IGBC Green Homes®

IGBC Green Homes® Rating System

For Individual & Multi-dwelling
Residential Units

Version 2.0

Detailed Reference Guide

October 2013

Indian Green Building Council

Greening India since 2001

www.igbc.in

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Indian Green Building Council

C/o Confederation of Indian Industry

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INDIA

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- Ar Sharukh Mistry, Chairman, IGBC Green Homes Steering Committee & Director, Mistry Architects, Bangalore.
- Dr Prem C Jain, Chairman, Indian Green Building Council & Chairman and Managing Director, AECOM, Noida.
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- Dr Chandrashekar Hariharan, Vice Chairman, IGBC Bangalore Chapter & CEO, BCIL Bangalore.
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- Conserve Consultants Pvt. Ltd, Chennai
- Carrier Airconditioning & Refrigeration Limited, Gurgaon
- CEPT University, Ahmedabad
- CRN Architects & Engineers, Chennai
- CSR Estates, Hyderabad
- Design & Development Consultants, New Delhi
- DLF Services Limited, Gurgaon
- DLF Utilities Pvt Ltd, Gurgaon
- Dow Chemical International Pvt Ltd, Mumbai
- DSL Infrastructure & Space Developers, Hyderabad
- Dynacraft Air Controls, Mumbai
- Ecofirst Services Pvt. Ltd, Mumbai
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- Emaar MGF Land Limited, New Delhi
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- Energy Conservation Mission, Hyderabad
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- SEW Constructions Ltd, Hyderabad
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- Shika Management Services, Hyderabad
- Shilpa Architects, Chennai
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- SMR Live Spaces, Hyderabad
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- Team Labs & Consultants, Jaipur
- Terra Verde Architects, Hyderabad
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- Total Environment, Bangalore
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Contents

Foreword from the Indian Green Building Council (IGBC)

India is witnessing tremendous growth in infrastructure and construction development. The construction industry in India is one of the largest economic activities and is growing rapidly. As the sector is growing rapidly, preserving the environment poses a host of challenges. To enable the construction industry environmentally sensitive, CII-Sohrabji Godrej Green Business Centre has established the Indian Green Building Council (IGBC). IGBC is a consensus driven not-for-profit Council representing the building industry, consisting of more than 1,650 committed members. The Council encourages, builders, developers, owners, architects and consultants to design & construct green buildings thereby enhancing the economic and environmental performance of buildings.

The Green Building Movement in India has been spearheaded by IGBC (part of CII) since 2001, by creating National awareness. The Council's activities have enabled a market transformation with regard to green building concepts, materials and technologies.

IGBC continuously works to provide tools that facilitate the adoption of green building practices in India. The development of IGBC Green Homes® Rating System is another important step in this direction.

IGBC Membership

IGBC draws its strength from its members who have been partners in facilitating the Green Building Movement in India. The local chapters led by individual champions and committed members have been instrumental in reaching out the vision of the IGBC at the regional levels. IGBC is today seen as a leader in spearheading the Indian Green Building Movement. The Council is member-driven and consensus-based.

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I. Introduction

The housing sector in India is growing at a rapid pace and contributing immensely to the growth of the economy. This augurs well for the country and now there is an imminent need to introduce green concepts and techniques in this sector, which can aid growth in a sustainable manner.

Green concepts and techniques in the residential sector can help address national issues like water efficiency, energy efficiency, fossil fuel reduction in commuting, handling of consumer waste and conserving natural resources. Most importantly, these concepts can enhance occupant health, happiness and well-being.

By 2030, the country is expected to have 68 cities with a population of more than one million, 13 cities with more than 4 million people and 6 megacities with populations of 10 million or more, with Mumbai and Delhi among the biggest cities worldwide. *(Source: Ministry of Urban development)*

This implies that the country would see an upsurge in housing requirements for all strata of communities. Alongside this comes the demand for energy and water. The residential sector consumes about 24% of the electrical energy generated, which would continue to rise.

Most of the Asian countries are water stressed and in countries like India the water table has drastically reduced over the last decade. Water availability will continue to be an issue that needs greater attention.

The handling of waste in the domestic sector is by and large unorganised. Many cities are facing the problem of proper waste handling and disposal. This can adversely impact the health and hygiene of people.

The housing sector in the country needs to make judicious shifts towards sustainable living . Against this background, the Indian Green Building Council (IGBC) has launched 'IGBC Green Homes® Rating System' to address the National priorities. By applying IGBC Green Homes® criteria, homes which are sustainable over the life cycle of the building can be constructed. This rating programme is a tool which enables the designer to apply green concepts and criteria, so as to reduce the environmental impact, which is measurable. The programme covers methodologies to cover diverse climatic zones and changing lifestyles.

IGBC Green Homes® is the first rating programme developed in India, exclusively for the residential sector. It is based on accepted energy and environmental principles and strikes a balance between known established practices and emerging concepts. The system is designed to be comprehensive in scope, yet simple in operation. The Green Homes Rating System may be applied by individual home owners as well as developer driven housing projects.

IGBC has set up the Green Homes Core Committee to develop the rating programme. This committee comprised of key stakeholders including architects, builders, consultants, developers, home owners, academicians, institutions, manufacturers and industry representatives. The committee, with a diverse background and knowledge has enriched the rating system both in its content and process.

II. Benefits of Green Homes

Green homes can have tremendous benefits, both tangible and intangible. The most tangible benefits are the reduction in water and energy consumption right from day one of occupancy. The energy savings could range from 20-30 % and water savings around 30-50%.

Intangible benefits of green homes include enhanced air quality, excellent daylighting, health & wellbeing of the occupants, lower energy bills, safety benefits and conservation of scarce national resources. Green Homes rating system can also enhance marketability of a project.

III. National Priorities Addressed in the Rating System

The Green Homes Rating System addresses the most important National priorities which include water conservation, handling of house-hold waste, energy efficiency, reduced use of fossil fuels, lesser dependence on usage of virgin materials and health & well-being of occupants.

- **Water Conservation:**

  Most of the Asian countries are water stressed and in countries like India, the water table has reduced drastically over the last decade. Green Homes Rating System encourages use of water in a self-sustainable manner through reducing, recycling and reusing strategies. By adopting this rating programme, green homes can save potable water to an extent of 30-50%.

- **Handling of House-hold Waste:**

  Handling of waste in residential buildings is extremely difficult as most of the waste generated is not segregated at source and has a high probability of going to land-fills. This continues to be a challenge to the municipalities which needs to be addressed. IGBC intends to address this by encouraging green homes to segregate the house hold waste.

- **Energy Efficiency:**

  The residential sector is a large consumer of electrical energy. Adopting simple measures homes can reduce energy consumption in lighting, air conditioning systems, motors, pumps, etc., The rating system encourages green homes which select and use BEE labeled equipment and appliances. The energy savings that can be realised by adopting this rating programme can be to the tune of 20-30%.

❖ **Reduced Use of Fossil Fuels:**

Fossil fuel is a slowly depleting resource, world over. The use of fossil fuel for transportation has been a major source of pollution. Besides the fuel depletion, transport vehicles create road pollution affecting health of the people. The rating system encourages the use of alternate fuels for transportation and captive power generation.

❖ **Reduced Dependency on Virgin Materials:**

The rating system encourages projects to use recycled & reused material and discourages the use of virgin wood thereby, addressing environmental impacts associated with extraction and processing of virgin materials.

❖ **Health and Well-being of Residents:**

Health and well-being of occupants is the most important aspect of Green Homes. IGBC Green Homes® Rating System ensures minimum performance of daylighting and ventilation aspects which are critical in a home. The rating system also recognises measures to minimise the indoor air pollutants.

IV. IGBC Green Homes®

IGBC has set up the Green Homes Core Committee to focus on residential sector. The committee includes builders, developers, home owners, architects, consultants, experts on building science, manufacturers and industry representatives. The varied experience and professions of the committee members brings in a holistic perspective in the process of developing the rating programme.

A. Evolution of the Rating System

IGBC, in its endeavor to extend green building concepts to all building types envisioned a rating programme for homes in December 2007. A core committee was formed under the leadership of Ar Sharukh Mistry, Mistry Architects, Bengaluru. The committee drafted the pilot version of the programme which was launched in July 2008. After one year of implementation, feedback from pilot projects were reviewed by the core committee and the suggestions have been incorporated in the version 1.0 of the rating system launched in April 2009.

Based on the feedback and learning from various projects that have implemented the rating programme. The latest version 2.0 (Abridged Reference Guide) has been launched in March 2012. The rating system is designed to suit Indian climatic conditions and residential construction practices. This document is a detailed reference guide for Version 2.0

About 220 members representing 120 organisations have participated in the development of the rating programme. As on date (October 2013), 833 green home projects with over 724 million sq.ft. of built-up space are in various phases of design and construction is registered under the rating programme.

The rating system will be subject to review by the core committee, every year, to ensure that it is updated and contemporary.

B. Features of IGBC Green Homes®

IGBC Green Homes® Rating System is a voluntary and consensus based programme. The rating system has been developed based on materials and technologies that are presently available. The objective of IGBC Green Homes® is to facilitate the effective use of site resources, water conservation, energy efficiency, handling of house-hold waste, optimum material utilization and design for healthy, comfortable & environmentally friendly homes.

The rating system evaluates certain mandatory requirements & credit points using a prescriptive approach and others on a performance based approach. The rating system is evolved so as to be comprehensive and at the same time user-friendly. The programme is fundamentally designed to address national priorities and the quality of life for occupants.

The rating programme uses well accepted National standards and wherever local or National standards are not available, appropriate international benchmarks have been considered.

C. Scope of IGBC Green Homes®

IGBC Green Homes® Rating System is a measurement system designed for rating new and major renovation of residential buildings which are broadly classified into two construction types:

1. Individual residential unit
2. Multi-dwelling residential units
    - Gated communities.
    - High-rise residential apartments.
    - Hostels, Service apartments, Resorts, Motels and Guest houses.

In general, all dwelling spaces which can meet the mandatory requirements and minimum points can apply. Various levels of green building certification are awarded based on the total points earned.

D. The Future of IGBC Green Homes®

Many new green building materials, equipment and technologies are being introduced in the market. With continuous up-gradation and introduction of new green technologies and products, it is important that the rating programme also keeps pace with current standards and technologies. Therefore, the rating programme will also undergo periodic revisions to incorporate the latest advances and changes. It is important to note that project teams applying for IGBC Green Homes® should register their projects with the latest version of the rating system. During the course of implementation, projects have an option to transit to the latest version of the rating system.

*IGBC will highlight new developments on its website on a continuous basis at www.igbc.in

V. IGBC Green Homes® Rating System

IGBC Green Homes® rating system addresses green features under the following categories:

- ❖ Site Selection and Planning
- ❖ Water Conservation
- ❖ Energy Efficiency
- ❖ Materials & Resources
- ❖ Indoor Environmental Quality
- ❖ Innovation & Design Process

The guidelines detailed under each mandatory requirement & credit enables the design and construction of green homes of all sizes and types. Different levels of green building certification are awarded based on the total credits earned. However, every Green Home should meet certain mandatory requirements, which are non-negotiable.

The various levels of rating awarded are:

Certification Level	Recognition
Certified	Best Practices
Silver	Outstanding Performance
Gold	National Excellence
Platinum	Global Leadership

a. When to use IGBC Green Homes®

IGBC Green Homes® is designed primarily for new residential buildings. However, it is also applicable for existing buildings designed in accordance with the IGBC Green Homes® criteria.

The project team can evaluate all the possible points to apply under the rating system using a suitable checklist. The project can apply for IGBC Green Homes® certification if it can meet all mandatory requirements and achieve the minimum required points.

b. IGBC Green Homes® Registration

Project teams interested in IGBC Green Homes® Pre-certification/Certification for their project must first register with IGBC. Projects can be registered on IGBC website (www.igbc.in) under 'IGBC Green Homes®'. The website includes information on registration fee for IGBC member companies as well as non-members. Registration is the initial step which helps establish contact with IGBC and provides access to the required documents, templates, important communications and other necessary information.

IGBC web site will have all important details on IGBC Green Homes® registration & certification - process, schedule and fee.

c. Pre-certification

Projects by developers can register for Pre-certification. This is an option provided for projects aspiring to get pre-certified at the design stage. The documentation submitted for pre-certification must detail the project design features which will be implemented. The rating awarded under pre-certification is based on the project's intention to conform to the requirements of IGBC Green Homes® Rating system. It is important to note that the pre-certification rating awarded need not necessarily correspond to the final certification.

Pre-certified projects are required to provide the status of the project to IGBC, in relation to the rating, once in every six months until the award of the final rating.

Pre-certification gives the owner/ developer a unique advantage to market the project to potential buyers.

Those projects which seek pre-certification need to submit the following documentation:

1. General information of project including
   a. Project brief stating project type, different type of spaces, occupancy, number of floors, area statement, etc.,
   b. General drawings (in PDF format only):
      i. Master/ Site plan
      ii. Parking plans
      iii. Floor plans
      iv. Elevations
      v. Sections
      vi. Photographs/ Rendered views
2. Filled-in Master Template (in excel format)
3. Narratives and supporting documentation such as conceptual drawings, estimate/tentative calculations (in excel sheets), declarations from the owner, etc., for each mandatory requirement/credit
4. **In addition, project teams can refer the 'Documentation Required for Pre-certification' section provided under each mandatory requirement/credit.**

The above necessary details are mentioned in this guide, under each mandatory requirement and credit.

IGBC would take 35 days to review the first set of pre-certification documents. On receiving the clarifications posed in the first review, IGBC would take another 35 days to award the precertification.

A certificate and a letter are provided to projects on precertification.

d. IGBC Green Homes® Certification

The rating system caters to projects like individual homes, gated communities, high-rise residential apartments, residential buildings with major renovation, hostels, service apartments, resorts, motels, guest houses, etc. The projects are broadly classified into two categories:

1. Individual residential unit
2. Multi-dwelling residential units

The threshold criteria for certification levels are as under:

Certification Level	Individual Residential Unit	Multi-dwelling Residential Units	Recognition
Certified	38 – 44	50 – 59	Best Practices
Silver	45 – 51	60 – 69	Outstanding Performance
Gold	52 – 59	70 – 79	National Excellence
Platinum	60 - 75	80 – 100	Global Leadership

e. Documentation

To earn the IGBC Green Homes® Rating, the project must satisfy all the mandatory requirements and the minimum number of credit points.

The project team is expected to provide supporting documents at preliminary/design and final/ construction stage of submission for all the mandatory requirements and the credits attempted.

The project needs to submit the following:

1. General information of project including
   a. Project brief stating project type, different type of spaces, occupancy, number of floors, area statement, etc.,
   b. General drawings (in PDF format only):
      i. Master/Site plan
      ii. Parking plans
      iii. Floor plans
      iv. Elevations
      v. Sections
      vi. Photographs/Rendered views
2. Filled-in Master Template (in excel format)
3. Narratives and supporting documentation such as drawings, calculations (in excel sheets), declarations/contract documents, purchase invoices, manufacturer cut sheets/letters/material test reports, etc., for each mandatory requirement/credit
4. In addition, project teams can refer the 'Documentation Required for Certification' section provided under each mandatory requirement/credit.

The necessary details are mentioned in this guide, under each mandatory requirement and credit.

Documentation is submitted in two phases-preliminary submittal and final submittal:

- ❖ The preliminary submission involves those credits which can be evaluated at the design stage. The reference guide provides the list of design and construction phase credits. After the design submission, review is done by third party assessors and review comments are provided within 35 days.
- ❖ The next phase involves submission of clarifications to preliminary review queries and final submittal. The construction document is submitted on completion of the project. This review would be provided within 35 days, after which the rating is awarded.
- ❖ It is important to note that the mandatory requirements/credits earned at the preliminary review are only considered as anticipated. These mandatory requirements/credits are not awarded until the final documents are submitted, along with additional documents showing implementation of design features. If there are changes in any 'credit anticipated' after preliminary review, these changes need to be documented and resubmitted during the final review.
- ❖ IGBC will recognise homes that achieve one of the rating levels with a formal letter of certification and a mountable plaque.

f. Physical Verification & Monitoring

Before the award of rating, the residential project would be physically audited to verify implementation of the design measures.

g. Credit Interpretation Ruling

In some instances the design team can face certain challenges in applying or interpreting a mandatory requirement or a credit. Project Teams may face peculiar/site specific conditions which require an alternative compliance path to meet the intent behind the credit.

To resolve this, IGBC uses the process of 'Credit Interpretation Ruling' (CIR) to ensure that rulings are consistent and applicable to other projects as well.

The following are the steps to be followed if a project team faces an issue not addressed in the Detailed Green Homes Reference Guide:

i. Consult the Detailed Reference Guide for description of the credit intent, compliance options, sample calculations, approach & methodologies, documentation required, related credits, case studies, definitions and annexures.

ii. Review the intent of the mandatory requirement/credit and self-evaluate whether the project satisfies the intent.

iii. Review the Credit Interpretation web page for previous CIR on the relevant mandatory requirement or credit. All projects registered under IGBC Green Homes will have access to this page.

iv. If a similar CIR has not been addressed or does not address the issue sufficiently, submit a credit interpretation request (A CIR shall not exceed 600 words or 5,000 characters including spaces). Only registered projects are eligible to post CIRs. Two CIRs are answered without levying any fee and for additional CIRs beyond the first two CIRs, a fee is levied.

The CIR Rulings for the earlier CIR raised by project teams is available in www.igbc.in

h. Appeal Process

In rare cases, mandatory requirements or credits may be denied due to misinterpretation of the intent. On receipt of the final review, if a Project Team feels that sufficient grounds exist to appeal a credit denied in the final review, the project has an option to appeal to IGBC for reassessment of denied mandatory requirements or credits. The documentation for the mandatory requirements or credits seeking appeal may be resubmitted to IGBC along with necessary fee. IGBC will take 35 days to review such documentation. If an appeal is pursued, please note that a different review team will assess the Appeal Documentation.

The following documentation should be submitted:

1. General information of project including
   a. Project brief stating project type, different type of spaces, occupancy, number of floors, area statement, etc.,
   b. General drawings (in PDF format only):
      i. Master/Site plan
      ii. Parking plans
      iii. Floor plans
      iv. Elevations
      v. Sections
      vi. Photographs/Rendered views
2. Filled-in Letter Template for respective mandatory requirement/credit.
3. Original, re-submittal, and appeal submittal documentation for only those mandatory requirement/credits that the project is appealing for. Also include a narrative for each appealed mandatory requirement/ credit to describe how the documents address the reviewers` comments and concerns.

i. Fee

Registration, Certification, Appeal and CIR fee details are available on IGBC website (www.igbc.in) or projects can write to IGBC (igbc@cii.in).

VI. About IGBC Green Homes Detailed Reference Guide

The IGBC Green Homes Detailed Reference Guide is a supporting document to the IGBC Green Homes Rating System. The guide is intended to assist project teams in understanding the rating system and ways of complying with each criterion. The guide includes examples of strategies that can be used in each category, case studies of buildings that have implemented these strategies successfully and additional resources that will provide more information. This guide is not intended to provide an exhaustive list of strategies for meeting the criteria. It does not provide all the detailed information that design teams may need to evaluate applicability of each credit to their project. Designers are encouraged to explore ideas and come up with strategies, to meet the rating requirements.

VII. Updates and Addenda

This is the first version of IGBC Green Homes® Version 2.0 Detailed Reference Guide. As the rating system continues to improve and evolve, updates, addenda and errata to the Detailed Reference Guide will be made available through the IGBC website. These additions will be incorporated in the next version of the rating system.

Checklist for
IGBC Green Homes® Version 2.0

Checklist for Green Homes

		Points Available		
		Individual Residential Unit	Multi-dwelling Residential Units	Design/ Construction
Site Selection and Planning				
SSP Mandatory Requirement 1	***Local Building Regulations***	*Required*	*Required*	C
SSP Mandatory Requirement 2	***Soil Erosion Control***	*Required*	*Required*	C
SSP Credit 1	Basic House-hold Amenities	1	2	D
SSP Credit 2	Natural Topography or Vegetation : 15%, 25%	2	4	D
SSP Credit 3	Heat Island Effect, Non Roof : 50%, 75%	NA	2	D
SSP Credit 4	Heat Island Effect - Roof : 50%, 75%	4	4	D
SSP Credit 5	Parking Facilities for Visitors : 10%	NA	1	D
SSP Credit 6	Electric Charging Facility for Vehicles : 5%	NA	1	D
SSP Credit 7	Design for Differently Abled	1	2	D
SSP Credit 8	Basic Facilities for Construction Workforce	1	2	C
SSP Credit 9	Green Home Guidelines, Design & Post Occupancy	NA	1	D
		9	**19**	
Water Efficiency				
WE Mandatory Requirement 1	***Rainwater Harvesting, Roof & Non-roof, 25%***	*Required*	*Required*	C
WE Mandatory Requirement 2	***Water Efficient Plumbing Fixtures***	*Required*	*Required*	D
WE Credit 1	Landscape Design: 20%, 40%	2	4	D
WE Credit 2	Management of Irrigation Systems	1	1	D
WE Credit 3	Rainwater Harvesting, Roof & Non-roof: 50%, 75%	4	4	C
WE Credit 4	Water Efficient Plumbing Fixtures: 25%, 35%	4	4	D
WE Credit 5	Waste Water Treatment and Reuse: 100% & 50%, 95%	NA	4	D
WE Credit 6	Water Metering	NA	1	D
		11	**18**	
Energy Efficiency				
EE Mandatory Requirement 1	***CFC-free Equipment***	*Required*	*Required*	D
EE Mandatory Requirement 2	***Minimum Energy Performance***	*Required*	*Required*	D
EE Credit 1	Enhanced Energy Performance : 3%, 6%, 9%, 12%, 15%,18%, 21%, 24%, 27%, 30% (or) 2%, 4%, 6%, 8%, 10%,12%, 14%, 16%, 18%, 20%	10	10	D

EE Credit 2	On-site Renewable Energy: 2.5%, 5%, 7.5% (or) 10%, 20%, 30%	6	6	D
EE Credit 3	Solar Water Heating System : 50%, 95% (or) 25%, 50%	4	4	D
EE Credit 4	Energy Saving Measures in Other Appliances & Equipment	2	2	D
EE Credit 5	Distributed Power Generation	NA	2	D
EE Credit 6	Energy Metering	NA	1	D
		22	**25**	
Materials & Resources				
MR Mandatory Requirement 1	***Separation of House-hold Waste***	*Required*	*Required*	D
MR Credit 1	Organic Waste Management, Post Occupancy : 95% (or) 50%, 95%	2	4	C
MR Credit 2	Handling of Construction Waste Materials : 50% (or) 50%, 95%	1	2	C
MR Credit 3	Reuse of Salvaged Materials : 2.5%, 5% (or) 1%, 2%	2	4	C
MR Credit 4	Materials with Recycled Content : 10%, 20%	2	2	C
MR Credit 5	Local Materials : 25%, 50%	2	2	C
MR Credit 6	Rapidly Renewable Building Materials & Certified Wood : 50%, 75%	4	4	C
		13	**18**	
Indoor Environmental Quality				
IEQ Mandatory Requirement 1	***Tobacco Smoke Control***	*Required*	*Required*	D
IEQ Mandatory Requirement 2	***Minimum Daylighting: 50%***	*Required*	*Required*	D
IEQ Mandatory Requirement 3	***Fresh Air Ventilation***	*Required*	*Required*	D
IEQ Credit 1	Enhanced Daylighting : 75%, 95%	4	4	D
IEQ Credit 2	Enhanced Fresh Air Ventilation	2	2	D
IEQ Credit 3	Exhaust Systems	2	2	D
IEQ Credit 4	Low VOC Materials, Paints & Adhesives	2	2	C
IEQ Credit 5	Building Flush-out	1	1	C
IEQ Credit 6	Cross Ventilation : 50%, 75%	4	4	D
		15	**15**	
Innovation & Design Process				
ID Credit 1	Innovation & Design Process	4	4	D/C
ID Credit 2	IGBC Accredited Professional	1	1	D
		5	**5**	
	Total	**75**	**100**	

IGBC Green Homes®-Certification Levels

Rating	Points	
	Individual Residential Unit	Multi-dwelling Residential Units
Certified	38 – 44	50 – 59
Silver	45 – 51	60 – 69
Gold	52 – 59	70 – 79
Platinum	60 - 75	80 – 100

Site Selection & Planning

Introduction

The Site Selection & Planning section addresses the ecology and environment concerns related to residential construction & site development activities. Construction and development activities often have a negative impact on the ecology of the site. These activities impact the natural vegetation of the site, stormwater runoff patterns, perviousness of the site and also affect the existing migratory corridors of the site fauna.

When considering site alternatives, it is important to consider environmental criteria throughout the site selection process. The major ecological features of the site should be identified, including the site topography, existing trees, vegetation, wildlife and prior site history.

The erosion and sedimentation control plan can be implemented during construction to ensure that the existing vegetation on site is protected and the nutrient rich top soil is not washed away with the site water run-off. Flooding in urban areas during monsoons is largely caused by the debris clogging up the municipal stormwater ways. Projects shall consider implementing post occupancy strategies such as rainwater harvesting pits, storm water drain with filtering media, swales, retaining vegetation to mitigate the soil erosion and sedimentation control.

Increase in constructed areas leads to urban heat island effect where the local temperature increase due to heat retention. The urban heat island effect results in increased cooling energy requirement and affects the site flora and fauna.

Green homes are recommended to have easy access to basic amenities in order to take advantage of the existing infrastructure and enhance the quality of life of the occupants.

Visitor parking is encouraged in-addition to local bye-law norms so that parking in public places can be avoided. Reducing carbon emissions during transit of occupants is also of importance while selecting a site.

It is also important to minimise the negative impacts on surrounding areas after construction is complete. While it is known that many a time, the site selection may not be fully under the control of the occupant or developer, all possible measures can be explored.

Construction workers must be provided with safety and basic facilities such as sanitation facilities, drinking water, first aid, personal protection, etc., A green home design must be user friendly to differently abled and senior citizens.

Local Building Regulations

SSP Mandatory Requirement 1

Intent:

Ensure that the building(s) complies with necessary statutory regulatory codes.

Compliance Options:

The following approvals are required from the competent local Government authority:

- Approval of building plan (or) site plan
- Fit-for-occupancy certificate

Green Building Concerns:

- Unregulated spaces lead to chaotic situation such as overcrowding, unsafe structures which are may not be fit for Human habitation.
- Projects which do not follow the local norms, compromise the quality of environment at a community level.

Approach and Methodologies:

Carry-out a study to understand all the statutory requirements in the project's location. Ensure that these requirements are incorporated at the design stage.

The project team should ensure that the designed project should meet the local building bye-laws. The bye-laws would typically include fire safety norms, ground coverage, height restrictions, maximum built up area, minimum open space requirements, parking provisions, etc.,

Benefits:

- Prevent the growth of unregulated structures.
- Restrict excessive and unsafe development within the site.
- Reduce the negative environmental impacts caused due to superfluous development.

Documentation Required:

Precertification Level

(Only for Multi-dwelling Residential Units)

- ❖ Site plan approved by local Government authority.
  (Or)
- ❖ Project commencement certificate issued by local Government authority.

Note:

Projects which have not yet received site plan approval from local Government authority may submit an undertaking from the Project Owner(s) that Project drawings have been submitted for approval from the local Authorities and documentation demonstrating approval from the local Authorities shall be submitted at the time of Certification.

Certification Level

(For Individual Residential Units & Multi-dwelling Residential Units)

- ❖ As-built drawings (floor plans, elevations, sections, etc.,) approved by local Government authority.
- ❖ Fit-for-occupancy certificate issued by local Government authority.
- ❖ Photographs of the building(s) taken at various stages of construction.

Note:

Projects which have not yet received fit-for-occupancy certificate issued by local Government authority may submit an undertaking from the Owners that a fit-for-occupancy certificate shall be obtained from local Government authority prior to handover, to show compliance.

Related Mandatory Requirements & Credits:

There are no related credits and mandatory requirements.

Soil Erosion Control

SSP Mandatory Requirement 2

Intent:

Control soil erosion and sedimentation thereby, reducing negative impacts to the site and surroundings.

Compliance Options:

Adopt the following measures:

- Soil erosion control measures for pre-construction and during construction must conform to the best management practices highlighted in the National Building Code (NBC) of India, Part 10, Section 1, Chapter 4-Protection of Landscape during Construction and Chapter 5-Soil and Water Conservation.
- Fertile topsoil to be stockpiled prior to construction, for reuse later either on site or sold/donated for use off-site.
- Develop a storm-water management plan during construction to ensure that the storm-water runoffs during construction are filtered to remove the TSS prior to conveying into the municipal storm-water drain.
- Develop appropriate measures to address soil erosion, post occupancy.

Green Building Concerns:

- Loss of topsoil greatly reduces the soil's ability to support plant life, regulate water flow, and maintain the biodiversity of soil microbes.
- Run-off from developed sites carries pollutants, sediments, and excess nutrients that disrupt aquatic habitats in the receiving waters.
- Suspended solids and sediments in the stormwater run-offs clogs up municipal storm-water systems and leads to flooding during monsoon season. Sedimentation also contributes to the degradation of water bodies and aquatic habitats.
- Airborne dust from construction activity can have both environmental and human health impacts.

Approach and Methodologies:

Develop strategies to address the erosion and sedimentation control at pre-construction stage, during construction and post occupancy.

Pre-Construction stage measures:

The pre-construction stage measures typically include site barricading, protection & stockpiling fertile top soil and reuse later for landscaping purpose. The stockpiled soil can also be donated to other sites for landscaping.

Consider adopting erosion control measures such as temporary and permanent seeding, mulching, earth dikes, silt fencing, sediment traps, and sediment basins as appropriate. Other strategies include landscaping open areas with native/adaptive vegetation; paving surface areas with permeable paving materials. For impermeable surfaces, divert rainwater run-offs towards collection pits.

Picture 1:
Photographs showing top soil preservation & top soil protection

During Construction measures:

Ideally, excavation work can be planned during dry weather conditions when the potential for erosion is lowest. Before commencing excavation, have a plan to store the top soil and use later for landscaping.

Protect existing vegetation to the maximum extent, to minimise the quantity of soil exposed to erosion. Avoid felling of trees or consider transplanting of trees which may obstruct the construction activities as appropriate. For every tree uprooted consider planting of atleast 5-7 saplings or as per local bye-law requirement, whichever is stringent. Reduce air borne pollution by ensuring all trucks transporting loose material is covered. Consider sprinkling water to reduce dust generation.

Site barrication

Swales

Sprinkling of water

Picture 2: Photographs showing Erosion & Sedimentation Control Measures

Post - occupancy measures:

Segregate areas of development and adopt measures to avoid storm water flow to neighbouring sites and prevent loss of top soil & contamination of storm water run-off.

The following measures can be considered for erosion and sedimentation control:

- ❖ Extensive vegetation.
- ❖ Construct sedimentation basins and traps to allow settling of sediments from storm water volumes.
- ❖ Regular maintenance of storm-water systems/structures.
- ❖ Permanent seeding to stabilise the soil.
- ❖ Rain water harvesting structures/ percolation pits.

Benefits:

- ❖ Soil erosion control measures prevent loss of top soil which is the most fertile
- ❖ Contamination of receiving water bodies due to storm water run-off can be reduced

Documentation Required:

Precertification Level

(Only for Multi-dwelling Residential Units)

- ❖ Narrative describing the proposed Erosion and Sedimentation Control (ESC) measures to be implemented on-site, during construction and post occupancy.
- ❖ Conceptual site drawing highlighting proposed ESC measures to be implemented on-site:
- ❖ During construction.
- ❖ Post occupancy.
- ❖ Photographs showing site conditions taken at various stages of construction, before construction and during construction, as applicable based on current status of project.

Certification Level

(For Individual Residential Units & Multi-dwelling Residential Units)

- Narrative stating the Erosion and Sedimentation Control (ESC) plan implemented at the time of construction and post occupancy. The narrative must demonstrate implementation of National Building Code (NBC) of India, Part 10, Section 1, Chapter 4-Protection of Landscape during Construction and Chapter 5-Soil and Water Conservation, relevant to the Project.
- Site drawing highlighting ESC measures implemented on-site:
  - During construction.
  - Post occupancy.
- Photographs showing site conditions taken at various stages of construction, before construction, during construction and post occupancy.

Related Mandatory Requirements & Credits:

- SSP Credit 2-Natural Topography or Vegetation (Vegetation on ground).
- SSP Credit 4-Heat Island Effect, Roof (Vegetation over roof).
- WE Mandatory Requirement 1-Rainwater Harvesting, Roof & Non-roof (Vegetation on ground and over roof; rainwater management).
- WE Credit 3-Rainwater Harvesting, Roof & Non-roof (Vegetation on ground and over roof; rainwater management).
- WE Credit 1-Landscape Design (Vegetation on ground and over roof).

Definitions:

Erosion is a combination of processes in which materials of the earth's surface are loosened, dissolved or worn away, and transported from one place to another by natural agents.

Mulching is placing hay, grass, wood chips, straw or gravel on the soil surface to cover and hold soil.

Permanent Seeding is planting grass, trees and shrubs to permanently stabilise soils.

Sedimentation is the addition of soil to water bodies by natural and human-related activities. Sedimentation decreases water quality and accelerates the aging process of lakes, rivers and streams.

Sediment Trap is an excavated pond area or constructed earthen embankments which allow for settling of sediment from stormwater volumes.

Silt Fence is constructed post with a filter fabric media to remove sediment from stormwater volumes flowing through the fence.

Temporary Seeding is planting fast growing grasses to temporarily stabilise soils.

Basic House-hold Amenities

SSP Credit 1 **Points: 1; 2**

Intent:

Reduce negative impacts caused to the environment from automobile use by providing basic house-hold amenities, thereby, enhancing the quality of life.

Compliance Options:

For Individual Residential Unit: (1 point)

Select a site with access to atleast five basic house-hold amenities, within a walking distance of 1 km from the building entrance.
(For list of basic house-hold amenities, refer Exhibit-A)

For Multi-dwelling Residential Units: (2 points)

Select a site with access to atleast seven basic house-hold amenities, within a walking distance of 1 km from the building entrance.
(For list of basic house-hold amenities, refer Exhibit-A)

(AND)

Additionally, provide the following within the campus premises:

- ❖ Seating facility and toilets in the common area for service staff & visitors (minimum one toilet for every 50 dwelling units).
- ❖ Tot-lot(s) for children.

Notes:

- *This point can be earned only if the basic amenities are available before or at the time of project completion.*
- *Basic amenities within the campus can also be considered to show compliance.*
- *Toilets provided in the common area can be designed to cater both differently abled people and service staff & visitors.*
- *Toilets provided in the clubhouse cannot be considered towards credit compliance calculations.*

Green Building Concerns:

- Urban sprawl affects quality of life because commuters spend increasing amounts of time in their automobiles.
- Urban redevelopment affects all areas of site design, including site selection, transportation planning, building density and storm water management.

Approach and Methodologies:

Wherever possible, select sites near public transit and/or household services and amenities that are accessible by safe, convenient pedestrian pathways.

Research shows that a person would normally walk for about 800 m comfortably. Therefore it would be in the best interest of communities to locate minimum basic amenities close to the site. This would encourage people to walk to such facilities, thereby avoiding use of personal vehicles. By doing so, fuel is conserved and vehicular pollution is reduced to a great extent.

Many-a-time, having basic amenities may not be within the control of the home owner or developer. Efforts and resources can be pooled to get such basic amenities close to the site, particularly in-cases of large scale developments. Common facilities or amenities may be even shared by the neighborhood. Providing functional sidewalks and pathways to amenities within the development would encourage people to walk.

Please refer Exhibit-A for list of basic amenities.

Benefits:

- Minimises the negative environmental impacts resulting from the use of automobiles.
- Saving of fuel used in commuting.
- Encourages people to walk or cycle, thereby improving health.
- Promotes community level interaction and better quality of life.

Exhibit A-List of Basic Amenities

- ❖ Bank
- ❖ ATM
- ❖ Beauty saloon
- ❖ Bus stop
- ❖ Railway station
- ❖ Educational institutions (Pre-school, School, College, etc.,)
- ❖ Electricity
- ❖ Water utility bills payment counter
- ❖ Electrical
- ❖ Plumbing services
- ❖ Grocery store/Super market
- ❖ Hardware shop
- ❖ Laundry
- ❖ Medical clinic
- ❖ Hospital
- ❖ Park/Garden
- ❖ Place of Worship
- ❖ Playground/Jogging track
- ❖ Pharmacy
- ❖ Restaurant
- ❖ Refueling station for automobiles
- ❖ Sports club/Fitness center/Gym
- ❖ Stationary shop
- ❖ Theater

Note:

- *All basic house-hold amenities are to be considered only once.*
- *The amenities should be accessible to building/campus visitors also.*

Documentation Required:

Precertification Level

(Only for Multi-dwelling Residential Units)

- ❖ Site vicinity map highlighting location of existing/proposed basic house-hold amenities from the proposed project, showing pedestrian access.

Notes:

Project(s) having multiple buildings can show compliance through a combination of the following criteria:

- *From center of the project site.*
- *From the farthest building within the project site.*
- *Conceptual drawings showing the proposed location of seating facility & toilets in the common area and tot-lots within the campus.*

Certification Level

(For Individual Residential Units)

- ❖ Site vicinity map with a graphical scale, highlighting location of existing/ proposed basic house-hold amenities from the project, showing pedestrian access.
- ❖ Photographs showing the basic house-hold amenities.

(For Multi-dwelling Residential Units)

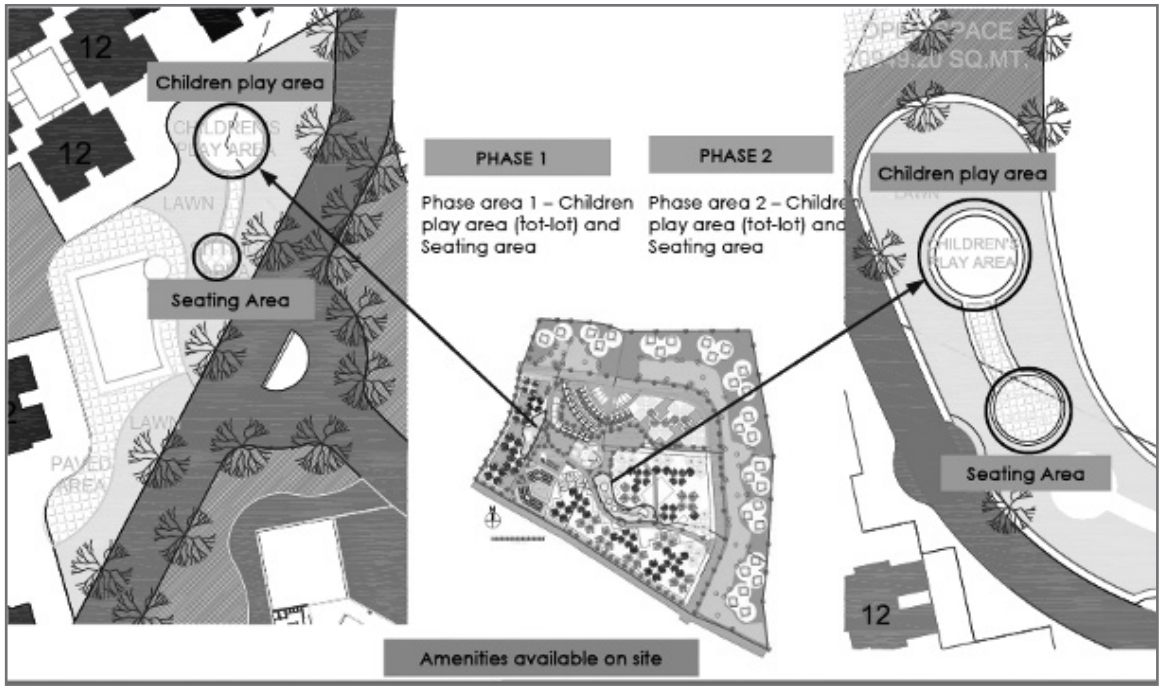
- ❖ Site vicinity map with a graphical scale, highlighting location of existing/ proposed basic house-hold amenities from the project, showing pedestrian access.

Notes:

Project(s) having multiple buildings can show compliance through a combination of the following criteria:

- *From center of the project site.*
- *From the farthest building within the project site.*
- *Photographs showing the basic house-hold amenities.*
- *Drawings and photographs showing location of seating facility & toilets in the common area and tot-lots within the campus.*

Picture 3: Site vicinity map highlighting the basic amenities



Picture 4: Site drawing highlighting the location of the seating & children play area

Related Mandatory Requirements & Credits:

- ❖ SSP Credit 7-Design for Differently Abled (Common toilets)

Exemplary Performance:

This credit is not eligible for exemplary performance under Innovation & Design Process.

Natural Topography or Vegetation

SSP Credit 2 **Points: 2 ; 4**

Intent:

Minimise disturbances to the site so as to reduce long-term environmental impacts.

Compliance Options:

Avoid disturbance to the site by retaining natural topography or vegetation and/ or design vegetated spaces for atleast 15% of the site area.

Points are awarded as below:

Percentage of Site area with Natural Topography and/or Vegetated area	Points for Individual Residential Units	Points for Multi-dwelling Residential Units
≥ 15%	1	2
≥ 25%	2	4

Notes:

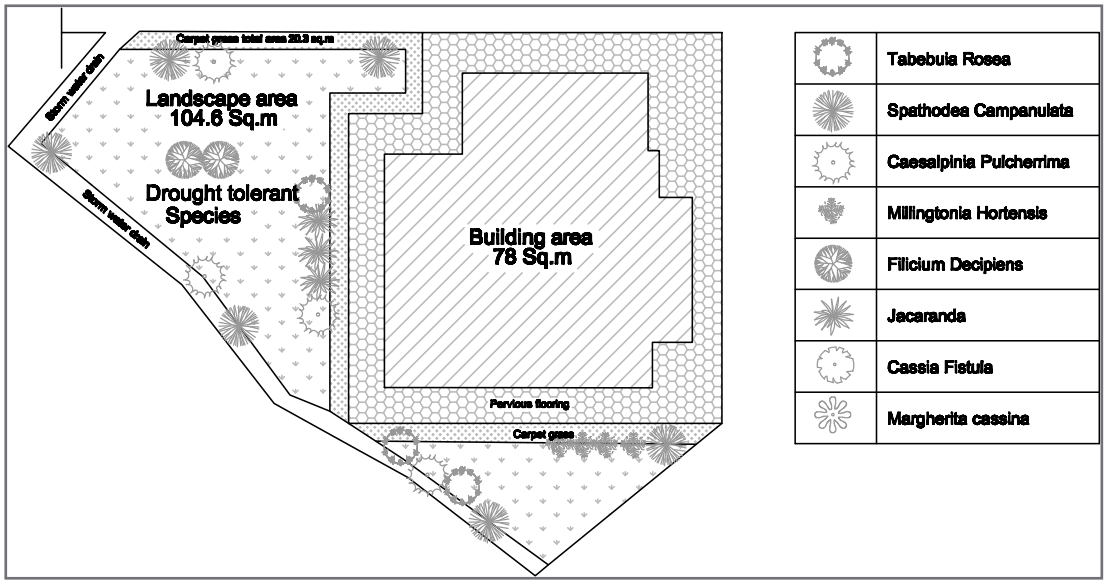
- *Retaining 'Natural Topography' in its broad sense means preserving natural features of the terrain such as natural rocks, water body, etc.,*
- *For this credit, vegetation on the ground only shall be considered and vegetation over built structures such as roofs, basement, podiums, etc., cannot be considered.*
- *For this credit calculation, potted plants should not be considered as vegetation.*
- *Grass medians, grass pavers, jogging track, open-air theatre, parking areas, playground, swimming pool, tot-lots, walkways etc., may not be considered as natural topography and be counted towards compliance calculations.*

Green Building Concerns:

- ❖ Development on building sites often damages site ecology, indigenous plants and regional fauna.
- ❖ Natural areas address important ecological issues, including effective and natural management of storm water volumes.
- ❖ Loss of urban forestry in many of the Indian cities is reflecting on the micro-climate.
- ❖ Many cities have been witnessing loss of bird species due to the large spread developments in urban areas.

Approach and Methodologies:

The broader goal in this credit is not to disturb the earth, in the first place, so that the natural eco-system is retained in its pristine form. Design the building with a minimal footprint. Consider retaining the natural topography on the site or design landscape with vegetation to the maximum extent. For sites which have fully grown trees, avoid felling of trees or consider transplanting of trees which may obstruct the construction activities. For every tree uprooted consider planting of atleast 5-7 saplings or as per local bye-law requirement, whichever is stringent.



Picture 5: Conceptual site drawing highlighting area retained with natural topography

CIR on natural topography:

The project has raised a CIR for including vegetated areas over the built structures such as roof, basement and podium surfaces as natural topography or vegetation under this credit.

The project has considered an integrated approach during the design stage to convert (and/or) restore the hardscapes into softscapes (vegetation) over the built structures. However, it is important to know that the intent of SSP Credit 2-Natural Topography or Vegetation is to 'minimise disturbances to the site so as to reduce long-term environmental impacts'.

The broader goal in this credit is not to disturb the earth, in the first place, so that the natural eco-system is retained in its pristine form.

Though softscapes (vegetation) may be developed over the developed areas, the site disturbance is considered to have already taken place. Hence, for this credit, only natural vegetation on the ground being considered.

However, the vegetation over built structures can be considered for calculations under the following credits:

- ❖ SSP Credit 3 - Heat Island Effect, Non-roof.
- ❖ SSP Credit 4 - Heat Island Effect, Roof.
- ❖ WE Mandatory Requirement 1 & WE Credit 3 - Rain Water Harvesting.
- ❖ WE Credit 1 - Landscape Design.

Benefits:

- ❖ Preservation of natural habitat
- ❖ Enhances biodiversity
- ❖ Site conservation and limiting the urban sprawl

Sample Calculations:

The calculation methodology for determining the natural topography & vegetation on-site involves preserving existing trees/vegetation, rocky terrain and existing water bodies or proposing new vegetation on ground. Assuming a residential project having a site area of 15,000 sq.m. To show credit compliance the project proposes to retain 1,500 sq.m of site area with natural topography (i.e. existing vegetation & rocky terrain) and also proposes new vegetation of 3,000 sq.m of site area, on natural ground. Hence the area retained with natural topography & vegetation accounts to 30% of total site area.

The sample filled-in template calculation is shown below:

Total site area	**(sq.m)**	**15,000**
Total area retained with natural topography and/ or vegetation	**(sq.m)**	**4,500**
Area retained with natural topography	(sq.m)	1,500
Area with vegetation (Vegetation on ground only)	(sq.m)	3,000
Percentage		**30.0%**

Documentation Required:

Precertification Level

(Only for Multi-dwelling Residential Units)

- ❖ Conceptual site drawing highlighting the area with natural topography (and/or) vegetation.
- ❖ Site area calculations (approximate) indicating the total site area, area with natural topography (and/or) vegetation on the ground only.

Certification Level

(For Individual Residential Units & Multi-dwelling Residential Units)

- ❖ Site drawing highlighting area with natural topography (and/or) vegetation.
- ❖ Site area calculations indicating the total site area, area with natural topography (and /or) vegetation on the ground only.
- ❖ Photographs showing the site area with natural topography (and/or) vegetation.

Note:

- *The total site area must be consistent across all the credits.*

Exemplary Performance:

The project is eligible for exemplary performance under Innovation & Design Process, if more than 35% of the site area is left undisturbed (i.e. retained with natural topography and/or vegetated).

Related Mandatory Requirements & Credits:

- ❖ WE Mandatory Requirement 1-Rainwater Harvesting, Roof & Non-roof (Surface type & area).
- ❖ WE Credit 1-Landscape Design (Vegetated area on ground).
- ❖ WE Credit 3-Rainwater Harvesting, Roof & Non-roof (Surface type & area).

Definitions:

Building Footprint is the area on a project site that is used by the building structure and is defined by the perimeter of the building plan. Parking lots, landscapes and other non-building facilities are not included in the building foot print.

Development Footprint is the area on the project site that has been impacted by any development activity. Hardscape, access roads, parking lots, non-building facilities and building structure are included in the development footprint.

Landscape refers to soft landscaping which include only vegetative materials.

Natural Topography in its broad sense means preserving natural features of the terrain.

Open Space Area is the property area minus the development footprint. Open space must be vegetated and pervious, thus providing habitat and other ecological services.

Site Area is same as property area.

Heat Island Effect, Non-roof

Not applicable for Individual Residential Units

SSP Credit 3 **Points: 2**

Intent:

Reduce heat islands to minimise impact on microclimate, human and local bio-diversity.

Compliance Options:

For atleast 50% of exposed non-roof impervious areas (such as footpaths, pathways, roads, uncovered surface parking and other impervious areas) within the project site, provide atleast one or combination of the following:

- ❖ Shade from tree cover within 5 years
- ❖ Open grid pavers, including grass pavers

Points are awarded as below:

Non-roof impervious area as a percentage of total non-roof area	Points
≥ 50%	1
≥ 75%	2

Note:

- *Trees/Saplings should be in place at the time of occupancy.*

Green Building Concerns:

- ❖ Because of heat island effect, ambient temperatures in urban areas are artificially elevated by 2° to 5°C compared with surrounding suburban and undeveloped areas.
- ❖ Heat islands are detrimental to site habitat, wildlife and animal migration corridors.
- ❖ Flora and fauna are also sensitive to large fluctuations in daytime and night time temperatures and may not thrive in areas affected by heat islands.

Approach and Methodologies:

With the growing urbanisation and the urban sprawl, the demand for new buildings, roads, parking lots and other infrastructural requirements are on the rise. The use of dark surfaces for parking, roofs and other hardscapes absorbs the sun's warmth, which in turn radiates to

the surrounding areas. This inturn leads to differences in ambient temperatures in urban and sub-urban areas. This in turn disturbs the flora and fauna thriving in those areas.

Picture 6: Photographs showing grass pavers & tree cover options for non-roof areas

Benefits:

- ❖ Reduction in local temperatures
- ❖ Encourages biodiversity of a region

Sample Calculations:

The calculation methodology for determining exposed non-roof impervious areas within the project site include footpaths, pathways, roads, uncovered surface parking and other impervious areas. Assuming a residential project having a site area of 15,000 sq.m. The building footprint is say 6,000 sq.m and net exposed non-roof impervious area for the project consisting of parking and hard paved areas is 3,000 sq.m. To meet the credit intent, the project is proposing a tree cover of 900 sq.m and grass pavers proposed with an area of 900 sq.m. Hence net non-roof covered with combination of tree cover + grass pavers accounts to 60% of the net non-roof impervious surface area.

The sample filled-in template calculation is shown below:

Total exposed non-roof impervious (hardscape) surface area	**(sq.m)**	**3,000**
Total non-roof impervious surface area shaded with tree cover and/ or with open-grid pavers/ grass pavers	**(sq.m)**	**1,800**
Shade from tree cover within 5 years	(sq.m)	900
Open-grid pavers/ grass pavers	(sq.m)	900
Percentage		**60.0%**

Documentation Required:

Precertification Level

(Only for Multi-dwelling Residential Units)

- Narrative describing the proposed strategies to reduce heat island effect from non-roof areas.
- Conceptual site drawing highlighting non-roof impervious (hardscape) areas and areas covered with shade from tree cover within 5 years (and/or) open grid pavers, including grass pavers.
- Tentative calculations showing the exposed non-roof impervious areas and areas covered with shade from tree cover within 5 years, (and/or) open grid pavers, including grass pavers.
- Tentative list of existing trees/plant species which are likely to be grown in 5 years for shading.

Certification Level

(For Multi-dwelling Residential Units)

- Narrative detailing the strategies to reduce heat island effect from non-roof areas.
- Site drawing and photographs showing non-roof impervious (hardscape) areas and areas covered with shade from tree cover within 5 years (and/or) open grid pavers, including grass pavers.
- Calculations showing the break-up of the exposed non-roof impervious areas and areas covered with shade from tree cover within 5 years (and/or) open grid pavers, including grass pavers.
- List of existing trees/plant species which are grown or likely to be grown in 5 years.

Exemplary Performance:

This credit is eligible for exemplary performance under Innovation & Design Process, if more than 95% of exposed non-roof impervious areas are under tree cover and/or open grid pavers.

Related Mandatory Requirements & Credits:

- SSP Credit 2-Natural Topography or Vegetation (Tree cover)
- SSP Credit 5-Parking Facilities for Visitors (Uncovered surface parking only)
- WE Mandatory Requirement 1-Rainwater Harvesting, Roof & Non-roof (Surface type & area)
- WE Credit 3-Rainwater Harvesting, Roof & Non-roof (Surface type & area)

Definitions:

Heat Island Effect occurs when warmer temperatures are experienced in urban landscapes compared to adjacent rural areas as a result of solar energy retention on constructed surfaces. Principal surfaces that contribute to the heat island effect include streets, sidewalks, parking lots and buildings.

Heat islands are defined as thermal gradient differences between developed and undeveloped areas.

Heat Island Effect, Roof

SSP Credit 4 **Points: 4**

Intent:

Reduce heat islands to minimise impact on microclimate, human and local bio-diversity.

Compliance Options:

- Use material with high solar reflectance and thermal emittance (such as, white/ light coloured china mosaic tiles or white cement tiles or high reflective coatings or other high reflective materials/ surfaces) to cover atleast 50% of the exposed roof areas. (AND/ OR) provide pervious vegetation, to cover atleast 50% of the exposed roof areas.

Minimum Solar Reflective Index (SRI) values for different roof types are provided below:

Table 1-Solar Reflective Index (SRI) values for different roof types

Roof Type	Slope	SRI
Low-sloped roof	≤ 1:6	78
Steep-sloped roof	> 1:6	29

Points are awarded as below:

Percentage of high reflective material/ vegetation of the exposed roof areas	Points
≥ 50%	2
≥ 75%	4

Notes:

- *For this credit, all roof areas, including podium, covered surface parking and utility blocks, which are exposed to the sky (at and above ground level) should be considered for calculations.*
- *Exposed roof area need not include equipment platforms, areas with solar photovoltaic &, solar water heaters, skylights, swimming pool, driveways, pathways, roads, play areas etc.,*

- *SRI values of high reflectance materials should be as per ASTM Standards. China mosaic tiles are exempted from showing SRI value.*
- *The solar reflectance index (SRI) is a measure of the constructed surface's ability to reflect solar heat, as shown by a small temperature rise. It is defined so that a standard black surface (reflectance 0.05, emittance 0.90) is zero and a standard white surface (reflectance 0.80, emittance 0.90) is 100. To calculate the SRI for a given material, obtain the reflectance value and emittance value of the material. SRI is calculated according to ASTM E 1980. Reflectance is measured according to ASTM E 903, ASTM E 1918 or ASTM 1549. Emittance is measured according to ASTM E 408 or ASTM C 1371.*

Green Building Concerns:

- ❖ The use of dark, non-reflective surfaces for the roof/ terrace contributes to the heat island effect by absorbing the sun's warmth, which then radiates into the surroundings.
- ❖ Because of heat island effect, ambient temperatures in urban areas are artificially elevated by 2° to 5°C compared with surrounding suburban and undeveloped areas.
- ❖ Heat islands are detrimental to site habitat, wildlife and animal migration corridors.
- ❖ Flora and Fauna are also sensitive to large fluctuations in daytime and nighttime temperatures and may not thrive in areas affected by heat islands.
- ❖ The result is increased cooling loads in the summer, requiring larger heating, ventilation & air-conditioning (HVAC) equipment and greater electricity consumption, both of which generate greenhouse gases and pollution.

Approach and Methodologies:

With the growing urbanisation and the urban sprawl, the demand for new buildings, roads, parking lots and other infrastructural requirements are on the rise. Such developments have led to differences in ambient temperatures in urban and sub-urban areas. Difference in localised temperatures causes disturbances in day time and night time temperatures which in-turn disturbs the flora and fauna thriving in those areas. To minimise the impacts of such development, consider materials for roof application that have high solar reflectance index /vegetation. Typical materials with high reflective properties include, china mosaic, light coloured tiles, while cement tiles and paints with high Solar Reflective Index (SRI).

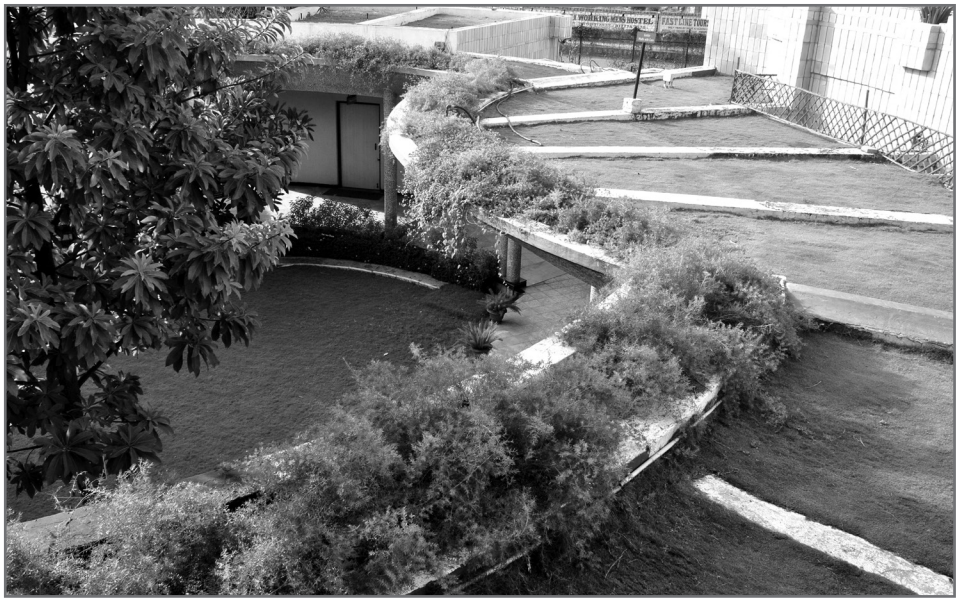
Green roofs are one of the best strategies to minimise heat island effect. Vegetated roofs can be very beneficial. They can reduce the heat island effect by replacing heat absorbing surfaces with plants, shrubs and small trees to cool the air through evapotranspiration. While designing green roofs, select native or adaptive plant species to reduce or eliminate the need for irrigation. Where irrigation is required consider using waste water or stored rain water to reduce potable water use for landscape irrigation.

The table below provides the Solar Reflectance Index (SRI) reflectance values for some of the typical materials:

Solar Reflectance Index (SRI) for some of the standard roofing materials

Materials	Solar Reflectance Index (SRI)
Gray Asphalt Shingle	22
Unpainted Cement tile	25
Light Gravel on Built – Up roof	37
White – Coated gravel on Built-up roof	79
White Cement Tile	90
White Coating – 2 coats, 20 mm	107

Picture 7: Exposed roof area covered with china mosaic



Picture 8: Vegetated roof

Operation & maintenance

Surface materials with high reflectivity should be cleaned atleast every 2 years to maintain good reflectance.

Benefits:

- ❖ Reduction in local temperatures.
- ❖ Green roofs can reduce stormwater runoff volumes from the roof.
- ❖ Vegetative roofs can be an aesthetic delight.

Sample Calculations:

Assuming a residential project having a site area of 15,000 sq.m and exposed roof area (excluding staircase area and solar hot water system) is 5,500 sq.m. The calculation methodology for determining exposed roof area includes excluding skylights, equipment areas i.e. solar hot water system, solar photo voltaics and service areas (stair case head room, service ducts & lift machine room).

To meet the credit compliance, the project is proposing to cover exposed roof area with china mosaic tiles for 3,000 sq.m; vegetation for 1,500 sq.m. Hence exposed roof area covered with china mosaic tiles+ vegetation is 4,500, which accounts to 81.8% of the exposed non-roof impervious surface area.

The sample filled-in template calculation is shown below:

Total roof area (Sum of all roof areas from bird's eye-view)	**(sq.m)**	**6,000**
Roof area covered with services & utilities	**(sq.m)**	**500**
Roof area covered with skylights & other surfaces	**(sq.m)**	**0**
Net exposed roof area	**(sq.m)**	**5,500**
Total roof area covered with china mosaic, cement tiles, high reflective material and / or vegetation	**(sq.m)**	**4,500**
White/ light colored china mosaic tiles	(sq.m)	3,000
White cement tiles	(sq.m)	0
High reflective coatings	(sq.m)	0
Other high reflective materials	(sq.m)	0
Vegetation	(sq.m)	1,500
Percentage		**81.8%**

Documentation Required:

Precertification Level

(Only for Multi-dwelling Residential Units)

- ❖ Narrative describing the proposed strategies to reduce heat island effect from roof areas.
- ❖ Conceptual roof plans highlighting location and the extent of high reflective roof materials/ vegetation.
- ❖ Tentative roof area calculation showing exposed roof area, service & utility areas and area covered with high reflective roof materials/vegetation.
- ❖ List of proposed high reflective materials (make & model).

Certification Level

(For Individual Residential Units & Multi-dwelling Residential Units)

- ❖ Narrative detailing the strategies implemented to reduce heat island effect from roof areas.
- ❖ Drawings highlighting location and the extent of highly reflective roof materials/ vegetation.
- ❖ Roof area calculations showing break-up of exposed roof area, service & utility areas and area covered with highly reflective roof materials/vegetation.
- ❖ Declaration letter from the owner/developer stating that the vegetated areas on the roof surfaces will be retained through the life-span of the Building.
- ❖ Purchase invoice/payment receipts of the high reflective roof materials sourced for the project.
- ❖ Letters/brochures from the manufacturer indicating Solar Reflective Index (SRI) of the high reflective roof materials used in the project.

Exemplary Performance:

The project is eligible for exemplary performance under Innovation & Design Process, if more than 95% of the exposed roof area is covered with vegetation.

Related Mandatory Requirements & Credits:

- ❖ SSP Mandatory Requirement 2-Soil Erosion Control (Vegetated area over roof).
- ❖ SSP Credit 5-Parking Facilities for Visitors (Covered parking only).
- ❖ WE Mandatory Requirement 1-Rainwater Harvesting, Roof & Non-roof (Surface type & area).
- ❖ WE Credit 3-Rainwater Harvesting, Roof & Non-roof (Surface type & area).
- ❖ WE Credit 1-Landscape Design (Vegetated area over roof).
- ❖ EE Credit 2-On-site Renewable Energy (Roof area).
- ❖ EE Credit 3-Solar Water Heating System (Roof area).

Definitions:

Emittance or Emissivity is the ratio of the radiation emitted by a surface to the radiation emitted by a black body at the same temperature.

Heat Island Effect occurs when warmer temperatures are experienced in urban landscapes compared to adjacent rural areas as a result of solar energy retention on constructed surfaces. Principal surfaces that contribute to the heat island effect include streets, sidewalks, parking lots and buildings.

Roof is the upper portion of the building envelope, including opaque areas and fenestration that is horizontal or tilted at an angle of less than 60° from horizontal.

Solar Reflectance (Albedo) is the ratio of the reflected solar energy to the incoming solar energy over wavelengths of approximately 0.3 to 2.5 micrometers. A reflectance of 100% means all the energy striking the reflecting surface is reflected back into the atmosphere and none of the energy is absorbed by the surface.

Solar Reflectance Index (SRI) is a measure of a material's ability to reject solar heat, as shown by a small temperature rise.

Parking Facilities for Visitors

Not applicable for Individual Residential Units

SSP Credit 5 **Points: 1**

Intent:

Provide adequate parking within the site to minimise disturbance caused due to parking on public roads, thereby enhancing the quality of civic life.

Compliance Options:

- **Resident Parking**

  Provide parking for residents, to meet or exceed local bye-law requirement.

- **Visitor Parking**

  Case 1: Local bye-law prescribes

  Provide parking facility for visitors as prescribed in the local bye-law.

  Case 2: Local bye-law does not prescribe

  Provide parking for visitors equivalent to 10% of the parking area/spaces required for residents as per local bye-law.

Green Building Concerns:

- Insufficient parking capacity leads to the parking on roadsides and creates traffic congestion

Approach and Methodologies:

Design the building to ensure adequate parking provisions are made to cater to the occupants as well as the visitors. Parking provisions should take into account two wheelers and four wheelers, as applicable according to local bye-law.

While designing parking facilities, consider basement/stilt(s) parking to reduce the heat island effect. If surface parking is planned, consider permanent cover; or other design strategies to address heat island effect as a result of such provisions.

Benefits:

- Reduced traffic congestions.
- Better traffic management and enhanced quality of civic life.

Documentation Required:

Precertification Level

(Only for Multi-dwelling Residential Units)

- ❖ Conceptual parking plans showing the resident and visitor parking spaces.
- ❖ A copy of the local bye-law highlighting the parking requirements.
- ❖ Tentative calculations showing the parking provisions as per local regulations and proposed for residents and visitors.

Certification Level

(For Multi-dwelling Residential Units)

- ❖ Parking plan showing the resident and visitor parking spaces.
- ❖ A copy of the local bye-law highlighting the parking requirements.
- ❖ Calculations showing the parking provisions as per local regulations and provided for residents and visitors.

Exemplary Performance:

This credit is not eligible for exemplary performance under Innovation & Design Process.

Related Mandatory Requirements & Credits:

- ❖ SSP Credit 6-Electric Charging Facility for Vehicles (Number of parking spaces).
- ❖ SSP Credit 7-Design for Differently Abled (Number of parking spaces).

Definitions:

Basement is the lower storey of a building below or partly below ground level.
Stilts are one of several posts supporting a structure built above the surface of land or water.

Electric Charging Facility for Vehicles

Not applicable for Individual Residential Units

SSP Credit 6 **Points: 1**

Intent:

Encourage the use of electric vehicles thereby reducing negative impacts resulting from fossil fuel based automobile use.

Compliance Options:

Provide electric charging facilities to cater to atleast 5% of the total parking capacity, provided on site for residents (excluding visitor parking).

Note:

- *If the project has exclusive parking spaces for two-wheelers, electric charging has to be provided in such areas also.*

Green Building Concerns:

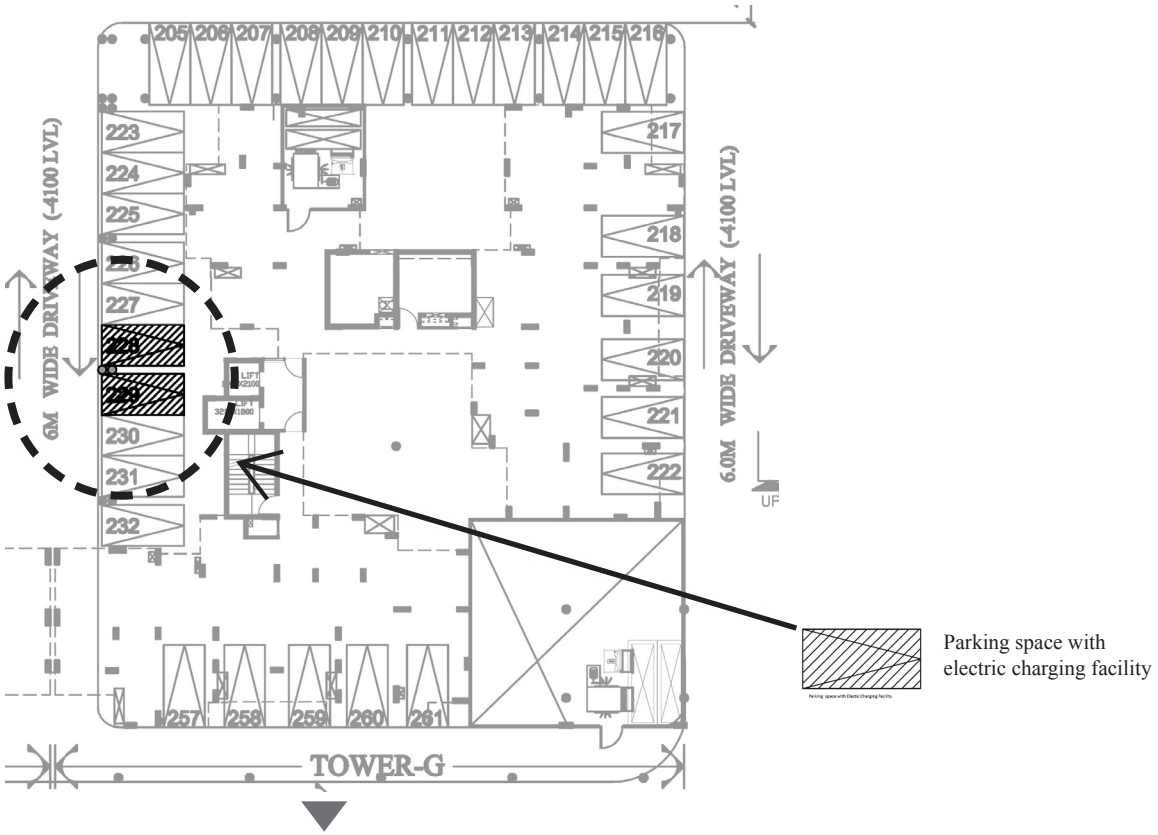
- ❖ The emissions from the conventional fuel automobiles pollutes the air and contributes to acid rain
- ❖ The use of electrical vehicle eliminates tailpipe exhaust and centralises the source of emissions at power plants, where the emissions can be better controlled

Approach and Methodologies:

Provide electric charging facilities for vehicles catering to both, two & four-wheelers of the parking proposed for the residents as per local bye-law. While considering such charging facilities, ensure that all safety aspects have been addressed. Consider sharing the costs of the facility with the residents. Locate car and two-wheeler parking spaces with electrical charging facilities in the common areas such that the facility is easily accessible to all occupants and visitors of the residential building.

Survey the type of electric vehicles already plying on the roads & the type of power points they require and also survey the kind of vehicles which may come up in the future. Create facilities so as to charge these kind of vehicles. Consider having adequate number of charging facilities based on their charging time.

Establish procedures for the use of allotted parking spaces with electric charging facilities; communicate the same to building occupants and assign operations staff for their administration. The procedures can include but not limited to providing list of qualifying vehicles (make, model, and year); establishing a system for enforcing use of designated spaces (e.g. permitting system) and tracking the use of designated parking spaces with electric charging facilities.



Picture 9 : Plan highlighting electric charging facilities

Benefits:

- ❖ Encourage more people to use electric vehicles.
- ❖ Reduced emissions on the road, providing better outdoor air quality.

Sample Calculations:

The calculation methodology for arriving at the parking calculations for electric charging facility includes both four and two-wheelers parking spaces, as applicable. Assuming a residential complex where, the local-byelaw prescribes 80 four-wheelers & 15 two-wheelers for residents, wherein the project proposes to provide parking for 85 four-wheelers & 18 for two-wheelers for residents.

To meet the credit compliance, the project must provide electric charging facilities catering to 4-four-wheelers & 1 two-wheeler. The project proposes to provide electric charging facilities for 18 four-wheelers and 5 two-wheelers.

The sample filled-in template calculation is shown below:

Vehicle Type	Resident Parking		Percentage	Meet or Exceed Credit Requirement (Yes/ No)
	Total Number of Parking Spaces Provided (excluding Visitor Parking)	Number of Parking Spaces Provid ed with Electric Charging Facility		
4-wheelers	85	18	21.2%	Yes
2-wheelers	18	5	27.8%	Yes

Documentation Required:

Precertification Level

(Only for Multi-dwelling Residential Units)

- Conceptual parking layouts highlighting location of parking spaces with electric charging facility.
- Tentative calculations indicating total number of proposed parking spaces (for residents) and electric charging facilities.
- Details of the electric charging points.

Certification Level

(For Multi-dwelling Residential Units)

- Parking layouts highlighting location of parking spaces with electric charging facility.
- Calculations indicating total number of parking spaces (for residents) and electric charging facilities provided in the project.
- Photographs showing electric charging facilities.

Exemplary Performance:

The credit is not eligible for exemplary performance under Innovation & Design Process.

Related Mandatory Requirements & Credits:

- SSP Credit 5-Parking Facilities for Visitors (Number of parking spaces)

Design for Differently Abled

SSP Credit 7 **Points: 1; 2**

Intent:

Ensure that the building/campus design caters to differently abled people.

Compliance Options:

Design the building/campus to provide the following, as applicable, for differently abled people in accordance with the guidelines of National Building Code (NBC) of India.

For Individual Residential Unit: (1 point)

- Easy access to the main entrance of the building
- Non-slippery ramps with hand rails on atleast one side
- Main entrance door with adequate width
- Uniformity in floor level for hindrance-free movement

For Multi-dwelling Residential Units: (2 points)

- Appropriately designed preferred car park space(s) having an easy access to the main entrance or closer to the lift lobby (one car park space for every 100 dwelling units).
- Easy access to the main entrance of the building(s).
- Non-slippery ramps with hand rails on atleast one side.
- Braille and audio assistance in lifts for visually impaired people.
- Elevator call buttons designed to be within reach of wheelchair occupants.
- Uniformity in floor level for hindrance-free movement in common areas & exterior areas.
- Rest rooms (toilets) in common areas designed for differently abled people (minimum one rest room for every 100 dwelling units.
- Walkways/pathways with adequate width in exterior areas.
- Visual warning signages in common areas & exterior areas.

Notes:

- *Toilets provided in the common area can be designed to cater both differently abled people and service staff & visitors*
- *Toilets provided in the clubhouse cannot be considered to show credit compliance*

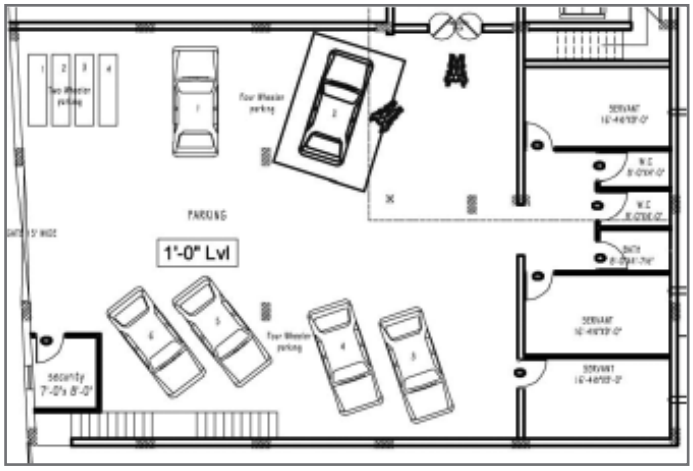
Green Building Concerns:

❖ User friendly design for easy movement for differently abled and senior citizens.

Approach and Methodologies:

Bye-laws of many states address the aspect of buildings being designed to cater to differently abled people. Study the local bye-laws or guidelines which provide specifications for such requirements.

Ensure that the design brief to the architect clearly specifies these requirements. Such facilities include providing easy access to main entrance, common areas like lobby space, club house, etc., Provide adequate rest rooms for differently abled.



Picture 10: Drawing highlighting preferred parking & photograph of ramp for differently abled

Benefits:

- Incorporating provisions for differently abled and senior citizens right at the design stage would encourage such people to visit the building.

Sample Calculations:

The calculation methodology for arriving at number for preferred parking & toilets for differently abled can be arrived considering the number of dwelling units. Assuming 12 dwelling units of 3-BHK residential flats, to meet the credit compliance, the project must provide one preferred parking space and one toilet for differently abled. The project proposes to provide two preferred parking spaces and one toilet for differently abled.

Sample filled-in template calculations are shown below:

Total Number of Dwelling Units (Value is taken from 'Dwelling Unit Details' sheet)	**Minimum Number of Preferred Parking Spaces Required**	**Number of Preferred Parking Spaces Provided**	**Meeting the Requirement**
12	1	2	**Yes**
Note: • Minimum one preferred parking spaces should be provided for every 100 dwelling units in the common area for differently abled ***Please specify the number of toilets provided for differently abled in the common areas:***			
Total Number of Dwelling Units (Value is taken from 'Dwelling Unit Details' sheet)	**Minimum Number of Toilets Required**	**Number of Toilets Provided**	**Meet or Exceed Requirement**
12	1	1	**Yes**

Documentation Required:

Precertification Level

(Only for Multi-dwelling Residential Units)

- A narrative describing all the measures proposed in building design for differently abled people.
- Conceptual drawings highlighting provisions for differently abled people.

Certification Level

(For Individual Residential Units & Multi-dwelling Residential Units)

- ❖ A narrative describing all the measures implemented in building design for differently abled people.
- ❖ Drawings highlighting provisions for differently abled people.
- ❖ Photographs showing the measures implemented.
- ❖ Manufacturer brochures for measures implemented, as applicable.

Exemplary Performance:

This credit is not eligible for exemplary performance under Innovation & Design Process.

Related Mandatory Requirements & Credits:

- ❖ SSP Credit 1-Basic House-hold Amenities (Common toilets)
- ❖ SSP Credit 5-Parking Facilities for Visitors (Common toilets)

Definitions:

Preferred Parking refers to parking areas which are closer and have easy access to the main entrance of the project.

Ramp is a sloping surface connecting two level surfaces that deviate from what would otherwise be considered as normal level.

Basic Facilities for Construction Workforce

SSP Credit 8 **Points: 1; 2**

Intent:

Promote welfare of construction workforce by providing safe and healthy work conditions.

Compliance Options:

For Individual Residential Unit: (1 point)

Provide the following on-site basic facilities for construction workforce:

- Mobile/Permanent toilet (atleast one toilet seat).
- First-aid facility.
- Adequate drinking water facilities.
- Personal protective equipment (by owner/contractor)
- Dust suppression measures.
- Adequate illumination levels in construction work areas.

For Multi-dwelling Residential Units: (2 points)

Provide the following on-site basic facilities for construction workforce:

- Adequate housing to meet or exceed local/labour bye-law requirement.
- Sanitary measures to meet or exceed local/labour bye-law requirement (OR) provide atleast one toilet seat/urinal for every 50 workers in any shift, whichever is more stringent. The sanitary measures should be provided separately for men and women.
- First-aid and emergency facilities.
- Adequate drinking water facilities.
- Personal protective equipment (by owner/contractor).
- Dust suppression measures.
- Adequate illumination levels in construction work areas.
- Day care/creche facility for workers' children.

Green Building Concerns:

- Safety of the construction workers, who are vulnerable to injuries, due to lack of proper protection equipment & precautions.
- Improper safety measures may lead to life-threatening accidents.

Approach and Methodologies:

Construction workers need basic facilities such as toilet and washing facilities, drinking water facilities, etc., these are basic requirements which are sometimes neglected. The personal protective equipment for site workers include safety helmet, full body safety belt, nose mask, hand gloves (cotton, leather, rubber), gum boots, raincoat, ear plug, ear muff, fall arrestor, reflective jacket, face shield, life jacket, safety goggles, etc.,

Study the local/ labour bye-law requirement facilities for construction workforce and ensure that provision of such facilities is included in the construction contract agreement.

Benefits:

- Health and well-being of the workers.

Documentation Required:

Precertification Level

(Only for Multi-dwelling Residential Units)

- A narrative describing the basic facilities proposed in the project for construction workforce.
- Conceptual drawings highlighting the basic facilities proposed in the project for construction workforce, as applicable.
- Copy of the construction contract agreement highlighting facilities proposed, as applicable.

Certification Level

(For Individual Residential Units & Multi-dwelling Residential Units)

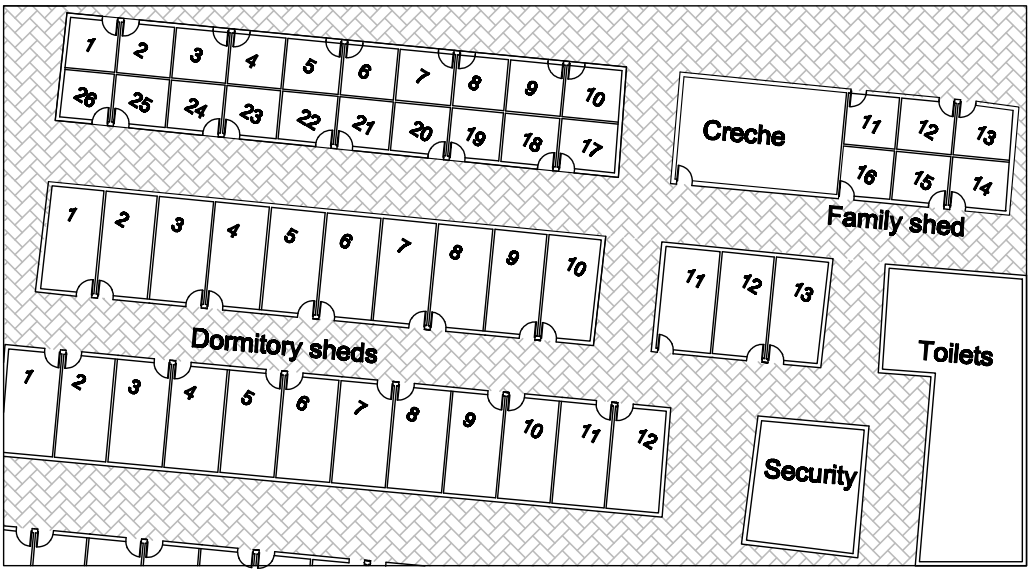
- A narrative describing the basic facilities provided in the project for construction workforce.
- Drawings highlighting the basic facilities provided for construction workforce, as applicable.

- ❖ Copy of the construction contract agreement highlighting facilities provided, as applicable.
- ❖ Photographs showing the measures implemented.

Exemplary Performance:

This credit is not eligible for exemplary performance under Innovation & Design Process.

Picture 11: Vicinity map highlighting workers camp & site premises



Picture 12: Drawing highlighting housing, dormitory, creche, toilets and security cabin

Green Home Guidelines, Design & Post Occupancy

Not applicable for Individual Residential Units

SSP Credit 9 **Points: 1**

Intent:

Provide prospective buyers and occupants with descriptive guidelines that educate and help them implement green design features within their flats/ houses.

Compliance Options:

- **Design Stage:**
  Include green design features proposed, in the project brochures.
- **Post-occupancy Stage:**

Publish green home guidelines providing information that helps occupants implement green features.

Approach and Methodologies:

Educate the occupants on the sustainable design features implemented in the project which would spread awareness on green building concepts. Develop a summary of sustainable design features incorporated in the Green Home project. Also include tips and guidelines which can be considered by the occupants in designing the interiors.

The guidelines should clearly specify the rating the project aims to achieve. If the project is precertified before the formal launch, a copy of the checklist or the final review document can be enclosed. A brief on the proposed green features can be included. The green homes guidelines should be a comprehensive document on all operational issues which will enable the occupants to adopt green practices within their homes.

The list below illustrates the type of information (illustrative and not exhaustive):

1. *Green strategy, design and features*
   Provide details of specific design strategies including environmental benefits and cost savings. Strategies / features could include passive solar design, insulation, energy efficient windows, heat recovery systems, solar hot water systems, photovoltaics, passive vents or the use of certified wood.

2. *Information on green features*

   Provide information on all green features for example, No Smoking Policy, electric charging facilities, segregation of house-hold waste, water efficient plumbing fixtures, rainwater harvesting, on-site STP, etc.,

3. *Operational and maintenance instructions*

   Provide information about the services and maintenance requirements of the building so that it can be operated with optimum use of water and energy.

4. *Recommendations for practices within the home*

   List all possible water and energy conservation measures which can be easily adopted within homes. Provide Green purchase recommendations for home interior works such as use of low VOC paints, certified wood, efficient light fixtures T5, CFLs, LED, BEE star rated equipment & appliances, etc.,

Benefits:

- Edu*cates buyer about the green building features*
- *Enables ma*intenance of the green building, throughout its lifespan

Documentation Required:

Precertification Level

(Only for Multi-dwelling Residential Units)

- Narrative describing the strategies planned by the project team to create awareness among buyers/ residents.
- A draft copy of the project brochure along with the proposed green design features.
- A draft copy of the 'Green Home Guidelines' which will be circulated amongst the residents.

Certification Level:

(For Multi-dwelling Residential Units)

- Narrative describing the strategies adopted by the project team to create awareness among buyers/ residents.
- A copy of the project brochure along with the green design features.
- A copy of the 'Green Home Guidelines' which will be circulated to the residents.

Exemplary Performance:

This credit is not eligible for exemplary performance under Innovation & Design Process.

Related Mandatory Requirements & Credits:

There are no related credits and mandatory requirements.

Water Efficiency

Introduction

Water is a National priority for India. Most of the Asian countries are water stressed and the water table has reduced drastically over the last decade. With the present scenario, if water is not used diligently, water would become scarce for the future generations. The residential sector is one of the significant water consumer, after agriculture. There are tremendous opportunities to conserve water in homes.

The earth's surface is covered with 70% water, of which 97.5 % is salt water & 2.5 % is fresh water. 69.5% of fresh water is locked in glaciers and 30.1% is in the form of ground water. Only about 0.4% is surface water, which is available for human consumption. Hence, every drop of water is precious and to be used diligently.

Green Homes encourages water usage in a self-sustainable manner through 3 R's-Reduce-Recycle-Reuse.

The broad approach for water reduction in homes is through the use of efficient plumbing fixtures, water recycling by installing the on-site Sewage Treatment Plant and reusing treated water for applications such as flushing, landscaping etc.,

Landscape is a visual delight. By striking a balance between the aesthetic value & water usage, alternate strategies such as capturing free rainwater through storage tanks, recharging ground water, using drought tolerant species, native species, efficient irrigation system, segregation of plant species based on watering needs can be adopted.

Monitoring actual water consumption can play a significant role in optimising the water usage.

Case studies indicate that there is a potential to save more than 40% of potable water by incorporating strategies that reduce, reuse and recycle water.

Rainwater Harvesting, Roof & Non-roof

WE Mandatory Requirement 1

Intent:

Enhance ground water table and reduce municipal water demand through effective rain water management.

Compliance Options:

Case 1:

Provide rainwater harvesting system to capture 25% of run-off volumes from roof and non-roof areas. The harvesting system designed should have harvesting capacity of atleast 1 day's normal rainfall* occured in the last 5 years.

Case 2:

In areas where the central/ state ground water board does not recommend rain water recharge (or) if the groundwater table is less than 4 m, the projects are deemed to have shown compliance, without installing rainwater harvesting system.

Notes:

- *For rainfall information, refer Indian Metrological Department data at http://www.imd.gov.in*
- **To arrive at the normal rainfall, divide peak month rainfall occurred in each year (in last 5 years) by number of rainy days in the respective month and take the average of the five values obtained. Abnormal rainy days like flash floods can be excluded from calculations.*
- *Projects which do not have data on the number of rainy days, a maximum of 15 rainy days can be considered to arrive at normal rainfall.*
- *In areas where the water percolation is limited, collection tanks may be provided to meet the above requirement.*

Run-off co-efficients for typical surface types are listed below:

Table 2 - Run-off co-efficients for Typical Surface Types

S No	Surface Type	Runoff Coefficient
1	Cemented / Tiled Roof	0.95
2	Roof Garden (<100 mm thickness)	0.95
3	Roof Garden (100 – 200 mm thickness)	0.3
4	Roof Garden (201 – 500 mm thickness)	0.2
5	Roof Garden (≥ 500 mm thickness)	0.1
6	Turf, Flat (0 - 1% slope)	0.25
7	Turf, Average (1 - 3% slope)	0.35
8	Turf, Hilly (3 - 10% slope)	0.4
9	Turf, Steep (≥ 10% slope)	0.45
10	Vegetation, Flat (0 - 1% slope)	0.1
11	Vegetation, Average (1 - 3% slope)	0.2
12	Vegetation, Hilly (1 - 3% slope)	0.25
13	Vegetation, Steep (≥ 10% slope)	0.3
14	Concrete Pavement	0.95
15	Gravel Pavement	0.75
16	Open-grid Concrete Pavement	0.75
17	Open-grid Grass Pavement	0.5

Green Building Concerns:

- Potable water is a scarce resource in most parts of India. Harvesting rainwater would help decrease dependence on energy intensive municipal infrastructure
- In developed areas, surface permeability is reduced, resulting in increased stormwater runoff that is transported via municipal gutters, pipes and sewers to receiving waters
- Increase in the frequency and magnitude of stormwater run-off due to development can increase erosion,
- Conveyance and treatment of stormwater require significant municipal infrastructure and maintenance

Approach and Methodologies:

Survey the water table in the project's location. Design appropriate harvesting systems based on the sub-surface characteristics. Factors to be considered include weathering fractures and joints for rocky sites and depth of aquifer for sedimentary sites. Depending on the ground water levels strategies such as recharge pits can be considered for low groundwater levels and rainwater storage systems can be considered for shallow ground water table levels.

The captured rain water from roof top can be reused for flushing and landscaping purposes. The design should also include flushing arrangement to let out impurities in the first few showers. Such pollutants and impurities include paper waste, leaves, bird droppings, dust, etc.; the rainwater runoff contains contaminants like sediments, leaves and other materials which impact the receiving waters such as streams, rivers and other water bodies.

In places where the withdrawal of water is more than the rate of recharge, an imbalance in the groundwater reservoir is created. Detailed investigations need to be carried out for selection of a location for such artificial recharge. In such cases, artificial recharge system with forced pumping can be an approach for the credit, as applicable.

Benefits:

- Reduces dependency on potable water supply.
- Reduction in amount of water being discharged into drains and watercourses, thereby reducing the risk of localised flooding.
- Recharging of aquifers maintains groundwater levels and combats progressive depletion of ground water levels.

Sample Calculations:

The calculation methodology for arriving at the normal per day rainfall involves peak rainfall of last 5 years or peak rainfall in the last 30 years along with rainy days in respective months. If the number of rainy days is not available, project can consider maximum of 15 rainy days/ month for calculations. The sample normal rainfall is shown below:

Average Normal Rainfall Calculation

Last 5 Years Average					
Location (Text is taken from 'Dwelling Unit Details' sheet)	**Year** (Choose 'Year' from dropdown below)	**Peak Rainy Month** (Choose from dropdown below)	**Total Rainfall** (mm)	**Number of Rainy Days**	**Average Rainfall/ Day** (mm)
Hyderabad	2007	August	280	15	19
	2008	July	472	15	31
	2009	July	304	15	20
	2010	June	346	15	23
	2011	August	233	15	16
Average Normal Rainfall/ Day (mm)					**22**
Average Normal Rainfall/ Day (m)					**0.022**

Rainwater Harvesting Calculation

To arrive at the rainfall volumes, the run-off from roof and non-roof surfaces must be considered. Assuming a residential project having a site area of 15,000 sq.m and a roof area of 6,000 sq.m; the total run-off volumes from the roof and non-roof is 217 cu.m. To meet the compliance the project proposes a storage and harvesting system having a total capacity of 65 cu.m. This accounts to storing & harvesting 30% run-off volumes from roof and non-roof areas.

The sample filled in template calculation is shown below:

S.No.	Surface Type (Choose from drop-down)	Run-off Coefficient	Area (sq.m)	Impervious Area (sq.m)
1	Cemented / Tiled Roof	0.95	6,000	5,700
2	Roof Garden (<100 mm thickness)	0.95	500	475
3	Concrete Pavement	0.95	3,000	2,850
4	Vegetation, Flat (0 - 1% slope)	0.10	4,000	400
5	Others (Natural topography - Rocks)	0.95	550	523
6	Others (Water body)	0.00	950	0
Total impervious area			(sq.m)	**9,948**
Average normal rainfall			(m)	0.022
Total roof & non-roof run-off volume			(cu.m)	217
Total storage / harvesting capacity			(cu.m)	**65**
Storage capacity eg: pond, tank, etc.			(cu.m)	40
Harvesting capacity (consider porosity factor & percolation rate) eg: recharge pit			(cu.m)	25
Percentage				**30.0%**

Documentation Required:

Precertification Level

(Only for Multi-dwelling Residential Units)

- ❖ Narrative describing proposed strategies to capture/ harvest rain water from roof & non-roof areas.
- ❖ Details of the rainwater harvesting system specifying approximate storage capacity of water captured/ harvested.

Notes:

If rain water harvesting pits are proposed, then submit details of porosity factor and percolation rates.

- *Conceptual site drawing highlighting external rain water drainage system and location of rain water harvesting system (e.g.: ponds, pits, storage tanks, etc.,), including cross sectional drawings (as applicable).*
- *Submit the third party report confirming the level of water table, if project's water table is less than 4 meters.*
- *A document from the Indian Metrological Department or any other reliable source substantiating the rainfall data used in the calculations.*

Certification Level

(For Individual Residential Units & Multi-dwelling Residential Units)

- ❖ Narrative describing strategies implemented to capture/ harvest rain water from roof & non-roof areas.
- ❖ Details of the rainwater harvesting system specifying storage capacity of water captured/ harvested.

Notes:

If rain water harvesting pits are provided, then submit details of porosity factor and percolation rates.

- *Site drawing highlighting external rain water drainage system and location of rain water harvesting system (e.g.: ponds, pits, storage tanks, etc.,), including cross sectional drawings (as applicable).*
- *Submit the third party report confirming the level of water table, if project's water table is less than 4 meters.*
- *A document from the Indian Metrological Department or any other reliable source substantiating the rainfall data used in the calculations.*

Related Mandatory Requirements & Credits:

- ❖ SSP Credit 2 – Natural Topography or Vegetation (Surface type & area)
- ❖ SSP Credit 3 – Heat Island Effect, Non-roof (Surface type & area)
- ❖ SSP Credit 4 – Heat Island Effect, Roof (Surface type & area)
- ❖ WE Credit 1 – Landscape Design (Surface type & area)
- ❖ WE Mandatory Requirement 2 – Water Efficient Plumbing Fixtures (Water balance)
- ❖ WE Credit 3 – Rainwater Harvesting, Roof & Non-roof (Rainwater harvesting measures)
- ❖ WE Credit 4 – Water Efficient Plumbing Fixtures (Water balance)
- ❖ WE Credit 5 – Waste Water Treatment and Reuse (Water balance)

Definitions:

Impervious Surfaces are surfaces that promote runoff of precipitation volumes instead of infiltration into the subsurface.

Porous Pavement and Permeable Surfaces are used to create permeable surfaces that allow runoff to infiltrate into the subsurface.

Water Efficient Plumbing Fixtures

WE Mandatory Requirement 2

Intent:

Minimise the use of municipal water and reduce load on waste water systems.

Compliance Options:

Select water efficient plumbing fixtures whose flow rates / capacities meet the baseline criteria.

The baseline criterion is as below:

Table 3 - Baseline Flow Rates / Capacity for Plumbing Fixtures in a Typical House-hold

Fixture Type	Maximum Flow Rate / Capacity	Duration	Daily Uses per Person/ Day
Water Closets	6 LPF (High flush)	1 Flush	1
	3 LPF (Low flush)	1 Flush	4
Health Faucet/ Bidet, Hand-held spray*	8 LPM	15 Seconds	1
Faucet*	8 LPM	15 Seconds	8
Kitchen Sink*	8 LPM	15 Seconds	6
Showerhead* / Hand-held Spray*	10 LPM	8 Minutes	1

Source: Uniform Plumbing Code – India, 2008

** At a design pressure of 3 bar*

Notes:

- *The number of permanent occupants has to be considered as two persons each for the first two bed rooms and one additional person for each additional bedroom.*
- *Rain showers (if any) need to be considered in the calculations. Considering that bath tubs may not be used on a daily basis, they may be excluded for the calculations.*
- *Treated waste water/ captured rain water can be reused for flushing. The reused quantity for flushing can be subtracted from the annual water use and compared against the baseline annual quantity.*

- *Groundwater is considered as potable water and cannot be used to show water savings.*
- *The baseline flows can be demonstrated at flowing water pressure of 3 bar. Flowing water pressure of 3 bar does not mean that the water supply in the building is at 3 bar. The building fixtures can operate at lower pressures, but to demonstrate compliance under this mandatory requirement, the design flow rates are to be considered at 3 bar.*

Green Building Concerns:

- ❖ The water withdrawal from rivers, streams, underground aquifers and other water bodies is increasing over the years at a rate
- ❖ Using grey water for irrigation reduces the amount of wastewater delivered to water treatment facilities, thereby saving on municipal infrastructure
- ❖ There are still some behavioral concerns amongst the construction industry in using the treated grey water, which need to be addressed
- ❖ Municipalities are under pressure to source the capital investment needed for water supply and wastewater treatment infrastructure

Approach and Methodologies:

Consider selecting low flow water plumbing fixtures such as dual flush fixtures for water closet, aerators for sink taps & wash taps and low flow showers & health faucets. The aerators are small in size and big in water savings.

Survey the market for efficient plumbing fixtures before finalising the fixtures as per design. Generally the product catalogue or the brochure may detail the flow rates at various pressures. Fixtures are available with ultra-high efficiency which can substantially reduce water consumption.

For further water savings, project can consider reusing treated waste water and captured rain water for flushing & landscape irrigation purposes. In such cases, ensure periodic testing of the treated water to meet the quality standards for flushing, as prescribed by Central / State Pollution Control Board. If treated water is reused for flushing purposes, ensure to have a dual plumbing systems.

Benefits:

- ❖ Ensures 20-30% water saving by installing low flow fixtures
- ❖ Less dependency on potable water for flushing requirements by using treated waste water
- ❖ Reduces the load on the wastewater treatment facilities and the need for wastewater treatment infrastructure
- ❖ Helps to sustain healthy aquatic ecosystems

Sample Calculations:

The calculation methodology for arriving at the water usage calculations involves estimation of water demand for plumbing fixtures (flush & flow), flow rates of the installed plumbing fixtures, duration and number of uses.

Assuming 3 BHK residential apartment with 10 dwellings. The default occupancy would be 5 persons per apartment, considering 2 persons each for the first two bedrooms + 1 person for the third bedroom. This would result in an occupancy of 50 individuals.

To meet the compliance the project proposes to install water efficient plumbing fixtures (flush & flow) and shows a 26.5% water reduction when compared to base case. The proposed flush fixtures include dual flush having flow rates of 4/2 LPF. The flow rates of proposed flow fixtures include health faucets having 6 LPM; faucets having 8 LPM, kitchen sink having 6 LPM and shower head having 8 LPM. The overall water usage for plumbing fixtures annually is 26,00,625 liters over the base case of 35,49,500 liters, annually.

The sample filled-in template calculation is below:

Fixture Type	Duration per Use (in minutes)	Daily Uses (per person/ day)	Total Number of Occupants	Baseline		Proposed	
				Flow Rate / Capacity (in LPF/ LPM)	Total Daily Water Use (liters)	Flow Rate / Capacity (in LPF/ LPM)	Total Daily Water Use (liters)
Water Closets (High flush)	1 Flush	1	50	6 LPF	300	4.0	200
Water Closets (Low flush)	1 Flush	4	50	3 LPF	600	2.0	400
Health Faucet/ Bidet, Hand-held spray*	0.25	1	50	8 LPM	100	6.0	75
Faucet*	0.25	5	50	8 LPM	500	8.0	500
Kitchen Sink*	0.25	2	50	8 LPM	200	6.0	150
Showerhead* / Hand-held Spray*	8	2	50	10 LPM	8,000	8.0	6,400
Daily volume from flush fixtures (Black water)				**(Liters)**	**900**		**600**
Daily volume from flow fixtures (Grey water)				**(Liters)**	**8,800**		**7,125**
Number of operational days					**365**		

Description	Baseline (Liters)	Proposed (Liters)
Annual volume from flush fixtures (Black water)	3,28,500	2,19,000
Annual volume from flow fixtures (Grey water)	32,12,000	26,00,625
Annual volume from flush & flow fixtures (Black & Grey water)	**35,40,500**	**28,19,625**
Annual volume of treated waste water reused for flush fixtures		1,46,000
Annual volume of stored rain water reused for flush fixtures		73,000
Annual volume, after reuse of treated waste water / stored rain water for flush fixtures (liters)		**26,00,625**
Percentage		**26.5%**

Documentation Required:

Precertification Level

(Only for Multi-dwelling Residential Units)

- ❖ Summary sheet of the proposed list of plumbing fixtures (flow and flush), with respective make & model and flow rates.
- ❖ Schematic drawing showing proposed dual plumbing lines, if treated waste water is reused for flushing. (Optional)
- ❖ Manufacturer cut-sheets/ brochures/ letters indicating the flow rates of the proposed plumbing flow and flush fixtures. (Optional)

Certification Level

(For Individual Residential Units & Multi-dwelling Residential Units)

- ❖ Summary sheet of the list of plumbing fixtures (flow and flush) installed, with respective flow rates.
- ❖ Schematic drawing showing dual plumbing lines, if treated waste water is reused for flushing.
- ❖ Purchase invoice or payment receipts/ letter from manufacturer confirming the installation of plumbing fixtures (flow and flush) with make & model.
- ❖ Manufacturer cut-sheets/ brochures/ letters indicating the flow rates of the plumbing flow and flush fixtures.

Related Mandatory Requirements & Credits:

- ❖ WE Mandatory Requirement 1: Rainwater Harvesting, Roof & Non-roof (Water balance)
- ❖ WE Credit 3 – Rainwater Harvesting, Roof & Non-roof (Water balance)
- ❖ WE Credit 4 – Water Efficient Plumbing Fixtures (Water conservation measures)
- ❖ WE Credit 5 – Waste Water Treatment and Reuse (Water balance)
- ❖ EE Credit 3 – Solar Water Heating System (Occupancy)
- ❖ MR Credit 1 – Organic Waste Management, Post Occupancy (Occupancy)

Landscape Design

WE Credit 1 **Points: 2; 4**

Intent:

Design landscape to ensure minimum water consumption.

Compliance Options:

Limit use of turf on the site so as to conserve water and/ or ensure that landscaped area is planted with drought tolerant species.

Points are awarded as below:

Individual Residential Unit: (2 points)

Drought Tolerant Species as a Percentage of Total Landscaped Area	Points
≥ 20%	1
≥ 40%	2

Multi-dwelling Residential Units: (4 points)

Turf Area as a Percentage of Total Landscaped Area	Points
≤ 20%	2
≤ 40%	1

Drought Tolerant Species as a Percentage of Total Landscaped Area	Points
≥ 20%	1
≥ 40%	2

Notes:

- *This credit is applicable only for those projects which have a vegetated area which is atleast 15% of the site area.*
- *For this credit, landscape areas over built structures such as basements, podium, roofs, etc., can be considered for landscape area calculations.*
- *Landscape here refers to soft landscaping which includes only vegetation.*
- *Areas planted with turf should not exceed a slope of 25 percent (i.e., a 4 to 1 slope).*
- *For this credit calculation, potted plants should not be considered under landscaping.*

Exemplary Performance:

This credit is eligible for exemplary performance under Innovation & Design Process, if:

- The designed landscape has no turf i.e. 0%
  (AND)
- More than 60% of the landscaped area is planted with drought tolerant species

Green Building Concerns:

- Water-efficient landscaping helps conserve local and regional potable water resources. Maintaining natural aquifer conditions is important for providing reliable water sources for future generations
- The irrigation cost can be reduced or eliminated through planning and careful plant selection and layout. Drought tolerant species further reduce operating costs because they require less fertilizer and maintenance than turf grass

Approach and Methodologies:

Design landscape with plants, shrubs and trees adaptive to the region which survive on natural rain fall and which require less or no water for irrigation after planting. While designing the landscape, minimise site areas covered with turf to a maximum extent possible.

Develop a comprehensive landscape plan for the proposed site. A well designed landscape plan, using most of the existing landscape features, will help to create a water efficient outdoor space.

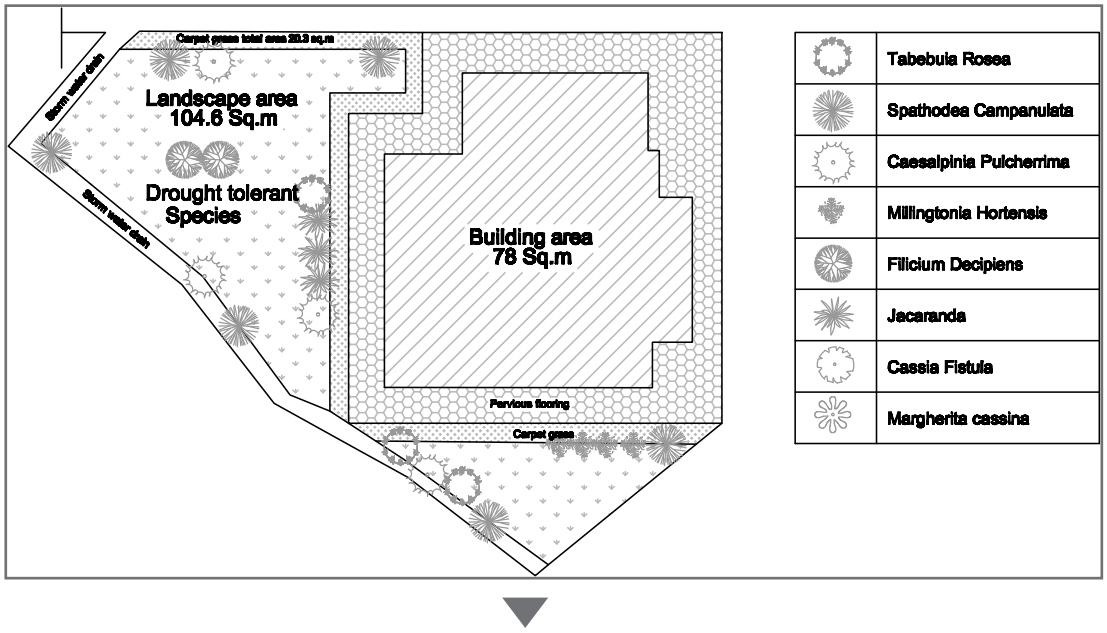
The following strategies could be adopted for an efficient landscape design:

- Bedding plants according to their water needs
- Selecting plants which consume less water
- Limit turf areas for only functional uses
- Use of highly efficient irrigation systems
- Scheduling of irrigation as per requirement
- Providing fertile soil to maintain plant health
- Mulching around plants to reduce evaporation, soil erosion and suppress weed growth
- Regular maintenance activities

Limit turf areas to only those functional areas required for recreation or any other site specific requirements. Non-functional areas can be covered with drought-tolerant/ native grass or alternative ground covers. The use of treated waste water for landscape irrigation is another approach to reducing the amount of potable water required for irrigation.

Note :

- *For details on few drought tolerant species based on climatic zones, please refer to Annexure-VI*



Picture 15: Landscape plan highlighting drought tolerant species and turf

Benefits:

- ❖ Increased green cover
- ❖ Conserves local & regional potable water resources and helps in conserving water for our future generations
- ❖ Reduces the stress on the ground water table
- ❖ Promotes local bio-diversity

Sample Calculations:

The calculation methodology for arriving at the landscape area includes vegetated spaces on roof surfaces (i.e. podium, etc.,) and on ground.

Assuming a residential project having a site area of 15,000 sq.m; landscaped area is 3,500 sq.m (including vegetation on built structures).

The landscaped area is 23.3% of site area. To meet the intent of the credit, the project proposes turf for 1,300 sq.m and drought tolerant species area for 1,650 sq.m.

The turf area is 37.1% and drought tolerant species area is 47.1% of the total landscaped area.

The sample filled-in template is shown below:

Total site area			(sq.m) **15,000**
Total landscaped area (includes vegetation on ground & built structures)			(sq.m) **3,500**
Type of Vegetation	**On Ground** (sq.m)	**On Built-structures** (sq.m)	**Sum**
Turf	1,000	300	1,300
Drought tolerant species	1,500	150	1,650
Other plant species	500	50	550
Total	**3,000**	**500**	
Percentage of total landscape area to total site area			**23.3%**
Percentage of vegetated area with turf			**37.1%**
Percentage of vegetated area with drought tolerant species			**47.1%**

Documentation Required:

Precertification Level

(Only for Multi-dwelling Residential Units)

- ❖ Conceptual landscape plan highlighting total landscaped area covered with turf, drought tolerant species & other plant species on the ground and over built structures.
- ❖ Tentative landscape area calculations indicating total site area; break-up of landscaped area covered with turf, drought tolerant species area & other plant species on the ground and over built structures.
- ❖ List of proposed drought tolerant species & other plant species in the project.

Certification Level

(For Individual Residential Units)

- Landscape plan highlighting total landscaped area covered with drought tolerant species area & other plant species on the ground and over built structures.
- Landscape area calculations indicating total site area; break-up of landscaped area covered with drought tolerant species area & other plant species on the ground and over built structures.
- A narrative with a list and brief description of drought tolerant species & other vegetation species planted in the project.
- Photographs showing the landscaped areas.

(For Multi-dwelling Residential Units)

- Landscape plan highlighting total landscaped area covered with turf, drought tolerant species area & other plant species on the ground and over built structures.
- Landscape area calculations indicating total site area; break-up of landscaped area covered with turf, drought tolerant species area & other plant species on the ground and over built structures.
- A narrative with a list and brief description of drought tolerant species & other vegetation species planted in the project.
- Photographs showing the landscaped areas.

Related Mandatory Requirements & Credits:

- SSP Credit 2 – Natural Topography or Vegetation (Vegetated area on ground)
- SSP Credit 4 – Heat Island Effect, Roof (Vegetated area over roof)
- WE Mandatory Requirement 1: Rainwater Harvesting, Roof & Non-roof (Surface type & area)
- WE Credit 3 – Rainwater Harvesting, Roof & Non-roof (Surface type & area)

Definitions:

Potable water is water that is sourced from wells or municipal water systems. Well water, which is not of potable quality, would also be deemed as potable water.

Drought tolerant species are those species that do not require supplemental irrigation. Generally accepted time frame for temporary irrigation is one to two years.

Native (or indigenous) plants are adapted to a given area during a defined time period and are invasive.

Turf refers to lawn an area of grass maintained for decorative or recreational use. It involves high water consumption, high continuous maintenance. In green building design it is recommended to limit the use of turf to conserve water.

Xeriscaping refer to landscaping and gardening in ways that reduce or eliminate the need for supplemental water irrigation. It is promoted in regions that do not have easily accessible, plentiful or reliable supplies of fresh water.

Management of Irrigation Systems

WE Credit 2 **Points: 1**

Intent:

Reduce water demand for irrigation through water efficient management systems and techniques.

Compliance Options:

Provide or install highly efficient irrigation systems incorporating the features mentioned below:

For Individual Residential Unit: (minimum three features)

- Central shut-off valve
- Turf and each type of bedding area must be segregated into independent zones based on watering needs
- Atleast 50% of landscape planting beds must have drip irrigation system to reduce evaporation
- Pressure regulating device(s) to maintain optimal pressure to prevent water loss
- Any other innovative methods for watering

For Multi-dwelling Residential Units: (minimum four features)

- Central shut-off valve
- Moisture sensor controller
- Turf and each type of bedding area must be segregated into independent zones based on watering needs
- Atleast 50% of landscape planting beds must have drip irrigation system to reduce evaporation
- Time based controller for the valves such that evaporation loss is minimum and plant health is ensured
- Pressure regulating device(s) to maintain optimal pressure to prevent water loss
- Any other innovative methods for watering

Green Building concerns:

- ❖ Conventional landscape irrigation practices consume large quantities of potable water. Improved landscaping practices can dramatically reduce and even eliminate irrigation needs
- ❖ The irrigation cost can be reduced or eliminated through planning and careful plant selection and layout

Approach and Methodologies:

Design irrigation management system based on the requirements of the landscape plan. Manual landscape irrigation practices consume higher volumes of water than automatic, pre-programmed irrigation system which are optimised based on the requirement. Manual practices are labour intensive and time consuming. Automatic irrigation systems can be programmed based on the landscape needs, weather conditions, etc., to minimise the water consumption. Watering landscape with high efficient irrigation system can dramatically improve the efficiency by using irrigation scheduling techniques.

Conduct a market survey on the technologies available to manage irrigation efficiently. Also identify local manufacturers supplying equipment like moisture sensor & controllers and time based controllers.

In other words, the irrigation system should supply landscape with the optimum amount of water to keep it healthy. For example, the system should shut-off when it rains and should increase watering time during dry spells. A well designed system would supply only the required amounts of water to different types of plants and thus would eliminate over-spray onto sidewalks and pavements. The irrigation program can be programmed regularly based on the seasonal changes which can result in substantial water savings.

Picture 13: Sprinklers for irrigation Picture

14: Segregation of turf and each bedding area based on water needs

Picture 15:
Photograph showing pop-up sprinklers

Picture 16: Photographs showing drip irrigation system for shrubs & plants

Picture 17: Photographs showing pressure regulating device & central shut off value

Benefits:

- About 40 - 60% of potable water savings for landscape irrigation
- Controlled and optimised irrigation would result in healthier plants

Documentation Required:

Precertification Level

(Only for Multi-dwelling Residential Units)

- Narrative describing all the proposed water efficient irrigation systems and techniques.
- Conceptual landscape plan highlighting drip irrigation system. (Optional)
- Manufacturers' cut-sheets/ brochures of the proposed water efficient irrigation systems. (Optional)

Certification Level

(For Individual Residential Units & Multi-dwelling Residential Units)

- Narrative describing all the installed water efficient irrigation systems and techniques.
- Landscape plan showing drip irrigation system.
- Manufacturers' cut-sheets/ brochures of the installed water efficient irrigation systems.
- Photographs showing the installed irrigation systems and techniques.

Exemplary Performance:

This credit is not eligible for exemplary performance under Innovation & Design Process.

Related Mandatory Requirements & Credits:

- ❖ WE Credit 1 – Landscape Design (Segregation of landscape areas)

Definitions:

Drip Irrigation is a high-efficiency irrigation method in which water drips to the soil from perforated tubes or emitters. Drip irrigation is 90% efficient than conventional irrigation system.

Potable water is water that is sourced from wells or municipal water systems. Well water which is not of potable quality would also be deemed as potable water.

Rainwater Harvesting, Roof & Non-roof

WE Credit 3 **Points: 4**

Intent:

Enhance ground water table and reduce municipal water demand through effective rain water management.

Compliance Options:

Provide rainwater harvesting system to capture atleast 50% of run-off volumes from roof and non-roof areas. The harvesting system designed should cater to atleast 1 day of normal rainfall* occurred in the last 5 years.

Points are awarded as below:

Rainwater Harvesting System to Capture / Recharge	Points
≥ 50% from roof & non-roof areas ≥ 75% from roof & non-roof areas	2 4

In areas where the central/ state ground water board does not recommend artificial rain water recharge (or) if the groundwater table is less than 4 m, the projects can show nominal compliance by collection & reuse and points are awarded as below:

Rainwater Harvesting System to Capture	Points
≥ 10% from roof & non-roof areas ≥ 20% from roof & non-roof areas	2 4

Notes:

- *For normal rainfall, refer Indian Metrological Department data at http://www.imd.gov.in.*
- ** To arrive at the normal rainfall, divide peak month rainfall occurred in each year (in last*
- *5 years) by number of rainy days in the respective month, and take the average of the five values obtained. Abnormal rainy days like flash floods can be excluded from calculations.*
- *Projects which do not have data on the number of rainy days, a maximum of 15 rainy days can be considered to arrive at normal rainfall.*

- *In areas where the water percolation is limited, collection tanks may be provided to meet the above requirement.*

Run-off co-efficients for typical surface types are listed below:

Table 2 - Run-off co-efficients for Typical Surface Types

S No	Surface Type	Runoff Coefficient
1	Cemented / Tiled Roof	0.95
2	Roof Garden (<100 mm thickness)	0.95
3	Roof Garden (100 – 200 mm thickness)	0.3
4	Roof Garden (201 – 500 mm thickness)	0.2
5	Roof Garden (≥ 500 mm thickness)	0.1
6	Turf, Flat (0 - 1% slope)	0.25
7	Turf, Average (1 - 3% slope)	0.35
8	Turf, Hilly (3 - 10% slope)	0.4
9	Turf, Steep (≥ 10% slope)	0.45
10	Vegetation, Flat (0 - 1% slope)	0.1
11	Vegetation, Average (1 - 3% slope)	0.2
12	Vegetation, Hilly (1 - 3% slope)	0.25
13	Vegetation, Steep (≥ 10% slope)	0.3
14	Concrete Pavement	0.95
15	Gravel Pavement	0.75
16	Open-grid Concrete Pavement	0.75
17	Open-grid Grass Pavement	0.5

Approach and Methodologies:

Please refer to approach & methodologies under WE Mandatory Requirement 1 – Rain water harvesting, Roof & Non-roof

Sample calculations:

Please refer to Sample Rain Water Harvesting Calculations under Mandatory Requirement 1 – Rain water Harvesting, Roof & Non-roof.

Documentation Required:

Precertification Level

(Only for Multi-dwelling Residential Units)

- ❖ Narrative describing proposed strategies to capture/ harvest rain water from roof & non-roof areas.
- ❖ Details of the rainwater harvesting system specifying approximate storage capacity of water captured/ harvested.

Notes:

If rain water harvesting pits are proposed, then submit details of porosity factor and percolation rates.

- *Conceptual site drawing highlighting external rain water drainage system and location of rain water harvesting system (e.g.: ponds, pits, storage tanks, etc.,), including cross sectional drawings (as applicable).*
- *Submit the third party report confirming the level of water table, if project's water table is less than 4 meters.*
- *A document from the Indian Metrological Department or any other reliable source substantiating the rainfall data used in the calculations.*

Certification Level

(For Individual Residential Units & Multi-dwelling Residential Units)

- ❖ Narrative describing strategies implemented to capture/ harvest rain water from roof & non-roof areas.
- ❖ Details of the rainwater harvesting system specifying storage capacity of water captured/ harvested.

Notes:

If rain water harvesting pits are provided, then submit details of porosity factor and percolation rates.

- *Site drawing highlighting external rain water drainage system and location of rain water harvesting system (e.g.: ponds, pits, storage tanks, etc.,), including cross sectional drawings (as applicable).*
- *Submit the third party report confirming the level of water table, if project's water table is less than 4 meters.*

- *A document from the Indian Metrological Department or any other reliable source substantiating the rainfall data used in the calculations.*

Exemplary Performance:

This credit is eligible for exemplary performance under Innovation & Design Process, if more than 95% run-off from roof & non-roof areas is captured and/ or recharged.

Related Mandatory Requirements & Credits:

- ❖ SSP Credit 2 – Natural Topography or Vegetation (Surface type & area)
- ❖ SSP Credit 3 – Heat Island Effect, Non-roof (Surface type & area)
- ❖ SSP Credit 4 – Heat Island Effect, Roof (Surface type & area)
- ❖ WE Mandatory Requirement 1 – Rainwater Harvesting, Roof & Non-roof (Rainwater harvesting measures)
- ❖ WE Mandatory Requirement 2 – Water Efficient Plumbing Fixtures (Water balance)
- ❖ WE Credit 1 – Landscape Design (Surface type & area)
- ❖ WE Credit 4 – Water Efficient Plumbing Fixtures (Water balance)
- ❖ WE Credit 5 – Waste Water Treatment and Reuse (Water balance)

Definitions:

Impervious Surfaces are surfaces that promote runoff of precipitation volumes instead of infiltration into the subsurface.

Porous Pavement and Permeable Surfaces are used to create permeable surfaces that allow runoff to infiltrate into the subsurface

Water Efficient Plumbing Fixtures

WE Credit 4

Points: 4

Intent:

Minimise the use of municipal water and reduce load on waste water systems.

Compliance Options:

Select water efficient plumbing fixtures whose flow rates / capacities are atleast 25% less than the baseline criteria.

The baseline criterion is as below:

Table 3 - Baseline Flow Rates / Capacity for Plumbing Fixtures in a Typical House-hold

Fixture Type	Maximum Flow Rate / Capacity	Duration	Daily Uses per Person/ Day
Water Closets	6 LPF (High flush)	1 Flush	1
	3 LPF (Low flush)	1 Flush	4
Health Faucet/ Bidet, Hand-held Spray*	8 LPM	15 Seconds	1
Faucet*	8 LPM	15 Seconds	8
Kitchen Sink*	8 LPM	15 Seconds	6
Showerhead* / Hand-held Spray*	10 LPM	8 Minutes	1

Source: Uniform Plumbing Code – India, 2008

** At a design pressure of 3 bar*

Points are awarded as below:

Water Efficient Plumbing Fixtures	Points
≤ 25% less than baseline criteria	2
≤ 35% less than baseline criteria	4

Notes:

- *The number of permanent occupants has to be considered as two persons each for the first two bed rooms, and one additional person for each additional bedroom.*
- *Rain showers (if any) need to be considered in the calculations. Considering that bath tubs may not be used on a daily basis, they may be excluded for the calculations.*
- *Treated waste water/ captured rain water can be reused for flushing. The reused quantity for flushing can be subtracted from the annual water use and compared against the baseline annual quantity.*
- *Groundwater is considered as potable water and cannot be used to show water savings.*
- *The baseline flows can be demonstrated at flowing water pressure of 3 bar. Flowing water pressure of 3 bar does not mean that the water supply in the building is at 3 bar. The building fixtures can operate at lower pressures but to demonstrate compliance under this mandatory requirement, the design flow rates are to be considered at 3 bar.*

Approach and Methodologies:

Please refer for approach & methodologies under Water Efficiency Mandatory Requirement 2.

Sample Calculations:

Please refer to Sample Calculations under WE Mandatory Requirement 2 – Water Efficient Plumbing Fixtures.

Documentation Required:

Precertification Level

(Only for Multi-dwelling Residential Units)

- ❖ Summary sheet of the proposed list of plumbing fixtures (flow and flush), with respective make & model and flow rates.
- ❖ Schematic drawing showing proposed dual plumbing lines, if treated waste water is reused for flushing. (Optional)
- ❖ Manufacturer cut-sheets/ brochures/ letters indicating the flow rates of the proposed plumbing flow and flush fixtures. (Optional)

Certification Level

(For Individual Residential Units & Multi-dwelling Residential Units)

- Summary sheet of the list of plumbing fixtures (flow and flush) installed, with respective flow rates.
- Schematic drawing showing dual plumbing lines, if treated waste water is reused for flushing.
- Purchase invoice or payment receipts/ letter from manufacturer confirming the installation of plumbing fixtures (flow and flush) with make & model.
- Manufacturer cut-sheets/ brochures/ letters indicating the flow rates of the plumbing flow and flush fixtures.

Exemplary Performance:

This credit is eligible for exemplary performance under Innovation & Design Process, if water consumption is 45% lesser than the baseline criteria.

Related Mandatory Requirements & Credits:

- WE Mandatory Requirement 1: Rainwater Harvesting, Roof & Non-roof (Water balance)
- WE Mandatory Requirement 2 - Water Efficient Plumbing Fixtures (Water conservation measures)
- WE Credit 3 – Rainwater Harvesting, Roof & Non-roof (Water balance)
- WE Credit 5 – Waste Water Treatment and Reuse (Water balance)
- EE Credit 3 – Solar Water Heating System (Occupancy)
- MR Credit 1 – Organic Waste Management, Post Occupancy (Occupancy)

Waste Water Treatment and Reuse

Not applicable for Individual Residential Unit

WE Credit 5 Points: 4

Intent:

Reduce consumption of potable water and waste water generation to minimise the burden on municipal water supply.

Compliance Options:

Waste Water Treatment: (2 points)

- ❖ Provide an on-site treatment system to treat 100% of waste water generated in the building/ campus, to the quality standards suitable for reuse as prescribed by Central (or) State Pollution Control Board, as applicable.

Waste Water Reuse: (2 points)

- ❖ Reuse treated waste water or captured rain water for atleast 50% of landscaping & flushing water requirements.

Points are awarded as below:

Percentage of Landscaping & Flushing Water Requirement catered through Treated Water	Points
≥ 50%	1
≥ 95%	2

Notes:

- *Waste water here refers to both grey and black water.*
- *The credit point(s) can be claimed only if the waste water is treated in-situ and reused in-situ.*
- *Potted plants should not be considered under landscaping.*

Green Building Concerns:

- The total amount of water withdrawn from natural water bodies should be reduced so as to preserve the biodiversity
- Waste water that leaves the site puts pressure on public infrastructure, chemical inputs, energy use, and emissions at municipal water treatment works
- If the on-site waste water treatment plants are not maintained well, it could lead to health issues. An agency can be entrusted with this responsibility

Approach and Methodologies:

Residential developments generate significant volumes of grey water which is typically diverted to municipal streams without any treatment thereby, putting pressure on the local municipal treatment plants. The on-site waste water treatment systems transform perceived waste water into resources that can be used on the project site.

The project should estimate all the waste water volumes generated in the building. While designing the treatment system, ensure that the treated waste water meets the required quality standards based on its purpose of application. Ensure that the quality of the treated waste water is suitable for reuse by meeting the State Pollution Control Board/ Central Pollution Control Board norms.

Estimate the water demand for flushing based on occupancy and for irrigation based on landscape design. As a thumb rule the project can consider a volume of 5 to 8 liters/ sq.m/ day for irrigation requirements, if actual values are not available. For projects using treated waste water for flushing purposes, install dual plumbing lines during the initial construction to avoid the substantial cost and difficulty in adding them later.

Prioritise the use of treated waste water for the above applications considering the availability of treated waste water. Excess treated waste water, if any, can also be used for car washing, housekeeping and other purposes. Ensure periodic testing of the treated water to meet the quality standards as prescribed by Central / State Pollution Control Board. Have adequate signages all around the building to caution occupants and housekeeping staff that this water is not potable.

Benefits:

- Brings self-sufficiency with respect to water needs within the project
- Reduces the dependency on municipal water supply
- The local aquifer is conserved as a water resource for future generations

Sample Waste Water Reuse Calculations:

The calculation methodology for estimating the waste water generation involves the grey water generated from flow fixtures and black water from flush fixtures. To meet the compliance the project must install an on-site STP. While estimating the capacity of the STP, the project must consider the efficiency of the installed STP. The treated waste water can reused for flushing & landscaping purposes. For water balance, the project must calculate the water demand for flushing and landscaping purposes.

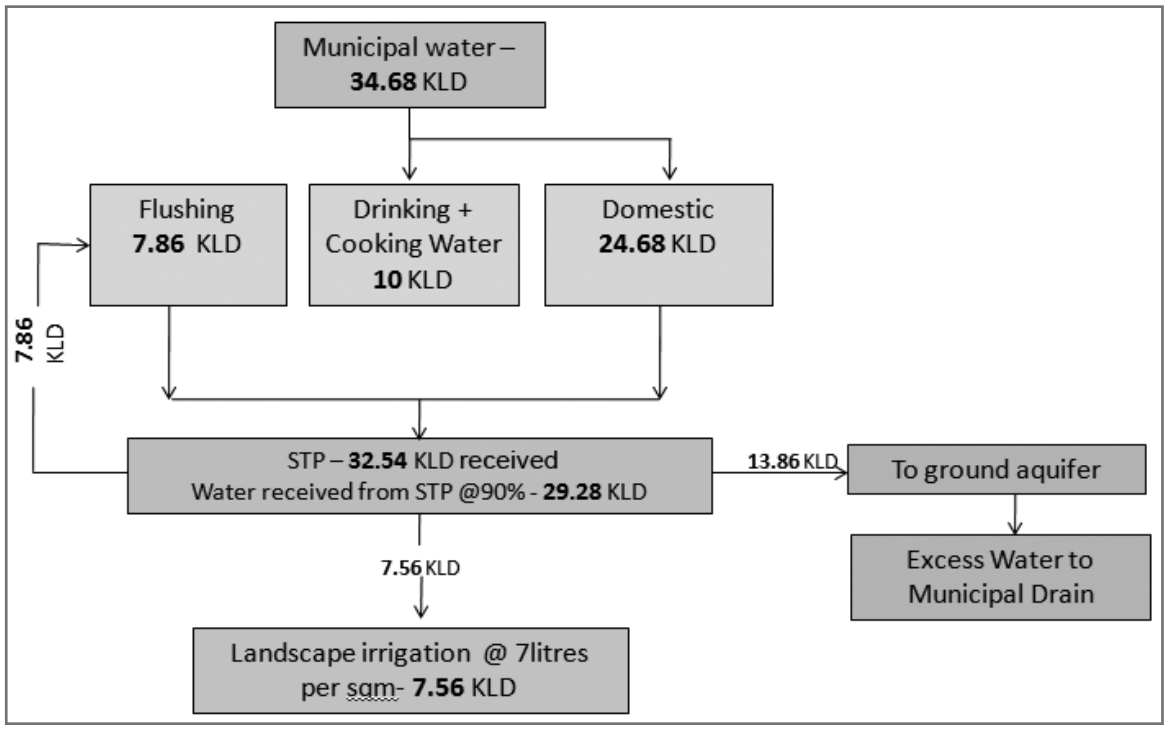
The sample filled in-template calculation is shown below:

Total volume of waste water generated	**(liters/ day)**	**7,725**
From flush fixtures (black water)	(liters/ day)	600
From flow fixtures (grey water)	(liters/ day)	7,125
Capacity of sewage treatment plant	(liters/ day)	5,000
Percentage		**64.7%**

Efficiency of STP	**(%)**	**90%**
Volume of treated waste water available	**(liters/ day)**	**6,953**
Number of operational days		**365**
Total volume of treated waste water available annually	**(liters)**	**2 5,37,663**

Application	**Volume of Water Required Annually** (Liters)	**Volume of Water Reused Annually**	
		Treated Waste Water (Liters)	**Stored Water** (Liters)
Flushing	2,19,000	1,50,000	25,000
Landscaping	21,000	10,000	8,000
Total	**2,40,000**	**1,60,000**	**33,000**

Total volume of water required annually (for landscaping & flushing)	(liters)	**2,40,000**
Total volume of treated waste water / stored water used annually (for landscaping & flushing)	(liters)	**1,93,000**
Percentage		**80.4%**



Picture 18: Flow chart of Annual Water Balance in a residential project

Documentation Required:

Precertification Level

(Only for Multi-dwelling Residential Units)

- ❖ Narrative describing the proposed on-site waste water treatment system, along with quality standards of the waste water treated and reused.
- ❖ Tentative daily and annual water balance of the project.

Note:

The water balance shall include calculations (approximate) showing quantity of waste water generated & treated; water demand for landscaping, flushing & other applications, and quantity of waste water reused for such applications.

- *Site plan highlighting the location of proposed on-site waste water treatment system.*
- *Submit schematic drawing showing proposed dual plumbing lines, if treated waste water is reused for flushing. (Optional)*

Certification Level

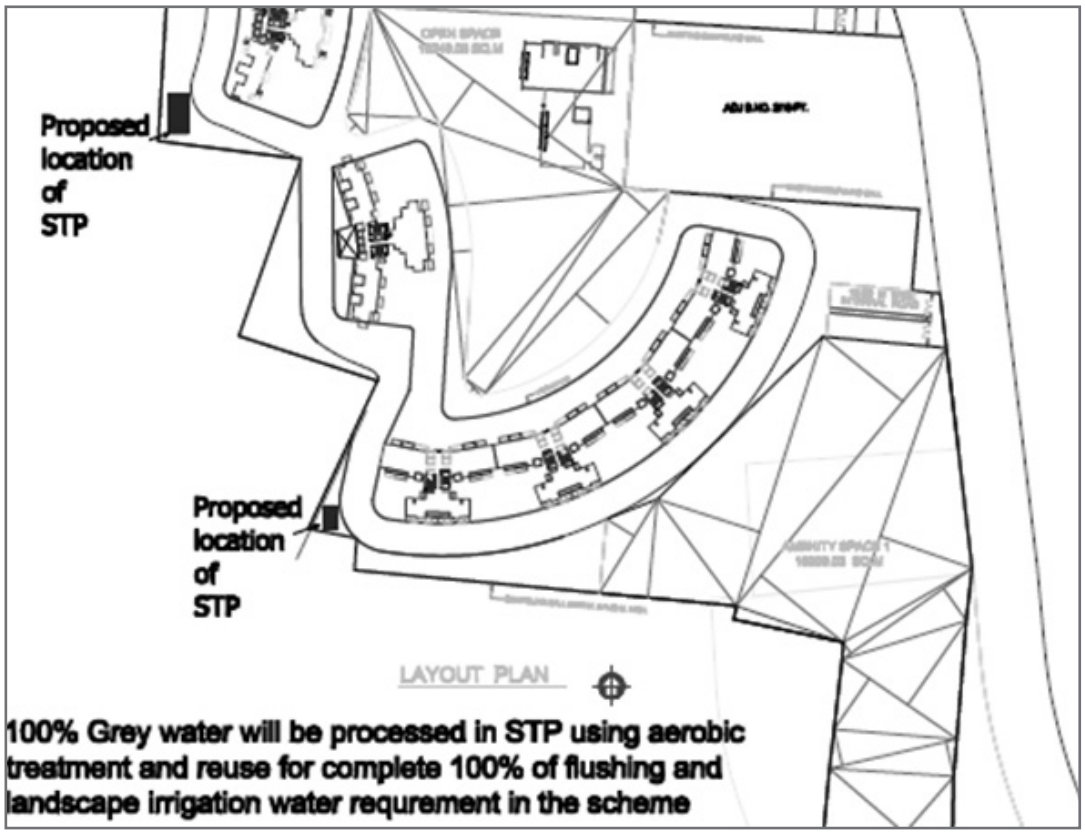
(For Multi-dwelling Residential Units)

- ❖ Narrative describing the installed on-site waste water treatment system, along with quality standards of the waste water treated and reused.
- ❖ Daily and annual water balance of the project.

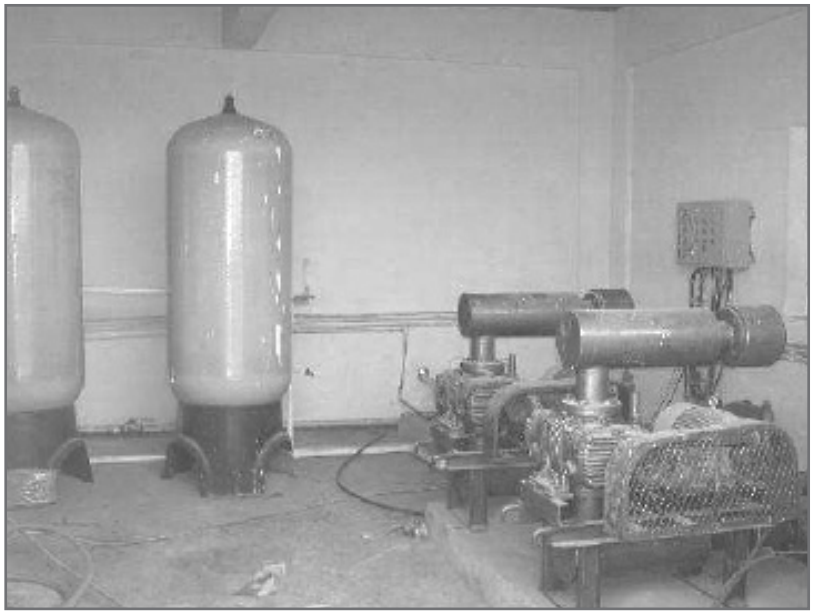
Notes:

The water balance shall include calculations (approximate) showing quantity of waste water generated & treated; water demand for landscaping, flushing & other applications, and quantity of waste water reused for such applications.

- *Site plan highlighting the location of installed on-site waste water treatment system.*
- *Photographs showing the on-site waste water treatment system installed.*
- *Submit schematic drawing showing dual plumbing lines, if treated waste water is reused for flushing.*



Picture 19: Photograph of installed STP in a residential project



Picture 20: Layout highlighting the location of on-site STP in a residential project

Exemplary Performance:

This credit is not eligible for exemplary performance under Innovation & Design Process.

Related Mandatory Requirements & Credits:

- ❖ WE Mandatory Requirement 1- Rainwater Harvesting, Roof & Non-roof (Water balance and rain water captured)
- ❖ WE Credit 3 – Rainwater Harvesting, Roof & Non-roof (Water balance and rain water captured)
- ❖ WE Mandatory Requirement 2 – Water Efficient Plumbing Fixtures (Water balance and water reused for flushing)
- ❖ WE Credit 4 – Water Efficient Plumbing Fixtures (Water balance and water reused for flushing)
- ❖ WE Credit 1 – Landscape Design (Water reused for landscaping)

Definitions:

Grey Water is waste water from showers, bathtubs, washing machines and sinks that are not used for disposal of hazardous or toxic ingredients or wastes from food preparation.

Sewage Treatment is a process of removing contaminants from waste water and household sewage. Its objective is to produce an environmentally safe fluid waste stream suitable for disposal or reuse using advanced technology it is possible to reuse sewage affluent for drinking water (e.g.. Singapore).

Tertiary treatment is the highest form of wastewater treatment that includes the removal of nutrients, organic and solid material, along with biological or chemical polishing generally to effluent limits of 10 mg/L BOD5 and 10 mg/L TSS.

Total suspended solids (TSS) are particles or floes that are too small or light to be removed from stormwater via gravity settling. Suspended solid concentrations are typically removed via filtration.

Waste Water from kitchen sinks, showers or bathtubs may be considered black water by state or local codes. Project teams should comply with the black water definition as established by the authority having jurisdiction in their areas.

Water Metering

Not applicable for Individual Residential Units

WE Credit 6 **Points: 1**

Intent:

Encourage continuous monitoring to enhance the water performance of residential dwelling unit(s).

Compliance Options:

Provide water meters for the following, as applicable: (minimum three water uses to be metered)

- ❖ Potable water consumption at individual dwelling unit level
- ❖ Captured rain water reuse
- ❖ Landscape water consumption
- ❖ Hot water consumption through solar systems, at building level
- ❖ Treated waste water consumption
- ❖ Air-conditioning cooling tower make-up
- ❖ Any other major source of water consumption such as, swimming pools, water fountain, common car wash facilities, etc.,

Green Building Concerns:

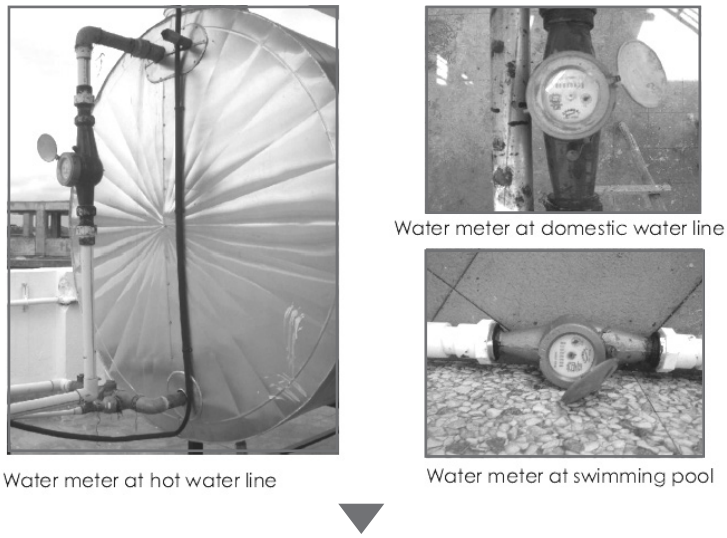
- ❖ Water leakages can be identified and rectified saving much of water wastage

Approach and Methodologies:

Identify all the major water consuming areas and install systems to monitor their consumption. Water meters can be installed at the water source or at the user's end to quantify consumption. Develop and implement a measurement and verification mechanism to compare the predicted water savings and the reduction in water consumption achieved. Track the performance of the installed systems by comparing the predicted performance to the actual performance. This aids in evaluating the performance of the installed systems in comparison the baseline performance and for further enhancements if necessary.

Benefits:

- **'What cannot be measured cannot be saved'.** Water meters can help measure and any deviations can always be diagnosed & corrected thereby reducing additional water costs.



Picture 21: Photograph showing water meters for various applications

Documentation Required:

Precertification Level

(Only for Multi-dwelling Residential Units)

- A narrative describing the proposed list of water metering system/equipment in the project.
- Single line diagram showing the proposed water metering system/equipment. (Optional)

Certification Level

(For Multi-dwelling Residential Units)

- A narrative describing the installed water metering system/ equipment in the project.
- Single line diagram showing the installed water metering system/ equipment.
- Purchase invoice/ payment receipts and manufacturer cut-sheets/ brochures of the installed water meters.

Exemplary Performance:

This credit is not eligible for exemplary performance under Innovation & Design Process.

Energy Efficiency

Introduction

India is a rapidly growing economy where the energy demand far outstrips the generation. Also, almost 68%* of the energy generated in India is from fossil fuel based thermal power plants, which are amongst the biggest sources of atmospheric pollution. Energy conservation has been identified as a national priority by the Government of India and several measures have been initiated towards promoting energy efficiency. *(*Source: Ministry of Power, Government of India website -http://www.powermin.nic.in)*

The broad approach to energy efficiency is to optimise the energy use by reducing energy demand in apartments and homes.

Energy consumption can be substantially reduced by incorporating strategies that are economically viable with an attractive return on investment. Simple measures like orientation, harvesting daylight, providing for abundant ventilation, adopting passive measures and selecting energy efficient appliances can go a long way in enhancing the energy efficiency. The beneficiaries are the end users who can reap the benefits through the life of the building. This can result in National benefits like reducing the dependence on fossil fuels and the associated pollution impacts

In India, Sun is the source of abundant untapped energy. Roof tops may be used for generating hot water and also for generating renewable power with solar photovoltaic cells. Other sources of renewable on-site energy such as bio-gas digesters, small wind systems using organic waste may also be explored.

Incorporating energy efficiency reduces the monthly bills and also result in environmental benefits

CFC-Free Equipment

EE Mandatory Requirement 1

Intent:

Avoid use of refrigerants and ozone depleting gases which has negative impact to the environment.

Compliance Options:

Zero use of chlorofluorocarbon (CFC) refrigerants in Heating, Ventilation & Air-conditioning (HVAC) equipment and Unitary Air-Conditioners installed in the building(s).

Green Building Concerns:

- ❖ Some refrigerants used in heating, ventilating, air conditioning, and refrigeration (HVAC & R) systems cause significant damage to Earth's protective ozone layer if they are released into the atmosphere.
- ❖ Other refrigerants contribute to greenhouse gas emissions, causing global climate change.

Approach and Methodologies:

CFC can destroy stratospheric ozone molecules which shields the earth against incoming ultraviolet radiation. Ultraviolet radiation can cause harmful effects on human beings, such as skin cancer and cataract.

Survey the market for CFC-free HVAC system/ unitary air-conditioners. Install HVAC equipment/ unitary air-conditioners which does not use CFC based refrigerant.

Specify non CFC based refrigerants in all air conditioning systems proposed to be used within the project.

While selecting the refrigerants, one can consider factors like life of the refrigerant, Ozone depleting potential (ODP) and Global warming potential (GWP). Ideally, refrigerants chosen should have shorter lifetimes, lower ODP and GWP values.

Some of the characteristics of commonly used refrigerants are listed in the table below:

Environmental Characteristics of Refrigerants

Refrigerant	ODP	GWP
Hydrochloroflurocarbons		
HCFC-22	0.04	1,780
HCFC-123	0.02	76
Hydrofluorocarbons		
HFC-23	~ 0	12,240
HFC-13a	~ 0	1,320
HFC-245fa	~ 0	1,020
HFC-404A	~ 0	3,900
HFC-407C	~ 0	1,700
HFC-410A	~ 0	1,890
HFC-507A	~ 0	3,900
Natural refrigerants		
Carbon dioxide (CO2)	0	1.0
Ammonia (NH3)	0	0
Propane	0	3

Benefits:

- ❖ Reduces adverse health impacts
- ❖ Protects the ozone layer from further depletion

Documentation Required:

Precertification Level

(Only for Multi-dwelling Residential Units)

- ❖ Declaration letter signed by owner/ developer stating the proposed HVAC system(s) under owner's /developer's scope, if any, and type of refrigerant.
- ❖ A copy of draft tenant guidelines stating the use of CFC-free refrigerants in the HVAC system(s). (Optional)
- ❖ List of proposed HVAC systems, with make and model.
- ❖ Manufacturer cut-sheet/ brochure indicating the type of refrigerant to be used in the proposed HVAC system(s). (Optional)

Certification Level

(For Individual Residential Units)

- Declaration letter signed by owner stating the HVAC system(s), if any, and type of refrigerant.
- List of installed HVAC systems, with make and model.
- Purchase invoice/ payment receipts of the HVAC system installed, as applicable.
- Manufacturer cut-sheet/ brochure indicating the type of refrigerant installed in the HVAC system(s).

(For Multi-dwelling Residential Units)

- Declaration letter signed by owner/ developer stating the HVAC system(s) under owner's /developer's scope, if any, and type of refrigerant.
- List of installed HVAC systems, with make and model.
- Purchase invoice/ payment receipts of the HVAC system installed, as applicable.
- Manufacturer cut-sheet/ brochure indicating the type of refrigerant installed in the HVAC system(s).
- A copy of tenant guidelines stating the use of CFC-free refrigerants installed in the HVAC systems. (Optional)

Related Mandatory Requirements & Credits:

- EE Mandatory Requirement 2 – Minimum Energy Performance (Air-conditioning system)
- EE Credit 1 – Enhanced Energy Performance (Air-conditioning system)
- IEQ Mandatory Requirement 3 – Fresh Air Ventilation (Air-conditioning system)
- IEQ Credit 2 – Enhanced Fresh Air Ventilation (Air-conditioning system)

Definitions:

Chlorofluorocarbons (CFC) are hydrocarbons that deplete the stratospheric ozone layer.

Refrigerants are the working fluids of refrigeration cycles. They absorb heat from a reservoir at low temperatures and reject heat at higher temperatures.

Minimum Energy Performance

EE Mandatory Requirement 2

Intent:

Improve energy efficiency of the proposed building(s) and system(s) to reduce environmental impacts from excessive energy use.

Compliance Options:

The project can choose any one of the following options to show compliance for minimum energy performance:

- ❖ Option 1 – Prescriptive Approach
- ❖ Option 2 – Performance Based Approach

Note:

- Projects having multiple building types must independently (i.e. each residential typology; e.g.: apartments, villas, club house, etc.,) meet the minimum energy performance criteria.

❖ Option 1 - Prescriptive Approach

The prescriptive approach allows the project to comply with applicable criteria for all the parameters as outlined below:

1. Building Envelope:

The project must ensure that the following building envelope measures meet the baseline criteria as outlined in Annexure –I.

- ➢ Solar Heat Gain Coefficient (SHGC) *
- ➢ Window Glazing U-value (only if WWR ≥ 30%) **
- ➢ Overall Roof Assembly U-value

Notes:

- **Low SHGC value can be achieved through chajjas or other sun shading devices or efficient fenestration or a combination of both*
- ***Compliance for window glazing U-value should be shown only if window-to-wall ratio (WWR) is more than 30%*
- *Compliance for overall wall assembly U-value need not be shown for mandatory requirement*

2. Lighting:

The project must ensure that the interior, exterior, common and parking area lighting power densities meet the baseline values through 'building area method' as outlined in Annexure–I.

Notes:

- *Individual dwelling unit should show compliance for interior and exterior lighting, whereas Multi-dwelling units should show lighting compliance for all the areas which are in developer's/ owner's scope only.*
- *Compliance for interior, exterior, common and parking area lighting must be shown separately.*
- *Decorative lighting in respective areas should be considered for lighting power density calculations.*
- *The areas to be considered while calculating the Exterior LPD should be those areas which are illuminated by external lighting and not the entire exterior area.*
- *This LPD includes the power consumption of the complete fixtures, which includes lamps and ballasts.*

3. Air-conditioning Systems:

(Applicable for project only if 25% of the total regularly occupied spaces are air-conditioned, excluding kitchen & bathroom)

The project must ensure that the air-conditioning systems meet the baseline criteria as outlined below:

- Unitary air-conditioner(s) must be BEE minimum 3-star rated or equivalent

  (Or)
- Centralised air-conditioning system(s) must meet the baseline values as per Annexure - I

Notes:

- *Both Individual and Multi-dwelling units should show compliance for all the air-conditioning system(s) installed in the project, within the owner's/ developer's scope*
- *For latest list of air-conditioners rated by BEE, please refer BEE website http://www.bee-india.nic.in*

❖ **Option 2 – Simulation Based Approach**

The simulation (performance) based approach involves a building energy simulation and modeling. **This approach allows the project to demonstrate compliance with the baseline criteria.**

The project must perform building energy simulation considering the following, as per Annexure - I:

a. Building envelope

- Solar heat gain coefficient (SHGC)
- Window glazing U-value
- Overall wall assembly U-value
- Overall roof assembly U-value

b. Lighting

- Interior, exterior, common & parking area lighting, whichever is in owner's/ developer's scope

c. Air-conditioning

d. Space heating

e. Plug loads & Process loads

The following comfort conditions should be considered for energy simulation:

- Indoor temperature set point for simulation should be 26^0C for cooling systems & 20^0C for Space heating systems all through the year.
- Comfort conditions should be considered both for summer and winter.

Notes:

- *Trade-offs among different building parameters (such as lighting, air-conditioning, etc.,) is permissible.*
- *Projects which use on-site renewable energy sources (such as solar photovoltaics, wind turbines, etc.,) can be subtract the renewable energy generated from the total energy of the proposed case.*
- *Solar hot water systems should not be modeled in either the base case or the proposed case, to show energy savings. Such systems are separately recognised under EE Credit 3 – Solar water heating systems.*

- *The base case requirements for the energy simulation module are given in Annexure - I.*
- *The protocol for energy simulation, calculation of the proposed & baseline building performance and indicative format for reporting energy simulation results are detailed in Annexure - III.*

Green Building Concerns:

- ❖ Energy efficiency reduces the environmental burdens associated with generation and energy use.
- ❖ The process of extracting and generating energy from fossil fuels causes many environmental impacts, including air and water pollution, land degradation, solid waste generation, and greenhouse gas emissions.
- ❖ Data from the Bureau of Energy Efficiency (BEE) shows that residential sector is responsible for over 30 percent of electrical energy consumption in the country, and is rising annually at the rate of 8 %.
- ❖ Even seemingly small conservation measures can be significant; for instance, replacing a single 40W incandescent lamp with a 11W fluorescent lamp, which uses up to 75% less energy, can save substantial energy

Approach and Methodologies:

A residential building can be energy efficient by adopting various strategies. Few of the strategies include orientation; better envelope which includes type of wall, type of roof, glazing type & shading devices; efficient lighting design for exterior & interior spaces; efficient air-conditioning system (unitary/ centralised) and use of sophisticated technologies such as day light sensors, motion sensors, lighting controls, etc.,

The right approach would be to look at reducing the energy consumption by optimum design in terms of orientation, form of the building, choice of materials etc. during the conceptual design stage. Identify the climatic zone in which the building is located and study the weather patterns. This would have significant impact on the building design and selection of materials. For example, glazing characteristics for tropical climate (warm-humid) would differ from those that are required for buildings situated in temperate climate.

Residential buildings situated in high temperature zones, should be designed such that heat ingress is arrested. Whereas for homes situated in extremely cold temperature zones, orient

the building such that heat is absorbed. The design should consider the above criteria and select appropriate measures to meet the functional requirements.

Design should include measures such as insulation of walls; over deck/ under deck insulation for roof and selection of glass which depends on window to wall area ratio (WWR), orientation and building form. Glass characteristics such as U-value, SHGC (Solar Heat Gain Coefficient) & VLT (Visible Light Transmission) play a large role in balancing day-lighting with heat gain/loss.

Select the materials and equipment available in the market and their properties with regard to energy performance. While selecting these materials and equipment, consider their associated environmental impacts.

The selection of efficient building equipment & technologies are critical in optimising energy efficiency. The use of passive technologies like wind tower, geothermal air-conditioning systems, tunnel air-conditioning systems are increasingly becoming popular. However, to achieve comfort conditions all through the year, the design can consider a combination of passive technologies and conventional air-conditioning systems.

Identify energy efficient products available in the market and their properties with regard to energy performance. While selecting these products & equipment, consider their operating cost through their life rather than the initial cost alone. Selecting BEE star rated appliances and equipment can be one of the best approach to enhance energy savings.

Efficiency of conventional air-conditioners has improved to a very large extent in past ten years. Part load efficiency for these systems many a times can be higher than full load efficiencies. This is very important due to the fact that no system can be designed to exactly meet the heat loads in a building.

For projects using unitary air-conditioning systems, individual residential unit owners can select BEE three star rated or more efficient air conditioners. Developers using larger systems can compare the Energy Efficiency Ratios (EER) of unitary systems available in the market and select systems with higher EER values. While selecting unitary systems, ensure that the refrigerants used are CFC free.

Major changes are seen in the way that lighting systems are designed. The advent of high efficiency luminaries like CFLs, T5, LEDs have reduced the Lighting Power Densities (LPDs) in many homes. Home automation systems are also slowly gaining popularity in high-end homes. These systems can yield significant energy savings.

Benefits:

- ❖ Reduced energy bills
- ❖ Energy cost savings of 20-30% with payback time of 1-2 years. Reduced environmental impacts

Sample Calculations:

Assuming a 3BK residential apartment with 10 dwelling units, the project can adopt Prescriptive Approach or Performance Approach to show compliance. To meet the compliance the project must show that the designed residential building meets the parameters as per Annexure – I: Baseline Criteria for Building Performance.

Prescriptive Approach:

The sample filled-in template is shown below:

Option 1 - Prescriptive Approach	
Location of the project	Hyderabad
Climatic zone of the project	Hot and Dry

Window-to-wall Ratio (WWR) (%)			30%	
Climate Zone	Envelope Measures	Baseline	Proposed	Meet or Exceed Baseline Criteria (Yes/ No)
FALSE	SHGC value	-	0.32	**Yes**
	Glazing U-value (W/m^2K)	Not Applicable		Not Applicable
	Overall Roof Assembly (W/m^2K)	-	1.00	**Yes**

Lighting	**Applicable Areas**	**Baseline LPD (W/m^2)**	**Proposed LPD (W/m^2)**	**Meet or Exceed Baseline Criteria** (Yes/ No)
Interior Lighting (for residential units)	Individual dwelling unit, Apartments, Villas, Gated communities	5.0	3.2	Yes
Interior Lighting (for non-residential units)	Resorts, Motels, Service apartments, Hostels, Guest houses, etc.,	10.8		---
Exterior Lighting, excluding Parking Area (for residential & non-residential units)	Landscaping, Façade, Street lighting, Pathways, Signages, etc.,	2.5	2.2	Yes
Common Area Lighting, excluding Parking Area (for residential & non-residential units)	Corridors, Lobbies, Staircases, Terrace, etc.,	4.0	3.2	Yes
Parking Area	Surface parking (covered & uncovered), Basement parking,	2.5	2.1	Yes

Performance Approach:

The illustration of energy simulation report showing energy savings achieved in a residential project can be referred in **Annexure – IV.**

Documentation Required:

Precertification Level

(Only for Multi-dwelling Residential Units)

Prescriptive Approach

- ❖ Narrative stating the climate zone and the list of proposed Energy Conservation Measures (ECMs) to be implemented.
- ❖ Comparison of the baseline building parameters and the proposed building parameters
  - ➢ Refer Annexure – I for 'Baseline Criteria for Building Energy Performance'.
- ❖ Details of proposed glazing along with the list of identified manufacturers and respective specifications of glazing (SHGC value, U-value and VLT). Also, specify window-to-wall ratio (WWR) for each building.

Notes:

- Projects having chajjas (overhangs/ vertical fins), can consider M-factor calculations to arrive at SHGC value.
- Window glazing U-value details need to be submitted only if, window-to-wall ratio (WWR) is greater than 30%.
- *Construction details of proposed roof (including roof insulation material, etc.,) along with the U-value of the overall roof assembly.*
  - ➢ *Sectional drawings of roof assembly.*
- *Details of the proposed lighting system including list of interior and exterior lighting fixtures, with make and model.*
  - ➢ *Proposed LPD calculations for interior, exterior, common and parking areas, in owner's/ developer's scope, separately.*
  - ➢ *Conceptual lighting layout of interior and common areas for each typical floor, as applicable*
  - ➢ *Conceptual exterior lighting layout*

- *Details of the proposed air-conditioning system indicating the COP/ EER values or BEE star rating along with make and model.*
- *Manufacturer brochures/ cut-sheets/ letters indicating the efficiency parameters for glazing (SHGC value, U-value and VLT), roof insulation materials, lighting fixtures and air-conditioning system, as applicable. (Optional)*

Performance Approach

❖ Building simulation analysis to be documented and the information shall include the following:

➢ Narrative stating the climate zone and the list of proposed Energy Conservation Measures (ECMs) to be implemented.

Note:

The list shall include all ECMs that differ from the baseline building performance to proposed building performance.

➢ *Comparison of the baseline building performance and the proposed building performance with percentage improvement*

❖ Refer Annexure – I for 'Baseline Criteria for Building Energy Performance'

❖ Refer Annexure – III for 'Protocol for Building Energy Simulation'.

➢ *The schedules for lighting power, thermostat set-point, HVAC system, miscellaneous equipment power, etc., for proposed building, as determined by the designer.*

➢ *Input and output report(s) from the simulation program or compliance software including a breakdown of energy usage for the following components, but not limited to: interior lighting and exterior lighting, space cooling & heat rejection equipment, space heating equipment, fans, other HVAC equipment (such as pumps), internal and external equipment loads, etc., The output reports shall also show the amount of time any loads are not met by the HVAC system for both the proposed design and baseline building design.*

➢ *An explanation of any error messages noted in the simulation program output.*

- ❖ Details of proposed glazing along with the list of identified manufacturers and respective specifications of glazing (SHGC value, U-value and VLT). Also, specify window-to-wall ratio (WWR) for each building.
- ❖ Construction details of proposed wall (including wall insulation material, etc.,) along with the U-value of the overall wall assembly.
  - ➢ Sectional drawings of wall assembly.
- ❖ Construction details of proposed roof (including roof insulation material, etc.,) along with the U-value of the overall roof assembly.
  - ➢ Sectional drawings of roof assembly.
- ❖ Details of the proposed lighting system including list of interior and exterior lighting fixtures, with make and model.
  - ➢ *Proposed LPD calculations for interior, exterior, common and parking areas, in owner's/ developer's scope, separately.*
  - ➢ *Conceptual lighting layout of interior and common areas for each typical floor, as applicable*
  - ➢ *Conceptual exterior lighting layout*
- ❖ *Details of the proposed air-conditioning system indicating the COP/ EER values or BEE star rating along with make and model.*
- ❖ *Manufacturer brochures/ cut-sheets/ letters indicating the efficiency parameters for glazing (SHGC value, U-value and VLT), wall & roof insulation materials, lighting fixtures, air-conditioning system and space heating system, as applicable. (Optional)*

Notes:

- *Projects having multiple building types must independently (i.e. each typology e.g.: apartments, villas, club house, etc.,) meet the Minimum Energy Performance criteria.*
- *To arrive at overall energy savings for projects having multiple building types, consider an aggregate of energy consumption of each typology, so that overall energy performance is arrived for buildings of varying types and sizes, within a certifying group.*

Certification Level

(For Individual Residential Units & Multi-dwelling Residential Units)

Prescriptive Approach

- ❖ Narrative stating the climate zone and the list of Energy Conservation Measures (ECMs) implemented.
- ❖ Comparison of the baseline building parameters and the proposed building parameters
  - ➢ Refer Annexure – I for 'Baseline Criteria for Building Energy Performance'.
- ❖ Details of installed glazing along with the list of manufacturers and respective specifications of glazing (SHGC value, U-value and VLT). Also, specify window-to-wall ratio (WWR) for each building.

Notes:

- *Projects having chajjas (overhangs/ vertical fins), can consider M-factor calculations to arrive at SHGC value.*
- *Construction details of installed roof (including roof insulation material, etc.,) along with the U-value of the overall roof assembly.*
  - ➢ *Sectional drawings of roof assembly.*
- *Details of the installed lighting system including list of interior and exterior lighting fixtures, with make and model.*
  - ➢ *LPD calculations for interior, exterior, common and parking areas, in owner's/ developer's scope, separately.*
  - ➢ *Lighting layout of interior and common areas for each typical floor, as applicable*
  - ➢ *Exterior lighting layout*
- *Details of the installed air-conditioning system indicating the COP/ EER values or BEE star rating along with make and model.*
- *Manufacturer brochures/ cut-sheets/ letters indicating the efficiency parameters for glazing (SHGC value, U-value and VLT), roof insulation materials, lighting fixtures and air-conditioning system, as applicable.*

Performance Approach

- Building simulation analysis to be documented and the information shall include the following:
  - Narrative stating the climate zone and the list of Energy Conservation Measures (ECMs) implemented.

Notes:

The list shall include all ECMs that differ from the baseline building performance to proposed building performance.

  - *Comparison of the baseline building performance and the proposed building performance with percentage improvement*

- Refer Annexure – I for 'Baseline Criteria for Building Energy Performance'.
- Refer Annexure – III for 'Protocol for Building Energy Simulation'.
  - *The schedules for lighting power, thermostat set-point, HVAC system, miscellaneous equipment power, etc., for the building, as determined by the designer.*
  - *Input and output report(s) from the simulation program or compliance software including a breakdown of energy usage for the following components, but not limited to: interior lighting and exterior lighting, space cooling & heat rejection equipment, space heating equipment, fans, other HVAC equipment (such as pumps), internal and external equipment loads, etc., The output reports shall also show the amount of time any loads are not met by the HVAC system for both the proposed design and baseline building design.*
  - *An explanation of any error messages noted in the simulation program output.*
- Details of installed glazing along with the list of manufacturers and respective specifications of glazing (SHGC value, U-value and VLT)
- Construction details of proposed wall (including wall insulation material, etc.,) along with the U-value of the overall wall assembly.
  - *Sectional drawings of wall assembly.*
- Construction details of installed roof (including roof insulation material, etc.,) along with the U-value of the overall roof assembly.
  - *Sectional drawings of roof assembly.*

- Details of the installed lighting system including list of interior and exterior lighting fixtures, with make and model.
  - *LPD calculations for interior, exterior, common and parking areas, in owner's/ developer's scope, separately.*
  - *Lighting layout of interior and common areas for each typical floor, as applicable*
  - *Exterior lighting layout*
- *Details of the installed air-conditioning system indicating the COP/ EER values or BEE star rating along with make and model.*
- *Manufacturer brochures/ cut-sheets/ letters indicating the efficiency parameters for glazing (SHGC value, U-value and VLT), wall & roof insulation materials, lighting fixtures, air-conditioning system and space heating system, as applicable.*

Note:

- *Projects having multiple building types must independently (i.e. each typology e.g.: apartments, villas, club house, etc.,) meet the Minimum Energy Performance criteria.*

Related Mandatory Requirements & Credits:

- SSP Credit 4 – Heat Island Effect, Roof (High SRI material/ Vegetated roof)
- EE Mandatory Requirement 1: CFC-Free Equipment (Air-conditioning system)
- EE Credit 1 – Enhanced Energy Performance (Energy conservation measures)
- EE Credit 2 – On-site Renewable Energy (Renewable energy)
- IEQ Mandatory Requirement 3 – Fresh Air Ventilation (Air-conditioning system & Fresh air quantities)
- IEQ Credit 2 – Enhanced Fresh Air Ventilation (Air-conditioning system & Fresh air quantities)

Definitions:

Coefficient of Performance (COP) - cooling is the ratio of the rate of heat removal to the rate of energy input, in consistent units, for a complete refrigerating system or some specific portion of that system under designated operating conditions.

Coefficient of Performance (COP), heat pump – heating is the ratio of heat delivered to the rate of energy input, in consistent units, for a complete heat pump system, including the compressor and, if applicable, auxiliary heat, under designated operating conditions.

Energy Efficiency Ratio (EER) is the ratio of net cooling capacity in Btu/h to total rate of electric input in Watts under designated operating conditions.

Lighting Power Density (LPD) is the installed lighting power per unit area.

Proposed Building Performance is the annual energy cost calculated for a proposed design.

Solar Heat Gain Coefficient (SHGC) is the ratio of the solar heat gain entering the space through fenestration area to incident solar radiation. Solar heat gain includes directly transmitted solar heat and absorbed solar radiation, which is then re-radiated, conducted into space.

U-value (thermal transmittance) is heat transmission in unit time through unit area of a material or construction and boundary air films, induced by unit temperature difference between the environments on each side.

Visible Transmittance (Tvis) is the ratio of total transmitted light to incident light. In other words, it is the amount of light passing through a glazing surface divided by the amount of light striking the glazing surface. A higher Tvis value indicates that a greater amount of incident light is passing through the glazing.

Enhanced Energy Performance

EE Credit 1 **Points: 10**

Intent:

Enhance energy efficiency of the building(s) to reduce environmental impacts from excessive energy use.

Compliance Options:

The project can choose any one of the following options:

- ❖ Option 1 – Prescriptive Approach (Maximum 10 points)
- ❖ Option 2 – Performance Based Approach (Maximum 10 points)

Note:

- *Projects having multiple building types must independently (i.e. each typology e.g.: apartments, villas, club house, etc.,) meet the minimum energy performance criteria to be eligible for Enhanced Energy Performance.*

❖ **Option 1 - Prescriptive Approach**

The prescriptive approach allows the project to comply with applicable criteria for the parameters as outlined below:

1. Building Envelope:

The project should ensure that the building envelope measures meet the below criteria as outlined in **Annexure - II.**

- ➢ Solar Heat Gain Coefficient (SHGC)
- ➢ Window Glazing U-value
- ➢ Overall Wall Assembly U-value
- ➢ Overall Roof Assembly U-value

Points are awarded as below for Building Envelope Measures:

Building Envelope Measures	Points for Individual Residential Units (Maximum 5 points)	Points for Multi-dwelling Residential Units (Maximum 7 points)
Solar Heat Gain Coefficient (SHGC)	2	
Window Glazing U-value	1	1
Overall Wall Assembly U-value	1	2
Overall Roof Assembly U-value	1	2

Note:

- *SHGC can be achieved through chajjas or other sun shading devices or efficient fenestration or a combination of both*

2. Lighting:

- *Lighting Power Density (LPD): (2 points)*

  The project must ensure that the interior, exterior, common and parking area lighting power densities are reduced by atleast 20% from the baseline values through 'building area method' as outlined in **Annexure -I.**

Points are awarded as below for Lighting Power Density (LPD):

Reduction in Interior, Exterior Common & Parking Area LPDs from Baseline Values	Points
≥ 20 %	1
≥ 30 %	2

- *Lighting Controls: (1 point)*

  All non-emergency exterior & common area lighting such as façade, pathways, landscaping, surface and covered parking, street lighting, staircases should have atleast one of the following:

- Day light sensor
- Occupancy/ Motion sensor
- Timer

Notes:

- *Individual dwelling unit should show compliance for interior and exterior lighting, whereas Multi-dwelling units should show compliance for all the areas which are in developer's/ owner's scope only.*
- *Compliance for interior, exterior, common and parking area lighting must be shown separately.*
- *Decorative lighting in respective areas should be considered for lighting power density calculations.*
- *Exterior areas illuminated by lighting only should be considered for lighting power density calculations.*
- *This LPD includes the power consumption of the complete fixtures, which includes lamps and ballasts.*

3. Air-conditioning Systems:

(Applicable for project only if 25% of the total regularly occupied spaces are air-conditioned, excluding kitchen)

The project must ensure that the air-conditioning systems meet the enhanced criteria as outlined below:

- Unitary air-conditioner(s) must be BEE 5-star rated or equivalent (2 points)

(Or)

- Centralised air-conditioning system(s) must be efficient by atleast 10% from the baseline values as outlined in **Annexure -I** (2 points)

Points are awarded as below for Centralised Air-conditioning Systems:

Efficiency in Centralised Air-conditioning Systems from Baseline Values	Points
≥ 10 %	1
≥ 20 %	2

Notes:

- *For latest list of air-conditioners rated by BEE, please refer BEE website http://www.bee-india.nic.in*
- *Minimum Efficiency Requirements for VRF Systems can be referred from ASHRAE Standard 90.1-2010*

4. Space Heating Systems (1 point)

(Applicable for project only if HDD** 18 is greater than 150)

- Unitary heat pumps must meet the baseline criteria, as per Annexure - I
- Non-electricity based heating system should have a minimum thermal efficiency of 70%

Notes:

- ***Degree day: The difference in temperature between the outdoor mean temperature over 24 hour period and a given base temperature*
- ***Heating degree day base 18°C, HDD 18: for any one day, when the mean temperature is less than 18°C, there are as many degree-days as degree Centigrade temperature difference between the mean temperature for the day and 18°C. Annual heating degree-days (HDDs) are the sum of the degree-days over the calendar year*

Option 2 – Performance Based Approach

The simulation (performance) based approach involves a building energy simulation and modeling. **This approach allows the project to demonstrate improvements over the baseline criteria.**

Points are awarded based on energy cost percentage savings as detailed below:

Option - 2: Points for Energy Performance

Percentage Energy Cost Savings above base case		Points
Individual Residential Unit	**Multi-dwelling Residential Units**	
3 %	2 %	1
6 %	4 %	2
9 %	6 %	3
12 %	8 %	4
15 %	10 %	5
18 %	12 %	6
21 %	14 %	7
24 %	16 %	8
27 %	18 %	9
30%	20 %	10

The project must perform building energy simulation considering the following, as per annexure - I:

- Building envelope
  - Solar Heat Gain Coefficient (SHGC)
  - Window Glazing U-value,
  - Overall Wall Assembly U-value
  - Overall Roof Assembly U-value
- Lighting
  - Interior, exterior common and parking area lighting, whichever is in owner's / developer's scope
- Air-conditioning
- Space heating
- Plug loads & Process loads

The following comfort conditions should be considered for energy simulation:

- Indoor temperature set point for simulation should be 26^{o}C for cooling systems & 20^{o}C for Space heating systems all through the year.
- Comfort conditions should be considered both for summer and winter.

Notes:

- *Projects having multiple building types must independently (i.e. each typology e.g.: apartments, villas, club house, etc.,) meet the minimum energy performance criteria to be eligible for Enhanced Energy Performance.*
- *Trade-offs among different building parameters (such as lighting, air-conditioning, etc.,) are permissible.*
- *Projects which use on-site renewable energy sources (such as solar photovoltaics, wind turbines, etc.,) can subtract the renewable energy generated from the total energy of the proposed case.*
- *Solar hot water systems should not be modeled in either the base case or the proposed case, to show energy savings. Such systems are separately recognised under EE Credit 3 – Solar water heating systems.*
- *The base case requirements for the energy simulation module are given in Annexure - I.*

- *The protocol for energy simulation, calculation of the proposed & baseline building performance and indicative format for reporting energy simulation results are detailed in Annexure - III.*

Sample Calculations:

Please refer to 'Sample Calculations' under EE Mandatory Requirement 2 – Minimum Energy Performance.

To meet the compliance the project must show energy savings over the building design parameters as per Annexure – II: Prescriptive Criteria for Building Envelope Measures.

Documentation Required:

Precertification Level

(Only for Multi-dwelling Residential Units)

Prescriptive Approach

In addition to the documents required under EE Mandatory Requirement 2 – Minimum Energy Performance, provide the following:

- ❖ Comparison of the baseline building parameters and the proposed building parameters
  - ➢ Refer Annexure – II for Prescriptive Criteria for Building Envelope Measures.
  - ➢ Refer Annexure – I for Prescriptive Criteria for Lighting, Air-conditioning and Heating Systems/ Equipment.
- ❖ Construction details of proposed roof (including roof insulation material, etc.,) along with the U-value of the overall roof assembly.
  - ➢ Sectional drawings of roof assembly.
- ❖ Details of the proposed space heating system along with the manufacturer cut-sheets/ brochures indicating the minimum efficiency.
- ❖ Manufacturer brochures/ cut-sheets/ letters indicating the efficiency parameters for wall insulation materials and space heating system, as applicable. (Optional)

Performance Approach

- Please Refer 'Documentation Required' under EE Mandatory Requirement 2 – Minimum Energy Performance.

Note:

Projects having multiple building types must independently (i.e. each typology e.g.: apartments, villas, club house, etc.,) meet the Minimum Energy Performance criteria to be eligible for Enhanced Energy Performance.

Certification Level

(For Individual Residential Units & Multi-dwelling Residential Units)

Prescriptive Approach

In addition to the documents required under EE Mandatory Requirement 2 – Minimum Energy Performance, provide the following:

- Comparison of the baseline building performance and the proposed building performance
  - Refer Annexure – II for Prescriptive Criteria for Building Envelope Measures.
  - Refer Annexure – I for Prescriptive Criteria for Lighting, Air-conditioning and Heating Systems/ Equipment.
- Construction details of proposed wall (including roof insulation material, etc.,) along with the U-value of the overall wall assembly.
  - Sectional drawings of wall assembly.
- Details of the installed space heating system along with the manufacturer cut-sheets/ brochures indicating the minimum efficiency.
- Manufacturer brochures/ cut-sheets/ letters indicating the efficiency parameters for wall insulation materials and space heating system, as applicable.

Performance Approach

- Please Refer 'Documentation Required' under EE Mandatory Requirement 2 – Minimum Energy Performance.

Note:

Projects having multiple building types must independently (i.e. each typology e.g.: apartments, villas, club house, etc.,) meet the Minimum Energy Performance criteria to be eligible for Enhanced Energy Performance.

To arrive at overall energy savings for Projects having multiple building types, consider an aggregate of energy consumption of each typology, so that overall energy performance is arrived for buildings of varying types and sizes, within a certifying group.

Exemplary Performance:

This credit is eligible for exemplary performance under Innovation & Design Process, if:

Prescriptive Based Approach:

- Interior, exterior, common and parking area lighting power densities are reduced by 40% from the baseline values through 'building area method' as outlined in Annexure -I.

(Or)

- Centralised air-conditioning systems are 30% better than the baseline system, as outlined in Annexure - I.

Performance Based Approach:

- Energy cost savings is more than 22% in individual dwelling units and 33% in multi-dwelling units, when compared to the base case as outlined in Annexure - I.

Related Mandatory Requirements & Credits:

- SSP Credit 4 – Heat Island Effect, Roof (High SRI material/ Vegetate roof)
- EE Mandatory Requirement 1 – CFC-Free Equipment (Air-conditioning system)
- EE Mandatory Requirement 2 – Minimum Energy Performance (Energy conservation measures)
- EE Credit 2 – On-site Renewable Energy (Renewable energy)
- IEQ Mandatory Requirement 3 – Fresh Air Ventilation (Air-conditioning system & Fresh air quantities)
- IEQ Credit 2 – Enhanced Fresh Air Ventilation (Air-conditioning system & Fresh air quantities)

Definitions:

Coefficient of Performance (COP) -cooling is the ratio of the rate of heat removal to the rate of energy input, in consistent units, for a complete refrigerating system or some specific portion of that system under designated operating conditions.

Coefficient of Performance (COP), heat pump –heating is the ratio of heat delivered to the rate of energy input, in consistent units, for a complete heat pump system, including the compressor and, if applicable, auxiliary heat, under designated operating conditions.

Energy Efficiency Ratio (EER) is the ratio of net cooling capacity in Btu/h to total rate of electric input in Watts under designated operating conditions.

Lighting Power Density (LPD) is the installed lighting power per unit area.

Proposed Building Performance is the annual energy cost calculated for a proposed design.

Solar Heat Gain Coefficient (SHGC) is the ratio of the solar heat gain entering the space through fenestration area to incident solar radiation. Solar heat gain includes directly transmitted solar heat and absorbed solar radiation, which is then re-radiated, conducted into the space.

U-value (thermal transmittance) is heat transmission in unit time through unit area of a material or construction and boundary air films, induced by unit temperature difference between the environments on each side.

Visible Transmittance (Tvis) is the ratio of total transmitted light to incident light. In other words, it is the amount of light passing through a glazing surface divided by the amount of light striking the glazing surface. A higher Tvis value indicates that a greater amount of incident light is passing through the glazing.

On-site Renewable Energy

EE Credit 2 **Points: 6**

Intent:

Promote self sufficiency in energy through renewable technologies for on-site power generation and use within the project.

Compliance Options:

For Individual Residential Unit:

Install renewable energy systems for atleast 5% of total connected load (or) total annual energy consumption of the building.

Points are awarded as below:

Renewable energy as a percentage of total connected load/ total annual energy consumption of the building	Points
≥ 5 %	2
≥ 10 %	4
≥ 15 %	6

For Multi-dwelling Residential Units:

Install renewable energy systems for atleast 2.5% of total connected load (or) total annual energy consumption of the building/ campus (includes interior, common and exterior areas).

Points are awarded as below:

Renewable energy as a percentage of total connected load/ total annual energy consumption of the building or campus	Points
≥ 2.5 %	2
≥ 5 %	4
≥ 7.5 %	6

Note:

- *Solar hot water systems cannot be considered as power generation source and cannot be subtracted from the total energy of the proposed case.*

Exemplary Performance:

This credit is eligible for exemplary performance under Innovation & Design Process, if:

- ❖ More than 20% of total annual energy consumption of the building is through renewable energy systems for Individual residential unit.
- ❖ More than 10% of total annual energy consumption of the building/ campus is through renewable energy systems for Multi-dwelling residential units.

Approach and Methodologies:

Consider the feasibility of installing renewable energy systems on site while determining the power requirement from the local utility. The following are the sources of renewable energy that can be considered under this credit: Solar energy, Wind energy, Biomass, Bio-gas etc.,

Picture 22: Photograph of solar PVs installed on-site for power generation

Picture 23: Photograph of on-site renewable energy generation

Assess the potential to generate power from renewable energy source based on the geographical location and climatic conditions. Estimate the annual energy requirement for the project and the appropriate renewable energy source. Today small renewable energy systems to source domestic requirements are available. These include hybrid systems such as a combination of solar and wind as well.

Notes:

- *Passive solar, solar hot water heating and daylighting will not be considered under this credit, as they do not generate power.*
- *The annual energy consumption met through installed renewable energy sources can be deducted from the over energy savings under EE Credit 1.*

Green Building Concerns:

- ❖ Use of renewable energy instead of fossil fuel–based energy can dramatically improve outdoor environmental quality.
- ❖ Energy production from traditional, fossil fuel–based sources is a significant contributor to air pollution, releasing such pollutants as sulfur dioxide, nitrogen oxide, and carbon dioxide, which have widespread and adverse effects on human health, especially respiratory health, and contribute to acid precipitation, smog, and concentrations of greenhouse gases.
- ❖ Although renewably generated electricity is not entirely benign, it greatly lessens the negative environmental impacts of power generation.

Benefits:

- ❖ Reduces the adverse environmental impacts caused by fossil fuel based energy production and use.
- ❖ Ensures energy security for the country.

Sample Calculations:

The intent is to generate power on-site through renewable resources. The calculation methodology involves estimation of the connected load/ annual energy consumption. Project can opt either of the two options shown below:

Option 1:

The total connected load for a typical 3-BHK flat include lighting loads, fans, air-conditioners and equipment loads. Assuming a 3BHK residential apartment with 10 dwelling units, the total connected load works out to be 600 kW. To show credit compliance, the project proposes to install solar photovoltaic having capacity of 15 kW. This accounts to 2.5% of total connected load. The sample filled-in template is shown below:

⊙ Option 1: Connected Load			
Total connected load of the project (including interior, common and exterior areas)		**(kW)**	**600**
Total capacity of installed on-site renewable energy systems		**(kW)**	**15**
Solar photovoltaics	Capacity	(kW)	15
Percentage			**2.5%**

Option 2:

Assuming a 3BHK residential apartment with 10 dwelling units, the annual energy consumption works out to be 26,28,000 kWh.To show credit compliance, the project proposes to install solar photovoltaics having 75,000 kW capacity. This accounts to 2.9% of annual energy consumption. The sample filled-in template is shown below:

⊙ Option 2: Annual Energy Consumption			
Total annual energy consumption of the project (including interior, common and exterior areas)		**(kWh)**	**26,28,000**
Total annual power generation through on-site renewable energy		**(kWh)**	**75,000**
Solar photovoltaics	Generation	(kWh)	75,000
Percentage			**2.9%**

CIR on Renewable Energy:

Project is requesting credit interpretation ruling for 'On-site Renewable Energy' credit, to consider total annual energy consumption instead of total connected load to show compliance under 'On-site Renewable Energy' (EE credit 2)

It can work either way. There have been instances when the RE requirement as calculated based on connected load is lower particularly when the building operates 24X7. When the operating hours are less, it may work out that rating based on annual consumption is lower.

It is correct that the space available is a constraint particularly in multi-dwelling units. The objective is to encourage developers and architects to design as much renewable energy as possible. Given the constraints of space, all residential project types registered under Version 2.0 can henceforth opt to calculate the RE requirement based on either the total connected load (OR) total annual energy consumption.

Documentation required:

Precertification Level

(Only for Multi-dwelling Residential Units)

- ❖ Narrative describing the proposed renewable energy systems.
- ❖ Proposed list of renewable energy systems with manufacturer details (make).
- ❖ Tentative calculations indicating total annual energy consumption of the project (kWh), capacity of the renewable energy system (kW) and energy generation from the renewable energy systems (kWh).
- ❖ Drawing showing the location of proposed renewable energy systems.
- ❖ Feasibility study report with technical details of the proposed renewable energy systems.

Certification Level

(For Individual Residential Units & Multi-dwelling Residential Units)

- Narrative describing the installed renewable energy systems.
- List of installed renewable energy systems with make and model.
- Calculations indicating total annual energy consumption of the project (kW), capacity of the renewable energy system (kW) and energy generation from the renewable energy systems (kWh).
- Drawing showing the location of installed renewable energy systems.
- Technical details of the installed renewable energy systems.
- Purchase invoice/ payment receipts of the installed renewable energy systems.

Related Mandatory Requirements & Credits:

- EE Mandatory Requirement 2 – Minimum Energy Performance (Renewable energy)
- EE Credit 1 – Enhanced Energy Performance (Renewable energy)

Solar Water Heating System

EE Credit 3 **Points: 4**

Intent:

Encourage use of solar energy for water heating applications in the building(s).

Compliance Options:

Provide solar water heating system to meet hot water requirement for domestic purposes. The minimum hot water requirement for domestic purposes should be considered as 20 liters per person per day.

Points are awarded as below:

Individual Residential Unit

Hot water through solar water heating system as a percentage of total hot water requirements of the building(s)	Points
≥ 50 %	2
≥ 95 %	4

Multi-dwelling Residential Units

Hot water through solar water heating system as a percentage of total hot water requirements of the building(s)	Points
≥ 25 %	2
≥ 50 %	4

Green Building Concerns:

- ❖ Use of solar energy instead of fossil fuel–based energy can improve outdoor environmental quality.
- ❖ Energy production from traditional, fossil fuel–based sources is a significant contributor to air pollution, releasing such pollutants as sulfur dioxide, nitrogen oxide, and carbon dioxide, which have widespread and adverse effects on human health, especially respiratory health, and contribute to acid precipitation, smog, and concentrations of greenhouse gases.

- Although renewably generated electricity is not entirely benign, it greatly lessens the negative environmental impacts of power generation.

Approach and Methodologies:

Calculate hot water requirement for the entire project. The use of high grade energy like electricity, which is generated after many conversions, is not an efficient method of heating water. Solar hot water systems can be effective even on a cloudy day.

Install solar water heating system, thereby catering to hot water requirement in the project. Standard sizes are available in the market. Select solar water heating systems considering the hot water requirement for the project and the availability of space to install the solar panels.

When a solar water heater replaces an electric water heater, the electricity bills are significantly reduced. The average life expectancy of solar water heating systems could be 10-15 years. Depending on the use, the typical payback period can be 2 to 4 years.

Benefits:

- Helps in substantially reducing energy bills and mitigating carbon emissions.

Sample Calculations:

The calculation methodology involves estimation of the hot water requirement for the project. Assuming a 3BHK residential apartment with 10 dwelling units, the hot water requirement at 20 liters/ day for 50 occupants works out to be 1,000 liters/ day. To meet the compliance, the project proposes to install solar water heating system having a capacity of 800 liters/ day which accounts to 80% of the total hot water consumption.

The sample filled-in template is shown below:

Hot water requirement/ person/ day	(liters)	20
Number of occupants		50
Total hot water requirement/ day	(liters)	1,000
Capacity of solar water heating system	(liters)	800
Percentage		**80.0%**

Documentation required:

Precertification Level

(Only for Multi-dwelling Residential Units)

- Narrative describing the proposed solar hot water system.
- Proposed list of solar water heating system with make and model.
- Tentative calculations indicating the total hot water requirement in the project (liters/ day) and capacity of the proposed solar hot water system (liters/ day).
- Conceptual drawings showing the location(s) of proposed solar hot water system.
- Technical details of the proposed solar hot water system. (Optional)

Certification Level

(For Individual Residential Units & Multi-dwelling Residential Units)

- Narrative describing the installed solar hot water system.
- List of installed solar water heating system with make and model.
- Calculations indicating the hot water requirement in the project (liters/ day) and capacity of the installed solar hot water system (liters/ day).
- Drawings showing the location(s) of installed solar hot water system.
- Technical details of the installed solar hot water system.
- Purchase invoice/ payment receipts of the installed solar hot water system.
- Photographs of the installed solar hot water system. (Optional)
- Schematic of plumbing design showing the hot water line.

Exemplary Performance:

For Individual residential unit, this credit is not eligible for exemplary performance under Innovation & Design Process.

For Multi-dwelling residential units, this credit is eligible for exemplary performance under Innovation & Design Process, if solar water heating system meets 75% of hot water requirement for domestic purposes.

Related Mandatory Requirements & Credits:

- SSP Credit 4 – Heat Island Effect, Roof (Roof area)
- WE Mandatory Requirement 2 – Water Efficient Plumbing Fixtures (Occupancy)
- WE Credit 4 – Water Efficient Plumbing Fixtures (Occupancy)
- MR Credit 1 – Organic Waste Management, Post Occupancy (Occupancy)

Energy Saving Measures in Appliances & Other Equipment

EE Credit 4 **Points: 2**

Intent:

Conserve energy in the use of house-hold appliances and other equipment, thereby reducing environmental impacts.

Compliance Options:

Individual Residential Unit: (2 points)

Provide any four of the following with minimum BEE 4-star rated or equivalent appliances:

- ❖ Ceiling Fans
- ❖ Electric geysers
- ❖ Refrigerators
- ❖ Television
- ❖ Washing machines (Semi-automatic/ Automatic)
- ❖ Pumps & Motors*
- ❖ Other rated appliances

* Where BEE star rating is not applicable, compliance can be shown through ISI certified Pumps & Motors

Multi-dwelling Residential Units: (2 points)

Provide any two of the following measures:

- ❖ Pumps: BEE 4-star rated Pumps (or) Minimum 60% efficiency for Pumps of capacity greater than 3 HP and ISI certified pumps for others
- ❖ Motors: BEE 4-star rated Motors (or) Minimum 75% efficiency for Motors of capacity greater than 3 HP and ISI certified motors for others
- ❖ Elevators operating with intelligent group controls
- ❖ Energy efficient parking garage exhaust system
- ❖ Other energy efficient equipment/ system

Green Building Concerns:

- ❖ Reduces carbon emissions into the atmosphere.

Approach and methodology

Determine the applications where energy saving measures can be adopted. There are number of areas in a residential dwelling where simple techniques can be implemented to save energy. Level controllers for water tanks, operating unitary air-conditioners in sleep mode are such simple examples. While selecting water pumps, motors, gas burners, etc., ensure that ISI labeled equipment is specified so that minimum efficiencies are guaranteed.

Conduct market survey before selecting appliances. Consider the energy efficiency of these appliances and select minimum BEE 4-star rated or equivalent appliances.

Benefits:

- Reduction in energy consumption, thereby reducing associated adverse environmental impacts.

Documentation Required:

Precertification Level

(Only for Multi-dwelling Residential Units)

- List of the proposed energy efficient appliances & other equipment in the project, with the energy efficiency parameters.
- Manufacturers' cut-sheets/ brochures of the proposed appliances & other equipment. (Optional)

Certification Level

(For Individual Residential Units & Multi-dwelling Residential Units)

- List of the installed energy efficient appliances & other equipment in the project, with the energy efficiency parameters.
- Purchase invoice/ payment receipts and manufacturer cut-sheets/ brochures of the installed appliances & other equipment.

Exemplary Performance:

This credit is not eligible for exemplary performance under Innovation & Design Process.

Related Mandatory Requirements & Credits:

There are no related mandatory requirements and credits.

Distributed Power Generation

Not applicable for Individual Residential Units

EE Credit 5 **Points: 2**

Intent:

Reduce dependence on fossil fuels for in-situ power generation.

Compliance Options:

Install hybrid distributed power generation sets which operate with both, bio-fuels/ non-edible oils/ any other non-fossil based fuel and fossil fuel catering to atleast 15% of the total annual energy consumption of the building.

These sets should comply with the Central Pollution Control Board (CPCB) requirements for emission and noise levels.

Notes:

- *Distributed Power Generation is an energy system based on interconnected small and medium size power generators.*
- *Hybrid DG sets are currently available in mid size ranges.*

Green Building Concerns:

- ❖ Energy production from traditional sources (such as coal, natural gas, and other fossil fuels) is a significant contributor to air pollution in India, releasing pollutants such as sulfur dioxide, nitrogen oxide, and carbon dioxide.
- ❖ These pollutants are primary contributors to acid rain, smog, and climate change.
- ❖ Along with other associated pollutants, they have widespread and adverse effects on human health, especially respiratory health.

Approach and Methodologies:

The use of fossil fuels like diesel for power generation –have a variety of impacts - the depletion of fossil fuels, low efficiencies and the associated emissions. Hybrid power generation sets operating on both bio-fuels and non-edible oils are now available with reputed manufacturers. Bio-fuels are renewable and fuels such as bio ethanol & bio diesel are cleaner fuels. Importantly, they may be easier to commercialise than other forms of energy since they can be stored and distributed using existing infrastructure.

Survey the market for available captive power generators which operate on bio-fuels or non-edible oils and diesel generator sets, which are CPCB compliant for emissions and noise. Estimate the capacity of the generator sets required for the project. Also, consider availability of bio-fuels on a sustained basis and economic viability of the system.

Picture 24: Photograph of hybrid DG set

Benefits:

- ❖ Reduce emissions of greenhouse gases

Sample Calculations:

The calculation methodology involves estimation of total connected load of the project. Assuming a residential project having 10, 3-BHK flats the total connected load of the project works out to be 600 kW. To meet the credit compliance the project proposes to install a hybrid DG set having a total capacity of 250 kVA. This amounts to providing hybrid DG sets for 33.3% of the total connected load. The sample filled-in template is shown below:

Total connected load of the project (includes interior, exterior & common areas)	(kW)	**600**

Details of proposed DG sets:

Rated Capacity of DG set (kVA)	Number of DG units	Total capacity (kVA)
250	1	250

Total capacity (kVA)	250
Total capacity (kW) (Please convert kVA to kW)	250

Total rated capacity of the generator sets (Value is taken from cell E25 of this sheet)	**200**
Percentage	**33.3%**

Documentation Required:

Precertification Level

(Only for Multi-dwelling Residential Units)

- Narrative describing the proposed hybrid distributed power generation system, with make and model.
- Tentative calculations indicating the total annual energy consumption per day (kW) of the project and capacity of the proposed hybrid distributed power generation system (kW).
- Manufacturer cut-sheets/ brochure of the proposed hybrid generator system showing technical specifications and compliance with the CPCB norms for emission and noise levels. (Optional)

Certification Level

(For Multi-dwelling Residential Units):

- Narrative describing the installed hybrid distributed power generation system, with make and model.
- Calculations indicating the total annual energy consumption per day (kW) of the project and capacity of the installed hybrid distributed power generation system (kW).
- Manufacturer cut-sheets/ brochure of the installed hybrid generator system showing technical specifications and compliance with the CPCB norms for emission and noise levels.
- Purchase invoice/ payment receipts of the installed hybrid generator system.

Exemplary Performance:

This credit is not eligible for exemplary performance under Innovation & Design Process.

Related Mandatory Requirements & Credits:

There are no related mandatory requirements and credits.

Energy Metering

Not applicable for Individual Residential Units

EE Credit 6 **Points: 1**

Intent:

Encourage continuous monitoring to enhance the energy performance of residential dwelling unit(s).

Compliance Options:

Provide energy meters for any three of the following, as applicable:

- Energy meter for external lighting
- Energy meter for municipal water pumping
- Energy meter for grey water pumping for flushing
- Energy meter for water pumping for landscaping
- Btu Meter for chilled water consumption

Green Building Concerns:

- Measurement and verification of a building's ongoing energy use optimize performance and minimize the economic and environmental impacts associated with its energy-using systems.
- Implementation of metering can help ensure accountability and contribute to realizing optimal energy performance.

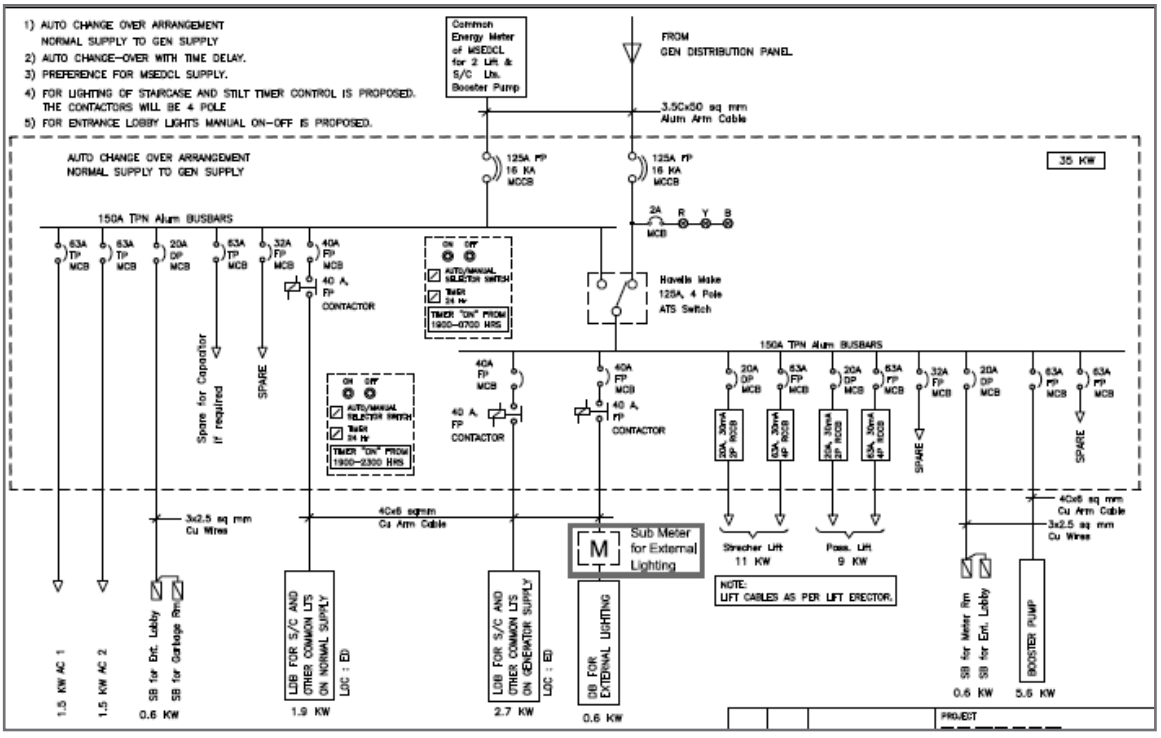
Approach & Methodologies:

Identify all the major energy consuming equipment and install systems to monitor energy consumption. Develop and implement a measurement & verification mechanism to compare predicted savings to actual energy performance of the installed meters.

Benefits:

- Reduction in energy consumption, thereby reducing associated adverse environmental impacts.

Picture 25: Photographs showing the energy meters installed



Picture 26: Single Line Diagram highlighting the proposed energy meters

Documentation Required:

Precertification Level

(Only for Multi-dwelling Residential Units)

- ❖ Narrative describing the proposed energy metering system/ equipment in the project.
- ❖ Single line drawing showing the proposed energy metering system/ equipment. (Optional)

Certification Level

(For Multi-dwelling Residential Units)

- ❖ Narrative describing the installed energy metering system/ equipment in the project.
- ❖ Single line drawing showing the installed energy metering system/ equipment.
- ❖ Purchase invoice/ payment receipts and manufacturer cut-sheets/ brochures of the installed energy meters.

Exemplary Performance:

This credit is not eligible for exemplary performance under Innovation & Design Process.

Related Mandatory Requirements & Credits:

There are no related mandatory requirements and credits.

Materials & Resources

Introduction

Building materials consume a significant amount of energy right from the process of extraction of raw materials to transportation to the construction site. Optimizing the embodied energy in materials plays a significant role in sustainability as activities related to raw material extraction often result in habitat loss and degradation of land & pollution. Materials and Resources section addresses the environmental concerns relating to materials selection, waste disposal and construction waste reduction.

Homes generate a large amount of house-hold waste on daily basis. Disposing such waste properly is critical as otherwise it would arise hygiene and disposal issues

The Materials & Resources section encourages segregation of waste at house hold level and diversion of construction waste from landfills at site levelwhile improving the building environment through responsible waste management and material selection.

One of the most effective strategies to reduce the negative impact to the environment is to reduce the consumption of virgin raw materials, by reusing and recycling materials. It is important to consider variousalternative materials in order to reduce dependency on virgin materials.

Other interventions could be to design with local materials, materials with recycled content, extending the life of the salvaged materials. Selection of salvaged materials can substitute new materials which reduce emissions due to extraction of raw materials.The use of materials extracted and manufactured locally help reduce the energy required for transportation and also may add a vernacular identity to the home.

The green home also encourages to promote rapidly renewable materials such as bamboo, eucalyptus, bagasse and certified wood for all wood applications in the home. The advantage of rapidly renewable materials is that they can be harvested in a cycle of ten years, which would significantly add to the sustainability quotient of a home.

Separation of House-holdWaste

MR Mandatory Requirement 1

Intent:

Facilitate segregation of house-hold waste at source so as to prevent such waste being sent to land-fills.

Compliance Options

For Individual Residential Unit:

Provide separate bins to collect dry waste (paper, plastic, metals, glass, etc.,) and wet waste (organic).

For Multi-dwellingResidential Units:

Provide separate bins to collect dry waste (paper, plastics, metals, glass, etc.,) and wet waste (organic) at each dwelling unit and common areas (as applicable) in the building(s)/ campus.

Additionally, provide a common facility with separate bins to collect waste which should cover the following, including dry and wet waste bins:

- Batteries
- 'e' waste
- Lamps

Green Building Concerns:

- The recycling industry needs to be encouraged. Recycling of paper, metals, glass, cardboard, and plastics reduces the need to extract virgin natural resources. For example: recycling 1 ton of paper prevents the processing of 17 trees and saves 81 cubic feet of landfill spaces
- Many a time, waste collection and recycling is not accorded due importance. By creating convenient collection and segregationfacilities the mindsets and behavioral patterns can be changed
- Identifying landfills poses a problem to the Governments and society.
- Diverting waste from landfills can help minimise land, water and air pollution

Approach and Methodologies:

Segregation of waste at source is one of the major issues in handling of domestic waste. By effective segregation, waste materials which are likely to be dumped in landfillscan be converted into value added products. Therefore, every household should be encouraged to segregate the waste generated within.

Allocate suitable space on-site for sorting out dry and wet waste. The best way to reduce the volume of waste materials is to reduce and reuse materials before recycling. Examine the scope for recycling of waste collected from the project. Identify local dealers to collect and dispose waste material such as paper, plastic, metals, glass, cardboard, organic waste, batteries, 'e' waste and lamps. In multi-dwelling units, a centrally accessible area can be earmarked to store such segregated waste. This would make it easy for municipalities to collect and utilise the domestic waste.

Educate residents and maintenance personnel about various recycling and disposal methods, during post occupancy.For example, the building occupants can reduce the generation of waste volumes by reusing bottles, jute bags, containers, etc.,

Benefits:

- Reduces the burden on landfills
- Encourages the manufacturing industry to re-utilise waste materials Facilitates local municipal corporations to generate power from waste

Documentation Required:

Precertification Level

(Only for Multi-dwelling Residential Units)

- Narrative describing the strategies to be implemented to segregate and divert dry & wet waste fromthe easily accessible common facility.
- Conceptual plan showing the location of proposed waste bins at individual level.
- Provide a narrative stating how the segregated waste (dry &wet) will be collected at individual house-hold level. Also, provide strategies to be implemented todispose the other waste such as batteries, e-waste and lamps from the common facility.
- Conceptual plan showing location of the easily accessible common facility.

Certification Level

(For Individual Residential Units)

- Narrative describing the strategies implemented to segregate and divert dry & wet waste.
- Plan showing the location of waste bins.

(For Multi-dwelling Residential Units)

- Narrative describing the strategies implemented to segregate and divert dry & wet waste from the easily accessible common facility.
- Plan showing the location of waste bins at individual level.
- Provide a narrative stating how the segregated waste (dry&wet) will be collected at individual house-hold level. Also, provide strategies implemented todispose the other waste such as batteries, e-waste and lamps from the common facility.
- Plan showing location of the easily accessible common facility.

Definitions:

Landfill is a waste disposal site for the deposit of solid waste from human activities.
Recycling is the collection, reprocessing, marketing and use of materials that were diverted or recovered from the solid waste stream
Reuse is a strategy to return materials for active use in the same or a related capacity.

Case Study of House hold waste segregation:

One of the residential project has implemented a waste management plan where all the residents were provided 2 waste segregation bins and to segregate all domestic and solid waste generated into
a) wet / organic waste b) dry waste and put into the appropriately labeled bins.
The wet or organic waste was collected andsegregated into organic waste and non-decaying waste, of these; the organic waste was taken to the roof and put into the bins, which would be converted into manure over a period of 20 days. The manure is used for gardening and the excess manure is donated.
The dry waste was removed by the facilities management team, which was further segregated into paper, metal, glass and plastic. A local recycler was identified and contracted to remove the segregated dry waste on a weekly basis.

Organic Waste Management, Post-occupancy

MR Credit 1 **Points:2;4**

Intent:

Ensure effective organic waste management, post-occupancy, so as to prevent waste being sent to land-fills.

Compliance Options:

For Individual Residential Units: (2 points)

Install on-site waste treatment system for treating 95% organic waste generated from the building. The output from such systems like manure, power, etc., should be reused in-situ.

For Multi-dwelling Residential Units: (4 points)

Install on-site waste treatment system for treating atleast 50% organic waste generated from the building(s). The output from such systems like manure, power, etc., should be reused in-situ.
Points are awarded as below:

Percentage of treated organic waste	Points
≥ 50%	2
≥ 95%	4

Notes:

- *Organic waste includes household kitchen and garden waste.*
- *The number of permanent occupants has to be considered as two persons each for first two bed rooms, and one additional person for each additional bedroom.*
- *Default organic waste quantity per person per day can be considered as 0.25 kgsor as prescribed by the local bye-law, whichever is more stringent.*

Green Building Concerns:

- ❖ Individual homes and apartments still do not have waste segregation and disposal strategies. Segregating and treating the organic waste will reduce the load on municipal infrastructure.

Approach and Methodologies:

A significant percentage of house-hold waste generated by residential communities is initially dumped at nearby community bins. This is further diverted to notified landfill sites. These landfills / dumping sites have significant health impacts on community and environment, as they become breeding places for harmful bacteria and attract diseases. Also, the garbage from dumping sites may enter water bodies during monsoon and pollute the receiving streams. Therefore, residents must be encouraged to segregate dry & wet waste at individual dwelling unitlevel, post occupancy.

Based on the organic waste generated, the project can propose suitable capacity of the organic waste treatment plant, to efficiently manage the waste. Designate / demarcate a common space on-site to adopt possible technologies to treat organic waste generated. Typical treatment systems that can be considered include organic waste converters, in-vessel composting, vermi-composting and kumbhas.

Waste materials such as plant debris, food waste, paper products and other wastes that are organic in nature can be recycled using biological composting and digestion processes which decompose the organic matter. Explore a variety of composting & digestion methods which vary in complexity from simple home compost heaps to large-scale enclosed-vessel digestion of mixed domestic waste.

High-rise apartments and gated communities can explore utilising the organic waste for bio-gas plants to generate methane gas which in turn can be reused in household kitchens. Also, the output from these treatment plants can be used as mulch or compost which can be used for landscaping purposes.

Picture 27: Photograph showing the vermi-composting bins

Benefits:

- ❖ Reduces the requirement for fertilisers. The soil is also enriched with nutrients
- ❖ Use of bio-gas plants can reduce the dependence on conventional LPG for household purposes
- ❖ Minimises haulage of such wastesto long distance landfill sites

Sample Calculations:

The estimated quantity of organic waste generated in the project is based on the number of occupants. Assuming a residential project having 10 numbers of 3 BHK dwelling units (5 persons/dwelling unit) 50 occupants. The organic waste generated would be (50 x 0.25kg) 13 kg. To meet the credit compliance, the project proposes to install an organic waste treatment system on-site having capacity of 10 kgs, thereby treating 80% of organic waste generated.

The sample filled-in template is shown below:

Quantity of organic waste generated in the project per day	**(kg)**	**13**
Number of occupants		50
Organic waste (kitchen waste) generated per day	(kg)	0.25
Capacity of organic waste treatment system	(kg)	**10**
Percentage		**80.0%**

Documentation Required:

Precertification Level

(Only for Multi-dwelling Residential Units)

- ❖ Narrative describing the proposed organic waste treatment system.
- ❖ Site plan highlighting the location of proposed on-site organic waste treatment system.
- ❖ Tentative calculations indicating the amount of organic waste (kitchen waste) generated and treated.
- ❖ Narrative describing the proposed strategies to handle garden waste, as applicable.
- ❖ Manufacturer brochure of the proposed organic waste treatment system, as applicable. (Optional)

Certification Level

(For Individual Residential Units & Multi-dwelling Residential Units)

- ❖ Narrative describing the installed organic waste treatment system.
- ❖ Site plan highlighting the location of installed on-site organic waste treatment system.
- ❖ Detail calculations indicating the amount of organic waste (kitchen waste) generated and treated.
- ❖ Narrative describing the strategies implemented to handle garden waste, as applicable.
- ❖ Manufacturer brochure/ cut-sheet of the installed organic waste treatment system, as applicable.
- ❖ Purchase invoice/ payment receipts of the installed organic waste treatment system.
- ❖ Photographs showing the installed organic waste treatment system.

Exemplary Performance:

This credit is not eligible for exemplary performance under Innovation &Design Process.

Related Mandatory Requirements & Credits:

- ❖ WE Credit 4 – Water Efficient Plumbing Fixtures (Occupancy)
- ❖ EE Credit 3 – Solar Water Heating System (Occupancy)

Definition:

Mulch is organic waste, grass, hay, straw or gravel placed on the soil surface to cover and hold soils.

Handling of Construction Waste Materials

MR Credit 2 **Points: 1; 2**

Intent:

Encourage practices to manage construction waste, thereby, avoiding waste being sent to land-fills.

Compliance Options:

Avoid atleast 50% of the waste generated (by either weight or volume) during construction from being sent to landfills.

Points are awarded as below:

Percentage of Construction Waste Materials Handled	Points for Individual Residential Unit	Points for Multi-dwelling Residential Unit
≥ 50%	1	1
≥ 95%	-	2

Note:

- *Excavated earth & stones should not be considered under this credit.*

Green Building Concerns:

- ❖ Post occupancy, the debris is diverted to landfills. Many a time, useful materials are also sent along with the debris. The Ministry of Urban Development, Government of India estimates that 10-12 million tons of such debris is generated annually, through construction activity.
- ❖ Extending the lifetime of existing landfills through effective construction waste management can avoid the need for expansion or new landfill sites.

Approach and Methodologies:

Construction and demolition works generate enormous quantities of waste. Diversion to landfill sites is one of the major issues in handling of construction waste. By proper disposal, waste materials which are likely to be dumped in landfillscan be converted into value added products.

Designate a specific area on-site to collect and segregate possible construction waste for later reuse in the site, diversion to other construction site, selling to scrap vendors, etc.,

Collect all construction debris generated on-site. Segregate these waste based on their utility. Explore methods of reusing such waste within the project/ other projects, (or) identify appropriate vendors to divert such waste to manufacturing units which would use them as raw materials. Typical construction debris in residential projects include broken bricks, steel bars, mortar/plaster waste, concrete waste broken tiles, glass, wood waste, paint cans, cement bags, packing materials, etc.,

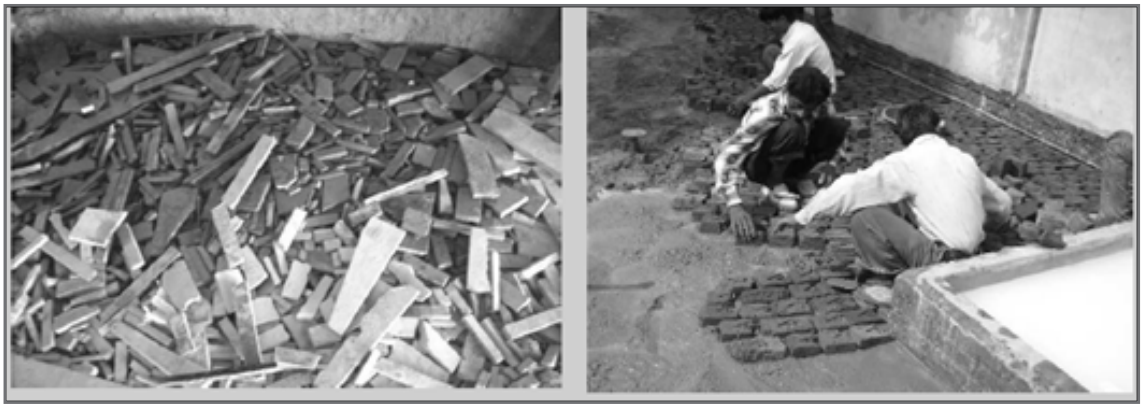
Develop an effective construction waste management plan which addresses strategies such as Reduce, Recycle, Reuse and Donation.

For example:

1. Broken bricks, broken tiles, concrete / cement mortar waste can be reused for backfill or leveling purposes within the site.
2. Steel scrap, broken glass, aluminum waste, paint cans can be sold to scrap vendors who will reuse for manufacturing process.
3. Shuttering waste which has served the purpose in the proposed project can be sent or donated to other projects.Train site workers on recycling procedures and display signages in native language at all waste segregation areas on site.

Set up a monthly reporting and feedback on waste management plan to assess progress and track recycling efforts. It is important to note that sand and stones excavated from site are considered as natural resources available on site and they should not be treated as construction waste.

Picture 28: Picture of Segregation of scrap steel&Broken Bricks



Picture 29: Picture of tile scrap & broken bricks being used for brickbat coba

Benefits:

- ❖ Reduces the burden on landfills and associated environmental impacts
- ❖ Reduces impacts associated with resource extraction & processing
- ❖ Facilitates conservation of virgin materials
- ❖ Better waste management contributes towards mitigating the effects of global climate change.

Sample Calculations:

The calculation methodology involves estimation of the construction waste generated during the construction process e.g.: steel, concrete, paint cans, vitrified tiles, etc., According to the intent of the credit, the project must divert the generated waste from being sent to landfills. The strategies to divert such waste include reuse within the site, selling to scarp dealers for recycling process and donate to construction sites. Assuming a 3BHK residential project having 10 dwelling units; the estimated quantity of construction debrisgenerated is 13,050 kg. To meet the credit compliance, the project proposes to reuse, recycle and selling to recycler for 12,500 kgs of waste generated on the site. This shows that 95.8% of construction waste generated on-site has been diverted.

The sample filled-in template is shown below:

Construction Material	Units (Metric) (Please choose from dropdown below)	Quantity of Waste			Please Select Diversion Category (Please choose from dropdown below)	Reuse/ Recycle Application
		Generated	Reused / Recycled	Sent to Land-fills		
Steel	kg	2,000	2,000	0	Reuse/ Recycle	Sold to supplier
Cement bags	kg	400	400	0	Reuse/ Recycle	Onsite application
Ceramic tiles	kg	600	600	0	Reuse/ Recycle	Onsite application
Glass	kg	350	350	0	Reuse/ Recycle	Sold to supplier
Timber	kg	1,750	1,750	0	Reuse/ Recycle	Onsite application
Concrete debris	kg	4,500	4,500	0	Reuse/ Recycle	Onsite application
AAC blocks	kg	1,900	1,900	0	Reuse/ Recycle	Onsite application
MS pipes	kg	1,000	1,000	0	Reuse/ Recycle	Sold to supplier
Mixed waste	kg	550	0	550	Reuse/ Recycle/ Landfill	Landfill
Total	kg	13,050	12,500	550		
Percentage						**95.8%**

Typical onsite reuse of construction debris includes but is not limited to:

- Backfill
- Concrete debris is typically used for leveling and road soling
- Broken brickbats/masonry blocks are reused on the terrace as koba
- Broken tiles are reused for china mosaic on the terrace or for flooring in the service areas.

Documentation Required:

Precertification Level

(Only for Multi-dwelling Residential Units)

- ❖ Narrative describing the strategies to be implemented to handle construction waste. The strategies shall include the following:
  - ➢ List of construction waste materials likely to be generated and diverted for reuse, recycle & land-fill.
  - ➢ Proposed applications of construction waste materials diverted for reuse, within or outside the project.

- ❖ Site plan highlighting the proposed construction waste management yard.
- ❖ Tentative calculations indicating the amount of waste generated, reused, recycled and sent to landfill, either by weight or volume. (Optional)

Certification Level

(For Individual Residential Units & Multi-dwelling Residential Units)

- ❖ Narrative describing the strategies implemented to handle construction waste. The strategies shall include the following:
  - ➢ List of construction waste materials generated and diverted for reuse, recycle & land-fill.
  - ➢ Applications of construction waste materials diverted for reuse, within or outside the project.
- ❖ Site plan highlighting the construction waste management yard.
- ❖ Calculations indicating the amount of waste generated, reused, recycled and sent to landfill, either by weight or volume.
- ❖ Photographs showing the construction waste management.

Exemplary Performance:

This credit is not eligible for exemplary performance under Innovation &Design Process.

Related Mandatory Requirements & Credits:

- ❖ MR Credit 3 – Reuse of Salvaged Materials (List of materials)
- ❖ MR Credit 4 – Materials with Recycled Content(List of materials)
- ❖ MR Credit 5 – Local Materials (List of materials)
- ❖ MR Credit 6 – Rapidly Renewable Building Materials & Certified Wood (List of materials)

Definitions:

A Landfill is a waste disposal site for the deposit of solid waste from human activities.

Recycling is the collection, reprocessing, marketing and use of materials that were diverted or recovered from the solid waste stream

Reuse of Salvaged Materials

MR Credit 3 **Points: 2; 4**

Intent:

Encourage the use of salvaged building materials and products to reduce the demand for virgin materials thereby, minimising the impacts associated with extraction and processing of virgin materials.

Compliance Options:

Ensure atleast 2.5% (or) 1% of the total building materials (by cost), used in the building(s)/ campus,are salvaged, refurbished and reused.

Points are awarded as below:

Individual Residential Units

Percentage of salvaged materials reused	Points
≥ 2.5%	1
≥ 5%	2

Multi-Dwelling Residential Units

Percentage of salvaged materials reused	Points
≥ 1%	2
≥ 2%	4

Notes:

- *Material Cost = Total Cost – (Labour Cost + Installation Cost).*
- *If Labour and Installation cost is not known, the default material cost can be considered as 60% of the total cost of the component.*
- *Cost of electrical, mechanical & plumbing - equipment, systems & appliances and movable materials &furniture should not be considered in the total material cost.*
- *Movable materials & furniture should not be considered under this credit.*

Green Building Concerns:

- ❖ Salvaging useful materials is seldom seen as an option. This needs change in mindsets and the willingness to explore. Reuse strategies divert material from the construction waste stream, reducing the need for landfill space and associated environmental impacts Salvaged materials can sometimes be costlier. There is a need to develop this industry

Approach and Methodologies:

Identify opportunities to incorporate salvaged materials into building. Consider using salvaged materials for applications such as bricks, beams & posts, doors, flooring, frames, paneling, steel railings, etc.,Study the durability, performance and environmental concerns with the use of such salvaged or refurbished materials.

Develop a strategy for reuse of salvaged or refurbished materials in the design stage of the project. If a project is shifting from an existing building to the new construction, Identify other sources for salvaged or refurbished building materials & products.

Note:

The salvaged materials can vary in availability, quality and uniformity. Ensure that materials are available to satisfy the project needs before specifying them.

Examples of reuse of salvaged materials

Reuse of packing wood | Reuse of 100 years old door frame | Reuse of salvaged tyres

Picture 30: Photographs showing reuse of salvaged materials

Benefits:

- ❖ Eliminates energy use and associated pollution that result from extraction of virgin resources& production of building materials.
- ❖ Reduces waste diverted to landfills and their associated negative environmental impacts.
- ❖ Few salvaged materials may have low embodied energy and also mayhave historical significance.

Sample Calculation:

Total construction cost (A)	**Rs 160,973,011**
Default total materials cost (60% of Total construction cost) (in case the actual materials cost is not available)	**Rs 9,65,83,807**

Salvaged Material	Quantity		Salvaged Material Cost		Application Areas in the Project	Information Source (Please choose from dropdown)
	Number	Units (Metric)	Cost per unit (Rs)	Total Cost (Rs)		
Steel	12	Tons	40,000	4,80,000	Pergolas on terrace	Vendor letter
SS 316 railing	75	Rmts*	20,000	15,00,000	Staircase	Vendor letter
Steel	5	Tons	40,000	2,00,000	Fire staircase	Vendor letter
Broken glazed tiles	2,000	Sq.m	250	5,00,000	Terrace china mosaic	Vendor letter
Granite sills	1,000	Rmts*	1,000	10,00,000	Window sills	Vendor letter
Railway sleeper wood	5	Tons	35,000	1,75,000	Panelling	Vendor letter
GI framing of false ceiling	200	Sq.m	250	50,000	Reception	Vendor letter
Total value of salvaged material						**39,05,000**
Percentage						**4.0%**

Rmts* - Running meters

Documentation Required:

Precertification Level

(Only for Multi-dwelling Residential Units)

- Narrative describing the proposed strategies implemented to source and reuse salvaged materials. The strategies shall include the following:
  - List of the proposed salvaged materialsand their applications.
  - Source of proposed salvaged material.
- Tentative calculations indicating the percentage of salvaged materials (in terms of cost) sourced by the project. (Optional)

Certification Level

(For Individual Residential Units & Multi-dwelling Residential Units)

- Narrative describing the strategies implemented to source and reuse salvaged materials. The strategies shall include the following:
  - List of the salvaged materialsand their applications.
  - Source of salvaged material.
- Calculations indicating the percentage of salvaged materials (in terms of cost) sourced by the project.
- Purchase invoice/ payment receipts from vendors confirming supply of salvaged materials to the project.
- Photographs showing the salvaged materials used (before & after).

Case Study of using Salvaged Materials:

Assuming a project with approximate built-up area of about 10,000 sqm, the following salvaged materials are been used in the green home design.

- Steel girders bought from recyclers used for constructing pergolas or trellis on the roof
- Steel bought from recyclers used to fabricate fire escape staircase
- 230mm wide pre-used granite strips bought from vendor used to make window sills
- Railway sleeper wood bought at auction used for wall paneling in the club house

Exemplary Performance:

This credit is eligible for exemplary performance under Innovation & Design Process.

For Individual Residential Units, more than 7.5% of the total building materials (by cost) used in the building must be salvaged, refurbished and reused.

For Multi-dwelling Residential Units, more than 3% of the total building materials (by cost) used in the building(s)/ campusmust be salvaged, refurbished and reused.

Related Mandatory Requirements & Credits:

- MR Credit 5 – Local Materials (Total materials cost & Material cost)
- MR Credit 6 – Rapidly Renewable Building Materials & Certified Wood (Total materials cost & Material cost)

Definitions:

Salvaged materials are construction materials recovered from existing buildings or construction sites and reused in other buildings. Commonly salvaged materials include structural beams & posts, flooring, doors, brick and decorative items.

Materials with Recycled Content

MRCredit 4 **Points:2**

Intent:

Encourage use of materials which contain recycled content to reduce environmental impacts associated with the use of virgin materials.

Compliance Options:

Use materials with recycled content such that the total recycled content constitutes atleast 15% of the total cost of the materials used in the building(s)/ campus.

Points are awarded as below:

Percentage of Materials with Recycled content	Points
≥ 10%	1
≥ 20%	2

Notes:

- *Material Cost = Total Cost – (Labour Cost + Installation Cost)*
- *If Labour and Installation cost is not known, the default material cost can be considered as 60% of the total cost of the component*
- *Cost of electrical, mechanical & plumbing - equipment, systems & appliances and movable materials &furniture should not be considered in the total material cost*

Approach and Methodologies:

Survey the materials with recycled content and locate such local suppliers. Often, projects mis-interpret recycled materials for recyclable materials. Recycled materials are building products that include raw materials that have recycled content. These materials are processed off-site vis-à-vis recyclable materials are building products that may not have recycled content in its product composition but have the capability of being used again. Typical examples for materials with recycled content include aluminum, cement, composite wood, concrete, glass, gypsum, false ceiling,fly ash blocks, steel, tiles, etc.,

Post-consumer recycled content is derived from materials that can no longer be used for their original purpose, and pre-consumer recycled content consists of raw material diverted from the waste stream during the manufacturing process.

Although the use of both types of recycled content is encouraged, postconsumer recycled content is accorded greater value because of its increased environmental benefit over the life cycle of the product.

Recycled content could be in the form of post-consumer or postindustrial. During construction, it has to be ensured that actual materials installed are those that were specified in the contract documents. Also, identify local suppliers for such materials so that additional costs due to transportation can be reduced. If the project procures recycled materials which are manufactured locally, then such recycled materials can also be applied to Materials credit 5 – Local Materials.

A good approach would be to prepare a Mastermaterial data sheet listing out all the materials used in the project and then identify materials with a recycled content to them.

While selecting materials withrecycled content ensure that they perform equally or better than virgin materials in terms of strength, maintenance and durability. A variety of materials with recycled contentmay be specified, some examples include:

1. **Structural frame work:**

   Steel typically has a recycled content that can vary from 25% to as high as 90% (if the steel is manufactured with the Electric Arc Furnace Process)

   Cement used in the concrete, plaster and mortar may have flyash, (recycled material)

2. **Building Envelope Construction:**

   Glass, AAC blocks, concrete blocks and flyash bricks have a high recycled content

3. **Interior Finishing:**

   Vitrified tiles, ceramic tiles and gypsum boards typically have a recycled content that may vary from 5% to 15%.

Often, the scrap that is generated during manufacturing process is reutilised / reclaimed within the same process that generated it. It is important to note that recycled content excludes such scrap used in back process.

Sample Calculations:

The calculation methodology involves estimation of the total materials cost for the project. To show compliance the project proposes to source materials with recycled content for 21.4% of total materials cost (i.e. Rs 9,65,83,807). The materials with recycled content include concrete, reinforcement, brick work, rough plaster, neeru plaster, plaster of paris-ceiling, plaster of paris-wall, tiling, aluminum works and glass work railing. The sample filled-in template is shown below:

Total construction cost (A)	**Rs 160,973,011**
Default total materials cost (60% of Total construction cost) (in case the actual materials cost is not available)	**Rs 9,65,83,807**

Material/ Product Name	Manufacturer Name	Quantity		Material/ Product Cost		Percentage of Recycled Content	Recycled Content Value (Rs)	Information Source (Please choose from dropdown)
		Number	Units (Metric)	Cost per Unit (Rs)	Total Cost (Rs)			
Concrete	ACC limited	1,67,892	cu.ft	99	1,66,21,308	20.00%	33,24,262	Mnf letter
Reinforcement	Bhagyalakshmi rolling limited	5,39,653	kg	51	2,75,22,303	35.00%	96,32,806	Others
Brick work (6" flyash blocks)	Ashtech Pvt Ltd	1,33,625	sq.ft	45	60,13,125	70.00%	42,09,188	Mnf letter
Rough plaster	ARCAT	2,05,576	sq.ft	5	10,27,880	15.00%	1,54,182	Others
Neeru plaster	ARCAT	35,976	sq.ft	7	2,51,832	15.00%	37,775	Others
POP-ceiling	A.B. Enterprises	71,952	sq.ft	12	8,63,424	15.00%	1,29,514	Others
POP-wall	A.B. Enterprises	1,33,625	sq.ft	11	14,69,875	15.00%	2,20,481	Others
Tiling	Nitco	1,38,764	sq.ft	100	1,38,76,400	13.00%	18,03,932	Mnf letter
Aluminium windows	Ken Designers	25,697	sq.ft	190	48,82,430	15.00%	7,32,365	Others
Glass work railing	Asahi India Glass	1,02,788	sq.ft	12	12,33,456	35.00%	4,31,710	Mnf letter
Total recycled content value							**(Rs) 2,06,76,213**	
Percentage							**21.4%**	

Benefits:

- Eliminates energy use and associated pollution that result from extraction of virgin resources& production of building materials.
- By diverting recyclable materials, construction waste volumes are reduced, that would otherwise be deposited in a landfill.

Documentation Required:

Precertification Level

(Only for Multi-dwelling Residential Units)

- Narrative describing the proposed strategies to be implemented to source materials with recycled content. The strategies shall include the following:
  - List of proposed materials specifying approximate recycled content.
  - List of proposed manufacturers to source materials with recycled content.
- Tentative calculations indicating the percentage of recycled materials (in terms of cost) with respect to the total materials cost of the project. (Optional)

Certification Level

(For Individual Residential Units & Multi-dwelling Residential Units)

- Narrative describing the strategies implemented to source materials with recycled content. The strategies shall include the following:
  - List of materials specifying recycled content.
  - List of manufacturers to source materials with recycled content.
- Calculations indicating the percentage of recycled materials (in terms of cost) with respect to the total materials cost of the project.
- Manufacturer letters/ cut-sheets/ brochures indicating the recycled content in the materials sourced.

Exemplary Performance:

This credit is eligible for exemplary performance under Innovation & Design Process, if more than 30% of the total building materials (by cost) used in the building(s)/ campusarewith materials with recycled content.

Related Mandatory Requirements & Credits:

- MR Credit 5 – Local Materials (Total materials cost & Material cost)

Local Materials

MR Credit 5 Points: 2

Intent:

Encourage use of building materials available locally thereby minimising theassociated environmental impacts resulting from transportation.

Compliance Options:

Ensureatleast 50%of the total building materials(by cost), used in the building(s)/ campus,aremanufactured within a distanceof 400km.

Points are awarded as below:

Percentage of local materials	Points
≥ 25%	1
≥ 50%	2

Notes:

- *Material Cost = Total Cost – (Labour Cost + Installation Cost)*
- *If Labour and Installation cost is not known, the default material cost can be considered as 60% of the total cost of the component*
- *Cost of electrical, mechanical & plumbing - equipment, systems & appliances and movable materials &furnitureshould not be considered in the total material cost*
- *Manufacturing refers to the final assembly of components into the building product that is furnished and installed by the tradesmen.*
- *Local materials are those which are assembled as a finished product within 400 km distanceof the project site. Assembly here does not include on-site assembly, erection or installation of finished components, as in structural steel, miscellaneous iron or systems furniture.*

Green Building Concerns:

- ❖ Trucks, trains, ships, and other vehicles deplete finite reserves of fossil fuels and generate air pollution; some of the raw materials used to manufacture building products are harvested or extracted far from the point of manufacture, also contributing to air and water pollution associated with transportation.

Approach and Methodologies:

The procurement of local building materials will reduce the transportation costs for the project. The availability of locally manufactured building materials is dependent on project location. In many cases, majority of building materials can be obtained within 400 km distance.

Survey and identify building materials which are in the specified distance, in early stages of project design. At times, raw materials for few building products are harvested or extracted far from the point of manufacture, and is likely to create air and water pollution due to transportation between point of extraction and point of manufacture. Therefore, it is recommended to source materials which are extracted and manufactured, locally.

A good approach would be to prepare a mastermaterial data sheet listing out all the materials used in the project and then identify which of the materials are manufactured locally and specify the same.

While selecting local materials, ensure that they perform better in terms of strength, maintenance and durability.

Benefits:

- ❖ Encourages vernacular architecture
- ❖ The support of regional manufacturers and labor forces retains capital in the community, contributing to a more stable tax base and a healthier local economy, as well as showcases the resources and skills of the region.

Sample Calculations:

The calculation methodology involves estimation of the total materials cost for the project. According to the intent of the credit, the project must procure materials with recycled content. To show compliance the project proposes to source materials locally for 51.6% of total materials cost (i.e. Rs 9, 65, 83,807). The local materials includereinforcement steel, brick work, tiling, glass cubicles and glass work railing.

The sample filled-in template is shown below:

Total construction cost (A)	**Rs 16,09,73,011**
Default total materials cost (60% of Total construction cost) (in case the actual materials cost is not available)	**Rs 9,65,83,807**

Material / Product Name	Manufacturer Name	Quantity		Material/ Product Cost		Distance between Project Site & Manufacturing Location (km)	Information Source (Please choose from drop-down below)
		Number	Units (Metric)	Cost per Unit (Rs)	Total Cost (Rs)		
Reinforcement steel	Bhagyalakshmi rolling limited	5,39,653	kg	50	2,69,82,650	300	Mnf letter
Brick work	Ashtech Pvt Ltd	1,33,625	sq.ft	45	60,13,125	100	Mnf letter
Tiling	Nitco	1,38,765	sq.ft	100	1,38,76,500	150	Mnf letter
Glass cubical	Ashahi glass	325	m	5,248	17,05,600	100	Mnf letter
Glass work railing	Ashahi glass	1,02,788	sq.ft	12	12,33,456	100	Mnf letter
Total cost of materials manufactured locally							**(Rs) 4,98,11,331**
Percentage							**51.6%**

Documentation Required:

Precertification Level

(Only for Multi-dwelling Residential Units)

- Narrative describing the proposed strategies implemented to source local materials. The strategies shall include the following:
  - List of the proposed local materials and respective manufacturers specifying approximate distance from the project site to the place of manufacturing units.
- Tentative calculations indicating the percentage of local materials sourced (in terms of cost) with respect to the total materials cost of the project. (Optional)

Certification Level

(For Individual Residential Units & Multi-dwelling Residential Units)

- Narrative describing the strategies implemented to source local materials. The strategies shall include the following:
  - List of the local materials and respective manufacturers specifying approximate distance from the project site to the place of manufacturing units.
- Calculations indicating the percentage of local materials sourced (in terms of cost) with respect to the total materials cost of the project.
- Supplier/ vendor letters indicating the distance from the project site to the place of manufacturing unit

Exemplary Performance:

This credit is eligible for exemplary performance under Innovation & Design Process, if more than 75% of the total building materials (by cost), used in the building(s)/ campus,are sourced locally.

Related Mandatory Requirements & Credits:

- MR Credit 3 – Reuse of Salvaged Materials (Total materials cost & Material cost)
- MR Credit 4: Materials with Recycled Content (Total materials cost & Material cost)
- MR Credit 6 – Rapidly Renewable Building Materials & Certified Wood (Total materials cost & Material cost)

Definitions:

Local Materials are those materials which are manufactured close to the site location. For the purpose of this credit, the distance between location of site and place of manufacture is defined as 400 km.

Rapidly Renewable Building Materials & Certified Wood

MR Credit 6 **Points:4**

Intent:

Minimise use of virgin wood thereby encouraging responsible forest management and maximise use of materials which are rapidly renewable.

Compliance Options:

Ensure atleast 50% of all wood based materials (by cost) used in the building(s)/ campusmust be:

- ❖ Rapidly renewable

  (AND/ OR)

- ❖ Wood certified by Forest Stewardship Council (FSC) or Programme for the Endorsement of Forest Certification (PEFC) or a local programme

Points are awarded as below:

Percentage of Rapidly renewable material / Certified wood	Points
≥ 50%	2
≥ 75%	4

Notes:

- *Material Cost = Total Cost – (Labour Cost + Installation Cost)*
- *If Labour and Installation cost is not known, the default material cost can be considered as 60% of the total cost of the component*
- *Movable materials & furniture should not be considered in the total material cost.*

Green Building Concerns:

- ❖ Irresponsible forestry practices cause ecosystem and habitat destruction, andsoil erosion, replacing wood products with rapidly renewable resources & certified wood reduces a product's overall environmental impact.

Approach and Methodologies:

Survey the market for rapidly renewable materials/ certified wood for applications such as doors, door frames, flooring, fixed cabinetry, wood products and other project applications. Identify all major wood usage in the project to determine the types of products needed (e.g. wooden doors & windows, interior partitions, framing, etc.)

- ❖ Explore the possibility of using rapidly renewable materials and wood certified by Forest Stewardship Council (FSC) or Programme for the Endorsement for Forest Certification (PEFC) or equivalent, for all such wood based applications. Sourcing rapidly renewable materials reduces the use of raw materials whose extraction and processing have greater environmental impacts. A common example is the use of agricultural fiber such as wheat in composite panels as a substitute for wood products, reducing the overall consumption of wood.

Identify local dealers who supply rapidly renewable materials and wood certified by FSC or PEFC or equivalent. Also, while sourcing wood for various applications, specify the quality or grade of wood required. Some applications like veneer may require lesser grades. Locate local suppliers so as to reduce additional costs and environmental impacts caused during transportation.

Identifypossible applications of rapidly renewable materials and explore the possibility of using FSC / PEFC/ equivalent for all such wood based applicationsin the building design.

The list of possible rapidly renewable materials that can be used for each type of application is as follows:

1. **Flooring:**
   - ➢ Bamboo
   - ➢ Linoleum
2. **Panels or Partitions:**
   - ➢ Bamboo
   - ➢ Sunflower seed
3. **Cabinetry/ Fittings:**
   - ➢ Bamboo
   - ➢ Rose Wood
   - ➢ Eucalyptus

The above list of materials is illustrative and not exhaustive.

Benefits:

- ❖ Encourages sustainable construction practices.
- ❖ Rapidly renewable materials also require less land and therefore they are considered more environment friendly Sourcing certified wood would ensure preserving and increasing the existing forest cover. Promotes responsible forest managementwhich helps in sustainable wood harvesting, preserving wildlife habitat and bio-diversity, maintaining soil and water quality and conserve endangered forests.

Sample Calculations:

The approach involves identifying all the wood based materials and applications in the project. The calculation methodology involves estimation of the cost of wood based materials procured in the project. According to the intent of the credit, the project must source rapidly renewable or FSC/ PEFC certified/ other equivalent wood material. To meet the credit compliance the project proposes to source rapidly renewable materials 100% of wood source in the project (by cost).

The sample filled-in template calculation is shown below:

Total Wood Material Cost (excluding labor & equipment)	**Rs 2,26,800**

Rapidly Renewable Material

Material / Product Name	Manufac-turer Name	Quantity		Material / Product Cost		Percentage of Rapidly Renewable Content	Value Qualifying as Rapidly Renewable (Rs)	Application Areas in the Project	Information Source (Please choose from drop-down below)
		Number	Units (Metric)	Cost per unit (Rs)	Total Cost (Rs)				
New wood in the project	Arjoviggins	3,780	sq.ft	60	2,26,800	100.00%	2,26,800	Plywood for modular kitchen	Mnf letter
Total cost of rapidly renewable and/ or certified wood or equivalent									**2,26,800**
Percentage									**100.0%**

Documentation Required:

Precertification Level

(Only for Multi-dwelling Residential Units)

- Narrative describing the proposed strategies to source rapidly renewable materials (and/ or) wood certified by Forest Stewardship Council (FSC) / Programme for the Endorsement for Forest Certification (PEFC) / equivalent. The strategies shall include the following:
  - List of proposed rapidly renewable material (and/ or) certified wood by FSC/ (PEFC)/ equivalent and their applications.
  - List of proposed manufacturers to source rapidly renewable material (and/ or) certified wood by FSC/ (PEFC)/ equivalent.
- Tentative calculations indicating the percentage of rapidly renewable material (and/ or) certified wood by FSC/ (PEFC)/ equivalent sourced, to the total cost of new wood used in the project. If certified wood is sourced, provide manufacturer CoC number/ certificate and details of type of certified wood e.g. pure, mixed, etc., (Optional)

Certification Level

(For Individual Residential Units & Multi-dwelling Residential Units)

- Narrative describing the strategies implemented to source rapidly renewable materials (and/ or) wood certified by Forest Stewardship Council (FSC) / Programme for the Endorsement for Forest Certification (PEFC) / equivalent. The strategies shall include the following:
  - List of rapidly renewable material (and/ or) certified wood by FSC/ (PEFC)/ equivalent and their applications.
  - List of manufacturers to source rapidly renewable material (and/ or) certified wood by FSC/ (PEFC)/ equivalent.
- Calculations indicating the percentage of rapidly renewable material (and/ or) certified wood by FSC/ (PEFC)/ equivalent sourced, to the total cost of new wood used in the project. If certified wood is sourced, provide manufacturer CoC certificate and details of type of wood e.g. pure, mixed, etc.,
- Purchase invoices and payment receipts of the sourced rapidly renewable material (and/ or) certified wood by FSC/ (PEFC)/ equivalent.

Exemplary Performance:

This credit is eligible for exemplary performance under Innovation & Design Process, if more than 95% of all wood based products (by cost), used in the building(s)/ campus,arecertified or rapidly renewable.

Related Mandatory Requirements & Credits:

- ❖ MR Credit 3 – Reuse of Salvaged Materials (Total materials cost & Material cost)
- ❖ MR Credit 5 – Local Materials (Total materials cost & Material cost)

Definitions:

Forest Stewardship Council is an independent, non-governmental, not for profit organisation established to promote the responsible management of the world's forests. Products carrying the FSC label are independently certified to assure consumers that they come from forests that are managed to meet the social, economic and ecological needs of present and future generations.

Programme for the Endorsement for Forest Certification is an international non-profit, non-governmental organization dedicated to promoting sustainable forest management. PEFC is the certification system of choice for small forest owners. PEFC Chain of Custody certification enables companies to send a clear and transparent message that wood and non-timber forest products have been sourced from legal and sustainably managed forests thus offering access to markets demanding eco-friendly products and market advantage in relation to companies with uncertified products. It enhances brand value with due respect to the environmental, economic and social standards

Rapidly renewable material is defined as material considered to be an agricultural product, that takes ten years or less period to grow or rise, and to harvest in an ongoing and sustainable manner.

Indoor Environmental Quality

Introduction

People spend about 2/3rd of their lives at home, where the quality of indoor environment has a significant impact on the health and well-being of the occupants. Historically, typical Indian homes are constructed to bring in natural sunlight and ventilation into the interior spaces.

The Sun is worshipped by many cultures throughout history because of its vast healing and therapeutic powers. Daylight is vital for body functions, gives a sense of time and place and connects the occupants to the environment. A green home should be designed such that the regularly occupied areas have access to sunlight, natural ventilation, cross ventilation. Daylighting, views to the exterior environment and fresh air are measures for enhancing the quality of life to occupants.

A good ventilation system removes the exhaled carbon dioxide and also helps remove unwanted moisture and other contaminants from the interior spaces. Homes require a continuous flow of outside air to maintain a habitable quality of indoor air.

We often see how, due to insufficient exhaust, carbon is deposited around the exhaust system, perhaps due to cooking oil kitchens require to be designed with adequate exhaust and fresh air provisions.

Many materials used in the residential construction and interior fit-outs contain Volatile Organic Compounds (VOC) which poses serious health risks to building occupants. VOC's are also found in many common construction materials. However, many alternative low / zero VOC products are available in the market. Such materials include paints, polish coatings, wood & glass sealants, adhesives for plywood, laminate, and veneer applications. It is also important to run a flush out after the interior fit-out is complete and before occupying the home

Tobacco Smoke Control

IEQ Mandatory Requirement 1

Intent:

Minimise exposure of non-smokers to the adverse health impacts arising due to passive smoking, post occupancy.

Compliance Options:

Individual Residential Unit:
Smoking should be prohibited in the common areas of the building.

Multi-dwelling Residential Units:

Smoking should be prohibited in the common areas of the building(s) and campus.

Green Building Concerns:

- The purpose of this prerequisite is to limit the exposure of building occupants to Environmental Tobacco Smoke (ETS),
- The relationship between smoking and various health risks, like lung disease, cancer, and heart diseases, are well documented.

Approach and Methodologies:

Design the building to eliminate or minimise tobacco smoke pollution in the common areas. Prohibit smoking in common areas like corridors, lobby, lifts, etc. Signage can be displayed at several places in the building/ campus to educate occupants and visitors.

Benefits:

- Reduces health hazards caused due to passive smoking.
- Improves air quality thereby improving the health of the community as a whole.

Documentation Required:

Precertification Level

(Only for Multi-dwelling Residential Units)

- Declaration letter from the owner/ developer stating that 'smoking' will be prohibited in the common areas of the project.
- A narrative stating the proposed strategies (e.g. signage, brochures, home user guidelines, etc.,) on how 'no smoking' policy will be communicated to all the residents and visitors.
- A copy of the 'no smoking policy'.

Certification Level

(For Individual Residential Units)

- Declaration letter from the owner stating that 'smoking' will be prohibited in the common areas of the project.

(For Multi-dwelling Residential Units)

- Declaration letter from the owner/ developer stating that 'smoking' will be prohibited in the common areas of the project.
- A narrative stating the strategies implemented (e.g. signage, brochures, home user guidelines, etc.,) on how 'no smoking' policy will be communicated to all the residents and visitors.
- A copy of 'no smoking policy'.
- Photographs showing the 'no smoking' signages installed in the project.

Definitions:

Tobacco Smoke consists of airborne particles emitted from the burning end of cigarettes, pipes, beedi & cigars and exhaled by smokers. These particles contain about 4000 different compounds, up to 40 of which are known to cause cancer.

Minimum Daylighting

Mandatory Requirement 2

Intent:

Ensure connectivity between the interior and the exterior environment, by providing adequate daylighting.

Compliance Options:

The project can choose any one of the following options:

- ❖ Option 1 – Prescriptive Approach
- ❖ Option 2 – Simulation Approach

Option 1: Prescriptive Approach

For Individual Residential Unit:

Achieve minimum glazing factors as listed below in at least 50% of the regularly occupied spaces.

For Multi-dwelling Residential Units:

Achieve minimum glazing factors as listed below in at least 50% of the regularly occupied spaces in each dwelling unit.

Glazing factors for Regularly Occupied Spaces

Type of Regularly Occupied Spaces	Glazing Factor (GF)*
Living/ Bedroom	1
Study room	2
Kitchen	2

Note:

For other regularly occupied spaces which are not listed in the table above, a minimum glazing factor of 1 should be achieved.

Glazing Factor Calculation

Glazing factor can be calculated using the formula given below:

Glazing Factor = Window Area [sq.m] / Floor Area [sq.m] x Actual Visible Transmittance of Glazing x Constant x 100

Constant Values:

Windows on wall : 0.2

Window on roof (skylight) : 1.0

Notes:

- *Regularly occupied spaces include living room, bed rooms, dining room, study room, kitchen, etc.,.*
- *Regularly occupied spaces which are used for multi- purpose, such as living-cum-dining room, can be considered as separate spaces based on the function. The room boundary need not be a physical boundary.*
- *Window openings where the angle of obstruction of objects obscuring the sky dome is greater than 700 from the horizontal shall not be considered for daylight calculations (refer figure no.1)*

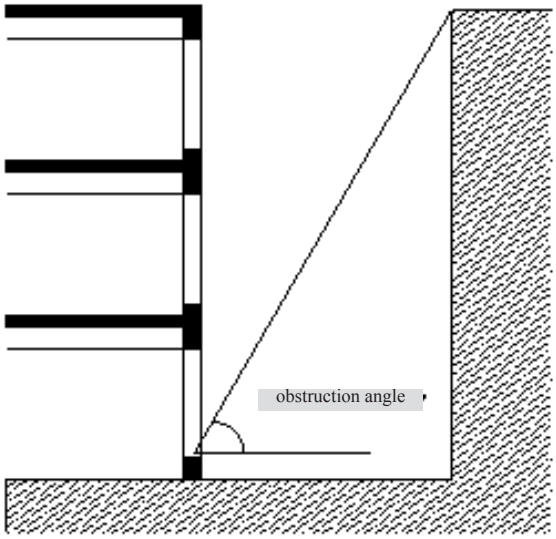


Figure No.1 – Angle of Obstruction

Alternative Compliance for Prescriptive Approach:

For dwelling units, where compliance cannot be shown through the prescriptive approach, daylight simulation tools can also be used to demonstrate that the required illuminance levels are achieved.

Option 2: Simulation Approach

For Individual Residential Unit

Demonstrate through computer simulation that 50% of the regularly occupied spaces achieve daylight illuminance levels of a minimum of 10 foot-candles (fc) (108 lux) in a clear sky condition on September 21 at 12 noon, at working plane.

Multi-dwelling Residential Units:

Demonstrate through computer simulation that 50% of the regularly occupied spaces, in each dwelling unit, achieve daylight illuminance levels of a minimum of 10 foot-candles (fc) (108 lux) in a clear sky condition on 21st September at 12 noon, at working plane.

Notes:

- *Please note that the working plane is considered as a height of 2'-6" or 750mm from the finished floor level.*
- *Please refer to the sample daylight simulation report under Annexure-V*

Green Building Concerns:

- ❖ Daylighting is often not accorded due importance. Research has demonstrated that direct access to daylighting results in greater overall occupant satisfaction
- ❖ When designing for maximum daylight, designers may have to balance a number of environmental factors, such as heat gain and loss, glare control, visual quality, and variations in daylight availability.

Approach and Methodologies:

In residential dwelling units, access to natural light in all the living spaces plays a vital role in maintaining good health and well-being of the occupants. A good design with ample daylighting involves multiple openings of adequate window sizes to the exteriors, openings in proper orientation preferably north or east facing, selection of glass having high Visual Light Transmittance (VLT) index and maintaining distance between neighboring dwelling units/ towers.

Window design in a home plays a vital role to ensure sufficient daylight ingress in the interior spaces without increasing the heat load. Excessive daylighting may cause glare and cause the occupants to use curtains / blinds. Hence selection of glass and window opening are critical in achieving the minimum daylight factor.

Picture 31: Daylighting

Few daylighting concepts to bring in natural light into the regularly occupied spaces include double height window, light shelves, sky lights, openings above lintel level (i.e. 7 feet height), etc.,

To show compliance, project must submit daylight factor calculations for each typical dwelling unit indicating prescribed daylight factor in regularly occupied spaces like living room, bedrooms, kitchen and dining spaces. For calculations the dwelling units should consider the obstruction angle (700) for showing compliance. The angle of obstruction should be drawn from the window sill of the lowest habitable floor to the highest point of the neighboring buildings.

Regularly occupied spaces which do not meet the obstruction angle criteria must consider the daylight factor as zero for calculations and compliance for such spaces can be shown through alternate compliance i.e. simulation approach. (Refer sample daylight simulation under Annexure-V)

Benefits:

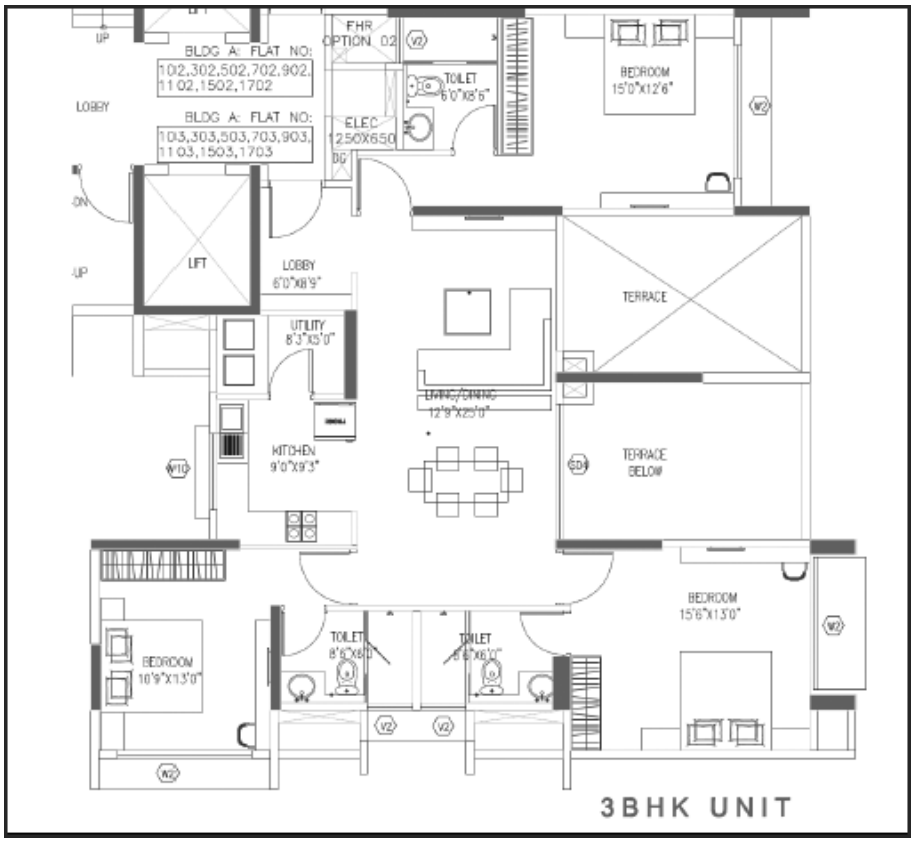
- ❖ Lower electricity bills
- ❖ Improves quality of life
- ❖ Connectivity to exterior environment.
- ❖ Better health and well-being of occupants.

Sample Calculations:

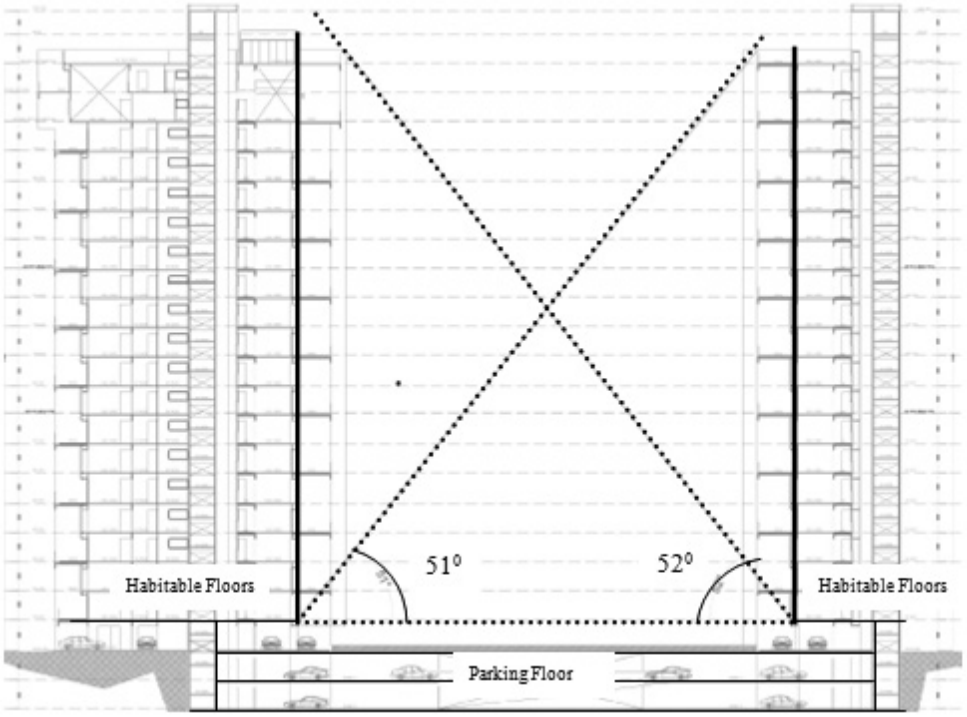
The methodology for calculating daylight factor for regularly occupied spaces (i.e. living room, dining room, bed room, etc.,) involves window areas of the respective spaces and their floor areas. Assuming a 3BHK residential project having 10 dwelling units; to meet the intent, the project must calculate the daylight factor considering window areas and their respective floor area for each regularly occupied spaces. The regularly occupied spaces for the above typical 3-BHK flat include living & dining, bed room 1, bed room 2, master bedroom and kitchen. To show compliance, the project has designed the spaces such that 85% of regularly occupied spaces meet the daylight factor criteria.

The sample filled-in template calculation is shown below:

Regularly Occupied Space	Type of Regularly Occupied Space (Please choose from dropdown below)	Floor Area (sq.m)	Window Area (sq.m)	Window Glazing VLT (%)	Skylight Area (sq.m)	Skylight Glazing VLT (%)	Glazing Factor Achieved	Glazing Factor to be Achieved	Regularly Occupied Spaces Meet or Exceed the Cirteria (Yes/ No)	Area of Regularly Occupied Spaces Meeting the Criteria
Living & Dining room	Living/ Bedroom	53.2	12.1	53.0%	0.0	0.0%	2.4	1	Yes	53.2
Bedroom 2	Living/ Bedroom	16.9	6.0	53.0%	0.0	0.0%	3.8	1	Yes	16.9
Bedroom 3	Living/ Bedroom	19.2	5.8	53.0%	0.0	0.0%	3.2	1	Yes	19.2
Master Bedroom	Living/ Bedroom	21.7	10.5	53.0%	0.0	0.0%	5.1	1	Yes	21.7
Kitchen	Kitchen	19.2	3.0	53.0%	0.0	0.0%	1.7	2	No	--
Total		**130.2**								**111.0**
Percentage										**85.3%**



Picture 32: Sample 3 BHK dwelling unit plan



Picture 33: Elevation showing obstruction angle between two towers

Documentation Required:

Precertification Level

(Only for Multi-dwelling Residential Units)

Prescriptive Approach

- ❖ Site/ master plan showing all the buildings.
- ❖ Drawing(s) showing the angle of obstruction between the buildings within the project and the adjacent neighboring buildings.
- ❖ Conceptual floor plans with window and skylight schedule.
- ❖ Glazing factor calculations for each typical dwelling unit in the project.
- ❖ Manufacturer brochure/ cut-sheet/ letter of the proposed glass showing the visual light transmittance (VLT). (Optional)

Simulation Approach

- ❖ Site/ master plan showing all the buildings.
- ❖ Conceptual floor plans with window and skylight schedule.
- ❖ Daylighting simulation report stating the sky conditions (such as date & month; time; ambient lux levels; wall, floor & roof reflectance properties; etc.,) and showing the daylight analysis for each typical dwelling unit in the project. During simulation, consider shading devices and 'shadow effect' of adjacent neighboring buildings.
- ❖ Manufacturer brochure/ cut-sheet/ letter of the proposed glass showing the visual light transmittance (VLT). (Optional)

Note:

Compliance for this mandatory requirement can also be shown with combination of both prescriptive and simulation approach.

Certification Level

(For Individual Residential Units & Multi-dwelling Residential Units)

Prescriptive Approach

- Site/ master plan showing all the buildings.
- Drawings showing the angle of obstruction between the buildings within the project and the adjacent neighboring buildings.
- Detail floor plans with window and skylight schedule.
- Glazing factor calculations for each typical dwelling unit in the project.
- Manufacturer brochure/ cut-sheet/ letter of the installed glass showing the visual light transmittance (VLT).
- Photographs showing the building elevations (all sides).

Simulation Approach

- Site/ master plan showing all the buildings.
- Detail floor plans with window and skylight schedule.
- Daylighting simulation report stating the sky conditions (such as date & month; time; ambient lux levels; wall, floor & roof reflectance properties; etc.,) and showing the daylight analysis for each typical dwelling unit in the project. During simulation, consider shading devices and 'shadow effect' of adjacent neighboring buildings.
- Manufacturer brochure/ cut-sheet/ letter of the installed glass showing the visual light transmittance (VLT).
- Photographs showing the building elevations (all sides).

Note:

Compliance for this mandatory requirement can also be shown with combination of both prescriptive and simulation approach.

Related Mandatory Requirements & Credits:

- IEQ Mandatory Requirement 3 – Fresh Air Ventilation (Carpet area and Door & Window schedule)
- IEQ Credit 1 – Enhanced Daylighting (Carpet area and Door & Window schedule)
- IEQ Credit 2 – Enhanced Fresh Air Ventilation (Carpet area and Door & Window schedule)
- IEQ Credit 6 – Cross Ventilation (Carpet area and Door & Window schedule)

Definitions:

Daylighting is the controlled admission of natural light into a space through glazing with the intent of reducing or eliminating electric lighting. Daylighting creates a stimulating and productive environment for building occupants.

Skylight is a fenestration surface having a slope of less than 60o from the horizontal plane. Other fenestration, even if mounted on the roof of a building, is considered vertical fenestration.

Visible Transmittance (Tvis) is the ratio of total transmitted light to incident light. In other words, it is the amount of light passing through a glazing surface divided by the amount of light striking the glazing surface. A higher Tvis value indicates that a greater amount of incident light is passing through the glazing.

Fresh Air Ventilation

Mandatory Requirement 3

Intent:

Avoid indoor pollutants affecting indoor air quality by providing adequate outdoor air ventilation.

Compliance Options:

For Naturally Ventilated Spaces:

Provide openable windows or doors to the exteriors in all regularly occupied spaces of each dwelling unit such that the openable area is designed to meet the criteria as outlined in the table below:

Table 6 - Design Criteria for Openable Windows and Doors to the Exteriors

Space type	Net Openable area as a percentage of total carpet area
Living Spaces	10%
Kitchen	8%
Bathrooms*	4%

Notes:

- *Regularly occupied spaces include living room, bed rooms, dining room, study room, kitchen etc.,*
- *For sliding windows / doors, only openable area to the exteriors shall be considered in calculations*
- **Compliance for bathrooms can also be shown through exhaust system and/ or louvers. The minimum intermittent exhaust flow requirements for bathroom should meet the criteria listed in IEQ Credit 3 – Exhaust Systems, whereas the louver openings should be with an openable area of 4% of total carpet area.*

For Air Conditioned Spaces:

Design a ventilation system for air-conditioned spaces, with 5 cfm of Outside Air per person for each air-conditioned space.

Note:

- *Projects installing unitary air conditioning system(s) for a limited period in a entire year can show compliance by providing openable windows & doors. Projects installing centralised air-conditioning system(s) should meet the fresh air requirement of 5 cfm per person in each of the conditioned spaces*

Approach and Methodologies:

Design the building envelope with adequate window openings to bring in fresh air into the building, thereby ensuring good indoor air quality. The approach would be to have sufficient openings in atleast two different directions, so as to allow for adequate cross-ventilation. The specific approach and design of natural ventilation systems will vary based on building type and local climate. However, the amount of ventilation depends on the design of internal spaces, size and placement of openings in the building. Some of the design strategies that could be adopted during the design stage are as follows:

- Orient the building such that wind obstructions are minimal.
- Size windows openings adequately to ensure sufficient ventilation.
- Consider the use of courtyards or vented skylights.
    - A courtyard or a vented skylight will provide a vent opening for stale air to escape.

For fresh air ventilation calculations, the residential buildings must consider the window types (i.e. sliding, openable, pivot, etc.,). For all window types only openable area should be accounted for showing compliance. For example, in case of a sliding window with two tracks, 50% of window area should be considered as the net openable area.

While designing the air-conditioning system, install fresh air intakes away from possible sources of contamination. Possible sources of contamination include exhaust fans, street traffic, parking areas, toilet exhausts, etc., ensure that the outside air capacity for the ventilation system meets the minimum fresh air ventilation requirement under the credit. Consider filtering the outside air if the quality of the ambient air is of poor quality.

Also, study the possible methods of taking in fresh air into the air-conditioned spaces, considering the quality of the fresh air through appropriate treatment methods. Taking in fresh air may result in higher energy consumption; however suitable technologies of pre-cooling the fresh air or heat recovery may be incorporated during the design stage.

Green Building Concerns:

- ❖ People increasingly spend a maximum amount of their time indoors, where concentrations of pollutants are often much higher than those outside.

Benefits:

- ❖ Reduces respiratory problems such as asthma.
- ❖ Enhances indoor air quality
- ❖ Improves quality of life
- ❖ Good health and well being of the occupants

Sample Calculations:

The methodology for calculating fresh air ventilation for regularly occupied spaces (i.e. living room, dining room, bed room, etc.,) and bathrooms involves openable window/ doors of the respective spaces to the exteriors and respective floor areas. Assuming a 3BHK residential project having 10 dwelling units; to meet the intent, the project must calculate the fresh air ventilation considering openable windows & doors opening to exterior environment . The spaces for the typical 3-BHK flat include living & dining, bed room 1, bed room 2, master bedroom, kitchen and wash rooms. To show compliance, the project has designed the spaces such that most of regularly occupied spaces meet the fresh air ventilation criteria. The sample filled-in template calculation is shown below:

Regularly Occupied Space	Type of Living Space (Please choose from dropdown below)	Floor Area (sq.m)	Openable Window Area (towards exterior) (sq.m)	Openable Door Area (towards exterior) (sq.m)	Openable Area as a Percentage of Total Carpet Area	Meet or Exceed Mandatory Requirement (IEQ MR 3) (Yes/ No)	Meet or Exceed Credit Requirement (IEQ Cr 2) (Yes/ No)
Living & Dining room	Living Space	41.8	6.8	0.0	16.3%	Yes	Yes
Bedroom 2	Living Space	17.4	2.8	0.0	16.1%	Yes	Yes
Bedroom 3	Living Space	13.0	2.8	0.0	21.5%	Yes	Yes
Master Bedroom	Living Space	18.7	2.8	0.0	15.0%	Yes	Yes
Kitchen	Kitchen	7.7	0.8	0.0	10.4%	Yes	Yes
Bath 2	Bathroom	4.7	0.6	0.0	12.8%	Yes	Yes
Bath 3	Bathroom	4.7	0.4	0.0	8.5%	Yes	Yes
Master bath	Bathroom	4.7	0.2	0.0	4.3%	Yes	No

Documentation Required:

Precertification Level

(Only for Multi-dwelling Residential Units)

Naturally Ventilated Spaces

- ❖ Conceptual floor plans with door and window schedule.
- ❖ Tentative calculations indicating the openable area (i.e. window/ door) as a percentage of carpet area in each of the regularly occupied spaces and bathrooms, for each typical dwelling unit.

Air-conditioned Spaces

- ❖ A narrative stating the proposed building ventilation design and fresh air intake volumes.
- ❖ Tentative calculations indicating fresh air intake volumes in all regularly occupied spaces, for each typical dwelling unit.

Note:

Compliance for this mandatory requirement can also be shown with a combination of both natural ventilation and mechanical ventilation.

Certification Level

(For Individual Residential Units & Multi-dwelling Residential Units)

Naturally Ventilated Spaces

- ❖ Detail floor plans with door and window schedule.
- ❖ Calculations indicating the openable area (i.e. window/ door) as a percentage of carpet area in each of the regularly occupied spaces and bathrooms, for each typical dwelling unit.

Air-conditioned Spaces

- ❖ A narrative stating the building's ventilation design and fresh air intake volumes.
- ❖ Calculations indicating fresh air intake volumes in all regularly occupied spaces, for each typical dwelling unit.

Note:

Compliance for this mandatory requirement can also be shown with a combination of both natural ventilation and mechanical ventilation.

Related Mandatory Requirements & Credits:

- ❖ EE Mandatory Requirement 1: CFC-Free Equipment (Air-conditioning system)
- ❖ EE Mandatory Requirement 2 – Minimum Energy Performance (Air-conditioning system)
- ❖ EE Credit 1 – Enhanced Energy Performance (Air-conditioning system)
- ❖ IEQ Mandatory Requirement 2 – Minimum Daylighting (Carpet area and Door & Window schedule)
- ❖ IEQ Credit 1 – Enhanced Daylighting (Carpet area and Door & Window schedule)
- ❖ IEQ Credit 2 – Enhanced Fresh Air Ventilation (Carpet area, Door & Window schedule and fresh air quantities)
- ❖ IEQ Credit 6 – Cross Ventilation (Carpet area and Door & Window schedule)

Definitions:

Air Conditioning is the process of treating air to meet the requirements of a conditioned space by controlling its temperature, humidity, cleanliness and distribution.

Mechanical Ventilation is ventilation provided by mechanically powered equipment, such as motor-driven fans and blowers, but not by devices such as wind-driven turbine ventilators and mechanically operated windows.

Natural Ventilation is ventilation provided by thermal, wind or diffusion effects through doors, windows or other intentional openings in the building.

Skylight is a fenestration surface having a slope of less than 60o from the horizontal plane. Other fenestration, even if mounted on the roof of a building, is considered vertical fenestration.

Ventilation is the process of supplying air to or removing air from a space for the purpose of controlling air contaminant levels, humidity or temperature within the space.

Enhanced Daylighting

IEQ Credit 1 **Points: 4**

Intent:

Ensure connectivity between the interior and the exterior environment, by providing adequate daylighting.

Compliance Options:

The project can choose any one of the following options:

- Option 1 – Prescriptive Approach
- Option 2 – Simulation Approach

Option 1: Prescriptive Approach

For Individual Residential Unit:

Achieve minimum glazing factors as listed below in at least 75% of the regularly occupied spaces.

For Multi-dwelling Residential Units:

Achieve minimum glazing factors as listed below in at least 75% of the regularly occupied spaces in each dwelling unit.

Points are awarded as below:

Percentage of daylighting in regularly occupied spaces	Points
≥ 75%	2
≥ 95%	4

- Glazing factors for Regularly Occupied Spaces

Type of Regularly Occupied Spaces	Glazing Factor (GF)*
Living/ Bedroom	1
Study room	2
Kitchen	2

Note:

For other regularly occupied spaces which are not listed in the table above, a minimum glazing factor of 1 should be achieved.

Glazing Factor Calculation

Average glazing factor can be calculated using the formula given below:

Daylight Factor = $\frac{\text{Window Area [SF]}}{\text{Floor Area [SF]}}$ x Actual Visible Transmittance of Glazing x Constant x 100

Constant Values:

Windows on wall : 0.2

Window on roof (skylight) : 1.0

Notes:

- *Regularly occupied spaces include living room, bed rooms, dining room, study room, kitchen, etc.,.*
- *Regularly occupied spaces which are used for multiple purposes, such as living-cum-dining room, can be considered as separate spaces based on the function. The room boundary need not be a physical boundary.*
- *Window openings where the angle of obstruction of objects obscuring the sky dome is greater than 70^0 from the horizontal shall not be considered for daylight calculations (refer figure no.1)*

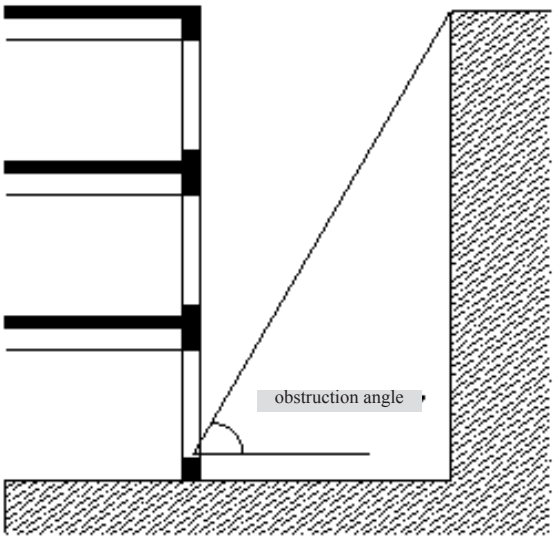


Figure No.1 – Angle of Obstruction

Alternative Compliance for Prescriptive Approach:

For dwelling units, where compliance cannot be shown through the prescriptive approach, daylight simulation tools can also be used to demonstrate that the required illuminance levels are achieved.

Option 2: Simulation Approach

For Individual Residential Unit

Demonstrate through computer simulation that 75% of the regularly occupied spaces achieve daylight illuminance levels of a minimum of 10 foot-candles (fc) (108 lux) in a clear sky condition on September at 12 noon, at working plane.

Please note that the working plane is considered as a height of 2'-6" or 750mm from the finished floor level.

Multi-dwelling Residential Units:

Demonstrate through computer simulation that 75% of the regularly occupied spaces, in each dwelling unit, achieve daylight illuminance levels of a minimum of 10 foot-candles (fc) (108 lux) in a clear sky condition on September 21 at 12 noon, at working plane.

Sample Calculations:

Please refer to 'Sample Calculations' under IEQ Mandatory Requirement 2: Minimum Daylighting.

Documentation Required:

Precertification Level

(Only for Multi-dwelling Residential Units)

Please refer IEQ Mandatory Requirement 2 – Minimum Daylighting.

Certification Level

(For Individual Residential Units & Multi-dwelling Residential Units)

Please refer IEQ Mandatory Requirement 2 – Minimum Daylighting.

Exemplary Performance:

This credit is not eligible for exemplary performance under Innovation & Design Process.

Related Mandatory Requirements & Credits:

- ❖ IEQ Mandatory Requirement 2: Minimum Daylighting (Carpet area and Door & Window schedule)
- ❖ IEQ Mandatory Requirement 3 – Fresh Air Ventilation (Carpet area and Door & Window schedule)
- ❖ IEQ Credit 2 – Enhanced Fresh Air Ventilation (Carpet area and Door & Window schedule)
- ❖ IEQ Credit 6 – Cross Ventilation (Carpet area and Door & Window schedule)

Definitions:

Daylighting is the controlled admission of natural light into a space through glazing with the intent of reducing or eliminating electric lighting. Daylighting creates a stimulating and productive environment for building occupants.

Skylight is a fenestration surface having a slope of less than 60o from the horizontal plane. Other fenestration, even if mounted on the roof of a building, is considered vertical fenestration.

Visible Transmittance (Tvis) is the ratio of total transmitted light to incident light. In other words, it is the amount of light passing through a glazing surface divided by the amount of light striking the glazing surface. A higher Tvis value indicates that a greater amount of incident light is passing through the glazing.

Enhanced Fresh Air Ventilation

IEQ Credit 2 **Points: 2**

Intent:

Avoid indoor pollutants affecting indoor air quality by providing adequate outdoor air ventilation.

Compliance Options:

For Naturally Ventilated Spaces:

Provide openable windows or doors to the exteriors in all regularly occupied spaces of each dwelling unit such that the openable area is designed to meet the criteria as outlined in the table below:

Design Criteria for Openable Windows and Doors to the Exteriors

Space Type	Net Openable area as a percentage of total carpet area
Living Spaces	13%
Kitchen	10%
Bathrooms*	5%

Notes:

- *Regularly occupied spaces include living room, bed rooms, dining room, study room, kitchen etc.,*
- *For sliding windows / doors, only openable area to the exteriors shall be considered in calculations*
- **Compliance for bathrooms can also be shown through exhaust system or louvers. The minimum intermittent exhaust flow requirements for bathroom should meet the criteria listed in IEQ Credit 3 – Exhaust Systems, whereas the louver openings should be with an openable area of 5% of total carpet area.*

For Air Conditioned Spaces:

Design a ventilation system for air-conditioned spaces, with meet 6.5 cfm of outside air per person for each air-conditioned space.

Note:

- *Projects installing unitary air conditioning system(s) for a limited period in a entire year can show compliance by providing openable windows & doors. Projects installing centralised air-conditioning system(s) should meet the fresh air requirement of 5 cfm per person in each of the conditioned spaces*

Sample Calculations:

Please refer to sample Fresh Air Ventilation Calculations under IEQ Mandatory Requirement 3 – Fresh Air Ventilation.

Documentation Required:

Precertification Level

(Only for Multi-dwelling Residential Units)

Please refer IEQ Mandatory Requirement 3 – Fresh Air Ventilation.

Certification Level

(For Individual Residential Units & Multi-dwelling Residential Units)

Please refer IEQ Mandatory Requirement 3 – Fresh Air Ventilation.

Exemplary Performance:

This credit is not eligible for exemplary performance under Innovation & Design Process.

Related Mandatory Requirements & Credits:

- ❖ EE Mandatory Requirement 1 – CFC-Free Equipment (Air-conditioning system)
- ❖ EE Mandatory Requirement 2 – Minimum Energy Performance (Air-conditioning system)
- ❖ EE Credit 1 – Enhanced Energy Performance (Air-conditioning system)
- ❖ IEQ Mandatory Requirement 2 – Minimum Daylighting (Carpet area and Door & Window schedule)
- ❖ IEQ Mandatory Requirement 3 – Fresh Air Ventilation (Carpet area and Door & Window schedule and fresh air quantities)
- ❖ IEQ Credit 1 – Enhanced Daylighting (Carpet area and Door & Window schedule)
- ❖ IEQ Credit 6 – Cross Ventilation (Carpet area and Door & Window schedule)

Definitions:

Air Conditioning is the process of treating air to meet the requirements of a conditioned space by controlling its temperature, humidity, cleanliness and distribution.

Mechanical Ventilation is ventilation provided by mechanically powered equipment, such as motor-driven fans and blowers, but not by devices such as wind-driven turbine ventilators and mechanically operated windows.

Natural Ventilation is ventilation provided by thermal, wind or diffusion effects through doors, windows or other intentional openings in the building.

Skylight is a fenestration surface having a slope of less than 60o from the horizontal plane. Other fenestration, even if mounted on the roof of a building, is considered vertical fenestration.

Ventilation is the process of supplying air to or removing air from a space for the purpose of controlling air contaminant levels, humidity or temperature within the space.

Exhaust Systems

IEQ Credit 3 Points: 2

Intent:

Ensure that kitchens and bathrooms are adequately ventilated, so as to improve the quality of indoor environment.

Compliance Options:

Design exhaust systems in kitchen and bathrooms as per the requirements provided in the table below:

Minimum Intermittent Exhaust Flow Requirements

Location	Minimum Airflow	
Kitchen	For ≤ 9.3 sq.m (100 sq.ft) floor area	100 cfm
Bathroom	For ≤ 4.64 sq.m (50 sq.ft) floor area	50 cfm

Notes:

- *For rooms with higher floor areas than the above values, airflow has to be proportionally increased.*
- *For kitchens, kitchen range vent hoods which meet the above air flows are also acceptable*
- *Ensure exhaust systems take away the polluted indoor air to the outdoors (i.e. exhaust outlets into common areas are not allowed)*

Approach and Methodologies:

We often see how, due to insufficient exhaust, carbon is deposited around the exhaust system, perhaps due to cooking oil Kitchens require to be designed with adequate exhaust and fresh air provisions. Hence in green homes providing proper exhaust system and fresh air ventilation in kitchen is recommended. In addition to the window openings provided in the kitchens and bathrooms, there is a need to provide exhaust systems to purge out the polluted indoor air.

The exhaust systems help in removing the stale air/ smoke from bathrooms and kitchens thereby enhances indoor air quality within homes. It is not just adequate to install exhaust fans, but sizing these systems to purge-out sufficient quantities of indoor air will determine the performance.

Survey the market for exhaust systems which meet the minimum airflow requirements specified under the credit. Develop a database of such systems, and include the list in the 'Green Home Guidelines', which would be circulated to all residents.

Sample Calculations:

According to the intent of the credit, the project must install mechanical systems such as exhaust fans & chimneys to purge in fresh air in kitchens and bathrooms. Assuming a 3 BHK residential project having 10 dwelling units, to show compliance, the project has calculated fresh air ventilation in bathrooms & kitchens based on the systems installed and the floor area.

The sample filled-in template calculation is shown below:

Location	Type of Space (Please choose from dropdown)	Floor Area (sq.m)	Required Minimum Airflow (cfm)	Designed Airflow (cfm)	Meet or Exceed Credit Requirement (Yes/ No)
Kitchen	Kitchen	7.7	100	100	Yes
Bath 2	Bathroom	4.7	51	60	Yes
Bath 3	Bathroom	4.7	51	80	Yes
Master bath	Bathroom	4.7	51	60	Yes

Documentation Required:

Precertification Level

(Only for Multi-dwelling Residential Units)

- Conceptual floor plans showing the location of exhaust systems in bathrooms and kitchens.
- Technical specifications of the proposed exhaust system(s).
- Manufacturer brochures of the proposed exhaust system(s). (Optional)

Note:

The exhaust systems have to be installed by the owner/ developer to achieve this credit.

Certification Level

(For Individual Residential Units & Multi-dwelling Residential Units)

- ❖ Floor plans showing the location of exhaust systems in bathrooms and kitchens.
- ❖ Technical specifications of the installed exhaust system(s).
- ❖ Purchase invoice/ payment receipts and photographs showing the installed exhaust systems.

Exemplary Performance:

This credit is not eligible for exemplary performance under Innovation & Design Process.

Related Mandatory Requirements & Credits:

- ❖ SSP Credit 1: Basic House-hold Amenities (Common toilets)
- ❖ SSP Credit 7: Design for Differently Abled (Common toilets)

Definitions:

An **Exhaust System** is a mechanical ventilation system which, when ducted to the exterior of the building, draws out stale, impure and humid air thereby improving the quality of indoor air.

Low VOC Materials, Paints & Adhesives

IEQ Credit 4 **Points: 2**

Intent:

Encourage use of materials with low emissions so as to reduce adverse health impacts on building occupants.

Compliance Options:

- ❖ Use paints and coatings with low or no VOC content for 100% of interior wall and ceiling surface area. (1 point)

  (AND)
- ❖ For adhesives and sealants used within the interiors, ensure that the VOC content does not exceed the limits as specified in the table below. (1 point)

Table 9 - VOC Limits for Materials

Type of material	VOC Limit (g/L less water)
Paints:	
Non-flat (Glossy) paints	150
Flat (Mat) paints	50
Anti-corrosive/ anti-rust paints	250
Varnish	350
Adhesives:	
Glazing adhesive	100
Tile adhesives	65
Wood adhesive	30
Wood flooring adhesive	100

Note:

- *If the project has used small quantities of non- complying paints and/or adhesives, a VOC budget can be calculated to demonstrate that the weighted average VOC of all products (based on litres of each applied) is below the allowed limit, by each type.*

Green Building Concerns:

- Many building products contain compounds that have a negative impact on indoor air quality and occupant health and well being.
- VOCs react with sunlight and nitrogen oxides (NOx) in the atmosphere to form ground-level ozone, a chemical that has detrimental effects on human health, agricultural crops, forests, and ecosystems.
- This ground-level ozone damages lung tissue, reduces lung function, and sensitizes the lungs to other irritants. Additionally, ground-level ozone is also a major component of smog.

Approach and Methodologies:

Volatile Organic Compound (VOC) impact indoor air quality and contribute to sick building syndrome, building related illness and multiple chemical sensitivities. This credit applies to products installation processes that have the ability to adversely affect indoor air quality on-site.

Carry out a market survey for available low VOC content interior finishes (i.e. adhesives, sealants, interior paints, coatings, varnish, carpets, composite wood and agrifiber products). Identify possible manufacturers/ vendors supplying low VOC content interior finishes. For Multi Dwelling Residential Units, develop a database of low VOC products and include the list in the Green Home Guidelines which will be circulated to all occupants.

Benefits:

- Reduces adverse impact on occupant health caused by impure indoor air
- No sick building syndrome

Documentation Required:

Precertification Level

(Only for Multi-dwelling Residential Units)

- List of proposed low or no VOC content materials (make & model) to be used in the building interiors.
- Manufacturer cut-sheets/ brochures/ Materials Safety Data Sheet (MSDS) indicating the VOC content (in g/L, less water) of the paints & adhesives to be sourced (Optional).

Certification Level

(For Individual Residential Units)

- List of low or no VOC content materials (make & model) used in the building interiors.
- Manufacturer cut-sheets/ brochures/ Materials Safety Data Sheet (MSDS) indicating the VOC content (in g/L, less water) of the paints & adhesives sourced (Optional).
- Purchase invoice/ payment receipts of the paint & adhesives sourced for the project

(For Multi-dwelling Residential Units)

- List of low or no VOC content materials (make & model) used in the building interiors.
- Manufacturer cut-sheets/ brochures/ Materials Safety Data Sheet (MSDS) indicating the VOC content (in g/L, less water) of the paints & adhesives sourced.
- Purchase invoice/ payment receipts of the paint & adhesives sourced for the project.

Exemplary Performance:

This credit is not eligible for exemplary performance under Innovation & Design Process.

Related Mandatory Requirements & Credits:

There are no related credits and mandatory requirements.

Definitions:

Volatile Organic Compounds (VOCs) are carbon compounds that participate in atmospheric photochemical reactions (excluding carbon monoxide, carbon dioxide, carbonic acid, metallic carbides and carbonates and ammonium carbonate). The compounds vaporise (become a gas) at normal room temperatures.

Sick Building Syndrome is a situation in which a substantial portion of building occupants experience acute discomfort and negative health effects as a result of exposure to contaminated air inside the building.

Building Flush-out

IEQ Credit 5 **Points: 1**

Intent:

Avoid occupant's exposure to indoor airborne contaminants before occupying the premises, so as to reduce the adverse health impacts on building occupants.

Compliance Options:

Perform a building flush-out for ten days by keeping all windows open before the building is occupied. Flushing is to be carried after paints & coatings and adhesives & sealants have been applied.

(OR)

If the Project Team prefers to carry out the flush-out using forced ventilation systems, the flush-out can be carried out for five days.

Green Building Concerns:

The dust, VOCs and other pollutants which might have accumulated indoors will have adverse impacts on the occupants.

Approach and Methodologies:

Flush-out needs to be carried out just before the occupancy, and after interior finishes such as adhesives, sealants, interior paints, coatings, varnish, carpets, composite wood and agrifiber products, etc., are used. Once the home is ready including the interiors, flushing will be effective in driving away the pollutants in the building.

While performing the building flush out, care should be taken with regard to humidity levels and microbial growth depending on the seasonal weather conditions. Allowing 100% outside air can be a challenge. Forced ventilation such as exhausts may be used to carry out the building flush out.

Benefits:

- ❖ Reduces exposure to air borne contaminants.
- ❖ Eliminates odour from recently installed building materials and finishes.

Documentation Required:

Precertification Level

(Only for Multi-dwelling Residential Units)

- ❖ Narrative stating the flush-out procedure that will be adopted.

Certification Level

(For Individual Residential Units & Multi-dwelling Residential Units)

- ❖ Narrative stating the flush-out procedure followed.
- ❖ Declaration letter from the owner/ developer indicating the dates and number of days for completing flush-out.

Exemplary Performance:

This credit is not eligible for exemplary performance under Innovation & Design Process.

Related Mandatory Requirements & Credits:

There are no related credits and mandatory requirements.

Definitions:

Contaminant is an unwanted airborne constituent that may reduce quality of the air.

Cross Ventilation

IEQ Credit 6 Points: 4

Intent:

Encourage adequate cross ventilation in the design thereby, providing a healthy environment.

Compliance Options:

Ensure that minimum 50% of the regularly occupied spaces (by area) in each dwelling unit shall have an opening (doors/ ventilators/ windows) to the outdoor environment, in atleast two of the orientations.

Points are awarded as below:

Percentage of regularly occupied spaces with cross ventilation	Points
≥ 50%	2
≥ 75%	4

Notes:

- *Regularly occupied spaces include living room, bed rooms, dining room, study room, kitchen, etc.,*
- *The doors/ ventilators/ windows should not have any obstruction within 2 m from outside surface.*
- *The opening considered should meet IEQ Mandatory Requirement 3 - Fresh Air Ventilation criterion.*
- *Regularly occupied spaces with an opening to the outdoors only in one orientation can also be considered for calculations, if there is a permanent opening to the adjoining room which meets cross ventilation criteria (refer figure no.2).*

(In figure no.2, along with the drawing room and kitchen, the living cum dining room will also have adequate cross ventilation through the permanent opening from drawing room).

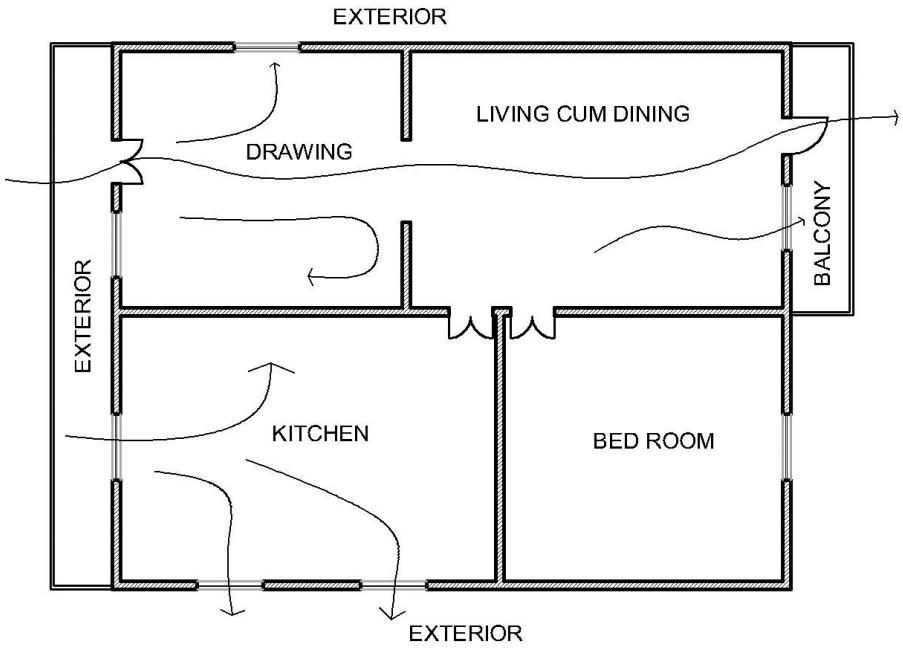


Figure No. 2 – Cross Ventilation

Green Building Concerns:

- ❖ Lack of good ventilation would result in adverse health impact for the occupants
- ❖ Cross ventilation facilitates continuous air changes in the space and removes the polluted indoor air. Sometimes, this may be compromised for want of space

Approach and Methodologies:

Cross ventilation is part of natural ventilation and is based on the paths of breeze and wind. Cross ventilation techniques use high and low pressure zones created by wind and breezes to draw fresh air through a building. The wind flow patterns, correct orientation of the house, placement of windows, doors and other openings is crucial for implementing the success of this strategy.

Fresh air ventilation is essential for providing acceptable indoor air quality and maintaining comfortable indoor environment. In addition, cross ventilation helps to bring more fresh air into interiors thereby removing hot air/ foul air to exteriors through multiple openings/ ventilators. In order to maintain acceptable air quality, ventilation systems must be designed to supply fresh air and exhaust stale air, either by natural or mechanical means.

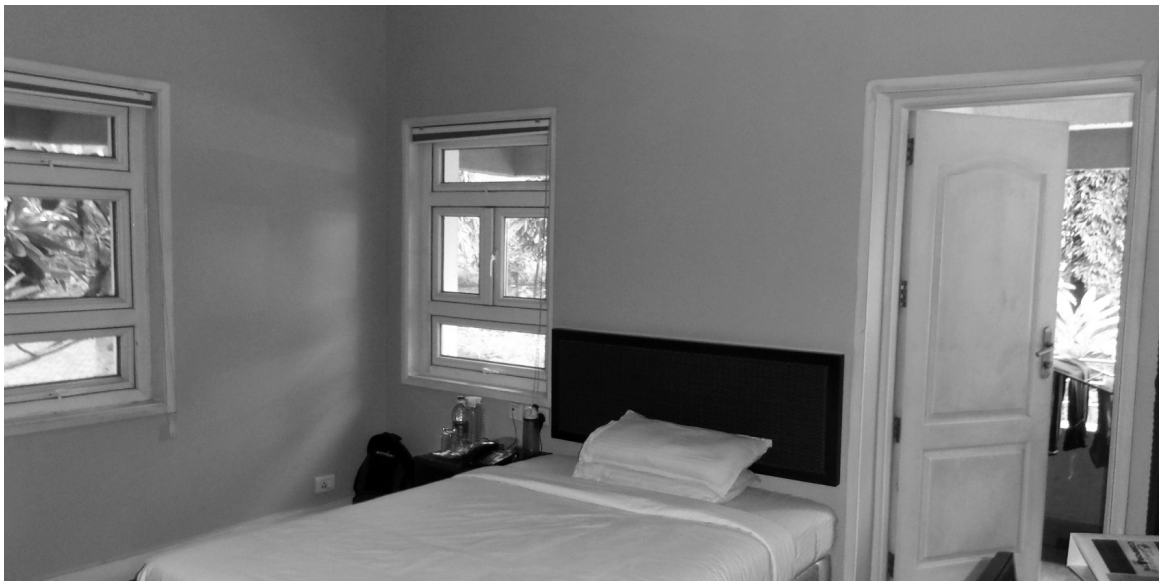
Adequate spaces between dwelling units is important to ensure cross ventilation. Many a time, this aspect is neglected which can lead to poor indoor environment, both in terms of indoor air and the daylighting aspect. Narrow corridors can impact the indoor environment as well. Providing cross ventilation for all living spaces especially in case of multi-dwelling units can be challenging. However through proper planning at the design stage, effective cross ventilation may be achieved.

Benefits:

- ❖ Enables good circulation of fresh air
- ❖ Controls humidity and eliminates odour
- ❖ Flushes out contaminants and provide a better indoor environment.

Sample Calculations:

Regularly Occupied Space	**Floor Area (sq.m)**	**Doors / Ventilators / Windows Opening in atleast Two Orientations** (Choose 'Yes'/ 'No' from drop-down below)	**Area with Cross Ventilation**
Living & Dining room	41.8	Yes	41.8
Bedroom 2	17.4	Yes	17.4
Bedroom 3	13.0	Yes	13.0
Master Bedroom	18.7	Yes	18.7
Kitchen	7.7	No	Not eligible
Total	**99**		**91**
Percentage of regularly occupied space with cross ventilation			**92.2%**



Picture 34: Photograph showing openings in two orientations for cross ventilation in living space

Documentation Required:

Precertification Level

(Only for Multi-dwelling Residential Units)

- ❖ Site/ master plan showing all the buildings.
- ❖ Conceptual floor plans with door and window schedule, for each typical dwelling unit.
- ❖ Tentative calculations indicating the regularly occupied spaces compliant with cross ventilation, for each typical dwelling unit.

Certification Level

(For Individual Residential Units & Multi-dwelling Residential Units)

- ❖ Site/ master plan showing all the buildings.
- ❖ Floor plans with door and window schedule, for each typical dwelling unit.
- ❖ Calculations indicating the regularly occupied spaces compliant with cross ventilation, for each typical dwelling unit.

Exemplary Performance:

This credit is eligible for exemplary performance under Innovation & Design Process, if more than 95% of the regular occupied spaces have cross ventilation.

Related Mandatory Requirements & Credits:

- ❖ IEQ Mandatory Requirement 2 – Minimum Daylighting (Carpet area and Door & Window schedule)
- ❖ IEQ Mandatory Requirement 3: Fresh Air Ventilation (Carpet area and Door & window schedules)
- ❖ IEQ Credit 1 – Enhanced Daylighting (Carpet area and Door & Window schedule)
- ❖ IEQ Credit 2 – Enhanced Fresh Air Ventilation (Carpet area and Door & window schedules)

Definitions:

Natural Ventilation is ventilation provided by thermal, wind or diffusion effects through doors, windows or other intentional openings in the building.

Ventilation is the process of supplying air to or removing air from a space for the purpose of controlling air contaminant levels, humidity or temperature within the space.

Innovation & Design Process

Introduction

Sustainable design practices & emerging technologies are constantly evolving. Due to the demand of innovative products, new technologies are continually introduced in the market. Designers have been continuously developing sustainable strategies for homes. Local conditions sometimes provide opportunities for unique sustainable solutions. Also, design strategies may result in exceeding the requirement of rating system to a great extent.

The Innovation and Design Process section has been developed to recognise and reward projects which have demonstrated exemplary performance in various categories in the IGBC green homes rating programme.This section provides an opportunity for the designer to innovate in their green designs which are unique and not addressed under any of the other sections in the rating programme.

Designing green homes is an integrated process, where the trained professional hand-holds the project team in terms of developing the documentation and educate them on the latest technologies for developing the sustainable design. It is encouraged to involve the accredited professional right from the earliest stages of the design development.

The Innovation & Design recognises project teams,who develop **'out-of-the-box'** sustainability solutions in their green home designs.

Innovation & Design Process

ID Credit 1 Points: 4

Intent:

Provide design teams and projects an opportunity to attempt for exemplary performance above thresholds set by the IGBC Green Homes Rating System and/or innovative performance in green building categories not specifically addressed by the IGBC Green Homes Rating System.

Compliance Options:

Credit 1.1: Innovation & Design Process

Identify the intent of the proposed innovation credit, the proposed requirement for compliance and the proposed documentation to demonstrate compliance and the design approach used to meet the required measures.

Credit 1.2: Innovation & Design Process

Same as credit 1.1

Credit 1.3: Innovation & Design Process

Same as credit 1.1

Credit 1.4: Innovation & Design Process

Same as credit 1.1

Approach and Methodologies:

Exemplary Performance: Projects should identify appropriate strategies that significantly exceed the requirements of IGBC Green Homes rating system credits. As a general rule, innovation credits for exemplary performance are awarded for doubling the credit requirements and/or achieving the next incremental percentage threshold. Eligibility criteria for different credits are defined in respective credits (refer Exhibit - B).

Innovative Performance: The projects can also identify the innovation strategies those are not addressed by any existing credits in the rating system. These strategies should demonstrate a comprehensive approach and have significant, measurable environmental benefits. For example, only signages in a building would not be considered a significant educational effort by itself. The measurable impacts of such interventions need to be identified and documented.

Notes:

The project should also meet the following criteria for achieving an Innovation point:

- *Quantitative performance improvements (comparing a baseline and design case)*
- *Strategy must be significantly better than standard sustainable design practices*
- *Measures must be voluntary. Measures that are mandated by the local bye-laws and addressed in the rating system, are not eligible for Innovation.*
- *Measures should be applied both in common areas and tenant areas, as applicable.*

Benefits:

❖ Leads to more sustainable design/ practices thereby benefiting the environment.

Documentation Required:

Precertification Level

(Only for Multi-dwelling Residential Units)

Innovation:

❖ A narrative describing intent, requirements, proposed potential strategies and technologies to be adopted to achieve the respective innovation credits. Strategies adopted must be significantly better than standard sustainable design practices.

❖ Tentative quantitative performance improvements, comparing baseline and design case.

❖ Other supporting documents such as drawings, illustrations, cut-sheets, test-reports, etc., as applicable.

Note:

There is no need to provide any other supporting documents, if these documents are available in the respective base credit folders.

For materials related credits, submit calculations supporting the claim.

Certification Level

For Individual Residential Units & Multi-dwelling Residential Units, provide the following:

INNOVATION & DESIGN PROCESS

Innovation:

- ❖ A narrative describing intent, requirements, potential strategies and technologies adopted in the respective innovation credits. Strategies adopted must be significantly better than standard sustainable design practices.
- ❖ Quantitative performance improvements, comparing a baseline and design case.
- ❖ Other supporting documents such as drawings, photographs, illustrations, cut-sheets, test reports, etc., as applicable.

Notes:

- *Measures must be voluntary. Such measures which are mandated by the local bye-laws and not addressed in the rating system are not eligible for Innovation..*
- *Measures should be done both in common areas and tenant areas, as applicable.*

Exemplary Performance:

- ❖ A narrative describing the proposed strategies to be adopted for exemplary performance in the respective base credits.

Exemplary Performance:

- ❖ A narrative describing the strategies adopted for achieving exemplary performance in the respective base credits.

Note:

No need to provide any other supporting documents, if these documents are available in the respective base credit folders.

- For materials related credits, submit calculations supporting the claim.

Related mandatory Requirements & credits:

Refer to the 'Exemplary Performance' of each credit in this reference guide.

Example for Innovative Performance:

One of the Projects has implemented a Green Housekeeping Programme for the apartment both in tenant & common areas. The project intended to adopt eco-friendly house keeping practices during maintenance by using bio-degradable / eco-friendly chemicals, to address health, hygiene and well-being of building occupant & maintenance staff.

In order to meet the credit compliance, the following submittal is to be provided:

- Intent
- Requirements
- Statement of Purpose
- Design Approach
- Procedural requirement of Operational Staff and Training

Exhibit B - List of Base Credits eligible for Exemplary Performance

Site Selection and Planning

SSP Credit 2	Natural Topography or Vegetation : 35%
SSP Credit 3	Heat Island Effect, Non Roof : 95%
SSP Credit 4	Heat Island Effect, Roof : 95% (Vegetation)

Water Efficiency

WE Credit 1	Landscape Design: 60%
WE Credit 3	Rainwater Harvesting, Roof & Non-roof: 95%
WE Credit 4	Water Efficient Plumbing Fixtures: 45%

Energy Efficiency

EE Credit 1	Enhanced Energy Performance : 33% (or) 22%
EE Credit 2	On-site Renewable Energy: 20% (or) 10%
EE Credit 3	Solar Water Heating System: 75%

Materials & Resources

MR Credit 3	Reuse of Salvaged Materials : 7.5% (or) 3%
MR Credit 4	Materials with Recycled Content : 30%
MR Credit 5	Local Materials : 75%
MR Credit 6	Rapidly Renewable Building & Certified Wood Materials : 95%

Indoor Environmental Quality

IEQ Credit 6	Cross Ventilation : 95%

IGBC Accredited Professional

ID Credit 2 Point: 1

Intent:

Support and encourage involvement of IGBC Accredited Professional in green home projects, so as to integrate appropriate design measures and streamline certification process.

Compliance Options:

Atleast one principal participant of the project team shall be an IGBC Accredited Professional.

Approach and Methodologies:

Identify an IGBC Accredited Professional who has expertise in IGBC rating systems and green building concepts. The Accredited Professional understands the importance of integrated design and considers synergy amongst various requirements.

Benefits:

- ❖ Hand holding the project team in designing green buildings
- ❖ Impart knowledge to other team members about green buildings

Documentation Required:

Precertification Level

(Only for Multi-dwelling Residential Units)

- ❖ A copy of IGBC Accredited Professional certificate of the principal participant.

Certification Level

For Individual Residential Units & Multi-dwelling Residential Units, provide the following:

- ❖ A copy of IGBC Accredited Professional certificate of the principal participant.

Related Mandatory Requirements & Credits:

There are no mandatory requirements or credits.

Annexures

Annexure - I : Baseline Criteria for Energy Performance of the Building

A. Envelope Measures:

(* For Climatic Zones of India, please refer Exhibit – C)

Fenestration - SHGC value

Climate Zone *	Maximum SHGC Value		
	WWR < 20%	WWR 20 to 30%	WWR > 30%
Composite	0.5	0.42	0.36
Hot and Dry	0.5	0.42	0.36
Warm and Humid	0.5	0.42	0.36
Moderate	0.6	0.48	0.40
Cold	0.8	0.80	0.80

Glazing U-value

Climate Zone *	Maximum U-Value (W/m^2K)
Composite	5.7
Hot and Dry	5.7
Warm and Humid	5.7
Moderate	5.7
Cold	5.7

Wall Assembly U Value

Climate Zone *	Maximum 'U'-Value of the Overall Wall Assembly (W/m^2K)
Composite	2.5
Hot and Dry	2.5
Warm and Humid	2.5
Moderate	2.5
Cold	1.1

Roof Assembly U Value

Climate Zone *	Maximum 'U'-Value of the Overall Roof Assembly (W/m^2K)
Composite	1.2
Hot and Dry	1.2
Warm and Humid	1.2
Moderate	1.8
Cold	1.2

B. Lighting Power Density

The Lighting Power Density (LPD) can be achieved by the Building area method. The baseline LPDs are outlined as below:

Lighting	Applicable Areas	Baseline Lighting Power Density (LPD)
Interior Lighting (for residential units)	Individual dwelling unit, Apartments, Villas, Gated communities	5.0 W/m^2
Interior Lighting (for non-residential units)	Resorts, Motels, Service apartments, Hostels, Guest houses, etc.,	10.8 W/m^2
Exterior Lighting, excluding Parking Area (for residential & non-residential units)	Landscaping, Façade, Street lighting, Pathways, Signages, etc.,	2.5 W/m^2
Common Area Lighting, excluding Parking Area (for residential & non-residential units)	Corridors, Lobbies, Staircases, Terrace, etc.,	4.0 W/m^2
Parking Area	Surface parking (covered & uncovered), Basement parking,	2.5 W/m^2

Notes:

- ***Individual dwelling unit should show compliance for interior and exterior lighting, whereas Multi-dwelling units should show lighting compliance for all the areas which are in developer's/ owner's scope only.***

- ***Compliance for interior, exterior, common and parking area lighting must be shown separately.***
- ***Decorative lighting in respective areas should be considered for lighting power density calculations.***
- ***The areas considered to calculate the LPD should be those areas which are illuminated by external lighting (not the entire exterior area).***
- ***This LPD includes the power consumption of the complete fixtures which include lamps and ballasts.***
- ***Solar powered street lights may be deducted from exterior lighting LPD calculations.***

C. Air conditioning and Heating Systems/ Equipment

(* For Climatic Zones of India, please refer Exhibit – C)

Depending on the climatic zone, heating/ cooling systems should be considered as follows:

Heating and Cooling requirements for Climatic Zones:

Climate Zone *	System
Composite	Cooling & Heating (for places having more than 150 Heating degree days** – HDD18)
Hot and Dry	Cooling
Warm and Humid	Cooling
Moderate	Cooling
Cold	Heating

- **Degree day: The difference in temperature between the outdoor mean temperature over 24 hour period and a given base temperature
- **Heating degree day base 18^{o}C, HDD 18: for any one day, when the mean temperature is less than 18^{o}C, there are as many degree-days as degree Centigrade temperature difference between the mean temperature for the day and 18^{o}C. Annual heating degree-days (HDDs) are the sum of the degree-days over the calendar year.

Air-Conditioners:

- **Unitary air-conditioners**

  Baseline air-conditioning system to be considered as unitary air-conditioners with COP/ EER equivalent to 3-star rated equipment under BEE labeling programme.

  For latest list of air-conditioners rated by BEE, please refer BEE website http://www.bee-india.nic.in

❖ **Centralised air-conditioner systems**

The baseline COP/ IPLVs for centralised air-conditioning systems are detailed below:

Minimum Efficiency Requirements

Equipment Type	Size Category	Minimum Efficiency	Test Procedures
Air-Cooled, with Condenser, Electrically Operated	All Capacities	2.80 COP 3.05 IPLV	ARI 550/590
Air-Cooled, without Condenser, Electrically Operated	All Capacities	3.10 COP 3.45 IPLV	
Equipment Type	**Size Category**	**Minimum Efficiency**	**Test Procedures**
Water-Cooled, Electrically Operated	All Capacities	4.45 COP 5.20 IPLV	ARI 550/590
Air-Cooled Absorption, Single Effect	All Capacities	0.60 COP	ARI 560
Water-Cooled Absorption, Single Effect	All Capacities	0.70 COP	
Absorption Double Effect, Indirect-Fired	All Capacities	1.00 COP 1.05 IPLV	
Absorption Double Effect, Direct-Fired	All Capacities	1.00 COP 1.00 IPLV	

Note: *Minimum Efficiency Requirements for VRF Systems can be referred from ASHRAE Standard 90.1-2010*

Heat Pumps:

For buildings with unitary heat pumps, the minimum efficiency requirements are detailed below.

Minimum Efficiency Requirements for Packaged Terminal Heat Pumps (PTHP)

Equipment Type	Size Category (Input)	Minimum Efficiency COP	Test Procedures
PTHP (Heating Mode)	All capacities	2.5	ARI 310/380

Annexure - II : Prescriptive Criteria for Building Envelope Measures *(EE Credit 1 - Enhanced Energy Performance)*

A. Envelope Measures:

(* For Climatic Zones of India, please refer Exhibit – C)

Fenestration - SHGC value

Climate Zone *	Maximum SHGC Value		
	WWR < 20%	WWR 20 to 30%	WWR > 30%
Composite	0.38	0.32	0.27
Hot and Dry	0.38	0.32	0.27
Warm and Humid	0.38	0.32	0.27
Moderate	0.50	0.40	0.30
Cold	0.80	0.80	0.80

Glazing U-value

Climate Zone *	Maximum U-Value (W/m^2K) WWR ≤ 30%	Maximum U-Value (W/m^2K) WWR > 30%
Composite	3.3	2.8
Hot and Dry	3.3	2.8
Warm and Humid	3.3	2.8
Moderate	5.7	3.3
Cold	3.3	2.8

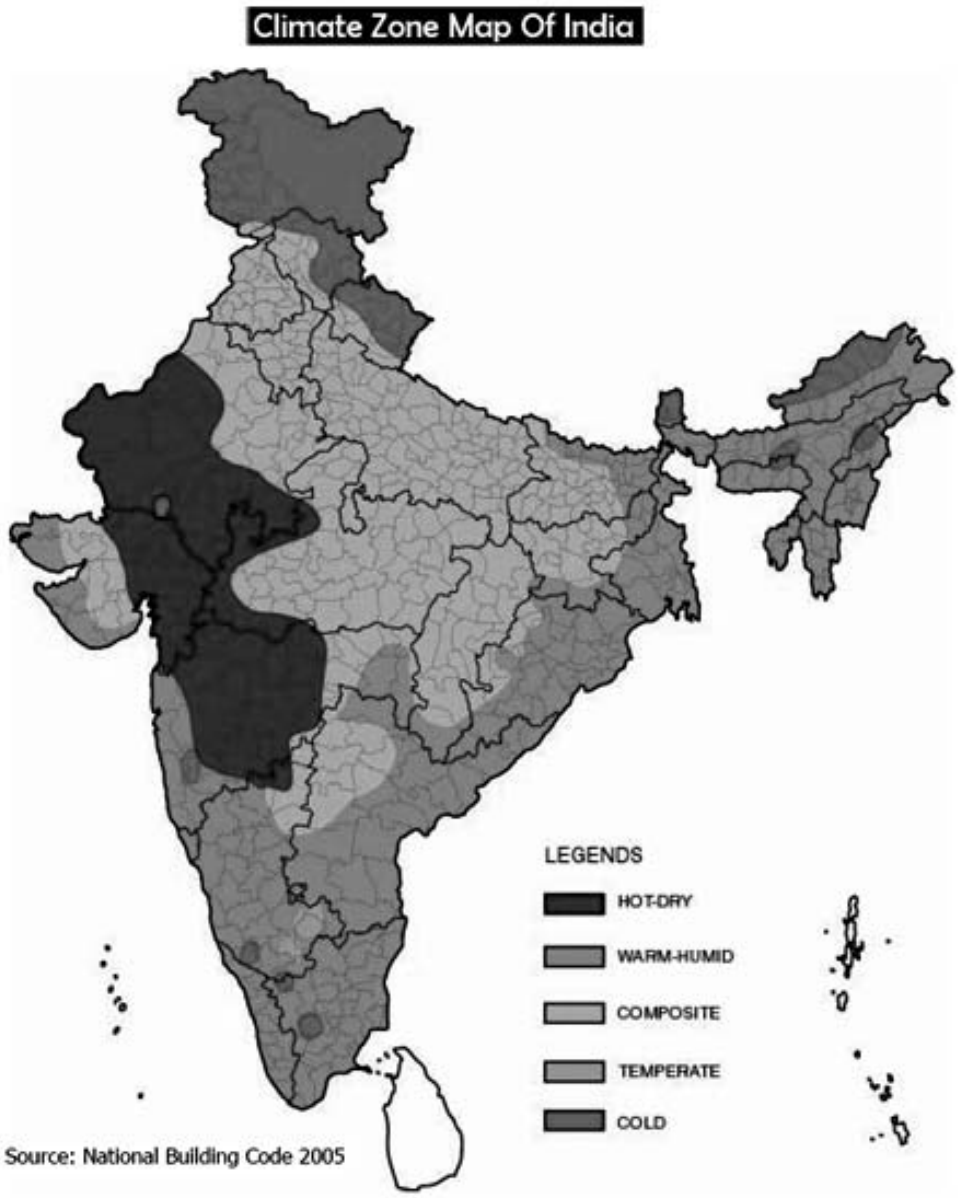
Wall Assembly U-value

Climate Zone *	Maximum 'U'-Value of the overall assembly (W/m2K)
Composite	1.8
Hot and Dry	1.8
Warm and Humid	1.8
Moderate	1.8
Cold	0.8

Roof Assembly U-value

Climate Zone *	Maximum 'U'-Value of the overall assembly (W/m2K)
Composite	0.5
Hot and Dry	0.5
Warm and Humid	0.5
Moderate	0.75
Cold	0.5

Exhibit C – Climatic Zones of India



Annexure - III : Protocol for Building Energy Simulation

Performance Based Approach

This method can be adopted for buildings which implement energy efficiency measures beyond those specified in the baseline parameters outlined in Annexure I.

Simulation General Requirements

❖ **Performance Evaluation:**

The proposed building performance and baseline building performance shall be evaluated using the same:

(a) Simulation program

(b) Weather data

(c) Energy rates

❖ **Simulation Program:**

The simulation program shall be a computer-based program for the analysis of energy consumption in buildings. A program such as, but not limited to, DOE-2 (or using DOE-2 based programmes), IES, BLAST, or Energy Plus may be used. The simulation program shall include calculation methodologies for the building components being modeled. For components which cannot be modeled by the simulation program, the project may submit calculations for performance of such components.

The simulation program shall, at a minimum, have the ability to explicitly model all of the following:

- 8,760 hours per year
- Hourly variations in occupancy, lighting power, miscellaneous equipment power, thermostat set points, and HVAC system operation, defined separately for each day
- Thermal mass effects
- Two or more thermal zones
- Part-load performance curves for mechanical equipment
- Capacity and efficiency correction curves for mechanical heating and cooling equipment
- The simulation program shall have the ability to either (1) directly determine the proposed building performance and baseline building performance or (2) produce hourly reports of energy use by an energy source suitable for determining the proposed building performance and baseline building performance using a separate calculation.

❖ **Climate Data:**

The simulation program shall perform the simulation using hourly values of climatic data, such as temperature and humidity from representative climatic data, for the site in which the proposed design is to be located. For cities or urban regions with several climatic data entries, and for locations where weather data are not available, the designer shall select available weather data that best represent the climate at the construction site. The selected weather data shall be approved by IGBC.

❖ **Energy Rates:**

Annual energy costs shall be determined using actual rates for purchased energy.

❖ **On-Site Renewable Energy Sources:**

Projects which use on-site renewable energy sources (such as solar photovoltaic, wind turbines, etc.,) can be subtracted from the total energy of the proposed case.

❖ **Water Heating Systems:**

Solar hot water systems should not be modeled in either the base case or the proposed case, to show energy savings. Such systems are separately recognised under EE Credit 3 – Solar water heating systems.

❖ **Exceptional Calculation Methods:**

Where no simulation program is available that adequately models a design, material, or device, IGBC may approve an exceptional calculation method to demonstrate above-standard performance using this method. Applications for approval of an exceptional method shall include documentation of the calculations performed and theoretical and/or empirical information supporting the accuracy of the method.

❖ **Schedules:**

Schedules capable of modeling hourly variations in occupancy, lighting power, miscellaneous equipment power, thermostat set points, and HVAC system operation shall be used. The schedules shall be typical of the proposed building type as determined by the designer and approved by IGBC.

❖ **General Baseline HVAC System Requirements**

- **Equipment Efficiencies:**
- All HVAC equipment in the baseline building design shall be modeled at the minimum efficiency levels, both part load and full load. Where efficiency ratings, such as EER and COP, include fan energy, the descriptor shall be broken down into its components so that supply fan energy can be modeled separately.

- **Equipment Capacities:**
- The equipment capacities for the baseline building design shall be oversized by 15% for cooling and 25% for heating as compared to the system sizing done by the simulation programme.
- **Unmet Load Hours:** (for centralised air-conditioning system)

  Unmet load hours for each of the zones in the proposed design or baseline building designs shall not exceed 300 hours. The unmet hours in the proposed case shall not exceed the unmet hours in the base case by more than 50 hours.

  If unmet load hours for the proposed design or baseline building design exceed 300, simulated capacities shall be increased incrementally, and the building with unmet loads shall be re-simulated until unmet load hours are reduced to 300 or less.
- Fan System Operation: (for centralised air-conditioning system)
- Supply and return fans shall operate continuously whenever spaces are occupied and shall be cycled to meet heating and cooling loads during unoccupied hours. If the supply fan is modeled as cycling and fan energy is included in the energy-efficiency rating of the equipment, fan energy shall not be modeled explicitly. Supply, return, and/or exhaust fans will remain on during occupied and unoccupied hours in spaces that have health and safety mandated minimum ventilation requirements during unoccupied hours.
- Ventilation:
- Minimum outdoor air ventilation rates shall be the same for the proposed and baseline building designs. Design a ventilation system for air-conditioned spaces, as 5 cfm per person for each air-conditioned space in base case.
- Design Air Flow Rates: (for centralised air-conditioning system)
- System design supply air flow rates for the baseline building design shall be based on a supply-air-to-room-air temperature difference of 11.1°C (20°F). If return or relief fans are specified in the proposed design, the baseline building design shall also be modeled with fans serving the same functions and sized for the baseline system supply fan air quantity less the minimum outdoor air, or 90% of the supply fan air quantity, whichever is larger.

❖ **Heat Pumps:**

Electric air-source heat pumps shall be modeled with electric auxiliary heat. The systems shall be controlled with multistage space thermostats and an outdoor air thermostat wired to energize auxiliary heat only on the last thermostat stage and when outdoor air temperature is less than 4.4°C (40°F).

❖ **Receptacle and Process Loads:**

Both the proposed building performance and the baseline building performance shall include all end-use load components, such as receptacle and process loads.

Receptacle, process and equipment loads shall be estimated based on the building type or space type category and shall be assumed to be identical in the proposed and baseline building designs. These loads shall be included in simulations of the building and shall be included when calculating the baseline building performance and proposed building performance.

The default receptacle and process loads cost shall be considered as 25% of the total energy cost for the baseline building.

For buildings, where the process energy cost is less than 25% of the baseline building energy cost, the submittal must include supporting documentation substantiating that process energy inputs are appropriate.

Receptacle and Process loads include, but not limited to, refrigerator, washing machine, television, electric geysers, computers, parking garage exhaust, pumps & motors, elevators, etc.,

Documentation Requirements:

Simulated performance shall be documented, and documentation shall be submitted. The information submitted shall include the following:

1. A list of the energy-related features which are included in the design. This list shall document all energy features that differ between the models used in the baseline building performance and proposed building performance calculations.
2. Comparison & calculated values for the baseline building performance and the proposed building performance.
3. The percentage improvement in energy consumption between baseline building performance and proposed building performance.
4. The schedules for lighting power, thermostat set-point, HVAC system, miscellaneous equipment power, etc., for proposed building, as determined by the designer.
5. Input and output report(s) from the simulation program or compliance software including a breakdown of energy usage by atleast the following components: lights, space cooling & heating equipment and heat rejection equipment, fans, other HVAC equipment (such as pumps), internal equipment loads, etc.,. The output reports shall also show the amount of time any loads are not met by the HVAC system for both the proposed design and baseline building design.
6. An explanation of any error messages noted in the simulation program output.

Annexure - III : Protocol for Building Energy Simulation

Calculation of the Proposed and Baseline Building Performance

Building energy modeling requirements for proposed and baseline building:

The baseline model shall be identical to the proposed model except as specifically detailed in the table below.

S. No.	Case	Proposed building	Baseline building
1.	Design model	a) The simulation model of the proposed design shall be consistent with the actual design and should include envelope measures and all systems b) All end use energy consumers in the building and associated with the building must be modeled.	a) The baseline model should have the same conditioned area and same number of floors as the proposed building. b) All end use energy consumers in and associated with the building in the base case should be the same as the proposed case
2.	Schedules	The schedules for lighting power, thermostat set-point, HVAC system, miscellaneous equipment power, etc., shall be typical of the proposed building as determined by the designer.	Same as proposed design
3.	Building envelope	All components of the building envelope in the proposed design shall be modeled as shown on architectural drawings or as installed for existing building envelopes. a) Orientation: As per design	The standard design shall have identical conditioned, unconditioned floor area and identical exterior dimensions and orientations as proposed design, unless otherwise mentioned. a) Orientation: The baseline energy performance shall be the average of the performance with original orientation and after rotating the entire building 90, 180, 270 degrees. The building shall be modeled so that it does not shade itself.

S. No.	Case	Proposed building	Baseline building
		b) Opaque assemblies such as roof and walls shall be modeled with the same heat capacity and U-value as per proposed design.	b) Opaque assemblies such as roof and walls shall be modeled with the same heat capacity as the proposed design but the U-values as per Annexure I.
		c) Fenestration: as per design manually operated fenestration shading devices such as blinds or shades shall not be modeled. Permanent shading devices such as fins, overhangs, and light shelves shall be modeled.	c) Fenestration: Fenestration areas shall be equal to that in the proposed design or 30% of gross wall area above grade, whichever is smaller, shall be distributed on each face of the building in the same proportions in the proposed design. • No shading projections are to be modeled; fenestration shall be assumed to be flush with the exterior wall or roof. • Manually operated fenestration shading devices such as blinds or shades shall not be modeled. • Fenestration U-factor and SHGC shall be as per Annexure I.
		d) For exterior roofs the reflectance and emittance of the roof surface shall be modeled as 0.45 if the actual value is more than 0.7 for reflectance and 0.75 for emittance.	d) Roof albedo: all roof surfaces shall be modeled with a reflectivity of 0.30.

S. No.	Case	Proposed building	Baseline building
4.	Lighting	Lighting power in the proposed design shall be as per the actual design. In addition, the following Energy conservation measures (ECM) can be factored, if considered in design. a) Occupancy/Motion sensors with daylight cut-off features used in the common areas (like staircases, common corridors, parking areas) in the proposed case, should not be modeled but can be giving a direct saving upto15% over the lighting power of those fixtures connected to such sensors. b) Using timer/ daylight based controls for the external lighting systems (areas like façade lighting, landscape lighting, and street lighting) will have a direct saving upto15% on the lighting power of those fixtures connected to such controls. ***Notes:*** ***Individual residential unit – Interior & Exterior LPDs should be considered as per design.*** ***Multi-dwelling residential units - Interior LPD should be same as base case (or, as per design, if interior lighting is in the scope of developer) and Exterior, Common & Parking area LPD should be considered as per design.***	Lighting power in the standard design shall be determined using the Baseline values as detailed in Annexure - I.

S. No.	Case	Proposed building	Baseline building
5.	Heating and Cooling systems	a) Where a cooling and heating system has been designed for more than 25% of living spaces of the project, the model shall be consistent with design documents. b) Where no heating or cooling system is proposed, the system shall be same as the baseline.	a) The Cooling system for the base case is to be modeled considering the system defined in Annexure I. If the building requires heating (as defined in the table 'Heating and Cooling Requirements for Climatic Zones' of Annexure I) the heating system would incorporate heat pump with efficiencies as per the baseline criteria – Annexure I. ***Notes:*** ***Individual & Multi-dwelling residential units:*** • ***In actual design, if less than 25% of living spaces are air-conditioned, then model atleast 25% of living spaces as air-conditioned in both base case and proposed case.*** • ***If more than 25%, then consider air-conditioned area as per actual design in both base case and proposed case.*** • ***The project should consider minimum of 12 hours per day for atleast 120 days in a year (for cooling & heating in summer and winter respectively), for air-conditioning in both base case and proposed case.***

S. No.	Case	Proposed building	Baseline building
6.	Receptacle and Process loads	a) Receptacle and Process loads shall be modeled as designed. All end-use load components shall be modeled.	a) Receptacle and Process loads shall be modeled same as the proposed design. ***Notes:*** • ***The default receptacle and process loads cost shall be considered as 25% of the total energy cost for the baseline building.*** • *For buildings, where the process energy cost is less than 25% of the baseline building energy cost, the submittal must include supporting documentation substantiating that process energy inputs are appropriate.*

Note: In cases, where the parameters and their values are not specified in the protocol, they should be referred to ECBC or ASHRAE 90.1 – 2007. If the values are specified neither in ECBC nor in ASHRAE 90.1 – 2007, they should be taken from the proposed design.

Format for Reporting Energy Simulation Results:

Energy Savings

End Use	Proposed Building			Baseline Building		Percentage Savings
	Energy	Energy	Peak	Energy	Peak	Energy
	Type	(10^6 kWh)	(10^6 kW)	(10^6 kWh)	(10^6 kW)	(%)
Interior Lighting*	Electricity					
Exterior Lighting*	Electricity					
Air-conditioning						
Space Heating	Electricity					
Total Building Consumption						

Energy Cost Savings

Energy Savings	Proposed Building		Base Building		% Improvement	
	Energy Use (10^6 kWh)	Energy Cost (Rs/yr)	Energy Use (10^6 kWh)	Energy Cost (Rs/yr)	Energy %	Cost %
Electrical energy						
Savings through exceptional methods						
Total						

Notes:

- *The tables detailed are not exhaustive and only indicate the format for energy savings from the energy simulation results.*
- **Interior space lighting, common area lighting, exterior lighting and parking area lighting power density calculations should also be submitted along with simulation report.*
- *A sample energy simulation report can be referred under Annexure-IV*

The improved performance of the proposed building design shall be calculated using the following formula:

$$\text{Percentage improvement} = 100 \times \frac{(\text{Baseline building performance} - \text{Proposed building performance})}{\text{Baseline building performance}}$$

Annexure - IV :

Performance Approach – Sample energy simulation report

The following is an example that shows how the performance based approach is applied to a Green Home Project. The apartment is a 37-storey; 2,186 dwelling unit residential complex which consists of 7 podium floors for parking with fitness center on 7th podium. The residential units comprise from 9th floor to 37th floor. The Project is analyzed for energy performance using the **Visual DOE 4.1 software program.**

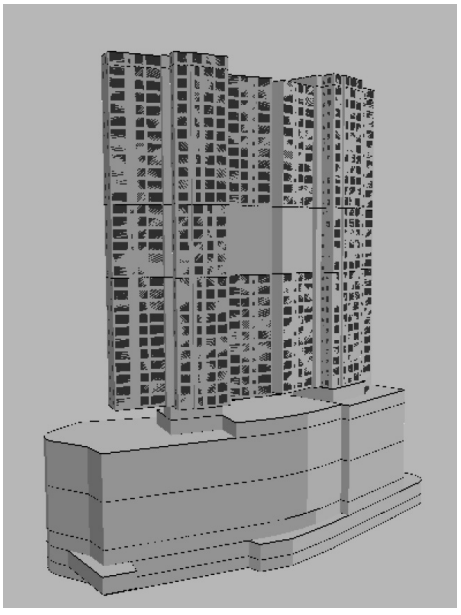
The base building is simulated with actual orientations and then again simulated after rotating the buildings to 90, 180 and 270 degrees. The average of all the 4 cases is the considered as Baseline case for comparing the energy consumption with the proposed building case.

The Proposed case is determined by incorporating the feasible Energy Conservation Measures to the baseline case. Annual Energy saving compared to the budget case are determined in the terms of percentage of operational cost savings.

Note: Actual Geometry of the Budget and the proposed building remains the same.

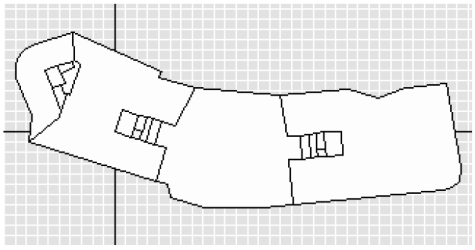
Building Model & Geometry:

The 3-dimensional graphical display of the proposed project as seen in the Visual DOE is attached below:

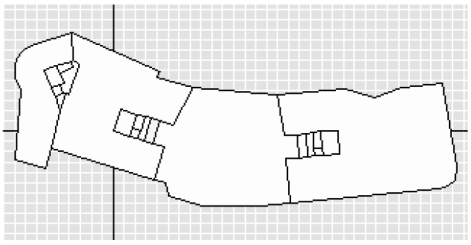


3D Model of project

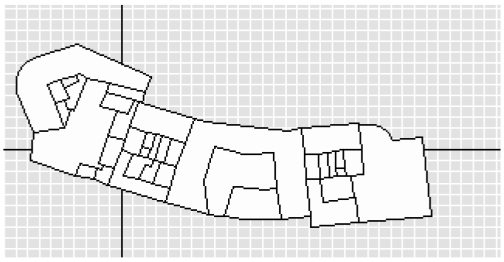
Following are the Individual Floor Plans which are modeled close to the actual floor plans and only few simplifications were made to improve the accuracy of the modeling software.



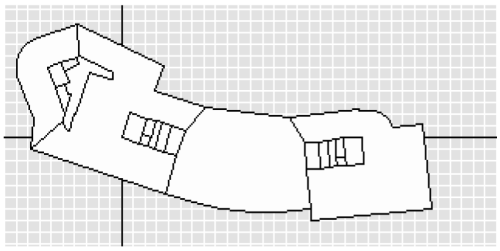
Lower basement



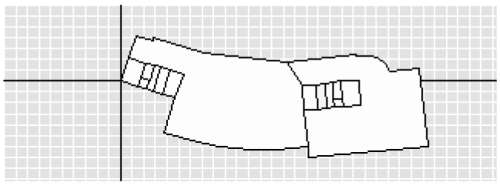
Upper basement



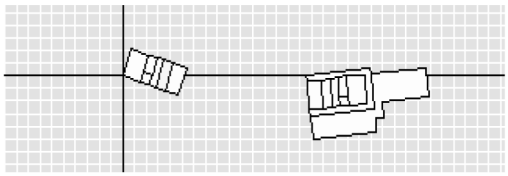
Ground Floor



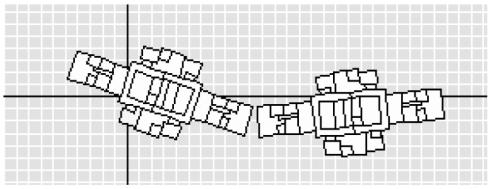
Podium Floors



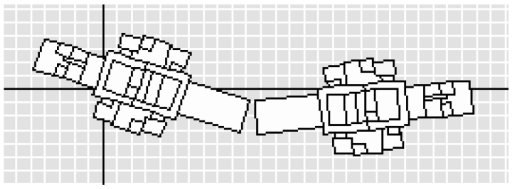
7th Podium Floor



8th Service floor



Typical Floors



Refuge Floors

Weather Data:

The weather data file for city of Mumbaiwas taken from ISHRAE with the following details:

Latitude (°N) : 18.9

Longitude (°E) : 72.8

Annexure - IV : Sample energy simulation report

Baseline & Proposed Design Input parameters:

The building was first modeled on the basis of the guidelines specified in reference guide of IGBC Green Homes. The building was simulated with following input parameters:

Comparison of Proposed & Baseline Parameters:

Building Element	Proposed Design Input	Baseline Design Inputs (Annexure-I)
Envelope		
Exterior Wall Construction	U-factor= 0.28Btu/hr.ft20F (6" flyash brick wall with plaster on both sides)	U-factor=0.22Btu/hr.ft20F
Roof Construction	RCC slab+ 3" overdeck insulation + China mosaic U-factor=0.088 Btu/ hr.ft2.0F	Insulation entirely over deck U-factor = 0.088 Btu/ hr.ft2.0F.
Window-to-gross wall ratio	19.2%	19.2%
Fenestration type	Single glazed unit (SGU)	All Orientations
Fenestration U-factor	0.99 Btu/hr.ft2.0F	0.88 Btu/hr.ft2.0F
Fenestration SHGC - North	0.47	0.38
Fenestration SHGC - Non-North	0.47	0.38
Fenestration Visible Light Transmittance	0.52	0.30
Shading Devices	Yes in the form of overhangs for windows of bedrooms and living rooms	None
Electrical Systems & Process Loads		
Interior Lighting Power Density (W/sq. ft.)	Space by space method – As per the design provided – 20% reduction only in common areas like stairs, lift lobbies, parking etc	Space by space method – as provided in Annexure 1 of IGBC HOMES guidelines
Exterior Lighting Power	Total Power = 12 kW	Total Power = 15 kW
Process Lighting (kW)	None	None

Building Element	Proposed Design Input	Baseline Design Inputs (Annexure-I)
Receptacle Equipment Power Density (Watts)	Different values for different areas: 1. Liv./Din. : 1.5 w/sq.ft. 2. Kit. : 3.0 w/sq.ft. 3. Bed. : 1.0 w/sq.ft. 4. Gym : 2.0 w /sq.ft.	Different values for different areas: Liv./Din. : 1.5 w/sq.ft. Kit. : 3.0 w/sq.ft. Bed. : 1.0 w/sq.ft. Gym : 2.0 w /sq.ft.
Mechanical & Plumbing Systems		
Primary HVAC System Type	**Packaged terminal air conditioner of EER of 2.7** Note: All bedrooms & living are considered as Air-conditioners to quantify the effect of excellent envelope. The developer would not provide air-conditioner to these areas. Hence EER will be considered 2.7. EER considered for Gymnasium is 3.1	This is a Residential building. Baseline System Description is as follows:- **Packaged terminal air conditioner of EER of 2.7** Note: All bedrooms and living rooms are considered as Air-conditioners to quantify the effect of excellent envelope. The developer would not provide air-conditioner to these areas.
Water Heating system	Same as baseline	Electric water heating with 20 lit/person/day as prescribed by IGBC Green Homes Guidelines
Basement Ventilation	CO sensor based ventilation	No sensor based operation

Basement Ventilation:

CO monitoring would be installed in basement and it was modeled with a shift of 9 hours, it is assumed that the maximum vehicular movement in the parking areas would happen only for 2 hours, in which the amount of CO levels would raise above the acceptable level, triggering the fans. (Since Visual DOE has restriction on number of end meters basement ventilation and elevator kW was clubbed under Ext. Equipment energy end use).

Annexure - IV : Sample energy simulation report

Here as the usage is residential we have assumed the operation for 12 hours wherein maximum vehicular movement would be for 4 hours.

Base case : 224 kW

Proposed case : 196 kW

Table - Average budget case figures of Annual Energy Consumption

The following tabulated values determine the Average budget case figures of annual energy consumption of the building. The budget case was initially modeled with the original orientation and then again modeled each time by rotating the same to 90, 180 and 270 degrees

Table 5: Baseline Performance – Performance Rating Method Compliance							
Particulars	**Energy Type**	**Annual Energy & Peak Demand**	**0° rotation**	**90° rotation**	**180° rotation**	**270° rotation**	**Average Baseline**
Interior Lighting	Electricity	Energy Use (Kwh)	848,568	848,568	848,568	848,568	848,568
Equipment	Electricity	Energy Use (Kwh)	641,174	641,174	641,174	641,174	641,174
Heating	Electricity	Energy Use (Kwh)	0	0	0	0	0
Cooling	Electricity	Energy Use (Kwh)	629,276	678,424	631,262	675,746	653,677
Ventilation Fans	Electricity	Energy Use (Kwh)	388,190	402,307	395,067	396,113	395,419
Hot Water	Electricity	Energy Use (Kwh)	38,647	38,647	38,647	38,647	38,647
Exterior Lighting	Electricity	Energy Use (Kwh)	50,644	50,644	50,644	50,644	50,644
External Equip.	Electricity	Energy Use (Kwh)	897,017	897,017	897,017	897,017	897,017
Total	**Electricity**	**Energy Use (Kwh)**	**3,493,516**	**3,556,781**	**3,502,379**	**3,547,909**	**3,525,146**

Table 6: Percentage Improvement				
Particulars	**Energy Type**	**Annual Energy &** Peak Demand	**Proposed Building results**	**Baseline building results**
Interior Lighting	Electricity	Energy Use (Kwh)	**771,364**	**848,568**
Equipment	Electricity	Energy Use (Kwh)	**641,174**	**641,174**
Heating	Electricity	Energy Use (Kwh)	**0**	**0**
Cooling	Electricity	Energy Use (Kwh)	**588,490**	**653,677**
Ventilation Fans	Electricity	Energy Use (Kwh)	**313,512**	**395,419**
Hot Water	Electricity	Energy Use (Kwh)	**38,647**	**38,647**
Exterior Lighting	Electricity	Energy Use (Kwh)	**40,516**	**50,644**
External Equip.	Electricity	Energy Use (Kwh)	**775,669**	**897,017**
Total	Electricity	Energy Use (Kwh)	**3,169,372**	**3,525,146**
Savings	Electricity	Energy Use (Kwh)		**11.23%**

The proposed project can achieve 11.23% savings over the base building thus yielding 6 pointsfor Energy Efficiency.

Annexure - V

List of Plants: Drought Tolerant Species for different Climatic Zones in India

Note: The Species listed below are only illustrative and not exhaustive

LIST OF DROUGHT TOLERANT PLANT SPECIES OF DIFFERENT CLIMATIC ZONES				
HOT - DRY	**TREES**		**SHRUBS**	
	Botanical Name	Common Name	Botanical Name	Common Name
1	Prosopis cinerarea	Khejdi, Saangri	Bambusa Sps.	Bamboo
2	Ficus religiosa	Peepal	Asparagus racemosus	Shatawari
3	Syzigium cumini	Jaamun	Commiphora mukul	Indian bedellium, Guggal
4	Ziziphus mauritiana	Ber, Indian jujube		
5	Phoenix dactylifera	Khajur, Dates palm		
6	Acacia leucophloea	Ronjh, Ahite barked acacia		
7	Holoptelea integrifolia	Kanju, Indian elm		
WARM - HUMID	**TREES**		**SHRUBS**	
	Botanical Name	Common Name	Botanical Name	Common Name
1	Lagerstromia Lanceolata	Crape-myrtle	Bambusa Sps.	Bamboo
2	Saraca Ashoka	Ashoka	Ocimum sanctum	Tulasi
3	Ficus bengalensis	Banyan	Hybiscus rosasinensis	Jupa
4	Dalbergia latifolia	Shisham, Indian Rosewood	Vetiveria zizanioides	Vetiver grass, Khas
5	Terminalia paniculata	Kindal	Alpinia sps.	

LIST OF DROUGHT TOLERANT PLANT SPECIES OF DIFFERENT CLIMATIC ZONES				
WARM - HUMID	**TREES**		**SHRUBS**	
6	Madhuca indica	Mahua	Hedychium coronarium	
7	Musa paradisiaca	Plantain	Pleomele reflexa	
8	Barringtonia racemosa	Cornbeefwood	Bougainvillea sps.	
9	Cassia fistula	Indian Laburnum, Amaltas	Acalypha wilkesiana	
10	Prosopis julifora	Kabuli keekar	Eclipta alba	Brungaraja
11	Cocos nucifera	Coconut	Chrysanthem Indicum	Sevantika
COMPOSITE	**TREES**		**SHRUBS**	
	Botanical Name	**Common Name**	**Botanical Name**	**Common Name**
1	Azadirachta indica	Neem	Alpinia Sps.	
2	Cassia fistula	Indian Laburnum, Amaltas	Barleria cristata	
3	Delonix regia	Gulmohur	Bougainvillea sps.	
4	Ficus religiosa	Peepal	Caesalpinia pulcherimma	
5	Syzigium cumini	Jaamun	Tabernamontana	
6	Albizia lebek	Shirish, East Indian walnut	Furcraea gigantea	
7	Callistemon lanceolatus	Bottlebrush	Hibiscus Sps.	
8	Erythrina variegata	Indian coral tree	Ixora varities	
9	Dalbergia latifolia	Shisham, Indian Rosewood	Nerium oleander	

Annexure - V : List of Drought Tolerant Species

LIST OF DROUGHT TOLERANT PLANT SPECIES OF DIFFERENT CLIMATIC ZONES				
COMPOSITE	**TREES**		**SHRUBS**	
	Botanical Name	**Common Name**	**Botanical Name**	**Common Name**
10	Jacaranda mimosaefolia	Jacaranda	Ocimum sanctum	Tulasi
11	Grevillea robusta	Silver Oak	Solanum Indicum	Bruhati
12	Anthocepalus cadamba	Kadamba	Datura alba	Dhatura, Thorn apple
13	Plumeria	Temple tree, Frangipani	Calatropis gigantea	Arka
14	Polyalthia longifolia	Ashok	Jasminum sambac	Mallika
15	Pongamia pinnata	Karanj, Indian Elm	Indian pennywort	Brahmi
16	Tectona grandis	Teak		

TEMPERATE	TREES		SHRUBS	
	Botanical Name	Common Name	Botanical Name	Common Name
1	Jacaranda mimosaefolia	Jacaranda	Allamanda neriifolia	
2	Butea monosperma	Flame of the forest, Palash	Alpinia Sps.	
3	Nyctanthes arbor-tristis	Parijatha	Bauhinia galpinii	
4	Dalbergia latifolia	Shisham, Indian Rosewood	Hibiscus	
5	Cocos nucifera	Coconut	Yucca	
6	Tabebuia	Tabebuia	Cassia biflora	Twin flowered cassia
7	Bombax ceiba	Silk Cotton	Ficus benjamina	Weeping fig
8	Erythrina variegata	Indian coral tree	Hamelia patens	Fire bush
9	Lagerstromia Lanceolata	Crape-myrtle	Heliconia psittacorum	Parakeet flower
10	Peltophorum ferrugineum	Copper pod tree	Hymenocallis littoralis	Spider lily
11	Pongamia pinnata	Karanj, Indian Elm	Jasminum auriculatum	
12	Polyalthia longifolia	Mast tree	Ocimum sanctum	Tulasi
13	Cassia javanica	Java cassia	Vitex nigundo	Nirgundi
14	Millingtonia hortensis	Indian Cork tree	Nerium indicum	Karaveera
15	Bauhinia variegata	Kachnar	Ricinuc communis	Castor
16	Albizia saman	Rain tree		
17	Spathodea companulata	Tulip tree, Fountain tree		
18	Terminalia Arjuna	Arjuna		
19	Aegle marmelos	Bel, Bilva		

Annexure - V : List of Drought Tolerant Species

LIST OF DROUGHT TOLERANT PLANT SPECIES OF DIFFERENT CLIMATIC ZONES				
COLD	**TREES**		**SHRUBS**	
	Botanical Name	**Common Name**	**Botanical Name**	**Common Name**
1	Abies pindrow	Himalayan Silver fir	Ocimum sanctum	Tulasi
2	Tectona grandis	Teak	Jasminum multiflorum	
3	Rhododendron		Withania somnifera	Winter cherry
4	Cedrus deodara	Deodar		
5	Salix tetrasperma	Indian Willow, Bilsa		
6	Shorea robusta	Sal		
7	Pinus roxburghii	Chir pine		
8	Juglans regia	Walnut, Akhrot		
9	Nyctanthes arbor-tristis	Parijat		
10	Morus	Mulberry		
11	Epiphyllum oxypetalum	Brahmakamal, Queen of the night		
12	Cassia fistula	Indian Laburnum, Amaltas		
13	Dalbergia latifolia	Shisham, Indian Rosewood		
14	Bauhinia variegate	Kachnar		

Glossary

Amenity- Includes roads, street, open spaces, parks, recreational grounds, play grounds, gardens, water supply, electric supply, street lighting, sewerage, drainage, public works and other utilities, services and conveniences

Approved- As approved/sanctioned by the Authority under these Bye-Laws

Adapted Plants: Plants that reliably grow well in a given habitat with minimal attention from people in the form of water irrigation, or fertilization once root systems are established in the soil. Adapted plants are considered to be low maintenance but not invasive.

Albedo is synonymous with solar reflectance.

Air-conditioning is the process of treating air to meet the requirements of a conditioned space by controlling its temperature, humidity, cleanliness and distribution.

Agrifiber products are made from agricultural fiber. Examples include particleboard, medium-density fibreboard (MDF), plywood, oriented-strand board (OSB), wheatboard, and strawboard.

Biodiversity: The variety of life in all forms, levels and combinations, including ecosystems diversity, species diversity, and genetic diversity.

Balcony- A horizontal projection, cantilevered or otherwise including a parapet" handrail, balustrade, to serve as a passage or sit out place

Built-up-Area: Built-up area is the carpet area plus the thickness of outer walls, common areas such as the lobby, lifts shaft, stairs, etc. The plinth area along with a share of all common areas proportionately divided amongst all unit owners makes up the super built-up area.

Basement is the lower storey of a building below or partly below ground level.

Blackwater is wastewater from toilets and urinals is always considered blackwater

Baseline building performance is the annual energy cost for a building design intended for use as a baseline for rating above standard design, as defined in IGBC Green Homes Annexure-I & II.

The BEE Star Rating System for Buildings, developed by Bureau of Energy Efficiency, Ministry of Power, Govt. of India, rates energy efficient buildings based on their actual performance in terms of specific energy use. The Rating is on a 1-5 Star scale, with 5 labeled buildings being the most energy efficient. (http://www.beeindia.in/)

Courtyard- A spaces permanently open to sky, enclosed fully or partially by buildings and may be at ground level or any other level within or adjacent to a building.

Chlorofluorocarbons (CFC) are hydrocarbons that deplete the stratospheric ozone layer.

Coefficient of Performance (COP) - cooling is the ratio of the rate of heat removal to the rate of energy input, in consistent units, for a complete refrigerating system or some specific portion of that system under designated operating conditions.

Contaminant is an unwanted airborne constituent that may reduce quality of the air.

Drought tolerant species are those species that do not require supplemental irrigation. Generally accepted time frame for temporary irrigation is one to two years.

Drain- A system or a line of pipes, with their fittings and accessories, such as manholes, inspection chambers, traps, gullies, floor traps used for drainage of building or yards appurtenant to the buildings within the same cartilage; and includes an open channel for conveying surface water or a system for the removal of any waste water.

Dwelling- A building or a portion thereof which is designed or used wholly or principally for residential purposes for one family.

Daylighting is the controlled admission of natural light into a space through glazing with the intent of reducing or eliminating electric lighting. Day lighting creates a stimulating and productive environment for building occupants.

Drip Irrigation is a high-efficiency irrigation method in which water drips to the soil from perforated tubes or emitters. Drip irrigation is 90% efficient than conventional irrigation system.

Dual flush Water Closet: A dual-flush toilet WC is a variation of the flush toilet that uses two handles to flush different levels of water. The smaller level is designed for liquid waste, and the larger is designed for solid waste.

Erosion: A combination of processes in which materials of the earth's surface are loosened, dissolved or worn away, and transported from one place to another by natural agents (such as water, wind or gravel).

E-waste: It includes discarded materials from a range of electronic devices such as computers, refrigerators, televisions, air-conditioners, personal stereos, mobile phones etc.

Exhaust System is a mechanical ventilation system which, when ducted to the exterior of the building, draws out stale, impure and humid air thereby improving the quality of indoor air.

Energy simulation model is a computer-generated representation of the anticipated energy consumption of a building. It permits a comparison of energy performance, given proposed energy efficiency measures, with the baseline

Fit for Occupancy Certificate: A certificate of occupancy is a legal binding document that permits the construction of a building. It indicates that the building complies with the building codes set by the law. The building is termed as fit for occupancy. The certificate is mandatory in the case a new building is constructed

Fly Ash: The solid residue derived from incineration processes. Fly ash can be used as substitute for Portland cement in concrete.

Flow rate: Flow rate is a parameter used to mark the efficiency of appliances using liquids. For water fixtures, flow rates give the amount of water (in litres) that flows from a particular fixture in a given time (in minutes)

Fire Tower: Means an enclosed staircase that can only be approached from the various floors through landings or lobbies separated from both the floor area and the staircase by fire resistant doors.

Forest Stewardship Council is an independent, non-governmental, not for profit organisation established to promote the responsible management of the world's forests. Products carrying the FSC label are independently certified to assure consumers that they come from forests that are managed to meet the social, economic and ecological needs of present and future generations.

Floor Area Ratio (FAR)- The quotient of the ratio of the combined covered area (plinth area) of all floors, excepting areas specifically exempted under these regulations, to the total area of plot, viz.: -

$$\text{Floor Area Ratio (FAR)} = \frac{\text{Tota1 Covered Area on All Floors}}{\text{Plot Area}} \times 100$$

Group Housing means a building unit constructed or to be constructed with one or more floors having more than two dwelling units having common service facilities

Grey Water is waste water from showers, bathtubs, washing machines and sinks that are not used for disposal of hazardous or toxic ingredients or wastes from food preparation

Greenhouse Gases: Gases such as carbon dioxide, methane and Chlorofluorocarbons CFCs that are relatively transparent to the higher-energy sunlight, but trap lower –energy infrared radiation.

Grass Pavers: Cellular blocks with grass growing in the voids. These are mostly used for external paving, gardens. They need maintenance and have good infiltration capacity.

Heat Island Effect: Occurs when warmer temperatures are experienced in urban landscapes compared to adjacent rural areas as a result of solar energy retention on constructed surfaces. Principal surfaces that contribute to the heat island effect include streets, sidewalks, parking lots and buildings.

Hydrofluorocarbons (HFCs) are refrigerants that do not deplete the stratospheric ozone layer but may have high global warming potential. HFCs are not considered environmentally benign

HVAC systems: Include heating, ventilation and air-conditioning systems used to provide thermal comfort and ventilation for building interiors.

Impervious Surfaces are surfaces that promote runoff of precipitation volumes instead of infiltration into the subsurface.

In-vessel composting is an industrial form of composting biodegradable waste that occurs in enclosed reactors. These generally consist of metal tanks or concrete bunkers in which air flow and temperature can be controlled, using the principles of a "bioreactor". Generally the air circulation is metered in via buried tubes that allow fresh air to be injected under pressure, with the exhaust being extracted through a bio filter, with temperature and moisture conditions monitored using probes in the mass to allow maintenance of optimum aerobic decomposition conditions.

Irrigation: Technique for applying water or wastewater to land areas to supply the water and nutrient needs of plants.

Landscape refers to soft landscaping which include only vegetative materials.

Local Materials are those materials which are manufactured close to the site location. For the purpose of this credit, the distance between location of site and place of manufacture is defined as 400 km.

Local Zoning Requirements: Local government regulations imposed to promote orderly development of private lands and to prevent land use conflicts.

Land fill: A waste disposal site for the deposit of solid waste from human activities

Landscape Area: Area of the site equal to the total site area less the building footprint, paved surfaces, water bodies, patios. Etc.,

Laminate adhesive is used in wood or agrifiber products, such as veneered panels, composite wood products contained in engineered lumber, and door assemblies.

Lighting Power Density (LPD): The installed lighting power, per unit area.

Low-flow fixtures: Low-flow fixtures use high pressure to produce a comfortable, pleasing flow without using much water.

Mixed Land Use Building- A building partly used for non-residential activities and partly for residential purpose

Mechanical Ventilation is ventilation provided by mechanically powered equipment, such as motor-driven fans and blowers, but not by devices such as wind-driven turbine ventilators and mechanically operated windows.

Mulching is placing hay, grass, wood chips, straw or gravel on the soil surface to cover and hold soil.

Native (Indigenous) Plants: Any plant species that occurs and grows naturally in a specific region. Native plant species do not require watering other than during the initial years of establishment.

Natural Topography in its broad sense means preserving natural features of the terrain.

Natural ventilation, or passive ventilation, is provided by thermal, wind, or diffusion effects through doors, windows, or other intentional openings in the building; it uses the building layout, fabric, and form to achieve heat transfer and air movement.

Non-occupied spaces include all rooms used by maintenance personnel that are not open for use by occupants. Examples are closets and janitorial, storage, and equipment rooms

Open Space Area: The property area minus the development footprint or as defined by local zoning requirements. Open space must be vegetated and pervious, also includes non-vehicular, pedestrian oriented hardscape spaces.

Open-grid pavement is less than 50% impervious and accommodates vegetation in the open cells.

Perviousness is the percentage of the surface area of a paving system that is open and allows moisture to soak into the ground below.

Porous Pavement and Permeable Surfaces are used to create permeable surfaces that allow runoff to infiltrate into the subsurface.

Potable water is water that is sourced from wells or municipal water systems. Well water, which is not of potable quality, would also be deemed as potable water.

Preferred Parking refers to parking areas which are closer and have easy access to the main entrance of the project.

Proposed Building Performance is the annual energy cost calculated for a proposed design.

Programme for the Endorsement for Forest Certification is an international non-profit, non-governmental organization dedicated to promoting sustainable forest management. PEFC is the certification system of choice for small forest owners. PEFC Chain of Custody certification enables companies to send a clear and transparent message that wood and non-timber forest products have been sourced from legal and sustainably managed forests thus offering access to markets demanding eco-friendly products and market advantage in relation to companies with uncertified products. It enhances brand value with due respect to the environmental, economic and social standards.

Residential Building- includes a building in which sleeping and living accommodation is provided for normal residential purposes, with cooking facilities and includes one or more family dwellings, apartment houses, flats, and private garages of such buildings.

Permission or Permit- A valid permission or authorization in writing by the competent Authority to carryout development or a work regulated by the Bye-Laws

Ramp is a sloping surface connecting two level surfaces that deviate from what would otherwise be considered as normal level.

Rapidly renewable material is defined as material considered to be an agricultural product, that takes ten years or less period to grow or rise, and to harvest in an ongoing and sustainable manner.

Recycling is the collection, reprocessing, marketing and use of materials that were diverted or recovered from the solid waste stream

Refrigerants are the working fluids of refrigeration cycles. They absorb heat from a reservoir at low temperatures and reject heat at higher temperatures.

Reuse is a strategy to return materials for active use in the same or a related capacity.

Refurbished materials are products that could have been disposed of as solid waste. These products have completed their life cycle as consumer items and are then refurbished for reuse without substantial alteration of their form. Refurbishing includes renovating, repairing, restoring, or generally improving the appearance, performance, quality, functionality, or value of a product.

Roof is the upper portion of the building envelope, including opaque areas and fenestration that is horizontal or tilted at an angle of less than 60° from horizontal.

Renewable Energy: The electricity generated by renewable energy sources such as solar, wind, water, biomass & geothermal sources reduce the impact of air pollution.

Salvaged materials are construction materials recovered from existing buildings or construction sites / second hand market and reused in other buildings. Commonly salvaged materials include timber frames, MS railing, door shutters, window shutters, decorative items, railway sleepers etc.

Sedimentation is the addition of soil to water bodies by natural and human-related activities. Sedimentation decreases water quality and accelerates the aging process of lakes, rivers and streams.

Sediment Trap is an excavated pond area or constructed earthen embankments which allow for settling of sediment from storm water volumes.

Site boundary is the portion of the project site submitted for IGBC green homes certification. For single apartment, this is the entire project scope and is generally limited to the site boundary. For multiple residential apartments, the IGBC project boundary may be a portion of the development as determined by the project team.

Sewage Treatment is a process of removing contaminants from waste water and house-hold sewage. Its objective is to produce an environmentally safe fluid waste stream suitable for disposal or reuse using advanced technology it is possible to reuse sewage affluent for drinking water (e.g. Singapore).

Sick Building Syndrome is a situation in which a substantial portion of building occupants experience acute discomfort and negative health effects as a result of exposure to contaminated air inside the building.

Skylight is a fenestration surface having a slope of less than 60o from the horizontal plane. Other fenestration, even if mounted on the roof of a building, is considered vertical fenestration.

Solar Heat Gain Coefficient (SHGC) is the ratio of the solar heat gain entering the space through fenestration area to incident solar radiation. Solar heat gain includes directly transmitted solar heat and absorbed solar radiation, which is then re-radiated, conducted into space.

Solar Reflectance (Albedo) is the ratio of the reflected solar energy to the incoming solar energy over wavelengths of approximately 0.3 to 2.5 micrometers. A reflectance of 100% means all the energy striking the reflecting surface is reflected back into the atmosphere and none of the energy is absorbed by the surface.

Stilts are one of several posts supporting a structure built above the surface of land or water.

Solar Reflectance Index (SRI): A measure of a material's ability to reject solar heat, as shown by a small temperature rise. It is defined so that a standard black (reflectance 0.05, emittance 0.90) is 0 and standard white (reflectance 0.80, emittance 0.90) is 100. Materials with highest SRI values are the coolest choices for paving.

Swales: Low tract of land, especially one that is moist and marshy. Kind of open drain system is usually designed to manage runoff.

Top soil conservation: The process of removing and protecting the top soil from any construction or development site for reusing it onsite later.

Transplantation: The process of digging up a plant / tree and moving it to another location.

Temporary Seeding is planting fast growing grasses to temporarily stabilise soils.

Tertiary treatment is the highest form of wastewater treatment that includes the removal of nutrients, organic and solid material, along with biological or chemical polishing generally to effluent limits of 10 mg/L BOD5 and 10 mg/L TSS.

Tobacco Smoke consists of airborne particles emitted from the burning end of cigarettes, pipes, beedi & cigars and exhaled by smokers. These particles contain about 4000 different compounds, up to 40 of which are known to cause cancer.

Turf refers to lawn an area of grass maintained for decorative or recreational use. It involves high water consumption, high continuous maintenance. In green building design it is recommended to limit the use of turf to conserve water.

U-value (thermal transmittance) is heat transmission in unit time through unit area of a material or construction and boundary air films, induced by unit temperature difference between the environments on each side.

Ventilation is the process of supplying air to or removing air from a space for the purpose of controlling air contaminant levels, humidity or temperature within the space.

Visible Transmittance (Tvis) is the ratio of total transmitted light to incident light. In other words, it is the amount of light passing through a glazing surface divided by the amount of light striking the glazing surface. A higher Tvis value indicates that a greater amount of incident light is passing through the glazing.

Volatile Organic Compounds (VOCs) are carbon compounds that participate in atmospheric photochemical reactions (excluding carbon monoxide, carbon dioxide, carbonic acid, metallic carbides and carbonates and ammonium carbonate). The compounds vaporize (become a gas) at normal room temperatures.

Vegetated area: The area in the site which has plantation or greenery on it in any form, such as shrubs, grass, trees etc.

Window- An opening to the outside other than a door, which provides all or part of the required natural light or ventilation or both to an interior space and not used as a means of egress/ingress

Waste Water from kitchen sinks, showers or bathtubs may be considered grey water by state or local codes. Project teams should comply with the grey water / black water definition as established by the authority having jurisdiction in their areas.

Xeriscaping refer to landscaping and gardening in ways that reduce or eliminate the need for supplemental water irrigation. It is promoted in regions that do not have easily accessible, plentiful or reliable supplies of fresh water.

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About CII

The Confederation of Indian Industry (CII) works to create and sustain an environment conducive to the development of India, partnering industry, Government, and civil society, through advisory and consultative processes.

CII is a non-government, not-for-profit, industry led and industry managed organization, playing a proactive role in India's development process. Founded over 118 years ago, India's premier business association has over 7,100 member organizations, from the private as well as public sectors, including SMEs and MNCs, and an indirect membership of over 90,000 companies from around 257 national and regional sectoral associations.

CII charts change by working closely with Government on policy issues, interfacing with thought leaders, and enhancing efficiency, competitiveness and business opportunities for industry through a range of specialised services and global linkages. It also provides a platform for consensus-building and networking on diverse issues.

Extending its agenda beyond business, CII assists industry to identify and execute corporate citizenship programmes. Partnerships with over 120 NGOs across the country carry forward our initiatives for integrated and inclusive development, in affirmative action, healthcare, education, livelihood, diversity management, skill development, empowerment of women, and water, to name a few.

The CII Theme for 2013-14 is Accelerating Economic Growth through Innovation, Transformation, Inclusion and Governance. Towards this, CII advocacy will accord top priority to stepping up the growth trajectory of the nation, while retaining a strong focus on accountability, transparency and measurement in both the corporate and social eco-system, building a knowledge economy, and broad-basing development to help deliver the fruits of progress to many.

With 63 offices including 10 Centres of Excellence in India, and 7 overseas offices in Australia, China, France, Singapore, South Africa, UK, and USA, as well as institutional partnerships with 224 counterpart organizations in 90 countries, CII serves as a reference point for Indian industry and the international business community.

About IGBC (Indian Green Building Council)

The Indian Green Building Council (IGBC), part of Confederation on Indian Industry (CII) was formed in the year **2001**. The vision of the Council is to enable sustainable built-environment for all and facilitate India to be one of the global leaders in sustainable built-environment by 2025.

IGBC is strong with a membership base of more than **1,659** members which is progressively increasing over the years. Members comprise of all stakeholders of the construction industry viz. Architects, Interior Designers, Landscape Consultants, MEP Consultants, Builders, Developers, Product and Equipment Manufacturers, Corporate, Institutions and Government agencies.

The Council presently has 13 Chapters spread all over the country to cater to the aspirations of various states and regions. These chapters are headed by eminent Architects and Developers.

To seed the ideas of green building concepts in the minds of young people, IGBC has started Student chapters in various architectural and engineering colleges.

The council has in the past 10 years facilitated **2,272** Green Buildings in the country with a footprint of **1.71 Billion sq.ft.** covering the varied building types viz. commercial, residential, hospitals, airports, retail, factory buildings, townships and SEZs.

The council closely works with State and Central Governments, World Green Building Council, bilateral and multi-lateral agencies in promoting green building concepts.

National by Choice

Global in Performance

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