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From President's Desk

On 25th September 2015, 193 member countries of the UN General Assembly adopted the 2030 Development Agenda titled "Transforming our world: the 2030 Agenda for Sustainable Development". This agenda has 17 Sustainable Development Goals (SDGs). Main thrust of SDGs is on overall sustainable development which also includes sustainable construction.

For maintaining the Eco System of the Environment, sustainability is important element of construction industry. However, much of what we call sustainability has deep roots in quality. Quality is based on a set of values and beliefs at its centre, such as "do no harm," "zero-waste", "driving out fear" between management and employees. Quality is the symbol of human civilization and many issues such as innovation, ethics, trust and reputation could be regarded as parameters within Quality Management System (QMS).

While these sound like the latest ambitious mantras of Corporate Social Responsibility (CSR), they are core principles and definitions of the quality movement, defined by the quality gurus decades ago. Quality also has a very strong focus on people—not just customer satisfaction, but also quality of working life and employee satisfaction. The impact of quality extends beyond customer satisfaction; it can also have direct impact on organization's reputation.

Construction projects are an extremely complex process, involving a wide range of issues. There are plenty of factors affecting the quality of construction, such as design, materials, machinery, topography, geology, hydrology, meteorology, methods of operation, technical measures, construction technology and management systems and so on.

In construction, general perception for quality remains limited to quality control and quality assurance only and other important aspects of quality management are generally perceived non essential.

An organisation focused on quality promotes a culture that results in the behaviour, attitude, activities, processes that deliver value through fulfilling the needs and expectations of customers and other relevant interested parties.

There is a need for implementation of the strict quality management system by all the stake holders in the Construction industry for ensuring sustainability. IBC is continuously working in this direction to spread awareness among all stake holders in the construction industry to implement the quality management system in its true sense for ensuring sustainable construction.

(Pradeep Mittal)

Activities of State/Local Centres

Tamilnadu State Centre – Chennai

General Meeting of Tamilnadu Centre held on 11th Dec. , 2021

On the initiative of Shri C. Debnath, Vice President, IBC, a Special General Meeting of Indian Buildings Congress, Tamilnadu State Centre was held on 11th Dec., 2021 at 11:00 AM at the Conference Hall of the Association of Tamilnadu Highways Engineers, Saidapet, Chennai. The meeting was presided over by Dr. T. Arul, Secretary, IBC, Tamilnadu Centre. Dr. T. Arul, welcomed all in the meeting. Thereafter Shri C. Debnath, Vice President briefed about the role & vision of IBC, its activities and various issues related to IBC Centre of Tamilnadu alongwith rules & regulations for continuation of activity of the Centre.

Following decisions were taken in the meeting:

Request letter will be sent to the Engineer-in-Chief, PWD for providing two rooms in the office complex of E-in-Chief, PWD, Tamilnadu for office of IBC, Tamilnadu Centre. Till allotment of this accommodation, the office of the E-in-Chief, PWD, Tamilnadu will be considered for corresponding office address of IBC, Tamilnadu Centre. The committee meeting will be held on 3rd Saturday of every month. The quarterly report of the Centre is to be submitted to the IBC HQ . The annual Report and Audited Accounts Report shall be submitted after the Annual General Meeting to be held sometime in April, 2022. Special drive will be initiated for expanding membership base of IBC. Technical programmes will be organized on various subject in which IBC HQ will be requested to send experts. Programme will be organized on construction materials and specification.

The Executive Committee of IBC Tamilnadu Centre has been reconstituted which will function up to April 2022 when the next Annual General Meeting will be held. The non members who are included in the committee, shall take the membership of IBC within one month. A Working group of IBC, Tamilnadu centre will be created for better co-ordination amongst the members and for circulation of all information. The eleven member Committee has been constituted as detailed below.

Chairman- Sh.C. Kalyana Sundaram, SE, PWD; Vice Chairmen - Sh. M. Sappany Pillai, M.D., Ishwarya Homes and Sh. B. Dhanaseelan, DE, Highways; Secretary- Dr. T. Arul, Director, Vasanth Builders; Asstt. Secretaries- Dr. R.N. Krishna, Consultant and Sh. K. A. Rajasekharan, SE,PWD;. Treasurer- Sh. R. Jeyakumar, M.D., RCC Ltd.; Asstt. Treasurer- Sh. K.Vinodh Raja, Consultant; Executive Members- Sh. K.C. Sabari, Consultant, Sh. J.Tamilselvan, E.E., TnEB and Sh.K. Venkatesan, E.E., Southern Railways.

Puducherry Local IBC Centre

General Meeting of Puducherry Centre held on 13th Dec., 2021

On the active initiative of Shri C. Debnath incoordination with Council Member Shri. V. Sathyamurthy, CE, PWD, Puducherry, a special General Meeting of the members of Indian Buildings Congress attached to Puducherry U.T. was held on 13th Dec., 2021 noon at the Conference hall of office of the Superintending Engineer, Circle-II, PWD, Puducherry for formation of Centre. Many engineers were present in the meeting who expressed their willingness to take membership of IBC.

Shri A. Rajasekharan, SE, PWD represented the Chief Engineer, PWD in the meeting. Shri A. Rajasekharan, SE, PWD, Puducherry welcomed all in the meeting. Thereafter Shri C. Debnath, Vice President, IBC briefed about the IBC's activities and various issues related to the formation of IBC Centre at Puducherry alongwith rules and regulations for continuation of activities of the Centre. In the meeting eleven member adhoc committee has been formed which will continue till next AGM in April 2022. In the adhoc committee, some names

have also been included who are not members of IBC. But as they shown keen interest to take membership of IBC within one month, it was dicided to include their names in the adhoc committee.

The adhoc committee consisted of the following:

Chairman- Sh.V. Sathyamurthi, CE, PWD Puducherry; Vice Chairmen- Sh. R.P. Lokhande, SE, CPWD Puducherry, Sh. S. Sammanthane, AE, PWD Puducherry; Secretary- Dr. S. Thirougnaname, AE, PWD Puducherry; Asstt. Secretaries- Sh. S. Sivakandan, Builder & Valuer, Sh.S. Suresh, Builder & Valuer; Treasurer- Sh. V. Baskaran, Builder & Valuer; Asstt. Treasurer- Sh. C. Sadhasivam, Retd. AE, PWD Puducherry; Executive Members- Sh. T.V. Srinivas Murthy, Engineer-in-Charge, Aurobinda Ashram, Sh.V.R. Ajitchandran, Builder & Valuer, Sh.S. Ramamoorthy Retd. AE, PWD Puducherry.

In the meeting following decisions were taken- PWD will provide one room in the office of the S.E. Circle-I, PWD, Puducherry to use as office of IBC Puducherry Centre. Request letter will be sent to Chief Engineer PWD, Puducherry for allotment of one room in the office complex of PWD Puducherry to use as office of IBC, Puducherry Centre. The committee meeting will be held on 2nd Friday at 6:00 PM of every month. SE, CPWD also participated in the discussion and gave assurance for initiating special drive of membership of IBC in his organization. It was assured that before next AGM scheduled in April 2022, the membership strength will be increased to get recognition by the IBC HQ. Spl. Drive will be initiated to enroll Student Members. The quarterly report will be sent to HQ. by the Committee.

Corrigendum

Built Environment Sept-Oct. 2021 issue, page no. 8, against serial no. 5, O/o the EE (Air force), MES may be read as O/o the CE (Air force), MES.

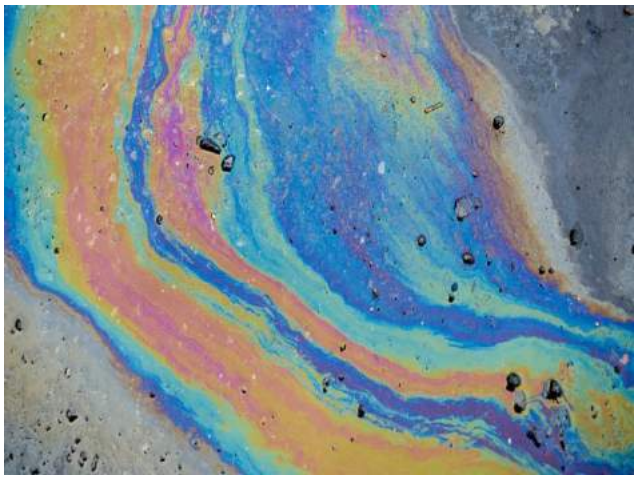
NATIONAL NEWS

Environmental Friendly Superabsorbent Cotton

The Bhabha Atomic Research Centre (BARC), the premier nuclear research institute based in Mumbai, has developed a highly efficient super-hydrophobic (water disliking) and super-oleophilic (oil liking) cotton by radiation technology which is capable of tackling oil spills.

"There is no absorbent currently available that can remove floating oil from the water surface and sediment oil (underwater) simultaneously," said Dr. A.K. Mohanty, Director, BARC.

This biodegradable superabsorbent can be used multiple times around 50 to 100.



In December 2020, an Indian patent was granted on this unique superabsorbent and the technology was transferred to a private company, according to a press statement issued on 23rd July, 2021.

He informed that the "Superabsorbent Cotton" has been developed by Dr. Subhendu Ray Chowdhury, a scientist working in Isotope and Radiation Application Division, BARC and he has been conferred with National Award for Technology Innovation, 2019 by the Ministry of Chemicals and Fertilizers, Government of India for this innovation.

The material was developed by bio-inspired molecular-scale surface engineering through tuning of surface roughness (topography) and surface energy with the help of radiation-assisted covalent integration. Typically, one gram of the material can pick up a

minimum of 1.5 kg of oil from water media which can be recollected by simple squeezing or compression from the superabsorbent cotton.

The cotton can be used for the removal of toxic organic liquids such as Benzene, Toluene, Ethylbenzene, Chloroform, Dichloromethane, Tributyl Phosphate (TBP), Triphenyl Phosphate (TPP), etc. from industrial or municipal wastewater.

In addition to this, superabsorbent cotton can also be used for the separation of various oily solvents in industry/laboratory setups and cleaning of solid surfaces in oil stations, spillage on road, etc.

The cotton retains its property and performance in acidic, alkaline, sea environment and even at high temperature. After multiple usages, the cotton can be disposed of without any hassles as it is biodegradable.

Conventional oil removal techniques generate secondary pollution and lose the oil either due to burning or consumed by microorganisms. However, the current technique is cost-effective, recovers the oil and adds value to the environment as well as the economy.

The process to produce superabsorbent cotton in large quantities has been developed and scaled up. Due to design flexibility and weather resistance, this material can be packed and stored as per requirement. Thus, in the 'Swachh Bharat Abhiyan' of the Government of India, it is a contribution of BARC, Dr. P. K. Pujari, Director, Radiochemistry & Isotope Group, BARC said.

Recycling Plastic Waste into Fabric

Developing an idea for making the world better has no age limit as it is a collective responsibility of everyone. Following the same responsibility, a 17-year-old boy from Rajasthan, Aditya Banger, has applied an innovative idea for reducing plastic waste. The boy has started a company named Trash to Treasure that turns waste into the fabric. He belongs to a family, which runs a textile manufacturing business.

The 17-year-old boy went on a trip to China with his uncle when he was in 10th standard, with the purpose to import new fabrics manufacturing techniques in India. During the business trip, Aditya came across a unit that was converting massive amounts of waste into the fabric. This technique also created employment in the local area. After coming back to India, he shared the startup idea of producing fabric from plastic with his family.

Listening to Aditya's idea, his uncle and parents agreed to back the venture and collaborated with a foreign company to set up a manufacturing unit in Bhilwara. The company produces fabric for Kanchan India Limited, a textile business company run by his parents. Aditya's venture now produces durable fabrics from PET-grade plastic and sells them further so that wearables and other products can be made out of them.

The plastic waste for producing fabric is collected from local sources and households. It is thoroughly cleaned to get rid of all the adultering substances. After the cleansing process, it is chopped and melted into fine plastic filament. Later, the filament is mixed with cotton to produce high-quality fiber.

Aditya claims that it has been helping to eradicate almost 10,000 kg of plastic waste since January 2021. He used to purchase the waste at Rs 40 per kilograms, which was not very cost-effective. Currently, the company has opened a portal for the general public who are keen to submit plastic waste.

Country's First Green Hydrogen Microgrid Project to come up at NTPC Simhadri Plant in Andhra Pradesh

Green hydrogen is produced by splitting water into hydrogen and oxygen using an electrolyzer powered by renewable energy sources such as wind and solar. The fuel can be a game-changer for the energy security of India, which imports 85% of its oil and 53% of gas requirements. To promote clean fuels, India is considering making it mandatory for fertilizer plants and oil refineries to purchase green hydrogen.

"NTPC Ltd, India's largest integrated energy company has awarded project of 'Standalone Fuel-Cell based Micro-grid with hydrogen production

Reader's View

View dated 08/12/2021 of Shri A. Ramchander (ML-2142)

"I am proud to say that magazine out of 5 to 7 Professional Institutes which I am receiving, IBC Bi-monthly is best of all."

using electrolyser' at NTPC Simhadri (Andhra Pradesh). This will be India's first Green Hydrogen based Energy Storage Project and one of world's largest," NTPC said in a statement.

"The hydrogen would be produced using the advanced 240 kW Solid Oxide Electrolyser by taking input power from the nearby Floating Solar project. The hydrogen produced during sunshine hours would be stored at high pressure and would be electrified using a 50 kW Solid Oxide Fuel Cell. The system would work in a standalone mode from 5 PM to 7 AM," the statement said. Indian firms, including Reliance Industries Ltd, Adani Group, Greenko and Acme Solar Holdings Ltd, have announced their green hydrogen plans. During the International Solar Alliance (ISA) assembly, a solar hydrogen programme was also launched to produce the emission-free fuel at $2 per kg, sharply lower than the present price of $5 per kg.

NTPC Renewable Energy Limited (NTPC REL) has also inked a pact with the Union territory of Ladakh for a green hydrogen mobility project, with the company along with NVVN jointly executing the project. India plans to soon call bids for building 4 gigawatt (GW) of electrolyzer capacity as part of its energy security strategy. "It would be a precursor to large scale hydrogen energy storage projects and would be useful for studying and deploying multiple microgrids in various off-grid and strategic locations of the country," the statement added.

As part of its diversification strategy, NTPC is also looking to leverage hydrogen for transportation by mixing the fuel with natural gas for City Gas Distribution (CGD) network.

"This unique project configuration is designed in-house by NTPC. This unique project for India would open doors for decarbonising the far-off regions of the country like Ladakh, Jammu & Kashmir (J&K) etc., hitherto dependent on diesel generators. The project is in-line with the vision of the Hon'ble Prime Minister for becoming carbon neutral by 2070 and making Ladakh a carbon-neutral territory," the statement said.

Passive Solar Architecture in Icy Ladakh - A Sustainable Buildings Construction Technology

Passive solar design takes advantage of a building's location and climate with use of materials such as earth and local resources that will lead to low or almost nil use of energy for heating all through the day and still provides sufficient natural light.

With the mercury dipping to minus 20 degrees Celsius or lower during winter nights, and about minus 5 degrees Celsius at night during March and April, it becomes virtually impossible to live without proper heating in Ladakh.

Ladakh is not connected to the national electricity grid. It has a few areas that get power from local hydropower plants while de-centralised solar power helps in many other remote areas but is highly inadequate.

With extreme climatic conditions and remote habitations, Ladakh faces massive problems transporting diesel, kerosene and even firewood from long distances. It not just involves cost but also becomes a major contributing factor to air pollution in the fragile Himalayan ecology.

Available sunshine for almost 300 days a year with high radiation is one of the best alternatives to offset the burning of fossil fuel adding to India's overall emissions. As the third largest polluter in the world (after the US and China), India has pledged in the Paris Agreement to reduce dependence on fossil fuels and encourage renewables in its action plan to combat climate change.

Wangchuk is one of the founders of the Students' Educational and Cultural Movement of Ladakh (SECMOL). The SECMOL Alternative School, started in 1988 with an aim to reform the educational system of Ladakh, is an eco-friendly campus near Leh town.

The school buildings which are designed with passive solar architecture (Earth and Sun Architecture) are heated without using any of the conventional energy sources releasing carbon dioxide. But the heating is so good that the temperature in the interiors of the main building at Phey village (near Leh) remains comfortable even in peak winter without electric-powered heating or firewood burning. The inside temperature of the buildings in SEMCOL designed with solar passive architecture remains steady at around 15° Celsius even at low outside temperatures upto -15° Celsius.

The most important feature of the concept — the south face of a building needs to be all windows, as it

gets maximum heat from sunrise to sunset exposure in winters.

The SECMOL School's main building's south side has a huge thick plastic sheet attached to these windows

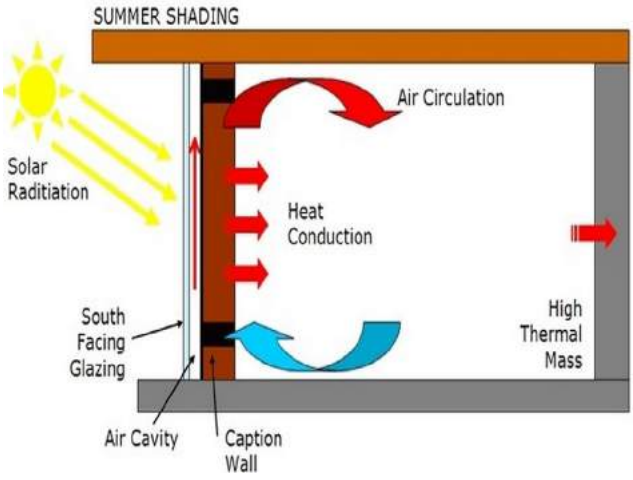


Fig. Solar Passive Design

at an angle. This stops strong chilly winds but allows sunlight and heat in winters. This sheet is rolled up in summer to let in fresh air and to avoid overheating.

The top of the building has glass openings to keep the insides of the building well illuminated during the day and also trap heat in winters. Essentially, it is the double-layered, south-facing windows (plastic sheet and glass or both glass) of the main building and also that of the students' hostel.

The other sidewalls are made of thick mud with insulation in between. The mud is also mixed with parali

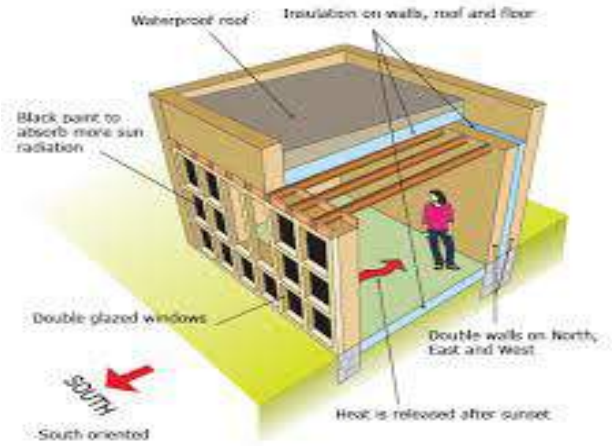


Fig. Solar Passive Architecture

which is available in abundance in North India. The insulation is at times air and at times a mixture of waste paper and dried grass. "The best example for insulation is the room where we have our water tanks," Konchok

Fig.View of SECMOL School Building

Norgay the teacher in-charge of the SEMCOL school told indiaclimatedialogue.net. "We fill those up by diverting running water from a nearby spring at night, and even in peak winters, we can keep it in unfreeze condition."

"The idea of passive solar design is that it absorbs and traps all the heat directly from sunlight and the architecture lets us store it for long," he said. "Even without using any energy-demanding artificial heating methods, we have been staying and running the school here every winter for more than a decade now."

During last three years four passive solar heating mud buildings have been constructed in the SEMCOL campus. The Ladakhi clay has been mixed with pumjab parali to manufacture Mud building blocks for walls which insulate the building. The buildings are oriented towards south where double glazed facade windows have been fixed. Double glazed facade captures the solar energy and stores in no / low cost water batteries because these batteries use water pockets as battery fluid and they are made of waste plastic bottles. At night the water bottles releases the heat to the rooms. In the walls, ceilings and floors, heavy insulation made of wood waste and wool waste from the local pashmina industry is provided. In January the inside temperature of the solar heated buildings has been 15^0 to 20^o Celsius whereas the outside temperature was -15^o Celsius.

Over the years, acclimatisation and access to electricity to power tents at higher altitudes have been critical priorities for the Indian Armed Forces, especially

in the Northern borders. The lack of access to electricity for years has forced them to turn to other heating solutions like burning diesel, kerosene or firewood. The over-reliance on tents and heating solutions through diesel or firewood has become a major logistics issue for the security establishment, which is now finding new ways to keep the Armed Forces warm and healthy at the higher altitudes.

The Indian Army had invited Sonam Wangchuk to its seminars on warm habitats in cold places like Ladakh. Two winters ago, Wangchuk and his team had even built a prototype of a cost-effective solar-heated mud-built house for officers, and the army has been testing it.

"The Indian Army spends a lot of money and carbon for keeping soldiers warm in a cold place like Ladakh whereas Ladakh is one of the sunniest places,"Wangchuk told indiaclimatedialogue.net. "You don't really need to drain national treasures to buy Qatar oil and become vulnerable to enemy fire on your supply line. You can be

Fig.Solar Tent Design

independent in every way using the sun. The model has been proved." The technology can be extremely useful for the Indian Army establishments in the cold desert areas of Ladakh, J&K and North Eastern Region and can protect the environmental pollution from the burning of fossil fuel to a great extent besides recurring burden of the fuel cost on national exchequer.

The idea that the relatively low-cost housing pattern can be of use in the long term has found many takers. It can generate lot of employment, become a source of Livelihood for housing entrepreneurs and can consume lot of parali available in north India which has become source of environmental pollution due to burning.

INTERNATIONAL NEWS

Electricity Generation from Waves

Electrical energy generated by harnessing the up-and-down motion of ocean waves. Wave power is typically produced by floating turbine platforms or buoys that rise and fall with the swells. However, wave power can be generated by exploiting the changes in air pressure occurring in wave capture chambers that face the sea or changes in wave pressure on the ocean floor.

The areas of greatest potential for wave energy development are in the latitudes with the highest winds (latitudes 40°–60° N and S) on the eastern shores of the world's oceans (which border the western edges of the continents). For instance, the world's first operational wave power generator is located off the coast of Aguçadora, Portugal, producing as much as 2.25 megawatts from three huge jointed tubes that float on the surface of the Atlantic Ocean; individual power generators are located at the tubes' joints and activated by wave motion. In addition, a large potential for wave power systems exists in the British Isles and the Pacific Northwest of the United States. Estimates of the annual wave energy potential along the continental shelf of the U.S. coasts range between 1,170 and 2,640 terrawatt-hours, equivalent to 33–65 percent of U.S. electricity demand in 2015.

Despite the enormous energy potential of wave power, technical challenges remain. Research funding is low compared with that supporting solar, wind, and other renewable forms of energy, and thus the process

of experimentation and refinements with different wave energy collector designs is not as well developed. The development of massive machines for use in the oceans is expensive; salt water in the oceans corrodes steel and other metals, and the physical force of the waves fatigues wave energy collectors, transmission wires, and other infrastructure over time.

Create Fuel out of Thin Air: Engineers Founded A New Way of Creation

Engineers in Switzerland have found a new way to create fuel 'out of thin air'. Scientists said they have created a new system that can create fuel out of sunlight and air. The ETH Zurich scientists demonstrated the stable and reliable operation of the solar mini-refinery under real on sun conditions. This unique system can produce liquid transportation fuels such as methanol or kerosene. These are produced from sunlight and air in a multi stage thermochemical process. What makes in new system unique is that it can work under field condition rather than in a laboratory. The solar reactor needs direct sunlight, with no clouds in the way. The solar refinery consists of three thermo-chemical conversion units.

First unit captures direct air and extracts CO_2 and H_2O directly from the ambient air. Second the solar redox unit converts CO_2 and H_2O into a specific mixture of CO and H_2 syngas and Third the gas-to-liquid synthesis unit finally converts the syngas into liquid hydrocarbon.

The new system produced drop-in- fuels. These are synthetic alternatives for petroleum derived liquid hydrocarbon fuels such as kerosene and gasoline. Drops in fuels are fully compatible with the existing infrastructures for storage, distribution and use of transportation fuels. Drops in fuels are carbon neutral because solar energy is used for their production. They also release only as much CO_2 during their combustion as was previously extracted from the air for their production. The system could be used to create carbon-neutral fuels for sectors like aviation and shipping. Aviation and shipping currently contribute 8% of total human made CO_2 emissions. Growth in tourism and global trade will increase this contribution further.

Meet Vinisha Umashankar, Indian teen who gave powerful speech at COP26 in Glasgow

A 14 year old schoolgirl from Tamil Nadu Vinisha Umashankar had designed a solar-powered ironing cart useful for the common artisan with the potential to improve air quality across India. Vinisha Umashankar, is a finalist of Prince William's Earthshot Prize, dubbed the Eco Oscars.

Earthshot Prize finalist Vinisha Umashankar

She delivered her powerful speech during the World Leaders' Summit "Accelerating Clean Technology Innovation and Deployment", at the COP26 Summit, in Glasgow, Scotland, on Tuesday Nov. 2, 2021. In the U.N. climate summit in Scotland's biggest city Glasgow, leaders from around the world had gathered to lay out their vision for addressing the common challenge of global warming.

In her powerful speech, she urged world leaders to "stop talking and start doing". The student asked leaders to stand with her generation and back the innovations, solutions and projects working to repair the planet.

"I'm not just a girl from India. I'm a girl from Earth and I'm proud to be so. I'm also a student, innovator, environmentalist and entrepreneur but most importantly, I'm an optimist," she said emphatically in her speech that lasted less than five minutes. She received a rousing applause from the audience as well as Prince William, who stood on stage, proudly watching her speak.

Prince William posted a message of appreciation for Umashankar, saying how proud he was to see her speak on the global platform.

Highly Efficient -Ultra Thin Printable Solar Panels - A New Revolution in Power Generation

The University of Newcastle, Australia has created printable photovoltaic solar cells which could revolutionize Urban Power Generation. Ultra Thin Solar Panels can be printed like newspaper. The panels, which are only 0.075mm thick, were created with proprietary technology making use of organic polymers which can capture solar energy and conduct electricity. Traditional photovoltaic solar panels rely on silicon to carry out these functions and can often weigh up to 15 kg per square meter. The liquid nature of the organic polymer means it can be printed from printers much like those used to mass produce newspapers and books. According to University of Newcastle physics Professor Paul Dastoor, printed solar technology has a number of broad applications such as power for street lights, water pumps, disaster shelters, camping equipment, building smart blinds for buildings and even powering vehicles. The cost of production is also much cheaper than traditional panels coming in at around 10 Australian Dollar per square meter. A full scale commercial plant could print kilometers of solar panels a day. The printed sheets can also be stuck with a special adhesive tape to a variety of surfaces, meaning no expensive and intrusive installation methods. The technology is currently on public display at 'THE CANOPY' in lane cove on Sydney's north shore. The panels which are attached to a covered walkway generate power for a series of lights that come on at night and track passers by with sensors.

पराली से बनाई बैट्री, लागत कम और चलेगी ज्यादा

भारतीय प्रौद्योगिकी संस्थान (आई.आई.टी) रुड़की के पूर्व छात्रों ने रिचार्जेबल बैट्री के मामले में बड़ी उपलब्धि हासिल की है। उन्होंने प्रदूषण का पर्याय समझे जाने वाली पराली से बैट्री बनाने की तकनीक विकसित की है। इससे न केवल किसानों की आय बढ़ेगी, बल्कि पराली से होने वाले प्रदषण की समस्या से भी निजात मिल जाएगी। यही नही, पराली जलाने से कृषि भूमि की उर्वरा शक्ति पर पड़ने वाले प्रतिकूल असर को भी खत्म किया जा सकेगा। पूर्व छात्रों के स्टार्ट अप (कंपनी) इंडी एनर्जी ने आई.आई.टी. रुड़की

आई.आई.टी.रुड़की के स्टार्ट अप इंडी एनर्जी की टीम की ओर से पराली से बनाई गई सोडियम आयन बैट्री

में भौतिक विज्ञान विभाग के प्रोफेसर योगेश शर्मा की अगुआई में यह शोध किया।

प्रोफेसर योगेश शर्मा बताते है कि बैट्री बनाने के लिए कोबाल्ट, निकल और लिथियम जैसे रासायनिक तत्वों की जरूरत होती है। अभी तक चीन के पास ही इनकी उपलब्धता है। ऐसे में बैट्री उत्पादन के क्षेत्र में भारत पूरी तरह से चीन पर निर्भर है। भारत को इस क्षेत्र में आत्मनिर्भर बनाने के लिए आई.आई.टी. रुड़की के पूर्व छात्रों के स्टार्ट अप ने यह तकनीक विकसित की है। उनके अनुसार, भारत में लिथियम का विकल्प खोजकर ऐसी तकनीक विकसित करने वाली इंडी एनर्जी संभवतः पहली कंपनी होगी। उन्होंने बताया कि पराली से कार्बन बनाने के लिए भारत सरकार की ओर से अनुमति मिल गई है और पेटेंट करा लिया गया है।

पराली से बनाया गया कार्बन

कार्बन तैयार करने के लिए पराली को छोटे-छोटे टुकड़ो मे काटा जाएगा। इसके बाद केमिकल से प्रोसेस करके भट्टी में एक निश्चित तापमान पर गर्म करके इससे कार्बन बनाया जाएगा। उनके अनुसार उत्तर भारत में हर साल करीब 14-15 लाख मीट्रिक टन पराली जलाई जाती है।

प्रोफेसर योगेश शर्मा के मुताबिक, रासायनिक प्रक्रिया का इस्तेमाल कर नमक से सोडियम और पराली से कार्बन बनाया जाएगा। इन दोनों को मिलाकर सोडियम आयन बैट्री तैयार की जाएगी। पराली से बनने वाली सोडियम आयन बैट्री का प्रयोग मोबाइल, इलेक्ट्रिक वाहन, सोलर स्ट्रीट लाइट आदि में किया जा सकेगा। प्रोफेसर योगेश शर्मा के अनुसार, एक किलो पराली का प्रयोग करके 3000 एमएच की चार बैट्रियां बनाई जा सकती है।

प्रोफेसर शर्मा ने बताया कि आई.आई.टी. रूड़की लैब में 500 एमएच की बैट्री बनाने का प्रयोग किया गया, जो सफल रहा। स्टार्ट अप ने 10000 एमएच तक की बैट्री बनाने का लक्ष्य रखा है। इसके लिए पायलट प्रोजेक्ट के तहत पराली से कार्बन बनाने के लिए आई.आई.टी. रूड़की परिसर में प्लांट स्थापित किया जाएगा। जल्द ही इस पर काम शुरू हो जाएगा। पराली के लिए उत्तर प्रदेश और उत्तराखंड के किसानों से संपर्क किया जा रहा है।

इंडी एनर्जी के सी.ई.ओ. श्री आकाश सोनी का कहना है कि इस बैट्री की कीमत लिथियम बैट्री के मुकाबल कम होगी। यह ज्यादा समय तक भी चलेगी। मसलन रिक्शा चालकों को लिथियम का बैट्री हर साल बदलनी पड़ती है, लेकिन यह बैट्री तीन से पांच साल तक चलेगी।

दुनियाभर में बैट्री का सालाना कारोबार करीब तीन लाख करोड़ रूपये का है। भारत में यह लगभग 30 हजार करोड़ रूपये है। वहीं, हर साल करीब तीन करोड़ टन पराली जलाई जाती है। यदि इससे सोडियम आयन बैट्री बनाई जाए तो पूरी दुनिया के काम आ सकती है।

माइनस 30 डिग्री में भी नल से मिलेगा जल

हिमाचल प्रदेश के लाहुल-स्पीति में चीन सीमा पर डटे जवानों को सर्दियों में अब बर्फ पिघलाकर पानी पीने की नौबत नहीं आएगी। काजा के समदो में अब माइनस 30^0 सेल्सियस तापमान में भी जवानों को नल से जल मिलेगा। योजना का नाम है भारत तिब्बत सीमा पुलिस (आई.टी.बी.पी.) एंड डोगरा स्काउट उठाऊ पेयजल योजना।

जलशक्ति विभाग ने काजा में स्पीति नदी के किनारे करीब एक करोड़ रुपये की योजना से 2700 मीटर की ऊचाई पर बोरवेल के जरिये 24 घंटे पानी पहुचाने की व्यवस्था की है। यहां 25,000 लीटर की क्षमता की पानी की टंकी बनाई गई है। इस टंकी में बोरवेल का पानी बिजली के मोटर के जरिए चढ़ाया जाएगा। टंकी से 300 मीटर की ऊंचाई तक पानी पहुंचाने के लिए जो पाइपलाइन डाली गई है, उसके साथ हीट ट्रेसिंग केबल को एक विशेष टेप से जोड़ा गया है। इस पाइपलाइन को ताप कुचालक (बैड कंडक्टर) पालीयूरेथेन फोम से ढक कर भूमिगत बिछाया जाएगा। हीट ट्रेसिंग केबल में बिजली का प्रवाह करने से केबल की क्वायल गर्म हो जाती है और पाइप का पानी भी जमता नहीं है, गर्म रहता है। इस ऊंचाई पर आई.टी.बी.पी., सेना और सीमा सड़क संगठन के जवान ड्यूटी पर तैनात रहते है। यहां एक गांव में करीब 150 लोग भी रहते है। इससे योजना से करीब 2400 व्यक्तियो की आबादी को लाभ मिलेगा।

फसलों की सिंचाई पर निर्भरता कम कर देगा यह बैक्टीरिया

विज्ञानियों को एक ऐसा जीवाणु (बैक्टीरिया) हाथ लगा है, जो कृषि क्षेत्र में ऊर्जा, जल और अर्थ प्रबंधन को पूरी तरह बदल सकता है। इस बैक्टीरिया के प्रयोग से सरसों की फसल बिना सिंचाई लहलहाएगी तो गेहूं की फसल को दो सिंचाई की ही आवश्यकता होगी। यह बैक्टीरिया फसल को मुरझाने या सूखने नहीं देता है। इससे सिंचाई में होने वाले खर्च मे बचत होगी और ईधन (डीजल और बिजली) की खपत भी घटाई जा सकेगी। सबसे बड़ी बात पीने योग्य भूगर्भ जल का सिंचाई में इस्तेमाल कम होगा।

उत्तर प्रदेश के मऊ जनपद के कुशमौर स्थित राष्ट्रीय कृषि उपयोगी सूक्ष्मजीव ब्यूरो (एन.बी.ए.आई. एम.) के विज्ञानियों ने इस बैक्टीरिया को उच्च लवण सांद्रता (हाई साल्ट कंसनट्रेशन) वाले क्षेत्र से खोजा है। ब्यूरो के निदेशक डा. अनिल कुमार सक्सेना के निर्देशन में वरिष्ठ विज्ञानी डा. हिलोल चकदर व प्रधान विज्ञानी डा. आलोक श्रीवास्तव ने अध्ययन में पाया कि यह एक पूरा बैक्टीरिया है। इसका अर्थ यह हुआ कि यह बैक्टीरिया के ज्ञात इतिहास से भी पुराना है। विज्ञानियों ने प्रयोग में पाया कि गेहूं और सरसों

के बीज को इस बैक्टीरिया से उपचारित कर बोआई करने से यह उन्हे इतनी शक्ति प्रदान करता है कि सरसों की फसल को शीत या आसपास के खेतों से महज नमी मिलती रहे तो सिंचाई की जरुरत नहीं रह जाती। गेहूं की फसल को भी तीन के बजाय दो सिंचाई की आवश्यकता ही रह जाती है। डा. श्रीवास्तव ने अपना यह शोध हाल ही में बी.एच.यू. मे 15वीं कृषि विज्ञान कांग्रेस में प्रस्तुत किया था।

यह बैक्टीरिया जड़ों के साथ मिट्टी में कालोनी बना लेता है और पौधे में आवश्यक पोषक तत्वों की कमी को पूरा करता है। इसमें ऐसे गुण पाए जाते है जो पानी की कमी के कारण पौधों में पैदा होने वाले तनाव के खिलाफ मजबूती प्रदान करते हैं। यह बैक्टीरिया पौधों को इतना ताकतवर बनाता है कि विपरीत मौसम में भी फसल लहलहाती रहती है।

डा. श्रीवास्तव ने बताया कि इस बैक्टीरिया से पानी, इंधन, परिवहन और मानव श्रम की बचत कर गेहूं की खेती की लागत को करीब 33 फीसद तक घटाया जा सकता है। गेहू विश्व में सबसे ज्यादा उपजाई जाने वाला फसल है। एक सिंचाई कम होने से वैश्विक स्तर पर बचत का अनुमान लगाया जा सकता है।

दो किशोर बालकों का अनूठा पर्यावरण सुधार अभियान

पर्यावरण को बचाने की ललक हो तो उम्र किसी तरह की बाधा नहीं बन सकती है। इसे राष्ट्रीय राजाधानी के दो किशोर भाइयों ने 'वन स्टेप ग्रीनर अभियान' शुरु कर साबित कर दिखाया है। वसंत विहार के रहने वाले 17 वर्षीय विहान और 14 वर्षीय नव अग्रवाल ने बढ़ते प्रदूषण को देखते हुए इस अनूठे अभियान की शुरुआत की है। इसमें वे अब तक एक हजार से अधिक घरों, स्कूलों और कार्यालयों से सूखे कचरे को इकट्ठा कर उसका रिसाइकिल कर शिक्षण सामग्री बना रहे हैं। इसी तरह धरा को हरा-भरा बनाने के लिए उन्होंने अब तक दो हजार से अधिक पौधे भी लगाए हैं। इन प्रयासों व प्रयोगों के लिए इन दोनों भाइयों को इस वर्ष के प्रतिष्ठित अंतरराष्ट्रीय बाल शांति पुरस्कार से सम्मानित किया गया है। हाल ही में अंतरराष्ट्रीय संस्था किड्स राइट फाउंडेशन के इस प्रतिष्ठित पुरस्कार को इन दोनो भाइयों ने नीदरलैंड में नोबेल पुरस्कार विजेता कैलाश सत्यार्थी से ग्रहण किया।

विहान को बचपन से ही अस्थमा की शिकायत है। ऐसे में प्रदूषण के बीच घर से बाहर निकालने पर वे अक्सर बीमार पड़ जाते थे। इस वजह से वे कई बार दोस्तों के साथ खेलने भी नहीं जा पाते थे। वे कहते हैं कि हम लोग प्रदूषण के बारे में रोज सुनते हैं, लेकिन इसे कम करने या रोकने के विषय पर कोई गंभीरता नहीं दिखाता है। यहीं से उन लोगों के मन में कुछ करने का विचार आया। दिल्ली के गाजीपुर लैंडफिल ढहने, कचरे और वायु प्रदूषण के बीच की कड़ी को समझने की प्रक्रिया ने दोनों भाइयों को 'वन स्टेप ग्रीनर' बनाने के लिए प्रेरित किया। प्रदूषण कैसे उत्पन्न होता है, इस पर दोनों ने गहरी पड़ताल की।

इस अभियान की शुरुआत दोनों भाइयों ने अपने घर से ही की। कई दिनो तक सूखे कूड़े को बाहर नहीं फेंका। इससे उनके घर में कूड़े का ढेर लग गया। इसे कम करने के लिए उन्होंने कूड़ें के रिसाइकिल करने के व्यवसाय से जुड़े लोगों से संपर्क किया और कूड़े का काफी हिस्सा कम किया। इसे देखते हुए उन्होंने दूसरे के घरों से भी सूखे कूड़े को इक्ट्ठा करना शुरु किया। तब 15 घरों से शुरु हुआ यह अभियान आज एक हजार से अधिक घरों, स्कूलों और कार्यालयों तक पहुंच गया है। अब तक 1,73,630 किलोग्राम कचरे का रिसाइकिल हो गया है। इससे वे शिक्षण सामग्री बैग, पोस्टर, डिब्बे और अन्य उत्पाद बना रहे हैं। इससे उन्हें कुछ आय भी हो रही है। ऐसे में उन्होंने इसके लिए पांच कर्मचारी भी रख लिए है। इसके साथ ही उनकी टीम में 11 युवा वालंटीयर भी है जो 'कचरा मुक्त भारत' की मुहिम को आगे बढ़ा रहे हैं। दोनों बताते हैं। कि पहले लोग उनके ऊपर हंसते थे और कहते थे कि पढ़ाई की उम्र में यह सब करना गलत है, लेकिन इससे उन्हें खुशी मिल रही थी।

पर्यावरण से लगाव होने के कारण इसके प्रति जागरुकता बढ़ी और इस अभियान को शुरु करने में मदद मिली। नव अग्रवाल ने बताया कि उन्हे बचपन में जंगल और प्रकृति के बीच रहने में अच्छा लगता था। इससे धीरे-धीरे पर्यावरण के प्रति जिज्ञासा बढ़ती गई। आज वे पर्यावरण को बचाने मे लगे हुए हैं। उन लोगो ने अब तक दो हजार से अधिक पौधे लगा लिए है और आने वाले वर्ष मे 30 हजार से अधिक पौधे लगाने का लक्ष्य है।

नोबेल पुरस्कार से सम्मानित कैलाश सत्यार्थी ने कहा कि बच्चो ने हमेशा दुनिया को रास्ता दिखाया है। वास्तव में दुनियाभर में बच्चो के साहस और बहादुरी का सबसे जरुरी वैश्विक मुद्दों से निपटने पर बहुत प्रभाव पड़ता है। दुनियाभर में बच्चो के प्रयासों से बदलाव आ रहा है। उन्होंने कहा कि मुझे खुशी है

कि विहान और नव ने प्रदूषण के प्रति जरुरी कार्य किया है।

सेब की लुग्दी बनी सेहत एवं पर्यावरण का कवच

आम के आम गुठलियों के दाम मुहावरा पुराना है, लेकिन इसे नया आयाम दिया है सोलन जिला स्थित डा. वाइ.एस. परमार औद्यानिकी एवं वानिकी विश्वविद्यालय, नौणी ने। विश्वविद्यालय के विज्ञानियों ने ऐसी तकनीक विकसित की है, जिससे सेब का जूस निकालने के बाद बचे पोमेस यानी सेब के भीतरी हिस्से से कई खाद्य वस्तुएं बनाई जा सकती हैं तथा पर्यावरण की रक्षा की जा सकती है। विश्वविद्यालय के फूड साइंस एंड टेक्नालाजी विभाग ने केक, बिस्किट, पोमेस पाउडर व जैम जैसे उत्पाद तैयार किए हैं। एप्पल पेक्टिन केमिकल भी तैयार किया है। इससे जेली बनाई जा सकती है।

हिमाचल प्रदेश सहित पहाड़ी राज्यों मे सेब का व्यापक स्तर पर उत्पादन किया जाता है। सेब से जूस निकालने के बाद जो पोमेस शेष रह जाता है, उसे अधिकांशतः फेंक दिया जाता है जो कि पर्यावरण को दूषित करता है। विश्वविद्याालय में इस पर शोध किया गया । पोमेस को पहले फ्रिज में रखना होता है, ताकि यह खराब न हो। इसके बाद इसमें से बचा जूस निकालकर सिलेरी यानी पल्प तैयार किया जाता है। पल्प बनाए जाने के बाद इसमे स्वाद के अनुसार चीनी डाली जा सकती है। निश्चित तापमान में गर्म करने के बाद इससे जैम व चटनी बनाई जा सकती है।

एप्पल पोमेस पाउडर स्वास्थ्य के लिए बेहद लाभदायक है। इसमें पर्याप्त मात्रा में फाइबर पाया जाता है, जो शरीर में कोलेस्ट्रोल और हृदयाघात की आशका को कम करता है। उच्च रक्तचाप को नियंत्रित करने में भी यह कारगर है। विटामिन सी व कैल्शियम भी प्रचुर मात्रा मे पाया जाता है। खास बात यह है कि पोमेस पाउडर मे एंटी कैंसर तत्व भी होते है।

एप्पल पोमेस की यूनिट लगाकर दोहरी कमाई की जा सकती है। जूस को बेचा जा सकता है और इसके बाद जो पोमेस रह जाता है, उससे कई प्रकार के खाद्य पदार्थ तैयार किए जा सकते हैं। सैंपल के तौर पर लैब मे कई उत्पाद तैयार किए गए है।

हिमाचल में सेब का काफी अधिक उत्पादन होता है, इसलिए कच्चे माल की कमी नही है। एप्पल पोमेस व इससे बनने वाले उत्पाद के लिए विश्वविद्यालय हर संभव सहायता करेगा। तकनीक का लाभ पर्यावरण की रक्षा के अतिरिक्त देशभर के बेरोजगार युवाओं को मिल सकता है।

यदि कोई बेरोजगार एप्पल पोमेस की यूनिट स्थापित करना चाहता है तो नौणी विश्वविद्यालय पूरी सहायता करेगा। विश्वविद्यालय 40 हजार रुपये में तकनीक बेचेगा। उत्पादन व मशीनरी से संबधित सभी प्रकार की तकनीक भी मिलेगी। आठ से 10 लाख रुपये खर्च कर यूनिट स्थापित की जा सकती है। इसके लिए ड्रायर, चिलिंग वैन, जूस निकालने की मशीन, सिलेरी बनाने के लिए मिक्सचर की जरुरत होती है। आठ से 10 लोग इसमे काम कर सकते हैं।

पर्यावरण सुरक्षा हेतु-नेट जीरो के लिए हर उद्योग की अलग नीति की योजना

प्रधानमंत्री श्री नरेन्द्र मोदी की तरफ से ग्लास्गो में आयोजित काप-26 सम्मेलन में भारत के लिए घोषित नेट जीरो लक्ष्यों को लेकर काम की शुरुआत हो चुकी है। इस लक्ष्य के तहत वर्ष 2070 तक भारत को अधिकांश उद्योगों से कार्बन उत्सर्जन को पूरी तरह से खत्म करना है। लक्ष्य हासिल करने को केन्द्र सरकार सबसे ज्यादा कार्बन उत्सर्जित करने वाले आठ बड़े उद्योगों को पर्यावरण अनुकूल बनाने को विस्तृत रोडमैप तैयार कर रही है। रोडमैप के तहत रिफाइनिंग, स्टील, उर्वरक, सीमेंट, जहाजरानी, रसायन, मोबिलिटी और रसोई गैस उद्योग में ऊर्जा की जरुरत का स्वरुप पूरी तरह से बदलने का खाका होगा। इसके तहत ही नेशनल हाइड्रोजन मिशन लागू किया जाएगा जिसे कैबिनेट से मंजूरी दिलाने की तैयारी चल रही है।

बिजली व गैर-पारंपरिक ऊर्जा स्रोत (आरई) मंत्री श्री आर.के. सिंह के अनुसार वर्ष 2070 तक देश में कार्बन उत्सर्जन को पूरी तरह से खत्म करने के लिए अभी से तैयारी शुरु हो गई है लेकिन चरणबद्ध तरीके से कार्यक्रम को लागू करने का काम वर्ष 2024-25 से शुरु होगा। विभिन्न बदलावों को लेकर कुछ मंत्रालयों से सुझाव आए हैं। यह एक रोडमैप होगा जो विभिन्न उद्योगों में लागू किया जाएगा। मसलन, रिफाइनिंग उद्योग में बड़ी मात्रा में कार्बन उत्सर्जन होता है। इस सेक्टर में हमारा लक्ष्य यह है कि 2030 तक वहां 50 प्रतिशत ग्रीन हाइड्रोजन का उपयोग हो जाएगा। इसके लिए हमें बड़े पैमाने पर घरेलू स्तर पर इलेक्ट्रोलाजर बनाने

की जरुरत होगी। हम वर्ष 2024 से देश में इलेक्ट्रोलाइजर का निर्माण शुरु होता देखना चाहते हैं। पहले चरण में ही हम 8,800 मेगावाट क्षमता का इलेक्ट्रोलाइजर निर्माण प्लांट लगाने का ठेका देंगे। इसे प्रोत्साहन आधारित उत्पादन (पी.एल.आइ.) योजना के तहत लगाया जाएगा। प्रधानमंत्री ने हाल ही में जिस राष्ट्रीय हाइड्रोजन मिशन की बात की है उसका उद्देश्य ग्रीन हाइड्रोजन का उपयोग बढ़ाना है।

श्री सिंह ने बताया, सरकार रसोई गैस में भी पांच प्रतिशत ग्रीन हाइड्रोजन के मिश्रण से शुरुआत करना चाहती है। जहाजरानी उद्योग के बारे में उन्होंने बताया, पायलट परियोजना के तौर पर दो बड़े जहाजों को बैट्री से चलाने पर काम शुरु किया जाएगा। इस उद्योग को लेकर काफी शोध की जरुरत होगी। जबकि उर्वरक उद्योग के बारे में उन्होंने बताया, यहां भी काफी कार्बन उत्सर्जित होता है। यहां ग्रीन हाइड्रोजन का उपयोग जल्दी व बड़े स्तर पर किया जाएगा। कोशिश यह होगी कि वर्ष 2034-35 तक 75 प्रतिशत उर्वरक उद्योग में पर्यावरण अनुकूल ग्रीन हाइड्रोजन का इस्तेमाल होने लगे।

Challenges in Design and Construction of Radiant Floor Heating System in High Altitude Areas of Ladakh Region

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Introduction

Leh is at an altitude of 11,500 feet & is located in northern most part of India as a Union Territory. Leh has a cold desert climate with long cold winters from October to March with temperatures varing from -30°C to +30° C, rainfall of 1 to 2 cm per annum, very low humidity (i.e) 40% ± 10% along with occasional snowfall. This area is largely occupied by the defence forces because of its strategic importance, hence it is the duty of the service providers to make necessary arrangements for the troops during winters to keep them warm.

The Central Heating Systems (CHS) adopted in Ladakh Region have been chosen after lot of research, experimentation & based on feedback received on account of following:

- Improper architectural designs of living accommodation of troops and office complexes due to temporary nature as most of the habitats for troops are prefabricated.
- Use of kerosene bukharis which lead to release of burnt gases into the atmosphere through chimneys which is detrimental to environment of the region.
- Use of firewood heating system leads to deforestation. Studies show that average requirement of firewood increases three times for heating requirement in high altitude areas like Ladakh region.
- The calorific values of conventional materials such as firewood, kerosene, coal is high but can't be reimbursed thereby create adverse environmental conditions.

Various components of Central Heating System are as follows:-

- Plant room building with internal and external services.
- Boilers / Hot Water Generators with accessories.
- Glycol circulation Centrifugal Pumps : Primary & Secondary
- Heat Exchanger
- Glycol makeup Centrifugal Pump
- Flue Gas Chimney
- Glycol Fluid Tanks
- Bulk & Daily Oil Storage Tanks
- Transfer Gear Oil Pumps
- HSD Oil Pipings with fittings
- Hot Glycol Fluid Piping with fittings
- Glycol Charge
- Dispersal Equipment for Hot Air inside Buildings can be anyone of following:-

(i) Fan Coil Units

(ii) Radiators

(iii) Air Handling Units

(iv) Floor Heating System

- Stand by Generator Set in places like Leh where there is shortage of power supply in winter.

Challenges in Ladakh Region

- Geographical Challenges

  (i) The Ladakh region is situated at an altitude varying from 12000 ft to 18000 ft and with very limited vegetation resulting in the deficiency of oxygen in the entire region than rest of India.

  (ii) The region is cutoff from the rest of India for approx. six months in a year due to closure of the mountain road passes due to heavy snowfall i.e Zoji La and Rohtang Pass.

- Administrative Challenges

  (i) Due to closure of roads for six months in peak winters, heavy snowfall and drop in temperature upto -30oC there is deterioration of the moving parts and other materials of the heat source.

  (ii) Lack of spare parts in the region and difficulty to buy them from rest of India in winters.

  (iii) Lack of local repairing expertise for repairs in the region.

Various Types of CHS introduced in the region

Although several technologies are available but most commonly used have been described here. The major components where choice is available is in type of Hot Water Generator and dispersal of hot air in the buildings. The Boilers/Hot water Generators generally used in the region are diesel fired as there is acute shortage of power supply in winters and all stations except Leh and Kargil do not have state power supply. At some of the stations electric driven, hot water generator /Boilers have also been used.

Two types of Fan Coil Units have been used

(a) Wall Mounted Fan Coil Unit

(b) Floor Mounted Fan Coil Unit

Radiator Panels

The radiator is the most common way of heating. There are several types of radiators, most are made from copper or aluminium but majority of them are made of steel. A radiator works by transferring heat to the air in the room as it passes over the radiator panel. Warm air rises and pushes cold air down and over the radiator surface again.

Constraints in FCUs/ Radiator

Panel:-

(i) FCUs require more maintenance due to moving parts.

(ii) FCUs are prone to rat Menace.

(iii) Radiator Panel takes longer time for heating & not effective in case of less working hours & frequent power failures.

Air Handling Unit (AHU): Duct Based

The hot air received from Hot water generators/ boilers is passed through the ducts and dispersed to different rooms of buildings through vents after heat exchange takes place in AHU plant room.

This article mainly deals with the floor heating system designed and executed for the office complex at Leh, Ladakh.

Radiant Floor Heating

- The habitats for defence units maintained in Ladakh region were dependent on Conventional solutions which required radiators and FCUs for heating. For last few decades these conventional solutions had advantage of being cheaper and easy to install, but disadvantage of being extremely inefficient due to their failure to distribute heat evenly in a room, expensive to run due to their high energy consumption and require frequent maintenance.

- During winters there is acute shortage of electricity in Ladakh region forcing the service providers to bring a suitable and energy efficient alternative. The suitable alternative to one such heating solution is Radiant

Floor Heating system which provides an efficiency level almost 25-30% higher than the conventional heating systems.

Principle:

- The basic principle of radiant systems is to transfer radiant energy directly from the floor to the people or its surrounding objects via infrared radiation. The heat energy is transmitted by electromagnetic waves and through the process of convection. The natural circulation of heat takes place as the air warmed by the floor rises above towards ceiling.
- There are different ways of heating using the radiant systems but the most popular and cost effective is Hydronic system.
- In this system, heated water or water glycol mixture from a hot water generator is pumped through tubing laid in a pattern of circuits under the floor.
- The water glycol mixture circulates between floor & boiler in closed loop.
- Concrete screed floor diffuses heat across surface providing even temperature at floor level.
- The outflow from hot water generator is controlled through the use of zoning valves and thermostats. To regulate the temperature in the room depending upon occupancy of room/zone independent manifolds boxes are installed in different zones/ rooms.
- Floor heating system is more efficient than forced air heating because it reduces duct loses.
- Thermal mass of floor is large & heat stored in it will keep room comfortable for 4-6 hours.
- Radiant floor heating works well with almost any floor finish i.e. tiles, carpets, timber floors, plaster etc.

Design:

- The process of designing an efficient radiant floor heating system was indeed a challenging task as it involved lot of survey, planning, calculations and replacement of old existing FCUs.
- So, there was a need for customisation after considering several parameters for making system more efficient.
- The area of floor, walls, ceilings of various rooms/zones was worked out and heat loss calculations were made based on standard coefficients and design of pipes and network layout was prepared.
- Based on this data the size of the PE-X pipe was decided along with several other factors including the temperature of the system, the water flow rate, the spacing of the pipes and the exact length of the circuits.
- This variation in the size of the circuits ensures that the loss of heat is reduced to the minimum.
- The size of the boilers and pumps was then decided after the system flow rate and the circuit head loss was calculated.
- The design, selection, length, spacing and layout of PE-X pipes of size 20mm OD was carried out using American Society of Heating, Refrigerating & Air-conditioning Engineers (ASHRAE) software and the work was executed accordingly.
- Different loops of 1,2,3,4 and 5 circuits were selected as per the room sizes.
- The PE-X pipes used are of high density of 0.939 gm/cm^3 with anti oxygen vapour barrier in Ethylene Vinyl Alcohol (EVOH) complying with ENISO-15875 (European Norms International Standard Organisation) suitable for pressurised distribution of hot glycol water mixture. The spacing between each PE-X pipe was maintained at 150 mm.
- The main distribution line carrying hot glycol water mixture from the plant room is 80mm dia MS pipe duly insulated with elastomeric nitrile insulation.
- The sizes for further distribution varied from 80mm to 25 mm dia as per flow requirement.

- The system comprises of two circuits, primary and secondary. The primary circuit feeds hot glycol water mixture at about 70°C to the ceiling mounted package air handling units heating the corridors and toilets.
- Since the floor temperatures has to be maintained at 27°C to 30°C, glycol water mixture supply temperature has to be reduced to 55°C from 70°C of glycol water mixture supplied by hot water generator. This is done in the secondary circuit by using plate heat exchanger to supply hot glycol mixture to the radiant under floor pipes to maintain the desired temperature.
- The manifolds installed in rooms have inlet and oulet shut off valve for maintenance / isolation.
- The flow regulation of each circuit is maintained by three way motorized valve fitted in manifold actuated by a thermostat to bypass the flow of the room once the inside temperature is maintained.

Installation:

- The installation was indeed equally challenging vis a vis planning and design as it involved complete vacation of the buildings, shifting of stores and creating adhoc arrangements.
- One of best aspects of installing under floor heating is that it gives complete freedom to design the space after installation without any restrictions since all the piping is underground which also gives this system a much longer life than any other heating systems.
- The process of installation begins by concealing the floor with layers of insulation in order to avoid the heat loss to the ground.
- Tracks for the piping are then fastened through the insulation on the floor depending on the circuit design, size of the pipe and water flow pressure.
- Each circuit is then connected to the inlet valve and fastened on the track along with clips in the spacing.
- The end of the pipe circuit is then connected to the outlet valve in the manifold box.
- Each circuit is connected to the manifold box which have individual valves that help control the flow rate as well as purgers for removing air locks.
- The water/glycol mix is run through an assembly of valves connected to both the inlet and outlet valves.
- After this temperature and pressure gauges are installed in the lines of circuit a layer of concrete is then poured on the pipes before installing the desired type of flooring above.
- The material used for flooring is also very important factor as materials with high heat conductivity will require higher supply water temperature.
- Heating is more efficient when it is used zone by zone with a thermostat controlling each zone. Therefore heat is supplied to the room only when it is required reducing the energy consumption.

Advantages over other Heating Systems:

- The efficiency is almost 25-30% higher than other heating systems.
- The floor heating only needs to run at 27°C to 30°C whereas the other system needs to maintain temperature at 65-70°C thereby consuming less energy.
- It can be used zone wise by thermostat controlling each specific zone thereby saving energy.
- Hydronic systems produce radiant heat which helps transfer the heat much faster than conventional systems. Although the initial pull down time is more in comparison to conventional systems, heat stays for much longer as it is transferred and stored in the concrete.
- Objects heated through radiant energy maintains the natural humidity in a room, whereas convection of warm air tends to reduce humidity which can make the heated area feel stuffy.

- Since whole floor of the room is heated, the radiant heat gives even spread of heat, whereas conventional heating heats one area initially and then takes time to circulate to reach the required comfort levels.
- Rising air temperature through conventional heating can cause discomfort and overheating, which in turn can reduce oxygen levels and ultimately can cause breathing problems if the air is too warm.
- The other major advantage of radiant floor heating is that its stops the circulation of bacteria and other harmful particles in the air which normally keep getting circulated with FCU or radiator systems.

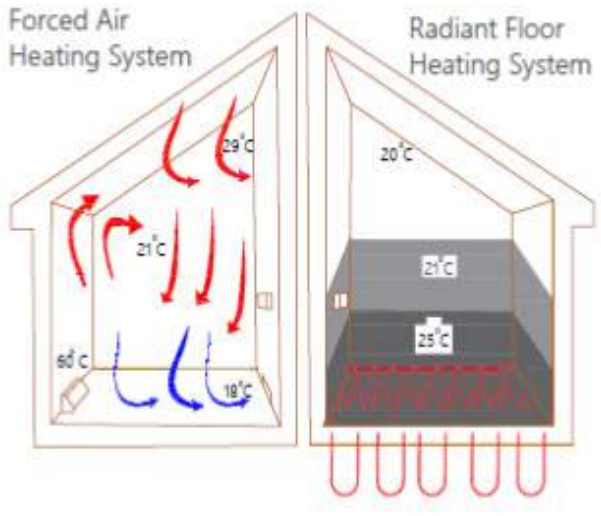

Fig.1 Comparison of Forced Air Heating Vs Floor Heating System

Summary of Heat Loss Calculations of various zones of office complex are as follows:

After Derating 35% and efficiency

factor of 90% of Hot

Water Generator = 4,24,760.94 Watts

Add 5% losses = 21,238.04 Watts

Total = 4,45,998.98 Watts

= 445.99 KW

Total Heat load = 3,84,104.42 Kcal/Hr*

Facilities	Floor Area SM	Heat Load Watts
Zone A	150.21	48074.36
Zone B	317.36	101207.03
Zone C	210.74	58571.56
Zone D	129.60	40632.20
Total		248485.15

Nearest working capacity of Hot

Water Generator = 2 x 2,00,000 Kcal/Hr

Standby Hot

Water Generator @ 50%= 1 x 2,00,000 Kcal/Hr

* 1 KW = 861.24 Kcal/Hr

Detailed Heat Load Calculations : Zone A

Outside Max Temp : (-) 30^{0}C

Inside Temp : (+) 25^{0}C

ΔT : 55^{0}C

Area of Floor =150.21 Sqm

Area of roof=150.21 Sqm

Area of glass (1/5 area of wall)=54.59 Sqm

Length of walls=85.30 M

Area of walls 85.3x3.2=272.96 Sqm

Net area of the walls(less glass) =218.37 Sqm

H1(Heat loss through Floor)

Area of Floor x U x ΔT

150.21 x 5.40 x 0.00 = 0.00 Watts (No heat loss in floor heating)

H2(Heat loss through Roof)

Net Area of Roof x U xΔT +17^{0}C

150.21 x 0.61 x 72 = 6597.22 Watts

H3(Heat loss through walls)

Net Area of wall x 'U' Wall xΔT+7^{0}C

218.37 x 0.60 x 62 = 8123.36 Watts

H4(Heat loss through Glass)

Net Area of glass x 'U' glass x ΔT +7^{0}C

54.59 x 7.07 x 62 = 23928.98 Watts

H5 (Heat loss due to fresh Air Changes)

Cubic metre/min (CMM) :

Nos of Persons x CMM/Person

CMM :15 x 0.56 = 8.4

H5 = CMM x 20.4 xΔ T

8.4 x 20.40 x 55 = 9424.80 Watts

Total Heat in watts (H1+H2+H3+H4+H5) = 48074.36 Watts

Detailed Heat Load Calculations: Zone B

Outside Max Temp : (-) 30^{0}C

Inside Temp : (+) 25^{0}C

ΔT : 55^{0}C

Area of Floor =317.36 Sqm

Area of roof=317.36 Sqm

Area of glass (1/5 area of wall)=127.23 Sqm

Length of walls=198.80 M

Area of walls 198.80 x 3.2 =636.16 Sqm

Net area of the walls (less glass)= 508.93 Sqm

H1(Heat loss through Floor)

Area of Floor x U xΔT

317.36 x 5.40 x 0.0 = 0.00 Watts (No heat loss in floor heating)

H2(Heat loss through Roof)

Net Area of Roof x U xΔT +17^{0}C

317.36 x 0.61 x 72 =13938.45 Watts

H3(Heat loss through walls)

Net Area of wall x 'U' Wall x ΔT+7^{0}C

508.93 x 0.60 x 62 = 18932.19 Watts

H4(Heat loss through Glass)

Net Area of glass x 'U' glass xΔT +7^{0}C

127.23 x 7.07 x 62 = 55769.99 Watts

H5 (Heat loss due to fresh Air Changes)

Cubic metre/min (CMM) :

Nos of Persons x CMM/Person

CMM :20 x 0 .56 = 11.2

H5 = CMM x 20.4 xΔT

11.2 x 20.40 x 55 = 12566.40 Watts

Total Heat in watts(H1+H2+H3+H4+H5) = 101207.03 Watts

Detailed Heat Load Calculations: Zone C

Outside Max Temp : (-) 30^{0}C

Inside Temp : (+) 25^{0}C

ΔT : 55^{0}C

Area of Floor=210.74 Sqm

Area of roof=210.74 Sqm

Area of glass (1/5 area of wall)=62.59 Sqm

Length of walls=97.80 M

Area of walls 97.80 x 3.2 = 312.96 Sqm

Net area of the walls (less glass) = 250.37 Sqm

H1(Heat loss through Floor)

Area of Floor x U xΔT

210.74 x 5.40 x 0.0 = 0.00 Watts (No heat loss in floor heating)

H2(Heat loss through Roof)

Net Area of Roof x U x ΔT +17^{0}C

210.74 x 0.61 x 72 =9255.70 Watts

H3 (Heat loss through walls)

Net Area of wall x 'U' Wall x ΔT+7^{0}C

250.37 x 0.60 x 62 = 9313.76 Watts

H4 (Heat loss through Glass)

Net Area of glass x 'U' glass x ΔT +7^{0}C

62.59 x 7.07 x 62 = 27435.70 Watts

H5 (Heat loss due to fresh Air Changes)

Cubic metre/min (CMM):

Nos of Persons x CMM/Person

CMM :20 x 0.56 = 11.2

H5 = CMM x 20.4 x ΔT

11.2 x 20.40 x 55 = 12566.40 Watts

Total Heat in watts (H1+H2+H3+H4+H5) = 58571.56 Watts

Detailed Heat Load Calculations: Zone D (PEB Shelter)

Outside Max Temp : (-) 30^{0}C

Inside Temp : (+) 25^{0}C

ΔT : 55^{0}C

Area of Floor =129.60 Sqm

Area of roof=129.60 Sqm

Area of glass (1/5 area of wall)=32.25 Sqm

Length of walls=50.40 M

Area of walls 50.40 x 3.2 = 161.28 Sqm

Net area of the walls(less glass) = 129.02 Sqm

H1(Heat loss through Floor)

Area of Floor x U xΔT

129.60 x 5.40 x 0.0 = 0.00 Watts (No heat loss in floor heating)

H2 (Heat loss through Roof)

Net Area of Roof x U xΔT +17^{0}C

129.60 x 1.23 x 72 =11477.37 Watts

H3 (Heat loss through walls)

Net Area of wall x 'U' Wall x ΔT+7^{0}C

129.02 x 1.092 x 62 = 8735.17 Watts

H4 (Heat loss through Glass)

Net Area of glass x 'U' glass x Δ T +7^{0}C

32.25 x 7.07 x 62 = 14136.46 Watts

H5 (Heat loss due to fresh Air Changes)

Cubic metre/min (CMM):

Nos of Persons x CMM/Person

CMM : 10 x 0.56 = 5.6

H5 = CMM x 20.4 x ΔT

5.6 x 20.40 x 55 = 6283.20 Watts

Total Heat in watts (H1+H2+H3+H4+H5) = 40632.20 Watts

U FACTOR for Zone: A,B & C

The following parameters are considered:

Thickness 'x' (m)

Thermal conductivity 'k'(W/m^{0}C)

Thermal conductance 'C' (W/m^2 ^{0}C)

'U' factor: 1/ ($\sum$x/K+$\sum$1/C)

U factor for walls : 0.60

U factor for roof : 0.61

U factor for floor : 5.40

U factor for glass : 7.07

Heat Transfer Coefficients (U FACTOR) for Zone: D

U factor for walls : 1.092

U factor for roof : 1.23

U factor for floor : 5.40

U factor for glass : 7.07

Overall Heat Transfer Coefficient (U factor for wall): Zone A, B & C

Table 1: Heat Transfer Coefficient for Wall

	"x"	"k"	"C"	
Outside thin air film	-	-	34.1	0.029
Outside plaster	0.015	0.72	-	0.021
PCC block wall	0.23	1.44	-	0.160
Inside plaster	0.015	0.72	-	0.021
Glass wool insulation	0.05	0.04	-	1.250
Plywood finish	0.009	0.13	-	0.069
Inside thin air film	-	-	9.4	0.106
U factor 1/($\sum$X/K+$\sum$ 1/C)	0.60			

Overall Heat Transfer Coefficient (U factor for roof): Zone A, B & C

Table 2: Heat Transfer Coefficient for Roof

	"x"	"k"	"C"	
Outside thin air film	-	-	34.1	0.029
Outside plaster	0.015	0.72	-	0.021
RCC roof	0.2	1.44	-	0.139
Inside plaster	0.015	0.72	-	0.021
Glass wool insulation	0.05	0.04	-	1.250
Plywood finish	0.009	0.13	-	0.069
Inside thin air film	-	-	9.4	0.106
U factor $1/(\sum X/K+\sum 1/C)$	0.61			

Overall Heat Transfer Coefficient (U factor for floor): Zone A, B & C

Table 3: Heat Transfer Coefficient for Floor

	"x"	"k"	"C"	
Outside thin air film	-	-	-	-
Outside plaster	-	-	-	-
PCC flooring (1:4:8)	0.075	1.44	-	0.052
PCC flooring (1:2:4)	0.03	1.44	-	0.021
Tiles	0.01	1.73	-	0.005
Plywood finish	-	-	-	-
Inside thin air film	-	-	9.4	0.106
U factor $1/(\sum X/K+\sum 1/C)$	5.4			

Overall Heat Transfer Coefficient (U factor for Glass): Zone A, B & C

Table 4: Heat Transfer Coefficient for Glass

	"x"	"k"	"C"	
Outside thin air film	-	-	34.1	0.029
Window glass	0.005	0.79	-	0.0063
Inside thin air film	-	-	9.4	0.106
U factor $1/(\sum X/K+\sum 1/C)$	7.07			

Overall Heat Transfer Coefficient (U factor for wall): Zone D (PEB Shelter)

Table 5 : Heat Transfer Coefficient for Wall

	"x"	"k"	"C"	
Outside thin air film	-	-	34.1	0.029
CGI Sheet	0.0007	18	-	0.00003
Puff insulation	0.078	0.10	-	0.78
CGI sheet	0.0007	18	-	0.00003
Inside thin air film	-	-	9.4	0.106
U factor $1/(\sum X/K+\sum 1/C)$	1.092			

Overall Heat Transfer Coefficient (U factor for roof): Zone D (PEB Shelter)

Table 6: Heat Transfer Coefficient for Roof

	"x"	"k"	"C"	
Outside thin air film	-	-	34.1	0.029
CGI Sheet	0.006	18	-	0.00033
Air Gap	0.04	0.14	-	0.286
CGI Sheet	0.0007	18	-	0.00003
Puff insulation	0.039	0.10	-	0.39
CGI Sheet	0.0007	18	-	0.00003
Inside thin air film	-	-	9.4	0.106
U factor $1/(\sum X/K+\sum 1/C)$	1.23			

Overall Heat Transfer Coefficient (U factor for floor): Zone D (PEB Shelter)

Table 7: Heat Transfer Coefficient for Floor

	"x"	"k"	"C"	
Outside thin air film	-	-	-	-
Outside plaster	-	-	-	-
PCC flooring (1:4:8)	0.075	1.44	-	0.052
PCC flooring (1:2:4)	0.03	1.44	-	0.021
Tiles	0.01	1.73	-	0.005
Plywood finish	-	-	-	-
Inside thin air film	-	-	9.4	0.106
U factor $1/(\sum X/K+\sum 1/C)$	5.4			

Overall Heat Transfer Coefficient (U factor for Glass): Zone D (PEB Shelter)

Table 8 : Heat Transfer Coefficient for Glass

	"x"	"k"	"C"	
Outside thin air film	-	-	34.1	0.029
Window glass	0.005	0.79	-	0.0063
Inside thin air film	-	-	9.4	0.106
U factor $1/(\sum X/K+\sum 1/C)$	7.07			

x- Thickness in 'm'

k- Thermal Conductivity in (W/m^{o}C)

C- Thermal Conductance in (W/m^{2} ^{o}C)

Conclusion

The design and installation of radiant floor heating system in Ladakh region by replacing the other existing conventional type of heating system has emerged advantageous compared to other heating systems being versatile & good option for heating system.

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Expansion of Nehru Hospital at PGIMER, Chandigarh - A Sustainable Highly Energy Efficient Building

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Introduction

PGIMER Chandigarh was conceived and planned in 1960 to provide a physical and intellectual milieu for young scientists working in multiple disciplines of medicine, to advance the frontiers of knowledge to render humane service to sick and suffering, and to train medical and paramedical manpower in Chandigarh. The institute was established in 1962 as "Nehru Hospital" under the erstwhile state of Punjab. Later It was declared as an Institute of National Importance by an Act of Parliament w.e.f. 1st April 1967, with the following mandate:

- Provide high quality patient care.
- Attain self-sufficiency in postgraduate medical education and to meet the country's need for highly qualified medical teachers in all medical and surgical fields.
- Provide educational facilities for the training of personnel in all-important branches of health activity.
- Undertake basic community based research.

With the passage of time and advancement in medical profession and the technology, to meet the present requirement, many gaps were noticed in existing infrastructure of PGIMR, Chandigarh. Therefore to upgrade the hospital facilities and to reduce the gap, it was decided for expansion of the Nehru Hospital at PGIMER, Chandigarh. CPWD was assigned the PMC. CPWD in consultation with the PGIMER authorities developed the plan for up gradation for reduction in gaps observed by proposing sustainable high energy efficient buildings. In the building highly sophisticated hospital services have been provided. The Building has been awarded the Platinum certificate by Indian Green Building Council (IGBC) under its (Green Healthcare) rating system.

Scope of Work

The scope of expansion consisted of construction of state of the Art, 334 bedded extension block in PGIMER alongwith modern hospital services by integrating with intelligent building design. The Building consisted of basement +G+4 floors having built-up area of 25607 sqm. including all the necessary modern services.

Planning & Design

Central Public Works Department took up the planning, designing and execution of the Work. The floor wise planning and designing was done as under:

- Ground Floor consists of 55 number faculty rooms, Administration and Cafeteria, Linear Accelerator, Radiation Therapy wing & Diagnostics.
- First Floor consists of ENT Wards, ICU and minor OTs, Oncology Wards, ICU and Wing.
- Second Floor consists of Hepatology Wing, ICU and Wards, Endocrinology Department and Wards, nuclear medicine Private Wards.
- Third Floor consists of private wards.
- Fourth Floor consists of Modular operation theatres with pre and post operative ICUs and CCUs.
- 39 IP based services duly integrated with intelligent building design in the hospital.
- Total Built up area of the building is 25607 Sqmtr.
- In the initial phase sanction of construction of building was received and in the 2nd phase the sanction for construction of 39 IP based services was received.

Execution

On getting the sanction from the PGIMER Authorities, CPWD did detailed planning of the work, invited the tenders and took up the construction work. By adopting Green Building concept, energy efficient measures, water conservation measures, automated materials transport system , Human circadian-centric lighting, healing garden, artwork & colour psychology to create a therapeutic environment have been created in the complex. The work of planning, designing, tendering and execution of 39 different services and finishing work was taken up and completed in record of time 18 months. The Built up area of the building is 25607 Sqmtr. The construction cost of the work is Rs. 173 crores.

On expansion of the hospital the objectives of covering the main gaps like minimizing hospital acquired infection, creating therapeutic environment in the hospital for enhanced healing and reducing the plant recovery time, facilities to reduce stress on the hospital staff, energy efficiency and conservation, use of new technologies, operational savings etc. have been achieved.

Major Facilities and Services provided in the Building:

There are about 39 IP based services which has been provided in this project. They include: 10 no state of art Modular OTs (SMS Technology) with Integration, Medical Gas Pipeline System, Automated Material Transport System,(4 X200 KVA) ultra high efficiency UPS, 3 x 1600 KVA Substation with SCADA, 3 X 1010 KVA DG Sets, 1800 TR AC Plant, 9 nos LIFTs, entire hospital & office furniture, Automatic addressable Fire Alarm system, Wet Riser & sprinkler system, Fire check doors, Fire curtains, Digital PA System, Professional sound system & Display system(smart screens), CCTV System, Nurse calling system, Grid interactive Solar PV (100 Kwp), Solar water Heating 10,000 LPD, RO 10,000 LPH, STP 300 KLD, Organic waste processor 100 KG per day, Rain water harvesting, circadian centric lighting & Intelligent lighting control, E Podiums, Interactive Kiosks, Mobile charging stations, LAN & WIFI, IP based video call enabled Telephony, Intelligent Building Management System, vehicle charging stations, Emergency Lighting system etc.

Intelligent Building Design Features:

More than 39 different E&M and hospital services have been provided in this building. All the systems are IP based and are scheduled, monitored and controlled through highly advanced BMS system. Each ACB & MCCBs of the building can be controlled as well as monitored for energy management and power quality. For indoor air quality CO2 & CO sensors have been installed. BTU meters, water meters, smart meters have been installed at every place to monitor energy consumption . Nurse calling system has been provided with which every patient can communicate with the Nurse. Hospital information system comprising of interactive kiosks and 180 screens/Displays has been provided. All seminar rooms have been provided with state of ART Audio visual system and E Podiums. OT integration has been provided for live telecast of operations. Air quality monitors alongwith display has been provided at various locations.We have also provided Kiosks based on Artificial intelligence.

Green Building Concepts

Energy Efficiency Measures:

Some of the energy efficiency strategies which have been employed in this project are as follows :

- Use of double layered AAC blocks(150mm AAC +25 mm insulation+125 mm AAC) with insulation in-between for building envelope
- Use of Double Glazed Units (DGU) with high performance glass having solar factor of 0.2 and U value of 1.6 W/m^2 degree K.
- Highly efficient centrifugal pump with VFD and Screw chillers to cater to part-load on cooling system
- Chilled Water and heating Water pumps with VFD controls.
- Circadian centric LED lighting with LPD value of 0.5 W/ft^2 with occupancy sensors with centralized control and monitoring system.
- BMS for monitoring and controlling real-time building performance
- Use of Heat recovery wheels.
- High Delta-T on evaporator and condenser with reducing the approach to the wet bulb for cooling tower design.
- High C.O.P. chiller at duty conditions.
- Variable speed drives for partial load equipments e.g. Secondary chilled water pumps, air handlers, etc...
- Chiller plant manager for energy optimization.
- Air source hot water generator for better plant COP
- Low pressure drop filtration on air side.
- Use of automatic tube cleaning system for chillers.
- All the equipments used complies to either ECBC super or ECBC plus category of ECBC 2017.
- Use of LIFTs with regenerative braking.
- Use of solar reflective tiles.

The above strategies have helped to reduce the building energy consumption by 146 Kwh/m^2/annum for 334 bedded hospital vis a vis benchmarked weighted EPI of the project. This translates into annual energy savings of Rs 4 crores for this project.

Water Conservation Measures:

This project has been designed to conserve water and some of the salient features are:

- Use of low-flow fixtures
- Dual flushing system
- Sensor based urinals
- 300 KLD MBR based STP for recycling water for cooling tower makeup water, toilet flushing and irrigation
- For irrigating the landscape, drip irrigation has been employed to reduce irrigation water demand by 60%
- Three sets of rainwater harvesting system has been provided at this site.

Fire & Life Safety Measures:

Intelligent addressable fire alarm, Wet Riser & sprinkler system, Gas suppression system, addressable emergency lighting system, Digital PA & Emergency announcement system, smoke extraction system, Fire curtains. Fire seals & Fire resistant doors have been provided.

Innovative Technologies and Materials Adopted

Automated Materials Transport System

Among other futuristic technologies used in this project, Automated Materials Transport System (AMTS) will despatch samples for tests through a tube system to avoid physical carrying of samples by patients and their attendants.

"Samples in a carrier capsule will be pushed through the tubes to the laboratory within 30 seconds, saving the patients from the trouble of running around between departments." The capsule can transport drugs, blood samples, organ and tissue samples, other samples (urine etc), imaging documents (X-rays etc) among others.

The system will put aside dependence on ward boys, patient's attendant, elevators and it will save re-deputation of staff, monotony of logistics work, diversion of staff, samples breakages and delays, making the test system more efficient.

Control of Airborne Infection

To prevent hospital acquired infections (HAI), the air handling units (AHUs) has been provided with central air cleaners which work on trap and kill technology to take care of viral, bacterial and fungal pathogens, PM 2.5 particles and other air pollutants. Airborne microorganisms are a major cause of spreading diseases.

Another factor that can lead to HAI is the poor indoor air quality (IAQ) in the hospital building and it can lead headache, fatigue, eye and skin irritations and other symptoms. Multistage air purification along with active carbon filter will ensure efficient reduction in all three pollutants of indoor air (particulate matter, pathogens and volatile organic compounds).

Human Circadian-Centric Lighting

In the project, circadian lighting has been provided which changes the ambient colour as per the outdoor lighting colour which helps in aligning the patient's body clock with the natural one.

"By using human circadian compatible lighting, a patient gets undisturbed sleep and has a chance to correct his or her health in synch with Nature." This system has been provided for energy saving and speedy recovery of patients.

Healing Garden, Artwork & Colour Psychology

Medicinal plants have been planted in the garden, which shall also help in enhancing local air quality and a round in the landscape area shall help in creating positive impact on patients and their relatives health and morale. Different colors have been used for treating patients based on the type of diseases.

Challenges Faced and Lessons Learnt

This project was started in 2011 and upto 2017 only structure was completed as sanction was not there for more then 30 specialized services including Modular OT, Medical Gas pipeline system, Hospital Furniture etc. It was only after sanction was given in 2017 the work was resumed and planning, design, tendering and execution of 39 different services and all civil finishing works were completed in a record time of 18 months.

Another challenge was to achieve false ceiling levels of 2.8 mtr or more with floor to ceiling height of 3.7 mtrs (due to height restrictions).With so many services above the false ceiling this was extremely difficult task but with meticulous planning this could be managed. There were 16 different agencies who worked in this project and their coordination was also a big challenge.

Awards & Recognitions

Indian Green Building Council (IGBC) has awarded its highest Platinum Certification for Extension of Nehru hospital building under its (Green Healthcare) rating system. This is the first platinum rated Government Hospital in the country.

Conclusion

By optimizing the design and by using efficient products and by ensuring competition per bed cost is less than Rs 50 Lacs in this Project which is normally Rs 1 crore per bed in fully furnished hospital of similar standards. In PGI project several innovative schemes and new services for the comfort of the patients and for meeting the functional requirement of the hospital have been introduced. Latest features in the medical field, safety, automation, energy efficiency and green building features have been incorporated while designing this hospital. This is by far the most energy efficient hospital in the country.

From Editor-in-Chief Desk

Engineering professionals – Developing their alround Capabilities

Civil, Electrical and other engineering professionals join Government department, private construction firms, Design organizations etc. to pursue their profession. Generally they work for work's control, design, planning and also for administrative control. They are paid for their assignment pursued by them.

Like any other human being they have to develop their personality for their life long involvement in the profession. The most important initiative to be taken in this direction is the training. The training courses are conducted by (i) Institutions within the organization, (ii) institutions run by Government and (iii) private bodies. Besides, universities and engineering colleges also run training courses. They also have higher education programmes. Besides for training there are educational institutions abroad. Thus for development of personality of professionals, training plays a very important role.

For developing academic capability, professionals can decide to study for higher education in engineering colleges, management institutions etc., within the country and even abroad.

For professional development and to share their knowledge, it is very important that professionals participate in different committees of BIS, as per their interest. It will be their contribution for enhancing knowledge base of country. Direct benefit goes to the profession.

For continuous professional development and interaction with other experts in the field, membership of different professional bodies is necessary. Professionals must join societies like Indian Buildings Congress, Indian Roads Congress, The Institution of Engineers (I) etc. They should find time to read publication of these societies. Besides, conferences, seminars, workshops etc. are organized by these societies. Professionals must participate in these events. Moreover, to share experience gained, professionals should write paper and present in these conferences. Thus societies like Indian Buildings Congress play role in alround development of professionals.

(K.B. Rajoria)

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