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From the desk of Vice Chancellor

I am happy to note that the Civil Engineering Department has brought out -“The Civil Engineering Times”, an in house civil engineering magazine of the department, the second volume, issue in September 2018.

This is undoubtedly a great attempt by the department to publish a magazine that contains interesting technical articles, facts and other relevant topics that will prove to be useful to the faculties, students and working professionals of Civil Engineering Department. This magazine is very informative and well structured. I would take the pleasure of appreciating all the faculties of the department for their participation and efforts.

I would request them to continue publication of such in house magazines in a regular manner which would reflect the collective wisdom, knowledge base and research intensive technical updates of the Engineering Department, at large. I would like to congratulate the head of the department and all his colleagues and students for this commendable endeavor.

Prof. (Dr.) Sajal Das Gupta
From the desk of HOD (Civil Engineering)

It is a matter of great happiness and pride that the department of Civil Engineering is bringing out the second volume of the civil magazine which would provide an opportunity to all students and the faculties to share information and improve their technical knowledge and in general, showcase the cumulative efforts of the department.

This magazine is planned to be published on a quarterly basis, thereby providing a platform that would promulgate their skills, inculcate interest and create a good academic ambience in the department.

I congratulate all the members of the civil engineering department- faculties, staff and students for their contribution to the magazine. Heartiest congratulations to the Editorial Team for the in house development of this magazine. I hope that the students and staff members will utilize this opportunity to enhance their knowledge and disseminate it.

Prof. Somnath Hazra
Head of the department, Civil
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From childhood days everyone of us has heard stories about how the great Statue of Liberty was built and gifted by France to the United States, which became a worldwide icon showcasing the country’s power and mesmerizing the people. Whenever the picture of the statue would flash in front of us we would want to feel the magnificence of such a marvelous structure. Oh! How proud must the Americans feel to bask in the glory of possessing such a National Treasure? We Indians need not pang anymore, for we are going to have our own share of glory as we gear up to host the tallest and largest of the statues present in the current world. Named as the Statue of Unity and built as the physical figure of our beloved freedom fighter Sardar Vallabhbhai Patel, it promises to be the Magnum Opus in the history of statues glorifying our past and exemplify the united India.

The Statue of Unity is an iconic 182 meter tall landmark statue dedicated to Sardar Vallabhbhai Patel, a visionary leader and statesman hailed as the Iron Man of India, due to his pivotal role in the country’s struggle for independence and subsequent integration. Post inauguration on 31st October 2018, the Statue of Unity will be the world's tallest statue.

As a memorial to Sardar Patel, the Statue of Unity will provide visitors a meaningful experience that both educates and entertains, by focusing on his personage, life, and accomplishments. To this end, the statue is conceived as a naturalistic and historically accurate representation of Sardar Patel, wearing his characteristic garments, and assuming a walking stance. Additionally, a viewing gallery at around 500 feet will provide visitors a spectacular view of the Sardar Sarovar dam and its environs.

A special purpose vehicle established by the government of Gujarat for the construction of the statue, Sardar Vallabhbhai Patel Rashtriya Ekta Trust (SVPRET), is developing the Statue of Unity project in the area surrounding the Sardar Sarovar Dam in the Narmada district of Gujarat. Through this project, the government intends to promote inclusive and equitable socio economic growth in the region with tourism development as the key tool. This involves the development of multiple tourist attractions in the region coupled with infrastructure creation for promotion of education, research, health, rural and tribal development.

**Project Objectives**

As a memorial to Sardar Vallabhbhai Patel, the statue will not only remind every individual of our great nation’s freedom struggle but will also inspire the people of our country to inculcate Sardar Vallabhbhai Patel's visionary ideologies of unity, patriotism, inclusive growth and good governance. This monument will not just be a mute memorial like the rest, but a fully functional, purpose-serving tribute that will spur all round socio-economic development, in the form of better connectivity, healthcare & education infrastructure, research centre for agriculture development and various tribal development initiatives. The underlying themes and pillars associated with the monument are:
Livelihood Generation
(ii) Tribal Development
(iii) Research & Education
(iv) Social Infrastructure
(v) Employment Generation
(vi) Environment Protection

A monument of this stature will act as a catalyst to accelerate growth of the Narmada District, benefitting the resident population at large. This 182 meter tall Statue depicting Sardar Vallabhbhai Patel, will be surrounded by an enormous man-made lake spread across 12 km of area.

Core Team

SVPRET has appointed a consortium comprising Turner Project Management India Private Limited as Lead Member, Meinhardt India Private Limited and Michael Graves & Associates Inc. to provide the design, engineering, project management and construction management services for the Statue of Unity project.

Larsen & Tourbo : Indian’s largest engineering and construction company Larsen & Toubro has been given the responsibility for design, engineering, procurement, construction, operation and maintenance of the Statue of Unity project.

Mr. Ram V Sutar, a recipient of the Padma Bhushan award and the creator of over 40 monumental sculptures over the past 40 years of his career, has been appointed the designer and sculptor for the Statue of Unity.

Location

There could not be a more grand or apt location for the Statue of Unity than the Sardar Sarovar Dam on the Narmada River. The iconic 182 meter tall statue, a tribute to the Iron Man of India, is being built at the Sadhu-Bet Island, approximately 3.5kms south of Sardar Sarovar Dam at Kevadia in the Narmada district of Gujarat. Located in what is already a favoured tourist spot, especially in the monsoons when the Sardar Sarovar Dam overflows in all its magnanimity, the Statue of Unity promises to be one of the most visited tourist spots not only of the nation but also the world.

Reference


Subham Roy, Final Year Student, Civil Department, UEMK.
What is retrofitting?

Retrofitting is the addition of new building materials, building elements and components not provided in the original construction. It is done in order to make the building more stable against seismic activity (earthquake resistance).

Need of Retrofitting:

The issue of upgrading the existing civil engineering infrastructure has been one of great importance over a decade. Deterioration of bridge decks, beams, girders and columns, buildings, parking structures and other maybe attributed to ageing, environmentally induced degradation, poor initial design and/or construction, lack of maintenance, and to accidental events such as earthquakes. The infrastructure's increasing decay is frequently combined with the need of upgrading so that the structures can meet more stringent design requirements (for example, increased traffic volumes on bridges exceeding the initial design loads) and hence the aspect of civil engineering infrastructure renewal has received considerable attention over the past few years throughout the world. At the same time, seismic retrofit has become important especially in the areas of high seismic risks.

Different methods of retrofitting:

1. **Concrete Jacketing**: Involves increasing size of the existing reinforced concrete section by adding more reinforcement and concrete (fig a.). It could be accomplished by either of the following methods:
   a) **Conventional concrete** - It is done by pouring concrete around the member to be strengthened with additional steel reinforcement properly anchored to the existing sections.
   b) **Sprayed concrete** - Pneumatically projecting concrete onto the reinforced and preparing the surface of the member being strengthened with a spray gun.
   c) **Pre-packed aggregate grouting** - Pumping of cementitious grout into washed/graded coarse aggregate placed with proper anchored reinforcement around the member to be strengthened in a tightly shield form-work.

2. **Steel Plate Bonding** - This technique involves enhancing strength (shear, flexure, compression) or improving the stiffness of deficient reinforced concrete members by bonding steel plates of calculated thickness with adhesives and anchors to the existing sections. This technique is useful for the flexural and shear strengthening of bending elements such as beams and slabs and for compression capacity enhancement of columns.

3. **FRP (fiber reinforced polymers) Strengthening** - A fiber reinforced polymer (FRP) typically consists of high tensile continuous fibers oriented in the desired direction in a specially resin matrix. These continuous fibers are bonded to the external surface of the member to be strengthened in the direction of tensile force or as confining reinforcement normal to its axis. It can enhance shear, flexural, compression capacity and ductility of the deficient members. FRP systems commonly used for structural applications, come in many forms including wet lay-up (fiber sheets or fabrics saturated at site), pre-preg (pre-impregnated fiber sheets off site) and pre-cured (composite sheets and shapes manufactured off site).
4. **Steel Plate Bonding** - This technique involves enhancing strength (shear, flexure, compression) or improving the stiffness of deficient reinforced concrete members by bonding steel plates of calculated thickness with adhesives and anchors to the existing sections. This technique is useful for the flexural and shear strengthening of bending elements such as beams and slabs and for compression capacity enhancement of columns.

5. **Repair and Rehabilitation of bridges using Composites**: The service life of bridges is often reduced due to the corrosion of steel reinforcing bars in bridge decks and to the cracking caused by loading in access to the original design values due to the increased traffic volumes. In India numerous bridges are in need of upgrading (fig c.). Current upgrading practices include replacing the part of deteriorated portion of the deck structure by patching damaged areas or replacing the whole deck structures. Both of these practices have drawbacks. Therefore, alternative solutions should be devised from the upgrading of deteriorated bridge decks in India. Many industries such as the aerospace and the auto-mobile industries have successfully used fiber reinforced polymer composites (FRPC). This type of composite material offer significant advantages over conventional civil engineering materials such as concrete and steel.

6. **Base isolation**: Isolation of superstructure from the foundation is known as Base Isolation. It is the most powerful tool for passive structural vibration control technique. (fig d.) This method isolates building from ground motion, but this method is expensive and cannot be applied partially to structures unlike other retrofitting also challenging to implement in an efficient manner.

7. **Wall Thickening**: the existing walls of building are added certain thickness by adding bricks, concrete and steel aligned at certain places as reinforcement, as reinforcement such that the weight of wall increases and it can bear more vertical and horizontal loads.

**Conclusion:**

This article considers the retrofitting of buildings vulnerable to earthquakes and briefly discuss about the methods of retrofitting. In conclusion it is hoped that the material presented here will be useful in understanding of earthquake engineering problems and seismic retrofitting.

**Reference:**

1. Externally bonded FRP reinforcement for strengthening RC structures by Pathik DebMallik.
2. https://theconstructor.org
When one comes across company hoardings that say, “Building one floor per day, every day...guaranteed!”, one is left awestruck as to how something like this is feasible or rather doable. But thanks to Tunnel formwork, such a construction is possible in the wink of an eye. **Tunnel form** is a formwork system that is a modern method of construction that allows the builders to cast walls and slabs in one operation in a daily cycle. It combines the speed, quality and accuracy of factory/off-site production with the flexibility and economy of in-situ construction. It is nothing but “an inverted L” like structure. The entire formwork is made of steel & made specifically to the project design that can be readily modified for subsequent projects. It is generally designed to last upto 1000 reuses/floors of building and therefore will last and can be reused for several projects with only small modular adaptations and variations needed from project to project. Two units are joined to form inverted U, box sized steel. The formwork system is supported with hot air blowers which accelerates the setting of the concrete. So that one can achieve one slab in one day i.e. 24 hours slab cycle. This system becomes more economical for symmetric construction like mass housing projects and contains huge quantum of symmetrical work.

**COMPONENTS OF A TUNNEL FORMWORK**

1. Vertical, Deck and back panel: Retain fresh concrete until it gets set and cured.
2. Stripping platform, gable end platform and working platform: Provided for movement and working of labors and machinery and also for stripping out tunnels.
3. Push-pull props, wheeled prop: To maintain line and level of tunnel.
4. Lifting triangle: Placed at centre of mass of tunnel form deck panel for lifting by tower.
5. Slab stop end, Wall stop end: Provided as stopper to retain fresh concrete up to wall and slab line.
6. Block outs: Block outs are fixed at vertical panels to provide door, window and ventilation windows in walls.

**The Casting Process of Tunnel Formwork:**

1) **Stage One**: Prefabricated Wall reinforcement is placed by crane along the entire wing prior to casting the kickers (used to position wall formwork).
2) **Stage Two:** Two and a half tunnel is craned into place, bolted together and ties are added.

3) **Stage Three:** The wall concrete is poured.

4) **Stage Four:** The slab reinforcements are fixed.

5) **Stage Five:** The slab concrete is placed. The formwork system provides for a pour to be wrapped in tarpaulins and for the use of butane heaters to maintain a sufficiently high temperature for the concrete to reach its striking strength overnight.

6) **Stage Six:** The tunnel-forms are removed next day.

7) **Stage Seven:** The process is repeated for the next two bays.

Tunnel form can produce strong and durable in-situ cellular structures. This method of construction can achieve time savings up to 25% with cost savings of 15%.

Since the concrete finish is very good, the requirement for post construction trades such as plasterers and electricians are greatly reduced.

**Comparative study of tunnel formwork to the Aluminium formwork**

<table>
<thead>
<tr>
<th>No. of repetitions/m²</th>
<th>Red Tunnel formwork</th>
<th>Green Aluminium formwork</th>
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**Entry into the INDIAN construction industry**

Tunnel formwork has been adopted by the big companies like Tata Projects, Omkar Realtors, Rohan group of companies, Shapoorji Pallonji. Other conventional formworks are slowly but steadily on the verge of being replaced by Tunnel formworks mainly due to their fast, strong, easy to reuse and smooth construction process.

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Ranit Roy,
Second year student,
Civil Department, UEMK.
Concrete is the second most consumed material in the world (first being water).

Jeddah Tower, when completed will stand 1001 m tall, and will become the tallest manmade building in the world.

Alexandre Gustave Eiffel, designer and builder of famed Eiffel Tower was actually a chemical engineer.

The oldest book on engineering is “The Ten Books On Architecture” written by Roman Emperor Vitruvius. It holds records of the process of design and construction of buildings during his

The modern day steel concrete combination is an efficient replacement of clay, straw combination used by Babylonians and Egyptians.
Plastics can be made as strong as steel in both tension and compression, and are practically indestructible.

Imhotep, an Egyptian Physicist, Mathematician, Engineer, Inventor of building in stone is considered to be the designer of Pyramids. He eventually became to be worshipped as God.

6th richest man on the planet, Carlos Slim is a civil engineer.

Pre-fabricated buildings were built as early as 1940s. Pier Luigi Nervi’s pre-fabricated airplane hanger withstood WWII bombings.

Hagia Sophia, built in A.D 532 served as a Christian church uninterrupted through fourteen centuries, it still stands firm in Istanbul.
KOLKATA UNDERWATER METRO (EAST-WEST METRO CORRIDOR PROJECT)

Kolkata will soon have an underground Metro which will pass through tunnels many feet under the Hooghly River wherein the commuters between Howrah and Mahakaran metro stations will be under the river for about a minute when the metro train will pass through the tunnel at a speed of 80 km per hour.

ABOUT THE PROJECT

The East West corridor is another first. To start with, a transportation tunnel is unique to India because never in the history of the country has a tunnel been made beneath a flowing river. The first transportation tunnel of India is ready and the second too is expected to be completed soon. The East-West Metro is scheduled to be operational by August/December, 2019. The internal diameter of each tunnel is 5.55m and the thickness of the wall is 275mm. The distance between the two tunnels is 16.1m with walkways in the tunnels for evacuation of passengers in case of emergency. The metros will have 6 coaches with the capacity of carrying 1000 passengers and will be fully automated i.e. driverless.

The engineers and employees of Afcons Transtonnelstroy, an Indo-Russian joint venture and Kolkata Metro Railway Corporation Ltd, the two entities implementing the East West Metro have completed boring the country’s first tunnel under the Hooghly River for establishing metro link between Howrah and Kolkata before the deadline. The machine was brought from Herrenknecht AG plant in Schwanau in Germany. The final TBM assembly in place was ready in April 2017.

The giant Tunnel-Boring Machine (TBM) goes by the name Rachna and was deployed to dig the length of 502 metres underwater tunnel to run under the river. The entire project is 16.6 km long, out of which 10.8 km runs under the ground. Of this 10.8 km, 520 metres is under the water. The project connects Howrah to the west and Salt Lake to the east.

AIM OF THE PROJECT

The East West Metro Line will align with the existing 27.23-km North South Line, which ferries 6 lakh passengers on a weekday. This was the first metro railway in the country and has been operational since 1984. Considering the population growth, it is projected that by 2035, 10 lakh passengers will take the East West Metro daily. Among major Indian metros, the ratio of road space to city space in Kolkata is the lowest, at 6%. Along with the East West Metro project, four metro networks are in the pipeline, which will finally put an end to this ordeal.

STRETCH OF THE PROJECT

Having traversed a distance of 520 m below the riverbed, the two tunnels, about 3.8 km long, are the first underwater transport tunnels in India. The depth of the crown of the tunnel below the riverbed is 13 m. The stretch of 16.6 km will have 12 stations, six of which will be under the ground, while the remaining six stations will be on elevated tracks.
**CHALLENGES FACED**

Experts who oversaw the construction of the engineering marvel say the challenge was not only boring the tunnel below the riverbed but taking it past some of the oldest buildings in Kolkata, two Jewish synagogues, the Raj Bhavan and a few Ramshakkled Railway buildings which could not even be evacuated, with most issues solved as cited it may finally be over essentially by December 2019.

Hurdle being faced by the East West Metro Project is the threat the tunneling work may pose to three heritage buildings in Kolkata. The Currency Building, an Italian structure that served as one of first banks of the country, and two 19th century Jewish monuments the Maghen David Synagogue and the Beth-El Synagogue stand close to the Metro tunnels.

As per the existing rules, construction and mining operations are prohibited within 100 meters of protected monuments but the Currency Building is 24 metres away from the Metro’s alignment, and the Beth-El and Maghen David synagogues are at a distance of about 17 metres and 9.8 metres respectively.

After the issue was raised by the Archaeological Survey of India, an expert committee from the Indian Institute of Technology, Kharagpur, was constituted to look into the matter. The committee said there would be no “adverse effect” on the protected monuments.

**ENGINEERING FEAT**

The reinforced concrete segmental tunnel linings have a thickness of more than a quarter of a metre and are trammeled with a composite gasket of neoprene and hydrophilic rubber to seal the tunnel from seepage of water. It is claimed that this technology is an innovative first in India while being a rare venture worldwide.

The underground portion of the corridor has adopted the latest boring process, rather than the top down cut and cover process (which citizens have experienced during the construction of the North-South metro), sparing the citizens inconvenience and traffic snarls.

And to bore the tunnels, “Earth Pressure Balance” Tunnel Boring Machines procured from Germany. These mammoth TBMs (almost 2-story high) operating many metres under earth surface bore upto 15 metres a day, excavating up to 500 m³ of earth a day, while for life & activities on city surface it is business as usual unaffected by the frenetic tunnel boring going right beneath them.

The tunnels have been designed to withstand the extreme water tightness and earth pressure. The waterproofing, and the design of gaskets were the major challenges. The tunnel is being constructed to provide a serviceability of atleast 120 years. The seismic angle had to be kept in mind since Kolkata falls in seismic zone 3. Accordingly material and design used has to cater to keep tunnel protected against the eventuality of quakes.
CURRENT STATUS

The section between Sealdah and Mahakaran station was realigned due to the objection of GoWB. Work at Howrah Maidan have started in March 2016. The section between Howrah Maidan and Esplanade station is being built by Afcons – Transtonnelstroy JV team, two tunnel boring machines from Herrenknecht are being used to dig the tunnel. This section will pass through the river Hooghly for a distance of 520 meters. The section under the river will be at a depth of 30 meters (roof to ground distance) whereas the average roof to ground distance is 17 meters. The Howrah station on the west side of the river will be at a depth of 24 meters. Tunneling started from Howrah Maidan side. On 23rd May one of the TBM named Rachna completed the tunneling under the Hooghly River in 36 days. The other TBM named Prerna also completed the tunneling work under the river on 21-June-2017. There were some concerns during tunneling under Brabourne road as the tunnel would pass within 100 meters of heritage structures and there were also many old and dilapidated buildings in this section. KMRC received permission from Archaeological Survey of India in June 2017. Construction of tunnel till Mahakaran station was completed in November 2017. For the Mahakaran-Esplanade section, tunneling of one of the tunnel have been completed on 23 March 2018 the other tunnel will be completed by April 15. In this sections also shops and residents of the buildings have been shifted in phased manner before tunneling. The Esplanade - Sealdah section will be executed by ITD-ITD Cementation JV and has been started in May-2018. The TBMs have already been deployed.

--------Gaurav Saha, Final Year Student, Civil Department, UEMK.
Drones are everywhere! High priced or low, they are the decade’s new toy. There is no doubt that drones are really making their presence felt throughout the industrial applications. But the use of drones in surveying is still a largely unknown fact for many individuals. Being a relatively new device, drones are often not thought of first when it comes to using them for surveying purposes.

Drones are particularly useful and cost-saving in areas which are inaccessible or otherwise difficult and tough to navigate. It sends back a full image of the territory to teams planning logistics for next steps. Operators can share the imaging with personnel on site, in headquarters and with sub-contractors. Eventually this technology could change the industry and make the process much more accurate and efficient.

**Working Principle**

To understand the *modus operandi* of drone-surveying, an overview of its workflow is presented below.

**Step 1: Flying and capturing images**

Drone mapping provides us to gain an easy access to the most up-to-date information of the entire site or specific areas on a regular basis. One important aspect of aerial surveying is the spatial resolution, which in photogrammetry terms is described as Ground Sampling Distance or GSDs. GSD is the distance between two consecutive pixel centers measured on the ground which in simple terms is the size of the pixel in the field. It has been observed that a using a professional drone one could achieve 1 cm GSD at a flying height of 60 meters.

There are several cameras which have specific in-built feature of 3D mapping. Any drone, equipped with an intervalometer triggers the camera shutter to capture a minimum of 1 photo every 2 seconds. Some of the UAVs come with LiDAR mounted onto the drones. LiDAR actually means “Light Detection and Ranging” which comes with a laser scanner to measure the height of points in the landscape below the UAV. These UAV LiDARs can capture several square kilometres of land area in a single day and are capable of measuring 10-80 points per square meter, thus creating a very detailed digital 3D model of the landscape.
Step 2: Data Processing

Pix4Dcapture and Agisoft are some of the modern automated photogrammetric softwares used to process the captured raw image data. Each image is divided into a set of pixels and the software then determines pixels from each photograph that match each other and creates automated tie points, generating an orthomosaic. An orthomosaic or orthoimage is an aerial photograph geometrically corrected by eliminating lens errors and distortions such that its scale is uniform throughout. Unlike any random aerial image, an orthoimage can be used to measure true distances and is an accurate representation of the Earth’s surface.

Step 3: Adjust with the GCPs

Drones are equipped with GPS units that allow the surveyor to properly stitch the images together and generate 3D models. However, these are typically not accurate enough to place the said model exactly where it needs centimetre-level accuracy. So, we need GCPs (Ground Control Points) for absolute orientation of reconstructed model. GCPs are visual markers on the ground whose coordinates are known. GCPs help to increase the accuracy of drone survey and to fit the model in a geodetic coordinate system.
Step 4: Drawing and Reports

The output files of the orthomosaic image are compatible with different computer-aided design and drafting software (like AutoCAD), which are used for developing drawings. The drawings are then checked with the field data for any discrepancy before the final report is being prepared.

Benefits of Drone Surveying

- **Survey speed**: Instead of days or weeks, drone mapping takes minutes to complete a site survey with the same amount of accuracy. A traditional ground survey team may need a month to map a 100-acre site, but a mapping drone can complete the same task in less than half an hour.

- **Access to Unreachable Locations**: Surveying roadways, flooded areas or congested city landscapes are perfect assignments for drone technology. The technology offers a cost-effective alternative to surveying hazardous sites, in a matter of hours compared to days or weeks.

- **Single Tool**: Instead of theodolites, infrared reflectors and GPS, land surveyors can now use drones that autonomously pilot with the push of a button. These drones are capable of producing equivalent results which would in turn allow the surveyors to be safer, spend less time and save or re-budget the money.

- **Risk Reduction**: Safety and accidents related to falling due to rugged terrain or land elevations can add to construction budgets and impact construction workflow which can be significantly reduced when using drones to map or photograph construction projects.

- **Project Budget**: Drone mapping will accelerate processes, facilitate quality inspections and assess problems. The increased speed and automation that drone mapping provides permit companies to safely take on and complete more jobs for more clients, on more sites, in less time.

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- Introduction To UAV Photogrammetry And Lidar Mapping Basics by Fintan Corrigan
Ryugyong Hotel

Also known as "Hotel of Doom", is situated in Pyongyang, North Korea. It is 105 storied and is the tallest unoccupied building in the world, having kept this title for more than 25 years. Construction started in 1987 and is still not completed.

Its design is based on Egyptian Pyramids, and if completed will be one of the tallest hotels in the World.