DECEMBER 2018

VIEWPOINT

OFFICIAL QUARTERLY MAGAZINE OF CEAI

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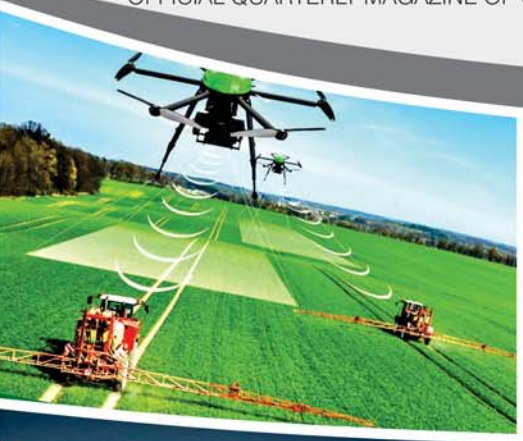


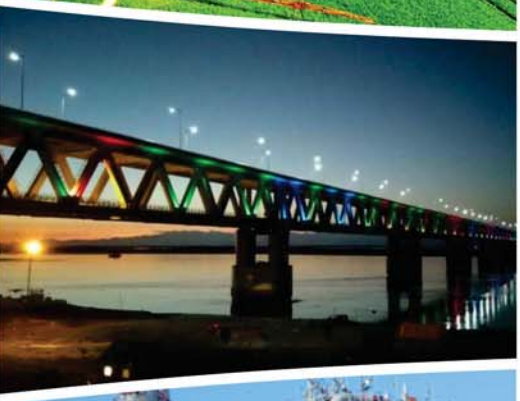




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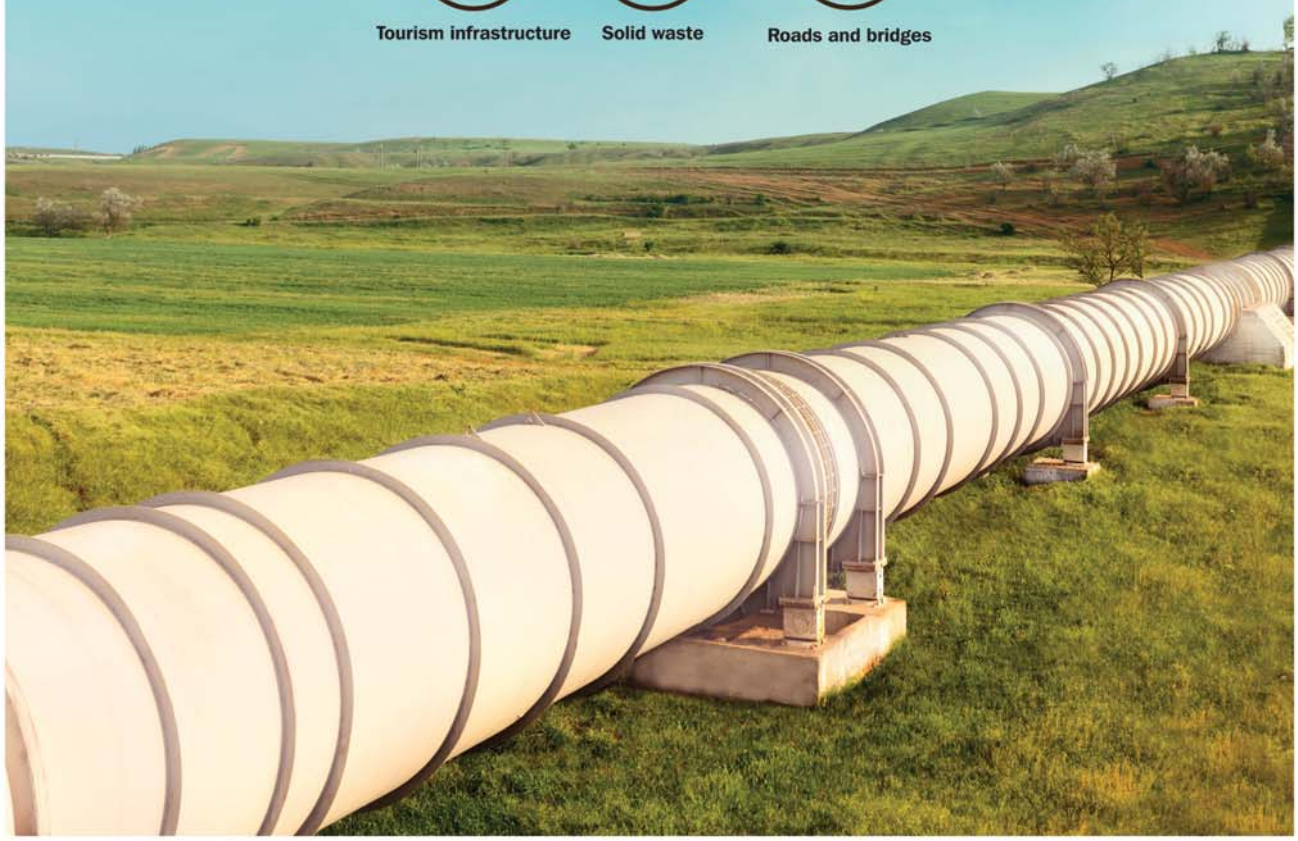

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MESSAGE FROM CHIEF EDITOR

Dear Fellow Consulting Engineers,

Wishing Each and Everyone
A Very Successful & Bountiful New Year

The past seven issues covered themes on *Water and Sustainability, Transportation, Engineering Education in India, Railway & Metros -Safety, Signalling & Telecommunication, Environment and Climate Change, Asset Management,* and *Built Environment – Energy Conservation for Utilities*.

The current issue on *Engineering Consultancy for Nation Building* discusses the undeniable and indelible contribution by engineering consultants to the country's development. To really understand that, one should appreciate that an engineer's services are a necessity right from the time that a project is conceived and that gives rise to a Concept Note. The Pre-Feasibility & Feasibility Studies that follow are engineering expressions of that concept. No doubt professionals from other disciplines such as Finance, Economy, Legal, Architecture et al do play a role but that is limited. It is the engineering disciplines that make the concept fructify into physical reality and thereafter operate and maintain it for its design life. In fact engineering today pervades across all other spheres to improve the quality of life, providing for sustainable solutions to the Country's objectives in terms of growth, yet protecting the environment.

It is the engineers who are responsible and accountable for ensuring that the project as built conforms to codal requirements of robustness, safety, serviceability and be fit for the purpose intended. It is the engineers who operate the facilities and also maintain them. The role of the engineers is therefore paramount in a project.

The term project is not limited to building or any construction project, it is generic and covers A to Z all sectors of engineering and their specialties – Aerospace, Aeronautical, Agriculture, … to … Systems, … Vehicles, Veterinarian, Water & Waste Water, Web … to Zoologist Engineers, many of which are inter-disciplinary. With such a large sphere of operation encompassing all activities in the world and space it is imperative that an engineer does the work that the engineer is engaged in diligently with proper application of best practices and statutory norms and at the same time innovate to take it to a higher level of performance. Every new task should be seen as an opportunity to improve upon what was done earlier so that the benefit is far better and more widespread across not only society but also the plant and animal kingdoms.

The contribution of engineers is essential in the urban and rural development as well as industrial employment schemes launched by the Government commencing with the "Make in India" campaign to bring the latest technology to the country and increase its industrial base and provide employment to the large number of engineers who come out of the hallowed portals of the engineering colleges and institutions.

Appointment of Consultants and determining their fee & other charges is still a challenge. The Public and the Private sector need to understand that for all goods and services they must pay what is commensurate with the requirements. They should not expect that the assignment to be done at a loss for then the question of survival arises. CEAI has prepared *"Guidelines for Selection of Consultants and Professional Compensation Structure"* (October 2016) which could be used as a basis.

To be able to meet the expectations of the nation and the government it is essential that the engineers – consultants, contractors, engineering and industrial organizations, et al also invest in Research & Development in not only the digital sphere but in all fields of Engineering. It is from these investments that economic benefits will be derived over time in terms of new and improved materials, processes, plant & equipment, services, etc. Science and technology play an important part in all R&D activities. In fact it was for that reason that the Government of India founded the Indian Institute of Technology at Kharagpur and added many others over the years – to blend laboratory research with practical application and improve engineering capabilities. It is also the duty of engineers to provide sustainable solutions at a commensurate project cost. Mentoring of the ambitious gen next is imperative to blend the wisdom of experience into latest engineering tools at their disposal.

Cost effective online value added academic programs from higher Institutions combined with Industrial perspectives and discipline specific seminars from Industry stalwarts, would enhance the overall knowledge base improving the National output of the Engineering Fraternity.

It is up to the Government, the Public and the Private sectors to ensure that the engineers are gainfully deployed and their talent nurtured and honed so that they evolve and develop as human beings and excellent engineers. Legislation for Engineers would go a long way in assuring that the profession develops fairly and fully to be able to serve the needs of the nation.

Happy Reading and Learning in the New Year

A P Mull

MESSAGE FROM MS. SAYONA PHILIP, IMMEDIATE PAST PRESIDENT - CEAI

*LOOKING BACK…..**LOOKING FORWARD***

*As the year 2018 comes to a close, I wish to end it by thanking all the members who have supported the outgoing Governing Council **2017-18** with their unstinting support.*

I also take the liberty to share with you some of my thoughts….

The CEAI has around five hundred members comprising both Organisational and Individual Members.

As a Member Association of FIDIC in India, whilst representing the Consulting Engineering profession in India and abroad, one of our stated objectives and primary role is to promote the professional interests, rights and privileges,and enhancethe status of the consulting industry.

*However, this is an ongoing process, and can **only** be strengthened with the realization by members that they are the **primary stakeholders** and, therefore, need to be invested in this objective, by contributing their best.*

Each of us is committed professionally to his or her respective organisation/ career. However, we endeavor to voluntarily spare some of our valuable uncommitted time to the cause of the Association and our Consulting fraternity. Be it interventions with the Government or capacity building initiatives taken by the Association, these can be carried forward or yield better results, only when members participate enthusiastically. The opportunities are several - in the form of Workshops/ Seminars/ Conferences/ FIDIC technical trainings/ interactions with Government and other officials who can make a difference.

*It behoves each and every Consultant member, big or small, to participate in and contribute his mite to enhance the visibility of the CEAI and help in the **brand building** process.*

While it may be the primary responsibility of the Governing Council and its Office bearers, your feedback, views and suggestions improve the quality of the interaction with Government Agencies, Ministries or Multilateral Development Banks. Our collective representation helps them appreciate, defer to our views and concede to our requests, always taken up on behalf of members.

*Having said that, growth is a dynamic process and we recognize that it is imperative that we look for opportunities and ideas to continuously evolve and step up our game, in keeping with a challenging business environment, to remain **competitive** yet ensure our profession survives as a **viable entity**.*

Having realized that Annual Business Plans were not adequate to address our issues in the long term, CEAI decided to take up a Strategic Plan covering a six year period 2019- 2024, as a first step.

Thus, the Strategic Plan Committee under the leadership of Mr Mahendra Raj was commissioned to prepare this Strategic Plan. It comprised nine task forces. All the task forces have given their reports. The process of finalising the ***CEAI STRATEGIC PLAN 2019-2024*** *is currently on. We hope its implementation will go a long way in making CEAI an even more effective and influential body of professionals.*

Having that said, on behalf of the ***outgoing GC****, I would like to state that it has been an interesting and eventful two years and we have been able to continue with the initiatives of the previous GC and start some of our own. We are confident that the GC that succeeds us will do even better in taking forward those initiatives, and particularly the implementation of the Strategic Plan.*

I would like to thank ***all*** *the Governing Council members for their unstinting support. I have been privileged and fortunate to have the guidance and advice of the Founder members and the most senior and very active GC members, Mr. Mahendra Raj, Mr. Srikumar Ghosh, Mr. Umesh Shrivastava, Dr. S Chatterjee, Mr. A P Mull, Mr. Sudhir Dhawan, Mr. K K Kapila and several more; our Regional Centre Heads, Mr. Amitabha Ghoshal, Mr. Uttam Sengupta and Mr. Vishwas Jain who managed, superbly, the activities in the regions, with their respective teams.*

All of this would not have been possible without the tremendous back end effort and whole hearted commitment of the CEAI Secretariat team.

I am confident that the ***New GC*** *with* ***Mr. Amitabha Ghoshal*** *as* ***President CEAI****, will carry forward the various initiatives with even more enterprise, zeal and enthusiasm.*

In this endeavor, I am confident the New Year brings with it a fresh new resolve by Members to effectively contribute better, and support the new CEAI President and the Governing Council discharge their responsibilities.

CEAI certainly can achieve greater heights with sincerity and dedicated effort from the collective whole.

With best wishes for a Happy and Prosperous New Year!

Sayona Philip

CONSULTING IN THE AGE OF AUTOMATION AND DIGITIZATION

Pradeep Chaturvedi
Chairman, Strategic Plan Committee
The Institution of Engineers (India)

The global business turmoil has caused ripples in the Indian economy. Concerns for job security for the citizens are forcing politicians round the world to come up with new kinds of tariff and non-tariff barriers.The world trade order is passing through severe stress.These uncertainties have thrown open new challenges and opportunities for the global consultancy organisations. Many experts believe that in either case whether economic 'upturn' or 'downturn' consultancy firms can always get good business opportunity.In case the industry is booming they have enough surpluses and have no problem in retaining consultancy firms to advise them on cost- effective expansion. On the other hand when there is downturn in the economy the industry has to per-force employ consultancy firms in the hope that they can bring in new ideas from outside and provide innovative approaches and solutions.In either case the consultancy firms can prosper depending on their flexibility to adapt to the situation, innovative management approach and indulgence in disruptive technology.They need to focus on all the three at the same time.

A consulting or consultancy firm is a business of one or more experts (consultants) that provide professional advice to an individual or an organization for a fee.

Consultancy firms normally target company executives and provide them with consultants, also known as industry specific specialists and subject matter experts, usually trained in management or business schools.The deliverable of a consultant is usually advice or a recipe to follow to achieve a company's objective, leading to a company project.

Overtime, the industry in India is realizing that the foreign educated and trained experts who are now working as consultants do not perfectly match with the requirements in Indian situation.The business schools and engineering colleges in India are identifying the needs and creating full time courses and short-term courses to meet the emerging needs.The quality of such training programmes is still not convincing.

More and more consulting firms are supplementing the strategic deliverables by providing the plans to implement the recommendations, either by the consultants themselves or by providing technical expertise through outsourcing.This has opened up new markets for these companies. Indian industry has also moved on from the stage of seeking only advisory from major management consultancy firms to mandating their indulgence in the delivery process so that the deliverables are ensured.This has created a new discipline and pressure on the consultancy firms that can no longer move out after only issuing the advisory without being accountable for the deliverable outcome. The technical consultancy firms are mostly involved in executing the project.

Consultancy services are part of tertiary sector and accounted for several hundred billion dollars in annual revenue between 2010 and 2015, the ten largest consulting firms alone made USD 170 billion growth revenue and the average annual growth rate of around 4%.

The segmentation of advisory services varies widely across organizations and countries. Categorization is unclear, in part because of the upheavals that have occurred in the industry in recent years.

Industry 4.0 and Mechanical Engineering Interventions

There are different types of consulting firms serving different sectors. Since the concern here is with the infrastructure development, one of the sectors is manufacturing and it is necessary to have a proper understanding of how manufacturing is changing in the era of Industry 4.0.

Consulting Engineers Association of India is having membership that cuts across all sectors and requires consultants with varied experience. In this paper, the effort is to deal with small segment of impact of mechanical engineering in the age of automation and digitization keeping in view Industry 4.0.

The manufacturing sector encompasses a set of industries to make or produce anything in a factory, and therefore, it requires a great deal of specialized knowledge. During the last two decades a lot of innovations due to R&D have taken place in the field of mechanical engineering which has made industries more efficient, both in terms of productivity and quality. However, due to lack of integration of these innovations with actual requirement of the industries and due to drastic changes in global economy, the manufacturing sector in India is facing stiff competition from local and global players.

Achieving UN Sustainable Development Goals by 2030 is just not possible with the current development model.The world needs integrated technological solutions to achieve the SDGs, — solutions that are socially acceptable, economically feasible and affordable, and that take into account the natural boundaries of the planet that all share. New integrated technological solutions will have to focus on accelerating the implementation of existing market-ready technological solutions. A major bottleneck to the achievement of SDGs is the lack of financing and investments in technology innovation. It is always necessary to review the need for new business models and investments to further the application of emerging technologies in different sectors and regions of the country. Mechanical engineering has to play a lead role.

Role of Standards

Mass production is the basic element behind success of industries anywhere in the world. Globalisation promoted large scale trade of goods and services and emergence of micro, small and medium industries as the ancillary to the large scale industries and thereby a greater need for standardization of operations. Standards became crucial during the first industrial revolution, over 250 years ago, and they play a critical role even during the present industrial revolution or what we call Industry 4.0. This revolution refers to the emerging technologies, which are integrating the role of physical, digital and biological worlds. This increased connectivity of men and machines is impacting the way that people/ companies produce, trade and communicate, much like steam power transformed production methods and the way of life of many societies during the first industrial revolution. In the Eighteenth Century, the transition from manual work to machinery and factory work raised the need for standards for the first time. Presently, standards have attained a new dimension when artificial intelligence, automation, robotics and man-machine interface and working in conjunction is the scenario of global production.

The National Certification bodies from various countries in the world met in Germany in September 2018 to discuss the need for developing standards responding to Industry 4.0. The experts were of the opinion that whereas Industry 4.0 is based on technology innovation where revolutionary developments can take place in a short time and the pace of change of technology is so rapid that its final shape cannot be predicted. The standards can only be formulated on well defined parameters of products and processes and is an evolutionary process which needs a minimum of 2-3 years. Therefore, the world will push Industry 4.0 rapidly but it will have to live with the standards which already exist and wait for the responsive standards to evolve over time which could be a minimum of 3 years.

Shifting Thrust of Manufacturing Sector in Digital Age

The above scenario brings us back to the stage as to what innovative steps manufacturing sector has to undertake.

Manufacturing is seizing new sources of revenue by connecting outside of their organizations directly with customers and breaking down the silos between sales people and service representatives, production/warehouse workers and delivery drivers. A number of companies who had applied to the Golden Peacock Awards in 2017/2018 have indicated how data collection, quick analysis and dissemination are impacting manufacturing, marketing and purchasing habits. By collaborating across organizational boundaries, manufacturers can engage customers throughout manufacturing and business processes and access new avenues from plants, value chains, customers and products. There is also the rise of smart machinery, which has introduced a hybrid approach for virtual and actual contents and thereby warehousing facilities thus freeing-off manpower on the production collaboration side of the industry. Going a step ahead, digital transformation impacts every aspect of operation and supply chain. It starts with equipment design and continues through production design, production process improvement and ultimately monitoring and improving the end-user experience. Cloud-based technology is being used for an enormous array of functions. From small business that utilized cloud-based infrastructure services to multi-national companies that use cloud services to enable powerful omni-channel solutions; the business applications are as broad as themanufacturing field. Cloud computing services are in fact helping manufacturers in building, testing, deploying and making applications and services through a global network of managed data centers.

The physical-virtual-digital connection leveraging new cloud-based and IoT technologies, such as machine learning, advance analytics and artificial intelligence is helping manufacturers connect with previously siloed business areas and revolutionize the way they engage with increasing technology-based methods.This advancement is the canvas on which solutions for the future need to be built and continuously evolve to meet the changing needs of customers and capture new business opportunities. Manufacturers need to strategize digital scenarios, developuse cases, and build a smart production platform with the aim to increase productivity and grow business.

A significant observation is the shift in the industry's approach. A reality that represents the interconnected factories where all equipment are on-line, intelligent and in some ways, capable of making decisions. While the first industrial revolution was all about mass production (and many of the companies in India still continue to focus on that) the Industry 4.0 is about using technology to move from mass production to mass customized-production, and it is already happening at a rapid pace. This allows manufacturers to react to consumer demand more efficiently and directly. Not only is the right product being delivered to the right person for the right price, the process of how products are designed and delivered is beginning to attain a new level of sophistication. One of the Golden Peacock Awards applicant, an apparels company had presented a case study on how instead of selling just only the standard sizes on-the-shelf of their stores, they have developed the model where a customer goes to one of their showrooms, gives his measurements and preference for the shirt and the same is delivered at the company price in 15-days time (or any other assured time).This customized-production in the consumer product sector could be possible only because of using digital platform.This system has enabled manufacturers virtually model any design and develop the mechanism for effective customized production.

A number of companies have presented their case studies on how they are adopting and understanding the digital transformation and converting into the competitive advantage for the company. No doubt the senior management has experienced a certain amount of resistance from the Board in some companies but by creating a proper understanding of digital ideology it is slowly sinking into the Directors of the companies to move towards the digital era.

Impact of Automation on Productivity

The McKinsey Global Institute estimates that about 50% of tasks done in our economy could be automated. But such statistics are often misinterpreted.The 50% merely described the "technical feasibility" of what can be automated with existing and emerging technologies. The number of actual jobs will depend on the costs and benefits of replacing people with machines.

A debate on whether jobs are lost by automation or not, continues. It is pertinent to discuss this issue first.

This phenomenon is being described by the economists as the productivity paradox: while big-data, automation and AI should, in theory, be making businesses more productive, boosting the economy and creating more jobs to offset the ones being lost, this hasn't happened. Some economists think it is just a matter of time – though it could take many years.

The debate about how many jobs are gained or lost, obscures a much more important point.The location of jobs and the kind of work that are involved is changing, and that is what is causing real pain to people and to local economy.

It is estimated that between 400 million and 800 million individuals could be displaced by automation and need to find new jobs by 2030 around the world based on the midpoint automation adoption scenario. New jobs wouldbe available based on the scenarios of future labour demand and the net impact of automation. Of the total number of persons displaced about 75 million to 375 million may need to switch to new occupational category and learn new skills.

In absolute terms, China faces the largest number of workers needing to switch occupation – up to 100 million, if automation is adopted rapidly, or 12% of the 2030 workforce. While that may seem like a large number, it is relatively small compared with the tens of millions of Chinese, who have moved out of agriculture in the past 25 years.

India has relatively modest potential for automation over the next 15 years, reflecting low-wage rates. The analysis finds that more occupational categories will grow in India reflecting its potential for strong economic extensions. However, India's labour force is expected to grow by 138 million people by 2030, or about 30%. Experts believe India could create enough new jobs to offset automation and employ these new entrants by undertaking new investments. Scenario creations are not projections and evidence has to emerge.

The Productivity Paradox

MIT Technology Review has focused on the aspects of productivity paradox. It mentions that to become wealthier, a country needs strong growth in productivity – the increased output of goods or services from given inputs of labour and capital. For most people, in theory at least, higher productivity means expectation of rising wages and abundant opportunities.

Productivity growth in most of world's rich countries has been dismal since around 2004. Especially vexing is the sluggish pace of what economists called total factor productivity – the part that accounts for the contribution of innovations and technology. In a time of Facebook, smart phones, self-driving cars and computers that can beat a person at just about any board game, how can the key economic measures of technological progress be so pathetic? The economists therefore call it a productivity paradox.

AI is what economic historians consider a general purpose technology. They consider AI as inventions like the steam engine, electricity, and the internal combustion engine. Eventually they transform how we live and work. But business had to be reinvented and other complementary technologies had to be created to exploit the breakthrough and that took decades. Even as new technologies appear, huge gains in productivity are not guaranteed. Europe missed out on

the dramatic 1990s productivity boost from the IT revolution, largely because European companies, unlike US-based ones, lacked the flexibility to adapt.

Automation and the new World of Work

Powerful new technologies are increasing productivity, improving lives and reshaping our world. But what will happen to the economic growth and the social impact in terms of employment opportunities and their locations. Five fundamental issues have been identified for a proper understanding of future of work in the transitioning world in an era marked by rapid advances in automation and artificial intelligence.

(a) What impact will automation have on work?

(b) What are possible scenarios for employment growth?

(c) Will there be enough work in the future?

(d) What will automation mean for skills and wages?

(e) How do we manage the upcoming workforce transitions?

The Shifting Paradigm of Higher Education

Paradigm shifts may be the result of new knowledge being introduced into the domain through new evidence or as a result of new ways of conceptualizing or thinking about a problem or as a result of fundamental changes in society. Mechanical engineering education also needs a paradigm shift with the process of digitization now directing automation, robotics, and artificial intelligence in a big way.

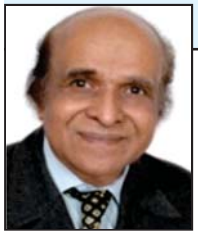
Major paradigm shift has occurred leading to the development of the global knowledge society. IMF has projected in September, 2018 that India will attain a growth rate of 7.3% and will be leading the global economies with highest growth rates. This position can only be achieved and retained if India puts major thrust on innovation and continuous improvement in its skills development programme. This will call for major shifts in our engineering education incorporating various aspects of information technology, automation, artificial intelligence, and analytics. Mechanical engineering aspects are undergoing a significant change with the process of digitization playing an important role.

Conclusion

The Industry 4.0 revolution has already set in but seizing its full potential for improving the quality of life of the society will need a lot of high level research in engineering and technology. The rapid pace of change being brought in by Industry 4.0 has its own challenges. There are issues presented by new generation of smart technologies, characterized by big data, increased integration, cloud storage and open communication. These will have important role in future growth.

CEAI is currently predominantly civil engineering discipline-based body of professional engineers. However, the shift in government thrust to manufacturing sector and promoting MSME sector will encourage CEAI to consider that consultants with expertise on Artificial Intelligence are also given space in its policies; programmes and actions.The future economic growth and employment and income generation opportunities come from there. As MSMEs and start-up will have a greater role they will need competent, ethical and transparent community of consultants to respond to the needs of Industry 4.0.

LEARNING CURVE OF A CONSULTANT

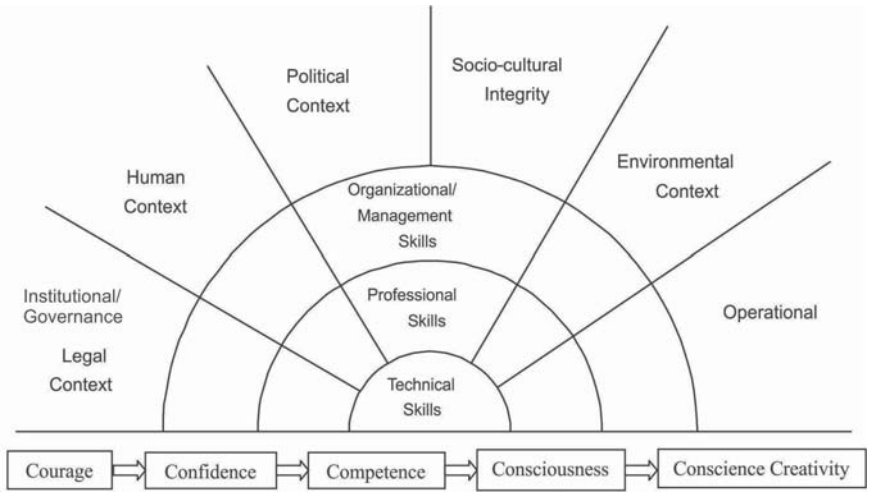


A.K. Jain
Former Commissioner (Planning), DDA.
Visiting faculty at various Schools of Planning and Architecture
Consultant UN Habitat

Training is everything. The peach was once a bitter almond; cauliflower is nothing but cabbage with a college education.
-Mark Twain

In a world of rapid technological strides, it is a challenge to bridge the gap between consultancy and new skills. A consultant plays a vital role in the changing socio-economic development for which he/she has to be a lifelong learner, particularly in the following areas:

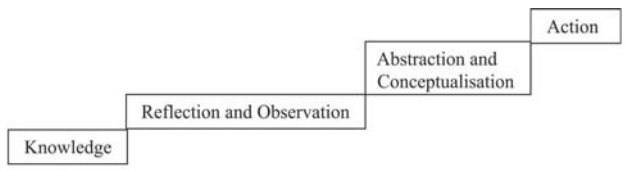
- The Learning Curve
- Changing Role
- Multi-view
- Soft Skills
- Innovation
- Open-Ended Learning
- Social Learning
- Lateral Thinking
- Personal Action Plan
- Visualisation

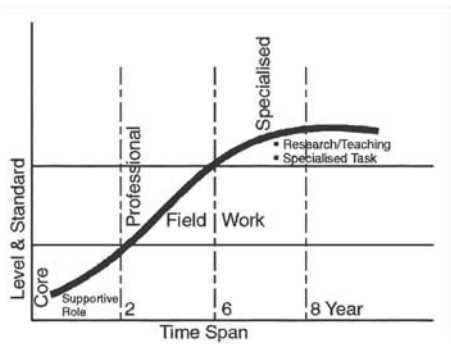


Consultancy: Multiple Contexts

A consultant works in a political, socio-cultural environmental, human, institutional/legal and financial context. As such, he should understand and learn inter-relationships among these multiple aspects. This involves the integration of professional and management skills and a synthesis of technical, political, environmental, and operational aspects of development. A professional develops courage, confidence, and creativity by a deeper and updated knowledge of his/her subject. The knowledge by itself is not enough unless it is converted into action:

At every step, skills are necessary as given below:



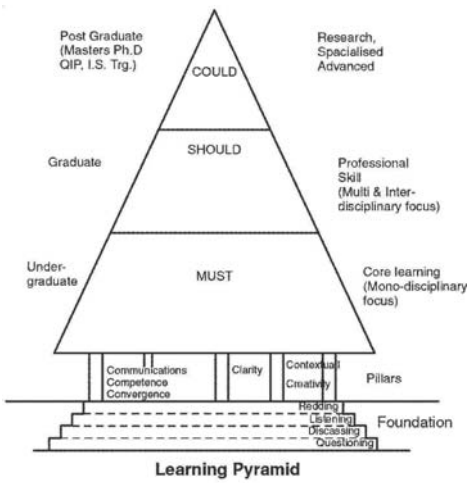


Learning Curve is a continuous process of development of professional skills

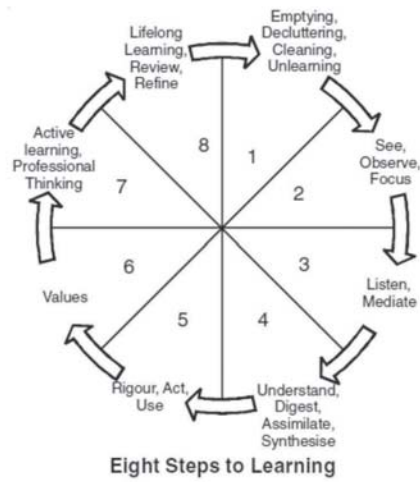
Table 1: Critical Skills

Learning	Skill Development
Knowledge	**Knowledge - Knowing the 'Unknown'** • Information System-digital. IT based ground truth • Processes and technical knowledge • Policies, principles and practices • The purpose, position and problem
Reflection and Observation	**From Knowledge to Comprehension, Interpretation and Understanding** • Analysis of issues • Interfacing environment, technological, legal, institutional, social and financial aspects
Concept	**Conceptualising and Abstraction** • Vision • Concept Development, Plan/Design • Communication, public consultation/participation
Action	**From Overview to Details; 'General' to Specific; Thinking to Acting and Interacting** • DPR/ Program/ Schedule/ Phasing • Management and Organisation • Institutional Frame • Implementation/CPM • Environment, technology, legal, institutional, social and financial planning • Delivery • Monitoring and MIS

The objective is to equip the consultant to take up adequately and effectively the responsibility of development and change management. In a world of unending information flow, the consultant can catalogue learning into 'Must', 'Should' and 'Could' categories. These stand on the sub-structure of reading, listening, discussing and questioning. The pillars of learning are communication, competence, clarity and creativity



Learning Pyramid

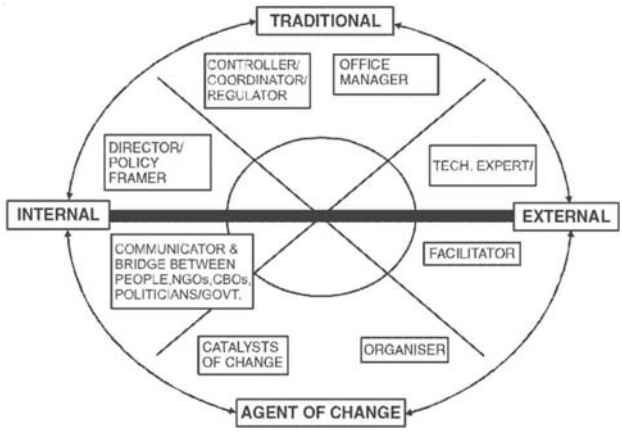


Eight Steps to Learning

Today, information technology (IT) has opened up the floodgates of fast knowledge and diversions. The explosion of communication, entertainment, connections, and the noise keep the consultant distracted. For a consultant, it is necessary to regularly de-clutter the mind, cleanse it and give it rest by restricted use of mobile, internet, TV, etc., and also to eliminate and forget what is not necessary. Hobbies, physical activities, deep breathing, meditation and positive thoughts help in de-cluttering and opening up of mental locks and blocks.

Changing Role

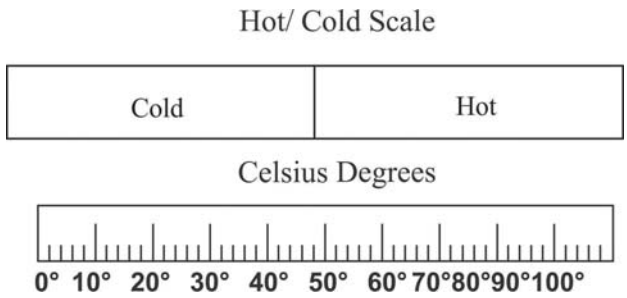
In the context of new challenges and changes in policy context, the traditional role of a professional, policy planner or a technical expert, is changing, and he/she is more of a catalyst, a facilitator and an organizer. A consultants' role is emerging as a bridge between the people, politicians and the government.



Changing Role of the Professional

Multiview

People have a strong tendency to use two-valued or 0-1 thinking ("It's a hot day," ''the city is polluted"). The two valued scale is very gross, and it is unclear what the boundary between the two values means.



Two-valued versus Multi-valued Thinking

Two-valued thinking is often a rhetoric or demagoguery. It simplifies the situation to the point of non-reality, and people delude themselves ("our consultancy is the best and doesn't need improvement"). Multi-valued thought is the tool of those trying to understand a real situation and initiate effective corrective action. Multi-valued thought uses a scale with fine gradations and precise location of the values.

Different observers see the same situation differently. How a person sees a situation tells more about the person's way of observing and about the person than about the situation. This is a key idea. If one is to understand the various concerns of people, one must break out of the mindset that how one sees something is how it is and that the other

person's viewpoint or concern is wrong. One must try to validate the perspectives of others - to understand how they see the situation, so one can understand them. To become an open observer and discover the Multi view, the following are the rules-of-thumb:

(i) Defer assessment about the viewpoint of others; try to understand the other person's point of view.

(ii) Note down what the other person says, digest it before reacting.

(iii) To find the Multi view, one has to become more *open*, understand how others see things, and why their perspective on the situation makes sense.

Knowledge is what drives today's world. The consultants are looking at new ways to stay competitive and relevant in the changing landscape. Information Technology is a key driver in today's world.
Source: www.digitallearning.in

Soft Skills

Knowledge has two sides-one is hard thinking which tends to be logical, precise, exact, specific and consistent. It is like a spotlight-bright, clear and intense, however, the focus is narrow. Soft thinking is like a floodlight. It is more diffuse, not as intense, but covers a wider area. Soft skills trigger one's own thinking and search for connections among things, rather than on their differences (Table 2). Every Indian has the background of soft thinking - mythology, metaphors, dreams, poetry, plays, etc., which can be usefully cross-bred with hard mediums. The objective is to convert a layman's mind into professional way of thinking.

Table 2: Soft and Hard Mediums of Learning

Soft	Hard	Soft	Hard	Soft	Hard
Metaphor	Logic	Dream	Reason	Humour	Precision
Ambiguity	Consistency	Play	Work	Approximate	Exact
Fantasy	Reality	Paradox	Direct	Diffuse	Focused
Hunch	Analysis	Generalization	Specifics		

"As we know there are known knowns. There are things we know. We also know that there are known unknowns. That is to say that we know that there are something we do not know. But there are also unknown unknowns. The one's we don't know that we don't know."

Donald Rum field, US Secretary of Defence

Table 3: Difference Between a Professional and a Layman

Professional	Non-Professional/ Layman
Position as it is	Judgemental, temperamental
Open, fresh and clear mind	Personal preferences/likings
Observation	Prejudices
Simplifying the complex	Complicating simple things
Originality	Relies on popular media, hackneyed knowledge
Understanding, process, learning	Borrowed teaching, correcting
Facts and figure	Weak facts, figures and fictions
Empirical analysis, logic	Default logic, fault finding
Conceptualisation	Winding statements, piecemeal ideas
Forming right questions	Jumping to conclusions and answers
Relate to context, specifics	Generalisation
See positive side, learn from success	Over critical, learn from failures
Continuity, clarity of communication	Ad-hoc statements, jumps and jerks
Aggregation, big picture	Fragmentation, piecemeal, disjointed
Objective	Subjective, image worship
Literature scanning, references, credits	Poor reading, no references, no credit
Structured thinking	Flesh without bones, cosmetic
Honest, practical, examples, illustrations	Too verbose, literary/jargons
Evolving, innovative, transformative	Rigid, fixed

Innovation

Innovation is not just about introducing new, high-tech products. Joseph Schumpeter, a pioneer innovation economist, defined innovation as the recognition of opportunities for profitable change, and the pursuit of those opportunities all the way through to their adoption in practice. It means that innovation is not just about creating new products or services, but about 'change.' It, therefore, includes new ways of doing things, such as the assembly line or the direct sale of PC, new services, such as online banking or micro-credit, or new business models such as low-cost flying or free newspapers.

Entrepreneurs drive that process by creating new products, new firms and new markets. They transform ideas or technologies, into social artefacts. Often, entrepreneurs also drive scientific progress. Entrepreneurial cultures that exist without a scientific environment tend to get stuck into non growth ventures. Increasingly, technology must go hand-in-hand with developing the entrepreneurial culture.

Open Ended Learning: Learning is breaking out of the narrow boxes. There is an increasing dialogue towards a new culture of Open-Ended Learning (OEL) which focuses on the following goals:

1. **Problem-based Learning:** The consultant inducted into a certain problem through a set of learning activities in order to solve specific problems.
2. **Inquiry-based Learning:** The consultant may seek to delve deeper into specific challenges in the subject area and pursues answers to specific questions that are encountered in the course of learning.
3. **Case-based Learning:** The consultant works on cases in a particular context and arrives at a set of alternatives or solutions.
4. **Discovery-based Learning:** The consultant may follow an organic path of discovery and explore into his/her area of interest, leading to research and formulation of hypothesis.

Social Learning

A consultant may engage in an informal mode of learning involving extensive interactions among the communities and groups and learn by sharing information and ideas. The modern consultant is SMART - Systematic, Meticulous, Active, Realistic and Tactful. Albert Bandrura, Professor of Psychology at the Stanford University has put forth a Theory of Social Learning. It says that the most learning takes place due to observation and imitation. This 'observational learning' was empirically confirmed in Bandura's famous Bobo doll experiment of 1961, wherein children who watched adults being violent towards dolls later replicated the same behaviour without any inducement or provocation.

While it would be a stretch to link the observational models of learning (that rely more on physical proximity and observations) to the social media tools of today, it would be difficult to totally disregard the important role that social media plays in helping discover and connect with people or follow conversations that one might never have come across in the physical world. By enlarging and enriching the universe from which one can draw upon for experiences and acquaintances, social media is doing yeoman's service in expanding learning.

Social media has had a profound impact on politics. Barack Obama raised millions of dollars in campaign funding through Twitter. Social media has had a great impact on governance campaigns such as India Against Corruption. Social media has impacted almost all areas of human endeavour.

Lateral Thinking

Edward de Bono, author of more than 60 books, developed the concept of lateral thinking, which he taught in universities like Oxford, Cambridge and Harvard. Bono developed a five-stage process or framework of thinking - TO, LO, PO, SO and GO. TO refers to where we are going, or the aims, objectives and the purpose of thinking which determine the direction of thinking. LO involves looking into the information needed, available and accumulation of the same. PO refers to the stage of generating every alternative possibility and solution. SO involves selection of the best from the available alternatives. Finally GO is going ahead or action steps. Evidently the emphasis is on perception and information from which decisions flow. Edward de Bono put forward a number of techniques to help people structure their thinking processes. He called this lateral thinking.

Personal Action Plan

A Personal Action Plan (PAP) can be a vehicle to optimise learning and transmit learning into practice. If no improvement or change is reflected in the individual's performance, the purpose of learning, experience or training would be futile. The PAP process comprises the following:

i Developing a positive attitude towards learning

ii Understanding

iii Observation

iv Experience/Contents

v Distillation, Conceptualisation, Analysis and Evolving a Process

vi Communication

vii Experimentation

viii Performance.

A Personal Action Plan involves a synthesis of experiences, understanding, perceptions and abilities into a workable plan. As such, a Personal Action Plan (PAP) translates and accomplishes learning into the practice. The objective of the PAP is to draw up a realistic plan which can be implemented in a particular context. Its contents consist of an analysis of the problem, identifying the main actors and the individual's role among them, statement of objectives and an action programme. The process is to identify the options and relate those with concrete experience, reflective observations abstract conceptualisation and active experimentation.

Visualisation

A picture tells a thousand words. It helps to create interest among listeners and to hold their attention. Difficult concepts which are critical for understanding can be explained more clearly with the help of visuals. Visuals also help to illustrate the linkages, relationships and concepts. These also facilitate a wider spread of the presentations and interaction with the stakeholders.

Visual aids should be simple, clear and accurate. Colour can be used to highlight the major points, text and explanation, which should be brief and complement the visual. Participants 'interaction and questions help in better understanding of the subject. Structure should have a consistent storyline and gradual transition from known to unknown, from simple to complex, from observation to analysis, from analysis to abstractions and from general to particular.

Conclusion

Three gentlemen arrived together at the Pearly Gates and were informed there was only room for one. They decided that the man with the oldest profession would be the one allowed to come in. The first stepped forwardand said, "The Lord made Adam and then created Eve out of a rib from Adam and that took surgery. I am a surgeon, so I guess it's me." But before he could move in, the second one said, "Wait, Before the Lord did that, he worked six days. Everything was chaos and he worked six days and created Earth. That makes him an engineer. I'm an engineer, so I guess that call is for me." Then the third one stepped up and said, "Hold on a minute. I'm a consultant, who do you think made all that chaos?"

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INNOVATION AND LEADERSHIP IN ENGINEERING CONSULTANCY

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The world is in the midst of a technological revolution. A revolution not only in the way infrastructure is designed, constructed, operated and managed but also in the way businesses are designed, operated and managed. The speed of the current breakthroughs has no historical precedent. Technologies such as BIM, Cloud computing, Artificial Intelligence, 3D printing, Virtual Reality, Internet of Things and Blockchain are providing powerful tools and processes. Using these new tools and processes to carry out mundane tasks in a faster and cheaper manner would be a waste of such exceptional opportunities. A paradigm shift is required to ensure that these tools are exploited in thefuture.

In India, the Engineering Consultancy sector serves key sectors that are drivers for nation building and the economy. These are the Infrastructure sector including power, transportation, water and urban infrastructure like township, housing and buildings and the Industrial sectors comprising Oil & Gas, Petrochemicals, Fertilisers, Chemicals, Metals, Steel, Pharmaceuticals, Consumer products, and the like. It is therefore clear that the Indian Engineering Consultancy sector plays a critical role in nation building.

The challenges faced by the Engineering Consultancy sector are highlighted by Martin Fischer, Howard Ashcroft, Dean Reed, Atul Khanzode in their book *Integrating Project Delivery*:

"In just the past 20 years, buildings and infrastructure have become vastly more complex than they were for most human existence. Advances in mechanical, electrical, plumbing, conveying, information, and other systems have led to rapidly increasing specialization, dramatically increasing the coordination required to engage the many specialists in a timely, efficient and effective manner. Construction projects also suffer from variability, unpredictability and uncertainty, such as which specific system will eventually be selected, who is involved in the building process, how facilities and their systems and parts are produced and assembled, and a host of external factors such as weather, market conditions and so on. Each project brings together different set of players who might or might not have worked together before; every project is unique in some way. The knowledge and experience of each professional and each company is not integrated in a consistent and timely manner, and consequently innovative ideas and opportunities are missed, overlooked or ignored. Current contractual agreement, rather than reinforcing the need to bring the team members together to create innovative solutions, drives them apart to work in independent silos."

Computer automation and global connectivity are among many trends that are fundamentally changing the engineering profession. The challenge is to harness these trends to expand the role of engineers as innovators and leaders who play a critical role in improving the safety and well-being of the nation.The Engineering Consultancy sector must create and use innovative technologies to design inspiring projects while ensuring the economic and sustainable use of natural resources.

Engineers must expand their knowledge by networking with colleagues from diverse backgrounds and from other nations. As professionals, in this era of networking and global connectivity, engineers need to shift from a competitive

to a collaborative mindset. Collaborative Engineering is a model in which highly qualified resources converge to provide a world of smart engineering.

This is possible through Building Information Modelling or BIM which is a virtual intelligent 3D model-based process that gives architecture, engineering and construction professionals the insight and tools to more efficiently plan, design, construct, and manage buildings and infrastructure. BIM is an information tool which facilitates the application of collaboration to projects and engineering works.

Business Organisation in Engineering Consultancy

The business organisation in the engineering sector has evolved over time as:

1. Professional engineering
2. Engineering firm
3. Exponential engineering organization

In engineering consultancy, the earliest organisations consisted of individual discipline engineers using their skills to execute projects; their scope was always aligned with their specific knowledge and their location. As specializations became diversified and global communication became easily available, this model is mostly outdated.

Over the years, it became necessary to have multi-disciplinary skills. This led the transition to engineering firms, which solved multi-disciplinary projects. However, the technological levels reached today are making this model inefficient in terms of costs and the required skilled resources.

Hence, Exponential Organisations (ExOs) are emerging in Engineering consultancy. These organisations are introducing practices like crowd sourcing and Lean where a required resource can be engaged at the precise time it is needed. The Exponential Organisationis a service aggregator, a centralised system that finds people, contractors and suppliers, then aggregates and coordinates them.

This model is suitable for the network-friendly engineering sector. Work can be centred on BIM and the cloud, allowing all collaborators to participate and interact freely without hierarchy.

The technology drivers for the paradigm shift in engineering consultancy are the Network, BIM and the Cloud while the essential human enablers are Leadership, Technical skills and Innovation.

The Network

The Network is a system of connections that allows interaction between people in order to share information, exchange products, services and intuitions.

Online networking improves problem-solving skills, augmenting the effects of collective intelligence. By widening the scope of cooperation through the use of online tools like the cloud and BIM, engineers can exploit the variety of skills available; explore ideas in greater depth, and produce cheaper, better and faster solutions.

The Network is suited to the Engineering consultancy sector since it can:

- provide the large number of team players required
- vary the team based on the project needs

- provide the necessary high level of expertise
- make recruitment easier and quicker
- facilitate collaboration via online platforms

BIM

BIM is widely used in the Indian Engineering Consultancy sector for industrial projects like Oil & Gas, Refineries, Petrochemicals, Metals etc, using software like PDMS, Smartplant 3D and the like. Civil and structural components, Mechanical equipment, Piping with their supports, Electrical and Instrumentation items and cable trays are modelled in minute detail by creating a database. Such detailed modelling involves a significant amount of time, skill and cost. However, the benefits derived from the intelligent 3D CAD model have established it as a best practice in the industry.

Formal model reviews and "walk throughs" are conducted with the owner's representatives and process licensors in a conference room setting at pre-defined stages. For global projects the 3D model is concurrently built and used in collaboration with offices around the globe. The model is accessed by using server-based networks.

The use of BIM needs a major thrust for infrastructure and building projects in India as it is still not widely used in this sector.

BIM offers many advantages, including the following:

- the ability to produce all documents related to the engineering project work within a single model, which in turn incorporates all the modifications and additions that occur as the work proceeds;
- the ability of using a tablet or a 3D viewer for visualising the facilities on-site in the exact position where they will be erected; a virtual representation of the project design;
- the ability for all participants to enter the same "3D model", to communicate via a single platform, and to make observations and report on specific aspects of the work to be done, highlighting relevant issues in real time and accelerating their resolution.
- the possibility of immediately examining each task listed in the programme of works, its date of execution, the relevant 3D views,its evolving cost over time, etc.
- the ability to update project accounting records in real time, thus saving time during the selection process and avoiding the detailed development of costly over-budget solutions

Cloud

Cloud computing means storing and accessing data and programs over the Internet instead of a computer's hard drive so that stored information can be accessed via an internet connection.

In the near future the BIM model will be accessed through a cloud platform with the required capacity and processing power. The BIM model will be accessed from anywhere by using simple devices like a tablet or smartphone using tools like 3D viewer**.** All the documentation pertaining to the tasks for all the participants in project execution will be available in real time. With the easy and cheap internet access in India, there is immense potential for the exploitation of BIM for nation building.

Engineers will be able to review the entire project as a BIM model and to extract the hard-copy design documents like floor plans, layouts, elevations, sections, construction details, etc. from the BIM model. The transition from paper to digital media is progressing rapidly. For the various phases of the project, the approach will be to publish the design and administrative documents and have them digitally signed to make the digital media legally valid. The cloud would streamline the handling of paper documents until they are eliminated, reducing the confusion caused on construction sites by large volumes of paperwork.

Leadership

In engineering projects, today, Engineers play a technical support role. Engineers do not view themselves as leaders and have not developed leadership skills. In the future,engineers need to be involved in key decisions for these projects. To play that role, Engineers should be better prepared in business and leadership. Engineers should view leadership as a fundamental obligation. Students need to learn it in college while engineering consultancy organisations need to develop and promote it.

By solving the business risk issues associated with engineering projects, engineers can contribute towards project conception, development, design and construction. Engineers should be conversant with financing, land use, constructability, construction costs and methods.

Technical Skills

Engineers are expected to have strong technical skills. While in the past technical skill implied an ability to calculate something by hand, in the future technical skill will involve the interpretation of a computation done by a computer.

Technical ability today is defined more by a body of knowledge than an ability to create. In the future, Engineers will need to direct their technical skill toward innovation by developing intuition about systems.

In the future, Eengineers will need to have a clear understanding of conceptual engineering fundamentals rather than remembering detailed factual knowledge stipulated in design standards and specifications. At present Engineers are in transition; the computational tools are available and advancing, but most education has not evolved to exploit these tools.

Innovation

Technology has encouraged innovation for engineers by enabling modelling and design. Having automated routine tasks, technology provides the opportunity for innovation. Engineers need to think outside the traditional boundaries of engineering to apply new technologies to engineering practice.

An example of innovation is the emerging concept of performance-based design as opposed to code prescribed design.

If how a building must perform is defined but freedom is left to how the engineer provides that performance, the possibilities for amazing solutions to difficult problems are thrown open.

Summary

In summary, engineers need to constantly refine and redefine their value in the light of technology, to participate in its advancement, either as drivers, creators or creative users.

Engineers need to exploit technology to speedily perform their tasks, avoid unnecessary steps and eliminate errors.

ROLE OF PROFESSIONAL CONSULTANTS IN NATION BUILDING

V. Suresh
Chairman, Indian Green Building Council
President, Good Governance India Foundation
Vice Chairman, National Building Code of India
Former CMD HUDCO

1. CONTEXT

India is on the move. With demographic explosion and doubling of urban population, India is poised for major growth in building and infrastructure to meet the massive demands from all sectors. These cover buildings of all occupancy classes' namely residential, commercial and business, educational, institutional, mercantile and retail, assembly, storage, hazardous and industrial buildings. On the infrastructure side there is water supply, sewerage, drainage, roads, bridges, railways, MRT, ports, airports, logistics, etc.

These construction initiatives are taken up by all sectors - Governments at Centre, State and local level, public and private sector entities, builders, developers, corporate and undertakings.

Massive investments are involved from all resources from governments, corporate and financial institutions. It is therefore absolutely essential that all these resources are gainfully utilised and create assets of strength, durability, safety, performance, and serviceability whose asset value justify the investment.

2. DEVELOPMENT PROCESS

The construction development process is a comprehensive exercise commencing with conceptualizing the project, surveying the site, conducting geotechnical and other physical investigations, environmental impact analysis, doing holistic designing and detailing, quantity surveying, contract management and administration project execution, planning, scheduling and construction and project management, construction and execution and installation of civil works and services, completion, commissioning, operation and occupancy. Add on the latest new dimension of Assets and Facilities Management with strong Operations and Maintenance Management process.

All these involve the association of competent professional capabilities, exposure, experience and capacities from various disciplines to avail of their knowledge and expertise.

The professional lineup is large for large complex projects:

* Architects
* Civil Engineers
* Surveying Specialists
* Structural Engineers
* Public Health Engineers
* Environmental Engineers
* MEPF Services Engineers
* Estimating, Quantity and Chartered Surveyors
* Contracting and Contract Management teams
* Procurement of Materials, Machineries and Manpower
* Project Execution, Planning and Scheduling and Management
* Construction Management team
* HSE Specialists
* Green Building and Sustainability Engineers & Specialists

* Financial Resource Planner and time linked financial resources infusion
* Landscape Architects and Specialists
* Interior Designers
* Commissioning Specialists
* Assets and Facility Managers

The success of execution of any project of any size or scale depends on the professional team being assembled. These could be individuals or groups.

The qualifications, experiences and capability for works vary widely. Professional practices and codal needs prescribe the minimum educational qualifications for each professional and length of service experience needed for competency decision for availing various services whether it is for selection as employees or as consultants, individually or in groups.

The professional bodies and regulators governing the professional practices also indicate norms for the same. Like Institution of Engineers, Indian Institute of Architects, Council of Architecture, Institute of Town Planners, Urban Designer Institute, Institution of Structural Engineers, Institute of Public Health Engineers, Institute of Fire Engineers, Association of Consulting Civil Engineers, Consulting Engineers Association of India, ISHRAE, etc. Further the National Building Code of India and local Building Rules and Regulations as well as Plumbing, Electricity and Lifts installation authorities, etc. require association of professionals of right qualifications (of degree or diploma levels) and experience for carrying out various activities.

The submission of papers and documents for evaluation of the technical qualifications should be done by only the accredited and authorised specialists for services needed for the various stages of statutory approvals for the same.

The fixing of responsibility and accountability for right or faulty services for penal actions is also an important criterion.

3. CHALLENGES

Availing consultancy services for various professional services and the corresponding deliverables is a burgeoning and challenging task. The pre qualification through a competitive selection process must clearly bring out the requisite criteria.

The technical capabilities and commercial terms need to be sought in separate sealed envelopes or electronic bidding format. The latter is always a matter of discussion. Should consultancy services be on competitive bidding terms? There are many situations where many smaller groups can quote low priced offers for providing services in a very competitive environment. The L1 or L2 can be very low level quotes. The project in that case tend to suffer as the quality of service deliverables could be lower and the quantum of manpower hours of inputs needed could be compromised. Internal bench mark standards for the reasonable expected man hour inputs and pricing based on market costs and overhead costs should be kept as lower bench marks. The short list should also be of comparable pedigree.

The consultants can be local Indian and also international. Even international groups can have both international and local consultants. The cost of services would vary depending on the terms for availing services in Indian or foreign currencies.

The total cost for consultancy services for various activities and deliverables also need to be pegged with respect to Project Costs, Investigation costs, design visits, project execution costs due to internal or external, etc.

Payment terms for deliverables on stage wise basis are also an important issue.

In many cases deliverables could be completed but the project may not take off, or the design brief may change due to for internal or external or market conditions that may warrant that the project course be shifted.

Many consultants make available an offer for comprehensive services, although the parent group may have only limited capability and the remaining services are outsourced with tie ups.

4. INDIVIDUAL OR COLLECTIVE RESPONSIBILITY

The consultancy services could be of superior, just right or inferior quality.

The defective services which could lead to deficiencies from structural, mechanical, electrical or fire services malfunction would create problems in fixing responsibilities and accountability.

If it is structural issues, then that could be on account of design or construction deficiency due to bad workmanship or lack of proper reinforcement placing as well as right grade of concreting and lack of curing. Therefore, differential responsibility is provided for the design consultant and construction supervision teams. The responsibility certificate could also be different, if need be.

There could be issues between the structural and the fire consultants. The structural integrity of roof, floors, columns, and beams will depend on degree of fire resistance needed for 2 hour, 3 hour or 4 hour fire resistance rating as needed. This is an additional facet that the structural engineer has to provide with increasing cover for additional hour of fire resistance for the fire severity to which the building has to be designed. The question that arises - Can there be room for joint action?

Air-conditioning, Ventilation, Electrical, and People moving installations also have strong links with the fire protection and safety requirements. Here also the question arises - How can the responsibility and accountability be apportioned between the four MEPF consultants?

The classic case of shifting responsibility is the newer geo-technical engineer with soil and base/ foundation structure interaction and foundation failure due to problems in rock or soil data or base subsidence or land slide, etc.

The architectural, civil, structural and fire teams can have issues on right level of exits, compartmentalization, change in building use resulting in consequent change in loading patterns, as well as interior designs adding flammable and combustible fire load than those originally conceptualised and provided for in the base/ initial design and construction.

The role of owner and client also is important for bringing in changes due to commercial considerations beyond statutory approval limits. Joint responsibility including criminal negligence could come into play. The consultants have to be ever vigilant in their role clarity and their specific deliverables.

The techno - legal regime issues need to be clearly brought out in the contract for availing and delivering services.

5. ROLE OF ETHICS AND PROFILE UPGRADE

Many professional bodies have ethics as a tenet while making available comprehensive services.

Action can be taken for providing deficient services as well as issues of impropriety and integrity.

Healthy professional development on a continuous basis by adding upgrades through continuous education is a must to keep track of fast changing technological developments.

6. NBC AND CONSULTANTS

The National Building Code of India (NBC) has provisions in Part 0 for healthy development of multi disciplinary professional inputs.

Part 2 provides qualification and competence levels for carrying out work and the responsibilities that go with differing scale and scope of work to be performed.

Indian Consultancy capabilities have come of age and have professional and technical capability to handle any major assignment across globe with right tie up as well with global players.

Reference:

National Building Code of India 2016

ENGINEERING CONSULTANCY FOR NATION BUILDING

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Background

Engineering consultancy plays a pivotal role in the development of a nation, is a fact that cannot be overlooked and should be considered seriously by the ministries at national and state levels as well as by local authorities and bodies. Engineering and Medicine cater to the core areas of human needs and have been in existence since civilisation took roots. Other areas of consultancy like financial, legal, advertising/ media, etc. came into existence much later after the basic needs of humans were satisfied and societal rules were formed.

This article is an expression of working in this industry and the experience there from. All the statements/ views/ opinions expressed in this article are hence applicable to the construction industry only.

The Real Estate and Construction sector is the second largest employer after farming and employed 67 million in 2017. It is estimated to reach 75 Million in the near future.

The Services sector which includes 'Financial, **Real Estate & Professional Services,** Public Administration, Defence and Other Services, Trade, Hotels, Transport, Communication and Services related to Broadcasting is currently the backbone of the Indian economy and contributing around 53.66% of the Indian GVA.

With such a staggering numbers, the consultancy in construction industry needs to be considered with special attention. The building industry predominantly needs core engineering expertise in areas such as Civil, Electrical, and Mechanical, plus other disciplines such as electronics, computer, instrumentation & control, etc.

Architecture too finds its place in the Building industry which is a sub-sect and integral part of the construction industry. Except for this, architecture is not much used in other areas of construction like infrastructure, chemical and industrial projects, etc.

Consultancy is an important aspect of nation building as it contributes in literal sense in 'building' the nation. Construction of physical infrastructure is possible only due to capable and experienced consultants. Modern large and tall projects cannot be built by leaving it to thumb rules of even the very skilled and experienced workers; engineers have to be involved to conceptualise, plan, design and construct/ fabricate etc. Every industry needs construction of structures, plant structures, roads, water, wastewater, etc. which are designed, estimated and supervised by consultants.

Types of Engineering Consultancy

Engineering consultancies are of various types and follow a sequence of processes/ operations and procedures in their respective areas of engineering which include engineering design consultancy, drafting specifications, tendering, vendor evaluation, contracts drafting, quality control/ assurance during execution, bill certification, project management up to

handing over. These are the main tasks that a consultant takes up and the same can be elaborated further and the list could easily go to 50 tasks or even more.

The above are preceded by a Detailed Project Report (DPR), Economic viability, Environmental Impact Assessment (EIA) for a project.

Build Operate Transfer (BOT) or Build Own Operate Transfer (BOOT) or Public Private Participation (PPP) or People Public Private Participation (PPPP) types of projects need different engineering and project management expertise coupled with economist, legal and other professionals in the team. Such projects need very careful selection of consultants.

Consultancy, as practised in India

Consultancy is one of the oldest professions in the world with Lord Krishna himself offering pure consultancy to Arjun during the times of war. Though this statement is made on a lighter note, facts cannot be sidelined when one thinks of Consultants like Chanakya to Chandragupt Maurya, Tenalirama to Krishnadevaraya, Birbal to Akbar, et al. They were advisors (or consultants) to the rulers and advised them on matters relating to ruling their kingdoms.

Consultancy per se could be considered as advice given to a customer on the manner and methods to perform tasks for a project so that desired results are achieved and inter alia includes advising customers' on financial matters especially how to spend judiciously to maximise the return on investment or for the best benefit of the customer and society.

Appointment of consultants in public sector - Central and State Governments, PSUs, Authorities, Bodies etc. still follow the guidelines laid down by the Central Vigilance Commission (CVC) on the presumption that all bidders are equally capable and experienced, which in reality is not so. In the private sector the practice of reference and past performance are also looked at while appointing a consultant. The chances of 'repeat customer relationship' is thus high in case of the latter. In most cases selection and appointment of consultant on the basis of quality cum cost is recommended where as for sophisticated, complex and high end projects it should be on capability and experience. The large projects which are funded by multi-lateral agencies also follow the Quality and Cost Based Selection (QCBS) of consultants.

'Repeat customer relationship' is a long term mutually beneficial relationship that develops between a customer and a consultant. This is based on the confidence that a customer develops on a consultant based on successful past performance viz. experience and competence of the consultant, and the mutual comfort level that develops since the paying policy of the customer and such other aspects affect a consultants work. It is an extremely beneficial arrangement for both, the customer and the consultant since both have their expectations fulfilled at the end of the project. This is possible since both have their datum bar of expectations set to a level which is practically achievable by both.

Appointment of a consultant strictly to the lowest bidder can prove to be counterproductive since the customers do not get the requisite returns on the fees paid to the consultants. The consultants too could be unhappy in case they have not quoted judiciously which could inter alia include a strategy to get the project by all means. In such cases undesirable practices creep in and in the process they work against the project environment. In such cases the whole project suffers, be it the cost or quality or timeline.

Another solution for the selection of consultant for normal projects is to award the work to the consultant whose quote is the closest to the mean of the reasonable quotes received. This would prevent consultants from quoting either out of desperation or as a strategy to first get into the project and then think of alternative ways of not going into a loss on it. All the consultants would be inclined to quote fees commensurate to their efforts and that would eventually prove beneficial to the customer and the project.

The QCBS by carrying out technical and financial evaluation of the techno-commercial bids received from the consultants is far better than the lowest bidder one. The process per se needs to be made objective and subjectivity or favouritism minimised by getting the evaluation also done by a team which is independent of the project authorities.

The technical marks of both the teams should be displayed on the web-site of the Customer. If the technical presentations of the competing consultants are also made available on the web-site then transparency could be achieved and bias minimised since it could be questioned. This would improve the selection process substantially and benefit the project immensely.

Challenges faced by Consultants

1) HR Challenge

Consultancy is primarily the deployment of human brains to use and put into practice the knowledge and experience gained over the years. It, therefore, behoves that the best talent available in the industry be deployed. The consultant needs to attract the best talent and thereafter retain the same.

With the coming of age of computerisation, perpetual upgrading of hardware and software has also become essential and adding new software as may be necessary. The engineers also need to be trained to use the new hardware and software. The finances of the consultancy business have to be managed to enable all that.

The customers also have their own engineering set up and those engineers also need to be well versed with the latest in the field concerning the engineering and managerial requirements for the project. The same applies to the contactors engineering staff.

There is a tendency amongst the younger engineers to do just desk jobs and not really get their hands soiled. This needs to be guarded against since they then do not really develop and evolve as an engineer holistically and have the courage of conviction of what they design or instruct to be done. They have to relaise that they are responsible and accountable for what they do.

Multinational consulting companies who have set base in the country are raising the standard but also making it harder for local companies to rise up the ladder primarily because of the propensity of the multinational consulting companies to pay higher wages since for them the Indian operations are a small percentage of their total international operations.

Enduring success of a consultancy organisation is achieved by nurturing the engineers, fresh as well as experienced, into the culture of the organisation of being through in their work and work as a team. The organisation must also inculcate ethical values in them and the need to give back to the society as part of the Corporate Social Responsibility (CSR) activities. They must groom them to be engineering managers.

With the brain drain to the west slowly ebbing, it is upto the organisation to help the engineers to keep their knowledge and skills continuously updated. In fact it should be made a requirement for their promotion. They must also be allowed to give vent to their ideas so that they get into the habit of introspecting on what they have done and see how to improve on that the next time around.

2) Consultancy Charges/ Fees

It has been brought out earlier that the selection of a consultant should be such that the fees are commensurate with the assignments to be performed. The fee is the fulcrum on which the quality of inputs and outputs from a consultant depend. Hence it is for the Customer to appreciate and make sure that the fees paid are such that

enable the Consultant to do justice to the assignment since if the financial dynamics are affected then the heart of the consultant is not in the quality of work but just as a means to keep the organisation afloat. That is neither in the interest of the Customer nor the Consultant. The Customer must appreciate that Engineering Consultant is responsible for the work done hence the fees must be commensurate with the responsibility and accountability that is placed on the Consultant.

3) Mergers & Acquisitions (M&A)

The Indian consulting engineering sector had been free of Mergers & Acquisitions till some years back when the larger international consultancy organisations began to acquire Indian organisations or inducting individuals to do work in India and/ or to use them as a back office for their assignments elsewhere, basically for financial benefits. Some Customers feel that the Indian Consultant is not all that capable to engineer and deliver certain type of works basically to adopt new materials, products and processes and hence advise them to collaborate with an international organisation/ individual. This may not necessarily be the right approach. The country has a history of innovating and developing bench scale ideas to full blown project size to suit its needs. What may be advised by an international consultant may not be appropriate for the conditions prevailing here. One just needs to delve into history to ascertain that and even look at some of the sectors where foreign knowhow was not forthcoming. The engineers brewed internally and grew on their own to deliver world class facilities.

Way Forward for Indian Engineering Consultancy Companies

1) Investment in R & D

With the country developing on a fast track it is imperative that the scientists, technologists, and engineers give the necessary attention that is warranted to innovating through trial and testing and come up with solutions that are suitable for the location.

For that the Indian engineering consultancy and contracting organisations must whole heartedly support R & D on analysis and design solutions as well on materials and construction plant, equipment and techniques. The companies must financially as well as technically support educational institutions such as IITs and where necessary set up R&D establishments. Planned fundamental research needs to be done and not assorted and random research would not yield value and enable use of R&Ds full potential.

Developing of import substitutes will save scarce foreign exchange. This applies to computer hardware, software, construction plant and equipment. The locally manufactured items must be at par in quality albeit at lower costs vis-à-vis those imported including those from China. In fact India should aim at exporting what is manufactured locally. In all this, one should not lose sight of sustainability.

2) Investment in Training

As mentioned earlier in the article, consultancy organisations must invest in training technical talent - both On the Job (OTJ) and In Classroom. The objective should be betterment and upgradation of society and the nation in long run.

A small anecdote:

CFO (Chief Financial officer) to CEO- Sir, why do we invest in training? What if we train and they leave us?

Reply from the CEO- It's to ensure that orgainsation have the capability and is prepared to take up assignments as and when they arise. Besides if it does not help the staff to expand their knowledge and be proficient in new skills then the orgainsation would stagnate. It can also be considered as a part of the CSR activities.

3) Standing As One

With projects becoming bigger and more complex and inter-disciplinary in nature there is a greater need for bigger multi-disciplinary consultancy companies which can grow to keep up with the requirements. Alternatively companies could associate either on job basis or have a long term Memorandum of Understanding (MoU). Special Purpose Vehicle (SPV) or Joint Venture (JV) is another option to bid for bigger jobs and even international ones. Pooling of resources would bring together talents from different disciplines of engineering and encourage learning on a wider spectrum and at a faster pace.

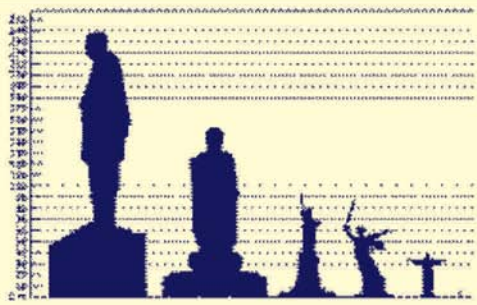
Although Engineering employs lakhs people yet it is still not a legally recognised profession. The Government needs to enact legislation for the Engineers just as it has for Doctors, Chartered Accountants, Lawyers, Architects, et al. This has become essential since engineers in the private sector today are far more than those in the government service. The latter derive their relevance and legality by some act or regulation which empowers them. Those in the private sector have no such legality yet they are supposed to be responsible and accountable for what they do. **The Government of India needs to speedily enact legislation for engineers.**

STATUE OF UNITY

The Statue of Unity in Gujarat is the world's tallest statue. It was inaugurated by Prime Minister of India, Mr. Narendra Modi on October 31 2018. The statue has been built in honour of India's first Deputy Prime Minister Sardar Vallabhbhai Patel on the occasion of his 143rd birth anniversary. The Prime Minister said the Statue of Unity is "a symbol of our engineering and technical prowess."

Salient features

Cost	~ Rs. 2,900 crores
Materials Used	
Bronze plates	1,700 tonnes
Bronze cladding,	1,850 tonnes 565 Macro panels 6000 Micro Panels
Concrete	210,000 cubic metres
Reinforcing steel	18,500 tonnes
Structured steel	6,500 tonnes
Manpower	
Engineers	250
Labourers	3,400
Time lines	56 months 15 m Planning 40 m Construction 2 m Handing over



1. Statue of Unity 240 m (incl. 58 m base)
2. Spring Temple Buddha 153 m (incl. 25 m pedestal and 20 m throne)
3. Statue of Liberty 93 m (incl. 47 m pedestal)
4. The Motherland Calls 87 m (incl. 2 m pedestal)
5. Christ the Redeemer 38 m (incl. 8 m pedestal)
6. Statue of David 5.17 m (excl. 2.5m plinth)

Source: https://en.wikipedia.org/wiki/Statue_of_Unity

CONSULTING ENGINEERS FOR REALISING THE BUILT ENVIRONMENT

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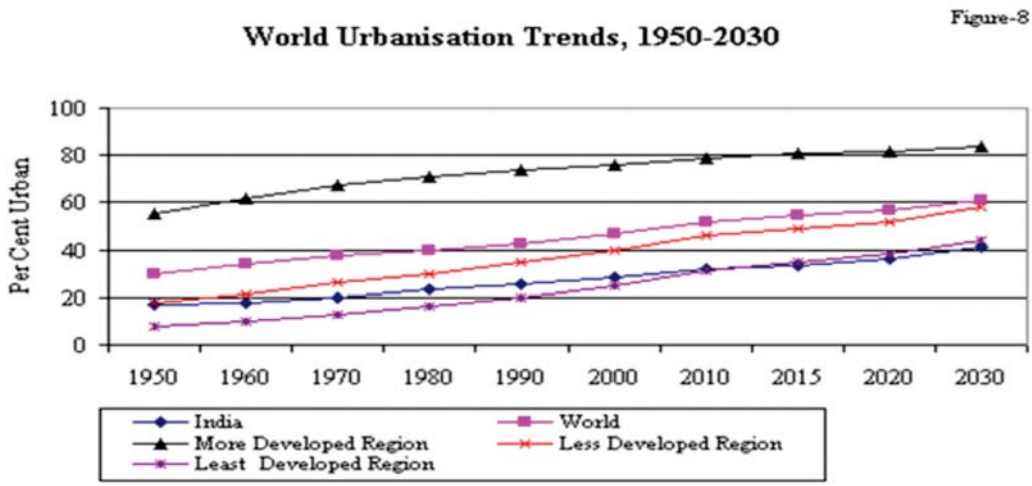
Introduction

India is one of the world's fastest growing economies, and is experiencing extraordinary development. The cities have become growth engines giving employment to many rural and urban people due to industrialization and their being economic centres. The percentage of population residing in urban areas is continuously increasing.

The growth of urban population in India is following the path of other developed countries in the world and may cross 40% of the total population in India.

Figure-8



Source :- The State of World Population, 1999 and Population Projections for India 1996-2016

Infrastructure Situation

The population growth in urban areas is adding more pressure on existing infrastructure in terms of employment, housing, water, power and allied facilities.

In the absence of affordable housing, the migratory population prefers to create temporary shelters, *zopadis* on easily available plots, government lands, hillocks or forest areas. The continuous high demand leads to deterioration of the existing infrastructure which fast becomes inadequate to cater for the population addition.

India's current annual investment in infrastructure is $118 BN, against a requirement of $230 BN of estimated baseline need, as per Asian Development Bank (ADB).

The infrastructure and housing provisions for various cities is presently being handled by various departments such as housing boards, water boards, municipal corporations, electric supply distribution companies, etc.

The Government of India, the State Governments and Urban Administrations have taken various measures to support the infrastructure for growing Indian cities and meet the aspirations of the people. Some of the projects undertaken to support infrastructure provisions are.

- External funded projects such as by ADB, The World Bank, JICA, et al
- Projects from Internal funding by Municipal Corporations, Governments
- JNNURM funded Projects
- Amrut funded Projects
- Smart City Initiatives

Built Environment (BE) Sector

The Built Environment projects are aligned to various Government initiatives through Private sector investments or Funding agencies and provide solutions to improve the quality of life since they are aimed at providing/improving urban infrastructure, health services, housing for people and industrial developments leading to employment generation and economic sustainability.

Projects of National Importance

Some of the key projects are:

A. Urban Renewal Projects

The journey of wholesome city development started around 2000 by State Governments. The first to come up were for the reconstruction and upgradation of earthquake affected areas in Gujarat. Next were the Asian Development Bank (ADB) funded five cities namely Kota, Ajmer, Jaipur, Bikaner and Jodhpur in Rajasthan under RUIDP Project. The two cities namely Jodhpur and Bikaner have been awarded as Best Design project by CNBC TV 18. Then were the four cities in Madhya Pradesh viz. Jabalpur, Bhopal, Gwalior and Indore.

ADB further added Jammu and Kashmir Urban Sector Development Investment Program for the sustainable economic growth in Jammu and Srinagar though the provision of urban infrastructure services and the promotion of urban management improvement.

B. Skill Development by Micro Small & Medium Enterprises (MSMEs)

For Country's Economic Development, the Government has put strong emphasis on the Manufacturing Sector. A Technology Centre System Program (TCSP) is proposed under the Ministry of Micro Small & Medium Enterprises (MSMEs) in order to develop the technological and skill base in select manufacturing industries, via upgraded and new technology centers. Each centre is planned to train about 8000 technicians every year, thus the total expected employment generation is 1,44,000 technicians per year distributed across the country.

Consulting engineers are helping set up the new Technology Centres and also for the up gradation of existing Technology Centres (TCs). The assistance from Consultants involves environmental assessment, providing technical assistance for obtaining statutory approvals, master planning, detailed engineering, bid process management and monitoring & supervision of construction activity.

C. Growth Engine — Delhi Mumbai Industrial Corridors (DMICDC)

The Government of India planned the Delhi Mumbai Industrial Corridor including planning of various urban growth centres along the route. Consulting engineers are the key to make these a reality. Some of the projects which have gone for planning and execution include DMICDC-Dholera, Dadri, Ujjain and Shendra Bidkin. The DMIC corridor is spread across many states and the work at various nodes such as Manesar Bawal, Pithampur Dhar are also in progress.

The aim is to initiate *sustainable* and financially viable industrial development leading to employment generation and providing essential infrastructure and services with green, smart city initiatives and promoting live-work-play-learn (work-life balance).

Similar developments in the form of Visakhapatanam - Chennai Corridor and the Samrudhhi Mahamarg in Maharashtra are under consideration.

D. Warehouse & Logistic Industry

In the recent study done by The World Bank, India has jumped 19 positions in the Logistics Performance Index (LPI). The warehouse industry in India is worth INR 560 billion and is growing at a rate of 10% - 12% per annum. The Indian logistics industry provides employment to more than 22 million people. Consulting engineers provide the necessary know-how for large column free high rise areas for the all weather warehouses to function efficiently in controlled environments. Cold Storages are also a part of the programme.

E. Housing for People

Governments are committed to providing housing for all and thus have schemes for Economically Weaker Section (EWS), Lower Income Group (LIG), Medium Income Group (MIG) and Higher Income Group (HIG). These schemes are very important to enable good living conditions, clean environment to be maintained and realize the goal of "Swachh Bharat". The urban infrastructure projects also focus in providing better infrastructure for slum and low income group people to improve living conditions.

F. Health Services

Health care facilities – general and specialty such as for cancer are being set up by public and private sectors across the country. Engineers here again provide all the necessary enclosures for the patients, doctors and the medical equipment for the specialized requirements of hygienic environments. The health services also include mid size hospitals at town levels to cater for semi urban or rural population.

G. Livable Developments under Smart Cities

The Government of India launched the Smart City initiative to improve the civic infrastructure of urban bodies. The smart city definition calls for sustainable economic development and a high quality of life, with wise management of natural resources, through participatory action and engagement. The contribution by the consulting engineers is significant since practically all disciplines of engineering are involved. In a focused approach the Government of India appointed Design and Project Management Consultants for over 90 cities under the Smart City program. For many Smart Cities, execution of works for the improvement of transportation, water supply, smart communications, parks, river front developments are in progress.

H. Transportation

Transportation, be it by road, rail, air or water is essential to speed up development and growth of the country. All of them must be planned, designed, well executed and properly maintained to be able to serve the purpose they are intended. Consulting Engineers, here again play a crucial role. The integration and holistic planning is being done by adding major Expressways, Highways, Freight Corridors, Rail routes, Ports, Inland Waterways, airports, and upgrading existing infrastructure to meet the requirements of the developing nation.

I. Industrial Growth

Project to manufacture utility vehicles (UVs), light transport vehicles (LTVs) and commercial vehicles (CVs), two wheelers, etc. are essential to provide mobility to the people. Corporations also plan for setting up manufacturing

plants for white goods, security solutions and interior divisions. Consulting Engineers provide the appropriate designs for the vehicles and also the facilities to manufacture and maintain them.

Conclusions

India's large annual investment in infrastructure through various initiatives by the Government, Private and Funding agencies are resulting in improvements all around in infrastructure, employment generation and better living. Consulting engineers are partnering with various developmental projects to improve the quality of life and sustain the country's growth and economy.

Tata Consulting Engineers has been at the forefront in taking the various initiatives forward by providing sustainable and feasible solutions. The availability of varied manpower enabled TCE to handle the large size projects like Gujarat Earthquake Rehabilitation Project, Rajasthan Urban Infrastructure Development Project, Green field mixed use developments along Delhi Mumbai Industrial Corridors, housing projects by Gujarat Housing Board, Tata and Vedanta Cancer Hospitals, Logistic Parks for Embassy, industrial development projects for Corporate houses like Mahindra, Godrej, IT parks for software companies Wipro, TCS, et al and many Smart Cities across India.

BOGIBEEL BRIDGE

The Bogibeel Bridge over the River Brahmaputra is located 17km downstream of the town of Dibrugarh is situated in the highest earthquake zone in the country. It was inaugurated by Prime Minister of India, Mr. Narendra Modi on 25th December 2018. It will connect Dibrugarh in the south to Lakhimpur in the north.

The 4.94km bridge is the 4th longest bridge in India after the Bhupen Hazarika Setu, Mahatma Gandhi Setu and the Bandra-Worli Sea Link. It is India's first bridge to have a superstructure of composite fully welded steel truss of built-up box sections and reinforced concrete that can withstand earthquakes of Magnitudes upto 7 on the Richter Scale. It is also Asia's 2nd longest rail-cum-road bridge that has a serviceable period of around 120 years.

The Bogibeel Bridge has 39 spans of 125 m. It is designed to carry two broad gauge railway tracks (1,676 mm; 5ft 6in track gauge) on the lower deck and a 2-lane road on the upper deck. The bridge is supported on well foundations and 42 piers.

Source: https://en.wikipedia.org/wiki/Bogibeel_Bridge
https://www.railway-technology.com/projects/bogibeel-rail-bridge/

ENGINEERING CONSULTANCY IN THE WORLD'S ENVIRONMENTAL MOVEMENT

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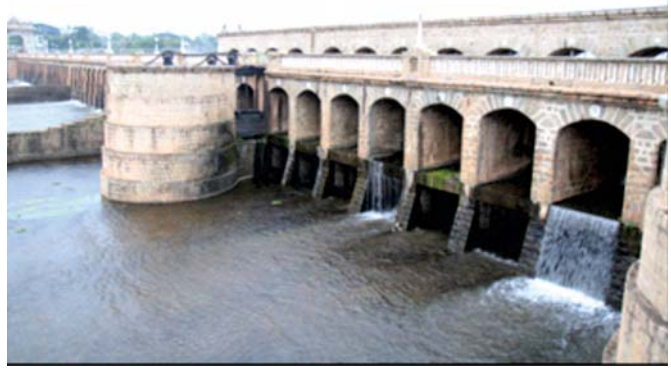
Insight

From the past and up to modern times, Construction and Consulting Engineering have been at the heart of economic development and well being of every state and country. They provide creative thinking which help with the growth and continuous evolution of ideas for meeting the needs of human civilization. However, Engineering Consultancy for Nation Building has been receiving greater attention aided by engineering software using the Building Information Management (BIM) platform. The latter is set to pervade engineering consultancy and construction technology by helping them to simplify complex processes and deliver in shorter timeframes. The practice of engineering permeates modern society – all sectors from information technology and entertainment to agriculture and healthcare, apart from construction, manufacturing and transport. Furtherance has driven it because of human need. In most cases in nation building, the resources are finite and hence innovative thinking and creativity in engineering are necessary to come up with inexpensive solutions.

Throwback: My Admiration



I am an admirer of Sir Mokshagundam Visvesvaraya (1861-1962) who utilised his knowledge of engineering to contribute to nation building. He was truly a great engineer of his time. He was not only India's pioneering engineer but also an administrator and a man of action who focused on the nation's progress and development keeping in mind the environment. Sir Visvesvaraya stands out as a pioneering Indian engineer who contributed to road building, dams, bridge construction, canal excavation, irrigation work, drinking water connection, sewerage work, and environmental engineering. An excellent example of his works in nation-building is the Krishna Raja Sagara dam (see picture above) in Karnataka's Mandya District. The flood protection system for Hyderabad is another one.

Engineering Values in Nation Building

It is engineering practice through Engineering Consultancy professionals that lays down the requirements of Space Planning, Green Buildings, Sustainable Design Management for Energy and Environment, Materials Management, Value Engineering, and Design for development and growth of a nation. The role of nation-building is well defined, and it now lies in accomplishing project of larger magnitudes all over the world. The projects include -Townships, Corporate Buildings, Industrial Complexes, Educational Institutions, Healthcare, Airports, Commercial Complexes, Bridges, Dams

and the Utility Services that provides for Water Supply, Sewerage, Storm Water Drainage, Water Treatment Plants, Over Head Tanks, Street Lighting, Electrical Distribution Network, Chimneys, Cooling Towers, District Cooling/ Heating, and other engineering activities.

Engineering Consultancy now a days is more inclined to energy conservation using technology and keeping sustainability in mind as the primary goal in today's competitive landscape. Energy conservation plays a significant role in reducing the effect on global climate change. Replacement of non-renewable resources with renewable energy can impact the environmental development in the competitive landscape. (Refer 'Energy Conservation for Utilities means Sustainability' by Ronald Valledor Gomeseria in CEAI ViewPoint September 2018 for further details of the impact of energy conservation delivered on the competitive landscape).

The engineering value of the proposition for nation building with Green Buildings is an opportunity to manage the resources responsibly throughout a structure's life cycle. It means creating buildings that are healthier for owners, occupants, and the natural environment. As compared to the conventional designs, green buildings have numerous benefits which include savings in the operating cost, with improved business productivity, reduced risk and liability, enhanced public image, and higher asset value. All of which are readily attainable within the project budgets when an integrated approach to project management.

Green building requires that the whole-building solution address the relationships between the structure with its environment. It is an approach that demands a significant degree of collaboration among the design and construction specialists.

Hence, in any engineering practice, Engineering Consultancy is vital for all the sectors which have been prioritized in the government's growth strategy that builds the existing strengths be it aerospace, pharmaceuticals, software and computing, automotive, renewable energy, healthcare, etc. The engineering consultancy for nation building can perform all the studies and investigations required for new builds, which aim to ensure superior comfort and long-term service life as solutions and as part of a lifecycle costing approach.

Nevertheless, Engineering Consultancy for Nation Building is not solely the responsibility of the Government but also the responsibility of every individual citizen in the country. Today most of employers are struggling to meet the requirement of knowledgeable and capable engineers at the senior level. It is therefore necessary that they invest in training younger engineers in high-skill works and also help them to increase their knowledge. This is vital for their gainful employment and the country's economy. The presence of good senior engineers coupled with high-quality engineering research can have a very positive impact on regional development. It will help to generate new economic activities and employment, which are vital for a country.

Environmental Movement in the Construction Industry

The good thing about the mother Earth's environmental movement is that the natural wealth that it harbours is to be carefully extracted so that a nation can attain their cherished vision of serving the citizens in a sustainable manner. However, every exploration results in some negative effect on the environment because of CO_2 emission which then contributes to global warming. There is dramatic improvement in many regions of the world primarily due to the inputs by the Engineering Consultancy with respect to the built environment on different scales.

The West Bay Doha View At The Financial Center (Flicker)

The Doha West Bay Area (see photograph) has been witnessing a lot of development as part of nation building. Sustainability is a key word in Engineering Consultancy for all projects. Even in the oil and gas industry, sustainability requirements are being incorporated.

The environmental movement of a nation is a translation of the country leader's vision which results in futuristic development for nation building with the ecological possibilism implications through construction. However, with that environmental pollution concerns arise due to the construction, which is the leading causes for dust generation due to excavations or digging everywhere in on account of construction of buildings, roads, and trenching for utilities with the dust and sands flying all over. The environmental pollutions created due to construction devastate the human ecological movement especially the construction workers. Air Pollution has a negative impact on everyone at site and the neighbourhood and results in injuries and sickness. It is for the Environmental Engineers and Scientists who are also a part of the nation building programme to ensure a safe environment, with adequate dust collection and suppression means.

Producing 1 ton of cement is roughly equivalent to a ton of CO_2 emission. Burning of fossil fuels has been tagged by US EPA (Environmental Protection Agency) as one of the third largest source of the greenhouse gas emission. Another material used in the construction is steel, which also is a major contributor to greenhouse gases.

It is great experience to be involved in Engineering Consultancy for various projects and be a part of nation building yet keep environmental and sustainability requirements in mind.

Environmental Advocacy in the Construction Industry for Nation Building

Construction is one of the most extensive industrial practice and business since it is a must for a country's socio-cultural and economic development.

The Green Building Council is continuously developing and improving ecologically responsive designs through a rating system that measures how a structure excels above and beyond the existing environmental regulations and standards. The Sustainable Engineering Consultancy's framework considers nine core areas as the fundamental criterion for building certification: 1) Energy Efficiency and Conservation, 2) Water Efficiency and Conservation, 3) Waste Management, 4) Use of Land and Ecology, 5) Environmental Management, 6) Green Materials, 7) Transportation, 8) Indoor Environment Quality, and 9) Emissions.

These need to be understood and so also the payback and the benefits of applying the green building principles - the incentives, lower insurance premiums, and the government initiatives for the green buildings.

Conclusion

Just as Sir Mokshagundam Visvesvaraya used concepts that would be termed green engineering today, it behoves all to follow the same principles. Engineering Consultancy through Environmental engineering and Sustainable Green Buildings designs is providing succour to the development of countries the World over and must continue to do so with greater zeal. The conceptual vision must always be to reduce the building carbon footprint that is commonly produced by the existing conventional design. The Green Building Council is also continuously developing and improving the green building policy for improved ecologically responsive designs.

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ENGINEERING CONSULTANCY IN WATER SECTOR

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Abstract

With a 1345 million population, India is the largest democracy in the world. India possesses a large pool of technical manpower with an annual intake of about 15,76,500 of graduates and post graduates from 10,949 technical institutions (as in 2013) spread all over the country(CEAI-2017). Consultancy services offer a unique opportunity for the engineers in solving innumerable problems being faced by the society to ensure proper utilization of available manpower by .providing specialist services. The paper discusses about the scope of consultancy in the various disciplines in water sector mostly under Government control at present.

Keywords: consultancy, irrigation, hydro-power, river training, water transport, water transfer, water supply, coastal protection

1.0 INTRODUCTION

Engineering Consultancy can play a very significant role in the water sector in bridging the gap between private initiative and public responsibility and in allaying the fears of both the government and the private bodies (Nadeem Khalil,2004). Development of consultancy profession in India has been quite significant during the last few decades. Consultancy Development Center (CDC) under the Department of Scientific and Industrial Research (DSIR) of the Ministry of Science & Technology, Government of India, Engineering Council of India (ECI), Consulting Engineers Association of India (CEAI), etc. have prepared a data base of consultants/,consultancy firms - both public sector undertakings and private organizations - covering areas like agriculture and rural development, banking and finance, engineering, construction and construction management, health, education, etc. Consultants face stiff competition amongst themselves for wining projects by projecting bio-data of their experts who act as key persons in the various disciplines to prove their capability and worthiness. They train their engineers to efficiently perform the various jobs assigned to them by the team leaders and specialists to complete the project in a time bound, cost effective and efficient manner to the satisfaction of their clients. The project reports prepared by the consultants are also subject to scrutiny by other consultants in the area. Consultancy help in value addition, quality control, timely completion of projects in a cost effective and time bound manner. To establish their credibility, they help in identification and cross fertilization of best practices, development of best strategy, analytical techniques and software, technology up-gradation, innovative ideas, application of latest R&D and best management practices. Many a times, a consultant associates with other consultants of repute from India and abroad or outsource a part of the job where they lack in necessary expertise and experience. Consultants are very effective in the allocation and best utilization of available resources by providing specialist services for a limited period without obligation for permanent appointment. Knowledge transfer and training form an important aspect of consultancy. They also offer independent and impartial advice to clients on most suitable and cost effective methodology and solution to satisfy cliental need and interest. Collaboration strategies of consultancy organizations in India have been discussed in depth by Diwan (1999). Although consultancy has taken deep root in our country, still there are some shortcomings which have to be overcome. In this paper, the author has outlined several areas in water sector where consultants can play major role for Nation building (IWRS,2007).

2.0 CURRENT STATUS OF ENGINEERING CONSULTANCY IN INDIA

Scope of engineering consultancy services are steadily increasing in our country because of the government policy of outsourcing jobs. The number of consulting companies in different disciplines in engineering and technology are steadily increasing day by day due to gigantic developmental projects being undertaken by the government for improving urban and rural infrastructures e.g. roadways, railways, waterways, smart cities, etc. Consultancy organisations in India, in both public and private sectors, are rendering very valuable services to the nation by doing most of the jobs (which government departments used to do earlier) in a much more efficient, economic and time bound manner.

It is, however, unfortunate that majority of the consultants in India are reluctant to upgrade and modernize through collaborations with educational and research institutions in India for more effective use of their manpower, time and money. Currently, research and development in our country is generally confined to a narrow circle of academicians and end in conference or seminar and journal papers or reports with very little industrial application. The main challenge of transfer of such R&D from laboratories to field lies in organizing, implementing and directing the research efforts in a well coordinated manner through appropriate collaboration (Chakraborty,1999). Research and development must have strong linkages with industry for meeting socio-economic goals (Mazumder, 2014). University professors and the young research scholars working under the professors comprise an enormous pool of expertise and resources which must be tapped to solve many a challenging problems faced by the society in the fast changing world with global competition.

A major problem being faced by our educational, research, consultancy and industrial institutions today is how to attract and retain qualified and meritorious persons (CEAI, 2017). A large number of such persons leave the country for higher education abroad for better pay and perks, congenial environment for research, freedom of work and above all due recognition of their achievements. Post graduate study for teaching and research is the last priority in India today. If this situation continues, our educational, research and consultancy institutions have no future and we are going to be dependent on foreign institutions for higher education, research and consultancy forever.

3.0 CONSULTANCY IN WATER SECTOR

Water resources engineering is a branch of civil engineering where there is a lot of scope for research and consultancy (FICCI,2004). For any development project, a large number of consultants are needed in various disciplines of Civil Engineering viz. (i)Structural Engineering (ii) Geo-technical & Foundation Engineering (iii) Highways & Transportation engineering (iv) Hydraulic & Water Resources Engineering and (v) Environmental Engineering, et al. Although there are good numbers of private consultants in the first three disciplines, there are very few qualified and competent consultancy organisations under the next two which are at present solely dealt with by the government departments. The author wishes to focus on the fourth discipline i.e. Hydraulic and Water Resources Engineering where there is a vast scope for research and consultancy in both private and public sector (Mazumder,2009).

3.1 Hydraulics and Water Resources Engineering

The areas which are covered under this discipline can be broadly sub-divided in to:

- Irrigation and Drainage
- Hydro-Power Development
- River Training and Flood Control
- Water Transport and Navigation
- Water Supply and Sanitation
- Water and Soil Conservation

- River Linking for Drought protection
- Coastal Area Protection

3.1.1 Irrigation and Drainage

Fig.1 shows the Growth of Population, Food Production and Irrigated Area in India during 1951-2050. Presently,78% of our precious water resources are used for food production and food security (INCID,1998).

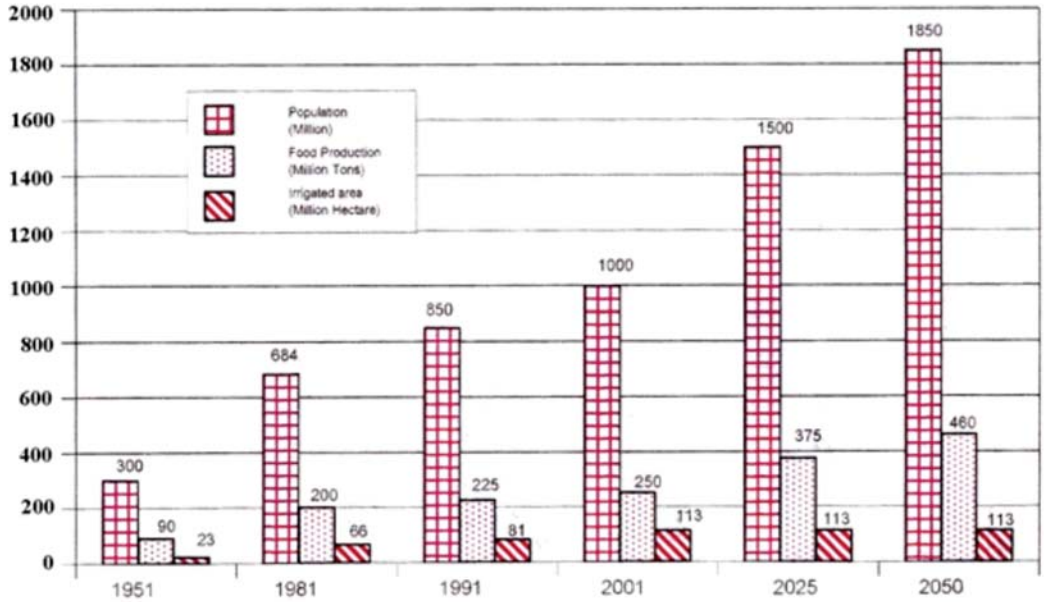

Fig. 1 Growth of Population, Food Production and Irrigated Area in India (1951-2050)

There are only a few storage reservoirs like Bhakra which can hold flood waters in high rainfall years to fight consecutive droughts due to scanty rainfall. It is not advisable to build dams like Bhakra today, because of their environmental impact. The only way left is to properly manage the available water resources in a judicious and efficient manner (CWC,2010). There is a huge loss of water in surface irrigation schemes primarily due to heavily subsidized water supply policy and poor on-farm development (Ministry of Agriculture, 1979). Even a marginal increase in irrigation efficiency will generate enough water to meet the requirements for our future need of food and other requirements, provided of course our population can be stabilized at 1850 million by the year 2050 (Fig.1).The overall efficiency of irrigation projects (also called project efficiency) in India is too low at an average of 35% in the case of major and medium irrigation projects (INCID,1998) as compared to 55% in China and 70% in Japan (CWC,2010). Most of the irrigation water is found to be lost in conveyance and field application and extremely poor management of water at the farm level (Mazumder, 2017). While emphasizing the present day need of intensive irrigation for maximizing yield per unit of area and unit of time, Bharat Singh (1991) identified the following major short comings of our present irrigation schemes:

- Gap between the creation of irrigation potential and its utilization
- Unreliable and inadequate water supply
- Inequitable distribution of water between head and tail enders.
- Non-responsive and authoritarian administration
- Lack of control, poor administration and increasing malpractices
- Low efficiency of canal systems and poor on farm management of water.

Planning Commission(1992), renamed as Niti Aayog, recognized the three major shortcomings responsible for poor performance of irrigation schemes in India, namely,

- Unlined channels
- Lack of land consolidation, improper leveling and sizing of irrigated land
- Poor on- farm management of irrigation water beyond outlets.

Several steps for improving irrigation efficiency by reducing avoidable losses have been outlined by Mazumder and Kumar (2015). Since there is a lot of risk involved in water availability, depending on natural rainfall, private consultants, except a few, are reluctant to invest in water sector. However, there is great scope for consultancy in the area of irrigation and irrigation management in India (Mazumder, 2010).

3.1.2 Hydro-power Development

India has a hydro–power potential of 90,000 MW at 60% load factor corresponding to a potential installed capacity of 1,50,000 MW. Currently hydro-power share is about 17 % against an ideal share 40% in hydro-thermal mix of power supply. Out of 1,45,320 MW of major hydro-potential of India, 94,900 MW i.e. 65.3% is yet to be developed in the country. The State of Arunachal Pradesh with a major potential of about 50,000 MW has developed only 5-6% of its hydro-power potential so far. A large numbers of projects are in the pipeline in Arunachal, Himachal and Uttarakh and states (Mazumder,2017). There is a great scope for private participation and consultancy services in the area which needs high quantum of expertise and experience.

3.1.3 River Training and Flood Control

River and river water is in the concurrent list of Indian Constitution. On an average, there is a annual flood damage of about Rs. 40,000 million (based on 2003 prices) due to recurring floods in all parts of the country, apart from loss in communication and unimaginable sufferings of people (CEAI, 2018). River training and flood control is at present under the exclusive domain of the State and Central Governments. There is a great deal of mismanagement, corruption and inefficiency in this sector. Consultants with proper knowledge and experience in the subject can play a major role in the area in improving performance of the projects in a time bound and economic manner.

3.1.4 Water Transport and Navigation

Water transport is the cheapest mode of transport (especially for bulk goods), compared to other modes of transport like airways, roadways and railways. Government of India is going to develop 106 National Waterways (e.g. NW-1: Allahabad – Haldia stretch of Ganga, NW-2: Sadiya-Dhubri stretch of Brahmaputra, NW-3:Kollam-Kozhikode Stretch of West Coast, etc.) for navigational purposes. Similar to Highway Authority of India, Government of India has entrusted the job to Inland Waterways Authority of India for proper planning, design, execution and maintenance of these projects at huge capital costs. It needs qualified and experienced engineers and consultancy services to expedite the timely completion of these projects.

3.1.5 Water Supply and Sanitation

Apart from agriculture, water supply is needed in other sectors like industries, power plants, municipal supplies, etc. for building smart cities and providing improved infrastructures including ‘Swatch Bharat’. Assured water supply and sanitation in a sustainable manner is an important task for improving quality of life for our urban and rural poor. Function of ministry of water resources has been extended to rejuvenation of river Ganga and river development to face the immense challenges of river pollution and river development for water transport and water transfer from surplus to deficit basins.

Treatment of waste water and re-use of treated water is highly effective not only in reducing fresh water requirement but also in combating increasing pollution of surface and sub-surface water (CEAI, 2018). Consultants of high caliber, knowledge and appropriate training are essentially needed for implementing the ideals of the Government for planning, design, construction, operation and maintenance of water supply and sanitation projects.

3.1.6 Water and Soil conservation

Utilizable water resources of India are estimated as 1120 billion cubic meter (BCM) which comprise 690 BCM of surface water and 430 BCM of replenish able ground water (Iyer, 1989). 748 BCM is lost to the atmosphere through evapo-transpiration from rain fed agriculture, barren lands, forests, natural vegetation, natural ponds and lakes, etc. Water conservation through rain water harvesting is a must to meet the ever increasing demand of water by our growing population. We have poor storage capacity of about 305 BCM only and many of the storage reservoirs built in 50s and 60s are fast depleting their capacities due to siltation of the reservoirs (CWC, 1991). Soil conservation is badly needed not only for extending the life of the reservoirs but also for control of landslides, floods and associated calamities, especially in hilly areas. The area is at present fully under government control. Considering its severe implications, private participation and consultancy are essentially needed in this area.

3.1.7 River Linking for Drought protection

Average per capita water availability in India is estimated as 1545cubic meter (Iyer, 1989) in the year 2025. Areas having per capita availability of less than 1000 cubic meter and less are considered to be water stressed. Considering the regional variation in precipitation, many parts of the country are already facing acute shortage of water and droughts as indicated in Table-1. Many more states are going to be water stressed soon due to increasing demand of water. Considering rapid growth of our population and increasing river pollution, Government of India has proposed 30 river link projects for water transfer from surplus to deficit basins of India (Fig.2). Implementation of these projects is a herculean task and faces many difficulties (IWRS,1996). Obviously, execution of such projects needs host of consultancy services in multiple disciplines of civil engineering from both public and private sectors.

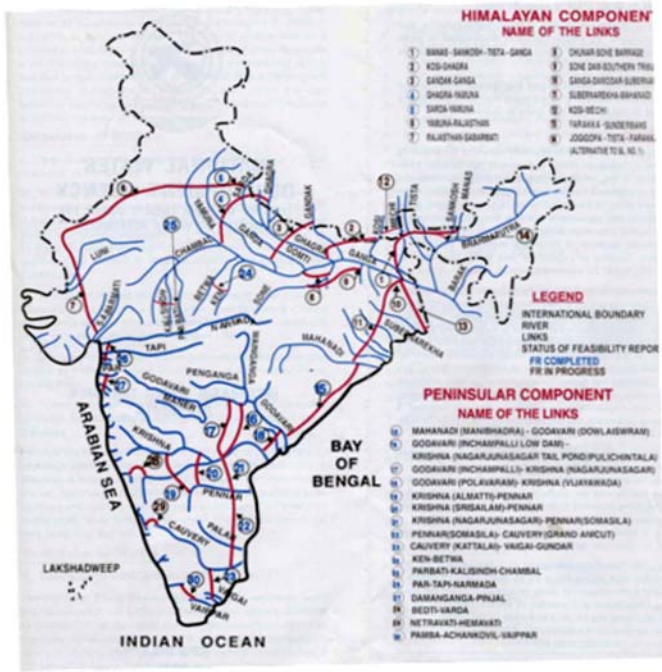

Fig.2 Interlinking Indian Rivers

Table-1: Surplus and Scarce Basins in India

Surplus Basins		Scarce Basins	
Basins	**Per Capita Availability (cum/ year)**	**Basins**	**Per Capita Availability (cum/ year)**
Brahmaputra Basin	18,417	East flowing Rivers between Mahanadi and Pennar	919
Barak Basin	7,646	Cauvery	666
Eastflowing Rivers between Tadriand Kanyakumari	3,538	Pennar	648
Eastflowing Rivers between Tapiand Tadri	3,194	Westflowing River Basin of Kutch and Saurashtra including Luni	631
Narmada	2,855	East flowing River Basins between Pennar and Kanyakurnari	383
Brahmani-Baitarni	2,696		
Mahanadi	2,546		
Godavari	2,026		
Indus	1,757		
Ganga	1,473		

3.1.8 Coastal area Protection (http://cwc.gov.in/CPDAC)

India has a coastline of 7500 km of which 2700 km is on the east coast, 3000 km on the west coast and the remaining in Lakshadeep and Andaman groups of islands. The continental shelf extending up to 50 km in the east and 150 km in the west beyond the shoreline also belong to India. Several storms occur both on east and west coasts due to disturbances in the ocean. The frequency of such storms is low (about 2 in a year) on the west coast as compared to those on the east coast (about 5 in a year). The coastal processes in sediment transport and coastal erosion due to oblique attack of sea waves and tidal currents are responsible for coastal erosion affecting coastal population, shipping, fishing, transport, harbors, ports and docks, etc. Sea defense works consisting of sea walls, artificial nourishing of sea beach, dykes, bulkheads, groins, gabions, stone pitching, etc. are necessary for protection of the vast coasts of the country. These are very costly measures and need high expertise in their implementation. There is a lot of scope of consultancy services in this discipline.

4.0 CONCLUSIONS

India produces a large numbers of graduates and post graduates every year from both public and private institutions. Through proper industrial training and updating of knowledge, consultancy services-through public, private and PPP schemes- offer great opportunity for the Engineers in execution and maintenance of all development projects envisaged by the governments in an economic and time bound manner. There is a great scope of consultancy services in water sector e.g. Irrigation, hydro-power, water supply, water treatment, river training, river linking, coastal protection etc. which are by and large performed by the Government at present.

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INDIGENOUS TRAIN 18 NOW FASTEST IN INDIA

NEW DELHI: Train 18, an indigenously developed semi-high speed train, has officially become the first train in India to cruise at a sustained speed of 180 km per hour making it the fastest train in the country, railway minister Piyush Goyal announced through a Tweet on Wednesday.

The Chief Commissioner of Railway Safety (CCRS) has given the go-ahead for the train to run at a maximum speed of 160 kmph with certain conditions paving the way for its commercial operation. The conditions include providing "sturdy fencing" all along the track to avoid any mishap. The CCRS in its communication to the Railway Board has said, "Railway shall ensure provision of sturdy fencing at vulnerable location on need basis for operation up to 130 kmph. For speed beyond 130 kph and upto 160 kmph, provision of sturdy fencing all along the track shall be ensured." It has laid down 21 conditions that the railways must comply with to run at maximum speed of up to 160 kmph.

The clearance from CCRS is a pre-requisite for any train with new technology to start service.

Railway Ministry sources said the train speed can also go up where the track condition is superior. Tweeting a video clip of the train, Goyal Tweeted, "Need for Speed: Train 18 seen cruising at a sustained 180Km/h, officially becoming the fastest train in India."

The first such train manufactured in India at a cost of approximately Rs 100 crore is scheduled to ply between Delhi and Varanasi via Allahabad. Prime Minister Narendra Modi will flag off the train and the date of starting the service has not yet been decided.

The CCRS has put the conditions while giving go ahead for the train operation after it recently carried out inspection of the new 16-coach train during speed trial between Safdarjung railway station and Agra. The train is fully air-conditioned and has modern amenities to make the travel comfortable and safe. The train can accommodate 1,128 passengers.

Source: http://timesofindia.indiatimes.com/articleshow/67264642.cms?utm_source=contentofinterest&utm_medium=text&utm_campaign=cppst

CONSULTING ENGINEERS CONTRIBUTION - WATER AND ENVIRONMENTAL SECTORS

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Introduction

Asset creation/ developing any facility require engineers for planning, designing, execution and maintaining it in a sustainable and environmental friendly manner for the benefit of all stake holders.

Consulting Engineers play vital role in execution of Projects which aid the economic development of the Nation by creating employment, wealth and also bettering the living conditions of the citizens.

Projects are initiated by the Government or private sector entities and are engineered by Consultants who are also involved in implementation/execution of the same. Thus Engineering Consultancy plays a very crucial role in nation building as a key stake holder.

Water and Environmental Projects

Water and Environmental Projects initiated by government sector are funded by government, funding agencies and through private sector investment as PPP model/hybrid annuity based models. Providing safe drinking water of adequate quantity for any city/ rural population is one of the primary obligations of that city's municipal authorities or any independent authority constituted for the purpose. Therefore one of the main objectives of such an authority would be to plan well ahead and identify additional resources of water for meeting additional demand in the coming years for the increased population and also for stepping up per capita water supply. The waste water generated has to be managed properly to prevent contamination/pollution of rivers and water bodies and also unhygienic conditions developing.

Environmental projects are mainly focused on protecting natural water bodies and managing solid waste to create hygienicand safe environment for the habitants. Of late some of the projects have also focused on generating power from the solid and liquid wastes.

Many major infrastructure projects planned and initiated by State or Central government agencies have been engineered by Consultants and some of the projects are of national importance. Some of the Projects initiated at State and Central levels are:

- Preparation of Master Plans for Water and Sewerage Infrastructure
- Water and Energy Audit Projects
- Urban Renewable Projects – Atal Mission for Rejuvenation and Urban Transformation (AMRUT)
- Interlinking of Rivers
- National River Conservation Directorate (NRCD) sponsored Projects
- Namami Gange Project
- Solid Waste Management and Waste to Energy Projects.

Preparation of Master Plans for Water and Sewerage Infrastructure

Many consulting firms are working on the preparation and implementation of Water and Waste Water Management Infrastructure Projects in urban and rural areas.

The objective of these projects is to provide sufficient quantity of quality water to the people and also manage the waste water generated in order to protect water bodies, and also prevent ground water contamination.

Consulting Engineers are the largest Indian private sector players providing engineering consultancy services in the infrastructure sector for decades and play a major role in developing master plans and designs for water and sewerage infrastructure and also implementation of the same in order to cater to present and future needs of people of major cities, towns and rural areas.

They have contributed by providing safe surface water to areas with fluoride affected ground water by implementing regional water supply schemes covering many villages, in order to improve sanitation condition of the population who are getting inadequate water by way of septage management and soak pits.

Water Treatment Plant

Sea Water Intake and Desalination Plant

Water and Energy Audit Projects

Water projects have been designed and implemented with minimum operating cost and the performance of assets as per optimal design standards. Over a period of time due to poor maintenance and other reasons the performance of these assets deteriorates and starts working at sub optimal level which increases operating cost and also resulting in lesser revenues. Sub optimal performance of assets deprives the availability of scarce commodity to a larger community.

The outcome of these projects have resulted in savings of upto 30% of the water supplied which was accounted as Unaccounted for Water (UFW) and resulted in increase in water supply rate/ to a larger population and in turn increase in revenue to water authorities.

Energy Audit Work

Installation of Flow Meter

Data Logger

The outcome of Energy Audit Projects reduced operating costs and saved energy to be used for other purposes.

Urban Renewable Projects – Atal Mission for Rejuvenation and Urban Transformation (AMRUT)

The mission of AMRUT is to provide basic services such as water supply, sewerage, urban transport, solid waste management, etc., to households and build amenities in cities which will improve the quality of life for all, especially the poor and the disadvantaged. This is the initiative of Ministry of Urban Development (MoUD), Government of India (GOI) and consulting engineers are playing a vital role in implementing them. Some of the projects are storm water drainage, creating and upgrading green spaces, parks and recreation centres and creating parking spaces .

Interlinking of Rivers

Interlinking of Rivers in India is a national project initiated by the Ministry of Water Resources, Government of India with the objective to effectively manage the country's water resources by linking rivers by a network of canals and reservoirs and thus reduce the persistent annual flooding in some parts and water shortages in other parts of the country. Sharing of water resources equitably across the country would result in better economic growth of the country in terms of increase in irrigation potential and also power generation apart from eliminating destruction of property due to floods and also reduce droughts in other parts.

National River Conservation Directorate (NRCD) sponsored Projects

The National River Conservation Directorate (NRCD) in the Ministry of Environment, Forests and Climate Change is implementing the Centrally Sponsored Schemes of National River Conservation Plan (NRCP) for conservation of rivers. Major cities have been selected under this projects which are located in the watershed/basin of important rivers such as Bengaluru, Allahabad, Kanpur, Ahmedabad,et al., to prevent contamination of untreated liquid waste entering into the rivers.

Namami Gange Programme

The Namami Gange Programme is an integrated conservation project for abatement of pollution, conservation and rejuvenation of the River Ganga and its tributaries. It is being implemented by the National Mission for Clean Ganga (NMCG) under the Ministry for Water Resources, River Development and Ganga Rejuvenation, Government of India.

River Rejuvenation

Liquid waste include the effluents of industries, fertilizer and pesticide solutions from agricultural fields, leachate from landfills, urban run-off of untreated waste water and garbage, construction wastes, etc which are contaminating the

River Ganga and its tributaries. Rejuvenation of River Ganga and also using this as Inland water ways will go a long way to develop the economy of the people living in these river basins.

Solid Water Management andWaste to Energy Projects

Swachh Bharat Abhiyan or the Swachh Bharat Mission is a nation-wide campaign in India that aims to clean up the streets, roads and infrastructure of India's cities, towns, and rural areas initiated by the Ministry of Housing and Urban Affairs, Government of India.

Consultants are working on the WTE projects by implementing schemes for generation of power from solid waste generated in cities and towns. Solid waste management is a major issue in bigger cities in terms of segregation, treatment and disposal.

Consultants are also involved in implementation of STPs with energy generation. Energy recovery from the sludgehelps reduce greenhouse gasemissions. The waste to energy solution is designed to contribute to about 35% of the total energy requirement for the operation of sewage treatment plant perse.

Conclusions

Consulting Engineers are playing a pivotal role in implementation of water and environmental projects for providing quality and sufficient quantity of water and also meeting the ever increasing demand due to population growth. They are also acting as the major stake holder in handling and managing solid and liquid water generated in cities and converting waste into energy to meet part of energy requirement.

They are also vital for ensuring equitable distribution of water resource by way of interlinking of rivers and protecting the rivers and water bodies from contamination/pollution on account of solid and liquid waste entering them.

The contribution of Consulting Engineers has resulted in improvement in the standard of living of people, growth of country's economy and helping it to become a strong nation.

GREEN LIGHT: INDIA TO NEAR CLEAN ENERGY GOALS IN 2019

India's renewable energy (wind and solar) sector's contribution to the overall power generation mix is expected to cross 10% in FY20 as the country will add 10 Giga-Watt (GW) generation capacity during the period. In the preceding three years, the share of renewable in total generation mix has risen to 7.8% as of March 2018 from 5.6% in FY15 owing to large capacity additions witnessed in the wind and solar power segments. India plans to have 40% of installed power generation capacity on clean sources by 2030.

The boost came mostly from central and state governments policies, as well as the improved tariff competitiveness of wind and solar power. The lowest tariffs for solar and wind power now stand at Rs 2.44/unit and Rs 2.43/ unit, respectively. The average rate at which states buy non-renewable power is Rs 3.53/unit.

The calendar year 2018 also saw over 10 GW of project awards by the central nodal agencies and state distribution utilities, which provide a healthy visibility for renewable capacity addition in calendar year 2019 and FY20.

To meet India's 175 GW renewable energy target by 2022, the ministry of new and renewable energy plans to tender 60 GW of solar and 20 GW of wind capacity by March 2020, leaving a two year window to complete the projects within the target period. As per estimates, 9 GW and 20 GW of renewable capacity would be added in FY19 and FY20, respectively.

https://www.financialexpress.com/industry/green-light-india-to-near-clean-energy-goals-in-2019/1428566/

DUAL PURPOSE STRUCTURE FOR BRIDGE AND WATER STORAGE - NEED OF THE DAY

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1. Introduction

Maharashtra has a tradition of constructing Bridge Cum Bandhara (BCB). These structures are popular as they serve dual **purposes of providing a bridge for crossing the river as well as for storing water**. The tradition started in 1960 in Kolhapur where extensive sugar cane is grown. It was observed that the **irrigated water would percolate into the river bed and was thus not utilised**. Hence they started to **recycle the water** and structure to collect the water came to be known as Kolhapur Bandhara (see typical photograph). It consists of closely spaced piers having a clear distance of 2m. Gates are fixed in slots to create the water storage. The gates are fixed at the end of the monsoon and removed before onset of the next monsoon. Such structures have been used to tap post monsoon flow to create storage not exceeding 3.50m in depth. They are ideal structure for situations such as:

i. To tap post monsoon flow to create storage of up to 3.5 m depth. The storage is created by fixing needles/gates between bandhara piers to tap the last flow.

ii. Stored water is used for drinking and irrigation.

iii. It recharges the ground water which is then available for irrigation as well as domestic use.

iv. Surplus water that percolates into the ground on account of irrigation activities again goes into the river and is retapped and reused for irrigation.

v. Such stored water can be used for artificially recharging the nearby bore wells as well as open wells to augment the ground water.

The water is stored within the river banks hence it does not require additional land acquisition and therefore the scheme is popular. These structures were not necessarily built along the regular roads but at suitable convenient locations. Later on designs were developed to construct new bridges or to convert existing bridges on planned roads also to be used as Bridge cum Bandhara (BCB).

Typical Kolahpur type BCB

A few photographs of Bandhara constructed are given below.

Bridge cum Bandhara

2. Limitations of Traditional BCBs

The traditional BCB designs has certain advantages and disadvantages. The major limitation of the traditional structure is that the gates are required to be fixed when the monsoon subsides and removed before the onset of the next monsoon. The gates need to be stored at a suitable place for around 8 months. The Government therefore encouraged formation of societies of beneficiaries who would undertake the responsibility of the operations and also authorized them to recover the charges from the beneficiaries. However, the potential benefits of the system were not fully used due to lack of interest by farmers. Damages are reported due to non removal of gates or storage not created due to delay in fixing. Theft of the gates is also common.

3. Problems of Small Rivers/Nallas

In rivers having a width of up to 30 to 35 m the **maximum depth of water during flood does not generally exceed 4.5 m and their** behaviour **is also similar. Once the rain stops, the water drains off in a few hours and river becomes virtually dry.** For nallas up to 10 m width it may require only a few hours to be completely empty. Even in monsoon these minor rivers can be crossed after a few hours of stoppage of rain. Each village has such a **natural**

small river course as water is a prime need for survival. Villages settled near the natural course of these rivers **do not play an active role in conserving and recharging the ground water. Photographs taken on 14th August 2018 show the dry riverbeds. Even the well in the river bed is dry.**

4. Innovative, Affordable and Cost Effective Elliptical Shaped Curved Weir as BCB for Small Rivers

A new design of an elliptical curved concrete weir which was deemed to be ideally suitable for small rivers as a BCB structure was evolved. It has removed the limitation of traditional BCBs which require fixing and removal of gates. **The design involves constructing elliptical shape arches made of reinforced cement concrete touching the bridge to serve as weirs**. This structure then ensures water for the entire monsoon period and also helps to pond the water on the upstream side.

5. Neri Peth Project

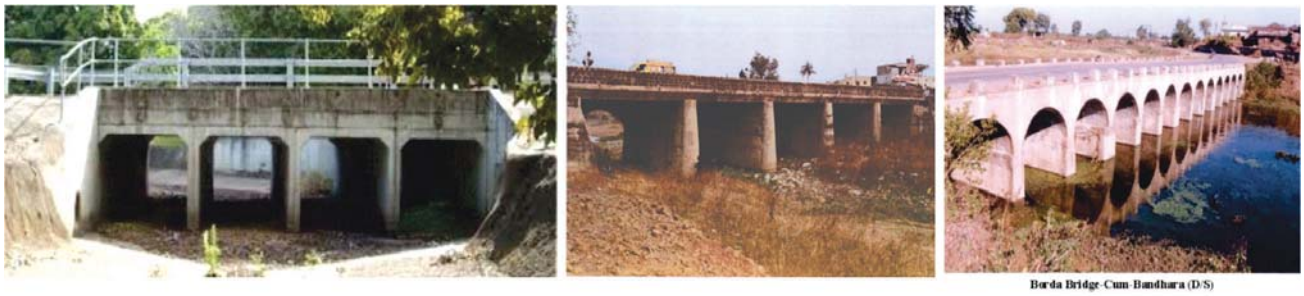
The culvert crossing is constructed using multicell Hume pipes at Neri Peth. Thereafter the elliptical arch dams were constructed in RCC which act as the weirs. Once the water reaches the top of the arch it spills over the crest and passes through the pipe opening. The construction sequence is shown in the photographs.

The Neri Peth structure was completed in one month and there was standing water for the entire monsoon period thus helping the recharging of the ground water in a big way.

6. BCB and Minor Bridges

The typical structures for which the arch type BCB can be constructed at affordable cost are:

1. Multi cell Hume Pipe culverts
2. Culverts/Minor bridges having multiple spans with each span of less than 6m
3. Single/multicell box culvert of size 2x2m,3x3m,2x3m, etc.
4. 2m semicircular arch culverts
5. Kolhapur type weirs



Borda Bridge-Cum-Bandhara (D/S)

7. Functioning of the Elliptical Arch

By constructing elliptical arches the lineal **waterway of the bridge** is not reduced. The arches function as curved weirs and only change the direction of flow. Extensive model studies have been done for determining the formulae for discharge over such curved weirs. The **Model study has proved that the normal formula for discharge over a straight weir is applicable except that equivalent length could be 1.20 to 1.30 times that of the straight length depending on the curved shape.** The height of such curved weir can be decided to create standing storage and find the afflux for the designed highest flood. **The afflux level for maximum designed flow must be within the banks of the river/ nalla for the proposed storage level. Standard formulae to calculate afflux for weir can be used.**

8. Model Study

Extensive model studies have been done at 1) Pune Engineering College, 2) Amravati Engineering College and 3) Chandrabhaga Canal to get a **better understanding of** the **behaviour of the flow**. All these model studies have revealed that there are no adverse flow conditions such as heavy turbulence, hydraulic jump, vortex formation, etc. On the contrary the flow is smooth. The model study also confirmed that afflux as calculated by the curved weir formula is reasonably correct.

Model study at Pune Engineering College

Study of flow over the elliptical weirs at Chandrabhaga Canal

9. Efficient Structure System leading to effective solution

The curved weir is an alternate to cement concrete plug or low height straight weirs which are all gravity structures and constructed to ensure standing water to help ground water recharging. The length of the straight weirs has to be kept slightly more than the natural width of the river to keep the afflux within the banks. Wing walls are a must to contain flood waters. Besides, as there is free fall of the water over the straight weirs, elaborate protection measures are required to be provided on the downstream side.

However, the elliptical arch weir system is structurally more efficient and hence cost effective. All the forces acting on the arch weir are transferred to the main bridge hence the weir structure is light. There is also no need for separate wing walls. As the water overflowing the curved weir falls on impounded water, hence elaborate protection measures are not required. The curved length of weir increases the flow hence afflux is also less. Due to all these advantages the cost of the curved weir as a storage structure is 30 to 40% that of a similar straight concrete weir serving the same purpose. The average cost of the elliptically curved weir comes to Rs. 40,000 to Rs. 50,000 per running meter.

10. Shape of Arch

The arch shape has been selected based on findings of the model studies and analyses for hydraulic behaviour of bridges. With the objective to have a safe structure, the arch shape was selected so that the cumulative plan area of the arches is at least 1.25 times that of the waterway of the straight span to cater for the designed flood lineal waterway. The elliptical shape was found to be fulfilling the condition. Various shapes as parabola, circle, hyperbola, etc were studied and it was found that in an elliptical shape the curve length is least and hence would prove cost effective. As individual spans may vary the shape of the arch was so selected that a common formwork with minimum changes would suffice so as to keep cost of form works low.

11. Construction Methodology

The cost of each of the elliptical arch structure does not exceed Rs. 4 to Rs. 6 lakhs. Since the weir works required to be constructed are scattered over a large area hence to keep the cost low the works need to be got executed through local contractors. Good quality formwork is essential along with M25 grade self compacting concrete. The cost of formwork and concrete are virtually the same. To achieve economy through repetitive use, it is intend to encourage an agency to own the formwork and rent it to local contractors. To ensure better quality and accelerate construction, it is proposed to pre-cast the arches in sections at a centralised place/factory. The cast sections would be erected at site and joined by in situ concreting. This technique is currently under development.

12. Potential use of Elliptical BCB

As the cost is low and affordable with great benefits, the technology is expected to be used by many. The potential usages are:

a) **Groundwater recharging**-In the areas under consideration rainfall occurs on an average for 20 to 25 days in a year. During each of these rainfalls 7,000 to 8,000 cubic meter of water is collected which translates to about 1.5 lakh cubic meter per annum. The water needs to be used for recharging of the ground water through simple techniques which are readily available. Even if 30% of the water is saved a village can be made tanker free.

b) **Potable water at affordable price in saline tracks of land**: In saline areas an ordinary sand filter costing around Rs. 1.5 lakh too can supply potable water at Rs. 1.5 for 20 liters. Since rain water is being purified, costly RO systems are not required. At village Apoti in Akola District one scheme has been sanctioned by the Government of Maharashtra and is under implementation.

c) **Artificial ponds/ Malgujari tanks**: The Government of Maharashtra is providing subsidy and encouraging farmers to construct Farm ponds (Shettale-small water bodies) which can be filled with water using solar pumps to create irrigation facilities. In Chandapur District there are several natural small lakes called Malgujari tanks. The cost of small tanks, solar systems, pipe lines, etc. normally do not exceed Rs. 30,000 per acre which is much less compared to the average cost of Rs. 4.5 lakhs per acre of a major irrigation project.

13. Funding for implementation

As water is a priority sector, the Government is providing funds for water conservation projects. The solution suggested to augment ground water is affordable and cost effective. They can be implemented in many areas. A few pilot projects demonstrate the economical advantage of the scheme enumerated above. Funds therefore would be available through budget or through the MLA/MP discretionary funds on account of low cost of individual scheme. CSR funds could also be available. The Government has announced that they want to double the income of farmers. Thus this scheme will enable the Government to fulfill this important objective. The Government of India has decided that for all National Highways and PMGSY works the funding for BCB will be done by the Government of India. Large scale National Highways improvement program is in progress hence the BCB structures can be constructed from the contingencies of the ongoing works.

Acknowledgements

The authors are thankful to Shri Debadwar, Chief Engineer, Shri Jaiswal Executive Engineer and other staff of Maharashtra PWD who were involved in the implementation of projects. Shri Jangade, Former Secretary, Maharashtra PWD and former Member MPSC took lot of efforts in scrutinizing the design and gave critical comments. Shri Garibdas of Innovative Construction, has played a major role in developing construction technology. Shri Dhawae, Superintending Engineer, Minor Irrigation Project has extended all help in conducting model study at a large scale Similarly Prof. Mrs. Thube of Pune Engineering College and Dr. Tatewar of Amravati Engineering College, took lead in laboratory studies which helped to draw useful conclusions. The authors are also thankful to all the experts involved in making the scheme successful.

IN SEARCH OF A RIGHT SOLUTION: International Conference on *"Innovations in Concrete - to meet Housing & Infrastructural Challenges"*, ICI-IWC 2018

Mainak Ghosal, Prof. Consultant
ICI Active Life Member; Faculty, Private Engineering College; PhD Research Scholar, IIEST, Shibpur, Howrah

1.0 INTRODUCTION

Innovative World of Concrete – IWC is the Indian concrete industry's only quinquennial event. Itwas first organized in Bengaluru in 1993 and is dedicated to the commercial concrete and masonry construction industries. After being held in many cities, IWC - 2018 was again organized in the Silicon Valley, Bengaluru at Nimhans Convention Center after a gap of 25 years. Just as the *World of Concrete* (WOC) is the global concrete industry's annual event supported generally by American Concrete Institute, IWC-2018 is supported by Indian Concrete Institute(ICI), featur ingindoor and outdoor exhibits showcasing innovative products and technologies along with exciting demonstrations and competitions by the industry's leading suppliers. There is a world-class education program together with the information needed to help sustain and grow businesses.

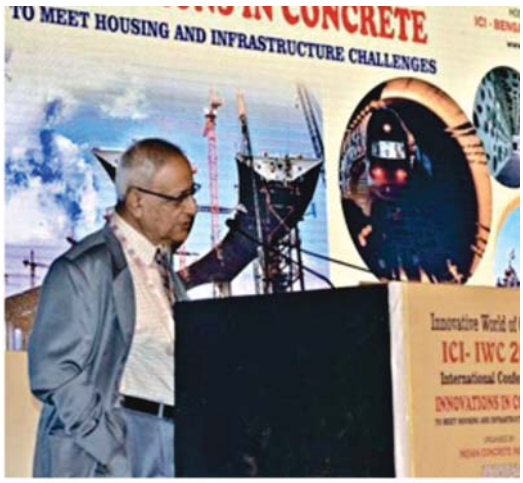
Lighting of the Lamp

Releasing of Compendium

BRIEF DISCUSSION

The 2.5 days conference which started on 19th September and concluded on 22nd September 2018 saw 6 Keynote addresses and 13 Lead lectures from industry experts, apart from 15 regular Papers. They touched all aspects of concrete and innovations in materials, shuttering systems, technology, research & development, sustainability, life cycle management, etc. providing a great deal of information to scholars, researchers and practicing field engineers.

Cement being the only standard material used in concrete, the building industry faces the major challenge of finding ways to low-carbon based construction the world over. Infact in future when the construction industry comes under ISO, concepts like carbon credits and carbon taxing will emerge to determine the amount of CO_2 released in atmosphere by the construction companies which may or may not face penal action as a consequence. Though steel, wood and glass too are major constituents, their consumption by the industry is much smaller in terms of volume.



Keynote address by Mr. Anjan K. Chatterjee (Pic. Courtesy: The Hindu, Sep'21, 2018)

Delegate Feedback Session by Mr. Mainak Ghosal

Although there is still no replacement for large scale cement use, it leaves a large carbon footprint on the environment as kiln furnaces have to be heated up to 1,500 degree Celsius using enormous amount of fossil fuels. Globally, 8 to 10% of total carbon dioxide emissions are believed to be contributed by the cement manufacturing process. A search is therefore on to find alternatives and replacement for cement in the construction industry. If statistics pertaining to global final energy consumption are any guide, building industry consumes the major amount of energy i.e., 31% against 28% by all other industries, 27% by transport and 15% by other sectors. Conversely, the building industry contributes 29% to global emission (2014 figures) against 22% by transport, 35% by industry and 12% by other sources.

India produced 425 million tonnes of cement last year. Of the total energy consumed, around 30% goes for buildings (construction, cooling, heating, lighting put together). Figures pertaining to annual growth in building floor area suggest that by 2050, India will overtake North America and Western Europe. In 2015, Indian construction industry built 15.8 billion square metres of floor area which is set to more than double by 2030 and rise up to 57 billion square metres in 2050. Going by these figures, the carbon emission scenario will be extremely dangerous. **('***How to build without a carbon footprint', The* Hindu, Sep'21, 2018**)**

2.1 Low Clinker Factor

Delivering the keynote address at the IWC 2018, Mr. Anjan K. Chatterjee, former whole time Director of ACC, said the task of tackling emission is enormous as well as complex. He also said strategies should focus on using cement

with low clinker factor, cutting down volume of cement in construction and using recycled coarse and fine aggregates. He said composite cement comprising 35 to 65% Portland cement clinker, 15 to 35% fly ash, and 20 to 50% of granulated slag could be one alternative but cautioned that very limited types of supplementary cementitious materials were permitted to be used. Even widely available and proven materials like silica fume, calcined clay (metakaolin) and limestone were left out. Mr. Chatterjee opined that the studies so far have focused only on testing and not on making the composite cements of superior performance and application-friendly. "The industry needs to probe if the partial substitution of natural aggregates by recycled aggregates could be made mandatory." The discussants were unanimous that transition to low-carbon concrete construction required multidisciplinary approach. Large volumes of construction in widely varying environment make the tasks complex much beyond simple proportioning and testing. Adoption of modelling onmultiple scales, based on actual field data,was necessary. Though much innovation has happened, more was needed in finding substitutes for cement.

2.2 Affordable Housing

India has a huge latent demand for affordable housing. There were 280 million households in India in 2016 but only 190 to 200 million of them were living in *pucca* structures. With current population growth at 1.3% and nuclear families growing at a pace of 0.9%, the nation faces the challenge of providing 10 million housing units to fulfil the latent gap in housing. Mr. Arun V Kashikar, VP and Head, R&D, Tata Housing Development Company, said that continuous demand was currently the driver of growth in the affordable housing sector but there was not much prospect of reduction in pricing. Mr. Kashikar added that precast process helps brings down the cost and speed up construction with the added benefit of cutting down waste. He also said that latest innovations in prefab technology have addressed the issues of leakage, seepage, joint weakness and misalignments and developers could easily go for ground plus floors in the LIG sector. He said a complex of precast houses coming up in Peenya (under Tata Housing) was totally shorn of noise and dust. He further added that even if four to five million housing units are built in a year, the current gap of *pucca* structures needed to house all people will take a decade. (The Hindu,Sep'21, 2018)

Poster Session & Live Technical Demonstration at ICI-IWC 2018

2.3 Innovativeness

Papers like 3-D printing from IIT,Madras had a huge footfall and Mr. S.J. Vijay, Chairman, Salmon Leap Associates and Director, Home Mission India, said the new era in construction was one of "industrializing the buildings" where homes could be bought off the shelves. He said that precast technology had progressed from precast slabs to building monolithic modules of rooms and washrooms which are built offsite and moved to the site of the housing complex. He said these modules could be incorporated with doors, windows and ventilators and washrooms with sanitary fitting offsite. He said 85% of housing construction has moved offsite in Singapore due to induction of new technology and laws mandating such practices.

Apart from the Poster sessions, there were Live Technical Demonstrations by construction companies, the first of its kind in the history of IWC at the IT capital of India, where Ultratech introduced 'Umix', a ready-to-use and mix-in-the-bag product that may help households to carry out repairs, and enable filling of cracks quickly without creating a mess. The concrete can be prepared by adding two litres of water to a 20 kg bag.

2.0 CONCLUSIONS

The opportunities of learning and networking saw a spurt of delegates from the industry, academia and even from Bangladesh and Sri Lanka. There were large number of registrations even from the government bodies and departments - Bangalore Metro, NCCBM, NMRC, ISRO, DRMC, KRDL, Mangalore Paper Mills(I) Ltd., Minor Irrigation, Tamil Nadu PWD, Road & Engineering Dep't., Karnataka State Police Housing, Mangalore Chemicals, KBJNL, BJNL, KPCC, BHEL, SERC (Chennai), CPWD, et al.

Grand Photo session at ICI-IWC 2018

INDIA TO BUILD NEW VERTICAL BRIDGE TO REPLACE PAMBAN BRIDGE

Indian Railways is building the country's first vertical-lift bridge to connect Rameswaram to mainland India. The bridge will allow ships and steamers to pass through without any hindrance.

The new bridge would replace the existing 104-year-old Pamban Bridge. It would be ready in the next four years.

About the New Vertical Bridge: The New Bridge will have a 63-metre stretch which will lift up while remaining parallel to the deck to allow access to the ships. The lifting would be done using sensors at each end. The new bridge will have electro-mechanical controlled systems which will be interlocked with train control systems in place of existing manual operation and control.

Pamban Bridge connects the town of Rameswaram on Pamban Island to mainland India. Pamban Bridge was the first sea bridge of India and was the longest sea bridge in India until the Bandra-Worli Sea Link was opened in 2010. Pamban Bridge is located in a very challenging location. It is located in the world's second most corrosive environment after Florida and is prone to high-velocity cyclones. This makes maintenance very challenging.

currentaffairs.gktoday.in/month/current-affairs-december-2018/page/10

CEAI NEWS

SEMINAR ON "SUSTAINABLE INFRASTRUCTURE DEVELOPMENT - THE KOLKATA STORY"

CEAI hosted a National Seminar on the theme *"SUSTAINABLE INFRASTRUCTURE DEVELOPMENT - The Kolkata Story"*, jointly with the Institute of Public Health Engineers, India and in association of the Institution of Civil Engineers, UK(who are celebrating their 200th anniversary this year), at the Rotary Sadan Auditorium, Kolkata on 16th& 17thNovember 2018.

Rapid urbanisation, that is doubling the population of every urban centre in a short period of 30 years, is a daunting challenge to every planner and engineer in our country.

Speaking on the choice of the theme, Mr. Amitabha Ghoshal, Chairman of the Organising Committee, as also of the East & Northeast Regional Centre of CEAI, explained that there is much to learn by studying the development, decline and redevelopment of an Urban Centre like Kolkata. Built three hundred and thirty years back, as the second largest city of the colonial British dominion, and nurtured to become one of the best urban centres in the world, the city went through many challenges during the last hundred years, like being a military base for two world wars, massive influx of settlers during partition of country and then the Bangladesh liberation war, migration of industry and capital, and so on. Kolkata city is showing signs of improvement in quality of infrastructure in recent years, and there are lessons to be learnt from this unusual case of a city's survival and regeneration.

Inaugural Session

The two day seminar was divided into four technical sessions devoted to Planning, Mobility, Water Sourcing and Supply, and Environment Concerns in Waste Management. The Inaugural Session hosted three eminent personalities involved in Urban Infrastructure development; two of them seasoned bureaucrats. The Valedictory deliberations were conducted by Dr. Bindeswar Pathak, the person who introduced Pay and Use Toilet concept in the country.

Valedictory Session

Participated by more than hundred and sixty delegates with intense interest, the Seminar was lauded by one and all as a successful technical event of the year.

CEAI-IIC LECTURE SERIES

CEAI, jointly with India International Centre, New Delhi is organising a series of six Lectures on ***'Engineer & the Society***'. The Lectures are being held every month and will continue till January 2019.

THIRD LECTURE

The third lecture in the series was held on the topic

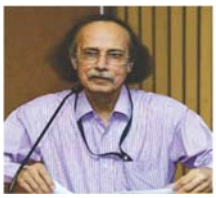
L to R: Mr. Masood Husain, Dr. S K Sarkar, Mr. A B Pandya, & Ms. Sayona Philip

'Interlinking of Rivers & Management of Water Resources' at India International Centre on 10th October 2018.

The Chairperson of the session was Dr. S K Sarkar, Former Secretary, Ministry of Water Resources, Government of India, and Senior Director at The Energy Resource Institute (TERI).

Mr. A B Pandya, Secretary General, International Commission on Irrigation and Drainage (ICID), and former Chairman Central Water Commission, spoke about 'Role of water in Energy Production and Food Security through Water'.

The second speaker, Mr. S Masood Husain, Chairman, Central Water Commission, presented his views on the need for inter basin water transfers.



Dr S K Sarkar, Chairperson addressing the participants

Mr. A B Pandya delivering his lecture

Mr. Masood Husain delivering his lecture

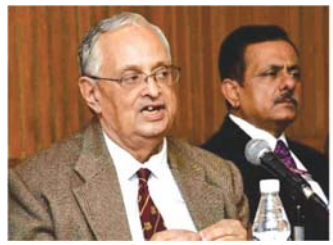
Interaction with the audience

FOURTH LECTURE

L to R: Ms Sayona Philip, Mr. Harutoshi Hayasaka, Mr. Vinoo Mathur, Mr. Naveen Kumar Shukla & Mr. Somenath Ghosh

The fourth lecture in the series was held on the topic **"*High Speed Rail Travel in India*"** at the India International Centre on 24th November 2018.

The Chairperson for the lecture session was Mr. Vinoo Mathur, Former Member Railway Board with several decades of experience in the Sector and Sr. Advisor to the JICA Study Team. He introduced the topic and gave his perspective on the future status of the sector and the plans to make a quantum jump to upgrade and modernise India's railway system and also provide the High Speed rail system. He also gave his views on the way forward. He introduced the other Speakers and moderated the Question and Answer session with the audience.



Mr. Vinoo Mathur, Chairperson addressing the participants

Mr. Naveen Kumar Shukla, delivering his lecture

The other eminent Speakers were Mr. Naveen Kumar Shukla, Principal Executive Director (Head of Mobility Directorate) Railway Board, and Mr. Harutoshi Hayasaka, Civil Group Project Manager, JICA Study Team. He talked about the need for construction of new tracks specially for high speeds, allowing a maximum running speed of at least 250kmph (155mph) and about existing tracks specially upgraded for high speeds, allowing a maximum running speed of 200kmph (124mph), but with some sections having a lower allowable speed (for example due to topographic constraints, or passage through urban areas).

Mr. Harutoshi Hayasaka delivering his lecture

Mr. Harutoshi Hayasaka gave a presentation on 'Mumbai-Ahmedabad High Speed Railway Project".

A view of the participants

Mr. Sudhir Dhawan addressing the participants

FIFTH LECTURE

The fifth lecture was held on the topic "Management ***of Air Pollution & Solid Waste in Indian Cities"*** on 11th December 2018 at India International Centre.

L to R: Ms Sayona Philip, Ms. Manju Mohan, Ms. Sunita Narain & Mr. Suneel Pande

Ms. Manju Mohan opening the lecture session

Ms. Sunita Narain delivering her lecture

Dr. Suneel Pandey delivering his lecture

Ms. S Philip, President CEAI, addressing the audience

The Chairperson for this session was Prof Manju Mohan, Head of Centre of Atmospheric Sciences, IIT Delhi.

The speakers were Ms. Sunita Narain, Director General, Centre for Science & Environment, and Dr. Suneel Pandey, Senior Fellow & Director, Environment and Waste Management, TERI.

A view of the audience

BRUNEL INTERNATIONAL LECTURE

CEAI jointly with ICE, UK organised the Brunel International Lecture on *"Transportation Infrastructure and Interdisciplinary Interfaces on Complex Mega Projects"* on Saturday 17th November 2018 atthe PHD Chamber of Commerce and Industry, New Delhi.

Ms Linda Miller delivering her lecture

The lecture was delivered by Ms. Linda Miller, Construction Director, Sydney Metro Tunnels and Stations Excavation. Sydney Metro is Australia's biggest public transport project, which, when complete, will incorporate 31 Metro Stations and more than 66 km of new tunnels,

including tunnels crossing under the iconic Sydney Harbour.

A view of the participants

WEBINARS

A) LONG SPAN BRIDGES – STATE OF THE ART

CEAI organised a webinar presentation on***"Long Span Bridges - State of the Art"***on 12th November 2018.

Mr. Alok Bhowmick, Governing Council Member of CEAI, delivered the lecture and gave a broad overview of the scientific and technological development that has taken place around the world in the field of Suspension Bridges, Cable Stayed Bridges, Hybrid Bridges, Arch Bridges and Cantilever Girder Bridge having span length of more than 150m.

The webinar was attended by 28 professionals from across the country.

B) ELECTRIC VEHICLES ECONOMY

Mr S V S Prasad, Associate Vice President - Electrical in the Technology Organisation of Tata Consulting Engineers Ltd. at Bengaluru, presented on **"Electric Vehicles Economy"**on 17th December 2018.

In his presentation, Mr Prasad covered briefly on the types of Electric Vehicles in the market, the extent of global growth so far witnessed and the expected growth going forward and the factors assisting and the affecting the growth of Electric Vehicles. It also covered the aspects such as EV charging methodologies, EV batteries, environmental aspects associated with EVs and EVs grid interface. Mr Prasad briefly provided a glimpse of present scenario in India as for as Electric Vehicles are concerned.

The webinar was attended by 23 Professionals from across the country.

YOUNG PROFESSIONALS MEET AT CEAI, NEW DELHI

CEAI organized an interactive session with Young Professionals (YPees) on 8th December 2018 at CEAI Centre.

The discussion focused on energizing YPees and also their personal transformation in engineering consultancy. Twenty (20) Young Professionals from six (6) consulting organisations (ICT, Jacobs, Mott McDonald, MRC, STUP and TCE) participated in the meeting.

Captain Prerana Dubey, Deputy Director, CEAI welcomed the participants and introduced CEAI. Mr. J K Singh, Convener YP forum of CEAI made a brief presentation to orient the new YPees about CEAI, its history, activities, publications, etc. and apprised them of ASPAC 2019 which is being hosted by CEAI in July 2019.

Mr. Sudhir Dhawan and Mr. Pankaj Vatsa steered the interactions and encouraged the YPees to come up with ideas. The YPees present voiced that much needs to be done for enhancing visibility of CEAI activities and they assured to actively take it up thru' social media, viz. Twitter, Facebook, etc. Various ideas on webinars, topics, dedicated page for YPees in VIEWPOINT were discussed. It was also decided to conduct such interactive meets frequently, possibly on 1st Saturday of every month.

Some of the ideas emerged in the form of introducing "Subscribe Me" option in CEAI webpage and registering countrywide consultants and publishing category wise list of available consultants.

Ms. S Philip joined the meeting in the end. Expressing her delight, she encouraged all YPees for actively participating in CEAI activities.

NATIONAL WORKSHOP ON NATIONAL BUILDING CODE OF INDIA 2016 & REVISED SEISMIC CODES

CEAI jointly with Bureau of Indian Standards (BIS) and IIT-Guwahati, is organizing a two day Workshop on *'National Building Code of India 2016 and Recently Revised Seismic Codes – Impact on Design, Construction & Safety of Built Structures'* on 11th & 12th January 2019 at IIT Guwahati.

There has been an increased awakening among professionals, owners, builders, planners and the society at large about the importance of safety of structures vis-à-vis earthquakes. At the same time, there have also been constant research and studies in the field of earthquake science and seismic engineering, necessitating updating of codes and standards from time to time.

IS 1893 (Part 1) has been recently revised to incorporate the state of the practice and the progress made in research, scientific and technological development globally. Similarly the IS code on ductile detailing of Reinforced Concrete Structures subjected to seismic forces, namely IS 13920 has also been revised recently. IS 4326 was revised in 2013 and the National Building Code of India in 2016.

There is an often-repeated saying, *'Earthquakes don't kill people, buildings'*.Though as a structural engineer, one can't control the seismic hazard in the community where one lives or works, but one can certainly influence the most important factor in saving lives and reducing losses from an earthquake by the adoption and enforcement of up-to-date building codes.

Adopting the latest building codes is only part of the solution. Codes must also be effectively enforced to ensure that buildings and their occupants benefitted from advances in seismic provisions in the latest codes. Revision of codes also brings into focus the question of safety of old buildings. It's possible to make these buildings more resistant to earthquakes through seismic retrofitting.

CEAI, IIT-G and BIS aim to bring together civil & structural consultants, architects, academicians, builders and developers, urban planners, policy makers and associated government agencies to discuss the impact of the newly released revised codes structural design of buildings. The exclusive two-day workshop will witness presentations by some of the stalwarts in the industry and the code makers themselves. This workshop will give ample opportunities to all delegates to interact directly

with the experts in the domain and gain knowledge through interaction and social networking events.

For more details please visit our website: https://ceai.org.in/events.

GOVERNING COUNCIL MEMBERS FOR PERIOD 2018-2020

The results for the election of Governing Council members for the period 2018-2020 were declared on 6th December 2018. The following members were declared elected to the Governing Council:

A) INDIVIDUALS

1. Mr. Alok Bhowmick
2. Mr. Sudhir Dhawan
3. Dr. Samarjit Chatterjee
4. Dr. Ajay Pradhan
5. Mr. Prashant Kapila

B) ORGANISATIONS

1 Dr. Rajashekhar R Malur
Tata Consulting Engineers Limited

2 Mr. Kiran Kumar Kapila
Intercontinental Consultants & Technocrats Pvt Ltd

3 Mr. N J Singh
Consulting Engineers Group Ltd

4 Mr. Amitabha Ghoshal
STUP Consultants Pvt Ltd

5 Dr. Dhaval M Parikh
Aarvee Associates Architects, Engrs & Consultants

6 Dr. Vinod Jain/ Mr. S C Mehrotra
Mehro Consultants

7 Mr. Amit Kumar
Mott MacDonald Pvt Ltd

8 Mr. Navin Kumar Jha
Balaji Railroad Systems Ltd

9 Mr. Pradeep Kumar Mittal
Holtec Consulting Pvt Ltd

10 Dr. Harshavardhan Subbarao
Construma Consultancy Pvt. Ltd.

11 Mr. Arvinder S Brara
Mantec Consultants Pvt Ltd

12 Mr. Girish Chandra Mishra
Saviram Engineering Consultants Pvt. Ltd.

13 Mr. Sutanu Ghosh
Ghosh, Bose & Associates Pvt Ltd

14 Mr. Aman Khullar
Advanced Technology & Engineering Services

IMMEDIATE PAST PRESIDENT

Ms. Sayona Philip

CHAIRMAN EMERITUS

Mr. Mahendra Raj

FIRST MEETING OF NEWLY ELECTED GC

The first meeting of the newly elected members of the Governing Council was held on 14th December 2018 at IIC, New Delhi to elect the President of CEAI for the period 2018-2020.

Newly elected GC members

Mr Amitabha Ghoshal addressing the GC

PRESIDENT ELECT

The newly elected Governing Council members at the first meeting held on 14th December 2018 unanimously elected Mr. Amitabha Ghoshal, Chief Advisor to the Board of Directors, STUP Consultants Pvt. Ltd. as the new President of CEAI.

Mr. Ghoshal is the Chairman of CEAI Eastern and North Eastern Region. He was the Vice President of CEAI during the period 2010-2012.

Mr. Ghoshal has very extensive experience in the management of design office with a large manpower. Development of Consultancy Services in various countries of South East Asia, Middle East Countries and Africa. Overseeing design consultancy and Project Management Consultancy in various sectors including Highways and Railways, Port and Harbour, Industrial Structures and infrastructure for Urban infrastructure including water supply, treatment drainage and waste water system, buildings and township development.

GENERAL BODY MEETINGS OF CEAI

a) Extraordinary General Body Meeting

An Extra-Ordinary General Body Meeting (EGM) of CEAI was held on Friday, 14th December 2018 at the India International Centre, Lodhi Road, New Delhi, to consider additions, amendments, deletions of the Rules of the Association as recommended by the Governing Council.The Extra Ordinary General Body approved the changes given below:

EXISTING RULES	PROPOSED AMENDMENTS
2.4 Member (Individual) **2.4.1** Every applicant for Member (Individual) of the Association shall satisfy the Governing Council that **b(3)** has been an employee in service in a responsible capacity in a reputed firm /firms of Consulting Engineers, for a period not less than twenty years.	**2.4 Member (Individual)** **2.4.1** Every applicant for Member (Individual) of the Association shall satisfy the Governing Council that **b(3)** has been an employee in service in a responsible capacity in a reputed firm /firms of Consulting Engineers, for a period not less than**TEN** years.
2.5 Affiliate Member (Individual) d) he/she is a graduate from a recognized university or institution in the field of economics, sociology, geography, environment, law and any other field and he/she should be involved in engineering consultancy or a consulting profession for a minimum period of 3 years, which enables holistic appreciation and fulfilment of any engineering work.	**2.5 Affiliate Member (Individual)** d) he/she is a graduate from a recognized university or institution in the field of economics, **management,** sociology, geography, environment, law and any other field and he/she should be involved in engineering consultancy or a consulting profession for a minimum period of 3 years.
2.9 Affiliate Member (Organisation) Every applicant for Affiliate Member (Organisation) shall satisfy the Governing Council that the firm/organisation/institution a) subscribes to the aims and objectives of the Association AND b) is engaged in activities relevant to the Consulting Engineering profession.	**2.9 Affiliate Member (Organisation)** Every applicant for Affiliate Member (Organisation) shall satisfy the Governing Council that the firm/organisation/institution a) subscribes to the aims and objectives of the Association AND b) is engaged in activities relevant to the Consulting profession.

2.10.1 (e) Eligibility to seek election to the Governing Council, representing the particular Category of membership the Member belongs to. To be eligible, the Member shall have completed at least one year as member of the Association and that his/her subscription is not in arrear as on the last date for submission of nomination papers.	**2.10.1 (e)** Eligibility to seek election to the Governing Council, representing the particular Category of membership the Member belongs to. To be eligible, the Member **ie Individual / organization** shall have completed at least one year as member of the Association and **the member's**subscription **shall** not **be** in arrear**s and the member shall have no outstanding dues to CEAI** as on the last date for submission of nomination papers.
EXITING RULES	**PROPOSED AMENDMENTS**
NIL	**2.10.3 Affiliate Members** **a) Eligibility to represent affiliate members in the Governing Council: To be eligible, the Affiliate Member ie Individual / Organisation shall have completed at least one year as an Affiliate member of the Association and the affiliate member's subscription shall not be in arrears and the affiliate member shall have no outstanding dues to CEAI as on the last date for submission of nomination papers** **b) shall be eligible to vote for election of the Affiliate members' representative in the Governing Council** **- Affiliate Member (Individual) 1 vote** **- Affiliate Member Organisation** **Grade / Total No. of Employees / Votes** **Grade 1 / 5-25 / 2 votes** **Grade 2 / 26-50 / 4 votes** **Grade 3 / 51-300 / 6 votes** **Grade 4 / 301 & above / 8 votes** **Only affiliate members, whose subscription is not in arrears, as on the last date for submission of ballot papers, shall be eligible to vote** **c) shall be eligible to attend AGM and EGM as observers.** **d) shall be eligible to support application for any Affiliate membership**

2.10.3 Honorary Fellow, Young Professional Member (Individual), Affiliate Member (Individual) and Affiliate Member (Organisation). **a)** shall have no voting right **b)** shall not be eligible to be members of the Governing Council **c)** shall not be eligible to requisition EGM or to be invited for AGM/EGM. **d)** shall not be eligible to support any applicant for membership.	**2.10.4**Honorary Fellow, Young Professional Member (Individual) **a)** shall have no voting right **b)** shall not be eligible to be members of the Governing Council **c)** shall not be eligible to requisition EGM or to be invited for AGM/EGM. **d)** shall not be eligible to support any applicant for membership.
EXITING RULES	**PROPOSED AMENDMENTS**
4.0 GOVERNING COUNCIL **4.1 Composition** 4.1.1 The affairs of the Association shall be managed by the Governing Council which shall consist of not more than 30Members of the Association:- • 20 duly elected Members, • 1 Immediate Past-President • 4 Regional Centre Representatives. (maximum) • 5 Co-opted Members	**4.0 GOVERNING COUNCIL** **4.1 Composition** 4.1.1 The affairs of the Association shall be managed by the Governing Council which shall consist of not more than **32** Members of the Association:- • 20 duly elected **by** Members, • 1 Immediate Past-President • 4 Regional Centre Representatives. (maximum) • 5 Co-opted Members • 1 **duly elected by Affiliate Members (individual and organization)** • 1 **Chairman Emeritus**
NIL	**4.2.8 Every Affiliate Member, whether Affiliate Member (Individual) or Affiliate Member (Organisation) shall have voting rights as per 2.10.3 b) of the rules in respect of election of Affiliate Member to the Governing Council.**

A View of members

b) Annual General Body Meeting

The 22nd Annual General Body Meeting of CEAI was held on Friday, 14th December 2018 at the India International Centre, Lodhi Road, New Delhi. The AGM took the following decisions:

i. Confirmed the Minutes of the 21st Annual General Meeting held on 16th December 2017.

ii. Adopted the Annual Report of the Association for the year ended 31st March 2018.

iii. Passed the Audited Accounts of the Association for the year ended 31st March 2018.

iv. Appointed M/s A L Seghal & Co as Auditors for the Financial Year 2018-2019.

v. In addition to the above, the President announced the results of the Governing Council Election and handed over the charge to the new President, Mr. Amitabha Ghoshal.

AGM -on the dias (L To R) Mr Pankaj Vatsa, Ms S Philip, Mr P K Mittal

A view of members

Mr. ALOK BHOWMICK CONFERRED WITH THE 24th S B JOSHI MEMORIAL AWARD (*SMRUTI PURASKAR*)

In recognition of the commendable work and invaluable contribution in the field of bridge and structural engineering, the Alumni Association of the College of Engineering, Pune felicitated Mr Bhowmick for ***'Excellence in Bridge and Structural Engineering'*** on 12th October 2018 and conferred the prestigious award on him. He is the 24th recipient of the award.

The S B Joshi award was instituted by the Alumni Association of the College of Engineering, Pune in 1995. It is conferred every year, since 1995, to the person who has contributed immensely to the Indian Construction Industry.The 1strecipient of the award was Mr. E Sreedharan in the year 1995.

Mr. Alok Bhowmick is the Managing Director of B&S Engineering Consultants Pvt. Ltd., an organisation well known in the field of bridge consultancy. He is an active member of several professional association and code committees. He has contributed immensely in the field of bridge engineering. He has written over 50 technical papers in Indian as well as International journals. He is presently the Honorary Secretary of Indian Association

of Structural Engineers, India; Vice Chairman of Indian National Group of IABSE, Chairman, editorial board of the quarterly journal published by ING-IABSE and a Governing Council member of CEAI.

PROF. MAHESH TANDON RECEIVED DISTINGUISHED ALUMNUS AWARD OF IIT-ROORKEE

Indian Institute of Technology Roorkee presented its 'Distinguished Aluminus Award 2018' to Prof Mahesh Tandon, Managing Director of Tandon Consultants Pvt Ltd, in the category of 'Excellence in Engineering or Technology Innovation' on 25 November 2018.

Prof Tandon is an international expert in the field of Structural Engineering. Many of the structures designed by him and his firm Tandon Consultants Pvt Ltd have been widely acclaimed and have received recognition in India as well as internationally. He has spearheaded the development of new codes of practice and path-breaking bridge technologies suited to Indian conditions.

SPACE AMBASSADOR

Er. Avinash Shirode has been designated as "Space Ambassador" by USA based International Organization "National Space Society" (NSS) working in the field of "Space Exploration and Settlement" since last 45 years. Er. Avinash Shirode, after obtaining Master of Engineering degree from Indian Institute of Science, Bangalore, has worked in ISRO in its initial stages of development of India's first launch vehicle SLV-3. He is the President of NSS Nashik India Chapter and organized the "World Space Week" 4th – 10thOctober 2018 which was acclaimed as the "Unprecedented" best and biggest program.

The National Space Society (NSS), is an independent, educational, grassroots, non-profit organization dedicated to the creation of a spacefaring civilization. It was founded in USA in 1974. NSS is widely acknowledged as the preeminent citizen's voice on space. NSS has over 68 chaptersin the United States and around the world.

Humanity is no longer limited to the Earth's surface and its limited resources! Our solar system has abundant energy, and material resources, millions of times more than on the surface of the Earth. The future of humanity will be enhanced as it uses the bountiful resources in space. It requires sharing Passion and Excitement for Space Exploration with Others Through Educational Outreach Presentations.

A Space Ambassador is required to make presentations to educate students and the general public on space related subjects. It addresses engineering and scientific subjects explaining current space exploration activities and findings to the public and also to educate and motivate young people and adults to knowledgably discuss and participate in supporting space exploration programs and interest in human space exploration and settlement.

There are 2 phases of certification process for the designation of Space Ambassador. Phase 1 had 934 applicants from 150 countries, 71 from India, which was second only to the USA with 373. Phase 2 is more tightly controlled; only 20 Applicants who passed Phase 1 are

preparing for Phase 2. **At present there are only 8 Certified Space Ambassadors from all over the world.** ***So far, Mr. Shirode is the only Certified Space Ambassador from India.***

CONFERENCE ON "NEXT FRONTIERS IN CIVIL ENGINEERING – SUSTAINABLE AND RESILIENT INFRASTRUCTURE"

The Civil Engineering Department of the Indian Institute of Technology, Bombay organized a two day conference on *"Next Frontiers in Civil Engineering – Sustainable and Resilient Infrastructure"* on 30th November and 1st December 2018 at its campus.

Mr. A P Mull, Past President CEAI was a Keynote Speaker at the conference for the session on Structures on the theme of *"Materials and Structures for the Future"*. He emphasized on maximising use of appropriate, locally available and recycled materials with smaller ecological footprint; high performance materials with low quantum consumption. He added that structures & facilities be conceptulaised holistically in an integrated manner with frugal design but yet be robust to meet strength and serviceability criteria as well as the functional needs. In addition they must be designed and constructed to meet the 'Design Life' requirements of the structure and the assets created be operated and maintained properly in a planned manner. He stressed that the designers must keep in mind at all times that only finite amount of materials are available. Hence, they must use them sensibly and judiciously so that future generations are assured of their availability on a Good Earth.

FIDIC NEWS

FIDIC ASPAC CONFERENCE IN 2019

CEAI is honoured to have accepted an invitation to host the FIDIC-ASPAC International Conference in July 2019 in New Delhi.

ASPAC represents the consulting engineering industry in Asia and Pacific Region as the regional grouping of FIDIC Member Associations. ASPAC has 22 member countries. The main objective is to encourage regional cooperation amongst the member associations by sharing and enhancing knowledge on the different infrastructure requirements of each country.

The Conference theme ***"Quality Infrastructure for Clean and Sustainable Development"*** has been selected keeping safety of the people in mind. Many of the member associations of ASPAC are investing significantly in infrastructure development not only with their own financial resources but also with funding from MDBs. The theme of the Delhi conference is expected to cover the most important parameters for infrastructure development i.e. Quality, Clean and Sustainable Solutions.

We expect business leaders from all nations representing the ASIA-Pacific Region. It would be of great benefit for members to attend the conference and have the opportunity to network with global industry leaders from the Asia-Pacific Region.

Further details about the conference will be communicated soon and put up on CEAI's website.

OTHER NEWS, VIEWS & NOTES

VIEW POINT

The next issue of the View Point will be published in **March 2019,** the theme for which will be on ***"Remote Sensing & Remote Monitoring for Engineering Projects".***

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

Authors could share their knowledge enriched by the works executed, first hand accounts of the challenges faced, practical issues experienced and the solutions to those, etc. Photographs would benefit our readers for better appreciation of the issues encountered and addressed.

The articles for March issue need to reach CEAI by 10th February2018. Articles need to be in Times New Roman 12 with single line spacing on A4 size.

ADVERTISEMENT IN VIEW POINT

VIEW POINT 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.

Advertising in the VIEW POINT gives the advertiser wide exposure and visibility.

The rates for advertisements in VIEWPOINT are given below. This is excluding GST @18% or as prescribed, which will be extra:

ADVERTISEMENT TARIFF

	Rate Per issue *	Discounted rate at 20% for 4 consecutive issues (from March 2019 to December 2019)*
Back Cover	- Rs. 25,000/-	Rs 80,000/-
Inside Front Cover**	- Rs. 15,000/-	Rs 48,000/-
Inside Back Cover**	- Rs. 15,000/-	Rs 48,000/-
Full Page	- Rs. 10,000/-	Rs 32,000/-

**GST @ 18% or as prescribed will be added to the above rates.*

*** Inside Front & Back covers booked till June 2019.*

Tech Quiz

1. Who designed the nano-engine?
   a. James Watt
   b. Nikolaus Otto
   c. Johannes Roßnagel
   d. Frank Whittle
   e. Georhe B Selden
2. WhichX-Ray telescope was launched by NASA in 1999?
   a. NuSTAR
   b. Chandra (AXAF)
   c. ASTERIA
   d. XMM-Newton
   e. HiRISE
3. When was a drone first used in warfare?
   a. 1900
   b. 1849
   c. 1995
   d. 1839
   e. 1918
4. Which is the tallest building constructed in India?
   a. Ashoka Towers D
   b. World One
   c. Sri Vrindavan Chandrodaya Mandir
   d. India Tower
   e. Imperial I
5. When was the Transformer invented?
   a. 1885
   b. 1900
   c. 1700
   d. 1850
   e. 1905
6. Who is the inventor of Portland cement?
   a. William Aspdin
   b. Ernest Leslie Ransome
   c. Joseph Aspdin
   d. I. K. Brunel
   e. Stephen Stepanian
7. Who invented the first semiconductor devise?
   a. Walter Brattain
   b. Jagadis Chandra Bose
   c. Michael Faraday
   d. Alessandro Volta
   e. John Bardeen
8. When was hot rolled deformed steel reinforcing bar developed?
   a. 1988
   b. 1920
   c. 1960
   d. 1963
   e. 1983
9. Who invented the cell phone?
   a. Antonio Meucci
   b. Ray Tomlinson
   c. Steve Jobs
   d. Martin Cooper
   e. Alexnader Graham Bell
10. Who discovered the electron?
    a. NeilsBhor
    b. J J Thomson
    c. John Dalton
    d. Ernest Rutherford
    e. Erwin Schrödinger

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 his/ her photograph in the next issue.

Contributed by A P Mull

Answers to Tech Quiz September 2018 issue

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

Prof Mainak Ghosal, Consultant is the winner of the Tech Quiz with full/ maximum marks.

FIDIC PUBLICATION

1	**The Short Form of Contract (First Edition, 1999).** Agreement, General Conditions, Rules for Adjudication and Notes for Guidance
2	**Conditions of Contract for EPC Turnkey Projects (First Edition, 1999).** General Conditions; Guidance for the Preparation of Conditions Particular Application; Forms of Tender and Agreement, etc.
3	**EPC/Turnkey Contract 2nd Ed (2017 Silver Book)**
4	**Conditions of Contract for Construction (First Ed. 1999).** For Building and Engineering Works designed by the Employer. General conditions; Guidance for Preparation of Particular Conditions; Forms of Tender, etc. FC-RA-A-AA-09
5	**Construction Contract 2nd Ed (2017 Red Book).** For Building and Engineering Works designed by the Employer.
6	**Conditions of Contract for Plant & Design-Build (First Ed, 1999).** For Electrical & Mech. Plant & For Building & Engineering Works Designed by the Contractor.
7	**Plant and design-build contract 2nd ed (2017 yellow book)**
8	**Dredgers Contract 2nd Ed (2016 Blue-Green Book).** Form of Contract for Dredging and Reclamation Works (Dredgers Contract; Second Edition, 2016). Agreement, General Conditions, Dispute Adjudication and Notes for Guidance
9	**Conditions of Subcontract for Construction (First Edition, 2011**). For building and engineering works designed by the Employer.
10	**FIDIC Contracts Guide** to the Construction, Plant and Design-Build and EPC/Turnkey Contracts (1st Edition, 2000)
11	**Conditions of Contract for Design, Build and Operate Projects (1st Ed, 2008)** GOLD BOOK
12	**Conditions of Contract for Construction -MDB**(Multilateral Development Bank Harmonised Harmonised Ed. Version 3: June 2010)
13	**Conditions of Contract for Electrical and Mechanical Works** (3rd Edition, 1987; Reprinted 1988).
14	**Conditions of Contract for Works of Civil Engineering Construction (4th Edit. 1987 reprinted 2011**, reprinted 1988 with editorial amendments, reprinted 1992 with further amendments). Part I: General Conditions with forms of tender + agreement; Part II: Conditions of particular application + guidelines for preparation of Part II clauses.
15	**Client/Consultant Model Services Agreement 5th Ed (2017 White Book)**
16	**Model Joint Venture (Consortium) Agreement 2nd Edition (2017)**
17	**Selection of Consultant 2nd Ed (2013)**
18	**Definition Of Services Guidelines (Building Construction) 2009**

19	**Insurance of Large Civil Engineering projects (2004),** including the 1997 Progress Report and Update and the 2004 Update
20	**Conditions of Contract for Design-Build and Turnkey (1st Edition, 1995 Orange Book).** Part 1: General Conditions; Part 2: Guidance for the Preparation of Conditions Particular Application. **-Reprinted in 2011**
21	**Quality Based Selection (QBS) Guidelines (2011)**
22	**Standard Prequalification Form** for Contractors (3rd Edition, 2008), including guidance and sample forms
23	**Professional indemnity insurance** and the insurance of project risk, 2004.
24	**FIDIC Business Integrity Management System** (BIMS) Training Manual (1st Edition, 2002)
25	**Capacity Building** : Building the capacity of the industry (2001) with five inserts
26	**ISO 9001:2000 quality management interpretive guide 1st ed (2001) .** A guide to the interpretation and application of the ISO 9001:2001 Standard for the consulting engineering industry (1st Edition, 2001).
27	**Integrity Management System (Fims) Guidelines 1st Ed (2011) Part1** -FIDIC Guidelines for Integrity Management (FIM) in the consulting industry (First Edition 2011), Part 1- Policies and principles: describes the FIDIC Integrity Management System (FIMS)
28	**DBO(2008 gold book) contract guide 1st edition 2011** -Contract Guide for the FIDIC Conditions of Contract for Design, Build and Operate Projects (2008 Gold Book; 1st Ed)
29	**Guidelines For Integrity Management System in the Consulting Industry 1st Ed (2015) Part 2.**
30	**FIDIC Procurement Procedures Guide 1st Ed (2011)**
31	**Conditions of Contract for Electrical and Mechanical Works (3rd Edition, 1987; Reprinted 1988)**
32	**Operation, Maintenance And Training Guidelines (1991 OMT)**
33	**Client/Consultant Model Services Agreement (1998 White Book) Guide 2nd Ed (2001)**
34	**Project Sustainability Management Guidelines (2004)**
35	**Quality Management Training Kit 1st Ed (2001)** -Quality management in the consulting engineering industry training kit (1st Edition, 2001)
36	**EMS Handbook: Environmental Management Systems Handbook Test Ed**
37	**Model Representative Agreement (1st Ed, 2013)**
38	**Sub-Consultancy Agreement 2nd Edition (2017)**

For more details, please contact CEAI Secretariat

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STUP, established in 1963, an Indo-French organization of international repute which provides design, construction engineering, technology transfer and project management services for multiple sectors.

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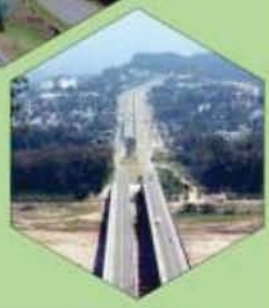

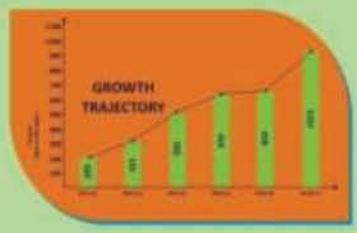

"Build Together, A Better World"

Rodic Consultants Private Limited - a name which spells excellence and inspires confidence - was established in the year 2000 with a vision to provide a spectrum of consulting services in the filed of infrastructure. Over the last sixteen years, It has emerged as a strong, motivated and sound organisation that has time and again proven its core competence in providing expertise in the sectors of Highways, Bridges, Tunnels, Railways, Rodic has also made inroads into Hydropower. Power - T&D, Inland Waterways, Water Resources and Urban Development sectors.

Certified with an ISO9001:2008, ISO14001:2004, OHSAS 18001:2007 and TRACE certification. Rodic has moved from strength to strength in its quest for excellence. Our confidence has further grown by being associated with projects involving major funding institutions such as The World Bank and The Asian Development Bank, the Government of India. We have a strong Pan-India client base, whose confidence and trust we have earned with our exemplary expertise in the areas of Consulting and Engineering, Advisory Services, Feasibility Studies, Detailed Engineering, Proof Checking, Value Engineering, Detailed Design, Detailed Project Report Preparation, Construction Supervision, Owner's Engineer and Project Management.

Our strength lies in the value of sincerity and hardwork that our Company upholds. We are further enriched by the more than one thousand four hundred skilled and motivated professionals who work with us in a spirit of team-work and productive co-operation. A continuous striving for excellence has always been our Mantra and we lay a high premium on commitment and client satisfaction. Our Value-system encompasses - competence, innovation, client-centric approach and delivering within time frames.

AWARDS AND RECOGNITION'S

- Achievers Award 2015 conferred on Mr. Raj Kumar, Chairman and Managing Director, for successfully achieving milestones in the implementation of the AIIMS - Digha Elevated Corridor by the Hon'ble Chief Minister of Bihar Shri Nitish Kumar, on the occasion of 6th foundation day of BSRDCL.
- Rodic Consultants Pvt. Ltd. was featured in "Leading SME of India" published by Dun and Bradstreet.

JOB OPENINGS

We are also looking for qualified and experienced professionals from relevant disciplines to join Rodic family for our various current and upcoming projects on a Pan India basis. Interested candidates are encouraged to forward profiles by email to career@rodicconsultants.com

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