

Shashwat

Volume 2 | Issue 2 | February 2016 ₹50

Let Nature Be

Cities of the Future



A GRIHA Council Publication



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in India's INDCs

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MD, BIOME Environmental

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Façade System

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FEBRUARY 16-20, 2016 | INDIA HABITAT CENTRE, NEW DELHI

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Dr Ajay Mathur

President, GRIHA Council

Dear Friends,

It is an honour for me to join the GRIHA family, and it is especially memorable that I embark on my journey with you just at the time of the 7th GRIHA Summit.

GRIHA is all the more important now because of its relevance and importance in meeting our national goals, especially in relation to the Intended Nationally Determined Contributions (INDCs) that we have submitted to the United Nations Framework Convention on Climate Change (UNFCCC). We have promised that the carbon intensity of our economy in 2030 would be 33–35% less than it was in 2005. All analyses indicate that building energy efficiency would play a large role in enabling us to meet this target. The INDC document acknowledges this, and states that “in order to both recognize energy-efficient buildings as well as to stimulate their large scale replication, India has developed its own building-energy rating system GRIHA (Green Rating for Integrated Habitat Assessment).” As we go ahead, the rating of both new buildings—which are expected to account for nearly two-thirds of the building stock in 2030—and existing buildings is important inasmuch as they tell both the building occupants, as well as the country, that each GRIHA certified building is yet another contribution towards meeting our national goals.

Our constant interaction with various stakeholders, including those in the Central and State governments, architects, builders, and building occupants have built up the credibility of the GRIHA rating system. The experiences, practices, and lessons from the GRIHA projects have provided the learning and information that have led to the inclusion of green building norms in a range of instruments, such as the schedule of rates, plinth area rates, and other guidelines and work practices. The learnings have also enabled GRIHA to launch new versions that strive for “greener” shades that include social and economic aspects of the project development as well.

I look forward to working with the entire GRIHA community in enabling a greener building sector.

Dr Ajay Mathur

“GRIHA is all the more important now because of its relevance and importance in meeting our national goals, especially in relation to the Intended Nationally Determined Contributions (INDCs) that we have submitted to the United Nations Framework Convention on Climate Change (UNFCCC).”



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Mili Majumdar

Secretary cum Treasurer, GRIHA Council

Dear Friends,

“GRIHA is suitably positioned to address the green building needs of the upcoming smart cities. Over years of existence and experience, there has been substantial knowledge acquired from ongoing engagements, projects, and partnerships.”

Welcome to the 7th edition of the annually awaited event of the year: The GRIHA Summit. This is the time of the year to look back at the past year to be able to look ahead. The year 2015 has been a memorable one in the history of emerging India. Several flagship schemes have been launched to realize the vision for a cleaner and greener India. India is charting a path to sustainable development in the construction sector through its flagship programme on smart cities. With 80 per cent of buildings in the area development projects of smart cities to be designed as green, it is quite important that these cities are able to derive benefits from existing knowledge and stewardship on green buildings. GRIHA is suitably positioned to address the green building needs of the upcoming smart cities. Over years of existence and experience, there has been substantial knowledge acquired from ongoing engagements, projects, and partnerships. The new version of GRIHA, namely GRIHA 2015, is a culmination of collective knowledge and experience, that not only attempts to re-classify GRIHA criteria based on ease of application, but has incorporated new concepts such as real time monitoring and reporting.

The master plan of IIT Gandhinagar was the first project rated under GRIHA for large developments, followed closely by IIT Ropar. Both are 5 star rated. With over 1,000 evaluators and trainers on board, 700 registered projects spanning over 28 million sq. m built up space, GRIHA is a key game changer in the construction sector in the country.

The GRIHA Council has undertaken extensive training and capacity-building sessions all over the country. Students and media professionals have been the key stakeholders/beneficiaries in this effort, in addition to professionals. We are indeed very thankful to our user groups, partners, patrons, sponsors, and friends for their immense support and collaboration.

As we move into 2016, we know that GRIHA will continue in its mission and zeal to ensure a greener and cleaner planet. Personally for me, it has been a great journey and I do wish the future leadership of GRIHA a very enriching and successful journey ahead.

Mili Majumdar



GRIHA Timeline

2000



- TERI conducted over 100 building audits
- TERI Retreat constructed as Green building

Rail Nirman Nilayam,
Secunderabad



2007



Ministry of New and
Renewable Energy, GoI

- MNRE adopts GRIHA as a National Rating system for green buildings
- ECBC code released in India

Grand
Chola, ITC
Hotels Ltd,
Chennai



Administrative
building for
PCNTDA,
Pune



2009



Government of India



- Committee of secretaries: 3 star GRIHA mandatory for all Government Buildings
- CPWD adopts GRIHA
- Acknowledged as an innovative tool by UN



Ministry of Environment,
Forests and Climate
Change, Government
of India



Akshay Urja
Bhawan
HAREDA,
Panchkula

SDB 7&8,
Infosys Ltd,
Chennai



Fortis
Memorial
Research
Institute,
Gurgaon



SABIC
Research &
Technology
Pvt. Ltd,
Bangalore



- TERI GRIHA released indigenous green building rating of INDIA

- National mission on sustainable habitat launched



- Evaluators' and trainers' programme launched

2005

Developed by



The Energy and Resources Institute

Supported by



Ministry of New and
Renewable Energy, GoI

2008

2010

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2011

- GRIHA adopted by PCMC (Premium discounts to developers and property tax rebate for buyers announced in PCMC for GRIHA rated projects)
- EC linked to GRIHA pre-certification
- Committee of secretaries recommends upscaling of GRIHA
- ADaRSH and CREDAI sign MoU



SIDBI Training Center, Bhubaneswar

2013

- Launch of GRIHA LD rating for large development
- GRIHA app launched for android
- GRIHA new user-friendly metro design website launched
- GRIHA adopted in Noida (FAR incentive for GRIHA rated projects in Noida)
- GRIHA adopted in Greater Noida (FAR incentive for GRIHA rated projects in Greater Noida)



- SVA GRIHA adopted by PCMC (Premium discounts to developers and property tax rebate for buyers announced in PCMC for SVA GRIHA rated projects)
- GRIHA adopted in Punjab (FAR incentive for GRIHA rated projects in Punjab)
- GRIHA adopted in Kerala

2015

- Launch of GRIHA & GRIHA LD v.2015
- Government of West Bengal, Department of Municipal Affairs adopts GRIHA
- FAR for GRIHA projects in Rajasthan
- FAR for GRIHA projects in Pune
- FAR for AUDA (Ahmedabad Urban Development Authority)



VVIP Circuit House, Pune

Panedas Residence, Guatemala City



Indira Paryavaran Bhawan, New Delhi



Manipal University Campus, Jaipur



- Launch SVA GRIHA rating for buildings less than 2,500 sq. m
- GRIHA product catalogue launched
- Guidelines for large development launched
- Concessional rate of interest for GRIHA rated projects by SIDBI

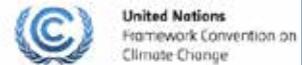


2012



- Launch of GRIHA Prakriti rating for existing day schools
- GRIHA app for iOS launched
- MoUD, Delhi Division, GoI FAR incentive for GRIHA rated projects
- MoU signed between USGBC and TERI
- Sikkim adopts GRIHA

2014



GRIHA recognized as India's own green building rating system in **INDIA's INDC** submitted to **UNFCCC**.



GRIHA App on >





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public authorities, and also to
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mass production of recycled
materials in a scientific way.



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Deepali Mishra in conversation
with Ar Chitra K Vishwanath,
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for *Shashwat*.



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This article talks about the
various water harvesting
systems weaved in the social
fabric of Rajasthan, their cultural
significance and the delicate
balance of such systems in the
man-water relation, and the
changes with time.



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Alison Taylor
Vice President
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Pictured: LEED Gold Wind Turbine Nacelle Assembly Facility, Hutchinson, KS

पी. पद्मनाभन

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**MESSAGE**

It gives me immense pleasure to know that GRIHA Council is organizing the 7th Annual GRIHA National Conference, 'The GRIHA Summit 2016' from 16th to 20th February, 2016 and is publishing a souvenir to commemorate the occasion.

The theme of the conference 'Cities of the Future' is very topical and relevant in the present context, keeping in view that the Govt. of India has unfolded its ambitious plans of transforming many cities across the country into Smart cities. This entails key issues related to architectural design and technology for efficient buildings in the Indian context to be deliberated upon. I am sure that the Summit will provide a platform to discuss various aspects of the theme threadbare with the involvement of all stakeholders.

We are privileged to associate with GRIHA for construction of our upcoming Corporate Office Building at Guwahati. We are happy to know that NRL's under construction Corporate Office Building at Guwahati registered for GRIHA rating has been nominated for exemplary performance award under Site management category. It augurs well with our credentials of being one of the most eco-friendly refineries in the country. Moreover, since the city of Guwahati has been included in the first list of Smart cities, the building can very well showcase the concept of green buildings in the region and become a torchbearer for promoting more such green buildings in the region.

I sincerely hope that the exchange of thoughts and ideas during the course of the Summit will pave the way for better understanding of the idea of sustainable development utilizing green technology.

I take the opportunity of wishing the ensuing event all success.

With best wishes and regards,

(P. Padmanabhan)

03-02-16

Guwahati



DIVAKAR GARG
Director General



सत्यमेव जयते
भारत सरकार
Government of India



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E-mail : cpwd_dgw@nic.in

MESSAGE

It gives me immense pleasure to know that the GRIHA Council is organizing its annual flagship event – ‘**The GRIHA Summit 2016**’ in New Delhi from 16th to 20th February 2016.

The theme chosen for the summit ‘**Cities of the Future**’ is very apt and topical in the present context of creation of sustainable, smart, energy efficient and affordable built environment in the country.

It is the need of the hour that the Cities of the future in the country should be the smart and green cities, providing a clean and sustainable environment by application of smart solutions, technological innovations, best eco-friendly engineering practices and intelligent use of ICT so as to give a decent, comfortable and hassle free living to its habitants.

I applaud the contributions of GRIHA Council in promoting and implementing GRIHA, the indigenous rating system for Green Buildings and Habitats in India. I am glad to know that GRIHA rating is being increasingly adopted by more and more organizations for developing their buildings and habitats.

I compliment GRIHA Council and extend my best wishes for success of the Summit.

(Divakar Garg)



सत्यमेव जयते

प्रमुख अभियंता

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Public Works Department (Government of Delhi)

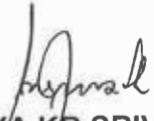
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I have great pleasure in conveying, on the occasion of their 7th flagship event- The GRIHA SUMMIT- Cities of the Future, my appreciation for the various initiatives taken by the GRIHA Council in the domain of sustainability for the built environment. This society created by TERI with support from the MNRE mainstreams true sustainability in the building sector through GRIHA. The Government of NCT, Delhi, was the first among states to mandate that all new buildings shall be at least 3-star GRIHA compliant. We are glad to be associated with the SUMMIT, and I extend my best wishes on behalf of PWD, Delhi, for its success being organized at IHC, New Delhi from 16th to 20th February 2016.


(SARVAGYA KR SRIVASTAVA)
Engineer-in-Chief

GREEN VS GREY

Is the journey more important than the result we want?

Akash Deep

In the current urban landscape, there seems to be an unending tug of war between the upcoming grey patches of concrete jungle and the vanishing green cover. However, it is clear that as of now, the urban sprawl is unchecked and is destroying more and more farmlands in the surrounding cities. Growing urban complexities present themselves as opportunities for environmentalists, urban planners, architects, and policymakers to work together in order to make our current and future growth sustainable. To preserve the balance between green and grey, many Central and State government approval bodies have been formulated. However, despite these measures, there seems to be a missing link vis-à-vis attaining the equilibrium, as can be seen with urban growth trampling the environment with increasing building cover in urban and suburban areas. The existing

systems are obviously facing problems in attaining the goal of balance and sustainability.

For a system to work properly in the set environment, implementation is a major factor which often becomes a setback in a developing country, such as India. Implementing a policy and making sure that it is performing as intended can be achieved either by incentivizing or penalizing the end user. It has to be understood that rules and regulations exist for the safety and well-being of users. With each new regulation in place, we find ourselves trying to look for innovative solutions to bypass the enforcement of these rules. Here I would like to ask the readers a simple question: Is the process or journey more important than the result we want? For achieving the goal, there may be a number of possible routes. However, due to our short-sightedness, we tend to choose a path that has benefits upfront but fails

to address future requirements. The urban development matrix consists of a complex network of interrelated parameters. Our urban environment comprises multiple levels. These levels can be identified as urban/city, campus, building, facility, and the individual.

Each of these levels has their respective processes and individuality.

For attaining the minimum amount of sustainability in our cities, each of these levels has a crucial role to play. If at any level the minimum sustainability standards are compromised, it will affect both the city and the individual. To achieve this minimum level of sustainability, we require a tool which can assess the development at each of these levels. Green Rating for Integrated Habitat Assessment, better known as GRIHA, the indigenous Indian rating system developed by The Energy and

Resources Institute (TERI) with support from the Ministry of New and Renewable Energy (MNRE), Government of India, presents itself as a rating tool to assess the credibility of new development towards sustainability. GRIHA, with its subsets GRIHA pre-certification (for fast-track environmental clearance), SVA GRIHA (Small, Versatile, and Affordable GRIHA for buildings with area of 2,500 m²), and GRIHA LD (rating to assess large developments), helps to integrate sustainability at all levels of urban complexities.

The fight between green and grey starts at the initial stage of a new proposal, when procuring environmental clearance, before proceeding further to get approval for construction. The GRIHA pre-certification process provides a platform for the project management team to discuss the proposed development and its effect on the environment. It is a tool to assess the project at the design stage and helps evaluate the project on the basis of multiple parameters. These parameters broadly consist of architectural design, planning for provision of services, such as water availability, wastewater management, sewage, rainwater harvesting, electricity supply, waste disposal, etc. The process facilitates the project team's work by providing specialist feedback regarding all the above parameters. As the project is at a crude level, the recommendations of the committee members,

which help to enhance the sustainability of the project, can be incorporated into the design with ease.

The documentation evaluated in pre-certification consists of the design parameters considered by the project team for the proposed development. These assumptions include architectural, energy, water, wastewater, waste, thermal and visual comfort, and other environmental impact factors, such as noise, air, flora, fauna, etc. Along with the above mentioned parameters, the process also evaluates a project for its urban impact; this in turn helps the project to address sustainability issues at the city level.

One such issue is the placement of the entry gate on the site premises. Though this seems to be a trivial question, I assure you that if left unsolved, this problem can pose a serious threat to our city's traffic. In most developments, we often see that the entry gate is placed on the main road without any provision for offsets. An offset is actually required to provide a buffer to the incoming traffic at the site. As most campuses tend to have a frisking facility for vehicles entering the premises, during this process, the waiting traffic at the entry gate creates a long queue on the access road, resulting in traffic jams, especially during peak hours. A slight offset to the main gate providing space for waiting for minimum three to four cars, depending on the peak

traffic inflow, helps in making the proposed development coherent with the municipal infrastructure rather than imposing a threat for the facilities. The proposed green cover in any new development is another significant aspect which is an interesting topic to discuss with the project teams. The green cover required as per bye-laws in various cities varies from nil to 70 per cent. The major parameters generally affecting the green cover are the urban location and the site area. One of the effects linked to the green cover is the Urban Heat Island Effect. Defined in layman's language, it is the excessive heat generated due to the hard surfaces (such as concrete) in any area. The hard/dark surfaces tend to absorb heat and later disseminate it in the atmosphere. This in turn results in rise in temperature in the urban surroundings. The GRIHA evaluation helps projects steal every inch of green area from the hard surfaces.

Other than the issues discussed above, there are many minor and major issues discussed in GRIHA pre-certification committee meetings which help the project team to achieve sustainability in all respects. The strength of the process lies in the evaluation of not just the final product (in this case the design of the building/campus) but also its design intent and process. Most of the sustainability issues can be addressed and resolved, if proper design measures are implemented in the proposed development.

The benefits and results can be explained in an unending essay. However, the best way to know the process and to weigh the benefits is to try out the process. 

*Akash Deep, Programme Manager,
GRIHA Council, New Delhi*



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With increasing population, the burden of waste is also increasing. The fast-paced, industrialized world is plagued by the humungous challenge of managing waste, which is exerting unavoidable pressure on planet Earth. This is due to inadequate manpower, financial resources, implements, and machinery and is resulting in environment pollution. As per the standards, the municipal solid waste generation is at the average rate of 0.4 to 0.6 kg per person per day. The higher the income level and rate of urbanization, the greater the amount of solid waste generated. Out of 48,134 MT/day of solid waste generated in India, only 2,786 MT/day receives treatment before disposal. Further, India being largely an agrarian economy, the waste generation from agricultural sources is of huge quantity. As per 2012 estimates, India generates nearly

700 MT of solid waste from agricultural sources, annually. Rapid industrialization has also resulted in a grave problem of disposal of industrial wastes. Industrial wastes, including, solid and liquid, hazardous and non-hazardous, in sectors such as sugar, pulp and paper, fruit and food processing, sago/starch, distilleries, dairies, tanneries, slaughterhouses, poultries, etc., need to be systematically discarded.

This calls for innovative solutions to reuse the waste in a productive manner. Even though the Solid Waste Management Rules enforced by the Ministry of Environment, Forest & Climate Change (MoEFCC), Government of India, has given a set of guidelines for proper collection, segregation, and disposal of various kinds of waste, the re-utilization of the same in the form of building materials still needs to be regularized. The green rating

system, which is voluntary for adoption by project proponents, does require utilization of waste (including industrial waste, such as fly ash and agro-waste) in building materials; however, it is not mandatory by law in our country to reuse waste as a set percentage in the building materials. For instance, GRIHA, the national green building rating system of India, awards credits for utilization of BIS recommended waste materials in building structure and interiors. The intent is to reduce the need for virgin materials in the building and help divert waste from landfills.

A step in the right direction is the new legislation passed by Government of India in November 2015 that requires road developers to utilize plastic in road construction for increased longevity and quality. This serves as a solution for scientific disposal of plastic waste and also reduces the cost of road construction



C & D bricks

Table 1: Potential applications of various types of waste in building materials

Waste Category	Waste type & Source	Potential building applications	
Agriculture Waste (organic)	Sugarcane bagasse, rice and wheat straw and husk, coconut shell, fibres and husk cotton stalk, saw mill waste, ground nut shell, banana stalk and jute, sisal and vegetable residues.	Particle boards, insulation boards, wall panels, printing paper and fillers, roofing sheets, fuel, binders, fibrous building panels, bricks, acid proof cement, coir fiber, mats, reinforced composite, Polymer composites, cement board; Thermally insulated bricks made from sugarcane bagasse.	
	Industrial waste/ Municipal solid waste (inorganic)	Coal combustion residues, steel slag, bauxite red mud, and construction debris	Cement, bricks, blocks, tiles, paint, aggregate, concrete, wood substitute products, ceramic products
		Fly ash	Mineral filler in asphalt paving mixtures, component of cement in concrete production, soil stabilization and structural fill
		Blast furnace slag	Aggregate, surface course in asphalt and addition to Portland cement concrete
		Foundry sand	Landfill, precast concrete manufacture
		Glass	Used in place of aggregates in concrete
		Plastics	Many uses for recycled plastics, such as fencing, furniture and outdoor landscape elements.
		Newspaper, Paper wastes	Component of Bricks / blocks along with clay.
Scrap tires	Tire chips are used in embankments, retaining walls and as backfills in abutments. Used in rubberized asphalt pavements, rail-road crossings as panels to be fitted with tracks and with timber crossings. Shredded tires are used as alternative aggregate material. Scrap tires used economically for shock absorbing and as a noise barrier in construction. Other uses, such as stair treads, mats, flooring tiles, sewer rings, guard rails, golf driving mats and playground covers		
Construction and demolition debris	Recycled concrete	Raw material in cement clinker, admixture in cement and as aggregates in concrete. Can be used as aggregate base for pavements, sub base for new pavements, shoulders, base course for foundations or backfill for utility trenches.	
	Wood waste	Scrap lumber can be processed and used for landscaping and building products. Wood fibres used for fibreboard products for various applications such as sub flooring, sheathing and structures for insulation and damping of sound. Wood fibres are mixed with Portland cement to make rigid boards which can be used as fire barriers, sheet roofing systems, or sub flooring for ceramic tiles. Fibre strips made from wood fibres are used to fill expansion joints in concrete roads and walkways. Wood residues are mixed with plastic fibres to make plastic lumber suited for water front docks, piers and dockings. Oriented strand boards manufactured using wooden fibres on the outside and a thick inner layer of polystyrene foam has good application in residential construction. Composite structural wall system made using wooden fibre up to 90 per cent and reinforced concrete. Wooden particles are used as decorative wood chips, mulch or other ground cover products, including geotextiles, which is biodegradable product. Wood-based geotextiles and sheet mulches provide percolation and vegetative layers in landfill designs.	
	Soil and rubble	Used as aggregates in concrete	
	Asphalt	Asphalt paving	
	Metals	Sold as scraps for re-use and re-cycling	
	Mining/minerals	Coal washers waste, mining overburden waste, tailing from iron, copper, zinc, gold, aluminum industries	Bricks, tiles, lightweight aggregates, fuel
Hazardous waste	Metallurgical residues, galvanizing waste, tannery waste	Cement, bricks, tiles, ceramics, and board	

Source: Adapted from A K Kasthurba, K R Reddy, and Venkat Reddy 2014. Sustainable Approaches for Utilizing Waste in Building. *International Journal of Earth Sciences and Engineering*. vol. 7, no. 3.

Conclusion

A major source of environmental pollution is waste that is inappropriately disposed of into landfills or drained into water bodies. With rapid urbanization, the construction projects present a huge opportunity to utilize these wastes and lessen the burden on freshly sourced raw materials. Even waste generated after natural disaster and earthquakes can also be channelized for reuse in

new construction. There have been successful researches in recycling wastes in building materials, however, rules and regulations to encourage and permit contractors to use recycled products are lacking. There is a need for commercial promotion of recycled materials by private and public authorities, and also to establish industries to enable mass production of recycled materials in a scientific way. Proper quality

control and quality assurance guidelines need to be developed for use of recycled wastes in construction materials. Also, entrepreneurs and construction agencies should be encouraged and incentivized to develop new such products. All these measures would ensure streamlining the mass production of building materials with high-recycled waste content. ■

Deepali Mishra, Assitant Architect, CPWD



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“ Adopt Sustainable habits—Its no more a fad, it’s a need! ”

“ *Dharti par swarg hai wahan, ped paudhe hain jahan! Pedon se vayu, vayu se aayu, Pedon ko mat kato bhai, ye karte praktik bharpayi!* ”

APPLICATION OF PROJECT MANAGEMENT PRACTICES TO MEET OBJECTIVES OF SUSTAINABILITY

Mukul Gupta

Project Management is applied universally to meet the objectives of various projects. It is already an established fact that project management practices/methodologies help in improving the possibilities of attaining project objectives. Wherever a project exists, project management practices help in successfully meeting the deliverables. The need is to perceive sustainability objectives as project/s and to understand various project management practices, so that an appropriate amalgamation can be achieved to optimize the output.

In fact, sustainability is already a huge project (in wider terms, it can also be termed as a programme and even portfolio in several instances) and its success is the need of the hour. It is a group of several independent projects leading to the same objective—a sustainable living environment for us and the future generations. The projects comprise green buildings, energy saving, fossil fuel conservation, waste recycling, efficient transportation, non-polluting manufacturing, and so on.

The measure of attainability of the sustainability objective, in case

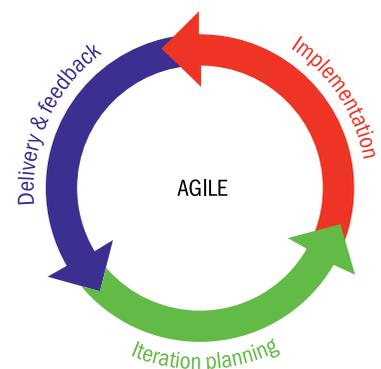
of green buildings, is where GRIHA (Green Rating for Integrated Habitat Assessment) plays an important role under the direction and guidance of India's INDCs (Intended National Determined Contributions) commitment to the world forum which has been highly appreciated in the world sustainability circles. This will not only improve the intention of the constructors and owners but also increase the awareness and pride of contribution, amongst the end users, towards minimization of carbon footprints in the ecosystem.

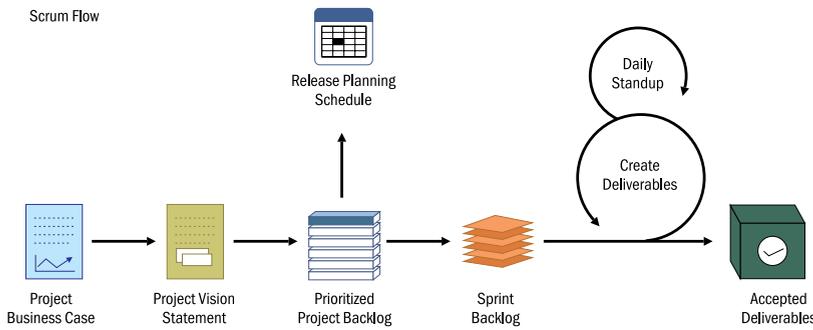
To meet the implementation of rating system of green buildings, GRIHA has two approaches—one, to develop a system for rating of green buildings; second is to develop trainings and respective certifications for the users and advisors. Each of it is a project in itself where the project management practices can be applied.

Let us understand the two major Project Management approaches—first is the traditional method, also known as waterfall method, in which everything is defined and the path is set which must be followed by all members working on it. Another

is the adaptive method which is now adopted in the term 'agile', wherein the project is performed in iterations, each of which is adaptive to the changes and incorporates learnings, from each and every iteration. In this, the project is delivered progressively till the final objective is attained.

In our situation where the results of various approaches are not very clear, understanding and adopting Agile Project Management can be more beneficial, rather than the traditional waterfall method. Some explicit sub-projects might be perfect to use traditional (waterfall) Project Management, however, from the point of view of sustainability objectives, we will concentrate on the most appropriate one, i.e., Agile Project Management.





The agile methodology was developed in the late 20th century when traditional project management was observed to be unsuitable for delivering the results in a fast changing environment, especially the IT industry. Several methodologies gradually developed to cope with the challenges of project success, involving competitive and rapidly changing requirements of the IT industry. These were more or less evolved versions of adaptive project management, with their own nomenclature.

Agile became an umbrella terminology encompassing these various approaches like Scrum, Kanban, Extreme Programming (XP), Crystal, Feature Driven Development (FDD), and others. Agile became a group of product and service development techniques, using an iterative and incremental approach in which solutions are delivered in stages. Although perceived as relevant to the IT Industry, but it is applicable to all sectors where the project success is encompassed in uncertain and frequent changes.

In 2001, the 'Agile Manifesto' was developed which formalized the values and principles of Agile. All methodologies, to be termed under Agile, were expected to comply with these values and principles.

By now we can have a fairly good understanding that the Agile

approach is very much hand-in-hand with the approach we are looking for in order to meet the sustainability objectives. What is left to us is to modulate our activities with the Agile project management methodology in order to achieve our objectives.

Since Agile is adaptive, therefore, during the course of application of whichever Agile methodology we choose for sustainability objectives, it can be modified to adapt with the available scenarios.

Scrum is one of the most popular Agile methodologies for Project Management and Product Development. It is an adaptive, iterative, fast, and effective methodology designed to deliver significant value quickly and throughout the project lifecycle.

Scrum is guided by its six principles:

- Empirical Process Control
- Self-organization
- Collaboration
- Value-based Prioritization
- Time-boxing
- Iterative Development

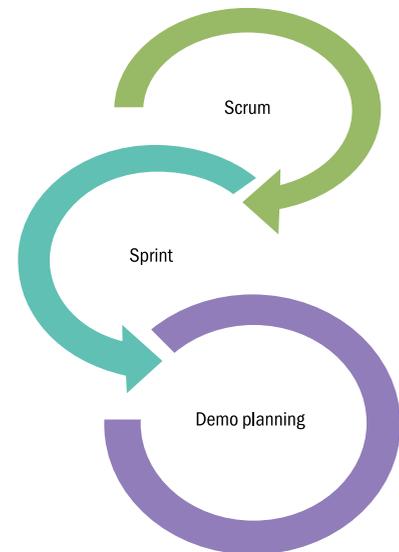
The crucial five aspects of Scrum are as follows:

- Organization
- Business Justification
- Quality
- Change
- Risk

Besides this, the Scrum processes address the specific activities and flow of a Scrum Project. In total, there are 19 processes which are grouped into five phases:

- Initiate
- Plan and Estimate
- Implement
- Review and Retrospect
- Release

Each process had its own Inputs, Tools & Techniques, and Outputs which interact during iterations (known as Sprints) during the project lifecycle.



A further study is recommended to understand the Scrum methodology and current processes being followed so as to adopt and integrate them to effectively achieve the desired products and services of sustainability. In fact, Scrum may not be restricted to any one project of sustainability only but can be scaled to other projects as well in order to attain the desired sustainability as deliverable. 📄

Mukul Gupta is a Project Management Trainer and Consultant with more than 30 years of Project Management experience in India and abroad. For further information, he may be approached at mukul@shimuk.com

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CLIMATE RESPONSIVE DESIGN

Deepali Mishra in conversation with
Ar Chitra K Vishwanath

Managing Director, BIOME Environmental Solutions

Q Our lifestyles and habits play a great role in sustainable living. How can architects shape the lifestyle of the inhabitants of the buildings they design.

Architects can apply sagacity and frugality in the design which will directly affect the way resources are consumed.

Q Preaching and practicing sustainability are two different dimensions in promulgation of the idea of sustainable building. Which component of sustainability, according to you, is the most ignored in practice?

Commonsense!

Q With the danger of climate change looming over the world, climate – responsive design is becoming ever more challenging in the current scenario. What are the strategies that can enable building design to be responsive to the extreme weather conditions?

Designing with passive strategies

and designing for both adaptation and mitigation.

Q Your architectural style is characterized by interfacing ecology with the designed spaces, utilizing local materials. In the context of the trending smart solutions and intelligent building, how do you think your design has evolved?

Our designs are SMART in mnemonic sense. They are S– Specific to the context, specific to the brief which incidentally is derived by a robust process of questioning and introspection with the clients, M–Measurable, which means it is objective, since solutions are derived for the purpose and to the nature of brief. A–Achievable, that is, we strategize through design that the ecological design parameters are possible to incorporated within the available funds and skill levels thereby also making the working of the building robust, R–Relevant, again this is relating to the context, and making the building part of the ecosystem, T–Time bound, being time sensitive and within a time frame.

Q With increasing pressure on land, an answer to India's housing needs lies in building high-rise. How sustainable are high rise residential buildings as compared to low rise—high density model of traditional community living in India?

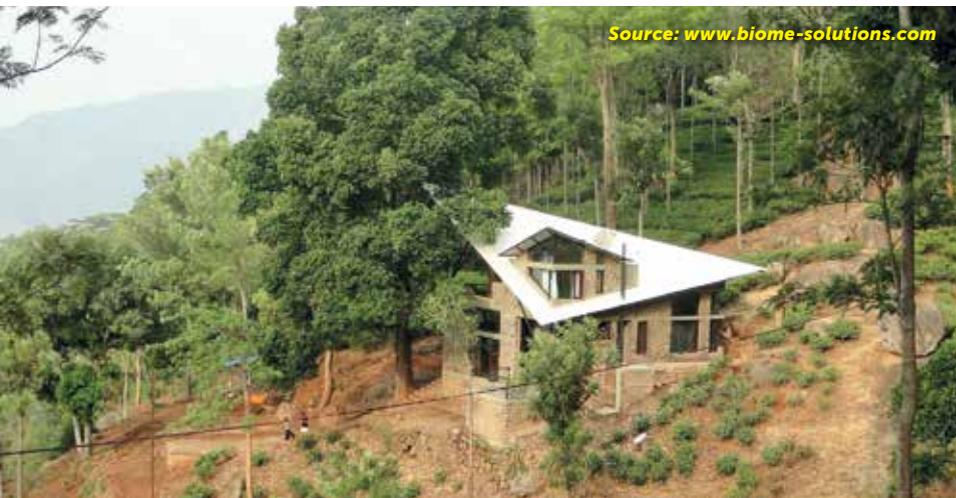
I have difficulty agreeing to the statement. With increasing pressure on land, an answer to India's housing needs lies in building high-rise. I believe like air and water, land should also be a fundamental right for every citizen and it is possible still leaving enough land for food production, forests, and for public purposes. There is need for a paradigm shift in the development model where it needs to be based on the carrying capacity of the biome with respect to water, food needs, clean air availability, and waste absorption within the parcel of habitation.

Q Design is a process of constant evolution. What is the most radical sustainability idea that you have worked upon in your architectural practice?

Incorporating waste to food cycle in the design, waste as a resource to build with, and finally making a good building!

Q Which contemporary building, according to you, can be termed as the best example of sustainable building design?

Our home.....:):) 🏠



Source: www.biome-solutions.com



“MAKE IT SUSTAINABLE BUILDING MATERIALS - MiSBM PROJECT”

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- Alignment of environmental claims and declarations to international standards and practices
- Inclusion of products’ life-cycle in the definition of their environmental features
- Use of reliable information in the Green Building Schemes and Ratings
- Support the implementation of Green Procurement Policies from public authorities

The **“Make It Sustainable Building Materials – MiSBM Project”** project was launched by the *Indo Italian Chamber of Commerce & Industry (IICCI), Centro Estero Piemonte (CEIP), Italy and Coventry University Enterprises (CUE), UK* and funded by EBTC (European Business Technology Centre) and with the technical support of ICMQ India, is an answer to these needs.

The objectives of the project are:

- **To lay down a set of PEP - Product Environmental Protocols** based on the principles of the ISO 14020 standards for *Cement, Concrete & Mortars, Waterproofing & Insulation, Bricks & Tiles*
- **To define a modular and scalable certification scheme for eco labelling (ISO 14024) and EPD - Environmental Product Declaration (ISO 14025)**
- **To adapt the European best practices to the Indian market** in the field of eco-product certification

The PEPs will be officially launched at the **GRIHA SUMMIT 2016** on **Wednesday, 17th February, 2016** (Juniper, India Habitat Centre; 2 to 5 pm) during a *Technical Presentation & Panel Discussion* with the participation of experts and practitioners will be organized by the project partners, in collaboration with TERI-GRIHA Council.

For more details, you may contact us on Tel: 022-67728186; email: misbm@indiaitaly.com

ENERGY AUDIT AS A STEP TOWARDS SUSTAINABLE URBAN ENERGY MANAGEMENT

Dr Sanjay Mangala Gopal and Meenal Utturkar

Mahatma Gandhi, the great visionary of the modern era, has quoted, "Earth has enough for every body's needs but not for anybody's greed!" (quoted in Reddy & Balachandra 2006). This statement is best suited to describe the cause behind today's global energy and climate disasters. Man has always strived to make his living comfortable by innovating continuously using what is available in nature. This human urge to conquer nature in order to have a better and easier life is motivation for development. Since the industrial revolution, development has galloped in leaps and bounds and there seems to have no limit to its advancement. Technological development has led to economic development and whole world is sucked into this vortex of development which has energy usage as its main criteria. More is the use of energy, more is the development. The nations are categorized as developed, developing, and under developed and one of the bases for this categorization is their per capita energy utilization. The main source of energy has always been burning of wood and fossil fuels like coal, gas, and petroleum products. Use of wood for producing energy has resulted in vast ruction in forest areas. Greenhouse gas (GHG) emissions

which result from burning of fossil fuels are majorly responsible for the global warming, ozone layer depletion, and climate change.

In the late 1980s, world awareness about the environment threats posed by human development increased greatly, in part due to ozone layer depletion, tropical deforestation, the dramatic rise in species extinction, and the realization of the effects of human-induced global warming (Foster 1999). "Global climate change represents the major environmental challenge of the modern era" (Byrne *et al.* 2008: 27). Carbon dioxide contributes more than 75 per cent of greenhouse gas emissions from human activity and more than 95 per cent of those global carbon dioxide emissions are due to fossil fuel burning and land use changes (Byrne *et al.* 2008). Since the 1972 United Nations Conference on Environment and Development, there have been efforts at the global level to employ strategies and means to mitigate the disastrous impacts of climate change (Schreuder 2009).

In spite of the growing awareness and increasing numbers of international treaties, protocols, and agreements on the issue of climate change, the situation continues to deteriorate. The 'usual' technological means of dealing with problems have not

worked. Our entire past progress needs to be reviewed from a new perspective, giving us a clearer vision about our future course of actions, strategies, and proposals. A 'paradigm shift' (Kuhn 1970) is required in our ideas about economic development, lifestyles, and consumption. Human beings are co-evolved with the nature (Norgaard 1994) and need to understand, appreciate, and "co-evolve" with rather than conquer or manage nature. At the same time, living in a society, human beings are social animals (Aristotle 1912 [335-323 BCE]: 1.1253a). Thus, it is important that individuals and society work together to address the pressing issues of our time.

With the advancement of industrialization and globalization, urbanization is increasing all around the globe. Urban centers consume a disproportionate amount of energy and contribute disproportionately to ecological degradation (Byrne *et al.* 2007). For the first time in history, more than half of the world population lives in urban areas. Cities now account for 75 per cent of energy consumption and 75 per cent of carbon emissions. With approximately 50 per cent of the global population now residing in emerging economies that are rapidly urbanizing and developing, the need for green city planning,

infrastructure, and transportation is paramount (UNEP 2011:20).

Energy Scenario and Policies in India

India is a fast emerging economy and, as a part of globalizing world, is following the neo-liberal development path that embraces urbanization and industrialization, tying its future to the global energy system. Indeed, the energy sector is a key in India's urban development and is usually controlled by the private sector. This is resulting in increasing private control over urban economic and social activities, and local people are losing control over their own public spaces. As Foster (1999) suggests, the problem of environmental degradation of the earth is not of nature but of society. Climate change may be a proof of imbalance between our ecology and economy. Rather than indulging in competition, what we may seek to follow is our longstanding tradition of human cooperation to redesign our economic system so that it can meet the challenge of climate change as well as ensuring ability to our descendents to live peacefully later (Cato 2011).

India is the only country which has a dedicated ministry for renewable energy at the central and state levels. "The broad vision behind the energy policy is to reliably meet the demand for energy services of all sectors...through safe, clean, and convenient forms of energy at the least-cost in a technically efficient, economically viable and environmentally sustainable manner" (Planning Commission of India 2006: xiii). Though India is the fifth largest in its power generation capacity in the world, its per capita power consumption

is far below that of world average. Also, according to the report of World Energy Council, 44 per cent of Indian households live without access to electricity (Alva 2009).

In addition, India is not self-reliant in terms of the resources used in the country; the country depends on imported petroleum and oil resources. About 35 per cent of India's current energy needs are fulfilled by imports. Coal is still considered as primary energy resource for electricity production, even for the long term (PSI Media Inc. 2010). India is also significant since it is home to one-third of the world's poor. The socioeconomic disparity in the country is reflected in the access to electricity. Only 6 per cent of rural and 25 per cent of the urban population receives power for 24 hours (Desai et al, 2010). "Even those who have access to electricity suffer from shortages and poor quality of supply" (IEP 2006). Employment generation, sound industrialization, and all-round sustainable development, all do need increased amount of power. However, power is not required for 'sustainable higher growth path' as recommended by Planning Commission of India (2006) but for the sustainable livelihood of society. Mere power generation alone without considering its potential impact on environment, ecology, and society at large may not provide appropriate figures for power demand. Instead of mere focus on demand, it may be worth to consider demand side management as a prerequisite to improve the existing power scenario (Sharma 2010). Without ample considerations for environmental impacts, mere focus on economic growth "irreparably harms the interests of Indians" making efforts futile. (Badrinarayana 2010: 10,711).

The current electrical power industry scenario in India clearly shows its dependence on import of fuels to meet its energy needs. More than 35 per cent of the country's primary energy needs are met through imports (Global Energy Network Institute [GENI] 2010 & PSI Media 2010). The scarcity of conventional resources (Planning Commission of India 2006) on one hand and rising demand on the other, have pushed the Government of India to consider renewable energy sources as an integral part of the country's growth strategy. With increasing population, increasing urbanization, and the increasing growth rate of the country, the gap between supply and demand continues to rise. Renewable Energy Sources (RES) is considered by Government of India as one of the options to meet its future needs (Planning Commission of India 2006). RES also would be beneficial for achieving energy independence and to gaining energy security (Planning Commission of India 2006).

Public Participation along with Sustainable Energy Utility Model as the Way Forward

Although the Indian government has many policies in place for the spread and growth of renewable energy sources, it has advanced to a far lesser extent than expected. The main reason for its unpopularity is the lack of awareness and proper knowledge among common people. Also, there is absence of efficient machinery of technologists, manufacturers, suppliers, and effective marketing as compared to the conventional energy sources. People also very seldom have any access to financing for sustainable choices, and

need to negotiate with complex, bureaucratic labyrinths to obtain any funding (Houck & Rickerson 2009). To overcome these difficulties Dr John Byrne, a Nobel Laureate and Distinguished Professor of Center for Energy and Environment Policy, University of Delaware, has invented and successfully implemented Sustainable Energy Utility (SEU) model in many states of USA. The SEU is an all-inclusive system for handling the energy and environment issues communities at the local and global levels (Byrne & Martinez 2009). The key features of an SEU include a focus on provision of services to meet needs rather than the sale of a commodity, an emphasis on carbon-free energy usage, and the prominence given to community and a democratic management structure. The SEU helps citizens, from both residential and business sectors, conserve, utilize less energy, use energy more efficiently, and generate their own clean, local alternative (Houck & Rickerson 2009; Hughes 2009b). An SEU model is based on simultaneous and synergistic quest of energy efficiency and renewable energy resources (Houck & Rickerson 2009).

Akshay Urja Abhiyan as Citizen's Energy Movement

To foster SEU model for the 'renewablization' of urban centres, there has to be a dedicated campaign for awareness building and technical and service support to build on the awareness, thus created, to result into the increasing utilization of renewable energy sources, use of energy efficient devices, and paradigm of energy conservation. Samata Vichar Prasarak Sanstha,

a 25-year-old NGO in Thane city working basically for the educational benefits for under privileged students has undertaken the task of spreading awareness of renewable energy by starting a campaign, 'Akshay Urja Abhiyan'. The campaign was initialized by arranging a meeting of many distinguished thinkers from different stratas of the society, such as professors, technocrats, government officials, journalists, energy auditors, students, housewives, social activists, and obtaining inputs from their suggestions for the process of energy movement. The first programme it has launched is free energy audit of the common utility of housing societies in Thane city. Since its inauguration by the Mayor of Thane city in May 2015, it has generated tremendous response and more than 120 buildings have participated till date. Certified energy auditors, electricians, social workers, and college students are involved in the process of energy audit. By performing energy audit and submitting the report where along with their current consumption pattern the future course for energy efficiency, energy conservation, and greater use of renewable energy are explained to the members. Members take the initiative and follow the recommendations of energy savings and renewable energy options. The societies who have implemented the immediate recommendations like shifting to LED, smart pump operations with sensors, etc., have observed a marked decrease in their electricity bills.

Energy Audit—Outcome and Conclusion

There are many benefits of this campaign. Common people have become more energy conscious

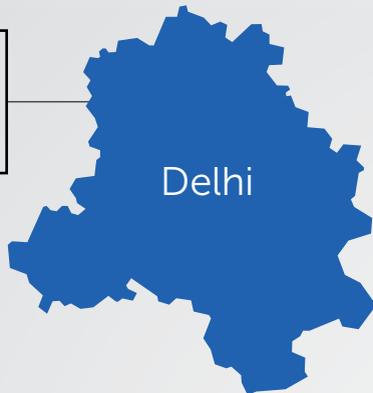
and more aware about energy conservation and renewable energy options. Energy audit is being looked upon as the first step towards achieving optimum energy consumption and reduction in the energy bill. Society members are more willing to participate in the energy management of their society. As they participate in the discussion and presentation of the energy audit team, they become more aware about energy usage in their homes as well as in their offices. This has resulted in many inquiries for energy audits for their commercial premises as well as residential units.

This campaign has the backing of Thane Municipal Corporation which has been declared as the 'solar city' by the Central government and has initiated and implemented many renewable energy projects in the city. The Maharashtra Energy Development Authority has also extended support to the campaign. This process involves many professionals as well as engineering students and students from underprivileged communities. Enrolment of college students as volunteers in this campaign has greatly influenced their outlook towards energy resources, usage, and wastage. They have come to realize the importance of energy conservation and renewable energy resources from the point of view of the future sustainable world. Also, working with energy professionals has opened up a new field of the employment for them. The campaign which aims towards efficient and sustainable energy management seems to be a small but determined step towards sustainable cities and the nation. ■

Dr Sanjay Mangala Gopal and Meenal Utturkar. Email: akshayurja.abhiyan@gmail.com

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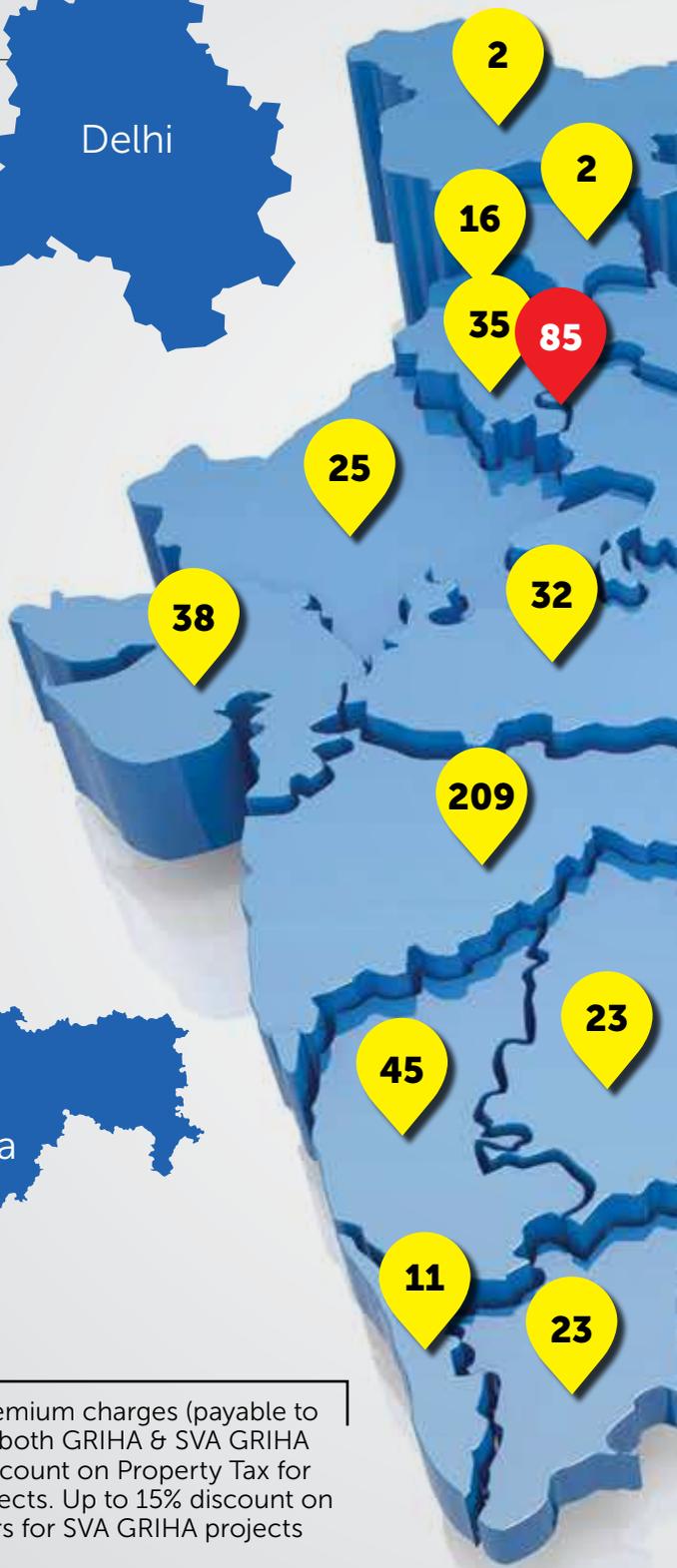
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AUDA: 5% discount on chargeable FAR payable to approving authority

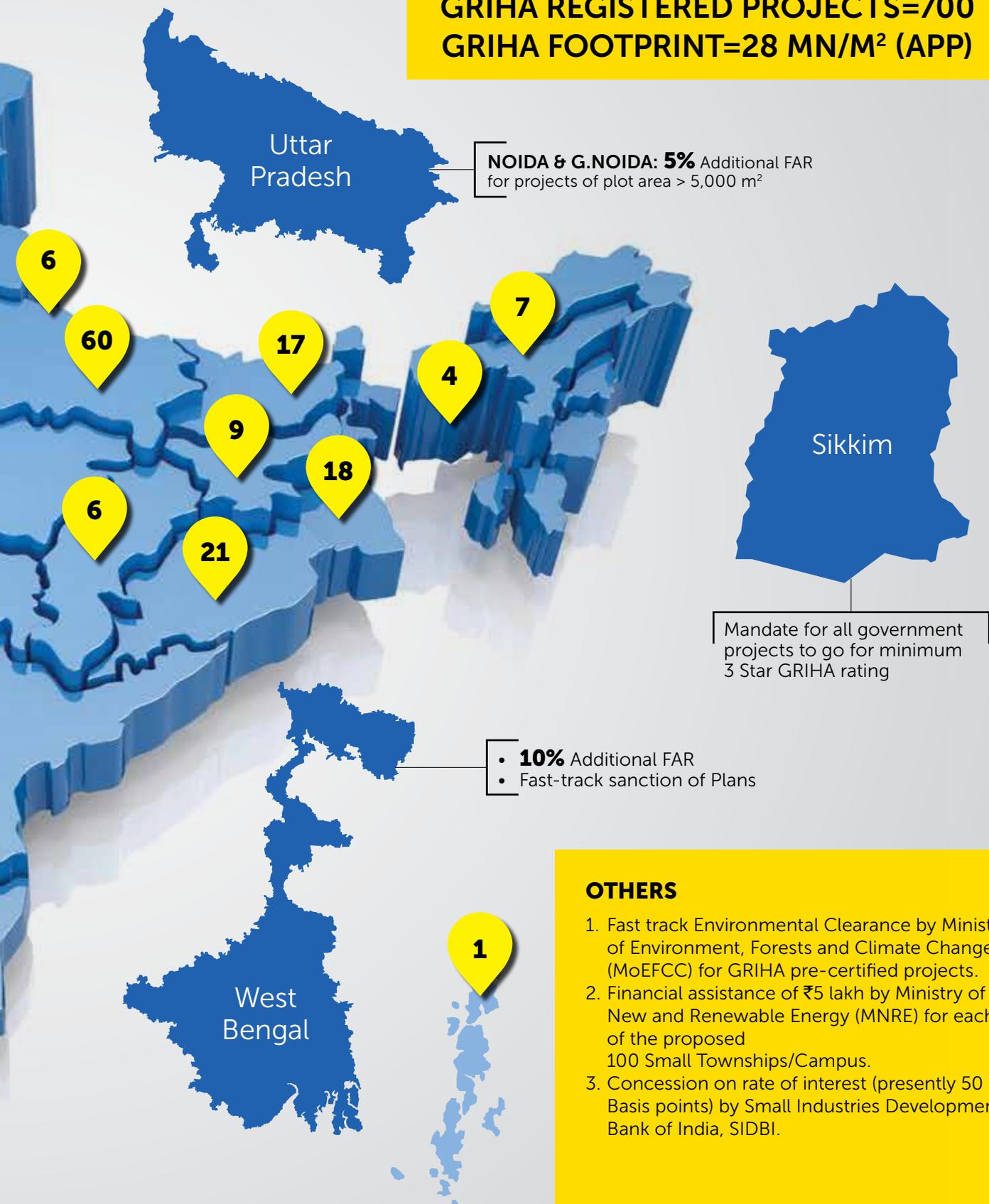
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*The numbers indicated in the map represent registered projects for Rating with GRIHA Council.

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THE DIMINISHING REVERENCE OF WATER IN RAJASTHAN

Ashu Dehadani

This article talks about the various water harvesting systems weaved in the social fabric of Rajasthan, their cultural significance and the delicate balance of such systems in the man–water relation, and the changes with time.

Water is the precious nectar around which human civilization has developed, be it the Egyptian Civilization around River Nile or the Harappan settlements along River Indus. In the absence of a river, people settled around ponds or lakes. Communities all over the world have been endowed with the wisdom of collecting rainwater wherever it falls so one can find such structures all around the world.

Water, being a basic necessity for the survival of life, has been saved, preserved, stored, and revered, particularly, by the residents of desert towns since times immemorial. Rainwater harvesting has been an indigenous technology weaved seamlessly in all desert areas around the world. In Rajasthan, such structures have a history of their own with unique architecture and neighbourhood development in the surrounding areas. The structures constructed for rainwater harvesting have become focal points for many activities of a community. The architecture around such structures shows the need for making water conservation much more than just a fulfillment of a

need. However, with the advent of modern technologies and an exponentially growing society, these water bodies are losing their place in the social fabric.

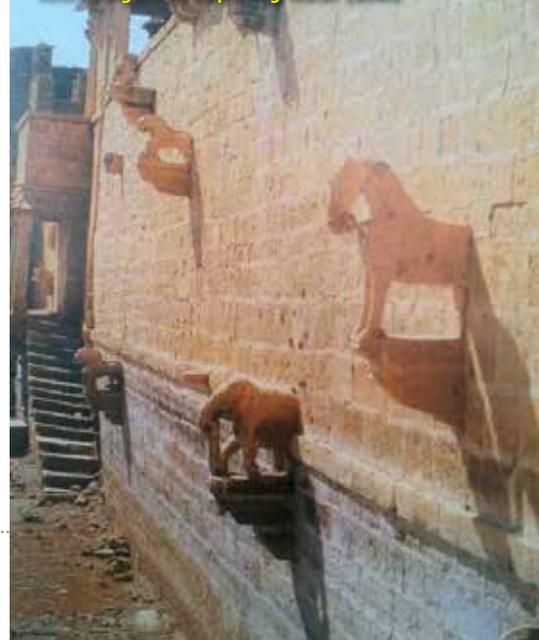
Traditional Water Harvesting Practices in Rajasthan

Water harvesting can be understood as the collection and storage of any form of water—snow or rainfall in a particular watershed. Water harvesting has been adapted in various ways as per the climatic and regional conditions and thought processes of the people. Such is the importance and impact of pure, drinking water on the civilization, that the basic concept has been the same everywhere.

In spite of the fact that water is the first parameter for development of a settlement, the communities of Rajasthan never mourned the unpredictability or scarcity of rainfall. Rather they developed, celebrated, and maintained rainwater harvesting and collecting water bodies, which are thriving till date. The people weaved their lives around the ponds or *talabs* in a manner that these structures became an

integral part of their folk tales, rituals, festivities, which resulted in making them a collective responsibility. The semi-arid state of Rajasthan is dotted with various water collecting structures, which lie redundant with the advent of British Raj and then independent India. Before that such structures were a communal responsibility. In 1863, the Public Works Department (PWD) was created, thus withdrawing local control (of the village community) from *johars* and *talabs*. It marked the end of the community's interest for their upkeep and their attitude of religious reverence for the water bodies.

Animal Figurines Depicting Water Levels



The architecture around the water bodies has always celebrated the life of the community around. It is a manifestation of the ideas, needs, and the culture of the people of the particular era and place. These spaces nourish the community emotionally and spiritually. The arched pavilions, for instance at Abaneri, Jaipur, around a water body provided refuge to the people. They acted as a place to sit and talk during the extreme hot weather, protected from the dusty, hot 'loo'.

The stepwells have been socio-religious institutions manifesting the indigenous architecture of the area. The structure pushed deep into the earth has its own practical reasons of insulation and shade but such spaces have been used as resting and gathering spaces. Despite their functional desuetude of fetching water in today's context, they continue to inspire visitors till today. And even now, few are functional in cities like Jodhpur, for instance, Tapi Bawri has water round the year. It's been a place for the local children to learn swimming and the Water Works Department still supplies water from it although it creates a sense of despair in the viewer's mind with the garbage lying around.



Tapi Bawri, Jodhpur City

The Shekhawati '*Kuan*', an elaborate structure with a tall pillars, raised platform, and painted *chattris*, used to act as a meeting place for the village women and as a *chaupal* for the elders.

Water is such a precious commodity that such places were treated like temples. Even the current water level of a pond was not depicted with simple markers but elaborate animal figurines which were the base of legendary stories. Galtaji is an ancient Hindu pilgrimage site situated 20 km from Jaipur. It is an amalgamation of temples, pavilions, holy *kunds* (water tanks), and natural springs. The famous Galta Kund, one of the seven kunds, does not ever go dry. The Galtaji Temple is a souvenir of the former age and a sacred pilgrimage of the Hindus. Even, Sawai Jai Singh based the location of 'Pink City', as Jaipur is popularly known, as if it's been watched and guarded by the temple.

The Kos Minars built during the reign of Akbar are simple Minars marking the distance in 'kos' or 3 km. Besides keeping the royal entourage on track, they helped travellers reach their destinations without losing their way. There was a stepwell built around every tenth Minar that had a steady supply of cool drinking water for the weary traveller. This also served as a vital spot for communication as a drummer and a horse mounted soldier were deployed at all these Minars.

The old city of Jodhpur was designed with the foremost aim of collecting rainwater and storing it optimally. The Fort of Jodhpur is flanked on one side by the revered Ranisar and Padamsar which supplied water to a very large segment of the old city. Their auspicious and royal status made sure of the sanctity of

water and even today, the water is clean.

Whereas the talabs like Fateh Sagar have lost their place and transformed into a dumping ground. This talab had witnessed the celebration of Doodh Poonnima with hundreds of floating diyas each year. Now the deep foundations of residences all around have disrupted the underground flow to the water body.

Conclusion

The traditional water harvesting bodies in Rajasthan have been very different in comparison to the water features incorporated in design all over the world. Here, water becomes the lifeline of a community. It's not a bare ornament, but a live, breathing phenomenon.

Rajasthan is the largest state of India with an area comprising 10 per cent of the total geographical area of the country and only 1 per cent of the total surface resources of the country. The rivers of the state are rainfed and are classified into 14 major basins with a per capita availability of 780 m³. The traditional rain water harvesting systems can be the answer to water logging and salinity generated by large-scale projects, such as Indira Gandhi Nahar Pariyojana. In cities like Jodhpur, there existed an intricate network of such structures which were the life of the community in every sense. With the growing water crisis, it's the duty of an architect or a planner to design such rainwater harvesting structures that are connected with the cities' urban landscape and people feel the need to preserve and protect these city sculptures. 

Ar Ashu Dehadani, Project Officer
(GRIHA Council)

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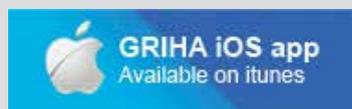
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FUEL CELL: A PROMISING GREEN TECHNOLOGY FOR BUILDINGS

Amar Nath

Domestic sector is the second largest consumer of electricity; attention should be paid towards the increasing efficiency and reducing demand for electricity in domestic sectors. At present, domestic sectors depend mainly on electricity which comes from conventional fuel-based power plants. Since, conventional energy resources are limited in nature and will exhaust after a certain period of time; moreover the reckless consumption of fossil fuels will create multi-dimensional problems to human beings. Hence, there is a strong need to look for some alternative which could fulfill the requirements in such a manner that it should be long-lasting and also be a source of clean energy production.

Fuel cell is one of the answers to the above problem. Fuel cell is an electrochemical device which converts chemical energy of fuels (such as, hydrogen, natural gas, methanol, gasoline, etc.) into electrical energy. This conversion takes place as long as

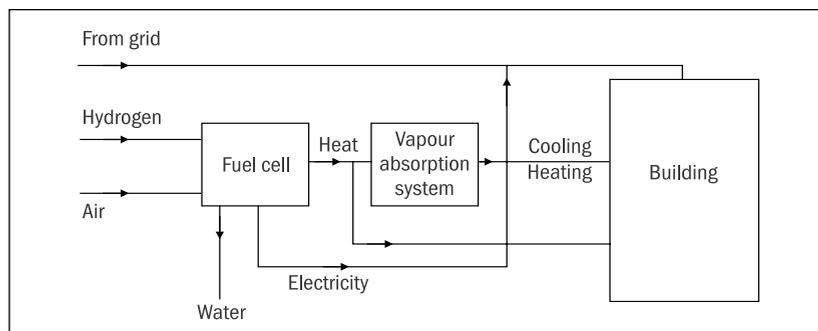
fuel and oxygen is supplied to the electrodes of the fuel cell. In this process heat and H_2O come out as by products.

The concept of fuel cell for providing power to buildings is increasing nowadays. This is simply because of its clean and noise free energy production, fuel flexibility, reliability, extended run time, low/zero emissions, energy independence, and improved efficiency as compared to other conventional fuel-based power plants.

There are different types of fuel cells. Classification is done on the basis of different backgrounds; one of them is the type of electrolyte used in it. The classification is stated below:

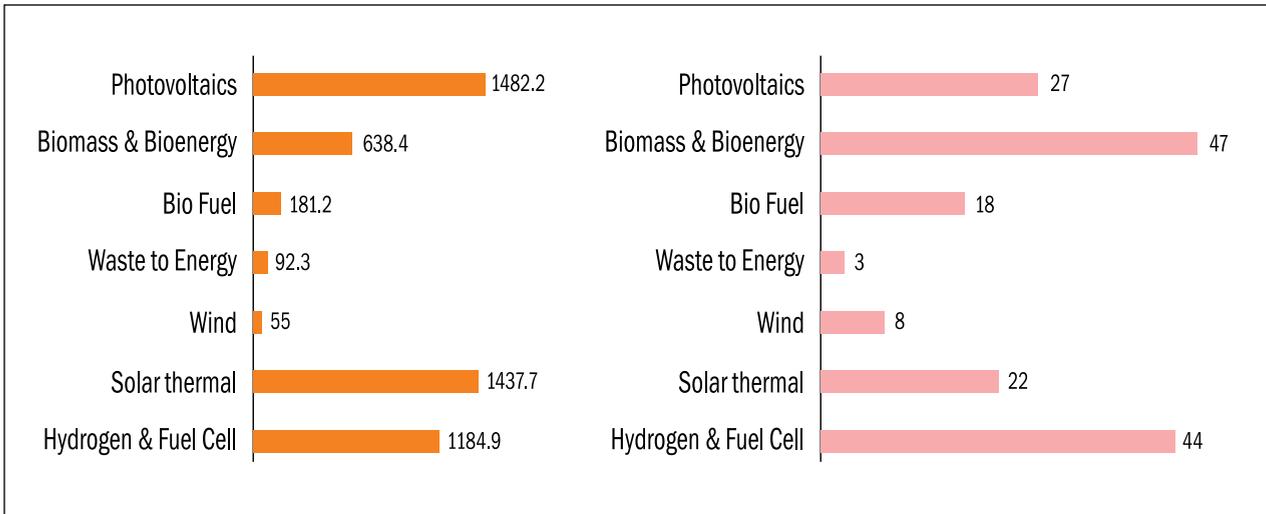
- Polymer electrolyte membrane fuel cell ([PEFC] 2). Alkaline fuel cell (AFC)
- Phosphoric acid fuel cell (PAFC).
- Molten carbonate fuel cell (MCFC)
- Solid oxide fuel cell (SOFC direct methanol fuel cell (DMFC)

Fuel cell can fulfill electrical and thermal needs of a building. Combined heat and power (CHP) systems based on Polymer electrolyte membrane fuel cell (PEFC) and Solid oxide fuel cell (SOFC) are most suited for these kind of applications. In comparison to coal, the efficiency of fuel cell is about 35–45 per cent when used as standalone as compared to the coal-based power plant which has an efficiency of about 32 per cent. When it is used as a CHP, its efficiency increases to 80–90 per cent. A natural gas PEFC fuel cell system comprises of (i) a fuel cell stack, in which the chemical energy contained in hydrogen is converted into electricity, (ii) a fuel



Block diagram showing a typical fuel cell based CHP system





R&D and efforts during 11th five year plan

(Source: IPHE official website)

processor, which converts the hydrocarbon fuel into a hydrogen-rich mixture that can be used in the stack, (iii) heat recovery equipment, and (iv) auxiliary systems, such as compressors and pumps. The generated electricity is direct current (DC) which can be utilized in the building directly or it can be first converted into alternating current (AC) with the help of inverters for general use in the building. Heat is a

by-product of the process. This heat can be effectively used for many applications, for example, hotels can use generated heat for heating water of their swimming pools, individual buildings can use the same to produce hot water for shower, or this heat can also be used to heat the building or to cool the building with the help of Vapour Absorption Machine (VAM).

Life cycle analysis shows that the carbon intensity of electricity generation from an SOFC fuel cell is estimated to be about 400g/kWh which is much lower than coal based power plants (900g/kWh). Solar PV and wind turbine are also emerging as renewable energy sources in India, however, they have limitation in terms of availability of sun insolation and wind flow, respectively, and hence are not completely reliable. However, a cogeneration system, coupled with solar PV and fuel cell is the most effective solution for continuous and effective energy resources. Fuel cells run on hydrogen, which can be obtained from many sources such as, ethanol, methane, and propane. Natural gas, a conventional hydrocarbon fuel is rich in methane and can be used as a fuel

with the help of a reformer which extract the hydrogen from it. Hydrogen can also be generated from many other processes, such as electrolysis of water (however it consumes a lot of energy), or through *E.coli* bacteria. There are many manufactures who offer fuel cells for energy production at household level. The capacity of these fuel cells ranges from 1kW to 5kW. Some of the companies who are pioneer in this domain are AFC Energy, Tropical S.A., Bloom Energy, Ceramic Fuel Cells, ITM Power, Ceres Power, etc.

Commercially available fuel cell systems are very easy to install. Input of the fuel cell system needs to be connected with the natural gas supply and with deionized water supply of the building. The output is to be connected with the building's electricity board and space air-conditioning system. The system will then use the natural gas supply to generate hydrogen which is then used to feed the hydrogen fuel cell system. The fuel cell's electro-chemical process that combines the hydrogen molecules with oxygen will generate electricity as well as thermal energy to heat water and can be used for air-



conditioning purpose. Japan and South Korea are leading in fuel cell CHP system. The Japanese government has provided support for the commercialization of fuel cells in residential heat and power through the Ene-Farm scheme. The UK provides a feed-in tariff for renewable generation devices up to 5MW, also for residential fuel cell CHP systems of any fuel type up to 2kW. Germany is the European leader in the uptake of fuel cell micro-CHP systems. Some other countries which have shown interest in Fuel Cell

technologies are China, Denmark, Iceland, the Netherlands, Norway, and South Africa. In 2010, IPHE (International Partnership for Hydrogen and Fuel Cells in the Economy) members invested over \$1 billion for hydrogen and fuel cell RDD&D, and subsidies for technology deployment.

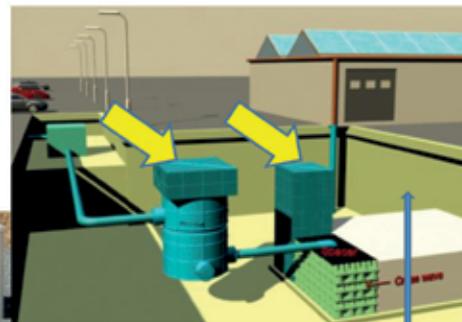
India was the fourth-largest consumer of crude oil and petroleum products in the world in 2013, after the United States, China, and Japan. However, in terms of its funding for growth and development of hydrogen

and fuel cell, its contribution is much less as compared to other countries. More attention and funding are required to make the growth of fuel cell sustainable in nature. In a country like India, where electricity supply is so unreliable and unpredictable, policy level intervention is required from bureaucrats to come up with some concrete solutions for effective adoption of such type of a clean energy production technology. ■

Amar Nath, Freelance Energy Consultant, New Delhi.



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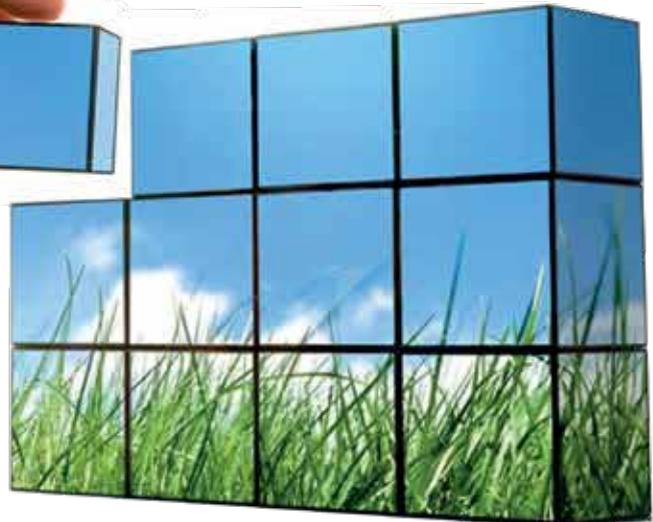
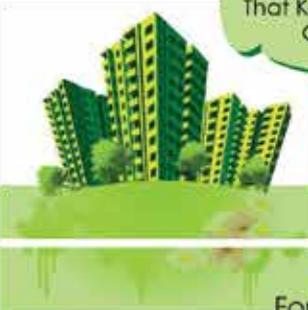
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Built up Area	: 19,768.52 m ²
Typology	: Residential
Air-conditioned Area	: 4,942.13 m ²
Non Air-conditioned Area	: 14,826.39 m ²
Energy Consumption Reduction	: 80.64 per cent reduction in energy consumption compared to benchmark EPI
EPI	: 20.45 kWh/m ² /year
Renewable Energy	: Rated capacity of solar PV installed on site is 16 kWp
GRIHA provisional rating	: 3 Stars
Year of completion	: 2014

Integrated Design Team

Client

Goel Ganga Development

Coordinator

Mr Sagar Kumbhar

Principal Architect

Ar Parvez Jamadar & Associates
and Ar Jagdish Deshpande & Associates

Landscape Architect

Ar Mahesh Chinchalkar

Green Building Consultant

Eco Solutions, Pune

The following strategies were adopted to reduce the building impact on the natural environment:

Sustainable site planning

- The site planning has been done in a manner to maximize the cross ventilation within the buildings.
- Drainage has been planned according to the site topography for gravity flow.
- 810 new trees have been planted on site.
- Utility corridors have been designed along roads and pathways on site.
- 865.45 m³ of top soil which was excavated from the site was stored and later used for landscaping on site.

Reducing water consumption

- Use of low-flow fixtures and fittings help reduce building

water use by 51 per cent from GRIHA base case.

- Reduction in landscape water demand by 37 per cent against GRIHA benchmark using less lawn area and more native trees.
- By use of RMC and ponding techniques reduction in water consumption during construction.

Reducing energy consumption (compared to GRIHA benchmarks) while maintaining occupant comfort

- For achieving visual comfort: More than 75 per cent of the total living area is day-lit in all the blocks and meets daylight factor as prescribed by NBC 2005 SP41.
- Glass installed has an effective SHGC value less than 0.45 which in combination with the shading devices has reduced the heat gain into the building.
- ECBC compliant motors,

transformers and pumps have been installed in the project.

Renewable energy technologies installed on site

- Sixteen per cent of internal lighting requirement of the project is met by solar PV installed on the rooftop of the project.
- Renewable energy based hot water system is installed on site, which helps in saving of 34 per cent of electrical energy.

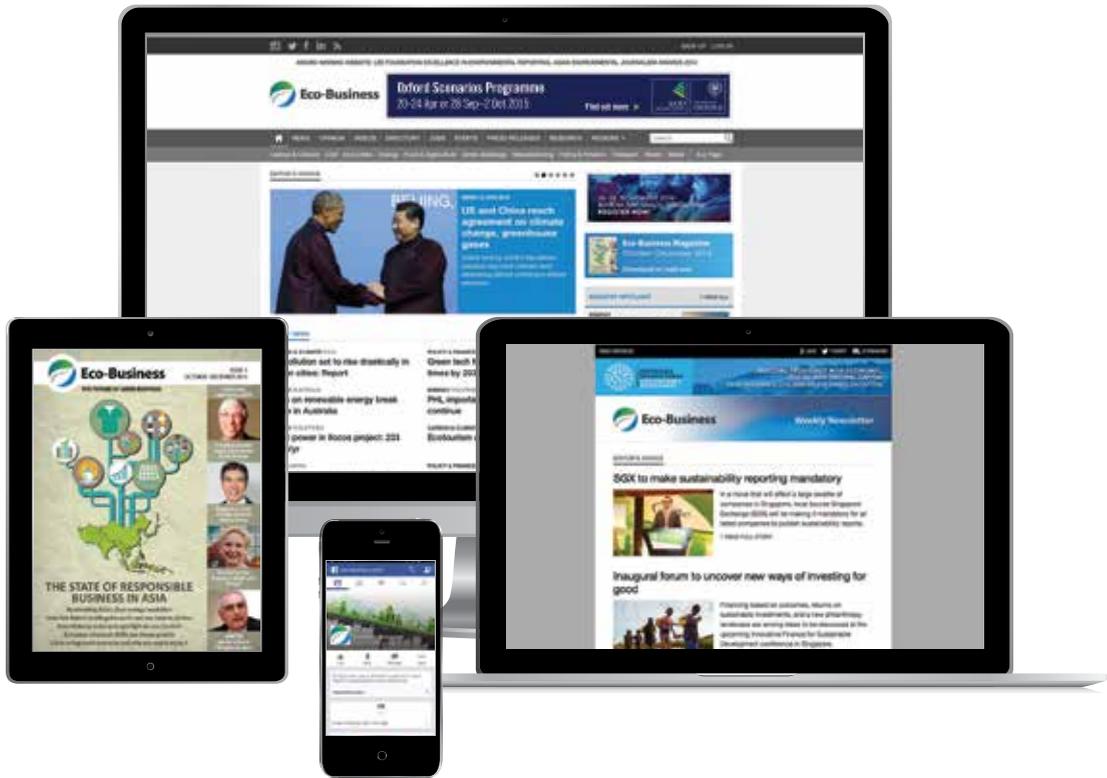
Use of low energy materials

- Flyash bricks were used for improving concrete performance.
- PPC with a content of more than 25 per cent flyash has been used for structural, plastering, and mortar.
- Low VOC paints, adhesives and sealants are used in the project. 



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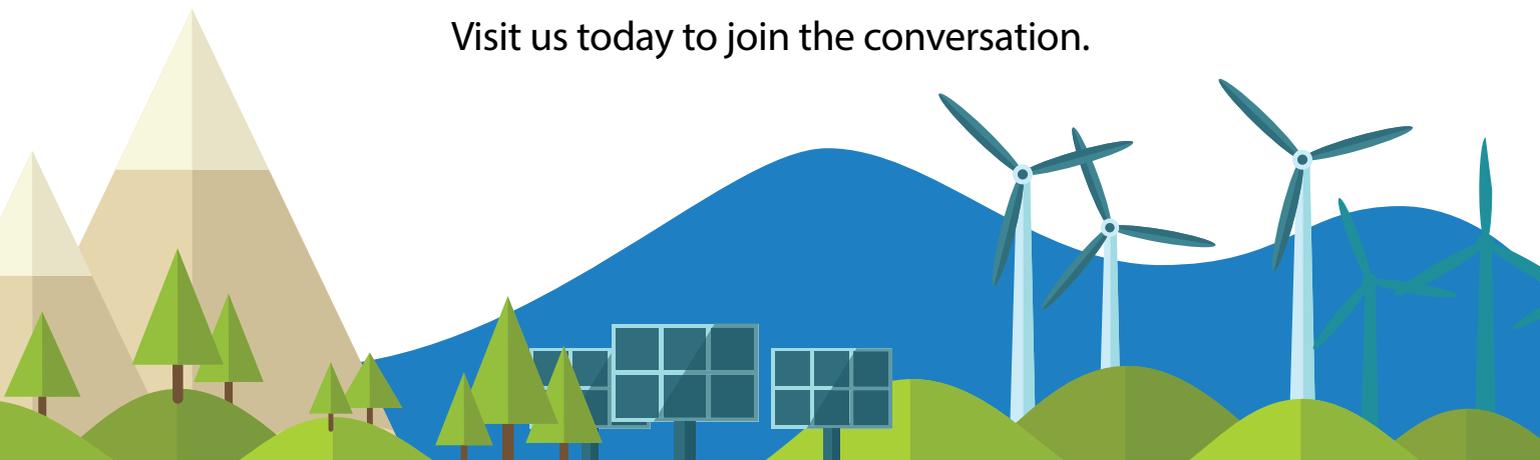
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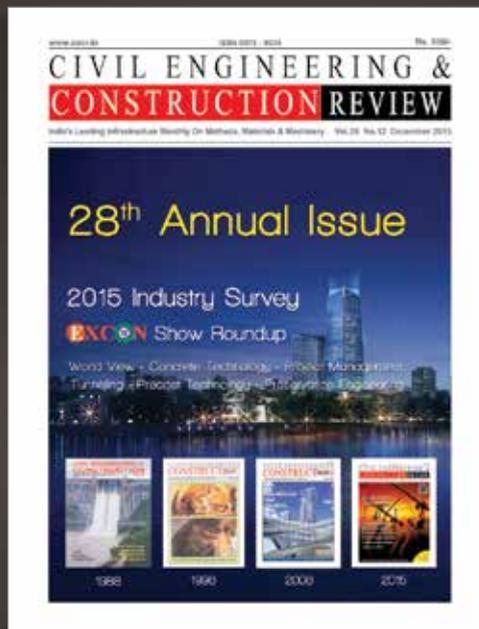
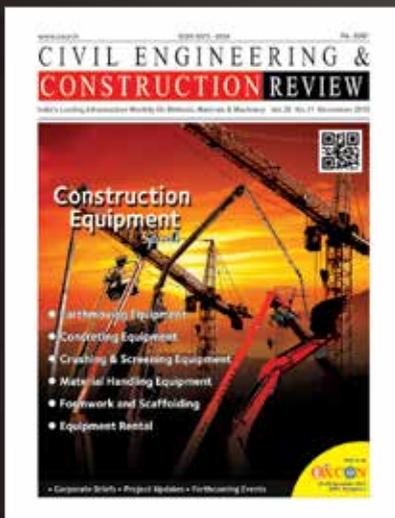
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PHOTOSYNTHETIC FAÇADE SYSTEM

Reshmi Ghosh



Source: www.algaeenergy.weebly.com

As the earth is sprinting towards a slow decline, initiated by the callous nature of humans, an initiative to adopt 'Green Buildings' will ensure the decline is checked. Statistics show that 40 per cent of the total carbon dioxide (CO₂) emissions are contributed by buildings in the US. In a developing country like India, this percentage will be much higher, owing to the malpractices followed at construction sites. As more and more high risers

are adopting reflective glass façades and larger window-to-wall ratio designs, it is leading to higher solar heat gain, resulting in increasing the load on HVAC (Heating, Ventilation, and Air Conditioning) systems to cool the building.

Owing to the growing energy demands of the buildings, architects and engineers have now proposed a sustainable solution—photosynthetic façade system. A photosynthetic façade is an integration of glazing

system and algae bioreactor. This unique combination of algae in a glass system is set to replace conventional glazing systems by providing thermal insulation, structural integrity, adequate day light transmission, and shading capability. This system will also result in improving the indoor ambient air quality by absorbing carbon dioxide and giving out oxygen during the process of photosynthesis and, hence, the name photosynthetic façade system. Another major benefit is

that the algae grown in the algae façade system can be converted into renewable fuel stocks, such as biomass or biofuel. A typical photosynthetic façade system consists of an algae bioreactor system, integrated between two glazing systems.

The bioreactor system is contained between two sheets of acrylic where the algae grow in a nutrient-rich liquid. A 'vision zone' and an 'algae-growing zone' are configured to offer good energy and structure performance. An unobstructed vision zone allows viewing, daylighting, and ventilation where necessary. The algae-growing zone is a water cavity containing algae cultures. The algae growing apparatus is made up of distribution pipes and mechanical systems, including an air pump, a water pump, and an algae filtration system.

The photosynthetic façade system is slowly gaining recognition in developed countries. A leading construction company, Arup manufactured its own photosynthetic façade system product called SolarLeaf. This product was used for the largest 5-storey building with algae façade system, the Bio Intelligent Quotient (BIQ) building in Hamburg, Germany.

SolarLeaf's bioreactors comprise of four glass layers. Either side of these panes with insulating argon-filled cavities help to minimize heat loss. Compressed air is introduced to the bottom of each bioreactor at intervals. The gas emerges as large air bubbles and generates an upstream water flow and turbulence to stimulate the algae to take in CO₂ and light. At the same time, a mixture of water, air, and small plastic scrubbers wash the inner surfaces of the panels. SolarLeaf integrates all servicing pipes for the inflow and

outflow of the culture medium and the air into the frames of its elements. A central building management system controls all the processes necessary to operate the bioreactor façade and to fully integrate it with the energy management system of the building. This includes the control of the algal cell density and the temperature in the culture medium. The heat obtained from the façade has a temperature of about 40°C and is either used directly to heat water or is stored in the ground by use of a geothermal system. The system can be operated all year long. The efficiency of the conversion of light to biomass is 10 per cent and to heat, 38 per cent. For comparison, photovoltaic systems have an efficiency of 12–15 per cent and solar thermal systems 60–65 per cent. Hence, the bioreactor façade is competitive, relative to these other technologies. In addition, bioreactor facades remove CO₂ from flue gas at quantities equivalent to the build-up of biomass and thus, reduce the CO₂ emissions from buildings and help to improve the overall CO₂ balance. The Bio Intelligent Quotient (BIQ) house has a bioreactor façade, which is expected to produce biomass of 30 kWh/m² per annum and heat energy of 150 kWh/m² per annum. In total, the façade will reduce the CO₂ emissions of the building by 6 tonnes per annum and in addition, eliminate 2.5 tonnes of CO₂ per annum. The building is specifically designed to achieve synergies between the façade and the other systems (e.g., the building technology, energy and heat distribution, and water circulation systems) as well as to minimize CO₂ emissions. In the plant room, the heat is removed from the culture medium

by a heat exchanger and either directly used in the building or stored. The generated biomass is harvested by a separator from the culture medium automatically. Besides controlling all parameters affecting the biochemical processes, the building automation system can alter the orientation of the elements towards the sun so as to control the production of biomass and heat as well as the shading and sound absorbing capacities. A Rockwell SPS system manages the entire process.

Some salient features of the SolarLeaf panels designed by Arup include, a bioreactor façade producing high value biomass. It provides dynamic shading and increases the thermal and acoustic performance. It is ideal for south facing windows and can reduce carbon footprint of the entire building, making it a greener solution in this fast-aging planet.

The Bio Intelligent Quotient house in Germany stands out as an example to the world, on how the integration of living organisms in the inorganic components of a building can result into fruitful reduction of greenhouse gases. Similar technology can be applied to office buildings in the cities of India, which are designed with complete glazing system on all four sides with a glass of higher solar heat gain coefficient. It can also be applied to industries for the generation of heat, which will be fuelled by the reaction of algae in the bioreactors. Though the initial set up cost is very high in the current scenario, further research will enable us to use it in an economical way. Thus, the potential of a 'green' solution to the emerging energy demands of the buildings and industries should be harnessed. ■

Reshmi Ghosh, GRIHA Evaluator



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STUDENT AWARENESS PROGRAMMES CONDUCTED IN 2015

GRIHA Council organizes a green building training programme for students from construction field. It focusses on sharing the knowledge about green buildings and idea of sustainability with our future generation.

The programme is divided into different sessions, designed in a way that the students acquire both practical as well as theoretical knowledge from the world of green buildings. These sessions include field trips/exercises, presentations, and group discussions.

The organized sessions included presentations conducted by GRIHA officials. The main focus of these presentations is to disseminate knowledge regarding rating process, criteria requirements, and compliance measures for different variants of rating provided by

During Site Visit/Hands-on Exercise



Amity
School of
Architecture,
Noida

During Workshop



During Site Visit/Hands-on Exercise



Chitkara
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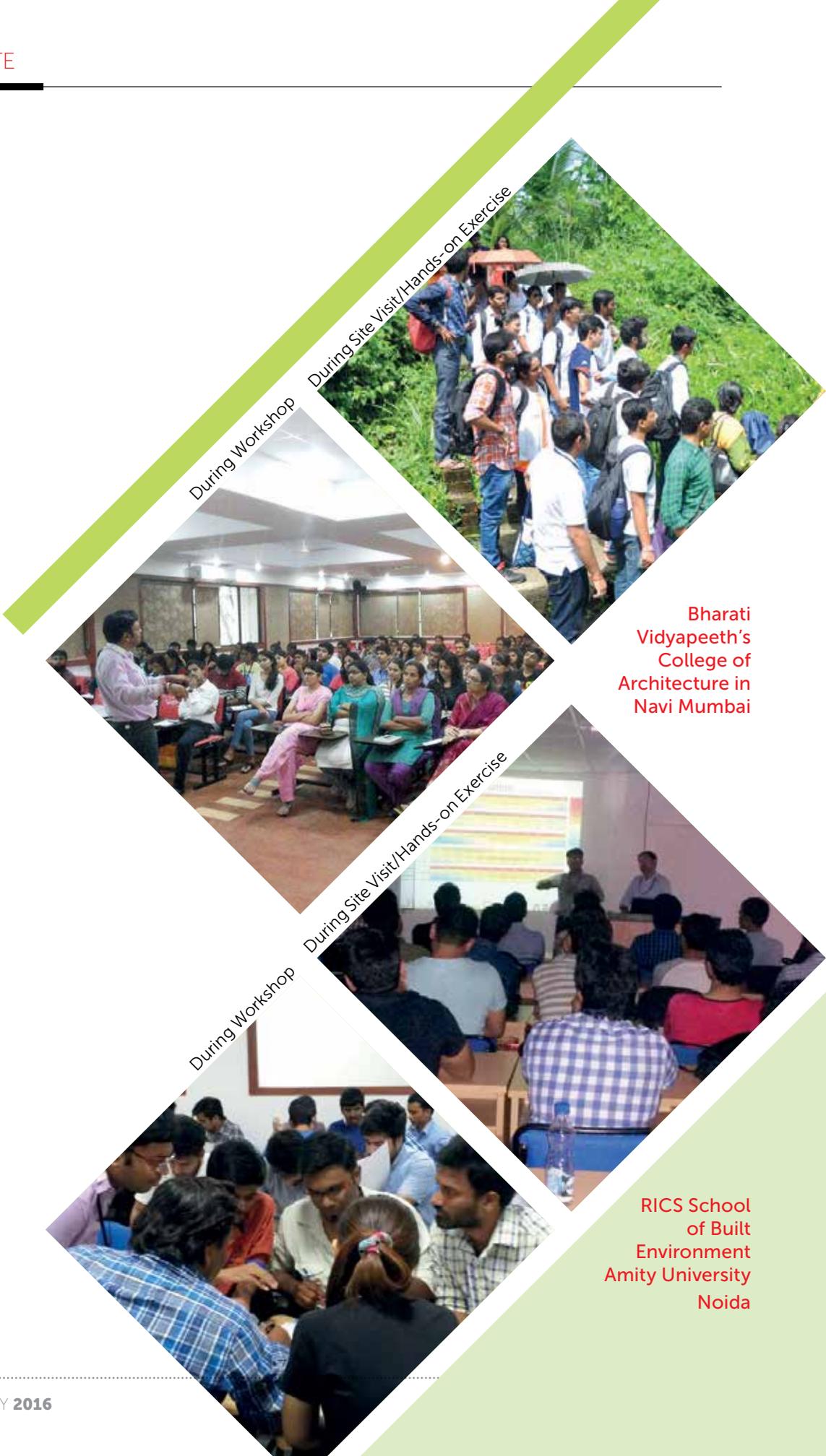
During Workshop



GRIHA Council, i.e., GRIHA, SVA GRIHA, and GRIHA LD are discussed.

The field exercise is organized with an idea of showcasing green measures implemented in net-zero buildings. The field visits and exercises help students to better understand the importance of designing buildings keeping in mind the visual, thermal, and acoustic comfort of the occupants of the building.

In the previous year, eight student programmes were conducted across the nation. The programmes received overwhelming response with more than 550 students and 50 professors/lecturers/professionals benefitting from it. Site visits were conducted to Indira Paryavaran Bhawan, New Delhi; Govardhan Ecovillage, Navi Mumbai; and Akshay Urja Bhawan, Panchkula. These GRIHA 5-Star rated projects have implemented many green features, which make them suitable as case studies for students and professionals from the architecture and construction field.



During Site Visit/Hands-on Exercise

During Workshop

During Workshop

During Site Visit/Hands-on Exercise

**Bharati
Vidyapeeth's
College of
Architecture in
Navi Mumbai**

**RICS School
of Built
Environment
Amity University
Noida**

The purpose of these awareness programmes was to demonstrate the green innovations and technologies that are being incorporated in the building design. The programmes gave the students an opportunity to explore green buildings and to understand the importance of going green.

School of Planning and Architecture; and Faculty of Architecture and Ekistics - Jamia Millia Islamia, New Delhi

During Site Visit/Hands-on Exercise



During Workshop



During Site Visit/Hands-on Exercise



During Workshop



**Sushant School of Art and Architecture
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A young woman with dark hair, wearing a white sleeveless dress, is smiling warmly while holding a baby wrapped in a white blanket. She is in a bathroom, with a sink and faucet visible in the background. The lighting is soft and natural, creating a warm and intimate atmosphere.

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