EXPERIMENTAL STUDY OF POLYCARBONATE IN SLAB

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INTRODUCTION

GENERAL

Past three decades, the researchers gave much attention to seismicity and the usage of composite materials as the replacement of constituent materials in concrete.

A composite material can be defined as a combination of a matrix and a reinforcement, which when combined gives properties superior to the properties of the individual components.

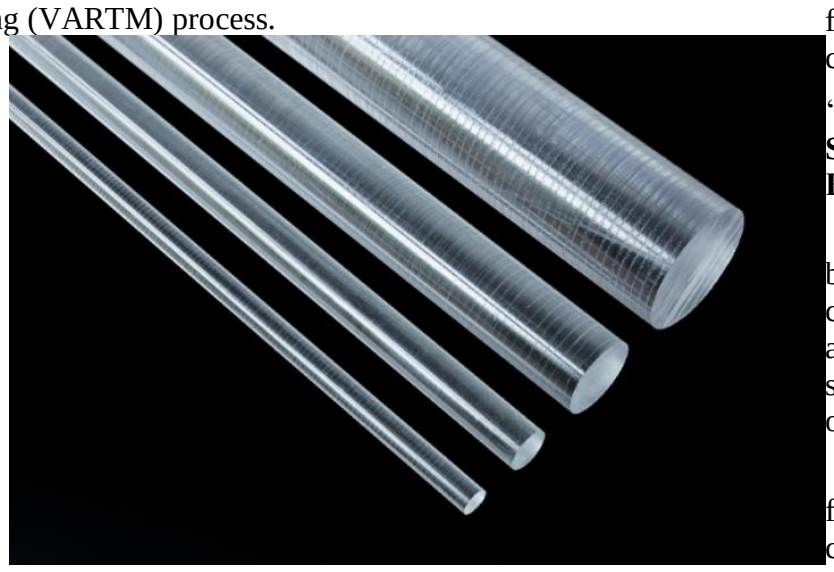
The most Common types of composites are Polymer matrix composites, Metal matrix composites, Ceramic matrix composites.

LITERATURE REVIEW

Various journals, articles and conference papers related composite construction, materials used in the construction, etc. have been referred for the purpose of developing ideas for the research work. Data from websites of the kind of informative types, advertisement types, blogs, groups, etc. have been considered and incorporated in the report work as well. Some of the informative data collected from certain journals and conference papers are summarized and given below.

'MANUFACTURING AND CHARACTERIZATION OF POLYURETHANE BASED SANDWICH COMPOSITE STRUCTURES'.

In this study, three designs of glass reinforced composite sandwich structures, namely boxes (web-core W1), trapezoid and polyurethane rigid foam, are fabricated using new generation of two-part thermoset polyurethane resin systems as matrix materials with vacuum assisted resin transfer molding (VARTM) process.



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The stiffness, load-carrying capacity and compressive strength were evaluated. Core shear, flatwise and edgewise compression tests were carried out for these three models.

The mechanical response of three designs of sandwich structures under flexural loading were analysed using commercial finite element method (FEM) software ABAQUS. The simulation results of flexural behaviour were validated by experimental findings

'A STRENGTH BASED CRITERION FOR THE PREDICTION OF STABLE FIBRE CRACK-BRIDGING',J.A.BENNETT(2006)

This paper demonstrates that a fibre will form a stable bridge across a propagating crack has been investigated by means of experimental measurements and the theoretical consideration of the balance between interfacial strength, fibre strength and the physical properties of the component materials.

A simple strength based criterion has been developed from traditional stress transfer models to predict if a fibre will form a stable bridge across a propagating matrix crack. Raman spectroscopy was used to measure the point to point distribution of fibre strain Zylon, T50u and M5 fibers embedded in an epoxy resin matrix and lying perpendicular to a matrix crack. The result shows that Polycarbonatefibres fractured with a small amount of debonding.

'INVESTIGATION OF THE CURING BEHAVIOUR OF CARBON FIBREEPOXY PREPEG BY DYNAMICMECHANICAL ANALYSIS DMA'

This paper says that Carbon fibreprepregs have found widespread application in lightweight constructions. They are based on a carbon fibre fabric impregnated with reactive epoxy resin. Measurements were carried out using commercially available prepreg material. For Dynamic Mechanical Analysis (DMA), a single cantilever measuring device was applied. The heating rates were 1 and 2 K/min, respectively. A glass transition of the uncured material (Tg0) near 1 C, and cross linking-induced vitrification and devitrification at the maximal glass transition temperature of the cured material (Tgmax) in the temperature range 220 to 230 C were found.

The activation energies for the glass transitions were determined using an Arrhenius plot. By detailed consideration of the influence of the frequency on the DMA data, indications for gelation were deduced. So by this work it is found that a carbon fibre epoxy needs a hot curing.

'BEHAVIOUR OF FIBRE COMPOSITE SANDWICH STRUCTURES UNDER SHORTAND ASYMMETRICAL BEAM SHEAR TESTS'

The behaviour of structural fibre composite sandwich beams made up of glass fibre composite skins and phenolic core material was investigated under three-point short beam and asymmetrical beam shear tests. The effect of the shear span-to-depth ratio (a/D) on the strength and failure behaviour of the composite sandwich beams was examined.

The results showed that with increasing a/D ratio, the failure load of the sandwich beam is decreasing. On the contrary, the coupling effect of flexural stresses increases with increasing a/D ratio. Noticeably, the fibre composite sandwich beams tested under asymmetrical beam shear exhibited higher failure load compared to beams tested under short beam shear.

Analysis showed that the shear stress in the core is more dominant than flexural stress when the a/D ratio is 1 for the sandwich beams under short beam test and 1–3 for the sandwich beams tested under asymmetrical beam shear test.

'VIBRATION CHARACTERISTICS OF FIBER REINFORCED POLYMER BRIDGE SUPERSTRUCTURE',AMJAD J. AREF(2001)

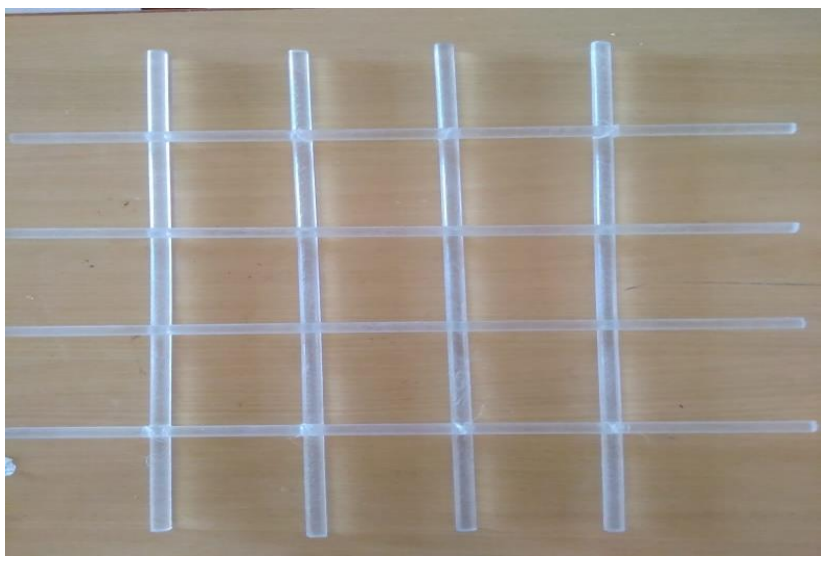
This paper demonstrates that the dynamic response of first fiber reinforced polymer composite bridge built in US was studied using experimental modal tests. This slab bridge was manufactured with a longitudinal joint as a shear key and is connected in the field using epoxy resin.

An experimental model was used to evaluate the integrity followed by a finite element model validated with field test data was developed to further study the effect of deformation on the vibration characteristics of the structure. Results showed that there is less deformation in the bridge due to vibration. This paper helped us to understand that there will be less deformation in a structure when it is made of a fiber reinforced polymer material.

'MICROMECHANICAL PHENOMENA DURING HYGROTHERMAL AGEING OF MODEL COMPOSITES INVESTIGATED BY RAMAN SPECTROSCOPY.PART I: TWARON FIBRES WITH DIFFERENT SURFACE TREATMENTS',A.J.CERVENKA(2004)

This paper explains that the Raman spectroscopy combined with gravimetry has been used to investigate hygrothermal ageing in model composites based on an epoxy resin containing a single filament of a Polycarbonatefibre. Polycarbonate fibres have been studied: untreated fibre (HM), fibre with a surface finish (HMF) and fibre with an activated surface (HMA) using two specimen configurations: the diffusion slab (DS) and the double pull out geometry.

Time evolutions of the Raman strain profiles 3(x,t) and the water uptake M(t) have been determined for specimens immerse in liquid water and exposed to water vapour. Eliminating the exposure time, the swelling behaviour of the matrix is assessed and a concept for determination of the interface fracture energy is proposed.



Time dependencies of n, Ld and G(t) are used to rank surface treatments of Polycarbonatefibres as to durability of their interfaces during hygrothermal ageing. This paper reveals that Polycarbonatefibres had better durability properties and interface fracture energy during hygrothermal ageing.

'MICROMECHANICAL PHENOMENA DURING HYGROTHERMAL AGEING OF MODEL COMPOSITES INVESTIGATED BY RAMAN SPECTROSCOPY. PART II: COMPARISION OF THE BEHAVIOUR OF PBO AND M5 FIBRES COMPARED WITH POLYCARBONATE',A.J.CERVENKA(2004)

This paper explains that Raman spectroscopy combined with gravimetry has been used to investigate hygrothermal ageing in model composites based on an epoxy resin containing a single filament of a polymeric fibre. Two fibres have been studied—PBO and M5—using two specimen configurations:

The diffusion slab (DS) and the double fibre pull-out (DFPO). Simple micromechanical models developed for rationalizing data obtained for Polycarbonate are used to process measurements for PBO and M5 (PIPD). This reveals that compared with the other two fibers used Polycarbonate shows better durability characteristics.

'INFLUENCE OF FIBER ORIENTATION AND THICKNESS ON THE RESPONSE OF GLASS/EPOXY COMPOSITES SUBJECTED TO IMPACT LOADING',RAHUL S. SIKARWAR(2014)

Composite laminates, made of glass/epoxy using compression molding technique, were subjected to impact loading. The ballistic limit and energy absorption capacity of the laminates were obtained. Experiments were carried out to study the effect of fiber orientation and thicknesses on ballistic limit and energy absorption of the laminates, by using a rigid conical bullet having 9.5 mm diameter and mass of 7.5 g in an air gun. This paper shows that if the thickness and dynamic modulus is increased it showed high resistance to impact loading.

'INFLUENCE OF CARBON NANOTUBE INCLUSION ON THE FRACTURE TOUGHNESS AND BALLISTIC RESISTANCE OF TWARON/EPOXY COMPOSITE PANELS',W.Y.WAN HANIF(2015)

This paper explains the effect of multi walled carbon nanotube (MWCNT) inclusion on the fracture toughness and the ballistic resistance properties in terms of energy absorption. The determination of fracture toughness of the epoxy/MWCNT matrix was carried out by using a single edge notch bending (SENB) method according to the ASTM D5045-99.Four different weight percentage (wt %) of multi-walled carbon nanotubes (MWCNTs) contents were used, which were 0wt.%,0.1 wt.%, 0.55 wt.% and 1.0 wt.%.

Epoxy binder and MWCNTs were mixed by using a mechanical stirrer for 10minutes at 1500rpm speed and was further sonicated for 30minutes at 30 Hz amplitude in order to enhance the homogeneity of MWCNTs in the matrix. The composite panels were subjected to a ballistic test using 9mm Full Metal Jacket bullet at different impacting velocities.

From the SENB results, it can be reported that MWCNT inclusion up to 1.0% w.t content shows significant influence towards increment of fracture toughness value. This paper helped us to know that polycarbonate has improved ballistic resistance to impact loading.

'MULTISCALE GRAPHENE OXIDE-CARBON FIBER REINFORCEMENTS FOR ADVANCED POLYURETHANE COMPOSITES',SHUAI JIANG(2016)

This paper demonstrates Multiscalegraphene oxide/carbon fiber (GO/CF) reinforcements were developed for polyurethane (PU) elastomer composites. GO was first coated on CF surface by electrophoretic deposition (EPD), aiming to improve the CF/PU interfacial adhesion.

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The EPD process improved the mechanical anchoring and chemical interaction between CFs and PU through increased surface roughness and oxygen content of CFs, thereby improved the CF/PU interfacial shear strength. The fibres were then mechanically mixed with GO to achieve a multiscale reinforcement. The strengthening of the matrix, especially the local stiffening of fiber/matrix interphase, is beneficial for the interfacial mechanical anchoring.

The multiscale reinforcement resulted in an improvement of 46.4% in the tensile strength of PU elastomer. The enhanced reinforcing performance of GO-deposited CFs was attributed to the improved fiber–matrix interfacial adhesion. This paper helped us to understand that polyurethane composites used as reinforcements may give better adhesion.

CONCLUSION

Fibersused Polycarbonate shows better durability characteristics.

It will givehigh resistance to impact loading.

Polycarbonatefibres had better durability properties and interface fracture energy during hygrothermal ageing.

It will be less deformation in a structure when it is made of a fiber reinforced on concrete.

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