Vol. No.01 Issue No. 07 Kochi December 2019

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CONSTRUCTION PHILOSOPHY

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CONSTRUCTION PHILOSOPHY

Vol. No. 01 Issue No. 07 | Kochi | December 2019

Pathways to progress

In the last ten years, construction industry had experienced tremendous growth in technology. construction methodology has improved dramatically during these years. The old way of designing and execution has changed with the invention of modern tools and artificial intelligence had given a big push to the growth of the industry. Every details are now at the tips of the finger. Earlier ways of execution and designing had many challenges including possibilities of fatal mistakes that can always be cumulative and sometimes applying changes could impair the structure in many ways. With the discovery of Augmented reality and virtual reality gears, an instantaneous information of the structure can be now made available at the site with precision that an engineer can apply it with real-time application. Superimposing of the structural design at an original scale on the actual structure is a revolution which lets the engineer figure out any errors likely while execution. All these discoveries when integrated to a project could largely improve the quality of the structure and reduce the duration of the project. Efficiency of projects has highest importance as it lessens destructions. We have seen many structural failure due to indecorous building practices. Construction if digitalized can bring in big changes that could enormously reduce such errors. This issue of "Construction Philosophy" discusses various technological developments in the industry with respect to digitalisation and the need of it to be incorporated.

Together let us raise our voice for quality.

Nebu Abraham
Editor

Voice a quality philosophy! We look forward to your feedback at editor@constructionphilisophy.com

Join our author family : Send your articles to Editor@constructionphilosophy.com to get it published in our upcoming volumes

Don't take soil for granted

Trying to save money in geotechnical investigations is a classic case of being 'penny wise and pound foolish'. Inadequate and improper investigations result in a very conservative value of allowable bearing capacity being recommended and adopted, says Madhav R. Madhira.

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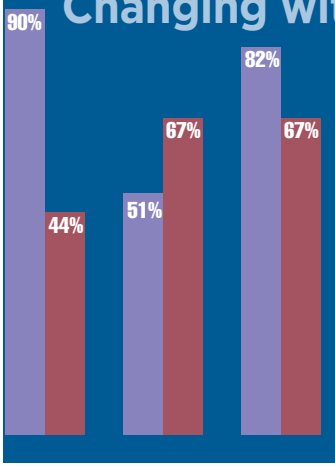
COVER STORY

Techno Storm Sweeps Construction Industry

Slowly yet surely, the construction industry of India is evolving under the influence of digital technology. The industry players have begun to embrace new technologies in a big way with a focus on cost and time saving, sustainability and newer aesthetics, writes **Cinu P Thomas.**

Changing with the climate



The times of climate change savvy Indian companies have come. The companies are recognising the positive gains in adopting the diverse climate protocols and regulations, writes **Ankur Modi**

Penn State's 3D reality mesh

Bentley's reality capture technology, ContextCapture- photogrammetry software, helped Penn State University, US, in simplifying the process of generating high quality, geospatially accurate 3D reality mesh from digital aerial images. says Chintana Herrin.

Digital transformation

The myriad ways in which technology has influenced the geotechnical sector, says **Ashish D. Gharpure**

Needed: Lessons in life skills

These days, students focus only on their curriculum which is quite evident during interviews, writes **Mirzam Malik**

Digital transformation, the Gleeds example

Adoption of new technology is not an option now. It has now become inevitable to sustain the construction industry, writes **Jagjit Avdeel**, Head, Gleeds Digital Service, UK.

Construction Philosophy is owned, printed and published by Nebu Abraham and printed at Sterling Print House Pvt. Ltd., Door No. 49/1849, Ponekkara-Cheranelloor Road, AIMS, Ponekkara PO, Cochin-682041, Kerala.

Published at : Door No: 43/1920-D, Peringattu Buildings, Peringattu Road, Palarivattom, Kochi, Kerala, PIN 682 025
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Excon ,2019 to be held in December 10 to 14th,Bangalore

10th Excon ,2019 South Asia's biggest construction events in India is about be held on Decement from 10th to 14th at Bangalore International Exhibition Centre (BIEC). The exhibition will showcase the latest advancements in construction engineering with emphasis on latest products, equipments & technology with specific emphasis on efficiency, productivity, safety, environment protection and construction quality. Excon exhibition is poised for immense growth with more international participation

Indian Railways enters into deal with MELPL for procurement and maintenance

Indian Railways and France's Alstom have entered into a procurement cum maintenance agreement with Madhepura Electric Locomotive (MELPL), where the country's most powerful electric locomotives are being manufactured.

The new twin Bo-Bo design locomotive with 22.5 tonnes axle load upgradable to 25 tonnes with design speed of 120 kmph will be powered by 12000HP was inaugurated in March 2018.

An agreement worth 3.5 billion Euro was signed to manufacture 800 electric locomotives for freight service and its associated maintenance.Touted as the largest Foreign Direct Investment (FDI) projects of Railways, the Ministry of Railways and Alstom came together in 2015. An agreement worth 3.5 billion Euro was signed to manufacture 800 electric locomotives for freight service and its associated maintenance.

The new powerful electric locomotive is expected to be a game-changer for the movement of freight by Indian Railways. The locomotive will have the capacity to haul around 6000T trains at a maximum speed of 100kmph. The locomotive will be used in the Dedicated Freight Corridor (DFC) for the faster movement of goods, especially coal and iron ore.

It is expected to be a game-changer for movement of coal trains in the DFC of Indian Railways. The project will allow faster and safer movement of heavier freight trains. The new locomotive will not only bring down the operational costs for railways, but will also reduce the congestion faced. This is the first time that a locomotive with such high horsepower is being tested on broad gauge network in the world by any railways.

More than 300 engineers from India and France are working in Bangalore, Madhepura, and France on the project. In two years time, more than 90% of the parts will be manufactured in India.

Mumbai: MHADA awards contract for key Goregaon project

The ambitious project of constructing at least 6,000 flats in Goregaon undertaken by the Maharashtra Housing and Area Development Authority (MHADA) is finally set to begin, with the appointment of a contractor on Wednesday. The housing body appointed BG Shirke Construction Private Limited Company as the contractor for building houses in Pahadi village near Goregaon's Inorbit Mall.

There was a 25-year-long legal battle over the ownership of this plot of land after a tehsildar had claimed ownership. A pre-bid meeting was conducted in December 2017, during which eligible developers were asked to show interest in the project. The meeting was attended by several developers, including Larsen and Toubro (L&T) Simplex Infrastructure Limited, Shapoorji Pallonji group, Shirke construction company. However, no bidders showed interest in the project due to some issues in the tender notice.

MHADA sources said there were several discrepancies in the terms and conditions of the project work, which included plans to construct a 24-storey building. Several developers had objected to this condition. The authority last floated tenders on May 8, after which the contractor, BG Shirke Construction, was selected. The company said it could construct houses at the rate of Rs. 25,700 per square metre. MHADA officials said houses constructed in Pahadi will measure approximately 300 square feet. "The lowest rate was quoted by Shirke as against L&T, which quoted Rs. 28,178 per square metre," said an official.10

5. KIFB sets up mobile quality management unit (autolab) in Kerala

On par with the Kerala state's motto of achieving development through innovative idea, Kerala Infrastructure Fund Board (KIFB) has come up with a mobile quality management unit (Autolab) to test the quality of the samples used in various projects. The Autolab is equipped with latest non-destructive test (NDT) devices like rebound hammer method, rebar locator to name a few. Being fitted with the latest GPS systems, the location and whereabouts of the Autolab can be accessed by the stakeholders. Also, the lab performs quality testing using drones and provides the status of the project. A quality monitoring studio has also been set up by KIIFB to monitor the quality standards adopted in sites.

Siemens signs MoUs with NTPC, TERI on decarbonisation, energy transition

Siemens Limited has signed a Memorandum of Understanding(MoU) with NTPC Limited to identify, evaluate and set up reference use cases of hydrogen sector-coupling for various upstream and downstream applications.

The collaboration is aimed at developing innovative technologies, solutions and techniques to reduce the dependence on Hydrocarbons in India.

It has also inked a separate MoU with TERI for collaboration on technologies to support the energy transition in India including sector-coupling. Among the objectives of the MoU with TERI is realizing the research and technology development projects to enable energy transitions across the electricity, transport and industrial sectors.

"One of the most important challenges recently is the decarbonisation of the global ecosystem. We take great pride in collaborating with NTPC and TERI as we believe technology will be a key contributor towards creating a carbon neutral society in India. This is also a huge step towards the sustainable development of existing and future power systems enabling efficiency, flexibility and sustainability," said Sunil Mathur, Managing Director and Chief Executive Officer, Siemens Limited.

CONSTRUCTION PHILOSOPHY

EVENTS

INVEST conference

The Indian Value Engineering Society (INVEST), an organisation since 1977 which helps various industries in improving their profitability through value engineering, conducted their 35th conference at Bangalore on 15 and 16th of November. The conference was successful in its objective of bringing the wisdom of several Value Engineering practitioners under the same roof. The 2 day conference also held paper presentation by eminent Value engineers across the world like Anita Lukose, Renee L Hoekstra, Muthaiah Kasi , Dorine A Cleton to name a few.

FutureFit – To make the Engineers Fit for the Industry

FutureFit, an event conducted by Construction Philosophy, aims to make the engineering graduates fit for the industry. The talk focuses on the expectations of the recruitizng world from the graduates and on what a student can do meet the demands. The third successful session of Futurefit was conducted at Sree Buddha College of Engineering, Kollam.


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Cinu P. Thomas
Managing Partner, InterCAD Systems Pvt.Ltd.

Techno Storm Sweeps

Construction industry is currently experiencing a paradigm shift with technology coming into play like never before. Digital is the buzz word today and 'Connected Construction', 5D Building Information Modelling (BIM), Robotic Process Automation (RPA), drones, Augmented Reality (AR) and GPS tracking systems revolutionizing the entire industry.

Construction Industry

Construction industry is in constant evolution. Its technology adoption rate in India has been slow given the huge stakes involved and the frustrating lag in change of professional and popular mindset. But things are changing now. Construction industry players have begun to embrace new technologies in a big way with focus on cost and time saving, sustainability and newer aesthetics. This is nothing short of a paradigm shift in the construction industry. The benefits are already in evidence. Project costs and risks have begun to come down, the participatory quotient of project execution has gone up and the industry is on a journey forward rather than remaining Janus-faced.

The Engineering and construction industry plays an integral role in building the future of the modern world amidst a number of potential obstacles such as material price volatility, talent shortages, and the rapid pace of technological changes. For someone running a construction company and wishing to ensure that he/she stays ahead of the game, it is imperative to grasp and assimilate the emerging trends in technology. It might be difficult to know which trends would be more popular than others on a future date, but there are a few important trends that are already gaining in popularity and significance.

As the industry becomes more competitive and the market shifts, harnessing these construction industry trends will prove valuable for any construction firm. Two of the main challenges for developers, designers and contractors are reducing costs and increasing safety, and there are technological innovations that can help with both these. Let's look at some of the emerging technologies that could transform the construction processes in the coming days.

Connected Construction

As per Deloitte's 2019 Engineering and Construction Outlook, Connected Construction provides a 360-degree approach. Digital is transforming not just cities, but also the way engineering and construction companies run their businesses. Within the construction industry, digital technologies like Robotic Process Automation (RPA) have the ability to make significant impact on back-office operations for engineering and construction firms to improve their cash-conversion cycles and financial constraints.

Similarly, Building Information Modeling (BIM) systems that allow contractors to create 3D models and make immediate changes to designs are evolving quickly. With the inclusion of cost and project scheduling as two additional dimensions, 5D BIM systems can help bring projects in on time and on budget, ensuring no overruns—a key to driving operational efficiencies with large construction projects. Keep an eye open for further maturity of BIM in the coming months into offerings that incorporate 7D, adding energy efficiency and facility management for comprehensive life cycle project management to the 5 dimensions that are already in play.

Digital is also driving 'connected construction' adoption. Drones, wearables, Augmented

Data is quickly becoming the core for future success in the construction industry. It moves business decisions from the 'reactive' to the 'predictive' and could enable engineering and construction firms to outpace their competition

Reality (AR), and GPS tracking services are revolutionizing job sites, streamlining surveying, improving worker safety, and capturing valuable data. In the years ahead, digital control towers for construction sites could evolve, tying together all the data captured through connected construction assets to deliver a true 360-degree view of an in-process project. And data is quickly becoming the core for future success in the construction industry. It moves business decisions from the 'reactive' to the 'predictive' and could enable engineering and construction firms to outpace their competition.

A data and analytics strategy can fuel the ability to deliver smart buildings and smart city projects, identify and address diminishing margins, and manage increasing project size and complexity. It can help identify not only what went wrong but also prevent it from happening in the future. Data related to engineering and construction projects exists in a multitude of sources, many of them outside traditional Enterprise Resource Planning (ERP) systems. Therefore, companies should devise a framework to collect data from all of these sources, using tools and models to analyze the data thus captured, and providing the insights gleaned from them to the right people at the right moment to make an impact on their businesses.

Digital twin technology

In the construction industry, transparency and proactive problem resolution drive productivity. Utilising digital twin platforms and reality-capture solutions can minimise rework in the field by creating an active view of the project's progress to be tracked and compared in real-time. This helps project stakeholders adapt blueprints as the work progresses and incorporate changes.

The most compelling factor of twin models is incorporation of 3D models from drone imagery with live key performance indicators (KPIs) that are monitored using IoT (Internet of Things) sensors. This means exact digital replicas can be created from a project's physical reality, creating higher data accuracy that can efficiently automate real-time progress. This also means users can virtually engage with models that combine 3D and as-built configuration. This level of full automation could potentially revolutionise the time spent on construction project decision-making cycles, including scheduling and budget updates.

Drone-based supervision and inspection

Drones are no longer a hobbyist's gadget as they have applications in many business sectors. Drones have been a major innovation in the last few years, and they've increased the number of activities that can be performed in a number of industries. Their uses are almost unlimited, and the construction industry has certainly seen a huge impact from them as well. Construction companies believe that drones are here to stay because they create a better working environment for employees. While the uses of drones do not include the actual labour phase of construction, they play a huge role in planning and analysis.

Drones are hugely popular in the building industry due to the fact that they provide an aerial view of a site at a comparatively smaller amount of the cost of construction. This means they can be used to develop plans, track progress and monitor any issue throughout the construction process. It is a simplified, budget-friendly and faster way to provide an up-to-date aerial view of a site. This has made drones quite popular in the construction industry. This sort of area coverage, in particular, could only previously be made possible with a manned aircraft.

By making supervision faster, drones can achieve significant cost savings. When aided by drones, an engineering company can supervise a larger number of projects simultaneously. Working conditions are also improved, since surveyors can inspect hard-to-reach places without exposing themselves to danger.

Augmented Reality

Augmented reality, or AR for short, is one of the most talked about technology trends in construction. Using advanced camera and sensor technology, AR combines one's physical surroundings with computer-generated information and presents it in real-time. While the technology has been used in video game for years, this 'augmented' experience is now making waves in the construction sector, offering immense opportunities to improve the project lifecycle.

By combining digital and physical views, augmented reality is helping construction teams drive more efficiency, accuracy, and overall confidence in their projects. The AR global market is expected to grow to $90 billion by 2020.

Rather than replacing workers on the field, AR can be used to greatly enhance the ways in which humans and digital machines work together. As the technology continues to mature and become adopted widely, augmented reality in construction will become an invaluable tool with the potential to change the future of building.

Completing a project on time and within a budget is a crucial part of the construction process. AR provides the tools for construction companies to plan a project from start to finish, ensuring accuracy, preventing rework, and saving building costs. This overall precision and efficiency can allow construction companies to have greater confidence in their projects, improving client relations and creating long-term ROI

Connected devices

Using sensors to monitor a building and manage it more effectively is nothing new. However, Internet of Things (IoT) is bringing connectivity to all types of devices. In the sphere of construction, this includes equipment, tools and even the gear worn by construction personnel. This generates abundant data that can be used for many purposes such as:

- Live monitoring, which allows construction activities to be programmed more efficiently, while preventing accidents.
- Tracking the performance of specific tools and equipment, revealing potential ways to improve their efficiency.

Connected devices can greatly benefit from GPS tracking, and especially construction equipment that travels long distances between projects. For example, when heavy machinery is equipped with telematics, construction managers can know the exact location of each truck and the distance traveled per day. This enhances fleet management, while helping prevent theft.

Be ready for change, or else...

The industry is facing clear challenges, from low productivity to shortage of labour like we have never seen before. With all of these technology advancements, there will be very few sustainable paths other than explosive growth. The next decade will be filled with exciting years for construction companies that understand how best to adopt and strategically incorporate these technological trends.

Jagjit Avdeel
Head of Gleeds Digital Services
Gleeds Consulting(India) Pvt Ltd. Bengaluru

Digital transformation, the Gleeds example

Gleeds is a world-class leading independent property and construction consultancy with more than 135 years' experience globally . As a multi-disciplined consultancy, we are proud to deliver award-winning projects around the world.

The construction industry the world over has already entered a new digitised era. Adoption of new technology is not an option now, it has now become inevitable to sustain this industry. It is important to optimize processes, data and tools in order to improve quality, save time and lower the costs of projects – and we at Gleeds know how to do this.

Gleeds is a world-class leading independent property and construction consultancy with more than 135 years' experience globally . As a multi-disciplined consultancy, we are proud to deliver award-winning projects around the world. We provide solutions for every stage of the construction and property lifecycle such as:

- Advisory
- Commercial and contract Management
- Programme project management to property
- Asset management services.

With technology fundamentally reshaping construction around the world, driving productivity and efficiency and redefining the project lifecycle, Gleeds Digital Services offer expertise and a range of services in the domains of:

- Realty capture
- 3D modelling
- Virtual tools
- M & E services

The urban population is constantly growing, leading to higher demand for construction. With the help of digital tools, construction consultants like us can respond to increasing demand by completing projects faster and more efficiently.

New digitization process 'BIM' helps to eliminate the problems faced by the construction industry with better collaboration, increased productivity, risk mitigation and value engineering. Building design was traditionally reliant on two-dimensional technical drawings. However, BIM added several dimensions to building design.

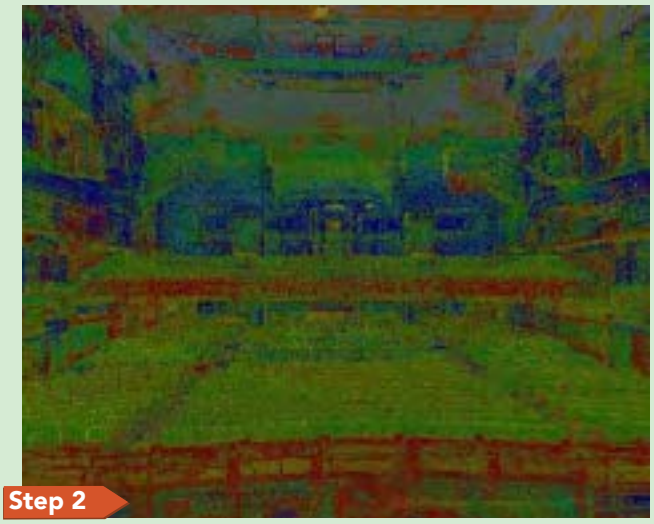
- 3D: Geometry and spatial representation
- 4D: 3D + Time
- 5D: 3D + Cost
- 6D: Whole life costing
- 7D: Maintenance planning

"Digitization in construction is the revolutionary method of working to improve the delivery, operation and renovation of built environment using digital tools and processes. Construction industry is aggressively moving towards digitization. Reality capture, 3D modelling, clash detection, 4D sequencing, 5D cost modelling, capabilities are the new prerequisites to support the construction industry in immediate future. As a part of Construction industry, understanding our role in the collaborative world of BIM

Below are some of the examples where we have utilised the digital tools and digital processes to capture existing site conditions accurately.

Step 1

Gleeds surveyors produced a high definition 3D terrestrial laser scan using 3D laser scanners and high dynamic range 360 TrueView images with HDR cameras.



Step 2

Raw scan files were registered and merged into three-dimensional point cloud files using Autodesk® Recap.

Step 3

Inserted point cloud data into BIM platform and developed a LOD300 3D model

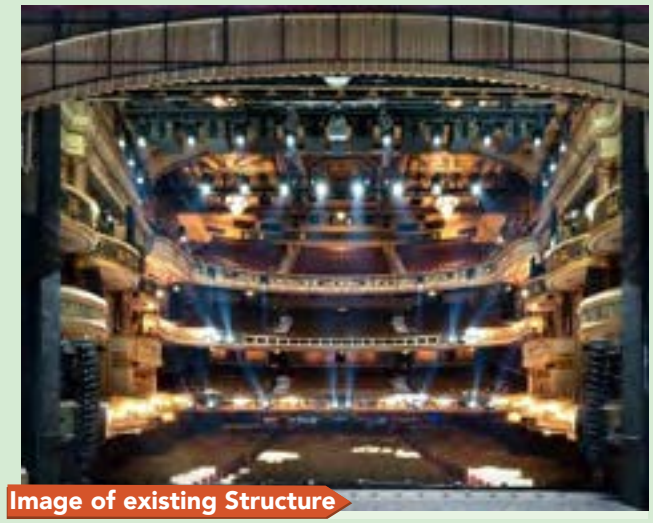


Image of existing Structure

"Digitization in construction is the revolutionary method of working to improve the delivery, operation and renovation of built environment using digital tools and processes. Construction industry is aggressively moving towards digitization. Reality capture, 3D modelling, clash detection, 4D sequencing, 5D cost modelling, capabilities are the new prerequisites to support the construction industry in immediate future. As a part of Construction industry, understanding our role in the collaborative world of BIM has helped us to create the foundations of a BIM culture within Gleeds." says Ben Huskisson, Managing Director, Gleeds India.

Ben Huskisson

has helped us to create the foundations of a BIM culture within Gleeds." says Ben Huskisson, Managing Director, Gleeds India.

BIM helps create a digital prototype of a project where all the stakeholders can work collaboratively on a 3D platform which helps to visualize projects, identify and resolve issues before hitting the ground. Through BIM, buildings are increasingly being delivered with a 'digital twin', a database of structured information (and not only geometric information) that can be collaboratively used to interrogate a range of critical information like cost, programme, maintenance, waste, or energy use. This will improve not only a buildings lifetime performance (and safety), but also inform and improve future design. It paves the way for machine learning, robotics and offsite construction. It also paves the way for resolution of the issues identified.

Gleeds have the intention to leverage digital to connect and augment our existing services, to create new services, products and companies, and enhance our capabilities and reach. An important focus of our digital transformation is to continuously enhance our delivery to our customers and enhance their experience. A specialist team within Gleeds have spent the last 18 months developing a suite of digital services to support the changing requirements of the built environment. Our team consists of geomatic surveyors, architects, civil engineers, mechanical engineers. It is worthy to note that most of our efforts are focused on digital collaboration of the new age construction technology.

Below are some of the examples where we have utilised the digital tools and digital processes to capture existing site conditions accurately.

We at Gleeds have taken the lead to link up our core cost management and project management services with our digital services offerings, by developing an in-house capability to cater to digitisation in the construction industry. Gleeds has a diverse and professional team of experienced architectural and MEP modellers combined with senior quantity surveyors/ project managers to effectively manage and execute complex projects on digital platforms ensuring correctness and accuracy of final deliv-

Eastman Dental Hospital
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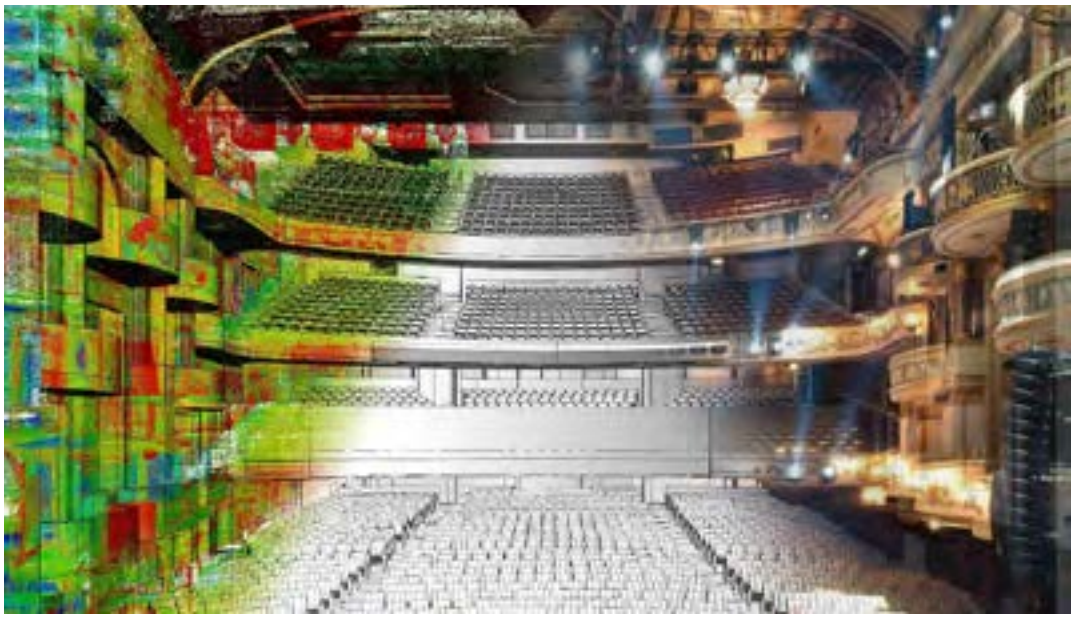


erables. We, at Gleeds, intend to carry out and deliver all our service offerings via digital tools and digital processes moving into 2020.

Not only for new builds, digitalization is booming for existing buildings as well. Laser scanners and drones are replacing tedious manual measuring processes to capture existing site conditions accurately. Implementing a digital reality capture process enables to minimize manhours, save time, and reduce project risk.

Measures which Gleeds are taking into consideration include:

- o Technology
  There is serious potential for losses due to technology failures or outdated technologies. Key risk areas will include scalability, compatibility, and accurate functionality of the implemented technology.
- o Cyber protection
  Security of our digital environment from unauthorized access/usage and ensuring confidentiality and integrity of Gleeds company is a major risk. Key controls will include platform hardening, network architecture, application security, vulnerability management, and security monitoring.
- o Resilience risk
  As and when all Gleeds operations are digital and digitalized, there will be a high dependency on interconnected and unitised technology, any issues with this technology will cause major disruption in operations and/or unavailability of our services. Key areas of consideration would include business continuity, IT/Network disaster recovery, cyber resiliency, and crisis management.
- o Data leakage
  Gleeds will ensure protection of our data, whether the data is in use, in transit or in storage. Key issues to be considered and addressed must include data classification, data retention, data processing, data encryption and storage. Gleeds believe that block chain technology could be a possible solution or be part of the solution.

Predictions for the next 3-5 years:

- o Big data will enable the revolutionising of the global construction industry
- o Artificial Intelligence (AI) will be hugely influential (in tandem with Big Data)
- o BIM will play an increasingly important role in impzroving construction
- o Maintenance management will be informed by real time data, asset tagging and sensors
- o Buildings will be smart and interconnected, saving energy, transferring energy and being more reactive to their occupant's requirements
- o Software companies will offer more solutions in order to capture professional's data and knowledge
- o Blockchain technology will be increasingly prevalent
- o Start-ups and innovations will be a constant threat and opportunity for Gleeds.

AD

Chintana Herrin

Senior manager, Product marketing
Digital CitiesBentley Systems India Pvt. Ltd.

Penn State's 3D reality mesh

Bentley's reality-capture technology provides an integrated data solution for America's largest public university.

Founded in 1855 with more than 24 campuses serving nearly 100,000 students, Pennsylvania State University (Penn State) is America's largest public university and has been ranked a leader in higher education for more than 150 years. The entire education system encompasses more than 23,000 acres and maintains close to 2,000 buildings and structures State-wide.

The university recently realized that using BIM and GIS datasets to create a digital model would not be enough to control costs and manage and operate the huge number of facilities more efficiently. The college thus set out to integrate the enormous amounts of asset, financial and space management issues, maintenance, projects, and BIM data into a 3D reality mesh, creating a virtual campus model.

This virtual 3D campus would act as a single interface into the numerous data sources the school relies on for daily and long-term operations and ensure that facility maintenance personnel could access the asset data to perform their jobs effectively. The project team decided to implement the virtual campus initiative at the school's main campus, the University Park in State College, which comprises 945 buildings and structures spanning 79 acres and occupied by 46,000 undergraduate students.

In order to capture images in a timely and efficient manner and develop a precise reality mesh of the numerous buildings, assets, and the

surrounding area, the team needed advanced reality modelling technology. Compounded by an additional serious data integration issue, the project required a collaborative, interoperable framework to integrate the disparate and disconnected datasets from the university's custom enterprise data systems into the 3D virtual model.

ContextCapture

Given the sheer size and number of structures and assets on the University Park campus, using traditional reality-capture technology such as 3D laser scanning was not a viable option. It is time consuming to capture the buildings and surrounding area and requires a large amount of work to stitch together separate models as a whole model. Use of Bentley's ContextCapture photogrammetry software simplified the process and enabled the team to quickly and cost-effectively generate a highly detailed, geospatially accurate 3D reality mesh from digital aerial images.

A manned Cessna aircraft was flown approximately 1,000 feet above ground, and with a handheld high-resolution camera, the flight team captured almost 2,500 photos within two hours of flight time. The team used ContextCapture to process the images, and relying on

the automated capabilities of the software to create contextual content, the team produced a 3D texturized reality mesh in less than two days.

The generated campus model is a large, 3D scalable mesh that includes detailed representation of each campus building, including enclosures, auxiliary structures, facades, hardscape, and landscaping elements, enabling more informed decisions regarding structural maintenance and reducing time necessary to survey existing conditions for retrofit projects.

With 3D viewing capability in relation to the surrounding area, the reality mesh provides an understanding of spatial constraints prior to maintenance work, minimizing risk and improving safety.

Interoperability

The reality mesh generated by ContextCapture provided only one data source within the 3D campus model. To fully leverage reality modelling as a solution for asset maintenance and facilities' management, the virtual model needed to incorporate disparate asset, facility management, and other datasets residing in different information systems and stored in numerous formats.

Penn State had been using a computerized maintenance and management system (CMMS) to store, manage, and query data related to assets and work orders focused on maintaining the campus assets. While each piece of data contained attributes of building name and number, the data was not associated with geospatial information which made it difficult for facility managers to picture where the data is located and hard to undertaken additional planning tasks related to location requirements.

According to Craig Dubler, Facility Asset Management Programme Manager at Penn State, "The Office of Physical Plant (OPP) must rely on CMMS data as well as accurate locations to dispatch technicians. To date, there is a disconnect between CMMS data and accurate locations."

The OPP provided the project team with GIS shape files representing the boundary of each campus building, as well as access to the CMMS data to incorporate into the reality mesh so that the model could ultimately be used to improve asset management and maintenance efficiency. Bentley's iModel Transformer enabled the integration of the work order data from the CMMS with the building shape files from the GIS resulting in a cohesive, composite iModel without programming through rules and scripts defining how disparate types of information are related.

The combined iModel was then integrated with the 3D reality mesh using MicroStation. As both data sources were geo-located, the reality mesh overlaid the integrated data files. Leveraging Bentley's interoperable reality and information modelling technology, the team implemented a successful integration framework to produce a rich 3D virtual campus model, providing a better spatial interpretation of maintenance tasks.

Connected data environment

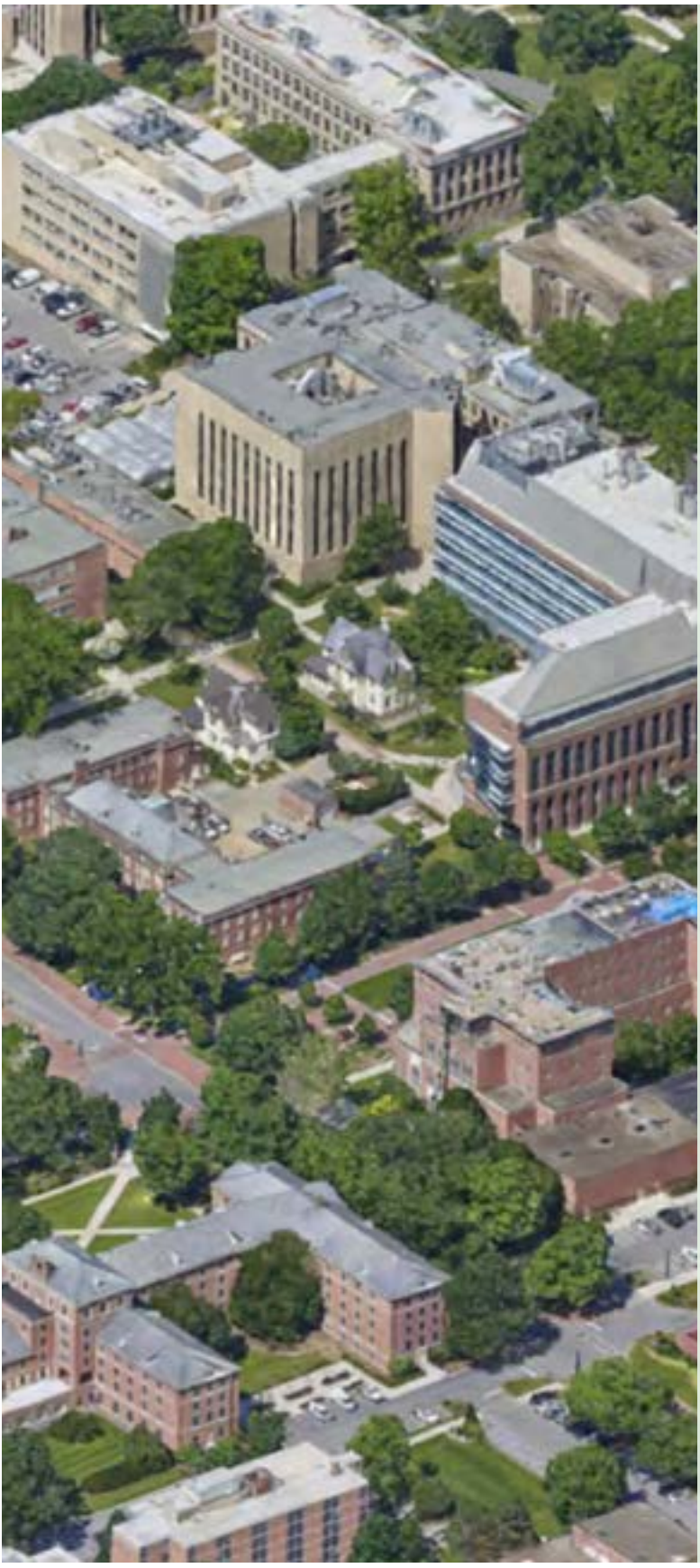
To improve asset management and maintenance activities, the project team tied all crucial information into a comprehensive 3D reality mesh using MicroStation, which allowed stakeholders to search and query work order data using built-in query functions.

The work order data files containing the query results can be selected, resulting in a highlighted display
of the corresponding buildings in the virtual model that satisfy the search criteria.

Using ProjectWise as the common platform for communication enables the model to be viewed and accessed through a Web browser. Bentley's project collaboration software enables facility managers and other stakeholders to share documents that are associated with work order data, such as work order request forms, and generate a hyperlink to the document providing easy access to these documents when querying in MicroStation.

Working in a connected data environment using Bentley applications to manipulate the virtual model offers facility personnel the ability to visualize accurate locations of work orders, accelerating response time and improving performance. "Each year, Penn State University responds to over 70,000 calls for maintenance and produces over 46,000 work orders across our University Park campus," explained Dubler.

With a single, intuitive interface, a user can select a building within the 3D model and pull up information about a job, the status of a work order, and the party responsible for the work. Facility managers can interactively move within the model to achieve desired maintenance



Precisely detailed and geospatially accurate 3D reality meshes of campus facilities were generated from digital aerial images through ContextCapture photogrammetry software.

information, for more efficient maintenance personnel distribution and scheduling, optimizing lifecycle asset maintenance and management. Using the integrated 3D campus reality mesh within a collaborative environment enables real-time monitoring of campus operations, allowing better information into the hands of facility managers and maintenance staff.

Extending the scope

"The Virtual Penn State initiative using ContextCapture, iModel [Transformer], and Project Wise to create an accurate and complete model of the campus and overlay CMMS data has provided both initial and potential benefits for maintenance activities for the Office of Physical Plant," remarked Dubler. Penn State's 3D reality mesh is much more than a means for accessing previously recorded data about its assets. It has the capability to provide asset data in real time, setting the groundwork for enabling workers to obtain up-to-the-second information about buildings and structures.

Although the reality mesh was integrated with facility data for this specific project, it also can be populated with other data sources for use in cases ranging from energy efficiency and environmental sustainability analyses, to generating master plans for future facility, transportation, utility, and security plans. Based on the successful use of the model for more efficient facilities, personnel distribution and asset maintenance, the university is considering connecting their building automation systems and security systems to the 3D virtual model.

In the near future, the reality mesh could offer access to current room temperature or show whether a security sensor has tripped. This comprehensive reality modelling solution not only benefits campus facilities management, but also empowers the university to be proactive and extend the value of its campus services across all applications and throughout the infrastructure lifecycle.

Ashish D. Gharpure
Managng Director, GENSTRU Consultants Pvt. Ltd.

Civil engineering in for Digital transformation

There is hardly anything on earth not affected by technology boom, especially digitisation and computerisation. The advent of new technologies is redefining engineering practices and the way we act in complex situations. Civil engineering cannot remain unaffected in this digital transformation.

While numerical modelling with calculation speed, accuracy, and efficiency was the first impact of technology on civil engineering, it quickly expanded from pure mathematics to subjective modelling like construction planning, stock/T&P management, resource utilisation etc.

For starters, technology with digitisation has made a huge impact, especially on topographical surveys, geological maps, geographical information, geo-tagging of assets, etc. And, we are seeing just the tip of an iceberg yet. Now that data is available on one's fingertips, the need for physical survey has been significantly reduced.

'Bhukosh'

Initially, the available data had to be digitised for storage and later use, as was the case with geological survey maps. Geological Survey of India (GSI) has now digitalized their map and it is ready for download and use (Refer figure 1). The digitalized database is named 'Bhukosh', which can be accessed using the link http://bhukosh.gsi.gov.in/Bhukosh/MapViewer.aspx

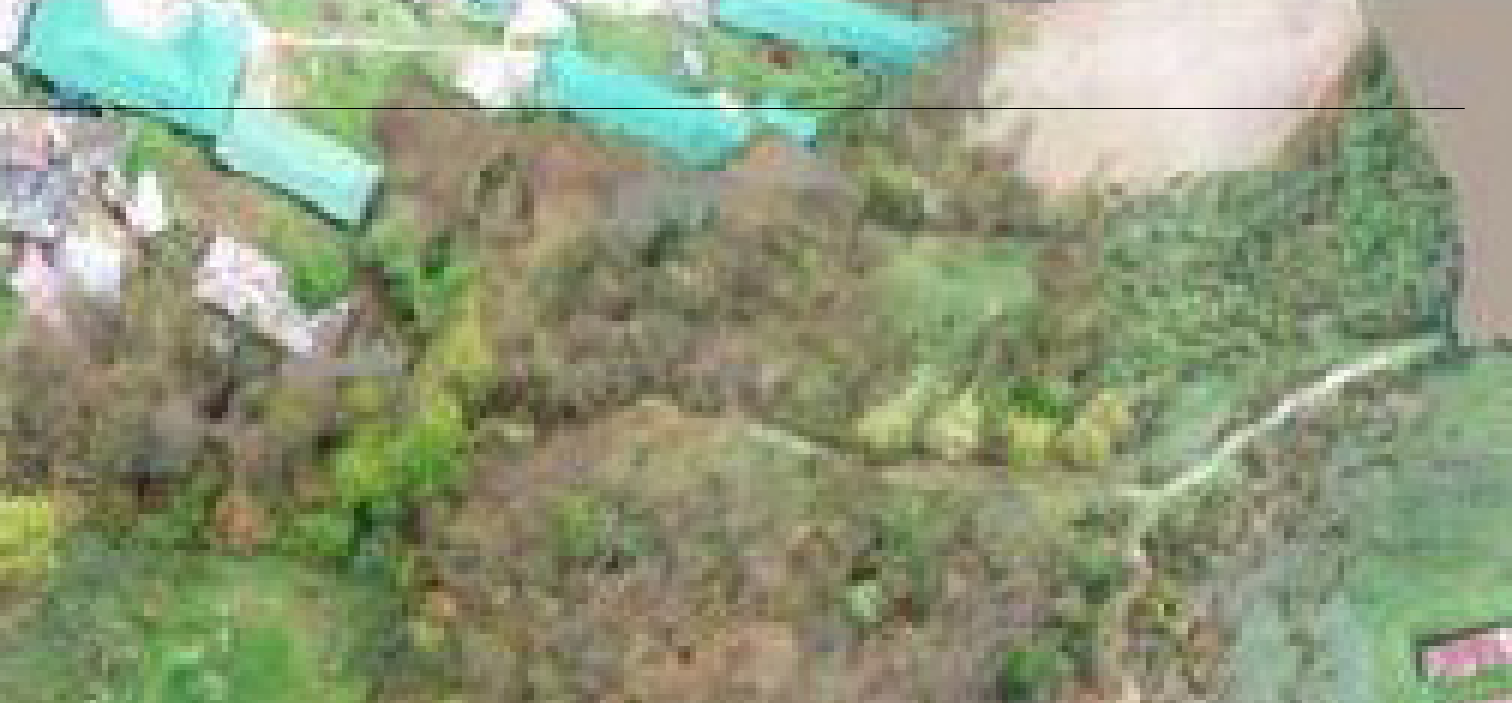
The next phase was availability of data captured in digitised format to begin with as in the case of topographical maps through satellite images, asset identification through CCTV, human resource identification through biometrics, etc. Some are listed below:

1. Topographical maps through Google
2. Drone survey maps

Aerial imaging using drone can be done at required altitude and with the desired percentage of overlap between subsequent images. After the acquisitions, images can be used as an input of the photogrammetric process. The raster data collected in the form of geo-referenced digital aerial

images through drone survey is then used to prepare 3D images. 3D images developed using drone survey is shown in figures 2 and 3.

The present phase involves analysis and interpretation of data using Data Science and Artificial Intelligence (AI)/ Machine Learning (ML) tools, as when interpreting satellite maps to identify what is beneath the earth's surface



and possible use of knowledge derived thus.

InSAR

Interferometric Synthetic Aperture Radar (InSAR) is an effective way to measure the changes in land surface deformation. InSAR makes measurements over large areas by using radar signals from earth-orbiting satellites to measure changes in land surface altitude at high degrees of measurement resolution and spatial detail (Galloway and others, 2000).

An overview of InSAR technique is shown in figure 5. This technique can potentially measure changes in deformation in millimetre scale over spans of days to years. It has applications for geophysical monitoring of natural hazards, volcanic activities and landslides, and in structural engineering, in particular monitoring of subsidence and structural stability.

BOReLOG

Many specific applications are getting developed by users/ consultants to overcome the challenges of reliable and accurate data keeping subjectivity at bay. My own firm has developed an app that we call BOReLOG, which is being used for geotechnical field bore logging in soil and rock.

This is a simple mobile application which has been developed for automation of borehole logging by engineers in the field. The app provides preliminary subsurface stratification adhering to standard guidelines based on information given by the user, thus avoiding the inconvenience of flipping through handbooks, textbooks, standards, etc.

The output generated by the app provides the information on order of occurrences and extent of soil and rock strata, nature and description of the soil and rock formations, location of groundwater etc. (Refer figure 8). It also summarizes the sampling type, equipment record such as circulation fluid, type of boring, etc., along with in-situ tests conducted on field.

Moreover, with connectivity, the app has the ability to share live updates from far off/inaccessible locations. This application can also be used to log borehole data offline, reducing manual calculations and is a real time saver. Ultimately, 'going paperless' makes it an economical, environment friendly and productive way of recording field data.

Land and property records are now-a-days stored using block-chain technology. This has the potential to eliminate land transfer/ownership related issues despite bifurcation, augmentation, multiple ownership and multiple transfer of properties, etc.

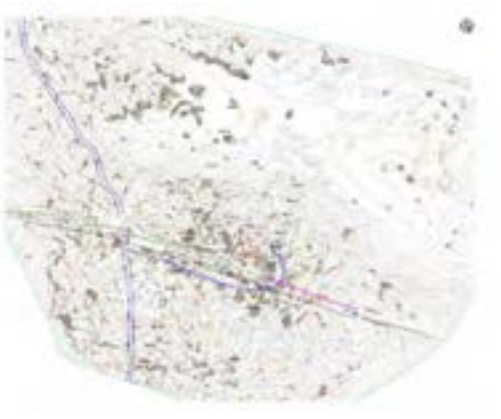
3D printing

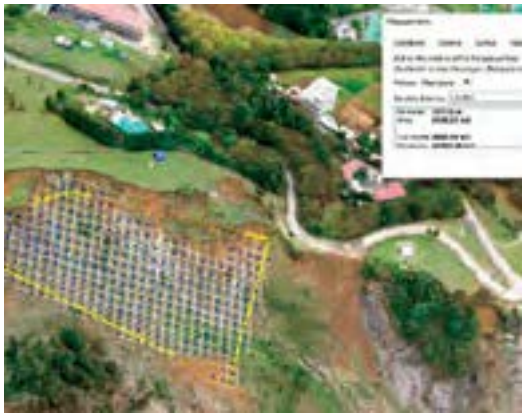
Digitisation will further lead to 3D printing of all construction work. 3D printed model houses have already demonstrated the potential of the technology. Self-executing contracts are something on the anvil where, for example, the construction stages linked to payments would be executed directly once digital capturing of construction progress is scrutinised. This will trigger the linked payments through automated bank requisitions. It is also possible now to activate penalty clauses for slow progress or liquidated damages.

Get ready for the change

Domain Knowledge is essential for interpretation

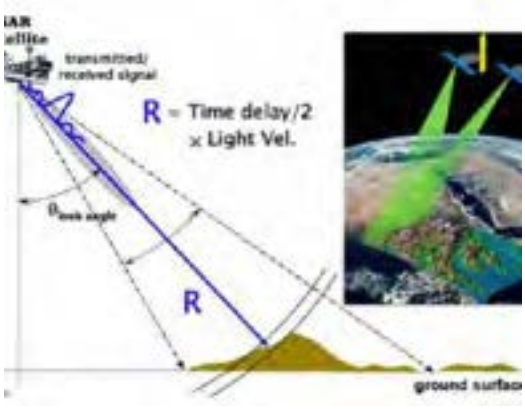
Distressed blisters in bottom slab





Crack location in the webs Crack location after filling with epoxy resin, plate bonding works carried out in previous repair

GPR testing and core drilling investigations



and use of data and, hence, there must be a combination of information, knowledge and wisdom. While conventional knowledge and practices would help, it is important to know that in future, the value of conventional wisdom would be very low once machines learn the processes and are ready to even extrapolate.

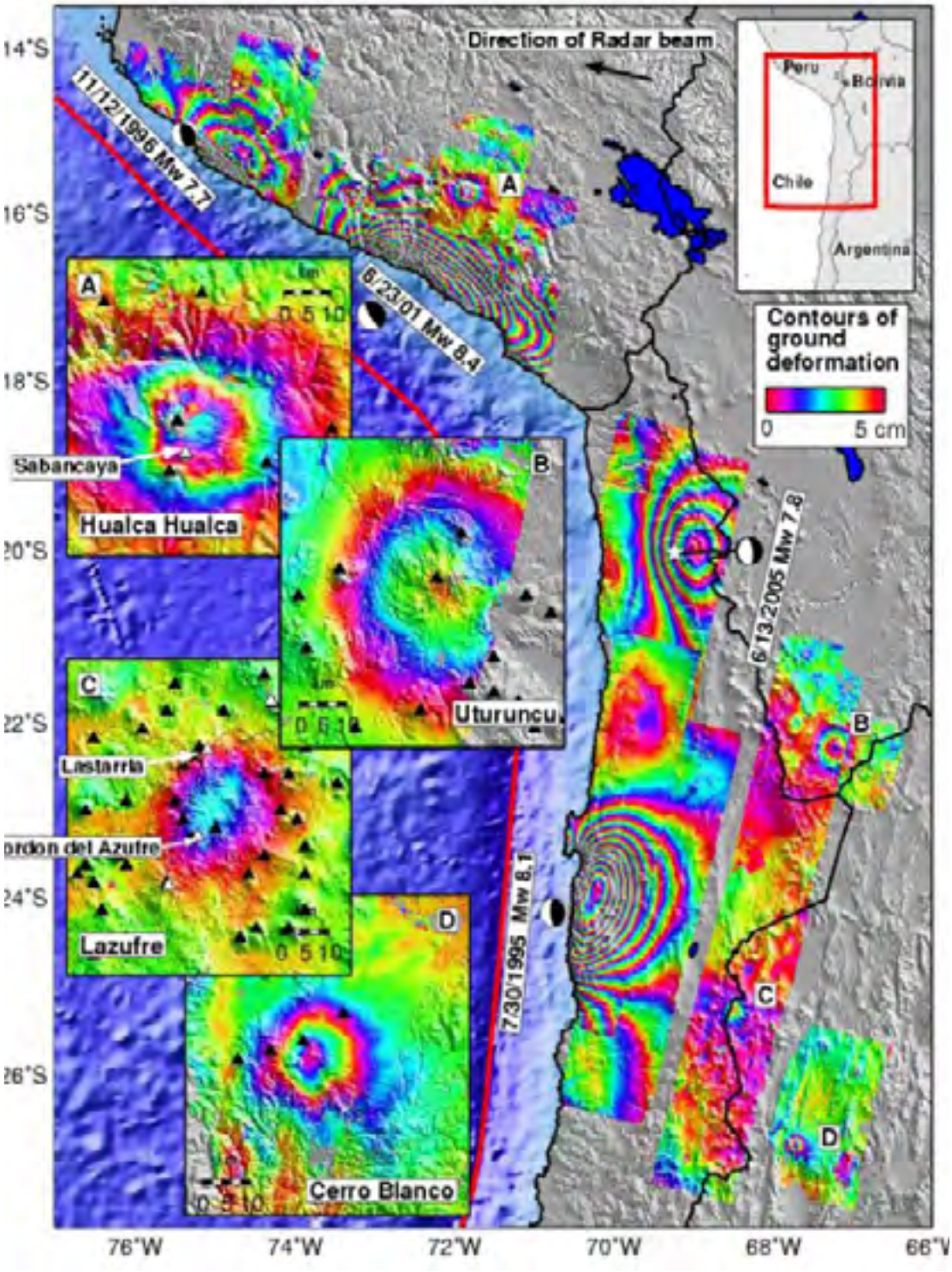
Digital data dynamics

There would soon be a quantum jump in the amount of information available in digital format. Capture, transport and storage of data through visuals, scanners, sensors, etc., would now be faster and broader than ever before. Which means it would be good to focus on unconventional and new technologies, new materials and practices that are going to evolve.

For example, polymers would soon be the mainstream construction material; construction supervision and quality controls would be through digitised visual recordings and multiple types of wave scanning; and designs would be more about right input selections while computers do the rest of the job.

Social impact

Each civil engineer would do well to come to



terms with the legal, environmental and social impact of technology, policy making, and regulatory provisions. Digitisation and technology will free up the practitioners' time. This would enhance the focus on entertainment people seek during their free time, which means people would follow their hobbies and what we today speak of as 'extra-curricular' activities would actually become the main work domain. With a bit of right orientation, civil engineers are actually going to reap huge benefits from the ongoing digital transformation.

Gopikrishnan V
Founders, BuildNext, Kochi

Construction goes hi-tech with BuildNext

BuildNext is an award-winning internet-based platform that connects professionals, manufacturers, traders, and service providers in the construction industry through standardised software-enabled delivery mechanisms, to provide seamless construction solutions to professionals and customers.

"The Internet is becoming the town square for the global village of tomorrow"

– Bill Gates

Internet has revolutionised almost every sector in the world today. Digital banking has taken the world by storm, ride-hailing tech companies in automobile industry, hyper local food delivery companies, etc., have taken customer experience in some of the largest industries in the world to never-seen-before levels. E-commerce companies such as Amazon or Alibaba are ideal examples of internet in business. Even offline commerce model in industries such as apparel or fast food chains are being managed through connected systems to benefit customers.

How would you rate your purchase experience with these any of these industries? There is a sense of delight and satisfaction at one point of time or the other. IMPS, UPI in banking, Swiggy or Zomato in deliveries, Uber or Ola in ride hailing, Amazon, all of them have at some point or the other given us top notch service experience, leave alone amazing (at times unsustainable) discounts! It's the same when we buy a car or a laptop from an offline store. There is no uncertainty, we always know how much we need to pay and for what we are paying for.

Internet for efficiency and improved CX

But what about the experience while building your dream home or furnishing your office interiors? Did you have a delightful experience procuring 50 bags of cement for concreting work at your home? If this sounds funny or weird, you

have a problem on your hands, which needs a solution right now.

'Build Next' started working on a platform for construction materials and services, where best practices, standards, and processes from other industries could be picked up and used to create enhanced efficiencies and customer experience in the construction sector.

Data for innovation and process improvement

"If you go back a few hundred years, what we take for granted today would seem like magic - being able to talk to people over long distances, to transmit images, flying, accessing vast amounts of data like an oracle. These are all things that would have been considered magic a few hundred years ago." – Elon Musk

We use simple data analytics and basic machine learning capabilities to keep improving our data - on supply patterns, technology comparisons, cost and efficiency comparisons, quality parameters and customer experience parameters. It will help us determine which areas could be further optimised, and help us identify specific opportunities for technology transfer and modularisation in the future.

For example, we know a particular activity, say brick masonry, has defined inputs to it in terms of labour person hours needed per cum, materials required, etc. If we get hundreds of data points from different service providers using our platform, doing the same activity per cum, we can easily find patterns and model the ideal optimal spent expected per cum of brick masonry activity. This simple data-based approach extended over hundreds of activities can help us easily innovate the way construction process is managed at site irrespective of size.

We don't trade data, and we ensure that we are able to keep data safe and protected, with all necessary access controls in place. We value the privacy of customers and businesses in terms of data management.

Software tools for delightful customer experience

"We see our customers as invited guests to a party, and we are the hosts. It's our job every day to make every important aspect of the customer experience a little bit better." – Jeff Bezos

Team BuildNext: Nirmal George, Gopikrishnan V (The one with spectacles) & Finaz Naha, Founders, Dileep P.G.

Our virtual reality product helps contractors and architects take the customer through a building as if it is already constructed, helps do virtual trials of various building finishes, fittings and furniture if needed, and also shows the cost impact of a new product replacement real time through our BoQ tool.

Our access-controlled PRO Tools experience has photo updates and timeline charts auto-created, to be accessed by customers with just the right amount of information and detail.

Construction is in-situ manufacturing

"Profitability is coming from productivity, efficiency, management, austerity, and the way to manage the business." – Carlos Slim

We try to look at construction as an onsite custom manufacturing activity and try to adopt best practices from a conventional factory-based manufacturing system to onsite building. We track simple parameters like completion and consumption of raw materials, labour, machinery use to track variances in actuals on time and cost with respect to plan. This tracking helps us fix issues much earlier than usual. These methods and their much-refined forms are being used in large projects using advanced software. What is special about BuildNext tools is the ability to use them on much smaller projects, with practically no extra effort.

Past, present, and future of Internet in construction

"I have been quoted saying that, in the future, all companies will be internet companies. I still believe that. More than ever, really." – Andy Grove

A lot of data collection and tracking that we do might not have been possible till the very recent past, when high speed mobile data became a norm. In future, we will see drastic improvements in processing power capabilities of devices, especially of handheld devices. We are going to see much faster data transfer and landmark changes in customer experiences in retail, financing, automotive, accommodation, restaurants, healthcare, tourism and education. Construction is definitely starting to catch up. At BuildNext, we strive to be at the forefront of that revolution, for as long as possible!

M.S. Kailashnath
Project Manager, H & K Constructions

BIM waiting for its boom time in India

Construction industries across the globe have acknowledged BIM with its detailed and interactive 3D models as the best integrated technology for higher performance and lower cost, but it is yet to be a favourite of Indian companies.

Technology has transformed every aspect of human life in more ways than one. New modalities are changing the way we live, helping us improve efficiency, reduce cost, and enhance comfort, health and safety.

Construction sector too is going through this phase. From human collaboration to build structures to the use of robots to print structures, it has advanced through many technologies. RoboticsX, a start-up in Germany, recently made an interesting statement that they are planning to send robots to Mars to build houses which will be monitored from here. Like this, there is a lot of buzz about new developments such as Augmented Reality, Virtual Reality, Automation, drones and more.

Among the new technological advancements, Building Information Modelling or BIM is one of the leading trends in the construction sector. It has applications from planning to the real-time operation of a structure or a building, and has replaced conventional 2D drawings with detailed and interactive 3D models. BIM is the process of managing information, which helps to collaborate the project into a single platform where all stakeholders can instantly review the design to

see the operation of a building.

Benefits of BIM

Two main aspects of any project are its cost and time. Mostly, when a project loses its control in coordination, it leads to cost overrun and schedule delay. So, a technology for better collaboration is the necessity of the times. The main benefit of implementing BIM is lower operational cost and effective time management. BIM enables the sharing of knowledge resources through integrated technology to ensure precise decision-making during the entire process of construction such as concept, design, construction, and subsequently through its operational life and demolition.

Design error and timely review is often a major issue for big projects. BIM provides better communication between designers and contractors. The initial concept of a building is always different from its final make. The design undergoes various changes before the work begins, and the constructability of an initial idea may be found difficult later. So, a better visualization of the first concept and details during the pre-construction stage can avoid many clashes and reworks during the construction, thereby reducing unwanted expenses and wastage of time.

BIM can also address other major issues in the sector such as lack of skill in construction and design. Producing a working detail is always a headache for architects. BIM makes the design process easier and more interactive. A-Line representation in 2D format can be instantly viewed as 3D which provides more clarity and precision to the design process. BIM works on the principle of parametric modelling which has everything in the model connected to everything else. For instance, when a designer changes a wall design, all other elements related to the wall will instantly be revised and he/she gets a clear estimation of additional cost and required coordination MEP and structure.

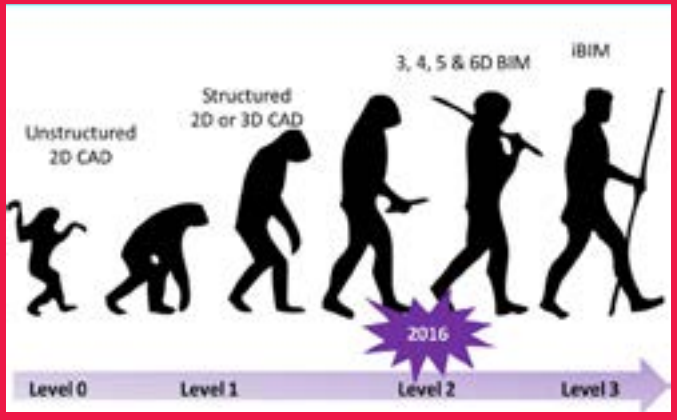
BIM can create real-time documentation without losing the quality and quantity of work details and provide better project information at each stage to the client. This ensures the client's total involvement in the construction. Nowadays, energy efficiency and sustainability are important factors, and BIM can do simulations by iterating the design for getting maximum energy efficiency and optimizing it to achieve the target with sustainable materials.

Wework, one of the largest companies in the shared working spaces, uses BIM for managing its facilities. For them, BIM is a solution to the fast furnishing of leased spaces. Three-dimensional models help them iterate design choices and analyse them on the basis of cost and potential revenue, and quickly deploy their designs using design-to-fabrication and lean construction processes. Not just Wework, many companies in the US and Europe too have adopted BIM and connected it to their ERP (Enterprise Resource Planning).

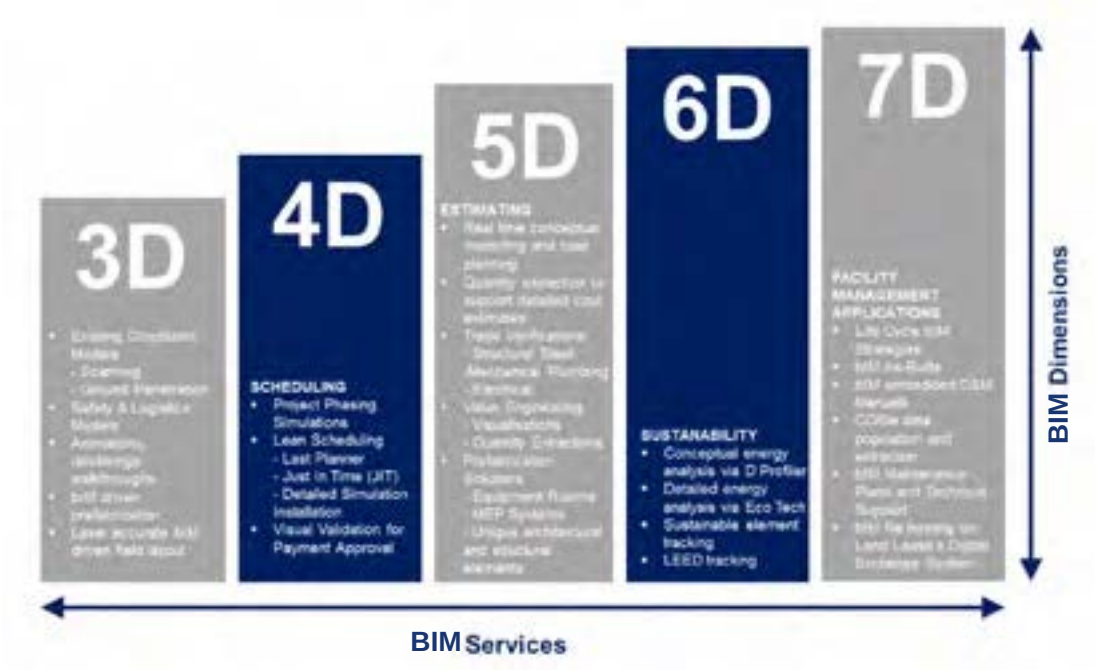
Combining BIM and ERP allows integration of actions and controls through effective communication of information that is made available to everyone from a central location. It leads to better financial management, project resource planning, project tracking against the estimated budget, avoidance of conflicts in contracts and risk mitigation.

Challenges for BIM in India

What clients think BIM is doing▲



What I think BIM is doing ▼



What my team think BIM is doing

What BIM is actually doing

Across the world, construction industry is rapidly going digital, however, the AEC sector in India is still very slow to adopt BIM. Many Indian companies provide BIM services to US, UK & Europe, but none of them have projects from India because not many here are aware of the benefits of BIM. Most firms believe that the implementation of new technology will cause additional expenses for capacity building and infrastructure.

Another major challenge is to make stakeholders aware of the advantages of BIM. For instance, 70% of the architects in India still follow conventional design methods. They need to come out of their comfort zone and realize that BIM has changed the design process in its entirety. The reluctance to experiment with new methods is common among all Indian architecture firms.

Also, India needs to have a common BIM standard that can be applied to all sorts of projects initially. Awareness among the top management in the Indian AEC industry is also important for the fast adoption of BIM. The implementation has started only in the micro-level—architects and designers—and a lot remains to be done. The people who can make it happen are the architects in India. Therefore, it is now up to them to break conventions and transform the construction industry embracing the new technological tool.

Reji Zachariah

Chief Consultant, S&R Consultants,
Structural & Geotechnical Consultants, Kochi

ERP: An integrated solution for sustainable construction

A software solution that brings together various modules of a business, ERP ensures better quality control, estimation, planning, risk assessment, inventory control and resource allocation

Sustainable construction has always been a major topic of discussion and debate within and outside the industry across the world. Its challenges are many, and benefits many more. Experts highlight one factor - sustainability in construction is all about sharp reduction in wastage of resources.

These wastages can generally be divided as -

Material	(5%)
Design	(5%)
Labour	(5%)
Time delay of 1 year in most projects	(22%)
Bank interest	(12%)
Inflation as	(5 %)
Rental loss	(5%)

It is obvious that delay is the major cause of wastage. It becomes manifold when one buys land because delay components are then applicable to the investment too.

If one were to consider the value of a project as Rs. 5,000 per sqft. (land value as Rs. 3,000 per sqft and construction cost as Rs. 2,000 per sqft), the total wastage of the total project due to time alone (22%) amounts to Rs 1,100 per sqft. That is roughly 50% of the entire construction cost which has been invested in the land.

It is interesting to note that 95% of the construction industry does not understand this loss, and 90% of all constructions has a standard delay of one year built into them, due to various reasons.

Can you avoid this? Yes, we can avoid this wastage and the remedy comes in the form of IT-based solutions at 2% of the cost of wastage, which means we can effectively save 50% or build two villas instead of one at the same cost.

How do we solve this?

Delay can be avoided by reducing the time requirement of past, present and future activities of construction stages and also the interaction between them. This can be done with better planning. Moreover, each activity can be made faster by the respective automated software systems.

Bringing together all knowledge in the construction industry is the only solution to reduce this wastage. An integration of all aspects of engineering, listed below, is possible nowadays with ERP (Enterprise Resource Planning) systems combined with 3D management softwares.

Design, Detailing

Estimation, Planning

Inventory management, QC (Quality Control), HR (Human Resources), Site Management

(Know more about the ERP system at www.aadspro.com, developed by our team)

So, what exactly is an ERP system?

ERP is a software solution that brings together various modules of a business under one umbrella. In the construction industry, ERP offers the advantages of a 360-degree view of all stages of a project which ensures better quality

control, estimation, planning, risk assessment, inventory control and resource allocation all in real-time.

In addition to 3D, time as the 4th dimension, cost as 5th and information exchange as the 6th dimension completes the ERP. Once the architectural layout of a project is finalised, engineering aspects of ERP can be synced with the construction process.

This was not possible earlier except for very large projects, but is now viable for even very small projects like villas with the emergence of high-speed internet at a relatively low price and the availability of cloud and storage options.

Similar systems have been operational in transportation (Uber), manufacturing and management industries for long, but civil engineering community was reluctant to use them due to the complexities involved.

Even though there are existing ERP software at play, they do not properly connect with engineering aspects like estimation, bar bending schedule, workflow resource allocation, scheduling etc. Without such an integrated approach, it is not possible to reap all benefits of an ERP. Like in the case of Uber, if the GPS is not functional, the transportation network will not work efficiently. So, for an effective EPR, every challenge in the construction industry is to be addressed and the flow of information has to be smooth and faster.

Let us look at the various departments involved.

Planning

The project is provided with an online server-based system. The user schedules tasks and updates it on a regular basis, which ensures that the project is completed within the allotted period.

Estimation

Estimax is a software that makes fast estimations by simply scanning the plan.

Bar Bending Schedule (BBS)

BBS for steel reinforcement can be obtained from aadspro which provides quality of work and ensures that it is in accordance with the design provided.

Optimization of Steel Bars

Optimax software optimises bar cutting pattern whereby wastage during cutting can be reduced to about 1% from 5%.

Quality Control

Quality control forms are to be used for bill checking, after completion of work, scanning the completed area of work will give you the

results immediately

3D updating of structure

3D modelling of the structure can be done using Autodesk, Revit software for an enhanced visualisation.

In addition to these, various other modules are available in ERP.

Inventory Management
Financial accounting
Asset management
Document management system
Human resource management
Work flow management

Some of the promising aspects of ERP are:

1. Google, Microsoft team integration
2. All that is manually entered presently can be stored or done in electronic media, making it accessible from anywhere at any time.
3. Data of one form can be made interpretable in other form thereby giving no room for error. For example, one can upload the BBS in estimation files and estimation files in ERP.
4. Reduction of wastage in materials. One can precisely decide the cuts and bents in bar bending and reduce wastage.
5. Recorded information at all stages of construction
6. Reducing phone-based communication by 90% to use higher forms of communication.
7. Reduction of repetitive jobs in construction. For example, BBS can be used for estimation as well.
8. Benchmarking of projects due to the availability of data
9. 'What you see is what you get' format
10. Access from mobile, iPad, laptop etc
11. Customization of and connections to existing platforms

In today's fast changing world, we face a number of challenges, and there is a growing need for sustainability. Therefore, the importance of innovative systems like ERP becomes even more relevant. It is high time the industry made use of it to overcome hurdles.

Vinod Kumar
General Manager(Tech),NCC Limited,

Digitisation in construction: Revolution in progress

"Millennials expect to create a better future, using the collaborative power of digital technology"-- Mal Fletcher

Like evolution according to Charles Darwin, civil engineering, especially building construction, evolved from caves to edifices. It is difficult to imagine a humbler beginning than tht of the civil engineering. Once this branch of learning and practice settled down, however, it has been an exciting journey, creating the ancient Pyramids of Giza, the Great Wall of China and the humongous monolithic temples of Ellora, are all testaments to the prowess of civil engineering.

For very long, civil engineering was being practiced with ink and paper. Architects drew up plans and drawings on paper for the project practitioners, who then made their estimates and work schedules into reports, which were then handed over to the engineers, who then created designs for each part of the building and gave those to the site engineers for the foremen to follow. It is a tried and tested method of conducting business–minds meeting over paper; planning, estimation, design and construction all done without the help of computers.

Although most other industries embraced digitalization during its first wave itself, construction industry stayed somewhat archaic in its operation. However, a revolution has now started and old methods are being eschewed in favor of the new, as the project practitioners now set their sights on bolder and more ambitious projects. Digitalization is coming into the industry in a big way, paving the way for conversion of analog information into digital information, which can be stored in and processed by computers.

On an industrial scale, digitalization refers to the conversion of the core as well as peripheral functions from paper and ink, to ones and zeros. It is the next logical step in the evolution of any industry, greatly expanding their capability and reach. As for the construction industry, there are several advantages to be had from digitalization. These are especially apparent in the preparation of preliminary cost estimates, controlling costs and the analysis of the building systems. Other areas of improvement are saving time on project delivery, increased productivity, speed of work and document quality. Today, software such as Prima Vera, MS projects, MS Excel, CAD, Tally and many other custom-made ones are revolutionizing all these processes.

Building Information Modelling, or BIM, is one key step the direction of digitalizing the whole industry. It is a comprehensive data management system, which promotes simultaneous and synergetic planning, and complete digitization of all phases of construction. It allows quick and easy access to all information on the building, and resolving design conflicts and shortcomings before they get executed. This has not been adopted universally, and still has limitations in terms of client-side knowledge, execution and scaling. However, this heralds a new age in the construction industry, and has generated a lot of excitement in the industry.

We are now in the era of BIM 7D, vaulting over but still using 2D, 3D, 4D, 5D and 6D, each adding new dimensions to construction planning and execution. With BIM 7D, it has gone beyond construction to post-construction functions such as maintenance, repair and retrofitting which continues till final decommissioning and demolition. Here, all the other dimensions: time, cost and sustainability along with the 3D models are modified or replaced with operation models, and the BIM effectively functions as an operating system for the facility.

Digitization has also brought about wholesome changes in the procurement process. With a computer-aided design, it is possible to estimate the requirements for a project with high degree of accuracy. This will eliminate the need for going with rough estimates, which leads to project delays and cost overruns. Using computerized inventory management for tracking material usage and finding potential sources of wastage will help streamline the procurement and construction process, while preventing wastage, and delays.

Advanced risk assessment is yet another tool offered by digitization, which helps create

predictive models to forecast potential risks and take steps to manage them. This further improves the cost effectiveness of a project because it is possible to avoid damages and losses. Cataloguing of vendors and suppliers in a database, which facilitates easy sourcing of materials at the best prices, along with real time tracking of shipments are all advancements that await proper testing and implementation.

One of the biggest advantages of digitization would be the reduction in conflicts. Conflicts arise due to asynchronous planning, and are usually discovered in the construction phase, which forces reworking of plans. This leads to wastage of materials, money and time, which can be avoided with digitization. Identifying and fixing all conflicts in the planning phase results in a quicker and smoother construction phase.

There has also been a conscious push towards preserving the environment. The construction industry has always been a source of pollution. Clearing of forests, emission of particulate matter into the air, degradation of water sources, noise and many other forms of pollution are common hazards of a major construction project. There have been many steps to address these issues, from using eco-friendly materials, ecology conscious sourcing of materials and equipment and even a complete overhaul of the organization and hierarchy of the project. This effort also includes changes in the designs of buildings in order to incorporate environment-friendly and cost efficient solutions.

We at NCC have already begun our journey towards digitization and we are determined to reach our destination of being a fully digitalized organization by 2022. The steps taken in this direction are in various departments dealing with project monitoring, plant and machinery, engineering design, etc. In project monitoring, we have digitized the process of reporting daily progress of executed quantities from construction sites, where the site engineer enters his daily executed quantities directly from his smartphone. This data is then processed and made available to all concerned stakeholders in the form of reports and tables, which are available on a mobile based app and are accessible from anywhere, anytime and on any type of device.

The application is currently live on 15+ project sites and will be scaled to all working sites in the near future. For monitoring plants and machinery, we are using a combination of telematics and GPS based solutions to track the utilization of machines, its efficiency and the productivity of drivers. Currently plant and

machines monitoring of projects is in the pilot stage and is being tested in the Samruddhi Expressway Project. In engineering design, we are using BIM software for various design purposes. We had used it in Nagpur Metro project and currently it is being used in Pune Metro packages, AIIMS Bilaspur, AIIMS Bhatinda etc.

Another innovation that drives the construction industry is 3D printing. In a process called Additive Manufacturing of Concrete (AMoC), buildings are being created by layering the concrete, much like a 3D printer. This technology is still in its infancy, and so far has very limited capacity. However, this technology has the potential to radically speed up construction, and carry out risky and dangerous tasks without endangering lives. It also promises massive cost savings that naturally comes with automation, while allowing for drastically more complicated designs.

The future of the construction industry holds many promises. Today, there is a potential for massive savings on cost and time, while making big projects environment-friendly. BIM 2D – 7D can be used to improve and streamline planning and construction. It brings in a demonstrable reduction in costs and delays, while also serving as a management tool post construction. In future, it would be helpful in designing amazing and environment-friendly buildings, towering skyscrapers and bridges that span the horizon. However, we must be cautious with our progress, and make sure that we don't leave anyone behind.

CUIRASS®
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Call: 1800 833 55 75
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We are the Doors to the Future

What does a customer look for, when they shop for stainless steel doors for their home? The answer seems to be simple at first glance- Safety. In most cases safety is the primary feature that influences the final decision; of course, the door has to keep a premise safe. A typical customer may think of durability, good looks and easiness in locking also. But Cuirass Galvanised steel doors offer a perfect combination of strength and elegance with the best in class functionalities along with more than 15 features that make the product a leader in the segment.

Cuirass replaces its wooden counterparts successfully with several distinctive characteristics, most of them were not heard before on a wooden door. Right from invisible doorbell alarm, fire-rated certifications, 5 inch bolt on both sides and guaranteed durability with UV protection to the anti-theft locking system, Cuirass range of doors present a host of advantages. The doors come with the factory finished the vibrant exterior look and aesthetically pleasing designs.

The galvanised steel (GI) used in Cuirass steel doors meets the international standards with 0.8 to 1 mm thickness. Galvanization or galvanizing is the process of applying a protective zinc coating to steel or iron, to prevent rusting. The final finishes are the same as wooden doors with the right noise and feel they generate when closing and opening. Moreover, the colours match with traditional and international wooden textures. The weight of a single door falls between 40 to 160 kg. This weight range is ideal to maintain high breaking resistance. Steel is naturally resistant to termites, moisture and expansion or contraction due to changes in weather. The product comes with a 5-year warranty for the locking system and hinges.

Cuirass steel doors are highly affordable compared to wooden doors. A single door can save 30 to 60 percent in erection and maintenance. The antitheft locking system, the reinforced door hinges and the door viewer that gives a clear and wider view of the surroundings, ensure maximum security. The multi-layered strengthened plate of lockset is characterized by impact resistance and breaking resistance. When the door is locked, it will automatically get double locked at 11 other points. For bedrooms, office & interior usage, doors with normal locking systems are also available.

The key and cylinder are made of brass, which is corrosion-resistant, hard and strong with a long life span. Each door comes with 5 sets of keys. The heavy-duty hinges are the toughest in the industry.

Cuirass steel doors are UV protected and unlike wooden doors, Cuirass does not react to any seasonal changes. The doors have proved that they withstand extreme weather conditions like fire from 1.5 hours to 2 hours.

World-class Manufacturing Process

The manufacturing process at Cuirass begins with product design and procurement of the right raw materials that meet the current architectural demands. After the steel shell is made, Honeycomb or Rock wool is filled in between the 0.8 mm to 1 mm thick structure. This double-layered Seated strip enables to give the same sound effect of the opening and shutting of the wooden doors. This does not generate any creaking sounds other steel products like steel cupboards make. The sandwiched door panel provides the exact look and feel of wooden doors.

The door thickness of the Cuirass steel door is 50 to 90 mm while normal wooden doors come with a thickness of 30 to 35 mm only. Door frames are made of 1.2 to 2mm sheets, which are very sturdy. The steel doorsills are helpful in air-conditioned environments. They reduce sounds from outside. Doors without doorsills are also available. The expanding bolts being used on the doors make installation easy.

The entire process follows eco-friendly sustainable manufacturing procedures. The facility is ISO 9001 certified.

Wide choice of designs

Cuirass steel doors offer the same elegance and appeal of wooden doors. A customer can choose from a wide variety of innovative options. Most of our designs are inspired by French or Italian architectural thoughts. The cuirass has more than 100 franchisees spread across South India that ensures proper delivery on time.

Are you looking for a robust door solution that offers protection from unreasonable price and labour charges, long-lasting and hassle-free support along with great international appeal? don't look further, walk into your nearest Cuirass outlet.

Cuirass offers
Pure Class and Elegance.

Alan Christy Joshy
Team Construction Philosophy

DRONES

The presence of digital technology can be seen everywhere. It has managed to sneak into the construction industry as well. The latest technological invasion comes in the form of drones or UAVs (Unmanned Aerial Vehicles).

Drones are aircrafts without pilots on board. They are part of Unmanned Aircraft Systems (UAS), which includes a drone, a ground based controller, and a system of communications between the two. Flight of drones can be controlled using a remote control by humans or by computers. How can these 'toys' be used in the construction industry? What benefits can we reap from them?

Drones have found their use in many sectors like agriculture, forestry, geological mapping, to name a few. The versatility of drones lies in the fact that they can capture high resolution images and videos and facilitate laser scanning by an operator on the ground. Some of the segments of the construction industry where drones are in use are the following:

Structural Inspection

Drones can be used for inspecting diverse structures, from high rises to highways and bridges. Usually bridge inspection commences with the review of the old inspection reports. Information about critical areas of the bridge is gathered to ensure that these defects have been repaired. The bridge inspection team then plans the inspection. In India, the evaluation is mainly dependent on the visual perception of the inspecting engineer. It is not possible to manually inspect every bridge, especially the railway overbridges that dot the country and long bridges with busy traffic. Drones can be used in cases where the bridge has to be inspected without affecting the flow of traffic.

Drones can be used to carry out inspections of high risk areas as it helps save time and reduces risk. The footage can be recorded from the safety of the office or site cabin and then sent to clients in real time for their prompt reviews and follow up action.

Site inspections can be carried out quickly and efficiently using drones, thereby making them user friendly. It can also work in most weather conditions and is useful in detecting damages caused to bridges during disasters like flood and cyclone in relatively short time without risking any lives.

Mapping and surveying

Drones have proved to be immensely useful in mapping and surveying since they provide a 'bird's eye view'. Not so long ago, the process of mapping used to be a long and tedious one.

Not to mention the cost of mapping! With the introduction of drones, it is possible to map even large areas of difficult terrain with ease now. They reduce the labour and time involved in producing accurate surveys. Since drones are inexpensive, they can be used by companies undertaking small projects as well, thereby eliminating the chances of getting wrong data.

Building surveillance

Drones can be used to spot unsafe areas in a construction site like roof of a building under construction. This enables the site supervisor to assess the roof conditions without actually getting on the roof using ladders or scaffolding, thereby making the whole process safer and cheaper.

Also, using drones in construction sites enables the user to monitor the daily progress by collecting images and sending them straight to the computer so that it can be analysed and compiled. It also helps to keep a tab on the workers at site, thereby ensuring their safety. It also offers the companies protection against theft.

Disaster management

Drones can be used in instances of disaster where human intervention is difficult. For example, during chemical leaks or during floods, when exposing humans can cause threat to their health and safety. Situations like these calls for swift, precise and effective data collection, for which drones can be put to use. The data collected can be used to assess the extent of destruction and also to discover people trapped in inaccessible locations. Drones can also be used to deliver emergency supplies and establish communication.

Challenges

Though the usage of drones in construction is advantageous, it also offers some challenges.

1. Drones need two people with technical knowledge about the type of drones and its sensors to operate them. Also, the person operating it should be well aware of the route that the drone will trace.
2. Though drones can be used in most weather conditions, it can prove to be difficult to operate during windy days or when there is thick cloud cover. There are chances of drones being swept off or losing control or even getting destroyed during strong windy days. This can lead to collection of wrong data.
3. Even though companies can save a large amount in the long run, the initial cost of buying a drone is quite high.

Don't take soil for granted

Madhav R. Madhira

Madhav R. Madhira has worked as Professor of Civil engineering at IIT Kanpur during 1978-2003. Currently he is with Jawaharlal Nehru Technological University as Professor Emeritus and with IIT, Hyderabad as Visiting Professor. In addition, as AICTE-INAE Distinguished Visiting Professor he is mentoring VNR VJIT Hyderabad. He taught various undergraduate and graduate courses in Geotechnical Engineering; Mechanics of Solids, Engineering Design, Environmental Design and Aesthetics, Engineering of Ground, etc.

People are reluctant to spend money and time on detailed soil investigations irrespective of the fact that it can bring down the cost of foundation construction. How important do you think is it to carry out a detailed investigation?

Many practitioners have a false sense of economy and are ignorant of the importance of knowing and understanding the uniqueness of ground conditions. While in all advanced countries, planning and designing are considered crucial and given 1 to 2 years' time, in India starting the project takes precedence.

Planners, architects and structural engineers are all familiar with and deal with manufactured products such as steel and concrete. They presume that ground and its constituents can also be dealt with in the same way. Most agencies just want a figure for the bearing capacity and do not ask for possible or anticipatable difficulties during construction.

Trying to save money in geotechnical investigations is a classic case of being 'penny wise and pound foolish'. Inadequate and improper investigations result in a very conservative value of allowable bearing capacity being recommended and adopted. As a result, foundation construction costs escalate because of deeper excavation deeper, unnecessary use of piles or excessive volume of concrete. Most projects are affected by cost escalations mainly because of these reasons. Many construction problems like support for deep excavation and dewatering can be avoided with proper advice from a knowledgeable geotechnical consultant.

Disastrous landslides are common in Kerala during rains. What according to you could be the reason for it? What are the mitigation procedures you suggest?

Landslides often occur due to human interference with nature. Most slopes got stabilized over centuries, but when they are steepened for road widening or new construction activities the initial state of the hill slopes gets altered. Lack of appreciation of the consequences of disturbing nature leads to these failures. Rains or seismic events are triggers. Ignorance of the importance of geotechnical issues and a false sense of economy, once again, are the possible reasons in several cases. Prevention of infiltration and proper drainage of rainwater would help mitigate this problem to a large extent.

The iconic Leaning Tower of Pisa, though stated to be a failure, stands as an engineering marvel. What according to you are the reasons for its failure? Is there a possible solution to rectify it?

One does not expect high degree of geotechnical knowledge or expertise in the twelfth century. Construction then was more an art than science. Incidentally, Tower of Pisa is not a failure but a testimony to the concept of limiting stability. Several towers in Italy have collapsed over the last century. Possible reasons for the tilt are inadequate geotechnical knowledge, variable thickness of soft clay strata, leaning instability of the tall structure on soft ground, etc. The Tower is in the shape of a 'banana' and is not straight in the strict sense. Hence it cannot be 'straightened'.

Are there any modern methods to build retaining structures in clayey soil in place of the conventional concrete and steel constructions?

It is not modern at all, but construction of

reinforced soil walls is the norm and not with concrete or steel. If anyone is still pursuing conventional methods, they are doing a disservice to the profession. Reinforced soil walls are safer, economical, environmentfriendly and have much less carbon footprint.

They are also faster to construct. Gabions can be used to retain clayey soil. Behind the gabion walls a geotextile can be placed to prevent internal erosion and for drainage purposes. Drainage should be provided on the top to prevent infiltration of water in to the soil.

The most important thing that should be taken care of while retaining fine grained soil is to provide surface drainage. Otherwise, water will soften the soil; particularly the fine grained ones such as silts and clays.

Pore pressure that develops due to this will make the wall unstable. The problem is not with clay, but with water that gets infiltrated. Proper surface drainage is ensured by providing gradient so that water gets collected in to drains and taken down through pipes or chutes.

What are your recommendations on failure studies by government agencies in the event of a disaster or failure?

Sadly, a failure study in the event of a disaster or failure is mostly done to apportion blame and not to learn from it. Accidents can happen, not always out of negligence. Whenever something happens in our industry, they want to blame someone instead of trying to understand the reason behind the problem or they try to cover it up.

Shortage of land leads to increasing demand for basement floors. Won't the increasing number of cellar floors pose threat to the environment?

Never heard that going under is a threat to environment. Why should it be? It is one option to optimise utilisation of limited land.

What is your opinion about the threat posed by dams to natural habitations and nature's behaviour pattern?

Once again, human needs arising from increasing population necessitates the construction of dams. But dams interfere with natural processes. Negative impacts due to construction of dams can be minimised, if not avoided completely with increasing awareness of the environmental impact of dams.

You have been a teacher for long and an active organiser of intensive programs for students. According to you, what should be done to upgrade the quality of graduating geotechnical engineers?

Geotechnical engineering is not science as is often believed it to be. It is more like practice of medicine. Soil Mechanics cannot be taught in the class alone. Both teachers and students should be sent to the field to learn the site conditions, sample collection, carry out SPT, issues involved in excavations, constructions, dewatering, etc. What is taught in the classroom or in the laboratory is a miniscule of the real or actual behaviour of the ground.

Suresh S.
Chartered Structural Engineer,
Associated Structural Consultants

Why do buildings fall?

Design flaws, abrupt changes, overload, lack of communication between design engineers and end users-- reasons could be many for a building to collapse. Here's a case study of a recent incident.

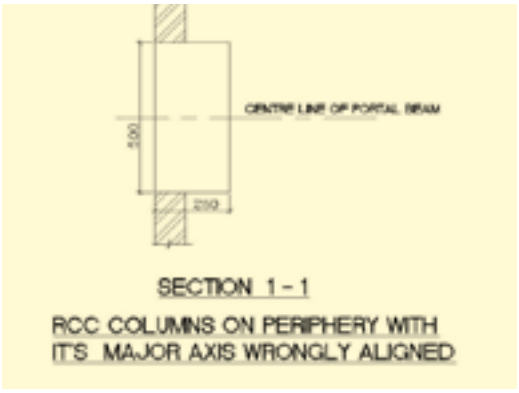
There have been reports of the collapse of a newly-built auditorium and the imminent fall of an accompanying building recently. And naturally the question comes up - what happened?

The structure consists of two auditorium buildings of size 36 x 27 x 12.5m and 30.5m x 22.25m x 12.2m built on either side of an RCC G + 2 building block. Inside, a height of above 12m was required for the functional use of the buildings for visual media presentations.

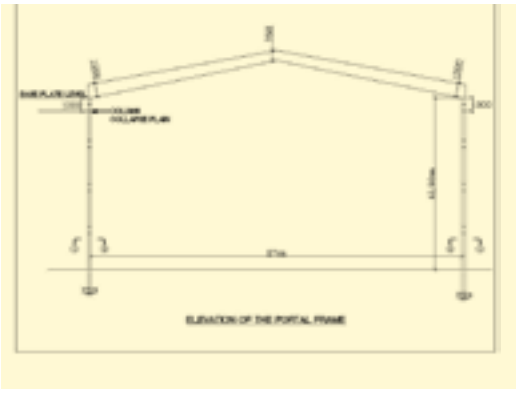
The auditorium was made of RCC footings and RCC columns on the top of which a portal rafter of plated I section was used to make a pitched roof of very shallow slope of 1/10. The structure consisted of RCC footings resting at 1.5m below natural ground level on saturated fine loose sand. RCC columns of 250 x 500 mm sizes along the periphery of the auditorium at a spacing of 6m were linked with tie beams at every 3m height.

The walls were made of solid blocks of 200 mm thickness. The building was covered with galvalume sheets resting on 'Z' purlins supported on plated portal I beam spanning 27m with about 1m depth. The structure was provided with false ceiling and false walls to give acoustics treatment as well as to conceal lighting and HVAC systems.

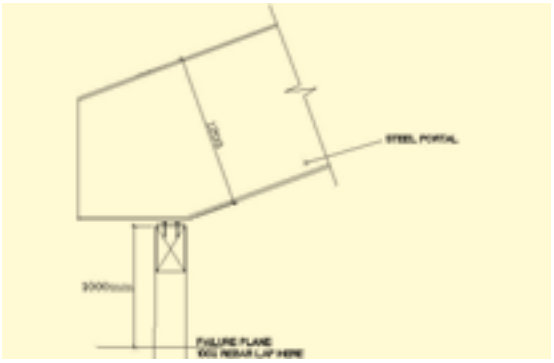
Construction work was over and the audi-

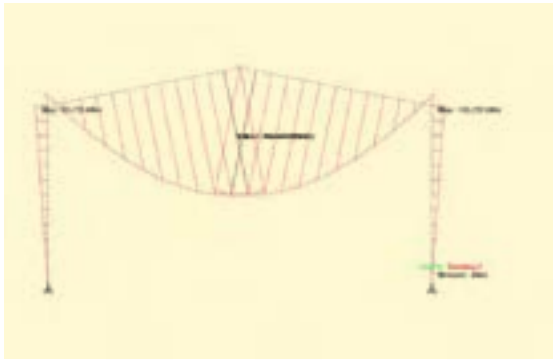


SECTION 1 - 1
RCC COLUMNS ON PERIPHERY WITH IT'S MAJOR AXIS WRONGLY ALIGNED



3 D Rendered View





DL + LL BMD (MAX BM = 1940 kNm)

DL + LL DEFLECTION

torium was getting final touches for the inauguration. However, by then, the false walls and ceilings of the second auditorium began to show some unusual strains like buckling of vertical members. The contractor's engineers inspected the structure, and it was concluded that the buckling occurred because the connection of false walls and ceiling malfunctioned. On the following day, people working inside the first building heard some unusual sounds from the roof and ran out. Within 10 minutes the whole roof collapsed.

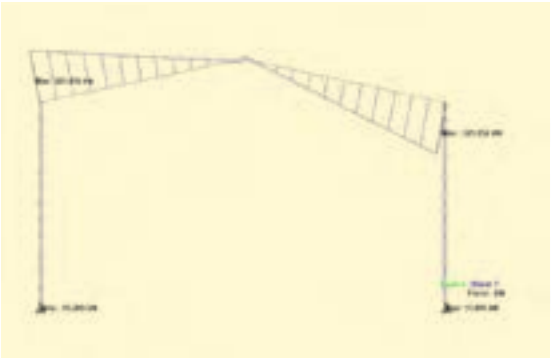
It was found that the second building's structure too was under strain. The first roof had collapsed due to dead weight and superimposed dead load alone. There was no rain, wind or imposed load on the roof at the time of its fall. So it was decided that the roof of the second building needs full retrofitting and interim propping to prevent further increase in strain.

Mistakes, blunders and more

A detailed forensic analysis was carried out to identify the causes of the roof structure's collapse and it was found that no structural design calculations, proof checking of records or even proper drawings of the structure were available. As part of the study, a new geotechnical investigation was carried out at the site. The detailed study of the structural arrangement showed that columns along the peripheral walls were aligned with the major axis parallel to portal trusses along peripheral wall. This caused the columns of 250 x 500 mm size standing for 12.5 m height with an effective lateral dimension resisting buckling as 250 mm causing on L/d ratio of 50. The primary loading on the structure is wind load. Such a slender column would not resist huge lateral load moments transferred by wind load on 12.5 m height.

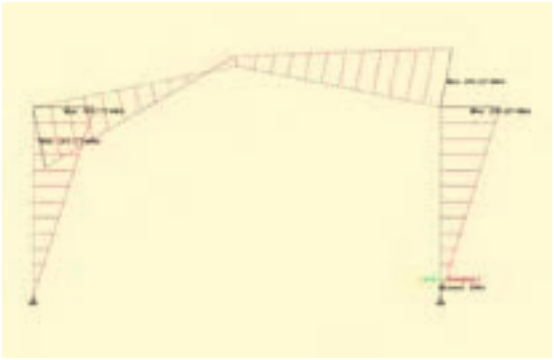
The investigation also showed that the portal girder of roof structure transferred significant moments to the columns which in turn acted on the minor axis of the columns. It also turned out that all the column bars were lapped 1m below base plate level due to an increase in height called for during construction. It was found that the columns failed exactly at this lap location during roof collapse. The columns were reinforced with 1.92% as longitudinal rebars. This unplanned column extension at top, making all longitudinal bars to lap without required precaution, made the column lap location as the weakest point in the structure.

Moreover, the building was loaded with a super imposed dead load of 3.5 kPa from HVAC, lighting, acoustics, false ceiling and catwalk system. The true design SIDL was around 0.5 kPa only. Together with the wall load and super imposed dead load, the columns were loaded



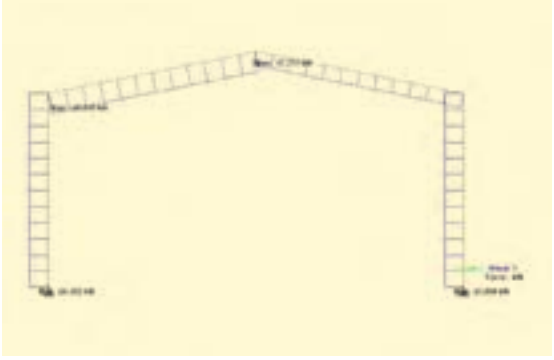
DL + LL SFD

WIND LOAD BMD



WIND LOAD DEFLECTION

WIND LOAD SFD



with about 550kN axial force at service stage itself. In addition to this the columns were subjected to 200 kN.m moment on their weak axis from the dead and live load alone, apart from the wind load. It also came to light that the portal roof was not considered during initial design stage and the same was opted as an alternative to the truss roof at a later stage. The truss roof is expected to transfer only vertical and horizontal forces at column top and not any moments. So,it is to be said that the column design did not consider any moments at the top.

The failure of roof designers to capture the true superimposed dead load of 3.5kPa and designing the portal with a SIDL of 0.5kPa became fatal for the building. Finally, the portal moments, due to dead load, transferred to the weak axis of the column ended up in failure.

So, how did it happen?

- No proper structural design or design basis report with the loads to be used for design were prepared and circulated among stakeholders prior to construction. It is sad that even the building codes (NBC or KMBR / KPBR) are silent on this.
- There was no agency assigned for proof checking and project management of the construction of such a large span and critical height. In fact, an independent proof checking or structural auditing should be made mandatory for all structures where critical spans, height, load or structural systems are involved.
- A portal roof structure (PEB type) substituted the normal truss roof which was anticipated in the original design. In fact, such changes of sheet arch roofing and portal frame roofing loaded to the top of columns designed for ordinary truss roof are very common now a days. This is a very dangerous practice as sheet arches and portal roof systems will transfer large horizontal reactions and/or moments to the top of columns for which they are not at all designed.
- Improperly spliced RCC column wherein 100% longitudinal bars are lapped without necessary precautions.
- Communication gap between design engineers of portal roof and the user of the building was the reason behind the abnormal difference between actual loading at site (3.5kPa) and loading used for the design (0.5kPa).

Each of the above facts contributed to the failure. In fact, the old saying "A design flaw, a construction flaw and an overloading together should act for a civil structure to fail" seems to have been proved yet again.

Swathi J.
Managing Partner,
InterCAD Systems Pvt. Ltd.

Get guidance from GIS

Several countries have developed precise soil maps incorporating GIS (Geographic Information System) technology. Soil maps help to determine the range of soil types in a territory. Unfortunately, in India there are hardly a few studies carried out using GIS technology.

Geotechnical engineering literally has a foundational role in the construction industry. Geotechnical engineers have a new ally in GIS technology, which can bring about substantial profits for the industry players and, additionally, cut back the time consumed for some of the pre-construction work like soil investigations.

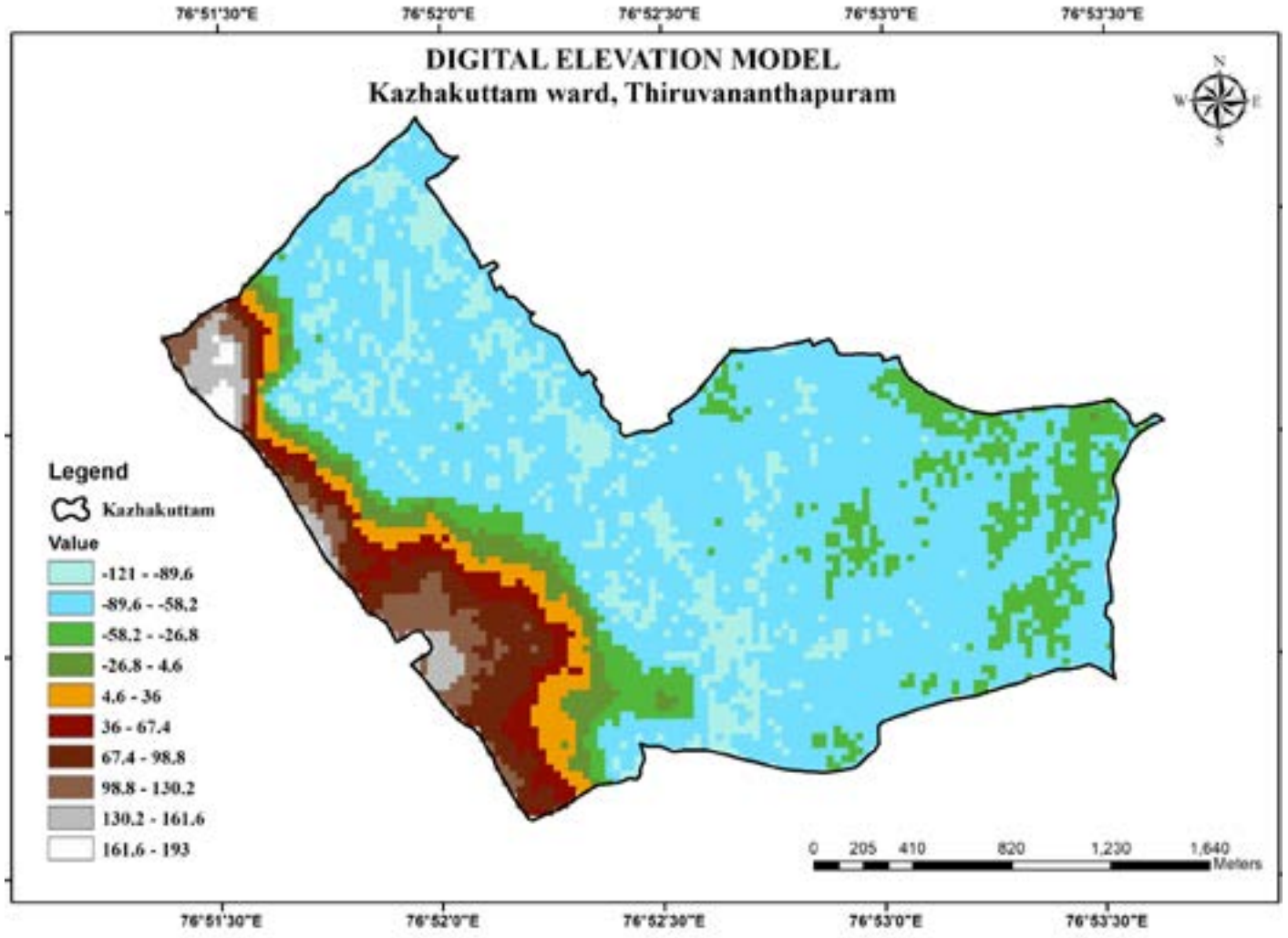
Before the advent of GIS, geotechnical characterisation of an area used to be an arduous task because of the complexity involved in presenting the data from soil logs. GIS was born out of the necessity to transform all the paper work (hard copies) into digital forms so as to make data quickly accessible for easy analysis. This geo-database and soil map are immensely beneficial to consultancies and researchers who undertake geotechnical engineering projects.

Geographic Information System is a software system that incorporates geographical features with tabular data so as to map, analyse, and assess some of the real world problems that exist. The data used in GIS technology is spatial data which allows people to more easily see, analyse and understand patterns and relationships as they exist on the location.

The information collected coupled with the geographic coordinates is referred to as attribute data. Any range of data for a particular location can be stored in the GIS worksheet, as attribute table. Hence the features of a location along with the spatial data enables GIS to be an effective problem-solving tool. For instance, GIS helps in analysing the attribute data and the geographic information using a spatial and statistical approach and the results of the analysis can be presented in the form of maps.

GIS has a vast and varied application in the field of science and technology and is quite a user-friendly technology. Nevertheless, in India it is assumed to be quite complex and hence underutilized when it comes to live projects in India. Both copyrighted and free versions of GIS are available in the market. QGIS for example is the free version and is extremely user friendly while ArcGIS is an authorised version of GIS created by the Earth Science Research Institute (ESRI).

Several countries have developed precise soil maps incorporating GIS technology. Soil maps help to determine the range of soil types in a territory and involves locating and distinguishing the various soils that exist, collating further information regarding their nature, properties and potential use. This is then recorded on



maps and supporting documents to point out the spatial distribution of each soil.

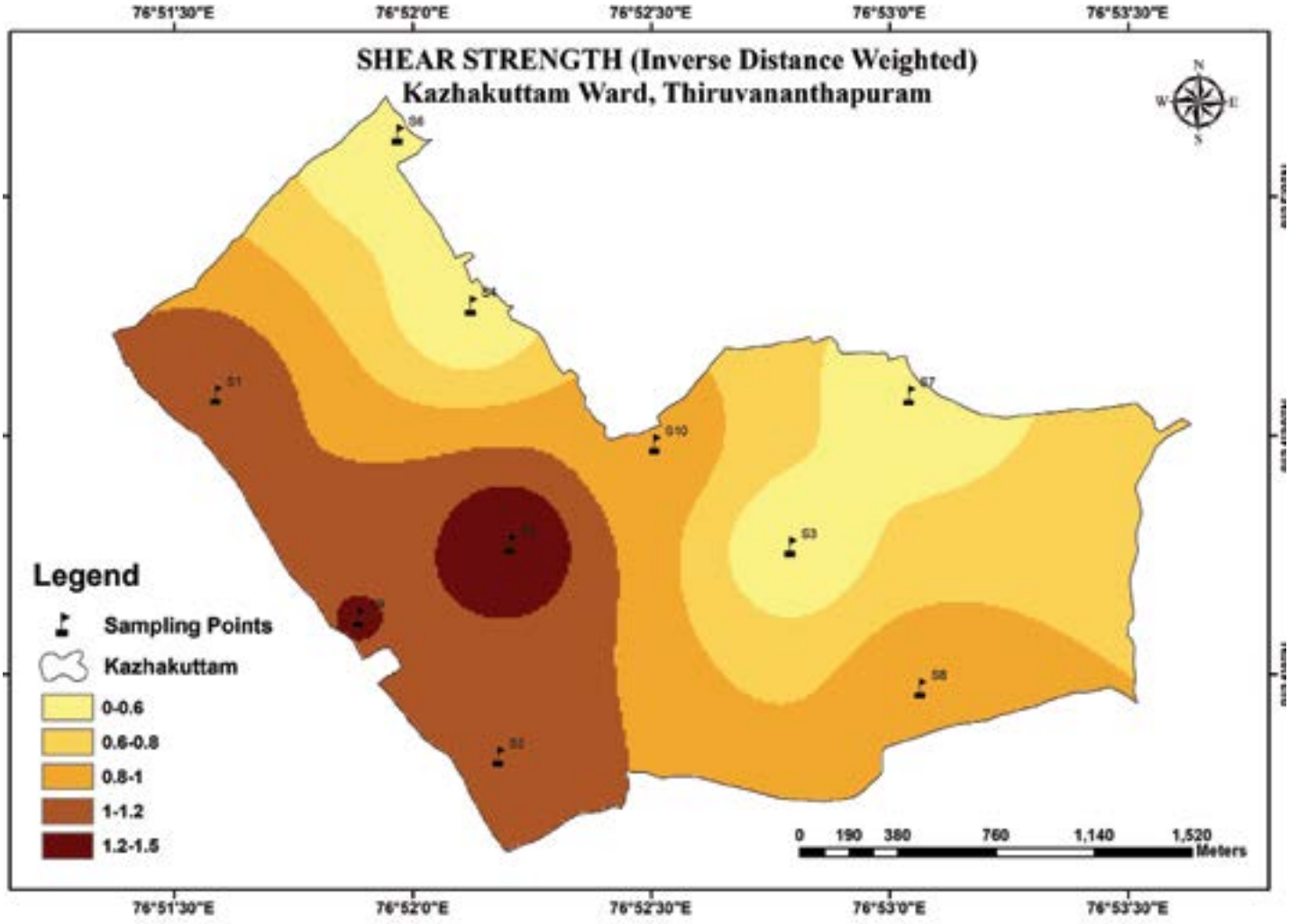
Unfortunately, in India there are hardly a few studies carried out using GIS technology and as far as we are aware, no such study has been reported from Kerala prior to this study of the Kazhakuttam area, which is the scene of massive construction activity thanks to the Software Technology Park (Technopark) that has emerged as the pride of Thiruvananthapuram.

While several major projects have been initiated in this area in the last few years, it does not have a proper geodatabase which could make civil engineering work easier. Due to the escalating cost of site investigations, acquiring geotechnical data accurately is expensive in Thiruvananthapuram and small projects, which usually have budgetary constraints, often have to overlook site characterisation.

The estimated soil data of Kazhakuttam area was georeferenced and incorporated into GIS technology (winning the Best M.Tech Project in Geotechnical Engineering in 2019 in Kerala).

Geographic coordinates of the study area was valued between $8^0$33'30" N to $8^0$36'30" N latitude and $76^0$51'00" E to $76^0$53'30" E longitude. The Digital Elevation model (DEM) is the digital representation of the earth's topography which can be used to derive topographic attributes, geo-morphometric parameters, morphometric variables and terrain information, in general. The DEM of the study area was obtained from the official website of United States Geological Survey (USGS), but it can also be obtained from BHUVAN, a site managed by India's ISRO.

From the DEM data, the hydrological struc-



tures and their flow direction, surface features like contour at different intervals, slope aspect and triangulated irregular network can be determined using GIS. These features are easily quantifiable and can be displayed as images called DEM derived surfaces.

A database of the engineering properties of soil samples (soil at 0.5m depth after removal of the top soil) collected from different regions of Kazhakuttam were estimated and using the software, soil property maps were generated. The bore-log details of soil investigations conducted by different geotechnical consultancies and construction builders were collected and the Standard Penetration Test results (SPT corrected N value) were taken to determine the maximum allowable safe bearing capacity of the soil at different depths.

Maps showing the variation of SPT N values and allowable safe bearing capacity of soil at 10ft, 25ft, 50ft, 75ft and 100ft depth were generated using GIS. The variation in soil properties and SPT N values were determined using the Inverse Distance Weighted (IDW) Interpolation technique.

IDW techniques were used to interpolate data for locations not sampled. From these maps, one can easily figure out the variation in soil properties at different locations, at each and every point. The database and maps are expected to be made available online so that it can be useful for any geotechnical or construction engineers working in the Kazhakuttam area in future.

Dr.Anusha S.P.

Assistant Professor, Department of Civil Engineering, College of Engineering, Trivandrum

Intelligent Transportation

Global digital solution for India's traffic woes

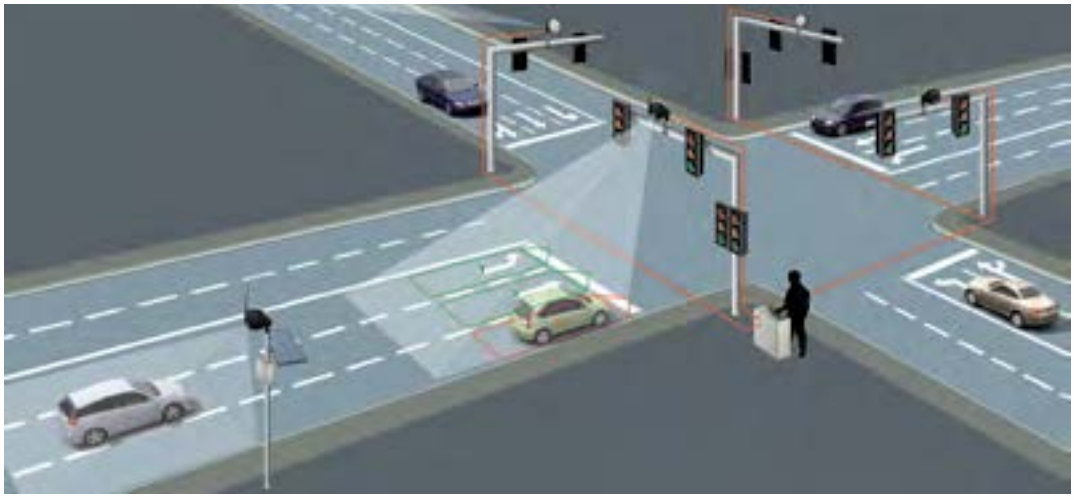
A case study highlights the advantages of ITS as an effective technology for efficient and safe road transport. Will it help Indian roads?

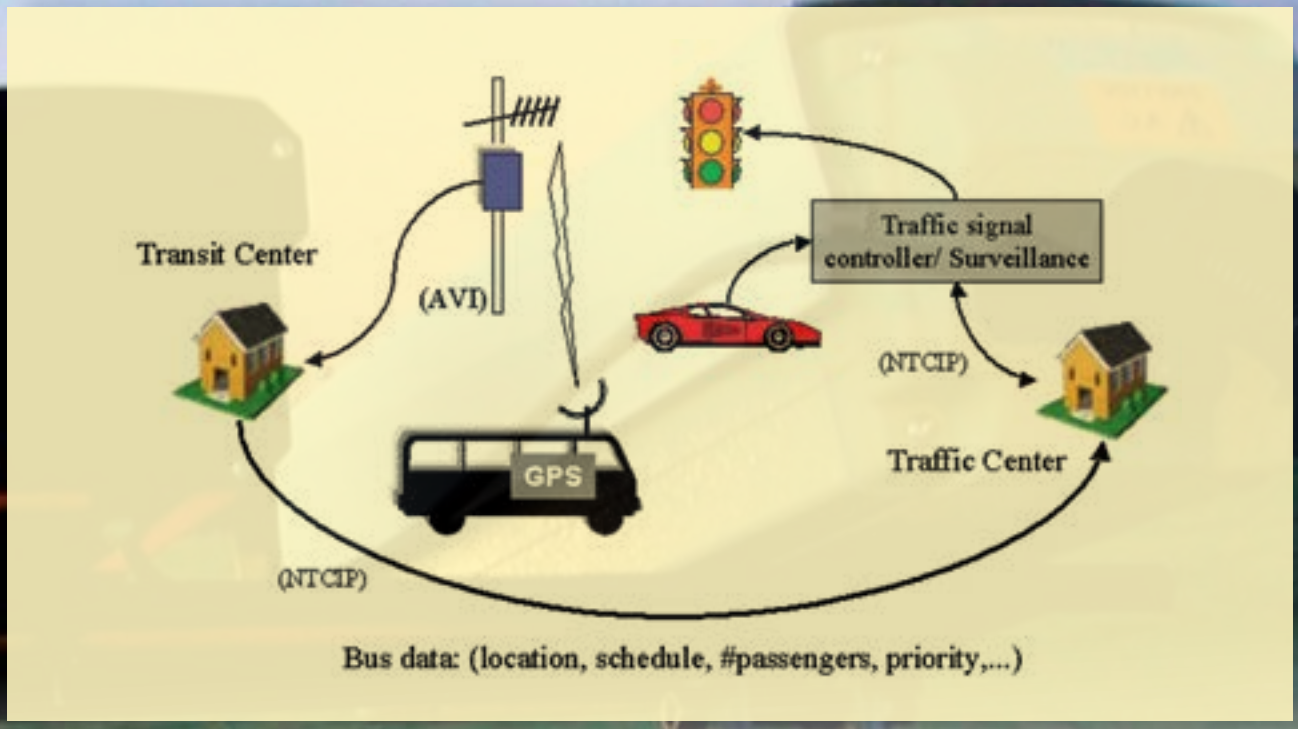
As every facet of life goes digital, why should road transport fall behind? Data and digital solutions are taking over road transport across the world, and the Intelligent Transportation System (ITS) is an effective model with a scientifically-proven record.

ITS is a worldwide initiative to use information, communication and control technologies to improve the transportation system and make it more effective, efficient and safe. Its benefits include improved mobility, increased safety, reduced emissions, informed trip making, better utilisation of roadway capacity, economic productivity and sustainability.

A Traffic Management Centre (TMC), which is the central system administered by the transportation authority, is vital for the functioning of ITS. Traffic data is collected and analysed for management of traffic in real time through sensors deployed within the vehicle or installed on roads. GPS-based probe vehicles, inductive loop detectors and video camera are some of the sensors.

Using these devices, data such as traffic count, travel speed, travel time, vehicle location, etc., are collected. Quick and real-time





▲ its-example

communication of information is another key factor that determines the efficiency of ITS implementation. The data collected from the field is transmitted to TMC for analysis and the processed information is further communicated to travellers through Variable Message Sign (VMS), internet, SMS or on-board units of vehicle. The data gathered at TMC is cleaned, synthesised and errors, if any, are rectified.

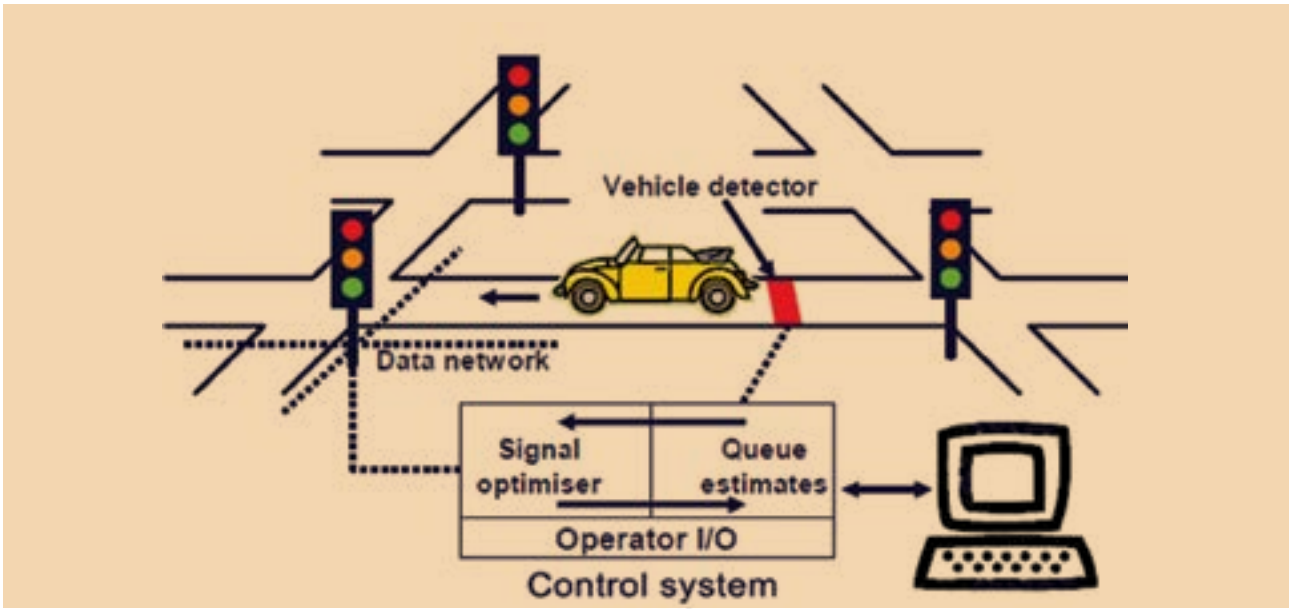
The accurate data is then analysed to predict traffic scenarios, which are delivered to users as real time information about travel time, travel speed, delay, accidents on roads, change in route, diversions, etc.This helps travellers plan their trips effectively. Currently, many western countries are using various ITS applications for efficient traffic management.

ITS Application – A case study

The journal of American Society of Civil Engineers recently published a case study of traffic data collected from loop detectors in Lincoln, U.S. The study fetched the author, along with co-authors, Dr. V. Lelitha Devi, Dr. C. S. Shankar Ram, Professors at IIT Madras, and Prof. Laurence Rilett, Director of Nebraska Transportation Centre, and Professor, University of Nebraska Lincoln, the Arthur M. Wellington prize for the best paper award that was given away at the ASCE convention held in Miami, Florida, on October 12, 2019.

The case study deals with the estimation of congestion evaluator near signals, such as queue length and delay, which are spatial variables that are difficult to measure directly from the field. These variables are commonly estimated using data from location-based sensors such as inductive loop detectors installed on the roads. The data obtained from these detectors are prone to errors that, in turn, lead to inaccurate estimates of queue length and delay. In order to account for the uncertainties associated with field measurements such as variations in traffic flow and detector errors, real-time estimation methodologies using Kalman Filter (KF) estimation scheme, which can effectively handle the detector errors present in field measurements, was used in the study.

The major contribution of the study was the development of model-based estimation schemes in the presence of detector errors. Two traffic scenarios namely queue within advance detector (QWAD) and queue beyond advance detector (QBAD) were evaluated, based on the location of the end of queue and the location of the detector. A comparison was made between the KF estimation models with and without the incorporation of the detector error properties. The results indicated that the KF estimation scheme that included the properties of detector error yielded better and more accurate estimates than the approach that ignored detector error. It was concluded that the



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proposed approach, which explicitly accounts for detector errors, can improve the estimation accuracy for queue length and delay in real-time applications.

The two engineering applications for the proposed models include estimating queue length and delay in real-time on urban arterials for real-time traveller information systems which would be useful for both system operators and individual drivers. The other application is that the proposed models can be used to determine the location of detectors to be placed in the field, based on traffic volume and traffic signal settings, with the goal of avoiding congestion at intersections.

ITS application in India

The application of ITS is in its infant stage in India, the Automated Electronic Toll Collection and the ITS applications for KSRTC buses in Mysore being two of the functioning models. The traffic stream in western countries are lane-based with the major traffic composition including cars and a fewer percentage of trucks. It makes the data collection from detectors less challenging. However, the Indian traffic is composed of different varieties of vehicles such as two-wheelers, three-wheelers, cars, buses and trucks moving without any lane discipline which makes data collection a challenging task. So, the identification of suitable sensors for data collection here is a challenge.

Some of the sensors developed by the research team for data collection under Indian conditions include a novel Inductive Loop Detector (ILD) for the heterogeneous and lane-less movement, Bluetooth and Wi-Fi sensors, and image processing based solutions. The ILD has unique shape and placement that enables classifying different types of vehicles moving anywhere along the road width. Wi-Fi and Bluetooth sensors detect signals from corresponding devices tagged on the vehicles or those enabled by the users in their electronic gadgets inside vehicles.Video image processing-based micro level data extractor is also developed for data collection under non-lane-based heterogeneous traffic conditions. Real time field solutions demonstrated include a dynamic bus arrival time prediction system and advanced traveller information system.

ITS and the Indian traffic scenario

There are various agencies working on developing ITS solutions for Indian traffic conditions. One possible positive change is the shift from private vehicles to a public transportation systemwhich will reduce congestion on roads. In order to achieve this, there should be seamless multi-modal integration among different travel modes such as buses, metro trains, water metro, Intermodal Public Transportation (IPT) systems, etc.,providing comfortable travel. With the availability of real time information on arrival time of these modes, along with its seamless connectivity, it is expected that people would shift to public transportation system for all their travel needs. Similar ITS applications on Indian roads is expected to be a promising solution for the social and economic development of our nation.

Mirzam Malik
HR, Byju's Educational Technology Company

Needed: Lessons in life skills

Studies reveal a bleak scenario of highly unemployable youngsters graduating from our institutions. How do we change this situation? It is high time we equipped our students with the necessary job skills and life skills to meet the challenges of a highly competitive employment market.

We see many young faces on banners and

posters announcing their ranks and achievements in studies. And we read Facebook posts about boys and girls graduating from elite professional colleges with flying colours. They all score high in exams, but how good are they as engineers or other professionals?

The 'India Skills Report 2019', a joint initiative of the All India Council for Technical Education (AICTE) and the Association of Indian Universities (AIU) along with Wheebox, PeopleStrong and Confederation of Indian Industry(CII), states that only 47% of the engineering graduates are employable. And almost 60% of recruiters are of the opinion that candidates of the right quality are now unavailable. As per the survey, 63% of respondents feel that only a few candidates had the required skills.

It is a common sight during interviews to see students carrying a number of certificates but when asked about matters other than their subject, they are unable to answer. These days, students focus only on their curriculum which is quite evident during interviews. The culprit is our educational system and institutions that still follow outdated concepts.

What is required is for the system and curriculum to change. The curriculum should be on par with the current scenario. Changing the entire curriculum would take time but we must strive together for a change.

Our educational system should be designed in such a way as to identify the skills of each student and tap them effectively. As Albert Einstein said, "Everybody is a genius. But if you judge a fish by its ability to climb a tree, it will live its whole life believing that it is stupid." That should not be the case with our youngsters.

Every student should be guided according to his or her talents and abilities. These days, most students choose their undergraduate programme due to parental or peer pressure and not according to their own interests. What we see in the long run is decline in the quality of graduates and, as a consequence, a yawning gap between the quality of the graduates and the expectations of the industry. As a plant thrives in favourable conditions, when a student focuses on what he or she likes, the chances of his or her success is more. Students too are responsible for this situation. They live in their own comfort zone, and when they join a company, they are unable to meet the work pressure or targets. This happens either because they are unaware of what is expected of them or they lack interest in the profession. The need of the hour is for students to be given an idea of what the real world is like.

Colleges should start a programme wherein one day per week is allotted for career guidance which should be led by a professional. He or she should give students an idea about what is happening outside the college. They should be given assignments and tasks that would build their soft skills. Though most colleges have a 'Training and Placement Cell' to give career guidance, it is also important that students take up the initiative to improve themselves. When institutions create institutional frameworks, students should make complete use of them instead of bunking them.

Also, the concept of differentiating students based on their marks must change. It is seen that students with high marks are often given more chances irrespective of the fact that students with lesser marks may have better abilities. Institutions should ensure that students develop good communication skills. Any person who can communicate well and have fluency in language, especially English, have an added advantage over others. Any skill that the candidate possesses are dwarfed if his communication skills are not good enough.

Another negative factor is the tendency of students to parrot everything. They often attend interviews with "internet ready" answers. Most of them search internet on the eve of the interview and learn some available information by heart. They do not realise that the interviewer has already heard the same answer from different candidates. For example, when asked to describe themselves, students often start with "My name is... ". And that is not right. Students should know that they don't have to repeat personal details that are listed in the resume since the interviewer has already gone through that.

It is also important for the candidates to be honest and let the interviewer know when they are unable to answer a question. Also, the students should keep themselves updated on what is happening around them. They cannot just flow with the tide ignoring the new lessons and needs.

On top of all this, it is imperative that families, educational institutions and the society in general join hands to ensure that our youngsters come out of colleges well-equipped for a productive professional career. And for a fruitful life too.

Kannan K.
Assistant Professor, Department of CE, Marian Engineering College.

Disastrous practices trigger landslides

Excess rainfall, lack of proper drainage, overburden thickness and pore pressure at potential slide surface are some of the primary causes for landslides in Kerala, but equally important are the disastrous construction practices being followed in the hilly terrain of the State.

In the aftermath of the heavy rains that affected Kerala in the last two consecutive seasons, people have come to realize that this small coastal State is not immune to the shattering consequences of climate change. The predominant characteristic of the 2019 monsoon was the massive landslides that claimed more life and property than the rainfall induced floods.

Experts across the nation have since been analysing data to try and understand if such 'gravity mass wasting, the geological term for all downhill rock and soil movement due to gravity can be predicted in the future. Mass wasting occurs when a slope is too steep to remain stable with the existing material and conditions.

Apart from the disastrous practices followed by hill construction contractors, it is evident that there are no proper landslide control measures in the hilly remotes of the State. Fig. 1 shows a typical mass wasting observed in Kerala (Pullurampara, 2012). Fig. 2 presents the key components in a gravity mass wasting.

Slope Failures in Kerala

Some of the slope failures observed across the State have been debris flow, landslide, slab slide, slump rock fall and ground subsidence. While many of these are a characteristic of all hilly terrains, what is interesting is that unlike in

Location	Rainfall on the day of the slide (mm)	Rainfall 3 days prior to the slide (mm)
Vadavathoor (1995)	60	151
Amboori (2001)	64	112
Pasukkadavu (2004)	54	292.8
Akamala (2004)	120	160.3
Chengara (2007)	85	154
Kakkayam (2010)	66.2	101.3
Kunjithanni (2013)	228	371.2
Methottimala (2013)	40.5	364.3
Upputhara (2013)	40.5	364.3

Rainfall as a Key Factor

Debris flow in Pullurampara

The initial failure of a channelised flow in Kerala

other States, some of these slope failures have occurred in much gentler slopes.

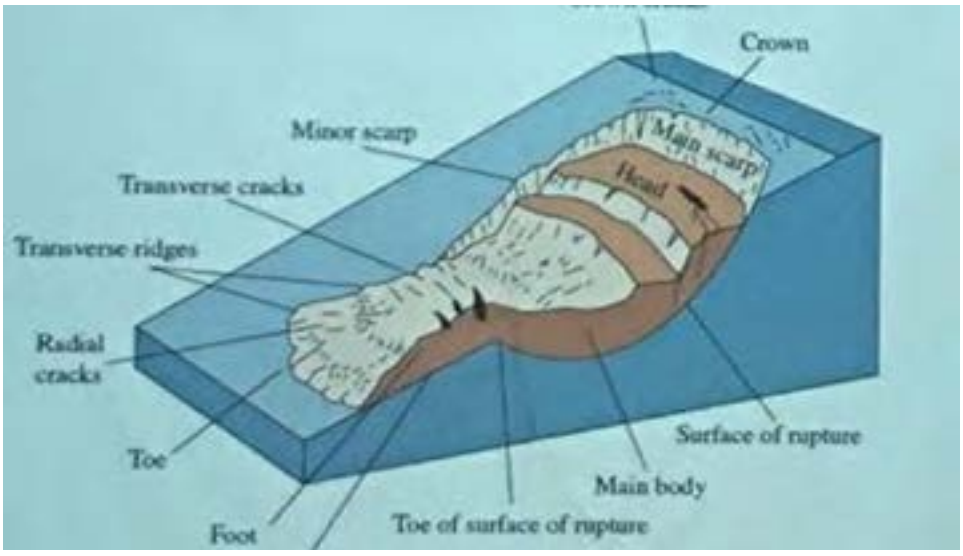
Natural factors like rainfall, earthquake, lack of proper drainage, lithology, joint pattern and frequency, altitude, overburden thickness, and pore pressure at potential slide surface can be causes, of which rainfall – an excess of it – has been the primary cause in Kerala.

Table 1 demonstrates this link. What can be clearly seen is that rainfall three days prior to the slide was often twice if not more, than on the day of the slide, indicating that the lack of drainage most likely contributed to the landslide.

The change in land-use and land-cover pattern has reduced the extent of infiltration of water into the soil, resulting in additional surface runoff. The problem at most of the landslide locations was the flow of overburden material from uphill into the valley.

The water flow starts from uphill as a small stream but due to absence of proper drainage path, it progresses into a wide stream which slowly saturates the overburden, to finally trigger the movement of the saturated mass (which has reduced shear strength due to the presence of water).

Understanding the principles of rock mechanics is also very important in predicting and managing potential slope instabilities in mountainous regions. This assumes even greater significance in tropical areas with intense seasonal rainfall coupled with high temperatures, like in the case of Kerala. Weathering is a progressive process. The



Anatomy of a Slope Failure

The second phase of the rapd, flow-type failure in Kerala, India

degree of weathering decreases with depth and the rock properties change accordingly. The design of slopes in weathered rock must take into account the changes in the weathering profile at each depth which means that slope design must change with depth.

It has been reported that a large number of landslides in the mountainous regions of Kerala occurred from the debris created due to weathering. It is therefore necessary to use slope designs that are specifically suited to the properties of weathered rock.

From the data at hand since late 90's, it is very clear that 65% of the failures occurred at critical, and highly unstable zones. Lack of awareness among the local people also played a role in the damages caused. All small-scale landslips are an indication of major ones to follow and ought to be taken as a warning of sorts, but it is often ignored.

Deforestation and construction close to ephemeral channels and the subsequent blockage of natural drainage has been another key ingredient for disaster. Steep cutting particularly for road building, resulting in day lighting of rock/overburden interface is another important aspect which needs immediate attention pertaining to rock falls.

This will need micro level mapping of geotechnical parameters and an extensive land use planning at the Panchayat level if such disasters are to be averted in the future. Making use of the available technology is the need of the hour.

Ankur Modi
Managing Partner,
InterCAD Systems P Ltd

Indian industries

Changing with the climate

Indian companies are becoming savvy about the gains to be made from becoming climate change compliant. It is not the fear about regulatory risks that is prompting companies to adapt to climate change strategies, but also the many positive gains to be had adapting to the diverse climate protocols and regulations.

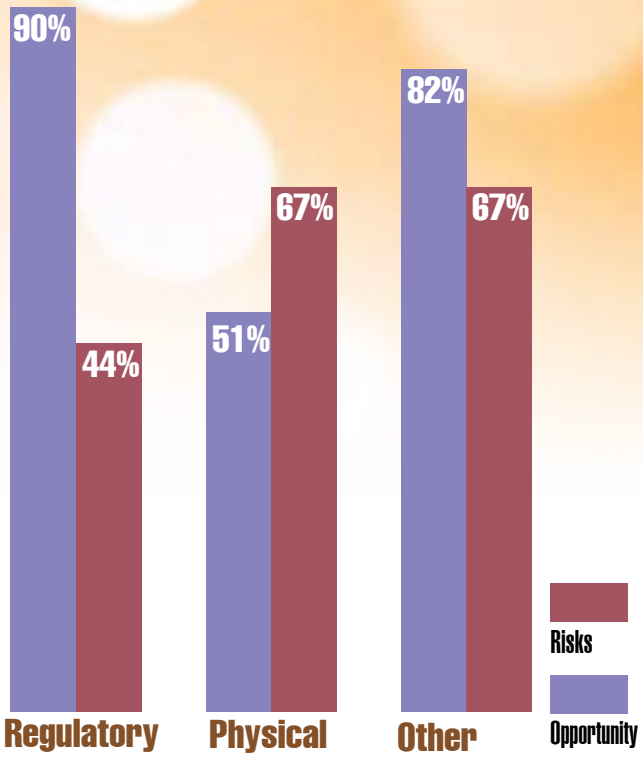
Every end product or service is always followed by a footprint of associated resource, energy and emission. Actions to reduce these footprints make business sense, as they can lower energy requirements and ultimately, the price of the end products/services.

Businesses with a vision to identify and act on the opportunities, while managing the risks, are going to be well placed to meet current and future market challenges. The early movers, with their actions and innovations, will not only reduce their overall carbon footprint, but will also have a competitive advantage.

According to the Carbon Disclosure Project (CDP), 2010, more than 84% of the top 200 industries which responded to the survey have put in place or assigned a senior level committee or an executive body to develop their climate change strategy. In addition, companies are becoming more transparent and increasingly sharing information with stakeholders on their actions to mitigate climate change. CDP 2010 responses from Indian companies suggest that there has been a paradigm shift in emphasis from an approach dominated by risk, to one that now embraces opportunity.

Among the most frequently cited policy concerns as regulatory risks are the Kyoto Protocol, National Action Plan on Climate Change (NAPCC), Perform Achieve & Trade Scheme and ECBC (Energy Conservation Building Code) Guidelines. But a few of the industries also anticipate opportunities for their organisations emerging from climate regulation domestically and internationally. Technology solution providers also foresee the opportunity of developing innovative solutions to help society adapt to climate change. Indian companies with a portfolio of products designed to curb emissions and energy intensive practices are already accounting for sizeable profit linked opportunities.

The CDP 2010 also shows that although



India has not yet mandated any GHG emissions reduction targets for industrial sectors, Indian businesses have been proactive in setting their own Voluntary Reduction Targets. This positive approach by the Indian industry creates a conducive environment for future regulatory policies and sustainable development.

Risks & Opportunity Analysis (CDP 2010)

Regulatory Risks (CDP 2010): The regulatory risks have emerged due to India's non-Annexure 1 status under the Kyoto Protocol and the lack of any statutory derivatives for mandatory GHG emissions reductions. The companies or sectors that fail to adjust to a changing business environment created by new regulations fall into competitive disadvantages, and the regulatory uncertainties make it difficult for the companies to plan their future.

One of the highlighted impacts of direct regulatory risks is the likelihood of additional financial responsibilities in terms of capital investment required for energy efficiency and carbon abatement projects. Apart from this, another theory says that in future, non-compliance with regulatory guidelines may also lead to financial penalties, which shall further create an impact as a regulatory risk for the industries.

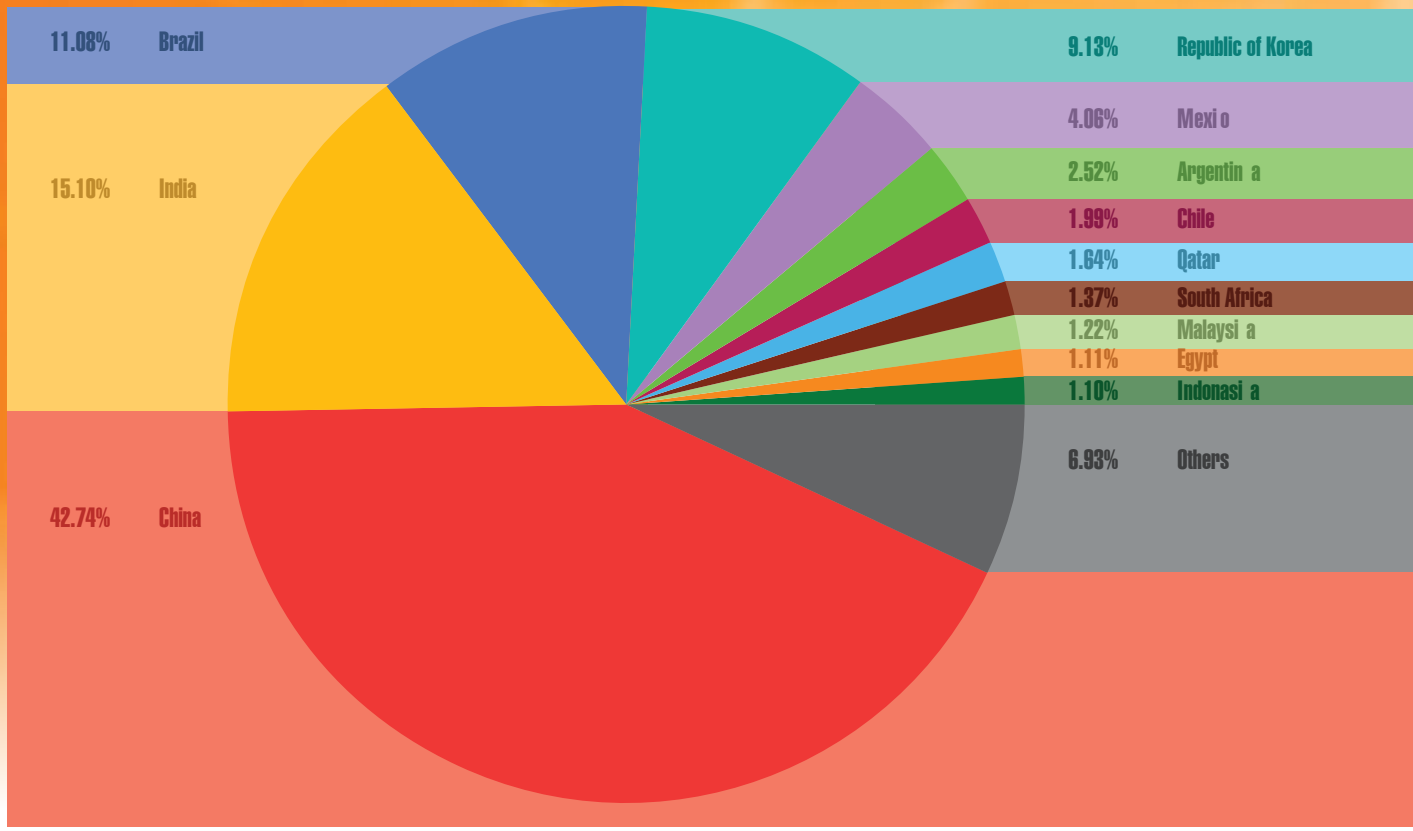
Physical Risks (CDP 2010): As per the CDP 2010 review, extreme weather conditions shall have a major impact on the value chain of the industries, leading to increase in fuel and utility overheads. Failure of electronic and telecommunication networks due to unwanted conditions places certain industries in a position of vulnerability.

Companies believe such unpredictable phenomena, categorised as physical risks, contribute significantly towards loss of productivity and sales. These factors have prompted companies to invest in sustainable raw materials and renewable energy technologies.

Reputational & Litigation Risks (KPMG 2007): Risks of this type are mainly faced by industries which lack transparency in their disclosures on environmental performances and are more vulnerable to negative public impression. Relatively, the degree of risks cited by the companies in this segment is fewer, but the scale and scope of such factors seem to be on the rise.

Opportunities (KPMG 2007)

As quoted by Bernard Wientjes, Chairman of the Netherlands Confederation of Industry and Employers, 'Business can be the solution'. In an open and global economy, a competitive position is necessary if long term investment is to be secured. A report issued by KPMG in 2007 shows that Indian companies can exploit numerous business opportunities that are likely to arise out of climate change mitigation and adaptation. The global market for low-carbon technologies is estimated to grow to USD 3 trillion a year by 2050 (KPMG, 2008; European Commission, 2007), throwing up significant

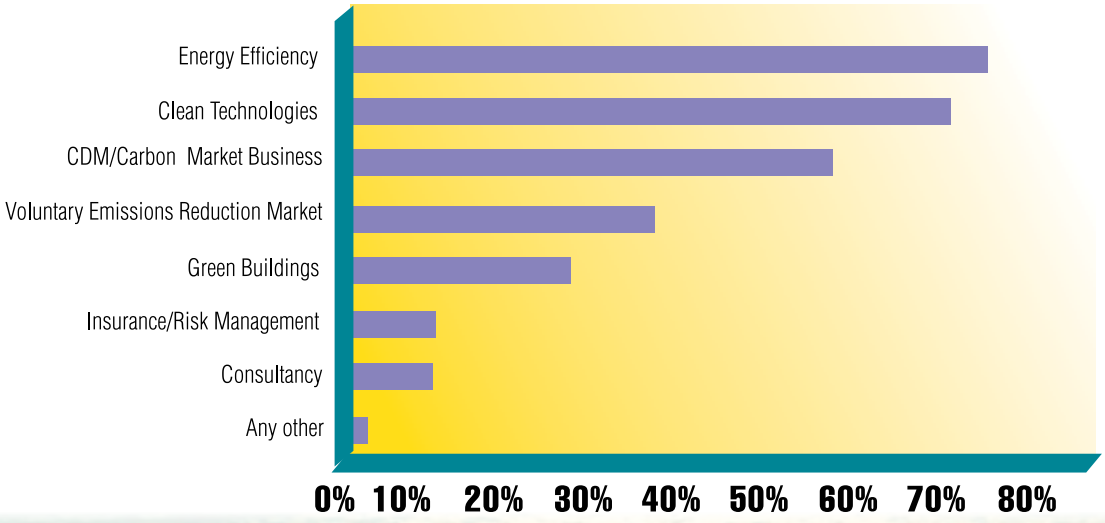


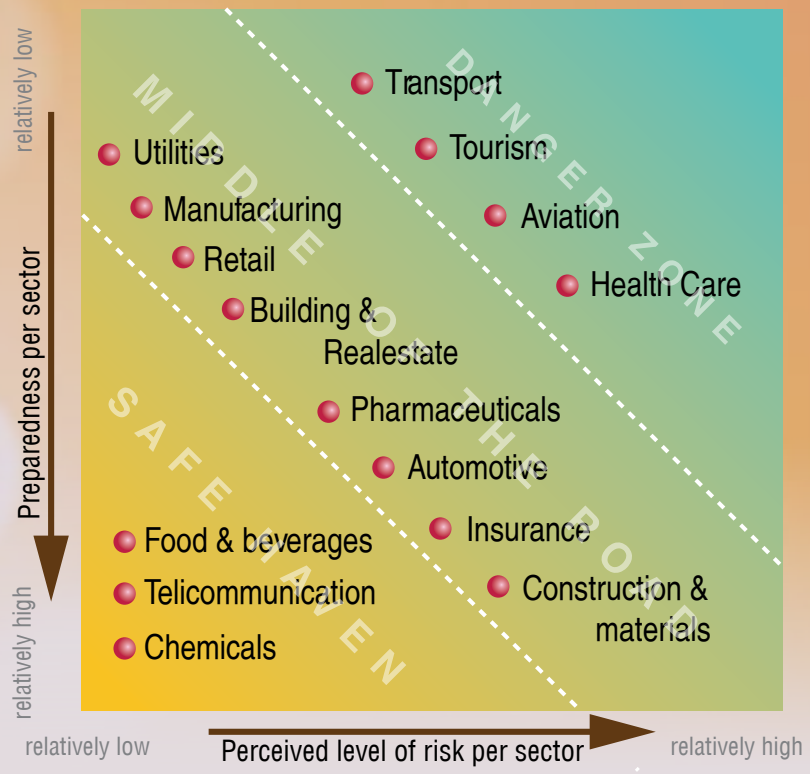
Expected average annual CERs from registred projects by host party. Total: 152,375,647

commercial opportunities.

Further, the Clean Development Mechanism (CDM) under the Kyoto Protocol affords businesses in developing countries like India the opportunity to reduce their emissions with the technological and financing support of entities in developed countries. Also, reducing emissions at the firm level has been established to result in significant efficiency gains in various business processes (KPMG, 2008).

Indian industries have grabbed the opportunity provided by the Clean Development Mechanism (CDM) with both hands. A survey conducted by UNFCC shows that about one fifth of all Certified Emission Reductions issued so far have been from India (Bhushan 2009, p19).





KPMG's risk preparedness Framework

Regulatory Opportunities (CDP 2010): In the context of the Kyoto Protocol, generation of green revenue through the Clean Development Mechanism (CDM) has been found to be the most frequently identified regulatory opportunity. Apart from profits through sale of Certified Emission Reductions (CERs), opportunities to build corporate reputation and energy savings are some of the other benefits companies derive through CDM projects.

As per the CDP 2010, some of the companies are also finding that the National Energy Labelling Programme, which pertains to product labelling regulation and standards, stimulates demand for new and improved products. Opportunities for financing energy efficiency and renewable energy projects are unanimously observed by banks and diversified financials.

Physical Opportunities (CDP 2010): There are two significant emerging trends as derived by the survey conducted by CDP 2010. In the first case, adaptation to adverse climatic impacts favourably influences the demand for certain products and services. The second trend pertains to indirect opportunities associated with the supply chain. A majority of the companies recognise opportunities to provide goods and services that may enable others to adapt to the physical consequences of climate change. Supply chain opportunities arise when a company stands to gain from logistical disruptions in its competitors' supply chains. In such cases, favourable product availability essentially translates to better sales margins.

Other Opportunities (CDP 2010): These can be broadly classified as benefits through reputational gains and market opportunities. Reputational gains are obtained when there is a positive enhancement in an organisation's corporate image as a result of its conscientious and proactive stance on climate change. Companies with a strong environmental performance can enjoy certain competitive advantages related to reputation (Bali et. al. 2010).

Companies adopting best practices and processes are well rewarded in terms of improved energy efficiency, monetary savings and reduced emissions. If these carbon savings were to be sold on CER markets, they would fetch even higher returns. The carbon market, therefore, presents new opportunities for the Indian business sector (Bali et. al. 2010).

Anju A.
Team, Construction Philosophy

A tech way to safe work sites

Construction wearables use technology to enhance workers' safety by bringing down chances of accidents and injuries at workplaces

The numbers are alarming. According to a recent study on fatal accidents in the Indian construction industry, around 48,000 people die at work sites in India every year. Construction-related work are among the most hazardous occupations in the country as fall from great heights, electrocutions and collapse of walls and scaffoldings lead to the death of one-in-four Indian construction workers at sites.

Besides the intensely physical nature of the work, there are several factors that make the construction site hazardous. These include the size and complexity of the site, usage of heavy equipment and hazardous materials, limited communication between various trades and shortcomings in monitoring of the location and activities and constant movement of people and equipment at the work sites.

What can construction companies do to bring down these staggering numbers of fatalities? One answer to this question is the wide use of construction wearables, which are devices attached to a construction worker's body, clothing, or personal protective equipment to collect and deliver data about his or her environment, activities and health conditions.

The wearables provide support to enhance the workers' safety, efficiency and quality of life by reducing injuries at site. With the advent of digital technologies in the construction industry, these objectives are not hard to achieve. Construction wearables use portable sensors,

computers and electronics to meet their goal. Their technology analyses each employee individually and he or she is automatically alerted to a hazardous situation prior to a would-be accident.

This futuristic system monitors the fatigue level of each worker and warns him/her when they are too close to moving equipment, edges or dangerous areas. It also autonomously informs them and their supervisors if an immediate behaviour change is required to prevent injury.

How it improves safety.

The monitoring functions of construction wearables can be categorised into four main categories:

- Physiological monitors gauge the physiological state of the worker such as body temperature and fatigue.
- Environmental monitors check the environment around the worker
- Proximity detection relies on a global positioning system to monitor locations of workers and proximity to on-site hazards
- Ergonomics that helps the workers know they are lifting or bending correctly to reduce muscle strain

Types of wearables

- Visual wearables: These devices use optical aids to produce images for remote viewers and/or the wearer. It connects field employees to remote technical employees, allowing both parties to view items simultaneously. Sharing visual information overlaid on actual work environments can enhance instructions, training and verification of practices and materials.
- Tactile wearables: These are designed as exoskeletons that provide extra strength or endurance to the wearer. They also limit the force on the wearer's musculo-skeletal frame and reduce chances of strains, sprains and back injuries while simultaneously increasing a wearer's capacity and endurance by monitoring the force constantly.
- Sensing wearables: These devices can sense the biological, environmental and physical conditions of the worker at site. Sensors come in many forms including badges, actuators, biosensors, gyroscopes and more. They record and evaluate the wearer's physical condition, location and environment. These wearables can sense location, impact, motion, temperature, vital signs and blood gases and evaluate and interpret the data to provide actionable information.

Sensors can be attached to hardhats, safety glasses or personal protective equipment. Clip-on wearables can be attached to shirts, vests and belts. Wearables can also be embedded in the sole of shoes or worn as insoles.

Challenges on sites

Bringing about change is always tough, especially to an industry that has done things in a certain way for so long. Even when the technology is here to save lives, people often complain about wearing them and how uncomfortable it is to work with them on. Workers are also concerned about their privacy with the amount of information that the devices collect. While wearables can ensure safety, they can also be a distraction for the workers, and they can affect productivity if workers keep toying with the devices.

Recent years have witnessed a revolution of the construction industry under the influence of digital technology. Though the wearable technology helps in enhancing the safety of workers, it is not be to be forgotten that the construction industry is innately bonded to humans and machines working together. At the end of the day, technology should not be used as a crutch and it cannot replace human competence.

Pranitha Elizabeth Joseph
Team Construction Philosophy

Target zero waste

'Waste is not waste until it is wasted'. This might sound like a pompous statement, but a group of professionals in Bengaluru have come together to provide a waste management solution for the denizens of the garden city through Swachha Eco Solutions.

Since its inception in 2008, Swachha has gradually risen to become one of the leading waste management service providers in the country. Swachha has entered into a Memorandum of Understanding (MoU) with the Bruhat Bengaluru Mahanagara Palike (BBMP) for operation and maintenance of a string of Dry Waste Collection Centres (DWCCs) in 10 select wards of Bengaluru, collecting 3,000 MTPA of plastic waste a year.

To achieve zero waste, Team Swachha piloted sustainable waste management in two wards out of the 198 wards in Bengaluru. Under the pilot project, they covered a population of 2.25 Lakh persons, who generated 18-20 tonnes of waste a day. Of this, 6-10 tonnes comprised plastic waste. From day one, they have been collecting wet and dry waste segregated at source, storing it in designated centralised yards to be transported for processing/recycling. The dry waste is sent to Swachha-operated by Dry Waste Collection Centres (DWCCs), aggregation centres and drop-off centres. The dry waste is collected in a single stream, which means all recylabes are collected in one bin.

Dry waste segregated at source undergoes secondary segregation into plastic, paper, metal, rubber and other 30-40 types of waste. Plastic thus segregated is sent to Swachha Eco Solutions' Dry Waste Processing Centre (DWPC) for further segregation based on desired parameters for recycling. The plastic waste is ground using a grinding machine and the resultant flakes are loaded onto a plastic extruder to convert waste plastic into useful raw materials as granules. The reprocessed plastic granules are then loaded on to a pipe extrusion machine which produces good quality pipes for use by farmers.

Re-Tiles (Recycled Tiles)

One innovative manner in which Swachha has been trying to put recycled plastic is the manufacture of Re-Tiles, short form for Recycled Tiles. These are interlocking tiles made of completely single grade plastic for use as paver blocks. Household plastic waste such as shampoo bottles and containers of polypropelene grade are used to create this block .The tiles are homogenous in nature which can be further recycled again. The product has been tried and tested in all conditions and have proved to be better than all other conventional tiles available in the market.

These tiles can be used for indoor and

swachha eco solutions
Towards a greener tomorrow

The Swachha story

outdoor paving, especially in footpaths and driveways. The tiles are made without using adhesives such as sand, as is normally done, to avoid wastage of natural resources. One square feet area can be covered with three recycled tiles, each weighing 135 grams.

Product features and benefits

100% recycled Polypropylene, 100% cradle-to-cradle recyclable, waterproof, anti-microbial, chemical & stain-resistant composition, slip-resistant and provides excellent comfort, easy to replace, move and reuse, done in wood grain (straight grain and parquet styles) patterns, art work and design possibilities for aesthetics, rainwater harvesting features, anti-slippery design features, accidental fire retardant and dynamic load bearing possibilities as required.

Better cut rate and life, good surface finish, value for money, fast installation, minimal sub floor preparations needed, immediate walk-on, no downtime or disruptions, cost up to 100% deductible in the first year and may qualify for 50% bonus depreciation.

Environmental Impact:

Lower carbon footprint, reduces use of plastic for landfill, ground water recharge compliant, resource and energy efficient and high environmental performance.

Swachha recycling services:

Swachha offers recycling services for both residential properties and commercial properties. Waste is collected on a periodic basis and carefully recycled. Collection models are designed to help the residents segregate and store waste. With a large facility for waste storage and secondary sorting, the team is able to recover most of the materials and recycle it.

Commercial Recycling Services

Swachha Eco Solutions founder by **Rajesh Babu, Victoria, Joslin, Disouza, Vinay Raghavan** has a holistic waste management solution for the commercial sector. Swachha's approach to commercial waste management is customised to client needs, providing the most suitable and efficient solution for the collection, removal/processing or recycling of all categories of waste.

They also provide waste disposal services for the commercial sector that includes retail Industry, gated community centres, public and private sector establishments, leisure establishments, hotels and restaurants, construction and demolition outfits, manufacturing, industrial and educational institutions, offices and businesses, event organisers and places of worship.

Consultancy services

Swachha strives to meet all environmental service needs of its clients and provide turnkey consultancy solutions with special advantages such as diverse teams from different functional areas carrying out the entire project. With vast experience in the field, Swachha also offers unique services such as biomedical and hazardous waste collection, transportation, treatment and disposal/recycling. Swacha also has active initiatives in e-waste management.

Steve George
University of Bath, UK.

Learning from a textbook called worksite!

How many of the people around us are aware of the importance of civil engineering? Its functions are part of our daily life. When we take a shower in the morning, when we drive along the road or when we charge a phone, what we use are the benefits of civil engineering. The water comes to us through a supply system consisting of a well-designed network of pipes, water treatment plant and numerous related services.The chain of roads we use to reach any place, the huge structural bridges we come across and the tall buildings where we work, all have been designed and constructed by civil engineers. Even the electricity is made available to us through towers constructed by engineers for transmission lines.

All this go to show that civil engineering has a significant role in the life of every human being, though one may not often realize its true worth in one's daily routine.

For me, this branch of engineering was not an accidental option but a deliberate choice. After my four-year-long study, I wanted to take a break before joining any company. But a job offer from Bangalore changed my plans. It was my dream city for a career. So, I accepted it without a second thought and packed my bag with four years of textbook acquaintance for the new adventure.

My first day went well as all I did was to sit in an air-conditioned room and browse through the structural and architectural designs of a few housing projects. Some symbols in the designs were familiar, but some others looked alien even with the help of Google. I gave up the hunt and went to the senior project engineer who explained everything in 30 minutes.

Another challenge was unit conversion. All calculations and designs in my curriculum were in metres and centimetres but sites mostly did the measurements in feet and inches. But it was really fun converting the units with mental mathematics.

The real battle began on Day 2 when I was asked to accompany the project engineer on a site visit. Language played the villain as my knowledge of Kannada or Hindi was limited, forcing me to depend on gestures. The first task was to calculate the volume of concrete required for the roof concreting of two houses. It took me 25 minutes to do the calculation, but the site officer finished it in four minutes. At that moment, I realized that there is more to civil engineering than text book learning.

The greatest learning on the site was during my apprenticeship with the project manager for a technical assessment and reconnaissance survey conducted for a new construction intervention. It was a multifaceted approach with precision, taking into consideration different aspects like soil quality, construction possibilities, site conditions, easiness of transport and logistics, suitable construction material, topography and construction feasibility. Different modules like construction engineering and management, geotechnical engineering, surveying, building drawing and quantity surveying were studied in one shot. And I learned that challenges in a project start from the pilot stage and last until the last day of execution.

On my visit to a community housing project in a Maharashtra village, I was surprised to see that the locally manufactured sun-dried mud bricks with organic binders satisfied the Indian Standard code criteria for bricks when tested. For a fresher like me, it was an eye-opener that a village community with limited proficiency in advanced construction technology was making a cost effective, innovative and sustainable construction material.

During some concreting days, water/cement ratio of 0.8 to 1 was used when the mix design was 0.6. Similarly cement mortar with a mix ratio of 1:12 to 1:14 was used in place of 1:6 mix ratio. It was always a problem to convince site workers to change or modify the conventional construction method. Another interesting lesson from the site experience was the sporadic nature of site workers and wastage of materials, thereby hurting the project budget.

I could actively participate in the construction activities during the final days of some projects to complete them within the time frame and they helped improve my time management and project management skills. The use of spirit levels and plumb bob to check the verticality, straight edge to keep the surface even, total station for checking levels of two different floor beams and calculation of materials required for a day's works were all new learning for me. Quality control tests for each construction material like cement, sand, coarse aggregate, bricks, concrete and steel were exactly the same as the laboratory tests done during our course.

The completion of each housing project brought a sense of fulfilment and realization of a dream to every family, irrespective of ethnicity, economic status, creed or caste. And to me, it was a moment of immense work satisfaction as a civil engineer. Each day of site supervision was a new learning experience.

One year on the site taught me many aspects of civil engineering which the four-year degree programme could never give. The exposure to various facets of site work was a valuable experience which helped me hone my skills. There is still a lot to learn in this domain. A day on the site is full of challenges with issues and problems popping up every now and then, each calling for different tools to resolve it in an efficient and economic manner.

Sometimes we have to seek help from other disciplines. Considering the complex situation involved in site work, one needs to be trained with the right skill and methodology which is obtained through experience and education. A combination of strong theoretical foundation and practical experience makes a civil engineer truly competent.

When it comes to building

A NEW WORLD,

It is not always about

The OUTPUT

Sometimes it is only about

The INPUT

Join hands with
Construction Philosophy to

DO IT RIGHT

An event jointly with all
Civil Engineering associations,

A Construction Sector
Open Panel Discussion

CONSTRUCTION PHILOSOPHY

Bridging Souls of Quality

AECOM-Canyon Partners Announce $500 Million Fund Close

LOS ANGELES —AECOM-Canyon Partners ,a joint venture between AECOM Capital, the investment adviser of global infrastructure firm AECOM, and Canyon Partners, LLC, a global alternative asset management firm declared final close of its fund. The fund hit its hard cap with just over $500 million in total commitments. with over $25 billion in assets under management. The partnership represents a unique combination of complementary skill sets in both investment and development.

The platform intends to provide joint venture equity across over $4 billion of assets with high quality development partners, primarily targeting "build-to-core" investments in the top 25 U.S. markets across all property types, including multifamily, mixed-use, office, hospitality, industrial, and student housing. In addition to capital, the joint venture partnership is seeking to deliver best-in-class design, construction management, and engineering expertise as well as credit support for its development partners.

Notable investments to-date include Ivy Station, a 519k square foot mixed-use development in Culver City where HBO has pre-leased all 240k square feet of office space; Union Place, a 525-unit luxury multifamily project in Washington, D.C. that is in the process of leasing; and Hotel Nia, a 250 key hotel adjacent to Facebook's headquarters in Menlo Park, CA

Shanghai Tower owner champions BIM for design and construction of one of the world's tallest (and greenest) buildings

A striking new addition to the Shanghai skyline is currently rising in the heart of the city's financial district. The super high-rise Shanghai Tower will soon stand as the world's second tallest building, and adjacent to two other iconic structures, the Jin Mao Tower and the Shanghai World Financial Center. The 121-story transparent glass tower will twist and taper as it rises, conveying a unique feeling of movement and growth, while reflecting the reemergence of Shanghai's economic and cultural influences amid the rise of an increasingly modern China. The massive mixed-use facility will include commercial and retail space; entertainment and cultural venues; a conference center; a luxury hotel; and public gardens, all evoking the sense of a self-contained city within Shanghai

Autonomous robots saves time on sites for capturing data and images.

The devices, created by Barcelona-based startup Scaled Robotics, create a 3D map of a site at the internal fit-out stage.This robot captures complete data for a 2,000 sq m floor plan in 40-50 minutes, which would take a human up to seven hours.The robots use a mixture of data, including spatial and time measurements and 360-degree images, to produce a detailed digital replica of their surroundings. These maps can then be compared to the company's original BIM model to assess build quality. Kier has previously trialled Scaled Robotics technology on a school build in London and another site in Cambridge.

Miral announces opening date for Clymb Abu Dhabi

Abu Dhabi based Miral has announced that its new sports and leisure attraction, Clymb Abu Dhabi, is close to completion and will open on November 29, 2019.

The $100 million project is designed to present unique sporting challenges to active lifestyle enthusiasts from around the world and will feature the world's tallest indoor climbing wall and widest skydiving flight chamber.

The attraction features a range of food and beverage outlets and can provide a space to host parties and social events. An easily accessible and air-conditioned passageway links Clymb Abu Dhabi to Yas Mall and Ferrari World Abu Dhabi enabling seamless connection and convenience, Miral stated.

According to a statement from Miral, Clymb Abu Dhabi's architecture has been inspired by the UAE's rugged, mountainous landscape – an environment that enthuses skydivers and rock climbers from around the world.

With its geometric exterior resembling a crystal-like structure, the venue has already become a Yas Island landmark, significantly adding to the integrated leisure, lifestyle and entertainment experiences available to visitors, Miral stated.

Gleeds starts work on New facility for sarstedt Limited

The facility, at Optimus Point, was officially granted planning permission in the summer following the appointment of International property and construction consultancy Gleeds by Wilson Bowden Developments Ltd. Gleeds acts as the employer's agent and project manager.

The new distribution centre will be located on 5.3 acres of land at Plot 10 Optimus Point, Glenfield and requires the construction of a 61,640 square foot unit including ancillary two-storey offices and core facilities. Other requirements of the site include associated external parking, a service yard, and landscaped areas.

The facility is the latest addition to Optimus Point, an established 65-acre development scheme that sits next to Junction 21a of the M1, featuring a range of local and national industrial warehouse operators.

Sarstedt Limited is currently based in Beaumont Leys however a bigger site in order to expand. Construction is already underway and is expected to take 36-weeks, with anticipated completion date of 1 May 2020.

Working closely with Sarstedt Limited and developing their detailed design from the outset has enabled the project team to offer a complete design and build solution that satisfies Sarstedt Limited's ambitions for future growth.

New companies win places on the contractor league table

Six new companies have entered the top ten places on the Barbour ABI League Table of the top 50 performing construction companies in the UK.

This month on the league table it was the company Fluor Limited which claimed the number one spot after being awarded the £800M Fawley Refinery upgrade works project, with this being the only project needed to take them to the top.

Following on from Fluor Limited there then came Balfour Beatty who accrued a total monthly income of £343M, £457M behind first place, over a total number of five projects, although it cannot be said that they are as new to the higher places on the league table as a company like Fluor.

The company to claim third place on the table, however, is definitely not as accustomed to being at the higher end of the table as Balfour Beatty as this place was won by the company Fileturn Limited, who accumulated a total income of £291M after being appointed to the £270M London Hilton, Park Lane development and refurbishment project.

In fourth and fifth came Wates Construction Limited and ISG with £220M and £211M respectively and in sixth place was the contractor company McLaren Construction which gained a total income of £190M courtesy of the redevelopment of 101 Cleveland Street in Westminster.

In seventh place came the Costain Group which were awarded the £161M Preston Western New Road project whereas McAleer and Rushe

INTERESTING FACTS

Revolutinsing the idea of traditional earth based foundation, A New York-based firm has come up with asteroid-suspended sky-scraper that orbits around the world.The tower proposed called ' Analemma Tower' - which is being proposed by the Clouds Architecture Office - is designed to be suspended downward on an asteroid orbiting 50,000km from earth using high strength cables. It would orbit in a figure-eight pattern across the northern and southern hemispheres in a 24-hour cycle each day.This system is referred to as the Universal Orbital Support System (UOSS).

"The proposal calls for Analemma to be constructed over Dubai, which has proven to be a specialist in tall building construction at one-fifth of the cost of New York City construction," the designers said.

This includes separate parts of the tower dedicated to business; sleeping quarters; devotional activities; a gardening and agricultural centre; "transfer stations" that allow for the transfer of people and goods between the earth's surface and the orbiting structure; and space for dining, shopping and entertainment.

The two highest sections of the tower - starting at between 17,000 and 20,000 metres above earth - are reserved for a reliquary section (which would house religious relics) and a funerary section. The tallest point of the tower above earth is planned for about 32,000 metres above ground.

Doha Airport Mosque

The Doha Airport Mosque provides a blissful prayer space with its peculiar dome shape spread throughout the entire building. The dome is made of glass with elegant circular pattern that looks like a flower. The interior of the mosque has calligraphy on the top. The dome has great lighting in night with the lamps hanging from the top and day's lighting is the sunlight that comes inside mosque from the glass ceiling.

K.R Jayaraj & Babu Poulose
Doha-Qatar

NILAGIRI HILLS

Robin Jose
Naipunya School of Management, Cherthala

Sent us your clicks to mail@constructionphilosophy.com with a brief of the structure location and a self introduction

TENDER DETAILS

Narmada Water Resources And Water Supply Department

TDR no. : 21586004
Tender Brief : Engineering, Procurement and Construction (Epc) Contract for Construction of Bhadbhut Barrage, Flood Protection Embankments and Associated Works Across River Narmada Near Village Bhadbhut of Bharuch District
State : Gujarat
Due Date : 23/12/2019
EMD : INR 424519000.00 /-
Tender Value : INR 4245.19 Crore /-

National Highways and Infrastructure Development Corporation Limited

TDR no. : 22506927
Tender no. : NHIDCL/ Assam/E-170377/DP Bridge/NH127B/2019
Tender Brief : Construction of Four Lane ridge Including Approaches over River Brahmaputra Between Dhubri on North Bank and Phulbari on South Bank In the State of Assam / Meghalaya on Nh-127B
State : Assam
Publish Date : 14/11/2019
Due Date : 30/12/2019
Tender Opening Date : 31/12/2019
Tender Value : INR 3548.50 Crore /-

National Highways Authority of India

TDR no. : 22497474
Tender no. : NHAI/BM/VMEPhaseIB/ 2018/PKG VI
Tender Brief : Construction of Eight Lane Access Controlled Expressway From Km 217. 500 To Km 254. 430 of Vadodara Mumbai Expressway Ena to Kim Section In The State of Gujarat on Ham Under Bmp I Pkg Vi
State : Delhi
Publish Date : 14/11/2019
Due Date : 03/01/2020
Tender Opening Date : 04/01/2020
EMD : INR 152700000.00 /-
Tender Value : INR 1526.86 Crore /-

Bhabha Atomic Research Centre

TDR no. : 22049548
Tender Brief : Tender For Construction of Block-I 13, 107C, 108C, 1 25C Infiltration Gallery At Inrpc, Nrb, Barc, Tarapur.
State : Maharashtra
Due Date : 23/12/2019
EMD : INR 55300000.00 /-
Tender Value : INR 543 Crore /-

Company : Indian Aviation Academy

Job position : Civil Engineer (Repairs and maintenance)
Qualification : B.Tech in Civil Engineering.
Masters in Civil Engineering or Diploma in Project Management (Desirable)
Experience : 6 years
Company : Lucknow Metro Rail Corporation

Job position : Junior Engineer

Qualification : Diploma in Civil Engineering
Pay : Rs.33,000 – 67,300

Company : Lucknow Metro Rail Corporation

Job position : Assistant Manager
Qualification : B.Tech in Civil Engineering
Pay : Rs 50,000 - 160000

Pidilite

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