstrate compliance with Appraisal 7.1.1.

OR

Submit a valid GRIHA Product Catalogue certificate as applicable for the products to demonstrate compliance with Appraisal 7.1.1.

7.2.3 Submit the purchase orders reflecting the full quantities of various systems and their components to demonstrate compliance with Appraisal 7.1.1.

7.2.4 Submit a simulation report with input and output files for all building blocks in a project highlighting the peak heat gain values for the building envelope to demonstrate compliance with Appraisal 7.1.2.

7.2.5 Submit window-to-wall ratio (WWR) and SRR calculations with supporting drawings (.dwg format) such as floor plans, elevations, and building sections to demonstrate compliance with Appraisals 7.1.2 and 7.1.4.

7.2.6 Submit the envelope cross-sections (for walls, roof, and glazing) indicating material specification, thickness, etc., to demonstrate compliance with Appraisals 7.1.2 and 7.1.4.

7.2.7 Submit the technical specification sheets/brochures of building material used, highlighting the U-values in the case of walls to demonstrate compliance with Appraisals 7.1.2 and 7.1.4.

OR

Submit a valid GRIHA Product Catalogue certificate as applicable for the products to demonstrate compliance with Appraisals 7.1.2 and 7.1.4.

7.2.8 Submit the technical specification sheets/brochures of glazing material used in the project, highlighting the U-value and SHGC to demonstrate compliance with Appraisals 7.1.2 and 7.1.4.

OR

Submit a valid GRIHA Product Catalogue certificate as applicable for the products to demonstrate compliance with Appraisals 7.1.2 and 7.1.4.

7.2.9 Submit the purchase orders reflecting the full quantities of wall, roof, and glazing assembly and subassembly materials to demonstrate compliance with Appraisals 7.1.2 and 7.1.4.

7.2.10 Submit the calculations for luminous efficacy of each type of lamp used in outdoor lighting to demonstrate compliance with Appraisal 7.1.3.

7.2.11 Submit the technical specification sheets/brochures for the lamps, ballasts, luminaires, and automatic controls to demonstrate compliance with Appraisal 7.1.3.

OR

Submit a valid GRIHA Product Catalogue certificate as applicable for the products to demonstrate compliance with Appraisal 7.1.3.

7.2.12 Submit the purchase orders reflecting the full quantities of outdoor lamp fixtures to demonstrate compliance with Appraisal 7.1.3.

7.2.13 Submit a simulation report with input and output files for all building blocks in the project highlighting HVAC and internal lighting energy consumption as well as all input parameters used in the simulation to demonstrate compliance with Appraisal 7.1.4.

7.2.14 Submit a narrative and calculations demonstrating compliance and/or reduction from the GRIHA benchmark for EPI as per Appraisal 7.1.4.

7.2.15 Submit an operating schedule for electrical, lighting, HVAC systems, and equipment of the project as per the building typology (refer to ASHRAE 90.1, Appendix G or ECBC 2017, Whole Building Method, Clause 9.6, and Tables 9–10 and 9–22).

7.2.16 Submit an occupancy schedule for the project as per the building typology to demonstrate compliance with Appraisal 7.1.4 (refer to ASHRAE 90.1, Appendix G or ECBC 2017, Whole Building Method, Clause 9.6, Tables 9–10 and 9–22).

7.2.17 Submit the purchase orders reflecting the full quantities of equipment/appliances purchased to demonstrate compliance with Appraisal 7.1.5.

7.2.18 Submit a copy of the tenant agreement in the case of leasing out to a tenant, highlighting the clause that mandates the use of BEE-star labelled or equivalent equipment/appliances as per Appraisal 7.1.5.

7.2.19 Submit the technical specification sheets/brochures for all installed equipment/appliances indicating BEE-star labelling or ascertaining equivalent performance to demonstrate compliance with Appraisal 7.1.5.

OR

Submit a valid GRIHA Product Catalogue Certificate as applicable for the products to demonstrate compliance with Appraisal 7.1.5.

CRITERION 8

Renewable Energy Utilization

INTENT

The intent of this criterion is to promote the use of RE in the projects and, thereby, reduce the project's dependency on fuels derived from conventional sources.

Maximum Points: 5

8.1 APPRAISALS

Alternative 1 (On-site/On-site and off-site combination renewable energy system)[9]

8.1.1 Ensure installation of on-site and off-site RE system to offset a part of the annual energy consumption of internal artificial lighting, and HVAC systems as mentioned in Table 8.1c.

- Mandatory + 5 Points

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TABLE 8.1c: *Point weightage for on-site and off-site renewable energy system installation*[10]

Daytime Occupancy		**24-hours Occupancy**						**Points**
5 days a week		**7 days a week**						
Institutional	**Office**	**Healthcare**	**Hospitality**	**Office**	**Residential**	**Retail**	**Transit Terminals**	
5%	5%	1%	1%	1%	-	1%	1%	Mandatory (On site)
10%	10%	3%	3%	3%	10%	3%	3%	1
15%	15%	5%	5%	5%	15%	5%	5%	2
20%	20%	7%	7%	7%	20%	7%	7%	3
25%	25%	10%	10%	10%	25%	10%	10%	5

Alternative 2 (Off-site renewable energy system)

8.1.1 Demonstrate that 100% of the annual energy consumption of internal artificial lighting and HVAC systems is offset through off-site RE systems.

- Mandatory + 5 Points

9 All renewable energy systems recognized by the MNRE can be accepted under this criterion.

10 For buildings/projects with more than 80% built-up area (both FSI and non-FSI) falling under residential use shall be considered as a residential project.

8.2 COMPLIANCE

8.2.1 Submit calculations and simulations for sizing the RE system, based on, energy consumption for HVAC, and internal lighting in consistency with Criterion 7, Appraisal 7.1.4.

Alternative 1

8.2.2 Submit calculations and simulations for on-site and off-site RE generation potential.

8.2.3 Submit technical specification sheets/brochures of the RE system, highlighting the system performance (as per the standard test conditions).

OR

Submit a valid GRIHA Product Catalogue certificate as applicable for the systems and their components.

8.2.4 Submit drawings (.dwg format) showing the location of RE systems on-site.

8.2.5 Submit purchase orders reflecting the full quantities of RE systems installed on-site. To demonstrate compliance with purchase of RECs (over and above mandatory requirement) ensure that the procurement for at least 5 years along with a declaration that the RECs are not being used for any other obligatory requirements and will be purchased every year.

Alternative 2

8.2.6 Submit documents supporting off-site generation of energy through RE systems.

These may be RECs for at least 5 years along with a declaration that the RECs are not being used for any other obligatory requirements and will be purchased every year.

OR

Submit power purchase agreement from the utility for purchase of green power. In the agreement, the address of the site must be mentioned.

CRITERION 9

Low ODP And GWP Materials

INTENT

The intent of this criterion is to ensure the use of materials with low GWP and ODP in building insulation, HVAC, refrigeration equipment, and firefighting systems.

Maximum Point: 0

9.1 APPRAISALS

9.1.1 Ensure that all the insulation used in the building envelope and for HVAC systems are CFC and HCFC free.

– Mandatory

9.1.2 Ensure that the refrigerant used in the HVAC systems and refrigeration equipment is CFC and HCFC free.

– Mandatory

9.1.3 Ensure that the fire suppression systems and fire extinguishers installed in the project are halon free.

– Mandatory

9.2 COMPLIANCE

9.2.1 Submit a narrative with date-stamped photographs highlighting the insulation and refrigerants used in different applications in the building to demonstrate compliance with Appraisals 9.1.1– 9.1.3.

9.2.2 Submit technical specification sheets/brochures of the insulation, refrigeration equipment, and fire-fighting systems to demonstrate compliance with Appraisals 9.1.1–9.1.3.

OR

Submit a valid GRIHA Product Catalogue certificate as applicable for the products to demonstrate compliance with Appraisals 9.1.1–9.1.3.

9.2.3 Submit purchase orders reflecting the full quantities of insulation, HVAC systems, refrigeration equipment, and fire-fighting systems used in the project highlighting their respective types to demonstrate compliance with Appraisals 9.1.1 – 9.1.3.

SECTION 4

Occupant comfort

CRITERION 10

Visual Comfort

INTENT

The intent of this criterion is to ensure that visual comfort (daylighting and artificial lighting) is provided to the building occupants through the integration of active and passive design measures.

Maximum Points: 4

10.1 APPRAISALS

DAYLIGHTING

Demonstrate mean DA or UDI compliance as per Alternatives.

Alternative 1

Project may show compliance with either of Option A or Option B

Option A

10.1.1 Ensure that WWR does not exceed 60% and the vertical fenestration complies with minimum visual light transmittance (VLT) of 0.27.

— Mandatory

10.1.2 Ensure that the project meets the SHGC compliance as per Table 10.1c.

OR

Ensure that the project meets the weighted average facade SHGC for each orientation as per Table 10.1c requirements.

OR

Use Tables 9 and 10 of SP 41 to design the shading device for all the windows.

OR

Conduct solar path analysis for all regularly occupied spaces (both conditioned and non-conditioned) to ensure that the windows are completely shaded for the duration between 0900 hours on March 15 to 1500 hours on September 15.

OR

Use any combination of the above strategies to show compliance for 100% of the fenestrations.

— Mandatory

10.1.3 Ensure that the skylight roof ratio (SRR) does not exceed 5% and SHGC for skylights[13] does not exceed 0.35. Only transparent, semi-transparent, or translucent horizontal fenestrations installed for the purposes of daylighting and/or views are considered skylights.

— Mandatory

Table 10.1c: *Maximum SHGC for vertical fenestration for different climate typologies*

Orientation of Fenestration		Composite	Hot and Dry	Warm and Humid	Temperate / Moderate	Cold
Maximum SHGC Non-North*		0.27	0.27	0.27	0.27	0.62
Maximum SHGC - North	For latitude ≥ 15°N	0.5	0.5	0.5	0.5	0.62
	For latitude < 15°N*	0.27	0.27	0.27	0.27	0.62

10.1.4 Ensure that all regularly occupied spaces meet or exceed illuminance level between 100lux and 2000lux for the minimum percentage of floor area prescribed in Table 10.2c for 90% of the potential daylight time in a year. UDI compliance must be demonstrated through simulation using a validated software.

— Mandatory + 4 points

TABLE 10.2c: *UDI benchmarks for percentage of above grade floor area for different building typologies*

UDI Benchmarks for Different Building Typologies							
Points	**Office**	**Retail***	**Residential**	**Health care**	**Hospitality**	**Institutional**	**Transit Terminal**
Mandatory	40%	10%	45%	30%	45%	40%	10%
2 Points	50%	15%	55%	40%	55%	50%	20%
4 Points	60%	20%	65%	50%	65%	60%	30%

** Retail spaces to be considered in the calculation: All regularly occupied spaces except retail shops with special display lighting requirements, for example, lobby areas, atriums, food courts, toilets, entryways, corridors, and other congregation/circulation spaces.*

Option B

10.1.1 Ensure that the project meets the SHGC compliance as per Table 10.3c.

OR

Ensure that the project meets the weighted average facade SHGC for each orientation as per Table 10.3c requirements.

OR

Use Tables 9 and 10 of SP 41 to design the shading device for all the windows.

OR

Conduct solar path analysis for all regularly occupied spaces (both conditioned and non-conditioned) to ensure that the windows are completely shaded for the duration between 0900 hours on March 15 to 1500 hours on September 15.

OR

Use any combination of the above strategies to show compliance for 100% of the fenestrations.

— **Mandatory**

Table 10.3c: *Maximum effective SHGC for vertical and horizontal fenestration for different climate zones for all building typologies.*

Orientation of Fenestration		**Composite**	**Hot and Dry**	**Warm and Humid**	**Temperate / Moderate**	**Cold**
Maximum SHGC Non-North*		0.5	0.5	0.5	0.5	0.68
Maximum SHGC - North	For latitude ≥ 15°N	0.65	0.65	0.65	0.65	0.68
	For latitude < 15°N*	0.55	0.55	0.55	0.55	0.68

Note: *Projects opting for alternative 1 Option B under criterion 10 can show compliance to appraisal 7.1.2 and 7.1.4 only through alternative 2 of criterion 7.*

10.1.2 Ensure that all regularly occupied spaces meet or exceed illuminance level between 100lux and 2000lux for the minimum percentage of floor area prescribed in Table 10.2c for 90% of the potential daylight time in a year. UDI compliance must be demonstrated through simulation using a validated software.

— Mandatory + 4 points

Alternative 2

10.1.1 Demonstrate through simulation[11] that mean DA requirement (<3000lux) is met for 100% of the annual analysis hours for 100% of the regularly occupied areas.

— Mandatory

10.1.2 Demonstrate through simulation that mean DA requirement (>300lux) is met for the annual analysis hours as listed in Table 10.4c for 100% of the regularly occupied areas.

— Mandatory + 4 points

TABLE 10.4c: *Daylight autonomy benchmarks for percentage hours exceeding 300lux for different building typologies*

Daylight Autonomy Annual Analysis Hours Benchmarks for Different Building Typologies							
Points	**Office**	**Retail***	**Residential**	**Health care**	**Hospitality**	**Institutional**	**Transit Terminal** **
Mandatory	**25%**	**5%**	**25%**	**20%**	**25%**	**25%**	**10%**
2 Points	30%	10%	30%	25%	30%	50%	20%
4 Points	35%	15%	35%	30%	35%	60%	30%

** In the case of transit terminals, all regularly occupied spaces must be considered for calculations except security checkpoints and retail shops that have special lighting requirements. For example, concourse, entryways, check-in counters, waiting areas, food courts, toilets, atriums, and other congregation/circulation spaces.

ARTIFICIAL LIGHTING

10.1.5 Artificial lighting design to fall within limits (lower and higher range limits) as recommended space/task-specific lighting levels as per National Building Code (NBC) 2016[16] and to meet a minimum uniformity ratio of 0.4.

— Mandatory

10.2 COMPLIANCE

10.2.1 Submit drawings in .dwg format (floor plans, elevations and sections and doors-windows schedule, skylight schedule with North clearly marked) highlighting various shading devices.

10.2.2 Submit a narrative detailing the alternative opted for and the simulation methodology used for daylight simulation.

10.2.3 Submit technical specification sheets for all glazing types highlighting SHGC and VLT.

OR

Submit a valid GRIHA Product Catalogue certificate, as applicable for the product.

10.2.4 Submit purchase orders reflecting full quantities of all glazing.

10.2.5 Submit date-stamped photographs of all elevations/windows installed.

Alternative 1 (Option A)

10.2.6 Submit WWR calculation for the entire building envelope along with drawings (in. dwg format) highlighting the opaque, translucent, and transparent areas in the façade to demonstrate compliance with Appraisal 10.1.1.

10.2.7 Submit narrative and calculations demonstrating compliance for Appraisal 10.1.2.

- Effective SHGC calculation for all fenestration as prescribed in ECBC 2017

AND/OR

- Fenestration design in accordance with Table 9 and Table 10 of SP41

AND/OR

- Solar path analysis

OR

- Any combination of the above strategies can also be used to show compliance for 100% of the fenestrations.

10.2.8 Submit calculations detailing the SRR and SHGC for skylights to demonstrate compliance with Appraisal 10.1.3.

10.2.9 Submit the following documents for all the above grade floor areas as per Appraisal 10.1.4.

- Simulation report (input and output files) highlighting areas meeting the requisite UDI requirements.
- Narrative and calculations demonstrating compliance with the UDI requirements.

Alternative 1 (Option B)

10.2.10 Submit narrative and calculations demonstrating compliance for Appraisal 10.1.2.

- Effective SHGC calculation for all fenestration as prescribed in ECBC 2017

AND/OR

- Fenestration design in accordance with Table 9 and Table 10 of SP41

AND/OR

- Solar path analysis

OR

- Any combination of the above strategies can also be used to show compliance for 100% of the fenestrations.

10.2.11 Submit the following documents for all the above grade floor areas as per Appraisal 10.1.4.

- Simulation report (input and output files) highlighting areas meeting the requisite UDI requirements.
- Narrative and calculations demonstrating compliance with the UDI requirements.

Alternative 2

10.2.12 Submit a daylight simulation report (input and output files)[17] highlighting areas meeting the requisite mean DA requirements to demonstrate compliance for all regularly occupied areas as per Appraisals 10.1.1 and 10.1.2.

10.2.13 Submit narrative and calculations demonstrating compliance with the DA requirements through extrapolation in the case of mixed-use buildings.

ARTIFICIAL LIGHTING

10.2.14 Submit artificial lighting simulation report for all representative spaces using validated software demonstrating that the artificial lighting levels meet the recommended lux levels and uniformity ratio as per Appraisal 10.1.5.

10.2.15 Submit interior artificial lighting layout plans/reflected ceiling plans.

10.2.15 Submit technical specification sheets for all internal lighting fixtures highlighting the lumen output and wattage.

OR

Submit a valid GRIHA Product Catalogue certificate, as applicable for the product.

10.2.16 Submit purchase orders reflecting the full quantities of all interior lighting fixtures.

CRITERION 11

Thermal and Acoustic Comfort

INTENT

The intent of this criterion is to ensure that occupants of the building are thermally and acoustically comfortable through compliance with relevant standards and intelligent design features.

— Maximum Points: 2

11.1 APPRAISALS

11.1.1 Demonstrate that the project meets the thermal comfort requirements for all regularly occupied spaces as specified in Table 11.1c.

– Mandatory

TABLE 11.1c: *Thermal comfort requirement for all regularly occupied spaces*

<table>
<tr><th>Air-conditioned Spaces</th><th>Non-air-conditioned Spaces (With Operable Windows)</th><th>Mixed Mode Spaces</th></tr>
<tr><td rowspan="2">Demonstrate using simulation that the regularly occupied spaces meet the thermal comfort requirements as per NBC 2016, ASHRAE 55, or the Indian Adaptive Comfort model ensuring that the maximum number of unmet hours do not exceed 300</td><td>Alternative 1:

Demonstrate using simulation that the regularly occupied spaces meet the thermal comfort requirements as per NBC 2016, ASHRAE 55 or the Indian Adaptive Comfort model for 90% of the occupied hours for buildings in composite, moderate, hot and dry, and cold climates, and 60% of the occupied hours for buildings in warm and humid climate</td><td rowspan="2">Demonstrate using simulation that the regularly occupied spaces meet the thermal comfort requirements as per NBC 2016, ASHRAE 55 or the Indian Adaptive Comfort model for 90% of the occupied hours for buildings in all climate typologies</td></tr>
<tr><td>Alternative 2:

Demonstrate using at least 7 strategies (refer to Table 11.2c for prescribed strategies) that all the exterior fenestration is designed in accordance with NBC 2016 in terms of window orientation, size, placement, and shading design to facilitate wind flow into the interior spaces

AND

Demonstrate that the optimum size/number of fans are installed in rooms of different sizes in accordance with NBC 2016. Refer to Tables 11.3c and 11.4c</td></tr>
</table>

TABLE 11.2c: *Strategies for natural ventilation (NBC 2016)*

S. No.	Strategies for Natural Ventilation
1	A building need not necessarily be oriented perpendicular to the prevailing outdoor wind; it may be oriented at any convenient angle between 0° and 30° without losing any beneficial aspect of the breeze. If the prevailing wind is from east or west, the building may be oriented at 45° to the incident wind so as to diminish the solar heat without much reduction in the air motion indoors
2	Maximum air movement at a particular plane is achieved by keeping the sill height of the opening to at least 85% of the critical height (such as head level) for the following recommended levels of occupancy: For sitting on chair (0.75m) For sitting on floor (0.40m)
3	For the normal-sized rooms with identical windows on opposite walls, the average indoor air speed increases rapidly by increasing the width of the window up to at least two-thirds of the wall width. Beyond this, the increase is in much smaller proportion than the increase of the window width
4	The air motion in the working zone is the maximum when the window height is at least 1.1m. A further increase in the window height promotes air motion at a higher level of window but does not contribute additional benefits as far as air motion in the occupancy zones in the buildings is concerned
5	The greatest flow per unit area of openings is obtained by using inlet and outlet openings of nearby equal areas at the same level
6	The total area of openings (inlet and outlet) should be at least 25% of the floor area; however, even under the most favorable conditions, the maximum average indoor wind speed does not exceed 40% of the outdoor velocity
7	The size of the inlet should be kept within at least 45% of the total area of openings
8	In case of rooms with only one wall exposed outside, provision of two windows on that wall is preferred over a single window
9	Windows located diagonally opposite to each other give better performance than other window arrangements for most of the building orientations
10	Provision of horizontal sashes inclined at an angle of 45° in an appropriate direction helps in promoting indoor air motion. Sashes projecting outwards are more effective than projecting inwards
11	In the case of narrow buildings, cross-ventilation can be obtained through one side of the building to the other (with single-loaded corridors) by the provision of large and suitably placed windows or a combination of windows and wall ventilators for the inflow and outflow of air
12	A verandah opening on three sides is preferred since it causes an increase in the room air motion for most of the orientations of the building with respect to the outdoor wind
13	Provision of a partition with spacing of 0.3m underneath helps in augmenting air motion near floor level in the leeward compartment of wide-span buildings

14	Air motion in two wings oriented in parallel to the prevailing breeze is promoted by connecting them with a block on downstream side.
15	In the case of multiple buildings on-site, under the purview of the building owner, air motion in a building is not affected by constructing another building of equal or smaller height on the leeward side but it is slightly reduced if the leeward building is taller than the windward block

Source: NBC (2016)

TABLE 11.3c: *Optimum fan size/ number of fans for rooms of different sizes NBC 2016*

S No.	Room Width (m)	Optimum Size (mm)/Number of Fans for Room Length										
		4m	5m	6m	7m	8m	9m	10m	11m	12m	14m	16m
1	3	1200/1	1400/1	1500/1	1050/2	1200/2	1400/2	1400/2	1400/2	1200/3	1400/3	1400/3
2	4	1200/1	1400/1	1200/2	1200/2	1200/2	1400/2	1400/2	1500/2	1200/3	1400/3	1500/3
3	5	1400/1	1400/2	1400/2	1400/2	1400/2	1400/2	1400/2	1500/2	1400/3	1400/3	1500/3
4	6	1200/2	1400/2	900/4	1050/4	1200/4	1400/4	1400/4	1500/4	1200/6	1400/6	1500/6
5	7	1200/2	1400/2	1050/4	1050/4	1200/4	1400/4	1400/4	1500/4	1200/6	1400/6	1500/6
6	8	1200/2	1400/2	1200/4	1200/4	1200/4	1400/4	1400/4	1500/4	1200/6	1400/6	1500/6
7	9	1400/2	1400/2	1400/4	1400/4	1400/4	1400/4	1400/4	1500/4	1400/6	1400/6	1500/6
8	10	1400/2	1400/2	1400/4	1400/4	1400/4	1400/4	1400/4	1500/4	1400/6	1400/6	1500/6
9	11	1500/2	1500/2	1500/4	1500/4	1500/4	1500/4	1500/4	1500/4	1500/6	1500/6	1500/6
10	12	1200/3	1400/3	1200/6	1200/6	1200/6	1400/6	1400/6	1500/6	1200/7	1400/9	1400/9
11	13	1400/3	1400/3	1200/6	1200/6	1200/6	1400/6	1400/6	1500/6	1400/9	1400/9	1500/9
12	14	1400/3	1400/3	1400/6	1400/6	1400/6	1400/6	1400/6	1500/6	1400/9	1400/9	1500/9

TABLE 11.4c: *Additional requirements for energy savings (NBC 2016)*

Requirement	Description
Capacity of a ceiling fan	The capacity of a ceiling fan to meet the requirement of a room with the longer dimension D meter should be about 55 Dm3/min
Height of fan blades	The height of fan blades above the floor should be $(3H + W) \div 4$, where H is the height of the room and W is the height of the work plane
Minimum distance between fan blades	The minimum distance between fan blades and the ceiling should be about 0.3m
Regulators	Electronic regulators should be used instead of resistance-type regulators for controlling the speed of fans
Ventilation zone	When the actual ventilated zone does not cover the entire room area, then the optimum size of the ceiling fan should be chosen based on the actual usable area of the room, rather than the total floor area of the room. Thus, a small-sized fan could be chosen and energy saving could be achieved

Source: NBC (2016)

11.1.2 Adopt at least two of the following noise mitigation strategies to demonstrate that acoustic comfort is met for exterior spaces in the project.

- Interposing buffer zones on site such as vegetation.
- Protection of habitable spaces by introduction of green belts (dense tree cover along the site boundary) etc.
- Shading and screening by interposing less vulnerable buildings between the noise sources and more vulnerable buildings.
- Shading and screening by providing a solid barrier wall around the project boundary that is at least 8 feet high.
- Provision of adequate sound insulation (with NRC values above 0.5) on compound walls.
- Provision of sound absorption materials (with NRC values above 0.5) in the exterior areas of the site.

— 1 Point

11.1.3 Demonstrate that indoor noise levels are within acceptable limits as per NBC 2016, Part 8, Section 4 and key noise sources on-site (DG, chiller plant, etc.) have sufficient acoustic insulation as per NBC 2016 to maintain acoustic comfort are met for all regularly occupied spaces.

— 1 Points

Note: *If the building is operational for 24 hours, the noise testing to be conducted for day time and night time*.

11.2 COMPLIANCE

THERMAL COMFORT

11.2.1 Submit drawings in .dwg format highlighting area distribution for air-conditioned, non-air-conditioned, and mixed-mode spaces.

Air-conditioned spaces

11.2.2 Submit a simulation report (input and output file) to demonstrate that thermal comfort conditions are met for the project highlighting which thermal comfort model is being adopted and the total unmet hours.

11.2.3 Submit a single-line diagram of high-side and low-side HVAC system with set points for all seasons.

Non-air-conditioned spaces (Alternative 1)

11.2.4 Submit a simulation report (input and output file) to demonstrate that thermal comfort conditions are met for the project highlighting which thermal comfort model is being adopted and the total unmet hours.

11.2.5 Submit a technical specification sheets and purchase orders (reflecting full quantities) of ceiling fans.

Non-air-conditioned spaces (Alternative 2)

11.2.6 Submit detailed narrative of the strategies adopted for adequate window design.

11.2.7 Submit drawings (plans, elevations, sections, interior elevations with D/W schedules) in .dwg format supporting the adopted strategies.

11.2.8 Submit floor plans of all relevant spaces highlighting ceiling fan layout.

11.2.9 Submit technical specification sheets/GRIHA product Catalogue certificate and purchase orders (reflecting full quantities) of ceiling fans.

Mixed-mode spaces

11.2.10 Simulation report (input and output file) to demonstrate that thermal comfort conditions are met for the project highlighting which thermal comfort model is being adopted and the total unmet hours.

11.2.11 Submit a narrative and HVAC schedule highlighting duration of conditioned and unconditioned modes, respectively.

ACOUSTIC COMFORT

11.2.12 Submit photographs highlighting the strategies adopted in the project to mitigate the effect of outdoor noise.

11.2.13 Submit drawings (landscape plan highlighting species and canopy areas of mature trees, floor plans, wall sections, and elevations) in .dwg format supporting the adopted strategies.

11.2.14 Submit technical specification sheets/brochures of HVAC/other mechanical equipment highlighting corresponding NR values.

11.2.15 Submit technical specification sheets of noise insulation and/or glazing used in the building for noise reduction, highlighting its NRC/STC/CAC rating or equivalent (as per ASTM International Classification E413, E 1414, and E90).

OR

Submit a valid GRIHA Product Catalogue certificate, as applicable for the product.

11.2.16 Submit indoor noise audit report for all representative spaces.

CRITERION 12

Indoor Air Quality

INTENT

This criterion ensures design and monitoring of ventilation systems such that IAQ meets the minimum requirement as recommended by the relevant standards.

Maximum Points: 7

12.1 APPRAISALS

12.1.1 Ensure that the minimum requirements of CPCB (National Ambient Air Quality Standards [NAAQS]) for assessing the quality of fresh air are fulfilled.*

–1 point

12.1.2 Ensure that the minimum requirements of ASHRAE Standard 62.1–2010, Sections 4–7, Ventilation for Acceptable Indoor Air Quantity (with errata), or NBC 2016, Volume 2, Part 8, Section 3, for quantity of fresh air are met.

–1 point

Applicability check: Spaces with operable windows are exempted from Appraisals 12.1.1 and 12.1.2.

For exemption from Appraisals 12.1.1 and 12.1.2, submit the following:

- Floor plans, building elevations, and window sections (in .dwg format)
- Photographs clearly indicating that the windows installed in the building are operable

12.1.3 Ensure continuous monitoring of CO, CO2, temperature, and RH levels such that they meet the permissible thresholds as per Indian Society of Heating, Refrigerating and Air Conditioning Engineers (ISHRAE) standard 10001:2016, Table 6, for all habitable areas either at space level or at AHUs by installation of sensor(s) deployed with feedback system as per the alternatives mentioned in Table 12.1 c and 12.2c.

TABLE 12.1c: *Requirements of sensors/monitoring devices and display for maintaining good IAQ*

Requirement	Alternative 1 (Space Level)	Alternative 2 (AHU Level)	Points
Sensors/ monitoring devices	Install one sensor for each space ≥30m2 and ≤100m2 For spaces >100m2, install additional sensor for every 100m2 For spaces <30m^2, install sensors in common areas	Install one sensor at each AHU (return air duct)	1
Display	Install digital display showing monitored values for CO, CO2, temperature, and RH at each floor level (common areas) with permissible thresholds (as per Table 12.2c only for CO and CO2) and clear visibility for all occupants		1

* Appraisal 12.1.1 shall cover treatment of outdoor air predominantly for PM10 & PM2.5.

TABLE 12.2c: *Permissible thresholds as per ISHRAE standard 10001:2016*

Parameter	Threshold
CO	<9 (ppm)
CO2	Ambient + 500 (ppm)

12.1.4 Ensure that all interior wall and ceiling finishes (including, but not limited to, primers and paints) have low volatile organic compound (VOC) content as per below table and lead content to be within permissible limits (<=90ppm).

– 1 Point

TABLE 12.3c: *VOC limits for liquid coating*

Paint Application	Type of Finish	VOC Limit (g/L)
Interior coatings	Flat	<50
	Non-flat	<150
Exterior coatings	Flat	<200
	Non-flat	<100
Anti-corrosive	Gloss/semi-gloss/flat	<250

12.1.5 Ensure that all adhesives and sealants used have low VOC content as per Tables 12.4c and 12.5c and that interior composite wood products do not have urea–formaldehyde as a bonding resin.

–1 Point

TABLE 12.4c: *VOC limits for adhesives*

Architectural Adhesive Application	VOC Limit (g/L)
Wood flooring	100
Industrial/rubber flooring	60
Ceramic tiles	65
Structural glazing	100
Multi-purpose construction	70
Sub-floor	50
Wall boards/panels	50

PVC welding	285
Adhesive primer for plastic	250
Structural wood member	140
Sub-specific use metal to metal	30
Wood	30
Fiber glass	80
Plastic foam/porous materials (except wood)	50

TABLE 12.5c: *VOC limits for sealants*

Sealant Application	VOC Limit (g/L)
Architectural/roadways	250
Single-ply roof material installation/repair	450
Other	420
Sealant primer application architectural non-porous	250
Sealant primer application architectural porous	775
Other sealant primer applications architectural	750

12.1.6 Ensure improved IAQ by adopting a minimum of three strategies from Table 12.6c.

–1 Point

TABLE 12.6c: *Suggested strategies for improved IAQ in habitable space*

S. No.	Strategy	Requirement
1	Installation of indoor plants	1% of carpet area to be covered by potted plants
2	Promoting use of carpets and mats at all entrances	To capture particulates from occupants' shoes at all regularly used entrance(s) to the project, including doors with pedestrian traffic only to/from terraces or patios (no traffic to/from surrounding grounds), one of the following is installed and is maintained on a weekly basis. Three level of mats Scraper mat: 6ft. (1.83 m) Absorption mat: 6ft. (1.83 m) Finishing mat: 8ft (2.44 m)

3	Use of green cleaning products for housekeeping	Policy/tenant agreement to be formulated elaborating use of green cleaning (green seal or equivalent rated and non-irritant) products in all regularly occupied spaces
4	Installation of separate exhaust system for janitor/storage rooms for chemicals	In conformity with ASHRAE 62.1(2016), Normative Index B, separation of exhaust outlets and indoor air intakes
5	Installation of air curtains	Air curtains to be installed at all major entrances and exits
6	Air sanitization (filtration of microbes, isolation systems, UVGI system, negative air ionization, etc.)	Air sanitation is the system of removing the impurities present in air inside the buildings to protect its occupants from infections. Sanitation of air is essential in enclosed places like in buildings which are conditioned and have non-operable windows to prevent the spread of infections
7	Demand control ventilation	Carbon dioxide or air quality sensors may be used to check the level of pollutants in the occupied space and indicate to the building management system to control the opening of outside air dampers, thereby effectively providing ventilation on demand A demand-controlled ventilation system uses a variable speed drive based on the opening and closure of the fresh air dampers, controlled by the carbon dioxide sensors (refer to NBC 2016, Volume 2, Part 8, Section 3, Clause 11.5.4 and Part 11, Clause 11.6 a) A typical basement exhaust system may use a variable speed drive controlled by carbon monoxide sensors' centrifugal/screw chillers with variable speed drives. Projects in composite climates with 24-hour working schedules may incorporate free cooling systems

12.2 COMPLIANCE

12.2.1 Submit documentation detailing the specifications of the filtration system to demonstrate that fresh air quality meets the minimum requirements of CPCB (NAAQS) to demonstrate compliance with Appraisal 12.1.1.

OR

Submit a valid GRIHA Product Catalogue certificate as applicable for the product demonstrating compliance with Appraisal 12.1.1.

12.2.2 Submit space-by-space heat load calculations highlighting the provision of sufficient fresh air in the HVAC system design as per the ASHRAE 62.1 or NBC 2016, Volume 2, Part 8, Section 3, Clause 6.3.1, Table 3, to demonstrate compliance with Appraisal 12.1.2.

12.2.3 Submit floor plans and/or HVAC system plans (in .dwg format) highlighting the location of various CO, CO_2, temperature, and RH sensors, and digital displays to demonstrate compliance with Appraisal 12.1.3.

12.2.4 Submit technical specification sheets/brochures of the filters, sensors, and digital displays installed in the project to demonstrate compliance with Appraisal 12.1.3.

OR

Submit a valid GRIHA Product Catalogue certificate as applicable for the product demonstrating compliance with Appraisal 12.1.3.

12.2.5 Submit purchase orders reflecting the full quantities of the filters, sensors, and digital displays installed in the project to demonstrate compliance with Appraisal 12.1.3.

12.2.6 Submit technical specification sheets/brochures of all interior walls and ceiling finishes, highlighting that they have low VOC and lead content to demonstrate compliance with Appraisal 12.1.4.

OR

Submit a valid GRIHA Product Catalogue certificate as applicable for the product demonstrating compliance with Appraisal 12.1.4.

12.2.7 Submit purchase orders reflecting full quantities of all interior walls and ceiling finishes, to demonstrate compliance with Appraisal 12.1.4.

12.2.8 Submit the technical specification sheets/brochures of all adhesives and sealants highlighting that they have low VOC content to demonstrate compliance with Appraisal 12.1.5.

OR

Submit a valid GRIHA Product Catalogue certificate as applicable for the product demonstrating compliance with Appraisal 12.1.5.

12.2.9 Submit purchase orders reflecting full quantities of all adhesives and sealants to demonstrate compliance with Appraisal 12.1.5.

12.2.10 Submit technical specification sheets/brochures of the bonding resin used in the making of composite wood-based products highlighting that they are urea-formaldehyde free to demonstrate compliance with Appraisal 12.1.5.

OR

Submit a valid GRIHA Product Catalogue certificate as applicable for the product demonstrating compliance with Appraisal 12.1.5.

12.2.11 Submit purchase orders reflecting full quantities of the bonding resin used in the making of composite wood-based products to demonstrate compliance with Appraisal 12.1.5.

12.2.12 Submit a documentation to demonstrate compliance with the strategies adopted to improve IAQ as per Appraisal 12.1.6.

SECTION 5

Water Management

CRITERION 13

Water Demand Reduction

INTENT

The intent of this criterion is to reduce overall building and landscape water demand of the project.

Maximum Points: 4

13.1 APPRAISAL

BUILDING WATER DEMAND REDUCTION

13.1.1 Demonstrate reduction in building water demand from the GRIHA base case as per Table 13.1c. Refer Table 13.2c for GRIHA base case.

- Mandatory + 2 points

TABLE 13.1c: *Percentage reduction in building water demand*

Reduction from GRIHA Base Case (X)	Points
X ≥ 20%	Mandatory
20% > x ≤ 30%	1
x > 30%	2

Note: *All faucets, which are installed in spaces with water head heights less than 5m/17ft, in a gravity-fed system, are exempt from calculations in Appraisal 13.1.1.*

TABLE 13.2c: *GRIHA base case for plumbing fixtures*

Water Fixtures	Flow Rates
Water closet (solid/liquid)	6/6 LPF
Urinal	3.8 LPF
Showerhead	10 LPM
Lavatory faucet	8 LPM
Kitchen faucet	8 LPM

LANDSCAPE WATER DEMAND REDUCTION

13.1.2 Demonstrate reduction in landscape water demand from the GRIHA base case as per Table 13.3c. Refer Table 13.4c and 13.5c for plant factor and irrigation efficiency values.

TABLE 13.3c: *Percentage reduction in landscape water demand*

Reduction from GRIHA Base Case (*x*)	Points
50% < *x* < 75%	1
x ≥ 75%	2

TABLE 13.4c: *Plant factor of different plant species*

Plant Species	Plant Factor
Lawn	1
Native Grass	0.45
Existing native trees	0
Newly planted native shrubs	0.3
Newly planted exotic shrubs	0.9
Newly planted native trees	0.15
Newly planted exotic trees	1.65
Vertical garden	0.35
Grass on podium	2
Newly planted native shrubs on podium	0.6
Newly planted exotic shrubs on podium	1.8
Newly planted native trees on podium	0.3
Newly planted exotic trees on podium	3.3
Newly planted native grass on podium	0.9

TABLE 13.5c: *Irrigation efficiency of various irrigation systems*

Irrigation System	Irrigation Efficiency
Flood	0.4
Furrow	0.80
Sprinkler	0.85
Drip	0.90
Micro spray	0.87
Seepage	0.80

13.2 COMPLIANCE

BUILDING WATER DEMAND REDUCTION

13.2.1 Submit calculation(s) using GRIHA building water demand reduction calculator to demonstrate compliance with Appraisal 13.1.1.

13.2.2 Submit technical specification sheets/brochures for all fixtures installed within the project highlighting the flow rates at 45 psi or 3.1 bar pressure to demonstrate compliance with Appraisal 13.1.1.

OR

Submit a valid GRIHA Product Catalogue certificate as applicable for all the fixtures installed within the project to demonstrate compliance with Appraisal 13.1.1.

13.2.3 Submit purchase orders reflecting full quantities and model numbers for the low-flow fixtures installed in the project to demonstrate compliance with Appraisal 13.1.1.

LANDSCAPE WATER DEMAND REDUCTION

13.2.7 Submit calculation(s) using GRIHA landscape water demand reduction calculator to demonstrate compliance with Appraisal 13.1.2.

13.2.8 Submit a detailed landscape plan (in.dwg format) demarcated with separate polylines of surface finishes indicating the list of plants along with the area statement demonstrating compliance with Appraisal 13.1.2.

13.2.9 Submit technical specification sheets/brochures for the irrigation system(s) highlighting its type and efficiency to demonstrate compliance with Appraisal 13.1.2.

OR

Submit a valid GRIHA Product Catalogue Certificate as applicable for the irrigation system(s) installed on-site to demonstrate compliance with Appraisal 13.1.2.

13.2.10 Submit purchase orders reflecting full quantities and model numbers for the irrigation systems installed on-site to demonstrate compliance with Appraisal 13.1.2.

13.2.11 Submit landscape irrigation plan (.dwg format) indicating the irrigation system installed on-site such as sprinklers, drip irrigation, etc., highlighting the areas to which it caters to demonstrate compliance with Appraisal 13.1.2.

13.2.12 Upload date-stamped photographs of the irrigation system installed on-site.

CRITERION 14

Wastewater Treatment

INTENT

The intent of this criterion is to promote grey-water and black-water segregation and further treat them on-site to reduce the project's dependency on freshwater.

Maximum Points: 2

14.1 APPRAISALS

14.1.1 Ensure that 100% of wastewater generated on-site is treated through either a chemical-based or a natural wastewater treatment system.

–1 Point

14.1.2 Ensure that 100% of wastewater is segregated (into grey water and black water) and treated independently on-site.

–1 Point

Applicability check: If the wastewater (both black and grey water individually) generated in the project is less than 5KLD, then Appraisals 14.1.1 and 14.1.2 will not be applicable.

To claim non-applicability from Appraisals 14.1.1 and 14.1.2, submit the following:

- Water balance diagram for the project indicating the quantity of wastewater generated
- On-site and various freshwater intake sources (municipal supply, borewell, tanker, stored rainwater, etc.).
- Detailed calculations showing various demand/supply values considered in water balance diagram along with reference(s).

14.2 COMPLIANCE

14.2.1 Submit technical specification sheets/brochures for wastewater treatment system installed on-site highlighting its type, capacity, efficiency and sludge disposal to demonstrate compliance with Appraisals 14.1.1 and 14.1.2.

OR

Submit a valid GRIHA Product Catalogue certificate as applicable for wastewater treatment systems installed on-site to demonstrate compliance with Appraisals 14.1.1 and 14.1.2.

14.2.2. Submit purchase orders/work order highlighting the capacity and technology of the wastewater treatment system installed on-site to demonstrate compliance with Appraisals 14.1.1 and 14.1.2.

14.2.3 Upload contextual photographs of wastewater treatment systems installed on-site to demonstrate compliance with Appraisals 14.1.1 and 14.1.2.

14.2.4 Submit calculation demonstrating the amount of blackwater and greywater generated from the project.

14.2.5 Submit a detailed plumbing design basis report indicating wastewater treatment system details to demonstrate compliance with Appraisals 14.1.1 and 14.1.2.

CRITERION 15

Rainwater Management

INTENT

The intent of this criterion is to manage rainwater efficiently to minimise run-off generated from the project.

Maximum Points: 5

15.1 APPRAISAL

15.1.1 Demonstrate that the post-construction storm-water run-off from the site is being managed within the GRIHA project boundary as per Table 15.1c based on the peak hourly rainfall (mm/h).

TABLE 15.1c: Percentage of storm-water runoff managed on-site

Post-construction Storm-Water Runoff Managed On-site (*x*)	Points
25% ≤ *x* < 50%	1
50% ≤ *x* < 75%	2
75% ≤ *x* < 100%	4
x = 100%	5

15.2 COMPLIANCE

15.2.1 Submit site plan (.dwg format) demarcated with the separate polylines of surface finishes and provide detailed area statement for the verification of all areas considered in the calculation.

15.2.2 Submit soil percolation test report highlighting the percolation rate of soil of the site.

15.2.3 Submit calculation(s) using GRIHA rainwater management calculator.

15.2.4 Submit storm-water drainage plan (.dwg format) for the site indicating the location of rainwater storage tank or/and harvesting pit on-site.

15.2.5 Submit drawings (.dwg format) depicting cross-section and plan of rainwater storage tank or/and harvesting pit on-site.

CRITERION 16

Water Quality and Self-Sufficiency

INTENT

The intent of this criterion is to evaluate both the quality and the quantity of water available for a project to push it towards becoming self-sufficient (net zero) and reduce dependency on municipal or ground water sources.

Maximum Points: 5

16.1 APPRAISAL

16.1.1 Ensure that the project meets water quality norms for drinking/domestic use as per BIS 10 500: 2012and treated water for irrigation and discharge should be as per the CPCB.

– Mandatory

16.1.2 Ensure that the project demonstrates reduction from GRIHA benchmark WPI (Water Performance Index) as per Table 16.1c. For base case WPI values, refer table 16.2c.

TABLE 16.1c: *Percentage reduction from GRIHA benchmark for WPI*

Reduction from GRIHA Base Case (*x*)	Points
10% ≤ *x* < 25%	1
25% ≤ *x* < 50%	2
50% ≤ *x* < 75%	4
x ≥ 75%	5

Note: *WPI does not include water requirement for medical procedures and luxury practices such as swimming pool, steam bath.*

TABLE 16.2c: *Percentage reduction from GRIHA benchmark for WPI*

Typology	Sub-category	Base Case
Healthcare Facility	Hospital	572
	Clinic 572	
	Medical College	
	Dispensary	
Hospitality	Hotel	320
	Guest House	
	Service Apartment	
Institutional	Universities	80
	School	
	Colleges	

	Library	
	Laboratories	
	Sport Complex	
Offices	Core & Shell	52
	IT Building	
	Owner Occupies Building	
	Co-working Spaces	
	Industries	
Residential	Multi Dwelling Unit Project	120
	Hostels	
	Bungalow	
	Villa Mansion	

16.2 COMPLIANCE

16.2.1 Submit third-party (from labs accredited by NABL) water quality test reports for water used for various purposes in the project demonstrating compliance with Appraisal 16.1.1.

16.2.2 Submit the calculations using GRIHA WPI calculator to demonstrate reduction from GRIHA benchmark as per Appraisal 16.1.2.

16.2.3 Submit a water balance diagram for the project indicating the quantity of wastewater generated on-site and various freshwater intake sources (municipal supply, borewell, tanker, stored rainwater, etc.) demonstrating compliance with Appraisal 16.1.2.

16.2.4 Submit date-stamped photographs along with descriptions of various measures implemented on-site to reduce the WPI of the project demonstrating compliance with Appraisal 16.1.2.

SECTION 6

Solid Waste Management

CRITERION 17

Waste Management—Post Occupancy

INTENT

The intent of this criterion is to provide the necessary infrastructure to future occupants of the project so that they can sustainably manage on-site solid waste during the operation phase and comply with the statutory norms for disposal in a way that augments resource recovery.

Maximum Points: 4

17.1. APPRAISAL

17.1.1 Demonstrate compliance with all relevant government-notified waste management rules.*

–Mandatory

All the entities listed in Table 17.1c are considered bulk consumers and they need to mandatorily comply with the designated waste management rules.

TABLE 17.1c: *List of bulk consumers of respective waste typology*

Bio-Medical Waste	E-waste	Hazardous Waste	Plastic Waste
Hospitals, nursing homes, clinics, dispensaries, veterinary institutions, animal houses, pathological laboratories, blood banks, clinical establishments, research or educational institutions, health camps, medical or surgical camps, vaccination camps, blood donation camps, first-aid rooms in schools, forensic laboratories, and research labs generate bio-medical waste. Comply with all duties of Occupier as per the Bio-Medical Waste (M) Rules 2016	Central government or state government departments, public sector undertakings, banks, educational institutions, multinational organizations, international agencies, partnership, and public or private companies that are registered under the Factories Act (63 of 1948) and the Companies Act, 2013 (18 of 2013) and healthcare facilities that have a turnover of more than 1 crore or have more than 20 employees	Any project (e.g., research laboratories, testing facilities, etc.) that involve processes as per Schedule I and/ or generate waste in concentrations as per Schedule II of Hazardous Waste Management Rules 2016	All waste generators, local bodies, Gram Panchayats, manufacturers, Importers and producers.

* Comprising but not limited to SWM Rules 2016, E-Waste Management Rules 2016, Hazardous Waste Management Rules 2016, Bio-Medical Waste Management Rules 2016, Plastic Waste Management Rules 2016, Battery (Management and Handling) rules, (Amendment) 2010.

17.1.2 Provide infrastructure (multi-coloured waste bins/different refuse chutes to store e-waste, biomedical waste, organic waste, plastic waste, paper waste, and other inorganic solid waste) for building occupants to ensure segregation of waste at the source.

- Mandatory

17.1.3 Ensure that dedicated, segregated, and hygienic storage spaces are provided within the project site (for different types of waste listed in Appraisal 17.1.2) before treatment/ recycling.

- 2 Points

17.1.4 Provide contractual tie-ups with waste recyclers for safe handling and recycling of all types of inorganic waste generated on site. Also, ensure that 100% of recyclable waste is recovered/diverted (by means of recycling/processing through dedicated recyclers) and other inorganic waste (apart from recyclable waste) should be disposed off through authorized vendors.

- 2 Points

17.2 COMPLIANCE

17.2.1 Submit a copy of the agreement/tender document for the facility management team highlighting the practices for SWM to be adopted on site (segregation, collection, and transportation). Additionally, ensure that it includes clauses to demonstrate compliance with all applicable waste management rules as per appraisal 17.1.1.

17.2.2 Submit the SWM plan for the project—detail of the sizing of segregated waste storage facilities, strategy for primary and secondary collection, and storage to demonstrate compliance with Appraisal 17.1.2 and 17.1.3.

17.2.3 Submit a site plan (.dwg format) and building floor plans (.dwg format) indicating the location of various primary (multi-coloured waste bins) and secondary storage facilities to demonstrate compliance with Appraisal 17.1.2 and 17.1.3.

17.2.4 Submit purchase orders reflecting full quantities of all bins to be placed at refuse chamber/ waste storage facilities, specifically highlighting their sizing specifications to demonstrate compliance with Appraisal 17.1.2 and 17.1.3.

17.2.5 Submit documents highlighting contractual tie-ups with recyclers for ensuring safe recycling of recyclable inorganic wastes along with their quantities to demonstrate compliance with Appraisal 17.1.4.

17.2.6 Submit estimated calculations demonstrating percentage of inorganic waste that is targeted to be recovered by either recycling or processing to demonstrate compliance with Appraisal 17.1.4.

17.2.7 Maintain duly filled forms for keeping records of e-waste, hazardous waste and battery waste handled or generated that would be verified during the additional site visits.

17.2.8 Upload date-stamped photographs with description of the measures implemented.

CRITERION 18

Organic Waste Treatment

INTENT

The intent of this criterion is to divert organic waste from landfill sites by adopting strategies for treating it (preferably on-site otherwise off-site) and thereby mitigating its adverse effects on the surrounding environment.

Maximum Points: 2

18.1 APPRAISAL

18.1.1 Ensure that the organic waste generated on-site from the building (as per Criterion 17) and landscape areas is quantified and adopt strategies to treat 100% organic waste onsite/ offsite/combination of onsite and offsite to convert it into usable resources (manure, biogas, etc.).

– 2 Points

Applicability Check – If the Organic Waste (both kitchen and landscape) generated in the project is less than 50 kg. per day, then Appraisals 18.1.1 will not be applicable.

To claim non-applicability from Appraisals 18.1.1 submit the following:

- Calculation along with references showing that organic waste generation in the project is less than 50 kg per day.

18.2 COMPLIANCE

18.2.1 Submit calculation indicating total quantity of organic waste (food + landscape waste) generated on site.

18.2.2 Submit narrative detailing the strategies adopted for organic waste treatment, design and sizing of the organic waste treatment system installed (if on-site) along with supporting date stamped contextual photographs.

ONSITE TREATMENT

18.2.3 Maintain logbooks highlighting the quantity of the by-product (compost/biogas) used on-site, which would be validated during the additional site visits.

18.2.4 Submit site plan/building plan (.dwg format) highlighting the location of organic waste treatment plant on-site if applicable.

18.2.5 Submit purchase orders of the organic waste treatment system installed on-site.

18.2.6 Submit technical specification sheet/brochure specifying the capacity of the system along with its model number.

OR

Submit a valid GRIHA Product Catalogue certificate, as applicable for the product.

OFFSITE TREATMENT

18.2.7 Submit a copy of challans/receipts/ contract document/photographs, etc. demonstrating the treatment of organic waste outside the site.

18.2.8 Submit supporting documents (such as reports, certificates, website display, etc.) from the treatment agency on the treatment strategies adopted, to demonstrate compliance.

SECTION 7

Sustainable Building Materials

CRITERION 19

Utilization of Alternative Materials in Building

INTENT

The intent of this criterion is to encourage use of alternative materials, which minimize the detrimental impact of construction on environment by conserving natural resources, further minimizing the use of virgin materials and diverting usable (as per industry standards) wastes from the landfills to the construction industry.

Maximum Points: 5

19.1 APPRAISALS

STRUCTURAL SYSTEM*

19.1.1 Ensure minimum replacement of Ordinary Portland Cement (OPC) with the Bureau of Indian Standards (BIS) recommended waste materials by weight of cement used in structural concrete as per Table 19.1c.

Table 19.1c: *Replacement benchmarks for structural system*

Replacement Benchmark	Points
$20\% \leq x < 30\%$	1
$x \geq 30\%$	2

19.1.2 Ensure minimum 5% replacement of natural aggregate with recycled concrete aggregate (RCA)/recycled aggregate (RA) by weight of that category of aggregate in structural concrete.

OR

Ensure minimum 5% replacement of river sand with manufactured sand (M-sand) in structural concrete.

– **1 Point**

* Structural system will include both substructure and superstructure.

LOAD-BEARING AND NON-LOAD-BEARING WALLS

19.1.3 Ensure that all internal and external, load bearing, non-load bearing and partition walls are constructed with any, or combination of the below listed, alternative materials:

– 1 Point

- Concrete blocks (hollow, solid, or AAC) with minimum 40% fly ash content by Weight.
- Hollow clay blocks
- Adobe bricks/stabilized adobe/CSEB/stabilized mud blocks
- Rammed earth walls
- Stones from India (not including stone cladding)
- Bamboo/any other rapidly renewable material (not including bamboo cladding)
- Monolithic concrete wall demonstrating minimum 20% replacement of OPC with BIS recommended waste material by weight of cement

- C&D waste blocks demonstrating minimum 30% C&D waste material by weight
- Dry walls/boards with minimum 5% recycled content by weight

MASONRY MORTAR AND PLASTER

19.1.4 Ensure minimum 30% replacement of OPC with BIS recommended waste by weight of cement used in masonry mortar and plaster.

– 1 Point

Applicability Check – Projects where both cement mortar and plaster have not been used, those projects are exempted from Appraisal 19.1.4.

To exempt the project from Appraisal 19.1.4, please submit the following:

- Tender document along with date-stamped photographs highlighting the type of wall to be constructed, and the type of binding and finishing agent used for the same.
- Purchase orders reflecting full quantities of the alternative materials and the type of binding and finishing agent used for the same.

19.2 COMPLIANCE

STRUCTURAL SYSTEM

19.2.1 Submit a design mix report of each grade of concrete highlighting the technical properties of the ingredients to demonstrate compliance with Appraisal 19.1.1 and 19.1.2.

19.2.2 Submit a batch mix report for each grade of concrete to demonstrate compliance with Appraisal 19.1.1.

19.2.3 Submit a signed and stamped BOQ (relevant section only) highlighting the quantity of each grade of concrete used in the structural system to demonstrate compliance with Appraisal 19.1.1.

19.2.4 Submit a third-party test report of PPC highlighting the quantity of Pozzolana in the same to demonstrate compliance with Appraisal 19.1.1.

OR

Submit a valid GRIHA Product Catalogue certificate as applicable for the product to demonstrate compliance with Appraisal 19.1.1.

19.2.5 Submit calculation of the replacement benchmark achieved, in excel format, to demonstrate compliance with Appraisal 19.1.1 and/or Appraisal 19.1.2

19.2.6 Submit purchase orders reflecting full quantities of recycled aggregates along with declaration from the manufacturer highlighting the source and process of manufacturing these aggregates to demonstrate compliance with Appraisal 19.1.2.

LOAD-BEARING AND NON-LOAD-BEARING WALLS

19.2.7 Submit purchase orders reflecting full quantities of all types of materials used for constructing walls to demonstrate compliance with Appraisal 19.1.3.

19.2.8 Submit a signed and stamped BOQ (relevant section only) highlighting the quantity and type of material to be used for construction of all walls as mentioned in Appraisal 19.1.3.

19.2.9 In case concrete blocks are used for walls, submit a mix design of the blocks highlighting the BIS-recommended waste content in the same to demonstrate compliance with Appraisal 19.1.3.

OR

Submit a valid GRIHA Product Catalogue certificate as applicable for the product to demonstrate compliance with Appraisal 19.1.3.

19.2.10 In case of monolithic concrete walls and shear walls, submit batch mix and design mix reports of concrete highlighting replacement of OPC with BIS-recommended waste material to demonstrate compliance with Appraisal 19.1.3.

19.2.11 In case of dry wall construction, submit technical specifications/brochures of the material highlighting recycled content in the same to demonstrate compliance with Appraisal 19.1.3.

OR

Submit a valid GRIHA Product Catalogue certificate as applicable for the product to demonstrate compliance with Appraisal 19.1.3.

19.2.12 Submit date-stamped photographs showing type of material used for constructing walls as mentioned in Appraisal 19.1.3.

MASONRY MORTAR AND PLASTER

19.2.13 Submit calculation of the percentage of replacement made, in excel format, to demonstrate compliance with Appraisal 19.1.4.

19.2.14 Submit purchase orders reflecting the quantities of PPC and/or ready-mix plaster used for masonry mortar and plaster work in the project to demonstrate compliance with Appraisal 19.1.4.

19.2.15 Submit signed and stamped BOQ (relevant section only) highlighting the type of cement and mix proportion used for mortar and plaster to demonstrate compliance with Appraisal 19.1.4.

19.2.16 Submit a third-party test report of PPC and/or ready-mix plaster highlighting the quantity of Pozzolana in the same to demonstrate compliance with Appraisal 19.1.4.

OR

Submit a valid GRIHA Product Catalogue certificate as applicable for the product to demonstrate compliance with Appraisal 19.1.4.

CRITERION 20

Alternative Materials for External Site Development

INTENT

The intent of this criterion is to substitute conventional materials used for external site development with alternative materials, to reduce pressure on both mining for virgin materials and landfills required for the disposal of waste material.

Maximum Points: 2

20.1 APPRAISALS

20.1.1 Ensure that at least 70% of all roads and vehicular pathways within site premises are constructed with one, or any combination, of the following:

– 1 Point

- Bituminous road with minimum 6% plastic waste content by weight of bitumen
- Cast *in-situ* cement concrete road with minimum 30% fly ash content by weight of total cementitious
- material
- Concrete blocks with minimum 40% fly ash content by weight of block
- Paver blocks containing minimum 10% C&D waste content by weight of block
- Stones from India
- Any other product with minimum 10% recycled content by weight.

20.1.2 Ensure that 100% of the pavement/footpath including kerb stone constructed on-site are constructed with one, or any combination, of the following:

–1 Point

- Bituminous pavement with minimum 6% plastic waste by weight of bitumen
- Cast *in-situ* concrete with minimum 30% fly ash content by weight of total cementitious material
- Concrete blocks with minimum 40% fly ash content by weight of block
- Paver blocks containing minimum 10% C&D waste content by weight of material
- Stones from India
- Any other product with minimum 10% recycled content by weight

20.2 COMPLIANCE

20.2.1 Submit signed and stamped tender document/BOQ (relevant section only) highlighting the materials to be used for construction of roads, vehicular pathways, pavements/ footpaths, and kerb stone.

20.2.2 Submit purchase orders reflecting full quantities of kerb stone and blocks/tiles/stones used for construction of roads, vehicular pathways, pavements, footpaths, etc. in the project.

20.2.3 Submit a site plan (drawings in .dwg format) highlighting length and width of the total roads, vehicular pathways, pavement, footpaths, etc., constructed in the project along with legends highlighting the materials used in the same.

20.2.4 Submit calculations in excel format indicating compliance.

FOR BITUMINOUS ROADS AND/OR PAVEMENTS

20.2.5 Submit purchase orders reflecting full quantities and types of plastic waste procured.

20.2.6 Submit a job mix report of bituminous road and/or pavement highlighting the ingredients used in the same.

20.2.7 Submit date-stamped photographs of plastic waste used.

FOR CAST IN-SITU CONCRETE ROADS, AND/OR PAVEMENTS

20.2.8 Submit design mix report of concrete highlighting technical properties of the ingredients.

20.2.9 Submit batch mix report of concrete.

FOR CONCRETE BLOCKS, ROADS AND/OR PAVEMENTS

20.2.10 Submit a design mix report of concrete blocks highlighting the weight of each ingredient used in the same.

OR

Submit a valid GRIHA Product Catalogue certificate as applicable for the product.

FOR ROADS AND/OR PAVEMENTS MADE WITH PAVER BLOCKS CONTAINING C&D WASTE

20.2.11 Submit brochure/C&D waste procurement receipt from the manufacturer/grant given to the manufacturer to procure C&D waste by a local government body.

OR

Submit a valid GRIHA Product Catalogue certificate as applicable for the product.

FOR ROADS AND/OR PAVEMENTS MADE WITH PAVER BLOCKS CONTAINING OTHER RECYCLED MATERIALS

20.2.12 Submit technical specifications/brochures/relevant BIS compliance certificates or other equivalent international standards such as American Society for Testing and Materials (ASTM) and European Standards (EN) mentioning the use of recycled content in the product.

OR

Submit a valid GRIHA Product Catalogue certificate as applicable for the product.

SECTION 8

Life Cycle Assessment and Costing

CRITERION 21

Reduction in Global Warming Potential through Life Cycle Assessment

INTENT

The intent of this criterion is to reduce the impact of material selection on the environment and encourage the project to optimize construction product consumption efficiency by selecting low GWP (kgCO2eq) products through LCA of the building.

Maximum Points: 5

21.1 APPRAISAL

21.1.1 The project can choose any one of the following alternatives and points will be awarded based on percentage reduction as per table 21.1c.

- 5 Points

Alternative 1

Demonstrate a reduction in GWP values of the components in primary materials category of the project from baseline values according to table 21.1c.

Alternative 2

Demonstrate a reduction in GWP values of the components in primary and secondary materials category of the project from baseline values according to the table 21.1c.

Alternative 3

Demonstrate a reduction in GWP values of the components in primary, secondary, fit-outs and furniture materials category of the project from baseline values according to table 21.1c.

Table 21.1c: *Points criteria for Material and Product Life Cycle assessment*

Percentage reduction in GWP values from baseline in			Points awarded
Primary material	Primary & Secondary materials	Primary, secondary materials and Fit outs & furnishings	
≥ 25%	≥ 20%	≥ 10%	1
≥ 30%	≥ 25%	≥ 15%	3
≥ 35%	≥ 30%	≥ 20%	5

21.2 COMPLIANCE

21.2.1 Submit a Life Cycle Assessment report (using a third party LCA Calculator) for each individual material as per Table 21.3c. The stages to be considered for computing the GWP values are mentioned in Table 21.2c.

21.2.2 Submit Google Maps images highlighting the road distance from the manufacturing source of each material to the site along with a narrative explaining the same. Base case distance to be considered as per table 21.3c.

21.2.4 Submit building floor plans, sections and elevations (drawings in .dwg format) with dimensions and legends highlighting the use of materials which have a lower GWP.

21.2.5 Submit purchase orders reflecting full quantities of all low GWP materials used in the project.

21.2.6 Submit a signed and stamped BOQ (relevant sections only) highlighting the quantities of all the materials used in the project as per Table 21.3c.

21.2.7 Submit technical specification sheets/brochures and/or Environmental Product Declaration (EPD) of the materials used in the building superstructure, interiors, and finishes.

OR

Submit a valid GRIHA Product Catalogue certificate as applicable for the product.

21.2.8 Submit date-stamped photographs demonstrating the use of materials specified in appraisals.

Table 21.2c: *Life cycle stages considered under the criterion*

Life cycle Stages Considered Under this Criterion (Highlighted)							
Product Stage		**Construction Process Stage**		**Use Stage**		**End Stage**	
A1	Raw materials			B1	Use	C1	Deconstruction
A2	Transport			B2	Maintenance	C2	Transport
A3	Manufacture			B3	Repair	C3	Waste Processing
		A4	Transport	B4	Replacement	C4	Disposal
		A5	installation	B5	Refurbishment		

Table 21.3c: *Baseline materials and baseline transport distance*

Category	Base case definition	Base line transport distance	GHG numbers (kg CO_2 for per kg material)
PRIMARY MATERIALS			
Frame	RCC flat slab (Beams, columns, core/shear walls) M-40 Steel reinforcement Fe 415 h	500	36.4
Slab (Floor/stilt/mezzanine)			
Roof structure			
Roof covering	Brick bat coba	100	4.4
Internal & external Wall finish	Cement Plaster	300	4.8
	Emulsion paint	100	1.5
Internal & external walls	Brick wall with mortar	300	4.6
Partitions	Brick wall	300	3.5
Windows & Frame	Aluminum frame	500	280
	Single glazing 6mm thick	500	1.2
Floors/ flooring	Vitrified tiles 11mm thick	500	7.8
False Ceilings (Drop Ceilings)	Plaster board/ Gypsum panels with metal framing and fixtures	300	3.3
SECONDARY MATERIALS			
Doors & frames	Wooden frame and panel with metal hinges (wood hollow core)	300	77
Stairs	Vitrified tiles 11mm thk	500	7.8
Insulation	Rock wool	500	15
Railings	Wooden/metal	100	64
Wall panels	Natural wood	300	12
FITTINGS AND FIT OUT			
Cabinetry and shelving	Ply board with laminate/veneer finish	100	18
Countertops	Concrete	300	6.4
Moveable / detached furniture	Polished wood	100	18
Soft furnishings curtains, blinds carpets	100% polyester	100	9.52

Note: *For baseline materials to show reduction the following materials will be considered. For each building the baseline will be unique based on the factors of the site.*

Note

1. Transportation (A4) measures the distance between the manufacturing unit of the final product and the site location. In case of unavailability of documents and details to support the distance claimed, the base case transport distance as per Table 21.3c will be applicable to the design case as well.
2. If local materials are used, and supporting documentation is available, the project team may override the default transportation parameter in the design case.
3. All other stages not in Table 21.2c and building elements not mentioned in Table 21.3c shall be ignored for the purposes of the GRIHA LCA.
4. In case of any ambiguity on material/specification inclusion/exclusion from study, GRIHA will make final decision in consultation with project team.
5. Please ensure that the scope of LCA study is same as the scope considered in GRIHA LCA (Tables 21.2c and 21.3c).

Methodology

1. For the base case, the GWP (kg CO2eq) value of each material is given in Table 20.5c.
2. For the design case, calculate GWP (kg CO2eq) values of each individual material, considering the life cycle stages and building elements as defined in Tables 20.3c and 20.4c, for a period of 60 years, and with transportation distance as actual, using a third party LCA calculator.
3. Input the above generated design case GWP values for each material along with their respective quantities into the online GRIHA panel to generate the GWP value of the entire project.
4. The base case GWP value of the project will be autogenerated considering the same quantities of materials as in the design case however, with supporting structural calculations (STAD Pro recommended) project teams may consider different values in base case and design case. Subsequently, a total percentage reduction in GWP value will be computed for design case against the base case.

CRITERION 22

Life Cycle Cost Analysis

INTENT

The intent of this criterion is to assess the payback period for the cumulative strategies adopted across various sections: energy efficiency, water management, and sustainable building materials for enhancing the 'greenness' of the project.

Maximum Points: 3

22.1 APPRAISAL

Alternative 1

22.1.1 Demonstrate using the GRIHA LCC calculator that the cumulative discounted payback period for the project (for the life stages defined in Table 22.2c,) is below the GRIHA benchmarks as per Table 22.1c.

Table 22.1c: *GRIHA benchmarks for cumulative discounted payback period*

Cumulative Discounted Payback Period for the Project (*x*)	Points
10 years ≥ *x* > 8 years	1
8 years ≥ *x* > 6 years	2
x ≤ 6 years	3

Table 22.2c: *Life cycle stages defined as per BS EN 15978:2011, and highlighting the GRIHA LCC scope*

Life cycle stages considered under this criterion (Highlighted)									
Product Stage		**Construction Stage**		**Use Stage**		**End of life stage**		**Potential Benefits and loads**	
A1	Raw Material Supply			B1	Use	C1	Deconstruction	D	Recover, reuse, recycling potential
A2	Transport			B2	Maintenance	C2	Transport		
A3	Manufacture			B3	Repair	C3	Waste Processing		
		A4	Transport	B4	Replacement	C4	Disposal		
		A5	Installation	B5	Refurbishment				
				B6	Operational Energy Use				
				B7	Operational Water Use				

Alternative 2

22.1.2 Submit a Return on Investment (ROI)–based financial analysis to establish compliance with the criterion on economic viability.

- 3 points

- The analysis must encompass a 60-year design life and include all cost categories: initial investment, annual operating and maintenance expenses, component replacement costs, and terminal disposal or decommissioning costs, where applicable.
- The ROI methodology must evaluate the financial benefits derived from sustainable interventions related to energy efficiency, water conservation, and the use of environmentally responsible building materials.
- All calculations must be based on validated assumptions and supported by credible technical references and benchmarking against conventional practices.
- All financial estimates must be grounded in transparent assumptions and validated using appropriate cost benchmarks.

22.2 COMPLIANCE

22.2.1 Submit calculations to demonstrate the reduction in the cumulative discounted payback period for the project on GRIHA LCC calculator using LCC analysis from a third-party consultant.

22.2.2 Submit LCC analysis report from a third-party consultant.

MATERIAL PARAMETERS

22.2.3 Submit signed and stamped BOQ (relevant sections only), highlighting the materials used in the project (as per Table 22.3c).

22.2.4 Submit purchase orders reflecting full quantities with the cost of the materials used in the project (as per Table 22.3c).

22.2.5 Submit design mix reports and batch mix reports of all grades of concrete and steel used in the superstructure along with their respective quantities.

22.2.6 Submit technical specification sheets/brochures of the materials used in the building envelope (as per Table 22.3c).

OR

Submit a valid GRIHA Product Catalogue certificate as applicable for the products.

22.2.7 Submit building floor plans, elevations, and sections in .dwg format with legends demarcating the location of the materials installed in the project.

ENERGY PARAMETERS

22.2.8 Submit signed and stamped BOQ (relevant sections only) highlighting the source of procurement of various systems and components of HVAC and interior lighting installed in the project (as per Table 22.3c).

22.2.9 Submit purchase orders reflecting full quantities with the cost of various systems and components of HVAC, and interior lighting installed in the project (as per Table 22.3c).

22.2.10 Submit technical specification sheet/brochure of indoor lighting (lamps, ballasts, and luminaires) highlighting luminous efficacy (as per Table 22.3c).

OR

Submit valid GRIHA Product Catalogue certificate as applicable for the products.

22.2.11 Submit technical specification sheet/brochure of HVAC system highlighting chiller type, capacity, COP and IPLV or BEE or equivalent labelling for unitary, split, packaged air conditioners indicating the system type and its cooling capacity.

OR

Submit valid GRIHA Product Catalogue certificate as applicable for the products.

RENEWABLE ENERGY PARAMETERS

22.2.12 Submit signed and stamped BOQ (relevant sections only) highlighting the source of procurement of the renewable energy system installed on-site (as per Table 22.3c).

22.2.13 Submit purchase orders reflecting full quantities with the cost of the renewable energy system installed on-site (as per Table 22.3c).

22.2.14 In the case of on-site installation of renewable energy system, submit site plan in .dwg format demarcating its location.

22.2.15 Submit technical specification sheet/brochure of the installed renewable energy system on-site (as per Table 22.3c).

OR

Submit valid GRIHA Product Catalogue certificate as applicable for the products.

22.2.16 In the case of off-site installation, submit Renewable Energy Certificates (RECs) or Power Purchase Agreement (PPA) from the utility for the purchase of green power highlighting the cost involved.

WATER PARAMETERS

22.2.17 Submit signed and stamped BOQ (relevant sections only) highlighting the water fixtures, irrigation systems, rainwater harvesting system for water storage, STP/WTP/ETP installed on-site (as per Table 22.3c).

22.2.18 Submit purchase orders reflecting full quantities with the cost of the water fixtures, irrigation systems, rainwater harvesting system for water storage, STP/WTP/ETP on-site (as per Table 22.3c).

22.2.19 Submit signed and stamped BOQ (relevant sections only) highlighting each type of vegetation, such as shrubs, trees, grass, planted on-site.

22.2.20 Submit purchase orders reflecting full quantities with cost of each type of vegetation, such as shrubs, trees, grass, planted on-site.

22.2.21 Submit technical specification sheet/brochure of water-efficient fixtures highlighting flow rates, irrigation systems, STP/WTP/ETP installed in the project highlighting system capacities.

OR

Submit valid GRIHA Product Catalogue certificate as applicable for the products.

22.2.22 Submit site plan (.dwg format) demarcating the location of rainwater storage tanks, STP/ WTP/ETP on-site.

22.2.23 Submit landscape plan in .dwg format with legend highlighting all existing and newly planted vegetation, and polylines demarcating the soft cover.

Note: *The project team must maintain consistency in documents submitted across energy optimization, water management, sustainable building material, and LCC sections.*

Table 22.3c: *Various materials/systems covered in GRIHA LCC scope*

Sustainable Building Materials	
Building structure	Procurement of material and construction of structural frame (above the plinth level)

	Procurement of material and construction of ground floor slab and upper slabs
	Procurement of material and construction of roof slab and its covering
	Procurement of material and construction of envelope (solid portion)
	Procurement of material and construction of envelope (glazed portion)
Interior materials and finishes	Procurement of material and construction of internal wall and/or partitions
	Procurement of material and construction of wall finishes
	Procurement of material and construction of floor finishes
	Procurement of material and construction of ceiling finishes including false ceiling
Energy Optimization	
HVAC system	Procurement and installation of all air-cooled chillers; water-cooled chillers; unitary/split ACs; DX systems; packaged systems and VRV system. Note: The distribution network including ducting, piping, diffusers, AHUs, VAV boxes, etc., will not be considered for the base case and for the design case.
Interior lighting system	Procurement and installation of all lighting fixtures including all lamps and lamp housings. Note: The distribution network including wiring, piping, DBs, MCBs, electrical panels, occupancy, and daylight sensors will not be considered for the base case and for the design case.
Renewable energy system	Procurement and installation of all renewable energy systems including its major system components. For example, in the case of solar PV installation on-site or in the case of procurement of RECs or power purchase agreement from the utility, mounting structures, panels, solar inverters, etc., should be taken into consideration. Note: The distribution network including wiring, piping, DBs, MCBs, and electrical panels will not be considered for the base case and for the design case.

Table 22.3c: Various materials/systems covered in GRIHA LCC scope (contd...)

Water Management	
Rainwater harvesting system	Material procurement and construction (including labour costs) of rainwater storage tanks and desilting chamber. Note: The distribution network including piping, overhead water tanks, etc. will not be considered for base case and for the design case.
Systems for treating wastewater	Procurement and installation of all STP/WTP/ETP systems on-site. Note: The distribution network including piping, overhead water tanks, etc. will not be considered for base case and for the design case.

Water fixtures for building use	Procurement and installation of the water fixtures in the building(s). Note: The distribution network including piping, overhead water tanks, etc. will not be considered for base case and for the design case.
Plantation as per landscape plan	Procurement and stacking of shrubs, trees, grass, and other vegetation on-site. Note: Any RCC and/or masonry work for landscaping purposes will not be considered for base case and for the design case.
Landscape irrigation systems	Procurement and installation of irrigation systems on-site including all its major components such as piping, sprinkler heads (in the case of sprinklers), etc.

SECTION 9

Socio Economic Strategies

CRITERION 23

Safety and Sanitation for Construction Workers

INTENT

The intent of this criterion is to ensure safe, healthy, and hygienic working and living conditions for construction workers involved in the project.

Maximum Points: 1

23.1 APPRAISALS

23.1.1 Ensure compliance with the requirements of NBC 2016 for all of the following:

– Mandatory

Part 1: Provision of necessary safety equipment and safety measures for construction workers.

Part 2: Provision of clean drinking water, hygienic working and living conditions, and sanitation facilities for the workers.

23.1.2 Provide crèche facility for children of construction workers in case their families are allowed to work/live at the construction site/labour colony.

Applicability Check – If there are only male workers employed and residing on site, the project is exempted from providing creche facility.

AND

Adopt one alternative out of the following for the construction workers on-site.

– 1 Point

Alternative 1

Provide a grocery store/canteen within the site premises and/or labour accommodation.

Alternative 2

Organize at least two events during the entire construction phase to create environmental awareness among the construction workers.

23.2 COMPLIANCE

23.2.1 Submit tender document highlighting the measures to be taken by the contractor during the construction phase to demonstrate compliance with Appraisals 23.1.1 and 23.1.3.

23.2.2 Submit drinking water test reports conducted periodically, demonstrating that the water provided to workers meets the relevant Bureau of Indian Standards (BIS) drinking water norms to demonstrate compliance with Appraisal 23.1.1.

23.2.3 Submit narrative and date-stamped photographs of the measures adopted by the project team to demonstrate compliance with Appraisals 23.1.1 and 23.1.3.

Note: *Compliance with Appraisals 23.1.1 and 23.1.2 would be verified during site visit I and II. Please refer to Rating Process, for more details.*

CRITERION 24

Universal Accessibility

INTENT

The intent of this criterion is to encourage the adoption of measures that make the built environment barrier free and accessible to all, including people with disabilities and elderly persons.

Maximum Points: 2

24.1 APPRAISAL

24.1.1 Ensure that the project complies with the provisions of Harmonised Guidelines and Space Standards for Barrier Free Built Environment for Persons with Disability and Elderly Persons, 2016.

– 2 Points

24.2 COMPLIANCE

24.2.1 Submit drawings of sections, details, floor plan and site plan in .dwg format demonstrating that the project incorporates design measures as per Harmonised Guidelines and Space Standards for Barrier Free Built Environment for Persons with Disability and Elderly Persons, 2016.

24.2.2 Submit a narrative along with date-stamped photographs highlighting the measures implemented in the project.

CRITERION 25

Dedicated Facilities for Service Staff

INTENT

The intent of this criterion is to promote a better working environment for service staff by providing dedicated rooms for resting and toilets for them to ensure equity at work.

Maximum Points: 2

25.1 APPRAISALS

25.1.1 Ensure the provision of dedicated room(s) for resting for service staff on-site.

–1 Point

25.1.2 Ensure the provision of toilets on-site for service staff as per fixtures mentioned in NBC 2016, Volume 2, Part 9, Section 2, Clause 4.2 (refer Appendix 3).

–1 Point

25.2 COMPLIANCE

25.2.1 Submit drawings of sections and floor plans with area statement (drawing in .dwg format) highlighting the location of room/s and toilets for service staff to demonstrate compliance with Appraisals 25.1.1 and 25.1.2.

25.2.2 Submit calculations indicating the total number of service staff based on the building occupancy and the total number of water closets (WCs), washbasins, urinals provided for service staff to demonstrate compliance with Appraisal 25.1.2.

25.2.3 Submit a narrative along with date-stamped photographs highlighting the location of room/s and toilets for service staff to demonstrate compliance with Appraisals 25.1.1 and 25.1.2.

CRITERION 26

Positive Social Impact

INTENT

The intent of this criterion is to create a healthy environment by ensuring adoption of measures for clean indoor and outdoor air and raising environmental awareness amongst building occupants and the community.

Maximum Points: 2

26.1 APPRAISALS

ENVIRONMENTAL AWARENESS — POST OCCUPANCY

26.1.1 **On-site:** Ensure that the project adopts one measure on-site to create environmental awareness amongst its occupants and visitors.

–1 Point

26.1.2 Adopt one alternative out of the following for environmental awareness post occupancy:

Alternative 1 (On-site)

Ensure that the project adopts an additional (to 26.1.1.) measure for occupants and visitors to create environmental awareness.

Alternative 2 (Off-site)

Ensure that the project conducts a minimum of 2 programmes in a year to create environmental awareness amongst general masses.

–1 Point

TOBACCO SMOKE CONTROL

26.1.3 Demonstrate that the project team has implemented tobacco smoke control measures in case of air-conditioned and non-air-conditioned buildings as per the alternatives mentioned below:

– Mandatory

Alternative 1

Ensure that tobacco smoking is prohibited within the site premises.

Alternative 2

Ensure that designated smoking zone(s) is provided and the smoke is managed within a controlled environment (in case of air-conditioned buildings). Additionally, smoking must be prohibited in public spaces.

26.2 COMPLIANCE

ENVIRONMENTAL AWARENESS

26.2.1 Submit a narrative along with date-stamped photographs highlighting strategies implemented on-site/off-site to create environmental awareness to demonstrate compliance with Appraisals 26.1.1 and 26.1.2.

26.2.2 Submit a policy document/agreement for off-site environmental awareness programmes conducted by project team highlighting the details of the programmes to demonstrate compliance with Appraisal 26.1.2.

TOBACCO AND SMOKE CONTROL

26.2.3 Submit drawings in .dwg format indicating the locations of permanent no-smoking signage within the site premises to demonstrate compliance with Appraisal 26.1.3.

26.2.4 **Alternative 1:** Submit a policy to prohibit tobacco smoking within the site premises along with date-stamped photographs (of no-smoking signage) to demonstrate compliance with Appraisal 26.1.3.

Alternative 2: Submit a policy to restrict tobacco smoking to the designated zone(s) within the site premises along with date-stamped photographs of permanent no-smoking signage in public spaces to demonstrate compliance with Appraisal 26.1.3.

26.2.5 **For air-conditioned spaces:** Submit drawings in .dwg format indicating the location of dedicated smoking zone(s) within site premises separated from the non-smoking areas by full height impermeable internal partitions to demonstrate compliance with Appraisal 26.1.3.

For non-air-conditioned spaces: Submit drawings in .dwg format indicating the location of designated smoking zone(s) marking air inlets and outlets for ventilation to demonstrate compliance with Appraisal 26.1.3.

26.2.6 **For air-conditioned spaces:** Submit a signed template by heating, ventilation, and air conditioning (HVAC)/architectural consultant certifying that the following conditions are met:

- Designated smoking areas are independent of non-smoking areas within the building.
- Smoking zone is directly exhausted outside such that there is no recirculation of the tobacco smoke- containing air in the non-smoking zone of the building.

- Smoking zone is operated on a separate ventilation system, with higher ventilation rates than the non-smoking areas and is designed for at least 600CFM (cubic feet per minute).
- Smoking zone operates at a negative pressure compared to the surrounding non-smoking zone.

SECTION 10

Performance Metering and Monitoring

CRITERION 27

Project Commissioning

INTENT

The intent of this criterion is to ensure that all electro-mechanical systems and their components are designed and installed according to the operational requirements of the owner.

Maximum Points: 4

27.1 APPRAISALS

27.1.1 Ensure that a commissioning plan is developed and implemented for the systems as given in Table 27.1c. Additionally, maintain a record of finding logs and their rectification during the entire period of construction, installation, and functional testing of systems.

– 4 points

TABLE 27.1c: *Systems to be commissioned*

System Type	Description	Points
HVAC*	Low side: Air handling unit, fan coil units, cassette units, floor-mounted units High side: Chillers, cooling towers, primary and secondary pumps Boilers: Service hot water, electric/gas/oil-based boilers	2
Lighting and electrical	All circuits, sensors (occupancy, day-lighting, etc.) Transformers Diesel generator set Low-tension panel Renewable energy system	
Water	Water pumps and motors Treatment plant (sewage treatment plant/water treatment plant/ effluent treatment plant) Irrigation systems Rainwater harvesting systems	2
Waste	Organic waste composter Vermi-composters Garbage chute Other mechanical waste disposal/treatment systems	

**These include all types of HVAC systems not limiting to ones listed in this table. Therefore, all HVAC systems installed in the project will need to be commissioned.*

27.2 COMPLIANCE

27.2.1 Submit a document comprising an introduction to purpose and a general summary of the commissioning plan.

27.2.2 Submit a document comprising general information with an overview of the project emphasizing key delivery method characteristics, such as owner's project requirement (OPR) and basis of design.

27.2.3 Submit a commissioning plan consisting of the following:

- Commissioning scope including systems, subsystems, and equipment as per Table 27.1c
- A list of project-specific commissioning team members along with a hierarchy chart Communication plans, protocols, and documentation of the communication channels to be used throughout the project
- A detailed commissioning process describing project-specific tasks to be accomplished during the planning, design, construction, and tenant-occupancy stage with associated roles and responsibilities

27.2.4 Submit a project-specific commissioning schedule comprising specific sequences of events and their relative time frames, dates, and durations.

27.2.5 Submit a final commissioning report highlighting expectations, finding logs, rectification decisions and performance of systems and equipment. It is recommended to maintain an issue and- benefits log throughout the commissioning process.

CRITERION 28

Smart Metering and Monitoring

INTENT

The intent of this criterion is to promote smart metering and monitoring of energy and water consumption of the project to analyse its performance.

Maximum Points: 6

28.1 APPRAISALS

28.1.1 Demonstrate compliance with the source metering requirements as mentioned in Table 28.1c.

– Mandatory

TABLE 28.1c: *Source metering requirements*

Source	Description
Energy	Ensure regular monitoring of the project's energy consumption by installing digital meters at the following point sources at the project level for: • Utility grid • On-site renewable energy system • Diesel generator set, gas genset, etc. • Each building level (at each apartment level for residential and at each tenant level for retail and office buildings)
Water	Ensure regular monitoring of the project's water consumption by installing digital meters at the following point sources: • Municipal supply • Borewell • Treated water outlet from sewage treatment plant (grey/black) • Captured rainwater for reuse in project

28.1.2 Demonstrate compliance with the extended metering requirements as mentioned in Table 28.2c.

– 2 points

28.1.3 Ensure installation of smart metering systems which are capable of tracking energy and water consumption through a web-hosted portal for all meters, as mentioned in Appraisal 28.1.1.

– 2 points

All smart metering and monitoring systems should be capable of the following:

- Hourly data reporting in near real time (no more than 15-minute delay)
- Energy mix breakdown and consumption patterns

- Water consumption patterns from various sources
- Ability to set energy and water consumption targets, alarms, and pricing
- Ability to compare historical trends and benchmark data
- Real-time monitoring with user interface that operates even on mobile devices

TABLE 28.2c: *Extended metering requirements*

Source	Description	Points

Energy	Digital energy meters to be installed at the following points to monitor energy consumption:
	• Office/institutional/retail/transit terminals/ healthcare/ hospitality:
	  ○ Heating, ventilation and air conditioning central plant: Air handling unit, cooling tower, chillers [British thermal unit meters/multi-function metering, and/or distributed units (split/ window ACs)]
	  ○ Lighting (indoor and outdoor)
	  ○ Basement parking lighting
	• Residential
	  ○ For basement parking lighting, community/recreation centre, water pumping, outdoor lighting
	  ○ Lifts and common areas
		1

Water	Digital water meters to be installed at the following points to monitor water consumption: • Flushing (at each building level) • Domestic (at each building level) • Irrigation • Heating, ventilation and air conditioning	1

28.1.4 Ensure sharing of monthly energy and water consumption data of the project by connecting with the GRIHA Online Benchmarking platform* for 5 years.

– 2 Points

* Relaxation in recertification can be proposed in case a project connects with GRIHA's IT platform and shares energy and water consumption data for five years.

28.2 COMPLIANCE

28.2.1 Submit single-line diagram (in.dwg format) for energy meters and wet riser diagrams (in.dwg format) for water meters with corresponding legends to demonstrate compliance with Appraisals 28.1.1 and 28.1.2.

28.2.2 Submit purchase orders reflecting full quantities of the various meters installed in the project to demonstrate compliance with 28.1.1, 28.1.2, and 28.1.3.

28.2.3 Submit technical specification sheets indicating system capabilities and accuracy of smart meters to demonstrate compliance with Appraisal 28.1.3.

OR

Submit a valid GRIHA Product Catalogue certificate as applicable for the product to demonstrate compliance with Appraisal 28.1.3.

28.2.4 Share energy and water consumption data monthly for meters mentioned in Appraisal 28.1.1 using the GRIHA Online Benchmarking platform via an Application Programming Interface (API).

28.2.5 Submit a declaration stating that the API will be shared for a duration of five years.**To demonstrate compliance with Appraisal 28.1.4.

28.2.6 Submit the following to demonstrate compliance with Appraisal 28.1.4.

- API indicating sensor/meter listing
- API with monthly log as per Table 28.1c

** In case of system breakdown/changes, due to which loss in connectivity or change in energy consumption patterns can occur, the project team must immediately inform the GRIHA Council.

CRITERION 29

Operation and Maintenance Protocol

INTENT

The intent of this criterion is to ensure the incorporation of detailed O&M procedures for various systems in the building. It is compulsory for the staff to undergo the necessary training.

Maximum Points: 0

29.1 APPRAISALS

29.1.1 Ensure that a core facility/service group is formed, which will be responsible for the O&M of the building systems and equipment post installation.

– Mandatory

29.1.2 Ensure the inclusion of a specific clause in the contract document of the system's supplier for providing training to the core facility/service group responsible for the O&M of the building systems.

– Mandatory

29.1.3 Ensure the development of O&M protocol in the form of a manual/compact discs (CDs)/ multimedia/information brochure enlisting the best practices for O&M of the building systems.

– Mandatory

29.2 COMPLIANCE

29.2.1 Submit documents to validate the provision for a core facility/service group responsible for the O&M of the building systems and equipment post installation to demonstrate compliance with Appraisal 29.1.1.

29.2.2 Submit a contract document (mutually signed between respective parties) confirming that training will be provided to the core facility/service group for proper O&M of systems and equipment installed in the project to demonstrate compliance with Appraisal 29.1.2.

- O&M protocol should contain the following:
- Inspection plan for respective systems
- Preventive maintenance plan
- Sample records (in the form of checklist) to track the periodic inspection and maintenance

29.2.3 Submit guidelines for O&M of the systems installed in the project in the form of manuals /CDs/multimedia/information brochures for the following as per Appraisal 29.1.3:

- HVAC system:*25* Air handling unit (AHU), cooling tower, chillers and pumps, variable refrigerant flow, etc.

- Electrical equipment: Transformers, diesel generator, high tension and low-tension panels, etc.
- Renewable energy systems: Solar photovoltaic panels, windmill, bio-gasifiers, etc.
- Water management systems: sewage, water, and effluent treatment plants, rainwater harvesting pits, irrigation systems, etc.
- Waste management systems: Organic waste converter, garbage chutes, vermicomposting, etc.

SECTION 11

Innovation

CRITERION 30

Innovation

INTENT

The intent of this criterion is to promote adoption and implementation of innovative strategies to enhance the sustainability quotient of the project.

Maximum Points: 5

30.1 APPRAISALS

30.1.1 Adopt any 5 innovative strategies independent of all 29 criteria to make the project more sustainable. The following are the examples of categories that can be considered.

- 5 points (1 point for each strategy)

- Heritage conservation/Cultural enrichment
- Provision of gender-neutral toilets
- Safety and security (Save Our Souls—SOS buttons)
- Real-time air quality monitoring during the construction phase
- Initiatives taken to form resilient and sustainable communities
- Zero concrete wastage sites
- Use minimum 5 products having Environmental Product Declaration (EPD) (as per ISO 14025) in the pro
- Dynamic performance/net positive energy or water.
- GRIHA-Certified Professional (CP)/GRIHA evaluator involved in the project from commencement to the completion.
- Ensure that all the insulation (used in the building envelope and for HVAC systems) and refrigerant in HVAC systems are HFC free.
- Liveability Index: Ensure that the per capita availability of green spaces for the project site is more than GRIHA benchmark of minimum 9 m^2 of green space per capita.
- Ensure that all washing equipments (clothes and dishes) are in compliance with GRIHA Benchmark for water factor limit.
- Any other innovative strategy enhancing the overall sustainability of the project.

30.2 COMPLIANCE

30.2.1 Submit detailed narrative and date-stamped contextual photographs clearly depicting the strategies implemented.

HERITAGE CONSERVATION/CULTURAL ENRICHMENT

30.2.2 Submit a survey plan highlighting the existing heritage structure within the GRIHA-registered boundary.

30.2.3 Submit Google Earth images showing the existing heritage structure within the GRIHA-registered boundary.

PROVISION OF GENDER-NEUTRAL TOILETS

30.2.4 Submit plans highlighting gender-neutral toilets provided on-site.

SAFETY AND SECURITY (SOS BUTTONS)

30.2.5 Submit a purchase order of SOS buttons provided on-site.

REAL-TIME AIR QUALITY MONITORING DURING CONSTRUCTION PHASE

30.2.6 Submit a purchase order of air quality monitors/sensors.

30.2.7 Submit date-stamped contextual photographs of air quality monitors/sensors.

30.2.8 Log sheet/digital entries of the data collected from the monitors.

RESILIENT AND SUSTAINABLE COMMUNITIES

30.2.9 Submit a narrative from the client stating that the project will provide a relief shelter in case of any disaster/calamity.

30.2.10 Submit a site plan highlighting the location of a relief shelter that will be provided on-site.

ZERO CONCRETE WASTAGE SITES

30.2.11 Submit quantum calculations for concrete waste generated and re-used on-site.

USE PRODUCTS HAVING EPD (AS PER ISO 14025)

30.2.12 Submit product EPD certificates highlighting conformity with IS 14025 guidelines along with purchase orders.

DYNAMIC PERFORMANCE

30.2.13 Submit drawings and narrative of proposed smart grid system and relevant Demand Side Management systems, highlighting the following:

- Electrical drawing highlighting integration of renewable energy sources
- Details of dynamic balancing of energy supply and various energy loads
- Real-time remote monitoring and control of the smart mini grid
- Demand side management and automatic controls for common loads such as street lighting, water pumping, etc.
- Supporting purchase orders/bill of quantities (BOQ)/tender documents along with installation photographs

NET POSITIVE ENERGY

30.2.14 Submit detailed calculations demonstrating the energy consumption of the project.

30.2.15 Submit calculations/simulation results highlighting the capacity of renewable energy system installed on-site.

30.2.16 Submit a purchase order of the renewable energy system installed on-site.

NET POSITIVE WATER

30.2.17 Submit a water balance diagram for the project indicating the source and quantity of potable water drawn, quantities required of various other uses on-site, quantity of wastewater generated on-site and treated, and rainwater harvested.

30.2.18 Submit the calculations to demonstrate net positive water consumption in the project.

30.2.19 Submit drawings of wastewater treatment plants and rainwater harvesting systems.

INTEGRATED DESIGN APPROACH

30.2.20 Submit a GRIHA Evaluator/CP certificate

HFC FREE

30.2.21 Submit a narrative with date-stamped photographs highlighting the insulation and refrigerants used in different applications in the building to demonstrate compliance.

30.2.22 Submit technical specification sheets/brochures of the insulation, refrigeration equipment, and fire-fighting systems to demonstrate compliance.

OR

Submit a valid GRIHA Product Catalogue certificate as applicable for the products to demonstrate compliance.

30.2.23 Submit purchase orders reflecting the full quantities of insulation, HVAC systems, refrigeration equipment, and fire-fighting systems used in the project highlighting their respective types to demonstrate compliance.

LIVEABILITY INDEX

30.2.24 Submit a site plan in .dwg format along with date-stamped photographs indicating external development including green spaces to demonstrate compliance.

30.2.25 Submit calculations indicating the provision of green space to be more than the GRIHA benchmark to demonstrate compliance.

WASHING EQUIPMENTS

30.2.26 Ensure that all washing equipment (clothes and dishes) are in compliance with GRIHA benchmark for water factor limit.

TABLE 13.5c: *GRIHA benchmark for water factor limit for washing equipment's (clothes and dishes)*

Equipment	Water Factor Limit
Dishwasher	< 24.6L/cycle
Clothes Washer	< 35.96L/cycle/cu.ft.

APPENDIX

APPENDIX 1A: BASIC AMENITIES/SERVICES

TABLE 1.1A: *Suggestive list of basic amenities/services*

Categories of Amenities/Services	Sub-Categories of Amenities/Services
Healthcare facility	Pharmacy, dispensary, general hospital, other healthcare facility, old age home, orphanage/children's centre, crèche, day-care centre, etc.
Education	Pre-primary school, primary school, secondary school, higher secondary school, college, school for the differently abled, vocational training centre, university, technical education centre, polytechnic college, etc.
Socio-cultural	Anganwadi, community centre, exhibition-cum-fair ground, auditorium, music, dance & drama centre/meditation & spiritual centre, movie theatre, old-age home, orphanage/children's centre, crèche, day-care centre, etc.
Distribution	Liquefied petroleum gas warehouse including booking office, permanent milk and fruit and vegetable booth, general/grocery stores, fuel filling and service station, food courts, restaurants, pharmacy, etc.
Sports and recreation	Community recreational club, parks/playgrounds, sports/fitness centre, etc.
Public transit	Bus stands, metro station, other public transit stations
Banking facilities	ATMs, banks, etc.
Religious facilities	Church, mosque, temple, sanctorum, etc.
Public service offices	Post office, telephone exchange, fire station, disaster management station, public library, social welfare centre, public grievance centre, etc.

TABLE 1.2A *List of amenities and their applicability for different building typologies*

Amenities	Building Typology						
	Health-care facility	Hospitality	Institutional	Office	Residential	Retail	Transit Terminal
Healthcare Facility		✓	✓	✓	✓	✓	✓
Education				✓	✓		
Socio-cultral			✓		✓		
Distribution	✓		✓	✓	✓		✓
Sport and recreation	✓		✓	✓	✓	✓	
Public transit	✓	✓	✓	✓	✓	✓	✓
Banking facilities	✓	✓	✓	✓	✓	✓	✓
Religious facilities	✓		✓	✓	✓		
Public service offices	✓	✓	✓	✓	✓	✓	✓

APPENDIX 1B: FOR VENTILATION STUDIES

COMPUTATIONAL FLUID DYNAMICS BOUNDARY CONDITIONS

- The Computational fluid dynamics (CFD) modelling shall be carried out using well-validated software.
- The CFD solver shall have the minimum capability of solving the Navier–Stokes fluid flow equations for a three-dimensional incompressible flow at a steady state. Turbulence modelling shall also be included with the minimum requirement of using the standard k-ε turbulence model, coupled with the standard wall function.
- All simulation models shall be carried out under isothermal conditions of 30°C air temperatures at a steady-state condition.
- The computational domain shall include the development of interest and the far field boundary, which should be located far enough from the building model to avoid artificial acceleration of the flow. As a general guideline, the direction blockage ratio6 (BRL [blockage ratio (length)] and BRH [blockage ratio (height)) along lateral and vertical directions should be less than 17%.
- The surrounding buildings residing within 500m distance from the edge of the development of interest should be modelled explicitly.
- Describe the simulation model assumption, limitations, and geometrical simplifications.
- Use zero velocity gradients and a zero normal gradient, that is, 'symmetry' condition for all variables at the top and lateral surfaces when the top and lateral boundaries of the domain are far away from the buildings.
- Use zero static pressure as the boundary condition at the outlet surface of computational domain.
- Apply second-order discretization schemes.
- In terms of the computational cell quality, the skewness of the cell is advised no greater than 0.9.

TABLE 1.1B: *Analysis grid size*

Location	Grid Size (m)
Within the functional spaces of interest	0.1–0.5
Building of interest	0.5–1.0
Surrounding buildings	1.0–5.0
From ground surface to 10m height in vertical direction	0.5–1.0
From 10m height to Hmax height in vertical direction (Hmax is the height of the tallest building among the group of buildings modelled explicitly)	1.0–5.0

- Residuals with at least four orders of magnitudes shall be achieved. Additionally, monitoring points should be defined in the region of interest and the velocities at those points should be recorded to ensure that the flow has reached steady values when simulation is converged properly.
- The naturally ventilated occupied spaces at the lowest level shall be selected for simulation. All naturally ventilated functional spaces at the selected floor are to be included in the simulation model except for enclosed spaces such as storerooms.

SUBMITTALS

Project description: Provide the project details (especially information on naturally ventilated design, building massing/orientation, gross floor area of naturally ventilated spaces, percentage of openings and windows, credible source of site information with surrounding buildings, vegetation and terrain, future development, etc.).

Building type: Describe the building functionality, targeted naturally ventilated spaces, occupants, and transit areas.

Problem statement: Describe naturally ventilated challenges, proposed solution, desired outcome, and work scopes from the simulation model.

Site information: Describe the site information (including surrounding buildings, terrains, and greenery) and illustrate how the geometrical information is incorporated into the simulation model.

Window modelling: To use the actual window opening size, attach the window schedule and drawing for verification.

OUTPUT

- Simulation results for the project for each wind direction considered.
- Static pressure (plan view ground and mid-level and at the level of simulated natural ventilation [NV] space, isometric views of building).
- Velocity vector and contour showing the plan view at ground and mid-level and at the level of simulated NV space, and a few isometric sectionals cut plans to show airflow patterns across the development.

Note: From the simulation results, the area-weighted average wind velocity of each simulated space shall be determined by considering the airflow conditions of the applicable areas. The area-weighted average wind velocities of these areas are to be computed at a horizontal plane of 1.2 m above the floor level.

The wind speed as per NBC 2016, Volume 2, Part 8, Section 1, Clause 5.2.3.1.2, Table 9 should be met for the average peak day temperature and relative humidity for 70% of the NV spaces.

APPENDIX 2A: DG SETS EMISSION LIMITS AS PRESCRIBED BY CPCB, 2016

Category	Emission Limits (g/kWh)			Smoke Limit (Light Absorption Coefficient, m^{-1})
	NO + HC	CO	PM	
Up to 19kW	≤7.5	≤3.5	≤0.3	≤0.7
More than 19kW and up to 75kW	≤4.7	≤3.5	≤0.3	≤0.7
More than 75kW and up to 800kW ≤4.0		≤3.5	≤0.2	≤0.7

APPENDIX 2B: PARAMETERS OF FERTILE TOPSOIL

Nutrients	Rating*			Recommended Test**
	Low	Medium	High	
pH	<6.5	6.5–8.2	>8.2	
Organic carbon	<0.5	0.5–0.75	>0.75	Colorimetric method
Available nitrogen alkaline KMnO4-N (kg/ha)	<280	281–560	>560	Kjeldahl apparatus
Available phosphorus (Olsen's P) (kg/ha)	<10	11–25	>25	Olsen method
Available potassium ammonium acetate-K (kg/ha)	<120	121–280	>280	Ammonium acetate extraction method

* Subject to minor variation as per local conditions.

**Tests to be performed at ICAR-accredited laboratory.

APPENDIX 2C: TEMPLATE FOR TOTAL AMOUNT OF WASTE GENERATED ON-SITE

S. No.	Type of Waste Generated	Quantity of Waste Generated	Date of Waste Sold	Recycle/Reuse / Landfill
1	Steel			
2	Stone			
3	Wood			
4	C&D waste			
5	Packaging waste			
6	Empty cement bags			
7	Drums			
8	Paint buckets			
9	Pipes			
10	Others			

APPENDIX 2D: TEMPLATE FOR SOURCE OF WATER USED IN CONSTRUCTION ACTIVITY

SOURCES OF WATER

S. No.	Source	Documents Submitted
1	Tanker (Fill in Logbook 1)	
2	Borewell (Fill in Logbook 2)	
3	If any other, please specify	

Appendix 3: Facilities required for Service Staff

Building Typology	Fixtures				
	WCs for Male	WCs for Female	Washbasins for Male	Washbasins for female	Urinals
Healthcare facility	1 for 15	1 for 12	1 per 15	1 per 12	Nil up to 6
	2 for 16-35	2 for 13-25	2 for 16-35	2 for 13-25	1 for 7-20
					2 for 21-45
					Add 3% over 45
Hospitality facility	1 for 15	1 for 12	1 per 15	1 per 12	Nil up to 6
	2 for 16-35	2 for 13-25	2 for 16-35	2 for 13-25	1 for 7-20
	3 for 36-65	3 for 26-40	3 for 46-70	3 for 26-40	2 for 21-45
	4 for 66-100	4 for 41-57	4 for 71-100	4 for 41-57	3 for 46 -70
		5 for 58-77			4 for 71-100
		6 for 78-100			Add 3% over 101 – 200
					Add 2.5% over 200
Institutional Buildings	1 for 15	1 for 12	1 per 15	1 per 12	Nil up to 6
	2 for 16-35	2 for 13-25	2 for 16-35	2 for 13-25	1 for 7-20
					2 for 21-45
					Add 3% over 45
Office building	1 per 25	1 per 15	1 per 25	1 per 25	Nil up to 6
					1 for 7-20
					2 for 21-45
					3 for 46-70
					4 for 71-100
					Add 3% over 101-200
					Add 2.5% over 200
Residential building	1 per 25	1 per 15	1 per 25	1 per 25	Nil up to 6
					1 for 7-20
					2 for 21-45
					3 for 46-70
					4 for 71-100

					Add 3% over 101-200
					Add 2.5% over 200
Retail buildings	1 per 15	1 per 12	1 per 15	1 per 12	Nil up to 6
	2 for 16-35	2 for 13-25	2 for 16-35	2 for 13-25	1 for 7 - 20
	3 for 36-65	3 for 26-40	3 for 36-65	3 for 26-40	2 for 21- 45
	4 for 66-100	4 for 41-57	4 for 66-100	4 for 41-57	3 for 46 -70
		5 for 58-77			4 for 71-100
		6 for 78-100			Add 3% over 101 - 200
Transit terminal	1 for 15	1 for 12	1 per 15	1 per 12	Nil up to 6
	2 for 16-35	2 for 13-25	2 for 16-35	2 for 13-25	1 for 7-20
					2 for 21-45
					Add 3% over 45

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