

**BEFORE THE NATIONAL GREEN TRIBUNAL SOUTHERN
BENCH CHENNAI**

APPLICATION NO. 02 OF 2023

IN THE MATTER OF:

Shri Jagan Kumar J

.....APPLICANT

VERSUS

**The Additional Chief Secretary
Government of Karnataka, Department Of
Forest, Ecology and Environmental Science & Ors**

..... RESPONDENTS

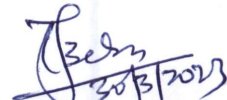
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Signed and verified on this 30th day of March, 2023 at Bengaluru



**COUNSEL FOR
CPCB**



DEPONENT

**J. Chandra Babu
REGIONAL DIRECTOR
CENTRAL POLLUTION CONTROL BOARD
REGIONAL DIRECTORATE - BENGALURU
(MIN. OF ENV. FOREST & CC, GOVT OF INDIA)
BENGALURU - 560 079. MOB: 9868278903**

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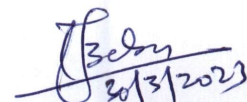
..... RESPONDENTS

**REPLY STATEMENT ON BEHALF OF THE RESPONDENT NO. 3, THE
CENTRAL POLLUTION CONTROL BOARD (CPCB)**

I, J Chandra Babu, son of late Shri. J Balaramaiah, aged 55 years, having office at the Regional Directorate, Central Pollution Control Board, 1st & 2nd Floors, Nisarga Bhavan A- Block, Thimmaiah Main Road, 7th D Cross, Shivanagar, Bengaluru - 560 079 do hereby solemnly affirm and state on oath as follows:

1. That I am presently working as Scientist 'E' & Regional Director, Regional Directorate, Central Pollution Control Board (hereafter called as CPCB), Bengaluru and authorized to file the present statement on behalf of the 3rd Respondent. I am fully conversant with the facts of the case and hence, competent and authorized to depose and swear this reply statement.





Regional Director

Central Pollution Control Board

1st & 2nd Floors, Nisarga Bhavan

Thimmaiah Main Road, 7th D Cross

Shivanagar, Bengaluru - 560 079

**REGIONAL DIRECTOR
CENTRAL POLLUTION CONTROL BOARD
REGIONAL DIRECTORATE - BENGALURU
(MIN. OF ENV, FOREST & CC, GOVT OF IND
BENGALURU - 560 079. MOB: 986827890**

Corrn:

Initial:

2. The Central Pollution Control Board (CPCB), the 3rd Respondent herein has been created under Section 3 of the Water (Prevention & Control of Pollution) Act, 1974, to perform the functions assigned to it under the said Act. Under Section 3 of the Air (Prevention & Control of Pollution) Act, 1981 the Central Pollution Control Board has also been entrusted to perform the functions under the said Act.
3. It is submitted that in the said application, the applicant is stating that high-rise commercial buildings architected with glass facades are also one of the major causes of climate change by referring to the research study conducted by Energy and Wetlands Research Group by the Centre for Ecological Sciences, Indian Institute of Science, Bengaluru, (Bengaluru's reality: towards unlivable status with unplanned urban trajectory).
4. It is submitted that Central Pollution Control Board has not conducted any such studies and has no comments to offer on the impact of use of glass facades in buildings.
5. It is submitted that Ministry of Environment, Forests & Climate Change (MoEF&CC) has framed the ***draft guidelines on "Environmental Guidelines for Buildings" with specific reference to EIA notification, 2006 [item 8 (a) of schedule]***. In the said guidelines, it is mentioned that appropriate processes and material be used to encourage reduction in carbon footprint. Use of glass be reduced by up-to 40% to reduce the electricity consumption and load on air-conditioning. If necessary, use high-quality double glass with special reflective coating in windows. Copy enclosed as **Annexure**. (Refer page No.43).

Corrn:
Initial:

J. Chandra Babu
30/3/2013

J. Chandra Babu
Regional Director

CENTRAL POLLUTION CONTROL BOARD
Regional Directorate - Bengaluru
Thimmaiah Main Road, 21st D Cross
Shivanagar, Bengaluru - 560 079
(MIN. OF ENV. FOREST & CC, GOVT OF INDIA)
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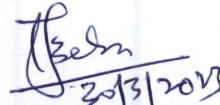
J. Chandra Babu
REGIONAL DIRECTOR
CENTRAL POLLUTION CONTROL BOARD
REGIONAL DIRECTORATE - BENGALURU
(MIN. OF ENV. FOREST & CC, GOVT OF INDIA)
BENGALURU - 560 079. MOB: 9868278903

6. That CPCB has not framed any guidelines/policies on percentage use of glass facades in construction of commercial/residential buildings as CPCB has no mandate in issuing of Environmental Clearance to such projects as per EIA notification, 2006.

In view of facts submitted above, it is respectfully prayed that the Central Pollution Control Board shall abide by any order/directions passed by this Hon'ble Tribunal and render justice.

Dated at Bengaluru on this the 30th day of March 2023


**COUNSEL FOR
3rd RESPONDENT**

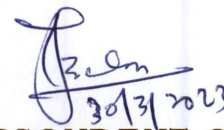

DEPONENT

**J. Chandra Babu
REGIONAL DIRECTOR
CENTRAL POLLUTION CONTROL BOARD
REGIONAL DIRECTORATE - BENGALURU
(MIN.OF ENV,FOREST & CC, GOVT OF INDIA)
BENGALURU - 560 079. MOB: 9868278903**

VERIFICATION

I, J Chandra Babu, son of late Shri. J Balaramaiah, aged 55 years, having office at the Regional Directorate, Central Pollution Control Board, 1st & 2nd Floors, Nisarga Bhavan A- Block, Thimmaiah Main Road, 7th D Cross, Shivanagar, Bengaluru - 560 079 do hereby solemnly affirm and sincerely state that the averments made paras 1 to 6 above are subject to the best of my knowledge belief and information.

Verified at Bengaluru on this the 30th day of March 2023.


3rd RESPONDENT-CPCB.



**J. Chandra Babu
REGIONAL DIRECTOR
CENTRAL POLLUTION CONTROL BOARD
REGIONAL DIRECTORATE - BENGALURU
(MIN.OF ENV,FOREST & CC, GOVT OF INDIA)
BENGALURU - 560 079. MOB: 9868278903**



INDIRA PARYAVARAN BHAWAN, JORBAGH ROAD, NEW DELHI, INDIA IS AN ENERGY POSITIVE BUILDING

Environmental Guidelines for Buildings

WITH SPECIFIC REFERENCE TO EIA NOTIFICATION, 2006
[ITEM 8 (a) of SCHEDULE

INDIRA PARYAVARAN BHAWAN, JORBAGH ROAD, NEW DELHI
Ministry of Environment, Forests & Climate Change
Government of India





Environmental Guidelines for Buildings

WITH SPECIFIC REFERENCE TO EIA NOTIFICATION, 2006

[ITEM 8 (a) of SCHEDULE



**Ministry of Environment, Forests & Climate Change
Government of India**

GUIDELINES ON SUSTAINABLE AND ENVIRONMENT FRIENDLY BUILDING CONSTRUCTION AND OPERATIONS

ITEM 8 (a) OF EIA NOTIFICATION, 2006





Green Building

Also known as **green construction** or **sustainable building** refers to a structure and using process that is environmentally responsible and resource-efficient throughout a building's life-cycle: from siting to design, construction, operation, maintenance, renovation, and demolition.

In other words, green building design involves finding the balance between homebuilding and the sustainable environment.

This requires close cooperation of the design team, the architects, the engineers, and the client at all project stages. The Green Building practice expands and complements the classical building design concerns of economy, utility, durability, and comfort.

... and therefore, a Guideline enabling compliance of all norms.





OUTLINE of the GUIDELINES

VALUES

- SUSTAINABLE CONSTRUCTION
- RESPONSIBLE LIVING

VISION

- ENERGY EFFICIENT
- WATER CO-EFFICIENT
- GREENS SUFFICIENT

MISSION

- REDUCE
- RECYCLE
- RECHARGE
- REUSE





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A WORD

**Good Designs are sustainable!
Great Designs are responsible!!**

**It is high time that we be responsible for today, and
towards posterity!!!**

In order to be pro-active in lessening incidences of natural calamities and to ensure an eco-friendly environment around the lives and surroundings of all living beings, the following must be made mandatory as the **MoEF&CC Defined Parameters**, necessary for EC for individuals, institutions, communities, builders / contractors / construction companies to be used for any and all types of building projects.

Primarily, it would contribute enormously in bringing about the aforesaid living standards at one hand, so on the other, it would **enable achievement of various environment and related targets & goals**.

A strategic **convergence** with relevant Ministries & their affiliate organisations & Missions and **synergy** with various resident, professional, & industrial bodies would need to be created to conduct a structured **communication drive** for fine-tuning perceptions regarding adoption of these recommendations and to **sensitise the communities** about its benefits.

These affiliations would also come handy for **crosscutting interventions**, and to **build capacities** including orientation, skill-development of all stakeholders in construction and allied activities from the **concept to ground-zero implementation**.

An on-line re-registration of all the above would ease to ensure compliance of the following _

Green Certified, preferably patented, proven **Building Materials**, which are energy efficient, environment friendly, healthy, bio-degradable, safe, & secure.

End-user Friendly design / architecture loaded with landscaping elements for productive greenery. Creating provisions to grow besides the medicinal, aromatic, remedial herbs, shrubs and flowers, some fruits & vegetables must be encouraged. Roof-top Vegetation, Green Wall concepts and the 4 Rs of Water Conservation; Reduce, Recharge, Recycle & Re-use must be adopted.

Energy Efficient construction to cost the same or less as traditionally built projects and **save the end-user energy costs considerably**. Possibly, all walls are designed to use airflow for better ventilation, all lights are LED powered by some sustainable alternate source of energy.

Healthy material set with adequate skills to ensure significantly less dust or pollen and no potential for mold rot or decay.

Safe, Solid & Secure structural integrity of reinforced concrete and ICF [Insulating Concrete Forms] must be in place to withstand and provide protection from burglary, any kind of fire, and the ravages of natural calamities including force winds and associated hazards,

Sustainable is not merely an 'adjective', it is more being civic and sensible. Ensure that there is **no jobsite waste left, and all scrap can be recycled**. Maintenance and operation costs are significantly reduced, and lifecycle of the End-Produce [Project] is measured in smiles for long years!

Responsible is surely an 'adjective', which adds a lot of value, for it stands for our 'ability-to-respond'. Sustainability can only be achieved only whence we become, "Responsible"! □





GUIDELINES ON SUSTAINABLE AND ENVIRONMENT FRIENDLY BUILDING CONSTRUCTION & OPERATIONS (ITEM 8 [a] OF EIA NOTIFICATION, 2006)

Background

1. INTRODUCTION:

1.1 **Construction activities** in India have been pursued without giving much attention on **environmental issues**. This has resulted in pressure on its finite natural resources. **Unplanned and unsustainable urban development** has led to severe environmental pressures. The **green cover and ground water resources** have been **forced to give way** to the rapidly developing urban centres.

1.2 **Modern buildings** built in our cities **have high levels of energy consumption** because of requirements of **air-conditioning and lighting**.

i. Approximately 50% of the energy use in buildings is devoted to producing an artificial indoor climate through heating, cooling, ventilation, and lighting.

ii. **Water conservation and efficiency** programs have distinct significance for this sector. Studies have shown that water-efficient appliances and fixtures can reduce consumption by up to 30% or more. As demand on water increases with urban growth, the economic impact of water conservation and efficiency will increase proportionately.

Water efficiency not only can lead to substantial **water savings**, but it also can reduce the requirement for **expansion of water treatment** facilities.

iii. In **building industry**, there is tremendous scope to recycle its waste but there is need to achieve significant waste reductions through more reuse of building material and adaptation, as opposed to demolition. In this scenario, it is necessary to critically assess the utilization of natural resources in these activities.

1.3 **Conventional buildings** often fail to consider the interrelationship among building siting, design elements, energy and resource constraints, building systems, and building function. Green buildings, through an integrated design approach, take into consideration the effect these factors have on one another. Climate and building orientation, design factors such as day lighting opportunities, and building envelope and system choices, as well as economic guidelines and occupant activities, are all factors that need to be considered in an integrated approach. Application of environment friendly building concepts can yield for savings during the construction process as well as operation phase.

1.4 **Measures that are relatively easy to implement can result in savings to natural resources in the following areas:**

(i) Lower energy costs , by monitoring usage, installing energy-efficient lamps and fixtures, and using occupancy sensors to control lighting fixtures;
(ii) Lower water costs , by monitoring consumption and reusing storm water and/or construction wastewater where possible;
(iii) Lower site-clearing costs , by minimizing site disruption and movement of earth and installation of artificial systems;
(iv) Lower landfill dumping cost and associated hauling charges, through reuse and recycling of construction and demolition debris;
(v) Lower materials costs , with more careful purchase and reuse of resources and materials;
(vi) Possible earnings from sales of reusable items removed during building demolition.





2. ENVIRONMENT CLEARANCE PROCESS:

- 2.1 The objective of the EIA Notification, 2006 is to set procedures of environmental clearance before initiation of a project or activity. The suitability of site for a proposed development is one of primary concerns in according environmental clearance to a project. The applicant has to furnish the application, information in Form 1 and the supplementary Form 1A, and a copy of the conceptual plan. These projects are in Categories B and mentioned in the Schedule as Item 8 (a). The State Environment Impact Assessment Authority (SEIAA) grants the Environment Clearance. In case the SEIAA is not in existence, the projects come to MoEF&CC for Environment Clearance. [8 (a) Building and Construction Projects $\geq$ 20000 sq.mtrs and $<1, 50,000$ sq.mtrs of Built-up Area].
- 2.2 Category 'B' will be treated as Category 'A' if located in whole or in part within 5 kms from the boundary of: (i) Protected areas notified under the Wildlife (Protection) Act, 1972; (ii) Critically polluted areas as identified by the Central Pollution Control Board, (iii) Eco-sensitive areas as notified under section 3 of the Environment (Protection) Act, 1986, such as, Mahabaleswar Panchangi, Matheran, Pachmarhi, Dahanu, Doon Valley and (iv) inter-state boundaries and international boundaries.
- 2.3 Provided that the requirement regarding distance of 10 km of the inter-state boundaries can be reduced or completely done away with by an agreement between the respective states or U.Ts sharing the common boundary in the case the activity does not fall within 10 kilometers of the areas mentioned at item (i), (ii) and (iii) above
- 2.4 The projects involving clearance under Coastal Regulation Zone Notification, 2011 are required to submit with the application a CRZ map duly demarcated by one of the authorized agencies, showing the project activities, and the recommendations of the State Coastal Zone Management Authority.
- 2.5 The projects to be located within 10 kms of the National Parks, Sanctuaries or in Eco-Sensitive Zone in case where it has been notified the project proponent shall obtain the clearance from the Standing Committee of the National Board of Wildlife.
- 2.6 As majority of the buildings which will come up will be having built-up area of less than 20000 sq. meter, so to get the full benefit of these environmental norms in buildings, it is proposed to cover all the buildings with built-up area of more than 5000 sq. meter.
- 2.7 So as to do away with the undue delays and consequent price-escalations, a quicker mechanism to foster the EC Process and the time it takes also needs to be in place.
Digital route to ensure a 'No delay Process for EC seems an apt solution. It would be equipped with a format, which would generate auto-clearances instantly if the 'Obligations-of-the-Project Proponent' is adhered to.

Both the above (Para 2.6 and 2.7), besides broadening the coverage under environmental norms for buildings will lessen the time of obtaining EC.

3. THE MAIN ENVIRONMENT FACETS:

The main Environment facets to be considered in relation to building construction are:

(a)	Land	(c)	Noise	(e)	Biological	(g)	Solid Waste Management
(b)	Air	(d)	Water	(f)	Socio-economic, and		

Hence, it is necessary to ascertain the baseline data of these environmental facets.

4. Prediction of Impact during Construction Phases:

- 4.1 The activities that take place during construction phases of the project are leveling of site, construction, and erection of buildings etc., and associated equipment in operation. The potential primary and secondary impacts on the environment, their prediction, significance, and mitigation should be documented. Dismantling of unwanted existing structures, site clearance, storage, and haulage of construction materials and disposal of surplus earth, debris, and refuse should be prepared.





- 4.2 Prediction of Impact during Operational Phases: The potential significant impacts are on topography, land use, soil quality, ambient air quality, noise levels, traffic densities, water resources, water quality, biological environment, demography, and socio-economics.
- 4.3 During construction and operational phase of the project, various activities may have impact on some or other environmental parameters. Various environmental attributes are to be studied during these phases for their overall impact on the surrounding environment.

Design and Siting Criteria

The process of site selection for sustainable development involves identifying and analysing the site with respect to the sustainable building design criteria. The development of the site for building purposes requires disruption and disturbance of the existing natural system.

The most sustainable and environment-sensitive development is one that entails minimal site disturbance. The selected site should be in conformity with the development plan/master plan/ UDPFI (Urban Development Plans Formulation and Implementation) guidelines.

This should comply with the provisions of eco-sensitive zone regulations, coastal zone regulations, heritage areas (identified in the master plan or issued separately as specific guidelines), water body zones (in such zones, no construction is permitted in the water-spread and buffer belt of 30 m minimum around the FTL [full tank level]), various hazard prone area regulations, and others if the site falls under any such area.

The delineation of the city form due to layout of roads, open spaces, or architectural forms should be analysed. For example, a building may be a visually unifying element, providing connections and continuity with adjacent buildings. Sites at the end of important vistas or adjacent to major city squares should be reserved for important public buildings.

Review the potential of views: Important city views of plazas, squares, monuments, and natural features (such as parks and waterfronts) should be considered. It is important to design the proposed building in a manner that will enhance and preserve such views for the public.

Pre-design & Site Selection Issues

Issues, which need to be identified at the pre-design and site selection stage, are _

- (1) **Connectivity** to infrastructure and public transport network,
- (2) **Power requirement** and power source,
- (3) **Water requirement** and water source, and
- (4) **Waste management** on the site.

Urban infrastructure and facilities, public transport, infrastructure for power, water supply to meet the estimated requirement, and sewage system network should be made available nearby or should be made available with minimum negative impact on the environment. The existing drainage pattern of the proposed site should be surveyed, and the proposed drainage pattern should not alter the existing drainage pattern. It should comply with the master drainage plan of the place. It is desirable to integrate the existing utility and infrastructure, and identify whether additional infrastructure needs to be planned for the proposed project.

The impact of proposed future development on the infrastructure should be considered while selecting the site. Efforts should be made to reuse negative urban spaces or industrial sites and brownfield sites, if possible, to reduce the pressure on undeveloped land. If possible and justified in terms of sustainable design goals, a site selected should offer the possibility of urban redevelopment (where development is constrained due to environmental pollution or increasing urban pressure) or it should use existing urban infrastructure confirming the desired density goals.

This, to some extent, will help reduce the perennial pressures on the undeveloped land. Layout and form of the project must conform to the landscape of the area without unduly affecting the scenic features of that place





Guidelines for efficient planning of utilities and site circulation

The site infrastructure includes traffic, transportation, utility systems, and planning the pattern of movement. Every site has a carrying capacity for human activity, which is based on the sensitivity of the site resources and the regenerative ability of the land. This capacity needs to be gauged during several phases of a development.

Planning infrastructure for a sustainable site forms the foremost issue in deciding the carrying capacity of the facilities, the concentration of facilities versus their dispersal, and their location according to natural site system. It would minimize the site disturbance, its ratio to gross site coverage, and dividing the site into impermeable areas. It would also enable the site design to be flexible enough for future extension or development.

There may be case of under-used infrastructure, waste materials, energy, and resources results in cutting down of natural habitat for plants and animals. Thus, optimal usage plan for the traffic flow, transportation, and utility becomes significant. The attempt should be to integrate and use the existing utility and transportation infrastructure and capacity to minimize the need for new infrastructure.

The utility systems should be selected in accordance with the established natural system on-site. Like use of gravity sewer systems, planning utility corridors, site utility systems with the landscape.

An analysis of the existing road system and networks for parking; and pedestrians should form the site circulation patterns. The design of the site plan should be to minimize the length of primary or secondary circulation, pedestrian walkways, utility lines, and building footprint, improve safety and security, plan for the alternative traffic/transportation strategies, and incorporating the use of telecommunicating strategies.

The natural functions of a plot of land (hydrologic, geologic, and microclimatic) can be disrupted by the placement of a building on it. The design of a building should factor in ways in which the natural site features can be protected or even restored. Layout of the site activities and building requirements after carrying out detailed site analysis so as to ensure sustainable site development in tune with its topographical, climatic, and ecological character should be done.

Site analysis evaluates all the on- and off-site determinants that affect the development of site and building programme—whether environmental, cultural, historical, urban or infrastructural. The main objective is to allocate and define the use of various parts of the site in a manner that is most appropriate to specific activities to be carried on-site.

The purpose of site analysis is to determine the site characteristics so that proper drainage systems, circulation patterns, landscape design, and other site development features can be considered in relation to the building design parameters such as building form, solar orientation, shape, skin-to-volume ratio, materials, and structural and mechanical systems.

The site planning should carry out a comprehensive site analysis to identify site characteristics that can be used to harness natural resources (like solar energy, wind, and water) and the potential qualities of the landforms that could contribute to making different areas of the site visually and thermally more comfortable for users.

The site planning should take into account heat island effect, size and density of the built-up areas cause heat island effect, wherein higher air temperatures are created in the dense urban areas as against the low-rise surrounding built-up areas.

The solar access in the morphology of clusters can be understood in terms of utilization of direct (and not reflected or diffused) solar radiation, mainly for day lighting and heat gain. This defines the minimal distances between the buildings and the relations between built-up volume and open spaces.

The choice of building types mainly depends on the cost of the land, infrastructure, and land availability and suitability as per the requirements. Each building type and combination of different types forms a matrix of environmental conditions, which affect the macro- as well as the microclimate around and inside the building. Building types may be detached/semi-detached, with courtyard/ patio, high-rise, and row house.





The proportion of open spaces and built-up edges should be designed such that it ensures winter solar access and summer ventilation.

Vegetation may provide as shading and promote evaporative cooling. In hot and dry climates, evaporative cooling through appropriately sized wet surfaces or fountains have a desirable effect. Categorize the climate zone as per the geographical attributes of the site.

The data collected should be assessed for site analysis to decide on the hierarchy of importance among the potential factors affecting sustainable design. Assess the impact of the proposed design for the topographical and hydrological site characteristics, after estimating the overall building footprint compatibility with site. Review the potential of any other alternative design scheme, which could mitigate upon resources, and merge the built form with reduced site disturbance. Analyse the efficiency model for the site on the basis of a set of constants, variables, and constraints.

Constants & Variables

Efficiency array with set of constants & variables

Form an efficiency array with set of constants & variables: Constants including the factors, which cannot be changed like the access road to the site, soil characteristics, and natural vegetation or the climate zone. The set of variables include the factors, which might give efficient results when mingled in different patterns like circulation patterns, site materials, and so on, and set of constraints; that is, some factors that form the psychological constraint for design like the building by-laws or local area regulations.

The most optimal & compatible combination can then be considered for a specific site development fit. After the potential factors affecting the sustainable design have been analysed and assessed, and site is selected thereof, the optimal patterns for a sustainable development should be layered upon each other to organize all the proposed building elements.

This will result in an effective and operational site development fit. The main intent is to optimize the use of resources and energy savings by reducing the site disturbance during constructional and occupancy phases of the project.

The underlying goal can then be frozen through a generic design process; that is, conceptually arriving at the best design through project requirements versus sustainable development by sequential incorporation of various design factors. These design factors can initially be conceptualized through sections or sketches.

The site development can be done on the best practices followed in each of the potential factors like land use and existing features, siting and orientation, landscaping, utility or infrastructure, pavements, external lighting, and construction management.

An important objective of site planning should be to reduce hard paving on-site (open areas surrounding building premises) and/or provide shade on hard-paved surfaces to minimize the heat island effect and imperviousness of the site.

Dark coloured and constructed surfaces are prone to absorption and retention of solar energy. The retained solar energy also is radiated to the atmosphere during times when ambient temperature gets cooler. This gives rise to warmer temperatures in urban landscapes, which have large areas of constrained surfaces of low reflectance.

This phenomenon of increased temperature in urban landscape is called heat island effect. Principle surfaces that contribute to the heat island effect include streets, sidewalks, parking lots, and buildings. Heat island effect can be minimized by the use of shading or reflective surfaces. As mentioned, hard-paved surfaces are one of the major constraints of heat island effect.

In addition to causing heat island effect, hard pavements also reduce the perviousness of a site. Enhanced perviousness of a site minimizes storm water run-off and is beneficial for localized aquifer recharge.





This method aims to encourage design measures to minimize negative impacts of the paved areas. Design methodologies, which address the heat island phenomenon and provide control for desired conditions, should be considered. Planting trees, bushes or a properly planned landscaping can help reduce the heat island effect by reducing ambient temperatures through evapo-transpiration.

The plan should be to plant vegetation around the building to intercept solar radiation and to shade the walls and windows of buildings (with South, South West or South East exposure) to prevent heat gain.

This would also help in reducing air-conditioning load/use. Besides, use of light coloured, reflective roofs having an SRI (solar reflectance index) of 50% or more should be promoted. The dark coloured, traditional roofing finishes have SRI varying from 5% to 20%.

A fine example of higher SRI is the use of broken china mosaic and light coloured tiles as roof finish, which reflects heat off the surface because of high solar reflectivity, and infrared emittance, which prevents heat gain.

There should use of commercially available, high solar reflective (albedo) roof coatings or heat reflective paints on roofs that shade paved areas.

There should not be use of stone mulches such as fine gravel, crushed granite or pebbles in unplanted areas immediately adjacent to buildings, as they can heat up, reflect solar radiation inside, and also cause glare.

Use of high albedo or reflective pavements to keep parking lots, pavements, and the inside roads cool should be adopted, because an increase in albedo of 0.1 decreases the pavement temperature approximately by 8 °F. There should be use of light coloured aggregates or 'white top' the pavements with a layer of cement concrete, 50 mm thick. Stabilizing the pavements with porous or permeable materials such as sand, crushed bricks, broken mosaic tiles or stones where the soil is stable or the traffic load is quite low serves the end.

There should be use of recycled materials such as demolished concrete (rubble), broken china, and mosaic tiles for this purpose.

Total paved area of the site under parking, roads, paths or any other use should not exceed 25% of the site area or net imperviousness of the site not to exceed the imperviousness factor as prescribed by the NBC 2005 (BIS 2005b), whichever is more stringent.

Total surface parking should not exceed the area as permissible under the local by-law and more than 50% of the paved area to have pervious paving/open-grid pavement/ grass paver or a minimum 50% of the paved area (including parking) to have shading by vegetated roof/pergola with planters or a minimum 50% of the paved area (including parking) to be topped with finish having solar reflectance of 0.5 or higher.





Land Environment

- Area with angular distance of 500 meters surrounding the project site should be the study area.
- The baseline data collection / monitoring should be from primary and secondary sources and field-monitoring studies should be collected.
- When secondary data is used source of data is to be mentioned clearly.
- The period of study for collecting primary data would be one season other than the monsoon season. Existing status of baseline conditions of land use can be determined by studying the changes in the land use pattern in the past 10 years by collecting data from secondary sources such as census records, agricultural census and land records.
- The land use pattern covering forest land, total irrigated land, non-irrigated land, cultivable waste, are to be calculated and prepared as a map.
- Mainly climate, geology, relief and other biotic interactions influencing soil formation should be studied.
- The soil characteristics in the project area, which would affect the agricultural and afforestation potential of the area need to be studied.
- Particle size scale is to be given based on the texture analysis.
- Soil porosity and SAR ratios are important and are to be assessed for all locations.
- The samples are to be collected and analyzed as per CPCB norms.

The hydraulic conductivities in soil are important for building construction activities, rating chart for the soil test values for primary nutrients, and physical and chemical properties of soil are to be collected and analysed. Impacts caused due to construction activities like compaction of soils by earth moving equipment, erosion and modification of surface, over exploitation of agricultural soils due to future development in a zone sensitive to erosion, irreversible salinization and acidification of mangrove swamp soils are important considerations.

The environmental impact of soil erosion can best be mitigated by removing vegetative cover only from the specific site on which construction is to take place and by disturbing the vegetation in adjacent areas as little as possible.

Land clearing activities should be kept to the absolute minimum and use of crushed stone rather than asphalt or concrete for surfacing parking areas should be attempted. Disturbing the existing vegetation and natural contour of the land as little as possible can mitigate increases in surface runoff.

Vegetation along watercourses should not be cleared indiscriminately. Neither should potholes or swamps be drained unless absolutely necessary for successful completion of the activity.

Construction, land management, or mining activities that result in the soil being laid bare could be scheduled in such a way that some type of vegetative cover appropriate to the site could be established prior to the onset of intense rain or windstorms.

If grass is to be seeded, mulch of straw will help to protect the soil from extreme erosive forces until vegetative and root development begins. Natural drainage patterns can often be maintained by preparing sodden waterways or installing culverts. Steep slopes can be terraced, thereby effectively reducing the length of slope.

Use of "floating" foundations and height restrictions in earthquake zones and increased foundation height, wall strength, and roof support in areas periodically subject to cyclones can reduce the hazards. All forms of temporary structures should be avoided from the flood plain, and all permanent structures should be raised to a height above the level which flood-waters can be expected to reach once every 100 years (100-year flood). Installation of underground drainage structures helps to reduce sediment loads.

Engineering plans can be drawn to reduce the area of earth cuts on fills below what might otherwise be acceptable, provide physical support for exposed soil or rock faces, concentrate or distribute – as appropriate the weight loading of foundations to areas or state better able to support that weight, restricting the number, frequency and area of movement of heavy machinery.





Preservation of topsoil: During construction, the soil becomes loose due to the removal of stabilizing material such as vegetation and disturbance of stabilized existing grade, resulting in loss of topsoil and its deposition in undesirable places. A soil erosion and sedimentation control plan should be prepared, prior to construction, and should be applied effectively. Measures for preservation of topsoil should be adopted. The collection, storage, and reapplication of topsoil from the areas where construction activity will disturb the topsoil should be mandatory for the development of projects.

Topsoil, which is rich in organic content and essential for new vegetation, should be stripped to a depth of 20 cm from the areas proposed for buildings, roads, paved areas, and external services. It should be stockpiled to a height of 40 cm in designated areas and reapplied during plantation of the proposed vegetation.

The topsoil should be separated from the subsoil debris and stones larger than 50 mm in diameter. The stored topsoil may be used as finished grade for planting areas. Sedimentation basin, a temporary dam or basin at the lowest convenient point of the site, should be constructed for collecting, trapping, and storing sediment produced by the construction activities.

A flow-detention facility must also be constructed for reducing peak run-off rates. This would allow most of the sediments to settle before the run-off are directed towards the outfall.

The measures adopted can be:

Contour trenching which is an earth embankment or ridge-and-channel arrangement constructed parallel to the contours, along the face of the slope, at regular intervals on the lengths and slopes greater than 10% (1:10).

They are used for reducing run-off velocity, increasing the distance of overland run-off flow. They are also used to hold moisture and minimize sediment loading of surface run-off.

Mulching is a protective layer of material that is spread on the top of soil.

Mulches can either be organic (such as grass clippings, straw, bark chips, and similar materials) or inorganic, (such as stones and brick chips). Mulching should be used with seedings and plantings on steep slopes (slopes > 33%). Steep slopes are prone to heavy erosion and, therefore, netting or anchoring should be used to hold it in place. Other surface run-off control measures, like contour terracing, to break up concentrated flows should be installed prior to seeding and mulching.

Materials such as straw, grass, grass hay, and compost shall be placed on or incorporated into the soil surface. In addition to stabilizing soils, mulching will reduce the storm water run-off over an area.

Mulching when done with seedings or plantings aids plant growth by holding the seed, fertilizers, and topsoil in place. It retains moisture and insulates the soil against extreme temperatures.

Select proper timing for the construction activity to minimize site disturbance such as soil pollution due to spilling of the construction material and its mixing with rainwater. Use staging and spill prevention and control plan to restrict the spilling of the contaminated material on-site. Protect the topsoil from erosion. Use collection storage and reapplication of the topsoil, sediment basin, contour trenching, mulching, and soil stabilization methods to protect the topsoil from erosion during construction. Specify and limit construction activity in pre-planned/designated areas.

These provisions and practice should vary with the size of the project area. But preservation of top soil should be the aim at each project site irrespective of the project area.

Preserving existing mature trees on-site during the course of construction by preserving and transplanting them should be another important objective.

The aim should be to compensate the loss of vegetation (trees) due to the construction activity by compensatory plantation. Replant the same native and/or non-invasive species, which existed on the site before elimination, in the proportion of 1:3. Plant in excess of 25% to the minimum requirement (that is, in addition to the requirement prescribed in) within the site premises.





Construction Waste Management

Construction phase would involve site clearances and preparation, infrastructure development, building construction and other related activities and operational phase would involve emission from vehicular movement and diesel generators, and negligible emissions from sewage and solid waste handling and disposal.

The construction debris & waste during construction are measure source of air pollution especially the particulate matters so it is important from health hazard point of view to ascertain quantities of various types of wastes generated during construction including the construction labour and the means of disposal.

The building material carrying vehicles as well as the construction machinery generate emissions and pollute the environment. Dusts include brick and silica dusts, wood dust from joinery and other woodworking and from earthmoving and other vehicle movements within the site. Asbestos- containing dust especially during the demolition of buildings is very harmful.

It is a difficult task to separate these wastes. Construction machineries pose a special threat to air quality. It is estimated that construction machineries emit toxic pollutants and are sources of fine particulate matter (PM_{2.5}, which lodges deeply in the human lung) and oxides of nitrogen (NO_x), a key ingredient in the formation of ground-level ozone and urban smog.

The mains concerns during demolition activities are the emissions generated by the vehicles and the machineries. Air Pollution may be caused by areas or point sources such as cities, industrial areas, factories or by linear sources such as highways.

Vegetation buffers can minimize the built- up of pollution levels in urban areas by acting as pollution sinks. Wind erosion is a serious problem in areas where the ground is virtually bare and devoid of vegetation. Vegetation methods are found to be most effective in the form of windbreaks and shelterbelts. A dense belt provides greater shelter immediately to leeward but the sheltered area is not as extensive as when a more permeable zone of vegetation is provided. Plants are good absorbers of sulphur dioxide. Parks with trees have an SO₂ level lower than city streets.

Heavy roadside planting in the form of shelterbelts can result in reduction in airborne lead. Complete dust interception can be achieved by a 30 m belt of trees. Even a single row of trees may bring about 25 percent reductions in airborne particulate. Evergreen trees are found to be more effective. The species chosen must be resistant to pollutants, particularly in the early stages of their growth.

Mitigation Measures for Dust Control:

Adopting techniques like, air extraction equipment, and covering scaffolding, hosing down road surfaces and cleaning of vehicles can reduce dust and vapour emissions. Measures include appropriate containment around bulk storage tanks and materials stores to prevent spillages entering watercourses. The other measures to reduce the air pollution on site are:

- Sprinkling of water and fine spray from nozzles to suppress the dust,
- On-Road- Inspection should be done for black smoke generating machinery,
- Promotion of use of cleaner fuel should be done,
- All DG sets should comply emission norms notified by MoEF&CC,
- Vehicles having pollution under control certificate may be allowed to ply,
- Use of covering sheet to prevent dust dispersion at buildings and infrastructure sites, which are being constructed,
- Use of covering sheets should be done for trucks to prevent dust dispersion from the trucks, implemented by district offices,
- Paving is a more permanent solution to dust control, suitable for longer duration projects.





High cost is the major drawback to paving, reducing the speed of a vehicle to 20 kmph can reduce emissions by a large extent. Speed bumps are commonly used to ensure speed reduction. In cases where speed reduction cannot effectively reduce fugitive dust, it may be necessary to divert traffic to nearby paved areas.

Material storages / warehouses:

Care should be taken to keep all material storages adequately covered and contained so that they are not exposed to situations where winds on site could lead to dust / particulate emissions.

Fabrics and plastics for covering piles of soils and debris is an effective means to reduce fugitive dust.

The construction phase waste will comprise of excavated and demolition material while operational phase waste may comprise of domestic, commercial and biomedical wastes, depending upon the type of the project. The different types of wastes need to be handled as per their needs and regulatory requirements. It is not possible to dispose-off all type of wastes onto the land and has to be dealt with depending upon their type and characteristics. Building construction leads to generation of sand, gravel, concrete, stone, bricks, wood, metal, glass, polythene sheets plastic, paper etc. as waste.

Type of wastes, which are generated, can be classified into four categories _

1. Construction or demolition waste, i.e., massive and inert waste
2. Municipal waste, i.e., biodegradable and recyclable waste
3. Hazardous waste,
4. E-waste

The waste characterization in constructional stage should be estimated by reviewing other similar already existing projects and given in tabular form. Similarly wastes generated in operational phase should be estimated and classified as biodegradable, recyclable, inert, hazardous and quantified for percentage composition estimation.

Construction and Demolition Waste Management:

The construction and demolition waste includes debris, concrete (often recycled and reused at the site), steel and other metals, pallets, packaging and paper products, fluorescent tubes, wood beams, joists, studs, baseboards, cabinets and cupboards, railings, brick, doors and casings, interior windows, bathroom fixtures, light fixtures, ceiling grid and tile, furnishings, replant trees, shrubs.

Orderly deconstruction is the proper measure for reuse of the demolished matter is important. In contrast to demolition, where buildings are knocked down and materials are either land filled or recycled, deconstruction involves carefully taking apart portions of buildings or removing their contents with the primary goal being reuse.

It can be as simple as stripping out cabinetry, fixtures, and windows, or manually taking apart the building frame. Gross segregation of construction and demolition wastes into roadwork materials, structural building material, salvaged building parts and site clearance wastes is necessary. Additional segregation is required to facilitate reuse/ recycling.

Waste recycling plans should be developed for construction and demolition projects, prior to beginning construction activity. The plans should identify wastes to be generated, and designate handling, recycling and disposal method to be followed.

Handling of waste material requires special precautions such as personnel protective equipment and special procedures to prevent the injury. Developers must operate safe methods for waste collection, storage, and disposal operations in a manner to protect the health and safety of personnel, minimize environmental impact and promote material recovery and recycling.

Solid Waste during Operational Phase: Adequate provision should be made for storage of solid waste and for easy access to the dustbins for labours from source to the place of storage, and from the place of storage to a collection point specified by the waste collection authority and/or contractor.





Three colours of wheeled bins: dark grey for inert waste, green for wood and ply waste and blue for hazardous waste can be used. A minimum of 4% of the total site area should be allocated for storage and pretreatment of the waste. This storage area should be covered and the pollutants from the waste should not affect the surrounding.

Access to and from Bin Storage Areas: Wheeled bins should be made with access to ramps. To ensure the vehicle access, paths should be paved and at least 1.2 meters wide with a maximum gradient of 1 in 10. The surface of the path should be smooth, continuous and hardwearing. Ramped kerbs should be provided, where the path meets the highway, and bins should not have to pass across designated parking spaces.

Where collection vehicles have to enter developments, there should be sufficient space on paved roads with turning circles for easy circulation. This ensures the refuse vehicles to enter the vicinity of the site without being prevented from doing so by cars parked close to the entrance. Vehicles should never have to reverse onto or from a highway to make a collection. Roadways used by refuse vehicles must be designed to withstand a laden weight of not less than 28 tonnes.

Three-bin system is a good option for segregation at household level.

Storage facilities should be created and established by taking into account quantities of waste generation in a given area and the population densities. A storage facility should be so placed that it is accessible to users, within a radius of 25 meter from the source. Local authorities should provide different coloured bins for different categories of waste. Adequate provision should be made for storage of solid waste.

Three colours of wheeled bins:

- _ Dark Grey for non-recyclable waste,
- _ Green for kitchen food/ compostable garden waste, and
- _ Blue for paper (generally used for flats, schools, offices etc.).

In addition, boxes must be provided for the collection of other recyclable materials _

- _ a green box is used for paper, and
- _ a black box is used for cans and plastic collections.
 - Individual properties should be allocated a 20-litter bin although for single-family occupancy.
 - Boxes should have lids.
 - Flats and multi-storied buildings should have bulk dustbin type container, with a general guide of one 1100 liter bin being adequate for every 60 units, for smaller blocks.
 - The one to five ratio [1:5] outlined above could be increased or decreased according to the number of properties with greater or less than two bedrooms per unit.
 - The ratio of approximately one paper bin to three residual waste bins [1:3] is only a guide.
 - Waste and Cleansing Section can advise on individual cases.

Hazardous Waste Management:

Products, such as paints, cleaners, oils, batteries, and pesticides that contain potentially hazardous ingredients require special care when you dispose of them. Improper disposal of household hazardous wastes can include pouring them down the drain, on the ground, into storm sewers, or in some cases putting them out with the trash. The hazardous wastes from construction and demolition activities are centering oil, formwork oil, tar and tar products (bitumen, felt, waterproofing compounds, etc.), wood dust from treated wood, lead containing products, chemical admixtures, sealants, adhesive solvents, Explosives and related products and equipment used in excavation, acrylics, and silica, etc.

The dustbins for these wastes should be made of durable materials like metal, HDPE, fiberglass and masonry if the projects spans for more than a year.





List of Hazardous wastes from construction projects:

- Asbestos products like insulation, tiles etc.,
- Fuels and Heating oils and other volatile / flammable liquids such as coolants, grease etc.,
- Centering oil, formwork oil, Tar and Tar products (bitumen, felt, water proofing compounds etc),
- Lead containing products, Chemicals, admixtures, sealants, adhesives solvents etc.,
- Paints, pigments, dyes and primers, Pesticides, Tarpaulin, Explosives and related products and equipment used in excavations,
- Product packaging (cement bags, cartons, containers, plastic covers etc), Plastics, Acrylics, Silica, PVC, Fluorescent Lamps Intact and Crushed, Halogen Lamps, Arc Lamps, UV Lamps, High Pressure Sodium Lamps, , Neon Lamps, Incandescent Lamps, Mercury Containing Lamps and Tubes, Mercury Vapour Lamps, Mercury Containing Devices – Mercury switches, relays, regulators, thermostats, thermometers, manometers and debris containing mercury.
- All types of Batteries, Electronic Ballasts, PCBs, Transformers, capacitors, switchgear, Lead Cable, Oil filled / gel filled cables, Electronic Waste– computer products, circuit boards, CRTs, electronic parts, solder dross, weld waste.

Due to the characteristics, the wastes generated from the healthcare establishments are also hazardous in nature. Biomedical wastes have to be dealt with as per the Biomedical Wastes (Handling & Management) Rules, 2000.

Lead based paints and other hazardous materials may be removed from the structure prior to deconstruction or demolition activities to minimize special handling and disposal requirements for the construction and demolition waste. These activities must be conducted by qualified personnel using appropriate health and safety procedures in accordance with the regulatory requirements. Isolated storage for hazardous wastes released from the whole site should be provided on site.

Source segregation of similar wastes is highly recommended. Installation of fire extinguisher is mandatory near storage of hazardous wastes.

E-waste Management Collection and storage:

Various types of electrical and electronic wastes generated in the building, which includes PC in case of offices and homes, Xerox machine components from office and shops, should be collected separately for transportation to the authorized recyclers approved by the state/Central pollution control boards. There should also be provision for storage of these wastes in the building before transportation.





Energy Efficiency in Buildings

1. Introduction

Buildings account for more than 20% of total energy used in the country and up to 30% of fresh potable water, and generate approximately 40% of total waste. Building construction is projected to increase rapidly as the country experiences rapid economic and population growth. The increase in the built up area may become multi-fold of the current critical mass, which may pose a major challenge in preserving our fragile environment. Although the present energy consumption per capita in India is a fraction of that of most of the developed nations, but with the projected growth, unless enough measures are taken, it may lead to acceleration of environment degradation, contributing to increased carbon footprint leading to global warming and climate change, resource scarcity and inequitable development. Moreover, sustainable buildings have demonstrated reduction in energy and water consumption to less than half of the present consumption in conventional buildings and almost complete elimination of the construction and operational waste through recycling.

2. Energy Conservation

Optimize use of energy systems in buildings that should maintain a specified indoor environment conducive to the functional requirements of the building by following mandatory compliance measures (for all applicable buildings) as recommended in the Energy Conservation Building Code (ECBC) 2007 of the Bureau of Energy Efficiency, Government of India. The energy systems include air conditioning systems, indoor lighting systems, water heaters, air heaters, and air circulation devices. Adopting energy efficient technologies for conservation of energy is needed.

A] Passive Solar Design:

Deployment of passive solar design concept for buildings to be followed using architectural design approaches that minimize energy consumption in buildings by integrating conventional energy-efficient devices, such as mechanical & electrical pumps, fans, lighting fixtures & other equipment, with the passive design elements, such as building orientation, landscaping, efficient building envelope, appropriate fenestration, increased day lighting design, and thermal mass.

- (i) The building should be oriented optimally based on Sun-path and engineering analysis to curtail excessive solar radiations.
- (ii) Adequate provision for external shadings including vertical shadings to prevent direct solar radiation and glare, specifically on the eastern and western facades;
- (iii) Adequate protection for the building envelope against thermal losses, drafts and degradation by natural elements such as wind, dust, sand, snow, rainwater, hail, etc.
- (iv) The building should have sufficient day lighting and should provide view to outside for majority of the occupants

B] Building Envelope:

The building envelope is the interface between indoor and external climatic conditions. The building envelope should be designed to conserve energy substantially, maximizes daylight, natural ventilation (access to fresh air) and views to the exterior, and enables to modulate solar heat gain and control/reduce noise. The building envelope should integrate systems for renewable energy and rainwater harvesting. In general, the design strategies to be drawn from long heritage of the country in its various climatic zonest. The building envelope for all air-conditioned buildings/spaces is to comply with the ECBC code (www.beeindia@nic.in).

- (a) **Insulation of Wall and Roof:** Use of insulation is recommended in the exterior walls and roofs of the building to keep out excess heat in hot weather and reduce heat loss in cold weather. The type and amount of insulation needed may vary according to building type,
- (b) **Reflective surfaces:** Reflective surfaces should be applied to improve building energy efficiency by reduce urban heat island effects and cool the built environment. The reflective surfaces, including, high Surface Reflective Index (SRI) roof coatings, cool roofs, LOW e-coating on windows etc.

(c) Use of Energy Efficient Windows:

Windows needs to perform several functions, including giving letting in daylight, providing outlook, and offering access during emergency etc. In most cases, windows should let in as much light as possible, but heat gain needs to be minimized in summer and maximized in winter.





Indian buildings still lack the use of energy efficient glazing system, whereas more and more buildings are being converted into air-conditioned buildings without implementing any energy efficiency measures in almost all the climatic zones.

This indicates a considerable amount of electricity wastage in Indian housing, which can be reduced easily through energy efficient glazing. A significant reduction in specific energy demand is possible just by replacing the current single glazed windows with energy efficient multiple glazed windows. In hot & dry with double glazed, double glazed Low-E and triple glazed energy efficient windows, savings of 5% to 27% were observed for 10% and 20% glazing area respectively.

Day-lighting through windows brings light into a building interior and distributing it in a way that provides more desirable and better quality illumination than artificial light sources. This reduces the need for electrical light sources, thus cutting down on electricity use and its associated costs and pollution.

The general day-lighting principles include:- Avoid direct sunlight on critical tasks and excessive brightness, Bring the daylight in at a high location, Filter the daylight, Bounce daylight off of surrounding surfaces, Integrate daylight with other building systems and strategies.

Important parameters for window Section are:

- Thermal Conduction (U-Value): This determines coeducation heat gain through Windows
- Solar Heat Gain Coefficient (SHGC): This determines Solar Radiation heat gain passes through windows
- Visual Light Transmission (VLT) : This determines visual portion of the solar spectrum passes through windows

C] Energy Efficient Lighting:

Lighting systems should comply with the ECBC 2007 and applicable to interior spaces of buildings, exterior building features, including facades, illuminated roofs, architectural features, entrances, exits, loading docks, and illuminated canopies, exterior building grounds etc. except emergency lighting and lighting in dwelling units.

Install only Low Energy Consumption Lighting Fixtures Lamps, luminaries, ballasts and the controlling systems for achieving energy efficiency through artificial lighting.

(a) Interior Lighting for new buildings:

Lamps – Lamps used for general lighting scheme shall conform to the following:

Point Light Source: All the point light sources installed in the building for general lighting shall be LEDs or LEDs or equivalent.

Linear Light Source: All the linear light sources installed in the building for general lighting shall be T-5 or at least 4 Star BEE rated TFLs or equivalent. The installed interior lighting power shall not exceed the LPD (Lighting Power Density) value as recommended by ECBC 2007.

(b) Automatic Lighting shutoff control:

Interior lighting/Exterior lighting systems shall be equipped with an automatic control device in accordance with ECBC 2007. Occupancy sensors that shall turn the lighting off within 30 minutes of occupant leaving the space. It should also have a option for manual turning off lights when the space is occupied. ECBC requires controls in daylit areas that are capable of reducing the light output from luminaires by at least half and Controlling of exterior lighting with photo-controls where lighting can be turned off after a fixed interval.

D] Energy Efficient Heating Ventilation and Air Conditioning (HVAC) Systems:

The era of Sustainable Building has brought with it a trend in improved HVAC design, where the new technologies and strategies are adopted to achieve higher energy performance. Green building is one that achieves high performance, over the full life cycle, in the following areas:

- Minimal consumption of energy – due to reduction of need and more efficient utilization of non-renewable natural resources, land, water, and other materials as well.





- Minimal atmospheric emissions having negative environmental impacts, especially those related to greenhouse gases (GHG), global warming, particulates, or acid rain.
- Minimal discharge of harmful liquid effluents and solid wastes, including those resulting from the ultimate demolition of the building itself at the end of its useful life.
- Minimal negative impacts on site ecosystems.
- Maximum quality of indoor environment, including air quality, thermal regime, illumination, acoustics/noise, and visual aspects.

The designer should ensure the HVAC system design meet the standard on energy front like ECBC and other related standards to achieve higher level of energy efficiency in new buildings. Building designer should incorporate solar passive techniques for building optimization with thorough analysis should be part of HVAC design, passive techniques that can be adopted in different climate zones of India should be explored to reduce building's heating/cooling demand.

a] Deployment of Passive Cooling, Heating, Natural Ventilation & Hybrid Passive System:

The passive cooling, passive heating, natural ventilation system should be used to reduce energy demand of the HVAC system. Various simulation tools can be used to design, verify the passive technologies. Few of the passive cooling/heating/ventilation technologies are _

- **Stack Effect:** Air movement can be designed using the temperature gradient of the building. This enhances the natural ventilation and helps in reducing the fan power energy demand.
- **Wind towers:** Wind towers catches the cool air, enhances the natural cooling and ventilation.
- **Night purging:** Night purging takes advantage of the diurnal variation in temperatures to lower the cooling demand of the space.
- **Roof Pond:** A water body on the roof may provide cooling wherein during summers it is covered with insulation with a surface finish of low absorptivity.
- **Evaporative cooling:** It is suited for hot climates with low humidity. The cooling of air is achieved by simple evaporation of water in air. An addition to the direct evaporative cooling is the indirect evaporative cooling, where humidity can be controlled by an additional heat exchanger.
- **Desiccant dehumidification/cooling systems:** Desiccant dehumidification/ cooling technology provides tool for controlling humidity levels for conditioned air spaces.
- **Geothermal heating and cooling:** Geothermal exchange loop use the constant temperature of the earth as the exchange medium instead of the outside air temperature. As the ground is warmer than ambient air during winters and cooler than ambient air during summers, geothermal exchange loop harnesses this phenomenon by exchanging heat with the earth through a ground to water/air heat exchanger.
- **Earth air tunnel system:** As earth temperature remains constant throughout the year at a depth of 4m to 5m, an earth air tunnel (EAT) is created by burying a pipe at this depth. Ambient air, thus sucked from one end is passed through EAT and depending on the ambient temperature, air gets cooled in summer and heated up in winter. This cooled/heated air is then supplied to the various areas in the building for meeting space cooling/heating demand and can provide recommended thermal comfort to the building occupants.

b] Pre-Cooling of Out-door Air

HVAC system uses significant amount of energy to cool/heat the out-side air, the following strategies should be adopted to minimize the out-side air conditioning energy demand:

- **Demand controlled ventilation:** CO² sensors may be used to check the level of pollutants in the occupied space. This gives feedback to building management system/HVAC controls to change the opening of outside air dampers thereby effectively providing ventilation on demand.
- **Heat Recovery:** Pre-cooling of hot/cold outdoor air can be achieved by recovering energy from exhaust streams of a building through either heat recovery wheel, cross plate heat exchangers or heat pipes. This helps in lowering the installed capacity of cooling/heating equipment.





- **Economizer Cycles:** In certain climates, air and/or water side economizer cycles may be used to take advantage of lower ambient air temperatures. Outside air load may be reduced by pre-treating the air and possibly combining strategies like earth air tunnel and adiabatic cooling.

(c) Air-Conditioning System

The following should be considered with regard to planning, design and installation of HVAC system, this tips of using high energy efficient systems:

Refrigerants: Manufacturers and designers should adopt balanced approach while selecting refrigerants. Some of the key criteria to be considered are as follows:

- Ozone depletion potential (ODP) – should be zero;
- Global warming potential (GWP) – should be as low as possible;
- Energy efficiency- part load, full load, system – should be as high as possible;
- Flammability – should be as low as possible and suitable risk mitigation process infrastructure needs to be opted to handle flammability; and
- Toxicity – should be zero / lowest possible.

Energy Efficient Chillers: Chillers are most common system for centralized system of large project, High COP and IPLV chillers are available in the market. In addition, use of VFD in compressor may also be explored as it offers improved part load efficiency.

Variable Refrigerant Flow Systems: These are the systems can provide a superior performance over conventional unitary equipment/package units. The part load efficiency of these systems is higher compared to conventional DX systems.

Vapour absorption system: Waste steam/heat may be used for refrigeration; this system can couple to solar panels (heated water) to produce cooling in buildings. Vapour absorption machines may also be considered in co-generation systems.

Variable speed drives: Variable frequency drives (VFDs) can be used on various components for energy efficiency such as condenser water circulation pump, cooling tower fans, chiller's primary and secondary water circulation pumps, air handling units etc.

3. Use of Renewable Energy

All efforts need to be made towards optimum and efficient use of energy sources for life sustenance. The increasing thrust on using non-fossil fuel energy for all needs have to be given priority consideration.

The tapping of renewable sources of energy for lighting, heating, cooling and ventilation needs, deserve special attention. For captive solar power generation, a minimum of 15 percent of sanctioned load is the requirement.

A] Installation of Solar Photovoltaic Panels:

Solar photovoltaic (SPV) systems are direct energy conversion systems that convert solar radiation into electric energy. SPV systems should be installed to reduced use of conventional sources of energy. Roof tops of buildings as well as other exposed areas such as of parking shades should be utilized for installation of SPV systems.

B] Installation of Solar Assisted Water Heating Systems

Hot water requirement in buildings may be met through use of various types of solar water heating systems, viz. flat plate collector: single glazed double glazed; evacuated tube collectors; and Water heating with solar concentrators.

- Solar water heating systems should be installed in the building used for hospitals, hotels, hostels, guest houses, police men/ army barracks, canteens, laboratories and research institutions, schools and colleges and other institutes.
- The solar water heating system should be mandatory in the hospitals and hotels, where the hot water requirements are of continuous nature. These buildings must be provided with auxiliary back-up system.
- The use of solar water heating system is recommended in the following type of buildings in Government/ Semi-Government and Institutional buildings where the hot water requirements may not be continuous/ permanent i.e. Guest Houses, Police men/Army barracks, Canteens, Laboratory & Research Institutions where hot water is needed.





- The Installation of the electrical back up in all such water heating system shall be optional depending on the nature of requirements of the hot water.
- It is recommended that solar heating systems of the capacity of about 100 liters per day based on thermos phonic with necessary electrical back-up be installed at residential buildings like hostels.
- In order to facilitate the installation of the solar water heating systems, the new buildings shall have the following provisions: all such buildings where solar water heating systems are to be installed will have open sunny roof area available for installation of solar water heating system. The roof loading adopted in the design of such building should be at least 50 kg per sq. m for the installation of solar water heating system.

A solar water heating system should be integrated with the building design. These should either be put on the parapet or could be integrated with the south facing vertical wall of the building.

The best inclination of the collector for regular use throughout the year is equal to the local latitude of the place. The Collectors should be facing south-west. However, for only winter use the optimum inclination of the Collector would be (Latitude + 15 degrees of the south). Even if the Collectors are built in south facing vertical wall of building the output from such Collectors during winter month is expected to be within 32% output from the optimum inclined Collector.

All the new buildings to be constructed shall have an installed hot water line from the rooftop and insulated distribution pipelines to each of the points where hot water is required in the building. The capacity of the solar water heating system to be installed on the building shall be described on the basis of the average occupancy of the building.

- Renewable energy utilization: Meet energy requirements for a minimum of 10% of the internal lighting load (for general lighting) or its equivalent from renewable energy sources (Solar, wind, biomass, fuel cells and others). Energy requirements will be calculated based on realistic assumptions, which will be subject to verification during appraisal.
- Renewable-energy based hot water system: Meet 70% or more of the annual energy required for heating water through renewable energy based water-heating systems.

4. Reduction in Energy embodied in construction

Buildings are constructed with a variety of building materials and each material consumes energy throughout its stages of manufacture, use and deconstruction. These stages consist of raw material extraction, transport, manufacture, assembly, installation as well as its disassembly, deconstruction and decomposition. The energy consumed in production is called the 'embodied energy' of the material and is the concern of energy consumption and carbon emissions.

To use low-embodied energy industrial-waste, such as fly ash as the construction material. Fly ash, an industrial waste with properties of cement and very low-embodied energy, is used in combination with cement that has high in embodied energy. Light-weight concrete blocks cellular light-weight concrete (CLC) blocks are substitutes to bricks and conventional concrete blocks in buildings with a density varying from 800 kg/m³ to 1800 kg/m³.

Use ready-mix concrete or high-volume fly ash concrete for construction or use Portland Pozzolana Cement (PPC) concrete for construction; PPC must meet the requirements of IS 1489: 1991.

(a) Advantages of cellular light-weight concrete blocks:

- Better strength to weight ratio.
- Reduction of dead load, which results in saving of steel & cement, and reduction in foundation size.
- Better acoustics and thermal insulation (air conditioning requirement is considerably reduced).
- Saving in consumption of mortar and higher fire rating.

(b) Development of fly ash-based polymer composites as wood substitute:

Fly ash-based composites is developed using fly ash as filler and jute cloth as reinforcement. After treatment, the jute cloth is passed into the matrix for lamination. The laminates are cured at specific temperature and pressure, and the number of laminates is used for required thickness.

The technology on fly ash polymer composites using jute cloth as reinforcement for wood substitute material can be applied in many applications like door shutters, partition panels, flooring tiles, wall paneling, and ceiling.





With regard to wood substitute products, it may be noted that the developed components/materials are stronger, more durable, resistant to corrosion and, above all, cost-effective as compared to the conventional material (wood).

(c) Ready-mix fly ash concrete:

Though ready-mix concrete is quite popular in developed countries, it consumes less than 5% of the total cement consumption in India. Only recently has its application started growing at a faster rate. On an average, only 20% fly ash (of cement material) in the country is being used. In ready-mix concrete, various ingredients and quality parameters are strictly maintained/controlled, which is not possible in the concrete produced on-site.

Hence, this cement accommodates still higher quantity of fly ash.

(d) Advantage of fly-ash bricks over burnt clay bricks:

- Lower requirement of mortar in construction,
- Plastering over brick can be avoided,
- Controlled dimensions, edges, and a smooth and fine finish.
- The bricks can be in different colours (using pigments). Cost-effective, energy-efficient and environment friendly as it avoids the use of fertile clay.

The MoEF&CC had issued notification 8.0.763(E), dated 14 September 1999, containing Directive for greater fly-ash utilization, some of which are listed below:

- Within a radius of 100 km from coal- or thermal power plants (TPP) lignite-based, manufacturers of bricks/blocks/tiles should use at least 25% of fly ash in their product.
- Every construction agency engaged in the construction of buildings within a radius of 50–100 km of TPP had to use 100% fly ash- based bricks/blocks in their construction project **by the end of August 2007**. Construction agencies, within 50 km radius of TPP, had to use 100% fly ash-based bricks/blocks **by the end of August 2005**. Any brick/ block containing more than 25% fly ash is categorized as fly ash brick/block.
- Utilization of fly ash in the building structure: Use of fly ash for RCC (reinforced cement concrete) structures with in-fill walls and load bearing structures, mortar, and binders.

Reduce volume, weight, and time of construction by adopting an efficient technology such as pre-cast systems, ready- mix concrete, and others.

5. Smart Energy Management System

Whatever may be the energy-saving strategy, energy management and control system (EMCS) is an important tool for monitoring of energy efficiency in building. The human efficiency requires a multi-pronged strategy; however, to obtain the best performance from equipment, facilities managers buildings should commission smart energy management system and operate it properly.

EMCS is a method of tracking the performance of the energy consumed by the different building systems. EMCS systems typically consist of electronic devices with microprocessors and communication capabilities and utilize widespread use of powerful, low-cost microprocessors and standard cabling communication protocols. Energy metering may be provided for the following applications:

- 1) Lighting (interior and exterior);
- 2) Air conditioning (heating/cooling);
- 3) Hot water systems;
- 4) Renewable energy systems;
- 5) Energy meters for pumping of municipal water, grey water and irrigation water;
- 6) Miscellaneous equipment such as elevators, computers escalators; etc.





WATER

Integrated and sustainable water management focusing on least anthropogenic water discharge from human activities should be pursued. Efforts are needed to substantially reduce water consumption in buildings. The use of water conserving fixtures, landscaping, rain water harvesting, aquifer recharging and waste-water recycling need to be given due consideration.

Rain Water Harvesting from roof and non-roof areas (by recharge) and designing rainwater harvesting system to capture at least 'peak-month rainfall' runoff volume from roof and non-roof areas and low water consumption plumbing fixtures using water efficient plumbing fixtures (as applicable) whose flow rates meet the baseline criteria in aggregate should be promoted.

The total annual water consumption of the building should not exceed the total base case water consumption computed.

Water Requirements (liters/day) for Different Types of Buildings

#	Type of Building	Consumption
01	Factories with bath rooms	45 per head
02	Factories without bath rooms	30 per head
03	Hospital (including laundry):	
a.	Number of beds not exceeding 100	340 per head
b.	Number of beds exceeding 100	450 per head
04.	Nurses' homes and medical quarters	135 per head
05.	Hostels	135 per head
06.	Hotel (up to 4 star)	180 per head
07.	Hotel (5 star and above)	320 per head
08.	Offices	45 per head
09.	Restaurants	70 per seat
10.	Cinemas, concert halls and theaters	15 per seat
11.	Schools	
a.	Day schools	45 per head
b.	Boarding schools	135 per head

In addition, water demand of visitors to these building is considered as 15 LPCD

Source: National Building Code, 2005

Construction Phase Water Requirements

The construction phase would involve water requirements for the following activities:

Site preparation: that is involving leveling for infrastructure development, and removal of vegetation.

Water is required for dust settlement, consolidation, compaction, and curing. Construction of building infrastructure involves water for construction activities and domestic & other water requirements for labour and staff onsite.

Keeping in view the use of large quantities of water in curing, measures for reducing water demand during construction should be followed. Curing water should be sprayed on concrete structures; free flow of water should not be allowed for curing. After liberal curing on the first day, **all concrete structures should be painted with curing chemical to save water.**

This will stop daily water curing hence save water. Concrete structures should be covered with thick cloth/gunny bags and then water should be sprayed on them. This would avoid water rebound and will ensure sustained and complete curing. Ponds should be made using cement and sand mortar to avoid water flowing away from the flat surface while curing.





Water ponding should be done on all sunken slabs, this would also highlight the importance of having an impervious formwork. Water conservation and management should focus on recycle, recharge, and reuse of water. Waste-water treatment by providing necessary treatment of water for achieving the desired concentration of effluents should be promoted.

The developer should ensure groundwater and municipal water meet the water quality norms as prescribed in the Indian Standards for various applications (Indian Standards for drinking [IS 10500-1991], irrigation applications [IS 11624-1986]).

In case the water quality cannot be ensured, necessary treatment of raw water for achieving the desired concentration for various applications be provided.

Landscape maintenance should adopt drip irrigation system or sub-surface drip irrigation system, which saves water as it avoids loss of water due to run-off, deep percolation or evaporation. The other system is sprinkler irrigation. Sprinklers are most suited to sandy soils with high infiltration rates.

The average application rate should be less than the basic infiltration rate of the soil so as to avoid surface ponding and run-off. It is better to use sprinklers that produce fine sprays than those that produce larger water droplets.

Water conservation can be attained by promoting use of native vegetation original to a particular place, including trees, shrubs, and other plants. These plants have low evapotranspiration loss. Evapotranspiration rate determines the rate at which plants lose water through evaporation. It is affected by humidity and temperature at a given time. These rates vary with the season.

To reduce water consumption in the building use of efficient fixtures be adopted. Use of efficient plumbing fixtures, sensors, auto control valves, and pressure reducing devices wherever possibly can result in significant reduction in water consumption. Use of water efficient fixtures be made as conventional toilets use 13.5 litres of water per flush, Low flush toilets are available with a flow rate of 6.0 litres and 3.0 litres of water per flush. Dual flush adapters can be used for standard flushing for solid waste and a modified smaller flush for liquid waste. Flush valves with 20–25 mm inlets can be used for restricting the water flow.

Water-efficient urinals:

Conventional urinals use water at a rate of 7.5–11 litres per flush. Use of electronic flushing system or magic eye sensor can further reduce the flow of water to 0.4 litres per flush. Furthermore, waterless urinals do not use water. Auto control valves, installation of magic eye solenoid valves (self-operating valves) can result in saving water.

Sensor taps have automatic on and off flow controls. These valves are not only convenient and hygienic but is also excellent water saving devices that can work under normal water pressure. They function with parameters such as distance and timing.

Pressure reducing device:

Aerators and pressure inhibitors for constant flow. Use of aerators can result in flow rates as low as 2 litres per minute, which is adequate for washing hands. Flow regulators are installed when aerators cannot be installed.

The use of potable water during construction should be minimized.

As per BIS, for residential buildings with a population of 20,000-1,00,000, the per capita consumption is 100-150 lpcd and for those with population above 1,00,000, the consumption is 150-200 lpcd. Out of the 150 to 200 litres per head per day, 45 litres per head per day for flushing requirements and the remaining quantity for other domestic purposes.

For the other types of buildings, the water requirement varies between 30 to 340 lpcd.

The physiography of the land will control the drainage pattern in the region.

The drainage pattern in the area is to be drawn. Hydro-geological settings and the ground water levels are to be examined and presented.





Ground water and surface water in the study area is to be collected as per CPCB norms and examined for physio-chemical, heavy metals and bacteriological parameters. It is required to collect the information on the total quantity of water requirement for the proposed project with the breakup of requirements for various uses.

The following should be ascertained proactively –

- the source from which water requirement will be met,
- the capacity (dependable flow or yield) of the proposed source of water,
- the quality of water required, in case, the supply is not from a municipal source (physical, chemical, biological characteristics with class of water quality),
- the water requirement, which can be met from the recycling of treated wastewater (the details of quantities, sources and usage)

If there is likelihood of diversion of water from other users, or any incremental increase in pollution load from wastewater generated from the proposed activity should be calculated. The water requirements met from water harvesting along with the details of the facilities created for the purpose be documented.

The impact of the land use changes occurring due to the proposed project on the runoff characteristics (quantitative as well as qualitative) of the area in the post construction phase on a long term basis.

The management of the storm water in the site, the provisions made to avoid flooding of the area, details of the drainage facilities provided along with a site layout indicating contour levels should be planned.

The impacts of the proposal on the ground water like will there be tapping of ground water; give the details of ground water table, recharging capacity, and approvals obtained from competent authority, if any be ascertained. The precautions/measures taken to prevent the run-off from construction activities polluting land & aquifers should be detailed.

The on-site facilities provided for the collection, treatment & safe disposal of sewage along with details of the quantities of wastewater generation, treatment capacities with technology & facilities for recycling and disposal be documented.

Details of dual plumbing system if treated waste used is used for flushing of toilets or any other use be planned and implemented.

Plumbing fixtures certified by IGBC under Green Product Certification Programme can be used by the project to show compliance, as and when certified fixtures are available.

As per MoEF guidelines, water reduction can be achieved up to 36% using water conserving fittings with sensors, auto valves, pressure-reducing device wherever possible which can result in significant reduction in water consumption.

- i. **Water closets (WCs):** Conventional toilets use 9 litres of water per flush. Low flush toilets are available with flow rate of 6.0 litres and 3.0 litres of water per flush. Dual flush adapters can be used for standard flushing for solid waste and a modified small flush for liquid waste. Flush valves with 20-25 mm inlets can be used for restricting the water flow
- ii. **WC faucets, washbasin taps, and kitchen taps:** Faucets and taps can have flow rates upto 25 litre/min. The flow rate can be reduced without compromising on the water pressure by having restrictors, pressure inhibitors, and aerators. Auto control valves can further help in reducing wastage.
- iii. **Pressure reducing device:** Use of aerators can result in flow rates as low as 2 litre/min, which is adequate for hand washing purpose.
- iv. **Auto control valves:** Installation of magic eye solenoid valve (self-operating valve) can result in water savings. The sensor taps has automatic on and off flow control. It functions with parameters such as distance and timing.
- v. **Urinals:** The conventional urinals use water at a rate of 7.5-11 litres per flush. Low flush urinals use only 2 litre/flush, Use of electronic flushing system or magic eye sensor can further reduce the flow of water to 0.4 litres per flush, Waterless urinals use no water.





vi. **Shower heads:** Conventional showerheads can deliver water at flow rates above 25litres/min. A perfectly pleasant shower can however, be obtained with flow rates well below 10 litres / min. Shower heads fitted with aerators and pressure regulators can reduce flow rates as low as 4.5 litres/min and their use will show a significant saving.

vii.Waste Water Recycle and Reuse:

- i. **Waste Water Treatment:** Design an on-site treatment system to handle 100% of wastewater generated in the building, to the quality standards suitable for reuse, as prescribed by Central (or) State Pollution Control Board, as applicable.
- ii. **Waste Water Reuse:** Use treated waste water for at least 25% of the total water required for landscaping, flushing, and cooling tower make-up water (if the project uses water- cooled chillers).The treated waste water could be used for landscaping, flushing and air- conditioning.

The project should provide facility for the treatment of wastewater generated in the building so as to have safe disposal and use of by-products.

Grey Water: Any water used in households, except water from toilets, is called grey water. This includes washings from shower, sink, kitchen sinks, and laundry water. This can be reused for various applications, especially landscape irrigation.

Black Water: Refers to sewage water from toilets

Sewage treatment plants based on biological processes are commonly used for treatment of wastewater that includes both grey water and black water. These are dependent on natural microorganisms, which utilize oxygen and the organic contaminants in the wastewater to generate CO₂, sludge, and treated water.

In the treatment systems, microorganisms exist in suspended form (for example, in an aeration tank, microbes are present freely in wastewater without any support) or attached form (such as reed bed systems, where microbes are attached to the roots of plants, sand, and gravel). These systems normally require a pre-treatment step such as a settlement chamber before the aeration unit. Artificial wetlands or reed bed systems, which are based on natural processes, are beneficial due to simple and low O&M cost.

Provide necessary treatment of wastewater for achieving the desired concentrations for disposal. Carry out water testing for various parameters prescribed in the Pollution Control Acts, Rules, and notifications, CPCB, 1998, for disposal in surface water and on land.

To utilize the treated wastewater and rainwater for various applications (including groundwater recharge) where potable municipal water is normally used to reduce the load on both the municipal supplies as well as the sewerage system and to improve the groundwater level.

Grey water from bathrooms, kitchens, and other washings can be suitably treated and reused for non-potable applications such as irrigation and flushing. Separation of the grey water from black water by installation of dual plumbing lines at the time of construction is economical.

Rainwater Harvesting

Rainwater can be harvested from rooftops, paved and unpaved areas, storm water drains, and water bodies. The basic components of a rainwater-harvesting system include the following.

Catchment	: Surface, where water falls directly (terrace, lawn, open ground, and roof).
Coarse mesh	: To prevent the debris from entering the water
Gutters	: To collect and transport water to storage tank (galvanized iron sheet or PVC material).
Conduits	: Pipelines or drains to carry water from the surface to storage. Filter – to remove suspended pollutants from rainwater collected (sand filter and charcoal filter). Storage – tanks of any shape and size depending on the capacity of rainwater that can be collected.

The recharging or storing of water depends on the rainfall of a particular region, and the sub-surface geology. In regions where the rainy season lasts for three to four months, groundwater recharge is beneficial rather than storage, as the storage cistern would remain empty during other parts of the year. In places where the surface is impermeable and groundwater is saline or not of potable quality, it is not advisable to go for groundwater recharging.





Recharging can be done through dugwells, borewells, recharge trenches, and recharge pits. Filter material at the entry point is essential to maintain the quality of water. A settlement tank acts as a buffer to hold the surplus water during the course of excess rainfall.

Infiltration techniques: Trenches filled with rocks receive storm water run-off from grass swales and water percolates through the void space of rocks into soil. Biofiltration swale/grass swale is a vegetated channel with slope less than 0.6%, so as to increase the flow residence time, increase the pollutant (suspended solids and trace metals) removal efficiency by effective infiltration, and reduce run-off.

Sand filter: Use of sand layer for filtering the storm water into drainage facility before storage in detention basins. This results in removal of total suspended solids. The efficiency is higher if the pre-treatment is achieved through trench and grass swales.

Detention basins Wet ponds: Constructed ponds to retain the filtered storm water.

Storm Water Wetlands: Wet ponds integrated with wetland plants, which will also facilitate storm water treatment.

Wet Vaults and Storage Tanks: Underground storage facilities in reinforced cement concrete used for irrigation at a later stage.

Notes:

1. Waste water here refers to both grey and black water. Wastewater can be treated in-situ and reused in-situ. In case the local authorities insist the project to divert wastewater to a centralized/ common wastewater treatment plant, then the project can show compliance, by reusing treated wastewater from the centralized/ common/ any other waste water treatment plant. Treated waste water from other sites/ local authorities through permanent piped connections or other means can also be considered to show compliance. Captured rain water can also be considered to show compliance. The water requirement and average number of watering days for landscaping shall be considered as 6 liters per sq. mts. per day (i.e. 6 liters/ sq. mts. / day) for a minimum of 300 days (or) Justify if the water requirement and the average number of watering days for landscaping is less than the above requirement.
2. Limit use of turf on the site to conserve water and/ or ensure that landscaped area is planted with drought tolerant / native / adaptive species. Avoid disturbance to the site by retaining natural topography (and/ or) design vegetated spaces on the ground, for at least 15% of the site area. Restore disturbed site area by designing vegetated spaces over built structures and on the ground, for at least 30% of the site area (including development footprint). Preserve or transplant at least 75% of existing fully grown trees within the project site / campus. Plant tree saplings that can mature into fully grown up trees within the next 5 years on the project site, as per the below criteria (including existing and transplanted trees in the project site).





AIR

The climatic data

The climatic data procured from secondary sources is very important for identifying the season and period of monitoring primary data. The climatic data can help in using suitable building technologies and energy conservation measures.

The methodology for collecting Climatic Data

The methodology to be adopted for collection of climatic data specific to the site is to compile the mean monthly normals of atmospheric parameters, from previous 10 years data recorded by the nearest IMD station. Wind Roses for each month giving the wind direction speed are to be collected and presented. Most probable wind speed class and wind direction at the nearest IMD site should be estimated from this.

Baseline data of air pollutant parameters

Baseline data of air pollutant parameters extending an area of 500 meters from the project should be monitored at a number of locations. Description of baseline data of ambient air parameters namely RSPM, nitrogen dioxide, sulphur dioxide, and carbon monoxide are to be collected.

- One season data is to be monitored other than monsoon as per the CPCB Norms.
- Sampling locations are to be located as per CPCB norms.
- Number and locations of Ambient Air quality monitoring (AAQM) stations are decided based on the nature of project, meteorological conditions, topography, selected pollution pockets in the area and likely impact areas.

It should be seen whether the project increases atmospheric concentration of gases & result in heat islands.

Details of background air quality levels with predicted values based on dispersion models taking into account the increased traffic generation as a result of the proposed constructions should be calculated.

The impacts on generation of dust, smoke, odorous fumes or other hazardous gases in relation to all the meteorological parameters should be compiled.

It should be seen whether the proposal create shortage of parking space for vehicles, details of the present level of transport infrastructure and measures proposed for improvement including the traffic management at the entry & exit to the project site should be prepared.

The details of the movement patterns with internal roads, bicycle tracks, pedestrian pathways, footpaths etc., for areas under each category should be prepared.

It should be ascertained that whether there will be significant increase in traffic noise & vibrations, details of the sources and the measures proposed for mitigation of the above be prepared.

The impact of DG sets & other equipment on noise levels & vibration in & ambient air quality around the project site be estimated.





Solid Waste Management

- i. To minimize waste generation; streamline waste segregation, storage, and disposal; and promote resource recovery from waste.
- ii. Reduction in waste during construction: Ensure maximum resource recovery and safe disposal of wastes generated during construction and reduce the burden on landfill.
- iii. Efficient waste segregation: Use different coloured bins for collecting different categories of waste from the building.
- iv. Storage and disposal of waste: Allocate separate space for the collected waste before transferring it to the recycling/disposal stations.
- v. Resource recovery from waste: Employ resource recovery systems for biodegradable waste as per the Solid Waste Management and Handling Rules, 2000 of the MoEF&CC. Make arrangements for recycling of waste through local dealers.
- vi. Maximize the conservation and utilization of resources (land, water, natural habitat, avi fauna, and energy) and enhance efficiency of the systems and operations.

Preserve and protect the landscape during construction/compensatory depository forestation.

- i. Proper timing of the construction, preserve topsoil and existing vegetation, staging and spill prevention, and erosion and sedimentation control.
- ii. Replant on-site trees in the ratio 1:3 to those removed during construction.
- iii. Proper topsoil laying, stabilization of the soil, and maintenance of adequate fertility of the soil to support vegetative growth.
- iv. Design to include existing site features and minimize the disruption of the natural ecosystem and design to harness maximum benefits of the prevailing micro-climate.
- v. Reduce hard paving on-site and/ or provide shaded hard-paved surfaces. Minimize storm water run-off by reducing hard paving on-site.
- vi. Enhance outdoor lighting system efficiency: Meet minimum allowable luminous efficacy (as per lamp type) and make progressive use of a renewable-energy- based lighting system.
- vii. Plan utilities efficiently and optimize on-site circulation efficiency: Minimize road and pedestrian walkway length by appropriate planning and provide aggregate corridors for utility lines.
- viii. Health and well-being: To protect the health of construction workers and prevent pollution.
- ix. Provide at least the minimum level of sanitation/safety facilities for construction workers: Ensure cleanliness of workplace with regard to the disposal of waste and effluent, provide clean drinking water and latrines and urinals as per applicable standard.
- x. Reduce air pollution during construction: Ensure proper screening, covering stockpiles, covering brick and loads of dusty materials, wheel-washing facility, and water spraying facility.

BIOLOGICAL / VEGETATION / PLANTATION

Baseline data from field observations for various terrestrial and aquatic systems are to be generated. Wildlife sanctuaries and National parks location within 10 km radius from project boundary are identified based on secondary data. Primary data on survey of the wild animals and birds in the study area is collected & identified with the classification into various schedules taken from secondary data.

The mitigation measures should be suggested that will help in reducing the impact on terrestrial ecology and aquatic ecology. Massive plantation, landscaping are to be ensured in the new construction areas. Also trees, plants should be identified for specific areas so that the plants survive in these conditions. It should be assessed if there any threat of the project to the biodiversity, construction involves extensive clearing or modification of vegetation, and measures proposed to be taken to minimize the likely impacts on important site features.

The plan should have details of proposal for tree plantation, landscaping, creation of water bodies etc along with a layout plan to an appropriate scale. It should be seen whether there is likelihood of any displacement of fauna- both terrestrial and aquatic or creation of barriers for their movement, any direct or indirect impacts on the avifauna of the area?

Provide details and measures should be prescribed such as corridors, fish ladders etc to mitigate adverse impacts on fauna.





Noise Management

Construction equipment and road traffic are the major sources of noise. Baseline data of noise at the project area and the neighbourhood habitat areas is to be ascertained. Day-time and night-time data should be collected and presented. During the construction phase of the site, the main source of noise pollution is construction equipment. During operational phase the main sources of noise pollution expected is diesel generator operations.

It is important that no new development is carried out within areas where expected noise levels will cause mental and physical fatigue or permanent loss of hearing. In case development in such areas is essential, adequate sound insulation should be provided for the building. There are two ways of applying controls or measures.

The first is to plan so as to keep the noise at a distance. Under this aspect comes the separation of housing from traffic noise by interposing buffer zones, and the protection of schools and hospitals by green belts, public gardens, etc. The second is the principle of shading or screening. Use of noise deflectors can also help in reducing the noise. This consists of deliberately interposing a less vulnerable building to screen a more vulnerable one or by providing a solid barrier such as a wall between the source and the location to be protected.

Setting up the barriers: National Building Code 2005 suggests that design solutions such as barrier blocks should be used to reduce external LA10 noise levels to at least 60-70 dB(A) at any point 1.0 m from any inward looking façade. Green belts and landscaping could act as an effective means to control noise pollution. In case of railway tracks, a minimum distance of 50m to 70m may be provided between the buildings and the tracks.

Thick belts of planting greater than 30 meters are useful for cutting the noise levels from road traffic. Strong leafy trees may be planted to act as noise baffles. Shrubs and creepers may also be planted for additional protection between tree trunks; artificial mounds and banks should be formed where practicable. As little hard paving and as much grass as possible may be used. The creation of green belt is particularly advisable on the perimeter of aerodromes, along railway lines and arterial roads, through or past built up areas and adjoining industrial zones.

Control of noise from Air traffic:

The problem caused by aircraft noise have become very acute, therefore a commonly used criterion is the noise exposure forecast (NEF). Aircraft noise can seriously affect living conditions no matter how much insulation has been applied. For this reason it is recommended that no residential development should be allowed beyond NEF 35 level.

For very critical buildings such as buildings necessary for maintaining and supplementing the airport services, and for commercial development, such as hotels, it is possible to provide sealed windows and to centrally air condition the entire building.

Control of noise from railway lines:

Wherever possible no residential or public building zone should be along the railway lines. The appropriate zones alongside railway lines are industrial and commercial buildings other than office buildings.

Control of noise from road traffic:

Trees with heavy foliage planted on both sides of carriage way help slightly muffle the noise provided; the foliage extends for a considerable distance of 30m or above.





Transportation:

Some of the factors are important and must be taken into the consideration, while planning, are the movement of heavy traffic loads and operation of construction machinery.

- Construction machinery due to its operation produces smoke, dust and noise and vibration.
- Internal road design should be done with due consideration for environment, and safety of the people residing or working near the roads.
- Proper sidewalk should be provided for the residence to commute.

Sidewalk: The width of sidewalk depends upon the expected pedestrian flows and should be fixed with the help of guidelines given by IRC in IRC: 103-1988. The parking provisions should take into consideration the two wheelers and four wheelers. It is also desirable to design parking facilities with basement / stilts parking to reduce the heat island effect. When inevitable the surface parking planned should cover issues to address heat island effect. It is also desirable to have electric charging facility for vehicles which could cater for both two and four wheelers.

Parking: Parking provision for bicycles, Internal Circulation to provide for movement of fire tender, paving that permits infiltration of rain water, avoidance of very sharp and blind corners, Elimination of risks to children and old people in crossing the internal roads to reach play areas and recreational facilities. Replace a part of energy-intensive materials with less energy-intensive materials and/or utilize regionally available materials, which use low-energy/energy-efficient technologies.

Sustainably managed materials: Sustainably managed materials, when compared with equivalent products for the same application, have the characteristics of natural resource conservation – low-energy content, reduction in the content of primary/high-energy materials, regional availability, and low emission levels of pollutant – in each stage of their life cycle. The amount of materials used in the construction of buildings, for either structural or non-structural applications, represents a significant use of natural resources in terms of extracted raw materials and embodied energy. The aim of this measure is to replace a part of the energy-intensive materials with less energy-intensive materials and/or utilize regionally available materials, which offers reduced transportation, with the use of low-energy/energy-efficient technologies (not based on the utilization of fly ash).

Examples of such structural or non- structural applications (excluding wood) are pre-cast technologies for roofing or flooring, pre- cast infill wall panels, composite ferrocement system, and traditional mud walling techniques. These techniques cause reduction/over-use in the volume of concrete or steel used and, at the same time, save on-site construction time. Stabilized compressed earth blocks are made up of mud stabilized with 5% cement lime and other materials, and compacted in block making machines with no burning. A good material for walls such as burnt bricks is economical, energy saving, and simple to manufacture. The soil to be used for the blocks should have the requisite component of clay, silt, and sand. Soil-stabilized hollow and interlocking blocks can provide better thermal insulation.

Stabilized adobe is an improvement over traditional adobe or hand-moulded and sun-dried mud block in which mud is mixed with a small proportion of cement, lime, broken or cut dry grass (as reinforcing media to impart added strength and lower the permeability). It is appropriate for dry climates.

Pre-cast stone blocks

Pre-cast stone blocks are of larger size than normal bricks. These are manufactured by using waste stone pieces of various sizes with lean cement concrete and enable a rationalized use of locally available materials. This saves on cement, reduces thickness of stonewalls, and eliminates the use of plasters on internal/external surfaces. Use native or quarried (stone where available within the delivery radius <100–150 km), which has a very less embodied energy content, negligible transport energy costs, and needs only shaping. Lightweight stone, which is made from cement and recycled aggregates or furnace clinkers, can also be a resourceful option. Pre-cast concrete blocks are made to similar dimension of stone blocks but without large size stone pieces. These blocks use coarse and fine graded aggregate with cement. They have excellent properties comparable to other masonry block. Pre-cast hollow concrete blocks, manufactured using lean cement concrete mixes and extruded through block-making machines of egg laying or static type, need lesser cement mortar and enable speedy construction as compared to brick.





Low Cost Housing

A habitat living condition is important to improve Self-respect, and provide a sense of belonging!

It's not easy to define affordability, given the extremely diverse income profiles of the urban poor – from the destitute and chronically poor to the highly variable low-income classes. EWS households are defined as those that earn less than Rs. 1 lakh a year, while LIG households are those with earnings between Rs. 1 – 2 lakh a year.

The MoHUPA has different ways of defining affordability. For one, affordability is defined as three-four times the annual income of the household.

In official schemes and projects that include government subsidies for individual dwelling units with a carpet area of not more than 60 sqm., a price range of maximum five times the annual income of the household is considered to be affordable. The areas prescribed for EWS units range between 21 – 27 sqm. and that for LIG units, 28 – 60 sqm.

The Ministry says that the loan amount should also be repayable within the working life of the householder (working life is assumed as longer for an office-goer and shorter for a manual/physical worker). The EMIs should not be more than 40% of the monthly income to ensure that the family can take care of its other needs with the remaining income.

An affordable housing project is also defined as one, where at least 60% of the floor area ratio (FAR)/floor space index (FSI) consists of dwelling units with a carpet area of not more than 6 sqm, and 15% of the total project FAR/FSI; or where 35% of the total number of dwelling units (whichever is higher), is reserved for the EWS category.

The state governments can additionally consider concessions and / or exemptions from state charges/taxes for affordable housing projects for EWS / LIG households.

There is now a customary acceptance of the fact that in the current situation, houses costing between Rs. 5 – 15 lakh can be considered affordable for low-income classes³. However, Experts warn that this may work in the second –rung cities, but not in the mega cities of Mumbai and Delhi, where property values have skyrocketed.

Logical approach for optimizing housing solutions:

There should be a logical approach for providing appropriate technology based on the availability of options, considering its technical and economic analysis.

1. There should be optimal space in the design considering efficiency of space, minimum circulation space.
2. Economy should be considered in design of individual buildings, layouts, clusters etc.
3. While preparing the specifications it should be kept in mind that, cost effective construction systems are adopted.
4. Energy efficiency has gained considerable importance due to energy crisis especially in developing countries. Orientation, built-form, openings & materials play a vital role besides landscaping / outdoor environment.
5. To develop an effective mechanism for providing appropriate technology based shelter particularly to the vulnerable group and economically weaker section.

The Low Cost Housing or Housing for Poor cannot have the same conditions featuring in their Environment Clearance as normal or high end buildings / residences. As the provisioning of double plumbing, usage of insulation etc. may not be possible in these buildings.

The suggested conditions are listed in the following pages.





HEALTH AND SOCIO ECONOMIC

- **Minimize Ozone Depleting Substances**

Objective: Eliminate or control the release of ozone-depleting substances into the atmosphere. The ozone depleting materials commonly used in buildings are CFCs or HCFCs in refrigeration and air-conditioning systems, halons in fire suppression systems and extinguishers, and in insulation. Substances containing chlorine (or bromine) contribute to the breakdown of the ozone layer in the stratosphere, resulting in harmful UV radiation reaching earth's surface, and thus contributing to global climate change. Such substances are mainly used in refrigerating and air-conditioning equipment, fire suppression systems and extinguishers, and in insulation. This has been a growing cause for concern.

Therefore, continued efforts are being made globally (in the form of international agreements) to minimize the use of ozone depleting substances, and gradually to replace them with environmentally friendly substances. Trichlorofluoromethane (R11) is used as reference for measuring the ODP (ozone depleting potential) of a substance. The ODP of R11 is Tobacco and smoke control

- **Health and well-being:**

Objective: To put in place health strategies such as prohibiting smoking in the indoor areas/building or providing designated/isolated smoking zones within the building designed with separate ventilation systems with higher ventilation rates than the non-smoking areas. This will ensure zero exposure of the non-smoking occupants to passive smoking. Smoking zone is operated on separate ventilation systems, with higher ventilation rates than the non-smoking areas, and is designed for at least 60 cfm (cubic feet per minute)/person. Smoking zone operates at a negative pressure in comparison with the surrounding non-smoking zone.

- **Mitigation Measures:**

Provide at least the minimum level of accessibility for persons with disabilities.

Objective:

- Ensure accessibility and usability of the facilities in the building by employees, visitors and clients with disabilities.
- Ensure access to facilities and services by adopting appropriate site planning to eliminate barriers as per the recommended standards (NBC 2005 [BIS 2005f]).
- Layout and designing of interior and exterior facilities as per principles of universal design such as prescribed by the National Building Code of India, building management policies and procedures, provision of auxiliary aids & appliances, and staff training in disability awareness.

Energy audit and validation

Objective: Validate the predicted energy consumption, thermal comfort, and visual comfort criteria by an energy auditor approved by the BEE, Government of India.

To ascertain continued safety in the operation of the electrical and mechanical systems of the building through proper maintenance by the owner or the occupants.

This will be ensured in the contract document by providing for the commissioning of all electrical and mechanical systems by the respective supplier or builder. Moreover, the respective facility management group, assigned by the owner or the occupants themselves, will carry out the maintenance facilities.

Environmental education: To promote awareness of significant environmental issues by imparting environmental education to the owner or the occupants of the building and to the community-at-large.

Life Cycle Costing

Objective: To provide comprehensive lifecycle cost analysis of the project, considering the costs arising from owning, operating, maintaining, and others considered important for the project viability.

Environment Management Plan

The Environment Management Plan would consist of all mitigation measures for each item wise activity to be undertaken during the construction, operation and the entire life cycle to minimize adverse environmental impacts as a result of the activities of the project.

It would also delineate the environmental monitoring plan for compliance of various environmental regulations. It will state the steps to be taken in case of emergency such as accidents at the site including fire.





Implementation

INSTITUTIONAL ARRANGEMENTS

The present arrangement provides for State Environment Impact Assessment Authority issuing the Environment Clearances on recommendations of State Expert Appraisal Committee. Both these bodies are recommended by the State and approved by the Ministry. The tenure of the above bodies is three years.

The Project Proponent files compliance report at interval of six months to the SPCB and the Regional Office of MoEFCC, which monitor the compliances. The increasing growth in building and construction sector has led to increase in number of cases filed before the SEAC / SEIAA. This pendency is taking longer time in clearance.

In the above background an institutional arrangement is required to expedite the clearance process without compromising on the rigor of Environment Impact Assessment and EC process.

This will be attained through requesting the States to incorporate the salient features of this guideline and EC conditions in their building bye-laws and make provisions for proper monitoring and enforcement of EC conditions through law. Those States / Urban local bodies, which will incorporate these guidelines into their building bye-laws and make arrangements for monitoring, will be exempt from the requirement of prior Environment Clearance subject to following these sustainable guidelines.

MONITORING

The compliance of the sustainable environmental guidelines conditions will be ensured by the respective State Pollution Control Board while giving 'Consent-to-Operate' and by the Local Urban Bodies and Development Authorities / State Authorities while giving the 'Occupancy Certificate' to the buildings and constructions.

Ministry of Environment, Forests and Climate Change can assess/evaluate/monitor the compliance of conditions enumerated in the Guidelines through verification by Regional Offices or deputed organisations / person.





Implementation

COMMUNICATION DRIVE

Pro-active

Lessening incidences of natural calamities

Ensuring an eco-friendly environment around the lives and surroundings of all living beings

Create synergy with various residents, professionals, & industrial bodies to conduct a structured communication drive for fine-tuning perceptions regarding adoption of these recommendations and to sensitise the communities about its benefits.

These affiliations would also come handy for crosscutting interventions, and to build capacities of all stakeholders in construction and allied activities from the concept to ground-zero implementation.

Awareness Generation Components:

- Guidelines
- Communication Drive to establish Community Connect [including Dedicated Website]
- Capacity Building of all stakeholders

Awareness Generation is to ensure compliance of the following _

Green Certified:

_ Building Materials

- Energy efficient,
- Environment friendly,
- Healthy, bio-degradable,
- Safe, & secure

End-user Friendly:

_ Design

- Architecture loaded with landscaping elements
- Indoors / outdoors scope to grow medicinal, aromatic, remedial herbs, shrubs, flowers, and some fruits & vegetables
- Provisions for Roof-top Vegetation, Green Wall concepts, and
- The 4 Rs of Water Conservation;

Reduce, Recycle, Recharge & Re-use

Capacity-building would have the following components _

Awareness generation

about the Guidelines

Orientation of functionaries / Sensitisation of beneficiaries (end-users) about its significance, and

Skill-development

in the domains required to execute the Guidelines, especially how to build green and sustain greens

Website

dedicated to the Guidelines to kick-start the process of its real-time implementation.





GUIDELINES TO BE FOLLOWED FOR BUILDING AND CONSTRUCTION PROJECTS TO ENSURE SUSTAINABLE ENVIRONMENTAL MANAGEMENT UNDER ENVIRONMENT IMPACT ASSESSMENT NOTIFICATION, 2006

Land, Air, Noise, Water, Energy, Biological, Socio-economic, and Solid & other Waste Management are the main environment facets to be considered in relation to **pre, during & post** building construction, therefore, it is necessary to ascertain the baseline data of these environmental facets.

The project proponent should file the information about description of project as per points described below prior to start of the project. Information pertaining to compliance on other points be filed at six monthly interval to the respective State Pollution Control Board and the Regional Office of the Ministry of Environment, Forests and Climate Change.

The compliance of the following conditions will be ensured by the respective State Pollution Control Board before giving 'Consent-to-Operate' and by the Local State Authorities while giving the 'Occupancy Certificate' to the buildings and constructions. Ministry of Environment, Forests and Climate Change can assess/evaluate/monitor the compliance of conditions enumerated in the Guidelines through verification by Regional Offices or deputed organizations / person.

S. No.	Environmental Parameters	Implementation and monitoring parameters to be included in local by-laws.
a.	Pre-requisites	Brief description of the project 01.Name of the Project, Survey number, Village, Taluka, District, State to be mentioned with Google Earth Image and GPS Co-ordinates of the plot to be submitted. 02.Location & distance from nearby landmark places / services to be mentioned. 03.Total Built-up area (FSI and Non- FSI) should be mentioned with detailed calculations certified by local planning and sanctioning authority. No. of tenements under this proposal 04.Form 1, Form 1A and Consolidated statement as per Environment Notification dated September 14, 2006 to be submitted to local planning and sanctioning authority, Regional Office, MoEFCC and SPCB
b.	Environment Impacts on Project Land	05.The building layout, set-back/side margin, podium, basement ventilation etc. is prepared based on local building bye-laws and is approved by local competent authorities. The Project Proponent shall obtain all necessary clearance/ permission from all relevant agencies including Town Planning Authority before commencing the work. 06.Provisional fire NOC to be obtained from local CFO (Chief Fire Officer) 07. "Consent-to-Establish and Consent-to-Operate" shall be obtained from State Pollution Control Board under Air (Prevention and Control of Pollution) Act, 1981 and Water (Prevention and Control of Pollution) Act, 1974 08.The project proponent shall put in place a credible enforcement mechanism for compliance of energy conservation measures with its allottees, as projected, in perpetuity. This would be monitored by the designated Energy Conservation/ efficiency Authority in the State. 09.Soil and ground water samples will be tested to ascertain that there is no threat to ground water quality by leaching of heavy metals and other toxic contaminants. 10.Top fertile soil to be preserved and to be later used in landscape. 11.The excavation/demolition debris must be disposed off in designated landfill areas or to be used within site for leveling purpose. Under no circumstance, the debris will be disposed in river bed/lakes etc.





S. No.	Environmental Parameters	Implementation and monitoring parameters to be included in local by-laws.
b.	Environment Impacts on Project Land ... contd.	12.Undertaking to be given by project proponent that occupancy will be given only after drainage and water connections are in place. 13.Dust/smoke prevention measures such as wheel washing, water sprinkler; screening, barricading and debris chute must be installed. 14.This should comply with the provisions of eco-sensitive zone regulations, coastal zone regulations, heritage areas (identified in the master plan or issued separately as specific guidelines), water body zones (in such zones, no construction is permitted in the water-spread and buffer belt of 30 m minimum around the FTL [full tank level]), various hazard prone area regulations, and others if the site falls under any such area. 15.The site planning should take into account heat island effect, size and density of the built-up areas cause heat island effect, wherein higher air temperatures are created in the dense urban areas as against the low-rise surrounding built-up areas. The solar access in the morphology of clusters can be understood in terms of utilization of direct (and not reflected or diffused) solar radiation, mainly for day lighting and heat gain. This defines the minimal distances between the buildings and the relations between built-up volume and open spaces. 16.The proportion of open spaces and built-up edges should be designed such that it ensures winter solar access and summer ventilation.
c.	Water	17.Proponent shall obtain permission for ground water withdrawal from State Ground Water Authority. 18.Storm water control and its re-use as per CGWB and BIS standards for various applications. 19.The natural flow of existing storm water channel should not be altered or diverted. 20.Keeping in view the use of large quantities of water in curing, measures for reducing water demand during construction should be followed. Curing water should be sprayed on concrete structures; free flow of water should not be allowed for curing. After liberal curing on the first day, all concrete structures should be painted with curing chemical to save water. Concrete structures should be covered with thick cloth/gunny bags and then water should be sprayed on them. This would avoid water rebound and will ensure sustained and complete curing. Ponds should be made using cement and sand mortar to avoid water flowing away from the flat surface while curing. 21.The developer should ensure groundwater and municipal water meet the water quality norms as prescribed in the Indian Standards for various applications (Indian Standards for drinking [IS 10500-1991], irrigation applications [IS 11624-1986]). 22.The use of potable water during construction should be minimized. 23.Separation of grey and black water should be done by the use of dual plumbing line for separation of grey and black water. 24.Source of water to be identified. 25.Water treatment measures such as filtration, softeners, RO etc should be implemented. 26.Low flow fixtures and sensors to be used to promote water conservation. 27.Water meters to be installed to monitor consumption of water. 28.Water balance table/chart should be prepared. 29.Where feasible piped water from local authority shall be arranged by the PP. In such cases no water treatment plant shall be necessary. In case piped supply is not available, a WTP with capacity of drinking water (15 liters per person per day) & domestic water (75 liters per person per day) requirement must be installed





S. No.	Environmental Parameters	Implementation and monitoring parameters to be included in local by-laws.
d.	Waste Water Treatment	30. Waste Water Treatment: Sewage Treatment Plant (s)- STP(s) of capacity capable of treating 100% waste water shall be installed and ventilation for the same shall be provided as per the NBC norms for STP & pump room and the treated water shall be used for flushing & gardening. The technology of the STPs shall be based on one of the following: 1) ASP – Activated Sludge Process 2) MBBR – Moving Bed Bio Reactor 3) SBR – Sequential Batch Reactor 4) MBR – Membrane Bio Reactor 5) AOP – Advance Oxidation Process 6) Electrolysis Process. 31. Tertiary treatment such as dual media filter, activated carbon filter and ozonization/ chlorination to be provided so that the treated water characteristics are as per Central Pollution Control Board (CPCB) norms. 32. If STP and pump room are installed in basement, adequate ventilation as per NBC air changes norms should be provided. 33. Treated waste water to be recycled for flushing and gardening.
e.	Drainage Pattern	34. Excess treated water disposal plan to be submitted. 35. Total paved area of the site under parking, roads, paths or any other use should not exceed 25% of the site area or net imperviousness of the site not to exceed the imperviousness factor as prescribed by the NBC 2005 (BIS 2005b), whichever is more stringent. 36. The final disposal point for excess treated water discharge will be municipal sewer for areas where sewerage network is present. 37. In areas where sewerage network is absent, the excess treated water can be used for agriculture or can be disposed off as per CPCB rules. 38. A detailed storm water disposal plan shall be designed where the final disposal point for the excess treated water discharge shall be into the municipal storm drain and in case the storm water network is not present, the storm water surface runoff must be disposed off in nearby natural water streams/nallas and detailed design plan approval must be obtained from the competent authority. 39. The final disposal point for storm water will be municipal storm drain for areas where storm water network is present. 40. In areas where storm water network is absent, the storm water surface runoff can be disposed off in nearby natural water streams/ nallas. 41. In the event of the treated water being surplus after using for flushing & gardening, a disposal plan shall be designed where the final disposal point for the excess treated water discharge be municipal sewer and in case the sewerage network is not present, the excess treated water be used for agriculture or disposed off as per CPCB rules wherein a written permission & confirmation must be sought from the competent authority. The possession will be given only after drainage and water connections are in place and/or an NOC is obtained from the competent authority.
f.	Ground Water	42. Hydro-geological survey for ground water analysis shall be submitted. 43. Aquifer capacity and Ground water yield shall be determined. 44. Rain water harvesting plan shall be submitted indicating the number of recharge pits and bores and total rain water to be harvested. A rain water harvesting plan needs to be designed where the recharge bores (minimum one per 3000 sq. mts. of land) shall be provided (depth to be provided as specified by geological survey of India for different regions).





S. No.	Environmental Parameters	Implementation and monitoring parameters to be included in local by-laws.
f.	Ground Water ... contd.	Where possible the storm water drains may be connected to the recharge bores and excess water if any, shall be connected to the lowest point at the site if a natural water course exists or to the city storm water line as convenient. In recreational open spaces, the percolatable area shall be more than or equal to 50% of the recreational open spaces. Further, a minimum area of 30% of the other open to sky spaces shall be left unpaved to facilitate ground water recharge and reduce heat island effect. Note: Grass pavers for parking and driveways will be considered as unpaved. 45. Rain water to be harvested and as a safety precaution, rainwater on-line filters be provided as per NBC norms.
g.	Solid Waste Management	A} During construction phase: 46. Disposal of muck during construction phase should not create any adverse effect on the neighbouring communities and be disposed taking the necessary precautions for general safety and health aspects of people, only in approved sites with the approval of competent authority. 47. Construction spoils, including bituminous material and other hazardous materials, must not be allowed to contaminate watercourses and the dump sites for such material must be secured so that they should not leach into the ground water. 48. Any hazardous waste generated during construction phase, should be disposed-off as per applicable rules and norms with necessary approvals of the State Pollution Control Board. 49. Miscellaneous site debris such as broken tiles etc. shall be used on site for leveling /backfilling purpose. 50. Packaged STP /mobile toilets shall be provided for labour camp. 51. Polymer bags used for cement and gypsum shall be handed over to authorized recyclers. 52. Cardboard boxes and other packaging material will be handed over to authorized recyclers. B} Post construction phase: 53. Organic waste composter (OWC) or Vermiculture pits with a minimum capacity of 0.3 kg /tenement/day must be installed wherein the STP sludge may be used to be converted to manure which could be used at the site for landscaping or handed over to authorized recyclers for which a written tie up must be done with the authorized recyclers. 54. Separate wet and dry bins must be provided at the ground level for facilitating segregation of waste and all non-biodegradable waste and e-waste shall be handed over to authorized recyclers for which a written tie up must be done with the authorized recyclers. 55. STP sludge shall be removed using filter press or centrifuge mechanism. The dried sludge cakes shall be used as manure in landscaping. 56. Minimize waste generation; streamline waste segregation, storage, and disposal; and promote resource recovery from waste. 57. Resource recovery from waste: Employ resource recovery systems for biodegradable waste as per the Solid Waste Management and Handling Rules, 2000 of the MoEFCC. Make arrangements for recycling of waste through local dealers.





S. No.	Environmental Parameters	Implementation and monitoring parameters to be included in local by-laws.
g.	Solid Waste Management ... contd.	58. Dust, smoke & debris prevention measures such as use of covering sheets /tarpaulin on/at under-construction sites and on trucks to prevent dust dispersion. Washing of wheels /tyres when trucks with soil / debris are on road. Barricading & debris chute should be installed at the site during construction. 59. Hazardous Waste Management: Products, such as paints, cleaners, oils, batteries, and pesticides that contain potentially hazardous ingredients require special care when you dispose of them. Improper disposal of household hazardous wastes can include pouring them down the drain, on the ground, into storm sewers, or in some cases putting them out with the trash. The hazardous wastes from construction and demolition activities are centering oil, formwork oil, tar and tar products (bitumen, felt, waterproofing compounds, etc.), wood dust from treated wood, lead containing products, chemical admixtures, sealants, adhesive solvents, Explosives and related products and equipment used in excavation, acrylics, and silica, etc.
h.	Air Quality and Noise Levels.	A} During construction phase: 60. The diesel required for operating DG sets shall be stored in underground tanks and clearance from Chief Controller of Explosives shall be taken, as applicable. 61. Ambient noise levels should conform to residential standards both during day and night as per Noise Pollution (Control and Regulation) Rules, 2000. Incremental pollution loads on the ambient air and noise quality should be closely monitored during construction phase. Adequate measures should be made to reduce ambient air and noise level during construction phase, so as to conform to the stipulated standards by CPCB/ SPCB. 62. Burning of waste to be banned. 63. The construction site DG to be maintained regularly so that the smoke emission and noise levels are as per permissible norms. 64. Regular P.U.C check for all construction machinery coming on site be done. 65. Noise cancellation & insulation devices such as mufflers, barricades etc. shall be provided to avoid noise propagation to neighbouring areas. The provisions of the Air (Prevention and Control of Pollution) Act, 1981 (14 of 1981) and the rules made thereunder shall be complied for control of noise pollution during construction and operation. 66. The site must be made a 'No Smoking Zone'. Smoker's corners at appropriate locations, where no inflammable materials are stored shall be provided. B} Post construction phase: 67. The exhaust pipe of the DG must be at least 6 meters away from the boundary wall and minimum of 10 mts. away from the building or in case it is less than 10 mts. away, the exhaust pipe shall be taken up to 3m above the building. DG to be regularly maintained so that the smoke emission and noise levels are as per permissible norms. 68. Air quality monitoring to be done quarterly. 69. STP and water pumps, air blowers etc should be installed with noise cancellation devices or suitable acoustical enclosures to be given so that the noise levels as per NBC norms are maintained. C} During Construction & Operation 70. The provisions of the Air (Prevention and Control of Pollution) Act, 1981 (14 of 1981) and the rules made thereunder be complied for control of noise pollution during construction and operation.





S. No.	Environmental Parameters	Implementation and monitoring parameters to be included in local by-laws.
h.	Air Quality and Noise Levels. ... contd.	71.Setting up the barriers: National Building Code 2005 suggests that design solutions such as barrier blocks should be used to reduce external LA10 noise levels to at least 60-70 dB (A) at any point 1.0 m from any inward looking façade. Green belts and landscaping could act as an effective means to control noise pollution. In case of railway tracks, a minimum distance of 50m to 70m may be provided between the buildings and the tracks.
i.	Energy	72.Appropriate processes and material be used to encourage reduction in carbon foot print. 73.Use of glass be reduced by up-to 40% to reduce the electricity consumption and load on air-conditioning. If necessary, use high quality double glass with special reflective coating in windows. 74.Power Conservation: All common area lighting must be of LED/Solar lights along with automatic timer switches (that are also designed for manual control) and energy meters must be installed to measure overall energy consumption in the project and 75.Renewable Energy: 1% of the connected load shall be provided by way of Solar/PV power generation on site (roof tops of buildings/other exposed such as parking shades could be utilized for installation of Solar PV systems) or in the alternative 5% of the total connected load may be provided through off site by way of wind or solar farms 76.Solar Access & Ventilation: The proportion of the open spaces & built up edges should be designed such that it ensures winter solar access and summer ventilation and plan copies of the same will be kept by the proponent for audit purposes. 77.Solar water heater of minimum capacity 100 litres/apartment to be installed and detailed design plan along with confirmation has to be obtained from the competent authority and records for the same will be kept by the proponent for audit purposes. In the event wind power/solar power is used through wheeling into the local grid confirmation shall be obtained from the competent authority. 78.Fly ash should be used as building material in the construction as per the provisions of Fly Ash Notification of September, 1999 and amended as on 27th August, 2003 and 3rd November, 2009. 79.Wherever possible recycled materials having low embodied energy is used. 80.Use of light coloured, reflective roofs having an SRI (Solar Reflectance Index) of 50% or more should be promoted. The dark coloured, traditional roofing finishes have SRI varying from 5% to 20%. 81.Optimize use of energy systems in buildings that should maintain a specified indoor environment conducive to the functional requirements of the building by following mandatory compliance measures (for all applicable buildings) as recommended in the Energy Conservation Building Code (ECBC) 2007 of the Bureau of Energy Efficiency, Government of India. The energy systems include air conditioning systems, indoor lighting systems, water heaters, air heaters, and air circulation devices. 82.Use the concept of passive solar design of buildings using architectural design approaches that minimize energy consumption in buildings by integrating conventional energy-efficient devices, such as mechanical and electrical pumps, fans, lighting fixtures, and other equipment, with the passive design elements, such as building orientation, landscaping, efficient building envelope, appropriate fenestration, increased day lighting design, and thermal mass. 83.The building should be oriented optimally based on Sun-path and engineering analysis to curtail excessive solar radiations.





S. No.	Environmental Parameters	Implementation and monitoring parameters to be included in local by-laws.
i.	Energy ... contd.	84. Lighting systems should comply with the ECBC 2007 and applicable to interior spaces of buildings, exterior building features, including facades, illuminated roofs, architectural features, entrances, exits, loading docks, and illuminated canopies, exterior building grounds etc. except emergency lighting and lighting in dwelling units. 85. All the point light sources installed in the building for general lighting shall be LEDs or LEDs or equivalent. All the linear light sources installed in the building for general lighting shall be T-5 or at least 4 Star BEE rated TFLs or equivalent. The installed interior lighting power shall not exceed the LPD (Lighting Power Density) value as recommended by ECBC 2007. 86. Automatic Lighting shutoff control be installed: Interior lighting/Exterior Lighting systems shall be equipped with an automatic control device in accordance with ECBC 2007. Occupancy sensors that shall turn the lighting off within 30 minutes of occupant leaving the space. It should also have option for manual turning on lights when the space is occupied. ECBC requires controls in day lit areas that are capable of reducing the light output from luminaries by at least half and Controlling of exterior lighting with photo-controls where lighting can be turned off after a fixed interval. 87. The tapping of renewable sources of energy for lighting, heating, cooling and ventilation needs, deserve special attention. For captive solar power generation, a minimum of 15 percent of sanctioned load is the requirement. 88. Solar photovoltaic (SPV) systems are direct energy conversion systems that convert solar radiation into electric energy. SPV systems should be installed to reduced use of conventional sources of energy. Roof tops of buildings as well as other exposed areas such as of parking shades should be utilized for installation of SPV systems. 89. Hot water requirement in buildings should be met through use of various types of solar water heating systems, viz. flat plate collector: single glazed double glazed; evacuated tube collectors; and Water heating with solar concentrators. 90. The Project Proponent should ensure regular energy audit. - To validate the predicted energy consumption, thermal comfort, and visual comfort criteria by an energy auditor approved by the BEE, Government of India. - To ascertain continued safety in the operation of the electrical and mechanical systems of the building through proper maintenance by the owner or the occupants. 91. This will be ensured in the contract document by providing for the commissioning of all electrical and mechanical systems by the respective supplier or builder. Moreover, the respective facility management group, assigned by the owner or the occupants themselves, will carry out the maintenance facilities. 92. Energy conservation measures like installation of CFLs/LEDs for the lighting the areas outside the building should be integral part of the project design and should be in place before project commissioning Used CFLs and TFLs should be properly collected and disposed off /sent for recycling as per the prevailing guidelines/ rules of the regulatory authority to avoid mercury contamination. Use of solar panels may be done to the extent possible.
j.	Traffic Movement	93. Traffic Movement System Width of driveways, parking provision, ramp width and slope to be kept as per local by laws.





S. No.	Environmental Parameters	Implementation and monitoring parameters to be included in local by-laws.	
k.	Provisions For Differently-able	94. The Project Proponent should provide at least the minimum level of accessibility for persons with disabilities. • Ensure accessibility and usability of the facilities in the building by employees, visitors and clients with disabilities. • Ensure access to facilities and services by adopting appropriate site planning to eliminate barriers as per the recommended standards (NBC 2005 [BIS 2005f]). • Layout and designing of interior and exterior facilities as per principles of universal design such as prescribed by the National Building Code of India, building management policies and procedures, provision of auxiliary aids & appliances, and staff training in disability awareness.	
i.	Green Belt/Green Cover	95.	Provide minimum 1 tree for every 80 sq.mt of plot area.
		96.	Wherever trees are cut or transplanted, compensatory plantation in the ratio of 1:3 to be done in the premise.
		97.	Native species of trees to be planted.
		98.	Vegetation to provide as shading and promote evaporative cooling. In hot and dry climates, evaporative cooling through appropriately sized wet surfaces or fountains have a desirable effect. It should be planned for maximum benefit.
		99.	The project should have detail proposal for tree plantation, landscaping, creation of water bodies etc along with a layout plan to an appropriate scale.
m.	Disaster/ Risk Assessment Plan	100.	A detailed fire tender movement plan showing the place of assembly, firefighting system, turning radius and public address system as per the Fire Safety Norms/local by-laws (whichever applicable) must be submitted and approved detailed design plans must be kept in records for ready reference.
		101.	Firefighting system to be provided as per the fire NOC.
		102.	Turning radius to be kept as per Fire NoC or as prescribed in the local by-laws.
		103.	Public address system to be installed as per the Fire Safety norms.
		104.	Place of assembly to be indicated.
n.	Socio Economic Impact and CSR	105.	Biodegradable and non-biodegradable waste bins to be provided for every household to promote waste segregation at source.
		106.	Importance of environment and various environment drives to be initiated.
		107.	Importance of maintenance of environment infrastructure to be showcased by issuing pamphlets etc.
		108.	Provision for health care, medical kit, crèche, First-Aid room shall be given during construction phase for the construction workers.
		109.	Adequate shelter for resting hours, crèche, clean and potable drinking water to be provided to construction workers.
		110.	All local labour welfare laws must be complied.
		111.	Concerns of the communities being affected by the Project are to be responded on priority, and all possible CSR is to be rendered to make the responses effectively beneficial..
o.	Environment Management Plan (EMP)	112.	Detailed EMP comprising of estimated capital cost and O&M cost for the following environment infrastructure should be submitted: a. Sewage Treatment Plant b. Landscaping c. Rain Water Harvesting d. Power backup for environment infrastructure. e. Environment Monitoring f. Solid Waste Management g. Solar and Energy Conservation
		113.	Environment Monitoring Cell with defined functions and responsibility shall be set up and its details be submitted.

END NOTE: Industrial Shed*: The word 'industrial shed' implies building (whether RCC or otherwise) which is being used for housing plant and machinery of industrial units and shall include godowns and buildings connected with production related and other associated activities of the unit in the same premise.





[BACK COVER]

ADDRESS OF THE CONCERNED CELL OF THE MINISTRY
COMMUNICATION CHANNELS
PUBLISHER'S TAGLINE & OTHER MANDATORY INFORMATION REGARDING PUBLICATION

