CIVIL ENGINEERING TIMES

An illustrated in-house magazine of
DEPARTMENT OF CIVIL ENGINEERING

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*BIM
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From the desk of 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, volume two, issue two, December 2018.

I have always believed that a great university excels at both research and teaching, and I maintain that a university’s fundamental purpose is to provide a well-rounded outcome based education. Our ability to rise to challenges will depend on the clarity of our thinking and applying own knowledge for practical use and both will rely significantly on how well we inspire and enable university students to do experiment with their knowledge.

This is a great attempt by the department to continue 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 appreciate all the faculties of the department for their participation and efforts. I would like to congratulate the head of the department and all his colleagues and students for this commendable endeavor.

May you, the students of UEM, make the best of these openings and opportunities to shape your career, I wish you the very best.

Prof. (Dr.) Satyajit Chakraborty
Chancellor
From the desk of Vice Chancellor

This is undoubtedly a great attempt by the department of Civil Engineering to continue 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. 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, volume two, issue two December 2018.

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 like to congratulate the head of the department and all his colleagues and students for this exemplary venture.

I wish the department will put in sustainable team effort to continue publishing this magazine in the days to come, which will reflect the technological innovation and applications globally.

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

Firstly, I would like to congratulate all the members of the civil engineering department-faculties, staff and students for bringing out the second issue of second volume of the civil magazine. This magazine has continued to 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.

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. The magazine intends to continue providing a platform that would promulgate skills, inculcate interest and encourage technical writing skills in the students thereby leading to their overall development.

Prof. Somnath Hazra
Head of the department, Civil
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The MANALI-LEH highway has been one of the most problematic logistics nightmares for the Border Road Organization for long. Dotting the northernmost India, this 490km long highway connects Leh in Ladakh in Jammu and Kashmir State to Manali in Himachal Pradesh. It is one of the most versatile highways in the world traversing rough and dangerous terrains, taking about 22 hours to reach end to end by road. It remains inaccessible for 6 months due to heavy snowfall and blizzards. The only other road connecting Ladakh is through politically and religiously tumultuous area of Kashmir valley. Hence this road is of paramount importance for Indian defense personnel’s as well as for the daily chores of the inhabitants.

The completion date was then revised to 2014. Despite multiple announcements that the work on the tunnel would begin in 2008, no progress had been made by November 2009.

Recent activities of foreign intelligence in the Ladakh region have sparked national interest to upgrade the highway suitably for speedy movement of defense mechanisms and find way to reduce the travel time. The research has resulted in labeling parts of the old road inefficient and engineers have been tasked to design an ingenious way to achieve the target, which gave new life to the idea of The ROHTANG TUNNEL.

Afcons in a joint venture with Strabag AG was awarded the project, is constructing the world’s longest road tunnel 3000m above sea level for the Border Roads Organization (BRO), in Manali, Himachal Pradesh. The Rohtang Pass Highway tunnel is a single-tube bi-lane horseshoe shaped tunnel that will have a maximum vehicle speed of 80km/hr. Once complete, the tunnel will cut down the travel time between Manali and Lahaul by 5 hours and reduce distance by 46 km. Work on the project began on 28 June 2010.
Location

The tunnels south portal is situated in Dhundi (altitude 3060 meters) across the Beas River and the north portal is in Sissu (altitude 3071 meters). The tunnel cuts across the Pir Panjal Ranges, and opens in Sissu by the Chandra Valley where it meets the existing Leh-Manali Highway where the wind blows at a speed of 80 KMPH.

Importance

The Rohtang tunnel is planned to ensure an all-weather road route to strategically important areas of Ladakh and providing round-the-year connectivity to the remote Lahaul-Spiti valley. It is one of the most challenging tunnel projects in the world and negotiates through 20 landslides and avalanche zones. The main reason behind its construction is to help the Indian Army maneuver quickly and keep our country border safe.

Challenges faced

The most challenging task was to continue the excavation during heavy snowfall in winter. Excavation for tunneling was done from both ends. One fourth of the tunnel was excavated from the north end and three fourth was done from the south end. The other challenges faced were difficulty in disposal of the excavated rock and soil and heavy ingress of water from unstable rocks. More than 700 trees were cut down and questions were raised on its impact on ecology. Tunnel boring machines could not be used because of the inability to see inside, instead blasting and digging was used.

Support System Proposed

Fibre-reinforced concrete (100–300mm or 0–10 inch thick) combined with rock bolt (26.50mm dia, 5,000–9,000mm or 200–350 inch long) has been proposed as the principal support system. In areas of poor rock condition, yieldable steel ribs (ISMB 150/ISMB 300) have been proposed in addition. Tunnel ventilation: Semi-transverse system of ventilation has been proposed. A 2.25 m high and 3.6 m wide emergency tunnel will be integrated in the tunnel cross-section beneath the main carriageway.

The following parameters have been set in design:

(a) Upper tolerance limit for concentration – 150ppm
(b) Visibility factor – 0.009/m
(c) Vehicles
   (i) Cars – 3000 Nos.
   (ii) Trucks – 1500 Nos.
(d) Peak hour traffic – 337.50 PCUs
(e) Design vehicular speed in Tunnel
   (i) Maximum Speed – 80 km/h (50 mph)
   (ii) Minimum Speed – 30 km/h (19 mph)
Salient features of the proposed Rohtang Tunnel are as follows:

- Length of Tunnel: 8.8 km (5.5 mi)
- South portal coordinates: 32°21′49″N 77°08′00″E
- North portal coordinates: 32°26′21″N 77°09′51″E
- Shape (cross-section) of Tunnel: Horseshoe
- Finished width: 10.00 m (32.8 ft.) at road level. (8m pavement and 1m footpath on both sides)
- General altitude of the tunnel: 3,000–3,100 m or 9,840–10,170 ft.
- Designated vehicular speed: 80 km/h (50 mph)
- Overburden: Maximum 1,900 meters (6,230 ft.), average more than 600 m (1,970 ft.)
- Construction technique proposed: Drill & Blast with NATM
- Tunnel ventilation: Semi-transverse system of ventilation has been proposed.
- A 2.25 m high and 3.6 m wide emergency tunnel will be integrated in the tunnel cross-section beneath the main carriageway.

Fig. Shell used by tunnel boring machine.

Project Cost

Approximately Rupees.(INR)40 billion (Euro 250 million).

Current status

The excavation of the tunnel was completed in October 2017 and the completed tunnel may open in 2020.

References

As you read the title it will make you wonder how is even that possible? Because as per our common knowledge says it is an impossible thing. Every month the high-rise office buildings and other high-rise buildings like malls etc. have to spend a lot of money behind electricity bills much of which goes into account for the air conditioners and fans which are used in cooling the interiors of the building. But in 1991 Mr. Mick Pearce an African architect devised some passive cooling techniques which allow the building to cool itself.

The story began in 1991 when the developers of the Eastgate Centre approached Mr. Pearce for designing the Eastgate centre but they did not wanted to invest in the traditional air conditioning system for the building. One of the main reasons behind such decision is because in Harare’s climate the purchase, installation, and maintenance of a traditional air-conditioning for a building has immediate and long term costs. That left Mr. Pierce with a seemingly impossible challenge. How to design a building that cools itself?

Mr. Pierce found the solution to this problem within the termite mounds. The termite is one of nature’s most accomplished builders. A termite mound is the home to millions of termites some of which stretch an amazing 30 feet height. Although these termite skyscrapers might look solid from outside they are actually covered in tiny holes that allows air to pass through freely. Like a giant lung the structure inhales and exhales as temperature throughout the day.

How termites create this climate control system?

Termites in Zimbabwe build gigantic mounds inside which they farm a fungus which is their source for food. But this fungus must be kept at exactly 30 degrees Celsius, while the outside temperature ranges from 2 degrees Celsius at night to 41 degrees Celsius during daytime. The termites achieve this remarkable feat by constantly opening and closing a series of heating and cooling vents on the mound during the entire course of the day. Through a system of carefully adjusted convection currents air is sucked at the lower parts of the mound, down into enclosures with muddy wall, and up through a channel to the peak of the termite mound.
Process of air-conditioning in the Eastgate Centre:

There are 48 brick funnels along the ridge of the red tiled roof topping internal stacks which pull the exhaust air out of the seven floors of the offices below. Under the office floors a mezzanine plant room is located behind the cross chevron screen where 32 banks of low and high volume fans draw air from the atrium through filters. This air is pushed up through the supply section of the vertical ducts in the central spine core of each office wing. From the duct the air is fed through the hollow floors to low level grilles under windows. As it is warmed by human activity it rises to the vaulted ceiling where it is sucked out via the exhaust ports at the end of each vault through a system of masonry ducts to the exhaust sections of the central vertical stacks. In the office space uplighters use the concrete vaulted ceiling to reflect light downwards and to absorb their heat. The cold night air passing through the void festooned with concrete teeth removes the heat of the previous day and on the following day warm external air is cooled about 3 degree C by the same teeth before entering the room.

Eastgate and Passive Cooling Performance:

The building’s performance has been equal to or slightly better than that originally predicted by the architects and developers. The data logger graph ( in the figure below ) shows that in average conditions covering ten months of the year 3°C of cooling between outside and inside temperature is achieved. Optimum cooling is achieved when the external night temperature falls below 20°C. When 20°C is exceeded at night; mainly due to cloud cover (which prevents efficient heat radiation back to space), and when the following day is clear especially in October or November the office temperature remains fairly warm. The peak internal temperatures recorded at 4:00pm on occasions during 2 to 3 weeks of the whole year have been up to 27° - 28°C on certain days within that period. Usually during the rains in November onwards cloudy nights are followed by cloudy days and the internal office peak temperatures remain below 26°C was used.

Engineering Features of the Eastgate Centre:

The Eastgate Centre was designed in such a way so that it can naturally ventilate itself. Some highlights of this miraculous design are:

- The sandwich of the vaulted ceiling and the voided floor above acts as a heat exchanger.
- The high volume fans run at night to give ten air changes per hour and low volume fans run during the day giving two air changes per hour.
- The engineers have installed a data logger which continuously records air temperature at five critical positions.
- Eastgate uses 35% less total energy than the average consumption of six other conventional buildings with full HAVC in Harare.

References

2. Eastgate Centre Features: asknature.org/idea/eastgate-centre/#.W_5sBzgzblU.
In the current global scenario, the Urban Development has sadly occurred in ways opposing to the concept of sustainable development, this nonstop haphazard development leads to the higher growth in traffic footfall and increase of pressure on the environment, which in turn has lead us to find either alternative sources or use “Eco friendly” resources for a greater sustainable development. Humans require both roads and intact ecosystems, and hampering the development or function of one for the sake of the other will not benefit the nation.

Here are some globally recognized techniques on how to maximize the benefits of roads and minimize their impacts.

Plastone.

The “Plastic Man of India”, Padmasree Rajagopalan Vasudevan is known for devising an innovative way of disposing of plastic waste. In 2002, Vasudevan came up with the idea of spraying dry, shredded plastic waste, made up of pieces as small as 2 mm in size, over gravel or bitumen heated to 170 degrees Celsius. The plastic melted and coated the stones with a thin film.

**Uses of Plastic Roads:**

Plastic has become an integral part of all human requirements. Plastic carry bags, packaging material, bottles, cups, and various other items have slowly replaced everything made of other material due to the advantages of plastic. Plastic garbage is commonly seen around the country and has started causing several problems. And hence roads made of plastic i.e. Plastic roads are different from standard roads in the respect that standard roads are made from asphalt concrete, which consists of mineral aggregates and asphalt. The entire process is very simple. The plastic waste material is first shredded to a particular size using a shredding machine. The aggregate mix is heated at 165°C and transferred to the mixing chamber, and the bitumen is heated to 160°C to result in good binding. It is important to monitor the temperature during heating. The shredded plastic waste is then added to the aggregate. It gets coated uniformly over the aggregate coated uniformly over the aggregate within 30 to 60 seconds, giving an oily look. The plastic waste coated aggregate is mixed with hot bitumen and the resulting mix is used for road construction. The road laying temperature is between 110°C to 120°C. The roller used has a capacity of 8 tons.

Plastic waste helps increase the strength of the road, reducing road fatigue. These roads have better resistance towards rain water and cold weather. Since a large amount of plastic waste is required for a small stretch of road, the amount of waste plastic strewn around will definitely reduce.
The plastic-coated stones were then added to molten tar. Since both plastic and tar are petroleum products, they bind well. Vasudevan first tried out this technique to pave a road on the college campus. It yielded twin benefits: it reused plastic waste and built durable roads. And hence in 2012, ‘Plastone’ was born. A Plastone block made from a mixture of waste plastic and stone, has been found to withstand more pressure and resists water percolation. Plastone blocks are made using granite and ceramic waste, along with plastic waste. Each Plastone block consumes 300 plastic carry bags and around six PET bottles. Almost 10% of solid waste consists of used materials that can be broken into pieces and used in the making of Plastone. Industrial slug can also be used in the process.

Vehicle Wind Vane

Since Wind power is available in abundance and as there is a near constant source of wind power on the highways due to rapidly moving vehicles. A wind turbine can always be designed to recapture this wind energy from vehicles on the highway. The design of the turbines consists of blades, collars, bearings, a shaft, gears and a generator. Although one turbine may not provide adequate power generation, a collective of turbines on a long strip of highway has potential to generate a large amount of energy that can be used globally as an unlimited power source for streetlights and other public amenities. This design concept is meant to be sustainable and environmentally friendly.

Gorlov Helical Wind Turbine

The design of such a wind vane/turbine mainly consists of design of Shaft, Flange, Spoke& Blade etc.

Design of shaft:- The shaft of the turbine consists of a single two foot length of steel measuring 3/8ths of an inch in diameter. The use of steel over a lighter metal such as aluminum is based on the availability of materials. The steel rod that was purchased for the shaft had a straightness tolerance of ±0.05 inches where the aluminum rods had a tolerance given.

Design of Blades:- The turbine blades are the most important part of this design. They are 14 inches long and follow a helical path with a 5 inch radius over a 60 degree arc. The cross section is a standard NACA 0018 air foil with a 1.5 inch chord. Since the airfoil is symmetric along the chord, the mean camber line follows the chord. The helical path that the blade follows is drawn along the midpoint of the camber line and the blade is set at a 0 degree angle of attack.

These are just two popular methods and techniques, though there are many more and there will be more upcoming technology to make our roads smarter and safer to travel on. Along with these, the opportunities that arise for mitigating or reducing adverse environmental impacts in modifications and repairs to existing roads should not be overlooked. Environmental considerations should be included when plans are made to repair or modify existing roads, as well as when plans are made to build new roads.

References


------Aditya Banerjee Third Year, Civil Department, UEMK.
1. The Empire State building is designed to be a lightning rod. In fact, it is struck by lightning more than 100 times every year.

2. The Burj Khalifa can apparently be seen from 90 kms. Yes! this gigantic architecture is visible from a distance of approximately 295276 feet.

3. Hong Kong is the city with the highest number of skyscrapers. It has a total of 308 skyscrapers taller than 150 meters.

4. The Panama canal was one of the most difficult engineering projects ever. It is estimated that more than 25,000 workers lost their lives during the construction.

5. Sagrada Familia, a Roman catholic church located in Spain is still unfinished. However, the construction was started back in 1882. The same is expected to be finished by 2026.
MEGA STRUCTURES

The Empire State Building was the first to have 100 floors and was the tallest building of the world from 1931 to 1972.

The tallest turbine in the world, Vestas V164 in Belgium has rotor tips that reach over 220 meters (722 feet) above the ground.

The Pan-American highway is the longest highway in the world. It is 47,958 kilometers long and travels through 14 countries.

The Millau Viaduct is the highest bridge being 343 meters high. That’s more than the height of Eiffel Tower. A 90-story building extends that high.

The Petronas towers are the twin towers with deepest foundations. 104 concrete piles, ranging from 60 to 114 meters (197 to 374 ft) deep, are bored into the ground.
CELLULAR LIGHTWEIGHT CONCRETE

Cellular lightweight concrete, also known as aircrete, foamed concrete, foamcrete, foam concrete or reduced density concrete, is defined as a cement based slurry, with a minimum of 20% (per volume) foam entrained into the plastic mortar. As mostly no coarse aggregate is used for production of foam concrete the correct term would be called mortar instead of concrete; it may be called "foamed cement" as well. The density of foam concrete usually varies from 400 kg/m³ to 1600 kg/ m³. The density is normally controlled by substituting fully or part of the fine aggregate with foam.

Manufacturing

Cellular lightweight concrete typically consists of a slurry of cement or fly ash and sand and water, although some suppliers recommend pure cement and water with the foaming agent for very lightweight mixes This slurry is further mixed with a synthetic aerated foam in a concrete mixing plant. The foam is created using a foaming agent, mixed with water and air from a generator. The foaming agent used must be able to produce air bubbles with a high level of stability, resistant to the physical and chemical processes of mixing, placing and hardening.

Properties

1. **Batches of cellular lightweight concrete** is manufactured by combining key elements in an ordinary concrete mixer. The strength and dry density of the ingredients differ based on its composition and air pocket content.

2. **Continuous Cellular Lightweight Concrete** is produced by mixing light mortar and preformed foam under pressure in a special static mixer.

Density of Cellular Lightweight Concrete

The variable density is described in terms of kg per m³. The density of regular concrete is normally measured at 2400 kg/m³ whereas the density of the foamed concrete ranges from 400 kg/m3 to 1800 kg/m3. The density of cellular lightweight concrete can be effectively determined by introducing foam formed utilizing a foam-generator. Using fly-ash based CLC lowers the density but it has absolutely no effect on the overall strength of the structures.

Difference between Light weight concrete and Aerated Concrete:

Foamed concrete is often confused with gas or aerated concrete. In aerated concrete the bubbles are chemically formed due to reaction of aluminum powder with calcium hydro oxide and other alkaline compounds. The aerated concrete is produced by the mixing of an air-entraining agent to the concrete. Foam Concrete on the other hand is manufactured using completely different technique.
Advantages & Applications of Cellular Lightweight concrete

Cellular lightweight concrete has several advantages associated with their applications:

**Lightweight:** Cellular lightweight concrete is lightweight and thus it has a positive impact on weight management of building material and craning work making it a favourite choice for production of perlite plaster and perlite lightweight concrete.

**Fire resistance:** In CLC, the air pockets in its structure are responsible for high resistance to fire breakout. Irrespective of density range CLC walls are non-combustible and can endure fire breakout for hours and hence it is utilized as thermal insulation in the form of bricks and blocks over flat roofs or non-loading walls and also for production of special of light heat resistant ceramic tiles.

**Thermal insulation:** At reduced density foamed concrete acts as a perfect thermal insulator. Although at this density it has absolutely no structural reliability in terms of strength due to which it is ideal for production of heat-insulated light wall panel.

**Sound absorption and Acoustical Insulation:** The low density increases acoustical insulation and helps maintain Acoustical balance of concrete.

**Environmental Friendly:** Fly ash based cellular lightweight concrete is suitable for surrounding because fly-ash is one of the by-products of industrial waste.

Reference

4) Scholar: Composition of materials [https://scholar.google.co.in/scholar?q=cellular+lightweight+concrete&hl=en&as_sdt=0&as_vis=1&oi=scholart#d=gs_qabs&p=&u=%23p%3DzLgOvdllwflJ]
Wind power has been growing dramatically since the beginning of the 21st century. Recently, thanks to the development of small wind turbines, quiet and specified for urban use, it is possible to harness wind power for on-site energy generation or domestic production or agricultural districts.

These turbines, reaching a maximum of 20 kW of power, can also find space on rooftops or in gardens, they have relatively little visual impact and are able to produce energy even from modest wind flows. Small wind systems can be used both as stand-alone systems or as grid connected systems, and both can be paired with other energy conversion systems, such as photovoltaics.

The globally installed small wind capacity has reached more than 678 MW as of the end of 2012. China accounts for 37%, and the USA for 31% of this capacity. More than 100 MW of new small wind capacity were added in the year 2012, a global capacity increase of 18%.

Wind turbines located at the high wind speed zones in buildings are called Building Augmented Wind Turbines (BAWT) because the wind turbine makes use of the building as a concentrator of the wind. The concentrator effect will only be present for small wind turbine dimensions compared to the building dimension. By installing wind turbines in buildings, we produce energy where it is needed, and there is no loss of transmission.

The identification of the turbines position must however be preceded by a thorough analysis of available winds, because turbulences or areas of calm, generated by surrounding buildings or different obstacles located on the roofs (air conditioning systems, antennas), could lead to an energy production significantly lower than expected. At the same time, it is possible to benefit from the interaction between the wind and the built environment in order to channel air currents to very specific areas where wind turbines can be installed.

Turbines able to exploit the concentration of wind power due to the shape of the building are known as Building Augmented Wind Turbines (BAWT) and their different configurations can be divided in three main groups:

1) BAWT close to the building, on the rooftop or along the sides;
2) BAWT between buildings;
3) BAWT inserted in air conducts through buildings.

In all three cases, the areas of effective availability of air currents are limited in relation to the extension of the surfaces of the buildings, requiring the use of compact and properly located rotors to take advantages of them.

### A. BAWT Close to the Building

BAWT installations close to the building exploit the acceleration of the air flow at the upper corners and the sides of the facade of the building (Fig. 2). However this phenomenon is followed by the formation of turbulent areas because of the air flow separation, making vertical axis turbines more effective than turbines with horizontal axis.
The consequence of turbulence along the edges of the building may possibly be mitigated by using a curved roof (characterized by adherent, turbulence free air flow), or by placing the turbines on poles or shafts in order to reach the undisturbed air, or by creating spoilers and ailerons integrated into the building envelope, as in the case of Oklahoma Medical Research Foundation (Fig. 3).

At a precise distance, it is possible to make the facades surfaces exposed to the wind contribute to channel the prevailing winds. The two buildings can be positioned according to the direction of the wind so they can act as a funnel or as a diffuser, the latter capable of creating a higher pressure gradient, able to channel the input flow and accelerate it in correspondence with the turbines. Anyhow the turbines must be positioned before the vortex shedding edges so they can benefit from a flow perfectly directed to the rotor axis. Thanks to the possibility of channeling the wind, this solution is particularly suitable for horizontal axis turbines (HAWT) that can take advantage of a large section undisturbed air flow, obtaining good yields in the production of electrical energy due to the possibility of installing large rotors.

The Strata SE1 residential tower in London (Fig. 4), designed by the BFLS and completed in 2010, includes three wind turbines (19kWeachone) in its crown at 148 meters off the ground, able to produce up to 50 MW h/year, enough to power the common spaces of the building (8% of total consumption).

In the World Trade Center in Bahrain, designed by Atkins (Fig. 6), the two sail-shaped buildings inclined at 45° channel the air to three horizontal axis rotors of 29 min diameter (225 kW each one), which are able to produce almost 15% of the energy needs of the building.

### B. BAWT between Buildings

BAWT between buildings require special integration between the formal architectural design and the systems solution (Fig. 5). By locating buildings with a specific geometric shape (generally an airfoil profile)
Another architectural solution for the exploitation of wind energy involves the placement of turbines inside the building, in order to use the difference in air pressure generated by the winds that affect the opposing facades. A building hit by the wind builds up the air in motion on the windward side resulting in an area of relatively high pressure. On the leeward side instead, a shadow of the wind with a relatively low pressure is created. The presence of two opposite openings on the windward and on the leeward determines an air current which can be used to power a wind generator. The generated airflow is proportional to the difference in wind pressure existing in correspondence of the entrance and exit apertures, their overall size and the dimensional ratio between the openings. (Fig 7)

When the openings are located on two opposite sides the solution is effective only in areas characterized by constant prevailing winds that blow in a direction perpendicular to the openings plane. In case of variable winds it is necessary to provide interconnected openings on all the four sides in order to exploit winds at 360°. This way maximum efficiency is reached with winds oriented at 45° to the plane of any facade. Anyhow the architectural constraints on the air conducts size require the use of small rotors, but the air uptake and acceleration ability ensures a good energy yield. For example, In Pearl River Tower in Guangzhou, China, designed by SOM, there are corridors at the tech levels able to accelerate the air up to 2.5 times to feed the vertical axis turbines (Fig. 8).

Similarly, Pertamina Energy Tower, under construction in Jakarta, by the same studio, will have at the top of its 530 meters areal “funnel” to channel the prevailing winds to wind turbines.

Conclusion

In relation to the influence of wind conditions on turbines’ performance is absolutely essential, however, to carry out a thorough environmental analysis of the wind resource prior to the installation in order to identify the most suitable turbine model and its optimal location. Even in the presence of a good average wind speed, not all sites can in fact be suitable for the installation of wind energy systems. In consideration of the interaction between building shape and wind intensity and direction, it is also important, in the case of new constructions, for the design team to work from the beginning alongside fluid dynamics experts in order to identify architectural forms able to maximize the eventual production of wind energy (BAWT).

References

SUSPENSION BRIDGES

A suspension bridge is a type of bridge which is built by suspending the roadway from cables attached to a master cable which runs above the length of the bridge. The design of a suspension bridge is simple and straightforward, and takes advantage of several techniques to distribute the weight of the bridge safely and evenly. Suspension Bridges have received more attention due to their ability to cover the large spans for bridging the long and unsupported spans, the Suspension Bridges present the most elegant and efficient structural solution.

Forces acting on Suspension Bridge:

- **External forces:**
  Two kinds of external forces operate on any bridge: the static (dead) load, and the dynamic (live) load.
  - **Static load:** It refers to the dead load, i.e., weight of the bridge itself. Like any other structure, a bridge has a tendency to collapse simply because of the gravitational forces acting on the materials of which the bridge is made.
  - **Dynamic load:** It refers to the live load, i.e., the traffic that moves across the bridge as well as normal environmental factors such as changes in temperature, precipitation, winds, and extreme environmental factors.

- **Internal forces:**
  There are four main types of internal forces acting upon suspension bridges; tension, compression, torsion and shear (Fig a).
  - **Tension:** Tension is the pulling force that acts on the cables and suspenders of a suspension bridge.
  - **Compression:** Compression is a pressing force that acts on the towers of a suspension bridge as they are acted upon by gravity.
  - **Torsion:** Torsion is a twisting force that can be seen when suspension bridges are put under high wind speeds.
  - **Shear:** In a suspension bridge the towers and cables can experience opposite forces (cable pulling left/right while towers compress down) and if this is not taken into account for, the bridge will completely bend and break.
**Structural principles:**

The main forces in a suspension bridge of any type are tension in the cables and compression in the pillars. Since almost all the force on the pillars is vertically downwards and they are also stabilized by the main cables, the pillars can be made quite slender, as on the Severn Bridge, on the Wales-England border, given fig.

In a suspended deck bridge, cables suspended via towers hold up the road deck. The weight is transferred by the cables to the towers, which in turn transfer the weight to the ground. Assuming a negligible weight as compared to the weight of the deck and vehicles being supported, the main cables of a suspension bridge will form a parabola (very similar to a catenary, the form the unloaded cables take before the deck is added).

**Construction sequence:**

- The towers are set up on underwater piers, caissons are sunk and any soft bottom is excavated for a foundation. If bedrock cannot be reached, pilings are driven to bedrock or hard soil, or a large concrete pad may be constructed. The foundation piers are then extended to above water level.
- The towers when founded on dry land, deep foundations or pilings are used.
- From the tower foundation, towers of multiple columns are erected using concrete, stonework, or steel structures. At some elevation there must be a passage for the deck, with the columns extending high above this level.
- Smooth open cable paths called saddles are anchored atop the towers. These allow slight movements of the cable as the loads change during construction. The top of these saddles may be closed with an additional part after completion of the bridge.
- Anchorages are constructed to resist the tension of the cables. These will have multiple protruding open eyebolts.
- A temporary suspended walkway supported by wire rope follows the curve of the cables to be constructed, mathematically described as a catenary arc.
- Another set of wire ropes are suspended above the walkway and are used to support a traveller that has wheels riding atop these cables. There will be one set of wire ropes and a traveller for each cable to be spun.
- Pulling cables attached to winches are capable of pulling the traveller from one anchorage to the other, traveling in arcs to the tops of the two towers.

One can see the shape from the constant increase of the gradient of the cable with linear (deck) distance, this increase in gradient at each connection with the deck providing a net upward support force. Combined with the relatively simple constraints placed upon the actual this makes the suspension bridge much simpler to design and analyse actual deck, than a cable-stayed bridge, where the deck is in compression.
Longest Span Suspension Bridges:

Suspension Bridges are ranked by the length of the main span. A list of suspension bridges are arranged below based on the length in **Table 1**.

<table>
<thead>
<tr>
<th>Name of the Bridge</th>
<th>Situated in</th>
<th>Length(m)</th>
<th>Established in</th>
</tr>
</thead>
<tbody>
<tr>
<td>Akashi Kaikyō Bridge</td>
<td>Japan</td>
<td>1991</td>
<td>1998</td>
</tr>
<tr>
<td>Xihoumen Bridge</td>
<td>China</td>
<td>1650</td>
<td>2009</td>
</tr>
<tr>
<td>Great Belt Bridge</td>
<td>Denmark</td>
<td>1624</td>
<td>1998</td>
</tr>
<tr>
<td>Osman Gazi Bridge</td>
<td>Turkey</td>
<td>1550</td>
<td>2016</td>
</tr>
<tr>
<td>Yi Sun-sin bridge</td>
<td>South Korea</td>
<td>1545</td>
<td>2012</td>
</tr>
<tr>
<td>Runyang Bridge</td>
<td>China</td>
<td>1490</td>
<td>2005</td>
</tr>
<tr>
<td>Fourth Nanjing Yangtze Bridge</td>
<td>China</td>
<td>1418</td>
<td>2012</td>
</tr>
<tr>
<td>Humber Bridge</td>
<td>England</td>
<td>1410</td>
<td>1981</td>
</tr>
<tr>
<td>Yavuz Sultan Selim Bridge</td>
<td>Turkey</td>
<td>1408</td>
<td>2016</td>
</tr>
<tr>
<td>Jiangyin Bridge</td>
<td>China</td>
<td>1385</td>
<td>1999</td>
</tr>
<tr>
<td>Tsing Ma Bridge</td>
<td>Hong Kong</td>
<td>1377</td>
<td>1997</td>
</tr>
<tr>
<td>Hardanger Bridge</td>
<td>Norway</td>
<td>1310</td>
<td>2013</td>
</tr>
<tr>
<td>Verrazano- Narrows Bridge</td>
<td>United States</td>
<td>1298</td>
<td>1964</td>
</tr>
<tr>
<td>Golden Gate Bridge</td>
<td>United States</td>
<td>1280</td>
<td>1937</td>
</tr>
</tbody>
</table>

**Table 1: List of Suspension Bridges**

**Advantages of Suspension Bridge**

- These bridges have longer main spans compared to any other type of bridge.
- They are cost effective since less material may be required than other bridge types, even at spans they can achieve, leading to a reduced construction cost.
- Except for installation of the initial temporary cables, little or no access from below is required during construction, for example allowing a waterway to remain open while the bridge is built above.
- They can withstand earthquake movements better than heavier and more rigid bridges.

**Disadvantages of Suspension Bridge**

- It requires balancing the tensions during and after construction.
- Construction of cables

**References**

- The theory of Suspension Bridges by A.A. Jakkula
- [https://theconstructor.org/structures/suspension-bridges/20](https://theconstructor.org/structures/suspension-bridges/20)
- [https://en.wikipedia.org/wiki/Suspension_bridge](https://en.wikipedia.org/wiki/Suspension_bridge)
THE A B Cs of BIM (BUILDING INFORMATION MODELLING)

BIM (Building Information Modeling) is an intelligent 3D model-based process that gives architecture, engineering, and construction (AEC) professionals the insight and tools to more efficiently plan, design, construct, and manage a building within one 3D model. It can also span into the operation and management of buildings using data that owners have access to.

With BIM technology, an accurate virtual model of a building, known as a building information model, is digitally constructed.

When completed, the building information model contains precise geometry and relevant data needed to support the design, procurement, fabrication, and construction activities required to realize the building. After completion, this model can be used for operations and maintenance purposes.

From Blueprints to CAD to BIM

In the past, blueprints and drawings were used to express information about a particular building plan. This 2D approach made it very difficult to visualize dimensions and requirements.

Next was CAD (Computer Aided Design), which helped drafters see the benefit of plans in a digital environment. Later on, CAD turned 3D, which brought more realistic visuals to blueprints. Now, BIM (Building Information Modeling) is the standard—but it’s more than just a 3D model.

How Is BIM Information Shared?

This information in a BIM model is shared through a mutually accessible online space known as a common data environment (CDE), and the data collected is referred to as an 'information model'. Information models can be used at all stages of a building’s life; from inception to operation—and even renovations and renewals.

BIM Objects

BIM objects, the components that make up a BIM model, are intelligent, have geometry, and store data. If any element is changed, BIM software updates the model to reflect that change. This allows the model to remain consistent and coordinated throughout the entire process so that structural engineers, architects, MEP engineers, designers, project managers, and contractors can work in a more collaborative environment.
What are BIM Levels?

Different levels of BIM can be achieved for various types of projects. Each level represents a different set of criteria that demonstrates a particular level of 'maturity.' BIM levels start with 0 and go to 4D, 5D, and even 6D BIM. The purpose of these levels is to gauge how effectively, or how much information is being shared and managed throughout the entire process.

Below are brief descriptions of the first four levels and an explanation of what criteria is involved at each stage.

As BIM becomes increasingly more sophisticated, 4D, 5D, and even 6D BIM start to play a part in the process, depending on the project complexity.

Applications of Building Information Modeling

A building information model can be used for the following purposes:

- **Visualization**: 3D renderings can be easily generated in house with little additional effort.
- **Fabrication/shop drawings**: It is easy to generate shop drawings for various building systems.
- **Code reviews**: Fire departments and other officials may use these models for their review of building projects.
- **Cost estimating**: BIM software has built-in cost estimating features. Material quantities are automatically extracted and updated when any changes are made in the model.
- **Construction sequencing**: A BIM can be effectively used to coordinate material ordering, fabrication, and delivery schedules for all building components.
- **Conflict, interference, and collision detection**: As BIMs are created to scale in 3D space, all major systems can be instantly and automatically checked for interferences. For example, this process can verify that piping does not intersect with steel beams, ducts, or walls.

So why do we equate BIM with software?

BIM is not just software; it is a process and software. Software is how BIM is promoted. The BIM process requires the use of one coherent set of computer-generated models and the easiest way to do this is with one type of software that everyone uses to access the same project.

To create a proper BIM model, you must be able to federate or combine all of these layers of information for various building systems into a single "master" model. This is most easily achieved by standardizing the software used by team members to consolidate all the relevant information, which is a key principle of BIM.

Here are two examples of BIM at work in some of the world’s largest and most complex construction projects.
1. Crossrail

Crossrail is a 73-mile railway line under development in England that will run through portions of London as well as Berkshire, Buckinghamshire, and Essex counties.

The railway—which will cost an estimated £14.8 billion (almost $20 billion)—is set to open in December 2018. It’s a mammoth undertaking that began in 2009, employing more than 10,000 people at 40 construction sites.

2. Istanbul New Airport

The Istanbul New Airport is a megaproject under construction in Turkey’s largest city that, when finished, will be the largest airport in the world with an annual passenger capacity of 150 million.

As of August 2018, about 61% of construction had been completed; authorities hope to open the airport in February 2019. BIM has been heavily involved in this project, which includes a 90-meter tower in the shape of a tulip that won the “2016 International Architecture Award” from the Chicago Athenaeum Architecture and Design Museum and European Center for Architectural Design and Urban Research. Turkish company IGA is building the airport with the help of BIM.

The Future of BIM

Because of the clear benefits, it’s certain that BIM is here to stay. It has defined goals and objectives that are clearly beneficial to all those who work their way through the levels. Undoubtedly, the future of construction will be even more highly collaborative and digital. Furthermore, around the globe, there is an attempt to reduce waste in construction. Much of this is attributed to supply chain inefficiencies, clashes, and reworking. By working collaboratively in a BIM environment, all of this becomes much less likely, setting the stage for a better tomorrow.

References

Plastic bottles are ubiquitous, cheap, convenient, and lightweight—but once the beverage inside has been consumed, the bottle is typically tossed into the trash making our world glutted with mountains of plastic bottles.

And a wiser lot of the human species have tried to address this problem by repurposing plastic bottles as a construction material. Today, plastic bottles have been used to build not only houses, but also water wells, and garden sheds. So you can build your wall and help the environment too. Here is the how-

**Necessary Materials**

- **Bottles** – according to need.
- **Sand** - You will need sand—lots of it.
- **Cement** - Depending on the climate, you may need a little cement. The cooler the climate, the more cement you will need.

**Step 1: Prepare the Bottles**

First, filter the sand to remove any stones or debris and then the entire bottle should be compactly filled with sand as sand provides weight and durability. Experts believe that a compacted-sand plastic bottle is 20 times stronger than brick. Impressive!

**Step 2: Build a Foundation**

While you are filling the bottles you can dig the foundation for wall. All good construction requires a solid foundation. Fill your foundation with a high-quality cement mix. You may wish to call in an expert to complete this part of the job. Once done you are ready to start building.

**Step 3: Build Support Columns**

Next, build your support column at corners. Lay your sand-filled bottles flat on their sides, and make a tight circle with all the bottles oriented so that their spouts point inward. Secure them into position with a sand/cement mix, or mudify your soil if heavy clay. Place the second layer of bottles immediately above, and fill the gaps with mud or a sand/cement mix. When the support column has reached the desired height, bind everything together with string.

**Step 4: Build the Walls**

Line up all the sand-filled bottles, side by side. Use a spirit level as you go along to ensure they are straight, carefully use cement or mud to hold your bottles in position. When the wall has reached the required height, bind the bottleneck ends together in a cross-cross fashion with string.

When the construction is complete, the plastic-bottle walls will be rendered in a cement/sand-and-water mix, and the string will help keep everything in position.

For detailed info visit: https://owlcation.com/humanities/How-to-Build-a-House-Made-from-Plastic-Bottles
Capital Gate

Also known as “Leaning tower of Abu Dhabi”, is situated in Abu Dhabi, UAE. It is 160 meters and is the farthest man made leaning building in the world, with a tilt of 18 degree west.

It was able to achieve its inclination through an engineering technique, known as pre cambering, that allows floor plates to be stacked vertically up to the 12th story and staggered on over another.