SUSTAINABLE BUILT ENVIRONMENTS
ROADMAPS FOR THE FUTURE

With development, we are losing our cultural strength and becoming unsustainable. The need of the hour is to learn from our past and make our current growth sustainable with modern technologies. There is a need to tailor the solution as per our needs. In this article, **Akash Deep** elaborates on sustainable development in the building sector. He discusses the need for the management of energy and water through proper planning and use of sustainable sources, such as, wind, solar, and biogas, and emphasizes on finding local solutions for sustainable development.

Knowledge Versus Information

'Knowledge is one of the biggest tools' is a very old saying but most apt in the current times. With the growing and evolving IT sector, the physical distances between the human world have been bridged with the 'Internet'. This has resulted in the transfer of information in a split of second across the world. Owing to this, a lot of information is available for us to grasp and act accordingly.

Human action is generally the outcome of reasoning and informed decision. However, lately, with the vast information available on our fingertips, this often results in our impromptu reaction, making us less reasonable. It is said that reasoning ability is what makes us human. However, current times are contradicting our human nature.

The act of sorting the vast information and taking an informed decision after processing is possible only with knowledge. There is the saying that 'the easiest and shortest path is not always the correct path'. Probably after acquiring the knowledge, it will be possible for us to choose wisely. One such case that requires our urgent attention to choose wisely and take informed decision is 'sustainability'. The term in itself has so much meaning that it requires us to understand before we act. Interestingly, in today's time, sustainability is linked with almost each of our daily lives without even knowing how it needs to be addressed.

In its individuality, the word 'sustainability' means something that cannot end and that can sustain, that is, unending. However, we all know that in our materialistic world everything changes and comes to an end. So, does this mean that true sustainability is not possible? Nothing is constant, which means it can degrade or regenerate. Now the existing sustainability concept is not helping in regeneration. So does this mean that we are just trying to slow down the degradation? But then slow degradation cannot and should not be termed as sustainable as the current path leads to an end and it is not sustainable.

So Can We Become Sustainable?

The answer to this lies in our ancestral knowledge and culture. With development, we are losing our cultural strength and becoming unsustainable. The need of the hour is to learn from our past and make our current growth sustainable with modern technologies. However, in the run for development, we are aping other countries, thus making the adopted strategies non-local and unsustainable. With globalization, we try to find solution of our problems outside the contextual area and implement the learning without tailoring the solution as per our needs.

Sustainability has been the base of our culture, whether it is food, lifestyle habits, buildings, clothes, and so on. India being a large country with diverse climatic conditions is the best example of local but climate-responsive solutions in the past. The clothing style of each region was linked to its culture and in turn associated with the local climate, facilitating ventilation in the hot and dry season across the subcontinent.

Even the food habits were localized but climate responsive, for example, spicy and hot food to facilitate perspiration and in turn cool the body with forced ventilation in hot and dry regions and light and easy to digest food with less spice in the coastal region to produce less perspiration. The basic philosophy of life was also in sync with the Nature, that is, 'rise with the sun and sleep with the sun', making our lifestyle sustainable and less dependent on unsustainable sources of energy.

One of the most resource-intensive and unsustainable areas, which is the

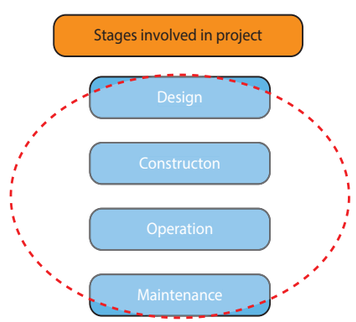
gift of our unreasonable growth and development, is the 'building sector'. Our ancestral design and planning philosophies along with the use of local materials reduced our demands of high embodied energy systems and materials and in turn provided us with the basic needs for which we make buildings, that is, 'visual, thermal, and acoustical comfort'. However, lately aping the Western culture in lieu of modernization has left us on the brink of biggest resource crunch.

Building sector majorly depends on the consumption of three primary resources, that is, energy, water, and materials, and produces huge amounts of the secondary resource, that is, 'waste'. If any of these resources are not managed and reduced properly, they will result in unsustainable development. Each of these resources has a key role to play if we aim to achieve sustainability. Of late, sustainability has been linked to systems and commercialized. It has lost its true meaning and contradicts the basics, that is, 'sustainable is affordable and affordable is sustainable'. In our times, it is thought to be a costly affair and at the same time considered as a stingy behaviour. We need to understand the difference between development and planned growth if we wish our future generations to survive.

Built Environment Not a Lost Cause

Currently, the green building movement is picking up pace in the Indian construction industry. However, the projects need to understand the affordable nature of sustainability and implement accordingly. When the aim is sustainability, resource efficiency is the most integral part of the process. There is always demand and supply side management when considering the efficiency of any of the resources. Lately, sustainability is linked more closely with supply management rather than demand reduction. In both energy and water resources efficiency, it is imperative that we start reducing our demands and following the reduction mitigate it through sustainable sources, such as wind, solar, and biogas, in case of energy and treated wastewater and rainwater in case of water.

Sustainability in a project is a life cycle commitment. In regard to buildings, it starts with design, continues through construction, and is maintained during operation and maintenance phase. If there is mismanagement at any stage, the whole concept of sustainability takes a hit. For example, if a project is designed keeping in mind the climate-responsive architecture, but there is a lot of wastage during the construction stage, the project is not sustainable. Similarly, if the design and construction are sustainable, but the maintenance team is not aware of operation phase requirements, all efficient systems will also not work and result in high energy



and water bills with lots of wastage of resources. Finally, if the base, that is, the design itself, does not have local climate-responsive features, none of the teams during construction or maintenance can help the project achieve sustainability.

Designing the Cost-free Solution

Design is the easiest and free of cost solution available to us to promote sustainability. Owing to commercialization of sustainability, it is often linked with various technologies, rather than cost-effective solution. However, technologies are promoted by industries. It will be interesting to note that the passive design solution does not have any marketing funds available and is not directly promoted. The passive design solutions help in saving both capital and operating costs in most of the buildings. If the right choices are made at the right time, sustainability cannot be costly.

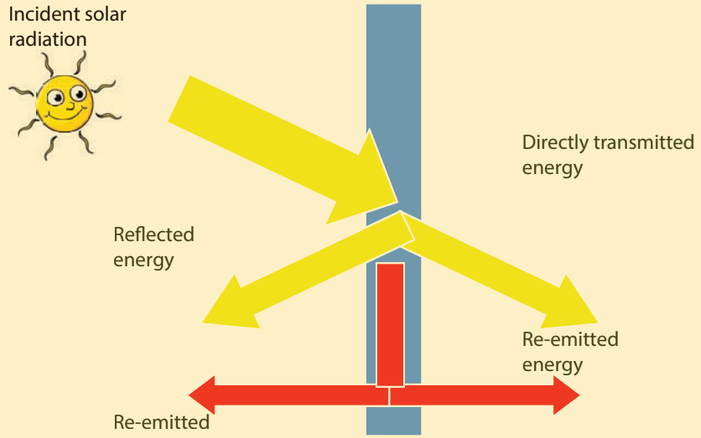
Modernization has forced our buildings to be aped from the Western designs and pushed for excessive use of glass in the building structure. However, our climate is majorly hot and dry in most of the regions, and most of the time due to the excessive use of glass and concrete, there is increased demand for air conditioning, which in turn increases our outdoor temperature. A very apt example to understand the issues of excessive use of glass in a building can be understood by how we look for shaded areas when parking our cars. The reasoning for this is simple: the car gets heated if parked without shade. The materials used for car are glass, metal, and plastics, while the materials used in buildings are glass, concrete, and steel. All these materials have much higher specific heat, which allows more heat to be absorbed. But when we are designing our new buildings, we always prefer curtain glass buildings. When we need to park a car for 2 h, we look for shade. However, in case of designing a building that would last for 50–80 years, we prefer glass building.

GLASS SELECTION TIP

Use of glass contributes to heat and light inside the building, and so when selecting the glass, it is important to consider the properties of glass to evaluate whether it suits the project or not. The heat intake from glass is contributed by its U factor and solar heat gain coefficient (SHGC) value, while the amount of light permitted by glass is governed by visual light transmittance (VLT).

Total heat gain in glass = Heat gain due to direct solar radiation (SHGC)** + Amount of heat transferred due to temperature difference (U value)

** Lower the SHGC, better the gain.



IRRAD (Institute of Rural Research and Development) complex shading design

Source: Ashok Lall Architects

Also, the excessive use of glass is supported by an argument that most of the building owners wish to have more daylight. Interestingly, increased use of glass in buildings does not contribute to excessive daylighting. However, it does increase the heat gain from glass and in turn increases the air conditioning load of the building. Optimization of glass use is very important along with proper shading design, which helps in reducing both the cost of glass and the energy consumption for lighting and space conditioning.

However, the moment we decrease the glass SHGC automatically, the VLT decreases. Hence, we need to balance the light to heat ratio when selecting the glass.

The original use of window in an enclosed environment was for the following purposes:

» Daylight
» Cross-ventilation
» Visual connectivity

Among these three, cross-ventilation has been reduced to none as most of the buildings have shifted for 100% air conditioning. In regard to daylighting, it needs to be understood that if there is direct sun falling on glass surface, there would always be a glare component in the interior spaces. The current industry practice is to focus on heat gain through the glass when selecting the glass, which is a major contributor towards space conditioning loads. However, we fail to realize that a curtain-glazed building without shading will result in high glare inside the building from east, west, and south sides, which in turn results in putting up blinds/curtains inside the buildings, and therefore the daylight integration in building loses its importance.

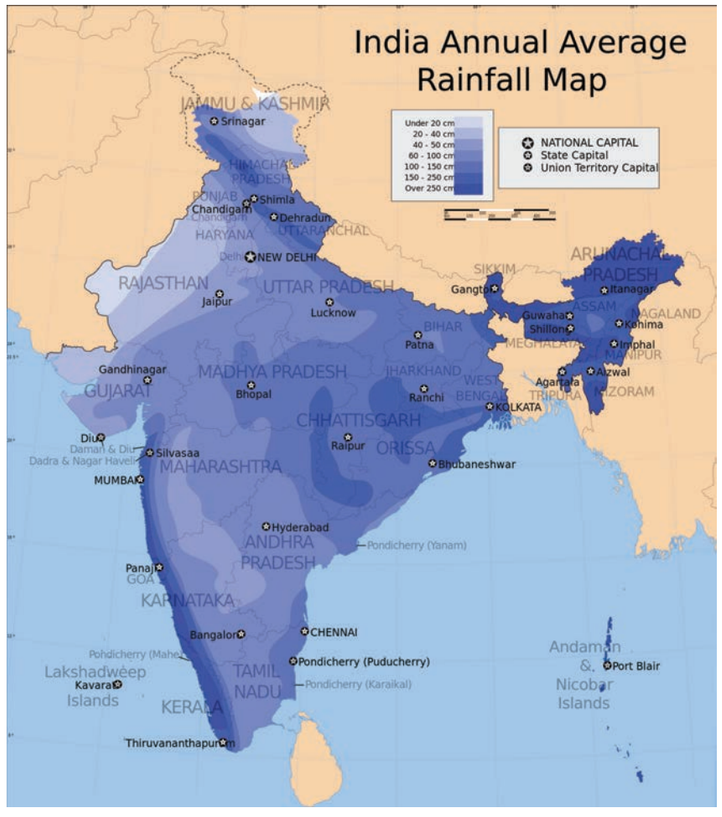
There are many more design interventions that can be adopted to reduce energy demands with passive cost-effective strategies.

Tug of War Between Energy and Water

Energy management in the last decade has taken a great leap with regard to self-sufficiency in many projects across the country. On the contrary, water has been totally neglected and has resulted in devastating effects in recent times. It needs to be understood that 'energy' can be generated; however, 'water' is very hard to generate. Energy is a comfort requirement, whereas water is a necessity. 'Too less water and even too much water are life-threatening'. However, the same cannot be said for energy.

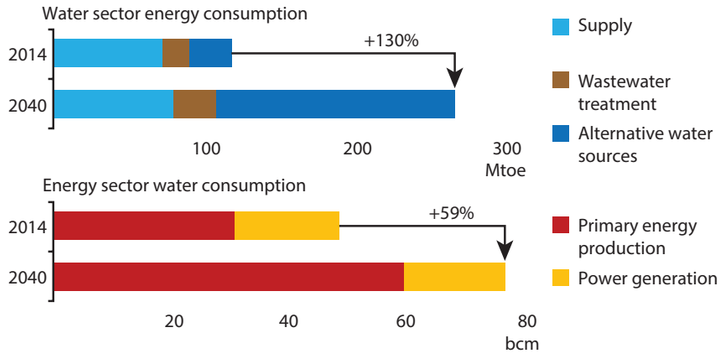
Water is the lifeline of all and one resource that needs our urgent attention if we aim to achieve sustainability. Most of our cities are fast approaching water stress levels. With no secondary resource for potable water, soon our urban population would be required to look for a water source for sustainability of life in cities. However, India has been fortunate in regard to the placement of its land mass in the world geography. In our country, water is the most freely available resource, but it is most ill managed.

We have managed to design cities across the Indian subcontinent that can be flooded in any topography, for example, Jammu and Kashmir, Uttarakhand, Himachal Pradesh, NCR, Odisha, Rajasthan, West Bengal, Gujarat, Maharashtra, Tamil Nadu, Kerala, and so on. We have built cities on hilly zones, valleys, deserts, coastal regions, and inlands – take any location and it can be flooded. It also does not make sense to say that some parts of the country are drought hit, while simultaneously some parts are flooded. If rainwater is managed judiciously, it can be a 24x7 source of potable water and also eliminate climatic disaster risks to our cities. The design philosophy for rainwater management needs to be understood and evolved as per the regional requirement rather than emulating the systems available in a different region.



Energy and water sector consumption

World Energy Outlook 2016



Most of the times floods are attributed to heavy rainfall; however, it is not the only cause of these natural disasters. The unplanned growth and ill practices across the nations have led to these challenges. Challenges often result in innovative solutions. If systems are installed with common sense, it will help us find most of the solutions locally. Our culturally rich cities, which were planned decades back, still provide solutions that can easily be modernized and implemented. Owing to mismanagement in the water sector, we often end up spending much energy in managing excess resource. If there is proper planning, both energy and water can be managed and provide a sustainable solution.

In projects, often rainwater management is attributed to the following two strategies to handle run-off:

» Recharge
» Store and reuse

Most projects try to adopt the recharge option without considering the feasibility of the same with regard to the site. The store and reuse strategy is facing many acceptance challenges in terms of both design and user adoption. If these strategies are applied using common sense and tailor-made for each project for its localized use, they will be effective. The current practice of aping the West has led to illogical implementations, resulting in malfunctioning.

The above process can be very easily understood with the rainwater recharge example. Recharging of rainwater has been mandated across all cities throughout our nation, which is a good policy. In our country, each region or site has different hydro-geological characteristics; therefore, the same system cannot work in all the locations. When we talk about rainwater recharge, what we intend to do is to inject run-off after the primary treatment into the groundwater through soil medium.

Traditional rain storage and recharging structures

RAINWATER RECHARGING TIPS

The following parameters are essential for designing the storm (rain) water management systems in any projects:

Soil percolation capacity (cum/h): It can be defined as the capacity of soil to recharge water in 1 h. For large sites, this may differ significantly across the whole site.

Site run-off (cum): This will depend on the amount of hard versus soft finishes provided on your site. The more impervious (hard) paved the site, the more the amount of water available for recharge.

Rainfall (mm/h): With regard to rainfall, there are generally two values associated, that is, average and peak. In the current designing calculations, most of the projects use average values rather than peak values, which results in insufficient system sizing. Average values can be calculated, while peak is the actual reading of rainfall. It is recommended to use peak hourly rainfall from at least last 2 years to calculate the amount of rain. This will help the project sites to handle peak hourly rainfall and make sure the sites and surrounding areas are not flooded. In most Indian cities, peak values might be almost three times the average values.

Holding capacity (cm): In most recharging structures designed across the country, the level difference between the filter media and the inlet pipe varies from 100 to 300 mm. During heavy rains, the available holding height is very less due to the speed of water, which results in the overflow of much water to the municipal drain. If the intent is to recharge the collected water, the system should provide enough holding height for water to stand still, which will then percolate into ground.

Note that the above parameters are indicative and need to be understood in detail before implementing any strategy in correlation to many other parameters.

Now in this scenario, the property of soil through which the water will be injected will differ across the nation and it might even differ depending on the ground strata structure for every kilometre. The most relevant property of soil to be considered before designing the rainwater recharge system is the soil percolation. Interestingly, it is one characteristic that is not tested and utilized in most of the recharging structures designed in projects.

Food for Thought

Almost 70% of India is yet to be built. If we still amend our ways and adopt sustainability, there is a ray of hope for our future generations. Points to remember:

- Sustainability does not cost more
- Sustainability is common sense
- Without sustainability, there is no future. EF

Akash Deep is Senior Manager, GRIHA Council, TERI, New Delhi.