GRIHA FOR EXISTING DAY SCHOOLS

A GRIHA Council Publication

VERSION-2

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Contents

LIST OF TABLES

LIST OF FIGURES

MESSAGE

PRESIDENT, GRIHA COUNCIL

Children are our greatest resource for the future and schools are the facilitators for inculcating knowledge and values in them. Schools, therefore, present a great opportunity for driving change towards sustainability in our communities, sensitizing young minds and presenting models for transformation.

GRIHA for Existing Day Schools is an attempt towards hand-holding students, teachers, and institutions in understanding and adopting sustainability. Moreover, *GRIHA for Existing Day Schools* holds potential for evaluating environmental performance which can help take decisive steps towards improving resource management in school buildings.

This exclusive rating for existing day schools is prudently designed to engage young minds in the 'greening' process. Simplified evaluation tools will help students to assess their school's performance and suggest adequate retrofits towards stimulating resource efficiency in our built environment.

Since its inception, the GRIHA rating has been instrumental in driving India's green building movement. It is our endeavour to facilitate drivers of change at their very inception by making sustainability intrinsic to the formal school curriculum of our country. I hope this GRIHA variant will serve as a valuable learning resource and that educational institutions, specifically day schools, will find it encouraging to adopt this framework for evaluating the efficiency of their buildings.

Ajay Mathur

FOREWORD

CEO, GRIHA COUNCIL

GRIHA for Existing Day Schools was introduced with the intention to instill the concepts of sustainability in the minds of children which are likely to be ingrained in them once they grow and become responsible citizens. Students have the potential to contribute in creating an enabling ecosystem for meeting the challenges of environmental degradation due to the onslaught of development. This is an opportunity to allow children to establish contact with nature and with each other using the approach of co-creation and understanding.

The rating is a dedicated assessment-cum-rating tool to evaluate overall environmental performance and provide pioneering solutions for existing schools to achieve enhanced energy and water efficiencies, increased thermal, visual, and acoustic comfort, improved indoor air quality, and social integration. This tool involves students and teachers throughout the entire rating process and also sensitizes them towards their individual responsibility in the school.

This abridged manual of *GRIHA for Existing Day Schools* has been developed through a consultative process across all stakeholders—ranging from school principals, teachers, research professionals, and other stakeholders—closely associated with schools.

I gratefully acknowledge the efforts invested by all the people associated with the development of this rating and look forward to their continued support to enhance and amplify it.

Sanjay Seth

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The *GRIHA for Existing Day Schools*, Version 2 abridged manual is a self-explanatory guideline created by the GRIHA Council to facilitate the teachers and students in their collaborative efforts to measure the greenness of their building. The manual is a result of the perseverance, efforts, and commitment of the technical team along with the experts who were involved in the formulation and upgradation of the existing rating. The GRIHA Council extends their sincere gratitude to all the experts for taking out time from their respective professional commitments and providing valuable inputs.

We would like to thank Dr Ram Boojh, Mobius Foundation; Mr Sanjay Prakash, Managing Director/Principal Consultant, SHiFT Architects; Mr Kabir Vajpayee, Principal Architect, VINYÃS – Centre for Architectural Research; Mr Gaurav Shorey, Founding Member, 5waraj; Ms Asha Bhattacharya, Assistant Director, Science, National Bal Bhawan; Ms Livleen K Kahlon, Fellow & Associate Director, Environmental Education and Awareness, TERI; Ms Mallika Preman, Principal, Tagore International School; Dr Rashi Bhargava, Assistant Professor, Department of Sociology, Maitreyi College; Ms Susan Thomas, Development Advisor, The Foundation School; Ms Sapna Sukul, Director, Petals World School; Dr B C Sabat, Director, MGICCC; Ms Seema Bali, Vice Principal, St. Mary's School; Dr Praveen Kumar Gupta, Professor, Jagan Institute of Management Studies; Mr Varun Sethi, Assistant Manager-MDP & Ecotourism, TERI, for their productive insights that helped in putting together this manual.

The point weightage of the entire rating system has been developed based on the Analytic Hierarchy Process (AHP), conducted to define thresholds. GRIHA Council would like to thank all the participants for taking out time to fill and submit the survey.

Lastly, we would like to thank Dr Ajay Mathur, President, GRIHA Council, for his leadership without which the development of this rating would not have been possible.

ABBREVIATIONS

AHU:	Air Handling Unit
BEE:	Bureau of Energy Efficiency
BIS:	Bureau of Indian Standards
BMS:	Building management system
CFC:	Chlorofluorocarbons
CO:	Carbon monoxide
CO_2:	Carbon dioxide
CPCB:	Central Pollution Control Board
dB:	Decibel
DG:	Diesel generators
ECBC:	Energy Conservation Building Code
EESL:	Energy Efficiency Services Ltd
FPM:	Fine particulate matter
GHGs:	Greenhouse gases
GoI:	Government of India
GRIHA:	Green Rating for Integrated Habitat Assessment
HCFC:	Hydrochlorofluorocarbons
HT:	High tension
HVAC:	Heating, ventilation, and air conditioning
Hz:	Hertz
IAQ:	Indoor air quality
kg:	Kilo gram
km:	Kilo meter
kWh:	Kilo Watt hours
LEDs:	Light emitting diodes
Lm:	Lumen
LT:	Low tension
MDGs:	Millennium Development Goals
MoEFCC:	Ministry of Environment, Forest and Climate Change
MV:	Mechanical ventilation
MW:	Mega Watt
MWh:	Mega Watt hours
NAAQS:	National Ambient Air Quality Standards
NABL:	National Accreditation Board for Testing and Calibration Laboratories
NBC:	National Building Code of India
O&M:	Operation and maintenance
OWC:	Organic waste composter
PV:	Photovoltaic
RE:	Renewable energy
RH:	Relative humidity
RO:	Reverse osmosis
RSPM:	Respirable particulate matter
RWA:	Resident Welfare Association
STP:	Sewage treatment plant
TWh:	Tera Watt hour
UDI:	Useful daylighting illumiance
UJALA:	Unnat Jyoti by Affordable LEDs for All
UNICEF:	United Nations International Children's Emergency Fund
U.S. EIA:	U.S. Energy Information Administration
VOC:	Volatile organic compound
VRF:	Variable refrigerant flow
W:	Watt
WASH:	Water, sanitation & hygiene
WC:	Water closet

GLOSSARY

Ambient noise: The sound pressure levels associated with a given environment. Ambient noise is usually a composite of sounds from near and far sources, none of which are particularly dominant.[1]

Audible Frequency Range: The range of sound frequencies normally heard by the human ear. The audible range spans from 20 Hz to 20 000 Hz.[2]

Biodegradable substance: A substance that can be degraded by microorganisms into simpler, stable compounds.[3]

Biodegradable waste: Waste which includes organic waste, such as kitchen waste, vegetables, fruits, flowers, leaves from the garden, and paper. [4]

Biogas: Biogas typically refers to a gas produced by the biological breakdown of organic matter in the absence of oxygen. Biogas originates from biogenic material and is a type of biofuel.[5]

Building maintenance: It is the work undertaken to maintain or restore the performance of the building fabric and its services to provide an efficient and acceptable operating environment to its users.

Catchment area: The catchment of a water harvesting system is the surface, which receives rainfall directly and contributes the water to the system. It can be rooftop, courtyard, paved area, lawn and so on.

CO_2 emissions: Polluting carbon substances released into the atmosphere.

Composting: A controlled process involving microbial decomposition of organic matter.[6]

Electronic-type regulator: Electronic regulators are the latest type of regulators available in the market. These are much smaller in size than resistance-type regulators. They use capacitors instead of resistors to decrease the voltage. Capacitors regulate the fan speed by regulating the waveform of power supply. They do not get heated up and thus, save electricity when the fan is running at low speeds. [7]

Equivalent Sound Pressure Level (LAeq): Average A-weighted sound pressure level, using frequency weighting and time weighing averages, determined within defined boundaries.

Evaporative cooling: It is a passive cooling technique suitable for hot climates with low humidity. The cooling of air is achieved by simple evaporation of water in air. In highly humid climates, evaporative cooling may have little thermal comfort benefit beyond the increased ventilation and air movement it provides.[8]

Insulation: Refers to thermal insulation materials, that is, materials used for making a building resistant to heat ingress and egress. A thermal insulator is a poor conductor of heat and has low thermal conductivity. Insulation materials may be divided into organic and non-organic groups (mineral fibres, glass wool, perlites) according to their raw materials. Organic materials can be subdivided into more environment-friendly categories, such as natural materials (cork, cotton, and wool) and less environment-friendly materials, such as synthetic materials (polyurethane rigid foam and polystyrene).[9]

Landfilling: Disposal of residual solid wastes on land in a facility designed with protective measures against pollution of groundwater, surface water and air fugitive dust, wind-blown litter, bad odour, fire hazard, bird menace, pests or rodents, greenhouse gas emissions, slope instability, and erosion.[10]

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1 National Building Code. 2016. Part 8 Building Services, Section 4 Acoustics, Sound Insulation and Noise Control, p. 5. New Delhi: Bureau of Indian Standards.

2 National Building Code. 2016. Part 8 Building Services, Section 4 Acoustics, Sound Insulation and Noise Control, p. 5. New Delhi: Bureau of Indian Standards.

3 National Building Code of India 2016, Part 9, Plumbing Services, p. 5. New Delhi: Bureau of Indian Standards.

4 National Building Code of India 2016, Part 12, p. 5. New Delhi: Bureau of Indian Standards.

5 Ilaboya I R, Asekhame F F, Ezugwu M O, Erameh A A and Omofuma FE. 2010. Studies on Biogas Generation from Agricultural Waste; Analysis of the Effects of Alkaline on Gas Generation. World Applied Sciences Journal 9(5): 537–545. Available at <http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.388.6476&rep=rep1&type=pdf>, last accessed on April 2, 2019.

6 National Building Code of India 2016, Part 9, Plumbing Services, p. 6. New Delhi: Bureau of Indian Standards.

7 Available at <https://www.bijlibachao.com/fans/choose-the-right-regulator-for-ceiling-fan-for-electricity-saving.html>, last accessed on April 2, 2019.

8 National Building Code of India. 2016. Part 11- Approach to Sustainability, p. 64. New Delhi: Bureau of Indian Standards.

9 National Building Code of India. 2016. Part 11- Approach to Sustainability, p. 50. New Delhi: Bureau of Indian Standards.

10 Refer footnote 6

Light-emitting diodes: A light-emitting diode (LED) is a semi-conductor device that emits visible light when an electric current passes through.

Light shelf: A daylighting system based on sun path geometry used to bounce the light off a ceiling, project it deeper into a space, distribute it from above, and diffuse it to produce a uniform light level below.[11]

Low-emissivity glass: A low-emissivity coating is a microscopically thin, virtually invisible, metal or metallic oxide coating deposited on a glazing surface. The coating may be applied to one or more of the glazing surfaces facing an air space in a multiple-pane window. The coating limits radiative heat flow between panes by reflecting heat. In case of air filled panes, the air gap between window panes can be filled with gases which have better thermal resistance property than air, such as argon and krypton.[12]

Lumen (Lm): It is the SI unit of luminous flux. The luminous flux emitted within unit solid angle (one steradian) by a point source having a uniform intensity of one candela.

Luminous efficacy: A measure of how well a light source produces visible light. It is the ratio of luminous flux to power, measured in lumens per watt in the International System of Units (SI).[13]

Maintenance policy: Scope and course of action taken to achieve an organization's objectives.

Mould: Moulds are part of the natural environment. Outdoors, moulds play a part in nature by breaking down dead organic matter, such as fallen leaves and dead trees, but indoors, mould growth should be avoided. Moulds reproduce by means of tiny spores; the spores are invisible to the naked eye and float through outdoor and indoor air. Mould may begin growing indoors when mould spores land on wet surfaces. There are many types of moulds, and none of these will grow without water or moisture.[14]

Municipal Solid Waste: Commercial and residential wastes generated in municipal or notified areas in either solid or semi-solid form, excluding industrial hazardous wastes and construction and demolition waste but including treated bio-medical wastes.[15]

Native plant: A plant indigenous to a particular locale.

Night flushing: Night flushing is the process whereby a building is flushed with cold ambient air for several hours each night by means of a (natural or) mechanical ventilation system. This process lowers the heat stored in the building structure such that the space heat gain may be reduced the following day. [16]

Non-biodegradable waste: Waste which cannot be decomposed by biological processes is called non-biodegradable waste. These are of two types—recyclable and non-recyclable. The former refers to waste having economic values but destined for disposal and can be recovered and reused along with their energy value, such as plastic, paper, old cloth, etc. Non-recyclable waste refers to those which do not have economic value of recovery, such as carbon paper, thermo coal, tetra packs, etc.[17]

Non-motorized transport: Non-motorized transport includes any form of transportation that provides personal or goods mobility by methods other than the combustion motor. For example, walking, cycling, human porterage, handcarts/wheelbarrows, etc.[18]

Particulate matter: The term for a mixture of solid particles and liquid droplets found in the air. Some particles, such as dust, dirt, soot, or smoke, are large or dark enough to be seen with the naked eye. Others are so small that they can only be detected using an electron microscope.[19]

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[11] National Building Code of India. 2005. Part 8 Building Services, Section 1 Lighting And Natural Ventilation, p. 6. New Delhi: Bureau of Indian Standards.

[12] National Building Code of India. 2016. Part 11- Approach to Sustainability, p. 32. New Delhi: Bureau of Indian Standards.

[13] Grum Franc and Becherer Richard. 1979. Optical Radiation Measurements, Vol 1. New York: Academic Press.

[14] U.S. Environmental Protection Agency (EPA). 2012 (reprinted). A Brief Guide to Mold, Moisture, and Your Home, EPA 402-K-02-003. Washington DC: Office of Air and Radiation, Indoor Environments Division, EPA.

[15] Refer footnote 6

[16] Jaco Vorster, R D. 2011. Sustainable cooling alternatives for buildings. Journal of Energy in Southern Africa, 22(4): 49–50.

[17] Bharadwaj, Alok, Yadav, Divyanshu and Varshney, Shreyshi. 2015. Non-Biodegradable Waste – Its Impact and Safe Disposal. International Journal of Advanced Technology in Engineering and Science. 3: 184–191.

[18] Guitink Paul, Holste Susanne, and Lebo Jerry. 1994. Non-Motorized Transport: Confronting Poverty Through Affordable Mobility. Washington DC: Transportation, Water and Urban Development Department, The World Bank. Available at <http://siteresources.worldbank.org/INTURBANTRANSPORT/Resources/T-UT-4.pdf>, last accessed on April 2, 2019.

[19] Available at <https://www.epa.gov/pm-pollution/particulate-matter-pm-basics>, last accessed on April 2, 2019.

Per capita: For each person; in relation to people taken individually.

Plumbing system: The plumbing system shall include the water supply and distribution pipes; plumbing fittings and traps; soil, waste, vent pipes and anti-siphonage pipes; building drains and building sewers, including their respective connections, devices, and appurtenances within the property lines of the premises; and water-treating or water-using equipment.

Rainwater harvesting system: Water harvesting techniques which harvest runoff from roofs or ground surfaces fall under the term 'rainwater harvesting'.[20]

Recycling: The process of transforming segregated solid wastes into raw materials for producing new products, which may or may not be similar to the original products.[21]

Renewable energy: A resource that is available naturally, harnessed, and can be replenished.

Resistance-type regulators: Traditional regulators used in our homes in the past which have resistors to decrease the voltage of the ceiling fan. The resistor heats up while decreasing the voltage and thus the electricity saved by reducing the fan speed is lost as heat in the regulator. The internal heat also damages the regulator in the long run. [22]

Reverberation time: Time required for the sound pressure level to decrease by 60 dB after the sound source has stopped.[23]

Segregation: To separate the municipal solid wastes into the groups of organic, inorganic, recyclables, and hazardous wastes.[24]

Sewage treatment plant: A place where sewage is cleaned from the waste water generated so that it is not harmful or dangerous to the environment.

Sick-building syndrome: The term 'sick building syndrome' (SBS) is used to describe situations in which building occupants experience acute health and comfort effects that appear to be linked to time spent in a building, but no specific illness or cause can be identified. The complaints may be localized in a particular room or zone or may be widespread throughout the building.[25]

Sound: A vibrational disturbance, exciting hearing mechanisms, transmitted in a predictable manner determined by the medium through which it propagates. To be audible, the disturbance shall have to fall within the frequency range of 20 Hz to 20 000 Hz.[26]

Task lighting: Fixed task lighting refers to a non-movable light source dedicated to lighting a specific task.

Ventilation: Supply of outside air into or the removal of inside air from an enclosed space.

Vermi-composting: A process of using earthworms for conversion of biodegradable wastes into compost.[27]

Volatile organic compounds: Volatile organic compounds (VOCs) are emitted as gases from certain solids or liquids. VOCs include a variety of chemicals, some of which may have short- and long-term adverse health effects. Concentrations of many VOCs are consistently higher indoors (up to ten times higher) than outdoors. VOCs are emitted by a wide array of products numbering in the thousands.

Organic chemicals are widely used as ingredients in household products. Paints, varnishes, and wax all contain organic solvents, as do many cleaning, disinfecting, cosmetic, degreasing, and hobby products. Fuels are made up of organic chemicals. All of these products can release organic compounds while usage, and to some degree, when they are stored.[28]

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[20] African Development Bank. Assessment of Best Practises and Experience in Water Harvesting Rainwater Harvesting Handbook. African Development Bank. Available at <https://www.pseau.org/outils/ouvrages/bafd_rainwater_harvesting_handbook.pdf>, last accessed on April 2, 2019.

[21] Refer footnote 6

[22] Available at <https://www.bijlibachao.com/fans/choose-the-right-regulator-for-ceiling-fan-for-electricity-saving.html>, last accessed on April 2, 2019.

[23] National Building Code. 2016. Part 8 Building Services, Section 4 Acoustics, Sound Insulation and Noise Control, p. 6. New Delhi: Bureau of Indian Standards.

[24] Refer footnote 6

[25] Indoor Air Facts No. 4 (revised) Sick building syndrome. Available at <https://www.epa.gov/sites/production/files/2014-08/documents/sick_building_factsheet.pdf>, last accessed on April 2, 2019.

[26] National Building Code. 2016. Part 8 Building Services, Section 4 Acoustics, Sound Insulation and Noise Control, p. 6. New Delhi: Bureau of Indian Standards.

[27] National Building Code of India 2016, Part 9, p. 6. New Delhi: Bureau of Indian Standards.

[28] Available at <https://www.epa.gov/indoor-air-quality-iaq/volatile-organic-compounds-impact-indoor-air-quality>, last accessed on April 2, 2019.

INTRODUCTION

India is considered to be the fastest growing economy in the world. It is the fourth largest emitter of the greenhouse gases, accounting for 5.8% of the global emissions. Between 1990 and 2012, India's greenhouse gas emissions have increased by 67.1% and are projected to grow to 85% by 2030. The above statistics suggest that India is progressing at a rapid pace, although the growth does not seem to be sustainable due to anthropogenic activities as is evident through a variety of worsened climatic indications, such as deteriorating quality of air, increase in urban flooding incidents, changing duration of seasons, etc.

Buildings, to some extent impact the ideology and thinking of its occupants. This is even more valid for schools wherein students spend almost majority their waking hours during their formative years. The values and lessons learnt at school become the foundation for students' outlook in life. Therefore, it is extremely important to ensure that students absorb maximum positive values from their time spent in school. Studies suggest that the children who study in 'sustainable' schools possess higher pro-environmental attitude and more frequently behave environment friendly compared to those in the schools with conventional design. Learning in a conducive environment helps improve the performance of students as well.

The *GRIHA for Existing Day Schools* has been developed as a framework to evaluate and rate the environmental performance of existing schools across India. The rating intends to develop a proactive attitude amongst the students and teachers to reduce their environmental footprint and adopt a greener lifestyle. The evaluation would be done using calculators with pre-fed data and the students and teachers will be working collaboratively to meet the requirements of the rating. The rating intends to imbibe the concept of resource conservation by means of learning through play activities thereby converging towards the national targets.

SCOPE OF THE RATING

Any existing school is eligible to apply for the *GRIHA for Existing Day Schools* rating, provided it complies with the mandatory requirements of the rating.

Each school, registered under the rating, would need to shortlist a team (to be called as 'Eco Team') which shall be working on the project. The team shall comprise of students, various subject teachers (physics, biology, environmental sciences, etc.), facility management officials, administration officials, and any other person deemed suitable for complying with the requirements of the rating criteria. Each section would be the responsibility of one teacher and a student along with a team of students working with them. The entire Eco Team would be headed by a student and teacher representative who should also be a part of the orientation workshop which will be conducted for the school post project registration.

RATING PROCESS

Online registration – The project proponent can initiate the registration process by filling the expression of interest (EoI) form available on the GRIHA website. The registration is complete after the feasibility checklist is successfully completed by the project team. On successful payment of the requisite fees, the project gets registered for *GRIHA for Existing Day Schools* rating.

Orientation workshop – The registration is followed by an orientation workshop conducted by the GRIHA Council which intends to provide detailed information of the rating, all criteria, and to address specific queries of the project team.

Collection of building data and filling survey forms and calculators – Eco Team, under the guidance of teachers, will collect the various building-related data and use the survey form and calculators to analyse their school's environmental performance.

Interim site visit (optional) – The project team can choose for an interim site visit to be conducted by GRIHA Council officials by paying additional charges. The interim visit helps the team to collate the data required and clarify any specific doubts at the site.

First submission of documents – The project team will then compile and submit documents according to the criteria.

Final site visit – Once the data is collected, forms and calculators are filled and submitted. The GRIHA Council officials will conduct a final site visit to verify the submitted documentation with the on-site implementation and also to verify compliance with various criteria in the rating.

Final submission of documents – After the GRIHA Council officials' visit on the site, the project team will submit the second set of documents for review based on the comments made during the first site visit.

Final review by GRIHA Council – The GRIHA Council shall evaluate the submitted documentation.

Award of rating – Final rating will be awarded based on the documentation submitted and observations made during site visit/s .

CRITERIA AND THEIR WEIGHTAGES

The *GRIHA for Existing Day Schools* rating is a performance-oriented where points are earned for meeting the intent (appraisals) of the criteria. Each criterion has a certain number of points assigned to it. Compliance, as specified in the relevant criterion, have to be submitted in the prescribed format. While the intent of some of the criteria is self-validating in nature, there are others, such as energy consumption, thermal and visual comfort, noise control, and indoor pollution levels, which need to be validated on site through performance monitoring. The points related to these criteria (specified under the relevant sections) are awarded after on site verification and also on the basis of documents and/or photographs to support the claims.

The *GRIHA for Existing Day Schools* rating is a 50-point system consisting of 16 criteria categorized under the following six sections—Energy Management; Occupant Health and Comfort; Air Quality; Water Management; Solid Waste Management; Well-being and Social Aspects and Bonus section. 8 of these 16 criteria have mandatory clauses while the rest are optional. It means that a project fulfilling the criterion requirement would qualify for the corresponding point/s. Also, if the project is not complying with the mandatory clauses, the project would be denied the rating. Different levels of certification (one star to five stars) are awarded based on the number of points achieved. The minimum percentile required for certification is 25.

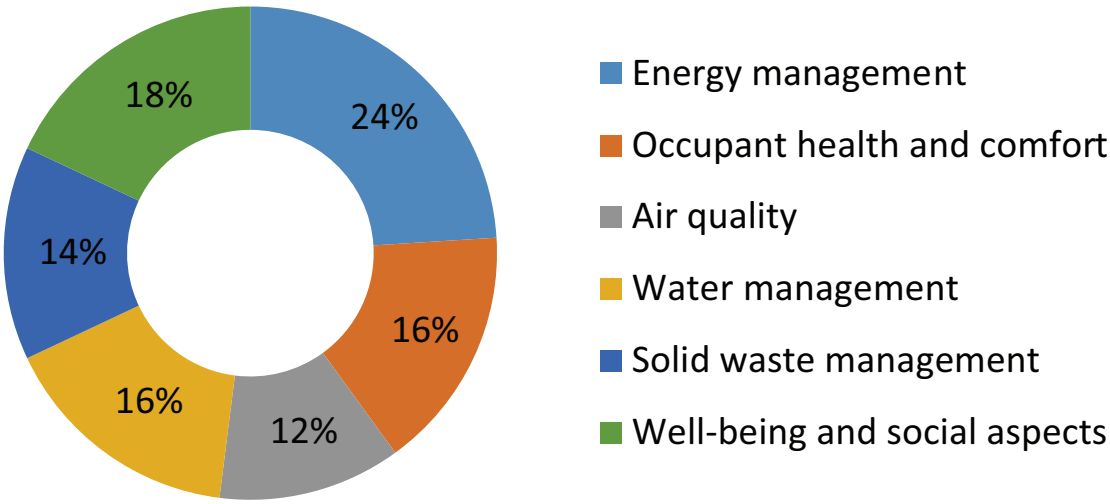
Percentile threshold	Achievable Stars as per GRIHA for Existing Day Schools
25–30	★
31–35	★ ★
36–40	★ ★ ★
41–45	★ ★ ★ ★
46 and above	★ ★ ★ ★ ★

ELIGIBILITY

All day schools (excluding hostel/ residential facilities) which have been operational for at least 1 year are eligible for certification under GRIHA for Existing Day Schools rating.

SECTION	LIST OF CRITERIA	MAXIMUM POINTS
ENERGY MANAGEMENT (12 Points)	Criterion 1 – Per capita CO_2 emissions – building and transport	4
	Criterion 2 – Operation and maintenance	3
	Criterion 3 – Efficient outdoor lighting	2
	Criterion 4 – Onsite renewable energy usage	3
OCCUPANT HEALTH AND COMFORT (8 Points)	Criterion 5 – Visual comfort	3
	Criterion 6 – Thermal comfort	3
	Criterion 7 – Acoustic comfort	2
AIR QUALITY (6 Points)	Criterion 8 – Indoor air quality	2
	Criterion 9 –Number of trees	4
WATER MANAGEMENT (8 Points)	Criterion 10 – Optimizing annual water consumption	5
	Criterion 11 – Rainwater harvesting	3
SOLID WASTE MANAGEMENT (7 Points)	Criterion 12 – Waste segregation	4
	Criterion 13 – Recycling organic and inorganic waste	3
WELL-BEING AND SOCIAL ASPECTS (9 Points)	Criterion 14 – Health and hygiene	3
	Criterion 15 – Social initiatives	6
BONUS (2 Points)	Criterion 16 – Bonus	2
Total points		**50 + 2 (bonus)**

Criteria and their weightages



ENERGY MANAGEMENT

ENERGY MANAGEMENT

SECTION 1

With the limited energy resources at India's disposal, it has become imperative to be increasingly energy efficient and re-engineer both new as well as existing buildings. Amongst all the public buildings (constructed for educational purposes), schools are known for having the major social responsibility in terms of imparting knowledge not only in academics but also in sustainability. Therefore, the energy performance of these buildings is crucial.

School buildings are an example of public buildings with public ownership and hence, have ample opportunity towards becoming energy efficient but within a limited budget. The limit on the annual budget of the schools arises mainly due to the energy cost which in turn affects the overall running cost of the schools.

This section focusses on managing the overall energy consumption by the schools by assessing the carbon dioxide (CO_2) emissions in building and transportation thereby arriving at the per capita CO_2 emissions value for the students. It also aids the schools to have in place all the operation and maintenance protocols thus, ensuring cost savings in the long run. Outdoor lighting is also targeted to be made efficient to reduce the energy consumption. Finally, the section also promotes the installation of renewable energy-based power systems on site to harness green power.

Besides making the school energy efficient, students will get excellent opportunities for practical learning and real-life applications while working on the various criteria under this section. Students can undertake and/or monitor actions taken and thus learn this important aspect of sustainability.

This section contains 4 criteria as mentioned in Table1.

Table 1: Energy management section criteria

CRITERION NO.	CRITERION NAME	POINTS
Criterion 1	Per capita CO_2 emissions – building and transport	4
Criterion 2	Operation and maintenance	3
Criterion 3	Efficient outdoor lighting	2
Criterion 4	Onsite renewable energy usage	3

Activity Time

To educate the students about calculating the actual electricity requirement of their respective classrooms and thus arrive at the values, such as the number of units consumed per day, per month, and annually. The intent here is to instigate a conscientious thought process around energy conservation in tandem with GRIHA's motto –'What gets measured, gets managed'.

CRITERION 1 – PER CAPITA CO_2 EMISSIONS – BUILDING AND TRANSPORT

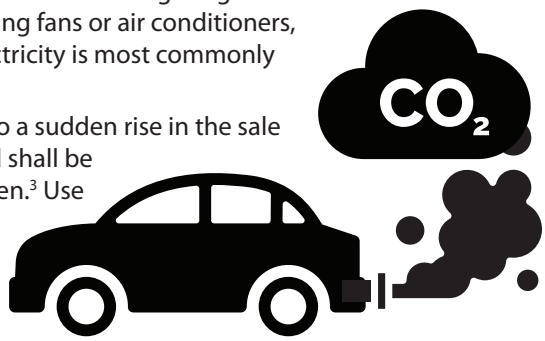
INTENT

Enable students to assess the amount of energy invested in the buildings and in vehicular transport and thereby calculate the school's CO_2 emissions in both the sectors.

Introduction

In India, the sectors that have shown significant growth in the greenhouse gas (GHG) emissions are cement production (6.0%), electricity generation (5.6%), and transport (4.5%).[1] Further, our nation is committed to reduce its carbon emissions by 30%-35% by the year 2030.[2] As a step towards this target, determining carbon emissions in the schools is crucial. Two key sectors have been identified in the context of schools – buildings and transport.

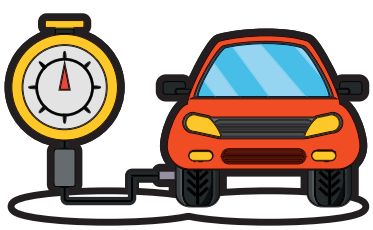
In a school building, electricity is used for several purposes ranging from artificial lighting – indoor and outdoor, space ventilation and conditioning – use of ceiling fans or air conditioners, refrigeration, heating water, cooking, office equipment, etc. This electricity is most commonly sourced from polluting sources such as coal and diesel generators.

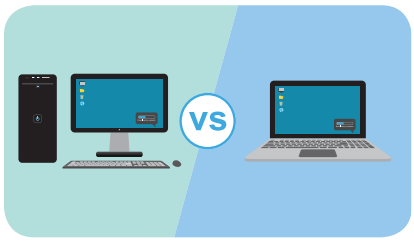


It is well known that vehicular emissions are increasing rapidly due to a sudden rise in the sale of number of vehicles. This implies that the number of cars on a road shall be exponentially high by the next decade if corrective steps are not taken.[3] Use of motorized transport leads to increased pollution as compared to cycles, bikes, rickshaws, etc. Therefore, the school can reduce their emissions by encouraging use of public transportation and school buses, instead of use of private vehicles.

Things to do

- Keep your air conditioning systems on a moderate setting while you are in the room since running your AC at 27°C versus 18°C can cut your electricity bill by over 30%.[4]
- Keep the tyres of vehicles well inflated.
- Travel by public transportation (e.g. buses, trains, metros, etc.) or simply choose to walk or cycle.
- Use the stairs as often as possible and avoid elevators.
- Regular maintenance of appliances, equipments, and vehicles will keep their efficiencies high.
- Switch off or unplug the appliances when not in use. Put stickers near switches to remind everyone to turn off all the appliances at the end of class.
- Buy a laptop instead of desktop as it consumes less electricity. If you buy a desktop, go for a LED screen.





[1] Ministry of Environment and Forests, Government of India, Indian Network for Climate Change Assessment (INCCA, New Delhi: Print Press, May 2010.

[2] Government of India, India's Intended Nationally Determined Contributions. New Delhi: Government of India, 2015.

[3] Refer footnote 1

[4] Available at, https://www.livemint.com/Money/VOUrj7s47bJreraISlca0J/Running-your-AC-at-27C-vs-18C-can-cut-your-electricity-bil.html, last accessed on 4 April, 2019

Green Facts

About 7%-10% of units of electricity that we consume throughout a month are wasted due to keeping the appliances in the standby mode.[5] It is hence, advisable that all the appliances should be switched off when not in use.

- **Every liter of petrol saved keeps 2.5 kg of carbon dioxide out of the atmosphere.[6]**
- **A computer turned off uses at least 65% less energy than a computer left on or kept idle on a screen saver mode.[7]**
- **Around 90% of the electricity used by an incandescent bulb is wasted in the form of heat.[8]**

1.1 Appraisal

1.1.1 Calculate the building, transport and per capita carbon footprint according to CO_2 emissions calculator.

- 4 Points

1.2 Methodology

The per capita carbon emissions in *GRIHA for Existing Day Schools* rating are calculated using the four simple steps mentioned below:

Step 1: CO_2 emissions in Building (B):

B = Energy derived from a source (kWh/annum) X CO_2 emission factor of that source (tonnes/MWh)

» *(Note: In case of renewable energy, CO_2 emissions are assumed to be 0)*

Step 2: CO_2 emissions in Transport (T):

T = Total distance (km) X CO_2 emissions for specified mode of transport (tonnes/km)

» *(Note: In case of cycling or any other Non-Motorised Transport, CO_2 emissions are assumed as 0)*

Step 3: Total strength of the school (P):

Total strength of the school = P = Total students+ Teachers+ School's non-teaching staff.

Step 4: Calculating per capita CO_2 emissions:

Per Capita CO_2 emissions = (B+T)/P

1.3 Compliance

1.3.1 Perform calculations and submit duly filled energy calculator to demonstrate compliance.

1.3.2 Submit duly signed document listing the population of the school – students (fixed) and the teaching and non-teaching staff.

1.3.3 Submit previous year's energy consumption data from all major sources, such as utility, diesel, and RE generation data in the form of bills.

1.3.4 Submit duly filled transportation survey formas shared in the energy calculator.

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5 Available at, https://www.bijlibachao.com/general-tips/switch-off-plug-point.html, last accessed on 4 April, 2019

6 Available at, http://pcra.org/pcra_adm/writereaddata/upload/files/fuel%20efficicncy.pdf, last accessed on 4 April, 2019

7 Available at, https://www.energystar.gov/ia/partners/prod_development/revisions/downloads/computer/ReducingPCPowerConsumption.pdf, last accessed on 4 April, 2019

8 Available at, http://large.stanford.edu/courses/2016/ph240/bonanni2/docs/LightingEfficiency.pdf, last accessed on 4 April, 2019

CRITERION 2 – OPERATION AND MAINTENANCE

INTENT

To ensure that good practices are followed in operation and maintenance (O&M) of the building and use of energy efficient appliances is promoted. It also focusses on the need of basic metering of water and energy being consumed by the school.

Introduction

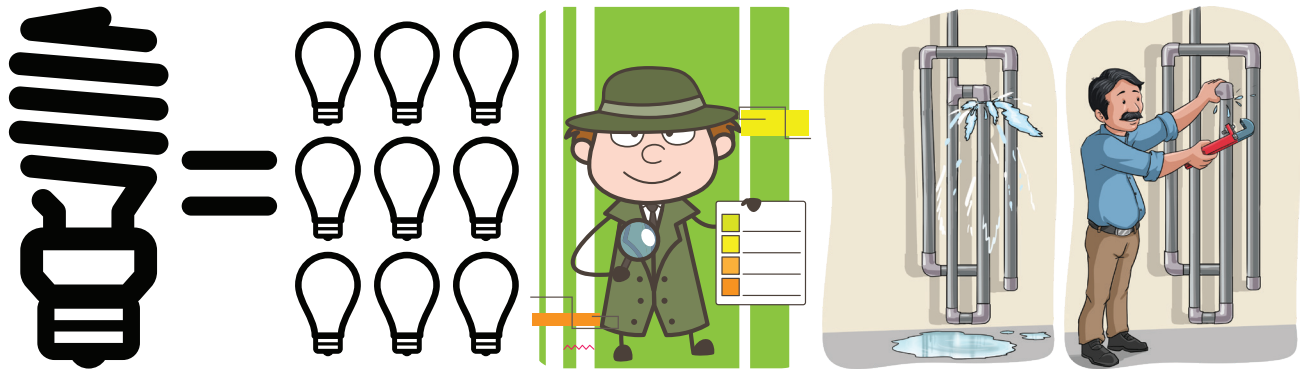
Typically, in an existing building, the operation and maintenance expenses often reach three times as that of the initial construction costs.[9] This cost can certainly be brought down by considering improved practices that take advantage of potential energy savings by identifying the O&M practices to be routinely performed for the upkeep of several building systems like electrical, heating, ventilation, and air conditioning (HVAC), plumbing, water treatment, renewable energy, etc.

The government through various plans and policies has been promoting the use of LEDs for efficient lighting and Bureau of Energy Efficiency (BEE) star labelled appliances for energy conservation over a decade now. This can help the schools to marginally bring down their energy consumption.

With modernization of the nation's electric infrastructure, metering technologies have gained increasing importance. The schools should not only take up the basic metering practices because of government implications but also as a step towards measuring and managing their actual energy and water consumption.

Things to do

- Replace incandescent bulbs and old lighting fixtures with energy-efficient lighting fixtures.
- Replace old energy-intensive air conditioners with BEE star labelled energy-efficient air conditioning systems.
- Make a habit to study and monitor your energy bills regularly.
- A lecture can be arranged from the O&M team of the school for the students for better understanding of various maintenance practices.
- Share your knowledge on the importance of energy efficiency among friends and family.



[9] Available at, https://www.wbdg.org/resources/design-for-maintainability, last accessed on 4 April, 2019

Green Facts

- **The UJALA scheme launched by Energy Efficiency Services Ltd. (EESL) aims to distribute 77 crore LEDs by March 2019 across 100 cities. The scheme will make an enormous impact by securing: annual energy savings of 10,000 crore kWh, 79 crore tonnes of reduction in CO_2 emissions per year, and avoid capacity generation of nearly 20,000 MW.[10]**
- **The US EIA's International Energy Outlook, 2017 projects that among all regions of the world, the fastest growth in energy consumption in buildings through 2040 will occur in India. Energy consumption for residential and commercial buildings in India is expected to increase by an average of 2.7% per year between 2015 and 2040, more than twice the global average increase.[11]**

2.1 Appraisals

2.1.1 Ensure that maintenance protocols exist and that they are followed for (whichever applicable) electrical, HVAC, plumbing, renewable energy (RE), rain water harvesting systems, for civil repair works, and so on. - Mandatory

2.1.2 Ensure that the refrigerant used in refrigerating equipment and the HVAC systems must be chlorofluorocarbon (CFC) free OR ensure that there is a phase out plan for CFC using equipment/ systems. - Mandatory

2.1.3 Ensure that the fire fighting systems must be halon free. - Mandatory

2.1.4 Maintain and follow a policy of purchasing appliances with at least 3-star BEE rating. **- 1 Point**

2.1.5 Demonstrate compliance with basic metering requirements as mentioned in Table 2. **- 2 Points**

Table 2: Basic metering requirements

Energy metering requirement - 1 Point	Water metering requirement - 1 Point
Ensure regular monitoring of school's energy consumption by installing digital meters at the following point sources: • Utility grid • Onsite renewable energy system • Diesel generators, gas generators, and so on.	Ensure regular monitoring of school's water consumption by installing digital meters at the following point sources: • Municipal supply • Bore well • Tanker water • STP outlet **Additionally, the quality of water used for various purposes shall conform to relevant national standards (Bureau of Indian Standards [BIS] or Central Pollution Control Board [CPCB]). Water quality should be tested at least quarterly. - Mandatory**

[10] Available at, https://www.eeslindia.org/content/raj/eesl/en/Programmes/UJALA/About-UJALA.html, last accessed on 4 April, 2019

[11] Available at, https://www.eia.gov/outlook/ieo/pdf/0484(2017).pdf, last accessed on 4 April, 2019

2.2 Compliance

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

2.2.2 Submit maintenance and safety protocols followed by the facility management team covering the following systems (whichever applicable):

- Electrical system: transformer, DG, HT and LT panels, and motors
- HVAC system: AHU, cooling tower, chillers and pumps, VRF, and ventilation fans
- Plumbing systems
- Renewable energy systems
- Sewage treatment plant and/or waste treatment plants
- Storm water drainage and rainwater harvesting systems
- All energy and water meters installed in the school
- Fire alarm and/or smoke detectors

2.2.3 Submit records and schedules of maintenance activity undertaken for all these systems in the last three months.

2.2.4 Submit specification sheets for the following (whenever applicable):

- HVAC and other cooling equipment in the building that are CFC free.
- Nameplate data of fire fighting systems that are halon free.

2.2.5 Submit a phase out plan for CFCs and HCFCs using equipment in the school fire fighting systems using halon, if such equipment is currently used.

2.2.6 Submit verified purchasing policy documents/contracts incorporating provisions of procurement of BEE 3 star labelled appliances.

2.2.7 Submit date stamped photographs of various types of meters installed in the school.

2.2.8 Submit latest water quality testing report of all applicable water sources, conducted by an National Accreditation Board for Testing and Calibration Laboratories (NABL) -accredited laboratory or by any other government-approved laboratory.

CRITERION 3 – EFFICIENT OUTDOOR LIGHTING

INTENT

To ensure that the effectiveness of outdoor lighting is increased by the use of efficient lighting fixtures and suitable technologies.

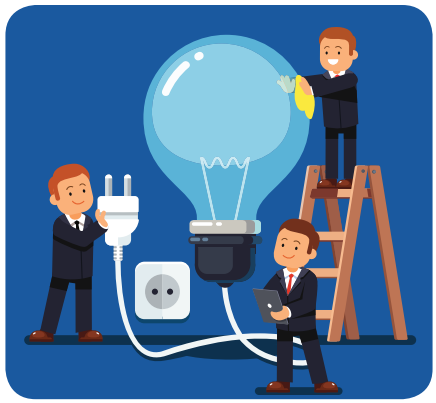
Introduction

Provision of outdoor lighting is primarily done to ensure safety. However, it is also seen that outdoor lighting is used to make the building more visible and enhance their aesthetic value. In day schools, the students are not going to benefit from outdoor lighting academically however; it is required to ensure security during the night time. Hence, it is logical to increase its energy efficiency and in turn pay reduced energy costs.

Most often, it is seen that outdoor lighting does not provide adequate luminance whilst consuming large amounts of energy. This occurs due to inadequacy in maintenance, inefficient lighting fixtures, and use of obsolete lighting technologies. There are numerous energy-efficient lighting fixtures and technologies available in the market with low payback periods.

Things to do

- Conduct a walkthrough audit and look for unused lighting lamps and remove them as they are redundant.
- Ensure that all the lamps are cleaned and dust is not settled on them, as that may have an impact on the lighting output.
- Install automatic controls for outdoor lighting.



Green Facts

- **Based on the report published by Lawrence Berkeley National Laboratory, it is estimated that the gross energy consumption for public lighting will be increased to 13.2 TWh in the year 2020 in India.[12]**
- **Energy costs can reduce up to 30%-50% with automatic energy control.[13]**

[12] Johnson, A., Phadke, A., & Can, S. (2014). Energy Savings Potential for Street Lighting in India, Berkeley: Ernest Orlando Lawrence Berkeley National Laboratory.

[13] US Department of Energy.Exterior Lighting Control Guidance.Tennessee : US Department of Energy, August 2013

3.1 Appraisals

3.1.1 Ensure that all outdoor lamps would comply with the GRIHA luminous efficacy threshold of 75 lumen/watt. **- 1 Point**

3.1.2 Demonstrate that all outdoor lights are controlled through automatic controls. **- 1 Point**

3.2 Methodology

To ensure that the outdoor lighting fixtures are efficient, their luminous efficacy value should be more than the GRIHA threshold of 75 lumen/watt.

The luminous efficacy can be calculated as per the formula mentioned below:

Luminous Efficacy = Lumen output of lamp (Lm) /connected load of the lamp (W)

(Note: Both these values shall be provided in the specification sheet of the lamp)

For example –

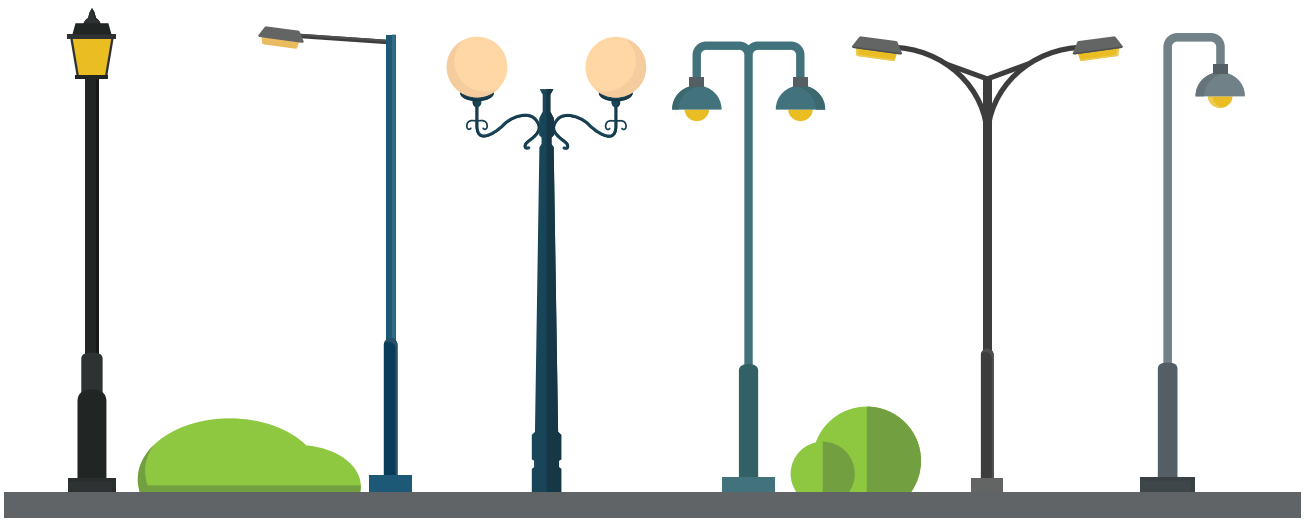
If an outdoor lighting fixture has luminous flux is 3000 lm and consumes 25 W power,

Luminous efficacy = 3000/25 = 120 Lm/W (which is greater than 75 Lm/W)

3.3 Compliance

3.3.1 Submit duly filled energy calculator for all outdoor lamps with their respective efficacy calculations.

3.3.2 Submit date stamped site photographs demonstrating installation of automatic controls for outdoor lighting.



CRITERION 4 – ONSITE RENEWABLE ENERGY USAGE

INTENT

To promote the use of renewable energy technologies and enable green energy generation on site.

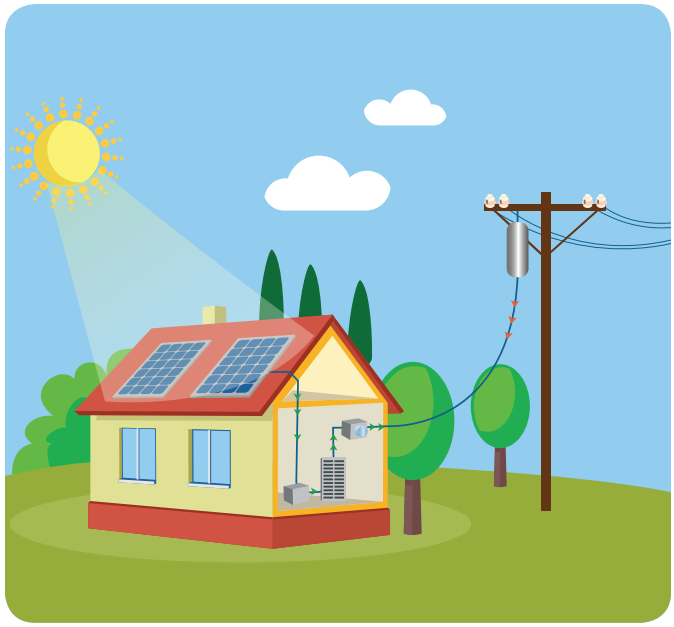
Introduction

Renewable energy is any natural resource that can replenish itself very fast and is inexhaustible. They are abundant, sustainable, environmentally-friendly, and accessible to all which makes them better sources of fuel as compared to other fossil fuels, such as coal and oil, which will eventually deplete and are polluting in nature.

Renewable energy systems have witnessed great inclination and popularity across the world due to their widespread market and growing economics. At least 30 nations around the world have already renewable energy contributed more than 20% to their respective energy supply.[14] Various sources to derive green power are wind energy, solar energy, geothermal energy, bio energy, hydro energy, etc.

Things to do

- Read more about the renewable energy sources and make small models or projects to understand them/their working better.
- Organize lecture series for the students so that, they can see and learn about renewable energy technologies from the experts.
- Conduct a small audit to see if any renewable energy technology (like solar) can be used to save money for water heating, lighting or to provide back-up electricity for computers and other critical services.



[14] Available at, http://www.ren21.net/wp-content/uploads/2017/10/GFR-Full-Report-2017_webversion_3.pdf, last accessed on 4 April, 2019

Green Facts

- Portugal in 2016, made a record to become entirely reliant on renewable energy sources after running for 107 hours without using any fossil fuels.[15]
- China in 2017, built 2 wind turbines every hour.[16]
- Siemens built the first ever commercial offshore wind turbine 30 years ago. Its blades were 5 m long, producing just 30 kilowatts of power. The latest model has 75 metre blades, producing 6 megawatts (25,000 times as much) – enough to power 6,000 homes.[17]
- A household rooftop solar panel system can reduce pollution by 100 tonnes of carbon dioxide in its lifetime — and this includes the energy to manufacture the solar panels.[18] Solar panels can improve future air quality for humans as well as the millions of birds, fish, and mammals that are negatively affected by pollution each year.

4.1 Appraisal

4.1.1 Ensure that the rated capacity of renewable energy system (Solar PV/Solar hot water[19] system/Biomass/Geothermal/Wind turbine) installed on site confirms to installation @ 1kWp per 500 m^2 of the total built up area thresholds as mentioned in Table 3:

Table 3: Point thresholds for total calculated installation

Percentage of total calculated installation @ 1kWp per 500 m^2 (on site only)	Points
At least 25%	**Mandatory**
At least 50%	1
More than 50%	3

4.2 Methodology

As per this criterion, the onsite installation should be in conformity with the GRIHA threshold of @ **1kWp per 500 m^2.**

For example -

If the built up area of the project is 5000 sq. m, then as per the GRIHA threshold, installation capacity of the renewable energy plant will be = 5000/500 = 10 kWp

Hence, to demonstrate compliance with mandatory requirement plant capacity of 25% of 10 kWp must be installed = **2.5 kWp**

Further, to achieve 1 point plant of capacity, 5 kWp should be installed (i.e. 50%), on site.

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[15] Available at, https://www.independent.co.uk/news/world/europe/portugal-runs-entirely-on-renewable-energy-for-four-consecutive-days-a7035561.html, last accessed on 4 April, 2019

[16] Available at, http://large.stanford.edu/courses/2017/ph240/chang-d2/, last accessed on 4 April, 2019

[17] Available at, https://www.siemensgamesa.com/en-int/newsroom/2019/01/new-siemens-gamesa-10-mw-offshore-wind-turbine-sg-10-0-193-dd, last accessed on 4 April, 2019

[18] Available at, https://www.nrel.gov/docs/fy04osti/35489.pdf, last accessed on 4 April, 2019

[19] 100 LPD solar hot water system will be equivalent to 1.5 kWp.

4.3 Compliance

4.3.1 Submit purchase orders of the renewable energy system installed along with technical specification sheet highlighting the performance of the applicable technology (as tested under standard test conditions).

4.3.3 Submit photographs clearly showing the installation of renewable energy systems on site.

4.3.3 If the renewable energy system is proposed to be installed, then submit the feasibility report.

OCCUPANT HEALTH AND COMFORT

OCCUPANT HEALTH AND COMFORT

SECTION 2

Schools are a complex building typology comprising several space functions, such as classrooms, labs, auditoriums, assembly halls, sport facilities, etc. Each of the space types include varied lighting and thermal and acoustic comfort requirements which need to be maintained to ensure proper functioning as well as adequate comfort levels for all the occupants. Adequate comfort conditions in the school environment not only ensure better performance levels by the students and staff alike but also help in the prevention of long-term disorders and diseases.

Since students spend a major part of their day in the school premises, it is imperative to provide them with a healthy, clean, and a thermally comfortable learning environment. Moreover, day schools have a great potential for harnessing daylighting which is important for the human body to produce certain essential hormones and vitamins. If properly addressed, daylight harnessing can also lead to substantial energy savings in the building.

In addition, with the increasing onset of sick-building syndrome, maintaining the prescribed temperature, humidity, and acoustic levels in regularly occupied spaces is quintessential for the prevention of diseases and improved student and staff performance.

This section focusses on examining compliance with the several standards governing comfort conditions ranging from visual, thermal and acoustic levels as per Indian climatic conditions and suggesting strategies for improving the comfort levels to ensure optimum indoor environmental quality.

Students acquire hands-on experience of learning tools to measure daylighting in their classrooms and understand the different comfort parameters within their space. This section also sensitizes young minds about the demerits of studying in a visually, thermally, acoustically uncomfortable environment and helps them learn strategies for improved comfort and the subsequent energy savings.

As is visible in Table 4, this section contains 3 criteria.

Table 4: Occupant health and comfort section criteria

CRITERION NO.	CRITERION NAME	POINTS
Criterion 5	Visual comfort	3
Criterion 6	Thermal comfort	3
Criterion 7	Acoustic comfort	2

Activity Time

To sensitize students on the varying climatic conditions across India and the challenges associated with providing comfort in the respective climatic conditions, exercises will be conducted to identify different climate zones and respective strategies for enhancing occupant comfort for each of them.

CRITERION 5 – VISUAL COMFORT

INTENT

To ensure that the classrooms are well lit with adequate lighting levels thus ascertaining a visually comfortable environment for the occupants. Measures should be taken to maximize daylight harnessing and minimize eye strains and headaches.

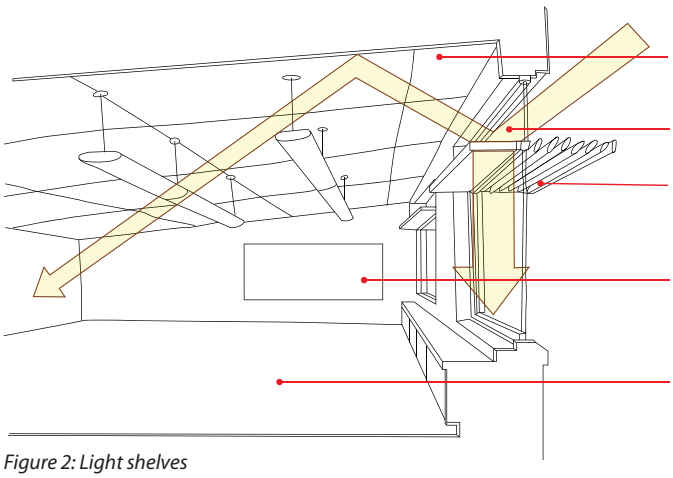
Introduction

Light plays a significant role in creating a pleasant environment for occupants in a building. 'Visual comfort' in a built space is attained when the quality, quantity, and distribution of lighting is appropriate for carrying out specific activities. 'Visual comfort' is a prerequisite in school buildings as it is a learning environment and has an impact on the productivity of students. Research has shown that appropriate lighting and student's performances are co-related*. In the 1960s, school buildings were designed to harness natural daylight through use of courtyards, light shelves, roof openings, etc., with a strong connection with the outdoor environment. However, with the advent of electricity, schools started depending on electrical sources and compromising on appropriate lighting design strategies specific to the climate. In buildings, good lighting is defined by various parameters ranging from location and sizes of windows, external shading devices, orientation of the windows, types of lighting used, the age of lamps, maintenance, etc. The synergies amongst passive design, artificial lighting, and energy efficient lighting are to be identified for good lighting design.

Things to do

1 Promote daylighting:

- Install light shelves within existing windows for daylight penetration in the classrooms.
- Use light colour finishes on walls and reflective paint on ceilings and other surfaces as they brighten up the room. Avoid using dark colours.
- Install operable shading devices to cut glare (especially on the south and west facades).
- Plant deciduous trees along windows to avoid glare and enhance diffused lighting in summers and allow the winter sun to penetrate the interiors.



» *Figure 2: Light shelves*

* R.W.Philips. *Educational Facility Age and the Academic Achievement and Attendence of Upper Elementary School Students* & 1: 1sr Edu, University of Georgia, 1997; pp178

2 Optimize lighting fixtures :

- Install task lighting for detailed tasks (e.g. lab work) and to reduce eye strain.
- Replace all flickering lamps, dim lamps, warm-coloured lamps with more efficient ones.
- Lighting fixtures should be cleaned regularly to minimize dim lighting.
- The colour of the lamp (e.g. warm or cool) and exact positioning (e.g. centre of ceiling/walls) with respect to the students is to be well thought over.
- Consider the function of each room and install/replace fixtures accordingly to meet the required lux levels.

- **Students with the most daylighting in their classrooms progressed 20% faster in maths and 26% in reading in one year than those with the least.[1]**
- **In a study of 90 Swedish elementary school students, over the course of a year, in four classrooms with varying daylighting levels results indicates work(ing) in classrooms without daylight may upset the basic hormone pattern, and this in turn may influence the children's ability to concentrate or cooperate, and also eventually have an impact on the annual body growth and absenteeism.[2]**

5.1 Appraisals

5.1.1	**Ensure that the total daylighted area (as defined in 5.2.1) is ≥ 25% of the living area.[3]**	**- Mandatory**
5.1.2	Ensure that the total daylighted area (as defined in 5.2.1) is ≥ 50% of the living area.	**- 1 Point**
5.1.3	Demonstrate that over 50% of living area meets NBC - 2016 recommended lux levels.	**- 1 Point**
5.1.4	Demonstrate that over 75% of living area meets NBC - 2016 recommended lux levels.	**- 2 Points**

[1] Heschong Mahone Group, "Daylighting in Schools,î Pacific Gas and Electric Company on behalf of the California Board for Energy Efficiency Third Party Program, August 1999

[2] Kuller, R. and C. Lindsten, "Health and Behavior of Children in Classrooms with and without Windows,î Journal of Environmental Psychology, 12, pp. 305-317, 1992

[3] Living area is defined as the functional area or full-time occupied area of the building that needs daylight for various activities. Total built-up area of the building is not equal to the total living area. The percentage of day-lit area is calculated by dividing the daylighted area by the total living area of the concerned building. Living areas in school buildings include Classrooms- desktop/ blackboard and Laboratories; Offices- general, drawing/ typing, enquiry; Libraries- reading room, counter area, catalogue room; Kitchens and any other regularly occupied spaces. (Basement areas, store rooms, toilets and AV rooms with special lighting requirements may be excluded from the calculation.)

5.2 Methodology

For meeting daylighting compliance as per Appraisal 5.1.1 & 5.1.2 the following methodology should be adopted:

5.2.1 **Daylighting compliance:** The daylight illuminated floor area under horizontal fenestration (Skylight) or adjacent to vertical fenestration (window) as illustrated in Figure 2. The detailed working examples are provided in **Appendix 1** for reference.

a) **Horizontal fenestration:** Horizontal fenestration is of three types— skylight, monitor, and saw tooth. The daylighted area under various horizontal fenestrations extends beyond the dimensions of the aperture of the top opening as demonstrated in the Figure 4:[4]

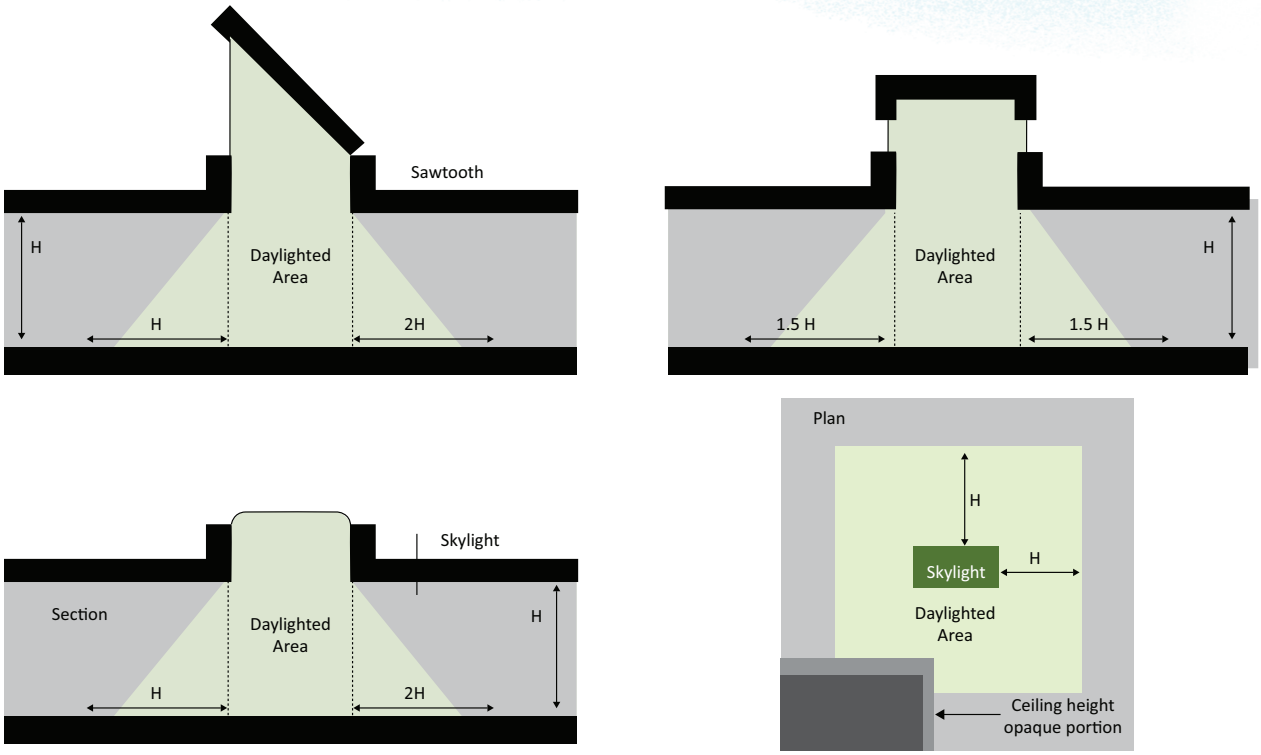
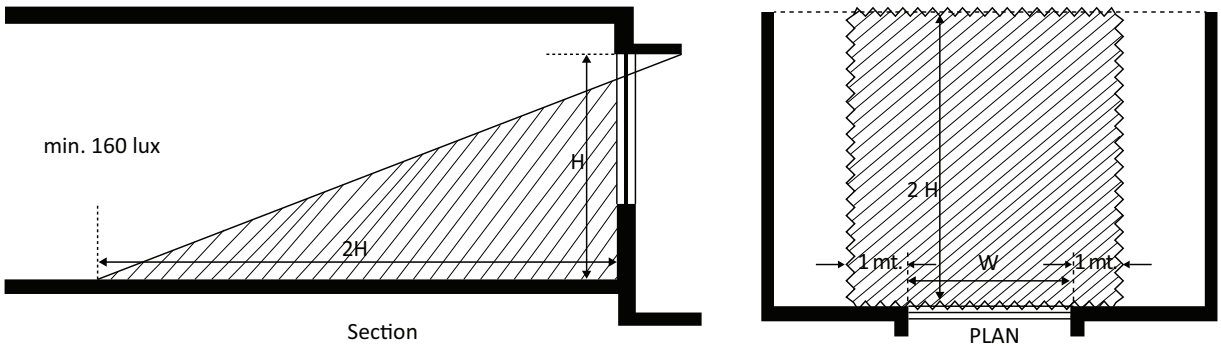


Figure 2: Total daylighted area for horizontal fenestration

b) **Vertical fenestration (window):** The daylighted area under vertical fenestration extends to the floor plate perpendicular to the side aperture, as demonstrated in Figure 3:



» *Figure 3: Total daylighted area for vertical fenestration*

[4] ECBC user guide 2007

5.2.2 Lux level compliance: The lighting requirements will vary depending on the function of each room. For instance, the lighting requirement in a classroom will differ from lighting requirements for a chemistry laboratory or an art room as the intricacy of the task is higher in the latter.

The National Building Code of India (2005) guide provides the required range of light levels, both lower and higher limit for various tasks in schools. The school should ensure that the classrooms are within this prescribed range (Refer Table 5).

Table 5: Indoor illuminance standards for schools

S. No.	Type of Interior or Activity	Range of Illuminance (lux)	Remarks
1.	Assembly halls (General)	200-300-500	-
2.	Platform and stage	200-300-500	Special lighting to provide emphasis and to facilitate the use of the platform/stage is desirable
3.	Teaching spaces (General)	200-300-500	-
4.	Lecture theatres (General)	200-300-500	-
5.	Demonstration benches	300-500-750	Localized lighting may be appropriate
6.	Seminar rooms	300-500-750	-
7.	Art rooms	300-500-750	-
8.	Needlework rooms	300-500-750	-
9.	Laboratories	300-500-750	-
10.	Libraries	200-300-500	-
11.	Music rooms	200-300-500	-
12.	Sports halls	200-300-500	-
13.	Workshops	200-300-500	-

5.3 Compliance

5.3.1 Perform calculations and submit the duly-filled daylight calculator to demonstrate compliance with Appraisals 5.1.1 or 5.1.2.

5.3.2 Submit lux level audit report (audit conducted by GRIHA officials for all representative spaces for one day) todemonstrate compliance with Appraisal 5.1.3 or 5.1.4.

CRITERION 6 – THERMAL COMFORT

INTENT

To provide a thermally comfortable indoor learning environment, thus enabling students to perform better. It also suggests strategies based on the building types for improving thermal comfort.

Introduction

Essentially conceived as shelters that protect humans from various weather conditions, building are designed to create a positive, healthy, and productive environment for the end users. Thermal comfort is "that condition of mind, which expresses satisfaction with the thermal environment" i.e. a state when a person feels neither too cold nor too warm. The indicators for thermal comfort are environmental factors, such as air temperature, relative humidity, air velocity, and personal factors, such as the type of activity, metabolic rate, and clothing layers.

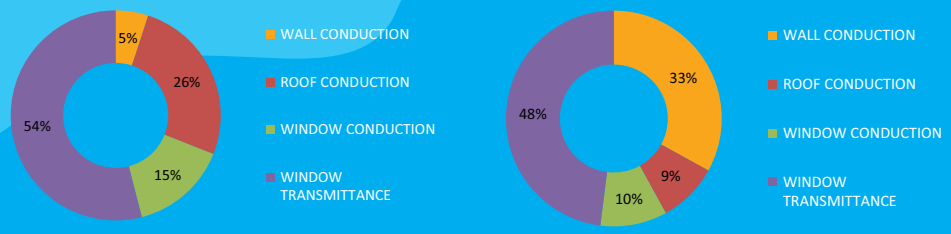
Determining whether the students and teachers are comfortable in schools is extremely essential. Thermal comfort has an impact on the learning ability and performance of the students and teachers. For instance, if a classroom is too warm due to a higher outdoor temperature, the attention span of students will be short as restlessness will creep in, thereby affecting their productivity. In naturally-ventilated schools, many a times discomfort is caused if classrooms are densely occupied, thereby causing higher internal heat gains. Thermal discomfort in classrooms can lead to headaches, dizziness, and difficulty in breathing for students. Hence, it is necessary to identify the reasons for discomfort and try to address them to create a pleasant-learning environment.

Things to do

- Seating arrangement in classrooms ca n be spaced out and re-arranged to improve comfort.
- Climate-appropriate dressing for students, for instance wearing ties during the summer season may be relaxed.
- Engage in discussions and feedback on thermal comfort and encourage innovative ideas.
- Specific control strategies may be implemented based on climatic zone and mode of cooling/ heating and ventilation.

Green Facts

- **Nearly 50% of the heat gains in a building (air-conditioned) are through glazing.[5]**
- **A seated student and a standing teacher can disseminate about 75 W and 100 W heat respectively.[6]**



» *Figure 4: Heat gain in buildings through the envelope in multistorey and single storey buildings respectively*

[5] Examining the Role of Building Envelope for Energy Efficiency in Office Buildings in India, Farheen Bano[1], Mohammad Arif Kamal, Faculty of Architecture, Dr, A.P.J. Abdul Kalam Technical University, Lucknow, India, Architecture Section, Aligarh Muslim University, Aligarh, India

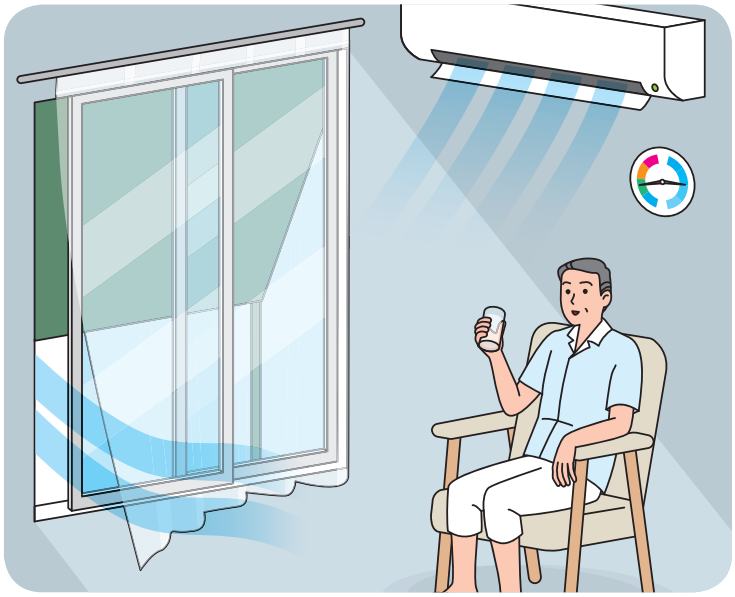
[6] Moderate thermal environments – Determination of the PMV and PPD indices and specification of the conditions for thermal comfort. (ISO), International Standards Organisation. Geneva : International Standards Organisation, 2005. ISO EN 7730.

6.1 Appraisals

6.1.1 Demonstrate that the prescribed 'post occupancy evaluation (POE)' survey is conducted for atleast 25% (>50% is ideal but not compulsory) of the student occupants[7] and 50% of the staff occupants to identify areas of improvement. - Mandatory

6.1.2 Ensure that over 50% of habitable area meets the thermal comfort conditions recommended by National Building Code (NBC) 2016. **- 2 Points**

6.1.3 Ensure that at least 3 passive/ active design strategies are adopted for enhancing thermal comfort. **-1 Point**



6.2 Methodology

The NBC 2016 and GRIHA V.3 specify a range of comfort requirements for various space types. Hourly temperature and humidity measurements have to be recorded (by GRIHA Council officials) to show that thermal comfort conditions in representative air conditioned areas specified in Table 6 are met for one day (i.e. day of audit) for buildings in all climate types.

Table 6: Inside design conditions for different air- conditioned spaces to meet thermal comfort standards

Sr. No.	Category	Inside design conditions	
		Summer	Winter
1	Classrooms	DB 23°C – 26°C	DB 23°C – 26°C
		RH 50% – 60%	RH not less than 40%
2	Auditoriums	DB 23°C – 26°C	DB 23°C – 26°C
		RH 50% – 60%	RH not less than 40%

Hourly temperature and humidity measurements have to be recorded (by GRIHA Council officials) to show that thermal comfort conditions in representative non-air conditioned areas specified in Table 7 are met for at least one day (i.e. day of audit) in all representative regularly occupied spaces.

[7] Student representatives from each of the classes above Class 6/ Grades 6 (Age 10 and above) must take the survey.

Table 7: Thermal comfort conditions for non-air conditioned buildings

Temperature	Less than 33°C
Humidity	Less than 70%

For mechanically-ventilated spaces, identify spots in classrooms that are not well ventilated and provide mechanical ventilation by use of ceiling fans. Table 8 may be referred for the adequate number of BEE star-rated ceiling fans for different room sizes. The additional guidelines for installation of fans are enumerated as follows:

- The height of fan blades above the floor should be (3H + W)/4, where H is the height of the room and W is the height of work plane.
- The minimum distance between fan blades and the ceiling should be about 0.3 m.
- Electronic regulators should be used instead of resistance-type regulators for controlling the speed of fans.

Table 8: Optimum size/number of fans for rooms of different sizes

Sl No.	Room Width	Optimum Size, mm/Number of Fans for Room Length										
	m	4m	5m	6m	7m	8m	9m	10m	11m	12m	14m	16m
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
i)	3	1 200/1	1 400/1	1 500/1	1 050/2	1 200/2	1 400/2	1 400/2	1 400/2	1 200/3	1 400/3	1 400/3
ii)	4	1 200/1	1 400/1	1 200/2	1 200/2	1 200/2	1 400/2	1 400/2	1 500/2	1 200/3	1 400/3	1 500/3
iii)	5	1 400/1	1 400/1	1 400/2	1 400/2	1 400/2	1 400/2	1 400/2	1 500/2	1 400/3	1 400/3	1 500/3
iv)	6	1 200/2	1 400/2	900/4	1 050/4	1 200/4	1 400/4	1 400/4	1 500/4	1 200/6	1 400/6	1 500/6
v)	7	1 200/2	1 400/2	1 050/4	1 050/4	1 200/4	1 400/4	1 400/4	1 500/4	1 200/6	1 400/6	1 500/6
vi)	8	1 200/2	1 400/2	1 200/4	1 200/4	1 200/4	1 400/4	1 400/4	1 500/4	1 200/6	1 400/6	1 500/6
vii)	9	1 400/2	1 400/2	1 400/4	1 400/4	1 400/4	1 400/4	1 400/4	1 500/4	1 400/6	1 400/6	1 500/6
viii)	10	1 400/2	1 400/2	1 400/4	1 400/4	1 400/4	1 400/4	1 400/4	1 500/4	1 400/6	1 400/6	1 500/6
ix)	11	1 500/2	1 500/2	1 500/4	1 500/4	1 500/4	1 500/4	1 500/4	1 500/4	1 500/6	1 500/6	1 500/6
x)	12	1 200/3	1 400/3	1 200/6	1 200/6	1 200/6	1 400/6	1 400/6	1 500/6	1 200/7	1 400/9	1 400/9
xi)	13	1 400/3	1 400/3	1 200/6	1 200/6	1 200/6	1 400/6	1 400/6	1 500/6	1 400/9	1 400/9	1 500/9
xii)	14	1 400/3	1 400/3	1 400/6	1 400/6	1 400/6	1 400/6	1 400/6	1 500/6	1 400/9	1 400/9	1 500/9

Specific strategies can be implemented for enhancing thermal comfort in schools depending on the mode of cooling and ventilation as defined in Table 9:

Table 9: Strategies for different building types

Naturally Ventilated Schools	Air Conditioned Schools
Encourage cross ventilation	Ensure there are no cooling losses though openings (air- tightness) — reduce infiltration by sealing gaps.
Install mechanical ventilation (fans/ coolers) in areas which do not meet thermal comfort requirements.	Minimize heat gain through external walls/ partitions by adding insulation/ vertical plantation.

Use evaporative cooling strategies to cool incoming air from fenestrations (windows, etc.).	Minimize heat gain through windows by replacing existing glass with Low-emissivity glass or installing solar films.
Use wind scoops, landscaping features, etc., to direct wind into interior spaces	Install shading devices on critical facades (South and West) to minimize heat gain while ensuring adequate daylighting
Minimize heat gain through opaque building fabric (solid walls/ partitions) by adding insulation/ vertical plantation.	Ensure that non- habitable rooms are NV or MV (corridors, lobbies, storage facilities, toilets, vertical circulation cores) with adequate wind flow.
Night flushing/ cooling strategies can be adopted to cool down buildings in hot summer months	Adequate operations and maintenance to ensure unused rooms do not have running air-conditioning
Install louvers on critical facades to allow for natural ventilation while blocking harsh sun.	Mixed- mode ventilation (use of fans with ACs running at a higher set point) may be used in certain rooms to reduce energy consumption.
	Night flushing/ cooling strategies can be adopted to cool down buildings in hot summer months in case there is provision of operable windows.

A combination of strategies can be used for mixed mode buildings while ensuring that there are no cooling losses though openings (air-tightness)— reduces infiltration by sealing gaps especially between AC and NV spaces.

6.3 Compliance

6.3.1 Conduct survey and submit duly filled 'post occupancy evaluation (POE)' survey and supporting photographs to demonstrate compliance with Appraisal 6.1.1.

6.3.2 Submit thermal comfort audit report (to be prepared by GRIHA officials) including hourly temperature and humidity profiles of all representative spaces for at least 1 day to demonstrate compliance with Appraisal 6.1.1.

6.3.3 Submit space-wise temperature and RH schedule maintained through BMS for all seasons (summer, winter, and monsoon, etc.) for centrally air-conditioned spaces.

6.3.4 Submit report and photographs to show fan placement in mechanically-ventilated spaces to demonstrate compliance with Appraisal 6.1.2.

CRITERION 7 – ACOUSTIC COMFORT

INTENT

To enhance acoustic comfort in the classrooms so as to enable effective communication and improved concentration level of students in schools.

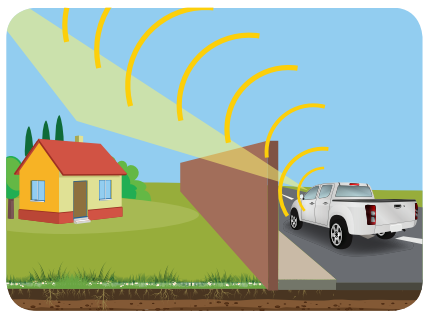
Introduction

Acoustics, as an aspect of comfort, determines the amount of noise that gets transmitted into the built space. A built environment is acoustically comfortable when the outdoor noise (e.g. traffic, trains) and indoor noise (e.g. neighbouring rooms) are cut off, and effective communication or any specific function can be carried out without disruption.[8] In a learning environment, more than 60% of activities involve communication between teachers and students hence, it is imperative that these environments are made acoustically comfortable.[9] Classrooms have become an environment for multimedia communications, further increasing the importance of classroom acoustics. Noise pollution results in distraction of the attention span of students and leads to reduced productivity. On the other hand, the concentration level of students has been found to increase if the classroom environment enables clear communication with improved acoustics.

Good acoustics support easy verbal communication due to low noise levels and fewer reverberations, thereby, aiding in the process of learning. In the past, classrooms may have been constructed without adequate consideration of sound acoustical principles. The sources of noise hampering students' concentration include noise from sources outside the school (vehicular traffic and aircraft flyover); noise from the hallways (foot traffic and conversation); noise from other classrooms (amplified sound systems and inadequate partition sound transmission loss); noise from mechanical equipment (compressors, boilers, and ventilation systems), and noise within the classroom itself (reverberation).

Things to do

- Conduct exercises or games to create awareness about consequences of higher noise exposures among students.
- Relocate activities or events with higher noise intensity away from the classrooms.
- Use noise barriers, such as use of dense plantation of trees, to block outdoor noise.
- The acoustical comfort in classrooms can be improved using various noise absorbing materials, such as acoustic ceiling and wall panels.
- To reduce noise from adjoining classrooms, doors should not be adjacent to each other or directly across from each other. Rather, offset the door locations to extend the sound travel path from one classroom to the next.
- Natural ventilation using operable windows is desirable in appropriate climate zones. However, before committing to that strategy, it is important to be aware of the outdoor acoustical environment around the building. Unacceptable levels of continuous or intermittent outdoor noise can preclude the use of this sustainable design strategy.



[8] Pelegrìn-Garcìa D, Brunskog, Lyberg-Ahlander V, Lofqvist. A: Measurement and prediction of voice support and room gain in school classrooms. s.l. : J. AcoustSoc Am.131(1):194-204, 2012.

[9] Accredited Standards Committee, Noise. 2002.

Green Facts

- **Research has found that schools that have classrooms with less external noise are positively associated with greater student engagement and achievement compared to schools with classrooms that have noisier environment.[10]**
- **In recent years, lifestyle changes, such as extensive use of earphones, portable speakers, rise in music concerts, etc., among young children has led to partial hearing impairment in early years. Thus, more than ever, characterization of noise sources in school campuses, such as cafeteria, playground, corridors, etc., will enable in making appropriate changes.**

7.1 Appraisals

7.1.1. Demonstrate that the outdoor decibel levels are in compliance with the Central Pollution Control Board (CPCB). **- 1 Point**

7.1.2 Demonstrate that the indoor decibel levels are in compliance with NBC 2016. **- 1 Point**

7.2 Methodology

Since acoustics is a quantifiable parameter, comparative analysis may be undertaken for different locations in the school campus. Principally, one has to identify the cause of noise pollution in the school campus and address the factors independently to provide an acoustically comfortable learning environment. The parameters that affect acoustic comfort are reverberation time, sound insulation, background noise, etc. The solutions will be specific to the function of the room, for instance the acoustics for a music room will vary from those for an auditorium or classroom.

The noise levels can be monitored in different locations by use of decibel meter. The monitored results should be within the prescribed limits as specified in Tables 10 and 11. These levels are to be entered in the given audit report format and submitted.

Table 10: Acceptable indoor noise levels as per NBC 2016 guidelines

Sl No.	Location	Noise Level dB(A)
1	Auditoriums and concert halls	20–25
2	Radio and TV studios	20–25
3	Cinemas	25–30
4	Music rooms	25–30
5	Hospitals, and cinema theatres	35–40
6	Apartments, hotels and homes	35–40
7	conference rooms, small offices and libraries	35–40
8	Courtrooms and classrooms	40–45
9	Large public offices, banks and stores	45–50
10	Restaurants	50–55

[10] Available at, https://sites.psu.edu/ceepa/2015/06/07/the-importance-of-school-facilities-in-improving-student-outcomes/, last accessed on 4 April, 2019

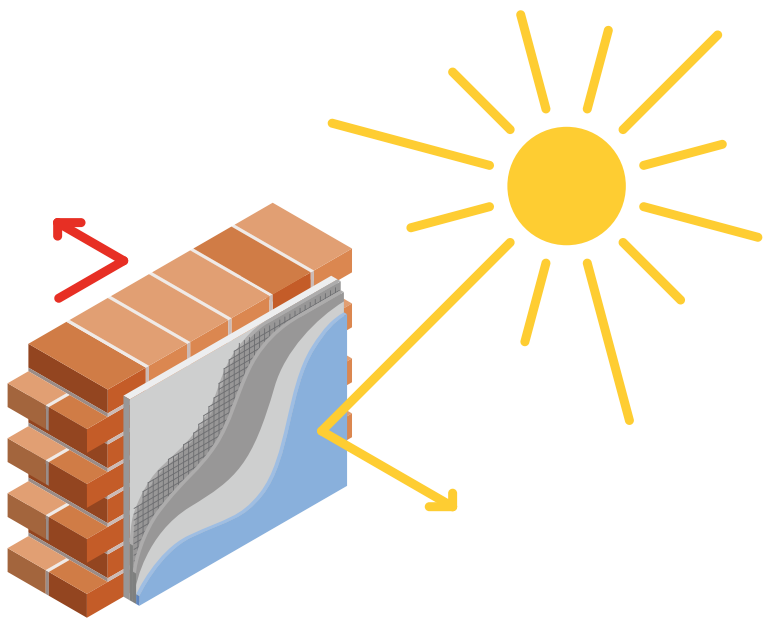
Table 11: Acceptable outdoor noise levels as per CPCB guidelines

Specific Environment	Time Base (hours)	Standard limits as per WHO guidelines	
		LAeq [dB]	LAmax, fast [dB]
Outdoor living area	16	50–55	-
School, playground outdoor	During play	55	-
Ceremonies, festivals, and entertainment events	4	100	110
Public addresses, indoors and outdoors	1	85	110
Impulse sounds from toys, fireworks and firearms	-	-	120 –140 (peak sound pressure (not LAmax, fast), measured 100 mm from the ear)
Outdoors in parkland and conservation areas	-	Existing quiet outdoor areas should be preserved and the ratio of intruding noise to natural background sound should be kept low	-

7.3 Compliance

7.3.1 Submit audit report to demonstrate compliance with Appraisal 7.1.1.

7.3.2 Submit audit report to demonstrate compliance with Appraisal 7.1.2.



AIR QUALITY

AIR QUALITY

SECTION 3

Considering the fact that schools are congregation spaces for a large number of children who are generally more vulnerable to diseases and disorders, it is essential that adequate comfort conditions are maintained for them within the school environment.

Moreover, children are more vulnerable to airborne pollutants than adults because their developing lungs breathe more air compared to their bodies, and their underdeveloped ability to communicate concerns in response to pollutant levels.[1] This necessitates the need for maintaining good indoor air quality.

The advent of new varieties of paints and sealants poses the increased threat of volatile organic compounds (VOCs) in the indoor environment which have been associated with a range of respiratory problems. Since there may be additional contaminants within the indoor environment with grave health effects, it is essential to address and monitor not only the materials used in the indoor spaces but also ensure adequate air changes for removal of airborne contaminants.

Another, more natural, way of improving the air quality is by propagating the greater plantation of trees. Trees play a critical role in enhancing the quality of surrounding air by acting as natural air filters to remove dust, smoke, noise, and fumes and soothe the environment. Dense plantation of trees in a school campus can lead to a significant drop in the indoor temperatures of buildings, bringing down the air conditioning demand, and augmenting the quality of life. Schools are a great place to inculcate the habit of nurturing trees and caring for the environment. Trees also raise the aesthetic value of a space whilst providing shade.

This section focusses on the various factors governing the indoor air quality and its appropriate measurement to devise means to improvise it. It also reiterates on the importance of preserving trees and enhancing their plantation within the school campus.

This section contains 2 criteria as mentioned in Table 12.

Table 12: Air quality section criteria

CRITERION NO.	CRITERION NAME	POINTS
Criterion 8	Indoor air quality	2
Criterion 9	Number of trees	4

Activity Time

Identify and compile a list of plants which will enhance the indoor air quality and place them inside the classroom. This way, students will not only connect with nature but the plants will also generate tremendous amount of oxygen and pass on the legacy to new comers which will create an improved and cleaner environment for the younger students.

[1] What do we know about indoor air quality in school classrooms? A critical review of the literature, Lia Chatzidiakou*, Dejan Mumovic and Alex James Summerfield, Intelligent Buildings International Vol. 4, No. 4, October 2012, 228– 259

CRITERION 8 – INDOOR AIR QUALITY

INTENT

To improve the indoor air quality (IAQ) of classrooms and ensure a healthy environment.

Introduction

We are all aware of the rising outdoor pollution levels due to vehicles and industries in the urban cities and their effects on health. However, it is proven that indoor air pollution is known to cause more harm to health than outdoor pollution, as most people spend 90% of time indoors. In schools, indoor air quality is a primary concern as it directly affects health, thus causing headaches, fatigue, cough, allergic reactions, and breathing disorders amongst students and teachers. Understandably, this affects the learning ability, speed of response, concentration levels, and compromises on the productivity of the students and teachers.

Indoor air pollution is caused by moulds and dampness, reduction in ventilation rates, use of synthetic building materials & furnishings, use of toxic chemicals in paints, adhesives, sealants, pesticides, and cleaning agents are proven to harm the health of the occupants. All these materials release various pollutants, such as carbon dioxide, nitrogen oxide, lead, and fine particulate matter which directly affect health. The presence of dirt, moisture, and warmth stimulates the growth of mould and other biological contaminants. Unsanitary conditions attract insects and vermin, leading to possible IAQ problems from animal or insect allergens. Excessive or improper use of pesticides for secondary control of insects, vermin, and head lice can also cause IAQ problems. Thus, it is essential that the indoor air quality is monitored on regular basis and action is taken to improve the quality of air to provide a healthy and productive learning environment to the students.[2]

Things to do

- Keep indoor plants in classrooms that are proven to improve air quality.
- If you spot mould growth or dampness in any classroom, report it to the school teachers.
- When a room is newly painted and smells different, spread the word among other students and do not go to the room until the smell subsides completely. Also, open all doors and windows in the room to flush out the contaminants.

Green Facts

- **It is estimated that in a crowded living and learning environment, more than 50% of children suffer from some kind of asthma or allergies.[3]**
- **Rising respiratory disease has led to increasing research focus on IAQ in schools. The World Health Organization (WHO) reports conclude that asthma is the most common chronic disease and the leading cause of hospitalization among children.[4]**

[2] WHO guidelines for indoor air quality: dampness and mould, ISBN 978 92 890 4168 3.

[3] T. Karimipanah, H.B. Awbi, M. Sandberg and C Blomqvist. Investigation of Air Quality, comfort parameters and effectiveness for two floor level air supply systems in classrooms. s.l: Building and Environment 42, 2007. pp. 647-655.

[4] WHO guidelines for indoor air quality : dampness and mould, ISBN 978 92 890 4168 3, pp. xii

Non-applicability clause: Appraisal 8.1.1 is not applicable for naturally ventilated spaces and air conditioned spaces with operable windows.

8.1 Appraisals

8.1.1 Ensure that indoor carbon monoxide (CO), respirable suspended particulate matter (RSPM), and fine particulate matter (FPM) levels are in compliance with CPCB - NAAQ standards for air conditioned spaces (with no operable windows). **- 1 Point**

8.1.2 Ensure that all interior paints are low VOC and lead free. **- 1 Point**

8.2 Methodology

The levels of indoor CO, RSPM - PM_{10}, and FPM - $PM_{2.5}$ are to be monitored in classrooms. The monitored results should be within the prescribed limits as specified in Appraisal 8.1. These levels are to be entered in the given IAQ audit report format and submitted.

8.3 Compliance

8.3.1 Submit IAQ audit report[5] to demonstrate compliance with Appraisal 8.1.1.

8.3.2 Submit specification sheets and purchase orders (reflecting full quantities) for low VOC paints used in the school interiors to demonstrate compliance with Appraisal 8.1.2.

[5] IAQ audit should be conducted by a third party consultant if CO, RSPM, and FPM monitoring is not being done in schools already.

CRITERION 9 – NUMBER OF TREES

INTENT

To preserve and protect the existing trees and plant native trees preferably within on outside the school campus thereby improving the quality of air.

Introduction

Trees are an integral part of our society. Human beings have always been dependent on trees for all kinds of needs, such as food, oxygen, shelter, medicines, paper, and so on. In recent times, with growing urbanization, deforestation has become rampant, contributing to climate change. It is estimated that 18 million acres, roughly the size of Panama, are lost each year due to deforestation. Even during such circumstances, trees aid in reducing the impact of floods, soil erosion, and climate change. Hence, protection, preservation, and compensatory plantation of trees is imperative and should be done on a wider scale. Today, children and their families have limited connectivity to nature. Many studies have shown that naturalizing the learning environment has numerous positive effects on children, such as enhancing creativity, boosting academic performance, increasing physical activity, improving their eyesight, and reducing stress.

Things to do

- Plant tree saplings within the school or outside the school campus.
- Take turns to water the saplings in your school campus.
- Carry out exercises among all age groups to connect with nature alongside creating awareness amongst your communities.
- Explore about the species native to your agro-climatic zone.
- Read about the tree species which produce the highest and lowest amount of oxygen.

Green Facts

- Trees reduce the 'greenhouse' effect by removing carbon dioxide from the air and releasing oxygen. Each year, a mature tree produces enough oxygen for 10 people.[6]
- Trees lower the surface and air temperatures by providing shade. Shaded surfaces may be 20°F–45°F cooler than the peak temperatures of unshaded materials.[7]
- Trees properly placed around buildings can reduce air conditioning needs by 30% and can save 20% – 50% in energy used for heating.[8]
- One tree produces nearly 260 pounds of oxygen each year. One acre of trees removes up to 2.6 tonnes of carbon dioxide each year.[9]
- Around 80,000 acres of forests disappear from the Earth everyday (approximately equal to parking space for 2 crore vehicles).[10]

9.1 Appraisals

9.1.1 Ensure that the total number of trees planted within the school campus must comply with GRIHA threshold[11] – 1 tree per 160 sq.m. - Mandatory

9.1.2 Demonstrate that the project increases tree plantation (above the Appraisal 9.1.1) as mentioned in Table 13:

Table 13: Alternative approaches for increasing tree plantation

Alternative 1	Alternative 2	Points
Onsite tree plantation	Offsite tree plantation	
25%	50%	1
50%	75%	2
75%	100%	4

» *Note: Please ensure that the trees planted onsite or offsite are native.*

[6] Available at, https://www.trafford.gov.uk/residents/environment/tree-management/importance-of-trees.aspx, last accessed on 4 April, 2019

[7] Available at, https://www.epa.gov/heat-islands/using-trees-and-vegetation-reduce-heat-islands, last accessed on 4 April, 2019

[8] Available at, http://www.fao.org/resources/infographics/infographics-details/en/c/411348/, last accessed on 4 April, 2019

[9] Available at, http://www.growingairfoundation.org/facts/, last accessed on 4 April, 2019

[10] Available at, https://economictimes.indiatimes.com/news/environment/the-good-earth/80000-acres-of-forest-disappear-a-day/articleshow/2698370.cms, last accessed on 4 April, 2019

[11] As deuined from MOEFCC threshold of 1 tree per 80 s.q.m

Available at, last accessed on 4 April, 2019

9.2 Methodology

GRIHA threshold[12] – 1 tree per 160 sq.m

For example -

Site area = 4000 sq. m

For Appraisal 9.1.1:

As per the mandatory clause (9.1.1), trees planted within the school campus (onsite);

= Site area/ GRIHA threshold

= 4000/160

T = 25 trees

For Appraisal 9.1.2:

Alternative 1: Onsite tree plantation

a) Increase in tree plantation by 25% above the mandatory clause (9.1.1)

= 25% of T

= 25% of 25

= 6.25

= 7 trees

Therefore, total no. of trees to be planted = 25 (onsite mandatory) + 7 (onsite) = 32 trees

b) Increase in tree plantation by 50% above the mandatory clause (9.1.1)

= 50% of T

= 50% of 25

= 12.5

= 13 trees

Therefore, total no. of trees to be planted = 25 (onsite mandatory) + 13 (onsite) = 38 trees

c) Increase in tree plantation by 75% above the mandatory clause (9.1.1)

= 75% of T

= 75% of 25

= 18.75

= 19 trees

Therefore, total no. of trees to be planted = 25 (onsite mandatory) + 19 (onsite) = 44 trees

Alternative 2: Offsite tree plantation

a) Increase in tree plantation by 50% above the mandatory clause (9.1.1)

= 50% of T

= 50% of 25

= 12.5

= 13 trees

Therefore, total no. of trees to be planted = 25 (onsite mandatory) + 13 (offsite) = 38 trees

[12] Refer footnote 11

b) Increase in tree plantation by 75% above the mandatory clause (9.1.1)

= 75% of T

= 75% of 25

= 18.75

= 19 trees

Therefore, total no. of trees to be planted = 25 (onsite mandatory) + 19 (offsite) = 44 trees

c.) Increase in tree plantation by 100% above the mandatory clause (9.1.1)

= 100% of T

= 100% of 25

= 25 trees

Therefore, total no. of trees to be planted = 25 (onsite mandatory) + 25 (offsite) = 50 trees

The Eco-team should consult a gardener and then conduct a survey of all the existing trees on site to ensure that the number of trees on site is within the prescribed threshold. If the number of trees is not within the mandatory threshold, additional native trees in the campus should be planted. To increase the points in this criterion, increase the percentage of the trees planted within or outside the campus as per the respective appraisals.

9.3 Compliance

9.3.1 Submit the tree survey in the tree calculator highlighting the total number of trees on site along with their species.

9.3.2 Submit date-stamped photographs indicating the trees planted/existed on-site and trees planted off-site, whichever is applicable.

9.3.3 In case new trees are planted, submit purchase order highlighting the species.

9.3.4 Submit calculations (as per the tree calculator) demonstrating the increase in percentage of the trees planted onsite/offsite.

9.3.5 Submit the permission letter clearly mentioning the number of trees planted in case they are planted off-site.

WATER MANAGEMENT

WATER MANAGEMENT

SECTION 4

Water has been a critical issue since a long time and its significance is unlimited and irreplaceable. With the pace that the world is moving, we are adding more population while the fresh water resources available are depleting, thereby creating an increased pressure on the existing water resources. Several experts say that the issue pertaining to water is so perilous that it might be a reason for a Third World War! Thus, there is need to educate the future generation about the judicious use of water resources. Schools as the first centres of formal learning have an added responsibility to teach the students about sustainable management of resources. These lessons when learnt during the initial years of life have a higher probability to be incorporated into the student's lifestyles.

Sustainable water management can contribute by providing benefits to the schools on educational, economic, and environmental aspects. The small financial savings that integrated water management can achieve by lower sewage charges or water bill when aggregated together can help in making further water management measures viable. Water management can be enhanced by driving majority of the building's non-potable requirements through either treated water or through the collected rainwater/storm water thus, reducing the burden on the existing drainage network.

This section focusses on calculating the annual water consumption of the school and then optimizing it by meeting the non-potable water demand through treated/rain water. It also caters into account the principles of rainwater harvesting, thereby aiding in the management of storm water run-off on site.

This section contains 2 criteria as mentioned in Table 14:

Table 14: Water management section criteria

CRITERION NO.	CRITERION NAME	POINTS
Criterion 10	Optimizing annual water consumption	5
Criterion 11	Rainwater harvesting	3

Activity Time

Every drop of water is precious. Our water consumption can only be reduced if we are aware of the amount of water we are consuming in our daily activities. The concept of water foot printing can be helpful in this regard. The water footprint measures the amount of water used to produce each of the goods and services we use. Students should carry out their water footprint analysis for a week and compare with other students to see who consumes less water.

CRITERION 10 – OPTIMIZING ANNUAL WATER CONSUMPTION

INTENT

To encourage the school authorities to track their water consumption and manage it judiciously by making use of treated water/rainwater specifically for meeting the non-potable water requirements of the school, thereby reducing the burden on the municipal supply lines as well as the groundwater aquifers.

Introduction

Human beings tend to value resources only when a considerable cost is attached to it. For instance, if we compare energy with water, individuals tend to value energy more than water since the cost associated with it is higher. However, for an individual to survive, water is certainly a more essential commodity than electricity. Nearly 70% of the world is covered by water, however, only 2.5% of it is fresh[1]. India has about 4% of the world's renewable water resources, but it houses 18% of the world's population. Thus, there is an urgent need to relook at how we use or manage our water resources.

Schools are the right places to promote water saving initiatives, since they are the knowledge centres for education and generating awareness. Also, children tend to learn much more from their teachers and peers than at home. Children are also the most vulnerable to diseases occurring due to water shortage or lack of safe water. The shortage of water is one of the major reasons for stunted growth of children in India and can also be related to the children dropout rate from schools.

Things to do

- The landscaping water consumption can be drastically reduced by using more native plant species, less grass and exotic species, and efficient irrigation systems (drip irrigation for trees, shrubs, etc., and sprinkler system for lawns).
- Using treated waste water/harvested rainwater for meeting all non-potable water demand.
- By installing efficient water fixtures (cisterns and taps) to reduce the building water consumption drastically.
- By installing aerators in the taps to reduce the flow of water, thereby reducing the wastage.
- Instilling behavioural changes by sensitizing people to practice viable water usage, such as open only half tap for reduced flow, close tap while brushing/applying soap, using bucket for bathing instead of showers, tracking and getting leaky faucets fixed, running the washing machine and the dishwashers only when they are full, etc.
- Storing the waste water from RO plants and air-conditioner drain pipes and using it for purposes other than drinking.
- Check for leaks in the water closet (WC), pipes, sinks, faucets, etc., and get them fixed in addition to conscious use of water.
- Conduct regular games and exercises to increase awareness among students, staff, and parents. Encourage new ideas for water conservation.

[1] Available at, https://www.nationalgeographic.com/environment/freshwater/freshwater-crisis/, last accessed on 4 April, 2019

Green Facts

- Every 2 minutes, a child dies because of a water-related disease.[2]
- Around 570 million children lack basic drinking water facilities at their schools.[3]
- Around 3–5 days is the average amount of time a human can survive with a complete lack of water.[4]
- By 2025, two-thirds of the global population will run short of fresh drinking water.[5]

10.1 Appraisals

10.1.1 Calculate the annual water consumption of the building and compare it with the annual water consumption requirements of NBC 2016. **- Mandatory**

10.1.2 Ensure that at least 20% of the annual water demand of the school is being met by treated waste water / rainwater. **- 1 Point**

10.1.3 Ensure that at least 30% of the annual water demand of the school is being met by treated waste water / rainwater. **- 3 Points**

10.1.4 Ensure that at least 40% of the annual water demand of the school is being met by treated waste water/ rainwater. **- 5 Points**

10.2 Methodology

- If the building has an STP and multiple water meters, estimate the monthly water consumption of the building from the water bills and record the metered data for bore well water usage, STP treated water usage for flushing, landscaping, and HVAC requirements.
- For a building with a single water meter:
  a) Record the monthly water consumption of the building from the water bills.
  b) The water consumption from the bore wells can be calculated using storage drums of known capacity and considering the number of times the drums are being filled and emptied in a day and recording it for a period of 5 days to arrive at consistent figures.
  c) The water consumption from the flow and flush fixtures (plumbing fixtures) can be calculated by considering the time taken for a 0.5 liter bottle to fill using a stopwatch.

  For instance, if a half litre bottle takes about 5 minutes to fill from a particular flow fixture/faucet, then its flow rate can be calculated using the following equation:

  Flow rate = 0.5litres/5 min= 0.1 liters/min.
  d) The flow rate of flush fixture can be calculated by measuring the dimensions of the cistern and calculating its volume dimensions.
  e) The landscape water consumption can be calculated using the following formula:

[2] Available at, https://water.org/our-impact/water-crisis/childrens-and-education-crisis/, last accessed on 4 April, 2019

[3] Refer footnote 2

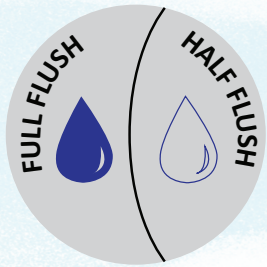
[4] Available at, https://blogs.unicef.org/blog/5-facts-about-water/, last accessed on 4 April, 2019

[5] Available at, http://savethewater.org/education-resources/water-facts/, last accessed on 4 April, 2019

Landscape water consumption = Volume of the hose pipe X time for which the watering is being done

f) In case there is a sprinkler system, calculate the volume sprayed in 1 minute and multiply it with the time for which the sprinkler works.

g) The quantity of rainwater stored can be estimated by calculating the area of the tank and then measuring the height till which the water is filled.



- Calculate the annual water consumption as per NBC 2016 considering the school working days as well as its population strength and compare the performance of your existing school with these.

10.3 Compliance

10.3.1 Perform calculations in the water management calculator provided to demonstrate compliance.

10.3.2 Submit copy of water bills for the last one year being considered for calculations.

10.3.3 Submit photographs of the typical faucets and fixtures, rainwater storage tanks, efficient irrigation system, STP, meters (if applicable), and the landscape areas.

CRITERION 11 – RAINWATER HARVESTING

INTENT

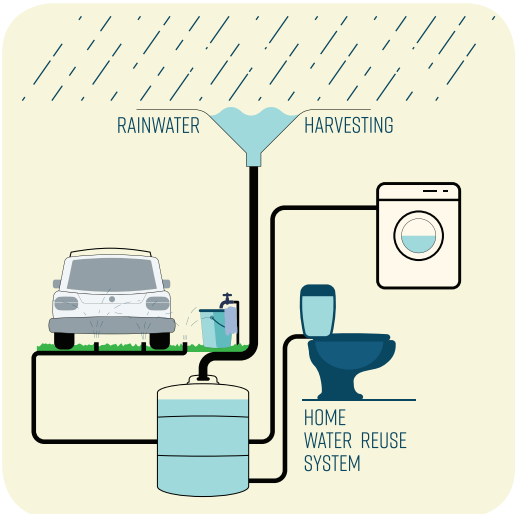
To ensure that the fresh water that we receive in the form of rain should be harvested and recharged into the ground to replenish the groundwater table after adopting an appropriate filtration mechanism to avoid contamination of groundwater.

Introduction

Over the past few decades, India has been grappling with rapid and intense uptake of ground water resources due to anthropogenic activities as well as climate change. Numerous issues have started cropping in such as the declining groundwater levels, shortage of safe and hygienic water along with the reckless usage of water that is available, particularly in the high end urban areas. According to a report by NITI Aayog, by 2020, majority of the Indian cities, such as Delhi, Bengaluru, and Hyderabad, are expected to reach zero ground water levels affecting access for 100 million people. Several states have less than 50% groundwater resources augmentation, highlighting the growing national crisis in which 54% of India's groundwater wells are declining. Rainwater harvesting is one such way to address the issue of depleting groundwater reserves and has been made mandatory in several states. However, the statistics indicate that the mandate is not being followed rigorously. The law making authorities should focus on better enforcement of such laws while the schools, which are the primary centers for imparting knowledge as well as creating awareness amongst the future leaders of the country, should propagate the concept of rainwater harvesting and recharging thereby inculcating the habit of water conservation.

Things to do

- Ensure that the catchment area is clean so that the rainwater being stored or recharged is clean.
- Rainwater from the first rain is generally impure due to dust, pollutants, etc., and should be allowed to flush out.
- All the rainwater should be filtered before recharging.
- Rainwater should be recharged at least 5 m above the ground water table to avoid contaminating the groundwater aquifers.
- If surface parking is provided on site and rainwater is being harvested from the site, then the harvesting pits should have a grease trap.



Green Facts

- 80% of the world's population lives in areas with high threats to water security.[6]
- 70% of our water is contaminated; India is currently ranked 120 among 122 countries in the water quality index and 130 out of 180 countries for its water availability.[7]
- Traditionally, exceptional techniques of rainwater harvesting and drainage were constructed in the cities of the Indus Valley Civilization. For instance, settlement of Dholavira in Gujarat, 'jhalara', 'taanka', 'bawari', etc .[8]

Non-applicability clause: If the Central Ground Water Board (CGWB) norm suggests that the groundwater table is high and groundwater recharging should not be done, then the project is exempt from this criterion.

11.1 Appraisal

11.1.1 For existing rainwater harvesting structures, ensure that the project is recharging rainwater for at least:

-70% of the runoff generated on site **-1 Point**

-100% of the runoff generated on site **- 3 Points**

OR

For a new rainwater harvesting system, ensure that the project is recharging rainwater for 100% of runoff generated after appropriate filtration. **- 3 Points**

11.2 Methodology

Rainwater harvesting is a traditional method that has a range of benefits on both project level and city level. It can be accomplished using two methods—storage for future use and recharge into the groundwater aquifer. Rainwater can be collected either from the rooftop or from the ground or a combination of both. The collected rainwater can be stored and reused for domestic purposes, landscaping, flushing, etc. This results in reducing the stress onthe municipal body thereby making the project self-sufficient. Whereas, when water is recharged into the ground post appropriate filtration, it helps in increasing the groundwater levels. By collecting rainwater either by storing or recharging, its drainage into the storm water channels is prevented thereby preventing situations like urban flooding.

a) In order to calculate the rainwater harvesting potential of a particular site, we need to calculate the catchment areas, that is, the areas of the roof, paved areas or lawn areas.

b) Selecting the type of surfaces and estimating the estimated run-off that would be generated from the site in the excel calculator.

c) Selecting the type of harvesting structures, such as recharge/percolation pits and storage structure.

d) The calculator can be used to size the rainwater harvesting pits/storage structures to manage the storm water on site.

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[6] Available at, http://savethewater.org/education-resources/water-facts/, last accessed on 4 April, 2019

[7] Composite Water Management Index (CWMI) Report by NITI Aayog. Available at: http://niti.gov.in/writereaddata/files/new_initiatives/presentation-on-CWMI.pd; last accessed on February 27, 2019

[8] Pal, Sanchari, Modern India Can Learn a Lot from These 20 Traditional Water Conservation Systems. The Better India. [Online] 2016. https://www.thebetterindia.com/61757/traditional-water-conservation-systems-india/

11.3 Compliance

11.3.1 Perform calculations in the water management calculator to demonstrate compliance.

11.3.2 Submit photographs of the existing rain water harvesting pits, storage tanks (if available), and filtration system.

11.3.3 In case of a proposed system, share the feasibility study conducted by third party for the same.

SOLID WASTE MANAGEMENT

SOLID WASTE MANAGEMENT

SECTION 5

India's major environmental issue attributed to the rapid increase in urbanization and industrialization, is management of municipal solid waste (MSW). Unsegregated waste collection and transportation leads to mounds of garbage being dumped in the open, which generates leachate and gaseous emissions, besides causing nuisance in the surrounding environment. Leachate contaminates the groundwater as well as the surface water in the vicinity. Moreover, gaseous emissions caused due to the decomposition of dumped garbage contributes to global warming. Municipal solid waste typically contains 51% organic waste, 17% recyclables, 11% hazardous substances, and 21% inert waste.[1] About 40% of the waste is not collected and is found littered around the city, thereby clogging the drains and polluting the surface water.

All humans are accountable for the waste that is generated and schools play a pivotal role in providing a platform for children to learn and develop a responsible behaviour towards the environment.

Everyone should adopt a waste reduction strategy whether at home or work or school and follow the 4R principle which includes reduce, reuse, recycle, and recovery. This will help in improving the economic and environmental performance of the school, besides providing numerous opportunities for the students to understand this issue and its implications on the environment. This, in turn, will not only save the depleting natural resources or reduce the amount of solid waste which goes to landfill but also turn waste into a resource.

This section contains 2 criteria as mentioned in Table 15.

Table 15: Solid waste management section criteria

CRITERION NO.	CRITERION NAME	POINTS
Criterion 12	Waste segregation	4
Criterion 13	Treat organic and inorganic waste	3

Activity Time

Students should carry out a survey of their homes to see the kind of waste that is being generated. They should then explore the ways of reducing waste being dumped into the dustbins and enhance the ways of reusing/recycling them into useful products. Post this, students should quantify and discuss the same with other students to see who generates less waste.

The waste-free activities will not only reduce the amount of trash generated at their homes but also teach them real-life concepts of reducing and reusing waste. This activity will help children connect to the natural world, and through this they will be able to make significant contribution to the environment.

[1] Available at, https://www.indiawaterportal.org/topics/solid-waste, last accessed on 4 April, 2019

CRITERION 12 – WASTE SEGREGATION

INTENT

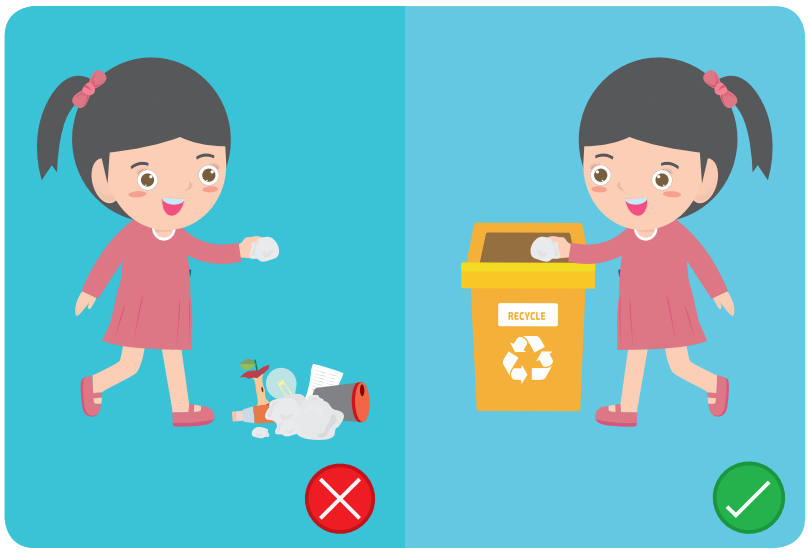
To provide infrastructure for segregation of solid waste and make it an inherent habit for children to sensibly discard garbage in designated dustbins.

Introduction

Disposal of solid waste is an emerging concern in our country as most of the waste generated in our residences, educational institutes, commercial buildings, and industrial buildings is dumped in landfills. The waste in the landfill generates toxic gases, such as 'methane', a greenhouse gas, which further leads to negative implications on the health of the human beings. In our country, 40%–60% of the waste generated is compostable (e.g. food waste, landscaping waste) and the rest is recyclable (e.g. plastic bottles, paper, etc.). Thus, by segregating the waste at the source and diverting it towards composting and recycling would minimize the quantum of waste in the landfills, thereby reducing the contamination of soil and ground water. Municipal Solid Waste Rules 2016, lay emphasis on the segregation of waste at source into three categories: —organic, inorganic, and hazardous waste.

Things to do

- Inculcating conscious consumption practices in students while focussing on quality, that is, buy things only if they are really needed.
- Place bins in strategic locations and make picture labels for each type of material (plastic, paper, glass, etc.
- Provision of multi-coloured dustbins (size as per the requirement) to collect organic, inorganic, and hazardous waste at every floor.
- One person's waste can be a resource for someone else—Try to donate things rather than disposing them off.
- Think of ways to reuse waste generated in schools. For example, reusing plastic containers as holders for crayons, pencils, etc., making greeting cards out of pencil waste.
- Composting food waste to make natural fertilizer for school garden/s and household plants.
- Provide dedicated centralized storage spaces to store different waste before sending it out for treatment/recycling/ disposal.



Green Facts

- **Research shows that if India continues to dump untreated garbage at its current rate, then we will need a landfilling area of 66,000 ha which is 10 m high and can hold 20 years' worth of waste. That is almost 90% of Bengaluru's area.[2]**
- **According to a report by the Central Pollution Control Board (CPCB), Maharashtra tops (India's waste generation) by generating 26,820 tonnes of solid waste per day (equal to average weight of 4.3 lakh people).[3]**

12.1 Appraisals

12.1.1 Ensure that multi-coloured bins (primary storage) are provided in all occupied spaces (such as classrooms, staffroom, library, playground, etc.) and the common areas of each floor.

12.1.2 Ensure that designated, centralized, and hygienic (secondary) storage spaces are provided on site to store waste before sending it out for treatment/recycling. **- 3 Points (Together – 12.1.1 & 12.1.2)**

12.1.3 Ensure that sanitary napkin dispenser/s along with the sanitary bins are provided in female toilets (students/ teachers) to dispose female hygiene waste. **- 1 Point**

12.2 Methodology

- Refrain from mixing different types of waste. Clearly label bins for proper segregation of glass, paper, plastic, metal, organic waste and female hygiene waste.
- Reduce wastage of paper and use of plastic products, such as plastic bottles, should be discouraged in schools.
- Size of bins should be provided according to the quantum of waste generated.
- The bins should be provided according to the type of waste being generated. For example, bins for e-waste/hazardous waste is not required in each classroom.
- Conduct workshops at the community level to disseminate the importance of waste segregation.

[2] Available at, https://thewire.in/environment/landfill-solid-waste-cpcb, last accessed on 4 April, 2019

[3] Available at, https://www.developmentchannel.org/2017/08/27/the-great-indian-urban-waste-problem-facts-you-should-know/, last accessed on 4 April, 2019

12.3 Compliance

12.3.1 Submit narrative and declaration stating the use of multi-coloured bins in all occupied spaces and common areas of each floor.

12.3.2 Submit solid waste management plan detailing the size of storage and collection facility.

12.3.3 Submit purchase order of the multi-coloured bins, sanitary bins and sanitary napkin dispensers.

12.3.4 Submit date-stamped photographs indicating the location of primary and secondary storage facilities.

Table 16: List of organic and recyclable waste

Organic waste	Recyclable waste
• Food waste	• Paper (cardboards/newspapers/magazines/snack boxes, etc.)
• Fruit and vegetable peels	• Plastic (bags/bottles/thermocol, etc.)
• Landscape and kitchen waste	• Soda cans
	• Glass (bottles/jars, etc.)
	• Metal (tin, aluminium, steel cans, etc.)

CRITERION 13 – TREAT ORGANIC AND INORGANIC WASTE

INTENT

Encourage the treatment of inorganic (dry/recyclable) and organic waste through various strategies thus minimizing disposal of waste in landfills and incinerators. This would imbibe in the students the habit of effective waste management and thereby wider range of people and/or communities can be sensitized.

Introduction

Global temperatures are rising and pollution levels are also increasing across the world. Every year, in a developing country including India, 62 million tonnes of waste is generated, out of which only 28% of waste is recycled and 72% is left on the roads and the landfill areas for several years leading to hazardous consequences.[4] Therefore, waste segregation, efficient waste collection, its proper disposal and resource recovery are vital for managing and diverting waste from the landfilling sites. Nothing is waste until it cannot be used anymore in any way. We generally see waste piled up but do not think deep enough on how to reuse it. A behavioural change is something that needs to be developed in order to find ways of reducing the waste being dumped and maximize waste recycling or reuse.

Things to do

- Minimize the use of plastic.
- Reuse empty bottles and empty jars and think about reusing the waste around school.
- Recycle waste—contact your local vendors to find out what can be recycled in your area.
- Start using recycled products, such as stationary, books, bags, furniture, etc., instead of using products made with virgin material and/or plastic.
- Display posters to create awareness on the importance of recycling materials and treatment of organic waste.
- In order to understand how composting works, make a composting pit within the school campus and use the treated waste as manure for landscaping.
- Explore the variety of available community-level composting systems which are very easy to operate and maintain.

Green Facts

- **Around 62 million tonnes (approximately equal to average weight of 11.5 million Asian elephants) of MSW generated annually by 377 million people in urban areas.[5]**
- **It is known from the study that from 1 tonne of waste, 260 kg of biogas can be generated from which we can light a house for 14 hours.[6]**

[4] Available at, http://home.iitk.ac.in/~anubha/H13.pdf, last accessed on 4 April, 2019

[5] Available at, http://planningcommission.nic.in/reports/genrep/rep_wte1205.pdf, last accessed on 4 April, 2019

[6] Available at, http://www.ijesi.org/papers/Vol(2)3%20(Version-4)/B230817.pdf, last accessed on 4 April, 2019

13.1 Appraisals

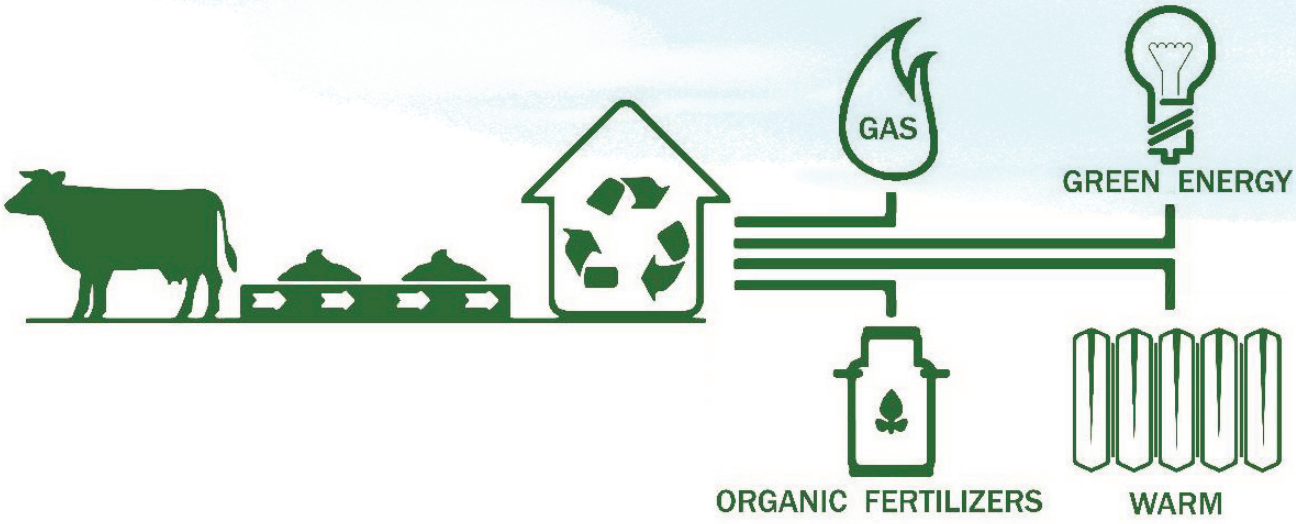
13.1.1 Ensure that appropriate strategies are in place for recycling paper, plastic, e-waste, etc., through tie-ups with informal/formal recyclers. **- 1 Point**

13.1.2 Demonstrate that 100% of the organic waste generated in the school is converted to biogas/manure. **- 2 Points**

13.2 Methodology

The organic waste should be segregated and composted within the same premises and then re-used for landscaping and/or cooking. In addition, all the recyclable waste, such as glass, paper, cardboard, and plastic waste should be collected by dedicated local recyclers and treated accordingly. However, in an urban setting, with the inadequate outdoor personal space and sprawling high rise towers, the garbage is collected together and then it is either sent to landfills or to incinerators. Nevertheless, one of the most sustainable methods of collecting waste from our residence/school/commercial spaces is still followed in our country by dedicated local recyclers, thus ensuring that minimum waste is directed to landfills and incinerators. Dedicated steps which a school should opt for are as follows:

- Schools can have contractual tie-ups with recyclers for regular collection of recyclable waste.
- Organic waste can be treated within the site using organic waste composter (OWC), vermi-composting, by installing biogas plants, etc.



Methodology for calculating waste quantity -

The quantity of waste generated in schools should be calculated by considering waste generation of 0.2 kg/person/day.[7]

Total solid waste generation (kg) = 0.2 X number of persons

Percentage of organic waste = 40%[8]

Total organic waste generation (kg) = 0.40 X total solid waste generation

For example

Total waste generated	= 0.2 X no. of persons (0.2 kg/capita/day)
No. of persons (assumed)	= 45
Therefore, total waste generated	= 0.2 X 45
	= 9 kg/day
Total organic waste generated	= 0.40 X total solid waste generation
	= 0.4 X 9
	= 3.6 kg/day
Therefore, waste to be treated on site	= 3.6 kg/day

13.3 Compliance

13.3.1 Submit narrative and date-stamped photographs indicating the recycling measures taken by the school to recycle inorganic waste, such as paper, metal, plastic, e-waste generated on site, etc.

13.3.2 Submit contractual tie-ups with the waste recyclers for safe recycling of recyclable wastes like metal/ paper/ plastic/ glass, e-waste, etc.

13.3.3 Submit narrative and date-stamped photographs indicating the measures taken by the schools to treat organic waste.

13.3.4 Submit duly filled waste calculator.

13.3.5 If organic waste composter is installed, submit its specification sheet, purchase order, and date-stamped photographs.

[7] As per the guidelines of National Building Code of India, 2016.

[8] Refer footnote 7

WELL-BEING AND SOCIAL ASPECTS

WELL-BEING AND SOCIAL ASPECTS

SECTION 6

The exposure of children to diverse environment since childhood enables them to learn, adapt and evolve habits that stay with them lifelong and help in shaping their personality. Whatever the kids learn and practice in school has a prolonged impact on their minds. Thus, the sooner the concepts of hygiene and social responsibility are introduced to them, better are the chances for them to adopt and integrate these into their lives. Several health diseases are prevalent amongst the school children due to insufficient sanitation and hygiene provisions, primarily due to lack of awareness. The absence of these facilities takes a huge toll on the health and well-being of the students and come at a large financial cost, including a sizable loss of economic activity. School is the first places where we are taught that people from all walks of life should be treated equally and with respect, irrespective of their physical disabilities or economic status. However, children tend to learn things by practice not just by being taught theoretically.

Thus, a huge responsibility to inculcate the right habits amongst the students lie in the hands of the elders with whom the students spend most of their time- for instance the teachers at school or family members at home.

This section thus aspires to imbibe the concepts of sanitation and hygiene in school since the in order to improvise the health of the future generation. Another aspect of this section is to prepare the next generation students to be more socially inclusive and environmentally conscious towards natural resource consumption.

This section contains 2 criteria as mentioned in Table 16:

Table 16: Well-being and social aspects section criteria

CRITERION NO.	CRITERION NAME	POINTS
Criterion 14	Health and hygiene	3
Criterion 15	Social initiatives	6

Activity Time

Children should focus on using fewer resources by contributing towards 'Buy Nothing Day.'

Celebrate Buy Nothing Day (once a year) by abstaining from purchasing any product of any kind. Thus, students will reflect upon the ideas of advertising (reduced consumption and waste) and will thereafter write about their experiences of buying nothing for a day.

CRITERION 14 – HEALTH AND HYGIENE

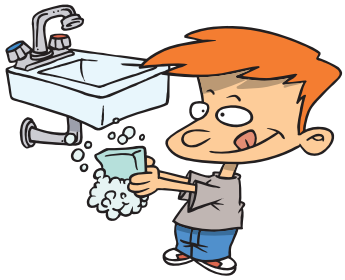
INTENT

To ensure that appropriate sanitation and hygienic conditions are maintained in the school for disease prevention and ensuring a healthy environment. It will also sensitize students about importance of cleanliness and hygiene at a young age.

Introduction

Right to education is a basic right of every child. However, many a times, the children are not able to attend school due to severe illness caused by inappropriate water supply, sanitation, and hygienic conditions. The reduced immunity due to the poor nutritional quality food adds to their susceptibility to illnesses, such as diarrhoea and other water and sanitation-borne diseases. An estimated 1.9 billion school days could be gained if the Millennium Development Goals (MDGs) related to safe water supply and sanitation are achieved and the incidence of diarrhoeal illness is reduced.[1] The WASH (Water, Sanitation and Hygiene) programme of UNICEF intends to provide clean sanitation and hygienic conditions in schools across the globe. The sanitation facilities are improving in India, especially after the launch of the 'Swachh Bharat Abhiyan' in 2014 which aims to achieve the vision of a 'Clean India' by sensitizing every Indian about the importance of sanitation and hygiene and hence, bringing a holistic change. However, the schools need to emphasize its significance amongst the students to make an everlasting impact in their young minds and through them convey the message to their families and the communities at large.

Things to do



- Ensure that the toilets and school premises are cleaned with a disinfectant on a daily basis.
- Ensure that there is adequate availability of water in the toilets.
- Wash hands after using the toilets with soap. Ensure that soap/hand wash is always available in the washrooms.
- Report if there is water leakage or stagnant water or garbage accumulation in the toilets.
- Provide dustbins in the toilets for storage and disposal of waste.
- Conduct discussions and workshops on the importance of maintaining sanitation and personal hygiene to sensitize these issues at the community levels.
- Display audio-visuals (short films, documentations, etc.) about sanitation and hygiene in the classrooms.
- Spray air fresheners in washrooms regularly.
- Periodic training must be organised for the maintenance staff to inculcate the values of sanitation and hygiene.

[1] Hutton, Guy and Laurence Haller, Evaluation of the Costs and Benefits of Water and Sanitation Improvements at the Global Level, World Health Organization, Geneva, 2004.

Green Facts

- **Unsafe drinking water, inadequate availability of water for hygiene, and lack of access to sanitation together contribute to about 88% of deaths from diarrhoeal diseases.[2]**
- **Hand washing can reduce the risk of respiratory infections by 16%.[3]**

14.1 Appraisals

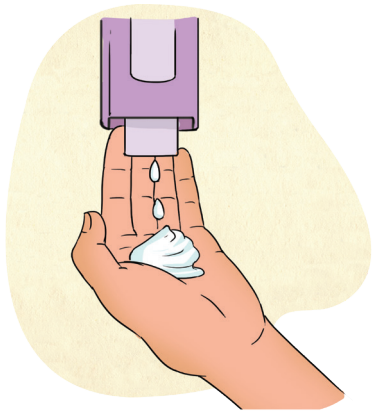
14.1.1 The school management needs to ensure that toilets are checked for leaks and/or garbage accumulation by a dedicated staff. Repairing of leaks and disposal of garbage needs to be done regularly and should be logged in sheets that will be maintained in the toilets. - Mandatory

14.1.2 The school needs to ensure that there is regular supply of water in the toilets. - Mandatory

14.1.3 Ensure that good sanitation measures (at least 3 apart from the mandatory ones) from the list mentioned below (refer methodology 14.2) are implemented within the school premises. **- 3 Points**

14.2 Methodology

- The school management must ensure that supervisors are allocated to regularly clean toilets with a disinfectant and refill the soap at regular intervals.
- Posters should be displayed in schools to create awareness about the importance of sanitation and hygiene.
- Audio-visual films (short films, documentaries, etc.) should be played in classrooms/auditorium on a monthly basis, to sensitize children about the importance of sanitation and hygiene.
- The school should conduct workshops and discussions at the community level to sensitize people on the importance of maintaining sanitation and personal hygiene. These workshops need to be conducted quarterly (every 3 months).
- Air fresheners should be regularly sprayed in each washroom.



14.3 Compliance

14.3.1 Submit list of supervisors assigned for maintenance of washrooms along with a standard operating procedure of washroom maintenance.

14.3.2 Submit log sheets/checklists maintained in washrooms.

14.3.3 Submit list of plumbing staff/contractual tie-up with plumbers.

14.3.4 Submit date stamped photographs and narrative elaborating the measures taken by the school to maintain hygienic conditions in the school premises.

[2] Pruss-Ustun A., Bos, R., Gore, F. & Bartram, J.2008. Safer water, better health: costs, benefits and sustainability of interventions to protect and promote health, WHO, Geneva.

[3] Rabie T, Curtis V. Handwashing and risk of respiratory infections: a quantitative systematic review. Trop Med Int Health. 2006; 11(3): 258-67

CRITERION 15 – SOCIAL INITIATIVES

INTENT

To ensure that schools takes appropriate social initiatives to enable 'inclusive development' of the country and sensitize students and staff about the importance of becoming responsible citizens.

Introduction

Indian society is grappling with numerous issues pertaining to a huge social and economic disparity within the nation. In order for the nation to progress and become a developed one, there is a burgeoning need to bring in the concept of inclusiveness into our developments and practices. This criterion aims to cater to the physically challenged, service staff personnel, malnourished and obese students, and any other individual who would be socially affected by the functioning of the school. Imparting knowledge amongst the various sections of the society enables them to imbibe qualities of leadership at a young age that would help fulfil the vision of transforming India into a developed nation.

Things to do

- Students must be encouraged to engage with various stakeholders in the society (e.g. municipal authorities, underprivileged section, and resident welfare associations [RWAs] on the importance of social and environmental awareness. It should be a part of the curriculum.
- Energy and water meters must be installed in strategic locations for enhanced visibility and for better resource management.
- The school canteen should have provision of healthy food items.
- Fire evacuation plan should be displayed on every floor and fire alarms should be tested periodically, along with conducting mock fire drills.
- Dedicated resting rooms should be provided for service staffs.

Green Facts

- **Out of the 121 crore population in India, about 2.68 crore people are 'differently-abled' which sums to about 2.21% of the total population.[4]**
- **Children generally perform better at school when they have breakfast. They are also more likely to maintain a healthy weight when they consume a healthy breakfast.[5]**

[4] Disabled Persons in India 2016, Ministry of Statistics and Programme Implementation (MoSPI)- http://mospi.nic.in/sites/default/files/publication_reports/Disabled_persons_in_India_2016.pdf

[5] Available at, https://www.betterhealth.vic.gov.au/health/healthyliving/healthy-eating-tips, last accessed on 4 April, 2019

15.1 Appraisals

15.1.1 Ensure that annual health check-ups/immunization camps are conducted within the school. - Mandatory

15.1.2 Ensure that the school should conduct regular fire drills and prepare fire prevention plans. - Mandatory

15.1.3 Demonstrate that the school adopts any 2 measures from the list of social measures provided below in the methodology (15.2). **- 4 Points**

15.1.4 Demonstrate that the school adopts any 4 measures from the list of social measures provided below in the methodology (15.2). **- 6 Points**

15.2 Methodology

- **Nutritional content of food:** The school should display the nutritional content of the food served in the canteens/ cafeteria within the school premises. This can be done in the following ways:
  a) Displaying posters around the school to sensitize students about the harmful effects of unhealthy/junk food.
  b) Provision of healthy food options in the canteen/cafeteria of the school.
- **Visual representation of energy and water consumption of the school:** The energy and water meter readings should be displayed in the common areas (canteen, library, notice boards. etc.) of the school.
- **Green tour to GRIHA-rated project:** Students and staff should be taken to a tour of any 5 star rated GRIHA project.
- **Universal accessibility measures:** The school should adopt universal accessibility measures as per the 'harmonized guidelines and space standards for a barrier-free built environment for the persons with disabilities and elderly persons' (refer **Appendix 2**) for the following minimum requirements:
  a) Provision of a ramp at the entrance,
  b) Parking (preferred parking near the entrance and parking specifications for the differently abled),
  c) Toilet for persons with disabilities
- **Resting spaces for staff:** Dedicated resting spaces for the service staff should be provided within the school premises
- Any other social activity that is conducted by the school.

15.3 Compliance

15.3.1 Submit narrative along with date-stamped photographs for each social measure that is implemented within the school.

15.3.2 Submit specification sheets for universally accessible lifts (if applicable) to be installed in the building.

15.3.3 Submit declaration for location along with the number of the resting spaces for service staff.

15.3.4 Submit a certificate from a doctor for conducting health check-ups for students in the school.

15.3.5 Submit date stamped photographs of the location of water, energy meters, and LCD screens displaying energy and water consumption within the school.

15.3.6 Submit the fire drill plan along with the list of preventive measures undertaken/displayed in the school.

15.3.7 Submit menu for healthy food that will be supplied in the canteen along with declaration from the food vendor.

BONUS

BONUS

SECTION 7

A rating is meant to create benchmarks which are used to evaluate a particular case on a defined set of parameters. Considering the fact that each project is unique and has different set of priorities in terms of complying with the cause of sustainability, a bonus section is devised for projects to enhance their sustainability on parameters other than those mentioned in the rating. The section provides flexibility to projects to choose strategies in accordance with their goals and plans.

This section contains 1 criterion as mentioned in Table 17:

Table 17: Bonus section

CRITERION NO.	CRITERION NAME	POINTS
Criterion 16	Bonus	2

CRITERION 16 – BONUS

INTENT

Project should adopt innovative measures (maximum 2) which have not been covered in the previous 15 criteria.

16.1 Appraisal

16.1.1 Adopt strategies, independent of 15 criteria, to make the project more sustainable.

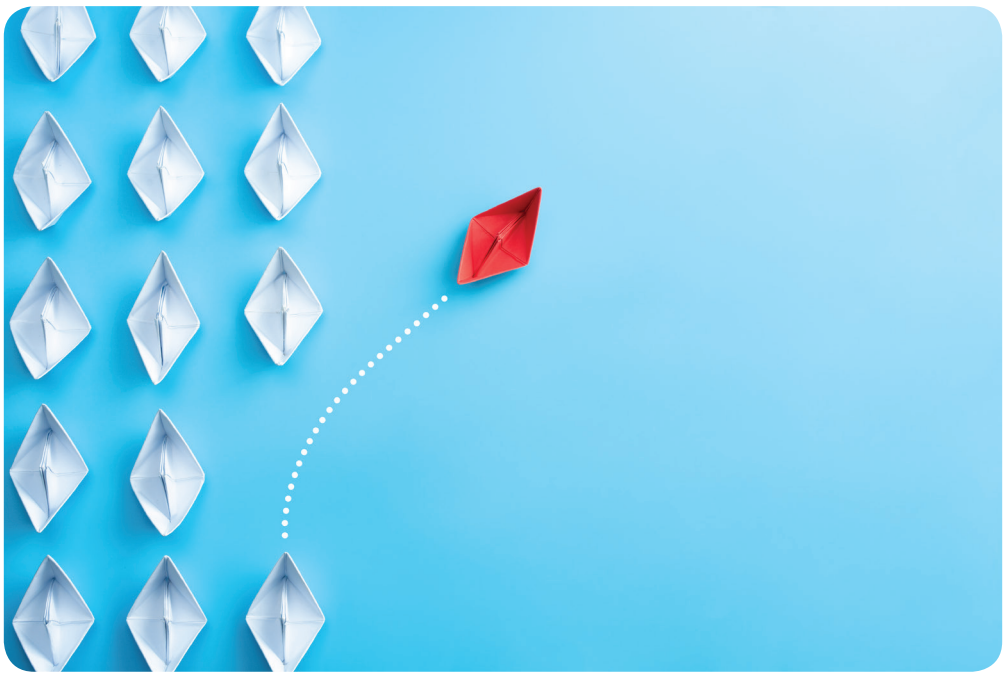
16.2 Compliance

16.2.1 Submit documents, narrative, declaration and date-stamped photographs, highlighting the measures implemented.

16.3 Optional Strategies

Strategies, outlined as follows, may be opted to achieve points in this criterion. Any other strategy towards enhancing green features/sensitization can also be chosen.

- Implement green housekeeping practices.
- Installation of smart metering and monitoring system for energy and/or water consumption.
- Implement any 3 activities enlisted in the 6 sections of this rating.
- Provision of e-charging facility at the parking.



APPENDIX 1: Occupant health and comfort

Criterion 5: Visual Comfort

Excerpts from methodology for daylighting compliance: Detailed working examples

Total daylighted area for vertical fenestration (window) = 2H X (W + 1m on each side of window)

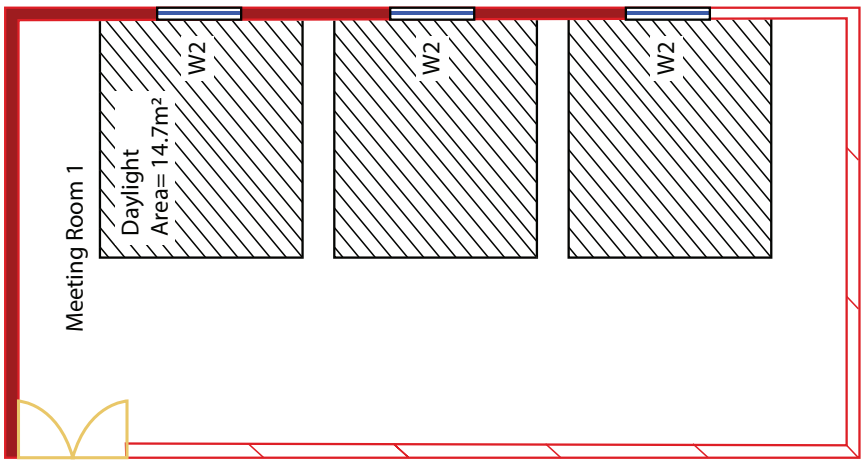
Example 1

For window type W2 (Width = 1.50m, Height = 1.50m, Sill height = 0.6m)

Daylighted area for W2 = 2H X (W + 1m on each side of window)

= 2(1.50+0.6) X (1.50+1+1) = 14.7m^2

Total daylighted area for Meeting room 1= (3 X 14.7) m^2 = 44.1m^2

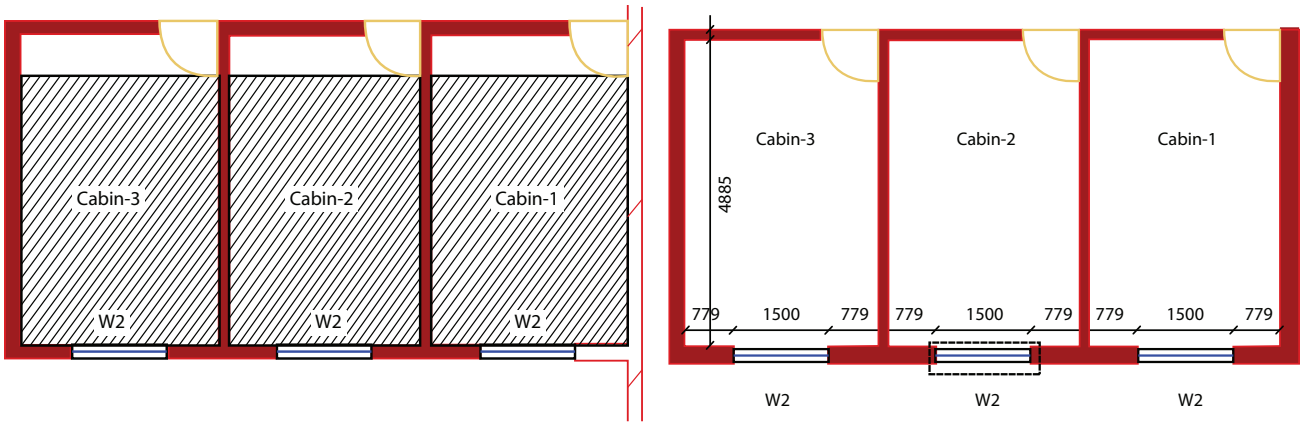


Example 2

For window type W2 (Width = 1.50m, Height = 1.50m, Sill height = 0.6m)

Since there is an obstruction (wall) at 0.79 m, Daylighted area for W2 = 2H X (W + 0.79m on each side of window)
= 2(1.50+0.6) X (1.50+0.77+0.77) = 12.768 m^2

Hence, Total Daylighted area for Cabin 1, Cabin 2, Cabin 3 = 12.768 m^2 each



Example 3

For window type W2 (Width = 1.50m, Height = 1.50m, Sill height = 0.6m) and window type W1 (Width = 2.10m, Height = 1.50m, Sill height = 0.6m)

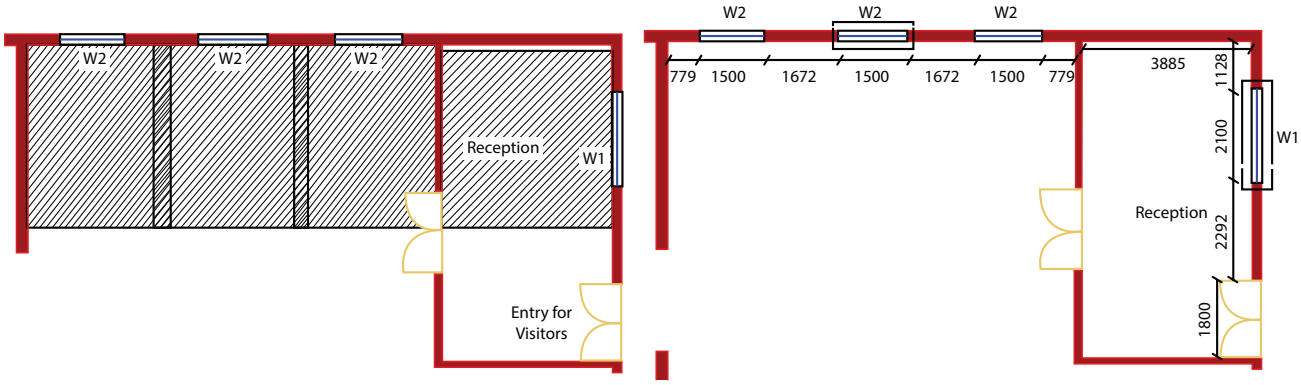
Since there is an overlap between daylighted areas in Work-space 1, double- counting of areas must be avoided.

Hence, Daylighted area for W2a, W2c = 2(1.50 0.6) X {1.50+[0.77+(1.672/2)]} = 13.04 m^2

Daylighted area for W2b = 2(1.50+0.6) X {1.50+[2 X (1.672/2)]} = 13.32 m^2

Hence, Total daylighted area for Workspace 1 = Daylighted area for W2a+W2b+W2c = (13.04+13.32+13.04) = 39.4 m^2

Since there is an obstruction (wall perpendicular to window) at 3.885 m,
Daylighted area for W1 = 3.885 X (2.10+1+1) =15.92 m^2
Total Daylighted area for Reception = 15.92 m^2



Note: Doors are not counted in daylighted area calculations

APPENDIX 2: Well-being and social aspects

Criterion 15 – Social Initiatives

Excerpts from harmonized guidelines and space standards for a barrier-free built environment for the persons with disabilities and elderly persons

Children and teachers spend most of their time inside schools which lack basic infrastructure, such as the provision of toilets, ramps, handrails, parking space, signage, lifts, and so on. The use of toilet is especially quite challenging for persons with disabilities (PwDs) and may result in uncomfortable conditions. In order to enable the movement of PwDs in buildings, it is imperative to identify the points of concern and take appropriate action to integrate the features enabling accessibility, as listed below.

Accessible design solutions

Buildings should be designed to aid mobility, vision, hearing, and speech. Consideration should be given to the provision of ramps, toilets with bedrooms, entrances, and so on, which should be able to accommodate PwDs and enable seamless movement. The harmonized guidelines should be referred to while designing major design parameters and the same has been compiled in this section.

1 Ramps and elevators

- Ramps and elevators enable movement of wheelchair users to different levels. The requirements for ramps and elevators are enumerated as follows:
- Elevators should become a part of the building where the building is more than G+1.
- Braille labels must be provided on the lift button panel.
- The minimum clear width of a ramp should be 1,200 mm.
- A single row of tactile warning blocks should be installed at 300 mm before the beginning and 300 mm after the end of each flight of steps.
- Ramps and landing surfaces should be slip-resistant. Outdoor ramps and their surfaces have to be designed in order to prevent water from accumulating on the walking surfaces.
- Ramps should extend horizontally, for not less than 300 mm beyond their topmost and bottommost point, to provide support for persons who may need help to negotiate the ramp.

» *Placement of warning blocks for steps*

2 Handrails/grab bars

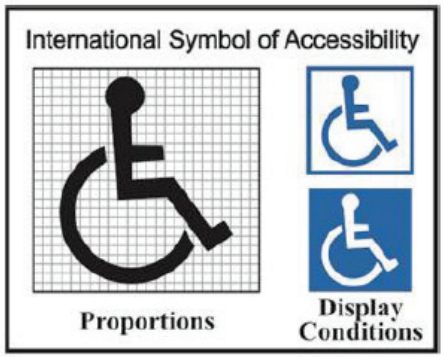
Many PwDs and the elderly rely on handrails/grab bars to maintain balance or prevent serious falls. Handrails/grab bars are extremely important features and must be designed to be easy to grasp and to provide a firm and comfortable grip, so that the hand can slide along the rail without obstruction.

- Handrails may be provided with Braille/tactile markings at the beginning and the end to give information to visually-impaired people.

Parking design

1 Signage

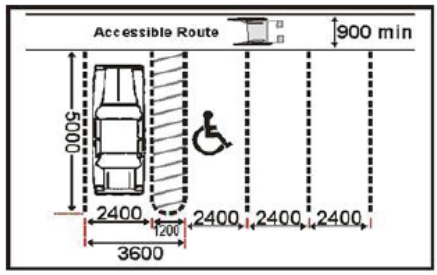
International symbols of accessibility, for example, the wheelchair sign, should be displayed at approaches and entrances to car parks to indicate the provision of an accessible parking lot for PwDs within the vicinity. Directional signs should be displayed at points where there is a change of direction to direct PwDs to the accessible parking lot.



2 Car park entrance

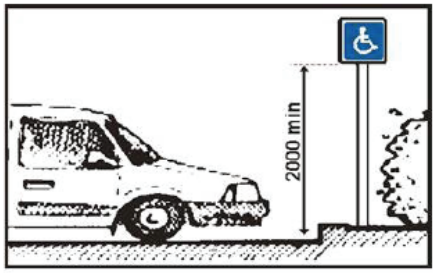
Car park entrances should have the following design features for universal accessibility:

- The car park entrance should have a height clearance of at least 2,400 mm.
- Accessible parking lots that serve a building should be located nearest to an accessible entrance and/or lift lobby within 30 m.
- In case access is through the lift, the parking shall be located within 30 m.
- An accessible route of 1,200 mm width is required for wheelchair-users to pass behind vehicles that may be backing out.



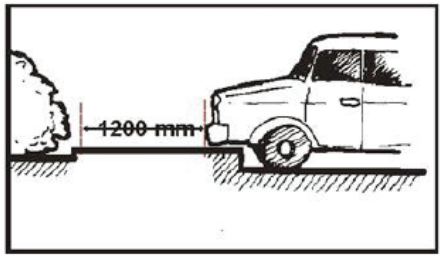
3 Accessible car parking lot

- An accessible car parking lot should have 5,000 mm×3,600 mm as its minimum dimensions; a firm, level surface without aeration slabs; and, wherever possible, be sheltered.
- When two accessible parking bays are adjoining each other, the 1,200 mm side transfer bay may be shared by the two parking bays.



Toilet

Toilets should be made according to the standards provided. Sensor taps should become part of toilets.



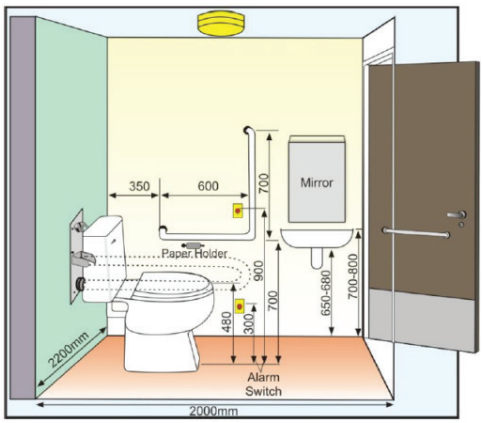
1 Signage

The signage at an accessible toilet entrance should be clearly visible and should comply with the International Symbol of Accessibility.

2 Unisex accessible toilets (multi-use)

A unisex accessible toilet allows PwDs to be assisted by caretakers of the same or opposite gender. One unisex accessible toilet should be provided in each toilet block on each floor with the following design features for universal accessibility:

- All toilet blocks must have one cubicle suitable for use by persons with ambulatory disabilities.
- The unisex toilet should have a minimum internal dimension of 2,200 X 2,000 mm.
- The layout of the fixtures in the toilet should be such that there is a clear maneuvering space of 1,800 mm x 1,800 mm in front of the water closet and wash basin in the accessible toilet unit.
- All fixtures and utilities should provide a clear space of 900 mm x 1,200 mm for wheelchair-users to access them and also have clear space—not less than 900 mm wide —next to the water closet.



3 Toilet doors

- A toilet door should either be an outward opening door, a two-way opening door, or a sliding type and should provide a clear opening width of at least 900 mm.
- It should be provided with a horizontal pull bar, at least 600 mm long, on the inside of the door, located such that it is 130 mm from the hinged side of the door and at a height of 1000 mm.
- The door should be capable of being locked from the inside by a device that is operable by one hand.

4 Water closets

- The top of a WC seat should be 450 to 480 mm from the floor.
- When a WC does not have the required height, the necessary height may be obtained by providing a circular base under the WC. The base so provided must not protrude beyond the circumference of the WC's base.

A GRIHA Council - TERI initiative

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