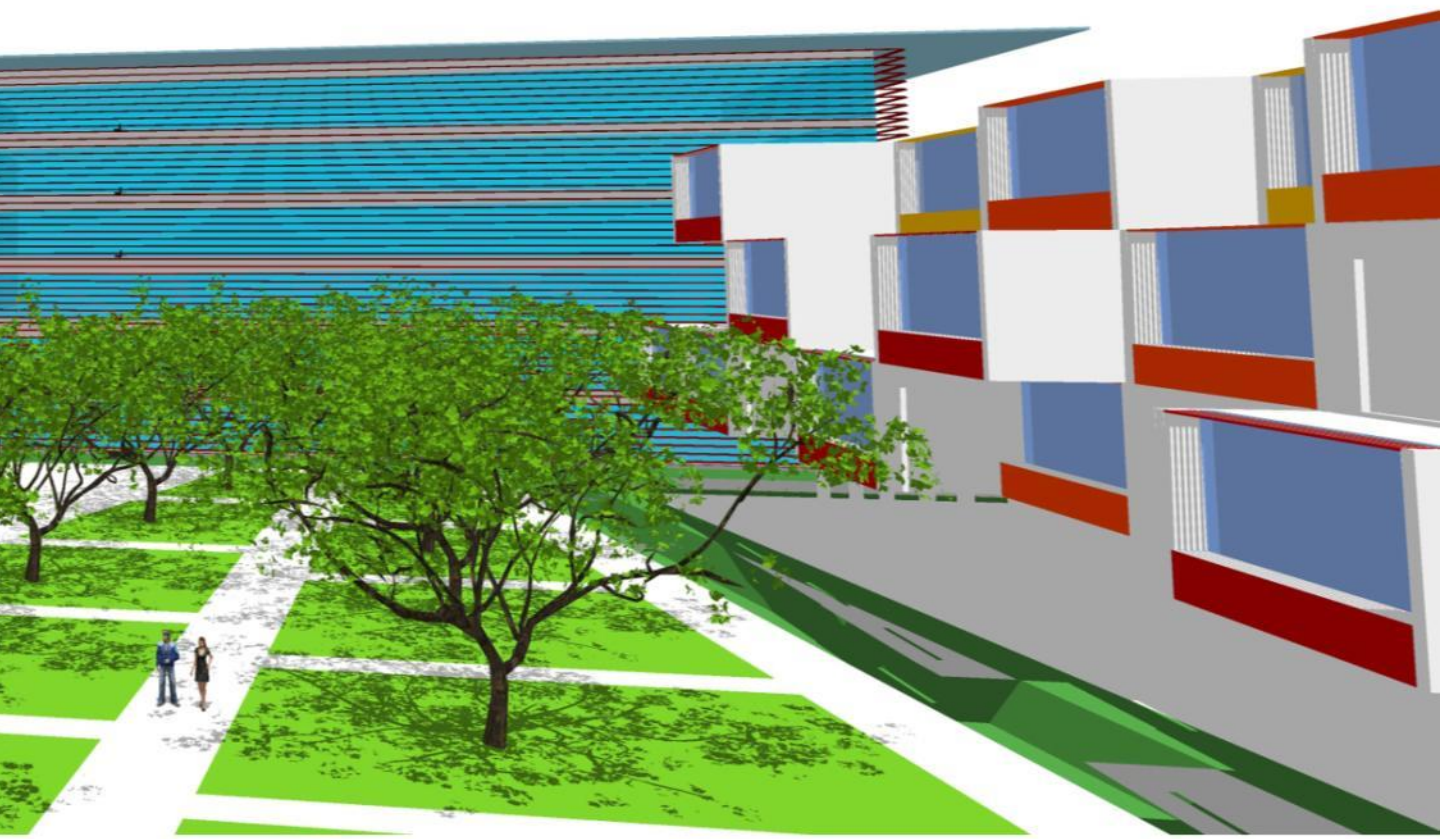
GRIHA

Version 2015



GRIHA Council

GRIHA V – 2015

Abridged Document

May 2016

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Abbreviations

- BIS Bureau of Indian Standards
- CEPT Centre for Environmental Planning and Technology University
- CGWB Central Ground Water Board
- CPCB Central Pollution Control Board
- ECBC Energy Conservation Building Code
- EPD Environmental Product Declarations
- EPI Energy Performance Index
- GRIHA Green Rating for Integrated Habitat Assessment
- NAAQS National Ambient Air Quality Standard
- NBC National Building Code 2005
- TERI The Energy and Resources Institute
- SUDS Sustainable Urban Drainage Systems

Update Notes

Key revisions added in the manual in the May 2016 update:

- DA clauses revised (Criterion 11)
- New Appendix added elaborating DA calculations
- Language correction in Appraisal 9.1.2
- Corrections in Appendix 6

Key Revisions added in March 2016 update:

- New EPI benchmarks of GRIHA released (Criterion 8)
- Peak Building Envelope Heat Gain benchmarks released (Criterion 8)
- Point distribution of two appraisals in Criterion 28 revised
- 6 new Appendices added

Introduction

GRIHA Version – 2015

The GRIHA rating has now entered its 8th year since inception. In this time, it has grown in scale and portfolio. Since 2007, GRIHA rating has managed to implement a vision for green buildings in India through a rating system designed for the Indian construction sector. There are currently over 650* projects registered with GRIHA Council totalling to over 230 million sq.ft. 30 projects have been rated so far. These 30 projects have led to a cumulative annual energy consumption reduction of 74,000 MWh and installation of 14.5 MWp of renewable energy. The potential impact of the current 650 projects is expected to lead to a cumulative annual energy consumption reduction of 16,00,000 MWh/annum and installation of 315 MWp of renewable energy.

Over the past 8 years, there have been major changes in the field of green buildings in India and the local green building industry has evolved significantly. Therefore, GRIHA rating underwent its fourth revision, to better reflect the current market scenario and create new benchmarks to push the market further. The discussions with various stakeholders, experience from ongoing GRIHA projects as well as market feedback helped the GRIHA Council to develop the next iteration of the GRIHA rating. This new version of GRIHA is called GRIHA V – 2015. This particular document highlights the key updates in the rating as well as describes, in brief, the new rating system. More detailed manuals will be released in the upcoming months.

This new version of GRIHA is a major revision compared to the previous versions. Therefore, the next few pages are dedicated to detailing out the changes made in this version of GRIHA as compared to GRIHA V.3 which was released in 2013. That is subsequently followed by description of the new criteria of the rating.

The registrations for GRIHA V-2015 will start from March 2015. The project teams can continue to register their projects in GRIHA v3 till 30th June 2016. For any queries, please write to info@grihaindia.org.

Modifications

GRIHA Version – 2015: Modifications

The following are the modifications that have been made in the GRIHA V2015 rating:

1. **Change in rating structure:** The overall sequence of criteria, and the appraisals contained within them, has been changed. The new sequence is segregated into specific sections and previous criteria have been modified accordingly. There are now only 31 criteria in the rating. The table below lists the new structure.

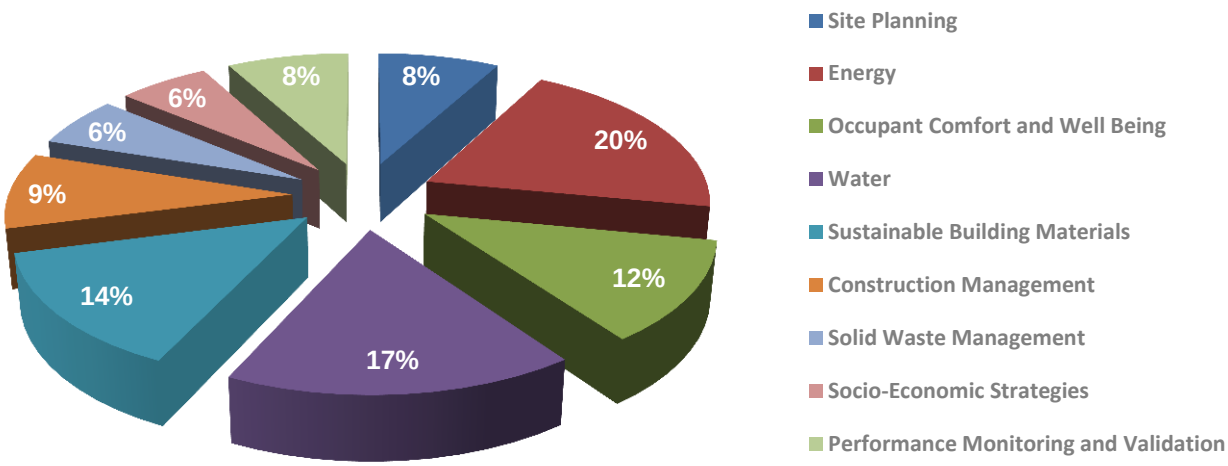
Sections	Criterion No.	Criterion Name	Max. Points
Site Planning	1	Site Selection	1
	2	Low-impact design	4
	3	Design to mitigate UHIE	2
	4	Site Imperviousness Factor	1
Construction Management	5	Air and water pollution control	1
	6	Preserve and protect landscape during construction	4
	7	Construction Management Practices	4
Energy	8	Energy efficiency	13
	9	Renewable energy utilization	7
	10	Zero ODP materials	0
Occupant Comfort and Well Being	11	Achieving indoor comfort requirements (visual/thermal/acoustic)	6
	12	Maintaining good IAQ	4
	13	Use of low-VOC paints and other compounds in building interiors	2
Water	14	Use of low-flow fixtures and systems	4
	15	Reducing landscape water demand	4
	16	Water Quality	2
	17	On-site water reuse	5
	18	Rainwater Recharge	2
Sustainable Building Materials	19	Utilization of BIS recommended waste materials in building structure	6
	20	Reduction in embodied energy of building structure	4
	21	Use of low-environmental impact materials in building interiors	4
Solid Waste Management	22	Avoided post-construction landfill	4
	23	Treat organic waste on site	2
Socio-Economic Strategies	24	Labour safety and sanitation	1
	25	Design for Universal Accessibility	2
	26	Dedicated facilities for service staff	2
	27	Increase in environmental awareness	1
Performance Monitoring and Validation	28	Smart metering and monitoring	8
	29	Operation, Maintenance Protocols	0
	30	Performance Assessment for Final Rating	0
	31	Innovation	4
Total			**100**

GRIHA Version – 2015: Modifications

2. **New rating thresholds:** The scores for achieving rating have also been revised. The new thresholds for achieving GRIHA rating are mentioned below:

New Rating Thresholds	GRIHA Rating
25 – 40	1 star
41 – 55	2 star
56 – 70	3 star
71 – 85	4 star
86 or more	5 star

3. **Revised point weightages:** The points assigned to different criteria have been modified based on survey conducted to better reflect current resource priorities of India. The point split of various sections is given below:



4. **No points for mandatory appraisals:** In this version of GRIHA, no points will be awarded to any mandatory appraisals.

5. **Non-linear point distribution:** The concept of non-linear point distribution has been introduced. For example, observe the point distribution in the criterion on landscape water reduction :

Reduction in water requirement in design case versus base case	GRIHA V 2015	GRIHA V3
30%	1	1
40%	2	2
50%	4	3

GRIHA Version – 2015: Modifications

6. **Restructured criteria:** Several criteria have been made by regrouping appraisals of previous version's criteria without change in technical requirements. The list below highlights the restructured criteria:

- Criterion 4: Site imperviousness factor
- Criterion 5: Air and water pollution control
- Criterion 6: Preserve and protect landscape during construction
- Criterion 7: Construction Management Practices
- Criterion 9: Renewable Energy Utilization
- Criterion 11: Achieving indoor comfort requirements (visual/thermal/acoustic)
- Criterion 16: Water Quality
- Criterion 17: On-site water reuse
- Criterion 18: Rainwater recharge
- Criterion 21: Use of low-environmental impact materials in building interiors
- Criterion 22: Avoided post-construction land-fill

7. **Addition of new criteria:** Several new criteria have been added to the rating system. One such example is the criterion on Smart Metering and Monitoring. These are listed below:

- Criterion 12: Maintaining good indoor air quality
- Criterion 26: Dedicated facilities for service staff
- Criterion 27: Increase in environmental awareness
- Criterion 28: Smart Metering and Monitoring

8. **Technical revisions in existing criteria:** There have been several technical revisions in GRIHA V 2015. The criteria in which new appraisals have been added and those in which existing appraisals have been modified are listed below (the list below does not contain restructured criteria):

- Criterion 1: Site Selection
- Criterion 2: Low-Impact Design
- Criterion 3: Design to Mitigate UHIE
- Criterion 8: Energy efficiency
- Criterion 9: Renewable Energy Utilization
- Criterion 11: Achieving indoor comfort requirements (visual/thermal/acoustic)
- Criterion 20: Reduction in embodied energy of building structure
- Criterion 21: Use of low-environmental impact materials in building interiors
- Criterion 24: Labour safety and sanitation

PLEASE NOTE

In case of a project with multiple buildings, it is mandatory for each building to meet the minimum mandatory requirements of various Criteria of GRIHA.

The overall points may be achieved based on averages as may be defined in different appraisals.

Criteria

Site Planning

Criterion 1: Site Selection

Intent:

Site selection is the first step to a sustainable habitat and needs to be done prudently. The intent of this criterion is to ensure that the site meets the relevant masterplan/local development plans.

Maximum Points: 1

Appraisals:

- **1.1.1: The site plan must be in conformity with the development plan/master plan/UDPFI guidelines (mandatory). 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), water body zones (in such zones, no construction is permitted in the water-spread and buffer belt of 30 meter minimum around the FTL), various hazard prone area regulations, and others if the site falls under any such area - Mandatory**
- 1.1.2: The project site is a brownfield site OR a redevelopment project OR there are at least 5 services (from the list given below) within the campus or within 500m walking distance from main entrance of project **– 1 point**

  Services: Grocery store, pharmacy, Bank/ATM, Park, Restaurant, Community Centre, School, Gym, Metro Station/Public transit stop

Compliances:

- 1.2.1: Submit documentation to demonstrate conformity to local development plant/master-plan.
- 1.2.2: Submit documentation (narrative/site plan/photographs) to demonstrate either:
  - site was a brownfield site OR
  - that the project is a redevelopment project OR
  - at least 5 basic services are located within 500 m walking distance from main entrance of project.

Criterion 2: Low-impact design

Intent:

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

Maximum Points: 4

Appraisals:

- 2.1.1: Demonstrate reduction in environmental impact through design by adoption of various passive design and low-impact site planning strategies.

No. of strategies adopted	Points
2	1
3	2
4	4

Compliances:

- 2.2.1: Submit analysis to demonstrate compliance with the Low-Impact Design strategies mentioned in the Appraisal 2.1.1
- 2.2.2: Submit drawings to highlight the Low-Impact Design strategies integrated into the building design/site planning
- 2.2.3: Upload photographs, with descriptions, of the measures incorporated

Criterion 2: Low-impact design

Strategy	Analysis required
Control annual Heat Gain through favourable orientation and design of facades	Submit analysis demonstrating that the heat gain in design case is lower than GRIHA base case. Formula: insolation x window area of specific orientation In the base case, the total window area to be equally distributed on all orientations.
Internal zoning/layout of the floor plate	Demonstrate that at least 50% of total external wall area on unfavorable orientations like West, are abutting buffer zones/service areas
Facilitating cross ventilation in naturally ventilated/mixed-mode ventilation spaces	Submit CFD analysis to demonstrate cross ventilation in the naturally ventilated/mixed-mode ventilation spaces
Building design has been done in a manner to not obstruct the solar access to the neighbouring buildings, especially if the neighbouring building has solar photovoltaics and solar water heaters installed on the roof	Annual sun path/shading analysis to demonstrate compliance
Massing of the building/campus done in a manner to reduce insolation	Conduct insolation analysis for summer months (typically April to June) and demonstrate reduction against the base case (in which there is no mutual shading/effect of massing)
Use of trees to control heat gain	Demonstrate, through simulations, that insolation has reduced by at least 25% (as compared to base case of no trees) through planting of dense trees next to critical facades during Summer months (1st April to 30th June) – only in case of up to G+3 structures. Assume tree size at maturity (5 years old)
Site planning according to contours	Demonstrate that site planning has been done according to site contours - for contours with slopes equal to or greater than 1:4
Site plan designed to preserve existing vegetation/ existing water bodies /other topographical features like boulders etc.	Demonstrate at least 50% (by area) of such features on site must be preserved
Implementation of Sustainable Urban Drainage Strategies	Submit layout to demonstrate incorporation of appropriate SUDS strategies for managing over 90% of the storm water quantity on site
Any other passive design strategy	

Criterion 3: Design to mitigate UHIE

Intent:

The intent of this criterion is to ensure incorporation of site design strategies which assist in reduction of Urban Heat Island Effect (UHIE).

Maximum Points: 2

Appraisals:

- 3.1.1: More than 25% of the site surfaces visible to sky (including building roofs but not the landscape area*) are either soft paved/covered with high SRI coating (SRI > 0.5)/shaded by trees/shaded by vegetated pergolas/shaded by solar panels or any combination of these strategies – **1 point**
- 3.1.2: More than 50% of the site surfaces visible to sky (including building roofs but not the landscape area*) are either soft paved/covered with high SRI coating (SRI > 0.5)/shaded by trees/shaded by vegetated pergolas/shaded by solar panels or any combination of these strategies – **2 points**

Compliances:

- 3.2.1: Submit calculations to demonstrate compliance with Appraisal 3.1.1/3.1.2.
- 3.2.2: Submit site plan, with area statements, highlighting the site surfaces (as mentioned in Appraisal 3.1.1/3.1.2) which are soft paved/covered with high SRI coating/shaded by trees/vegetated pergolas/solar panels.
- 3.2.3: Submit purchase orders for high SRI paints/tiles (if used in the project)
- 3.2.4: Upload photographs, with description, of the measures implemented

* Landscape area in this criterion refers to green/vegetated area

Criterion 4: Site imperviousness factor

Intent:

High imperviousness on site leads to rapid runoff of rainwater, reduces urban rainwater recharge and contributes to conditions of urban flooding. The intent of this criterion is to ensure implementation of site design measures which assist in reduction of overall site imperviousness factor.

Maximum Points: 1

Appraisals:

- 4.1.1: Net Imperviousness factor of site meets the NBC 2005 norms & the site is designed such that post-construction storm water discharge from the site is zero* – **1 point**

Compliances:

- 4.2.1: Submit calculations and drawing demonstrating compliance with Net Imperviousness Factor of NBC 2005
- 4.2.2: Submit calculations demonstrating that post construction, the site does not discharge any storm water outside the site
- 4.2.3: Upload photographs, with description, of the measures implemented

* Analyze for the peak average daily rainfall of the year

Construction Management

Criterion 5: Air and water pollution control

Intent:

The intent of this criterion is to minimize air and water pollution during construction on site.

Maximum Points: 1

Appraisals:

- **5.1.1: Adopt at least 3 measures (from the list given with first being mandatory) on site to curb air pollution during construction – Mandatory**
    - Provision of 3 meter high barricading around the construction area - Mandatory
    - Wheel washing facility at the vehicular entrance of the site
    - Covering of fine aggregate and excavated earth on site with plastic/geotextile sheets
    - Water sprinkling on fine aggregate (sand) and excavated earth
    - All diesel gensets on site to have proper chimneys with their outlet facing away from the site
- 5.1.2: Develop and implement a spill prevention plan (to control effects of spill from hazardous materials like bitumen, diesel etc.) on site **– 1 point**

Compliances:

- 5.2.1: Submit relevant sections of tender document showing that air pollution prevention measures are required to be implemented by the contractor during construction on site.
- 5.2.2: Submit narrative describing the spill prevention plan, with description of spill control measures, adopted on site
- 5.2.3: Upload photographs, with description, of the measures implemented

Criterion 6: Preserve and protect landscape during construction

Intent:

The intent of this criterion is to ensure preservation of mature trees and fertile top soil on site, thereby minimizing the impact of construction activities on existing landscape.

Maximum Points: 4

Non-applicability :

- If there are no mature trees on site, then project is exempt from 6.1.1 & 6.1.2
- If the top soil is not fertile & can't be made fertile through organic means, then project is exempt from 6.1.3

Appraisals:

- **6.1.1: Ensure that no existing mature tree is cut on site OR transplant mature trees within the site and ensure they survive OR Plant 3 trees for every 1 tree cut of the same native/naturalized species OR any combination of these for all mature trees on site – Mandatory**
- 6.1.2: Increase total number of trees on site by 25% above the pre-construction phase OR Plant 4 trees for every 1 tree cut of the same native/naturalized species **– 2 points**
- 6.1.3: Preserve top soil during construction, maintain its fertility (during construction phase) and use for landscape post-construction **– 2 points**

Compliances:

- 6.2.1: Submit site plan (drawing) of existing landscape plan highlighting (in different colour coding/layer) the following:
    - Existing trees which have been protected and preserved, along with table listing their species
    - Existing trees which have been transplanted
    - Existing trees which have been removed
    - Area from where top soil has been removed
    - Location on site (or off-site) where top soil will be preserved

Criterion 6: Preserve and protect landscape during construction

Compliances (contd.):

- 6.2.2: Submit CAD drawing of proposed landscape plan highlighting (in different colour coding/layer) the following:
    - Replantation of new trees in the ratio of 1:3 for each tree which has been cut, with the details about the species that have been planted
    - Replantation of tree done in excess of 25% than the minimum requirement, with the details of the species that existed
    - Landscape area where top soil has been reapplied
- 6.2.3: Submit soil fertility test reports of site's top soil from an ICAR (Indian Council of Agricultural Research)-accredited laboratory
- 6.2.4: Upload photographs, with description, of the measures implemented

Criterion 7: Construction Management Practices

Intent:

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

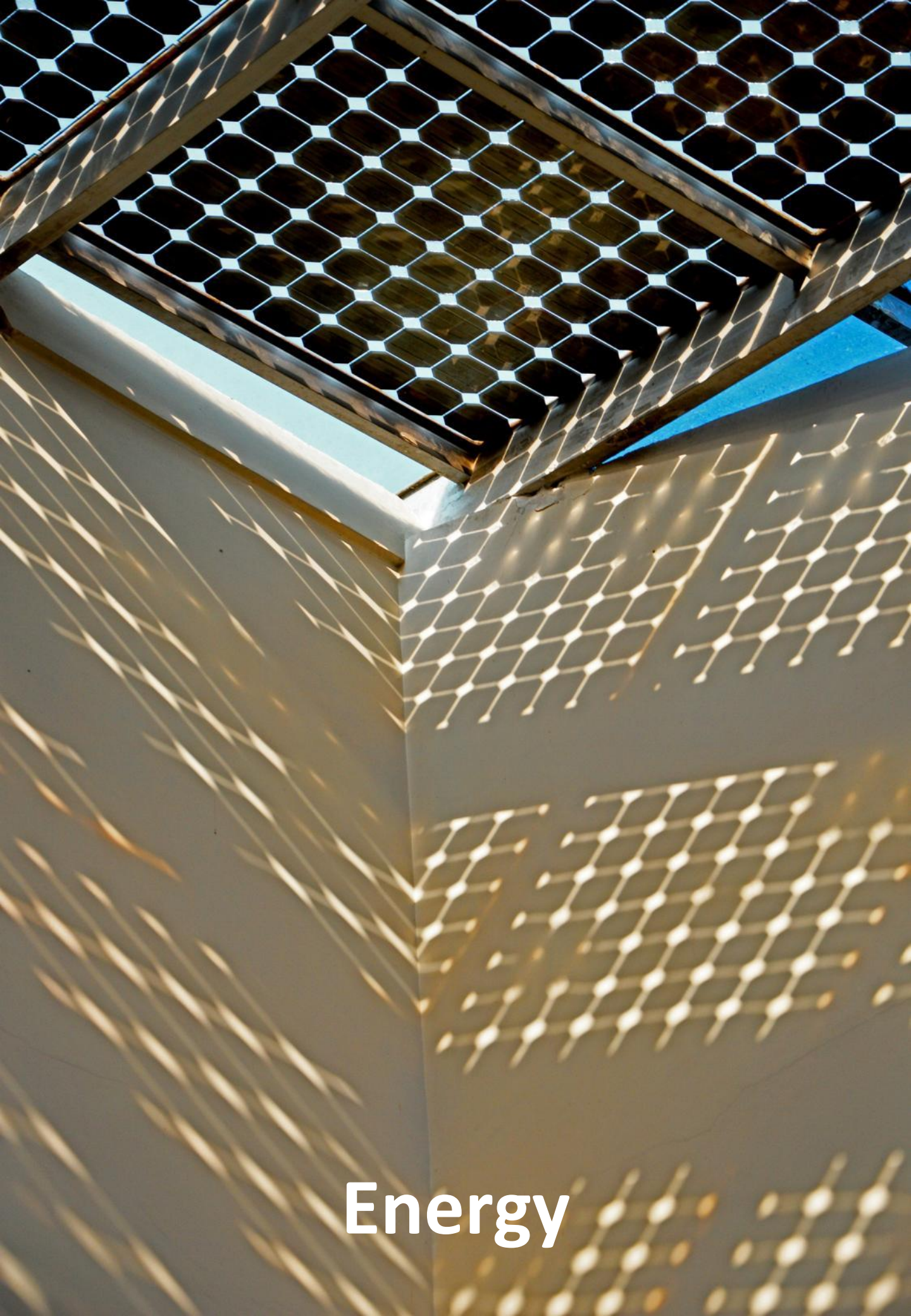
Maximum Points: 4

Appraisals:

- 7.1.1: Adopt staging during construction on site – **1 point**
- 7.1.2: Adopt strategies to prevent/reduce movement of soil (not top soil) outside the site through adoption of various strategies (like soil erosion channels, sedimentation control etc.) **– 1 point**
- 7.1.3: Adopt strategies (at least 3 from the list below) to manage water during construction – **1 point**
    - Using gunny bags for curing and using ponding for curing
    - Monitoring to avoid leaks and water wastage
    - Use of additives to reduce water requirements during curing
    - Use of treated waste water/captured storm water
- 7.1.4: A construction waste management plan for segregation of construction waste, its safe storage and on-site/off-site recycling is developed and implemented in the project **– 1 point**

Compliances:

- 7.2.1: Submit narrative detailing the following practices on site:
    - staging practices adopted during construction
    - strategies implemented to reduce soil erosion from site
    - strategies adopted to reduce potable water during construction
- 7.2.2: Submit a site plan (drawing) highlighting the following:
    - Site boundary, proposed building footprint and staging boundary on site
    - Location of measures to block soil erosion from site
    - Construction waste storage locations (primary and secondary)
- 7.2.3: Submit narrative highlighting the quantum of waste generated during construction, storage facilities for inert and hazardous wastes and measures employed for its safe disposal/recycling
- 7.2.4: Upload photographs, with description, of the measures implemented



Energy

Criterion 8: Energy efficiency

Intent:

The intent of this criterion is to ensure the energy efficiency of the project.

Maximum Points: 13

Non-applicability: Appraisal 8.1.2 is applicable only for AC buildings (non-residential)

Appraisals:

- **8.1.1: Ensure that the project meets the mandatory requirements of ECBC* & all fans must be BEE star rated - Mandatory**
- 8.1.2: Peak heat gain through building envelope (for each AC building individually) should meet the GRIHA Building Envelope Peak Heat Gain Factor thresholds – **2 points**

GRIHA Thresholds for Building Envelope Peak Heat Gain Factor (W/sqm)	
Climate	Threshold
Composite/Hot & Dry	40
Warm and Humid	35
Moderate	30

- 8.1.3: Demonstrate that 100% of outdoor lighting fixtures (lamps + lamp housing) meet the luminous efficacy requirements of GRIHA – **1 point**
    - All lamps + lamp housing must demonstrate luminous efficacy of at least 75 lumens/watt.
- **8.1.4: Demonstrate (through simulations) that project EPI is below GRIHA benchmark# - Mandatory**
- 8.1.5: Additional reduction in EPI will be awarded points as mentioned below:

Reduction from EPI benchmark	Points
10%	2
20%	3
30%	5
40%	7
50%	10

**For ECBC Mandatory requirements for different building typologies, please refer to Appendix 2*

***For Peak heat gain through building envelope calculation methodology, please refer to Appendix 3*

 # Please refer to Appendix 4 for Residential buildings' assumption for EPI analysis using ResBuild toolkit & Appendix 5 for EPI modifications for different occupancy schedules in Commercial buildings

Criterion 8: Energy efficiency

Energy Performance Index Benchmarks (EPI) – (kWh/ m^2/year)		
Climate Classification	Day time occupancy	24 hours Occupancy
	5 Days a week	7 Days a week
Commercial/Institutional/Academic/Hospital buildings		
Moderate	75	225
Composite / Warm and humid / hot and dry	90	300
Residential buildings/Hostels		
Moderate	50	
Composite / Warm and humid / hot and dry	70	

Compliances:

- 8.2.1: Submit documentation (narrative, specification sheets, purchase orders – reflecting full quantities) demonstrating compliance with all mandatory requirements of ECBC
- 8.2.2: Submit specification sheets and purchase orders to demonstrate that all fans being installed in the project at BEE star rated
- 8.2.3: Submit analysis demonstrating that the project complies with the GRIHA Building Envelope Peak Heat Gain Factor thresholds
- 8.2.4: Provide documentation (specification sheets & purchase orders) to demonstrate that all outdoor lamps meet the luminous efficacy levels of 75 lumens/watts
- 8.2.5: Submit narrative and drawings highlighting the various Energy Conservation Measures incorporated in the project
- 8.2.6: Provide simulation reports (along with I/O file) to demonstrate annual energy consumption and reduction vis-a-vis the GRIHA Benchmarks
- 8.2.7: Upload photographs, with description, of the measures implemented

Criterion 9: Renewable energy utilization

Intent:

The intent of this criterion is to ensure incorporation of renewable energy sources in the project.

Maximum Points: 7

Appraisals:

- 9.1.1: On-site/Off-site renewable energy system installation to offset a part of the annual energy consumption of internal artificial lighting and HVAC systems as mentioned in the table below:

Daytime Commercial/ Institutional Buildings	Residential Buildings	24 X 7 occupied buildings	Points
2.5% (only On-site)	**-**	**0.5% (only On-site)**	**Mandatory**
5%	5%	1%	1
10%	10%	3%	2
15%	15%	5%	4
20%	20%	7%	5
25%	25%	10%	7

OR

- 9.1.2: Off-site renewable energy system to offset 100% building energy demand *(this appraisal is available for only non-residential buildings)* – Mandatory +**7 points**

Compliances:

- 9.2.1: Submit calculations/simulations for renewable energy system sizing & on-site annual energy generation potential
- 9.2.2: Submit specification sheets and purchase orders (reflecting full quantities) of the renewable energy system, highlighting the panel performance (as tested under standard test conditions)
- 9.2.3: Submit drawings in CAD format to show location of renewable energy systems
- 9.2.4: Submit documents supporting off-site generation of energy through renewable energy systems. These may be either: Renewable Energy Certificates (RECs) for at least 2 years along with a declaration that the RECs are not being used for any other obligatory requirements and will be purchased every year OR Power Purchase Agreement from the utility for purchase of green power. In the agreement, the address of the particular site must be mentioned
- 9.2.5: Upload photographs, with description, of the measures implemented

Criterion 10: Low ODP materials

Intent:

The intent of this criterion is to ensure use of materials in building insulation, HVAC & refrigeration equipment and fire fighting systems with low ozone depleting potential.

Maximum Points: No Points

Appraisals:

- **10.1.1 All the insulation used in building should be CFCs and HCFCs free – Mandatory**
- **10.1.2 All the refrigerant in the HVAC and refrigeration equipment should be CFCs free – Mandatory**
- **10.1.3 The fire suppression systems and fire extinguishers installed in the building are free of halon – Mandatory**

Compliances:

- 10.2.1: Submit specification sheets & purchase orders (reflecting full quantities) highlighting that the insulation, HVAC system, refrigeration equipment and fire fighting systems comply with Appraisal 10.1.1 – 10.1.3

Occupant comfort and Well-being

Criterion 11: Achieving indoor comfort requirements (visual/thermal/acoustic)

Intent:

The intent of this criterion is to ensure that the building spaces are designed to deliver visual, thermal and acoustical comfort to building occupants.

Maximum Points: 6

Appraisals:

- **11.1.1: Demonstrate compliance with either of the alternatives mentioned – Partly Mandatory**

<table>
<tr><th>Alternative 1</th><th>Alternative 2</th></tr>
<tr><td>The WWR and SRR to not exceed 60% & 5% respectively &;
All the fenestrations meet the SHGC requirement of ECBC-2007/Weighted Façade average SHGC (for each orientation) meets SHGC requirements of ECBC-2007 OR;
Alternatively use Tables 9 & 10 of SP 41 to design the shading device for the windows. OR;
Conduct solar path analysis for windows of AC as well as non-AC spaces, to ensure that the window is completely shaded for the duration between 10:00 am on 1st April to 15:00 on 30th September OR;
Any combination of the above strategies on 100% of the fenestrations – Mandatory</td><td rowspan="2">• Demonstrate that the mean DA requirements (300* lux or more) are met over the total living area for at least 25% of total annual analysis hours (area-weighted) – Mandatory
• Demonstrate that the mean DA requirements (3000 lux or more) are never exceeded over the total living area for across the total annual analysis hours – Mandatory

• Demonstrate that the mean DA requirements (300* lux or more) are met over the total living area for at least 50%/75% of total annual analysis hours (area-weighted) – 2/4 points

annual analysis hours – 800 to 1800 each day</td></tr>
<tr><td>• Minimum of 25% of the living area should meet adequate level of daylight (daylight factors) as prescribed in SP 41 – Mandatory

• If the adequate daylight factors are achieved in more than 50%/75% of total living area - 2 /4 points</td></tr>
</table>

For residential typologies, the DA limit is 100 lux

#For living area definitions and Living area (weighted) calculations, please refer to Appendix 6

Criterion 11: Achieving indoor comfort requirements (visual/thermal/acoustic)

Appraisals (contd.):

- **11.1.2: Artificial lighting design to fall within limits (lower and higher range limits) as recommended space/task specific lighting levels as per NBC** and to meet a minimum uniformity ratio of 0.4 – Mandatory**
- **11.1.3: Demonstrate that project can achieve the thermal comfort requirements[#] of NBC 2005 OR ASHRAE 55 OR requirement of Indian Adaptive Comfort Model as mentioned in Appendix 1 – Mandatory**
- 11.1.4: The indoor noise levels should be within the acceptable limits as specified in NBC 2005 and key noise source on site (like DG sets, chiller plants etc.) should have sufficient acoustic insulation as per NBC 2005 norms - **2 points**

Compliances:

- 11.2.1: Submit drawings (floor plans, relevant elevations and sections and doors-windows schedule) for the project, detailing various shading devices
- 11.2.2: Submit narrative providing overview of compliance with all appraisals of the criteria
- 11.2.3: *Appraisal 11.1.1 – Alternative 1:* Submit calculations detailing the WWR and SRR of the project
- 11.2.4: *Appraisal 11.1.1 – Alternative 1:* Submit calculations demonstrating that all fenestrations comply with either SHGC requirements and/or shading requirements
- 11.2.5: *Appraisal 11.1.1 – Alternative 1:* Submit simulation reports demonstrating that at least 25% (or more) of total living area of project meets daylight factor requirements of SP 41
- 11.2.6: *Appraisal 11.1.1 – Alternative 2:* Submit simulation reports demonstrating that the total living area (time-weighted) achieves the DA requirements as mentioned
- 11.2.7: Submit artificial lighting simulation reports demonstrating that the artificial lighting levels meet the NBC 2005 recommended levels and uniformity of 0.4
- 11.2.8: Submit interior artificial lighting layout drawings

***** For indoor artificial lighting levels for residential spaces only, please refer to Appendix 7.***

[#] To demonstrate thermal comfort compliance in non-AC spaces/buildings, projects must submit analysis of either TRNSYS or ENERGY PLUS only.

Criterion 11: Achieving indoor comfort requirements (visual/thermal/acoustic)

Compliances (contd.):

- 11.2.9: Submit simulation reports to demonstrate that thermal comfort conditions as specified in Appraisal 11.1.3 are met in the project
- 11.2.10: Submit drawings and narratives highlighting various measures adopted to meet indoor noise levels of NBC 2005 and to limit noise from noise sources mentioned in Appraisal 11.1.4
- 11.2.11: Submit specification sheets, purchase orders (reflecting full quantities) and BOQ of relevant products used in building to meet Appraisals 11.1.1 – 11.1.4 including but not limited to the following:
    - Glass specifications
    - Interior lamps and luminaires
    - Thermal insulation
    - Acoustic insulation
- 11.2.12: Upload photographs, with description, of the measures implemented

Criterion 12: Maintaining good IAQ

Intent:

Maintenance of good indoor air quality is imperative for ensuring healthy living conditions for the building occupants. The intent of this criterion is to ensure design and monitoring of ventilation systems such that indoor air quality meets the minimum requirements, as recommended in the standards.

Maximum Points: 4

Non-applicability: Appraisal 12.1.1 is not applicable for non-AC spaces/residential spaces with operable windows

Appraisals:

- 12.1.1: Meet the minimum requirements of
    - CPCB National Ambient Air Quality Standard (NAAQS)for quality of fresh air; and
    - ASHRAE Standard 62.1–2010, Sections 4–7, Ventilation for Acceptable Indoor Air Quality (with errata), or a NBC-2005 for quantity of fresh air – **2 points**
    - The clause shall cover treatment of outdoor air for predominantly PM 10 and PM 2.5
- 12.1.2: Monitoring the CO_2, temperature and RH at the occupied spaces or at AHUs for the air conditioned spaces – **2 points**

Compliances:

- 12.2.1: Submit documentation detailing the specifications of the filtration system to demonstrate that fresh air quality meet the minimum requirements of CPCB NAAQS
- 12.2.2: Submit space by space sheet Heat Load Sheet highlighting provision of sufficient fresh air in the HVAC system design as per the ASHRAE 62.1 or NBC 2005 norms
- 12.2.3: Submit drawings (floor plans and/or HVAC system plans) highlighting the location of various CO_2, temperature and RH sensors
- 12.2.4: Submit specification sheets and purchase orders (reflecting full quantities) for the filters and sensors installed in the project
- 12.2.5: Upload photographs, with description, of the measures implemented

Criterion 13: Use of low-VOC paints and other compounds in building interiors

Intent:

The intent of this criterion is to promote use of low-VOC and lead-free interior paints as well as low-VOC adhesives and sealants in order to maintain good indoor air quality for the project occupants.

Maximum Points: 2

Appraisals:

- 13.1.1: Ensure that all interior paints are low-VOC *(as mentioned in the GRIHA manual) and lead-free – **1 point**
- 13.1.2: Ensure that all adhesives and sealants used shall be low-VOC *& that interior composite wood-products do not use urea-formaldehyde as a bonding resin – **1 point**

Compliances:

- 13.2.1: Submit specification sheets for the following:
    - low-VOC and lead-free paints being used in building interiors
    - low-VOC adhesives, sealants used in building interiors
    - composite wood products demonstrating that they do not use urea-formaldehyde as a bonding resin
- 13.2.2: Submit purchase orders (reflecting full quantities) for the above materials
- 13.2.3: Upload photographs, with description, of the measures implemented

**** Please refer to Appendix 8 for table listing low-VOC content limits***


Water

Criterion 14: Use of low-flow fixtures and systems

Intent:

The intent of this criterion is to ensure reduction in the building water consumption through the use of low-flow fixtures.

Maximum Points: 4

Non-applicability: All faucets, which are installed in spaces with water head heights less than 5 m / 17 feet, in a gravity fed systems (without pressure reduction) are exempt from calculations in this criterion

Appraisals:

- **14.1.1: Reduce water demand through selection of low-flow fixtures by 30% below the GRIHA base case – Mandatory**
- 14.1.2: Reduce water demand through selection of low-flow fixtures by 50% below the GRIHA base case – **2 points**
- 14.1.3: Reduce water demand through selection of low-flow fixtures by 70% below the GRIHA base case – **4 points**

Compliances:

- 14.2.1: Provide calculations demonstrating compliance with Appraisals 14.1.1 – 14.1.3
- 14.2.2: Submit specification sheets from manufacturers for each fixture indicating the flow rates (at design pressure of 45 psi for faucets)
- 14.2.3: Submit purchase orders (reflecting full quantities) for the low-flow fixtures used in the project
- 14.2.4: Upload photographs, with description, of the measures implemented

Criterion 15: Reducing landscape water demand

Intent:

The intent of this criterion is to promote the planting of native/naturalized flora and use of water efficient irrigation system to reduce the demand for landscape water.

Maximum Points: 4

Appraisals:

- 15.1.1: Reduce landscape water demand by at least 30% from the GRIHA base case – **1 point**
- 15.1.2: Reduce landscape water demand by at least 40% from the GRIHA base case – **2 points**
- 15.1.3: Reduce landscape water demand by at least 50% from the GRIHA base case – **4 points**

Compliances:

- 15.2.1: Provide calculations demonstrating compliance with Appraisals 15.1.1 – 15.1.3
- 15.2.2: Submit landscape plan indicating plant list, along with area covered and species
- 15.2.3: Submit manufacturer cut-sheets and purchase orders (reflecting full quantities) for the irrigation systems installed on site
- 15.2.4: Upload photographs, with description, of the measures implemented

Criterion 16: Water Quality

Intent:

Ensuring quality of water available for use during building operation is important from two perspectives – overall hygiene for building occupants as well as longevity of plumbing systems. It is also important to ensure that the water being discharged from the site meets the relevant disposal norms. The intent of this criterion is to ensure that the water being used in the project meets the relevant national standards.

Maximum Points: 2

Non-applicability: If the total waste water generated on site is less than 10 kLD, then the project is exempt from appraisal 16.1.2 and 17.1.1.

Appraisals:

- **16.1.1: Water used for various purposes like drinking, irrigation etc. shall conform to the BIS standards - Mandatory**
- 16.1.2: The STP installed on site meets the CPCB norms **– 2 points**

Compliances:

- 16.2.1: Submit potable water quality, treated waste water and captured rainwater quality test reports from various sources before and after treatment (if required) - from an NABL accredited laboratory on the quality of potable water
- 16.2.2: Submit narrative (including capacity of water treatment) of the type of treatment plant installed on site along with plumbing drawings of the system
- 16.2.3: Submit the specification details indicating the capacity and components of the water treatment plant along with drawings (product details from the manufacturer)
- 16.2.4: Submit document indicating the quantum of treated water generated along with the use/disposal steps
- 16.2.5: Submit narrative on disposal and reuse of other by-products such as sludge
- 16.2.6: Upload photographs, with description, of the measures implemented

Criterion 17: On-site water reuse

Intent:

The intent of this criterion is to promote recycle and reuse of waste water as well as reuse of captured rainwater on site to meet the water demand, thereby reducing the water required from the local municipal supply/groundwater aquifers.

Maximum Points: 5

Appraisals:

- 17.1.1: Demonstrate that the project meets the on-site water reuse requirements (through on-site recycle and reuse of waste water and use of on-site harvested rainwater) in its annual water requirements for domestic use, buildings, landscape and utilities as mentioned below:

On-site water reuse	Points
20%	1
40%	2
60%	4
80%	5

Compliances:

- 17.2.1: Submit calculations (Water Balance) demonstrating the total quantity of water treated and harvested and the amount being used for different applications including use within the building and irrigation and that which is recharged into underground aquifers
- 17.2.2: Submit drawings detailing the dual plumbing systems and/or treated waste water storage tanks and/or rainwater capture and storage tanks on site
- 17.2.3: Submit site level plumbing drawings indicating delivery lines for treated waste water and captured rainwater to their respective points of use
- 17.2.4: Upload photographs, with description, of the measures implemented

Criterion 18: Rainwater Recharge

Intent:

The intent of this criterion is to promote the recharge of groundwater aquifers.

Maximum Points: 2

Non-applicability: If the CGWB norms suggest that the ground water table is high and ground water recharging should not be done, then the project is exempt from this criterion

Appraisals:

- 18.1.1: Recharge of surplus rainwater into aquifer (through appropriate filtration measures) – **2 points**

Compliances:

- 18.2.1: Submit details of rainwater harvesting for ground water recharge and its filtration system to show that adequate preventive measures are being taken to avoid damage to the aquifer by the recharged rainwater
- 18.2.2: Upload photographs, with description, of the measures implemented

Sustainable Building Materials

Criterion 19: Utilization of BIS recommended waste materials in building structure

Intent:

The intent of this criterion is to promote use BIS recommended wastes (such as fly ash, blast furnace slag etc.), having properties similar to conventional construction materials for building construction. These being low embodied energy materials as well as waste products, reduce the need for virgin materials in the building structure and help divert waste from landfills.

Maximum Points: 6

Appraisals:

- 19.1.1 Minimum 15% replacement of Ordinary Portland cement with fly ash* by weight of cement used in structural concrete – **1 point**
    - If replacement is more than 25% - **2 points**
- 19.1.2 Minimum 40% composition of building blocks/bricks by fly ash* by volume, for 100% load bearing and non-load bearing masonry walls – **2 points**
- 19.1.3 Certify minimum 15% replacement of Ordinary Portland cement with fly ash* in plaster/masonry mortar – **1 point**
    - If replacement is more than 25% - **2 points**

Compliances:

- 19.2.1: Submit documentation (calculations, manufactures cut-sheets & purchase orders – reflecting full quantities) demonstrating 15% (or higher) replacement of OPC in structural concrete by fly ash*
- 19.2.2: Submit documentation (calculations, manufactures cut-sheets & purchase orders – reflecting full quantities) demonstrating that fly ash* constitutes at least 40% of load bearing and non-load bearing walls (by volume of materials)
- 19.2.3: Submit documentation (calculations, manufactures cut-sheets & purchase orders – reflecting full quantities) demonstrating 15% (or higher) replacement of OPC in plaster and/or masonry mortar by fly ash*
- 19.2.4: Upload photographs, with description, of the measures implemented

** or any BIS recommended waste*

Criterion 20: Reduction in embodied energy of building structure

Intent:

The intent of this criterion is to promote reduction in the embodied energy of the building structure through the use of low-embodied energy materials.

Maximum Points: 4

Appraisals:

- 20.1.1: Demonstrate reduction in combined embodied energy of load-bearing structure and masonry walls by at least 10% below the base case **– 1 point**
- 20.1.2: Demonstrate reduction in combined embodied energy of load-bearing structure and masonry walls by at least 20% below the base case **– 2 points**
- 20.1.3: Demonstrate reduction in combined embodied energy of load-bearing structure and masonry walls by at least 30% below the base case **– 4 points**

Base Case: RCC structure with burnt clay brick masonry. The live load, equipment load and spans between the design and the base case should be same. The total length of masonry walls between design and base case should be same.

Compliances:

- 20.2.1: Submit calculations (through software output files recommended) demonstrating reduction in embodied energy as per Appraisal 20.1.1 – 20.1.3
- 20.2.2: Submit manufacturer cut-sheets of the low-energy materials used in building structure and masonry walls
- 20.2.3: Submit CAD drawings highlighting the use of low embodied energy materials in the relevant floor plans, with clear dimensioning
- 20.2.4: Submit purchase orders (reflecting full quantity) and relevant sections of the BOQ highlighting the low-energy materials used
- 20.2.5: Upload photographs, with description, of the measures implemented

Recommended Sources for Embodied Energy numbers:

- *Embodied energy assessment of building materials in India using process and input–output analysis - K.I. Praseed, B.V. Venkatarama Reddy, Monto Mani, Energy and Buildings – 86 (2015)*
- *Effect of construction materials on embodied energy and cost of buildings—A case study of residential houses in India up to 60 m2 of plinth area - Deepak Bansal, Ramkishore Singh, R.L. Sawhney – Energy and Buildings – 69 (2014)*

Criterion 21: Use of low-environmental impact materials in building interiors

Intent:

The intent of this criterion is to promote installation of low environmental impact materials in the building interiors.

Maximum Points: 4

Appraisals:

- 21.1.1: Project demonstrates that at least 25% of all materials (calculated by surface area) used for building interiors* meets the GRIHA criterion low-impact material requirements **– 1 point**
- 21.1.2: Project demonstrates that at least 50% of all materials (calculated by surface area) used for building interiors* meets the GRIHA criterion low-impact material requirements **– 2 points**
- 21.1.3: Project demonstrates that at least 75% of all materials (calculated by surface area) used for building interiors* meets the GRIHA criterion low-impact material requirements **– 4 points**
    - Following materials will be accepted as low-environmental impact:
        - Stones from India
        - Composite wood based products
        - FSC Chain of Custody certified products
        - Manufactured products with at least 5% recycled content
        - Products with EPD (cradle to gate) analyzed and published as per ISO 14025 / ISO 21930
        - Products with water footprint (cradle to gate) analyzed and published as per ISO 14046

* false ceilings/internal partitions/paneling/in-built furniture/flooring/internal door & window panels & frames

Compliances:

- 21.2.1: Provide manufacturer cut-sheets highlighting specifications of low environmental impact finishes/products used in the building interiors
- 21.2.2: Provide CAD drawings demarcating (by highlighting with clear dimensions) the use of aforesaid finishes/products in the interior layouts/plans.
- 21.2.3: Submit purchase orders (reflecting full quantities) and relevant sections of the BOQ for the low environmental impact materials used
- 21.2.4: Upload photographs, with description, of the measures implemented

Solid Waste Management

Criterion 22: Avoided post-construction landfill

Intent:

The intent of this criterion is to provide infrastructure to future occupants of the project so that they can sustainably manage on-site solid waste during operation phase.

Maximum Points: 4

Appraisals:

- 22.1.1: Provide infrastructure (multi-coloured dustbins/different garbage chutes) to building occupants to ensure segregation of waste at source
- 22.1.2: Provide dedicated, segregated and hygienic storage spaces in the project site to store different wastes before treatment /recycling
- 22.1.3: Provide contractual tie-ups with waste recyclers for safe recycling for recyclable wastes like metal, paper, plastic, glass etc.

Together – 4 points

Compliances:

- 22.2.1: Submit the Solid Waste Management plan for the project – detailing the sizing of segregated waste storage facilities, strategy for primary and secondary collection and storage.
- 22.2.2:Submit site plan indicating location of various primary (multi-coloured dustbins) and secondary storage facilities
- 22.2.3: Submit document highlighting tie-up with recyclers for ensuring safe recycling of recyclable wastes
- 22.2.4: Upload photographs, with description, of the measures implemented

Criterion 23: Treat organic waste on site

Intent:

The intent of this criterion is to promote recycling and reuse of organic waste on site.

Maximum Points: 2

Non-applicability: If the total waste generation on site is less than 100 kg/day, then the project is exempt from this criterion.

Appraisals:

- 23.1.1 Implement strategies to treat all organic (kitchen and landscape) waste on-site and to convert it into a resource (manure, biogas etc.) **- 2 points**

Compliances:

- 23.2.1: Submit narrative detailing the design and sizing of the on-site waste treatment strategy and highlight method of reuse on site
- 23.2.2: Upload photographs, with description, of the measures implemented

Socio-Economic

Criterion 24: Labour safety and sanitation

Intent:

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

Maximum Points: 1

Non-applicability : If no families are allowed to work and live at construction sites, then appraisal 24.1.3 is not applicable

Appraisals:

- **24.1.1: Ensure compliance with the NBC (2005) safety norms for providing the necessary safety equipment and measures for construction workers – Mandatory**
- **24.1.2: Ensure provisions for drinking water, hygienic working & living conditions and sanitation facilities shall be provided for the workers – Mandatory**
- 24.1.3: Provide a crèche facility for children of construction workers – **1 point**

Compliances:

- 24.2.1: Submit relevant sections of tender document showing that the conditions mentioned in Appraisal 24.1.1 and 24.1.2 are required to be implemented by the contractor during construction on site.
- 24.2.2: Submit test reports demonstrating that the drinking water provided to workers meets the relevant BIS drinking water norms
- 24.2.3: Submit narrative on provision of crèche facility for children of construction workers
- 24.2.4: Upload photographs, with description, of the measures implemented

Criterion 25: Design for Universal Accessibility

Intent:

The intent of this criterion is to promote adoption of measures in the project to make it universally accessible.

Maximum Points: 2

Appraisals:

- 25.1.1: Compliance with National Building Code norms on Requirements for Planning of Public Buildings Meant for Use of Physically Challenged **- 2 points**

Compliances:

- 25.2.1: Submit drawings demonstrating that the project incorporates design measures for Universal Accessibility as recommended in NBC 2005
- 25.2.2: Upload photographs, with description, of the measures implemented

Criterion 26: Dedicated facilities for service staff

Intent:

The intent of this criterion is to promote provision of resting spaces and toilets dedicated for project's service staff.

Maximum Points: 2

Appraisals:

- 26.1.1: Provide dedicated resting rooms for the service staff on site **– 1 point**
- 26.1.2: Provide toilets for the service staff on site **– 1 point**

Guidance for estimation		
Assume total service staff population to be about 5% of total fixed building occupancy. If staff works in shifts, count the position only once.		
Fixtures	Male	Female
WCs	1 per 25	1 per 15
Washbasins	1 per 25	1 per 25
Urinals	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	

Compliances:

- 26.2.1: Submit drawings demarcating the location of various toilets and/or resting rooms for service staff
- 26.2.2: Upload photographs, with description, of the measures implemented

Criterion 27: Increase in environmental awareness

Intent:

The intent of this criterion is to create awareness on sustainability amongst the building users & visitors.

Maximum Points: 1

Appraisals:

- 27.1.1: Adopt measures to create environmental awareness **– 1 point**

Compliances:

- 27.2.1: Submit narrative with supporting photographs highlighting strategies implemented, in the project, to create environmental awareness

Performance Monitoring & Validation

Criterion 28: Smart metering and monitoring

Intent:

The intent of this criterion is to promote smart metering and monitoring of energy and water consumption on site to analyze the performance of the building.

Maximum Points: 8

Appraisals:

- **28.1.1: Comply with following Basic metering requirements of GRIHA – Mandatory**

Basic Metering Requirements	
Energy	Water
Ensure regular monitoring of 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 Genset, Gas Genset etc. • Each building level	Ensure regular monitoring of project's water consumption by installing digital meters* at the following point sources at the project level for: • Municipal Supply • Bore well • Treated water outlet from STP • Captured rainwater • Each building level

- 28.1.2: Comply with Extended metering requirements as mentioned in the table **– 2 points**

Extended Metering Requirements	
Energy	Water

Sub-meter* the following points to monitor energy consumption:
• Commercial/Institutional:
  • HVAC central plant- AHU, Cooling tower, Chillers (BTU meters) and/or distributed units (split/window ACs)
  • Lighting (Indoor and outdoor)
  • UPS
  • Basement parking lighting
• Residential:
  • For Basement Parking Lighting, Community/Recreation center, Water pumping, Outdoor Lighting
  • Lifts and common areas
	Sub-meter* at the following points to monitor water consumption:
	• Irrigation
	• Cooling Tower
	• STP/WTP/ETP
	• Each apartment/commercial tenant

Criterion 28: Smart metering and monitoring

Appraisals (contd.):

28.1.3: Installation of one-way communicable[#] Smart metering* and monitoring system capable tracking energy and water consumption through a web hosted portal and also capable of the following, for at least all meters mentioned in 28.1.1 – **3 points**

- •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 & water consumption targets, alarms and pricing
- •Ability to compare historical trends and benchmark data
- •Real time monitoring with user interface which operates even in mobile devices

28.1.4: Connect to GRIHA Online Benchmarking platform (linked to smart metering) to allow for two way communication on the following: **– 3 points**

- •Monthly energy consumption (with fuel mix) and water consumption (with source split) with GRIHA IT platform
- •Receive, average energy and water consumption (normalized for building typologies, location and area) for display to building occupants to assess building energy and water efficiency

Compliances:

- 28.2.1: Submit drawings indicating the location of various meters in the project
- 28.2.2: Submit specification sheets and purchase orders of the various meters installed in the project
- 28.2.3: Submit details and purchase orders of the Smart Metering system installed in the project
- 28.2.4: Upload photographs, with description, of the measures implemented

**All Energy meters that are installed to be of at least class 1 with Class 1 CT's/PT's, and should have an active RS-485 port, with industry standard Modbus protocol with publicly available register maps.*

**All Water/BTU meters should have an RS 485/RS232 port with publicly available/industry standard Protocol (Modbus,etc.) and register maps*

**All meters/CT should be calibrated by an authorized certified auditor at least every 2 years.*

**The metering and monitoring hardware and software should support compliance with the relevant requirements of "IS/ISO 50001 - Energy Management Systems - Requirements with Guidance for Use".*

[#] Project teams may opt for two-way communicable if they want to enable demand response.

Criterion 29: Operation & Maintenance Protocols

Intent:

The intent of this criterion is to ensure implementation of an Operation and Maintenance protocol.

Maximum Points: No points

Appraisals:

- **29.1.1: Provision for a core facility/service group responsible for the O&M of the building's systems after installation as per GRIHA requirements. Inclusion of a specific clause in the contract document of the systems supplier for providing training to the core facility/ service group responsible for the O&M of the building systems after installation, on the operating instructions/dos and don'ts/ maintenance requirements for the specific system, as per GRIHA requirements. Development of a fully documented O&M manual/ CD/ Multimedia /information brochure enlisting the best practices for O&M of the building's systems as per GRIHA requirements – Mandatory**

  O&M protocol should be submitted for

  - **HVAC plant- AHU, Cooling tower, Chillers and pumps , VRF**
  - **Electrical- Transformer, DG, HT & LT panels**
  - **Energy Systems: Solar PV, wind mill, bio gasifier etc.**
  - **STP and/or WTP**

Compliances:

- 29.2.1: Submit proof of provision for a core facility/service group responsible for the operation and maintenance of the building's systems after installation. This should be supported with the contract (mutually signed between the respective parties) document or supportive documents, verified and signed by the responsible parties).

  O&M protocol should contain the following:

  - Provision of inspection as per respective system schedules
  - Corrective measures to be implemented according to the periodic inspection report.
  - Records tracking the periodic inspection and maintenance
  - Provision for training staff members

Criterion 30: Performance Assessment for Final Rating

Intent:

The intent of this criterion is to validate the performance of the energy, water and comfort conditions in the building as predicted during the design and development stage.

Maximum Points: No points

Appraisals:

- **30.1.1 The energy systems, water systems and solid waste management systems of the building are performing as predicted and match the information provided at the time of award of provisional GRIHA rating**
- **30.1.2: The visual, thermal and acoustic comfort conditions of the building meet the requirements of GRIHA Criterion 11**
- 30.1.3 Any improvement in the following 4 parameters can be attempted by the project, post-GRIHA Provisional Rating, in order to improve its overall GRIHA points tally:
    - Hard/soft/shaded paving on site – Criterion 3
    - Renewable energy installation – Criterion 9
    - Noise levels – Criterion 11
    - Innovation – Criterion 31

Please note: Reattempt/fresh attempt of a criterion will not be allowed in this; only improved performance will be evaluated.

Compliances:

- 30.2.1: Submit audit report and bills by an independent BEE certified auditor highlighting the following:
    - Annual energy and water consumption
    - Compliance with visual, thermal and acoustic comfort conditions in building interiors
    - Functioning solid waste management strategies
- 30.2.2: Submit narrative/drawings/photographs highlighting improved performance in criteria mentioned in 30.1.3

Criterion 31: Innovation

Intent:

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

Maximum Points: 4

Appraisals:

- 31.1.1: 1 point per Innovation strategy up to a maximum of 4.
    - Examples of innovation:
        - A GRIHA certified professional (Trainer or Evaluator) is involved in the project from beginning to end)
        - First Mover: Implementation of a technology for the first time in the country.
        - E-waste recycling
        - STP technologies which do not use chemicals
        - Net-Zero Energy/Water

Compliances:

- 31.2.1: Submit supporting documentation for each Innovation strategy

Appendix 1
Indian Adaptive Comfort Model
Source: CEPT University

Design of Indoor conditions as per Adaptive Thermal Comfort Model:

Standard based on an adaptive thermal comfort model can play a major role in reducing energy use whilst maintaining the comfort, productivity and well-being of occupants. This approach recognizes that people's thermal comfort needs depend on their past and present context and that these needs vary with the outdoor environmental conditions of their location. People living year-round in air-conditioned spaces are likely to develop high expectations for homogeneity and cool temperatures, and may become quite critical if thermal conditions deviate from the center of the comfort zone they have come to expect. In contrast, people who live or work in naturally ventilated buildings, where they are able to control their immediate interior spaces, get accustomed to variable indoor thermal conditions that reflect local patterns of daily and seasonal climate changes. Their thermal perceptions – preferences as well as tolerances – are likely to extend over a wider range of temperatures. It allows buildings to operate within broader temperature bands. The specification of a broader comfort band suited to the Indian context has the potential to reduce the use of energy intensive space cooling for Indian buildings.

Theories deals with adaptive thermal comfort model which differentiate the thermal response of occupants in air conditioned and naturally ventilated buildings. It is imperative to specify indoor comfort conditions separately depending upon operation of building – Air Conditioned buildings as well as naturally ventilated buildings.

Operative temperature is more suitable index to measure thermal comfort in the building having low indoor air velocities, since the index also accounts for impact of building surface temperatures (radiant temperatures) on human comfort. Indoor operative temperature, for sedentary activities, can be approximated as an arithmetic mean of indoor air and radiant temperatures. For operating air conditioning system based on operative temperature, the prevalent conditions along with the historical outdoor trend can be used to derive suitable operative temperature limits. Statistically analyzed typical climatic conditions of various Indian locations is in public domain.

In case of buildings having higher indoor air velocity (more than 0.5 m/s), effective temperature based approach is recommended since in addition to all factors considered in operative temperature, it also takes into account heat dissipation from human body through convective heat transfer. High air velocity can give opportunity of keeping higher air temperature without compromising thermal comfort. However, it is also suggested to keep under consideration noise and other effect of high indoor air velocity. For reference comfort conditions range derived as per adaptive model for Indian cities. These are indicative simplified values using weather files. More accurate design conditions can be derived using following equations.

a) For Naturally ventilated (NV) buildings

The following equation should be used for design and operation of naturally ventilated (NV) buildings. It indicates that occupants in NV buildings thermally adapt to the outdoor temperature of their location. It is based on the 30-day outdoor running mean*.

Equation:

Indoor Operative Temp. (˚C) **= 0.54 * outdoor temp. + 12.83**

Where indoor operative temperature (˚C) is neutral temperature, and outdoor temperature is the 30-day outdoor running mean air temperature (˚C)

The 90% acceptability range for the India specific adaptive models for naturally ventilated buildings is ±2.38˚C.

b) For Mixed-mode (MM) buildings

Mixed-mode buildings, where HVAC is operated only during extreme outdoor conditions, are becoming prevalent in India. The occupants in mixed-mode buildings are more adaptive when compared to those in AC buildings and somewhat less adaptive compared to occupants in NV buildings.

Equation:

Indoor Operative Temp. (˚C) **= 0.28 * outdoor temp. + 17.87**

Where indoor operative temperature (˚C) is neutral temperature and outdoor temperature is the 30-day outdoor running mean air temperature (˚C)

The 90% acceptability range for the India specific adaptive models for mixed-mode buildings is ±3.46˚C.

**NOTE: To calculate the 30-day outdoor running mean air temperature for a given day 'n', the first step is to identify the maximum and minimum temperature of 30 days preceding 'n', that is day 'n-1' (the day before the current day) to day 'n-30'. The daily mean temperature for these 30 days is calculated. The daily mean is the arithmetical mean of the daily maximum and minimum temperature. 30-day outdoor running mean air temperature is the arithmetical mean of the daily mean temperatures of the last 30 days.*

c) For Air conditioned (AC) buildings[#]

Studies shows that static Predictive Mean Vote (PMV) model over-predicts the sensation on the warmer side of the 7-point sensation scale in AC buildings. One of the two methods should be adopted while determining indoor conditions of fully air-conditioned buildings. This is based on Air temperature or Based on Standard Effective Temperature (SET*) which includes effect of body surface area, RH Air Velocity (Va) Air Temperature (Ta), Radiant Temperature (Tr), Outdoor Temperature (Tout), Clothing Insulation (Clo) and activity rate (MET).

1) Air temperature based approach:

Equation:

Indoor Operative Temperature (˚C): = 0.078 * outdoor temp. + 23.25

Where indoor operative temperature (˚C) is neutral temperature and outdoor temperature is the 30-day outdoor running mean air temperature (˚C)

[#]Analysis of AC buildings done by MNIT, Jaipur

The 90% acceptability range for the adaptive models for conditioned buildings is ±1.5˚C.

2) Standard Effective Temperature Based Approach:

Equation:

Indoor Operative Temperature (˚C): = 0.014 * outdoor temp. + 24.53

Where indoor operative temperature (˚C) is neutral temperature and outdoor temperature is the 30-day outdoor running mean air temperature (˚C)

The 90% acceptability range for the adaptive models for conditioned buildings is ±1.0˚C.

Above equations are not applicable for outdoor running mean temperatures below 15(˚C*)*

NV = Naturally ventilated buildings

MM = Mixed-mode buildings

AC.air.tem = Air temperature based approach

AC.std.eftv = Standard Effective Temperature Based Approach

	City	Ahmedabad				Amritsar			
Months	90% Acceptibility Range	NV	MM	AC.air.tem	AC.std.eftv	NV	MM	AC.air.tem	AC.std.eftv
January	Max. Temp in °C	26.3	27.1	26.4	25.8	22.4	25.1	25.8	25.7
	Min. Temp in °C	21.5	20.2	23.4	23.8	17.6	18.1	22.8	23.7
February	Max. Temp in °C	26.5	27.2	26.4	25.8	22.5	25.1	25.8	25.7
	Min. Temp in °C	21.7	20.2	23.4	23.8	17.8	18.1	22.8	23.7
March	Max. Temp in °C	28.6	28.3	26.7	25.9	24.5	26.2	26.1	25.8
	Min. Temp in °C	23.8	21.3	23.7	23.9	19.8	19.2	23.1	23.8
April	Max. Temp in °C	31.3	29.7	27.1	25.9	27.6	27.8	26.5	25.9
	Min. Temp in °C	26.5	22.7	24.1	23.9	22.9	20.9	23.5	23.9
May	Max. Temp in °C	33.2	30.7	27.4	26	30.3	29.2	26.9	25.9
	Min. Temp in °C	28.5	23.8	24.4	24	25.6	22.3	23.9	23.9
June	Max. Temp in °C	33.7	30.9	27.4	26	31.9	30	27.2	26
	Min. Temp in °C	28.9	24	24.4	24	27.2	23.1	24.2	24
July	Max. Temp in °C	32.1	30.1	27.2	26	32	30.1	27.2	26
	Min. Temp in °C	27.4	23.2	24.2	24	27.3	23.1	24.2	24
August	Max. Temp in °C	30.7	29.4	27	25.9	31.4	29.7	27.1	26
	Min. Temp in °C	25.9	22.4	24	23.9	26.7	22.8	24.1	24
September	Max. Temp in °C	30.8	29.4	27	25.9	30.9	29.4	27	25.9
	Min. Temp in °C	26	22.5	24	23.9	26.1	22.5	24	23.9
October	Max. Temp in °C	31.4	29.7	27.1	26	29.4	28.7	26.8	25.9
	Min. Temp in °C	26.7	22.8	24.1	24	24.6	21.8	23.8	23.9
November	Max. Temp in °C	30.1	29.1	26.9	25.9	26.7	27.3	26.4	25.8
	Min. Temp in °C	25.4	22.2	23.9	23.9	21.9	20.4	23.4	23.8
December	Max. Temp in °C	28.1	28	26.6	25.9	24	25.9	26	25.8
	Min. Temp in °C	23.4	21.1	23.6	23.9	19.2	18.9	23	23.8

	City	Aurangabad				Akola			
Months	90% Acceptibility Range	NV	MM	AC.air.tem	AC.std.eftv	NV	MM	AC.air.tem	AC.std.eftv
January	Max. Temp in °C	26.2	27	26.3	25.8	26.9	27.4	26.4	25.8
	Min. Temp in °C	21.4	20.1	23.3	23.8	22.1	20.4	23.4	23.8
February	Max. Temp in °C	26.9	27.4	26.4	25.8	28	28	26.6	25.9
	Min. Temp in °C	22.2	20.1	23.4	23.8	23.3	20.4	23.6	23.9
March	Max. Temp in °C	28.9	28.4	26.7	25.9	29.7	28.8	26.8	25.9
	Min. Temp in °C	24.1	21.5	23.7	23.9	24.9	21.9	23.8	23.9
April	Max. Temp in °C	31.2	29.6	27.1	25.9	31.9	30	27.2	26
	Min. Temp in °C	26.4	22.7	24.1	23.9	27.2	23.1	24.2	24
May	Max. Temp in °C	32.4	30.2	27.2	26	33.7	30.9	27.4	26
	Min. Temp in °C	27.6	23.3	24.2	24	28.9	24	24.4	24
June	Max. Temp in °C	31.7	29.9	27.1	26	32.8	30.5	27.3	26
	Min. Temp in °C	27	23	24.1	24	28.1	23.5	24.3	24
July	Max. Temp in °C	30	29	26.9	25.9	30.9	29.4	27	25.9
	Min. Temp in °C	25.2	22.1	23.9	23.9	26.1	22.5	24	23.9
August	Max. Temp in °C	28.9	28.4	26.7	25.9	29.6	28.8	26.8	25.9
	Min. Temp in °C	24.1	21.5	23.7	23.9	24.9	21.9	23.8	23.9
September	Max. Temp in °C	29	28.5	26.7	25.9	30.2	29.1	26.9	25.9
	Min. Temp in °C	24.2	21.6	23.7	23.9	25.5	22.2	23.9	23.9
October	Max. Temp in °C	29.2	28.6	26.8	25.9	30.2	29.1	26.9	25.9
	Min. Temp in °C	24.4	21.7	23.8	23.9	25.5	22.2	23.9	23.9
November	Max. Temp in °C	28.1	28	26.6	25.9	28.8	28.4	26.7	25.9
	Min. Temp in °C	23.4	21.1	23.6	23.9	24	21.5	23.7	23.9
December	Max. Temp in °C	26.6	27.3	26.4	25.8	27.4	27.6	26.5	25.8
	Min. Temp in °C	21.9	20.3	23.4	23.8	22.6	20.7	23.5	23.8

	City	Allahabad				Belgaum			
Months	90% Acceptibility Range	NV	MM	AC.air.tem	AC.std.eftv	NV	MM	AC.air.tem	AC.std.eftv
January	Max. Temp in °C	23.9	25.8	26	25.8	26.9	27.4	26.4	25.8
	Min. Temp in °C	19.1	18.9	23	23.8	22.1	20.5	23.4	23.8
February	Max. Temp in °C	24.9	26.3	26.1	25.8	27.4	27.7	26.5	25.8
	Min. Temp in °C	20.1	18.9	23.1	23.8	22.7	20.5	23.5	23.8
March	Max. Temp in °C	27.9	27.9	26.6	25.9	29	28.5	26.7	25.9
	Min. Temp in °C	23.2	21	23.6	23.9	24.2	21.6	23.7	23.9
April	Max. Temp in °C	31.2	29.6	27.1	25.9	30.3	29.1	26.9	25.9
	Min. Temp in °C	26.5	22.7	24.1	23.9	25.5	22.2	23.9	23.9
May	Max. Temp in °C	33.2	30.7	27.4	26	30.3	29.1	26.9	25.9
	Min. Temp in °C	28.5	23.8	24.4	24	25.5	22.2	23.9	23.9
June	Max. Temp in °C	33.7	30.9	27.4	26	29.3	28.6	26.8	25.9
	Min. Temp in °C	28.9	24	24.4	24	24.5	21.7	23.8	23.9
July	Max. Temp in °C	32.4	30.2	27.2	26	28.1	28	26.6	25.9
	Min. Temp in °C	27.6	23.3	24.2	24	23.4	21.1	23.6	23.9
August	Max. Temp in °C	31.4	29.7	27.1	26	27.6	27.8	26.5	25.9
	Min. Temp in °C	26.7	22.8	24.1	24	22.8	20.8	23.5	23.9
September	Max. Temp in °C	31.2	29.6	27.1	25.9	28.1	28	26.6	25.9
	Min. Temp in °C	26.4	22.7	24.1	23.9	23.3	21.1	23.6	23.9
October	Max. Temp in °C	30.6	29.3	27	25.9	28.4	28.2	26.7	25.9
	Min. Temp in °C	25.9	22.4	24	23.9	23.6	21.2	23.7	23.9
November	Max. Temp in °C	28.7	28.3	26.7	25.9	28	28	26.6	25.9
	Min. Temp in °C	23.9	21.4	23.7	23.9	23.2	21	23.6	23.9
December	Max. Temp in °C	25.6	26.7	26.3	25.8	27.4	27.6	26.5	25.8
	Min. Temp in °C	20.9	19.8	23.3	23.8	22.6	20.7	23.5	23.8

	City	Bengaluru				Bhopal			
Months	90% Acceptibility Range	NV	MM	AC.air.tem	AC.std.eftv	NV	MM	AC.air.tem	AC.std.eftv
January	Max. Temp in °C	26.8	27.3	26.4	25.8	25.1	26.5	26.2	25.8
	Min. Temp in °C	22.1	20.4	23.4	23.8	20.4	19.5	23.2	23.8
February	Max. Temp in °C	27.8	27.8	26.6	25.9	25.6	26.7	26.3	25.8
	Min. Temp in °C	23	20.4	23.6	23.9	20.9	19.5	23.3	23.8
March	Max. Temp in °C	29	28.5	26.7	25.9	28.3	28.1	26.6	25.9
	Min. Temp in °C	24.3	21.6	23.7	23.9	23.5	21.2	23.6	23.9
April	Max. Temp in °C	30.2	29.1	26.9	25.9	30.6	29.3	27	25.9
	Min. Temp in °C	25.5	22.2	23.9	23.9	25.8	22.4	24	23.9
May	Max. Temp in °C	30.2	29.1	26.9	25.9	32.6	30.3	27.3	26
	Min. Temp in °C	25.5	22.2	23.9	23.9	27.8	23.4	24.3	24
June	Max. Temp in °C	29.4	28.7	26.8	25.9	33.2	30.7	27.3	26
	Min. Temp in °C	24.6	21.8	23.8	23.9	28.4	23.7	24.3	24
July	Max. Temp in °C	28.5	28.2	26.7	25.9	31	29.5	27	25.9
	Min. Temp in °C	23.7	21.3	23.7	23.9	26.2	22.6	24	23.9
August	Max. Temp in °C	28.1	28	26.6	25.9	29.8	28.9	26.9	25.9
	Min. Temp in °C	23.4	21.1	23.6	23.9	25	22	23.9	23.9
September	Max. Temp in °C	28.2	28.1	26.6	25.9	29.5	28.7	26.8	25.9
	Min. Temp in °C	23.4	21.1	23.6	23.9	24.7	21.8	23.8	23.9
October	Max. Temp in °C	28.1	28	26.6	25.9	29.2	28.6	26.8	25.9
	Min. Temp in °C	23.3	21.1	23.6	23.9	24.4	21.6	23.8	23.9
November	Max. Temp in °C	27.7	27.8	26.5	25.9	27.8	27.9	26.6	25.9
	Min. Temp in °C	22.9	20.9	23.5	23.9	23.1	21	23.6	23.9
December	Max. Temp in °C	26.8	27.4	26.4	25.8	26.2	27	26.3	25.8
	Min. Temp in °C	22.1	20.4	23.4	23.8	21.5	20.1	23.3	23.8

	City	Bhubaneshwar				Bhuj			
Months	90% Acceptibility Range	NV	MM	AC.air.tem	AC.std.eftv	NV	MM	AC.air.tem	AC.std.eftv
January	Max. Temp in °C	27.1	27.5	26.5	25.8	25.9	26.9	26.3	25.8
	Min. Temp in °C	22.3	20.6	23.5	23.8	21.2	20	23.3	23.8
February	Max. Temp in °C	28.6	28.2	26.7	25.9	26.3	27.1	26.4	25.8
	Min. Temp in °C	23.8	20.6	23.7	23.9	21.5	20	23.4	23.8
March	Max. Temp in °C	30.3	29.2	26.9	25.9	28.5	28.2	26.7	25.9
	Min. Temp in °C	25.6	22.2	23.9	23.9	23.7	21.3	23.7	23.9
April	Max. Temp in °C	31.6	29.8	27.1	26	30.9	29.5	27	25.9
	Min. Temp in °C	26.8	22.9	24.1	24	26.1	22.5	24	23.9
May	Max. Temp in °C	31.9	30	27.2	26	32.5	30.3	27.2	26
	Min. Temp in °C	27.1	23.1	24.2	24	27.7	23.4	24.2	24
June	Max. Temp in °C	32.6	30.3	27.3	26	32.5	30.3	27.2	26
	Min. Temp in °C	27.8	23.4	24.3	24	27.8	23.4	24.2	24
July	Max. Temp in °C	31.4	29.7	27.1	25.9	32.1	30.1	27.2	26
	Min. Temp in °C	26.6	22.8	24.1	23.9	27.3	23.2	24.2	24
August	Max. Temp in °C	30.6	29.3	27	25.9	31.3	29.6	27.1	25.9
	Min. Temp in °C	25.9	22.4	24	23.9	26.5	22.7	24.1	23.9
September	Max. Temp in °C	30.6	29.3	27	25.9	31	29.5	27	25.9
	Min. Temp in °C	25.8	22.4	24	23.9	26.2	22.6	24	23.9
October	Max. Temp in °C	30.2	29.1	26.9	25.9	31.7	29.9	27.1	26
	Min. Temp in °C	25.4	22.2	23.9	23.9	26.9	23	24.1	24
November	Max. Temp in °C	28.9	28.4	26.7	25.9	30.3	29.1	26.9	25.9
	Min. Temp in °C	24.1	21.5	23.7	23.9	25.5	22.2	23.9	23.9
December	Max. Temp in °C	27.4	27.6	26.5	25.8	27.6	27.7	26.5	25.9
	Min. Temp in °C	22.6	20.7	23.5	23.8	22.8	20.8	23.5	23.9

	City	Barmer				Bhagalpur			
Months	90% Acceptibility Range	NV	MM	AC.air.tem	AC.std.eftv	NV	MM	AC.air.tem	AC.std.eftv
January	Max. Temp in °C	25	26.4	26.2	25.8	25.5	26.7	26.2	25.8
	Min. Temp in °C	20.3	19.5	23.2	23.8	20.7	19.7	23.2	23.8
February	Max. Temp in °C	25.3	26.6	26.2	25.8	26.1	27	26.3	25.8
	Min. Temp in °C	20.5	19.5	23.2	23.8	21.3	19.7	23.3	23.8
March	Max. Temp in °C	27.9	27.9	26.6	25.9	28.3	28.1	26.6	25.9
	Min. Temp in °C	23.1	21	23.6	23.9	23.5	21.2	23.6	23.9
April	Max. Temp in °C	30.9	29.5	27	25.9	30.7	29.3	27	25.9
	Min. Temp in °C	26.1	22.5	24	23.9	25.9	22.4	24	23.9
May	Max. Temp in °C	33.1	30.6	27.3	26	31.6	29.8	27.1	26
	Min. Temp in °C	28.4	23.7	24.3	24	26.8	22.9	24.1	24
June	Max. Temp in °C	34	31.1	27.5	26	31.9	30	27.2	26
	Min. Temp in °C	29.3	24.2	24.5	24	27.2	23.1	24.2	24
July	Max. Temp in °C	32.9	30.5	27.3	26	31.5	29.8	27.1	26
	Min. Temp in °C	28.2	23.6	24.3	24	26.7	22.8	24.1	24
August	Max. Temp in °C	31.8	29.9	27.1	26	31.5	29.8	27.1	26
	Min. Temp in °C	27	23	24.1	24	26.7	22.9	24.1	24
September	Max. Temp in °C	31.5	29.8	27.1	26	31.4	29.7	27.1	26
	Min. Temp in °C	26.7	22.9	24.1	24	26.7	22.8	24.1	24
October	Max. Temp in °C	31.7	29.9	27.1	26	31	29.5	27	25.9
	Min. Temp in °C	26.9	23	24.1	24	26.3	22.6	24	23.9
November	Max. Temp in °C	29.6	28.8	26.8	25.9	29.5	28.7	26.8	25.9
	Min. Temp in °C	24.8	21.9	23.8	23.9	24.7	21.8	23.8	23.9
December	Max. Temp in °C	26.8	27.3	26.4	25.8	27.2	27.5	26.5	25.8
	Min. Temp in °C	22	20.4	23.4	23.8	22.4	20.6	23.5	23.8

	City	Bikaner				Chennai			
Months	90% Acceptibility Range	NV	MM	AC.air.tem	AC.std.eftv	NV	MM	AC.air.tem	AC.std.eftv
January	Max. Temp in °C	22.7	25.2	25.8	25.7	28.8	28.4	26.7	25.9
	Min. Temp in °C	17.9	18.3	22.8	23.7	24	21.4	23.7	23.9
February	Max. Temp in °C	23.9	25.8	26	25.8	29.4	28.7	26.8	25.9
	Min. Temp in °C	19.1	18.3	23	23.8	24.7	21.4	23.8	23.9
March	Max. Temp in °C	26.7	27.3	26.4	25.8	30.3	29.2	26.9	25.9
	Min. Temp in °C	22	20.4	23.4	23.8	25.6	22.2	23.9	23.9
April	Max. Temp in °C	30.3	29.1	26.9	25.9	31.4	29.7	27.1	25.9
	Min. Temp in °C	25.5	22.2	23.9	23.9	26.6	22.8	24.1	23.9
May	Max. Temp in °C	32.6	30.4	27.3	26	32.6	30.3	27.3	26
	Min. Temp in °C	27.8	23.4	24.3	24	27.8	23.4	24.3	24
June	Max. Temp in °C	34	31.1	27.5	26	32.9	30.5	27.3	26
	Min. Temp in °C	29.2	24.2	24.5	24	28.1	23.6	24.3	24
July	Max. Temp in °C	33.4	30.8	27.4	26	31.9	30	27.2	26
	Min. Temp in °C	28.7	23.9	24.4	24	27.1	23.1	24.2	24
August	Max. Temp in °C	32.6	30.3	27.3	26	31.5	29.8	27.1	26
	Min. Temp in °C	27.8	23.4	24.3	24	26.7	22.8	24.1	24
September	Max. Temp in °C	32.4	30.2	27.2	26	31.3	29.7	27.1	25.9
	Min. Temp in °C	27.6	23.3	24.2	24	26.5	22.7	24.1	23.9
October	Max. Temp in °C	31.1	29.6	27	25.9	30.8	29.4	27	25.9
	Min. Temp in °C	26.3	22.6	24	23.9	26	22.5	24	23.9
November	Max. Temp in °C	28.4	28.2	26.7	25.9	30	29	26.9	25.9
	Min. Temp in °C	23.7	21.3	23.7	23.9	25.3	22.1	23.9	23.9
December	Max. Temp in °C	25	26.4	26.2	25.8	29.2	28.6	26.8	25.9
	Min. Temp in °C	20.3	19.5	23.2	23.8	24.5	21.7	23.8	23.9

	City	Chitradurga				Dehradun			
Months	90% Acceptibility Range	NV	MM	AC.air.tem	AC.std.eftv	NV	MM	AC.air.tem	AC.std.eftv
January	Max. Temp in °C	27.7	27.8	26.5	25.9	22.61	25.17	25.82	25.72
	Min. Temp in °C	22.9	20.9	23.5	23.9	17.85	18.25	22.82	23.72
February	Max. Temp in °C	28.6	28.3	26.7	25.9	22.95	25.34	25.87	25.73
	Min. Temp in °C	23.8	20.9	23.7	23.9	18.19	18.25	22.87	23.73
March	Max. Temp in °C	29.8	28.9	26.9	25.9	24.77	26.29	26.13	25.78
	Min. Temp in °C	25	22	23.9	23.9	20.01	19.37	23.13	23.78
April	Max. Temp in °C	30.9	29.5	27	25.9	27.42	27.66	26.51	25.85
	Min. Temp in °C	26.1	22.5	24	23.9	22.66	20.74	23.51	23.85
May	Max. Temp in °C	30.9	29.5	27	25.9	29.66	28.82	26.84	25.9
	Min. Temp in °C	26.1	22.5	24	23.9	24.9	21.9	23.84	23.9
June	Max. Temp in °C	29.7	28.8	26.8	25.9	30.66	29.34	26.98	25.93
	Min. Temp in °C	24.9	21.9	23.8	23.9	25.9	22.42	23.98	23.93
July	Max. Temp in °C	28.6	28.3	26.7	25.9	30.14	29.07	26.91	25.92
	Min. Temp in °C	23.9	21.4	23.7	23.9	25.38	22.15	23.91	23.92
August	Max. Temp in °C	28.2	28.1	26.6	25.9	29.66	28.82	26.84	25.9
	Min. Temp in °C	23.5	21.2	23.6	23.9	24.9	21.9	23.84	23.9
September	Max. Temp in °C	28.4	28.2	26.7	25.9	29.34	28.66	26.79	25.9
	Min. Temp in °C	23.7	21.3	23.7	23.9	24.58	21.74	23.79	23.9
October	Max. Temp in °C	28.5	28.2	26.7	25.9	28.21	28.07	26.63	25.87
	Min. Temp in °C	23.7	21.3	23.7	23.9	23.45	21.15	23.63	23.87
November	Max. Temp in °C	28.1	28	26.6	25.9	26.04	26.94	26.31	25.81
	Min. Temp in °C	23.3	21.1	23.6	23.9	21.28	20.02	23.31	23.81
December	Max. Temp in °C	27.5	27.7	26.5	25.8	24.09	25.93	26.03	25.76
	Min. Temp in °C	22.8	20.8	23.5	23.8	19.33	19.01	23.03	23.76

	City	Dibrugarh				Gorakhpur			
Months	90% Acceptibility Range	NV	MM	AC.air.tem	AC.std.eftv	NV	MM	AC.air.tem	AC.std.eftv
January	Max. Temp in °C	23.47	25.61	25.94	25.74	23.6	25.68	25.96	25.75
	Min. Temp in °C	18.71	18.69	22.94	23.74	18.84	18.76	22.96	23.75
February	Max. Temp in °C	23.88	25.82	26	25.75	24.55	26.17	26.1	25.77
	Min. Temp in °C	19.12	18.69	23	23.75	19.79	18.76	23.1	23.77
March	Max. Temp in °C	25.37	26.6	26.22	25.79	27.49	27.7	26.52	25.85
	Min. Temp in °C	20.61	19.68	23.22	23.79	22.73	20.78	23.52	23.85
April	Max. Temp in °C	26.91	27.4	26.44	25.83	30.27	29.14	26.93	25.92
	Min. Temp in °C	22.15	20.48	23.44	23.83	25.51	22.22	23.93	23.92
May	Max. Temp in °C	28.28	28.11	26.64	25.87	31.83	29.95	27.15	25.96
	Min. Temp in °C	23.52	21.19	23.64	23.87	27.07	23.03	24.15	23.96
June	Max. Temp in °C	29.64	28.81	26.83	25.9	32.11	30.09	27.19	25.97
	Min. Temp in °C	24.88	21.89	23.83	23.9	27.35	23.17	24.19	23.97
July	Max. Temp in °C	29.93	28.96	26.88	25.91	31.43	29.74	27.09	25.95
	Min. Temp in °C	25.17	22.04	23.88	23.91	26.67	22.82	24.09	23.95
August	Max. Temp in °C	30.06	29.03	26.9	25.92	31.34	29.69	27.08	25.95
	Min. Temp in °C	25.3	22.11	23.9	23.92	26.58	22.77	24.08	23.95
September	Max. Temp in °C	29.95	28.97	26.88	25.91	30.89	29.46	27.01	25.94
	Min. Temp in °C	25.19	22.05	23.88	23.91	26.13	22.54	24.01	23.94
October	Max. Temp in °C	28.94	28.45	26.73	25.89	30.12	29.06	26.9	25.92
	Min. Temp in °C	24.18	21.53	23.73	23.89	25.36	22.14	23.9	23.92
November	Max. Temp in °C	27.19	27.54	26.48	25.84	28.46	28.2	26.66	25.87
	Min. Temp in °C	22.43	20.62	23.48	23.84	23.7	21.28	23.66	23.87
December	Max. Temp in °C	24.92	26.36	26.15	25.78	26.14	27	26.33	25.81
	Min. Temp in °C	20.16	19.44	23.15	23.78	21.38	20.08	23.33	23.81

	City	Guwahati				Gwalior			
Months	90% Acceptibility Range	NV	MM	AC.air.tem	AC.std.eftv	NV	MM	AC.air.tem	AC.std.eftv
January	Max. Temp in °C	24.62	26.21	26.11	25.77	23.1	25.42	25.89	25.73
	Min. Temp in °C	19.86	19.29	23.11	23.77	18.34	18.5	22.89	23.73
February	Max. Temp in °C	25.03	26.42	26.17	25.78	24.46	26.13	26.09	25.77
	Min. Temp in °C	20.27	19.29	23.17	23.78	19.7	18.5	23.09	23.77
March	Max. Temp in °C	26.34	27.1	26.36	25.82	26.85	27.36	26.43	25.83
	Min. Temp in °C	21.58	20.18	23.36	23.82	22.09	20.44	23.43	23.83
April	Max. Temp in °C	28.14	28.03	26.62	25.87	29.84	28.92	26.86	25.91
	Min. Temp in °C	23.38	21.11	23.62	23.87	25.08	22	23.86	23.91
May	Max. Temp in °C	29.47	28.73	26.81	25.9	32.53	30.31	27.25	25.98
	Min. Temp in °C	24.71	21.81	23.81	23.9	27.77	23.39	24.25	23.98
June	Max. Temp in °C	30.38	29.2	26.94	25.92	34.03	31.09	27.47	26.02
	Min. Temp in °C	25.62	22.28	23.94	23.92	29.27	24.17	24.47	24.02
July	Max. Temp in °C	30.36	29.18	26.94	25.92	32.51	30.3	27.25	25.98
	Min. Temp in °C	25.6	22.26	23.94	23.92	27.75	23.38	24.25	23.98
August	Max. Temp in °C	30.59	29.31	26.97	25.93	31.38	29.71	27.09	25.95
	Min. Temp in °C	25.83	22.39	23.97	23.93	26.62	22.79	24.09	23.95
September	Max. Temp in °C	30.47	29.24	26.95	25.93	31.46	29.75	27.1	25.95
	Min. Temp in °C	25.71	22.32	23.95	23.93	26.7	22.83	24.1	23.95
October	Max. Temp in °C	29.64	28.81	26.83	25.9	29.96	28.98	26.88	25.91
	Min. Temp in °C	24.88	21.89	23.83	23.9	25.2	22.06	23.88	23.91
November	Max. Temp in °C	28.17	28.05	26.62	25.87	27.64	27.77	26.55	25.85
	Min. Temp in °C	23.41	21.13	23.62	23.87	22.88	20.85	23.55	23.85
December	Max. Temp in °C	26.14	27	26.33	25.81	24.61	26.21	26.11	25.77
	Min. Temp in °C	21.38	20.08	23.33	23.81	19.85	19.29	23.11	23.77

	City	Hisar				Hyderabad			
Months	90% Acceptibility Range	NV	MM	AC.air.tem	AC.std.eftv	NV	MM	AC.air.tem	AC.std.eftv
January	Max. Temp in °C	23.19	25.47	25.9	25.74	27.18	27.54	26.48	25.84
	Min. Temp in °C	18.43	18.55	22.9	23.74	22.42	20.62	23.48	23.84
February	Max. Temp in °C	23.9	25.84	26.01	25.76	28.32	28.13	26.64	25.87
	Min. Temp in °C	19.14	18.55	23.01	23.76	23.56	20.62	23.64	23.87
March	Max. Temp in °C	26.64	27.26	26.4	25.83	29.84	28.92	26.86	25.91
	Min. Temp in °C	21.88	20.34	23.4	23.83	25.08	22	23.86	23.91
April	Max. Temp in °C	29.88	28.94	26.87	25.91	31.57	29.81	27.11	25.95
	Min. Temp in °C	25.12	22.02	23.87	23.91	26.81	22.89	24.11	23.95
May	Max. Temp in °C	32.78	30.44	27.29	25.99	32.15	30.11	27.2	25.97
	Min. Temp in °C	28.02	23.52	24.29	23.99	27.39	23.19	24.2	23.97
June	Max. Temp in °C	33.87	31	27.44	26.01	31.83	29.95	27.15	25.96
	Min. Temp in °C	29.11	24.08	24.44	24.01	27.07	23.03	24.15	23.96
July	Max. Temp in °C	33.73	30.93	27.42	26.01	30.5	29.26	26.96	25.93
	Min. Temp in °C	28.97	24.01	24.42	24.01	25.74	22.34	23.96	23.93
August	Max. Temp in °C	32.48	30.29	27.24	25.98	29.42	28.7	26.8	25.9
	Min. Temp in °C	27.72	23.37	24.24	23.98	24.66	21.78	23.8	23.9
September	Max. Temp in °C	31.74	29.9	27.14	25.96	29.52	28.75	26.82	25.9
	Min. Temp in °C	26.98	22.98	24.14	23.96	24.76	21.83	23.82	23.9
October	Max. Temp in °C	30.72	29.37	26.99	25.93	29.15	28.56	26.76	25.89
	Min. Temp in °C	25.96	22.45	23.99	23.93	24.39	21.64	23.76	23.89
November	Max. Temp in °C	28.42	28.18	26.66	25.87	28.51	28.23	26.67	25.87
	Min. Temp in °C	23.66	21.26	23.66	23.87	23.75	21.31	23.67	23.87
December	Max. Temp in °C	25.58	26.71	26.25	25.8	27.47	27.69	26.52	25.85
	Min. Temp in °C	20.82	19.79	23.25	23.8	22.71	20.77	23.52	23.85

	City	Imphal				Indore			
Months	90% Acceptibility Range	NV	MM	AC.air.tem	AC.std.eftv	NV	MM	AC.air.tem	AC.std.eftv
January	Max. Temp in °C	22.23	24.97	25.76	25.71	25.05	26.43	26.17	25.78
	Min. Temp in °C	17.47	18.05	22.76	23.71	20.29	19.51	23.17	23.78
February	Max. Temp in °C	22.65	25.19	25.83	25.72	25.83	26.84	26.28	25.81
	Min. Temp in °C	17.89	18.05	22.83	23.72	21.07	19.51	23.28	23.81
March	Max. Temp in °C	24.28	26.03	26.06	25.77	27.67	27.79	26.55	25.85
	Min. Temp in °C	19.52	19.11	23.06	23.77	22.91	20.87	23.55	23.85
April	Max. Temp in °C	25.96	26.9	26.3	25.81	30.23	29.12	26.92	25.92
	Min. Temp in °C	21.2	19.98	23.3	23.81	25.47	22.2	23.92	23.92
May	Max. Temp in °C	27.32	27.61	26.5	25.84	32.06	30.07	27.18	25.97
	Min. Temp in °C	22.56	20.69	23.5	23.84	27.3	23.15	24.18	23.97
June	Max. Temp in °C	28.45	28.19	26.66	25.87	31.86	29.96	27.15	25.96
	Min. Temp in °C	23.69	21.27	23.66	23.87	27.1	23.04	24.15	23.96
July	Max. Temp in °C	28.76	28.36	26.71	25.88	30.27	29.14	26.93	25.92
	Min. Temp in °C	24	21.44	23.71	23.88	25.51	22.22	23.93	23.92
August	Max. Temp in °C	28.99	28.47	26.74	25.89	29.11	28.54	26.76	25.89
	Min. Temp in °C	24.23	21.55	23.74	23.89	24.35	21.62	23.76	23.89
September	Max. Temp in °C	28.78	28.37	26.71	25.88	28.87	28.41	26.72	25.88
	Min. Temp in °C	24.02	21.45	23.71	23.88	24.11	21.49	23.72	23.88
October	Max. Temp in °C	27.92	27.92	26.59	25.86	29.06	28.51	26.75	25.89
	Min. Temp in °C	23.16	21	23.59	23.86	24.3	21.59	23.75	23.89
November	Max. Temp in °C	25.94	26.89	26.3	25.81	27.76	27.84	26.56	25.86
	Min. Temp in °C	21.18	19.97	23.3	23.81	23	20.92	23.56	23.86
December	Max. Temp in °C	23.47	25.61	25.94	25.74	26.05	26.95	26.32	25.81
	Min. Temp in °C	18.71	18.69	22.94	23.74	21.29	20.03	23.32	23.81

	City	Jaipur				Jaisalmer			
Months	90% Acceptibility Range	NV	MM	AC.air.tem	AC.std.eftv	NV	MM	AC.air.tem	AC.std.eftv
January	Max. Temp in °C	24.13	25.95	26.04	25.76	24.9	26.36	26.15	25.78
	Min. Temp in °C	19.37	19.03	23.04	23.76	20.14	19.44	23.15	23.78
February	Max. Temp in °C	24.58	26.19	26.1	25.77	25.31	26.57	26.21	25.79
	Min. Temp in °C	19.82	19.03	23.1	23.77	20.55	19.44	23.21	23.79
March	Max. Temp in °C	27.09	27.49	26.47	25.84	28	27.96	26.6	25.86
	Min. Temp in °C	22.33	20.57	23.47	23.84	23.24	21.04	23.6	23.86
April	Max. Temp in °C	29.96	28.98	26.88	25.91	31.11	29.58	27.05	25.94
	Min. Temp in °C	25.2	22.06	23.88	23.91	26.35	22.66	24.05	23.94
May	Max. Temp in °C	32.5	30.29	27.25	25.98	33.18	30.65	27.35	26
	Min. Temp in °C	27.74	23.37	24.25	23.98	28.42	23.73	24.35	24
June	Max. Temp in °C	33.78	30.96	27.43	26.01	33.89	31.01	27.45	26.01
	Min. Temp in °C	29.02	24.04	24.43	24.01	29.13	24.09	24.45	24.01
July	Max. Temp in °C	32.41	30.25	27.23	25.98	33.17	30.64	27.34	26
	Min. Temp in °C	27.65	23.33	24.23	23.98	28.41	23.72	24.34	24
August	Max. Temp in °C	30.71	29.37	26.99	25.93	32.43	30.26	27.24	25.98
	Min. Temp in °C	25.95	22.45	23.99	23.93	27.67	23.34	24.24	23.98
September	Max. Temp in °C	30.69	29.36	26.99	25.93	32.29	30.18	27.22	25.97
	Min. Temp in °C	25.93	22.44	23.99	23.93	27.53	23.26	24.22	23.97
October	Max. Temp in °C	30.71	29.37	26.99	25.93	32.16	30.12	27.2	25.97
	Min. Temp in °C	25.95	22.45	23.99	23.93	27.4	23.2	24.2	23.97
November	Max. Temp in °C	28.63	28.29	26.69	25.88	29.96	28.98	26.88	25.91
	Min. Temp in °C	23.87	21.37	23.69	23.88	25.2	22.06	23.88	23.91
December	Max. Temp in °C	25.99	26.92	26.31	25.81	26.89	27.39	26.44	25.83
	Min. Temp in °C	21.23	20	23.31	23.81	22.13	20.47	23.44	23.83

	City	Jodhpur				Jabalpur			
Months	90% Acceptibility Range	NV	MM	AC.air.tem	AC.std.eftv	NV	MM	AC.air.tem	AC.std.eftv
January	Max. Temp in °C	25.44	26.64	26.23	25.8	24.43	26.11	26.08	25.77
	Min. Temp in °C	20.68	19.72	23.23	23.8	19.67	19.19	23.08	23.77
February	Max. Temp in °C	25.63	26.73	26.26	25.8	25.54	26.69	26.24	25.8
	Min. Temp in °C	20.87	19.72	23.26	23.8	20.78	19.19	23.24	23.8
March	Max. Temp in °C	28.47	28.2	26.66	25.87	27.55	27.73	26.53	25.85
	Min. Temp in °C	23.71	21.28	23.66	23.87	22.79	20.81	23.53	23.85
April	Max. Temp in °C	31.72	29.89	27.13	25.96	30.12	29.06	26.9	25.92
	Min. Temp in °C	26.96	22.97	24.13	23.96	25.36	22.14	23.9	23.92
May	Max. Temp in °C	33.49	30.81	27.39	26	31.9	29.98	27.16	25.96
	Min. Temp in °C	28.73	23.89	24.39	24	27.14	23.06	24.16	23.96
June	Max. Temp in °C	33.99	31.07	27.46	26.02	32.46	30.27	27.24	25.98
	Min. Temp in °C	29.23	24.15	24.46	24.02	27.7	23.35	24.24	23.98
July	Max. Temp in °C	33.06	30.59	27.33	25.99	30.84	29.43	27.01	25.94
	Min. Temp in °C	28.3	23.67	24.33	23.99	26.08	22.51	24.01	23.94
August	Max. Temp in °C	31.6	29.83	27.12	25.95	29.66	28.82	26.84	25.9
	Min. Temp in °C	26.84	22.91	24.12	23.95	24.9	21.9	23.84	23.9
September	Max. Temp in °C	31.58	29.82	27.11	25.95	29.82	28.9	26.86	25.91
	Min. Temp in °C	26.82	22.9	24.11	23.95	25.06	21.98	23.86	23.91
October	Max. Temp in °C	31.85	29.96	27.15	25.96	29.41	28.7	26.8	25.9
	Min. Temp in °C	27.09	23.04	24.15	23.96	24.65	21.78	23.8	23.9
November	Max. Temp in °C	29.58	28.78	26.83	25.9	27.69	27.8	26.55	25.85
	Min. Temp in °C	24.82	21.86	23.83	23.9	22.93	20.88	23.55	23.85
December	Max. Temp in °C	27.03	27.46	26.46	25.84	25.31	26.57	26.21	25.79
	Min. Temp in °C	22.27	20.54	23.46	23.84	20.55	19.65	23.21	23.79

	City	Jagdalpur				Jamnagar			
Months	90% Acceptibility Range	NV	MM	AC.air.tem	AC.std.eftv	NV	MM	AC.air.tem	AC.std.eftv
January	Max. Temp in °C	25.78	26.81	26.28	25.8	25.5	26.67	26.24	25.8
	Min. Temp in °C	21.02	19.89	23.28	23.8	20.74	19.75	23.24	23.8
February	Max. Temp in °C	26.6	27.24	26.4	25.83	25.83	26.84	26.28	25.81
	Min. Temp in °C	21.84	19.89	23.4	23.83	21.07	19.75	23.28	23.81
March	Max. Temp in °C	28.04	27.98	26.6	25.86	27.33	27.62	26.5	25.84
	Min. Temp in °C	23.28	21.06	23.6	23.86	22.57	20.7	23.5	23.84
April	Max. Temp in °C	30.06	29.03	26.89	25.91	29.33	28.65	26.79	25.9
	Min. Temp in °C	25.3	22.11	23.89	23.91	24.57	21.73	23.79	23.9
May	Max. Temp in °C	31.23	29.63	27.06	25.95	30.82	29.42	27	25.93
	Min. Temp in °C	26.47	22.71	24.06	23.95	26.06	22.5	24	23.93
June	Max. Temp in °C	30.52	29.27	26.96	25.93	31.59	29.83	27.12	25.95
	Min. Temp in °C	25.76	22.35	23.96	23.93	26.83	22.91	24.12	23.95
July	Max. Temp in °C	29.3	28.63	26.78	25.9	31.25	29.65	27.07	25.95
	Min. Temp in °C	24.54	21.71	23.78	23.9	26.49	22.73	24.07	23.95
August	Max. Temp in °C	28.71	28.33	26.7	25.88	30.33	29.17	26.93	25.92
	Min. Temp in °C	23.95	21.41	23.7	23.88	25.57	22.25	23.93	23.92
September	Max. Temp in °C	28.91	28.43	26.73	25.89	30	29	26.89	25.91
	Min. Temp in °C	24.15	21.51	23.73	23.89	25.24	22.08	23.89	23.91
October	Max. Temp in °C	28.82	28.39	26.72	25.88	30.23	29.12	26.92	25.92
	Min. Temp in °C	24.06	21.47	23.72	23.88	25.47	22.2	23.92	23.92
November	Max. Temp in °C	27.54	27.72	26.53	25.85	29.04	28.5	26.75	25.89
	Min. Temp in °C	22.78	20.8	23.53	23.85	24.28	21.58	23.75	23.89
December	Max. Temp in °C	26.17	27.01	26.33	25.81	27.08	27.49	26.47	25.84
	Min. Temp in °C	21.41	20.09	23.33	23.81	22.32	20.57	23.47	23.84

	City	Jorhat				Kolkata			
Months	90% Acceptibility Range	NV	MM	AC.air.tem	AC.std.eftv	NV	MM	AC.air.tem	AC.std.eftv
January	Max. Temp in °C	23.84	25.81	26	25.75	25.87	26.86	26.29	25.81
	Min. Temp in °C	19.08	18.89	23	23.75	21.11	19.94	23.29	23.81
February	Max. Temp in °C	24.3	26.04	26.06	25.77	26.5	27.18	26.38	25.82
	Min. Temp in °C	19.54	18.89	23.06	23.77	21.74	19.94	23.38	23.82
March	Max. Temp in °C	25.86	26.85	26.29	25.81	28.93	28.45	26.73	25.89
	Min. Temp in °C	21.1	19.93	23.29	23.81	24.17	21.53	23.73	23.89
April	Max. Temp in °C	27.29	27.59	26.5	25.84	31.2	29.62	27.06	25.94
	Min. Temp in °C	22.53	20.67	23.5	23.84	26.44	22.7	24.06	23.94
May	Max. Temp in °C	28.53	28.24	26.67	25.88	31.6	29.83	27.12	25.96
	Min. Temp in °C	23.77	21.32	23.67	23.88	26.84	22.91	24.12	23.96
June	Max. Temp in °C	29.93	28.96	26.88	25.91	31.75	29.9	27.14	25.96
	Min. Temp in °C	25.17	22.04	23.88	23.91	26.99	22.98	24.14	23.96
July	Max. Temp in °C	30.42	29.22	26.95	25.92	31.18	29.61	27.06	25.94
	Min. Temp in °C	25.66	22.3	23.95	23.92	26.42	22.69	24.06	23.94
August	Max. Temp in °C	30.72	29.37	26.99	25.93	31.15	29.6	27.05	25.94
	Min. Temp in °C	25.96	22.45	23.99	23.93	26.39	22.68	24.05	23.94
September	Max. Temp in °C	30.54	29.28	26.96	25.93	31.07	29.56	27.04	25.94
	Min. Temp in °C	25.78	22.36	23.96	23.93	26.31	22.64	24.04	23.94
October	Max. Temp in °C	29.64	28.81	26.83	25.9	30.54	29.28	26.96	25.93
	Min. Temp in °C	24.88	21.89	23.83	23.9	25.78	22.36	23.96	23.93
November	Max. Temp in °C	27.81	27.86	26.57	25.86	29.26	28.62	26.78	25.89
	Min. Temp in °C	23.05	20.94	23.57	23.86	24.5	21.7	23.78	23.89
December	Max. Temp in °C	25.21	26.52	26.2	25.79	27.23	27.56	26.49	25.84
	Min. Temp in °C	20.45	19.6	23.2	23.79	22.47	20.64	23.49	23.84

	City	Kurnool				Kota			
Months	90% Acceptibility Range	NV	MM	AC.air.tem	AC.std.eftv	NV	MM	AC.air.tem	AC.std.eftv
January	Max. Temp in °C	28.35	28.15	26.65	25.87	24.76	26.28	26.13	25.78
	Min. Temp in °C	23.59	21.23	23.65	23.87	20	19.36	23.13	23.78
February	Max. Temp in °C	29.39	28.68	26.8	25.9	24.88	26.35	26.15	25.78
	Min. Temp in °C	24.63	21.23	23.8	23.9	20.12	19.36	23.15	23.78
March	Max. Temp in °C	30.91	29.47	27.02	25.94	27.4	27.65	26.51	25.85
	Min. Temp in °C	26.15	22.55	24.02	23.94	22.64	20.73	23.51	23.85
April	Max. Temp in °C	32.86	30.48	27.3	25.99	30.91	29.47	27.02	25.94
	Min. Temp in °C	28.1	23.56	24.3	23.99	26.15	22.55	24.02	23.94
May	Max. Temp in °C	33.8	30.97	27.44	26.01	33.75	30.94	27.43	26.01
	Min. Temp in °C	29.04	24.05	24.44	24.01	28.99	24.02	24.43	24.01
June	Max. Temp in °C	33.11	30.61	27.34	25.99	34.43	31.29	27.53	26.03
	Min. Temp in °C	28.35	23.69	24.34	23.99	29.67	24.37	24.53	24.03
July	Max. Temp in °C	31.52	29.79	27.11	25.95	32.25	30.16	27.21	25.97
	Min. Temp in °C	26.76	22.87	24.11	23.95	27.49	23.24	24.21	23.97
August	Max. Temp in °C	30.59	29.3	26.97	25.93	30.73	29.38	26.99	25.93
	Min. Temp in °C	25.83	22.38	23.97	23.93	25.97	22.46	23.99	23.93
September	Max. Temp in °C	30.25	29.13	26.92	25.92	30.6	29.31	26.97	25.93
	Min. Temp in °C	25.49	22.21	23.92	23.92	25.84	22.39	23.97	23.93
October	Max. Temp in °C	30.22	29.11	26.92	25.92	30.59	29.31	26.97	25.93
	Min. Temp in °C	25.46	22.19	23.92	23.92	25.83	22.39	23.97	23.93
November	Max. Temp in °C	29.51	28.75	26.82	25.9	28.63	28.29	26.69	25.88
	Min. Temp in °C	24.75	21.83	23.82	23.9	23.87	21.37	23.69	23.88
December	Max. Temp in °C	28.39	28.16	26.65	25.87	26.18	27.02	26.33	25.81
	Min. Temp in °C	23.63	21.24	23.65	23.87	21.42	20.1	23.33	23.81

	City	Lucknow				Mumbai			
Months	90% Acceptibility Range	NV	MM	AC.air.tem	AC.std.eftv	NV	MM	AC.air.tem	AC.std.eftv
January	Max. Temp in °C	23.71	25.74	25.98	25.75	28.82	28.39	26.72	25.88
	Min. Temp in °C	18.95	18.82	22.98	23.75	24.06	21.47	23.72	23.88
February	Max. Temp in °C	24.61	26.2	26.11	25.77	28.89	28.42	26.73	25.88
	Min. Temp in °C	19.85	18.82	23.11	23.77	24.13	21.47	23.73	23.88
March	Max. Temp in °C	27.18	27.54	26.48	25.84	29.28	28.62	26.78	25.89
	Min. Temp in °C	22.42	20.62	23.48	23.84	24.52	21.7	23.78	23.89
April	Max. Temp in °C	30.33	29.17	26.93	25.92	30.14	29.07	26.91	25.92
	Min. Temp in °C	25.57	22.25	23.93	23.92	25.38	22.15	23.91	23.92
May	Max. Temp in °C	32.48	30.28	27.24	25.98	31.15	29.6	27.05	25.94
	Min. Temp in °C	27.72	23.36	24.24	23.98	26.39	22.68	24.05	23.94
June	Max. Temp in °C	33.06	30.59	27.33	25.99	31.3	29.67	27.07	25.95
	Min. Temp in °C	28.3	23.67	24.33	23.99	26.54	22.75	24.07	23.95
July	Max. Temp in °C	32.12	30.1	27.19	25.97	30.68	29.35	26.98	25.93
	Min. Temp in °C	27.36	23.18	24.19	23.97	25.92	22.43	23.98	23.93
August	Max. Temp in °C	31.17	29.61	27.06	25.94	30.23	29.12	26.92	25.92
	Min. Temp in °C	26.41	22.69	24.06	23.94	25.47	22.2	23.92	23.92
September	Max. Temp in °C	30.72	29.37	26.99	25.93	30.23	29.12	26.92	25.92
	Min. Temp in °C	25.96	22.45	23.99	23.93	25.47	22.2	23.92	23.92
October	Max. Temp in °C	29.71	28.85	26.84	25.91	30.4	29.21	26.94	25.92
	Min. Temp in °C	24.95	21.93	23.84	23.91	25.64	22.29	23.94	23.92
November	Max. Temp in °C	27.8	27.86	26.57	25.86	30.22	29.11	26.92	25.92
	Min. Temp in °C	23.04	20.94	23.57	23.86	25.46	22.19	23.92	23.92
December	Max. Temp in °C	25.45	26.64	26.23	25.8	29.28	28.63	26.78	25.89
	Min. Temp in °C	20.69	19.72	23.23	23.8	24.52	21.71	23.78	23.89

	City	Mangalore				Nagpur			
Months	90% Acceptibility Range	NV	MM	AC.air.tem	AC.std.eftv	NV	MM	AC.air.tem	AC.std.eftv
January	Max. Temp in °C	29.72	28.86	26.85	25.91	26.52	27.2	26.38	25.82
	Min. Temp in °C	24.96	21.94	23.85	23.91	21.76	20.28	23.38	23.82
February	Max. Temp in °C	29.8	28.89	26.86	25.91	27.48	27.69	26.52	25.85
	Min. Temp in °C	25.04	21.94	23.86	23.91	22.72	20.28	23.52	23.85
March	Max. Temp in °C	30.32	29.16	26.93	25.92	28.8	28.38	26.71	25.88
	Min. Temp in °C	25.56	22.24	23.93	23.92	24.04	21.46	23.71	23.88
April	Max. Temp in °C	30.81	29.42	27	25.93	30.99	29.51	27.03	25.94
	Min. Temp in °C	26.05	22.5	24	23.93	26.23	22.59	24.03	23.94
May	Max. Temp in °C	31.07	29.55	27.04	25.94	33.34	30.73	27.37	26
	Min. Temp in °C	26.31	22.63	24.04	23.94	28.58	23.81	24.37	24
June	Max. Temp in °C	30.25	29.13	26.92	25.92	33.67	30.9	27.42	26.01
	Min. Temp in °C	25.49	22.21	23.92	23.92	28.91	23.98	24.42	24.01
July	Max. Temp in °C	29.17	28.57	26.77	25.89	31.34	29.69	27.08	25.95
	Min. Temp in °C	24.41	21.65	23.77	23.89	26.58	22.77	24.08	23.95
August	Max. Temp in °C	28.94	28.45	26.73	25.89	29.83	28.91	26.86	25.91
	Min. Temp in °C	24.18	21.53	23.73	23.89	25.07	21.99	23.86	23.91
September	Max. Temp in °C	29.28	28.62	26.78	25.89	29.91	28.95	26.87	25.91
	Min. Temp in °C	24.52	21.7	23.78	23.89	25.15	22.03	23.87	23.91
October	Max. Temp in °C	29.64	28.81	26.83	25.9	29.94	28.97	26.88	25.91
	Min. Temp in °C	24.88	21.89	23.83	23.9	25.18	22.05	23.88	23.91
November	Max. Temp in °C	29.96	28.98	26.88	25.91	28.44	28.19	26.66	25.87
	Min. Temp in °C	25.2	22.06	23.88	23.91	23.68	21.27	23.66	23.87
December	Max. Temp in °C	29.91	28.95	26.87	25.91	26.79	27.33	26.42	25.83
	Min. Temp in °C	25.15	22.03	23.87	23.91	22.03	20.41	23.42	23.83

	City	Nellore				New Delhi			
Months	90% Acceptibility Range	NV	MM	AC.air.tem	AC.std.eftv	NV	MM	AC.air.tem	AC.std.eftv
January	Max. Temp in °C	28.67	28.311	26.695	25.879	22.7	25.22	25.83	25.72
	Min. Temp in °C	23.91	21.391	23.695	23.879	17.94	18.3	22.83	23.72
February	Max. Temp in °C	29.43	28.701	26.803	25.899	23.61	25.69	25.96	25.75
	Min. Temp in °C	24.67	21.391	23.803	23.899	18.85	18.3	22.96	23.75
March	Max. Temp in °C	30.57	29.296	26.969	25.928	26.08	26.97	26.32	25.81
	Min. Temp in °C	25.81	22.376	23.969	23.928	21.32	20.05	23.32	23.81
April	Max. Temp in °C	32	30.033	27.175	25.965	29.66	28.82	26.84	25.9
	Min. Temp in °C	27.24	23.113	24.175	23.965	24.9	21.9	23.84	23.9
May	Max. Temp in °C	33.25	30.685	27.356	25.998	32.49	30.29	27.25	25.98
	Min. Temp in °C	28.49	23.765	24.356	23.998	27.73	23.37	24.25	23.98
June	Max. Temp in °C	33.15	30.632	27.341	25.995	32.98	30.54	27.32	25.99
	Min. Temp in °C	28.39	23.712	24.341	23.995	28.22	23.62	24.32	23.99
July	Max. Temp in °C	32.31	30.194	27.219	25.973	32.19	30.14	27.2	25.97
	Min. Temp in °C	27.55	23.274	24.219	23.973	27.43	23.22	24.2	23.97
August	Max. Temp in °C	31.67	29.863	27.127	25.957	31.69	29.87	27.13	25.96
	Min. Temp in °C	26.91	22.943	24.127	23.957	26.93	22.95	24.13	23.96
September	Max. Temp in °C	31.5	29.775	27.103	25.952	31.42	29.74	27.09	25.95
	Min. Temp in °C	26.74	22.855	24.103	23.952	26.66	22.82	24.09	23.95
October	Max. Temp in °C	30.97	29.504	27.027	25.939	30.49	29.25	26.96	25.93
	Min. Temp in °C	26.21	22.584	24.027	23.939	25.73	22.33	23.96	23.93
November	Max. Temp in °C	29.9	28.948	26.872	25.911	28.08	28	26.61	25.86
	Min. Temp in °C	25.14	22.028	23.872	23.911	23.32	21.08	23.61	23.86
December	Max. Temp in °C	29.04	28.5	26.747	25.888	24.9	26.35	26.15	25.78
	Min. Temp in °C	24.28	21.58	23.747	23.888	20.14	19.43	23.15	23.78

	City	Panjim				Patna			
Months	90% Acceptibility Range	NV	MM	AC.air.tem	AC.std.eftv	NV	MM	AC.air.tem	AC.std.eftv
January	Max. Temp in ºC	29.57	28.78	26.82	25.9	24.19	25.99	26.05	25.76
	Min. Temp in ºC	24.81	21.86	23.82	23.9	19.43	19.07	23.05	23.76
February	Max. Temp in ºC	29.7	28.84	26.84	25.91	24.72	26.26	26.12	25.78
	Min. Temp in ºC	24.94	21.86	23.84	23.91	19.96	19.07	23.12	23.78
March	Max. Temp in ºC	29.89	28.94	26.87	25.91	27.13	27.51	26.47	25.84
	Min. Temp in ºC	25.13	22.02	23.87	23.91	22.37	20.59	23.47	23.84
April	Max. Temp in ºC	30.73	29.38	26.99	25.93	29.99	28.99	26.88	25.91
	Min. Temp in ºC	25.97	22.46	23.99	23.93	25.23	22.07	23.88	23.91
May	Max. Temp in ºC	31.27	29.66	27.07	25.95	31.44	29.74	27.09	25.95
	Min. Temp in ºC	26.51	22.74	24.07	23.95	26.68	22.82	24.09	23.95
June	Max. Temp in ºC	30.55	29.28	26.97	25.93	32.24	30.16	27.21	25.97
	Min. Temp in ºC	25.79	22.36	23.97	23.93	27.48	23.24	24.21	23.97
July	Max. Temp in ºC	29.77	28.88	26.85	25.91	31.44	29.74	27.09	25.95
	Min. Temp in ºC	25.01	21.96	23.85	23.91	26.68	22.82	24.09	23.95
August	Max. Temp in ºC	29.47	28.73	26.81	25.9	30.82	29.43	27.01	25.93
	Min. Temp in ºC	24.71	21.81	23.81	23.9	26.06	22.51	24.01	23.93
September	Max. Temp in ºC	29.79	28.89	26.86	25.91	30.9	29.47	27.02	25.94
	Min. Temp in ºC	25.03	21.97	23.86	23.91	26.14	22.55	24.02	23.94
October	Max. Temp in ºC	30.13	29.07	26.91	25.92	29.89	28.94	26.87	25.91
	Min. Temp in ºC	25.37	22.15	23.91	23.92	25.13	22.02	23.87	23.91
November	Max. Temp in ºC	30.48	29.25	26.95	25.93	27.99	27.96	26.6	25.86
	Min. Temp in ºC	25.72	22.33	23.95	23.93	23.23	21.04	23.6	23.86
December	Max. Temp in ºC	30.03	29.01	26.89	25.91	25.69	26.76	26.26	25.8
	Min. Temp in ºC	25.27	22.09	23.89	23.91	20.93	19.84	23.26	23.8

	City	Pune				Rajkot			
Months	90% Acceptibility Range	NV	MM	AC.air.tem	AC.std.eftv	NV	MM	AC.air.tem	AC.std.eftv
January	Max. Temp in ºC	25.91	26.88	26.3	25.81	26.91	27.4	26.44	25.83
	Min. Temp in ºC	21.15	19.96	23.3	23.81	22.15	20.48	23.44	23.83
February	Max. Temp in ºC	26.44	27.15	26.37	25.82	27.66	27.78	26.55	25.85
	Min. Temp in ºC	21.68	19.96	23.37	23.82	22.9	20.48	23.55	23.85
March	Max. Temp in ºC	28.03	27.98	26.6	25.86	29.39	28.68	26.8	25.9
	Min. Temp in ºC	23.27	21.06	23.6	23.86	24.63	21.76	23.8	23.9
April	Max. Temp in ºC	29.78	28.89	26.85	25.91	31.41	29.73	27.09	25.95
	Min. Temp in ºC	25.02	21.97	23.85	23.91	26.65	22.81	24.09	23.95
May	Max. Temp in ºC	30.73	29.38	26.99	25.93	32.78	30.44	27.29	25.99
	Min. Temp in ºC	25.97	22.46	23.99	23.93	28.02	23.52	24.29	23.99
June	Max. Temp in ºC	30.29	29.15	26.93	25.92	33.05	30.58	27.33	25.99
	Min. Temp in ºC	25.53	22.23	23.93	23.92	28.29	23.66	24.33	23.99
July	Max. Temp in ºC	28.93	28.45	26.73	25.89	31.78	29.92	27.14	25.96
	Min. Temp in ºC	24.17	21.53	23.73	23.89	27.02	23	24.14	23.96
August	Max. Temp in ºC	28.28	28.11	26.64	25.87	30.63	29.33	26.98	25.93
	Min. Temp in ºC	23.52	21.19	23.64	23.87	25.87	22.41	23.98	23.93
September	Max. Temp in ºC	28.23	28.08	26.63	25.87	30.52	29.27	26.96	25.93
	Min. Temp in ºC	23.47	21.16	23.63	23.87	25.76	22.35	23.96	23.93
October	Max. Temp in ºC	28.75	28.35	26.71	25.88	31.16	29.6	27.05	25.94
	Min. Temp in ºC	23.99	21.43	23.71	23.88	26.4	22.68	24.05	23.94
November	Max. Temp in ºC	27.84	27.88	26.57	25.86	30.59	29.3	26.97	25.93
	Min. Temp in ºC	23.08	20.96	23.57	23.86	25.83	22.38	23.97	23.93
December	Max. Temp in ºC	26.44	27.15	26.37	25.82	28.65	28.3	26.69	25.88
	Min. Temp in ºC	21.68	20.23	23.37	23.82	23.89	21.38	23.69	23.88

	City	Ratnagiri				Raipur			
Months	90% Acceptibility Range	NV	MM	AC.air.tem	AC.std.eftv	NV	MM	AC.air.tem	AC.std.eftv
January	Max. Temp in °C	29.02	28.49	26.74	25.89	25.9	26.87	26.29	25.81
	Min. Temp in °C	24.26	21.57	23.74	23.89	21.14	19.95	23.29	23.81
February	Max. Temp in °C	28.8	28.37	26.71	25.88	26.99	27.44	26.45	25.84
	Min. Temp in °C	24.04	21.57	23.71	23.88	22.23	19.95	23.45	23.84
March	Max. Temp in °C	29.14	28.55	26.76	25.89	29.15	28.56	26.76	25.89
	Min. Temp in °C	24.38	21.63	23.76	23.89	24.39	21.64	23.76	23.89
April	Max. Temp in °C	29.97	28.98	26.88	25.91	31.47	29.76	27.1	25.95
	Min. Temp in °C	25.21	22.06	23.88	23.91	26.71	22.84	24.1	23.95
May	Max. Temp in °C	30.7	29.36	26.99	25.93	33.12	30.62	27.34	25.99
	Min. Temp in °C	25.94	22.44	23.99	23.93	28.36	23.7	24.34	23.99
June	Max. Temp in °C	30.52	29.27	26.96	25.93	32.87	30.49	27.3	25.99
	Min. Temp in °C	25.76	22.35	23.96	23.93	28.11	23.57	24.3	23.99
July	Max. Temp in °C	29.93	28.96	26.88	25.91	30.55	29.28	26.97	25.93
	Min. Temp in °C	25.17	22.04	23.88	23.91	25.79	22.36	23.97	23.93
August	Max. Temp in °C	29.44	28.71	26.81	25.9	29.95	28.97	26.88	25.91
	Min. Temp in °C	24.68	21.79	23.81	23.9	25.19	22.05	23.88	23.91
September	Max. Temp in °C	29.48	28.73	26.81	25.9	30.03	29.01	26.89	25.91
	Min. Temp in °C	24.72	21.81	23.81	23.9	25.27	22.09	23.89	23.91
October	Max. Temp in °C	29.86	28.93	26.87	25.91	29.85	28.92	26.86	25.91
	Min. Temp in °C	25.1	22.01	23.87	23.91	25.09	22	23.86	23.91
November	Max. Temp in °C	30.25	29.13	26.92	25.92	28.38	28.16	26.65	25.87
	Min. Temp in °C	25.49	22.21	23.92	23.92	23.62	21.24	23.65	23.87
December	Max. Temp in °C	29.63	28.81	26.83	25.9	26.84	27.36	26.43	25.83
	Min. Temp in °C	24.87	21.89	23.83	23.9	22.08	20.44	23.43	23.83

	City	Ramagundam				Ranchi			
Months	90% Acceptibility Range	NV	MM	AC.air.tem	AC.std.eftv	NV	MM	AC.air.tem	AC.std.eftv
January	Max. Temp in °C	27.35	27.63	26.5	25.84	24.06	25.92	26.03	25.76
	Min. Temp in °C	22.59	20.71	23.5	23.84	19.3	19	23.03	23.76
February	Max. Temp in °C	28.48	28.21	26.67	25.87	24.64	26.22	26.11	25.77
	Min. Temp in °C	23.72	20.71	23.67	23.87	19.88	19	23.11	23.77
March	Max. Temp in °C	30.01	29	26.89	25.91	26.87	27.38	26.43	25.83
	Min. Temp in °C	25.25	22.08	23.89	23.91	22.11	20.46	23.43	23.83
April	Max. Temp in °C	32.04	30.06	27.18	25.97	29.52	28.75	26.82	25.9
	Min. Temp in °C	27.28	23.14	24.18	23.97	24.76	21.83	23.82	23.9
May	Max. Temp in °C	33.61	30.87	27.41	26.01	30.94	29.49	27.02	25.94
	Min. Temp in °C	28.85	23.95	24.41	24.01	26.18	22.57	24.02	23.94
June	Max. Temp in °C	33.25	30.68	27.36	26	31.18	29.61	27.06	25.94
	Min. Temp in °C	28.49	23.76	24.36	24	26.42	22.69	24.06	23.94
July	Max. Temp in °C	31.15	29.59	27.05	25.94	29.97	28.98	26.88	25.91
	Min. Temp in °C	26.39	22.67	24.05	23.94	25.21	22.06	23.88	23.91
August	Max. Temp in °C	30.3	29.15	26.93	25.92	29.07	28.52	26.75	25.89
	Min. Temp in °C	25.54	22.23	23.93	23.92	24.31	21.6	23.75	23.89
September	Max. Temp in °C	30.55	29.28	26.97	25.93	28.95	28.46	26.74	25.89
	Min. Temp in °C	25.79	22.36	23.97	23.93	24.19	21.54	23.74	23.89
October	Max. Temp in °C	30.36	29.19	26.94	25.92	28.42	28.18	26.66	25.87
	Min. Temp in °C	25.6	22.27	23.94	23.92	23.66	21.26	23.66	23.87
November	Max. Temp in °C	28.99	28.47	26.74	25.89	26.93	27.41	26.44	25.83
	Min. Temp in °C	24.23	21.55	23.74	23.89	22.17	20.49	23.44	23.83
December	Max. Temp in °C	27.5	27.7	26.52	25.85	25.22	26.52	26.2	25.79
	Min. Temp in °C	22.74	20.78	23.52	23.85	20.46	19.6	23.2	23.79

	City	Raxaul				Solapur			
Months	90% Acceptibility Range	NV	MM	AC.air.tem	AC.std.eftv	NV	MM	AC.air.tem	AC.std.eftv
January	Max. Temp in °C	23.66	25.71	25.97	25.75	28.37	28.15	26.65	25.87
	Min. Temp in °C	18.9	18.79	22.97	23.75	23.61	21.23	23.65	23.87
February	Max. Temp in °C	23.8	25.78	25.99	25.75	29.16	28.56	26.76	25.89
	Min. Temp in °C	19.04	18.79	22.99	23.75	24.4	21.23	23.76	23.89
March	Max. Temp in °C	25.39	26.61	26.22	25.79	30.92	29.47	27.02	25.94
	Min. Temp in °C	20.63	19.69	23.22	23.79	26.16	22.55	24.02	23.94
April	Max. Temp in °C	27.96	27.94	26.59	25.86	32.37	30.23	27.23	25.97
	Min. Temp in °C	23.2	21.02	23.59	23.86	27.61	23.31	24.23	23.97
May	Max. Temp in °C	30.26	29.13	26.92	25.92	32.85	30.48	27.3	25.99
	Min. Temp in °C	25.5	22.21	23.92	23.92	28.09	23.56	24.3	23.99
June	Max. Temp in °C	31.09	29.56	27.04	25.94	32.15	30.12	27.2	25.97
	Min. Temp in °C	26.33	22.64	24.04	23.94	27.39	23.2	24.2	23.97
July	Max. Temp in °C	31.01	29.52	27.03	25.94	30.75	29.39	26.99	25.93
	Min. Temp in °C	26.25	22.6	24.03	23.94	25.99	22.47	23.99	23.93
August	Max. Temp in °C	30.88	29.45	27.01	25.94	29.74	28.86	26.85	25.91
	Min. Temp in °C	26.12	22.53	24.01	23.94	24.98	21.94	23.85	23.91
September	Max. Temp in °C	30.56	29.29	26.97	25.93	29.94	28.97	26.88	25.91
	Min. Temp in °C	25.8	22.37	23.97	23.93	25.18	22.05	23.88	23.91
October	Max. Temp in °C	29.64	28.81	26.83	25.9	29.86	28.93	26.87	25.91
	Min. Temp in °C	24.88	21.89	23.83	23.9	25.1	22.01	23.87	23.91
November	Max. Temp in °C	27.73	27.82	26.56	25.85	29.53	28.76	26.82	25.9
	Min. Temp in °C	22.97	20.9	23.56	23.85	24.77	21.84	23.82	23.9
December	Max. Temp in °C	25.47	26.65	26.23	25.8	28.91	28.44	26.73	25.89
	Min. Temp in °C	20.71	19.73	23.23	23.8	24.15	21.52	23.73	23.89

	City	Saharanpur				Shilong			
Months	90% Acceptibility Range	NV	MM	AC.air.tem	AC.std.eftv	NV	MM	AC.air.tem	AC.std.eftv
January	Max. Temp in °C	21.69	24.69	25.69	25.7	19.16	23.38	25.32	25.63
	Min. Temp in °C	16.93	17.77	22.69	23.7	14.4	16.46	22.32	23.63
February	Max. Temp in °C	22.46	25.09	25.8	25.72	19.37	23.49	25.35	25.64
	Min. Temp in °C	17.7	17.77	22.8	23.72	14.61	16.46	22.35	23.64
March	Max. Temp in °C	24.41	26.1	26.08	25.77	20.66	24.16	25.54	25.67
	Min. Temp in °C	19.65	19.18	23.08	23.77	15.9	17.24	22.54	23.67
April	Max. Temp in °C	27.21	27.55	26.48	25.84	22.62	25.17	25.82	25.72
	Min. Temp in °C	22.45	20.63	23.48	23.84	17.86	18.25	22.82	23.72
May	Max. Temp in °C	29.2	28.58	26.77	25.89	24.16	25.97	26.04	25.76
	Min. Temp in °C	24.44	21.66	23.77	23.89	19.4	19.05	23.04	23.76
June	Max. Temp in °C	30.32	29.16	26.93	25.92	25.09	26.45	26.18	25.79
	Min. Temp in °C	25.56	22.24	23.93	23.92	20.33	19.53	23.18	23.79
July	Max. Temp in °C	31.18	29.61	27.06	25.94	25.47	26.65	26.23	25.8
	Min. Temp in °C	26.42	22.69	24.06	23.94	20.71	19.73	23.23	23.8
August	Max. Temp in °C	30.88	29.45	27.01	25.94	25.61	26.72	26.25	25.8
	Min. Temp in °C	26.12	22.53	24.01	23.94	20.85	19.8	23.25	23.8
September	Max. Temp in °C	30.18	29.09	26.91	25.92	25.32	26.57	26.21	25.79
	Min. Temp in °C	25.42	22.17	23.91	23.92	20.56	19.65	23.21	23.79
October	Max. Temp in °C	28.32	28.13	26.64	25.87	24.27	26.03	26.06	25.76
	Min. Temp in °C	23.56	21.21	23.64	23.87	19.51	19.11	23.06	23.76
November	Max. Temp in °C	25.59	26.71	26.25	25.8	22.23	24.97	25.76	25.71
	Min. Temp in °C	20.83	19.79	23.25	23.8	17.47	18.05	22.76	23.71
December	Max. Temp in °C	23.1	25.42	25.89	25.73	20.21	23.92	25.47	25.66
	Min. Temp in °C	18.34	18.5	22.89	23.73	15.45	17	22.47	23.66

	City	Surat				Thiruvananthapuram			
Months	90% Acceptibility Range	NV	MM	AC.air.tem	AC.std.eftv	NV	MM	AC.air.tem	AC.std.eftv
January	Max. Temp in °C	27.43	27.67	26.51	25.85	29.97	28.98	26.88	25.91
	Min. Temp in °C	22.67	20.75	23.51	23.85	25.21	22.06	23.88	23.91
February	Max. Temp in °C	28.13	28.03	26.62	25.86	30	29	26.89	25.91
	Min. Temp in °C	23.37	20.75	23.62	23.86	25.24	22.06	23.89	23.91
March	Max. Temp in °C	29.15	28.56	26.76	25.89	30.45	29.23	26.95	25.93
	Min. Temp in °C	24.39	21.64	23.76	23.89	25.69	22.31	23.95	23.93
April	Max. Temp in °C	30.86	29.44	27.01	25.94	30.91	29.47	27.02	25.94
	Min. Temp in °C	26.1	22.52	24.01	23.94	26.15	22.55	24.02	23.94
May	Max. Temp in °C	31.91	29.99	27.16	25.96	30.8	29.41	27	25.93
	Min. Temp in °C	27.15	23.07	24.16	23.96	26.04	22.49	24	23.93
June	Max. Temp in °C	31.89	29.98	27.16	25.96	30.33	29.17	26.93	25.92
	Min. Temp in °C	27.13	23.06	24.16	23.96	25.57	22.25	23.93	23.92
July	Max. Temp in °C	31.04	29.54	27.04	25.94	29.77	28.88	26.85	25.91
	Min. Temp in °C	26.28	22.62	24.04	23.94	25.01	21.96	23.85	23.91
August	Max. Temp in °C	30.34	29.18	26.94	25.92	29.63	28.81	26.83	25.9
	Min. Temp in °C	25.58	22.26	23.94	23.92	24.87	21.89	23.83	23.9
September	Max. Temp in °C	30.36	29.19	26.94	25.92	29.8	28.9	26.86	25.91
	Min. Temp in °C	25.6	22.27	23.94	23.92	25.04	21.98	23.86	23.91
October	Max. Temp in °C	30.78	29.4	27	25.93	29.89	28.94	26.87	25.91
	Min. Temp in °C	26.02	22.48	24	23.93	25.13	22.02	23.87	23.91
November	Max. Temp in °C	30.18	29.09	26.91	25.92	29.73	28.86	26.85	25.91
	Min. Temp in °C	25.42	22.17	23.91	23.92	24.97	21.94	23.85	23.91
December	Max. Temp in °C	28.46	28.2	26.66	25.87	29.93	28.96	26.88	25.91
	Min. Temp in °C	23.7	21.28	23.66	23.87	25.17	22.04	23.88	23.91

	City	Tiruchchirapalli				Tezpur			
Months	90% Acceptibility Range	NV	MM	AC.air.tem	AC.std.eftv	NV	MM	AC.air.tem	AC.std.eftv
January	Max. Temp in °C	29	28.48	26.74	25.89	24.59	26.19	26.11	25.77
	Min. Temp in °C	24.24	21.56	23.74	23.89	19.83	19.27	23.11	23.77
February	Max. Temp in °C	29.62	28.8	26.83	25.9	25.09	26.45	26.18	25.79
	Min. Temp in °C	24.86	21.56	23.83	23.9	20.33	19.27	23.18	23.79
March	Max. Temp in °C	30.87	29.45	27.01	25.94	26.64	27.26	26.4	25.83
	Min. Temp in °C	26.11	22.53	24.01	23.94	21.88	20.34	23.4	23.83
April	Max. Temp in °C	32.24	30.16	27.21	25.97	28	27.96	26.6	25.86
	Min. Temp in °C	27.48	23.24	24.21	23.97	23.24	21.04	23.6	23.86
May	Max. Temp in °C	32.44	30.26	27.24	25.98	28.74	28.35	26.7	25.88
	Min. Temp in °C	27.68	23.34	24.24	23.98	23.98	21.43	23.7	23.88
June	Max. Temp in °C	32.1	30.09	27.19	25.97	30.14	29.07	26.91	25.92
	Min. Temp in °C	27.34	23.17	24.19	23.97	25.38	22.15	23.91	23.92
July	Max. Temp in °C	32.1	30.09	27.19	25.97	30.48	29.25	26.96	25.93
	Min. Temp in °C	27.34	23.17	24.19	23.97	25.72	22.33	23.96	23.93
August	Max. Temp in °C	32.13	30.11	27.19	25.97	30.54	29.28	26.96	25.93
	Min. Temp in °C	27.37	23.19	24.19	23.97	25.78	22.36	23.96	23.93
September	Max. Temp in °C	31.77	29.92	27.14	25.96	30.29	29.15	26.93	25.92
	Min. Temp in °C	27.01	23	24.14	23.96	25.53	22.23	23.93	23.92
October	Max. Temp in °C	30.92	29.48	27.02	25.94	29.43	28.7	26.8	25.9
	Min. Temp in °C	26.16	22.56	24.02	23.94	24.67	21.78	23.8	23.9
November	Max. Temp in °C	30.15	29.07	26.91	25.92	27.9	27.91	26.58	25.86
	Min. Temp in °C	25.39	22.15	23.91	23.92	23.14	20.99	23.58	23.86
December	Max. Temp in °C	29.47	28.72	26.81	25.9	25.87	26.86	26.29	25.81
	Min. Temp in °C	24.71	21.8	23.81	23.9	21.11	19.94	23.29	23.81

	City	Varanasi				Veraval			
Months	90% Acceptibility Range	NV	MM	AC.air.tem	AC.std.eftv	NV	MM	AC.air.tem	AC.std.eftv
January	Max. Temp in °C	23.67	25.71	25.97	25.75	27.86	27.89	26.58	25.86
	Min. Temp in °C	18.91	18.79	22.97	23.75	23.1	20.97	23.58	23.86
February	Max. Temp in °C	24.65	26.22	26.11	25.77	28.01	27.97	26.6	25.86
	Min. Temp in °C	19.89	18.79	23.11	23.77	23.25	20.97	23.6	23.86
March	Max. Temp in °C	28.09	28.01	26.61	25.86	28.57	28.26	26.68	25.88
	Min. Temp in °C	23.33	21.09	23.61	23.86	23.81	21.34	23.68	23.88
April	Max. Temp in °C	30.74	29.38	26.99	25.93	29.98	28.99	26.88	25.91
	Min. Temp in °C	25.98	22.46	23.99	23.93	25.22	22.07	23.88	23.91
May	Max. Temp in °C	32.26	30.17	27.21	25.97	30.74	29.38	26.99	25.93
	Min. Temp in °C	27.5	23.25	24.21	23.97	25.98	22.46	23.99	23.93
June	Max. Temp in °C	32.64	30.37	27.27	25.98	31.37	29.71	27.08	25.95
	Min. Temp in °C	27.88	23.45	24.27	23.98	26.61	22.79	24.08	23.95
July	Max. Temp in °C	31.82	29.94	27.15	25.96	31.14	29.59	27.05	25.94
	Min. Temp in °C	27.06	23.02	24.15	23.96	26.38	22.67	24.05	23.94
August	Max. Temp in °C	31.12	29.58	27.05	25.94	30.48	29.25	26.96	25.93
	Min. Temp in °C	26.36	22.66	24.05	23.94	25.72	22.33	23.96	23.93
September	Max. Temp in °C	31.14	29.59	27.05	25.94	30.43	29.22	26.95	25.92
	Min. Temp in °C	26.38	22.67	24.05	23.94	25.67	22.3	23.95	23.92
October	Max. Temp in °C	30.18	29.09	26.91	25.92	30.82	29.43	27.01	25.93
	Min. Temp in °C	25.42	22.17	23.91	23.92	26.06	22.51	24.01	23.93
November	Max. Temp in °C	28.39	28.16	26.65	25.87	30.53	29.28	26.96	25.93
	Min. Temp in °C	23.63	21.24	23.65	23.87	25.77	22.36	23.96	23.93
December	Max. Temp in °C	26.08	26.97	26.32	25.81	29.06	28.51	26.75	25.89
	Min. Temp in °C	21.32	20.05	23.32	23.81	24.3	21.59	23.75	23.89

Appendix 2: ECBC Table Compliance Requirements for GRIHA projects

		Commercial/ Institutional/ Hospitals/ Hotels/ Office		Residential/ Hostel		Laboratory		Airport
		Non-AC	AC	Non-AC	AC	Non-AC	AC	AC
5.2.1: Natural Ventilation	Natural ventilation shall comply the design guidelines as mentioned in NBC 2005 Part 8 section 1, 5.4.3 and 5.7.1	√	X	√	X	√	X	X
5.2.2: Minimum Equipment Efficiencies	Chillers shall meet or exceed the minimum efficiency levels as mentioned in Table 5.1. All other heating and cooling equipment's shall comply with ASHRAE 90.1-2004	X	√	X	√	X	√	√
	Unitary air-conditioners ,split air conditioners and boilers shall meet the relevant IS standards	X	√	X	√	X	√	√
5.2.3: Controls	1. Mechanical cooling and heating system shall be controlled by a time clock that:							
	a) can accommodate different schedules for three different day types per week.	X	√	X	√	X	√	√
	b) can retain programming and time setting during loss of power for a period of at least 10 hours	X	√	X	√	X	√	√
	c) includes an accessible manual override that allows temporary operation of the system for up to 2 hours.	X	√	X	√	X	√	√
	2. All heating and cooling equipment shall have temperature control. For units providing both heating and cooling should be capable of providing a dead band of 3ºC (5ºF). When separate heating and cooling equipment serve the same space, thermostats shall be interlocked to prevent simultaneous heating and cooling.	X	√	X	√	X	√	√
	3. Cooling towers and close circuit fluid coolers shall have either two speed motors, pony motors or variable speed drives for controlling the fans.	X	√	X	√	X	√	√

		Commercial/ Institutional/ Hospitals/ Hotels/ Office		Residential/ Hostel		Laboratory		Airport
		Non-AC	AC	Non-AC	AC	Non-AC	AC	AC
5.2.4: Piping and Ductwork	Piping for heating system shall have minimum R-4 insulation for design operating temperature ≥ 60C, and minimum R-2 insulation for design operating temperature ≥40C and <60 C. Piping for cooling system with design operating temperature <15C, and refrigerant suction piping for split system shall have minimum R-2 insulation. The insulation exposed shall be protected by aluminum sheet metal, painted canvas, or plastic cover.	X	√	X	√	X	√	√
	Insulation of ductwork shall be in accordance with Table 5.2	X	√	X	√	X	√	√
5.2.5: System Balancing	Construction documents shall provided with a balanced report of HVAC system serving zones for air-conditioned area exceeding 500 m2	X	√	X	√	X	√	√
5.2.5.1.1: Air system balancing	Minimize throttling losses and adjust fan speed to meet design flow conditions (for fan system with capacity >0.75 kW (1 hp)).	X	√	X	√	X	√	√
5.2.5.1.2: Hydronic system balancing	Minimize throttling losses and adjust pump speed or trim pump impeller to meet the design flow conditions.	X	√	X	√	X	√	√
5.2.6: Condensers	Condenser location shall be such that heat sink is free of interference from heat discharge by devices located in adjoining spaces and also does not interfere with such other systems installed nearby.	X	√	X	√	X	√	√
	All high rise buildings using centralized cooling water system shall use soft water for the condenser and chilled water system	X	√	X	√	X	√	√

		Commercial/ Institutional/ Hospitals/ Hotels/ Office		Residential/ Hostel		Laboratory		Airport
		Non-AC	AC	Non-AC	AC	Non-AC	AC	AC
Note: Clause 6.2.2-6.2.6 is applicable only if solar hot water system is installed								
6.2.2: Equipment Efficiency	i) Solar water heating system shall meet the minimum efficiency levels as mentioned in IS 13129 Part (1 & 2) ii) Gas instantaneous water heaters shall meet minimum efficiency levels as mentioned in IS 15558 with above 80% thermal efficiency iii) Electric water heater shall meet minimum efficiency levels as mentioned in IS 2082.	√	√	√	√	√	√	√
6.2.3: Supplementary water heating system	Supplementary water heating system can have i) Heat recovery from hot discharge system (e.g. condenser) ii) Use of gas fired heaters iii) Electric heaters as last resort.	√	√	√	√	√	√	√
6.2.4: Piping Insulation	Piping insulation shall comply with 5.2.4 of ECBC. The entire hot water system including storage tanks, pipelines shall comply relevant IS standards	√	√	√	√	√	√	√
6.2.5: Heat Traps	Vertical pipe risers serving storage water heaters and storage tanks, not having integral heat traps and serving a non recirculating system shall have heat traps on both the inlet and outlet piping as close as practical to the storage tank.	√	√	√	√	√	√	√
6.2.6: Swimming Pools	Heated pool shall be provided with a vapor retardant pool cover on or at the water surface. Pools with temperature >32 C shall have pool cover with a minimum insulation value is R-12	√	√	√	√	√	√	√

		Commercial/ Institutional/ Hospitals/ Hotels/ Office		Residential/ Hostel		Laboratory		Airport
		Non-AC	AC	Non-AC	AC	Non-AC	AC	AC
Lighting Control								
7.2.1.1: Automatic lighting shutoff	Interior lighting in buildings> 500 m^2 (5000ft^2) shall be equipped with an automatic control device. Inside the building, office spaces < 30 m^2 (300 ft^2) shall be equipped with occupancy sensors.	X	X	X	X	X	X	X
	For other spaces, this automatic control shall function on I. a schedule- A schedule is provided for areas not more than 2500 m2 and not more than one floor. II. occupancy sensors that shall turn off the lights within 30 min. of occupant leaving the space.	√	√	X	X	√	√	√
7.2.1.2: Space Control	i) Each space control capable of controlling max 250 m2 area for a space ≤1000 m2 and max 1000 m2 area for a space >1000m2. ii) Space control may be capable of overriding the shutoff control for not more than 2 hours. iii) Control should be readily accessible to the occupant.	√	√	X	X	√	√	√
7.2.1.3: Control in Day lighted areas	Luminaries located in day lighted area >25 m^2(250ft^2) shall be equipped with a control device that I. is capable of reducing the light output of the luminaries in the day lighted areas by at least 50%. II. controls only the luminaries which are located entirely in day lighted areas.	√	√	√	√	√	√	√
7.2.1.4: Exterior Lighting Control	Lighting for all exterior applications shall be controlled by a photo sensor or astronomical time switch.	√	√	√	√	√	√	√

		Commercial/ Institutional/ Hospitals/ Hotels/ Office		Residential/ Hostel		Laboratory		Airport
		Non-AC	AC	Non-AC	AC	Non-AC	AC	AC
7.2.1.5: Additional Control	Following lighting applications shall be equipped with a control device:							
	a) Display/Accent Lighting: Display or accent lighting greater than 300 m2 shall have a separate control device.	√	√	√	√	√	√	√
	b) Case Lighting: Lighting in cases used for display purpose greater than 300 m2 area shall be equipped with a separate control device.	√	√	√	√	√	√	√
	c) Hotel and motel guest room lighting: Hotel and motel guest rooms and guest suites shall have a master control device at entry that controls all luminaries and switched receptacles.	√	√	√	√	√	√	√
	d) Task lighting: Supplemental task lighting including permanently installed under shelf or under cabinet lighting shall have a control device integral to luminaires or be controlled by a wall mounted control device provided the control device complies with 7.2.1.2 (c).	√	√	√	√	√	√	√
	e) Non-visual lighting: Lighting for non visual applications, such as plant growth and food warming, shall be equipped with a separate control device.	√	√	√	√	√	√	√
	f) Demonstration Lighting: Lighting equipment for sale or for demonstration in lighting education shall be equipped with a separate control device accessible to authorized personnel.	√	√	√	√	√	√	√
7.2.2: Exit Signs	Exit signs shall not exceed 5W per face	√	√	√	√	√	√	X

		Commercial/ Institutional/ Hospitals/ Hotels/ Office		Residential/ Hostel		Laboratory		Airport
		Non-AC	AC	Non-AC	AC	Non-AC	AC	AC
Transformers								
8.2.1.1: Maximum allowable power transformer losses	The power transformer selected shall satisfy the minimum acceptable efficiency at 50% and 100% load.	√	√	√	√	√	√	√
8.2.1.2: Measurement and reporting of transformer losses	Transformer losses shall be measured by using calibrated digital meters of class 0.5 or better. For transformers of capacity ≥ 500kVA shall be equipped with additional current transformers(CTs) and potential transformers(PTs) for loss monitoring.	√	√	√	√	√	√	√
8.2.2: Energy efficient motors	1. All poly phase motors of (capacity >0.375 kW and operating hours >1500 hours/year) and (capacity >50kW and operating hours >500 hours/day) shall follow minimum efficiency level as per IS 12615 for energy efficient motors.	√	√	√	√	√	√	√
	2. Motor horsepower rating shall not exceed 20% of the calculated maximum load being served.	√	√	√	√	√	√	√
	3. Motor nameplate shall list nominal full load efficiencies and full load power factor.	√	√	√	√	√	√	√
	4. Proper rewinding practices shall be ensured for any rewound motor. If motor rewinding can not be assured it should be replaced by a new energy efficient motor.	√	√	√	√	√	√	√
	5. After rewinding of a motor, new efficiency test shall be performed and record is to be maintained.	√	√	√	√	√	√	√
8.2.2: Power factor correction	All electricity supplies exceeding 100A, 3 phases shall maintain their power factor between 0.95 lag and unity at point of connection	√	√	X	X	√	√	√
8.2.4: Check-metering and monitoring	1. For services>1000 kVA, shall have permanently installed electrical metering for recording demand (kVA), energy(kWh), power factor, current(in each phase and neutral), voltage(between each phase and neutral), and total harmonic distortion(THD) 2. For services >65 kVA and <1000 kVA, shall have permanently installed electrical metering for recording demand (kW), energy(kWh), and power factor. 3. For services <65 kVA shall have permanently installed electrical metering for recording energy(kWh).	√	√	√	√	√	√	√

Appendix 3: Peak Heat Gain through Building Envelope Analysis methodology

Background

The envelope holds a substantial share in the overall heat gain for a conventional building. Thus along with other building systems, it is of prime importance to optimize the building envelope to mitigate heat gain through it. Adopting a passive approach in designing the envelope, as reflected in our traditional wisdom, can help attain the optimization, whilst ensuring comfort. Accomplishment of such a passive approach in the design of the envelope is in the scope of designers and architects. Development of benchmarks for peak heat gain from building envelope provides designers with flexibility to work with various materials and varying window wall ratio, but at the same time limiting heat gain from the façade which is crucial for a holistic green building design. .

A peak heat gain envelope benchmark for air- conditioned buildings is being introduced in the GRIHA Rating System as a part of Criterion 8, Appraisal 8.1.2. The performance of designed envelope could be analyzed using either simulation method, using, software such as Visual DOE, eQuest etc to demonstrate performance of design case is better than the GRIHA benchmark provided for peak heat gain from envelope. Or, by calculating the Envelope Performance Factor (EPF) for design case using the GRIHA Calculator and demonstrating it to be lower than the GRIHA Base case EPF.

Methodology

Simulation softwares such as VisualDOE, eQuest etc. can be used to carry out the simulations for the designed envelope. The simulation program calculates for the peak time of the year in which maximum cooling will be required.

Note:

- The simulation model should be prepared as per the architectural geometry and building materials selected.
- Simulation should be done for 24 Hour occupancy, since peak time throughout the day is considered.
- The indoor temperature set-point should be according to NBC standards. (Table 2, Clause 4.4.3)

From simulation, heat gain through conduction from roof, walls, glass, and solar heat gain from glass can be derived (figure 1). The summation of this total heat gain should be divided by the total façade + roof area to calculate the Building Envelope Peak Heat Gain Factor in W/m2.

This value should be less than the prescribed value (table 1) for the given climate, in order to comply with the criterion.

	SENSIBLE (KBTU/H)	SENSIBLE (KW)	LATENT (KBTU/H)	LATENT (KW)
WALL CONDUCTION	74.985	21.971	0.000	0.000
ROOF CONDUCTION	5.935	1.739	0.000	0.000
WINDOW GLASS+FRM COND	55.381	16.227	0.000	0.000
WINDOW GLASS SOLAR	53.013	15.533	0.000	0.000
DOOR CONDUCTION	0.000	0.000	0.000	0.000
INTERNAL SURFACE COND	0.000	0.000	0.000	0.000
UNDERGROUND SURF COND	2.985	0.875	0.000	0.000
OCCUPANTS TO SPACE	8.240	2.414	10.940	3.205
LIGHT TO SPACE	31.990	9.373	0.000	0.000
EQUIPMENT TO SPACE	32.896	9.638	0.000	0.000
PROCESS TO SPACE	0.000	0.000	0.000	0.000
INFILTRATION	16.672	4.885	15.461	4.530
TOTAL	282.097	82.654	26.401	7.736
TOTAL / AREA	0.016	0.052	0.002	0.005
TOTAL LOAD	308.498	KBTU/H	90.390	KW
TOTAL LOAD / AREA	17.92	BTU/H.SQFT	56.505	W/M2

Figure 1: Simulation Results example

Building Envelope Peak Gain Components (Watts)	
Simulation done for:	(time,day,month)
Building Envelope Heat Gain	(Watts)
Wall Conduction Gains	21971
Roof Conduction Gains	1739
Window Glass+Frame Conduction Gains	16227
Window Glass Solar Gains	15533
Total	**55470**
Envelope Area (sqm)	2000
Heat gain/ Envelope Area (W/m2)	27.74

Figure 2: Calculator for Building Envelope Peak Heat Gain Factor

Appendix 4: Key Assumptions for analysis of residential buildings' EPI on ResBuild toolkit

Key Assumptions for analysis on ResBuild toolkit:

- WWR 30% for each type of building
- Conditioned area for 2 BHK - 45%, 3BHK - 55% and 4 BHK - 65%
- Common area is 20% of total built-up area
- Celling fans for 2 BHK - 4, 3BHK - 5 and 4 BHK - 6
- Split AC unit as per GRIHA benchmark for 2 BHK - 2, 3 BHK - 3 and 4 BHK - 4
- Heating schedule would vary as considering to climate condition.
- Assumed 5 LPD for Internal area lighting and 4.5 LPD for common area.
- For composite climate at least 2 heaters per apartments of 2000 Watt and 6 hours minimum operating.
- Cooling operating schedule 8h/7d from 1st May to 15 October
- Lighting schedule is from 6-9 am and 17.30-23.00 pm with maximum 60% diversity.

Appendix 5: Modifying EPI for projects with different schedules

Projects which do not fall under any of the following two EPI categories, should use the methodology provided in the table below to calculate the benchmark EPI for their project:

- Category 1: Office/Academic institution building – 5 days a week, 8 hours a day
- Category 2: Malls, hospitals, hotels, BPOs – 24 x 7 occupied buildings

The following table illustrates the methodology using the EPI for Composite climate: For projects with more than one type of space, please use weighted average.

Category 1 buildings	
Initial GRIHA benchmark	90 kWh/sqm/annum
Methodology for extrapolation	Linear
Conditions	1. Total occupied hours cannot be greater than 16 per day 2. Total number of operational days cannot be more than 6
Example 1	The total number of occupied hours per day is 12 and total operational days in a week are 5. The benchmark for the project is: 90 x (12/8) = 135 kWh/sqm/annum
Example 2	The total number of occupied hours per day is 8 and total operational days in a week are 6. The benchmark for the project is: 90 x (6/5) = 108 kWh/sqm/annum
Category 2 buildings	
Initial GRIHA benchmark	300 kWh/sqm/annum
Methodology for extrapolation	Linear
Conditions	1. Total operational days must be 7 2. Total number of occupied hours cannot be less than 14 per day
Example 3	The total number of occupied hours per day is 18. The benchmark for the project is: 300 x (18/24) = 225 kWh/sqm/annum

Appendix 6: Daylighting – Living area & Daylight Autonomy – Living Area (Time-Weighted)

Living Area:

For Criterion 11 - Appraisal 11.1.1 – Alternative 1, the following spaces (or equivalent as mentioned below the table) mentioned in the SP 41 will be considered as Living areas. The daylight factor analysis will be conducted for all these spaces.

Sr No	Type of building	List of Living Area	Daylight Factor Percent
1	Dwellings	Kitchen	2.5
		Living Room	0.625
		Study room	1.9
		Circulation	0.313
2	Schools	Class room desk top, black board	1.9—-3.8
		Laboratory	2.5—3.8
3	Offices	General	1.9
		Drawing, typing	3.75
		Enquiry	0.625—1.9
4	Hospitals	General wards	1.25
		Pathological laboratory	2.5-3.75
5	Libraries	Stack room	0.9—1.9
		Reading room	1.9-3.75
		Counter area	2.5—-3.75
		Catalogue room	1.9—2.5

Equivalent Spaces:

- Bedrooms – residences/hostels/hotels – will be equivalent to Dwellings – Living room
- Meeting Rooms – offices etc. – will be equivalent to Office – General
- Dining areas – residences/hostels – will be equivalent to Dwellings – Living room
- Common lounge areas/waiting areas – will be equivalent to Dwellings – Living room

Living Area (time-weighted):

For Criterion 11 - Appraisal 11.1.1 – Alternative 2, the spaces as mentioned on the previous page would qualify as living areas. After identification of living areas, the following method should be used to calculate annual hours (area-weighted):

$$DA_w = \frac{(A_1 \times DA_1 \times t_1) + (A_2 \times DA_2 \times t_2) + \ldots\ldots + (A_n \times DA_n \times t_n)}{(A_1 \times t_1) + (A_2 \times t_2) + \ldots\ldots + (A_n \times t_n)}$$

where;

DA_w	= Project's total annual analysis hours (area-weighted)
A_1	= Living area of Building 1/Space 1
DA_1	= Total annual hours when DA_{300} is met in Building 1/Space 1
t_1	= Number of buildings/spaces identical to Building 1 (Typical)
A_2	= Living area of Building 2/Space 2
DA_2	= Total annual hours when DA_{300} is met in Building 2/Space 2
t_2	= Number of buildings/spaces identical to Building 2 (Typical)
A_n	= Living area of Building n
DA_n	= Total annual hours when DA_{300} is met in Building n/Space n
t_n	= Number of buildings/spaces identical to Building n (Typical)

Appendix 7: Artificial Lighting levels for Residential Spaces (based on NBC 2005)

Type of Interior or Activity	Range of Illuminance in Lux		
Rooms	Lower	Middle	Higher
Kitchen	200	300	500
Bed rooms	30	50	100
Bathroom	50	100	150
Living Room	50	100	150
Drawing/Dining Room	50		200

Appendix 8: Low-VOC content

Limits for low-VOC content in interior paints

Paint applications	VOC limits (grams of VOC per litre)	
Interior coatings	Flat	<50
	Non-flat	<150
Exterior coatings	Flat	<200
	Non-flat	<100
Anti corrosive	Gloss/ semi gloss/ flat	<250

Limits for low-VOC content in adhesives in interior applications

Architectural adhesive application	VOC content limit (g of VOC/litre)
Wood Flooring	100
Industrial/rubber flooring	60
Ceramic tile	65
Structural glazing	100
Multi-purpose construction	70
Sub-floor	50
Wall boards/panel	50
PVC welding	285
Adhesive primer for plastic	250
Structural wood member	140
Sub-specific use metal to metal	30
Wood	30
Fibre glass	80
Plastic foams/porous materials (except wood)	50

Limits for low-VOC content in interior sealants

Sealant Application	VOC Content limit (grams of VOC per litre)
Architectural/roadways	250
Single-ply roof material installation/repair	450
Others	420
Sealant Primer applications architectural non-porous	250
Sealant Primer applications architectural porous	775
Other sealant primer applications architectural	750

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