



**2nd Awareness and Capacity Building Workshop on Sustainable Energy:
Sustainable Habitat & Learning Environment**

IIC, New Delhi, 6th June 2014

Proceedings

Knowledge Partner:
Sgadesignlab

Organized by:

Climate Change Research Institute

jointly with

Society for Economic and Educational Development *and* India International Center, New Delhi

Sponsored By: SSGA, New Delhi



2nd Awareness and Capacity Building Workshop on
Sustainable Energy

**Sustainable Habitat & Learning
Environment**

PROCEEDINGS

Date : 6th June, 2014
Organized by : Climate Change Research Institute
Venue : Seminar Hall-2, India International Centre (IIC), New Delhi.

PREFACE



Future economic development strategy for India is expected to lead to an accelerated growth in the construction activity and building energy demand. In this context, a few case studies of Sustainable Habitat and Learning Environment in India and abroad are presented here.

The Climate Change Institute jointly with India International Centre (IIC) and Society for Education and Economic Development organized the Workshop. Sgadesignlab was knowledge partner in this. A number of real-time architectural design features in buildings especially educational campuses were presented in achieving sustainability.

It is indeed a great honor that Dr S. Y. Quraishi Ex- Chief Election Commissioner of India graced the occasion. Its our privilege that Prof G. D. Sharma, Dr S. Chatterjee, Mr Peter Cox, Mr. K. N. Rai participated in the sustainable energy workshop. In this Awareness and Capacity Building Workshop there have been discussions about the green buildings as well as smart cities – both from national and international perspectives. We really had very enlightened discussions.

The workshop was held also to create awareness about World Environment Day. We took a pledge on this occasion as follows.

“At Climate Change Research Institute we take action to create awareness about the Planet Earth, its weather, climate, conservation of its natural resources and environment to different strata of society to educate youth from schools & colleges, and to researchers in academia & industry. We shall work for all the 3 Es, Energy, Environment and Education as our agenda”.

We thank all our partners for great cooperation and successful deliberations.

Dr. (Mrs) Malti Goel
CEO, Climate Change Research Institute

2nd Awareness and Capacity Building Workshop on Sustainable Energy

Sustainable Habitat & Learning Environment

Venue: Seminar Hall-2, India International Centre (IIC), New Delhi

6th June, 2014

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EXECUTIVE SUMMARY

* Dr. S. Y. Quraishi, former Chief Election Commissioner graced the Workshop organized by Climate Change Research Institute on June 6th, 2014. The Awareness and Capacity Building Workshop on Sustainable Energy was held jointly with India International Centre and Society for Education and Economic Development as part of World Environment Day Celebrations. More than 40 participants by invitation from architecture and non architecture disciplines attended the workshop.

* The programme began with welcome address by Dr. Malti Goel, CEO Climate Change Research Institute and Former Adviser DST. She focussed on importance of science & technology in the building sector. She said that a balance approach between input & output energy can lead modern buildings on a low carbon path.

* Prof. G.D. Sharma, Former Secretary UGC, in his Inaugural Address gave an account of an alternate model for development and linkages with general awareness about the issues of sustainability and environment. He talked about the learning environment and need for taking action at the education level. Prof Sharma is also President of Society for Education and Economic Development.

* Dr. S. Chatterjee, Registrar JNU in his Brief Address highlighted lack of discipline and chaos that exist in mega cities, without a concern for environment. The challenges can be surmounted by change in mindset. He said touching upon the role of liberal arts/skills that were considered essential in order to take an active part in civic life. He observed that modern cities need a cultural and social focus.

* Mr. Peter Cox, PCA Directions Australia in the Keynote Address described smart & sustainable cities in Australia from a building economist perspective. He informed learning from Victoria's experience and gave an example of smart city coming up in Gujarat in India. He also discussed health performance of buildings.

- * Er. Ajay Raj, A2S Consulting Engineers Presented the HVAC analysis of MNIT lecture theater under construction at Jaipur by the efficient use of air-conditioning system matching with climate of the region. He explained use of high efficiency chillers and automation for energy conservation.

- * Ar. Sandeep Goel, Sgadesignlab in his presentation on Green Educational Campuses in India, drew a holistic approach for considering sustainability in design of buildings in campuses through traditional and modern scientific approach. Environmental design considerations in IIT Guwahati, IIM Indore, Hostels in IISC Bangalore and lecture theatre at IIT Delhi were explained.

- * Mr. Christopher Mitchell, from AWW Inspired Environment, UK gave highlights about the Sustainable learning environment in UK with an eye on interiors for School & Colleges.

- * Mr. Avinash Kumar from SGS India Ltd on Green Building rating systems suggested the need for trust delivery between people, organization and government and making green buildings economical.

- * Ar. Sachin Rastogi, Zero Energy Design Lab on a case study of NIAB campus in Hyderabad threw light on integration of microclimatic parameters in the building design stage.

- * Mr. Karan Mangotra, BEE (UNDP) talked about energy efficiency and improvements achieved in commercial buildings through ECBC guidelines. Importance of Smart Cities was highlighted.

- * Dr. S. Y. Quraishi in his VALEDICTORY ADDRESS to the participants inspired them to adopt best practices in energy as well as water resources in building sector. He gave examples from the Haryana State. He also shared his vision on the transformational changes made in the Election Commission during his tenure as Chief Election Commissioner and described how linking sustainability to National Election campaigns led to development of a Green Election Model in India. Dr. Quraishi led the CCRI pledge on World Environment Day, to take action about creating environmental awareness.

- * In the Workshop both national and international perspectives of experts towards low carbon path ways in building sector and also smart city development with case studies on challenges faced in academic complexes were shared. The declaration made by Climate Change Research Institute on the World environment day was signed by all present.

- * The workshop sponsored by Sgadesignlab ended with vote of thanks.

INAUGURAL SESSION

**Guest of Honor – Prof. G.D. Sharma
Former Secretary UGC**



Dr. Malti Goel, CEO - CCRI

Introductory Remarks

Good Morning! We welcome you to the workshop on Sustainable Habitat & Learning Environment to celebrate the World Environment Day which falls on 5th of June every year. The celebrations can go on, a day before and a day after or even for the whole week. World Environment Day (WED) was started in 1972, soon after Stockhome Conference took place on Development and Human Environment. It was decided that there will be a world environment day every year to create awareness and to take some kind of commitment from all nations that they are concerned with the environment and our planet. The theme for this year WED has been “Small Island States and Climate Change”. Theme slogan is *Raise your voice, not the sea level.*

We are in the 21st century, everything is changing very fast and no one can say that how the habitat will change in 2020 and in 2030. Construction activities are in full swing in our country. Those who have lived in Delhi for last 30-40 years know that Delhi has changed a lot. Most significant changes occurred during Asian Games in 1982 and then during Commonwealth Games in 2010. At the same time, if we go to the smaller cities or towns, we hardly find any change. Indian cities need to change with growth and development. Then there are global issues like climate change. We have to respond to global concerns also. Building sector has a major role and that’s why the sustainability issues come.

A lot of changes are happening in the building sector in India. To recall when my father constructed a house in my home town several years ago, I saw an engineer who was advising him. Gradually the focus has changed from engineers to architects in supervising buildings. Building designs perceived by me as blending of Science, Arts and Technology are changing fast and modern buildings are becoming more fascinating, more functional and are concerned with energy use.

Computers are indispensable for architecture today. Not only the buildings but the city planning is more dependent on computers. When we talk of Green buildings or sustainable habitat (as architects prefer to call it) it is essentially to maintain a balance between the input energy and output energy. The materials, energy, water, garbage everything needs to be recycled. And that’s why when we talk about zero emission building then we

say nothing would be emitted or wasted. Whatever is being used, whatever is being produced is recycled or reused. Green buildings are actually involving practical and climate conscious approach. 'Green' is where the input and output is balanced, just like a tree.

We also like to have resilient cities - are also called Green cities, or Smart cities. Smart is a *buzz* word today - smart phones, smart cars, smart grids, smart cities. Everything has to be smart. It is a two way communication between Man and Machine using information technology. Smart cities can provide smart services, smart mobility and are also Green, having lessor CO₂ footprints. Green buildings were initially coined as "Intelligent Buildings". I recall in 1990s as part of Greenhouse Gas Technology Information Exchange (GREENTIE) programme wherein I represented as country officer, they were called intelligent buildings. India was quite ahead then and the first Intelligent came up in Bangalore.

Today's Interactive workshop on 'Sustainable Habitat & Learning Environment' is being organized by Climate Change Research Institute (CCRI) jointly with the Society for Education and Economic Development and India International Centre. The CCRI has been founded with a mission to promote environmental education, research, innovation and impart trainings. Its objectives are to involve youth in schools and colleges about eco system changes, about the consequence of climate change, through awareness and capacity building on topics on scientific as well as societal interest such as energy, health, air, water etc. The institute plans to work with industry to undertake trainings for meeting their needs for corporate social responsibility. We also undertake research studies on scientific or technology measures to stabilize greenhouse gas emissions in the atmosphere. The society has conducted a number of awareness and capacity building workshops as well as trainings. It is proposed to launch an academy for youth.

We are here to discuss the architectural innovations in modern buildings which have taken place in India and also outside India. The workshop is conceived by Mr Sandeep Goel, the Chief architect of Sgadesignlab, to focus on innovations in educational campuses. Dr. S. Y. Quraishi, Former Chief Election Commissioner, who was to inaugurate the program, was held up at the last minute and he would be delivering the Valedictory Address at 4.15 pm. With these remarks, I extend a warm welcome to all the dignitaries Prof. G. D. Sharma, Dr. S. Chatterjee, Mr. K. N. Rai, Mr. Peter Cox, Mr. Christopher Mitchell and all distinguish delegates to this interactive workshop. We seek your wholehearted participation. Thank you



Prof S. Chatterjee, Registrar JNU

Brief Address

Thank you very much Dr. Malti Goel. Welcome once again to all the dignitaries and honored Guests of this workshop – Sustainable Habitat and Learning Environment. In fact for the last two days those who are in Delhi must have felt uncomfortable to see that the temperature has been fluctuating and it has crossed 44°C. The challenge in front of us is the challenge of global warming resulting from the accumulation of greenhouse gases. With that the challenge is also to design and look into the building concepts not only for housing but also for other activities which includes academic institutions, offices and industries.

Through this interactive workshop we need to discuss about the three M's which are important as Man, Machine and Material. Taken together how the balance between the nature and human activities is maintained so that the pace of progress is not interrupted. Certainly these have come to limelight in terms of damage done to the mother nature. In the building sector; green buildings, energy efficiency, how to take care of the natural light and air draft mechanisms are some of the important factors so that much of the energy can be conserved.

We often give example of cities like Singapore, where there is much of discipline and less of chaos, everything runs perfect. They run all the programs and courses on engineering, medical and architecture in a more disciplined manner. No doubt Singapore is an excellent example of clean city with law and order. But I personally feel that little bit of chaos, 1 or 2 percentage is enjoyable and it gives us a scope to learn. Too much of discipline can lead to fatigue. In the architectural, civil engineering and in construction, and in our modern day living there is a great challenge of balance between 'chaos' and 'discipline'.

What you construct today and how it helps the nature or disturbs the nature in the long-run, becomes important. For example the major disaster incident which happened last year in Uttarakhand at Kedarnath resulting in major floods and devastation because of the cloud burst and the melting of the snow across the Himalayan range. The unplanned constructions of buildings and

mismanaged land use have led to such destruction. We can say that it occurred because of more `chaos' and less of `discipline'. Sustainability therefore becomes the key issue in balancing between chaos and discipline or input and output as Madam said for resolving climate change impacts. He concluded by saying that he is sure that in the day- long deliberations, we will be engaging our selves and contributing.

Dr. S. Chatterjee, Registrar JNU in his brief address highlighted lack of discipline and chaos that exist in mega cities without a concern for environment. The challenges can be surmounted by change in the mindset, he said touching upon the role of liberal arts/ skills that were considered essential in order to take an active part in civic life.



Dr G D Sharma, Former Secretary UGC

Inaugural Address

First of all let me congratulate Dr Malti Goel for undertaking a big task of making people and particularly the educational institutions aware of the climate change. Our Society for Education and Economic Development links the education and economy together. Unless you understand the forces of economics and the forces of education, you cannot develop. That is the logic behind the and the society have 500 colleges as member of our forum. We conduct research, studies and all the activities on this area. We also bring out a journal 'College Force'. That is journal of higher education.

In the workshop today we are looking for alternate model of development for our country. I will deal with it and why this 'chaos', as Dr. Chatterjee just spoke about it. Yes, some models of development create chaos. How it happens I will give one or two examples. Then I would move on to three other areas. These major issues are always there when a habitat is being constructed; water & air, energy resources and good harmonious living conditions.

I give an example of Yemen, where I was doing a UNDP consultancy. I was traveling from Sama to Tais. One important thing I observed that all through everything was littered with polythene waste. No doubt we had revolutionized the carrying process with the use of polythene; one can carry water and many things etc. But this is causing polythene pollution everywhere. When I reached Tais there were suggestions about environmental education to the people. Tais has also faced problem of floods. Floods used to take place and the UNDP came with the support of erecting flood structures. I realized in our old cities like Jodhpur flood structures concept was there in India much before. There were tunnels created, these tunnels were going through two big talabs and the water was used for the purpose of drinking. One of the important challenge is now that these flood structures were getting blocked because everybody throws polythene waste. When water goes from there to the dam, passing through the area, it gets

so much polluted. On one side we had a lot of water coming from the hillocks and other side it was creating the havoc in terms of floods, flash floods. On Third side it was polythene etc. and water was not moving. This is one of the model of development.

Another model of development is an example from India. As we went for industrialization in a big way and we did not look into its other dimensions. Industrialization also has an impact on environment besides development. As an industry there will be effluents and as a result the water gets contaminated and many other pollutants go in to air. Many cities including Delhi and Bombay facing the real problem of industrialization – Development leading to choking the people. This has to be taken care of by early planning.

Third example is from Rajasthan, a region where there is water scarcity. In Bikaner water harvesting was a way of life of the people. All the structures were created so that water would come inside the house. It was collected by the household people and put in the tank. Every household used to have a tank. There was collection of water within the home and collection of water in ponds, lakes and talabs. Development of cities also came up during that period. With the impact of all those developments, life becomes little less harmonious. When the cities were coming up, all cities had a philosophy, they tried to solve the problems which are likely to occur. Yet in our model process of development, we didn't look what will be the implications of this development to the society at large. This led to creation of chaos.

We needed leaning environment there. There are two types of environment – Physical and Learning. In learning environment they evolved and they learned from this. Then they developed the text from this. And those texts became very useful in teachings. In our teachings we got the text from other countries. When we started developing in earlier times, it was related to what are the implications and how the implications could be addressed. In the world the knowledge which was generated over a period of time was passed on to next generation. In India the knowledge that was generated was passed on verbally as there were no documents. How the first ray would come and touch the forehead of deity, that was the kind of skill in Surya Temple. But there was no documentation. We never developed what is available, never learnt from the existing. When some one was asked questions, they could not think of Fatehpur Sikri, because the course in our books didn't have any mention of construction of it or Qutub Minar or construction of temples or mosques etc. They did not know what civil engineering techniques were used in these ancient constructions.

One major breakthrough has taken place in the world today and there is an alternate model of development. New model of development has to look into adopting the environmental education with knowledge and innovation. Technology is bringing innovation but at the same time what is needed in a particular area, what are the human habits and how are they going to change. We need to think in terms of alternate model of development. For example, to solve the chaos in the area of traffic, model of development necessarily have to do micro management of peoples movement. When the metro came to Dwarka, commuting of people to their homes from the station was a great problem initially. Now the e-rickshaws have come. That was required to be planned earlier in a development model. It is application of knowledge to a situation, which is contextual.

Water and energy are going to be serious issues in the future and it is important to conserve of energy and water. Leakages and wastages of water and energy have to be addressed. In many developing countries I have seen in Yemen, Ghana, Cameroon one of the problems is that despite of large amount of natural resources they have large amount of wastage of resources. Because their models of development did not really look into the utilization of energy resources and water resources. In the developed world on the other hand in Paris or UK, they look into it very extensively.

Some examples of sustainable development do exist in other countries. University in Malaysia is planned in such a manner that on all sides they had the buildings and cater to a beautiful lake. They allowed the water coming to this lake from a tunnel. Developing countries have a challenge of this kind and need to have a new model of development, which is more suited to their requirement and is also addressing the concerns of economy, human resources, and other resources etc.

I would say `Smart city' is one which would integrate into electronic facilities. Countries like France has used the electronics to save the energy by introducing the small sensors on all the lighting arrangements. People are developing their own battery because their battery consumption used to be very high. `Smart' should be smart in the context of your requirements. Technology enables us to achieve the smartness.

Thank you.

Technical Session-I

Sustainable Learning Environment

Session Chair:

Dr. S. Chatterjee, Registrar, JNU



Mr. Peter Cox, PCA Directions, Australia

Keynote Address

SMART DESIGN

1. Products
2. Buildings

PCA Directions

Smart & Sustainable Cities Conference Delhi, June 2014

SMART DESIGN

1. Products
2. Buildings
3. Streets + Public Spaces

sustainability.vic.gov.au

Sustainability Victoria

Introduction PCA Studies

Hospital Finance (20 year)

Smart & Sustainable Cities Conference Delhi, June 2014

A building economist's perspective

Presenter: Peter Cox

Results

Use (absolute)

Year	Difference	% Change
10-1	-0.9	-2.1
2	4.4	10.5
9	7.6	9.7
2	1.5	9.0
	0.5	6.3

PCA Directions

Smart & Sustainable Cities Conference Delhi, June 2014

Triple bottom line focus (creating High Performance buildings)

Smart & Sustainable Cities—an Australian and Indian building economists' perspective

Mr. Peter Cox, PCA Directions, Australia

Good morning! I am very pleased to be part of this forum as India has been my second home for about 14 years. In the year 2000 I first came to India with my wife and have enjoyed my journey in India since. During this session I propose to share little of my practical experiences whilst working as a building economist here and also in Australia. Forgive me if I introduce some more buzz words to add to the 'smart' and 'green' themes and briefly talk about three specific case studies; One is a city wide, state wide view of sustainability. Second is referencing my home city of Melbourne and share with you a plan for the city of Melbourne to work with a city in Gujarat to develop a smart and sustainable city in India. Finally, if we have time then I would like to add "healing environments" to the conference theme.

By way of background most of my Australian and international project experience relates to the institutional sectors, namely health care, justice, science and research. In India my experience base is related more to the IT sector, the hospitality sector with hotel majors like ITC and Taj Group, along with some Residential townships with Godrej and L&T. I was honored to be involved in the reconstruction of the Taj Mahal Hotel which is recently brought back to its former glory. We are very proud of that result.

Smart & Sustainable cities - It is true that as part of the globalization trend, cities, states and countries do compete with each other. They may compete for investment and for people and talent etc. The new Indian Prime Minister has set a mandate for development especially Smart cities and Infrastructure. Mr. Modi's mandate is very relevant to the theme of this conference because with development comes many challenges as well as potential competing interests and conflicting objectives. Like businesses and other enterprises, to be successful, Cities and Buildings need to demonstrate value and offer improved quality of life for their occupants. Quality of life is taken for granted in the definition of sustainability. Historically, there has been a lot of focus on initial cost of development without other considerations such as whole of life or life cycle including social and environmental impacts. In our terms the livability concept is firstly related to sustainability, sustainability is now converted into policy research and education. It is very much consistent with the development model described by Dr Sharma during the earlier session. Through this conference

initiative, the conveners like me, are trying to shift the focus to a new paradigm of long-term livability and sustainability.

Case study - City of Melbourne - Melbourne is the capital city of the state of Victoria in the south east corner of Australia and has a relatively small geographic size, but in population and GDP it represents about a quarter of the economy of Australia. Victoria's total population is about 5 million. In Indian terms it is quite small. Melbourne city is about 200 years old. We are very fortunate that for a variety of reasons the city seems to attract a lot of educated people. One of the outcomes for Melbourne's community is that it has become a very livable city.

Melbourne is fortunate to have attracted a very large number of urban planners and renowned designers. The building, construction and design industry provides a significant source of employment and contributes around 25% to the national economy. Yet Victoria's urban areas face challenges similar to India. Melbourne's climatic conditions are quite similar to Delhi's. When we are enjoying winter you are enjoying summer. We also suffer from seasonal and variable rainfall which encourages us to preserve water. In addition we face the same challenges of the interface between industrial and residential area etc. Hence a lot of focus is on clean technology, which is developing and now being exported.

The Environment Protection authority, Sustainability Victoria, is the second oldest regulator in the world. It is responsible for regulating the quality of the air, the water and how we manage waste. I acknowledge that they have done a very good job and there has been an unquestionable improvement in all three areas under the control of the agency. Sustainability Victoria is also responsible for championing waste management, resource utilization and resource recovery. Whilst it is a regulatory body it is also proactively involved in educating the city's residents and especially its businesses and facilitating the related processes.

Sustainability Victoria is a very innovation focused group. There are many programs that Sustainability Victoria has developed to assist small and medium businesses to make improvements. They work with small business to help them to reduce their operating cost while reducing environmental impacts. These businesses are very keen to get involved as there is money on the table and they feel motivated to introduce sustainable ways of developing their businesses.

Educating the community and consumers is also a part of Sustainability Victoria activities. It has a whole education program using 'smart' ways for

purchase of washing machine, television, computer etc., raising the awareness and sustainable thinking. Comparing energy use at residential level across five main States of Australia, Victoria is ranked as number one and has been consistently reducing the amount of energy used by its residents. The statewide average reduction is 2.5%, compared to the others which have increased by between 6% to 10%. This result is largely derived from changing attitudes. The ultimate measure of the success of the city's commitment is that the Melbourne city has been ranked the world's most livable city by the Economist Magazine for the past three years.

One other Australian innovation relates to the Green Building rating system. Traditional green ratings area means of assessing the potential performance of building. The NABERS rating has been developed in Australia to measure the actual performance of a building in use. This rating relies on both scientific testing as well as surveying the occupant's views about the building as a place to live or work. It assesses the indoor environment quality (IEQ) in terms of natural and artificial lighting, thermal comfort, acoustic performance and also tests for emissions from the furniture and equipment used inside the building.

A good example of the application of all of the knowledgebase and design innovations mentioned previously is the Pixel building in Melbourne which is believed to be the world's first zero energy building. There is a focus on the use of technologies and creating a "living and breathing" building envelop and careful use of public spaces. These features have been designed to adapt to the climate conditions.

Case study: a new smart and sustainable city in Gujarat–This project involves a plan combining the best of traditional sustainable thinking from India, with best of traditional sustainable thinking from elsewhere for a new city in Gujarat. The objective is to create a city which is truly sustainable with some of the objectives, very much in triple bottom line thinking with the involvement of environmental, sociologic and economic aspects. Obviously adopting best practice and collaboration between professionals from both of the countries is fantastic. We already have a memorandum of understanding in place between the Govt. of Gujarat and Victoria and now moving to a city to city memorandum of understanding. Private sector players are expected to now become involved.

The project will involve collaboration between India and Australia in areas such as Policy, Guidelines, Urban planning, Design and Construction as well as

long term Asset management and maintenance. We hope this will be the first of many such projects.

Understanding Indoor Environment Quality (IEQ) and High Performance Buildings - Indoor environment quality is about improving indoor environment, indoor climate, the infrastructure, and the management of the facility as well as optimizing the well-being of staff.

I have done extensive research working with my clients in various parts of the world. The importance of thinking beyond the initial building investment and seeing it as an environment for an organization, and that organization will have people. For most enterprises the people cost over the lifetime is many times more than initial building capital cost and also many times more than the lifetime cost of energy, but I am not downplaying the importance of energy.

We have adopted the term “high performance work environment”. This involves triple bottom-line thinking, recombining environmental, social and economic impacts. It also involves a shift in thinking about Green buildings, away from just environmental considerations to a much broader view. In socio-economic terms it means thinking about the well-being of the occupants in terms of the quality of the space, quality of life and finally in the case of Commercial buildings, looking at the way the indoor environment will impact on the financial performance of the organization or enterprise as a whole.

The architectural profession, which many of you here are practicing and or aspiring to be part of it, has already impacted and can impact on the organizational outcomes of your client’s enterprises as much as you can impact on the environmental outcomes. This is one of my key messages to come out of this session. There is a body of research available to demonstrate the potential influences which the work environment can have on employee well-being and productivity. The potential variation in productivity alone is up to 15%. Design innovation is at the centre of un-tapping this potential which I believe should encourage more carefully thinking about the planning of such work and living environments.

One of my associated companies is CETEC which is an environmental science and indoor environment quality consulting group. They measure and compare the various environmental impacts. For this example project the client wanted to push the boundary on energy and operational performance for a Commercial office project. By using best practice design innovation and

technologies the designers were able to improve the energy consumption and demonstrate a saving equivalent to Rupees 800 per sq.mtr per annum. More significantly they were also able to produce an improved Indoor environment and demonstrate labor productivity gains equivalent to Rupees 2000 per sq.mtr per annum.

Key message is here is the indoor environment is good for people and for profitability.

Case study: Creating Healing Environments (High Performance Hospitals) -

Much of my own personal and company experience base relates to planning of healthcare facilities including several hundred hospitals. I did some research recently for a healthcare agency who were looking at their long term investment in the sector. The research looked at the net present value of the initial investment (capital), the maintenance of that facility and all the operations including salaries (recurrent) over its lifetime of about thirty years. We found that the initial investment represents only about 1/10 of the whole of life investment. That is the first message to take home. The second message to take home is the pragmatism shouldn't be overlooked. It is very important to look at the whole life expectancy of the materials used and the amount of energy that are going to consume. All of these are going to represent half of the initial investment of that building. Finally by far the most significant investment (about 85%) is the operational or recurrent costs. Hence one should be more aware about this aspect while planning.

We have developed a facilitation process that we use to help the client and design team to optimize the process of making decisions and ensuring that the outcome represents a true High Performance Building. At the planning stage we help define the project objectives (in triple bottom line terms). During the Design phase we help evaluate the design innovations against each of the objectives. This provides an audit trail to provide evidence to support every decision that was taken. Finally a post occupancy evaluation is done to confirm that the expected outcomes are achieved.

As part of the process we also look at all the factors which can impact on objectives, working with the design team to examine possible solutions and innovation that can drive improvements in the process. Obviously we use economic evaluation, to look at the gross cost and benefit, help us to determine whether it is a good idea, or a marginal idea or not a good idea. We basically go through a series of workshops, where we throw a series of innovations that the

design has come up. Then we come back and look about the impact of the innovations, whether these can be justified.

To underscore the importance of getting the objectives right is independent published research which shows that frequently defining of the objectives not done properly. About half of all major projects fail to meet their operational objectives and or have project cost and timeline targets blow out by over 25%.

Conclusion

In conclusion I have talked about a balanced approach to planning for smart and sustainable cities and buildings. I believe there is ample evidence of the demonstrable benefits from smart and sustainable cities & buildings and the potential for a positive return on investment. Sometimes such approach does require additional investment to achieve the desired performance of the cities or building. In our experience more enterprises are ready to invest in such projects. Government of India has recently introduced some new legislation under the Corporate Social Responsibility program. This is an excellent initiative and I am hoping the related investments will lead to a lot of more innovative thinking.

The challenge today for designers and other professionals is to take a leadership role for promoting sustainability through innovation. Along with our partners including Sgadesignlab we are looking for more research and development partners. Such partners could include some of the academic organizations and institutions represented at this conference. We want to work with city developers and investors who share the vision and who want to produce smart and sustainable cities and projects which can be win-win for the promoters and for India.

Thank you again!



Er. Ajay Raj, A2S Consultant, New Delhi

Challenges in green Buildings-MNIT Lecture Theatre

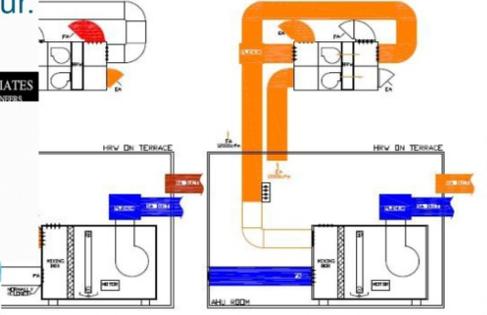


HVAC CASE STUDY
MNIT Jaipur.

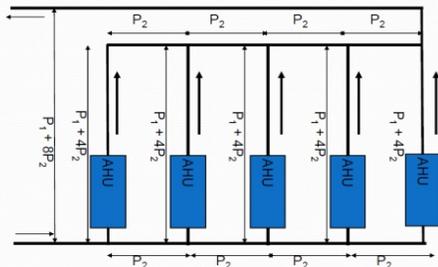
Architect
SURESH GOEL & ASSOCIATES
ARCHITECTS PLANNERS ENGINEERS

MALVIYA NATIONAL INSTITUTE OF TECHNOLOGY

Ajay Raj
A2S consulting Engineers.
C64B, Kalkaji, New Delhi
Email: ajayraj69@gmail.com



Reverse return systems



AHU with VFD & VAV boxes

- ✓ Floor mounted AHUs – FM 24Nos & CS 4Nos
- ✓ Filtration with MERV – 13.
- ✓ VFD.
- ✓ Double skin



- ✓ VARIABLE AIR VOLUME (VAV) BOXES - Enthalpy sensor



CO2 sensors & BMS

Intelligent building address both owner & occupants needs.

- Energy (Operating cost)
- Comfort environment



BMS will control

- ✓ Chillers
- ✓ Pumps
- ✓ Cooling tower
- ✓ AHU control
- ✓ Mechanical ventilation (Demand ventilation – CO2 Sensors)
- ✓ Scheduling
- ✓ Sequencing
- ✓ Monitoring. – Record Temperature, Humidity, air quality

Challenges in green Buildings-MNIT Lecture Theatre

Er. Ajay Raj, A2S Consultant, New Delhi

Good Morning everybody! I will be talking on the case study on MNIT Jaipur from sustainable environment point of view. The site location is in Rajasthan, which comes under composite climate as per ECBC norms 2007. About the outside conditions, summers are very harsh. With this in view we have chosen a design temperature of 43 degree centigrade, but the temperature may go up as high as 50 degree centigrade. The design is for the monsoon and summer conditions. As for winter season temperature, data shows that only around 1024 hours in a year, the temperature is less than 15 degree centigrade. During this time we need to minimize fresh air requirement to run lecture theaters. The temperature is from 15-20 centigrade, for 1276 hours per year. During this period free cooling is adequate. Temperature around 20-26 degree centigrade is for about 1943 hours. During this period fresh air from outside cools the inside and exhausts expell the heat.

Further, temperature is 26-35 degree centigrade for 3689 hours in a year which is actually as per ARI (American Refrigeration Institute) gives us the standard for giving the tonnages for air conditioning. All the machines are designed for that. Most of the machines will be very efficient during this temperature range. At higher temperatures from 35-43 which is around 928 hours they become less efficient. These 928 hours in a year add to around two summer months. During this time the college remains closed. Adding all these makes total 8760 hours in a year.

For summer and monsoon we have design parameters as indoor temperature of $26 \pm 1^{\circ}\text{C}$ and the humidity around $55 \pm 5\%$. In a green building, we have used high efficiency chillers. Cooling towers with VFDs are used. Primary variable pumping system and reverse system for automatic balancing are selected for reducing the operating cost. Night barging and AHUS with VFDs have been used with pre insulated desks. CO₂ sensors and BMS system for the building have been adapted to make the building climate friendly. U values and solar heat efficieny are considered as per ECBC norms.

The MNIT building is basically a basement, ground plus three floors with total covered area of around 3,65,600 sq. fts. The air conditioning is designed for around 1 lakh 30 thousand sq. ft. of area with occupancy around 19 people per sq. ft. Except for a lecture theater of 2200 sq. ft., where we have around 120 people.

Energy Performance Index (EPI) of this particular building was 29.2 kW hr. per sq. mtr. per annum as against a benchmark of 140 kW hr. per sq. mtr. per annum. The percentage reduction is somewhere around 79%.

Initially the proposed chiller capacity was 3 x 350 TR, with two working on standby. Now it is 3 x 160 TR all working. Water cool screw machines with VFDs have been used for chilling. These are very highly efficient machines. Heat recovery units for all AHUs are more efficient by innovations made to suit Indian climate condition and temperature difference between day and night.

As an intelligent office building it addresses the need for both owners and occupants. Owners are concerned about the energy or the operating cost. Occupants are more concerned about the comfort. A BMS system takes care of both. AHU controls are on a BMS system. Scheduling, sequencing, switching on or off can be done by advance planning for the month or for a year using computers.

In terms of the built environment best applications of AHUs and USPs can be made. In MNIT Jaipur 16 points rating under GRIHA were achieved.

Thank you.

Technical Session-II

Towards Near Zero Buildings and Campuses

Session Chair:

Mr. Peter Cox, Australia



Mr Avinash Kumar, SGS

Sustainable Habitat – Green Rating

SGS

SGS

DESIGN INTEGRATION

- Daylight and Views:
- Space Planning
- Solar control/glare control strategies
- Lighting balance and luminance ratios
- Lighting fixture layouts and controls
- Colors and Materials inside spaces
- Occupant fine-tuning (shades, blinds, etc.)

SGS

GOOD PRACTICE

ilities for materials recycling
 'Construction Waste Recycling – target 75-95%
 'all non-hazardous materials
 um Recycled Content
 gional Manufacture
 vested 50% FSC-Certified hardwoods and
 'all built-in millwork and casework

SGS

BUILDING ENERGY CONSUMPTION

SGS

SCENARIO: GREEN BUILDINGS

■ Break-up of Energy consumption in

■ Registered
 ■ Certified

SGS

- Initial Cost
- Service cost
- Preventive Maintenance Cost
- Operating Cost
- Disposal Costs

■ Reduce
 ■ up to 15%

SGS

CASE STUDY 2

only
 3.26%

Sustainable Habitat – Green Rating

Mr. Avinash Kumar, SGS

Good afternoon! I am from SGS, which is a Swiss company, having 140 offices across the world. When SGS talk about the sustainability or sustainable habitat, it always thinks about which is easily available and cost effective.

Sustainable development and green buildings are concerned with economic development, environmental protection, social reforms and people's empowerment. The entire sustainable movement, sustainable habitat revolves around people, development and environment. There are various rating systems which are right now into use in India; GRIHA, LEED, BIS's star rating of office buildings etc. It is very important that all these rating systems must have a very close co-ordination with these three verticals: people, development and empowerment. LEED is a 100 point rating system, which revolves around 5 essential components of site, water, energy, materials, indoor air quality and innovation. Basically a building which has efficient utilization of energy, water, materials and the best of interior quality, can be called it a green building. Green buildings and conventional buildings may look alike from outside but there is a huge difference. In a green building there is a lot of thermal comfort, better air quality & operational savings.

The first step towards green building is sustainable sites. Our focus should remain on sedimentation control, the top soil erosion, planning for bicycle tracks, persons working at the site. Proper focus should be on eco-friendly vehicles, light colored paving materials, building approachable by public transportation. If the growth is near public transportation, one can reduce the carbon emissions by reducing numbers of cars. In the sustainable site the focus remains on native plantations, species, so that they can consume less water, when compared to other foreign species. In case of water the focus remain on using the efficient fixtures, automatic fosset option for toilets and urinals. Waterless urinals nowadays are quite famous as they save a lot of water. Onsite collection and reuse of strom water in landscape irrigations is important.

How heat is gained through various building components of glazing or roof conductions, internal gains or wall conduction?; 55% by glazing, roof-16% and again internal gain-3% and walls-26%. Heat load variations determine energy consumption. At the end of the day, operational savings are very important. If it is a green building LEED consultant are already on board and

they give some demonstrations and dos/don'ts with respect to miscellaneous equipments. Ultimately, a lot depends on how do occupants operate those equipments.

How we approach regarding green building with respect to energy depends on various factors; orientation, building envelop measures, wall glazing, chillers, lightings building management system, temperature, humidity, commissioning and measurements & verification (M&V). In lot of projects people don't give too much focus on M&V part. In LEED there is a provision of having certain points towards measurements & verification. Once the building is complete, M&V carries a lot of weightage because whatever saving has been projected before the building is completed, they are hypothetical. M&V actually verifies whether the savings which were projected are authentic or not. We estimate that the building will give us a 15% or 50% savings, but actually whether they are 50% or 25% or 40% can only be found M&V.

In term of actual requirement, the lighting Load should be less than 1 volt per sq. ft. It can become 0.7 or 0.6 by maximizing day lighting and by using the CFL, LED etc. Building Management System (BMS) is an integral part of a green building or sustainable habitat. Best of equipment, controls should be in place. They can give a lot of savings. In terms of materials and resources, focus remains on conservation. For water, Reduce, Recycle and Reuse, How we can recycle waste water generated at the site, during the construction and after that? There should be dedicated place for recycling, segregation, quantification of waste, as well as awareness program for building occupants. There should be proper policy in place to tackle that waste and to recycle that waste. Products which are manufactured are having the recycle content. Products that are regionally or locally manufactured are very important, because it saves energy. It is a holistic approach required in a green or sustainable building. Innovative strategies in terms of using the materials, having good life cycle like, bamboo and other eco friendly materials like bio composing counter loop materials, are applied.

Indoor environmental quality is very important. A building which is having very good air quality, increases productivity by 1%, up to 15% over one year. This is documented research done by US-EPA. Here the indoor air quality revolves around 62 point standard plan. What sort of activity can be done during the construction and after the construction to save the site with respect to indoor air quality? Using the eco friendly paints, having less chemicals VOCs, using carpet tiles, adhesive ceilings etc. are recommended. Design integration with respect to indoor air quality- the focus remains on day lighting, outside views,

reducing glazing. In terms of innovation, demand controlled ventilations with respect to control CO₂ and humidity etc.

Green building is one way to show our commitments towards climate change, toward sustainability or towards meeting CSR also. In terms of intangible benefits, obviously the health & safety benefits are there. How productivity can be increased if indoor air quality is good in a building? Ultimately there is a bottom line, there will be fewer sick leaves. There can be a lot of savings with respect to water, with respect to energy, and all these savings are variable. The benefits will depend on at what stage the concept of green building. Whether one starts thinking about the green building during the construction or during the design stage or once the building is about to finish?

At present three LEED Platinum rating Buildings are performing with respect to saving and with respect to percentage reduction in energy as compared to baseline, namely WIPRO and ITCCI in Gurgaon and Godrej in Hyderabad. The percentage reduction with respect to baseline is around 14% to 45.6% and therefore saving sufficient amount of money. Lot of things however depend upon the local climate where the building is, whether it is in Bangalore or it is in Jaipur.

Green building movement is going very fast in India and right now there are more than 3000 buildings (according to IGBC) which are registered for Green. In case of incremental cost, investment in green building can be recovered during the operating part of the buildings. In one of the case studies it was projected that 2% increase in cost of green buildings, could save 15% operating cost close to 1.2 cr. And pay back credit is over 2.8 years. Appropriate time to register for green building is the design stage. Green buildings are affordable. At SGS we have our building policy. They have declared their own principles that whatever building they would be taking on in India it would be green or it would be energy efficient building. So we are dedicated towards the movement of green buildings.

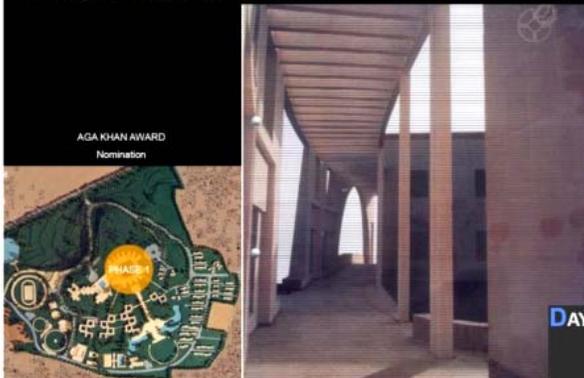
Thank you very much.



Mr. Sandeep Goel, Sgadesignlab
Green Campuses in India



CENTRAL DRUG RESEARCH INSTITUTE Lucknow
725 ACRES | SELF CONTAINED MIXED USE GREEN TOWNSHIP

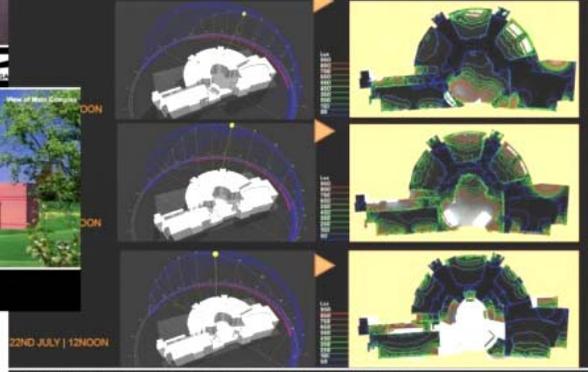


INDIAN INSTITUTE OF MANAGEMENT Indore
200 ACRES | SELF CONTAINED MIXED USE GREEN TOWNSHIP



AGA KHAN AWARD
Nomination

DAY LIGHTING ANALYSIS



BITS Pilani | Hyderabad Campus
200 ACRES | SELF CONTAINED MIXED USE GREEN TOWNSHIP

INDIAN INSTITUTE OF TECHNOLOGY Delhi
325 ACRES | SELF CONTAINED MIXED USE GREEN TOWNSHIP

Green Campuses in India

Mr Sandeep Goel, Sgadesignlab, New Delhi

Good Afternoon! We are finding that today architects and engineers are working very hard to embrace the new materials, the new scientific way of working in the building designs, so as to make our buildings Green. We just learnt from Mr. Avinash Kumar that 3000 projects are already registered as green buildings in India.

I will share our experience at Sgadesignlab in the design of Green Educational Campuses. While we strongly feel that green campuses are the need of the hour, what really helps us to achieve a green environment for the academic community? Most important is the indoor air quality. Then the energy reduction both in terms of heating or cooling energy and in terms of the lighting, thirdly use of resources such as water and materials. It is our experience that energy consumption can be brought down by 30-50% in terms of contributing to the overall sustainable effort. Carbon emissions can be brought down up to 35%, not just 10-20%. Water usage can be shrink down to 60% of the conventional and solid waste which is becoming a big problem of management today, can be recycled up to 70%. In that context, green campuses can contribute their bit in achieving sustainable objectives as we all are seeing the underlying importance of the same.

There are two major aspects in campus design that I would focus today. One is on the land aspects and second is the conservation & the sensible use of resources. On one hand the land is reducing and on the other hand the resource demand is increasing. That's a constant contradiction and challenge which is taking place. Snapshots of IIT Guwahati and IIT Delhi expansion are showcasing as case studies. IIT Guwahati, can be seen as compact clusters in design and a lot of open space in between. Open spaces help in achieving quick movement and less dependence on mechanical transportation. IIT Delhi was set up about 40 years before IIT Guwahati in a more traditional pattern and is now impressing to change with time. Very interesting aspect about land utilization is seen in these campuses. IIT Guwahati when it was planned, it was 15 students per acre. Now it is going up to 20 in the next 2 years. IIT Delhi on the other hand, which is more of an open campus, has a density of nearly 30 students per acre with growing students' strength. Compare this to JNU campus which is in about 1000 acres. It has 7500 to 8000 students, probably 10000 now, but still has a density of 10 students per acre.

Recent campuses, which are coming up now have got a density of as much as 90 students per acre. That means the density is increasing by 10 to 12 folds compared to initially designed JNU campus. This is one of the challenges that land availability is reducing but the resource demand is increasing. Taking the other extreme, at city level the density is as high as 400 persons per hectare, which works out to about 150 persons per acre. Effectively the new campuses will be more and more urban in character and this is going to be a further challenge in terms of design and how we are going to approach the same. Other IITs like IIT Bombay is undergoing a transformation from 9000 to 20000 students and so means the density will be more than double from the present in the next 10 years. There is also a redevelopment which is happening. At Sgadesignlab we are trying to make sustainable design a way of life. Case studies will show the approach adapted from that on first principles, to a more scientific approach in today's time.

Coming to the details, IIT Guwahati was designed in a way that related to the first principles of orientation. It adhered to the compact clusters, cross ventilation because it is a very humid area and utilization of the more flat portions so that minimum cutting and filling happens. This was done in a more traditional way, how the thinking was there two decades or one and a half decades back. The campus was blended with hillocks and designed in a way that they could contribute to an overall impact. All the academic buildings have preferred North-South orientation, the hostels are all primarily North-South barring some minor aberrations, which were also detailed out in terms of projections and illustrations. Various aspects, like movement etc were given a lot of emphasis. Housing was also developed with the slops in order to minimize the cutting field and also to foster community feeling within the shallow like portion of the site. Emphasis was on connectivity at different levels, at the same time meeting the service requirements. Overall the emphasis was on the landscape with the view that the users should be able to enjoy a lot of ambience of the complex.

There is the road along the hillocks. A main lake of the campus around which the housing is developed. With the traditional principles we could achieve about nearly 25% to 30% energy savings by maximizing ventilation, day lighting and the orientation comfort as well as by conserving water. The central academic complex is located in central places at site. The idea was that in the campus, students and the faculty should be able to look out all around the academic

complex. Whenever they are outside the class room, they enjoy a very nice view, which would inspire them in this campus.

Before I come to IIT Delhi expansion, a few examples of our transition from traditional approach to scientific approach are presented here. IIM Indore demonstrated how a campus is developed in 200 acres. It is unique inspired by Mandu architecture. Being a very low density campus with hardly 10 students per acre at that point of time, it was a direct comparison of the Mandu architecture and how it was utilized to create light and shade into the buildings. The energy saving principles was backbone of the design. We got a nomination for the Aga Khan award in this project.

With the current challenges and demands on land and resources, the need for applying scientific approach is growing to achieve Green ratings for our buildings. The Indian Institute of Science, Bangalore, hostel is for 1000 students. It manifested into a larger project in the area of only 45 acres. For a 100 years old educational large campus of the IISC we felt the need to keep the building low energy to maximize the student comfort. We adhered to the North-South and the wind direction and tried to avoid lifts. We used the side slopes to our advantage. Ground was cut to create a lower ground floor. We kept the lift provision but we did not have to install the lift because it was pretty much walkable for the students to go up to four floors and one floor down. With these 5 floors we were able to achieve total avoidance of mechanical energy dependence for a vertical movement and energy consumption was drastically reduced. On the other hand user comfort was kept in view with design to have corridors at the end. There were punctures in the middle, which allowed for cross ventilation.

This project responded well to the surroundings. The privacy of the buildings and the user comfort was very important, both for the people who are going to stay here and the people who are already staying here. None of the rooms were directly facing into any of the existing developments. The project also gained from water harvesting. Water harvesting was made a landscape feature and totally did away with all electrical heatings. All the heating for water for toilets, for the kitchens is through the solar. Results for energy use were documented over the next 2-3 years and it was found that about 30% of the energy was saved compared to other hostels.

Reverse planning was done in the process of redevelopment of a master plan, which allowed for new facilities to enjoy the green spaces and openness at the same time to meet the requirements of expansion. It started actually making

the environment more integrated. The space is central, but it also integrates all the existing buildings that were retained in this process. In a similar hostel at IIT Delhi because of the pressure on land we decided for a much higher model of development, in this case being a 8 storey block where the parking was taking place on the ground level and the entrance was through a podium because there is a rock in the base. We didn't go for any basements in this case. Care was taken for students sit-outs distributed at different levels, so that the students would not have to come down every time to be able to interact with each other. A ramp was also put into design so that the physically challenged movement could also happen.

Indian Institute of Technology at Delhi-expansion plan is another case study. About 15 years back the campus had only 2500 students and in now it has become 8000 students. So it has expanded by almost 3 folds. The process of design was tuned with a scientific approach using technology and simulating software in a much more integral way. As it was a largely built up campus, but the mandate was that we should not take away any of the green space which were existing in the site. A lot of reclaiming of land which were either used for solid waste disposal or which were having only single story buildings was done to save trees. To retain all the green spaces in the campus we covered potentially some more space as the campus strength has been increasing and there was a lot of demand for more open space.

A detailed study was made of the built form and how these buildings would integrate with each other and at the same time retain the openness of the campus. Some buildings were existing, while some of them we designed. A pilot project on solar roof integration was taken up by us way back in 1990s. This technology had created a new paradigm of approach for our practice in India that time where besides responding to the traditional aspects of orientation, day lighting, shading, use of indigenous materials, we took upon addressing the challenges of space, densification, reducing the heat gains through use of simulation and softwares. Initially, this was done in a traditional format where the loover orientation was the first principles. As we progress, use of technology became more integral and one of the aspects was introduction of the cooling systems and the recycling of the energy.

In the Lecture Theatre Complex of the institute all the energy simulations were carried out, firstly for day lighting. This was the central piece of development in this master plan here. A new lecture theater complex was planned to house for the lecture rooms for the 1st year and 2nd year of students

because the numbers of students were increasing phenomenally. In the simulation process day lighting for both the summer and winter seasons were mapped. Summer part was critical only for a few months because of the holidays. We also did a CFD analysis, day lighting analysis and a ventilation analysis, so that we could minimize the air conditioning requirement in this building. This was done for the lecture theatres to analyze how we could ensure that the lecture theatres have light, not direct glare and at the same time they also do not have so much of heat gain. Just to reduce the number of fans, a scientific process was started by introduction of light shells and the adjustment of the ventilator heights, use of types of glasses etc. The entire common areas are ventilated naturally by figuring out amount of openings, which are to be provided in the building.

The building is on the reclaimed land, is compact in having a lab wing and lecture theatre wing. On the ground floor there are six 300 seat lecture theatres. These are 6000 sq. ft. theatre area column free and on the upper floors we have smaller lecture theatres. It was to keep maximum number of students on the lower floors i.e. ground and first. Also we built ramp stairs on both sides so that we have least dependence on lifts. Lifts were there but for 300 students to be using lifts would need more in no. Two ramps are placed strategically that could cater to both the wings at the same time. There is a deck so that many students can use it for various interactions. It is also being used for Kiosk, a café etc. by the institute. The way forward for us at that point of time was not just to use technology but to use research on vernacular system, which was one of the points made by Prof. G D Sharma today. By applying scientific principals in our approach all these combinations were utilized to detail the cross-ventilation and maximize the day lighting.

The last case study is an office complex, a high tech industrial kind of environment. It is located in Delhi in about 150 acres, The design is demonstrative of the fact that how the scientific approach became more reflecting in the way the design processes is carried out for a workplace of about 2 lac people. Each office complexes need about 30 thousand people to be working. And 30 thousand is a very large number (India Habitat Centre houses about 5000 people), we didn't want to have closed office. To have it open much as possible as North-South and lot of openness. A central spine with some interspaced activities for 30 thousand people was planned. It could act as a pulling factor for nearly 2 lac people, who would be eventually working here. The spine had a distinct character of landscape. As traditional as Humayn Tomb, where walk ways are slightly elevated level of the podium. Integration of vernacular aspects into the

modern architecture with elevated walkway connecting all the blocks and shaded connection during the summer season looked very appealing.

The facades and the envelop of the office building have been developed using simulation and softwares. It could be detailed out to the extent how much is the open area requirement. From the vernacular architecture view point the amount of area of opening that could actually be justposed into a sort of a modern *'jally'*. One could have more opening in the north side and less opening in the south side or west side. This could result in huge savings in the cooling energy which was required for this kind of a huge complex. We estimated that enormous amount of energy as much as about 10 MW could be saved in this process. So at Sgadesignlab we are concerned with conservation of energy, environment, materials, and other resources.

Thank you very much.



Mr. Christopher Mitchell, AWW Inspired Environment, UK

Low Carbon Education Designs

School

aww

Room arrangement options

aww

Interiors - concept for flexible, re-configurable break-out space

aww

aww

Experience | BIM | Fundamentals

Low Carbon Education Designs

Mr. Christopher Mitchell, AWW Inspired Environment, UK

Working closely with Mr. Sandeep Goel and his team at Sgadesignlab, New Delhi we find that it is very important that there is possible involvement in projects at all stages, so that the benefits and experiences are fully shared. We use technology to create a better environment. Building information model which is a new way of FGD representation of buildings and environment modeling software are used. We have in-house software designers to help us in the designs process. In our collaboration in a couple of projects with Mr. Sandeep Goel the use of software has been made to understand the best way of orientation to the building.

We do mainly higher education buildings and universities. There are number of campus universities, with very large ground coverage and open spaces. In London land is at premium. We are still achieving good results. Green buildings not only mean naturally ventilated buildings, it is equally important to have efficient mechanical ventilation systems. The student accommodation has to be provided in the same city, where the university is located. There is pressure on land in UK and the pressure on agricultural land is increasing for school buildings and is more in cities. The solutions have to be worked out. The UK based planners are bringing out programs on the reef, high rise buildings, but the schools especially primary schools are single storied and use more land.

No doubt, today all countries are looking at sustainability very hard. We are also doing a couple of works in West Africa in Nigeria. There are very large sites. A master plan which we have for a population of 10 to 15 thousand people is being made. The idea is to create a town here with all facilities and office. The town will be organically growing with all facilities. In an educational building in Nigeria, we are using natural ventilation. If a building is not an inspiration to someone it is not benefitting in any way. To get maximum potential out of it, it has to be an inspiration. Sustainability also couples with the energy crisis of using more renewable and that increases the energy cost. We must do something to make our buildings more energy efficient.

We make use of technology, I-Pad and others, available to the students in primary classes and they are already used to this. In UK one can get a job at the age of 16 and he may not continue in the same job till he attains 65-70 years. It is not that people will have the same job for the life. Our education system has been the same as it was 50-60 years ago. So we need to think about the way we educate

our students. Our secondary schools are being designed for students, in the age group 11 to 16. The classrooms are used in the evenings for education. During weekends, people access through the libraries. I think this is something which has to change and to have schools purely for the 10 years. Schools should be a place to give ability benefits and the schools really got to address how people are going to work and live with it.

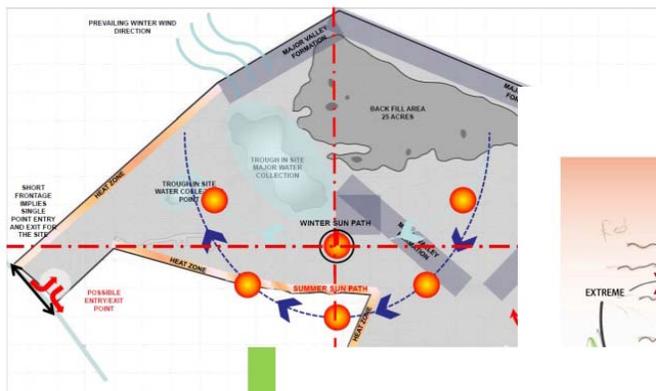
Use of Building Information Modeling is, essentially creating a single 3 D model of a building adapted by the architects, engineers, conservers etc. It is to build a building in a virtual reality before it is constructed. It cuts an enormous amount of waste. Driving architectural efficiency and the better use of materials is significant for the sustainable buildings. Understanding the educational needs is really very important. It is very important that every one collaborates together because the most important part of any scheme is the actual understanding of both the outcome and needs. Finally, we need to make concrete, imaginative and inspirational environments because that is really important.

Thank you.



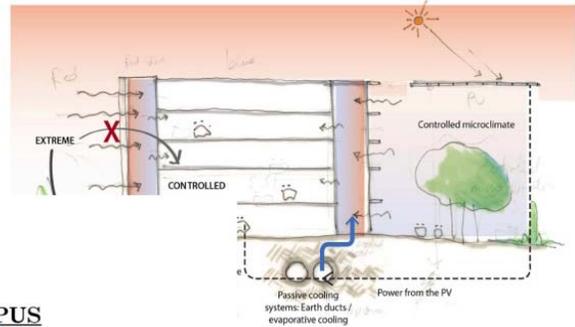
Ar. Sachin Rastogi, Zero Energy Design Lab

NIAB Campus, Hyderabad Sustainable Strategies



SITE ANALYSIS

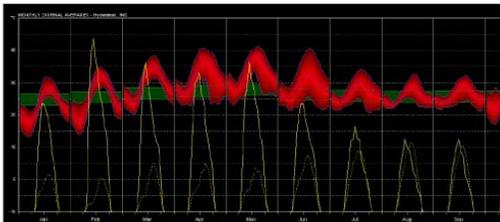
Façade environmental strategy



NIAB CAMPUS
HYDERABAD
SUSTAINABLE STRATEGIES

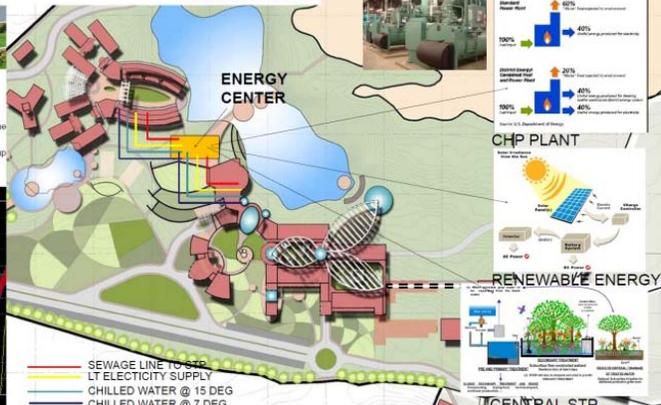
Façade environmental strategy

North Façade – Vertical & horizontal louvers were planned to reduce heat gains from western sun during evening hours.
 East & West façades – GRC Jali was planned to cut down heat gains & glare from low eastern & western sun. The density of the solar isolation analysis.
 South façades – Horizontal shading devices were devised to cut down high sun from south while allowing view out to the occupiers outside.

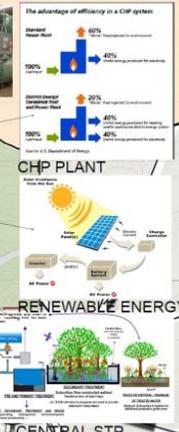


Climate Analysis -

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SEWAGE LINE
 LT ELECTRICITY SUPPLY
 CHILLED WATER @ 15 DEG
 CHILLED WATER @ 7 DEG



NIAB Hyderabad – Sustainable Strategies

Ar. Sachin Rastogi, Zero Energy Design Lab

Zero Energy Design Lab is an architectural and design lab consultancy working on various live and competitive entries like IIM Raipur, NIAB Hyderabad, and IISER Kolkata with Sgadesignlab. I will present here the design features in NIAB Campus, Hyderabad, which is focusing on the sustainable strategies. Unlike the traditional methods where sustainability is just an add-on feature into the already designed building, the focus of Sgadesignlab has been to integrate the sustainable principles right at the design stage, so as to minimize the cost. We adopted 3 M strategy of Measure, Minimize and Mitigate. While measuring, we do the climate analysis since we recognize that a building in Delhi and a building in Jaipur are different. It is important to analyze that where your building is located, to make realistic heat load calculations. Then we minimize through passive measures like building orientation, understanding urban fabric and micro climate.

Micro climate is certainly very important aspect of building design because it is not designing just an indoor space but it is also about the relationship between the outside. In the institution buildings it is the interaction with outside which is more important. Choosing the right appropriate HVAC systems which is more efficient based on the climate analysis and air conditioning is important. Third step is to mitigate through clean energy which is solar or wind, whichever is a more appropriate as per location.

Detailed analysis of climate is made from the study of the temperature, relative humidity and wind parameters. The temperature chart is built with red showing the average temperature; the green shows the comfort zone and yellow graph shows the amount of solar radiation in various months. In Hyderabad the temperature is as low as 10 degrees during the winter season and it reaches up to close to 40 degrees in summer. The temperatures are well above the comfort zones. There is a need of the air conditioning systems during the day times. However during night time and in the morning time the temperatures are well within the comfort zone, so ventilation is adequate observing night time. During the monsoon, the temperatures during the day time are not much above the comfort zone. So with slight loss of thermal mass we can actually achieve thermal comfort inside the building. However, in spite of temperature, it is the relative humidity that is killing in the monsoon time and we need air conditioning to dehumidify the air, which is again an important factor.

During the winter season, the temperatures are well within the comfort zone during the day, but early morning and during the night time the temperatures are below the thermal comfort zone. If it is an office building there is no need to worry as its use is in day time only. But if it is a residential building, we need more thermal mass to have smoother temperature change. Knowing the season, we need night ventilation, we need a dynamic skin which can perform well in peak summer, during monsoon i.e., a tighter envelop in summers and in winters and more openable envelop during the monsoon season. The relative humidity during the hot and dry period is really low. There is strong potential of evaporative cooling for outdoor as well as indoor comfort. During the monsoon season the humidity level rises up, specifying the need of air conditioning. Again the humidity levels are low in September. We need an envelope to change its dimension because more ventilation is needed at night time and less ventilation is needed during the day time. So building needs to be dynamic.

In the site analysis of NIAB Campus very interesting features were seen. There are some strong belly areas and which eventually become a water body, being in a low lying area. We retained this water body and used it as heat sink. There are three natural sources of heat sinks which are available on most of the sites, one is water, second is earth and third is sky. We need to exchange heat absorbed by the building with either of the three to maximize the potential of passive cooling. We have utilized the water body and also tried to do radiant cooling because it was in a rural setting, where there is hardly any micro climate. As it was not an urban situation, we needed to create a sheltered space. We studied the summer sun path and the winter sun path and based on all the site analysis design philosophy was identified.

Courtyard philosophy was very important to understand in the academic block its use is primarily during the day time. We have kept all the courtyard shaded with solar panel roofs, whereas in the hostel block the courtyard is not shaded because it is primarily used in the morning and the evening hours where the temperatures are not very hot. There is a potential of cooling down through variant cooling and exchange heat with night sky and provide very comfortable situation outdoor as well. That is how different aspects, usability pattern have been taken care of.

To conserve resources, the existing water body is used as a heat sink by exchanging the heat. There are pipes in the court yard through which the water is running and decreasing the radiant temperature of the surface of the court yard

making it more comfortable for an outdoor environment. The radiant temperatures are very low as compared to something which is exposed to 45 degrees outside, making it very comfortable during the day time. During the night time water is pushed back through to the water body for the heat exchange with the night sky. The water is cooled during the night time and the cooled water is used during the day time to provide thermal comfort. Solar PV cells roof can generate 62 KW of energy and having a total investment of Rs.1 crore. The pay back period for this is 8 to 10 years. After 10 years all the electricity which is generated by this will be free of cost. It provides shade and the micro climate all time.

Le Corbusier once said that building is a 'bay shell' which is same for something in Antarctica and in Delhi. It behaves just like human beings. We change our clothing as per the climate. Building will now have to change its clothing as per the climate, since we saw in the climate analysis that we need to be really dynamic. We are proposing that, the building retain the permanent structure and we add a skin to it which is like a layer of clothing we have. When you need it can become thicker in the winter season. It becomes lighter in weight during the summer seasons.

The space which is air conditioned at 25 degree centigrade and the outside temperature is 45, so there is temperature difference of 20 degrees in the facade. By shading the façade we can reduce the solar heat gains and lower the load on AC. Things like earth air tunnels and evaporative cooling can cool the skin to intermediate temperature. We came up with this strategy where during the day time it has got skin on the outside and skin on the court yard side as well, which provides defused light as a day lighting source and control the micro climate. Based on the eco tech analysis, we came out with the strategy of vertical loovers for the west and east facade. A combination of both for the southern and northern facade. A 3D picture of the proposed building where you can see the louvers, the *chiyazi jallies*, a very well shaded envelop that is shaded from the top as well.

Building simulation showed that about 50% energy above the ECBC base case, could be saved by adopting passive design strategy with the building envelop design. Site level strategy is also adopted by using centralized energy systems for large campuses. That can further provide you chilled water through vapour absorption in cooling machines.

For rain water harvesting all the rain water channeled through the area is planned to be converted into urban sustainable drainage system as a landscape feature. There is hardly any cost in creating these. There are natural slopes in the site area, all the water will flow into the natural aqua fare which will then recharge the ground water sources.

This is Sustainable design approach adopted at NIAB Hyderabad Campus.

Thanking You.



Mr. Karan Mangotra, BEE

Energy Efficiency Improvements in Commercial Buildings



Energy Efficiency Improvements in Commercial Buildings

Karan Mangotra
Bureau of Energy Efficiency

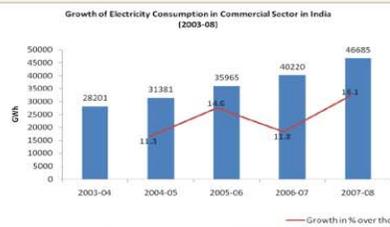
Growth in the Indian Building Sector

Commercial Buildings Floor Area - Growth Forecast

- Currently, ~ 659 million m² (USAID ECO-III Internal Estimate Using MOSPI, CEA and Benchmarked Energy Use data)
- In 2030, ~ 1,900 million m² (estimated)*
- 66% building stock is yet to be constructed



Electricity Growth in Commercial Sector



UNDP-GEF-BEE Project on Energy Efficiency Improvements in Commercial Buildings



Snapshot: Partnership to Advance Clean Energy – Deployment (PACE-D) Technical Assistance Program

OBJECTIVE: To accelerate India's transition to a high performing, low emission and energy secure economy

Project formally launched: July 31, 2012



PACE-D TA Team

- Chief of Party (TBD)
- Deputy COP – Energy Efficiency
- Deputy COP – Renewable Energy
- Communications Specialist
- M & E Specialist
- Program Associate
- Support Team



Project Aim

- To address informational, capacity, institutional and financial barriers to help bring ECBC under mandatory regime
- Indicators/targets: new building space ECBC compliant is increased from 5 to 117 million m² by 2014
- Average energy consumption in new buildings is reduced from 210 to 180 kWh/m²/y.
- Direct energy saving of 90.7 GWh/y, i.e. 1.27 million tCO₂ and indirect emissions reductions of 2.7 to 49 million tCO₂ by 2020

Project schedule	Indicators
Work Programme (for FSP)	Nov 2006
CEO endorsement	Feb 2011
GEF agency approval	Mar 2011
Implementation start	April 2011
Mid-term review	March 2012
Implementation completion	April 2013

UNDP-GEF-BEE Project Outcomes

Demonstration Projects/Design Assistance for commercial buildings	Assisting states in ECBC implementation	Knowledge dissemination and sharing	Technical capacity building	Building materials/components testing and certification	Fiscal & Regulatory Incentives
Technical assistance to demonstration projects in 5 climatic zones	Developing framework for enforcement, Augmenting capacities of key stakeholders	Case studies on demonstration projects, Development of web portals for creating a building database, newsletters	Training of trainers, Training of various stakeholder s, training curricula and modules, Certification of professionals, EE software, guidelines/templates.	Study on building materials, Test standards, Protocols, Accreditation of labs, capacity development of labs	Financing schemes designed with banks for investors, award scheme for efficient investments in commercial buildings

Energy Efficiency Improvements in Commercial Building

Mr. Karan Mangotra, BEE

The presentation has primarily focus on policy interventions in building sector towards energy conservation. What is the need for energy efficient buildings or green buildings in the country? There is primarily a consensus for the energy efficient buildings but cities are still trying to figure out what the term 'Smart' City means and what specific actions to take? Let us see, What a smart city is not? A city is not smart when there is too much of everything - *A smart city would turn its surpluses into resources.* A city is not smart when different networks that define a city do not communicate with each other, are not integrated - *the network solutions of a smart city must be integrated and multi functional.* A city is not smart when the systems and networks which it contains are static and not mobile - *smart city character is high level of mobility.* A city is not smart when it does not include all its stakeholders - a smart city is based on knowledge sharing, collaboration of all levels of society.

In the past, human beings have lived in harmony with the environment. Comfort requirements were different. Smaller population meant modest requirement, low energy needs and lower emissions. Waste products were mostly recyclable and bio degradable. They were mobile communities which were primarily a low threat to the environment. The modern built eco-system has imbalance in whatever inputs go into it and what comes out of it. The building materials become used materials. Energy becomes wasted heat and CO₂. Water becomes grey water. Consumer goods are waste recyclable materials.

Coming to the aspect of green buildings in a smart city set up, an analysis has been done by the Bureau of Energy Efficiency. We will look at the overview of India's commercial building sector. In the sector wise electricity consumption residential and commercial building share is 30%. Out of which commercial buildings share is 8%. Currently we are at 21 billion sq. ft. which was of 2005 data. We are anticipated to grow to 104 billion sq. ft. by 2030. Lack of energy conscious design can still lead to a lot of rampant in efficiency.

An BEE Audit has shown the potential of saving between 30% to 70% in existing buildings. Key areas of building energy usage are buildings envelop, the lighting, H pack, the water heating systems and electric systems. Energy conservation building code has been made voluntary since May 2007 and is currently only applicable to commercial buildings. Why not have codes for the

residential area also? The intent for that is the star rating of appliances is taking care of most of energy efficiency aspect of residential areas as of today.

Current policies and program initiatives of the Bureau is that the ECBC has been targeting commercial buildings in all the climatic zones of the country. There is also a keen interest on the existing buildings through retrofitting. There are empanelled Energy Service Companies who do all lighting and retrofitting to achieve energy efficiency through performance contracting. Benchmarking is a key area for these guidelines to be implemented. Targeting the appliance in the equipment program like air conditioner efficiencies under the star labeling programs, an outreach was planned through media and ECBC technical fact sheets, user guides, advertisements and the labels.

The target is that all new commercial buildings that come up during 12th plan period i.e. from 2012 to 2017, is 75% of those would adhered to the energy conservation building code. There is an equal impetus on the existing commercial buildings also – 20% of them achieve energy efficiency through retrofitting. During the last plan period in the 11th plan, all the policies and initiatives taken by the BIS accrued to a saving of an avoided capacity of 10300 MW. In the 12th plan period, anticipated savings are 12350 MW. Energy efficiency in buildings will have major role. Based on the Energy Performance Index (EPI), the number is calculated and a ‘Star’ is given. One can improve EPIs i.e. energy usage per sq. mt. over a period of a year and get better stars. The most important thing to note in star rating is that the star comes with a date of award of the star. In every three years the number goes down by 1. So the building has to go through a re-audit process. The star labeling of appliances has penetrated into the market extremely well. Everybody understands it, everybody looks for appliances with these stars and we want to do this for the buildings as well. Labeling for buildings for which BIS has been extremely effective.

Apart from all these initiatives, the BEE is being assisted by 3 bilateral arrangements. Indo – US bilateral is primarily looking at moving toward a net zero energy building. Energy efficiency aspects of a building to the max and then integrating renewable into the building so as to achieve a net zero energy building. The Indo - Swiss program is the only bilateral program with the government in the building sector which is looking at the residential energy efficiency measures. The UNDP programme is looking at the demonstration projects and designing fiscal and financial incentives to promote ECBC and uptake energy efficiency in commercial buildings. Thank you.

Valedictory Session

Session Chair:
Prof. Malti Goel, India



Valedictory Address

**Ex- Chief Election Commissioner of India -
Dr. S. Y. Quraishi**

This is a subject which is very close to my heart. I have had some association with the energy sector, when I was Secretary, Power in Haryana and also a Secretary, Renewable energy, at HREDA. That was in 1997-99. Later on I was Additional Secretary and Financial Advisor in the Ministry of Renewable Energy, Govt of India, besides Ocean Development and some other ministries. I do feel that although in terms of awareness and regulations in Government, we do talk of environment and green buildings, at the same time it has not percolated down to the national psyche. We still do it because we are forced to do it. We have to come out of that mind set. We should take pride and pleasure that we all want to do something different and something new at whatever the cost. Lot of greening of India has come through Supreme Court and we should thank them for it. National Green Tribunal has been set up. But for them, India would have been 50 years behind.

In India environment consciousness, at least in the government level is pretty high. We talk of environment safety and control more than probably they do in the USA. The advanced countries are creating greenhouses gases and whatever little they are trying to do to promote climate change mitigation, only to compensate the havoc which they are causing. To that extent we can be proud that our futuristic thinking has been there. But it should become our national habit and should come in our national psyche. We still have a long way to go. To give an example, recently I built my house where solar energy and solar water heating system was also compulsory. Water harvesting structures are also compulsory. But I was quite shocked to be repeatedly told by the contractors, that it is not necessary if I pay, they will get me certificate. It was shocking attitude because five years or ten years down the line, we all will be dying of thirst. Why it is not that we take it as a responsibility? All have to be compelled to do this.

I remember that when I was Secretary, Irrigation and Power under Chief Minister Mr. Bansilal in Haryana we had a Haryana Model of development. In a workshop with World Bank on Water Conservation, it occurred to me that why should water conservation be the job of the Irrigation Department only. We

identified 6-7 departments who should also be involved such as Agriculture, Tube Well Corporation, Power etc. Eventually, the list was expanded to 29 Departments, who could contribute to Water Conservation. I called a meeting of all those and told them to make a presentation in just 2 slides, *not less, not more*. One slide will tell us whether you are doing anything for water conservation at all. Second slide, what is that you think that you can do. Invariably the answer was we are doing nothing, and these are the 6-7-10-15 things that are can do. I suggested please convert these targets into action plan. We can set up a Water Conservation Mission. But once you are transferred, programs also die with you, so things have not been followed up.

Coming to the energy saving in buildings, for electricity, master switches is a very good idea. Because in a hurry, many times we leave one light open in the bath rooms or somewhere. Now in this age of technology, when every gadget is on the standby mode we don't realize that every standby mode is using 15% of power. The main switch at the door is where the architects have a role to play. They have to design it in such a manner that it saves energy, sensors are other options.

New finding is that 75% of the accidents happen at a place which is supposed to be a safest place, your home. Every now and then in the kitchen, we find the cylinder will burst because somebody by mistake left the gas open or it was leaking. Simple solution can be found when Kitchen is built by having a small opening at the bottom, like a base reflect system, and a small opening on the top so that gas will circulate. These simple safety measures do not cost much. We need to make right intervention at the right time, innovate and have to be conscious about these small- small things.

Green buildings are coming up in India. To give an example an IT building in Gurgaon which is a LEED certified as a Green Building and Rs.18 lacs per month of power saving is there. Cost of the construction was actually lesser. Obviously people will do it for no other reason except cost. Many things you can implement just because of economics. I remember, there was a time when CNG was just started there used for public vehicles que of 5 hours or 10 hours for people to just fill up CNG. I asked a taxiwalla, look you are standing in the que for 5 hours, when do you earn. He said petrol cost 30 rupees and this cost 9 rupees. He never said it was the order of the Supreme Court. This is an eye opener, how economics work. Therefore we should make Green building an economic proposition, so as to succeed on large scale.

Now I would share my experience in the Election Commission and say a few words about the election system in India. You have just heard that India's Elections are Green Elections. We were doing it normally, routinely. Ever since the introduction of the electronic voting machines, we are saving 11000 tons of papers, which saves 2 lac 80 thousand tons of emissions every election and we have on average 2 elections in five years. In elections we introduced regulations about control of sound pollution, decibel control, timing norms, no loud speaker will blare after 10.00 pm. We do not allow use of plastics in the election. Banners, posters, handbills or anything plastic is totally banned. We do not allow defacement of walls. There were times when electoral processions with one thousand or two thousand cars were very common. How much pollution it was causing? We went overboard and from a thousand cars we have reduced it to three cars in a procession. We enforced these laws with great effort. Every election in the last three years is not green but has given us the highest turnout in history.

In doing so we have actually saved the environment, we have saved people from nuisance and we have made it into a festival. That's the reason why the Election of India is regarded worldwide as a model to emulate. Madame Hilary Clinton recently called it a world standard. We have more voters than every continent put together, 815 million voters. For that we have to go to every nook and corner of the countries, in the Indian Ocean, in deep forests and 16000 ft. up in the mountains. While we have big numbers, we also had a polling station for a single voter in Gir Forest of Gujarat. About 11 million people conduct the elections for us. All that discipline has been possible because such a great institution has been created by our Constitution. India International Institute of Democracy in the Election Management has been created to train our 11 million people. Besides these 11 million people we will also train some 1100 people from other countries. In the last 3 years, 42 countries have got training from us. The Institute should be a green building, and I want it to be an iconic building, so that people remember. I think with all this we have in India, if provided a will we can try and do it.

There are lots of organizations doing good work. But how to just get into everybody's mind is our challenge. In that context Dr. Malti Goel, thank you very much for inviting me and reviving my interest in the whole subject. Surely I would like to develop these ideas further. Even internationally we will try to create a model of Green Election because that is on what I am invited to speak all over the world. India has all kinds of good stories and bad stories. Let us try and ensure that we have more of success stories. Thank you very much.

Climate Change Research Institute

Interactive Workshop on: sustainable habitat & learning environment

6th June 2014

Venue: Seminar Hall-2, India International Centre (IIC), New Delhi, (Entry from Gate No. 1)

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6th June 2014

Venue: Seminar Hall-2, India International
Centre (IIC), New Delhi, (Entry from Gate No. 1)

Interactive Workshop on sustainable habitat & learning environment

TENTATIVE PROGRAMME

- 9:30 to 10:00 Hrs. Registration
- 10:00 to 10:30 Hrs. Lighting of Lamp } Dr. Malti Goel
Welcome Speech } Former Adviser, DST
- 10:30 to 10:50 Hrs. Brief Address
- Prof. S. Chaterjee, Registrar JNU
- 10:50 to 11:10 Hrs. Inaugural Address
- Dr. G. D. Sharma, Former Secretary UGC
- 11:10 to 11:20 Hrs. Tea Break
- 11:20 to 12:15 Hrs. Smart & Sustainable Cities – an
Australian and Indian building
economists' perspective
- Mr. Peter Cox, Australia
- 12:15 to 12:40 Hrs. Challenges in green buildings –MNIT
Lecture Theatre
- Er. Ajay Raj
- 12:40 to 13:00 Hrs. Question & Answers
- 13:00 to 13:45 Hrs. Lunch
- 13:45 to 14:15 Hrs. Sustainable Habitat-Green Rating
- Shri Avinash Kumar, SGS
- 14:15 to 14:45 Hrs. Green Campuses in India
- Ar. Sandeep Goel
- 14:45 to 15:15 Hrs. Low Carbon Education Designs
- Mr. Christopher Mitchell, UK
- 15:15 to 15:55 Hrs. NIAB Hyderabad – Sustainable Strategies
- Ar. Sachin Rastogi
- 15:55 to 16:15 Hrs. Energy Efficiency Improvements in Commercial Bldg.
- Mr. Karan Mangotra
- 16:15 to 16:45 Hrs. VALEDICTORY ADDRESS
- Dr. S.Y.Quraishi, Former Chief
Election Commissioner of India
- 16:45 to 17:00 Hrs. Question & Answers
- 17:00 Hrs. High Tea

WED 2014 Pledge

As part of World Environment Day celebrations Climate Change Research Institute, held, Brainstorming Workshop on SUSTAINABLE HABITAT AND LEARNING ENVIRONMENT on June 6th, 2014 at India International Centre.
The CCRI pledged on this day

'On WED 2014 at Climate Change Research Institute, we pledge to create awareness about the Planet Earth, its weather & climate, conservation of its natural resources, and Environment to different strata of society to Educate youth from schools and colleges to researchers in academia and industry'


Dr S. Y. Quraishi

NAME Karan Mangotra
(KARAN MANGOTRA)


(SANDEEP GOEL)


6/6/2014
(DR. SANDEEP CHATTERJEE)

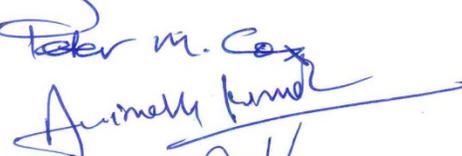
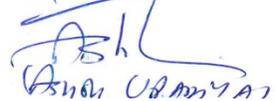

(PRAVEE SAXENA)


(Sachin Rastogi)


(K. N. Rai)


C. Mitchell


Peter M. Cox


Anjali Kumar

Anshu Udayan


Dr. Mahi Goel


(ADIT KUMAR)

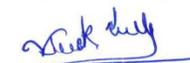

(Usha Sharma)

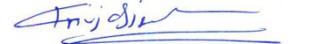

AJAY RAJ


(EKANSH)


Anubhav


Rahul Kharkho


Nishu Dely


Pawan

Prishu



Sponsored by
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Climate Change Research Institute
In Collaboration with
India International Centre
In Association with
Society for Education and Economic Development
6th June, 2014, Seminar Hall-2, India International Centre, New Delhi



Vision

Mission

To innovate and become of excellence for capacity building in climate change mitigation and adaptation technology.

CCRI

Climate Change Research Institute is a registered Society, founded with a mission to promote environment education, innovation and teachings. It aims to address on our lives and taking control measures. Institute is taking initiative to create awareness on energy security and sustainability through lectures in schools and college, workshops and internet reach. Its future work plan would include development of educational tools on topics of scientific and societal interest; such as energy, health and water in the climate change context. Research and studies would be undertaken on science & technology measures aimed at climate change mitigation and ways of CO2 recycling.