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A Civil Engineering Magazine

Civil-o-sphere

by Department of Civil Engineering
Technique Polytechnic Institute

- **ENVIRONMENTAL FRIENDLY CONCRETE**
- **LOW COST, ENERGY-SAVING RADIATIVE COOLING SYSTEM READY FOR REAL-WORLD APPLICATION**
- **BAMBOO REINFORCED CONCRETE**
- **HYPERLOOP: FUTURE OF TRANSPORTATION**
- **INDIA'S 'WORST WATER CRISIS IN ITS HISTORY' IS ONLY GOING TO GET WORSE, GOVERNMENT THINK TANK SAYS*BY 2030, THE COUNTRY'S WATER DEMAND IS PROJECTED TO BE TWICE THE AVAILABLE SUPPLY*'**
- **COST CONTROL TECHNIQUES FOR CONSTRUCTION PROJECT**
- **IMPROVEMENT OF TALL BUILDING DESIGN AFTER 9/11**

Vision of Our Institute

To be a premier institute in pursuit of excellence in technical education and skill development committed to serve the society.

Institute Mission Statements

1. **To promote excellence in learning, teaching and technology transfer.**
2. **To improve the quality of skilled workforce through a structured programme and professional skills training.**
3. **To inspire students to learn and facilitate their overall development with social orientation and values.**

Vision of the department:

To become excellent in the field of Civil Engineering in developing highly competent technically skilled manpower to meet the current and future challenges.

Mission of the department:

1. To impart quality education and consultancy services to the community in all areas of Civil engineering.

2. To impart knowledge with emphasis on the development of leadership qualities among students in a congenial learning environment.

3. To impart knowledge and to equip students with skills to prepare them for successful diverse professional career.

4. To promote among the students attitude to serve society and the nation by providing solutions to the challenges in the field of Civil Engineering.

5. To provide opportunities to students and faculty members to innovate and disseminate knowledge.

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Contents

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IMPROVEMENT OF TALL BUILDING DESIGN AFTER 9/11

By – **SAIKAT SARKAR**

(Lecturer Civil Engineering Department)

Abstract

When buildings collapse killing hundreds – or thousands – of people, it's a tragedy. It's also an important engineering problem. The 1995 collapse of the Alfred P. Murrah Federal Building in Oklahoma City and the World Trade Center towers in 2001 spawned many vows to never let anything like those events happen again. Many structural engineers of world figuring out what happened, and doing extensive research on how to improve buildings' ability to withstand a terrorist attack.

Overview

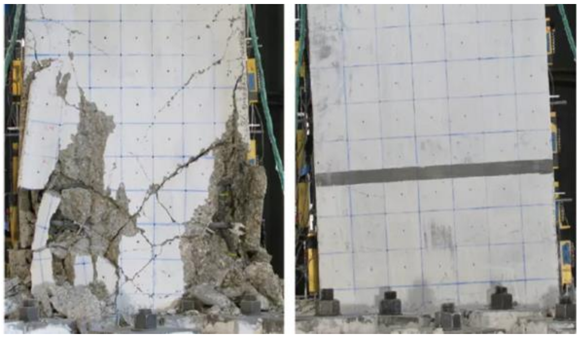
The attack on the Murrah building taught us that a building could experience what is called "progressive collapse," even if only a few columns are damaged. The building was nine stories tall, made of reinforced concrete. The explosion in a cargo truck in front of the building on April 19, 1995, weakened key parts of the building but did not level the whole structure. Only a few columns failed because of the explosion, but as they collapsed, the undamaged columns were left trying to hold up the building on their own. Not all of them were able to handle the additional load; about half of the building collapsed. Though a large portion of the building remained standing, 268 people died in the areas directly affected by the bomb, and in those nearby areas that could no longer support themselves. A similar phenomenon was behind the collapse of the World Trade Center towers on September 11, 2001, killing nearly 3,000 people. When exposed to the high temperatures created by burning airplane fuel, steel columns in both towers lost strength, putting too much load on other structural supports. Until those attacks, most buildings had been built with defenses against total collapse, but progressive collapse was poorly understood, and rarely seen. Since 2001, we now understand progressive collapse is a key threat. And we've identified two major ways to reduce its likelihood of happening and its severity if it does: improving structural design to better resist explosions and strengthening construction materials themselves.

Earthquake Protection

Research has found ways to keep columns and beams strong even when they are stressed and bent. This property is called ductility, and higher ductility could reduce the chance of progressive collapse. It's a common concern when building in earthquake-prone areas. In fact, for years building codes from the American Society of Civil Engineers, the American Institute of Steel Construction and the American Concrete Institute have required structural supports to be designed with high enough ductility to withstand a major earthquake so rare its probability of happening is once every 2,000 years. These requirements should prevent collapse when a massive earthquake happens. But it's not enough to just adopt those codes and expect they will also reduce or prevent damage from terrorist attacks: Underground earthquakes affect buildings very differently from how nearby explosions do. Another key element structural engineers must consider is redundancy: how to design and build multiple reinforcements for key beams and columns so the loss of, say, an exterior column due to an explosion won't lead to total collapse of the entire structure. Few standards exist for redundancy to improve blast resistance, but the National Institute for Building Sciences does have some design guidelines..

Making Concrete Stronger

The materials that buildings are made of also matter. The steel columns in the World Trade Center towers lost strength rapidly when the fire reached 400 degrees Fahrenheit. Concrete heated to that temperature, though, doesn't undergo significant physical or chemical changes; it maintains most of its mechanical properties. In other words, concrete is virtually fire proof. The new One World Trade Center building takes advantage of this. At its core are massive three-foot-thick reinforced concrete walls that run the full height of the building. In addition to containing large amounts of specially designed reinforcing bars, these walls are made of high-strength concrete. An explosion generates very high pressure – how much depends on how big the blast itself is, and how close it is to the structure. That leads to intense stress in the concrete, which can be crushed if it is not strong enough.

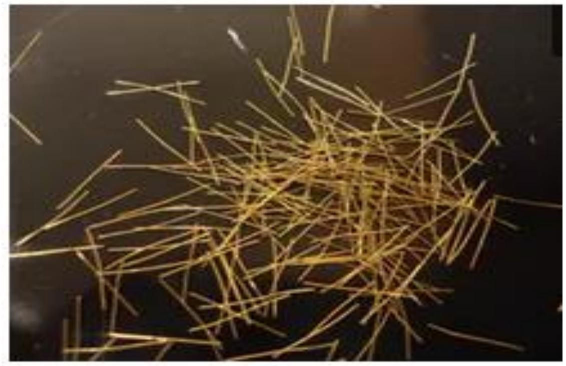


At left, standard reinforced concrete; at right, ultra-high-performance fiber-reinforced concrete, under similar severe earthquake loadings. Shih-Ho Chao, CC BY-ND.

Regular concrete can withstand 3,000 to 6,000 pounds of compression pressure per square inch (psi); the concrete used for One World Trade Center has a compressive strength of 12,000 psi. Using materials science to more densely pack particles, concrete's strength has been increased up to 30,000 psi.

Improving reinforcement

While traditional reinforced concrete involves embedding a framework of steel bars inside a concrete structural element, recent years have brought further advancement. To enhance concrete's toughness and blast resistance, high-strength needle-like steel microfibers are mixed into the concrete. Millions of these bond with the concrete and prevent the spreading of any cracks that occur because of an explosion or other extreme force. This mix of steel and concrete is super strong and very ductile. Research has shown that this material, called ultra-high-performance fiber-reinforced concrete, is extremely resistant to blast damage. As a result, we can expect future designers and builders to use this material to further harden their buildings against attack. It's just one way we are contributing to the efforts to prevent these sorts of tragedies from happening in the future.



High-strength steel fibers like this are mixed into concrete to make it even stronger and tougher. Shih-Ho Chao, CC BY-ND

Building Code Changes

NIST was not prescriptive in its recommendations. Instead, NIST encouraged competitive solutions to the issues it raised and supported public policymakers to adopt revised standards and codes By 2009, the push for new construction standards won out, bringing sweeping changes to the International Building Code and the International Fire Code, which serve as the basis for building and fire regulations across the United States. The International Code Council (ICC) approve changes every three years when the codes are updated. Some of the new safety requirements for buildings included additional stairways and more space between stairways; stronger walls in stairwells and elevator shafts; reinforced elevators for emergency use; stricter standards for construction materials; better fire-proofing; backup water sources for the sprinkler system; glow-in-the-dark exit signs; and radio amplifiers for emergency communications

The New Normal: Architecture, Safety, and Sustainability

In 2010, the Burj Khalifa in the United Arab Emirates shattered world records for building height. Yet, while it rises a whopping 2,717 feet (828 meters), the skyscraper incorporates multiple evacuation lifts, super-high-speed elevators, thick concrete reinforcement in the stairways, and many other safety features .of course, a building as tall as Burj Khalifa poses other problems. The maintenance costs are astronomical and the demands on natural resources extreme. These shortfalls point out the real challenge that every designer faces. One World Trade Center stands near where the destroyed twin towers once stood, replacing office space but never taking the place of memories — the National 9/11 Memorial is now where the twin towers stood. A number of safety, security, and green building features have been incorporated into the design and construction of the new WTC, design details that may have been missing in the original buildings. For example, safety systems now exceed the requirements of the New York City Building Code; elevators are housed in a protected central building core; protected tenant collection points are on each floor; a dedicated staircase for firefighters and extra-wide pressurized staircases are part of the design; sprinklers, emergency risers, and communication systems are concrete-protected; the building is the most environmentally sustainable project of its size in the world, attaining a LEED Gold Certification; the building's energy performance exceeds code requirements by 20 percent, cooling systems use reclaimed rainwater, and waste steam helps generate electricity.

Conclusion

Designing buildings has always meant working within rules. In addition to fire codes and safety laws, modern-day construction must meet established standards for environmental protection, energy efficiency, and universal accessibility. Local zoning ordinances impose additional restrictions that can affect anything from paint colors to architectural style. And then, of course, successful buildings also respond to the demands of the landscape and the needs of the client and the community.

LOW COST, ENERGY-SAVING RADIATIVE COOLING SYSTEM READY FOR REAL-WORLD APPLICATIONS

By – **RABI DAS**

(Lecturer Civil Engineering Department)

Abstract

Engineers have successfully scaled up an innovative water-cooling system capable of providing continuous day-and-night radiative cooling for structures. The advance could increase the efficiency of power generation plants in summer and lead to more efficient, environmentally-friendly temperature control for homes, businesses, utilities and industries.

Introduction :

University of Colorado Boulder and University of Wyoming engineers have successfully scaled up an innovative water-cooling system capable of providing continuous day-and-night radiative cooling for structures. The advance could increase the efficiency of power generation plants in summer and lead to more efficient, environmentally-friendly temperature control for homes, businesses, utilities and industries.

Description :

The new research demonstrates how the low-cost hybrid organic-inorganic radiative cooling met material, which debuted in 2017, can be scaled into a roughly 140-square-foot array -- small enough to fit on most rooftops -- and act as a kind of natural air conditioner with almost no consumption of electricity.

"You could place these panels on the roof of a single-family home and satisfy its cooling requirements," said Dongliang Zhao, lead author of the study and a postdoctoral researcher in CU Boulder's Department of Mechanical Engineering.

The findings are described today in the journal *Joule* and take advantage of natural radiative cooling principles.

"As Earth's temperature warms due to the absorbed heat from the sunlight during the day, it continuously emits infrared light to the cold universe all the time," said Professor Ronggui Yang of Mechanical Engineering and lead author of the study. "During the night, Earth cools down due to the emission without the sunshine."

The researchers' film-like material reflects incoming almost all sunlight while still allowing an object's stored

heat to escape as much as possible, keeping it cooler than ambient air even in the midday sun.

"The material, which we can now produce at low cost using the current roll-to-roll manufacturing techniques, offers significant advantages." said Associate Professor Xiaobo Yin of Mechanical Engineering and CU Boulder's Materials Science and Engineering Program.

"We can now apply these materials on building roof tops, and even build large-scale water cooling systems like this one with significant advantages over the conventional air conditioning systems, which require high amounts of electricity to function," said Associate Professor Gang Tan of the University of Wyoming's Department of Civil and Architectural Engineering.

The researchers tested their system outdoors in a variety of weather conditions, including wind, precipitation and humidity. In experiments conducted in August and September 2017, their proprietary Radi Cold module kept a container of water covered by the metamaterial 20 degrees Fahrenheit cooler than the ambient air between 12:30 p.m. and 3 p.m., the most intense summer sunlight of the day.

The researchers also introduced an element of dynamic scheduling to their technology, anticipating that structures such as offices may have limited or no cooling demand at night. In a building-integrated system, however, a cold storage unit could be added to capture the cold through heat transfer fluid such as water in this system and allow it to be retrieved during the subsequent day to reduce the cooling strain during peak demand periods.

"We have built a module that performs in real-world, practical situations," said Yang. "We have moved quite far and fast from a materials level to a system level."

The Radi-Cold module could become a viable solution for supplemental cooling for single-family homes, businesses, power plants, municipal utilities and data center facilities among other potential applications, Yang said.

Additional co-authors of the study include CU Boulder graduate students Ablimit Aili and Yao Zhai as well as senior undergraduate students Jiatao Lu and Dillon Kidd of Mechanical Engineering. The U.S. Department of Energy's Advanced Research Projects Agency -- Energy (ARPA-E) provided funding for the research. The technology has been licensed to Radi-Cool Inc.

Reference:

Dongliang Zhao, Ablimit Aili, Yao Zhai, Gang Tan, Xiaobo Yin, Ronggui Yang. **Subambient Cooling of Water: Toward Real-World Applications of Daytime Radiative Cooling**.

BAMBOO REINFORCED CONCRETE

By – SOMEDEB SAHA

(Lecturer Civil Engineering Department)

Abstract

The use of small diameter bars and/or split bamboo has often been proposed as an alternative to relatively expensive reinforcing steel in reinforced concrete. The motivation for such replacement is typically cost—bamboo is readily available in many tropical and sub-tropical locations, whereas steel reinforcement is relatively more expensive—and more recently, the drive to find more sustainable alternatives in the construction industry. This review addresses such 'bamboo-reinforced concrete' and assesses its structural and environmental performance as an alternative to steel reinforced concrete.

A prototype three bay portal frame, that would not be uncommon in regions of the world where bamboo- reinforced concrete may be considered, is used to illustrate bamboo reinforced concrete design and as a basis for a life cycle assessment of the same. The authors conclude that, although bamboo is a material with extraordinary mechanical properties, its use in bamboo-reinforced concrete is an ill-considered concept, having significant durability, strength and stiff- ness issues, and does not meet the environmentally friendly credentials often attributed to it.

Introduction:

The mechanical properties of bamboo and its avail- ability in developing regions has led to its empirical use as reinforcement in concrete structures. The proposition of its widespread use as a sustainable alternative to steel in reinforced concrete structures, poses key questions to builders, engineers and researchers with regards to its structural capacity and compatibility, as well as constructability and sustain- ability issues. This paper discusses these issues, providing a holistic review of the literature in the field and a structural comparison between steel reinforcement and bamboo reinforcement in a typical concrete structure. The principle scope of this review is intentionally limited to the use of small diameter whole-culm (bars) and/or split (a.k.a. splints or round strips) bamboo. Recent advances in bamboo-compos- ite materials may represent a viable bamboo-based concrete reinforcing product that will be only briefly discussed in this paper. Other applications of bamboo- derived materials in concrete structures such as bahareque construction, bamboo fibre reinforcement and bamboo ash admixtures are beyond the scope of this discussion.

Bamboo is frequently referred as a highly renew- able and high-strength alternative material to timber and, occasionally as a 'strong-as-steel' reinforcement for concrete. The high rate of biomass production and renewability of sustainably managed bamboo planta- tions are undeniably key benefits of bamboo. Nonethe- less, favourable comparison with steel, in terms of strength, is not valid. In a dry state, bamboo charac- teristic strengths are, at best, comparable to that of high-grade hardwood—between 30 MPa (Oak) and 50 MPa (American White Oak) . Bamboo is a typically hollow, anisotropic, natural material with high variability of physical and mechanical properties across the section and along the culm. The density of bamboo varies through the cross section (from the inner culm wall to the outer), with typical values ranging from 500 to 800 kg/m^3. In longitudinal tension-dominated failure modes, bamboo typically exhibits a brittle behaviour. The variability of longi- tudinal mechanical properties of bamboo are similar to those of wood, having coefficients of variance between 10 and 30% . Due to the absence of radial fibres, however, bamboo is particularly weak in the direction perpendicular to the fibres, making it especially susceptible to longitudinal shear and trans- verse tension and compression failures. Steel, on the other hand, is a man-made, isotropic and ductile material having a density of 7800 kg/m^3 and a tensile yield strength of conventional reinforcing bars between 400 and 550 MPa. Additionally, steel is easily shaped to optimize its mechanical efficiency, requiring relatively little material to resist loads in a predictable manner. Such optimization is not easily accomplished with bamboo without substantial pro- cessing, altering its properties and nature. The oft-repeated claim that bamboo is 'the green steel' is founded in comparable-to-mild-steel.

values of strength and specific modulus. Some tests of small 'clear' (i.e., defect free) specimens of bamboo have reported ultimate tensile strengths on the order of 250 MPa. However, such results are not representative of the strength that can be mobilised in a full or partial culm: characteristic strength on the order of 40 MPa and safe working stress for design on the order of 16 MPa— similar to hardwood timber. The tensile modulus of bamboo is on the order of 20 GPa , about 10% of that of steel. The specific modulus—the ratio of elastic modulus per unit density—for bamboo in the longitudinal direction is approximately 25 9 10^6 m^2/s^2; a value comparable to both steel and Douglas Fir.

However, unlike steel, the highly anisotropic nature of bamboo results in a specific modulus in the transverse or tangential directions barely a tenth of the longitudinal value; values comparable to nylon and poly- styrene. Thus, the mechanical properties of bamboo and its appropriateness for structural applications are often misunderstood. On the other hand, when com- paring embodied energy and CO_2 footprint during manufacturing of bamboo and steel, a strong argument can be made in favour of bamboo. The embodied energy of medium carbon steel is about 29–35 MJ/kg, while for bamboo culms this value is about 4–6 MJ/kg Similarly, the carbon footprint of steel is significantly greater than that of bamboo, with 2.2–2.8 $kgCO_2/kg$ (equivalent kg of CO_2 per kg of material) for medium carbon steel and 0.25 $kgCO_2/kg$ for bamboo .

Mechanics and behaviour of reinforced concrete

Reinforced concrete is a composite material. Design of simple concrete cross sections is based on Bernoulli beam theory simultaneously satisfying conditions of equilibrium and strain compatibility. Equilibrium requires only knowledge of the concrete and reinforcing material constituent behaviours (modulus and strength). Strain compatibility requires bond between the concrete and reinforcing material to be maintained. Bond of non-prestressed reinforcing elements (bars) to concrete is primarily mechanical (through interlock with the surrounding concrete). Plain (undeformed) bars exhibit limited friction-induced bond. Any chemical bond between bar and concrete is rapidly

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HYPERLOOP: FUTURE OF TRANSPORTATION

By – ABIR BARAN PAL

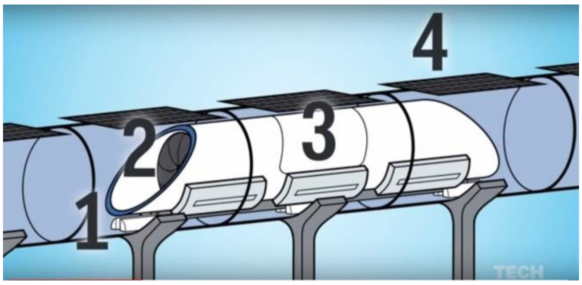
(Lecturer Civil Engineering Department)

Abstract

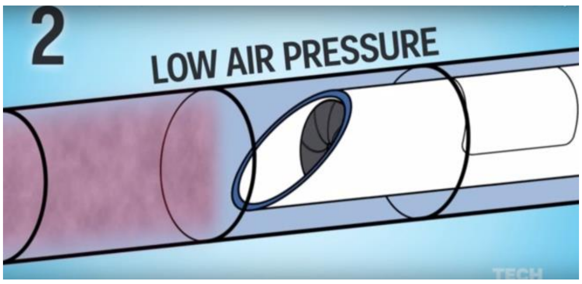
Hyperloop is basically a transportation system via pods which is similar to a railway transportation system, but the time taken to travel from one place to another is very minimum. First proposed by Elon Musk, the theoretical transportation system we call hyperloop would propel people- or cargo-filled pods over long distances through steel tubes. Magnetic levitation and big vacuum pumps would do away with pesky friction and air resistance, letting those bus-sized vehicles zip along at tremendous speeds. It wouldn't just be fast, the developers say: Hyperloop could be cheaper and better for the environment than the planes, trains, and cars.

How does it work?

Hyperloop has four key features:



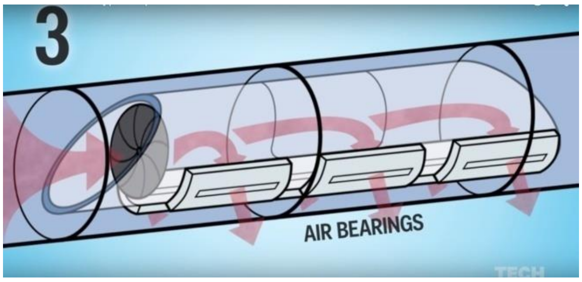
1) The passenger capsules aren't propelled by air pressure like in vacuum tubes, but by two electromagnetic motors. It is aimed to travel at a top speed of 760 miles per hour.

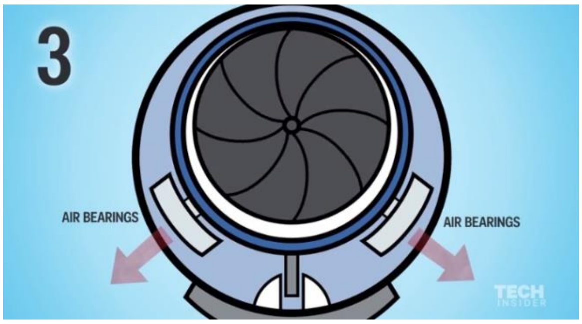


2) The tube tracks do have a vacuum, but not completely free of air. Instead, they have low pressure air inside of them.

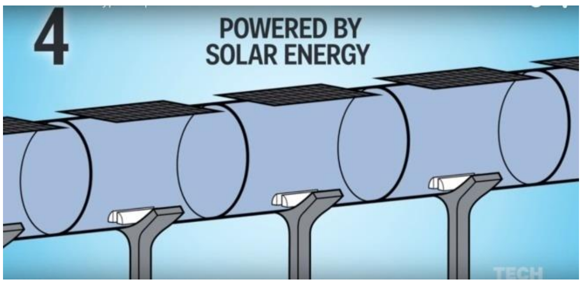
Most things moving through air tubes will end up compressing the air in the front thus, providing a cushion of air that slows the object down. But the hyperloop will feature a compressor fan in the front of the capsule. The compressor fan can redirect air to the back of the capsule.

3) Air bearings are ski like paddles that levitate the capsules above the surface of the tube to reduce friction.





4) The tube track is designed to be immune to weather and earthquakes. They are also designed to be self-powering and unobsrtuctive. The pillars that rise the tube above the ground have a small foot-print that can sway in the case of an earthquake. Each of the tube sections can move around flexibly of the train ships because there isn't a constant track that capsules rely on.

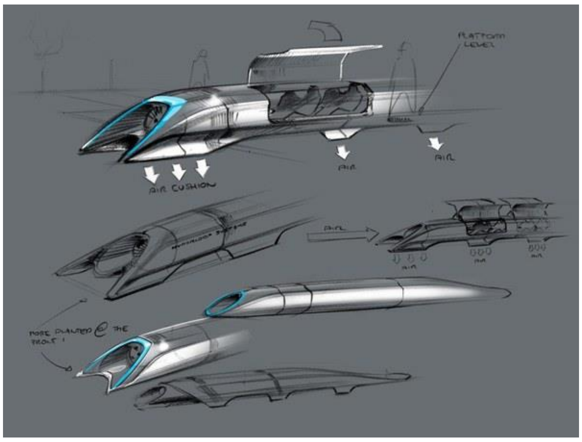


Other than that solar panels on the top the track supply power to the periodic motors.

Inception & Brief History

The tubular tizzy started in 2012, when Tesla and SpaceX CEO Elon Musk suggested The Hyperloop as a new form of transportation, one that would be twice as fast as a plane and totally solar powered. He didn't offer any engineering specifics at the time, but in

August 2013 he produced a 57-page white paper that outlined his technical thinking for how this system would work.



Original sketch from Mr. Musk's Paper

At its core, hyperloop is all about removing the two things that slow down regular vehicles: friction and air resistance. To do away with the former, you make the pod hover above its track, like a magnetic levitation train. Musk originally suggested doing this with air bearings, little jets of air on the bottom of the pod. Think of air hockey, he said, but where the air comes out of the puck instead of the table. Today, most hyperloop engineers have decided instead to rely on passive magnetic levitation. Where standard maglev systems are power hungry and expensive, this system uses an array of permanent magnets on the vehicle. When those magnets move over conductive arrays in the track, they create a magnetic field that pushes the pod up, no current required. A complementary magnet system (think of two magnets pushing off one another) would give the pods a push every few miles or so—the near total lack of friction and air resistance means you don't need a constant propulsion system.

As for air resistance, that's where the tube comes in. (Yes, tubes also just feel like the future, but that's not the point.) The tubes enclose the space through which the pods move, so you can use vacuums to hoover out nearly all the air—leaving so little that the physics are like being at an altitude of 200,000 feet. And so, like a cruising airplane, a hyperloop needs only a little bit of energy to maintain the pods' speed, because there's less stuff to push through. More speed with less power gets you to where you're going faster, greener, and—depending on energy costs—maybe cheaper too.

After explaining all this, Musk said he was too busy to build the thing himself. He was running both Tesla and SpaceX and didn't have time to remake yet another industry. So he encouraged anyone interested to have a go. Let there be hyperloop, he said.

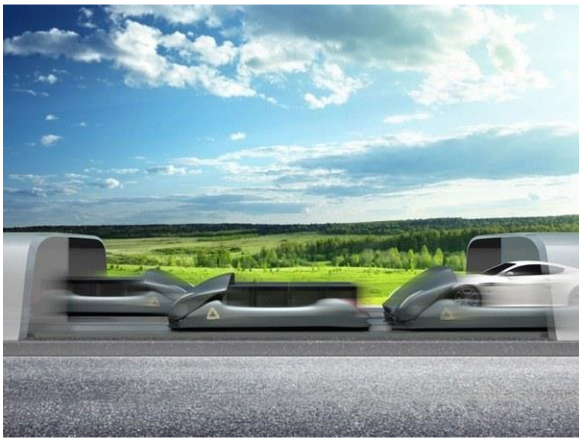
And there was hyperloop. Well, a hyperloop industry, anyway. Soon after Musk's paper hit the internet, a handful of companies sprung up, bringing together engineers and VC money to solve the problems for real. From the beginning, LA-based Virgin Hyperloop One has appeared to be the most serious contender, with serious VC backing, hundreds of employees, a full bank account, and a test track in the Nevada desert where, in December, it sent a pod racing to 240 mph.

Hyperloop Transportation Technologies takes a less built-up approach. Nearly all its engineers have day jobs at other companies (places like Boeing, NASA, and SpaceX). In their free time, they work together, mostly online and in distinct groups, to solve the engineering problems standing between humanity and hyperloop. It has plans to build networks in Central Europe, South Korea, and India. Similarly, there's rLoop, a Reddit-based community of people who study the various engineering problems in the mission of "decentralizing high technology."

Oh, and Elon Musk is back in the game. The hyperloop progenitor started by hosting a series of student engineering competitions, using a short length of tube he built at Space X's headquarters. Then, last summer, he confirmed he wants to build a hyperloop of his own. His plans are particularly vague, but he thinks the tubular system would go great with the tunnels he wants to create using another new venture, the Boring Company.

Benefits and Future Scope

Supporters argue that Hyperloop could be cheaper and faster than trains and car travel, and cheaper and less polluting than air travel. They claim that it is quicker and cheaper to build than traditional high-speed rail; as such, Hyperloop could take the pressure off gridlocked roads, making travel between cities easier and potentially unlocking major economic benefit.



Hyperloop technology is still in development even though the basic concept has been around for many years. At the moment, the earliest any Hyperloop is likely to be up and running is 2021.

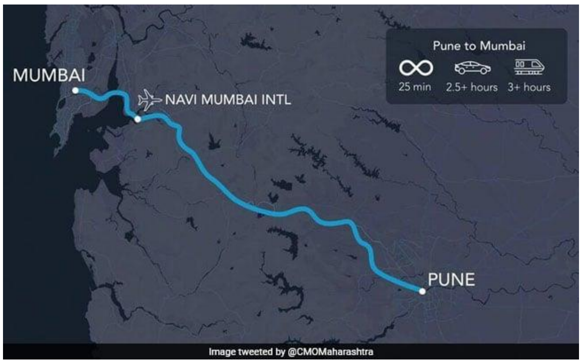
It's still not clear where Hyperloops will actually be established but a number of companies have sketched out routes in the US, Europe, and elsewhere. Potential routes include New York to Washington DC, Pune to Mumbai, Kansas City to St Louis, Bratislava to Brno, Vijaywada and Amaravati, and many more.

Hyperloop In India:

A deal has been signed that paves the way to build what could be the world's first hyperloop track in the Indian state of Maharashtra. The announcement by Virgin Hyperloop One, lays the groundwork for a hyperloop system capable of travelling between the Indian cities of Pune and Mumbai — about 100 miles by road — in 25 minutes.

The hyperloop between Pune and Mumbai would also stop at Navi Mumbai International Airport, and could be used to rapidly move light cargo between the Port of Mumbai and Pune.

The first step under the agreement between Virgin Hyperloop One and the Indian government, announced today by Virgin Hyperloop One chairman



Sir Richard Branson in the presence of Indian Prime Minister Narendra Modi, will be building an operational demonstration track

A study conducted by Virgin Hyperloop One estimated that the Pune-Mumbai route could eventually support 150 million passenger trips each year and over 30 years of operation could result in $55bn (INR 350,000 crores)-worth of socio-economic benefits — via time savings, emissions and accident reduction, and operational cost savings.

The Pune-Mumbai hyperloop project will begin with a six-month in-depth feasibility study, which will analyze and define the route, examining issues such as the environmental impact, economic and commercial aspects, the regulatory framework, and cost and funding model recommendations.

After the public-private partnership for building the track has been established a demonstration track will be built, and is expected to be complete within two-to-three years. The construction of the full route with follow, and is expected to be completed in five-to-seven years.

Future projects could also extend the route to link central Pune with the New Pune International Airport, and Jawaharlal Nehru Port in Mumbai with Pune's industrial economic zones.

NEW DEVEVOLOPEMENTS: ENVIRONMENTALLY FRIENDLY CONCRETE

By – PRIYA PAUL

(Lecturer Civil Engineering Department)

Abstract

A potentially sustainable new form of concrete has been recently created that might make it the most environmentally friendly type of building material.

Concrete in its traditional form is made from cement, mixed with a range of coarse aggregates such as gravel, limestone or granite, and some finer particle aggregates such as sand or fly ash.

These are mixed together with water, to form a quick drying bonded structure, which can easily be manipulated into many forms such as the surface of roads, or driveways or footings for structures. It is the most commonly used building material in the world - some estimate that in the region of 7 cubic kilometres of concrete are manufactured each year, and that there already is 1 cubic metre of concrete for every human on earth.

Unfortunately concrete is not an environmentally friendly material, either to make, or to use, or even to dispose of. To gain the raw materials to make this material, much energy and water must be used, and quarrying for sand and other aggregates causes environmental destruction and pollution.

Concrete is also claimed to be a huge source of carbon emissions into the atmosphere. Some claim that concrete is responsible for up to 5% of the world's total amount of carbon emissions, which contribute to greenhouse gases. This is created in the heat

that is needed to create the raw cement - cement is burnt at high temperatures.

A New Form of an Old Material -

Scientists at a British concrete manufacturer, the London-based Novacem, claim to have developed a new form of concrete that effectively absorbs large amounts of carbon dioxide as it hardens. Novacem's new version of concrete, uses a different raw material, magnesium sulphate, which requires much less heating. Novacem claim that each tonne of cement can absorb up to 0.6 tonnes of CO2. This is opposed to figures that claim that each tonne of old style cement emits about 0.4 tonnes of CO2.

For any building material to actually absorb carbon rather than just emit it in its production, is really a breakthrough, though Novacem admit the material is still in its trial period. The consequences of having an environmentally friendly building material available and on the market for builders to use, and for architects and designers to insist on using in the design of buildings and roads, is immense, and a real development for a sector which has been very guilty of creating carbon emissions through building operations.

The British Cement Association have reacted with some scepticism to Novacem's announcement, stating that they have several non-cement alternatives being tested currently, and that there is little worldwide geological availability of other materials to create such alternative concrete, without the traditional cement. Novacem state that they estimate that there are around 10,000 billion tonnes of magnesium silicates available worldwide, and that their process could use alternative by-products as well that also contain forms of magnesium.

novacem is so confident of the sustainable and carbon negative potential of this new product that they have initiated a 1.5 million pounds pilot plant project in the uk, to further research this new type of concrete, experiment with it and seek the necessary licences to manufacture it. the product itself could be several years away from being available to the building public and the building trade in general, but it does have great potential, and is eagerly awaited.

FINISHING OF CONCRETE SURFACE

Eco Concrete (Reducing The Carbon Footprint) : The cement industry produces a lot of CO_2 (approx 900kg of CO_2 is produced for every 1000kg of cement). In a typical concrete mix their might be around 250kg/m^3 of cement of carbon footprint of around 225kg/m^3. An environmentally friendly concrete by replacing a portion of cement with flyash which lowers the carbon footprint of the concrete by 10-25% on a typical mix. Flyash is a waste product from the coal burning power stations that might otherwise end up in landfills, when added to concrete and in the presence of Portland cement the flyash acts similarly to cement, hardening and gaining strength. Flyash has other benefits in concrete such as making the concrete more creamy and make it easy to place and lowers the water demand of the concrete and improves durability. Eco concrete has same colour as the normal concrete, can be used in exposed, coloured and structural concretes and costs around the same as standard concrete.

ECO FRIENDLY CONCRETE, ACHIEVED BY 25% REDUCTION OF CO_2

ENVIRONMENTAL BENEFITS TO USING GREEN CONCRETE- Green concrete is part of a movement to create construction materials that have a reduced impact on the environment. It is made from a combination of an inorganic polymer and 25 to 100 percent industrial waste. Here is a list of 4 benefits to using green concrete.

Lasts Longer• Green concrete gains strength faster and has a lower rate of shrinkage than concrete made from Portland cement. Structures built using green concrete have a better chance of surviving a fire (it can withstand temperatures of up to 2400 degrees on the Fahrenheit scale). It also has a greater resistance to corrosion which is important with the effect pollution has had on the environment (acid rain greatly reduces the longevity of traditional building materials). All of those factors add up to a building that will last much longer than one made of ordinary concrete.

Uses Industrial Waste• Instead of a 100 percent Portland cement mixture, green concrete uses anywhere from 25 to 100 percent fly ash. Fly ash is a byproduct of coal combustion and is gathered from the chimneys of industrial plants (such as power plants) that use coal as a power source. Hundreds of thousands of acres of land are used to dispose of fly ash. A large increase in the use of green concrete in construction will provide a way to use up fly ash and hopefully free many acres of land.

Reduces Energy Consumption• If you use less Portland cement and more fly ash when mixing concrete, then you will use less energy. The materials that are used in Portland cement require huge amounts of coal or natural gas to heat it up to the appropriate temperature to turn them into Portland cement. Fly ash already exists as a byproduct of another industrial process so you are not expending much more energy to use it to create green concrete. Another way that green concrete reduces energy consumption is that a building constructed from it is more resistant to temperature changes. An architect can use this and design a green concrete building to use energy for heating and cooling more efficiently.

Reduces CO2 Emissions• The manufacturing of green concrete releases has up to 80 percent fewer CO2 emissions. As a part of a global effort to reduce emissions, switching over completely to using green concrete for construction will help considerably.

MATERIAL/PRODUCT SELECTION CRITERIA

Overall material/product selection criteria:

• **Resource Efficiency**: Resource efficiency basically includes properties like recycled content, natural or renewable, resource efficient manufacturing process, locally available, salvaged/refurbished or remanufactured, reusable or recyclable and durability.

• **Indoor Air Quality**: Indoor air quality (IAQ) is enhanced by utilizing materials that meet the following properties: low or non-toxic, minimal chemical emission, moisture resistant and healthfully maintained.

• **Energy Efficiency**: This mainly refers to the energy used for making the concrete. Those materials are preferred that require the minimal amount of energy at the time of construction of the concrete.

• **Water Conservation**: Materials that help us and conserve water in landscaped areas are preferred to be used as construction. Save water at the time of construction or even help reduce water consumption in building materials.

• **Affordability**: Affordability can be considered when building product life-cycle costs are comparable to conventional materials or as a whole, are within a project-defined percentage of the overall budget.

REPLACEMENT MATERIAL FOR GREEN CONCRETE :

Cement is replaced by Municipal Solid Fly Ash, Sludge Fly Ash, Recycled Glass, Silica Fume.

Coarse Aggregates are replaced by recycled aggregate , waste ready-mix concrete, waste glass.

Fine Aggregates are replaced by Fine recycled aggregate, demolished brick, waste quarry dust, marble powder waste.

<u>INDIA'S 'WORST WATER CRISIS IN ITS HISTORY' IS ONLY GOING TO GET WORSE, GOVERNMENT THINK TANK SAYS*BY 2030, THE COUNTRY'S WATER DEMAND IS PROJECTED TO BE TWICE THE AVAILABLE SUPPLY'*</u>

By – SAYANTIKA SAHA

(Lecturer Civil Engineering Department)

Abstract :

India is suffering from the worst water crisis in its history and around 600 million people face a severe water shortage, according to a government think tank.
Approximately 200,000 people die every year due to inadequate access to clean water and it's "only going to get worse" as 21 cities are likely to run out of groundwater by 2020.
In the longer term, the undersupply will become even more acute in the South Asian nation, as demand increases with the 1.4 billion population growing at a rate of around 1 per cent.
"By 2030, the country's water demand is projected to be twice the available supply," the Niti Aayog report reads. "[This will cause] severe water scarcity for hundreds of millions of people."

At least 54 dead in extreme weather across India
"There is an imminent need to deepen our understanding of our water resources and usage and put in place interventions that make our water use efficient and sustainable."
The expected degree of water scarcity will account for a 6 per cent loss in India's gross domestic product.
Indian cities and towns often run out of water throughout the summer due to the absence of infrastructure to deliver piped water to homes.
Sprawling queues for government water tankers and public taps are already a common sight in Indian slums since people are reliant on the service and the impending disaster would leave this provision even more thinly stretched.
Erratic rainfall also causes chaos in rural areas where people are similarly affected by a lack of access to safe water.
Forced to deal with the problem, water-scarce states are the best at managing the resource (AFP)
Groundwater is increasingly used for farming when monsoon rains do not deliver a sufficient level of precipitation meaning there is little to drink. There has been an effort to develop sustainable water supplies in India in recent years with water conservation legislation existing in 80 per cent of the country.
However, poor data management and an abject failure to properly price water has prevented the country from making any significant progress.
"Where data is available, it is often unreliable due to the use of outdated collection techniques and methodologies," according to the report. "For example, groundwater data in India is based on an inadequate sample of around 55,000 wells out of a total approximately 12 million in the country."
In what could serve as encouragement to step up the pursuit of policies to better conserve water, several water-scarce states are the best at managing the resource.

Some of the best performers in the national composite water index – Gujarat, Madhya Pradesh, Andhra Pradesh, Karnataka, Maharashtra, Telangana – are states that have suffered from severe droughts in recent years.
"The action taken by these states, and their subsequent good performance on the index, are likely driven by necessity in the face of looming water shortages," asserts the report.
Other policies, such as the provision of free utilities, have not had the anticipated result.
"Policies like several states giving free electricity to farmers or giving financial support for groundwater extraction – borewells and tubewells – results in uncontrolled exploitation and wastage of resource," Suresh Rohilla, director of urban water management at the Centre for Science and Environment, told CNN.
Drip irrigation, a method that means farmers use drastically less fertiliser and diesel, has failed to become popular and its implementation is expensive for most people with state governments providing limited support.
"Primarily, water is not valued in India. It is very cheap in India," Samrat Basak, director for urban water at the World Resources Institute, told CNN. "People think it is free."
Alarmingly, the states ranked lowest – like Uttar Pradesh, Haryana and Jharkhand – are home to almost half of India's population along with the majority of its agricultural produce.

Water scarcity in India :

It involves water stress, water shortage or deficits, and water crisis. This may be due to both nature and humans. Main factors that contribute to this issue include poor management of resources, lack of government regulation, and man made waste. 8 percent of the world's population which resides in India only has access to 4 percent of usable water sources. Official data in the past decade depicts how annual per capita availability of water in the country has plummeted significantly with 163 million Indians lacking access to safe drinking wate

Causes

The water sources are contaminated with both bio and chemical pollutants. 21% of the country's diseases are water-related with only 33% of the country having access to traditional sanitation. Excessive use of groundwater for agriculture has also caused a strain in the resource. As India is one of the top agriculture producers in the world, the consumption of water for land and crops is also one the highest. The results of the widespread use of ineffective techniques used for irrigation aligned with mismanagement are few of the reasons for the water deficit.

A significant portion of water used for industrial and domestic purposes is waste when returned to the streams. The demand for freshwater is increasing with the growing population, but the decreasing amount of supply fails to meet the needs of the people.The increased amount of solid wastes in water systems such as lakes, canals and rivers also heavily pollute the water. To combat this problem, the government issued the Ganga Action Plan issued in 1984 to clean up the Ganges River. However, much of the river remains polluted with a high coli form count at many places. This is largely due to lack of maintenance of the facilities as well inadequate fees for service. Due to this issue, urgent need for safe drinking water is 70.1% of the households in urban areas. 18.7 % in rural received organized pipe water supply and others have to depend on surface and ground water which is untreated.

Freshwater deficit :

Along with the strain on surface water, the country is also facing great stress with freshwater. Lack of strict state regulation on ground water development has caused a strain on the amount of freshwater available. Indifference from bureaucratic powers and constant neglect has caused the problem to intensify. In hand with the lack of government interference and continued industrial waste deposited into major rivers, most freshwater entering the bodies of water is defiled. The approximation of the untreated water entering the water sources such as rivers and lakes is 90 percent and only furthers the problem.

Impact on cities

In 2016, the city of Latur experienced a great water shortage. Much of the farming industry came to a halt and created both food insecurity and massive unemployment. Much of the local economy and farming regions nearly collapsed with the citizens having no choice but to use the polluted water.

Raising awareness :

The Canadian start-up Decode Global has developed the mobile game ***Get Water!***, a game for social change focusing on the water scarcity in India and the effect it has on girls' education. The game's primary goal is to raise awareness of the water crisis, by educating children as well as adult gamers. To put more focus on children'd learning, the company has published a 6-part lesson plan for 4-6 grade teachers, available for download as a pdf from the game's website.

Utilization of ground water

The Central Ground Water Authority (CGWA) has notified 82 areas (Districts, Blocks, Mandals, Talukas, Municipalities) for regulation of **ground water** development. In these areas, installation of new ground water abstraction structures is not permitted without prior specific approval of the Authority / Authorized officer. Moreover, proposals for setting up/expansion of ground water based industries including bottled water manufacturing units are forwarded by State Pollution Control Boards and **Bureau of Indian Standards** to CGWA for seeking No Objection Certificate (NOC) for ground water withdrawal. NOC is not accorded to such industries including bottled water manufacturing units p as notified by the Authority. In non-notified areas, NOC is issued with mandatory pre-conditions of adoption of rain water harvesting system, monitoring of ground water abstraction as well as monitoring of ground water level and quality etc. by the industry. For enforcement of the regulatory directions issued under Section 5 of Environment (Protection) Act,1986, concerned.

Deputy Commissioners/District Collectors have been authorized to take necessary action in case of violations of directives of CGWA in the notified areas.

According to Indian government report, warns that 21 cities will run out a groundwater by years of 2020.

Rainwater harvesting – Rain water is accumulated and used for ground water recharge. This increase the ground water availability**.**

Farm pond – Farm ponds are constructed near the farming field. The rain water which runs off the ground are collected by these ponds. These pond helps agriculture in dry lands.

COST CONTROL TECHNIQUES FOR CONSTRUCTION PROJECT

By – RAJA SAHA

(Lecturer Civil Engineering Department)

Abstract –

Today due the increasing the population space required for living to human being is decreases so need to build-up high rise structure, budget required for construction of high rise structure in too much. For high rise structure first of all to calculate the cost required from drawings. The cost required for construction is more that time need to reduces the cost by using various methods and techniques. In this research the cost of construction of residential building is reduced by using alternative material as well as to reducing the reactive accident which is reduces the cost of project work. At the time of construction of building think on the important issues like same project work done in past mean that to avoid the proactive accident done on same project. In this project the cost is controlled by reducing the wastage at the time of construction such as material waste (bricks, concrete and wood) , insulation nails, electrical wiring, etc.

***Key Words*: Cost planning, Cost plan accuracy management, Cost control, Cost reduction, Budget**

1. INTRODUCTION

1.1 Importance of cost planning and cost control

Now days in construction sector the main objective is the reduce the cost of project or the control the cost of work and the finish the project work within the duration of project hence we can reduces the cost of project. The cost plan is useful for the controlling the estimated cost of project during the construction and the design phase of work. The success of the construction project or the construction sector is depends on the how the management reduces the cost of the work. The management of inventory like material management, scheduling, avoiding cost overrun, etc., the management of project work is doing in systematically means according to the day by day activity that time it is easy to understand and easy to obey, then time required for the understanding the activity and it's time period is less so due to this project is completed within the duration that time there are a lot of chances to control the cost of project. The cost plan is provided one type of cost framework and it's make sure about the project is within the budget or not. The cost planning is done according to the architectural drawings, as well as market rate of material, labour, equipment, etc.

1.2 Concept of cost planning and control

1) Cost Planning: Cost planning is the process of management looks for the control the design and development with the buyer's budget. This help to buyer for choose the how he/she wants to issue the budget to the different types of part of project work, and it is used for representational cost plan for project. The project planning is providing the cost structure of the work. It is useful for the deciding the cost of project or the budget of project and the activity of element construction work as well as the duration of project work.

2) Cost control: Cost control is the process of reducing the project budget by using various techniques and by replacing the alternative material which help to reduce the cost of project. The cost is controlled by using the past construction information and reducing the wastage of material, extra equipment as well as the using the alternative material by replacing costly material for construction. The main aim of cost control is the gain maximum profit within the decided project duration.

1.3 Problem statement

In construction sector it is usually the actual cost of project work is more than estimated cost. This type problem need to proper management, planning and control the work to resolve this type of problem, so the cost of work can control by the replacing the material by alternative material and reduces the proactive and reactive accident.

1.4 Objective for the project work

The objective for the project is the control the cost of project by replacing the alternative material and the avoiding the proactive as well as reactive accident at construction site.

1.5 Description of project work

The project work choose for the study is the residential building ‘Pride Ashiyana’ it is the suburban area of Dhanori situated near to lohegaon, Pune. It offers 548 apartments covering the total area of 10 acres; this is only for the second phase of construction of project.

2. LITERATURE REVIEW

2.1 Background for the study

Layer et al. (2002) found the three different kinds of estimation calculations within the production process, along with a diagram representing the concept of determining costs. Pre-calculation estimates the future costs before start of production and used for cost based decision making as well as intermediate calculations are performed within the project for the purposes of control the cost.

Most of the problems on building sites are the wastage of material due to the varying circumstances (Butler 1982).This type of problem need to strict supervision on the losses. According to the Hendrickson (1988), the wastage of material takes place within the procurement process, storage and uses i.e. the damage due to the unnecessary handling, transportation etc. According to Chitkara (2005) some of unavoidable wastage is inherent during utilization, but excessive wastage of concern to the material management and it affects productivity adversely, with consequences of extra cost. Alinaitwe (2006) observed that construction of industrializing would probably reduce the cost of construction by about 30% which would likely settle the back log of 25% of Ugandans without proper housing.

Chitkara (2005) said the relationship between the time and cost is very important for the control the cost of project. It is important to keep record and daily report of all work involving material, labour and plant on sites daily diary report and the project budget. Labour productivity achieved at the construction site for given task provides a measure of laborer’s efficiency and the level of site organization. it shows the total time for which labour was employed at work, the time he was productive on work and the time he remained unproductive (Chitkara 2005).

3. RESEARCH METHODOLOGY

3.1. Introduction

For this project the cost is controlled by replacing the alternative material which can help to control the cost of construction as well as the maintain the quality of construction.

Cost control techniques

In this research the cost is controlled by avoiding the reactive and proactive accident.

1. The proactive accident which avoids at the time of construction which given bellow:

- Create the safety plan specific to the project and site.
- Training should be provided ongoing activity of project to all employees.

After updating day to day progress report up to Do not allow the work to resume until the issue has been adequately addressed.

- Monitor, evaluate and adjust. As work progresses, conditions changed drastically from one day to next day.

2. The reactive accident which avoids at construction site as bellow:

   - The worker not wearing the proper protective aprons for job.
   - A worker not following the rules and regulation.

Cost is controlled by using alternative material

The material which is replaced by using alternative material which is save the profit and maintain the quality.

The material which is replaced is given in table.

Element	Alternatives	Alternative chosen	Justification
Window	Glass louvered aluminum frame, Glass casement	Powder Coated Aluminum	Preserve the cool air, lower electricity consumption; longer machine life.
Floor	Parquet, cement sand screed, polyvinyl plastic terrazzo, ceramic tiles	Terrazzo ceramic tiles	Durable withstands moisture, abrasion resistant, easy to clean.
External render	Tyrolean render, emulsion paint	Special weather resistant paint	Resist mould attack which is common in the locality.
Plumbing and Eng. Install	Vary	Grouping of pipes on one stake	Easy maintenance

4. CONCLUSIONS

This project of residential building is accomplished as per planning, estimating and controlling. Total cost of project can be calculated in feasibility; even in case of knowing the constructional area that time it's easy to calculate.

As per planned:

Project duration=550days

Planned budget of project=555,972,500

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