GRIHA LD

GRIHA for Large Developments

Association for Development and Research of Sustainable Habitats

GRIHA for Large Development

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Abbreviations

- BIS Bureau of Indian Standards
- CGWB Central Ground Water Board
- CPCB Central Pollution Control Board
- ECBC Energy Conservation Building Code
- EPI Energy Performance Index
- GRIHA Green Rating for Integrated Habitat Assessment
- NBC National Building Code 2005
- TERI The Energy and Resources Institute
- SUDS Sustainable Urban Drainage Systems

Introduction

Need

With increasing urbanization, economic growth, and the rising consumption pattern in India, there has been an increasing trend to consume more natural resources per capita. Higher incomes have given rise to greater demand for better standards of living, thereby adding to the already significant stress on the environment and various other natural resources. This results in an ever widening gap between demand and supply for electricity, potable water, and many other things. According to the 12th Five Year Plan, released by the Planning Commission of the Government of India, nearly 285 million people were living in urban agglomerations. This number increased to almost 380 million in the year 2011 and by 2030, almost 600 million people will be living in urban areas. Increasing population coupled with continued urbanization is likely to result in the emergence of about 60-70 cities with population of more than a million by 2030. In the past five years, the Central government has focused a lot on the development of SEZs, educational campuses, and new townships. Even the private construction sector has now begun developing large-scale projects that offer multiple product options as a part of a single package. So, for instance, a housing project may offer lifestyle facilities such as on campus club-houses, gymnasia, swimming pools, convenience stores, etc. There are an increasing numbers of such large developments coming up in the country. These comprise the following:

1. Large (mixed–use) townships:
    - Housing complex by builders
    - Housing complexes by urban development organizations
    - Housing board and Public Sector Undertaking Townships
    - Plotted developments with part construction by the developer

2, Educational and institutional campuses

3. Medical colleges and Hospital complexes (eg: AIIMS)

4. Special economic zones

5. Hotels/ resorts

When a large project is planned and implemented, it comprises multiple buildings and other infrastructural facilities, on a single site. Environmental Performance Assessment for such projects should go beyond the environmental design of each building, and calls for assessment of larger environmental issues, and their effects that are brought out by the built environment. Emergence of these new large-scale developments/

townships/ neighbourhoods and the growth of the older ones are bringing in complex changes to ecology, natural resources and environment at local, regional, and global scales. It is high time we pay heed to our planning practices and guidelines that are followed to plan our cities and make them in such a way that they promote sustainable development with lesser impact on environment.

GRIHA - LD

The Association for Development and Research for Sustainable Habitats (ADaRSH), in association with The Energy and Resources Institute (TERI) and the Ministry of New and Renewable Energy (MNRE), has launched the Green Rating for Integrated Habitat Assessment (GRIHA) and Simple Versatile Affordable GRIHA (SVA GRIHA), in order to address and promote green buildings in India. However, a need was felt to create a framework to assess the environmental performance of larger developments, the singular units which together make up cities – neighbourhood/townships – and with this focus; ADaRSH along with TERI has developed a rating system for large developments titled – GRIHA LD (Large Developments). The intent of GRIHA LD is to provide a consolidated framework for assessment of environmental impacts of large scale developments.

Qualification for rating

All projects with ***total site area greater than or equal to 50 hectares (125 acres)*** may apply for a GRIHA LD rating:

Framework

All sites in their native state sustain various ecological cycles. Construction leads to disruption of various cycles as well as exerts demand for various resources like energy, water, etc. Therefore, conventional construction practices have a detrimental impact on their surroundings. In the framework of GRIHA LD, projects which reduce their detrimental impact on the surroundings to the minimum and attempt to become self-sufficient in aspects like energy, water, etc., will be given the highest rating. Therefore, the lower the negative impact of a development on its surrounding, the better the GRIHA LD star rating.

In GRIHA LD the development will be evaluated in six different sections as listed below:

- Site Planning
- Energy
- Water and waste water
- Solid waste management
- Transport
- Social

Each section comprises two parts: Resource Impact and Environmental Quality. Quality of resource/services is as important as quantity. Therefore, each section (except Social) will be evaluated on resource impact parameters as well as those pertaining to environmental quality. In the section on Social, since there are no resource impact parameters, the evaluation will be done based on only qualitative parameters.

The overall rating for the project will be awarded based on the overall impact reduction. The calculation of the rating has been elaborated in detail in the following sections.

Note: The current GRIHA LD rating framework has been developed based on the Green Guidelines and Benchmarks for Large Area Developments developed and released by TERI and MNRE in 2012. A technical advisory committee is being set up to review and finalize the rating framework.

The Green Guidelines and Benchmarks for Large Area Developments may be downloaded from the GRIHA website: www.grihaindia.org

Resource Impact

- Each of the five sections (except Social) assesses the development on a single "impact" parameter. This impact parameter is linked to the detrimental impact of the development on its surroundings. Each section has an independent scale of 0 per cent impact to 100 per cent designed around its impact parameter. The 100 per cent impact refers to a conventional construction practice whereas 0 per cent impact refers to the state of the site before construction has started, i.e., in its native state. The lower the impact percentage, the better is the overall environmental performance of the development. For example, in its native state, the site requires no energy. However, post-construction, it will exert a certain energy demand on the utility grid/diesel genset, thereby causing environmental damage. By making the site self-sufficient in energy through energy-efficient designs and installation of clean, renewable energy, the impact may be reduced considerably. Therefore 100 per cent impact – in energy – is when buildings and site infrastructure is conventionally designed and receive energy from utility grid/diesel gensets and 0 per cent impact in energy is when the site generates all its annual energy requirement through on-site renewable energy. The impact parameter of each section is listed below:

Section	Impact parameter
Site Planning	Increase in ambient outdoor temperature
Energy	Net kWh required from the utility grid/diesel gensets
Water and Waste Water	Total water required from the municipal supply/groundwater source
Solid Waste Management	Total organic waste treated on site

- The resource impact for each aforementioned section is calculated as a percentage and lower the impact percentage, the better the development is considered.
- Additionally, each section has been assigned a "normalizing multiplier" to reflect the following:
  - different national priorities revolving around resource scarcity
  - relative variation in investment for different strategies
  - balance between social, economic and environmental aspects; and
  - balance between Resource Impact parameters and Environmental Quality parameters

Resource Impact				
Section	Reduction in Impact	Quantitative Impact (from 0 to 100%) (Qn)	Normalizing Factors	Final impact score in each section
Site Planning	0	100	0.9	I_n
Energy	0	100	1	
Water	0	100	1	
Waste	0	100	0.8	
Total				

Appraisal

Environmental Quality

- Each section has a total of 100 points assigned in the qualitative section which have been divided across several measures. The more points a project scores in each section, the better the overall environmental performance. Higher scores depict measures taken to improve quality on site. However, since the GRIHA LD awards rating based on reducing the overall detrimental impact on the environment, the impact in this section is calculated by deducting the total points achieved from 100. The resulting number is the qualitative impact. As in the Resource Impact section, the each score is multiplied by a normalizing factor.
- The environmental quality of each aforementioned section shall also be calculated in percentage. The following attached table delineates the normalizing multiplier against each section and cumulative environment impact.

Environmental Quality				
Section	Reduction in Impact	Qualitative Impact (from 0 to 100%) (QI)	Normalizing Factors	Final impact score in each section
Site Planning	0	100	1	I_q
Energy	0	100	0.8	
Water	0	100	0.9	
Waste	0	100	0.8	
Transport	0	100	0.9	
Social	0	100	0.9	
Total				

- The net impact of Resources and Environmental Quality parameters (I_n and I_q respectively) will be totalled and compared against the base case impact of 100 per cent. The following formula will be used for the same:

$$I_t = \frac{I_{n\,(design\ case)} + I_{q\,(design\ case)}}{I_{n\,(base\ case)} + I_{q\,(base\ case)}} \times 100$$

- The lower the overall impact per cent , the higher the GRIHA LD rating project can attain. The following table will be used to determine the project rating:

Overall Impact - I_t	Rating
75% - 66%	★
65% - 56%	★ ★
55% - 46%	★ ★ ★
45% - 36%	★ ★ ★ ★
35% - 25%	★ ★ ★ ★ ★

- Since large scale developments get built over a period of 10-15 years or more, there may be revisions in the local bye laws with respect to the permissible FAR etc. in the interim. Therefore, the Masterplan rating and rating provided to each individual phase shall take into account the relevant local bye laws at the time of rating.

Process

Masterplan Rating:

- The Masterplan Rating will include the following steps:
  - Registration of the project
  - Half day workshop for the project team
  - Access to online documentation tool
  - Receipt of completed documentation by ADaRSH
  - Review of documentation by ADaRSH and comments sent to Project team
  - Receipt of revised documentation by ADaRSH
  - Documentation sent to External Evaluators by ADaRSH
  - Comments of External Evaluators forwarded to Project team
  - Revised documentation from Project team shared with External Evaluators
  - Masterplan rating awarded by ADaRSH based on points and feedback of External Evaluators

Rating of Each Phase:

- The following steps will be followed for rating of each phase:
  - Registration of the project phase (First phase would be registered with Masterplan rating)
  - Half day workshop for the project team (Workshop of First phase and Masterplan Stage would be done together at Masterplan Rating stage)
  - Access to online documentation tool
  - ADaRSH to conduct 3 site visits to the site during the course of the construction of the phase
  - Receipt of completed documentation by ADaRSH
  - Review of documentation by ADaRSH and comments sent to Project team
  - Receipt of revised documentation by ADaRSH
  - Documentation sent to External Evaluators by ADaRSH
  - Comments of External Evaluators forwarded to Project team
  - Revised documentation from Project team shared with External Evaluators
  - Masterplan rating awarded by ADaRSH based on points and feedback of External Evaluators

Carrying Capacity & Carbon footprint

Intent

Carrying capacity is defined as the ability of a natural and artificial system to absorb population growth or physical development without considerable degradation or damage'(K.Oh et al,2005)1. The intent is to analyze carrying capacity to assess the optimum population that the proposed development can hold using critical environmental parameters of "water availability" and "available green cover per capita". Availability of water and green areas is extremely important to ensure quality of life, health, and environmental benefits for the population to reside. The objective of the carrying capacity assessment is to arrive at allowable population density for the site and/or allowable FAR. Once the optimum population is decided, it would be compared with the allowable FAR/ population density of the site and the variation shall be noted. The determining factors for assessment would be including:

- Water - Quantum of municipal supply, other sustainable sources of water available
- Green Cover - Total per capita green cover available/made available on site
- Carbon footprint is defined as the total carbon dioxide equivalent (CO_2e) emissions released from energy use within a development / city/ state/ country /sector. The intent is to analyze and thus reduce the energy use within the proposed development by involving green construction practices, adopting clean energy on site and reducing use of motorized vehicles on site. The objective is to analyze annual CO_2 emissions per capita of the proposed development. The determining factors for assessment would be including:
    - Net annual CO_2 emissions from the buildings
    - Net annual CO_2 emissions from transport

[1]2005. Kyushik, Oh. et al. "Determining Development Density using the Urban Carrying Capacity Assessment System". Landscape and Urban Planning, 73 (2005) 1-15.

Commitment

- It has been observed that most of the upcoming developments do not prepare in advance for the pressures that the proposed population is going to put on their surroundings, nor is the quantification of the available resources on and around site is done to envisage the site population. Availability of adequate amount of clean, potable water and green cover must be ensured before planning any development. Water scarcity is on the rise in urban centers in India and with the recharge rate significantly falling behind consumption rate, sources of readily accessible water are depleting fast. Many of the new developments in India rely on packaged drinking water as well as private water tankers to provide them with this most critical daily essential. It is therefore important, to strike the right balance between population on site and water availability. In this context, it becomes essential to conduct an analysis to understand the total water that is available from municipal and groundwater sources and the total demand being exerted on site by the proposed population. There must be enough water available on site to cater to the population being planned on it.
- Green areas are essential for our survival. Trees and shrubs not only help in reduction in global Greenhouse Gases, they are also necessary for clean air and water. Urban green areas also help in maintaining the balance between the physical and the psychological health of people while simultaneously improving social cohesion amongst the community. Therefore, it becomes important that every large scale development provides for optimal green cover for its residents. According to the World Health Organization, there must be at least 9 sq.m. green cover per capita in the development. Landscape design must be done in a manner such that sufficient amount of green areas are provided on site.
- Carbon footprint, in the context of GRIHA LD, is defined as the total CO_2 equivalent emissions released from energy use within a development. Given the rising concerns on global warming and climate change, it becomes necessary to promote low-carbon growth, in order to reduce CO_2 emissions due to the upcoming development. The per capita estimate for CO_2 emissions in India was about 1.18 tonnes/annum. The CO_2 emissions for the proposed development can be controlled / reduced by adopting clean energy on site, constructing green buildings and reducing the need to use motorized transport. It is recommended for the development as a whole to adopt low-carbon strategies which

Commitment

- In order to reduce the carbon emissions on account of vehicular movement, in a development, it becomes extremely important that the planning of the development is done in a manner to promote easy access to daily necessities through walking and cycling. A clean, safe and secure road environment should be created for pedestrians and cyclists. Planning of a site as mixed use development or as a single use development can have a different pattern of vehicular movement thus impacting the quantity of carbon emissions. When an upcoming large development is designed as a single use development, it increases the use of personal vehicles. For example, consider a residential-only development. In order to get to work, the residents will have to travel outside the site every day, thereby increasing the reliance on and use of private vehicles, whereas when a development is mixed-use, it reduces the need for people to travel and use personal vehicles by offering day to day necessities within the development. Additionally, mixed use developments provide more safety to residents than single use developments. The overall planning of an upcoming development hence will have an impact on the amount of travel and the CO_2 emissions generated on account of the same. Well-planned developments that promote walking and cycling and shorter motorized trips generate lower CO_2 emissions. CO_2 emissions expected on account of travel activities within the development will be estimated in this part. The base case in this section accounts for carbon emissions by development considering the residents will have to drive a car for all their daily needs.

Compliance

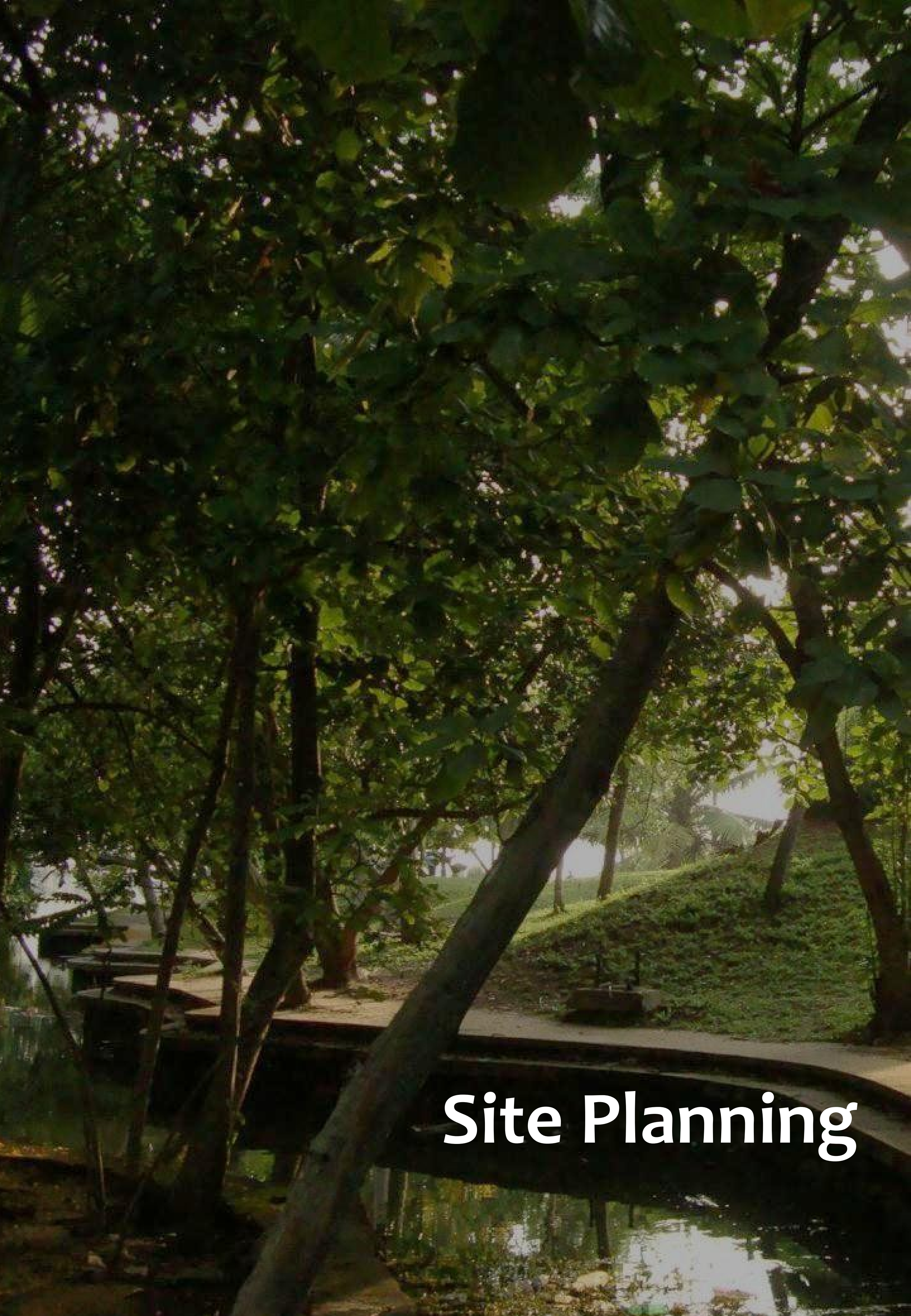
Design Stage

- Submit environment clearance document providing the calculations estimating the total projected population of the development.
- Submit clearance document from the local municipal authority highlighting the total water which will be supplied to the development.
- Submit design documents, detailing the total water requirement estimation for the site.
- Submit a site plan demarcating the different areas under landscape, along with an area statement.
- Provide calculations to ascertain the total kWh (estimated) that would be consumed by - the buildings, services, water pumping, and street lighting on site. (Please refer the section on Energy for more details).
- Provide calculations to estimate total number of vehicles on the road and the total projected CO_2 emissions.

Each Subsequent Stage

- Submit the final landscape plan for the completed development phase, with the landscape (green) areas clearly demarcated.
- Submit document highlighting the expected population for the phase.
- Final estimation of CO_2 emissions from the development phase.

Sections



Site Planning

Intent

Sustainable site planning is the first step to ensure sustainability of any large development. Rapid urbanization pays insufficient attention to the conservation of the natural ecosystem and as a result ecologically valuable lands are getting converted into concrete jungles at a very fast rate. The intent of natural resource mapping is to protect and preserve the sensitive natural features existing on the site, and guide the entire development (residential, commercial, institutional, recreational, etc.) in such a way that it creates less impact on the environment.

Conventional site planning strategies do not pay sufficient heed to the existing natural features and surface drainage on site. Elimination of natural drains and water bodies and unification of highly impervious surfaces during site planning results in flash floods during monsoons and increased local temperatures – Urban Heat Island Effect (UHIE). The site planning needs to be in tandem with the site natural topography. Site planning must ensure appropriate surface drainage channels and recharge areas to facilitate better storm water management along with overall low imperviousness of the proposed development. In addition, it also becomes extremely important to protect and maintain the tree cover on site and preserve the existing fertile top soil on site. All new trees being planted on the site should be native to the region in order to promote and sustain the local biodiversity.

Resource Impact

- Urban Heat Island Effect (UHIE) refers to a phenomenon common to dense urban clusters. Hard paved surfaces (like concrete paving, concrete buildings, etc.) absorb more heat than soft paved surfaces (like grass, shrubs, water bodies, etc.). As a result, in dense urban areas, the ambient outdoor temperature often rises up to 4-5 degree centigrade higher than the surrounding rural areas. This phenomenon is extremely pronounced in metropolises. Studies have recorded temperature variations of up to 4 degree centigrade between dense business districts of Delhi and its green, protected Ridge area. The increased ambient temperature has a significant impact on thermal comfort, air-conditioning consumption as well as air pollution levels. Dense urban clusters also restrict the flow of wind. This leads to further trapping of heat inside the urban areas since low wind movement restricts removal of heat from the cities. Therefore, site planning of large developments must be done in such a manner that it reduces the overall heat build-up. In order to help indicate the effect that the design would have on the ambient temperature, a Heat Island Calculator has been included in the Impact section of Site Planning[#]. The calculator in the GRIHA LD calculates the effect of the urban geometry and green area on the ambient temperature. The analysis is to be carried out for 21st March. Various strategies may be adopted for the same; these include:
    - The total hard paved area on site should be reduced to as low as possible, preferably not more than 25 per cent of the overall site area. The lesser the hard paved area on site, the lower is the heat buildup at the development.
    - Constructing medium to low-rise buildings with wide spacing on site increases urban wind flow which allows for the built-up heat to be removed from the area; however wind direction must be taken into consideration, as planning against the wind direction might lead to entrapment of heat.
    - Trees, shrubs, and green areas absorb incident solar radiation

[#] The source of formula used to develop the Heat Island Calculator is based on the following paper by Steve Kardinal Jusuf, National University of Singapore: http://heatisland2009.lbl.gov/docs/221410-jusuf-doc.pdf

- but do not radiate the same back to their surrounding environment. Therefore increasing green area and interspersing them within built up areas helps in mitigating the heat island effect. The calculator uses the Green Plot Ratio (GnPR) to analyze the effect of vegetation on ambient temperature.

In this section, the ambient daytime outdoor temperature, for a location, on 21st March is to be considered. The rise in ambient air temperature, in the base case, will be considered as 100 per cent impact and a 0 degree centigrade rise will be considered as having a 0 per cent impact. The actual project may have a temperature rise lower than the base case which will reflect the reduction in impact.

Environmental Quality

- In order to enhance the environmental quality, judicious site planning must be carried. Every site has several key natural features that must be retained during construction and incorporated in the final development plan. The development must conduct a natural resource mapping to identify the key natural features on site such as dense tree clusters, natural water bodies, surface drainage, etc. Construction in such areas should be avoided in order to enhance the environmental quality of the upcoming development. Natural water bodies and surface drainage channels should be retained in order to maintain natural water flow across the site. Alteration of these critical site features like drainage and retention channels has a tremendous impact on the downstream water cycles, water cycle of areas outside the site, as well as the disruption in groundwater recharge. Therefore, the site plan of the project must be developed in manner such that the key natural water bodies and surface drainage is preserved and any construction causing damage to them should be avoided.
- Vegetation / tree cover on site is an extremely important feature to be protected. Trees provide us with clean air; they help in sequestration of CO_2 emissions, in reducing soil erosion, and support various other flora and fauna. Therefore, the development should be planned in a manner such that mix-species tree clusters, which are either moderately-dense* or very dense**, on site are left undisturbed and p

Moderately dense forests are those with canopy density between 40-70% (Forest Survey of India (FSI) 2009).

***** Very Dense Forests are those with canopy density greater than 70% (FSI - 2009).***

protected during construction. Areas around dense tree clusters should be cordoned off during construction. Fertile top soil is essential for sustenance of any vegetation on site. In conventional construction practice, top soil is dug up along with sub-surface soil and thrown away. This wastes the fertile top soil which could be reused for the final landscaping. Soil fertility test must be done for the top soil of the site and if found to be fertile, top soil of the site must be preserved during construction to be reapplied later on the site proposed landscaped areas.

- Key topographical features like steep slopes, earth mounds, hillocks, etc., should be preserved and protected. The site planning must be done in a manner such that these features are retained as well as incorporated in the same.
- Most of the cities and towns in India have serious floods during monsoons due to reasons like lack of infrastructure specific for storm water discharge, clogging of drains and water bodies due to pollutant loading specially during and after storm events, blockage of natural drains from improper waste management, lack of systems to recharge groundwater with runoff or to harvest rainwater, and unplanned urban development with relation to the drainage patterns. The site planning of the development needs to be in tandem with the site's natural features, so that post-development, there are no major obstructions in the drainage patterns. Designing the development in this manner drastically reduces flash floods and water logging during monsoons, besides maintaining natural water bodies for recharge.
- A range of techniques as a part of Sustainable Urban Drainage Systems (SUDS) are available to achieve this. They are a flexible series of options, which allow a designer to select those that best suit the circumstances of a particular site. It represents an integrated system of techniques aimed at storm water management and is the anti-thesis of the conventional drainage techniques followed for flushing storm water out of the site.

Commitment

SUDS help storm water management in the following ways:

- They help in containing and managing run-off from the site, thereby reducing flooding
- They help in reducing the level of pollutants in the storm water
- They provide habitat for wildlife
- They encourage groundwater recharge

Some examples of SUDS include: infiltration trenches, infiltration basins, filter drains, swales, retention ponds, wetlands, etc.

- In addition to maintaining existing vegetation on site, the tree cover on site should be increased. Tree plantation is one of the most important activities in maintaining environmental sustainability. In case some trees are falling in the building or service footprint and design cannot be altered, then those trees should be transplanted on the site itself. Care must be taken to increase the tree cover by at least 25 per cent, over the existing tree cover on site (in addition to the mandatory replantation – non-applicable in case of sites without any existing mature trees). The trees and shrubs being selected for plantation on site must be of the native species. The top soil which was stored should be reapplied on site for the new landscape areas.
- In addition to these, steps must be taken to reduce the environmental damage due to the construction process. A construction management plan must be prepared and implemented with distinct demarcation of various construction zones, construction materials storage yard, protected natural features and tree clusters, provision of soil erosion channels and sedimentation tank.

Compliance

Design Stage & Each Subsequent Phase:

- Provide a site plan and narrative demarcating the following:
  - Total site area.
  - Building footprint.
  - Total landscape area.
  - Road network, footpaths, parking areas and other paved areas
  - Services layout
  - Paved area which is pervious/shaded/coated with high reflective finish (SRI > 0.5).
- Submit narrative explaining the Heat island calculations for the project.
- Provide a site plan and narrative demarcating the existing site features, including, but not limited to, the following:
  - Site contours with levels
  - Key topographical features on site.
  - Existing mature trees on site, especially dense mix-species tree clusters.
  - Existing built structure on site
  - Any contaminated area on site
  - Low-lying areas functioning as water recharge ponds and other natural drainages
  - Tree clusters, water bodies, drainage channels and other topographical features which are being preserved
- Submit a storm water management plan demonstrating that the post-development peak run-off rate and quantity from 5-year 24 hour design does not exceed the pre-development peak run-off rate and quantity.
- Submit site plan highlighting the various SUDS incorporated in the site planning.
- Construction management plan (drawing and narrative) highlighting the following:
  - Staging of construction on site
  - Location of site offices
  - Location od drinking water facilities and toilets for workers
  - Location of construction material storage yards
  - Areas where preserved top soil will be stacked and stored
- Submit landscape/plantation plan (drawing and narrative) highlighting the following:
  - Existing trees on site which are being preserved and/or transplanted
  - New trees being planted on site
  - Areas demarcated for reapplication of preserved top soil

Optional

- Adopt site planning strategies to ensure that the overall ambient outdoor temperature, before and after construction, does not change.

Mandatory

- Storm water management – 15 points.
    - Ensure that the storm water management plan on site is developed such that the post-development peak run-off rate and quantity from 5-year 24 hour design does not exceed the pre-development peak run-off rate and quantity

Optional

- Storm water management – 15 points
    - Ensure incorporation of appropriate SUDS for managing over 90% of the storm water quantity on site – 15 points
- Maintain existing site features – 30 points.
    - Ensure that more than 25% of the site area under existing natural features on site like water bodies, dense, mix-species tree clusters and contours with slopes greater than 1:4 are preserved – 10 points
    - Ensure that more than 50% of the site are under existing natural features on site like water bodies, dense, mix-species tree clusters and contours with slopes greater than 1:4 are preserved – 20 points
    - Ensure that more than 75% of the site area under existing natural features on site like water bodies, dense, mix-species tree clusters and contours with slopes greater than 1:4 are preserved – 30 points
- Manage construction activities in a manner to reduce environmental damage – 20 points
    - During construction, preserve and protect all the natural drainage channels on site – 10 points
    - Confine construction activities to pre-designated areas (staging) and adopt soil erosion and sedimentation control strategies (during construction) on site – 10 points
- New plantation on site – 20 points.
    - Increase existing vegetation cover on site by 25%per cent by ensuring plantation of native trees and shrubs – 10 points
    - Reapply top soil in more than 75% of the landscape areas – 10 points

    <u>Non-applicability:</u> If the top soil is not fertile and cannot be made fertile through addition of organic materials, then the second clause (related to top soil) is not applicable to the project.

Calculation Example for Heat Island Calculator (Resource Impact Section)

All sample calculations are only demonstrative and the values of various variables and assumptions would vary from project to project

- The calculator analyses the effect of urban geometry and vegetation on the ambient air temperature. The calculator can analyze the effects over an area of 50 m radius. Therefore, it is required for the project to select three representative areas of the project (more than 3 locations are recommended) and analyze the increase in ambient air temperature as an average of the various cases.
- The calculator will develop base cases for each design case and provide the incremental temperature. The average increment in ambient air temperature of the base cases will be considered by the tool as depicting 100% impact. Therefore, the base case for each location will be different and dependent upon the location.

Definitions of terms used in the calculator:

- **Average of ambient daytime hourly air temperature**
  - It is average of hourly air temperature taken for the reference day in any typical season. This average must be for the sunshine hours (for example morning 6 am to evening 6 pm) and must be taken for **21st March**. For example, ambient average daytime temperature for Delhi is 24.6°C, for Mumbai is 26.7°C, for Bengaluru is 27.3°C etc.
- **Daily (daytime) Average Solar Radiation (W/m^2)**
  - The daily average solar radiation for the location should also be for the day of 21st March.
- **Hard paved area (with in 50m radius) in %**
  - This is the total percentage of hard paved area (buildings as well as paved area) in the study area.
- **Average Height to building floor Area Ratio**
  - Average height to building area ratio represents the thermal mass in the environment and it refers to the ratio of average of heights of all buildings (in the study area) to the total of floor areas of all the buildings (in the study area).
- **Total Wall surface area (m^2)**
  - This is the total wall surface area of all the buildings which fall in the study area.
- **Green Plot Ratio (GnPR)**
  - Green plot ratio (GnPR) refers to the green density in the area and is calculated by the following formula:

  GnPR = (Total Tree Leaf Area + Turf Area) / Area of Circle (site = 50 m radius) 1

  Total Tree Leaf Area = No. of trees x Canopy Area x LAI 2

  - The Leaf Area Index is a number ranging from 0 to 6. 0 depicts barren site, grass has LAI of 1 and 6 depicts extremely dense tree vegetation. On an average, most mature trees in India have a standalone LAI ranging from 3.5 to 5.5. The following are the representative LAI of some of the Indian trees:

S.No.	Scientific Name	Common Name	LAI Value
1	Azadirachta indica	Neem tree	5.5
2	Mangifera indica	Mango tree	5
3	Saraca indica	Ashoka tree	4.5
4	Eucalyptus globulus	Eucalyptus tree	3.2
5	Delonix regia	Gulmohar tree	4
6	Ficus religiosa	Peepal tree	3.6
7	Plumeria	Champa tree	3
8	Bambuseae	Bamboo tree	5.7
9	Pterygota alata	Buddha Coconut tree	5.4
10	Mitragyna parvifolia	Kaim tree	3.5

- **Sky view factor**
  - Sky view factor is the extent of sky observed from a point as a proportion of the total possible sky hemisphere. Its value would vary between 0 and 1 based on the extent of sky visible at the point of observation, 1 being the sky is visible at the fullest extent and 0 being the least (Figure 1). Once we have the heights of the buildings and width of road sky view factor can be calculated using the simple formula given below.

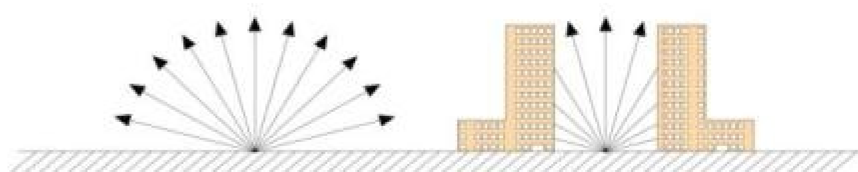


Figure 1. Illustration of Sky-view factor

Example Calculation using Calculator

Figure 2 presents a sample site for which increase or decrease in air temperature is predicted as explained below.

Calculation Example for Heat Island Calculator (Resource Impact Section)

All sample calculations are only demonstrative and the values of various variables and assumptions would vary from project to project

- **Step 1- Identifying the Zones to be studied using the tool**

  As mentioned earlier, the extent of area that needs to be considered for each calculation shall be of 50m radius (approximately 7854 sqm). For larger sites analysis can be done for various sub-sites selected to satisfy the scale requirement of the tool. The project must select sub-sites (for analysis in the calculator) on the basis of density of buildings – from most to the least. Each sub-site must contain at least 1 building. The project site can be divided into a grid as shown in Figure 3 and sub-sites can be identified. Figure 3 shows the sample three sub-sites considered for the calculation. For the example, Sub-Site 1 has been used.

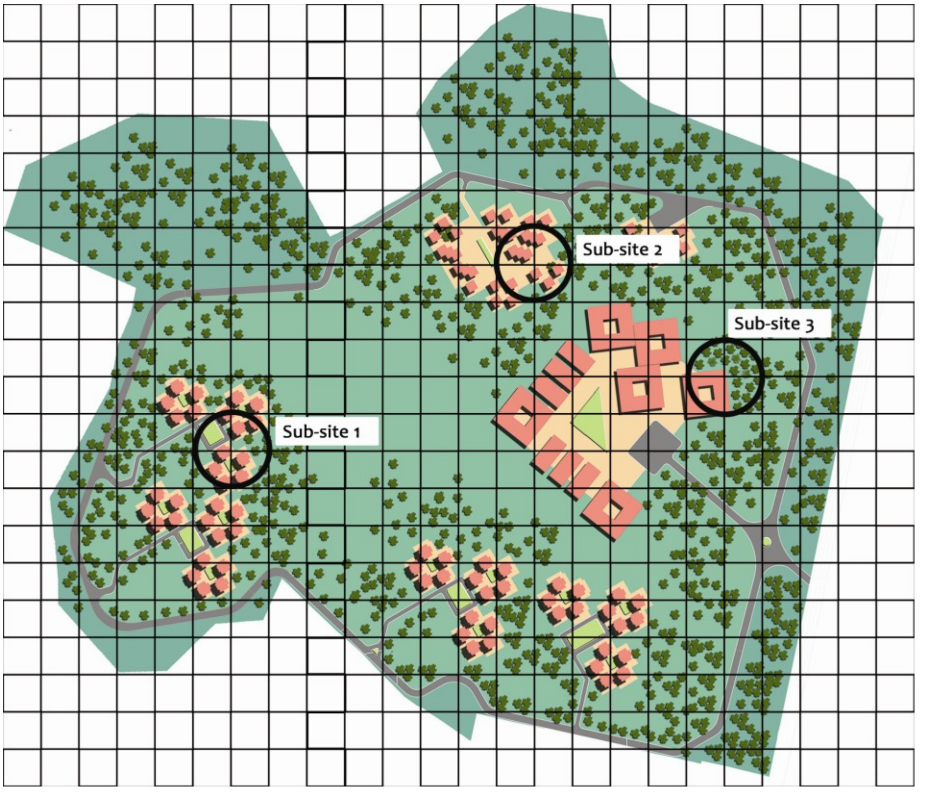


Figure 3. Zones divided in 50m of radius.
Three sample zones used for calculations are highlighted

- **Step 2. Calculation of Hard paved area of the selected Zone**

  Figure 3 shows the hatched area of the identified Sub-site 1 for calculation purpose. Area of non-green cover/ hard paved area needs to calculated from the 2D master plan of the site and to be distributed in terms of percentage. In the Sub-site 1, hard paved area is calculated as 70% of the total sub-site area.

Step 3. Calculation of Average height to building area ratio

- Average height to building area ratio of the building needs to be calculated from the architectural drawings. In non-green area of the selected Sub-site 1 (Figure 3), there are about 6 buildings each of 12 floors (Ground + eleven). The floor area of each building is about 284 sqm area. The average height of all the buildings is 42 m. Thus, Calculation Example for Heat Island Calculator (Resource Impact Section)

All sample calculations are only demonstrative and the values of various variables and assumptions would vary from project to project

Area of each floor of the typical building = 284 sqm

Total Floor Area (of all 6 buildings) = 284 X 6 x 12 = 20448 sqm

Average Heights of the Buildings = 42 m

Average height to building area ratio = 42/20448
= 0.002

- **Step 4. Calculation of Total Wall surface area**

  Total wall surface of the building needs to be calculated again from the architectural drawings. For the present case the calculations area done as below

  Wall Area of Each Building = 3024 sqm
  (Perimeter x building height)

  Total Wall Area (of all 6 Buildings) = 18144 Sqm

- **Step 5. Calculation of GnPR**

  The GnPR is calculated in two steps. The first step is to calculate the Total Tree Leaf Area. The formula for the same is given below:

  Total Tree Leaf Area = No. of trees x Canopy Area x LAI

Total Number of Trees	11
Canopy radius (in m)	4
Canopy Area (in sqm)	50.26
LAI	5
Total Tree Leaf Area (in sqm)	**2764.6**

GnPR = (Total Tree Leaf Area + Turf Area) / Area of Circle (site = 50 m radius)

Total Tree Leaf Area (in sqm)	2764.6
Turf Area (in sqm)	2356.2
Radius	50
Area of Circle (in sqm)	7854
GnPR	**0.652**

- **Step 5. Calculation of Sky View Factor**

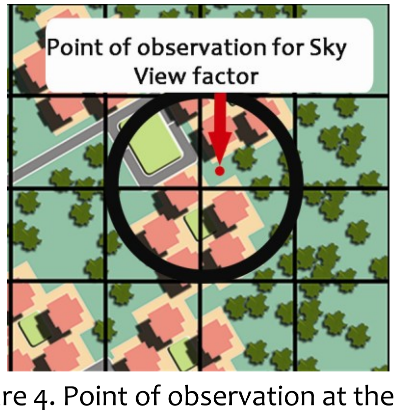


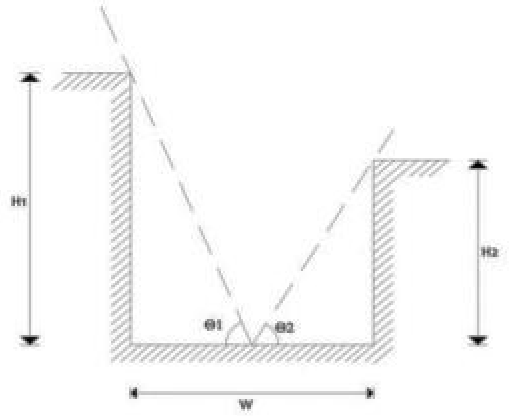
Figure 4. Point of observation at the centre of identified zone

Calculation Example for Heat Island Calculator (Resource Impact Section)

All sample calculations are only demonstrative and the values of various variables and assumptions would vary from project to project

In the present case (Figure 4), the sky view factor would be 1 as the point of observation is open to sky.

In case, the cardinal road passes through the point of observation (at the centre area influence area we assume in each zone), the following calculation could be done as explained below.



Assuming H1 = 42m, H2= 42m and W= 24m in above figure

Sky View Factor = cos (arctan (2*42/24)) = 0.27

- **Step 6: Design Case and Base Case incremental temperature:**

  The values calculated above are used in the tool to calculate the increase in ambient temperature. The analysis is done for the base case as well as design case. The base case analysis helps in providing the scale on which to measure the reduction in impact (for GRIHA LD purposes). The following assumptions are taken for the Base Case:

Variables	Base Case Assumptions
Ambient Temperature	Same as Design Case
Average Day-time radiations	Same as Design Case
Hard Paved %	100%
HBDG	Same as Design Case
Total Wall Surface Area	Same as Design Case
GnPR	0
Sky View Factor	0.5

In our example, the calculator returned the following results:

Ambient Temperature	Final Temperature – Base Case	Final Temperature – Design Case	Increment in temperature – Base Case	Increment in temperature – Design Case
24.6	25.85	25.46	1.25	0.86

The same calculation was repeated for the remaining 2 sub-sites. The results are tabulated below:

Cases	Ambient Temperature - 21st March (T_{am})	Base Case Output Temperature	Design Case Output Temperature	Average Increment in temperature against ambient – Base Case	Average Increment in temperature against ambient – Design Case	Reduction in Impact
SS 1	24.6	25.85	25.46	1.17	0.83	28.57%
SS 2		25.79	25.56			
SS 3		25.66	25.28			

Therefore, as a result of the design, the project is able to reduce the increase in ambient air temperature by 28.57% against the base case.

Energy

Intent

Energy is one among the top essential requirements to sustain our cities and us today. The ever-widening gap between demand of electricity, from upcoming as well as existing developments, and supply, is leading to severe power shortages across all cities, towns and villages of India and the situation is only expected to grow worse, if corrective measures are not taken at the earliest. Besides insufficient access to electricity, coal-fired thermal power plants lead to emission of CO_2 and other Greenhouse Gases, which are a leading factor for global warming. A two-pronged approach is recommended to address both demand as well as supply of energy for the upcoming developments. On demand side, it is imperative to design and construct energy-efficient buildings, design energy-efficient street lighting as well as energy-efficient site infrastructure and on the supply side, it is critical to promote generation of electricity through clean, renewable energy technologies to reduce the overall demand of the development from the grid or captive generation plants that rely on conventional forms of energy. Sustainable urban design complemented by solar passive design and intelligent systems like smart mini-grid that is supported through energy supply from renewable energy sources optimizes overall energy consumption of the development while enhancing the human comfort.

Commitment

Resource Impact

- Urban centers of India are faced with severe energy shortage. Therefore, it becomes imperative to design and construct upcoming large developments in a manner such that they are energy-efficient and are minimally dependent on conventional forms of energy. Bridging the demand supply gap is the first objective in this effort followed by meeting the balance demand through renewable forms of energy such as solar, wind, etc. In order to be self-sufficient in energy, the total demand created by the development must be less than or equal to the total energy which the project can generate through renewable energy technologies. This section, therefore, evaluates energy self-sufficiency in two parts – demand and supply.
- The demand for energy in a large scale development comes from the buildings coming up on the site, outdoor lighting (street lighting, security lighting, etc.), water pumping and electrical transmission systems. Buildings must be designed to reduce energy consumption without compromising on the visual and thermal comfort of the building occupants. All upcoming buildings on the site should be designed according the EPI benchmarks of GRIHA while complying with visual and thermal comfort standards of NBC 2005/ASHRAE55. All buildings should comply with all mandatory clauses of ECBC 2007. All street lighting should be designed to adhere to minimum energy efficiency norms as described in Guidelines and Benchmarks for Large Area Developments, MNRE and TERI, as well as to meet the minimum illumination levels and uniformity coefficient for different street categories. Necessary steps should be taken on site to reduce wastage of energy required for water pumping through efficient design and use of energy-efficient pumping systems. Pumps which are used for circulating water in pumping system consume significant amount of energy and pump selection optimization reduces energy wastage in pumping system. All pumps should be selected in a manner such that they never operate at less than 70 to 80 per cent efficiency. All motors fitted with pumps should be 'eff1'. In addition to the above, the electrical system on site should be designed in a manner which reduces the losses in electrical infrastructure. The distribution transformers should comply with minimum acceptable efficiency at 50 per cent and 100 per cent load rating as recommended in ECBC for dry type and oil cooled transformers. In addition, other aspects like maintaining power factor between 0.95 lag and unity, check-metering and monitoring and designing power distribution system for losses as recommended by ECBC should also be complied with on site.

Commitment

- The total energy required by the above mentioned systems on site will be the total energy demand on the project. In conventional scenario, this demand will be met through electricity supplied to the project by the utility grid and/or onsite diesel gensets. However, in a green large scale development, it becomes imperative to reduce the energy required from the utility grid and/or diesel gensets. In order to achieve this, the project should install renewable energy on site. The energy generated by the on-site/off-site renewable energy system will reduce the overall energy that the project would require from the utility grid and/or diesel gensets on site. Projects may install solar photovoltaic panels, small windmills, geothermal systems and/or biomass gasifiers (or any equivalent system which generates energy from biomass). The energy generated from the renewable sources will help in reducing the overall energy that the project will require from the utility grid/diesel gensets.
- In this section, the project is evaluated on energy self-sufficiency. For demand calculation (D), total annual energy (in kWh) required by the buildings, outdoor lighting and water pumping systems should be considered along with transmission losses. In the base case energy demand (D_{bc}), total energy required by the development can be calculated according to base case GRIHA benchmarks for buildings and conventional system design. In the design case (D_{dc}), demand for energy can be reduced by designing buildings which are more efficient than the GRIHA benchmark, selecting more efficient outdoor lighting, water pumping systems and electrical transmission systems.
- On the supply side (S), the project should install renewable energy systems on site or off-site to generate clean energy on site and reduce the energy demand from the utility grid and/or diesel gensets.
- The overall impact calculation will be done as a percentage – the percentage of energy (in kWh) required by the project from the utility grid/diesel genset. The following formula will be used for the same:

$$\frac{D_{dc} - S}{D_{bc}} \times 100$$

- If $D_{bc} = D_{dc}$ and S=0, then the impact will be 100 per cent. If $D_{dc} - S = 0$, then the impact is 0 per cent. Each development should attempt to be self-sufficient in demand of energy (kWh).

GRIHA LD Base Cases for Energy

GRIHA LD Base Case Table Energy Performance Index (EPI) – (kWh/ m^2/year)		
Climate Classification	Day time occupancy – 8 hours occupancy	24 hours Occupancy
	5 Days a week	7 Days a week
Commercial/Institutional buildings		
Moderate	120	350
Composite / Warm and humid / hot and dry	140	450
Residential buildings		
Composite / Warm and humid / hot and dry	100	
Moderate	85	

GRIHA LD Base Case for Street Lights				
S.No.	**Classification**	**Road Type**	**Width of Carriageway (m)**	**Lighting Power per run(W/m)**
1	A1	Dual/ Single Carriageway	14	14.5
2	A1	Dual/ Single Carriageway	17.5	17.5
3	A1	Dual/ Single Carriageway	21	21.5
4	A2	Single Carriageway	10.5	11.5
5	A2	Single Carriageway	7	10.5

Commitment

Environmental Quality

- Passive building design helps in reducing the overall energy demand while simultaneously improving occupant comfort. Good urban design site helps in improving thermal comfort in outdoor public spaces while simultaneously reducing detrimental environmental impact through sensitive planning. Passive urban design strategies help in ensuring that the public spaces, in between the buildings, are suitably shaded during summers. Design and massing of the buildings should be done in a manner such that neighboring buildings shade the in-between spaces. Solar path analysis should be carried out for the public spaces and the urban massing immediately surrounding them to enable mutual shading. The solar path analysis should also ensure that the roof areas reserved for installation of solar photo-voltaic panels are shade-free throughout the year.
- In addition to that, elements like green areas and water bodies should be interspersed evenly across the development to help in moderating the micro-climate of the development. Even distribution of green spaces and water bodies across the development has a better effect on local micro-climate than a large central green or water body.
- Urban massing can be done in a manner which does not hinder urban wind movements. It must be ensured that no elements which retard wind flow are placed in the path of the local winds/seasonal winds. However, one must ensure that wind flow during unfavorable months of the year is minimized. For example, wind flow should be curtailed during summer months for a project located in Jodhpur or Delhi or similar climates.
- Good outdoor lighting design is extremely important in large scale developments. Artificial lighting simulations should be done to ensure that the outdoor lighting design is done in a manner such that all critical roads and walkways meet the recommended lux levels as recommend by the Indian Roads Congress. Simulations must also be carried out for all security lighting to ensure that they meet the necessary lux levels required for security lighting in areas like parks, community centers, and other public spaces. All outdoor lighting systems should be connected to automatic controls. Automatic controls can be either timer-based or photo-sensor based.

Commitment

- A Smart Mini-Grid (SMG) is an intelligent electricity distribution network, operating at or below 11KV, to provide electricity to a community. These Smart Mini-Grids use advance sensing, communication and control technologies to generate, manage, distribute, and utilize electricity at the local distribution levels more intelligently and effectively. A SMG will have a central controller which has all the intelligence and strategies inbuilt in it. The controller utilizes the state-of- the- art digital technologies, control and automation technologies, mobile and telecommunication and Information technologies to monitor manage and control the entire Smart Mini-Grid. It continuously monitors the energy consumption of each of the load center/building and the total energy consumption as well as the energy generated from different energy sources. Based on the energy demand and energy availability, the central controller automatically and dynamically balances the energy supply and varying energy efficient loads of the Smart Mini-Grids with prioritization given to renewable energy sources. So in this case, in every situation, the maximum utilization of renewable energy will always happen and whatever RE source is available will be utilized first and subsequently the gap between energy demand and supply can be met through other available energy sources. In case of an energy supply constraint situation, the central controller can promptly schedule or shift certain loads in order to manage the demand.
- It also promotes demand side management and control of defined loads as per the set criteria. For example the lux level of certain path lights, street lights can be varied either by a fixed time based approach or based on the available ambience light and movements of the commuters.
- Another feature in SMG is user interface with real time monitoring and control even from a remote location if the location has a good mobile network. This features can be provided even in mobile devices such as tablets and smart phones so that the user can control it easily and instantly.

Commitment

- Operation and maintenance of electro-mechanical systems is extremely important in order to maintain optimum performance and efficiency. A comprehensive Operation and Maintenance (O & M) protocol should be established covering all electro-mechanical systems on site. The protocol should provide complete procedure and guidelines for the following:
  - Regular performance monitoring of the building systems.
  - Correct operation of equipment as per the guidelines specified by the manufacturers/suppliers.
  - Repair and upgradation of building systems as and when required, to ensure smooth functioning of equipment and processes.
  - Adjustment of the mechanical and electrical systems to function as per the varying occupant needs.
- In addition to the protocol, sufficient training should be provided to the maintenance personnel on site. Often, it is the lack of trained professionals which lead to inefficient performance of electro-mechanical systems on site/buildings. In addition to incorporation of green design features during design and construction of a development, it is equally significant to ensure that energy and environmental systems incorporated are performing as predicted during the design and development stage. Through audits, the performance of these systems may be evaluated and the validity of the predicted performance may be determined. In case a system fails to perform as it should have; the audit process will identify the cause for deterioration in the performance and also provide recommendations regarding any need for upgradations or modifications in the systems.

Compliance

Design Stage & Each Subsequent Phase

- Submit supporting drawings and narrative elaborating on the passive design measures highlighting the following:
    - Proposed built-up areas and untouched natural areas
    - Proposed urban massing demonstrating:
        - shading of common areas during peak summers without creating obstruction for renewable energy installation
        - minimum obstruction to local wind flows (except during summers – winters for cold climates)
    - Proposed location of various natural elements like green spaces, tree clusters, water bodies to moderate outdoor temperature
- Submit calculations elaborating on the energy consumption (EPI calculations) for the project highlighting the building and site level energy efficiency measures adopted in the project. Provide supporting drawings and narrative.
- Submit calculations elaborating on the proposed renewable energy system to be installed on-site/off-site, including the proposed energy generation potential – at least for the first phase. Provide supporting drawings and narrative.
    - ***Additional documents required for rating of each Phase: Supporting purchase orders/tender documents (representative sample, not all)***
- Submit proposed key building plans, elevations and sections – highlighting the energy efficiency (including Mandatory ECBC measures) measures. Provide supporting drawings and narratives.
    - ***Additional documents required for rating of each Phase: Supporting purchase orders/tender documents (representative sample, not all)***
- Submit layout of the following along with the proposed details of energy efficiency:
    - Outdoor lighting system with the proposed details of automatic controls
    - Water pumping system
    - Electrical transmission system
    - ***Additional documents required for rating of each Phase: Supporting purchase orders/tender documents (representative sample, not all)***
- Submit lighting simulations demonstrating that the street/road lighting meets the required lux levels
- Details of proposed smart grid system and building management systems.
    - ***Additional documents required for rating of each Phase: Supporting purchase orders/tender documents (representative sample, not all)***
- Document elaborating on the proposed Operation and Maintenance Protocol.

Appraisal Resource Impact

Mandatory

- Reduce the total amount of energy (kWh) required from the local Municipal grid/Diesel gensets by at least 25 per cent.

Optional

- Design the development to be self-sufficient in its annual energy requirement.

Appraisal Environmental Quality

Mandatory

- Outdoor artificial lighting – 25 points.
  - Outdoor road lighting meets the required lux levels – 10 points
  - Automatic switching/ dimming controls to be provided for all outdoor lightings – 15 points

Optional

- Smart Mini Grids – 25 points.
  - Integration of various energy sources with prioritization to Renewable Energy Sources (RES) and dynamic balancing of energy supply and varying energy efficient loads of the Smart Mini-Grids – 10 points
  - Real time remote monitoring & control of smart mini-grid with user interface which operates even in mobile devices –8 points
  - Demand Side Management and automatic Control of loads used for common services (like street lights, water pumping etc.) based on pre-defined criteria - 7 points
- Passive urban design – 30 points.
  - Design, massing and layout of buildings have been done in a manner to shade common areas during peak summer (reverse of cold climates) months while avoiding shading of roof areas being used for installation of solar photo voltaic panels – 10 points
  - Natural elements have been uniformly interspersed across the site to moderate outdoor temperature – 10 points
  - Street layouts and buildings have been designed to provide minimum obstruction to local wind flow (except for during unfavourable months for the region) – 10 points
- Operation and Maintenance – 20 points.
  - Dedicated operational staff for Operation and Maintenance of Electro-mechanical systems on site – 5 points
  - Operation and maintenance protocol to be established and implemented – 10 points
  - Periodic energy auditing (every year) to be carried out by in-house Operations team– 5 points

Calculation Example for Energy Calculator (Resource Impact Section)

All sample calculations are only demonstrative and the values of various variables and assumptions would vary from project to project

The sample project has 60 faculty residential blocks (G+2, building A), 18 hostel blocks (G+8, building B) and 6 administrative blocks (G+2, building C). The attached image is the plan of the project. The site is located in composite climate.

Building Energy consumption Calculation:

The energy consumption shall be done for one of the building - "A" as marked in the figure 1. There are total of 60 buildings each of 3 floors (Ground + 2). Thus design case and base case energy consumption of building A is:

Building A – Faculty Residence	
Typical (number of building on site identical to the building)	60
Diversity (for equipment use only)	.8
Total building built up area (all floors)	849 sqm
Design case EPI (based on simulations)	55 kWh/sq.m./annum
Base case EPI (from the GRIHA LD Base Case Table)	100 kWh/sq.m./annum
Equipment power density (considered here)	0.011 kW/sq.m.
Annual working hours (residential)	8760 h
Total energy consumption design case (Building A – 60 buildings)	6728.56 MWh/ annum
Total energy consumption base case (Building A – 60 buildings)	9020.86 MWh/ annum

Calculation Example for Energy Calculator (Resource Impact Section)

All sample calculations are only demonstrative and the values of various variables and assumptions would vary from project to project

Similarly energy consumption for all the building type on campus is calculated. The total energy consumption for design case and base case for this sample project is:

Total energy consumption by buildings for design case (= B1)	16478.05 MWh/annum
Total energy consumption by buildings for base case (= B2)	24000.79 MWh/annum

Street Light Energy consumption Calculation:

There are 2 different type of street in our project. The design case and base case street lighting energy consumption for all main streets – which is Street type A1- is calculated as below:

Street type – A1 – 14 m wide road	
Total length (of this particular street) across the development	3083m
Design case total connected load	30.2 kW
GRIHA LD benchmark	14.5 W/m
Base case connected load (length x LD base case benchmark)	44.7 kW
Total annual operational hours	4380
Design case energy consumption	132.28 MWh/annum
Base case energy consumption	195.79 MWh/ annum

Similarly energy consumption by different street on campus is calculated.

Total energy consumption design case (= S1)	**194.47 MWh/ annum**
Total energy consumption base case (= S2)	**268.98 MWh/ annum**

Pumping & Miscellaneous Energy consumption Calculation:

Miscellaneous & pumping energy consumption detail (based on project specific analysis and assumptions) (= P)	**3455.6 MWh/ annum**

Total Renewable Energy Generation on Site:

In our project, a 5 MW solar PV plant is to be installed. The total electricity to be generated from this is:

Annual energy generated through RE system (generation assumption @1500 kWh/kW/annum) (= R)	7500 MWh/annum

Net Energy impact calculation:

Therefore, total **Base Case Energy Consumption** = **BC** =

B2 + S2 +P = 27725.36 MWh/annum

And total **Design Case Energy Consumption** = **DC** =

B1 + S1 +P = 20128.12 MWh/annum

Net Impact = (DC- R)/BC x 100 = [(20128.12 – 7500)/27725.36] x 100

= (12628.12/27725.36) x 100

= 45.55%

Therefore, **reduction in impact is 54.45%.**

Water & Waste water

Intent

Potable water is a scarcer resource. With increasing population there is an ever increasing demand for potable water however the supply is deficit. Apart from the deficit supply of potable water the quality of water supplied is of much concern. It is of utmost importance to manage the available of supply of potable water by reducing the demand and reusing by treating the water. Additionally maintaining the quality of drinking water is equally important thus ensuring healthy and hygienic conditions for people. To ensure safe drinking water, both municipal groundwater and/or harvested rainwater have to be treated before use to varying levels depending on the water quality of the source and its end-use. Growing urbanization accelerates the situation of increasing water demands for domestic, industrial, commercial, and landscape purposes. As demand for water increases, water recycling will play a greater role in our overall water supply. By working together to overcome obstacles, water conservation along with water recycling and rainwater harvesting will help in conserving and sustainably managing our vital water resources. Water recycling is a sustainable approach and may prove to be a cost-effective solution in the long term.

Resource Impact

- Every development needs to be able to cater to the demand for potable water for its residents. In conventional developments, the development gets the water from either the municipal supply or the groundwater or both. With the ever increasing population and improving lifestyles, the demand for water has risen dramatically in the recent past. Thus any new development adds additional pressure on the already strained water resources. Thus, it becomes important to design upcoming developments to be as water self-sufficient as possible. The development should be made to rely, as much as possible, on harvested rainwater as well as recycled waste water from STP. This will ensure that the total amount of water required from the municipal grid and/or groundwater sources is significantly lesser as compared to a conventional large-scale development.
- In this section, the project is evaluated on water self-sufficiency. For demand calculation (D), estimate the total water required for use in the buildings and landscape in one year. This is the annual water demand. On the supply side (S), the project may adopt any or both of the following strategies:
  - Capturing and storing rainwater on site for reuse.
  - Recycling STP water for reuse on site.
- The total annual water, which the development requires from the municipal supply grid and/or groundwater source, is D – S. In this section, if S = 0, then the impact is 100 per cent and if D=S, i.e., the project is completely self-sufficient in its annual water requirement, then the impact is 0 per cent. Each development should attempt to ensure that it has 0 per cent demand of water from the municipal supply/groundwater sources and is fully self-sufficient through strategies like demand reduction, rainwater harvesting, and waste water recycling and reuse.

Environmental Quality

- Quality of water is one of the most important factors concerning health across the globe. Assurance of safe drinking water to the residents of any given development becomes imperative. Access to clean, potable water ensures prevention of diseases and health of its

Commitment

residents. Water required on the site for various purposes must meet the quality norms established by BIS for a given use. For example, all water being used for domestic purposes like drinking, cooking, etc., must comply with IS – 14543. Similarly, all rainwater that is harvested must undergo necessary filtration to ensure that it meets the quality standards of BIS standards / international standards (EPA or European) for a given use like bathing, make-up water for air-conditioning, etc. This is especially important for the recycled water from STP which is being used on site, it must meet the BIS norms, or international standards for uses not covered by BIS, before being allowed to be used on site.

- With growing urbanization, there has been a steady rise in pollution of the rivers and various other water bodies, where the city discharges its sewage effluents, leading to extensive water pollution and damage of aquatic ecosystems. In order to mitigate the same, the centralized/decentralized STP on site must adhere to the CPCB disposal norms.
- Use of low-flow fixtures should be promoted on site. The developer should promote the use of low-flow fixtures in the future upcoming buildings of site. The use of low-flow fixtures dramatically reduces the amount of water needed during activities like bathing, flushing, washing, etc. This helps in reducing the demand for potable water. Ensure that flow rates of all WCs are at least 3/6 lpf or less, lavatory and kitchen faucets should have a flow rate of 6 lpm or less, urinals should have a flow rate of 3 lpf or less and showers should be at least 10 lpm or less.
- Water is required not just by residents of a development but also for maintaining the biological cycles of the existing ecosystem that were disrupted during construction. Maintaining the natural water cycle is a very important aspect of sustainability. One of the measures that should be taken in that direction is to ensure that there are enough recharge wells and trenches on site which help in recharging groundwater tables to maintain water levels. Each recharge well/trench must have necessary filtration system to ensure that contaminated water does not reach the groundwater table. groundwater table levels should be monitored before and after rainfall to ascertain rise in water levels.

Commitment

- Water audit and monitoring are very critical aspects in water supply. Water audits should be undertaken at least once every year. Water audits on site help in identifying leakages in supply, illegal withdrawals, etc. Conducting a detailed audit helps in facilitating a better management of the water supply system with improved reliability. Systems like SCADA (Supervisory Control and Data Acquisition) can also be installed on it. Such systems help in easier extraction of data for future analysis and monitoring.
- Besides monitoring and audits, it is also extremely important to have an Operation and Maintenance (O & M) protocol established and at least one trained personnel on site who can perform the basic operations on the installed treatment system. Often due to lack of maintenance, STP systems stop performing after 2 - 3 years and become redundant. For effective functioning of the STP, it is essential to have an effective O & M plan in place. It helps in consistency in the performance of the treatment system, economizes the running cost of the system, ensures the recycling potential of the treated discharge and maintains the desired quality of the environment.

Compliance

Design Stage & Each Subsequent Phase

- Submit the proposed water balance table and calculations, along with supporting documents, for the entire development highlighting:
  - Total project water demand – building, landscape, utilities
  - Total quantity of recycled STP water being reused and total rainwater being reused
  - Total rainwater being recharged into the ground water aquifers
- Submit the site plan/plumbing layout along with narrative highlighting:
  - Main potable water storage facilities
  - Water supply lines
  - SUDS and other natural drainage channels on site
  - Location of STP and STP lines
  - Rainwater harvesting system and recharge wells – along with filtration system details
  - Key pumping installations
- Submit test certificate for water from various sources (municipal supply, groundwater, rainwater as well as recycled grey-water) ensuring compliance with requisite BIS codes/ equivalent international standards for quality, based on reuse application.
- Submit design details (drawings and specifications) for the STP plant. Provide details describing its specifications and compliance to CPCB disposal norms. In case of decentralized STP, submit the documents for all STP, if different in technical details.
- Submit a narrative elaborating on the use of low-flow fixtures in the project.
  - ***Additional documents required for rating of each Phase: Supporting purchase orders/tender documents (representative sample, not all)***
- Submit a detailed document elaborating on the proposed SCADA system and Operation and Maintenance Protocol.
  - ***Additional documents required for rating of each Phase: Supporting purchase orders/tender documents (representative sample, not all)***

Compliance

- Plumbing layout of the entire phase demarcating the following:
    - Drainage channels (both artificial and natural) across the site.
    - Provision of SUDS.
    - Key pumping and storage installations – of potable water, harvested rainwater and recycled grey-water.
    - Rainwater recharge wells along with filtration system details.
- Submit a contract document/purchase order for low-flow fixtures.
- Submit a detailed document elaborating on the Operation and Maintenance Protocol.
- Provide details of metering and monitoring systems, like SCADA, etc., across the development. The following plumbing lines must have a monitoring and metering mechanism:
    - All potable water lines – from municipal supply and groundwater source.
    - All plumbing lines carrying rainwater – both from storage as well as groundwater recharge.
    - All lines carrying recycled waste water from the STP.

Appraisal Resource Impact

Mandatory

- Reduce the total amount of water required from the local Municipal grid/groundwater by at least 25 per cent.

Optional

- Design the development to be self-sufficient in its annual water requirement.

Appraisal Environmental Quality

Mandatory

- Quality of water – 35 points.
    - Ensure that quality of potable as well as non-potable water complies with relevant BIS standards/international standards (EPA or European) – 20 points
    - Ensure that quality of captured rainwater for storage and recharge as well as recycled water for use, comply with the relevant BIS standards – 15 points

Optional

- STP/waste water treatment facility should meet the CPCB norms – 15 points
- Rainwater falling on site (besides that which is being stored for reuse) is recharged through appropriate filtration measures – 20 points (not applicable if not permitted by the CGWB norms)

    Non-applicability: ***If the CGWB does not allow for water to be recharged at the site, then the clause is not applicable to the project.***
- All fixtures on site (WCs, urinals, showers and kitchen and lavatory faucets) should be low-flow fixtures – 10 points
- Establish an effective monitoring systems like SCADA as well as an Operation and Maintenance Protocol for the various plumbing and water treatment systems (both centralized as well as decentralized) on site – 20 points

Calculation Example for Water Calculator (Resource Impact Section)

All sample calculations are only demonstrative and the values of various variables and assumptions would vary from project to project

The impact on municipal water supply/ ground water resource is based on two parameters the water demand on the campus and the water supply on site by treating waste water and through rain water harvesting. Consider the following example to calculate the net resource impact on municipal water supply/ ground water source. The sample large development has 60 faculty residential blocks (G+2, building A), 18 hostel blocks (G+8, building B) and 6 administrative blocks (G+2, building C). The attached image is the plan of the sample large development. The site is located in composite climate.

Building water consumption calculation:

For the example, the faculty residences are considered. There are 60 such buildings on campus each G+12 high. There are 3 residential units on each floor with 5 people each (assumption). Hence occupancy per building is 45.

lpcd norms for residential building (medium end residential)	175 lpcd
Total annual working days	365 days
Water demand for 1 faculty block (Pax = 45)	2.87 ML/annum
Water demand for 60 faculty blocks (Building A)	172.46 ML/ annum

Similarly, building water requirement for all buildings in the project is calculated. The total building water consumption – for the entire project is – **326.89 ML/annum.**

Landscape and utilizes water consumption calculation:

The total area under landscaping on campus is 389112sqm of which approximately 30% area is under lawns and rest under native shrubs and native trees. Using the calculator, the total landscape water demand comes to be 458.12 ML/annum. The total water requirement for various utilities is 81 ML/annum.

Total annual water demand = D = (326.89 + 458.12 + 81) ML/annum

= 866.01 ML/annum

Calculation Example for Water Calculator (Resource Impact Section)

All sample calculations are only demonstrative and the values of various variables and assumptions would vary from project to project

Waste-water recycle and rainwater harvesting calculation:

In our project, the total waste water being reused from the STP plant and total rainwater being captured and used is as follows:

Annual rain water captured and reused on site (R1)	47.8 ML/annum
Annual treated waste water being reused on site (R2)	360 ML/annum
Total annual water recycled and reused (including rainwater)	407.86 ML/annum

Net Water impact calculation:

Total Water demand (D)	866.01 ML/annum
Total annual water recycled and reused (including rainwater) (S)	407.86 ML/annum
Net Impact on Municipal water supply/ground water source	385.65 ML/annum
Net impact on municipal water supply/ ground water (%)	—— x 100
Net impact on municipal water supply/ ground water (%)	48.6%
Reduction in impact (%)	51.4%

Solid Waste Management

Intent

The prime objective here is to close the solid waste cycle loop and to follow a more systematic, integrated approach to solid waste management. Solid Waste Management covers all activities pertaining to the control, transfer, transport, processing, and disposal of solid waste in accordance with best principles and practices of public health, economics, engineering, conservation, and aesthetics. The best method to deal with waste is centered on a broadly accepted —hierarchy of waste management – which gives a priority listing of the technical and sociological options of waste management. The highest and most preferred rank of this integrated management hierarchy is waste prevention or waste minimization at source, which aims at reducing the amount of the waste produced. It is the most effective way to reduce the quantity of disposable waste, the cost associated with its handling and its adverse environmental impacts. Reuse, recycling, and energy recovery technologies then come as moderately suitable technologies. Land-filling is the last option of the hierarchy that involves controlled interment of the residual waste which has no further use on or in the earth‘s mantle.

Resource Impact

- Almost 50 per cent of the total solid waste generated in our cities today is organic waste. In common scenarios, this organic waste ends up in the landfill. Organic waste, being biodegradable, does not have the same dangers associated with disposal of other solid wastes like plastics, e-waste or hospital waste. However, organic waste can easily be converted into a resource, like biogas or manure, through appropriate treatment process. It is important to treat as much waste on site as possible in order to reduce the size of our ever growing landfills. In this light, it is recommended for the project to create a phase–wise strategy to treat 100 per cent of organic waste on site through appropriate strategies. In this section, if no organic waste is treated on site, then the impact will be considered to be 100 per cent. If strategies are being adopted to treat all the organic waste being generated on site, then the impact will be 0 per cent. Projects should strive to recycle and reuse all organic waste being generated on site.

Environmental Quality

- For solid waste to be managed and treated, it is extremely critical to provide the future occupants of the campus with good infrastructure for solid waste management. An Integrated Solid Waste Management (ISWM) plan should be prepared for implementation on site. An ISWM plan elaborates on the following strategies:
    - Primary and secondary collection of segregated solid waste
    - Hygienic transport / transfer of collected solid waste for treatment / disposal.
    - Treatment of waste – recycling / down-cycling and / or disposal of waste.

  An ISWM should be prepared for all different kinds of waste on site:
    - Organic waste, hospital/medical waste, e-waste and;
    - Other recyclable solid wastes like metal, paper, etc.
- There should be provision of multi-coloured bins, in public spaces like parks, community centers, etc., at the site level. Additionally, at a campus level, it is important to create a centralized storage facility, for storing different kinds of waste in segregated compartments and in a hygienic manner. Based on the collection frequency, once the

Commitment

waste is segregated and stored in a centralized location, it can then be either sent for treatment (in case of e-waste/medical waste) or sent for being recycled (in case of plastics, paper, metals, etc.).

- The capacities of various bins, storage areas, etc., should be enough to hold a minimum of two days of garbage or more depending on the frequency of waste collection.
- In case the development site is outside the municipal boundary limits and there is no provision for secondary collection / disposal of waste, then the selected temporary site for waste disposal should be made on the principles of engineered landfill.
- Besides the organic and inert-inorganic waste being generated on site, two types of hazardous waste might also be generated on site – e-waste and medical waste. Both these types of waste are extremely toxic in nature and their handling and disposal should be carried out in an extremely careful manner.
- E-waste collected from site should be sent to e-waste recyclers for recycling.
- Hospital and other medical wastes should be incinerated on site in accordance with the Management and Handling Rules – 1998. It must be ensured that untreated medical waste does not stay on site for more than 48 hours.
- Beside managing waste during occupation, it is also important to manage and recycle construction waste. It is estimated that almost 10-20 per cent of total municipal waste is construction and demolition waste. Therefore, for each development phase, a construction waste management strategy must be prepared and provided to the executing engineers on site. Inert and hazardous waste must be collected and stored separately from site. Proper training must be given to all construction workers in order to train them to be able to handle different kinds of wastes on site. In addition to segregating inert and hazardous waste, it is also important to either reuse the construction waste on site or safely dispose it off to designated agencies for recycling. All these steps are important to ensure that construction waste is diverted away from the ever-growing landfills.

Compliance

Design Stage & Each Subsequent Phase

- Submit narrative providing total estimated quantity of organic waste which will be generated on site during operation and sizing of the treatment plant.
- Submit narrative and details of incineration process for treatment of hospital/medical waste & of e-waste recycling strategy for the project – whichever is applicable.
- Submit the ISWM plan (drawings and narrative – for the operation phase), for the development – detailing the various processes (primary collection, secondary collection, transport / transfer of waste, disposal and treatment).
- Submit documents highlighting contractual tie-up with various recyclers – who will procure and recycle the inorganic recyclable wastes like paper, metal, plastics, etc., from the site – along with narrative on the recycling strategies being adopted by them to ensure that their recycling processes are hygienic, if possible, adhering to CPCB norms.
- Submit the proposed construction waste management plan and narrative for the project, highlighting the following:
    - Space provision for storage of segregated inert and hazardous construction waste on site.
    - Proposed location of segregated storage (primary and secondary collection) for waste generated by the construction workers on site.
    - Proposed recycling/reusing and/or disposal strategies for construction waste.

Compliance

- Submit construction waste management plan for each phase of construction, highlighting the following:
    - Segregated storage of inert and hazardous construction and demolition waste on site.
    - Segregated storage (primary and secondary collection) for waste generated by the construction workers on site.
    - Recycling/reusing and/or disposal strategies for construction waste.
- Submit contractual tie-up documents with various recyclers – who will procure and recycle the inorganic recyclable wastes like paper, metal, plastics, etc., from the site – along with a narrative on the recycling strategies being adopted by them to ensure that their recycling processes are hygienic and, if possible, adhering to CPCB norms.
- Submit details of the engineered landfill for waste disposal – if applicable. Supplement the same with photographs.
- Submit details of incineration process for treatment of hospital / medical waste – if applicable. Supplement the same with photographs.

Appraisal Resource Impact

Appraisal Environmental Quality

Optional

- Treat all organic waste being generated on site.

Mandatory

- Handling and treatment of special waste – 35 points.
  - On-site incinerators to be provided for treatment of medical / hospital waste or provision for the same to be sent to a treatment facility (if Applicable) – 20 points
  - Provide contractual tie-up with e-waste recyclers for purchase and safe recycling of e-waste from site – 15 points

Optional

- Segregation and storage of waste on site – 35 points.
  - Provision for hygienic secondary storage facility for organic and recyclable inorganic waste collected at site – 20 points
  - Provide contractual tie-up with recyclers for purchase and safe recycling of inorganic recyclable wastes like metal, plastic, paper etc., from site – 15 points
- Construction and demolition waste management – 30 points.
  - Develop a construction waste management plan, for safe handling, storage and recycling of construction waste, to be provided to the site engineers and implemented on site – 10 points
  - Provision of storage areas for segregated storage of inert and hazardous waste during construction – 20 points

Transport

Intent

As per IPCC, nearly 30 per cent of the global GHG emissions are contributed by the transport sector. The transport sector in India is no different. It contributes about 10 per cent of the energy related GHG emissions in the country. The transport sector in India is transforming as rapidly as the real estate sector. It is estimated that more than a 1,000 cars are added to Delhi's roads every day which translates to almost 3.5 lakh new cars per year. Other cities and towns of India are also facing a similar growth rate in personal motor vehicles; a trend that is leading to problems related to congestion, air polluting and road accidents. The share of walking, cycling, and public transport modes have been, however, declining gradually. It is imperative to shift /retain people to these clean modes of transport and discourage them from using private vehicles as far as possible. The way we plan our developments can help in achieving this motive. The circulation network that we plan in large developments should promote walking and cycling for trips within the development. Collective transport services should be provided to meet mobility demand within the development and provide connectivity to the nearest public transit stops. Innovative design and pricing measures should be employed to promote sustainable mobility modes and create an enabling environment for safe as well as secure mobility for all.

Commitment

Environmental Quality

While planning a development, it becomes important to design the streets in a manner that the traffic speed in the residential areas are kept low; this enhances the safety of pedestrians and cyclists. The overall speed of motorized traffic, in residential areas should be kept, less than 30 km/h. Several strategies like cul-de sacs, loops, etc., can be incorporated in the street network design. Many of these strategies make more optimized use of land while also making streets safer for pedestrians and cyclists. Additionally, the streets should not be more than 25 meters wide, since a human being cannot cross a wider road in under 30 seconds. Another important aspect is to incorporate measures, which help in reducing the overall speed of motorized traffic. This can be done through encouraging physical features like speed bumps, raised crosswalks, curb extensions, etc.

- Walking can serve all short trips (1-2 km) that people have to make and cycling can take people even further. However, whether people choose to use these modes totally depends on the quality and continuity of footpaths and cycling tracks and the support infrastructure provided to the pedestrians and cyclists. It becomes extremely important that all roads in a development should have footpath. All roads with heavy motorized traffic should have a cycling track on at least one side of the road. The minimum width of a footpath should be 1.5m and that of a cycling track should be 3m. In addition to the provision of cycling tracks and footpaths, it is also important to provide the same through open areas and greens in order to improve connectivity and access to different services across the development. This helps in reducing the distance a person has to walk and therefore, encourages walking and cycling.
- Another important aspect is to design the footpaths to be universally accessible and continuous. Footpaths and intersections should be designed for safe crossing for the elderly and children and should be universally accessible. Railings along footpaths, non-slippery surfaces, etc., are some of the strategies which should be adopted.
- Footpaths and cycling tracks are successful only when supporting infrastructure like bicycle parking, good landscaping design for shading, changing rooms, benches for rest, charging points for electric bikes, etc., are provided alongside the cycling tracks and footpaths.

Commitment

- Another important aspect of street design is to incorporate measures in the design which promote safety at the interface between pedestrians, cyclists, and motorized transport.
- A very important aspect is provision of street lights and signage. Ample street lighting is essential for maintaining visibility as well as safety.
- In order to control the growth of private vehicles in the development, it becomes important that steps are taken to ensure that people are discouraged from owning multiple vehicles. This can be ensured by limiting the parking area to only meet the minimum local bye-law/NBC 2005/Environmental Clearance requirements (whichever is applicable) and not providing extra vehicular parking space.
- Mass transport systems should be developed inside the development, to complement the transportation system of the city. This will enable residents to use the collective transport services like small electric buses, golf cars, etc., for travel within the development reducing their dependency on private vehicles. In addition collective transport services can also be linked to the nearest public transport stops, so that residents are encouraged to use city public transport services.
- The developments should also target the use of clean energy vehicles like electric cars and bikes. For this, the developers can work on providing the necessary electric charging infrastructure for electric vehicles across the site.

Compliance

Design Stage & Each Subsequent Phase

- Submit site plan and sections along with narrative, highlighting the following:
    - the provision of bicycling tracks and footpaths
    - steps to ensure safety of pedestrians and non-motorized transport users
    - Location of various services like grocery stores, parks, ATMs etc.
    - various entry/exit points of the site demarcated
    - residential, commercial and institutional zones highlighted
- Submit the site plan, along with narrative, elaborating the road network planning, highlighting road hierarchies and speed control measures.
- Submit drawings and narrative highlighting that the total area being provided under parking does not exceed the requirements of the local bye laws/NBC 2005/ Environmental Clearance (whichever is applicable).
- Submit a narrative elaborating on collective transport services system.
- Provide narrative and site plan highlighting location of electric vehicle charging infrastructure

Mandatory

- Provision of footpaths and bicycling tracks and for safe interaction of NMT traffic with motorized traffic – 40 points.
    - All roads (except access roads) should have footpaths/sidewalks and cycle tracks – 10 points
    - Footpaths, sidewalks and cycle tracks should be continuous, wide and universally accessible – 10 points
    - Supporting infrastructure and facilities like bicycle parking, landscaping, public conveniences, etc., should be provided on site – 10 points
    - Necessary physical safety measures like railings, non-slippery surfaces, etc., must be taken on site – 10 points

Optional

- Road network planning – 20 points.
    - Street network planning to be done in a manner to promote safety and efficiency.
    - Measures to control speed of vehicular traffic should be implemented on site.
- Parking for cars and two wheelers – 10 points.
    - Total parking should not exceed the parking requirements as recommended by the local bye-laws/NBC 2005/Environmental Clearance (whichever is applicable) – 10 points
- Collective transport services – 15 points.
    - Running collective transport services (route, stops, frequency, and capacity) for intra-site movement and to provide connectivity to nearest city public transport nodes – 15 points
- Electric charging infrastructure for vehicles – 15 points.
    - Electric charging infrastructure provided for at least 10% of cars and bikes parked on site – 15 points

Social

Intent

Equity and social well-being are pre-requisites for a harmonious society where people of all classes can co-exist besides helping each other in their various functions. Co-existence and equitable access to resources and opportunities, across all socio-economic classes of society, serve as the backbone of any inclusive development. Our conventional approach to urban development has ignored inclusiveness and has resulted in inequitable growth models (spatial and socio-economic). It is important therefore that future developments imbibe the principles of equity and inclusiveness to provide equal growth opportunities and resource access to all. With this intent, this section gives equal importance to elements like comfort and health as well as access to infrastructure like schools and health centers to all people connected to the development - those constructing it as well as its final residents. The aim is to create social infrastructure, which helps in forming a strong community.

Commitment

- It is important to ensure that the construction workers who are building the development do not live in squalor. It is also important that they do not get injured during construction. Therefore, during the course of construction, it must be ensured that all the safety facilities and provisions listed in the National Building Code (NBC) 2005 should be implemented on site. The construction workers should wear helmets, safety boots as well as high-visibility jackets. Safety nets, safety harnesses, etc., should also be provided to the workers.
- Ensuring good health of construction workers is important – both from the perspective of promoting social sustainability as well as to ensure the timely progress of construction. All construction workers on site must have access to clean drinking water as well as clean and hygienic toilets.
- The construction workers should also be provided with clean and hygienic living conditions. The accommodation facilities for the construction workers should be daylit, ventilated and hygienic. The accommodation area should have provision of clean drinking water, clean toilets, and bathing facility. Special care should be taken while designing the toilets and bathrooms for women.
- Child labour is an illegal practice under the Indian law. Child labour must be banned on site and steps should be taken to ensure the same.
- The entire development, for post-construction stage, should be designed according to NBC 2005 guidelines on universal accessibility. There should be provision of railings and non-slippery surfaces on all footpaths. There should also be provision for disable-friendly public toilets.
- Increasing environmental awareness amongst the residents of the development is an important step towards ensuring that the future occupants of the development continue to adopt a low-carbon lifestyle. Environmental awareness within the development can be increased through installation of information panels, digital displays, etc., with facts and tips about the environment and habitats.
- The public areas of the development should be declared as non-smoking zones, in keeping with the regulation passed by the Government of India.

Commitment

- The service staff – security guards, maids, garbage collectors, etc. – is an extremely critical part of our daily lives, but very little facilities are provided to them in our developments. There should be provision of dedicated toilet facilities for the service staff in the project as per the thresholds mentioned below:

Fixtures	Male	Female
WCs	1 per 25	1 per 15
Washbasins	1 per 25	1 per 25
Urinals	Nil up to 6 1 for 7 – 20 2 for 21 – 45 3 for 46 – 70 4 for 71 – 100 Add 3% over 101 – 200 Add 2.5% over 200	

- Each toilet block must have an adjoining, covered resting area.
- The site must have at lead two toilet-cum-resting blocks which must be spaced between 1-2 kms apart (For project sites which are smaller than 1 km in length, the facilities must be suitably distanced).
- In most of the upcoming developments, the target audience is people from the middle or higher income groups. In such scenarios, the needs and housing requirements of the economically weaker sections (EWS) of the society are usually disregarded. New developments create jobs for economically weaker sections of the society. Thus they move into such developments for economic opportunities but lack of housing facilities result in a lot of people living in informal slum settlements closer to such developments. The development must be planned in such a manner as to create adequate provision of EWS housing on site itself.
- Besides EWS housing, it is also important to create low-cost health care centres and educational facilities for lower income groups. An alternative to the same can be a mandatory, low-cost reservation in the healthcare facilities as well as educational institutes within the development.
- A significant portion of our daily needs for goods is available in informal markets and not formal shopping centres. Provision of areas reserved for informal markets is important in enabling livelihood security for lower income groups as well as for improving accessibility

Commitment

- of essential daily needs like fruits and vegetables, etc., to the residents. In case a dedicated space is not provided for such activities, there will be possible future encroachments to cater to these demands. Therefore, in order to avoid such occurrence in the future, it becomes important to plan for such spaces in advance.
- Food security has been a major concern in India. With the cities encroaching upon the surrounding agricultural lands, the area under farmland is reducing. However, the demand for food grains is increasing due to the rapidly increasing population. Therefore, it becomes important to ensure that part of the food requirements are met within the development itself. Urban agriculture, vertical farms etc. are the need of the hour.

Compliance

Design Stage & Each Subsequent Phase

- Submit contract documents and narratives detailing the strategy for the following:
  - safety provisions for construction workers
  - provisions for clean toilets and drinking water on site
  - provision of clean and hygienic labour huts
  - Ban on child labour on site.
- Submit narratives and relevant drawings detailing the strategies for the following:
  - implementation of smoking ban in public areas on site
  - provision of dedicated facilities for service staff
  - increasing environmental awareness
  - provision of disabled-friendly facilities
- Submit relevant plans, along with narrative, highlighting the following:
  - EWS housing
  - Space for informal markets
  - Health centers and schools – reserved for lower income group
- Submit landscape plan with area under urban farming demarcated, along with the type of fruits and/or vegetables and/or food-grains etc. which are being planned to be grown.

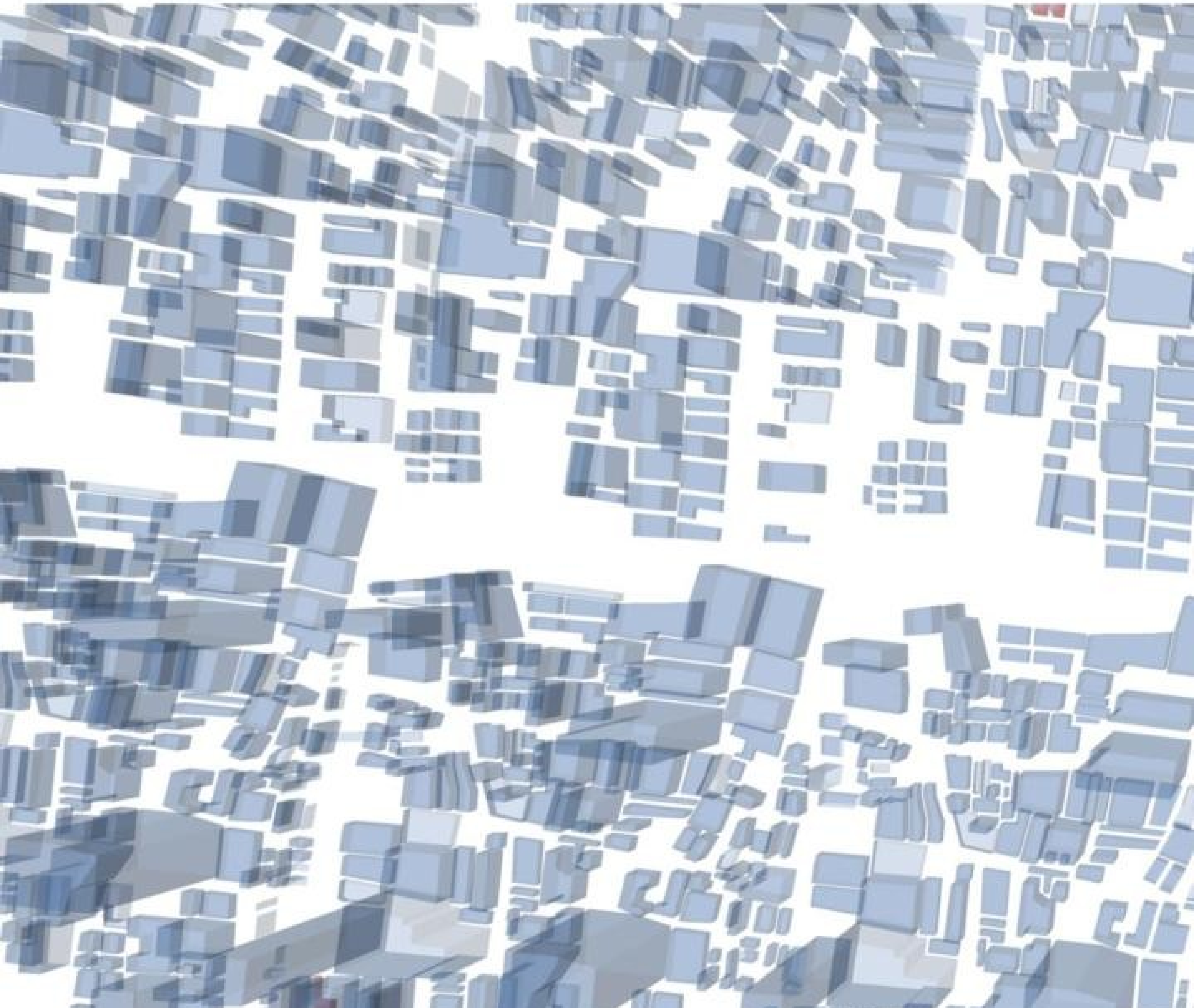
Mandatory

- Facilities for construction workers – 30 points.
    - All safety norms of NBC 2005 must be implemented on site during construction – 10 points
    - All construction workers must have access to clean drinking water and hygienic toilets on site – 5 points
    - Accommodation facilities for the construction workers must be clean, hygienic, with access to clean drinking water and toilets – 10 points
    - Child labour should be banned on site – 5 points

Optional

- Social infrastructure in development – 30 points.
    - Design of the development should be done according to guidelines on universal accessibility, including provision of disable-friendly public toilets – 10 points
    - Create environmental awareness through imparting information like display boards, panels etc. – 5 points
    - Identify smoke/tobacco free zones on site – 5 points
    - Provision of dedicated resting areas and toilets for service staff as per the GRIHA LD thresholds– 5 points
- Planning for low-income group population – 20 points
    - EWS housing should be provided on site – 5 points
    - Health centers and schools – reserved for lower income group - should be provided in the development as per Urban Development Plans Formulation and Implementation (UDPFI) guidelines (not applicable is SEZ) – 10 points
    - Planning to also consider adequate provision for informal market – 5 points

    Non-applicability: ***If the project is an SEZ or an educational campus, then the clause is not applicable to the project.***
- Food production on site – 20 points
    - Plan food production on at least 5% of the total landscape area or equivalent (vertical farming etc.) - 10 points
    - Plan food production on at least 10% of the total landscape area or equivalent (vertical farming etc.) - 20 points



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