



Proceedings of the Seminar covering International and National Perspective on Learnings and Challenges in the Promotion and Implementation of Building Insulation

INDIA INSULATION FORUM

Proceedings of the One Day International Seminar on

"Thermal Insulation of Buildings for Energy Efficiency"

August 4, 2016 New Delhi





Invites you to a One-day International Seminar

THERMAL INSULATION FOR ENERGY EFFICIENCY IN BUILDINGS

Deliberating Critical Topics Towards

Making India Energy Secure

- Participation from Government, Architects, Consultants, Engineers, Academia & Industry
 - Sharing International Experiences Panel Discussions Addressing Challenges

Venue

August 4, 2016 India Habitat Center New Delhi

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Agenda

09.30 AM Registration

10.00 AM Inauguration

10.30 AM Technical Session 1:

International Experiences in Energy

Efficiency

11.45 AM Technical Session 2:

Challenges in ECBC Implementation

02.00 PM Technical Session 3: Case Studies:

Lessons from Success & Failure

03.30 PM Panel Discussion:

Way forward for Insulation Industry in India



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INTRODUCTION

ALMOST EXACTLY A YEAR AGO, when the IIF launched its landmark Technical Manual, Dr. Ajay Mathur, the then Director-General of the Bureau of Energy Efficiency wrote the following as its Foreword:

The Government of India is on a mission to provide 24X7 power to all by 2019. This means that not only does it have to increase the generation capacity, but also reduce the demand for electricity. Buildings are one of the largest consumers of electricity and hence incorporating energy efficiency features in the design would help in reducing the energy consumption together with improving thermal comfort.

The building envelope plays a very critical role in the performance of energy efficient buildings as the major heat gain takes place through the roof and walls. Insulation is therefore a key element in achieving the building energy performance parameters as prescribed in building codes. Although the building codes are at the early stages of implementation, BEE is working closely with the urban development departments of the state governments for its wide-scale adoption. It is equally important to sensitize building design professionals and practitioners on the importance of appropriate building insulation usage.

It is heartening to see that the India Insulation Forum (IIF) is working towards creating a skilled workforce for enabling proper application of insulating material. This is equally essential in enhancing the confidence of building developers and the construction industry to the benefits of insulation usage for energy efficient building design. These guidelines developed by the IIF for insulation material applicators will help in adopting standard operating procedures for insulation application in buildings

These were strong words of encouragement which spurred the IIF into its core activities of Stakeholder Awareness, Training of Applicators and Testing Protocol for Insulation Materials.

As we complete 3 years of such activity, it is an excellent opportunity to take an overview stock of the situation within and without. This will provide us an assessment of the path taken thus far and guide us on the way forward.

With this intent, the One Day International Seminar has been organized. This

Brochure has been prepared to help the participants to gain an understanding on the dynamics as well as the inertia which the Indian environment is challenged with as it builds its insulation capacity. Each sector continues to have its unique challenges and invitations.

What we wish to achieve is a comprehensive recommendation to each stakeholder in the Energy Efficiency Value Chain. No player can work in silos. No progress can be achieved if the stakeholders fail to come together and share the common values of securing India's energy through every possible avenue. Insulation needs to rise in its priority rating to the community.

It is high time this word gets into the top of the mind of the nation's keepers!

KEYNOTE SPEECH

GCMODGIL

Founder, Sterling India Consulting Engineers

From ages past, man has strived to insulate – whether it be clothes or buildings. Protection from the environment has been advancing through greater efficiency and appropriateness. The oil crisis in 1973 was an eye opener on the limitations of energy resources, and thus the concept of energy savings began to make its presence felt.

India is no exception. With growth in GDP, energy demand has been on the rise at a fast pace and consequently the carbon footprint. While buildings are indeed the largest consumer of energy, the exceedingly high rate of growth poses genuine challenges. A very significant segment is the residential sector which is estimated to be 46% of the total consumption in buildings and expected to grow 8 times before we see 2050, with constructed floor area expected to grow five times. It is thus valid to formulate policy to address the residential sector on priority basis. They will be the drivers towards sustainable energy pathway.

The Green Building movement having begun its journey 25 years ago has evolved, spread and proved itself a path to sustainability which can be relied upon. Insulation ought to receive higher credit points to its account when rating a building. Insulation has social, economic and environmental benefits which give every reason to make it mandatory for India's energy security.

India's ECBC is moderately stringent; there are other countries which have set higher standards. While insulation is a one-time cost, the energy savings are annual and substantial business mileage can be drawn from simple steps of acknowledgement and implementation.

TECHNICAL SESSION 1

International Experiences in Building Insulation

To have knowledge of the best practices of leading governments who have responded proactively to the energy crisis and to study the policies which went behind them are vital to avoid pitfalls and clock the fastest route to energy security of buildings. Some have emphasized all round development giving insulation its due. Data is essential to build the rationale for the case of energy efficiency of buildings. Energy efficiency ceased to become a choice in those learned societies. It became a norm. Codes and standards took considerable time to develop and even longer to implement. However, whether it is national or regional level, the inertia gets finally broken and what is possible gets done. This session looks through the experiences of overcoming barriers and tackling the problems head on.

Framework For Transforming Buildings Sector In Developing Economies Based On Lessons Learned From Energy Efficiency & Sustainability Initiatives By The US Federal Agencies And Cities

OM TANEJA, PH. D., P.E., Fellow ASHRAE

The concept of sustainability and high performance is leading public and private sectors to shift their strategic direction towards integrating smart building technologies and training of operations and maintenance staff into all aspects of design and construction. This process is transforming the investments in buildings towards multiple dimensions of workforce productivity, lower cost of utilities and services, brand image, environmental compliance, eco-friendliness, and corporate and social responsibility. However, efforts to sustain the intended sustainable performance with regards to low energy use, indoor comfort and projected operating costs over the long term use of the building has become challenging. To mitigate this requires investment decisions promoting area specific applications, customer intimacy, behavioral changes, timely communications, and transformation of Buildings Managers. Further adoption of emerging buildings technologies that provide monitoring, tracking, benchmarking, selfdiagnostics and analytics for user-friendly guidance to the trained, certified and motivated operations staff can become an asset. Structured training of Buildings Managers and Operators can help in operational Improvements without significant capital needs. This presentation focuses on the tools and capacity building required in expanding economies to advance greater sustainability. Traditional "Rules of Thumb" need to be modified and strengthened for high performance buildings.

International practices and developments in building insulation

CLAUDE-ALAIN ROULET, PHD,

Prof. Emer. EPFL

Buildings are first built to provide comfort. This can be achieved by a combination of passive or architectural measures and active or technological means. Since passive measures use mainly renewable energy, they should be prioritised, and the technological means used as complement when needed. Among the passive ways, thermal insulation is one of the most efficient ways to provide thermal comfort, in particular when combined with thermal inertia, appropriate use of solar radiation and protection from it, and adapted airing. The best combination strongly depends on the climate, and the architecture should be adapted to this.

The general trend is now to design buildings that provide the necessary comfort with the smallest amount of non-renewable energy, and the smallest possible greenhouse gas emissions. When looked for the whole building life cycle, buildings can be designed to economically reach this objective. Most countries have now published building energy codes and energy labels intending to improve the building energy performance. Surveys have however shown that the actual energy use often differs from the design one, and outcome-based regulations may be useful to actually reach the energy policy objectives.

Ecolabelling and EPD for Insulation product

CESARE SACCANI

MD, ICMQ

The focus would be on the approaches to achieve eco label and EPD (Environmental Product Declaration) according to the international standards ISO 14020.

The final draft of the PEP (Product Environmental Protocol) prepared within the MISBM (Make It Sustainable Building Material) project launched by the Indo Italian Chamber of Commerce in collaboration with CEIP Piemonte (an Italian regional agency for innovation and internazionalization) and Conventry University and funded by EBTC (a European Union Agency) would be presented.

http://www.indiaitaly.com/IndoItalianSite/SpecialProjects.aspx?GId=4&PId=6&language=en

The scope of this project is to prepare PEP (Product Environmental Protocols) for three families of product:

- Cement, concrete and mortars
- Brick and tiles
- Insulation and Waterproofing

According to the international standards (ISO 14025 and EN 15804) this type of documents must be prepared by a multistakeholder Technical Committee and validated by a multistakeholders Review Committee.

http://www.indiaitaly.com/IndoItalianSite/SubSpecialProjects.aspx?GId=4&PId=6&CId=37

In the TC "Insulation and Waterproofing" there are two Indian companies represented. An introduction to the PEP "Insulation" would be made and this would be a very important opportunity to discuss along with IIF members about this document in order to collect feedback.

TECHNICAL SESSION 2

Challenges in ECBC Implementation

The ECBC was introduced in 2007 with much expectation. As the years progressed, a few states adapted it and made apparently some steps to implement. However, theory aside, the practical challenges in making the ECBC a practice can be listed as poor knowledge leading to low prioritization, lack of a conducive ecosystem as well as effective tools, and incentive through a correct approach to the business case of insulation. The revision and up gradation is work in progress. The questions persisting on the means and goals of the ECBC will be discussed in this session by eminent and experienced speakers. What will it take for the next decade to be different and progressive at a faster pace? What will be the drivers for the faster implementation of the ECBC 2017? Would we need the crisis situation to shake all from apparent stupor? Are there some sparks in the air which give us hope that we may not despair?

Symbiosis of thermal insulation and thermal mass

PROFRAJAN RAWAL

ED, CARBSE, CEPT University

This presenter will establish importance of measurements in buildings to achieve energy efficiency in context of Energy Conservation Building Code (ECBC) India. He will start with state of energy efficiency in buildings in India. He will elaborate on ECBC Implementation, challenges and opportunities. In view of the fact that India is looking at constructing large amount of floor space in near future; it is challenged by influx of various technologies; its markets are flooded with numerous products; it needs to reduce construction time and cost on one hand, and on the other, build capacities for appropriate contextual decision at policy, design and construction level. Challenges also lie at the institutional level in terms of training manpower to meet societal needs. This talk will emphasize the need to ingrain scientific decision-making process in India in collaboration with the industry and academia. This talk will also elucidate on recent research developments at Centre for Advanced Research in Building Science and Energy (CARBSE) at CEPT University with reference to symbiotic relation between thermal insulation and thermal mass. How measurable means can help society to pass on the acquired knowledge to future generations to build impeccable built environment will be key focus of this talk.

Energy Conservation Building Code (ECBC): Karnataka Initiatives

KANAGARAJG,

Architect

To give impetus to energy conservation in the country, Government of India enacted the Energy Conservation Act (EC Act) on 1st March 2002. Under the Act, the Government of India established the Bureau of Energy Efficiency (BEE), a statutory body under the Ministry of Power (MoP), Government of India. Under the EC Act, BEE has prescribed Energy Conservation Building Code (ECBC).

Karnataka is one of the most proactive states, which is spearheading the implementation of ECBC. The state of Karnataka has modified ECBC to suit to its local requirements and a notification was made in the Gazette of Government of Karnataka (part IV-A) on 27th November 2014. The ECBC is applicable to all buildings or building complexes in the urban area that have a connected load of 100 kW or greater, or a contract demand of 120 kVA or greater, or having conditioned area of 500 m² or more and used for commercial purposes. It is applicable for both Government and private buildings.

The ECBC sets minimum energy performance standards for buildings and covers building envelope, heating, ventilation and air conditioning, service hot water systems, interior and exterior lighting, electrical power and motors including thermal comfort in non-centrally air conditioned/heated buildings. The code, would provide multiple options for compliance that is, prescriptive for each sub-system and overall system or using trade-off between sub- systems or whole building performance based compliance, as per the prescribed procedure. The code is getting implemented through collaborative efforts of multiple stakeholders: Bureau of Energy Efficiency, UNDP GEF Building Energy Efficiency Project, Karnataka Public Works Department, Karnataka



Renewable Energy Development (KREDL), Electrical Inspectorate and ECBC Cell. These directives for the implementation of the Karnataka Energy Conservation Building Code will ensure construction of energy efficient buildings with reduced electrical energy demand by about 30% to 40%.

All India Institute of Local Self Governments (AIILSG) under the UNDP GEF BEE project has set up an ECBC Cell for one year duration in the office of Principal Chief Architect, Karnataka PWD. The ECBC Cell team over the past 6 months has been assisting Karnataka PWD ansd State Designated Agency (i.e. Karnataka Renewable Energy Development Limited) in mainstreaming ECBC in the state. Under the project, ECBC Cell has been mandated to make at least 10 of the PWD's new buildings as energy efficient, revision of the Schedule of Rates (SoR) of Karnataka, updating of Bengaluru bye-laws to include ECBC clauses and providing assistance for knowledge dissemination.

How the Indian Building Industry Ignores Insulation & Ways to remedy it

KKMITRA

Insulation Expert

Thermal Insulation of buildings is to provide comfort and reduce the energy bills of the end users, hence is not a priority for developers and shall always be considered by them as an additional / unnecessary expense. The benefits at the Macro level is seldom understood and prioritized by the building developers and contractors. Thermal Insulation application is a specialized activity and has to be executed by trained and experienced staff / labor / contractors; it is not a civil work item or part of waterproofing contract. Insulation of buildings sequentially happens as one of the large infrastructure finishing works in a project. It is many times diluted / sacrificed and not applied to its required thickness and density, thereby defeating its efficiency targets. Insulation of buildings – Selection of materials and its application has to be treated as a specialized and necessary construction item. Since it is a passive treatment and once properly placed, shall give beneficial results for a very long time and in some cases throughout the life of the building. World over, it is a highly practiced phenomena.

In the ancient times also, this treatment was highly practiced by building high mass walls and roofs but scarcity of raw materials and their escalated costs, somewhere down the line, the thickness / mass of the walls and roofs got replaced with structurally effective and commercially viable thin construction but in the process this important factor was overlooked and compromised. With the energy prices going up and the general temperature of the atmosphere rising, this issue can no more be neglected.

TECHNICAL SESSION 3

Case Studies: Lessons from Success & Failure

While green buildings have now crept to 3.8 billion sq. ft. since the movement started in India, high performance buildings have been far and few. There is the much hyped Net Zero Energy Clusters of the Smart Cities. As usual, it is mostly the private sector which has taken the lead in energy efficiency steps for buildings. Bayer, now Covestro, took upon itself to showcase the contribution which materials can give to the Net Zero Building. By far, it is the lone outstanding example of insulation playing a vital and indisputable role in the energy effectiveness of the building. We have examples of Infosys who have committed to build green infrastructure. Government-to-government cooperation brings best practices from all over the world. The Indo-Swiss BEEP is one effective instrument which brought about a remarkable transformation in the approach to intelligent efficiency. This session will highlight the lessons learnt from success and failure.

Importance of facade on building performance

GURUPRAKASH SASTRY

Regional Manager – Infrastructure, Infosys

One of the most essential parameters to achieve a high performance building is an efficient façade. A building façade not only gives the building a unique appeal but is also responsible for ensuring comfort for the occupants — in terms of reducing heat ingress and in getting adequate daylight into the space. It is very easy to undermine the benefits of insulation for a tropical country like India, but the fact is that there is very little understanding in the industry about the impact of insulation or high performance glass or shading. The common mistake among designers is that the cost for insulation is projected as an incremental cost whereas the benefits are not calculated with a holistic approach. Case studies at Infosys have shown that a high performance façade including insulated walls and roof have actually helped in reducing the overall cost of the building, and also ensured higher comfort for building occupants.

Case study of an Energy Efficient Building: Aranya Bhawan, Jaipur

PRASHANT BHANWARE

Energy Engineer, ECBC Master Trainer, Indo-Swiss BEEP

Aranya Bhawan is the new office building of the Rajasthan Forest Department in Jaipur, was one of the first projects selected for the BEEP Integrated Design Charrette and the charrette was held in December 2012. The project was implemented by the Rajasthan State Road Development and Construction Corporation Limited (RSRDC) and was inaugurated on 23 March 2015. It is a 5 storey building with one basement; having a

built-up area of ~14,000 m².

Simple energy efficiency measures were applied in this building which includes a cavity wall with insulation (50 mm extruded polystyrene), insulated roof (40 mm polyurethane foam insulation), reduction in glazed area, high performance double glazed windows, centralized high-efficiency water-cooled chiller, STP for waste water treatment and use of treated water in cooling tower and installation of a 45 kWp roof-top solar photovoltaic (PV) system with net metering.

Except solar PV system, all other energy efficiency measures increased the project cost by only 2%. The energy saving estimated was ~32% which results in a payback of ~3 years. Energy monitoring of this building has been done more than a year and confirmed the predicted energy savings. The energy performance index (EPI) of this building is ~43 kWh/m².y (considering only the regularly occupied areas) which is much below than the required EPI (<90) for a BEE 5-star rated building. The presentation would include details and key results of the energy monitoring.

Buildings of the future

ISAAC EMMANUEL

Covestro (india)

In the EU buildings account for some 40% of the overall energy consumption and approx. 20% of total CO2 emissions. Consequently, building insulation is a key solution to achieving defined climate goals. Hence industry came forward to support the development of the first energy plus commercial building refurbishment in the world, based on a building structure raised in the 1960s. With Covestro's involvement, a readiness to pave the way for innovative projects and future business opportunities was demonstrated.

The "Zukunftshaus" is located in Bottrop, Germany and part of the Innovation City program, which aims at a CO2 reduction of 50% for a large part of the city by 2020. The building uses advanced building technology, such as photovoltaics and heat pumps, to generate more energy than it needs for operation.

This is only possible because of a high-performance building envelope, including PU roof insulation and PU wall insulation to reduce heat losses to a minimum. The building was officially opened by the German Minster for the Environment, local politicians and Covestro on 16 October 2015.

PANEL DISCUSSION

Way Forward for Insulation of Buildings in India

Certain critical questions need to be answered before we come to the end of the day's proceedings. The questions pertain to figuring out the return of investment in insulation for all types of buildings, especially as the future for India's energy security is held closely to it. If energy saved is energy generated, are we factoring this in our calculations? As corporate growth remains sluggish, will companies invest in sustainability? As automation increases and cost-cutting becomes increasingly people-cutting, will insulation per se offer opportunities for employment? Are we ready for the proliferation of knowledge on training of applicators and testing of materials? What recommendations can we make to the government colleagues so as to allow the holistic and inclusive development of energy efficiency?

Building Insulation - Expectations for Tomorrow

shantanu jana, chief architect, larsen & toubro limited

With reference to the built environment, history gives us a host of solutions as seen in palaces with massive walls, fenestration, shading elements, landscaping, use of water features, layering, air circulation etc.

Today's scenario is however, is a resultant of the man-made scarcity of land, lack of organised landscape and the maximization of carpet areas in the built environment leading to creation of spaces which require a lot of mechanical support systems to make them amenable to human comfort.

In order to reach compliance for net zero buildings by 2050, this needs serious re-thinking. The challenge for the industry is to come up with good options which provide unified insulation solutions which provide good illumination, restrict maximum heat, resist fire, and cut sound at the same time, ideally with zero thickness to maximise carpet areas.

Another important aspect is the application of carrot and stick approach by the Statutory authorities with balanced incentives and penalties towards the appropriate technologies to meet the required ends in time.

The Role of New Materials

Dibakar Rakshit, Academic, IITD (same format as others)

In India most of the places experience extreme climatic conditions with temperature remaining above or below the human thermal comfort zone for most of

the time of the year. In both cases the most basic way to prevent corresponding heat gain into indoor space or heat loss to the ambient is to use thermal insulation in the walls and roofs of buildings. Bricks concretes with low thermal conductivity serve this purpose. However new methods of increasing thermal insulation of walls need to be investigated within these constraints. One such effective method of increasing thermal insulation of wall without increasing its thickness is to incorporate phase change materials in the walls.

The Impact of Insulation

Mili Majumdar, USGBC

Insulation has major impact on environment, in a positive way. Use of insulation in buildings can enable quantum amount of energy saving. I am indeed delighted to see the initiatives taken by the Indian Insulation Forum to spread knowledge and awareness on adequate and appropriate use of insulation materials in the construction industry. However, it must be ensured that harmful materials (that have impact on human health) that are part of some insulation products, be phased out over time. The industry should pay equal attention to energy benefits as well as human health for leaving a positive impression on environment.

Role of media in insulation promotion

R N Bhaskar,

Journalist

No amount of talk on energy efficient buildings with renewable material will become meaningful unless media is roped in.

- **1.** Use media that goes beyond literacy i.e., radio and TV -- for anecdotal instances of examples such as in housing, and the remaining media for making the stories data rich.
- **2.** Use anecdotal stories about case studies built in the past with principles of insulation, environment friendliness and protection all rolled in. Show how modern science can achieve this much better.
- **3.** Give out data on how much power is saved through insulation; how much of natural temperature can be managed by using environment friendly materials, and how society as a whole actually benefits from lower medicare costs thanks to the use of such technologies. Give data on lifecycle costs.

All this should be done as a series - one point at a time through various media, but in such a way that almost all the points are covered in say around 2-3 months. Then focus on how some uniquely designed buildings have helped save costs, and what makes them special. That in turn creates "Me-too" players in the marketplace.

How do our labs fare?

Prof. Claude Roulet

From a recently concluded Inter Lab Comparison of Test Samples of Insulation Materials, certain aspects on the way forward of technical capacity of India could be assessed. The dispersion of the results of thickness and density depends much more on the variations of the samples themselves than on the measurement techniques. The results of the measurements of each of the five laboratories are in close agreement.

The same conclusion can be drawn for thermal conductivity measurement, with the exception of one laboratory (Nirma), equipped with an old instrument that provides results significantly smaller than the others. This will be relooked when this laboratory will be equipped with a new instrument.

The reproducibility of the thermal conductivity measurement is good in all laboratories, and in conformity with the reproducibility announced by the manufacturers of their instruments.

PROFILES OF SPEAKERS

GCMODGIL

Founder, Sterling India Consulting Engineers

Mr. G. C. Modgil founded Sterling India Consulting Engineers in 1990. His passion is towards innovative design and integrated approach to provide efficient solutions to Engineering Services. He has contributed to many excellent examples of buildings whether it be an Institutional Building like India Habitat Centre Delhi or projects in Hospitality, Health care, Airports, SEZs, IT Parks, corporate offices, Diplomatic Missions and residential complexes.

After completing Bachelor of Engineering in Mechanical from Thapar Institute of Engineering and Technology, Mr. Modgil pioneered the art of thoughtful eco-friendly design in association with most reputed architects and his exceptional exposure to most difficult Architectural requirements of engineering services. While he has served leadership positions in ISHRAE & ASHRAE, he is currently chairing the ISHRAE Education & Research Foundation

Mr. Modgil was the prime Contributor for re-writing "Air Conditioning, Heating & Ventilation" Section of the new National Building Code (NBC-2005) of India. He also has the distinction of being one of the authors of "ECBC-2007" Energy Conservation Building Code brought by Bureau of Energy Efficiency Ministry of Power Government of India. Presently, he is Member Working Group Committee for BEE on ECBC(2017) Revision and Update

OM TANEJA, Ph. D., P.E.

Fellow ASHRAE

Dr. Taneja holds a Bachelor's degree in Mechanical Engineering from Indian Institute of Technology, New Delhi, Master's degree in Control systems and a Ph.D. degree in Systems Sciences and Operations Research from New York University. He is a licensed professional engineer, ASHRAE Fellow, USGBC Member and active in power generation and distribution, sustainability, energy-efficiency, innovative technologies, operations and maintenance issues.

Dr. Taneja has more than 35 years of diversified experience in the area of design, construction, operations and maintenance of large facilities, including the United

Nations Headquarters, General Electric Headquarters, US General Services Administration and 17 years in the Infrastructure Development for hospitals, court houses and varied commercial, industrial and historical facilities. He was the Chief of Planning, Design & Overseas Properties, at the United Nations Headquarters, New York for 12 years, where he had the responsibility for coordination and management of facilities, security and technology implementation for the United Nations Headquarters and Overseas Properties worldwide. At the United Nations he had the supervisory responsibilities for the Architecture & Engineering Unit, Office Space Planning Unit, environmental and budgetary issues.

Dr. Taneja was nominated ASHRAE fellow in 2015 and he has served on different Chapter and Technical Committees and has been a Member of the Board of Governors of ASHRAE NY Chapter since the year 2002. He was the Program and Student Committee Chairman and President of ASHRAE NY Chapter during 2008-2009. He served as a "Distinguished Lecturer" for ASHRAE for FY 2012-2014 and 2016-18 conducting seminars on technology adoption, smart buildings, transformation of facilities management, operations, maintenance and staff development.. In addition to being a Board Member of ASHRAE NY, Dr. Taneja was also a Board Member of the USGBC, New York Chapter which has lot of synergies in partnering with ASHRAE towards Energy Efficiency & Sustainability issues. He has been an active member of ASME, IFMA and USGBC.

PROF CLAUDE ROULET

Prof Emeritus, EPFL

Born in 1941, Claude-Alain Roulet studied Physics at the EPUL (École Polytechnique de l'Université de Lausanne) and got a PhD in sciences at the EPFL (École Polytechnique Fédérale de Lausanne) in 1973.

After a short job in the industry, where he developed a laser for boring holes in watch jewels, he worked as engineer at the Building materials laboratory, EPFL from 1974 to 1982 where her did research on the frost effects on building materials, and on measurement of thermal properties of building materials, in particular insulating materials. In 1973, he co-founded a factory making thermal solar absorbers and developed a selective black chrome coating for these solar collectors.

Since April 1982 he acted as senior scientist at the Solar Energy and Building Physics Research Laboratory (LESO-EPFL) where he did research on on-site measurement techniques related to energy and ventilation in buildings, thermal behaviour modelling of buildings and indoor environment quality and health. His research group also developed and validated ventilation models of buildings, and brought major contributions to several International Energy Agency and European Union research projects. He is author of four books, of about 100 peer-reviewed papers and 120 contributions to scientific conferences.

He also gave lectures in physics, building physics, and indoor environment quality at the EPFL continuously since 1966. He is now retired and Prof. Emeritus since April 1st, 2006, but still active as consultant in building physics.

By the way, he was also in the town council of Apples, Switzerland since 1994 and Mayor of this community from 2002 to 2011. He is married since 1964, has two children and three grand-children.

See also http://people.epfl.ch/claude.roulet

CESARE SACCANI

ICMQ India: Managing Director and legal Representative (since 2008)

He is also Indo Italian Chamber of Commerce: Vice President, Indo Italian Club for Infrastructure and Building Chairman, EU-India Chamber of Commerce council: Board Member & Fagioli India: Non-Executive Director

He started his career at Bocconi University by conducting a research study on "Quality and Certification" (1988) resulted into a book published by McGraw-Hill.

He has 20 years of managerial experience.

He started his career at Lombardy Foreign Trade Centre in the role of "Quality and Innovation manager".

From 1995 to 2001 he has been working in the role of Chief Operation Officer in the SoGePar group (owned by Prince Borromeo Arese family group), largest Stainless Steel Service centre in Europe (3 plants in Italy, 2 in UK, 1 in Belgium), in charge of quality, health and safety, organization and information system.

In 2001 he joined Anysteel Group, an e-commerce portal of metal products. In 2007 he joined ICMQ spa to prepare the business plan of a newco to be established in

India. Since 2008 he has been coordinating the start up process of ICMQ India, subsidiary of ICMQ Spa, Italian certification, inspection and training body providing services in the construction and infrastructure field.

He has large experience in Total Quality Management and Business Excellence and he is EFQM (European Foundation for Quality Management) Assessor and Faculty.

He conducted more than 50 assessment based on the EFQM Excellence model.

From 1997 to 2007 he chaired the Lombardy Excellence Award in Lombardy for Small and Medium companies promoted by Regione Lombardia and Unioncamere.

He published books in Italy. He is frequently invited as Lecturer and Key Note speaker in international conferences.

He is experienced in supporting Government and Authorities in setting rules and framework in the field of quality and sustainability.

He is qualified in Italy as "Independent Director" of listed companies.

Recently he published in India a Discussion Paper, along with Mr.Anil Jauhri, focused on "Policies for improving quality in infrastructure".

PROF RAJAN RAWAL

ED, CARBSE, CEPT University

Rajan Rawal is a faculty member at CEPT University. He is a licenced architect, graduated from School of Architecture, Institute of Environmental Design, Vallabh Vidyanagar. He worked with Vastu Shilpa Foundation for Studies and Research in Environmental Design as research associate before joining CEPT University. In the past, he served as Post Graduate coordinator at CEPT University and Head of Undergrad program at Faculty of Design, CEPT University. He teaches energy efficient built habitat, energy modelling, energy policy at post graduate level. His work emphasis is on 'energy performance of human habitat' and 'architectural science education'.

He is Executive Director of "Centre for Advanced Studies in Building Science and Energy" (CARBSE) at CEPT University. Prof Rawal leads Indo-US Joint Clean Energy R & D Centre - Building Energy Efficiency Sector. CARBSE is recognised as centre of excellence by Government of India, Government of Gujarat and United States Agency for International Development. Prof. Rawal is member of technical core committee for energy benchmarking of buildings, energy conservation building code, Window

Labelling Program committee at Bureau of Energy Efficiency Government of India, Member of National Building code, India BIS -CED 46 on Sustainable Buildings and BIS-CED 58 for sustainable construction, Technical Committee member for GRIHA rating system and technical expert at India Green Building Council. In 2014 he was appointed as senior expert at Global Building Performance Network. He served as member Board of Studies at various educational institutes. CARBSE operates out of an experimental 'Net Zero Energy Building - A living laboratory' situated within CEPT University campus.

Prof. Rawal is recognized trainer for building modelling and building energy efficiency, IGBC authorized evaluator for LEED certification rating for commercial buildings, and Green Homes. He is also GRIHA rating system empanelled assessor. He is founder member secretary of India Chapter of International Building performance simulation association (IBPSA) and also serves at Chair Education at IBPSA Executive committee. He serves as a research reviewer for a number of journals and research projects. In March 2016, Prof Rawal was nominated as an observer to International Energy Agency Annex 69 on Strategies and Practice of Adaptive Thermal Comfort in Low Energy Buildings.

KANAGARAJ GANESAN

Architect

Kanagaraj Ganesan has 8 years of experience in the field of building energy efficiency. He is a licensed architect with post-graduation in "Building Energy Efficiency" from the Indian Institute of Technology, Madras (IITM). In 2009, he spent nine months of his academic time at the Institute of Baueknomie, University of Stuttgart, Germany, where he acquired knowledge of building physics and building energy simulation. He also developed his post-graduation research work on "integrated design process".

Until June 2015, he was working as a Senior Programme Officer at Greentech Knowledge Solutions Pvt. Ltd, New Delhi, which has been appointed as Indian Project Management and Technical Unit (PMTU) for the Indo-Swiss Building Energy Efficiency Project (BEEP). BEEP is a bilateral project between the Ministry of Power, India, and the Federal Department of Foreign Affairs, Switzerland. Project aims to reduce energy consumption in new commercial buildings and disseminate best practices for the construction of low energy residential and public buildings. BEEP is funded by Swiss Agency for Development and Cooperation (SDC) for 5 years (2012–16). His work under

BEEP included (a) contributions to the development of Project Document; (b) conceptualisation of project activities; (c) providing technical and management inputs for the implementation of project activities; (d) liaising with Bureau of Energy Efficiency (BEE), SDC, and Public Works Departments (PWDs) of the states of Karnataka and Rajasthan; (e) coordination with Swiss and Indian experts, private building developers, and building sector professionals, (f) organising project seminars and events in collaboration with various professional associations.

From July 2015 onwards, he is working as an Independent Building Energy Efficiency Consultant. He intends to focus on mainstreaming "integrated design" for realising high performance buildings. Attainment of knowledge in architecture, energy engineering and applied research along with professional competencies of project management and analytical skills place him appropriately to make genuine contribution to "Building Energy Efficiency" practices in India.

KKMITRA

Vice-President, Lloyd Insulations

Mr. Mitra is also PRESIDENT ASHRAE INDIA with 29 Years of experience in the building insulation industry. He is member of Thermal Insulation committees of BIS, Committee member of Experts, ECBC, Member of Technical Standard, Committee of NHB. He has widely attended / given training programs on Building Insulation in India and abroad. He has also authored and presented number of technical papers in the field of thermal insulation for various national and international seminars.

GURUPRAKASH SASTRY

Regional Manager – Infrastructure, Infosys

Guruprakash has over 12 years of experience in sustainability & green buildings. Responsible for driving environmental sustainability initiatives across Infosys campuses with specific interest areas being high performance building facades, high efficiency building services design, innovative HVAC systems, etc., with the objective of taking leadership and setting new benchmarks for efficiency in the building industry.

PRASHANT BHANWARE

Energy Engineer, GKSPL

Prashant is an energy engineer with core expertise in building energy simulation, energy efficiency and renewable energy. He is a Bureau of Energy Efficiency

(BEE) certified Energy Auditor (EA-6602) and ECBC Master Trainer. He has a Bachelor's degree in Mechanical Engineering from National Institute of Technology, Raipur and a Master's degree in Energy Systems Engineering from Indian Institute of Technology (IIT), Bombay. He has around 12 years of experience in the energy sector in research and consultancy.

He started his career with The Energy and Resources Institute (TERI), worked there for 1.75 years as team member of projects on renewable energy resource assessment, experimentation of solar technology, feasibility studies/DPR preparation and energy master planning. He worked with International Institute for Energy Conservation (IIEC) for 1.5 years where he provided technical support and managed activities for projects on demand side management, energy efficiency, renewable energy (waste to energy) and energy audits. Since January 2008, he is working with Greentech Knowledge Solutions Pvt. Ltd. and involved in projects dealing with energy efficiency & decentralized renewable energy applications in buildings & industries. He is working on the Indo-Swiss Building Energy Efficiency Project (BEEP) since its inception and involved in management of BEEP activities as well as providing technical support for it.

ISAAC EMMANUEL

Head – Industrial Marketing & Advocacy, Covestro (India)

Isaac Emmanuel has a Polymer Materials background and has spent around 24 years in polyurethanes market development in various industries, ranging from automotive to footwear to industrial mechanical. In recent years, he has focused on building insulation and cold chain activities, also having developed new models for modular affordable housing. He plays an active role in the IIF activities as well as the Spray Foam Alliance of India. He sits in the Executive Committee of the Indian Polyurethane Association.

MILI MAJUMDAR

MD, Green Business Certification Institute Pvt Ltd

Mili is also Senior Vice President, USGBC. In her current role Mili is responsible for technical adaptation and customization of the portfolio of rating systems of GBCI for the Asia Pacific region. She is also responsible for customer coordination, education,

training, and developing market mechanisms for adoption of the tools and rating systems for the region.

An architecture graduate and a building technologies specialist, Mili has more than two decades of experience in the field of energy and environment with a focus on sustainable development of habitats. She has worked tremendously in the sectors of green buildings, climate resilient housing, city planning and urban transportation. She has led a team of professionals to develop a portfolio of green rating systems for habitats that have been widely accepted in India. Mili has also enabled the development of a large portfolio of green jobs through training and skill enhancement.

Mili led a team of professionals to develop a portfolio of green rating systems for habitats that has been widely accepted in India and is recognized as the National green building rating system for India (recognized in INDC as India's indigenous rating system for green buildings). She has enabled development of a large portfolio of green jobs through skill enhancement, training, and creation of enabling environment for income generation through credentialing, evaluation and consulting services. Has lectured in several national and international forums. She has authored several books and publications in the domain of Sustainable Habitats. Regular blogger in Economic Times of India

She is member of Committee for formulation of energy conservation building codes for India, Member of Committee of Bureau of Indian Standards (BIS) for revision and updating of National Building Code of India. She is Advisor to Delhi Urban Arts Commission and Glass Academy of Saint Gobain. She is Founder member of the Indian Building Performance Simulation Association. She is Member of Expert Appraisal Committee (Infrastructure-2) constituted for appraisal of infrastructure projects by Ministry of Environment, Forest & Climate Change (Government of India). She is Member of the Assurance Group of the World Business Council for Sustainable Development (WBCSD) Energy Efficiency in Buildings Project. She has been awarded the Construction World Woman of the Year 2011 by ASAPP media. She is widely travelled and has lectured in several national and international seminars and conferences.

SHANTANU JANA

Chief Architect, L & T (Corporate)

With 26 years of experience in the field of Architectural Design, he is the Chief

Architect (Corporate) for Larsen & Toubro Limited for the last 11 years.

He did his graduation from School of Architecture, CEPT, Ahmedabad and has a Masters Degree in Building Science from the University of Southern California, Los Angeles.

He has had a wide exposure in key positions with leading Architectural firms in India and abroad, such as MacKeller Transport Architects, UK; Gennselaer & Associates, USA; Jurong Consultants, Singapore, M/s. Hasmukh Patel, Ahmedabad, M/s. C P Kukreja, New Delhi, amongst others.

He has worked on many types of projects including Corporate Offices, Institutional, Residential, Recreation, Medical facilities and others.

His inherent inquisitive nature has helped in gathering a good understanding of building materials, their properties, appropriate usage, life expectancy, maintenance free life etc. by seeing projects from budget and conception to their go live and performance while in use.

Concentration has been on viable sustainability and continual improvement by sharing the learnings across corporates for overall growth.

DEBAJIT RAKSHIT

Asst. Professor, Centre for Energy Studies, IIT Delhi

Dr Dibakar Rakshit has ten years' experience in studying thermofluid sciences pertaining to design and optimization of energy systems. His special interests lie in thermofluid studies of solar thermal coupled heat exchanger designs, energy conservation in buildings, solar assisted refrigeration systems, multiphase flows and emission control system designs. In the context of building energy conservation his interests are mainly in the area of building directional optimization, utilization of phase change materials (PCM) for thermal energy storage and natural lighting options to for building energy conservation.

After joining Indian Institute of Technology Delhi (IIT Delhi) as an Assistant Professor Dr Rakshit continued his study of the thermal energy storage capacity of materials that can be utilized for building energy conservation. Dr Rakshit started his work with study of directional optimization of institutional building, selection of building insulation materials to minimize the heat loss for different Indian climatic

zones. These initial works were well appreciated by scientific community. Dr Rakshit then started pursuing his further research in the area of characterization of Nano Enhanced Phase Change Materials (NEPCM) for thermal energy storage in walls.

Since last 2 years Dr Rakshit is working in the area of low-energy buildings where the main aim is to utilize minimum energy to mitigate the carbon footprint. Corresponding results have been communicated in top-tier journal including ASME Journal of Solar Energy Engineering: Including Wind Energy and Building Energy Conservation and Taylor and Francis: Advances in Building Energy Research. Dr. Rakshit is also the co-author of a book chapter on Smart Cities, which will be appearing in Taylor and Francis Publication. At IIT Delhi, Dr. Rakshit's research has been sponsored by the Indo-Trento ITPAR program which is working on a sustainable grid free village. The research in which Dr Rakshit is involved is in designing a solar assisted vapor adsorption system for remote villages where grid independent cooling systems are required. Dr Rakshit received funding from IIT Delhi for developing a building material characterization laboratory. The major instruments which are purchased out of this funding are Differential Scanning Calorimeter and Infrared Camera. Recently Dr Rakshit's visit to Middle East for conference organized by American Society of Refrigeration and Airconditioning Engineers (ASHRAE) grabbed the attention of much collaboration in the field of building energy conservation and potential student exchange collaborations are in pipeline with three countries.

RNBHASKAR

Bhaskar is journalist, educationist and researcher. He is currently Consulting Editor with Firstpost-Network 18, Free Press Journal & Business India.

He is also guest faculty with management schools in India and overseas. Besides, he is chief mentor, Asiaconverge.com.

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