

JUNE 2020

# VIEWPOINT

OFFICIAL QUARTERLY MAGAZINE OF CEAI

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## Consulting Engineers Association of India

Apex Consulting Association of India

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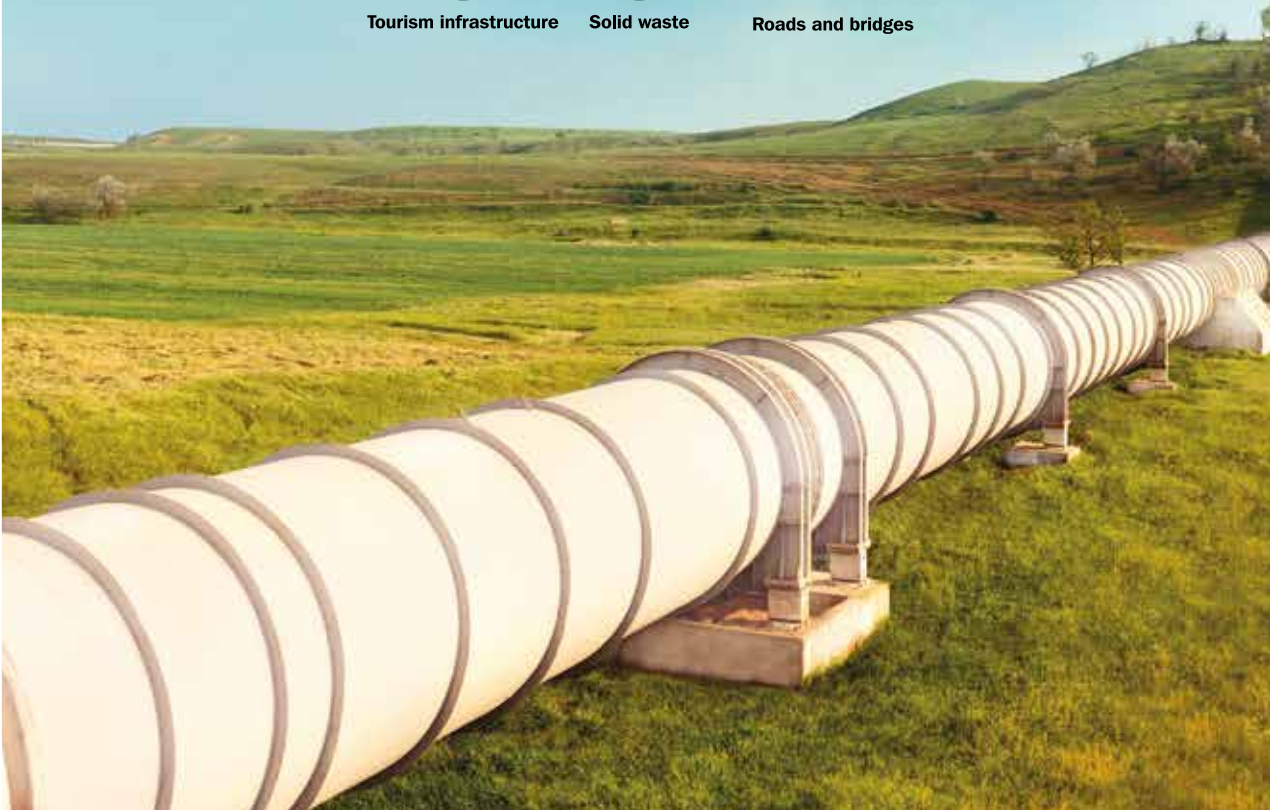
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## GREETINGS FROM THE PRESIDENT



Dear Friends,

It is a matter of great pleasure to for all of us in CEAI to recall that this year we have completed 60 years of service to the Consulting Engineering fraternity, cumulatively, and have grown from strength to strength.

The form and mode of working of the professionals have undergone transformations in these six decades. Engineers have moved from log tables to slide rules, to calculators and now computers. Each step enabled complex calculations to be done with greater ease. The same with drafting – manual 2D drawings are now vintage. Computer aided drawings are the norm now. Physical models have given way to 3D drawings with walk through facilities. Virtual Reality and Augmented Reality are taking this experience forward.

Construction techniques, the plant and equipment have also undergone dramatic changes. The degree of accuracy and possibility of many shapes, features and finishes which were earlier difficult to achieve can now be attained. Automation and robots are being increasingly deployed where hazardous work is involved. Remote control is becoming the order of the day and with AI added, the aspects of Safety and Health are being more easily addressed.

Sustainability has become the shibboleth of the day. Humans are slowly realising that it is Nature, and not them, that governs as to how Earth will be. The pandemic has thrust this lesson in no uncertain terms.

Since Contracts form the basis of laying down the manner in which a task or work is to be done, people also realised the importance of scrutinising contracts critically before entering into one. The one-sided contracts are being replaced with fairer contracts with more equitable allocation of risks, based on, who is most suited to take care of a particular risk. Accountability and responsibility are thus being assigned in a more rational manner.

CEAI has been working right through these decades, sometimes stable and at times turbulent, to bring the latest know-how vis-à-vis technology, engineering methodology and also updates on contractual conditions and framework to the knowledge of its Members so that they can update themselves.

In these turbulent times, CEAI has been holding webinars, to keep the consulting engineers abreast, of the ways and means for maintaining business continuity.

CEAI has also been actively putting forth the matters affecting the fraternity to the authorities concerned and have achieved desirable results in most cases. CEAI is there to support the fraternity and to that end has been pursuing with the Government of India for legislation for the profession of Engineering. It is utmost necessary to ensure that only those with proper qualification, experience and competency perform the works that only an Engineer with the specialised qualification, knowledge and skills acquired can perform.

We urge all engineers, with stake in Consultancy profession, to be Member of CEAI and help their fraternity to grow and prosper. Remember, in today's world, strength in numbers and solidarity, can only lead us to success.

*Happy Diamond Jubilee of our efforts!!*

A handwritten signature in black ink, appearing to read 'Amitabha Ghoshal'.

**Amitabha Ghoshal**

## *About CEAI*

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Consulting Engineers Association of India (CEAI) is the apex body of consulting engineers in India having membership of organisations as well as individuals. The membership represents large, medium and small consultancy companies/ organisations both in the private and public sector and eminent individual consultants. EPC organisations are also members of CEAI since they have planning and design engineers, apart from construction management consultants.

CEAI is the Member Association, of the International Federation of Consulting Engineers, commonly known as FIDIC, the acronym for Fédération Internationale Des Ingénieurs-Conseils, representing the Consulting Engineering Fraternity in India. FIDIC has membership of more than 100 Member Association of various countries and is headquartered in Geneva.

CEAI was incorporated in 1996, with the merger of two leading national associations Association of Consulting Engineers (India) {ACE(I)}, incorporated in 1960 and National Association of Consulting Engineers {NACE}, incorporated in 1976. Thus, CEAI has, behind it six decades of accumulated knowledge and experience.

- CEAI promotes the interest and works to enhance the status of the consulting engineering profession in India
- CEAI advocates global networking and co-operation
- CEAI's activities include:
  - Quality development of Consultants.
  - Productivity enhancement.
  - Promotion of ethical practices.
  - Facilitation and interaction with government and other authorities/ bodies to streamline and improve the system of engagement of consultants.
- Regional Centres in Jaipur, Bengaluru, Kolkata and Mumbai to broad base activities.

## *Aims & Objectives*

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- Promote the professional interest and establish the rights and privileges of the status of consulting engineering profession in India
- Represent the consulting engineering profession within India and abroad. Connect the members locally and globally.
- Disseminate among the members information on all matters pertaining to engineering, especially knowledge and information related to consulting engineering profession by way of holding Conferences, Seminars, Courses, Workshops, Field/ Site Visits, etc. and thus assist in Continuing Education for the Professional Development of Members.
- Act as the principal champion for consulting engineering profession through constantly informing and educating the public and lawmakers about key engineering issues and making it possible to have the voice of the profession heard by the policy makers.
- Promote adoption of equitable forms of contracts and other documents used in consulting engineering practice.

**SOME OF THE EVENTS ORGANISED BY CEAI IN THE PAST DECADE**



*Managing Innovation – The Way Forward  
FIDIC 2010, New Delhi*



*Transport Infrastructure 2025-Opportunities and  
Challenges, New Delhi 2012*



*Construction Contracts-International and Indian Experiences, Delhi & Chennai 2013*



*Role of Consulting Engineers, Contractors,  
Developers & Authorities in Infrastructure  
Development, Delhi 2014*



*Managing Innovation – The Way Forward  
FIDIC 2010, New Delhi*



*Indian Contracts & Risks – Time to Relook, Mumbai & New Delhi, 2016*



SOME OF THE EVENTS ORGANISED BY CEAI IN THE PAST DECADE



*Managing Physical Assets, 2017, Mumbai*



*Aspects of Consulting Profession in Architectural and Civil Engineering, Jaipur 2017*



*Sustainable Infrastructure Development - The Kolkata Story, Kolkata, 2018*



*River Action Plan, Flood Management and Basin Development, New Delhi, 2018*



*National Workshop on National Building Code of India 2016 and Revised Seismic Codes, Guwahati, 2019*



*FIDIC ASPAC 2019, New Delhi*



*Workshop on Global Vision 2030, New Delhi, 2020*



*Water Infrastructure for Urban Areas and Industries, Bhubaneswar, 2020*



## MESSAGE FROM CHIEF EDITOR

*Dear Fellow Consulting Engineers & Readers,*

Existential learning, full of synclines and anticlines has been encompassing the daily lives of the people all over the world for the past few months. It has affected their day to day means of sustenance, the work repertoire from home, wellbeing and safety. It has changed the whole concept and understanding of healthiness, safety and security in relation to just being able to be alive. The concept of human privacy has also been redefined for the sake of the larger good of all. Time, space and freedom of movement have also got new connotations, again for the sake of the larger good.

The experience in these times of the pandemic should serve to educate the authorities and the planners not to let congestion occur, not to let unplanned habitats - temporary or permanent, spring up across open ground. They must ensure that storm water drainage is not affected, waste collection and disposal are fully addressed and the environment is not tampered for personal reasons. They must acknowledge that Nature is Supreme and one cannot subsume the role of God. In the ultimate analysis it all boils down to abiding by accepted norms of living which have been propagated for centuries and would enable people to live safe and healthy lives and contribute effectively, positively, constructively and responsibly to the society, the planet and the universe.

The authorities will necessary have to create suitable Health infrastructure to deal with current and future pandemics, which is affordable to the majority.

The manner and mode of living and working will need to change after the current experience of Work from Home. Health and associated safety issues would need to be given greater consideration in all planning. Work from Home could become the norm in many sectors with periodic essential meetings in the office. The requirements of a home would thus consequently also change for many. Integrated and Holistic Planning and Execution are Essential and MUST. They should be made the NORM Immediately so that segmented and discipline wise or sector wise planning and execution are a thing of the past. Non-professional considerations and reasons of expediency must give way to what is the right thing to do for the sustainable good of our Planet EARTH.

The theme of this issue was decided as “New Materials and Systems for Buildings” however in view of the pandemic experience, it was considered advisable that it should also cover Industries. Hence the theme was changed to “New Materials and Systems for Buildings & Industries”.

The sudden lockdown affected the industry, trade and commerce adversely. The Oil & Gas, Chemical and Industrial Plants very the hardest hit - the processes

which are continuous could not be shut down although the number of personnel attending were reduced. The industries which had moved to greater degree of automation and remote working fared much better than others. Having said that, remote control of manufacturing activities has its own challenges in terms of Cyber security and the need will be felt to upgrade IT and prevent malicious cyber-attacks, especially those of sensitive installations. There is therefore a need to learn from the very pertinent issues that cropped up and had to be faced in the past few months. A small example is to train staff in safe start up procedures to avoid accidents, loss of life and property.

The same applies to the offices – administrative and commercial, public or private organisations. All were caught in the wake. They also must rethink their functioning.

The incidences that have occurred go to emphasise as to how important Risk Analysis is in all walks of life, including our personal lives. Risk Mitigation measures need to be therefore thought of for all conceivable situations and give credence to the learning that the most improbable could occur. The lessons learnt during the pandemic will also bring in changes in the manner that industrial processes are handled. Automation, robotics, IoT and remote control all powered by AI together with VR and AR will play a bigger role. Their incorporation will hardly be discretionary, it will be a necessity.

For the building sector per se, firstly, there is a need for use of materials that can be recycled or combined and recycled to create better materials albeit cheaper; that would last for the period that the building is to function. There would still be the need to invent or discover newer materials to meet the needs of newer requirements. The same logic ought to be applied to the various building systems, starting with the structure per se, then the building's external envelop and move on to the internal partitions and the finishes.

Then follow the plant and equipment for the various building services together with all their fittings, fixtures and appurtenances. A little thought would suffice to determine that the design life requirement of all that goes into a building would also be in that order - maximum for the structure and reducing for the services albeit with sub-classifications within them; however, all that would still be based on the consideration that due and regular preventive maintenance would be done. In this sector also digitization will need to be speeded up and easy to use maintenance modules introduced into popular ERP software, that can routinely capture and update data, for optimum OPEX results as well as reduction in, expensive downtime and spare parts inventory.

HVAC is critical for health; however, the system would need to be rethought of so as to provide once through fresh air supply with proper pressure differential between private and public areas. The exhaust air would need to be treated and then let out. Ducts, grills, filters, etc. to be amenable to vacuuming and fumigation/ UV irradiation for disinfecting them periodically.

Water, waste water fittings and fixtures will also need to be redesigned to make them contactless, self-sanitising, and coverable/ sealable. All systems in buildings including the fittings and fixtures associated with them would also require redesigning to provide similar features. Most importantly, accessibility for all must be ensured 24/7 in all areas of a built environment.

Construction works all across were badly hit on account of the pandemic. Migratory labourers' were the most unfortunate ones who were left in the lurch to fend for themselves. This phase has in fact demonstrated as to how important statistical data is, especially of the Essential Services, for the safety and security of all. It has also shown as to how essential it is record movements of all living things so that their movement can be reviewed, if and when necessary, to provide the appropriate and essential assistance or take recourse to other actions, when the need arises.

Needless to say, that with such a data repository comes responsibility for its security and prevention of its misuse. Nevertheless, it will become a dire necessity in the future.

The country, nay the whole world is going through stressing times on account of the COVID-19 pandemic which has derailed normal life and the economy. However, good leadership is ensuring, through social distancing, basic personal protection protocols, that the impact be hemmed and minimized. As responsible human beings it is our civic duty to cooperate, be vigilant and advise those who do not comprehend the gravity of the situation. It's only that which will take us out of this pandemic.

I repeat from the UNESCO extract which was given in the March 2020 issue.

### **Be an Engineer and Create a Better Future for the World.**

**“If you want to change the world for the better, become an engineer”**

Engineers must come out with revised work manuals to address health, safety and environmental issues in the wake of the pandemic. This is a scenario which now has to be routinely addressed in all discussions on strategy and the associated risks.

The Government must speed up the process for bringing out legislation for the profession of engineering so that the country benefits from the right rationale and sane advice on engineering matters and that all engineering works are done only by qualified, knowledgeable, experienced and competent Engineers.

Happy Reading & Learning for A Safer and Securer Life



**A P Mull**



## MESSAGE FROM THE GUEST EDITOR

Nature is inherently smart and relentlessly so with multiple ways of achieving its ordained objectives. It learns, unlearns and relearns on a continuous basis. Throw a stone in the path of flowing water – it knows how to go around and reach its destination. The stone also gets ground in the process of being an obstruction. Force knows how to travel in the path of least resistance and reach its destination. Human beings have always been on a journey to find better ways of doing things. In the quest to learn from nature, finding newer materials and systems for buildings and industries has been the human's approach towards mimicking nature. Some of these have been successes and some failures but the learnings have continued. Five out of top ten risks identified by the World Economic Forum in 2020 are related to Environment. The Green Revolution that is seen today is a result of the realization of what has gone right and what has gone wrong. Sustainability and a Circular Economy are of prime importance in the path of continuous improvement towards developing newer materials and systems. This issue of View Point, shares the thoughts from working professionals on the recent advances in new materials and systems for buildings and industries.

Urbanization, climate change and digitalisation are the key trends that are driving the economy. The focus is on creating sustainable materials and work towards zero waste from a building or an industry. There is a need to explore as to how buildings can be made energy neutral if not energy positive. Pollution eating materials have come up that eat pollutants in the air using sunlight and a honeycomb structure coated with titanium dioxide. Translucent concrete allows more sunlight inside a building or an industry reducing its power consumption. Self-healing concrete uses bacteria that germinate when water enters through a crack producing lime that seals the crack. Materials produced from recycled wastepaper as well as aerogels used in cryogenics are possible applications for thermal insulation. Thin film solar cells made of Perovskite are flexible, semi-transparent and light weight. Bicycles are made of carbon fiber composite that is very light but is the strongest and this material also provides the strength needed for tall buildings. Several technologies have emerged in glazing materials that are of low carbon intensity and environment friendly. Using 3D printing technologies – printing parts or whole of buildings have become a reality, albeit at smaller scales. Smart materials that respond to the environment are being developed and are termed intelligent.

Industry today is working towards using digital and intelligent technologies. Smart manufacturing and smart infrastructure are the current trends. Digital assets are being created for old plants which eventually become digital twins that enable optimum operation and maintenance of assets, termed asset sweating. Industry 4.0 is driving digital asset lifecycle management.

Construction simulation technologies are available that help resolution of issues that might crop-up during execution. Robotics applications in smart construction enable quality and schedule commitments. Smart cities have a central command and control center to operate and maintain the city. A set of plants are operated from a single command center using digital technologies that helps efficient decision support through learnings from the fleet at enterprise level. A Middle Eastern plant operator plans to operate 26 assets in the Middle East, Africa and Eastern Europe from Dubai. At system and component levels, predictive analytics support optimum usage of asset avoiding system failures. For utilities, demand forecasts using digital technologies, smart grids and artificial intelligence enable enhanced responsiveness to consumer needs.

The set of articles in this issue provide us a glimpse of technology developments in new materials and systems. Readers are requested to send their feedback so that CEAI's Editorial Team can learn, unlearn and relearn in its journey of assisting towards sustainability and circular economy by being closer to nature and being smart.

Trust all of you and your families are safe in these challenging times.

*Engineer to Stay Safe, Stay Healthy & Stay Connected.*



**Dr Rajashekhar Malur**  
Vice President and Head – Power Business  
Tata Consulting Engineers Limited

## NEW SUSTAINABLE MATERIALS FOR CONSTRUCTION



**R L Dinesh**

*Discipline Head Civil -Technology Vertical  
TATA Consulting Engineers Limited*

### ABSTRACT

*Construction materials like cement, steel, metals, glass, chemicals, wood and many more are extensively used in modern days for construction of infra structures and in providing human comfort facilities. Demand for these materials which is increasing day by day has resulted in increased energy demand and carbon emission. Many researches have been conducted to invent sustainable materials to reduce the energy demand and carbon emission. This article highlights few of the future sustainable materials which can be used in the civil engineering and architectural fields.*

### INTRODUCTION

Basic needs of human beings are met by the Mother Earth since life appeared. They utilized the material and space available in nature to better their living conditions. The material adopted ranged from soil, metals to Nano materials. Application of these materials varied from food, household, shelter, transportation, medicines and industries. Shelter and facilities for the transportation sector are the key areas where civil engineering and architecture evolved to provide better living conditions. Over a period, material usage grew based on needs and easy availability, strength and stability, aesthetics, durability, and today it's based on sustainability. Earlier days the mantra was on need, cost and easy availability in nature and hence used soil, stones and wood to create facilities. Later attention was given to improve the strength and use of lime was started. As the demand increased on space, vertical growth too started with the invention of cement and steel. Extensive use of cement concrete and steel in the civil engineering forced the architecture to look for alternate material to lime mortar which was used to create architectural features in earlier days. Glass, aluminum, FRP materials have changed the architectural concepts on aesthetics. Later on, environmental impact on cement concrete and steel started to affect the life span of the structure which was not the case before the use of these materials. This led to search for durable material like polymers, chemicals, fly ash, GGBS, polyvinyl material. Extensive use of all these materials created resource crunch and impacted the environment thus affecting lives on the earth. That caused engineers to look for sustainable materials. This article high lights a few innovative developments in sustainable materials and their applications.

### MASS TIMBER

Timber is a very old material and extensively used from the early days of human evolution. Its use got restricted in modern construction due its low strength and poor fire rating. However, it is a very sustainable material and has good thermal insulation properties. Well treated and some special wood is more durable and has lasted for several decades. Even after the life span of the structure built with wood is over, the wood may be reused, wood is bio degradable and doesn't cause any environmental issues. New research in wood technique industry has evolved new stronger material called **mass timber** to improve the properties of the wood. Solid wood is panelized and laminated to improve the strength and other useful properties which would be beneficial in construction of tall buildings.

The mass timber category includes mainly two types, cross laminated timber and glue laminated timber, which are manufactured by techniques called cross lamination and glue lamination. In cross-lamination technique wood strips are stacked and glued in alternative directions under high pressure. This can be used for large slab and wall panels in building construction. Glue-laminated timber is composed of several layers of dimensioned wood that are glued together using structural adhesive by placing the wood grains parallel to the member axis and is useful for creating strong beams to support wall or slab panels. They have been tested for fire resistance and proved that they can maintain their structural integrity. Study<sup>[1]</sup> presented in the Journal of Sustainable Forestry concluded that 14 to 31 percent of global emissions could be reduced by use of mass timber in place of concrete, steel and brick masonry in buildings. Mass timber like wooden log doesn't get ignited easily. An occurrence of fire chars the external layer which actually insulates the wood further and develops resistance to fire. This material has been used as structural members as well as architectural elements such as glazed windows, glazed doors, fins, internal partitions with glass panels. Timber buildings constructed with carefully placed mass-timber elements are lightweight and have high thermal performance with low carbon emission. American National Design specification for wood construction (ANSI/ AWC NDS 2018)<sup>[2]</sup> and Canadian National Standard for engineering design of wood (CSA 086)<sup>[3]</sup> have included chapters dedicated to design of Cross laminated timber structures.



*Mass timber- Laminated panels<sup>[4]</sup>  
Courtesy: FPInnovations*



*Beam and Slab Panels<sup>[4]</sup>  
Courtesy: Contractors install CLT at the  
LEVER Architecture-designed Albina Yard  
in Portland, Oregon. (LEVER Architecture)*



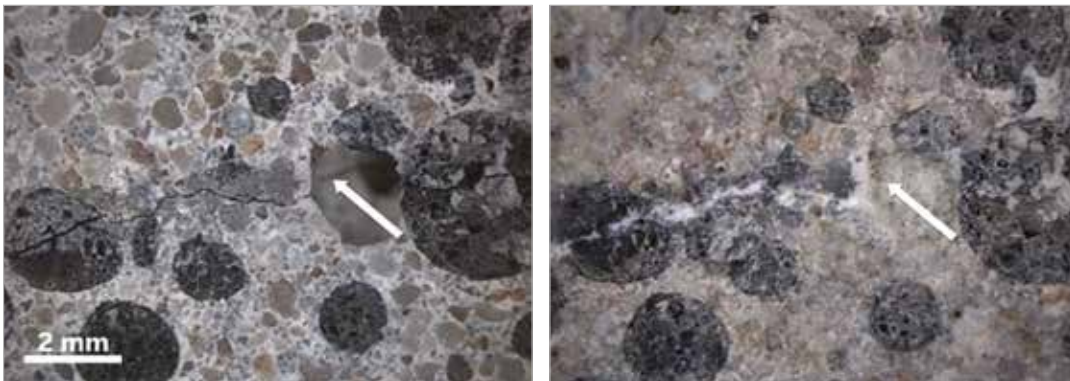
*CLT Wall Panels erection<sup>[5]</sup>  
CLT panel for Brock Commons in Vancouver  
(Courtesy: Naturally Wood).*



*Column and Slab construction<sup>[6]</sup>  
Courtesy: Construction on Brock Commons,  
an 18-storey mass timber building at the  
University of British Columbia. (SUPPLIED  
/ Postmedia*

## SELF-HEALING MATERIALS

Concrete is a composite material consisting of aggregates bound together using a binding material which is cement. Concrete is a very widely used construction material, possessing very good compressive strength but is weak in tensile strength. It is relatively cheaper and versatile material. To improve its behavior under tension, reinforcing bars are added to concrete. However, reinforced Concrete made with cement and reinforcing bars develop cracks over time due to thermal variations and environmental effects, which is detrimental to structure. Cracks in concrete allow moisture or water to enter inside the concrete and speedup the deterioration of concrete. In order to overcome this deterioration, researches have been conducted to evolve an additive material for producing a self-healing material. The self-healing material in the concrete utilizes ingress water to start chemical reaction and forms calcite to plug the cracks. There are many healing systems or material which uses this healing technique like expansive mineral additives, super absorbent polymers, microcapsules, bacterial carbonate precipitation and microfibers. Among these systems mixing of micro capsules in the concrete matrix and releasing the reactive agents after the development of cracks to activate the repair is most promising. Sodium silicate is the promising core material used in capsules which is mixed with concrete during manufacturing. When cracks develop in concrete, the capsule shell gets ruptured and releases the core material into the surrounding concrete matrix. Chemical reaction between the core material and surrounding concrete matrix gets activated after contact of moisture or water. The reaction yields hardened calcite component which fills the cracks in the concrete, which then partially or fully regains the main material properties. Other researchers have used bacterial spores along with calcium lactate, nitrogen, or phosphorous as ingredients. In case of bacterial concrete, Bacillus bacterial capsules and calcium lactate are mixed with wet concrete. During the life span of the concrete structure any development of cracks would lead to ingress of water into the cracks. The dormant bacterial spores use this water for germination and start releasing calcium lactate which is converted into insoluble limestone. The limestone fills the cracks and gets hardened to heal the damaged portion of the concrete. Researches have demonstrated that use of these materials in concrete do not reduce the engineering properties of the concrete.



*Concrete section with crack before healing<sup>[11]</sup>*

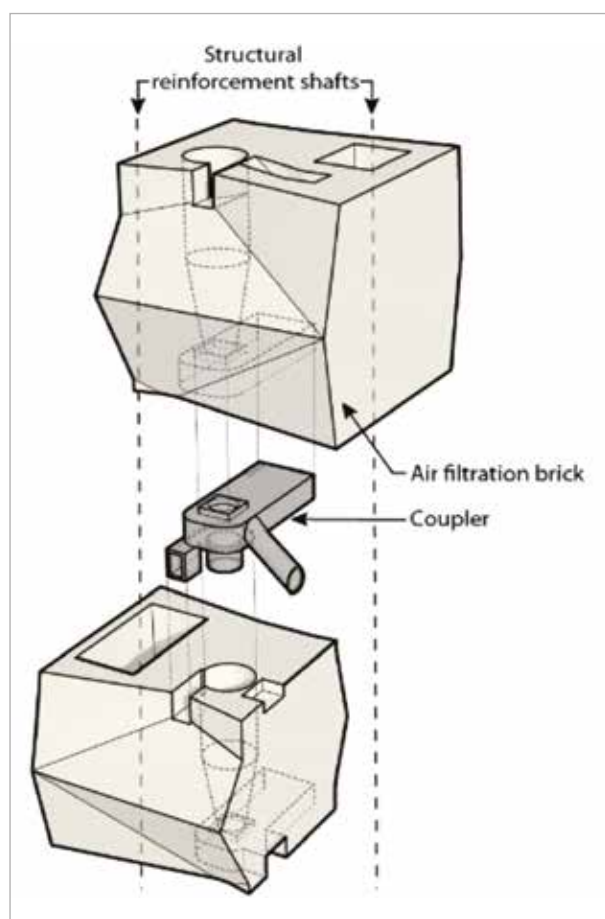
*Concrete section after healing.*

Courtesy: c&en CHEMICAL & ENGINEERING NEWS

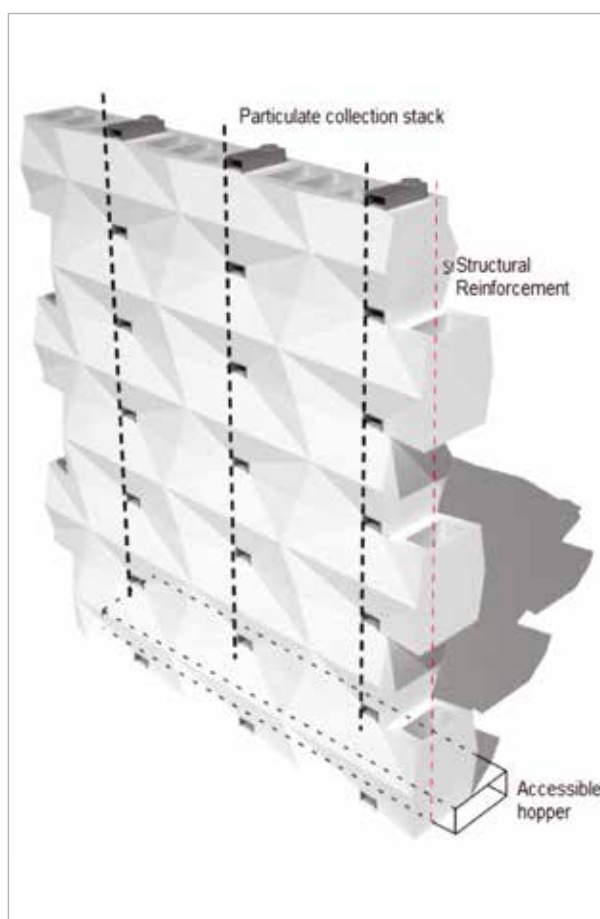
Durability of civil engineering structures built with reinforced concrete like buildings, water and waste water treatment plants, transportation structures, tunnels etc could be improved in long run without significant repairs or replacement by using self-healing materials. Materials saved in repair of concrete in the long run results in reduction in carbon emissions. At present cost of these material is high and further research is needed to bring down the cost to promote these materials for wider application in construction.

## AIR CLEANING BRICKS

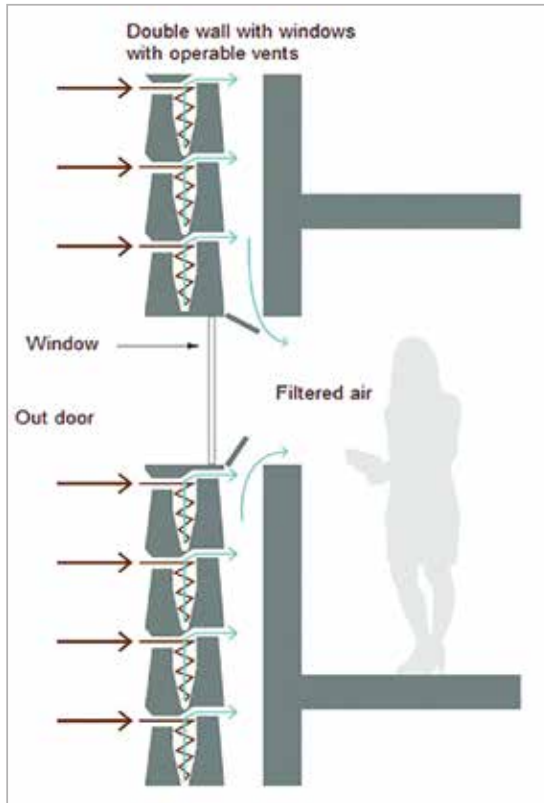
Maintaining good indoor air quality is a necessity in most buildings, especially in urban areas due to polluted air. Most of the present engineering solutions consume more energy to maintain good air quality within the buildings and hence more carbon emissions and pollutants in to the atmosphere in the long term. Researches have been conducted to address this issue and one of the innovations is to make use of brick wall as filter media as invented by assistant professor Carmen Trudell at Cal Poly San Luis Obispo's school of Architecture<sup>[12]</sup>. External walls built with air cleansing brick masonry consists of two layered façades. Outer façade is built with air cleansing bricks and internal façade wall is built with normal brick wall leaving a gap between the two walls for air passage. At the center of breath bricks façade, cyclone filtration system is provided. As the outer air enters the ventilation holes in the bricks, it gets filtered through cyclone filter media and solid particles get collected in the bottom hopper provided at floor level. Filtered air is supplied to the inner side of the building using either mechanical or passive ventilation system such as stack ventilation. Tests conducted on the performance of these bricks have confirmed that it is possible to remove about a third of fine particulates matter and 100 percent of coarse particles



*Isometric view of typical  
Air cleaning brick<sup>[12]</sup>*



*View of wall after erection of wall with  
Air cleaning bricks<sup>[12]</sup>*



Sectional view of wall constructed with Air cleaning bricks - showing air flow<sup>[12]</sup>



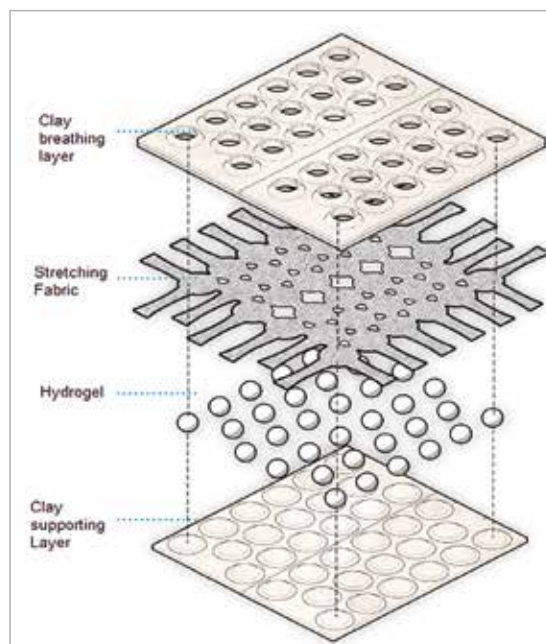
Typical View of an Air cleaning brick<sup>[12]</sup>.  
 Courtesy: Carmen Trudell Assistant  
 Professor -at School of Architecture Cal  
 Poly San Luis Obispo

## PASSIVE COOLING CERAMICS

Air-conditioning of inside the building consumes energy that accounts for a predominant portion of global carbon emissions. Passive cooling methods are very old, and most are ineffective to cater for very hot weather conditions. Research in Institute for Advanced Architecture of Catalonia's Digital Matter Intelligent Constructions studio<sup>[16]</sup> had invented a façade which is developed using clay composite and hydrogel that cools the building in a way that is similar to how our skin functions to cool the body. This façade namely, passive cooling ceramics, consisting of clay tiles embedded with hydrogel. Hydro ceramic tiles works on the principle that evaporation of water from a surface cools the surface. Hydrogel pellets embedded in the clay tiles spread over large area of structure facade can absorb large quantity of water. Hydrogel pellets provide a large surface area for evaporation to occur, which lowers the inside temperature and increases humidity around the façade. During testing of this material application, it was observed that a drop of 5°C temperature and increase in humidity of 15 to 16 % could be achieved. This would impact on energy consumption of air-conditioning by about 25 to 30%<sup>[16]</sup>. Application of these can be thought for Museums, Exhibition Centers, Theatres and the like.



*Hydro-ceramic roofing tiles* <sup>[16]</sup>  
 Courtesy of IAAC Institute for Advanced  
 Architecture of Catalonia



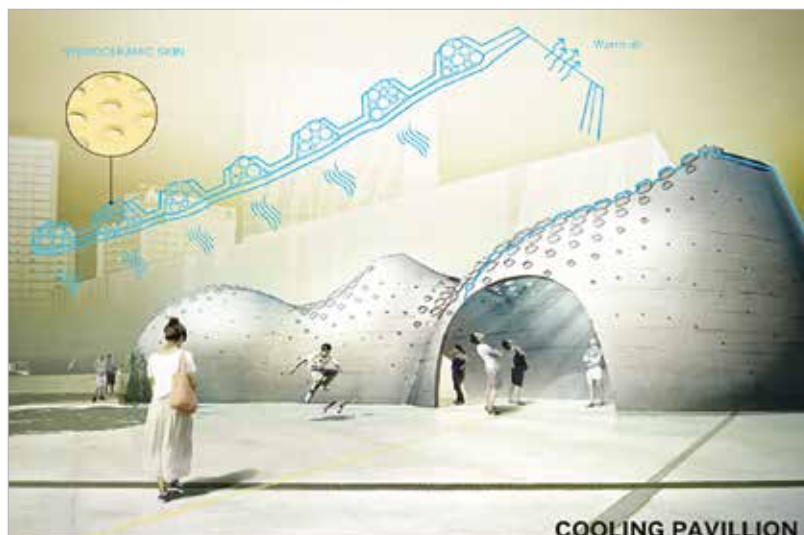
*Typical Hydro-ceramic tile parts* <sup>[16]</sup>

## SMART CEMENTS

### Electrical Energy Conducting Cement

Electrical energies consumption is high in modern days and mainly produced from natural resources like coal and gas. To reduce demand on natural resources there is worldwide need to capture green energy. Therefore, researches have been conducted to find new ways of generating energy and reduce the demand on conventional energy sources like coal, gas and nuclear energy. One such research carried out by Professor Mohamed Saafi of Lancaster University <sup>[17]</sup> was to use concrete structure to generate energy using special cement mixture

consisting of potassium Geopolymetric (KGP) composite, fly ash and alkaline solution. When these chemicals are mixed, they form cement material, containing potassium ions that act as the electrolyte. Research concluded that this special cement mixture could store and discharge electricity between 200 to 500W/m<sup>2</sup> area. Large structures built with KGP can be used to store excess renewable energy and release when demand is increases for grid balancing. Use of this cement in road curb stones could provide power to sensors capable of monitoring, drainage water flow, traffic flow and pollution levels. Movement of potassium ions in the structure will alter if there is a crack developed in the structure. Therefore, this smart cement can be used to monitor mechanical stresses, development of cracks and health condition of the structure.



*Hydroceramic roofing tiles- working concept* <sup>[16]</sup>



*Light emitting cement used in road construction<sup>[19,20]</sup>  
Courtesy of buildersmart.in/blogs*



*Light emitting cement used in ceiling of building floor<sup>[19]</sup>*

**LIGHT GENERATING CEMENT**

This smart material developed at University of Saint Nicholas Mexico by Rubio Avalos<sup>[18,19,20]</sup>, is a phosphorescent material, which absorbs light energy from sun or from lamps in case of indoor use. Later during night time, it releases stored energy in the form of light and reduces demand on thermal energy. As this material works on sun light energy, it can be used most effectively as road signs, road safety marking and process plants platforms in remote area where there is no access to electricity. It can also be used within buildings, building facades, parking lots, bath rooms and swimming pools. This material is prepared using process of polycondensation of silica, river sand, industrial waste, alkali and water at normal temperature. In addition, special admixtures are added to create a gel like micro structure within the cement matrix, which allows sun or other light to pass through and absorb within the cement matrix and later return to the environment as light. The durability of light-emitting cement is estimated to be greater than 100 years, it is inorganic in nature, and its material components are easily recyclable.

**CONCLUSION**

The construction industry will be looking for sustainable materials. Many research and development activities are taking place around the world for new sustainable construction materials. Mass timber is one of the new sustainable materials and many research works have been carried out worldwide to use the material in large scale building projects. American and Canadian standards have introduced design provisions or guidelines in their national standards. International Building Code (IBC) has also given guidelines for design of mass timber structures. Advantages of cross laminated timber (CLT) is that, it is lighter than concrete or steel material and well suited for prefabrication in larger size and promotes faster construction. Therefore, in future India may also look forward for buildings built using CLT and hence Indian engineering institutes can take up research work in the joining philosophy, leak proof joints, and establishing the design criteria.

Self-healing materials is another sustainable material as it reduces the demand of repairable materials for concrete structures. This can be effectively used for concrete structures where the structure is more exposed to atmosphere and durability is important.

Air Cleaning Bricks, Passive Cooling Ceramics and Smart Cements are another set of sustainable materials as they reduce the building energy demand for air-conditioning and lighting.

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## FUTURE OF BUILDING TECHNOLOGY USING NEW MATERIALS



**S K Kak**

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### Abstract

*Building Construction Technologies have been continuously evolving over centuries to meet the needs, demands and requirements of the human societies over the civilizational march. In the beginning buildings used the available natural materials, but as the required material properties outgrew those of the natural materials it promoted development of new materials to suit the design processes and sustainability requirements throwing challenges to material scientists also. Architectural and Engineering design, construction costs, energy efficiency in construction and operations, environmental impacts and maintenance challenges during the building lifetime, utilities used, safety and security of the occupants have spurred novel thinking for smart solutions to meet these multiple constraints.*

### VIEWPOINT

Building techniques and materials used for constructing them have been the corner stone of the human civilization since the dawn of social life over the past thousands of years. The need and urge to create protective shelter against weather, natural predators and elements gradually became secondary to the desire for comfort and modern living. The migration from cave shelters to multi-storey buildings is the history of both, human needs and wants.

Building constructions have always used layers of materials like logs of wood, stones, bricks – compacted and fired, with the binding materials varying from mud, lime mortar and later Portland cement for creating structures that rise layer by layer in the vertical direction. The walls, floors and stairs constructed by this process also have additional add-ons of other materials as embedded objects like Doors, windows and cupboards for providing the required access and décor. While stones and burnt bricks have been used over thousands of years the invention of Portland cement changed the ability to create stronger, larger and more elegant structures due to its ease of use, binding strength and durability <sup>[1]</sup>.

However, as the need for high rise, high density and higher accommodation for larger number of residents emerged the simpler Burnt Brick structures were replaced by concrete frame structures that could be reinforced with steel to overcome the weakness of cement, its crumbling and tensile strength. The next remarkable evolution was when Glass, Aluminium, Cement and Steel became the prime materials for new era building design and construction with number of floors going up to hundred plus.

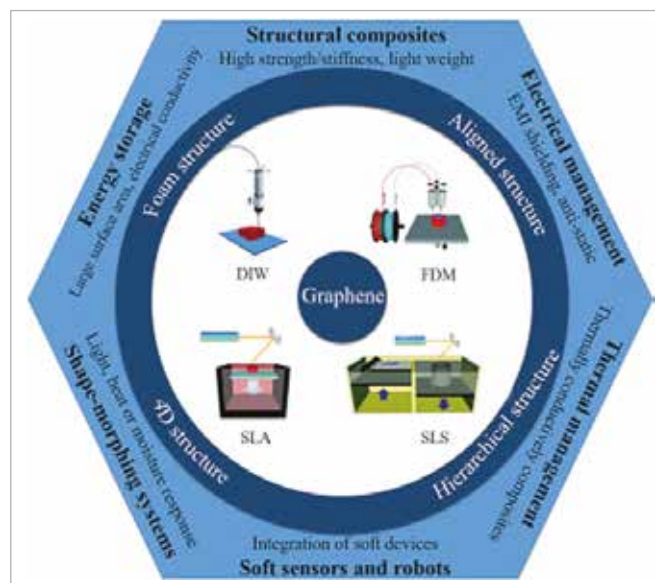
The building construction Industry has been constantly working at ways and materials <sup>[2]</sup> to reduce the construction costs, material wastage, ecological impact and construction time while improving sustainability of the constructed structure. The emergence of lean manufacturing for meeting these desired goals soon graduated to using prefabricated structures that could be mass produced and assembled on site to create the required structure, this was responsible for reducing construction time and even costs, but the material wastage remained high and even partially increased.

Constructing mega structures with hundred stories or more became so specialized due to requirement of analysing effects of vibrations, earthquakes, wind shear and temperature gradients inside and outside the building, for its stability, durability and operational life [3]. The cost of operating, servicing, maintaining and flexibly using these building emerged and continue to be important aspects of design. These new goals are vital to extend the life of the buildings to recover the extremely high construction costs coupled with the formidable maintenance costs of utilities like energy, water, sewage handling and lifts required for operating them.

The designers soon started thinking of innovative ways to reduce energy consumption for lighting, cleaning, transporting using lifts and escalators by use of smart techniques and on demand services while handling wear and damage to the structure by protective coatings and self-sealing materials. The desire to design, create and operate buildings that can be more efficient in energy use, wear resistant and locomotion wise efficient were thus the new goals in selecting materials, construction techniques and architectural design. This is now giving birth to structural use of Photochromatic Photovoltaic sandwich glass for electricity generation, environmental smart controls, self-healing and self-repairing systems that use special next generation materials, new construction techniques and programmable re-organizing structures for achieving flexibility of use [4, 5]. The need for self-isolation barriers, auto evacuation mechanisms like slides and other escape shoots for emergencies like in case of fire are becoming vital for meeting safety standards, these again use completely new kind of fibre glass composites [6].

The newer problems of access control, safety and security of the residents and entry management has demanded use of multi-spectral tracking cameras, face recognition and smart lifts that need in certain cases thumb print, palm print or even voice print to allow passengers inside. The ability to provide high level of intranet and internet communication, lighting and multimedia entertainment in the common areas, being activated by person movement to improve energy efficiency, spectral reuse, access regulation and intruder detection by use of high-end AI and ML techniques.

Manufacturing of structures that are needed for emergency mass production and deployment as in case of natural disaster and can be replicated by using computerized algorithmic processes have been developed through using 3DCP (3 Dimensional Concrete Printing) refer Figure 2. This novel manufacturing process has been under evolution for the past few years and is now being tried in many countries though still at preliminary stage and for various purposes of complex shapes, fast mass scale shelters and smart building construction. It basically uses a Robotic Gantry arm controlled and guided by a computer that has at the end a nozzle which can lay cement mix in a pre-



**Figure 1:** Six dimensional aspects of Materials, Design Techniques and Construction Technologies.



**Figure 2:** S3DCP (3 Dimensional Concrete Printing)

programmed layered manner as per the architectural shape that is to be achieved by the special software to convert the building design into slices of concrete that are then over laid in a progressive manner. One can understand that the structural design of the required building once made is converted into layers that can be printed by the 3DCP and using visual, proximity and thickness sensors and handled by the robotic arm as per the ML operational algorithm. The main advantage is almost complete elimination of material wastage, no need of moulds or scaffolding and high speed of construction, added to that is the ability to create complex geometries with reduced cost of the final structure [7].

**CONCLUSION**

Building construction techniques are becoming more efficient, resulting in reduction in costs of construction, operational overheads and, maintenance regime and security by using highly sophisticated and specialized materials, processes and designs to meet the new operational efficiency standards while providing a high quality of life for the occupants by ensuring services at the optimal state even under adverse climatic, safety and utility costs.



*Kooky Cubby was designed by FMSA Architecture and manufactured with 3D printing technology developed by the Architectural Robotics Lab at RMIT University. While the details and specifications remain undisclosed, the structure can be bid on starting at \$6,000.*

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## THE GROWING USE OF NANOTECHNOLOGY IN THE BUILT ENVIRONMENT



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### 1.0 INTRODUCTION

Rapid industrialisation after 1800s has led to many of the world's current environmental problems like, overcrowding, climate change, unsafe levels of pollution and toxins in the air, water and soil and consequently into food chain, the depletion of fishing stocks, high mounds of waste on land and in large areas in the ocean, loss of biodiversity, and deforestation. However, the 4th Industrial revolution or Industry 4.0 promises a sustainable future for all by leapfrogging traditional developments and ushering in fastest-ever technological disruptions like artificial intelligence (AI), robotics, advanced materials (including nano materials), 3D printing, block chains and biotechnology, the Internet of things (IoT), autonomous vehicles and drones. Though 3D printing, robotics, block chains and drones are already in use or close to deployment others like advanced materials, autonomous vehicles, biotechnologies, AI, etc. are in the various stages of development and testing. However, the question raised in the World Economic Forum in Davos was that whether we ready for this type of Technological revolution? This paper delves into the world of advanced nanomaterials and studies their impact on the construction industry vis-à-vis the built environment in India and abroad.

There are many applications of nanotechnology in building construction. It has given a new dimension for construction materials with its unique and amazing properties. However, this technology is not at all new and has its footprints in Ajanta Paintings, Tipu Sultan's Damascus Sword, and others. Various nano materials are used in building products depending on their applications. As per existing literatures, among the most important nano materials that can be mentioned are titanium dioxide, silver, silicon dioxide, calcium silicate, and aluminum phosphate and carbon nano tubes.



**Figure 1: Energy-Efficient House of the Future [1]**

Titanium dioxide (TiO<sub>2</sub>) is found in 58% of all nanotechnology products in the field of building. Increasing mechanical properties of the samples in the main structures, waterproofing application on internal and external surface of the buildings, prevention of dirt, UV-resistance, production of strengthened, self-repair and self-cleaning concrete, fireproof and self-cleaning glass and energy saving glass are the most important applications of these nano particles in building industry.

Nano silica (SiO<sub>2</sub>) possesses a high share of nanotechnology-based building products by having a share of 21%. The use of nano silica decreases the viscosity of cement mortar which results in a decrease in water consumption. Based on studies, silicone chains are created in the nano metric structure of cement with various lengths. The length of the chains is very important in the stability of cement. Fireproof glass is another achievement of nanotechnology in the field of building industry. This product is produced by adding a transparent layer of silica nano particles between the two sheets of glass. When the glass becomes warm, the transparent layer turns into a hard, dark and fireproof coating.

Nanotechnology has thus made the tasks of architects and engineers easier by introducing construction materials such as seismic wallpaper, thermal insulation and additives which are easy to use and can aid in improving the durability, and structural integrity of our infrastructure. China and Germany are the two leading countries in the production of nanotechnology-based products in the field of building industry; according to the statistics published by Statnano Database website. They are said to have possess a share of 30% and 25% of all nanotechnology-based building products in the global market, with Shanghai huzheng Co. alone producing 44 products. It is followed by USA (19%), Switzerland (6%), Greece (5%), Poland (5%), Singapore (3%), Finland (2%) and Denmark (1%). Surprisingly, India the 5th largest economy and 3rd in terms of GDP, stands nowhere in either active nano technological research or product development.

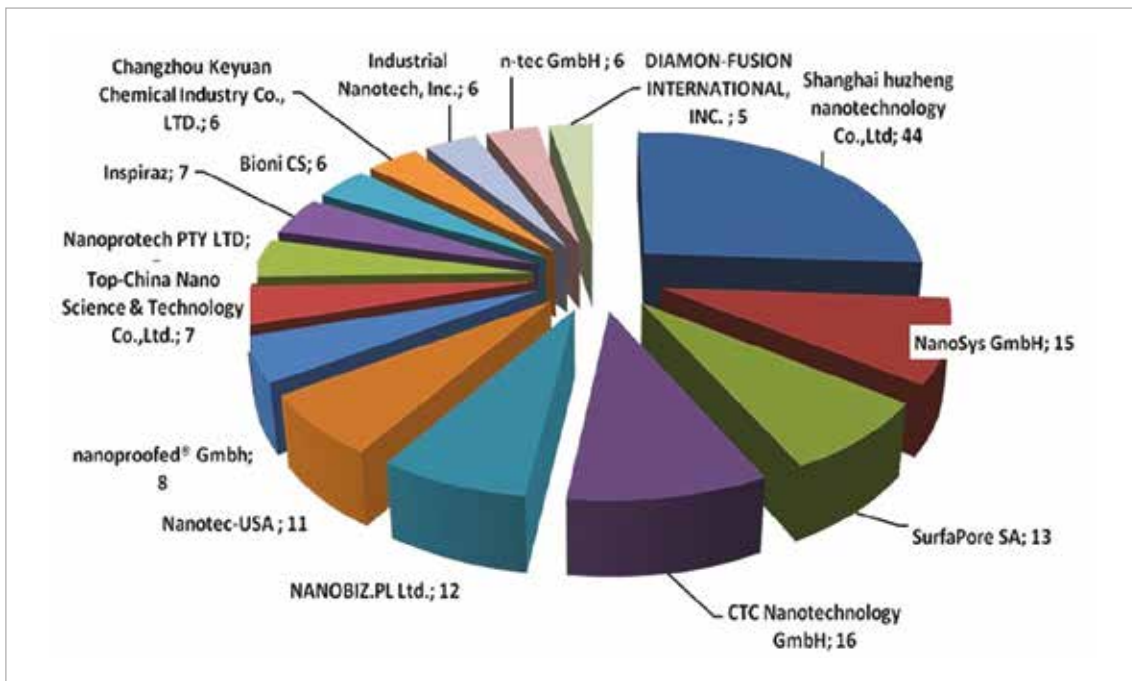


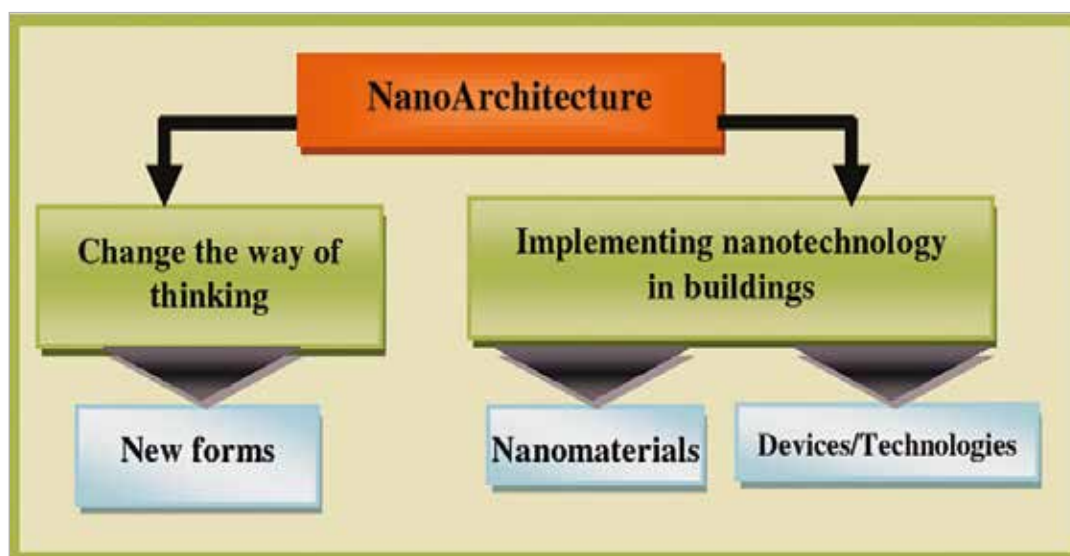
Figure 2: Most Active Enterprises in the Production of Nanotechnology-Based Building Products [5]

## 2.0 NANOTECHNOLOGY: GLOBAL DEVELOPMENT STORY

The manifestations of globalization are many sky scrappers for company headquarters and bank buildings, standardized hotel chains, franchise restaurants, shopping malls, name-brand stores and boutiques, speciality & multi-speciality hospitals, theme parks, fitness centers and multi-screen cinemas. The predominance of load bearing structures of the 19<sup>th</sup> century gave away to reinforced concrete construction (RCC) structures which dominated the whole of 20<sup>th</sup> century with some steel structures. Globalization has brought along new architectural trends which incorporate sustainability and the role of technology in it. With its buzzword ‘from micro to nano’ nanotechnology

is the continuation of the miniature revolution that was initiated with the discovery of sophisticated microscopes in the later part of the 20<sup>th</sup> century. Because of the opportunity it provides in creating new features in wide ranging applications, nanotechnology is already providing solutions to long-standing medical, social and environmental problems attracting more funding than any other technological areas with an unbeatable patent processing record but the problem with it is that it can't be made in isolation and requires team effort with people from multi-disciplinary fields like physics, chemistry, biology, engineering and medicine working together.

Technology plays an important role in globalization thus making our world a smaller and better place to live in. At the end of 20<sup>th</sup> century, nanotechnology, manipulation of matter at the atomic level made a leap from science fiction (Star Trek, Spiderman, etc.) to reality, with governments and industry around the globe began focusing on its anticipated economic benefits. One important impact is that nanotechnology may reinforce and magnify the already existing disparities between the rich and the poor. On the other hand it may also reduce the disparity by making things more affordable over a period of time. It is contemplated that like the digital divide that has accompanied with the introduction of ICT and computers, it is very likely that with differential rates of diffusion of these technologies, there will be 'nano divide'- nano have & have not countries. Some promoters of nanotechnology however, argue that scientific advances in this field will bring an end to material scarcity like wood or oil, due to the ability to synthesize similar materials. Discoveries in this domain would also lead to intense competition in acquiring patents and intellectual property rights amongst the nations reinforcing the concept of liberalization with MNCs continuing to play a strong role in shaping global policies in the matter of trade, relations and policy.



**Figure 3: Nanoarchitecture: Nanotechnology in Buildings** <sup>[2]</sup>

There are numerous examples of nanotechnology products moving from simple to complex. From the simple dirt repellent nano-coatings we have moved towards mobile phones which dramatically have become smaller & smaller but cleverer, faster & cheaper. The applications of nanotechnology are numerous and can be found in medicine, textiles, industry, communications, transportation, architecture and engineering. Nano functions can be effectively used in the interiors of commercial buildings as shown in Fig.4 for a Hotel Room or Office Room or also Hospital Room but strategically after studying their cost-benefit analysis as improved comfort and cost-effectiveness go hand in hand.

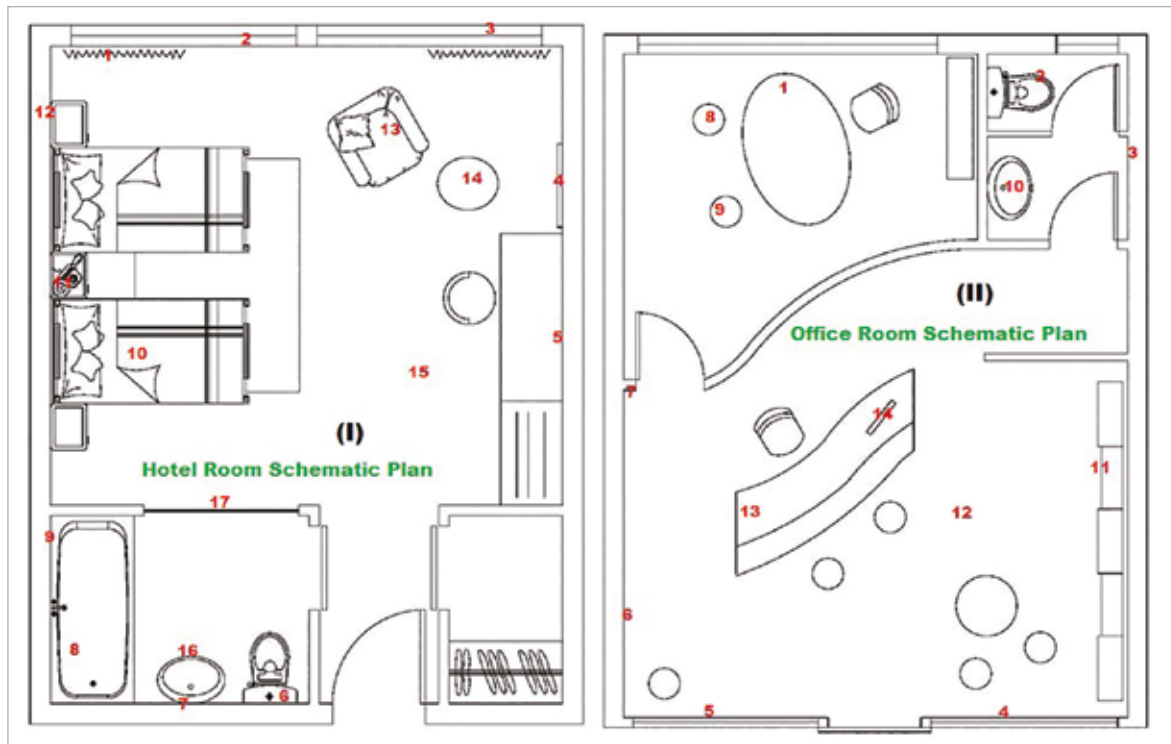


Figure 4: Schematic Plans of Hotel & Office Room for strategic use of Nanomaterials

(I) For Hotel Room	(II) For Office Room
Curtains: Air-purifying	01-Glass Table: Anti-fingerprints
Windows: Self cleaning photocatalytic	02-W.C.: Easy to clean
Windows: Self cleaning photochromatic or electrochromic	03-Walls: Nanoparticles ceramic covering
TV: Anti reflective	04-Windows: Self cleaning photochromatic or electrochromic
Wall Paint: Air-purifying	05-Windows: Self cleaning photocatalytic
W.C.: Easy to clean	06- Walls: Nanoparticles ceramic covering
Mirror: Anti-fogging	07-Switches & Handles: Anti-bacterial, non-stick
Bath tub & Shower screen: Easy to clean, non-stick	08-Chairs: Dirt-repellant
Walls: Nanoparticles ceramic covering	09-Upholstery: Air-purifying
Bedding: Anti-bacterial	10- Sanitaryware: Anti-fingerprints
Light Switches: Anti-bacterial, non-stick	11-Screen:Anti-reflective
Wall Paint: Air-purifying	12-Carpet: Air-purifying
Upholstery: Air-purifying	13-Counter: Anti-fingerprints
Glass Table: Anti-fingerprints	14-Screen: Anti-reflective
Carpet: Air-purifying	----
Sanitaryware: Anti-fingerprints	----
Frosted Glass: Anti-fingerprints	

With the increasing availability of nanotechnological consumer products worldwide, it was a general expectation that the public at large would be rather familiar with the term ‘nanotechnology’ and understand what it means. Though companies using nanotechnology often deny using them to their end-customers and thus in the midst of this accelerating commercialization, public worldwide remain largely in dark about nanotechnology perhaps due to fear of things they can’t visualize or perceive. Major studies in USA, Europe, Canada and even China have shown that majority of public has heard little or nothing about nanotechnology. What is even more surprising is that they have little or no faith in their government’s ability to manage the potential risks posed by nanotechnology. See what havoc nanoparticles like Coronavirus are playing in the world today with governments as mute spectators.

**Table 1. Nano-enabled construction products identified in the UK <sup>[3]</sup>**

Type	Number	Nanomaterials commonly used (bracketed entries less common)
Coatings	70	Silica, titanium, silver (CNTs)
Glass	23	Metal oxides
Concrete	22	Silica, titanium (CNTs)
Steel	11	Nanostructured
Insulation	10	Silica aerogels
Composites	1	(CNTs, nanoclays)
Other(roofs, floors)	19	Titanium, aluminium

### 3.0 NANOTECHNOLOGY: INDIA’S STORY

The micro-electronics revolution which occurred during 1970-80s failed to take off in India due to its then underdeveloped science and technological scenario. After the advent of liberalization-privatization-globalization in 1990s, the nation came to know of this nanotechnology but the government took no interest to develop it. However, in 2001, Nano Science & Technology Initiative (NSTI) was started under the nodal agency of the Department of Science and Technology (DST) of the Ministry of Science with a meager initial budget of only Rs.6 crores in the 11<sup>th</sup> - 5 Year Plan though the budget outlay for DST was Rs.20,000 crores. This was when private organisations like Reliance, Tata and a few other players had already made more investments in nanotechnological research.

In 2004, under the then President Dr. A.P.J.Abdul Kalam, a workforce was formed and in 2007 a Nano Mission was established in India with a budget of Rs.1,000 Cr. with 19 Centres of Excellence were established for research, development and applications of nanotechnology under the mission. That ‘nano-mission’ has been working to help scientists, institutions-industry interface in terms of promoting basic research, development of adequate manpower resources, international collaborations, augmentation of the infrastructure for research and generation of socially useful products. This nano-mission has resulted in about 5000 research papers and some useful products like nano hydrogel based eye drops, pesticide removal technology for drinking water, water filters for arsenic and fluoride removal and nano silver based antimicrobial textile coating.

India has been able to rank amongst the top 5 countries in the world for Scientific Publications in Nanoscience & Technology due to the efforts led by the Nano Mission. The Nano Mission has established national dialogues to promote R&D in the development of standards for nanotechnology and for laying down a National Regulatory Framework Road-Map for Nanotechnology (NRFR-Nanotech). The Department of Science and Technology and the Science and Engineering Research Board (SERB) called for a Short-term Research Grant for Antiviral Nano Coating COVID-19 in April 2020 to combat the pandemic.

The budget for Nano Mission which has decreased considerably from Rs.1,000 crores in 2007 to Rs.650 crores in 2012 to NIL now, developed physical infrastructure, with the DST, establishing Units on Nano Science, Centres for Nanotechnology, Centre of Computational Materials Science and Thematic Units of Excellence on Computational Material Science in various universities/,IITs and government research centres/ laboratories across the country. As far as human resource development is concerned, the Nano Mission has launched PG programmes (M.Sc and M.Tech in Nano science and Nanotechnology) at various universities and colleges all across India. The **Niti Aayog** which replaced the Planning Commission is completely silent on nanotechnology, except in one area, as expressed in its strategy paper, *New India @ 75: 'Foreign collaborators, consultants, visiting faculty, adjunct scientists, etc., need to be involved in pursuing R&D in the emerging areas of basic sciences such as **nano-technology**, etc. DST, in collaboration with Indian Missions abroad, may identify discipline wise foreign experts who can collaborate with Indian scientists to take basic research in these areas to the next level'*.

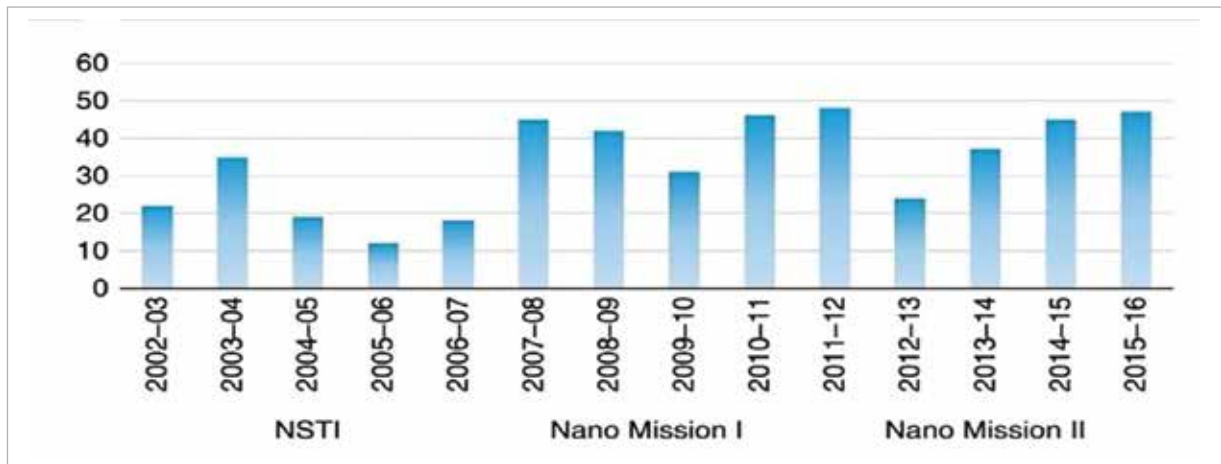


Figure 5: Government-led nanotechnology projects sanctioned in India since 2002<sup>[4]</sup>

#### 4.0 SUMMARY AND CONCLUSIONS

Globalization cannot be simply stopped and the only way countries have gone from being developing to being developed in the past is by unleashing a manufacturing/ industrial revolution albeit remaining self-sufficient of the food front. However, despite having a huge labour force and initiating economic reforms in 1991, India has missed out on the manufacturing revolution. India appears to have shifted from farming to services without having gone through an industrial stage which not only goes against conventional wisdom but also the experience of other fast-growing Asian economies particularly China.

China and other Asian countries (Japan, Taiwan, South Korea and countries of South East Asia) essentially followed an export oriented manufacturing strategy to create economic growth. They started with low-end exports and then gradually started going up the value chain. These economies usually started out by scaling up low-skill exports like making ready-made garments, toys, cheap household items and so on. With time, they all move up the value chain as wages rose and their workforce become more skilled. Their exports shifted to things like high-end electronics and automobiles. In the Indian case, nothing like that happened. After the 1991 economic reforms, India moved on to exporting complex automobile parts and pharmaceuticals. It also exported information technology and became a global hub of the business process outsourcing industry. India also saw a huge expansion in banking, hotels, airlines, cable television, and telecom and so on. None of this was low-end, like was the case of Asian countries as well as China. Hence, it jumped from farming to services, without going through an industrial/ manufacturing stage which saw the country’s largest car-maker Tata failing to increase the sale of Nano and ultimately stop its production though it did very well in the foreign countries.

As far as nanotechnology is concerned there are hardly any codes or standards which holistically address the performance evaluation of nanomaterials in cement concrete apart from the recent report from American Concrete Institute (ACI 241R-17) in 2017. Though the revised National Building Code of India, 2016 addresses nanotechnology/ nanomaterials as sustainable and as alternate building materials. There exists a lack of coherence between the academic field and the industrial requirements and the need for a strategy in the new industry creation in the nanotechnology field, where not only public research institutes, but also existing industries (including SMEs) can participate.

As seen in countries like Japan, China and Europe, to nullify the size disadvantage of nanomaterials and overcome diseconomies of scale, SMEs often utilize the process of technology transfer from public funded R&D institutions [6].

Indian codes such as IS:456-2000 and the revised IS: 10-26-2019 mention Silica fume (with more than 70% having particle size diameter within 100nm range, but they are not marketed as nanomaterials by the manufacturers) for concrete which has been in use for over 30 years and is widely available from most major concrete suppliers and possible UK brands include ‘Chronolia’ (Lafarge), ‘Rapidcrete’ (Breedon), ‘Diamondcrete’ (Aggregate Industries) and ‘Easyflow’ (Hanson). Hence, commercialization of nano-products still remains a challenge. As happens with ny emerging technology the parameters of Strategy + Demand + Policies + Initiatives are needed in sequence but in India does not have any regulatory framework for nanotechnology till now.

The pandemic has given India an opportunity to get on the bus for micro electronics and nanotechnology to boost ‘Make in India’ a success.



*Prof. Sabu Thomas receiving ‘Faculty Research Award’ by Careers 360 for his work on Nanoscience & Nanotechnology from Shri. Prakash Javadekar (Hon’ Union Minister of HRD, Govt.of India) on 20<sup>th</sup> of March 2018 at New Delhi.*

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## USE OF NEW AGE MATERIAL FOR ROOF OF BUILDING – REVIEW OF MATERIALS AND A CASE STUDY



**Manos De**  
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### ABSTRACT

*Design and selection of suitable material for roofing, the top skin of the building, is a specialized science and the rigours of design are in many ways like structural design of the primary framing of a building that resist the loads. The design of the roofing is mostly dominated by consideration of environmental loads like wind, snow, temperature and impact loads. Though failure of the roofing does not impair the safety of the building structure per se, a large portion of the functionality and the complete aesthetics of the building are lost resulting in significant loss of the value of the property. This article presents a comparative study on the aspects of design and selection of material for the reroofing an element for application in special areas especially at great heights. The design team must do a technical assessment of the current products available, select the appropriate product based on functional and other requirements and utilize the best product for a long-lasting solution. Case study for application to a roof structure of the central atrium of a seven-story green office building is also presented as an application case.*

### 1. INTRODUCTION

The roofing system forms the exterior finishing layer that acts as a barrier between the external and internal environment in a building. It performs multiple functions in a building including enhancing the aesthetic views, prevent ingress of external and undesirable materials from entering inside the building and improve the thermal and environmental performance of the building. The roofing elements resist and transfer the loads from wind, heat and impact to the primary load resisting framing system of the building. With the advent of tall building construction, the criticality of design of components of the roofing systems have become even more important.

An important aspect of such a building is to provide an efficient thermal design that would ensure comfortable working conditions inside the building while minimizing the operating cost of the ventilation and air-conditioning systems by reduction of energy consumption. The roof cladding over the central atrium of the building had been designed to both enhance the architectural appeal, while providing natural light and ventilation with the required thermal insulation to maintain the internal environment in the building.

### 2. SELECTION OF SHEETING MATERIAL

Various classes of roofing material are available – red mud plastic roof sheets, red clay roof tiles, fibre reinforced cement sheets, metal roofing systems with steel sheets, aluminium sheets or zinc-aluminium coated steel sheets, fibre reinforced plastic sheets and polycarbonate sheet (Ref. Fig. 1a, 1b). The metal sheets are generally used in industrial structures primarily for strength requirements, are completely opaque to light and do not provide heat insulation unless sandwich sheets with insulation layer are used. The polycarbonate sheeting systems are translucent and are mostly preferred for architectural applications where features like light transmission, façade upliftment, thermal insulation play a more important role in choice of material.



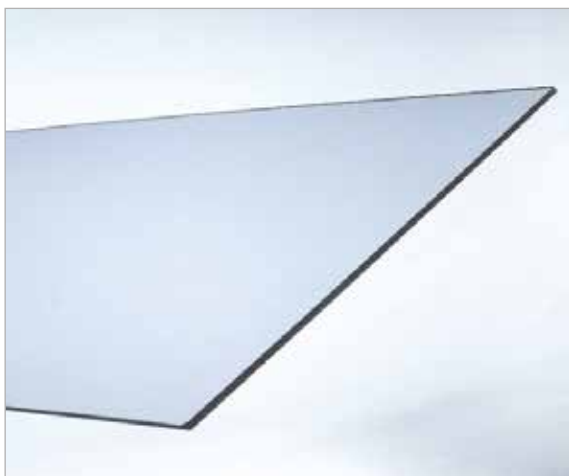
**Figure 1a:** Metal Sheet Roof System



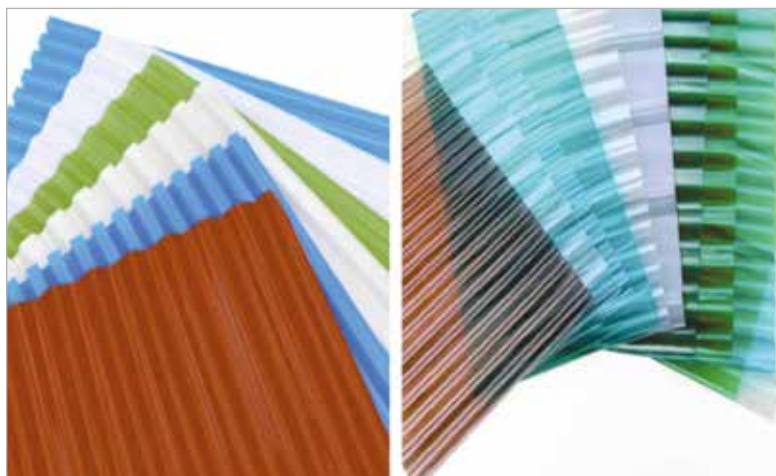
**Figure 1b:** Polycarbonate Sheet Roof System

Amongst the second class of material suitable for architectural applications, various types of materials are available. On the one hand is the embossed solid polycarbonate sheet and the other type includes panels with microcell structure. Solid sheets have been in use for roofing solutions since long time (Fig. 2a). The embossed polycarbonate sheets are fixed using rubber gasket sealing for clamps, silicon sealant for sheet intersection, aluminium angle and sheets for sheet edges. It has been generally found that sealants at joints are the points from where deterioration of the fixing normally originates due to hardening of the sealant. Profiled polycarbonate roof sheets (Fig. 2b) are also very popular in application in industrial buildings and warehouses where they are used in tandem with profiled metal roof sheets. The profiled polycarbonate sheets are used in designated parts of roof and side cladding to provide natural light inside the buildings.

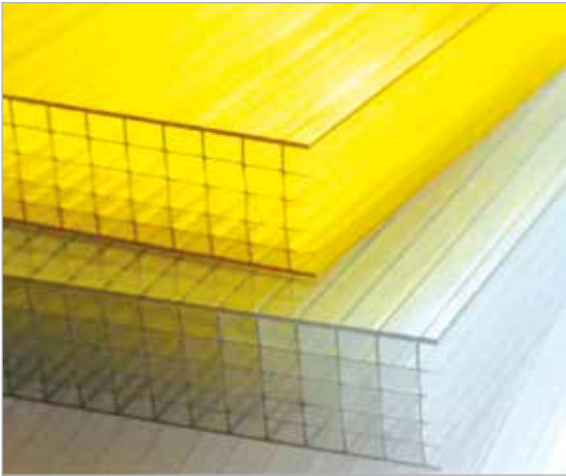
Multi-layered polycarbonate sheeting system is currently gaining wide popularity in installation practice for roofing applications. These systems are also available in different types – multiwall/ multi cellular (Fig. 3a) and multilayered (Fig. 3b), each with its special advantages. These multi-layered polycarbonate sheets are technically superior to the embossed polycarbonate sheet in terms of strength and load carrying capacity and also give better aesthetics with various colour options including dual colours. These sheets provide better thermal insulation due to lower heat transmission factor and lower solar heat gain coefficient compared to plain polycarbonate sheets. Both sheets have an advantage of dry installation using grip locking system without sealants.



**Figure 2a:** Solid Polycarbonate Plain Roof Sheet



**Figure 2b:** Profiled Polycarbonate Roof Sheet



**Figure 3a:** Multicell Polycarbonate Roof Sheet



**Figure 3b:** Multilayer Polycarbonate Roof Sheet

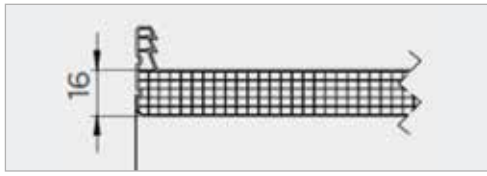
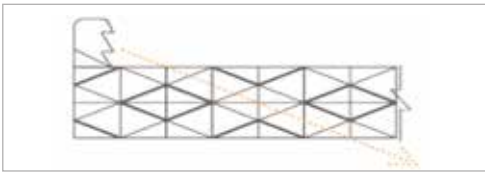
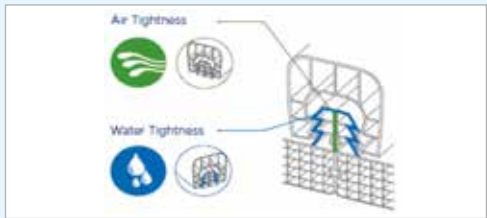
### 3. COMPARATIVE STUDY OF THE POLYCARBONATE SHEETING SYSTEMS

Comparison between Solid Polycarbonate sheets (including profiled shapes) and Multicell/ Multilayer sheets is given in Table-1 which shows the technological advantage of the new material in terms of visual appearance, light diffusion, thermal insulation, durability and weather resistance (Table-1). The micro level technical comparison between two different types of layered structure sheets highlights the advantage of the various products with respect to others to help in choosing suitable material for the specific application (Table-2).

**Table-1: Comparison of Solid Sheets with Layered Structure Sheet**

Property	Solid Polycarbonate Sheet	Layered Structure Sheet
Structure	Solid sheet	Tight multicellular structural matrix
Jointing at seam	Fixed with direct fastening method with washer head screws and sealant. Sealant prone to deterioration by weathering, periodic maintenance required	Modular joint with standing seam. Dry system without sealant.
Heat insulation	Solar heat gain coefficient 0.84	Solar heat gain coefficient 0.50
U-value (W/m <sup>2</sup> /K)	U-value 5.4 results in heat being transferred inside	U-value 1.53 ensures less heat transmission
Soft light	Causes direct glare, difficult to work under skylight	Soft light panels ensure no glare or hot spots
Engineered system	Panel width to be reduced or thickness increased for wind load	Fasteners can be suitably designed for wind speed up to 41m/s
Impact strength	Safety mesh required below sheet to allow person to attend roofing system for maintenance	High impact strength, no safety net required
Colour stability	Turns yellow after 4-5 years, light transmission changes, panel may crack and break	Warranty against colour change for 10 years

Table – 2: Comparison of Multicellular and Multi-layered Structure Sheets

Property	Multicellular Panel Product A	Multi-layered Panel Product B
Profile		
Structure	Rectangular grid of horizontal and vertical panel walls of 4.5mmX4.5mm grid cell structure	Angular truss type structure with combination of opaque and translucent angular and vertical walls
Panel width & length	Width 900mm, length to suit structure profile with maximum length of +15m. One joint with vertical standing seam and grip- lock connector along length for each roof panel.	Width 900 – 1200mm, length to suit structure profile with maximum length of +15m. One joint with vertical standing seam and grip-lock connector along length for each roof panel.
Fastening of end clips to structure	SS expansion fastener and polycarbonate U connectors	HD trapezoidal fasteners with 3mm self-drilling screws with pull out load of 7kN
Load capacity	130 kg/sqm	300 kg/sqm
Impact resistance	25mm hailstone at 21m/s causes no penetration/ breakage	25mm hailstone at 21m/s causes no penetration/ breakage
UV protection	Coextruded UV protection up to 99.9% with transmission less than 0.1%	Coextruded UV protection up to 99.9% with transmission less than 0.1%
Light transmission (see Fig.4a, 4b)	47%	15% - 35%
Solar Heat Gain Coefficient (SHGC)	0.50	0.20 – 0.25
U-value	1.9W/m <sup>2</sup> K	2.5W/m <sup>2</sup> K
Climate compatibility	Designed for temperate European climate and exposure conditions	Designed specifically for tropical Indian climate and exposure conditions
Sourcing	Panel to be imported	Panel manufactured in India
Durability	Sheet manufacturing warranty of 10 years, no warranty on installation.	Sheet manufacturing warranty of 10 years, no warranty on installation.
Jointing of sheets (sheet is fixed with clip which is screwed to steel structure, the upright end seams are joined with the sawed grip locking piece)		Similar grip-lock arrangement.

The comparison of light transmission between products A and B show that the product B with angled walls offer better reduction of light transmission during the entire day for angles of incident sunlight. This gives a more uniform ambience inside the enclosure, free from glare and is advantageous for the use of the space covered by this sheeting.

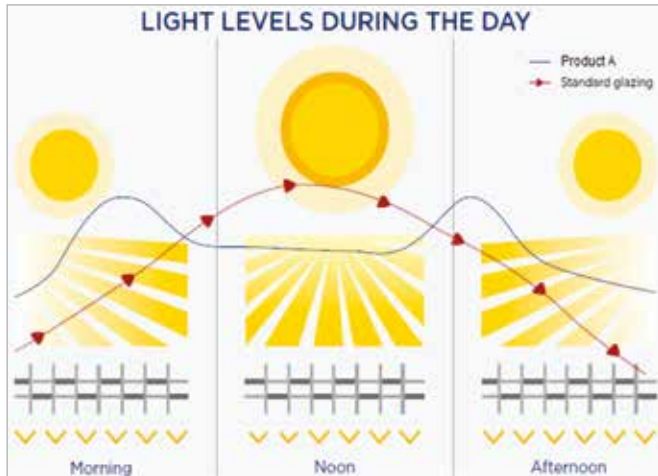


Figure 4a: Daylight Balancing - Product A

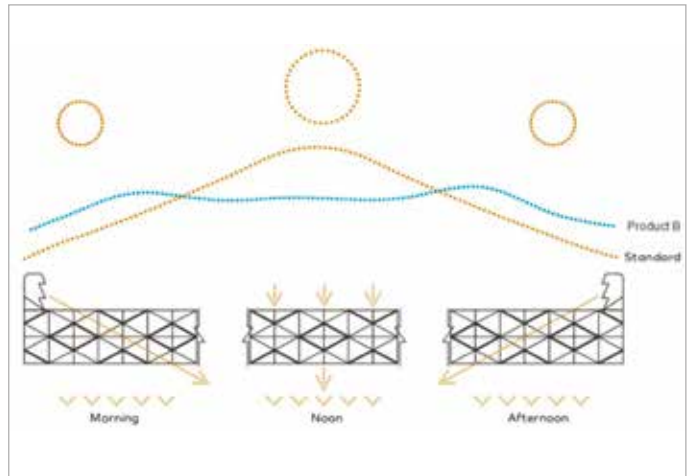


Figure 4b: Daylight Balancing - Product B

Cost comparison of the different types of sheeting material studied was also studied. The material cost of the structured sheets (multicellular/ multi-layered panels) is almost three times the cost of solid polycarbonate sheet but this is compensated by the improved aesthetics, strength parameters, durability, heat transmission and light transmission properties. This new material gives a better lifecycle advantage over the solid sheets by almost doubling the installed life of the sheeting. The costs of multiwall and multi-layer polycarbonate sheets were comparable with a difference of around 2%.

#### 4. CASE STUDY FOR APPLICATION OF POLYCARBONATE SHEETING

The office building is an iconic architecture that had been designed based on the principles of green building design employing state of the art materials and principles. The central atrium roof is formed of translucent sheeting for daylight installed over a truss type steel roof structure and also provide natural ventilation. The installation was done about a decade ago. The approximate covered area of the roof is 380 sqm. The roof sheet used was 3mm bronze solid polycarbonate sheet. During the service life of the building which is in the proximity of an industrial area, the sheets have been subjected to weathering action by atmospheric elements including industrial dust and had been showing signs of distress. The sheeting in some panels had developed cracks and pieces had broken away leaving openings through which rain water was entering onto the atrium floor at ground level causing nuisance and unsafe conditions for users.

The roof structure over the atrium is in the form of curved roof truss system with 11 frames with alternate braced panels arranged in stepped fashion. On plan the frame system is tapered with the north end having larger span than the south end.

## 5. TECHNO-COMMERCIAL EVALUATION OF THE SHEETING MATERIAL

Detail technical evaluation of the various alternative material was carried out along with commercial terms. Replacing with solid polycarbonate sheets was ruled out since it did not meet technical requirements and for supply related issues. The other two types of materials for which comparison table is given in the preceding section shows that the two products are almost similar and technically equivalent. The multilayer item has better aesthetics and lower SHGC and light transmission. No change in roof structure was required even with the change in the sheeting material due to its superior forming and load carrying capacity.

Use of polycarbonate roof sheets has been increasing in India for providing transparent roofing solutions in greenhouses, conservatories, pergola, skylights, awnings and carports. These sheets have multiple benefits over traditional materials like glass, fiberglass and acrylic. Polycarbonate sheets are many times more durable than glass but are much lighter and bendable to various shapes making them convenient to handle and install. The multi-layered sheets with coloured angular slat options greatly improve aesthetics of the structure. Polycarbonate sheets also provide good thermal insulation and UV resistance due to the coating provided on the sheet.

The sheets after installation are almost maintenance free and can get self-cleaned with washing by rain water. Periodic cleaning when required is done with soap solution and water. The panels are made with low environmental footprint processes and are 100% recyclable. The excellent thermal insulation and daylight admittance properties reduce electricity consumption in buildings for lighting and ventilation requirements thus reducing carbon footprint of the building in operation.

The connectors are specifically designed to ensure leakproof joints and achieve long span so that there no transverse joints. In this case long spans of more than 15metres could be covered with single piece of sheet. The dry joints also allow better thermal expansion thus reducing the temperature related stresses which tend to cause cracks and opening of joints with sealants. The double notched design of the upstand seam ensures complete air and water tightness.

## 6. VENDOR SELECTION AND INSTALLATION

It was seen from the study that selection of sheeting for an iconic architectural building, both at initial design stage and during its service when the life of the original material is exhausted can be a technically challenging task.

There are multiple suppliers for both multicellular and multi-layered type of products in India. These include manufacturers like SABIC under the brand name LEXAN, TUFLITE, SUNLITE from PALRAM, 3DLITE from DANPALON, POLYCARB by Gallina, ROOFLIGHT by Everest Industries, FLUX by DPI Daylighting, DUROTUFF by Power Chem Plast Limited, Bansal Roofing Products, PC LITE by MG Polyplast, Multiwall Polycarbonate sheets from Lotus Roofing.

The final selection of vendor for the works was based both on technical superiority of the new material and the benefits offered in terms of longer installed life. Another important factor considered was the local manufacturing capability of the chosen vendor. Some of the vendors provide imported material and this was perceived as a risk both at supply stage and later after installation in case any maintenance would be required.

The chosen vendor had already successfully installed similar roofing solutions at other sites including airport roofs, stadium roofs, roofs on institutional and commercial buildings, hospitals, industrial sheds, skywalks, and bus shelters.

The installation was done by a team of experts from the manufacturer to ensure that the correct installation technique and materials were used. The installation process itself was simple with the dry upstand seam jointing without requirement of washers and sealants. The system has stood the performance test of heavy monsoon showers without any leakage at the joints.

### 7. CONCLUSION

It is seen from this study that selection of sheeting for an iconic building, both at initial design stage and during its service when the life of the original material is exhausted can be a technically challenging task. The specific case was particularly complex since the concepts of green building design had to be preserved but the material used in the original design was not available. However, diligent study and critical review of technical parameters of the new material available provided the desired solution that met the performance requirement of the roofing to preserve the internal environment of the building.

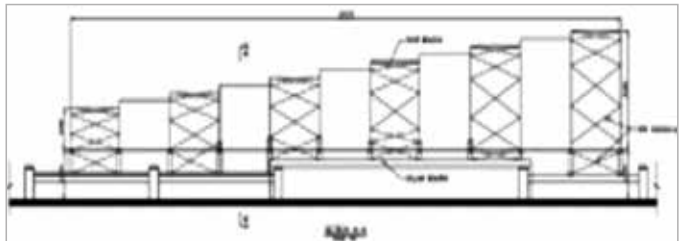
### 8. ACKNOWLEDGEMENTS

The author gratefully acknowledges the information shared by the vendors regarding technical details and installation practices for the work execution carried out at the office building of Tata Consulting Engineers Limited, Jamshedpur. Information from technical brochures of the manufacturers and publicly available information about the products available from internet is also acknowledged.

### 9. DRAWINGS AND PHOTOGRAPHS



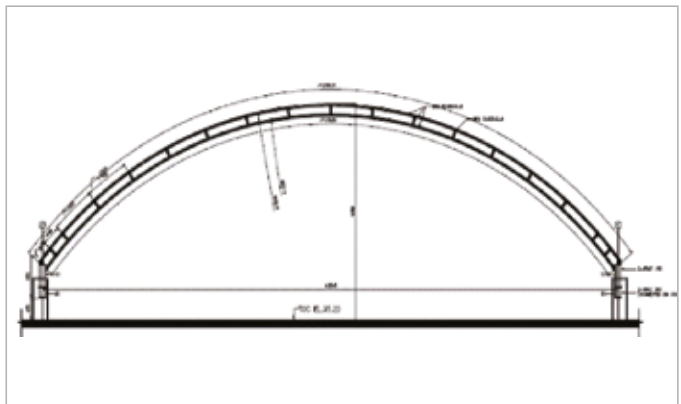
*Atrium roof structure*



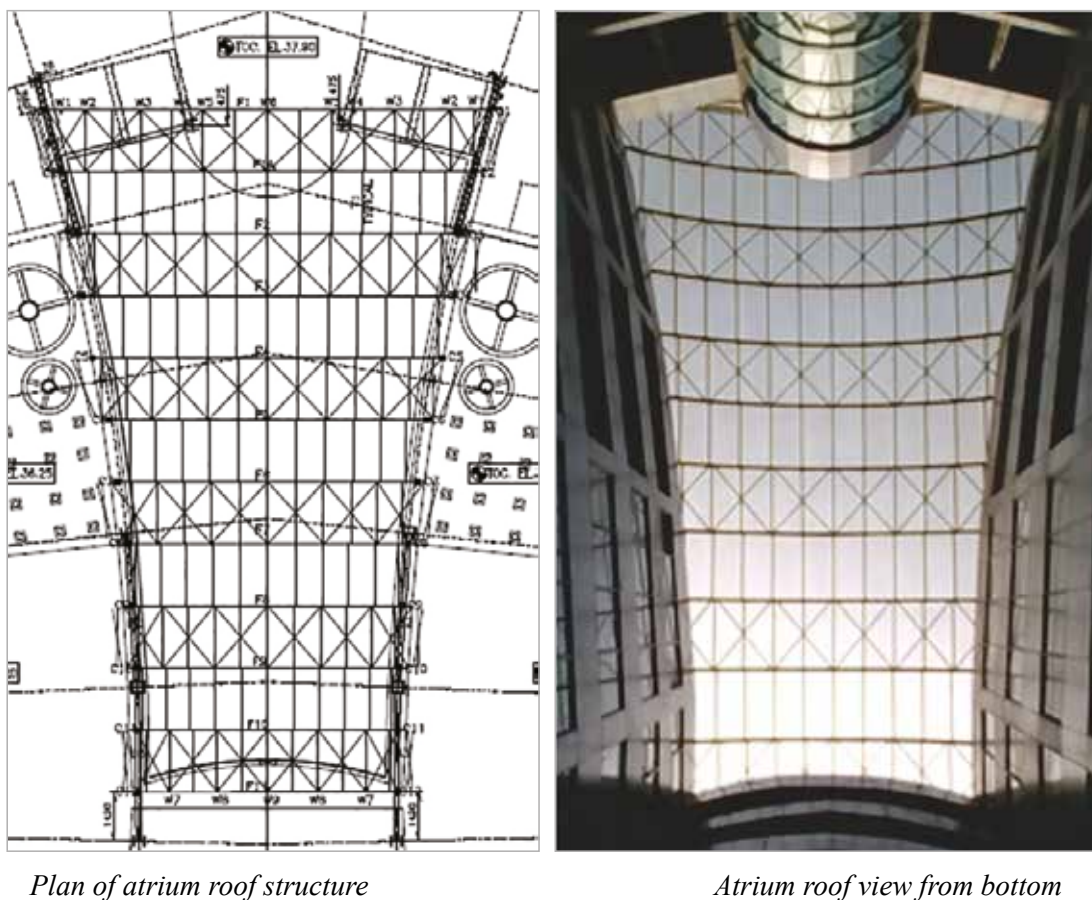
*Long section of roof structure*



*View of atrium roof*



*Cross section of typical roof frame*



*Plan of atrium roof structure*

*Atrium roof view from bottom*

**Figure 5:** Drawings of structure and site photographs

## REFERENCES

- 1 Structure drawings of Atrium Roof of Tata Consulting Engineers office at Jamshedpur
- 2 Vendors' Technical Data Sheets and Price Quotations
- 3 Vendor Installation Guides

### **“Bright” Green Buildings**

The intent of this research is to provide documented evidence and build tools that can be used to educate and influence end-users, building owners, architects, and contractors that a “greener building” can be achieved using intelligent technology, and will provide a tangible and significant return on investment. This concept – intelligent, green, and profitable – is what we call a bright green building.

This research identifies the exciting developments taking place on the technology front and analyses their implications for intelligent and green buildings, highlighting examples of “best in class” buildings employing green and intelligent technologies. These buildings are dynamic environments that respond to their occupants’ changing needs and lifestyles.

**Source:** *Bright+Green+Buildings\_CABA.pdf*; <http://www.caba.org/brightgreen>

## BUILDING SERVICES DESIGN TO PREVENT THE SPREAD OF COVID19



**Er. Ronald Valledor Gomeseria**

*PE MCEAI PEng, CEng, CEnv, CBuildE, ASEANEng, ACPE, APEC (IntPE) Master of Environment & Natural Resources Management Master of Science in Construction Management Ph.D. in Building and Construction Engineering Ph.D. in Environmental Engineering (Ongoing) Gomeseria Consultancy/ MEP Environmental Consultant*

### INSIGHT

As a Engineering, Environmentalist & Healthcare Professional (PE/ CEnv), the COVID19 pandemic around the world raises questions in the author's philosophical adventure on how this pandemic would be controlled in a manner that would prevent the virus spread within the airstream whenever the infected person is present in that place, especially within the uncontrolled air movement in the built environment which would become dangerous due to transmission and lockdown.

The author's suggestions for the built environmental system design is based on practical experience in the building services, however, other professionals could also contribute.

Building Services are essential elements for the designs of Life Safety by providing a healthy environment. The author's article, "*Building Services in the Environmental Landscape*," CEAI ViewPoint, March 2020 discussed the building environmental perspective from design, construction, implementation, and innovation stages for a high-performance building. The same concepts are used to suggest how to contain the transmission impact of a viral infection.

The proposed building services design process is similar to the healthcare engineering requirement as discussed in the author's article, "*Importance of Remote Sensing and Monitoring in the Engineering Projects*;" CEAI ViewPoint, March 2019 dealing with the importance of Remote Sensing and Remote Monitoring within a built environment.

The HVAC system design which primarily deals with the environmental aspects that provide the air for breathing and enables the building's health and life safety. The ventilation systems run throughout room spaces and draw-off uncirculated air outside the building thus positively impacting the working spaces.

A careful design study would enable taking care of how to deal with a pandemic or similar situation as is occurring today. The airborne transmission can be experienced much more in healthcare facilities which need to be designed as per requirements similar to that of isolation rooms. The lesson from the spread of viruses within the environment unconsciously is to strategically apply the principles applied in a healthcare facility to be also used in the residential, commercial' industrial, and other facilities as well.

### 2. SPREAD OF COVID19

It is surprising that the COVID19 (coronavirus) outbreak started in Wuhan, China in November 2019 but was declared a pandemic months later. Till then, those in the know perhaps thought that it would just blow over. In retrospect, there were lapses that humanity cannot easily forgive nor forget. Some of the reasons of how it spread and the possible implications of its spreading are given below:

- Ignorance about what the virus is, and the repercussion of poor people and facility management, unknowingly allowed all the infected people that were positive cases to act as carriers to travel from country to country without any medical check-up or check of traveler's background history and traces or having quarantine procedure in place, etc. when the COVID19 spread became known.
- The HVAC systems designed for an airport facility, a controlled environment, for human comfort could also harbour the virus and carry it from one area to another thus resulting in transmission to others.
- Aircraft and other people-movers with the controlled environment would be a major source of transmitting the virus again because of air circulation in a closed environment.
- At the destination after the passengers disembark, the problem is to have facilities to provide proper health checks, recording, tracing, and monitoring systems so that each and every passenger is monitored.
- Research studies conducted by the country's government investigational sources, it has been confirmed that the coronavirus carriers were amongst the passengers.
- The virus spread mostly from the cities where people from abroad disembarked and unknowingly transmitted the virus to those with whom they came in contact. The urban areas which are also the most crowded areas and susceptible to human contact and transmission through coughing and sneezing were most affected. The rural areas where people from outside the area did not enter remained free of the effect of the virus.
- The coronavirus is comfortable in a cool climate and hence that is one reason why cold countries are the most affected.

## 2.1 THEORETICAL EFFECT AND RESULTS

The workings of COVID19 are still being researched even while it has been declared as a pandemic. Researchers have found that the building services materials & system design in use have been identified as one of the sources of contamination.

## 3. ENVIRONMENTAL IMPACT ON BUILDING SURFACES AND LIFESPAN OF THE VIRUS

The pandemic has become a major global crisis and has adversely affected the commercial landscape in both public and private institutions across the globe. It has had major implications on individuals and economic growth worldwide.

### 3.1 SMOG AND BUILT ENVIRONMENTAL IMPACT ON HUMAN CONTACT

As per research study conducted by the EPA-USA about the prolonged exposure to the environmental effect of COVID19 virus and in tandem with high levels of air pollution, nitrogen dioxide (NO<sub>2</sub>) is a key ingredient in smog pollution and contributes to increase in death rates. In the author's article, "*Environmental Management towards Air Pollution Afflicting the Country*," Research Gate, June 2019, the effect of air pollution due to dirt and dust along with the smog have been discussed since they cause photochemical reactions in the atmosphere based on three air pollutants (organic chemicals, nitrogen oxides, and sulphur oxides). The term "smog" or nitrogen dioxide (NO<sub>2</sub>) is a contraction of fog and smoke in the atmosphere. The smog is caused by automobiles within the urban areas where the virus is affecting human health.

Long-term exposure to NO<sub>2</sub> pollution causes lung inflammation and is one of the most essential contributors to potentially fatal immune systems caused by the virus. On the built environment side, the environmental impact

assessment example was presented in the author’s article, “*Environmental Possibilism*” CEAI ViewPoint, March 2018, which discussed the environmental perspective and innovation within the socio-cultural aspect of development as well as their implication that contributes to the climate change because of the collected pollution generated from various building structures as discussed in author’s article, “*Environmental Engineering in Built-Up Areas*” CEAI ViewPoint, December 2019.

With the given environmental impact scenario as described above the fresh air intake for a building be filtered before letting it into the built environment to sustain and maintain the required healthy environment for the building occupants based on ASHRAE 170/ 62.1.

### 3.2 ENVIRONMENTAL IMPACT ON BIODIVERSITY

Biodiversity is the very foundation of everybody’s human health and if not taken care of, it would lead to environmental damage that would, in turn, lead to human disease in many ways as has been brought by the COVID19 virus. The author’s article, “A View on the Implementation of Biodiversity Conservation” Durreesamin Journal, December 2018, has raised dilemmas for today’s generation because of poverty with the daunting tasks of low income around the globe which result in:

- **Climate Change** compelled disease-carrying animals to push to new places.
- **Forest Disturbance** caused the disease-prone wildlife to drives into human contact.
- **Industrial Farming** affected the breeds of pathogens toward antibiotic-resistant bacteria.
- **Biodiversity Loss** with habitat reduction, habitat fragmentation, and over-harvesting resulted in the predators and all big wildlife which are disease-carriers to flourish and get into human contact and cause illness such as the COVID19 virus that the world is facing.
- **Wildlife Trade** resulted in a change in habits relating to food, fashion, and traditional medicine and brought new diseases in contact with people. It is because of the heavy pressure caused by human activities, over-exploitation, and over-harvesting that has depleted natural resources despite considerable scientific and political efforts.

### 3.3 ENVIRONMENTAL IMPACT OF SURFACES & TRANSMISSION

The virus cannot be seen by the naked eye and is transmitted by contact and even as some studies say it is also airborne. The lifespan of the virus on different surfaces is given below. The virus can harm individuals silently from particles or droplets of sizes as shown in Figure 1, which also shows the time for particles to settle instill the air. It is a very alarming and dangerous situation nowadays when this airborne contamination can silently affect anyone.

According to the World Health Organization (WHO), the airborne transmissions are not easy to control but the human to human interaction can be controlled. The life of the virus after coming in contact with different physical non-porous surfaces like copper, cardboard, plastic, and glass are given below.

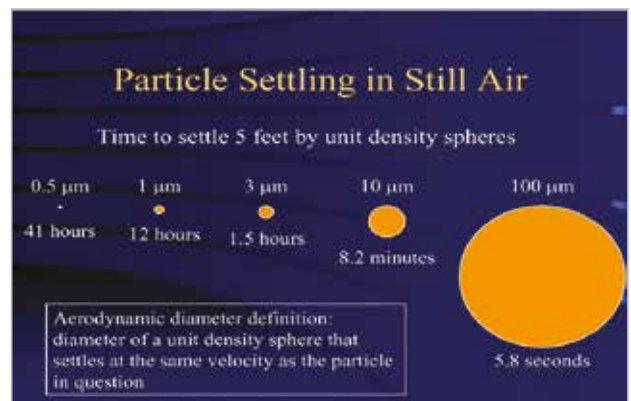


Figure 1: Comparative settling times of the particle diameter for particles settling in still air (Baron, n.d.)

1. **Air:** in an indoor airstream for 3 hours (180-mins) that encompass and stays in the moisture held from the infected human through coughing, sneezes and speaking; as well as through a fog, dust, and medical gas envelope;
2. **Copper:** for about 4 hours, on surfaces of accessories such as plumbing fixtures e.g. taps, shower hose, and drawer handles within the toilets and kitchen areas for possible transmission;
3. **Non-Porous Surfaces:** about 4 days or more on surfaces of household doorknobs, elevator buttons, handrails, & light switches in the building for possible transmission;
4. **Cardboard:** for about 24 hours (1-day) on all packages and mail materials but they are unlikely to transmit COVID19 virus to humans;
5. **Plastic:** about 2 to 3 days on bottles, any plastic bags, containers alike, plastics; and
6. **Glass:** for about 9 days, on mobile phones and other glass.

The surface to surface contamination is more prevalent where there are poor hygiene practices by individuals such as lack of hand cleaning. Personal hygiene is mandatory for all individuals to prevent any infectious viruses or particles from entering the human system. They can spread in seconds especially in the built-environment through sneezes and coughs particles or droplets, inhalation, and human contacts. The number of such particles or droplets that flow also depends on their size and the air currents within the spaces.

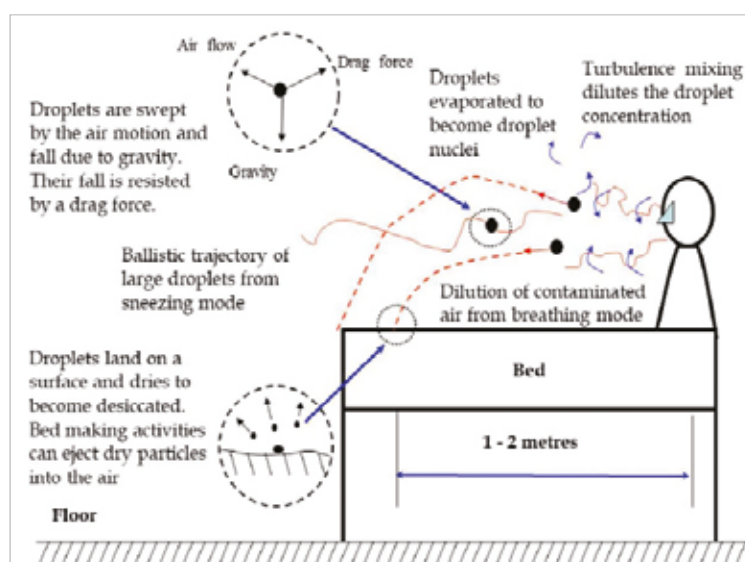
### 3.4 CHARACTERISTICS OF THE VIRUS AND CHANGE IN HVAC REQUIREMENTS

Diseases like the COVID19 virus can be referred to as an infectious particle too that can be transported long distances by droplets from the infected person who either coughs or sneezes or is talking in a room. The virus droplets or particles are <5 microns (Figure 1) and cause desiccated respiratory conditions.

Hence the virus is very dangerous for human life and this fight has to be won at all costs to prevent and secure a healthy environment in the future. The need for an air distribution system and the location of inlets and outlets together with an air filtration system are discussed later and would provide some food for thought.

### 4. HVAC ENVIRONMENTAL APPLICATION AND SOCIAL DISTANCING REQUIREMENTS

Some suggestions are provided here that could help in modifying the building services materials and systems. Primarily it is the HVAC System that deals with the built environment for human comfort in terms of indoor air quality, temperature, humidity, and air movement which could control the movement of a virus.



*Figure 2: The theoretical aerobiology of transmission of droplets and small airborne particles by an infected patient with acute infection, (Yuguo Li, n.d.)*

#### 4.1 ENVIRONMENTAL TEMPERATURE APPLICATION

The ASHRAE and CDC's recent study shows that the comfortable temperature for human body ranges from 23°C to 37°C (98.6°F). Accordingly, the indoor designed room temperature should be maintained at 23°C (73.4°F) to 24°C (75.2°F). However, these are also ideal for the virus to replicate and spread in the built environment. Alternatively, the ionair technology principle for the built environment as discussed later in the paper can be used effectively.

It requires temperatures of 56°C (132.8°F) or higher to effectively kill the virus but the source of fresh air intake in Figure 3 along with an appropriate air filtration system material selection to limit contamination and distributed accordingly with the correct airflow pattern.

#### 4.2 SOCIAL DISTANCING REQUIREMENT

The COVID19 infectious disease is being referred to as a transmissible or communicable disease, therefore social distancing is important. A distance of 1 to 2 meters to be maintained to prevent human to human contact to avoid transmission of infection. However, the HVAC system application in the built environment can impact on how an infection could be prevented by a proper air diffusion system and diluting pollution/ virus by directing the airflow away from the breathing zone or venting out the air from within the comfort zone, thus preventing the growth of airborne microbes in the space by using a dedicated 100% extraction system and discharging the air at least 10 meters from the air intake zone.

According to the Centers for Disease Control and Prevention (CDC), a new observation of air samples from the hospitals taken from coronavirus patients shows that the virus can travel up to 4 meters away from the infected person (*David Matthew, New York Daily News, 12 April 2020*), which is more than twice the recommended 1 to 2 meters distance advised by WHO and ASHRAE. The highest concentrations of the virus were found on the floors, doorknobs, bed rails, trash cans, and other areas and items that can receive a lot of contacts. Therefore, between 2 to 4 meters is more effective to prevent any form of contamination to occur.

#### 4.3 ENVIRONMENTAL EFFECT AND THE REPERCUSSIONS

The pandemic forced the governments all around the world to lockdown their country to implement the work from home policy. The ventilation systems designs are thus an essential part of the built environment to provide a comfortable environment to sustain the required air change for the group of people within the space while diluting, capturing and extracting the airborne contaminants held from an infected person who either coughs, sneezes or talks in a closed space. Without providing high-quality ventilation in the built environment people would become exposed to air contaminants, if the ventilation system is poorly designed since any increase in the concentration of the airborne contaminant, increases susceptibility to infection due to a moist environment that would lead to high rates of contamination.

### 5. DESIGN PROVISION IN BUILT ENVIRONMENT TO PREVENT THE SPREAD OF VIRUS

Design concepts similar to those for healthcare design facility would help prevent the spread of contamination in residential, commercial, and industrial facilities. This process would help maintain and sustain a healthy environment in a clean space. The building services materials, equipment, and systems should be carefully selected and designed according to the provisions that would suit the requirement for a built environment using the criterion or a combination of them that would help in the prevention of the spread of the infectious airborne viruses.

1. Air Change and Positive Pressure Differential Requirements,
2. Air Distribution System and Air Terminal Placement Requirements,
3. Air Filtration System Requirement,
4. Design Temperature Requirement,
5. Source of Fresh Air Intake for Built Environment Requirement,
6. Relative Humidity Requirement to Prevent the Spread of COVID19, and
7. Building Built Environment Indoor Air Quality Requirement.

*These are discussed below.*

### 5.1 AIR CHANGE AND POSITIVE PRESSURE DIFFERENTIAL REQUIREMENTS

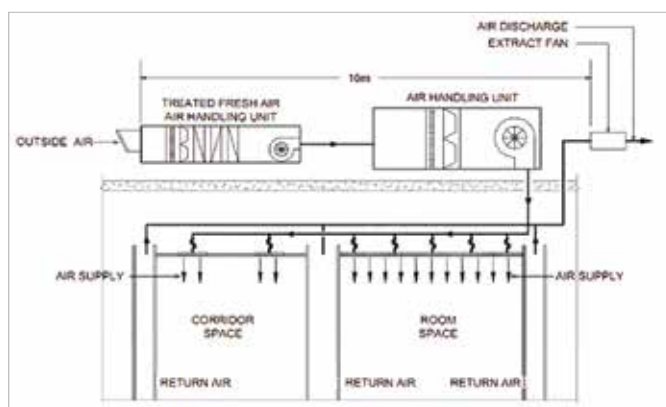
The fresh outdoor supply air within the building must meet the **air change and pressure differential requirements** given by ASHRAE 170 (Ventilation of Health Care Facilities) or *ASHRAE 62.1 (Ventilation for Acceptable Indoor Air Quality)* whichever is applicable and should be properly designed not only for the healthcare facility but for any building facilities (residential, commercial and industrial applications) where COVID19 is now present or could be in future. This would sustain the occupant's ventilation requirement so that the infection concentration is diluted.

Along with the fresh air supply system, a dedicated 100% extraction system should be designed to draw off the contaminated airborne virus from every room and discharged directly to the outdoor space. This is to assure that the air within the rooms provides a safe and healthy environment.

In this process, there is no air recirculation from the room spaces to be treated and recirculated back to the room spaces as practiced in the traditional design. The traditional design process has to be avoided so that the contamination particularly the particle droplets from an infected person do not mix with the fresh air supply and can be easily removed from every room space through a dedicated 100% extraction system. Going forward the air distribution provided in the renovation planned for existing buildings or new ones, these designs should be applied so that the acquired infection would be diluted by the air change process and the pressure differential requirements.

The normal recirculation should not be provided in an environment with an airborne virus so as to limit and prevent the droplets generated by a person who has either coughed or sneezed or talked in a room from spreading and coming in contact with other persons. The droplets usually evaporate within the comfort zone or the breathing zone in just milliseconds and immediately get devitalized and be carried away by the supply air from the ceiling diffuser whereas the return air grilles are located at the floor level.

This is the design concept for Clean Rooms and it ensures that the air movement can immediately combat the spread of a virus and control the contamination. This would aid in decelerating the rate of virus growth that might be produced and if they stay on a surface.



**Figure 3:** Proposed Equipment & Air Terminal Placement for the HVAC Equipment, Materials & System Layout (drawn credit; Cyrel de Guzman)

As mentioned earlier the building services design application must be evaluated for the required impact necessary, based on *ASHRAE Position Document Table 1*, for Airborne Infectious Disease. However, the building services materials & systems should be selected based on a dedicated 100% air supply and extraction system, when doing the cooling load design calculation. Refer Figure 3 for air distribution system arrangement (sections 5.2 / 5.7).

## 5.2 AIR DISTRIBUTION SYSTEM AND AIR TERMINAL PLACEMENT REQUIREMENTS

The air supply, refer to Figure 3, should be placed at the ceiling level so that the air would force any droplets or particles downward. Since particles of <5 microns stay airborne for hours and have the ability to be transported over a long-distance within an airstream. For the particles to be moved down quickly the return air should be extracted quickly and for that, the grilles are placed 200mm above the floor level to catch or draw-off immediately the virus without them getting in contact with the floor.

However, the designed diffuser-face-velocity should not exceed 30 fpm (0.15 m/s) as for ISO Class 5 to 8 clean rooms so as to avoid disrupting the thermal plume in the room. As per *ASHRAE (Klaus 2011) Design Manual for Hospital and Clinic*, the volumetric flow required per person for dealing with coughs and sneezes is 35 CFM (16.5 L/s) of fresh outdoor air. Since the virus would remain in the indoor airstream for 3-hours (180-minutes) it would stay in the moisture held from human coughs and sneezes as discussed earlier in section 3.3 if there will be no ventilation provided in the room.

Consider the scenario in which the microbes stay 14 minutes resident in the room, then there would be a need to dilute with 450 CFM (35 CFM x 12.85 ACH) per person which would be replaced with clean air (treated fresh air) at the same rate at 12.85 ACH (180 minutes /14 minutes). In this case, the best method to reduce the number of microbes coming in contact with a person who is infected or has been exposed to human coughs and sneezes within the built-environment is by diluting with clean air and discharging into outside the building. With this air distribution system and air terminal placements (Figure 3), the contamination could be avoided even when people are gathered in a group within the room.

## 5.3 AIR FILTRATION SYSTEM REQUIREMENT

Air quality has also to be strictly monitored by providing air filtration systems for the outdoor air. The fresh air handling equipment has to be provided with the required fine air filter (F8 or equivalent) on the outdoor side. These have 65% to 90% rated efficiency particularly for 80 to 160 nanometers particle size by diffusion mechanism. Ensuring proper filtration and airflow is essential since according to WHO, the COVID19 virus could stay active and remain in the indoor airstream for 3 hours long and for 2-3 days on surfaces in a room without proper ventilation. Most of the traditional systems in practice are designed with negative pressure using window type, split type, and packaged type equipment that have no proper outdoor air filtration units attached nor provide the air changes required. They do not provide any fresh air and hence the rooms are prone to high risk of the airborne transmission of contamination due to their recirculation without any fresh air being supplied. This practice cannot provide a healthy and secure building environment.

## 5.4 DESIGN TEMPERATURE REQUIREMENT

In the Middle East with 46°C to 50°C ambient temperature during summer the outdoor air has to be cooled to an acceptable indoor temperature. To deal with the unconditioned and unexpected outdoor air conditions throughout the year, the system must be fully equipped with sand trap louvers in the outdoor air intake side of the equipment so that

the volume of dust accumulated (especially during sandstorm) is trapped before entering the equipment whenever the HVAC system is in operation. It must be cleaned regularly during maintenance operations. The strategic principle vis-à-vis the HVAC equipment would be to protect it through regular maintenance and make it last for a long period to make it cost-effective.

## 5.5 SOURCE OF FRESH AIR INTAKE FOR BUILT ENVIRONMENT REQUIREMENT

The air outdoor equipment (Fresh Air Handling Unit) must be located on the roof of the building so that the air intake's proximity to potential contaminants would be avoided as discussed earlier. The source of the fresh air intake on the roof is a more advisable location and advantageous in also addressing dust collection which can be high at the ground level. The distance between the air intake source and the air exhaust/ forced extraction ventilation fan should be 10-meters to minimize the chances of cross-contamination by recirculation.

## 5.6 RELATIVE HUMIDITY REQUIREMENT TO PREVENT THE SPREAD OF COVID19

In addition to room temperature, the design also considers the Relative Humidity (RH). It is kept at a maximum of 60% RH to provide comfortable conditions for human occupancy and also minimize the risk from the airborne contaminants. If it exceeds more than 70% RH over a prolonged period it could create problems in an environment having airborne viruses hence the design must be based on the ASHRAE Position Document Table 1, for Airborne Infectious Disease as well as using psychrometric analysis if the requirements can be achieved with the traditional cooling system integration.

Condensation must be avoided on surfaces within the built environment by selecting proper RH values, and air to be discharged outside the building so that the growth of virus is prevented by ensuring that the room temperature is above the surface dew-point temperature. This is important since the RH value affects the evaporation rate and the virus (infectious agents) survival depends partly on the RH levels.

## 5.7 BUILT ENVIRONMENT INDOOR AIR QUALITY REQUIREMENT



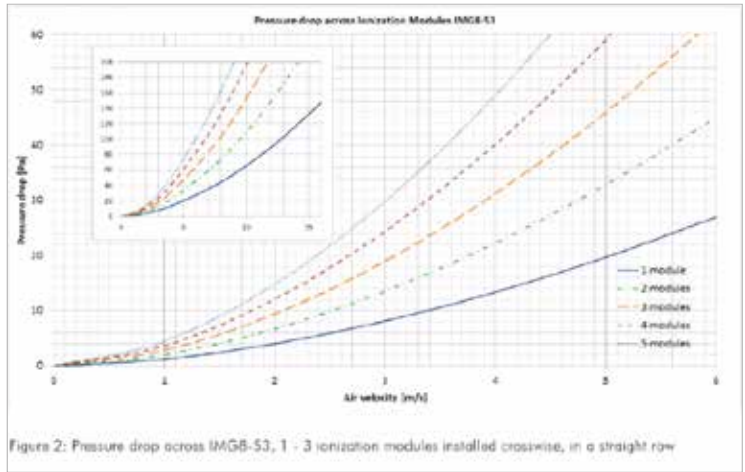
*Figure 4: Ionair Ionization System for Buildings*

A factor that can help the built-environment is to implement the **Indoor Air Quality (IAQ)** improvement strategies within the current HVAC systems to minimize the spread of the virus in line with the latest updated recommendations from WHO and ASHRAE. The strategy focuses on air ionization technology, which is an efficient tool using an easy retrofit for the existing ventilation systems to protect the vital facilities.

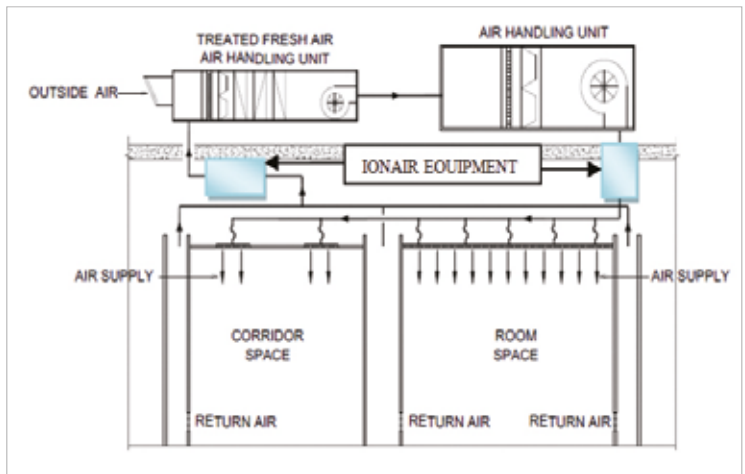
Ionair ionization system (Figure 4) can be provided in commercial establishments such as hospitals, airports, hotels, mixed-use buildings and public transportation systems to secure a healthy built environment. It can be done by way of retrofitting in existing buildings in their HVAC system or provided in new buildings. The use of ionair technology in the built environment would offer an indoor climate-energy saving solution for comfort climate, air purification, and odor neutralization.

The ionization system in the built environment would mobilize a self-cleaning system by capturing the gaseous elements including VOCs and odours as well as other particulate contaminant microorganisms by irradiation, which destroys bacteria, fungus, and virus-like COVID19. The system selection must be carefully studied and should have a lower pressure drop selection, refer to Figure 5. Incorporating this in the design process relative to other OPEX and power-savings, this would last a lifetime plus provide a safer and healthier environment.

The material and the system selection for the typical pressure drop across with the HVAC components using the fine particle filter (new) at 2-3m/s (100-250 Pa), fine particle filter (polluted) at 2-3m/s (300-500 Pa), activated carbon filter (cartridge, new) at 3m/s (150 Pa), and the cooling coil (ribbed tube, six-rows) at 3m/s (200 Pa) is to be done considering the requirement based on the ASHRAE Position Document Table 1, for Airborne Infectious Disease either for retrofit in an existing building or providing in a new building. A good example is shown in Figure 6 for the ionair system application which can be installed at the main return air duct before reaching the equipment (FAHU) as well as on the main supply air duct after the AHU before distribution to room spaces for providing good IAQ retrofit.



**Figure 5: Ionair Ionization System Modules - Pressure Drop Selection**



**Figure 6: Ionair System Application on both Supply & Return Main Ducts**

**6. SYSTEM ANALYSIS AND CONCLUSION**

The Environmental Impact Assessment involves understanding the nature of whatever changes that have taken place as well as to determine their significance relevant to human life whilst attributing or contributing about the impact on their interventions within the built environment that directly affects the target group because of airborne transmission of viruses, their impact on surfaces and lifespan involving the transmission within the built environment.

The COVID-19 scenario has affected communities throughout the world and is now becoming harsher and difficult to handle as the spread increases. The virus is transmitted by human to human contact in less than 1 meter because of the droplets or particles brought by the infected person or being exposed to human coughs, sneezes, and speaking within the built environment. Therefore social distancing of a minimum of 2 meters is necessary. The most prevalent precaution in the present scenario is to stay home and stay safe all the time and work from home. Wearing a face mask and hand glove in public places is a great help.

***ASHRAE Table 1, Airborne Infectious Disease Engineering Control Strategies: Occupancy Interventions and Their Priority for Application and Research***

Strategy	Occupancy Categories Applicable for Consideration*	Application Priority	Research Priority
Dilution ventilation	All	High	Medium
Temperature and humidity	All except 7 and 11	Medium	High
Personalized ventilation	1, 4, 6, 9, 10, 14	Medium	High
Local exhaust	1, 2, 8, 14	Medium	Medium
Central system filtration	All	High	High
Local air filtration	1, 4, 6, 7, 8 10	Medium	High
Upper-room UVGI	1, 2, 3, 5, 6, 8, 9, 14	High	Highest
Duct and air-handler UVGI	1, 2, 3, 4, 5, 6, 8, 9, 14	Medium	Highest
In-room flow regimes	1, 6, 8, 9, 10, 14	High	High
Differential pressurization	1, 2, 7, 8 11, 14	High	High

*Note: In practical application, a combination of the individual interventions will be more effective than any single one in isolation.*

#### \* Occupancy Categories

1	Health Care (Residential and Outpatient)	9	Public assembly and Waiting
2	Correctional Facilities	10	Transportation Conveyances
3	Educational < age 8	11	Residential Multifamily
4	Educational > age 8	12	Retail
5	Food and Beverage	13	Sports
6	Internet Café / Game Rooms	14	Laboratories where infectious diseases vectors are handled
7	Hotel, Motel, Dormitory		
8	Residential Shelters		

**Source:** ASHRAE Position Document on Airborne Infectious Diseases; Technology Council

As an Environmentalist, the approaches to environmental issues will change after this pandemic scenario and the concerns will mainly be for the health of the occupants of residential, commercial and industrial establishments that need to be rethought so as to secure the health of the occupants. The government policy towards the built environment also has to be revised based on the experience of the pandemic to provide a healthy and sustainable living.

The building services engineering materials & systems selection and design provisions in the built environment to prevent the spread of a virus have been discussed as the most important aspect to consider in the design process not only for healthcare facilities but also for residential, commercial and industrial facilities that need to be secured with a healthy built environment. The possibilities to consider in the design process and how to improve the indoor air quality using the air ionization system in existing as well as new buildings based on the ASHRAE Position Document Table 1, for Airborne Infectious Disease have been also identified.

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## BATHROOM TO MEET HIGH HYGIENE & COMFORT REQUIREMENTS



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Human beings over the centuries have become more and more aware of the necessity of maintaining personal hygiene and hence the demand for better water closets, baths, faucets, and fixtures has been increasing. Manufacturers of sanitarywares, fittings and fixtures have been designing and innovating to meet the requirements. Ingenious and innovative technologies are being developed for everything that today's consumers want from a toilet & bathroom furniture - designed for being easy to clean, hygienic and fitted with a shower function for the utmost comfort.

To meet growing demands, in recent years, the toilet has been continuously honed in terms of flushing technology, design, sustainability, comfort and hygiene. Today, only 4.5 litres instead of 9 liters of water are required for flushing. Special new ceramic finishes are also environmentally friendly. They are easy to clean and that helps to reduce the use of both water and cleaning agents. Antibacterial glazes, which effectively kill bacteria, meet consumers' demands for greater hygiene. The addition of a shower-toilet seat offers even greater comfort: the warm water cleanses gently and efficiently, thus meeting the need for hygiene and cleanliness.

### Open rim and efficient flushing technology

Rimless® technology, based on the successful interaction of geometry, optimized flow and design, has created an example of pure efficiency. The open design of the toilet rim enables innovative and efficient flushing. A dynamic and powerful flow of water describes a horizontal arc, before the water runs down, flushing the entire inner surface of the bowl (Figure-1). The applicable standards with regard to possible splashing are also observed and, in part, even exceeded. Thanks to technology no additional mechanism/ water pressure is required to channel the water inside the rim area



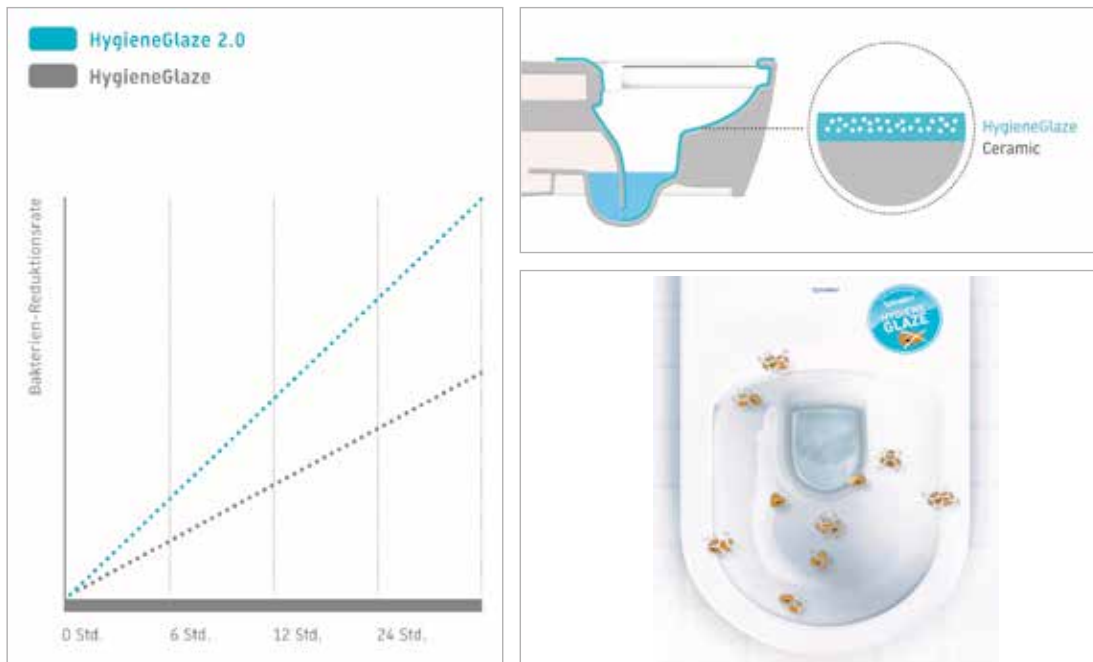
**Figure 1:** Water flow of Rimless with HygieneGlaze 2.0 can be perfectly integrated into the external rectangular form of the toilet.

### SMALL FLUSHING VOLUME, EASY TO KEEP CLEAN

The flushing standards recommend 6 lt per flush for full flush however, with the new technology hygienic flushing results are achieved even with small water volumes of just 4.5 liters (for toilet) and 1 lt for urinals. Due to the open, easily accessible rim area, the bowl is also particularly easy to keep clean. The tried-and-tested Wonder Gliss coating makes the toilet even easier to keep clean. The optional coating that is baked into the ceramics, doesn't give dirt and limescale a chance to deposit since they cannot adhere and are therefore flushed away more easily with the water.

### HYGIENICALLY CLEAN

The use of Hygiene Glaze 2.0 further improves the hygienic properties of the toilet. The new development is not a surface coating but an antibacterial ceramic glaze that provides almost indefinite effectiveness. The optimized combination of four different metal ions and other components forms the basis for the effectiveness of Hygiene Glaze 2.0, which kills bacteria and germs. Hygiene Glaze is integrated into the ceramic glaze during firing (Figure-2). This manufacturing process ensures an extremely effective reduction in pathogens such as Escherichia coli. Fired into the inside of the toilet as far as the rim, it kills the unwanted bacteria that are often concealed in toilets and urinals. After six hours, it eliminates up to 90 percent and, after 24 hours, 99.999 percent – an unprecedented level (Figure-3).



**Figure 2:** HygieneGlaze 2.0 - after 6 hours, 90% of all bacteria are effectively killed. After 12 hours, 99.999% reduction is achieved.

### SURPASSING EXISTING MEASURING LIMITS

During the hygienic microbiological tests, the effect of the innovative glaze on the bacteria was so powerful that the measuring procedure results far exceeded the current limit. For this reason, subsequent investigations considered kinetics for the first time. Beforehand, only the starting and finishing concentrations after 24 hours were measured. Now, researchers can measure effectiveness over time and thereby show how many bacteria have been wiped out after 6, 12 and 24 hours.

## GREATER COMFORT WITH A SHOWER-TOILET

Nothing is as thorough, as hygienic, as natural and as refreshing as cleansing with water. This is why the shower-toilet – a toilet-bidet combination – is becoming increasingly popular. Considerably softer and gentler than toilet paper, water also provides freshness. The shower-toilet leaves users feeling clean and refreshed. The latest addition is SensoWash®, a high-quality shower-toilet that meets every requirement for the contemporary bathroom – contactless, hygienic cleanliness, high operating comfort and sustainable design.

The new shower-toilet is convenient to operate via a remote control, freely configurable via an App; it includes a minimalist design for maximum shower-toilet comfort. The technology within all components has undergone further development and has been reorganized to now house all technology within the ceramic body. The flat seat with a height of just 40 mm and the white cover located behind it form a flush-mounted unit: contemporary design and comfort-enhancing technology in perfect harmony.

The innovative remote control with its flat, elegant design feels pleasant in the hand and all functions are controlled intuitively. Comfort is guaranteed thanks to technical finishing touches such as the motion sensor for automatic cover opening through the user ID in the seat up to a wide range of setting options for seat heating, for the shower flow, and the controllable hot air dryer.



*Figure 3: Electronic shower toilet Starck F with remote control*

The associated App enables individual configuration of the shower-toilet, or it can be optionally controlled in the standard way with a remote control.

The flush function and odor extraction system may also be controlled via remote control or app if the wall-mounted element is combined with the electronic actuator plate. (Figure-3)

The new Rimless® technology and an optimized basin and siphon geometry, provides improved water flow for perfect flushing results. HygieneGlaze® 2.0, which kills 99.999% of bacteria in a relatively short time, guarantees an optimum hygiene standard.

The flat, heated toilet seat is made of an especially rugged material and, like the cover, is very hygienic thanks to its scratch-resistant, pore-free surface.

The design of the new shower-toilet impresses with its pared-down aesthetics and timeless modernity. The shower-toilet offers easy installation, and an integrated, fully automated descaling function.

### WASHBASIN DESIGN

Washbasins with their independent fittings and fixtures are a cleaning nightmare. Hence a new design which creates washbasin solutions based on the c-bonded technology has been developed. It's a globally unique process in which ceramics and bathroom furniture are combined almost seamlessly. Accurate and precise-fitting connecting technology enables the ceramic and furniture parts to merge to form a single unit. The actual thickness of the washbasin is invisible and reduced to a precise edge. The transition from the cool, smooth ceramic to the natural texture of the wood is a unique sensation to the touch. (Figure-4)



*Figure 4: C-bonded Washbasin*

### CONCLUSION

*Visible and invisible impurities lurk especially in the bathroom.*

Contactless, easily cleanable and maintainable sanitary and plumbing fittings and fixtures are making it possible to meet the requirements of hygiene and safety. Also the symbiosis of toilet and bidet is becoming increasingly popular all over the world because nothing is as thorough, as hygienic, as natural and as refreshing as cleansing with water.

## POLYPROPYLENE THREE LAYER PIPE - PARADIGM SHIFT IN SWR APPLICATIONS



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### Abstract

*The building construction industry is adapting and changing very fast in terms of usage of new products and technologies. The reasons for this fast changes are due to the limitation of availability of skilled manpower, financial constraints and the necessity to follow the ambit of RERA (Real Estate Regulatory Authority). It is therefore imperative to use the best in-class technologies.*

Soil, Waste and Rain water pipes system (SWR) are the veins of a building, therefore there is a need to address their layout and design carefully. Any usage of wrong products may create many problems many problems like seepage in building, inconvenience of occupants and time and cost of iteration plus maintenance issues.

Polypropylene three layer pipe is able to address the SWR application related problems. It not only addresses regular problems like leakage, joint opening and breakage, etc. but other issues like low noise, chemical resistance and working perfectly in hot water temperature as well as sub-zero temperature.

This article explains the characteristics of the three layer polypropylene pipes and their benefits. The term plumbing in this papers implies SWR (Soil, Waste and Rain water) piping systems.

### INDIAN CONSTRUCTION INDUSTRY

The Indian construction industry is second largest employer of labour in India, and is also the second largest economic activity after agriculture. Due to the increase in the domestic and international manufacturing activities, Indian construction industry has grown at an average rate of 9-11% a year.

This industry is already capitalizing the growth. Hence it is very important for the construction industry to resolve inefficiencies in time, cost product related challenges, skilled manpower etc.

Plumbing systems are one of the life lines in any building, and are necessary to ensure that the building can function. The key to running any building efficiently are the, correct plumbing system design, use of right materials and good workmanship.

### PROGRESS IN SWR SYSTEMS

Any new product when it is introduced has to overcome the inertia of change and the comfort of using existing products. The SWR systems have evolved from CI (Cast Iron) to UPVC pipe and now PP pipe. Some of the challenges in CI pipe are:

1. Heavy weight – handling, transportation and laying in position are difficult
2. Time consuming and expensive jointing systems
3. Blockage and leakage are difficult to attend to, and
4. Challenge for pipe repair and replacement.

When the UPVC system for SWR was developed it addressed most of the challenges that were being faced with the CI pipe which also enabled fast and efficient flow and removal of waste without blockage and leakage. It also has high impact strength and is chemical and corrosion resistance.

Long life and virtually zero maintenance have made UPVC system as a preferred drainage and rain water system.

The PP pipes not only address the challenges of UPVC pipes like low impact resistance, not suitable for hot water, less chemical resistance, etc. –but also the other latent one such as sound insulating for low noise drainage and sewerage piping system. The PP pipes are suitable for drainage of both commercial and residential waste water. PP pipes comply with the requirements of non-pressurized waste water piping as laid down in DIN EN 12056 and DIN 1986-100.

### **PARADIGM SHIFT IN PLUMBING - SWR**

Due to the need for more urban dwelling units and shortage of land, buildings are being developed vertically rather than horizontally. Hence there are more condominium, /high rise and tall buildings.

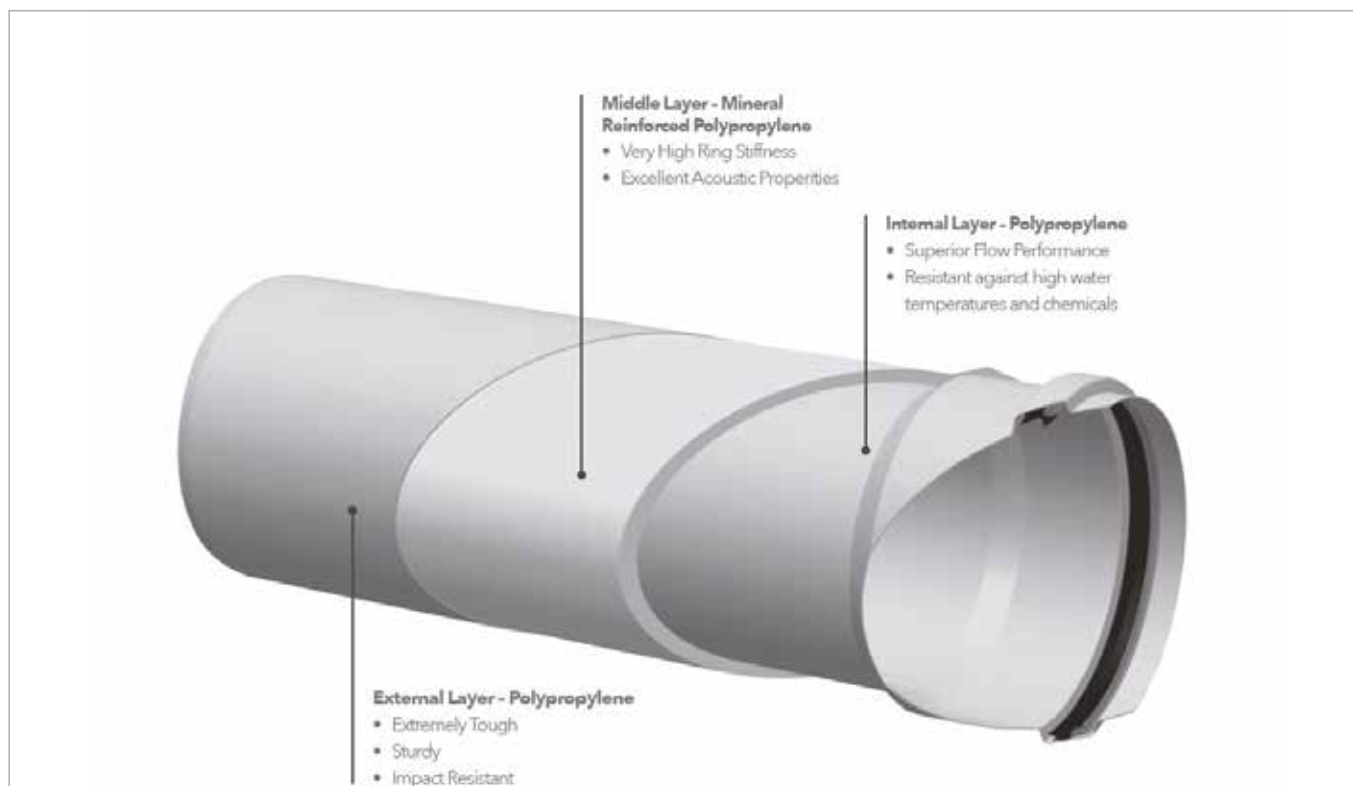
The need of the hour, if for a product to address the challenges of high rise building very little or zero maintenance, structurally bonded noise insulation layer, etc. This scenario gave the impetus to the industry to introduce a new material for SWR systems, the PP pipe to the Indian market.

### **PP PIPE COMPOSITION**

PP pipe have, a mineral reinforced polypropylene compound, designed to provide both excellent acoustic and mechanical properties. The Molecular density of 1.9 gm/cm<sup>3</sup> is one of the highest in the industry and it significantly improves the sound dampening properties of the waste water drainage system. Compounding of PP pipe offers superior ring stiffness and the impact resistance which are essential for a drainage and sewerage piping system.

### **PIPE STRUCTURE**

A PP pipe is constructed of 3 layers Sandwich construction, each layer is meant to meet its respective requirements, as targeted. Refer Figure-1



*Figure 1: 3 layered sandwich construction of Polypropylene Pipe*

Three separate layers are meant to impart different characteristics to the pipe. The abrasion resistant low friction inner layer ensures the easy transit of waste. The mineral filled mid-layer ensures enhanced sound dampening properties and also offers increased stiffness. Finally, the robust outer layer is tough enough to withstand impacts and shocks. These ideal characteristics are achieved through the three-layer structure of the pipe and the specialized adaptation of each individual layer to its respective requirement: - High ring stiffness - Excellent impact strength of the outer layer at low temperature - Increased UV-resistance - Abrasion-resistant and smooth inner layer - Highly rigid and sound-insulating middle layer made of mineral reinforced polypropylene.

## FITTINGS & FIXTURES

Pipe systems experience local vibrations where the flow changes directions due to the turbulence caused in the portion. This can have a negative effect on the sound related properties. To minimize this effect and to counter the negative influences, it is important to have properly designed fitting and adequate mass. PP pipe fittings are specifically designed to address this condition.

The fittings too have the same density of 1.9 gm/cm<sup>3</sup> as the pipes and are made of identical PP mineral filled compounds. Special fittings are designed like Access pipes, Clean out Tees and Bends (Door Tee and Door Bend) with special inner cap that ensures smooth flow as well as minimum sound generation.

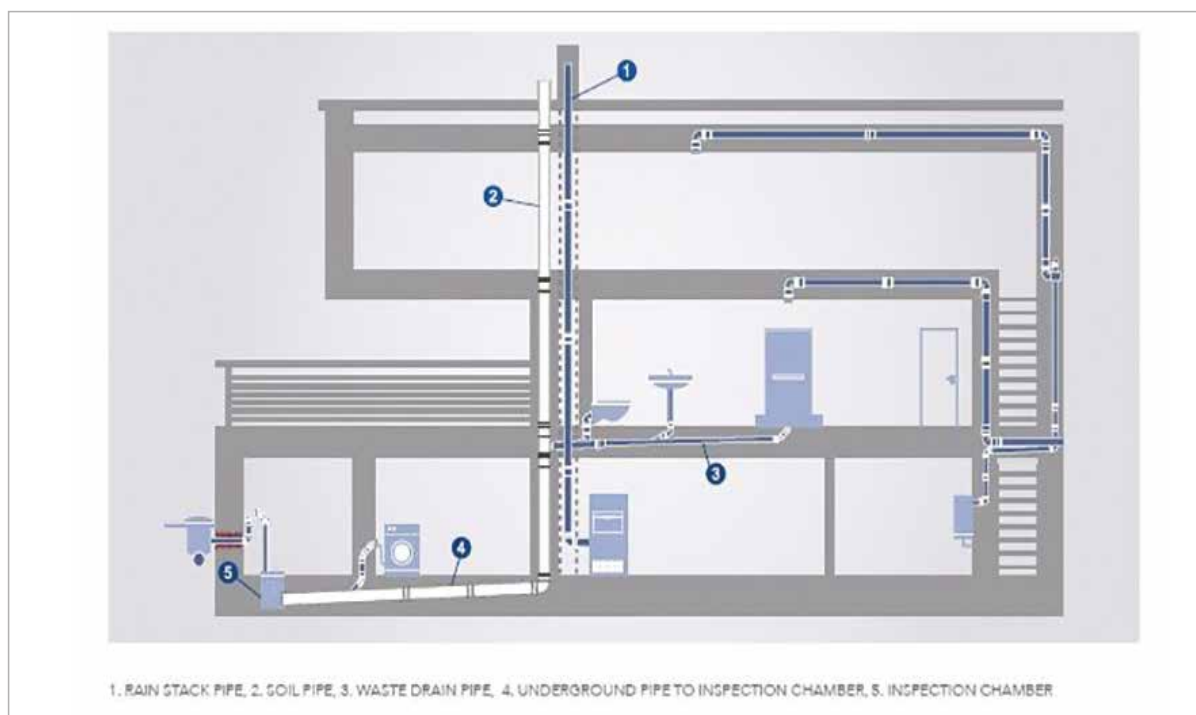


*Figure 2: Fitting for Polypropylene SWR pipes*

**FIELDS OF APPLICATIONS**

Drainage Systems Inside Buildings-Sanitary Pipework, Layout and Calculation and DIN 1986-100 Drainage System on Private Ground. Local - national standards, code of practice and regulations must be followed during the design and installation of drainage system using PP pipe. The pipes, fittings and seals can operate continuously at 90°C/ 194°F (95°C/203°F for intermittent use only).

They are suitable for the drainage of chemically aggressive waste water with pH value of 2 (acidic) to 12 (basic). Fire resistance of PP pipe corresponds to B2 normal combustibility according to DIN 4102 Fire Behaviour of Building Materials & Building Components-Building Materials, Concepts, Requirements and Test and D-s2, d0 according to EN 13501-1. Fire Classification of Construction Products and Building Elements- -Classification using data from reaction to fire tests. The pipe connections are leak-proof up to an internal excess water pressure of 0.5 bar (5 m /16.4 feet of water column). The possible usage of PP pipe are shown in the figure below:



1. RAIN STACK PIPE, 2. SOIL PIPE, 3. WASTE DRAIN PIPE,  
4. UNDERGROUND PIPE TO INSPECTION CHAMBER, 5. INSPECTION CHAMBER.

*Figure 2: Piping for Soil, Waste and Rain waters*

## RESIDENTIAL BUILDING

Due to its excellent sound insulating properties, <math> < 10\text{dB}</math> @2LPS as per EN 14366- Laboratory Measurement of Noise from Waste Water, PP pipe is an ideal choice for all kinds of residential buildings where noise reduction is required as per DIN 4109 Sound Insulation in Buildings-Minimum Requirements or VDI 4100 Sound Insulation between Rooms in Building-Dwellings-Assessment and proposals for enhanced sound insulation between rooms. It can be used for standard drainage system also. The typical examples of such occupancies are; Single Family House, Condominiums and Multi-storey Residential Apartments. Apart from the noise generated by external sources, internal sources are also responsible for the noise generation. PP pipe reduces the drain noise considerably and enables the living spaces to be quiet and comfortable. The maximum detectable flow noise in this system is less than the noise generated by ticking of a wrist-watch.

## LARGE COMMERCIAL BUILDINGS

PP pipe can be installed in buildings with elevated sound insulation requirements as per VDI guideline 4100. Thanks to its excellent sound insulation properties, PP pipe is ideal choice for Hotels, Office buildings, Hospitals, Restaurants, Rehabilitation Homes, Libraries, Community Centres and Educational Institutes. PP pipe sound-insulating piping system is designed to ensure a comfortable environment.

The pipe dimensions are in accordance with EN 1451 Plastic Piping systems for Soil and Waste discharge –Low and High temperature - within the building structure for PP. Specifications for Pipes, Fittings and the

System or EN 1401 Plastic Piping Systems for non-pressure underground drainage and sewerage for PVC-U.

**COMMERCIAL KITCHENS**

PP pipe is ideal for application such as an inlying collecting pipe for draining greasy waste water from commercial kitchens to the grease separator. Due to its high temperature resistance (short-term exposure to 95°C / 203°F) long-term exposure to 90°C / 194°F, PP pipe would be the ideal choice for commercial kitchens where waste water with high temperature is drained. It also meets the basic prerequisites of DIN EN 12056 Gravity Drainage Systems Inside Buildings-Sanitary Pipework, Layout and Calculation and the associated norms of DIN 1986-100 Drainage System on Private Ground. For grease separators at a great distance, the use of pipe heat tracing may be necessary. This prevents premature grease accumulation. Ideal temperature of the pipe trace heating for plastic pipes should not exceed 70°C / 158°F. Apart from this, PP pipe can be used for other applications like Industrial Environment, Laboratory Drainage and Chemical Industries.

**CHEMICAL RESISTANCE**

PP pipe is resistant from pH2 to pH 12, to a wide range of chemicals and can be used for their drainage. Mechanical behaviour can be impaired in cases where tension and the presence of chemicals occur simultaneously (tension fracture corrosion).

Comparison between Silencio, CI, uPVC				
Properties	Silencio	CI	uPVC	Advantage of Silencio
Material	PP/mineral filled/ PP	Cast Iron	uPVC	Higher density then uPVC
Internal surface	Very smooth	Rough	Smooth	No choke up and blockages
Acoustic property	< 10dB @ 2l/s	NA	NA	Better acoustic
Installation	Easy push fit joint	Cumbersome jointing method	Need solvent cement for jointing	Fast installation possible
Impact Resistance	High even at -20 °C	High	Brittle at low temperature	No ambient temperature effect
Chemical Resistance	High - from pH 2 to 12	High	Poor chemical resistance	Can be used in wide soil and waste environment
Hot Water Resistance	Upto 90 °C	High	May not stand at higher temperature	Can be used in commercial kitchens, hospitals
Fittings	Swept & door fittings with special design	No innovative design	Limited option	Technically advanced design
Maintenance & Flexibility	Easy to replace the damage part of line	Complicated system to replace the damaged part	Limited option	Easy for maintenance and cleaning
Pipe Weight	Light	Heavy	Light	Easy to handle and transport

## KEY PROPERTIES

1. Noise insulation at its best
2. As strong as metal
3. Easy installation
4. Chemical resistance
5. High impact resistance, extremely tough
6. Resistance to hot water
7. Smooth inner surface

## CONCLUSION

PP pipe is the solution for the problems currently being faced by SWR plumbing systems. It helps to achieve efficiency in the plumbing work due to low maintenance. PP pipe provides noise cut off, better jointing, and chemical resistance which makes building function more efficient. Using best material gives longer life to the building.

In SWR system, fitting is the weakest link and major cause of leakage, cleaning problem, etc. PP fitting comes with high density-1.9 gm/cm<sup>3</sup> as well as unique feature like depth gauge (ensure the gap for expansion) Swept angle (smooth flow), Door cap (to prevent the accumulation of waste) and External ribs for higher strength.

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### CarbonCure Technology Says Goodbye To Carbon Dioxide, Hello To Greener Concrete

Jeff Kart Contributor

The concrete industry has a huge footprint; the cement used to make concrete is responsible for up to 7% of the world's carbon dioxide emissions. A company called CarbonCure makes a technology for concrete producers that introduces recycled CO<sub>2</sub> into fresh concrete. The CO<sub>2</sub> is converted into a mineral and becomes permanently captured.

The Canadian startup says it's on a mission to save up to 500 megatonnes of CO<sub>2</sub> emissions per year. As of this writing, a counter on its website is nearing 24,000 tonnes (or metric tons). CarbonCure says its tech is being used by more than 100 producers across North America, in concrete masonry and ready mixed concrete plants in the United States and Canada.

**Source:** <https://www.forbes.com/sites/jeffkart/2019/02/23/carboncure-technology-says-goodbye-to-carbon-dioxide-hello-to-greener-concrete/#6d7fa0667311>

## AN OVERVIEW OF THE NEW ELEVATORING SYSTEMS FOR BUILDINGS



**Anandi Khandekar**  
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### 1 INTRODUCTION

As the proverb goes, “necessity is the mother of invention”, every few years with the increased space crunch, especially in the cities, there are inventions in every field including the E&E (Elevator & Escalator) industry. This article is written to highlight the latest or the new technologies available in the E&E industry, their advantages and disadvantages.

In the past few decades many new technologies have been invented and are a boon to the rapidly growing urban infrastructure. Few of the technologies are double-deck elevators, TWIN elevators, MULTI elevator system, jump elevators, IoT (Internet of Things) and AI (Artificial Intelligence) for elevators & escalators and high speed elevators.

**These technologies are elaborated in the paragraphs below.**

### 2 DOUBLE-DECK ELEVATORS

Though the technology of Double-deck Elevator was invented way back in 1931, the reason this technology is detailed here is because till date there is not a single Double-deck installation in India. A few technical details of a Double-deck Elevator are:

- Double-deck Elevator is an elevator with two cabs attached together, one on top of the other,
- This allows the passengers on 2 consecutive floors to be able to use the elevator simultaneously,
- By virtue of the design of this Elevator, passenger capacity per hoistway increases significantly,
- For conventional Double-deck Elevators, the floor rise of each floor has to be equal

Customized option of Elevator serving unequal floor rise is available at an additional cost.



**Figure 1:** Double-deck Elevators at Midland Square, Nagoya, Japan (figure shown just to indicate the Double-deck design)

### Some of the advantages are:

- If the building/ structure is designed well, the number of hoistways could reduce considerably which would reduce the core space requirement,
- During peak period, when both the decks are fully loaded, energy is saved,
- In many scenarios the upper deck is used as passenger elevator and during non-peak hours the lower deck is doubled up as service/ goods Elevator, hence saving up on providing separate service/ goods Elevator.

### It has a few disadvantages are given below:

- During non-peak hours, even though the traffic is less both the decks will operate,
- Few designers may find the equal floor rise a constraint,
- For efficient usage of the double-deck system, even number of floors is preferred, and
- There is no standard/ code in India as of now

## 3 TWIN ELEVATORS

TWIN Elevator system is a proprietary product invented by ThyssenKrupp in 2003. TWIN is the system in which 2 Elevator cabs run independently in 1 hoistway. The ideal scenario is where the upper cab serves the upper half of the building and the lower cab is serves the lower half of the building (number of floors served is a function of the traffic analysis results).

### Some technical details of TWIN elevator system are:-

- TWIN Elevator system if designed efficiently could result in saving of around 25% space,
- TWIN is designed on a TÜV-tested safety concept to satisfy even the most stringent requirements, and
- This system is suitable specially for hotel, office, mixed-use buildings where 2 separate entities operate in a single building

### Some of the advantages are:

- If the building/ structure is designed well, the number of hoistways could reduce considerably which would reduce the core space requirement,
- Both the cabs use the same single hoistway, same set of landing doors and guide rails,
- Unlike in a Double-deck Elevator where even during non-peak hours, both the decks are run, in the TWIN system, one of the cabs could be parked and only 1 cab could be utilized,



*Figure 2: DIndicative TWIN Elevator system (Figure credit ThyssenKrupp)*

- Upper cab could be made to serve the lowest landing (with proper pit design)

**A few disadvantages are:**

- Standalone TWIN system is not completely efficient unless there is a supporting Elevator/s transferring passengers to the upper cab/ upper entry level,
- Ideal for buildings with 2 entry levels/ zones,
- There is no standard/ code in India as of now

**4 MULTI SYSTEM**

MULTI system was announced in 2017 and is a proprietary product of ThyssenKrupp. This system is the world’s first rope-free Elevator system, in which multiple cars move in a single hoistway horizontally as well as vertically.

Some technical details of MULTI system are:

- Through the use of magnetized cabins, which operate in the same shaft on an electromagnetic track, enables the cabs to travel sideways as well as up and down,
- Leveraging the linear motor technology developed for the magnetic levitation trans-rapid train, the cabins move up one shaft, travel horizontally, and then come down another in a continuous loop,
- Exchanger mechanisms like railway switches help to guide the cars, which are mounted with carbon-fiber bearings called slings that allow them to change direction,
- Since this system runs on magnets and motors, fewer and smaller hoistways are required in comparison to conventional cable operated Elevators
- Not having cables might seem that the system is less safe but that’s not the case. The linear motors are safe because they need to be energized before they move. That means that without energy, the cabins can’t move. That’s why the cabins are equipped with batteries in case of energy breakdown. In addition, a multi-step braking system is designed that doesn’t allow cabins to move freely.



*Figure 3: Indicative MULTI system (Figure credit ThyssenKrupp)*

**Some of the advantages are:**

- Endless possibilities with the architectural design as the building can be served both horizontally and vertically for passenger/ goods movement,

- If the building/ structure is designed well, the number of hoistways could reduce considerably which would reduce the core space requirement

**A few disadvantages are:**

- Not suitable for low rise/ mid-rise buildings where the footprint is small,
- Cost effectiveness compared to the conventional Elevating system for a particular project needs to be evaluated, and
- There is no standard/ code in India as of now

## 5 JUMP ELEVATORS

Jump Elevators/ Lifts were developed by Kone Elevators in 2001. It is a self-climbing Elevator system that is installed as soon as the first levels of completed floors are constructed. It allows hoistway construction and Elevator installations to continue at higher floors while the Elevator is operating in the same hoistway at lower floors, below a protection deck. The permanent Elevator cabin is used in this system which is equipped with temporary fixtures and protective materials so they can be used during construction time. With proper planning and execution, Jump Elevators can be a good solution to improve construction efficiency and speed. They are a good alternative to external hoists.

**Some technical details of Jump Elevators are given below:**

- Jump Elevators/ Lifts use the permanent hoistway,
- Jump Elevators/ Lifts are fitted with automated doors as any other regular Elevator/ Lift, making the usage safer,
- The mobile machine room contains the hoisting machine and the Elevator controls. It moves upwards as the building progresses,
- The double protection deck is used to protect against any possible falling of objects & is locked to pockets in the hoistway walls,
- The deflection deck is attached to the slip form very close to the formwork position, deflecting any objects or possible wet concrete that may fall to the shaft,
- The installation platform is used to install the guide rails and other elevator components, and
- The separation deck isolates the working area from the operating elevator below it. It prevents any objects from falling into the operational section of the elevator shaft. The deck is integrated with the lifting beams, which are used to pull the heavy mobile machine room up with the aid of a rope hoist. The whole process is self-powered and does not require a site crane.

**Some of the advantages are:**

- With proper planning, construction process could be faster,
- Labour, material & tools reach their destination floor faster,
- As against an external hoist used during construction, jump Elevator/ Lift has an all-weather operation, and
- Façade can be completed faster than when external hoist is used

**A few disadvantages are:**

- Needs proper planning during the construction phase, and
- This product is limited to few suppliers only.

**6 IOT & AI FOR ELEVATORS AND ESCALATORS**

Elevators and Escalators have become an inevitable part of most of the tier 1 and 2 cities across the globe. And with increased number of installations, managing the service, operation and maintenance is a big task for the suppliers. IoT and AI enabled Elevators and Escalators help in many of those tasks such as:

- IoT enabled Elevators / Escalators can gather data related to electrical circuits, load weighing, number of trips, number of door cycles, wait times, traffic trends, ride analysis, harmonic analysis, etc.,
- Data collected by IoT aids in improving the preventive maintenance schedule,
- The systems help in keeping track of wear and tear, is another useful way to predict when and where maintenance would soon become necessary,
- IoT devices enable real-time data transmission to the designated mechanic which can allow the mechanic to proactively attend to the problems,
- IoT devices monitor the equipment 24/7 and serve as the eyes and ears of whoever is responsible for maintaining a building's vertical transportation systems,
- IoT data can help improve the innovation/ research process of the manufacturers,
- Monitoring the equipment often and avoiding breakdowns can also lead to increased life cycle,
- AI is helping anticipate the problems and manage the traffic flow better in the Elevators & Escalators

**7 HIGH SPEED ELEVATORS**

There are many articles and design guidelines about high speed Elevators. The design details are mentioned in NBC 2016 as well. But the reason this topic is included here is to highlight that the fastest Elevator in the world which is running at 21.0mps (meter per second) and was installed by Hitachi Building Systems Co. Ltd. at Rosewood Guangzhou, China in 2019. Till date, the speed of the highest Elevators installed in India is 6.0mps. They are installed at The Imperial, Mumbai, Omkar 1973, Mumbai and World One, Mumbai.

**8 CONCLUSIONS**

To conclude let's recall the caution by the World Health Organization (WHO) on the current pandemic situation that the world is grappling with.

As per WHO, the COVID-19 would be here for a very long time, rather forever. There definitely is a risk in using Elevators and Escalators but that risk is significantly lower than all the other activities one would be involved with before and after getting to the Elevator or Escalator. Hence, few precautions which could help prevent the spread of a virus, from an E&E industry perspective are:

- Passengers to make use of sanitizer before entering an Elevator/ Escalator and before touching the call button/ COP

- Wear a mask
- The car to be loaded up to 50% only, so as to maintain ‘social distancing’
- Do not lean on the walls inside an Elevator,
- Avoid overcrowding an Escalator

There are few non-touch applications for call entering like QR Code, Apps, WhatsApp, pedal controlled, voice controlled and Hologram, but using these could only add to the waiting times. Imagine every passenger spending more than 10 seconds (minimum) to register their call using these applications, which will only increase the waiting times.

Pedal operator are now being advertised. The picture below is from a newspaper clipping. Imagine a passenger stepping on the footmark (in front of the pedal operator) to register the call and other passengers waiting at the floor or inside the car. As mentioned above, minimum time to register a call by this pedal operator would be 10 seconds and then the next passenger will register the call, by which the waiting times have already gone for a toss. The question that arises is how by installing the pedal operator, is one going to maintain social-distancing inside a car when a car is occupied with more than 2 or 3 passengers especially for cars of higher capacity (6 passenger, 8 passenger or 10 passenger)? In such a small area if the pedal operator is installed, maybe only 2 or 3 passengers can travel during 1 trip. Hence, one needs to understand the total implications of installing any new technology.



**Figure 4:** Picture showing pedal operator being installed inside an Elevator/ Lift car (source: local newspaper)

And more than ever the design of the Vertical Transportation System is critical so that the cars could be loaded to only 50% capacity but still the waiting times are not too high. The under elevatored buildings will definitely face some challenges which need to be dealt on a case by case basis.

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# LIGHTING MANAGEMENT SYSTEM



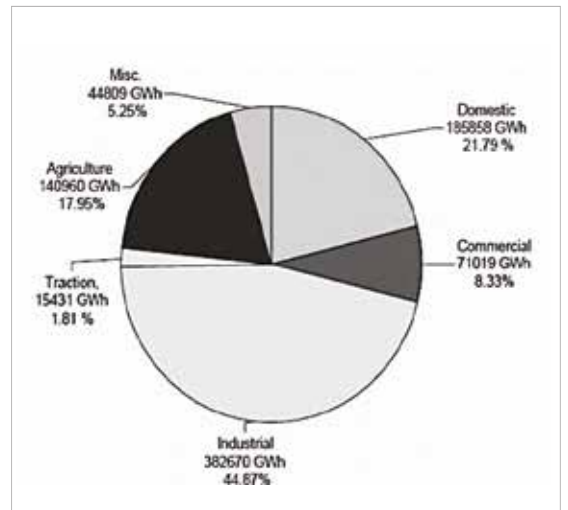
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## INTRODUCTION

The sector wise energy consumption in India, Figure-1 shows that more than 40% of the energy consumption is by Industries, of which about 8-10% is for lighting, refer Figure-2. Light sources have evolved over a period in the sense that their capacity to give light output in relation to the wattage has improved. During planning of a project while it is imperative to use the most efficient lighting luminaire, it is equally important as well to select an appropriate control system. The control requirements of different areas of building/ industry could be different and the control system should be able to effectively address all these requirements. Further, the system should also be able to take into consideration the availability of natural lighting to the maximum possible extent thereby optimising the requirements of artificial lighting. Considering the post pandemic scenario the thrust on automation would tend to increase so as to minimize manual intervention for any kind of control. The lighting management system would have to be versatile, flexible and user friendly to meet the different requirements.

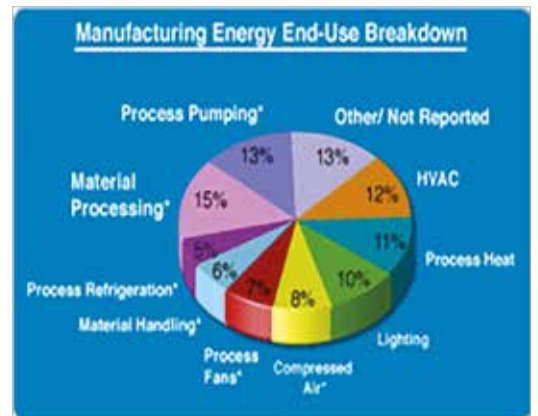


**Figure 1: Sector Wise Energy Consumption in India**

## OPTIONS FOR LIGHTING CONTROL

There are different options for control of lighting which could be categorized as:

1. Switching Control – Manual ON/OFF at desired intervals
2. Based on Timer Inputs – ON/OFF control based on Astronomical Timer
3. Based on Sensor Control- Photocell or Motion or Occupancy sensor
4. Based on Coverage of Control – Group or Individual control
5. Others- Daylight Harvesting, Personal ON/OFF/Dimming through handset, control of window shades (auto/ manual)



**Figure 2: Manufacturing industry end use breakdown**

6. Fine Tuning – A lighting system is designed with a certain utilization factor which comprises of the lamp lumen output depreciation factor and the maintenance factor (about 0.8 for an indoor area). Thus, during initial few years i.e. till the time lumen output depreciation is significant, there is additional lighting to the tune of about 20% and hence there is a possibility of saving by dimming without compromising on comfort or visibility.
7. Dimming Control – Dimming of fixtures through dimmable drivers.

**Switching Control** – This is a very primitive way of control wherein the lighting in a given area is switched ON/OFF manually. The extent of saving is totally dependent on the OFF hours. This is not a reliable system since manual intervention is necessary.

**Based on Timer Inputs** – An astronomical timer is provided in the lighting distribution circuit, which switches OFF the power supply based on a preset time. This is mainly used for outdoor lighting wherein the lighting needs to be put ON in the evening and OFF in the morning. In case outdoor lighting is required to be put ON during rainy season/cloudy day during day time then for this option manual intervention is required. This option can also be used for switching ON/OFF one-third/two third lighting in case of street lighting.

**Based on Sensor Control** – The lighting can be put ON/OFF based on the inputs from a sensor like a Photocell, Motion sensor or Occupancy sensor. The photocell is mainly used for outdoor lighting wherein the lighting would get switched on based on sunlight availability. It is also used for indoor areas. The Motion sensor could be used for outdoor lighting to switch ON or OFF based on the movement of an approaching person or vehicle. The Occupancy sensor is mainly for indoor areas to control the switching operation based on occupancy in a given area.

**Based on Coverage of Control** – This is an area based group control system wherein a group of fixtures in a particular area are controlled.

**Others** – The utilization of natural lighting can have a direct impact on the energy consumption for an enclosed area. This would include daylight harvesting to the maximum possible extent, control of window shades (manual/motorized), localized control through individual handsets, etc.

**Dimming Control** – The dimming techniques are:

### Analogue Dimming

- (i) Phase Dimming

A dimmer is used to control AC sinusoidal wave form. Refer Figure-3. There are two types of dimming viz. Leading edge and Trailing edge. There are also dimmers which support both type of dimming or only one type



*Figure 3: Phase Dimming by Dimmer*

Leading Edge Dimming – The dimmer is connected in series with the phase wire and the lighting fixture. The dimmer chops off part of the AC waveform. 1-100% variation is possible. There is no requirement of a control wire. Refer Figure-4. This is more suitable for resistive and inductive loads

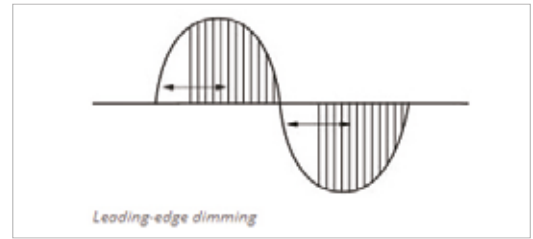


Figure 4: Leading Edge Dimming

Trailing Edge Dimming – The dimmer is connected in series with the phase wire and the lighting fixture. The dimmer chops off part of the AC waveform. 1-100% variation is possible. There is no requirement of a control wire. Refer Figure-5. This is more suitable for resistive and inductive loads

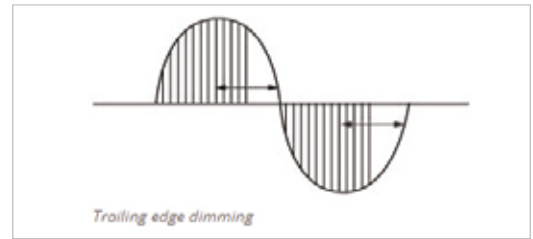


Figure 5: Trailing Edge Dimming

- (ii) 1-10V signal- This requires a two wire control system. Analogue signal of 1-10V is given to the driver of a LED lighting fixture. This is a low cost solution but operation can get affected based on voltage drop in a control cable. The dimming system is unidirectional i.e. the controller gives command to the fixture. The power and control cables both pass through the dimmer. Refer Figure-6.

As per code requirements there can be 8-10 lighting fixtures on one circuit. So, for each lighting circuit a separate signal cable is to be wired from the controller to lighting fixtures.



Figure 6: 1-10V Signal Dimming

The lighting fixtures can be controlled in a group. Refer Figure-7. Once the groups are formed and wired it would not be possible to make changes in future e.g. if two fixtures of group 5 are to be merged with group 6 it would not be possible without doing wiring modifications.

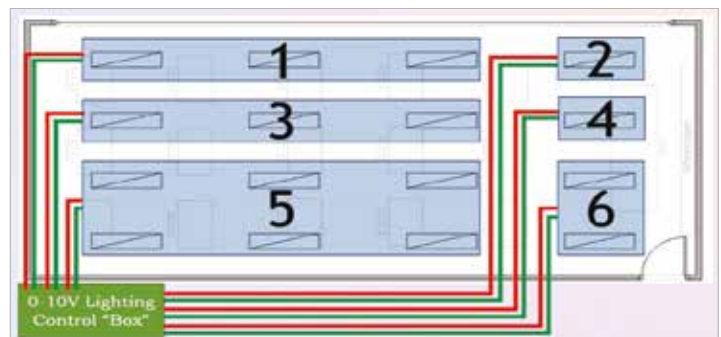
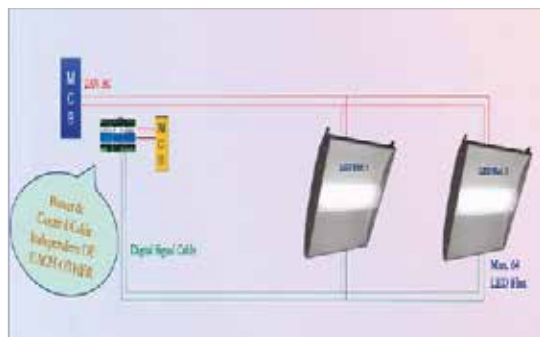
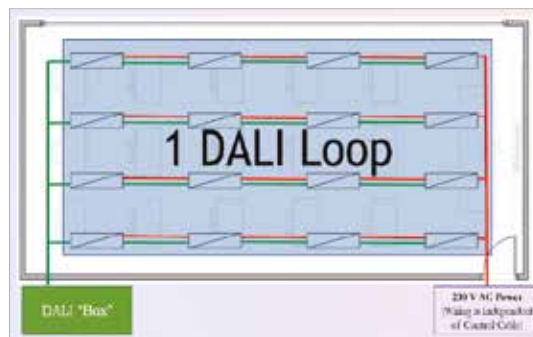


Figure 7: Wiring for 1-10V Signal Dimming

**Digital Dimming-** DALI is a digital automation technology used for lighting systems. This is an international standard as per IEC 62386. While 1-10V analogue control is a one way communication wherein the control system gives commands to the driver, DALI is a two way communication between the LED driver and the DALI controller.

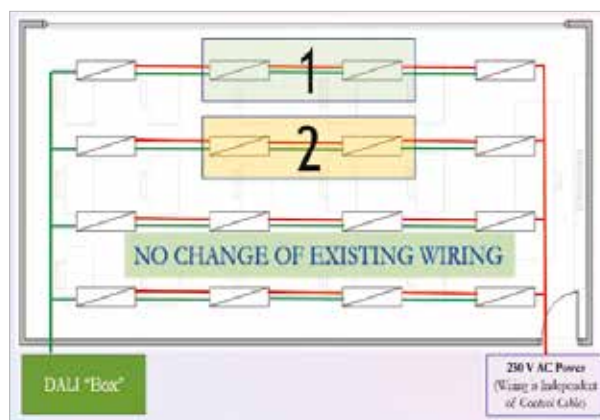


**Figure 8:** Wiring for DALI Dimming



**Figure 9:** DALI wiring One group

Digital signals are given to the driver of a LED lighting fixture. Power and control cables are separate as shown in Figure-8. All the fixtures irrespective of the lighting circuit can be looped (64 fixtures can be looped). Each fixture would have a unique ID and the grouping for control can be programmed. In case of change in interior layout, the control groups can be easily modified through software without any wiring modifications. Refer Figures-9 and 10. e.g. if two fixtures from group 1 are to be separated out and controlled as group 2 it can be easily done through the software. Thus, DALI offers simplicity in wiring and flexibility in operation



**Figure 10:** DALI Wiring Two Groups

## LIGHTING MANAGEMENT SYSTEM FOR AN INDUSTRIAL PLANT – A CASE STUDY

A comprehensive lighting management system comprising a combination of the above methods of control was designed based on area specific needs for a project. The Digital Addressable Lighting Interface (DALI) system was implemented.

**PROJECT BRIEF** –The proposed production shop was a PEB structure with skylight panels for natural lighting. The shop requirement was that 400 lux should be always available at the working plane. The plant was proposed to be operated in two shifts. Hence, all the lighting in the shop would be required to be switched ON at 6AM when the first shift started. Lighting would have to be manually switched OFF after 9AM if it was felt that the natural lighting due to sunlight was adequate. Similar check would have to be done post lunch. After say 3PM the maintenance person would be required to switch ON the fixtures. During monsoon periods or cloudy days the artificial lighting could have to be kept switched ON all the time. Thus, in the absence of an auto system, the operation of lighting fixtures would have to be left to the judgement of the maintenance person. A need was therefore felt to have an automated lighting management system which could ensure the desired lux level at all times through individual control of lighting fixtures plus optimize the energy consumption.

## SYSTEM DETAILS

### The main requirements of the project could be summarized as:

- (i) A comprehensive lighting management system for dimming, day light harvesting, time scheduled control setting, switching, etc. while ensuring to meet the specified lux levels and adding up the artificial lighting only to the extent required vis-à-vis the illumination provided by natural lighting.
- (ii) User interface graphical software wherein it would be possible to configure, control, monitor and analyse from a central location.

A centralized, Lighting Management System (LMS) with Energy Saving & Control measures was considered to provide:

- (a) Daylight harvesting in the Manufacturing block.
- (b) Switch ON / OFF lights automatically to a user defined schedule or occupancy based switching with manual override in offices.
- (c) Provision to dim different ratings and types of light sources. (For the project only LED luminaires were provided).
- (d) Monitor/ Control the entire system in any zone from a single location.
- (e) Provision for Remote Diagnostics and Remote Real Time programming.
- (f) Provision for database archiving such that in the event of data corruption, all the features can be restored without having to re-programme.

### The system components were:

- (a) Routers cum Data Logger units –DALI routers cum data loggers were installed in the respective electrical rooms. The router processor is capable of controlling several zones and has an integral real time and astronomical clock. The data logger facilitates centralised data collection, data logging on real time basis and USB enabled operation.
- (b) Daylight Sensor - The sensor has a field of view of 360 degrees, and is capable of measuring lighting levels in the range of 20 to 3000 Lux and regulating lighting in the range of 40 to 1600 Lux
- (c) Occupancy Sensor - The occupancy sensors can detect movement by sensing natural thermal radiation emitted from any standalone body/ moving body. In addition, the unit features a light level sensor to automatically switch lighting on, under low light conditions. The unit has a coverage distance of up to 6 m and field view of 360°.
- (d) Day light control interface.
- (e) Power switching panels.
- (f) Wall button panels for On-Off operations.

(g) Central Operation Management Station.

(h) Special cables for interconnecting the various components laid in raceways/conduits.

## ENERGY SAVING OPPORTUNITIES

The energy saving measures implemented were Daylight Harvesting, High End Trimming, Time-Based Switching and Occupancy sensing. A typical wiring is shown in Figure-11.

**Daylight Harvesting** – The lighting fixtures in a given area are dimmed based on the availability of natural lighting to achieve the desired lux level. The daylight sensor senses the changing light conditions throughout the day and adjusts (switches ON/OFF/Dims) the lights.

**Occupancy Sensing** – They control the lights in specified zones based on occupancy.

**High End Trim** – This is dimming of fixtures without affecting the comfort level e.g. those fixtures whose lumen outputs have not depreciated.

**Time Based Switching** – Operation based on time scheduling.

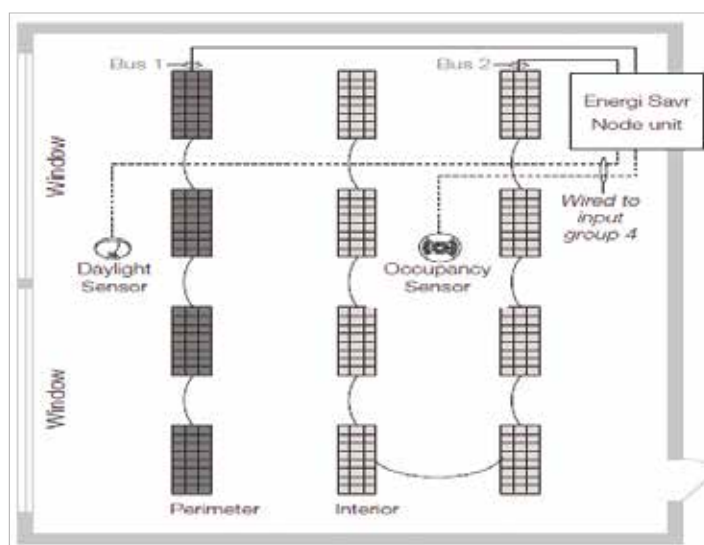
The possibilities for energy saving have been analysed area wise and the measures have been implemented accordingly. Some of the examples are as below:

Cabins/ Rooms- Occupancy sensing + High End Trimming

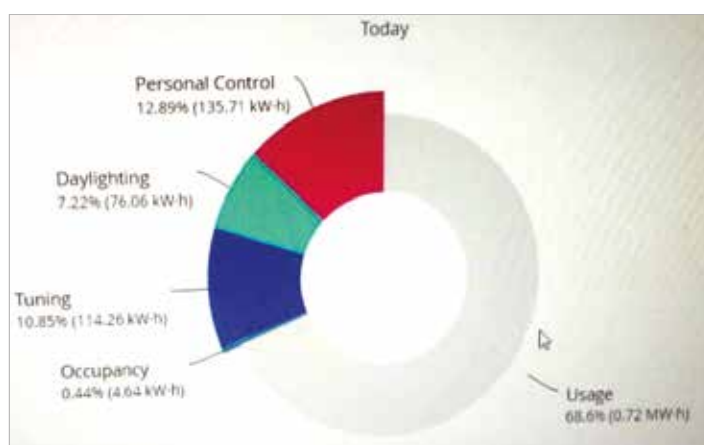
Open Office/ Common areas – Occupancy sensing, High End Trimming, Daylight harvesting

Shop areas - Daylight Harvesting, Time-Based Switching

Over 500LED High Bay fixtures were provided in the Shops and over 400 LED tube lights in the Offices. The dash board screen shot for one day is shown in Figure-12. The saving on the particular day was about 30%. The personal control mentioned in the Figure is also done remotely from the Operation Console in the Control Room.



*Figure 11: Typical wiring*



*Figure 12: Dash Board showing Energy Saving*

## CONCLUSION

### Implementation of the lighting management system resulted in the following benefits:

- (a) No manual control (hence no physical contact thus being a health compliant design).
- (b) 20-30% saving (For a given project, specific analysis would have to be done considering the requirements like nature of operation, extent of use, extent of imported items, etc. before arriving at a decision).
- (c) Optimum level of lighting for an enhanced user experience.
- (d) Single point software based control and monitoring.
- (e) Integration with other systems like BMS.
- (f) Lamp burning hours, Lamp failure identification and reporting.
- (g) Availability of customized alerts.
- (h) Dashboard view.
- (i) Improvement in life of LED fixtures due to dimming, and
- (j) Wireless devices and sensors providing flexibility of use.

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### Why Legislation is essential for the Engineering Profession?

1. Accord a legal status to the Profession of Engineers,
2. Restrict the usage of the title and style of "Engineer",
3. Regulate the profession of engineering and create a cadre of engineers of high caliber in all the disciplines in a sustained manner,
4. Uniformly decide across the country on the qualification, competency and experience requirements of engineers for a particular work,
5. Direct that each and every engineer continuously updates knowledge and skills,
6. Regulate entry of foreign professionals and also have a reciprocal arrangement for acceptance of Indian engineers in other countries,
7. Discipline engineers and bring in accountability and responsibility,
8. Take up the issues of the engineers with any authority, and
9. Keep track (through Ministry) of number of engineers graduating in each field,

**A P Mull** | Chief Editor ViewPoint, Past President CEAI, Former CEO & MD, TCE Consulting Engineers Limited

## CONSTRUCTION TECHNOLOGY FOR AFFORDABLE HOUSING



**Arun Kashikar**  
Associate Partner  
Shashank Mehendale and Associates

### INDIAN REAL ESTATE INDUSTRY AND AFFORDABLE HOUSING

The Indian Real Estate Industry is going through tiring times. On one hand there is oversupply of units in premium and luxury housing segments resulting in average 3 to 4 years of inventory overhang across the cities, while on the other hand there is huge demand-supply gap in the affordable housing segment. Most of the projects are also getting delayed; the average delay being about one year across sectors.

The current shortage of affordable homes in India exceeds 24million units. Labour is also in short supply and this shortage is likely to increase with time. Besides, the productivity of Indian labour is much lower compared to many other countries of the world. With the current labour dependent construction practices and increasing shortage of labour, meeting the current housing demand, especially in affordable housing sector, is an uphill task.

The global pandemic of Covid-19 is going to change the way that the construction industry will function in the future. The Construction industry depends on migratory labour which may reduce drastically due to the issues they faced during the pandemic.

### CURRENT TECHNOLOGY USED FOR HOUSING CONSTRUCTION IN INDIA

More than 90% projects in India are being constructed using Beam-Column RCC framed construction with brick infill masonry walls. This technology has many limitations viz.

- 1) Only RCC beam column frame, which consumes hardly 10% volume of the entire structure, is load bearing part of the structure, while the major part of the structure like masonry walls are loads acting on these frames. This makes the structural system highly inefficient.
- 2) Masonry walls are mostly made up of red clay bricks, which are highly unsustainable material – climatically, as the top fertile soil is used for their manufacturing. Besides, brick manufacturing kilns at times employ child labourer.
- 3) This type of construction requires the masonry walls to be plastered, a process which is very laborious.



*Conventional construction technology – beam column frame with brick infill wall*

- 4) The entire RCC structure is cast-in-situ at site using wet concrete and there after the masonry walls also a site work which is again labour intensive and therefore highly vulnerable from safety and quality perspectives.

Considering the above, it is essential to adopt newer technologies which would make the structural system more effective, climate friendly and require lesser manual labour at the construction site. Safety and quality also need immense improvements and that could happen only if construction is modularised and moved to an off-site location or even if at site for very large projects, in a controlled area.

### MONOLITHIC CONSTRUCTION

This utilises lightweight aluminium formwork system, wherein all the elements of one floor including walls, slabs, staircase, etc. are cast in one go, resulting in saving of construction time. The form work can be used for more than 100 repetitions, thus achieving economy.

#### **This technology overcomes major limitations of conventional technology viz:**

- 1) The structural system is shear wall–slab system, hence a major portion of the structure comprises load bearing element instead of just adding to the dead load thus making the structural system very efficient.
- 2) Plaster is eliminated with smooth off-shutter finish, making it less labour intensive.
- 3) Since the entire floor is cast in one go, a typical slab cycle is 7 days, making it much faster compared to conventional mode of working, wherein the typical slab cycle is 15 days or more.

### REINFORCED CONCRETE BLOCK SHEAR WALL-SLAB SYSTEM



*RCB – under construction, New Haven, Ahmadabad – Tata Housing*

The Reinforced Concrete Block Shear Wall - Slab System is an improvement over the conventional load bearing wall construction, which was prevalent but now largely replaced by RCC framed construction. The conventional load bearing construction went out of vogue because of two issues – a) Strength of bricks used was limited by the quality of local clay available, which required thicker walls as the height of a building increased, and b) structures constructed using this technology were poor in earthquake resistance. Recent advancements have made it possible to manufacture high strength concrete blocks, which can replace conventional clay bricks. That resulted in keeping

the wall thickness to 200mm even for a seven storey building. Introduction of reinforcement and ductile detailing of the structure made it one of the best systems for earthquake resistant structures. In fact, RCB is used as earthquake resistant seismic rehabilitation structures in almost all earthquake prone areas in India.

**This technology has many advantages viz.**

- a) Customer acceptability is not an issue, as look and feel is same as conventional construction.
- b) There is a significant cost and time saving compared to the conventional construction.
- c) Specialised labour is not required as this is adaptation of conventional load bearing structure used in India for many years.

**There are some limitations also, which restrict its use to houses:**

- a) As most of the walls are load bearing, modification of walls post construction is not possible.
- b) Load bearing wall thickness of less than 200mm is not desirable, thus the wall loading per se increases.
- c) This technology cannot be used easily for the structures more than 10 storeys high.

## PRECAST TECHNOLOGY



*Precast construction - under erection at Peenya, Bengaluru – Tata Housing*

A solution to reduce the labour dependency at site is to change the place of construction from sites to a controlled factory like environment where precast concrete elements could be prepared for construction. Since, in this case, a number of cranes and allied equipment are required and structure have to be designed for 'handling stresses' in addition to the usual loads/ forces, the cost of structure becomes slightly higher compared to conventional construction. Therefore, cost effectiveness in precast construction can be achieved only when volume of construction is high and time saving is significant.

Precast was introduced in India around 70, almost simultaneously in infrastructure and housing. Its use was mainly limited to government projects. Joint detailing and their sealing were an issue and delayed its adoption on a mass scale.

The precast industry for buildings globally has evolved over the years and with improvement in processes new systems as given below were introduced.

- 1) Hollow core slab: Prestressed, pretensioned hollow core slabs, suitable for large spans. Mainly useful for commercial buildings, parking shades, etc. where large uninterrupted spans are important.
- 2) Double wall + filigree slab: This combines the advantage of precast and cast-in-situ monolithic construction. There is a monolithic cast-in-situ concrete layer on both – the wall and the slab, which eliminates chances of leakages though joints.
- 3) Long wall-slab system: This is a precast shear wall, slab system. In this case there are multiple joints, which need to be detailed properly to avoid leakage. A suitable sealant from outside is a must in addition to non-shrink grout and joint detailing.
- 4) Pre-finished, Precast, Volumetric Construction (PPVC). In this system, three dimensional precast modules are cast, fully finished along with services and architectural finishes, then lifted and placed in position and joined side by side and one above the other to construct a high-rise building.
- 5) Tilted wall system - large wall panels are cast on ground and tilted up: This is useful for low rise structures.

There are various types of equipment/ combination of equipment used for precast construction. Two major types of precast plants used are:

- 1) Battery moulds and tilting table combinations with or without hollow core slab unit: In this case battery moulds are used to cast typical walls and tilting table is used to cast ‘non-typical walls’ and other elements. Slab can be cast either using hollow core machine or using separate slab moulds.
- 2) Carousel plant



*Carousel plant at New Haven, Peenya, Bengaluru, Tata Housing*

The carousel plant is very similar to car factory, wherein all elements of a building including walls and slabs are cast on workstation known as pallets. Pallets move on pedestals from one workstation to another after time required to complete particular activity is over. The plant can be fully automated with minimal manual intervention. The elements cast in this factory are then moved to site, erected and joined to complete the building.

**A precast system has its pros and cons. The limitations are:**

- 1) **Transportation Cost** – A central plant serving various sites in a radius of 100 km becomes feasible only if minimum production from the plant is approximately 0.3 million sqm per year. In case of volume less than this, transportation cost becomes prohibitive. For volume around 0.1 million sqm per year, a site based plant is most suitable, which not only avoids transportation cost but attracts less GST as this is treated as a captive plant.
- 2) **Sales Velocity** has to be in line with the production capacity: If the plant has to stop production intermittently due to sales velocity not matching with the production capacity, a precast plant becomes commercially unviable.
- 3) **Design before Production:** It is very essential to finalise the entire design before production starts. There can be no changes once the forms are made.
- 4) **Structural Design:** Design of precast structures differs from a cast-in-situ one. Aspect such as design for progressive collapse and partial failure need careful consideration. Joints not only need careful detailing but also need rigorous testing for leakages.
- 5) **Cranes:** Precast construction invariably needs mechanisation and a system of very heavy cranes.

**On the other hand, precast construction has many advantages, some of which are:**

- 1) The entire construction is done off-site in a controlled factory environment, making it one of the safest ways of housing constructions.
- 2) **Quality Control** is excellent since it's more easily achievable for all the elements as the work is done in a controlled factory environment.
- 3) The finish is excellent.
- 4) **Labour requirement** at site is reduced by 60% as compared to cast-in-situ construction. With a mechanised and an automated factory, the labour requirement in the plant is also small.
- 5) **Construction time** is reduced by 50%.
- 6) **Material wastage** is minimal, practically zero.
- 7) Since the technology is much less dependent on manual labour, on-time completion of projects can be ensured.

### 3D PRECAST

The 3D Precast technology is an advancement over plain 2D precasting technology, wherein three dimensional modules are cast in the moulds, off-site. A series of the 3D modules are then transported and erected at the construction site to make the complete building. The advantage in this case over plain precast is reduction in number of joints, making it less vulnerable to leakages through joints.



### GFRG PANELS SHEAR WALL SLAB SYSTEM

In this panels made up of ‘Glass Fibre Reinforced Gypsum’ are fabricated in the factory. These panels are then transported and erected at site like precast concrete construction. Climatically this is a very sustainable technology since the panels are made up of phosphogypsum, which is a byproduct of the fertilizer industry and recycled glass fibre.

### 3D PRINTING FOR CONSTRUCTION

3D printing is disrupting the entire manufacturing industry including the housing industry, however, there is much more development necessary and a long way to go before it becomes practical and affordable for housing construction. A major hurdle currently is the availability of printable construction material which has good compressive as well as tensile strength in addition to other essential properties like modulus of elasticity, durability, etc. However, it will be the in thing in due course of time.

### CONCLUSIONS

Though the Indian Real Estate Industry has remained largely conventional till today, it has started moving towards industrialised construction due to labour shortage, labour productivity and quality issues which lead to projects delay. Introduction of RERA, and the likely labour shortage as an aftermath of the Covid-19 pandemic will further enhance use of industrialised construction. Project completion on time is also becoming legally binding and that also would further enhance automation in the industry. Adoption of sustainability and health safety considerations will be very important aspects and will govern any new technology becoming popular. Precast construction offers immense possibilities especially to provide low cost accommodation at a fast pace in lieu of unauthorised temporary hutments which are the bane of a clean environment and consequently health.

## SYSTEMS FOR ECOLOGICAL, SUSTAINABLE, RESILIENT AND SOCIALLY RESPONSIBLE RIVERFRONT DEVELOPMENT



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**C R Indumathi**  
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### SYNOPSIS

Rivers have been the spring points for civilisations and have sustained numerous settlements - villages, towns, cities and mega-cities since human life appeared. As civilisations matured, rivers also served as a connection between the landscapes and communities. They became the means of involving the people for bringing in ideas for a creative and sustainable environment friendly form of living as per the codes that evolved. Hence, even in the present times, it is imperative that people from all strata of society, private and public stakeholders are involved in the development of river management plans since then all would feel being a part of the system. Creation of a sense of participatory ownership would result in effective solutions to harness the natural resources. Integration of natural and cultural landscape values of the river in historically important areas would create potential tourism centres in those regions and would also improve river tourism and recreation in a sustainable manner. Thus, the main aim of river restoration studies is to provide both economic and ecological benefits. Development plans of cities/ towns abutting rivers should focus on the sustainable ecological characteristics of rivers. Besides, the boundaries of the floodplain should be determined and dealt with appropriately. Hence, it is important that both urban open and green space systems in these areas are evaluated so that the public are benefitted.

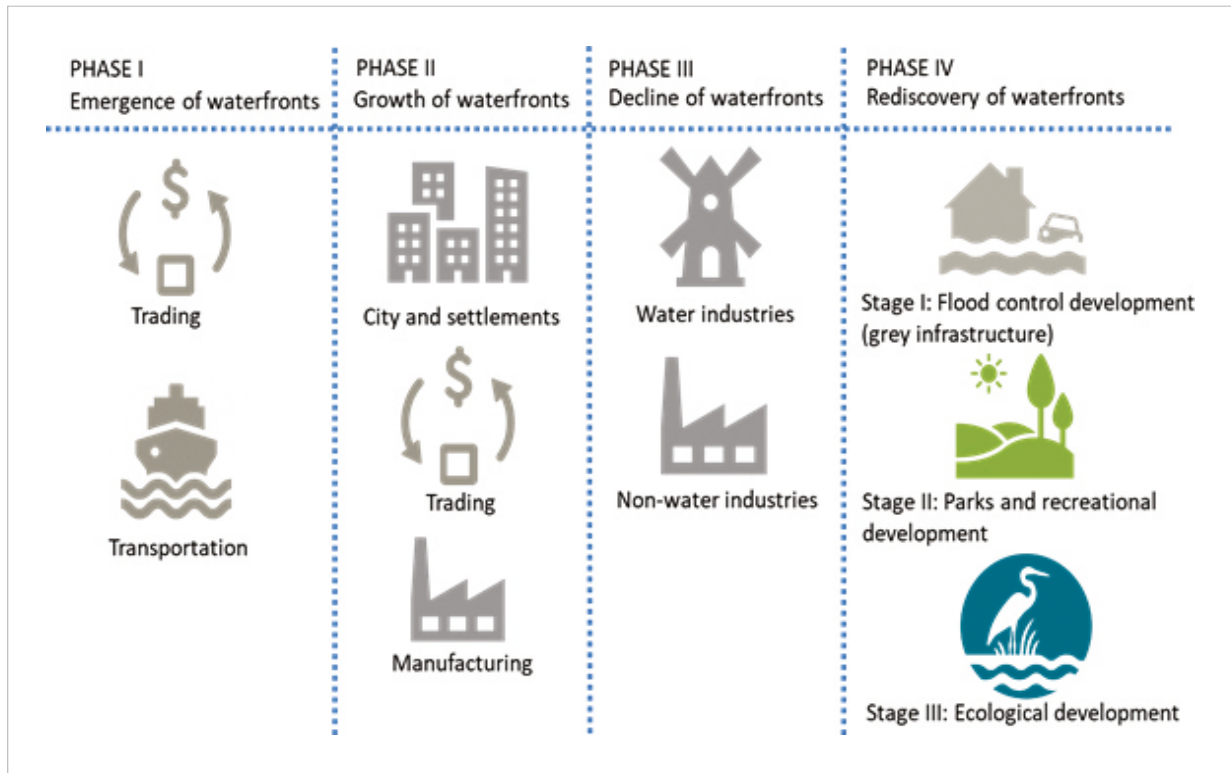
### INTRODUCTION

#### The River Front Development

As mentioned above, historically, human settlements have clustered along the river banks due to the plentiful availability of resources - food and water. These settlements developed into large urban centres when trade and commerce developed. However, the dawn of the industrial era with growing urban populations and economic activity turned the rivers abutting the urban areas from freshwater sources to polluted water streams, carriers of industrial and human wastes produced in the urban centres. The 20<sup>th</sup> century, witnessed a resurgence of urban riverfront development with enhanced focus on commercial, retail and residential use, along with vibrant public spaces, resulting in a competition for development of prime riverfront properties. The urban river front development design and planning strategies have to be integrated with water management policies to allow cities to respond better to urban hydrological cycles and extreme weather events.

Urban riverfront development projects invariably focus on the built environment (construction, landscaping and beautification) and the potential economic benefits to be derived. There is limited consideration of the social, hydrological, environmental and ecological concerns in these projects. Discounting these aspects of riverfront development can lead to severe hydrological, ecological and environmental impacts as well as disasters like urban floods and loss of life and property. Hence, it is essential that a proper system is evolved to emphasise on all aspects relating to engineering methodology, environmental factors, social and economic considerations keeping sustainability as the guiding principle.

Phasewise riverfront development systems are shown in the Figure-1.



**Figure 1:** Systems for Riverfront Development

*(Source: NMCG’s Riverfronts in India, Guidance Note for Environmentally Sensitive, Climate Adaptive and Socially Inclusive Urban Riverfront Planning and Development Document)*

Effort has been made to present a few river front development projects briefly explaining the salient features of the projects and then summarize the use of sustainable materials adopted.

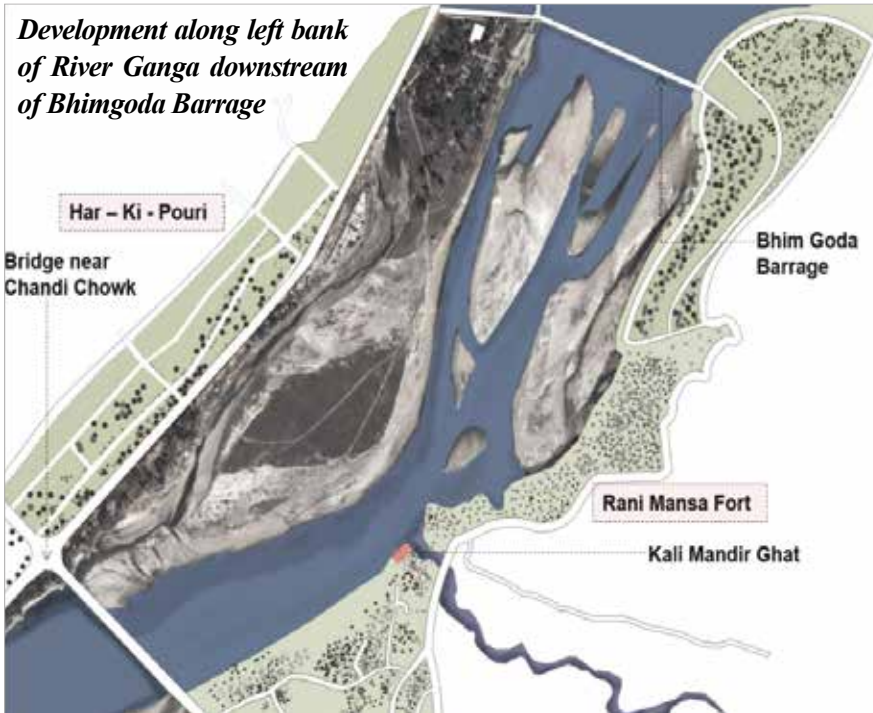
**CASE STUDIES: THE RIVER FRONT DEVELOPMENT**

**1. CHANDI GHAT RIVER FRONT DEVELOPMENT (RFD), A PROJECT OF NATIONAL MISSION FOR CLEAN GANGA**

About 1.2 km downstream of the Bhimgoda barrage along the left bank of river Ganga, there is a small hillock called “Rani Mansa Devi Fort” now popularly known as “Peer ki Samadhi”. The elevation of this point is much higher than the river bank which is a hard mixed clayey soil. The stretch is almost 767 m long along the Ganga, of which 627 m is a bathing ghat and 140 m is the crematoria.

Based on Site Analysis, Condition Assessment and Contextual Analysis, facilities have been developed as a part of the development of Chandi Ghat. The photographs illustrate the development of this stretch and the facilities provided. The ghat is located close to Chandi temple and Kali temple. A large number of tourists visit Chandi temple. The accessibility to Chandi Ghat is through road, by foot or ropeway.

*Development along left bank of River Ganga downstream of Bhimgoda Barrage*



**COMPONENTS OF CHANDHI GHAT DEVELOPMENT**

- River Protection works
- Bathing Ghat
- Extension of Bathing Ghat
- Crematoria
- Intake Well
- Chlorinator
- Overhead Tank and Water Supply Network
- Sewage Treatment Plant and Sewage Network
- Visitor Information Centre
- Parking in Cremation Ghat
- Parking in Bathing Ghat



## 2. PATNA RIVER FRONT DEVELOPMENT, A PROJECT OF NATIONAL MISSION FOR CLEAN GANGA

Patna’s riverfront development along the Ganga river has been an on-going project with various state and local agencies leading the site work. Initially conceptualized as an urban improvement project by the State Tourism Department, the 6 km riverfront project was implemented by the Bihar Urban Infrastructure Development Corporation. The project obtained funding from The World Bank and the National Mission for Clean Ganga. The project aimed to improve the condition of existing ghats along the Ganga River in Patna City and add new ghats to increase high-quality urban space for citizens and eventually increase tourist footfall to the riverfront.

There were challenges such as construction of a major expressway by the National Highway Authority of India impinging on the view from the riverfront as the work was by a different agency. The State Water Resources Department and the Inland Waterways Department were also required to be a part of the implementation strategy to provide clearance for riverbank constructions and to manage water level and water releases from upstream areas during construction. Land acquisition along the riverfront was another major concern where there were both informal settlers who had to be rehabilitated and private homes and campuses abutting the river edge. With only a narrow strip of land available to develop this project construction had to enter into the river space in certain stretches to accommodate the design. The project also carried a risk of flooding in case of rise in the water level during the monsoons.

The project focused primarily on increasing riverfront (ghat) space in the form of hardscaped surfaces for people to be able to access a longer stretch of the river. Existing historical and cultural spaces were retained in the design and their appearance augmented. The riverfront development also implemented a continuous riverwalk of 6 km connecting all (existing and new) ghats and added amenities such as lighting, seating, toilets, drinking water points, food stalls, etc. In most of the ghats the existing trees, historic and religious structures were retained, but additional greenscaping was provided.

Larger community amenities such as an Electric Crematorium, Convention Center and Theatre space have also been constructed. Some of these spaces are expected to function as paid services and help generate revenue to support O&M works for the riverfront. Public artwork has also been included extensively along the riverfront to improve the quality of the public realm. Basic interception mechanisms were implemented where drains and storm drains flow into the river to minimise solid waste inflows.



*Riverfront Development along River Ganga at Patna*

### 3. DRAVYAVATI RIVER FRONT DEVELOPMENT, JAIPUR

The Dravyavati riverfront development is envisioned as an enhanced public space for citizens of Jaipur and includes public plazas, parks and a riverwalk. This 47.5 km long project also aims to improve the river quality which had deteriorated in the 20th century due to reduced rainfall, industrial and domestic wastewater outflows and siltation. Based on a watershed approach the project is also geared towards pollution abatement, flood management and to improve river ecology. The deteriorated river condition was the primary challenge in this project with the river having turned into a wastewater stream (nalla) carrying domestic and industrial effluents. Reduced rainfall had also led to lower flows in the river with stretches of stagnation leading to unhygienic conditions along the river. Encroachments onto the river floodplain also impacted the flow of the river and posed a risk of flood to dwellings in the region.

The prime restoration work was the channelization and concrete lining of the river. Along with this there was extensive greening that has been undertaken with sixteen parks along with a

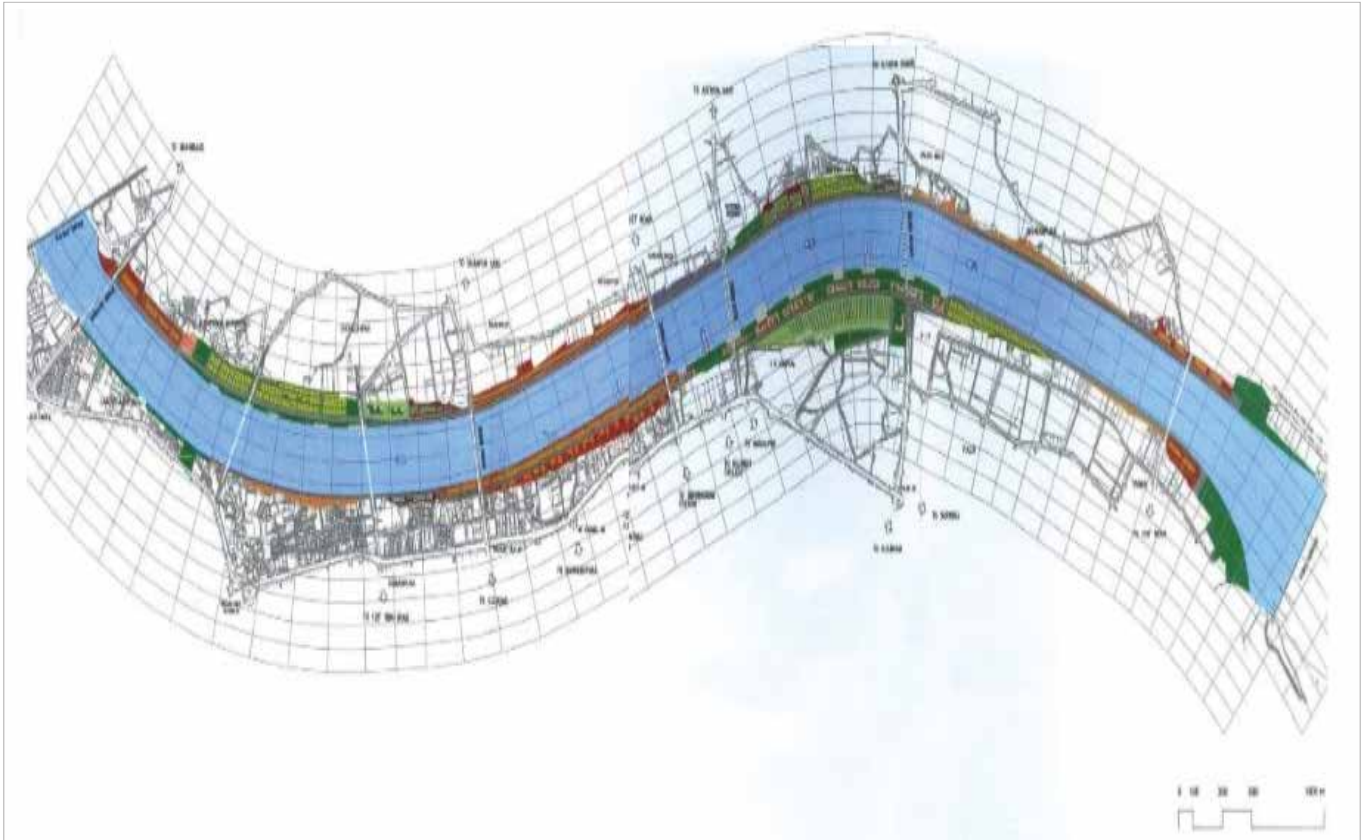


botanical garden, shaded sit-out areas and seven plazas as urban nodes where main roads intersect with the river. A promenade stretches along the entire length of the urban river. The other side of the river has a continuous tree-scaped and grass lawns along the embankment which abuts a road. Enhanced public space for users incorporates plaza space, green space and a walkway. It is a barrier free space ensuring that able and differently able-bodied persons can access this space.

### 4. SABARMATI RIVER FRONT DEVELOPMENT

Sabarmati River Front Development Project is a 16 km stretch urban project conceptualised to significantly improve the habitat, structure and conditions of the river and its adjoining areas. The Riverfront Development reclaims the banks of the River Sabarmati which are publicly accessible. The project covers ten kilometres of continuous pedestrian promenade on either banks and the public Ghats that have direct access to the water. Recreational parks and sports facilities, gardens and plazas constitute 85% of the proposed riverfront development. Inclusion of civic and cultural institutions such as exhibition spaces, monuments, museums and amphitheatres has significantly enhanced the availability of civic amenities.

The key element of this project is a linear promenade designed in two levels.



The upper promenade consists of public buildings, parks and plazas, commercial development and institutional buildings. The lower promenade which is 10 m wide, provides uninterrupted pedestrian access to the water and lies just above the water level. The project has created public spaces in the heart of the city which includes public parks, gardens and shaded plazas. All streets have dedicated cycle tracks, pedestrian paths, parking bays with 6 m wide carriageways. The streets have been planned to serve as effective circulation conduits along both the banks thus providing continuous access to the riverfront development. Relocation of affected population and development of reclaimed land into informal markets were undertaken as social influence measures.

For construction of embankments, Reinforced earth panel technology has been adopted. The technique combines three elements – strong reinforcements, modular facing panels and controlled backfill that form a durable retaining structure. Fish breeding to curb mosquito menace and infiltration wells for ground water recharge are some environmental initiatives adopted.

### **USE OF SUSTAINABLE MATERIALS: GRASS CRETE, BAMBOO, RENEWABLE ENERGY IN THE RIVERFRONT DESIGN**

**Grass crete:** Grass cretes are porous pavers that allow ground cover to be planted and also allows emergency vehicles access and landscaping at the same time and has a controlled runoff.

These materials have been used in Dravyavati Riverfront, Jaipur and enable River Front Developments to embrace maximum use of pervious surfaces



*Use of pervious pavers instead of full concrete cover*

Bamboo frames, wooden platforms supported by bricks and shaded by jute cloth stretched across over bamboo poles, cloth/ burlap strung over ropes stretched between bamboo poles for commercial activities provide ideal ways to create some amazing forms of shelters. Bamboo is



a versatile material, deployable for structures such as Changing Rooms, Pavilions, Seating's instead of hard concrete structures along the river fronts.



*Use of Sustainable materials- Bamboo use for the riverfront design - Deployable Changing Rooms at Ghats*

**USE OF REFLECTIVE CONCRETE MATERIAL IN DESIGN OF SPACES - LIGHT TRANSMITTING CEMENT**

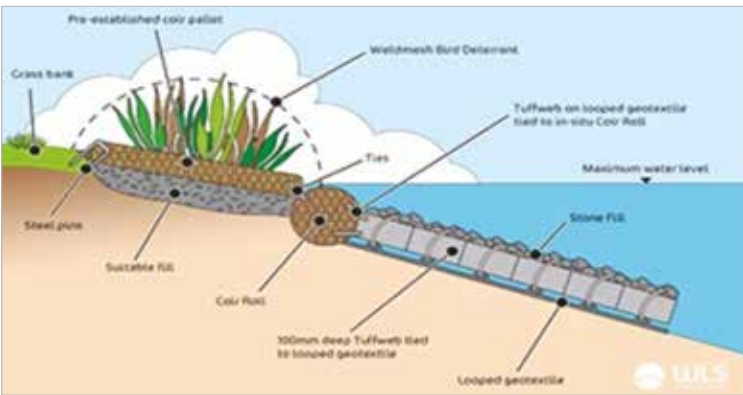
Light transmitting cement is emerging as a new sustainable material as it addresses the lack of sustainable solutions in the construction and cuts down the carbon foot print and is also affordable. This cement has the capacity to absorb and irradiate light energy and provides greater functionality and versatility to concrete with regards to energy efficiency.



The durability of light-emitting cement is estimated to be quite high due to its inorganic nature, and its material components which are easily recyclable. This new material is obtained by polycondensation of raw materials (silica, river sand, industrial waste, alkali, and water). The cement acts as a light source for dark walkways without creating light pollution which disturbs wildlife and humans alike and is charged by natural light from the sun.

**EMBANKMENT TREATMENT**

This is another area where sustainable materials can play a larger role. In most of the riverfronts there is extensive use of sacks and blocks as a means of protection of banks. However, the sacks are made of plastic and would cause plastic pollution when they get damaged due to weathering action and cause extensive ecological imbalances. Hence, blocks and sacks are not a good method of treatment from the viewpoint of riverine ecology. An ecologically sensitive approach needs to be adopted and use softer bioengineering based bank protection like pole planting and coir roll, wherever hydrologically feasible. However, if engineered revetments are necessitated from hydrological considerations, it would be better to use gabions and mattresses instead of sacks and blocks.

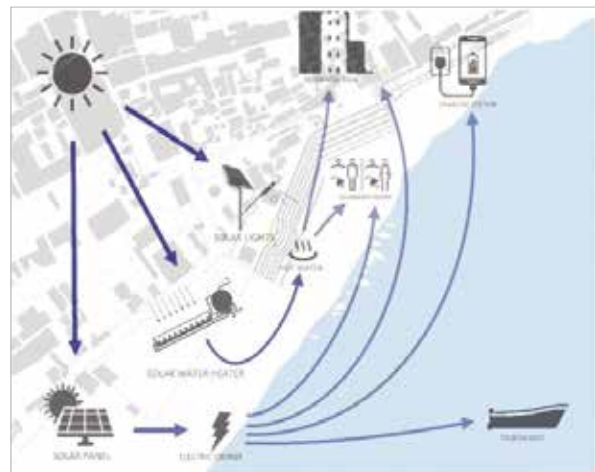


*Softer bioengineering based bank protection approach like pole planting and coir role*

**Use of Solar Lighting, LED luminaires in River Front Developments for efficient and energy conserved lighting.**



*Solar Panels*



*Use of Renewable Energy Sources*

More and more cities are incorporating environment friendly measures while designing their riverfronts. Solar Lighting is being widely used in for development of riverfronts now.



Different types of solar lighting are used in riverfront developments. The Pedestrian roads, Natural trail, Activity zones like Kids play area and Pathways in park are provided with High post top lights. Bamboo bridges, Viewing decks, Cultural hubs, Parks, Open Gyms, Health park, Organic Farm areas are provided with Post Top Lights. Further, Bamboo bridges can have uplighters and the viewing Decks can have down lighters. Cultural hubs can have both Up and Down lighters to highlight the features. The Ghats are provided with mast lights and vehicular roads could have double arm street lights. Bunches of trees are provided with LED strips which enhance the aesthetic appeal.

## CONCLUSION

A properly designed riverine ecosystem provides many benefits such as groundwater recharge, microclimate control, increasing biodiversity and controlling floods. Further, healthy urban rivers can also support fishing, recreational activities and water activity-based tourism as livelihood options for citizens. Adoption of sustainable measures and incorporating in to design the use of locally available environmentally safe materials would make these projects economically viable and provide many other benefits. Use of sustainable renewable energy measures especially solar lighting would make the project not only aesthetically pleasing but also accrue economic benefits.

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## VR AR TECHNOLOGY FOR OIL & GAS INDUSTRY IN A PANDEMIC



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### 1. BROAD STRUCTURE OF THE OIL & GAS INDUSTRY AND ITS CHARACTERISTICS

The Oil & Gas sector was considered as one of the largest industrial sectors in the world in terms of dollar value prior to the lockdown across the globe. As per reports as recent as March 2020, the combined business in the entire value chain of this sector was in multiples of Trillions of dollars. Although the global lockdown due to the current pandemic has resulted, and is likely to continue to result, in a drastic fall in global revenues, yet this sector can be expected to revive once the world gradually gets back to regular operations.

The Oil & Gas Sector as a whole is broadly broken up into three groups namely Upstream, Midstream and Downstream, as depicted below:

Upstream	Midstream	Downstream
		
<p><b>Exploration &amp; Production</b></p> <p>Exploration of new oil &amp; gas fields. Field development. Drilling and Oil &amp; Gas production.</p>	<p><b>Transportation, Processing &amp; Storage</b></p> <p>Submarine and land-based pipelines. Oil &amp; Gas processing. LNG production. Storage.</p>	<p><b>Refining, Petrochemicals</b></p> <p>Fuels, intermediates. Petrochemicals, Plastics, fibers. Ammonia, Urea based fertilizers.</p>

This industry is characterised by the involvement of multitude of stakeholders and complexities of operations and of design/ engineering and project implementation processes. Further factors such as the following make the operations in the value chain of this sector all the more challenging:

- Remote locations of the Oil & Gas facilities.
- Risks and costs involved in creating (and re-creating) real situations for imparting training to personnel in wide ranging functions, especially those pertaining to hazardous environments.
- The need to urgently resolve issues at plant sites so as to avoid forced shutdown of plant operations, or for several other reasons.
- Difficulties involved in undertaking maintenance and troubleshooting of complex machineries.
- Involvement of multitude of stake-holders operating from distant locations and the need to have their participation at one location for purposes such as joint project reviews, inspection of critical machinery, etc.
- Several others.....

The significant growth in this sector in terms of volume of business as well as development of advanced process technologies, project implementation of processes and plant operations has been made possible due to advent and emergence of thousands of innovative technologies, manufacturing processes, work methodologies, all leading to production of new materials as well as greater efficiencies of operations.

Against this backdrop, the situations caused by Pandemics which necessitate distancing of personnel, add very significantly to the challenges faced by the industry. It is in this context that the emerging digital technologies of Virtual Reality (VR) and Augmented Reality (AR) play an important role in helping the industry to overcome these challenges.

## 2. BASIC ELEMENTS AND FEATURES OF VR AND AR TECHNOLOGIES

Digital technologies have been playing a critical role in the rapid growth seen by various sectors of Industry, in their entire value chains covering all the business functions. Emergence of immersive technologies of VR and AR have particularly been revolutionising the way business is conducted in a wide range of sectors of the economy such as Energy and Oil & Gas, Infrastructure projects, Manufacturing, Healthcare, Aviation, Education & Training, Tourism and so on. As regards the Oil & Gas sector, the applications of VR and AR are seen to cover the complete range of the sector's value chain in all its business functions. Very broadly, the essential features of VR and AR are:

### a) Virtual Reality

Virtual Reality is an immersive multimedia or computer-simulated environment that mimics physical presence in the imaginary world. It also lets the user interact with that world. It can artificially create sensory experiences, which can include sight, hearing, touch and movement.

### b) Augmented Reality

Augmented Reality provides a live view of the physical 'real world' where digital elements are overlaid or superimposed by computer-generated graphics, sound, haptics or GPS data. It can also provide new ways to interact with digital information within a user's field of view - including voice control, head motion, hand gestures, smell and touch.

### 3. DEVICES FOR VR AND AR

A very brief overview of some of the important hardware items used for VR and AR applications is provided below.

As the name “Virtual” suggests, the Headsets used for Virtual Reality permit a view of only the “virtual” world and the real surroundings are completely blocked from the user’s view. When the user wears the VR headset, the user is taken to the midst of an entirely new and imaginary environment and surroundings with which the user can interact. Among the major suppliers of VR Headsets in the world, Oculus and HTC are some of the popular brands:



*Oculus Quest*



*HTC Vive Focus Plus*

Both these models are standalone type, in the sense that they do not need to be connected with a PC or a laptop since they have their own memory and software. There are other earlier models such as Oculus Rift, HTC Vive which were the so called “tethered type” requiring to be connected to a PC.

Among the popular brands of the devices for Augmented Reality are Microsoft HoloLens developed by Microsoft, and HMT1 developed by RealWear:



*RealWear HMT-1*



*Microsoft HoloLens*

Both these devices are suitable for outdoor environment and can be worn along with hard hats or helmets. They can be readily used at construction sites where the site based personnel wearing these can collaborate with the experts based in the design office or the project office of an organization.

The relevance of VR and AR to Oil & Gas industry and their typical use cases especially for maintaining social distance are described below.

#### 4. RELEVANCE OF VR AND AR TO OIL & GAS INDUSTRY

Some of the underlying reasons that VR and AR have the potential to play an important role in all the various business activities in the Oil & Gas Sector are:

- The immersive nature of the VR technology imparts a very good understanding of the environment to the user with very high level of knowledge retention in mind. This makes it suitable and effective for training, familiarization and orientation of personnel of an organization. This is demonstrated to be far more effective as compared to conventional methodologies used by industry such as Training manuals, Operations & Maintenance manuals, Lecture series with PowerPoint presentations, Demonstration of operations, etc.
- This feature of VR also enables immersive presentation of complex systems such as process plant sections, internal configuration of complex machinery such as compressors and turbines to the project teams or to client teams having interest in procuring such systems.
- The superimposition of the virtual on the real through the AR technology opens up a large number of possibilities in the way collaboration can be brought about between distantly located individuals or groups.
- The superimposition feature of the AR technology enables the readily available visualization based work instructions and guides which obviate or substantially reduce the dependence of inexperienced personnel on the conventional O&M manuals and/ or the expert assistance and supervision.



*VR training in Oil & Gas Plant Operation (courtesy Unigine website)*



*AR based Remote Assistance (Courtesy Microsoft website)*

While the Oil & Gas sector did experience initial hurdles in acceptance and implementation of VR and AR solutions, the situation is seen to be fast changing.

Global Oil & Gas companies as well as several EPC Contractors of global repute are seen to be adopting these technologies through deployment of a wide range of applications in various use cases and functions in their routine operations<sup>2</sup>.

## 5. CHALLENGES FACED BY OIL & GAS INDUSTRY IN PANDEMIC SITUATIONS

A global pandemic situation calls for rigorous social distancing and that results into several challenges for the Oil & Gas industry:

- Quarantining of personnel, business closure/ slowdown, impact on material availability, travel ban, closure of establishments and operations, impact on educational institutions, etc.
- Urgent need for substitution of regular personnel by new teams - this may call for extensive training before the new team starts fully contributing.
- Emergency troubleshooting work hampered due to non-availability of experts due to travel difficulties, leading to possible interruption in operations or leading to shutdown.
- In person meetings for purposes such as project reviews, review of construction work, etc made difficult – limited effectiveness of remote meetings held over conventional means such as VC and WebEx leading to delayed decision making.
- Prolonged recovery period to come out of the impending crisis.

The emerging technologies of VR and AR due to their immersive nature and other features described above bring to the table several possibilities for the Oil & Gas industry to address and effectively overcome these challenges.

## 6. MITIGATION OF PANDEMIC CHALLENGES THROUGH VR AR SOLUTIONS

The organizations that have already adopted VR AR technologies and implemented solutions based on the same in their operations, would have found themselves in a better position to mitigate the impact of social distancing, as compared to the non-starters. A few sample cases of how VR AR solutions play a role in this are:

### **Risk - Key plant operations personnel not available, operations to be undertaken by substitutes -**

Non-availability of regular and experienced personnel for several key functions such as operations of complex and critical units is one of the most likely situations that would be faced by several companies. This can be a potential threat to the plant operations in the event these operations are not performed correctly. VR based training has the advantage in getting the relatively in-experienced people as well as fresh recruits to raise the skill level quickly whereby the fresh team members can start contributing to business in a meaningful way in a short time frame.

This can cover multitude of subjects such as plant familiarization before the personnel are physically deployed at the plant sites, training in several critical system operations such as Fired Heater Start-up, operation of chemical injection systems, managing PSA system operations, and so on.

The training is imparted through VR Head Mounted Devices with the corresponding application for the given use case duly uploaded. Another alternative is the “CAVE”<sup>3</sup> technology which permits this VR based training to be imparted to a group of several trainees at the same time.

Another training application which is AR based permits a kind of X-ray vision revealing the internal features of a machine or an equipment to be deployed in the process plant. This AR-enhanced visualisation permits demonstration of the design aspects and the operational characteristics of the system through a 3D representation by projecting the camera on the device toward the component of interest. This activates the application to show details such as pump internals, cooling mechanism and how the sub-systems fit together and perform the assigned functions. The training of personnel on such complex systems through this feature is found to be significantly more effective and can be done in much shorter time than the training with manuals and other conventional means. It leaves a photographic memory with the trainee.

### **Risk - Plant technicians facing problems with restarting of plant machinery during resumption of plant operations -**

Several process plants as well as other manufacturing facilities in the Oil & Gas value chain may have been forced to shut down operations during the pandemic crisis. Resumption of operations will always have difficulties in start-up of certain complex machinery. This would call for inexperienced personnel and staff to step into the shoes of senior and experienced colleagues, however these members may not be adequately trained to undertake these complex activities.

In such situations, the AR based pre-authored instructions can be made available through these applications on a tab or iPad, or can be accessed through AR Head mounted devices, the latter having the advantage of hands-free operation.

This AR application is seen to be redefining the maintenance and troubleshooting function. AR addresses the shortcomings of conventional methods through real time, on-site, step-by-step graphically guided instructions on various tasks in process plants or manufacturing work-places. The feedback feature of this application also has the capability to incorporate the feedback on the effectiveness of the instructions, permitting improvements in subsequent versions of the application.

**Risk - Inadequate effectiveness of meetings over Video Conferencing, Webex and other conventional collaborative tools.**

Several topics and subjects of discussion call for in-person meetings with participation of all key personnel. The current COVID crisis is seen to prevent this from happening and this would be contributing to the inadequate effectiveness of such meetings on available tools such as VC and Webex, leading to sub-optimal decision making. Project progress reviews, review of design details of complex machinery looking at deep design details, are some examples.

The VR based functionality of Remote Collaboration permits far flung professionals to collaborate remotely, but in an immersive way. This proves to be an effective tool to undertake joint review of a project, design review of complex machines or review of an equipment layout wherein remotely located participants join in for a meeting in person, at the virtual common location. This also enables a joint walk-through in the 3D model of the plant site in the virtual manner, opening up components of machines in the 3D virtual model to review its design aspects, or conduct a project progress review in the 3D model reflecting the current project status in virtual manner.

This is made possible by each participant wearing the VR Head Mounted Device with the concerned application such as the complete configuration of a process plant or a complex equipment, duly loaded.

**Risk – Inexperienced personnel not in a position to undertake repairs and maintenance/ troubleshooting work without advice and guidance from experts.**

Any operating facility routinely experiences machinery malfunctioning and breakdown, which calls for urgent trouble shooting for which the expert has to often travel to the plant location. This poses an unusual challenge under the pandemic conditions since the expert may not be in a position to travel.

This situation is very readily mitigated through the AR based collaboration between the site based technician on one side and the expert connected from any part of the world on the other side. The AR based Smart Glasses to be worn by the technician permit this possibility where the expert sees on his computer exactly what the technician sees. The application provides for expert's advice to the technician duly supported by annotations, marked up drawings, written instruction, etc. that can be seen by the technician on the virtual screen in front of him, adjacent to the machine being attended. The application also permits verbal dialogue between the two.

**Need to impart HSE training to new personnel, in short timeframe.**

Training of personnel in various aspects of Health, Safety and Environment (HSE) with physical exposure to Safety incidents has always proven to be a challenge, the reason being such safety incidents and situations (such as fire, fall from height) cannot be created for the purpose of training. VR functionality removes this barrier. Today standard immersive VR applications are available which simulate fire incidents, hazards of high tension electrical systems, working at height or enclosed spaces, in which the participants can be trained to take necessary actions in such

situations. Use cases specific to a requirement would need to be custom built. The retention rates of the lessons learned by the trainees through this immersive experience are found to be far greater than any conventional training program and these personnel become fit to be deployed into real life situations in a very short time frame.

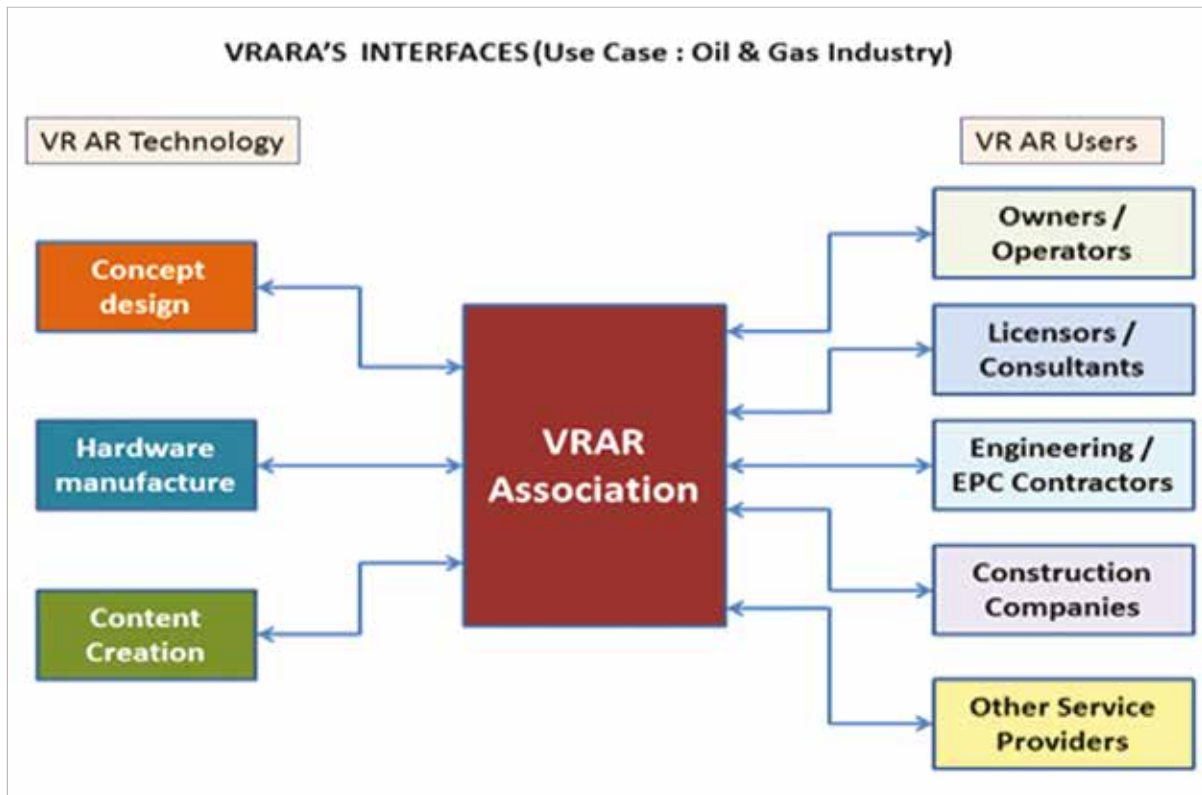
These VR based training modules are especially useful due to the need to train several new employees in these safety aspects very quickly in this situation created by the present crisis.

The above are just a few use cases applicable to Oil & Gas Industry. It can be readily seen that organizations that have already deployed VR and AR based applications in their operations, stand to be in far better position to address and overcome the challenges in the midst of a pandemic crisis, as compared to those who are yet to come on board.

### 7. GLOBAL VR AR ECOSYSTEM THROUGH THE VR AR ASSOCIATION

While the world has seen a steady and steep growth in development as well as adoption of the VR AR technologies in wide ranging sectors of the economy, the active role played by the global body VR AR Association (VRARA) headquartered in USA has been helping in creating a large ecosystem for the entire value chain of VR AR technologies<sup>4</sup>.

This association is designed to foster collaboration between organizations with the objective to accelerate growth, encourage research, and to develop industry best practices and guidelines for deployment of VR AR based solutions in various industrial and other sectors. VRARA has created a comprehensive ecosystem for all the stakeholders of these technologies and plays a pivotal role in terms of acting as a common platform for all the stakeholders in the VR AR Value chain to collaborate in several different ways. Interfaces within the VRARA network with Oil & Gas industry as a user sector are depicted in the chart



VRARA brings onto the table the appropriate and latest solutions, through its close links with the VR AR Technology community, to the user organizations in various sectors such as Oil & Gas. Among other activities and initiatives, VRARA has established several Communities of Practices in order to bring in focus on the development of VR AR applications relevant to these specific sectors and industries, such as Energy/ Oil & Gas, Education, Healthcare, Defence, Aviation, and so on.

Accordingly, as regards Oil & Gas industry, VRARA becomes a common platform for stakeholders in the industry on one hand, with the stakeholders on the VR AR technology side on the other hand. This has been seen to provide immense benefit to both sides, leading to creation of VR AR applications taking into account the specific needs of the Oil & Gas industry functions.

## 8. CONCLUSIONS

The crisis that mandated social distancing has brought up a multitude of challenges for every component of global economy. This has resulted into a unique situation since such a scenario was not envisaged. The Oil & Gas industry is therefore staring at tough and challenging times ahead as it gears up to restart operations once the lockdown eases up, which one can hope will happen in due course.

VR AR are the evolving technologies having immersive capabilities. Applications based on these technologies are proving to be of great benefit for wide ranging sectors including the entire value chain of Oil & Gas industry. Stakeholders in the industry who have already deployed VR AR solutions in their business functions are in a better position to effectively mitigate the operational difficulties posed by lockdown and social distancing. On the other hand, those organizations that are yet to come on board with these technologies would also stand to gain these benefits, the sooner they adopt these solutions.

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### Smart materials for the 21st Century

#### *What is 'Smart'?*

The terms 'smart', 'functional', 'multifunctional' and 'intelligent' are often used interchangeably. This is reasonable, if confusing, for the first three terms but the last almost certainly suggests a degree of consciousness that does not exist in any non-biological system. There is arguably no such thing as a 'smart material' per se -there are only materials that exhibit interesting intrinsic characteristics which can be exploited within systems, or structures that, in turn, can exhibit 'smart' behaviour. This argument is exemplified by comparing a photochromic material that changes its colour state when exposed to light and a simple metal that changes its physical state when passing through its melting point when subjected to heating. The first is often termed 'smart'; whilst the latter is not.

**Source:** *Smart materials for the 21st Century, The Institute of Materials, Minerals & Mining*



*Arvinder S Brara*  
*Environmentalist CMD*  
*Mantec Consultants Pvt Ltd*

## THE CORONAVIRUS

Let's take care my friend  
When during the coronavirus trend

We stay at home lock down  
As going out will get us a frown

Oh! To see so many movies all day  
And have a drink to make us gay

Oh! To get so much done  
Trading jokes and WhatsApp what fun

All things have a positive side  
Follow the rules far and wide

All will get well soon  
Getting rid of coronavirus will be such a boon

If you want in future to be Virus free  
Help improve the Environment and Plant a Tree

Thank God for all mercies done so far  
Together we will win the war against the virus  
by hitting par

## THE ENVIRONMENT

Love the natural environment my friend  
As we all need to follow this trend

Stop using plastic only use a biodegradable  
bag  
As such actions are already at a lag

Plant many a tree  
So your children can run free

Do not kill animals for meat  
Otherwise a poor fate you shall meet

Food and water will be hard to come by  
As mankind over consumes and years go by

So live simply with nature and love,  
Spread the message of peace with nature as a  
white dove

Every day and specially on June 5th World  
Environment Day  
Nourish flora & fauna and for their well being  
pray

## CEAI NEWS

In the interest and for the benefit of the engineering fraternity CEAI switched to sharing knowledge and skills through Webinars after the Lockdown and Social Distancing norms were announced in the third week of March 2020. The holding of seminars, conferences, workshops etc. where physical meetings took place have now globally given way to this model. Accordingly, the first webinar was held on 22<sup>nd</sup> April 2020 to help provide guidance to queries being raised by many Members.

CEAI had already digitalised its operations considerably years earlier, hence the switch from physical interaction to an online mode could be done seamlessly. The CEAI Website is also being revamped and upgraded to improve the online systems and the help facilities provided to its Members especially for their publicity.

### WEBINAR ON “ENABLING REMOTE WORKING FOR ENGINEERING CONSULTING ORGANISATIONS”

The COVID19 Pandemic created an extraordinary situation globally, and with Lockdown being extended, continuity of operations in all spheres were seriously affected. It significantly adversely impacted individual lives, businesses, commerce and consequently the economy.

Some Member companies generously offered to share best practices to provide guidance to companies and stakeholders, to face the challenges during the lockdown period. CEAI, therefore, decided to organise Webinars to help Members prepare for such eventualities and optimise productivity.

The first such Webinar was organised by CEAI, and hosted by Tata Consulting Engineers Ltd. on 22<sup>nd</sup> April 2020, on the topic “*Enabling Remote Working for Engineering Consulting Organisations*”. The speakers were, CEAI GC Member Dr. Rajashekhar Malur, Chief Technology Officer and Mr. Pravinchandra Shahu, Head, Information Technology & Business Head - Advance Technologies, TCE.

The webinar proved very timely in view of the long lockdown imposed, with hardly any notice, by Government of India, the States and Union Territories to restrict the spread of the pandemic. The participants attended the hour long webinar which covered the details of systems, network, architecture, etc. for organisation and employees to access their servers, data and communicate with other colleagues from their home.

Most of the organisations had not moved to digital working in to since they did not have a budget, big enough, for IT systems and Support Services. However, it is now very important to allocate additional budget for new IT Systems including hardware and software to be able to do Work from Home (WfH), without compromising on quality and timely delivery. Going forward, post the pandemic, it is believed that WfH would be new normal for the Consultancy business. Hence, it is essential for organisations, small or big, to upskill their staff with training and capacity development.

This new work culture is going to be very challenging which requires not only investment on systems and training, but also adjustments in creating an enabling environment, to be able to work and deliver the services. Organisation that were already involved in offshore engineering and delivery services for domestic and international clients are going to be the least affected.

There would be a new cost implication towards consulting fees with higher allocation on IT OH. Organisation would need to have their strategies to either absorb the additional OH internally or to add to the fees. It was felt that, there

would be a growing number of small and medium companies with the new work culture and business model in coming days.

The presentation is available at <https://www.ceai.org.in/enabling-remote-working-for-engineering-consulting-organizations/>

## **WEBINAR ON “CHALLENGES FOR CONSTRUCTION & CONSULTING FRATERNITY – CONTRACTUAL PERSPECTIVE DURING POST PANDEMIC SCENARIO”**

CEAI, as part of its COVIDTIMES WEBINAR SERIES, in association with STUP and ICT Consultants had organised a Webinar on the topical issue of **“Challenges for Construction & Consulting Fraternity – Contractual Perspective During Post Pandemic Scenario”** on 22<sup>nd</sup> May 2020. The Webinar was addressed by an eminent Panel comprising Mr. R. K. Pandey, Member, NHAI, Mr. Abhin C. Alimchandani, Chairman, STUP Consultants, Mr. Gagan Anand, Managing Partner, Legacy Law Offices, and Mr. V. N. Heggade, CEO, STUP Consultants. The Webinar was moderated by Mr. K. K. Kapila, CMD, ICT and focused on the following aspects:

1. Force Majeure and aspects of Extension of Time (EOT), Cost Escalation and Damages,
2. Requirements for claiming Relief on account of Force Majeure and Mitigation Measures,
3. Relief under Applicable Laws, and
4. Managing the Balance Sheet;

Moderating the Webinar, Mr. Kapila mentioned that COVID 19 was an unprecedented event in the history of mankind and brought forth inadequacies in the Contracts and supporting legal provisions. The lock-down rules were executed through the Disaster Management Act 2005 which challenged the Construction and Consulting fraternity adversely by impacting performance of a Contract. The glaring impact that came to the fore was with regard to the Migratory Labour force personnel, who were suddenly rendered jobless, roofless, and without money which forced their mass exodus to their homes. The Consulting Engineering Fraternity was rendered extremely vulnerable by the Pandemic which further compounded the long outstanding issues such as GST dispensation, delays in Income Tax Refunds, Bank Guarantees for individual projects, etc. These issues were escalated to the Hon. Minister, Ministry of Finance and the Hon. Minister, Ministry of Road Transport & Highways, Government of India by CEAI’s Infrastructure Committee.

Mr. R. K. Pandey, NHAI informed that Chairman, NHAI had invited suggestions from the Consulting Fraternity on improving the performance of the Organisation in the coming days and years and during the financial year end when lock down had begun. NHAI had promptly cleared payments due to the Consultants as a show of support. He remarked that this Webinar was very timely and relevant and that NHAI would keenly look forward to the takeaways and emerging recommendations from the Webinar to move forward.

Mr. Abhin Alimchandani, STUP Consultants lucidly brought out the impact of the pandemic on the Consulting industry where the manpower cost constitutes 65 to 70%, a cost that organisations would continue to incur without any revenue during the lock down and post pandemic period. He added that besides the persisting liquidity crunch, the industry faced other issues such as 18% GST, high TDS rates, inadequate definition of MSME, banking and finance problems and preferential treatment to the international consultants and firms. He mentioned that necessary representations were being made through CEAI to address these issues.

Mr. Gagan Anand, Legacy Law Offices touched upon various Contractual Issues such as Black Listing, Debarment, Termination, Penalty, etc. and the restrictive clauses and moved on to review them in the light of Post COVID scenario. Talking about the issue of Force Majeure, he explained that the pandemic factor did not find explicit mention in most contracts in India. Sections 32 and 56 of the Indian Contracts Act 1872 could be referred to provide relief to the concerned Parties in a Contract. He also explained about the concerned issues of EOT and BGs and how relief can be availed in the pandemic period. He further suggested that provisions ought to be made by Clients for reimbursing additional costs incurred by the Consultancy firms and Construction companies for deployment of resources during the additional period beyond the envisaged contractual period. The Client Authorities ought to consider various policy-level interventions in order to validate the changed budgets, not only of the consultancy firms but also of the EPC Contractors and PPP Concessionaires, so as to obviate prospective Dispute Resolution proceedings, such as Arbitration and Court Cases.

Mr. V.N. Heggade, STUP Consultants briefly touched upon the need for a relook at the schedule of payment for DPRs. He recommended for doing away with 70:30 method of Selection under QCBS as it was similar to L1 bidding. Given the lock down scenario which has necessitated Work from Home even for Sectors other than IT, he suggested that the Government should expedite clear directions on Home/Office Input. Most of the Consultants have arrangements for working from home for design jobs in place. This crisis period should be used for completion of designs including approvals with joint effort from consultants and their clients. Importance of collaborative digital platforms also needs to be expedited to complement the efforts.

In conclusion, Mr. Kapila remarked that for Home Office input it needs to be ensured that the Professional Indemnity and general insurance coverage to the staff who operate from home are available to the Consulting Organizations. The need of the hour was to work on Contract Clauses which explicitly caters to any untoward unprecedented scenario as has happened during pandemic to address such conditions in the future. The Clauses should clearly spell out the responsibilities of the Clients in such situations and also provide for automatic EoT and payments to Contractors/Consultants during any lock down or similar circumstances. He further stated that all Contractors must take CAR Insurance (Construction All Risk) Policy which should cover events such as the pandemic.

He further stated that the CEAI will be working on drafting Contract Clauses with the aim to enlist their adoption and facilitate an appropriate legal provision in the Contract, so that what happened with the Migratory labour this time is never ever repeated again.



## WEBINAR ON THE TIME HAS COME FOR “TAKING CONSULTING ENGINEERING FORWARD”

Seeing the concern being voiced by the Consulting Engineering fraternity as a consequence of the pandemic, the lockdown that was adopted by the countries all over the world and the physical distancing norms that ensued, CEAI organised a webinar on The Time Has Come For “*Taking Consulting Engineering Forward*” on 19th June 2020. The Indian Association of Structural Engineers (IAStructE), the Association of Consulting Civil Engineers (India) {ACCE(I)}, the Institution of Engineers (India), (IEI), Delhi State Centre and NSS (USA) India Chapter, partnered with CEAI for the webinar. The intent was to make Engineers realize their place, status and role in the society and be ready to tackle the “Unknown Unknown” and help the society and the county to develop sustainably. Discussions accordingly revolved around

1. Engineers - the backbone of the country
2. The Architecture-Engineering coherence
3. Legislation for Registration & Practicing for Engineers
4. Qualifications and Competence of Professionals - NBC 2016
5. Engineering for Growing Sustainably

The panelists comprised eminent engineers Mr. V K Jayaswal, Director General, Central Public Works Department,(CPWD), Mr. Dinesh Kumar, Chairman, Delhi State Chapter, IEI, Dr. Aswath M U, President, ACCE(I), Mr. Manoj Mittal, Past President, IAStructE, Mr. Sanjay Pant, Head Civil Engineering, Bureau of Indian Standards, (BIS), Mr. Avinash Shirode President, NSS (USA) India Chapter, Mr. Amitabha Ghoshal, President, CEAI and Mr. A P Mull, Past President, CEAI. Mr. Anish Dayal, Advocate Supreme Court of India was also a panelist. The webinar was very well attended even though it was a working day. The feedback was very encouraging.

President CEAI, Mr. Amitabha Ghoshal welcomed the panelists and the audience. He stressed on the fact that Engineers engineer the development of civilizations and in that the Consulting Engineers are the harbingers of all development. He added that while the New Normal for Consulting Engineers are Digitisation, Resilience and a Healthy Balance Sheet, the concerns were Knowing the Unknown Unknown, Leadership & Communication and Sustainability of Operations. He stressed that the Consulting Engineers have always worked with a shoestring budget but now they have to not only Make in Indian but also Made from India and take Indian consulting engineering across the globe juts as our IT brethren have done and make a hallmark.

Mr. A P Mull, Past President CEAI, stressed that Engineers are the Backbone of the country since its they who ensure the 3 essential needs for survival – Air, Water and Food. He added that CEAI through its quarterly magazine ViewPoint always exhorts Engineers to Awake, Arise and Move Forward to flag their Rightful Status in Society, however Engineers must also be more aware of their Duties, Rights, Responsibilities and Accountabilities. He informed of the Key Message from UNESCO on the World Engineering Day (4<sup>th</sup> March) “*If you want to change the world for the better, become an engineer*”. He explained the irreplaceable roles of engineers with reference to buildings and the capabilities of Indian Engineers to provide world class services. He reminded Engineers of what they need to be committed to their profession for the Upliftment and Sustenance of Society. He reiterated the reasons as to why Legislation is required for the Profession of Engineering, all of which are also given under ‘*Engineers Colloquy*’ in the CEAI’s website. The great difference in the number of practicing Engineers vis-à-vis other profession was highlighted. He explained that to enable Engineering for Growing Sustainably, Qualified and Competent Engineers with the requisite Experience should be appointed directly by the client and not through any other agency since that

could lead to subjugation of the engineering judgment and consequently the engineering requirements. Independence of Engineers to take decisions was necessary and imperative for the Safety, Stability and Robustness of the works. Since Physical Distancing would be the norm, digitization would be the in thing. He informed that he would get back to the Big Q? – The Way Forward Post Pandemic at the end of the webinar.

Mr. V K Jayaswal, Director General, Central Public Works Department, highlighted the stellar role that Engineers perform for the progress and prosperity of the society and that the country's ability to retain its technological and economic excellence was because of them. He added that Engineers have been the critical agents of change and have been the link between science and society, policy and practice. While talking about the achievements of Engineers he stressed on the need to adopt new ways of construction due to the situational conditions created by the pandemic – digitization, motivating workers, pre-engineered, prefabricated & precast construction, increased automation and mechanization. He informed that CPWD had already taken a lead in adoption of new technologies for faster and economical constructions. He went on to call upon the entire engineering fraternity to demonstrate their professional and social responsibilities in a most befitting and exemplary manner in such times of crises. He cautioned about abiding by the Values revolving around Conscience, Ethics and Accountability in the work undertaken for the Social, Economic, Cultural and Political development of the country. Regarding the regulating of the engineering profession he advocated for giving it a legal recognition; for making Engineers Responsible for their Professional Practice, upholding Professional Ethics and Integrity - as those Values have a direct impact on the Functioning of Industry and Infrastructure, Environment, Health, Safety which are crucial for the Society and the Country.

Mr. Manoj Mittal, Past President IAStructE, explained a person with an engineering degree is an Engineer however, a person cannot be stopped from practicing engineering even if that person does not have a degree since there is no law as such. Engineering is not a legally recognized profession. He went on to explain that a Consulting Engineer renders engineering services to a client, who do not have the expertise, for a fee but is different from a service provider. For a Professional, Qualification, Skill, Experience, Competence, Membership of national institution, Code of Ethics, Accountability, Autonomy and Confidentiality are all important but there is no credible mechanism to ensure all these at present. Hence a regulation through legislation for Engineers is a must. It will enhance the status and take Consulting Engineering forward. Qualification and competence are very important for a Consulting Engineer but are being prescribed by many organisations – National Building Code, state and town level authorities/ bodies, etc. These are not uniform, there are discrepancies, variations, and the same engineer may not qualify. NBC is the most appropriate since it's based on inputs from all stakeholders. An Engineer at present has to register with different organisations with different criteria and also pay a fee. Any change in qualification requirement should be done through the means of the NBC of BIS only. Efforts for legislation must be made by all so that Members of a Professional body do not require any further registration with a local body.

Mr. Avinash Shirode, President, NSS (USA) India Chapter, dealing with the matter of Architecture-Engineering coherence informed that while architecture could be done by anyone with a good head for layout and aesthetics, engineering could only be done by Reliably and Safely ONLY by a Qualified and Experienced Engineer of the concerned discipline with relevant specialization. He mentioned about the misguided projections being made by the Council of Architecture (COA) vis-à-vis the Architects Act 1972. He dwelt on the evolution of the Act since its first draft in 1968 and the debates in the Parliament. In order that the provisions of the Constitution are not impinged upon and people deprived of their legitimate rights and means of livelihood, the Committee decided to only protect the title and style "Architect" so that others could practice architecture but not call themselves an "Architect". The Supreme Court of India in its judgment for Civil Appeal No 1819 of 2020, has observed that '*Section 37 of the Architects Act does not prohibit individuals not registered under the Architects Act from undertaking the practice of architecture and*

*its cognate activities*'. Mr. Shirode went to inform that COA has been and has issued a misleading Public Notice. It was therefore necessary to inform all concerned authorities, bodies organisations that the contribution of an Architect for anu building work is rather small and the major work is done by Engineers. He added that the National Building Code of India 2016 brings out the scope and responsibilities of various Professionals for a Building. Hence Architects must work as a team with the Engineers, just as all the Engineers of various disciples and specialisation do, to make a project into reality and fit for the intended purpose for its design life. For a team to succeed there should be no Me First attitude. Instead, Safety, Security, Health and Environmental requirements must be paramount.

Dr. Aswath M U, President, ACCE(I), presented challenges that are facing the industry – how to bridge the Qualification Gap between Academia and Industry in India. He pointed out that it was the role of Professional Bodies to ensure that people with the requisite Qualification and Competence function as Professionals. He presented the 2025 Vision for Civil Engineering: 'Entrusted by society to create a sustainable world and enhance the global quality of life, civil engineers serve competently, collaboratively, and ethically as master.' He stressed that the Core Values as Nation Builders, would be creating a new era which is sustainable, a new dawn where the limited natural resources are valued and a new world order where future generations can breathe a sigh of relief. He went on to spell out how and what the Professional Bodies should provide – networking opportunities, continuous professional development to foster ideals of profession, promote friendship, establish rules for professional and ethical conduct and to develop social awareness and responsibility in the members. He also talked of the what the activities of these professional bodies should be doing – establishing and running institutes, collaborating with each other, the Government, Educational Institutes and R&D organisations. They should also take up issues of the Engineers with the appropriate authority/ body/ organization, bring out publications to disseminate knowledge. He concluded by stressing on a startup MSME culture in Civil Engineering.

Mr. Dinesh Kumar, Chairman, Delhi State Chapter, IEI, very succulently brought out that Scientists discover while Engineers innovate and went out to define Engineering as the application of mathematics and natural sciences. He then dealt with the skills essential for which inter alia include Strong technical capability, Commitment to lifelong learning and being Multidisciplinary. He explained what Engineers do and their various roles – Analyst, Designer, Innovator, Integrator and A Social catalyst. He moved on to explaining as to what is requires for a Profession to prosper, linked Engineering to Humanity and explained Intrinsic Nature of Engineering - The engineer is the key figure in the material progress of the world. It is his engineering that makes a reality of the potential value of science. An Engineer is thus the link between Scientific Knowledge and Societal Needs. He spelt out IEI Code of Ethics, the benefit of being a Professional Engineer and the need for experienced professional manpower not only in India but also other developing countries in the African continent, South-East Asia and other countries. He said that an action plan needs to be made to exploit the tremendous potential available for growth of the consulting market.

Mr. Sanjay Pant, Head (Civil Engineering), BIS, explained regarding the qualification and competence requirements for planning, design and construction of buildings as provided in the National Building Code of India (NBC) 2016. He first of all informed that as per the Constitution of India Schedule VII, Entry No. 35, Construction is a State Subject and that as per the 74<sup>th</sup> Constitution Amendment Act, Schedule XII with 18 entries therein, it entrusts the works relating to urban planning, town planning, regulation of land-use and construction of buildings, fire services, water supply, sanitation conservancy, public health, etc. to be done by Local Bodies. The 74<sup>th</sup> Amendment also provides that the regulation of building activities be done by Local Bodies; which they do through Local Building Bye-Laws, etc. Since the safety of the citizens is the responsibility of the State hence it is the State which has to ensure that the Built Environment is Safe. He mentioned that the codes encapsulate the performance based Building Regulatory Systems which are the four pillars of Safety - Structural Safety, Fire Safety, Health Safety and Public Safety.

He added that the target is to increase the proportion of engineered buildings in the country which would be approved by the Local Bodies since earthquakes and other natural calamities have been time and again destroying inadequate but otherwise normal looking buildings or those built by raj misrty (masons) without any professional technical inputs, that is those which are not engineered. Hence, a greater number of buildings need to be brought into the ambit of the regulatory process so that someone could be held responsible. As per the Constitution this responsibility lies with the State Government and the Local Bodies. Today buildings are becoming taller and taller with more complex services involved and at times the Local Bodies may not be equipped to verify and check the submissions and may not be able to give a judgemental view on the works of specialists. Therefore, a second system has to be brought into play along with the core regulatory system of the Local Body, namely the Supporting Regulatory System. The Local Body gets support from Professionals who do the planning, designs and construction and certify them; a system that is used worldwide. Thus, the hands of the Local Body get strengthened. Since the number of services are large, thus for better and sustainable design, the Professionals for the various services would need to be involved where required. He explained that a Professional was one who did his homework well and did not require day to day advise. However, he went on to add that the Professional may need advice when an exceptional or new situation is encountered, hence there could be persons with the same qualification but different competence. Competence has to be developed right from the stage of education - the way students are educated. Those charged with education and training including professional institutions must ensure that competence is built – by bringing out more documents, sharing knowledge to train and making the people more competent.

Talking about the paradigm of Qualification, Competence and Professionalism he stressed that people must move to next level of Professionalism. Professional have to get charged to meet the challenge of Sustainability. Many professionals have been produced in the country but the bench mark is to be whether the quality of life of the citizens has improved over the years. He queried - are buildings better, safer, more durable, has the quality of life really improved, are people more happy today, does the country have the required resilience, if an earthquake of magnitude 7.5 on the Richter Scale were to strike, can the buildings be certified or can it be assured that the buildings would stand?

He moved on to address as to what BIS does to improve Qualification, Competence and Professionalism. BIS brings out a Standards Ecosystem. First of all are the Standard Specifications for Materials – with provision of BIS certification (with ISI mark) are available; however, materials are changing – with new materials and technologies keep coming and there are materials from waste, reconstituted materials, requiring different testing regime. Next those which have also been addressed through Indian Standards are the series of Codes of Good Practices, Guidelines for Construction Project Management (IS:15883), Guidelines for Habitat and Welfare Requirements for Construction Workers (IS:16601), etc. The NBC weaves together the various provisions so that they are cogent, can be understood and applied for planning, design, execution, repairs, maintenance, and retrofitting of the built environment. He informed that the Standards are now available for free download from BIS website and requested that people download them and circulate this information to increase awareness and implementation of the same. He then added that NBC, right from 1970 (the 1st edition) to the 4th edition of 2016 has been a dynamic process and talked of the qualifications and competence of Professionals. He stated that it was not possible to give guidelines for each of the large number of professionals involved and advised that one must see as to who is better, based on experience, qualification and competence. NBC is based on the understanding of addressing three basic components - Planning, Design and Supervision for a built facility. Hence the qualification and competence have been given in NBC based on who is qualified and competent to plan at township level or at building level, the second is who is competent to design – structure or services, thirdly who is competent to supervise. The extent of planning, design and supervision vary. Planning and other related works may involve architecture planning, architecture and space planning, landscape

planning and design, urban design, town planning. Second question is who is competent to design - a structure, the services. Thirdly, who is competent to do supervision. Hence NBC gives the qualification and competence of these professionals accordingly. He explained that a structural engineer is also a Civil Engineer, hence, if the person is also registered as a Civil Engineer that person could do planning and supervision as well and perform multiple roles as per the provisions given for the Civil Engineer in the Code.

Moving on, he said that there are several professionals who can additionally contribute and provide inputs to various planning, design and execution work relating to accessibility, sustainability, fire safety, HSE, IT enabled building installations, lifts, escalators and moving walks, etc. and even a medical expert. An important area that has now been covered in NBC 2016 is that of Contractor or Constructor or Builder who realizes the plans and designs approved by the Local Body. NBC does not recognise an organization, it only recognises an individual in the organization or working independently. That person has to be equally qualified and competent as the person who has planned and designed. Hence a parity has been brought and the Qualification and Competence have been matched with the complexity involved. Thus, for large sites only Geotechnical Engineer are recognized.

He clarified that NBC does not subdivide Engineers for Utilities; that has been left to Professional Bodies to decide. All specialists cannot be specified, they would need to be brought in as required. NBC is specific where it can be so but does not limit a professional from any one discipline for doing a certain work since persons from more than one discipline are capable of doing it and infact are doing so and gave many instances. He however, cautioned that with buildings becoming more complex and taller, the qualification, competence and capability of a professional need to be carefully considered.

Mr. Anish Dayal, Advocate Supreme Court of India, explained about the Architects Act, the related court judgments and their impact on the engineering profession. The central issue being whether the Architects Act prohibited all those not registered under the Act could practice architecture. The issue has been agitated a number of times since 1975 in various courts of India. He mentioned the chronological list of some cases that decided on this issue ending with the 2018 case of Sudhir Vora vs ROC in the Delhi High Court and Civil Appeal No. 1819 of 2020 decided in March 2020 by the Supreme Court of India. The Delhi judgement relies on the clear language of Section 36 and 37 and more importantly the Statement of Objects and Reasons of the Act. They are very clear hence as the matter have been clarified there is no restriction on persons or entities not registered with COA from performing architectural services or a company mentioning this as an objective in their Memorandum of Association, so long as they do not call themselves as “Architect”.

At the end Mr. A P Mull reverted for discussing solutions to the **“Big Q, How to go forward with Physical Distancing being the Norm”**. He suggested judicious digitization by all stakeholders. For Individual and Smaller companies, he suggested Cooperative/ Community mode of working to suit all the members for sharing hardware and software within a geographical area. However, he cautioned that Safety and Security should be top priority and that proper Backup facilities were utmost essential. Besides that, Document Management must be implemented. Clients would also need to go in for enterprise wide digitization of all the business processes. Construction would need to be more automated and use gadgets ubiquitously with digitization deployed enterprise wide. All these would go a long way to **reduce Paper Usage and Save the Trees**.

Mr. Amitabha Ghoshal, thereafter, summed up the discussions of the webinar and thanked the audience for remaining connected and added that the online feedback received was very positive, encouraging and added to the knowledge of the audience.

The Video of the webinar and Presentations made are uploaded on CEAI's website.

The link is <https://www.ceai.org.in/webinar-on-the-time-has-come-for-taking-consulting-engineering-forward/>

CEAI has also published a webinar video on YouTube.

The URL is <https://www.youtube.com/watch?v=rNps9AKq4jw>



The next interactive webinar on *'Investing in Remote Working by Small companies'*, to be held on Saturday, 18<sup>th</sup> July 2020 starting at 11.00 am was announced.

## **REPORT ON THE MEETING (ON-LINE) WITH SHRI PIYUSH GOEL HON'BLE MINISTER FOR COMMERCE AND INDUSTRY ORGANISED BY SERVICE EXPORT PROMOTION COUNCIL (SEPC) ON 23RD JUNE 2020**

### **PREAMBLE**

An SEPC – CEAI workshop on 'GLOBAL VISION 2030 - ENGINEERING AND CONSTRUCTION SERVICES – Challenges and the Way Forward' was held on 28th January 2020.

In March 2020 a communication was sent to the Secretary, Ministry of Commerce and Industry regarding the concerns of the consulting engineering fraternity on the Government's planned withdrawal of the export incentives vide the Services Export from India Scheme (SEIS). These have been reported in the March 2020 issue of ViewPoint.

Interactions have taken place, since, at various levels, regarding matters concerning the Consulting/ Services fraternity. They culminated in a meeting being arranged by the SEPC between the Hon'ble Minister and representatives of the Services Sector. The occasion enabled the Services Sector to reach out to the Honourable Minister via the SEPC platform.

### **THE MEETING OF 23 JUNE 2020**

**Mr. Piyush Goel**, Minister of Commerce and Industry (CIM) had a meeting with the Central Governing Council (CGC) Members of the **Service Export Promotion Council (SEPC)** on 23<sup>rd</sup> June 2020, along with officials of the Ministry of Commerce and Industry.

Mr. Amit Sharma, Central Governing Council Member, representing Other Services, including the Engineering Services, a Champion Sector, on the SEPC attended. Mr Sharma, Managing Director, Tata Consulting Engineers, a **Member Organisation** of Consulting Engineers Association of India (**CEAI**) duly represented the interests of CEAI.

Twelve sector leads made presentations. Mr. Sharma made a presentation on behalf of the Engineering Consultancy Sector. The presentation was created with valuable inputs from the core team of CEAI representing the Consulting Engineering sector and various industry leaders - pan India.

### **THE PRESENTATION:**

The theme was - India's aspiration of a \$5 Trillion Economy along with AtmaNirbhar campaign towards a Modern India requires renewed thrust on CONSULTING Engineering & Design.

The points put forth at the presentation were:

### **POLICY REFINEMENTS**

- a) Consultants in India are suffering from poor cash flow and weak balance sheet. Projects are awarded on lowest cost (L1) basis. Business has become unviable on account of payment delays and the unsustainable payment terms which are not commensurate with the effort requirement or upfront expenses incurred viz., surveying, soil investigation, data collection, etc.
- b) There needs to be modifications in the mode of GST payment by Consultants where it should be payable only on receipt of payment and not at the time of invoicing.
- c) The need to adopt FIDIC contract terms, wherever feasible, in order to have transparent and fair terms and conditions, to enable an ethical and professional ecosystem.
- d) The importance of having suitable prequalification criteria that can ultimately result in enhanced competency and competitiveness of Indian Consultants.
- e) Consulting tenders up to Rs 200 Cr across all sectors – to be solely for Indian consulting firms as lead consultant, with a maximum 20% partnership or consortiums with international players for fulfilling PQ or Key CV gaps. Where exception is taken there must be at least a 51% value of contract reserved for Indian Companies with the Lead Company to be Indian consulting company. A foreign partner, if required, to be brought in for necessary expertise not readily available in the country. This would facilitate knowledge transfer in niche sectors.

## DOMESTIC FORMALISATION

- a) The Consulting Engineering Sector needs to be made part of National Policy making. Formalising and strengthening the Consulting Engineering service sector with proper guidelines that ensure there is no dilution when similar services are offered by Audit, Strategy, OEM and Owner firms. An Engineers Bill is needed with careful analysis and providing appropriate safeguards.
- b) The definition of an Indian firm needs to be clear and unambiguous. It should mean a firm that is owned with majority of the Directors on the Board to be from India. The majority of the company ownership and shareholding should be of Indian Nationals only.
- c) Eligibility of MSME registration should be only for Indian firms, such that with a defined path and time-frame they could grow and become self-sustaining firms of global standards and repute.
- d) Holistic Cluster approach to be adopted to enable strategic sectors like infrastructure, renewable energy, etc., to grow in India.
- e) Government support for adoption of **Industry 4.0** tools, techniques and investments to be provided tax exemptions as R&D expenses under an Industry 4.0 promotion scheme - that will encourage sectors such as Consulting Engineering, Construction, Project Management, Smart Plant, Green Energy production, etc. to innovate and enhance their competitiveness and productivity.

## INTERNATIONAL THRUST

- a) India must have a strong voice in WTO negotiations to have a more favourable position under the **CPC 8672X Engineering Consulting category** – as Indian firms have severe restrictions for international bids in the Western markets. However, international firms have unrestricted access to operate in India.
- b) Indian Consulting Engineering firms dealing in Knowledge Sector must be supported by schemes such as SEIS for Export Oriented incentives. Support is additionally required on costs related to specialized Engineering, software and hardware, international certifications, employee training, etc.
- c) To promote international benchmark working and trade, Foreign Exchange earnings for **Consulting Engineers** should be TAX Exempt.
- d) Similar to global practice, the Ministry of Commerce and Industry and Ministry of External Affairs need to facilitate and enable **Indian firms penetrate the international markets**. MITI-JETRO/ JICA(Japan), DIT(UK), ITA(USA) are examples of such agencies overseas.
- e) EXIM Bank's Consulting Engineering tenders should promote both PSU and Indian Private sector players – for Exim Bank projects. '75% Indian Content' needs conveyance to the recipient Country from Day-1 to facilitate their internal budget preparation.
- f) Strengthen Indian Consulting Engineering play by instituting stringent offset clauses to be expanded beyond Defence sectors such as Construction, Railways, Critical infrastructure, Healthcare sectors, etc.

## FURTHER DISCUSSIONS

The online meeting with Mr. Piyush Goel, CIM was productive as the participants managed to convey to the Minister and the Ministry their achievements, challenges, concerns and the scope of services for exports. One of the items ie the matter regarding SEIS could not be conclusively discussed, as the CIM seemed convinced that the scheme as it

exists at present is not feasible and needs changes.

Post the meeting a representation for continuation of SEIS benefits was again made. SEPC intends to get some positive progress on continuity of SEIS for the year 2019-20 and 2020-21. Presently, the notification for the year 2019-20 is on hold.

They proposed that SEIS should continue for certain stressed sectors and the value cap should be for all sectors and up to a certain amount. If the cap is Rs. 100 cr of exports, then the incentive should be available to all up to that limit, regardless of overall turnover. They also reiterated the need for 'Indian' firms to be beneficiaries.

As the domestic Construction and Engineering sector is impacted with no work possible at most domestic construction sites – it has very severely impacted all Engineering Consulting firms. The SEIS benefit must continue for the Engineering Services sector as it will help this industry to survive during the pandemic and also bring valuable foreign exchange to the country. Additionally, the work that consulting firms provide for international projects also brings in valuable learnings, best practices and latest technology and engineering knowhow that is leveraged for Indian/ domestic projects and also helps the Nation immensely through the project implementation opportunities for the Construction sector.

The interaction provided an opportunity for the Services sector to highlight their diversity and contributions to the Nation, its international footprint and future potential and to focus on the support requirement and much needed policy interventions to promote and grow the Services sector. Further follow up on various points will be made with the Secretary, Joint Secretary, Director of the Ministry in the coming days.

## CEAI INTERVENTIONS

*CEAI has been pursuing various issues with the Government Departments with regard to the issues being faced by the Consultants.*

### **a) TDS on Technical Services - wef 1st April 2020 - 2% instead of 10%**

Finance Bill 2020: Section 194 J of the Income Tax Act relating to TDS on Fees for Professional or Technical Services, has been amended to provide for replacement of 10% to 2%, w.e.f. 1st April 2020. The Consulting Engineering Services fall in the purview of the Technical Services as it involves special skills and expertise for rendering such services. Supporting explanatory notes prepared by Accountancy firms, in this respect have been circulated to Members.

CEAI intends to brief all Government and non-Government Clients, with the request to deduct TDS at the new rate for all payments made henceforth for Consulting Engineering w.e.f. 1st April 2020.

Members may forward list of their clients to CEAI, so that CEAI can follow up in case higher deduction is made.

### **(b) NHAI Circular on Reduced Rate of TDS U/S 194J**

NHAI issued a circular on 23.06.2020 with regard to reduced rate of TDS u/s 194J. The circular is reproduced below:



## भारतीय राष्ट्रीय राजमार्ग प्राधिकरण

(सड़क परिवहन और राजमार्ग मंत्रालय)

### National Highways Authority of India

(Ministry of Road Transport and Highways)

जी-5 एवं 6, सेक्टर-10, द्वारका, नई दिल्ली-110075

G-5 & 6, Sector-10, Dwarka, New Delhi-110075

No. NHAI/P&A/TDS/Vol-X/2016-17/SM

दूरभाष / Phone : 91-11-25074100/25074200

फैक्स / Fax : 91-11-25093507 / 25093514

Dated 23.06.2020

#### CIRCULAR

**Sub: Clarification on Deduction/reduction in rate of Tax Deduction at Source (TDS) U/s-194J-reg.**

- On the above mentioned subject, it is to inform herewith that Finance Act 2020, has reduced rate for tax to be deducted under section 194J of the Act in case of fees for technical services (other than professional services) to two (2) per cent from existing ten per cent. The TDS rate in other cases under section 194J of the Act would remain the same at ten (10) per cent.
- Further, Central Board of Direct Taxes ('CBDT') recently has announced reduction in the rate of TDS by 25% vide its press release dated 13th May 2020, to deal with the economic slowdown situation arising out of COVID -19 pandemic. The new rates have come into effect from May 14, 2020 and will remain effective till March 31, 2021, i.e., till the end of the financial year 2020-21.
- Now, considering the above, following is hereby clarified:-

**(a) TDS against Payments to IEs/ AEs/SCs:-** As per analysis of legal provision and judicial pronouncements, payments made to IEs/ AEs/SCs are in the nature of Fees for Professional Services (the transaction with IEs/ AEs/SCs should be read with question no. 30 of Circular No.715, dated 8.8.1995, issued by the CBDT, clarifying position on TDS in case of reimbursement of expenses. This circular clarified that in such a scenario, TDS should be deducted on the gross amount of the bill, including reimbursements, because **reimbursements cannot be deducted out of the bill amount for the purpose of tax deduction at source**) and therefore deduct TDS @ 7.5% (if transaction made between 14th May 2020 to 31st Mar 2021), on the payment to IEs/AEs/SCs account.

**(b) TDS against Payments to DPR Consultant:-** DPR Consultants renders services of technical assistance in preparation of drawings or design, consulting and engineering services in the preparation of technical design, technical assistance in preparation of project reports etc., which is in the nature of Technical Services. Further, these services are not in nature of construction services and can't be termed as Professional Fees. Therefore, TDS should be deducted @ 1.5% (if transaction made between 14th May 2020 to 31st Mar 2021), on the payment to DPR Consultant.

**(c) Apart from above, it is to mention herewith that in case IEs/AEs/SCs/DPR consultants are non-resident, then no benefit of reduced TDS rate given in Finance Act, 2020 and Press Release dated 13 May 2020 will be available and the rate of TDS applicable should be analyzed thoroughly and beneficial provisions either of Act or of DTAA should be considered.**

Further, it should be ensure that PAN details of the IEs/ AEs/SCs/ DPR consultants are available with NHAI. In the absence of PAN details, the provisions of section 206AA of the Act shall prevail i.e. in such a scenario the rate of TDS applicable would be flat 20% irrespective of the time period of the payment / credit to the IEs/AEs/SCs/ DPR consultants.

This is issued with the approval of Competent Authority.

  
(B. M. Rao)  
GM (Finance)

**c) Covid 19 Countermeasures – A Proposal by the Consulting Engineers Fraternity for Business Continuity**

CEAI have submitted a representation to the Hon. Minister, Ministry of Finance on April 6<sup>th</sup>, 2020 to provide the Consulting Engineering fraternity with urgent relief, in view of the Pandemic. Highlights of the representation are as under:

- COVID-19 - be declared as a Force Majeure event for all Consultancy Contracts under implementation or under service, viz., preparation of Feasibility Report and DPR, Detailed Engineering, Project Management, Authority Engineer, etc.
- The running contracts expiring during the lock-down period should be given an automatic extension of time and there should be a waiver for Submission/ Extension of Bank Guarantees as provided for in the Contracts, during this emergency (pandemic) period. Provision for payments need be made for deployment during extended period along with the overheads.
- Release of payments up to 90% of the already submitted Invoice amount, as per valid payment clause, prior to scrutiny of Invoice by the Department staff. The balance payment may be released after the due process. This would enable Consultants to pay to their staff and to the support organizations that work for them as well as to the large number of informal persons whose services are availed from time to time.
- For redressal of immediate financial crisis, the Income Tax refunds for FY 2016-17 and 2017-18 may be released on top priority across the spectrum, particularly to the Engineering Consultancy fraternity, who operate on a small capital base.
- GST is required to be paid by the Consulting Engineers within 30 days of raising the invoice while the payments from the Clients are received anywhere between 4-6 months or even beyond (as late as a year). This puts an enormous pressure on the Consulting Engineer's cash flows. As such, an urgent correction is required in GST dispensation, which could be explored by the esteemed Ministry to give reprieve to the Consulting Fraternity/ Service Sector. The possible corrections could be one of the following options:
  - The GST is paid by the Service Receiver (Client) directly on similar lines as TDS.
  - The Service Provider deposits the GST within 30 days of receipt of payments from the Client. This was the practice in vogue prior to 2012 when the present dispensation was introduced.
  - If, however, for any reason the above two options do not find favour with the esteemed Ministry, then the Service Provider may be given a timeline of 120-180 days from raising of invoice to deposit the GST, in line with receipt of payments from the Client. The Client may be mandated to make the payment alongwith the GST to the Service Provider, with a copy to concerned GST office.
- For Government Projects/ Contracts, digital signature on documents to be made valid for all proposals, contracts, etc., and physical copies or other documents shouldn't be demanded. To propagate and popularize digital signatures concept, an online payment process with access should be provided for the Government officials for dynamic and smooth processing of projects and contracts. This would positively impact and enhance ability of the companies to work on government projects and contracts.
- It is felt necessary that the Government of India provides clear directives that "home office inputs" would be covered under the definition of workplace, ensuring that the Professional Indemnity insurance coverage to the staff who operate from home is available to the Consulting Organizations.

- Various Clients have been insisting on providing individual BG against professional indemnity, against each Contract. It is humbly submitted that this be changed to the concept of Omnibus BGs, to be provided Client-wise for specified values, on a slab matrix, depending on the quantum of work each Consultant has with that particular Client.

### **Media have provided wide publicity to the representation.**

#### **d) Request from Chairman NHAI**

In response to the request from Chairman NHAI inviting suggestions regarding improvement in the working of NHAI, CEAI invited suggestions from its Members. CEAI Infrastructure Committee compiled the responses received from the Members and have sent the same to Chairman NHAI.

#### **e) Reminder letter to Hon. Minister, Ministry of Finance**

CEAI sent a reminder letter to Hon. Minister, Ministry of Finance with the request to her urgent indulgence to the following issues so as to facilitate an environment for the Engineering Consultancies to sustain and survive the current onslaught of COVID 19 and provide business continuity.

- i) Release of payments up to 90% of the already submitted invoice amount, as per valid payment clause, prior to scrutiny of Invoice by the Department staff. The balance payment may be released after the due process. This would enable the Consultants to pay to their staff and to the support organizations that work for them as well as to the large number of informal persons whose services are availed from time to time.
- ii) For addressal of immediate financial crisis, the Income Tax refunds for FY 2016-17 and 2017-18 may be released on top priority across the spectrum, particularly to the Engineering Consultancy fraternity, who operate on a small capital base.

The clearances of these outstanding payments would be of significant bearing to the Engineering Consultancy Industry and would instill hope and confidence to carry on post COVID 19 lock down towards business continuity.

- iii) The other issue where CEAI would like an urgent direction pertains to the current GST dispensation process, which mandates deposit of GST without actual realization of payments from the Clients. CAEI would like to bring to your kind attention to suggestions shared (vide the communication enclosed with the letter) on rationalization of the process, which would be a win-win for both the Consulting Fraternity (Service Sector) and the Government Exchequer.

#### **f) Recommendation for implementation of release of Performance Security**

Ministry of Finance has issued several notifications as part of the economic relief package announced by the Government of India. This package was necessitated to mitigate the adverse disruption of economic activities in the entire country on account of the lockdown announced by the Ministry of Home Affairs (MHA). The relief package is aimed to facilitate the nations rebuilding process under the *Aatmanirbhar* Bharat Package.

In this regard CEAI invited the attention of Secretary (RT&H), MoRTH vide letter dated 1st June 2020 to the Office Memorandum No. F18/4/2020-PPD dated 13.05.2020 issued by the Ministry of Finance, Department of Expenditure, Procurement Policy Division, Government of India, wherein it has been directed as under:

- (a) *Where an application is made by a contractor/ supplier who is not in default of any contractual obligations: or*
- (b) *Where FMC is invoked by a contractor/ supplier and the requirement of FMC are fulfilled,*

The Contractee (Government Department/ Agency) may return the value of Performance Security to the contractor/ supplier as is proportional to the supplies made /contract work completed to the total contract value.

#### **g) Recommendations to the Secretary (RT&H)**

CEAI submitted the following recommendations to the Secretary (RT&H), for seamless execution of the relief to the Consultants:

- With regard to the design and feasibility consultancy projects, the quantification of work completed for the purpose of release of proportional performance security should be derived on the basis of payments made to the consultants towards the invoices. The invoicing and payment milestone is a fair benchmark to ascertain the work completed.
- With regard to the consultancy services for supervision projects where consultants are paid on the basis of actual deployment against the contractual rates and man months, the computation of work completed should be assessed based on the actual cumulative amount billed in relation to the contract value taking into consideration approved extension of time.
- Internal implementation circular should include the following:
  - a. The phrase “Performance Security” as contained in the above referred memorandum should mean to include Performance Bank Guarantee, Retention Money and Security Deposit for ensuring performance of the services.
  - b. The custodian of Performance Security should be delegated with the requisite authority to compute the work done and return of proportionate Performance Security.

#### **h) Payments to the Authority Engineer towards Reimbursable Items**

CEAI issued a letter to Secretary (RT&H), MoRTH on 3<sup>rd</sup> June 2020 and submitted the following remedial measures for consideration:

- Payment of Reimbursable Items must be de-linked from the Percentage of Progress of Civil Works and paid as per actual deployment, using the contractual unit rates.
- For payments beyond the original contract duration, EOT granted must cover both remuneration of staff and reimbursable items.
- On existing contracts, at the end of the original contract duration, the Consultants must be paid the amount withheld thus far towards the reimbursable Items, which has been admitted as expense incurred, but withheld as it has been linked to progress of work. In the EOT period, in addition to the remuneration, the Reimbursable Items should be paid on actual deployment basis.

#### **i) MoRTH Circular - Atmanirbhar Bharat : Relief for Contractors/ Developers of Road Sector**

The Circular dated 3<sup>rd</sup> June 2020 issued by Ministry of Road Transport & Highways (MoRTH) is reproduced below :

**No. COVID-19/RoadMap/JS(H)/2020**  
**Government of India**  
**Ministry of Road Transport & Highways**  
**(Highways Division)**  
 Transport Bhawan, 1, Parliament Street, New Delhi - 110001

Date: 03.06.2020

To

1. The Chairman, National Highways Authority of India, G-5 7 6, Sector-10, Dwarka, New Delhi - 110075
2. Director General(RD) & Special Secretary, Ministry of Road Transport & Highways
3. The Managing Director, NHIDCL, PTI Building, New Delhi -110001
4. Principal Secretaries/Secretaries of all States/UTs Public Works Department/ Road Construction Department/ Highways Department (dealing with National Highways and other centrally sponsored schemes)
5. All Engineers-in-Chief and Chief Engineers of Public Works Department/ Road Construction Department/ Highways Department (dealing with National Highways and other centrally sponsored schemes)
6. The Director General Border Roads, Seema Sadak Bhawan, Ring Road, New Delhi - 110010
7. All CE-ROs, ROs and ELOs of the Ministry of Road Transport & Highways

**Subject: Atmanirbhar Bharat: Relief for Contractors/Developers of Road Sector- reg.**

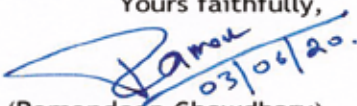
Reference: MoRTH O.M. No. COVID-19/Roadmap/JS(H)/2020 dated 18<sup>th</sup> May, 2020 regarding a Committee constituted for this purpose

Sir

After due consideration of the representations received from the Construction Industry, the Competent Authority in the Ministry of Road Transport & Highways has approved following measures for providing urgent relief to the contractors, concessionaires and developers of road sector in view of the prevailing situation due to COVID19 for immediate implementation by all the concerned agencies.

- (i) Retention money (which is a part of the Performance Security till construction period) is recommended to be released in proportion to the work already executed in accordance with the Contract specification and further retention money from the period from 03 months to upto 06 months may not be deducted from the Bills raised by the Contractor. For HAM/ BOT Contracts, Performance Guarantee may be released on pro-rata basis of that as provided in the Contract, if Concessionaire is not in breach of the Contract.
- (ii) Extension of Time to Contractor/ Concessionaire for meeting their obligation under the Contract for 03 months to upto 06 months depending on site conditions.
- (iii) Relaxation in Schedule H to provide monthly payment to the Contractor for the work done and accepted as per the specification of the contract during the month under EPC/ HAM Contract.
- (iv) Direct payment to approved Sub-Contractor through Escrow Account.

- (v) Waiver of penalty for delay in submission of Performance Security/ Bank Guarantee in new Contract entered into during March, 2020 to September, 2020.
  - (vi) To allow Extension of Time to Consultants i.e I.E/ A.E for 03 months to upto 06 months depending on site condition. During this Force Majeure Event, they may be considered as if they were on duty.
  - (vii) BOT/ TOT Concessionaire: Before CoD, the concession period of BOT contracts shall be extended by a period equal in length to the duration of 03 months to upto 06 months. Further for loss in collection of user fee, the concession period shall be extended by a period in accordance with the Contract till the time daily collection is below 90% of the average daily fee.
  - (viii) For all National Highway Tolling Contracts, loss in collection of fee may be compensated in accordance with the Contract.
2. After receipt of the proposal from the Contractor/ Concessionaire invoking provisions under FMC, the Authority Engineer/ Independent Engineer will examine and recommend for giving relief under the above measures to the Contractor/ Concessionaire by the PD/ Executive Engineer who will approve the relief measures as mentioned above.
  3. It is directed that all the measures indicated above shall be implemented by the executing agencies with immediate effect.

Yours faithfully,  
  
 (Ramandeep Chowdhary)  
 Deputy Secretary to the Govt. of India  
 Tel No: 23718575

#### j) Mid Sized / Medium Indian Consulting Engineers

CEAI sent a representation to Hon'ble Union Minister, Ministry of Micro, Small and Medium Enterprises on 26th June 2020, and submitted the following suggestions to support the MSME Sector:

- i) Define Indian Firms as those with more than 51% shareholding by Indian Nationals.
- ii) Only Indian Firms to be eligible to be registered under the MSME Category and draw the benefits that the Government provides to MSMEs.
- iii) Prequalification criteria on tenders to beset, keeping in mind credentials of "Indian firms". Else, "Indian Firms" need to be necessarily in the lead with the possibility to add International Firms to have access to the Pre-qualification experience and the domain knowledge. "Indian Firms" must participate at a minimum of 40% of the contract value.
- iv) All tenders with an estimated fee of Rs 200 Cr. must be restricted for "Indian Firms" only.
- v) In line with the Finance Act 2019, the turnover limit of Rs.400 Cr (This turnover should be excluding the international earnings) be applied for a Medium Enterprise under the MSME Act, who will also be treated as Suppliers like Micro / Small Enterprises for the purpose of receiving their dues within 45 days of their billing.

## k) MSME Notification

## MINISTRY OF MICRO, SMALL AND MEDIUM ENTERPRISES

## NOTIFICATION

New Delhi, the 26th June, 2020

**S.O. 2119(E).**—In exercise of the powers conferred by sub-section (1) read with sub-section (9) of section 7 and sub-section (2) read with sub-section (3) of section 8, of the Micro, Small and Medium Enterprises Development Act, 2006, (27 of 2006), hereinafter referred to as the said Act, and in supersession of the notifications of the Government of India in the Ministry of Micro, Small and Medium Enterprises number S.O.1702 (E ), dated the 1<sup>st</sup> June, 2020, S.O. 2052 (E), dated the 30<sup>th</sup> June, 2017, S.O.3322 (E ), dated the 1<sup>st</sup> November, 2013 and S.O.1722 (E ), dated the 5<sup>th</sup> October, 2006, published in the Gazette of India, Extraordinary, Part II, Section 3, Sub-Section (ii), except as respects things done or omitted to be done before such supersession, the Central Government, after obtaining the recommendations of the Advisory Committee in this behalf, hereby notifies certain criteria for classifying the enterprises as micro, small and medium enterprises and specifies the form and procedure for filing the memorandum (hereafter in this notification to be known as “Udyam Registration”), with effect from the 1<sup>st</sup> day of July, 2020, namely:--

**1. Classification of enterprises.**—An enterprise shall be classified as a micro, small or medium enterprise on the basis of the following criteria, namely:--

- (i) a micro enterprise, where the investment in plant and machinery or equipment does not exceed one crore rupees and turnover does not exceed five crore rupees;
- (ii) a small enterprise, where the investment in plant and machinery or equipment does not exceed ten crore rupees and turnover does not exceed fifty crore rupees; and
- (iii) a medium enterprise, where the investment in plant and machinery or equipment does not exceed fifty crore rupees and turnover does not exceed two hundred and fifty crore rupees.

**2. Becoming a micro, small or medium enterprise.**—

- (1) Any person who intends to establish a micro, small or medium enterprise may file Udyam Registration online in the Udyam Registration portal, based on self-declaration with no requirement to upload documents, papers, certificates or proof.
- (2) On registration, an enterprise (referred to as “Udyam” in the Udyam Registration portal) will be assigned a permanent identity number to be known as “Udyam Registration Number”.
- (3) An e-certificate, namely, “Udyam Registration Certificate” shall be issued on completion of the registration process.

**3. Composite criteria of investment and turnover for classification.**—

- (1) A composite criterion of investment and turnover shall apply for classification of an enterprise as micro, small or medium.
- (2) If an enterprise crosses the ceiling limits specified for its present category in either of the two criteria of investment or turnover, it will cease to exist in that category and be placed in the next higher category but no enterprise shall be placed in the lower category unless it goes below the ceiling limits specified for its present category in both the criteria of investment as well as turnover.
- (3) All units with Goods and Services Tax Identification Number (GSTIN) listed against the same Permanent Account Number (PAN) shall be collectively treated as one enterprise and the turnover and investment figures for all of such entities shall be seen together and only the aggregate values will be considered for deciding the category as micro, small or medium enterprise.

**4. Calculation of investment in plant and machinery or equipment.**—

- (1) The calculation of investment in plant and machinery or equipment will be linked to the Income Tax Return (ITR) of the previous years filed under the Income Tax Act, 1961.

- (2) In case of a new enterprise, where no prior ITR is available, the investment will be based on self-declaration of the promoter of the enterprise and such relaxation shall end after the 31<sup>st</sup> March of the financial year in which it files its first ITR.
- (3) The expression “plant and machinery or equipment” of the enterprise, shall have the same meaning as assigned to the plant and machinery in the Income Tax Rules, 1962 framed under the Income Tax Act, 1961 and shall include all tangible assets (other than land and building, furniture and fittings).
- (4) The purchase (invoice) value of a plant and machinery or equipment, whether purchased first hand or second hand, shall be taken into account excluding Goods and Services Tax (GST), on self-disclosure basis, if the enterprise is a new one without any ITR.
- (5) The cost of certain items specified in the *Explanation 1* to sub-section (1) of section 7 of the Act shall be excluded from the calculation of the amount of investment in plant and machinery.

#### 5. Calculation of turnover.--

- (1) Exports of goods or services or both, shall be excluded while calculating the turnover of any enterprise whether micro, small or medium, for the purposes of classification.
- (2) Information as regards turnover and exports turnover for an enterprise shall be linked to the Income Tax Act or the Central Goods and Services Act (CGST Act) and the GSTIN.
- (3) The turnover related figures of such enterprise which do not have PAN will be considered on self-declaration basis for a period up to 31<sup>st</sup> March, 2021 and thereafter, PAN and GSTIN shall be mandatory.

#### 6. Registration process.—

- (1) The form for registration shall be as provided in the Udyam Registration portal.
- (2) There will be no fee for filing Udyam Registration.
- (3) Aadhaar number shall be required for Udyam Registration.
- (4) The Aadhaar number shall be of the proprietor in the case of a proprietorship firm, of the managing partner in the case of a partnership firm and of a karta in the case of a Hindu Undivided Family (HUF).
- (5) In case of a Company or a Limited Liability Partnership or a Cooperative Society or a Society or a Trust, the organisation or its authorised signatory shall provide its GSTIN and PAN along with its Aadhaar number.
- (6) In case an enterprise is duly registered as an Udyam with PAN, any deficiency of information for previous years when it did not have PAN shall be filled up on self-declaration basis.
- (7) No enterprise shall file more than one Udyam Registration:  
Provided that any number of activities including manufacturing or service or both may be specified or added in one Udyam Registration.
- (8) Whoever intentionally misrepresents or attempts to suppress the self-declared facts and figures appearing in the Udyam Registration or updation process shall be liable to such penalty as specified under section 27 of the Act.

#### 7. Registration of existing enterprises.--

- (1) All existing enterprises registered under EM-Part-II or UAM shall register again on the Udyam Registration portal on or after the 1<sup>st</sup> day of July, 2020.
- (2) All enterprises registered till 30<sup>th</sup> June, 2020, shall be re-classified in accordance with this notification.
- (3) The existing enterprises registered prior to 30<sup>th</sup> June, 2020, shall continue to be valid only for a period up to the 31<sup>st</sup> day of March, 2021.

- (4) An enterprise registered with any other organisation under the Ministry of Micro, Small and Medium Enterprises shall register itself under Udyam Registration.

### 8. Updation of information and transition period in classification.--

- (1) An enterprise having Udyam Registration Number shall update its information online in the Udyam Registration portal, including the details of the ITR and the GST Return for the previous financial year and such other additional information as may be required, on self-declaration basis.
- (2) Failure to update the relevant information within the period specified in the online Udyam Registration portal will render the enterprise liable for suspension of its status.
- (3) Based on the information furnished or gathered from Government's sources including ITR or GST return, the classification of the enterprise will be updated.
- (4) In case of graduation (from a lower to a higher category) or reverse-graduation (sliding down to lower category) of an enterprise, a communication will be sent to the enterprise about the change in the status.
- (5) In case of an upward change in terms of investment in plant and machinery or equipment or turnover or both, and consequent re-classification, an enterprise will maintain its prevailing status till expiry of one year from the close of the year of registration.
- (6) In case of reverse-graduation of an enterprise, whether as a result of re-classification or due to actual changes in investment in plant and machinery or equipment or turnover or both, and whether the enterprise is registered under the Act or not, the enterprise will continue in its present category till the closure of the financial year and it will be given the benefit of the changed status only with effect from 1<sup>st</sup> April of the financial year following the year in which such change took place.

### 9. Facilitation and grievance redressal of enterprises.--

- (1) The Champions Control Rooms functioning in various institutions and offices of the Ministry of Micro, Small and Medium Enterprises including the Development Institutes (MSME-DI) shall act as Single Window Systems for facilitating the registration process and further handholding the micro, small and medium enterprises in all possible manner.
- (2) The District Industries Centres (DICs) will also act as Single Window facilitation Systems in their Districts.
- (3) Any person who is not able to file the Udyam Registration for any reason including for lack of Aadhaar number, may approach any of the above Single Window Systems for Udyam Registration purposes with his Aadhaar enrolment identity slip or copy of Aadhaar enrolment request or bank photo pass book or voter identity card or passport or driving licence and the Single Window Systems will facilitate the process including getting an Aadhaar number and thereafter in the further process of Udyam Registration.
- (4) In case of any discrepancy or complaint, the General Manager of the District Industries Centre of the concerned District shall undertake an enquiry for verification of the details of Udyam Registration submitted by the enterprise and thereafter forward the matter with necessary remarks to the Director or Commissioner or Industry Secretary concerned of the State Government who after issuing a notice to the enterprise and after giving an opportunity to present its case and based on the findings, may amend the details or recommend to the Ministry of Micro, Small or Medium Enterprises, Government of India, for cancellation of the Udyam Registration Certificate.

[F. No. 21(5)/2019-P&G/Policy (Pt-IV)]

A. K. SHARMA, Secy.

**CEAI Urge Govt. to redefine definition of Indian company to make Atma Nirbhar Bharat**

**The Hindu Business Line**

**Consulting Engineers' body urges govt to change definition of 'Indian company'**

India News - Business  
23 Jun 2020  
New Delhi, June 22

Consulting Engineers' apex body CEAI on Monday urged the government to change the definition of Indian company wherein Indian nationals should have at least 51 per cent stake.

Presently, any company registered in India and paying tax is considered Indian, Consulting Engineers Association of India (CEAI) said in a statement.

There is need to change the definition of Indian company under the Companies Act by making it mandatory to have a minimum 51 per cent shareholding by Indian nationals or entities, it added.

"CEAI, the apex body of consulting engineering professionals in the country, has urged the government to immediately change the definition of Indian company in the Companies Act to make the country Atma Nirbhar Bharat, said CEAI President Amitabha Ghoshal.

Per the Companies Act, presently any company registered in India and paying taxes is considered an Indian entity. This provision allows foreign companies to register themselves in India, pay taxes and carry the profits home, the statement said.

"While it is okay for them to operate as subsidiaries, the current definition allows such companies to enjoy all benefits provided to Indian companies, especially the MSMEs," KK Kapila, former CEAI president said.

Mumbai's Transport and Infrastructure Development Authority recently cancelled the bidding process for design, manufacture, supply, testing and commissioning of 10 monorail rakes due to the reason that both the bids it had received were only Chinese manufacturers, the statement said.

It apprehended that these manufacturers can set up a wholly owned subsidiary and based on the current definition, be an Indian Company and again enter the bidding process.

Therefore, the immediate need is that the definition of Indian Company is modified to reflect its Indian status by having a minimum of 51 per cent shareholding by Indian nationals or entities, Kapila argued.

**સીઇએઆઇની આત્મનિર્ભર અંગે સરકારને ભલામણ**

નવી દિલ્હી: કન્સલ્ટીંગ એન્જિનીયરિંગ એસોસિએશન ઓફ ઇન્ડિયા (સીઇએઆઇ), કે જે દેશમાં કન્સલ્ટિંગ એન્જિનિયરિંગ પ્રોફેશનલ્સની સર્વોચ્ચ સંસ્થા છે તેણે દેશને 'આત્મનિર્ભર ભારત' બનાવવા માટે કંપની ધારામાં ભારતીય કંપનીની વ્યાખ્યાને તાત્કાલિક બદલવા માટે સરકારને વિનંતી કરી છે, તેમ સીઇએઆઇના પ્રમુખ અમિતાભ ગોષ્ઠાએ જણાવ્યું હતું. કંપની ધારા મુજબ વર્તમાનમાં કોઇપણ કંપની ભારતમાં નોંધણી કરાવે અને તેની ચૂકવણી કરે તેને ભારતીય એકમ વર્ગીકરણ ગણાવામાં આવે છે. આ જોગવાઈ વિદેશી કંપનીઓને ભારતમાં તેમની નોંધણી કરાવી, કર ચૂકવી અને તેમના ઘરે નફો લઈ જવા માટેની પરવાનગી આપે છે.

**કંપની ધારામાં ભારતીય કંપનીની વ્યાખ્યાને બદલવા સરકારને વિનંતી**

નવી દિલ્હી, ૨૩ જૂન - કન્સલ્ટીંગ એન્જિનિયરિંગ એસોસિએશન ઓફ ઇન્ડિયા (સીઇએઆઇ), કે જે દેશમાં કન્સલ્ટિંગ એન્જિનિયરિંગ પ્રોફેશનલ્સની સર્વોચ્ચ સંસ્થા છે તેણે દેશને 'આત્મનિર્ભર ભારત' બનાવવા માટે કંપની ધારામાં ભારતીય કંપનીની વ્યાખ્યાને તાત્કાલિક બદલવા માટે સરકારને વિનંતી કરી છે, તેમ સીઇએઆઇના પ્રમુખ અમિતાભ ગોષ્ઠાએ જણાવ્યું હતું. કંપની ધારા મુજબ વર્તમાનમાં કોઇપણ કંપની ભારતમાં નોંધણી કરાવે અને તેની ચૂકવણી કરે તેને ભારતીય એકમ વર્ગીકરણ ગણાવામાં આવે છે. આ જોગવાઈ વિદેશી કંપનીઓને ભારતમાં તેમની નોંધણી કરાવી, કર ચૂકવી અને તેમના ઘરે નફો લઈ જવા માટેની પરવાનગી આપે છે.

**Presently Any Company Registered In India And Paying Tax Is Considered Indian**

Ahmedabad, The Consulting Engineers Association of India (CEAI), the apex body of consulting engineering professionals in the country, has urged the government to immediately change the definition of Indian company in the companies Act to make the country 'AtmaNirbharBharat', said Mr. Amitabha Ghoshal, President, CEAI. "As per the Companies Act, presently any company registered in India and paying taxes is considered an Indian entity. This provision allows foreign companies to register themselves in India, pay taxes and carry the profits home. While it is okay for them to operate as subsidiaries, the current definition allows such companies to enjoy all benefits provided to Indian companies, especially the MSME's," said Mr. K K Kapila, Past President, Consulting Engineers Association of India (CEAI) and Chairman, Infrastructure Committee of CEAI. (1-7)



**NAV GUJARAT SAMAY**

**કન્સલ્ટીંગ એન્જિનીયર્સ આત્મનિર્ભર ભારત કોમ્પોઝનને સહજ બનાવવા માટે ભારતીય કંપનીની વ્યાખ્યાને પુનઃ વ્યાખ્યાયિત કરવા માટે સરકારને વિનંતી કરે છે**

નવી દિલ્હી, ૨૩ જૂન - કન્સલ્ટીંગ એન્જિનિયરિંગ એસોસિએશન ઓફ ઇન્ડિયા (સીઇએઆઇ), કે જે દેશમાં કન્સલ્ટિંગ એન્જિનિયરિંગ પ્રોફેશનલ્સની સર્વોચ્ચ સંસ્થા છે તેણે દેશને 'આત્મનિર્ભર ભારત' બનાવવા માટે કંપની ધારામાં ભારતીય કંપનીની વ્યાખ્યાને તાત્કાલિક બદલવા માટે સરકારને વિનંતી કરી છે, તેમ સીઇએઆઇના પ્રમુખ અમિતાભ ગોષ્ઠાએ જણાવ્યું હતું. કંપની ધારા મુજબ વર્તમાનમાં કોઇપણ કંપની ભારતમાં નોંધણી કરાવે અને તેની ચૂકવણી કરે તેને ભારતીય એકમ વર્ગીકરણ ગણાવામાં આવે છે. આ જોગવાઈ વિદેશી કંપનીઓને ભારતમાં તેમની નોંધણી કરાવી, કર ચૂકવી અને તેમના ઘરે નફો લઈ જવા માટેની પરવાનગી આપે છે.



કંપની ધારા મુજબ વર્તમાનમાં કોઇપણ કંપની ભારતમાં નોંધણી કરાવે અને તેની ચૂકવણી કરે તેને ભારતીય એકમ વર્ગીકરણ ગણાવામાં આવે છે. આ જોગવાઈ વિદેશી કંપનીઓને ભારતમાં તેમની નોંધણી કરાવી, કર ચૂકવી અને તેમના ઘરે નફો લઈ જવા માટેની પરવાનગી આપે છે.

**CEAI urge Government to redefine the Definition of Indian Company to Make Atma Nirbhar Bharat**

New Delhi, The Consulting Engineers Association of India (CEAI), the apex body of consulting engineering professionals in the country, has urged the government to immediately change the definition of Indian company in the companies Act to make the country 'AtmaNirbharBharat', said Mr. Amitabha Ghoshal, President, CEAI. "As per the Companies Act, presently any company registered in India and paying taxes is considered an Indian entity. This provision allows foreign companies to register themselves in India, pay taxes and carry the profits home. While it is okay for them to operate as subsidiaries, the current definition allows such companies to enjoy all benefits provided to Indian companies, especially the MSME's," said Mr. K K Kapila, Past President, Consulting Engineers Association of India (CEAI) and Chairman, Infrastructure Committee of CEAI. (1-7)

Western Times, Gujarat

**"Need to replace Bailey Bridges with Quick Launch Bridges – CEAI"**

**dailyhunt** Need to replace bailey bridges with quick launch bridges: CEAI



New Delhi, June 24 (IANS) Amid the India-China face-off and the collapse of an important Bailey bridge in Uttarakhand, the Consulting Engineers Association of India (CEAI) has demanded from the government to do a survey of all bridges and culverts on rail and road networks. The CEAI suggested the government to opt for the 'Quick Launch Bridges' that have replaced Bailey Bridges the world over. In a statement, CEAI, which is an apex body of consulting engineers, expressed concern at the collapse of a Bailey bridge near Line of Actual Control (LAC) in Uttarakhand a couple of days ago at a time when these areas face security issues and need reliable infrastructure. The CEAI also highlighted that in the past several similar incidents happened leading to the loss of lives. "The Union Ministry of Road Transport and Highways and the National Highway Authority of India have already appointed consultants to carry out inventory and conditions survey of bridges and

culverts for updating the bridge management survey (BMS) on existing highways and roads," K.K. Kapila, former Chairman, CEAI said in a statement. Kapila, who is also the Chairman, Infrastructure Committee of CEAI, said that the Ministry of Railways, state governments and municipalities should be proactive when it comes to safety of vehicles and pedestrian bridges. He stressed on the similar inventory and condition process to be carried out for bridges less than 20 feet -- smaller bridge structures or pedestrian bridges, as is the practice worldwide. "This will lay the foundation of a good bridge maintenance programme based on quality inspection data, including complete and accurate information on the bridge structures falling in the purview of the Centre, state or a city agency," he said, adding that these structures need to be regularly inspected for 'sufficiency' rating as per requirement of bridge inventory standards. "Monitoring this will ensure safety of vehicular and pedestrian bridges and public life", he said. He also stressed on the need to review use of sub-optimal unsafe equipment bridges especially on National Highways and roads with security implications. Bridges with sub-optimal specifications reduce the capacity of the road, by lowering the speed of traffic and the loads carried. This is aggravated when single lane bridges like the Bailey Bridge are constructed on double lane roads and their load capacity is as low as 12-15 tons as in the recent incident close to the LAC and with a wider bridge and load capacity of a 100 tons (Class 70 R), the through put is increased 4-6 times and the bridge is much safer.

**Outlook**

THE NEWS HIGHLIGHTS JUNE 2020 Last Updated at 9:57 PM | SOURCE: IANS

**Need to replace bailey bridges with quick launch bridges: CEAI**

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**Need to replace bailey bridges with quick launch bridges: CEAI**

Last Updated: Wed, Jun 24th, 2020, 10:52:00hrs

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**Need to replace bailey bridges with quick launch bridges: CEAI**

June 24, 2020 6:11 PM Admin 0 Comments

Reading Time: 2 minutes

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## OBITUARY

**MR. SRIKUMAR GHOSH**

CEAI regrets to convey the sad demise of Mr. Srikumar Ghosh on 12<sup>th</sup> May 2020. He was the Founder member and a Former President of CEAI and earlier of the National Association of Consulting Engineers (NACE). Mr. Ghosh had been actively involved in various activities of CEAI since its inception. Mr Ghosh was awarded the CEAI Life Time Achievement Award 2012 for his tremendous contribution for the engineering profession.

Mr. Ghosh was an internationally recognized eminent project design, development, delivery expert in the field of infrastructure, energy and environmental engineering. He had over 55 years of executive, business management and technical experience.

Mr. Ghosh was the Co-Founder, Former Chairman, Managing Director of CES (India) Pvt. Ltd.; one of the largest and most diverse provider of design, engineering, consultancy and project management services in the infrastructure sector in India. Its operation spread across India, Middle East, South East Asia and East Africa. CES merged with Jacobs Engineering Group, one of the world's largest Engineering Company, in 2011.

Mr. Ghosh had extensive operating experience in India, Middle East, East Africa and South East Asia. He had been an Executive Committee member over a span of 30 years of various major international industry institutions/ organizations like NACE, CEAI, PIANC, FIDIC, CII, IStructE et al.

Mr. Ghosh received his B.E. from Bengal Engineering College, Calcutta (Kolkata) University where he was recipient of the prestigious Gold Medal award as the University topper. He did his Post Graduation from Imperial College of Science & Technology, London, UK.

Mr Ghosh had always been involved in varied knowledge-dissemination efforts of the various professional learned bodies he had been associated with. He had presented highly laudable papers in international/ national forums. The passion of Mr Ghosh had ever and always been working for the good of the profession and his fellow professionals.

## OTHER NEWS, VIEWS & NOTES

### WEBINAR ON HYDROPOWER, DAM SAFETY AND RISK MANAGEMENT AMIDST COVID -19 CHALLENGES

The World Bank Group organised a webinar on “*Hydropower, Dam Safety and Risk Management Amidst Covid 19 Challenges*” on 28<sup>th</sup> May 2020.

Dr. Ajay Pradhan, Vice President CEAI, was one of the Speakers. He presented his views on “*Water Infrastructure and Dam Safety in India*”.

### WEBINAR - PANEL DISCUSSION ON “ROLE OF STRUCTURAL ENGINEERS IN POST COVID-19 SCENARIO”

IAStructE organised a Panel discussion on 27<sup>th</sup> June 2020 on “*Role of Structural Engineers in Post COVID-19 Scenario*” to discuss about the impact of COVID-19 to the Structural Engineering fraternity in the short, medium and long term range.

Mr. Amitabha Ghoshal, President CEAI was one of the Panelists and the Moderator.

#### THE PANELLISTS WERE:

- **Prof. Mahesh Tandon, Past President IAStructE;** MD, Tandon Consultants Pvt. Ltd., New Delhi
- **Mr. Alok Bhowmick, President IAStructE;** MD, B&S Engineering Consultants Pvt. Ltd.
- **Prof. Reshma Shah, Associate Professor;** FT - CEPT University, Ahmedabad
- **Mr. Arvinder S. Brara;** CMD, Mantec Consultants Pvt Ltd., New Delhi
- **Mr. I. K. Pandey;** DG (RD) & SS, MoRT&H, New Delhi
- **Mr. Anil Kumar Sharma;** Former Special DG, CPWD, Noida
- **Mr. Vipul Ahuja;** Vice President (North) IAStructE; Director & CEO, Ahuja Consultants Pvt. Ltd.

#### VIEW POINT

**The themes for the next two issues of Viewpoint would be:**

- (a). Stakeholder Management in Public Infrastructure Projects (September 2020)
- (b). Digital Engineering (December 2020)

Considering the experience of CEAI members and various stakeholders in the subjects, CEAI would be happy to receive articles on the above themes.

Authors could share their knowledge and experience by providing case studies of the works executed or in execution, first-hand accounts of the challenges faced, practical issues experienced and the solutions to those, etc. Photographs,

charts, diagrams, drawings, etc. would benefit our readers for better appreciation of the issues encountered and addressed.

The articles for an issue need to reach CEAI at least 6 weeks prior to the end of the month of the View Point issue.

Articles need to be in Times New Roman 12 with single line spacing with before and after 6 pt and normal margin on A4 size. A recent clear and bright passport size photograph of the author is to be sent along with the article.

## ADVERTISEMENT IN VIEW POINT

VIEW POINT is circulated to all CEAI Members, FIDIC, Ministries of the Government of India, Public and Private Sector Undertakings, Construction Firms, Contractors, Consultants, Foreign Missions and Funding Institutions in India and other organisations related to or dealing with the engineering profession.

### ADVERTISING IN THE VIEW POINT GIVES THE ADVERTISER WIDE EXPOSURE AND VISIBILITY.

Support from CEAI members and stakeholders are sought in increasing the number of advertisements, such that View Point gain in its stature as an unique Technical Publication.

The rates for advertisements in VIEWPOINT are given below. This is excluding GST @ 5% or as prescribed, which will be extra:

Item	Rate Per issue* (Rs)	Discounted rate at 20% for 4 consecutive issues* (Rs)
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Inside Back Cover	15,000/-	48,000/-
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*\*GST @ 5% or as prescribed will be added to the above rates.*

*\*\* Back Cover booked till Sept 2020*

*\*\*Inside Front Cover booked till June 2021*

## Tech Quiz

1. **In which coal-based power plant was the first Flue Gas Desulphurisation system installed?**
  - a) Hawthorn, Kansas City, USA
  - b) Drax Power Station, UK
  - c) Shimonoseki, Japan
  - d) Battersea Power Station, UK
  - e) Cholla, Arizona, USA
2. **Who first coined the term Artificial Intelligence?**
  - a) Vanevar Bush
  - b) Alan Turing
  - c) John McCarthy
  - d) Edward Feigenbaum
  - e) Joshua Lederberg
3. **Who proposed the concept of Self Compacting Concrete?**
  - a) Prof. Hajime Okamura
  - b) Swedish Cement and Concrete Research Institute
  - c) Prof. K. Ozawa
  - d) Delft University of Technology, The Netherlands
  - e) Northwestern University, USA
4. **Which is the most environment friendly promising fuel for cars?**
  - a) Ethanol
  - b) Biodiesel
  - c) Compressed Natural Gas
  - d) Li-ion battery
  - e) Hydrogen Fuel Cell
5. **Where was the world's first 3D printed concrete community housing constructed?**
  - a) Tabasco, Southern Mexico
  - b) El Salvador
  - c) Eindhoven, Netherlands
  - d) Yaroslavl, Russia
  - e) 3D printed houses by WinSun, China
6. **When was the first human carrying electric vehicle made?**
  - a) 1884
  - b) 1881
  - c) 1888
  - d) 1890
  - e) 1891
7. **Which was the first rechargeable battery invented?**
  - a) Voltaic Pile
  - b) Daniell Cell
  - c) Lead Acid Battery
  - d) Nickel-Cadmium Battery
  - e) Li-ion battery
8. **Who were the scientists to first isolate a single graphene sheet?**
  - a) Boehm, H. P., Clauss, A., Fischer and G., Hofmann, U.
  - b) B C Brodie and P. R. Wallace
  - c) G. Ruess and F. Vog
  - d) Andre Geim and Kostya Novoselov
  - e) Philip Kim and Yuanbo Zhang
9. **Which is the strongest material known to man in terms of strength compared to weight?**
  - a) Diamond
  - b) Wurtzite boron nitride
  - c) Buckypaper
  - d) Silicon carbide
  - e) Graphene
10. **When did IoT/ IIoT start?**
  - a) 1968
  - b) 1975
  - c) 1999
  - d) 2002
  - e) 2006

The first person who mails the correct answers to CEAI [info@ceai.org.in](mailto:info@ceai.org.in) will get a congratulatory mail and will be acknowledged by publishing the persons photograph in the next issue

**Contributed by Manos K De**

**Answers to Tech Quiz March 2020 issue**

1(c), 2(e), 3(a), 4(d), 5(a), 6(e), 7(b), 8(a), 9(c), 10(d)



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