JAMIA MILLIA ISLAMIA

Jamia was established in 1920 by a group of nationalist Muslim intelligentsia at Aligarh, Uttar Pradesh during the khilafat and Non-Cooperation Movement in response to Gandhiji's cell to boycott government-supported educational institutions. Among those who enthusiastically responded to this call were Shaikhul Hind Maulana Mahmud Hasan, Maulana Mohammed Ali Jauhar, Hakin Ajmal Khan, Dr. Mukhtar Ahmad Ansari, Abdul Majeed Khwaja and Dr. Zakir Husain and others. In 1925, its campus shifted from Aligarh to Delhi and the foundation stone of the present campus was laid on 1st March 1930. Since then, it has been continuously growing, always refurbishing its methods and branching out from time to time to meet new needs. True to the ideals of its founders, it has, over the years, tried to enhance the physical and mental development of its students, and has become known as a premier educational institution of the country. Recognizing its contributions in the field of teaching, research and extension work Jamia Millia Islamia was declared a Deemed University under Section 2 of University Grants Commission (UGC) Act in 1962. Jamia was declared a Central University, as per Jamia Millia Islamia Act 1988, which was passed by the Parliament on 26th December 1988.

Jamia Millia Islamia is an ensemble of a multi layered educational system which covers all aspects of schooling, undergraduate and postgraduate education and research. The University recognizes that teaching and research are complementary activities that can advance its long-term interests. It has Natural Sciences, Social Sciences, Engineering & Technology, Education, Humanities & Languages, Architecture & Ekistics, Fine Arts, Law and Dentistry Faculties. It also has the well-known Centre namely the AJK Mass Communication Research Centre besides several other research Centers that have given an edge to Jamia in terms of critical research and programmes that can offer opportunities to its students and teachers to expand their horizons. Jamia Millia Islamia conducts Undergraduate, Postgraduate, M. Phil. and Ph.D. as well as Diploma and Certificate courses.Jamia Millia Islamia has been declared a "Minority Institution" by National Commission for Minority Educational Institutions on February 22, 2011 under Article 30 (1) of the Constitution of India read with Section 2 (G) of the National Commission for Minorites Institutions Act.

जामिया मिल्लिया इस्लामिया
(केन्द्रीय विश्वविद्यालय)
मौलाना मोहम्मद अली जौहर मार्ग, नई दिल्ली-११००२५

JAMIA MILLIA ISLAMIA
(Central University)
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(ACCREDITED "A" GRADE BY NAAC)

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प्रोफेसर नजमा अख़्तर
कुलपति

Professor Najma Akhtar
Vice Chancellor

پروفیسر نجمہ اختر
شیخ الجامعہ

Vice Chancellor's Message

It gives me immense pleasure to present, TA'MEER, a magazine brought out by Department of Civil Engineering, Jamia Millia Islamia. It opens a window of opportunity for the students to express their creativity, perceptions, innovations and scholarly appreciation of innovative activities and works, enumerating the impressive strides made by Department of Civil Engineering. It aspires to showcase the latest growth, development and innovations, engaging the students pursuing their curriculum, researches and investigations, reflecting the ethos and aspirations of Department of Civil Engineering, its students and faculty members.

With its spectacular performance in NIRF Rankings, Jamia Millia Islamia figures among top six Universities of India. It has been providing accessible and affordable quality education since its inception. Committed to delivering the best experiential education and keeping abreast of changing trends and paradigm shift in pedagogy, technology and innovation, it fosters creativity, inspires critical thinking and pursuit of excellence.

I congratulate the Head, Department of Civil Engineering, the Editor, editorial team, students and faculty members on bringing out such a wonderful issue of TA'MEER.

Wishing a resounding success!

Najma Akhtar

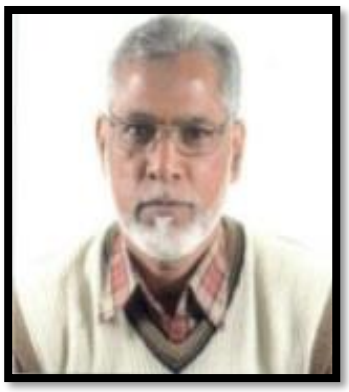
(Prof Najma Akhtar)

Message from Dean

Prof. Ibraheem

Nurturing creativity and inspiring innovation are two of the key elements of a successful education, and a civil engineering department magazine is the perfect amalgamation of both. It gives me great pleasure to know that ‘TAMEER’ is a college magazine of 2021 is ready for publication. The Title of the magazine 'TAMEER' may seem difficult; but it just means "to construct"; a clear vision of civil engineers.

I take this opportunity to congratulate the editorial board for bringing out this magazine as per schedule, which in itself is an achievement considering the effort and time required. May all our students soar high in uncharted skies and bring glory to the world and their profession with the wings of education.



Message from Head of Department

Prof. Shamshad Ahmad

To encourage creativity and innovation among the students has always been a foremost objective of the department. The departmental magazine provides the students a platform to share their creative ideas in the form of articles with fellow students and faculty members. Tameer, the departmental magazine of students, has gained popularity among the students and faculty because of its thought provoking and analytical articles.

I convey my best wishes for the current issue of Tameer. I also congratulate the editorial board of Tameer for publishing the magazine for last five years on a regular basis.

Message from Editor

Prof. Nazrul Islam

I take this opportunity to congratulate the students of civil engineering department for bringing out this magazine and contributing the technical articles with great enthusiasm. The area of civil engineering deals with several aspects of human civilization and its development. The "TAMEER", a civil engineering magazine harness the creative energy of academic community and distils the essence of their inspired imagination in the most brilliant way possible. Hence it gives me immense pleasure to bring out "TAMEER" 2021 a civil engineering magazine. A special thanks to honorable vice chancellor and Jamia administration for their encouragement and support. Also, I would like to thank all my research scholars and my colleagues.

About Civil Engineering Department

Department of Civil Engineering the Department of Civil Engineering (DCE) offers two undergraduate courses in Civil Engineering and Master's program with specializations in Environmental Engineering and Earthquake Engineering. More than 80 Ph. D. scholars including foreign students from different countries are currently working in the Department on emerging research areas. DCE also renders technical advice to various Government and Private Sector companies on consultancy basis. DCE has many collaboration programs with foreign universities including University of Applied Sciences, Erfurt, Germany; Wessex Institute, UK; University of Waterloo, Canada; Asian Institute of Technology, Bangkok. DCE regularly organizes international and national conferences, seminars and workshops on current themes. This international conference is a sequel to the earlier conferences held on the themes of sustainability and development and is an endeavor of the DCE to focus on the emerging areas of smart city development.

Today, Jamia Millia Islamia is "A" grade Central University accredited by NAAC. Jamia Millia Islamia Continues to cater to the interests of students from all communities, but also aims to meet the particular needs of the disadvantaged sections of the Muslim society. True to the legacy of its founders, it continues to support measures for affirmative action and foster the goals of building a secular and modern system of integrated education.

Road Infrastructure: A Way to Prosperity

Mohd Azam Khan

It was the year 1927 when the foundation of Indian Road Congress was laid down by the British Indian rule. slowly but steadily with the collective efforts of government along with private players independent India has traveled from the muddy and gravely roads to the magnificent signature bridge (of wazirabad) and giant expressway (like recently inaugurated Purvanchal and Yamuna expressway) and much more.

Though the network in India has increased from 3.99 lakh kilometers in 1951 to more than 6 million kilometers at present. In modern society road infrastructure has become an indispensable part of daily life. Individual road users along with logistic firms and public transport agencies expect reliable and safest road infra for transporting goods and people from one location to other. Road agencies need to properly plan, build, and maintain along with operation to create high value for commuters. Recent development includes the performance measures to evaluate the efficiency and effectiveness of the service and to make the structures disaster resilient as also pushed by the government in its Coalition for Disaster resilient Infrastructure (CDRI) initiative.

Signature bridge: an Icon

Bridges play a key role in infrastructure development and can become an important landmark for a city or a region at the same time. One such bridge is the "Signature Bridge" in Wazirabad, Delhi (fig 1.1) , which is a new landmark while helping to channel traffic flows. India's first signature bridge being constructed across the Yamuna River at Wazirabad, promises to be a great attraction of New Delhi. An ambitious project of the Delhi Tourism & Transport Development Corporation.

The area around the bridge will later be developed based on the concept of the architect Ratan J. Batliboi into a park and the Yamuna River will be widened to lakelike dimensions. Therefore, the client had asked for a rather long span but light-weight bridge and a design which could become one of the area's attractions.

This bridge is an unsymmetric cable-stayed bridge with a main span of 251 meters and total length of 675 meters, the bridge's composite deck carries 8 lanes (4 in each direction). It is about 35m wide and is supported by lateral cables spaced at 13.5 meters intervals. The height of the steel tower is approximately 150 meters.

The pylon consists of several legs made of steel boxes fusing into one upper pylon zone in which the cables connecting the main span as well as the backstays are supported and connected. As this is the first of its kind but as the need of roads for logistics as well as aesthetic purpose is increasing day by day more of these structure which will be designated as the signature of a city come into existence.

Expressways: Pathways to future

The superhighways free of steep grades, sharp curves, frequent and arbitrary entry/exit points with Magnificent span and width represents the expressway on which a spectacular speed can be achieved. They have lots of advantages like high speed, greater safety, comfort and convenience for drivers and passengers. Along with benefits expressways also brought some pains due to high speeds and foggy roads in winter especially so many commuters lost their lives.

Among the so many examples of expressways and super highways. The Yamuna expressway and recently inaugurated Purvanchal expressway needs special mention. A 6 lane and 165.5 km long access controlled highway connecting pari chowk in Greater Noida with kuberbur in Agra built by Utter Pradesh government in 2012 is known as Yamuna expressway. It was the one of its kind at that time and reduced the travel time between the heritage city of Agra and capital city New Delhi to 3 hrs. Now the significance of Yamuna expressway will be enhanced with the construction of Jewar International Airport, the world's fourth largest airport. It will surve the crores of people in cities including Delhi, Noida, Ghaziabad, Aligarh, Agra and Faridabad.

Next in line is The Purvanchal Expressway which traverse the 340.8 km long distance with its 6 wide lanes. It covers the development hungry area of purvanchal by connecting the Gosainganj in Lucknow with Haydariya village in Ghazipur district. This expressway also has some spectacular features like inbuilt air strip which can be used in case of emergencies and on demand. During inauguration the Prime Minister of India landed at airstrip in a C-130 Hercules plane. There are 18 flyovers, seven railways over bridges, seven long bridges, 104 minor bridges, 13 interchanges and 271 underpasses on the highway.

As the main purpose of constructing big highways is to decongest the older routes and make the commutation faster and economical. But in terms of Logistics Performance India stands at 44th rank in the World Banks Logistics Performance Index. As far as the regional disparity is concern the Gujarat retains a top slot on logistics performance index. However, the states like north eastern and eastern states are not performing well.

To make use of existing infrastructure and building new one, active push from the sides of different governments and other stakeholders is required. By keeping in mind the socio-economic differences of the regions. Spending on Research and Developments must needs to be enhanced. Multimodal projects will play a special role in linking the best of different modes of transportation.

The global spectacular projects should be keenly observed so that we can train our engineers to execute world's best infra projects. Public Private Partnership should be given push so that financial crunch can be addressed by keeping in mind the exploitative side of privatisation and finally the collective efforts of governments, engineering communities, MNCs and other big players should be ensured so that India can traverse the way to prosperity.

Act of GOD or ill-Will of Man?

Manish Sharma

A natural disaster also known as 'Act-Of-God' is not the only one which turns down the happy faces.

The severity of destruction caused by a natural disaster emerges a day after it has ravaged. The reason of grief does not only extend from the fact that we are unaffected by people dying in some remote corner of the world while we are safely twiddling with a remote control in our comfortable recliner but also stems from the notion that people are willing to feast on the aftermath of it as well. "It's difficult to read a book close to your eyes", the sentence can aptly be exemplified by a man's action. We talk of satellites, Galaxies, and life on Mars, when we don't even give importance to thousands of lives forfeited in natural disasters.

Albert Einstein once said: "The true sign of intelligence is not knowledge but imagination."

Even a toddler knows that he has to clear the mess he has created (to avoid a good thrashing of course) but we are always a step behind. We do know accurately that we are a partly the reason for the occurrence of natural calamities, however our efforts to thwart the same are rather naïve and slim.

Imagine a scenario of sky-high structures with their frontages knocked out as if pounded by mortars, and plethora of rubble and dead strewn all over the roads, where electricity and cell-phone towers have been flattened all over, hospitals packed with people and essentials like food and water have become pricier than gold and transportation cost is inching closer by every penny to the air travel cost.

I am sure it has melted your heart, but some seek an opportunity even in such tragedies. So far mankind has been a victim of the worst kinds of destruction caused by nature. But what really destroys mankind is its hunger, unquenchable and unbeatable. As if the mess and destruction caused by the calamity itself is insufficient, even then shoplifters feast on the aftermath.

A research division on disaster management with umpteen scholars doing Ph.D. and a whole department dedicated to manage disasters is present in our government and yet here we stand dubious of our future. After any calamity, we often hear about several rescue campaigns. The newspapers are flooded with articles on political statements by our government leaders, their tours, their promises on the evacuation and sustenance aids, and even more so on rewards for lamenting the dead. Then amongst the plethora of havoc, the aids announced by the government first satisfy the hungers of middle-men and the small politicians, the kin of the victim has to fill hundreds of forms and 20 rounds of the authority office.

A ‘Noah’ with his great arc would come for our rescue or not is uncertain but a serious, well-planned, well-structured, and duly executed disaster management technique and technology is needed at this great hour of need. Preparedness, response, and recovery needs to be embedded in systems designed for disaster management. With satellite technology literally reaching sky-limits we have the power and means to achieve anything, the thing only required is the well depicted ‘Hinoishi’ in literal arts. It means the will of fire, strong and kind that burns away every last bit of evil from a tree and from which new buds of flowers can grow again.

Technology can play a multivariate role in this context –

Early warning and disaster preparedness

Search and rescue of disaster survivors

Energy and power supply

Food supply, storage, and safety

Water supply, purification, and treatment

Medicine and healthcare for disaster victims

Sanitation and waste management in disaster mitigation

Disaster-resistant housing and construction

Emerging technologies is striving to make streetlights with wireless technology to provide detection of rising floodwaters and even display the evacuation route. It was invented as a response to the chaos created at the streets during 9/11 said Harwood, president of ‘Intellistreets’. IDAWG— Intelligent Deployable Augmented Wireless Gateway During an emergency communication between victim and authorities or even both victims is both necessary and difficult. Much research and effort is going on to develop a device that will maintain communication between different devices without relying on cell towers or Internet networks. Merely reading and pondering cannot save lives, we have to act now.

After all Life is precious.

A Study on High Performance Concrete

Mohammed Arham Siddiqui

Advances in civil engineering constructions tends to progress towards more economical design and construction through improved methods of design and use of high strength materials. Conventional concrete which is designed only to fulfil the compressive strength requirements of a structure do not provide other functional requirements as it is not found sufficient in Challenging surroundings, energy absorption capacity, construction duration, repair and retrofitting jobs, and so on are all factors to consider and loses its tensile resistance after the formation of multiple cracks. Hence, it becomes a necessity to design high performance concrete which will be far more superior to its precursor, although basic component for both the concrete remain the same. High strength concrete aims at enhancing strength and various other advantages that are a direct result of improved strength, the term high performance concrete is used to refer to a concrete of required performance for the majority of construction applications. The American Concrete Committee on HPC held by American concrete institute (ACI) adheres to the following six criteria such as ease of placement, long-term mechanical properties, early-age strength, toughness, life under severe environments, and volume stability for material selections, mixing, placing, and curing procedures for concrete.

Lack of adequate HPC provisions in various national codes of practice is a major obstacle to its widespread use. HPC is a concrete in which certain characteristics are developed for a particular application and environment, so that it will give excellent performance in the structure in which it will be placed, in the environment to which it will be exposed to, and with the various kinds of loads (dead, live, wind, earthquake) to which it will be subjected during its design life. It may also include concrete, which significantly reduces construction time without compromising future serviceability.

In recent years, improvements in concrete properties have been achieved and it is called high performance concrete by improvements involving a combination of improved compaction, improved paste characteristics and aggregate matrix bond and reduced porosity. In this a substantial reduction in water-to-cement ratio is achieved through the use of superplasticizers, further some of the properties have been achieved through the addition of minerals micro fillers (cementitious materials such as silica fumes and fly ash).

AN OVERVIEW OF HIGH-PERFORMANCE CONCRETE

Though there are many definitions for high performance concrete (HPC), the most widely accepted one is that given by the American concrete institute (ACI), which states “High performance concrete is concrete that meets special performance, add uniformity requirements that cannot always be achieved routinely by using only conventional materials and normal mixing, placing and curing practices.” It is therefore, impossible to offer a singular definition of HPC without considering the high-performance requirements of the intended use of concrete.

FEATURES OF HPC

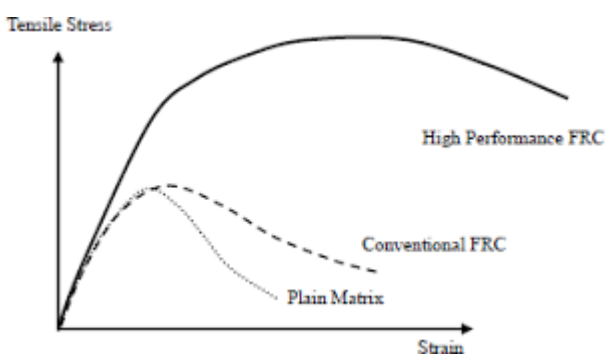
In terms of performance HPC should triumph normal strength concrete. The most important features that a construction material should have are good strength, ductility and durability and these are some of the basic features that high performance concrete possesses.

Strength

Concrete with a compressive strength less than 50 MPa is regarded as normal strength concrete (NSC), while high strength concrete (HSC) may be defined as that having a compressive strength of a about 50 MPa. Recently, concrete with compressive strength of more than 200 MPa has been achieved. This concrete is known as ultra-high strength concrete. In general, the addition of admixture not only significantly improves the concrete strength but it also enhances the other aspects of performance such as ductility and durability which are equally important in terms of performance. Thus, the characteristics of HSC are very similar to that of HPC.

Ductility

When high strength is the primary criteria, high performance concrete is more brittle than regular strength concrete. The ductility of HPC can be considerably increased by applying confining pressure to it. Besides applying confining pressure, the ductility of HPC can be improved by altering its composition through the addition of fiber in the design mix. Concrete with fiber inside is regarded as fiber reinforced concrete (FRC). Due to the tensile response the mechanical behavior of FRC can be categorized into two classes. When compared to the plain matrix, conventional FRC formed by adding fibers in NSC only shows an increase in ductility, whereas high performance FRC formed by adding fibers in NSC only shows an increase in ductility in HPC shows a significant strain hardening type of response, resulting in a large improvement in both strength and toughness. Owing to the improvement in terms of ductility high performance FRC is referred to as ultra-ductile concrete. Mechanical behavior of FRC in comparison to plain matrix is shown below



Durability

Permeability of concrete has a great influence on the durability of concrete. Concrete permeability is highly dependent on permeability of each constituent material and their geometrical arrangement. The permeability of cement paste is primarily related to pore structure, which includes porosity, pore size and connectivity, while poor structure is a function of the what is the cement ratio and the degree of hydration. The aggregates have a lower permeability as compared to cement pastes. In consideration of the durability characteristics of high-performance concrete, three criteria may need to be considered in concrete mix design to obtain a durable concrete. The three criteria are permeability, strength and crack resistance.

Strength criterion assures that concrete can resist the design stress without any failure.

The permeability requirement assures that concrete has a low flow penetration rate during the design period of service life, reducing vulnerability to water and chemical ion attack.

The crack resistance criterion assures that concrete can withstand cracking caused by environmental factors including temperature and moisture shrinkage.

ADVANTAGES OF HPC OVER CONVENTIONAL CONCRETE

Although High Performance Concrete has the same basic components such as the normal concrete, their much higher qualitative and quantitative performance make them different from the already existing conventional materials. They provide various benefits based on their application, such as increased durability, lower permeability, higher strength, and so on, all at a low cost. High performance concrete has been mainly used in tunnels, bridges, high-rise buildings and paved roads for its strength, durability and high modulus of elasticity. It has also been used in poles, short create, repairs, parking garages and agricultural application. Conventional concrete which is only good at handling compressive strength does not meet many functional requirements such as impermeability, resistance to frost, thermal cracking adequately. Conventional Portland cement concrete lacks basic functional requirements such as durability in severe environments, time of construction is more, energy absorption capacity (for earthquakes resistant structure), repair and retrofitting jobs etc. High performance concrete is considered far superior to conventional cement concrete as constituents of the HPC contribute in a most operational and efficient manner to the various properties.

APPLICATION OF HPC IN CIVIL ENGINEERING

There are various structures where high performance concrete can be used. Some of the structures where high performance can be used are:

Bridges

The use of high-performance concrete would result in less pre-stress loss, allowing for higher permitted stress and a smaller cross-section i.e. this will allow the pre-stressed girders to span over long distances and hence in turn carry heavier loads. In addition, improved durability allows for longer service life of the building. In case of pre cast girders due to reduced weight the transportation and handling will be economical. Railway bridges are usually built as concrete structures to eliminate noise and excessive vibrations also the maintenance cost is quite low.

High Rise Structures

High rise structures have excessive load (as dead) which causes a lot of deflection, also due to lateral loads (wind, earthquake) the vibrations at higher altitudes are quite problematic. Hence to overcome this problem high performance concrete is used which also reduces the maintenance cost.

Highway Pavements

Due to the potential economic benefits of early strength gain, lower permeability, higher wear or abrasion resistance to steel studded tyres , and improved freeze-thaw endurance, high performance concrete is increasingly being used for highway pavements.

CONCLUSION

This paper gives an overview of high-performance concrete and some of its uses in civil engineering structures.

Although high-performance concrete is made with the same components as of normal concrete, their much higher qualitative and quantitative performances make them new material for usage.

At an economical cost they provide various advantages such as enhanced strength, reduced permeability, better workability etc.

The purpose of high-performance concrete is not to produce the most expensive product, but simply to provide the means to produce concrete that will do a satisfactory job at a reasonable cost of service life.

Conventional concrete, which is designed primarily for compressive strength, fails to meet numerous functional requirements such as impermeability, frost resistance, and thermal cracking.

Fire Resistant Structures

Shreeja Kacker

According to the Accidental & Death Statistics India (ADSI) Report 2018, released by National Crime Records Bureau (NCRB), we have lost 60,507 lives due to fire accidents over the years 2015 to 2018. Out of this data, 56% of these deaths have been due to fire outbreaks in residential buildings are most prone to fire outbreaks. Most of these deaths occur when people are asleep, as the smoke causes them to lull into unconsciousness.

Needless to say, this data highlights the need to construct building structures that are fire resistant, if not completely fire proof so as to delay the damage, if not completely prevent it, thereby allowing ample time for the residents to move out & save their lives.

As a civil engineer, we must use materials that are fire resistant and can with-hold damage for a longer duration for example, steel, concrete, plaster, terra-cotta etc. Keeping this is mind; Part 4 of the National Building Code of India (NBC), Bureau of Indian Standards, has suggested certain fire safety requirements and stipulations regarding construction materials. The code clearly mentions, 'All the structural components of a building should be constructed in such a way and of such materials that they withstand fire as an integral member of the structure, for the desired time period according to the type of construction, in case of fire, so that during such time it allows occupants to come out and also the building does not collapse during such time.'

Classification of Fire-resistant Construction

Construction is classified into five classes on the basis of their fire-resistant properties:

Type 1: Fire-resistive construction: This comprises of tall buildings, up to 23m high, made up of concrete and reinforced steel, which can tolerate fire for up to 4 hours before failure. These buildings are highly unlikely to collapse during fire. Type 1 structures are often facilitated with specialized HVAC systems and self-pressurizing stairwells.

Type 2: Non-combustible construction: This consists of relatively new type of buildings with reinforced masonry walls, tilt slabs and metal roofs. Shopping malls and large storehouses, up to 15m high, fall under this category. These structures are provided with ventilation in order to prevent the temperature from rising which may cause the metal roof to collapse. Type 2 structures can hold fire damage up to 3 hours.

Type 3: Ordinary construction: This accounts for old & new buildings like school buildings, houses, and other structures with wood-framed roof, a combustible material but non-combustible walls. With a combination of non-combustible masonry and fire-cut joists, the exterior walls can stay standing even if the floors collapse. These buildings collapse after 1.5 to 2 hours of fire resistance.

Type 4: Heavy Timber construction: This type of construction comprises of old buildings with large dimensional lumber used for structural elements. The load bearing walls are usually made of non-combustible materials. Even though these structures are made of timber, they can hold fire for up to 1.5 hours, simply because of the magnificent size of the building components.

Type 5: Wood-framed construction: Modern buildings with combustible frames and roofs make up for this type of construction. These buildings are highly susceptible to damage & collapse in case of a fire, as timber is a combustible material and also the size of these components is not very large.

Some of these fire-resistant design specifications are given as follows:

Walls

The load bearing walls or column of masonry or RCC should be thicker in section so that they can resist fire for a longer time and also act as vertical barriers for the passage of heat and fire and give minimum smoke.

Walls of lightweight concrete are preferred to dense concrete as far as fire resisting qualities are concerned.

Both load-bearing and non-load bearing walls should be plastered with fire resistant mortar to get the fire-resistant construction.

Normally, 20 cm thickness of the common wall separating two buildings is sufficient from fire-resistant point of view but it should be raised above the roof level by at least 90 cm.

The partition walls should be of fire-resistant materials such as, R.C.C or reinforced brickwork, hollow concrete, burnt clay tiles, reinforced glass, asbestos cement board, or metal lath covered with cement plaster.

Columns

The desirable fire grading is of 4 hours for columns and girders whereas for beams it is of 3- hours, depending upon type of structure. Therefore, RCC framed structures are preferred to steel structure for fire resistance.

As steel columns are liable to twist or buckle or distort under intense fire, they should be protected by use of insulating materials such as concrete, hollow clay tiles, bricks, metal lath followed by plaster etc.

It has been recommended for a structural component like columns, girders, trusses, etc. to have a cover of at least 50 mm outside the main reinforcement.

Floors

The floors and roofs should be made of fire resisting materials as they act as horizontal barriers for spreading of heat and fire in a vertical direction.

Flooring with a material, like concrete, ceramic tiles and brick, is regarded to be most suitable from the viewpoint of fire-resisting qualities. The use of terrazzo, marble and slate as floor surfaces is also quite satisfactory.

While using combustible materials, such as cast iron, wrought iron, carpet, etc., they should be protected by a covering of various insulating material such as ceramic tiles, plaster, tera-cotta, bricks, etc.

Roofs

For fire resistance of roofs, the flat roof should be preferred to sloping roofs or pitched roofs.

In case, the use of sloping roof is restricted due to some reasons, then the trusses should be of either R.C.C. or protected rigid steel should be used with a covering of asbestos cement sheet.

The ceiling should be made fire resistant by fixing asbestos cement boards, fibre boards, and metal lath with plaster to their framework.

Wall Openings

From fire resistant construction point of view, firstly the opening in the walls should be restricted to a minimum and secondly, they should be protected by suitable arrangements in case of fire.

If properly protected these openings also serve as means of escape in a fire. Otherwise, they provide the passage for the spread of fire in the horizontal direction. Doors and windows should be made of suitable fire-resistant material.

All those openings which are used for communication should have double fire-proof doors and other openings may have single fire-proof doors.

Any window exposed to the roof or other structure should be protected by fireproof shutters.

All escape doors should be in such a way so that it provides free circulation to the people in passages, lobbies, corridors, stairs, entrances, etc. and are made up of fire-proof materials.

Fire Escape Elements

These include Stair-cases, Corridors, Lobbies, Entrances, etc. All these fire-escape elements should be constructed of fire-resistant material and well separated from the rest of the building.

Doors to the staircases, corridors and lifts should be made of fireproof materials.

Staircases should be located next to the outer walls and should be accessible from any floor in the direction of the exits from the building.

The fireproof doors to these emergency staircases should be fixed in such a way so that they can be closed from inside only. Such an arrangement will help the people to leave and evacuate the building safely and quickly in case of fire accident.

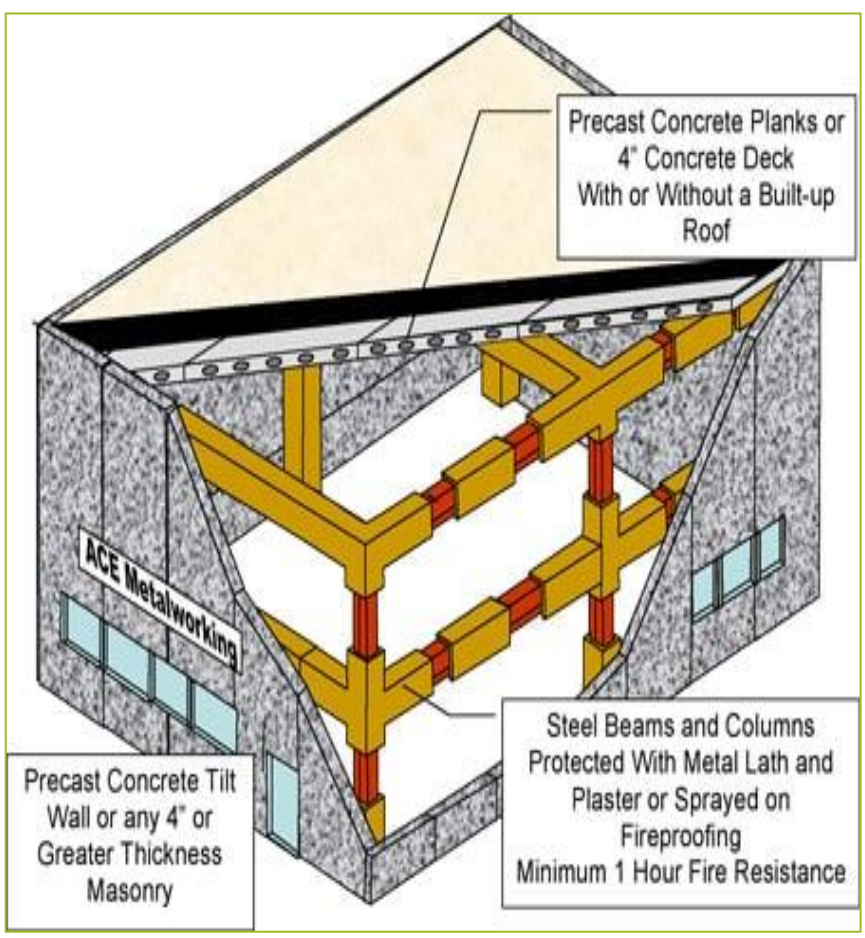


Figure 1: Fire resistive design considerations

Fire-resistant Materials

Glass: Windows, important for visibility and light, can nonetheless be a fire hazard. Even before a window is in direct contact with flames, the intense heat of a nearby fire can cause the glass to break. And a broken window allows flames to enter a building easily. In addition, the heat from a fire outside might be enough to simply ignite flammable items inside a home without direct contact.

To protect your house, consider installing fire-resistant windows. One example is dual-paned glass windows, which, in addition to providing energy efficiency, also double the time it would take for fire to break the windows. The outer layer will break first before the inner layer. Tempered glass, which is heat-treated to make it about four times stronger than regular glass, is also effective. It is also wise to note the importance of window framing. Steel framing offers the best fire protection, followed by wood and aluminum. Vinyl is the least effective.

Concrete: Concrete, one of the most common building materials, is also an excellent fire-resistant material. It is noncombustible and has low thermal conductivity, meaning that it takes a long time for fire to affect its structural, load-bearing ability, and it protects from the spread of fire. It's actually significantly more fire-resistant than steel, and often used to reinforce and protect steel from fire.

Stucco: Stucco is a plaster that has been used for centuries for both artistic and structural purposes. Modern stucco is made of Portland cement, sand and lime, and it serves as an excellent and durable fire-resistant finish material for buildings. It can cover any structural material, such as brick or wood. It usually consists of two or three coats over metal reinforcing mesh. A one-inch layer of stucco can easily lend a 1-hour fire rating to a wall.

Gypsum: Many structural materials will require underlying gypsum sheathing in order to achieve a good fire-resistant rating, and gypsum board is the most commonly used fire-resistant interior finish. Gypsum board, also known as drywall, consists of a layer of gypsum sandwiched between two sheets of paper.

Brick: As bricks are made in a fire kiln, they're already highly resistant to fire. However, it's true that individual bricks are much more fire-resistant than a brick wall. A brick wall is held together with mortar, which is less effective. Nevertheless, brick is commonly cited as among the best building materials for fire protection. Depending on the construction and thickness of the wall, a brick wall can achieve a 1-hour to 4-hour fire-resistance rating.

The fire-resistive approach of construction enables the building to become self-sustainable in case of critical situations like a hazardous fire. Thereby, it is of utmost need to inculcate various techniques to fire proof the building.

The building materials used in the construction of the building elements above will have a fire- resistance rating. Fire-resistance rating typically means the duration for which a passive fire protection system can withstand a standard fire resistance test. Fire-resistance rating is essentially important, which is basically the other factor in determining the construction class of a building based on its typology.

Waste Plastic on Roads

Mohammad Arib

The safe disposable of plastic waste is a new challenge in solid waste management. It has a negative impact on the ecosystem, contaminate soil, water and air when burnt. It also adversely affects sewerage, drainage system and cattle' s lives. One way of safe disposal of plastic waste is to use it in bituminous road construction. Plastic roads are composites of plastic with other materials. Plastic roads are different from standard roads because standard roads are made from asphalt concrete, which consists of mineral aggregates and asphalt. Most plastic roads sequester plastic waste within the asphalt as an aggregate. Prof Rajagopalan Vasudevan is the man behind this innovation. In 2018, he was awarded Padma Shri, the government's fourth highest civilian honour. Rajagopalan Vasudevan is known as the "Plastic Man of India" for devising an innovative way of disposing of plastic waste – by using it to build roads.

Need

Plastic has slowly become an integral part of all human requirements. Plastic carry bags, packaging material, bottles, cups, and various other items have gradually replaced everything made of other material due to the advantages of plastic. Plastic waste clog drains, causing floods. It chokes animals who eat plastic bags, etc. Plastics found in fields blocks germination and prevent rainwater absorption.

Recycling plastic can be done only 3-4 times, and melting the plastic for recycling releases highly toxic fumes.

Studies have revealed that waste plastics have great potential for use in bituminous construction as its addition in small doses, about 5-10%, by weight of bitumen helps in substantially improving the marshall stability, strength, fatigue life and other desirable properties of bituminous mix, leading to improved longevity and pavement performance.

Materials to be Used

Bitumen

The bitumen for bituminous mixes for wearing course with waste plastic shall comply with the Indian Standard Specifications for viscosity graded paving bitumen IS 73. Guidelines for selection for grade of viscosity graded paving bitumen shall be in accordance with the IRC:111-2009.

Aggregates

The aggregates shall comply to IRC:111-2009, for dense graded mixes and IRC:14-2004, IRC: SP:78-2008 and IRC:11 0-2005 for open graded mixes respectively.

Filler

The filler for dense graded mixes shall comply with IRC:111-2009.

Waste Plastic

The waste plastic shall conform to the size passing 2.36 mm sieve and retained on 600-micron sieve.

Dust and other impurities shall not be more than1 percent. An easy method to determine the quantity of impurity is to determine the ash content at 600°C.

To ascertain the ability of plastic to mix with the binder, the melt-flow value shall be tested as per ASTM D 1238-2010, for which the range shall be as follows:

For LDPE: 0.14-58 gm/10 min

For HDPE: 0.02-9.0 gm/10 min

*Poly Vinyl Chloride (PVC) sheets or Flux sheets should not be used in any case.

Design of Mix

Open Graded Mixes

Waste Plastic @ 6 to 8 percent of the weight of the bitumen can be used for Open-Grade Premix Surfacing and Mix Seal surfacing mix. Quantity of bitumen can be reduced correspondingly.

Basic Procedure of Construction

There are two processes, namely dry process and wet process, for manufacturing bituminous mixes using waste plastic. In the dry process, processed waste plastic is added after shredding in hot aggregates, whereas in the wet process, processed waste plastic in the form of powder is added in the hot bitumen. Presently, the dry method is in extensive use.

Once all the plastic waste is shredded (a technique where all the dust particles are eliminated and plastic items are shredded into fine pieces), these are heated at 165°c. Next, the shredded pieces are added to bitumen mix, which is also heated at 160°c. The final mix is used for constructing roads.

Steps:

Waste plastic is first shredded

The plastic is then mixed with hot gravel

The mix is added to molten asphalt4) Road is paved using the regular process

Advantages Of Dry Process

Easy process without any new machinery.

In-Situ process.

Simple process without any industry involvement.

Use of lesser percentage of bitumen and thus savings on bitumen resource.

Use 60/70 and 80/100 bitumen is possible.

Both Mini Hot Mix Plant and Central Mixing Plant can be used.

Only aggregate is polymer coated and bitumen is not modified.

Use of plastics waste for a safe and eco-friendly process.

No evolution of any toxic gases like dioxin.

Where in India?

Chennai was among the first cities globally to adapt the technology in a big way when the municipality commissioned 1000 km of plastic roads in 2004. While the plastic roads may be a new concept in many parts of India, Chennai has been experimenting with it since 2011. Chennai has used nearly 1,600 tonnes of plastic waste to construct 1,035.23 kilometres length of roads in recent years.

Pune: Using bitumen technology on waste plastic, the Pune Municipal Corporation constructed a 150-metre stretch of Bhagwat Lane at Navi Peth near Vaikunth Crematorium in 2016.

Jamshedpur: Jamshedpur Utility and Services Company (JUSCO), which is a subsidiary company of Tata Steel, constructed a 12–15 km road in the steel city as well as Tata Steel Works using plastic road.

Dating 2014, the Madhya Pradesh Rural Road Development Authority (MPRRDA) has constructed around 35 km of roads in 17 districts with plastic waste.

Surat: The idea of using plastic-bitumen mix was executed in January 2017. The problem of potholes significantly reduced as no cracks developed in areas where roads were layered with waste plastic.

Ghaziabad: Ghaziabad Municipal Corporation (GMC) in July,2019 constructed a 100 meter long road in Sanjay Nagar area using plastic waste.

I've personally visited this road which is in front of Yashoda Hospital. I talked to few officials and they said that "the road has passed all the necessary tests and they're planning to construct more such roads as it's a good way of using waste plastic and the roads are technically fit".

Plastic Road in Ghaziabad

Advantages of Plastic Roads

Plastic waste mixed in at 8% ratio to asphalt world-wide may solve the issue of plastics in landfills and oceans world-wide.

Using less asphalt saves on resources. Asphalt concrete requires petroleum which is becoming scarcer.

Since plastics come with various chemical and physical properties, roads can be engineered to meet specific requirements (e.g., weather and wear resistance).

The addition of plastic in asphalt can reduce the viscosity of the mix. This allows a lower working temperature, which lowers VOC and CO emissions.

Plastic-bitumen composite roads have better wear resistance than standard asphalt concrete roads.

They do not absorb water, have better flexibility which results in less rutting and less need for repair.

Road surfaces remain smooth, are lower maintenance, and absorb sound better.

Disadvantages Of Plastic Roads

Pure plastic roads require use of compatible plastics because, when melted, plastics of different types may phase-separate and cause structural weaknesses, which can lead to premature failure.

Plastics in the road can break down into microplastics and can find their way into the soil and bodies of water. These microplastics can also absorb other pollutants.

Toxic present in the co-mingled plastic wastes would start leaching.

The presence of chlorine will definitely release HCL gas.

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