JUNE 2023

VIEWPOINT

OFFICIAL QUARTERLY MAGAZINE OF CEAI

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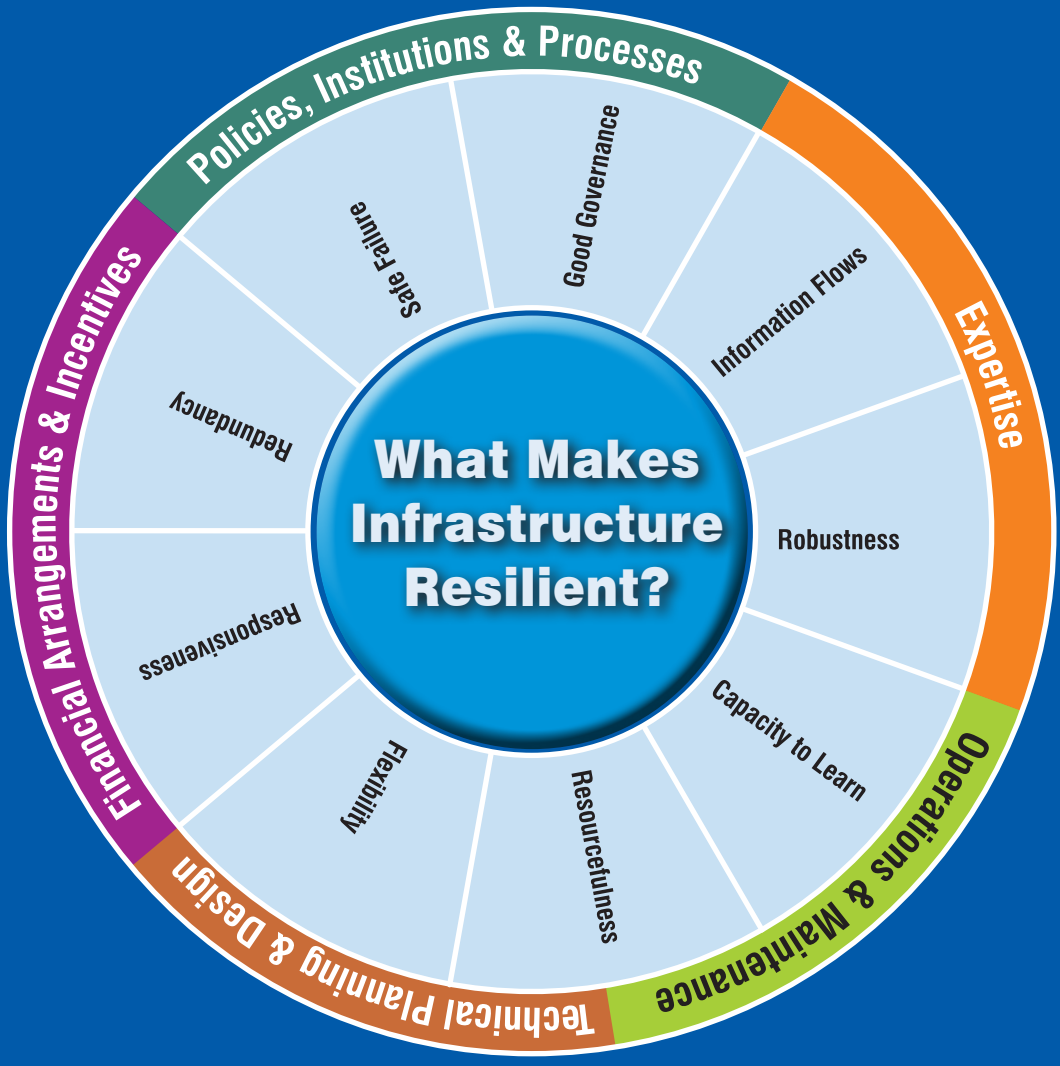
Climate Resilient Infrastructure



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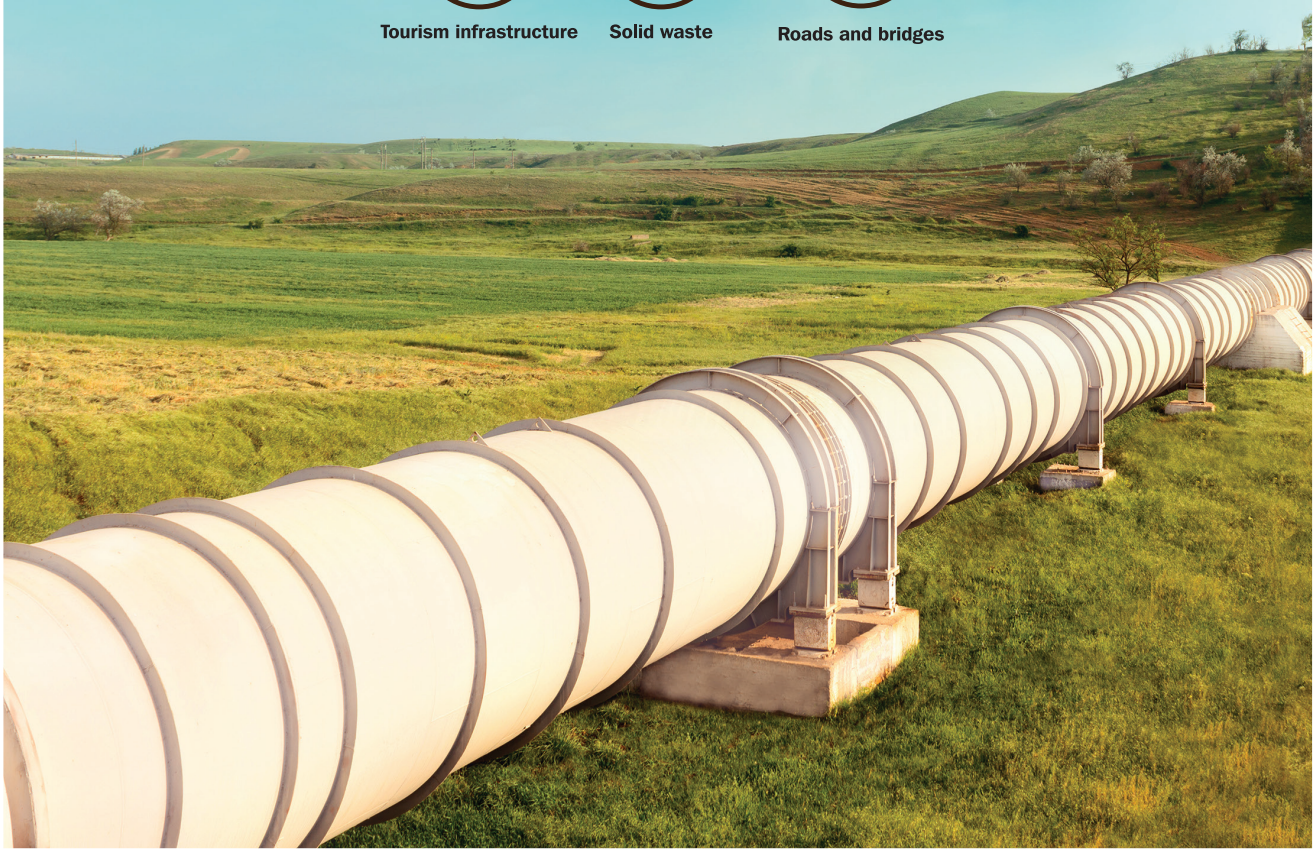

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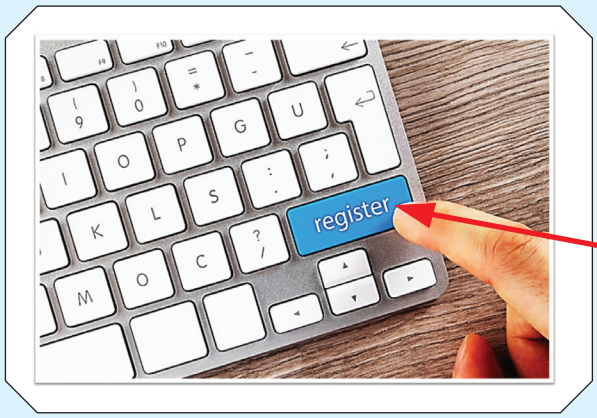
Cover image is from *"Implementing Circular Economy Strategies in Buildings—From Theory to Practice"* by Kamel Mohamed Rahla, Ricardo Mateus and Luís Bragança



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- CEAI provides excellent opportunity to present papers in seminars and technical lectures organised from time to time
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- CEAI takes-up various issues confronting the profession with government and other authorities from time to time with the objective of making the conditions of engagement on a fair and equitable basis so that Consulting Engineers can function in the best interest of the country
- CEAI promotes the cause of Women Engineers with a view to ensure rightful places for them in the engineering consultancy arena
- CEAI helps to develop Young Engineers who are the Future Leaders

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CODE OF ETHICS

June 2023

PREAMBLE

Engineering consultancy services make significant contributions to the economic growth and sustainable development of the nation, and in safeguarding health, safety, welfare, and happiness of the society.

For the nation and the society to derive maximum benefits from engineering servics, it is essential that, in addition to being of high technical standards, the services provided are of the highest universally accepted moral and ethical standards.

With a view to achieve the stated objective the Consulting Engineers Association of India (CEAI) has framed a "Code of Ethics" which is mandatory for all members of the Association to adopt and abide by.

This Code presupposes that every member of CEAI is a law abiding, truthful, honest, fair and just citizen of the society. In addition, the member must follow the directives of the Code in his/her professional practice.

THE CODE

Each CEAI Member shall:

Responsibility to Society	1	Ensure that he/she shall be ethically and socially responsible, and his/her professional services safeguard and enhance the health, happiness and safety of the society.
	2	Ensure he/she, in his/her profession upholds the principles of environmentally sustainable development and considers climate change in decision-making with appropriate knowledge and training, and also informs clients about the need for its inclusion.
	3	Treat all persons fairly and encourage equitable participation without regard to religion, race, caste, gender, descent, place of birth, or residence, so that everybody works with honesty, integrity, and mutual trust and respect in a transparent manner.
Responsibility to Profession	4	At all times, uphold the dignity, standing and reputation of the profession.
	5	At all times, provide services: (a) in accordance with the principle of 'Duty of Care', implying the obligation to take reasonable steps to avoid foreseeable harm to another person, group, or their property and society; (b) to meet and fulfill the requirements as agreed with the client as per the Design Brief of the client, or as required by the employer as per the employment contract, and give feedback for any changed context; and, (c) to ensure that the said services utilise appropriate technology, and be fit for the design life of the product or facility and for its intended purpose and use.
	6	Always be responsible and accountable for all the professional services provided under his/her responsible charge, including using validated and legal algorithms and software.

	7	Refrain from: (a) expressing in public an opinion on a professional topic unless he/she is sufficiently informed on the facts relating to the topic and he/she is competent to comment on it; (b) making public statements which are not in an objective and truthful manner; (c) casting any aspersions of an unjust or malicious nature; and, (d) performing any service beyond his/her competency.
	8	Imbibe, inculcate and emphasise the Code of Ethics periodically and internally within the organisation and also for oneself.
	9	Maintain knowledge and skills at levels consistent with developments in technology, legislation and management, and apply due skill, care and diligence in the services rendered to the client or employer.
	10	Continue professional development and advancement throughout his/her career.
Integrity	11	Act, without prejudice to the rights of other stakeholders, in the legitimate interests of the client or employer, and perform professional services with integrity and faithfulness.
	12	Act with fairness and justice towards his/her client or employer, and towards vendors, contractors, and other professionals in all matters pertaining to contracts relating to his/her professional services.
	13	Refrain from: (a) indulging or being or getting involved in any activity which in any manner seeks to affect or in any way influence the client or employer with regard to the selection of or the compensation for professional services; and/or affect or influence the impartial judgement of the professional himself/herself; and, (b) participating in any shape or form in the process of giving, promising or taking money, gift, or favour which may influence the judgment or conduct of a person in a position of trust or authority.
	14	Inform: (a) the concerned client or employer organisation's management first, of any unethical or unsafe act or situation; known or learnt by him/her in the course of his/her work or in any other work within his/her competency; and (b) the appropriate authorities, if the client or employer organisation's management is unable or unwilling to address the unethical or unsafe act or situation referred to in (a) above
	15	Facilitate in ensuring legal compliance by client or employer, contractors, vendors and others.
	16	(a) Refrain from utilising any data, information, computer hardware or software in his/her work that might infringe upon any Intellectual Property Rights, without obtaining proper legal clearance; and (b) Use all the data, business plans or strategies, and any other sensitive or confidential documents or materials, whether from the client or employer, or internal to the organisation, in a responsible manner, so that their confidentiality and security are not compromised.
	17	Promote an ethical culture in the organisation based on shared values, beliefs and norms such as trust, honesty, integrity, fairness, confidentiality and accountability, and actively adopt them to uphold professional ethics, and make decisions that are above reproach.

Impartiality	18	Be free of prejudice and personal preferences, in his/her professional advice and judgement.
	19	Refrain from accepting an assignment for services which prejudices his/her independent judgement.
	20	Inform the client or employer of any potential conflict of interest that exists or might arise in the performance of an assignment.
	21	Promote the concept of quality based services to encourage fair competition
	22	Cooperate fully with any legitimately constituted investigative body appointed or setup for inquiry into the administration of any contract where the professional is involved.
Relations with Other Consultants	23	Refrain from directly or indirectly injuring/damaging or attempting to injure/damage the professional reputation or practice or prospects of another fellow professional, except when the fellow professional is incompetent or has violated ethical norms.
	24	Refrain from associating in work with a professional whose methods of practice do not conform to the ethical practices as laid down in this Code.
	25	Refrain from: (a) trying to supplant another professional in any particular assignment; and (b) intervening in work of any kind which to his/her knowledge has already been entrusted to another professional, except when appointed as a Reviewer by the client or employer.
	26	Refrain from taking over the services being provided by another professional unless the client or employer formally appoints the professional to take over the ongoing assignment, after legally terminating the previous contract, and legally indemnifies the appointed professional against any deficiencies and losses already incurred or liable to be incurred due to the errors of omission and commission by the previous professional.
Relation with Clients	27	(a) Refrain from disclosing confidential information concerning the assignment, any technical process or any related matter, of the client or employer without the client's or employer's consent. (b) making comments in public/ social media regarding the work being done for the client.
	28	Publicity material as well as any paper/ article developed, written and published by the professional regarding the project to be as per the contract and the scope of work therein.
	29	Amicably attempt to resolve any issue with the client.
Relation with Employees	30	Provide opportunities for the professional development and advancement to other professionals in his/her employment or control, aimed to foster a culture where people are motivated, engaged, valued and can learn, develop, and grow.

Message from Chief Editor

Dear Fellow Consulting Engineers & Readers,

The March 2023 issue of the ViewPoint was on ***"Consultant - Client Relationship"*** relating to engineering projects. Extending the matter of relationship further vis-à-vis a project the question that arises is what should be the relationship between the stakeholders, the Project and Nature. In the December 2022 issue there were papers on ***"Circular Economy for Sustainability".*** They invariably raised concerns and advised that care is to be taken that the natural materials are consumed with great caution. Another aspect that enforces that thought is that Natural phenomena are becoming more devastating. Replacing or rehabilitating damaged infrastructure is not only time consuming but also eats into the coffers of the nation.

It is therefore necessary that the concern for Nature is taken down to the brass tacks. That necessitates all the stakeholders in a project also look at the project from a different perspective, albeit keeping functional requirements and the service design life in view. They need to review as to which natural material, normally used, will get permanently depleted, what naturally growing renewable material can be substituted, what is the embodied carbon in the materials and review alternate options which are less harmful to the environment, how will the project affect the existing natural contours, watershed, flora, fauna, pollution issues from its emissions, effluents, other wastes, etc. Replenishable materials with reduced embodied carbon must be made the first choice and recyclable materials the second. Usage of materials which fall into the 'one use only' or 'once use only' categories should be phased out in a time bound manner. The era of consumerism and spendthriftness need to be also phased out. Along with those steps it is also important that what is built is long lasting to withstand the vagaries of nature for its design service life.

Designing to function and remain functionable in the face of the ever-changing climate is what the articles in this issue on "Climate Resilient Infrastructure" talk about. It's about designing, not for the unknown but for what could be foreseen as being highly probable. Another way would be to spread the development of habitations and reduce the concentration in a few places by developing satellite townships, etc. The concept of metropolitan areas needs to be looked at a fresh since with each of them there is a trail of services/ functions which need to be kept alive 24/7. Waste disposal has become a big issue hence, any new development must address that for the next 75 to 100 years; 25-30 years is a very short horizon for planning. Quite a bit of the life of the facility is lost before it really starts to function fully. While waste disposal in terms of Reducing, Recycling and Reusing is good, it will be far better to gradually reduce the manufacture of items which cause waste and pollution issues.

If one looks dispassionately at the urban development trend in the past few decades, it is obvious that each new project is advertised as being bigger, taller, being built faster, incorporating many more artificial materials, etc. Just stop to think whether all that is really necessary apart from satisfying ego and pride. What will happen to all those facilities after half a century. The state of the infrastructure which was the pride of USA, is no more that. They are neither able to replace the deteriorated and broken infrastructure nor even maintain it. Roads, highways,

bridges, dams, etc. are failing since they are not being repaired or strengthened. The same is true of other countries as well – the Dutch dykes for example.

Cyclone *Biparjoy* which hit the coast of Gujarat in June 2023, clearly demonstrated that climatic conditions are changing and that the effect of any disturbance can be wide spread and have far reaching consequences. Areas in Rajasthan that normally hardly have any rainfall worth mentioning, were flooded for days. It would thus be prudent not to go by historical trends of the past century or more but to give much greater weightage to the vagaries of nature in the past decade or so and try to decipher a pattern, if any, and use that as a guideline but with care. A certain minimum emergency rehabilitation and relief material, essential resources for sustaining life, plant & equipment and other facilities need to be provided for each and every habitation – be it urban or rural.

Codes and standards for buildings, roads, drainage, distance from the waterlines, etc. all need to be looked at afresh. The oft lee way given to bypass even the current rules and regulations which affect natural terrain, inter facility spacing, etc. has to be made a thing of the past. One has to be in sync with nature or else face the consequences.

It is the Engineers who can utilize their knowledge and expertise to keep the earth from becoming a quagmire. They need the freedom to do what is best under the circumstances for the project and necessary to factor in climate changes. Trust in the profession is key to this and to establish that all Engineers must abide by a Code of Ethics. The Engineers MUST be in the driver's seat. It is for that reason that CEAI and allied associations have been pursing with the Government of India for legislation for the Profession of Engineering. That would also help to put the Indian Engineers at a better level vis-à-vis other countries.

Sync with Nature and Learn from its Rebound

Plan to Endure the Changing Patterns of Climate

With Fortitude and Foresight

Engineers MUST Take the Stand

To Save the Earth for Posterity

Happy Reading & Learning

A P Mull

Message from President

Dear Colleagues, Friends and Members,

Past six months have seen lot of activities by the association starting with the constitution of various committees, taking up issues with government bodies, organising and holding physical and online events for professional development, committee meetings to improve and enhance the functioning of the association, giving publicity for enhancing the image of the consulting engineers and the engineering fraternity in general, etc.

A lot of push is being given to develop the infrastructure which is necessary and essential for the country to grow and prosper since this sector holds the key to linking the country – physically and virtually. That will open avenues for all the regions of the country to develop and prosper economically.

The consulting engineers in India, who are well versed with the requisite knowledge and experience need to spread out and help other developing countries on their path of progress. That would help the brand India spread far and wide.

The participation in the webinar on *"Ethics & Integrity at the Workplace"* showed the interest and importance that Ethics & Integrity are receiving by the engineering fraternity.

The Young Professional Forum of CEAI has been quite active in arranging topical webinars which are being well attended.

CEAI's Western Region Centre embarked on organising extended courses; the *"Construction Law Course"* being the first one. It has received a very good response, is running very well and the participants are appreciating it.

The FIDIC Committee has organised a Training course on the FIDIC *Conditions of Contracts* from 4th September to 7th September 2023.

In the interest of the profession, Members are requested to be more actively and positively involved with the association - its functioning and activities. One of the intents of CEAI is to present the excellent works being done by professional engineers without whom development would not be possible. CEAI is awarding the individuals and organisations for their excellence in various fields, every year.

Looking forward to meeting you all at CEAI events.

Join CEAI, know and be known to keep the profession in the limelight

Rama Shanker Sharma

01

Climate Resilience in Design

Arshi Bhutani
General Manager

Luqman Ummer
Consultant – Engineering & Project Management

TATA Consulting Engineers Limited

Abstract

Infrastructure, which play a vital role in social as well as economic development of a nation, include transportation - roads, railways, airports, docks & harbours; energy grids, water & waste water systems, communication systems, etc., all of which play a vital role in the delivery of key services such as people and material movers, health, agriculture and supply chain. Cross dependencies exist among the infrastructure and one inadequately designed system could impact the functioning of the others. Today's infrastructure needs to be robust, designed to last generations and be resilient to the challenges of today as well as tomorrow. This aspect is best addressed in the design phase itself.

This paper discusses some of the challenges such as climate change, adequacy of prevailing design codes, choice of materials for climate-resilient design, sustainability issues, etc., and identifies focus areas for enhancing the resilience of infrastructure in terms of design, engineering, materials and construction practices. It touches upon the role played by national and regional statutory departments in delivering planning and institutional actions suited to local conditions in cities and other habitats. It also covers the significance of climate-responsive architecture as a design practice centered on creating buildings that function in lockstep with the local climate, not despite it. The governance of infrastructure in terms of planning, financing, contracting, and building of the public physical infrastructure essential for economic and social activities, involves more than the provision of brick and mortar assets.

Introduction to Climate Resilient Infrastructure

For an infrastructure to be climate resilient, it needs to be planned and designed in such a way that it is capable of facing and surviving the changes in climatic conditions that it will face during its design service life. It needs to be built and operated in such a way that it can adapt to such changes. It needs to be capable of withstanding and recovering from all sorts of disruptions throughout its lifecycle. (*www.oecd.org/environment*)

All climatic changes may not translate into a risk for infrastructure. The extent to which such a change could pose a risk or threat depends on various factors, such as:

1. Extent of exposure
2. Vulnerability
3. Geographic location
4. Adverse effect of developments elsewhere

Risk, by its very nature, can be moderated and mitigated by implementing suitable counter measures. However, the following economic considerations would prevail.

1. Likelihood of occurrence
2. Cost of mitigation
3. Likely extent of disruption
4. Cost of disruption and recovery (both direct & indirect)

Risk mitigation could be broadly classified as two types:

1. Structural measures such as specification changes or scope changes.
2. Management measures such as innovative standard operating procedures or purchasing insurance to offset financial consequences.

The former addresses the physical asset whereas the latter is only the financial consequence and not really a risk mitigation measure per se where climate change is concerned since its ability to address risks on a national scale is open to question.

All the same, in a nutshell, climatic resilience means that the risks have been considered and managed to achieve an acceptable level of performance given the available information, and that capacities to withstand and recover from shocks are in place. (*www.oecd.org, OECD - 2014a*)

Climate-resilient infrastructure reduces, but may not fully eliminate, the risk of climate-related disruptions. (*Policy Perspectives - OECD Environment Policy Paper No. 14*)

Understanding Climate Resilience

There are three main aspects of climate resilience - preparation, adaptation, and recovery. (*www.climate.mit.edu*)

How well an infrastructure is prepared to endure and survive conditions that are likely to arise in the future is mostly defined during the design and engineering stage of that project. The BEDD (Basic Engineering and Design Data) / Detailed Project Report (DPR) document which is prepared during basic engineering is a document which can contribute and support the drive towards climate resilience.

Climate risk workshops can help to identify future risks, likelihood of occurrence, probable consequences and mitigations. These can be both qualitative and quantitative. The Project scope can consider including such mitigations.

Considering extraneous factors outside the project physical boundary is another measure of preparation. Examples of such factors could be proximity to the sea coast with potential rise in sea level, proximity to rivers and water bodies, glacial action, landslides, development work in the neighbourhood leading to seasonal disruptions and at times disasters. Such considerations could alter project specifications in terms of material selection, grade and finished floor elevations, etc. It could even result in the identification of outside community projects such as construction of seawalls or improved drainage systems as a pre-requisite. Alert and warning systems like trend tracking or early warning mechanisms for specific threats may have to be included in the project scope.

Preparation also includes communication of identified risks to the local community and governing bodies, along with evacuation and shelter guidelines.

In a global warming scenario, the hazards and the risks are ever changing. Adaptation is a measure of how flexible and responsive the prevailing systems, codes and standards are to the needs of the present as well as the future. It is necessary to continuously update the building codes and standards to reflect climate projections. It is worthwhile to study if including authorized local climate projections in BEDD/ DPR can support such efforts.

It is equally important to have plans, systems and resources in place for a rapid recovery in the event of an incident occurring. That, more often than not, calls for a collaborative effort from the facility owner as well as the community and local governing bodies. The importance of rapid recovery and return to normal business activity is evident from the fact that the fastest recovering communities in New Orleans after hurricane Katrina, were those that opened schools

the earliest. (*Brand, Anna Livia, Karl Seidman et al. 2008)* The Uttarakhand Disaster Recovery Project (UDRP) has enabled resilience to be integrated into the reconstruction of disaster affected houses. *Mumbai city has been suffering from heavy floods in the past hence disaster preparedness including increasing the capacity of the Drainage systems has been undertaken by the authorities.*

In 2022, Bengaluru witnessed one of the worst flash floods in its recent history. Various studies that followed point towards two main contributors (*www.climatetrends.in, et.al.)*. Impact on monsoon systems due to climate change leading to torrential rain. And poor urban planning which prevented the natural drainage of the rain water. The natural drainage network between the numerous lakes of this erstwhile garden city was badly broken, leading to flooding and inundation of various residential areas (*www.timesofindia.com, et.al.).* The IPCC (*Intergovernmental Panel on Climate Change*) in its *Climate Change Report 2022* has warned about the increasing trend in human induced impacts on climate change.

Significance of Climate Resilience Infrastructure

After understanding climate resilience, the next important aspect to address is the requirement to address it; the adaptations for foreseeable changes. The adaptation can deliver a strong return both by reducing costs from climate-related damage to infrastructure itself and by avoiding significant knock-on effects on a wider scale. If carefully planned, adaptation actions can reduce exposure to climate risk.

There is no one-size-fits-all approach to ensure that climate adaptation efforts have positive results and include the concerns of everyone affected. For example, the developmental projects like bridges, roads and hydropower plants in highly fragile ecosystem and environmental sensitive zones like the Himalayas in India are prone to frequently occurring earthquakes, landslides, avalanches and floods. Thus, local and regional governments play an essential role in delivering planning and institutional action suited to local conditions in the cities and other habitations.

Depending on the scale of the change required, efforts to adapt to climate change can be different. The same is reflected in Figure-1 as well as detailed below:

1. **Incremental**

   The incremental changes are the changes done in the existing system to adapt to the new conditions while the basic characteristics of the system are maintained. This can be clearly illustrated by cases wherein the existing capacity is increased or changed to meet the requirements. For e.g., increasing sewerage capacity or placing flood gates at buildings, or adopting multi-level parking, etc.

2. **Reformist**

   The reformist adaptation is the shift by adapting to a better sustainable solution. For e.g., the decarbonization of the energy sector, developing sustainable and inclusive cities that provide core infrastructure and enable a clean and sustainable urban environment. Increase in the share of bio- and e-fuels which have a low carbon footprint supports the reformist adaptation towards climate resilience.

   Bharat Petroleum Corporation Limited's first integrated 2G+1G #BioEthanol refinery in Odisha, is scheduled for mechanical completion by next year. That will be using biomass from non-edible whole plants or food grain residues for 2G ethanol and sugarcane juice, molasses & damaged grains for making 1G ethanol. India has a surplus of about 120 to 160 million metric tonne annually, which if converted has the potential to yield 3000 crore litres of Ethanol annually. It is a step in the alignment towards the National Biofuel Policy according to which India has a target of 20% Ethanol blending in petrol by 2030.

3. **Transformational**

   The transformational changes aim to reduce the root causes of vulnerabilities to climate change by transforming them into more just, sustainable, or resilient states. That needs attention from

policy makers and the need to shift towards sustainability taking the future into account. The international ban on ozone-depleting chemicals to preserve the ozone layer and prevent a significant increase in global warming is an example of a transformational change. Some practical example of the transformational adaptation are: in 2021, at COP26, India announced its ambition to become a net-zero emitter by 2070; India has pledged that by 2030 half of power-installed capacity would be from non-fossil fuel-based energy resources and to achieving a 45 percent reduction in emissions intensity from its 2005 levels. Promoting Electrical vehicles is another step by the Government of India.

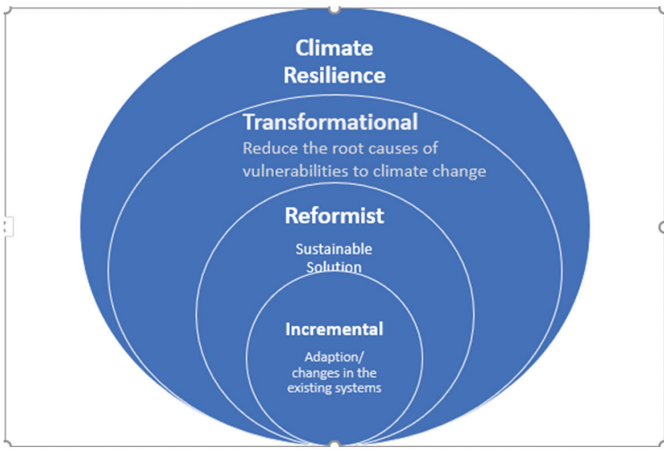

***Figure-1**: Different modes to advance towards Climate Resilience ©*

Resilience Considerations in Design

For reformational or transformational changes for adaptation to climate change, resilience considerations in the design phase itself can go a long way. Many of the design phase considerations can generate significant returns on investment in preventing or reducing damages from climate hazards, and some (for example, early warning systems, better urban design) would have near-term positive returns. Undoubtedly that requires capital investment, and thus needs alternate financing and public-private collaborations.

Infrastructure usually involves large investments in assets that are designed to operate over a long term. Coal-fired plants are designed for 40 to 50 years, for example, and hydropower dams and large geotechnical structures for up to 100 years. To date, the design of these facilities typically has assumed a future climate that is much the same as today. However, a changing climate and the resulting more extreme weather events mean those climate bands are becoming outdated, leaving infrastructure operating outside of its tolerance levels. That can present direct threats to the assets as well as significant knock-on effects for those that rely on the services those assets deliver. Small increases in climate hazard can have nonlinear effects, as tolerance levels for infrastructure are breached. What is important to note is that both chronic and acute climate hazards can affect infrastructure. There are interdependencies; damage to a single infrastructure could have a negative impact on other areas as well. The existing codes and practices for infrastructure design and development are mostly outdated and lack state-of-the-art technology options and provisions to address climate change.

It is important to address the root cause through a transformational adaptation in the design phase, through the type of equipment, materials, structure or other such considerations.

Importance of Standards & Guidelines

The governance of infrastructure—planning, financing, contracting, and building of the physical infrastructure for public use is essential for economic and social activities.

Incorporating climate projections into building and infrastructure design standards, investment and appraisal criteria, and model building codes is currently not common. Some resilience guidelines and risk-informed frameworks have been developed by public entities. Such manuals can offer guidance for adaptive design methods, characterization of extremes, development of flood design criteria, flood load calculation and the application of adaptive risk management principles to account for more severe climate/ weather extremes.

Zoning laws (the restrictions on where structures can be built) and building codes (the standards to which

structures are built) need to be continuously updated to reflect climate projections.

India has furthered its climate adaptation ambitions and actions, especially focusing on the need to develop resilient infrastructure. In 2016, India released its National Disaster Management Plan, aligned with the Sendai framework and with an emphasis on its objective of *"...investing in disaster resilient infrastructure and committing to improved disaster preparedness and building back better in recovery."* In 2019, India launched the Coalition for Disaster Resilient Infrastructure (CDRI), an international coalition of countries, development organizations and the private sector, aligned with the UN objectives of supporting developing countries in covering their infrastructure deficit and building climate resilience.

The National Action Plan for Climate Change (NAPCC) is a Government of India's programme launched in 2008 to mitigate and adapt to the adverse impact of climate change. The action plan is designed and published under the guidance of the Prime Minister's Council on Climate Change (PMCCC).

The existing guidelines and regulations need to be strengthened to integrate resilience into infrastructure development. Government ministries and departments must work together and make policies more effective through transparent monitoring and compliance. These mechanisms exist in the form of EIA in India, but their implementation/ execution must be made more effective. Disclosures of climate risk and measures taken to address these are important ways of transitioning to improved transparency to facilitate effective engagement.

The Move Towards Resilience

Climate change is a global as well as a local issue. In the climate change perspective, resilience is of utmost importance. Resilience is not an absolute term but a relative term. It is an essential component of any adaptation. The causes and the broad impacts affect everyone, but resilience efforts must be executed at the asset, neighborhood, or individual level. There is a need to understand the risk, both the threat and vulnerability aspects.

Benefits and Opportunities

Incorporating resilience considerations in the design phase would reduce climatic risks by increasing preparedness through better design and asset management. New Infrastructure Resilience means developing the infrastructure asset, resilient in terms of its location, design, materials, build and operation aspects. It can be supported by many examples such as use of Fly ash, ban of CFC, using the carbon free energy, use of solar energy, wind energy, solar panels, lowering carbon design approaches, improving construction techniques, adopting circular economy approaches, and shifting to lower carbon material options. The use of adaptive technologies like three-dimensional (3D) printing would enable quicker production, cost-effectiveness, reduction in wastage, customizable design, with the ability to produce complex geometries. 3D printing has a potential to reduce wastage through a wide variety of techniques and compatible materials. Thus, it becomes very useful in environmental applications in air, water, and energy.

According to the National Disaster Management Authority (NDMA), in India around 12% of the total land area is exposed to floods, about 68% of land is vulnerable to droughts, landslides and avalanches, 58.6 % landmass is earthquake-prone, and 5,700 km of the7,516-km long coastal line is highly vulnerable to frequent cyclones and at times tsunamis.

The Asian Infrastructure Investment Bank (AIIB) and The World Bank are helping India with a project that aims to improve the durability and accessibility and thus enhance the climate resilience of the gravel-surfaced rural roads in Madhya Pradesh. (*www.aiib.org*)

Rules to regulate architectural design and construction aspects of buildings, to help protect from hazards like fires, earthquakes, structural failures, etc. were framed by the Ministry of Housing and Urban Affairs (MoHUA), Government of India, need to be followed.

Flooding is an important aspect for Climate resilient planning. It requires adequacy of the storm water systems and integration with the overall water system, drains, water bodies, other urban development components impacting flood flow, direction and catchment boundaries.

Climate adaptation benefits include better management of storm-water runoff, lowering incidents of combined storm and sewer overflows (CSOs), water capture and conservation, flood prevention, protection against sea level rise (with potential of storm-surge protection measures.)

The Challenges

There is limited awareness and capacity to design viable innovative sustainable projects at the level of the public officials who are responsible for the clearance or providing the go ahead.

Government ministries and departments must work together while making policies effective for compliance to sustainability requirements. Although a few mechanisms are there in India by way of the Environmental Impact Assessment (EIA), their implementation/ execution must be made more effective. Disclosures of climate risk and measures taken to address them are important ways of transitioning to improved transparency.

The challenge is that climate resilience will occur beyond the time horizons considered by decision makers, while costs are incurred in the present time. Climate change is complex and additional capacity may be needed to support decision-making where uncertainty prevails.

The uncertainty also adds to the projections which are probabilistic in nature. Information may not be available with sufficient geographic resolution for infrastructure planning. That impacts the investment decisions.

The private sector is highly vulnerable to losses accrued due to climate change, hence their participation for building and investing in resilient infrastructure are critical. The role of the private sector can be pivotal in adapting climate- resilient approaches; their role and responsibility need to be expanded beyond the current one of corporate social responsibility and other small grants.

An example of an area where such solutions would be most needed is watershed development programmes, which aim to restore degraded watersheds in rain-fed regions to increase their capacity to capture and store rainwater, reduce soil erosion, and improve soil nutrients and carbon content. Those together with afforestation could turn arid areas into green ones. At present all these come under the purview of the state governments, however, there is need for involvement of experts having hands on experience, and the multiple stakeholders for effective design and implementation. The complexity makes it challenging to fix responsibility and accountability for framing effective solutions and implementation plans, resulting in conventional models being preferred over the innovative resilient solutions. What is required is a collaborative and participatory framework for all stakeholders to operate in.

Summary

There are enough data points that indicate that the risks of climate change are real, and hence there is a need to manage them, adapt to their impacts, plan and build for resilience or the costs of inaction will have to be paid. Climate-resilient infrastructure saves both lives and money. Research by the MIT Concrete Sustainability Hub has found that investments in climate-resilient construction can prevent enough damage to pay for itself in as little as two years in hazard-prone areas. Other studies have concluded that every dollar invested in resilience can save up to $11 in repair costs over time. (*Center for Climate and Energy Solutions - Investing in Resilience, Nov 2019*)

It is noteworthy to address that to have transformational and reformist adaptation there is need to have mechanisms designed to mobilize increased investment in resilience. Besides, this perspective of investment should not only rely on regulation but there should also be incentive mechanisms to drive investment.

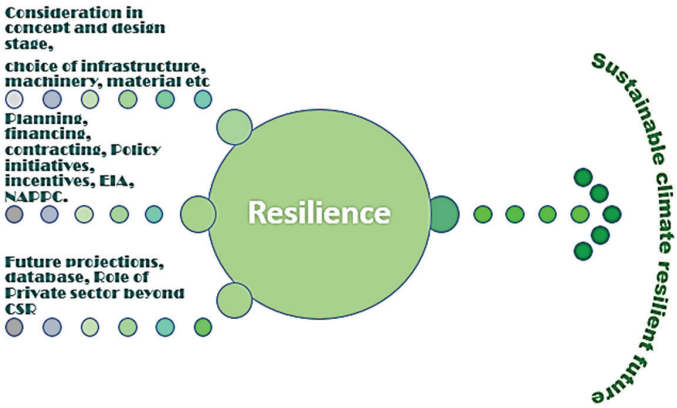

***Figure-2**: Inputs to lead towards Sustainable Climate Resilient Future ©*

The path forward is to adapt to climate resilience for the existing infrastructure and mandate it for the new infrastructure planned by way of the requisite and necessary changes in the concept and design phase. The equipment/ infrastructure, and material used, should all comply with the future requirements and thus lead to sustainability, as illustrated in Figure-2. That should be further enhanced with projections and forecast assumptions which cover the risk of climatic impacts. Increase in investments would be a viable trade off against a sustainable, resilient, and prosperous future for the nation and the world. A risk based approach would result in more cost-effective climate protection, while creating a sustainable future and opportunities towards the conservation of nature.

References

1. Brand, Anna Livia and Karl Seidman – "Assessing Post-Katrina Recovery in New Orleans: Recommendations for Equitable Rebuilding." Jan, 2008
2. Dodman, D., B. Hayward, M. Pelling, et.al: Cities, Settlements and Key Infrastructure. In: Climate Change 2022: Impacts, Adaptation and Vulnerability
3. H. O. Pörtner, D.C. Roberts, et.al: IPCC, 2022: Summary for Policymakers In: Climate Change 2022: Impacts, Adaptation and Vulnerability
4. Josh Foster, Ashley Lowe, Steve Winkelman: The Center for Clean Air Policy, February 2011
5. Kai Wegrich, Gerhard Hammerschmid, and Genia Kostka: The Challenges of Infrastructure: Complexity, (Ir)Rationalities, and the Search for Better Governance
6. Thematic Brief Climate Resilient Infrastructure *www.greenclimate.fund*
7. Climate-resilient Infrastructure: Policy Perspectives - OECD Environment Policy Paper No. 14

. Mobilizing the Private Sector for Developing Resilient Infrastructure in India: Report by Snapfi July 2021. *(www.diw.de/snapfi)*

9. Rajat Gupta, Shirish Sankhe, Naveen Unni, and Divy Malik :Decarbonising India: Charting a pathway for sustainable growth *ES-Oct-2022.pdf (mckinsey.com)*
10. www.c2es.org
11. Will infrastructure bend or break under climate stress: Climate risk and response: Physical hazards and socioeconomic impacts, McKinsey Global Institute, Case Study, June 2020
12. Center for Climate and Energy Solutions - Investing in Resilience, Nov 2019
13. www.oecd.org/environment
14. www.climate.mit.edu
15. www.aiib.org
16. www.climatetrends.in
17. www.timesofindia.com
18. IPCC (Intergovernmental Panel on Climate Change) - Climate Change Report 2022
19. Climate resilience - Wikipedia

02

Resilient Sanitation Infrastructure for Coastal Cities in South Asia – A Perspective

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Climate change impacts on organised sanitation infrastructure are progressively becoming serious and important issues to reckon with, especially in vulnerable coastal urban areas in the South Asian countries. However, with regards to establishing resilient infrastructure, it can be observed that the various processes, namely, awareness, observation, analysis, prediction, planning, provision, and operation, are not in tune with the actual requirements. This paper is an attempt to pinpoint that gap and suggest a probable procedure for effective implementation towards achieving adequately robust facilities which can withstand the possible climate change effects.

The author was involved in the planning of organised sanitation infrastructure of one of the coastal cities in South Asia where a position of Climate Change Expert was specially introduced later keeping in view the vulnerability of the concerned city against possible effects of climate change. It was indeed a big step forward in recognising and attempting to incorporate the impacts of climate change early in the planning stage of providing sanitation facilities. However, the attempt actually missed the target in ensuring the establishment of adequately resilient components as no concrete values were adopted in the design considerations at the end of the exercise.

In order to narrow down the relevant factors regarding the city in question, which is close to the sea coast, an analysis was done to cover the possible climate change impacts. Those were evaluated and predicted for: (a) sea level rise, (b) cyclone storm surges, (c) river flooding, (d) heavy rainfall, (e) siltation, (f) drought, (g) extreme heat, (h) landslide, and (i) subsidence. Unfortunately, there are no existing regulations that emphasize the implementation of established standards for safeguarding the upcoming sanitation infrastructure. Current awareness about climate change impact and infrastructure resilience stops at only literary analysis and documentation which fail to provide any concrete and mandatory guidelines and standards to be included in the planning and design of the sanitation facility imparting the much-needed resilience. The situation is not unique only to this city but demonstrates a typical scenario all across South Asia and probably beyond. That renders the whole exercise meaningless in the absence of any ensuing recommendations which could be included in the design of the sanitation facilities and components.

The most critical shortfall of building any resilient facility lies in converting the predictions of climate change impacts into tangible engineering provisions which can then be strategically formulated and incorporated into the planning, design, detailing, implementation, and long-term operation of a robust facility. That is exactly what is missing in most cases and most efforts stop at analysing the climate change impact in the form of a report. Little attention is paid as to what should be done in converting

such predictions into an improvement of the engineering designs and robust construction which can eventually deliver a better and more resilient facility.

By virtue of the occasional volunteering effort undertaken by the author for qualifying chartered engineers from different countries, it was indicated by several such aspiring engineers during the course of their reviews that in some developed economies, keeping provisions for an additional 20% to 40% for stormwater drainage design (in case of 1 in 100-year storm event) is being promulgated by adopting suitable regulations. The background of such numbers and their justifications cannot be verified by the author; but in all probability, there should be some basis for advocating such numbers. Such specific provisions in regulations cover in a more quantitative way the possible climate change impacts and are now being made mandatory in planning and design. That demonstrates the impending requirement of establishing a suitable set of regulations as the primary step towards addressing and quantifying the issue of climate change and sanitation infrastructure resilience by some tangible steps in planning and design.

In India, climate change impacts and their predictions are still limited to reports and documents. Their remedial measures have not been formulated as a mandatory provision for building sanitation infrastructure in vulnerable coastal cities. It is difficult to assess and indicate the kind of engineering interpretations of climatic predictions without conducting a correlation analysis of the cause and effects. and unless the necessary provisions are pinpointed with some supporting quantifications and critically mentioned in the recommendations. Probably, for some more years to come, the disconnection between climate change effect predictions and actual engineering attitude would prevail. Consequently, missing or neglected provisions will stay till some more catastrophic events definitively pinpoint the fundamental flaws in building robust sanitation facilities in climatically vulnerable cities.

Organized sanitation infrastructure usually comprises buried sewers, manholes, appurtenances, transfer stations, transfer mains, treatment facilities, and disposal lines. The author strongly recommends that the climatic predictions should come up with some tangible recommendations or additional provisions in terms of capital, regular, and future investments so that those additional provisions and earmarked resources can be used to build resilient facilities as per certain norms or standards or deal with any climatic eventualities.

Building sewage treatment facilities by the side of tidal rivers and streams is quite a common. In most cases, such facilities are expected to be prone to flooding, high water table, and seawater intrusion, among other issues. Hence, critical aspects of such facilities would have to be the fixation of site formation level, embankment protection, use of the special type of concrete, the maximum extent and the depth of excavation, possible ground improvement works, type of foundation, etc. The process and the hydraulics of the plant and its ancillary works are all related to such engineering provisions and decisions which must emerge from the recommendations of the climate change impact report and vulnerability analysis. Those engineering provisions remain the missing link between the predictions of the report on climate change and their ground-level interpretation and implementation. The criteria and changing conditions to be dealt with in the climate change analysis report should address, but not be limited to only the following:

- How much clearance needs to be kept between the maximum flood water level and the site formation level and what would be the type of embankment protection works?
- What type and grade of concrete and any special protection to be used for building the facilities which can withstand long-term corrosive effects of subsurface seawater intrusion?
- What kind of foundation can be best suited for catering to such climatic eventualities?
- What kind of ground improvement needs to be implemented for buried concrete structures?
- Up to what depth buried underground structure can be safely built and can be protected against buoyancy in case of site submergence?
- What kind of provision to be kept for designing and providing stormwater drainage in the site?

- What kind of final treated wastewater disposal arrangement can be provided so that the same can isolate the site in case of submergence due to flooding by rising sea or river water or back water levels?
- What kind of emergency remedial measures need to be kept for clearing the site in case of any sudden and persisting submergence due to flooding?

All of the above questions are relevant for planning and designing of the sewage collection network across the corresponding catchment area (of the treatment plant) and associated appurtenant works. However, those must be further stretched to other questions and the provisions to be considered in case of any climatic eventualities like flooding, local inundation, massive siltation, possible structural damage, etc. In those cases, also, certain aspects can be prescribed.

- The enhanced engineering parameters to be adopted in the design of sewers which can withstand the climate change effects,
- The special protection to be adopted for the buried sewers in case of any climatic events to insulate them from such effects,
- The provisions to be kept for excessive flooding, siltation, etc. so that the sewers can be restored and reinstated as early as possible following such events, so that they could continue to perform their expected service,
- The ways that the buried sewers can be built in a resilient way to avoid any damage following certain severely predicted climatic events?

Resilient sanitation infrastructure translates into adequate engineering facilities built to robust metrics in order to withstand severe climatic events of a predetermined or predicted magnitude. In addition, these additional designs need to be simplistic to allow for modifications to be made over time as and when necessary, as climatic conditions change over time.

The systematic approach to be noted that would make the sanitation infrastructure resilient can be broken down into five key categories and their implementation at the policy level would probably have to be in the order as follows:

- Step 1: Framing policies, defining the responsibilities of relevant institutions, and establishing the processes,
- Step 2: Recognising the necessary expertise and strategizing their mutual coordination,
- Step 3: Validating and technical planning and design aspects as per recommendations,
- Step 4: Provisions to be made during operation and maintenance, and
- Step 5: Financial arrangements and incentives duly including all the above aspects.

Conclusions

The relevant authorities will have to face the issue of their incapability to detect the deterioration of existing infrastructure due to climate change effects that is yet to be fully visible let alone understood. For now, that constitutes an uncharted territory and presents a critical constraint as existing and aging infrastructure must be phased out or would require more intensive maintenance management and retrofitting than previously envisaged. Thus, to negate this, interpreting the correct expertise in terms of engineering metrics would be required to mitigate the impact of climate change on the infrastructure. As such, to enable the early detection of deterioration, the need to have appropriate tools and detection mechanisms, which can facilitate the requirements for enhancing resilience, need to be mandatory.

Infrastructure resilience plays a crucial role in determining its durability and sustainability. As per the UN SDG 9 goal ("*build resilient infrastructure,* promote *inclusive and sustainable industrialisation and foster innovation*"), civil engineering advisors and asset owners should look closely to enhance this particular aspect. It is about time that based on predictions from climate change report(s), definite and tangible recommendations for engineering planning and design of sanitation facilities are made, as opposed to being just a formality to generalise the provisions and remain a theoretical approach.

03

Planning and Designing Water Resilient and Water Secure Surroundings

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The environmental effects of climate change are broad and far-reaching, affecting oceans, ice, weather, increased heat waves, high intensity rainfall events, loss of property, livelihood, and life. Extremely wet or dry events have increased in India and East Asia; infact the world over. The losses in terms of business and human, animal life during such Events has become more visible now.

The term "climate resilient" refers to the ability of a system, community, or infrastructure to withstand and adapt to the impacts of climate change. It involves building or designing systems in a way that reduces their vulnerability to climate-related hazards, such as extreme weather events, rising temperatures, sea-level rise, and changes in precipitation patterns.

Climate resilience focuses on **enhancing the capacity** of individuals, communities, organizations, and ecosystems **to cope with and recover from the effects of climate change**. It involves proactive measures to minimize risks and build adaptive capacity, enabling societies to continue functioning and thrive in the face of changing environmental conditions.

The Sustainable Development Goals Nos 11 & 13 are more related to urban floods and climatic changes. Goal No 11 is about making cities and human settlements inclusive, safe, resilient, and sustainable. Goal 13 is about taking urgent action to combat climate change and its impacts.

Climate resilience strategies could inter alia include:

- **Infrastructure Improvements**: Constructing or retrofitting buildings, roads, bridges, and other infrastructure to be more resistant to extreme weather events, such as hurricanes, floods, or heatwaves. That calls for various actions at the planning and design stage of the infrastructure including required systems during the operation phase and handling of critical natural disasters.

- **Ecosystem-Based Approaches**: Protecting and restoring natural ecosystems, such as wetlands, forests, water streams and coral reefs, which provide valuable services like flood mitigation, carbon sequestration, and habitat preservation. Identifying and mapping the existing natural systems is the key for planning restoration and protection measures.

- **Diversification of Resources**: Developing diversified and sustainable sources of energy, water, and food to reduce dependence on

vulnerable systems and ensure availability during climate-related disruptions. The decentralization of sources and systems helps in addressing the disruptions during critical events.

- **Risk Assessment and Management**: Conducting comprehensive risk assessments to identify vulnerabilities and develop strategies to manage and reduce risks associated with climate change.

- **Community Engagement and Capacity Building**: Involving local communities in decision-making processes, raising awareness about climate change impacts, and building their capacity to adapt to changing conditions.

- **Policy and Governance Frameworks**: Implementing policies and regulations that promote climate resilience, such as land-use planning, building codes, and incentives for sustainable practices. The review & improvement of existing codes, design manuals is required to include climate resilience measures, planning and designs.

By incorporating climate resilience into various sectors, including infrastructure, agriculture, urban planning, and disaster management, societies can prepare more effectively for the challenges posed by climate change and work towards a more sustainable and secure future.

Climate Change and Water Sector

Climate change has a significant impact on **water availability**, as it alters the Earth's hydrological cycle and exacerbates water scarcity in many regions. Some key connections between climate change and water availability are:

1. **Precipitation Patterns**: Climate change affects precipitation patterns, leading to changes in the timing, intensity, and distribution of rainfall. Some areas experience increased rainfall and flooding, while others face reduced precipitation and drought. These shifts can disrupt water availability for agriculture, drinking water supplies, and the ecosystems. The variation in duration and intensity of rainfall has an impact on crops, selection of crops and irrigation systems.

2. **Melting Glaciers and Snowpack**: Rising temperatures cause the melting of glaciers and reduced snow accumulation in mountainous regions. The glaciers act as natural reservoirs,

storing water that is released gradually during the warmer months. Their loss reduces the availability of freshwater, particularly in areas dependent on glacial melt for water supply.

3. **Changes in Runoff**: Changes in precipitation patterns and melting of snow and ice influence the timing and magnitude of runoff. For example, if rainfall occurs in intense bursts, it may lead to increased runoff and reduced groundwater recharge. That could affect water availability during dry seasons or in regions reliant on groundwater resources. That also adds to increased runoff on storm water systems resulting in inundations.

4. **Sea-Level Rise and Saltwater Intrusion**: Climate change-induced sea-level rise threatens coastal freshwater sources by causing saltwater intrusion into underground aquifers and estuaries. Saltwater intrusion reduces the availability of fresh water for drinking and irrigation, affecting both coastal communities and agricultural productivity.

5. **Increased Evaporation**: Higher temperatures result in increased evaporation rates from water bodies, soil, and vegetation. The enhanced evaporation could lead to drier soils, decreased water availability for plants, and increased water demands for agriculture and irrigation.

6. **Extreme Weather Events**: Climate change contributes to more frequent and intense extreme weather events, such as hurricanes, cyclones, and severe storms. These events can damage water infrastructure, contaminate water sources, and disrupt water supply systems, causing temporary or long-term water shortages.

7. **Ecosystem Impacts**: Changes in water availability due to climate change can disrupt ecosystems and biodiversity. Reduced water availability affects wetlands, rivers, and lakes, altering their ecological balance and threatening the survival of various species. That is visible in some cities in India and the Authorities have to resort to reduced water supply whenever the monsoon is delayed.

Addressing climate change is thus crucial to mitigate its impacts on water availability. Efforts to reduce greenhouse gas emissions, improve water management practices, enhance water efficiency, promote sustainable agriculture, and protect ecosystems can help ensure future water security in the face of a changing climate. The United Nations Climate Change Conference COP27 at Egypt had a breakthrough agreement to provide "loss and damage" funding for vulnerable countries.

There are quite a few examples of efforts being made towards **water resilient** global development. Examples of climate-resilient water projects from Asia and the Pacific are:

1. **Integrated Urban Water Management in Chennai, India**: Chennai, a coastal city in southern India, has been facing severe water shortages and increased vulnerability to floods due to climate change. The Integrated Urban Water Management project aims to improve water resource management in the city by implementing measures such as rainwater harvesting, water recycling, and enhancing water storage infrastructure.

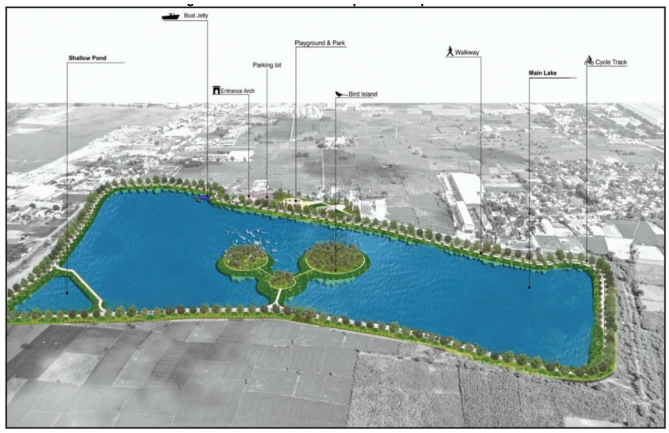

Image Source: https://www.adb.org/sites/default/files/project-documents/49107/49107-012-sddr-en.pdf

2. **Bengal Aerotropolis – A Water Sustainable Development**: The Bengal Aerotropolis township has been planned considering alternative water sources. The gross water demand has been 38.6 Mld. The quantum of water supply from fresh water source is 16.5 Mld whereas from tertiary treated sewage it is 22.1 Mld. All the 22 lakes in the 1700 acres of land have been retained along with

Tamla Nalla thus maintaining the water eco-system and rainwater harvesting of 800 Ml. Early warning system has been provided for potential hazards like floods, earthquakes including institutional arrangements for necessary action.

3. **Resilient Cities Development Project, Bangladesh**: Bangladesh is highly vulnerable to climate change impacts, including increased flooding and water scarcity. The Resilient Cities Development Project focuses on building climate resilience in several cities across the country. The project includes measures such as improving drainage systems, constructing flood shelters, and implementing climate-resilient urban planning.

4. **Red River Basin Flood Risk Management Project, Vietnam**: Vietnam is prone to frequent and severe floods, particularly in the Red River Basin. The flood risk management project aims to enhance the basin's resilience to climate change by improving flood forecasting and early warning systems, strengthening flood protection infrastructure, and promoting community-based flood management approaches.

https://www.mprnews.org/story/2011/04/12/photos-red-river-flood-aerial

5. **Mekong River Basin Climate Resilience Initiative**: This initiative focuses on enhancing the resilience of the Mekong River Basin, which stretches across multiple countries in Southeast Asia. The project includes measures such as improving flood forecasting systems, strengthening early warning systems, and promoting climate-resilient agriculture practices.

https://icem.com.au/portfolio-items/basin-wide-assessment-of-climate-change-impacts-on-socio-economic-vulnerability-in-the-lower-mekong-basin/#

6. **Pacific Adaptation to Climate Change (PACC) Project**: The PACC Project is a regional initiative implemented in several Pacific Island countries, including Fiji, Kiribati, Marshall Islands, and Samoa. The project focuses on strengthening the resilience of vulnerable communities to climate change impacts, including those related to water resources. It includes activities such as water storage and management, rainwater harvesting, and promoting climate-resilient agricultural practices.

Apart from these examples of climate-resilient water

projects from Asia and the Pacific, there are **many other initiatives** in the region aimed at addressing the challenges posed by climate change and ensuring sustainable water management practices.

Support from International Organizations

Multilateral Development Banks (MDBs) are playing a crucial role in promoting economic growth, reducing poverty, and improving living standards in developing countries by providing loans, grants, and technical assistance to support various sectors such as infrastructure development, education, healthcare, agriculture, and environmental sustainability.

Most MDBs support water resilient development. Some of the key initiatives and activities undertaken in regard to such development are:

1. **Financing for Water Projects**: Offering financial support and loans to countries for the implementation of water-related projects. That includes investments in water infrastructure such as dams, reservoirs, irrigation systems, and water supply and sanitation facilities. ADB, JBIC, and The World Bank have provided funding to some of the states in India such as Rajasthan and Madhya Pradesh for city infrastructure.
2. **Integrated Water Resource Management (IWRM)**: Promoting IWRM approaches to help countries manage their water resources sustainably. That involves coordinating water allocation, usage, and management across different sectors and stakeholders, considering social, economic, and environmental factors.
3. **Climate Resilience and Adaptation**: Supporting countries in building resilience to climate change impacts on water resources. That includes assisting in the development of climate adaptation strategies, investment in climate-resilient infrastructure, and implementation of measures to mitigate water-related risks.
4. **Knowledge Sharing and Capacity Building**: Facilitating knowledge exchange and capacity building initiatives to enhance the understanding and management of water resources. That involves providing technical assistance, conducting research, and sharing best practices to support informed decision-making and policy formulation.
5. **Water Governance and Institutional Strengthening**: Assisting countries in strengthening their water governance frameworks and institutions. That includes supporting the development of legal and regulatory frameworks, promoting stakeholder participation, and improving water sector governance for efficient and equitable water allocation.
6. **Water Supply and Sanitation Programmes**: Working to improve access to safe drinking water and sanitation services in developing countries. That involves supporting projects for expanding water supply networks, constructing sanitation facilities, and promoting hygiene practices to address water-related health challenges.
7. **Water-Energy-Food Nexus**: Recognizing the interdependencies between water, energy, and food security. It supports integrated approaches that consider the nexus among the sectors, aiming to enhance resource efficiency, promote sustainable agriculture, and optimize energy use in water-related activities.

The specific support provided by these agencies may vary depending on the country's needs, priorities, and the nature of water-related challenges they face.

Support at National Level

At the National level, different countries have self-financing programmes to upgrade the infrastructure and environmental sustainability. The Government of India is providing funds to cities through JNNURM, AMRUT, Smart City for upgrading city water, sanitation, water bodies improvements and other infrastructure provisions. The control and command centres under smart cities provide data acquisition provisions resulting in better system operations and early warning systems.

The Government also recommends that better designs be adopted and for that the work of updating and drafting new Design Manuals and Codes by involving Experts from Research, Academia and Operations personnel is underway.

Adopting a Bottom-up Approach

Achieving water-resilient habitation requires a bottom-up approach that recognizes the importance of local knowledge, participation, and adaptation. The decentralization of departments offers a pathway to harness these crucial elements by empowering local authorities, stakeholders, and communities. By decentralizing decision-making processes, one can foster context-specific, participatory, and innovative approaches for infrastructure development that effectively address the challenges posed by climate change.

Decentralization also presents an opportunity to build local capacity and strengthen resilience. By devolving power and responsibilities to local authorities, departments can nurture a cadre of skilled professionals equipped with the knowledge and expertise to address climate change impacts. Training programmes, knowledge-sharing platforms, and technical assistance can be channeled to enhance the skills of local staff, enabling them to effectively integrate climate considerations into infrastructure planning, design, construction, and maintenance.

Role of Engineering Consultants

Engineering consultants need to take the opportunity to design the projects in a pragmatic manner so as to be fit to receive funding or grants from the government or MDBs.

Consultants can play a crucial role in promoting water resilience and water security by going a little beyond the 'business as usual'. Some of the actions that they can take towards achieving the goals are:

- **Conduct comprehensive assessments** to evaluate the water resources, infrastructure, and vulnerabilities in each area by analyzing the availability, quality, and demand for water, as well as identifying potential risks and challenges. Identifying the alternatives for climatic events to ensure that the water security reduces the potential risks.
- **Develop water management plans** that integrate sustainable practices, conservation measures, and efficient water use considering climate change impacts, population growth, and long-term sustainability. The water management practices at utility level during planning and design stages, and by the consumers during the life of the facility need to be specified.
- **Design and oversee the construction** of resilient water infrastructure systems, such as dams, reservoirs, pipelines, and wastewater treatment plants to ensure that they withstand extreme weather events, reduce water loss, and ensure efficient distribution and treatment. Better design practices, material and workmanship specifications would go to enhance the life of infrastructure assets.
- **Work with communities, industries, and governments** to promote water conservation and efficiency practices. Building sustainable design practices as a part of the design services would promote resource optimization.
- **Advocate for the incorporation of green infrastructure solutions** in urban planning and development projects integrating features like green roofs, rain gardens, permeable pavements, and preservation and improvement of urban wetlands to manage stormwater runoff, improve water quality, and enhance natural water storage.
- **Explore and evaluate alternative water sources**, such as rainwater harvesting, greywater recycling, and desalination to diversify water supply and reduce dependence on traditional sources.
- **Recommend and implement advanced monitoring systems for water resources**. That includes deploying sensors, remote sensing technologies, and data analytics tools to collect real-time data on water availability, quality, and

usage patterns. The insights gained from these systems could be very useful for decision-making and early warning systems.

- **Engage with various stakeholders**, including government agencies, community groups, NGOs, and water utilities. Collaborative efforts can lead to shared understanding, effective planning, and implementation of water resilience strategies.
- **Provide technical expertise and guidance** in the development of policies and regulations related to water management, conservation, and resilience.
- **Emphasize the importance of continual monitoring, evaluation, and adaptation** of water resilience measures assisting in assessing the effectiveness of implemented strategies, identifying areas for improvement, and adapting plans to changing circumstances.

Conclusions

Water being essential for sustenance of life, there is an urgent need to pay attention to its sources, its transformation, its disposal and recycling and plan to minimize climatic changes that are caused by human intervention in what nature has planned and provided. The urban planners and infrastructure developers need to address these issues at the planning stage itself. A well thought planning process is required to create better, livable, resilient, and sustainable habitats. Awareness to be created among the utility authorities and developers for better planning of resources, and the residents about the low water consumption habits, fixtures, and appliances.

References

1. https://www.adb.org/sites/default/files/project-documents/49107/49107-012-sddr-en.pdf
2. https://www.mprnews.org/story/2011/04/12/photos-red-river-flood-aerial
3. https://icem.com.au/portfolio-items/basin-wide-assessment-of-climate-change-impacts-on-socio-economic-vulnerability-in-the-lower-mekong-basin/#

04

Building Resilient Infrastructure: The Power of Digital Twins and Advanced Analytics in Climate Adaptation

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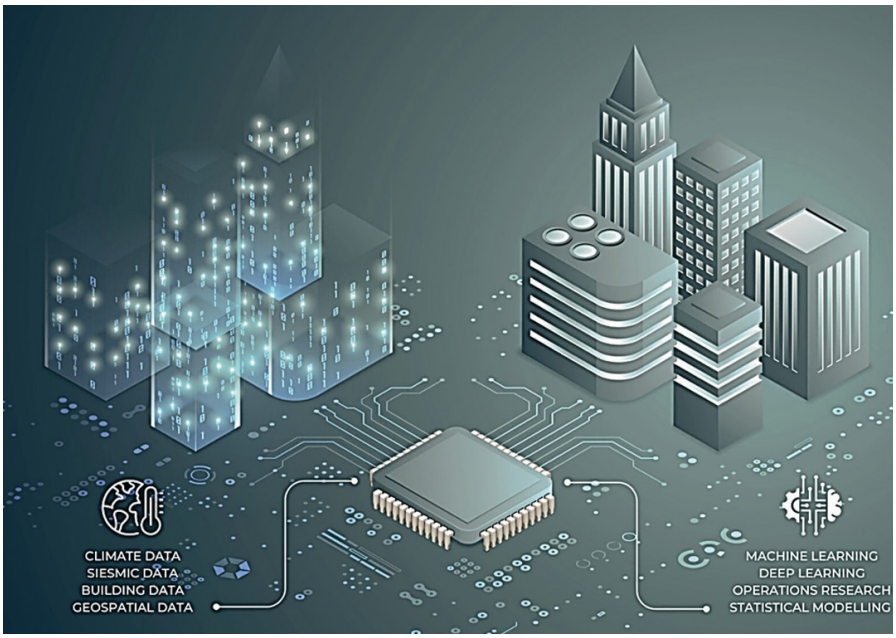
Climate change creates unprecedented challenges for our infrastructure systems. Rising sea levels, extreme weather events, and increased temperatures all threaten the reliability and longevity of critical infrastructure. Architects and engineers are turning to innovative solutions to enhance infrastructure resilience through design and during operation. One such solution is the use of digital twins, virtual replicas of physical assets that enable real-time monitoring, predictive analysis, and scenario planning. This article explores how digital twins can help build and operate climate-resistant infrastructure.

Digital Twins

Digital twins are virtual representations of physical assets, including buildings and land masses. They leverage real-time data, sensors, and advanced analytics to create dynamic models that mimic the behaviour and performance of their physical counterparts. By integrating data from multiple sources, digital twins provide analysts and engineers with a data-enabled view of infrastructure systems, enabling them to make informed decisions for optimal building performance.



A digital twin is more than just a static 3D model; it is a dynamic and interconnected system that mirrors the behaviour, performance, and lifecycle of its physical counterpart. It continuously receives and processes real-time data, allowing for synchronisation of the digital and physical worlds. This synchronisation enables architects, engineers, and operators to gain deep insights into the performance, condition, and potential future behaviour of the physical asset. The digital twin can be used throughout the lifecycle of the asset, from design and construction to operation and maintenance, providing

valuable insights and facilitating informed decision-making.

Digital twins can offer a multitude of tools for creating and managing climate-resistant infrastructure. By continually monitoring real-time data from sensors placed on physical assets, digital twins provide early warnings of potential failures or disruptions. That allows for proactive action to prevent or minimise damage. Digital twins enable predictive analysis, vulnerability identification, and maintenance optimisation to reduce downtime and costs. They facilitate scenario analysis, helping engineers simulate and assess the impact of climate change and extreme events on infrastructure systems, thus informing design and investment decisions.

Predicting Environmental and Climate Risks with Advanced Analytical Tools

Tools such as Machine Learning, Deep Learning, Operations Research, Statistical Methods, and other computational techniques can be employed for analysis of the physical asset data. The tools can process vast amounts of data, uncover hidden patterns, and provide valuable insights for assessing environmental and climate risks.

Machine Learning (ML): ML algorithms can analyse historical and real-time data to identify patterns, correlations, and anomalies in weather as well as historical building data. By training models on climate data and infrastructure performance data, ML algorithms can predict the impact of climate change on infrastructure systems. For example, ML algorithms can forecast the probability of flooding in a coastal area or predict the degradation rate of infrastructure components under changing climate conditions.

Deep Learning (DL): DL, a subset of ML, is effective in processing complex and unstructured data such as satellite imagery, sensor data, and climate models. DL algorithms can extract meaningful information from these datasets to assess climate risks. For instance, DL algorithms can analyse satellite images to identify areas prone to erosion or detect patterns in weather data to predict extreme weather events.

Operations Research (OR): OR techniques can help optimise infrastructure management under uncertain climate conditions. OR models can consider various scenarios, constraints, and objectives to determine optimal strategies for resource allocation, maintenance scheduling, and resilience planning. By incorporating climate data and risk analysis OR can help identify cost-effective adaptation measures.

Statistical Methods: Statistical analysis plays a crucial role in quantifying climate risks and estimating their potential impact on infrastructure systems. Statistical models can analyse historical climate data, identify trends, and project future climate scenarios. By integrating statistical methods with digital twins, engineers can assess the probability of infrastructure failures, evaluate the effectiveness of resilience measures, and quantify the economic and social impacts of climate-related events.

Deploying Analytical Tools for Identifying Ideal Locations for Critical Infrastructure

The combination of digital twins and advanced tools can also aid in identifying ideal locations for critical infrastructure. By leveraging geospatial data, environmental data, historical records, and predictive models, owners and engineers can evaluate many factors and determine optimal locations for infrastructure projects.

For example, in the case of a new power plant, digital twins can be used to simulate and analyse the impact of climate conditions on the plant's performance. By integrating climate data and statistical methods, they can identify regions with stable weather patterns, minimal risks of extreme events, and suitable environmental conditions for efficient power generation. Additionally, machine learning algorithms can analyse historical seismic data, geological characteristics, and localised factors to assess the seismic vulnerability of potential sites. That information can help select sites that are less

prone to earthquakes, reducing the risk of infrastructure damage.

Case Studies

Smart Grid Optimisation: Digital twins and advanced analytics can optimise the performance and resilience of smart grids, which play a crucial role in transitioning to renewable energy sources. By integrating real-time data from sensors and weather forecasts into digital twins, utility companies can predict energy demand, optimise power generation and distribution, and proactively manage potential disruptions caused by extreme weather events. Singapore has implemented a digital twin solution for its power distribution grid, enabling real-time monitoring, predictive maintenance, and improved outage management.

Flood Management Systems: In areas prone to flooding, digital twins coupled with advanced analytics can help design and operate effective flood management systems. By integrating data from weather sensors, river gauges, and hydraulic models into digital twins, engineers can simulate and analyse different flood scenarios to optimise infrastructure design and emergency response planning. The city of Amsterdam utilises a digital twin of its water management system to predict and manage flood risks, enabling proactive measures such as early warning systems and adaptive flood defences.

Transportation Infrastructure Optimization: Digital twins can help transportation infrastructure withstand climate-related challenges. By integrating real-time traffic data, weather forecasts, and predictive analytics, digital twins can optimise traffic flow, enhance route planning, and enable proactive maintenance. The Colorado Department of Transportation uses a digital twin of its transportation network to monitor road conditions, predict the impact of snowstorms, and guide snow removal operations.

Conclusions

Digital twins, coupled with advanced analytical tools such as machine learning, deep learning, operations research, and statistical methods present a powerful approach to address the challenges of climate change in infrastructure development. The combination of digital twins and advanced analytics can help predict and assess environmental and climate risks, enabling architects and engineers to design and manage infrastructure systems that are more resilient to future climate conditions.

Incorporating data-driven insights into the decision-making process can help infrastructure planners minimise the risks associated with climate change and ensure the long-term resilience of critical infrastructure.

References

1. https://www.ema.gov.sg/grid-digital-twin.aspx
2. https://ts2.space/en/the-role-of-digital-twins-in-smart-water-management/
3. https://geospatialresources.trimble.com/laser-scanning/demystifying-spatial-digital-twins

05

Green Buildings: A Call for a Unified Code in India

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"Environmental Conscious living has got to be a conscious choice."
– Hon. Minister of Finance, Ms. Nirmala Sitharaman.

In this era of new trends, the term sustainability has taken a prominent role, which in hindsight seems to have engaged the attention of various countries, whether developing or developed. Due to the recent reports of there being constant disturbances within the Earth's core and with some parts of the sun, this 'trend' has made the perfect case for the need of stringent and prompt action in its favour, the realization of which is also apparent within India and other foreign countries. A mere perusal of the Union Budget, 2023 reflects India's intention of shifting its focus from drastic developments in the field of Construction & Infrastructure, which were till now considered to be the building blocks of an economy, to sustainable construction with green buildings and green materials.

In fact, in his speech at the 26th session of the United Nations Conference of Parties, the Ambassador of India specifically, clarified one of its main goals to be the attainment of net-zero carbon emissions by the year 2070, wherein, that goal was further materialized in its theme of the 2023 G20 summit, the Country's submission to the United Nations Framework Convention, or the fifth priority in the Union Budget 2023.

'*Green growth'*, the term used by the Hon. Minister of Finance, during her Budget speech, sought to include various programmes, including green fuel, green energy, green farming, green equipment, green mobility and green buildings. Within her use of the term 'green buildings', the Minister sought to mention a scheme for 'sustainable cities for tomorrow', where it was specified that the States and UTs will be encouraged to undertake urban planning reforms and actions, for the purpose of achieving efficient use of land resources, resources for urban infrastructure, transit oriented development, enhance availability and affordability of land, and opportunities to all[1].

It is however, needful to note that even though the scheme and the term, as proposed by the Hon. Minister provided a positive outlook towards sustainable construction, it is yet to be properly formulated, due to an apparent absence of a centrally applicable legislation, which may support the development of green buildings or even sustainable cities.

Green Buildings & a Need for Supporting Legislation

A green building, as evident from its name, may be defined to be a structure which is environmentally efficient with a minimal wastage of resources and a probability of generating as much energy as may be used within such a structure. As per a report published on February 9, 2022, by the Green Business Certification

Corporation Inc., a company working with the support of the United States Green Building Council (USGBC), India ranked third, on the list containing the names of 10 countries that are 'making significant strides in healthy, sustainable, and resilient building design, construction, and operations, wherein a total of 146 buildings and spaces were certified with the USGBC rating system, namely, Leadership in Energy and Environmental Design (LEED) Green Building Rating System.

However, the number of buildings, so certified by the Nation, may be considered to be on the lower end, after considering the rates at which development and construction activities occur in the Country. As per a submission dated November 2022, made by the Ministry of Environment, Forests and Climate Change to the United Nations Framework Convention on Climate Change (UNFCC), a total of approximately 25.9% contribution was made by the industrial sector to India's Gross Value Added (GVA), in which construction and energy occupied almost 9% of that figure. It was also specified that urban India was expected to build 700 to 900 million square meters of residential and commercial spaces.

These figures were provided on account of the fact that presently, the building stocks contributed more than 40% of India's total energy consumption while the energy usage from buildings was steadily increasing at an annual rate of 8%[2]

Thus, it may be reasonable to infer that even though India's ranking in the USGBC survey, was a celebratory moment, however, upon considering the projected as well as the present rates of construction related activities, there is a need for substantial improvement in such ratings, which may only be achieved through an enforceable legislation.

A Study of the Existing Guidelines

The fact that India is the second most populated country of the world, and set to be the first in the category, it is but natural, that the construction activities within the country are rising at such a concerning pace. It is also necessary to mention that the search for a sustainable mode of supporting these activities has not been new to the country and has been furthered by various rating agencies as well as statutory bodies, in the form of different guidelines and directives. Although, owing to the inability of these authorities and agencies to have an enforceable hand, their directives and guidelines, have merely been ignored, due to their purported costs over and above the alleged construction outlays.

This fact is also apparent from the aforementioned UNFCCC submission, which specifies that buildings rated by voluntary green building ratings constitute approximately 5% of the Indian building market share, a figure which is considerably low as compared to the building stock amounts.

Nevertheless, the various Indian agencies continue with their efforts of supporting sustainable construction through green buildings and other energy efficient methods, with hopes of achieving relevance. The three main ones are: (a) the Indian Green Building Council (IGBC), which is purportedly based on the USGBC; (b) Green Rating for Integrated Habitat Assessment (GRIHA) by The Energy and Research Institute (TERI); and, (c) the Bureau of Energy Efficiency (BEE). Besides these there are other organizations.

From amongst these organizations, IGBC has defined the term 'green building' as a building which *"uses less water, optimizes energy efficiency, conserves natural resources, generates less waste and provides healthier spaces for occupants, as compared to a conventional building"*[3]. For GRIHA a 'green building' is evaluated on its performance through a holistic approach to its lifecycle. The latter organization has also released another term, called 'zero energy buildings' which defined those buildings which produce as much energy as they consume within a year[4].

The BEE, on the other hand, has taken a separate, more meaningful route, wherein instead of adopting the term and its different vague meanings, the agency issued a directive known as the 'Energy Conservation Building Code, 2017 (ECBC)', which sought to regulate the usage of energy by buildings and prescribes various standards in line with the major climatic zones of

India. The Code, being applicable to buildings having a connected load of 100 kW or more or a contract demand of 120 kVA or more, prescribes three levels of energy efficiency, namely, 'energy conservation building code compliant building', 'energy conservation building code plus building', and 'super energy conservation building code building'. These levels are classified on the basis of adaptation of the mandatory and prescriptive requirements of the buildings. ECBC, being a comprehensive code, seeks to save approximately 30% energy usage by a simple application over the buildings, even though its applicability is limited on account of a minimum requirement towards the energy usage of the building as well as its nature of allowing the states to voluntarily adopt it in the manner, they see fit. As of 2022, ECBC is applicable in 22 out of the 28 States of India, which has yet to reduce the staggering figures of energy consumption provided by the country's submission to the UNFCCC.

Need for a Central Green Building Code

As specified earlier, sustainability has been a new term and trend with many ways of achievement and different schemes offered by different countries. In India, the various ways in which such sustainability has been incorporated within the construction sector include 'smart cities', 'substitution of materials in construction' and through the various judgments passed by the Hon'ble Supreme Court of India, the different High Courts and the National Green Tribunal, from time to time.

It is needful to mention that while some of these schemes have been fruitful in terms of the fact that presently, the country is a home to over 100 smart cities, and that the construction activities are stringently regulated by the directives of the Government of India and the various adjudicatory bodies, the growth has however been stagnant, as compared to the various 'green growth' goals foreseen by the Government.

Even where certain certifications like the Environmental Impact Assessment Certificate have been made enforceable at a central level, there is still a dire need to include different provisions, not only for classifying what the term 'green building' should include, but to also provide for and set out provision as to how and when these buildings requirements can be made mandatory.

At this juncture, it is necessary to note that in 2016, the Bureau of Indian Standards issued the National Building Code of India with the primary objective of providing guidelines for regulating the building construction activities across the country. Since the year of its publication many other technologically and environmentally better options have also been developed which would make the requirements easier to incorporate and monitor the construction activities across the country. While NBC 2016 incorporates Sustainability, there is also a need for more specific codes and guidelines for metropolitan cities and towns, which needless to add, would require to be updated at shorter intervals of time. It is also needful to mention that tools like SCADA and ICT have also been in existence since decades, even if, in different forms, however, the effects of Climate Change and Sustainability are still sinking in and are still subservient to short time financial gains for most of the persons for political and administrative reasons.

NBC 2016 is mandatory only in the states that have adopted it. Owing to the aforementioned issues, it may be pertinent to note that there is a growing necessity for the other states to adopt the code as well. A successfully implemented central legislation, can help India in actually reaching its goal of a sustainable and 'green' construction growth, which can, in turn, prove to be a significant aspect of its 2070 net zero carbon emission objective.

References

1. Union Budget 2023 speech.
2. MoEFCC, *India's long-term low-carbon development strategy*, UNFCC 1, 59 (2022)., *https://unfccc.int/sites/default/files/resource/India_LTLEDS.pdf*.
3. INDIAN BUILDING GREEN COUNCIL, *https://igbc.in/igbc/redirectHtml.htm?redVal=showAboutusnosign*
4. UNEP & TERI, *Background Paper on Sustainable Buildings and Construction for India: Policies, Practices and Performance – Influence of Indian Buildings on Climate Change*, 1, 4 2018.

06

Environment & Climate Change Aspects of Port Projects: A Case Study

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Introduction

New Ports and expansion of existing ports are very important infrastructure projects. They can have major impacts on Environment and Climate Change unless the impacts are contained and mitigated. This article presents a case study of the Kandla Port (now renamed as Deen Dayal Port) as to how in their expansion plans the impact on Environment and the effects of Climate Change were assessed and contained through a detailed Environment Impact Assessment Study.

Details of the Project

1.1 Project Description

Kandla Port is situated on the shores of the Kandla Creek, in the district of Kutch, Gujarat. It is located on the west bank of the Kandla creek which runs into the Gulf of Kutch at a distance of 90 nautical miles from the Arabian Sea. The width of the channel varies from 200 meters to 1,000 meters. The contour depth along the shipping channel is around 10 meters. The total length of the Kandla Port approach Channel is around 23 kms.

Kandla Port handles dry cargo at its ten general cargo berths and through barges at Bunder Basin and Tuna. Both these facilities have a combined capacity of 46.28 Million Metric tonnes per annum (MMTPA), which includes dry handling capacity of 33.28 MMTPA and liquid cargo handling capacity of 13.0 MMTPA.

In order to ease pressure on the existing berths and increase the capacity of dry and liquid cargo handling, Kandla Port Trust has proposed to develop a new Barge Jetty at Tuna, a new Barge Jetty at Khori Creek and a new Oil Jetty at old Kandla for enhancing and upgrading the existing facilities at the Kandla Port. Commissioning of the proposed jetties will augment the handling capacities of the port. The Barge Jetty at Tuna will augment the dry cargo handling capacity by 5.49 MMTPA; the Barge Jetty at Khori Creek will augment the dry cargo handling capacity by 8.57 MMTPA; and the

new Oil Jetty at old Kandla will augment the liquid cargo handling capacity by 3.39 MMTPA.

1.2 Environment Management Plan:

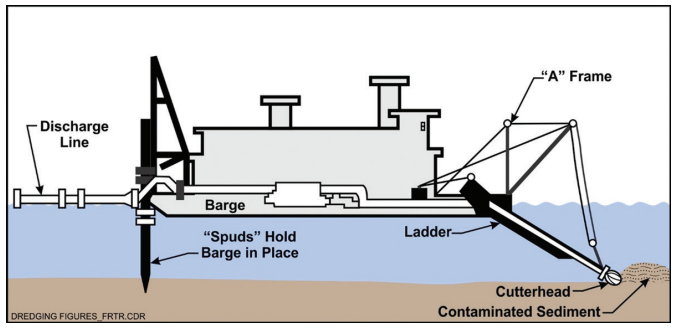
The Environment and Climate Change aspects have been addressed as follows to contain the impact on the environment and climate parameters

a. Dust Management

- Dry bulk materials storage and handling facilities are to be designed to m0inimize or control dust emissions, including:
- Storing pulverized coal and pet-coke in silos;
- Installing dust suppression mechanisms (e.g., water spray or covered storage areas);
- Using telescoping chutes to eliminate the need for slingers;
- Using vacuum collectors at dust-generating activities;
- Using slurry transport, pneumatic or continuous screw conveyors, and covering other types of conveyors;
- Minimizing free fall of materials.
- Minimizing dry cargo pile heights and containing the piles with perimeter walls;
- Removing materials from the bottom of piles to minimize dust re-suspension;
- Ensuring hatches are covered when material handling is not being conducted;
- Covering transport vehicles;
- Regularly sweeping docks and handling areas, truck/rail storage areas, and paved roadway surfaces.

b. Dredged Material Management

Construction and maintenance dredging, and the dredged soil disposal, may impact habitats and pose a significant hazard to human health and the environment, particularly if the sediments are contaminated by historical deposition and accumulation of hazardous materials, whether due to on-site or off-site activities.



Sketch - Dredging Process

A Cutter Suction Dredger

The recommendations to avoid, minimize and control impacts from dredged materials, are to be a part of a Marine Dredging Management Plan.

- **Dredge Planning Activities:** Dredging should only be conducted if necessary, and based on an assessment of the need for new infrastructure components or port navigation access to create or maintain safe navigations channels, or, for environmental reasons, to remove contaminated material stored cause risks to human health and the environment Prior to initiation of dredging activities, materials should be evaluated for their physical, chemical, biological, and engineering properties to evaluate the dredged materials either for reuse or disposal.
- **Dredging**: Select excavation and dredging methods to minimize suspension of sediments, minimize destruction of benthic

habitat, increase the accuracy of the operation, and maintain the density of the dredged material, especially if the dredged material is from contaminated areas. There are several dredging methods which are commonly used depending on the depth of the sediments and environmental concerns such as the need to minimize sediment suspension and increase dredging accuracy.

- Identify areas sensitive for marine life such as feeding, breeding, calving, and spawning areas. Where sensitive species are present, dredging (and blasting) to be conducted in a manner so as to avoid fish migration or disturbing spawning seasons, routes, and grounds;
- Deploy techniques (e.g., silt curtains), to minimize adverse impacts on aquatic life from re-suspension of sediments;
- Inspection and monitoring of dredging activities to be done to evaluate the effectiveness of impact prevention strategies, and re-adjusted where necessary.

- **Disposal of Dredged Material:** Dredged material to be analyzed in order to select appropriate disposal options (e.g., land reclamation, open water discharge, or contained disposal).
  - Beneficial reuse of uncontaminated, dredged material (e.g., for wet land creation or enhancements, habitat restoration, or creation of public access/ recreational facilities);
  - Use of lateral containment in open water disposal. Use of borrow pits or dikes reduces the spread of sediments and effects on benthic organisms;
  - Use of cap containment sediments with clean materials.
  - Level bottom capping or a combination of borrow pits/dikes with capping reduce the underwater spread of contaminated material;
  - Confined disposal facilities to be used, either near shore or upland, when open water disposal is not feasible or desirable. If dredged soil is contaminated, confined disposal facilities to include liners or other hydraulic containment design options to prevent leaching of contaminants into adjacent surface or groundwater bodies. Treatment of dewatering liquids (e.g., metals and persistent organic pollutants) may be required prior to discharge.

c. **Mangrove Plantation:** The Kandla Port Trust furnished an undertaking to the State Forest & Environment Department for afforestation of mangroves in an area of 1000 ha.
   - Implemented Mangrove Plantation in 170 hectares till date;
   - Mangrove Plantation in 200 hectares has been done through Gujarat Ecology Commission, Gandhinagar;
   - Proposed Mangrove Plantation in 300 hectares in 2012-2013 (workorder issued to State Forest Department);
   - Proposed Mangrove Plantation in 330 hectares in 2013-2014 (workorder issued to State Forest Department).
   - The increased Mangrove plantation will help in protecting the marine habitat and reducing the impact on the Environment and Climate Change.

d. **Biodiversity Management:** Construction and maintenance dredging, disposal of dredged soil, construction of piers, wharves, breakwaters, and other water-side structures, and erosion may lead to short and long-term impacts on

aquatic and shore line habitats. Direct impacts may include the physical removal or covering of sea floor, shore, or land-side habitat, in addition to changes to water flow patterns and related sedimentation rates and patterns, while indirect impacts may result from changes to water quality from sediment suspension or discharges of stormwater and wastewater. Additionally, the discharge of ballast water and sediment from ships during port operations may result in the introduction of invasive aquatic species. Measures to prevent and control these impacts include the following:

- Potential impacts to shoreline vegetation, wetlands, coral reefs, fisheries, bird life, and other sensitive aquatic and near-shore habitat during port construction and operation to be fully assessed with special consideration for areas of high biodiversity value or those required for the survival of critically endangered or endangered flora and fauna. The depth of the port to be considered at the design phase in terms of habitat destruction and the amount and nature of dredging required.
- Specific prevention and mitigation measures to be adopted for blasting activities which could cause considerable impacts to marine organisms and their habitats during construction;
- Port facilities that conduct cleaning or repair of ballast tanks to be equipped with adequate reception facilities able to prevent the introduction of invasive species. Treatment technologies might include those applied to other effluents accepted in Port reception facilities or more specific methods such as filtration, sterilization (e.g., using ozone or ultraviolet light), or chemical treatment (e.g., biocides).
- Kandla Port Trust to provide ship operators with details on the port, state, or port authority ballast water management requirements, including the availability, location, and capacities of reception facilities, as well as information on local areas and situations where ballast water uptake is to be avoided.

Conclusions

The EIA study reported that the baseline environment was found to be quite good and after the proposed projects there would not be any visual difference in the Environment baseline conditions with implementation of the Environment Management Plan. Almost all the impacts of the proposed project operations would be restricted to the premises only. The Kandla Port Trust needs to effectively implement the Mangrove Development, Protection & Management plan for control of impacts on mangrove habitat. There would not be any noticeable negative impacts on the Environment due to the proposed projects with the implementation of the Environment Management Plan to contain the impact on the Environment and Climate Change parameters.

07

Unkal Lake Rejuvenation for Sustenance

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Project Background

Sir. M. Visvesvaraya, the renowned and celebrated engineer constructed Unkal Lake in 1893 in the Northern part of Hubballi town to provide drinking water. It was the main source of drinking water for Hubballi till the augmentation schemes such as the Neerasagar and Malaprabha were taken up.

In the late 1990s and early 2000, the sewage from Navnagar and surrounding areas was diverted into the lake as it was not being used as a source for drinking water. That resulted in rapid silting and the water storage capacity decreased considerably. During the past decade, large areas of the lake, on its northern and western sides, have been reclaimed and encroached upon by construction. The water body receives raw sewage with high BOD levels and also the storm water from the surrounding human settlements on its western and northern sides.

Unkal Lake (Photograph-1) is suffering from serious problems of siltation and settled deposits containing nutrients and other contaminants from the inflow of wastewaters, decrease in surface area due to artificial land formation as a result of eutrophication especially in the north-east corner, thus reducing the surface area of the lake. Owing to high level of pollutants in the various influent flows, the surface water quality of the lake is rated as very poor. The resultant high level of nutrient has led to the algal bloom (microphytes). Land formation as a result of decayed plant deposits is evident especially near the outfalls of the major nalas. The dissolved oxygen is low and thus fish are practically absent in the lake.

Photograph-1: Unkal Lake

Objective

Hubballi-Dharwad has been selected as one of the cities to be developed under the Smart Cities Mission. As a part of Area Based Development (ABD) area development, a rejuvenation project was proposed for the Unkal lake. The objective of the project was to conserve and maximize its usage for the city of Hubballi-Dharwad not only as a precious water resource but also as a socio-cultural hub for the city.

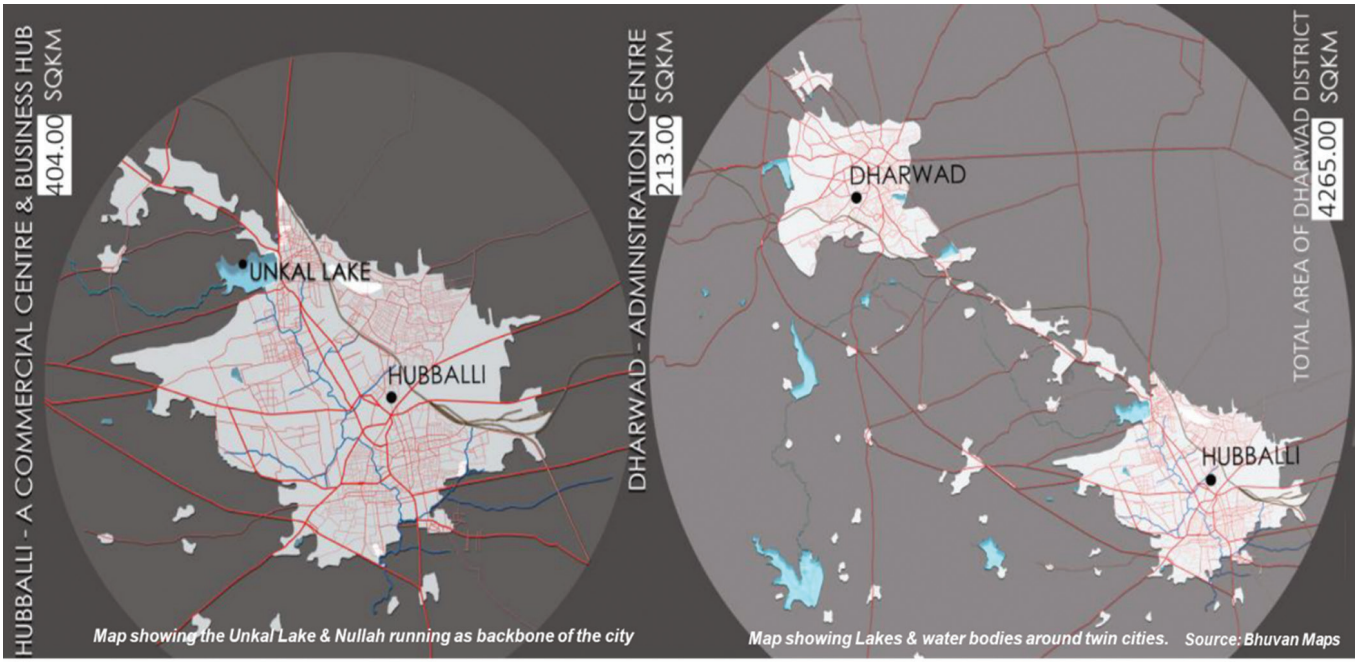

Figure-1: Map of Hubballi-Dharwad city showing Unkal Lake, Nullah and water bodies in the twin cities

Measures Undertaken for Improving the Water Quality of the Lake

In order to sustain the ecosystem, it was imperative to check the deterioration of the water and continuously treat it in a manner that over a period of time, the quality of water is improved. To achieve that, it was important to reduce COD, BOD levels and increase DO levels. The nutrients mainly in the form of N, P, K are to be absorbed so that they do not contaminate the water and allow aquatic plants such as water hyacinth and algal to grow. The measures undertaken for improving the water quality of Unkal lake are discussed below.

Bioremediation

Bioremediation, a natural and eco-friendly method along with some mechanization such as mechanical aeration system to support the aerobic microbes, enzymes, and protozoa, which clean up the polluted water, was deployed. The techniques used are described below, also refer Table-1.

Table-1: Systems to Improve Water Quality of Unkal Lake

Sl. No.	Description	Quantity
1	Bioremediation	5,000 ltrs/day
2	Aeration Systems	15 Nos – Specially Designed Cascade Aeration 5 Nos – JMS Natural Water Fountain Aeration
3	Ecological Floating Beds	7,500 sqm
4	Bamboo Plantation	0.5 acre (depending upon the available area)
5	JMS Bioframes	10,000 meters
6	JMS Trash Barrier	350 meters
7	Ecological Bridge Filter	300 sqm
8	Deweeding/ Water Hyacinth Removal	About 50 acres

Oxidization of Water Body and Bio Enzyme

Oxidation of the lake water was done to improve the level of dissolved oxygen to sustain the enzymes, microorganisms, and aquatic creatures. The oxygen intake increases at lower temperatures and with surface turbulations. The increased oxidation helped the enzyme reaction and increased the aerobic type microbe, phytoplankton, zoo plankton, fish, etc. and speeded up the breakdown of BOD. The introduction of Bio-Enzyme effectively supported the development of beneficial green algae that help in maintaining the level of DO.

Biological Treatment (Enzymes/ Microorganisms and Water Plants)

Biological treatment being a natural ecological pollution control system was used to reduce the nutrient load of the polluted lakes. The self-purification function of natural lakes and ponds provided an opportunity for biological treatment for water quality control. The application of JMS Bio-Enzyme, a blend of microorganisms and enzyme concentrate, helped the enzymes to rapidly liquefy organic waste such as grease and fats, protein, hydrocarbons, starches, and detergent which can then be easily digested by microbes and protozoa in the traditional treatment techniques.

- **Deweeding/ Removal of Water Hyacinth ---** Water hyacinth a free-floating perennial aquatic plant (or hydrophyte) is native to tropical and sub-tropical regions. The leaves are 10–20 cm across on a stem which floats because of buoyant bulb like nodules at its base above the water surface.

- **Desilting of Lake ---** Desilting, involved removal of silt (fine grained clay/lake-bed soil) from the lake-bed which was done using mechanical means and partly manually.

- **Diffused Aerators ---** Diffused aerators to increase DO of water were provided. Aeration is achieved by infusion of air into the bottom of the lake or by surface agitation from a fountain or spray-like device to allow for oxygen exchange at the surface. (Refer Photograph-2)

Photograph-2: Diffused Aerators

Specially Designed Surface Cascade Aerators

BOD Removal – A number of specially designed Surface Cascade Aerators have been deployed to remove 45 kgs x 13 = 585 kgs of Incoming BOD from the sewerage entering the lake every day.

JMS Natural Water Fountain Aeration

BOD Removal –JMS Natural Water Fountain Aeration have also been deployed to remove 360 kgs x 5 = 1800 kgs of Incoming BOD from the sewerage entering the lake every day.

- **JMS Bio frames:** These are designed for wastewater treatment by the bio-filter bed immersion method. They are formed with a large number of looped threads that extend radially, as a result, microorganisms easily adhere to the frame and multiply there. Refer Figure-2.

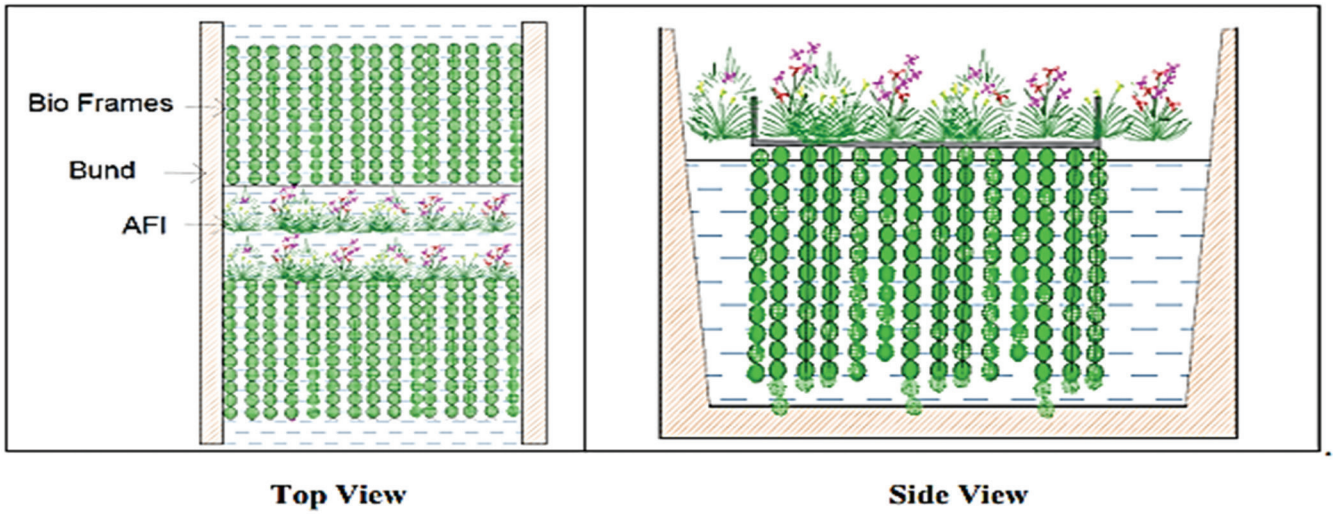

Figure-2: Cross section of JMS Bio Frames

- The Lake receives the maximum amount of sewage through the Amargol Drain. To enable treatment of wastewater in the drains and also before entering the water body, JMS Bioframes are provided in the Amargol Drain.

- **JMS Trash Barrier:** JMS Trash Barrier is designed with a top flotation device and bottom steel ballast chain that allows the barrier to control debris both on top of the water and under the water in various locations. The equipment is ideal for debris containment in water bodies like lakes, ponds, rivers, etc., as a barrier for small floating items, garbage, litter, etc. To ensure that the lake is free of plastic and other floating debris, a total of 500 meters of the Trash barrier has been provided at different locations. Refer Photographs – 3 & 4.

- **Special Artificial Floating Islands:** Ecological Floating Beds have been constructed of durable, non-toxic post-consumer plastics and vegetated with native plants that float on top of the lake water.

Photographs 3 & 4: JMS Trash barriers arresting floating matter from entering into the water body

They enhance the micro eco system underneath the surface of the water to clean up the pollutants. The Floating island is capable of reducing the BOD, Nitrogen, and Phosphate by 20-30% in the 100 m length of the island. It gives the advantages of purifying water quality, creating living space for living organisms, improving landscape, preventing waves, etc.

- **Ecological Bridge Filter:** Ecological Filter Bed comprising mainly of Gabion Baffle walls installed along with fibrous media provide a favourable space for microorganisms to purify the water quality of the contaminated water. A galvanic iron wire or a galvanic wire mesh structure is made by twisting a PVC-coated iron wire after galvanization and filled with pebbles or crushed stones to form the gabion.

- **Baffle Walled Reactor with Special Bamboo Plantation:** Disposal of municipal wastewater into rivers and lakes affects the water quality of the lake, river, marine biodiversity and threaten the existence of biodiversity. However, the same wastewater can be used as a 'resource' to enhance plant production, particularly for the biomass production for power generation.

With the Bioremediation techniques recommended for the treatment of the lake water, the quality of the lake water achieved is given in Table-2.

Table-2: Quality of Lake Water after Bioremediation

Sl. No.	Parameters for Inland Surface Water	Limiting Standards
1	pH	6.5-8.5
2	Biochemical Oxygen Demand mg/l	Less than 10
3	Chemical Oxygen Demand mg/l	Less than 10
4	Total Suspended Solids (TSS), mg/l	Less than 10
5	Ammoniacal Nitrogen (Nh4-N), mg/l	Less than 10
6	Total Nitrogen, mg/l	Less than 10
7	Fecal Coliforms, MPN/100ml	Less than 10
8	Total Phosphate(mg/l)	Less than 10
9	Total Residual Chlorine, mg/l	1

Dam Wall Beautification, Gabion Wall, and Pathway along Lake Edge

Pathway along Lake Edge: The Hubballi-Dharwad main road directly abuts the lake along the east side of the lake, refer Figure-3. To create a continuous connectivity along the lake edge, a pathway is provided along the lake in that stretch. An RCC retaining wall is also provided for the pathway along with lighting arrangement.

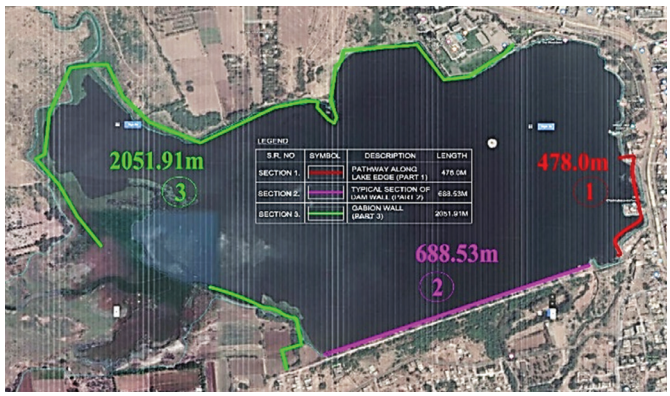

Figure-3: Pathway along edge of Unkal Lake

Dam Wall Beautification: As the lake water is not being utilized for drinking purposes, the dam wall is made accessible to the public for use as a pathway for passive recreation purposes like walking and sitting.

Gabion Wall and Pathway along Lake Edge: A pathway is also provided along the north side edge of the lake for allowing access to the public to the lake. The pathway connects the ecological park on the west and the garden and food plaza on the east. It comprises:

- Chain link fencing demarcating the lake edge from the surrounding private lands.
- Gabion retaining wall along the lake periphery for creating a pathway. The wall defines the lake edge while still allowing for water percolation and recharge from the surrounding lands.
- Appropriate plantation using indigenous species provide green cover and improve the ecology of the lake edge.
- Plantation along the gabion wall using indigenous wetland species like canna, vetiver, water lilies and cattail to help in natural treatment of water.

Photographs 5& 6: Lake Edge After Construction of Pathway Dam Wall after Beautification

The water quality parameters before and after adoption of the measures to improve the quality of water of unkal lake are given in Table-3.

Table-3: Water Quality Parameters Before and After Remediation Measures

Sl. No.	Parameters	Units	Amargol Inlet		Centre of the lake		BRTS Inlet	
			Before	After	Before	After	Before	After
1	pH @ 25°C	-	7	7.29	7.76	7.33	7.46	8
2	Total Suspended Solids (mg/L)	mg/L	134	7.3	10	21.6	23	10.2
3	Chemical Oxygen Demand (mg/L)	mg/L	112	24	32	16.45	48	8.22
4	Biological Oxygen Demand 3 days at 27°C (mg/L)	mg/L	42	6.3	15	4.2	23	2.2
5	Dissolved Oxygen (mg/L)	mg/L	-	3.3	-	6	-	5.7
6	Total Nitrogen (mg/L)	mg/L	20.27	8	1	2.66	8.28	10.9
7	Phosphate* (mg/L)	mg/L	6.18	2.53	0.1	0.99	0.18	0.31
8	Fecal Coliform (MPN/100ML)	MPN/ 100ML	-	33	-	9	-	33
9	Total Dissolved Solids (mg/L)	mg/L	777	790	-	362	970	700

Conclusions

The intent of the project was to conserve and maximize the water resource and transform it into a socio-cultural hub for the city.

The Unkal Lake project addressed three main areas of concern, viz:

Ecological: through measures for improving the quality and quantity of water through natural ecological measures thus ensuring the long-term sustainability of the lake.

Social: through beautification of the lake front and improving the accessibility to the lake from all sides.

Economical: the economic model for the lake proposes several revenue generating activities such as light and sound show, food court and ecological park which would aid for the long-term sustenance and upkeep of the lake water body. The lake activities are proposed to be developed under the PPP (Public Private Partnership) model.

Acknowledgement

The authors are thankful to TATA Consulting Engineers Limited for permission to write about the project.

References

Project Report – Unkal Lake Beautification Project in Hubbali

THE ECONOMIC TIMES News

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Earth's temperature is at an all-time high!

ET Online|
07 Jul 2023, 05:36 PM IST

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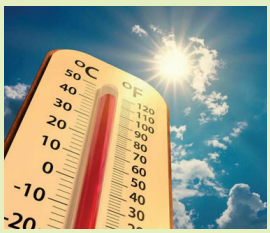
Third milestone

The blue planet is turning red. Earth's average temperature set a new unofficial record high on Thursday, the third such milestone in a week that already rated as the hottest on record, Associated Press reported. This means the average temperature keeps rising everyday, as worries on climate change continue.



2/5

How hot is the earth?

As per AP, the planetary average hit 63 degrees Fahrenheit, 17.23 degrees Celsius, surpassing the 62.9 and 17.18-degree marks set Tuesday and equaled Wednesday, according to data from the University of Maine's Climate Reanalyzer, a tool that uses satellite data and computer simulations to measure the world's condition.

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Where is the heat?

That average includes places that are sweltering under dangerous heat — like Jingxing, China, which checked in almost 110 degrees Fahrenheit (43.3 degrees Celsius) — and the merely unusually warm, like Antarctica, where temperatures across much of the continent were as much as 8 degrees Fahrenheit (4.5 degrees Celsius) above normal this week.

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A note

The National Oceanic and Atmospheric Administration on Thursday issued a note of caution about the Maine tool's findings, saying it could not confirm data that results in part from computer modeling. "Although NOAA cannot validate the methodology or conclusion of the University of Maine analysis, we recognize that we are in a warm period due to climate change," NOAA said.

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Climate change issues

Some climate scientists said this week they weren't surprised to see the unofficial records. Robert Watson, a scientist and former chairman of the UN's Intergovernmental Panel on Climate Change, said governments and the private sector "are not truly committed to address climate change." Nor are citizens, he said. "They demand cheap energy, cheap food and do not want to pay the true cost of food and energy," Watson said.

Read more on Earth's Temperature Record High Earth India Climate Change

Source: https://economictimes.indiatimes.com/news/international/ world-news/earths-temperature-is-at-an-all-time-high/third-milestone/slideshow/101576256.cms

08

Using Integrated Life Cycle Costs and Carbon Emissions Reporting to Decarbonise the Built Environment*

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Introduction and Background

The built environment sector is a significant emitter of greenhouse gases (GHG), contributing to the climate crisis. GHG emissions are measured in carbon dioxide (CO_2) equivalent (CO_2e) (interchangeably referenced as carbon emissions). Each greenhouse gas is converted into its CO_2e by multiplying the gas's Global Warming Potential (GWP). As per the latest Intergovernmental Panel on Climate Change (IPCC) report, approximately 79% of GHG emissions come from the energy, industry, transport, and buildings sectors (IPCC, 2023). A large portion of these emissions can be directly or indirectly attributed to the built environment sector. The emissions from the built environment can be divided into the following three categories (Whole Life Carbon Network, 2021):

1. **Embodied carbon emissions**: net emissions associated directly with the construction materials, products, and components during their production (including transportation), installation and assembly anytime during the life of the constructed asset (Akbarnezhad & Xiao, 2017; Hu & Esram, 2021).
2. **Operational carbon emissions**: emissions from the asset's energy use (and water use) during the in-use phase of the life cycle (Rodrigo et al., 2019).
3. **User carbon emissions**: emissions relating to users' utilisation of infrastructure and the service it provides during operation (Whole Life Carbon Network, 2021).

To better understand the emissions from the built environment sector, a link between the asset lifecycle, product (construction materials, products, and components) lifecycle, and emission is needed. See Table 1 for the mapping. There are further nuances that exist in the mapping. For example, A0 emissions are generally associated with infrastructure assets and are normally ignored for buildings. Similarly, biogenic carbon sequestered in the installed products is reported separately. Carbon emissions can also be categorised as scope 1, scope 2, and scope 3 emissions.

The built environment sector directly controls embodied and operational emissions, while the user carbon emissions are indirectly associated with the sector. User carbon can be reduced through broader interventions such as land use planning to achieve compact urban form, co-locating jobs, and housing, and supporting public transport (IPCC, 2023). Emissions categorised as embodied and operational are the focus of this article.

* Adapted from (Ballesty & Sawhney, 2023) under the Creative Commons Attribution 3.0 licence terms.

Considering only these two categories, the built environment sector emits 43% of all global CO_2e emissions (United Nations Environment Programme, 2022). Table-2 provides a detailed breakdown of these emissions. Residential and non-residential buildings together amount to 37% of the carbon emissions, of which 9% is attributed to embodied emissions. Emissions from infrastructure assets account for 6% of embodied carbon emissions. Most of the emissions from infrastructure assets are considered under the user carbon category (Module B8). For example, the emissions released by users when using a transportation network to reach their place of work fall under that category.

Table-1: Life Cycle Modules for Carbon Emissions from Constructed Assets

Lifecycle stages	Modules from ISO 21931:2022	Embodied carbon	Operational carbon	User carbon
Pre-construction	A0 Acquisition	X		
Product stage	A1 Raw material supply	X		
	A2 Transport	X		
	A3 Manufacturing	X		
Construction process	A4 Transport	X		
	A5 Construction and installation process	X		
Use stage	B1 Use	X		
	B2 Maintenance	X		
	B3 Repair	X		
	B4 Replacement	X		
	B5 Refurbishment	X		
	B6 Operational energy		X	
	B7 Operational water		X	
	B8 Users' activity			X
End-of-life stage	C1 Deconstruction demolition	X		
	C2 Transport	X		
	C3 Waste processing	X		
	C4 Disposal	X		
Circular economy	D Benefits and loads beyond the system boundary	Calculated and reported separately		

Table-2: Carbon Emissions from the Built Environment Sector

	Life Cycle Carbon (43%)		
	Operational Carbon		Embodied Carbon
	Direct	Indirect	
Residential	6%	11%	9%
Non-residential	3%	8%	
Infrastructure	-	-	6%
Total 43% (buildings = 37%)	28%		15%

Given the scale of these emissions, achieving the decarbonisation targets for the broader economy would require reducing emissions from the built environment sector. Therefore, the built environment sector will play an important role in reversing the growth of GHG emissions. Decarbonising the broader economy and carbon capture, storage, and utilisation strategies would likely benefit the sector. However, the sector must consider new and existing assets to reduce carbon emissions directly. That would require the sector to consider decarbonisation while regulating, initiating, designing, constructing, operating, maintaining, and deconstructing the built environment assets (United Nations Environment Programme, 2022).

While there is an increase in awareness and activities in the sector, significant progress is still required. For example, during the COP27 meeting, it was reported that operational emissions from the built environment increased by 5% last year compared to 2020 levels (United Nations Environment Programme, 2022). In a recent report published by Accenture, 93% of Accenture Global 2000 companies will miss their net-zero targets (Accenture, 2023).

Interventions Needed

With significant attention on the built environment sector, it is vital to consider a whole-of-life, whole-of-asset, and whole-of-industry approach. The sector's decarbonisation program would require several actions, including setting targets with appropriate milestones, standards to classify, measure, and report, digital tools to support work processes, databases and benchmarks, and a skilled workforce. Figure-1 lists broad actions needed to decarbonise the built environment. In addition to the supporting layers of data, standards, and knowledge, various stakeholders must work collaboratively to assemble all the building blocks. In this paper, the authors address some actions focused on classification systems, integrating cost and carbon reporting, and describe a path forward.

Focusing on Cost and Carbon

Over the past several decades, the construction industry has successfully created a program to reduce the operational energy use of assets. Research shows that most current environmental assessment methods focus solely on operational carbon emissions (de Wolf et al., 2015). While that is important, an equal emphasis is now needed on efforts to reduce embodied carbon emissions. As the energy grid decarbonises and more energy efficiency measures are adopted, operational carbon emissions would continue to reduce. Embodied carbon emissions, therefore, would become an important area to address. Approximately 11% of global GHG emissions come from embodied carbon emissions from the built

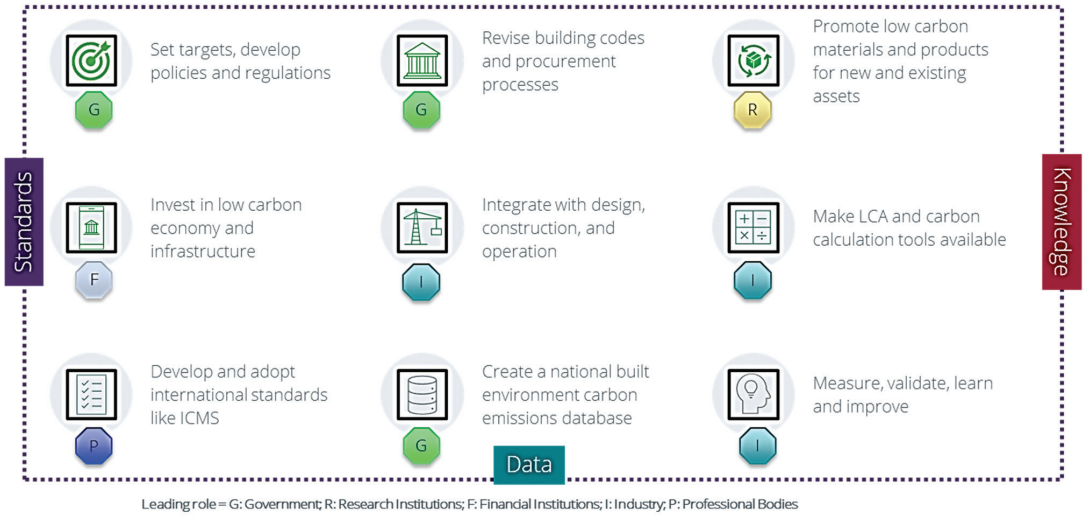

Figure-1: Interventions by Industry Stakeholder

environment sector. It is estimated that over time the proportion of embodied carbon emissions would become a more significant proportion of emissions from buildings. More importantly, embodied carbon emissions cannot be reversed. That can be seen (Figure 2) from a study conducted in Australia by the Green Building Council of Australia and thinkstep-anz (GBCA and thinkstep-anz., 2021).

However, it is not a zero-sum game, as an asset or portfolio's embodied and operational carbon emissions are interconnected. For example, when choosing a building envelope, the designer should select one with a low embodied and operational carbon footprint. A whole-of-life and whole-of-asset approach is needed in the selection process, as well as efficient data and information sharing between project team members.

As reduction targets are being set, the sector must follow an international standard for classifying, measuring, and reporting emissions. Managing and improving carbon emissions from constructed assets is difficult without measuring them. For various stakeholders to calculate the carbon footprint of new and existing assets, a set of artefacts, such as international standards for classifying, measuring, and reporting carbon emissions and standard calculation methodologies, are needed (RICS, 2017; UK House of Commons Environmental Audit Committee, 2022).

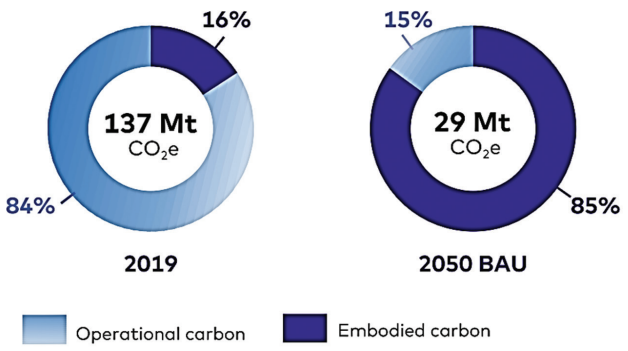

Figure-2: Changing Proportion of Embodied Carbon Emissions in Buildings (source: (GBCA and thinkstep-anz., 2021))

Embodied carbon emissions must be incorporated into project and asset design and construction decisions. Important decisions must be made considering the life cycle costs and carbon emissions. Not including life cycle costs would unnecessarily burden the project stakeholders with expensive options without careful analysis.

In previous studies, it has been established that there is a correlation between embodied carbon emissions and the cost of a building (Victoria et al., 2016). That signifies the importance of ensuring that life cycle costs are measured in sync with how life cycle carbon emissions are measured and reported. By using low-carbon materials, project teams can reduce embodied carbon emissions. At the same time, cost reduction can be achieved by using construction materials through local sourcing with reduced transportation requirements and by optimising construction operations and processes (Rodrigo et al., 2019). All these strategies have cost implications over the asset's life; therefore, studying them in conjunction with the total cost of ownership is crucial. A consistent and shared taxonomy of construction information about cost and carbon is needed.

International Cost Management Standards (ICMS)

To address the issues highlighted in the previous section, a coalition of global professional bodies came together to develop a life cycle cost and carbon emissions taxonomy (ICMS Coalition, 2021). That taxonomy is described in the International Cost Management Standards (ICMS) available on the ICMS Coalition website at https://icms-coalition.org/.

ICMS, which was originally started as the International Cost Measurement Standard, now provides a high-level structure and format for classifying, defining, measuring, recording, analysing, and presenting life cycle costs and carbon emissions associated with construction projects and constructed assets (ICMS Coalition, 2021). The first edition of ICMS provided the taxonomy for capital costs. In the 2nd edition, that was expanded to incorporate life cycle costs. Building on that, the 3rd edition, released in November 2021, combined both life cycle costs and life cycle carbon emissions. Figure-3 shows the taxonomy of ICMS.

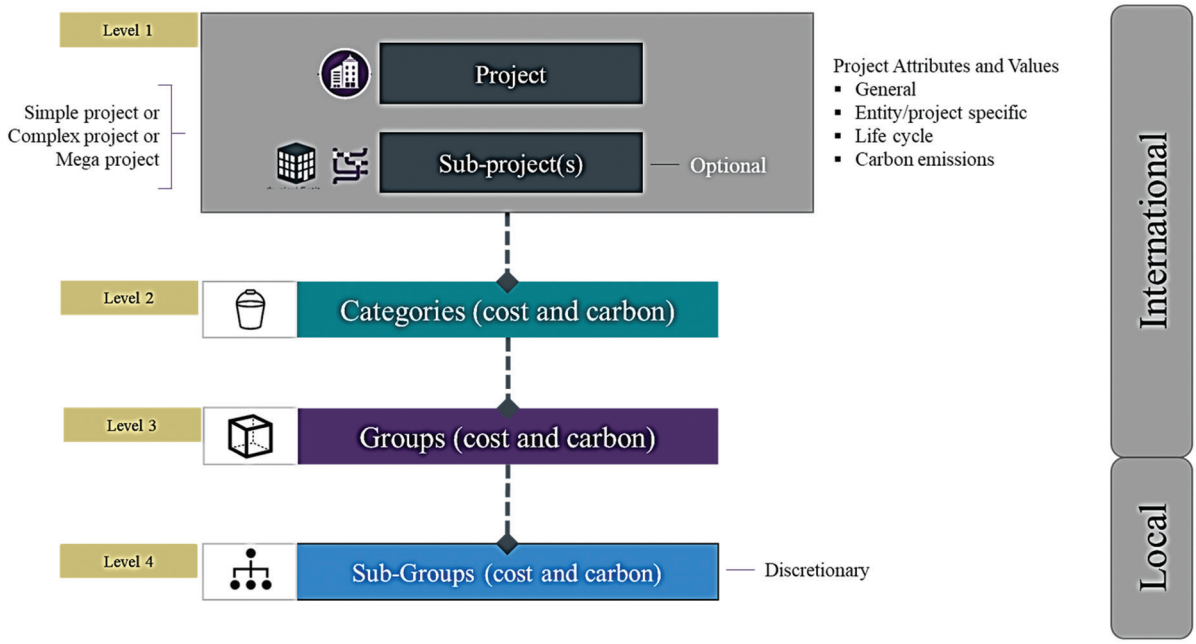

Figure-3: High-level Taxonomy of ICMS (Source: authors)

ICMS offers a high-level framework against which life cycle costs and carbon emissions can be classified, defined, measured, recorded, analysed, presented, and compared. The hierarchical framework has four levels (ICMS Coalition, 2021):

- **Level 1 Projects or Sub-Projects**: Users report their projects at level 1 of ICMS. Projects can be single or a series of construction intervention(s) with a single purpose or common purposes to create a series of or a single constructed assets commissioned by a client, or group of clients, with a defined start and end date. In project management parlance, a series of interventions are called programmes and portfolios. A project may comprise several sub-projects, for example, a multi-use development.

- **Level 2 Categories**: A category in ICMS is a division of the project or sub-project costs and carbon emissions. The divisions are encapsulated by the acronym ACROME which stands for Acquisition, Construction, Renewal, Maintenance, Operation, and End of Life.

- **Level 3 Groups**: At level 3 of the ICMS, a category is divided into broad groups to enable easy estimation or extraction of cost and carbon emissions data for quick, high-level comparison by design discipline or common purpose. The design of the groups is such that it can connect with an elemental, trade-based, or work-package-based breakdown.

- **Level 4 Sub-Groups**: The sub-groups are at the lowest level of the ICMS hierarchy. ICMS groups are divided into sub-groups. A sub-group is the division of a group solely according to its functions, services, or common purposes to enable alternatives serving the same function to be compared, evaluated, and selected.

Each Category, Group, and Sub-Group is used to report costs and carbon emissions. The composition of Levels 2 and 3 is mandated for all projects and sub-projects, although discretion is allowed at Level 4.

To enable consistent and concise evaluation and comparison between different projects or design schemes, ICMS provides a set of Project Attributes and Values describing the principal characteristics of each project or sub-project (RICS, 2022a). These attributes have been

carefully selected and are limited to those that have a direct bearing on the costs and carbon emissions (RICS, 2022a). Comparisons are made possible within project types by these Project Attributes and Values.

Figure-4 shows the taxonomy used in ICMS for life cycle costs and carbon emissions. The ACROME structure at level 2 (categories) is the summary level where project and sub-project level costs and emissions are provided. Below level 2, a common set of reporting groups and sub-groups is used to provide details for each category consistently.

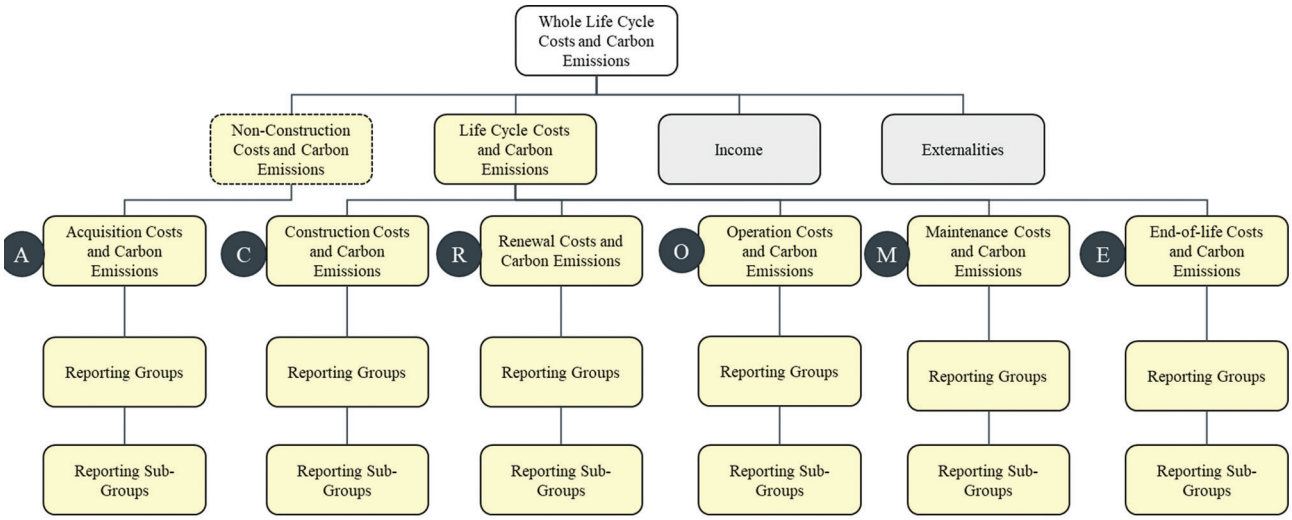

Figure-4: Integrated Taxonomy for Life Cycle Costs and Carbon Emissions (Source: adapted from (RICS, 2022a))

Figure-5 shows the groups for each category in ICMS. The construction, renewal, and maintenance categories use a common set of groups. Reporting costs and carbon up to the group level in ICMS is mandatory, and sub-groups for cost and carbon are provided as a recommendation. End-users can utilise their local classification system at that level by mapping to level 3. That feature of ICMS allows the users to map elemental, trade-based, or work package-based classification systems to ICMS. The aim is not to replace existing local standards but to provide an internationally accepted reporting framework into which data generated locally can be mapped and analysed for comparison. In time, it is expected that ICMS would become the primary basis for global and local construction cost and carbon emissions reporting.

ICMS provides a reporting framework for carbon emissions to be used with existing standards, guidance and tools, and emerging developments coming on stream to support decarbonisation. By using a common taxonomy for life cycle costs and carbon emissions, decision-makers can compare the costs associated with each carbon reduction strategy to the baseline, allowing the cost-effectiveness of decarbonisation strategies.

The project team members can develop these reports with support from an independent quantity surveyor. As more projects and assets are reported in the ICMS format, a benchmarking database can be created for providing early cost and carbon advice to project sponsors.

Table-3 shows an example of carbon footprint reporting for a new building project using ICMS. The example is adapted from a Whole Life Carbon Assessment Report for a proposed development of residential and commercial buildings (published in 2020 to support a UK planning application). Carbon emissions are reported across the ICMS categories, and the report includes both embodied carbon and operational carbon. The users also provide carbon emissions-related project attributes and values such as the boundary of carbon reporting, name of carbon assessment tool(s) used, main source(s) of material quantities for carbon emissions assessment, main source(s) of carbon emission factors, and source(s)

(and associated percentages) of operational energy. The exercise can be repeated for different construction options, and a comparison of life cycle costs and carbon emissions can be used to select the optimal alternative. Using an internationally agreed taxonomy with agreed inclusions and exclusions, benchmarking databases can be developed for early cost and carbon advice for new projects and retrofits.

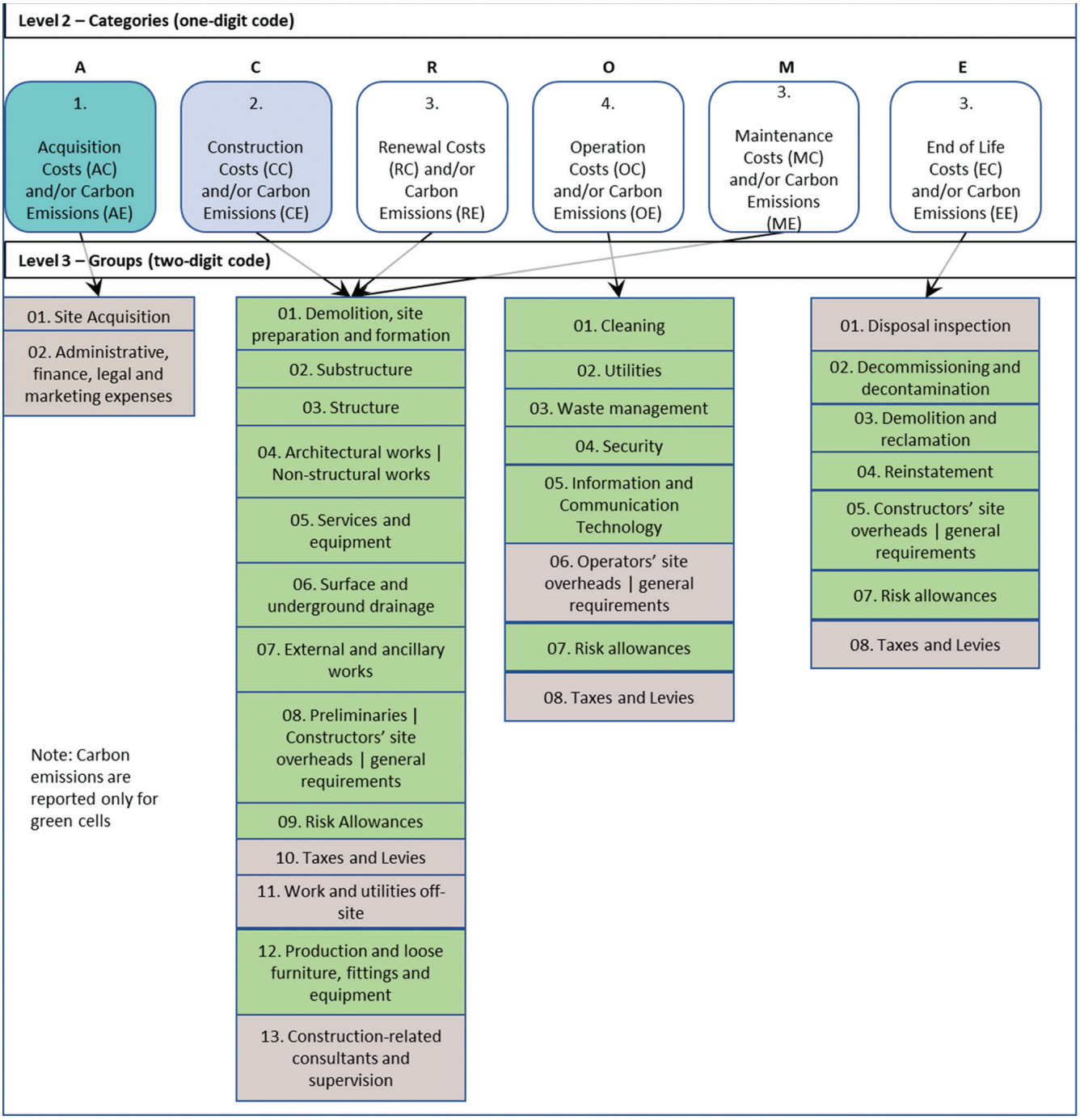

Figure-5: Groups for the ACROME categories (Source: adapted from (ICMS Coalition, 2021))

Role of Designers and Engineers

It is essential to undertake decarbonisation studies early in the life cycle of an asset. Decarbonisation is generally considered a design and engineering task, especially for new assets. However, without downstream stakeholders' support and participation, achieving the decarbonisation targets may not be possible. That requires the entire project team to participate in the decarbonisation strategy. Depending on the type of assets, different team members can take a lead role while others can provide support. For example, a quantity surveyor (QS) or cost management professional is central to calculating embodied carbon emissions (Zainon et al., 2019). Quantities of materials are used to determine the carbon footprint of the materials used for constructing, renewing, and maintaining constructed assets. These quantities are generally calculated from design and engineering documentation by a QS. Any error in these calculations can provide an incorrect value of the carbon emissions. QSs can help measure embodied carbon and assist in the choice of materials, systems, and components for construction by comparing various alternatives. Approximately 15% of the respondents to a RICS survey in 2022 reported using their skills in measuring embodied carbon emissions and materials selection (RICS, 2022b). However, in another survey conducted by RICS, 31% of the respondents suggested that QS and cost management professionals should take a leading role in carbon calculations for projects and assets. 59% responded that they should play a supporting role, with only 10% of the respondents recommending that they play no role in these calculations (Sawhney, 2023).

Table-3: Case Study Showing Carbon Footprint Calculations (Source: (RICS, 2022a)

Code	Category	Buildings		
		Life Cycle Costs	Emissions (tCO_2e)	tCO_2e/Qty
	Project Quantity	29,127		
	Quantity's Units of Measurement	Square meters		
1.	Acquisition (where significant)	Not included	Not significant	Not significant
2.	Construction	£43.35m	15,678	0.538
3.	Renewal	£8.73m	7,180	0.246
4.	Operation	£32.3m (30 years forecast)	8,005	0.275
5.	Maintenance	Out of scope	9,100	0.312
6.	End of Life	Out of scope	759	0.026
7.	Benefits and loads beyond the system boundary	Income and externalities not included	-2,106	-0.072

More specifically, professional engineers can help clients and project sponsors with the following services (Ma & Luu, 2013; Zainon et al., 2019):

- Development of sustainability strategy, including decarbonisation strategy for their projects, programs, and asset portfolio.
- Conduct life cycle cost appraisal.
- Advice setting targets, adopting a rating system, creating reports, and implementing international standards such as the ICMS.
- Compare life cycle costs of low-carbon materials, systems, and components.
- Develop a benchmarking database or help access a database.
- Advise on digital technologies, data requirements, and information management processes.
- Keep track of local policies and regulations related to decarbonisation.
- Suggest procurement routes.
- Monitor actuals closely during construction.

Conclusions

Decarbonising the built environment sector will be crucial to addressing the climate crisis. Taking a life cycle approach, reducing embodied carbon for new and existing assets, and paying close attention to costs would be important in the decarbonising journey of the sector (RICS, 2022b). With the help of an example, this article has shown how an integrated taxonomy for life cycle costs and carbon emissions can assist decision-makers in making prudent choices. Designers, engineers, and quantity surveyors are poised to take a central role in the process and advise project sponsors on a holistic carbon strategy. The work of the professionals, especially the QS, needs to be improved by a need for accepted standards, tools, databases, benchmarks, and guidance, which is seen as the principal barrier to reducing carbon emissions (RICS, 2022b). Other issues that must be addressed include high costs or low availability of low-carbon products, materials, and components. As professionals expand their roles, critical gaps in knowledge and skill shortages must be filled. The industry needs a decarbonisation toolkit to break down these barriers. The components of the toolkit include standards, data, and skills that the industry can rely on and use. There have been some advancements in those area. For example, ICMS now provides a globally consistent and integrated method for classifying, measuring, and reporting life cycle costs and carbon emissions for buildings and infrastructure projects. With a holistic approach, the sector can strive towards a low carbon built environment that generates lower carbon emissions than traditional assets and helps build resilience against exposure to extreme climate change events.

References

1. Accenture. (2023). Accelerating global companies toward net zero by 2050.
2. Akbarnezhad, A., & Xiao, J. (2017). Estimation and Minimization of Embodied Carbon of Buildings: A Review. Buildings, 7(4), 5. https://doi.org/10.3390/buildings7010005
3. Ballesty, S., & Sawhney, A. (2023). Decarbonisation of the Built Environment: using integrated life cycle and carbon emissions reporting. IOP Conference Series: Earth and Environmental Science, 1176(1), 012046. https://doi.org/10.1088/1755-1315/1176/1/012046
4. de Wolf, C., Yang, F., Cox, D., Charlson, A., Hattan, A. S., & Ochsendorf, J. (2015). Material quantities and embodied carbon dioxide in structures. Proceedings of the Institution of Civil Engineers - Engineering Sustainability, jensu.15.00033. https://doi.org/10.1680/jensu.15.00033
5. GBCA and thinkstep-anz. (2021). Embodied Carbon and Embodied Energy in Australia's Buildings. https://gbca-web.s3.amazonaws.com/media/documents/embodied-carbon--embodied-energy-in-australias-buildings-2021-07-22-final-public.pdf
6. Hu, M., & Esram, N. W. (2021). The Status of Embodied Carbon in Building Practice and Research in the United States: A Systematic Investigation. Sustainability, 13(23), 12961. https://doi.org/10.3390/su132312961
7. ICMS Coalition. (2021). ICMS: Global Consistency in Presenting Construction Life Cycle Costs and Carbon Emissions. https://icmscblog.files.wordpress.com/2022/06/icms_3rd_edition_final.pdf

. IPCC, 2023. (2023). Summary for Policymakers. In: Climate Change 2023: Synthesis Report. A Report of the Intergovernmental Panel on Climate Change. Contribution of Working Groups I, II and III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [Core Writing Team, H. Lee and J. Romero (eds.)].

9. Ma, T., & Luu, H. T. (2013, November). The Changing Role of Quantity Surveyors in the Green Building Development in South Australia. 38th AUBEA Conference at University of Auckland. https://www.researchgate.net/publication/270762327_THE_CHANGING_ROLE_OF_QUANTITY_SURVEYORS_IN_THE_GREEN_BUILDING_DEVELOPMENT_IN_SOUTH_AUSTRALIA
10. RICS. (2022a). *ICMS explained: A user guide for the International Cost Management Standard (ICMS), third edition*. www.rics.org
11. RICS. (2022b). *RICS Sustainability Report 2022*. www.rics.org
12. Rodrigo, M. N. N., Perera, S., Senaratne, S., Xiaohua,

J., & Jin, X. (2019). Embodied Carbon Mitigation Strategies in the Construction Industry. *CIB World Building Congress*, 17–21. https://www.researchgate.net/publication/333972516

13. Sawhney, A. (2023). *Role and importance of data and technology in quantity surveying and cost management practice*.
14. United Nations Environment Programme. (2022). *2022 Global Status Report for Buildings and Construction: Towards a Zeroemission, Efficient and Resilient Buildings and Construction Sector*. www.globalabc.org
15. Victoria, M., Perera, S., & Davies, A. (2016, September 20). *Design economics for dual currency management in construction projects.* https://rgu-repository.worktribe.com/output/247037/design-economics-for-dual-currency-management-in-construction-projects
16. Whole Life Carbon Network. (2021). *Improving Consistency in Whole Life Carbon Assessment and Reporting*. https://asbp.org.uk/wp-content/uploads/2021/05/LETI-Carbon-Definitions-for-the-Built-Environment-Buildings-Infrastructure.pdf
17. Zainon, N., Wei Lun, G., Suzaini Mohamed Zaid, N., Elyna Myeda, N., & Mardhiyah Aziz, N. (2019). Developing a Framework for Life Cycle Assessment of Construction Materials through Building Information Modelling (BIM). *International Journal of Innovation, Creativity and Change. Www.Ijicc.Net*, *10*(7). www.ijicc.net

IBEF

INDIA BRAND EQUITY FOUNDATION

Indian Economy News

About 50% of construction and demolition waste generated has been recycled and reused under the Swachh Bharat Mission

IBEF June 20, 2023

Every day, different cities around the nation produce about 30,000 tonnes of "Construction and Demolition (C&D)" garbage. To ensure the utilization of C&D garbage, the Ministry of Housing and Urban Affairs (MoHUA) has taken several steps as part of the Swachh Bharat Mission (Urban). At about 400 C&D garbage factories nationwide, more than 15,000 tonnes of debris is cleaned up every day. About 50% of the total C&D waste generated at present is being recycled and shaped into reusable products. In keeping with the concept of turning trash into wealth, C&D waste is recycled to make bricks, tiles, paver blocks, etc. As a matter of fact, C&D trash produces roughly 90% recyclable garbage. Of the remaining 10% of C&D waste, plastic and paper waste is sent to the Waste-to-Energy plants and metal waste is reused in Waste-o-Wonder projects.

To aid in the stakeholders' understanding of the C&D Trash Management Rules, 2016 and to achieve 100% utilisation of the trash generated, MoHUA recognised the need to keep track of the recycled production and usage of C&D waste. In cities with a population greater than 10 lakh, recycling facilities for C&D trash have been established.

In accordance with the Swachh Bharat Mission-Urban 2.0, all States are producing reusable goods in C&D waste facilities to prevent open debris piles and maintain a clean environment. Through "collection vehicles," this material is transported to the collection facilities and processing plants. The C&D waste is segregated into five to six categories like fine soil, mixed concrete, stones, etc.

To handle the construction and demolition trash, various governments are gradually establishing new C&D waste facilities. A C&D garbage factory with a 2,000 TPD waste processing capability has been established at Burari in Delhi. In addition, there are plants in Shastri Park, Ranikheda, and Mundka. Similarly, C&D plants of small and large capacities have been set up in many states, which are redefining the unique journey of cleanliness by reshaping the debris.

Since young, aspirational buyers want the full motorcycle experience, including rides, community, merchandise, accessories, and connected technologies, demand at the premium end of the market has continued to outpace the two-wheeler market overall.

Disclaimer: *This information has been collected through secondary research and IBEF is not responsible for any errors in the same.*

Source: https://www.ibef.org/news/about-50-of-construction-and-demolition-waste-generated-has-been-recycled-and-reused-under-the-swachh-bharat-mission

CEAI NEWS

WEBINAR ON MODERN TREND IN DESIGN & CONSTRUCTION OF STRUCTURE AND A CASE STUDY ON EXTRADOSED BRIDGE

The CEAI Young Professionals Forum for the term 2023-2024 organised its first webinar on ***"Modern Trend in Design & Construction of Structure and A Case Study on Extradosed Bridge"*** on the 14th April 2023. The speaker Dr. Bidhan Chandra Roy, has multi-faceted experience, encompassing teaching, project planning design and implementation, technology, innovations, research, management, business growth, and even preparation of standards and codes.

Dr. Roy briefed about the modern trends in the design and construction of bridges, elevated structures, underpasses and tunnels. He then presented a case study on the extra-dosed bridge (Nivedita Setu) which is the first of its kind in India. He also briefed about the basic concept of the design and construction of innovative structures.

WEBINAR ON "DESIGN & CONSTRUCTION OF NATM SCISSOR CROSSOVER FOR MUMBAI UNDERGROUND METRO"

The second webinar organised by the YP Forum was held on 10th May 2023 on ***"Design & Construction of NATM Scissor Crossover for Mumbai Underground Metro".***

The presentation was made by Mr. Prathap Muniyappa, Lead Designer (Tunnel & Geotechnical), Geo-consult India Pvt. Ltd.

Mr. Muniyappa briefed that the construction of underground structures for the metro rail projects is always challenging as the project works normally affect

many adjacent surface structures which have stringent settlement criteria and protection requirements. Project implementation becomes even more complex when the overburden is shallow and the area of the cross-section is comparatively large as was the case for the *crossover structure which had to be constructed between the twin TBM Bored tunnels*. For optimized construction feasibility, construction staging and geotechnical stability of the excavation are critical, hence detailed design of the primary support and modified construction sequence was carried out in accordance with the principles of NATM design.

WEBINAR ON "LEGAL AND GENERAL ASPECTS OF CONTRACT PROCESS AND CONTRACT ADMINISTRATION"

The third webinar organised by the YP Forum of CEAI was held on 14th June 2023 on **"Legal and General Aspects of Contract Process and Contract Administration".**

Mr Rama Shankar Sharma, President CEAI welcomed the speakers and the participants.

The presentations were made by eminent speakers:

Dr Vandana Bhatt, Contract Administration Consultant, PROCARE, made a presentation on the topic ***"Construction Contract Case Laws"***. She briefed on the basic concept of the need of learning the subject of Contract Administration and Law. She added that Engineers and Professionals need to know the laws

governing their activities to mitigate or reduce damage being done through ignorance of Law. Engineers should be aware of the basic laws to avoid damages to the project and the organization.

Ms Renjitha Nair, MBE. MRICS, MAPM and Member of Future Leader Forum of CEAI, made her presentation on ***"Contract Administration"***. The presentation was aimed to inculcate the significance and importance of contract administration among young engineers. By defining the important terms, the session focussed on the basic concept and processes involved in contract administration. The presentation also highlighted various scenarios that may be encountered in the administration of construction contracts, emphasizing the role of the contract administrator. The session intended to brainstorm young engineers to redefine the respective deliverable with due reference to the contract.

Link : https://www.youtube.com/watch?v=NpH28gFRrWc

WEBINAR ON "ETHICS & INTEGRITY AT THE WORKPLACE"

CEAI's webinar on ***"Ethics & Integrity at the Workplace"*** **was** held on 26th May 2023 to advocate ethical practices amongst the consulting fraternity in their day-to-day functioning, received a very good response.

Ms. Sayona Philip, Chairperson of the Ethics and Integrity Committee introduced the topic and explained how ethical conduct relates to oneself at a personal level and at an organisational level it relates to an organisation's own processes and procedures with respect to its employees and stakeholders, while rendering services to customers. It necessitates compliance to ethical business practices and attributes like transparency, integrity, trustworthiness, accountability, adherence to quality, safety, timelines, codes and standards, contractual commitments, etc. CEAI believes it all starts with instilling values of ethics & integrity in the **workforce at the workplace.**

Mr. R S Sharma, President CEAI in his opening remarks gave a brief about CEAI and its activities and said that ethics and integrity are two pivotal areas of importance for CEAI. He welcomed the speakers and participants to the webinar. He explained that the webinar is in continuation of the

efforts to achieve CEAI's objective to bring in a system and develop society with high moral and ethical values.

He welcomed the speakers and the participants to the webinar and introduced Ms S Philip as the Moderator for the Webinar.

Mr Craig L Martin, Former President and CEO of Jacobs Engineering Group

Mr Martin in his ***Keynote Address*** dealt with two aspects of ethics and integrity in the workplace and put them in the context of how the company and its people behave. He suggested that, in addition to a complete and thorough set of codes, policies, and procedures, a truly successful ethical company would have a strong culture built around "caring". He presented examples of good and bad cultures and called for action to build a "Culture of Caring" in one's company.

With regards to **Ethics and integrity at the workplace**, he chose Safety as a priority and conveyed his thoughts on other major issues such as bribery & corruption, conflicts of interest, procurement integrity, project ethics, engineering judgement, time, cost and quality, and lying, cheating and stealing.

Safety & Ethics are very important since the leadership of a company, in the context of the companies today, is very much like Kingship in the context of what was written 2000 years ago. Ethics and integrity have to begin with caring about the people, company, industry, and the nation. If one does not care, there is no point to the whole question of ethics and integrity.

Mr. Craig explained the approximate comparative fatality rates between India and the United States. Both countries have serious problems with safety. In the US there are about 0.09 fatalities per 1000 workers. With about 11 million workers in the industry, 1000 people are estimated to die every year.

India has about 0.31 fatalities per 1000 workers and about 53 million workers in the industry. Thus, there are about 16850 fatalities; somewhere in the range of 11000 and 22000. He stressed that in terms of opportunity, there must be a focus on the safety of the people and build a culture around their safety. Mr Craig said that he could not find any data on the injury rate or the fatality rate for consulting engineers but he presumed that it should not be better than the US.

Regarding **Safety Response,** he said when executives of companies are asked about their safety record to estimate how many of the failures in their organisations are truly blameworthy, their answers are usually perhaps 2 percent to 5 percent. Amy C Edmondson wrote *"But when I asked these executives how many of their failures are treated as blameworthy, they say 70 percent to 90 percent. The unfortunate consequence is that many failures go unreported, and their lessons are lost"*. There is a strong tendency to blame the employee for the injury - about 70 to 90 percent of the accidents were blamed on the employee. It is a cultural issue that if corrected could result in significantly better safety outcomes.

There is always pressure to compromise to cut corners and one has to sometimes go beyond the contractual scope. There is a real risk of acceptance and if the culture is one of acquiescence that can be a real challenge. There is a need for a moral compass around safety issues and great safety is driven by a caring culture.

Bribery and Corruption are also part of ethics at the workplace, trying to establish where one can go with the right kind of culture in the companies.

Mr Craig shared a graphic data of Corruption Perceptions Index from Transparency International. He added that it is generally about the perception of the public sector and that it is not just a third world problem. The US score is 69 that puts them at 24th in the world and that is significantly worse than 10 years ago, where the US's score was 73 when they were 19th in the world. They have a lot to do with some of the issues that were raised in the US where there are indirect forms of corruption in order to win or retain work.

India compares in some ways favourably even though its score is 40, considerably worse and India's overall score is 85. It is significantly better than ten years ago as the scores increased from 36 to 40. A number of India's neighbours are doing better, China at 65, Malaysia at 61, and Vietnam at 77.

To eliminate bribery and corruption one has to create a culture that cares about the company, its reputation, and company relationships.

He shared his personal experience regarding his Indian operations when he was incharge of Jacobs. Jacobs had about 5000 people in their team. There was no significant corruption in Jacobs from the beginning because the team was willing to accept that culture. **He said that CEAI has an excellent Code of Ethics and said that there is a lot of strength in it**.

Potential steps: As a potential step, he suggested developing or adopting a 'Code' like CEAI. Senior leaders and managers should demonstrate a strong leadership commitment to ethics and integrity and act as role models for the rest of the organisation. Senior leaders should encourage ethical, caring based decision-making and hold leaders accountable for their actions. Employees should be encouraged through regular communication, meetings, regular training programs, etc. Establish a confidential and secure whistleblowing mechanism that allows employees to report any concerns or misconduct and ensure that employees feel safe and protected when reporting such issues. Employees who consistently demonstrate desired behaviour should be recognised and rewarded. It should require suppliers and contractors to align with practices, such as safety, fair labour practices, environmental sustainability, and responsible sourcing. The ethical and cultural climate within the organisation should be regularly assessed and monitored. Organisations should conduct internal audits, surveys, and evaluations to identify areas of improvement and address any emerging challenges.

Business integrity is strongly correlated with financial performance. Establishing a 'Culture of Caring' can make huge differences in performance in every regard. The benefits of cultural caring dramatically improve safety, productivity, and better project outcomes. The culture creates much easier hiring and better retention and has better compliance and many more.

He referred to a quote of John Kenneth Galbraith - *"Faced with the choice of changing, building a culture of caring, or proving there is no need to do so, almost everyone gets busy on the proof".*

Mr. Richard Stump, Chair-Integrity Management Committee of FIDIC, delivered a special address on ***"Importance of Integrity and Ethics Beginning on Day One"*** as it is related to integrity in the workplace.

He set off by saying that everyone is familiar with integrity but as a reminder, it is really the quality of having strong ethical or moral principles. He clarified that there are many different aspects of integrity.

FIDIC advocates ethical integrity across the consulting engineering sector to fight corruption and an integrated management system as an approach to control and verify its performance in that regard. It begins with a firm's commitment to a code of conduct on behalf of all its members and leadership which demonstrates the commitment in a clear, viable ways.

Ernst & Young Global Fraud conducts surveys on business cases for integrity every year. In addition to the fact that new members are looking for a company and determining how they feel the company should act in the workplace, whether it has integrity or acts with integrity. Integrity is an important part to acquire and retain talent - since companies are looking to attract young people into consulting engineering or into a construction organisation given the fact that there is a lot of competition for talent. The survey in 2022 was completed as a part of a Global Integrity report with 4500 recipients across 54 countries in the world. The vast majority agreed integrity is truly important. 132 companies were named in the world's most ethical companies in 2020. They outperformed similar peer organisations across the publicity trades of US large cap companies by a significant margin of more than

14% over a five-year sustained period. Hence, acting with integrity in the business workplace pays. The results would be profitability and strong brand identity in the market and people would also recognise the value of working within that company and staying.

Each employee should be responsible for value-based integrity within the firm from day one when they start as young professionals, all the way to the top to become CEO and part of the Board of Directors. Being ethical would serve them well in their career. CEO has to lead by example and should set the standard across the entire company and if there is a problem, swift action should be taken. The system put in place should ensure that action is taken and people in the company get to know that action was taken. Finally, the CEO and leadership team need to allocate resources, positions, and responsibilities to make sure that the organisation holds itself accountable.

Part of the challenges, which start from the top actually, is communication. As per the Global Integrity Report that was published at the end of the last year, while 60 percent of board members said that their organisation has frequently communicated about the importance of behaving with integrity in the last 18 months, only 30 percent of employees remembered it.

Senior management and middle management of the firm are responsible to make sure that the direction from the leadership is disseminated. The future leadership of the firm comes from that group, those who behave with integrity and demonstrate ethical behaviour. In addition, there are the people lower in the management structure, who deal directly with new members of the firm. So, they have the biggest opportunity to influence behaviour as they are responsible for those new members from day one. They have the opportunity and the responsibility to demonstrate how an ethical code of conduct actually works in practice.

Unfortunately, as per the '**Global Integrity Report'** almost half of the respondents were senior managers within their organisation who would sacrifice integrity for short-term financial gain. The second troubling statement was that forty percent of the Board members agreed that unethical behaviour in their organisations was often tolerated when the people involved were senior or high performers.

The third issue was that thirteen percent of Board Members admitted that they had offered or accepted a bribe. It is evident from the statements that there are more people who would actually do it - and how integrity is important for the firm's performance; how it is perceived in the workplace.

The Code of Conduct is the foundation of any **Integrity Management System** and it is the foundation of what a company stands for. It would be a formal declaration of the company's value system and it needs to be easy to understand and remember. It should be permanently posted and available not just to the people inside the company but also to those who work with them or join that company.

Majority of survey respondents had agreed to have at least one of a mix of training, code of conduct, and whistleblowing policies in their company. One in six employees said that despite all the information available to them, they still did not know if there was a code of conduct or training available. Therefore, communication is important to make sure people understand their company's code, values, and ethics at all levels.

Mr Stump while concluding said that ethical decision making is a skill that can be learned and can be taught and therefore, it is important for the young members of the profession.

Ms Nidhi Mehandiratta, CHRO, Head-Ethics and CSR, TATA Consulting Engineers Limited

Ms Nidhi Mehandiratta presented on ***"Creating & Sustaining An Ethical Workplace Culture".*** She talked on how to bring about the caring culture that makes people care for the culture of the organisation as well.

She explained that people do not enter the workforce with a fixed moral character, hence it was important

that one should continuously drive and build an ethical work force and for that communication becomes the key. Many organisations rather than taking a long-term view, treat ethics training as a onetime event. That cannot be sustained. **Ethical learning** is a lifelong process, creating and sustaining an ethical workplace culture is an ongoing process. Neuroscientists based on their research assert - that when faced with moral dilemmas, people normally fall back on prototypes and, therefore, it is important that moral evaluation needs to be updated.

In addition to preparing people for one-time moral challenges, employers should foster an environment that encourages them to become more ethical in the long run by practicing moral reflection. Employees are likely to face ethical situations at the workplace that they might not encounter anywhere else.

One of the core values of TATA Consulting Engineers (TCE) is Professional Ethics and the prime promise of *Engineering A Better Tomorrow*. TCE has a proper Code of Ethics and its values expect every individual to live the Code of Conduct.

Another important aspect was **Leadership**. Seniors in the company routinely discuss Safety and Values, to motivate employees and create a conducive environment. When required, employees engage with the leadership or the Ethics Counsellors. The company tries to reinforce ethical behaviour through rewards, talking about it at the right platform and at multiple locations, etc.

Explaining the framework that TCE has adopted, Ms. Nidhi, said that it has three important pillars which are **Engage, Establish,** and **Encourage**. Engagement was awareness about the organisation; engaging with the employee by creating effective systems that would give clarity in terms of how the **Code of Ethics** has to be followed. There were training programs that were continuously offered to the employees and an internal social media platform that enabled discussion on ethical dilemmas. A strong compliance system had been established and there was a committee to take care of issues that come up. Employees were encouraged through social behaviour and there were internal committees to help the drive. She went on to explain TCE's digitilised 'Concern and Dilemma Management System'.

Mr. Himanshu Nautiyal, Former Head Business Excellence, WCM & Sustainability for Chemicals, fertilisers, etc. Aditya Birla Group

Mr Nautiyal shared the **ADE^{2}AR^5** framework for building culture at the workplace, which he had used for building a culture for behavioural based safety.

He went on to say that organisations today seek to be more ethical because there was a lot of expectation from the stakeholders. However, there were a lot of gaps and the organisations needed to build the culture at the grass roots level to fill that. The communication system has to be unambiguous, from the top leadership down to the operational level, where actions are being carried out. The result of that in the Aditya Birla Group was the **ADE^{2}AR^5** model. That is a framework basically which over a period of time works on building a culture on an operational level. Originally built for safety and other aspects, the same model is used for ethics also.

The framework "**A**(Analyse), **D**(Define), **E**(Eliminate), **E**(Educate), **A**(Apply), **R**(Review), **R**(Reinforce), **R**(Reward), **R**(Refine) and **R**(Report)" covers key aspects of building ethics within a framework. It outlines a series of steps that are valuable for establishing, implementing, and continuously improving ethical practices.

The framework begins with **Analysis**, which involves identifying ethical concerns and understanding the context. It is a crucial initial step to ensure a comprehensive understanding of the ethical landscape.

Defining ethical standards and principles is a vital component as it establishes the foundation upon which ethical behaviour can be built. Clear and well-defined ethical guidelines are essential for guiding decision-making and actions.

Eliminating unethical practices underscores the importance of actively identifying and addressing any elements that conflict with the established ethical standards. This step promotes a more ethical environment and helps build trust with stakeholders.

Educate. This step focuses on educating individuals within the framework about ethical principles, values, and the rationale behind them. It aims to enhance ethical awareness and understanding among stakeholders, thereby promoting a stronger ethical culture.

Including education as a distinct step recognizes the importance of providing the necessary knowledge and skills for individuals to navigate ethical challenges effectively. It can involve ethics training programs, workshops, and resources that help stakeholders develop a deeper understanding of ethical principles, ethical decision-making frameworks, and the potential consequences of their actions.

Applying ethical standards throughout the framework ensures consistency and fairness in the decision-making processes. Integrating ethical considerations into policies, practices, and day-to-day operations helps align actions with the defined ethical principles.

Reinforcing ethical behaviour emphasizes the need for ongoing support, training, and culture-building initiatives. By promoting and rewarding ethical conduct, organizations can foster a positive environment that encourages responsible actions.

The **Review** step acknowledges the importance of continuous evaluation and improvement. Regular assessments allow for identifying any shortcomings, addressing emerging ethical concerns, and making necessary adjustments to enhance the effectiveness of the framework.

The **Reward** aspect recognizes and incentivizes ethical behaviour, which can be instrumental in sustaining a culture of ethics. By providing positive reinforcement and recognizing individuals who demonstrate ethical conduct, organizations can reinforce the importance of ethical behaviour.

Refine acknowledges the dynamic nature of ethics and the need to adapt the framework over time. The ongoing refinement ensures that the framework remains relevant and responsive to evolving ethical challenges.

Lastly, the **Report** step ensures a structure to collect and report aspects of ethics from each of the aspects from ADE^{2}AR^4 model in a systematic manner to share with the stakeholders.

Ms. Sayona Philip moderated the Panel discussion and the Q&A. The participants evinced considerable interest which led to a lively interaction.

Mr. Umesh Shrivastava, Chairperson of Ethics Sub-Committee of CEAI while making the concluding remarks, thanked all the eminent speakers for sharing their time, expertise, and some unique perspectives and for making it a truly enriching experience for all the participants.

Link: https://www.youtube.com/watch?v=HtpchAVd8wo

CONSTRUCTION LAW COURSE

The ***"Construction Law Course"*** organized by the Western Region Centre commenced with the Inaugural function on the 10th June 2023 at the Indian Merchants' Chamber, Churchgate, Mumbai.

Dr. Harshavardhan Subbarao, Member Governing CEAI and Chairman, CEAI – Western Region Centre; Chairman & Managing Director Construma Consultancy Pvt. Ltd. welcomed everyone and gave a brief about CEAI. He next dwelt on need for the Course and later announced that the *"Construction Law Course"* is dedicated to the memory of Dr. Kirty Dave, a Civil Engineer who had become a renowned techno-legal consultant, a doyen in that field. Thereafter, he invited all present to introduce themselves. After that he requested the Chief Guest for lighting of the lamp. Other dignitaries also joined.

Dr. Subbarao then invited Dr. Vandana Bhatt to give a brief about the course.

Dr. Vandana Bhatt, ProCare, Contract Administration Consultant, explained the necessity for the course and went on to brief on its concept and content. She added that there was a dire need for an act relating to Construction works. Currently the law as applied was all based on the Indian Contracts Act, the Arbitration Act, etc. but there was nothing specific for Construction. Hence, the intent was to apprise the participants regarding laws that have evolved relating to Construction. Dr. Bhatt advised the attendees that the sessions would be more of knowledge sharing and hence they could gain by actively participating in the discussions which will be regarding *Engineering Law; Contractual Problems of Project Execution; Mechanism of Amicable Settlement of Differences; and Practical Application after which there would be a Moot Court.*

Dr. Subbarao, thanked Dr. Vandana Bhatt. He then introduced the Chief Guest Dr. P R Swaroop and invited him to give the Keynote Address.

Dr. P R Swarup, Director General, Construction Industry Development Council and Member Secretary Construction Industry Arbitration Council, the Chief Guest, emphasized on learning from first principles and learning from stories. He elucidated that Construction Law is about logic and precedence and went on to dwell on the etymological thicket of Broughton's Buzzwords. He posed some questions which were really advice to the participants as to how they need to enter into and operate contracts.

Mr. Sathish Rao, Vice President, Business Unit Head – PMC BU, TATA Consulting Engineers Limited, stated that the course satisfied a much needed input and would help the Engineers in their routine of executing and monitoring the contracts. He added that as advised by Dr. Bhatt, the participants need to learn by interactions with the faculty and one another.

Dr. Milind Wankhede, Legal Advisor, Construction Contracts & Arbitration Law; Adjunct Professor, Indian Institute of Technology Bombay thanked the Chief Guest, the Course Coordinator – Dr. Vandana Bhatt, other members of the faculty, CEAI – WRC, IMC, Supporting Organisations, Media Partners, Vendors, CEAI Director and its Secretariat, the Chempro Staff for their tirelessly working for CEAI-WRC, and all others who joined to bring the course to fruition.

MEETING WITH HON'BLE SHRI PIYUSH GOYAL, MINISTER OF COMMERCE AND INDUSTRY

The Hon'ble Shri Piyush Goyal, Minister of Commerce and Industry held a meeting on 19th April 2023, to appreciate and felicitate the services sector for the outstanding and record export of services for the year ending 31st March 2023. It was attended by stakeholders and services exporters.

Mr. Vipul Bansal, Joint Secretary, Department of Commerce addressed those present. The Hon'ble Commerce and Industry Minister listened to the various suggestions and difficulties represented by various members and said that the Ministry of Commerce would be keen to support the services sector in terms of creating business enabling environment including cross border, overcoming barriers, provide necessary infrastructure support, market access support and key support from Embassies/Mission. He reiterated that there would not be any SEIS kind of incentives. Service exporters must work out their costing and fees/ charges/ remunerations in a manner that they make a profit but do not ask for any financial assistance from the Government.

As regards the difficulties faced on Project Exports, the Hon'ble Minister suggested that the responsible council should interact with SEPC. Difficulties of GST and other provisions in Income Tax were also discussed and proposals were invited which should also give an increase in the exports and Foreign Exchange earnings for India.

The Ministry of Commerce would be requested to work with other ministries so that the Indian Missions would organize conclaves/ b2b meetings in foreign countries wherein India has a larger scope for export or for exporting to a country where Indian service providers have so far not been represented in the market.

Suggestions may be sent to CEAI to collate and put them forward effectively.

MEETING WITH CHAIRMAN NHAI

CEAI had submitted a representation to the Chairman NHAI in February 2023 giving a list of 11 items requiring immediate attention, viz.

1. Delay in approval of CVs of Professionals
2. Staffing for O&M Projects
3. Reduction in Remunerations of Professionals on leave/ absence
4. Voluntary Disclosure by Consultants
5. Extending the provisions of omnibus BG beyond 31.12.21
6. Payment of GST with Invoice
7. Deduction of TDS on DPR Services
8. Blacklisting of Key Professional
9. Timely Payment
10. Escalation in DPR Projects
11. Deterrent Actions against Consultant Firms

The Chairman NHAI invited a CEAI delegation for a meeting on 20th April 2023. The delegation comprised:

1. Mr. R S Sharma, President
2. Mr. K K Kapila
3. Mr. Yaduvendra Mathur
4. Mr. JVL Narayana
5. Mr. Alok Bhowmick
6. Mr. Tarun Rawat, and
7. Mr. Rajiv Maini

Mr. Venkataraman, Member NHAI and three senior CGMs joined the discussions along with the Chairman NHAI.

President CEAI briefed the Chairman NHAI about CEAI, its objectives, and activities. Thereafter, the items as per representation were taken up for discussion.

Apart from the issues stated in the representation, Mr. Kapila mentioned about the amendment in the FR rules for the procurement of Consultants and Contractors.

Mr. Yaduvendra Mathur mentioned about the eligibility conditions for a Team Leader requiring experience in DPR and an unreasonably high number of projects required to score full marks. He also mentioned about the requirement of DPRs in hand for AE/IE projects which were also responsible for low bids for the DPRs.

The Chairman expressed his concern about low bids and desired a solution to end the problem. Mr. L P Padhy, CGM NHAI mentioned that initially, the supervision Consultancy cost was about 6 % of the civil cost. In IE/AE the cost reduced to 4%. Now the AE/IE supervision cost is only about 0.5%, which is a cause for worry, as low bids may affect the quality adversely.

The proposal of CEAI Academy was well received by the Chairman NHAI and he assured his support.

The Chairman stated that he was very keen to discuss the issues in detail with CEAI and would arrange another meeting shortly. He asked CEAI to submit any further issues in writing so that the same could also be discussed in the proposed meeting.

CEAI members are requested to identify additional issues, if any, and give a brief write-up along with the suggestions for amendment of any provision in the RFPs of NHAI.

CEAI'S COMPENDIUM PRESENTED TO HON'BLE MINISTER OF EDUCATION

The Compendium prepared by CEAI was presented to Mr. Dharmendra Pradhan, Hon'ble Minister of Education by past President Dr. Ajay Pradhan on 12th May 2023. The Minister appreciated the work being done by CEAI.

MEMBER NEWS

Mr. K. K. Kapila has been honoured with the '**Award of Excellence'** for his immense contribution to the corporate world. This award has been bestowed on him for his **'Distinguished Leadership'.** It was organised by the EM-UEM Group of Educational Institutes. The seminar and Corporate Award Ceremony were held at the Research and Innovation Park, Indian Institute of Technology Delhi on the 22nd April, 2023.

This award is an acknowledgment of Mr. Kapila's years of hard work, dedication, and commitment to achieving excellence in his field. The ceremony was also an excellent platform to share knowledge and experience with others and inspire future generations of leaders. The award serves as evidence of Mr. Kapila's unwavering determination and steadfast pursuit of excellence.

Mr. V N Heggade has been named in the ***fib*** Fellows awarded in 2023. The International Federation for Structural Concrete (**fib -** *Fédération internationale du béton)* considers that it is crucial to recognise *fib* members that have been active for many years and have contributed to the goals of the *fib*. The *fib* fellows fulfill the following criteria: (1) they are current *fib* members and have been for the last ten years; (2) they have embraced the values of the federation, and (3) they have provided continuous outstanding contributions to the development of concrete and concrete structures or the development of the *fib* through the participation in Task Groups and Commissions or other means. The contributions to concrete structures can be in education, research, design, and construction.

VIEWPOINT

The theme for CEAI's quarterly magazine ***"ViewPoint"*** September 2023 issue is ***"Consultancy for Rural Area Development".*** Mr. Girish Mishra is the Guest Editor for the issue.

It is the heartland of a country that keeps it going and growing; it is an area that is essential for life to survive. India has put a lot of emphasis on the upliftment of the Rural areas – to provide a better quality of life by providing better houses, sanitation, schools, water, electricity, road and rail connections, small scale manufacturing facilities, etc. The Government of India has announced a number of schemes for the development of the Rural areas. Consulting Engineers are playing a key role in all these schemes and helping the country rise. Agricultural Engineers are also doing their share in helping to grow better crops, improving the yield and making farming a less tedious task. Digitalisation and IoT with their ubiquitousness have gone a long way in demolishing the rural and urban divide.

Papers are invited regarding the latest or projected systems, methods, technologies, etc. regarding different aspects encompassing Architectural, Civil, Geotechnical, Structural, Electrical, Instrumentation & Control, Communications i/c Information Technology, Mechanical engineering as well as Agricultural Engineering systems to cover all aspects for development of Rural areas.

Professionals are invited to share case studies of how they addressed the challenges faced, practical issues

experienced and the solutions to those, etc. Photographs, charts, diagrams, drawings, etc. would benefit readers for better appreciation of the issues encountered and the manner in which they were addressed.

The theme for the other issues for the term 2023-2024 are:

1. December 2023 – Consultancy in the Industrial Sector
2. March 2024 – Consultancy for Start-Up and MSME
3. June 2024 – Affordable Housing.
4. September 2024 – Energy Transition
5. December 2024 – Recycling & Reuse of Building Materials in Construction Industry.

The articles for an issue need to reach CEAI at least 3 weeks prior to the end of the month of the ViewPoint 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(s) is to be sent along with the article. For details of formatting please refer to *"Format for Articles for CEAI Viewpoint"* on CEAI's website, under *'Publications'*.

Advertisement in ViewPoint

ViewPoint is circulated to all CEAI Members, FIDIC, Ministries of the Government of India, Public & 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. Thus, all stakeholders partnering development and progress are its readers.

Catch the Customers Eye

Get Wide Exposure → **VIEWPOINT**

Improve Visibility

Support from CEAI members and stakeholders are sought for increasing the number of advertisements, so that ViewPoint gains in its stature as a unique Technical Publication for the fraternity and the public at large to spread information of how Consulting Engineers are helping society for improving the quality of life and doing so sustainably.

The rates for advertisements in ***VIEWPOINT*** with effect from 1st January 2023 are given below:

Item	Rate Per issue* (Rs)	Discounted rate at 10% for 2 consecutive issues* (Rs)	Discounted rate at 20% for 4 consecutive issues* (Rs)
Back Cover	**25,000.00**	**45,000.00**	**80,000.00**
Inside Front Cover	**18,000.00**	**32,400.00**	**57,600.00**
Inside Back Cover	**18,000.00**	**32,400.00**	**57,600.00**
Full Page (Colour)	**12,000.00**	**21,600.00**	**38,400.00**
Full Page (Colour), if a specific page position is required.	**14,000.00**	**25,200.00**	**44,800.00**
Full Page (B&W) **(such advertisements will be taken up for printing only when there are 4 or multiple of 4 advertisements for an issue)**	**8,000.00**	**14,400.00**	**25,600.00**

Notes: ****GST @ 5% or as prescribed will be added to the above rates.***
**Inside Front Cover booked till June 2023
***Inside Back Cover booked till Sept 2023

Tech Quiz

1. **Climate change is caused due to?**
   a. Reduction in green cover
   b. Depletion/ Reduction in number of waterbodies
   c. Heat island effect
   d. All the above

2. **Digitalisation cannot help address Climate Change issues**
   a. True
   b. False

3. **Sustainability Design focuses on?**
   a. Materials
   b. Environment
   c. Societal requirements
   d. Service Life of facility
   e. All the above

4. **Climate change considerations are addressed by SDG Nos?**
   a. All SDGs
   b. 11, 13, 14 & 15
   c. 6, 7, 8 & 9

5. **Green manufacturing would address Climate Change concerns**
   a. True
   b. False

6. **Water Management is necessary for?**
   a. Commercial Buildings
   b. All built facilities
   c. Residential Buildings

7. **In what phase of a project for any facility is impact of Climate Change to be considered?**
   a. Construction phase
   b. Conceptualisation phase
   c. Planning & Design phase

8. **Ethical conduct inter alia includes providing facilities as per considerations of sustainability?**
   a. True
   b. False

9. **Considerations for Climate Change are in addition to those for Sustainability**
   a. True
   b. False

10. **Digital twin of a facility**
    a. Will help to address and monitor Sustainability requirements and functions
    b. Necessary for addressing Sustainability requirements
    c. Will not help to address Sustainability requirements
    d. Will only help during construction

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

Contributed by A P Mull

Answers to Tech Quiz of March 2023 issue

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

Mr Suraj Prakash, Member Individual of CEAI is the winner of the Tech Quiz with maximum marks.

FIDIC Training

Module 1: Practical Use of FIDIC Conditions of Contract

4th - 5th September 2023
9:00 am to 5:30 pm

TRAINER
TANER DEDEZADE

Taner Dedezade from UK is an international expert on FIDIC conditions of contract. He is FIDIC certified trainer. He is construction barrister, dispute resolver, published author and world-renowned speaker.

He has won many accolades:

- FIDIC trainer of the Year 2020
- FIDIC President's List of Approved Dispute Adjudicators
- ICC Arbitrator
- FIDIC Certified Trainer

Taner has conducted many training programmes on FIDIC conditions of contract all the over the World.

As an international construction barrister, Taner specialises in the resolution and avoidance of disputes arising out of international construction and engineering projects, particularly under the FIDIC forms.

As a dispute resolver, Taner is currently acting as an ICC arbitrator and has been appointed by CLARB as arbitrator in relation to four commercial disputes.

OBJECTIVE

The investment in infrastructure is growing and would continue to grow at an accelerated rate in the near and distant future across the Globe and especially in developing economy like India.

VENUE
The Royal Plaza
19, Ashoka Road, New Delhi 110001

The multilateral financial institutions are pouring in funds and want to be a part of the India growth story. These MDBs invariably use the FIDIC Conditions of Contract which are acclaimed as the Gold Standard of Conditions of Contract Globally.

The FIDIC Conditions of Contract are being used the world over where multi-lateral development banks provide the funding. And in large complex Government projects.

With a number of large and complex projects BOTH on-going and planned in the country, this training course will bring the participant the necessary detailed knowledge and insights as to the claim management and dispute resolution provisions under the FIDIC Conditions of Contract.

It covers the identification of project risks, their allocation, and the various causes of claim which can emerge over a construction contract and the way FIDIC addresses those. It details the way to handle claims – preparation, submission, assessment, determination under FIDIC Contracts, and how disputes are prevented or otherwise resolved.

Consulting Engineers Association of India
Ph: +91 9871166102 | Email: ceai.ceai@gmail.com, events@ceai.org.in
www.ceai.org.in

WHO SHOULD ATTEND

- Consulting Engineers / Project Managers
- Quantity Surveyors
- Contractors / Sub contractors
- Owners
- Funding agencies
- Insurers
- Construction professionals
- Architects
- Lawyers
- Executives in PSUs of Infrastructure Sector
- Builders / Developers / Suppliers
- Ministries involved in projects

REGISTRATION FEE

PLEASE CLICK HERE FOR REGISTRATION

- Member - Rs. 30,000/- + GST 18% | Non Member - Rs. 32,000/- + GST 18%
- It is a Non Residential Course
- Discount of 10% for more than 2 members
- Discount of 20% for more than 5 members
- FIDIC Certificate will be issued by CEAI to those who complete two day training

PAYMENT

CEAI Bank Details for Bank Transfer

Account Name : Consulting Engineers Association of India |
Account No : 028394600000592 | Bank Name : YES BANK LTD |
Account type : Saving | IFSC CODE : YESB0000283 |
Branch Address : Ground Floor, Plot No 2, OCF, Sector B,
Pocket 11, Vasant Kunj, New Delhi 110070

CEAI UPI details

Name - Consulting Engineers Association of India
UPI Handle - 9871166102@paytm
Pay me on Paytm - https://p.paytm.me/xCTH/gqsm55kb

Scan the QR Code

MODULE 1 - PROGRAM SCHEDULE

Day One

0900-0945 : Session 1: Introduction to FIDIC

0945-1030 : Session 2 : Notices and Claims

1030-1045 : Tea/Coffee Break

1045-1130 : Session 3 : Claims for Delay

1130-1300 : Workshop 1

1300-1400 : Lunch Break

1400-1445 : Session 4 : Critical Path Analysis

1445-1530 : Session 5: Delay problem areas (concurrency, acceleration and time-at-large)

1530-1545 : Tea/Coffee Break

1545-1630 : Session 6 : Typical Claim Clauses

1630-1730 : Workshop 2

Day Two

0900-0945 : Session 7: Variations

0945-1030 : Session 8 : Prolongation, disruption and global claims

1030-1045 : Tea/Coffee Break

1045-1130 : Session 9 : Delay damages, defects and bonds

1130-1300 : Workshop 3:

1300-1400 : Lunch Break

1400-1445 : Session 10: Suspension and Termination

1445-1530 : Session 11: DAB

1530-1545 : Tea/Coffee Break

1545-1630 : Session 12: What's New in FIDIC 2017

1630-1730 : Workshop 4 : Valedictory Sessions & distribution of Certificate

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QUALITY SYSTEM CERTIFICATION DNV ISO 9001

ACHIEVEMENTS/MILESTONES

- Over 68,000 km of Road Feasibility and Detailed Engineering Design
- Design of over 4,200 Bridges and other Structures.
- Transaction & Financial Advisory for Projects of Capital Value over USD 7 Billion
- EIA / SIA for over 600 Projects.
- Nearly 27,000 km of Road Construction Supervision and Project Management.
- Over 60 Airport Projects Involving Planning, Design & Supervision
- Road Safety Audit/ Black Spots Improvement/ Awareness Campaigns in over 200 Assignments
- Water Supply Schemes for over 500 Towns and Villages
- Design of over 4200 Bridges, Tunnels and other Structures
- Over 45 Projects of Railways and Metro Rails
- Master Plan and Development Plans for over 77 Cities/Towns
- Irrigation Planning & Design of over 8,00,000 ha. Gross Command Area

KEY BUSINESS VERTICALS

Expressways and Highways

Tunnels

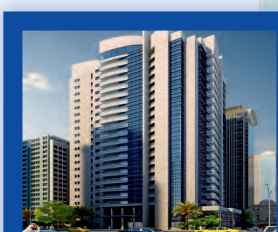
Bridges and Other Structures

Railways and Metro Rails

Airports and Aviation System

Urban Regional Planning and Smart City Solutions

Traffic Transportation and Road Safety



Building and Architecture

Institutional Strengthening and Capacity Building

Transaction and Project Finance

Water Resources and Public Health Engineering

Environmental and Social Sciences

Incorporated in	Worked on Over	Presence in Over	More than
1987	750 Projects	50 Countries	1000 Employees

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CEAI CENTRE