INTERNATIONAL JOURNAL OF ENGINEERING SCIENCES & MANAGEMENT

CEMENT CONCRETE WITH DIFFERENT FIBER MATERIALS

Vishal vadhwani[1], Pankaj Singh[2]
[1]R.K.D.F institute of technology,Bhopal(M.P.)INDIA
[2]Department of civil engineering,rajiv Gandhi Technical University of Madhya Pradesh India

ABSTRACT
Natural fibers are prospective reinforcing materials and their use until now has been more. natural fibers as the reinforcement in concrete has only taken place in comparatively recent years. Earlier, mechanical characterization and impact behavior of concrete reinforced with natural fibres were studied (Al-Oraimi and Seibi 1995). Here an experimental study was done using glass and palm tree fibres on high strength concrete. Mechanical strength properties such as compressive ,split tensile, flexural strengths and post cracking toughness were studied**,** . It was concluded that natural fibres are comparable with glass fibres. A finite element analysis was also done. Both the analytical and experimental results were compared and found acceptable Mix and specimens casting In preparation of test specimens, 43 grade ordinary Portland cement, natural river sand and stone aggregate were used. during mixing volume fraction of fibres was restricted to 1·0% only The mechanical strength tests were carried out in a PC controlled compression testing machine The earliest man-made composite materials were straw and mud combined to form bricks for building construction The methodology involved mix design of concrete with different fibers The objective behind carrying out this project is to note and observe the effect like compressive ,split tensile, flexural strengths and post cracking toughness on different fibers were studied.the results were tabulated discussed and concluded

INTRODUCTION

General Introduction

Natural fibers are prospective reinforcing materials and their use until now has been more traditional than technical. They have long served many useful purposes but the application of materials technology for the utilization of natural fibers as the reinforcement in concrete has only taken place in comparatively recent years. The distinctive properties of natural fibre reinforced concretes are improved tensile and bending strength, greater ductility, and greater resistance to cracking and hence improved impact strength and toughness. Besides its ability to sustain loads, natural fiber reinforced concrete is also required to be durable. Durability relates to its resistance to deterioration resulting from external causes as well as internal causes (Aziz et al 1984). Earlier, mechanical characterization and impact behavior of concrete reinforced with natural fibres were studied (Al-Oraimi and Seibi 1995). Here an experimental study was done using glass and palm tree fibres on high strength concrete. Mechanical strength properties such as compressive ,split tensile, flexural strengths and post cracking toughness were studied. It was concluded that natural fibres are comparable with glass fibres. A finite element analysis was also done using ANSYS software. Both the analytical and experimental results were compared and found acceptable .Comparison between theoretical and experimental investigations on the compressive strength and elastic modulus of coir and sisal fibre reinforced concretes for various volume fractions was also carried out (Ramakrishna and Sundararajan 2002). It was observed that both the experimental and analytical values of elastic modulus had shown 15% discrepancy, which can be regarded as comparatively small.

Experimental

Mix and specimens casting In preparation of test specimens, 43 grade ordinary Portland cement, natural river sand and stone aggregate were used. The maximum size of coarse aggregate was 19 mm. A sieve analysis conforming to IS 383-1970 was done. The concrete mix was designed to achieve 28 days cube strength of20 MPa with a constant water cement ratio of 0·5. To avoid the balling effect on concrete during mixing volume fraction of fibres was restricted to 1·0% only. From the earlier studies, it was evident that the optimum volume fraction of fibres in concrete without water reducing admixture was 1·5%. Similarly the maximum aspect ratio was 100. The reason for this limitation was workability of concrete .Probability of heterogeneous distribution and flocculation of fibres in concrete mix was increased by increasing l/d ratios. Homogeneous distribution of fibres at mixing and placing was required regardless of the type of fibres. According to their shape and quantity, fibres bear some stress that occurs in cement matrix themselves and transfer the other portion of stress at stable cement matrix portions (Yazici et al 2007). Earlier studies (Sivaraja and Kandasamy 2007, 2008, 2009) reported the workability, mechanical and flexural properties of fibrous concrete with the same natural fibres. The optimum volume fraction and aspect ratio obtained from the earlier studies are 1·5% and 60. Hence, in the present investigation, the fibrous concrete mix with coir and sugarcane fibres at a volume fraction of 1·5% and aspect ratio of 60 were selected. Cube specimens of 150 mm size for compressive strength, cylinder specimens of 150 mm diameter×300 mm height and prisms of size, 500×100× 100 mm were cast to study the mechanical strength properties. water–cement ratio used was 0·5. The fibre content was restricted to 1·5% volume fraction of concrete volume. Similarly aspect ratio of 60 was considered for both the fibres. The fibre reinforced concrete specimens were allowed for initial curing of 28 days. After 28 days curing, the alternate wetting and drying process was started. The wetting was given by immersing the concrete specimens for 3 days under water. After the wetting process, the specimens were allowed to dry in open air for the remaining 4 days of a week. The specimens were subjected to this alternate wetting and drying process for two years continuously.Test set up for flexural test Mechanical strength tests were carried out at room temperature and as per the Indian standards. The mechanical strength tests were carried out in a PC controlled compression testing machine. Modulus of rupture test was conducted in flexural testing machine. Middle third flexural loading was applied on reinforced concrete beams through hydraulic jack. The specimens were placed in 100 T loading frame and LVDTS was attached to measure the deflection readings. DEMEC as well as electrical strain gauges with strain indicator were used to measure the strain readings both in steel reinforcement and concrete. To examine and compare the effect on microstructure of natural fibres which are allowed to react with concrete for two years under alternat wetting and drying conditions, two types of samples were taken. One type of samples is the natural fibres used in this study such as coir and sugarcane in the as received condition. The second type of samples was obtained from the fibre reinforced concrete cube specimens. After two years, the fibres from the concrete specimens were collected carefully by using cutters. 2008)

GENERAL METHODOLOGY FOR COMPOSITE MATERIAL

Fabrication methods

Fabrication usually involves wetting or mixing or saturating the reinforcement with the matrix, and then causing the matrix to bind together (with heat or a chemical reaction) into a rigid structure. The operation is usually done in an open or closed forming mold, but the order and ways of introducing the ingredients varies considerably.

Mold overview

Within a mold, the reinforcing and matrix materials are combined, compacted, and cured (processed) to undergo a melding event. After the melding event, the part shape is essentially set, although it can deform under certain process conditions. For a thermoset polymeric matrix material, the melding event is a curing reaction that is initiated by the application of additional heat or chemical reactivity such as an organic peroxide. For a thermoplastic polymeric matrix material, the melding event is a solidification from the melted state. For a metal matrix material such as titanium foil, the melding event is a fusing at high pressure and a temperature near the melting point.For many moulding methods, it is convenient to refer to one mould piece as a "lower" mould and another mould piece as an "upper" mould. Lower and upper refer to the different faces of the moulded panel, not the mould's configuration in space. In this convention, there is always a lower mould, and sometimes an upper mould. Part construction begins by applying materials to the lower mould. Lower mould and upper mould are more generalized descriptors than more common and specific terms such as male side, female side, a-side, b-side, tool side, bowl, hat, mandrel, etc. Continuous manufacturing processes use a different nomenclature.The moulded product is often referred to as a panel. For certain geometries and material combinations, it can be referred to as a casting. For certain continuous processes, it can be referred to as a profile.

Vacuum bag moulding

Vacuum bag moulding uses a flexible film to enclose the part and seal it from outside air. A vacuum is then drawn on the vacuum bag and atmospheric pressure compresses the part during the cure process. Vacuum bag material is available in a tube shape or a sheet of material. When a tube shaped bag is used, the entire part can be enclosed within the bag. When using sheet bagging materials, the edges of the vacuum bag are sealed against the edges of the mould surface to enclose the part against an air tight mould. When bagged in this way, the lower mold is a rigid structure and the upper surface of the part is formed by the flexible membrane vacuum bag. The flexible membrane can be a reusable silicone material or an extruded polymer film. After sealing the part inside the vacuum bag, a vacuum is drawn on the part (and held) during cure. This process can be performed at either ambient or elevated temperature with ambient atmospheric pressure acting upon the vacuum bag. A vacuum pump is typically used to draw a vacuum. An economical method of drawing a vacuum is with a venturi vacuum and air compressor.A vacuum bag is a bag made of strong rubber-coated fabric or a polymer film used to compress the part during a cure or hardening process. In some applications the bag encloses the entire material, or in other applications a mold is used to form one face of the laminate with the bag being a single layer to seal to the outer edge of the mold face. When using a tube shaped bag, the ends of the bag are sealed and the air is drawn out of the bag through a nipple using a vacuum pump. As a result, uniform pressure approaching one atmosphere is applied to the surfaces of the object inside the bag, holding parts together while the adhesive cures. The entire bag may be placed in a temperature-controlled oven, oil bath or water bath and gently heated to accelerate curing.Vacuum bagging is widely used in the composites industry as well. Carbon fiber fabric and fiberglass, along with resins and epoxies are common materials laminated together with a vacuum bag operation.Woodworking applications In commercial woodworking facilities, vacuum bags are used to laminate curved and irregular shaped workpieces.Typically, polyurethane or vinyl materials are used to make the bag. A tube shaped bag is open at both ends. The piece, or pieces to be glued are placed into the bag and the ends sealed. One method of sealing the open ends of the bag is by placing a clamp on each end of the bag. A plastic rod is laid across the end of the bag, the bag is then folded over the rod. A plastic sleeve with an opening in it, is then snapped over the rod. This procedure forms a seal at both ends of the bag, when the vacuum is ready to be drawn.A "platen" is sometimes used inside the bag for the piece being glued to lay on. The platen has a series of small slots cut into it, to allow the air under it to be evacuated. The platen must have rounded edges and corners to prevent the vacuum from tearing the bag.When a curved part is to be glued in a vacuum bag, it is important that the pieces being glued be placed over a solidly built form, or have an air bladder placed under the form. This air bladder has access to "free air" outside the bag. It is used to create an equal pressure under the form, preventing it from being crushed.[6]

Pressure bag moulding

This process is related to vacuum bag moulding in exactly the same way as it sounds. A solid female mould is used along with a flexible male mould. The reinforcement is placed inside the female mould with just enough resin to allow the fabric to stick in place (wet lay up). A measured amount of resin is then liberally brushed indiscriminately into the mould and the mould is then clamped to a machinethat contains the male flexible mould. The flexible male membrane is then inflated with heated compressed air or possibly steam. The female mould can also be heated. Excess resin is forced out along with trapped air. This process is extensively used in the production of composite helmets due to the lower cost of unskilled labor. Cycle times for a helmet bag moulding machine vary from 20 to 45 minutes, but the finished shells require no further curing if the moulds are heated.

Autoclave moulding

A process using a two-sided mould set that forms both surfaces of the panel. On the lower side is arigid mould and on the upper side is a flexible membrane made from silicone or an extruded polymerfilm such as nylon. Reinforcement materials can be placed manually or robotically. They include continuous fibre forms fashioned into textile constructions. Most often, they are pre-impregnated with the resin in the form of prepreg fabrics or unidirectional tapes. In some instances, a resin film is placed upon the lower mould and dry reinforcement is placed above. The upper mould is installed andvacuum is applied to the mould cavity. The assembly is placed into an autoclave. This process is generally performed at both elevated pressure and elevated temperature. The use of elevated pressure facilitates a high fibre volume fraction and low void content for maximum structural efficiency.

Resin Transfer Moulding (RTM)

RTM is a process using a rigid two-sided mould set that forms both surfaces of the panel. The mould is typically constructed from aluminum or steel, but composite molds are sometimes used. The two sides fit together to produce a mould cavity. The distinguishing feature of resin transfer moulding is that the reinforcement materials are placed into this cavity and the mould set is closed prior to the introduction of matrix material. Resin transfer moulding includes numerous varieties which differ in the mechanics of how the resin is introduced to the reinforcement in the mould cavity. These variations include everything from the RTM methods used in Out of Autoclave Manufacturing for High-Tech aerospace components to vacuum infusion (for resin infusion see also boat building) to vacuum assisted resin transfer moulding (VARTM). This process can be performed at either ambient or elevated temperature.

FIBERS AND ITS PROPERTIES

Flax

Flax is a unicellular fibre and its length may vary from 45–60 cm with a mean diameter of 0.02 mm. Under the microscope the cells look like long and transparent cylindrical tubes. The fi bre cell has a narrow lumen running through the centre and the cell walls are thick and polygonal in cross-section.Flax has an average tenacity of around 0.57 N/tex and an extension at break of around 1.8% (dry fibre) or 2.2% (wet fi bre). It has a specifi c gravity of 1.54 and a regain of about 12%. It resists heat decomposition up to 120°C, when it begins to discolour. It is a good heat conductor. Under normal environmental circumstances flax has a high resistance to rotting. However, in a damp, warm and contaminated condition it may be attacked by mildews.

Hemp

Hemp is dark in colour and the individual cells are cylindrical and thicker than flax with an average length of around 13–26 mm, presenting many irregularities on the surface. The cells of the hemp fibres have a thick wall and are polygonal in cross-section, and the central lumen is wider than that of flax. Hemp is stiffer than fl ax as it is more lignifi ed. It has an average tenacity of around 0.47 N/tex and an extension at break of around 2.2%, with a specific gravity of 1.50. 5

Jute

Jute's colour may vary from dirty grey to yellow and brown, and it has a silky luster. It consists of bundles of individual fibres that may reach 2 m in length.The individual cells of jute have an average length of 2–6 mm. The cell surfaceis generally smooth presenting some nodes and cross-markings , and the fibresare covered with a layer of woody material. The cross-section of the cells is polygonal with thick walls and a broad lumen of oval cross-section and irregular along the length. Due to the irregular thickness of the cell walls, jute is not as strong or durable as flax or hemp, with a average tenacity of around 0.31 N/tex and an extension at break of around 1.8%. It has a specific gravity of 1.50 and it is a very hygroscopic fibre with a regain of about 13.75%, absorbing up to 23%of water in humid conditions. Due to the protective effect of lignin it is quite resistant to rot.

Ramie

Ramie fibres are lustrous and white. The fibre is durable and stiff and it absorbs water quite readily . The individual cells are up to 45 cm in length and are smooth and cylindrical with thick walls. The surface of the cell has markings and the lumen disappears towards the ends of the cell, which tapers to a round point. The fibres are strong with an average tenacity of around 0.59 N/tex and an extension at break at around 3.7%, with a specific gravity of 1.50.

Synthetic textile fibres for use in civil engineering applications

Nylon

Nylons are semi-crystalline polymers. The amide group – (–CO–NH–) – provide shydrogen bonding between polyamide chains, giving nylon high strength at high temperatures and toughness at low temperatures, combined with its other properties, such as stiffness, wear and abrasion resistance, low friction coefficient and good chemical resistance. These properties have made nylons one of the strongest man-made fibres in common use. Two-step melt spinning, comprised of spinning and drawing, is considered to be the conventional method to manufacture nylon fi laments. After melting, filtering, and de-aerating, the molten polymer is extruded through a spinneret into a chamber where the melt solidifies into a filament form. These filaments must be drawn subsequently to increase molecular orientation and crystallinity, and therefore improved properties such as initial modulus,tenacity, elongation-at-break, density equilibrium and moisture sorption. Rather than two-ste spinning (extrusion) and drawing, a one-step, high-speed spinning process is being used increasingly. Nylon 6/6 has a melting point of 263°C, high for a synthetic fibre, though not amatch for aramids. This fact makes it the most resistant to heat and friction and enables it to withstand heat setting for twist retention. Nylon 6 has a much lower melting point than nylon 6/6. 8

Nylon 6/6 has the following properties:

- tenacity (N/tex): around 0.66extension at break (%): in the region of 16
- elastic recovery at 8% extension (%): 100
- specific gravity: 1.14
- melting point: 263°C
- thermal conductivity (mW m^{-1} K^{-1}): 250
- extremely chemically stable
- no mildew or bacterial effects
- moisture regain (%): 4–4.5
- degraded by light as natural fi bres
- permanent set by heat and steam abrasion resistant resilient.

Polyester

The properties of polyester fibres are strongly affected by the fi bre structure. The fibre structure depends considerably on the process parameters of fibre formation, such as spinning speed, hot drawing, stress relaxation and heat-setting speed. Any stretching of the fi bre, whether obtained during fibre spinning or hot drawing, extends the PET molecules, resulting in better uniformity, lower elongation and higher strength, greater orientation, and high crystallinity. Relaxation consists of relieving the stresses and strains of the extended molecules, which results in a reduced shrinkage of the fibres. Heat setting is a treatment used to stabilize the molecular structure, enabling the fi bres to resist dimensional changes. The degree of crystalline orientation and the percentage of crystallinity may be adjusted in response to process parameters and this strongly affects fibre properties. The glass transition is usually around 75°C and crystallization and melting are around 130°C and 260°C, respectively. Polyester fibres display good resistance to sunlight, but long-term degradation appears to be initiated by UV radiation. Although PET is flammable, the fabric usually melts and drops away instead of spreading the flame.

Polyester fibres are resistant to mildew, aging and abrasion. 9 The

- properties of PET may be summarized as strong
- resistant to stretching and shrinking
- resistant to most chemicals
- quick drying
- crisp and resilient when wet or dry
- wrinkle resistant
- mildew resistant
- abrasion resistant

- thermal conductivity (mW m −1 K −1): 140
- specifi c gravity: 1.38
- moisture regain (%): 0.4
- melting temperature (°C): 258–263.
- In addition, polyester high-tenacity fi lament yarn has the following properties:
- tenacity (N/tex): 0.62–0.85
- extension at break (%): 10–20
- elastic recovery at 5% extension (%): 90
- initial modulus (N/tex): 10.2–10.6.

Polypropylene
Polypropylene fbres are composed of crystalline and non-crystalline regions. Fibre spinning and drawing causes the orientation of both crystalline and amorphous regions, and may lead to the formation of highly anisotropic microfi brillar structures, which in turn may result in anisotropic fibre properties. 10

Polypropylene fibres have the following properties:
- very lightweight
- specifi c gravity: 0.91 (very low)
- high strength (wet or dry)
- tenacity (N/tex): 0.65
- extension at break (%): 17
- initial modulus (N/tex): 7.1
- thermal conductivity (mW m −1 K −1): 120
- resistant to deterioration from chemicals, mildew, insects, perspiration, rot
- and weather
- abrasion resistant
- low moisture absorption
- stain and soil resistant
- lowest static component of any man-made fi bre
- sunlight resistant
- good washability, quick drying, unique wicking
- resilient, mouldable, very comfortable
- thermally bondable

Aramid
Rebouillat 11 presented a review of the relationship between structure and properties of aramid fibres. 11 Kevlar fibres are made up of long chains of molecules produced from PPTA (poly-paraphenylene terephthalamide), and inter-chain hydrogen bonds make these fibres extremely strong. The molecules that form the structure of Kevlar are relatively rigid, which is typical of planar sheet- like structures.

Aramid fibres have the following properties:
- high degree of orientation (which dominates their properties)
- good resistance to abrasion
- good resistance to organic solvents
- non-conductive
- no melting point, degradation starts from 500°C
- low fl ammability
- good fabric integrity at elevated temperatures
- sensitive to acids and salts
- sensitive to ultraviolet radiation
- prone to static build-up unless fi nished.
- In addition, para-aramids (such as Kevlar and Twaron) have the following
- properties:
- outstanding strength-to-weight properties
- tenacity (N/tex): 2 (high)
- extension at break (%): 2.4
- initial modulus (N/tex): 80 (high)

- low creep
- specific gravity: 1.44.

Carbon

The physical properties of carbon fibres have been reviewed extensively by Dresselhaus *et al* . 13 The characterization of carbon fibre microstructure has been mainly performed by X-ray scattering and electron microscopy techniques. In contrast to graphite, the structure of carbon fibre lacks any three-dimensional order. In PAN-based fibres, the linear chain structure is transformed to a planar structure during oxidative stabilization and subsequent carbonization. Basal planes oriented along the fibre axis are formed during the carbonization stage. In general, it is seen that the higher the tensile strength of the precursor the higher is the tenacity of the carbon fibre. Tensile strength and modulus are signifi cantly improved by carbonization under strain when moderate stabilizationis used. X-ray and electron diffraction studies have shown that in high modulus type fi bres, the crystallites are arranged around the longitudinal axis of the fibre, with layer planes highly oriented parallel to the axis. Overall, the strength of a carbon fi bre depends on the type of precursor, the processing conditions, heat treatment temperature and the presence of fl aws and defects. Carbon fi bres are very brittle because the layers in the fi bres are formed by strong covalent bonds. The sheetlike aggregations allow easy crack propagation and, on bending, the fi bre fails at very low strain. 14

Carbon HM fibres have the following properties:

- specifi c gravity: 1.83
- tenacity (N/tex): 1.2 (high)
- extension at break (%): 0.7–1.7
- initial modulus (N/tex): 256 (high).

Glass

Fibreglass or glass fibre, as it is also known, has no true melting point. However, it softens at 2000°C, where it starts to degrade. At 1713°C most of the molecules can move about freely, and if the glass is then cooled quickly they will be unable to form an ordered structure. 15 In the polymer, it forms SiO 4 groups that are configured as a tetrahedron with the silicon atom at the centre and four oxygen atoms at the corners. These atoms then form a network bonded at the corners by sharing the oxygen atoms. Glass fibre is formed when thin strands of silica-based, or other formulation glass, are extruded into many fibres with small diameters suitable for textile processing. Glass, even as a fibre, has little crystalline structure. The properties of the structure of glass in its softened stage are very much like its properties when spun into fibre. One definition of glass is 'an inorganic substance in a condition which is continuous with, and analogous to, the liquid state of that substance, but which, as a result of a reversible change in viscosity during cooling, has attained so high a degree of viscosity as to be, for all practical purposes, rigid'. 16 By trapping air within them, blocks of glass fibre make good thermal insulation, with a thermal conductivity in the order of 0.05 W/mK. Because glass has an amorphous structure, its properties are the same along the fibre and across the fibre. Humidity is an important factor in the tensile strength.

E-Glass fibres have the following properties:

- specific gravity: 2.58
- tenacity (N/tex): 0.78
- extension at break (%): 4
- initial modulus (N/tex): 28
- specific heat (J g^{-1} K^{-1}): 0.8.

Basalt

Structure and properties

Basalt is a common extrusive volcanic rock, which is usually grey to black and fi ne-grained due to rapid cooling of lava at the surface of a planet. It may be porphyritic, containing larger crystals in a fine matrix, or vesicular, or frothy scoria. Unweathered basalt is black or grey. The manufacture of basalt fibre requires the melting of the quarried basalt rock to about 1400°C, this is then extruded through small nozzles to produce continuous fi laments of basalt fi bre. There are three main manufacturing techniques, which are centrifugal-blowing, centrifugal-multiroll and die-blowing. The fibres typically have a fi lament diameter of 9–13 μm, which is far enough above the respiratory limit of 5 μm to make basalt fi bre a suitable replacement for asbestos. They also have a high elastic modulus, resulting in an excellent specific tenacity that is three times that of steel. The continuous basalt fibres derived from basalt rock have proven technical characteristics and performancespecifications.
Basalt fibres have the following properties: 17,18

- fibre diameter (μm): 9
- specific gravity: 2.65
- high thermal resistance (thermostability) and low fl ammability

- low-strength degradation at temperatures as low as −200 to 250°C and as high
- as +700 to 900°C., and of high humidity
- operative temperature (°C): −200 to +900
- high thermal and acoustic insulation properties
- sound proofi ng for 400–1800 Hz: 80–95%
- excellent adhesion to polymer resins and rubbers
- relatively high mechanical strength, abrasion resistance and elasticity
- tenacity (N/tex): 0.67–0.93
- extension at break (%): 3.1
- initial modulus (N/tex): 30–35
- high dielectric properties
- moisture regain (%): 1
- low water absorption
- high chemical resistance (especially to concentrated acids-based materials)
- ecologically clean and non-toxic.

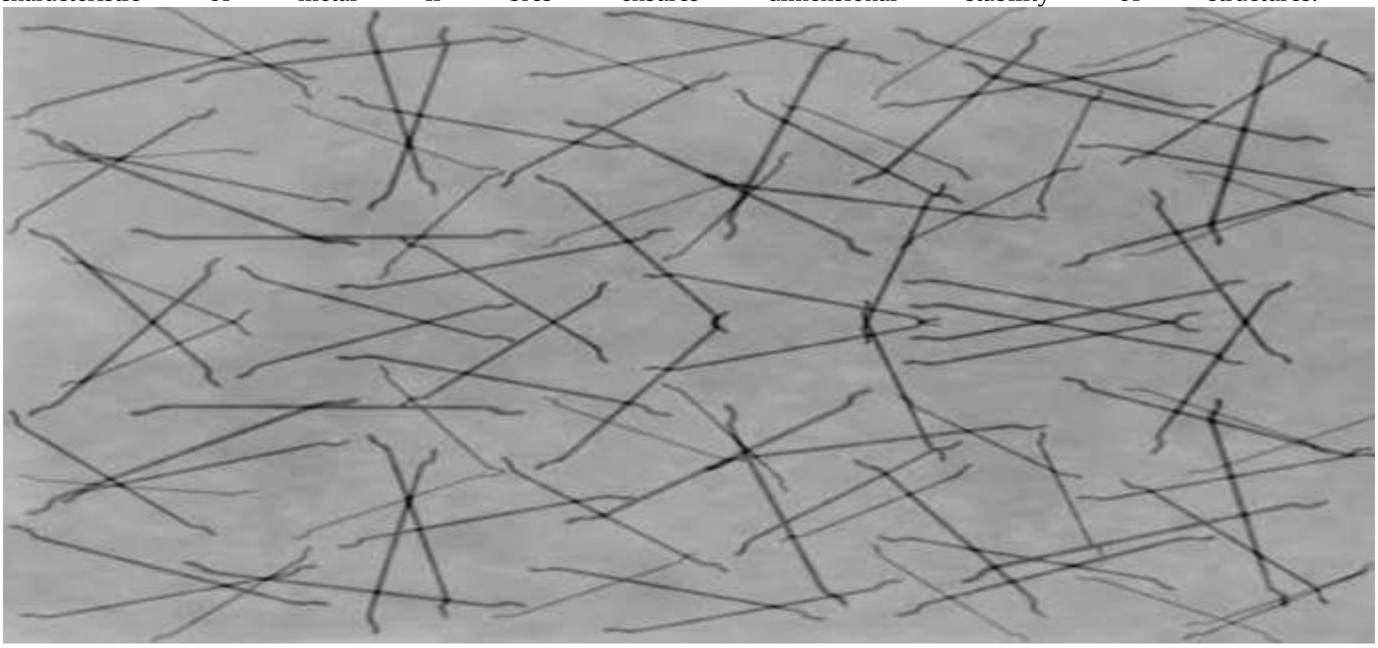
Polyvinyl alcohol (PVA) fibres

The PVA molecule contains a great number of hydroxyl groups and polyvinyl alcohol itself is soluble in water, and so the initially developed fi bres were limited to specialized water-soluble fibre applications. Efforts were made in Japan to produce water-resistant PVA fibres that succeeded and resulted in the highstrength/ high-modulus PVA fi bres used in civil engineering applications. The latter fibres are heat treated or acetalized to render them insoluble in water. Fibres are smooth on the surface, and white with silk-like lustre. The crosssection is generally U-shaped like a flattened tube. There is a pronounced skin layer, which is more crystalline than the core. The mean value of crystallinity is around 50%. 20 PVA fibres have the following properties:

- specific gravity: 1.3
- tenacity (N/tex): 0.7–1.23
- extension at break (%): 7%
- initial modulus (N/tex): 6.5–17.

Metallic fibres

The properties of a metal fibre are essentially those of the metal itself. The molecular architecture of metals imposes a characteristic behaviour under stress that differs from that of a typical organic textile fibre. The stress–strain curve of a metal fibre shows a completely elastic behaviour up to the yield point. It is devoid of viscous components such as are found in organic high polymers, and which are identifi ed as primary creep. The absence of a significant viscous. behaviour characteristic of metal fi bres ensures dimensional stability of structures.



A typical cold-drawn steel wire fi bre with hooked ends used for concrete reinforcement may have a diameter of 0.8 mm, a length of 60 mm and a tensile strength of 1000 N/mm 2 .Stainless steel fi bres (type 304) have the following properties:

- specifi c gravity: 7.9
- tenacity (cN/tex): 22.1–28.3
- extension at break (%): 1.5 (hard)–11 (annealed)
- modulus of elasticity (N/tex): 25.19.

Nano fibres

Polymeric nanofi bres may range in diameter from 50 to 500 nanometers, since a polyester crystallite has dimensions in the order of 40 nanometers. Polymeric nanofi bres may be produced by several methods, including electrospinning, melt blowing a fi bre with a modular die, and spinning bicomponent fi bres that split or dissolve (e.g. islands-in-the-sea (INS) fi bres using a standard spin/draw process). 22 Carbon nanotubes are an ordered array of carbon atoms which can have tensile strength up to 15 times that of steel. These tubes or fi bres are often called graphite or carbon nanofi bres as well as nanotubes. The technology for manufacturing carbon nanotubes is very different from common fi bre-production techniques. Shorter nanotubes (0.05–3 μm range) may be produced by a variety of techniques includingarc-discharge, laser oven, high-pressure CO conversion (HiPco) and fl uidized bed chemical vapor deposition (CVD). Longer nanotubes (from 100 μm up to the cmscale) may be produced by substrate growth CVD and catalytic gas fl ow CVD. Fibres containing only carbon nanotubes (CNTs) will yield great advances in high-tech applications if they can attain a signifi cant portion of the extraordinary mechanical and electrical properties of individual CNTs. Doing so will require that the CNTs in the fi bre are sufficiently long, highly aligned and packed in an arrangement that is nearly free of defects. The method of CNT roduction strongly influences the type (multi-walled CNT vs. single-walled CNT), length (submicron to millimetre), chirality and processability, which in turn determine the properties of the fi nal CNT-based macroscopic product. 23 An important advantage of nanofibres is the very high increase in surface area to volume ratio leading to a higher specifi c surface area. This may lead to a considerable enhancement of all sorts of fi bre properties. In relation to strength, it was recognized by Griffiths that the strength of any material was determined by the presence of fl aws of critical dimension. He demonstrated for glass that increasing the surface-to-volume ratio would lead to increased strength by reducing the number of fl aws of critical dimension. Thus, high-strength materials will be filamentary of fi ne diameter. In this context the strength of nanofibres should be extremely high. 24 Thanks to their extraordinary properties, some of the nanofibres described, especially CNTs, may be of great interest in civil engineering applications in the future. Carbon nanotubes have attracted a lot of attention in recent years for their extraordinary properties. They are cylindrical nanostructures of allotropes of carbon, and some of the most recently developed nanotubes may have a length-to diameter ratio of up to 132 000 000:1. Because of their properties, they find applications in a variety of fields including nanotechnology,electronics, optics and potentially in architectural fields. They are extremely strong, have very interesting electrical properties and are excellent thermal conductors. Nanotubes belong to the fullerene structural family. Nanotube chemical bonding may be described by orbital hybridization, which is a field of applied quantum chemistry, and it is composed entirely of *sp* 2 bonds, which are identical to those of graphite. Another interesting characteristic of carbon nanotubes is that they selfalign, forming ‘ropes’ held together by Vander Waals forces.
Single-walled CNTs have the following properties:

- specific gravity: 1.3–1.4
- tenacity (N/tex): 10–41
- extension at break (%): 16
- modulus of elasticity (N/tex): 770–3846.

Mix design of concrete

Mix design of M60 grade of concrete (opc 53 Grade)

It is the process of selection suitable ingradients and determine the relative property of objects. Concrete mix design M60 grade of concrete provided here is for reference purpose only. Actual site conditions vary and thus this should be adjusted as per the location and other factors.

A. Design stipulation

Characterstic comprehensive strength @ 28 days = 60 N/mm2 .
Maximum size of aggregate Degree of quality

Types of exposure = severe .

Minimum cement content as per IS 456 : 2000

B .Test data for concrete ingredients

Specific gravity of cement = 3.15

Water absorption 20 mm 1.540 , 10 mm 1.780 , R/sand 3.780 , C/sand 4.490. Characterstic strength @ 28 days 60 N/mm2 .

Target mean strength : depend upon degree of quality control " Good" and considering (std. Dev. As 5 N/mm2) .

Characteristic strength given by the relation 60 + (1.65*5) = 68.25 N/mm2

C . Quantities of ingredients (by absolute volume method)

Actual cement used = 450 kg /cum

W/C fixed = 0.24

Absolute volume of cement = 0.143

Absolute volume of air = 0.02

Total volume of CA and FA used = 1.00 –(0.143+0.02+0.137)=0.7 cum

D. Aggregate percent used

20 mm = 31 % , 10 mm = 25 % , R/sand = 24 % , C/sand = 10%

(2.729*0.31) + (2.747*0.25)+(2.751*0.34)+(2.697*0.10)*0.7*1000

546+444+604+174 = 1768

Aggregate : cement = 3.10 : 1

Mix proportion = 0.24:1:1.06:0.30:0.78:0.96

E. Abstract

20mm 546kg/cum

10mm 444kg/cum

r/sand 604kg/cum

c/sand 174kg/cum

water 137liter/cum

admixture 1.80% by weight of (C+F)

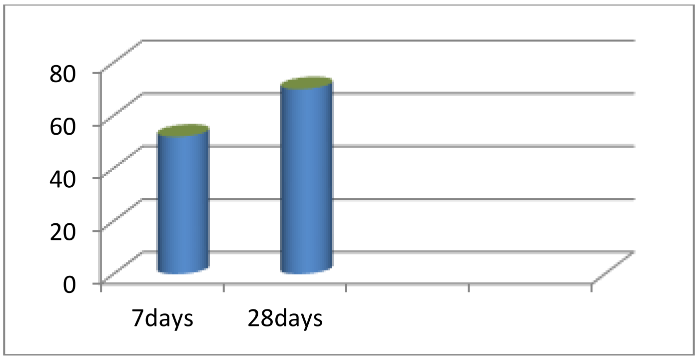
cube compressive strength (N/mm2)

3days=40.98 , 7days=57.71 , 28days=70.96

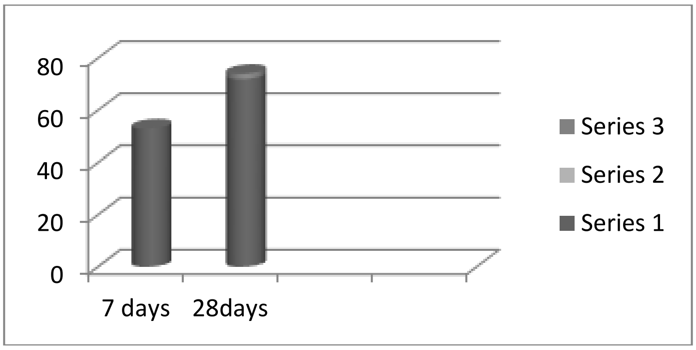
RESULT AND CONCLUSION

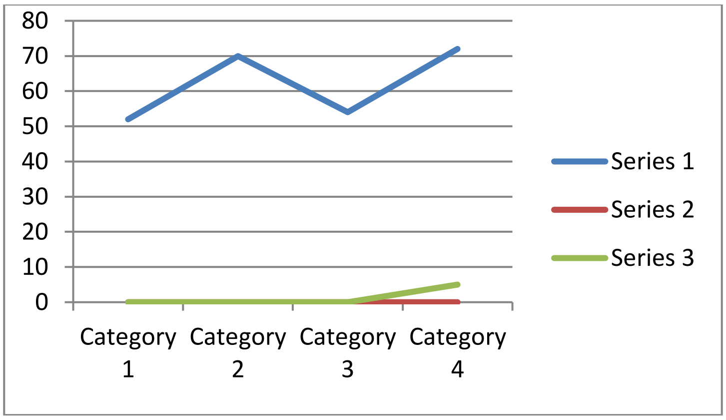
Result

Material –Bamboo rashes
For bamboo rashes there are two resuts come for fiber material mix with 1%and 2%.
Strength comes for 1%

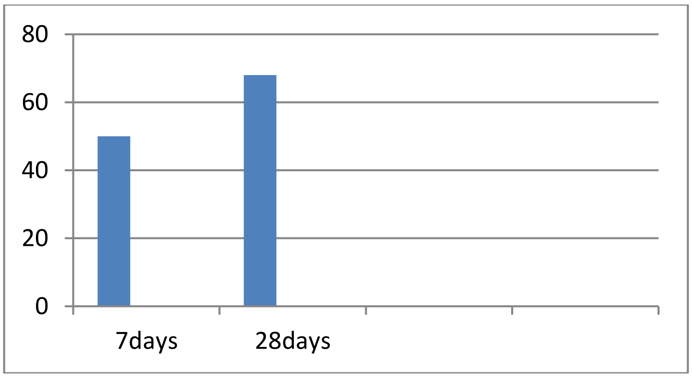


For 2 %



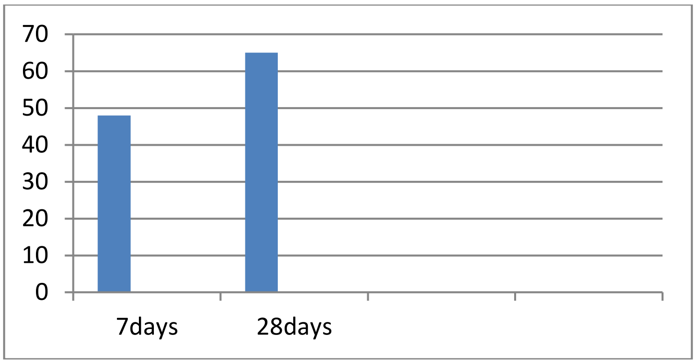


Material –coconut rashes

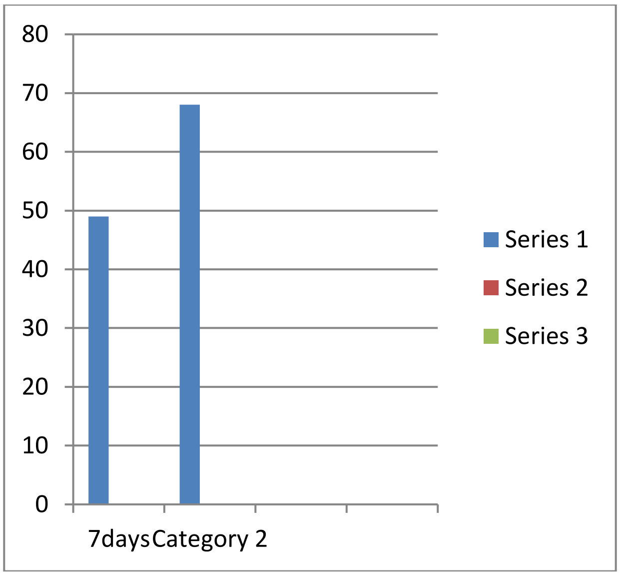


ISSN: 2277-5528
Impact Factor: 5.085

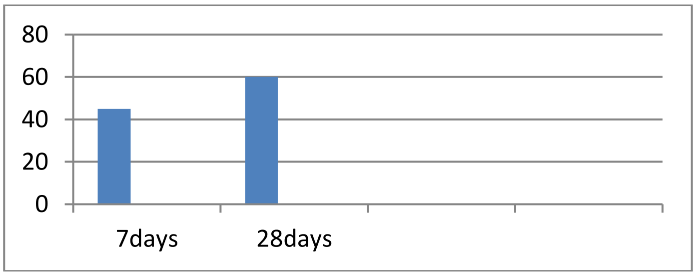
Material –nylon



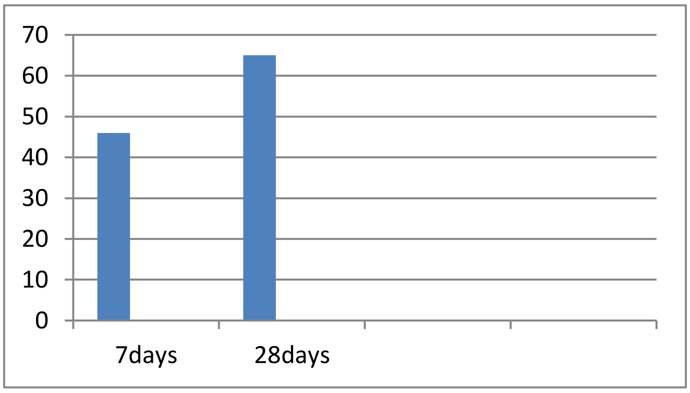
For 2 %



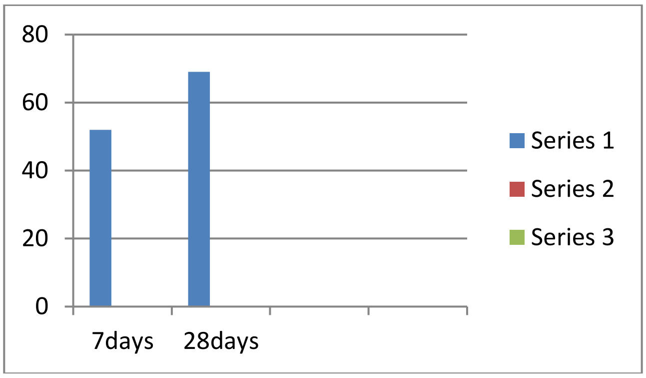
Material –borosilicate glass



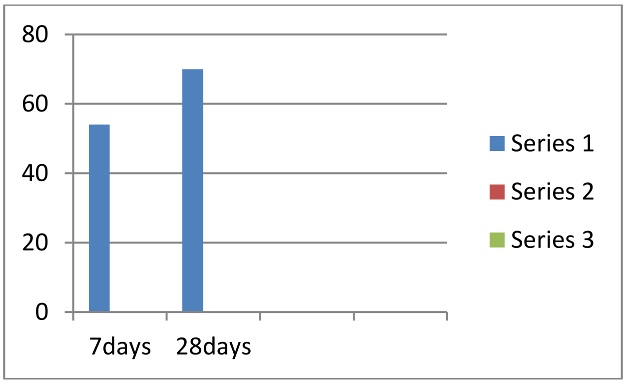
For 2%



Materal-jute

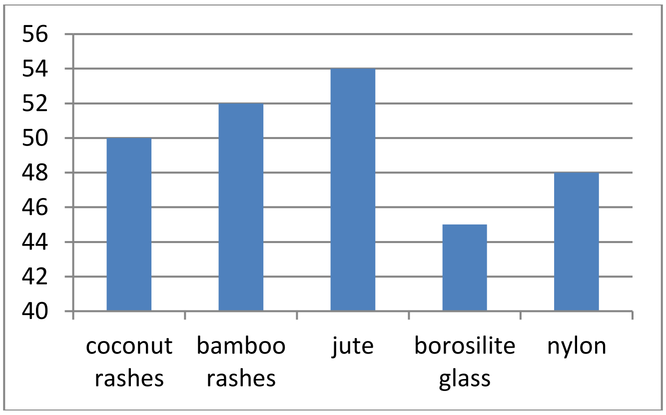


For 2%

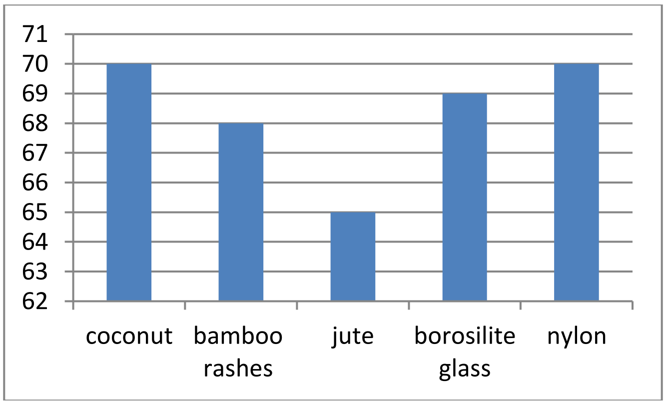


Combine strength of all material-

7 days



28days



ISSN: 2277-5528
Impact Factor: 5.085

Overall strength

s.no	**Name of material**	**Strength**	
		7 days	**28 ays**
1	Coconut rashes	52n/mm2	**69n/mm2**
2	Bamboo rashes	50n/mm2	68n/mm2
3	Jute	52n/mm2	70n/mm2
4	Borosilite glass	45n/mm2	65n/mm2
5	Nylon	48n/mm2	68n/mm2

REFERENCES

I. Code 10262:2009

II. S.S.BHAVIKATTI,CONCRETE TECHNOLOGY

III. M.L.GAMBHIR ,CONCRETE TECHNOLOGY

IV. EN14889-1:2006-Fiber for concrete steel fibers ,definitions,specifications and conformity

V. En14845-1:2007-test methods for fibers in concrete

VI. ASTM A820-16-Standard specification for fiber-reinforced concrete

VII. ASTM C1018-97 – Standard test Method for Flexural Toughness and first crack strength of fiber reinforced concrete

VIII. a b c "News - Fibres add much needed protection to prestigious tunnelling projects" . Wayback.archive.org. 2007-09-27. Archived from the original on 2007-09-27. Retrieved 2017-02-05.

IX. a b Li, V.; Yang, E.; Li, M. (28 January 2008), Field Demonstration of Durable Link Slabs for Jointless Bridge Decks Based on Strain-Hardening Cementitious Composites – Phase 3: Shrinkage Control (PDF), Michigan Department of Transportation

X. http://www.core-construction-products.com/pdfs/ACI-318-IBC-IRC-Evaluation-report-Helix-Steel-Micro-Rebar-Alternative-to-Steel-Rebar-Concrete-reinforcement-Vertical-Applications.pdf

XI. ACI 544.3R-93: Guide for Specifying, Proportioning, Mixing, Placing, and Finishing Steel Fiber Reinforced Concrete (PDF), American Concrete Institute, 1998

XII. Wang, Y.; Wu, HC.; Li, V. (November 2000). "Concrete Reinforcement with Recycled Fibers". Journal of Materials in Civil Engineering.

XIII. Ochia, T.; Okubob, S.; Fukuib, K. (July 2007). "Development of recycled PET fiber and its application as concrete-reinforcing fiber" .Cement and Concrete Composites . 29 (6): 448–455. doi : 10.1016/j.cemconcomp.2007.02.002